

RAVEN

Simply improving your position.SM

SmarTrax™ Universal Installation Manual



Caterpillar Tracked Tractors
B, C, D, E, 35, 45, 55 Series

Disclaimer

While every effort has been made to ensure the accuracy of this document, Raven Industries assumes no responsibility for omissions and errors. Nor is any liability assumed for damages resulting from the use of information contained herein.

Raven Industries shall not be held responsible or liable for the effects of atmospheric conditions and sunspot activity on the performance of our products.

Raven Industries cannot guarantee the accuracy, integrity, continuity, or availability of the GPS signal from the U.S. Department of Defense/NAVSTAR GPS satellites, the OmniSTAR correction service or the WAAS correction service.

Raven Industries accepts no responsibility for the use of the signal for other than the stated purpose. Raven Industries shall not be responsible or liable for incidental or consequential damages or a loss of anticipated benefits or profits, work stoppage or loss or impairment of data arising out of the use, or inability to use, the SmarTrax or any of its components.

TABLE OF CONTENTS

INTRODUCTION	3
ABOUT THIS GUIDE	4
WHO IT IS FOR	4
WHAT IT COVERS	4
UPDATES	4
INSTALLATION SAFETY REQUIREMENTS	5
SAFETY PRECAUTIONS	5
HYDRAULIC SAFETY PRECAUTIONS	6
ELECTRICAL SAFETY PRECAUTIONS	6
SAFETY SYMBOLS	6
SAFETY WARNING LABELS	7
HYDRAULIC WARNING LABEL	7
DRIVING SAFETY REQUIREMENTS	8
AREAS OF OPERATION	8
AVOIDANCE OF PEOPLE	8
AVOIDANCE OF MACHINERY AND EQUIPMENT	8
AVOIDANCE OF OBSTACLES	8
RESPONSIBILITIES OF OPERATOR	8
DISENGAGING STEERING ASSIST	9
OPERATIONAL EMERGENCY SAFETY STEPS	9
OTHER REFERENCES	9
CONTACTING RAVEN INDUSTRIES	9
INSTALLING HYDRAULIC COMPONENTS	10
INSTALLING THE HYDRAULIC BRACKET	11
MOUNTING THE VALVE TO THE BRACKET	12
HYDRAULIC SYSTEM INSTALLATION	13
SAFETY PRECAUTIONS FOR CONNECTING HYDRAULIC HOSES	13
HYDRAULIC STEERING SETUP BEFORE AND AFTER INSTALLATION	14
INSTALLING HYDRAULIC COMPONENTS	15
INSTALLING THE STEERING CONTROL VALVE HOSES	18
HYDRAULIC SYSTEM CHECKS AND SETUP	19
SETTING THE OVERRIDE PRESSURE SWITCH	20
CABLE CONNECTION AND ROUTING	21
OVERVIEW OF CABLE CONNECTION AND ROUTING	22
SMARTRAX LOOM ROUTING	22
SOLENOID CABLE CONNECTION & ROUTING	23
STEERING POSITION SENSOR (S.P.S.) CABLE CONNECTION AND ROUTING	23

Diagrams and Figures

Hydraulic Warning label	7
Valve Mounting Bracket	11
Bracket Mounting Plate	11
Hydraulic Valve Mounting Holes	12
Steering Block Diagram before installation	14
Steering Block Diagram after installation	14
Steering Control Valve Labelled	15
Hydraulic System Layout	16 - 17
Pressure Switch	20
Solenoid cable connection type 1 to Smartrax Loom	24

Introduction

About This Guide
Installation Safety Requirements
Safety Warning Labels
Driving Safety Requirements
Other References
Contacting RAVEN INDUSTRIES

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:

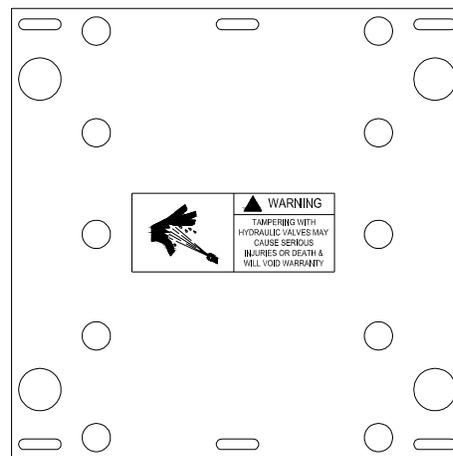
- Being aware not to damage the wheel angle sensor.
- Not tampering with the SmarTrax hydraulics valves.

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

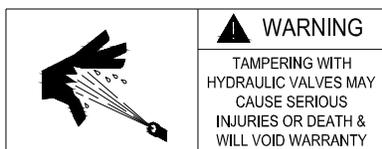
Hydraulic Warning Label

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

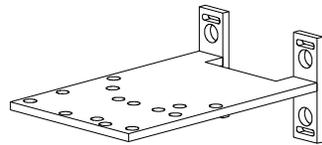
fcdinfo@ravenind.com

Installing Hydraulic Components

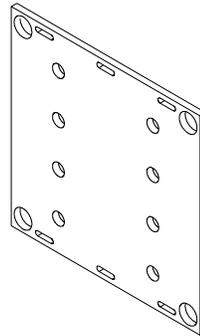
- Installing the Hydraulic Bracket
- Mounting the Valve to the Bracket
- Hydraulic System Installation
- Safety Precautions for Connecting Hydraulic Hoses
- Hydraulic Steering Setup Before & After Installation
- Installing Hydraulic Components
- Installing the Steering Control Valve Hoses
- Hydraulic System Checks and Setup
- Setting the Valve Spool Stops
- Adjusting the Sequence Valve
- Setting the Override Pressure Switch
- Installing the Rotary Steering Position Sensor (SPS)

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.



VALVE MOUNTING BRACKET

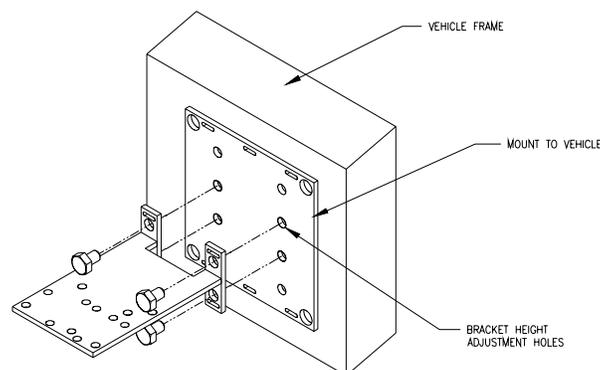


BRACKET MOUNTING PLATE

- ◆ 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.

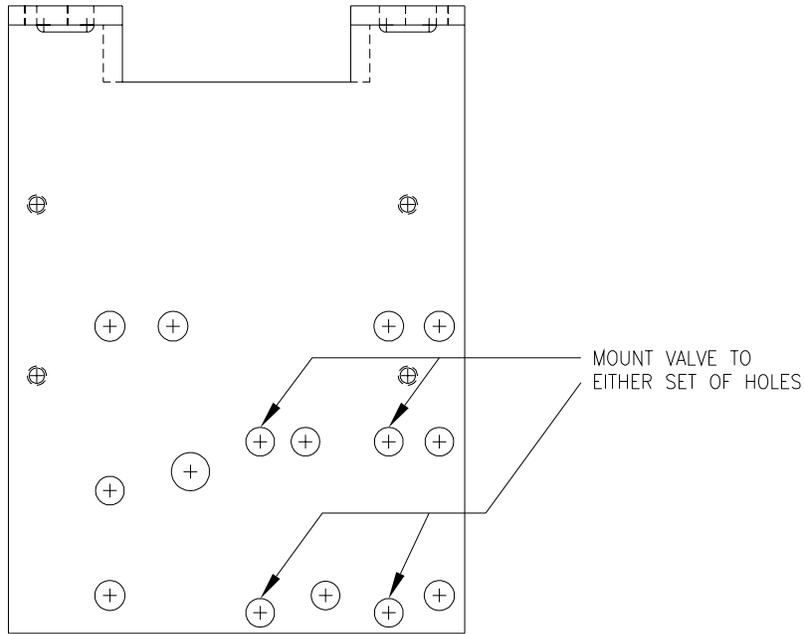


- ◆ In some installations, it may be more appropriate to use only the valve mounting bracket. If only the valve mounting bracket is used, mount the bracket using existing holes in the frame to securely fasten the bracket to the frame.

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.

117-9001-002



HYDRAULIC SYSTEM INSTALLATION

- ◆ The Raven Universal Hydraulic Kit does not come with hydraulic hoses. Hoses should be made per specifications noted on the installation worksheet.
- ◆ Adapter fittings will be needed for proper installation. Adapter fittings are not provided with the Steer Kit, but a kit is available (P/N 117-9001-015).

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.

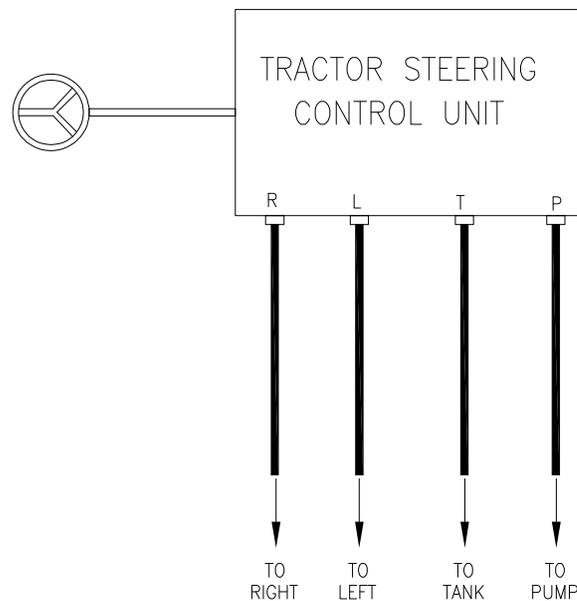
Prior to starting the installation of hydraulic hoses, ensure that the machine is switched off and that all pressure is relieved from the machine hydraulic system. This can be done by turning the steering wheel left and right.

It is important to make sure that the pressure hose is connect 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!**

Hydraulic Steering Setup Before and After Installation

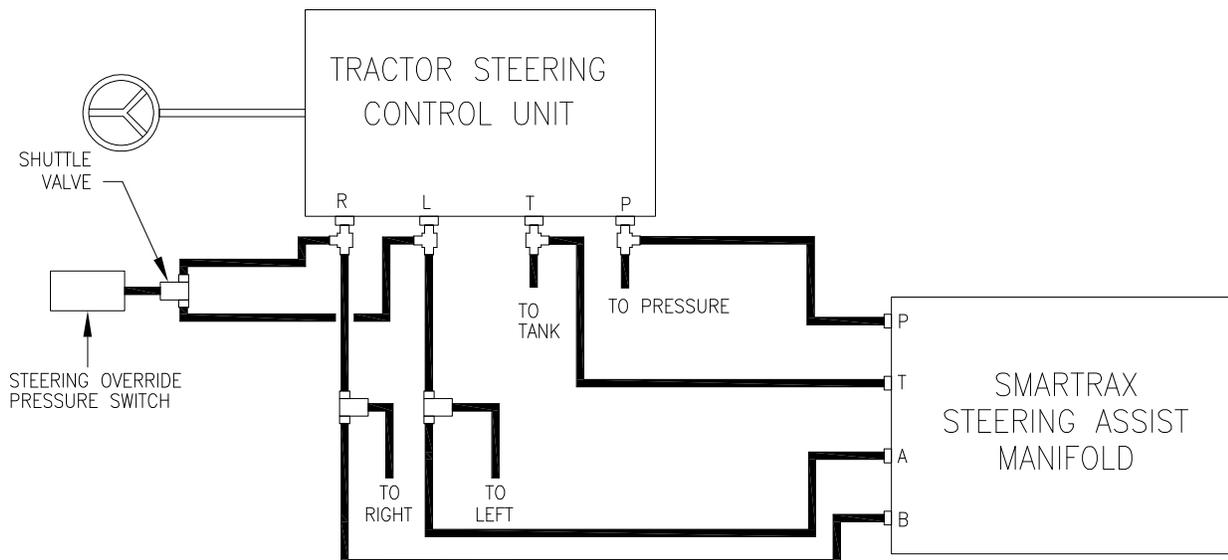
The following block diagrams shows how to setup the hydraulic steering setup before and after installation, including all hydraulic hose connections leading to each of their specified ports.

The Block Diagram below shows the Steering system setup before Installation of the SMARTRAX Steering has started.



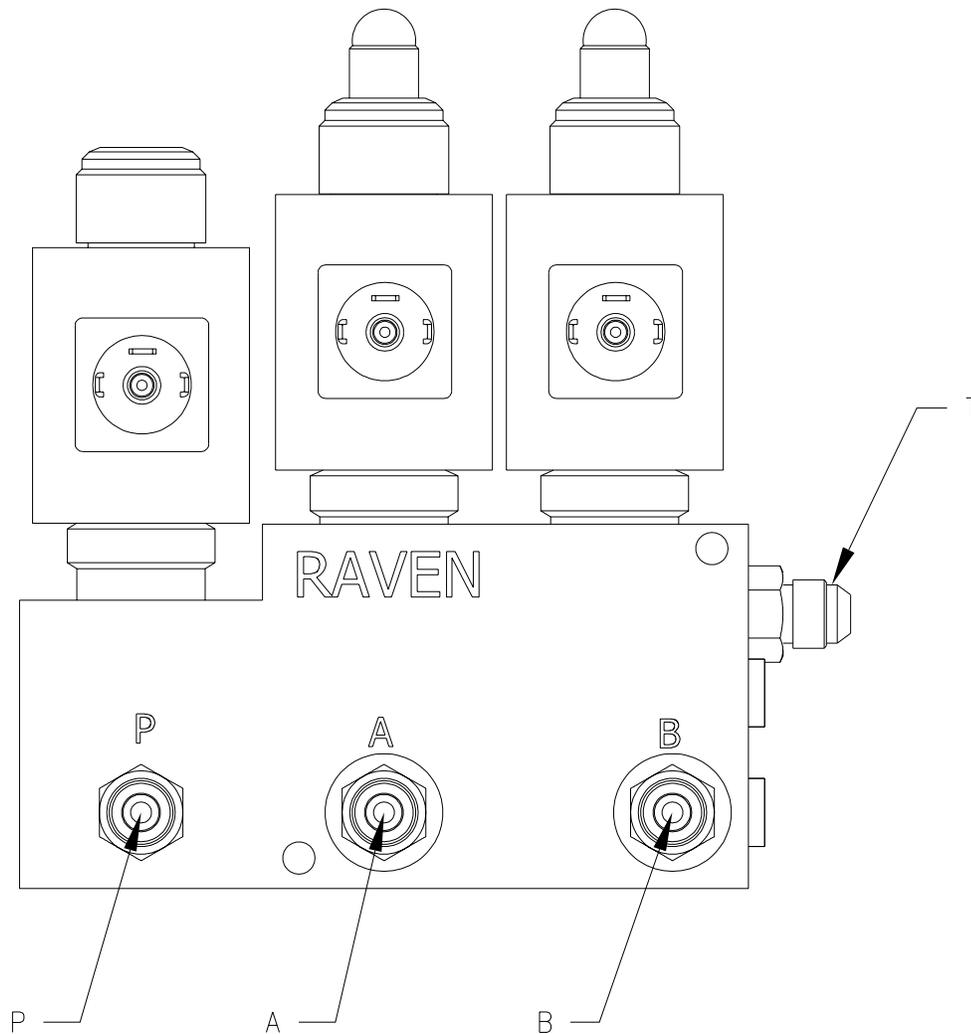
Steering Block Diagram Before Installation

The Block Diagram below shows the Steering system setup after the Installation of the SMARTRAX Steering has been completed.

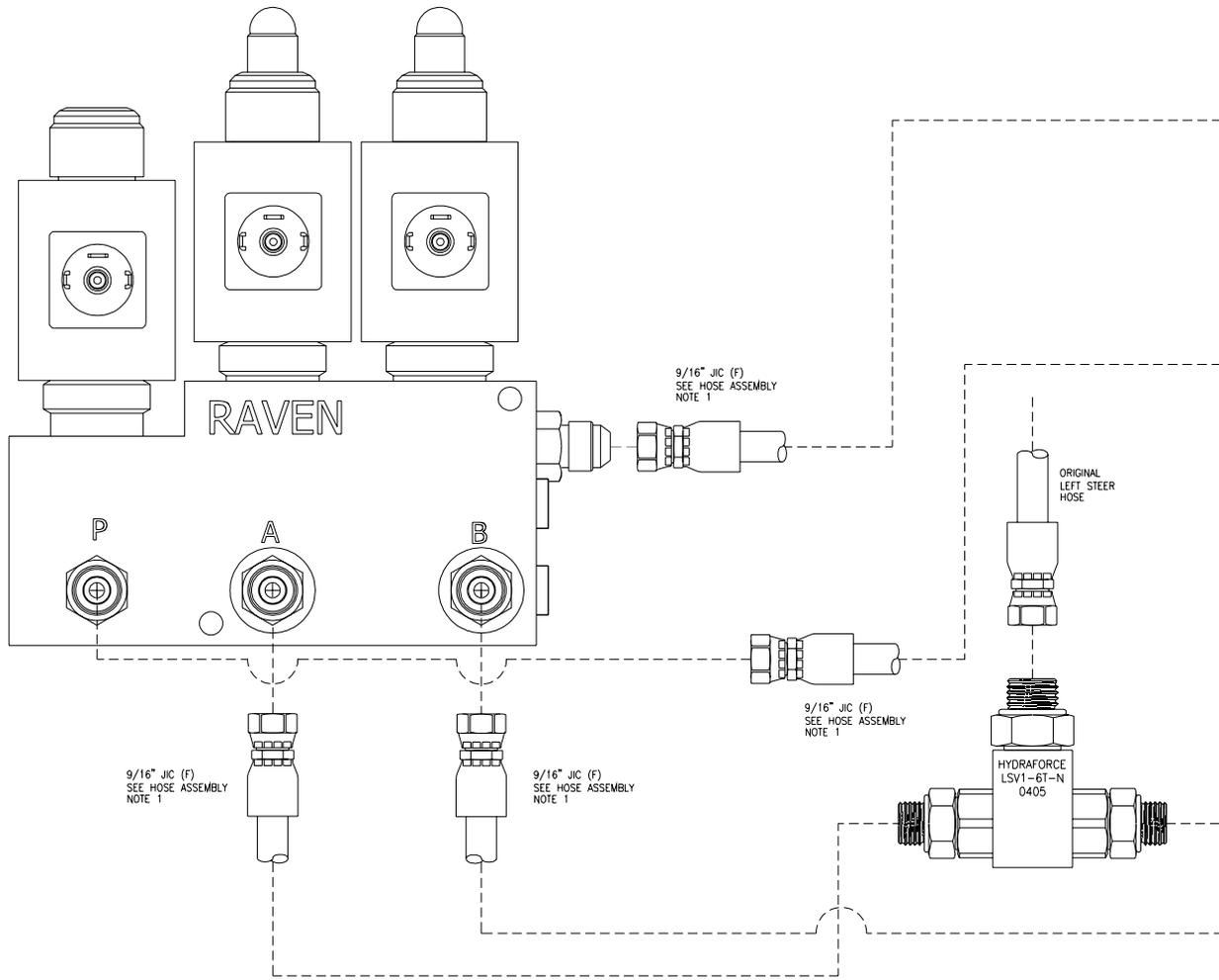


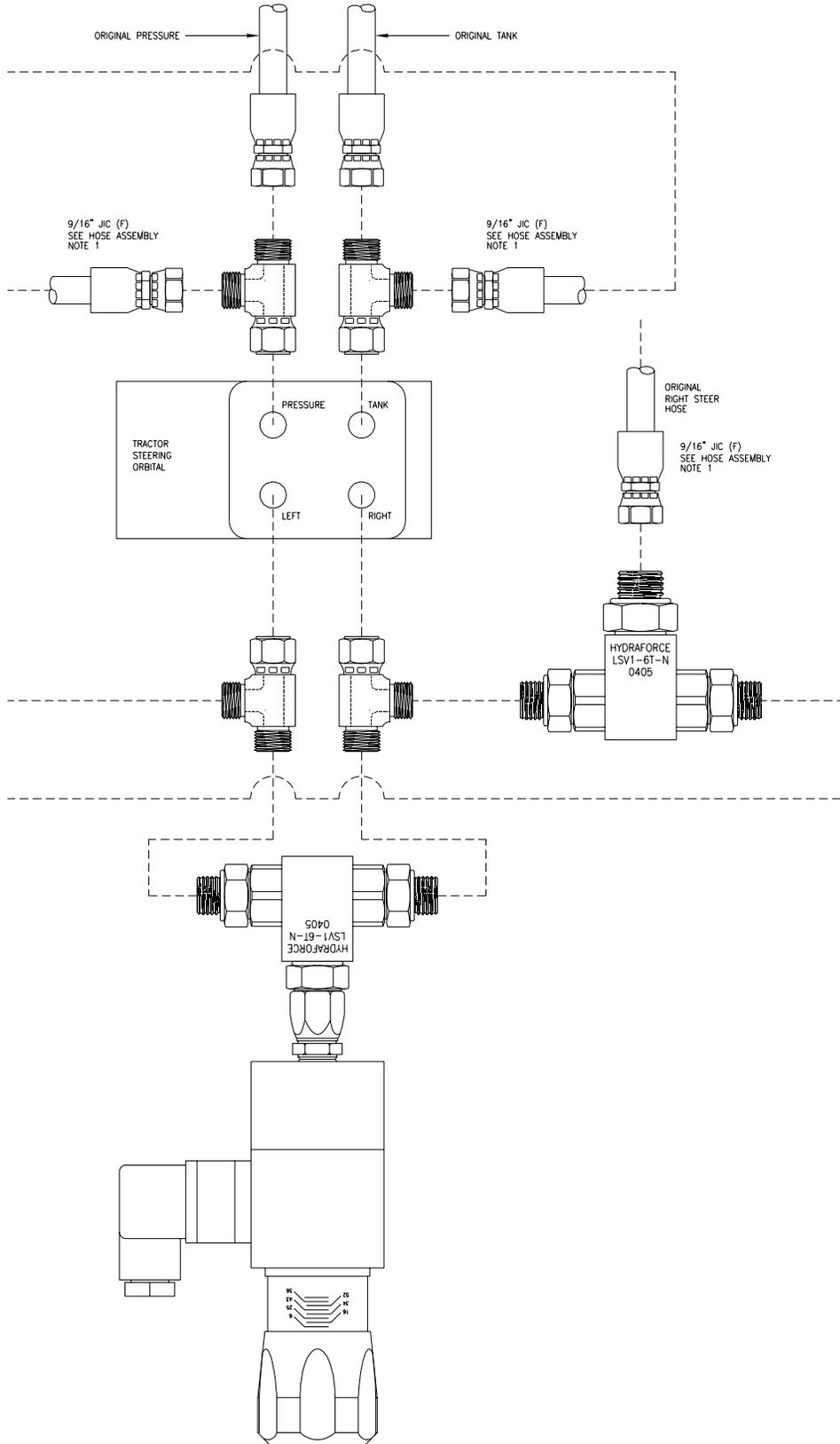
INSTALLING HYDRAULIC COMPONENTS

- ◆ 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 installers worksheet has been provided, which gives a detailed layout of the Auto Steer Hydraulic System. It is important that all parts are identified and documented and returned to Raven upon completion of the installation, using the postage paid envelope.



A-PORT – CONTROLS LEFT STEERING
B-PORT – CONTROLS RIGHT STEERING
P-PORT – PRESSURE INPUT PORT INTO THE VALVE
T-PORT – TANK PORT, RETURNING FLUID
BACK TO THE TANK





INSTALLING THE STEERING CONTROL VALVE HOSES

See the diagram on pages 20 and 21 for hydraulic system layout.

Left and Right Steer to Pressure Switch

1. Locate and disconnect Left and Right steer lines from steering unit.
2. Attach a tee fitting to open port. Do not reconnect Left or Right line to tee.
3. Attach Left and Right steer to pressure switch hose to tees.
4. Connect hoses to the sides of shuttle valve.
5. Attach pressure switch to top of shuttle.

Left and Right Steer Lines

1. Connect side of two additional shuttle checks to tees on left and right ports on steering control unit.
2. Connect other side of the shuttle checks to the A port on the Smartrax valve for left steer and the B port for right steer.
3. Reattach original left and right steer hoses to the top of the left and right shuttle checks.

Pressure Hose

1. Identify the pressure port on the tractor steering control unit. 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.

Tank Hose

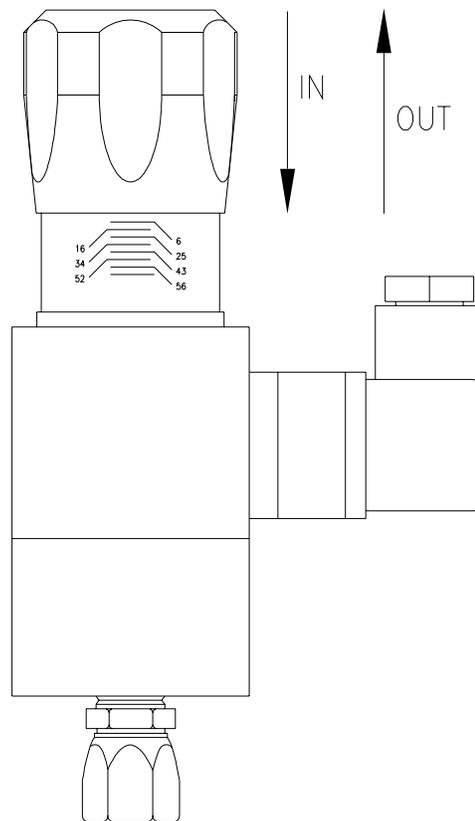
1. Identify the tank port on the tractor steering orbital. Hose may need to be traced to the hydraulic reservoir for proper identification. Once the port has been identified, remove the hose from the tractor steering orbital and install an appropriate tee fitting, found in the Raven adapter kit, to the steering orbital. Once the tee fitting is installed, reattach the original hose.
2. Construct a new hose to run from the T-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 tank line running to the Raven steering control valve goes to the port designated "T". 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.

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 OVERRIDE PRESSURE SWITCH

- ◆ The Override Pressure Switch must be set in order for the Auto-Steer system to disengage when the operator moves the steering wheel.
- ◆ The pressure switch can not be set until the Smartrax Controller is wired and all wiring to the hydraulic system is complete.
- ◆ To set the pressure switch, go to the Solenoid Configuration Menu on the Smartrax Controller. Once at this menu, arrow down to the "<Les R>" screen.
- ◆ With the tractor running and no movement of the steering wheel, the "s" should display as lower case. If the "S" is capital, the pressure switch knob must be turned in until a lower case "s" is displayed.
- ◆ Once the display reads lower case "s" while the vehicle is running and stationary, begin to turn the steering wheel. When the wheel is turned, the "s" should turn into a capital "S" indicating that the system is deactivated. If this does not happen, the pressure switch knob must be turned out to the point where, when the wheel is turned, the "s" is displayed as a capital letter.



Cable Connection and Routing

Overview of Cable Connection & Routing

Smatrix Loom Routing

Solenoid Cable Connection & Routing

Steering Position Sensor (*SPS*) Cable Connection and Routing

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 you 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

Smartrax Loom Routing

STEPS

- 1) Route the Smartrax Loom from the Valve towards the tractor 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

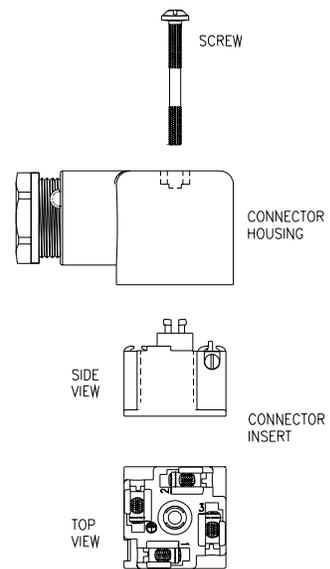
STEPS

- 1) Start by connecting the Solenoid cable to the Smartrax Controller (as shown on the following page).
- 2) Route the Solenoid cable towards the Steering Assist Valve Bank, where the Solenoid Valve and Steering Override Pressure Switch are located.
- 3) Connect the Solenoid Valve and Steering Override Pressure Switch to the wiring harness.

NOTE: Refer to Figure on the following page for information on cable connection.

KEY POINTS

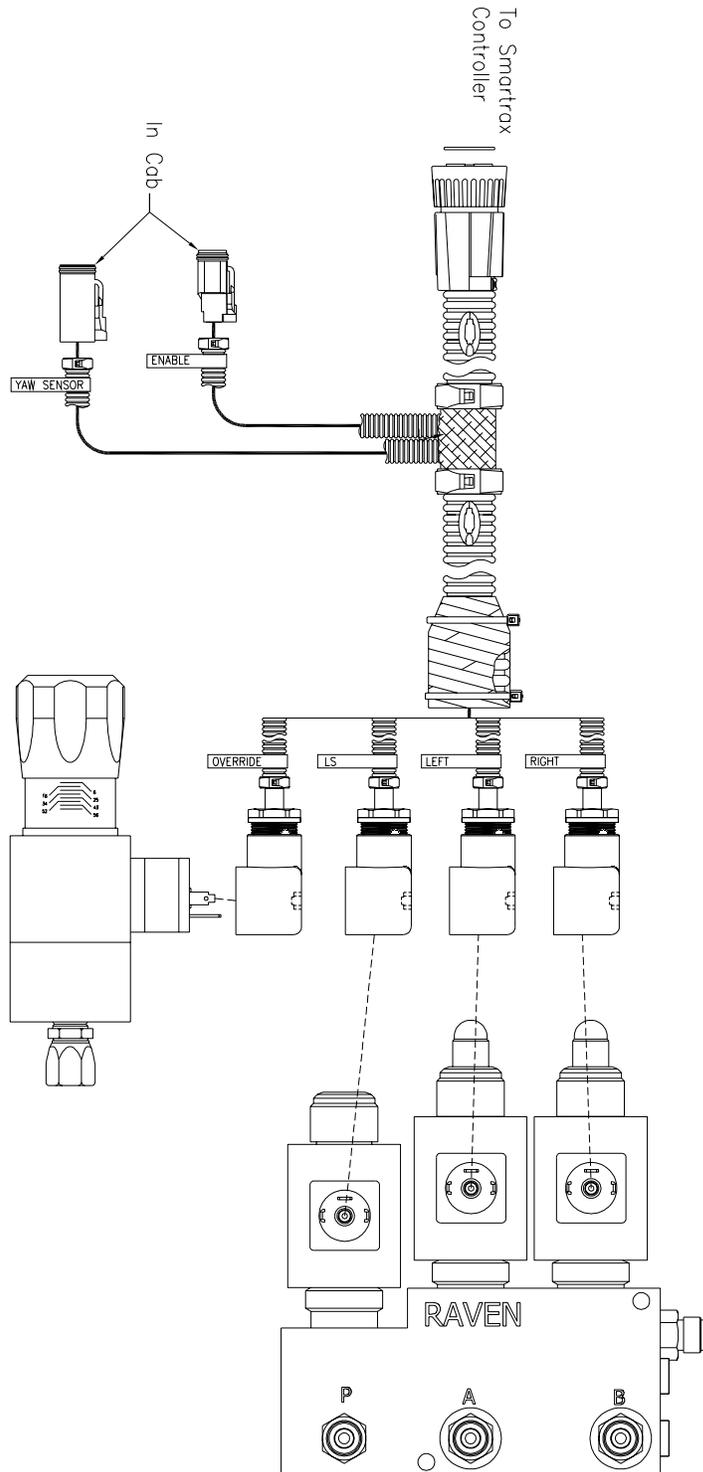
NOTE: Ensure Solenoid cable is mounted neatly. Secure it (*where possible*) to existing points on the tractor using cable ties. Ensure it is not routed near heated areas such as the exhaust. Do not route it in close proximity to moving parts.



STEPS

- 4) Once wiring is connected, ensure the Solenoid cable is cable-tied neatly and securely away from moving parts.

KEY POINTS



RAVEN

RAVEN INDUSTRIES

Limited Warranty

What Does this Warranty Cover?

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

How Long is the Coverage Period?

Raven Applied Technology Products are covered by this warranty for 12 months after the date of purchase. This warranty coverage applies only to the original owner and is nontransferable.

How Can I Get Service?

Bring the defective part and proof of purchase to your Raven Dealer. If your Dealer agrees with the warranty claim, the Dealer will send the part and proof of purchase to their distributor or to Raven Industries for final approval.

What Will Raven Industries Do?

Upon confirmation of the warranty claim, Raven Industries will, at our discretion, repair or replace the defective part and pay for return freight.

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 or other special 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.

R A V E N

Caterpillar B, C, D, E, 35, 45, 55 Series Tracked Tractors
SmarTrax™ Universal Installation Manual
(P/N 016-9001-013 Rev A 2/09)

Simply improving your position.™



Raven Industries
Applied Technology Division
P.O. Box 5107
Sioux Falls, SD 57117-5107

Toll Free (U.S. and Canada): (800)-243-5435
or Outside the U.S. :1 605-575-0722
Fax: 605-331-0426
www.ravenprecision.com
atdinfo@ravenind.com

Notice: This document and the information provided are the property of Raven Industries, Inc. and may only be used as authorized by Raven Industries, Inc. All rights reserved under copyright laws.