



SNOWPLOWS

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MECHANIC'S GUIDE



SNOWPLOWS

Featuring the

FloStat[®] Hydraulic System &
Isolation Module Light System

⚠ CAUTION

Read this manual before servicing the snowplow.

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PREFACE

This guide has been prepared to assist the trained mechanic in the service of WESTERN® snowplows. It also provides safety information and recommendations. We urge all mechanics to read this manual carefully before attempting to service the WESTERN snowplow equipment covered by this guide.

Service of your WESTERN snowplow equipment is best performed by your local Western Products outlet. They know your snowplow best and are interested in your complete satisfaction.



SAFETY INFORMATION

SAFETY DEFINITIONS

⚠ WARNING
Indicates a potentially hazardous situation that, if not avoided, could result in death or serious personal injury.

⚠ CAUTION
Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE: Indicates a situation or action that can lead to damage to your snowplow and vehicle or other property. Other useful information can also be described.

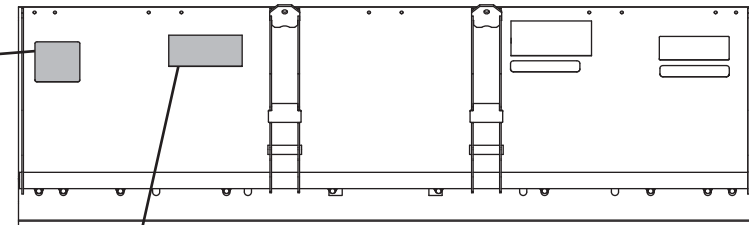
WARNING/CAUTION AND INSTRUCTION LABELS

Become familiar with and inform users about the warning and instruction labels on the back of the blade.

NOTE: If labels are missing or cannot be read, see your sales outlet.

Warning and Caution Label

⚠ WARNING
<p>LOWER BLADE WHEN VEHICLE IS PARKED.</p> <p>DO NOT EXCEED GVWR OR GAWR INCLUDING BLADE AND BALLAST.</p> <p>REMOVE BLADE ASSEMBLY BEFORE PLACING VEHICLE ON HOIST.</p>
⚠ CAUTION
<p>READ OWNER'S MANUAL BEFORE OPERATING OR SERVICING SNOWPLOW.</p> <p>TRANSPORT SPEED SHOULD NOT EXCEED 45 MPH. FURTHER REDUCE SPEED UNDER ADVERSE TRAVEL CONDITIONS.</p> <p>PLOWING SPEED SHOULD NOT EXCEED 10 MPH.</p> <p>SEE YOUR SALES OUTLET/WEB SITE FOR SPECIFIC VEHICLE APPLICATION RECOMMENDATIONS.</p>



Instruction Label

INSTRUCTIONS

MOUNTING PLOW (ON) Read Owner's Manual for complete instructions.

STEP 1
After seating plow horns in receiver brackets, pull Handle UP. Shoe will lift off the ground.

STEP 2
Pull and hold Lock Pin out; then rotate Handle UP and release Lock Pin. It must lock into UPPER hole. Stand Hook must grip Receiver Pin.

STEP 3
Plug in electrical connections.

HTS

REMOVING PLOW (OFF) Read Owner's Manual for complete instructions.

STEP 3
Push top of Shoe DOWN; Shoe will be on the ground.

STEP 2
Pull and hold Lock Pin out; then rotate Handle DOWN and release Lock Pin. It must lock into LOWER hole.

STEP 1
After lowering blade and turning control OFF, disconnect electrical connections.

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U.S. patents 5,420,480; 6,145,222; 6,209,231; 6,253,470; 6,526,677; 6,928,757; 6,941,685; 7,400,058; 7,430,821; RE35,700; CAN patents 2,060,425; 2,354,257; and other patents pending.

SAFETY INFORMATION

SAFETY PRECAUTIONS

Improper installation and operation could cause personal injury, and/or equipment and property damage. Read and understand labels and the Owner's Manual before installing, operating, or making adjustments.

⚠ WARNING

Lower blade when vehicle is parked. Temperature changes could change hydraulic pressure, causing the blade to drop unexpectedly or damaging hydraulic components. Failure to do this can result in serious personal injury.

⚠ WARNING

Keep 8' clear of the blade when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of the blade. If the blade hits or drops on you, you could be seriously injured.

⚠ WARNING

Keep hands and feet clear of the blade and A-frame when attaching or detaching the snowplow. Moving or falling assemblies could cause personal injury.

⚠ WARNING

Do not exceed GVWR or GAWR including blade and ballast. The rating label is found on the driver-side vehicle door cornerpost.

⚠ WARNING

To prevent accidental movement of the blade, always turn the control OFF whenever the snowplow is not in use. The power indicator light will turn OFF.

⚠ WARNING

Remove blade assembly before placing vehicle on hoist.

⚠ CAUTION

Refer to the current Kit Selection Guide for minimum vehicle recommendations and ballast requirements.

HYDRAULIC SAFETY

⚠ WARNING

Hydraulic fluid under pressure can cause skin injection injury. If you are injured by hydraulic fluid, get medical attention immediately.

- Always inspect hydraulic components and hoses before using. Replace any damaged or worn parts immediately.
- If you suspect a hose leak, DO NOT use your hand to locate it. Use a piece of cardboard or wood.

FUSES

The WESTERN® electrical and hydraulic systems contain several blade-style automotive fuses. If a problem should occur and fuse replacement is necessary, the replacement fuse must be of the same type and amperage rating as the original. Installing a fuse with a higher rating can damage the system and could start a fire. Fuse Replacement, including fuse ratings and locations, is located in the Maintenance section of the Owner's Manual.

PERSONAL SAFETY

- Remove ignition key and put the vehicle in park or in gear to prevent others from starting the vehicle during installation or service.
- Wear only snug-fitting clothing while working on your vehicle or snowplow.
- Do not wear jewelry or a necktie, and secure long hair.
- Wear safety goggles to protect your eyes from battery acid, gasoline, dirt and dust.
- Avoid touching hot surfaces such as the engine, radiator, hoses and exhaust pipes.
- Always have a fire extinguisher rated BC handy, for flammable liquids and electrical fires.

FIRE AND EXPLOSION

⚠ WARNING

Gasoline is highly flammable and gasoline vapor is explosive. Never smoke while working on vehicle. Keep all open flames away from gasoline tank and lines. Wipe up any spilled gasoline immediately.

Be careful when using gasoline. Do not use gasoline to clean parts. Store only in approved containers away from sources of heat or flame.

SAFETY INFORMATION

VENTILATION




WARNING

Vehicle exhaust contains lethal fumes. Breathing these fumes, even in low concentrations, can cause death. Never operate a vehicle in an enclosed area without venting exhaust to the outside.

TORQUE CHART

CAUTION

Read instructions before assembling. Fasteners should be finger tight until instructed to tighten according to torque chart. Use standard methods and practices when attaching snowplow including proper personal protective safety equipment.

Recommended Fastener Torque Chart (ft-lb)			
Size	 SAE Grade 2	 SAE Grade 5	 SAE Grade 8
1/4-20	6	9	13
5/16-18	11	18	28
3/8-16	19	31	46
3/8-24	24	46	68
7/16-14	30	50	75
1/2-13	45	75	115
9/16-12	66	110	165
5/8-11	93	150	225
3/4-10	150	250	370
7/8-9	150	378	591
1-8	220	583	893
Metric Grade 8.8 (ft-lb)			
Size	Torque	Size	Torque
M 6	7	M 12	60
M 8	17	M 14	95
M 10	35	M 16	155
These torque values apply to fasteners except those noted in the instruction.			

BATTERY SAFETY

CAUTION

Batteries normally produce explosive gases which can cause personal injury. Therefore, do not allow flames, sparks or lit tobacco to come near the battery. When charging or working near a battery, always cover your face and protect your eyes, and also provide ventilation.

Batteries contain sulfuric acid which burns skin, eyes and clothing.

Disconnect the battery before removing or replacing any electrical components.

SPECIFICATION

FloStat® Hydraulic System

⚠ CAUTION

Do not mix different kinds of hydraulic fluid. Some fluids are not compatible and may cause performance problems and product damage.

NOTE: Remove breather / fill plug slowly to relieve any pressure in reservoir.

Hydraulic Fluid

- WESTERN® High Performance Fluid to -25°F (-32°C) or other fluid conforming to Military Specification MIL H 5606A, such as Mobil Aero HFA or Shell AeroShell® Fluid 4.

Fluid Capacity

- Unit Reservoir = 1-1/2 Quarts
- System Total = 2-1/4 Quarts

Solenoid Valve Spool Travel = 0.07" for three- and four-way valves (S2, S3). Travel of two-way valve (S1) spool is not detectable with voltage applied to coil.

Fluid Level

With the system attached to the vehicle, activate the control. Lower the blade to the ground and turn OFF the control. Remove the fill plug. Fill the reservoir to within 2-1/2" of the top of the fill hole. Replace the fill plug.

Electrical System – approximate values:

- Solenoid Coil Resistance = 7 Ohm at room temperature
- Solenoid Coil Amp Draw = 1.5 Amp
- Motor Relay Coil Resistance = 16–17 Ohm
- Motor Relay Amp Draw = 0.7 Amp
- Motor Amp. Draw = 100 Amp at 1650 psi ± 50 psi
- Switched Accessory Lead Draw = 0.75 Amp

3-Port Module Vehicle Control Harness Fuse Size

- Park/Turn – 10 Amp (Mini)
- Control – 10 Amp (Mini)

4-Port Module (Automotive Blade-Type)

- Park/Turn – 15 Amp
- Control – 7.5 Amp

Tools Required to service the electrical and hydraulic systems:

- Long Slender Needle Nose Pliers
 - Flat Screwdriver
 - Deep Socket: 7/8"
 - 10 mm Socket
 - Sockets and Combination Wrenches: 5/16" thru 7/8", 1-1/16", 1-1/8"
 - 1/4" Socket or Nut Driver
 - 12V Test Light
 - Torque Wrench (in-lb / ft-lb)
 - Allen Wrench Set
 - 600 psi Pressure Gauge w/adaptor fittings
 - 3000 psi Pressure Gauge w/adaptor fittings
 - Flashlight
 - Pick Set
 - Hammer
 - Digital Volt/Ohm Meter
 - Pencil Magnet
 - Adjustable Pin Spanner Wrench (capacity range 2-1/2", 1/4" pin dia.)
- Available from your WESTERN® outlet:
- Hydraulic Pressure Test Kit (PN 56679)
 - Multiplexed Hyd. Diagnostic Harness (PN 29290-1)
 - Motor Bearing Sleeve Repair Kit (PN 64589)
 - Pump Shaft Seal Repair Kit (PN 28856)

Fastener Torque

MUX Straight Blade w/Scrape Lock Hydraulic Unit Torque Chart		
Location	Fastener Size	Torque
Pump Cap Screws	5/16-18 x 2-1/4	150–160 in-lb
Motor Terminals (+ and -)	M6 Nut	25–35 in-lb
Motor to Manifold Cap Screws	M5 x .8	35–45 in-lb*
Reservoir Screws	#10-24 x 5/16	30–35 in-lb*
Solenoid Valves	7/8 Hex Head	19–21 ft-lb
Coil Nuts	3/4 Hex Head Jam Nut	48–60 in-lb
SAE O-Ring Plugs	1/8 or 5/32 Internal Hex	55–65 in-lb
Hydraulic Unit Mount Bolts	3/8-16 x 1	22–25 ft-lb
Check Valves	7/8 Hex Head	19–21 ft-lb
Motor Relay Small Terminals	10-32 Nut	15 in-lb max
Motor Relay Large Terminals	5/16-24 Nut	35 in-lb max
Motor Relay Mount Screws	1/4-20 x 3/8	75–85 in-lb
Plow Module Mount Screws	1/4-20 x 3/8	60–70 in-lb

* Torque with low-strength thread locker

ATTACHING / DETACHING SNOWPLOW FROM VEHICLE & STORAGE

HTS™ Attach / Detach Diagram

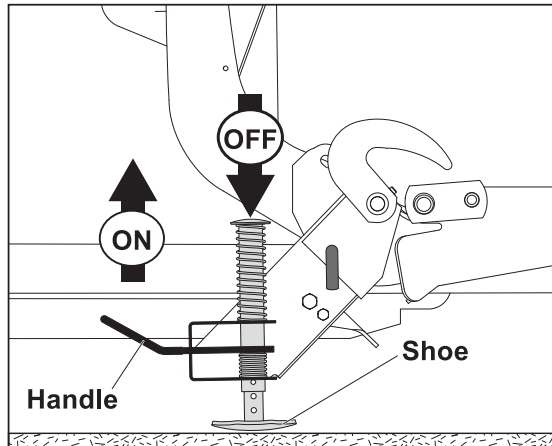
NOTE: After each use of the snowplow, reapply dielectric grease to the electrical plugs to maintain the protective coating on the terminals.

NOTE: Multiplexed 2-plug systems are equipped with plug covers.

MOUNTING PLOW (ON)

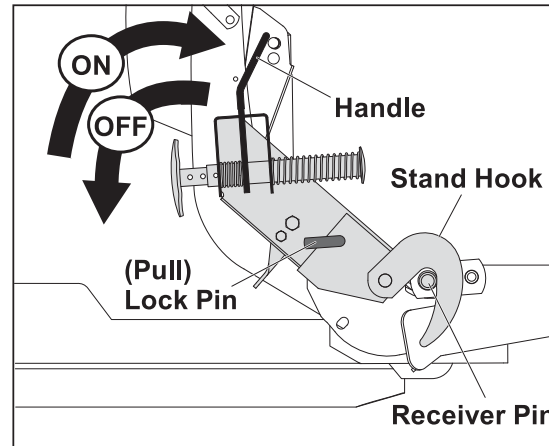
STEP 1

After seating plow horns in receiver brackets, pull Handle UP. Shoe will lift off the ground.



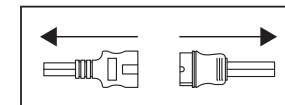
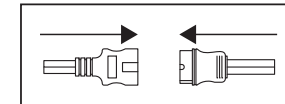
STEP 2

Pull and hold Lock Pin out; then rotate Handle UP and release Lock Pin. It must lock into UPPER hole. Stand Hook must grip Receiver Pin.



STEP 3

Plug in electrical connections.



STEP 3

Push down top of Shoe; Shoe will be on the ground.

STEP 2

Pull and hold Lock Pin out; then rotate Handle DOWN and release Lock Pin. It must lock into LOWER hole.

STEP 1

After lowering blade and turning control OFF, disconnect electrical connections.

REMOVING PLOW (OFF)

INSTALLING BLADE TO A-FFRAME

BLADE TO A-FFRAME

1. Remove the headlamp box and small parts box from carton. Remove carton wall sleeve by sliding it up and over box contents. Remove and discard the four corner tubes and place sleeve flat on the floor. Remove the (2) lag screws (located on either side of the lift ram) securing the A-frame to the pallet.

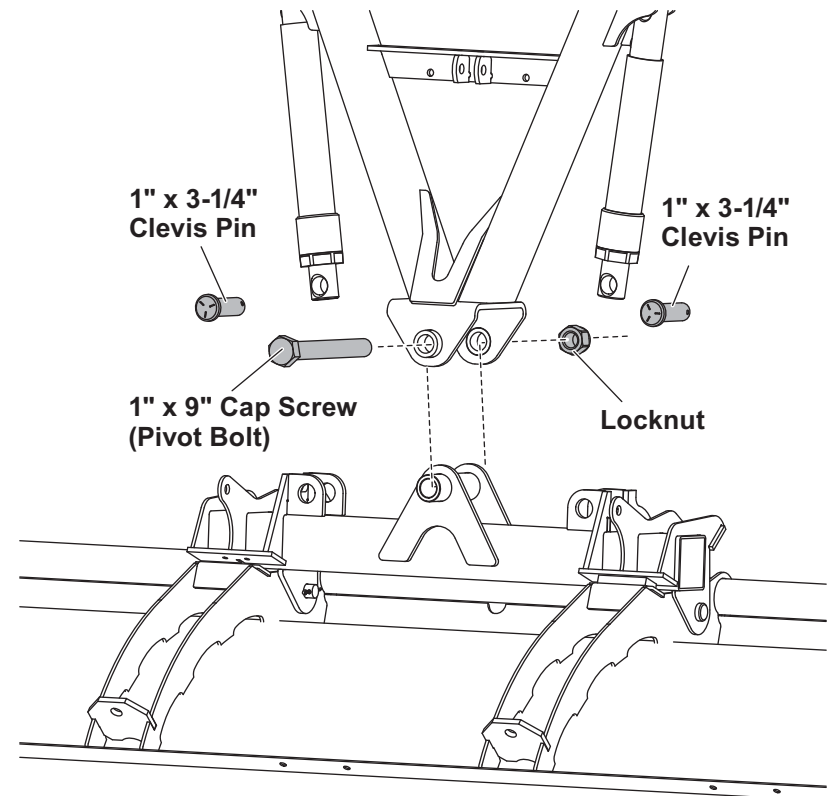
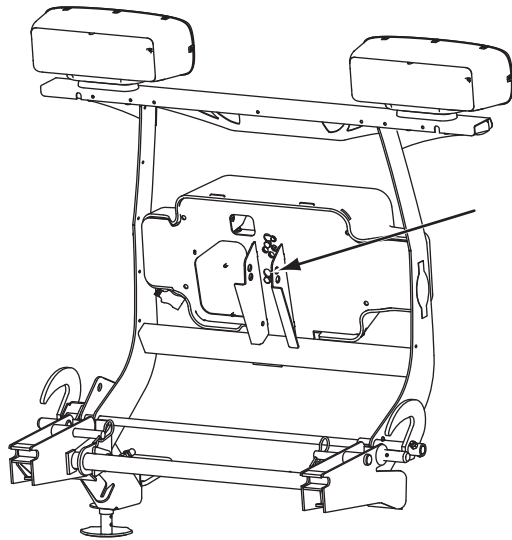
Insert the 5/8" x 3-1/2" clevis pin through the top hole on the lift frame to secure the base end of the lift ram to the lift frame. Remove the lift frame, A-frame and power unit assembly from the box and place it on the carton sleeve.

2. Place some cardboard or wood on the floor where blade will be assembled. Remove the blade from the pallet and place it face down.

3. Place the A-frame nose plate over the quadrant pivot section. Secure with one 1" x 9" cap screw (pivot bolt) and a locknut. Tighten locknut as much as possible while allowing A-frame and quadrant to pivot.

4. Position the rod ends of the two 8" rams in the brackets on the back of the quadrant with a 1" x 3-1/4" clevis pin (installed from the top down through bracket) and cotter pin.

NOTE: When the lift ram is pinned, the lift frame can still rotate forward when loaded. A relief valve is built into the lift portion of the hydraulic circuit.

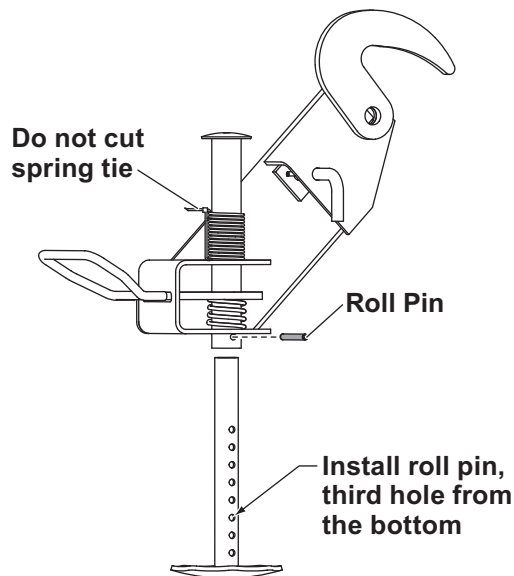


INSTALLING STAND SHOE AND RECEIVERS

STAND SHOE

A final adjustment of stand shoe will be made after attaching snowplow to vehicle.

1. Do not cut the spring tie until after final stand shoe adjustment.
2. Slide the stand shoe into the stand tube and align the 1/4" hole in the stand tube with the 1/4" hole in the stand shoe, third hole from the bottom.
3. Insert 1/4" roll pin.



4. Pull and hold the lock pin out; then rotate the handle DOWN and release the lock pin. It must lock into the LOWER hole. Push down on top of the shoe. The shoe will be on the ground.
5. Remove the support block from under the main A-frame tube.

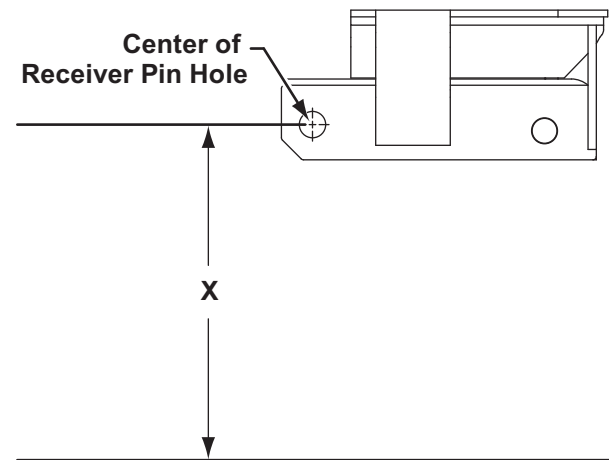
RECEIVER INSTALLATION

1. Before assembling the receiver to the vehicle undercarriage, determine if the height adjustment plate kits are needed.
2. Prior to measuring the vehicle undercarriage height, the undercarriage must be installed, and ballast must be installed if required. Park the vehicle on a level surface. Measure the distance from the ground to the center of the receiver pin hole on the undercarriage.

Refer to the chart below to determine if height adjustment plates are required.

3. Use dimension "X" from Step 2 and follow the chart below:

Dimension "X"	Height Adjustment Plate Kits Required
13.0"–15.5"	No
15.5"–17.5"	Yes



INSTALLING RECEIVERS

4. If adapter plates are required, install as follows:

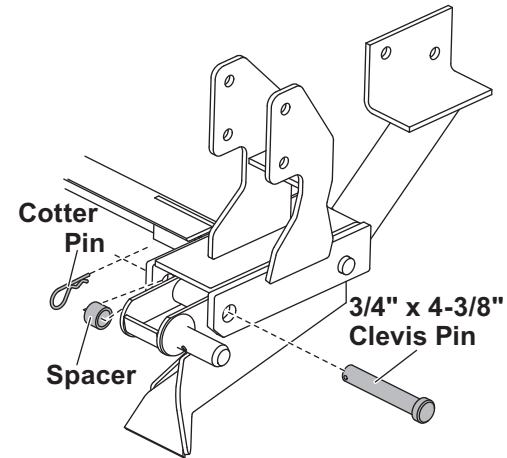
Position an adapter plate on each side of the receiver as shown. Insert a 3/4" x 2-3/4" cap screw through the lower front adapter plate hole and through the appropriate hole on the receiver. Secure with a locknut.

Insert a cap screw through the rear adapter plate hole, through the slot on the receiver. Secure with a locknut.

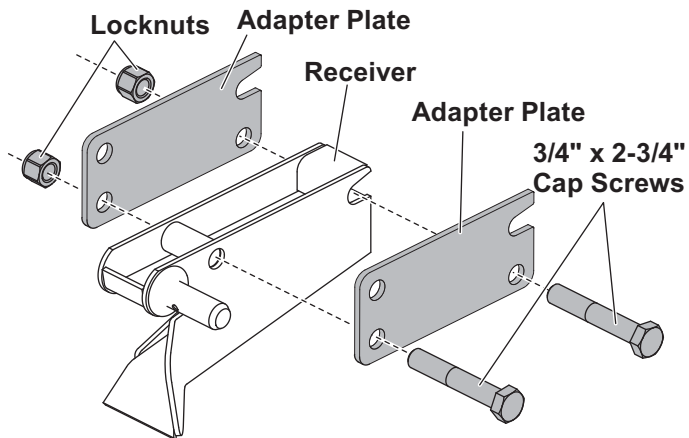
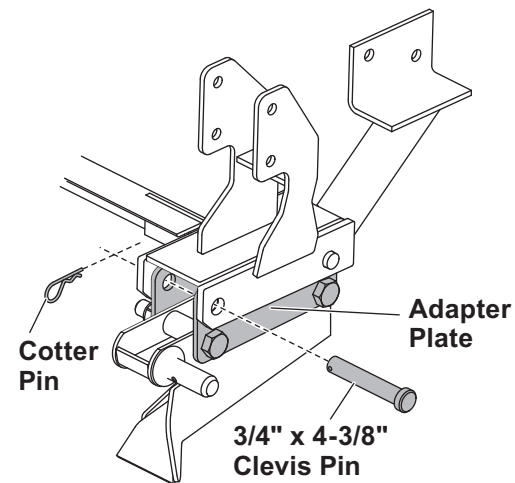
Repeat for the passenger's side. Tighten all fasteners according to the torque chart.

5. Position the receiver between the mount brackets on each side. Align the notches in rear of the receiver with pins in vehicle undercarriage. Rotate up and secure with a 3/4" x 4-3/8" clevis pin and hairpin cotter on each side. If the height adjustment plates are not used, insert the spacer provided between the receiver and the inner-most mount bracket.

Shown without adapter plate.



Shown with adapter plate installed.



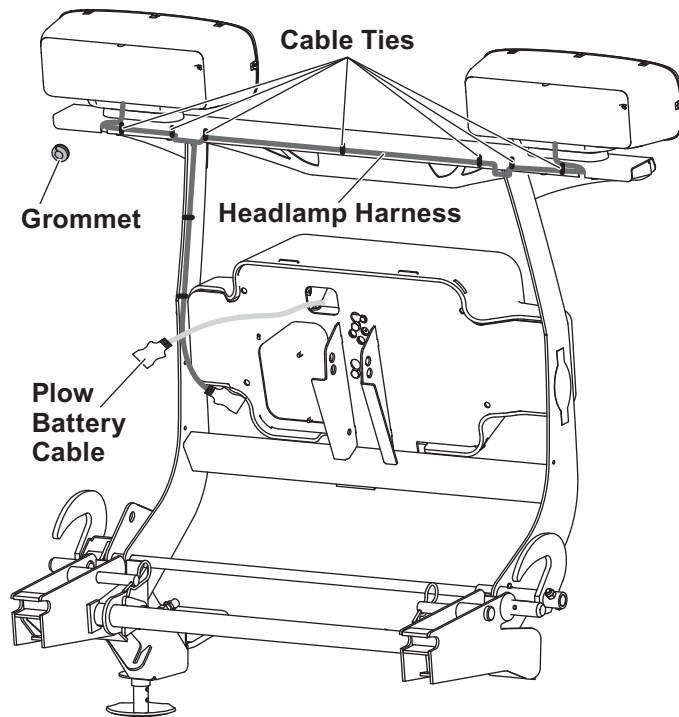
NIGHTHAWK™ HEADLAMPS

HEADLAMPS

⚠ WARNING

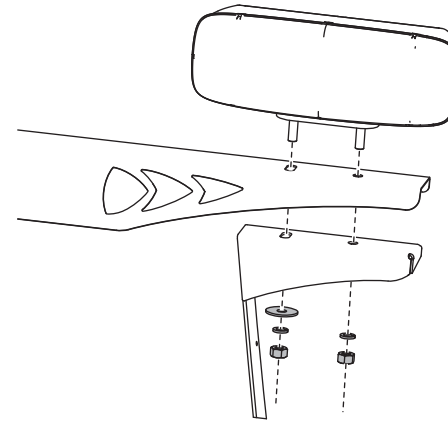
Your vehicle must be equipped with snowplow headlamps and directional lights.

Headlamps, hardware and instructions are found in the headlamp box. Additional hardware is found in the loose parts box.



Refer to figure above for the following instructions.

1. Remove the zip ties securing light bar to lift frame.
2. With the wire harness behind the lift frame, attach the headlamps to the hole and slot in the light bar by following the instructions included with the headlamps.
3. Insert seven cable tie anchors into 1/4" holes on the rear of light bar from the inside, with the locking tabs horizontal.
4. Install a split rubber grommet on each headlamp wire 3" from headlamp and insert wire grommet and wire into slot on rear of light bar.
5. Route the wires underneath the light bar, behind the vertical supports, and down along the inside of the driver-side vertical support, securing the wires to the anchors with cable ties.



OPERATIONAL TEST AND FINAL ADJUSTMENT

FILLING HYDRAULIC UNIT

⚠ WARNING

Keep 8' clear of the blade when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of the blade. If the blade hits or drops on you, you could be seriously injured.

1. Attach the snowplow to the vehicle according to the instructions on the back of the blade.

⚠ WARNING

To prevent accidental movement of the blade, always turn the ON/OFF switch to OFF whenever the snowplow is not in use. The control indicator light will turn off.

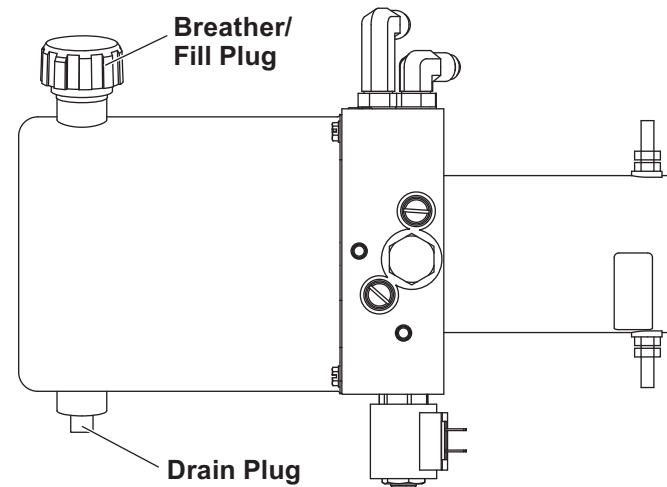
⚠ CAUTION

Do not mix different types of hydraulic fluid. Some fluids are not compatible and may cause performance problems and product damage.

The HTS™ snowplow hydraulic system comes pre-assembled, filled and fully tested from the factory.

2. Remove factory installed pipe plug. Reservoir fluid level should be within 2-1/2" from the top of the fill hole. If additional fluid is needed, fill the reservoir with WESTERN® High Performance Hydraulic Fluid or other fluid conforming to Military Specification MIL H 5606A, such as Mobil Aero HFA or Shell AeroShell® Fluid 4.

3. Replace with breather/fill plug (included in parts box).



FLUID CAPACITY

- FloStat® Unit Reservoir 1-3/4 quarts
- FloStat System Total 2-3/8 to 2-3/4 quarts

OPERATIONAL TEST AND FINAL ADJUSTMENT

BLADE DROP SPEED ADJUSTMENT

⚠ WARNING

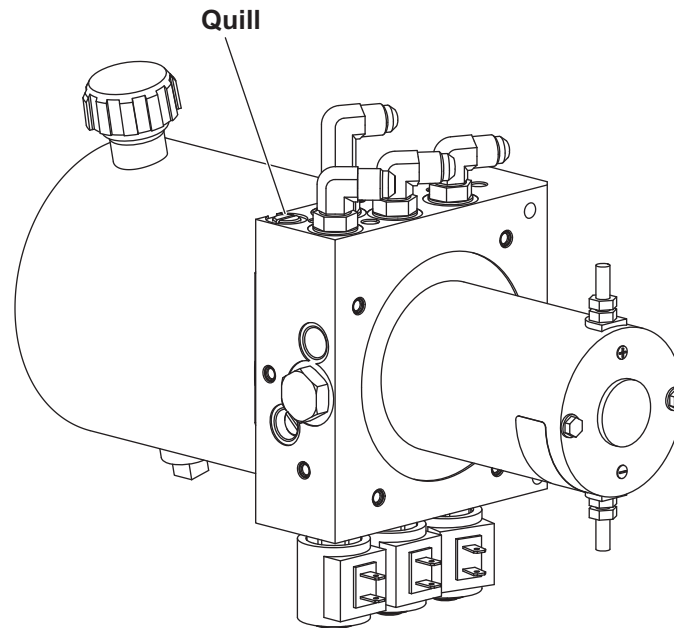
Keep 8' clear of the blade drop zone when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of blade. If the blade hits you or drops on you, you could be seriously injured.

1. The plow drop speed may be adjusted by turning the quill.

NOTE: The blade will not drop when quill is fully tightened (clockwise). Turn OFF the plow control, turn the quill 1/8 turn outward (counterclockwise), then proceed with blade drop speed adjustment.

2. Lower the blade to the ground before making adjustment.

3. Turn the quill inward (clockwise) to decrease the drop speed. Turn the quill outward (counterclockwise) to increase the drop speed.
4. Stand 8' clear of the blade drop zone when checking adjustment.

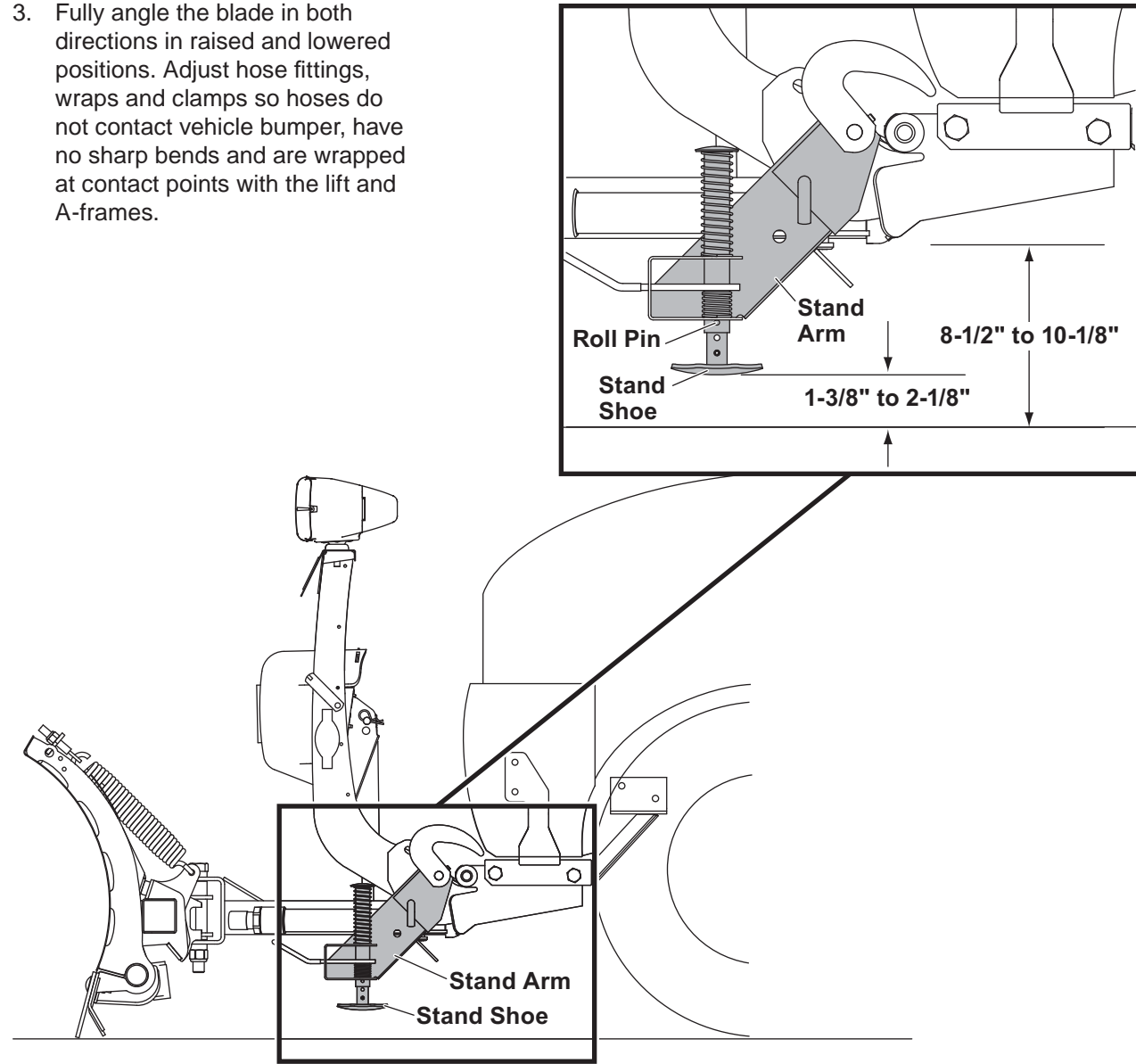


OPERATIONAL TEST AND FINAL ADJUSTMENT

FINAL INSPECTION AND ADJUSTMENT

1. Attach snowplow to the vehicle mount. With snowplow lowered to the ground and on level pavement, measure the dimension from the ground to the bottom of the A-frame side tube. This dimension must be 8-1/2" to 10-1/8".
2. With the snowplow attached and on the ground, place the stand arm in the lower position with the lock pin engaged and with the stand shoe fully retracted in the "UP" position. Measure the distance from the ground to the bottom of the stand shoe. This distance should be 1-3/8" to 2-1/8". The stand can be adjusted to achieve this dimension by removing the roll pin and selecting the proper hole in the stand stem. When the stand height is correct, cut and remove the spring tie.

3. Fully angle the blade in both directions in raised and lowered positions. Adjust hose fittings, wraps and clamps so hoses do not contact vehicle bumper, have no sharp bends and are wrapped at contact points with the lift and A-frames.



SYSTEM OVERVIEW

VEHICLE LIGHTING CHECK

1. Check the operation of vehicle lights and then snowplow lights with snowplow attached to vehicle and all harnesses connected.

Turn signals and parking lamps

Move vehicle headlamp switch to the parking lamp "ON" position.

Parking lamps ON:

- Both vehicle and snowplow parking lamps should be ON at the same time.

Driver-side turn signal ON:

- Both vehicle and snowplow driver-side turn signal lamps should flash at the same time.

Passenger-side turn signal ON:

- Both vehicle and snowplow passenger-side turn signal lamps should flash at the same time.

Headlamps

Move vehicle headlamp switch to the ON position. Connecting and disconnecting the headlamp harness plug should switch between vehicle and snowplow headlamps as follows:

Headlamp harness plug DISCONNECTED:

- Vehicle headlamps/parking lamps should be ON.
- Snowplow headlamps/parking lamps should be OFF.

Headlamp harness plug CONNECTED:

- Snowplow headlamps/parking lamps should be ON.
- Vehicle headlamps should be OFF.

Dimmer switch should dim whichever headlamps are operating. The high beam indicator on the dash should light when either set of headlamps is on high beam.

Daytime Running Lamps (DRLs) For PN 29070-1:

- On vehicles equipped with **DRLs integrated into the vehicle headlamps**. Activation of the switched accessory wire (a key-controlled power source) Port C, Position C, applies battery voltage to the module's high and low beam relay coils, which causes the relay contacts to shift from the "vehicle" to the "snowplow" position. **This module will transfer the vehicle headlamp DRLs to the snowplow (turns off vehicle DRLs).**
- **On vehicles equipped with dedicated DRL bulbs or vehicles using the turn signals as DRLs, this module will not turn OFF the vehicle bulbs. While the vehicle is in the DRL mode, this module will illuminate the snowplow light turn signal filaments.**

Joystick Control or CabCommand Hand-Held Control

The control indicator light should light whenever the control ON/OFF switch and the ignition (key) switches are both in the ON position. The snowplow plugs do need to be connected to the vehicle harness connectors.

2. Check aim of vehicle headlamps with snowplow removed.
3. Connect all snowplow and vehicle harnesses. Raise the snowplow and aim snowplow headlamps according to the Snowplow Headlamp Beam Aiming instructions included with the headlamps and any state or local regulations.

CAUTION

On 2-plug electrical systems, plug covers shall be used whenever snowplow is disconnected. Cable is 12-volt unfused source.

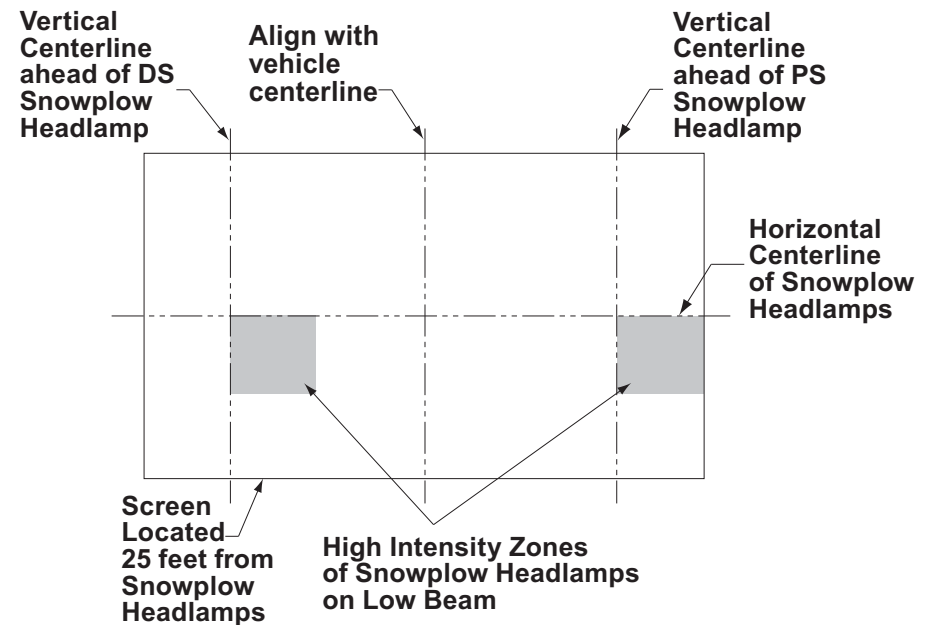
4. When the snowplow is removed from the vehicle, install plug covers on the vehicle battery cable and lighting harness. Insert the snowplow battery cable and lighting harness into the cable boot on the snowplow.

SYSTEM OVERVIEW

HEADLAMP BEAM AIMING

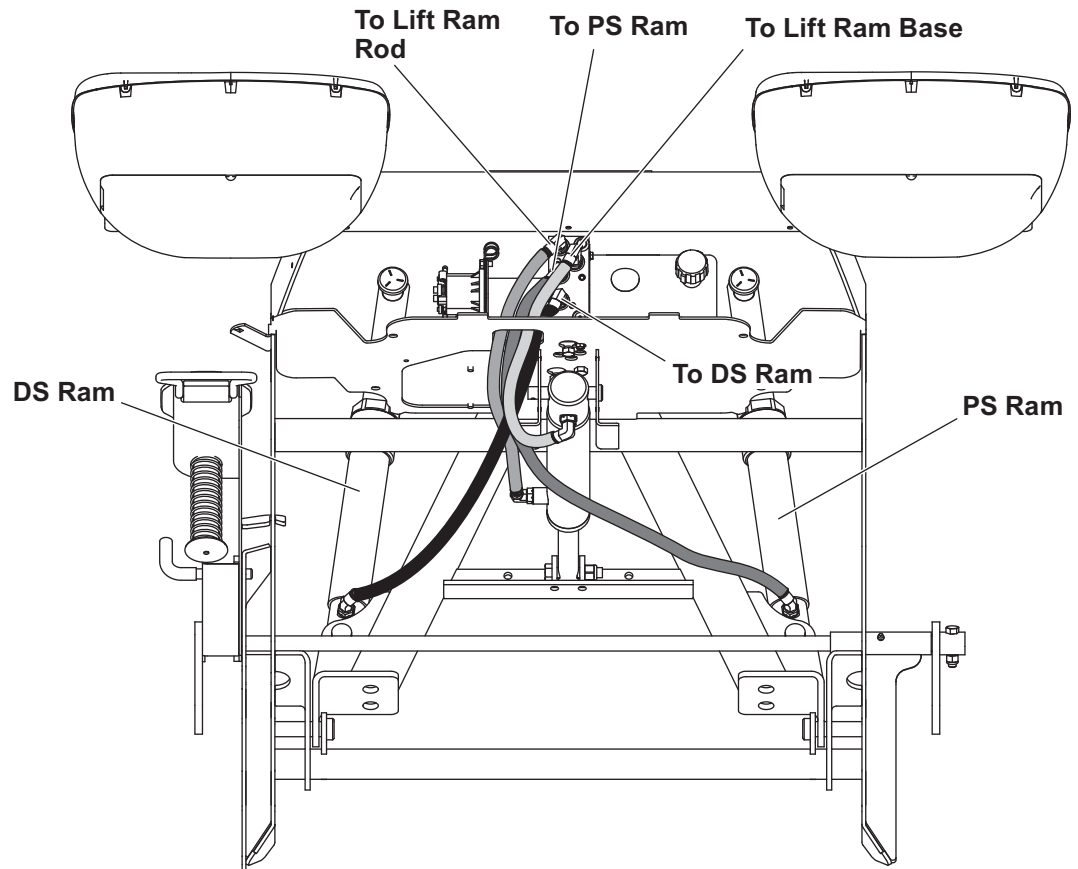
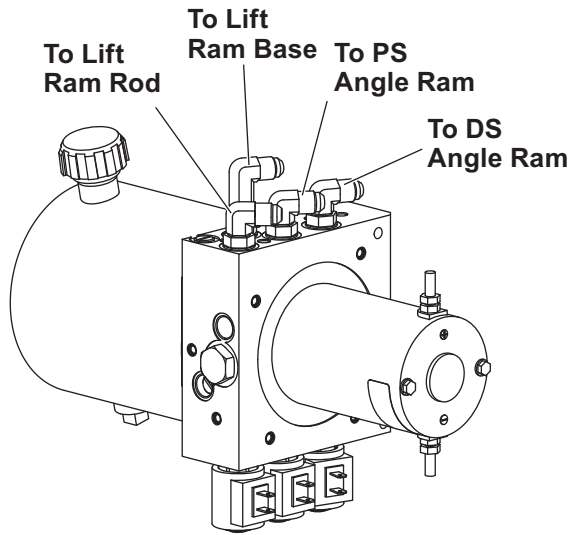
Torque headlamp fasteners to 45 ft-lb once correct visual aim is achieved.

1. Place vehicle on a level surface 25 feet in front of a matte-white screen, such as a garage door. The screen should be perpendicular both to the ground and to the vehicle centerline.
2. The vehicle should be equipped for normal operation. The snowplow blade should be in place and in raised position. Below are steps listed by the Society of Automotive Engineers (SAE) pertinent to headlamp aiming in specification #SAE J599d.
 - a. Remove ice or mud from under fenders.
 - b. Set tire inflation pressures to the values specified on vehicle information label.
 - c. Check springs for sag or broken leaves.
 - d. See that there is no load in the vehicle other than the driver and ballast as specified in the Kit Selection Guide.
 - e. Check functioning of any automatic vehicle leveling systems and specific manufacturer's instructions pertaining to vehicle preparation for headlamp aiming.
 - f. Clean lenses.
 - g. Check for bulb burnout and proper beam switching.
 - h. Stabilize suspension by rocking vehicle sideways.
3. Prepare vehicle for headlamp aim or inspection. Before checking beam aim, the inspector will:
 - a. Remove ice or mud from under fenders.
 - b. Set tire inflation pressures to the values specified on vehicle information label.
 - c. Check springs for sag or broken leaves.
4. Mark (or tape) the vertical centerline of the snowplow headlamps and the vertical centerline of the vehicle on the screen. Mark the horizontal centerline of the snowplow headlamps on the screen (distance from ground to snowplow headlamp centers).
5. Align the top edge of the high intensity zone of the snowplow lower beam below the horizontal centerline and the left edge of the high intensity zone on the vertical centerline for each snowplow headlamp. (Refer to diagram.)



SYSTEM OVERVIEW – HYDRAULIC HOSE ROUTING

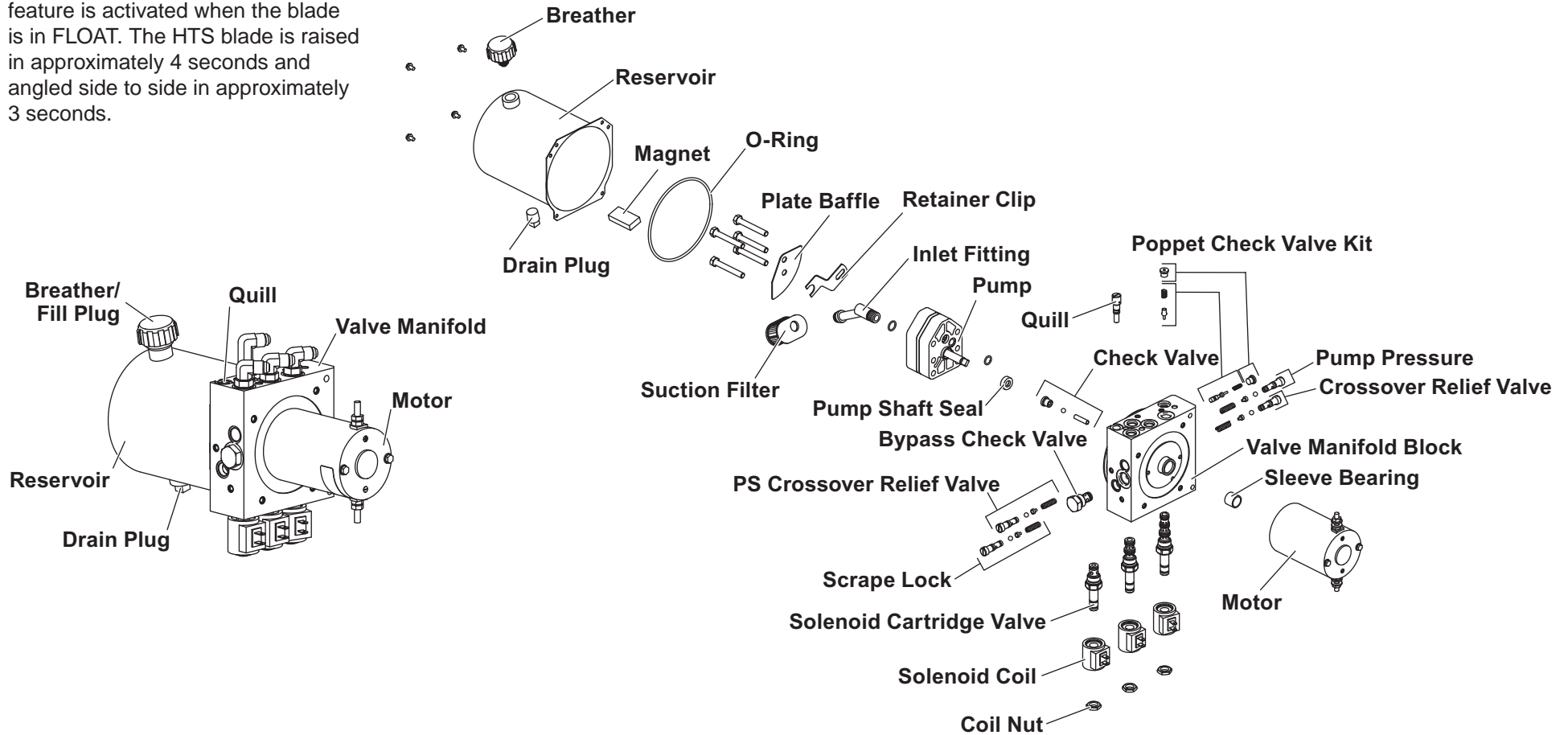
HOSE ROUTING FOR HTS™ BLADES



SYSTEM OVERVIEW – HYDRAULIC UNIT

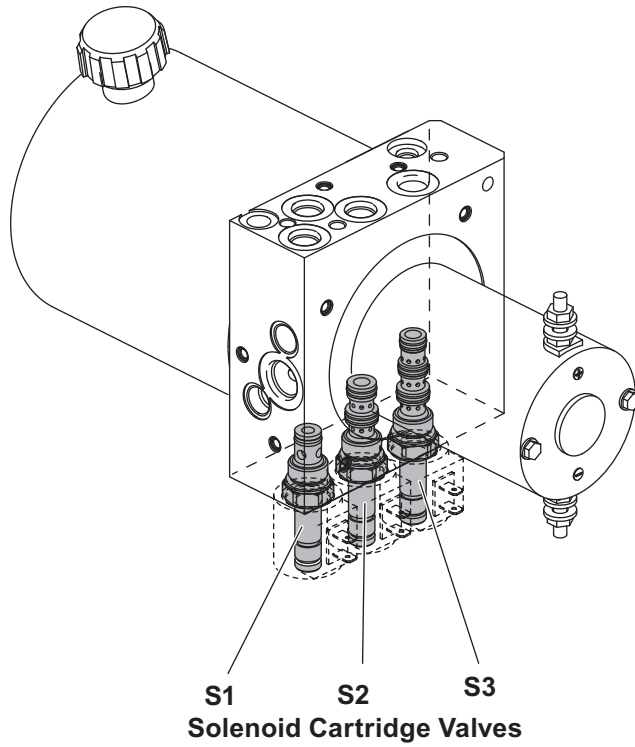
FloStat® HYDRAULIC UNIT

The HTS™ hydraulic unit has blade scrape lock circuitry built in. This feature is activated when the blade is in FLOAT. The HTS blade is raised in approximately 4 seconds and angled side to side in approximately 3 seconds.

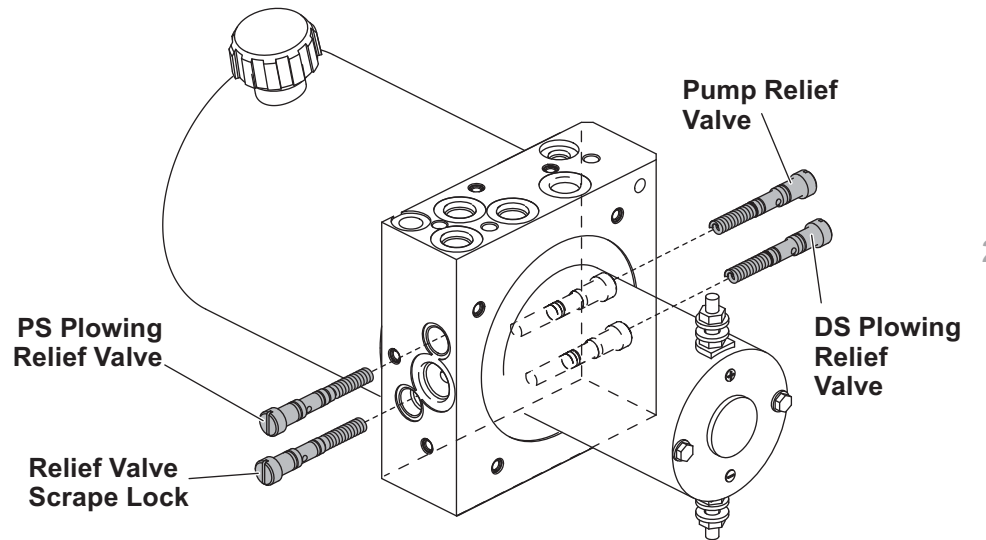


SYSTEM OVERVIEW – HYDRAULIC UNIT

SOLENOID CARTRIDGE VALVE IDENTIFICATION & LOCATION



RELIEF VALVE IDENTIFICATION & LOCATION

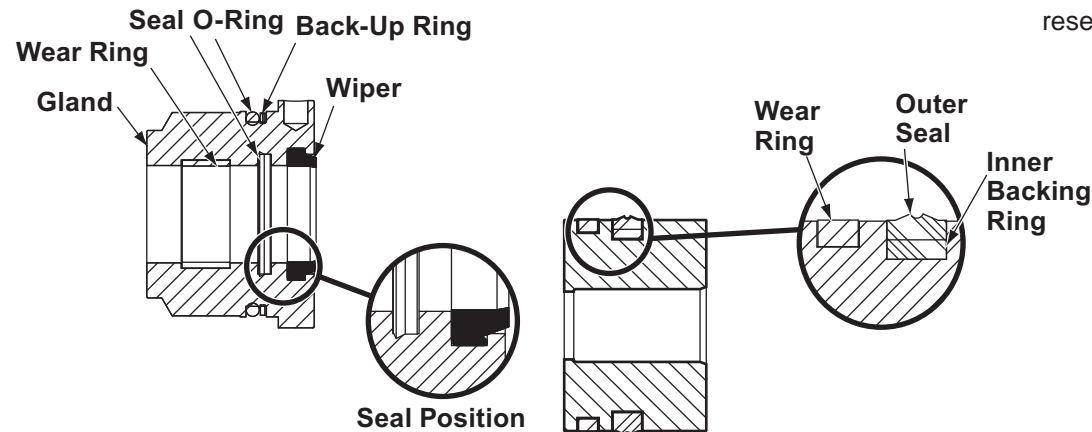
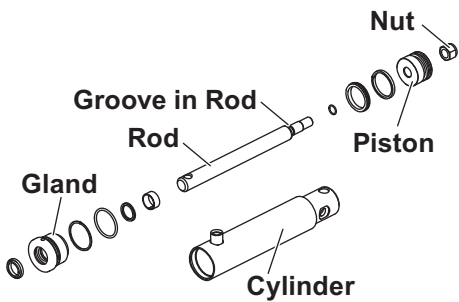


SYSTEM OVERVIEW – HYDRAULIC

HYDRAULIC COMPONENT INSTALLATION

Ram Seal Installation

1. Lubricate O-rings before assembly.
2. Assemble gland components as shown, then lubricate.
3. Remove piston from rod and assemble piston components as shown.
4. Assemble gland to threaded end of rod. Do not slide gland over cross hole in rod.
5. Reassemble piston to rod and tighten nut to 100–120 ft-lb.
6. Assemble O-ring into groove on rod. Use tape or other protection on threads.
7. Apply bead of medium-strength threadlocker all around threads of gland.
8. Lubricate piston seals and inside of cylinder.
9. Press rod assembly into cylinder and tighten gland to 30–40 ft-lb.

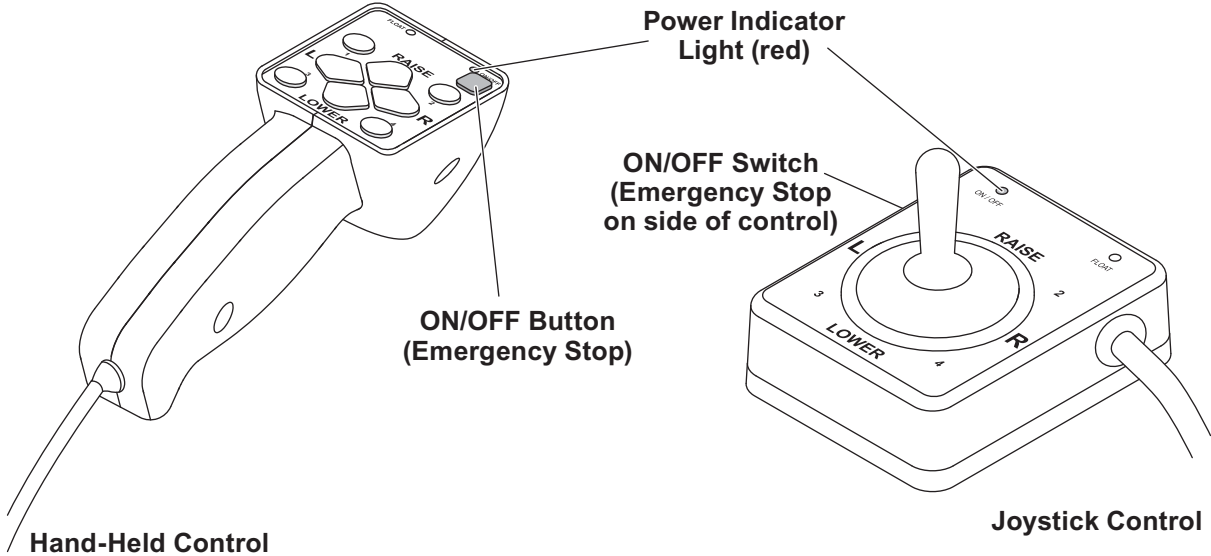


Cartridge & Check Valve Removal

It is possible to remove cartridges and check valves from a hydraulic unit without draining the hydraulic fluid from the reservoir.

1. Install the Diagnostic Harness (PN 29290-1) following the instructions included with the kit.
2. Cycle through the control functions twice to remove the pressure in the hydraulic unit.
3. Slowly remove the breather from the top of the hydraulic unit.
4. Either (a) completely drain reservoir and skip to Step 9 or (b) proceed with instructions on removing hydraulic components without completely draining reservoir.
5. Install a 3/8" barb fitting into the top of the reservoir tank.
6. Attach a hand-operated vacuum pump to the barb fitting.
7. Using the vacuum pump, pull a vacuum of approximately 5"–10" Hg.
8. You should now be able to remove cartridges and check valves from the hydraulic unit with minimal fluid loss. Maintain the vacuum until the replacement cartridge/check valve has been installed. Once the replacement part has been installed, release the vacuum and remove the 3/8" barb fitting.
9. Reinstall the breather and remove the 29290-1 Diagnostic Harness according to the instructions included with the kit.

SYSTEM OVERVIEW – HTS™ CONTROLS



HAND-HELD CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

⚠ WARNING

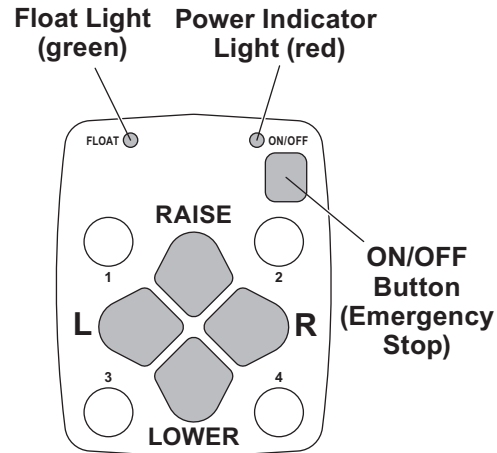
To prevent accidental movement of the blade, always push the ON/OFF button to switch the control OFF whenever the snowplow is not in use. The power indicator light will turn OFF.

CONTROL OVERVIEW

The SECURITY GUARD feature was developed as an electrical anti-theft system for the half-ton snowplows. The system provides a deterrent from theft and/or non-permitted use by allowing you to electronically lock the snowplow's hydraulic functions.

All half-ton snowplow controls come equipped with the SECURITY GUARD system. To use this function, you must complete the "Activation" process.

Each control is equipped with an ON/OFF switch and an indicator light to show when the control is powered ON or OFF. The controls are powered by the vehicle's battery, so your vehicle ignition (key) switch must be ON to use the controls.



Before Activating the SECURITY GUARD System:

Install the control as stated in the Hand-Held Control Kit Installation Instructions, and check all snowplow functions as described below.

OPERATING THE HAND-HELD CONTROL

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position.
2. Press the ON/OFF button on the control. The power indicator light glows red, indicating the control is ON. The power indicator light glows red whenever the control and the vehicle ignition switch are both ON and the electrical connections to the snowplow are completed.

The ON/OFF button operates as an emergency stop if required.

Function Time-Outs

All control functions, except LOWER/FLOAT, time out (stop) automatically after a period of time. This is to limit the amount of electrical energy required from the vehicle.

NOTE: If control function times out before desired blade movement is complete, release button and press again.

Automatic Shutdown

The control will automatically turn OFF after being idle for 20 minutes. To reactivate the control after a shutdown, press the ON/OFF button.

HAND-HELD CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

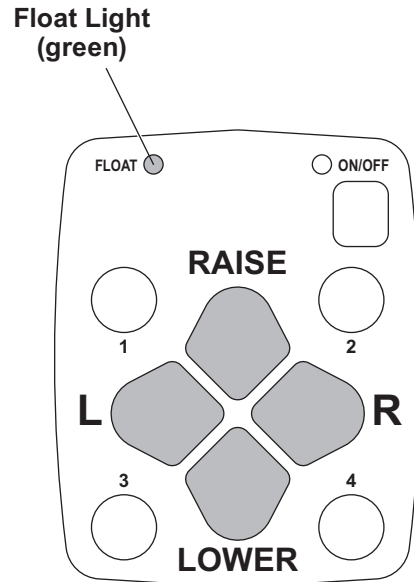
Smooth Stop

The control automatically allows the blade to coast to a stop when the button is released. This results in smoother operation, reduces the shock to the hydraulic system and increases hose and valve life.

Control Functions

Raise, Lower, Float, Angle

The four diamond-shaped buttons in the center of the control face, when pressed, will result in the blade movements described in the table.



Function	Description of Operation
RAISE	Press this button to raise the snowplow and cancel the FLOAT mode. Function times out after 4.8 seconds.
LOWER	Press this button to lower the snowplow. Release the button to stop blade at desired height.
FLOAT	Press the LOWER button and hold 3/4 second to activate this mode. The FLOAT indicator light in the upper left corner of the control face will illuminate. The blade will lower to the ground surface and follow the contour of the surface as it dips or raises. Function does not time out, but control will shut down after 20 minutes of nonuse. Press RAISE button momentarily to cancel FLOAT. Angling left or right will not interrupt (stop) the FLOAT function.
L (Angle Left)	Press this button to angle the blade to the left. Function times out after 9.6 seconds.
R (Angle Right)	Press this button to angle the blade to the right. Function times out after 9.6 seconds.
1 & 4	Used to access the SECURITY GUARD system activation mode.
2 & 3	Used to clear the entered SECURITY GUARD system code.

NOTE: If control function times out before desired blade movement is complete, release button and press again.

HAND-HELD CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

SECURITY GUARD System

Activation & Establishing a 4-Digit Security Code

NOTE: The snowplow must be attached to the vehicle, and all the electrical connections must be connected prior to activating the security code function.

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position. (It is not necessary to start the vehicle.)
2. Verify the control power indicator is OFF. If the power indicator light is red, the control is ON. Press the ON/OFF button to turn the hand-held control OFF.
3. To activate the SECURITY GUARD mode, press the control #1 button four consecutive times, and then press the #4 button four consecutive times (sequence: 1, 1, 1, 1, 4, 4, 4, 4). The green FLOAT light will flash quickly and the red POWER light will turn ON indicating the system is ready to accept your 4-digit security code. Enter your 4-digit security code by pressing any of the eight following buttons in any sequence: UP, DOWN, LEFT, RIGHT, 1, 2, 3 or 4.

Once you have entered your 4-digit security code, the FLOAT light will stop flashing and the POWER light will turn OFF. This indicates that your 4-digit security code is entered and stored in the SECURITY GUARD system.

4. Once a 4-digit security code is established and the plow/vehicle electrical connection are lost/disconnected, the SECURITY GUARD system will recognize any HTS™ control that has been programmed with the same 4-digit security code. Any control not programmed with the correct 4-digit security code will require the user to enter the established security code before activating the snowplow (see the Manual Unlock procedure).

NOTE: If the control POWER button is turned ON prior to completing the programming procedure, your 4-digit security code will be cancelled.

Manual Unlock

If the SECURITY GUARD system is activated and you are using a HTS™ control with a different 4-digit code than the established security code, you will be required to manually enter the 4-digit security code before operating a locked snowplow.

1. Turn the vehicle ignition to the "ON" or "ACCESSORY" position.
2. Turn the control on.
3. The POWER light will flash rapidly, indicating that the snowplow is locked.
4. Enter the 4-digit security code.
5. After entering the correct security code, the POWER light will change from flashing rapidly to a solid light to indicate the snowplow has been successfully unlocked.

NOTE: If the plow/vehicle electrical connection is lost or disconnected, the SECURITY GUARD system will reset, requiring any HTS control that is not programmed with the established 4-digit security code to manually re-enter the security code to activate the snowplow.

Clearing an Established 4-Digit Security Code

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position.
2. If the snowplow is locked (the control POWER light will be flashing at a fast rate), unlock the snowplow by following the Manual Unlock procedure.
3. Turn the control off. Verify that the power indicator is OFF.
4. With the control OFF, press the #2 button four consecutive times, and then press the #3 button four consecutive times. This sequence (2, 2, 2, 2, 3, 3, 3, 3) will clear the 4-digit security code from the SECURITY GUARD system. The FLOAT light will flash to indicate that the 4-digit security code was cleared.

NOTE: To enter a new 4-digit security code see Activation & Establishing a 4-Digit Security Code.

HAND-HELD CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

Light Flash Indicators

POWER – Red	Function
Off	Control is OFF
Solid On	Control is ON and active
Slow Flash	No communication
Fast Flash	Snowplow is locked – enter 4-digit security code to unlock

FLOAT – Green	Function
Solid On	Float function is active
Fast Flash	Security code activation in progress

Additional Notes

- The SECURITY GUARD system requires any HTS™ control (other than the one with the assigned 4-digit security code) to enter the security code before the snowplow can be activated. Once the security code is established, the SECURITY GUARD system recognizes that a control with the same security code is attached, and does not require a manual unlock to activate the snowplow. The system will recognize the control as "safe" and will automatically unlock.
- The SECURITY GUARD system is fully functional with hand-held control PN 96500.
- In the event that a snowplow is locked and cannot be manually unlocked or reset, contact your Authorized Distributor.
- REMINDER: Record your security code for future reference.

JOYSTICK CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

⚠ WARNING

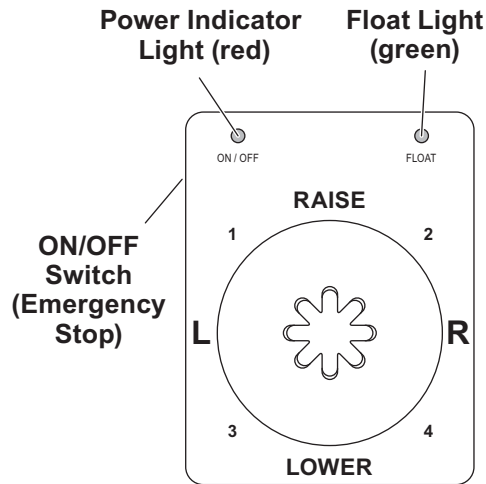
To prevent accidental movement of the blade, always move the ON/OFF switch to OFF whenever the snowplow is not in use. The power indicator light will turn OFF.

CONTROL OVERVIEW

The SECURITY GUARD feature was developed as an electrical anti-theft system for the HTS™ snowplows. The system provides a deterrent from theft and/or non-permitted use by allowing you to electronically lock the snowplow's hydraulic functions.

All half-ton snowplow controls come equipped with the SECURITY GUARD system. To use this function, you must complete the "Activation" process.

Each control is equipped with an ON/OFF switch and an indicator light to show when the control is powered ON or OFF. The controls are powered by the vehicle's battery, so your vehicle ignition (key) switch must be ON to use the controls.



Before Activating the SECURITY GUARD System:

Install the control as stated in the Joystick Control Kit Installation Instructions, and check all snowplow functions as described below.

OPERATING THE JOYSTICK CONTROL

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position.
2. Move the slide switch on the side of the control to the "ON" position. The power indicator light glows red, indicating the control is ON. The indicator light glows red whenever the control and the vehicle ignition switch are both ON and the electrical connections to the snowplow are completed.

The ON/OFF switch operates as an emergency stop if required.

Function Time-Outs

All control functions, except LOWER/FLOAT, time out (stop) automatically after a period of time. This is to limit the amount of electrical energy required from the vehicle.

NOTE: If control function times out before desired blade movement is complete, release the lever to the center position, then move back into the desired function.

Automatic Shutdown

The control will automatically turn OFF after being idle for 20 minutes. To reactivate the control after a shutdown, move the ON/OFF switch to OFF, then back to ON.

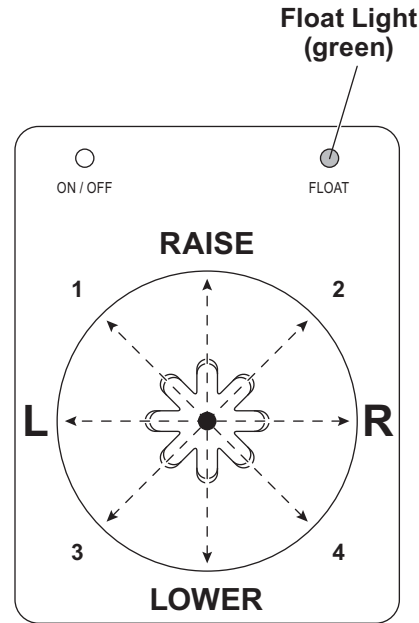
JOYSTICK CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

Smooth Stop

The control automatically allows the blade to coast to a stop when the lever returns to center position. This results in smoother operation, reduces the shock to the hydraulic system and increases hose and valve life.

Control Lever Movement

From the center position, the control lever can be moved in one of eight (8) directions to control various movements of the snowplow blade. To change from one movement of the blade to another, the control lever must be moved back to the center position before selecting the desired function. Whenever the lever is released, it should spring back into the center position to stop any blade movement.



Control Functions

Raise, Lower, Float, Angle

Moving the control lever in straight lines up and down or from side to side on the control body will result in the blade movements described in the following tables.

Function	Description of Operation
RAISE	Move the control lever toward the top of the control body to raise the snowplow and cancel the FLOAT mode. Function times out after 4.8 seconds.
LOWER	Move the control lever toward the bottom of the control body to lower the snowplow. Release the lever to stop blade at desired height.
FLOAT	Move the control lever to the LOWER position and hold 3/4 second to activate this mode. The FLOAT indicator light in the upper right corner of the control face will illuminate. The blade will lower to the ground surface and follow the contour of the surface as it dips or raises. Function does not time out; however, control will shut down after 20 minutes of nonuse. Move lever to the RAISE position momentarily to cancel FLOAT. Angling left or right will not interrupt (stop) the FLOAT function.
L (Angle Left)	Move the control lever straight to the left to angle the blade left. Function times out after 9.6 seconds.
R (Angle Right)	Move the control lever straight to the right to angle the blade right. Function times out after 9.6 seconds.
1 & 4	Used to access the SECURITY GUARD system activation mode.
2 & 3	Used to clear the entered SECURITY GUARD system code.

NOTE: If control function times out before desired blade movement is complete, release the lever to the center position, then move back into the desired function.

JOYSTICK CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

SECURITY GUARD System

Activation & Establishing a 4-Digit Security Code

NOTE: The snowplow must be attached to the vehicle, and all the electrical connections must be connected prior to activating the security code function.

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position. (It is not necessary to start the vehicle.)
2. Verify the control power indicator is OFF. If the power indicator light is red, the control is ON. Slide the ON/OFF switch to "OFF" to turn the control OFF.
3. To activate the SECURITY GUARD mode, move the control lever into the #1 position four consecutive times, and then in the direction of the #4 position four consecutive times (sequence: 1, 1, 1, 1, 4, 4, 4, 4). The green FLOAT light will flash quickly and the red POWER light will turn ON indicating the system is ready to accept your 4-digit security code.

Enter your 4-digit security code by moving the control lever into the position of any of the eight following positions: UP, DOWN, LEFT, RIGHT, 1, 2, 3 or 4.

Once you have entered your 4-digit security code, the FLOAT light will stop flashing and the POWER light will turn OFF.

This indicates that your 4-digit security code is entered and stored in the SECURITY GUARD system.

4. Once a 4-digit security code is established and the plow/vehicle electrical connection are lost/disconnected, the SECURITY GUARD system will recognize any HTS™ control that has been programmed with the same 4-digit security code. Any control not programmed with the correct 4-digit security code will require the user to enter the established security code before activating the snowplow (see the Manual Unlock procedure).

NOTE: If the control POWER switch is turned ON prior to completing the programming procedure, your 4-digit security code will be cancelled.

Manual Unlock

If the SECURITY GUARD system is activated and you are using a HTS™ control with a different 4-digit code than the established security code, you will be required to manually enter the 4-digit security code before operating a locked snowplow.

1. Turn the vehicle ignition to the "ON" or "ACCESSORY" position.
2. Slide the switch to turn the control on.
3. The POWER light will flash rapidly, indicating that the snowplow is locked.
4. Enter the 4-digit security code.
5. After entering the correct security code, the POWER light will change from flashing rapidly to a solid light to indicate the snowplow has been successfully unlocked.

NOTE: If the plow/vehicle electrical connection is lost or disconnected, the SECURITY GUARD system will reset, requiring any HTS control that is not programmed with the established 4-digit security code to manually re-enter the security code to activate the snowplow.

Clearing an Established 4-Digit Security Code

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position.
2. If the snowplow is locked (the control POWER light will be flashing at a fast rate), unlock the snowplow by following the Manual Unlock procedure.
3. Slide the control to the "OFF" position. Verify that the power indicator is OFF.
4. With the control OFF, move the control lever to the #2 position four consecutive times, and then to the #3 position four consecutive times. This sequence (2, 2, 2, 2, 3, 3, 3, 3) will clear the 4-digit security code from the SECURITY GUARD system. The FLOAT light will flash to indicate that the 4-digit security code was cleared.

NOTE: To enter a new 4-digit security code see Activation & Establishing a 4-Digit Security Code.

JOYSTICK CONTROL with SECURITY GUARD™ Snowplow Anti-Theft System

Light Flash Indicators

POWER – Red	Function
Off	Control is OFF
Solid On	Control is ON and active
Slow Flash	No communication
Fast Flash	Snowplow is locked – enter 4-digit security code to unlock

FLOAT – Green	Function
Solid On	Float function is active
Fast Flash	Security code activation in progress

Additional Notes

- The SECURITY GUARD system requires any HTS™ control (other than the one with the assigned 4-digit security code) to enter the security code before the snowplow can be activated. Once the security code is established, the SECURITY GUARD system recognizes that a control with the same security code is attached, and does not require a manual unlock to activate the snowplow. The system will recognize the control as "safe" and will automatically unlock.
- The SECURITY GUARD system is fully functional with joystick control PN 96400.
- In the event that a snowplow is locked and cannot be manually unlocked or reset, contact your Authorized Distributor.
- REMINDER: Record your security code for future reference.

HAND-HELD MASTER CONTROL FOR THE SECURITY GUARD™ Snowplow Anti-Theft System

⚠ WARNING

To prevent accidental movement of the blade, always push the ON/OFF button to switch the control OFF whenever the snowplow is not in use. The power indicator light will turn OFF.

UNIVERSAL CLEAR SECURITY

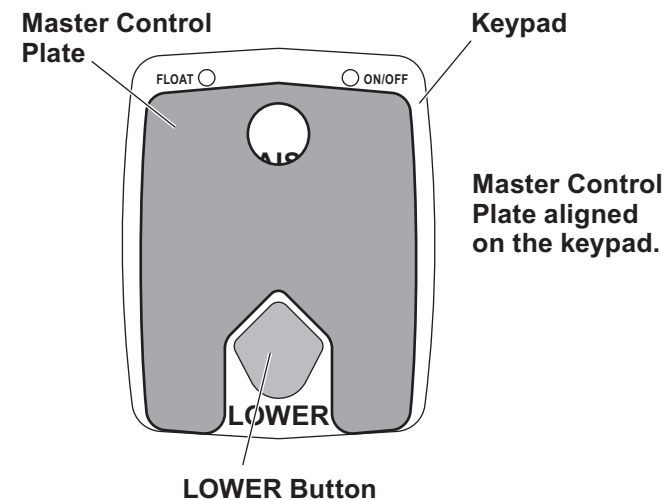
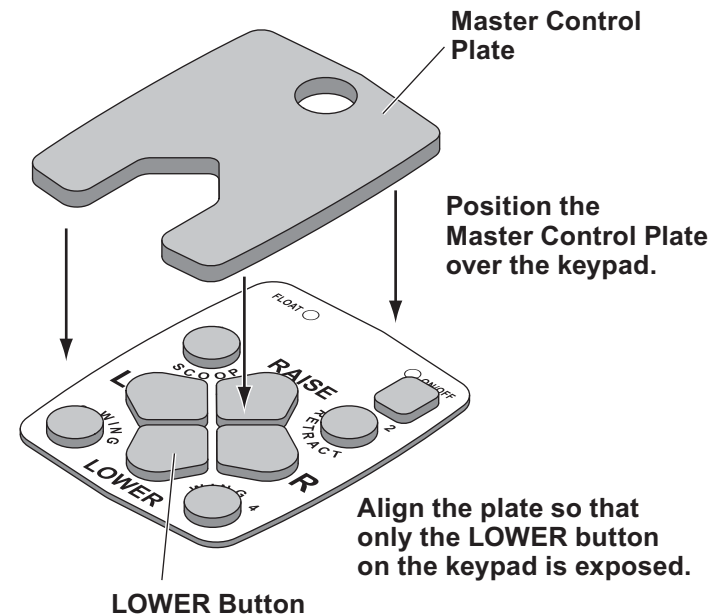
Perform the following steps to unlock and clear an established security code, without using the original control that was used to establish the code. This procedure should be used to reset the module if the security code is unknown.

IMPORTANT: The following steps must be performed using the Distributor Master Control (PN 48800). Only the Distributor Master Control can clear an established code within a snowplow module without using the original control used to establish the code.

1. Turn the vehicle ignition to the "OFF" position.
2. With the control power OFF, using the tool that was included in the Distributor Master Control box, place the tool over the keypad and push down on the plate.

NOTE: The only button that should be exposed is the LOWER button. All other buttons should be engaged and pressed down.

3. While pushing down on the tool engaging all functions except LOWER, turn the ignition ON.
4. Upon turning the ignition to the "ON" position, the module has been reset, and there is no security code associated with the snowplow.



THEORY OF OPERATION

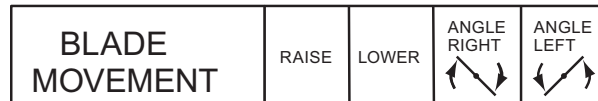
SNOWPLOW HYDRAULICS

The HTS™ snowplow hydraulic system performs four blade movements.

All movements require the vehicle ignition (key) switch to be in the run or accessory position and the power to be activated on the snowplow cab control.

Three of the four hydraulic movements require energizing the electric motor and appropriate solenoid cartridge valves. The fourth function, *lower*, does not energize the motor but requires activating a cartridge valve.

Power from the vehicle battery is supplied to the solenoid coils and the snowplow control via the Isolation Module. The solenoid cartridge valves operate in various combinations, directed by the cab control, to send hydraulic fluid to the snowplow lift and angle rams and/or back to the reservoir.



Snowplow Daytime Running Lights

Because Daytime Running Lamps (DRLs) are controlled differently on some vehicles, two Isolation Modules have been developed.

The standard Isolation Module transfers the DRL output from the vehicle headlamps to the snowplow lights when the vehicle ignition switch is turned on and the snowplow is attached.

The second Isolation Module, designed for vehicles with dedicated DRL bulbs, senses the vehicle in the DRL mode and a series of relays energize, placing the snowplow low beams in series. This Isolation Module does not turn off the vehicle's dedicated DRLs.

3-PORT MODULE ELECTRICAL

Overview

The Isolation Module acts as an electrical hub, automatically directing vehicle power to the appropriate vehicle or snowplow lighting devices, while also supplying battery power to the snowplow control.

The vehicle high and low beams enter and exit the Isolation Module through positions B (left side lighting) and position C (right side lighting). Park, turn, and DRL signals also enter through positions B and C.

The output of the vehicle high beam/low beam select switch is directed to the Isolation Module via the plug-in harness. When the snowplow is not attached to the vehicle, the signal passes through the normally closed relay contacts to the vehicle headlamps. During this time, the Isolation Module is inactive, placing no current draw on the vehicle's electrical system.

With the snowplow attached, the Isolation Module is still inactive until either of the two following conditions are met: the vehicle parking lights are turned on or the vehicle ignition switch is turned ON.

Turning on the vehicle parking lights activates a series of relays, automatically transferring the vehicle high and low beams to the snowplow while supplying battery power directly to the snowplow parking lights. All snowplow lighting exits the Isolation Module through position A.

Turning on the vehicle ignition switch energizes a snowplow control relay, supplying vehicle battery power directly to the control via the vehicle control harness and plug-in harness. The vehicle ignition switch also supplies power to the vehicle turn signals. Activating the vehicle turn signals energizes turn signal circuit, which supply vehicle battery power directly to the snowplow turn signals.

THEORY OF OPERATION

3-PORT MODULE ELECTRICAL

White Label NonDRL Module (PN 29060)

NOTE: Module has been replaced by PN 29070-1

Snowplow not attached to vehicle:

System is inactive. Vehicle lighting system functions normally. Reason: No ground to module.

Snowplow attached to vehicle:

System is inactive until either the switched accessory wire or the vehicle parking lights are activated. Vehicle and snowplow lighting systems function as outlined in the Theory of Operation Overview. Reason: ground path is established from battery common to Pin C on Port A of the 3-port module via the following harnesses: vehicle battery cable, vehicle control harness, plug-in harness, vehicle lighting harness and snowplow lighting harness.

- Activating a **switched accessory** wire (a key-controlled power source) applies battery voltage to the VACC input of the module, which energizes the coil of the control power relay (part of the 3-port module). Energizing the coil of the control power relay causes the relay contacts to shift from the "N.O." (normally opened) position to the "N.C." (normally closed) position, which supplies battery voltage to the snowplow control via the plug-in harness and the vehicle control harness. The switched accessory wire only controls battery voltage to the snowplow control.
- Activating the vehicle **park light** circuit applies battery voltage to the module park circuit input. The voltage is applied to a solid state power device, which causes the device to turn ON and apply battery voltage to the snowplow park lamp filaments via the vehicle and snowplow lighting harnesses. Voltage is also applied to the module's high and low beam relay coils, which causes the relay contacts to shift from the "vehicle" to the "snowplow" position.
- With the four headlamp relays shifted to the "snowplow" position, the **vehicle high and low beams** are now directed to the snowplow headlamps via the vehicle and snowplow lighting harnesses. Toggling the dimmer switch between high and low beam will toggle the snowplow high and low beams.
- Activating the **turn signal** applies battery voltage to the module turn signal circuit input. The voltage is applied to a solid state power device, which causes the device to turn ON and apply battery voltage to the snowplow turn signal lamp filaments via the vehicle and snowplow lighting harnesses.
- On vehicles equipped with **DRLs**—either integrated into the vehicle headlamps or separated into dedicated DRL lamps—this module *will not* turn OFF the vehicle DRLs or transfer them to the snowplow. DRLs will remain on the vehicle and operate as the vehicle manufacturer intended.

THEORY OF OPERATION

3-PORT MODULE ELECTRICAL

Green Label DRL Module (PN 29070-1)

Snowplow not attached to vehicle:

System is inactive. Vehicle lighting system functions normally. Reason: No ground to module.

Snowplow attached to vehicle:

System is inactive until either the switched accessory wire or the vehicle parking lights are activated. Vehicle and snowplow lighting systems function as outlined in the Theory of Operation Overview. Reason: ground path is established from battery common to Pin C on Port A of the 3-port module via the following harnesses: vehicle battery cable, vehicle control harness, adapter, plug-in harness, vehicle lighting harness and snowplow lighting harness.

- Activating a **switched accessory** wire (a key-controlled power source) applies battery voltage to the VACC input of the module. A control circuit senses the voltage and energizes the coil of the control power relay (part of the 3-port module). Energizing the coil of the control power relay causes the relay contacts to shift from the "N.O." (normally opened) position to the "N.C." (normally closed) position, which supplies battery voltage to the snowplow control via the plug-in harness and the vehicle control harness. The switched accessory wire only controls battery voltage to the snowplow control.
- Activating the vehicle **park light** circuit applies voltage to the module park circuit input. A control circuit senses the voltage and turns ON a solid state power device, which applies battery voltage to the snowplow park lamp filaments via the vehicle and snowplow lighting harnesses.
- With the park light circuit energized, the control circuit monitors the **vehicle high and low beam** inputs. When battery voltage is sensed, the appropriate solid state power devices are turned ON, supplying battery voltage to the snowplow headlamps via the vehicle and snowplow lighting harnesses. Toggling the dimmer switch between high and low beam will toggle the snowplow high and low beams.
- Activating the **turn signal** applies voltage to the module turn signal circuit input. A control circuit senses the voltage and turns ON a solid state power device, which applies battery voltage to the snowplow turn signal lamp filaments via the vehicle and snowplow lighting harnesses.
- **PN 29070-1 Only:** On vehicles equipped with **DRLs integrated into the vehicle headlamps**. Activation of the switched accessory wire (a key-controlled power source) Port C, Position C, applies battery voltage to the module's high and low beam relay coils, which causes the relay contacts to shift from the "vehicle" to the "snowplow" position. **This module will transfer the vehicle headlamp DRLs to the snowplow (turns off vehicle DRLs).**
- **On vehicles equipped with dedicated DRL bulbs or vehicles using the turn signals as DRLs, this module will not turn OFF the vehicle bulbs. While the vehicle is in the DRL mode, this module will illuminate the snowplow light turn signal filaments.**

THEORY OF OPERATION

3-PORT MODULE ELECTRICAL

Blue Label Module (PN 29760-1)

NOTE: Limited vehicle application.

According to the vehicle manufacturer, all 2008 Ford Super Duty F-250/350/450/550 trucks built before 04/18/2007 will require this module. Trucks built after that date and having the Plow Prep Package use the green label module (PN 29070-1).

Snowplow not attached to vehicle:

System is inactive. Vehicle lighting system functions normally.

Snowplow attached to vehicle and the electrical connections at the grille are made:

System is inactive until either the vehicle ignition switch or the vehicle parking lights are activated. Vehicle and snowplow lighting systems function as outlined in the Theory of Operation Overview.

- Turning on the vehicle ignition switch provides 12V to the switched accessory wire, which in turn applies battery voltage to the VACC input to the module at Port C, Pin C. A control circuit senses the voltage and energizes the coil of the module control power relay. Energizing the coil of the control power relay causes the relay contacts to shift from the "N.C." (normally closed) position to the "N.O." (normally opened) position, which supplies battery voltage to the snowplow control via the plug-in harness and the vehicle control harness. The switched accessory wire only controls battery voltage to the snowplow control.
- Activating the vehicle **park light** circuit applies battery voltage to the module park circuit input, Port B, Pin H. The voltage is applied to a solid state power device, which causes the device to turn ON and apply battery voltage to the snowplow park lamp filaments via the vehicle and snowplow lighting harnesses. Voltage is also applied to the module's high and low beam relay coils, which causes the relay contacts to shift from the "vehicle" to the "snowplow" position.
- With the headlamp relays shifted to the "snowplow" position, the **vehicle high and low beams** are now directed to the snowplow headlamps via the vehicle and snowplow lighting harnesses. Toggling the dimmer switch between high and low beam will toggle the snowplow high and low beams.
- Activating the **turn signal** applies battery voltage to the module turn signal circuit input. Left: Port B, Position G; Right: Port C, Position G. The voltage is applied to a solid state power device, which causes the device to turn ON and apply battery voltage to the snowplow turn signal lamp filaments via the vehicle and snowplow lighting harnesses.
- On vehicles equipped with **DRLs** integrated into the vehicle headlamps, activating a **switched accessory** wire (a key-controlled power source) applies battery voltage to the module's **high and low beam** relay coils, which causes the relay contacts to shift from the "vehicle" to the "snowplow" position. This module **will** transfer the vehicle headlamp DRLs to the snowplow.






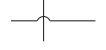





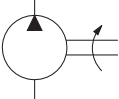

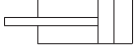











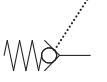
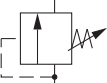





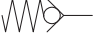
ELECTRICAL & HYDRAULIC SCHEMATICS

This section contains hydraulic and electrical schematics to help explain how the hydraulic unit performs the different functions. A schematic is an abstract drawing showing the purpose of each component in the system. Each component is represented by a graphical symbol. The hydraulic and electrical legends describe each symbol used in the schematics for this guide.

The first two schematics show an overview of the complete electrical and hydraulic systems. Other schematics highlight the flow of hydraulic oil and electrical current for each function the hydraulic unit performs as well as the flow of electrical current for the snowplow and vehicle lights.

- Bold lines and gray lines (ground) represent the circuit being activated only.
- Shaded components are either activated or shifted from their normal position.

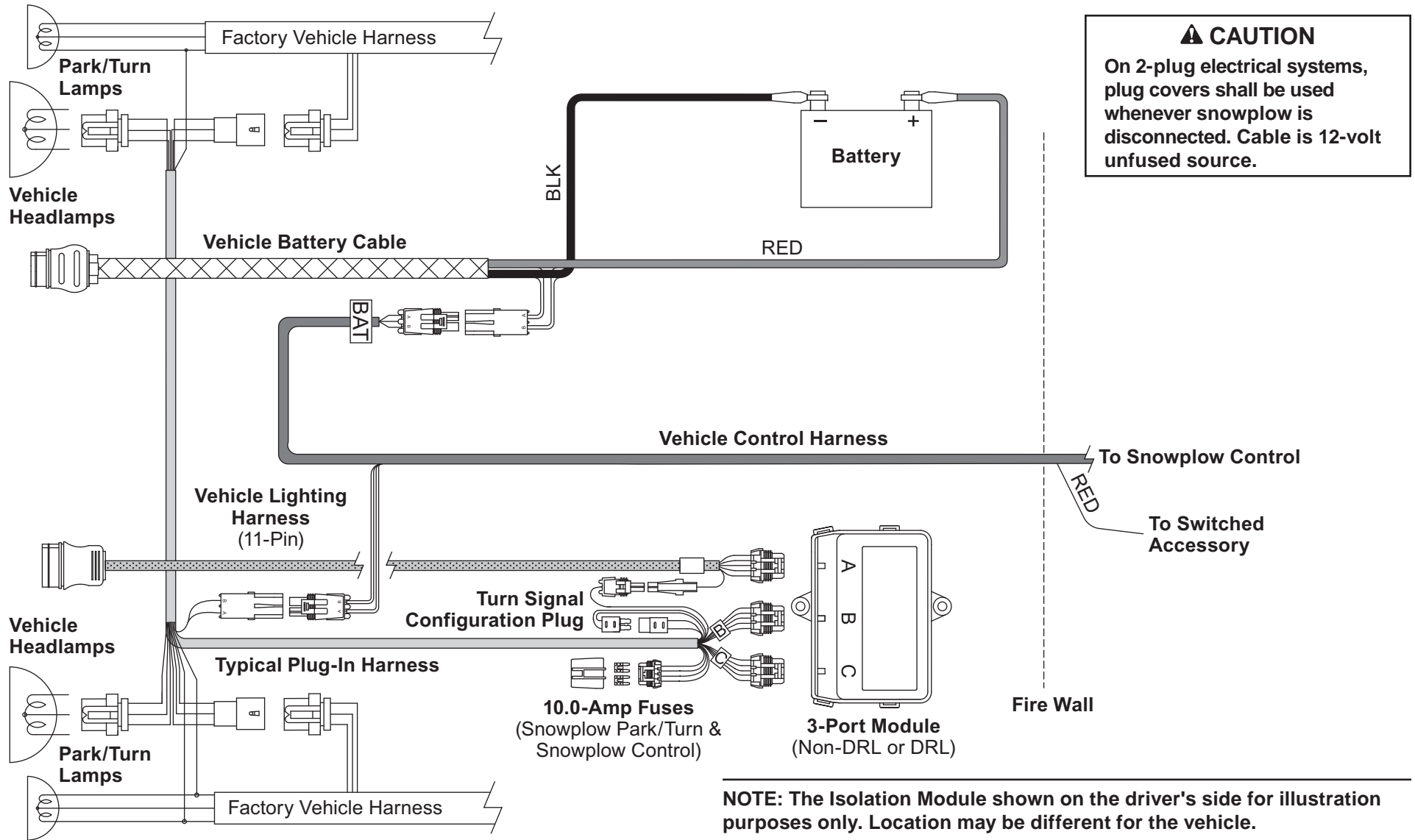
**NOTE: Left Side = Driver's Side (DS)
Right Side = Passenger's Side (PS)**

ELECTRICAL LEGEND		HYDRAULIC LEGEND	
	CROSSING WIRE		LINE, WORKING (MAIN)
	WIRE SPLICE		LINES JOINING
	IN LINE CONNECTOR		LINES CROSSING
	FUSE		FLOW, DIRECTION OF HYDRAULIC FLUID
	SOLENOID COIL		LINE, TO RESERVOIR BELOW FLUID LEVEL
	CIRCUIT GROUND		HYDRAULIC PUMP FIXED DISPLACEMENT
	MOTOR RELAY		CYLINDER
	BATTERY		ELECTRIC MOTOR
	MOTOR		FILTER, STRAINER, DIFFUSER
	HEADLAMP		COMPONENT ENCLOSURE
	PARK/TURN LAMP		
	PRINTED CIRCUIT BOARD		
	COMPONENT ENCLOSURE		SPRING
			SOLENOID, SINGLE WINDING
			PILOT OPERATED (P/O) CHECK VALVE
			VALVE, ADJUSTABLE PRESSURE RELIEF
			VALVE, FLOW CONTROL, ADJUSTABLE-NON-COMPENSATED
			VALVE, TWO POSITION, TWO CONNECTION (TWO WAY)
			VALVE, TWO POSITION, THREE CONNECTION (THREE WAY)
			VALVE, TWO POSITION, FOUR CONNECTION (FOUR WAY)
			ORIFICE PLATE
			CHECK VALVE

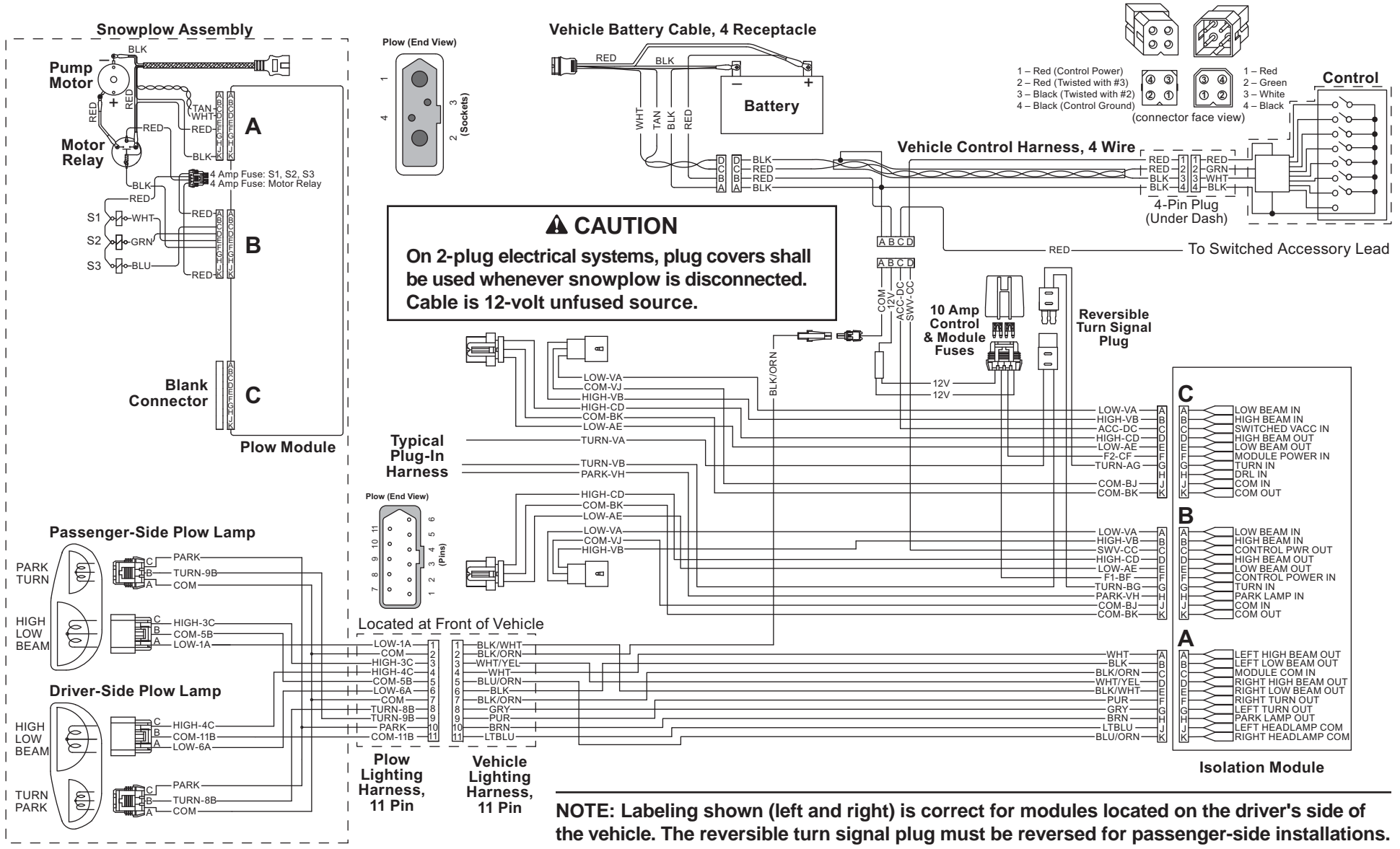
Wire Color Code				Abbreviations					
BLK	Black	BLU/ORN	Blue w/ Orange	GRY	Gray	PUR	Purple	DRL	Daytime Running Lamps
BLK/ORN	Black w/ Orange	BRN	Brown	LTBLU	Light Blue	RED	Red	MTR RLY	Motor Relay
BLK/RED	Black w/ Red	BRN/GRN	Brown w/ Green	LTGRN	Light Green	WHT	White	P/T SIG	Park / Turn Signal
BLK/WHT	Black w/ White	BRN/RED	Brown w/ Red	ORN	Orange	WHT/YEL	White w/ Yellow		
BLU	Blue	GRN	Green	PNK	Pink	YEL	Yellow		

SYSTEM OVERVIEW – ELECTRICAL

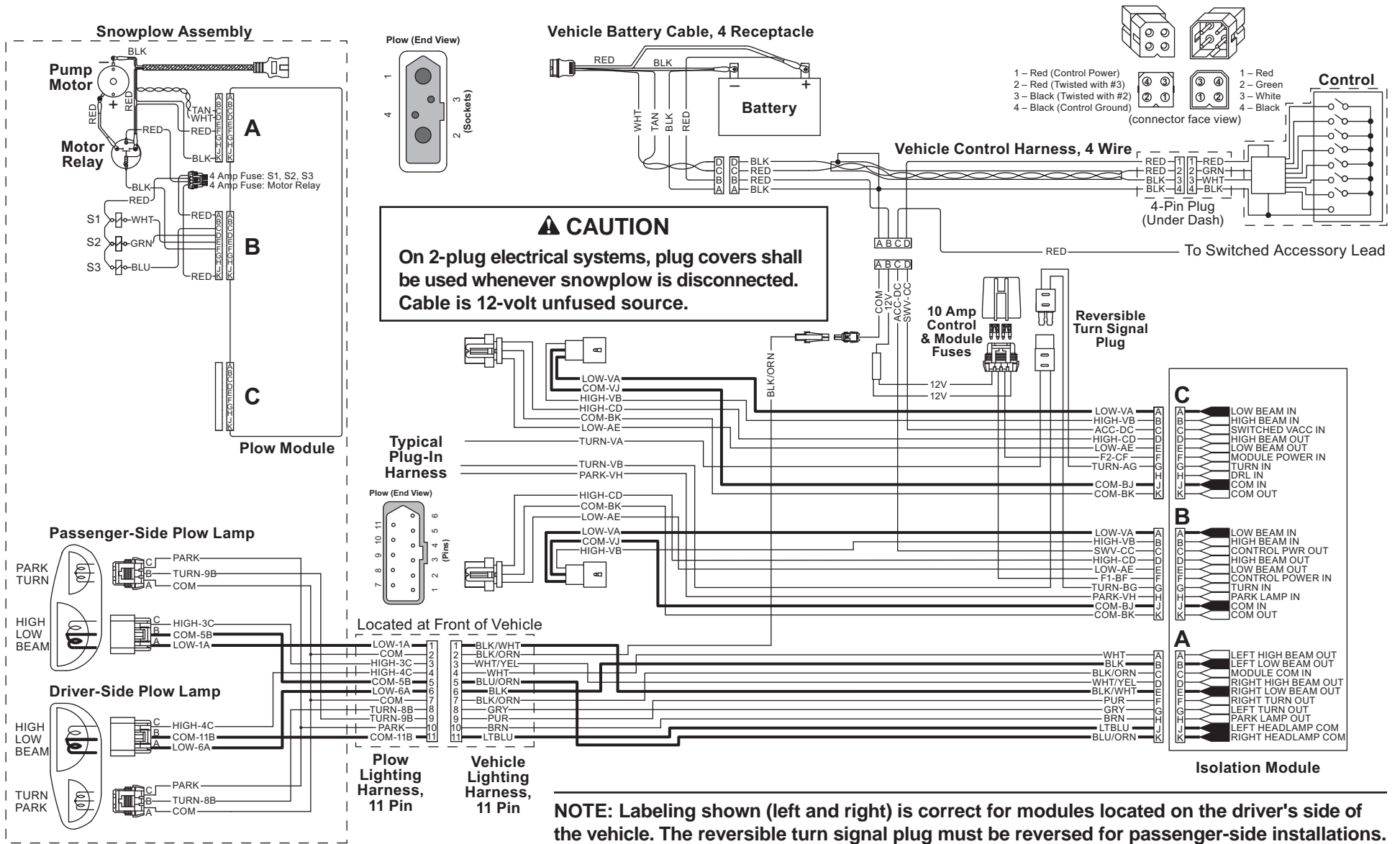
WIRING – 3-PORT MODULE



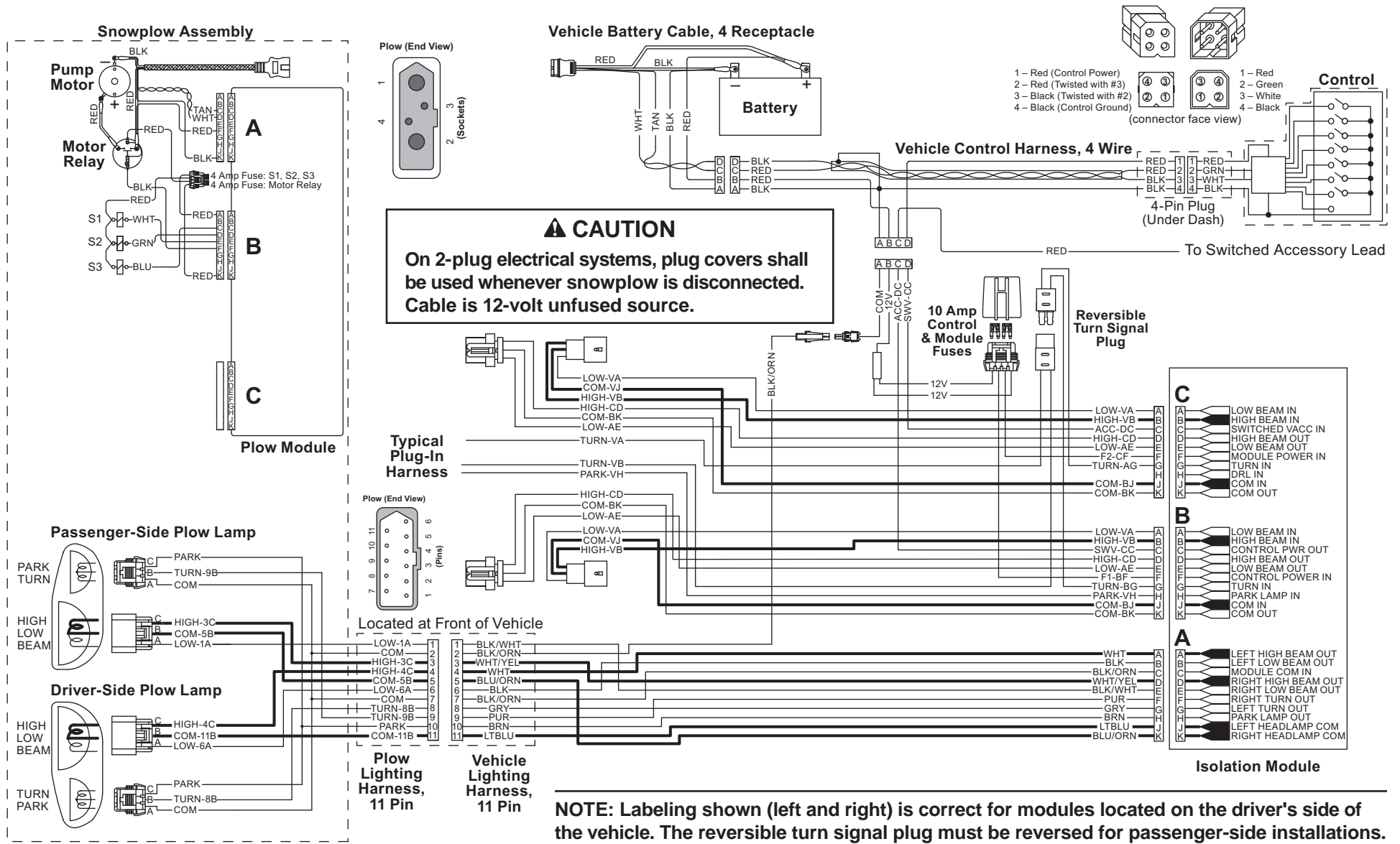
ELECTRICAL SCHEMATIC – 3-PORT MODULE



LOW BEAM HEADLAMPS WITH SNOWPLOW CONNECTED TO VEHICLE (3-PORT MODULE)



HIGH BEAM HEADLAMPS WITH SNOWPLOW CONNECTED TO VEHICLE (3-PORT MODULE)



THEORY OF OPERATION

4-PORT MODULE ELECTRICAL

Snowplow Headlamps

The Isolation Module acts as an electrical hub, automatically directing vehicle power to the appropriate vehicle or snowplow lighting devices, while also supplying battery power to the snowplow control.

The vehicle high and low beams enter and exit the Isolation Module through positions 3 (left-side lighting) and position 4 (right-side lighting). Park, turn and DRL signals also enter through positions 3 and 4. The output of the vehicle dimmer switch is directed to the Isolation Module via the long and short plug-in harnesses.

All snowplow lighting exits the Isolation Module through position 2.

When the snowplow is not attached to the vehicle, the signal passes through the normally closed relay contacts to the vehicle headlamps. During this time, the Isolation Module is inactive, placing no current draw on the vehicle's electrical system.

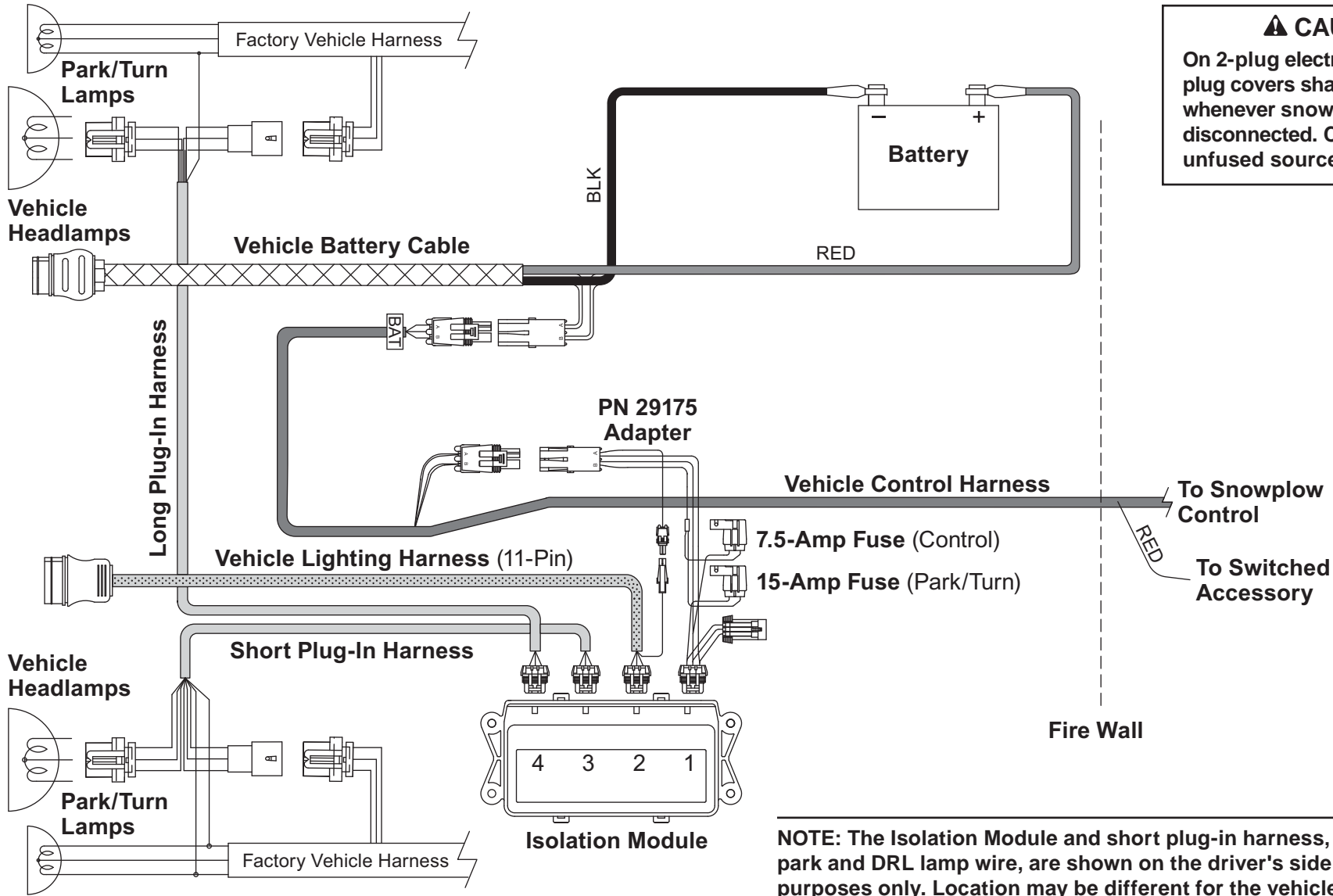
With the snowplow attached, the Isolation Module is still inactive until either of the two following conditions are met: The vehicle parking lights are turned on or the vehicle ignition switch is turned on.

Turning on the vehicle parking lights activates a series of relays, automatically transferring the vehicle high and low beams to the snowplow while supplying battery power directly to the snowplow parking lights.

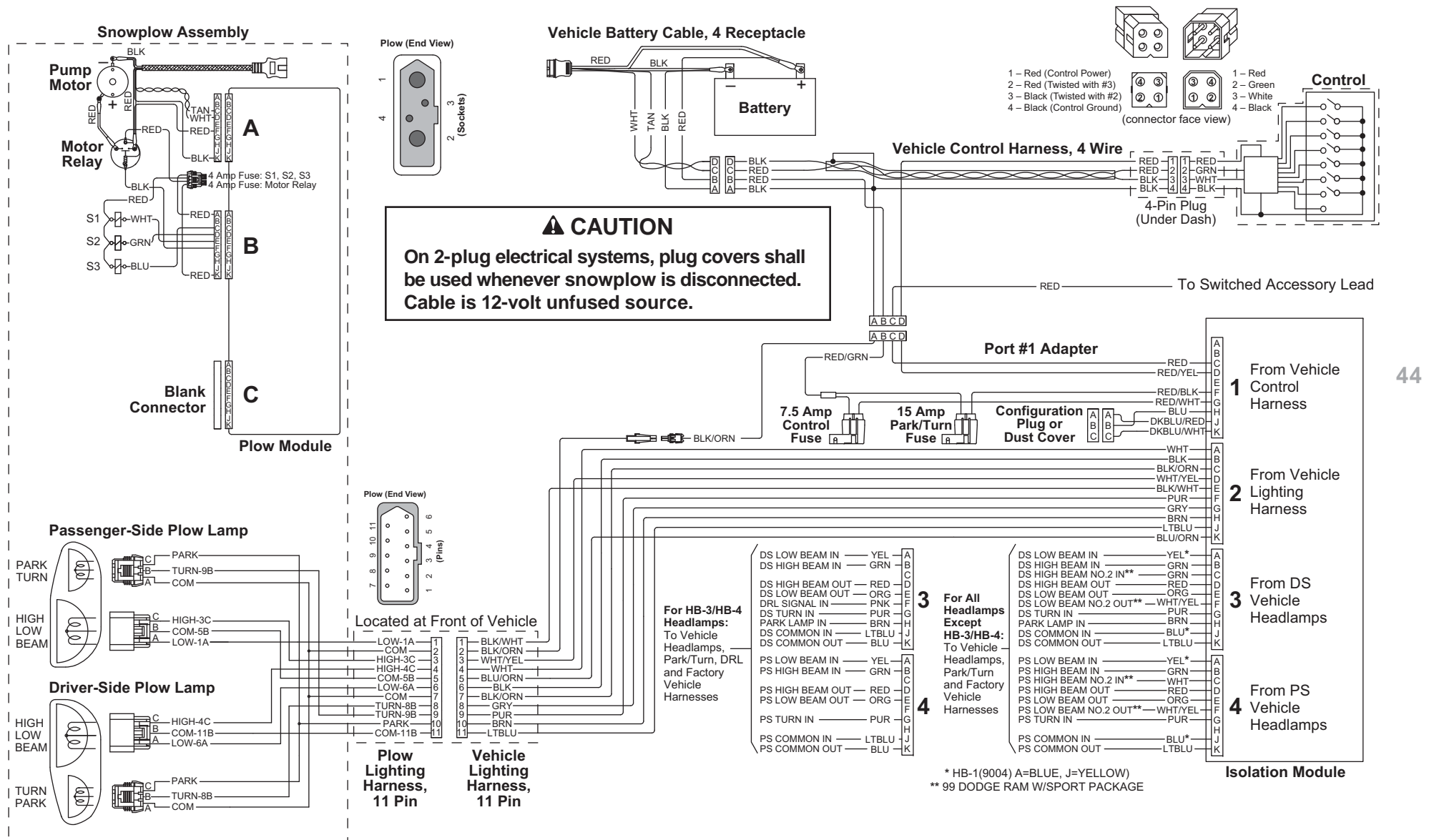
Turning on the vehicle ignition switch energizes a snowplow control relay, supplying vehicle battery power directly to the control via the vehicle control harness. The vehicle ignition switch also supplies power to the vehicle turn signals. Activating the vehicle turn signals energizes turn signal relays, which supply vehicle battery power directly to the snowplow turn signals.

SYSTEM OVERVIEW – ELECTRICAL

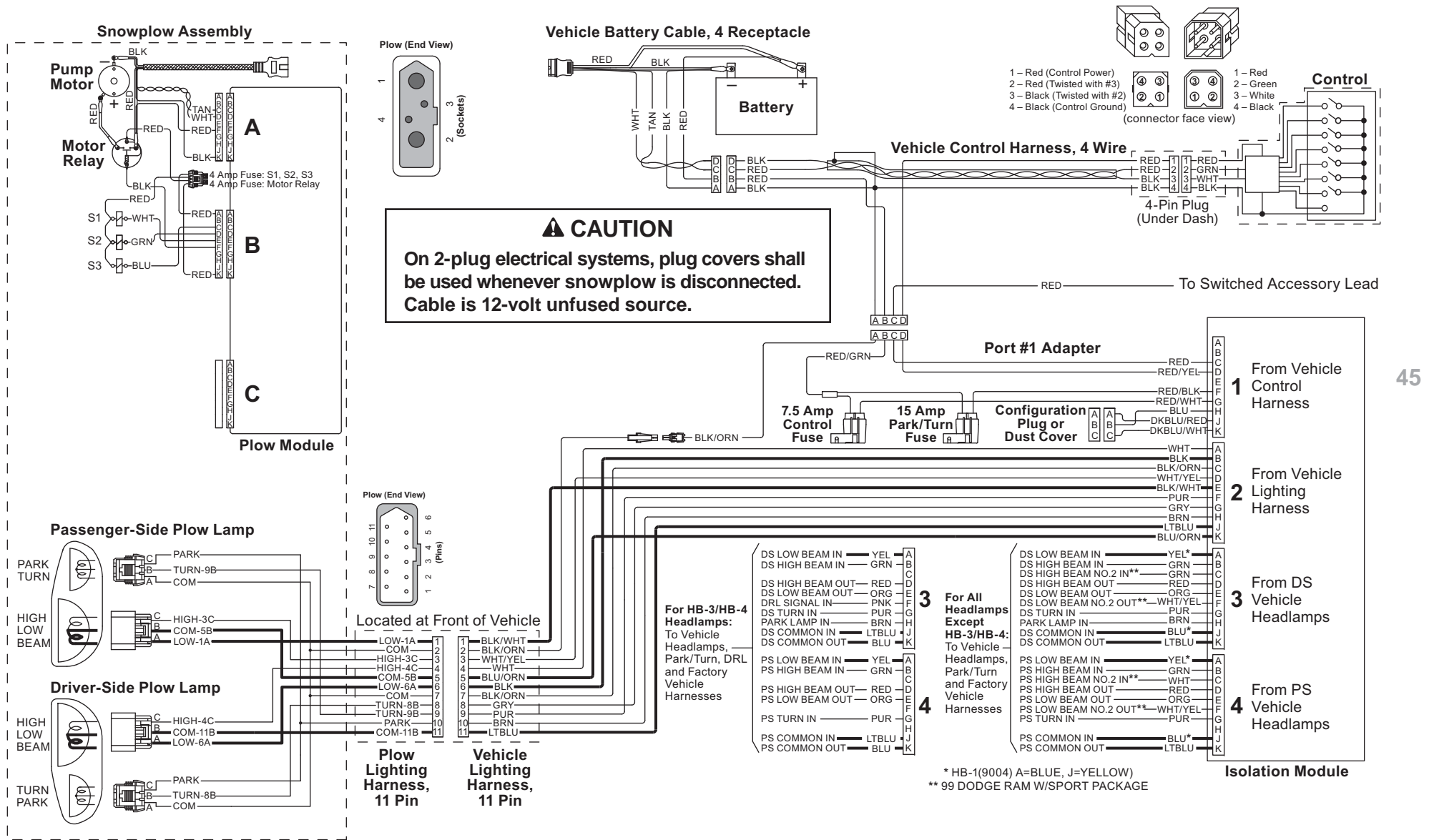
WIRING – 4-PORT MODULE



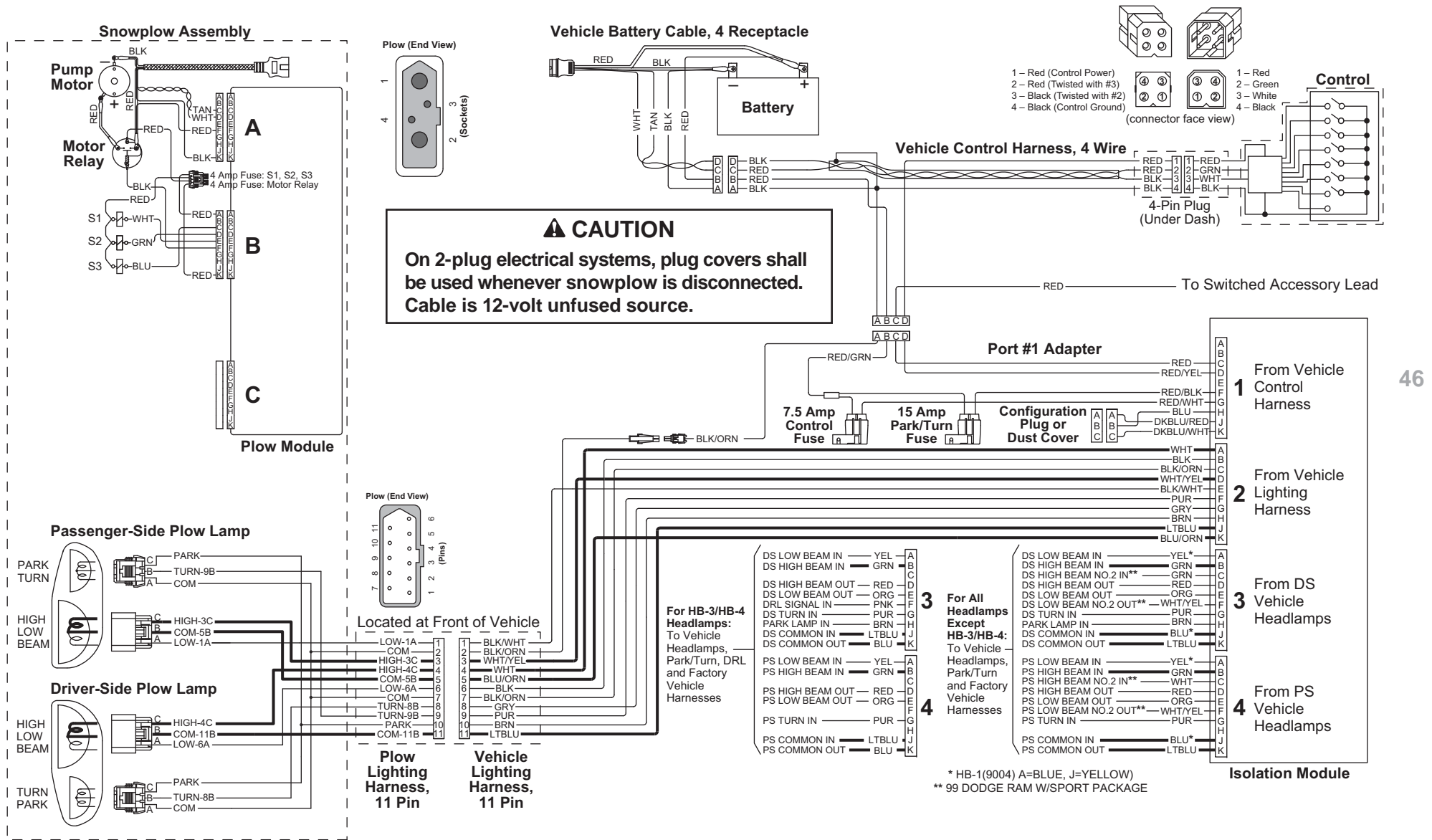
ELECTRICAL SCHEMATIC – 4-PORT MODULE



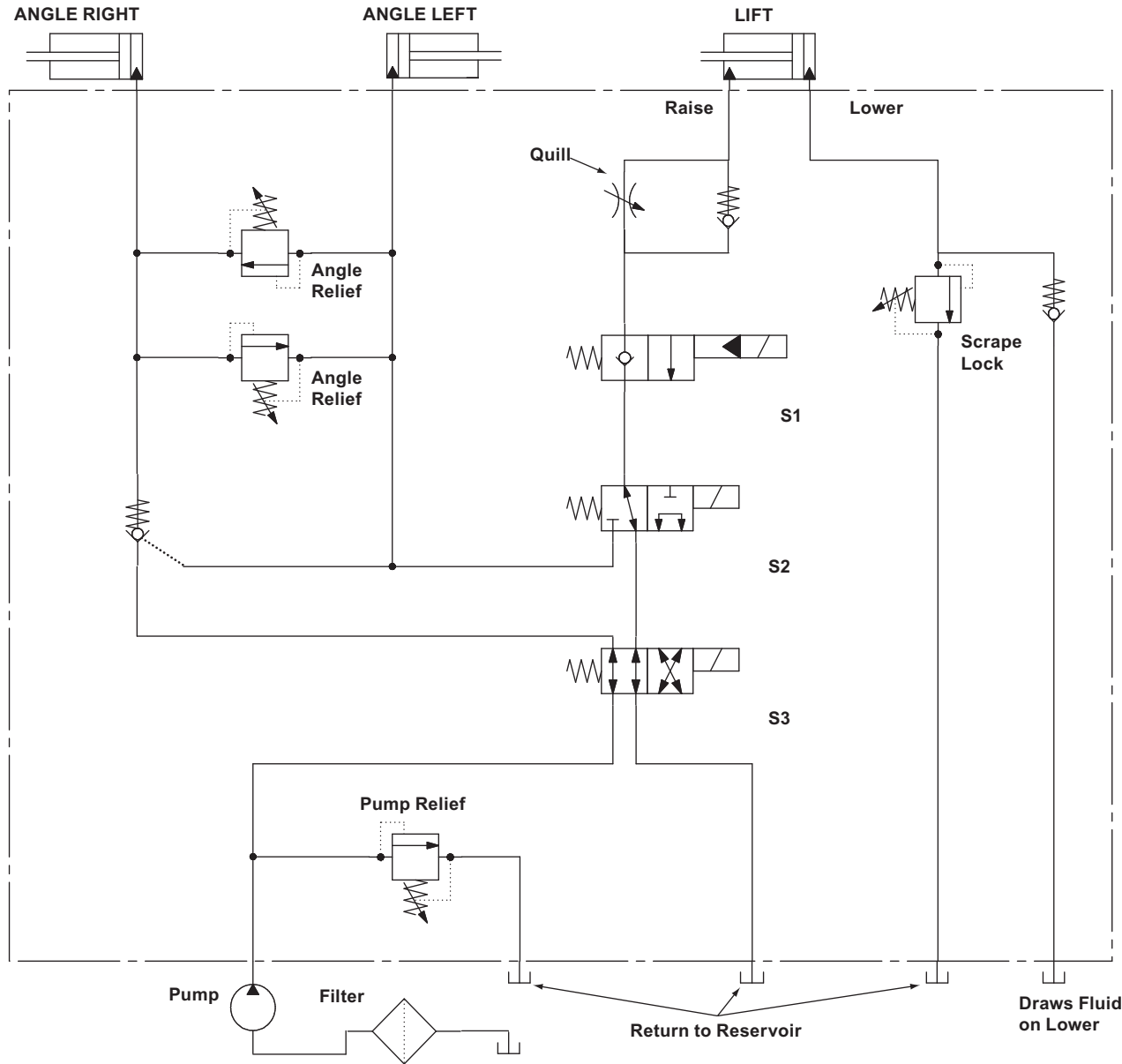
LOW BEAM HEADLAMPS WITH SNOWPLOW CONNECTED TO VEHICLE (4-PORT MODULE)



HIGH BEAM HEADLAMPS WITH SNOWPLOW CONNECTED TO VEHICLE (4-PORT MODULE)

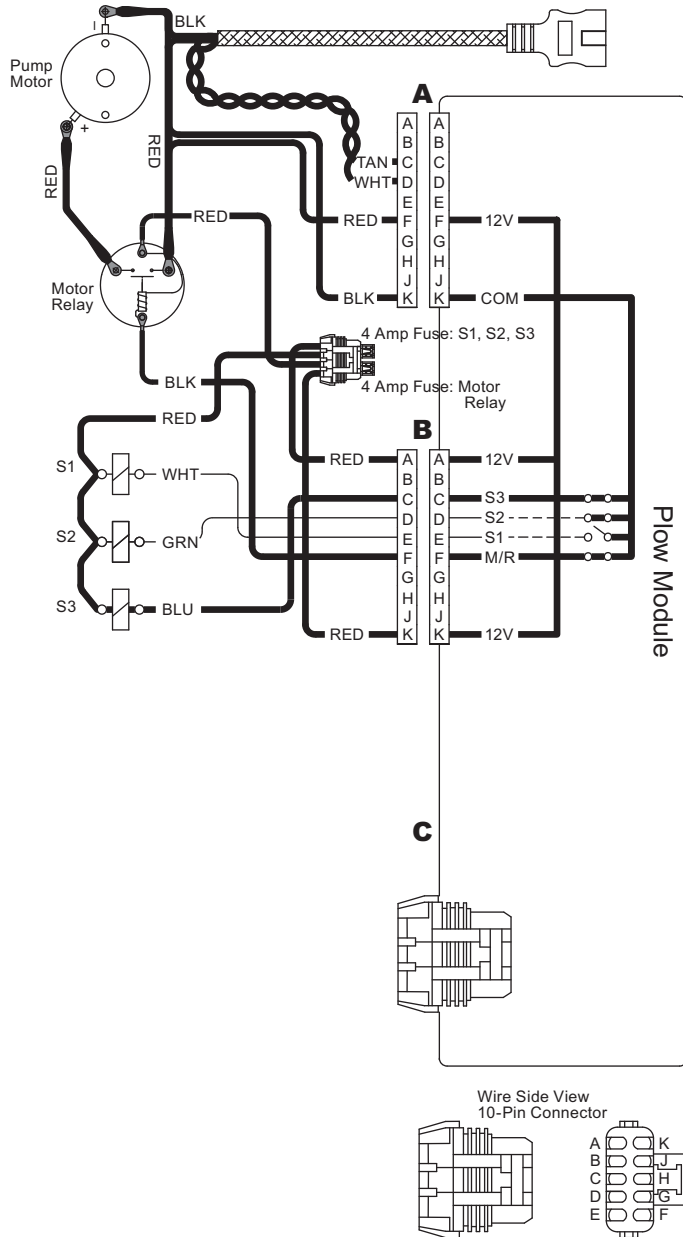


HYDRAULIC SCHEMATIC



BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		↔	↔
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON

RAISE – ELECTRICAL



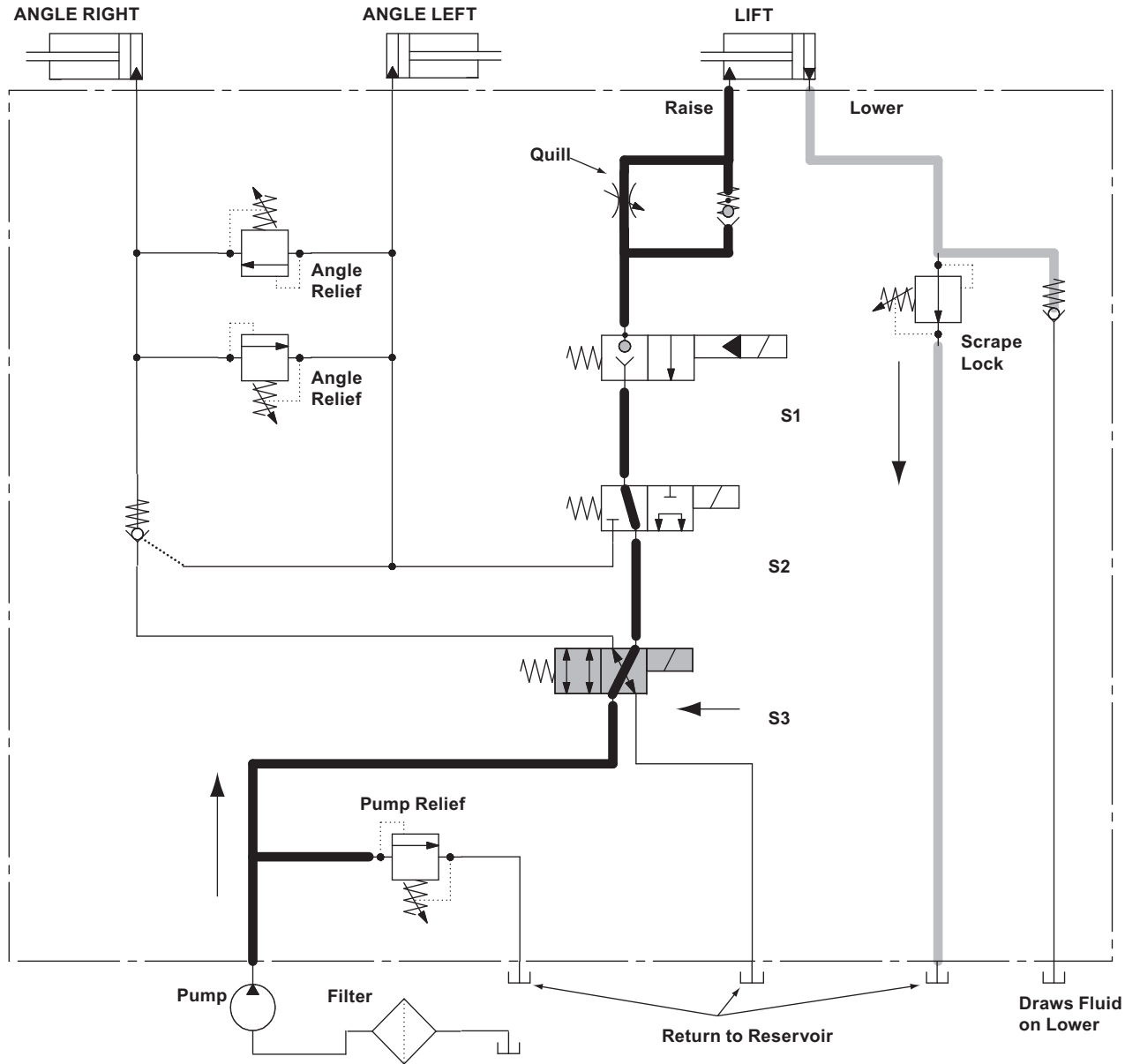
System Response

1. By activating the RAISE function on the cab control, the control sends a signal to the Plow Module to complete the **ground path** for the electrical circuit, activating the motor relay and solenoid cartridge valve S3.

2. Hydraulic fluid from the pump flows through the activated S3 and unactivated S2, through the internal check valve in S1, into the rod end of the lift ram, causing it to retract. At the same time, hydraulic fluid is being forced out of the base of the ram, through the scrape lock (RV4) relief valve and returned to the reservoir.

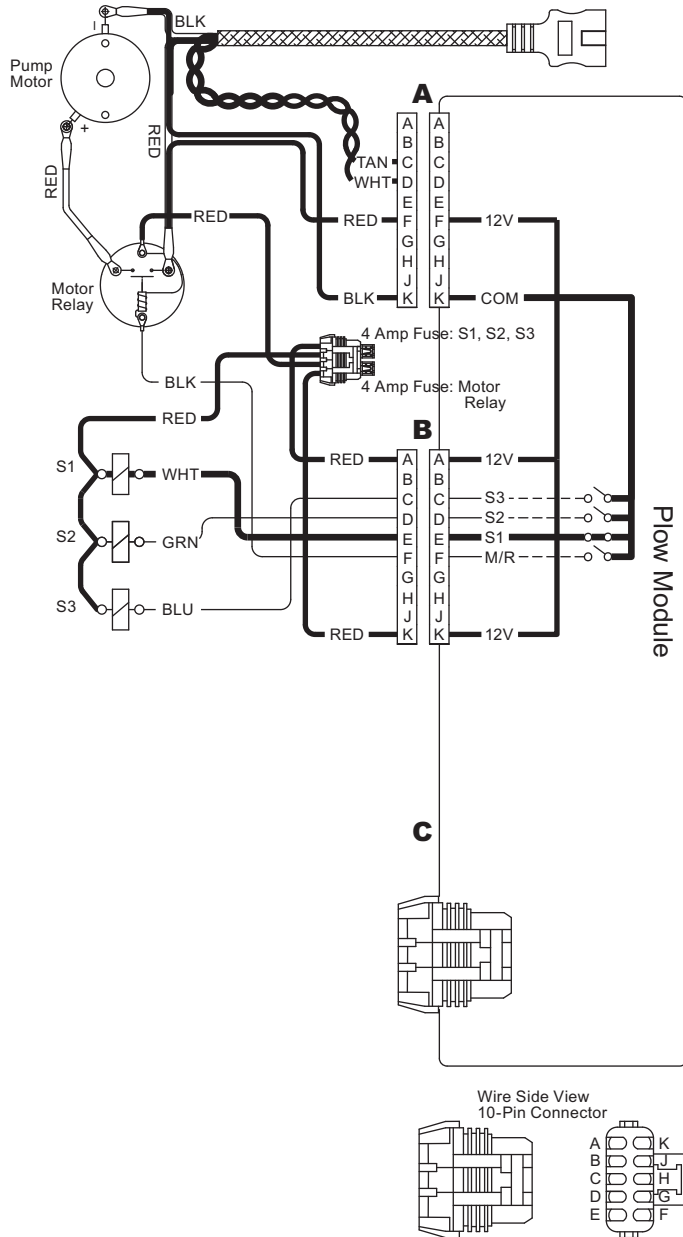
NOTE: Battery voltage is supplied to the plow module, the motor relay and the 3 solenoid coils when the snowplow is connected to the vehicle.

RAISE – HYDRAULIC



BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		↔	↔
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON

LOWER / FLOAT – ELECTRICAL



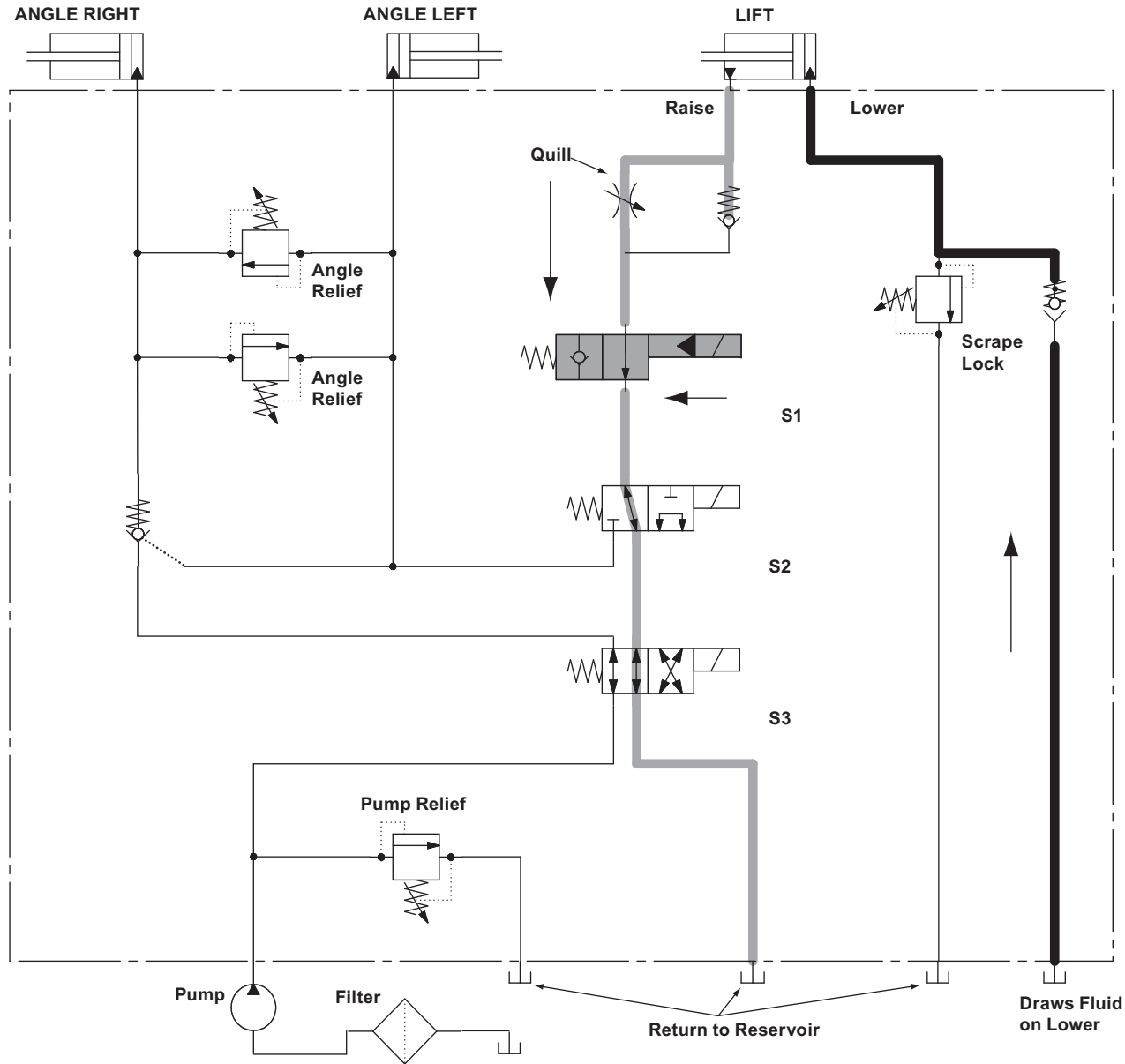
System Response

1. By activating the LOWER function on the cab control, the control sends a signal to the Plow Module to complete the **ground path** for the electrical circuit, activating solenoid cartridge valve S1.
2. With the weight of the snowplow on the rod end of the lift ram and S1 cartridge valve shifted, the lift ram extends. Hydraulic fluid is pushed out of the rod end, through activated S1, unactivated S2 and S3, and back to the reservoir. At the same time, hydraulic fluid is being drawn through CV2 into the base end of the ram from the reservoir.

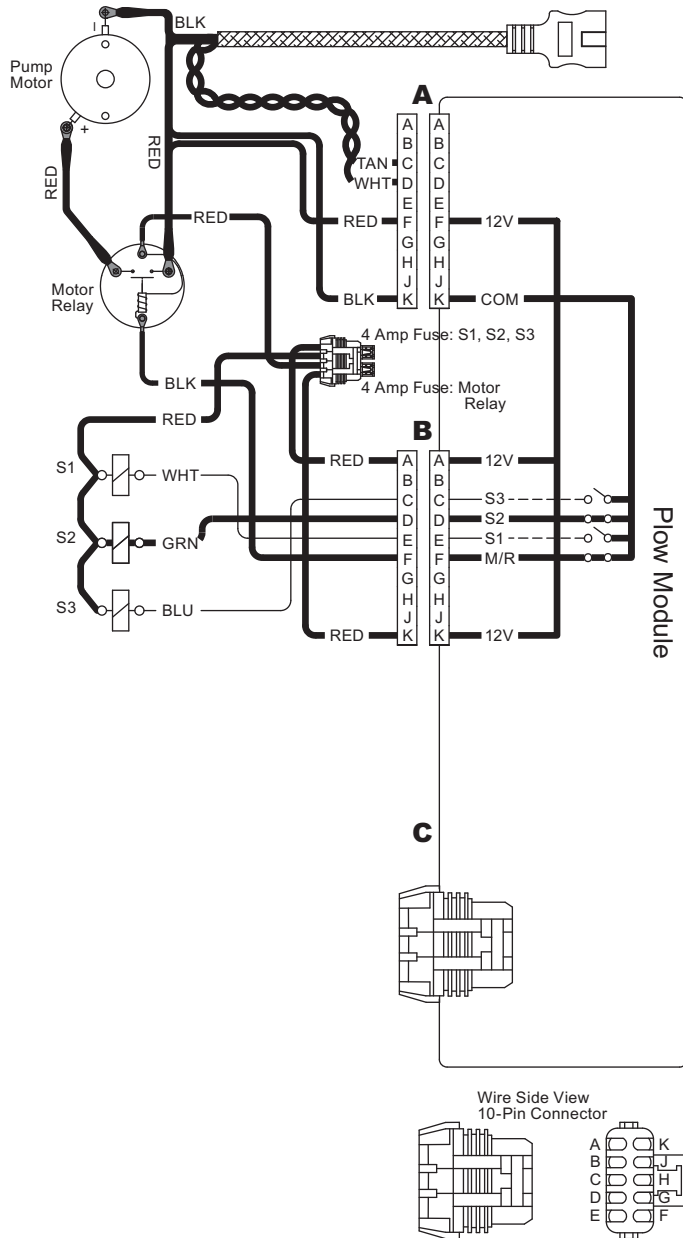
NOTE: When activating Float mode, the S1 cartridge stays open until the Raise function is activated.

NOTE: Battery voltage is supplied to the plow module, the motor relay and the 3 solenoid coils when the snowplow is connected to the vehicle.

LOWER – HYDRAULIC



ANGLE RIGHT – ELECTRICAL



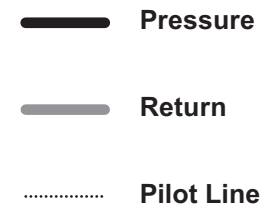
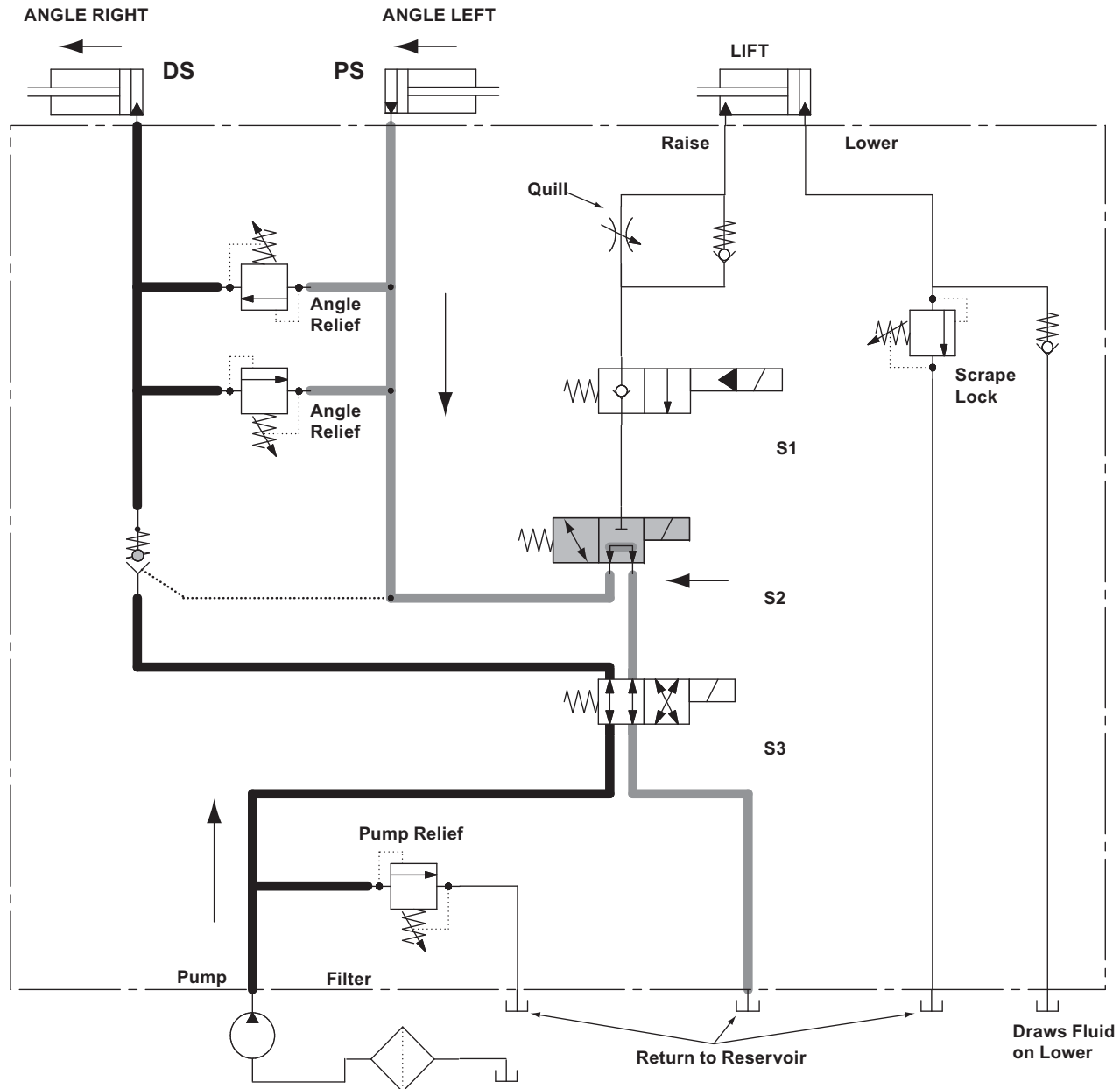
System Response

1. By activating the angle right (R on the control face) function on the cab control, the control sends a signal to the Plow Module to complete the **ground path** for the electrical circuit, activating the motor relay and solenoid cartridge valve S2.
2. Hydraulic fluid from the pump flows through unactivated S3, through PC1, into the base of the DS ram, causing it to extend.

3. The retracting PS ram pushes the hydraulic fluid out of its base end through the activated S2 cartridge and unactivated S3, back to the reservoir.

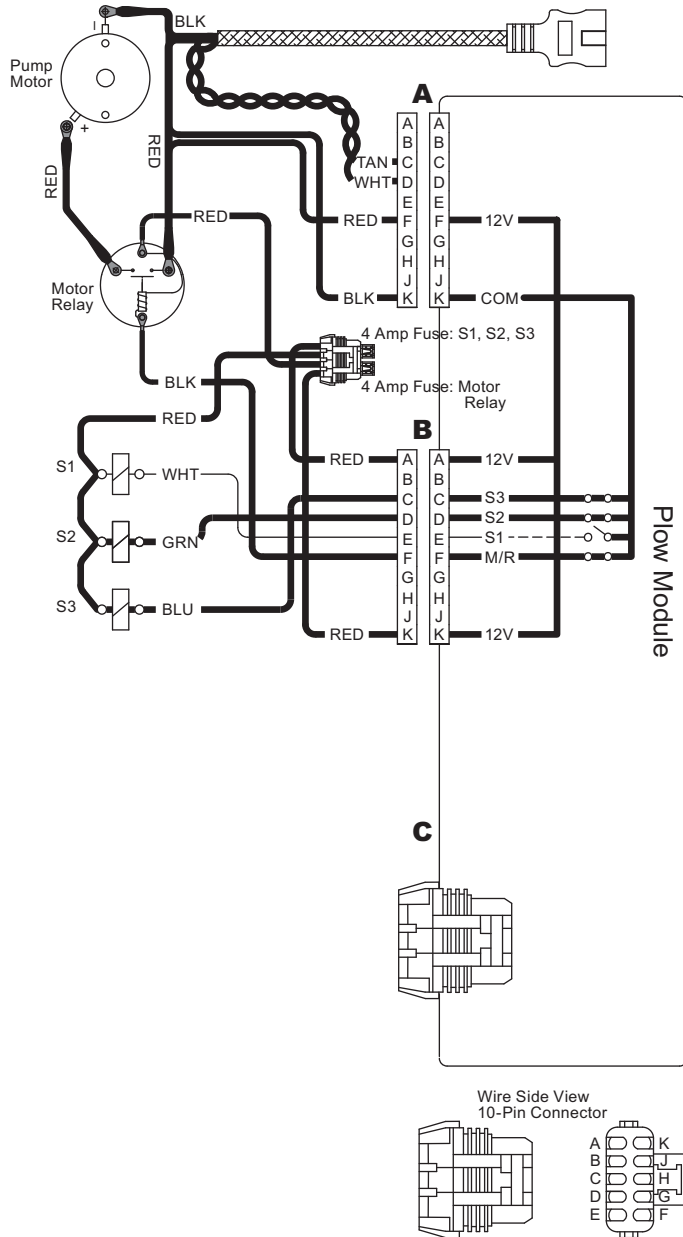
NOTE: Battery voltage is supplied to the plow module, the motor relay and the 3 solenoid coils when the snowplow is connected to the vehicle.

ANGLE RIGHT – HYDRAULIC



BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		ON	ON
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON

ANGLE LEFT – ELECTRICAL



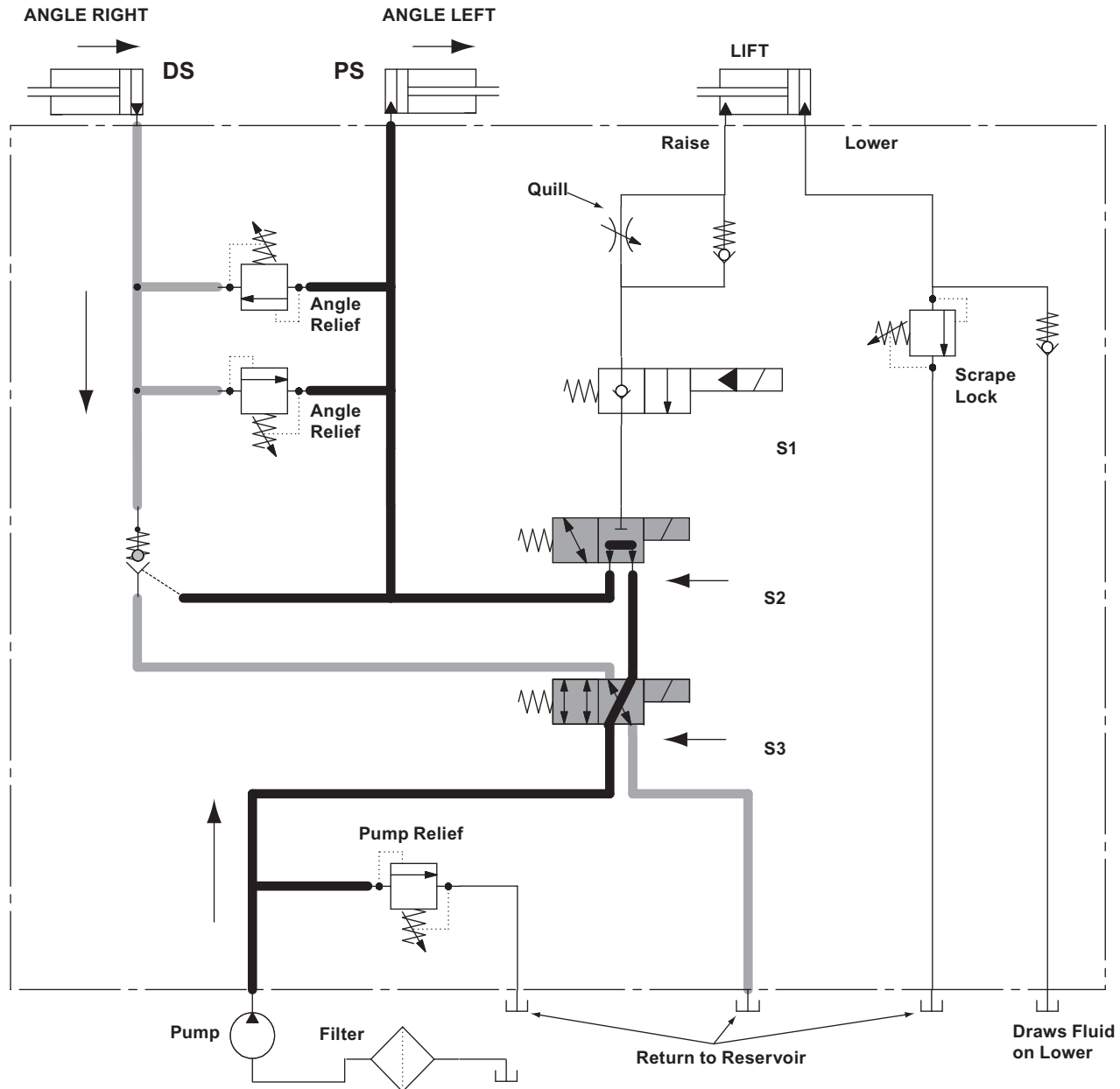
System Response

1. By activating the angle left (L on the control face) function on the cab control, the control sends a signal to the Plow Module to complete the **ground path** for the electrical circuit, activating the motor relay and solenoid cartridge valves S2 and S3.
2. Hydraulic fluid from the pump flows through activated S3 and S2 and into the base end of the PS ram, causing it to extend.

3. Pressure within the hydraulic circuit causes the P/O check valve (PC1) to open.
4. The retracting DS ram pushes the hydraulic fluid out of its base end through the open P/O check valve, through activated S3, and back to the reservoir.

NOTE: Battery voltage is supplied to the plow module, the motor relay and the 3 solenoid coils when the snowplow is connected to the vehicle.

ANGLE LEFT – HYDRAULIC



- Pressure**
- Return**
- Pilot Line**

BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		↔	↔
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON

HOLD IN RAISE POSITION – HYDRAULIC

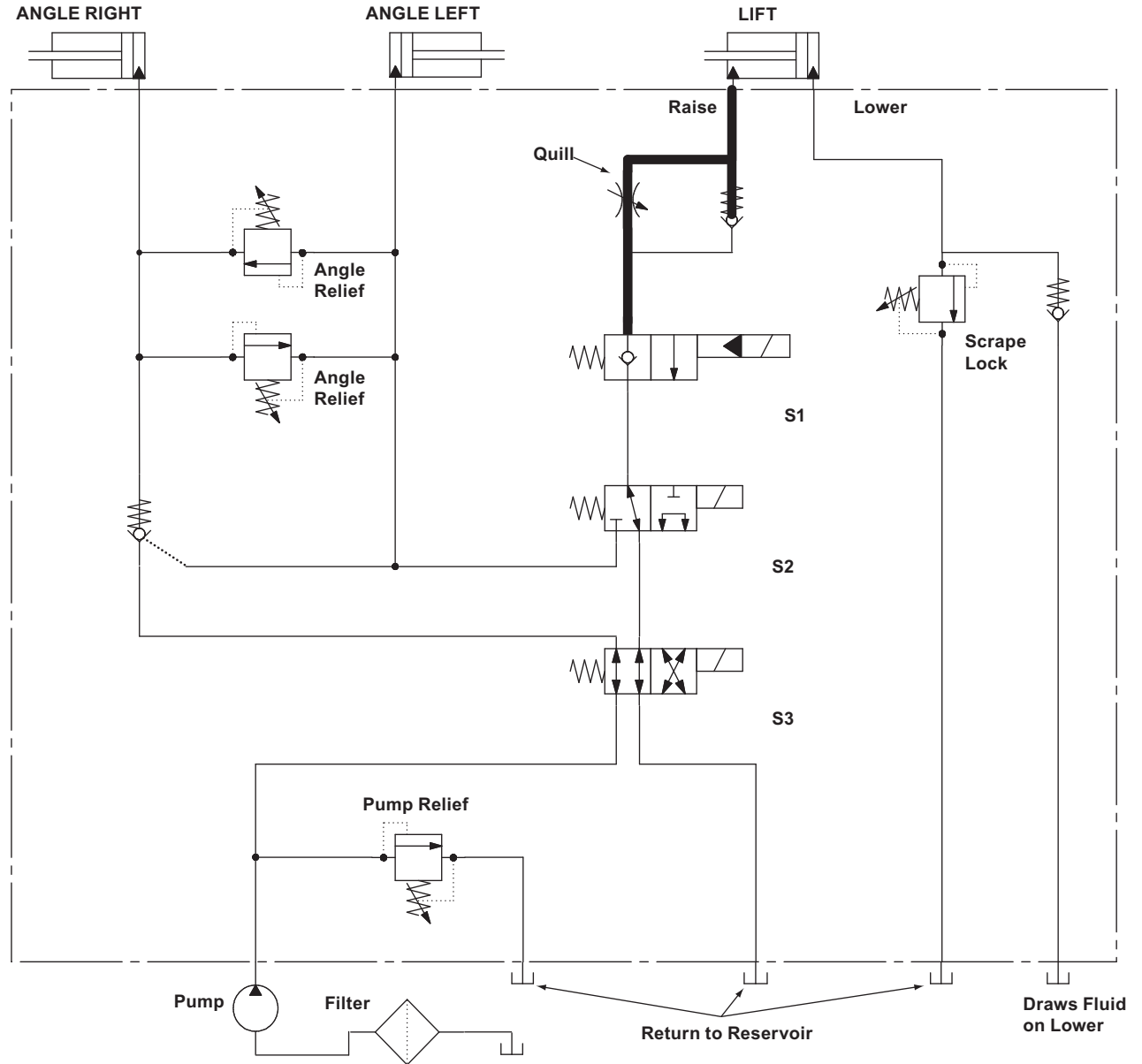
Control: None

System Response

- Hydraulic fluid is trapped in the rod end of the lift ram by the internal check valve in solenoid cartridge valves S1.

Pressure

BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		ON	ON
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON



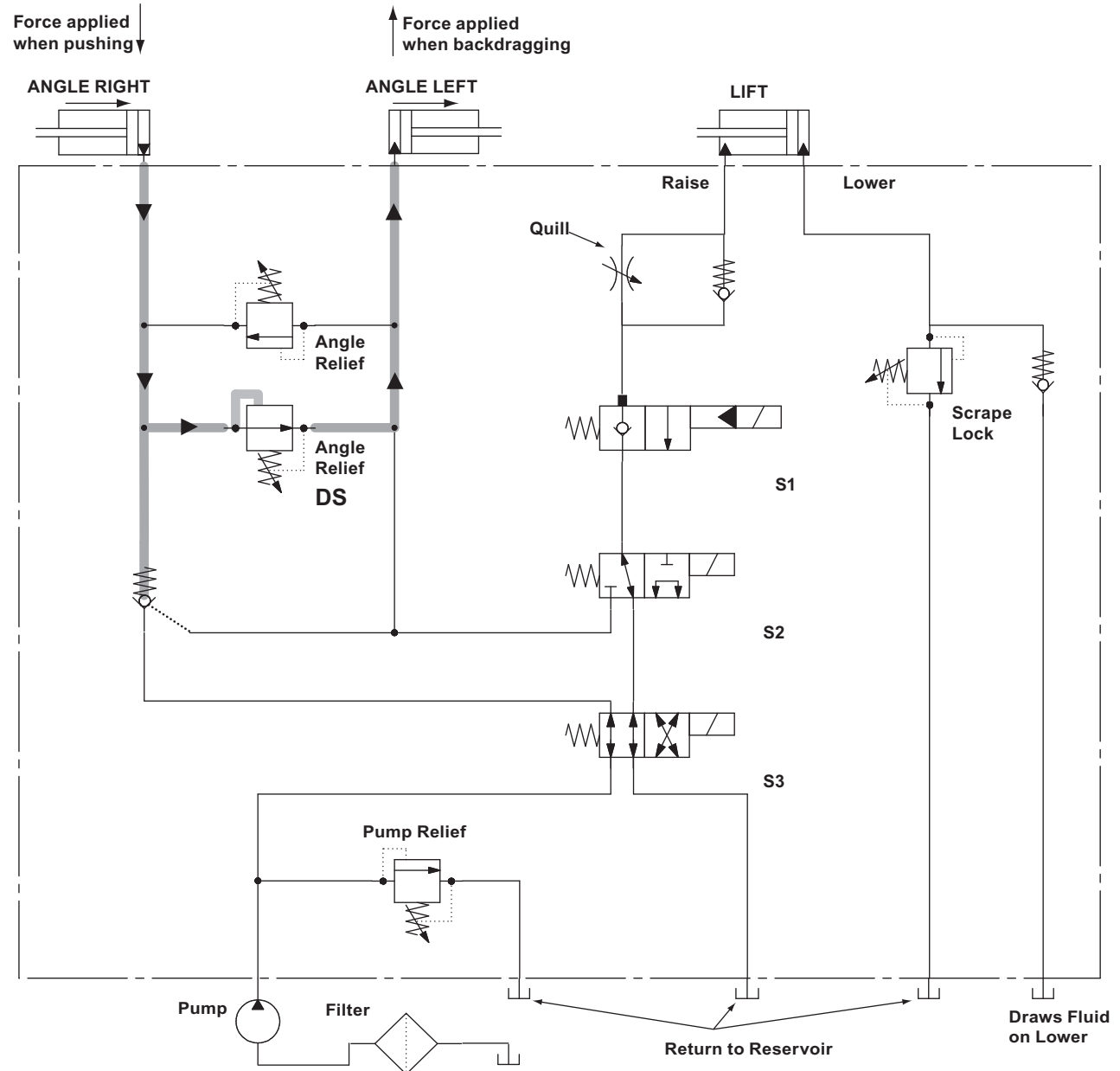
STRIKING AN OBJECT WHILE PLOWING

Blade Movement: Striking an Object While Plowing

Control: None

System Response:

1. Hydraulic fluid is trapped in the base end of the cylinders by the relief valves, the P/O check valve (PC1) and solenoid cartridge valve S2.
2. When the snowplow contacts an object, the force of the impact increases the hydraulic pressure in the base end of the cylinder. When the pressure exceeds the relief valve pressure setting, the relief valve opens allowing oil to flow to the base of the opposite cylinder.



BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		ON	ON
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON

STRIKING AN OBJECT WHILE PLOWING

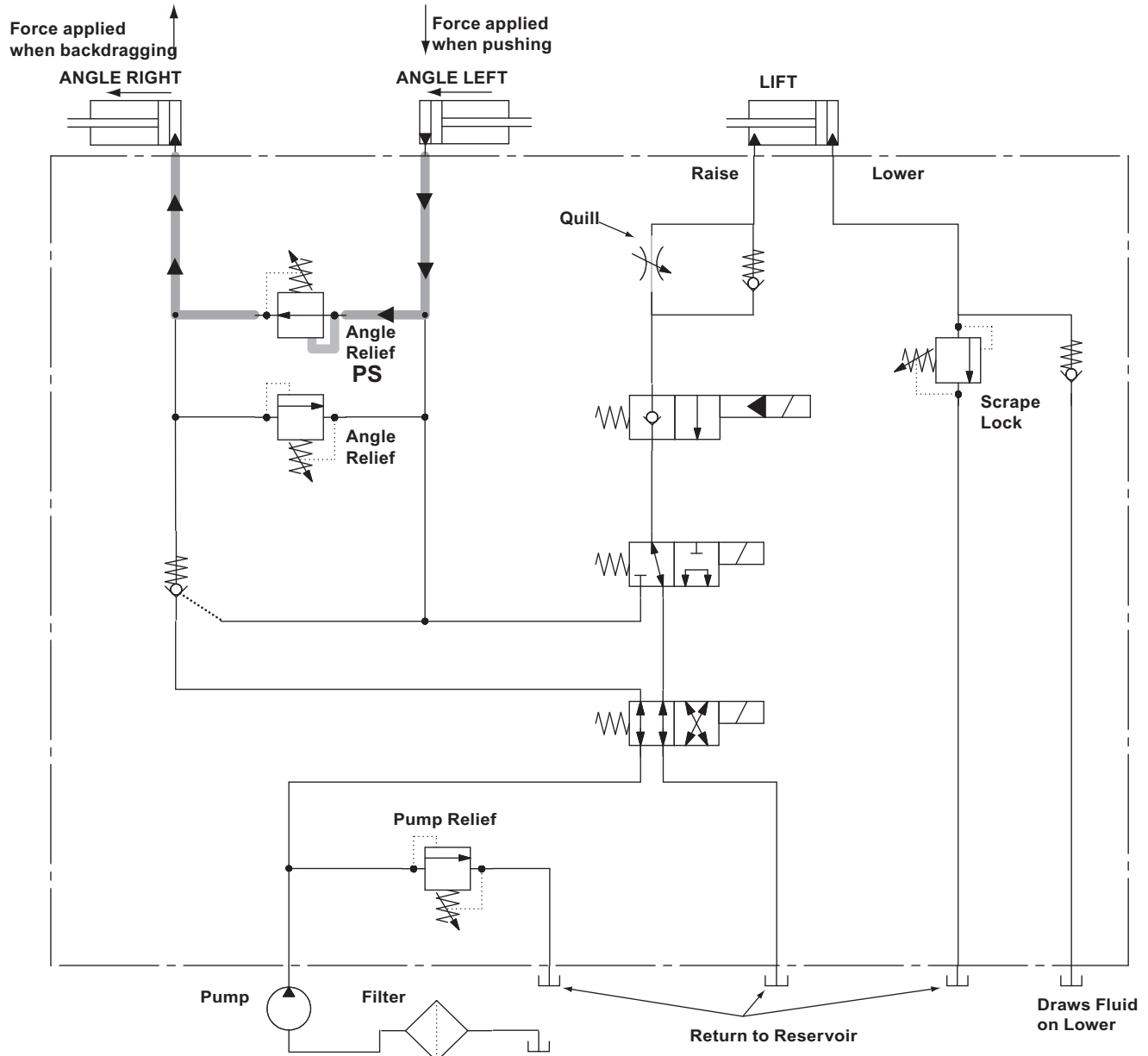
Blade Movement: Striking an Object While Plowing

Control: None

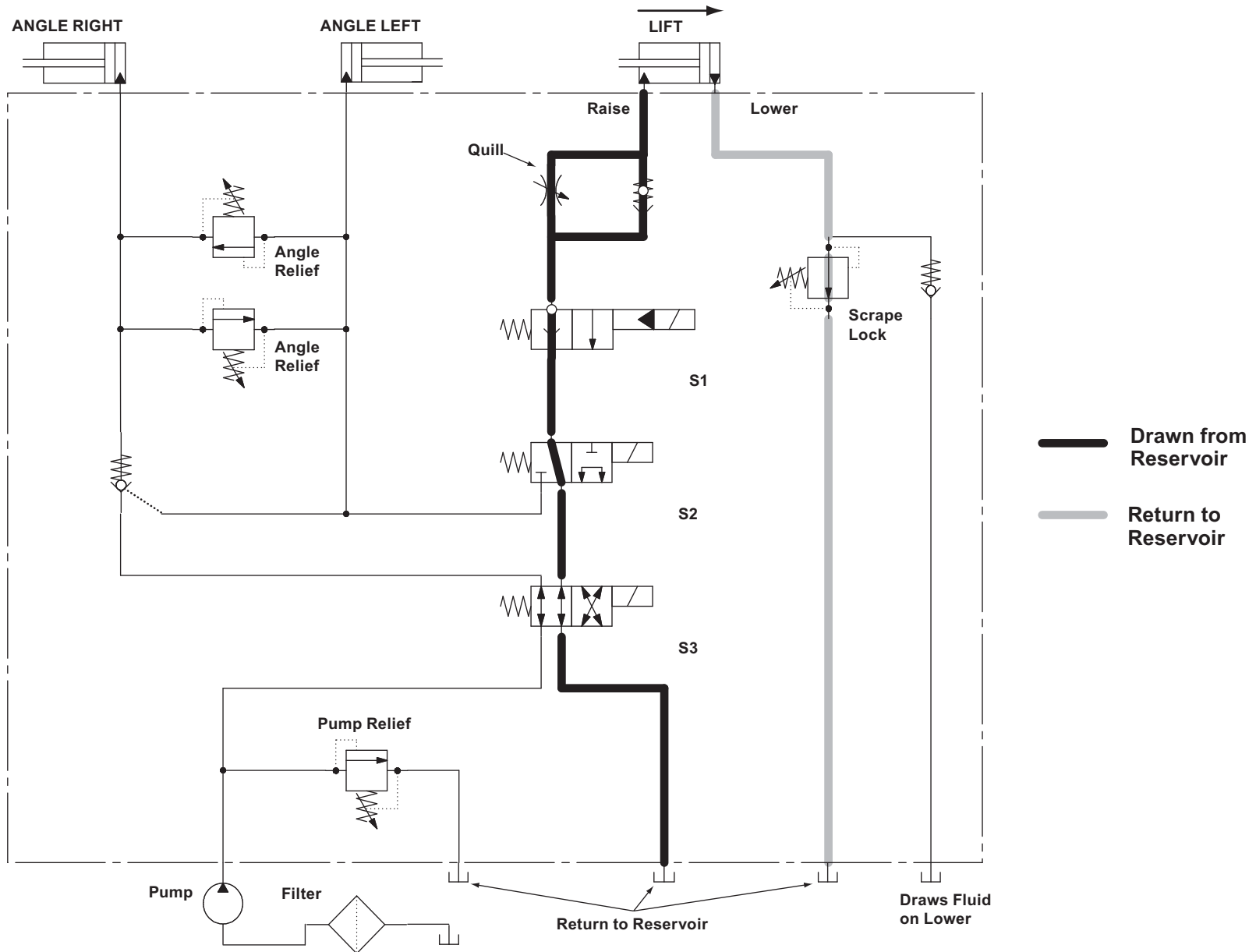
System Response:

1. Hydraulic fluid is trapped in the base end of the cylinders by the relief valves, the P/O check valve (PC1) and solenoid cartridge valve S2.
2. When the snowplow contacts an object, the force of the impact increases the hydraulic pressure in the base end of the cylinder. When the pressure exceeds the relief valve pressure setting, the relief valve opens allowing oil to flow to the base of the opposite cylinder.

BLADE MOVEMENT		RAISE	LOWER	ANGLE RIGHT	ANGLE LEFT
MOTOR	M	ON		ON	ON
SV08-2004	S1		ON		
SV08-31	S2			ON	ON
SV08-40	S3	ON			ON



SCRAPE LOCK OPEN (ALLOWS BLADE TO RAISE, FOLLOWING SURFACE CONTOUR)



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TROUBLESHOOTING GUIDE

INTRODUCTION

All malfunctions of the HTS™ snowplow can be categorized as structural, electrical or hydraulic. Structural issues are generally related to the blade, A-frame, lift frame and mount components and are usually identified by visual inspection. However, electrical and hydraulic issues can be difficult to trace.

Read and understand the Theory of Operation before attempting troubleshooting.

HOW TO USE THE TROUBLESHOOTING GUIDE

Because of the relative complexity of the snowplow electrical and hydraulic systems, some conditions must be eliminated in order to develop valid tests.

If the listed conditions are not met, the procedure can result in inaccurate results and wasted time.

In many cases, satisfying the listed conditions alone solves the problem.

1. Go to the Before You Begin section (next page), and satisfy the listed conditions. These conditions **must** be met before proceeding to any of the tables and tests that follow.
2. If a lighting problem exists, proceed to the proper Headlamp Troubleshooting tables for a list of basic test questions and solutions to common problems.

3. If still having problems or the problem is not related to the headlamps, go to the Hydraulic System Testing Section.
4. Follow along sequentially through the tables and tests, referring to the Hydraulic & Electrical Schematics and System Overview sections as needed. Eventually the problem can be identified at the component level.

ELECTRICAL TESTING

Read and understand the electrical circuit operation information in the Theory of Operation section. A simple 12-volt (12V) test light with a ground lead or volt meter can be used for circuit testing in most cases. The exception is the paired multiplex wiring, which carries a low level signal from the control to the plow module.

When directed to check for 12V, ground the test lamp lead or volt meter and probe the terminal. When asked to check for ground, attach the test lamp lead to +12V and probe the terminal.

NOTE: 12V is a nominal value. If using a voltmeter, actual voltage will vary with the vehicle and presence of loads in tested circuits. Continuity alone does not guarantee a good circuit. Poor connectors or damaged wires may have continuity but be unable to carry sufficient current.

TROUBLESHOOTING GUIDE

BEFORE YOU BEGIN

Before proceeding, or performing any tests, you *must* verify the following conditions:

1. **Verify** the customer has accurately and completely described the problem. Check all lighting and snowplow functions.
2. Check the **obvious**:
 - a. Snowplow is attached to vehicle and all harnesses are connected.
 - b. Ignition is turned on or engine is running if operating control from within the cab.
 - c. The control is connected in the cab and turned on. Verify that the control power LED is in a steady state and is not flashing. Verify that the snowplow anti-theft system is unlocked.
 - d. Fuses are good.
 - e. Vehicle battery and charging system are in good condition and battery connections are clean and tight.
 - f. Harness connector pins and terminals are free of corrosion, ensuring good connections, and coated with dielectric grease.

⚠ CAUTION
Fill the reservoir to within 2-1/2" from the top of the fill hole. Do not overfill. Overfilling could damage the unit.

⚠ CAUTION
Do not mix different types of hydraulic fluid. Some fluids are not compatible and may cause performance problems and product damage.

- g. Hydraulic reservoir is filled to proper level with recommended fluid when snowplow is in the lowered position and lift ram is fully retracted. See Product Specifications.
- h. There are no fluid leaks from hoses, fittings, rams or the hydraulic unit.
- i. Hoses are routed correctly.
- j. Coil wire connections are secure and correct.
- k. Correct cartridges are installed in the proper locations. This step may be better left until the results of the SCAT test are known, unless hydraulic repair or cartridge replacement took place recently.

TROUBLESHOOTING GUIDE

VEHICLE HEADLAMPS

Incorrect Operation or No Headlamps

	BASIC CHECK QUESTIONS	SOLUTIONS
1	DRL mode/automatic headlamp function	Fully understand OEM headlamp operation; refer to vehicle owner's manual.
2	Correct Isolation Module kit installed for application	Verify per Quick Match at www.westernplows.com .
3	OEM lights operating correctly prior to installation	OEM headlamps must be fully operational for correct Isolation Module operation.
4	OEM fuse tests good	Replace with proper fuse.
5	OEM headlamp bulb operational	Replace with proper bulb.
6	Plugged into OEM headlamp correctly	Connect per Isolation Module instructions.
7	Harnesses in correct location at Isolation Module and installed per installation instructions	Install using Isolation Module instructions.
8	Harnesses configured correctly for HB-1/HB-5 and/or kits using adapters	Install using Isolation Module instructions.
9	Configuration plug correct (only required on certain 4-Port Module installations)	Refer to Isolation Module instructions.
10	Correct harnesses and/or Isolation Module in kit	Refer to Isolation Module parts list.
11	Harness wired per drawing	See electrical schematics in this guide.
12	Verify power and ground in proper pin locations at Isolation Module	See electrical schematics in this guide.
13	Verify power and ground in proper pin locations to vehicle headlamp	See electrical schematics in this guide.
14	Test Isolation Module with Isolation Module tester	Test using instructions supplied with tester.

TROUBLESHOOTING GUIDE

SNOWPLOW HEADLAMPS

Incorrect Operation or No Headlamps

	BASIC CHECK QUESTIONS	SOLUTIONS
1	DRL mode/automatic headlamp function correctly	Fully understand OEM headlamp operation; refer to vehicle owner's manual.
2	Harnesses connected between vehicle and snowplow (all)	Harnesses must be connected for all snowplow and headlamp functions.
3	Harness connectors clean / not corroded	Replace as needed.
4	Ignition on	Ignition switch or vehicle park lights must be "ON" for snowplow headlamps to operate.
5	Control powers up with key on	Go to Control/Cable/Plow Module Test .
6	Correct Isolation Module kit installed for application	Verify per Quick Match at www.westernplows.com .
7	OEM lights operating correctly prior to installation	OEM headlamps must be fully operational for correct Isolation Module operation.
8	OEM fuse tests good	Replace with proper fuse.
9	Bulb burned out	Replace with proper bulb.
10	Plugged into OEM headlamp correctly	Connect per Isolation Module instructions.
11	Harnesses in correct location at Isolation Module and installed per installation instructions	Install using Isolation Module instructions.
12	Harnesses configured correctly for HB-1/HB-5 and/or kits using adapters	Install using Isolation Module instructions.
13	Configuration plug correct (only required on 4-Port Module)	Refer to Isolation Module instructions.
14	Correct harnesses and/or Isolation Module	Refer to Isolation Module parts list.
15	Harness wired per drawing	See electrical schematics in this guide.
16	Verify power and ground in proper pin locations at Isolation Module	See electrical schematics in this guide.
17	Verify power and ground in proper pin locations to vehicle headlamp	See electrical schematics in this guide.
18	Isolation Module operating correctly	Test using instructions supplied with tester.

TROUBLESHOOTING GUIDE

SNOWPLOW PARK/TURN LAMPS*

Incorrect Operation or No Park/Turn Lamps

BASIC CHECK QUESTIONS		SOLUTIONS
1	OEM park/turn lamps working	Refer to vehicle owner's manual for fuse location and size.
2	Harnesses connected between vehicle and snowplow (all)	Harnesses must be connected for all snowplow and headlamp functions.
3	Clean harness connectors	Replace as needed.
4	Ignition on	Ignition must be "ON" for snowplow headlamps to operate.
5	Control powers up with key on	Go to Control/Cable/Plow Module Test .
6	15-amp park/turn fuse good in #1 harness	Replace with proper fuse.
7	Black/orange "ground" wire connected to motor ground stud **	Refer to Isolation Module instructions.
8	Spliced into OEM park/turn circuit correctly	Refer to Isolation Module instructions.
9	Harnesses in correct location at Isolation Module and installed per installation instructions	Install using Isolation Module instructions.
10	Harness wired per drawing	See electrical schematics in this guide.
11	Verify power and ground in proper pin locations at Isolation Module	See electrical schematics in this guide.
12	Verify power and ground in proper pin locations to vehicle headlamp	See electrical schematics in this guide.
13	Bulb good	Replace with proper bulb.

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* Some applications may use the turn circuit for DRLs.

** Not applicable to NIGHTHAWK™ headlamps.

TROUBLESHOOTING GUIDE

SNOWPLOW DRL LAMPS*

Incorrect Operation or No DRL Lamps

	BASIC CHECK QUESTIONS	SOLUTIONS
1	Fully understand OEM DRL operation	Refer to vehicle owner's manual for DRL operation.
2	OEM headlamps and DRLs operating correctly	OEM headlamps must be fully operational for correct Isolation Module operation.
3	OEM DRL fuse tests good	Refer to vehicle owner's manual for fuse location and size.
4	Harnesses connected between vehicle and snowplow (all)	Harnesses must be connected for all snowplow and headlamp functions.
5	Corrosion at harness connectors	Replace as needed.
6	Ignition on	Ignition must be "ON" for snowplow DRL operation.
7	Does control power up with key on	Go to Control/Cable/Plow Module Test .
8	Snowplow headlamp and park/turn lamps all working correctly	See electrical schematics in this guide.
9	Correct Isolation Module kit installed for application	Verify per Quick Match at www.westernplows.com .
10	Isolation Module and harnesses correctly installed per instructions	Refer to Isolation Module instructions.
11	Harness wired per drawing	See electrical schematics in this guide.
12	Bulb burned out	Replace with proper bulb.

* Snowplow DRLs operate as a series circuit and will illuminate bulb at 1/2 intensity. In some applications, the OEM DRLs will stay illuminated with snowplow attached.

TROUBLESHOOTING GUIDE

SOLENOID COIL ACTIVATION TEST (SCAT)

NOTE: See the System Overview – Controls section for details on control time outs and wing functions.

The main purpose of the SCAT test is to narrow down a problem as either being electrical or hydraulic. Follow the steps below to diagnose the problem, then go to the appropriate test as directed.

1. Verify that harness B is properly attached to the solenoid coils. Refer to the labels on the hydraulic unit and the electrical schematics in this guide for details.
2. Install the Diagnostic Harness (PN 29290 or PN 29290-1) according to the instructions on the following pages.
3. When instructed to do so, perform the SCAT test by activating the control for each function and checking for magnetic pull at all three solenoid coils. A solenoid coil is magnetized if a screwdriver held nearby is attracted.

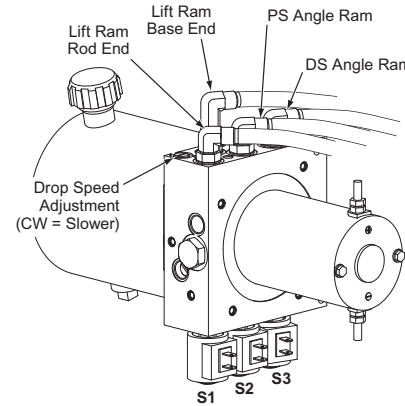
4. Compare the SCAT test results with the testing charts on the following pages.

If the motor relay LED is not activating when it should, go to the Motor and Motor Relay Test.

If a coil(s) is not magnetizing when it should be, you have an electrical problem. Using a test light, check the ground wires (not red) attached to the improperly acting coil(s) for switched ground while activating the function that should energize the coil(s). If switched ground is not present, go to the Control/Cable/Plow Module Test. If switched ground is present, go to the Individual Solenoid Coil Test.

5. **If the motor relay and all coils are working properly**, you have a hydraulic problem. Go to the Hydraulic System Test.

Harness B Solenoid Coil Connections



Solenoid Valve	S1	S2	S3
Valve Type	2-Way	3-Way	4-Way
Wire Color	White & Red	Green & Red	Blue & Red
Plow Function	Active Coil	Active Port	
Raise	S3	Lift Ram, Rod End	
Lower/Float	S1	Lift Ram, Rod End	
Angle Right	S2	DS Angle Ram	
Angle Left	S2 & S3	PS Angle Ram	
Torque Specifications			
All Solenoid/Check Valves:		19–21 ft-lb	
All Solenoid Coil Nuts:		48–60 in-lb	
Motor Relay Terminals:		Small 10–15 in-lb	
Motor Terminals:		Large 25–35 in-lb	
		25–35 in-lb	

TROUBLESHOOTING GUIDE

SOLENOID COIL ACTIVATION TEST (SCAT)

NOTE: This MUX-plow diagnostic harness kit can be used with or without the snowplow connected to a vehicle. Follow the appropriate instructions for each testing situation.

⚠ WARNING

Lower blade when vehicle is parked. Temperature changes could change hydraulic pressure, causing the blade to drop unexpectedly or damaging hydraulic components. Failure to do this could result in serious personal injury.

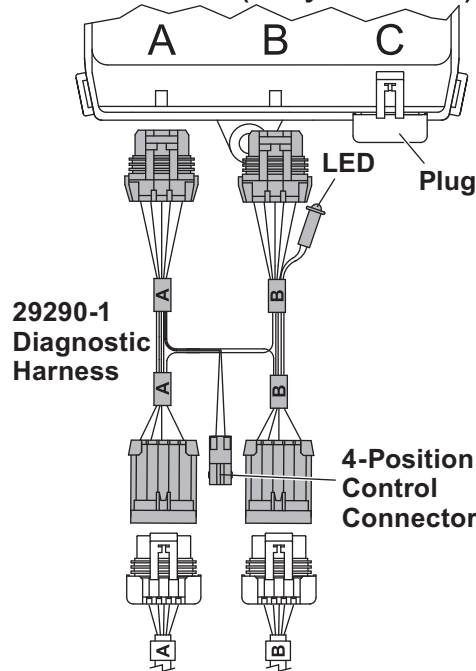
On-Truck Testing

Remove the vehicle ignition key and put the vehicle in park or in gear to prevent others from starting the vehicle during testing.

1. Disconnect the snowplow and vehicle battery cables, then remove the hydraulic unit covers.

2. Unplug the snowplow connectors from Ports A and B of the Plow Module.

Plow Module (on hydraulic unit)



3. Connect the diagnostic harness connectors A and B to the matching ports on the Plow Module (A to A and B to B).

4. Plug the connectors removed from the Plow Module into the matching connectors on the diagnostic harness (A to A and B to B).

5. Connect the snowplow control into the 4-position control connector either in the cab of the vehicle or on the diagnostic harness.

6. Reconnect the snowplow and vehicle battery cables.

NOTE: If you connect the control inside the cab of the vehicle, the engine does not need to be running, but the vehicle ignition key must be turned to the "ON" position before proceeding. If you connect the control to the diagnostic harness, the key should be left out of the ignition.

7. Turn the snowplow control "ON" and perform a SCAT test. See the following chart for solenoid numbers and functions. See the beginning of this section for instructions on performing a SCAT test.

NOTE: The green LED on the diagnostic harness will illuminate when the motor relay function is activated. This light only tests the Plow Module's motor relay output. Refer to Motor and Motor Relay Test Section for instructions on properly testing a motor relay.

Solenoid Coil Activation Test (SCAT) Chart	
Control Function	Component(s) Activated
Raise	S3 Motor Relay
Lower	S1
Angle Right	S2, Motor Relay
Angle Left	S2, S3, Motor Relay

8. After completing the SCAT test, turn the snowplow control and the vehicle ignition "OFF", then disconnect the snowplow and vehicle battery cables.

9. Perform any required repairs and retest as needed. Make sure to disconnect the snowplow and vehicle battery cables before removing the diagnostic harness.

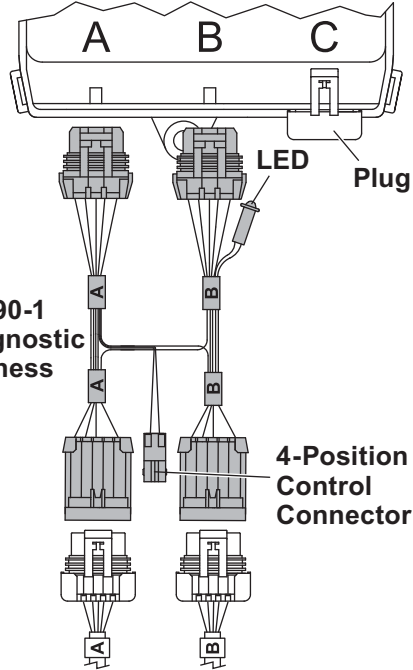
TROUBLESHOOTING GUIDE

SOLENOID COIL ACTIVATION TEST (SCAT)

Off-Truck Testing

1. Remove the hydraulic unit covers.
2. Unplug the snowplow connectors from Ports A and B of the Plow Module.

Plow Module (on hydraulic unit)



3. Connect the diagnostic harness connectors A and B to the matching ports on the Plow Module (A to A and B to B).

4. Plug the connectors removed from the Plow Module into the matching connectors on the diagnostic harness (A to A and B to B).

5. Connect the snowplow control into the 4-position control connector on the diagnostic harness.

6. Connect a 12V power source to the snowplow battery cable (POSITIVE [+] 12V to the red wire and NEGATIVE [-] to the black wire). Turn on the power source.

7. Turn the snowplow control "ON" and perform a Solenoid Coil Activation Test (SCAT). See the following chart for solenoid numbers and functions. See the beginning of this section for instructions on performing a SCAT test.

NOTE: The green LED on the diagnostic harness will illuminate when the motor relay function is activated. This light only tests the Plow Module's motor relay output. Refer to Motor and Motor Relay Test Section for instructions on properly testing a motor relay.

Solenoid Coil Activation Test (SCAT) Chart	
Control Function	Component(s) Activated
Raise	S3 Motor Relay
Lower	S1
Angle Right	S2, Motor Relay
Angle Left	S2, S3, Motor Relay

8. After completing the SCAT test, turn the snowplow control "OFF" and disconnect the power source.
9. Perform any required repairs and retest as needed. Make sure to disconnect the power source before removing the diagnostic harness.

INDIVIDUAL SOLENOID COIL TEST

1. Remove both wires from coil terminals.
2. Attach an ohmmeter across the coil terminals.
3. A reading that is not approximately 7 ohm indicates coil is damaged and must be replaced.
4. Attach an ohmmeter to one coil terminal and to the steel washer at the end of the coil.
5. A reading that is not "open" indicates that the coil has an internal short and needs to be replaced.
6. If both readings are OK (i.e., approximately 7 ohm across terminals *and* "open" between terminal and washer), then the coil is good.

NOTE: A good coil will draw approximately 1.5 Amp.

TROUBLESHOOTING GUIDE

CONTROL/CABLE/PLOW MODULE TEST

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Control power light is not on.	Snowplow is not connected	<ul style="list-style-type: none"> • Make sure grille plugs between snowplow and truck are properly connected.
	Incomplete harness connection(s) or damaged harness(es)	<ul style="list-style-type: none"> • With the vehicle switched accessory on, test the 4-pin connector inside the cab. If pin 1 does not have 12V and/or if pin 4 does not have ground, use the electrical schematic in this guide to trace the wires from the connector back to their source. Look for incomplete connections or damaged wires. Complete connections or repair/replace damaged wires and harnesses as needed.
	Single-pin connector on vehicle plow lighting harness is not connected.	<ul style="list-style-type: none"> • Make sure single-pin connector on vehicle plow lighting harness is properly connected.
	Harnesses connected to Isolation Module incorrectly.	<ul style="list-style-type: none"> • Using the electrical schematic in this guide, verify that Isolation Module and harnesses are properly connected.
	Control fuse is blown.	<ul style="list-style-type: none"> • Replace all blown fuses in under-hood electrical harnesses.
Control power light is blinking (slow flash).	Poor Connection between control and module, Damaged Control or Damaged Plow Module	<ul style="list-style-type: none"> • Make sure all plugs (control, between the snowplow and truck, on the snowplow, etc.) are properly connected. • Check continuity of twisted pair wiring between control connector and plow module connector. • If all plugs are properly connected, install a properly working control. If problem is corrected, replace PC board and/or coiled cord in damaged control. • If problem is not corrected with properly working control, replace Plow Module.
Control power light is blinking (fast).	Snowplow is locked	<ul style="list-style-type: none"> • Enter 4-digit security code to unlock snowplow.
Control power light is on, but snowplow does not respond.	Harnesses connected to Isolation Module incorrectly.	<ul style="list-style-type: none"> • Using the electrical schematic in this guide, verify that Isolation Module harnesses are properly connected.
	Blown fuse or Damaged Plow Module	<ul style="list-style-type: none"> • Replace all blown fuses on truck and snowplow. • If fuses are all okay, check for 12V at all coils and primary terminal of motor relay. If 12V is missing from any coil or relay, replace Plow Module. If 12V is present, go to next Possible Cause.
	Damaged harness(es) or cable(s)	<ul style="list-style-type: none"> • Perform a Solenoid Coil Activation Test (SCAT) according to the instructions in this guide. Replace/repair any damaged harnesses and cables.
	Damaged control or Plow Module	<ul style="list-style-type: none"> • Install a properly working control. If problem is corrected, replace PC board and/or coiled cord in damaged control. • If problem is not corrected with properly working control, replace Plow Module.

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To Safely Handle PCB:

⚠ CAUTION
Circuit board may be damaged by static electricity. Always touch ground before handling PC board.

Before disassembling control and touching the PC board, be sure to remove any static charge from yourself. Static charge can build up as a technician works on the control. Best practice is to work at a properly grounded work station with

a grounded wrist strap attached to the technician. In place of proper work station, the technician should work in an oil and solvent free area and touch a good ground each time before touching the PC board while servicing the unit.

Handle the PC board by the edges only.

Do not touch the carbon (black) areas of the keypad. Your skin oils will deteriorate the contact area.

TROUBLESHOOTING GUIDE

MOTOR AND MOTOR RELAY TEST

⚠ WARNING

Keep 8' clear of the blade when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of the blade. If the blade hits or drops on you, you could be seriously injured.

Perform this test if the control lights up and/or turns on, but the motor does not run.

1. Check the motor relay fuse on harnesses B. Replace if fuse is blown, then retest snowplow.
2. Remove the coil fuse F1 in harness B. Remove the 8" red battery cable from the large terminal of the motor relay and isolate it. Removing the fuses and isolating the battery cable will eliminate the potential of accidental blade movement during testing.

3. Check for 12V at the small terminal of the motor relay with the red wire attached to it. If 12V is not present, recheck the coil fuse F2 in harness B. If the fuse is good, check the red wire in harness B. Replace/repair either the wire or the harness as needed.

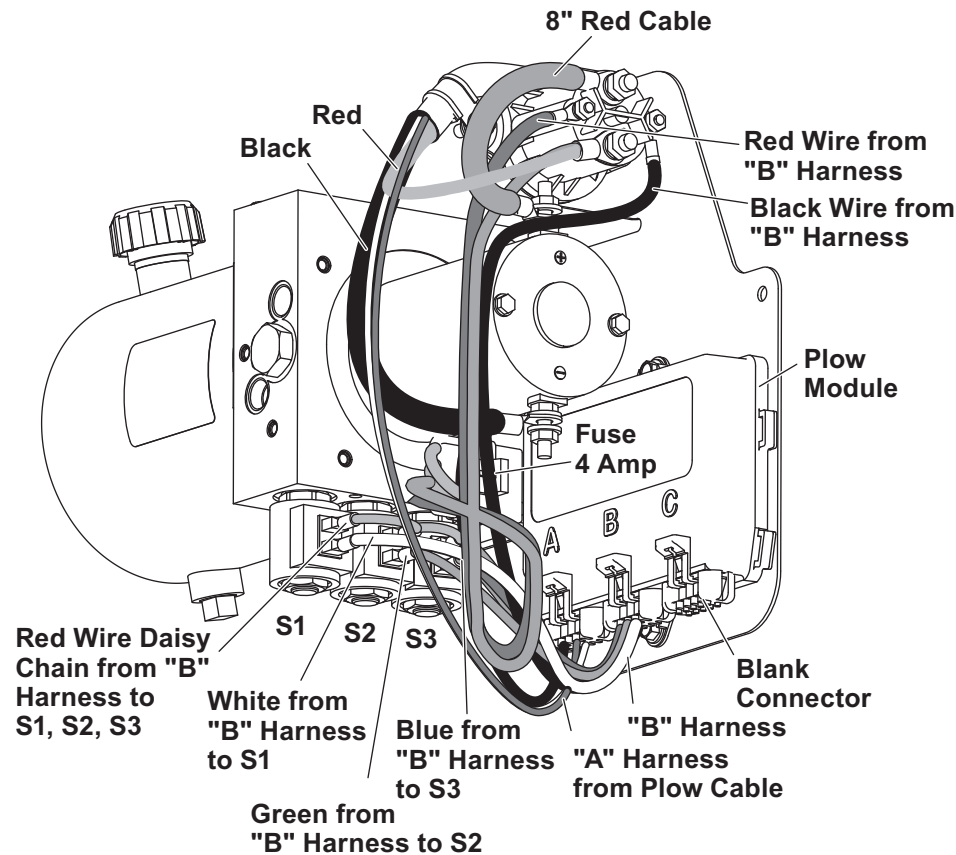
4. If 12V is present at the small relay terminal with the red wire, turn the control ON, then check for switched ground on the small terminal with the black wire attached to it while activating any function except lower. If switched ground is not present, check the

black wire in harness B of the plow module. Replace/repair either the wire or the harness as needed.

5. Check for switched 12V at the empty large motor relay terminal while activating any control function except lower. The empty terminal is the terminal that would normally contain the 8" red battery cable. If switched 12V is not present, replace the motor relay.

6. If switched 12V is present at the empty large motor relay terminal, replace the motor.

7. Once repair/testing is completed, reinstall fuses and 8" red battery cable, then retest snowplow.



* See wire stamping for fuse identification.

TROUBLESHOOTING GUIDE

PUMP PRESSURE TEST

⚠ WARNING

Keep 8' clear of the blade when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of the blade. If the blade hits or drops on you, you could be seriously injured.

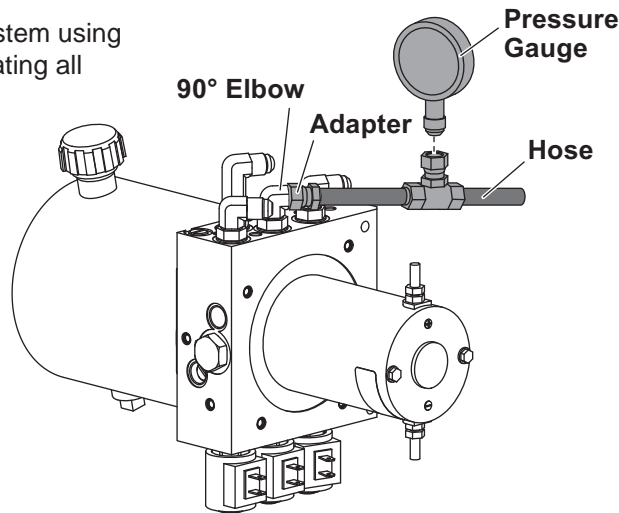
NOTE: Reservoir will contain residual pressure. Slowly remove, then reinstall, breather to release pressure before proceeding.

1. Verify proper fluid level before beginning test.
2. Relieve pressure in system using test harness and operating all snowplow functions.

3. Attach a 3000 psi hydraulic pressure gauge to the PS ram by teeing into the line.
4. Activate the left angle function until blade is fully angled.

NOTE: Control will time out after 9.6 seconds. Repeat command if blade is not fully angled.

5. Repeat the left angle function, and read the pressure shown on the gauge.
6. Refer to the following table.



CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Pump pressure is below 1650 ± 50 psi	Pump Relief Valve	<ul style="list-style-type: none"> • Pump relief valve may be out of adjustment. Turn relief valve clockwise 1/4 turn and retest pressure. Repeat until correct pressure (1650 ± 50 psi) is obtained. • If correct pressure is not obtained after readjustment, remove and inspect the relief valve and its components. Check O-ring, stem and ball for wear or damage. Reseat ball or replace relief valve as needed. Reinstall/replace and readjust valve, then retest pump pressure.
	O-Ring (between pump and valve block)	<ul style="list-style-type: none"> • Remove the pump and inspect the O-ring between the pump and the valve block for damage. Reinstall/replace O-ring and pump, then retest pump pressure.
	Pump	<ul style="list-style-type: none"> • Remove the pump and inspect it for wear or broken gears. Replace pump if needed, adjust pump relief valve, then retest pressure.
Motor slow/plow functions slow	Motor draws more than 100 Amp at pump relief.	<ul style="list-style-type: none"> • Replace the motor.

TROUBLESHOOTING GUIDE

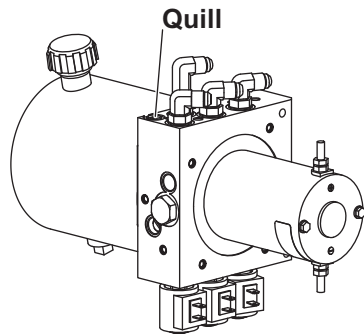
BLADE DROP SPEED ADJUSTMENT

⚠ WARNING

Keep 8' clear of the blade drop zone when it is being raised, lowered or angled. Do not stand between the vehicle and blade or directly in front of blade. If the blade hits you or drops on you, you could be seriously injured.

The quill in the valve manifold adjusts the blade drop speed.

1. Lower the blade to the ground before making adjustment.
2. Turn the quill IN (clockwise) to decrease drop speed. Turn the quill OUT (counterclockwise) to increase drop speed.



Fluid Level

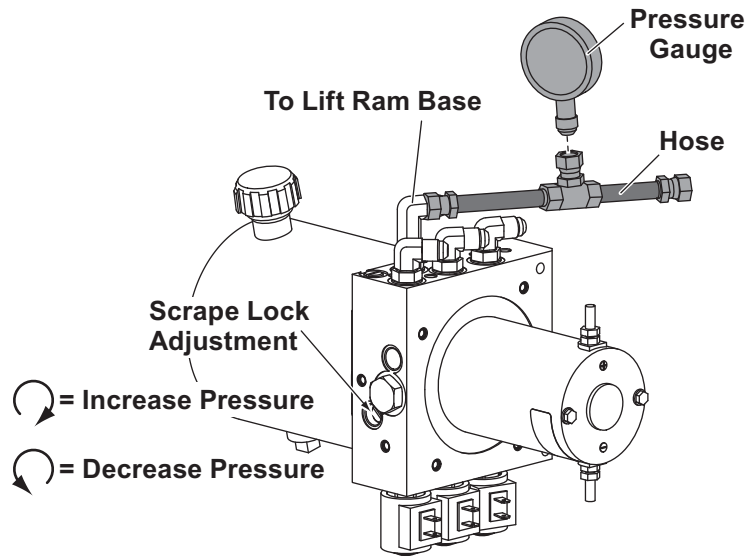
With UltraMount® system attached to the vehicle, activate control and lower the blade to the ground. Turn control OFF. Remove the filler/breather plug.

Fill reservoir to within 2-1/2" from the top of the fill hole and replace fill plug.

For hydraulic fluid type and filling instructions, see Hydraulic System, Annual Fluid Change, in the Maintenance section of this manual.

TROUBLESHOOTING GUIDE

SCRAPE LOCK ADJUSTMENT



Follow the instructions below to increase the pressure setting of the scrape lock feature. The snowplow must be attached to the vehicle, and the snowplow battery cable and lighting harness must be connected before beginning this procedure.

1. Park the vehicle on a smooth, level, hard surface, such as concrete. Lower the blade to the ground and turn the control OFF. Leave the snowplow attached to the vehicle. Turn the vehicle ignition to the "OFF" position.
2. Disconnect the snowplow battery cable from the vehicle battery cable.

3. Remove the hydraulic unit cover.
4. Loosen the breather/fill plug slowly to relieve any pressure in the reservoir.
5. Using a "Tee" fitting, install a 500–600 psi gauge in the lift ram base hose.
6. Retighten the breather/fill plug.
7. Reconnect the snowplow battery cable to the vehicle battery cable.
8. Turn the vehicle ignition to the "ON" or "Accessory" position. Turn the control ON.

9. While pressing the RAISE button on the snowplow control, note the hydraulic gauge pressure reading as the blade is rising. (The pressure can **only** be read as the blade is rising. It may be necessary to perform this process more than once to obtain an accurate reading.) The recommended pressure is 350 psi.

⚠ CAUTION

Never operate the unit while adjusting the scrape lock valve. Doing so will damage the scrape lock valve O-rings.

10. If the hydraulic pressure reading is less than 350 psi, increase the pressure by turning the scrape lock valve stem clockwise 1/4 turn and retest pressure.

NOTE: Adjustments should be made in 1/4-turn increments.

11. Repeat Steps 9 and 10 until the recommended pressure (350 psi) is obtained.

NOTE: Adjusting the scrape lock pressure in excess of the recommended pressure will increase Amp draw and will shorten the life of the plow motor.

12. Once the recommended pressure is obtained, lower the blade completely and turn the control OFF. Turn the vehicle ignition to the "OFF" position.
13. Disconnect the snowplow battery cable from the vehicle battery cable.
14. Loosen the breather/fill plug slowly to relieve any pressure in the reservoir.
15. Remove the hydraulic testing "Tee" fitting and gauge from the lift ram base hose.
16. Reconnect the lift ram base hose and tighten securely.

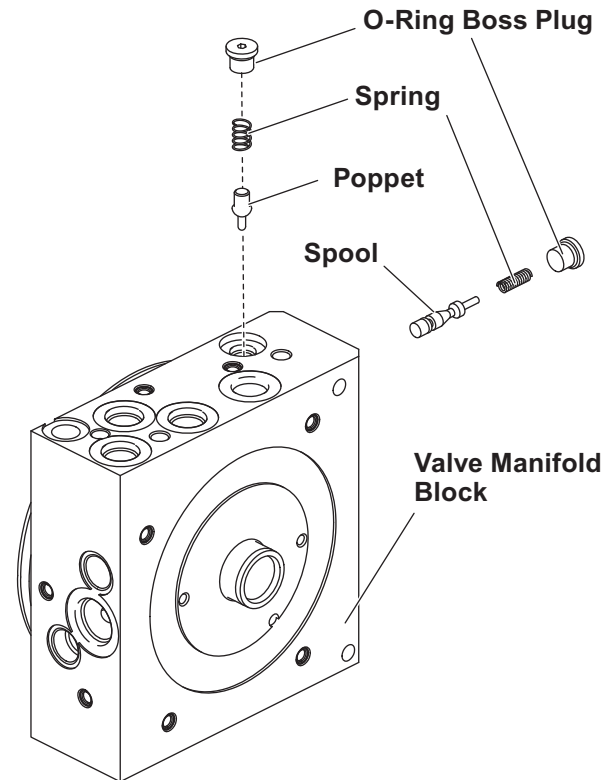
⚠ CAUTION

Do not mix different kinds of hydraulic fluid. Some fluids are not compatible and may cause performance problems and product damage.

17. Check the hydraulic fluid level and add if necessary.
18. Retighten the breather/fill plug.
19. Replace the hydraulic unit cover.

PILOT-OPERATED (POPPET STYLE) CHECK VALVE INSPECTION

1. Remove O-ring boss plug, spring and poppet.
2. Remove O-ring boss plug, spring and spool with O-ring. Use long/slender needle-nosed pliers to remove spool.
3. Inspect springs, poppet, spool, O-rings and poppet seat for wear, damage or contamination.
4. If the valve manifold block has a steel poppet seat, use a strong pencil magnet to push and pull on the seat. If the seat moves at all, reset with poppet seat tool (PN 28530). If the problem is not corrected, replace the valve block.
5. Re-oil O-rings, install spool fully into bore. Spool must insert smoothly.
6. Install poppet, springs and O-ring boss plugs. Torque O-ring boss plug to 60 in-lb.



RELIEF VALVE INSPECTION AND ADJUSTMENT

Relief Valve Inspection

1. Remove the valve stem, ball, spacer and spring.
2. Look for broken or damaged parts, contamination or missing or damaged O-rings.

CAUTION

Be careful to strike stem squarely. You can bend stem if you do not strike it squarely.

3. If parts are in good condition, place ball on hard wood block, hold stem seat on ball and lightly strike top of stem with a hammer. This seats the ball and valve stem.
4. Apply a light coat of anti-seize or grease to stem threads. Lubricate O-rings with hydraulic fluid. Reassemble components into valve block.

Adjustment

CAUTION

Do not adjust relief valve while it is under pressure.

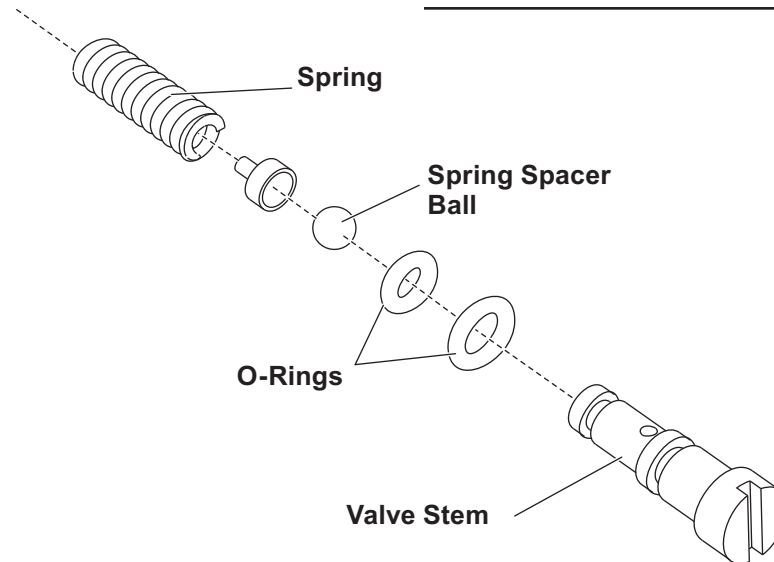
1. Adjust by tightening the relief valve stem until it bottoms out (until spring is fully compressed).
2. Back off valve stem (rotate counterclockwise) the number of turns indicated in the chart.

Hydraulic System

Relief Valve	No. of Turns Backed Off (CCW) From Fully Seated	Approximate Relief Valve Pressure ± 100 (psi)
C – Pump Relief*	2-1/2 – 2-3/4	1650
A & B – Angle Cylinder Crossover Relief	1 – 1-1/4	4000
D – Scrape Lock	1/2 – 3/4	350

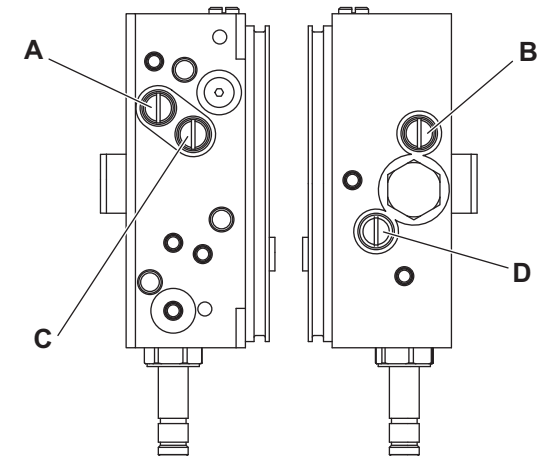
* See Pump Pressure Test to measure actual pump relief pressure.

NOTE: Relief Valve Service: Apply one drop of low-strength threadlocker to all relief valve stems. The spring for relief valve D is different from the other springs and should not be interchanged. Spring is made of a lighter wire and is gold in color.



Adjustment of Scrape Lock

See page 74.



NOTES



Western Products
P.O. Box 245038
Milwaukee, WI 53224-9538
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