# MAGNUM 180
# MAGNUM 190
# MAGNUM 210
# MAGNUM 225

## Tractor with CVT Transmission

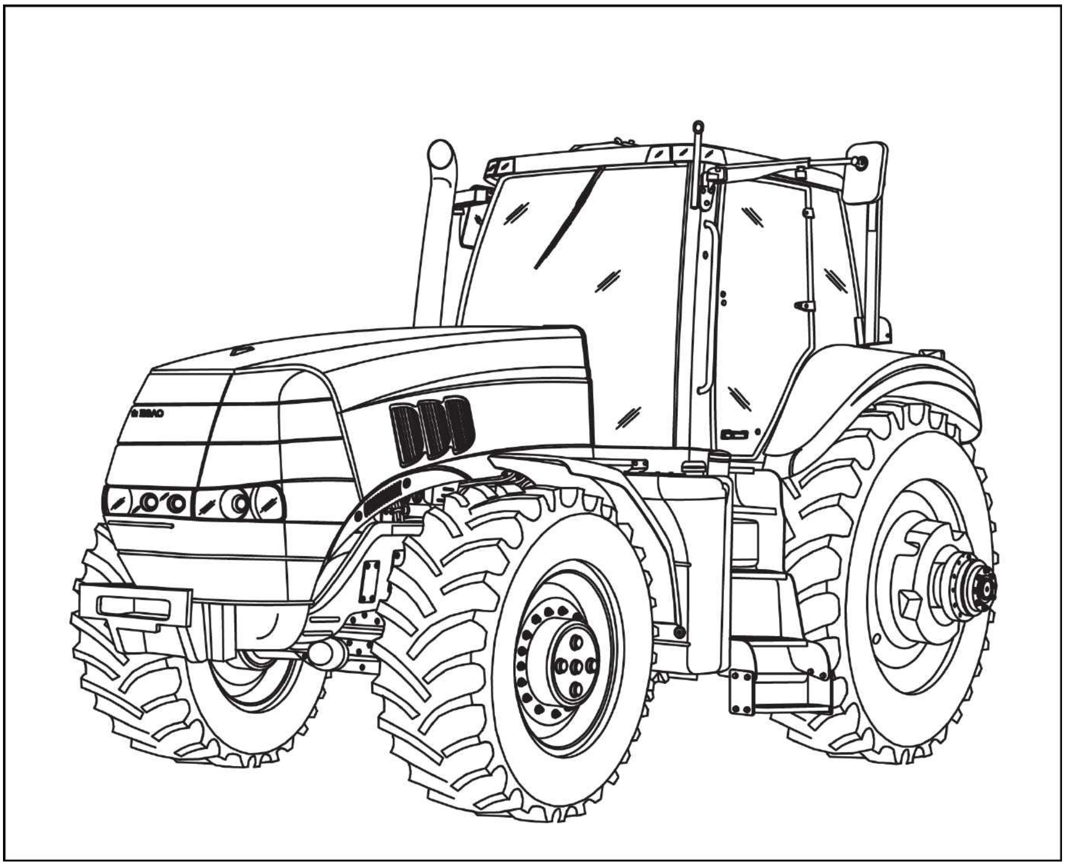
*from PIN ZARH06086*

# SERVICE MANUAL

**Part number 84386820**
English
November 2010

CASE IH AGRICULTURE

# SERVICE MANUAL



**Magnum 180 [ZARH06086 - ]**
**Magnum 190 [ZARH06086 - ]**
**Magnum 210 [ZARH06086 - ]**
**Magnum 225 [ZARH06086 - ]**

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# INTRODUCTION

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## INTRODUCTION

# Torque

Magnum 180, Magnum 190, Magnum 210

## Decimal hardware

### Grade 5 bolts, nuts and studs

| Size | Nm | lb in/lb ft |
|---|---|---|
| 1/4 in | 12 - 15 Nm | 108 - 132 lb in |
| 5/16 in | 23 - 28 Nm | 204 - 252 lb in |
| 3/8 in | 48 - 57 Nm | 420 - 504 lb in |
| 7/16 in | 73 - 87 Nm | 54 - 64 lb ft |
| 1/2 in | 109 - 130 Nm | 80 - 96 lb ft |
| 9/16 in | 149 - 179 Nm | 110 - 132 lb ft |
| 5/8 in | 203 - 244 Nm | 150 - 180 lb ft |
| 3/4 in | 366 - 439 Nm | 270 - 324 lb ft |
| 7/8 in | 542 - 651 Nm | 400 - 480 lb ft |
| 1 in | 787 - 944 Nm | 580 - 696 lb ft |
| 1-1/8 in | 1085 - 1193 Nm | 800 - 880 lb ft |
| 1-1/4 in | 1519 - 1681 Nm | 1120 - 1240 lb ft |
| 1-3/8 in | 1980 - 2278 Nm | 1460 - 1680 lb ft |
| 1-1/2 in | 2631 - 2983 Nm | 1940 - 2200 lb ft |

### Grade 8 bolts, nuts and studs

| Size | Nm | lb in/lb ft |
|---|---|---|
| 1/4 in | 16 - 20 Nm | 144 - 180 lb in |
| 5/16 in | 33 - 39 Nm | 288 - 348 lb in |
| 3/8 in | 61 - 73 Nm | 540 - 648 lb in |
| 7/16 in | 95 - 114 Nm | 70 - 84 lb ft |
| 1/2 in | 149 - 179 Nm | 110 - 132 lb ft |
| 9/16 in | 217 - 260 Nm | 160 - 192 lb ft |
| 5/8 in | 298 - 358 Nm | 220 - 264 lb ft |
| 3/4 in | 515 - 618 Nm | 380 - 456 lb ft |
| 7/8 in | 814 - 976 Nm | 600 - 720 lb ft |
| 1 in | 1220 - 1465 Nm | 900 - 1080 lb ft |
| 1-1/8 in | 1736 - 1953 Nm | 1280 - 1440 lb ft |
| 1-1/4 in | 2468 - 2712 Nm | 1820 - 2000 lb ft |
| 1-3/8 in | 3227 - 3688 Nm | 2380 - 2720 lb ft |
| 1-1/2 in | 4285 - 4827 Nm | 3160 - 3560 lb ft |

***NOTE:*** *Use thick nuts with Grade 8 bolts.*

## Metric hardware

### Grade 8.8 bolts, nuts and studs

| Size | Nm | lb in/lb ft |
|---|---|---|
| 4 mm | 3 - 4 Nm | 24 - 36 lb in |
| 5 mm | 7 - 8 Nm | 60 - 72 lb in |
| 6 mm | 11 - 12 Nm | 96 - 108 lb in |
| 8 mm | 26 - 31 Nm | 228 - 276 lb in |
| 10 mm | 52 - 61 Nm | 456 - 540 lb in |
| 12 mm | 90 - 107 Nm | 66 - 79 lb ft |
| 14 mm | 144 - 172 Nm | 106 - 127 lb ft |
| 16 mm | 217 - 271 Nm | 160 - 200 lb ft |
| 20 mm | 434 - 515 Nm | 320 - 380 lb ft |
| 24 mm | 675 - 815 Nm | 500 - 600 lb ft |
| 30 mm | 1250 - 1500 Nm | 920 - 1100 lb ft |
| 36 mm | 2175 - 2600 Nm | 1600 - 1950 lb ft |

**Grade 10.9 bolts, nuts and studs**

| Size | Nm | lb in/lb ft |
|---|---|---|
| 4 mm | 4 - 5 Nm | 36 - 48 lb in |
| 5 mm | 9 - 11 Nm | 84 - 96 lb in |
| 6 mm | 15 - 18 Nm | 132 - 156 lb in |
| 8 mm | 37 - 43 Nm | 324 - 384 lb in |
| 10 mm | 73 - 87 Nm | 54 - 64 lb ft |
| 12 mm | 125 - 150 Nm | 93 - 112 lb ft |
| 14 mm | 200 - 245 Nm | 149 - 179 lb ft |
| 16 mm | 310 - 380 Nm | 230 - 280 lb ft |
| 20 mm | 610 - 730 Nm | 450 - 540 lb ft |
| 24 mm | 1050 - 1275 Nm | 780 - 940 lb ft |
| 30 mm | 2000 - 2400 Nm | 1470 - 1770 lb ft |
| 36 mm | 3500 - 4200 Nm | 2580 - 3090 lb ft |

**Grade 12.9 bolts, nuts and studs**

| Size | Nm | lb in/lb ft |
|---|---|---|
| Typically the torque values specified for grade 10.9 hardware can be used satisfactorily on grade 12.9 hardware. | | |

## Steel hydraulic fittings

**37° flare fitting**

| Tube outside diameter/Hose inside diameter | | Thread size | Nm | lb in/lb ft |
|---|---|---|---|---|
| inch | mm | | | |
| 6.4 mm | 1/4 in | 7/16-20 in | 8 - 16 Nm | 72 - 144 lb in |
| 7.9 mm | 5/16 in | 1/2-20 in | 11 - 22 Nm | 96 - 192 lb in |
| 9.5 mm | 3/8 in | 9/16-18 in | 14 - 34 Nm | 120 - 300 lb in |
| 12.7 mm | 1/2 in | 3/4-16 in | 20 - 57 Nm | 180 - 504 lb in |
| 15.9 mm | 5/6 in | 7/8-14 in | 34 - 79 Nm | 300 - 696 lb in |
| 19.0 mm | 3/4 in | 1-1/16-12 in | 54 - 108 Nm | 40 - 80 lb ft |
| 22.2 mm | 7/8 in | 1-3/16-12 in | 81 - 135 Nm | 60 - 100 lb ft |
| 25.4 mm | 1 in | 1-5/16-12 in | 102 - 158 Nm | 75 - 117 lb ft |
| 31.8 mm | 1-1/4 in | 1-5/8-12 in | 169 - 223 Nm | 125 - 165 lb ft |
| 38.1 mm | 1-1/2 in | 1-7/8-12 in | 285 - 338 Nm | 210 - 250 lb ft |

**Straight threads with O-ring**

| Tube outside diameter/Hose inside diameter | | Thread size | Nm | lb in/lb ft |
|---|---|---|---|---|
| inch | mm | | | |
| 6.4 mm | 1/4 in | 7/16-20 in | 16 - 26 Nm | 144 - 228 lb in |
| 7.9 mm | 5/16 in | 1/2-20 in | 22 - 34 Nm | 192 - 300 lb in |
| 9.5 mm | 3/8 in | 9/16-18 in | 34 - 54 Nm | 300 - 480 lb in |
| 12.7 mm | 1/2 in | 3/4-16 in | 57 - 91 Nm | 540 - 804 lb in |
| 15.9 mm | 5/6 in | 7/8-14 in | 79 - 124 Nm | 58 - 92 lb ft |
| 19.0 mm | 3/4 in | 1-1/16-12 in | 108 - 174 Nm | 80 - 128 lb ft |
| 22.2 mm | 7/8 in | 1-3/16-12 in | 136 - 216 Nm | 100 - 160 lb ft |
| 25.4 mm | 1 in | 1-5/16-12 in | 159 - 253 Nm | 117 - 187 lb ft |
| 31.8 mm | 1-1/4 in | 1-5/8-12 in | 224 - 357 Nm | 165 - 264 lb ft |
| 38.1 mm | 1-1/2 in | 1-7/8-12 in | 339 - 542 Nm | 250 - 400 lb ft |

**Split flange mounting bolts**

| Size | Nm | lb in/lb ft |
|---|---|---|
| 5/16-18 in | 20 - 27 Nm | 180 - 240 lb in |
| 3/8-16 in | 27 - 34 Nm | 240 - 300 lb in |
| 7/16-14 in | 47 - 61 Nm | 420 - 540 lb in |
| 1/2-13 in | 74 - 88 Nm | 55 - 65 lb ft |
| 5/8-11 in | 190 - 203 Nm | 140 - 150 lb ft |

| O-ring face seal end | | | | | | O-ring boss end fitting or lock nut | | |
|---|---|---|---|---|---|---|---|---|
| Nominal SAE dash size | Tube outside diameter mm | Tube outside diameter in | Thread size | Nm | lb in/lb ft | Thread size | Nm | lb in/lb ft |
| -4 | **6.4 mm** | **1/4 in** | **9/16-18 in** | **14 - 16 Nm** | **120 - 144 lb in** | **7/16-20 in** | **23 - 27 Nm** | **204 - 240 lb in** |
| -6 | **9.5 mm** | **3/8 in** | **11/16-16 in** | **24 - 27 Nm** | **216 - 240 lb in** | **9/16-18 in** | **34 - 41 Nm** | **300 - 360 lb in** |
| -8 | **12.7 mm** | **1/2 in** | **13/16-16 in** | **43 - 54 Nm** | **384 - 480 lb in** | **3/4-16 in** | **61 - 68 Nm** | **540 - 600 lb in** |
| -10 | **15.9 mm** | **5/8 in** | **1-14 in** | **62 - 76 Nm** | **552 - 672 lb in** | **7/8-14 in** | **81 - 88 Nm** | **60 - 65 lb ft** |
| -12 | **19.0 mm** | **3/4 in** | **1-3/16-12 in** | **90 - 110 Nm** | **65 - 80 lb ft** | **1-1/16-12 in** | **115 - 122 Nm** | **85 - 90 lb ft** |
| -14 | **22.2 mm** | **7/8 in** | **1-3/16-12 in** | **90 - 110 Nm** | **65 - 80 lb ft** | **1-13/16-12 in** | **129 - 136 Nm** | **95 - 100 lb ft** |
| -16 | **25.41 mm** | **1.0 in** | **1-7/16-12 in** | **125 - 140 Nm** | **92 - 105 lb ft** | **1-5/16-12 in** | **156 - 169 Nm** | **115 - 125 lb ft** |
| -20 | **31.8 mm** | **1-1/4 in** | **1-11/16-12 in** | **170 - 190 Nm** | **125 - 140 lb ft** | **1‘-5/6-12 in** | **201 - 217 Nm** | **150 - 160 lb ft** |
| -24 | **38.1 mm** | **1-1/2 in** | **2-12 in** | **200 - 254 Nm** | **150 - 180 lb ft** | **1-7/8-12 in** | **258 - 271 Nm** | **190 - 200 lb ft** |

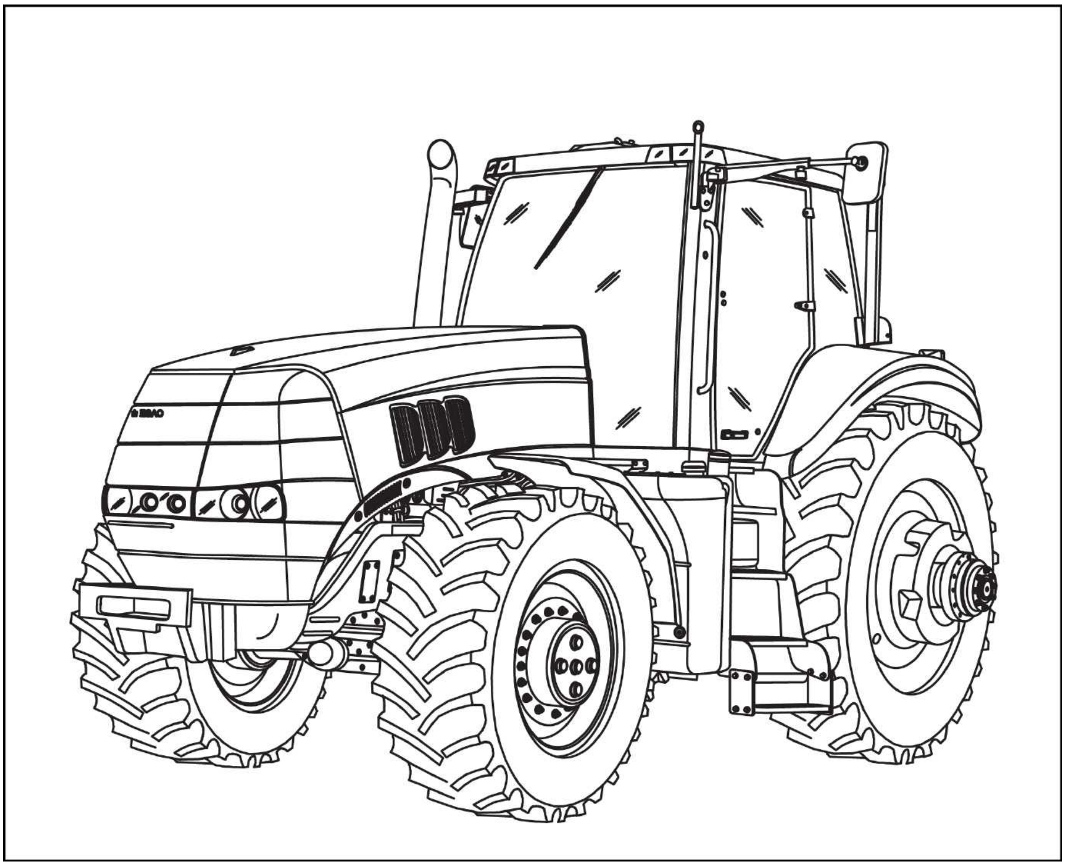
# Capacities

**Magnum 180, 190, 210 and 225**

| System | Metric | U.S. | Imperial |
|---|---|---|---|
| Engine Oil | | | |
| No filter change | **16 l** | **4.23 US gal** | **3.52 UK gal** |
| With filter change | **16.5 l** | **4.36 US gal** | **3.63 UK gal** |
| Cooling system | **23.65 l** | **6.25 US gal** | **5.2 UK gal** |
| Transmission/hydraulic system | | | |
| Full Powershift | **85 l** | **22.5 US gal** | **18.7 UK gal** |
| CVT | **100 l** | **26.4 US gal** | **22.0 UK gal** |
| Mechanical front drive (MFD) | | | |
| 4 pin – 10 bolt axle* | | | |
| Differential | **12.3 l** | **13 US qt** | **21.6 UK pt** |
| Planetary (each) | **1.4 l** | **3 US pt** | **2.4 UK pt** |
| 4 pin – 12 bolt axle* | | | |
| Differential | **11 l** | **11.6 US qt** | **21.6 UK pt** |
| Planetary (each) | **2.3 l** | **2.4 US qt** | **2.0 UK qt** |
| Fuel tank | **446 l** | **118 US gal** | **98.25 UK gal** |
| DEF/AdBlue® tank | **56.8 l** | **15 US gal** | **56.8 l** (**12.5 UK gal**) |
| MFD gearbox | **275 ml** | **9.3 US fl oz** | **9.7 UK fl oz** |
| * Pin and bolt quantity are determined by observing the wheel ends. | | | |

# SERVICE MANUAL

## HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS



**Magnum 180**
**Magnum 190**
**Magnum 210**
**Magnum 225**

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# HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS - A

## PRIMARY HYDRAULIC POWER SYSTEM - 10.A

**Magnum 180**
**Magnum 190**
**Magnum 210**
**Magnum 225**

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# HYDRAULIC - PNEUMATIC - ELECTRICAL - ELECTRONIC SYSTEMS - A

## PRIMARY HYDRAULIC POWER SYSTEM - 10.A

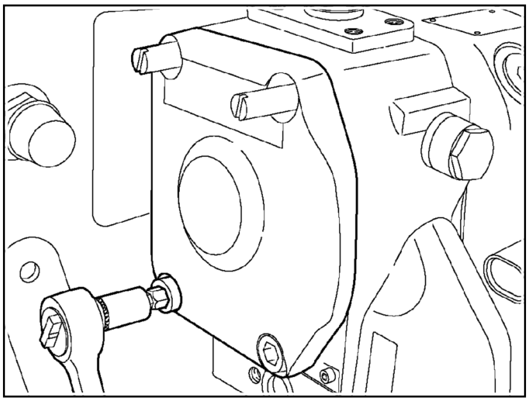
# Hydraulic pump - General specification - Vane pump

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

| | |
|---|---|
| Output @ engine speed **2200 RPM** | **60 l/min** (**15.9 US gpm**) |
| Pressure filter relief valve | **28 bar** (**406.0 psi**) |
| Low pressure regulated | **22 - 25 bar** (**319.0 - 362.5 psi**) |
| Over pressure switch closes | **27 bar** (**391.5 psi**) |
| Maximum displacement | **45 cm³** |
| Direction of rotation (view on pump shaft) | Counter clockwise |
| Minimum continuous pump speed | **900 RPM** |
| Maximum continuous pump speed | **3000 RPM** |
| Maximum flow | **130 l/min** (**34.3 US gpm**) |
| Minimum flow requirement of pump at **22 bar** | **3 l/min** (**0.8 US gpm**) |
| Minimum suction pressure at cold start - **30 °C**, no function required, pump without damage | **0.3 bar** absolute |
| Nominal suction pressure range | **0.8 - 1.2 bar** (**11.6 - 17.4 psi**) |
| Normal working pressure | **22 - 25 bar** (**319.0 - 362.5 psi**) |
| Overpressure resistance | **80 bar** (**1160.0 psi**) |

# Charge pump - Torque

Magnum 225 [ZARH06086 - ] CVT Transmission

| Component | Nm | Identification | lb-ft |
|---|---|---|---|
| Pump retaining bolts | **130 N·m** |  RCPH09CCH092AAC 1 | **96 lb ft** |

# Charge pump - General specification

Magnum 225 [ZARH06086 - ] CVT Transmission

***NOTE:*** *Pumps turn at approximately 1.25 times engine speed.*

| Type | Gerotor type pump |
|---|---|
| Charge Pump displacement | **90 cm³/rev** |
| Output at **2200 RPM** engine speed | **248 l/min** (**65.4 US gpm**) |
| Charge pressure pump dump valve:<br>Crack open | **10 bar** (**145.0 psi**) |
| Fully open | **15 bar** (**217.5 psi**) |
| Charge pressure | **2 - 4 bar** (**29.0 - 58.0 psi**) |
| Charge pressure switch closes | **1 bar** (**14.5 psi**) |

# Control valve - General specification - Priority valve

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

| | |
|---|---|
| Maximum inlet flow at port P | **165 l/min** (**43.59 US gpm**) |
| Maximum pressure at port P | **250 bar** (**3625.00 psi**) |
| Master priority working pressure | **5.8 - 11.6 bar** (**84.1 - 168.2 psi**) |
| Steering compensator working pressure | **12.8 - 17.4 bar** (**185.6 - 252.3 psi**) |

# Pressure/flow compensating (PFC) pump - Torque

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

| | |
|---|---|
| Pressure /flow compensating piston pump mounting bolts | **135 N·m** (**100 lb ft**) |
| Priority valve mounting bolts | **50 N·m** (**37 lb ft**) |
| Pump compensator valve mounting bolts | **5 N·m** (**4.0 lb ft**) |

# Pressure/flow compensating (PFC) pump - General specification

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

**Variable displacement pump**

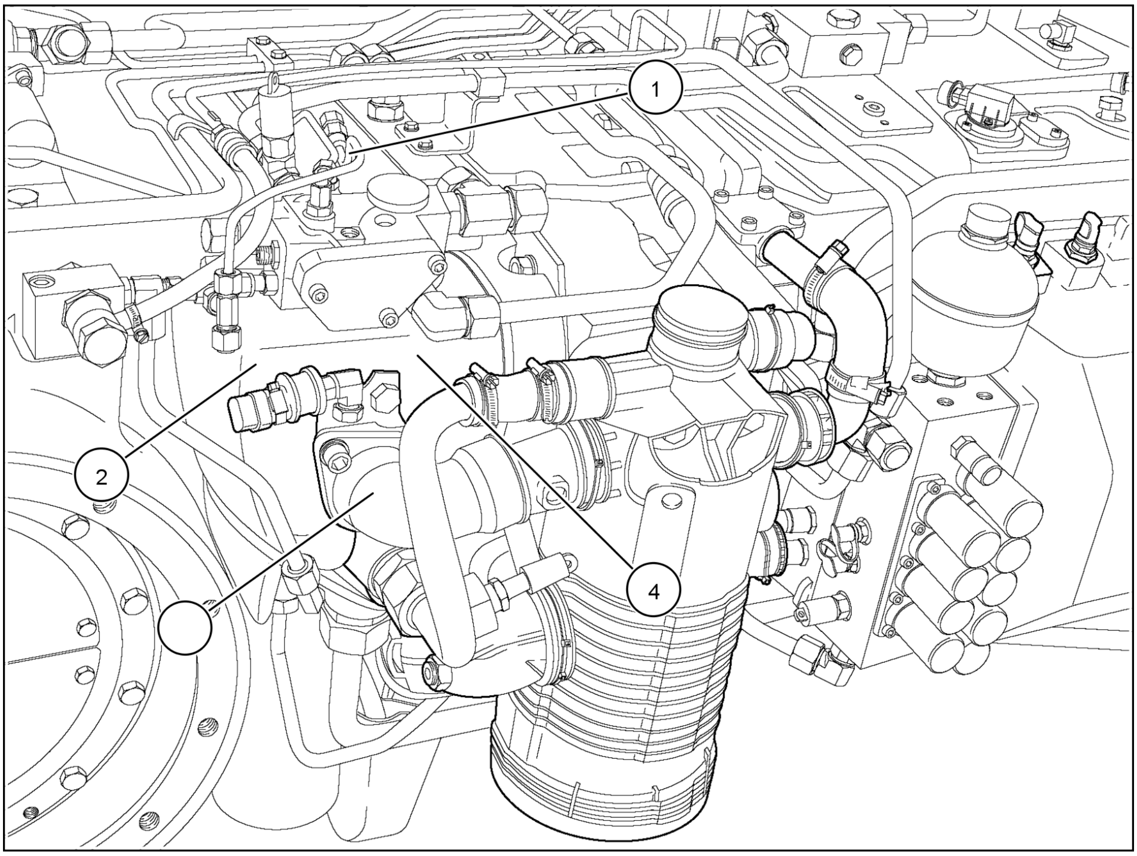
| **Type** | **Variable displacement closed center, load sensing piston pump** |
|---|---|
| Rotation | Clockwise |
| Pump speed at **2400 RPM** maximum rated speed (theoretical) | **3000 RPM** |
| Pump speed at **2200 RPM** engine speed | **2750 RPM** |
| Output at **2200 RPM** engine speed | **173 l/min** (**45.7 US gpm**) |
| Piston pump displacement | **63 $cm^3$/rev** |
| Low pressure standby | **26 bar** (**377.0 psi**) ± **1 bar** (**14.5 psi**) |
| High pressure standby | **210 bar** (**3045.00 psi**) ± **5 bar** (**72.5 psi**) |
| Maximum system pressure | **245 bar** (**3552.5 psi**) ± **5 bar** (**72.5 psi**) |
| Cooler bypass valve | **5.8 bar** (**84.1 psi**). |

# PRIMARY HYDRAULIC POWER SYSTEM - Dynamic description

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

The tractor is equipped with three hydraulic pumps, a pressure and flow compensated (PFC) piston pump, charge pump and a vane pump. All three pumps are driven through a drive housing on the right side of the transmission. The pump drive housing gears are driven by the PTO drive line. All three pumps turn at approximately 1.25 times engine speed.

The pressure and flow compensated (PFC) piston pump is attached and driven by the rear pump drive. The system charge pump is mounted directly onto the back of the PFC pump. All flow from the charge pump passes through the charge filter assembly and a portion passes through the oil cooler before delivery to the PFC pump inlet.

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| | |
|---|---|
| 1. PFC pump compensator | 3. Charge pump inlet |
| 2. Charge pump | 4. PFC pump |

## Pressure and flow compensated pump

The pressure and flow compensated (PFC) piston pump has variable flow output and operates at variable pressures. The pump matches hydraulic power output to the actual load requirements to ensure maximum efficiency and minimum fuel usage.

The PFC pump output is supplied directly to a flange mounted priority valve. The priority valve supplies the steering system first, the trailer brakes receive second priority (if equipped).

***NOTE:*** *The optional trailer brake valve, if equipped, mounts directly on the priority valve. Hydraulic trailer brakes receive second priority from PFC piston pump.*

Once steering and trailer brakes are satisfied, the PFC piston pump supplies the following circuits:

- Remote valves
- Hitch valve
- Mid mount valves

- Suspended axle control valve

## Charge Pump

The gerotor type charge pump is mounted on and driven by the PFC piston pump. The charge pump draws oil directly from main filter housing. The charge pump housing is equipped with a filter assembly. All charge pump flow passes through the charge filter assembly and a portion passes through the oil cooler before delivery to the PFC pump inlet. Any excess charge flow is routed to the main filter assembly and is available to the lube circuit. The charge pressure is limited to **1000 kPa** (**145 psi**) by the charge relief.

## Vane Pump (regulated circuit)

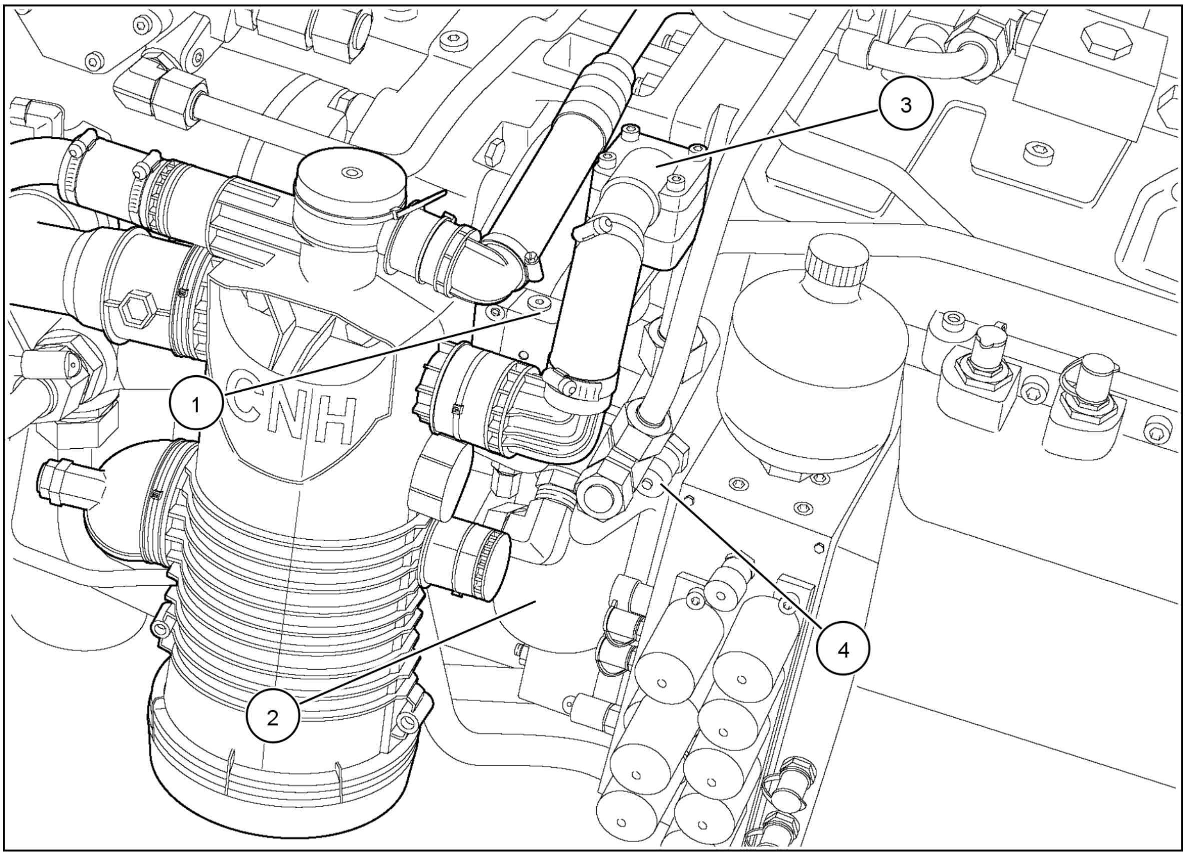
The vane pump is driven off the front of the pump drive assembly. The pump inlet is directly supplied from the main filter assembly. At start up the vane pump stator ring is held in full demand position by the stroking piston spring. This ensures that pumping will begin at start up. The vane pump control valve is also held in full demand position by the pressure control spring.

At start up charge pump pressure increases and is routed to the back side of the vanes forcing them outwards. Oil enters the pumping chambers from the suction gallery, as the rotating group turns the pumping volume decreases and exits the pressure “P” port. From the main output of the vane pump the flow is delivered through the vane pump filter assembly to the low pressure circuits:

The following circuits are supplied by the regulated pressure circuit:

- Front wheel drive (MFD) solenoid valve
- Differential lock valve solenoid
- PTO and PTO brake solenoids
- Remote valve pilot supply
- Mid mount valves pilot supply (if equipped)
- Transmission control valve
- Service brakes and brake booster accumulator
- CVT hydro pilot supply

The vane pump low pressure system is limited to **2200 - 2500 kPa** (**320 - 362 psi**) by the vane pump regulator assembly. At this regulated pressure the vane pump flow is also destroked. The vane pump system is limited to **2800 kPa** (**406 psi**) by the regulated circuit relief valve.

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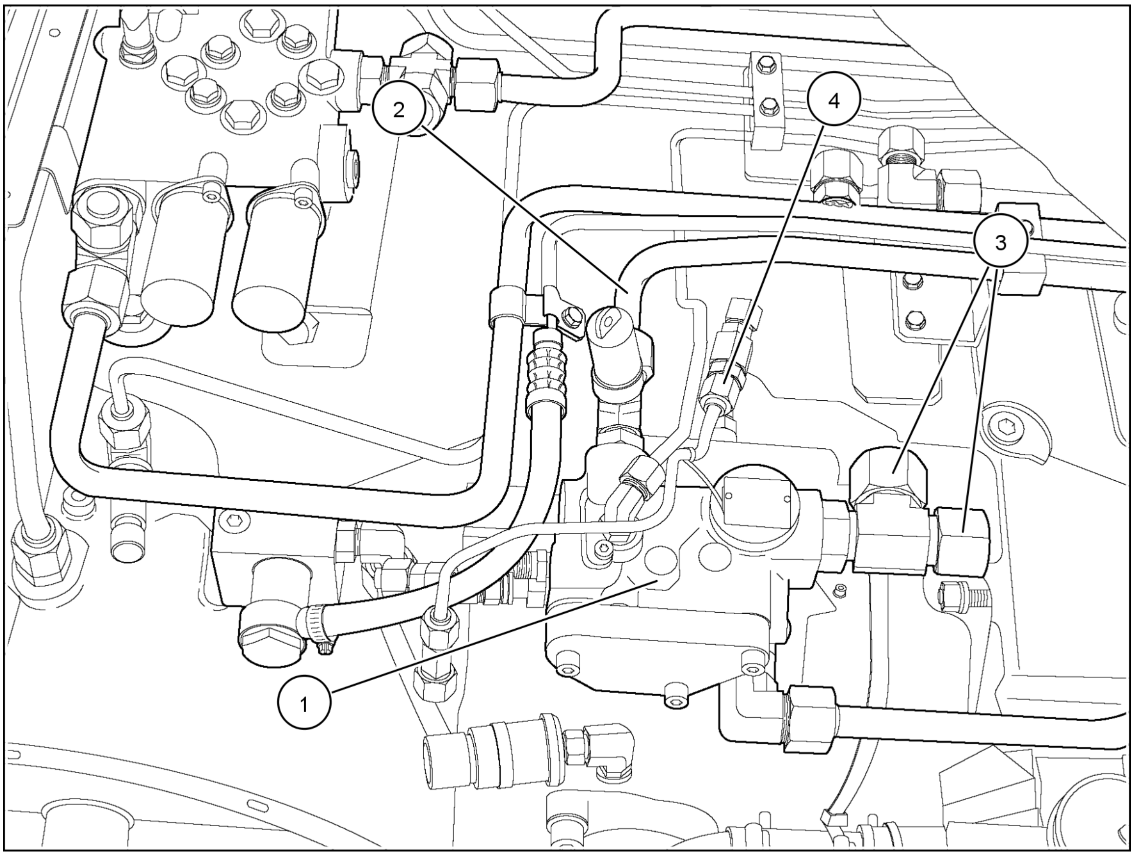
| | |
|---|---|
| 1. Vane pump | 3. Vane pump inlet |
| 2. Vane pump filter | 4. Vane pump test port |

## Priority valve

The priority valve is located on top, right side of the transmission housing. The valve is flange mounted directly onto the PFC piston pump outlet port.

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| | |
|---|---|
| 1. Priority valve | 3. Supply to PFC high pressure circuits |
| 2. Steering supply tube assembly | 4. Load sense line |

The trailer brake valve, if equipped, is flange mounted to the priority valve. Trailer brake circuit receives second priority to steering circuit.

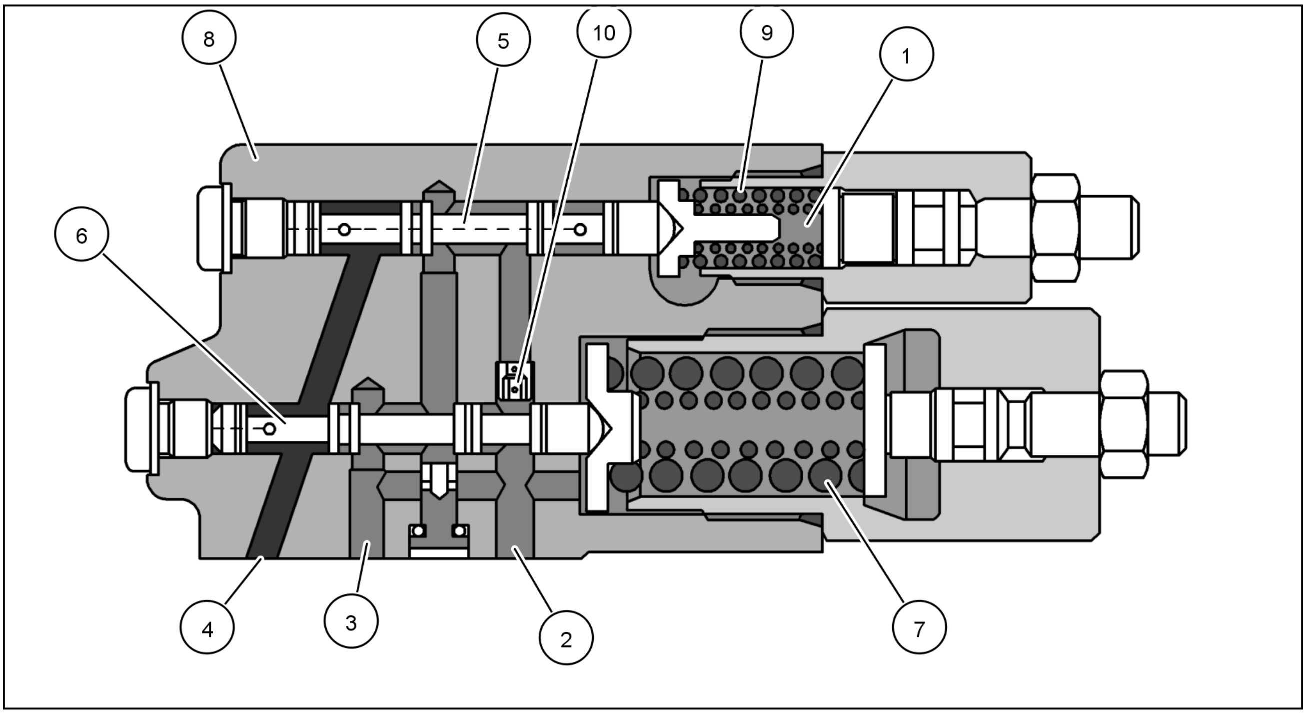
## Principle of control for PFC pump

All remote valves, the hitch control valve, the optional trailer brake, optional mid mount valve(s) and optional power beyond circuit contain a signal port. Each signal port directs signal pressure, equal to the working pressure of that circuit, through signal lines and check valves to the pump compensator spool. The compensator angles the pump swash plate to meet system demands.

A check valve is located in each signal line between the control valves and the compensator spool. If several control valves are operated at the same time, the signal line at the highest pressure causes the other check valve(s) at the lower pressures to seat themselves. This prevents signal bleed off through other control valves and ensures that the highest signal pressure acts on the compensator spool.

The pump is designed to operate in two different modes according to the demand for flow and pressure. The modes ares:

- Low pressure standby – when there is no demand for flow or pressure, the pump provides just enough flow to make up for internal leakage in the hydraulic system at low pressure. In this mode the pump requires very little power to drive it.
- Pressure/flow delivery and compensation – when there is a demand for flow and pressure from the hydraulic system, the pump responds to provide only the flow required. This limits the power consumption of the system.

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**Pressure compensator**

| | |
|---|---|
| 1. Signal line pressure | 6. High pressure compensator spool |
| 2. Pump case drain | 7. High pressure spring |
| 3. Control piston pressure | 8. Compensator assembly |
| 4. Piston pump outlet pressure | 9. Flow compensator springs |
| 5. Flow compensator spool | 10. Orifice plug |

## Low pressure standby

When there is no demand for flow, there is no pressure signal feedback to the pump, and the pump enters low pressure standby mode. Since there is no place for pump oil to flow, pressure builds at the pump outlet passage. This pressure is directed, through internal passages in the pump back plate, to the end of the compensator spool opposite the spring.

The spring acting on the flow compensator spool allows the spool to move at a **2500 - 2700 kPa** (**360 - 390 psi**) differential pressure. At this pressure, the flow compensator spool moves down and allows oil to flow into the passage to the pump control piston.

Pressure on this control piston tilts the pump swash plate against the swash plate control spring to a near neutral position. In this condition, the pump provides just enough flow to make up for internal leakage, thus maintaining a minimum system pressure of **2500 - 2700 kPa** (**360 - 390 psi**).

The pump remains in the low pressure standby position as long as there is no pressure or flow demand from the hydraulic system. In this mode, the pump produces very little heat and absorbs very little horsepower from the engine.

## Engine start up

Before the engine is started, the pump swash plate angle is at its maximum angle. As soon as the engine is cranked by the starter motor, the pressure and flow compensating (PFC) pump produces flow and pressure builds in the pump delivery passage. When this pressure reaches **2500 - 2700 kPa** (**360 - 390 psi**) the pump enters its low pressure standby mode. This occurs almost instantly and makes engine starting easier.

## Pressure/flow delivery and compensation

When oil is required in the system, flow is controlled by the difference in pressure at opposite ends of the compensator spool.

When a control valve is operated, pressure at the outlet of the piston pump drops slightly. Spring and signal line pressure shift the flow compensator spool away from the spring end, allowing oil from the control piston to drain past the spool and to tank.

As the oil drains out of the control piston, the swash plate angle increases and pump flow rises until the flow demand has been met. The flow from the pump is determined by the size of the orifice in the control valve which is being operated. This orifice is created by limiting the main valve spool travel within the control valve.

When a control valve is operated, oil pressure in the circuit being supplied increases to its operating pressure. This pressure is transmitted through the sensing line to the spring end of the compensator spool.

## Increased flow demand

When an additional control valve is operated, pressure drops slightly at the pump pressure passage. The compensator spool moved up and allows the oil behind the control piston to drain to tank. The swash plate moves and pump flow increases until the extra demand for flow has been met.

Pressure at the pump outlet increases until it is **2500 - 2700 kPa** (**360 - 390 psi**) above the signal line pressure. This pressure increase moves the pump compensator spool against the spring, allowing sufficient flow past the spool to the control piston. This action on the piston moves the swash plate to a position where increased flow is maintained and the pressure stabilized.

## Decreased flow demand

When flow demand is reduced, pump pressure increases until the pump outlet pressure exceeds the signal line pressure by more than **2500 - 2700 kPa** (**360 - 390 psi**). The flow compensator spool moves down to allow some oil to flow into the pump control piston. This action on the piston destrokes the pump against the spring and reduces pump flow.

When pump flow falls to match the reduced demand, the difference in pressure sensed on the opposite sides of the compensator spool returns to **2500 - 2700 kPa** (**360 - 390 psi**). The compensator spool moves and blocks off the passage to the control piston, which locks the swash plate at that pumping angle.

## High pressure standby

The hydraulic system high pressure standby is set for **20500 - 21500 kPa** (**2975 - 3120 psi**) through the high pressure compensator pressure setting. Additional protection is provided by maximum system relief valve set at **24500 kPa** (**3550 psi**)

When system pressure reaches the setting of the high pressure compensator spool, the pump high pressure compensator spool shifts against its spring, allowing the full pump pressure to be applied to the pump control piston. This destrokes the pump very rapidly from full stroke to almost zero (within 8 to 10 milliseconds). The swash plate stabilizes to provide just sufficient flow to make up for internal leakage.

The pump remains in the high pressure standby mode until the valve in operation returns to neutral. When this occurs, signal line feed from the valve is cut off. Signal pressure drops because the drain orifice plug passage is open to the pump case drain. When there is no signal line pressure, the pump immediately returns to a low pressure standby condition.

# PRIMARY HYDRAULIC POWER SYSTEM - Static description

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

The hydraulic systems can be separated into the following circuits:

Pressure and flow compensated (PFC) piston pump circuit

- Rear hitch system
- Remote hydraulic system
- Steering system
- Autoguidance system (if equipped)
- Mid mount remote valves (if equipped)
- Trailer brake (if equipped)
- Suspended front axle (if equipped)

Vane pump (regulated circuit)

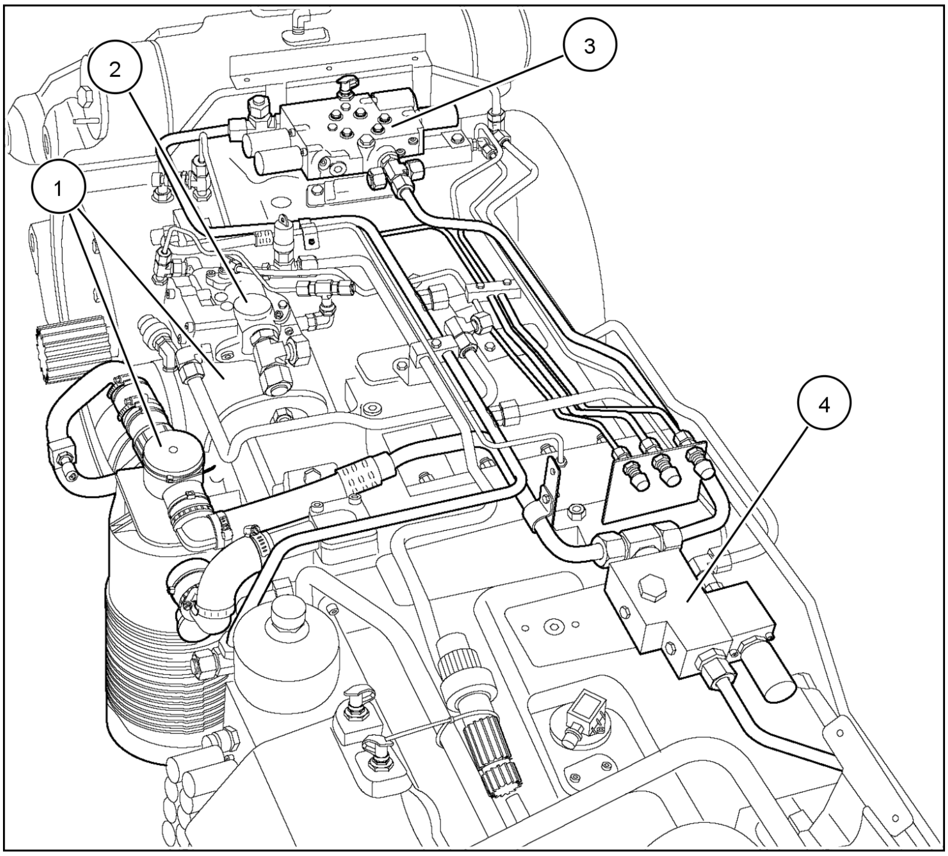
- Mechanical front wheel drive (MFD)
- PTO and PTO brakes
- Differential lock
- Transmission control valve
- Service brakes and brake booster accumulator
- Remote valve pilot supply
- Mid mount valve pilot supply (if equipped)
- CVT hydro pilot supply

Charge pump

- Charged supply to PFC inlet
- Brake lube
- Transmission lube
- Front drop box lube

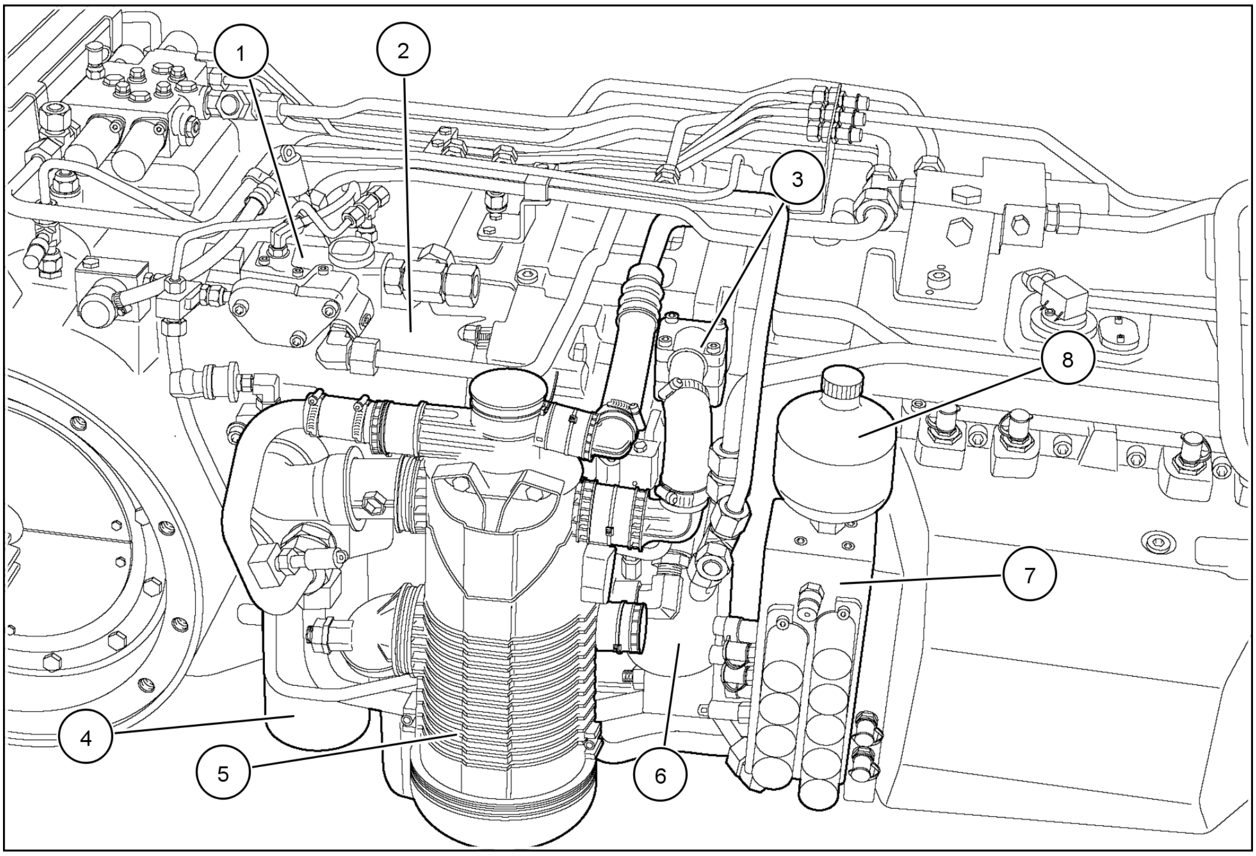
# PRIMARY HYDRAULIC POWER SYSTEM - Component identification

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission



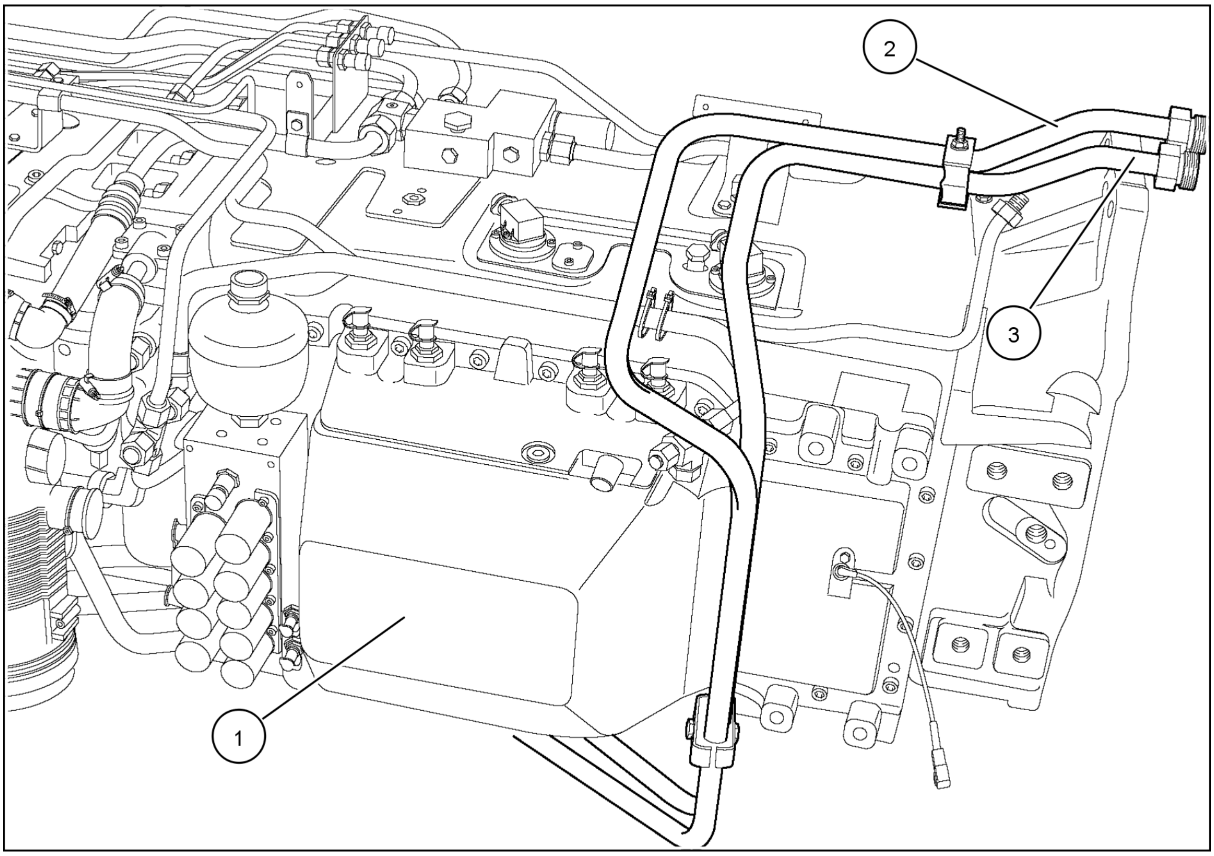

RCPH09CCH037FAE 1

| | |
|---|---|
| 1. Hydraulic pump and filter assembly | 3.PTO/Diff lock/MFD control valve |
| 2. Priority valve manifold | 4.Brake lubrication manifold |




RCPH09CCH026FAE 2

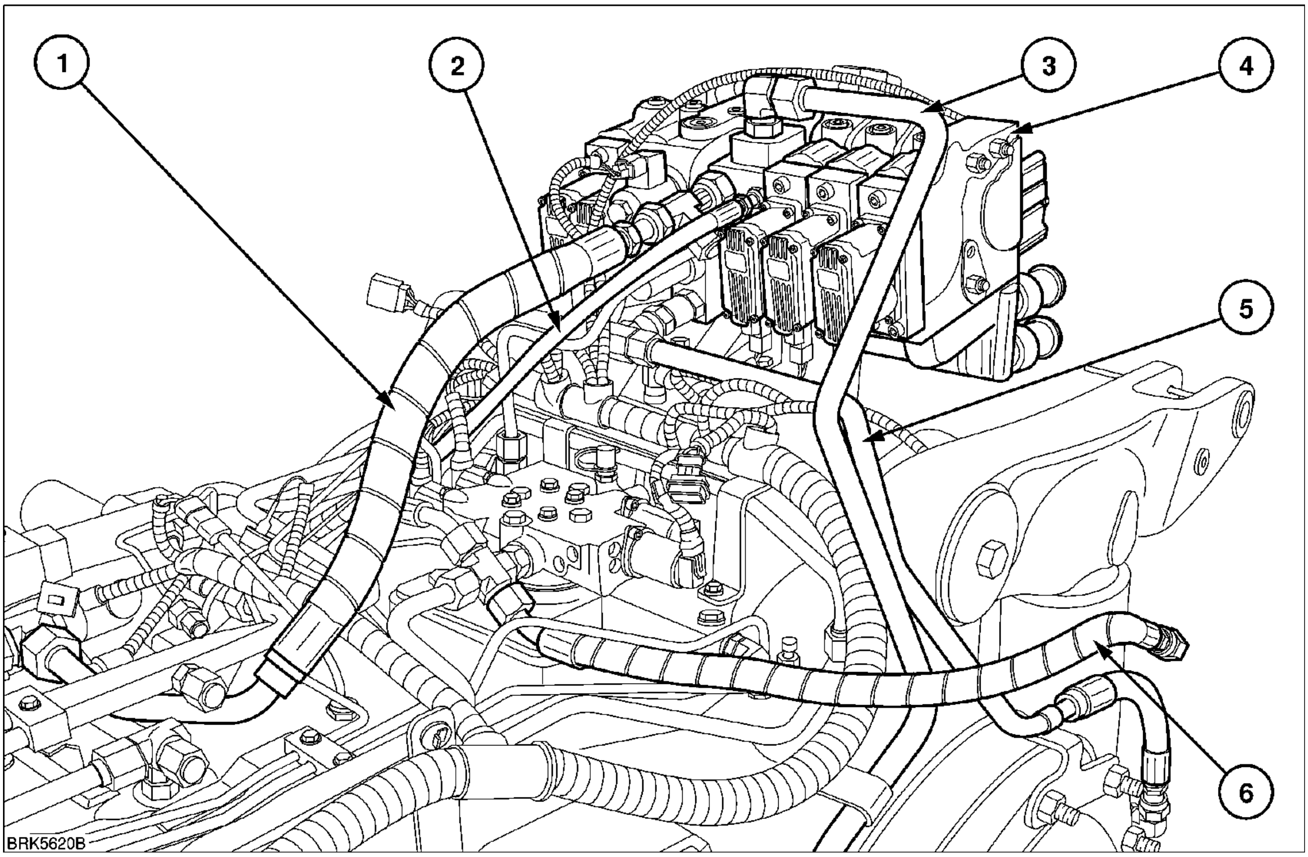
| | |
|---|---|
| 1. Priority valve | 5. Main filter housing |
| 2. PFC pump | 6. Vane pump filter |
| 3. Vane pump | 7. Transmission control valve |
| 4. Charge filter | 8. Transmission control valve accumulator |




RCPH09CCH029FAE 3

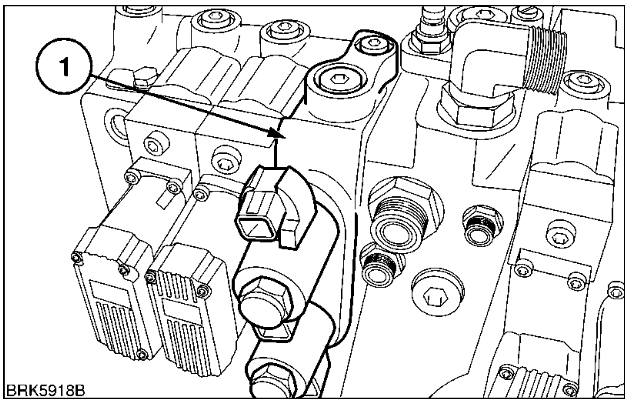
| | |
|---|---|
| 1. Transmission hydrostatic cover assembly | 3. Charge flow to cooler |
| 2. Return flow from cooler | |

***NOTE:*** *The transmission hydrostatic assembly is internal .*



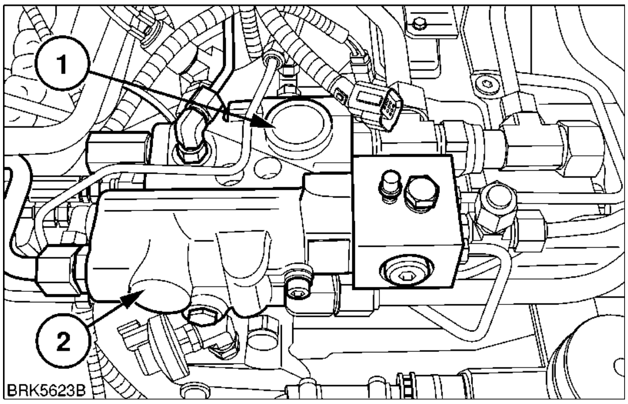

BAIL08CVT005FSA 4

| | |
|---|---|
| 1. Supply to remote/hitch valve assembly | 4. Remote valve assembly |
| 2. Load sense line | 5. Supply to hitch lift cylinders |
| 3. Return to tank | 6. Return flow from hitch cylinder |




BAIL08CVT084ASA 5

| |
|---|
| 1. Electronic draft control valve (Hitch valve) |




BAIL08CVT007ASA 6

| | |
|---|---|
| 1. | Priority valve |
| 2. | Trailer brake valve (If equipped) |

***NOTE:*** *The trailer brake valve is mounted directly on the priority valve.*

# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Schematic components

Magnum 225, Magnum 180, Magnum 190, Magnum 210

Accurate diagrams of hydraulic circuits are essential to the technician who must repair them. The diagram shows how the components interact. The diagram shows how the system works, what each component should be doing and where the oil should be going so the technician can diagnose and repair the system.

There are two types of circuit diagrams:

- Cutaway circuit diagrams show the internal construction of the components as well as the flow paths. Using colors, shades or various patterns in the lines and passages, they show many different conditions of flow and pressure. Cutaway diagrams take considerably longer to produce because of their complexity.
- Schematic circuit diagrams, the “shorthand” system of the industry, are usually preferred for troubleshooting. A schematic diagram is made up of simple geometric symbols for the components and their controls and connections.

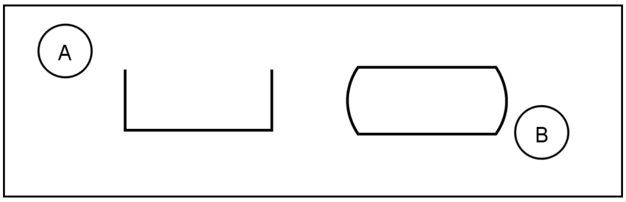
There are several systems of symbols used when making schematic diagrams:

- ISO – International Standards Organization
- ANSI – American National Standards Institute
- ASA – American Standards Association
- JIC – Joint Industry Conference

A combination of symbols from these systems are shown. There are differences between the symbol systems. There is enough similarity, however, so if you understand the symbols shown, you will be able to interpret other symbols as well.

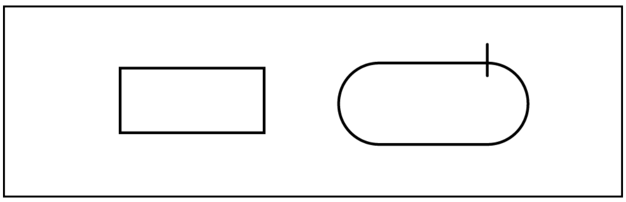
## Reservoirs

A rectangle with the top removed represents a vented reservoir **(A)**. A rectangle with the top in place represents a pressurized reservoir **(B)**.



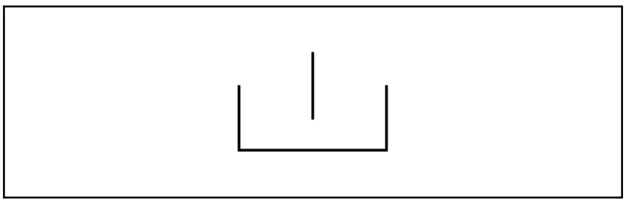

RCIL07CCH025AAA 1

There are other schematic diagrams that show a slightly different version of a pressurized reservoir, but the symbols are similar and easily recognized. An oval with a short line on top or a rectangle with curved sides represents a reservoir that is pressurized.



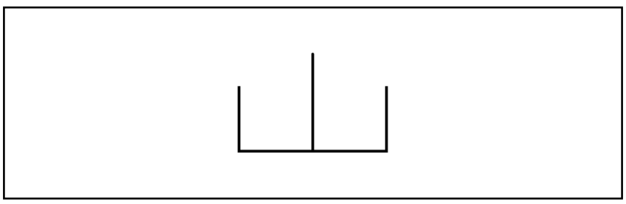
RCIL07CCH027AAA 2

Lines connected to the reservoir usually are drawn from the top, regardless of where the actual connection is. This symbol shows a line which returns fluid above the level in the reservoir.



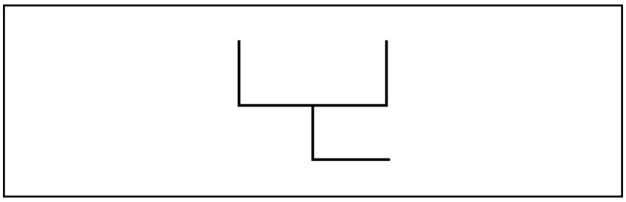
RCIL07CCH030AAA 3

If the hydraulic line returns fluid below the level in the reservoir, it is drawn all the way to the bottom of the symbol.



RCIL07CCH032AAA 4

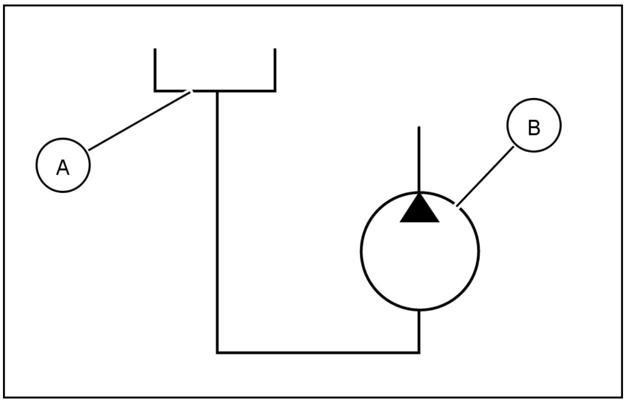
A hydraulic line connected to the bottom of the reservoir may be drawn from the bottom of the symbol if the bottom connection is essential to the systems operation.



RCIL07CCH033AAA 5

If the pump inlet **(B)** must be charged or flooded with fluid above the inlet port, the reservoir symbol **(A)** appears above the pump symbol, and the suction line is drawn out of the bottom of the reservoir symbol.

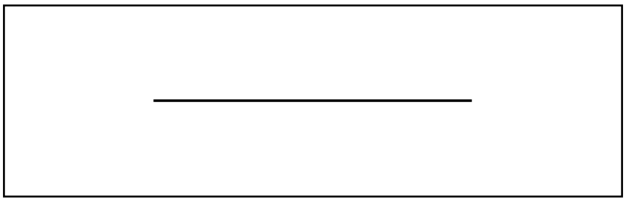
Every system reservoir has at least two hydraulic lines connected to it, and some may have many more. Often the components that are connected to the reservoir are spread all over the schematic. Rather than multiplying lines all over the schematic, individual reservoir symbols are drawn close to the components. The reservoir is usually the only component symbol pictured more than once on a diagram.




RCIL07CCH124AAA 6

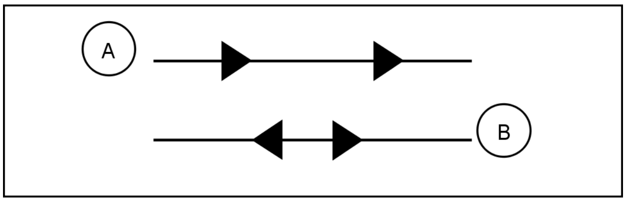
## Lines, tubes and hoses

A hydraulic line, tube, hose or any conductor that carries the fluid between components is shown as a line. A working line, such as an inlet pressure or return, is shown as a solid line.



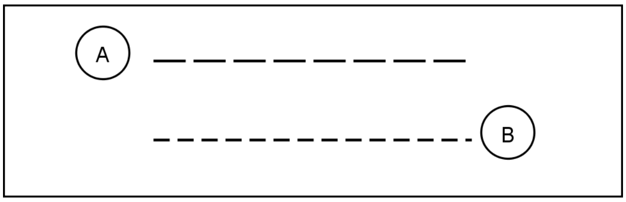
RCIL07CCH034AAA 7

Working lines with arrows show direction of flow. In the first example **(A)**, fluid flows in one direction only; in the second example **(B)**, fluid can flow in both directions.



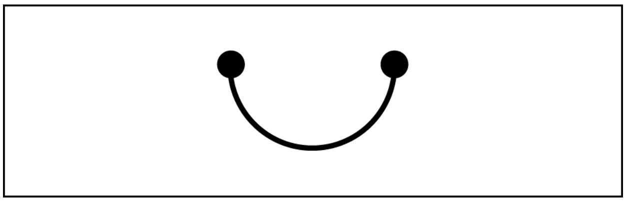

RCIL07CCH035AAA 8

Pilot or control lines **(A)** are broken into long dashes. Drain lines **(B)** for leakage oil are broken into short dashes.



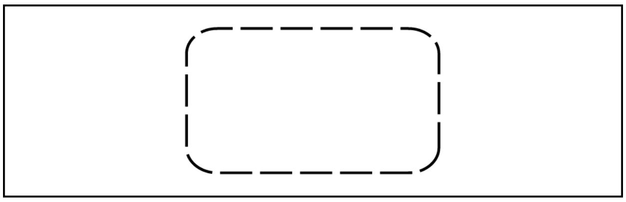

RCIL07CCH036AAA 9

A flexible line is shown as an arc between two dots and is always represented by a solid line.



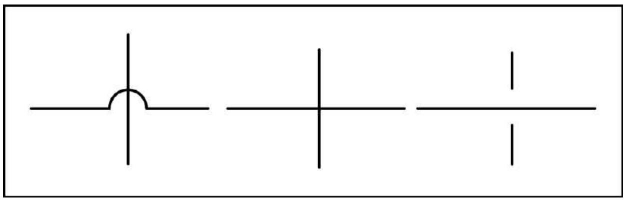
RCIL07CCH026AAA 10

An enclosure outline indicates that there are several symbols that make up a component assembly such as a valve or a valve stack. The enclosure outline is rectangular and is broken with dashes on all sides.



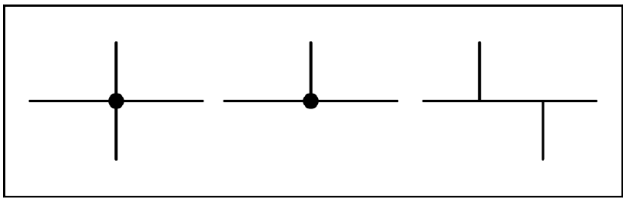
RCIL07CCH028AAA 11

Lines between components are drawn differently when they are crossing or connected. There are lines that cross other lines but are not connected. There are several ways to show crossing lines which are not connected.



RCIL07CCH038AAA 12

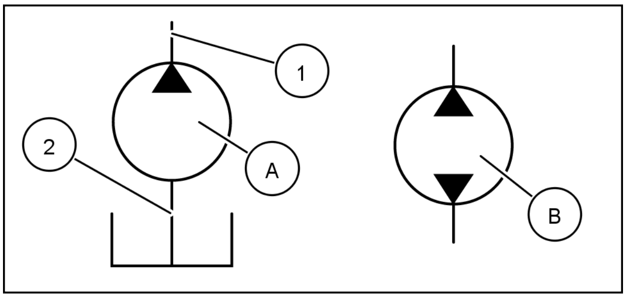
Lines that are connected are shown with a dot that represents the connection or shown as a tee connection. The dot connection is the most commonly used when drawing schematic diagrams.



RCIL07CCH047AAA 13

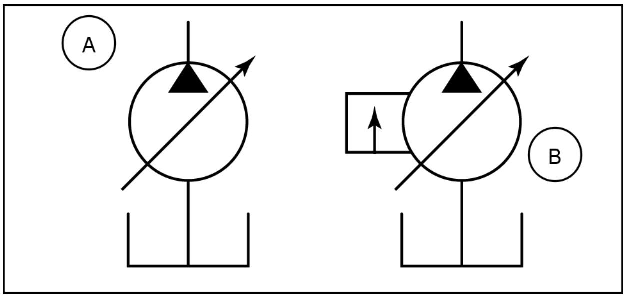
## Pumps

There are many basic pump designs. A simple fixed displacement pump **(A)** is shown as a circle with a solid arrow that pointing outward. The arrow points in the direction that the fluid flows. If the pump is reversible **(B)** or designed to pump in either direction, the symbol has two arrows which point in opposite directions. The pump normally has a pressure port and line **(1)** from which pressurized fluid is discharged and a suction port and line **(2)** into which fluid is drawn from the reservoir.



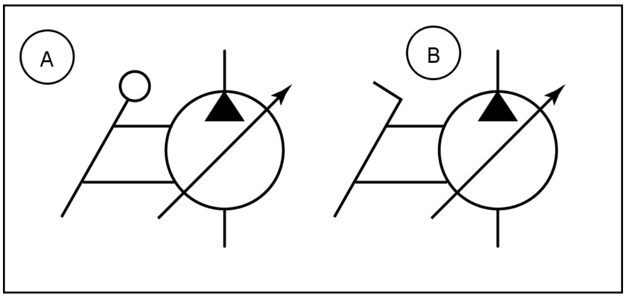

RCIL07CCH048AAA 14

A variable displacement pump **(A)** is shown by an arrow drawn through the pump symbol at a 45 degree angle. A variable displacement, pressure compensated pump **(B)** is shown by a small box with an arrow, added to the side of the pump symbol.



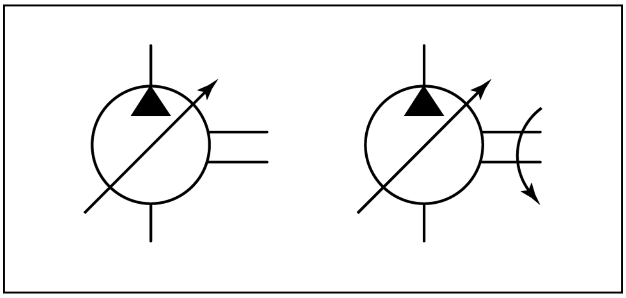

RCIL07CCH040AAA 15

If the pump is controlled by a lever **(A)** or a pedal **(B)**, the appropriate symbol is added to the side of the pump.




RCIL07CCH041AAA 16

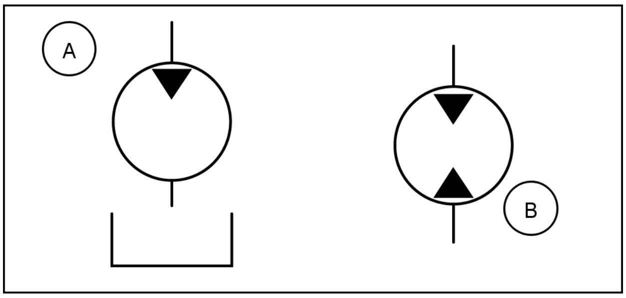
A drive shaft is shown as two short parallel lines extending from the side of the pump. A curved arrow, if present, on the drive shaft indicates the direction of rotation.



RCIL07CCH049AAA 17

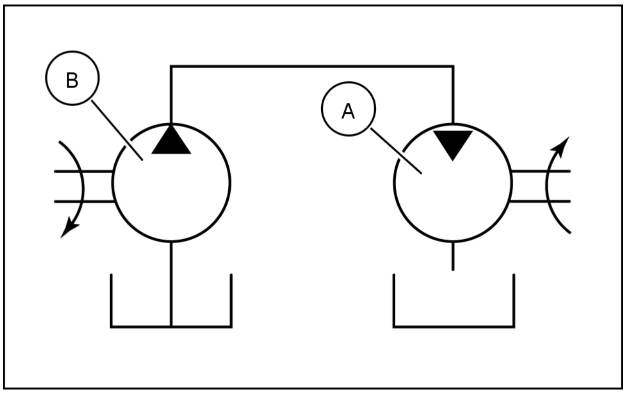
## Motors

Motor symbols are circles with solid black arrows, which point in the opposite direction of a pump's arrow, to show the motor as a receiver of fluid. One arrow is used for non-reversible motors **(A)**; and two arrows are used for reversible motors **(B)**.




RCIL07CCH051AAA 18

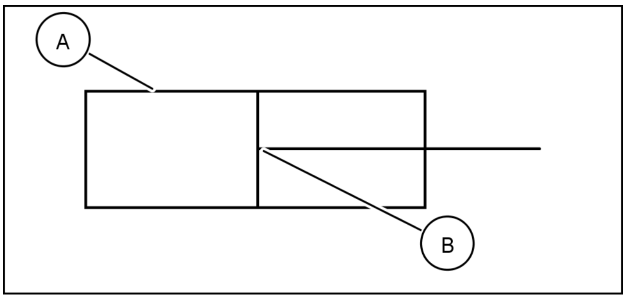
A simple schematic diagram is shown of a hydraulic motor **(A)** connected to a hydraulic pump **(B)**.




RCIL07CCH046AAA 19

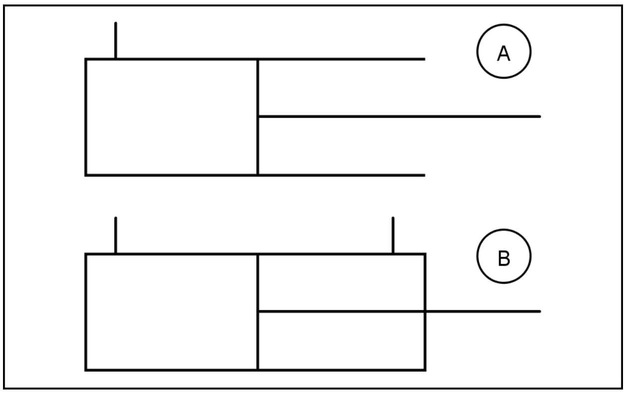
## Cylinders

A cylinder is a simple rectangle **(A)** representing the barrel. The piston and rod are represented by a tee **(B)**, inserted into the rectangle. The symbol can be drawn in any position.



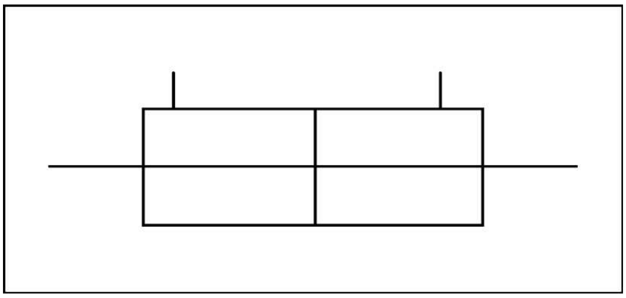

RCIL07CCH055AAA 20

If the cylinder is single-acting **(A)**, there is only one port shown on the end of the cylinder that receives pressurized fluid. The opposite end of the cylinder is left open. Both ends are closed on a double-acting cylinder **(B)**, and two ports are shown.



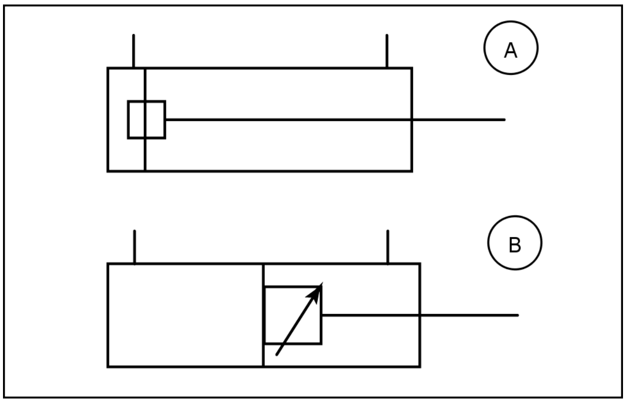

RCIL07CCH054AAA 21

A double rod end cylinder has a rod extending from each end of the rectangle.



RCIL07CCH057AAA 22

Some cylinders have cushions built into them. The cushion slows the movement of the piston as it nears the end of its stroke. Cylinder cushions are shown as a smaller rectangle **(A)** on the piston. If the cushion has an adjustable orifice, a slanted arrow is drawn at 45 degrees **(B)** across the symbol.

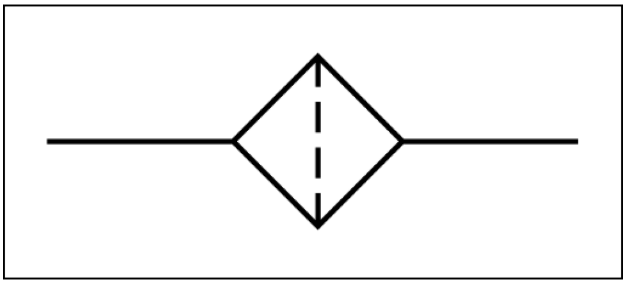



RCIL07CCH126AAA 23

## Accessories

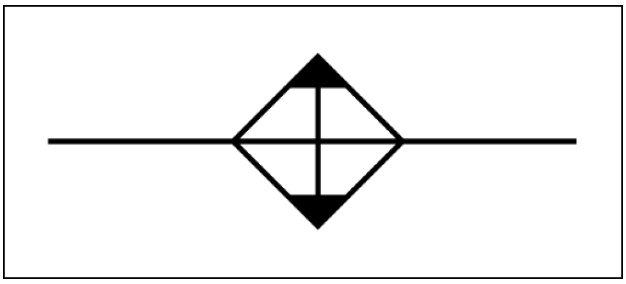
Filters, strainers and heat exchangers are represented as squares that are turned 45 degrees and have the port connections at the corners.

A dotted line perpendicular to the flow line represent a filter, strainer or screen.



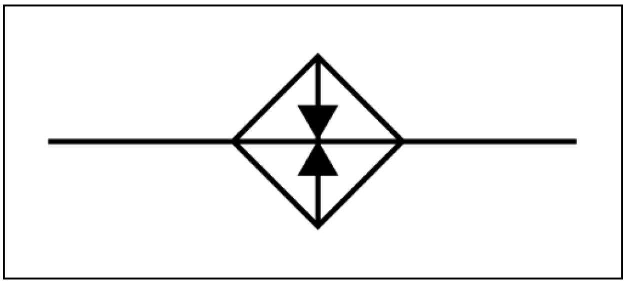
RCIL07CCH080AAA 24

A solid line perpendicular to the flow with solid arrows pointing outward represents a cooler.



RCIL07CCH081AAA 25

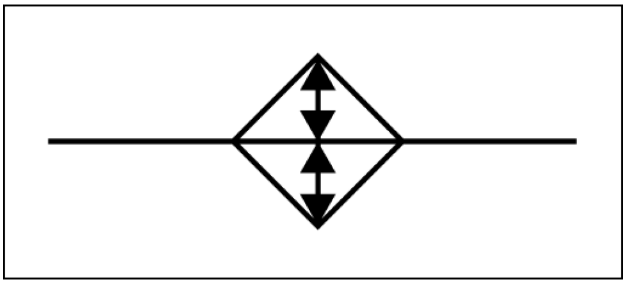
The symbol for a heater is like the symbol for a cooler, except the solid arrows point inward.



RCIL07CCH118AAA 26

Two sets of arrows pointing inward and outward represents a temperature control unit

The solid arrows point in the direction that heat is dissipated. Or in the case of the control unit, they show that heat can be regulated.

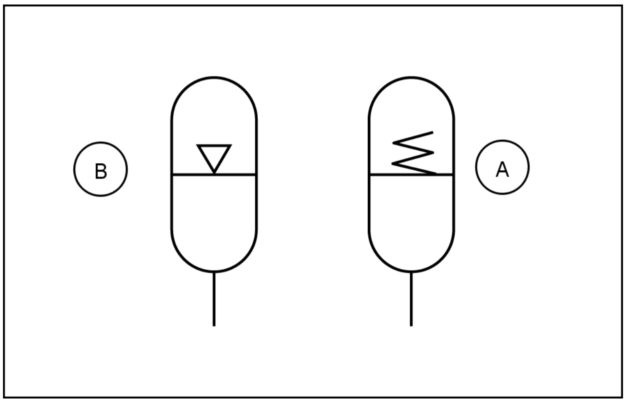


RCIL07CCH119AAA 27

An oval with details inside represents an accumulator. The details explain what type of accumulator it is: spring loaded **(A)**, gas charged **(B)**, or other features.

The divider line indicates there is a separator between the charge and the fluid. A hollow arrow indicates gas.

A spring indicates that the accumulator is spring-loaded.




RCIL07CCH130AAA 28

| | |
|---|---|
| Reference: | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Pressure control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Directional control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Composite (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Flow control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols (A.10.A)** |

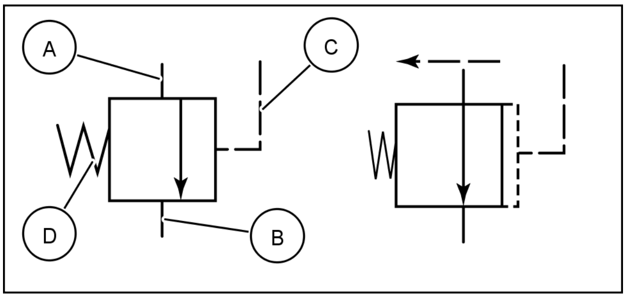
# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Pressure control

Magnum 180, Magnum 190, Magnum 210

The basic valve symbol is a square (which is called an envelope) with external port connections and an arrow inside to show the fluid passage and direction of flow. The valve usually operates by balancing fluid pressure against a spring, so a spring is shown on one side of the symbol and a pilot pressure line on the other side.

## Normally closed valve

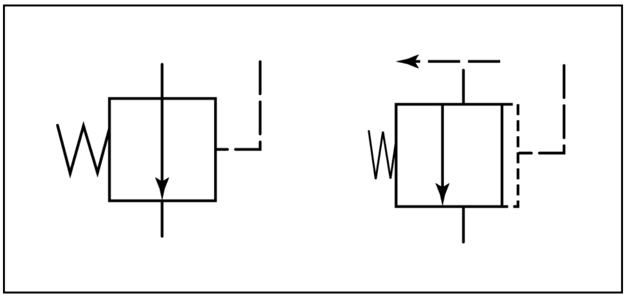
A normally closed valve, such as a relief or sequence valve, is shown with an arrow offset from the ports [inlet **(A)**, outlet **(B)**] toward the pilot pressure line **(C)** side of the square. The spring **(D)** holds the valve closed until the pilot line pressure is greater than the spring pressure. Mentally visualize a build up of pressure in the pilot line and the envelope moving over, compressing the spring. Fluid can now flow through the valve.




RCIL07CCH059AAA 1

## Normally open valve

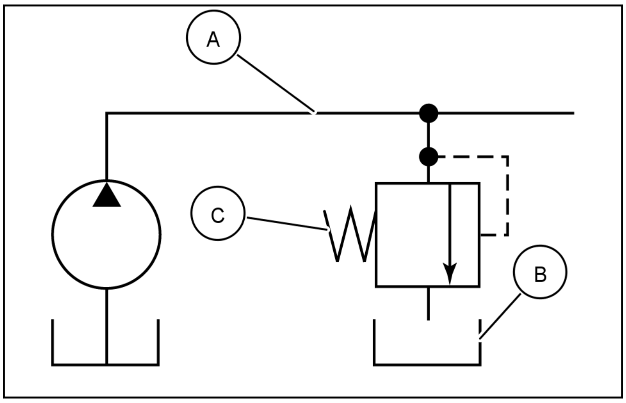
A normally open valve is shown with the arrow connecting the inlet and outlet ports. It closes when pressure overcomes spring force. Mentally visualize a build up of pressure in the pilot line and the envelope moving over, compressing the spring. Fluid flow through the valve is now blocked.



RCIL07CCH060AAA 2

## Relief valve

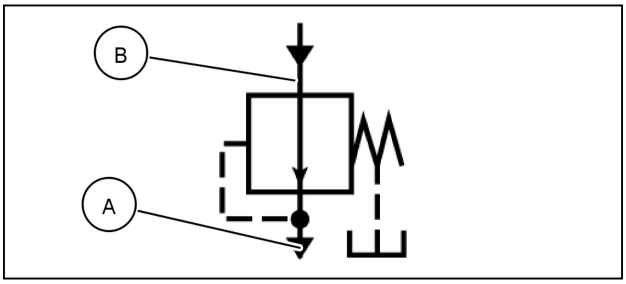
A relief valve is shown as a normally closed symbol connected between the pressure line **(A)** and the reservoir **(B)**. The flow direction arrow points away from the pressure line port and toward the reservoir. This graphically represents how a relief valve operates. When pressure in the system overcomes the valve spring **(C)**, flow is from the pressure line through the relief valve to the reservoir.




RCIL07CCH061AAA 3

## Pressure reducing valve

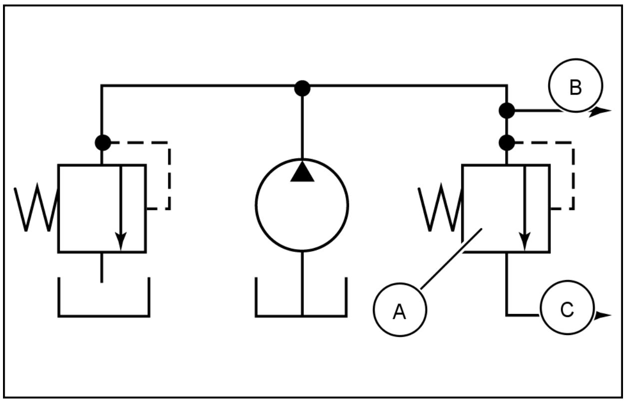
A pressure reducing valve is shown as a normally open symbol in a pressure line. This valve works opposite of a relief valve, since it senses outlet pressure **(A)** versus inlet pressure **(B)**. As the outlet pressure builds, it works against a predetermined spring force. As the spring force is overcome, flow through the valve is reduced or shut off.




RCIL07CCH063AAA 4

## Sequence valve

The normally closed symbol is also used for a sequence valve **(A)**. The inlet port is connected to a primary cylinder **(B)** and the outlet port to the secondary cylinder line **(C)**. When the piston in the primary cylinder reaches the end of its stroke, the pressure in the supply line increases. The sequence valve is also connected to the supply line and also feels the increase in pressure. As pressure increases, the envelope and directional flow arrow move over, connecting the inlet and outlet ports allowing fluid to flow to the secondary cylinder.




RCIL07CCH062AAA 5

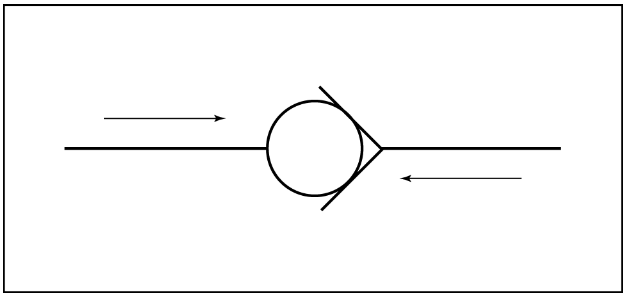
| | |
|---|---|
| Reference: | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Directional control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Composite (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Flow control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols (A.10.A)** |

# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Directional control

Magnum 180, Magnum 190, Magnum 210

## One way valve

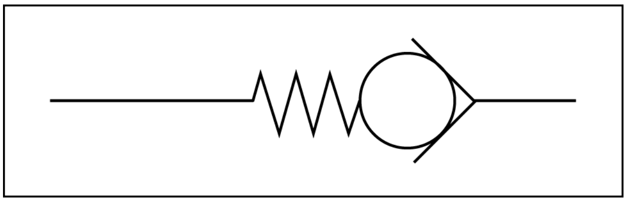
A simple ball check valve is shown. When fluid pressure is exerted on the left side of the ball, the ball is forced into the “V” and no fluid can flow though the valve. When fluid pressure is applied to the right side of the ball, the ball moves away from the “V” and fluid can flow through the valve.



RCIL07CCH066AAA 1

## Bypass valve

A bypass valve is shown as a one-way valve with a spring on the ball end of the symbol. Pressurized flow is necessary to overcome the spring force and allow flow around the ball.



RCIL07CCH067AAA 2

| | |
|---|---|
| Reference: | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Composite (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Flow control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols (A.10.A)** |

# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Composite

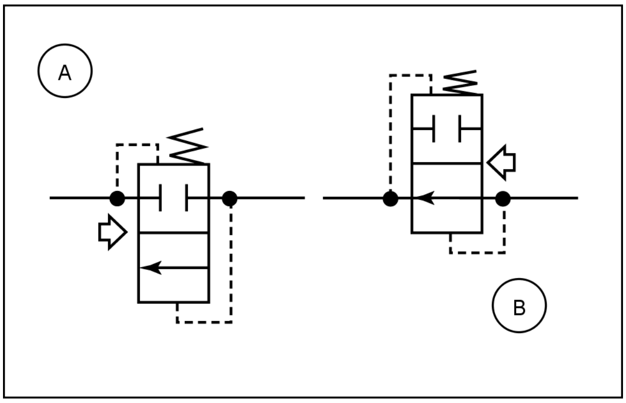
Magnum 180, Magnum 190, Magnum 210

## One way valve

A more complex one-way valve is shown. This directional control symbol uses multiple envelopes with a separate envelope for each valve position. Within each envelope, arrows show the flow paths when the valve is shifted to that position.

***NOTE:*** *All port connections are made to the envelope which shows the neutral condition of the valve.*

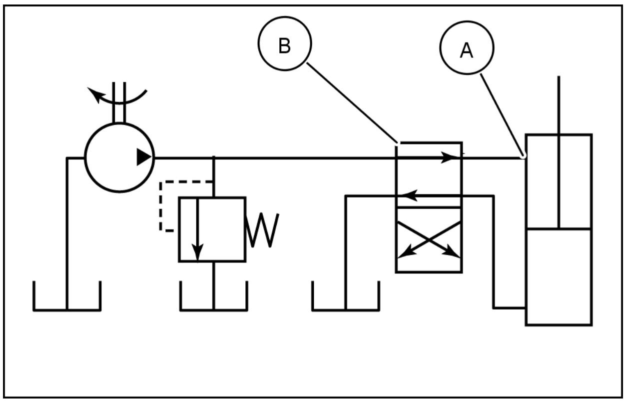
The left symbol **(A)** a one-way valve in the closed position. Mentally visualize a build up of pressure on the right side of the valve symbol **(B)** to enable free flow through the valve.




RCIL07CCH072AAA 1

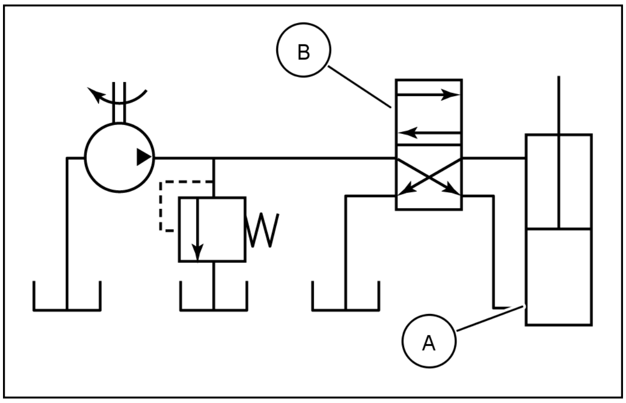
## Two position valve

Two envelopes (representing the spool) indicate a two position valve. Each envelopes shows the flow conditions for its position. This simple schematic shows fluid supplied to the rod end of the cylinder **(A)** from the control valve **(B)**. Return flow is from the piston end of the cylinder through the control valve to tank.




RCIL07CCH073AAA 2

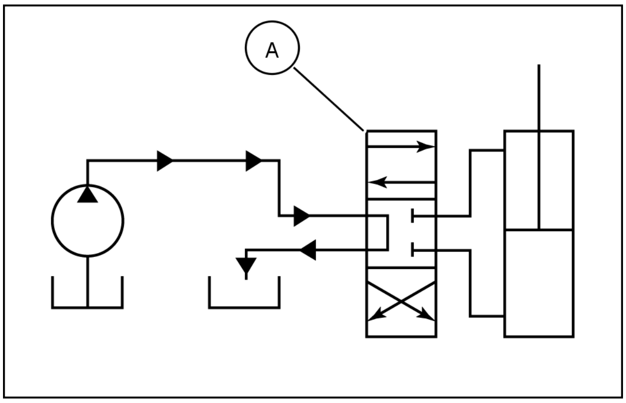
Mentally visualize the directional control valve shifted to the other position. Pressurized fluid is supplied to the piston end of the cylinder **(A)** from the control valve **(B)**, and return fluid flows from the rod end of the cylinder through the control valve to tank.



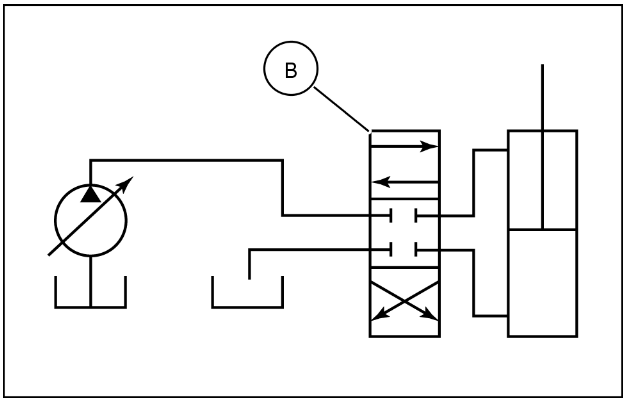

RCIL07CCH074AAA 3

## Three position valve

Three position valves have a centered (neutral) position. The centered position can be either open or closed to flow. The open center **(A)** is usually used with a fixed displacement pump, while the closed center **(B)** is usually used with a variable displacement pump.




RCIL07CCH068AAA 4

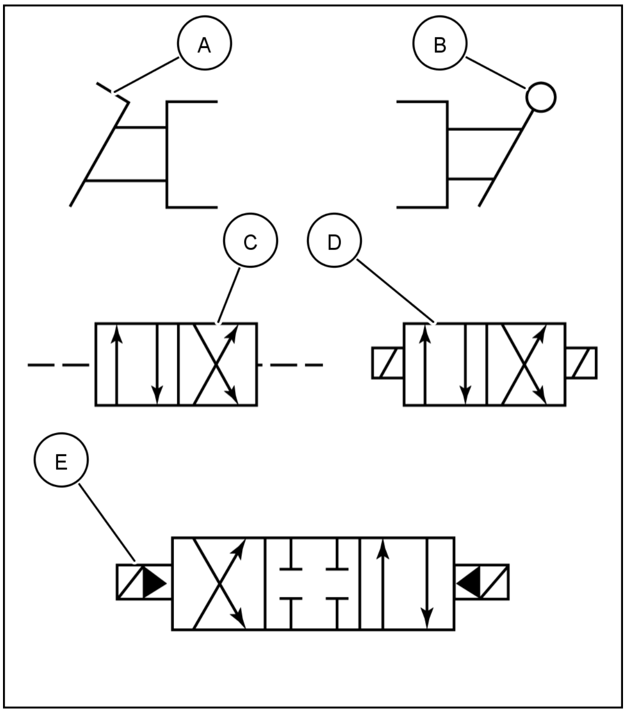



RCIL07CCH069AAA 5

## Actuating controls

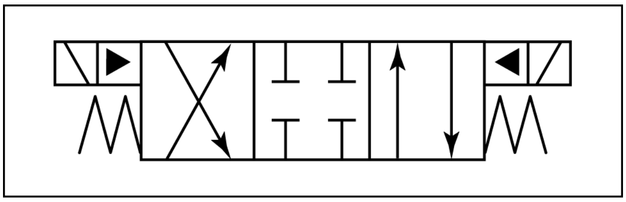
Valve spools are controlled by pedals **(A)**, levers **(B)**, pilot fluid **(C)**, electric solenoids **(D)**, etc., which are called actuating controls. These actuating controls are shown by symbols placed on the ends of the envelopes.

This symbol **(E)** is used when a solenoid is controlled with internal pilot assist pressure.




RCIL07CCH017BAA 6

To show that a valve is spring-centered, a spring symbol is placed at each end of the envelope. This symbol shows that a solenoid and pilot pressure assist are required to overcome spring force to move the valve spool.



RCIL07CCH070AAA 7

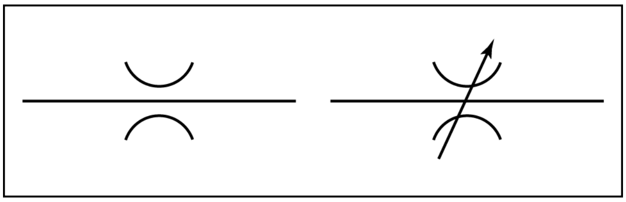
| | |
|---|---|
| Reference: | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Flow control (A.10.A)** |
| | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols (A.10.A)** |

# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Flow control

Magnum 180, Magnum 190, Magnum 210

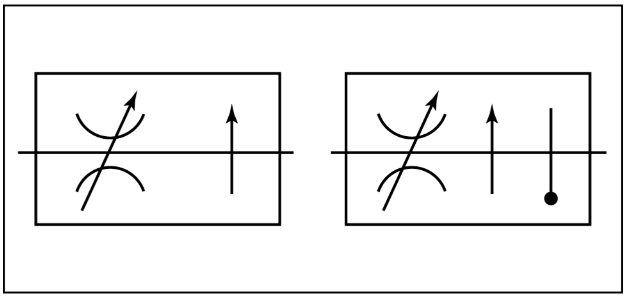
## Restrictors

The basic flow control symbol is a restrictor. If the restrictor is adjustable, a slanted arrow is drawn across the symbol. The restrictor could be a special fitting with a small hole in it or a small drilled passageway within a valve. An adjustable restrictor acts like a faucet: adjusting the restriction regulates flow. Restrictors are used to meter and bleed circuits.



RCIL07CCH075AAA 1

Adjustable restrictors can be pressure-compensated: the size of the opening in the restrictor changes with increases and decreases in pressure. A perpendicular arrow indicates pressure compensation. If the restrictor has both pressure and temperature compensation, the symbol for a thermometer is added.

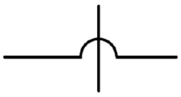
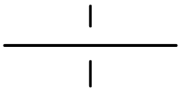
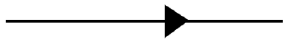
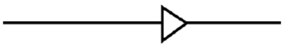
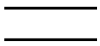
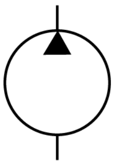
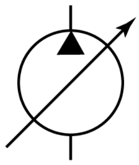
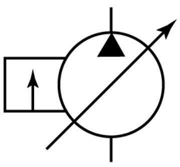
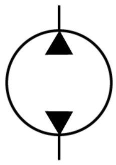
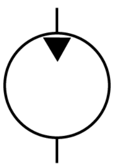
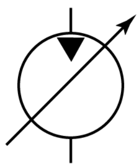


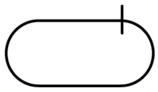
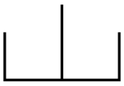
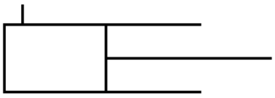
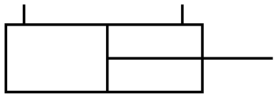
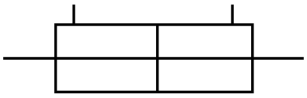
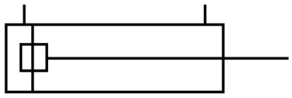
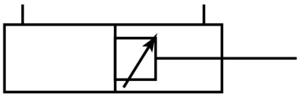
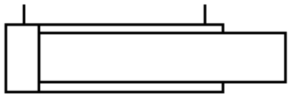
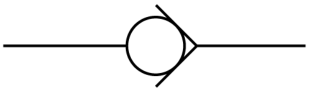
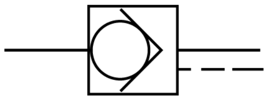
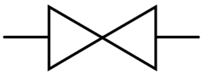
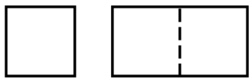
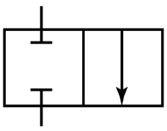
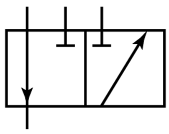
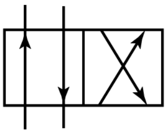
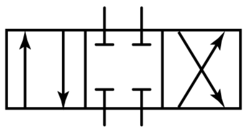
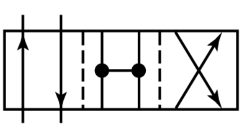
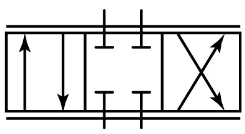
RCIL07CCH078AAA 2

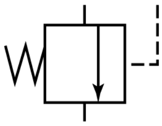
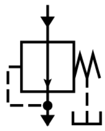
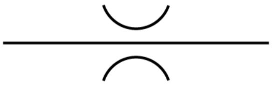
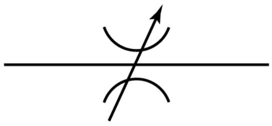
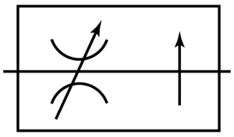
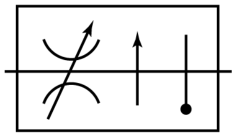
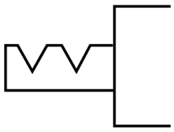
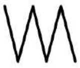
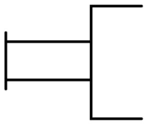
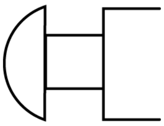
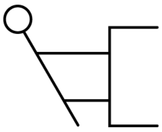
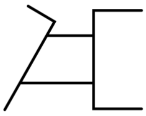
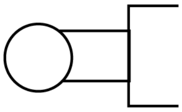
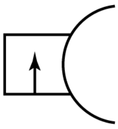
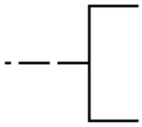
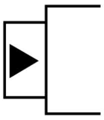
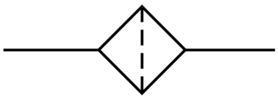
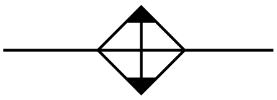
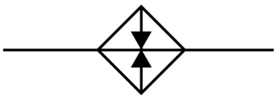
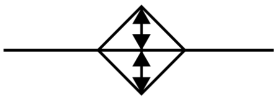
| Reference: | **PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols (A.10.A)** |
|---|---|

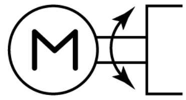
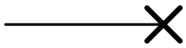
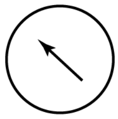
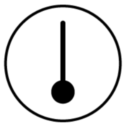
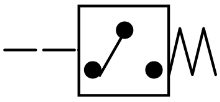
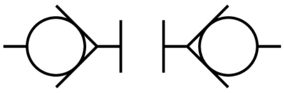
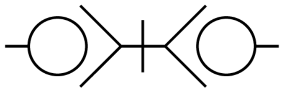
# PRIMARY HYDRAULIC POWER SYSTEM - Hydraulic symbol - Table of symbols

Magnum 180, Magnum 190, Magnum 210

| | | | |
|---|---|---|---|
| **Line and line functions** | | | |
| Solid line - main line |  | Dotted line - exhaust or drain line |  |
| Dashed line - pilot line |  | Enclosure outline |  |
| Lines crossing |  | Lines joining |  |
| Lines crossing |  | Liquid direction of flow |  |
| Gaseous direction of flow |  | Flexible line |  |
| **Mechanical devices** | | | |
| Connections (two parallel lines) for shafts, levers, etc. |  | Variable component (arrow intersects symbol at **45 °**) |  |
| Spring |  | | |
| **Pumps and motors** | | | |
| Pump, fixed displacement |  | Pump, variable displacement |  |
| Pressure compensated, variable displacement pump |  | Fixed displacement pump (bidirectional flow) |  |
| Motor, fixed displacement |  | Motor, variable displacement |  |

| | | | |
|---|---|---|---|
| Oscillator |  | | |
| **Reservoirs** | | | |
| Reservoir, open to atmosphere |  | Pressurized reservoir |  |
| Return line to reservoir below fluid level |  | Return line to reservoir above fluid level |  |
| **Cylinders** | | | |
| Single acting |  | Double acting, single rod end |  |
| Double acting. double rod end |  | Single rod end, fixed cushion both ends |  |
| Single rod end, adjustable cushion, rod end only |  | Differential cylinder |  |
| **Valves** | | | |
| Check valve |  | Pilot-operated check valve |  |
| On/Off manual shut off valve |  | Regulating or selector valves |  |
| 2 position, 2 way valve |  | 2 position, 3 way valve |  |
| 2 position, 4 way valve |  | 3 position, 4 way valve |  |
| 2 position, 4 way open center, crossover valve |  | Valve capable of infinite positioning (indicated by horizontal lines parallel to the envelope) |  |

| | | | |
|---|---|---|---|
| Pressure relief valve |  | Pressure reducing valve |  |
| Non-adjustable restrictor valve |  | Adjustable restrictor valve |  |
| Adjustable restrictor, pressure compensated |  | Adjustable restrictor, temperature and pressure compensated |  |
| **Valve actuators** | | | |
| Solenoid |  | Detent |  |
| Spring |  | Manual |  |
| Push button |  | Lever |  |
| Pedal |  | Mechanical |  |
| Pressure compensated |  | Pilot pressure, remote supply |  |
| Liquid supply |  | | |
| **Accessories** | | | |
| Filter |  | Cooler |  |
| Heater |  | Temperature controller |  |

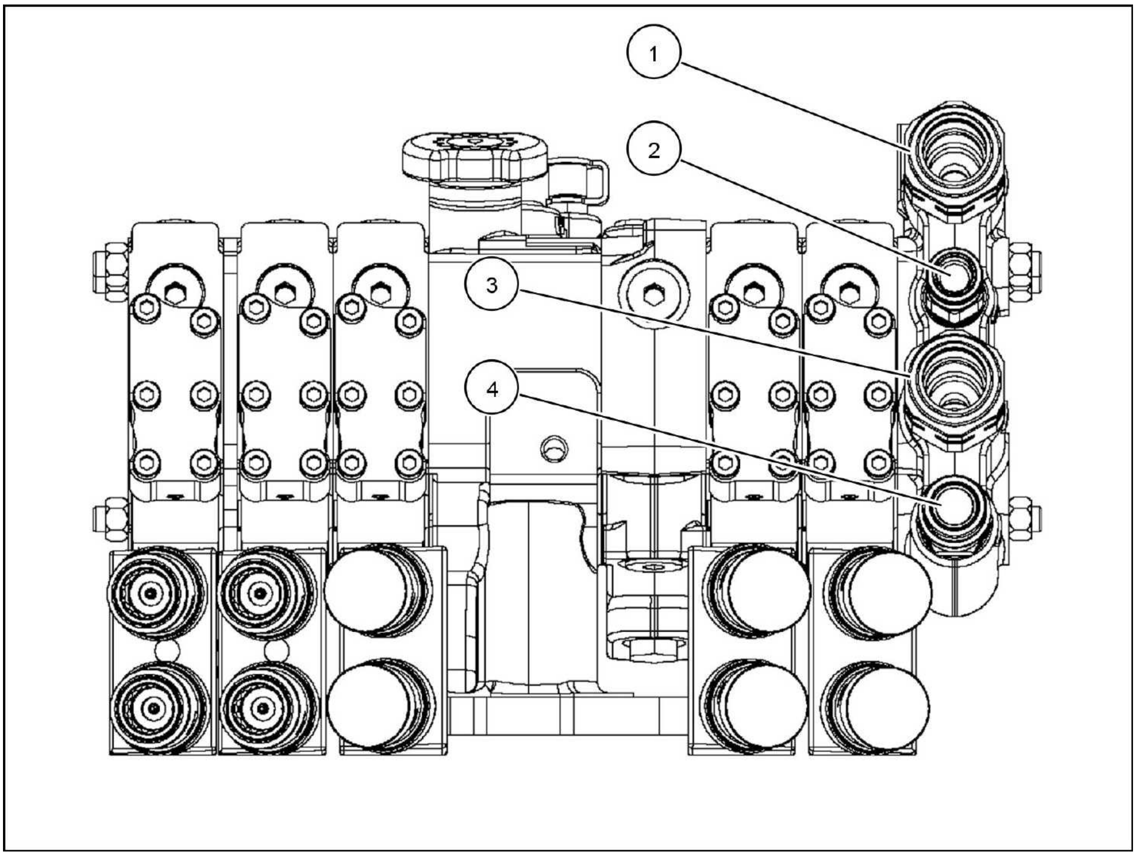
| | | | |
|---|---|---|---|
| Accumulator (hydro-pneumatic |  | Reversing motor | <br> |
| Station or test point |  | Pressure indicator |  |
| Temperature indicator |  | Pressure switch |  |
| Quick disconnect (disconnected) |  | Quick disconnect (connected) |  |

# Power beyond - Component identification

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

The power beyond is used for implements or attachments requiring continuous or high oil flow. The implement or attachment must be equipped with a closed center hydraulic valve system that will, through a sensing line, control oil flow from the tractor PFC piston pump.

The maximum flow available through the ISO supply port will depend on the output from the tractor PFC piston pump.

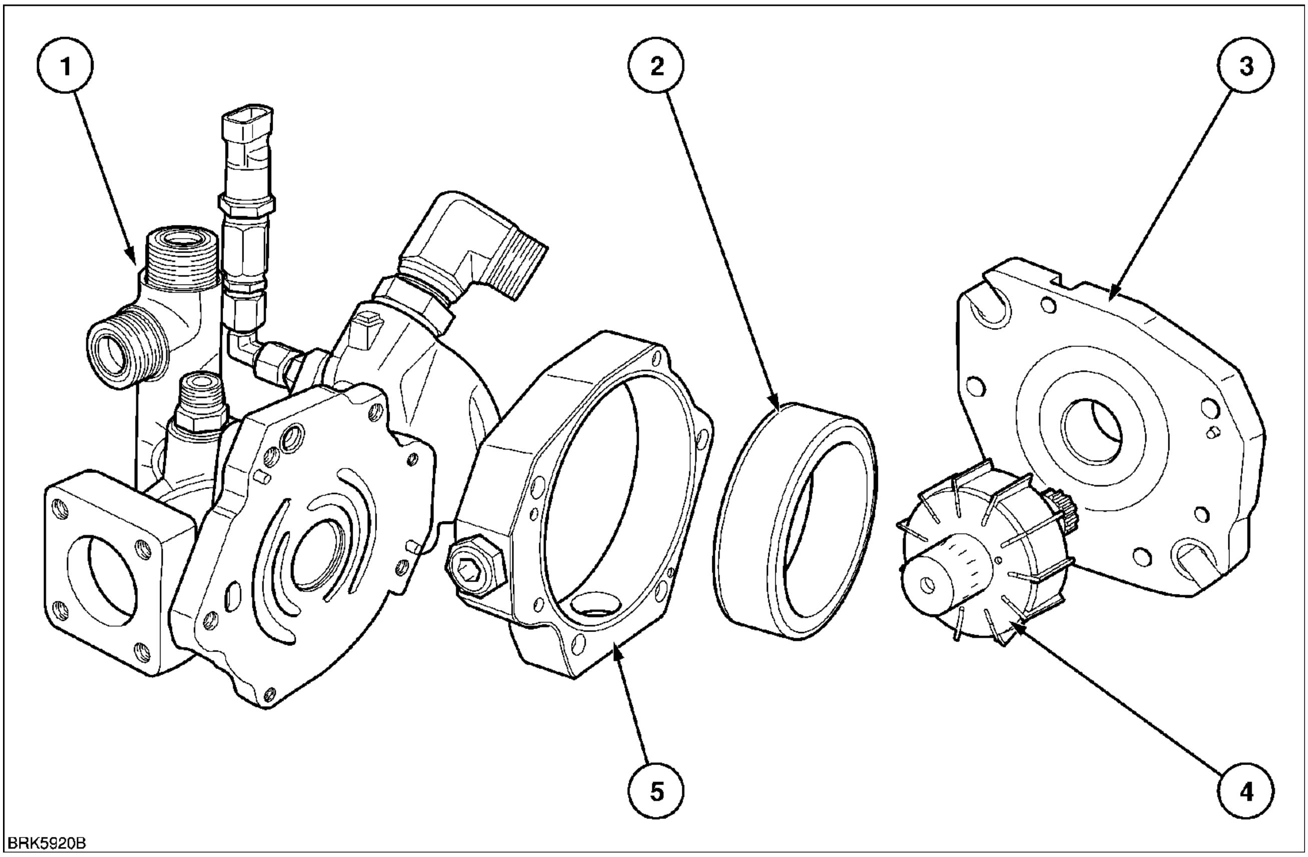



RCIL08CCH002GAE 1

| | |
|---|---|
| 1. Supply port | 3. Return port |
| 2. Load sense port | 4. Drain port |

# Hydraulic pump - Component identification - Vane pump

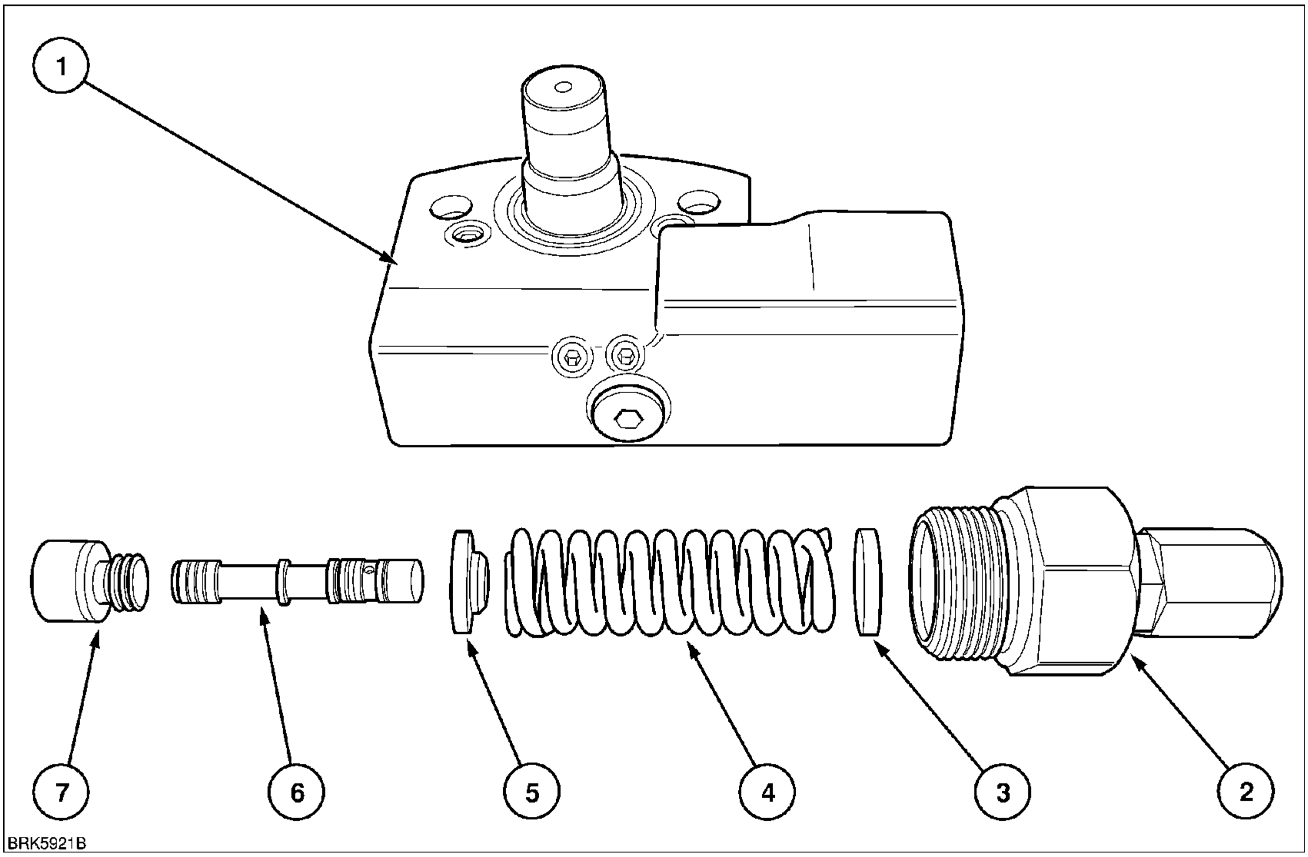
Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission




BAIL08CVT089FSA 1

**Vane pump components**

1. Valve body
2. Stator ring
3. Retaining plate
4. Rotor and vanes
5. Housing




BAIL08CVT090ASA 2

**Pressure controller components**

1.Pressure controller manifold
2.Pressure controller adjuster
3.Retainer
4.Spring
5.Retainer
6.Control spool
7.Plug

# Hydraulic pump - Dynamic description - Vane pump

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

The vane pump is directly driven by an intermediate gear connected to the PTO shaft. The pump consists of the following components; see **Hydraulic pump - Component identification - Vane pump (A.10.A)** for illustrated views:

- Housing
- End plate
- Rotor
- Vanes
- Stator ring
- Control valve and stroking piston
- Filter

## Prestart

The stator ring is held in the full demand position by the stroking piston spring. This ensures that pumping occurs immediately at start up. The control valve is also held in the full demand position by the pressure control spring.

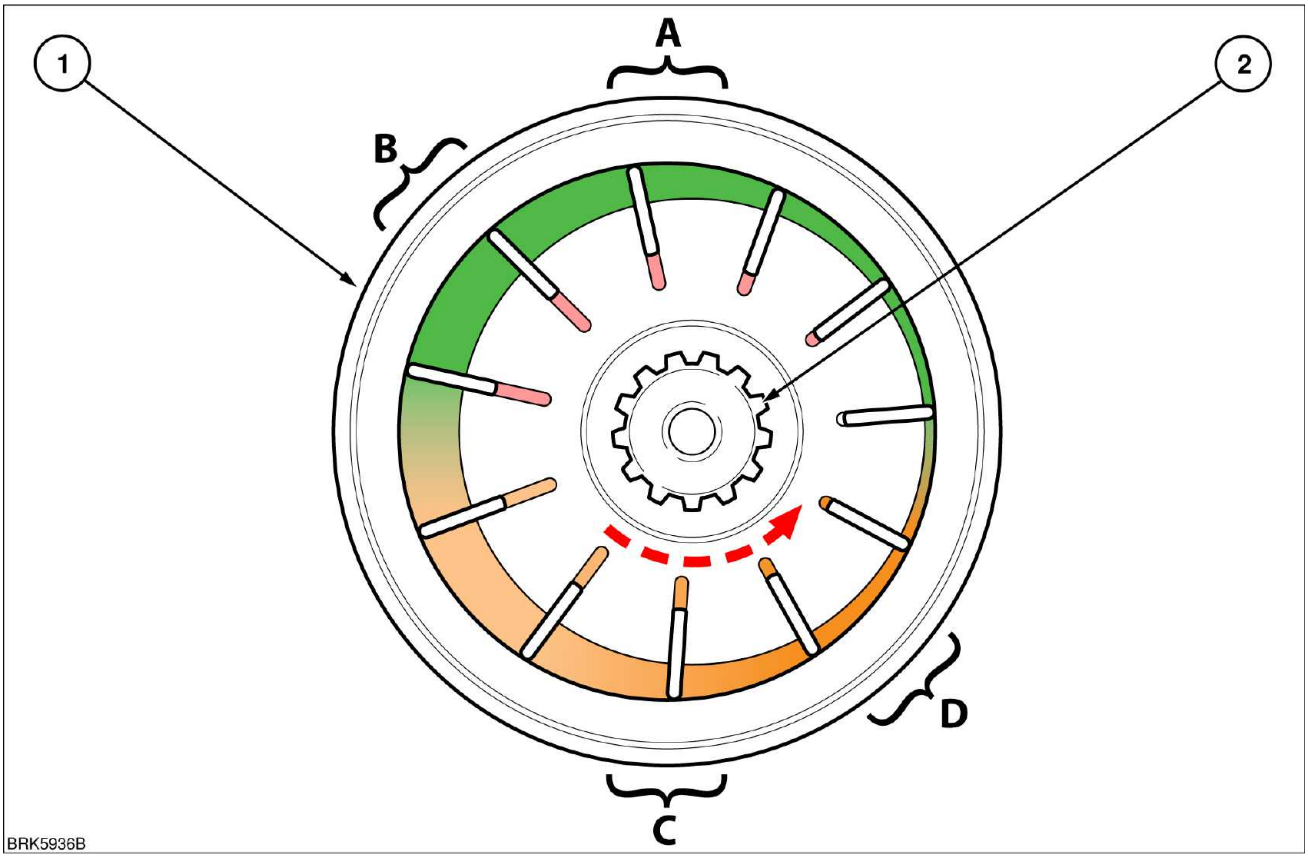
## Start up

1. The engine is cranked and the PTO shaft and pump drive begin to rotate. All three pumps (charge, PFC and vane) turn on the shaft.
2. Although the vane pump rotor turns, it does not pump until the vanes are fully extended against the stator ring.
3. Pressure increases from the charge pump via the V port and the pump gallery, and this pressure acts upon the back of the vanes forcing them outwards.
4. From the suction gallery to the bottom of the pump rotor the pumping volume increases and fluid is drawn into the pumping chambers. At this position the V gallery also ends and the vanes are now fed from the output pressure gallery Pv.
5. From the bottom of the pump to the top, the pumping volume decreases and the oil exits the gallery through port P.
6. From the main output of the pump, fluid is delivered through the pressure filter to the low pressure circuits. Prior to the filter is a filter/system protection valve. After the filter, oil pressure is also fed via the control valve to the stroking piston to assist the spring on the stator ring.

## Pump on demand

When on demand, the pressure created by the pump output flow is diverted to the control valve. The oil pressure passes through the control valve and on to the stroking piston. This assists the stroking spring to keep the pump on full demand/flow.

## Pressure variations within the pumping chamber.




BAIL08CVT100FSA 1

| | | |
|---|---|---|
| (green) | Suction | 1.Stator ring |
| (orange) | Low pressure. | 2.Rotor drive shaft |
| (pink) | Control pressure | |

The rotor is on a fixed axis and continually rotates if the engine is operating. The stator ring has a linear movement from top to bottom. During pumping the pressure at **(C)** compared to **(A)** and also **(D)** compared to **(B)** is higher. Therefore the stator ring is forced right and down against the thrust pin and piston, destroking the pump.

As the output pressure increases so does the stroking pressure to a point where the control valve spring is overcome. This becomes the regulated pressure.

## Pump off demand

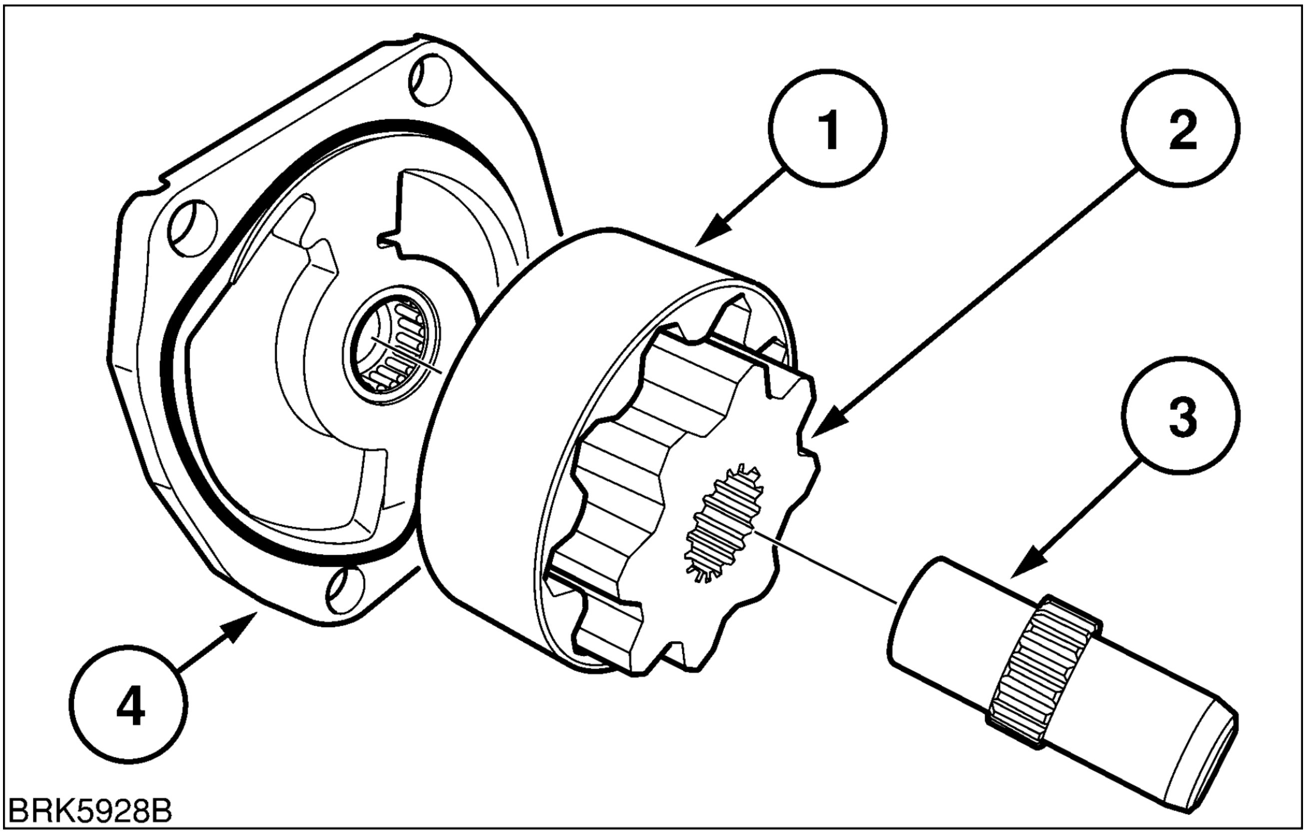
As the pump delivers flow and self strokes to on demand, the pressure continues to increase to the point where regulated pressure is reached. This point is determined by the rating of the control valve spring acting on the control valve spool. When regulated pressure is reached, the spool moves towards the spring, and restricts the flow being delivered to the stroking piston. This also allows the fluid in this part of the circuit to be vented to the suction side of the pump.

## Pump regulating

The pump is self regulating and fluctuates between on and off demand to deliver flow and a constant regulated pressure.

# Charge pump - Exploded view

Magnum 225 [ZARH06086 - ], Magnum 180, Magnum 190, Magnum 210

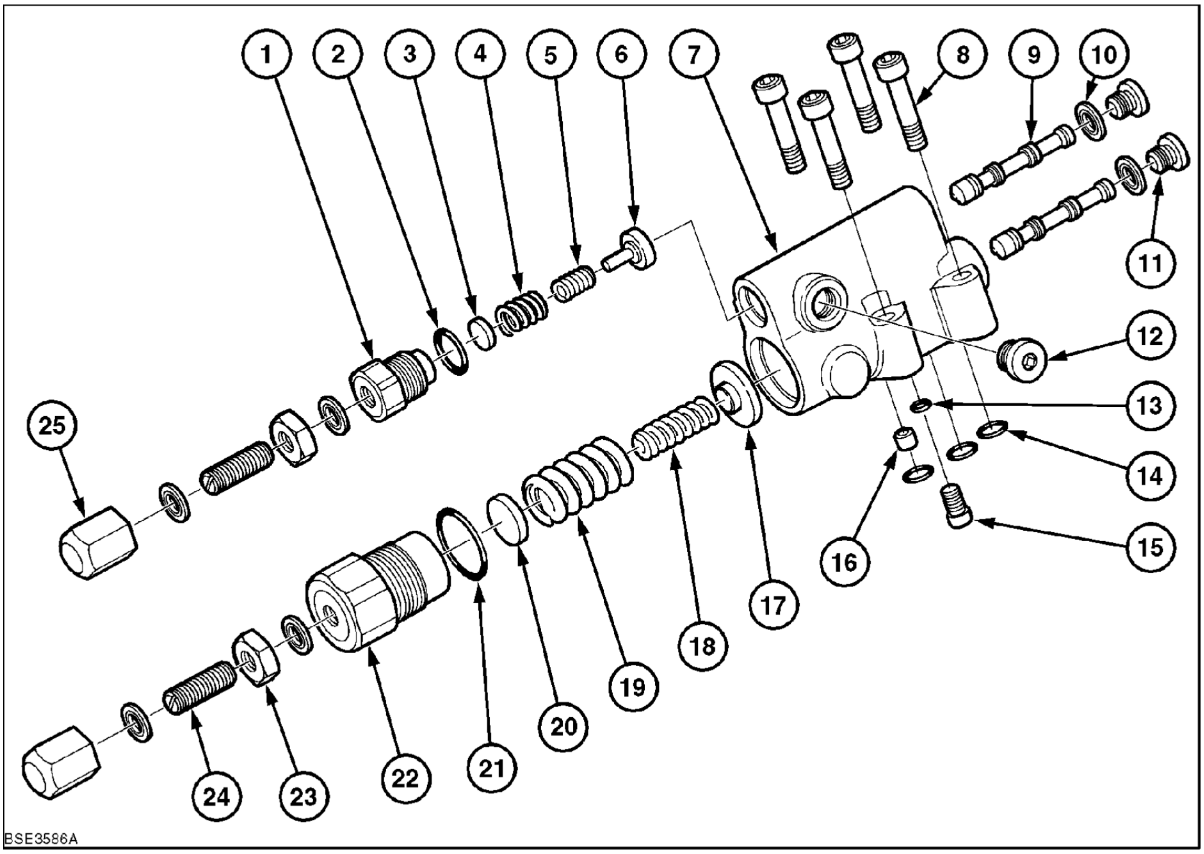



BAIL08CVT102ASA 1

1. Rotor housing
2. Rotor
3. Rotor shaft
4. End plate

# Compensator - Exploded view

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210




BSE3586A_454 1

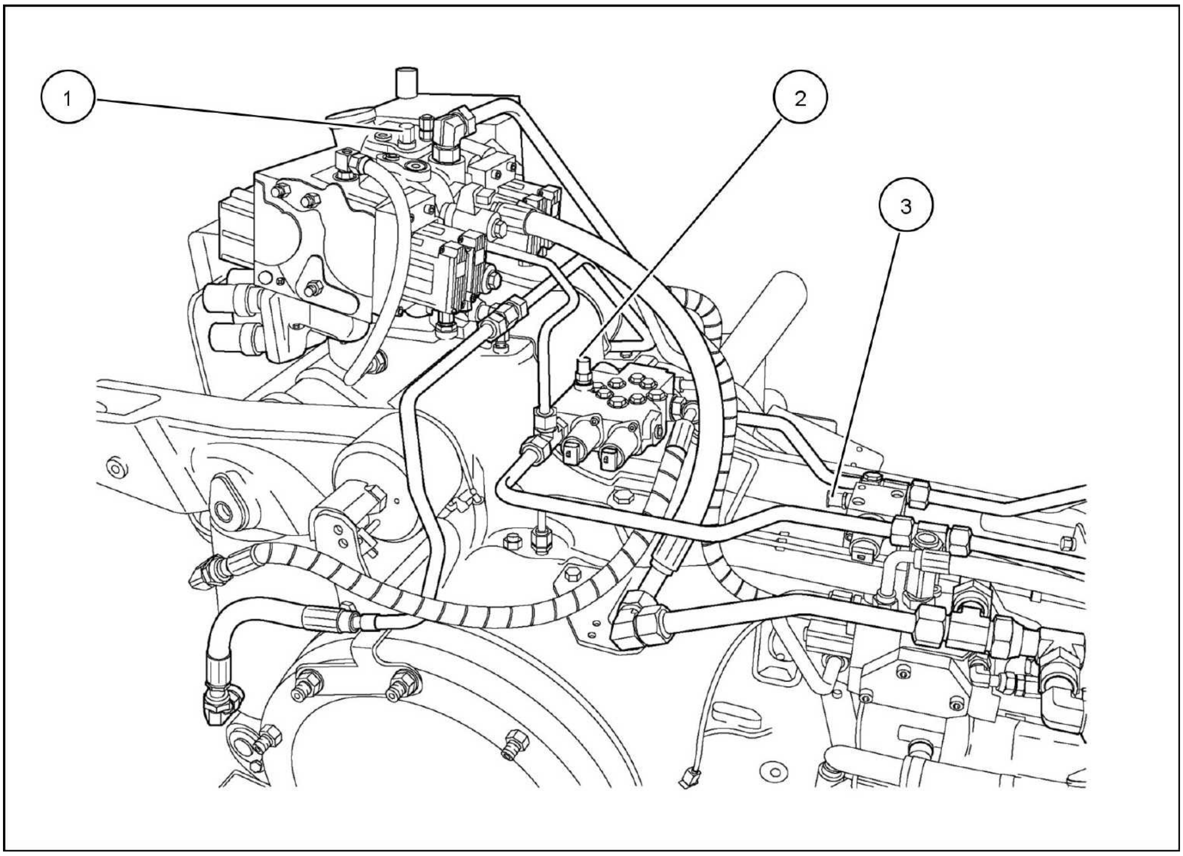
**Flow and pressure compensating valves**

| | | | |
|---|---|---|---|
| 1. Plug | 8. Screw | 15. Damper screw | 22. Plug |
| 2. Seal | 9. Spool | 16. Nozzle | 23. Nut |
| 3. Disc | 10. Seal | 17. Seat | 24. Adjusting screw |
| 4. Spring | 11. Plug | 18. Spring | 25. Cap |
| 5. Spring | 12. Plug | 19. Spring | |
| 6. Seat | 13. Seal | 20. Disc | |
| 7. Housing | 14. Seal | 21. Seal | |

# Diagnostic connector - Component identification

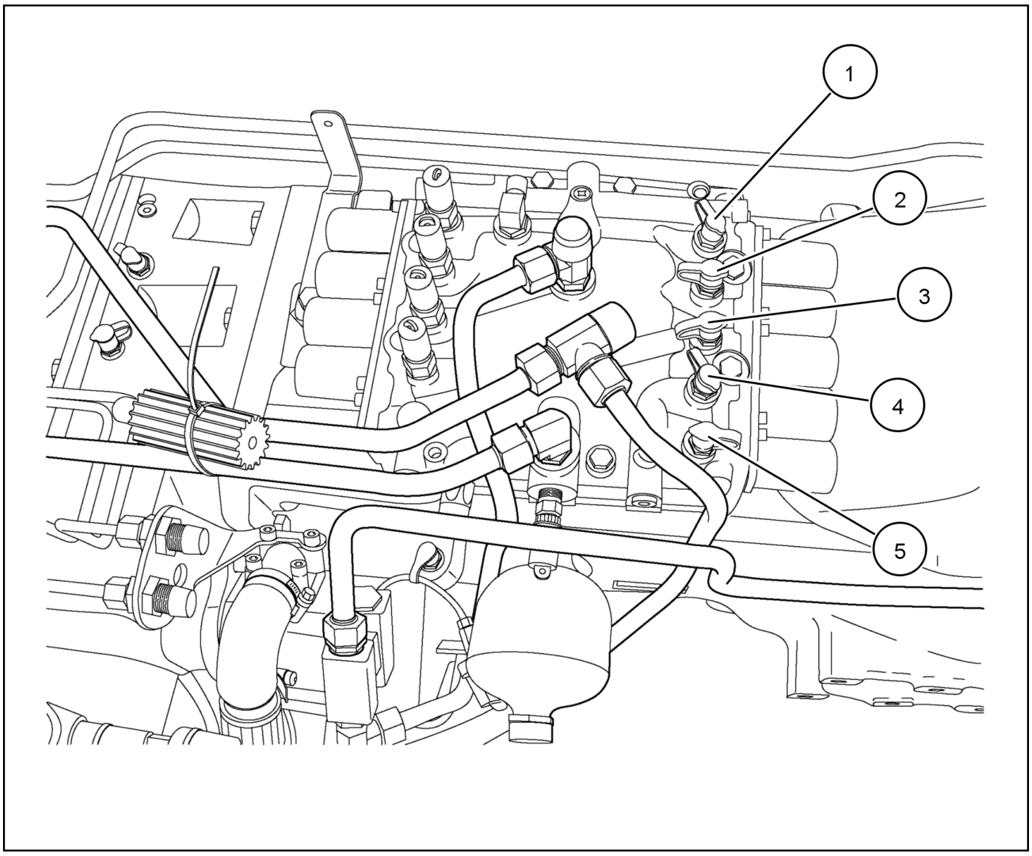
Magnum 180, Magnum 190, Magnum 210

The tractor hydraulic system is equipped with up to twelve diagnostic couplers.



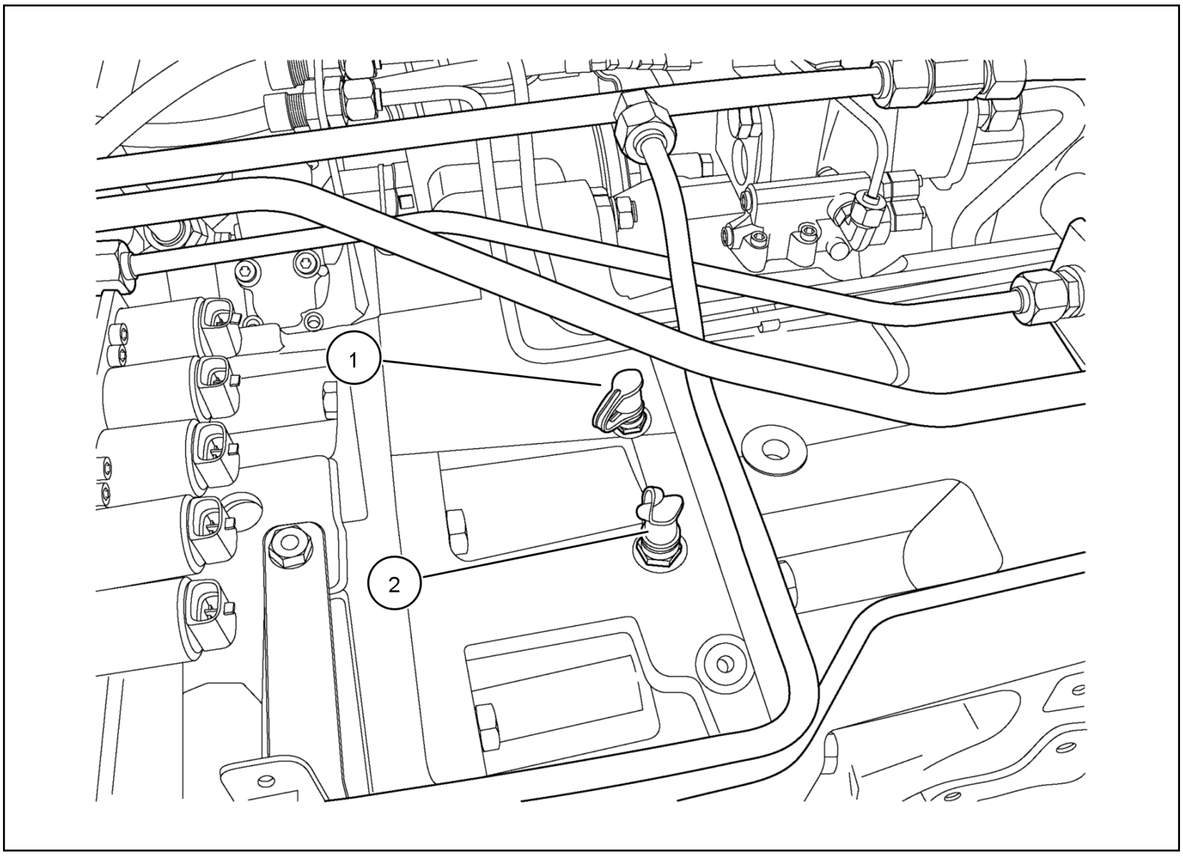

RCPH09CCH002FAE 1

| | |
|---|---|
| 1. Signal line pressure | 3. 19th gear/ **50 km/h** (**30 mph**)clutch pressure |
| 2. PTO clutch pressure | |



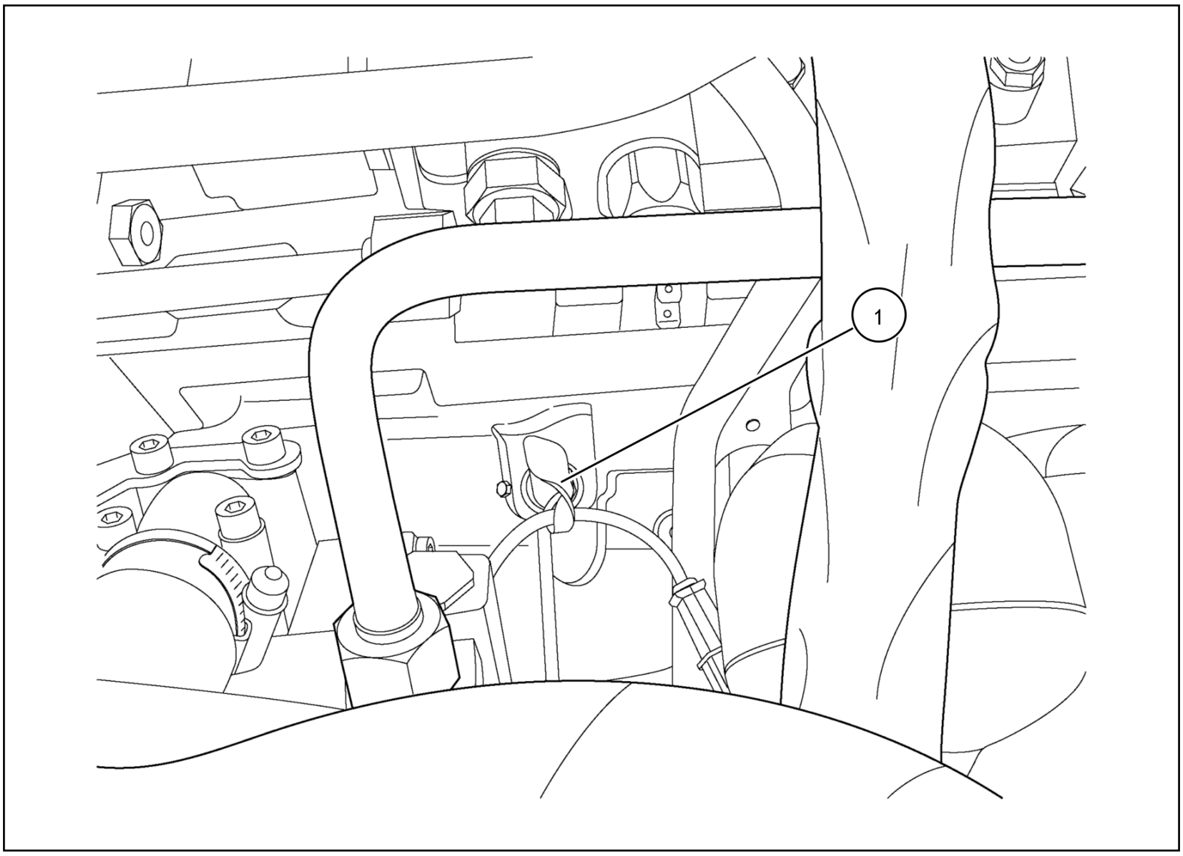

RCPH09CCH015FAE 2

| | |
|---|---|
| 1. "A" clutch pressure | 4. "D" clutch pressure |
| 2. "B" clutch pressure | 5. "E" clutch pressure |
| 3. "C" clutch pressure | |



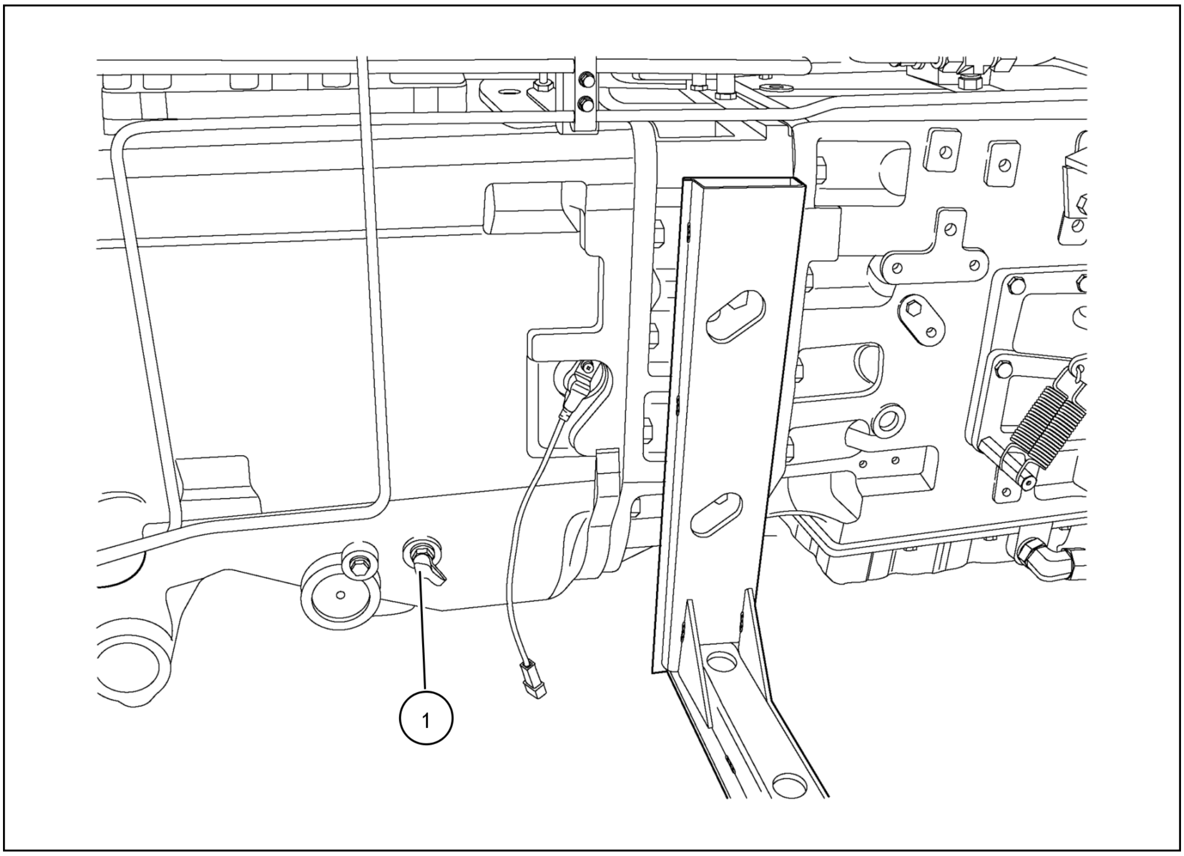

RCPH09CCH007FAE 3

| | |
|---|---|
| 1. Slow range clutch pressure | 2. Fast range clutch pressure |




RCPH09CCH005FAE 4

| |
|---|
| 1. Reverse clutch pressure (right side near steering pump) |

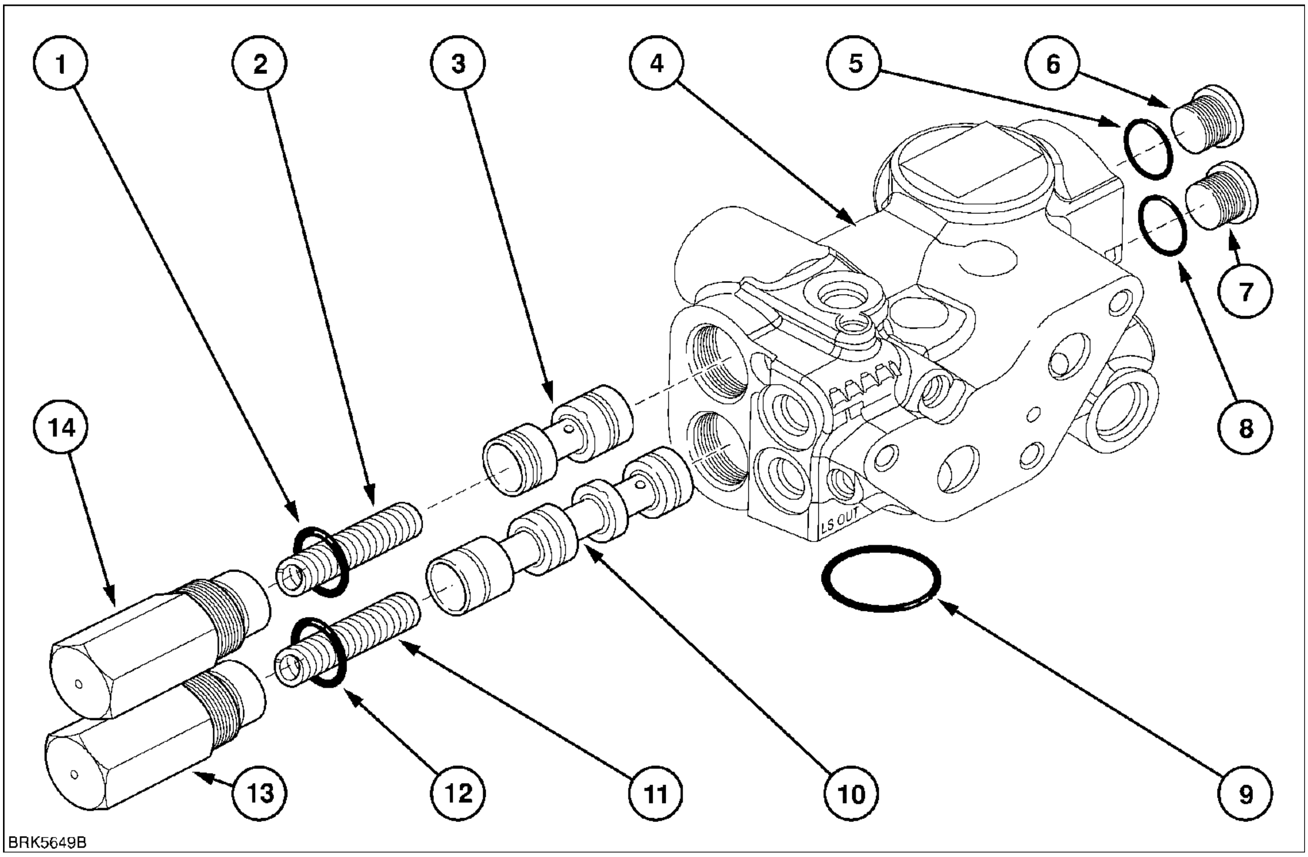



RCPH09CCH004FAE 5

| | |
|---|---|
| 1. | Medium range clutch pressure |

# Control valve - Exploded view - Priority valve

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

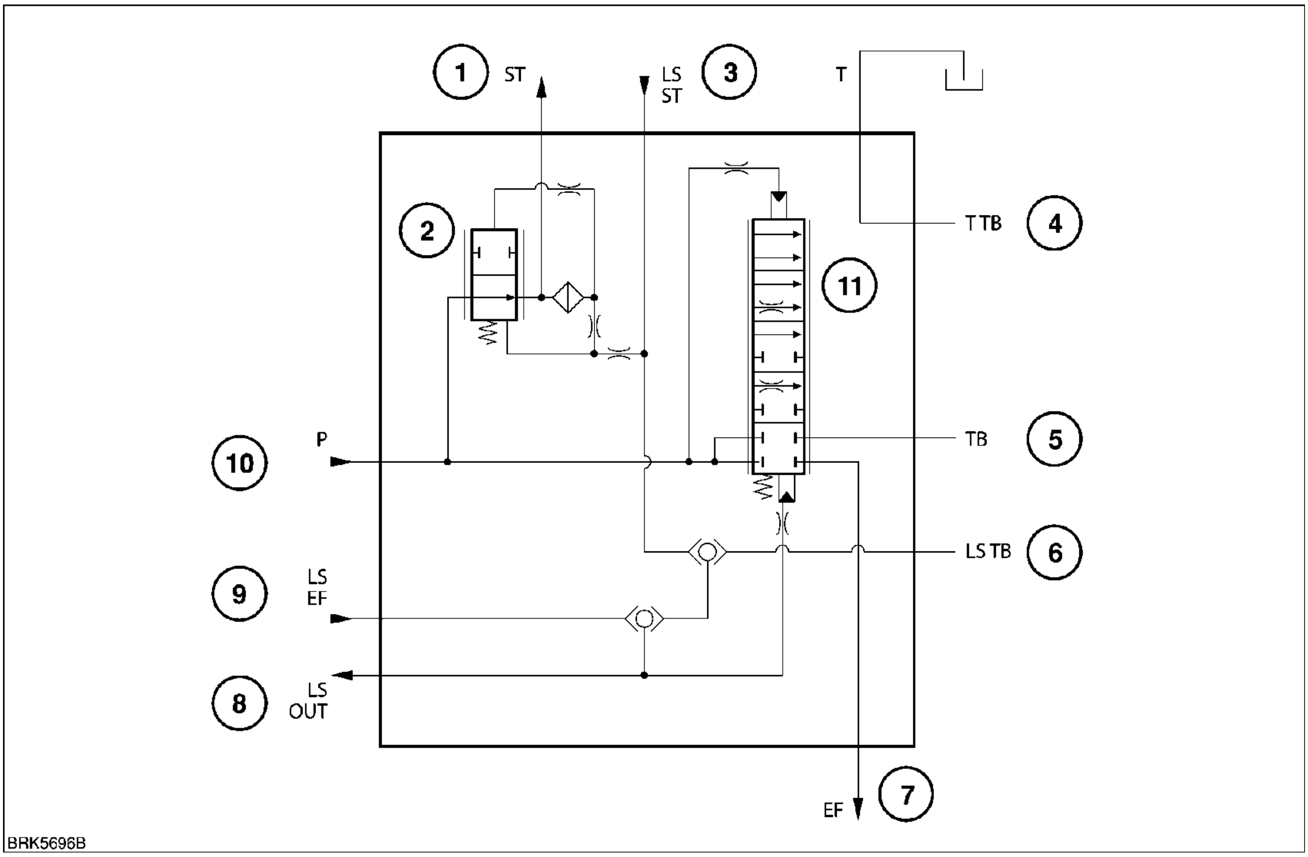



BAIL08CVT086FSA 1

| | | |
|---|---|---|
| 1. Seal | 6. Plug | 11. Spring |
| 2. Spring | 7. Plug | 12. Seal |
| 3. Steering priority spool | 8. Seal | 13. Cap |
| 4. Manifold body | 9. Seal | 14. Cap |
| 5. Seal | 10. Trailer brake priority valve spool | |

# Control valve - Hydraulic schema - Priority valve

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

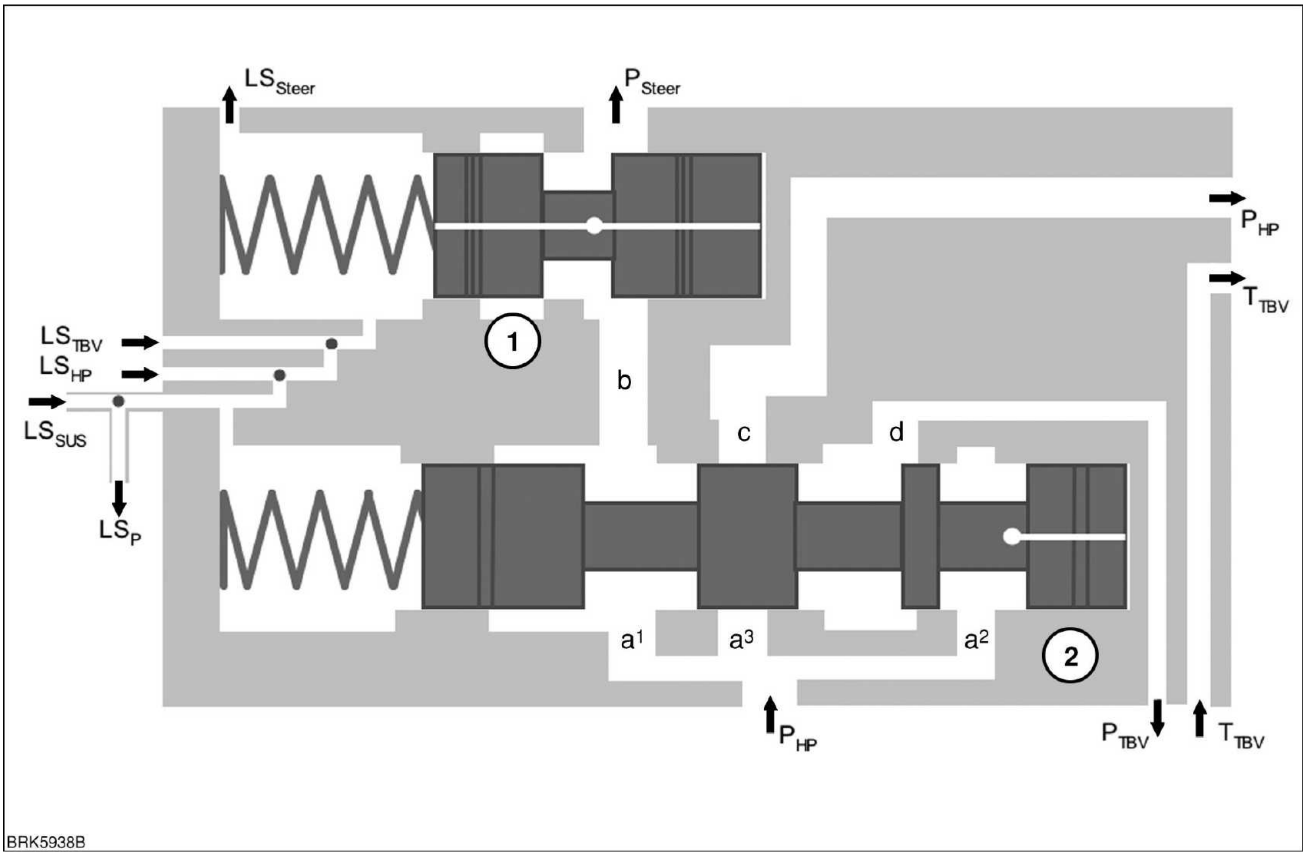



BAIL08CVT139FSA 1

1. Steering system line
2. Steering priority valve
3. Load sense line to steering
4. Trailer brake return to tank
5. Trailer brake pressure
6. Trailer brake load sensing line
7. Pressure to Remote valves
8. Load sensing line
9. Load sensing
10. High pressure from pump

# Control valve - Dynamic description - Priority valve

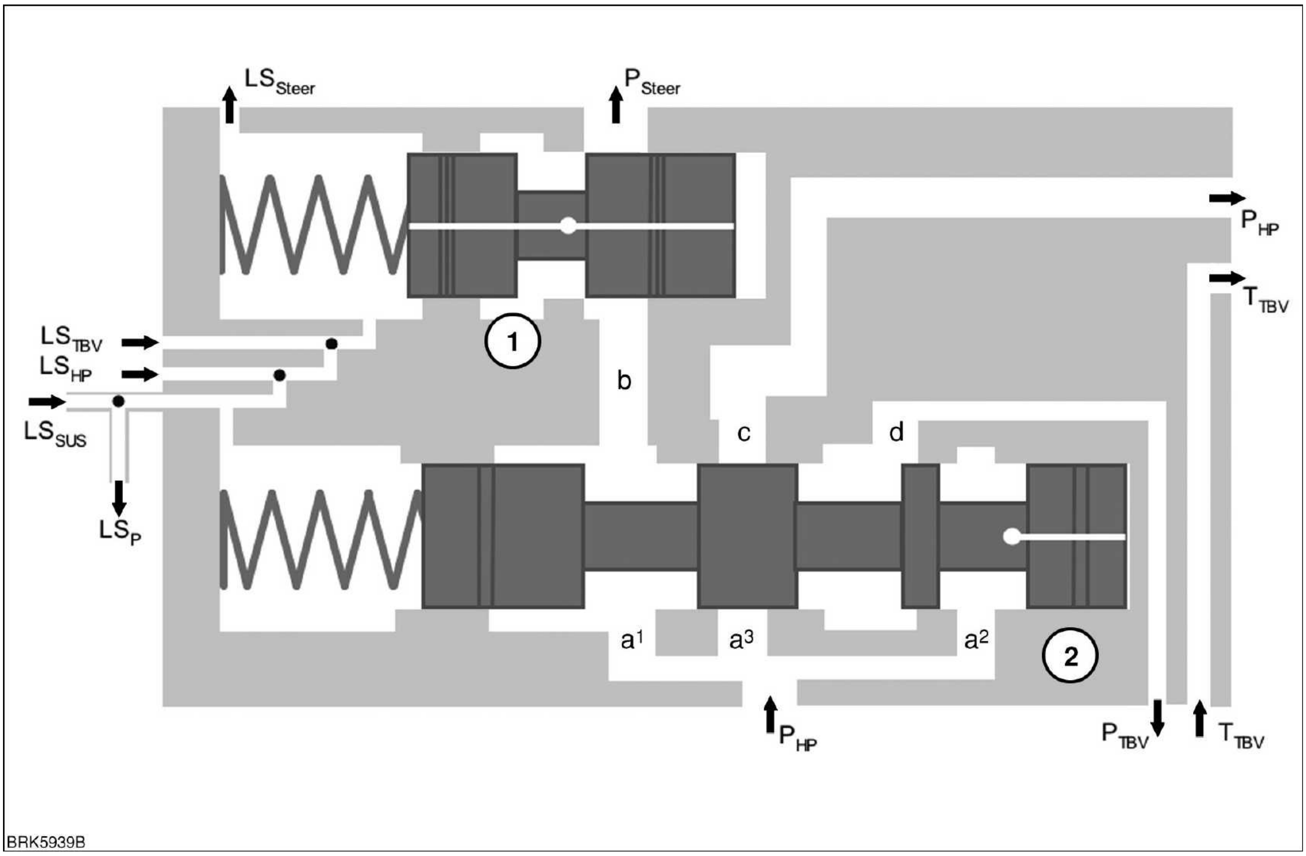
Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210




BAIL08CVT114FSA 1

**No demand**

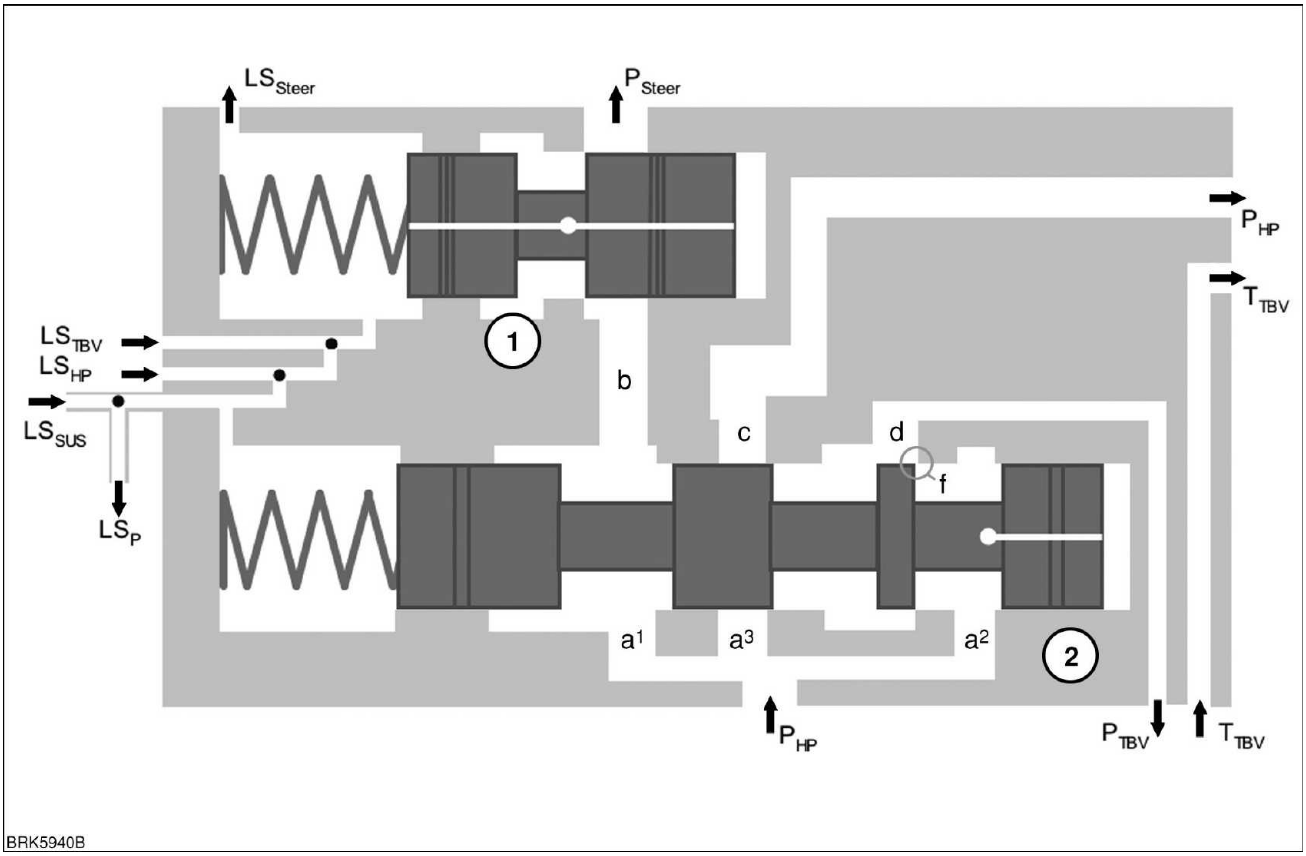
Pump oil from the variable piston pump enters at Php and is delivered at, $a^1$ the steering supply; $a^2$ the trailer brake supply; and $a^3$ the high pressure supply. Ports connect to the various tractor systems at PSteer, (steering); Ptbv, (trailer brake valve); and Php, (high pressure) circuits via galleries b, c, and d. Each system will transmit its pump requirements through the load sense lines LSsteer, (steering); LStbv (trailer brake valve); LSsus, (suspension); and LShp, high pressure lift and auxiliary remote valves. Sense line oil is fed to the pump compensating valves via LSp. A further gallery included is the trailer brake valve to tank TTBV for returning trailer brake oil.




BAIL08CVT115FSA 2

**Position 1**

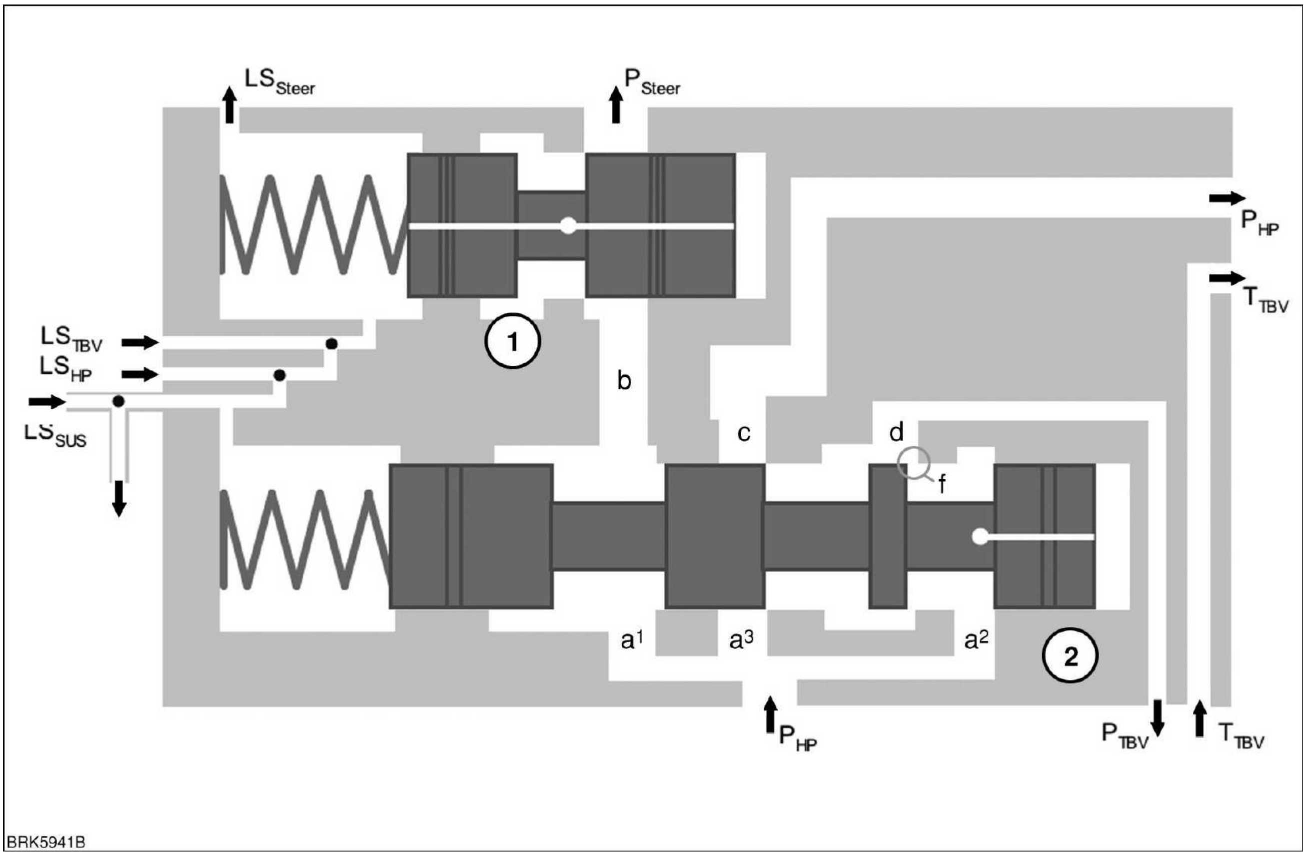
Pump oil passes $a^1$ to b then past the steering priority valve **(1)** then onto the steering orbital valve via PSteer. At the orbital valve the oil is capped and the pressure builds back through the circuit. Oil flows into the centre of the valve and out at each end via 2 restrictors. With the LSSteer port being open to tank at the orbital valve, less pressure can build on the spring side but can do so on the opposing side moving the valve **(1)** towards the spring causing a restriction. The reduced LS pressure is also seen at the pump flow compensating valve and adds pressure to the low pressure standby 'LPS' The pressure is now seen at gallery $a^2$ passes into the trailer brake priority valve **(2)** and acts on the end of the valve against the spring.




BAIL08CVT116FSA 3

**Position 2**

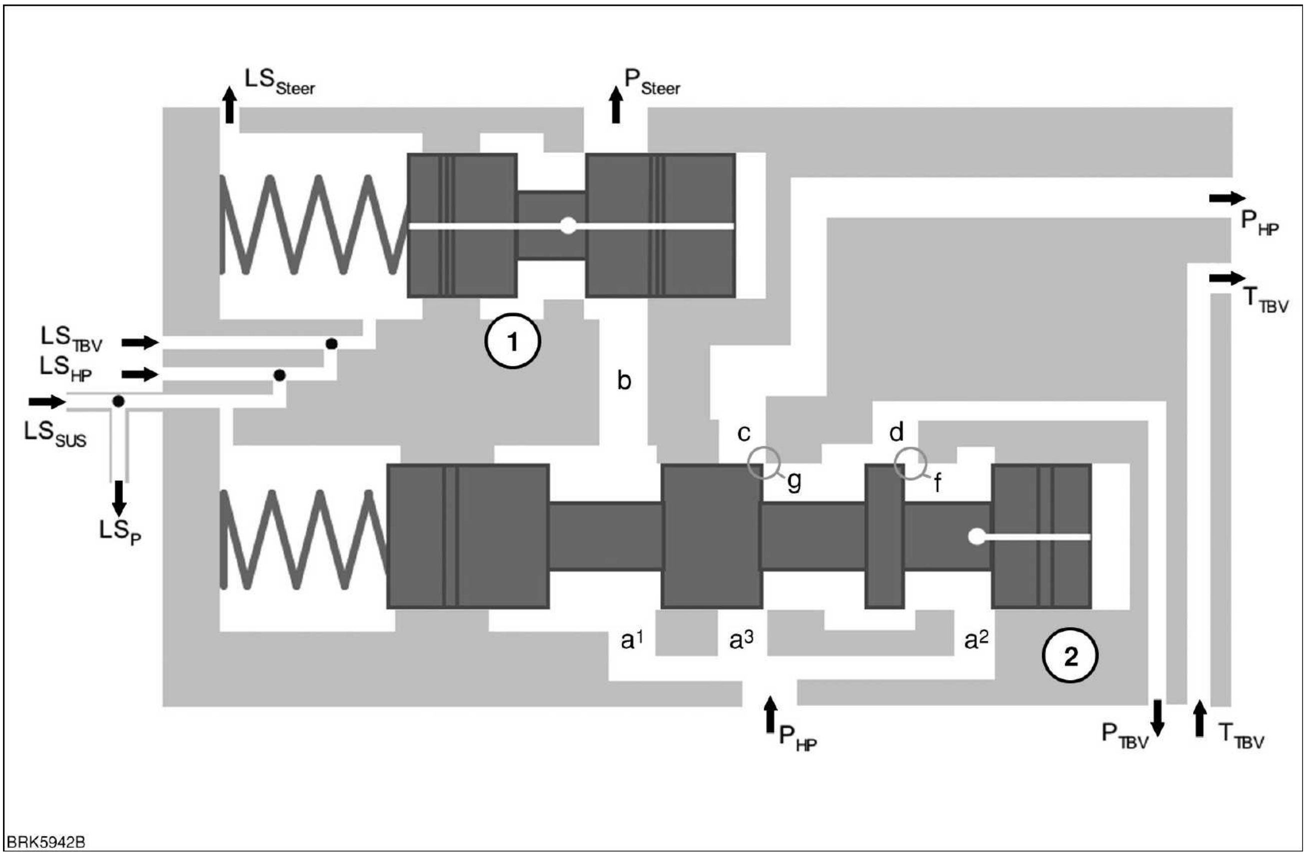
The valve moves to position 2. A restricted delivery is now being made to the trailer brake valve at “f.”




BAIL08CVT117FSA 4

**Position 3**

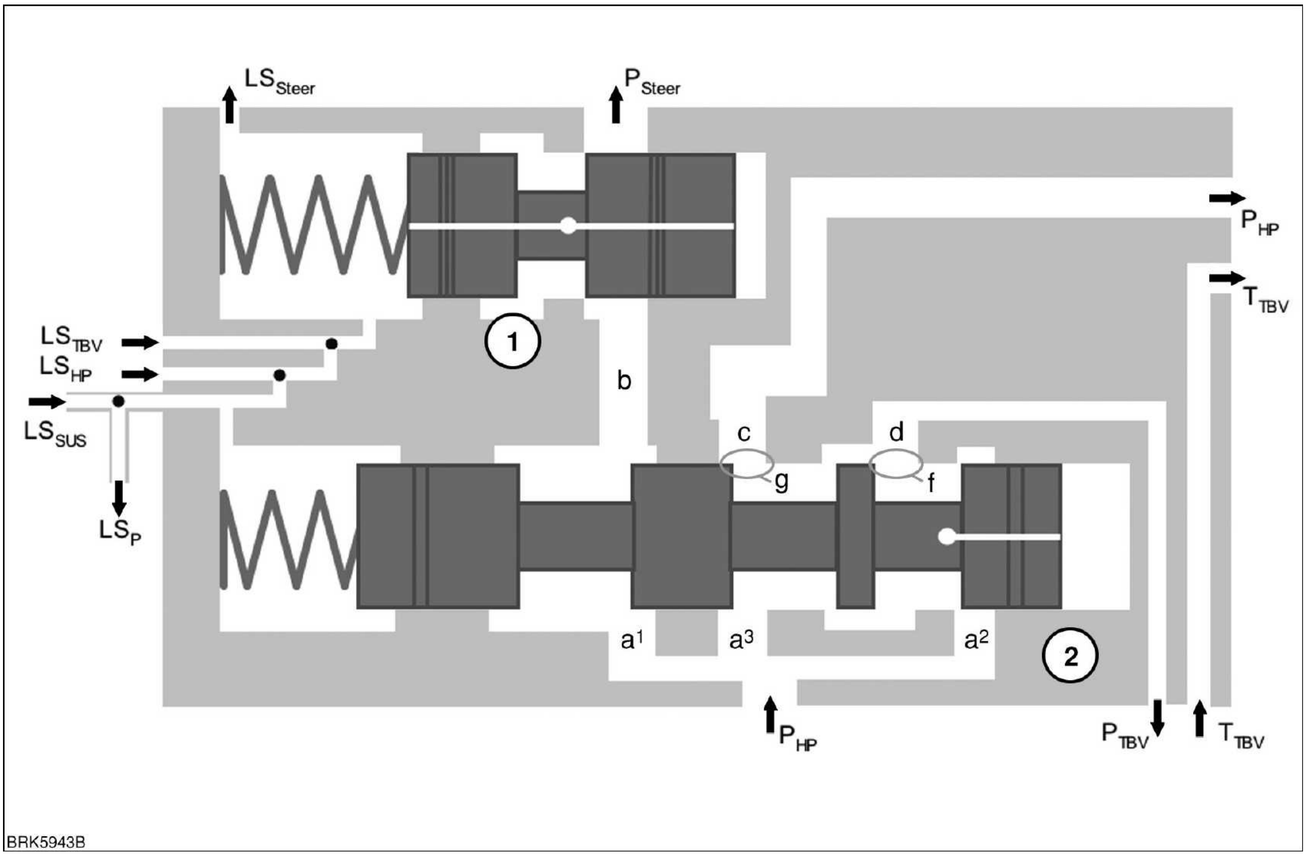
As pressure continues to rise against the spring the valve continues to move to position 3, with full delivery to the trailer brake valve at “f.”




BAIL08CVT118FSA 5

**Position 4**

As pressure continues to rise against the spring, the valve now moves to position 4, full delivery to the trailer brake valve at “f,” and a restricted delivery to the high pressure circuits at “g.”




BAIL08CVT119FSA 6

**Position 5**

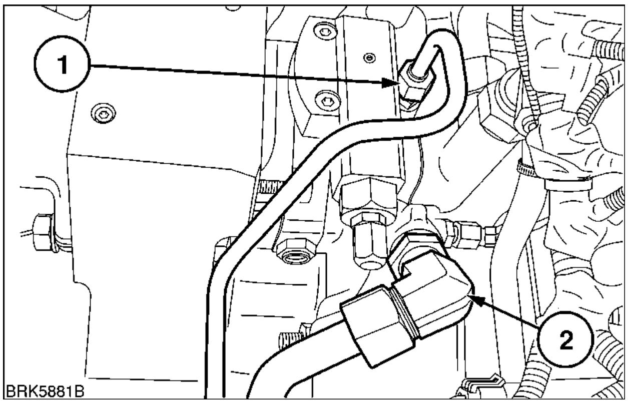
As all the circuits are satisfied and the pump meets the demands of tractor systems, pressure continues to rise against the spring, the valve continues to move to position 5, with full delivery to the trailer brake valve and the high pressure circuits. During steering, the LSSteer route to tank is stopped and pressure feed from the pump gallery of the orbital valve builds on the spring side of the valve **(1)** and also to the flow compensating valve. The priority valve moves with the spring allowing flow to the orbital valve and additional oil is provided by stroking the pump.

# Hydraulic pump - Remove - Vane pump

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

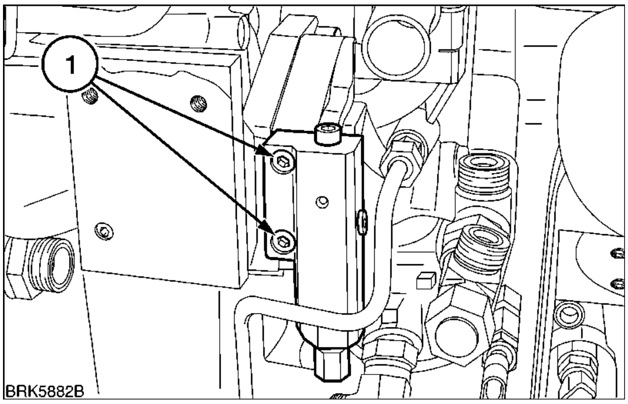
**Prior operation:**
**Filter - Remove - Main filter assembly (A.10.A)**

1. Remove line from the charge pump **(1)** and line to the sump **(2)**.



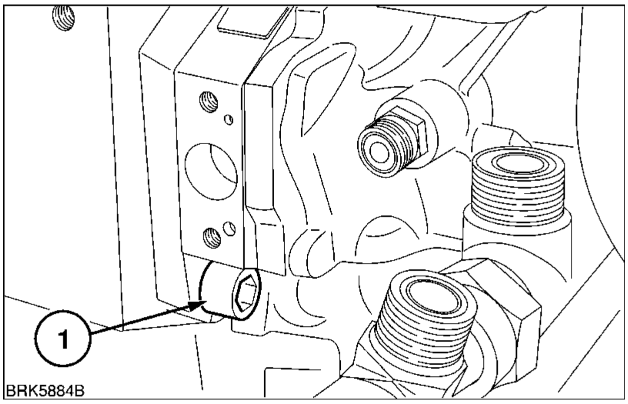

BAIL08CVT067ASA 1

2. Remove the pump regulator screws **(1)** and remove the regulator assembly from the pump.



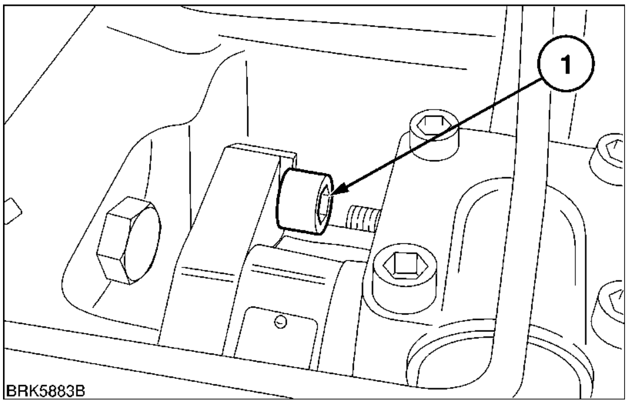

BAIL08CVT068ASA 2

3. Remove the lower socket head bolt **(1)**.




BAIL08CVT070ASA 3

4. Support the pump assembly and remove the upper socket head bolt **(1)** from the pump and lift the pump from the rear axle housing.




BAIL08CVT069ASA 4

## ⚠ WARNING ⚠

**Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.**

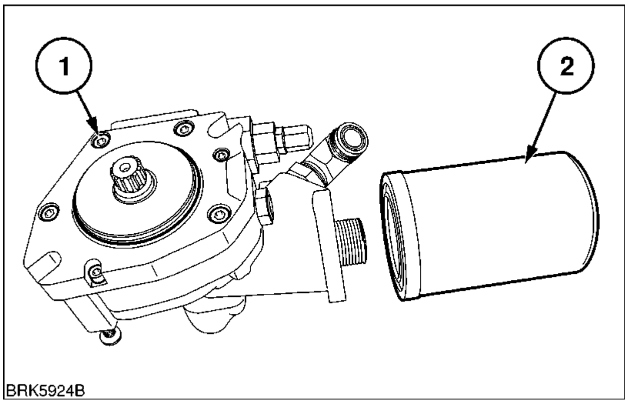
**B012**

**Next operation:**
**Hydraulic pump - Disassemble - Vane pump (A.10.A)**

# Hydraulic pump - Disassemble - Vane pump

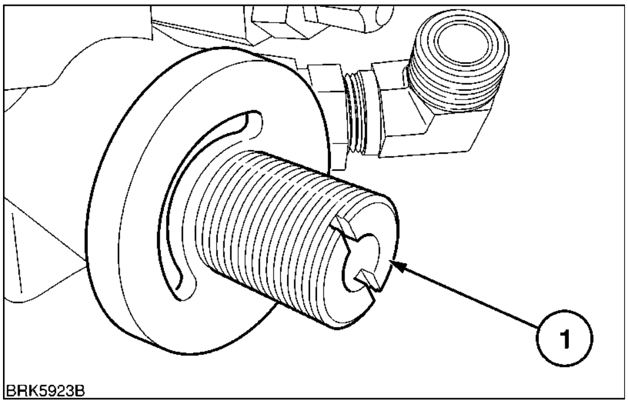
Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

1. Remove the filter **(2)** using a suitable tool. Undo and remove the socket head screws **(1)** from the pump housing . Separate the components and place on a clean surface.



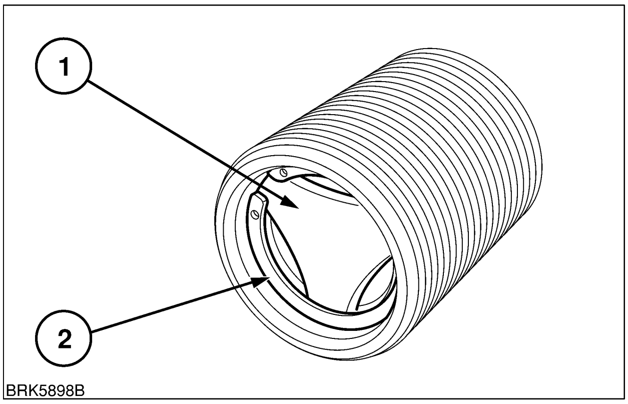

BAIL08CVT093ASA 1

2. Remove the filter mounting screw.



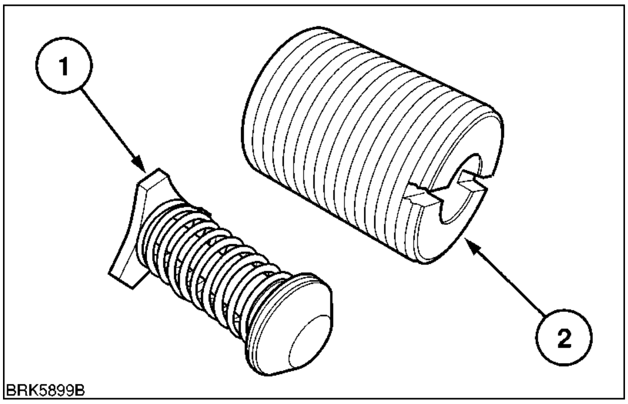

BAIL08CVT092ASA 2

3. Remove the retaining ring **(2)** and remove the regulator valve **(1)**.




BAIL08CVT087ASA 3

4. Regulator valve **(1)**.
   Filter screw **(2)**




BAILO8CVT088ASA 4

**Next operation:**
**Hydraulic pump - Assemble (A.10.A)**

# Hydraulic pump - Install - Vane pump

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180 CVT Transmission, Magnum 190 CVT Transmission, Magnum 210 CVT Transmission

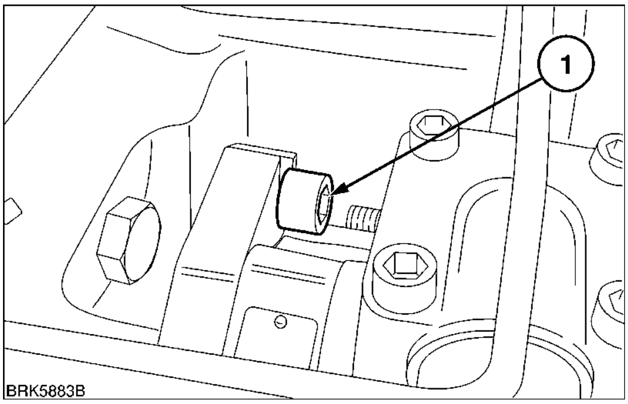
**Prior operation:**
**Hydraulic pump - Assemble (A.10.A)**

1. Support the pump assembly on the rear axle housing and locate the top retaining bolt **(1)** in the in the housing.

**⚠ WARNING ⚠**

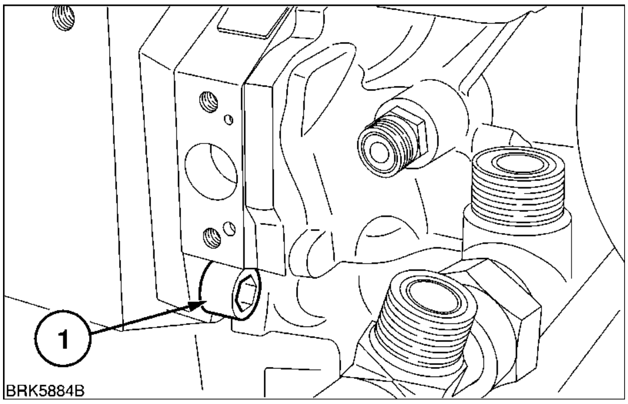
**Lift and handle all heavy components using lifting equipment of appropriate lifting capacity. Make sure that units or parts are supported by suitable slings or hooks. Make sure that no-one is in the vicinity of the load to be lifted. Failure to comply could result in serious injury or death.**

B012



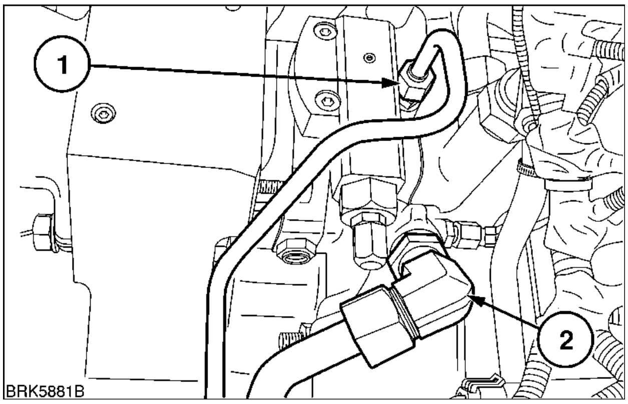

BAIL08CVT069ASA 1

2. Locate the lower retaining bolt **(1)** in the housing. Tighten to **60 Nm** (**44 lb ft**) .




BAIL08CVT070ASA 2

3. Install the regulator assembly on the pump with the screws removed earlier.
4. Connect the line from the rear axle sump **(2)** and the line to charge pump housing **(1)**.




BAIL08CVT067ASA 3

**Next operation:**
**Filter - Install - Main filter assembly (A.10.A)**

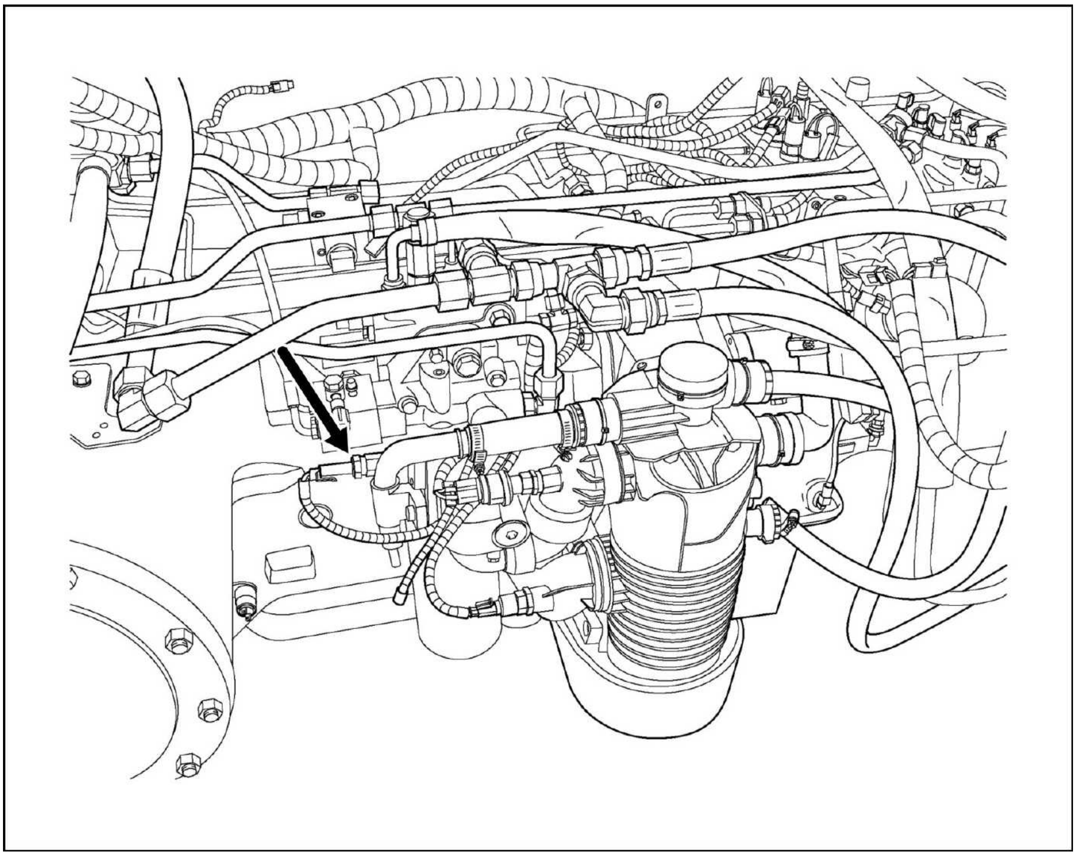
# Charge pump - Pressure test

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

Special Tools: Use pressure adapter kit **380000464** and hydraulic pressure test kit **380000240** for this test. Use an appropriate low pressure gauge for the charge pressure reading. A flowmeter **380001806** and **19 mm** (**0.75 in**) hoses with a minimum working pressure of **21000 kPa** (**3000 psi**) are required for this test.

***NOTE:*** *Make sure the proper maintenance schedule for the hydraulic system filters has been maintained, prior to running test.*

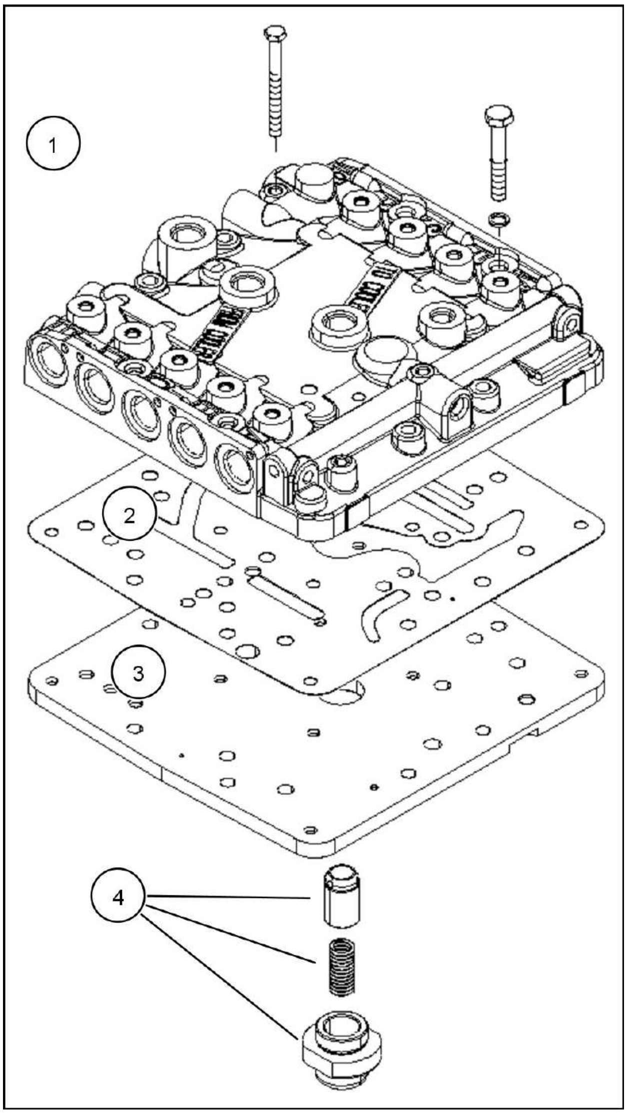
1. To perform this test:
   - Remove the charge pressure switch and adapter.
   - Install the quick release coupler and the quick release fitting from kit.
   - Install the low pressure gauge from kit.



RCPH09CCH013FAE 1

2. Set up the remote loop:
   - Set variable flow controls to the maximum flow position for the remote valves.
   - Set the valve timer control to the maximum time position.
   - Install the flowmeter into the first remote section. Place the remote valve control lever in the detent retract position.
   - Set the flowmeter load valve at minimum pressure – turned out counterclockwise.
   - Start and run the engine at **1500 RPM**.
   - Use a piece of cardboard to block air flow across the oil cooler to help heat the oil to **49 °C** (**120 °F**).
3. Maintain the engine speed at **1500 RPM**. Move the remote lever between the “retract” and “neutral” position. The charge pressure reading should maintain a minimum pressure of **160 kPa** (**23 psi**). If the pressure reading falls below **160 kPa** (**23 psi**), replace the hydraulic oil filters and check the main filter assembly **300 kPa** (**43 psi**) and **80 kPa** (**12 psi**) check valve assemblies on the main filter assembly. . The check valve assemblies are built into the main filter assembly. Make sure a check is not stuck open or damaged. After replacing filter and inspecting check valves retest the charge pressure.

4. If after retest the charge pressure is still below specification, inspect the maximum pressure lube relief valve **(4)**. The maximum pressure lube relief valve is located on the underside of the transmission control valve **(1)** manifold plate **(3)**.




RCIL09CCH001BAE 2

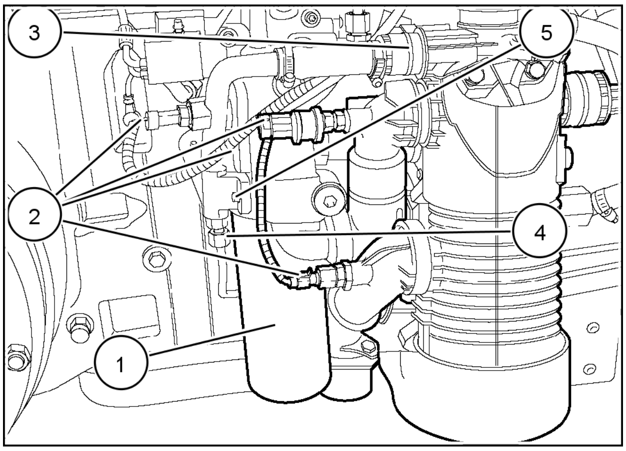
5. If the maximum pressure lube relief valve is stuck open or damaged, repair or replace as necessary.
6. If the maximum pressure lube relief valve is good and charge pressure remains low, disassemble and inspect charge pump.

# Charge pump - Remove

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

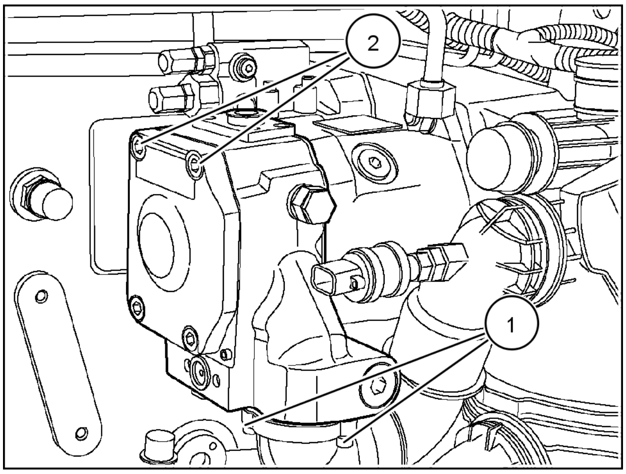
**Prior operation:**
**Control valve Priority/Regulator valve - Remove (A.10.A)**

1. Remove the external components from the charge pump:
   - Remove the charge pump filter **(1)**.
   - Unplug the harness connectors **(2)** and move harness aside.
   - Cut the tie strap and remove the locking clip **(3)**.
   - Disconnect the tube **(4)**.
   - Remove the two bolts **(5)**.
   - Remove the tube assembly.



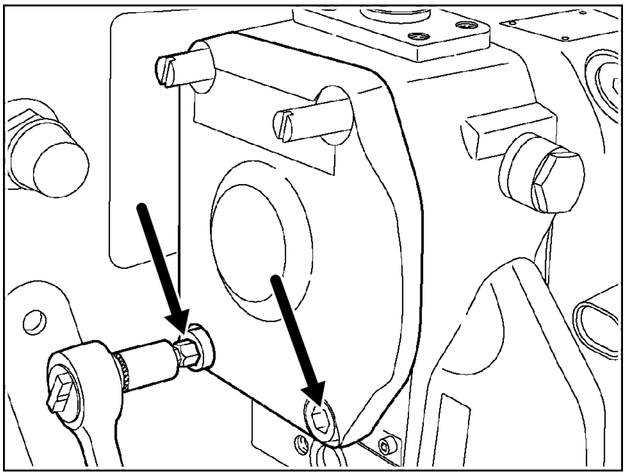

RCPH09CCH040AAC 1

2. Remove the two bolts **(1)** for the oil suction pipe as shown. Remove the two top bolts **(2)** for the rear cover of the charge pump, and install two guide pins.




RCPH09CCH091AAC 2

3. Remove the two bottom bolts, and remove the charge pump from the high pressure pump.



RCPH09CCH092AAC 3

**Next operation:**
**Charge pump - Install (A.10.A)**

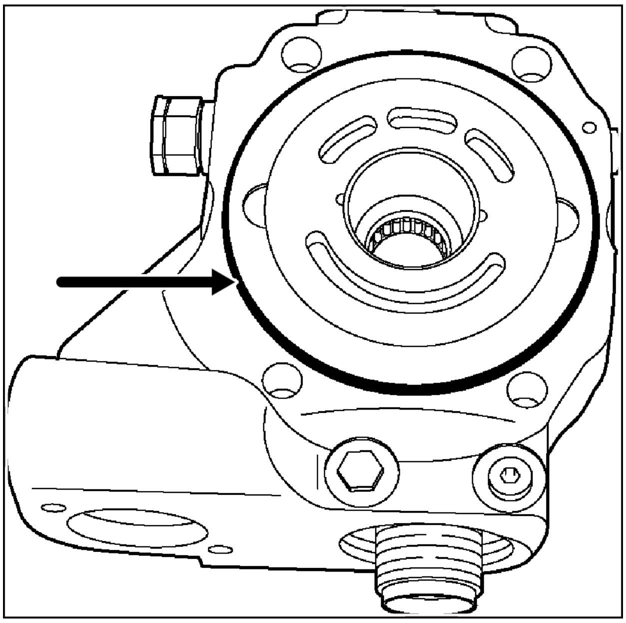
# Charge pump - Install

Magnum 225 [ZARH06086 - ] CVT Transmission, Magnum 180, Magnum 190, Magnum 210

**Prior operation:**
**Charge pump - Remove (A.10.A)**

1. Lubricate a new O-ring with petroleum jelly, and install the O-ring on the pump.

***NOTE:*** *Be sure all surfaces are clean, free of any debris.*



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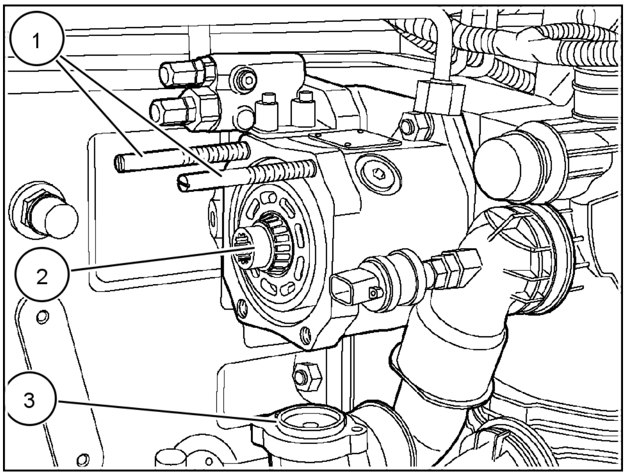
2. Install two guide pins **(1)** and the coupling **(2)** on the high pressure pump. Remove the cap from the oil tube and check that the seal **(3)** is in place.

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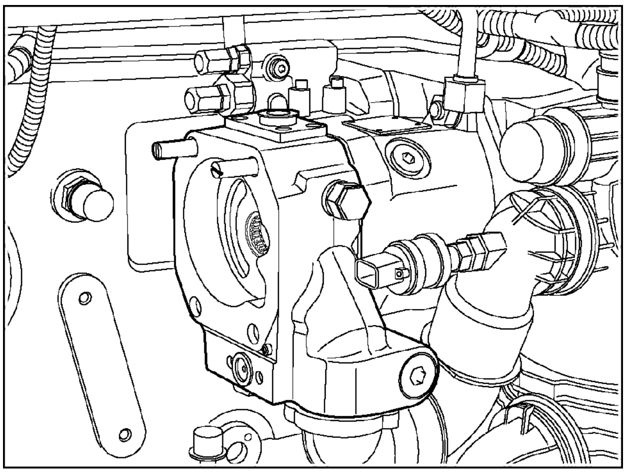
3. Install the charge pump on the guide pins and high pressure pump.



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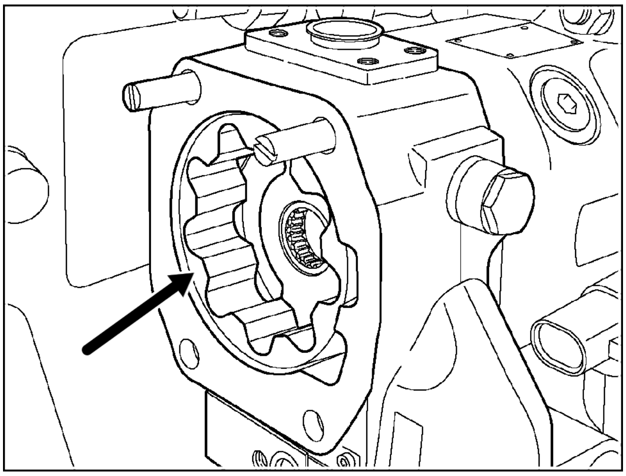
4. Install the rotor housing in the charge pump housing.

***NOTE:*** *When reassembling the pump, the punched dot markings on the rotor and rotor housing must face to the outside of the pump housing.*



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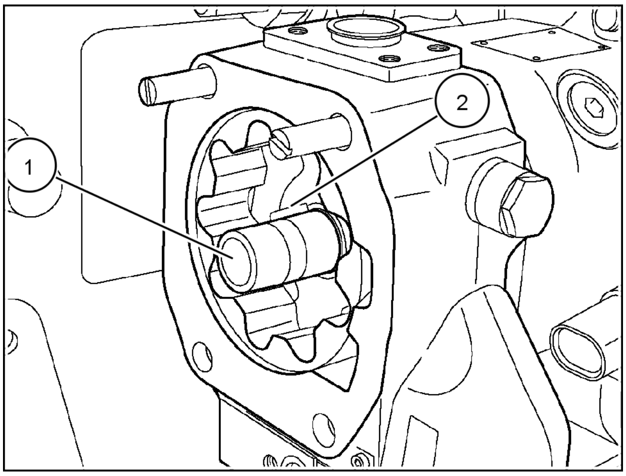
5. Install the shaft **(1)** and key **(2)**.

***NOTE:*** *Be sure the spline end of the shaft is inserted into the coupling.*

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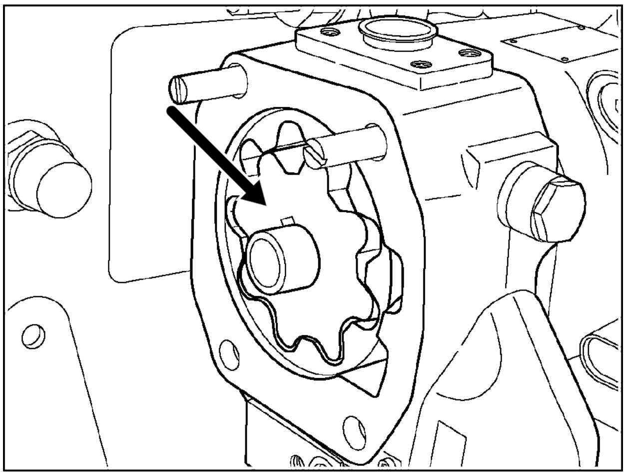
6. Install the pump rotor on the shaft.

***NOTE:*** *When reassembling the pump, the punched dot markings on the rotor and rotor housing must face to the outside of the pump housing.*



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