

RAVEN



UNIVERSAL HYDRAULIC STEERING KIT
INSTALLATION GUIDE FOR CLOSED
CENTER, PRESSURE COMP. SYSTEMS

117-9001-005

SmartTrax 
Straight shot to easy steering

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Introduction

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About This Guide

The aim of this guide is to provide up to date reference information about installation of the SmarTrax product.

Who it is for

This guide is intended for use by distributors who install new SmarTrax systems for Raven Industries.

What it covers

This guide presents:

- a parts checklist for the steering installation;
- installation procedures for the SMARTRAX hydraulic kit and cable routing

Updates

This guide will be updated periodically to reflect changes and additions to the range of SmarTrax products and to ensure that this guide fulfills users' needs for reference information. Updates will be supplied as soon as they are available.

Installation Safety Requirements

This section is divided between general safety precautions, specific safety measures in respect of the hydraulic and electrical system, and safety symbols used in this document.

The machine must remain stationary and switched off, and Steering Assist™ disengaged while installation or maintenance is being carried out.

Safety Precautions

When working with or near a machine with SmarTrax installed, the following safety measures must be observed. The operator *must*:

- Be alert and aware of surroundings.
- Not operate the SmarTrax while under the influence of alcohol or an illegal substance.
- Remain in the operator's position in the machine at all times when the SmarTrax is engaged.
- Be in complete control of the machine at all times when the SmarTrax is engaged.
- Disengage the SmarTrax when exiting from the operator's position and machine.
- Remain within the boundaries of a defined field when the SmarTrax is engaged.
- Not drive the machine with the SmarTrax engaged on any public thoroughfare or main road.
- Determine and remain a safe working distance from other machinery, equipment, and obstacles. The operator is responsible for disengaging the SmarTrax when the safe working distance has diminished.
- Determine and remain a safe working distance from other farm personnel or people. The operator is responsible for disengaging the SmarTrax when the safe working distance has diminished.
- Ensure the SmarTrax is disengaged prior to starting any maintenance work on the SmarTrax or machine.

Hydraulic Safety Precautions

When disconnecting hydraulic hoses or when purging is required, be aware that the hydraulic oil within the machine system may be hot and under high pressure. Caution must be exercised. Any work carried out on the hydraulics system must be performed in accordance with the machine manufacturer's approved maintenance instructions.

Raven Industries recommend that appropriate protective equipment be worn when working on the hydraulics system.

It is imperative that, when installing the SmarTrax hydraulics, performing diagnostics, maintenance, or routine machine servicing, that installers and customers **ensure all 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 adversely reduce performance, and possibly damage the SmarTrax hydraulic valves.

Electrical Safety Precautions

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

Safety Symbols



WARNING: Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Warning statements help you to:

- Identify a hazard.
- Avoid a hazard.
- Recognize consequences.

NOTE: Identifies information that is critical for successful application and understanding of the product.

Safety Warning Labels

Safety Warning Labels have been provided to highlight to users the importance of:

- Being aware not to damage the wheel angle sensor.
- Not tampering with the SmarTrax hydraulics valves.

These warning labels are to be placed in the specified locations as indicated below.

Steering Position Sensor Warning Label

It is essential that the Steering Position Sensor (SPS) is not damaged. Therefore Raven Industries has provided a '**Do Not Step**' warning label. This label is placed on the top surface of the Steering Position Sensor (*as shown below in **Figure 1***) with the label facing up where it should be visible to the operator.

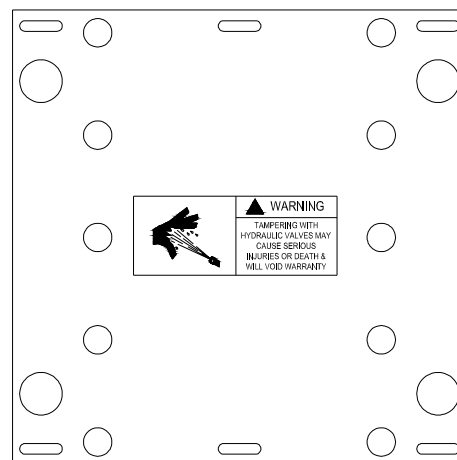
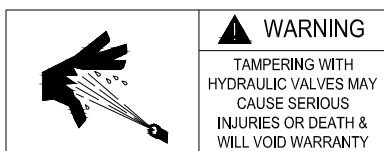


Steering Position Sensor Warning label

Hydraulic Warning Label

This label should be placed on the steering assist manifold or on the Hydraulic Valve Mounting Bracket as shown below in **Figure 2**. '**Tampering with hydraulic valves may cause serious injuries or death & will void warranty**'.

NOTE: That the picture shown below is only an example on where the hydraulic warning label is to be positioned on the steering assist manifold. Placement will vary depending on the valve used.



Hydraulic Warning label

Driving Safety Requirements

This section outlines the safety requirements used when driving a vehicle using the SmarTrax system.

Areas of operation

The SmarTrax must only be used on private property without public access. It must only be used within cleared fields. It must NOT be used when traveling on any public roads or access ways. Raven Industries advise that users familiarize themselves with the SmarTrax operations by first reading the Machine Operator Guide.

Avoidance of people

The SmarTrax must not be operated in the vicinity of people. People must be well outside of the machine's path while it is operating with Steering Assist engaged.

Avoidance of machinery and equipment

The SmarTrax operator must allow a safe distance between the machine's path and other machinery or equipment. To determine the safe distance, take into account the incorrect operation of the guidance system and the distance required for the machine to stop.

Avoidance of obstacles

The SmarTrax **CANNOT** detect obstacles such as fences, trees or boulders that are located within a defined Field. The SmarTrax assists the machine operator to steer the machine in straight lines in cleared fields. The machine operator must identify and avoid the obstacles while working a field.

Responsibilities of operator

The machine operator must remain in complete control of the machine at all times. Only when steering assist is enabled can there be hands-free operation.

The machine operator remains fully responsible for the operation of the machine and must remain in the operator's position within the machine at all times while the Steering Assist is engaged.

Disengaging steering assist

The operator must disengage the Steering Assist if an obstacle is in the line of travel. The operator must disengage Steering Assist by using one of the following methods listed below.

Turning the steering wheel in the normal manner, stopping the machine, or pressing the remote activation switch can disengage steering Assist.

Operational emergency safety steps

In case of an emergency, take one of the following steps to disengage Steering Assist:

- Press the brake and decelerate to under 0.6 mph / 1 kph;
- Turn the steering wheel in the normal manner; or
- Pressing the remote activation switch.

Other References

Contacting RAVEN INDUSTRIES

We welcome your feedback about this guide.

If you have any comments or suggestions for improvements, please let us know by contacting our Customer Support Center by any of the methods below:

By phone

1-800-243-5435

By mail

Raven Industries
Flow Controls Division
205 E. 6th St.
Sioux Falls, SD 57104

By Email

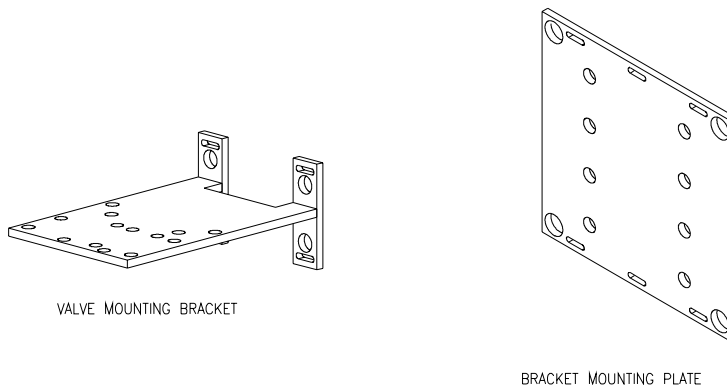
fcdinfo@ravenind.com

Installing Hydraulic Components

- Installing Hydraulic Bracket
- Hydraulic System Installation
- Safety Precautions for Connecting Hydraulic Hoses
- Installing the Flow Monitor to the Bracket
- Installing Hydraulic Components
- Installing the Steering Control Valve and Flow Monitor Hoses
- Hydraulic System Checks and Setup
- Setting the Valve Spool Stops
- Setting the Flow Monitor
- Hydraulic System Warning

INSTALLING THE HYDRAULIC BRACKET

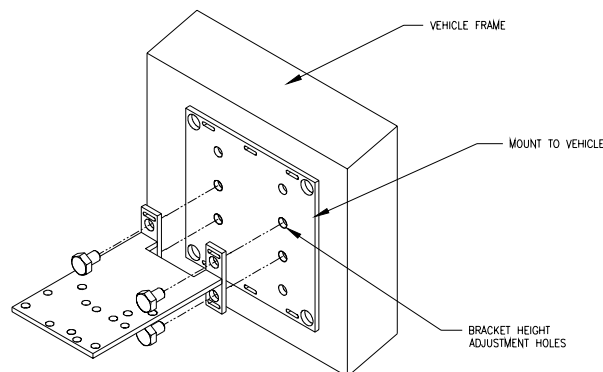
- ◆ The bracket is intended to be universal to accommodate valve mounting on various types of machines. It may be necessary to modify the provided brackets, such as drilling additional mounting holes, to fit the desired application.
- ◆ The valve-mounting bracket is made of two parts. The bracket with the valve mounting holes may be used independently and the secondary mounting plate may be discarded if not needed.



- ◆ Mount the bracket as close as possible to the steering orbital, in order to keep the hydraulic hoses as short as possible. Also, mount the bracket in a position that will protect the valve from getting damaged from mud, crops, etc.
- ◆ Mount the bracket mounting plate by using existing holes in the vehicle frame. The bracket mounting plate may need to have additional holes drilled in order to accommodate various hole patterns.

****NOTE: NEVER DRILL NEW HOLES INTO THE VEHICLE FRAME**

- ◆ If both brackets are used in the installation, first mount the bracket mounting plate to the vehicle. Once the plate is installed, mount the valve mounting bracket to the mounting plate bracket using the supplied bolts and washers.
- ◆ The bracket mounting plate is designed to provide valve height adjustment for easier hose routing by using the five pairs of mounting holes. To adjust the bracket up or down, unbolt the valve mounting bracket and move to the desired height and reattach using the supplied bolts.

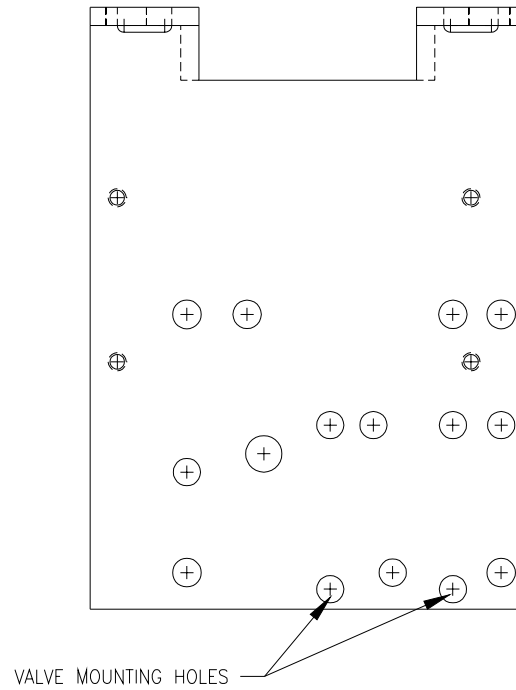


- ◆ In some installations, it may be more appropriate to use only the valve mounting bracket. If only the valve mounting bracket is used, mount the bracket using existing holes in the frame to securely fasten the bracket to the frame.

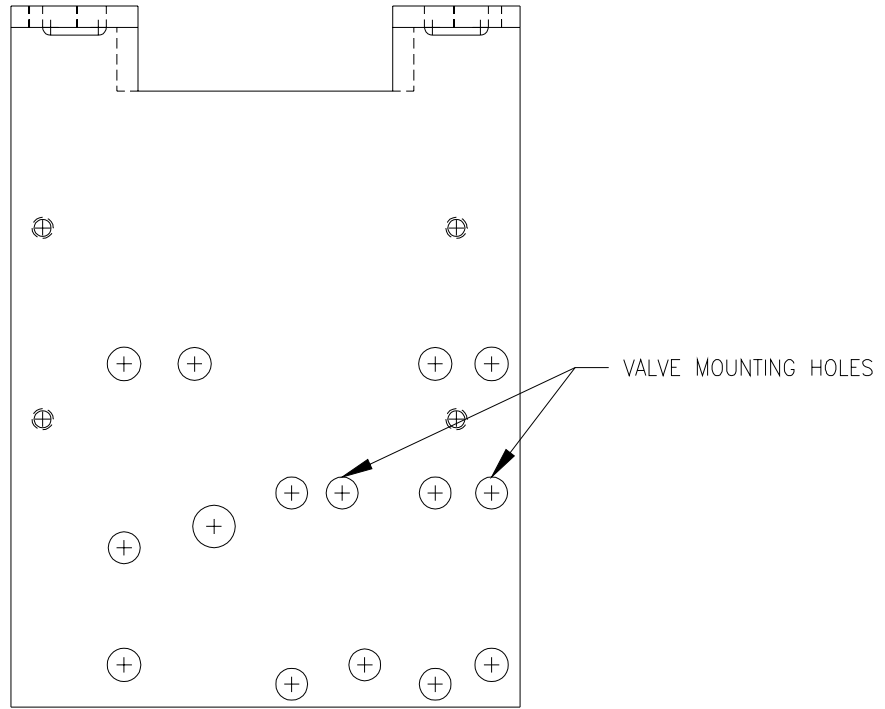
MOUNTING THE VALVE TO THE BRACKET

- ◆ Six different hydraulic valves are designed to mount to this bracket. To determine the hole pattern needed, look at the part number printed on the cover of this manual and reference the six following schematics for appropriate hole patterns.
- ◆ Bolts and washers needed to mount the valve are provided in the hardware kit.

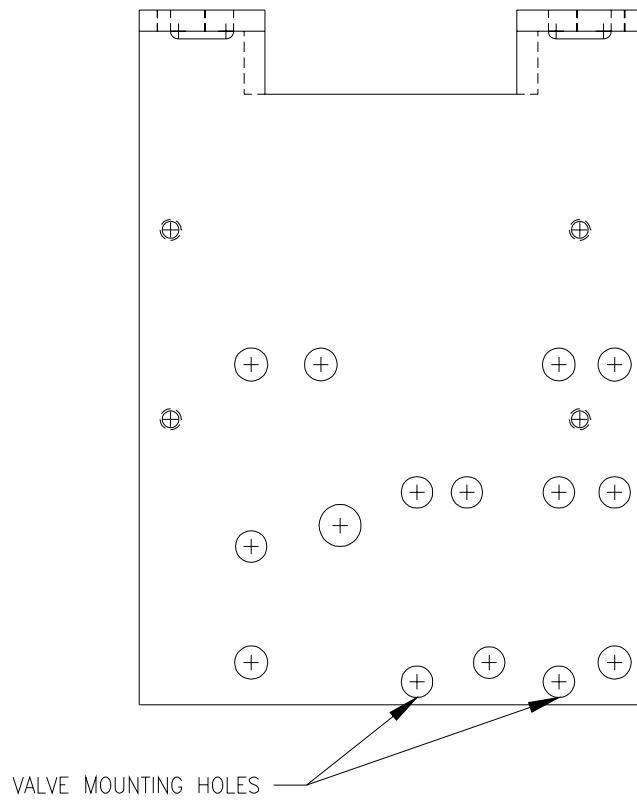
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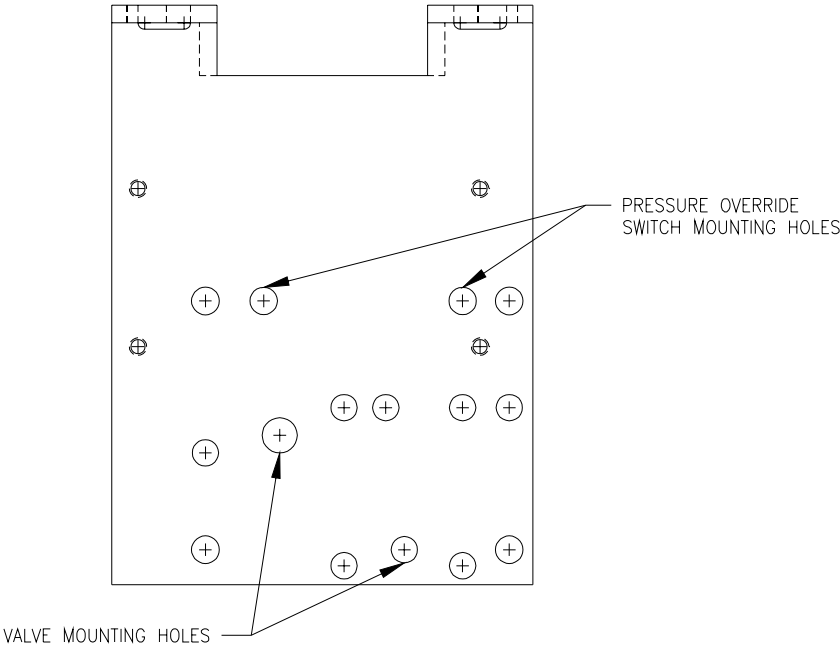


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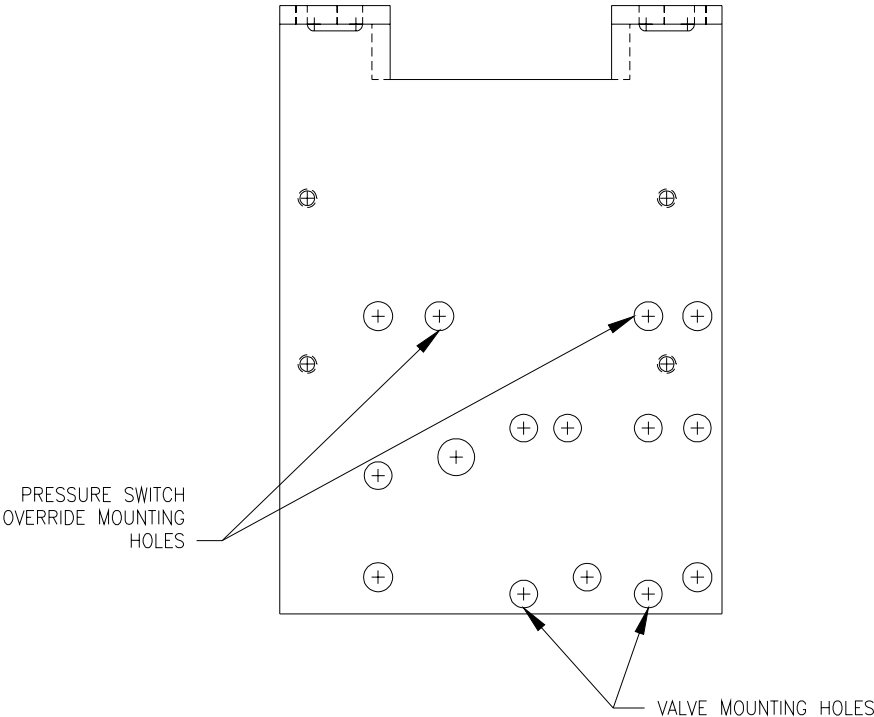
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NOTE: FOR THIS CONFIGURATION, THE STEERING CONTROL VALVE IS TO BE MOUNTED ON THE TOP SURFACE OF THE BRACKET AND THE OVERRIDE SWITCH IS TO BE MOUNTED ON THE UNDERSIDE OF THE BRACKET

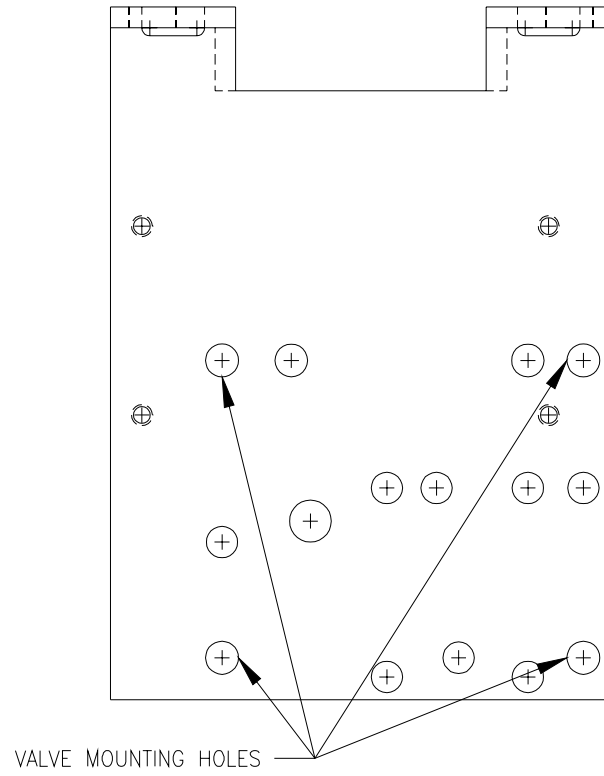


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NOTE: FOR THIS CONFIGURATION, MOUNT THE VALVE ON THE TOP SIDE OF THE PLATE AND THE FLOW SWITCH ON THE UNDERSIDE OF THE PLATE.



117-9001-006



HYDRAULIC SYSTEM INSTALLATION

- ◆ The Raven Universal Hydraulic Kit does not come with hydraulic hoses. Hoses should be made per specifications noted on the installation checklist.
- ◆ Adapter fittings will be needed for proper installation. Adapter fittings are not provided with the Steer Kit, but a kit is available (P/N 117-9001-018).

Safety Precautions For Connecting Hydraulic Hoses



WARNINGS:

- The machine must remain switched off, isolated, and stationary, while installation and maintenance is being done.
- When disconnecting hydraulic hoses, or when purging is required, it is important to be aware that hydraulic oil may be hot. **Caution** must be exercised.
- The risk of contamination of the hydraulic system is at its greatest when any fitting is removed. It is **essential** that, prior to the loosening of any fitting, the fitting is cleaned thoroughly with a spray cleaner such as Brake Clean™.
- **Note:** Brake Clean™ can cause premature failure to o-rings such as those used in ORFS fittings. If a fitting is to be cleaned internally, the o-ring should be removed first and cleaned with fiberless cloth.
- Lines should be capped with plastic blanking covers immediately on removal, to help prevent foreign matter contamination.

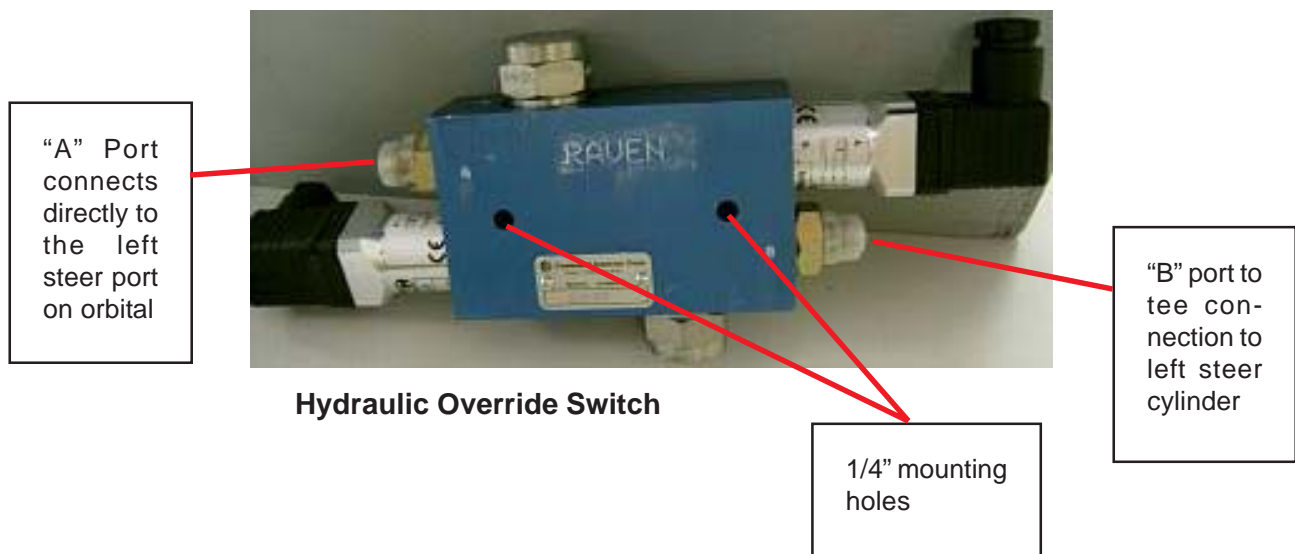
To install each component of the hydraulic steering kit as efficiently as possible, it is important to follow the order in which this procedure is outlined. Failure to do so can result in damage to components such as hydraulic hoses due to incorrect hose routing.

Prior to starting the installation of hydraulic hoses, ensure that the machine is switched off and that all pressure is relieved from the machine hydraulic system. This can be done by turning the steering wheel left and right.

It is important to make sure that the pressure hose is connected to the “P” Port on the Raven Valve and the Return Line is connected to the “T” Port on the Raven Valve. Connecting these lines backwards WILL DAMAGE VALVE SEALS!

WARNING: Prior to working with the hydraulic system, user must undertake the following safety provisions:

- ◆ **Wear appropriate protective equipment at all times while working on the hydraulics system,**
- ◆ **Perform all work carried out on the hydraulics system in accordance with the tractor manufacturer’s approved maintenance instructions, and**
- ◆ **Be aware that the hydraulic oil within the tractor system may be hot and under high pressure when disconnecting hydraulic hoses or when purging is required - exercise extreme caution.**



INSTALLING THE OVERRIDE TO THE BRACKET

- ◆ Position the override over the set of holes that matches the holes in the bracket. The override will be mounted on the underside of the bracket on the opposite side of the bracket from the hydraulic valve. Use the provided 1/4" x 2" hex head bolts along with the provided nyloc nuts to secure the override to the bracket.
- ◆ NOTE: The override may be in a position so only 1 hole is useable. In this case, use the threaded holes along with the provided bolt and nut.
- ◆ NOTE: There is no adjustment necessary for this override switch.

Installing Hydraulic Components

Raven Part #'s

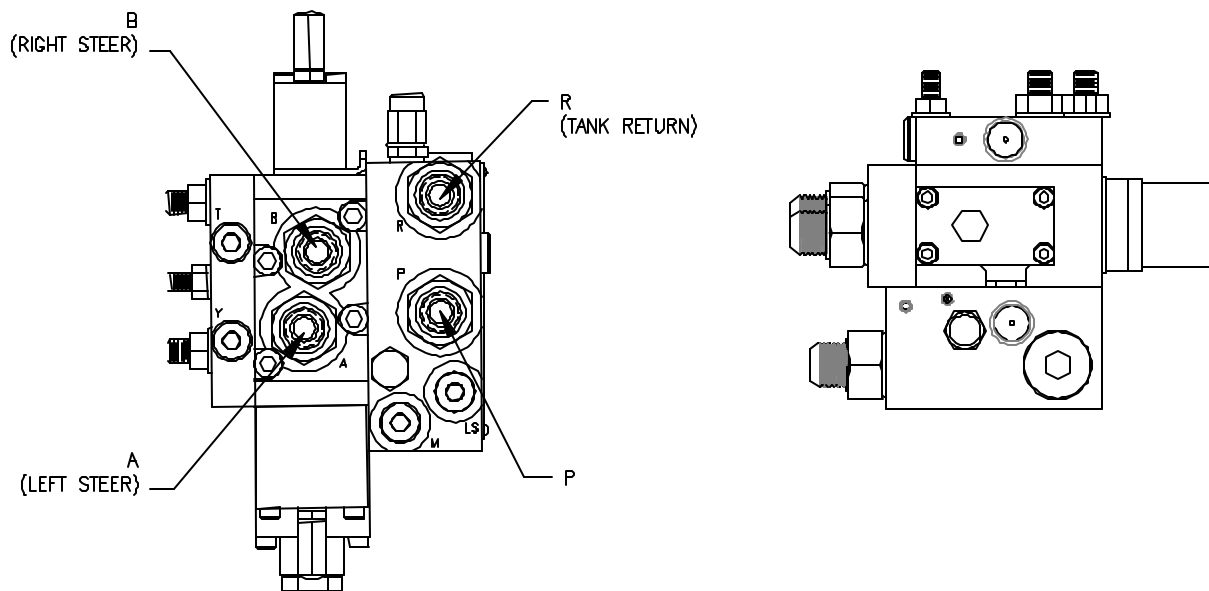
334-0003-042 - Hydraulic Valve, Hawe, Std. Manifold w/fittings

334-0003-024 - Override Switch

117-9001-018 - Fitting Kit, Hydraulic Closed Center, Pressure Compensated

- ◆ The Raven universal steering kit does **NOT** come supplied with hoses. Hoses must be made per specifications stated on the provided installation sheet. It is important that when new hoses are made, that every effort is made to properly clean out the new hose to prevent any contamination to the vehicles hydraulic system.
- ◆ An installer's worksheet has been provided, which gives a detailed layout of the auto-steer hydraulic system. It is important that all parts are identified, documented, and returned to Raven upon the completion of the installation using the postage paid envelope.

Raven Steering Control Valve Configuration



A-Port - Controls left steering

B-Port - Controls right steering

P-Port - Pressure input port into the valve

R-Port - Returning fluid port back to tank

A-Port - Hooked to left steer port on tractor orbital

B-Port - Hooked to tee fitting connecting left steer on auto steer valve to left steer line on tractor

Installing the Steering Control Valve and Flow Monitor hoses

Left steer hose

1. Identify the left steer port on the tractor steering orbital. Hoses may need to be traced to the hydraulic cylinders for proper identification. Once the port has been identified, remove the hose from the tractor steering orbital and cylinder.
2. Construct a new hose to run from the left steer port on the orbital to the “A” port on the override switch.
3. Construct a new hose to run from the “B” port on the override switch to a tee fitting. (In most cases, the tee should be installed on the open left steer port on the cylinder.)
4. Construct a new hose to run from the A-Port on the Raven steering control valve to the open branch on the installed tee fitting. (For more details, see the installers worksheet.)
5. An additional 45 or 90 degree elbow may be installed on the Raven valve to help hose routing. These elbows will be found in the hydraulic fitting kit.

Right steer hose

1. Identify the right steer port on the tractor steering orbital. Hoses may need to be traced to the hydraulic cylinders for proper identification. Once the port has been identified, remove the hose from the tractor steering orbital and install an appropriate tee fitting, found in the Raven adapter kit, to the steering orbital. Once the tee fitting is installed, reattach the original hose. (NOTE: Tees may be placed on the steering cylinder for easier installation.)
2. Construct a new hose to run from the B-Port on the Raven steering control valve to the open branch on the installed tee fitting. (For more details, see the installers worksheet.)
3. An additional 45 or 90 degree elbow may be installed on the Raven valve to help hose routing. These elbows will be found in the hydraulic fitting kit.

Pressure hose

1. Identify the pressure port on the tractor steering orbital. Hose may need to be traced to the hydraulic pump for proper identification. Once the port has been identified, remove the hose from the tractor steering orbital and install an appropriate tee fitting, found in the Raven adapter kit, to the steering orbital. Once the tee fitting is installed, reattach the original hose.
2. Construct a new hose to run from the P-Port on the Raven steering control valve to the open branch on the installed tee fitting. (For more details, see the installers worksheet.)
3. **It is extremely important that the pressure line running to the Raven steering control valve goes to the port designated “P”. Failure to do so will result in internal o-ring failure on the valve.**
4. An additional 45 or 90 degree elbow may be installed on the Raven valve to help hose routing. These elbows will be found in the hydraulic fitting kit.

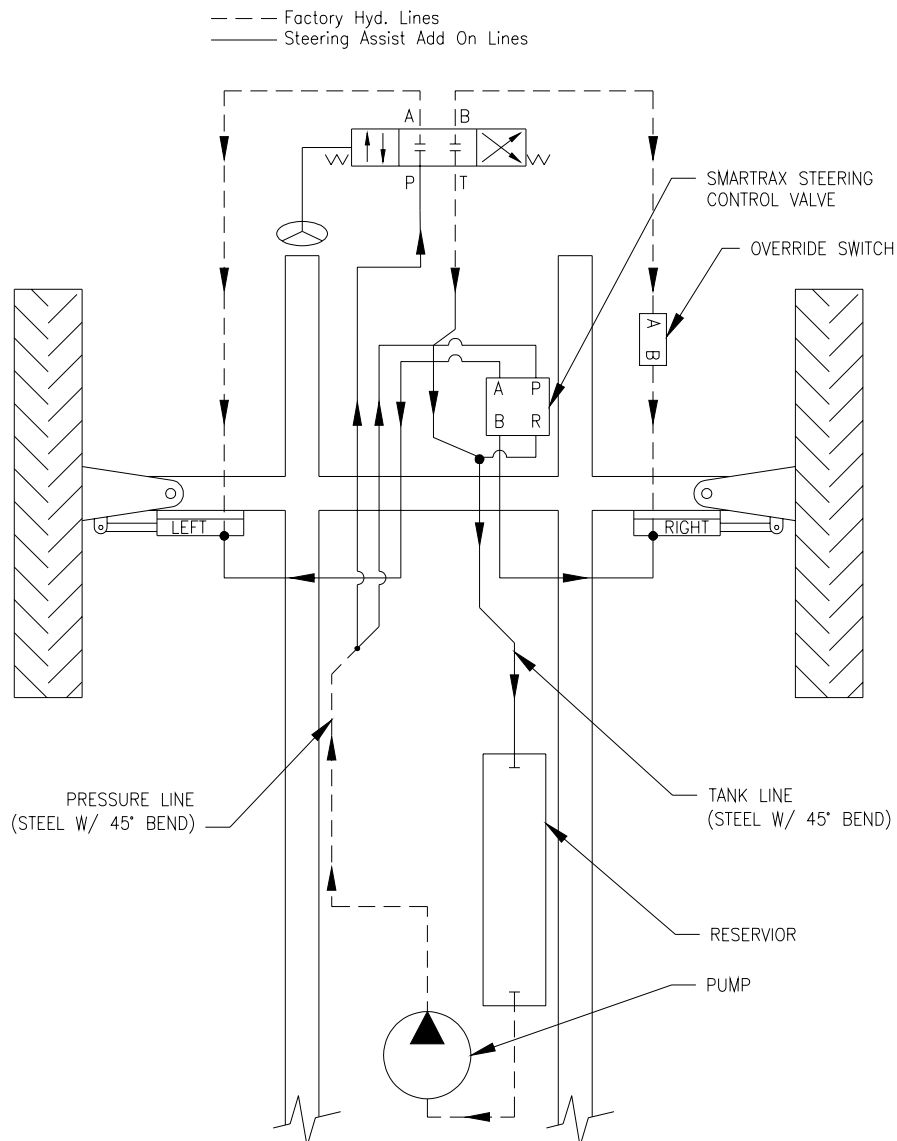
Return hose

1. Identify the tank port on the tractor steering orbital. (often designated by a “T” or “R” stamped into the orbital itself) Hose may need to be traced to the hydraulic reservoir for proper identification. Once the port has been identified, remove the hose from the tractor steering orbital and attach a tee fitting to the orbital.
2. On one open branch of the tee fitting, attach the original tank line. NOTE: Depending on the location of the tee fitting, a new hose may have to be constructed to run from the tank to the tee.
3. Construct a new hose to run from the Raven steering control valve R-port to the remaining open branch of the tee fitting. (See Installer’s Worksheet)

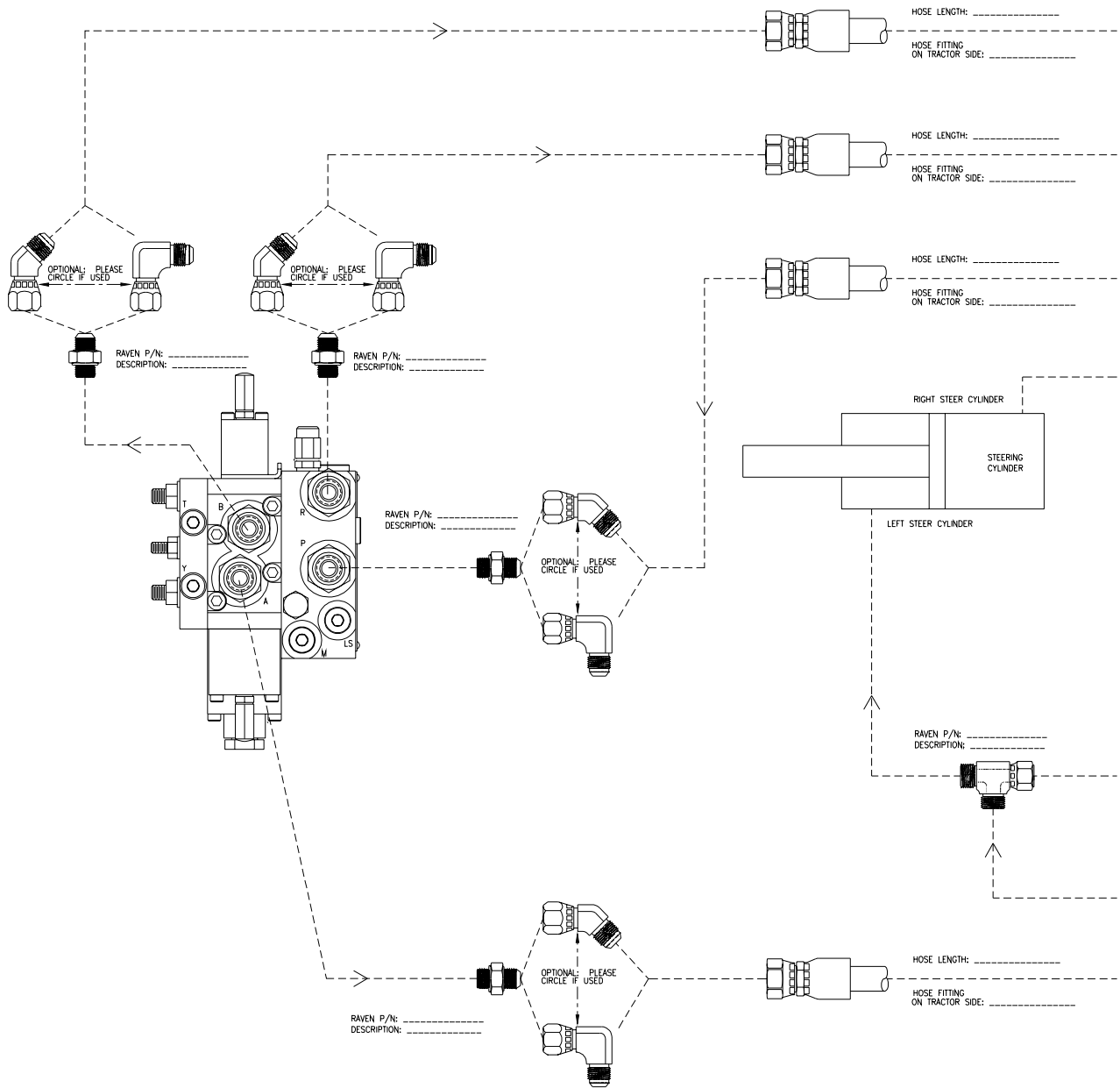
4. It is extremely important that the Return line running from the Raven control valve is attached to the tee fitting on the tank side of the Steering Orbital. Failure to do so will result in valve malfunction and/or failure.
5. An additional 45 or 90 degree elbow may be installed on the Raven valve to help hose routing. These elbows will be found in the hydraulic fitting kit.

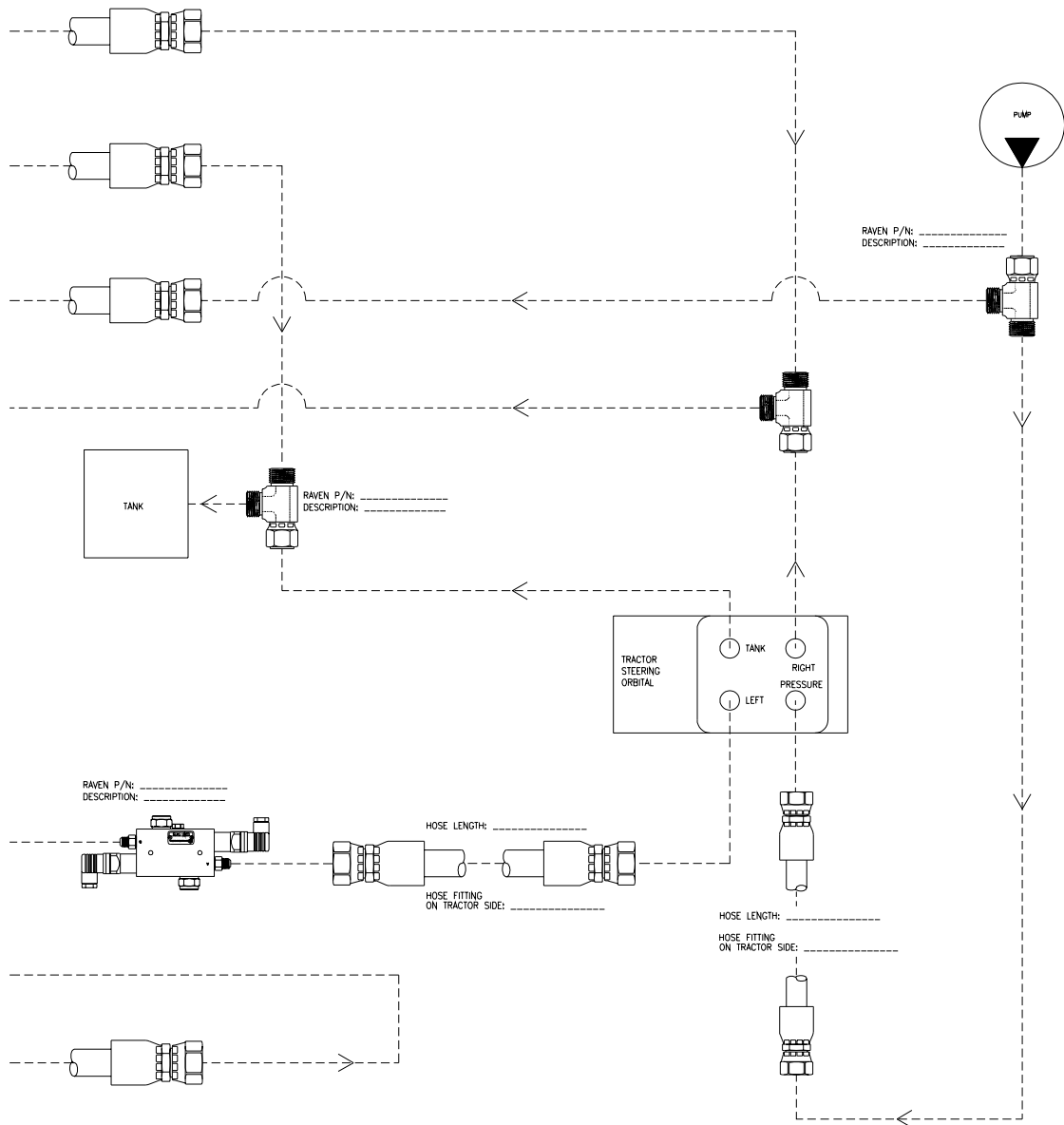
HELPFUL HINT!

- ◆ Before tightening the provided hoses to their tee-fittings, it is easiest to leave the hose fittings loose on the tee end and then run the hose to its proper port on the steering control valve. By doing this, it will allow the hoses to rotate and bend properly around corners.
- ◆ **NOTE:** If installing right and left hoses directly to the steering cylinder, It is important to remember that some machines have adjustable wheel tracking. When routing the hoses for the left and right steering cylinders to the Smartrax steering control valve, it is important to follow the same hose routing path as the factory installed hydraulic hoses. By doing this, damage to any of the installed hoses will be avoided when adjusting the track width.



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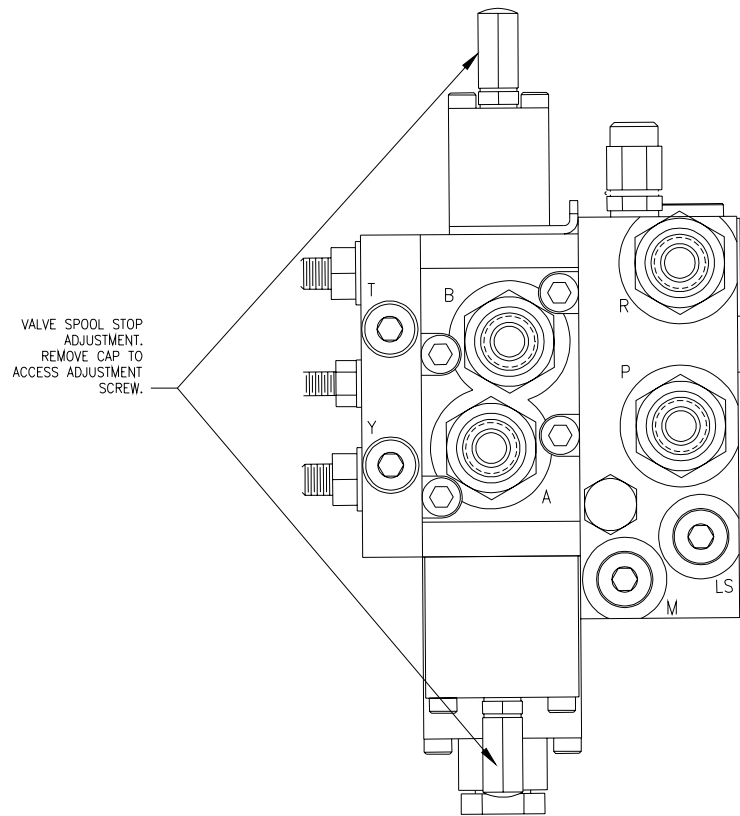


HYDRAULIC SYSTEM CHECKS AND SETUP

- ◆ Once all of the hoses have been hooked up, go back and verify that all hose fittings and connections are tight, and that the hoses are attached to their appropriate ports.
- ◆ Once the hydraulic system has been plumbed, it is important to start the tractor and verify that there are no leaks and that the hoses have been hooked up correctly.
 - ◆ **WARNING!** Upon initial system start up, it is important that any person near the machine stand clear, in the case that a hose has not been completely tightened.
- ◆ Once the machine is started and running, a complete inspection of the hoses, fittings and valves should be done to verify that the system is leak free.
- ◆ In some instances, it may be found that air has gotten into the hydraulic system. If this happens, it is important to remove the air from the system by turning the steering wheel from lock to lock several times.
- ◆ Once the valve is tested, attach the supplied warning label on or near the valve.

SETTING THE VALVE SPOOL STOPS

- ◆ The steering control valve will not come from the factory preset. Flow rates to the cylinders must be set so that the wheels turn left and right at the same rate.
- ◆ It is recommended that lock to lock turning time achieved by the steering control valve should be approximately 15 seconds in both directions. To verify this setting, the steering control valve must be pulsed using the SmarTrax controller. In the solenoid control config menu, use the LesR screen to pulse the valve.
- ◆ To pulse the steering control valve, the steering wheel should be turned all the way to the left, and then pulsed to the right.
- ◆ Once user is ready to manually control the steering control valve, it is important that the user measure the amount of time it takes for the wheel to turn all the way from the left to the right.
- ◆ If the time is **more or less than 15 seconds, the valve must be adjusted!**
 - ◆ For times less than 15 seconds, the valve spool stop must be turned in to slow the valve speed. To do this, user must first loosen the acorn covers on each side of the valve. Once these covers are removed, loosen the jam nuts and turn in the spool stop using an allen wrench. Once adjusted, reset the jam nut and put the acorn cover back onto the valve.
 - ◆ Left and right lock to lock times are set independently by each spool stop.
 - ◆ For times more than 15 seconds, the valve spool stop must be turned out. Repeat the same process as stated above to adjust spool stop.
- ◆ Once the valve has been adjusted, tighten down the spool stop acorn cover.
 - ◆ **WARNING!** Failure to secure the spool stop adjustment screw with the jam nut and acorn cover could result in a loss of auto steering.

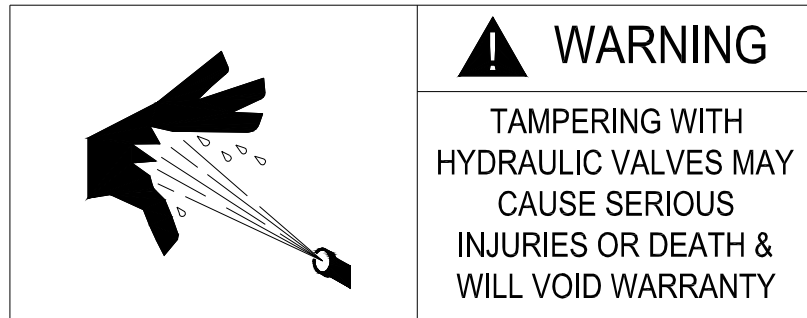


- ◆ Once the valve has been adjusted, return the wheels to the center position and turn tractor OFF.

HYDRAULIC SYSTEM WARNING!

Install the supplied hydraulic system warning label onto the hydraulic bracket.

- ◆ Before placing the sticker onto the bracket, make sure that the surface is clean.



Cable Connection and Routing

Overview of Cable Connection & Routing
Smartrax Loom Routing
Solenoid Cable Connection & Routing
Wiring the Solenoid and Override Switch

CABLE CONNECTION AND ROUTING

- ◆ In this portion of the installation, routing the necessary cables and wiring the electronic components that control the hydraulic components will be completed.
- ◆ The wire loom will be routed and connected to the solenoid cable and the Steering Position sensor cable.

Overview of Cable Connection & Routing

NOTE: The Cable Connection & Routing section of this manual is generic and has been designed to cover all tractor types currently available.

Before starting the Cable Connection and Routing section of this document user should first ensure that all components of the hydraulic steering kit are installed securely and neatly.

The cable connection and routing instructions that are included in this section consists of:

- Smartrax Loom connection and routing;
- Solenoid cable connection and routing; and
- Steering Position Sensor (*SPS*) cable connection and routing.

Smartrax Loom Routing

STEPS

- 1) Route the Smartrax Loom from the Valve to the cab. It should lead into the tractor cab through a suitable entry point.

NOTE: Ensure Smartrax Loom is mounted neatly. Secure it (where possible) to existing points on the tractor using cable ties. Ensure it is not routed near heated areas such as the exhaust. Do not route it in close proximity to moving parts.

KEY POINTS

NOTE: Ensure Smartrax Loom is securely connected to the Valve.

Solenoid Cable Connection & Routing

This series of hydraulics uses the Type 5 Solenoid Cable.

The Solenoid Cable Connection & Routing section will be updated periodically to reflect changes and add any additional tractor types to each of the corresponding types of solenoid cable connections. Updates will be supplied as soon as they are available.

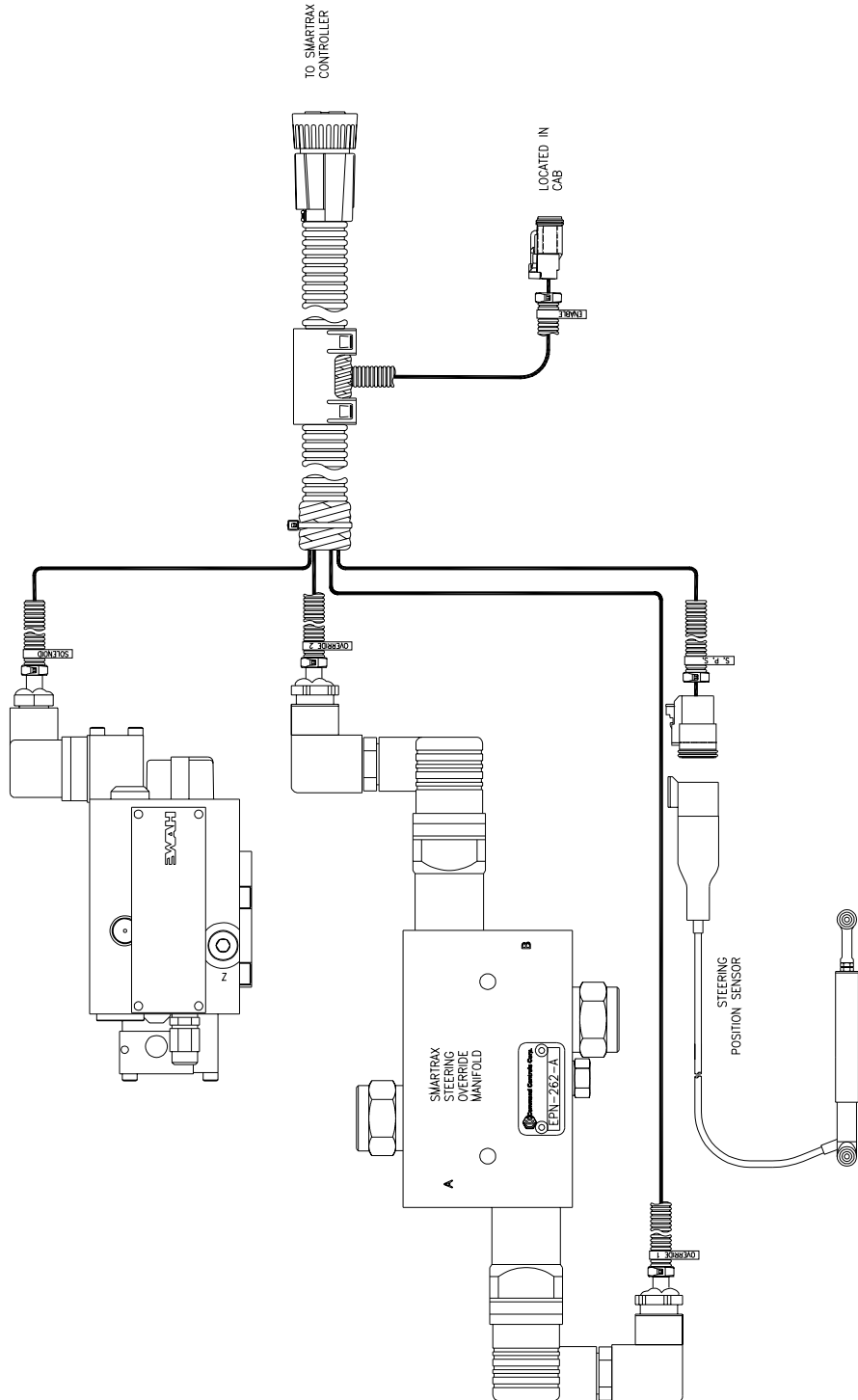
Solenoid cable connection - type 5

STEPS	KEY POINTS
<ol style="list-style-type: none"> 1. The Solenoid cable connection - type 5 comprises of 5 terminal points: <ul style="list-style-type: none"> ◆ 1 Solenoid Valve connections (labelled as Solenoid); ◆ 2 Steering Override Switch connections (labelled as Override). ◆ 1 SPS connection. ◆ 1 Enable connection. 2. Start by connecting the Solenoid cable to the Smartrax Controller (as shown on the following page). 3. Route the Solenoid cable towards the Steering Assist Valve Bank, where the Solenoid Valve, and Steering Override Pressure Switch are located. 4. Connect the Solenoid Valve, Steering Override Pressure Switch, and S.P.S. to the wiring. 5. Connect the footswitch to the enable connection. <p>NOTE: Refer to the figure on the following page for information on cable connection.</p>	<p>NOTE: Mount the Solenoid cable neatly and secure it, where possible, to existing points on the tractor using cable ties. Ensure it is not routed near heated areas such as the exhaust or in close proximity to moving parts.</p> <div style="text-align: center; margin-top: 20px;"> </div>

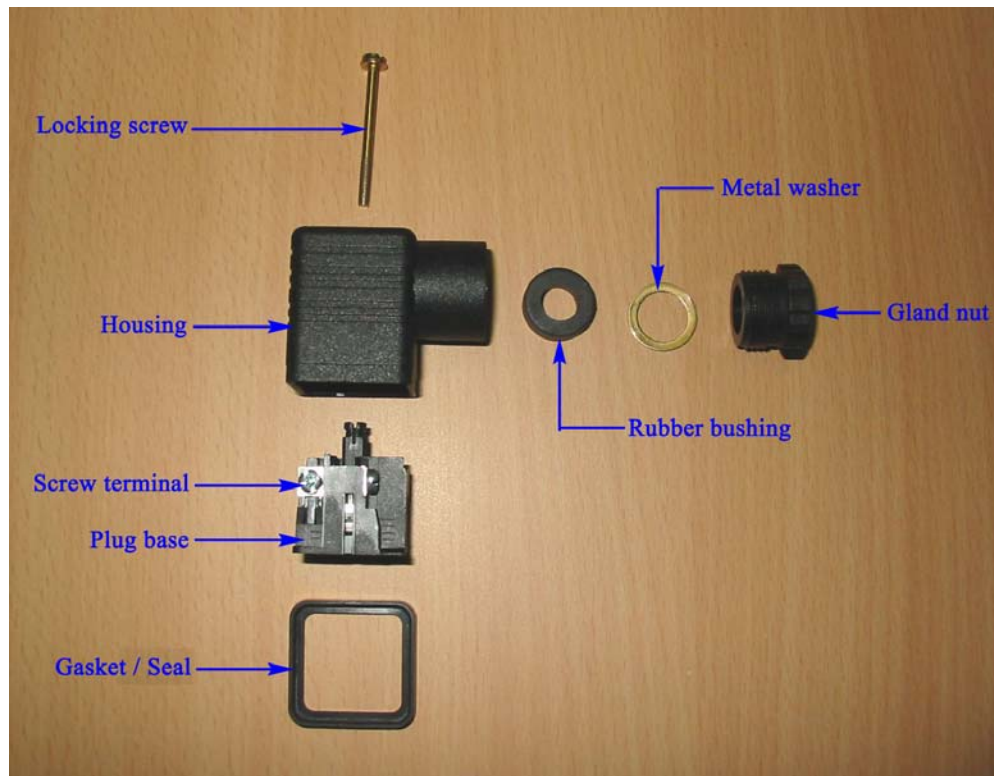
Connection	Pin	Color
Solenoid	1 2 3	Black Green Red
Override 1	1 2	White Blue
Override 2	1 2	White Blue
S.P.S.	A B C	Black Green Red

Wiring the Solenoid and Override Switch

- ◆ In this portion, the hydraulic valve and the flow monitor will be wired using the cable labeled Solenoid, Override, and S.P.S.
- ◆ The following schematic will show the wiring of the hydraulic system.
- ◆ Once wiring is connected, ensure the Solenoid cable is cable-tied neatly and securely away from moving parts.



- ◆ To wire the DIN connectors, disassemble the connector as shown in the following picture and connect the wires to their designated port.



DIN connector assembly

- ◆ Once the solenoid and override cables have been wired, connect the cable to the Smartrax loom.
- ◆ **IMPORTANT!** Once all cables have been run, it is important that they be run and tied down so that they will not be damaged. The Steering Position Sensor cable may need some slack as the sensor does move up to eight inches back and forth with axle as width changes.
- ◆ Run the 6 pin Deutsch male lead of the Smartrax loom into the cab of the sprayer.

A decorative border of a spiral notebook binding surrounds the text. The spiral is on the left and right sides, with leaf-like flourishes at the top and bottom corners.

RAVEN INDUSTRIES LIMITED WARRANTY

WHAT IS COVERED?

This warranty covers all defects in workmanship or materials in your Raven Flow Control Product under normal use, maintenance, and service.

HOW LONG IS THE COVERAGE PERIOD?

This warranty coverage runs for 12 months from the purchase date of your Raven Flow Control Product. This warranty coverage applies only to the original owner and is not transferrable.

HOW CAN YOU GET SERVICE?

Bring the defective part, and proof of date of purchase, to your local dealer. If your dealer agrees with the warranty claim, he will send the part, and proof of purchase to his distributor or to Raven for final approval.

WHAT WILL RAVEN INDUSTRIES DO?

When our inspection proves the warranty claim, we will, at our option, repair or replace the defective part and pay for return freight.

WHAT DOES THIS WARRANTY NOT COVER?

Raven Industries will not assume any expense or liability for repairs made outside our plant without written consent. We are not responsible for damage to any associated equipment or product and will not be liable for loss of profit or other special damages. The obligation of this warranty is in lieu of all other warranties, expressed or implied, and no person is authorized to assume for us any liability. Damages caused by normal wear and tear, misuse, abuse, neglect, accident, or improper installation and maintenance are not covered by this warranty.



RAVEN INDUSTRIES FLOW CONTROL DIVISION
205 East Sixth Street - P.O. Box 5107 - Sioux Falls, South Dakota 57117-5107
E-mail: fcinfo@ravenind.com
www.ravenprecision.com
Toll-free: 800-243-5435 - Fax: 605-331-0426

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