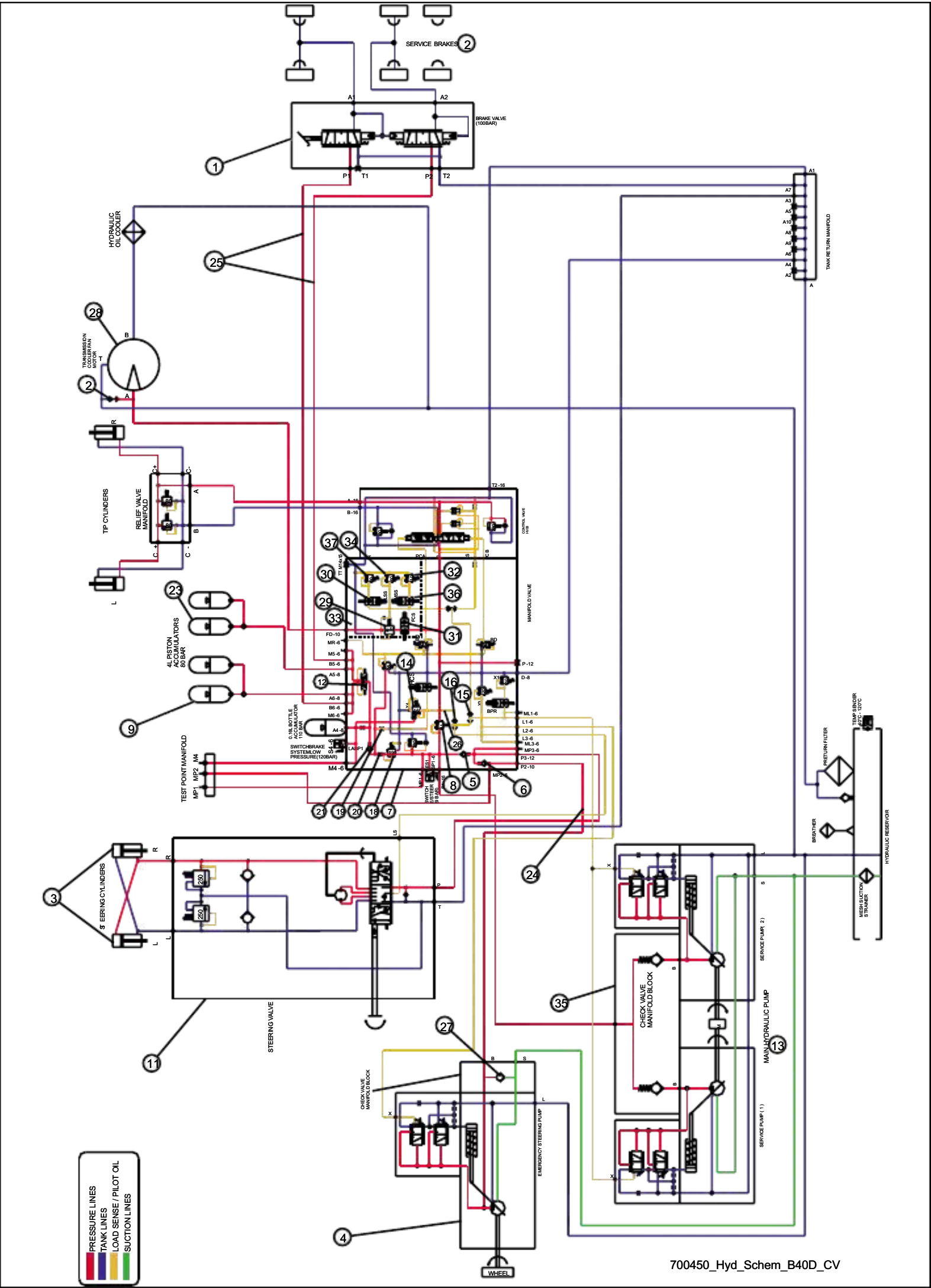


Hydraulic Schematic Wet Disc Brakes





## Service Brake System Operation

### Charging System

When operating the service brake valve (1), charge oil (25) pressure in the front brake accumulator (23) and rear brake accumulator (9) decreases.

The decrease of charge oil pressure in the brake accumulators is sensed by the accumulator charge valve (14).

When the accumulator charge oil pressure decreases below the lower pressure setting of the accumulator charge valve, the charge valve spring shifts the spool, blocking the flow of load sense oil (26) to the return circuit.

Charge oil continues to flow through the brake accumulator charge orifice (19), increasing load sense pressure.

The increasing load sense pressure shifts the priority valve signal shuttle valve (16) and main hydraulic pump signal shuttle valve (15) sending the load sense signal out of port L1 to the main hydraulic pump port X, stroking the pump, increasing flow, causing supply oil (17) pressure to increase.

This supply oil then flows through the accumulator pressure reducing valve (18), accumulator orifice (20), and accumulator charge check valve (21) charging the brake accumulator.

As pressure increases, accumulators are charged via flow fuse shuttle valve (12). Pressure to the accumulators is limited by accumulator pressure reducing valve. The accumulator orifice controls the rate of oil flow to

charge the accumulators.

When brake accumulator charge oil pressure increases to the upper pressure setting of accumulator charge valve, the charge valve spool shifts to the open position allowing load sense oil to flow to return, decreasing the load sense signal to the main hydraulic pump. The pump de-strokes decreasing supply oil flow to the accumulators.

### Charged System

When all accumulators are charged, charge oil (25) pressure in the brake accumulators (9 & 23) holds the accumulators charge check valve (21) closed. The brake accumulator charge oil pressure keeps the accumulator charge valve (14) open allowing pump load sense oil (26) to flow to return.

The rear and front brake accumulator circuits are separated by the flow fuse shuttle valve (12) and hold charge oil in the rear and front brake accumulators (9 and 23) and brake valve (1). The flow fuse shuttle valve enables the circuits to work independently of each other in the event of a malfunction in either circuit.

The pressure setting of the accumulator charge valve and accumulator pressure reducing valve (18) is critical to operation of the main hydraulic pump. If pressure setting of accumulator charge valve is higher than accumulator pressure

reducing valve, the load sense signal to the main hydraulic pump will remain high because the charge oil pressure from brake accumulator cannot open the charge valve allowing load sense oil to flow to return.

The pump will remain in stroke and not return to low stand-by (residual) pressure when all functions are in neutral.

### Brake Valve - Neutral

The service brake valve (1) is a dual circuit, modulated valve. The function of valve is to control the charge oil (25) from the rear and front brake accumulators (9 and 23) to actuate the service brakes.

The brake valve contains two separate circuits, each supplied by their own set of accumulators. The top valve is for the front axle brakes and the bottom valve is for the rear axle brakes.

The brake valve supplies charged oil to the rear brakes first and then the front brakes. In neutral, charge oil is blocked by the brake valve spools and the brake pistons are open to return.

## Brake Valve - Actuated

When service brakes (2) are actuated, the charge oil (25) in the accumulators flows through the brake valve (1) to the brake pistons, applying the brakes.

The pressure applied at the pistons and the force applied to the spring by the brake pedal act on opposite ends of the spools in the brake valve.

The pressure to the pistons is proportional to the force applied to the brake pedal (pressure to the pistons increases as the force on the brake pedal increases).

The pressure on the end of the spools balances against the spring force modulating the pressure to the pistons. The charge oil pressure is reduced by the amount of oil it takes to move the pistons.

Each application of the brake pedal reduces the charge pressure until the brake accumulator charge circuit is actuated by the accumulator charge valve (14).

## Steering And Secondary Steering System Operation

The function of the steering system is to route supply oil (17) from the main hydraulic pump (13) to the steering valve (11). The steering valve then controls the oil flow used to extend and retract the steering cylinders (3).

When the steering wheel is turned, the load sense signal from the steering valve enters the hydraulic system manifold (7) at port L3. The load sense signal is then sensed at the secondary steering pump (4) via port L2.

At the same time, the load sense signal shifts the shuttle valves (15 & 16), pressurizes the spring chamber of priority valve (8), and sends a signal to the main hydraulic pump via port L1.

The load sense signal will not exceed the steering load sense relief valve (6) pressure setting. The main hydraulic pump supplies the required flow rate through port P1, main hydraulic pump check valve (5), and out of port P3 to steering valve port P.

When the steering wheel is not being turned, the load sense signal is open to hydraulic reservoir through the steering valve and the main hydraulic pump will return to residual pressure.

The oil in the steering cylinders is trapped and the machine is held at that relative position. The ground driven secondary steering pump will assist with oil flow to steer the machine if main hydraulic pump cannot deliver the flow required.

Low oil flow may occur during an attempt to rapidly steer machine at slow engine speed. (Machine must be moving for secondary steering pump to work.)

Under normal steering operation, the pressure of secondary steering pump at port P2 is just below that of the main hydraulic pump at port P1 creating a differential pressure across secondary steering pump check valve (22).

When the main hydraulic pump cannot meet the flow requirements to steer the machine, the pressure in the main hydraulic pump circuit decreases the load sense signal at port L1.

The load sense signal to the secondary steering pump via port L2 is the same as that of the main hydraulic pump at port L1, enabling the pressure of secondary steering pump at port P2 to increase and overcome the pressure differential across secondary steering pump check valve.

Flow from the secondary steering pump (24), via port P2, eventually supplements the flow from the main hydraulic pump to the steering valve via port P3.

The rpm of the secondary steering pump is dependent on the machine travel speed. Supply oil flow available to steer the machine is reduced proportionately as the travel speed decreases.

When the machine stops, there is no secondary steering pump flow. The secondary steering system is also used to provide oil flow to the

steering circuit (while the machine is still moving) in the event there is a malfunction of the engine, transmission, power takeoff, pump drive shaft, or main hydraulic pump.

The system consists of the secondary steering pump, main hydraulic pump check valve, secondary steering pump check valve, and secondary steering pump **“Check Valve Bridge”** (27).

The secondary steering pump is a variable-displacement, axial-piston pump with a load sensing and pressure compensating regulator valve.

Operation of the secondary steering pump is similar to the main hydraulic pump. The residual valve pressure setting for the secondary steering pump is lower than the residual valve pressure setting for the main hydraulic pump.

When the machine is moving, the pressure at test port MP2 remains just below the pressure at test port MP1. The secondary steering pump is

~~mounted on the transfer case and is~~  
ground-driven as long as the gear train is being turned by the moving machine.

The secondary steering pump check valve is used to block oil flow from the main hydraulic pump to the secondary steering pump circuit.

In the event of a malfunction, main hydraulic pump check valve manifold oil flow from the secondary steering pump to the main hydraulic pump, fan drive valve, bin control valve, and brake accumulator charging circuit.

The secondary steering pump **“Check Valve Bridge”** allows oil to be directed to the correct ports, so that the pump can operate in both the forward and rearward direction.

## Fan Drive System

Supply oil from the hydraulic system manifold (35), enters the fan drive valve (33) and is allowed or not allowed by the fan drive solenoid valve (29) to continue on to the hydraulic fan drive motor (28).

The fan drive solenoid valve (31) will only opens when the oil temperature reaches 70°C.

Whenever the bin is in the raised (5° or above), the fan drive solenoid valve is energized, closing off supply oil to the fan drive motor.

The check valve (2) will supply oil to the fan drive motor when the fan drive solenoid is energized allowing the fan to coast to a stop.

The pressure reducing valve (29) controls the flow to the fixed displacement axial piston hydraulic fan motor (28) and the flow to the Load Signal Line.

When the oil temperature reaches 70°C, the fan drive solenoid valve (31) will be opened as well as the fan speed solenoid valve (30).

When this happens, a signal is send to the pump via the LS line and the pump will stoke in.

Pressure reducing valve (37) will restrict the pressure to 50 bar and the hydraulic fan motor will turn at **“Low Speed”**.

When the oil temperature reaches 85°C, the fan speed solenoid valve (30) will be closed and the fan speed solenoid valve (36) will be activated.

When this happens, the pressure in the LS Line will go up and the pressure reducing valve (32) will restrict the pressure to 110 bar.

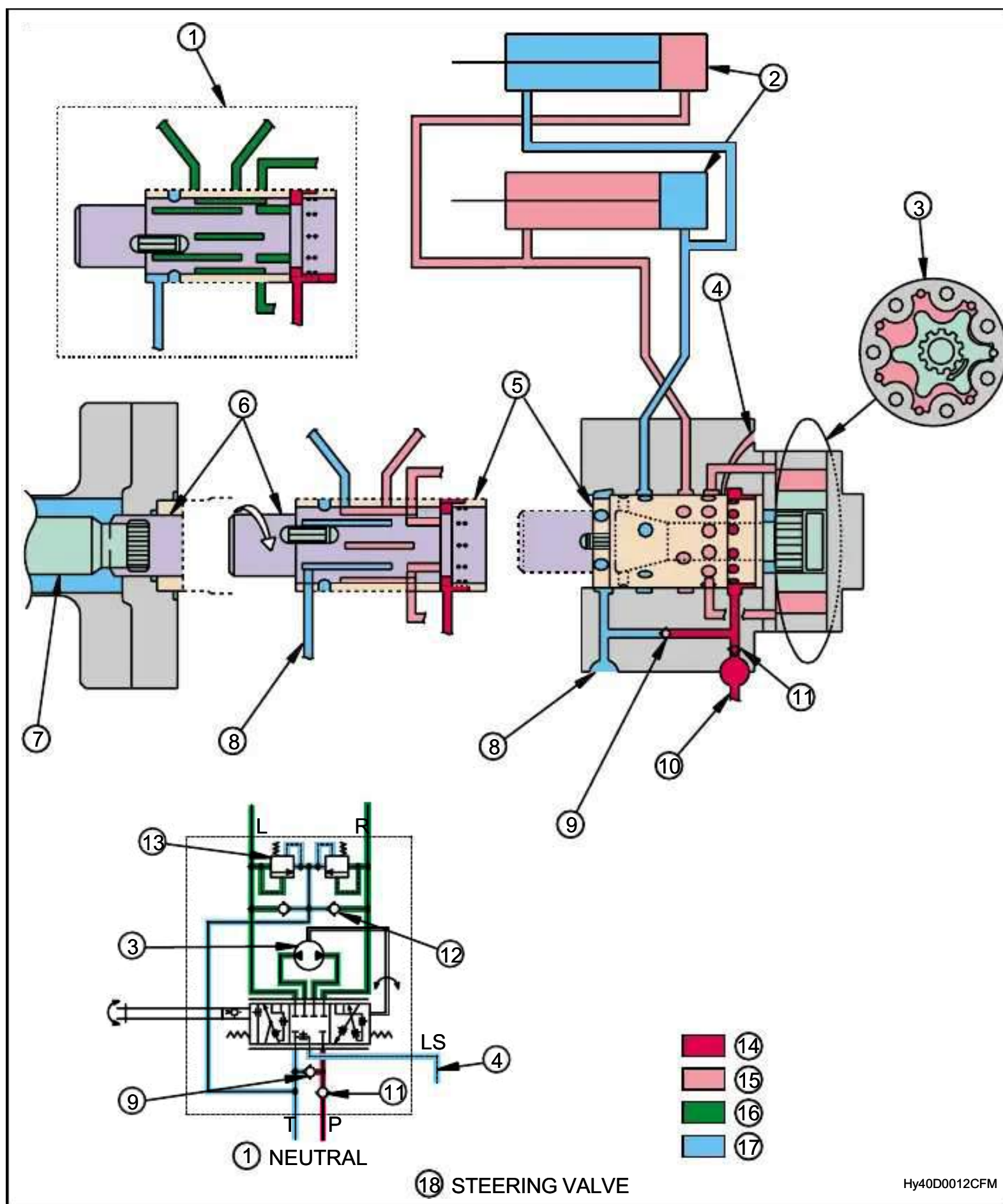
This higher load sense pressure will cause the pressure reducing valve to shift, allowing more flow to the hydraulic fan motor and causing the hydraulic fan motor to turn at **“Medium Speed”**.

When the oil temperature reaches 95°C, the fan speed solenoid valve (36) will be closed.

When this happens, the pressure in the LS Line will go up and the pressure reducing valve (34) will restrict the pressure to 160 bar.

This higher load sense pressure will cause the pressure reducing valve to shift, allowing maximum available flow to the hydraulic fan motor causing the hydraulic fan motor to turn at **“High Speed”**.

## Steering Valve Operation



- |                                                         |                                            |
|---------------------------------------------------------|--------------------------------------------|
| 1 Neutral.                                              | 7 Steering Shaft.                          |
| 2 Steering Cylinder.                                    | 8 Return.                                  |
| 3 Gerotor.                                              | 9 Make-Up Check Valve.                     |
| 4 Load Sense Port to Hydraulic System Manifold Port L3. | 10 From Hydraulic System Manifold Port P3. |
| 5 Sleeve.                                               | 11 Inlet Check Valve.                      |
| 6 Spool.                                                | 12 Anti-Cavitation Valve.                  |

- 13 Relief Valve.
- 14 Supply Oil.
- 15 Work Pressure Oil.
- 16 Trapped Oil.
- 17 Return Oil.
- 18 Steering Valve.

The steering valve (18) is a variable-displacement (flow amplification), closed-centre valve. Main valve components are the spool (6) inside a sleeve (5) within a housing and the gerotor (3).

Also included are the make-up check valve (9), inlet check valve (11), anti-cavitation valves (12), and relief valves (13).

When the steering wheel is not being turned, the valve is in neutral (1). In neutral, the spool and sleeve are held in alignment by the centring spring blocking the flow of supply oil (14) through the sleeve to the spool and gerotor.

Oil at the left and right work ports to the steering cylinders is trapped (16) by the sleeve holding the machine frames stationary.

Turning the steering wheel and shaft (7) left or right turns the spool relative to the sleeve, opening passages so supply oil flows from the hydraulic system manifold port P3 (10) through the sleeve into the spool.

From the spool, work pressure oil (15) flows to the gerotor (3) causing the gerotor gear and sleeve to turn. Work pressure oil flow is measured by the gerotor back into the spool where it is routed through the sleeve and out the left or right work port to the respective ends of the steering cylinders turning the machine.

Work pressure oil also flows out the load sense port (4) sending a load sense signal back through the hydraulic system manifold port L3 to the main hydraulic pump regulator valve to regulate pump flow. Load sense signal also goes to the spring chamber of the priority valve and to the steering load sense relief valve.

Return oil (17) flows back from steering cylinders, through the right or left work port, through the sleeve and spool to the return circuit (8).

As steering operation is stopped, the centring spring and gerotor continue to turn the sleeve until the sleeve and spool are in alignment, stopping the flow of oil through the spool to the gerotor. At this point, the valve is in neutral and remains there until the steering wheel and shaft are turned again.

The valve's variable-displacement (flow amplification) is proportional to the speed at which the steering wheel is turned.

When the steering wheel is turned slowly, the valve only measures oil through the gerotor to the steering cylinders and thus the effective displacement is equal to the gerotor displacement.

When the steering wheel is turned rapidly, the spool moves more, relative to the sleeve opening passages, so additional oil is allowed to bypass the gerotor, thus increasing the effective valve displacement, hence flow amplification occurs.

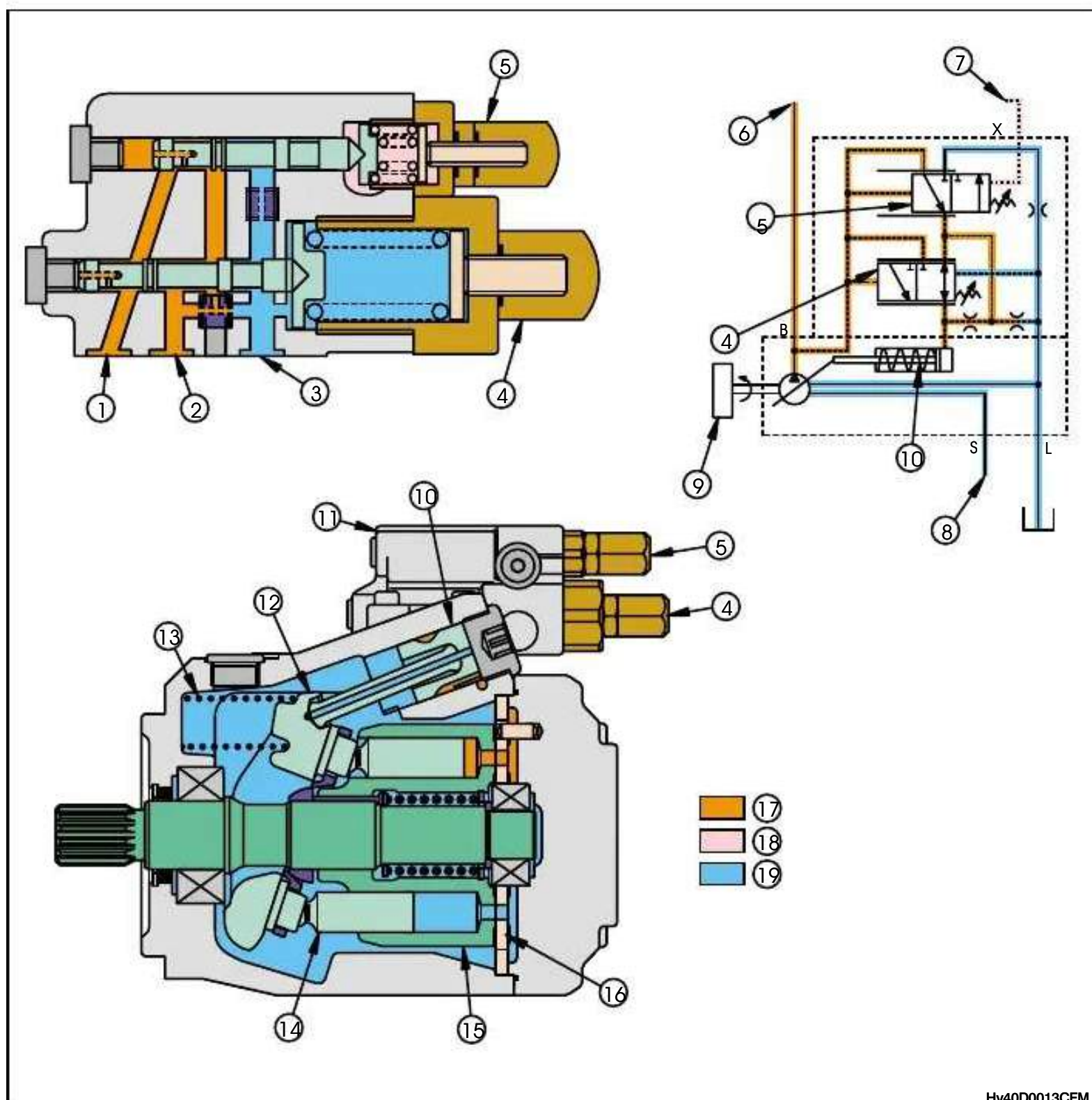
Relief valves (13) are used to relieve high pressure oil from a pressure spike created in the steering cylinders while steering is in neutral. In neutral, the steering valve blocks the flow of oil to and from the cylinders.

A pressure spike is created by the impact of the front or rear wheels against an obstacle, which is transmitted to the steering cylinders causing slight cylinder movement.

The cylinder movement that caused the pressure spike also causes a pressure drop and a void in the opposite end of the cylinders. Because of the pressure differential across the anti-cavitation valve (12), the pressure in the return passage pushes the valve open and oil flows into the void preventing cavitation.

Oil not used flows out port T and then back to the hydraulic reservoir.

## Secondary Steering Pump Operation



- |                                              |                                 |
|----------------------------------------------|---------------------------------|
| 1 From Pump Outlet.                          | 10 Control Piston.              |
| 2 To Control Piston.                         | 11 Pump Regulator Valve.        |
| 3 To Case Drain.                             | 12 Swash Plate.                 |
| 4 Compensator Valve.                         | 13 Spring.                      |
| 5 Residual Valve.                            | 14 Piston.                      |
| 6 To Hydraulic System Manifold Port P2.      | 15 Cylinder Block Oil.          |
| 7 From Hydraulic System.                     | 16 Valve Plate.                 |
| 8 From Main Hydraulic Pump Manifold Port L2. | 17 Supply Oil.                  |
| 9 Transfer Case.                             | 18 Load Sense Oil.              |
|                                              | 19 Return or Pressure-Free Oil. |

The secondary steering hydraulic pump is a load-sensing, pressure-compensating, variable-displacement axial-piston pump.

Pump displacement is varied by the angle of the swash plate (12). The swash plate angle is controlled by the control piston (10) and spring (13).

Spring pressure is applied to the swash plate at all times, trying to keep the pump at maximum displacement. Secondary supply oil (17) is applied to or released from the control piston by the residual valve (5) in response to load sense signal from hydraulic system manifold port L2 to load sense port X, varying displacement per load demand.

At full system pressure, the compensator valve (4) is shifted to route secondary supply oil to the control piston, de-stroking the pump.

As the angle of the swash plate is increased, the pistons (14) move in and out of their bores and displace oil as the cylinder block (15) is turned.

The pistons move into their bores during the first half of each revolution, and out of their bores during the last half of the revolution.

The piston bores are filled with oil through the valve plate (16) as the pistons move out of the bores.

The pistons moving into their bores push oil out through the valve plate, through the secondary steering pump anti-cavitation valve, and to the hydraulic system manifold port P2 (6).

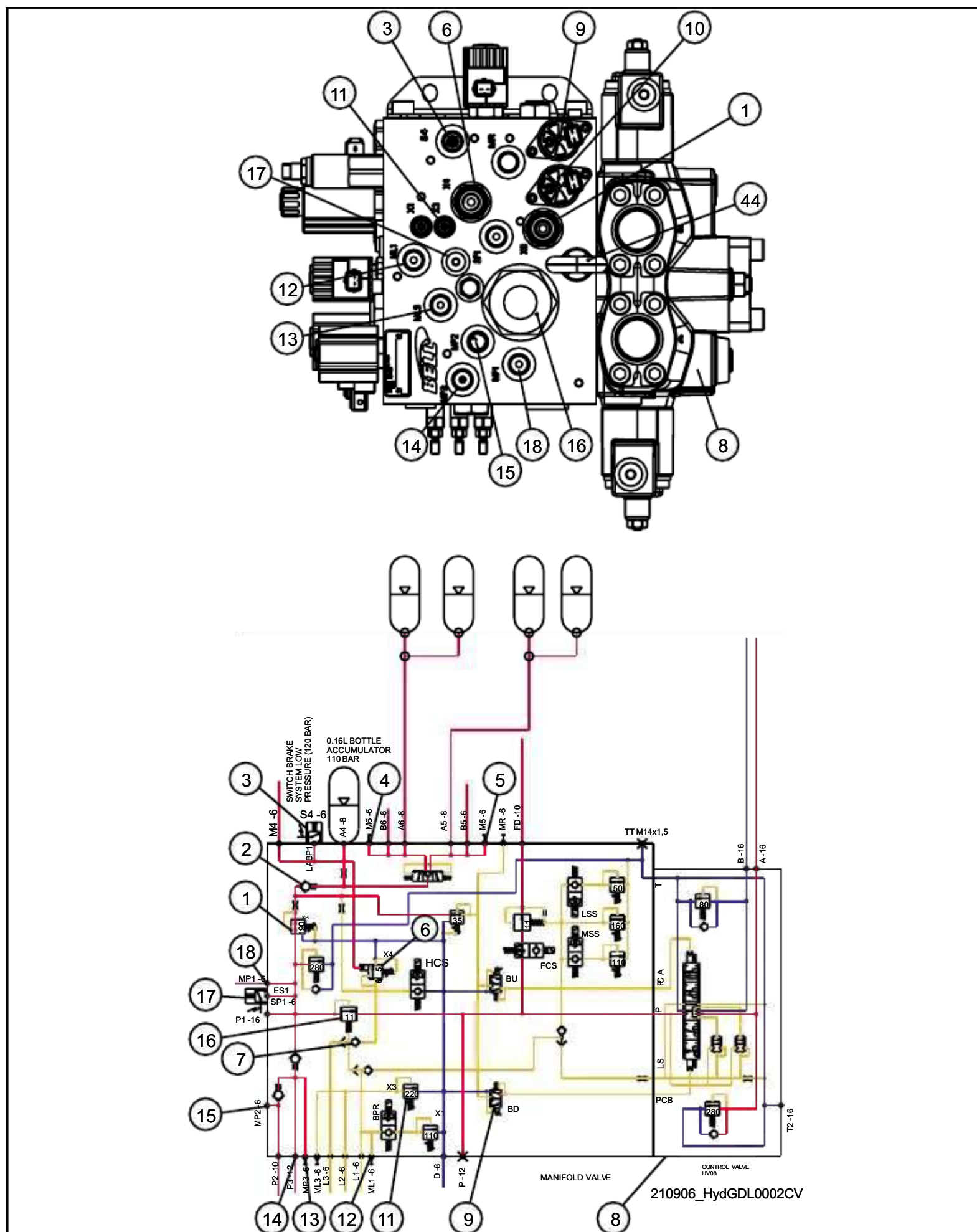
The pump displacement is regulated by the compensator valve and residual valve (load sensing).

Normal leakage to the pump case through clearance between the pistons, valve plate and cylinder block provides cooling and lubrication before flowing back to the hydraulic reservoir.

The secondary steering pump is mounted on the transfer case (9) and is ground driven as long as the gear train is being turned by the moving machine.

When the machine is not moving, there is no secondary steering pump flow. The secondary steering pump will not operate when machine is moving in reverse.

# Hydraulic System Manifold Operation (Top View)



- |                                             |                                         |
|---------------------------------------------|-----------------------------------------|
| 1. Accumulator Pressure Reducing Valve, XB. | 6. Accumulator Charge Valve, X4.        |
| 2. Accumulator Charge Check Valve.          | 7. Priority Valve Signal Shuttle Valve. |
| 3. Brake Low Pressure Switch, S4.           | 8. Bin Control Valve.                   |
| 4. Test Port, M6.                           | 9. Bin Down Solenoid.                   |
| 5. Test Port, M5.                           | 10. Bin Up Solenoid.                    |

11. Steering Load Sense Relief Valve, X3.
12. Test Port, ML1.
13. Test Port, ML3.
14. Test Port, MP3.
15. Test Port, MP2.
16. Priority Valve.
17. Secondary Steering Pressure Switch, SP1.
18. Test Port, MP1.

The hydraulic system manifold controls and distributes hydraulic oil through outlet ports to all components in the hydraulic system.

The hydraulic system manifold is a replaceable cartridge-valve-type manifold. The bin control valve (8) is mounted on the hydraulic system manifold. Numbers and letters are stamped on the manifold to help locate and identify components and ports.

Numbers and letters are stamped on the manifold to help locate and identify components and ports. The illustrated views given are with the hydraulic system manifold installed in the machine.

Test ports ML1 (11), ML3 (12), MP3 (13), M5 (5), and M6 (4) are equipped with high pressure quick couplers for making test connections to hydraulic system.

Test ports MP1 (17), MP2 (14), and M4 are connected by hydraulic lines to a test port manifold located behind the cab.

The brake low pressure switch, S4 (3) closes when brake accumulator pressure decreases below the lower limit of accumulator charge valve band.

The switch actuates the brake low pressure indicator light. The priority valve (16) gives priority to the steering valve and brake accumulator charging circuit over the bin control valve if supply oil flow from main hydraulic pump is not enough to satisfy the load demand.

During bin raise operation the priority valve remains open if the pressure to operate the brake accumulator charging and steering circuits is less than that of the bin raise circuit.

Oil takes the path of least resistance, meeting the load demand of charging and steering circuits.

When pressure to operate the brake accumulator charging or steering circuits is higher, their higher load sense signal assists the priority valve spring to move the valve spool, reducing the flow of oil to the bin control valve.

The main hydraulic pump can now meet the charging or steering circuit load demand.

The priority valve signal shuttle valve (7) routes the higher load sense signal from the steering valve or brake accumulator charging circuit to the spring chamber of the priority valve and to the main hydraulic pump signal shuttle valve.

The steering load sense relief valve, X3 (11) relieves excess load sense signal from the steering valve.

The secondary steering pressure switch, SP1 (17) closes when the main hydraulic pump loses pressure.

The switch actuates the secondary steering indicator light. The brake accumulator charge valve, X4 (6) maintains brake charge accumulator, A4 pressure between upper and lower limit of the charge band.

The brake accumulator pressure reducing valve, XB (1) limits pressure to the brake accumulators. The brake accumulator charge check valve (2) holds charge pressure in the brake charge accumulator so oil does not flow to the steering and bin control circuits when system pressure is less than charge pressure.

The bin down solenoid (9) (when energized) opens, pushing the bin valvespool to it's first

position, allowing the bin cylinder head end circuit to dump to the hydraulic reservoir. (See "Bin Control Valve Operation" on page 374).



Supply oil (41) flows from the main hydraulic pump to the inlet port P1 (18).

Supply oil flows from the secondary steering pump to the secondary steering pump port, P2 (24).

The secondary steering pump check valve (25) blocks supply oil flow from the main hydraulic pump to the secondary steering pump.

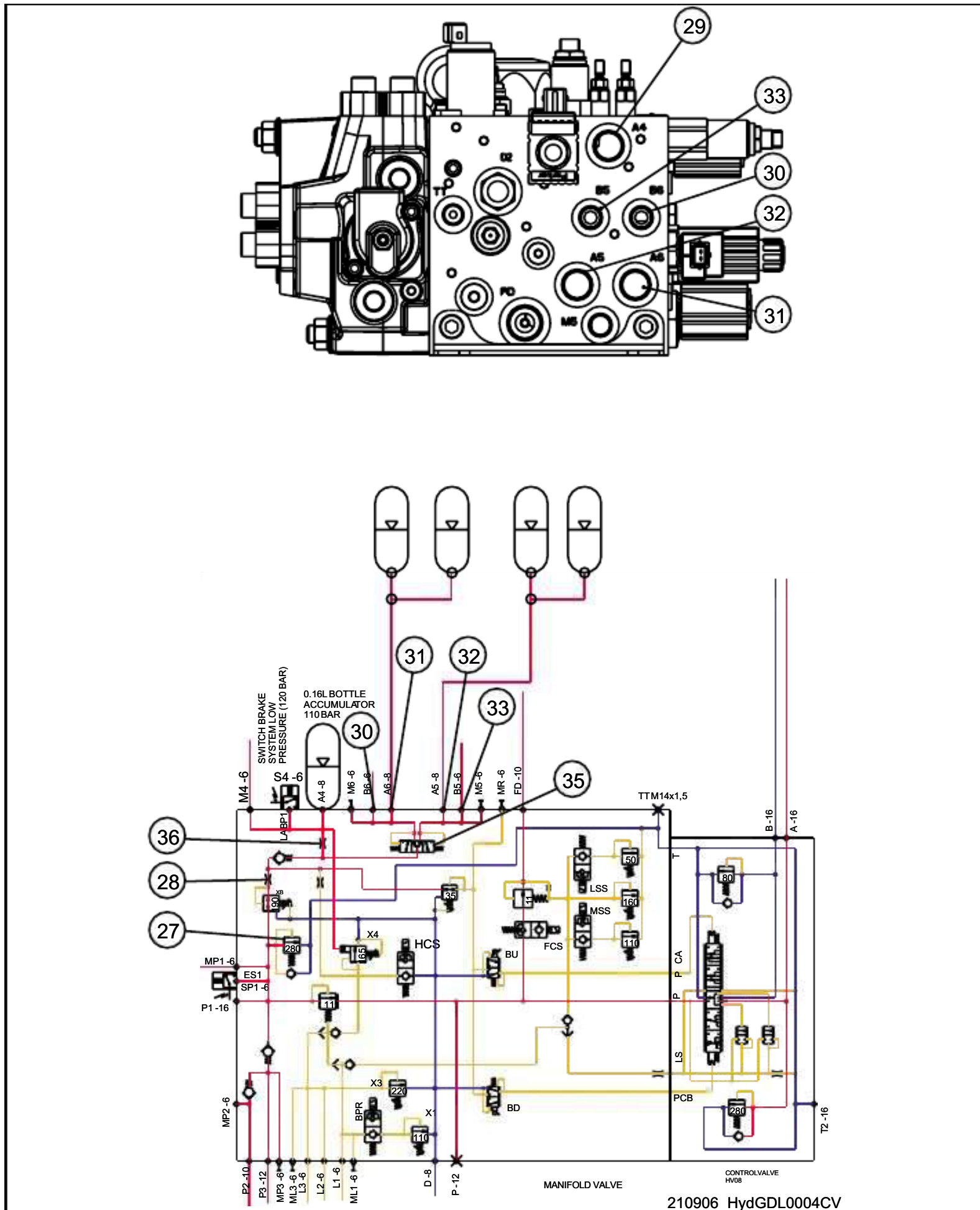
It also functions as the closed-centre valve for the secondary steering pump.

The check valve will open when the main hydraulic pump flow is low enough so that pressure drops below the pressure of the secondary steering pump, allowing the secondary steering pump to supply oil to the steering valve as long as the machine is moving.

The load sense signal from the main hydraulic pump load sense port, L1 (23) to the main hydraulic pump port, X causes the pump to go into stroke.

The load sense signal from the secondary steering load sense port, L2 (22) to the secondary steering hydraulic pump port, X.

## Hydraulic System Manifold Operation (Rear View)



- |    |                                    |     |                                    |
|----|------------------------------------|-----|------------------------------------|
| 27 | System Relief Valve.               | 32  | Rear Brake Accumulator, A5.        |
| 28 | Brake Accumulator Orifice, 2.5 mm. | 33  | Rear Brake Supply Port, B5.        |
| 29 | Brake Charge Accumulator, A4.      | 34  | Front Brake Check Valve.           |
| 30 | Front Brake Supply Port, B6.       | 35. | Flow Fuse Shuttle Valve.           |
| 31 | Front Brake Accumulator A6.        | 36  | Brake Accumulator Orifice, 0.8 mm. |

The system relief valve (27) relieves supply oil pressure spikes to the return circuit.

The brake accumulator orifice, 2.5 mm (28) controls the rate of supply oil flow to the accumulators.

Supply oil flows from the rear brake supply port B6 (30) to the rear brake valve.

Supply oil flows from port A6 (31) to the rear brake apply accumulator.

Supply oil flows from port A5 (32) to the front brake apply accumulator.

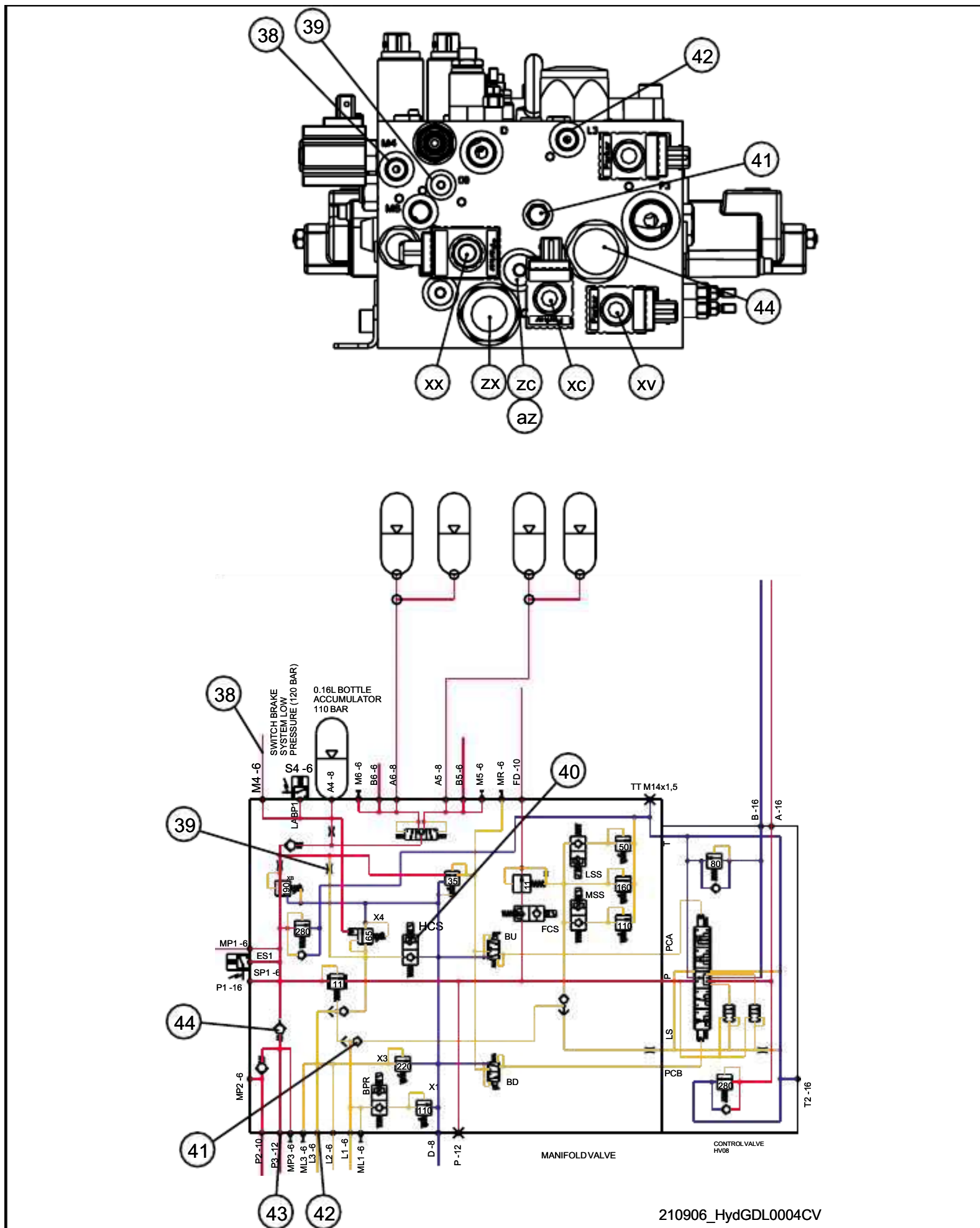
Supply oil flows from front brake supply port, B5 (33) to the front brake valve.

The flow fuse shuttle valve (35) will re-act to any pressure imbalance between the 2 brake accumulators.

This enables the circuits to work independently in the event of a malfunction in one of the circuits.

The brake accumulator orifice 0.8mm controls the rate of oil flow from the accumulator.

# Hydraulic System Manifold Operation (Right View)



- 37. System Pressure Port, TP1.
- 38. Test Port, M4.
- 39. Brake Accumulator Charge Orifice, 0.7 mm.
- 40. Hydraulic Cutoff Solenoid Valve.
- 41. Main Hydraulic Pump Signal Shuttle Valve.
- 42. Steering Load Sense, L3.
- 43. Steering Supply Port, P3.
- 44. Main Hydraulic Pump Check Valve.

The brake accumulator charge orifice, 0.7 mm (39) controls the rate of oil flow through the accumulator charge valve, X4 (6) to the return circuit when the brake charge accumulator, (39) is charged.

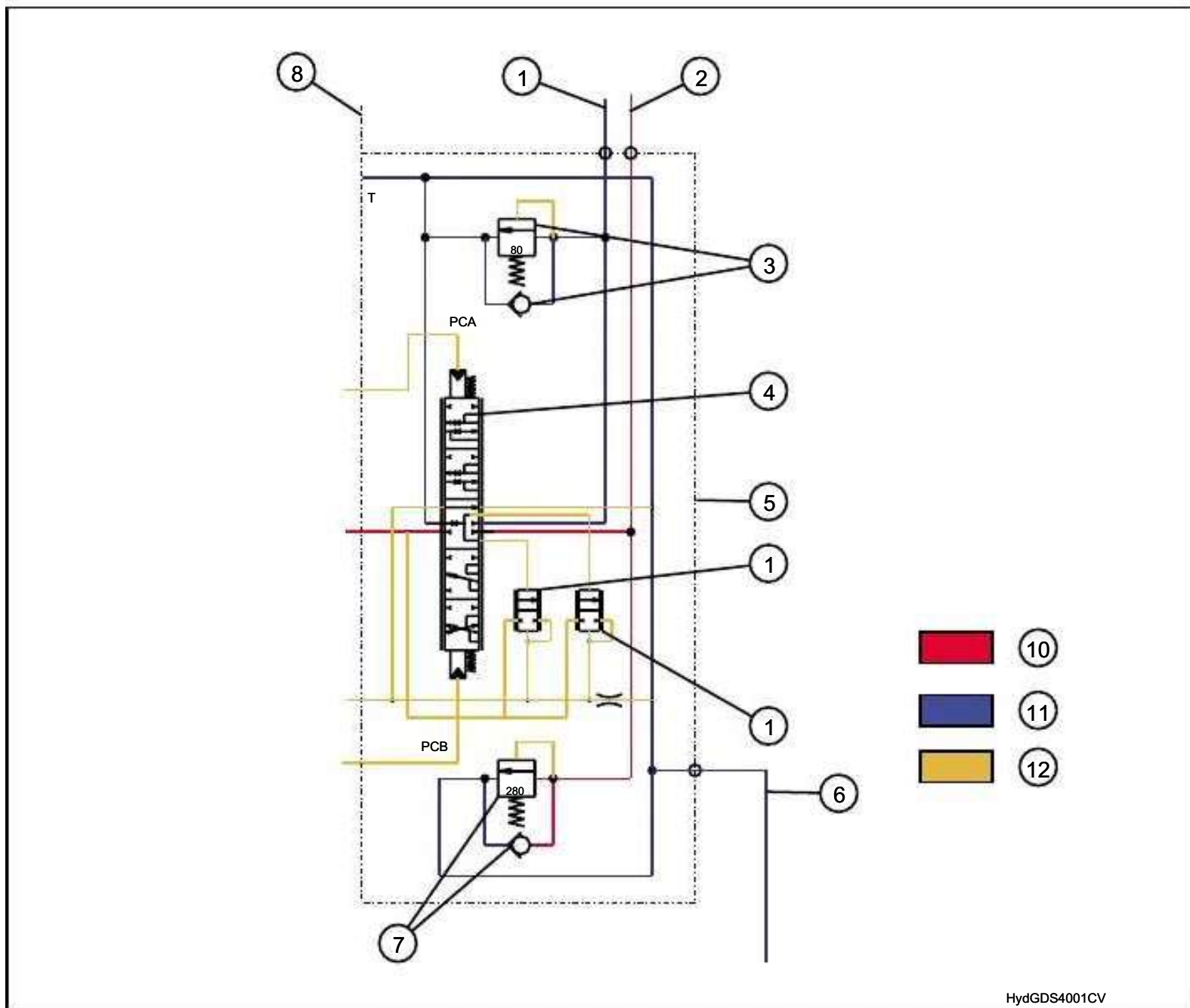
The hydraulic cutoff solenoid valve (40) prevents the brake charge accumulator and front and rear brake apply accumulators from being charged while starting the engine by opening the load sense signal to the return circuit.

The main hydraulic pump signal shuttle valve (41) routes the higher load sense signal from the bin control valve or the priority valve signal shuttle valve to the main hydraulic pump port, X.

The steering load sense port, L3 (42) receives the load sense signal from the steering valve port, LS. The steering supply port, P3 (43) sends supply oil to the steering valve port, P.

The main hydraulic pump check valve (44), prevents supply oil flow from the secondary steering pump from entering the brake charging circuit, and bin control circuit.

## Bin Control Valve Operation



- 1 To Bin Cylinder Rod End.
- 2 To Bin Cylinder Head End.
- 3 Bin Lower Circuit Relief and Anti-Cavitation Valve.
- 4 Air Actuated Spool Valve.
- 5 Bin Control Valve.
- 6 To Hydraulic Reservoir Return Filter.
- 7 Bin Raise Circuit Relief and Anti-Cavitation Valve.
- 8 Hydraulic System Manifold.
- 9 Bin Float Solenoid Valve.
- 10 Supply Oil.
- 11 Load Sense Oil.
- 12 Trapped Oil.
- 13 Return Oil.

The dump body control valve (5) is mounted on the hydraulic system manifold (8).

The dump body lower circuit relief and anti-cavitation valve (3) relieves pressure in the dump body cylinder rod end circuit.

The relief valve pressure setting is lower than the pressure setting for dump body raise circuit relief valve.

The anti-cavitation valve prevents cavitation from occurring when lowering the dump body with the engine not running.

Port B is connected to the dump body cylinder rod end (1). Return oil (13) flows from port T2 to hydraulic reservoir return filter (6).

In neutral, the load sense circuit for the dump body control valve is connected to return port T2 so there is no load sense signal.

Port A is connected to the dump body cylinder head end (2). The dump body raise circuit relief and anti-cavitation valve (7), relieves pressure in the dump body cylinder head end circuit.

The anti-cavitation valve prevents cavitation in the circuit if the cylinder is extended while the control valve is in neutral.

The hydraulically actuated spool valve (4) uses a hydraulic signal from the bin up or bin down solenoid valve pressure to shift the spool to the raise or lower position.

The spool is self-centering into the neutral position whenever the solenoids is not actuated.

When the dump body is lowered or stopped at approximately the last 5% (3. °) of travel, the bin down solenoid energizes, moving the bin valve spool to it's first position, allowing bin cylinder head end circuit to dump oil to the tank through an orifice.

The dump body will then float down until it contacts the frame.