EATON | Hydraulics

Electronic Proportional (EP) Control for Medium Duty 72400 Piston Pumps

EP Control for Medium Duty 72400 Piston Pumps

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This manual provides the necessary information to troubleshoot and repair the EP Control for Eaton® Medium Duty 72400 piston pumps.

The EP Control consists of two main parts, the valve assembly and the electronic module.

Note: Many EP Control components are not repairable, i.e., the EP Control electronic module has internal circuitry that is environmentally encapsulated into its housing. Replacing the electronic module with a new one is necessary if the module is the source of a fault. Complete kits are listed along with individual components should you choose to replace individual components.

⚠CAUTION

In order to assure the most reliable installation and operation of any electronic control, proper component selection and installation procedures must be followed with respect to interconnection wiring harnesses, input command signal devices, fusing, and input power switching.

Appropriate industry practices must be followed to prevent damage of and shorting of all electrical and electronic components caused by environmental hazards and application specific hazards. Typical hazards that damage the wiring harnesses or other components are abrasion, moving objects, and heat from the engine or exhaust system. Moisture can damage poorly sealed connectors and/or components, causing short circuits and other problems like corrosion.

A switch must be installed in line with (+ battery) power to the electronic module, so that power may quickly be disconnected in case of emergency (component failure or inadvertent commands). A fuse rated at the maximum module operating current (3 Amp) must be installed in the + battery line to the electronic module.

All the electrical connections to the EP Control electronic module must be disconnected prior to performing any electrical welding on the vehicle or machine. The electronic module and/or the hydraulic pump are not to be used as a connection point for electrical welding equipment.

During initial start-up and/or checkout of the machine after service, the machine must be placed on jack stands to prevent inadvertent movement.

The reliable operation and suitability of this product is dependent upon how it is applied and the other components used in the system. The system integrator must review all aspects of the application and all of the components used to assure proper operation and reliability.

Information contained in this parts and service manual is accurate as of the publication date and is subject to change without notice. Performance values are typical values. Customers are responsible for selecting products for their applications using normal engineering methods.

Parts List

ITEM	PART NO.	QTY.	DESCRIPTION
1	111520-016	1	Electronic Module - 1-6 V Input - 12/24 V
1	111520-020	1	Electronic Module - ±4-20 mA Input - 12/24 V
2	101673-175	4	10-24 Button Head Cap Screw (1/8" hex key) - 1.75"
3	16045-203	4	#10 Lockwasher
4	16147-326	6	10-24 Hex Head Cap Screw (5/32" hex key) - 2.75"
5	111501-000	2	Solenoid Tube Subassembly*
6	114241-012	1	Solenoid Coil Subassembly - 12 V (includes two coils and wiring harness)
6	114241-024	1	Solenoid Coil Subassembly - 24 V (includes two coils and wiring harness)
7	4993057-012	1	Valve Assembly - (includes items 5 & 6 - 12 V Solenoid Coil & Tube Subassemblies)
7	4993057-024	1	Valve Assembly - (includes items 5 & 6 - 24 V Solenoid Coil & Tube Subassemblies)
8	72400-752	2	Electronic Module Bracket
9	16147-312	4	10-24 Hex Head Cap Screw (5/32" hex key) - 1.25" (can use existing from pump)
10	72400-631	1	Control Valve Gasket

*Includes necessary O-Rings.

EP Control Kits

KIT NO.	MODEL CODE REFERENCE	KIT DESCRIPTION	INPUT SIGNAL	VALVE ASSEMBLY	ELECTRONIC MODULE	VOLTAGE
9900015-000	EE	EP Ctrl Kit MD 72400: 1-6 V input, w/o brackets	1-6 V	4993057-012	111520-016	12/24 V
9900016-000	EC	EP Ctrl Kit MD 72400: 12 V coils w/o electronics	—	4993057-012	—	12 V
9900017-000	ED	EP Ctrl Kit MD 72400: 24 V coils w/o electronics	—	4993057-024	—	24 V
9900019-000	EG	EP Ctrl Kit MD 72400: ±4-20 mA input, w/o brackets	±4-20 mA	4993057-012	111520-020	12/24 V
9900021-000	EG	EP Ctrl Kit MD 72400: ±4-20 mA input	±4-20 mA	4993057-012	111520-020	12/24 V
9900022-000	EE	EP Ctrl Kit MD 72400: 1-6 V input	1-6 V	4993057-012	111520-016	12/24 V
990830-000		EP Ctrl Electronic Module 1-6 V	1-6 V	—	111520-016	—
990832-000		EP Ctrl Electronic Module ±4-20 mA	±4-20 mA	—	111520-020	—
72400-942		Brackets and Screws				

Note: All kits using Eaton EP Control Electronic Modules use 12 V coils.

EP Control Connector Kits

Electronic Module Mating Connector Kit

KIT NO.		PART (QTY.)	DELPHI PACKARD P/N
990762-000	**Command Input Signal**	Connector (1)	1211 0293
		Terminal (3)	1204 8074
		Cable Seal (3)	1204 8086
		Cavity Plug (1)	1205 9168
		Secondary Lock (1)	1205 2845
	Power Supply	Connector (1)	1205 2641
		Terminal (2)	1204 8074
		Cable Seal (2)	1204 8086
		Secondary Lock (1)	1205 2634

Recommended wire size: 16 - 18 AWG
Recommended cable diameter: 2.03 - 2.80 mm
Alternate reference source: Pioneer Standard Electronics 1-800-257-6613
www.pios.com

Solenoid Coil Mating Connector Kit

(not needed when using an Eaton Electronic Module)

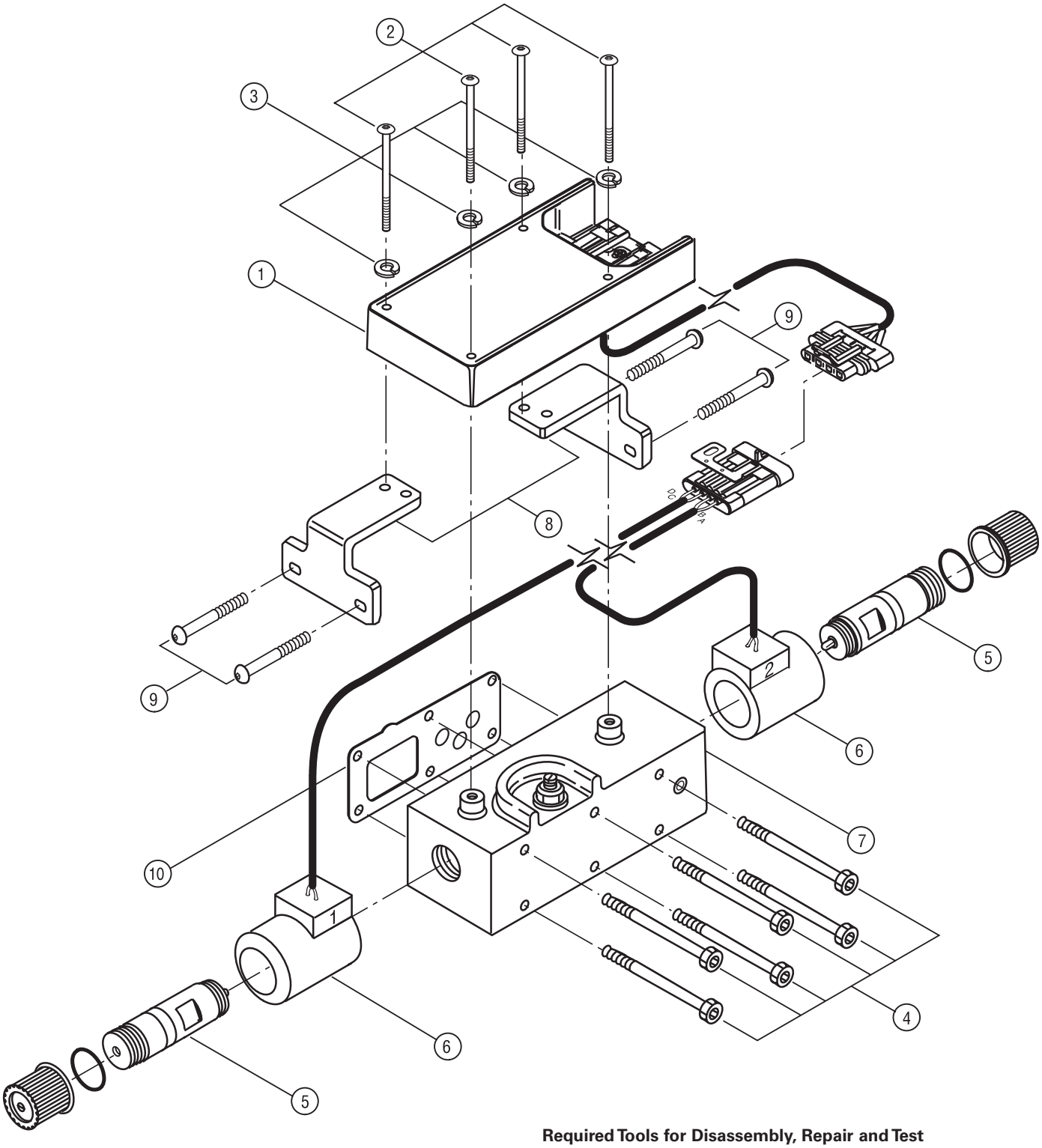
KIT NO.	PART (QTY.)	DELPHI PACKARD P/N
9900023-000	Connector (1)	1218 6568
	Terminal (4)	1204 8074
	Cable Seal (4)	1204 8086
	Secondary Lock (1)	1204 7948

Recommended wire size: 16 - 18 AWG
Recommended cable diameter: 2.03 - 2.80 mm
Alternate reference source: Pioneer Standard Electronics 1-800-257-6613
www.pios.com

Solenoid Connector Update Kit

KIT NO.	PART (QTY.)	DELPHI PACKARD P/N
9900045-000	Tool (1)	1209 4429
	4-Pin Housing Connector (Female) (1)	1218 6568
	4-Pin Housing Connector (Male) (1)	1218 6271

Parts



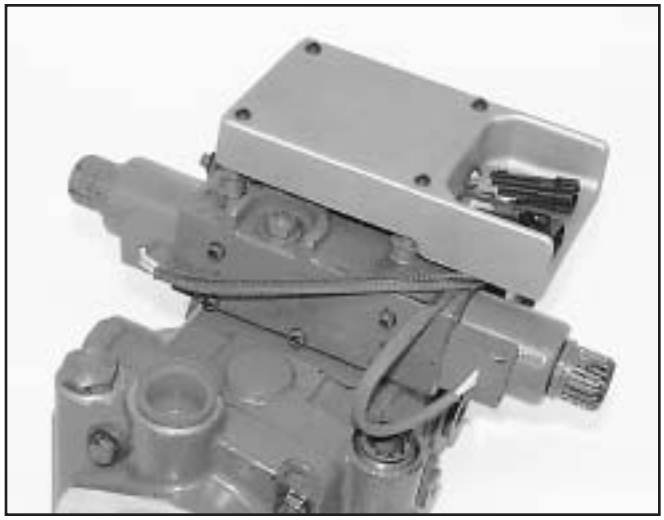
Required Tools for Disassembly, Repair and Test

- 1/8" Bit Socket or Hex Key
- 5/32" Bit Socket or Hex Key
- 9/16" Open-End Wrench
- 3/4" Open-End Wrench
- Flat Blade Screwdriver
- 12 VDC Power Supply or Battery
- Voltage Ohm Meter (VOM)
- Charge Pressure Gauge

Disassembly

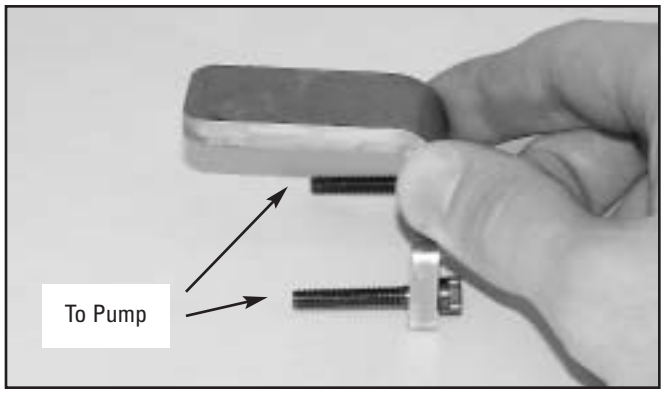
Step 1

Disconnect all power to the input device. Carefully disconnect the command input device from the three-pin connector on the EP Control electronics module by releasing the connector latches. Thoroughly clean the outside of the EP Control and surrounding pump surface.



Step 2

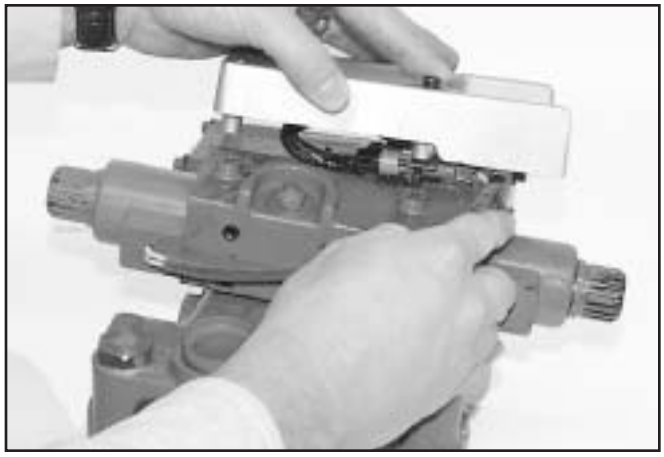
Using a 5/32" hex wrench (or bit socket), remove the two cap screws on each side of the pump holding the "L" brackets to the pump.



Step 3

Using a 1/8" hex key (or bit socket), remove the four 10-24 button head cap screws and lockwashers on top of the electronic control.

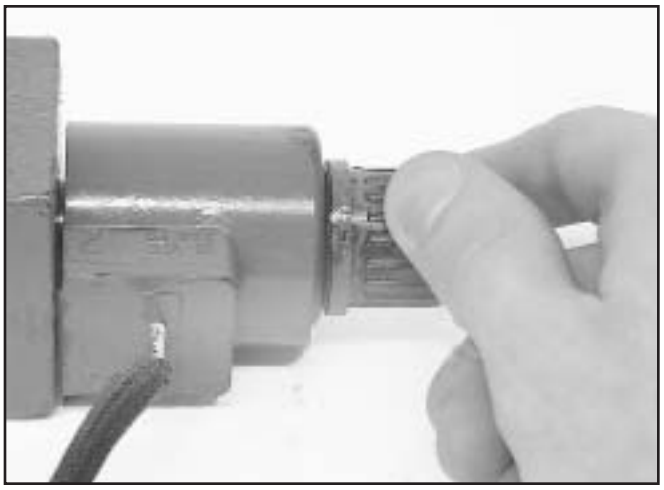
Disconnect the four-pin connector between the EP Control module and the solenoids. Caution must be used when disconnecting these connectors as they are latched with keepers.



Step 4

The two solenoid coils can be removed by turning each solenoid tube knob counterclockwise. Remove the knob and associated O-ring. Slide the coil off the tube subassembly. Repeat for other coil.

Note: Each coil is stamped with a position number "1" and "2" and the voltage "12V" or "24V". There are also numbers stamped on the valve assembly indicating positions #1 and #2. When reassembling the coils, the numbers stamped on the coil and valve assembly must match. Refer to page 3.



Step 5

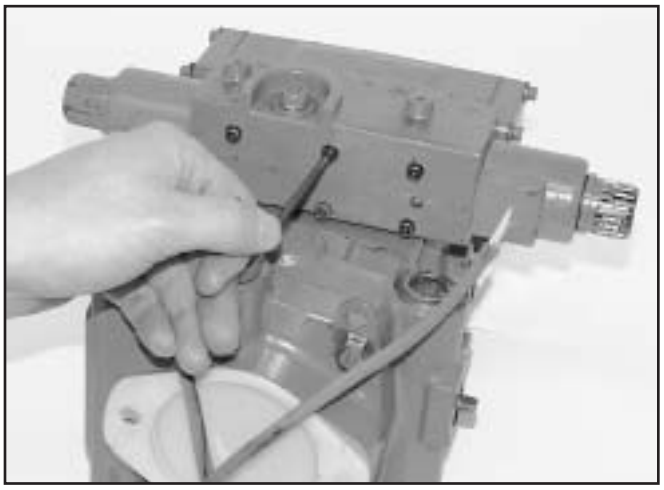
Using a 3/4" open-end wrench, remove each tube subassembly by turning counterclockwise.

If only replacing the coil and tube subassemblies, skip to Reassembly, Step 12.

Step 6

Using a 5/32" hex key (or bit socket), remove the six 10-24 hex head cap screws.

Carefully lift the EP Control valve assembly upward and slide the assembly away from the pump to disengage the feedback link from the servo piston. Note which slot the feedback link is assembled into.

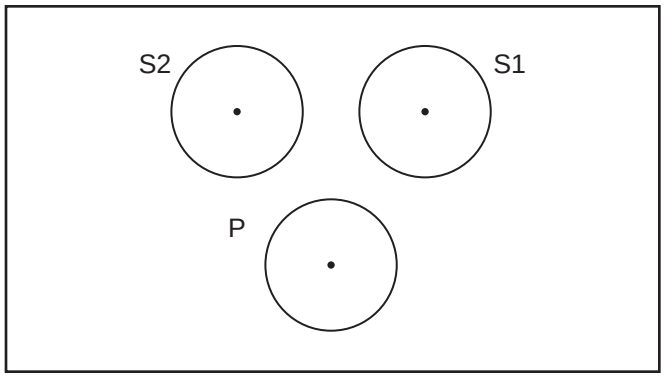


Step 7

Remove and discard the control valve gasket.

Step 8

In most cases it will not be necessary to remove the control orifices that are staked in the pump housing. Only remove if the orifice size needs to be changed. The orifice size is stamped on the flat plate orifices in the pressure, servo-1, and servo-2 ports.



Reassembly

Step 9

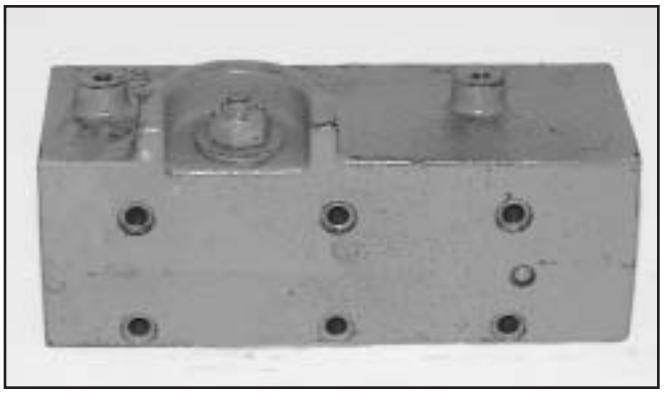
Clean the EP Control mounting surface. Install a new control valve gasket by aligning with screw and porting holes.

Step 10

Carefully install the EP Control valve assembly on the pump housing, making sure the feedback link is installed in the appropriate servo piston land.

Note: There is a narrow land on the servo piston for the EP Control feedback link and a wide land for the swashplate follower.

Replace and hand tighten the six 10-24 hex head cap screws.



Step 11

Locate the new solenoid tube subassembly. Each solenoid tube subassembly comes with new O-rings installed on the tubes. The tube subassemblies are interchangeable.

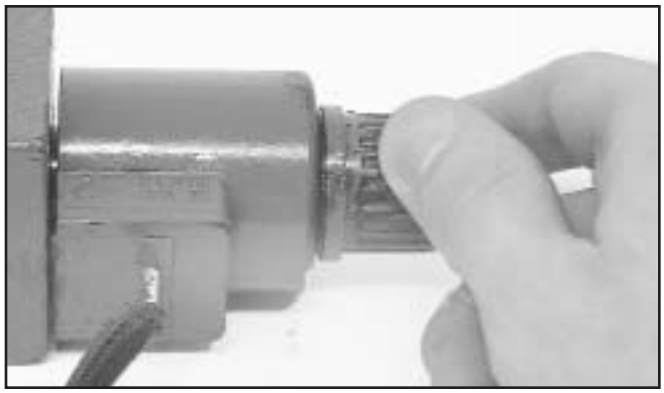
Step 12

Using a 3/4" open-end wrench, replace each tube subassembly by turning clockwise. Torque the solenoid tubes to 32.5 ±2.5 lbf·ft. Repeat for other tube subassembly.

Replace the coils. **Note:** The position number stamped on the coil and the valve assembly must match.

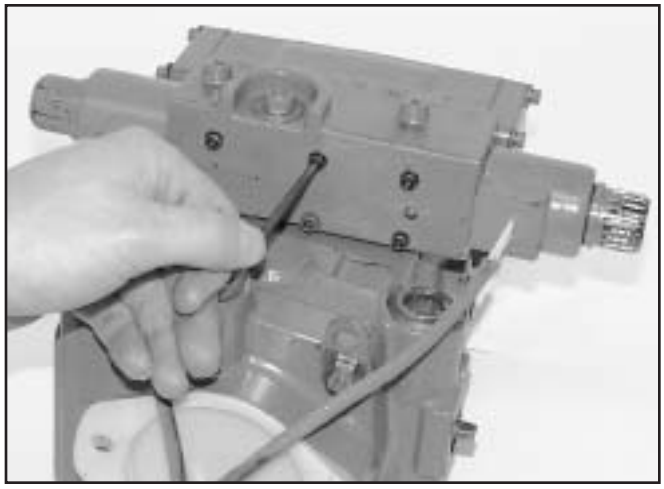
Step 13

Attach the retaining knob, and torque to 12±1 lbf·ft.



Step 14

Using a 5/32" hex key or bit socket, tighten the six 10-24 hex head cap screws. Torque to 60-68 lbf·ft.



Step 15

Neutral Adjustment

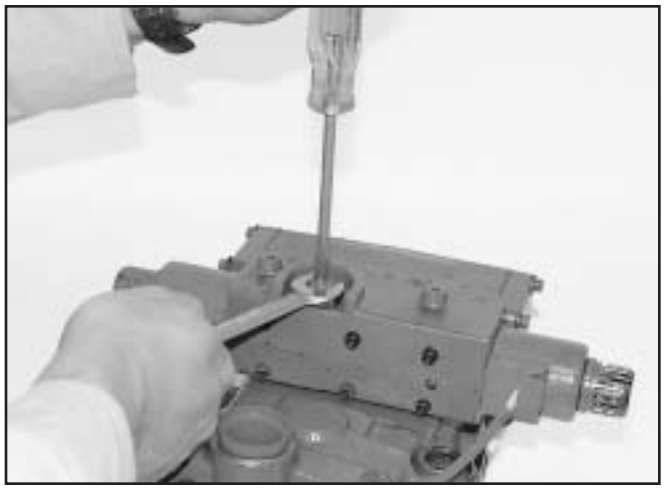
Caution: All hoses and fittings must be connected, and the pump ready for operation before attempting to check neutral adjustment. Electrical wiring harnesses for the solenoid coils and command input should be left disconnected while adjusting neutral.

A. Disengage the input drive to vehicle or elevate wheels.

B. Install charge pressure gauge. A 0-1000 psi or 0-1500 psi pressure gauge is recommended.

C. Start the prime mover.

D. Loosen the locknut holding the neutral adjustment screw until it is just snug enough that the threaded screw can be rotated. Use a 9/16" end wrench to hold the locking nut while rotating the neutral adjustment screw.



E. Note the number stamped on the cap of the low pressure relief valve. -022 is 220 psig (15 bar), -030 is 305 psig (21 bar), etc. This will be the high setting. Settings can vary from 155 psig (11 bar) to 325 psig (22.4 bar).

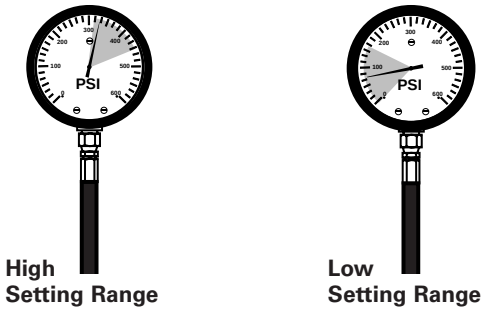
F. Slowly rotate the neutral adjustment screw clockwise until charge pressure drops to its low setting. Mark the neutral adjustment screw location.

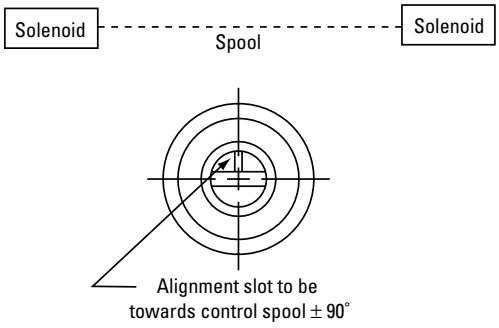
Note: The charge pressure low setting is usually 40-60 psig lower than the high setting.

G. Rotate the neutral adjustment screw counterclockwise. The charge pressure will rise. Continue turning counterclockwise until the pressure drops again to its low setting. Mark the neutral adjustment screw location.

H. Rotate the neutral adjustment screw to the position between the two marks.

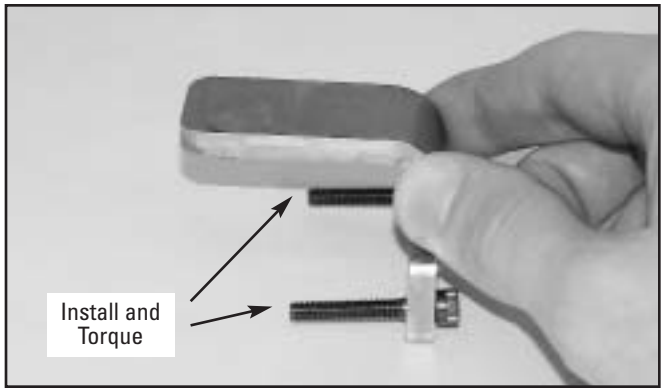
I. Carefully hold adjustment screw while torquing locknut. Torque locknut to 10±1 lbf·ft. Neutral adjustment is completed.





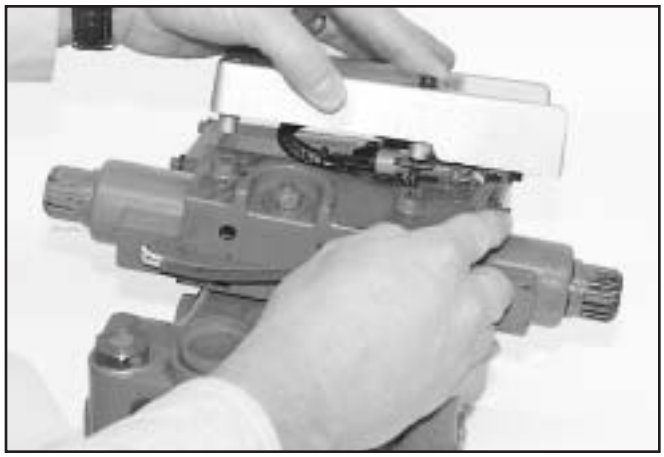
Step 16

Install the two "L" brackets on each end of the servo piston cap with the flat end facing up to hold the electronic module. Replace the 10-24 cap screws on the pump and torque with 5/32" hex key or bit socket to 60-68 lbf·in.



Step 17

Connect the four-pin connectors between the EP Control electronic module and the solenoid coils. The connectors must be latched securely.

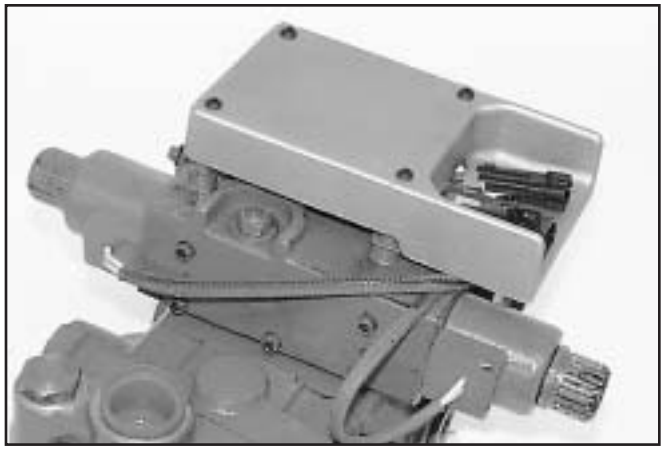


Step 18

Carefully position the EP Control electronic module. Tuck all cables under the module. **Caution:** Avoid pinching cables at mounting points.

Step 19

Install the four lockwashers and four 10-24 button head cap screws. Place two of the screws through the "L" brackets. Using a 1/8" hex key or bit socket, torque the four screws to 60-68 lbf·in.



Step 20

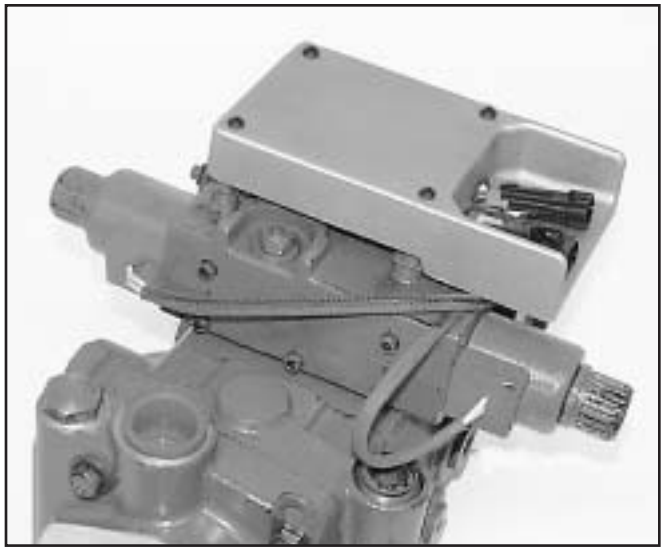
Power should still be disconnected to the input device. Connect the command input device to the three-pin connector on the EP Control electronic module.

Step 21

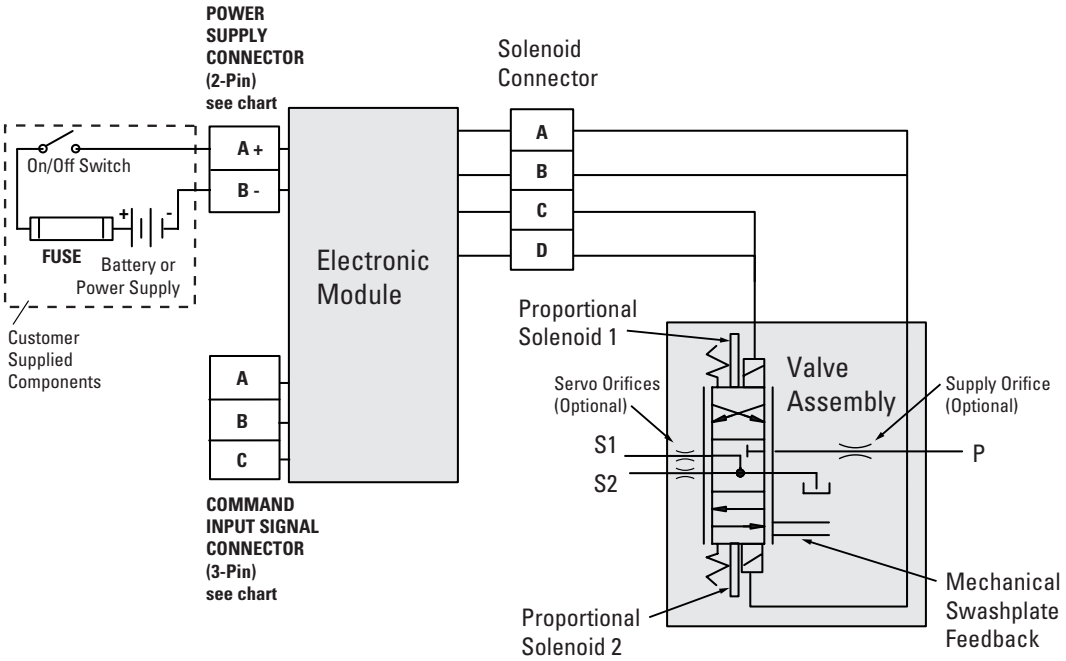
Connect the electrical power source to the two-pin connector on the EP Control electronic module. Install a 3 Amp SLO-BLO®fuse per the Interconnect Schematic on page 12. Recheck your work and then reconnect the power to the vehicle or system.

Step 22

The pump is now ready to return to operation.



Interconnect Schematic



Command Input Signal Connector

COMMAND INPUT SIGNAL	PINS	WIRE COLOR	SIGNAL
1 to 6 Vdc Potentiometric	A	Black	Ref Low - 1 Vdc
	B	Green	Command (wiper)
	C	Red	Ref Hi - 6 Vdc
4 to 20 mA Current Loop	A	Orange	Loop Return
	B	White	Loop In
	C	No Connection Required*	

*EP Control Electronic Module Mating Connector Kit 990762-000 contains plug used to seal mating end connector.

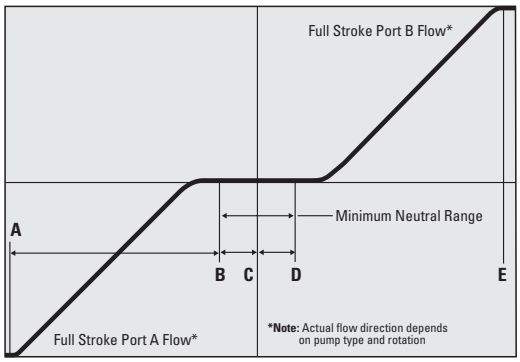
Power Supply Connector

PINS	WIRE COLOR	SIGNAL
A	Red	+ Supply Voltage
B	Black	Supply Return

Fuse Rating

3 Amp SLO-BLO® (Time Delay) fuse for 12-24 Vdc system - customer supplied

Pump Displacement vs. Input Signal



Typical Control Characteristics

	A (MAX)	B (MIN)	C	D (MIN)	E (MAX)
Command Input Signal					
1-6 Vdc	1.5 Vdc	3.3 Vdc	3.5 Vdc	3.7 Vdc	5.5 Vdc
±4-20 mA	-20 mA	-4.5 mA	0 mA	+4.5 mA	+20 mA
Shaft Rotation					
CCW	Solenoid #2		Neither	Solenoid #1	
	Flow OUT port "B"		No flow	Flow OUT port "A"	
CW	Solenoid #2		Neither	Solenoid #1	
	Flow OUT port "A"		No Flow	Flow OUT port "B"	

Note: The +20 mA command input signal configuration operates the pump in one direction. The customer has to change the polarity on the -20 mA signal to operate the pump in the opposite direction.

SYMPTOM	CAUSE	ACTION
No Flow in Either Direction	Defective Power Connection, or Loose Wires	Check Power Input. Disconnect the two-pin connector from the power supply to the EP Control electronic module. Inspect the two connectors for corrosion, loose wires or broken wires. Measure the DC voltage across pins "A" and "B" at the connector. The reading should be between 9 to 30 Vdc.
	Command Signal Missing	Check Command Input Signal. Disconnect the three-pin connector from the command input device to the EP Control electronic module. Inspect the two connectors for corrosion, loose contacts, loose wires and broken wires. If 1-6 Vdc joystick or potentiometer is used, measure the DC voltage across pins "A" and "B" at the connector. Move the joystick or potentiometer position. The voltage reading will be approximately 2.5 volts DC at joystick neutral or the half range position of the potentiometer. The DC voltage will be approximately 5 volts at one end of the joystick or potentiometer travel. At the opposite end of travel the DC voltage will be approximately zero. If ±4-20 mA current loop input is used, measure the DC voltage across pins "A" and "B" at the connector. The DC voltage reading should be approximately zero at zero input current which occurs at command input neutral. The DC voltage reading should be approximately ±5 volts for input command currents of ±20 mA respectively.
	Defective Solenoid Coil	Check Solenoid Coil. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. Disconnect the two mating four-pin connectors. Measure the coil resistance across the designated pins at the solenoid four-pin connector. Refer to the Solenoid 4-pin Connector chart on page 17 for typical readings.
	Defective Electronic Module	Check Electronic Module. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. **Caution:** The engine or motor driving the pump should not be running. Connect command input device and power to the module. Measure the current to the coil at the four-pin connector. Activate the input device end to end and at neutral. Monitor the current on one coil, and then on the other. Refer to Command Input Device chart on page 17 for typical readings.
	Manual Override Does Not Function	Check Manual Override. Disconnect two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion loose contacts, loose wires and broken wires. Remove the valve assembly. Refer to instructions on page 6. Use a small Phillips screwdriver to push on the manual override of the solenoid tube's solenoid tube actuator pin.
Flow Only in One Direction	Command Signal Incorrect	Check Command Input Signal. Disconnect the three-pin command input device connector from the EP Control electronic module. Inspect the two connectors for corrosion, loose contacts, loose wires and broken wires. If 1-6 Vdc joystick or potentiometer is used, measure the DC voltage across pins "A" and "B" at the connector. Move the joystick or potentiometer position. The voltage reading will be approximately 2.5 volts DC at joystick neutral or the half range position of the potentiometer. The DC voltage will be approximately 5 volts at one end of the joystick or potentiometer travel. At the opposite end of travel the DC voltage will be approximately zero. If ±4-20 mA current loop input is used, measure the DC voltage across pins "A" and "B" at the connector. The DC voltage reading should be approximately zero at zero input current which occurs at command input neutral. The DC voltage reading should be approximately ±5 volts for input command currents of ±20 mA respectively.

SYMPTOM:	CAUSE:	ACTION:
Flow Only in One Direction (con't)	Defective Solenoid Coil	Check Solenoid Coil. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. Disconnect the two mating four-pin connectors. Measure the coil resistance across the designated pins at the solenoid four-pin connector. Refer to the Solenoid 4-pin Connector chart on page 17 for typical readings.
	Defective Solenoid Tube Subassembly	Check Solenoid Tube Subassembly. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the two solenoid tube subassemblies. Visually inspect the actuator pin in the tube subassembly. The pin should be free to move.
	Defective Electronic Module	Check Electronic Module. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. **Caution:** The engine or motor driving the pump should not be running. Connect command input device and power supply to the electronic module. Measure the current to the coil at the four-pin connector. Activate the input device end to end and at neutral. Monitor the current on one coil, and then on the other. Refer to Command Input Device chart on page 17 for typical readings.
Flow in Neutral	Command Signal Incorrect	Check Command Input Signal. Disconnect the three-pin command input device connector from the EP Control electronic module. Inspect the two connectors for corrosion, loose contacts, loose wires and broken wires. If 1-6 Vdc joystick or potentiometer is used, measure the DC voltage across pins "A" and "B" at the connector. Move the joystick or potentiometer position. The voltage reading will be approximately 2.5 volts DC at joystick neutral or the half range position of the potentiometer. The DC voltage will be approximately 5 volts at one end of the joystick or potentiometer travel. At the opposite end of travel the DC voltage will be approximately zero. If ±4-20 mA current loop input is used, measure the DC voltage across pins "A" and "B" at the connector. The DC voltage reading should be approximately zero at zero input current which occurs at command input neutral. The DC voltage reading should be approximately ±5 volts for input command currents of ±20 mA respectively.
	Neutral Out of Adjustment	Check Neutral Adjustment. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. Disconnect the two four-pin solenoid connectors. Follow instructions for setting neutral on page 9 Step 15.
Flow Limited, Cannot Achieve Full Pump Stroke	Command Signal Incorrect	Check Command Input Signal. Disconnect the three-pin command input device connector from the EP Control electronic module. Inspect the two connectors for corrosion, loose contacts, loose wires and broken wires. If 1-6 Vdc joystick or potentiometer is used, measure the DC voltage across pins "A" and "B" at the connector. Move the joystick or potentiometer position. The voltage reading will be approximately 2.5 volts DC at joystick neutral or the half range position of the potentiometer. The DC voltage will be approximately 5 volts at one end of the joystick or potentiometer travel. At the opposite end of travel the DC voltage will be approximately zero. If ±4-20 mA current loop input is used, measure the DC voltage across pins "A" and "B" at the connector. The DC voltage reading should be approximately zero at zero input current which occurs at command input neutral. The DC voltage reading should be approximately ±5 volts for input command currents of ±20 mA respectively.

SYMPTOM:	CAUSE:	ACTION:
Flow Limited, Cannot Achieve Full Pump Stroke (con't)	Defective Electronic Module	Check Electronic Module. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. **Caution:** The engine or motor driving the pump should not be running. Connect command input device and power supply to the electronic module. Measure the current to the coil at the four-pin connector. Activate the input device end to end and at neutral. Monitor the current on one coil, and then on the other. Refer to Command Input Device chart on page 17 for typical readings.
	Manual Override Does Not Function	Check Manual Override. Disconnect the two-pin power supply and the three-pin command input device connectors from the EP Control electronic module. Inspect the connectors for corrosion loose contacts, loose wires and broken wires. Remove the valve assembly. Refer to instructions on page 6. Use a small Phillips screwdriver to push on the manual override of the solenoid tube's actuator pin should move the spool.
Does Not Return to Neutral	Command Signal Incorrect	Check Command Input Signal. Disconnect the three-pin command input device connector from the EP Control electronic module. Inspect the two connectors for corrosion, loose contacts, loose wires and broken wires. If 1-6 Vdc joystick or potentiometer is used, measure the DC voltage across pins "A" and "B" at the connector. Move the joystick or potentiometer position. The voltage reading will be approximately 2.5 volts DC at joystick neutral or the half range position of the potentiometer. The DC voltage will be approximately 5 volts at one end of the joystick or potentiometer travel. At the opposite end of travel the DC voltage will be approximately zero. If ±4-20 mA current loop input is used, measure the DC voltage across pins "A" and "B" at the connector. The DC voltage reading should be approximately zero at zero input current which occurs at command input neutral. The DC voltage reading should be approximately ±5 volts for input command currents of ±20 mA respectively.
	Neutral Out of Adjustment	Check Neutral Adjustment. Disconnect the two-pin power supply and the three-pin connectors from the EP Control electronic module. Inspect the connectors for corrosion, loose contacts, loose wires and broken wires. Remove the EP Control electronic module. Refer to instructions on page 5. Disconnect the two solenoid four-pin connectors. Follow instructions for setting neutral on page 9 Step 15.

Troubleshooting Reference Settings

Solenoid 4-Pin Connector

PINS	SOLENOID	12 VOLT COIL	24 VOLT COIL
A & B	Coil 1	5 ohms	21 ohms
C & D	Coil 2	5 ohms	21 ohms
Note: Only 12 volt coils are used with EP Control electronics module			

Joystick Position

	DC VOLTAGE MEASURED ACROSS DESIGNATED PINS AT THE CUSTOMER THREE-PIN CONNECTOR
	A to B
Full-Forward	5 Vdc
Neutral	2.5 Vdc
Full-Reverse	0 Vdc

Command Input Device – 12/24 Volt Systems (5 Ω coils)

	CURRENT TO COIL 1 PINS A & B YELLOW & WHITE WIRES	CURRENT TO COIL 2 PINS C & D ORANGE & BLACK WIRES
Max command in one direction	Minimum 1.5 A Maximum 2.0 A	0 A 0 A
Neutral	0 A	0 A
Max command in the same direction	0 A 0 A	Minimum 1.5 A Maximum 2.0 A

Eaton
14615 Lone Oak Road
Eden Prairie, MN 55344
Telephone: 952 937-9800
Fax: 952 974-7130
www.hydraulics.eaton.com

Eaton
20 Rosamond Road
Footscray
Victory 3011
Australia
Tele: (61) 3 9319 8222
Fax: (61) 3 9318 5714

Eaton
46 New Lane, Havant
Hampshire PO9 2NB
England
Tele: (44) 23 92 486 451
Fax: (44) 23 92 487 110

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