



Fisher Engineering

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MECHANIC'S GUIDE



SNOWPLOWS

Featuring the
Insta-Act® Hydraulic System
and the
E-Force Isolation Module System

⚠ CAUTION

Read this manual before servicing the snowplow.

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

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

SAFETY INFORMATION

⚠ WARNING

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

⚠ CAUTION

Indicates a situation that, if not avoided, could result in minor personal injury and/or damage to product or property.

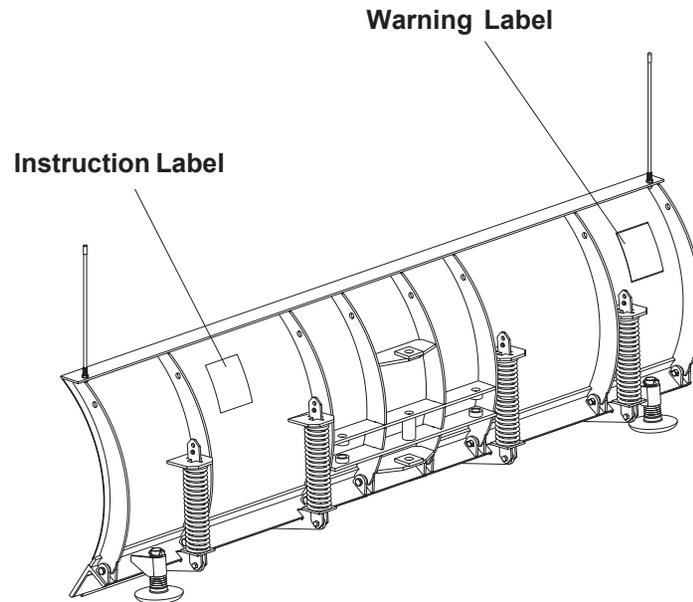
NOTE: Identifies tips, helpful hints and maintenance information the owner/operator should know.

BEFORE YOU BEGIN

⚠ WARNING

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

Please become familiar with and make owners knowledgeable of the Warning and Instruction labels on the back of the blade!



Warning Label

⚠ WARNING

LOWER BLADE WHEN VEHICLE IS PARKED.
REMOVE BLADE ASSEMBLY BEFORE PLACING VEHICLE ON HOIST.
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. REDUCE SPEED UNDER ADVERSE TRAVEL CONDITIONS.
PLOWING SPEED SHOULD NOT EXCEED 10 MPH.
REMOVE SLACK FROM CARRYING CHAIN BEFORE TRAVELING.
SEE YOUR FISHER OUTLET FOR APPLICATION RECOMMENDATIONS.

Instruction Label

		U.S. Patents 4,282,012; 4,958,455; 5,393,030; 4,421,443 and other patents pending
<p>MOUNTING PLOW</p> <p>A.</p> <ol style="list-style-type: none"> 1. Drive vehicle forward fully engaging pushplates into attachment arms. <p>B.</p> <ol style="list-style-type: none"> 1. Twist connecting pin to release tension. 2. Remove electrical covers on vehicle. 3. Attach electrical connector to corresponding connector on vehicle. 4. Repeat steps B 1-3 on passenger side of vehicle. 5. Connect hydraulic hoses to quick disconnects. (BELT DRIVE ONLY) <p>C.</p> <ol style="list-style-type: none"> 1. Release carrying chain and reattach it leaving plenty of slack. 2. Push headgear upward toward vehicle until connecting pins snap in place. 3. Pull jack lever outward and raise the jack stand. 	 	<p>REMOVING PLOW</p> <p>C.</p> <ol style="list-style-type: none"> 1. Remove slack from carrying chain and reattach. 2. Back vehicle away from plow. <p>B.</p> <ol style="list-style-type: none"> 1. Disconnect electrical connector and reinsert in protective cover. 2. Insert release rod under jack collar. 3. Push down on release rod as you pull and twist connecting pin. 4. Repeat Steps B 1-3 on passenger side. 5. Disconnect hydraulic hose couplings and cover with dust plugs. <p>A.</p> <ol style="list-style-type: none"> 1. Place cab control in "Lower/Float". 2. Push lift arm down. 3. Pull Jack lever outward. Jack stand will adjust to proper height.

SAFETY INFORMATION

BEFORE YOU BEGIN

⚠ WARNING

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

⚠ WARNING

Remove blade assembly before placing vehicle on hoist.

- Park the vehicle on a level surface, place shift lever in PARK or NEUTRAL and set parking brake.
- Leave the snowplow mounted on the vehicle and lowered for most service procedures, unless told otherwise.

PERSONAL SAFETY

- Wear only snug-fitting clothing while working on your vehicle or snowplow.
- Do not wear jewelry or a necktie, and secure long hair.
- Be especially careful near moving parts such as fan blades, pulleys and belts.

- 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 handy, rated BC for flammable liquids and electrical fires.

VENTILATION

⚠ WARNING

Vehicle exhaust contains deadly carbon monoxide (CO) gas. Breathing this gas, even in low concentrations, could cause death. Never operate a vehicle in an enclosed area without venting exhaust to the outside.

If you work on the vehicle or snowplow in a garage or other enclosed area, be sure to vent exhaust gas directly to the outside through a leakproof exhaust hose.

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.

HYDRAULIC SAFETY

⚠ WARNING

Hydraulic oil under pressure could cause skin injection injury. If you are injured by hydraulic oil, 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.
- Always loosen plugs, fittings and valves slowly to bleed off any residual pressure.

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.

PRODUCT SPECIFICATIONS

REQUIRED TOOLS

Insta- Act® Hydraulic System

⚠ CAUTION

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

Hydraulic Oil

- FISHER® High Performance Fluid to -25°F (-32°C)
- Fluid Capacity—Hydraulic Oil
- Unit Reservoir = 1-1/2 Quarts
- System Total = 2-1/4 Quarts

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

Electrical System – approximate values:

- Solenoid Coil Resistance = 7 Ohms at room temperature
- Solenoid Coil Amp. Draw = 1.5 Amp.
- Motor Relay Coil Resistance = 16 - 17 Ohms
- Motor Relay Amp. Draw = 0.7 Amp.
- Motor Amp. Draw = 190 Amp. at 1750 psi
- Switched Accessory Lead Draw = 0.75 Amp

Vehicle Control Harness Fuse Size

- Park/Turn – 15 Amp. (ATC)
- Control – 7.5 Amp. (ATC)

Mechanical

Fastener Torque in IN-LB	
Pump Cap Screws	150 – 160
Motor Terminal Nuts.....	50 – 60
Motor to Manifold Cap Screws	30 – 40
Reservoir Screws	15 – 20
Valve Cartridges.....	115 – 125
Coil Nuts	48 – 60
Cartridge / Coil Cover Screws.....	15 – 20
Check Valve.....	115 – 125

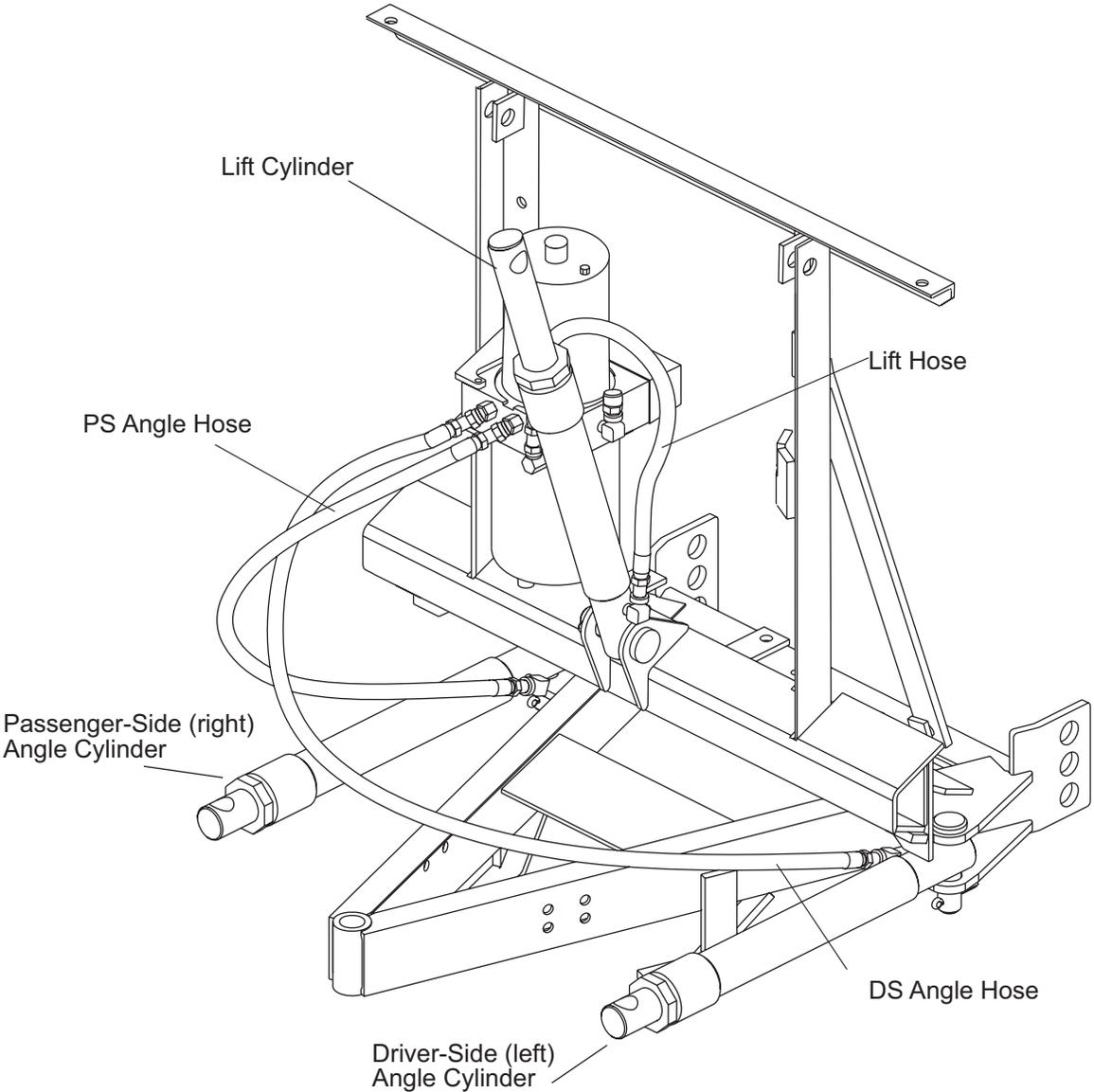
Tools Required to service the electrical and hydraulic systems:

- Long Slender Needle Nose Pliers
- Flat Screwdriver
- Sockets and Combination Wrenches: 3/8" thru 7/8", 1-1/16", 1-1/8"
- Deep Socket: 7/8"
- 1/4" Socket or Nut Driver
- 12 V Test Light
- Torque Wrench (in-lb)
- Allen Wrench Set
- 3000 PSI Pressure Gauge w/adaptor fittings
- Flashlight
- Pick Set
- Hammer
- Digital Volt/Ohm Meter
- Pencil Magnet
- T-20 Torx

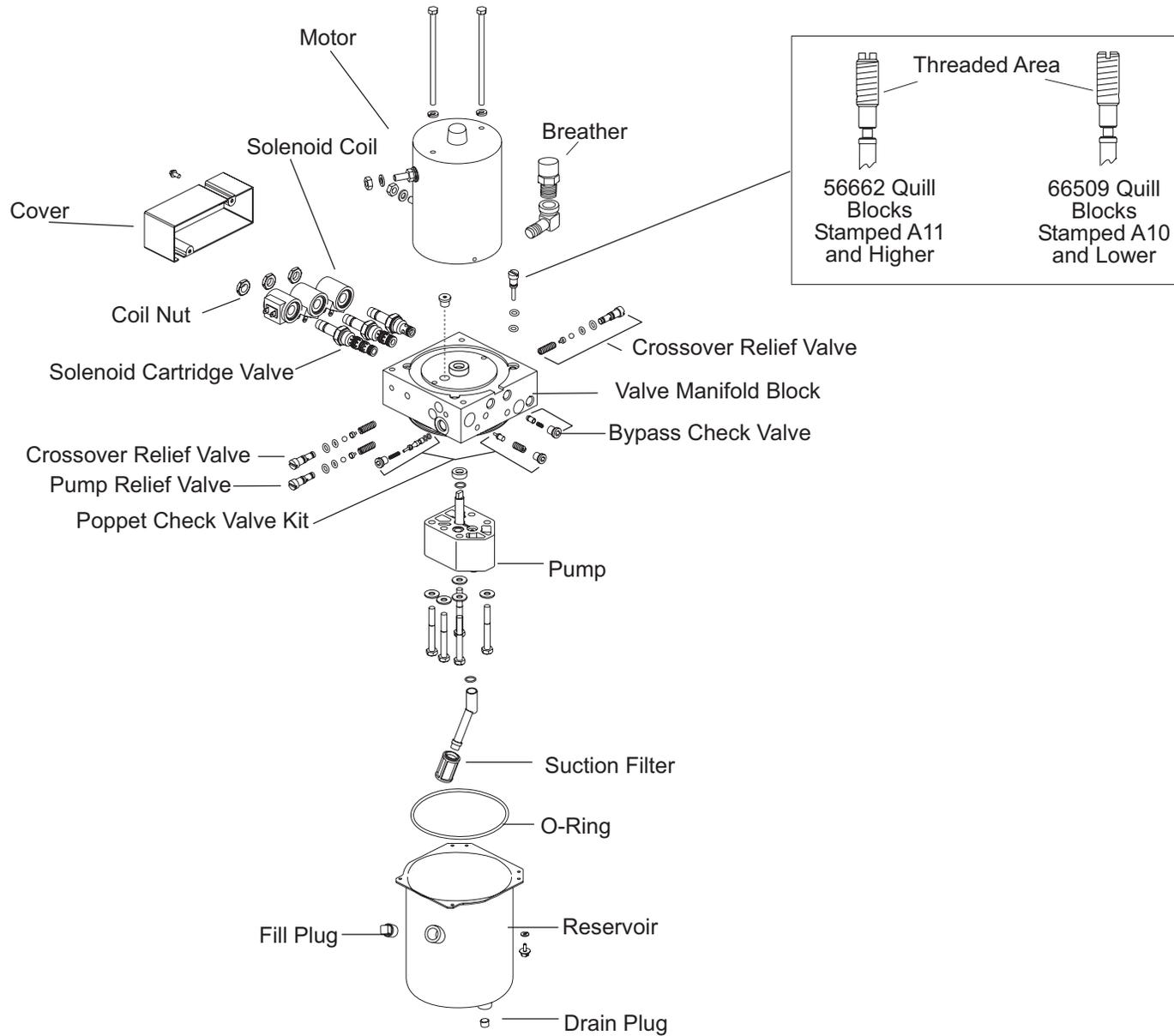
Available from your FISHER® outlet:

- Minute Mount® Electrical Tester
- Isolation Module Tester
- Removable Spring Tool (for replacing trip springs)
- Hydraulic Pressure Test Kit (Available late 2001)

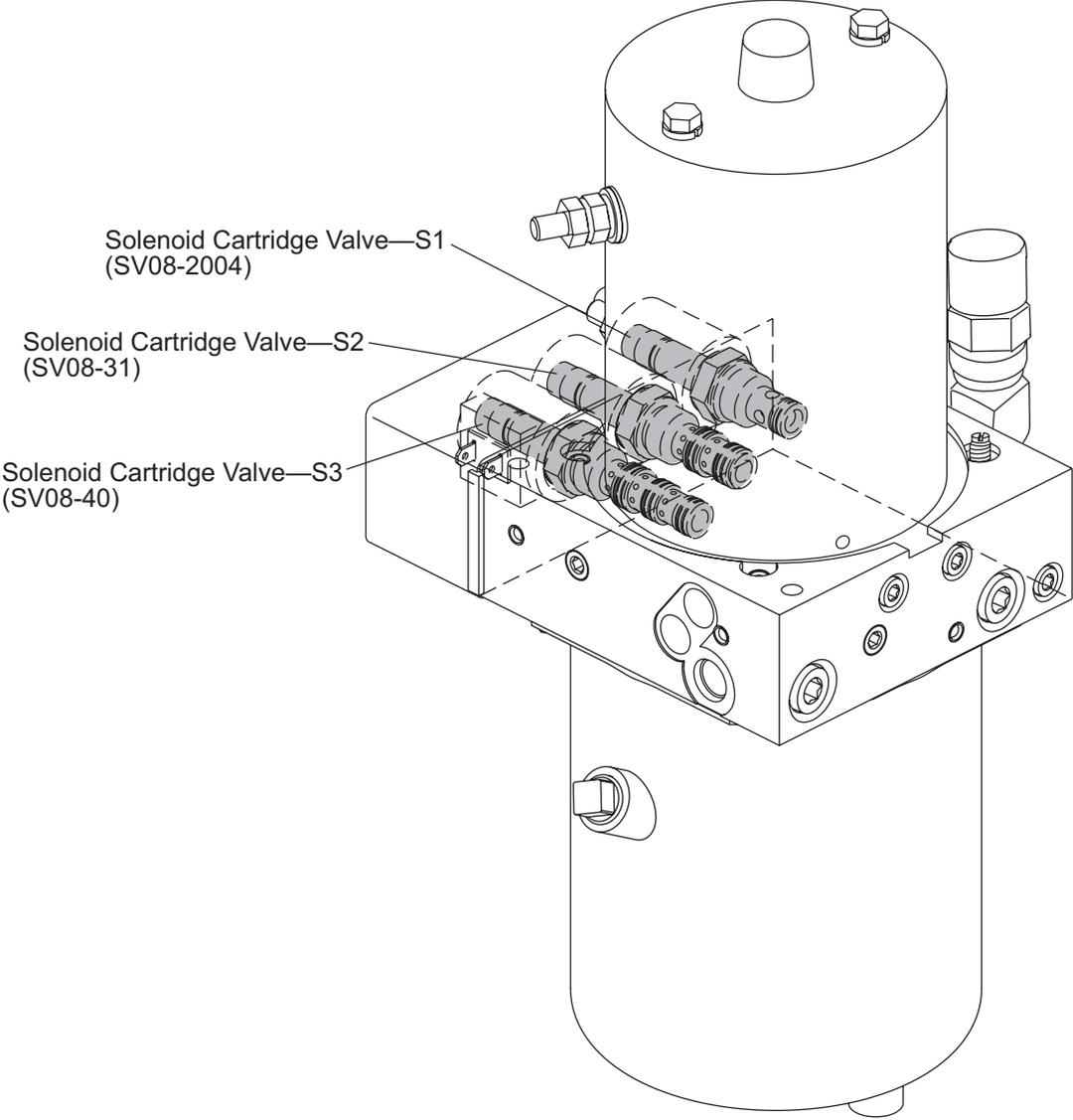
HYDRAULIC HOSE ROUTING



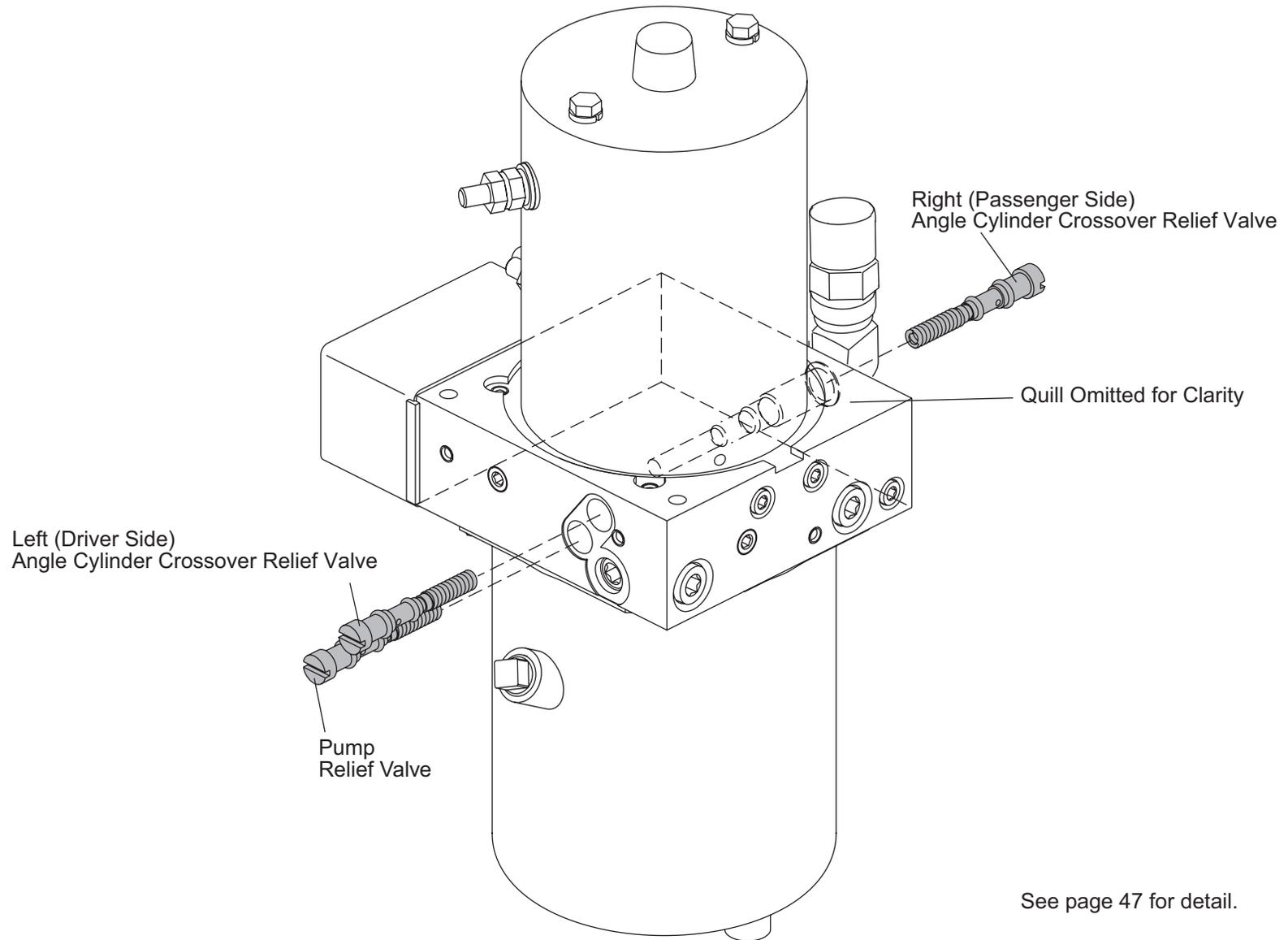
HYDRAULIC UNIT PARTS DIAGRAM



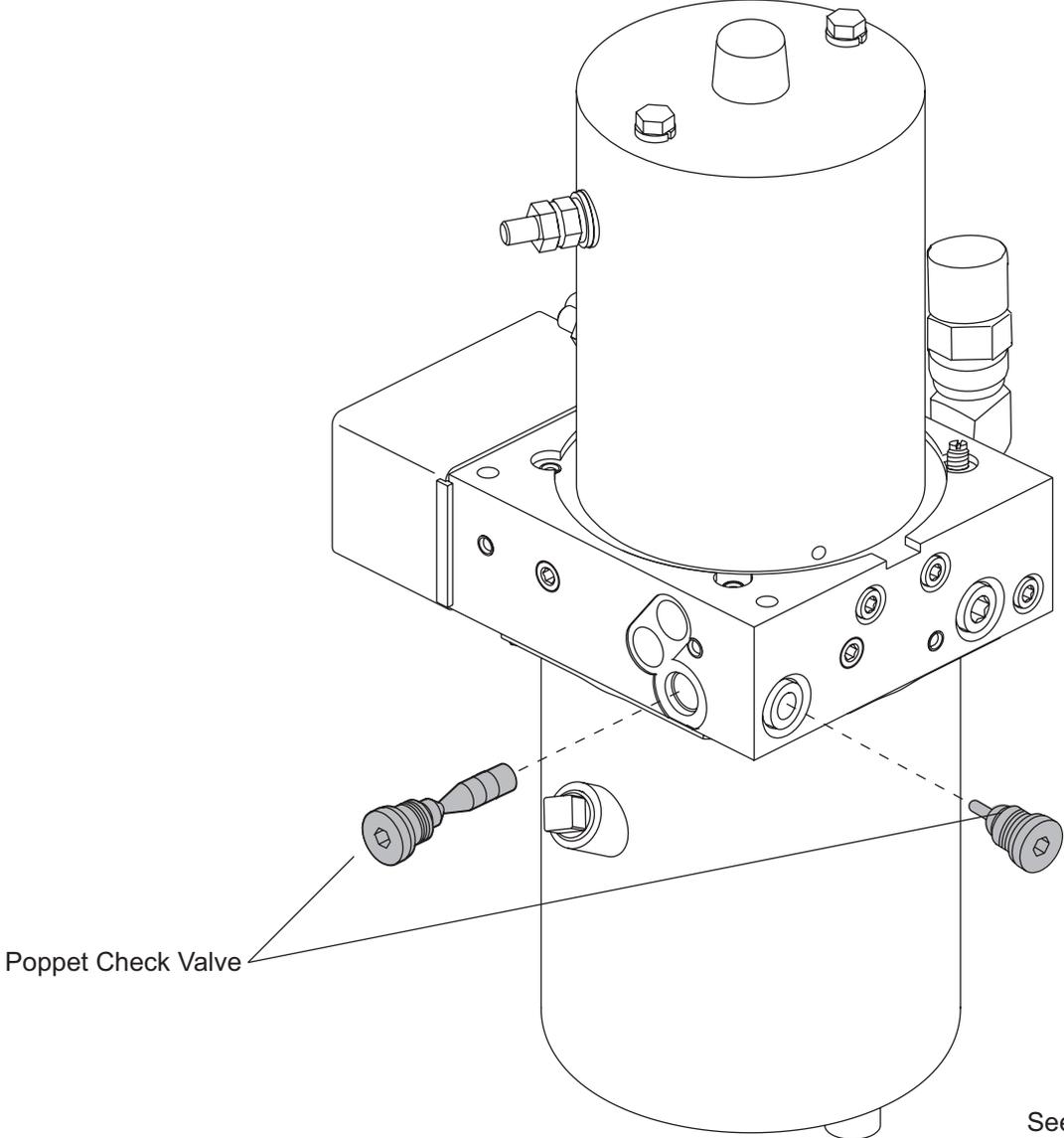
SOLENOID CARTRIDGE VALVE IDENTIFICATION AND LOCATION



RELIEF VALVE IDENTIFICATION AND LOCATION

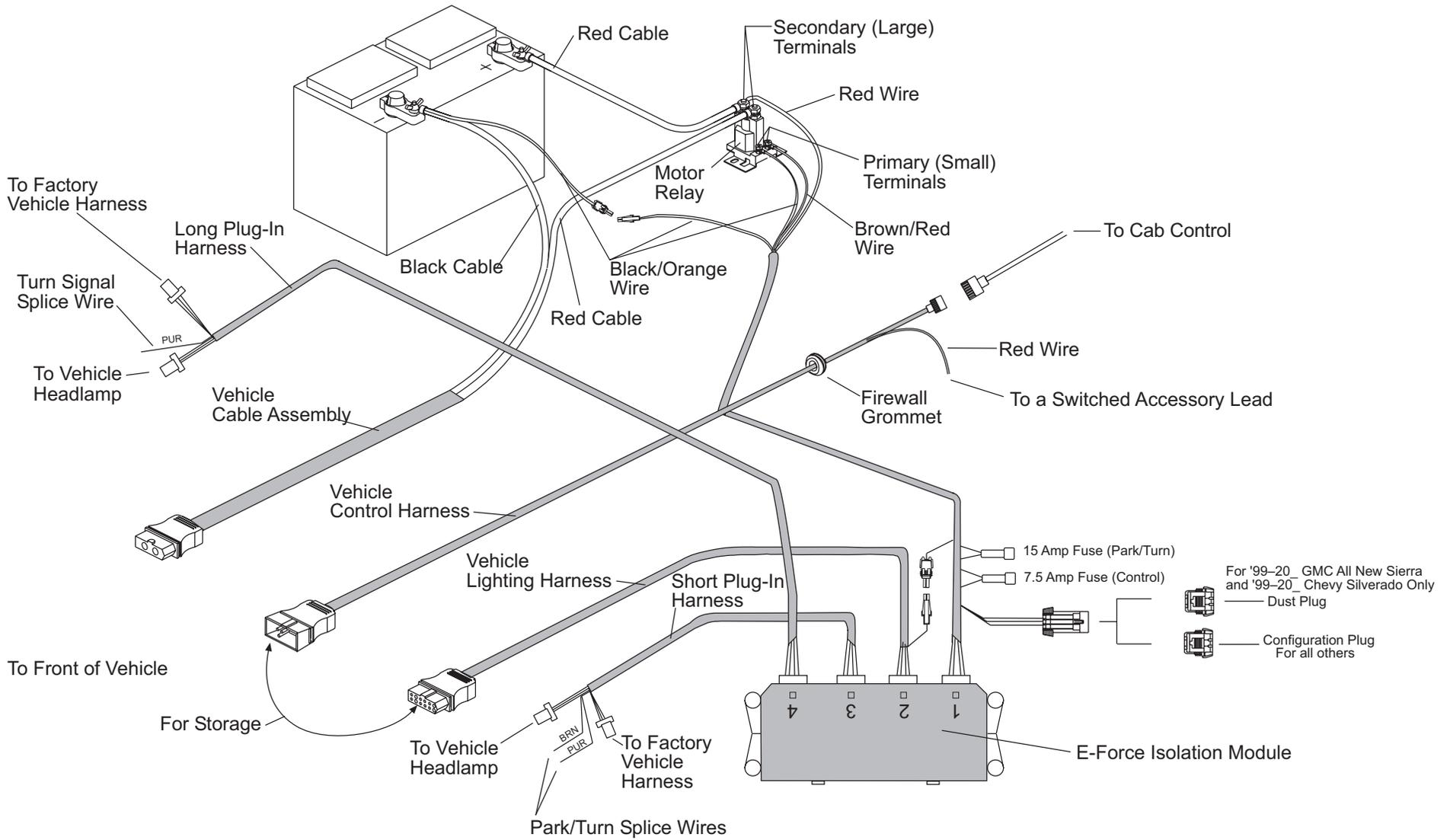


PILOT-OPERATED (POPPET TYPE) CHECK VALVE IDENTIFICATION AND LOCATION



See page 48 for detail.

VEHICLE HARNESS AND VEHICLE CABLE LOCATION



OPERATING THE SNOWPLOW

Solenoid Control

⚠ WARNING

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

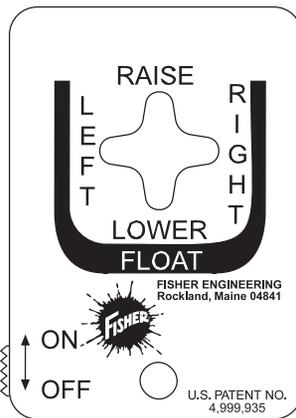
⚠ CAUTION

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

Mount the blade and attachments to the vehicle. Make the three electrical connections. Turn the vehicle ignition switch to the ON or the ACCESSORY position. Move control ON/OFF switch to the ON position. The control indicator light (red) should light whenever the control ON/OFF switch and the ignition (key) are both turned ON.

⚠ CAUTION

DO NOT hold control lever in RAISE, ANGLE LEFT or ANGLE RIGHT position after blade has reached desired position. To do so could result in the hydraulic fluid overheating.



Emergency Stop

Turn the vehicle ignition switch on. Turn the control on. The control indicator light should be on.

Action	Description of Operation
ON/OFF	Slide the control power switch to ON to activate the hydraulic system. Turn the control OFF to lock the blade in place. This prevents accidental movement of the blade.
Raise	Move the control lever up (forward) to raise the blade to the desired height.
Lower/Float	Move the control lever down (back) to lower the blade and activate the FLOAT mode.
Right	Move the control lever right to angle the blade to the right.
Left	Move the control lever left to angle the blade to the left.
Cancel Float	Cancel the FLOAT mode by momentarily placing the control in the RAISE position, turning the control off, or turning the vehicle ignition off. Angling left or right does not cancel float.

OPERATING THE SNOWPLOW

Fish-Stik® 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 the vehicle and the blade, or within 8 feet of a moving blade. A moving or falling blade could cause personal injury.

⚠ CAUTION

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

1. Turn the vehicle ignition switch to the ON or the ACCESSORY position. The control logo area illuminates.

2. Press the ON/OFF button on the control. The control indicator light glows red indicating the control is on. The control indicator light glows red whenever the control ON/OFF switch and the vehicle ignition switch are both ON.
3. Press the LOWER button for 0.75 seconds to engage the FLOAT mode. The control indicator FLOAT light glows green. Cancel the FLOAT mode by momentarily pressing the RAISE button.

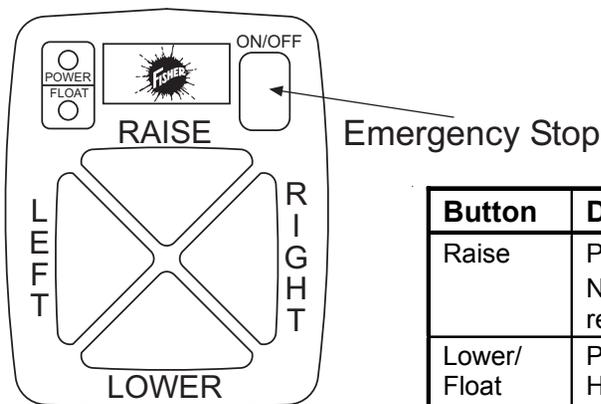
Function Time Outs

All control functions, except for LOWER, automatically time out—stop—after a period of time. This helps prolong the battery charge. The time-out period for the RAISE function is 4.8 seconds, while the angle function is 9.6 seconds.

The control automatically turns off after being idle for 20 minutes.

Smooth Stop

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



Button	Description of Operation
Raise	Press this button to raise the snowplow and to cancel the float mode. NOTE: Snowplow automatically stops raising after 4.8 seconds. To resume raising the snowplow, release the button and press again.
Lower/ Float	Press this button to lower the snowplow. NOTE: After reaching the desired height, release the button. Holding the button down for more than 0.75 seconds activates the float mode, indicated by green FLOAT lamp.
Right	Press this button to angle blade to the right.
Left	Press this button to angle blade to the left.
Cancel Float	Cancel the float mode by momentarily pressing and releasing the RAISE button, turning control off, or turning vehicle ignition off. Angling left or right <u>momentarily</u> cancels float.

THEORY OF OPERATION

Snowplow Headlamps

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

The vehicle high and low beams enter and exit the Isolation Module through positions 3 (left side lighting) and position 4 (right side lighting). Park, turn, and DRL signals also enter through positions 3 and 4.

The output of the vehicle dimmer switch is directed to the Isolation Module via the long and short plug-in harnesses. When the snowplow is not attached to the vehicle, the signal passes through the normally closed relay contacts to the vehicle headlamps. During this time, the Isolation Module is inactive, placing no current draw on the vehicle's electrical system.

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

Turning on the vehicle parking lights activates a series of relays, automatically transferring the vehicle high and low beams to the snowplow while supplying battery power directly to the snowplow parking lights. All snowplow lighting exits the Isolation Module through position 2.

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

Snowplow Daytime Running Lamps

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

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

The Isolation Module designed for the 1999-20_ GMC All New Sierra and 1999-20_ Chevy Silverado senses the vehicle in the DRL mode. A series of relays energize, placing the snowplow headlamps in the DRL mode. This Isolation Module does not turn off the dedicated vehicle DRLs.

THEORY OF OPERATION

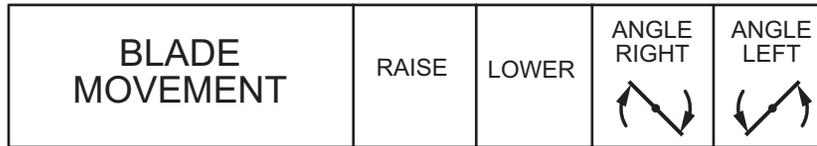
Snowplow Hydraulics

The snowplow hydraulic system performs four blade movements: RAISE, LOWER, ANGLE RIGHT, AND ANGLE LEFT.

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

Three hydraulic movements require energizing the electric motor, shifting solenoid cartridge valve(s) or activating check valves. The fourth function, LOWER, does not energize the motor but shifts a solenoid cartridge valve.

Power to the three solenoid cartridge valves is supplied by the vehicle battery, via the Isolation Module and cab control. The three solenoid cartridge valves operate in various combinations, electrically activated by the cab control, to send hydraulic fluid to the snowplow lift and angle cylinders or back to the reservoir.



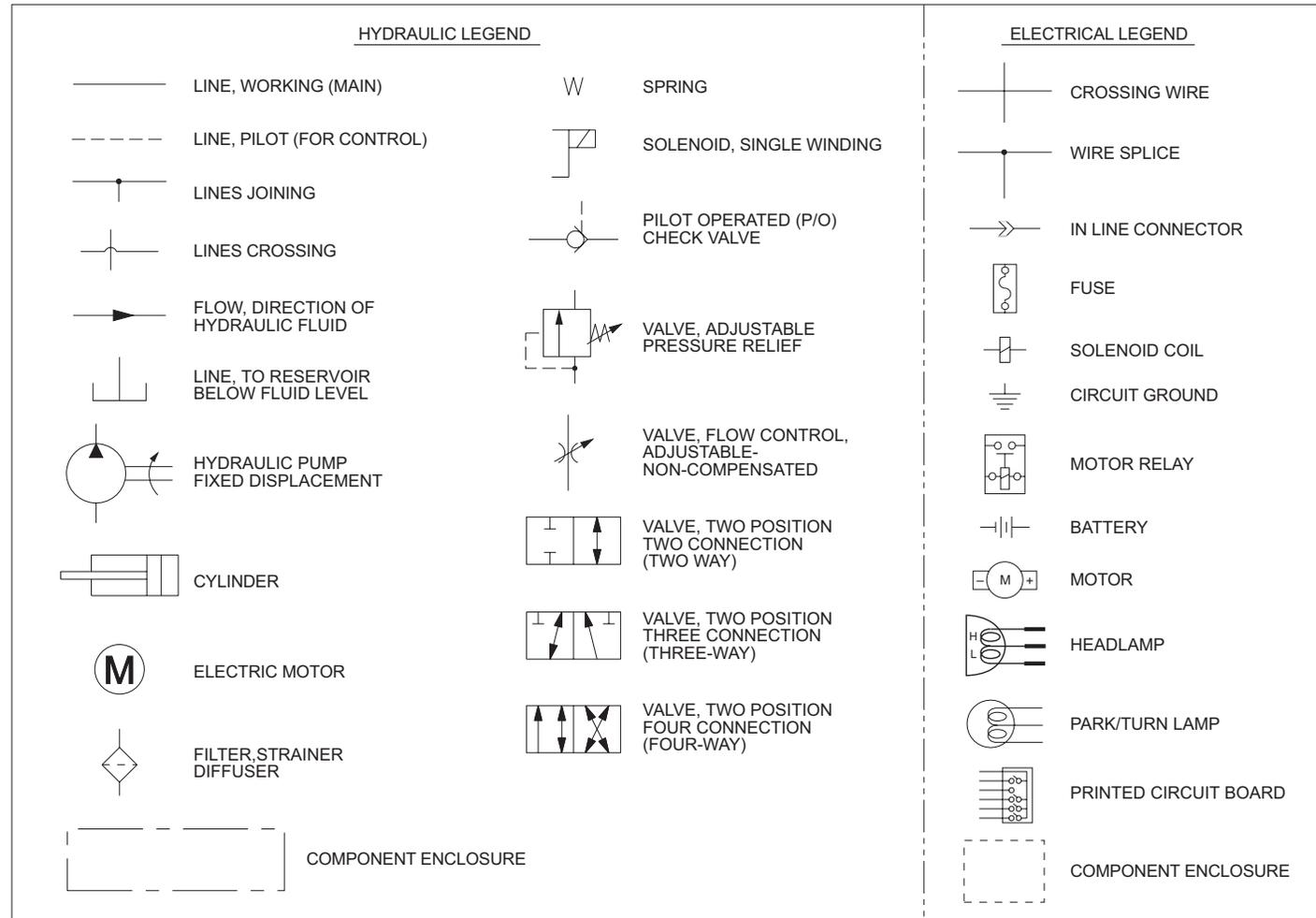
HYDRAULIC AND ELECTRICAL SCHEMATICS

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

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

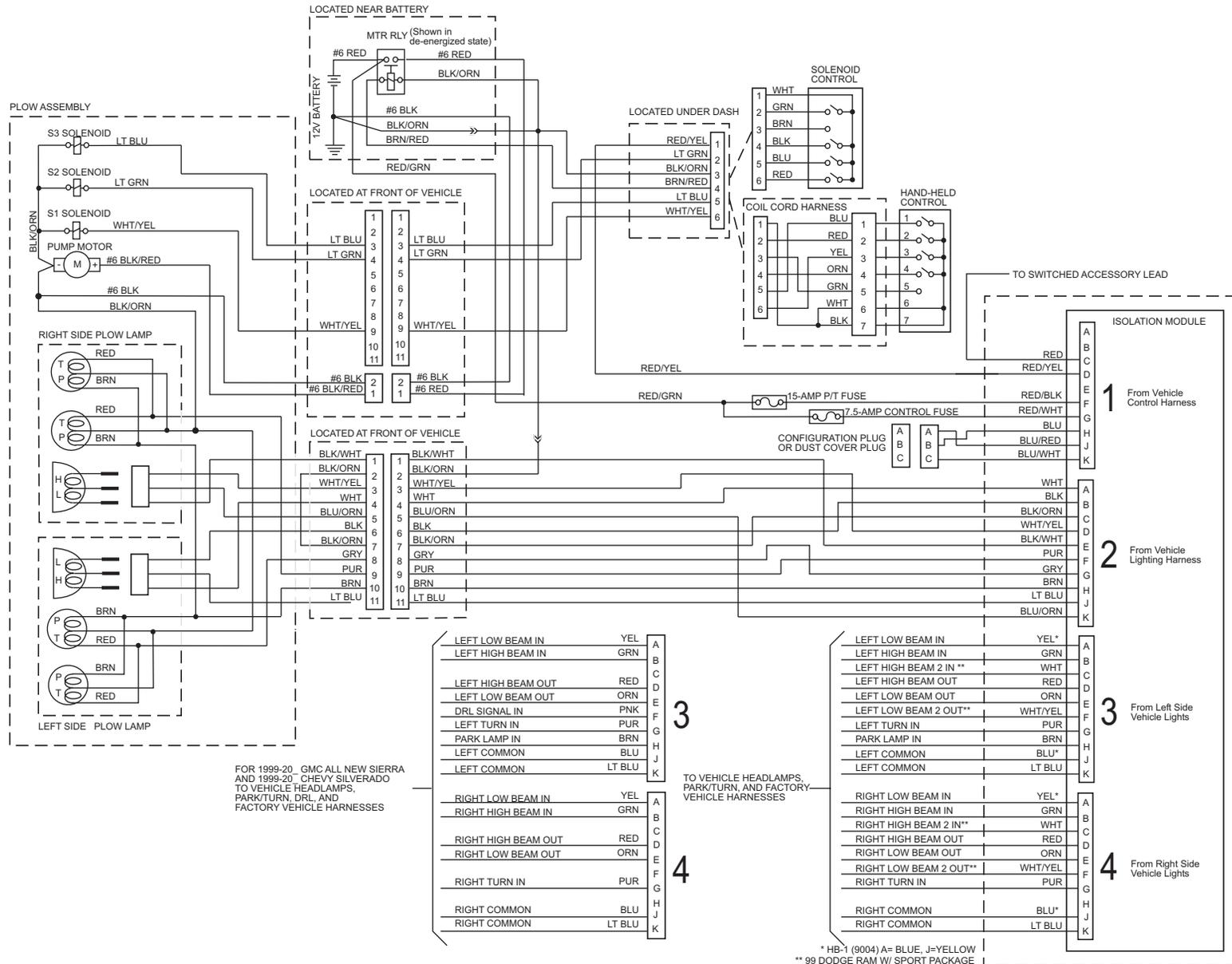
- Bold lines and gray lines (ground) represent the circuit being activated only.
- Shaded components are either activated or shifted from their normal position.

NOTE: Left side = Driver side
Right side = Passenger side

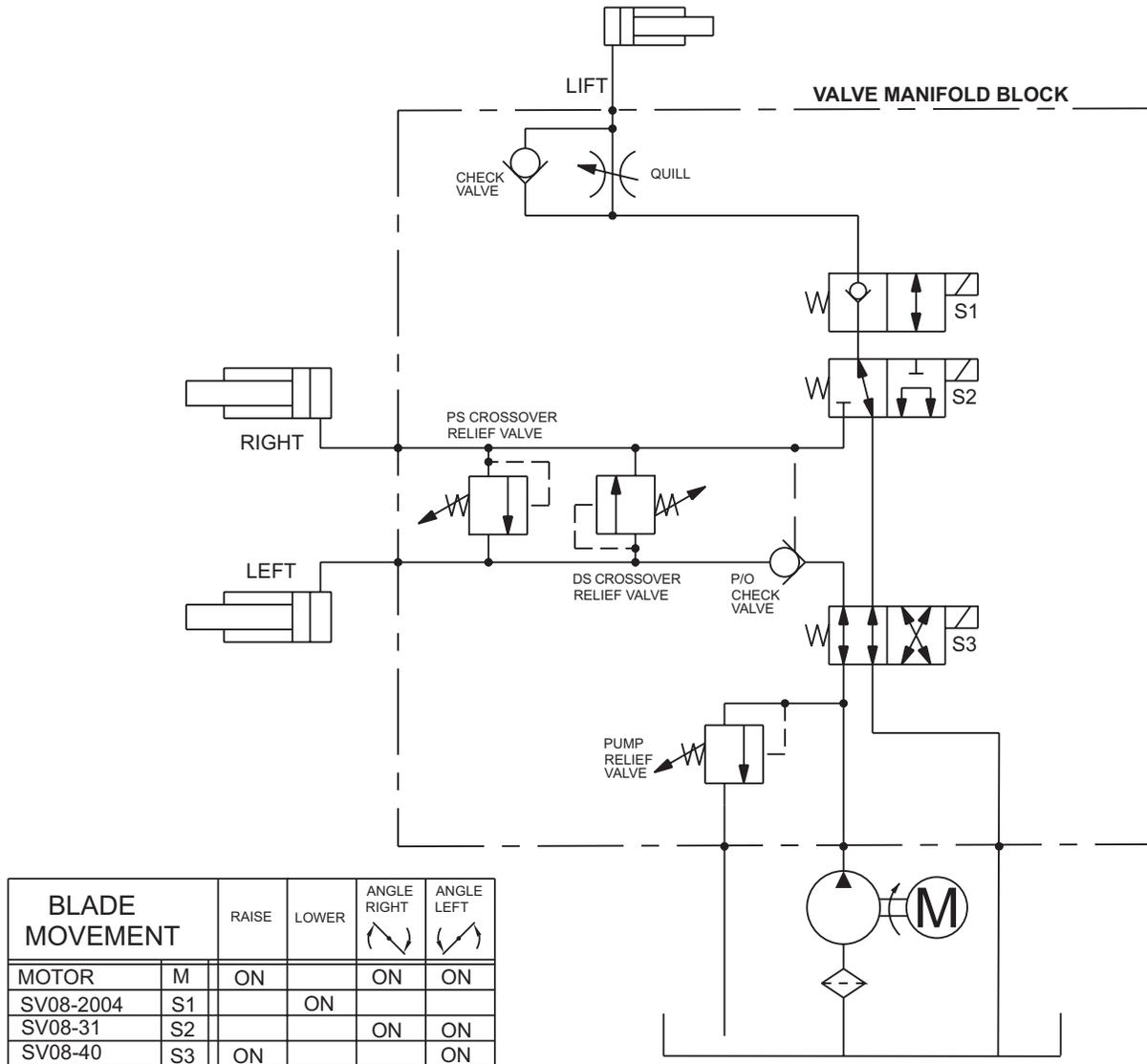


Wire Color Code				Abbreviations					
BLK	Black	BLU/ORN	Blue w/ Orange	GRY	Gray	PUR	Purple	DRL	Daytime Running Lamps
BLK/ORN	Black w/ Orange	BRN	Brown	LTBLU	Light Blue	RED	Red	MTR RLY	Motor Relay
BLK/RED	Black w/ Red	BRN/GRN	Brown w/ Green	LTGRN	Light Green	WHT	White	P/T SIG	Park / Turn Signal
BLK/WHT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

ELECTRICAL SCHEMATIC



HYDRAULIC SCHEMATIC



RAISE – ELECTRICAL

Blade Movement: Raise

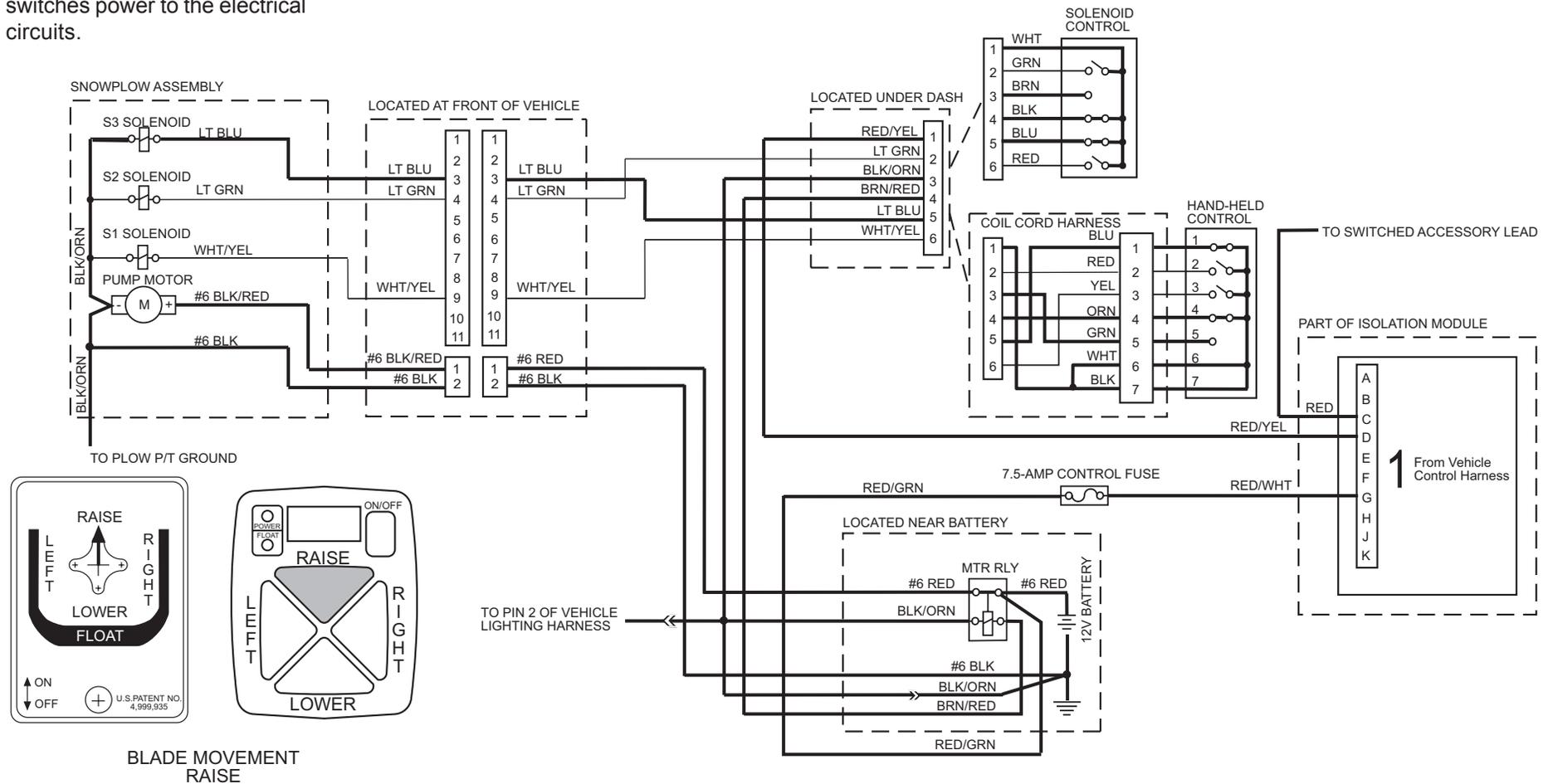
Control: Raise

System Response:

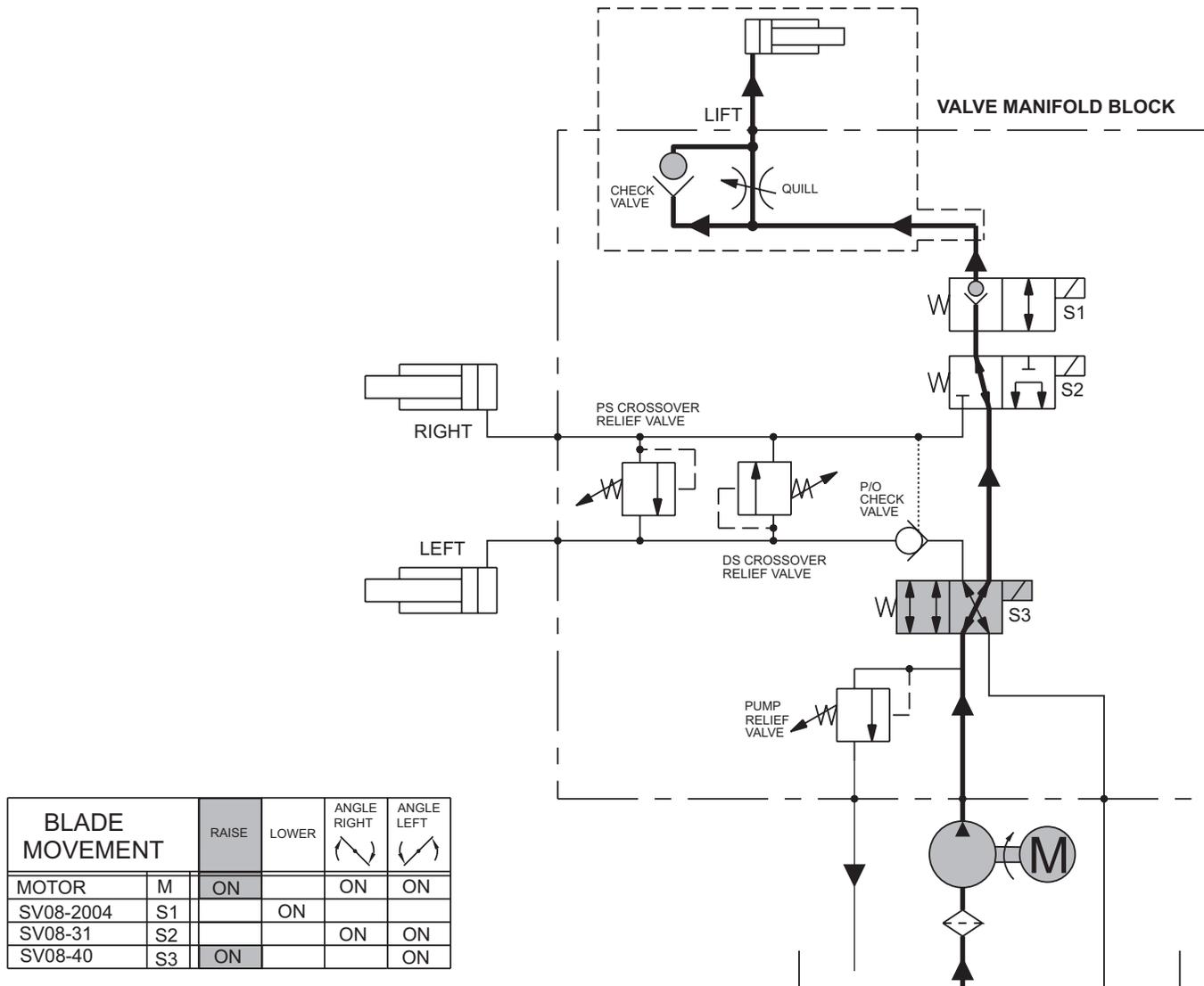
1) By moving control lever or pressing the control button, the circuit board within the cab control switches power to the electrical circuits.

2) Motor relay closes, current flows through the motor relay, activating the pump motor. +12V is applied to the coil of solenoid cartridge valve S3, shifting the spool.

3) Hydraulic oil from the pump flows through solenoid cartridge valves S3 & S2, through the internal check valve in solenoid cartridge valve S1 into the base end of the lift cylinder causing it to extend.



RAISE – HYDRAULIC



LOWER – ELECTRICAL

Blade Movement: Lower / Float

Control: Lower

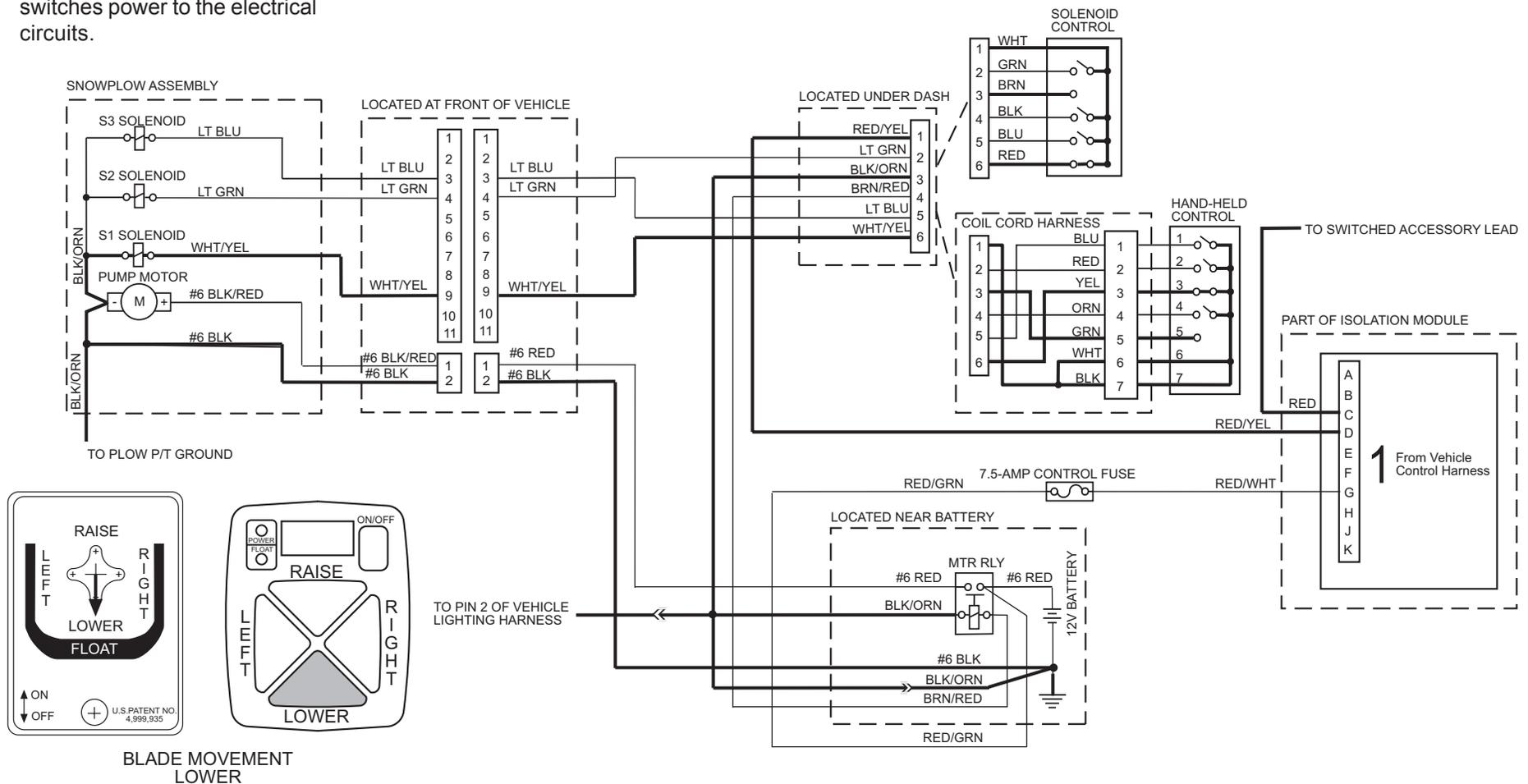
System Response:

- 1) By moving control lever or pressing the control button, the circuit switches power to the electrical circuits.

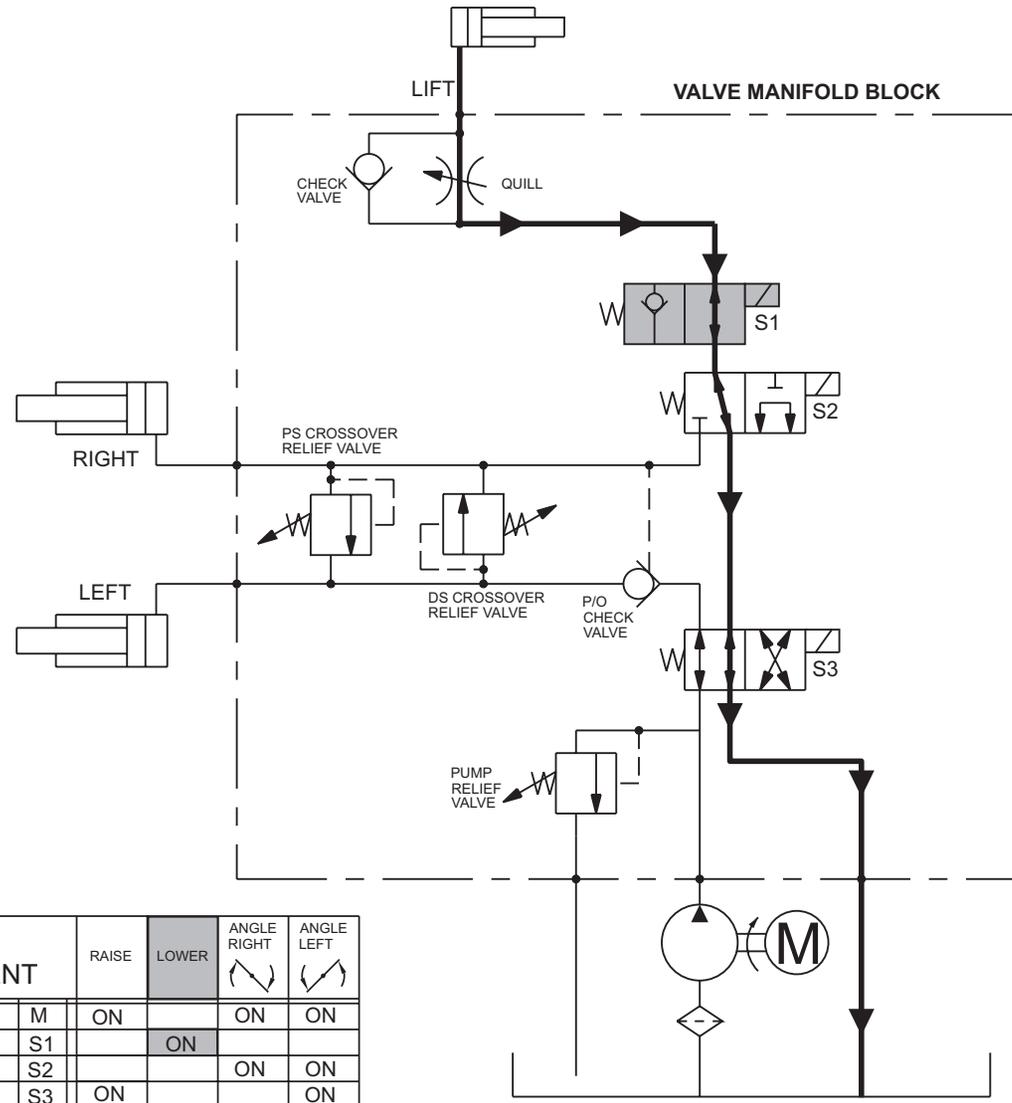
- 2) +12V is applied to the coil of solenoid cartridge valve S1, shifting the spool.

- 3) The weight of the plow forces the lift cylinder to retract. The retracting lift cylinder pushes the hydraulic oil out of its base end, through solenoid cartridge valves S1 & S2 & S3, and back to the reservoir.

NOTE: Angling left or right using the Fish-Stik® handheld control momentarily cancels Float while the button is depressed. Float is not cancelled by angling when using the solenoid control.



LOWER – HYDRAULIC



ANGLE RIGHT – ELECTRICAL

Blade Movement: Angle Right

Control: Right

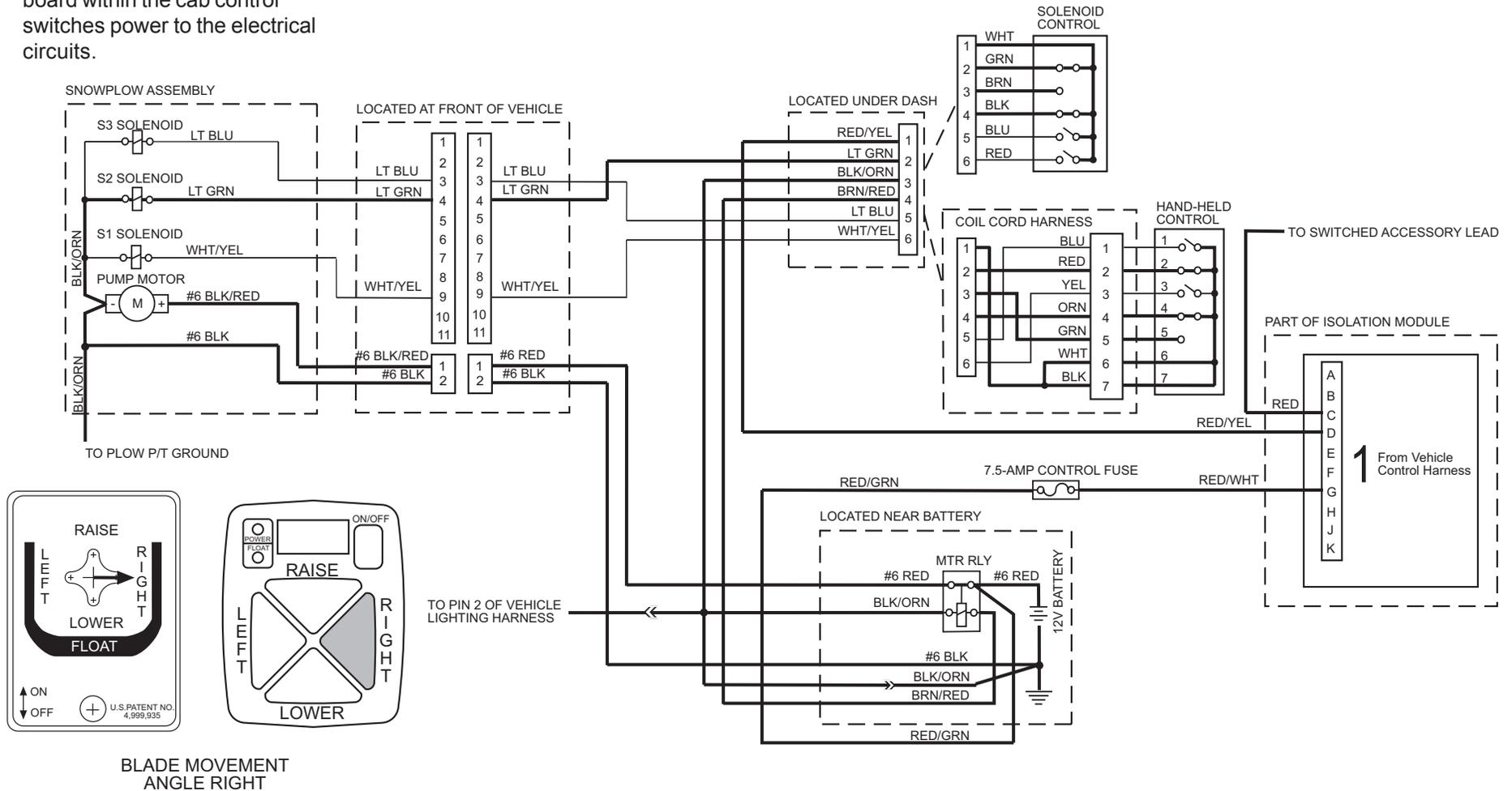
System Response:

- 1) By moving control lever or pressing the control button, the circuit board within the cab control switches power to the electrical circuits.

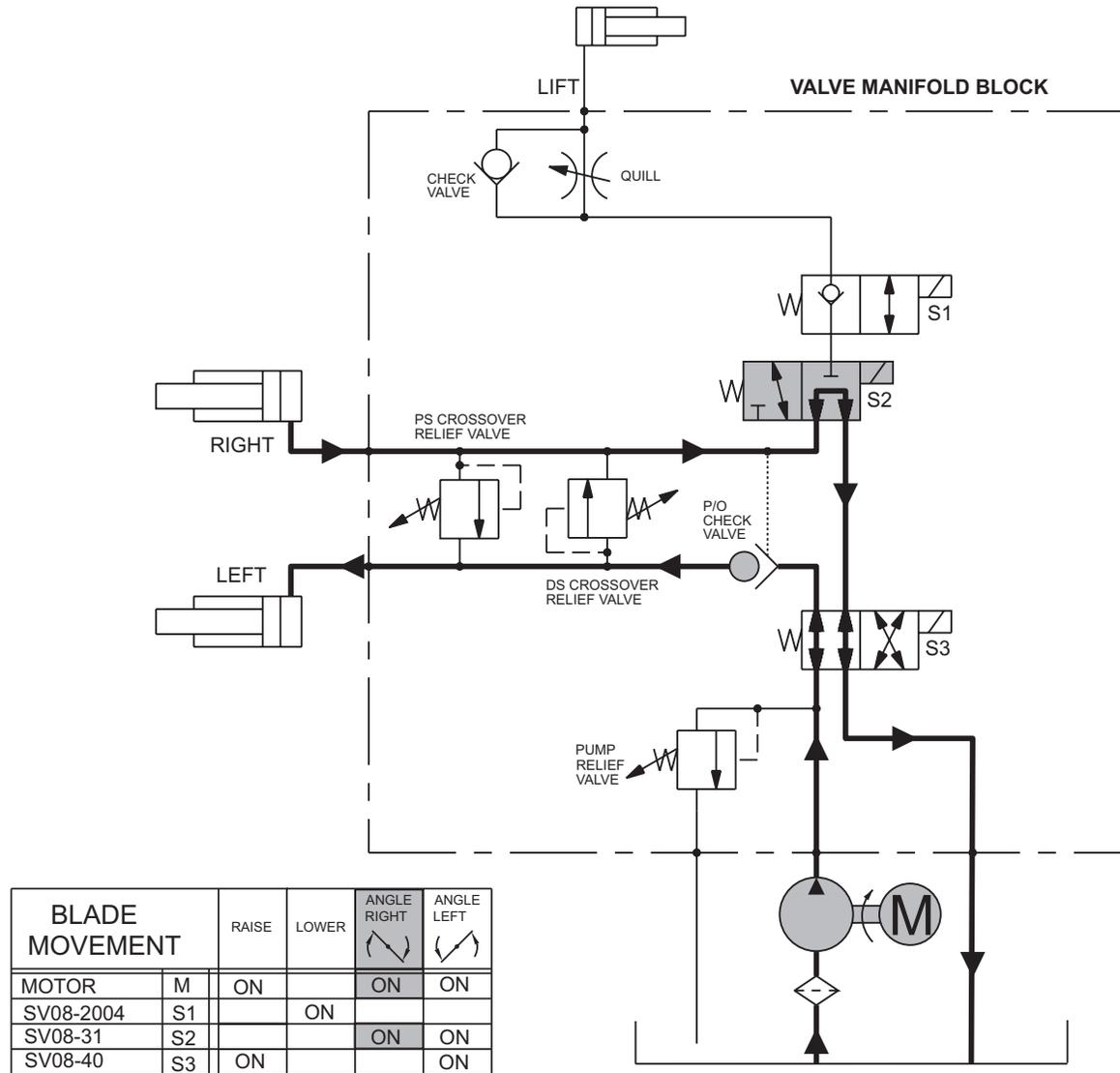
- 2) Motor relay closes, current flows through the motor relay, activating the pump motor. +12V is applied to the coil of solenoid cartridge valve S2, shifting its spool.

- 3) Hydraulic oil from the pump flows through solenoid cartridge valve S3, P/O check valve and into the base end of the left cylinder causing it to extend.

- 4) The retracting right cylinder pushes the hydraulic oil out of its base end, through solenoid cartridge valves S2 & S3 back to the reservoir.



ANGLE RIGHT – HYDRAULIC



ANGLE LEFT – ELECTRICAL

Blade Movement: Angle Left

Control: Left

System Response:

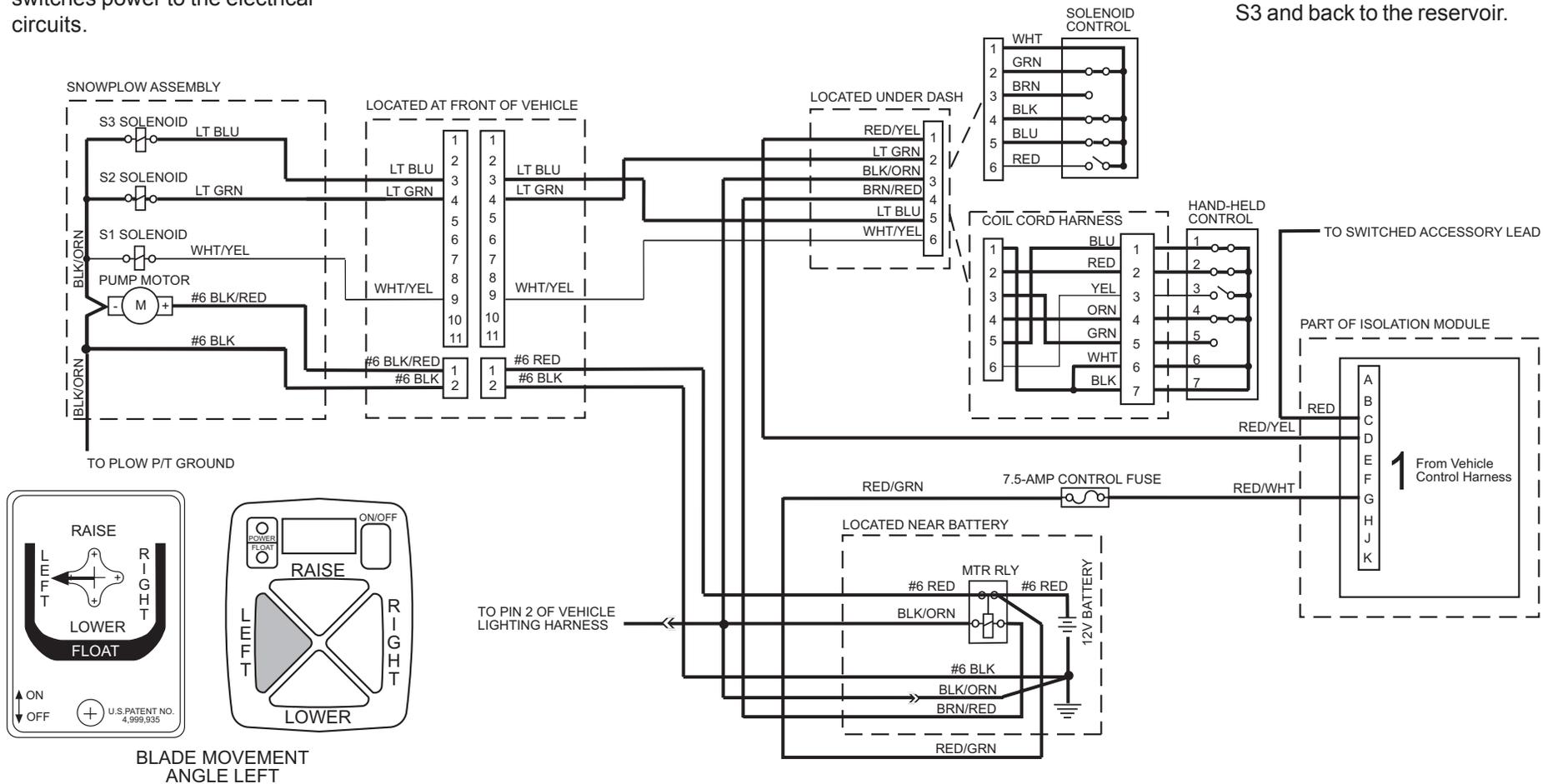
1) By moving control lever or pressing the control button, the circuit switches power to the electrical circuits.

2) Motor relay closes, current flows through the motor relay, activating the pump motor. +12V is applied to the coil of solenoid cartridge valves S2 & S3, shifting both spools.

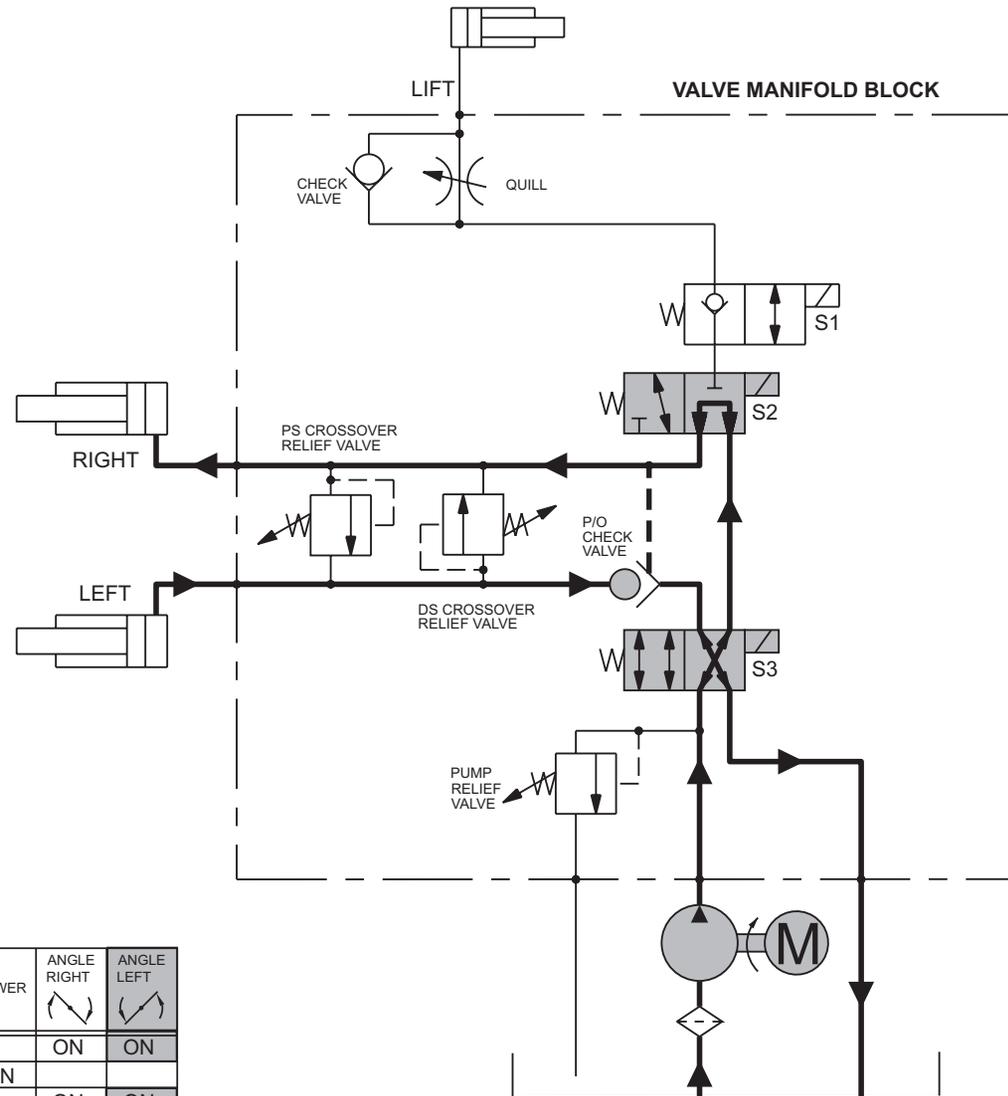
3) Hydraulic oil from the pump flows through solenoid cartridge valves S3 & S2 and into the base end of the right cylinder causing it to extend.

4) Pressure within the hydraulic circuit causes the P/O check valve to open.

5) The retracting left cylinder pushes the hydraulic oil out of its base end, through the open P/O check valve and solenoid cartridge valve S3 and back to the reservoir.



ANGLE LEFT – HYDRAULIC



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

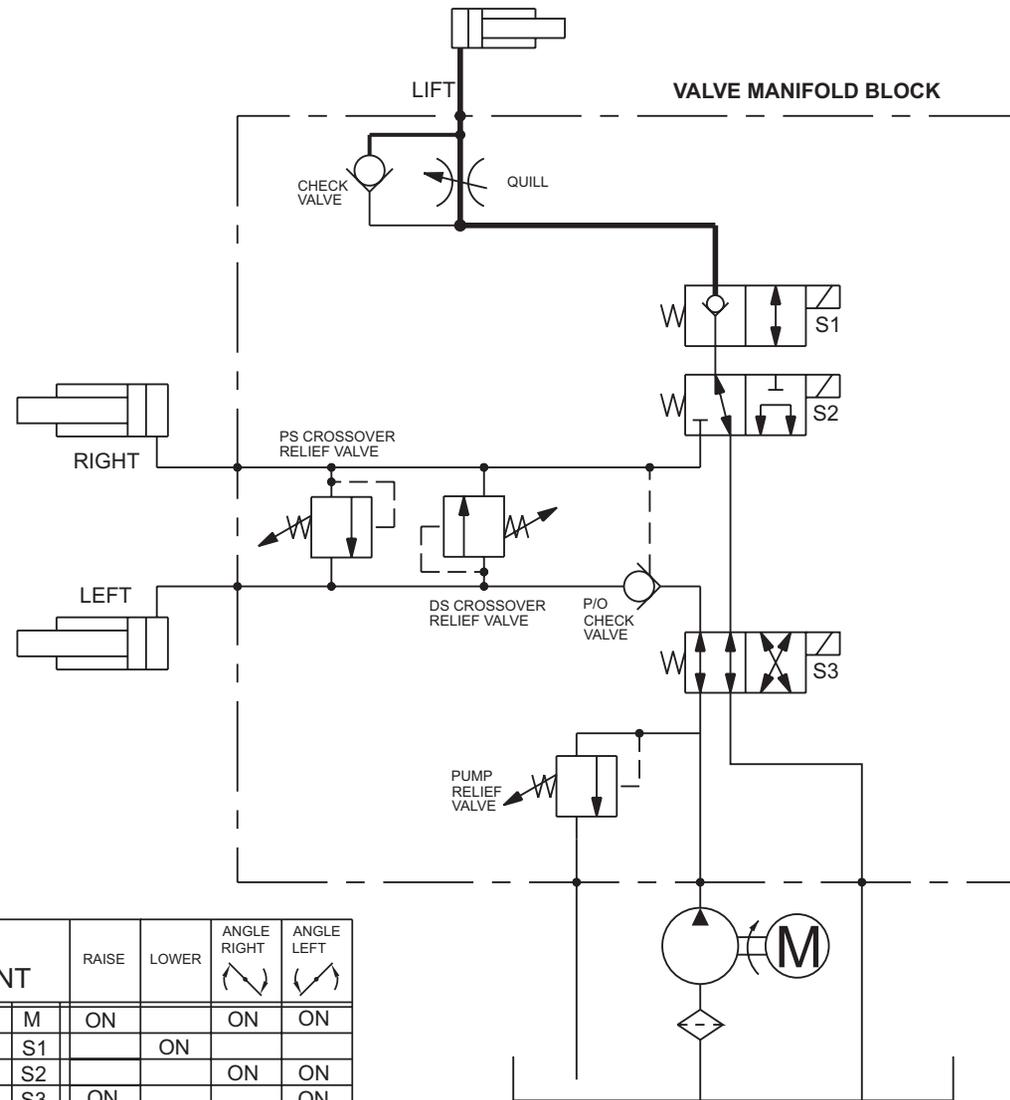
HOLD IN RAISE POSITION – HYDRAULIC

Blade Movement: Striking an Object While Plowing

Control: None

System Response:

- 1) Hydraulic oil is trapped in the base end of the lift cylinder by the internal check valve in solenoid cartridge valve S1.
- 2) When the snowplow contacts an object, the force of the impact increases the hydraulic pressure in the base end of the cylinder. When the pressure exceeds the relief valve pressure setting, the relief valve opens allowing oil to flow to the base of the opposite cylinder.



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

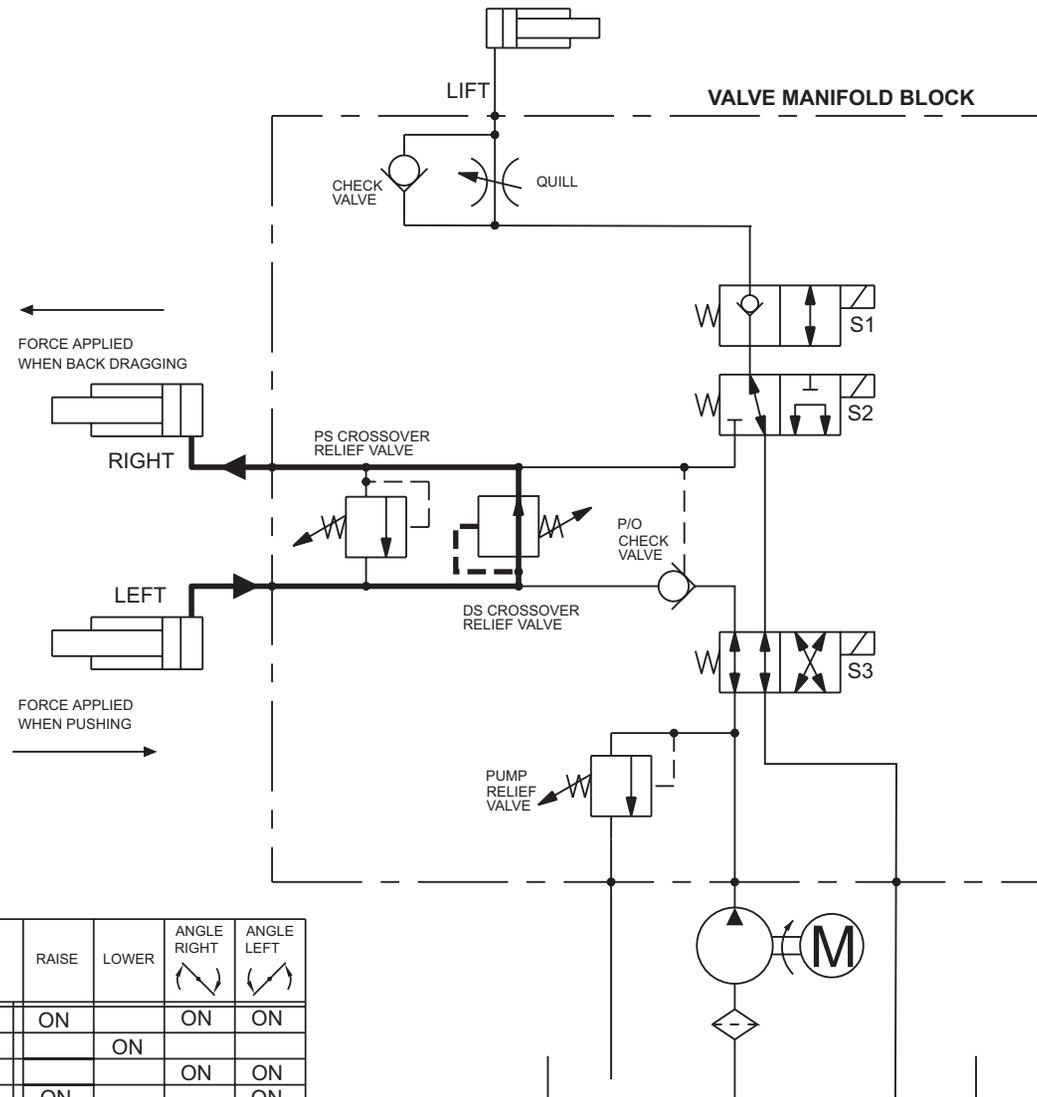
STRIKING AN OBJECT WHILE PLOWING – LEFT HYDRAULIC CYLINDER RETRACTS

Blade Movement: Striking an Object While Plowing

Control: None

System Response:

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



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

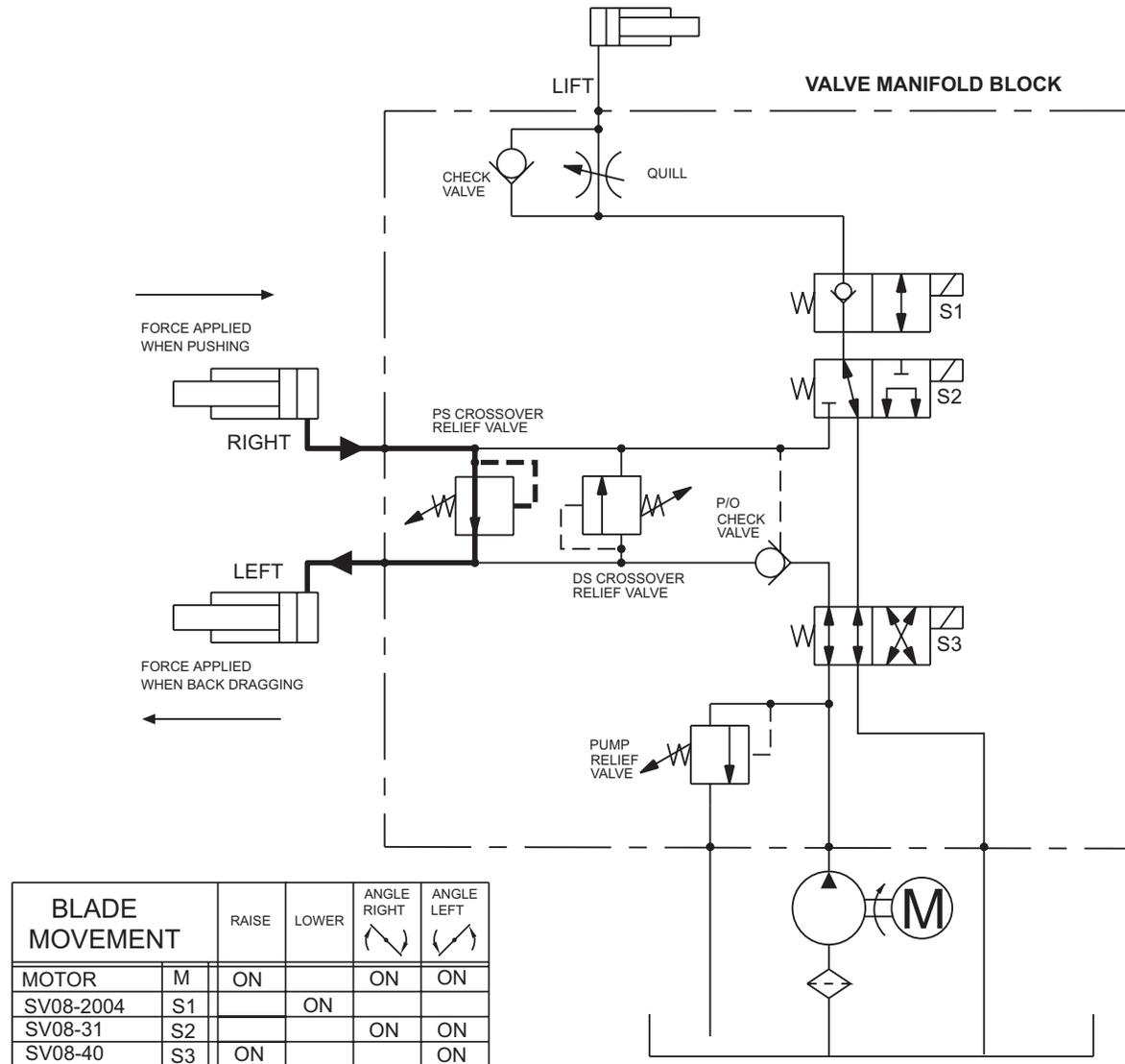
STRIKING AN OBJECT WHILE PLOWING – RIGHT HYDRAULIC CYLINDER RETRACTS

Blade Movement: Striking an Object While Plowing

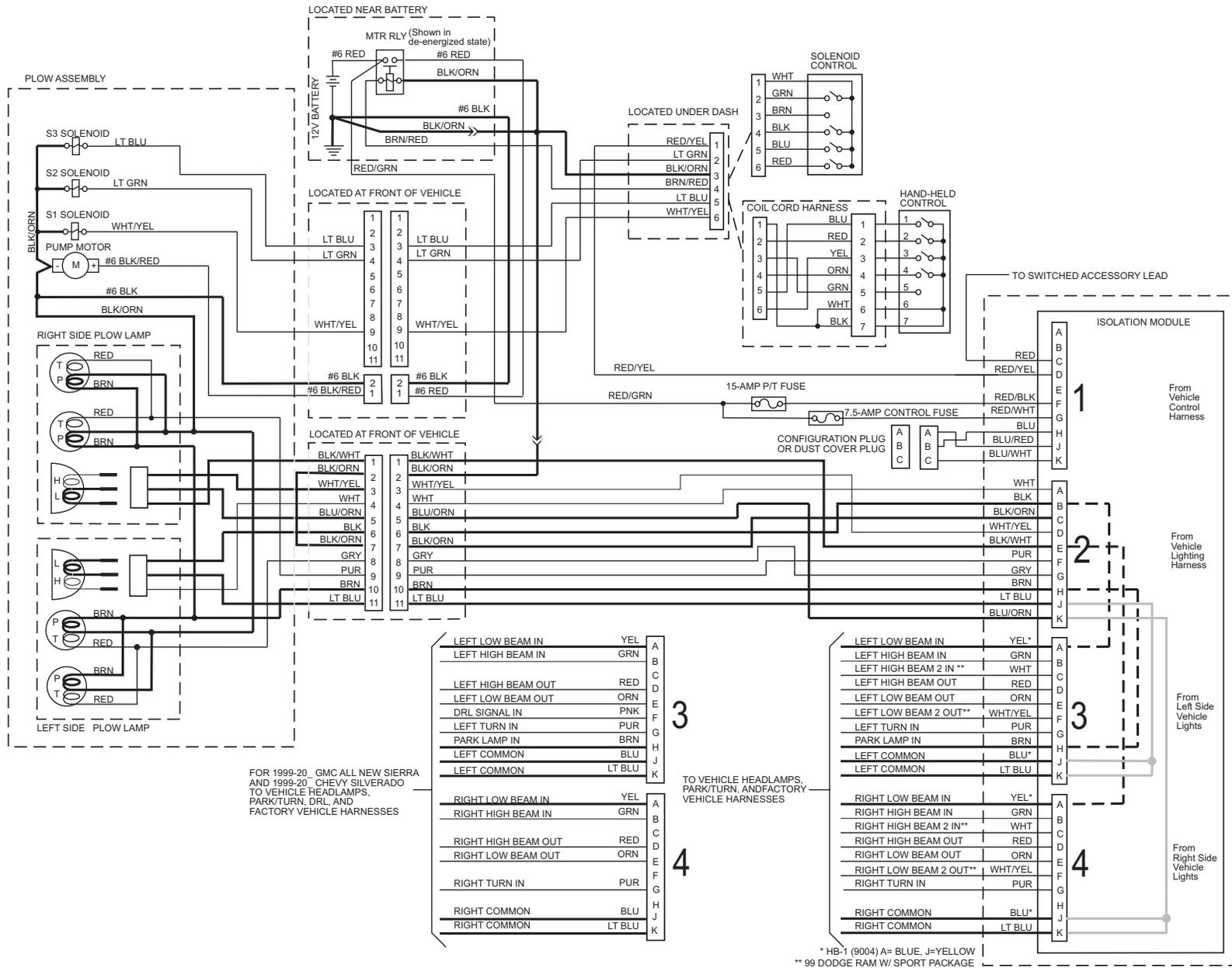
Control: None

System Response:

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



LOW BEAM HEADLAMPS WITH PLOW CONNECTED TO VEHICLE



TROUBLESHOOTING GUIDE

Troubleshooting Guide Contents

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Introduction

This guide consists of a series of tables, diagrams, flowcharts and other information. When used properly it helps the mechanic to identify and repair faulty system components. Fisher Engineering recommends using the Electrical Tester as a timesaving tool for electrical system diagnosis. When using this tester, refer to the supplied instruction manual.

All malfunctions of the snowplow can be categorized as mechanical, electrical, or hydraulic. Mechanical issues are generally related to the blade or attachments and can usually be identified by visual inspection. However, electrical and hydraulic issues can be difficult to trace to the component level and that is the purpose of this troubleshooting guide.

Read and understand the Theory of Operation before attempting troubleshooting.

How to Use the Troubleshooting Guide

When diagnosing the snowplow electrical and hydraulic systems, some conditions must be eliminated in order to develop valid tests. These conditions are listed before the tables or flowcharts and must be satisfied before proceeding.

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

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

1. Go to the General Diagnostic Table and satisfy the nine listed conditions. These conditions must be met before proceeding into the table or to any subsequent test.
2. Locate the condition in the table which best describes the problem and check possible causes and actions in the order listed.
3. Proceed to a service procedure, another condition, or a specific test as directed. All tests except the Hydraulic System Test use a

flowchart format. To use these flowcharts, first satisfy any listed conditions at the top of the page. Then begin at the upper left square and proceed as directed.

4. Follow along sequentially through the table and tests, referring to the hydraulic and electrical schematics in the Theory of Operation section and the component Identification and Location diagrams. Eventually the problem is identified at the component level.

Electrical Testing

Read and understand the Theory of Operation section. A simple 12V test light with a ground lead can be used for circuit testing. When directed to check for 12 volts (12V), ground the test lamp lead and probe the terminal. When asked to check for ground, attach the test lamp lead to +12V and probe the terminal. Note that 12V is a nominal value. If using a voltmeter, actual voltage will vary with the vehicle and the 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.

GENERAL DIAGNOSTIC TABLE

BEFORE USING THIS GENERAL DIAGNOSTIC TABLE, OR PERFORMING ANY TESTS, YOU MUST VERIFY THE FOLLOWING CONDITIONS:

1. Snowplow is attached to vehicle and all harnesses are connected.
2. Harness connector pins and terminals are free of corrosion, ensuring good connections, and coated with dielectric grease.
3. Vehicle battery and charging system are in good condition and battery connections are clean and tight.

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

4. Hydraulic reservoir is filled to fill plug level with recommended fluid when lift cylinder is fully retracted. See Product Specifications.
5. No oil leaks from hoses, fittings, cylinders or the hydraulic unit.
6. All built up snow and ice is removed from the snowplow.
7. FISHER® vehicle control harness fuses are good.
8. Ignition is turned on or engine is running.
9. The control is connected in the cab and turned on.

CONDITION	POSSIBLE CAUSE	ACTION
Motor does not run for any requested function.	Poor connection of vehicle's or plow's battery cable.	Tighten and/or clean connections.
	Motor relay inoperative.	Go to Motor Relay Test.
	Defective control.	Go to Control Test.
	Fault in vehicle control harness.	Go to Vehicle Control Harness Test.
	Motor worn or damaged or pump seized.	Go to Motor Test.
Motor runs continuously.	Motor relay sticking or always energized.	Go to Motor Relay Test.
	Defective control.	Go to Control Test.
	Fault in vehicle control harness.	Go to Vehicle Control Test.
Snowplow won't raise—motor runs.	Lift cylinder packing nut too tight.	Adjust lift cylinder packing nut.
	Clogged pump filter (all functions are affected). *	Clean or replace filter, flush reservoir.
	Worn or damaged pump.	Go to Pump Pressure Test.

* Thread sealant/tape is not compatible with hydraulics.

GENERAL DIAGNOSTIC TABLE

CONDITION	POSSIBLE CAUSE	ACTION
Snowplow won't raise—motor runs.	Solenoid valve coils not energizing properly.	Go to Cartridge Coil Activation Test.
	Hydraulic system malfunction. *	Go to Hydraulic System Test.
	Defective control.	Go to Control Test.
Snowplow raises slowly or partially—motor runs.	Poor connection of vehicle's or plow's cables.	Clean and re-attach all connections.
	Clogged pump filter (all functions are affected). *	Clean or replace filter, flush reservoir.
	Worn or damaged pump.	Go to Pump Pressure Test.
Snowplow will not lower or lowers slowly, or won't float.	Lift cylinder packing nut too tight.	Adjust lift cylinder packing nut.
	Solenoid valve coils not activating properly.	Go to Cartridge Coil Activation Test.
	Hydraulic system malfunction. *	Go to Hydraulic System Test.
	Defective control.	Go to Control Test.
Snowplow lowers by itself or won't stay in raised position.	Hydraulic system malfunction. *	Go to Hydraulic System Test.
	Defective control.	Go to Control Test.
Blade will not hold angled position.	Air in angle cylinders.	Cycle angle functions to purge cylinders.
	Oil bypassing crossover relief valve.	Go to Relief Valve Inspection and Adjustment.
	Hydraulic system malfunction. *	Go to Hydraulic System Test.
Snowplow does not perform the selected function or performs a different function.	Hydraulic hose routing incorrect.	Verify correct hose installation. See Hose Routing Diagram.
	Solenoid valve coils not energizing properly.	Go to Cartridge Coil Activation Test.
	Hydraulic system malfunction. *	Go to Hydraulic System Test.
	Defective control.	Go to Control Test.

* Thread sealant/tape is not compatible with hydraulics.

GENERAL DIAGNOSTIC TABLE

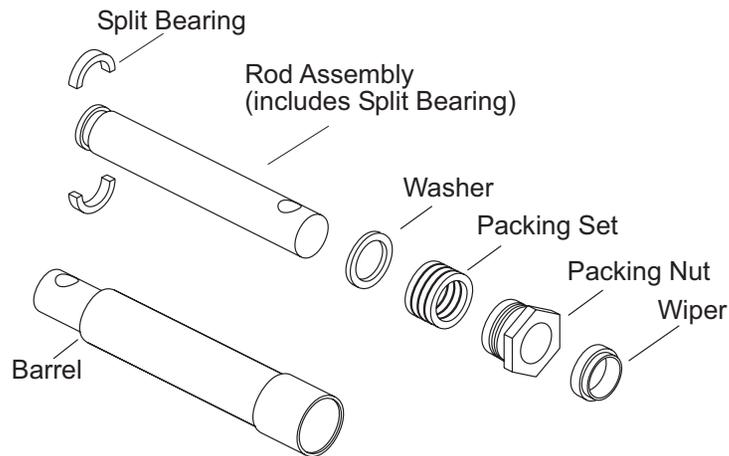
CONDITION	POSSIBLE CAUSE	ACTION
FISHER® vehicle control harness control fuse blows.	Red wire in vehicle harness is shorted to ground.	Repair wire or replace vehicle harness.
	Motor relay primary coil shorted internally.	Check primary coil with ohmmeter. Replace defective motor relay.
	Solenoid valve coil shorted internally.	Go to Individual Solenoid Coil Test. Replace shorted coils.
	Motor relay or solenoid coil wires in vehicle harness shorted to ground.	Repair wire or replace vehicle harness.
	Solenoid coil wires in snowplow harness shorted to ground.	Repair wire or replace snowplow harness.
	Defective control.	Go to Control Test.
Vehicle accessory fuse blows.	Circuit overloaded.	Consult vehicle owner's manual for correct application of aftermarket electrical loads.
Excessive load on vehicle electrical system while using snowplow.	Pump Relief incorrectly adjusted.	Go to Pump Pressure Test.
	Worn or damaged motor or pump.	Go to Pump Pressure Test.
	Poor connection of battery cables.	Inspect battery cables, clean and re-establish all battery connections.
Snowplow headlamps operate irregularly or not at all –snowplow attached. -or- Vehicle headlamps operate irregularly or not at all – snowplow removed.	Burned out bulbs or corroded sockets.	Replace bulbs, clean contacts.
	Wires improperly located in connector inserted into Isolation Module.	Review and correct wire installation. Go to Snowplow Headlamp Test.
	Isolation Module improperly connected.	Go to Isolation Module Test.
Vehicle daytime running lamps (DRLs) do not work.	Parking brake on, vehicle not in drive. Light sensor not deactivated.	Fully release parking brake, place vehicle in drive. Place light by sensor.
	Power in DRL circuit has been interrupted.	Turn lamp and/or ignition switch on and off to cycle the DRL circuitry. Go to Vehicle DRL Test.
Snowplow DRLs do not work.	Power in DRL circuit has been interrupted.	Go to Snowplow DRL Test.
Blade will not hold position.	Hydraulic system malfunction.	Go to Hydraulic System Test.

ANGLE AND LIFT CYLINDERS

Cylinder with Packing Nut

If equipped with this type of cylinder, periodically verify the lift or angle cylinder packing nuts have not loosened. If a packing nut is loose or leakage appears when activating the cylinder, tighten the packing nut 1/4-turn after you feel the packing nut contact the packing.

If adjustment fails to stop fluid loss, replacement of packing and/or rod (if the chromed surface is pitted) may be required.

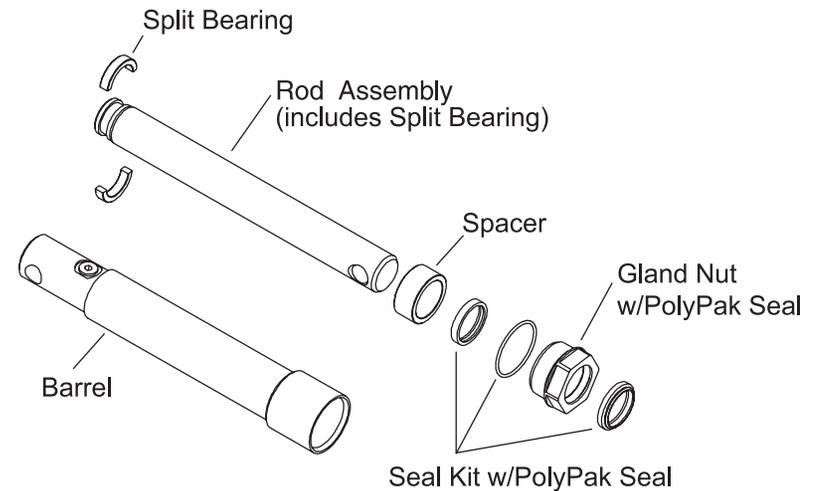


⚠ CAUTION
Do not overtighten the packing nut. Overtightening affects the operation and life of the packing.

NOTE: A small amount of leakage is acceptable to properly lubricate the rod.

Low Friction Cylinder

If equipped with this type of lift or angle cylinder, the gland nut is torqued to 150-180 ft-lbs at the factory. Fluid leakage past the internal seal to the outside indicates a bad seal and/or that chromed rod is pitted. Replacement of the damaged parts is required.



MOTOR TEST

⚠ WARNING

The driver shall keep bystanders clear of the blade during this test. Do not stand between the vehicle and the blade. A moving or falling blade could cause personal injury.

Refer to the Motor and Motor Relay Test Diagram.

Refer to the Motor and Motor Relay Test Diagram.

To activate the motor, the following conditions must be met:

1. All three (3) snowplow and vehicle harnesses and cable assemblies must be connected.

2. The vehicle control harness is plugged into position 1 of the Isolation Module.

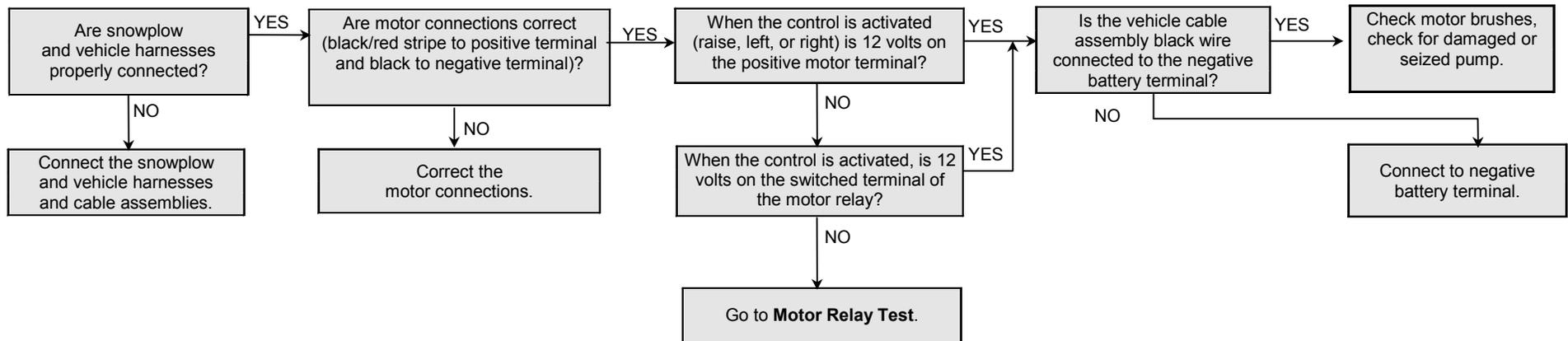
3. The vehicle lighting harness is plugged into position 2 of the Isolation Module.

4. +12V from the battery must be connected to one secondary terminal of the motor relay.

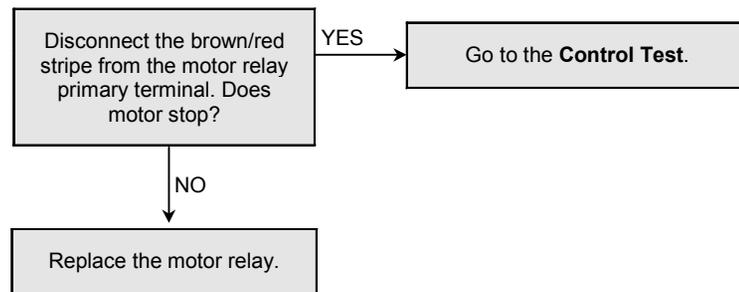
5. The vehicle ignition switch must be in the ON position.

6. The control must be turned on.

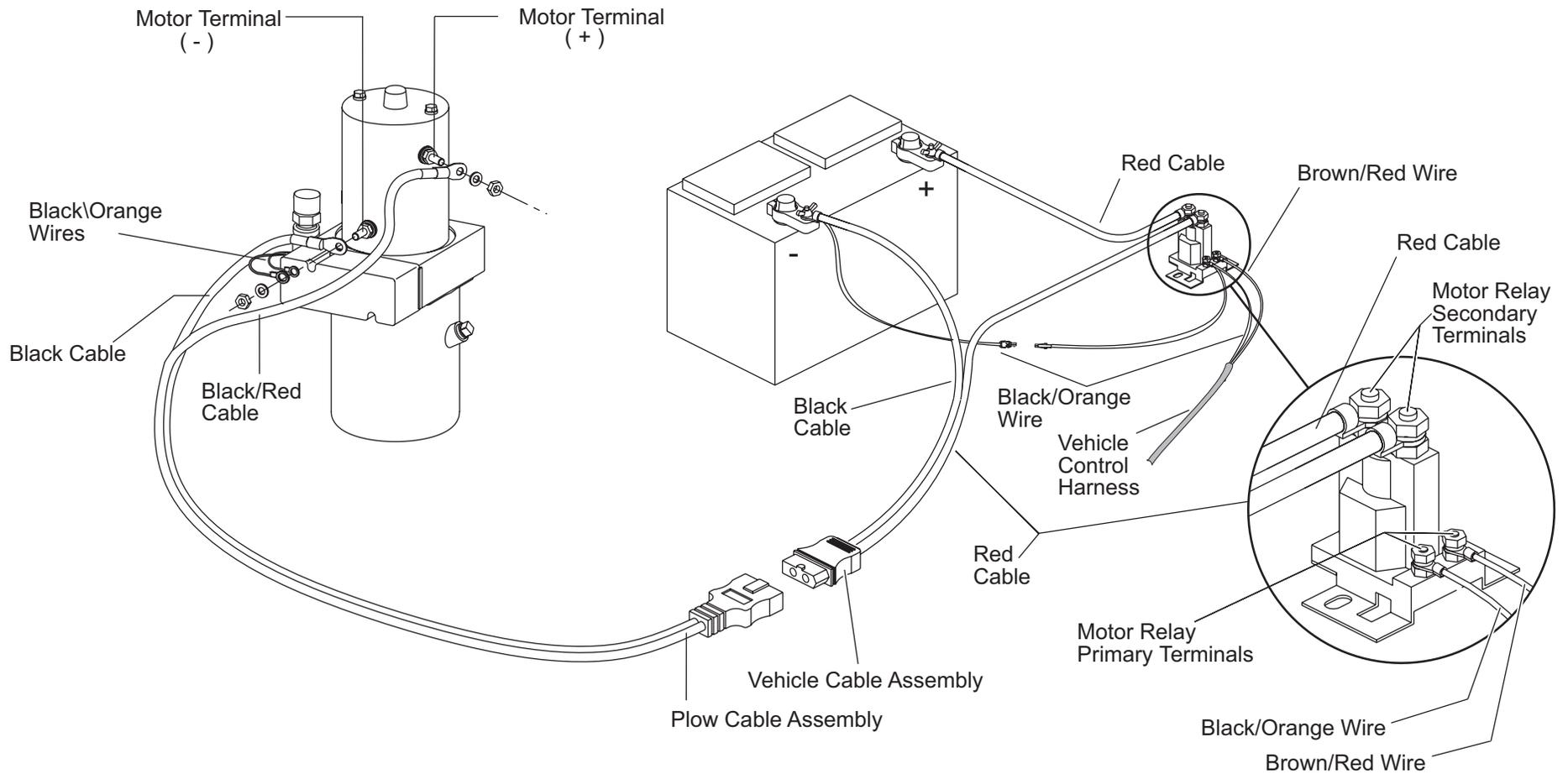
MOTOR DOES NOT RUN



MOTOR RUNS CONTINUOUSLY



MOTOR AND MOTOR RELAY TEST DIAGRAM



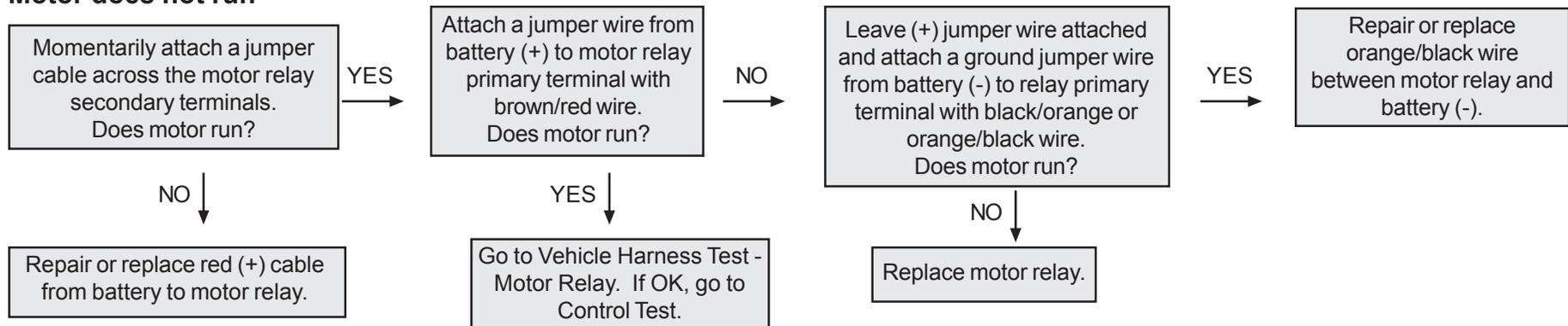
MOTOR RELAY TEST

⚠ WARNING

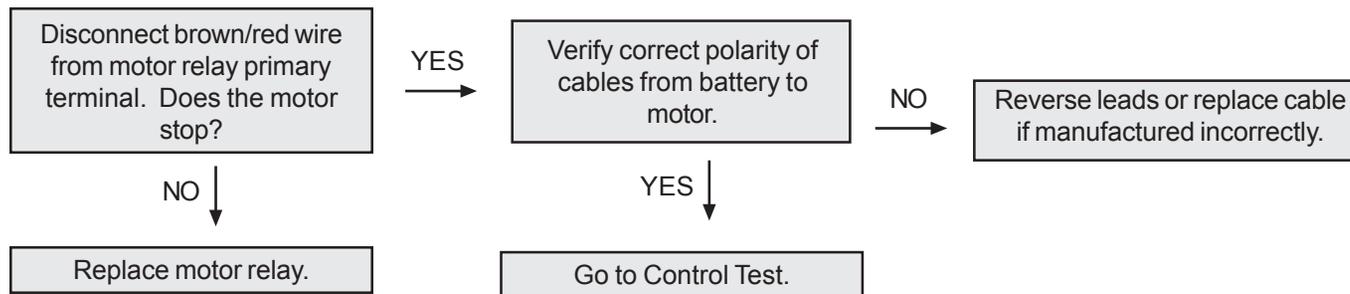
The driver shall keep bystanders clear of the blade during this test. Do not stand between the vehicle and the blade. A moving or falling blade could cause personal injury.

1. Momentarily jump power and ground directly from battery to motor to verify that the motor runs. Make final connection at the motor.
2. Refer to the Motor and Motor Relay Test Diagram, and Vehicle Harness and Vehicle Cable Location Diagram.

Motor does not run



Motor runs continuously



VEHICLE CONTROL HARNESS TEST

⚠ WARNING

The driver shall keep bystanders clear of the blade during this test. Do not stand between the vehicle and the blade. A moving or falling blade could cause personal injury.

Perform the Motor Test and Motor Relay Test first.

To check the Vehicle Control Harness, the following conditions must be met:

1. The snowplow and vehicle lighting harnesses must be connected.

2. The vehicle control harness is plugged into position 1 of the Isolation Module.

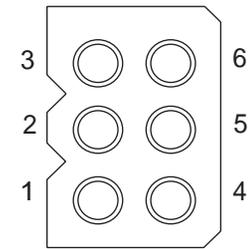
3. The vehicle lighting harness is plugged into position 2 of the Isolation Module.

4. **Disconnect** the control in the cab.

5. The vehicle ignition switch must be in the ON position.

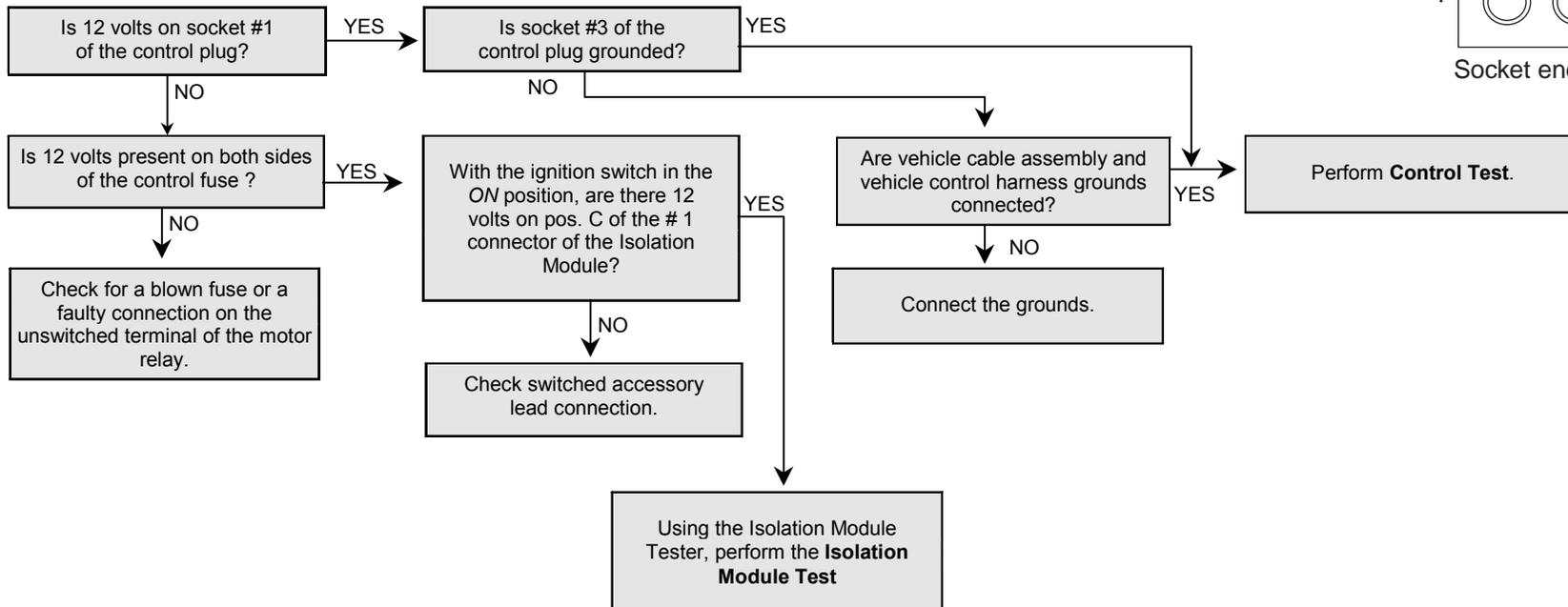
6. Refer to the 6-pin Connector diagram. Test the vehicle side of the connector in the cab as follows.

White 6-Pin Connector on vehicle control harness (located in cab)



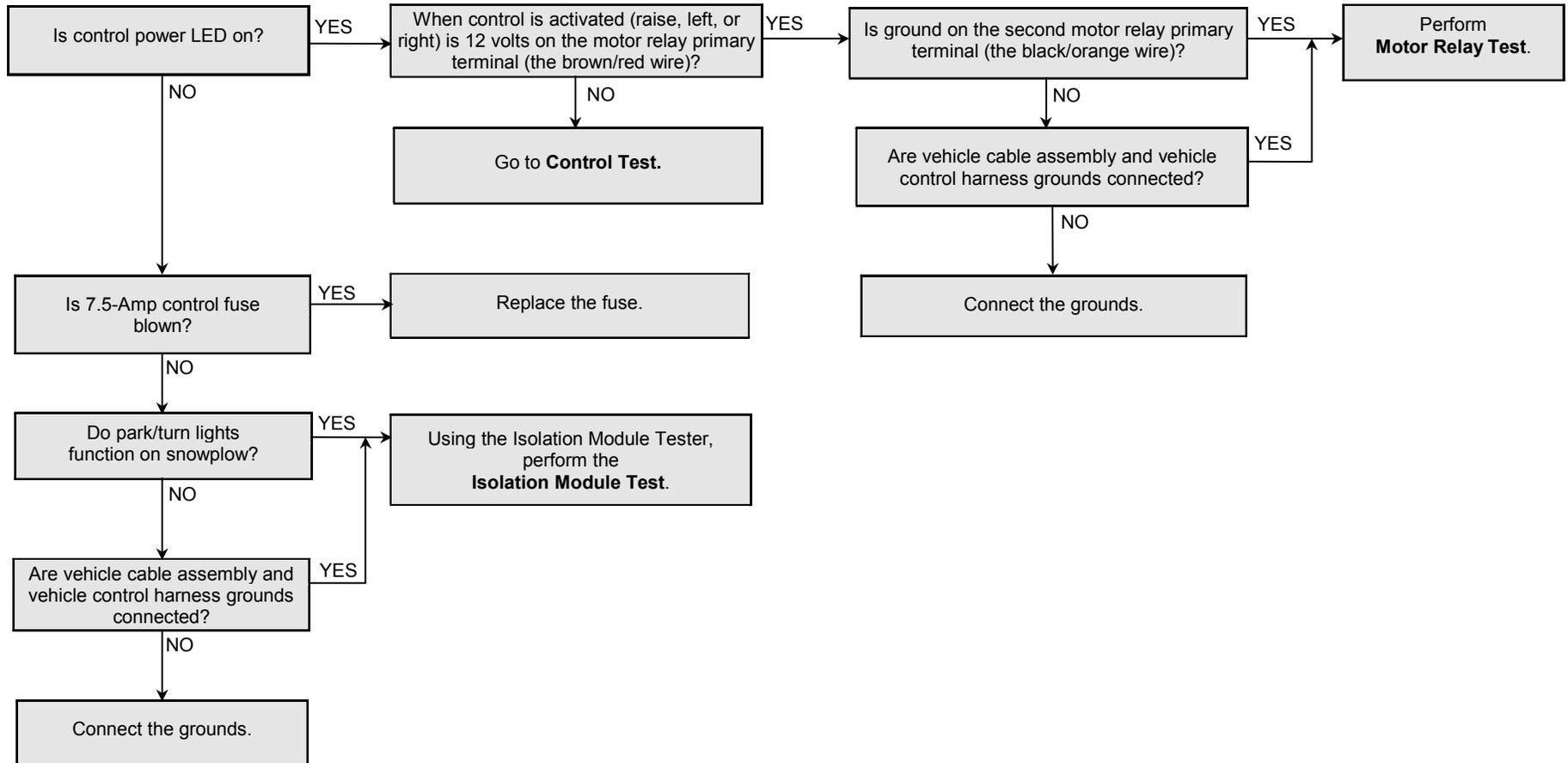
Socket end view

No Power To The Control



VEHICLE CONTROL HARNESS TEST

Motor Relay Will Not Activate



CONTROL TEST

Fish-Stik® Hand-held Control or Joystick Solenoid Control

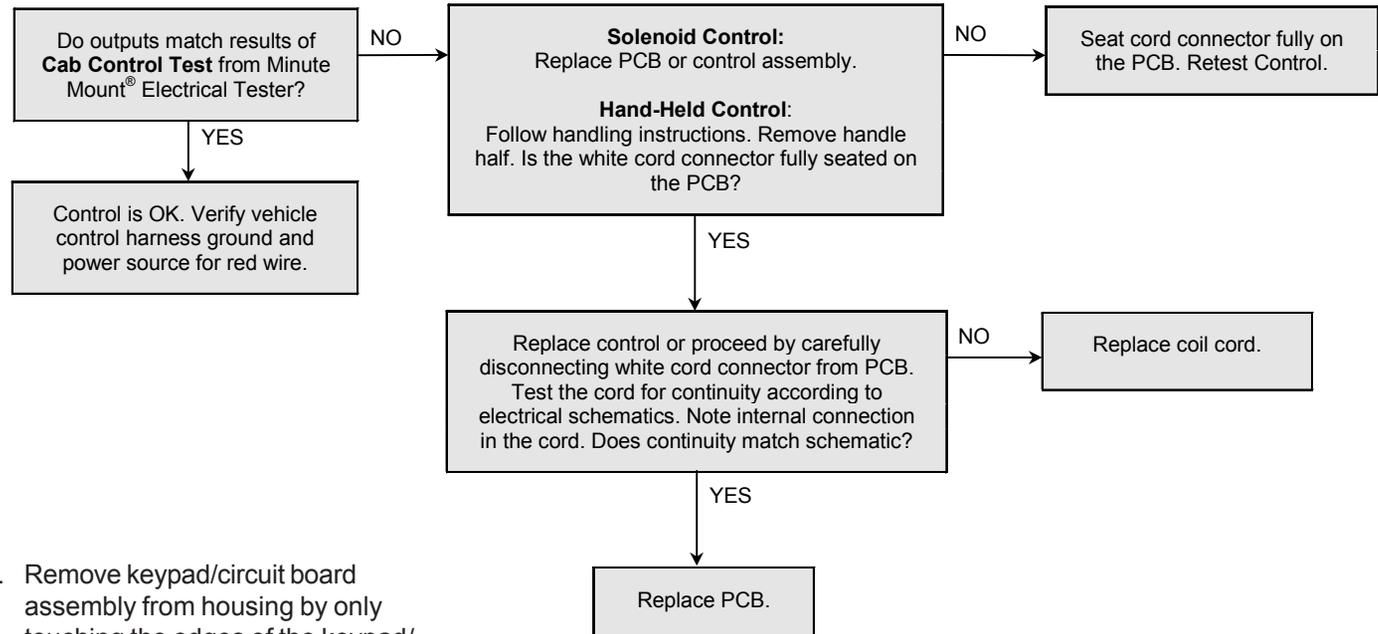
1. Disconnect the control in the cab and remove to work bench.
2. Perform the Cab Control Test using the Minute Mount® Electrical Tester.

To Safely Handle Hand-Held PCB:

⚠ CAUTION

Printed circuit board (PCB) is subject to damage from static electricity. Follow instructions below to safely handle PCB.

1. Disconnect the control in the cab and remove to a workbench.
2. Place control on its left side and remove right side of handle, leaving the keypad/circuit board assembly in left half.
3. Touch any grounded metal object to discharge possible static buildup.



4. Remove keypad/circuit board assembly from housing by only touching the edges of the keypad/circuit board assembly.
5. The keypad/circuit board assembly can be handled safely as long as contact with it is maintained.

PUMP PRESSURE TEST

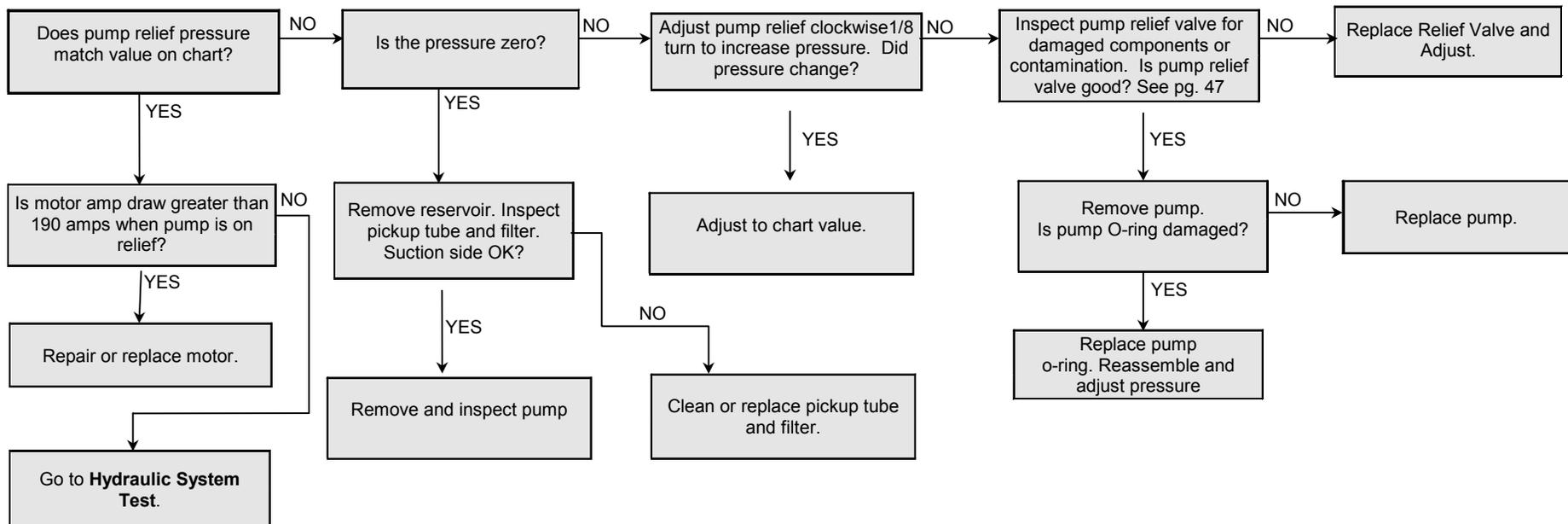
⚠ WARNING

The tester shall keep bystanders clear of the blade during this test. Do not stand between vehicle and the blade. A moving or falling blade could cause personal injury.

1. Check fluid level.
2. Lower blade to the ground to remove any pressure from the lift cylinder.
3. Carefully disconnect the hose for the base end of the lift cylinder at the valve manifold block.
4. Using a suitable adapter fitting, attach a 3000 psi pressure gauge to the valve block fitting.

Snowplow Type	Relief Valve Approx. turns out from fully seated	Pump Relief Pressure PSI ± 100 PSI
All Straight Blades	2½ – 2¾	1750

5. Activate the raise function with the control and read the pump relief pressure. The chart lists relief valve settings.



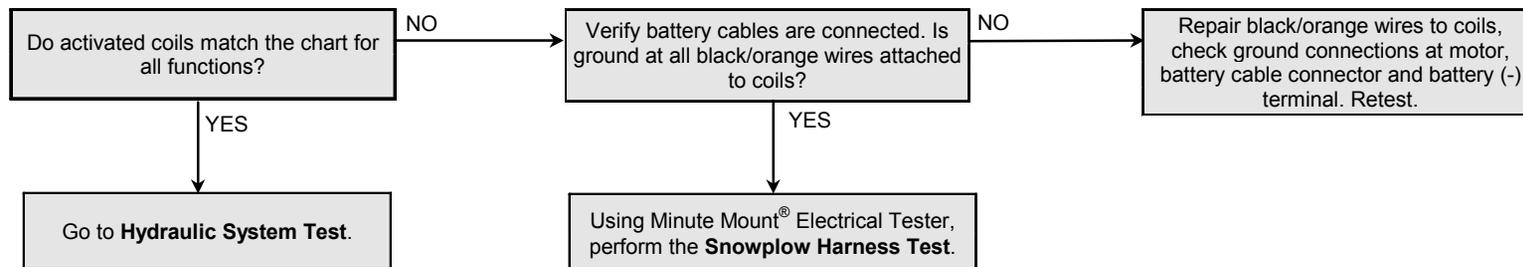
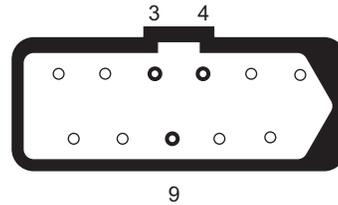
CARTRIDGE COIL ACTIVATION TEST

1. Disconnect the red (+) battery cable from the motor and isolate it.
2. Remove solenoid valve cover.
3. Verify wires are properly attached to solenoid coils. Refer to Electrical Schematic and Solenoid Cartridge Valve Identification and Location Table at top right of this page.
4. Activate the control for each function and check for magnetic pull at all three solenoid valve coils using common screwdriver. Only the coils designated as "ON" in the table below should activate for each function. After noting which coils are energized, proceed to the flow chart.

Solenoid Coil	Vehicle Control Harness Socket	Wire Color	Raise	Lower	Angle Right	Angle Left
S1	9	White/ Yellow	*	ON	*	*
S2	4	Light Green			ON	ON
S3	3	Light Blue	ON			ON

* S1 output is "ON" for all functions if control is in "FLOAT". Press "RAISE" button to cancel "FLOAT".
 Fish-Stik® Hand-Held Control Only – While in "FLOAT", pressing and holding the "RIGHT" or "LEFT" button turns off solenoid cartridge valve S1 until the button is released.

3-Pin Connector
Snowplow Side



HYDRAULIC SYSTEM TEST

This test consists of trying all the snowplow functions and comparing the snowplow reaction to the action requested in the following table. The table will pinpoint faulty solenoid valves or p/o check valve accurately if only one component is malfunctioning. If the snowplow reaction for a given function is not listed in the table, there may be a relief or p/o check valve which is stuck open or contaminated, missing or damaged o-rings or

backing rings on cartridge, relief or p/o check valve, or there may be two or more faulty components. In this case, use the specific function hydraulic schematic and carefully inspect each component in the flow circuit. If contamination is evident in more than one component, the hydraulic unit, hoses and cylinders must be completely disassembled, inspected and cleaned.

1. Perform Cartridge Coil Activation Test first.
2. Verify hydraulic hose installation is correct. Refer to the Hydraulic Hose Routing diagram.
3. Test all snowplow functions.
4. Inspect and clean or replace the suspected component. Refer to the Hydraulic Unit Parts Diagram.

5. Refer to the sections following the table for inspecting and adjusting solenoid cartridge valves, p/o check valve, and relief valves.

IMPORTANT: When testing the snowplow functions, be sure the control is not in "float."

ACTION REQUESTED	PLOW REACTION	POSSIBLE CAUSE
Raise	None	S3 not shifted
	Angle Left	S2 stuck shifted
Lower	None	S1 not shifted
		S2 stuck shifted
		S3 stuck shifted
Angle Right	Angle Left	S3 stuck shifted
	None	S2 not shifted
	Slow	Poppet check valve not opening
Angle Left	Angle Right	S3 not shifted
	Raise	S2 not shifted
	None	S2 and S3 not shifted
	Slow	Poppet check valve not opening
None (blade raised)	Lowers	S1 stuck shifted or has leaking internal check valve
None	Drifts Right	S2 stuck shifted
		Contamination, bad valve stem seat, or damaged O-rings in crossover relief valve
	Drifts Left	Poppet check valve open
		Contamination, bad valve stem seat, or damaged O-rings in crossover relief valve

RELIEF VALVE INSPECTION AND ADJUSTMENT

Relief Valve Inspection

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

⚠ CAUTION

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

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

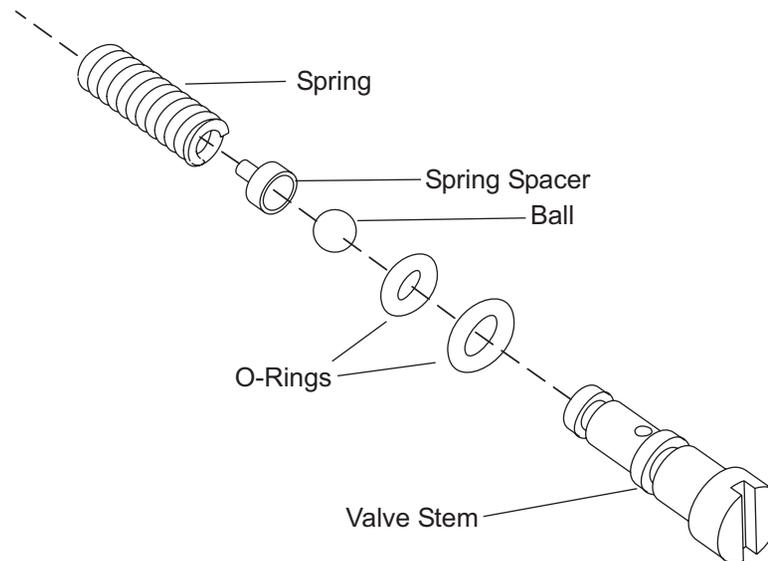
Adjustment

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

Hydraulic System

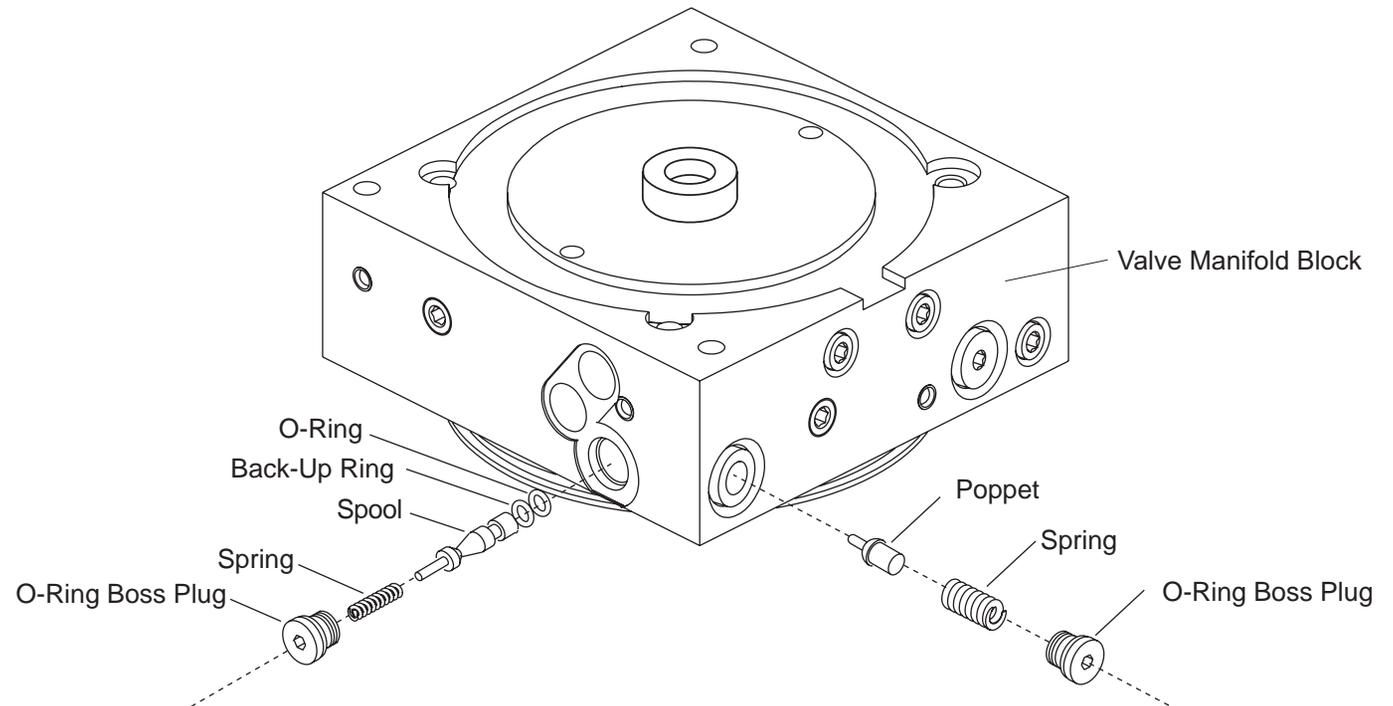
Relief Valve	No. of Turns Backed Off (CCW) From Fully Seated	Approximate Relief Valve Pressure ± 100 (PSI)
Pump Relief *	2½ – 2¾	1750
Angle Cylinder Crossover Relief		
Regular (RD & HD)	1¼ – 1½	4000
Commercial (MC)	2¼ – 2½	2500
LD	2¼ – 2½	2500

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



PILOT-OPERATED (POPPET STYLE) CHECK VALVE INSPECTION

1. Strike boss plugs squarely with a hammer to facilitate removal.
2. Remove O-ring boss plug, spring and poppet.
3. Remove O-ring boss plug, spring and spool with O-ring. Use long/slender needle-nosed pliers to remove spool.
4. Inspect springs, poppet, spool, O-rings and poppet seat for wear, damage or contamination.
5. If the valve manifold block has a steel poppet seat, use a strong pencil magnet to push and pull on the seat. If the seat moves at all, replace the valve block.
6. Re-oil O-rings, install spool fully into bore. Spool must insert smoothly.
7. Install poppet, springs and O-ring boss plugs. Torque O-ring boss plug to 60 in-lb.



INDIVIDUAL SOLENOID COIL TEST

1. Remove both wires from coil terminals.
2. Attach an ohmmeter across the coil terminals.
3. A reading of approximately 7 ohms indicates the coil is good. A good coil draws approximately 1.5 amps.

SOLENOID CARTRIDGE VALVE INSPECTION

1. Remove coils from the solenoid cartridge valves and remove cartridge valves from manifold. Look for visible contamination or damaged seals. Check for stuck spools with a plastic, aluminum, or soft brass probe by pushing on the spring-loaded internal spool from the end of the valve. The spool should move freely through its entire travel.

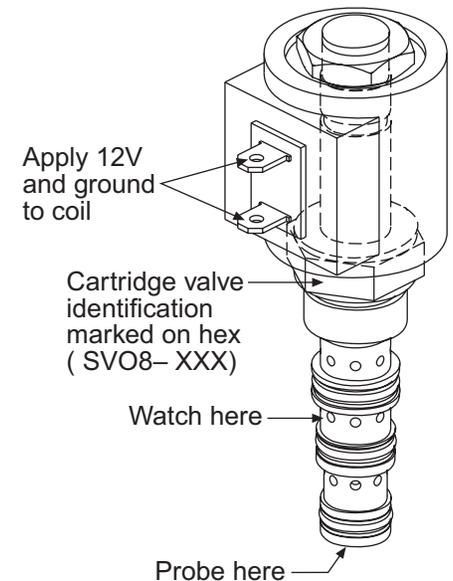
NOTE: Using probe to move spool may shear contamination which was affecting spool movement.

2. Bench test the cartridge valve by installing a coil on the stem and applying 12V and ground. Watch through the side ports for internal spool travel.

If the cartridge valve spool is stuck or its travel is restricted, replace the cartridge. If the cartridge valve is in good condition, clean it with parts cleaning solvent and dry with compressed air, being careful not to damage the seals. Check the spool travel again in case any internal contaminants were dislodged during cleaning. Re-oil the cartridge valve seals and o-rings and reinstall the

cartridge valve, torquing to 10 ft-lb. Install the coils and torque retaining nuts to 4 ft-lb.

NOTE: If contamination is seen in more than one component, it can be reasonably assumed that the entire system is contaminated and in order to perform a proper repair, the entire hydraulic unit must be disassembled and cleaned. The hoses and cylinders must also be disassembled and cleaned. The source of the contamination must be located and repaired before reassembly.



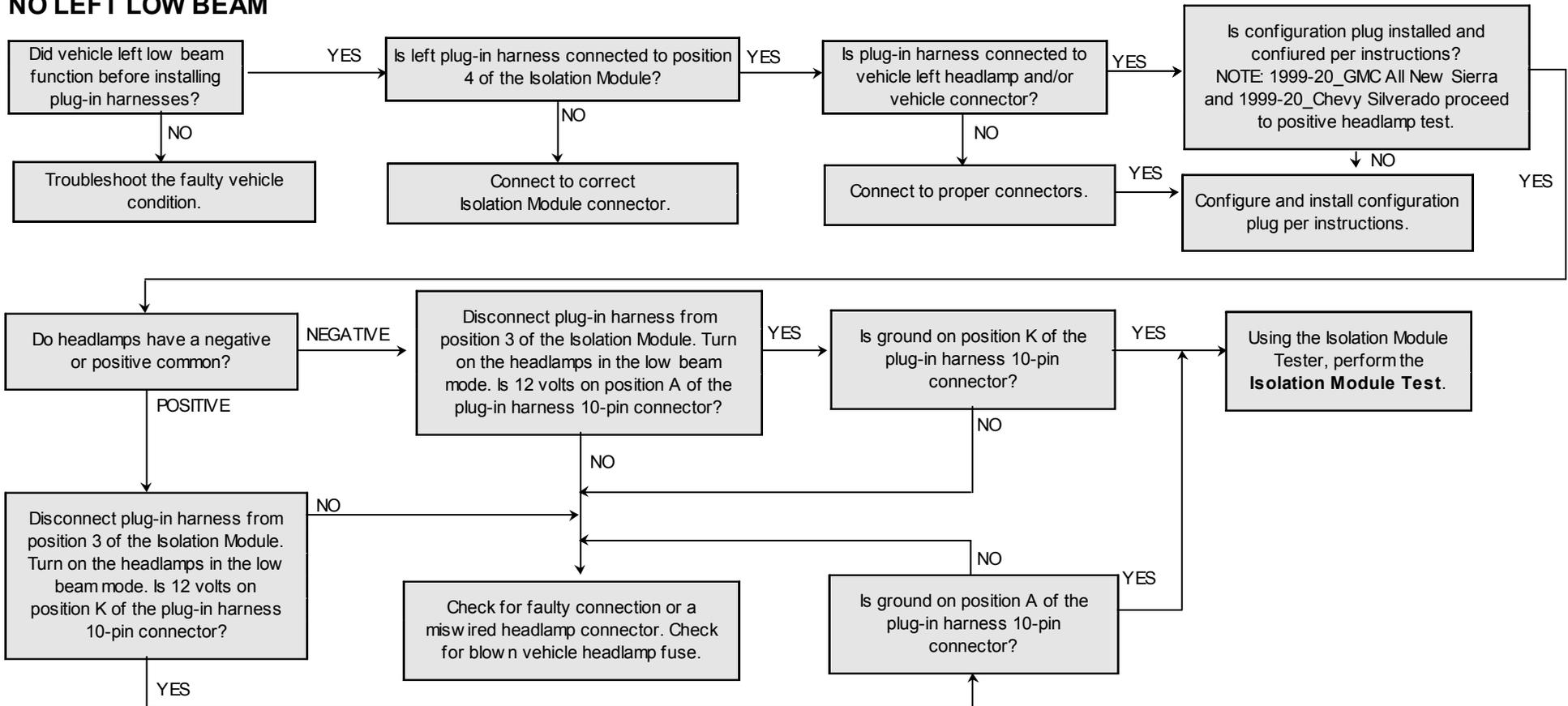
VEHICLE HEADLAMP TEST

Refer to Electrical Schematic.

To check the vehicle headlamps the following conditions must be met:

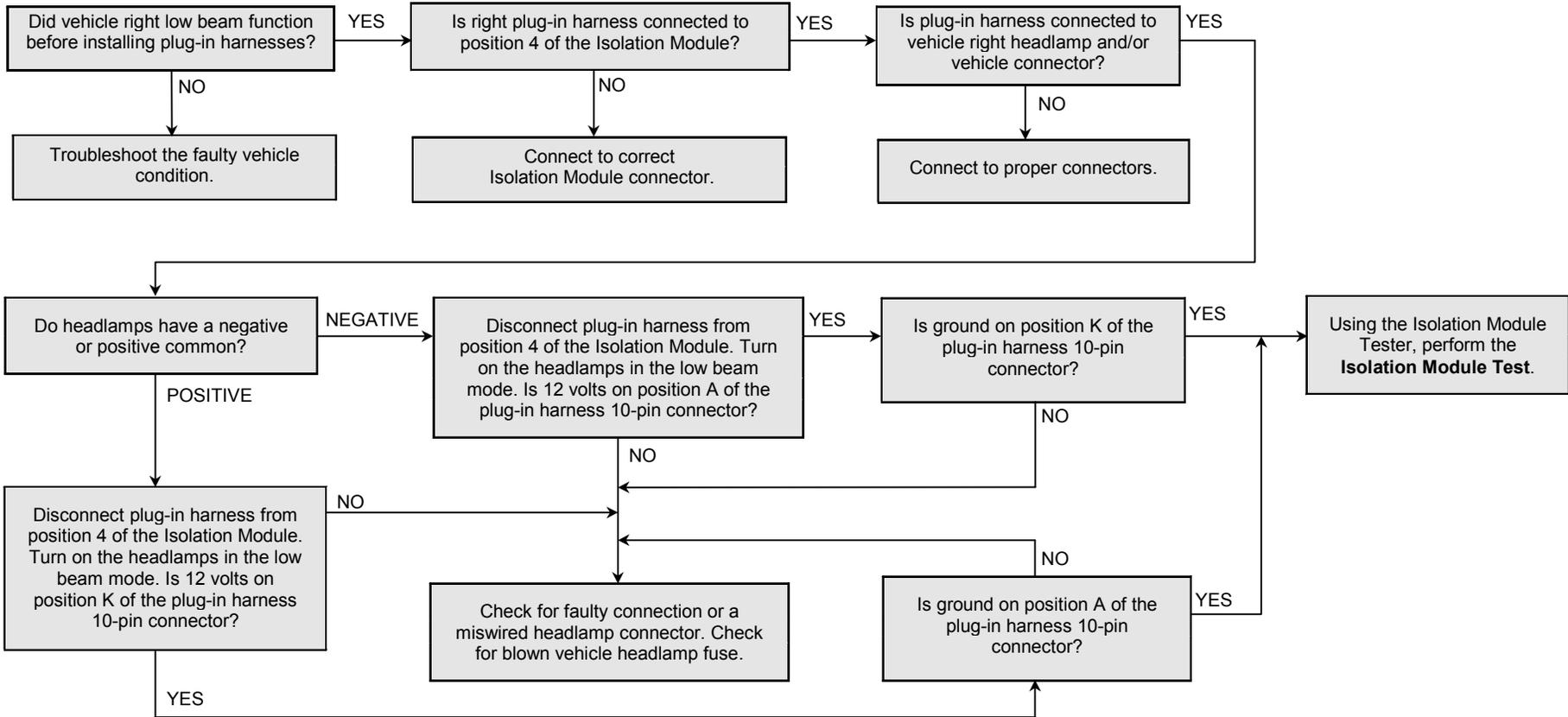
1. FISHER® park, turn, and DRL wires (if applicable) must be connected.
2. The vehicle control harness is plugged into position 1 of the Isolation Module.
3. The vehicle lighting harness is plugged into position 2 of the Isolation Module.
4. The vehicle ignition switch must be in the ON position.

NO LEFT LOW BEAM



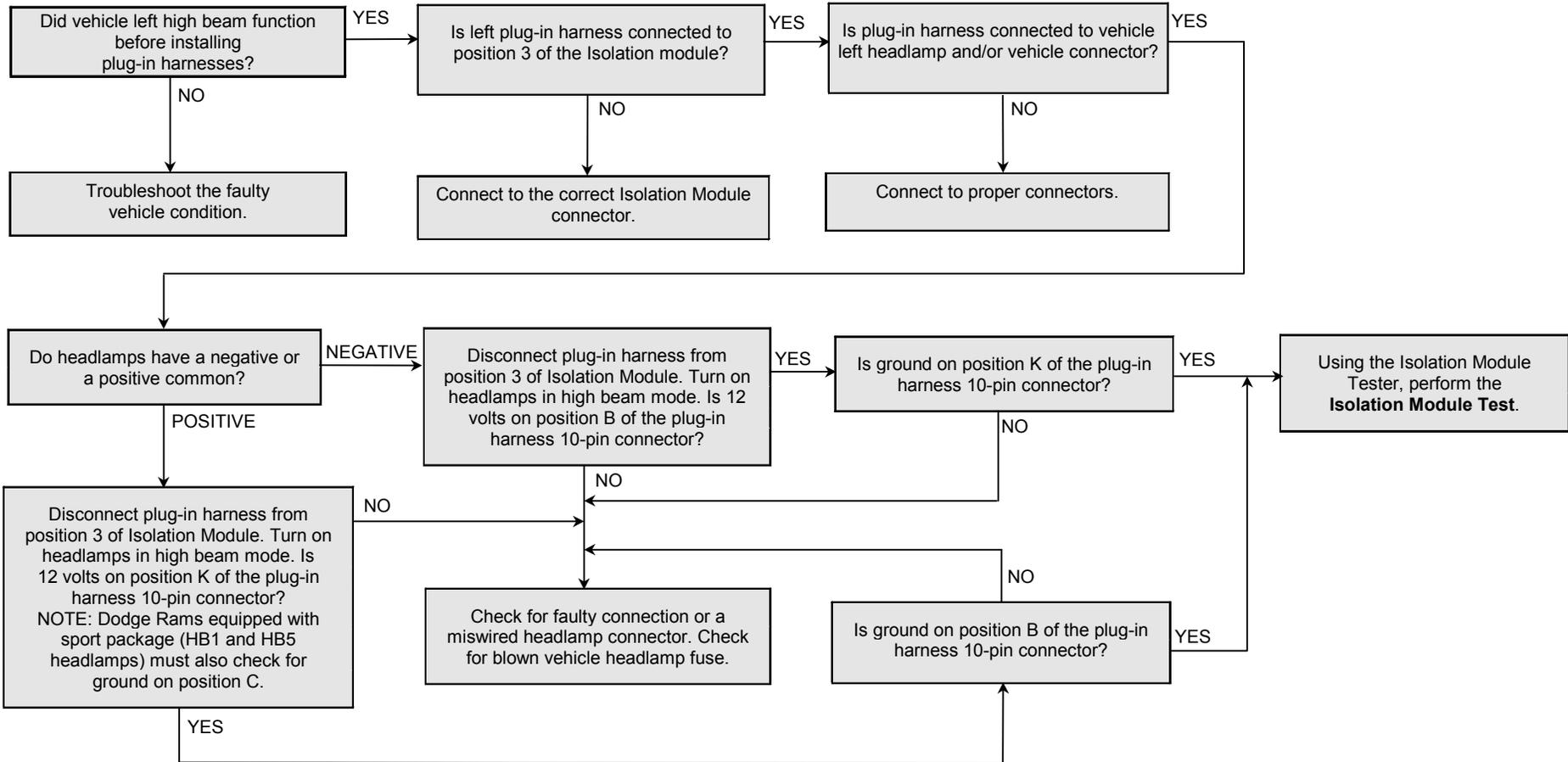
VEHICLE HEADLAMP TEST

NO RIGHT LOW BEAM



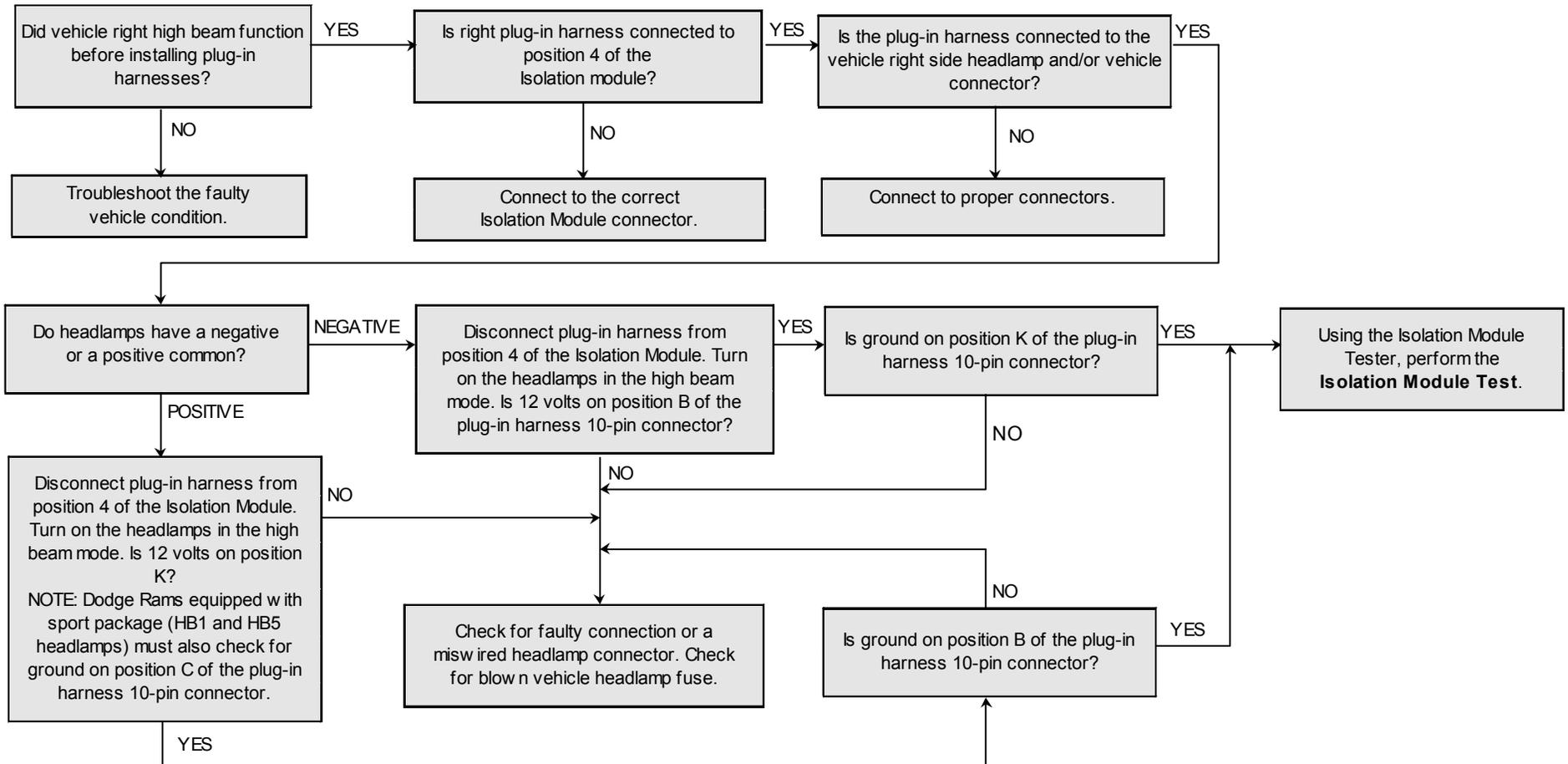
VEHICLE HEADLAMP TEST

NO LEFT HIGH BEAM



VEHICLE HEADLAMP TEST

NO RIGHT HIGH BEAM



SNOWPLOW HEADLAMP TEST

Refer to Electrical Schematic.

To check the snowplow headlamps the following conditions must be met:

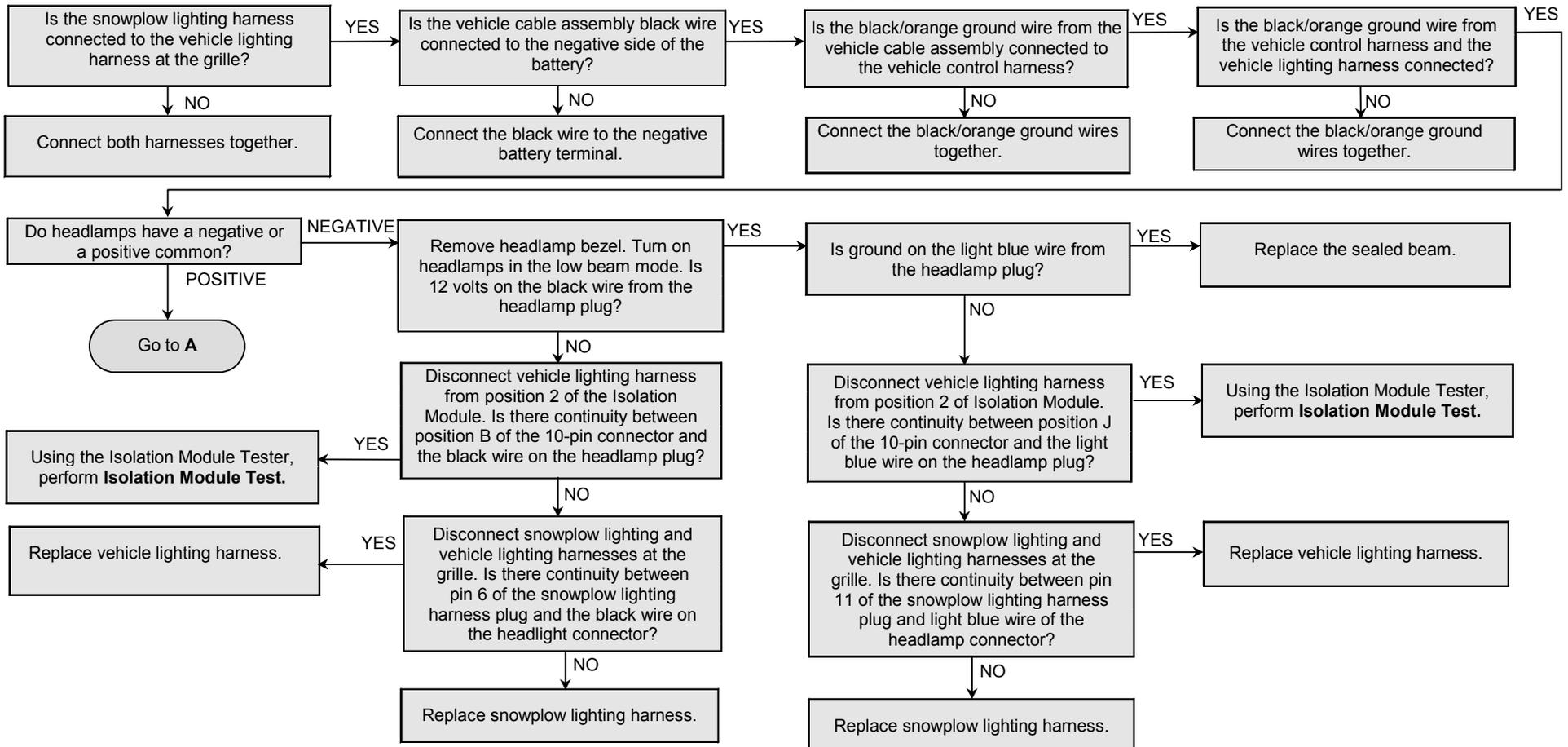
1. All vehicle lights must be functioning correctly with the Isolation Module installed. If the vehicle lights are not functioning correctly, run the Vehicle Headlamp Test before proceeding.

2. FISHER® park, turn, and DRL wires (if applicable) must be connected.

3. The snowplow lighting harness must be connected to the vehicle lighting harness.

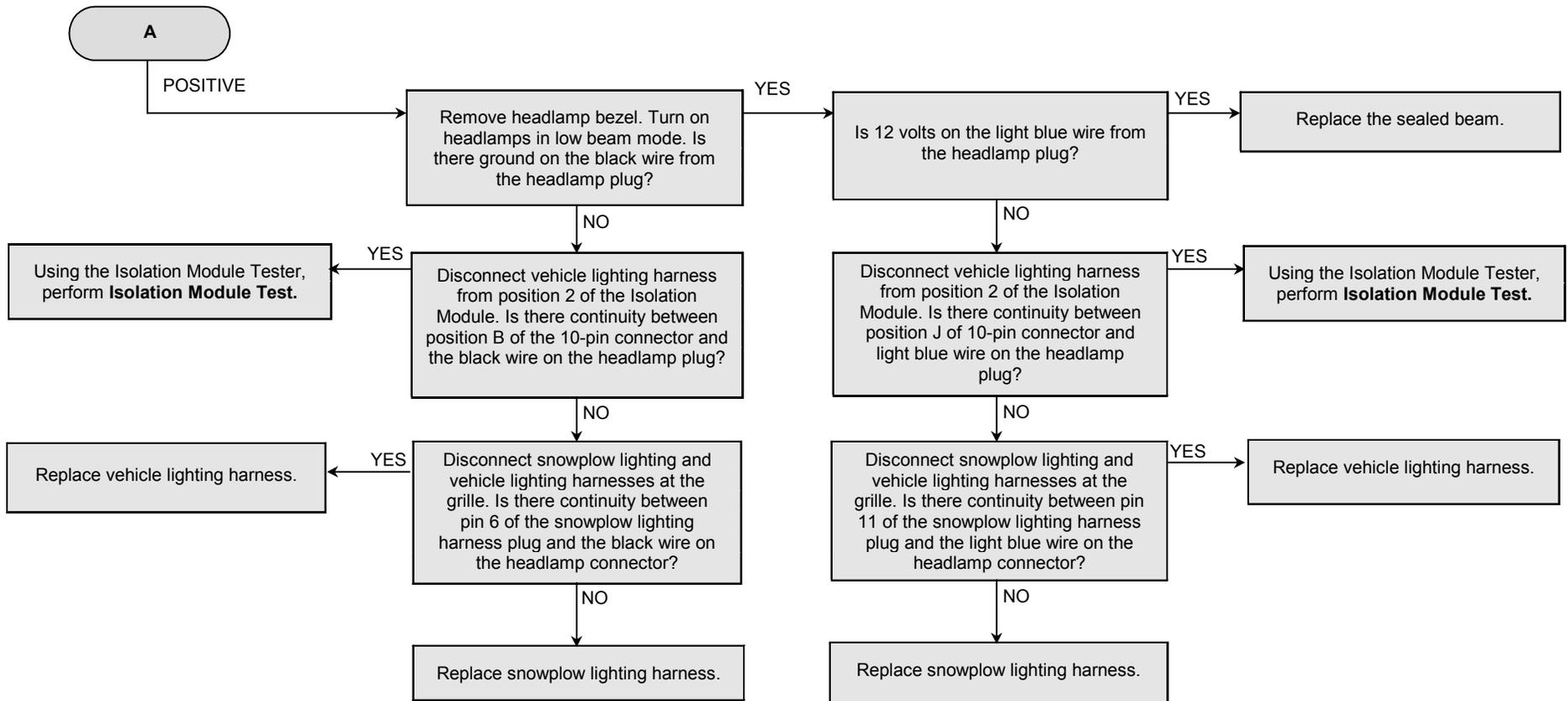
4. The vehicle ignition switch must be in the ON position.

NO LEFT LOW BEAM



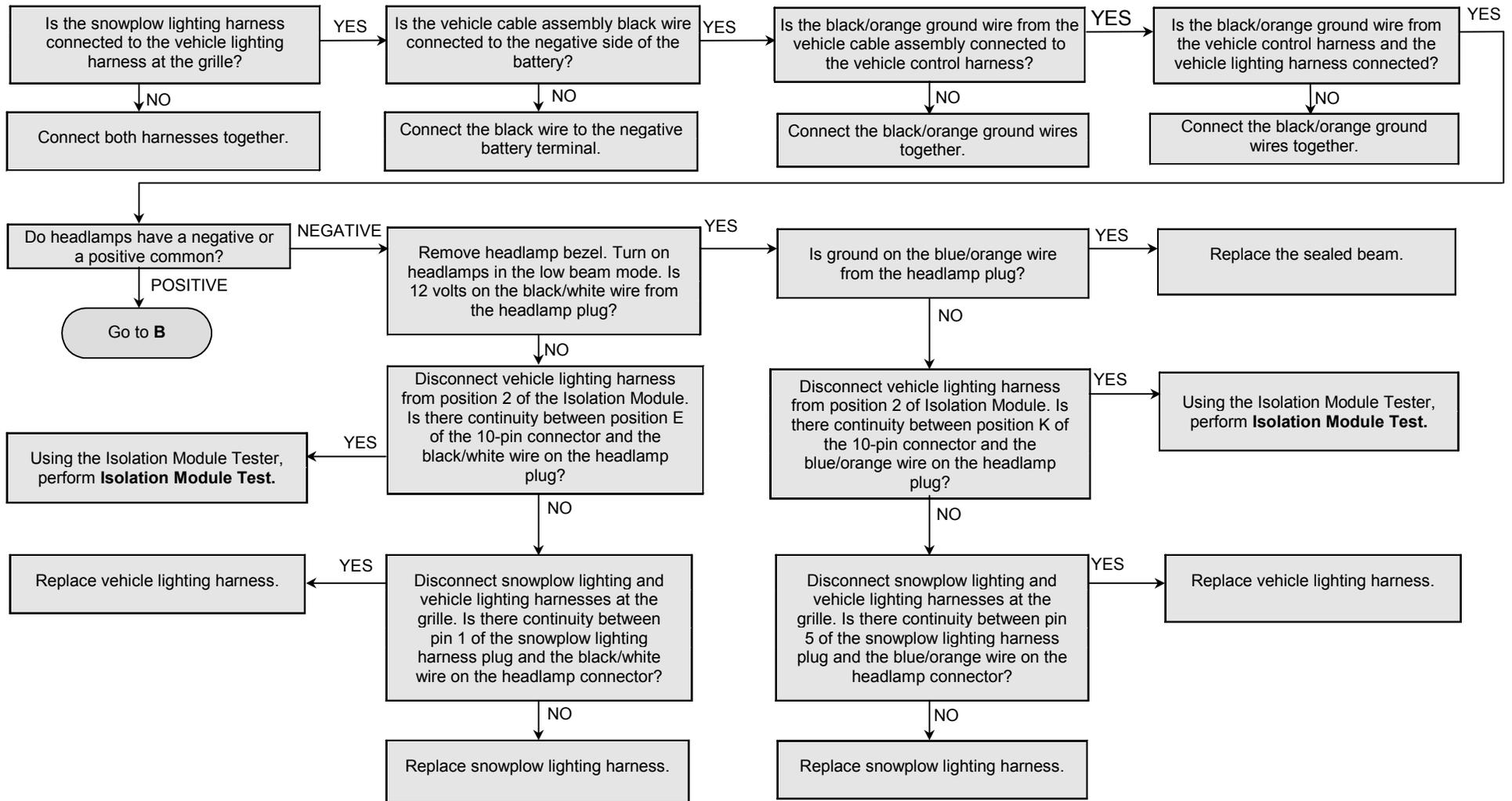
SNOWPLOW HEADLAMP TEST

NO LEFT LOW BEAM, CONTINUED



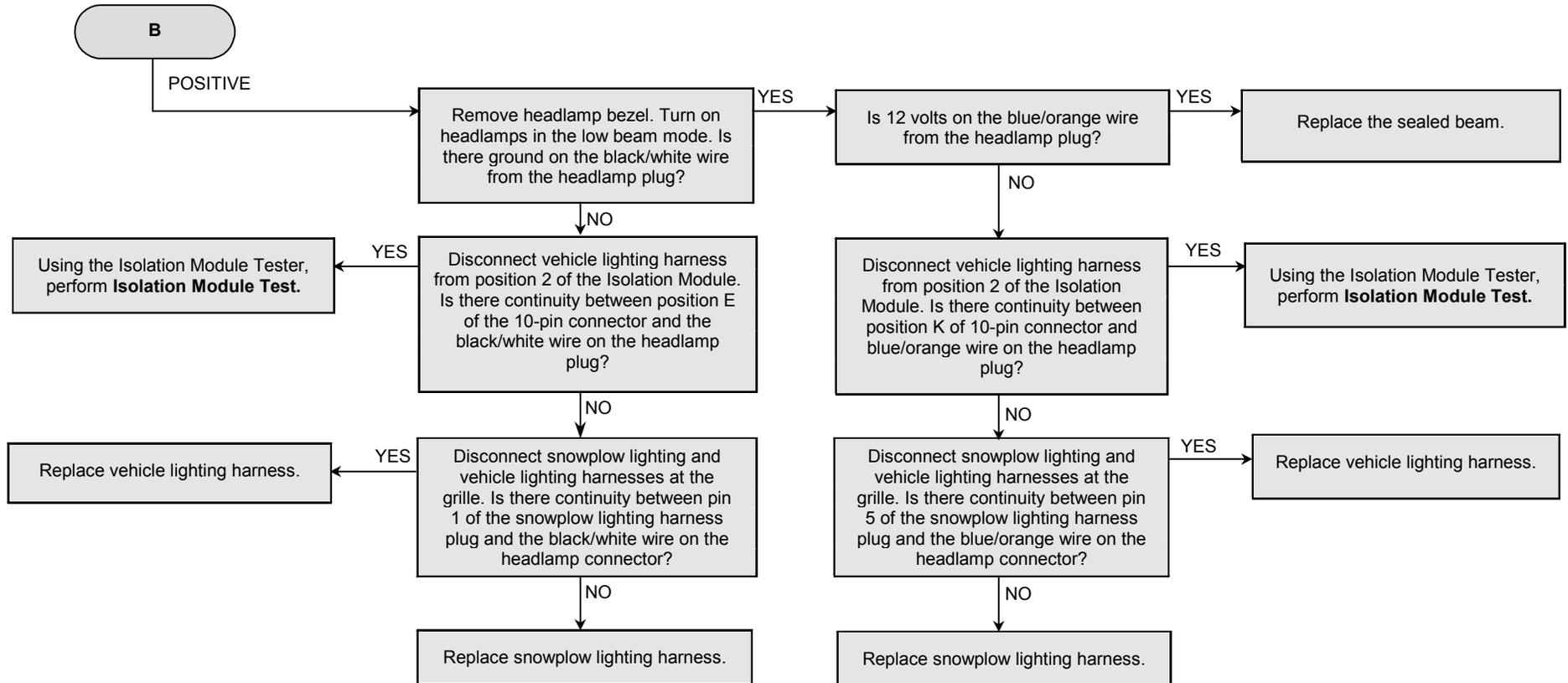
SNOWPLOW HEADLAMP TEST

NO RIGHT LOW BEAM



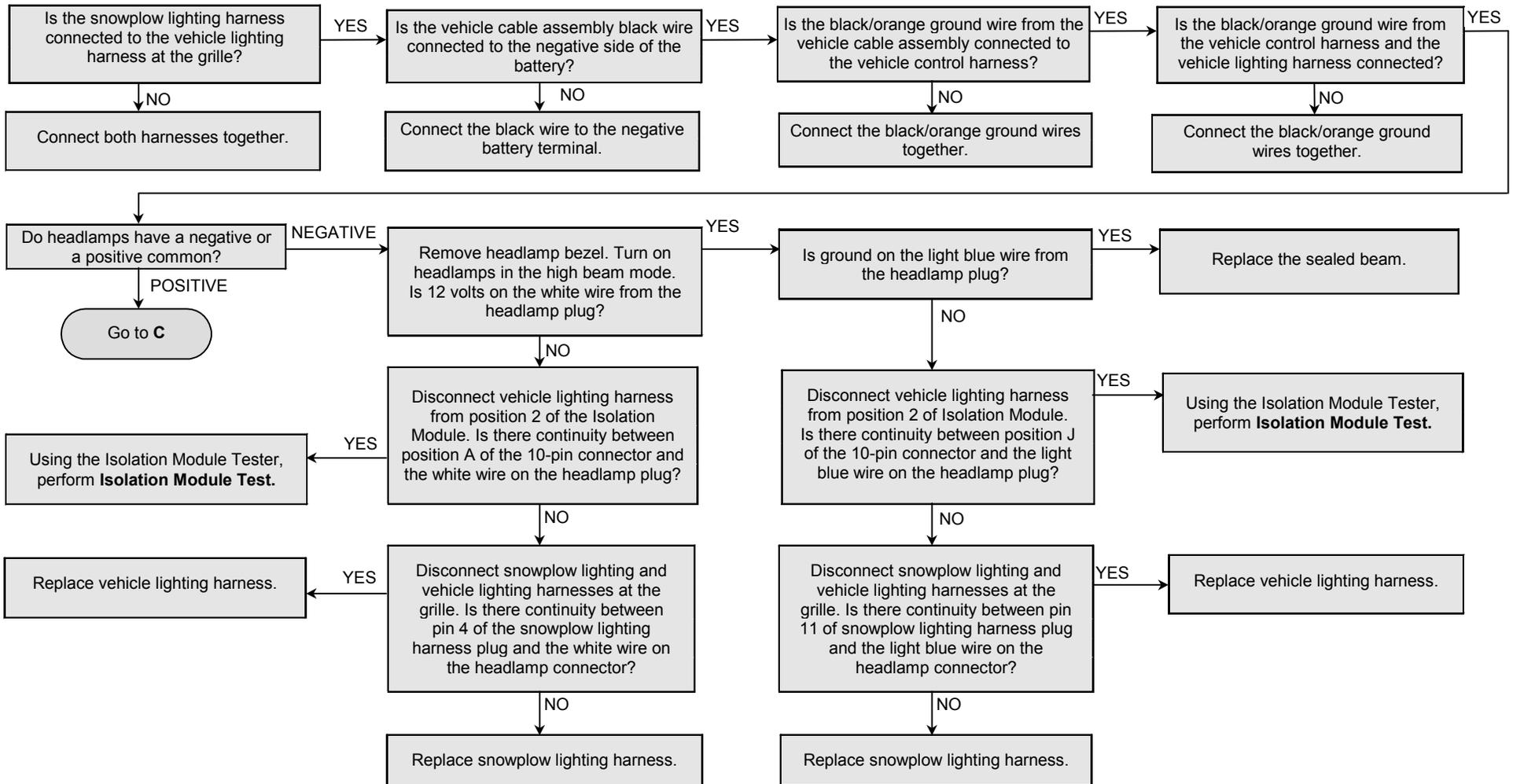
SNOWPLOW HEADLAMP TEST

NO RIGHT LOW BEAM, CONTINUED



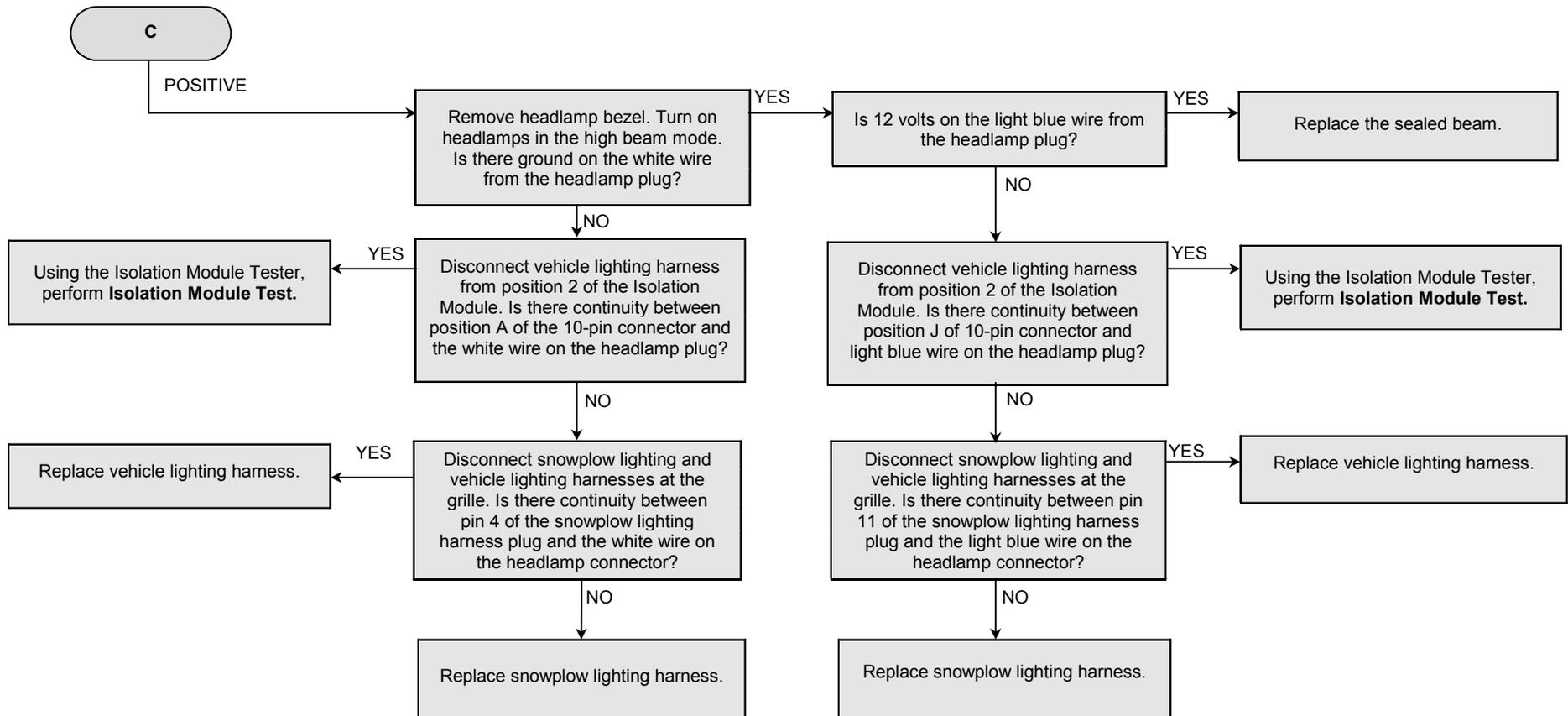
SNOWPLOW HEADLAMP TEST

NO LEFT HIGH BEAM



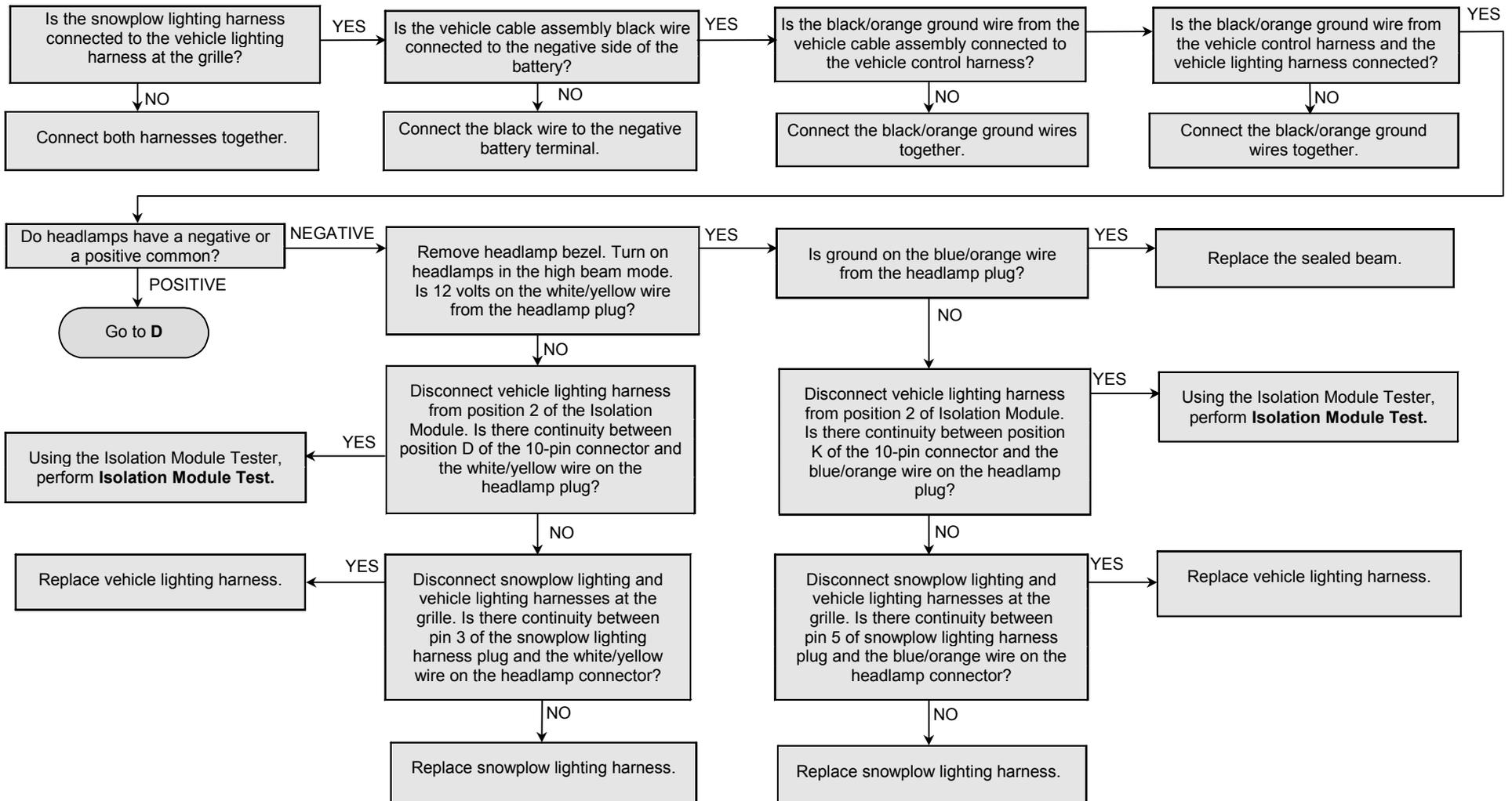
SNOWPLOW HEADLAMP TEST

NO LEFT HIGH BEAM, CONTINUED



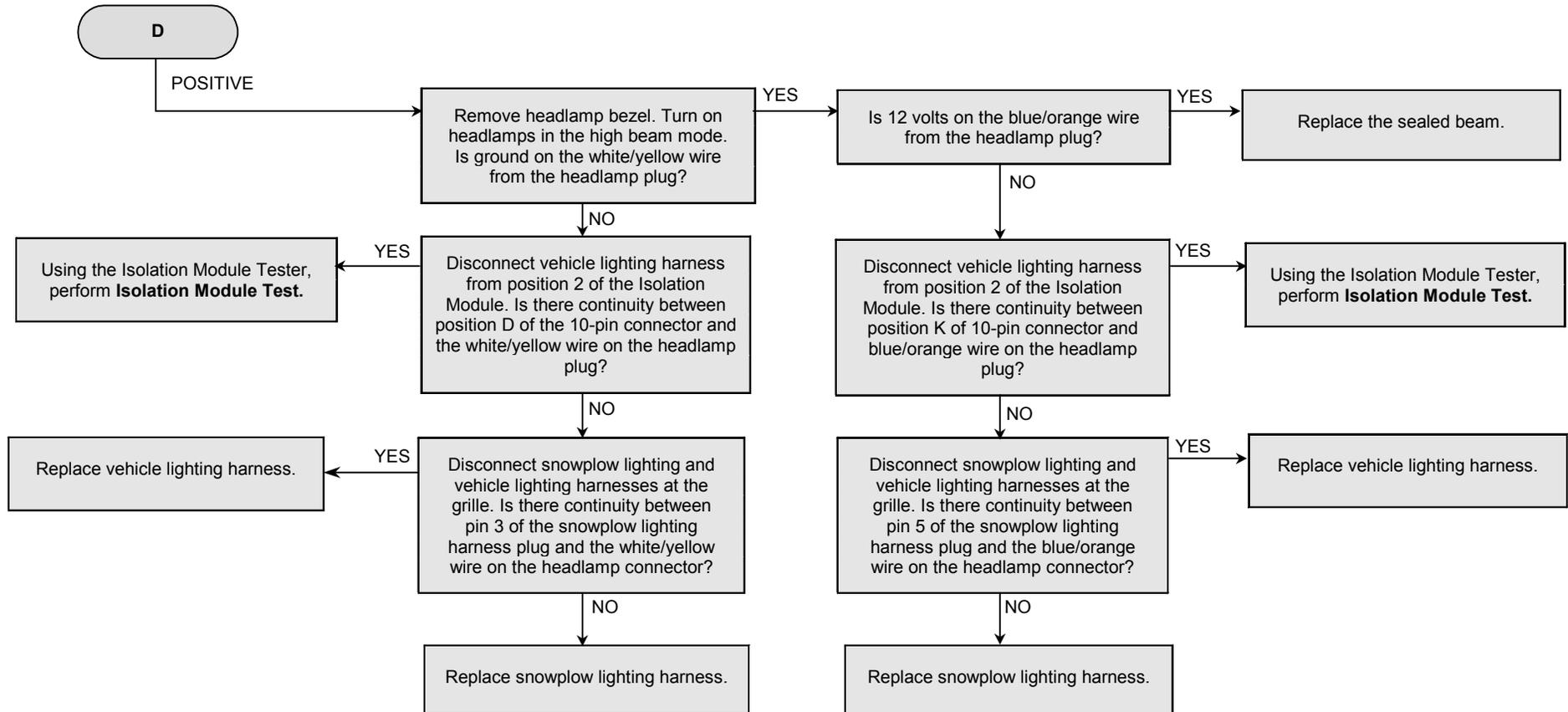
SNOWPLOW HEADLAMP TEST

NO RIGHT HIGH BEAM



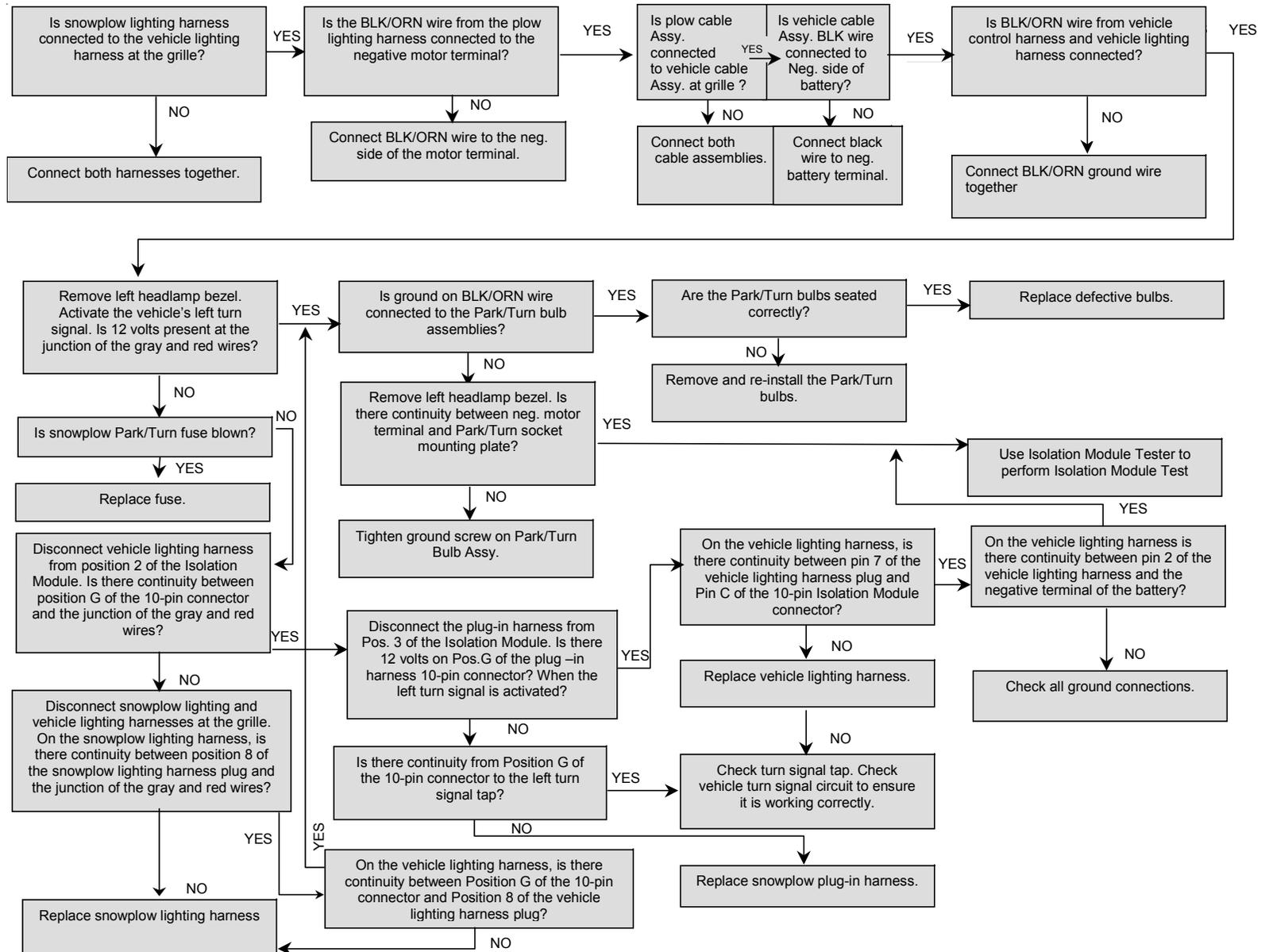
SNOWPLOW HEADLAMP TEST

NO RIGHT HIGH BEAM, CONTINUED



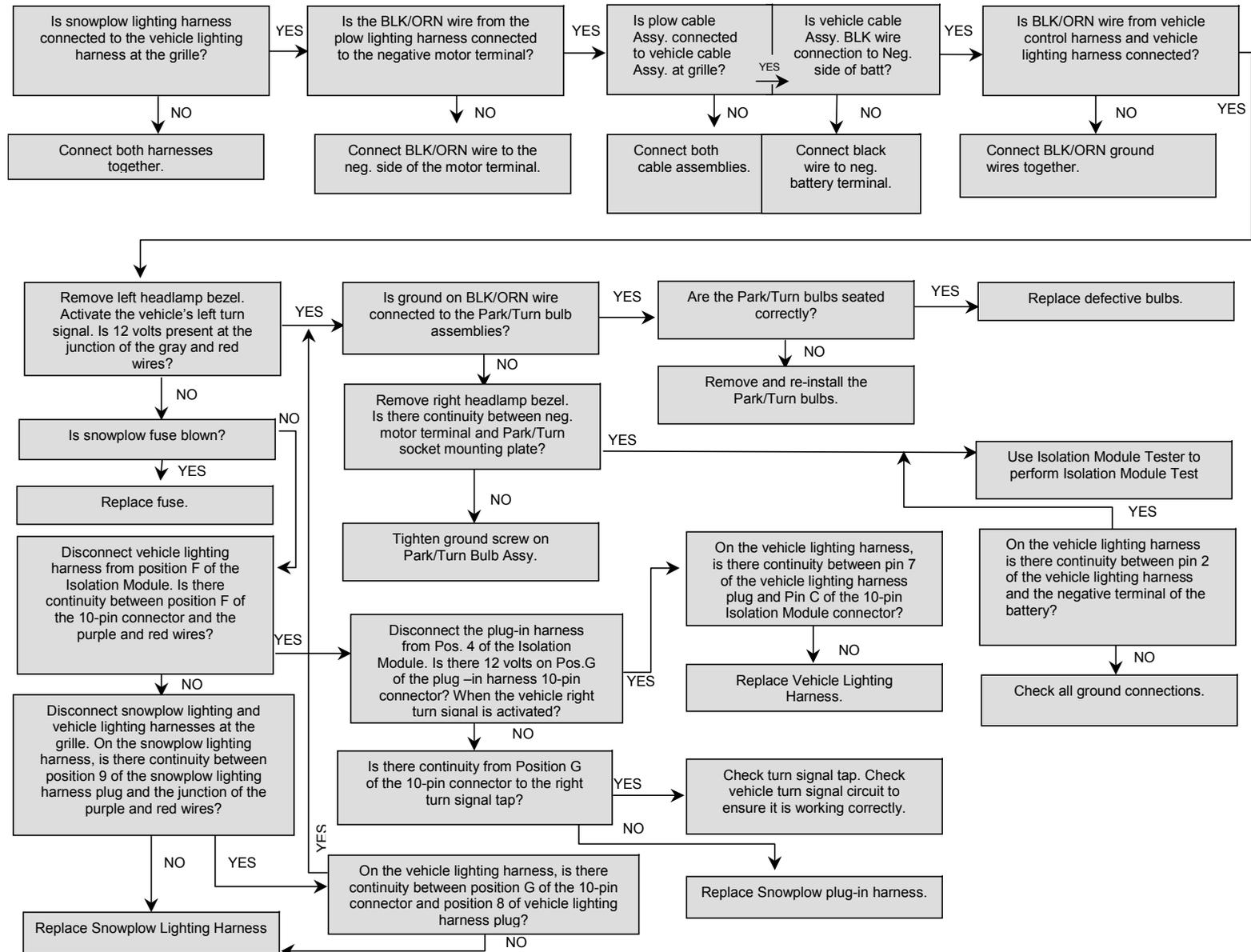
SNOWPLOW HEADLAMP TEST

NO LEFT SNOWPLOW TURN SIGNAL LAMPS



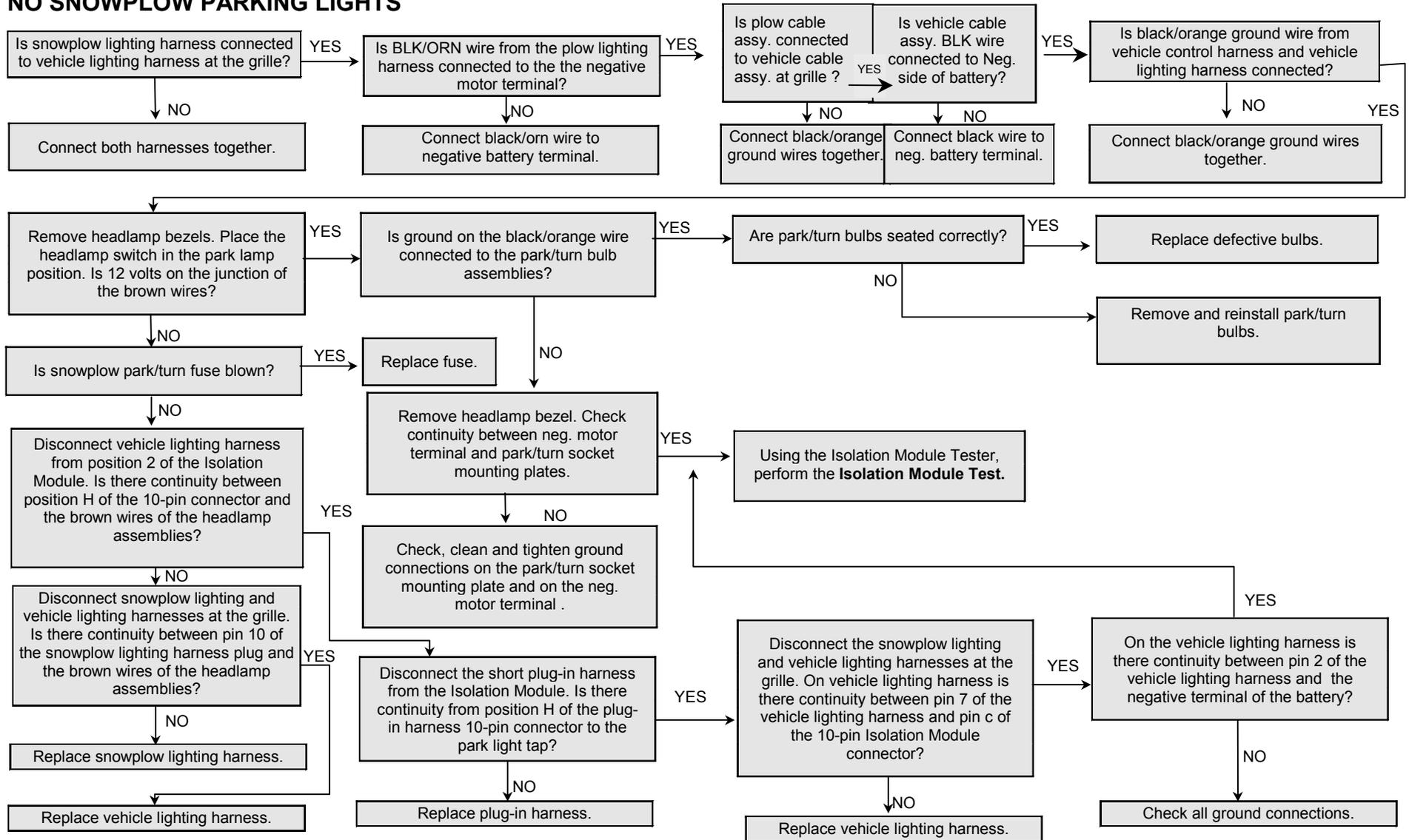
SNOWPLOW HEADLAMP TEST

NO RIGHT SNOWPLOW TURN SIGNAL LAMPS



SNOWPLOW HEADLAMP TEST

NO SNOWPLOW PARKING LIGHTS

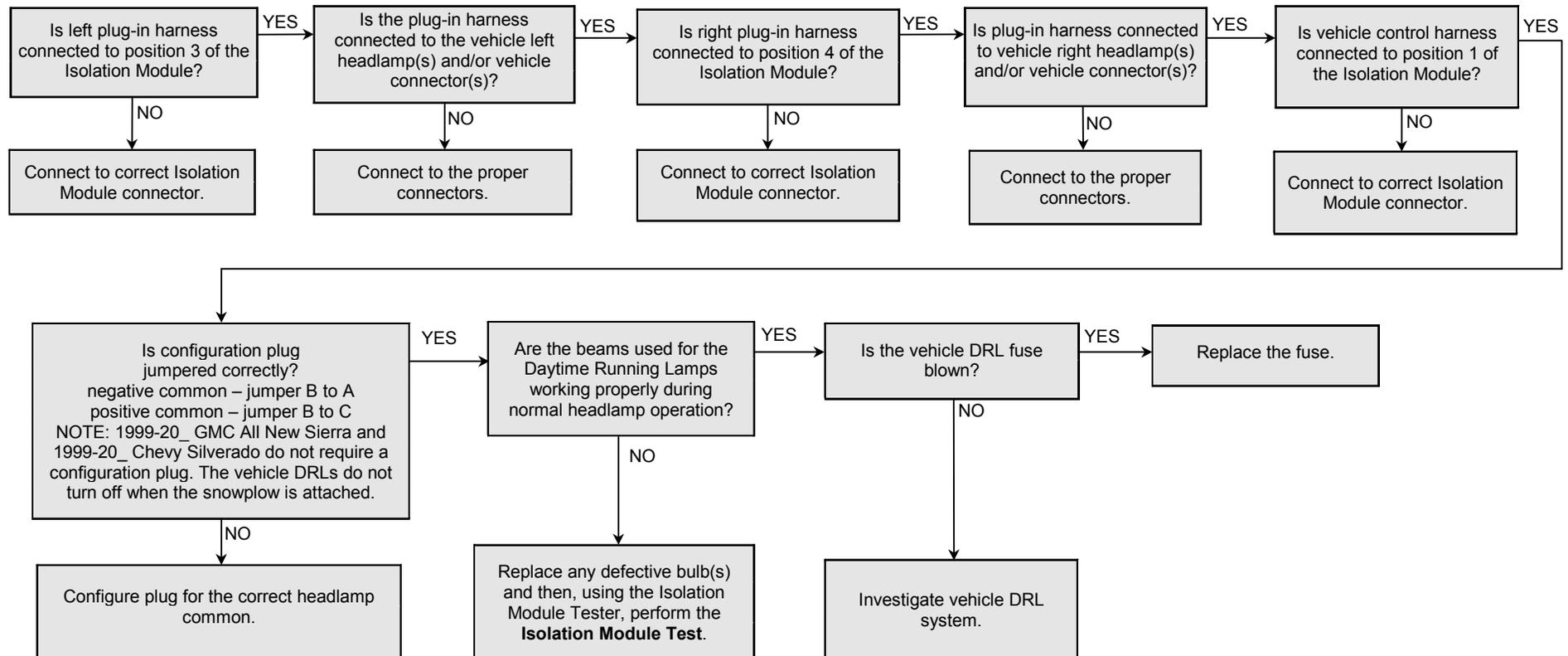


VEHICLE DAYTIME RUNNING LAMPS (DRL) TEST

To check the vehicle DRL system, the following conditions must be met:

1. Fully understand the operation of the vehicle DRL system before attempting to troubleshoot DRL problems on the snowplow.
2. All vehicle lighting systems must be functioning correctly before the Isolation Module is installed.
3. The Isolation Module and the associated harnesses have been installed using the installation instructions provided.
4. FISHER® DRL wires (if applicable) must be connected.
5. The vehicle ignition switch must be in the ON position.

NO VEHICLE DRLs

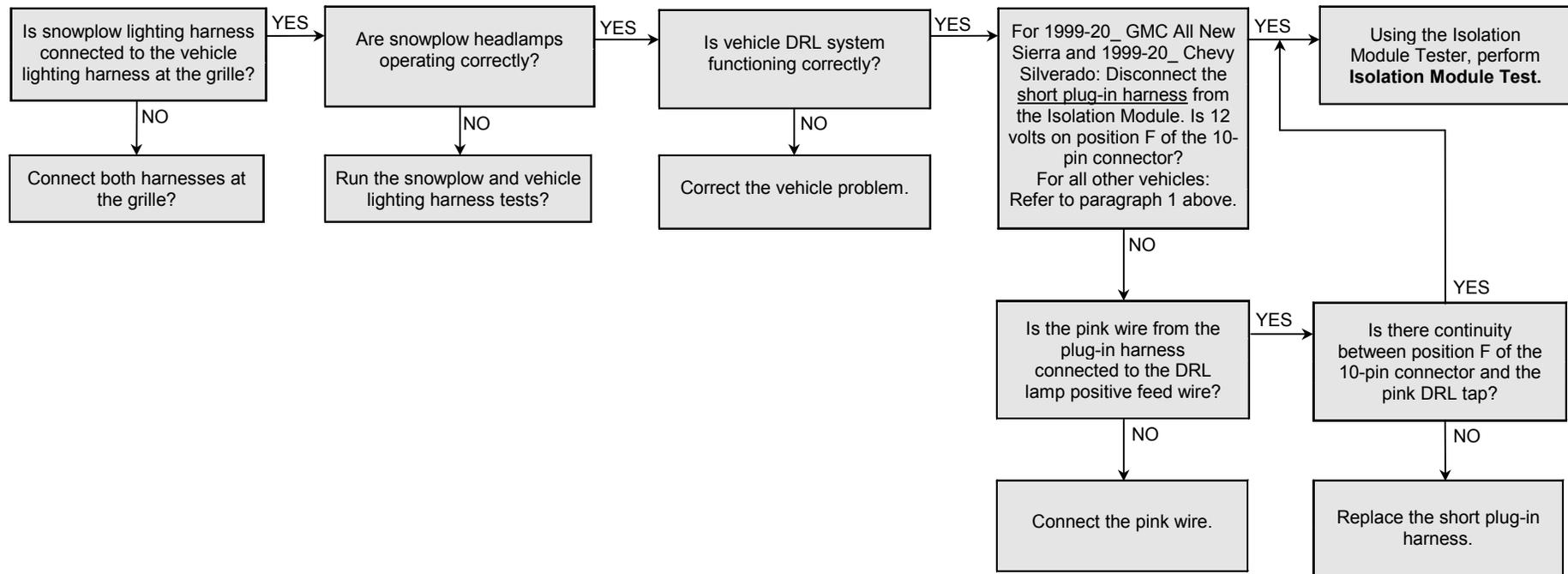


SNOWPLOW DAYTIME RUNNING LAMPS (DRL) TEST

To check the snowplow DRL system, the following conditions must be met:

1. Fully understand the operation of the vehicle DRL system before attempting to troubleshoot DRL problems on the snowplow.
2. All vehicle lighting systems must be functioning correctly before the Isolation Module is installed.
3. FISHER® DRL wires (if applicable) must be connected.
4. The vehicle ignition switch must be in the ON position.

NO SNOWPLOW DRLs



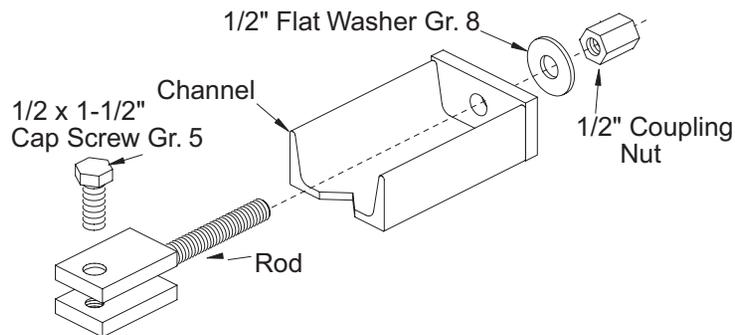
REMOVABLE SPRING TOOL

To Replace A Spring On The Blade, Follow The Instructions Below.

⚠ CAUTION

Servicing the trip springs without special tools and knowledge could result in personal injury. See your authorized FISHER® outlet for service.

1. Insert the threaded rod in through the hole in the channel weldment. Be sure the threaded hole in the tab on the rod is nearest to the channel.



2. Place the assembly on to the top anchor above the spring as illustrated. Be sure to place the spring bar in between the tabs on the rod. Insert the 1/2 x 1-1/2" Gr. 5 cap screw through the outside tab, through the hole in the spring bar, and tighten into the threaded hole.

3. Drop the 1/2" flat washer Gr. 8 over the threaded rod and fasten the nut to the threaded rod. Tighten the nut until the spring bar is raised enough to insert the pin through the pin hole. Center the pin within the hole.

4. Loosen the nut to lower the spring bar. Remove the spring tool assembly by removing the 1/2" cap screw.

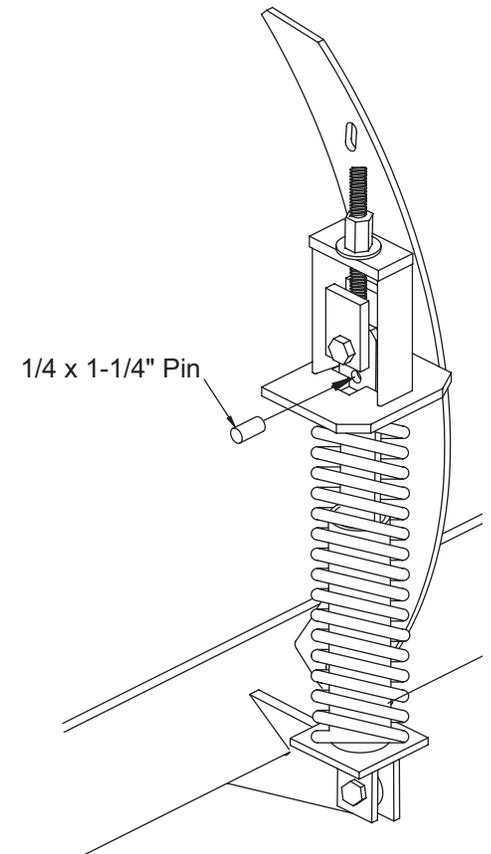
5. Remove the spring from the blade by removing the bolt from the bottom of the spring bar.

6. Insert the new spring with the spring bar up through the top anchor on the blade. Fasten the bottom of the spring bar to the anchor on the trip edge with the previously removed fasteners. Tighten.

7. Repeat steps 1 and 2 above.

8. Repeat step 3 above, except remove the pin from the spring bar.

9. Repeat step 4 above.



NOTES



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