Buhler Versatile SX240/SX280
SmarTrax™ Installation Manual

P/N 016-5031-005 Rev. B 10/15 E26380

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CHAPTER 1

Important Safety Information

NOTICE

Read this manual and the operation and safety instructions included with your implement and/or controller carefully before installing the SmarTrax™ system.

- Follow all safety information presented within this manual.
- If you require assistance with any portion of the installation or service of your Raven equipment, contact your local Raven dealer for support.
- Follow all safety labels affixed to the SmarTrax system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. To obtain replacements for missing or damaged safety labels, contact your local Raven dealer.

When operating the machine after installing SmarTrax, observe the following safety measures:

- Be alert and aware of surroundings.
- Do not operate SmarTrax or any agricultural equipment while under the influence of alcohol or an illegal substance.
- Remain in the operator's position in the machine at all times when SmarTrax is engaged.
- Disable SmarTrax when exiting the operator's seat and machine.
- Do not drive the machine with SmarTrax enabled on any public road.
- Determine and remain a safe working distance from other individuals. The operator is responsible for disabling SmarTrax when the safe working distance has diminished.
- Ensure SmarTrax is disabled prior to starting any maintenance work on SmarTrax or the machine.

⚠ WARNING

- When starting the machine for the first time after installing SmarTrax, be sure that all persons stand clear in case a hose has not been properly tightened.
- The machine must remain stationary and switched off during SmarTrax installation or maintenance.

⚠ CAUTION

Hydraulic Safety

- Raven Industries recommends that appropriate protective equipment be worn at all times when working on the hydraulic system.
- Never attempt to open or work on a hydraulic system with the equipment running. Care should always be taken when opening a system that has been previously pressurized.
- When disconnecting the hydraulic hoses or purging is required, be aware that the hydraulic fluid may be extremely hot and under high pressure. Caution must be exercised.
- Any work performed on the hydraulic system must be done in accordance with the machine manufacturer's approved maintenance instructions.
- When installing SmarTrax hydraulics or performing diagnostics, maintenance, or routine service, ensure that precautions are taken to prevent any foreign material or contaminants from being introduced into the machine's hydraulic system. Objects or materials that are able to bypass the machine's hydraulic filtration system will reduce performance and possibly damage the SmarTrax valve.

Electrical Safety

- Always verify that the power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the equipment.
- Ensure that the power cable is the last cable to be connected.

CHAPTER 2

Introduction

The SmarTrax system is designed to provide cutting-edge, hands-free steering of the machine via Global Positioning System (GPS) coordinates.

This manual applies to the following machines:

MAKE: Buhler Versatile
MODEL: SX240 - SX280

FIGURE 1. **Buhler Versatile SX280**

Preparing for Installation

Before installing the SmarTrax system, park the machine where the ground is level, clean, and dry. Turn off the machine and leave it off for the duration of the installation process.

During the installation process, follow good safety practices. Be sure to carefully read the instructions in this manual as you complete the installation process.

Recommendations

Raven Industries recommends the following best practices when installing or operating the SmarTrax system for the first time, at the start of the season, or when moving the SmarTrax system to another machine:

- Install the GPS antenna in the recommended location. Refer to the following table for the machine-specific antenna mounting location.

Machine Preset	Antenna X Position (left to right)	Antenna Y Position (fore/aft offset)	Antenna Z Position (ground to bottom of antenna)
Versatile SX 240-280	Centered	12 ft., 8 in./3.912 m	13 ft., 7 in./4.140 m

- Ensure the machine's hydraulic filters have been recently changed and there are no issues with the machine's hydraulic system (e.g., pump issues, faulty hydraulic motors, fine metal deposits in the hydraulic hoses, etc.).
- Ensure the machine's hydraulic system is using fresh oil and debris is flushed from the hydraulic hoses, valves, and filters.

Raven Industries recommends the following best practices when installing the SmarTrax system:

- Use part numbers to identify the parts.
- Do not remove the plastic wrap from a part until it is necessary for installation.
- Do not remove plastic caps from a part until it is necessary for installation.

Point of Reference

The instructions in this manual assume that you are standing behind the machine, looking toward the cab.

Updates

Software and manual updates are available on the Raven Applied Technology website:

http://www.ravenhelp.com

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

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

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

techwriting@ravenind.com

-Buhler Versatile SX240/SX280 SmarTrax™ Installation Manual
-P/N 016-5031-005 Rev. B
-Any comments or feedback (include chapter or page numbers if applicable).
-Let us know how long have you been using this or other Raven products.

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

Thank you for your time.

Kit Contents

This section contains a list of the components that are included in the SmarTrax kit. Before beginning the SmarTrax installation, compare the items in the kit with the components on this list. If you have questions about the kit, contact your Raven dealer.

Note: *The SmarTrax node (P/N 063-0173-441) is sold separately. Contact your local Raven dealer for ordering information. The machine is factory-equipped with the node harness (P/N 115-4001-201) and power harness (P/N 115-4001-202).*

TABLE 1. SmarTrax Installation Kit (P/N 117-5031-005)

Picture	Item Description	Part Number	Qty.
Not Pictured	Manual - Versatile SmarTrax Calibration & Operation	016-0171-532	1
Not Pictured	Manual - Buhler Versatile SX240-280 SmarTrax Installation	016-5031-005	1
Not Pictured	Kit, Hydraulic, SmarTrax, Versatile SX240/80	117-0199-132	1
	Valve - SmarTrax Hydraulic	334-0003-088	1
	Bracket - Hydraulic Valve Mounting	107-0171-908	1
	Bracket - Rotary Sensor Mounting	107-0171-945	1
	Bracket - Arm Weldment	116-0159-674	1
	Bracket - Rotary Sensor Mounting	116-0159-745	1

TABLE 1. SmarTrax Installation Kit (P/N 117-5031-005)

Picture	Item Description	Part Number	Qty.
	Cable - Valve Harness	115-4001-227	1
	Assembly - Foot Switch Enable	063-0172-470	1
	Assembly - Rotary Wheel Angle Sensor	063-0181-024	1
	Transducer, Pressure, 4-20MA 0-3000 PSI	422-0000-086	1
	Bolt - 5/16”-18 x 7/8” Hex	311-0052-104	4
	Bolt - 3/8”-16 x 1-1/4” UNC Hex	311-0054-107	2
	Bolt, M8 x 25 mm Hex	311-0070-001	3
	Bolt, Hex, Zinc, GR 8, M8 x 1.25 x 15	311-0070-015	3
	Nut - 3/8” Nylon Insert Lock	312-4000-061	2
	Washer - 5/16” Split Lock	313-1000-019	8
	Washer - 0.406” ID x 0.812” OD x 0.065” Thick	313-2300-014	4

TABLE 2. Hydraulic Installation Kit (P/N 117-0199-132)

Picture	Item Description	Part Number	Qty.
	Fitting, Elbow, 45 Swivel -8 JIC	333-0012-040	2
	Fitting - -4 JIC (M) to -6 SAE O-Ring (M) Straight Adapter	333-0012-044	1
	Fitting - -6 JIC (M) to -6 SAE O-Ring (M) Straight Adapter	333-0012-045	1
	Fitting - -6 JIC (M) to -8 SAE O-Ring (M) Straight Adapter	333-0012-046	1
	Fitting - -8 JIC (M) to -8 SAE O-Ring (M) Straight Adapter	333-0012-093	1
	Fitting - -6 JIC (M) to -10 SAE O-Ring (M) Straight Adapter	333-0012-106	2
	Fitting, Elbow, 90 Swivel -4JIC	333-0012-154	1
	Hydraulic Hose - -6 JIC (F) 90° to -6 JIC (F) - 48”	214-1000-499	2
	Hydraulic Hose - -8 JIC (F) 90° to -8 JIC (F) - 30”	214-1000-822	1
	Hydraulic Hose - -6 JIC (F) 90° to -8 JIC (F) 33”	214-1000-995	1
	Hydraulic Hose - -4 JIC (F) 90° to -6 JIC (F) - 63”	214-1000-996	1

Note: *The ECU cable and the ECU are not included in the kit but are not included in the kit.*

CHAPTER

3

Hydraulic System Installation

WARNING

Hydraulics are under pressure. Care should always be taken with a system that has been pressurized.

Before beginning the SmarTrax hydraulic installation, turn off the machine and relieve pressure by turning the steering wheel left and right.

Never work on a hot machine. Always allow it to cool before performing diagnostics, maintenance, or routine service.

When disconnecting or purging hydraulic hoses, be aware that the hydraulic fluid within the machine's system may be extremely hot and under high pressure.

Tampering with hydraulic valves may cause serious injury or death, and will void the warranty.

CAUTION

When installing SmarTrax hydraulic or performing diagnostics, maintenance, or routine service, ensure precautions are taken to prevent any foreign material from being introduced into the machine's hydraulic system.

Objects or materials that are able to bypass the machine's hydraulic filtration system will reduce performance and possibly damage the SmarTrax hydraulic valve.

NOTICE

The appearance of the SmarTrax hydraulic valve may vary slightly from the images contained in this manual. However, the fittings, hose connections, and cable connections remain the same.

Hydraulic Schematic

There is a “Hydraulic Diagram” on page 19 that shows a complete hydraulic installation. Use the schematic in addition to the procedure in this section to complete the hydraulic installation.

Install Fittings in the SmarTrax Valve

Before mounting the SmarTrax valve (P/N 334-0003-088) on the machine, install the proper fittings in the valve. This prepares the valve for installation and simplifies the hose connection process later in the procedure.

Fitting	Part Number	Port
Fitting - -6 JIC (M) to -10 SAE O-Ring (M) Straight Adapter	333-0012-106	A, B
Fitting - -6 JIC (M) to -8 SAE O-Ring (M) Straight Adapter	333-0012-046	P
Fitting - -8 JIC (M) to -8 SAE O-Ring (M) Straight Adapter	333-0012-093	T
Fitting - -4 JIC (M) to -6 SAE O-Ring (M) Straight Adapter	333-0012-044	LS STEER
Fitting - -6 JIC (M) to -6 SAE O-Ring (M) Straight Adapter	333-0012-045	LSPV

Fitting	Part Number	Port
Fitting - -6 JIC M/F 90° Swivel Elbow	333-0012-042	LSPV
Transducer - 0-3000 PSI Pressure	422-0000-086	PS

Mount the SmarTrax Valve

FIGURE 1. SmarTrax Valve Mounting Location

1. Identify the SmarTrax valve (P/N 334-0003-088) mounting location on the front walkway support on the left side of the machine.
2. Install the SmarTrax valve on the valve mounting bracket (P/N 107-0171-908) using four 5/16”-18 x 7/8” hex bolts (P/N 311-0052-104) and four 5/16” lock washers (P/N 313-1000-019).

FIGURE 2. SmarTrax Valve Mounted to the Machine

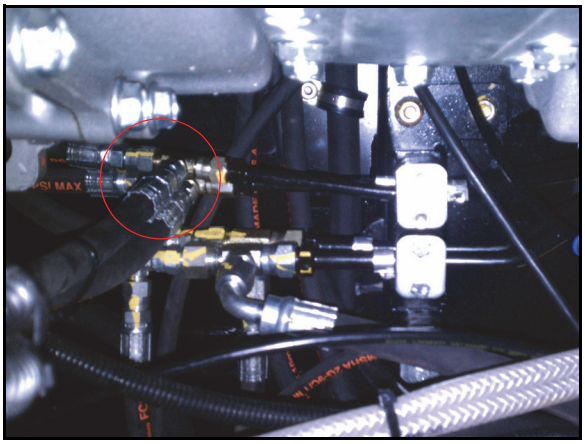
3. Secure the valve mounting bracket to the machine using the existing support mounting holes and two 3/8”-16 UNC hex bolts (P/N 311-0054-107), four washers (P/N 313-2300-014), and two 3/8”nylon insert lock nuts (P/N 312-4000-061).

Install the Left and Right Steering Hoses

FIGURE 3. Machine’s Left Steering Hose

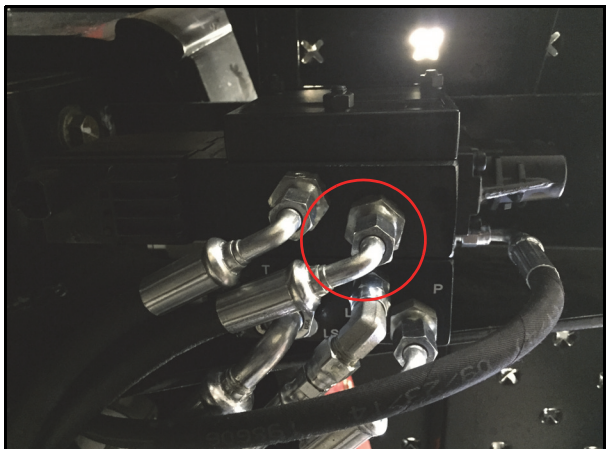
1. Locate the left steering hose from the steel line leading to the steering orbital.

FIGURE 4. Left Steering Hoses Installed on Steel Line



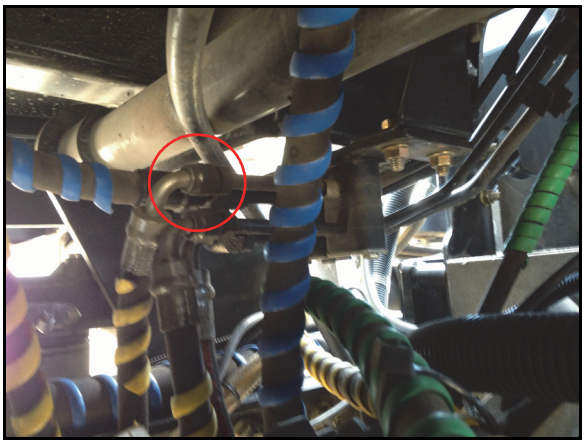
2. Locate the -6 JIC M/M/F swivel run tee adapter fitting.
3. Install the straight end of the supplied hydraulic hose (P/N 214-1000-499) branch of the tee end of the installed tee fitting.

FIGURE 5. **Left Steering Hose Installed on SmarTrax Valve**



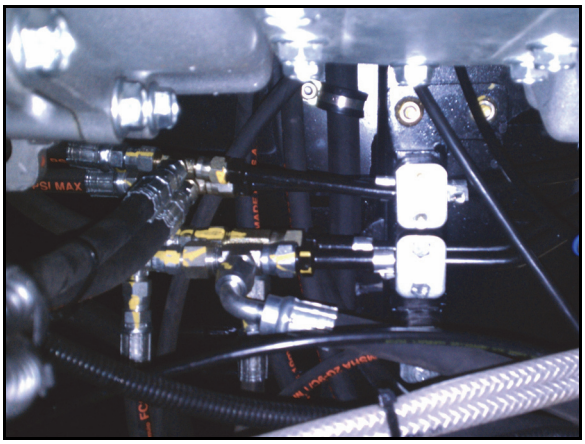
4. Connect the 90° end of the installed hydraulic hose to the fitting installed in Port A of the SmarTrax valve (P/N 334-0003-088).

FIGURE 6. **Machine's Right Steering Hose**



5. Locate the right steering hose from the steel line leading to the steering orbital.

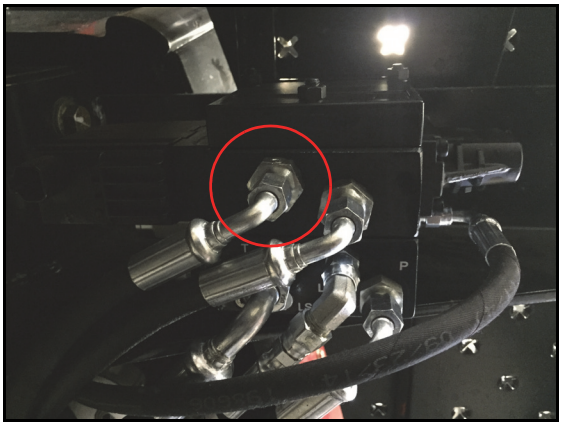
FIGURE 7. **Right Steering Hoses Installed on Steel Line**



6. Locate a -6 JIC M/M/F swivel run tee adapter fitting

7. Install the straight end of the supplied hydraulic hose (P/N 214-1000-499) branch end of the installed tee fitting.

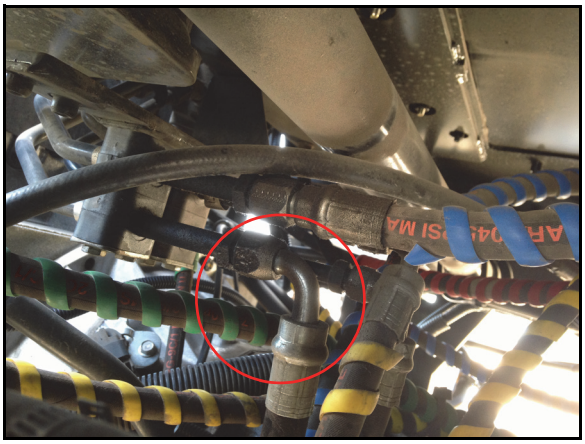
FIGURE 8. Right Steering Hose Installed on SmarTrax Valve



8. Connect the 90° end of the installed hydraulic hose to the fitting installed in Port B of the SmarTrax valve.

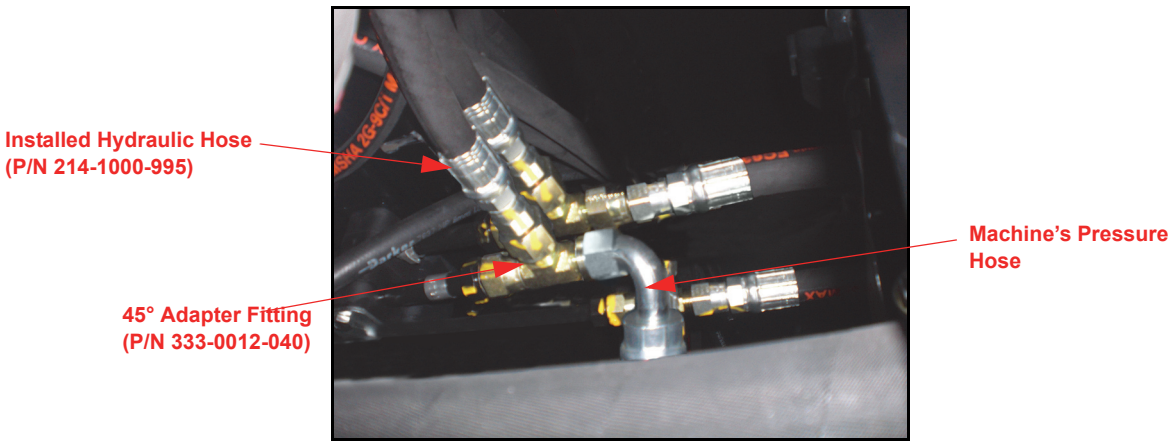
Install the Pressure and Tank Hoses

FIGURE 9. Machine's Pressure Hose on Steel Line



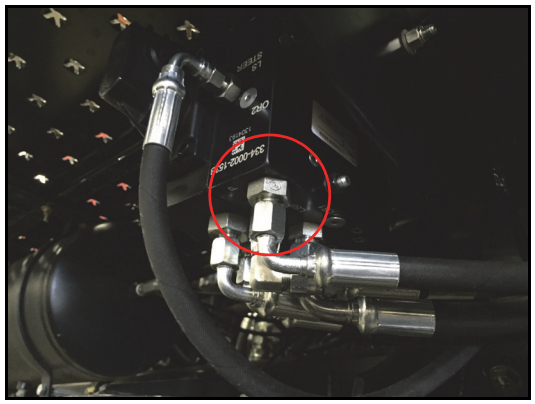
1. Locate the machine's pressure hose from the steel line leading to the steering orbital.

FIGURE 10. **Pressure Hoses Installed on Steel Line**



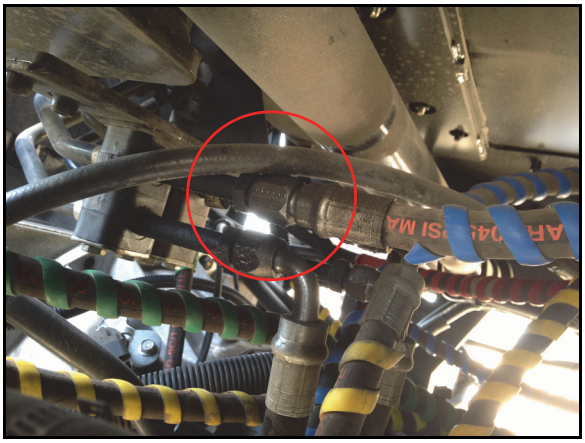
2. Locate the -8 JIC M/M/F swivel run tee adapter fitting.
3. Install a 45° fitting on the branch of the tee.
4. Install the straight end of the supplied hydraulic hose (P/N 214-1000-995) on branch end of the installed tee fitting.

FIGURE 11. **Pressure Hose Installed on SmarTrax Valve**



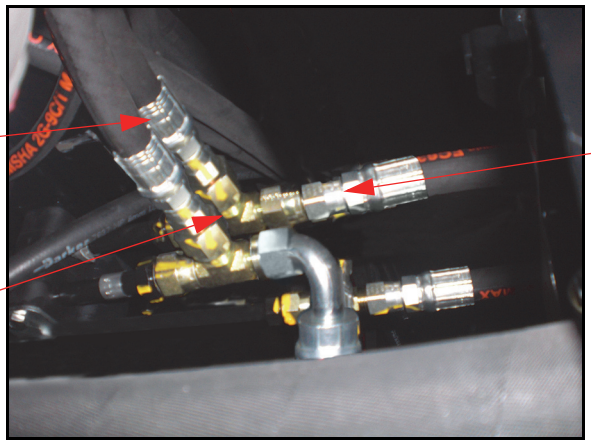
5. Connect the 90° end of the installed hydraulic hose to the fitting installed in Port P of the SmarTrax valve (P/N 334-0003-088).

FIGURE 12. **Machine's Tank Hose on Steel Line**



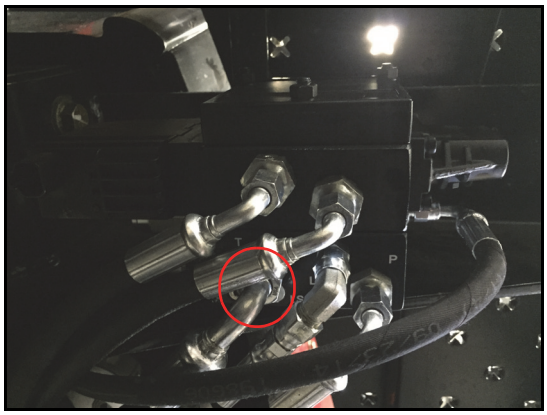
1. Locate the machine's tank hose running from the steel line leading to the steering orbital.

FIGURE 13. **Tank Hoses Installed on Steel Line**



2. Locate the -8 JIC M/M/F swivel run tee adapter fitting.
3. Install the 45° fitting on a branch of the installed tee fitting.
4. Install the straight end of the supplied hydraulic hose (P/N 214-1000-822) on the 45° end of the installed tee fitting.

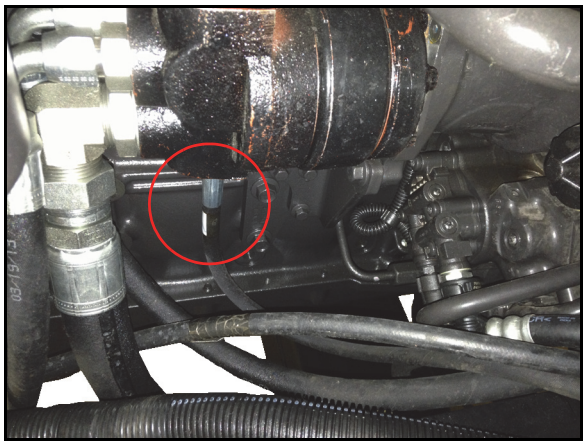
FIGURE 14. **Tank Hose Installed on SmarTrax Valve**



5. Connect the 90° end of the installed hydraulic hose to the fitting installed in Port T of the SmarTrax valve.

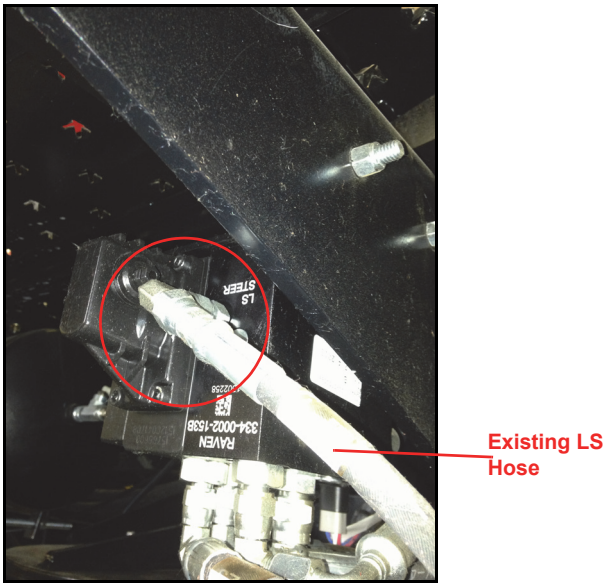
Install the Load Sense Hoses

FIGURE 15. **Machine's Existing Load Sense Hose on Priority Valve**



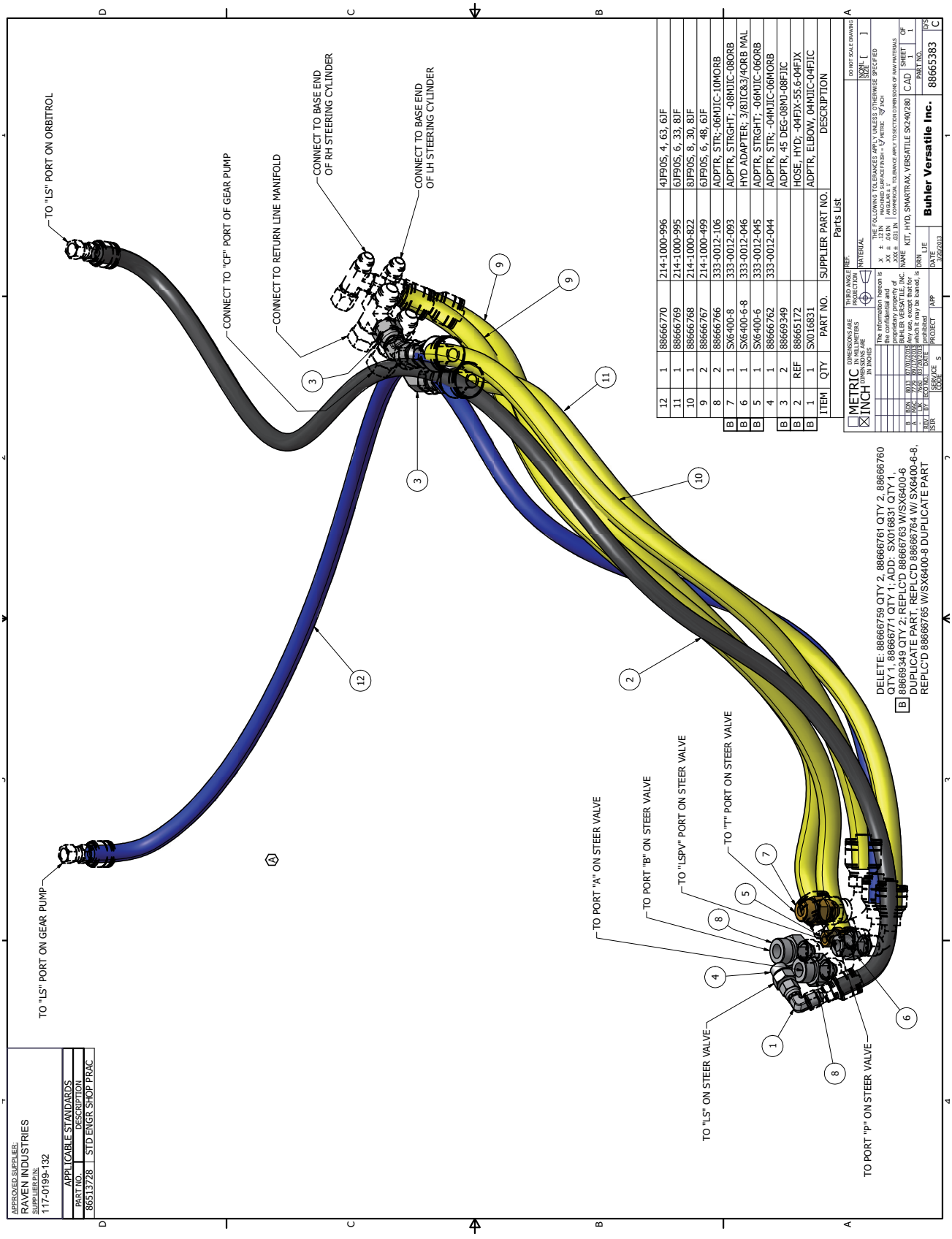
1. Locate and disconnect the machine's load sense hose from the priority valve located on the left side of the machine's engine.

FIGURE 16. **LS STEER Connection on SmarTrax Valve**



2. Connect the end of the existing hydraulic hose to the fitting installed in Port LS STEER of the SmarTrax valve.
3. Install the straight end of the supplied hydraulic hose (P/N 214-1000-996) on the machines priority valve. Refer to Figure 15 on page 17.
4. Connect the 90° end of the installed hydraulic hose to the fitting installed in Port LSPV of the SmarTrax valve (P/N 334-0003-088).

Hydraulic Diagram



CHAPTER

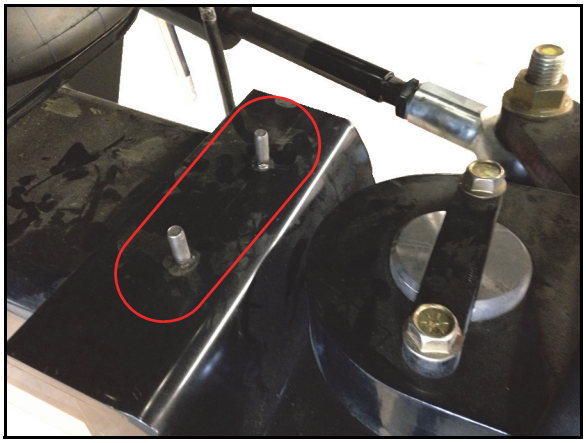
4

Wheel Angle Sensor (WAS) Installation

FIGURE 1. **WAS Installation Location on Front Right Axle**

1. Turn the machine's front wheels to the left to access the left front axle.

FIGURE 2. **Rotary Sensor Mounting Location**

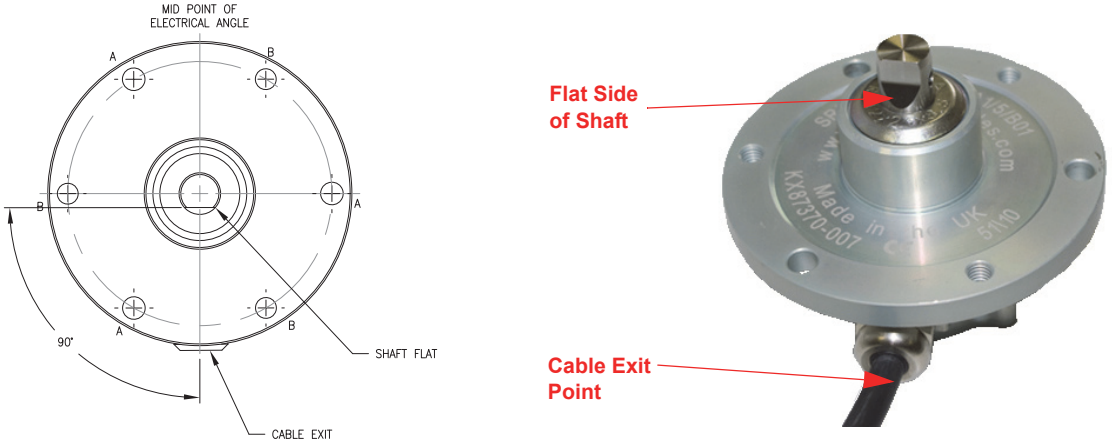


2. Locate the sensor mounting location on the left front axle.

FIGURE 3. Rotary Sensor Mounting Bracket Installed

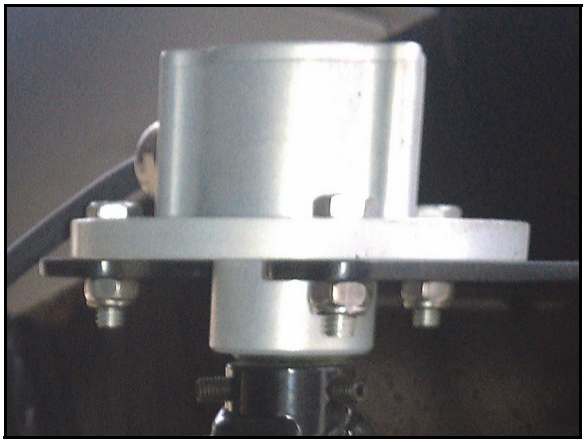
3. Install the rotary sensor mounting bracket (P/N 116-0159-745) on the mounting weldment using two 0.406” ID x 0.812” OD x 0.065” flat washers (P/N 313-2300-014) and two 3/8”-16 nylon insert lock nuts (P/N 312-4000-061).

FIGURE 4. Rotary Sensor Assembly Alignment



4. Align the flat side of the shaft of the WAS (P/N 063-0181-024) with the cable exit point as shown in the figure above.

FIGURE 5. **Rotary WAS Positioned on Machine**

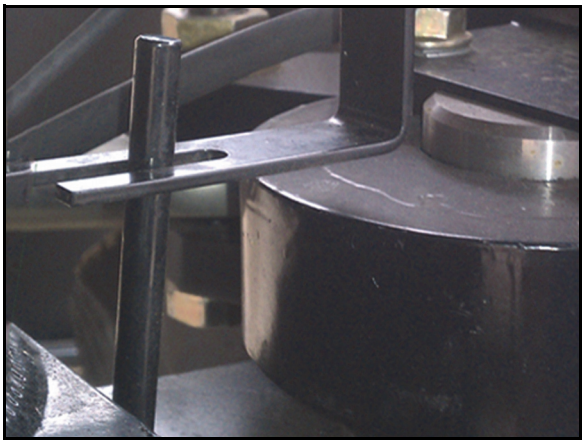


5. Install the rotary WAS on the rotary sensor mounting bracket (P/N 107-0171-945) using the supplied mounting hardware.

Important: *The WAS should be installed so that the cable points straight back.*

6. Install the set screws through the holes in the collar of the rotary sensor arm bracket (P/N 116-0159-674).

FIGURE 6. **Arm Bracket Installed on Sensor Mounting Bracket Shaft**



7. Slide the forked end of the arm bracket onto the shaft of the rotary sensor mounting bracket (P/N 116-0159-745).

FIGURE 7. **Arm Bracket Installed on WAS**

8. Using care not to move the sensor shaft, slide the collar end of the arm bracket over the sensor shaft.
9. Secure the arm bracket to the shaft by tightening the installed set screws.

CHAPTER 5

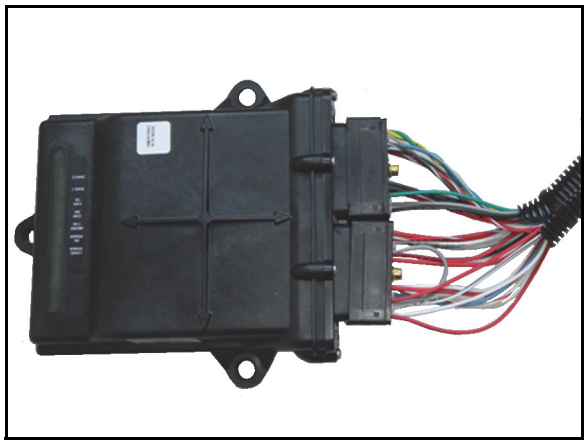
Cab Component Installation

Install the SmarTrax Node

Note: *The SmarTrax node (P/N 063-0173-441) is sold separately. Contact your local Raven dealer for ordering information.*

Mount the SmarTrax Node

FIGURE 1. **Node Harness Connected to the Node**

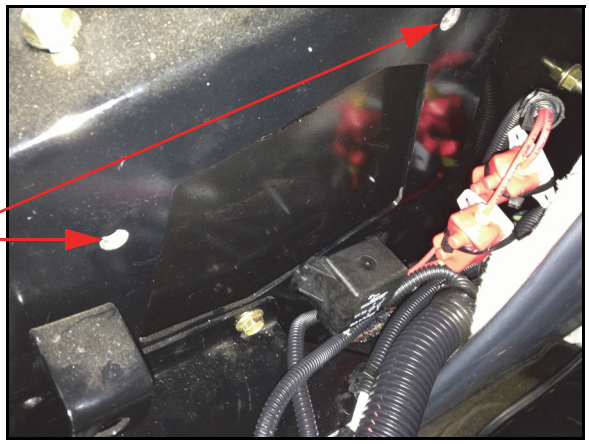


1. Install the two large, rectangular connectors of the node harness into the correct ports of the node, tightening the bolts on the connectors to secure the connections.

FIGURE 2. **Side Cover Panel**

1. Remove the side cover panel to the right of the operator's seat.

FIGURE 3. **SmarTrax Node Mounting Location**



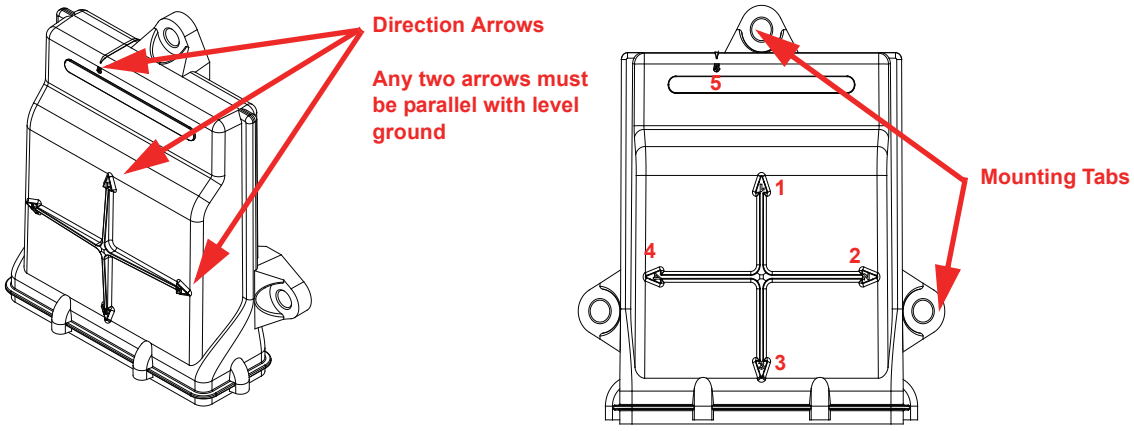
2. Locate the machine's existing fasteners that will be used to secure the node.

FIGURE 4. **Node Installed**

3. Secure the SmarTrax node to the wall of the side console using three M8 x 25 mm hex bolts (P/N 311-0070-015).

Node Mounting Locations

FIGURE 5. **Node Mounting**



When choosing the location for the SmarTrax node, consider the following points:

- Mount the SmarTrax node inside the machine's cab on a flat, level surface for proper performance and cable connection.
- One of the six numbered direction arrows on the node must be oriented in the direction of forward vehicle travel, one arrow pointing straight up, and two of the arrows parallel to the ground.

Note: *Make a note of the number of the arrow that is oriented in the direction of forward vehicle travel. This number will be needed during the SmarTrax calibration process.*

- The node mounting location must not create tripping hazards.
- Mount the node in a location where it will not be kicked or jarred during normal equipment operation.
- The location must allow cable routing to avoid crimping or damaging the cables or the node connections.
- Securely fasten the node using bolts or screws through at least two of the three mounting holes. When mounted properly, the node should not become loose or rotate.

Install the Foot Switch

FIGURE 6. **Foot Switch Installed**

1. Select a suitable location for the foot switch (P/N 063-0172-470) to be installed.

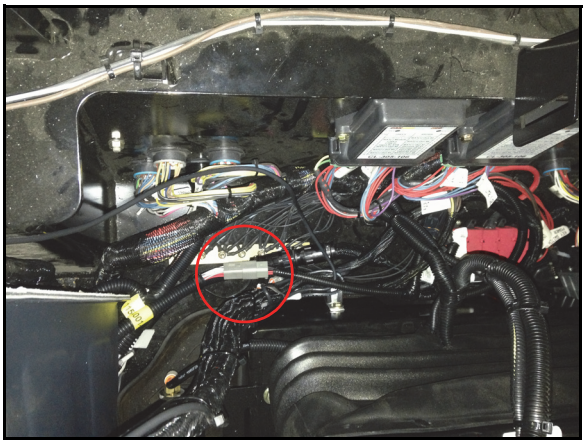
Note: *The foot switch should be installed in a location where the operator has easy access to it and is able to fully press the pedal.*

2. Using the holes in the foot switch as a template, drill holes in the floor of the cab.
3. Secure the foot switch to the floor by installing the supplied screws in each of the mounting holes.
4. Locate the ENABLE connector on the node harness and connect it to the foot switch connector.

Connect the Node Harness

Note: *The machine is factory-equipped with the chassis harness (P/N 115-4001-202).*

FIGURE 7. **Node Harness Connected to SmarTrax Node**



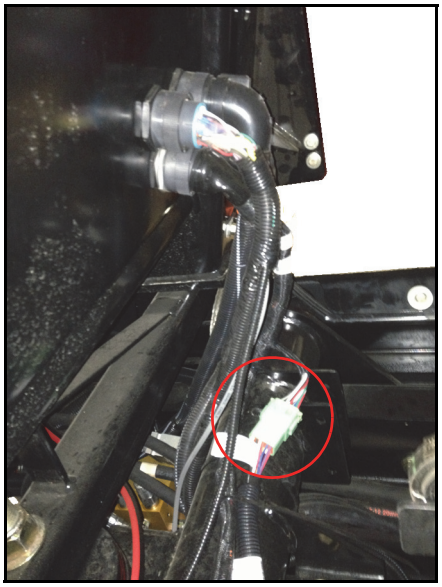
5. Connect the unlabeled 6-pin Deutsch connector to the mating connector on the machine's harness.
6. Verify that the DGPS connector is connected to the receiver or GPS source.

7. Secure the GPS INPUT FOR NON-STEERING SYSTEMS connector with plastic cable ties.

Note: *The GPS INPUT FOR NON-STEERING SYSTEMS connector is not used in the SmarTrax system.*

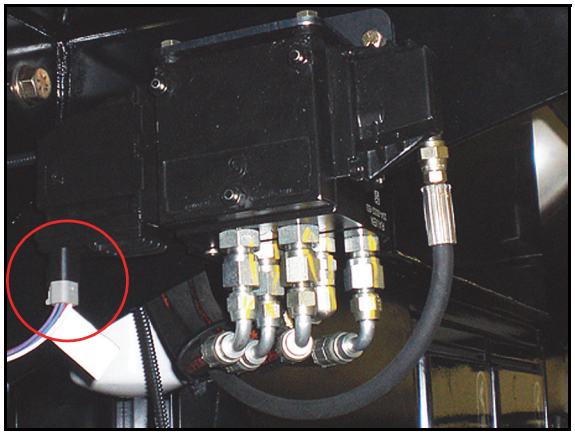
Install the Valve Harness

FIGURE 8. Valve Harness Connection



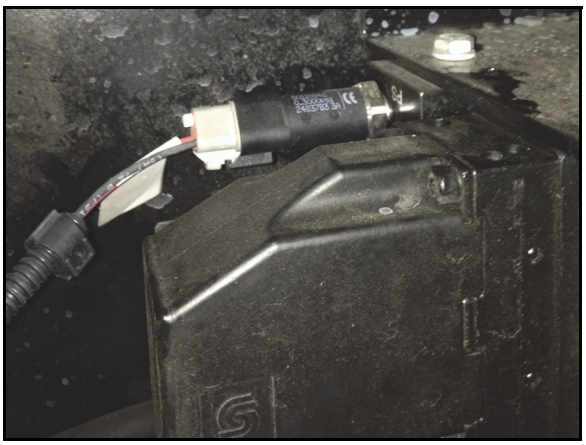
1. Connect the 12-pin connector of the valve harness (P/N 115-4001-227) to the mating connector of the machine's harness.

FIGURE 9. PVES Connection



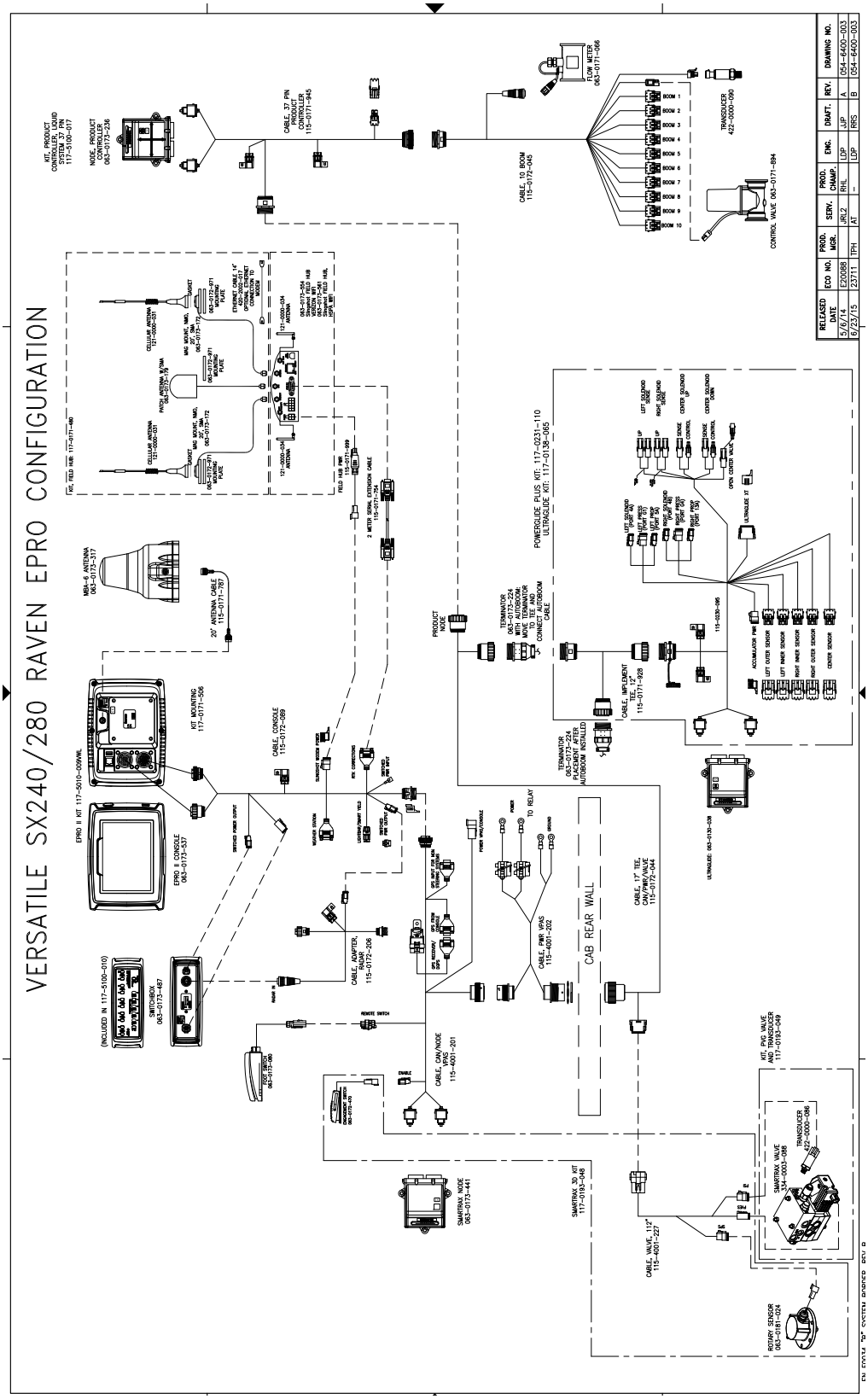
2. Connect the PVES connector to the open PVES port of the SmarTrax valve (P/N 334-0003-088).

FIGURE 10. **PRESSURE Connection**



3. Connect the PRESSURE connector to the pressure transducer (P/N 422-0000-086) installed in Port PS of the SmarTrax valve.
4. Connect the WAS connector to the installed WAS (P/N 063-0181-024) cable connector.

System Drawing



5

CHAPTER

6 Startup Procedures

WARNING

When starting the machine for the first time after installing SmarTrax, be sure that all persons stand clear in case a hose has not been properly tightened.

WARNING

Do not use hands to check for leaks. Hydraulic fluid under pressure can penetrate the skin and cause serious injury or death.

Verify the SmarTrax System Installation

1. Turn on the machine.
2. Double-check all fittings and hose connections to ensure that:
   - Hoses are not rubbing on or interfering with moving parts.
   - Hydraulic fluid is not leaking from the system.
3. Turn the machine's wheels fully from side to side repeatedly to remove air from the hydraulic system.

Note: *During the SmarTrax system installation, whenever the hydraulic system is purged for maintenance, or when fittings are loosened or disconnected, air is introduced into the lines of the hydraulic system. If air pockets are present, the wheels may not move consistently when the steering wheel is turned.*

4. Continue turning the wheels until they move steadily and smoothly when the steering wheel is turned.

5. Access the System Diagnostic screen by selecting the MACHINE TEST option on the Machine Type screen and turn the wheels using the Raven console.

Note: *If there are issues with the SmarTrax system, turn off the machine and correct them immediately. For additional assistance, refer to the SmarTrax and SmartSteer Calibration & Operation Manual (P/N 016-0171-532) or contact your local Raven dealer.*

6. Set the GPS Source to Internal via SmarTrax.

Note: *For more information on changing the GPS setting refer to the SmarTrax and SmartSteer Calibration & Operation Manual.*

Calibrate the SmarTrax System

Refer to the SmarTrax and SmartSteer Calibration & Operation Manual (P/N 016-0171-532) for instructions on calibrating the SmarTrax system, adjusting system settings, and system operation.