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MECHANIC'S GUIDE

ENFORCERTM **V-Plow**

Featuring the
FloStat[®] Hydraulic System

⚠ CAUTION

Read this manual before servicing the snowplow.

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INTRODUCTION

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

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

RECOMMENDED TOOLS

- Long/slender needle-nose pliers
- Flat screwdriver
- 12V test light
- Torque wrench
- Hex key set, including 3/8"
- Combination standard wrench set
- 1/4" drive ratchet set with 6" extension
- 3/8" drive ratchet set
- Deep socket: 7/8"
- Digital multimeter with amp clamp
- Ammeter
- Pressure test kit
- Flashlight
- Pick set
- Hammer
- Pencil magnet
- Fuses: 5A mini fuse
- Vacuum pump with 3/8" NPT barbed fitting
- 3/8" NPT plug

AVAILABLE SERVICE ITEMS

- Motor Bearing Sleeve Repair Kit, PN 64589
(requires 3/8"-24 x 4" cap screw, not included)
- Pressure Test Kit, PN 56679
(requires adapter fitting, not included)
- Spring Replacement Tool, PN 20043-1
- Diagnostic Harness Kit, PN 29290-2
- Pump Shaft Seal Repair Kit, PN 28856
(requires 1/4"-28 x 4-1/2" cap screw, not included)

SAFETY

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 local WESTERN® dealer.

Warning/Caution Label

⚠ WARNING




Blade could drop unexpectedly, crushing or trapping limbs. Lower blade when vehicle is parked.




Overloading could negatively affect vehicle handling. To avoid serious injury or death, do not exceed GVWR or GAWR including blade and ballast.


⚠ CAUTION



Read Owner's Manual before operating or servicing snowplow.



Transport speed should not exceed 45 mph (72 km/h). Further reduce speed under adverse travel conditions.



Plowing speed should not exceed 10 mph (16 km/h).

See your sales outlet/website for specific vehicle application recommendations.

www.

Instruction Label

UltraMount 2 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. Repeat Steps 1 and 2 on other side of snowplow.

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

STEP 3
Push top of Shoe DOWN. Shoe will be on the ground. Repeat Steps 2 and 3 on other side of snowplow. Back vehicle away.

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.

US patents 6,941,685; 7,134,227; 7,400,086; 7,430,821; 7,737,676; 8,850,724; 9,200,418; 9,822,583; 10,753,058. CAN patents 2,354,297; 2,358,145; 2,358,354; 2,466,766; 2,438,002; 2,843,960; and other patents pending.

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SAFETY

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 the 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.

⚠ WARNING

The driver shall keep bystanders clear of the blade when it is being raised, lowered, or angled. Do not stand between vehicle and blade or within 8 feet of a moving blade. A moving or falling blade could cause personal injury.

⚠ WARNING

Keep hands and feet clear of the blade and T-frame when mounting or removing 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 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 online selection system 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 electrical and hydraulic systems contain several automotive-style 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. See the Troubleshooting section of this guide for fuse replacement information.

PERSONAL SAFETY

- Remove the 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.

SAFETY

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.

CELL PHONES

A driver's first responsibility is the safe operation of the vehicle. The most important thing you can do to prevent a crash is to avoid distractions and pay attention to the road. Wait until it is safe to operate mobile communication equipment such as cell phones, text messaging devices, pagers, or two-way radios.

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.

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.

NOISE

Airborne noise emission during use is below 70 dB(A) for the snowplow operator.









VIBRATION

Operating snowplow vibration does not exceed 2.5 m/s² to the hand-arm or 0.5 m/s² to the whole body.

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					
Inch Fasteners Grade 5 and Grade 8					
Size	Torque (ft-lb)		Size	Torque (ft-lb)	
	 Grade 5	 Grade 8		 Grade 5	 Grade 8
1/4-20	8.4	11.9	9/16-12	109	154
1/4-28	9.7	13.7	9/16-18	121	171
5/16-18	17.4	24.6	5/8-11	150	212
5/16-24	19.2	27.3	5/8-18	170	240
3/8-16	30.8	43.6	3/4-10	269	376
3/8-24	35.0	49.4	3/4-16	297	420
7/16-14	49.4	69.8	7/8-9	429	606
7/16-20	55.2	77.9	7/8-14	474	669
1/2-13	75.3	106.4	1-8	644	909
1/2-20	85.0	120.0	1-12	704	995
Metric Fasteners Class 8.8 and 10.9					
Size	Torque (ft-lb)		Size	Torque (ft-lb)	
	 Class 8.8	 Class 10.9		 Class 8.8	 Class 10.9
M6 x 1.00	7.7	11.1	M20 x 2.50	325	450
M8 x 1.25	19.5	26.9	M22 x 2.50	428	613
M10 x 1.50	38.5	53.3	M24 x 3.00	562	778
M12 x 1.75	67	93	M27 x 3.00	796	1139
M14 x 2.00	107	148	M30 x 3.50	1117	1545
M16 x 2.00	167	231	M33 x 3.50	1468	2101
M18 x 2.50	222	318	M36 x 4.00	1952	2701
These torque values apply to fasteners except those noted in the instructions.					

BLADE, T-FRAME & HEADGEAR

T-FRAME TO BLADE ASSEMBLY

1. Remove the blade wings from the metal shipping brackets. Discard the shipping brackets and replace the cutting edge hardware.

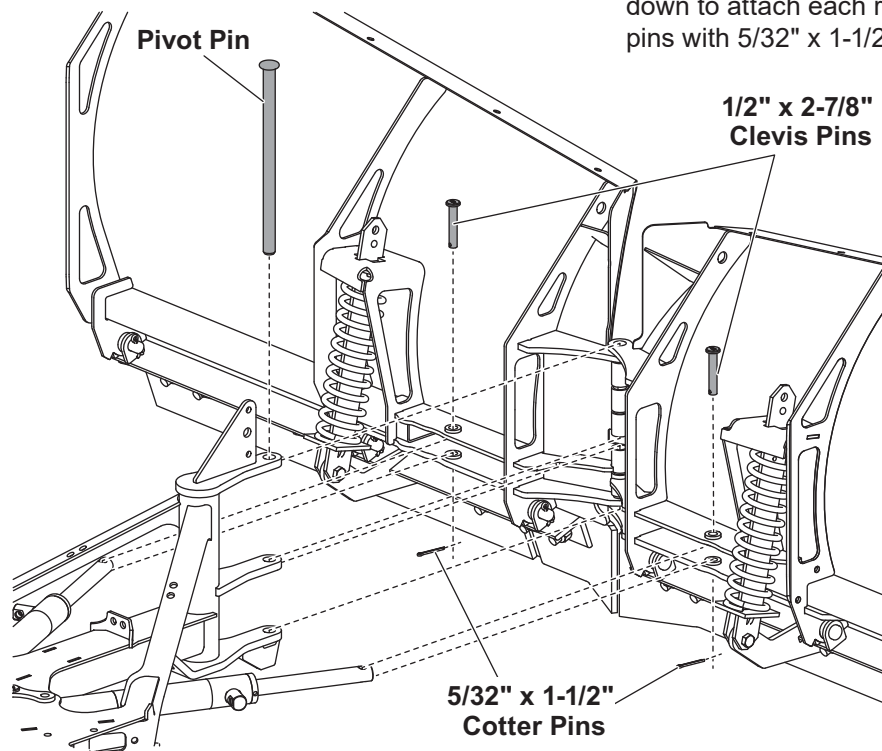
2. Align the hinges of each wing. Position the T-frame assembly between the blade wings so that the holes in the T-frame are aligned with the holes in wing hinges.

3. Insert the pivot pin from top to bottom through all hinges as shown.
4. Move the snowplow into a normal operating position.

5. Remove the protective packaging from the angle rams.

6. Align the holes in the rod end of the angle ram with the corresponding holes on the back of the blade.

7. Install a 1/2" x 2-7/8" clevis pin from the top down to attach each rod. Secure the clevis pins with 5/32" x 1-1/2" cotter pins.

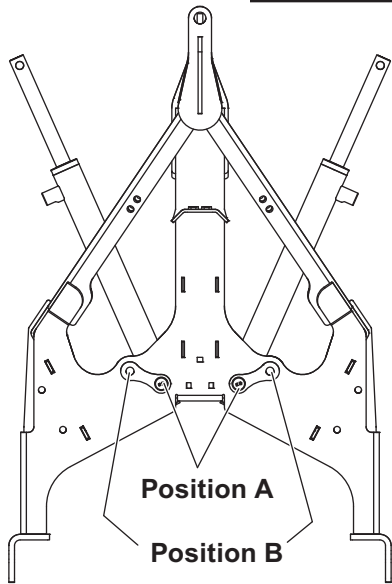


ANGLE RAM ADJUSTMENT

The ENFORCER™ V-plow has adjustable angle rams with two possible mounting positions at the base end of each ram, nearest the vehicle. This feature provides a means for making an adjustment in available ground clearance for when the snowplow is fully raised and in full angled or retracted (vee) positions.

The angle rams are installed from the factory in the inner holes (position A). If additional ground clearance is desired, reposition the rams to position B, being sure to use the same corresponding hole for attaching each ram.

NOTE: Failure to make the adjustment or failure to use the same corresponding holes for attaching the rams could result in poor performance or damage.



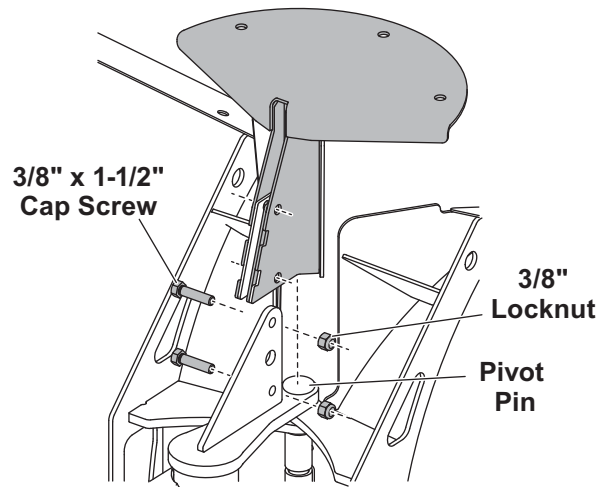
	Inner Holes	Outer Holes
V Width	81.00"	85.50"
Scoop Width	76.66"	69.50"
Angle Backward	29°	22°
Angle Forward	29°	37°

Based on Installation Instructions for ENFORCER V-Plow (Lit. No. 74914, Rev. 01).

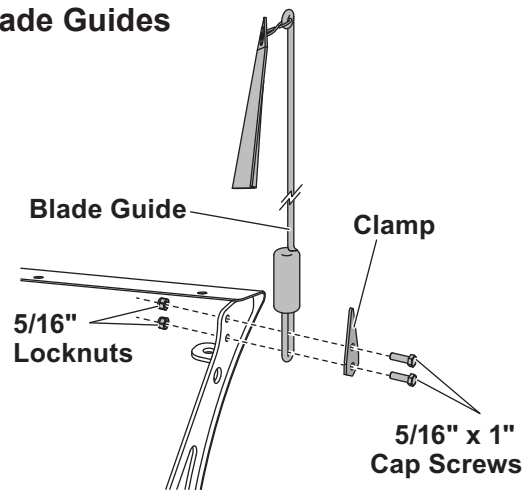
BLADE, T-FRAME & HEADGEAR

CENTER DEFLECTOR, BLADE GUIDES, AND STAND SHOE

Center Deflector



Blade Guides



Stand Shoe

⚠ WARNING

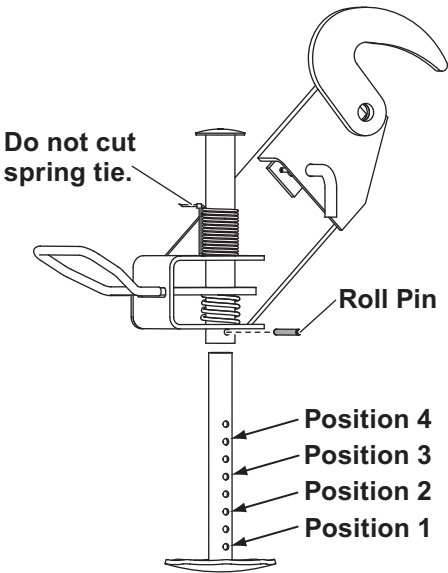
The stand plunger spring is shipped compressed and tied. Do not cut the spring tie until final stand shoe adjustment is complete and the roll pin is installed.

Initial stand shoe height adjustment is based on the receiver height measurement (distance "d") determined in Step 1 under "Pivot Plate Hole Position" in Installation Instructions. A final adjustment of the stand shoe will be made after attaching the snowplow to the vehicle.

- 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 as determined from the chart and illustration below.

Stand Shoe Position Chart	
Distance "d"	Position
13.0"–14.5"	1
14.5"–16.0"	2
16.0"–17.5"	3
17.5"–19.0"	4

- Insert a 1/4" roll pin.

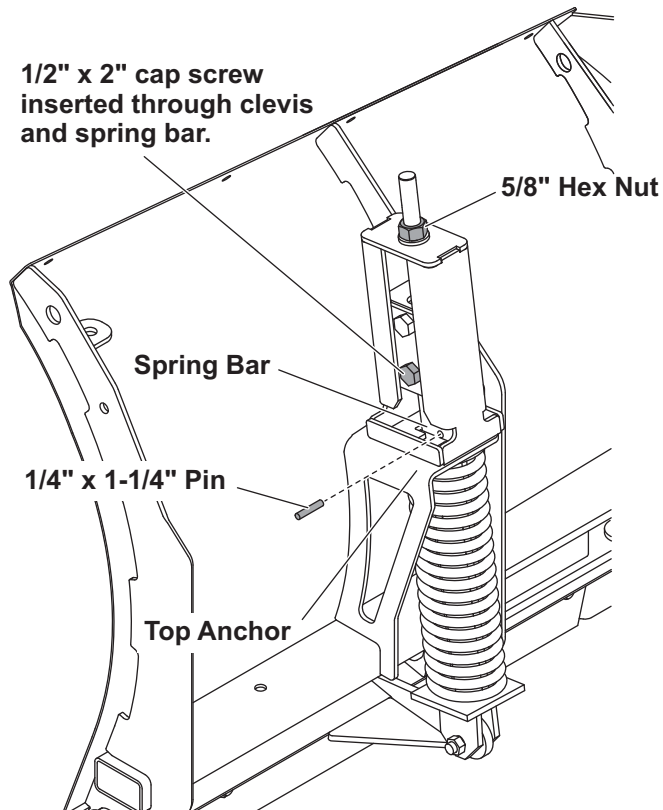
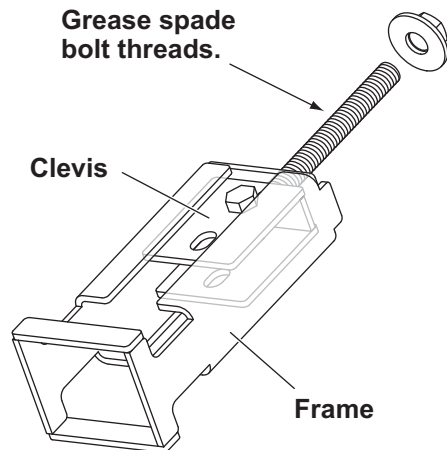


- Do not cut the spring tie until after the final stand shoe adjustment.

BLADE, T-FRAME & HEADGEAR

USING THE BLADE SPRING REPLACEMENT TOOL

1. Park the vehicle on a smooth, level, hard surface, such as concrete. Lower the blade to the ground and turn the control OFF. Disconnect the snowplow from the vehicle or turn the vehicle ignition to the "OFF" position and remove the key.
2. The spring replacement tool (PN 20043-1) ships fully assembled. Before using the tool, apply a light coating of multipurpose grease to the threaded end of the spade bolt.
3. Place the tool on the top anchor above the spring, making sure that the upper end of the spring bar is between the clevis tabs of the spring replacement tool. Insert a 1/2" x 2" cap screw through the lower hole in one clevis tab, through the top hole in the spring bar, then the hole in the other clevis tab. Install a 1/2" nut and hand tighten.



4. Use hand tools to tighten the 5/8" hex nut until the spring bar is raised enough to access the pin hole. Insert the 1/4" x 1-1/4" pin through the pin hole, centering the pin from side to side.
5. Loosen the 5/8" hex nut to lower the spring bar. Remove the spring tool assembly by removing the 1/2" x 2" cap screw inserted through the spring bar in Step 3.
6. Detach the spring from the blade by removing the shoulder bolt and locknut at the bottom of the spring bar. Retain the fasteners.
7. Insert the replacement spring with spring bar up through the top anchor on the blade. Install the bottom of the spring bar to the anchor on the trip edge using the retained shoulder bolt and locknut. Tighten to 50 ft-lb.
8. Repeat Step 3.
9. Use hand tools to tighten the 5/8" hex nut until the spring bar is raised enough to access the 1/4" x 1-1/4" pin inserted in Step 4. Remove the pin.
10. Repeat Step 5.

10

HYDRAULIC SYSTEM

FloStat® HYDRAULIC SYSTEM SPECIFICATIONS

The FloStat hydraulic system delivers fast and uniform speed for blade movement, raising the blade in two seconds and performing all angling functions in less than five seconds.

Relief Valve Settings

- Pump Relief Valve (1): 2250 ± 100 psi
1-3/4 turns CCW from fully seated*
- Base-End Relief Valves (2): 3400 ± 100 psi
1-1/8 turns CCW from fully seated*
- Rod-End Relief Valves (2): 2200 ± 100 psi
1-3/4 turns CCW from fully seated*

Pump Motor

12V DC with +/- connection
3.0" dia 0.8 kW motor
2200–2300 psi pump relief valve
3400 psi plowing relief valve
2200 psi back dragging relief valve
0.000477 gal/rev pump
Hydraulic hose SAE 100R1

System Capacity

- Unit reservoir: 1-3/4 quarts
- System total: 2-1/8 quarts

* The number of turns off seat is a starting point and may need further adjustment.

AeroShell® is a registered (®) trademark of Shell Oil Company.

Hydraulic Fluid

⚠ CAUTION

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

Use WESTERN® hydraulic fluid rated to –40°F (–40°C) or other fluid conforming to military specification MIL-H-5606 A, such as Mobil Aero HFA or Shell AeroShell® Fluid 4. Use of products other than these recommended fluids may cause poor hydraulic system performance and damage to internal components.

Fastener Torque Specifications

Pump Cap Screws	5/16-18 x 2-1/4	150–160 in-lb
Motor Terminals (+ and –)	5/16-18 Nut	50–60 in-lb
Motor to Manifold Cap Screws	M5 x .8 Bolt	30–40 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	40–60 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	25–33 ft-lb
Check Valves	7/8 Hex Head	19–21 ft-lb
Secondary to Primary Manifolds	1/4-20 x 3-1/2	10–13 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 5/8	50–70 in-lb
Plow Module Mount Screws	1/4-20 x 3/8	60–70 in-lb
Angle Ram –4 Elbow Fitting Nut		11–12 in-lb
Angle Ram Piston Locknuts		90–100 ft-lb
Lift Ram Piston Nut		90–100 ft-lb
Angle & Lift Rams Gland Nuts		120–150 ft-lb

Electrical System (approximate values)

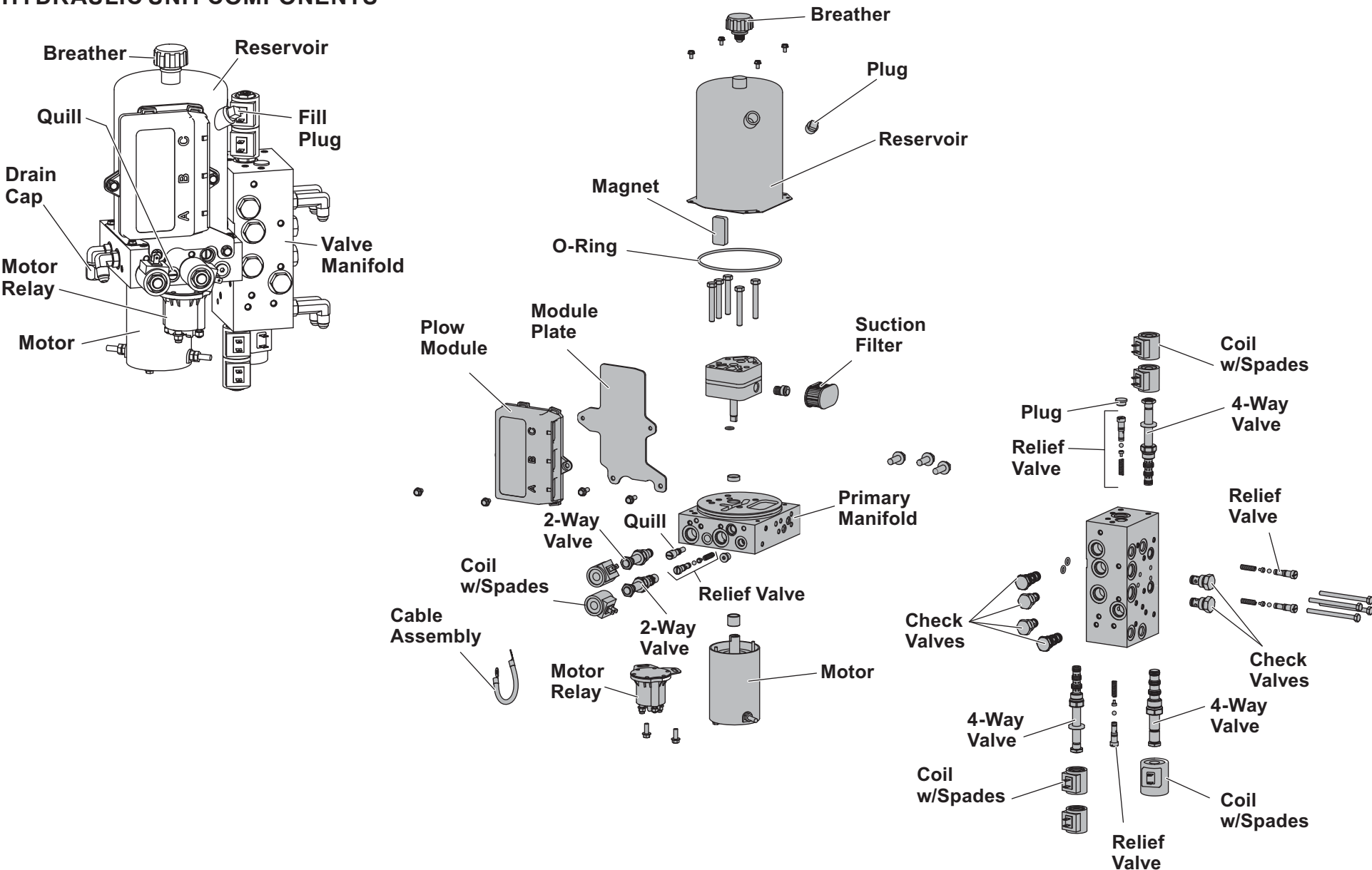
- Solenoid coil resistance = 7 ohm @ room temp.
- Solenoid coil amperage draw = 1.5A
- Motor relay coil resistance = 5.4 ohm
- Motor relay amperage draw = 3A
- Maximum motor amperage draw = 190A over relief at 2250 psi
- Switch accessory lead draw = 0.75A

Fuses

- Hydraulic unit harness fuses: 5A mini

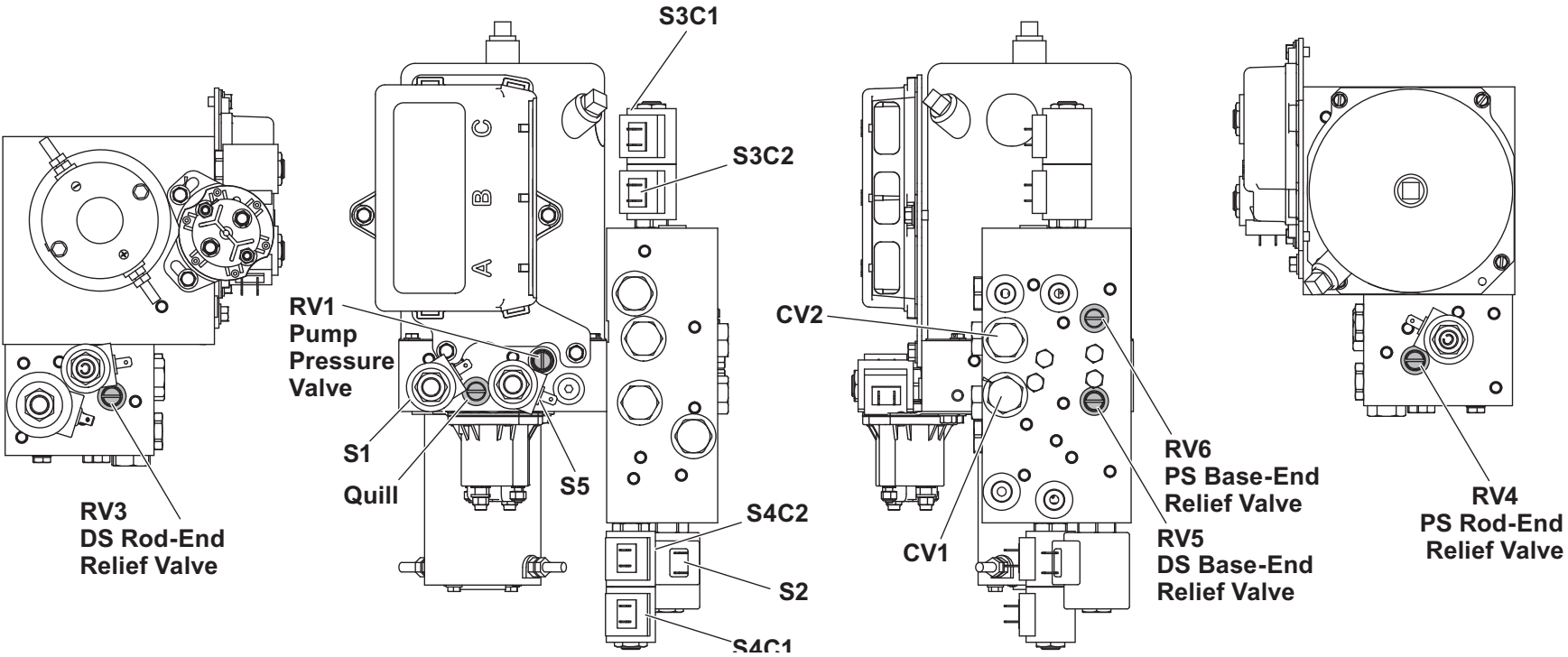
HYDRAULIC SYSTEM

HYDRAULIC UNIT COMPONENTS



HYDRAULIC SYSTEM

VALVE LOCATION



Solenoid Cartridge Valves		
Coil	Valve Type	Wire Color
S1	SV08-2004	Blue
S2	SV10-43	Dark Green
S3C1	SV08-47C	Brown
S3C2	SV08-47C	White
S4C1	SV08-47C	Purple
S4C2	SV08-47C	Orange
S5	SVCV08-20	Yellow

HYDRAULIC SYSTEM









CARTRIDGE VALVES

The ENFORCER™ V-plow hydraulic system performs ten blade movement functions.

All functions require the vehicle ignition (key) switch to be in the "ON" or "ACCESSORY" position and the power to be activated on the snowplow cab control.

Nine of the ten hydraulic functions require energizing the electric motor and opening solenoid cartridge valves. The LOWER function does not energize the motor but requires the opening of one cartridge valve.

Power from the vehicle battery is supplied to the solenoid coils and the motor relay via the plow 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 or back to the reservoir. (Power is supplied to the plow module via the battery cable and motor relay connection.)

Solenoid		Blade Movement									
		RAISE ↑	LOWER ↓	ANGLE RIGHT 	ANGLE LEFT 	VEE 	SCOOP 	RIGHT EXTEND 	RIGHT RETRACT 	LEFT EXTEND 	LEFT RETRACT 
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

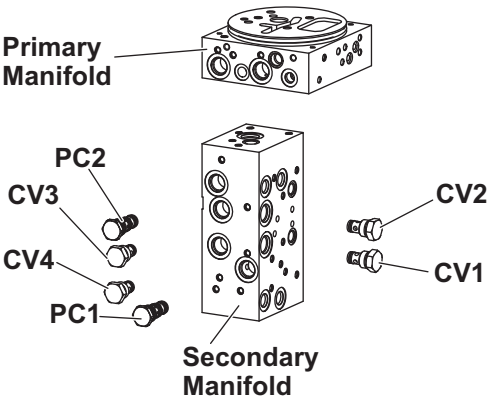
HYDRAULIC SYSTEM

CHECK VALVES

The check valves supply make-up fluid to the low-pressure side of a ram that is extending or retracting through a relief valve due to impact on one or both wings.

A pilot-operated check valve (PC) allows fluid to flow in only one direction unless it receives pilot pressure through another circuit to shift it to an open position.

Tighten check valves to **19–21 ft-lb**.



Check Valves	
CV1	CV08-2004
CV2	
CV3	
CV4	
PC1	CPB-0025
PC2	

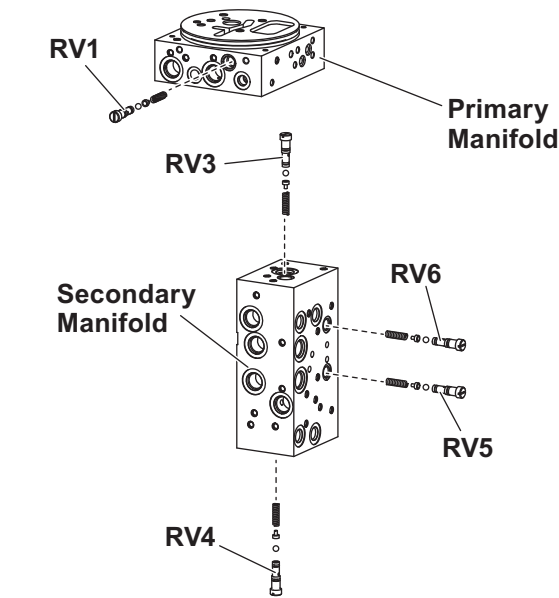
RELIEF VALVES

When all cartridge valves are closed, hydraulic fluid is trapped in the ram by the solenoid cartridge valves, check valves, base-end relief valves, and rod-end relief valves.

When the snowplow contacts an object while plowing, force of the impact increases hydraulic pressure in the base end of the ram. When pressure exceeds 3400 psi, the ram's base-end relief valves open, allowing hydraulic fluid back to the reservoir. Due to the small volume on the rod side of the piston, fluid is not replaced. This causes a slight temporary vacuum in that circuit.

When the snowplow contacts an object while back dragging, force of the impact increases hydraulic pressure in the rod end of the ram. When pressure exceeds 2200 psi, the ram's rod-end relief valve opens, allowing hydraulic fluid into the reservoir passage. The base-end check valve allows fluid to fill the base end of the ram. Because of differential area on either side of the ram's piston, fluid flows from the reservoir to the base end.

NOTE: See "Striking an Object While Plowing Forward" and "Striking an Object While Back Dragging" schematics for details.



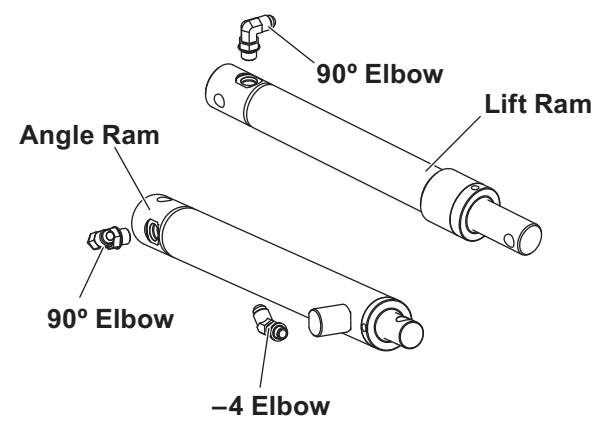
Relief Valve Settings		
RV1	Pump	2250 ± 100 psi
RV3	DS Ram Rod End	2200 ± 100 psi
RV4	PS Ram Rod End	
RV5	DS Ram Base End	3400 ± 100 psi
RV6	PS Ram Base End	

HYDRAULIC SYSTEM

HYDRAULIC FITTING AND HOSE INSTALLATION

NOTE: Overtightening JIC hose fitting ends will result in a fractured fitting.

DO NOT use thread sealant/tape on hydraulic hoses or fittings. These materials could damage the product. Always use two wrenches to ensure proper tightening of fittings and hoses.



Ram Sizes	
Lift Ram	1-1/4" x 8-5/8"
Angle Rams	1-1/2" x 12" DA

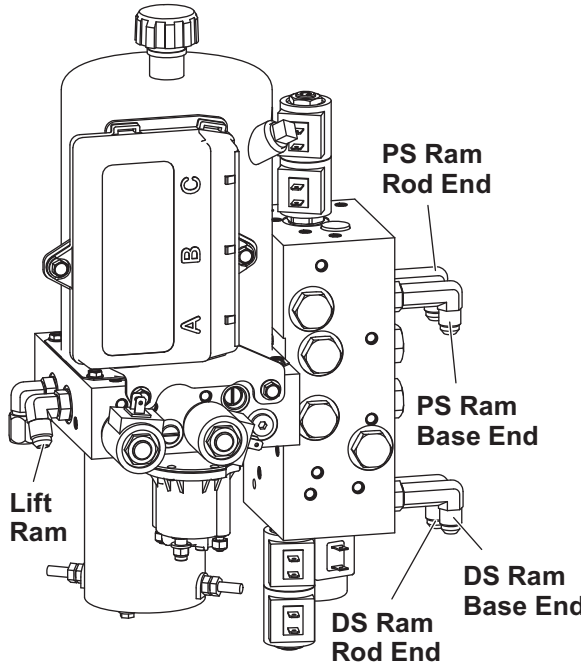
To install SAE O-ring fittings in the valve block and rams:

1. Turn the jam nut on the fitting as far back as possible.
2. Lubricate the O-ring with clean hydraulic fluid.
3. Screw the fitting into the port by hand until the washer contacts the port face and the shoulder of the jam nut threads.
4. Unscrew the fitting to its proper position; no more than one full turn.
5. Using two wrenches, hold the fitting body in position and tighten the jam nut until the washer again contacts port face, then tighten an additional 1/8 to 1/4 turn to lock the fitting in place. Final torque on the jam nut should be approximately 20 ft-lb.

To install hydraulic hoses:

1. Screw the flare nut onto the fitting flare and hand tighten it.
2. Align the hose so that there are no twists or sharp bends and so that it will not be pinched or pulled by moving parts.

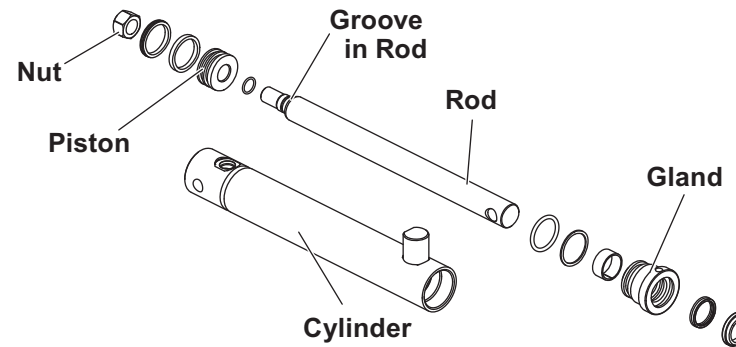
3. Using a pair of adjustable pliers, hold the hose in position, and use a wrench to tighten the flare nut 1/8 to 1/4 turn beyond hand tight. Final torque on the flare nut should be approximately 20 ft-lb.
4. Reinstall any protective hose wraps in their original positions.



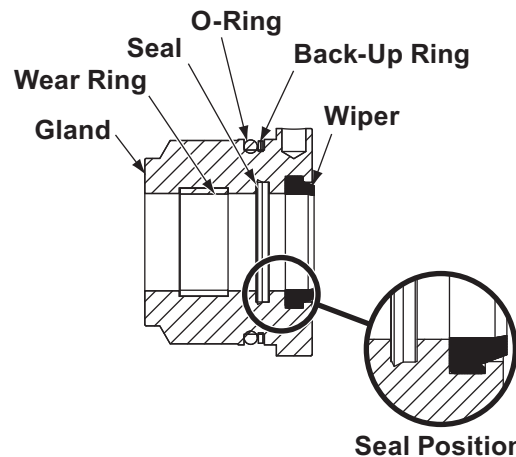
HYDRAULIC SYSTEM

RAM SEAL INSTALLATION

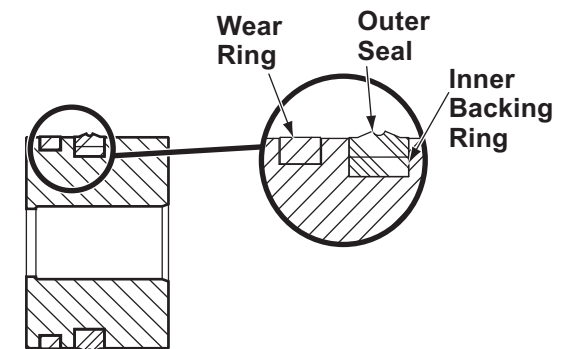
1. Lubricate the O-rings with hydraulic fluid before assembly.
2. Assemble the gland components as shown, then lubricate them with hydraulic fluid.
3. Remove the piston from the rod and assemble the piston components as shown.
4. Assemble the gland to threaded end of the rod. Do not slide the gland over the cross hole in the rod.
5. Reassemble piston to rod and tighten the nut:
 - 90–100 ft-lb for angle ram
 - 90–100 ft-lb for lift ram.
6. Assemble the O-ring into the groove on the rod. Use tape or other protection on the threads.
7. Apply a bead of medium-strength threadlocker all around the threads of the gland.
8. Lubricate the piston seals and the inside of the cylinder.
9. Press the rod assembly into the cylinder and tighten the gland nut to 120–150 ft-lb.



GLAND SECTION



PISTON SECTION



HYDRAULIC SYSTEM

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 29290-2) 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. **To remove cartridges or check valves without draining the reservoir**, proceed with Steps 5–8 and 10.

To drain the reservoir before replacing components, remove the drain plug and completely drain the reservoir. Reinstall the drain plug. Replace the desired components and skip to Step 9.

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.

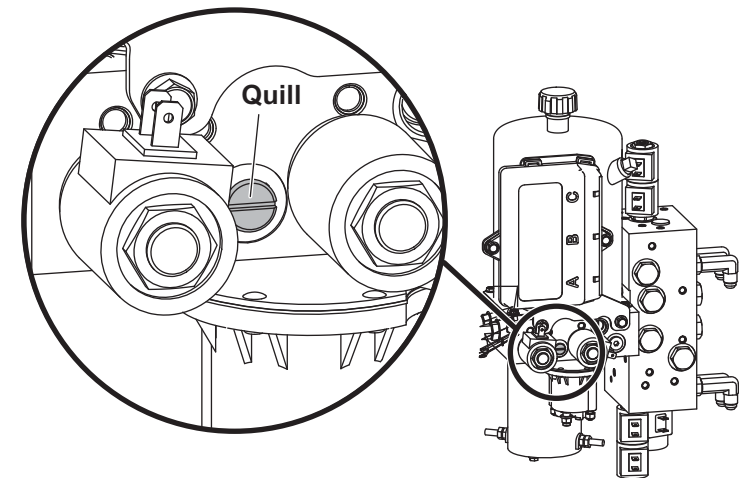
7. Using the vacuum pump, pull a vacuum of approximately 5 to 10 Hg.
8. You should now be able to remove cartridges and check valves from the hydraulic unit with minimal fluid loss. Maintain the vacuum until the replacement cartridge/check valve has been installed. Once the replacement part has been installed, release the vacuum and remove the 3/8" barb fitting.
9. **If the reservoir was completely drained** at Step 4 above, refill the reservoir with hydraulic fluid to 1-1/2" to 2" from the top.
10. Reinstall the breather and remove the 29290-2 diagnostic harness according to the instructions included with the harness kit.

BLADE DROP SPEED ADJUSTMENT

⚠ WARNING

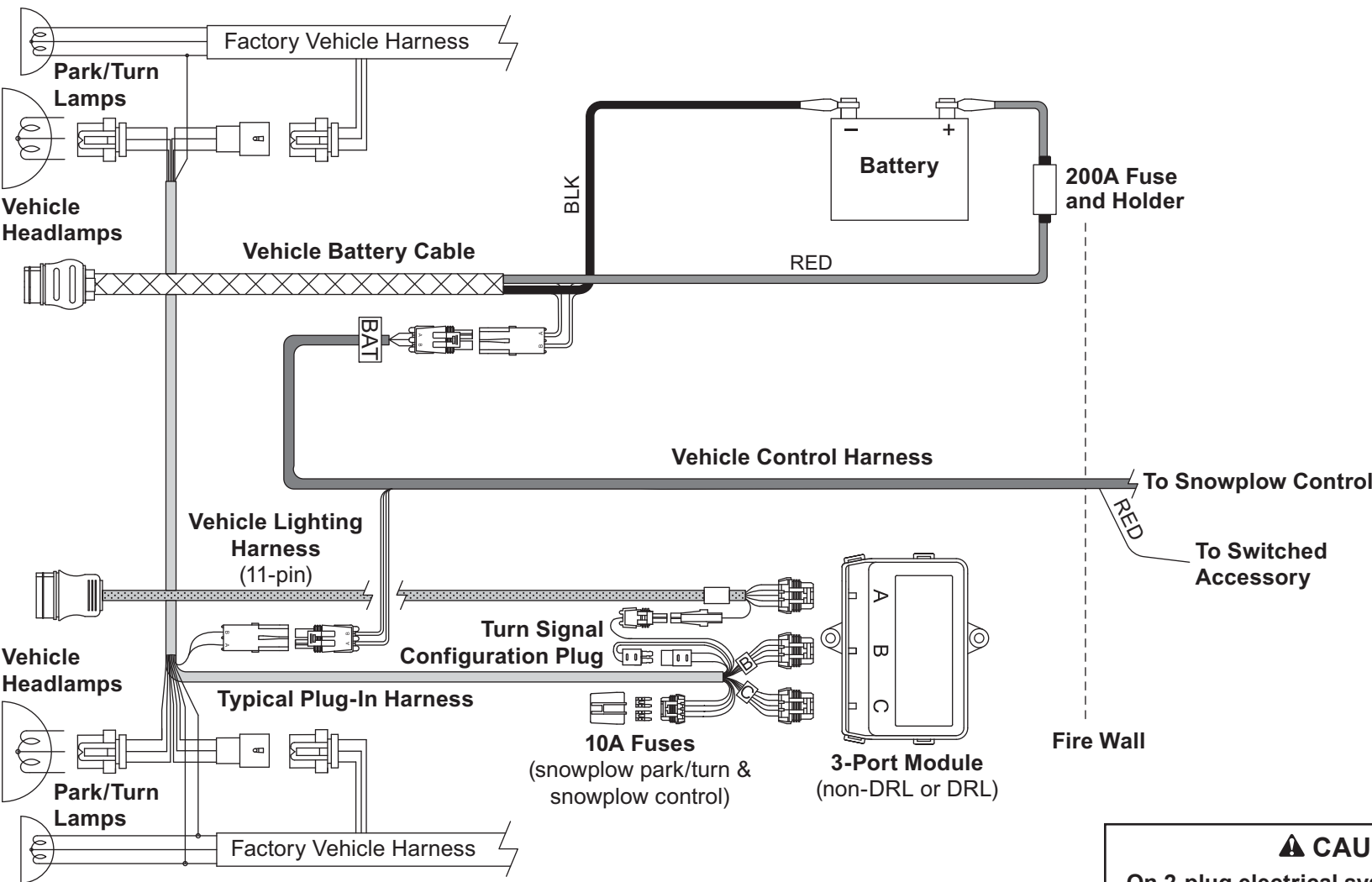
Keep 8' clear of the blade when it is being raised, lowered, or angled. Do not stand between vehicle and blade or within 8 feet of a moving blade. If the blade hits or drops on you, you could be seriously injured.

1. Lower the blade to the ground before making any adjustment.
2. Remove the hydraulic unit cover.
3. The quill in the valve manifold adjusts the blade drop speed. Turn the quill IN (clockwise) to decrease drop speed. Turn the quill OUT (counterclockwise) to increase drop speed.
4. Stand 8 feet clear of the blade when checking the drop speed adjustment.
5. Replace the hydraulic unit cover.



VEHICLE-SIDE ELECTRICAL COMPONENTS

HARNESS DIAGRAM



CAUTION

On 2-plug electrical systems, plug covers shall be used whenever snowplow is disconnected.

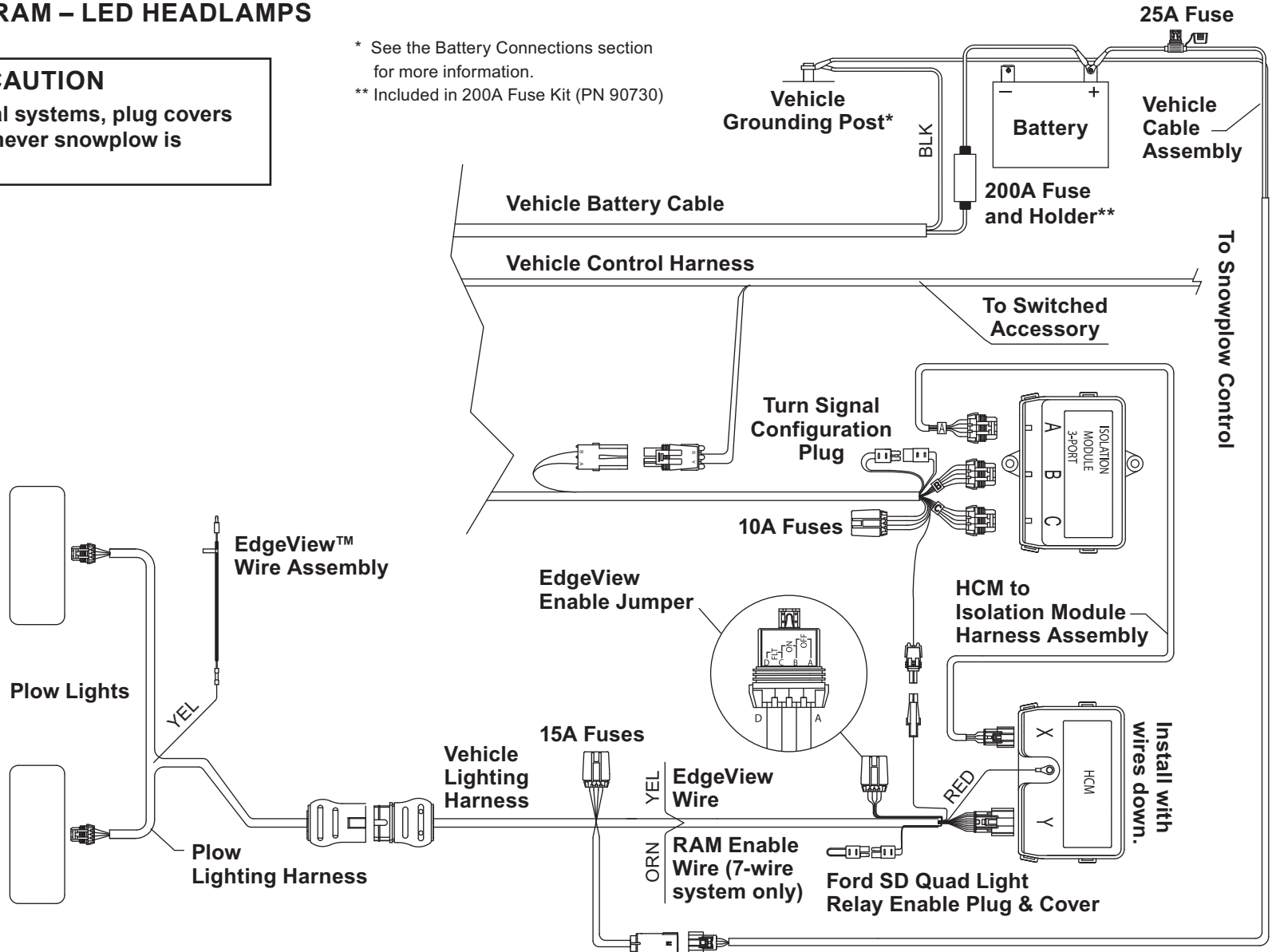
VEHICLE-SIDE ELECTRICAL COMPONENTS

HARNESS DIAGRAM – LED HEADLAMPS

⚠ CAUTION

On 2-plug electrical systems, plug covers shall be used whenever snowplow is disconnected.

- * See the Battery Connections section for more information.
- ** Included in 200A Fuse Kit (PN 90730)



OVERVIEW

⚠ 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.

The snowplow can be operated by a hand-held control or by a joystick-style control.

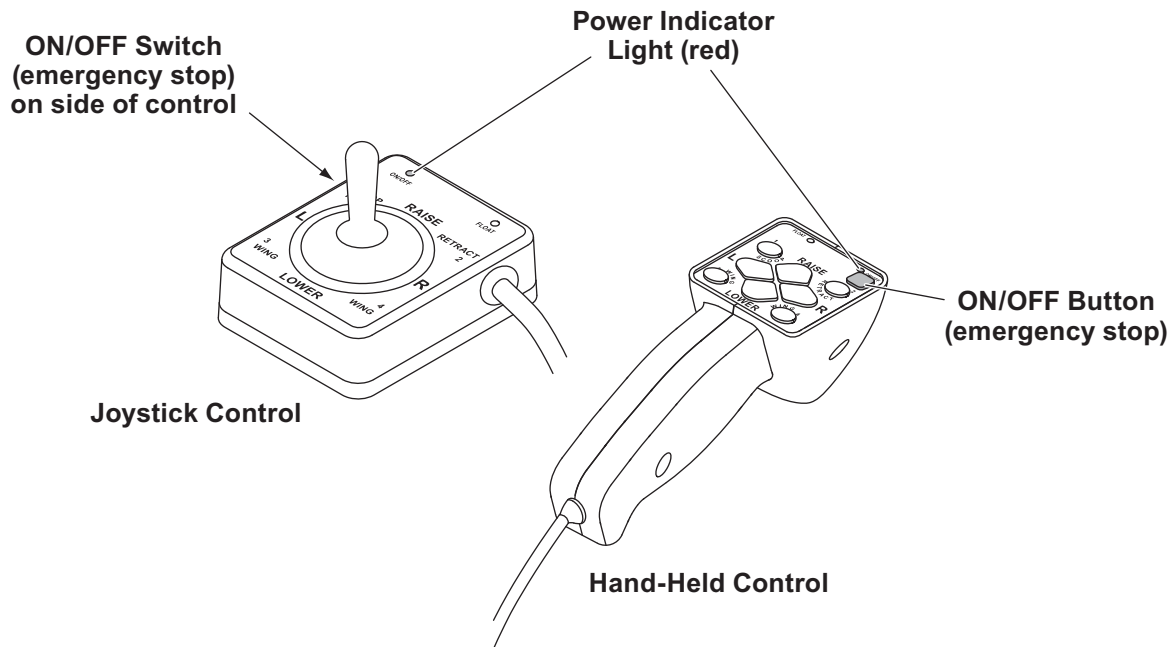
The vehicle ignition (key) switch controls a fused circuit that powers the control directly from the battery. The control is backlit, which will illuminate when the vehicle is turned to ACC or ON.

The ON/OFF button on the cab control allows you to turn OFF the control and prevent blade movement even when the ignition switch is ON.

The control ON/OFF button or switch serves as an emergency stop, if required.

All controls are protected by a replaceable fuse located in the control harness assembly. See "Fuse Replacement" in the Maintenance section of the Owner's Manual.

FLEET FLEX electrical system controls are able to sense a lack of communication with the electrical system. Should the indicator light start to flash, refer to "Control/Cable/Plow Module Test" in the Troubleshooting section of this guide.



CONTROLS

OPERATING THE CabCommand HAND-HELD CONTROL

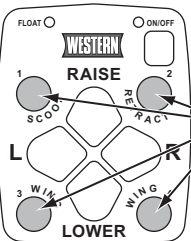
⚠ WARNING

The driver shall keep bystanders clear of the blade when it is being raised, lowered, or angled. Do not stand between vehicle and blade or within 8 feet of a moving blade. A moving or falling blade could cause personal injury.

- 1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position. The control backlight will illuminate.
- 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.

The round buttons numbered 1, 2, 3, and 4 operate the SECURITY GUARD™ system. See the SECURITY GUARD System section of this guide for instructions.



Buttons 1, 2, 3, and 4 control SECURITY GUARD system functions.

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 a control function times out before the desired blade movement is complete, release the button and press it again.

Automatic Shutdown

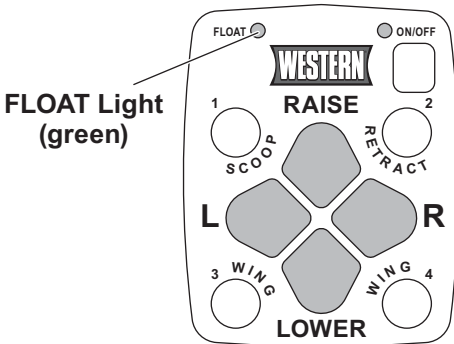
The control will automatically turn OFF after being idle for 20 minutes. To reactivate the control after a shutdown, press the ON/OFF button.

Smooth Stop

The control automatically allows the blade to coast to a stop when a control button is released. This results in smoother operation, reduces the shock to the hydraulic system, and increases hose and valve life. For instructions on enabling/disabling this feature, see "Smooth Stop" in the FLEET FLEX Electrical System section of this guide.

Control Functions

RAISE, LOWER, FLOAT, ANGLE



Pressing the four diamond-shaped buttons in the center of the control face will result in the blade movements described in the table.

Function	Description of Operation
RAISE	Press this button to raise the blade and cancel the FLOAT mode.
LOWER	Press this button to lower the blade. Release the button to stop the blade at the desired height.
FLOAT*	Press the LOWER button and hold 3/4 second to activate this mode. The FLOAT 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; however, control will shut down after 20 minutes of nonuse. Press the RAISE button momentarily to cancel FLOAT. Angling left or right will not interrupt (pause) the FLOAT function.

Table continues on next page.

Based on Operating Instructions for 85200 & 96500 CabCommand Hand-Held Control (Lit. No. 96582, Rev. 00).

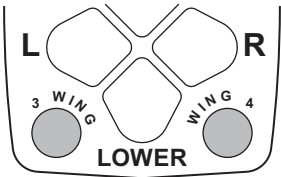
CONTROLS

CabCommand Hand-Held Control Functions, *continued*

L (Angle Left)	With wings in a straight line, press the L button to move both wings to the angle left position. The left wing retracts while the right wing extends.
R (Angle Right)	With wings in a straight line, press the R button to move both wings to the angle right position. The right wing retracts while the left wing extends.

* FLOAT mode activates immediately when the one-touch FLOAT feature is enabled. See "One-Touch FLOAT" in the FLEET FLEX Electrical System section for more information.

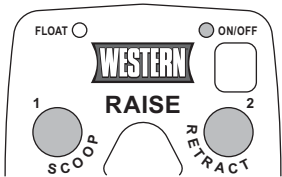
WING Positions



The two round buttons located to the left and right of the LOWER button move either wing independently of the other, as described below.

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

SCOOP/RETRACT Blade Positions



The two round buttons located to the left and right of the RAISE button move both wings at the same time, into the following blade positions.

Function	Description of Operation
SCOOP	Press this button to extend both wings forward into the scoop position.
RETRACT	Press this button to draw both wings into the fully retracted/vee position.

Function	Description of Operation
L WING	Press this button on the left side of the control to move the left wing. The first time the button is pressed after the control is turned ON or another function is used, the wing will extend. Repeated use of the same button, without using another function, results in movement in the opposite direction from the previous movement.
R WING	Press this button on the right side of the control to move the right wing. The first time the button is pressed after the control is turned ON or another function is used, the wing will extend. Repeated use of the same button, without using another function, results in movement in the opposite direction from the previous movement.

CabCommand Hand-Held Control Function Time-Outs (seconds)								
Raise	L (angle left)	R (angle right)	Scoop	Retract	L Wing (out)	L Wing (in)	R Wing (out)	R Wing (in)
4.0	3.0	3.0	5.0	3.0	3.0	3.0	3.0	3.0

CONTROLS

OPERATING THE JOYSTICK CONTROL

⚠ WARNING

The driver shall keep bystanders clear of the blade when it is being raised, lowered, or angled. Do not stand between vehicle and blade or within 8 feet of a moving blade. A moving or falling blade could cause personal injury.

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position. The control backlight will illuminate.
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 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 a control function times out before the desired blade movement is complete, release the lever to the center position, then move it 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.

Smooth Stop

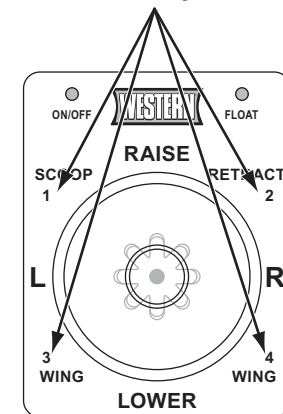
The control automatically allows the blade to coast to a stop when the lever returns to center position. This results in smoother operation, reduces the shock to the hydraulic system, and increases hose and valve life. For instructions on enabling/disabling this feature, see "Smooth Stop" in the FLEET FLEX Electrical System section of this guide.

Control Lever Movement

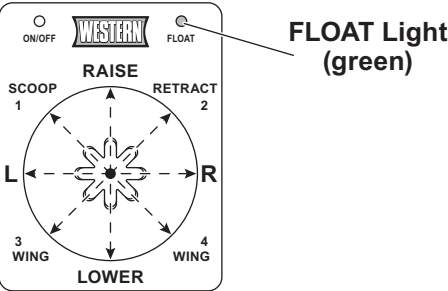
From the center position, the control lever can be moved in one of eight directions to control various movements of the snowplow blade. To change from one movement of the blade to another, the control lever must be moved back to the center position before selecting the desired function. Whenever the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

Moving the control lever diagonally from the center position toward any of the four digits on the face of the control body will operate the SECURITY GUARD™ system. For instructions, see the SECURITY GUARD System section of this guide.

Positions 1, 2, 3, and 4 control SECURITY GUARD system functions.



Joystick Control Functions



RAISE, LOWER, FLOAT, Angle

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

Function	Description of Operation
RAISE	Move the control lever toward the top of the control body to raise the blade and cancel the FLOAT mode.
LOWER	Move the control lever toward the bottom of the control body to lower the blade. Release the lever to stop the blade at desired height.
FLOAT†	Move the control lever to the LOWER position and hold 3/4 second to activate this mode. The FLOAT 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 rises. Function does not time out; however, the control will shut down after 20 minutes of nonuse. Move the lever to the RAISE position momentarily to cancel FLOAT. Angling left or right will not interrupt (pause) the FLOAT function.

Function	Description of Operation
L (Angle Left)	Move the control lever straight to the left to angle the blade left.
R (Angle Right)	Move the control lever straight to the right to angle the blade right.

* FLOAT mode activates immediately when the one-touch FLOAT feature is enabled. See "One-Touch FLOAT" in the FLEET FLEX Electrical System section for more information.

SCOOP/RETRACT Blade Positions

Moving the control lever from the center position toward "SCOOP" or "RETRACT" on the face of the control body will cause both wings to move at the same time, as described in the table below.

Function	Description of Operation
SCOOP	Move the control lever toward the word SCOOP on the control face to extend both wings forward into the scoop position.
RETRACT	Move the control lever toward the word RETRACT on the control face to draw both wings into the fully retracted/vee position.

WING Positions

Moving the control lever from the center position toward "L WING IN/OUT" or "R WING IN/OUT" on the face of the control body will cause one wing to move independently of the other, as described in the following table.

Function	Description of Operation
L WING	Move the control lever toward the <i>left</i> side of LOWER on the control face to move the left wing. The first time the lever is moved into the slot after the control is turned ON or another function is used, the wing will extend. Repeated use of the lever in the same slot, without using another function, results in movement in the opposite direction from the previous movement.
R WING	Move the control lever toward the <i>right</i> side of LOWER on the control face to move the right wing. The first time the lever is moved into the slot after the control is turned ON or another function is used, the wing will extend. Repeated use of the lever in the same slot, without using another function, results in movement in the opposite direction from the previous movement.

Joystick Control Function Time-Outs (seconds)								
Raise	L (angle left)	R (angle right)	Scoop	Retract	L Wing (out)	L Wing (in)	R Wing (out)	R Wing (in)
4.0	3.0	3.0	5.0	3.0	3.0	3.0	3.0	3.0

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

SMOOTH STOP AND ONE-TOUCH FLOAT FEATURES

Smooth Stop

Smooth stop, or soft stop, allows the blade to coast to a stop when the button/lever is released. The result is smoother operation, reduction in shock to the hydraulic system, and longer hose and valve life.

While there are advantages to having this feature, there are also advantages to temporarily disabling it. For example, disabling smooth stop allows for more precise movements of the blade while operating close to buildings and other obstacles.

All controls come standard with this feature **ENABLED**.

One-Touch FLOAT

One-touch FLOAT immediately activates the FLOAT mode and releases the blade to the ground, without having to hold the button or lever in LOWER. This can improve transition time when backing up to plow forward again, eliminating the time spent holding the control and waiting for the blade to fully drop.

All controls come standard with this feature **DISABLED**.

Enable/Disable Procedure

To enable/disable the smooth stop and one-touch FLOAT features, perform the following steps.

Performing the sequence multiple times will toggle the feature between enabled and disabled.

1. Turn the vehicle ignition switch to the "ON" or "ACCESSORY" position. The control backlight will illuminate. It is not necessary to start the vehicle.
2. Verify that the control power indicator is OFF. If the power indicator light is red, the control is ON. Turn the control OFF.

3. **Smooth Stop:** Move and hold the control lever to the "R" position or press and hold the R button while turning the control ON.

One-Touch Float: Move and hold the control lever to the "LOWER" position or press and hold the LOWER button while turning the control ON.

The power indicator light will turn ON and the FLOAT light will flash, indicating the status of the feature.

Light Flash Indicators	
Light	Description
POWER – Red	Solid ON = Control is ON
FLOAT – Green	1 Flash = Feature is <i>disabled</i> 2 Flashes = Feature is <i>enabled</i>

SECURITY GUARD™ SNOWPLOW ANTI-THEFT 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. The control backlight will illuminate. It is not necessary to start the vehicle.
2. Verify that the control power indicator is OFF. If the power indicator light is red, the control is ON. Turn the control OFF.
3. To activate the SECURITY GUARD mode, move the control lever to the #1 position or press the #1 button four consecutive times, and then move the lever to the #4 position or 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 indicator light will turn ON, indicating that the system is ready to accept your 4-digit security code.

Enter your 4-digit security code by moving the control lever to (or pressing the button for) any four of the eight following positions: RAISE, LOWER, LEFT, RIGHT, 1, 2, 3, or 4.

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

4. Once a 4-digit security code is established, the SECURITY GUARD system will recognize any FLEET FLEX control that has been programmed with the same 4-digit security code. If a control not programmed with the correct 4-digit security code is connected to the system, the established security code will have to be entered manually before the snowplow can be activated (see the Manual Unlock procedure).

NOTE: If the control 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 FLEET FLEX 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 switch to the ON or ACCESSORY position. The control backlight will illuminate.
2. Turn the control ON.
3. The power indicator light will flash rapidly, indicating that the snowplow is locked.
4. Enter the 4-digit security code.
5. After the correct security code is entered, the power indicator light will change from flashing rapidly to a solid light to indicate that 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 FLEET FLEX 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. The control backlight will illuminate.
2. If the snowplow is locked (the control power indicator light will be flashing rapidly), unlock the snowplow by following the Manual Unlock procedure described above.
3. Turn the control OFF. Verify that the power indicator light is OFF.
4. With the control OFF, move the control lever to the #2 position or press the #2 button four consecutive times, then move the lever to the #3 position or 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."

Light Flash Indicators

POWER – Red	Function
OFF	Control is OFF
Solid ON	Control is ON and active
Slow Flash (1 per second)	No communication
Fast Flash (2 per second)	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 control other than 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 only fully functional with joystick control PN 85250 and hand-held control PN 85200.
- In the event that a snowplow is locked and cannot be manually unlocked or reset, contact your authorized dealer.
- REMINDER: Record your security code for future reference.

SECURITY GUARD™ SNOWPLOW ANTI-THEFT SYSTEM, *continued*

Distributor Master Control

The distributor master control (PN 78800) can clear an established code in a snowplow module without using the original control that was used to establish the code. This procedure should also be used to reset the module if the security code is unknown.

IMPORTANT: The following steps must be performed using the distributor master control. Only the distributor master control is programmed to clear an established security code when the original control used to establish the code is not available.

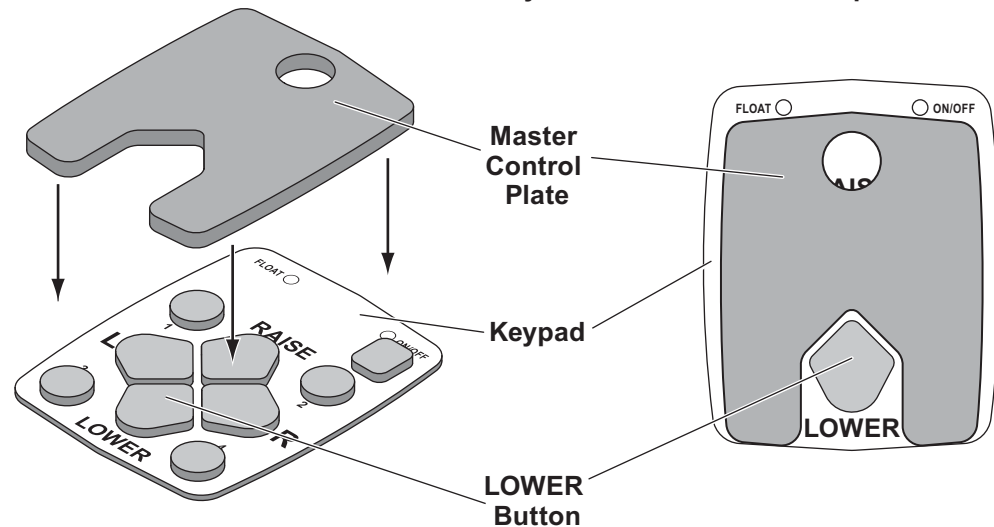
⚠ WARNING

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.

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.
3. Pushing the tool down will engage all functions except LOWER. While pushing down on the plate, turn the vehicle ignition ON.
4. When the ignition is turned to the "ON" position, the system will reset and the security code associated with the snowplow will be cleared.

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

Position the Master Control Plate on the keypad so that only the LOWER button is exposed.












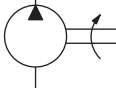















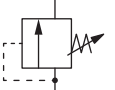


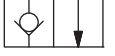
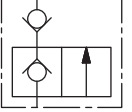




ELECTRICAL & HYDRAULIC SCHEMATICS

The following 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 of the components in the system. Each component is represented by a symbol. The hydraulic and electrical legends describe each of the symbols used in the schematics for this guide.

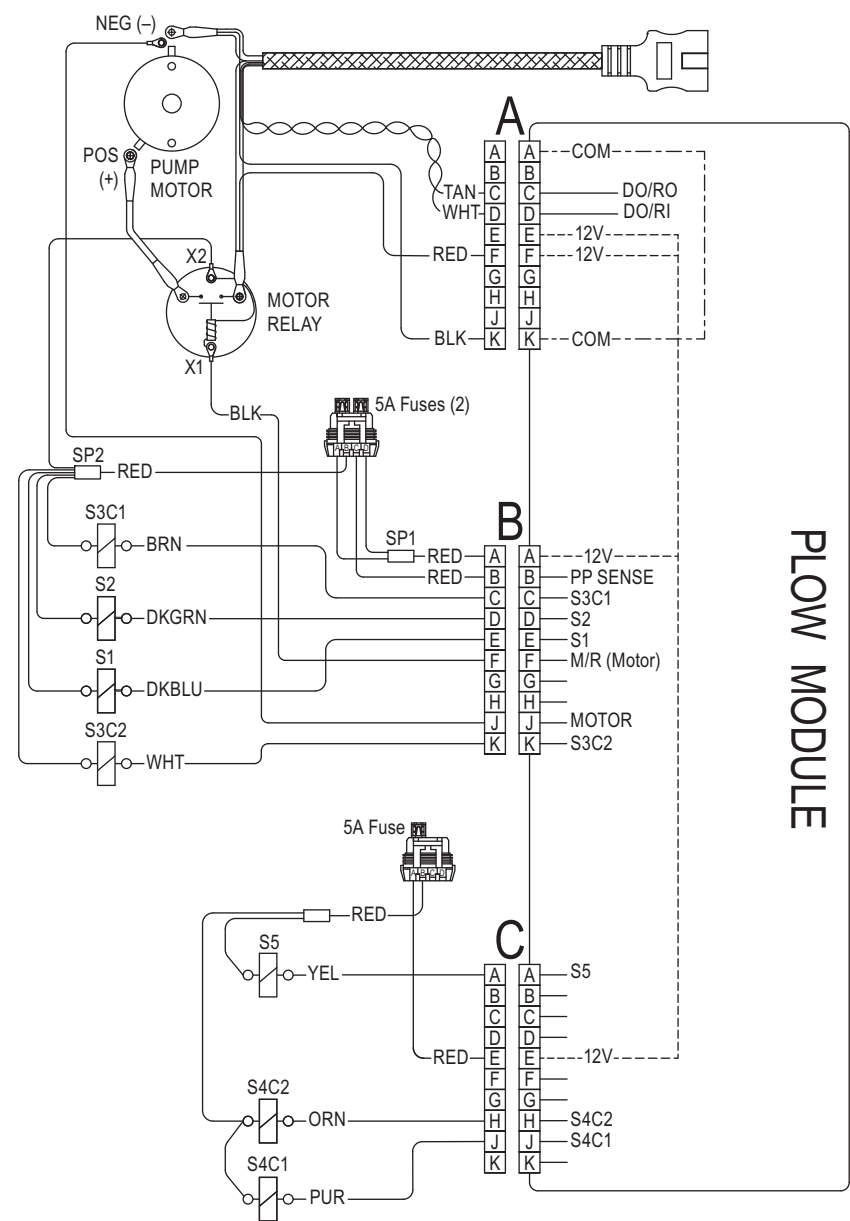
The first two schematics show a general overview of the complete hydraulic and electrical systems. Other schematics highlight the flow of hydraulic fluid and electrical current for each function the hydraulic unit performs, as well as the flow of electrical current for snowplow and vehicle lamps.

- Bold lines represent the circuit being activated.
- Shaded components are either activated or shifted from their normal position.

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		RAM
	BATTERY		ELECTRIC MOTOR
	MOTOR		FILTER, STRAINER, DIFFUSER
	HEADLAMP		COMPONENT ENCLOSURE
	PARK/TURN LAMP		SPRING
	PRINTED CIRCUIT BOARD		SOLENOID, SINGLE WINDING
	COMPONENT ENCLOSURE		CHECK VALVE
			PILOT-OPERATED CHECK VALVE
			VALVE, ADJUSTABLE PRESSURE RELIEF
			VALVE, FLOW CONTROL, ADJUSTABLE NON-COMPENSATED
			ORIFICE PLATE
			VALVE, 2-POSITION, 2-CONNECTION (2-WAY)
			VALVE, 2-POSITION, 2-CONNECTION (2-WAY) WITH INTEGRAL CHECK VALVE
			VALVE, 2-POSITION, 3-CONNECTION (3-WAY)
			VALVE, 2-POSITION, 4-CONNECTION (4-WAY)

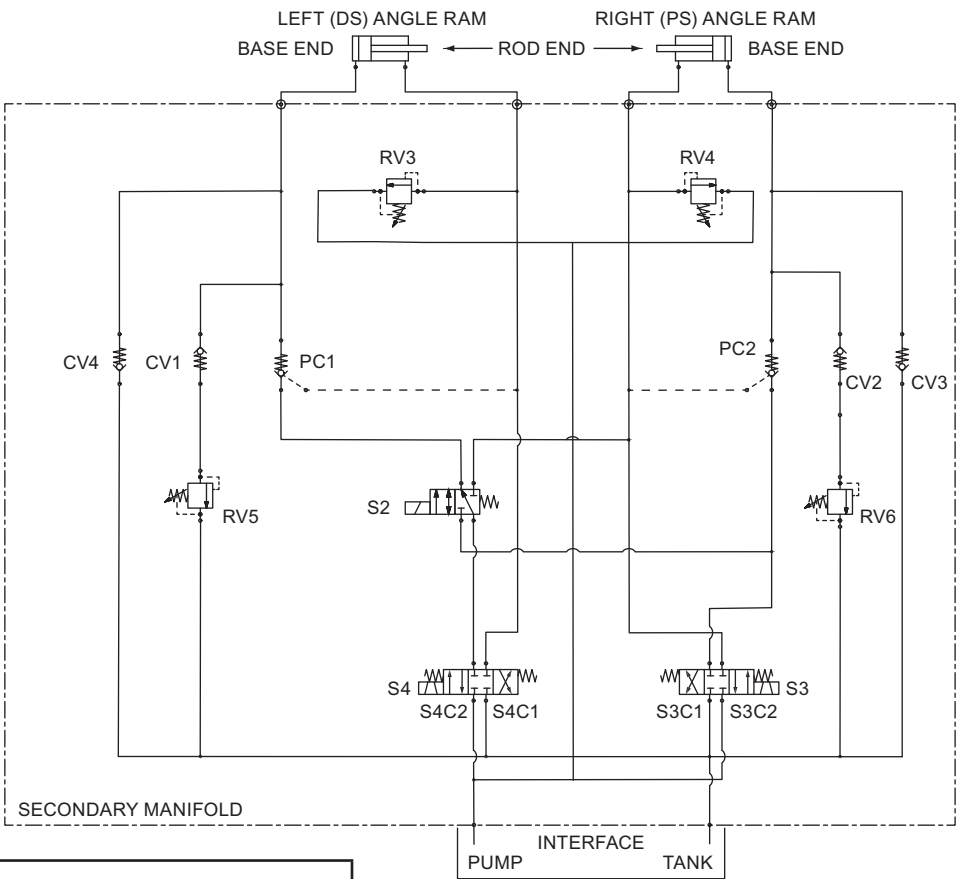
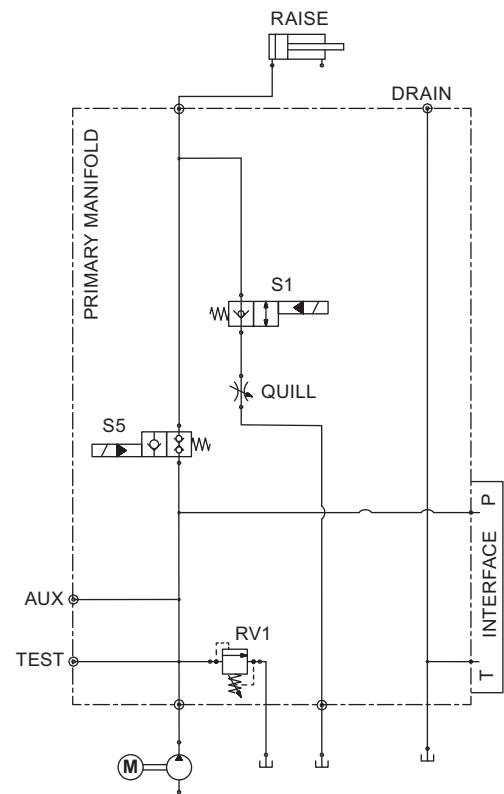
ELECTRICAL & HYDRAULIC SCHEMATICS

Electrical Schematic – V-Plow



ELECTRICAL & HYDRAULIC SCHEMATICS

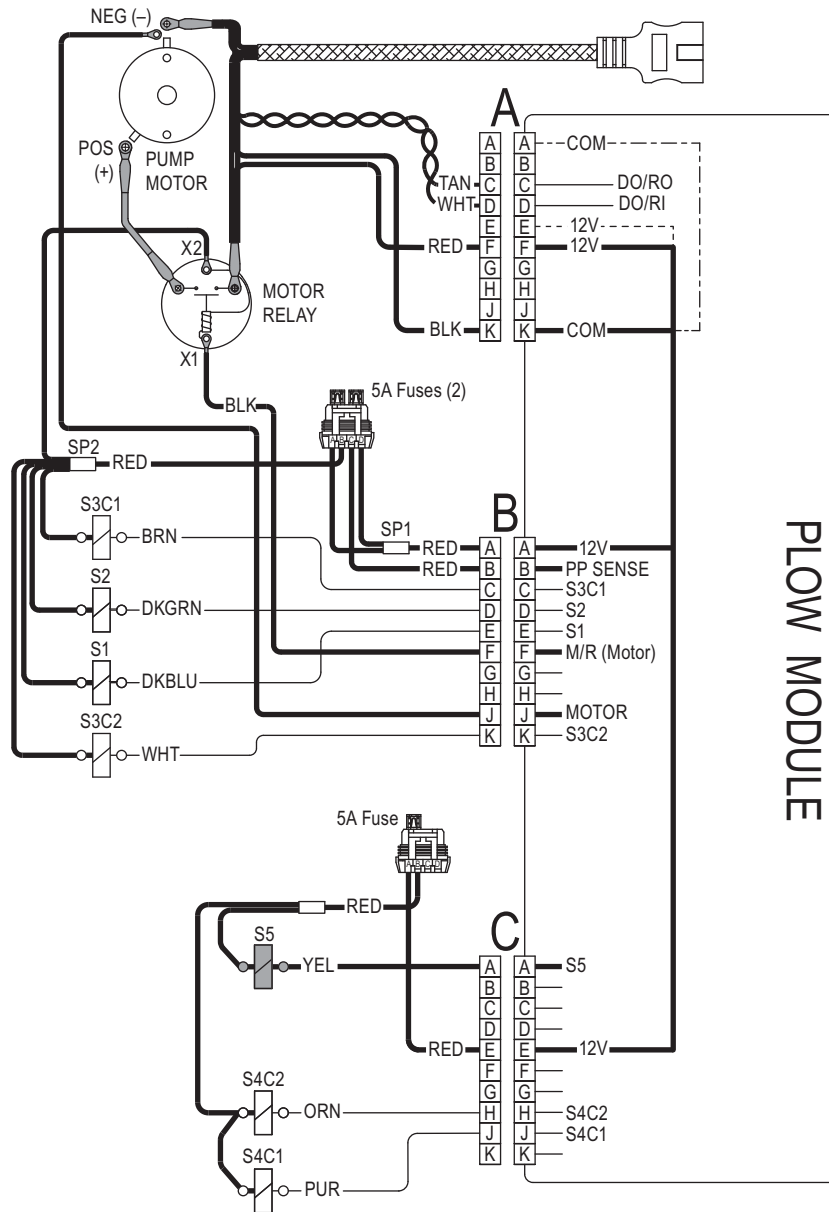
Hydraulic Schematic – V-Plow



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ↖	SCOOP ↗	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

Relief Valve Settings		
RV1	Pump	2250 ± 100 psi
RV3	DS Ram Rod End	2200 ± 100 psi
RV4	PS Ram Rod End	
RV5	DS Ram Base End	3400 ± 100 psi
RV6	PS Ram Base End	

RAISE – ELECTRICAL

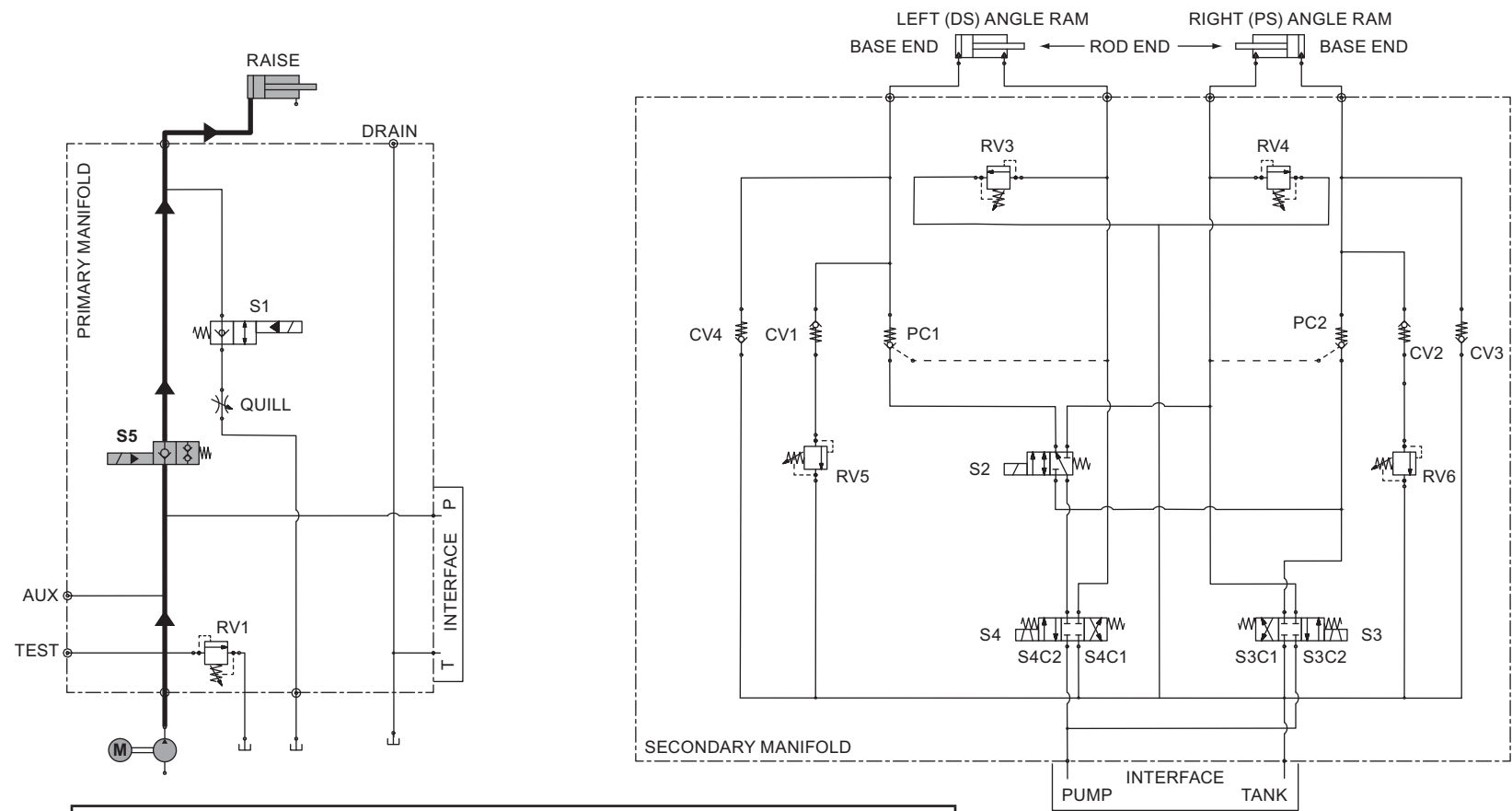


System Response

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 S5.
2. Hydraulic fluid from the pump flows through the activated S5 and into the base end of the lift ram, causing the ram to extend and raising the blade.

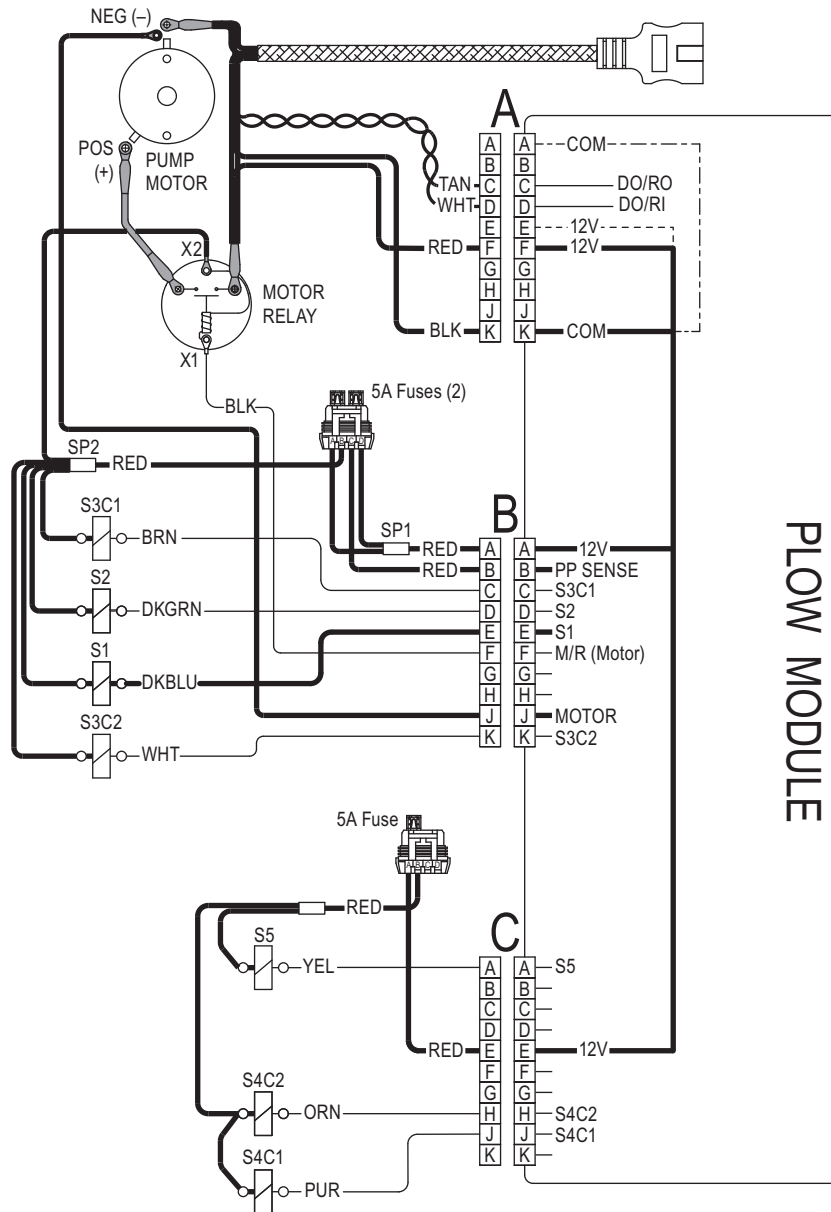
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

RAISE – HYDRAULIC



Solenoid		Blade Movement									
		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ∩	SCOOP ∪	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

LOWER/FLOAT – ELECTRICAL



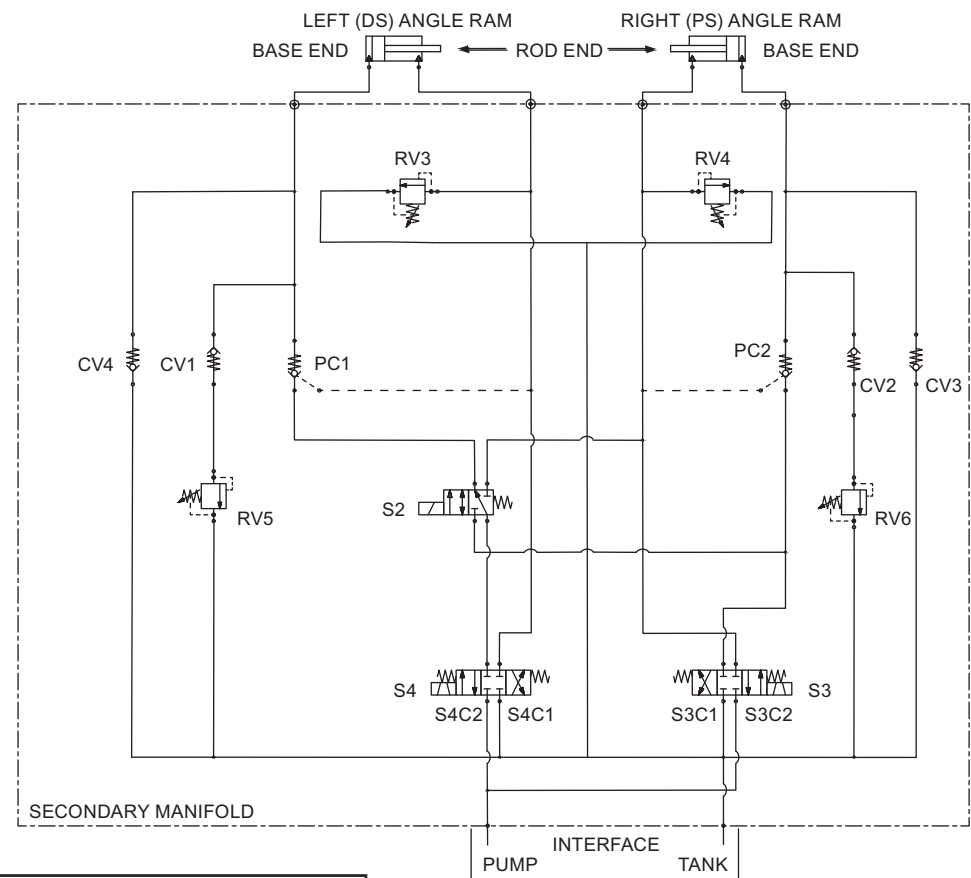
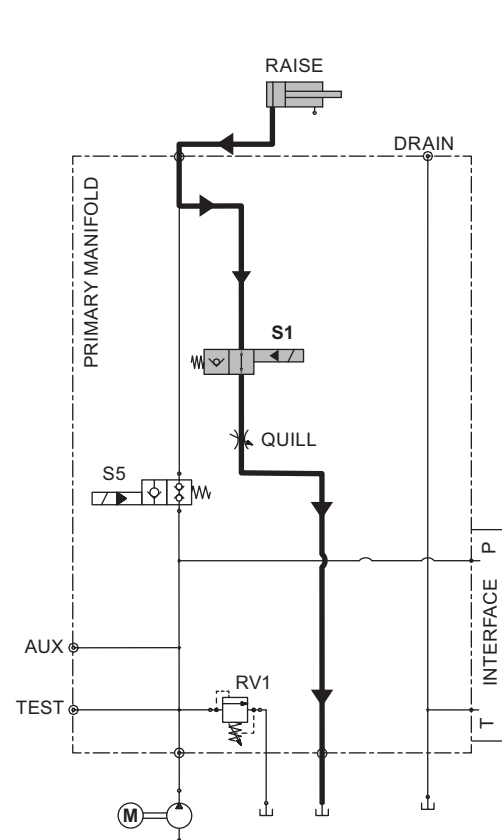
System Response

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. The weight of the snowplow forces the lift ram to retract. The retracting lift ram pushes the hydraulic fluid out of its base end through the activated S1 cartridge valve, through the quill, and back into the reservoir.

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

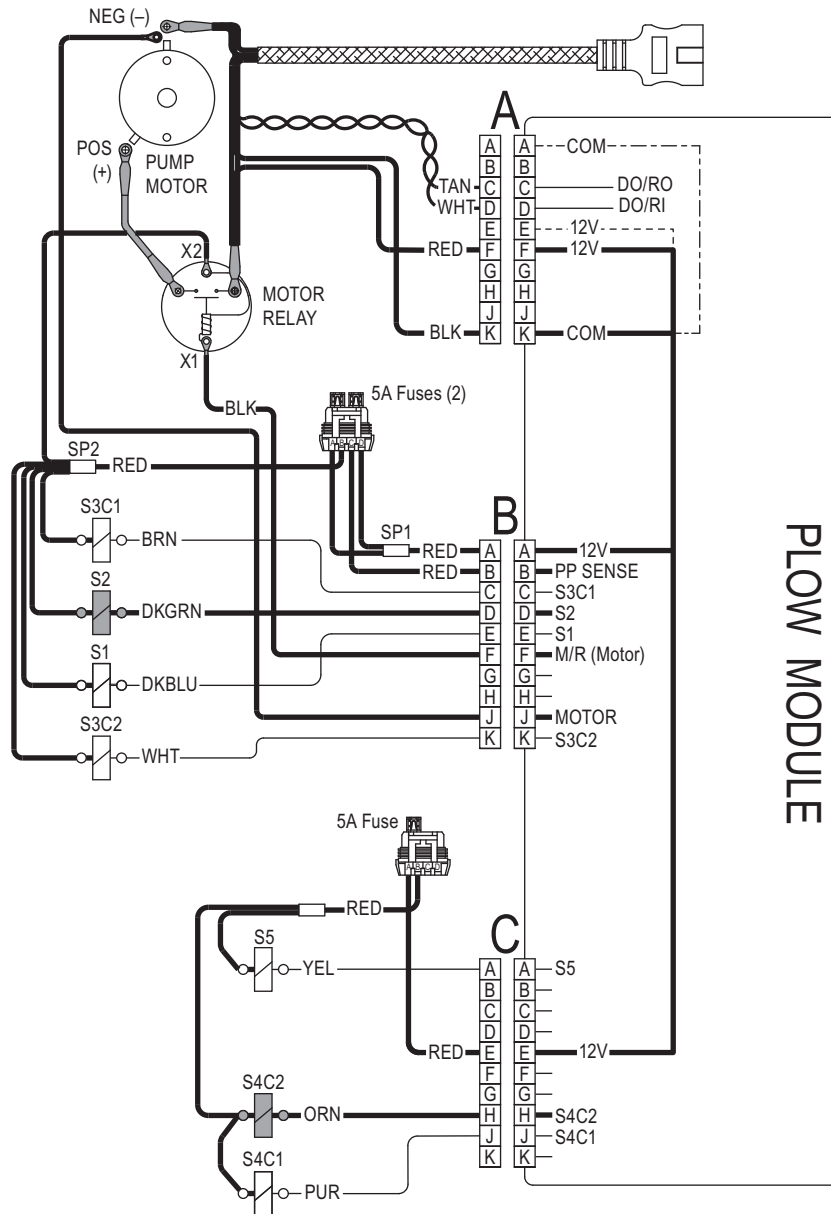
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

LOWER/FLOAT – HYDRAULIC



Solenoid		Blade Movement									
		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ∧	SCOOP ⋈	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

ANGLE RIGHT – ELECTRICAL

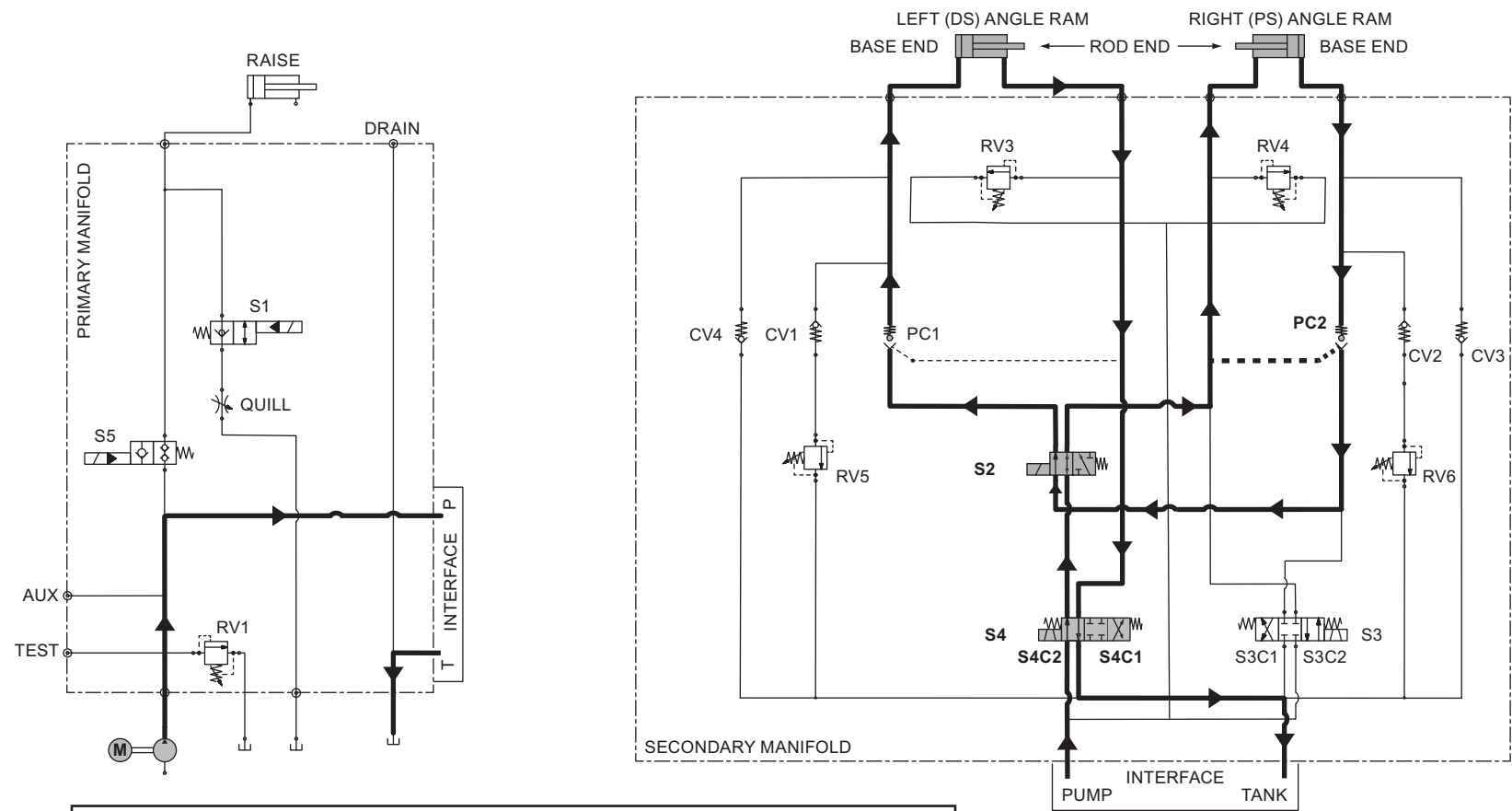


System Response

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 valves S4C2 and S2.
2. Hydraulic fluid from the pump flows through activated S4C2 and S2 cartridge valves and into the rod end of the right (passenger-side) ram, causing the ram to retract.
3. The retracting right ram pushes hydraulic fluid out of the base end of the ram, through the activated PC2 pilot-operated check valve, back through the activated S2 and the PC1 valve. The fluid then enters the base end of the left (driver-side) ram, causing the ram to extend.
4. The extending left ram pushes hydraulic fluid out of the rod end of the ram and back through the activated S4C2 to the reservoir.

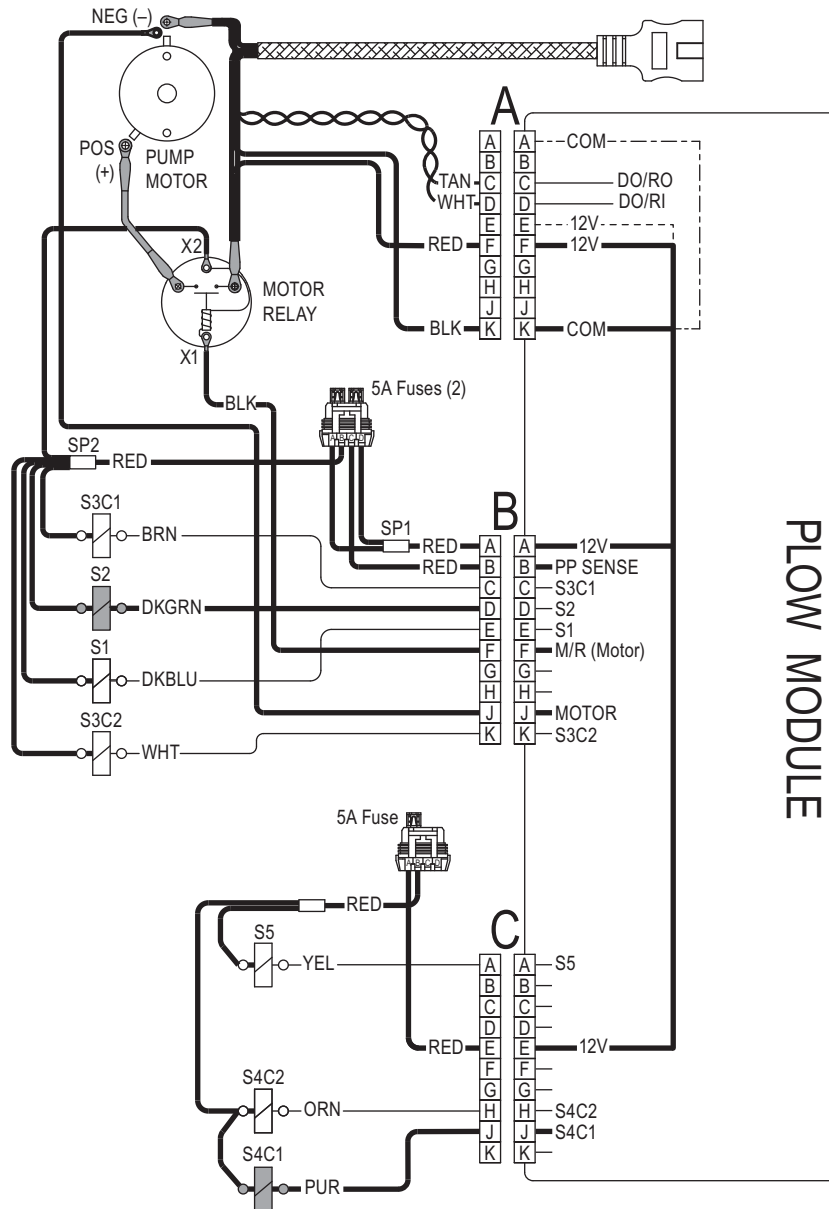
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

ANGLE RIGHT – HYDRAULIC



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT 	ANGLE LEFT 	VEE 	SCOOP 	RIGHT EXTEND 	RIGHT RETRACT 	LEFT EXTEND 	LEFT RETRACT
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

ANGLE LEFT – ELECTRICAL

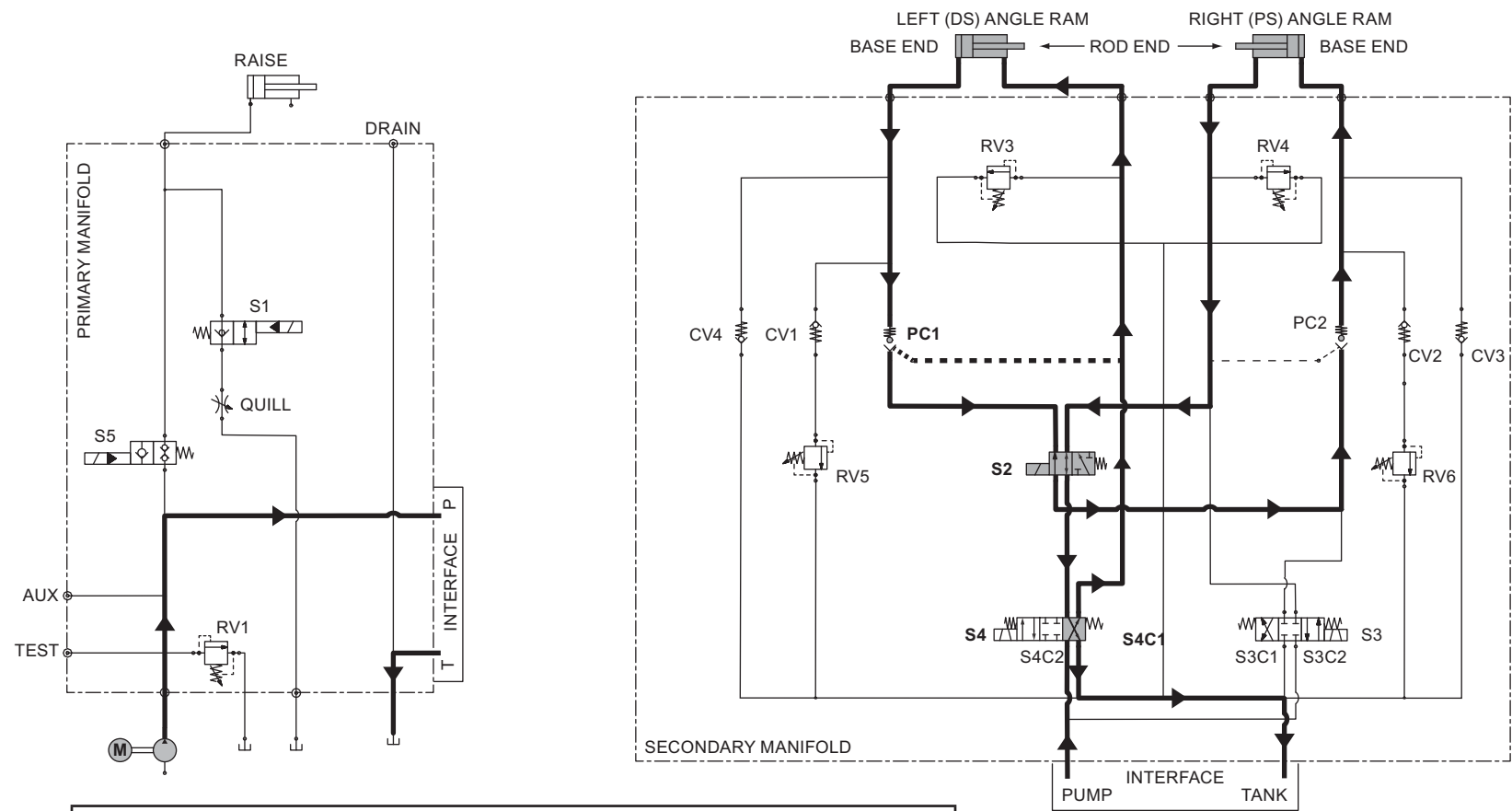


System Response

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 S4C1 and S2.
2. Hydraulic fluid from the pump flows through activated S4C1 and into the rod end of the left (driver-side) ram, causing the ram to retract.
3. The retracting left ram pushes hydraulic fluid out of the base end of the ram, through the activated PC1 pilot-operated check valve, back through the activated S2, and through PC2. The fluid then enters the base end of the right (passenger-side) ram, causing the ram to extend.
4. The extending right ram pushes hydraulic fluid out of the rod end of the ram and back through the activated S2 and S4C1 valves to the reservoir.

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

ANGLE LEFT – HYDRAULIC

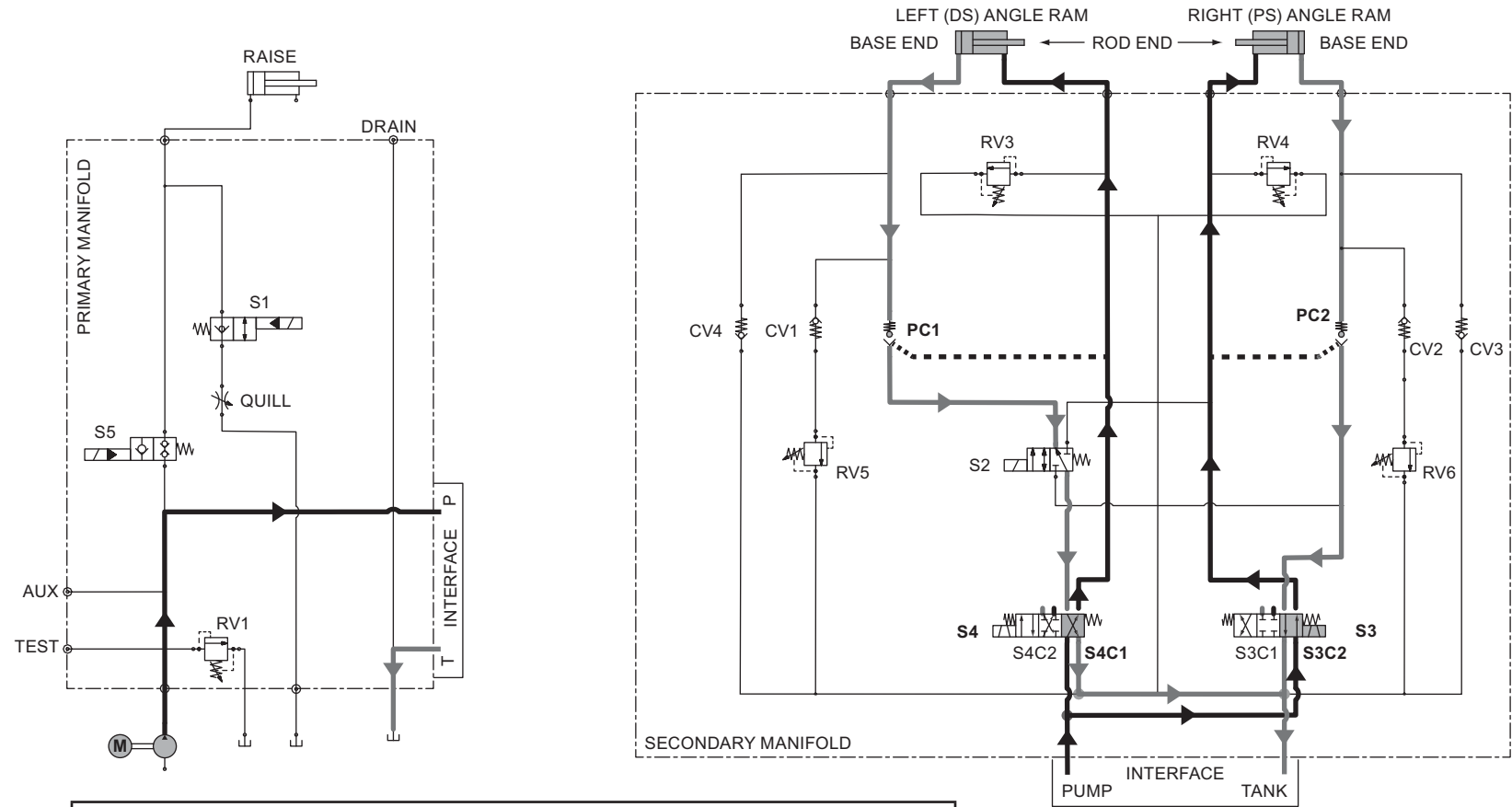


Solenoid		Blade Movement									
		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ∩	SCOOP ∪	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									



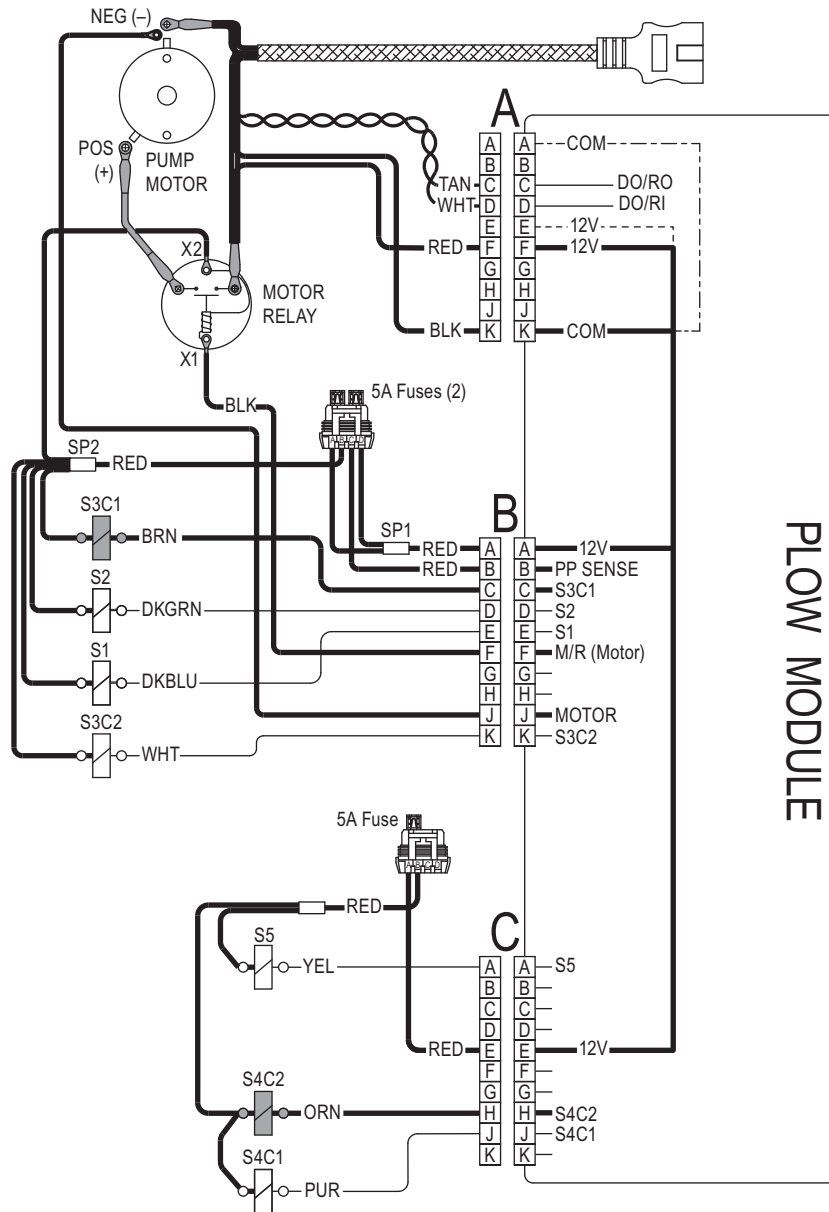
1. By activating the RETRACT (vee) function on the cab control, the control sends a signal to the plow module to complete the ground path for the electrical circuit, activating the motor relay and solenoid cartridge valves S4C1 and S3C2, activating these valves.
2. Hydraulic fluid from the pump flows through the activated S4C1 and S3C2 cartridge valves then into the rod end of both the driver-side (DS) and passenger-side (PS) angle rams, causing the rams to retract.
3. Pressure within the hydraulic circuit causes the PC1 and PC2 pilot-operated check valves to open.
4. The retracting driver-side ram pushes hydraulic fluid out of the ram base end, through the activated PC1, through the inactive S2, and back through the activated S4C1 to the reservoir.
5. The retracting passenger-side ram pushes the hydraulic fluid out of the ram base end, through the activated PC2, and back through the activated S3C2 to the reservoir.

RETRACT (VEE) – HYDRAULIC



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ↖	SCOOP ↗	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1					ON	ON				
	S3C2					ON		ON			
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

SCOOP – ELECTRICAL



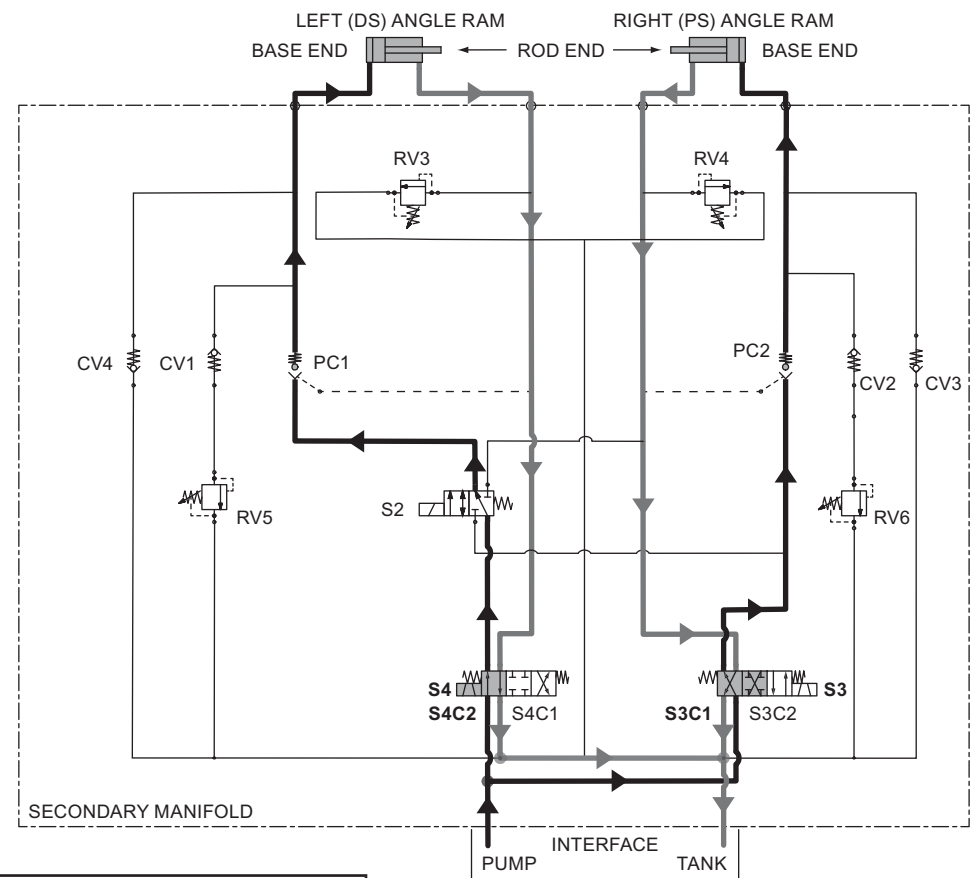
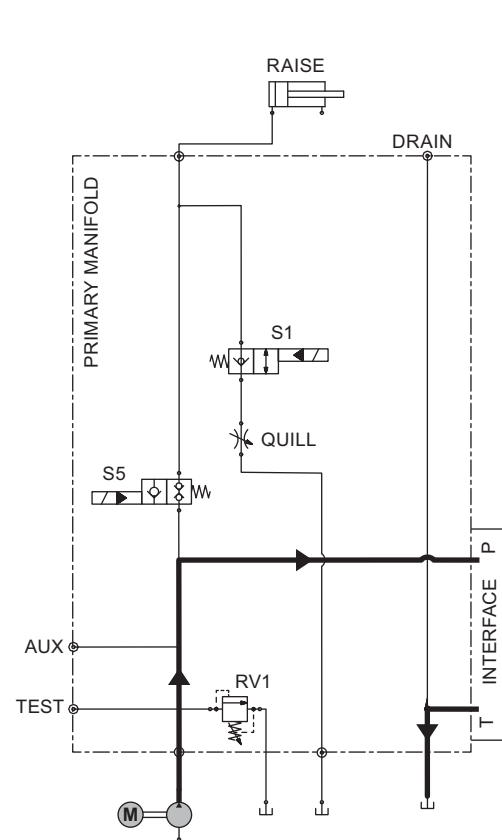
System Response

1. By activating the SCOOP 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 S4C2 and S3C1.
2. Hydraulic fluid from the pump flows through activated S4C2 and S3C1 cartridge valves, through the PC1 and PC2 pilot-operated check valves, then into the base end of both angle rams, causing the rams to extend.
3. The extending driver-side ram pushes hydraulic fluid out of the ram rod end and back through the activated S4C2 to the reservoir.
4. The extending passenger-side ram pushes hydraulic fluid out of the ram rod end and back through the activated S3C1 to the reservoir.

43

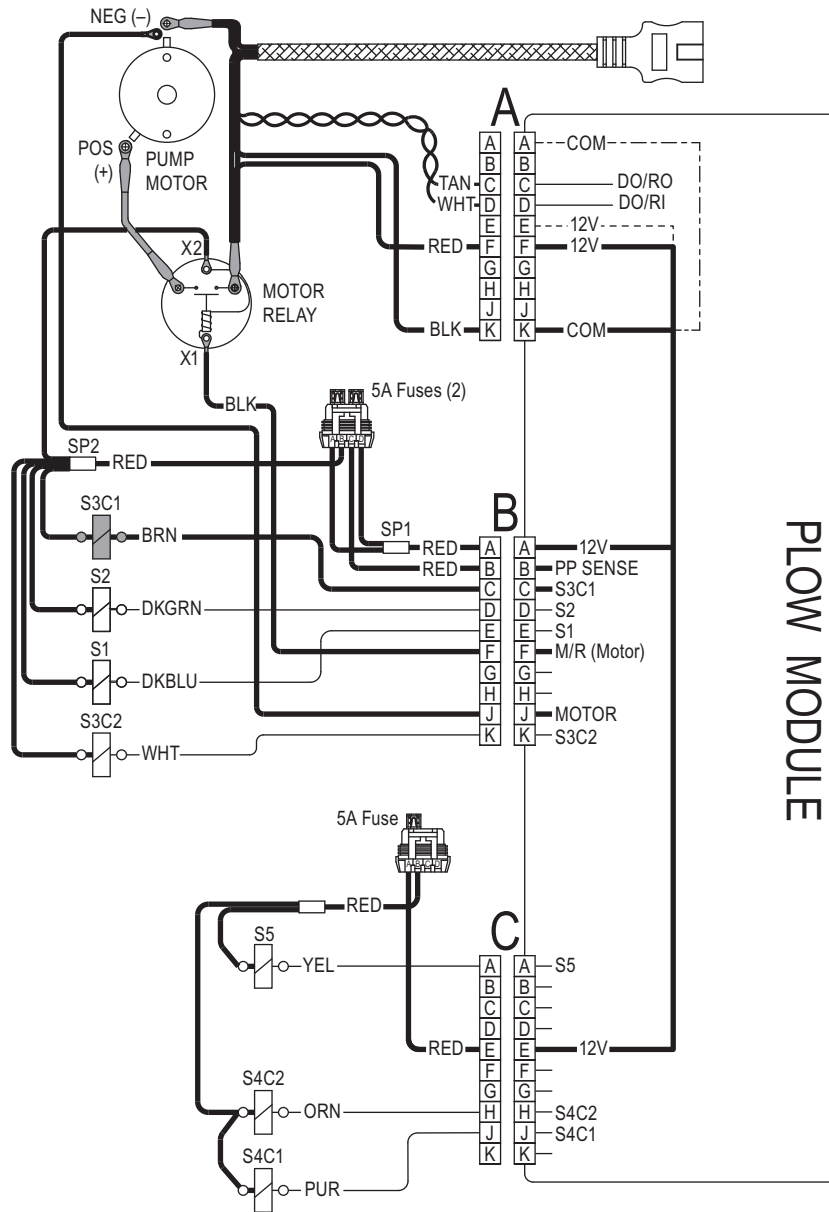
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

SCOOP – HYDRAULIC



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ⋈	SCOOP ⋈	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND →	LEFT RETRACT ←
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON		ON			
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

RIGHT (PS) WING EXTEND – ELECTRICAL



System Response

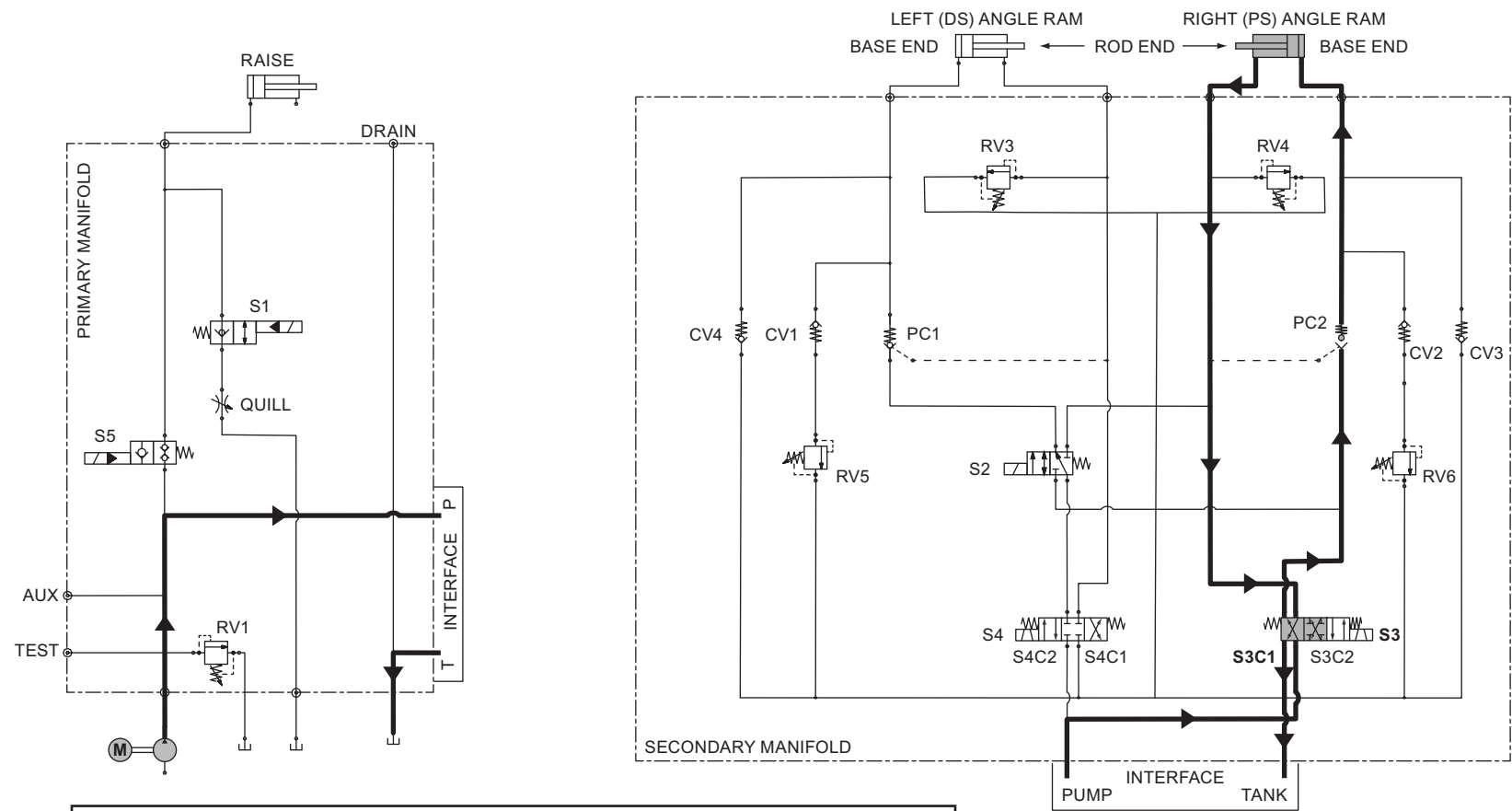
1. By activating the WING IN/OUT function (lower right corner on the control face) on the cab control, the control sends a signal to the plow module to complete the ground path for the electrical circuit, activating the motor relay and solenoid cartridge valve S3C1.

NOTE: The WING IN/OUT mode toggles back and forth between extend and retract functions.

2. Hydraulic fluid from the pump flows through the activated S3C1 and through the PC2 pilot-operated check valve into the base end of the passenger-side ram, causing it to extend.
3. The extending passenger-side ram pushes hydraulic fluid out of the ram rod end and back through the activated S3C1 to the reservoir.

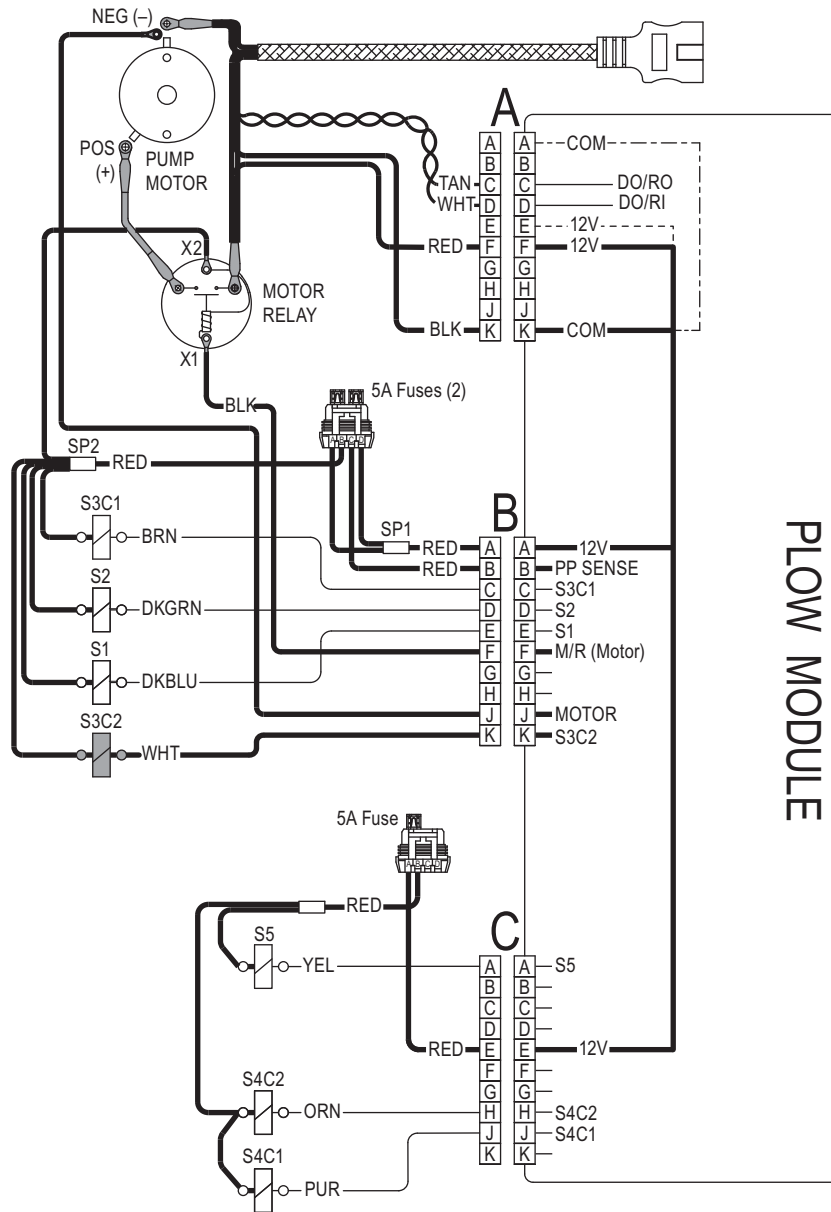
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

RIGHT (PS) WING EXTEND – HYDRAULIC



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ∧	SCOOP ⌢	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND ↘	LEFT RETRACT ↙
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

RIGHT (PS) WING RETRACT – ELECTRICAL



System Response

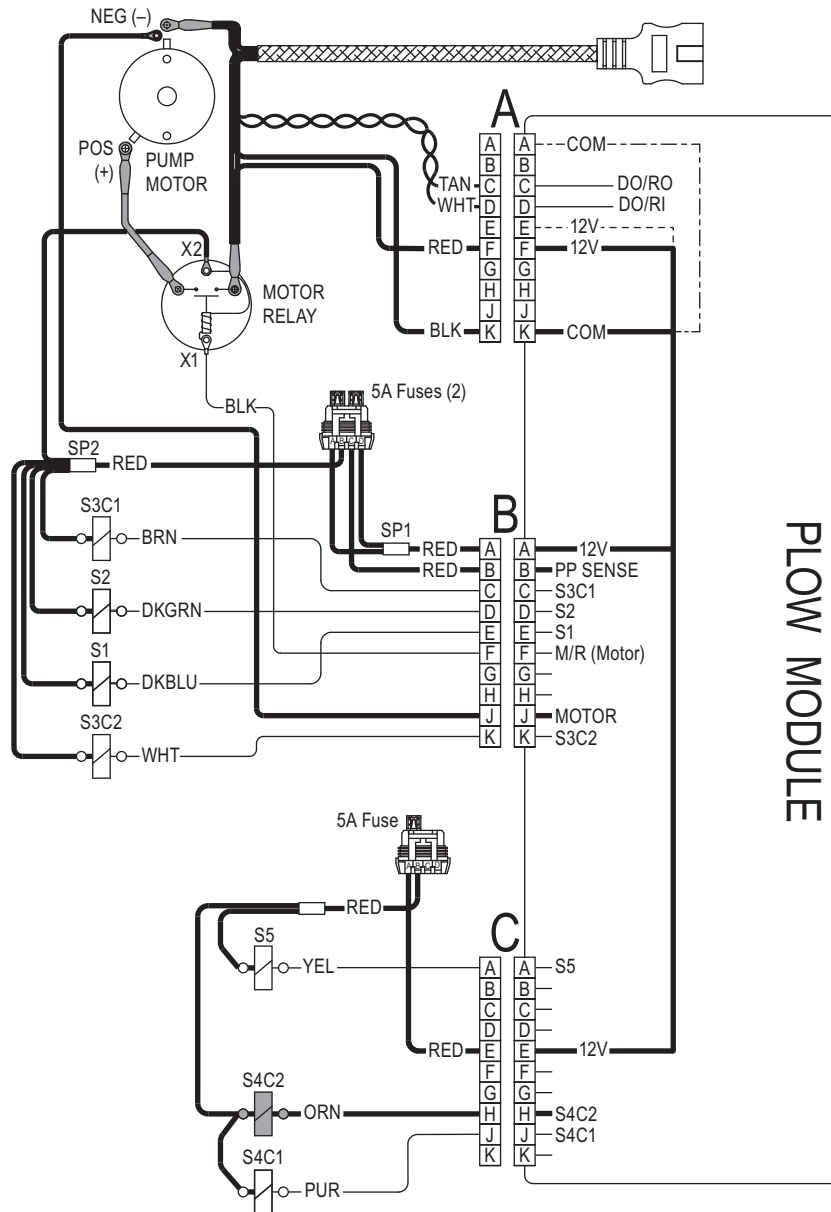
1. By activating the WING IN/OUT function (lower right corner on the control face) on the cab control, the control sends a signal to the plow module to complete the ground path for the electrical circuit, activating the motor relay and solenoid cartridge valve S3C2.

NOTE: The WING IN/OUT mode toggles back and forth between retract and extend functions.

2. Hydraulic fluid from the pump flows through the activated S3C2 into the rod end of the passenger-side ram, causing it to retract.
3. Pressure within this hydraulic circuit causes the PC2 pilot-operated check valve to open.
4. The retracting passenger-side ram pushes hydraulic fluid out of the ram base end, through the activated PC2, and back through the activated S3C2 to the reservoir.

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

LEFT (DS) WING EXTEND – ELECTRICAL



System Response

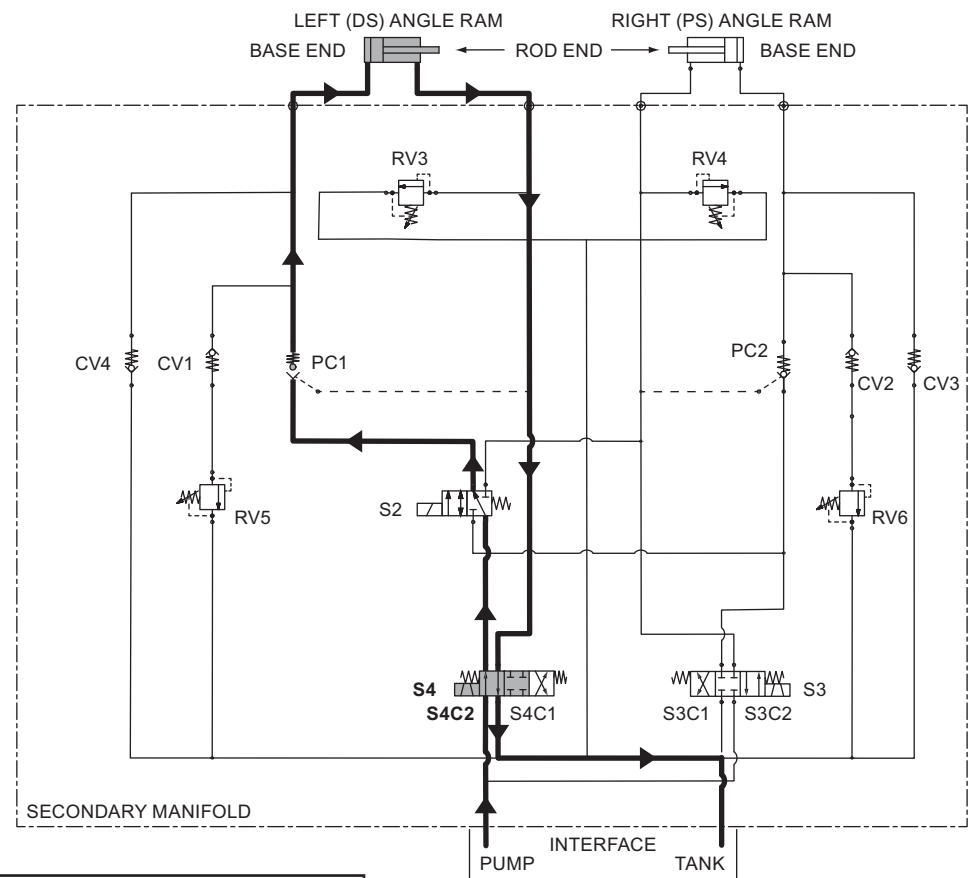
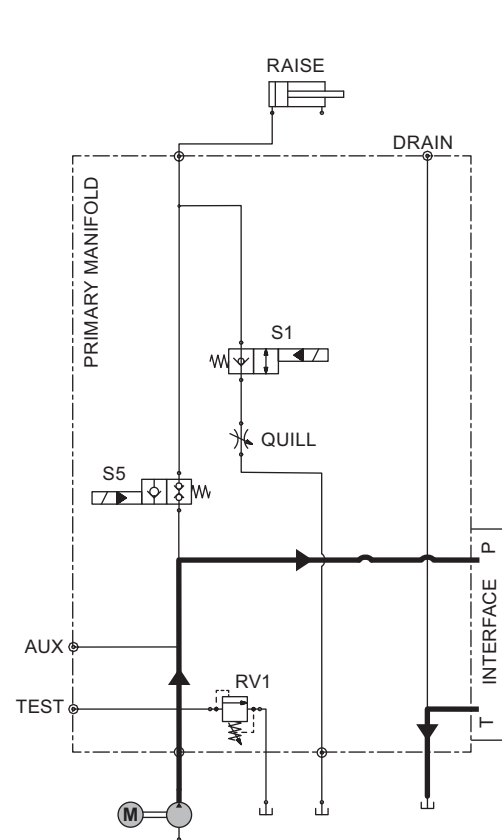
1. By activating the WING IN/OUT function (lower left corner on the control face) on the cab control, the control sends a signal to the plow module to complete the ground path for the electrical circuit, activating the motor relay and solenoid cartridge valve S4C2.

NOTE: The WING IN/OUT mode toggles back and forth between extend and retract functions.

2. Hydraulic fluid from the pump flows through the activated S4C2 and inactive S2, through the PC1 pilot-operated check valve into the base end of the driver-side ram, causing it to extend.
3. The extending driver-side ram pushes hydraulic fluid out of the ram rod end and back through the activated S4C2 to the reservoir.

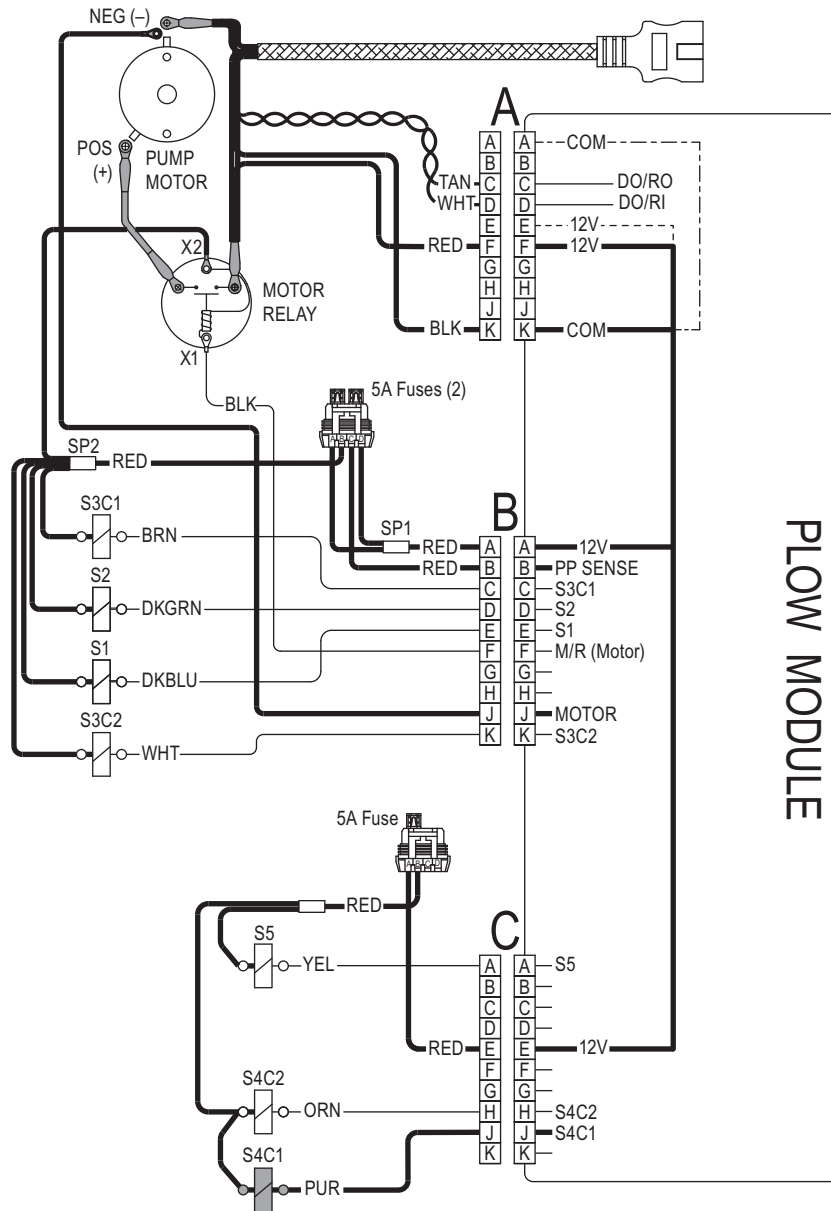
NOTE: Battery voltage is supplied to the plow module, the motor relay, and the seven solenoid coils when the snowplow is connected to the vehicle.

LEFT (DS) WING EXTEND – HYDRAULIC



		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT 	ANGLE LEFT 	VEE 	SCOOP 	RIGHT EXTEND 	RIGHT RETRACT 	LEFT EXTEND 	LEFT RETRACT
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON		ON			
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									

LEFT (DS) WING RETRACT – ELECTRICAL



System Response

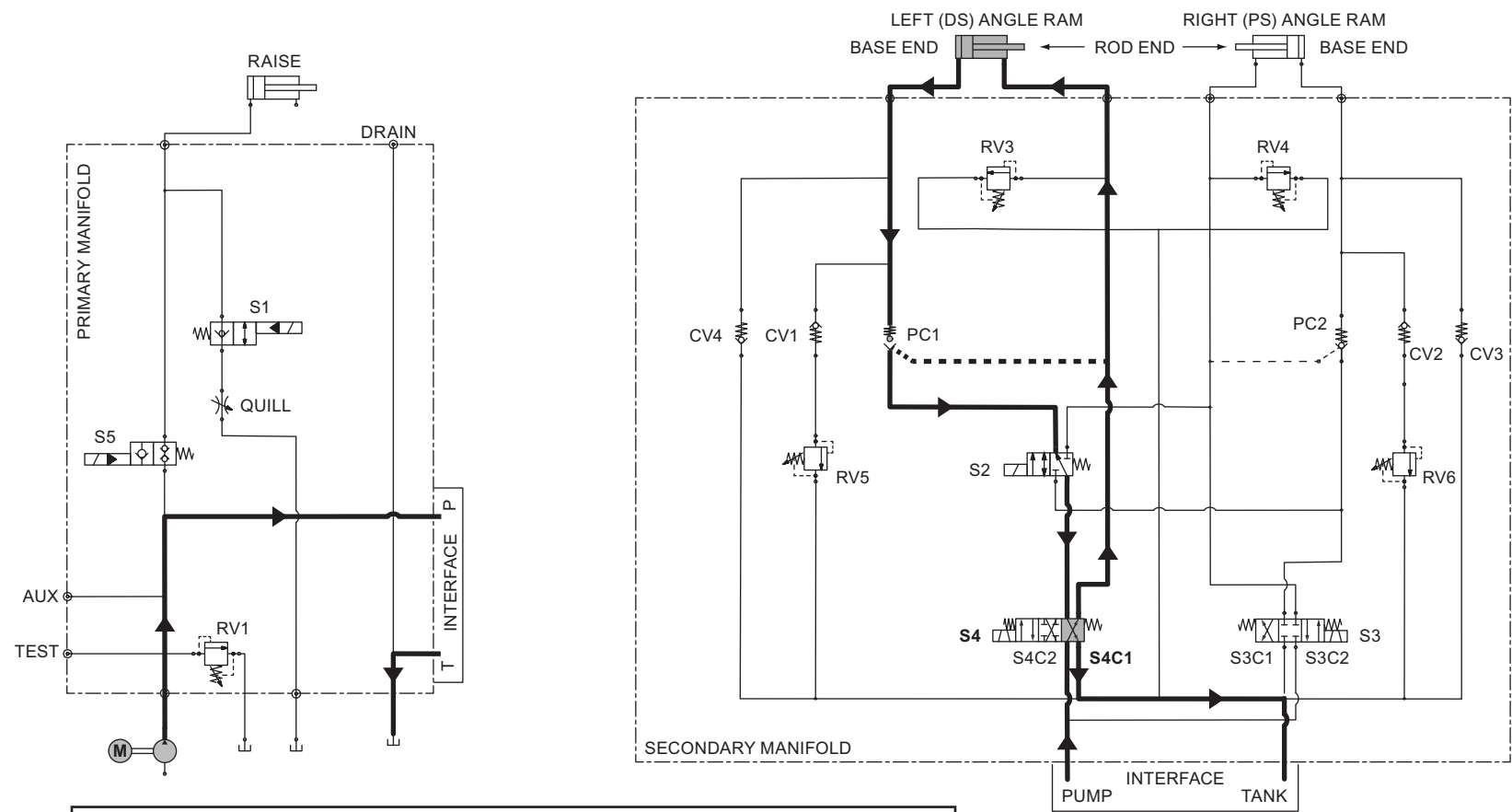
1. By activating the WING IN/OUT function (lower left corner on the control face) on the cab control, the control sends a signal to the plow module to complete the ground path for the electrical circuit, activating the motor relay and solenoid cartridge valve S4C1.

NOTE: The WING IN/OUT mode toggles back and forth between retract and extend functions.

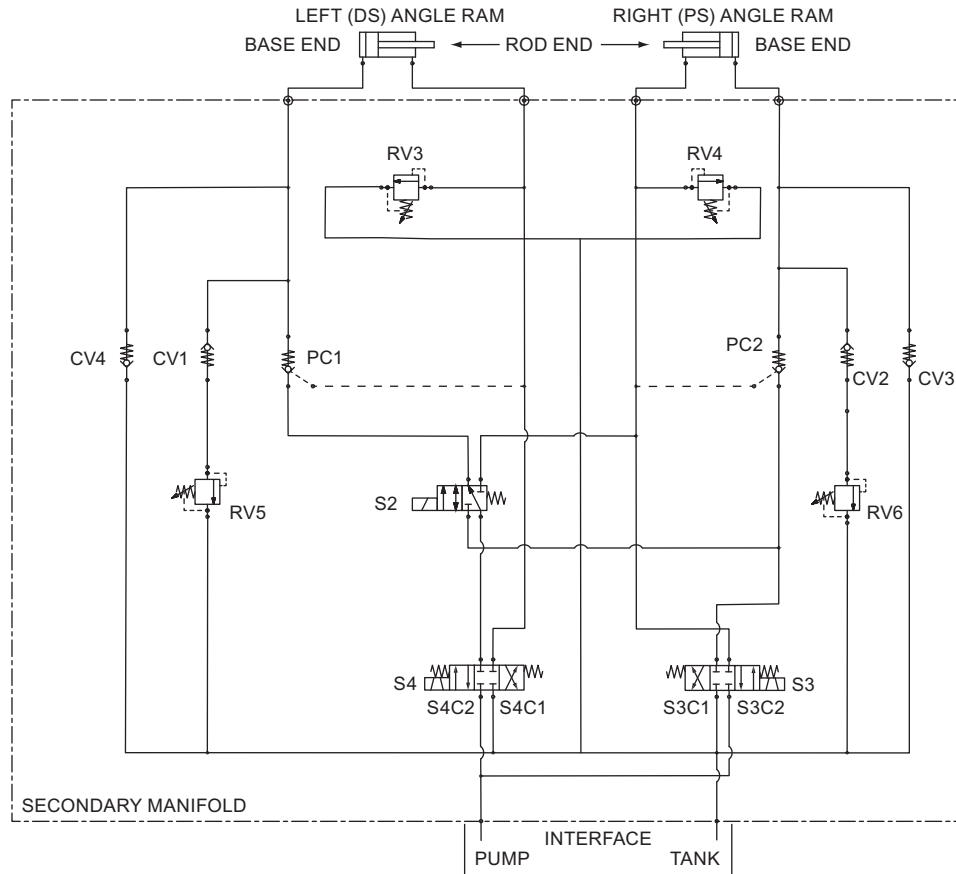
2. Hydraulic fluid from the pump flows through the activated S4C1 cartridge valve and into the rod end of the driver-side ram, causing it to retract.
3. Pressure within this hydraulic circuit causes the PC1 pilot-operated check valve to open.
4. The retracting driver-side ram pushes hydraulic fluid out of the ram base end, through the activated PC1 and the inactive S2, then back through the activated S4C1 to the reservoir.

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

LEFT (DS) WING RETRACT – HYDRAULIC



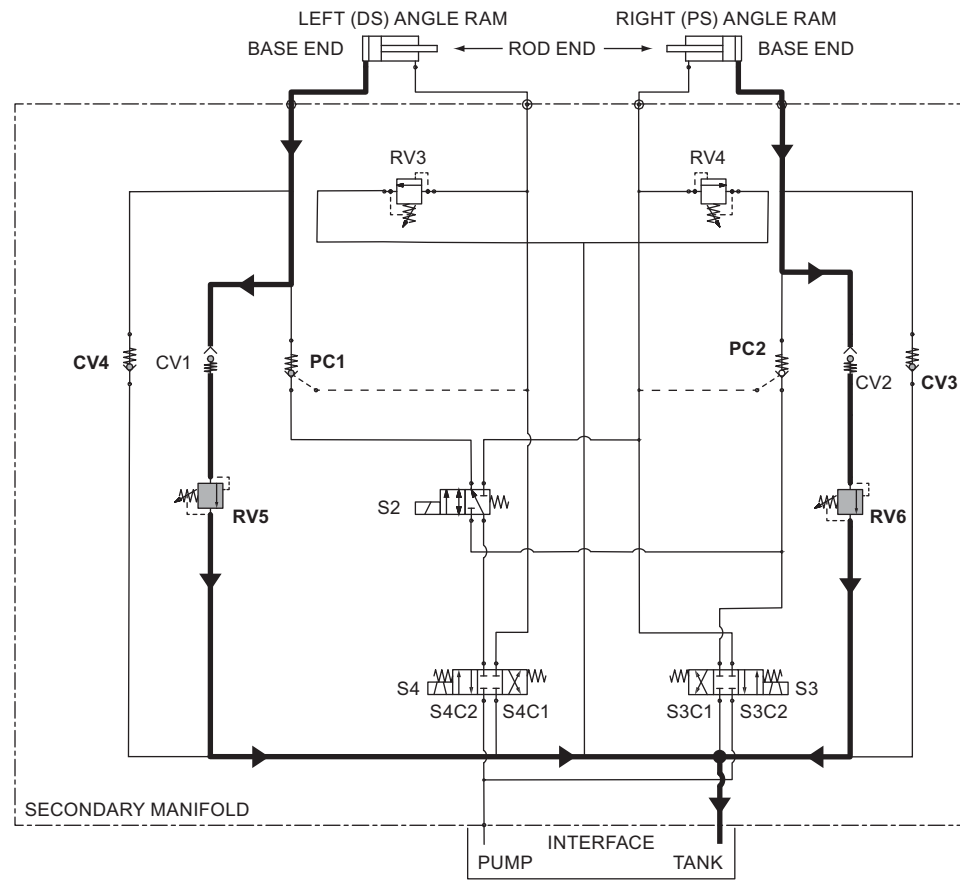
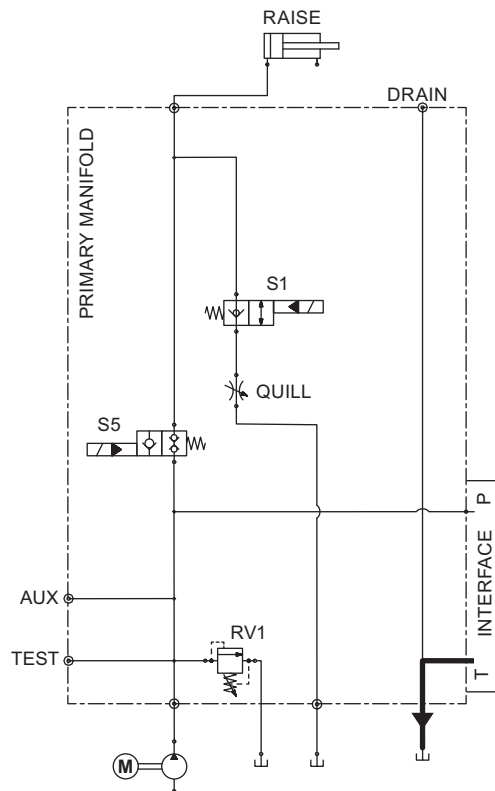
		Blade Movement									
Solenoid		RAISE ↑	LOWER ↓	ANGLE RIGHT ↘	ANGLE LEFT ↙	VEE ∩	SCOOP ∪	RIGHT EXTEND →	RIGHT RETRACT ←	LEFT EXTEND ↗	LEFT RETRACT ↖
Motor	M	ON		ON	ON	ON	ON	ON	ON	ON	ON
SV08-2004	S1		ON								
SV10-43	S2			ON	ON						
SV08-47C	S3C1						ON	ON			
	S3C2					ON			ON		
SV08-47C	S4C1				ON	ON					ON
	S4C2			ON			ON			ON	
SVCV08-20	S5	ON									



STRIKING AN OBJECT WHILE PLOWING FORWARD – HYDRAULIC

System Response

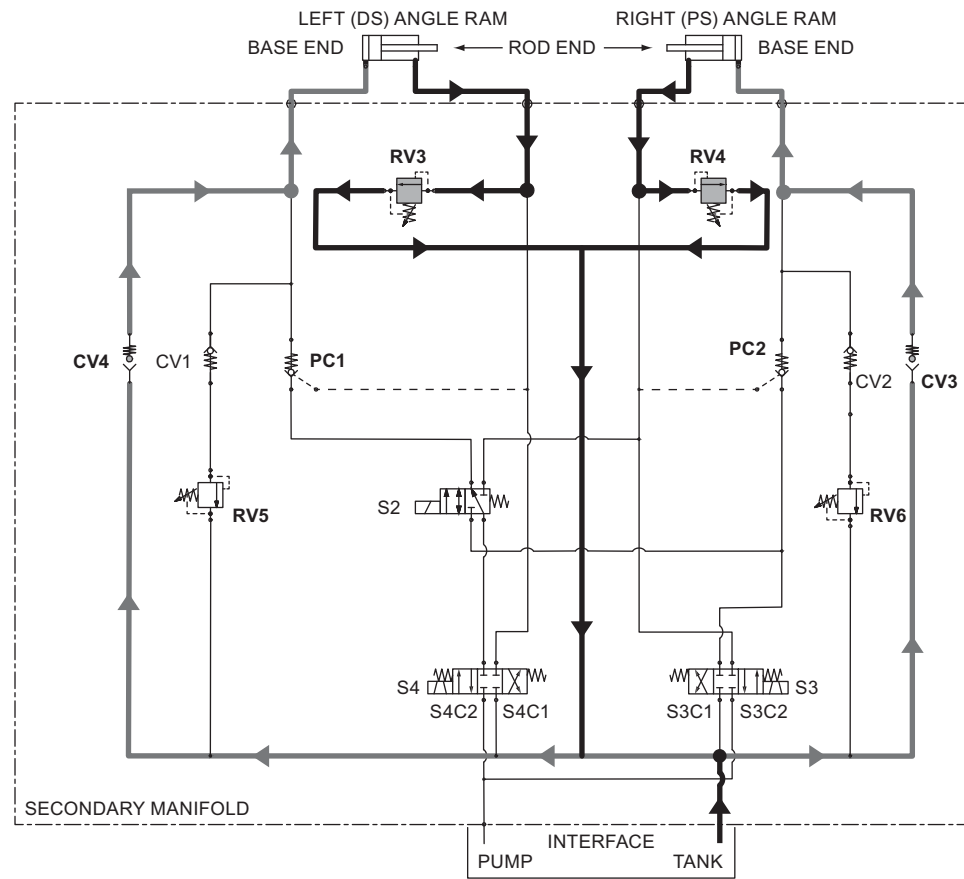
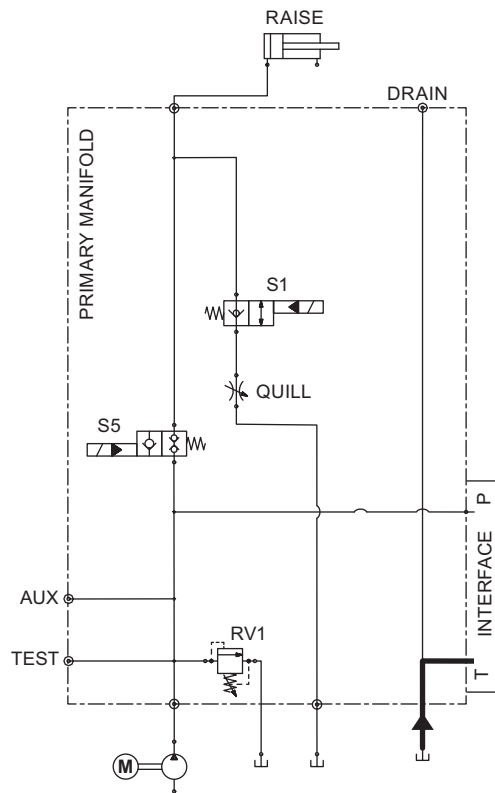
1. Hydraulic fluid is trapped in the base end of the driver-side ram by the CV4 check valve, RV5 relief valve, and PC1 pilot-operated check valve.
2. Hydraulic fluid is trapped in the base end of the passenger-side ram by the CV3 check valve, RV6 relief valve, and PC2 pilot-operated check valve.
3. When the snowplow contacts an object while plowing, the force of the impact increases hydraulic pressure in the base end of the ram. When the pressure exceeds 3400 psi, the ram's base-end relief valve opens (RV5 on the driver's side, RV6 on the passenger's side), allowing fluid to flow back to the reservoir.
4. Due to the small volume on the rod side of the piston, fluid is not replaced. This causes a slight temporary vacuum in that circuit.



STRIKING AN OBJECT WHILE BACK DRAGGING – HYDRAULIC

System Response

1. Hydraulic fluid is trapped in the rod end of the driver-side ram by the inactivated S4 solenoid cartridge valve and the RV3 rod-end relief valve.
2. Hydraulic fluid is trapped in the rod end of the passenger-side ram by the inactivated S3 solenoid cartridge valve and the RV4 rod-end relief valve.
3. When the snowplow contacts an object while back dragging, the force of the impact increases hydraulic pressure in the rod end of the ram. When the pressure exceeds 2200 psi, the ram's rod-end relief valve opens (RV3 on the driver's side, RV4 on the passenger's side).
4. The fluid leaves the rod end of the angle ram towards the reservoir, at which time fluid is also being drawn from the reservoir through CV4 (on the driver's side) or CV3 (on the passenger's side) to fill the base end of the angle ram. This happens due to the differential volume on either side of the ram's piston.

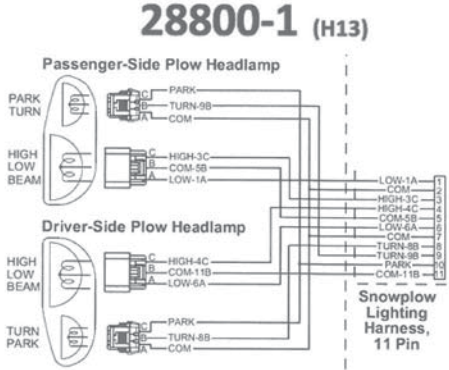
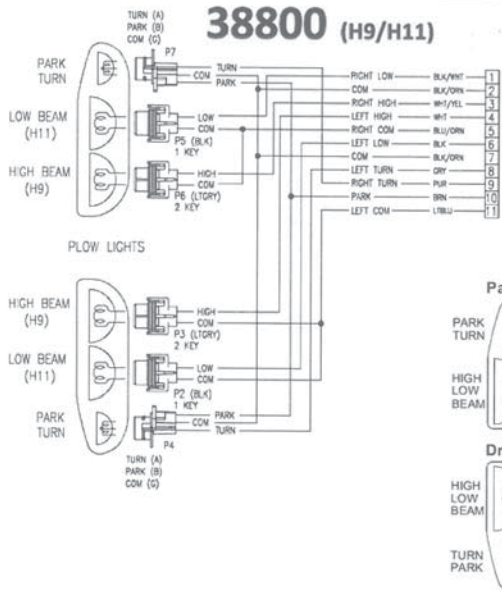
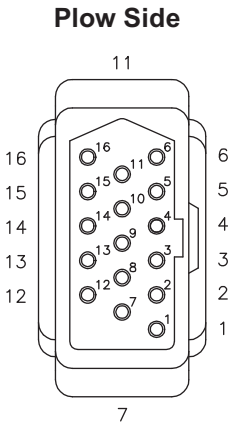
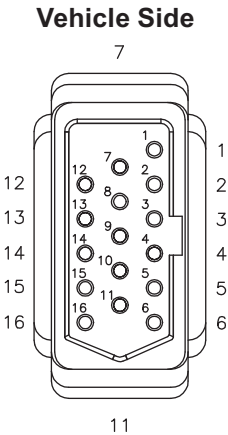
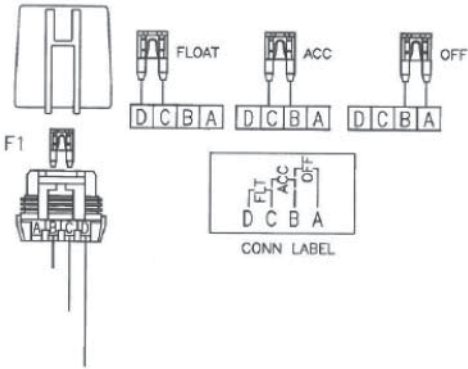


HEADLAMPS – ELECTRICAL/HARNESSES

FLOAT Ground	YEL	1	1	YEL	FLOAT Input
EdgeView™ SENSE IN	BLK/ORN	2	2	BLK/ORN	EdgeView LIGHT
COMMON	BLK/WHT	3	3	BLK/WHT	COMMON
RIGHT LOW	WHT/YEL	4	4	WHT/YEL	RIGHT LOW
RIGHT HIGH	WHT	5	5	WHT	RIGHT HIGH
LEFT HIGH	YEL	6	6	YEL	LEFT HIGH
BEL OUT	BLK/ORN	7	7	BLK/ORN	EdgeView LIGHT
COM	BLK	8	8	BLK	COMMON
LEFT LOW	GRY	9	9	GRY	LEFT LOW
LEFT TURN	PUR	10	10	PUR	LEFT TURN
RIGHT TURN	BRN	11	11	BRN	RIGHT TURN
RIGHT PARK	PNK	12	12	PNK	RIGHT PARK
RIGHT DRL	BLK/ORN	13	13	BLK/ORN	RIGHT DRL
COMMON	BLK/ORN	14	14	BLK/ORN	COMMON
COMMON	BRN	15	15	LTBLU	LEFT PARK
LEFT PARK	PNK	16	16	PNK	LEFT DRL
LEFT DRL					

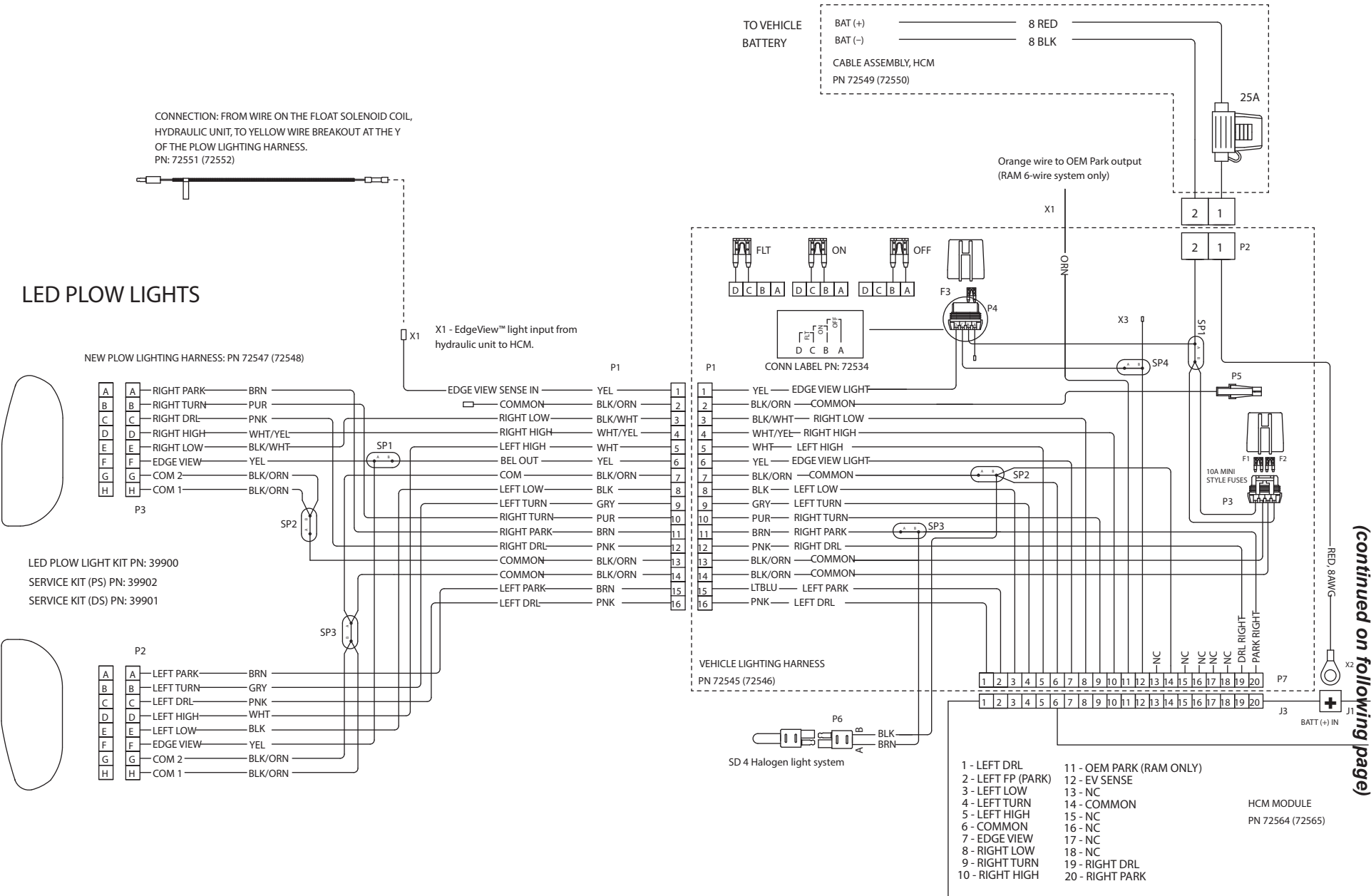
PLOW SIDE

VEHICLE SIDE

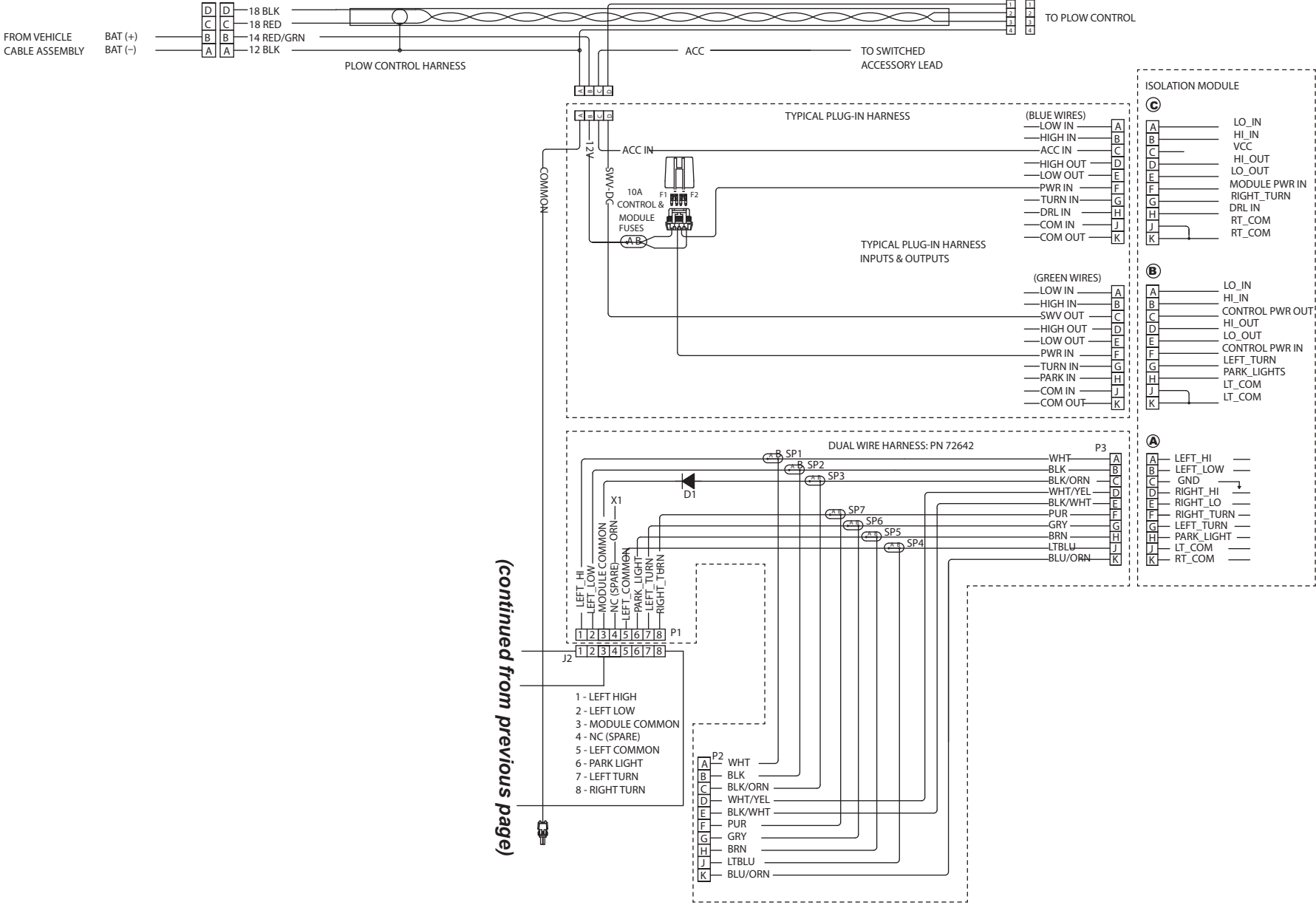


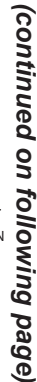


HEADLAMPS: TYPICAL LED SCHEMATIC (continued on following page)

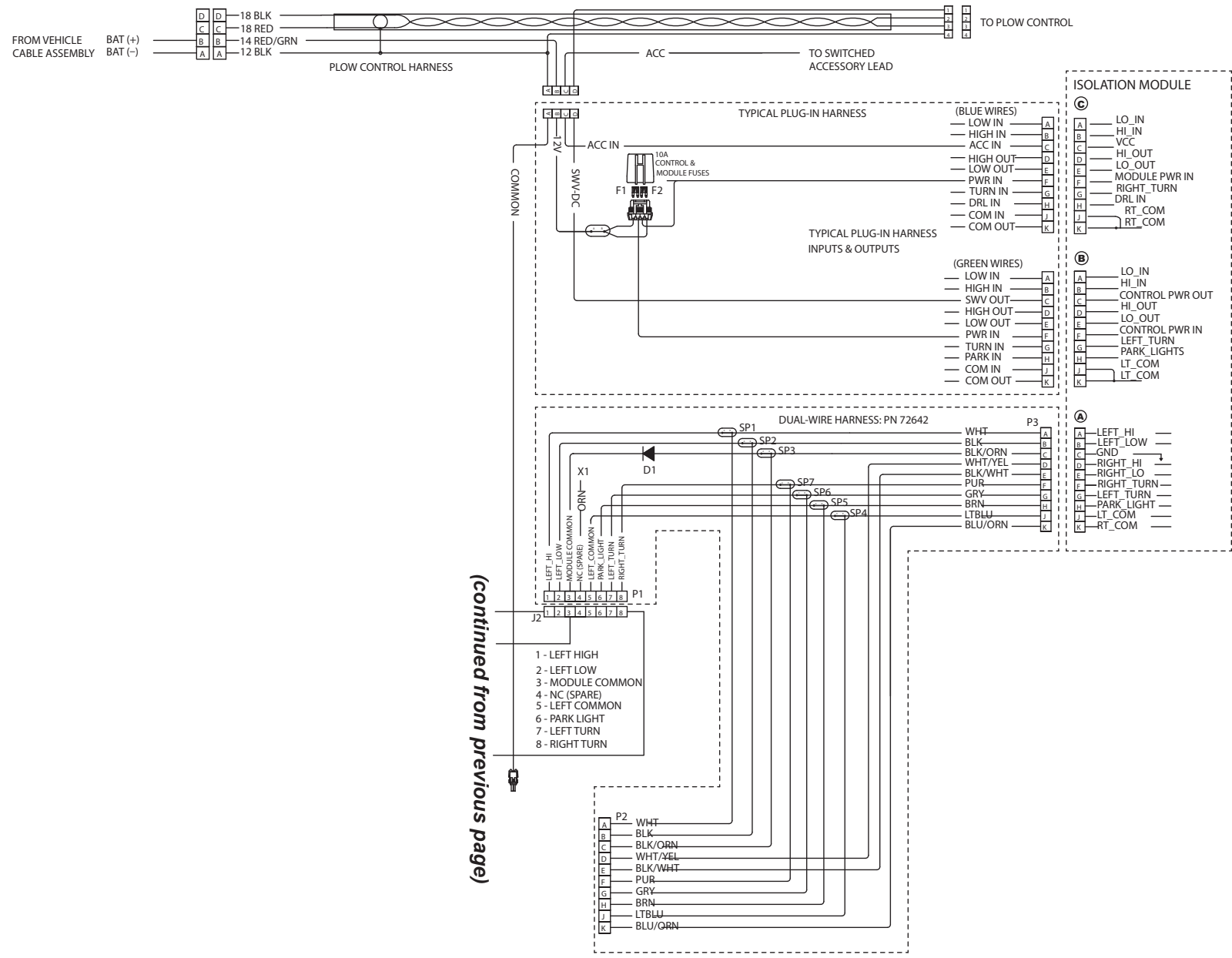


HEADLAMPS: TYPICAL LED SCHEMATIC (continued from previous page)

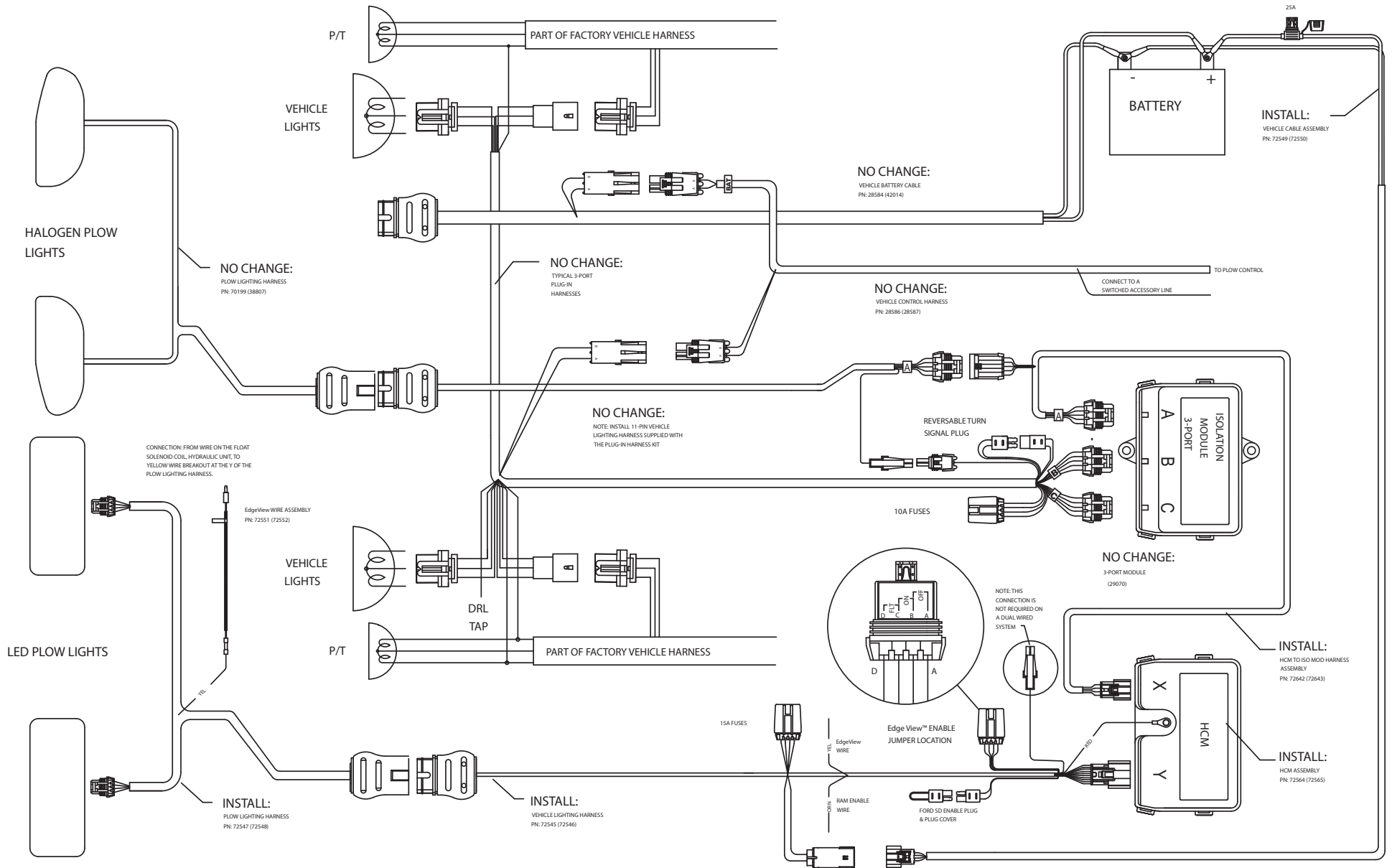




HEADLAMPS: TYPICAL DUAL-WIRE HALOGEN/LED SCHEMATIC (continued from previous page)



HEADLAMPS: DUAL-WIRE HALOGEN/LED INSTALLATION



Troubleshooting

TROUBLESHOOTING

HOW TO USE THE TROUBLESHOOTING GUIDE

All malfunctions of the ENFORCER™ V-plow can be categorized as structural, electrical, or hydraulic. Structural issues are generally related to the blade, T-frame, lift frame, and mount components, and are usually identified by visual inspection. Electrical and hydraulic issues, however, can be more difficult to trace.

Because of the relative complexity of the hydraulic system, some conditions must be met in order to develop valid tests. *If the listed conditions are not met, the procedure can result in inaccurate results and wasted time.*

Go to the "Before You Begin" instructions on the next page and satisfy the listed conditions before starting any testing. In many cases, satisfying the listed conditions alone solves the problem.

Follow along sequentially through the tables and tests, referring to the relevant sections of this guide as needed.

ELECTRICAL TESTING

CAUTION

Do not probe wires. Doing so will damage the wire insulation, causing the wire to fail prematurely.

A simple 12-volt (12V) test light with a ground lead 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. In this case, an ohmmeter will be needed to test for continuity between communication wires, and the power and ground wires. With the snowplow connected to the vehicle, start at the plow module and disconnect the connector in port A. Check for voltage between the power and ground wires. There should be a minimum battery voltage of 12V. With the vehicle ignition ON, test for voltage between one of the communication wires and the ground. Record this reading. Next, check between the other communication wire and the ground, and record this reading. The readings should be approximately 1.5V to 3V for each test. There needs to be an approximate difference of 1.5V between the two communication wires. If not, continue working back toward the vehicle, running the same test until the cause of the issue is found.

When directed to check for 12V, ground the test lamp lead and probe the terminal.

When asked to check for ground, attach the test light 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.

FUSE REPLACEMENT

The vehicle control harness contains one 2A automotive-style mini fuse and the hydraulic unit contains three 5A automotive-style mini fuses. (See schematics on pages 19, 20, and 30.)

The control fuse is "hot" when the vehicle ignition switch is ON.

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.

TROUBLESHOOTING

BEFORE YOU BEGIN

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

1. **Verify** that the customer has accurately and completely described the problem. **Observe** all snowplow functions.
2. **Check the obvious**, to confirm that:
 - a. The snowplow is attached to the vehicle and all harnesses are connected.
 - b. The ignition is turned ON, or engine is running if operating the control from within the cab.
 - c. The control is connected in the cab and turned ON. The control power LED is in a steady state and is not flashing.

- d. The fuses are good.
- e. The 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

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

CAUTION

Fill the reservoir to the fill level only. Do not overfill. Overfilling could damage the unit.

- g. The hydraulic reservoir is filled to the proper level with recommended fluid when the blade is sitting on the ground in the retracted (vee) position, with the vehicle setting level. **Fluid level should be at the level of the fill hole.**
- h. There are no fluid leaks from hoses, fittings, rams, or the hydraulic unit.
- i. All hoses are routed correctly.
- j. Coil wire connections are secure and correct.
- k. Correct cartridges are installed in the

TROUBLESHOOTING

SOLENOID COIL ACTIVATION TEST (SCAT)

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

The main purpose of the SCAT 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 harnesses B and C are 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 29290-2) according to the instructions on the following pages.
3. When instructed to do so, perform the SCAT by activating the control for each function and checking for magnetic pull at all the solenoid coils. A solenoid coil is magnetized if a screwdriver held nearby is attracted.

NOTE: When checking for magnetism on the activated coil, check the inactive coils for stray magnetism.

Only one coil at a time can be tested for magnetism. *To test double-stacked coils:*

- a. Remove the thin nut that holds the stacked coils on the valve stem. Verify that the steel spacer washer is in place between the coils.

- b. Separate the coils by approximately 1/2" and hold them in that position. Activate the function that uses one of the coils. If the coil is magnetized, the steel washer will be drawn to that coil. Activate the function for the second coil. If that coil is magnetized, the steel washer will be drawn to that side.

- c. After testing, retighten the coil nut to 48–60 in-lb.

NOTE: If a control function times out before the desired coil activation is complete, release the button and press it again (hand-held control), or release the lever to the center position, then move it back into the desired function (joystick control).

4. Compare the SCAT results with the testing table on the following page.

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

If one or more coils are not magnetized when they 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 present, go to the Individual Solenoid Coil Test.

If switched ground is not present, go to the Control/Cable/Plow Module Test.

If the motor relay and all coils are working properly, you have a hydraulic problem.

Solenoid Cartridge Valves		
Coil	Valve Type	Wire Color
S1	SV08-22	Dark Blue
S2	SV10-43	Dark Green
S3C1	SV08-47C	Brown
S3C2		White
S4C1	SV08-47C	Purple
S4C2		Orange
S5	SVCV08-20	Yellow

Torque Specifications	
All Solenoid Valves	19–21 ft-lb
All Solenoid Coil Nuts	48–60 in-lb
Motor Relay Terminals, Small	10–15 in-lb
Large	25–35 in-lb
Motor Terminals	50–60 in-lb

TROUBLESHOOTING

Diagnostic Harness Installation

The diagnostic harness kit can be used with or without the snowplow connected to a vehicle. Follow the appropriate instructions for each testing situation.

1. **Off-Truck Testing:** Begin with Step 2.

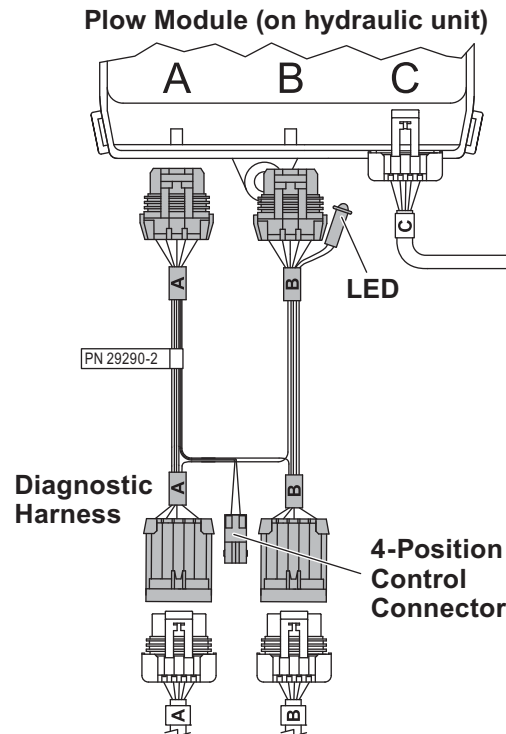
⚠ WARNING

Lower the blade when the 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: Lower the blade to the ground. Put the vehicle in PARK or in gear and remove the ignition key to prevent others from starting the vehicle during testing. Disconnect the snowplow and vehicle battery cables.

2. Remove the hydraulic unit covers.
3. Unplug the snowplow connectors from ports A and B of the plow module.

4. Connect the diagnostic harness connectors A and B to the matching ports on the plow module (A to A and B to B).



5. Plug the connectors removed from the plow module into the matching connectors on the diagnostic harness (A to A and B to B).
6. **Off-Truck Testing:** Connect the snowplow control into the 4-position control connector on the diagnostic harness.

On-Truck Testing: Connect the snowplow control into the 4-position control connector either in the cab of the vehicle or on the diagnostic harness.

7. **Off-Truck Testing:** 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.

On-Truck Testing: Reconnect the snowplow and vehicle battery cables.

NOTE: If you connected 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 connected the control to the diagnostic harness, the key should be left out of the ignition.

TROUBLESHOOTING

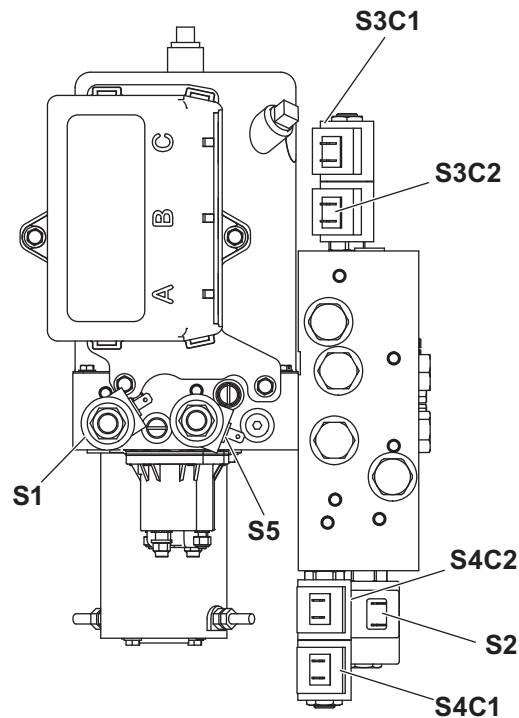
SOLENOID COIL ACTIVATION TEST (SCAT), continued

8. Turn the snowplow control ON and perform a Solenoid Coil Activation Test (SCAT) for each control function. Refer to the table for solenoid numbers and functions.

Control Function	Solenoid Coil(s) Activated
Raise	S5, motor relay
Lower/Float	S1
Angle Right	S2, S4C2, motor relay
Angle Left	S2, S4C1, motor relay
R Wing Extend	S3C1, motor relay
R Wing Retract	S3C2, motor relay
L Wing Extend	S4C2, motor relay
L Wing Retract	S4C1, motor relay
Scoop	S3C1, S4C2, motor relay
Vee	S3C2, S4C1, motor relay

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.

NOTE: If a control function times out before the desired coil activation is complete, release the button and press it again (hand-held control), or release the lever to the center position, then move it back into the desired function (joystick control).



9. After completing the SCAT, turn the snowplow control OFF.

Off-Truck Testing: Disconnect the 12V power source.

On-Truck Testing: Turn the vehicle ignition OFF. Disconnect the snowplow and vehicle battery cables.

10. Perform any required repairs and retest as needed.
11. When testing is completed, disconnect the power source or the snowplow and vehicle battery cables as described in Step 9 before unplugging the diagnostic harness. Plug the snowplow connectors back into ports A and B of the plow module.
12. Replace the hydraulic unit covers.

After On-Truck Testing: Reconnect the snowplow and vehicle battery cables.

TROUBLESHOOTING

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 internal shorts and needs to be replaced.
6. If both readings are approximately 7 ohm across terminals *and* "open" between terminal and washer, then the coil is good.

NOTE: A good coil will draw approximately 1.5A.

TROUBLESHOOTING

CONTROL/CABLE/PLOW MODULE TEST

CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Control power light is not ON.	Snowplow is not connected.	Make sure that the grille plug between snowplow and vehicle is properly connected.
	Incomplete harness connection(s) or damaged harness(es).	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. Complete any incomplete connections and repair or replace any damaged wires and harnesses.
	Harness is connected incorrectly.	Using the electrical schematic in this guide, verify that harnesses are properly connected.
	Poor connection, damaged control, or damaged plow module.	If the problem is not corrected with a properly working control, replace the plow module.
	Plow harness fuse is blown.	Replace blown fuse in plow harness.
Control power light is blinking.	Poor connection, damaged control, or damaged plow module.	Make sure that all plugs (control, between the snowplow and vehicle, on the snowplow, etc.) are properly connected.
		If all plugs are properly connected, install a properly working control. If the problem is corrected, replace the PC board and/or coiled cord in the damaged control.
		If the problem is not corrected with a properly working control, replace the plow module.
Control power light is ON but snowplow does not respond.	Harness is connected to module incorrectly.	Using the electrical schematic in this guide, verify that harnesses are properly connected.
	Blown fuse or damaged plow module.	Replace all blown fuses on vehicle and snowplow.
		If fuses are all intact, check for 12V at all coils and primary terminal of motor relay. If 12V is missing from any coil or relay, replace the plow module. If 12V is present, go to next possible cause (below).
	Damaged harness(es) or cable(s).	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.	Install a properly working control. If the problem is corrected, replace the PC board and/or coiled cord in the damaged control.
		If the problem is not corrected with a properly working control, replace the plow module.

To Safely Handle the Printed Circuit Board

⚠ CAUTION

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

Before disassembling the 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 for the technician to work at a properly grounded work station and wear a grounded wrist strap. In place of a 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. Skin oils will deteriorate the contact area.

TROUBLESHOOTING

MOTOR AND MOTOR RELAY TEST

⚠ WARNING

Keep 8' clear of the blade when it is being raised, lowered, or angled. Do not stand between 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 turns ON but the motor does not run.

1. Check both fuses on harness B. Replace any blown fuses, then retest snowplow function.
2. Disconnect the vehicle battery cable from the snowplow battery cable. Disconnect the 8" red battery cable from the large terminal of the motor relay and isolate it to eliminate potential for accidental blade movement during testing.
3. Reconnect the vehicle battery cable to the snowplow battery cable. Check for 12V at the small terminal of the motor relay with the red wire attached to it.

If 12V is not present, check the red wire and harness B. Replace/repair either the wire or the harness as needed.

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

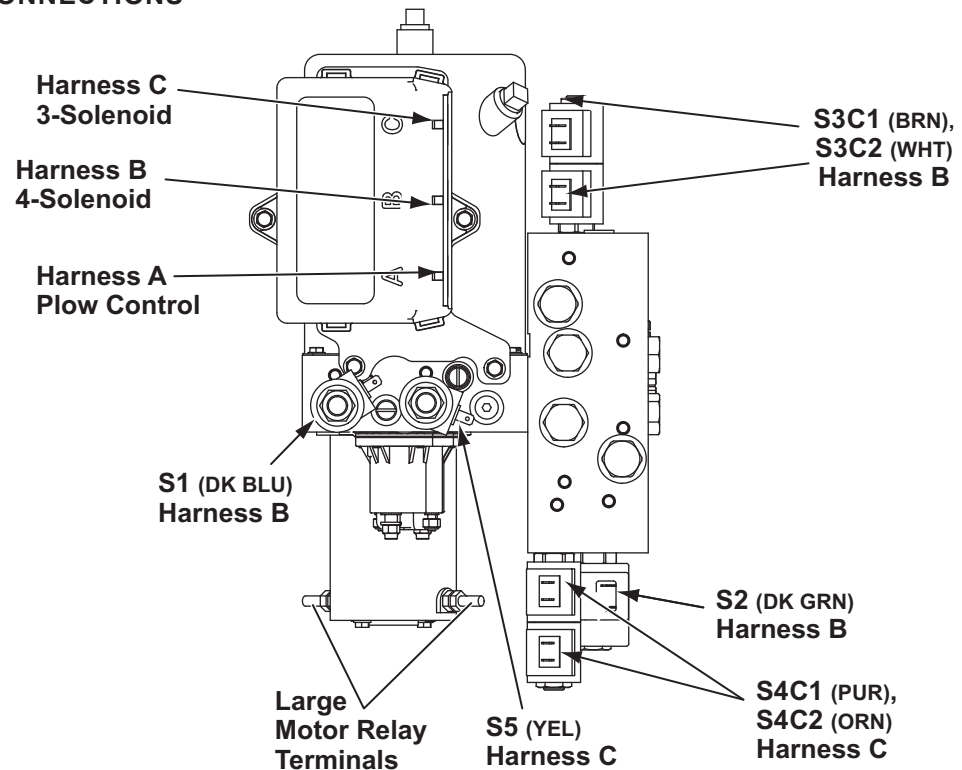
4. Check for switched 12V at the empty large motor relay terminal while activating any control function except LOWER. The empty terminal is the terminal that would normally connect the 8" red battery cable.

If switched 12V is not present, disconnect the vehicle battery cable from the snowplow battery cable and replace the motor relay.

If switched 12V is present at the empty large motor relay terminal, disconnect the snowplow battery cable from the vehicle battery cable and replace the motor.

5. Once testing is complete, reinstall the 8" red battery cable. Reconnect the battery cables, then recheck the snowplow functions.

HARNESS CONNECTIONS



TROUBLESHOOTING

PUMP PRESSURE TEST

⚠ WARNING

The tester shall keep bystanders 8' clear of the blade during these tests. Do not stand between vehicle and blade or within 8 feet of a moving blade. A moving or falling blade could cause personal injury.

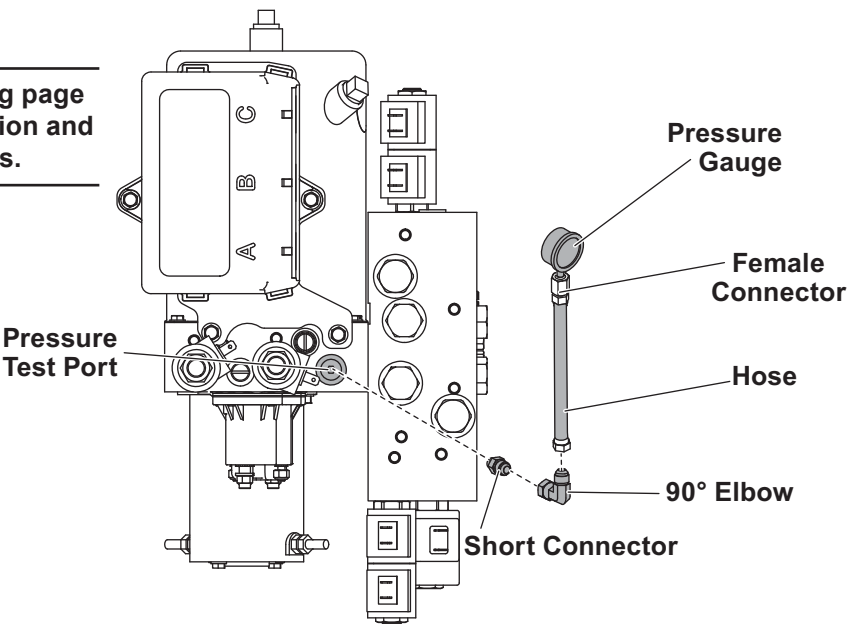
NOTE: Reservoir will contain residual pressure. Slowly remove, then reinstall, the breather to release pressure before proceeding.

- 1. Lower the blade to the ground. Verify proper fluid level before running the test.
- 2. Attach a 3000 psi hydraulic pressure gauge to the pressure test port in the location shown.
- 3. Activate the right RETRACT function until the wing is fully retracted.

NOTE: The control will time out after 3 seconds. Repeat the command if the blade is not yet fully retracted.

- 4. Repeat the right RETRACT function and read the pressure shown on the gauge.
- 5. Refer to the table to determine the necessary corrective action. Do not adjust the pressure setting more than 1/4 turn at a time. **Do not adjust the relief valve while the motor is running.**

NOTE: See the following page for Relief Valve Inspection and Adjustment instructions.



CONDITION	POSSIBLE CAUSE	CORRECTIVE ACTION
Pump pressure is below 2250 ± 100 psi.	Pump Relief Valve	The pump relief valve may be out of adjustment. Turn the relief valve clockwise 1/4 turn and retest the pressure. Repeat until correct pressure (2250 ± 100 psi) is obtained.
		If correct pressure is not obtained after readjustment, remove and inspect the relief valve and its components. Check the O-ring, stem, and ball for wear or damage. Reseat the ball or replace the relief valve as needed. Reinstall/replace and readjust the valve, then retest pump pressure.
	O-Ring (between pump and valve block)	Remove the pump and inspect the O-ring between the pump and the valve block for wear or damage. Reinstall/replace the O-ring and pump, then retest pump pressure.
	Pump	Remove the pump and inspect it for wear or broken gears. Replace the pump if needed, adjust the pump relief valve, then retest pressure.
Motor draws more than 190A at pump relief.	Motor	Replace the motor.

TROUBLESHOOTING

RELIEF VALVE INSPECTION AND ADJUSTMENT

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 the valve stem squarely. You can bend the stem if you do not strike it squarely.

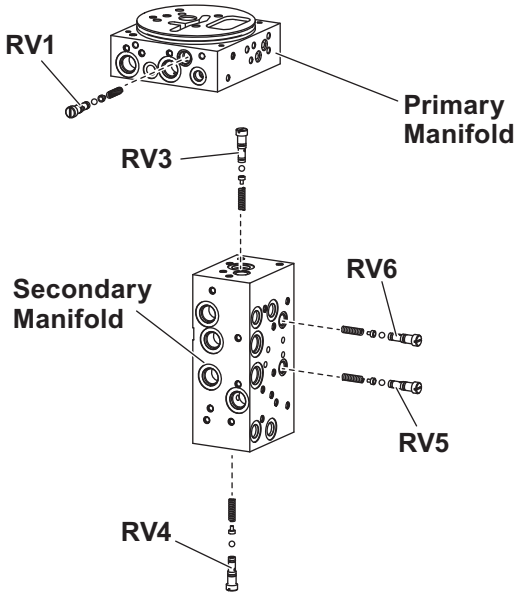
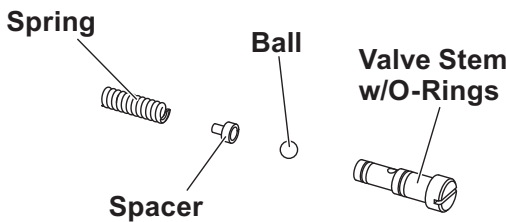
- 3. If all the parts are in good condition, place the ball on a hardwood block, hold the stem seat on the ball, and lightly strike the top of the stem with a hammer. This will seat the ball and valve stem.
- 4. Apply a light coat of anti-seize lubricant or grease to the stem threads. Lubricate the O-rings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

Adjustment

⚠ CAUTION

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

- 1. Screw the valve stem inward until the spring is fully compressed.
- 2. Back out the valve stem by turning it counterclockwise (CCW) the number of turns indicated in the table.



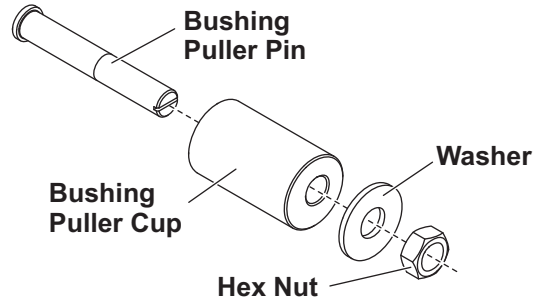
Relief Valve		Approximate Pressure	# of Turns CCW from Fully Seated
RV1	Pump	2250 ± 100 psi	1-3/4
RV3	DS Ram Rod End	2200 ± 100 psi	1-3/4
RV4	PS Ram Rod End		
RV5	DS Ram Base End	3400 ± 100 psi	1-1/8
RV6	PS Ram Base End		

TROUBLESHOOTING

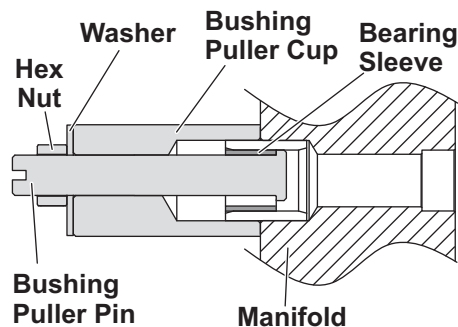
REPLACING DAMAGED BEARING SLEEVES

Remove Damaged Bearing Sleeve

1. Remove the reservoir, pump, and motor from the hydraulic manifold.
2. Insert the bushing puller pin into the bore end of the bushing puller cup, install the washer, and hand turn the hex nut onto the pin two to three full rotations.



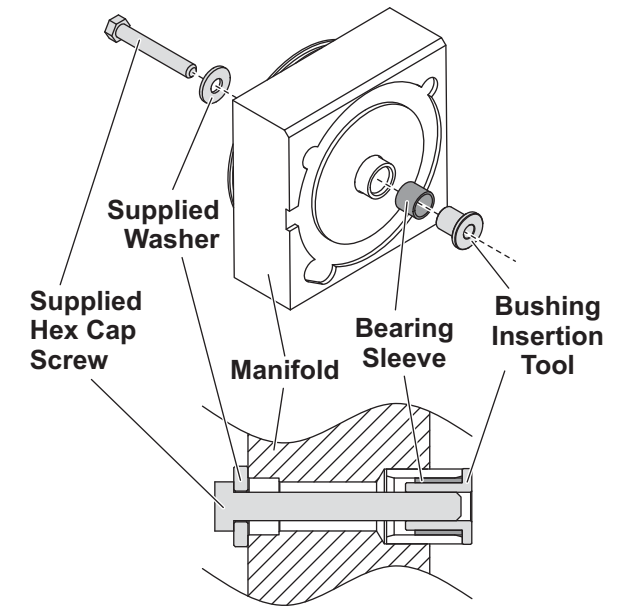
3. Insert the head of the puller pin into the bearing sleeve.



4. Turn the hex nut onto the bushing puller pin until the underside of the pin head is snug against the end of the bearing sleeve.
5. With a box wrench, slowly turn the hex nut until the bearing sleeve is removed from the aluminum bushing in the manifold. Use a flathead screwdriver in the bushing puller pin slot to keep it from rotating during the removal of the bearing sleeve.

Insert New Bearing Sleeve

1. After the damaged bearing sleeve has been removed, install the new bearing sleeve onto the bushing insertion tool as shown, and place it into the chamfer of the aluminum bushing in the manifold.
2. Install the supplied washer onto the supplied hex cap screw, and hand turn the cap screw into the bushing insertion tool from the pump side of the manifold.
3. Turn the cap screw into the insertion tool until the insertion tool contacts the aluminum bushing.



4. To remove the insertion tool, turn the cap screw three full turns counterclockwise, then lightly tap with a hammer. Repeat until the insertion tool is free from the bearing sleeve.

NOTE: Once this procedure has been completed, make sure that the pump shaft seal has not been damaged before reassembling the hydraulic unit.

NOTE: The bushing insertion tool sizes the ID of the bearing sleeve. Store the tool in the supplied bushing to prevent damage.

TROUBLESHOOTING

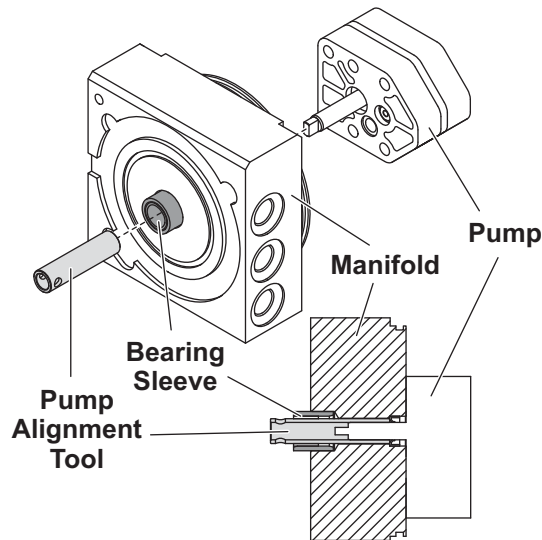
Pump Alignment

NOTE: The hydraulic pump may contain a .75" OD alignment ring that fits in a counter-bore around the shaft. This pump alignment procedure is necessary only for hydraulic pumps that do not utilize this alignment ring (as in the illustration) or if the alignment ring has been lost.

1. After the new bearing sleeve has been inserted, install the pump and pump fasteners, but do not tighten them yet.
2. Insert the pump alignment tool into the bearing sleeve and over the pump shaft.

3. With the pump alignment tool in place, alternately tighten the pump fasteners to 150–160 in-lb.
4. Remove the pump alignment tool.

NOTE: If the surface of the alignment tool is marred, it will damage the motor bearing sleeve. Store the tool in the supplied rubber tubing to prevent damage.



Excerpts taken from Motor Bearing Sleeve Repair Kit Service Literature (Lit. No. 64595, Rev. 02).



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