Hydraulic Fan Drive System

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Hydraulic Fan Drive System

Safety
The purpose of this safety summary is twofold. First, it is to help ensure the safety and health of personnel performing work on this Blue Bird product. Second, it is to help ensure the protection of equipment. Individuals performing service on this Blue Bird product should adhere to applicable warnings, cautions and notes contained herein.

Warnings
Warnings refer to a procedure or practice, that, if not correctly adhered to, could result in injury or death.

Caution
Cautions refer to a procedure or practice that, if not correctly adhered to, could result in damage to, or destruction of, equipment.

Introduction
The All American rear engine bus uses a hydraulic fan drive. The hydraulic fan drive creates airflow through the engine-cooling radiator and the charge air cooler.

Hydraulic Fan Drive Components
1. Hydraulic Reservoir
2. Hydraulic Pump
3. Priority Oil Flow Divider Valve
4. Fan Motor
5. Fan Motor Control Valve
6. Pilot Control System
7. Hydraulic Oil Cooler

Description of Operation
The fan drive system responds to cooling requirements by monitoring engine coolant temperature and charge air temperature. The system then provides a modulated fan speed to meet cooling requirements for each system. **Figure 1—System Oil Flow Diagram.**

A hydraulic fan motor directly drives the engine Modulated fan speed will depend on the amount of oil flowing through the fan motor. The oil flow is measured in gallons per (GPM) minute.

Low oil flow results in low fan speed. As oil flow increases, fan speed increases.

Oil flow through the fan motor will depend on three main areas of the hydraulic fan drive system.

1. Pump speed
2. The amount of oil allowed to bypass the fan motor
3. Fan Circuit Relief Valve

A pump creates oil flow necessary to operate the hydraulic fan drive system. The pump is a positive displacement gear type pump.

As engine Revolution Per Minute (RPM) increases proportionately, oil flow increases. As engine RPM decreases, oil flow decreases proportionately.

The amount of oil allowed to bypass the fan motor is controlled by the fan motor bypass valve. The valve is located in the fan motor control valve, which is integrated into the fan motor housing.

The fan motor bypass valve is controlled by the hydraulic pilot operated circuit. The hydraulic pilot circuit is, in turn, controlled by a charge air override valve and a thermo-valve.

The charge air override sensor and the thermo-valve monitor charge air temperature and engine coolant temperature. As charge air and engine coolant temperature increase, the charge air override solenoid valve and thermo-valve respond, to control oil flow through the pilot circuit.

With the engine at full speed and at maximum operating temperature, the following conditions exist.

1. The pump would deliver maximum oil flow to the fan motor control valve.
2. The fan motor bypass valve would allow minimum oil to bypass the fan motor. This would result in maximum pressure developing in the fan drive circuit.
3. The fan circuit relief valve would open, limiting the system pressure.
4. This would allow oil to bypass the fan motor. Pressure relief at the fan motor allows the pressure relief valve to control maximum fan speed under those conditions.

Reservoir

A 12-quart reservoir provides a supply of clean, air free oil to the pump. The reservoir is vented and uses a dipstick and sight glass for monitoring the oil level. The reservoir has an internal filter that filters return oil flow from the fan and the steering column.

Hydraulic Pump

The single stage hydraulic pump provides oil flow for the fan drive circuit and the power steering circuit. This is done by a priority flow divider valve integrated into the back of the pump housing.

Priority Flow Divider

The flow divider valve prioritizes the steering circuit by providing 4.3 GPM flow to the steering circuit regardless of oil flow available for the fan drive circuit.
With proper operation of the flow divider valve, both systems function as if they have dedicated pumps.

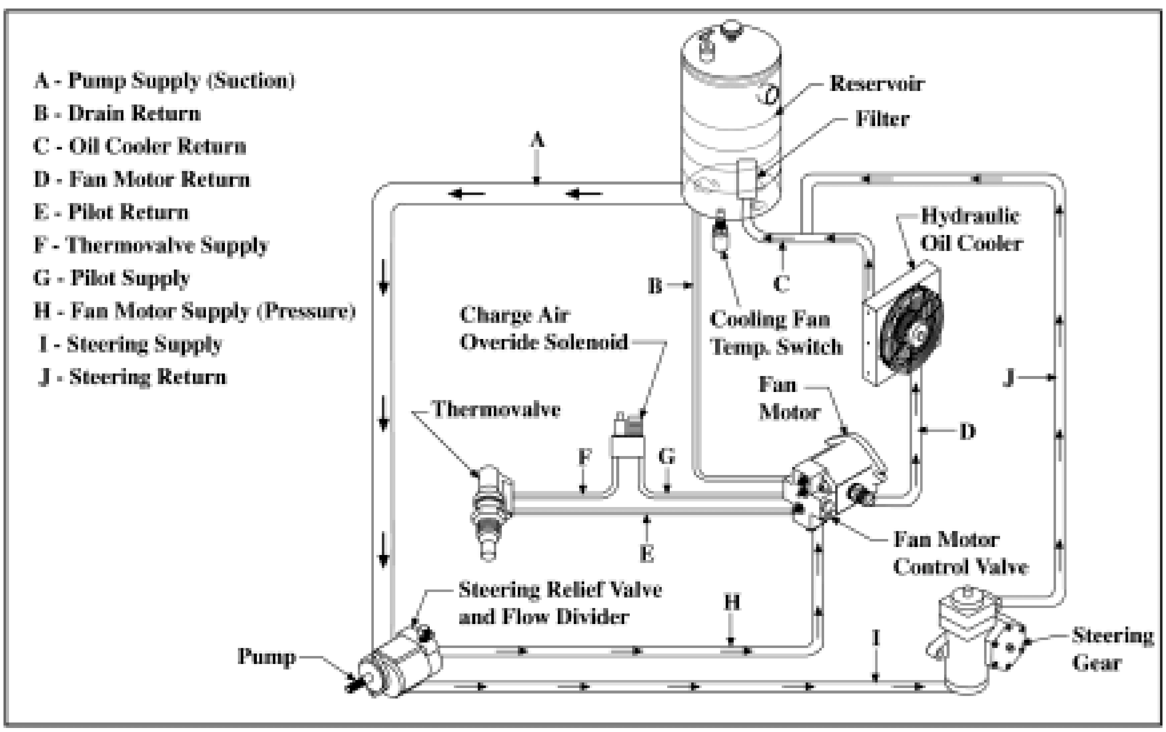


Figure 1—System Oil Flow Diagram

A steering circuit pressure relief valve is integrated into the flow divider housing. The valve limits pressure in the steering circuit only, and has no effect on the fan circuit.

Oil flow required for the fan drive circuit is approximately 4.3 GPM, depending on engine speed. Oil will flow to the fan motor control valve.

Fan Motor Bypass

The fan motor control valve has a fan motor bypass valve to modulate fan speed and a pressure relief valve to limit fan circuit pressure.

When the fan motor bypass valve is in the full bypass position, most of the oil will bypass the fan motor. Oil flow bypassing the fan motor flows through an integral passage in the fan motor control valve housing.

The fan will be in an "off" mode, with the engine operating below 185° Fahrenheit. In the "off" mode, the fan will rotate at a very low RPM, regardless of engine speed. As the engine RPM increases, there should not be a noticeable increase in fan RPM.

When the fan motor bypass valve is in full closed position, all fan circuit oil flow will be directed through the fan motor. The fan will be in a full run mode with the engine at maximum operating temperature and full engine speed.

As vehicle operating conditions change, the load on the engine changes. This will affect the engine operating temperature. To compensate for varying cooling needs, the bypass valve is designed and controlled to allow varying amounts of oil to bypass the fan motor.

This will result in a modulated (variable) fan speed of approximately 320 RPM at low operating temperatures to approximately 2240 RPM at maximum operating temperatures.

The RPM will vary, depending on the specific engine and engine specifications. The RPM referenced is for a typical 190-horse power (HP) Cummins Electronically Controlled "B" Series Engine. **Chart 1**.

Pilot Control Circuit

A hydraulic pilot circuit controls the fan motor bypass valve. A pilot-operated circuit is one hydraulic circuit controlling another hydraulic circuit. Usually, it is a smaller circuit controlling a large circuit.

This circuit consists of the following:

1. Hydraulic circuits that start at port P and stops at port R on the fan motor control valve. **Figure 1.1—Fan Motor Control Valves.**
2. Charge Air Override Solenoid
3. Thermo-valve
4. Bypass Valve

The pilot-operated circuit controls the position of the bypass valve by regulating the pressure in the pilot circuit. The pressure reacts against the bypass valve, spring tension and an opposing oil pressure to determine the bypass valve position.

Unrestricted oil flow in the pilot circuit will position the bypass valve in the full open position, allowing maximum oil flow to bypass the fan motor. This will result in a low fan speed. Any restriction in oil flow in the pilot circuit will result in a pressure increase, applying force to the bypass valve. This will make the valve move toward the closed position, limiting the amount of oil allowed to bypass the fan motor, resulting in an increasing fan speed.

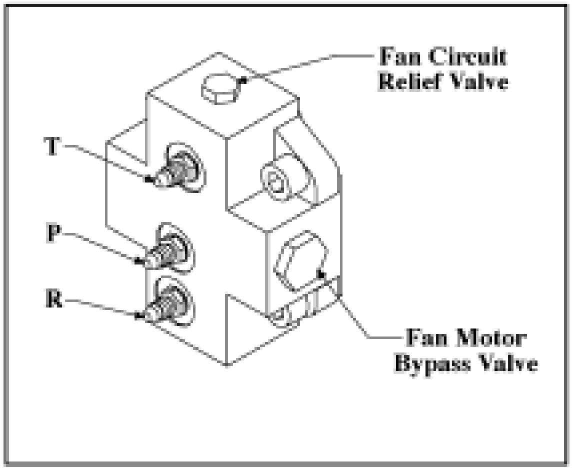


Figure 1.1—Fan Motor Control Valves

Charge Air Override Control Valve

There are two (2) control valves running in series in the pilot-operated circuit. Oil will flow from port P on the fan motor control valve to port P on the charge air override control valve. The oil will then flow to the port labeled "in" on the thermo-valve and return to the R port on the fan motor control valve, completing the circuit.

The charge air override solenoid consists of two (2) parts. The two parts are integrated into one valve body. These two parts are the charge air override solenoid (see **Figure 1.2—Pilot-Operated Circuit**) and the relief valve.

The charge air override solenoid is normally a closed, electromagnetic, on/off hydraulic solenoid valve. The solenoid is fully closed, maximum restriction (when de-energized) or fully open minimum restriction (when energized).

When the charge air temperature reaches 150° Fahrenheit, the charge air override sensor will open, de-energizing the solenoid valve. The closed valve will make a restriction, increasing pressure in the pilot-operated circuit. The pressure increase will force the bypass valve toward the closed position, increasing the fan speed.

Pressure will continue to increase in the pilot circuit, until the relief valve setting is reached. The valve will open, maintaining a moderate pressure against the bypass valve, while maintaining a moderate fan speed.

The integrated relief valve allows oil flow to bypass the solenoid valve when the solenoid valve is in the closed position. The relief valve is adjustable and preset at the factory. The valve allows a moderate fan speed during charge air fan operation.

A charge air override sensor monitoring charge air temperature in the engine air intake, controls the solenoid. It is normally a closed sensor set to open at approximately 150° Fahrenheit.

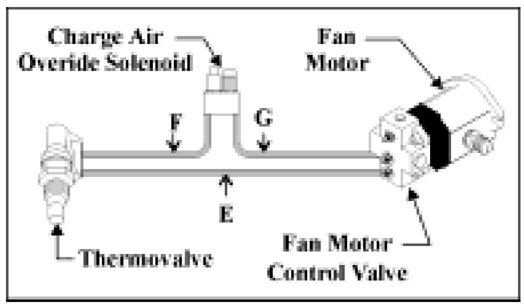


Figure 1.2—Pilot Operated Circuit

Thermo-Valve

Oil flow from the charge air override solenoid valve flows through the thermo-valve and returns to port T on the fan motor control valve.

The thermo-valve is a thermostatically sensitive hydraulic valve that monitors engine coolant temperature. This is the second valve in the pilot operated circuit.

The thermo-valve is designed to provide minimum restriction when engine coolant temperature is below 185° Fahrenheit and at maximum restriction when the engine coolant temperature increases to approximately 200° Fahrenheit.

The valve action is progressive, varying oil flow restriction for minimum to maximum, according to engine coolant temperature. This action varies oil flow restriction in the pilot-control circuit and varies fan speed from minimum to maximum, resulting in a modulated fan drive.

This configuration of the thermo-valve and the charge air override solenoid valve can independently, or in conjunction, control the fan speed.

Port T

Port T of the fan motor control valve is connected to the bottom of the reservoir. **Figure 1.1—Control Valves**.

Port T provides a vent line, preventing excessive pressure build up in low-pressure areas of the pump, including the area behind the shaft seal. This configuration extends the service life of the pump shaft seal.

Hydraulic Oil Cooler

Oil flowing from the fan motor flows through the hydraulic oil cooler, before returning to the reservoir. A liquid to air heat exchanger (Hayden oil cooler), separate from the engine cooling system, is used for cooling the hydraulic oil.

Air flow through the heat exchanger is created by an electric fan, controlled by a sensor, monitoring hydraulic oil temperature in the bottom of the hydraulic oil reservoir.

The sensor energizes the fan motor through a Bosch™ relay when the oil is approximately 160° Fahrenheit. The sensor will energize hydraulic oil over heat light on the instrument panel, if the oil reaches 200° Fahrenheit.

Description of Major Module

This section is used for the description and configuration of the major modules in the Hydraulic Fan Drive System.

Caution

When routing hydraulic hoses, make sure the hoses are away from sharp edges.

Caution

Do not operate the bus will a coolant leak, engine oil leak or hydraulic oil leak. Major engine damage will occur.

Hydraulic Reservoir

The 12-quart reservoir (39) supplies clean, air free oil to the hydraulic pump and is vented to the outside.

The reservoir has a sight glass to monitor oil level. The oil filter cleans return oil flow from the fan circuit and the steering circuit. **Figure 2—Oil Reservoir**.

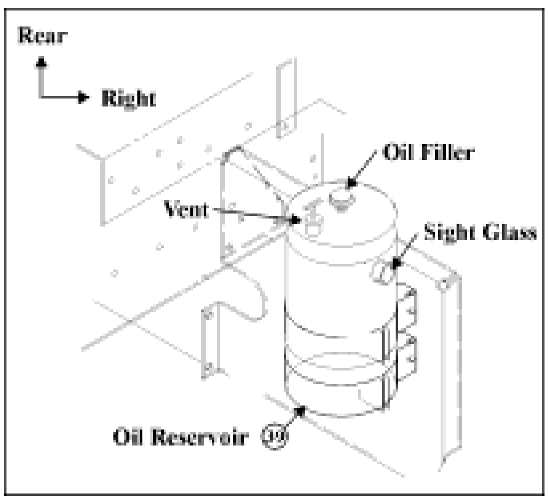


Figure 2—Oil Reservoir

Hydraulic Pump

The hydraulic pump (16) supplies oil flow for the fan drive circuit and the power steering circuit. The flow divider valve is responsible for the supply of oil flow to each circuit.

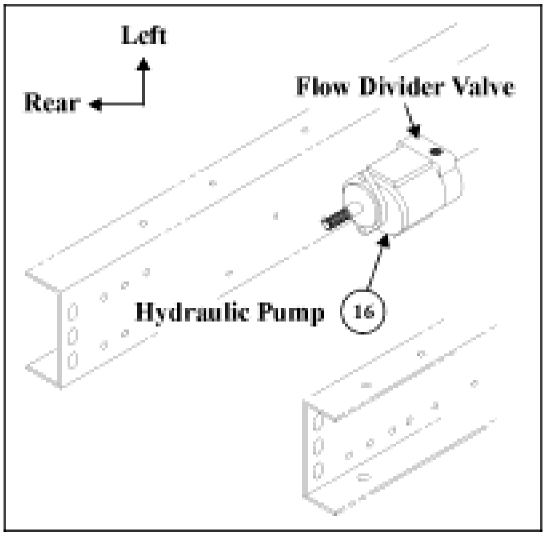


Figure 3—Hydraulic Pump

Hydraulic Fan Motor

The fan motor drives a fan to cool the charge air and engine coolant. The more oil that passes through the motor, the faster the fan speed.

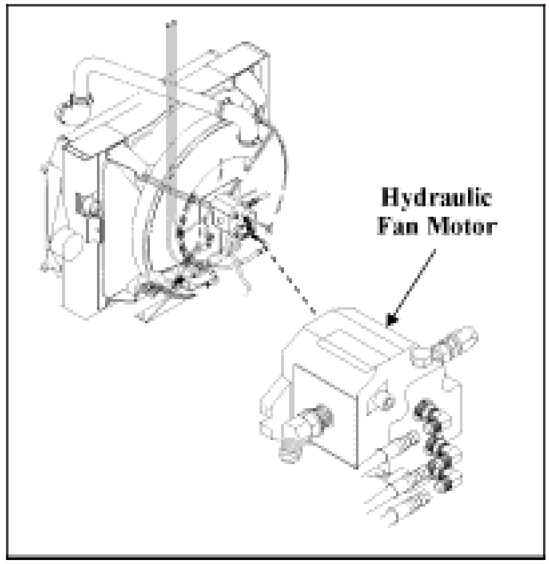


Figure 5—Hydraulic Fan Motor

Priority Oil Flow Divider Valve

The oil flow divider valve (16) prioritizes the steering circuit and supplies 4.3 GPM flow to the steering circuit. The valve has a pressure relief valve to limit steering circuit pressure.

The flow divider valve, the steering system and the hydraulic fan drive system function as if each system receives oil flow from a dedicated pump.

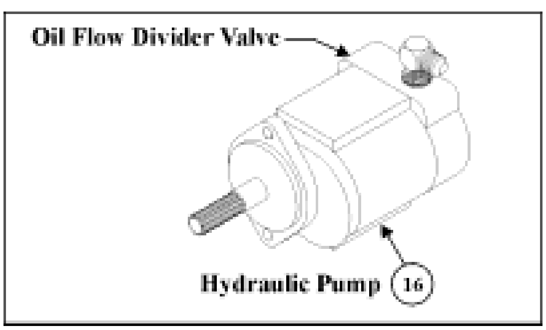


Figure 4—Oil Flow Divider Valve

Fan Motor Control Valve

The fan motor control valve uses the bypass valve and the pilot control system to module the fan. The fan motor control valve also serves as a pressure-limiting valve to protect the circuit.

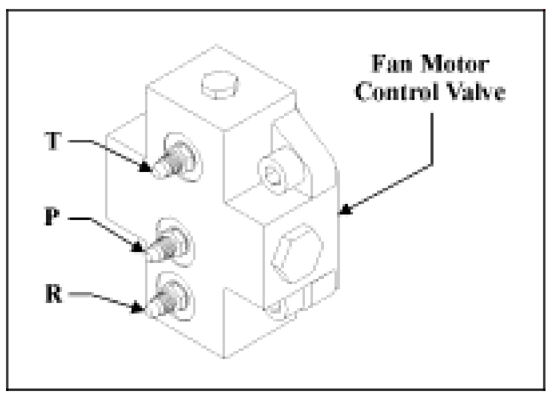


Figure 6—Fan Motor Control Valve

Pilot Control System Port (R P T)

The pilot control systems govern fan speed by using pilot oil flow restrictions.

Flow Restrictions convert to pressure and position the piston in the bypass control valve. The piston position determines the amount of oil flow that is delivered to the fan motor or reservoir.

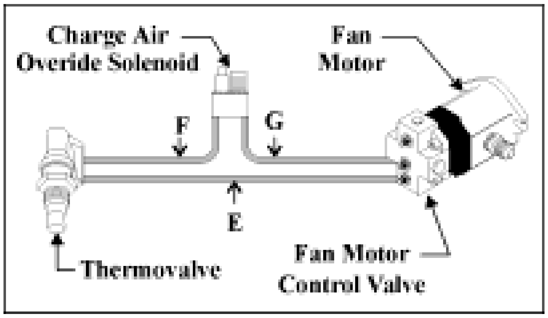


Figure 7—Pilot Control System Ports

Hydraulic Oil Cooler

The oil cooler (26) is an air to oil heat exchanger, located forward of the radiator (skirt-mounted).

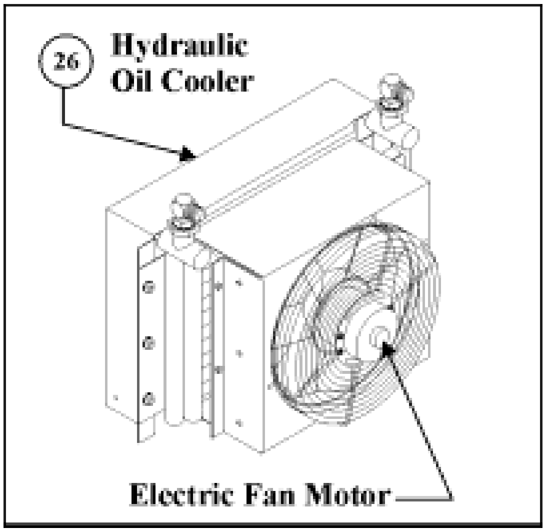


Figure 8—Hydraulic Oil Cooler

Engine Coolant Thermo-Valve

The thermo-valve (29) is the second valve in the pilot control circuit to receive oil and return the oil to port R.

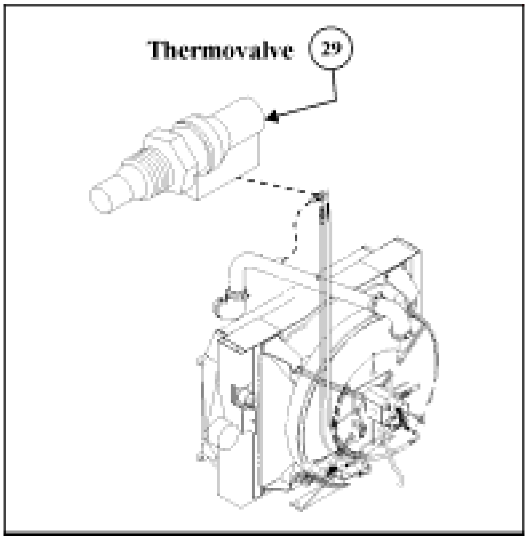


Figure 9—Engine Coolant Thermo-valve

Charge Air Override Control Valve

The solenoid (30) is an electromagnetic, on/off hydraulic relief valve, which is the first valve that receives pilot flow from port P in the fan control valve.

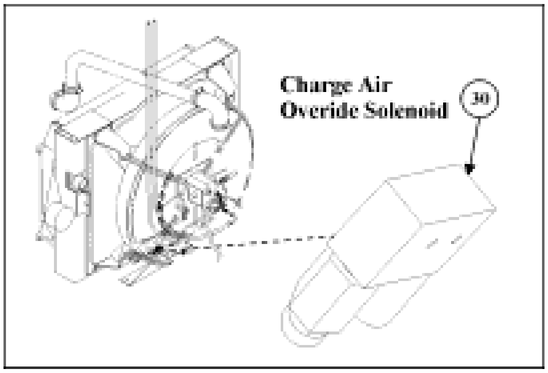


Figure 10—Charge Air Override Solenoid/Relief Valve

Charge Air Temperature Sensor (Kysor)

A Kysor™ sensor monitors the charge air temperature in the intake manifold and controls the charge air override solenoid.

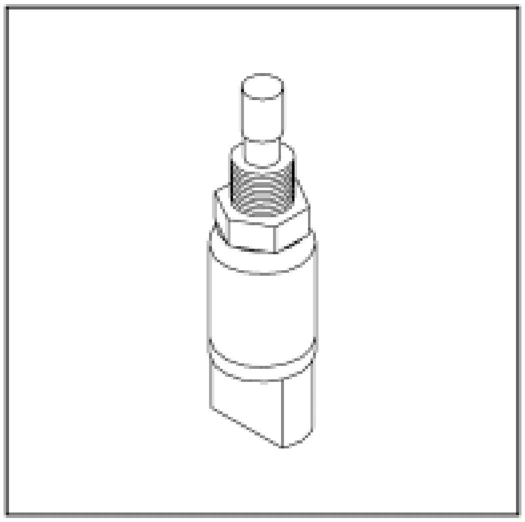


Figure 11—Charge Air Temperature Sensor

Cooling Fan Temperature Switch

The cooler fan temperature switch monitors the oil temperature controls the oil cooler electric fan and the hydraulic oil over headlight.

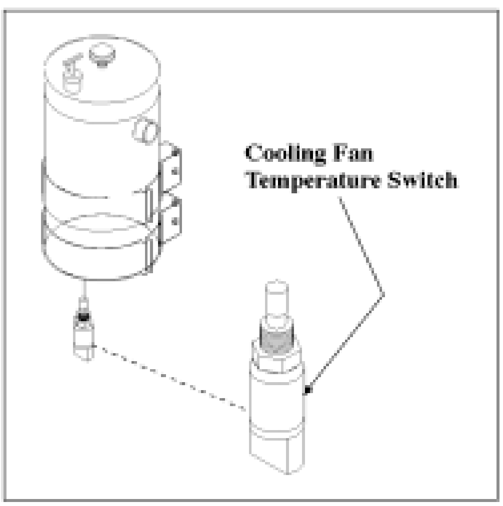


Figure 12—Cooling Fan Temperature Switch

Oil Reservoir Temperature Warning Light

The warning light turns on at 200° Fahrenheit. The light is located on the driver's instrument panel.

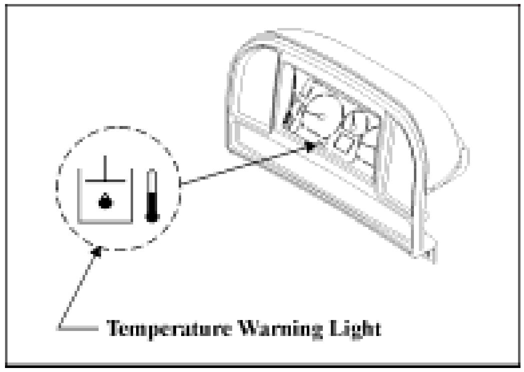


Figure 13—Oil Reservoir Temperature Warning Light

Hydraulic Fan Drive Troubleshooting

Tools Required

1. High pressure hydraulic test cut off valve
2. 0 to 4000 psi pressure gauge
3. Phototach
4. Power Steering Analyzer
5. Zero to 30 gallon per minute flow meter

Abbreviations

- Hydraulic fan drive circuit (HFDC)
- Hydraulic fan drive system (HFDS)
- Charge air override solenoid (CAOS)
- Gallon per minute (GPM)
- Revolution per minute (RPM)

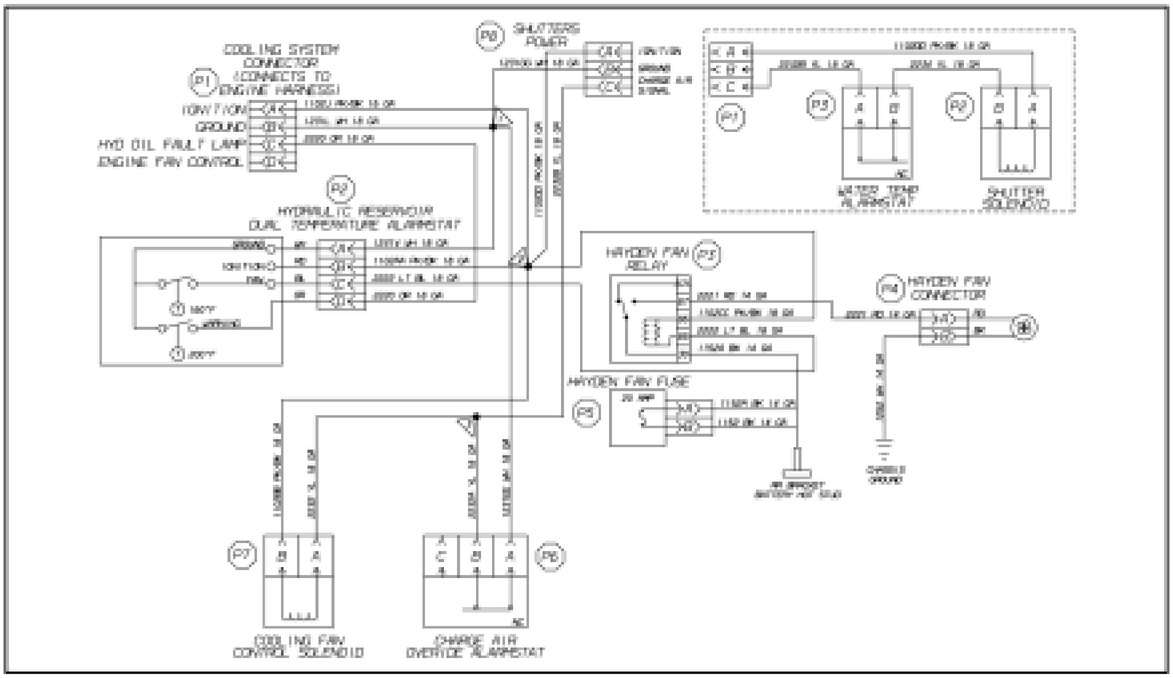
Symptom	Problem	Remedy
Hydraulic oil is not overheating. Hydraulic oil overheat indicator light is on.	Warning circuit or temperature sensor has failed.	1. Disconnect hydraulic oil temperature sensor connector. If light goes off, temperature sensor has failed. 2. Replace sensor. If light stays on, the warning circuit is grounded. 3. Check and repair circuit.
Hydraulic oil overheat light on.	Hydraulic oil overheating (Hydraulic System Failure) **Caution**: *Do not problem temperature sensor. Electronic circuitry can be damaged.* Hayden hydraulic oil cooler contaminated externally.	Refer to Hydraulic Fan Drive Troubleshooting Clean the cooler thoroughly.
Hayden oil cooler electric fan will not run.	1. Check Hayden fan fuse for continuity. 2. Check for 12 volt on number 30 pin of the Hayden fan cooler. 3. Jumper between terminal 30 and 87 of the fan relay. 4. If the fan does not run, jumper 12 volt to terminal A and a ground to terminal B of the Hayden fan connector. 5. If the fan motor does not run, the fan motor and fan circuits are okay. The relay or the hydraulic oil sensor has failed. With ignition on, check for 12 volt on terminal 86 of the fan relay. ➢ Disconnect the hydraulic oil temperature sensor on connector P2 ➢ Jumper a ground to terminal 85 of the Hayden fan relay.	1. Replace fuse if no continuity. 2. If 12 volt is not present, check circuit between fuse and relay. 3. If the motor does not run, the motor has failed. Replace motor. 4. If the motor does not run, the motor has failed. Replace motor. 5. Check relay and/or temperature sensor. If the fan runs, the hydraulic oil sensor or the circuit is at fault. If the fan runs, the hydraulic oil sensor or the circuit is at fault.

Chart 1—Troubleshooting (1 of 2)

Symptom	Problem	Remedy
Hayden oil cooler electric fan will not run	6. Jumper a ground to terminal C on the temperature sensor connector P2 7. With ignition on, check for 12 volt on pin B of the temperature sensor connector P2 8. Check for ground on pin A of the temperature sensor connector P2 9. It tests on pins A, B and C check OK, the temperature sensor is faulty	If fan runs, circuit is OK. If the fan does not run, check circuits between sensor and relay. If 12 volt is not present, check circuit. If a ground is not present, check circuit. Replace sensor.

Noisy Fan Drive	1. Low oil supply 2. Restricted oil supply	Check oil level and refill. Check for restriction to oil supply hose inside of reservoir. Check for restriction in supply line. Check for kinked supply line. Look for obstruction inside of supply hose. Check for a collapsed supply hose.
Air in the oil supply	**Note** Remove the dipstick, shine a light into the reservoir, and look for bubbles. Oil should be air-free.	Check oil level in reservoir. Check for loose fitting on supply lines. Check for restriction in supply hose. Check the hydraulic pump shaft seal.
Mechanical Failure	**Note** Rotation of fan is done in the normal rotation direction	Check for excessive metal in filter, as this will indicate a mechanical failure. With the engine off, spin the fan by hand and check for free rotation. Fan should rotate freely with no excessive noise.
Fan not rotating and hearing excessive noise		Remove and replace motor.
Normal oil color with air in the supply line	**Note** Oil overflowing will have air mixed with it or will be foamy	Reservoir may be overfilled Check for loose connection on the supply hose. Check for restriction in supply hose. Check hydraulic pump shaft seal.
Discolored oil is black like engine oil		Check pump shaft seal. Seal has failed, allowing engine oil to transfer into the hydraulic system.

Chart 1—Troubleshooting (2 of 2)



Schematic 1—Hayden Hydraulic Oil Cooler Circuit

Caution

Do not operate bus with a coolant leak, engine oil leak, or hydraulic oil leak. Major engine damage will occur.

Engine is Over-heating

A—Check Engine Coolant Level

1. Check all hoses for leaks.
2. Check all valves for leaks.
3. Check for radiator blockage.

B—Check Hydraulic Oil Level

1. Check reservoir level.
2. Check all hoses for leaks.
3. Check all valves for leaks.

C—Check for Air in the Hydraulic Oil

1. Remove the dipstick.
2. Shine a light in the reservoir and look for air bubbles.
3. If air bubbles are in the oil or the oil is foamy:
    a. Check oil level in reservoir.
    b. Check connections on the pump supply line.
    c. Check for restriction in supply hose, internal and external.
    d. Check the hydraulic pump shaft seal.

D—Check De-Energize the Charge Air Override Solenoid (CAOS)

Caution

Do not operate bus or run test if engine temperature is above 212° Fahrenheit. Major engine damage will occur.

Note

De-energizing the CAOS will cause the fan to operate in a charge air override mode all the time rather than cycling on and off to meet charge air-cooling needs. In this mode of operation, the hydraulic fan drive system will operate at approximately 50% to 60% of maximum efficiency.

1. With the engine temperature above 250°, accelerate the engine from idle to full RPM and visually observe the fan speed.
   a. If the fan speed does not increase as engine speed increases, disconnect the electrical circuit at the CAOS or the electrical circuit at the charge air override sensor.
2. Accelerate the engine to full RPM and observe the fan speed.
   a. If there is a large increase in fan speed with the CAOS de-energized, the thermovalve is at fault.
3. Replace the thermovalve
   a. If there is no large increase in fan speed, go to Step I—Check Hydraulic Fan Circuit Pressure
   b. If the engine temperature is below 200° Fahrenheit.
4. Disconnect the electrical circuit at the CAOS, disconnect the electrical circuit at the charge air override sensor.
5. Test-drive the bus to determine if this resolves the over-heating.
   a. If this resolves the problem, the thermovalve is at fault. Replace the valve.
   b. If this does not fix the problem, refer to Step I—Check Hydraulic Fan Circuit Pressure.

Caution

Do not operate a bus with the CAOS de-energized. This is a test procedure only. Operating the bus with CAOS de-energized can result in the following conditions.

- Shorten the life of the hydraulic fan drive system
- Increase service requirements for the HFD
- Decrease fuel mileage
- Over cool the engine
- Shorten the life of the engine thermostat
- Decrease efficiency of the engine
- Adversely affect the engine's emissions system

Caution

Operating the hydraulic fan system in a charge air override mode may provide adequate cooling under light operating loads and cooler weather. Bus may overheat under heavier loads and hotter climate.

E—Check the Condition of the Fan Blade

Warning

Rotating fan blade can cause serious bodily injury.

- *Check for cracked, chipped or broken fan blades.*
- *Replace the fan if needed.*

F—Check the Fan Motor for Free Rotation

Note

The hydraulic fan drive system should be thoroughly flushed when the system has been opened for mechanical repair.

Note

The fan should rotate smoothly with some resistance from oil in the fan motor.

- With the engine off, manually rotate the fan.
- A rough rotation indicates a mechanical failure in the fan motor.
- Repair or replace the fan motor.

G—Check Radiator for External Contamination

1. Inspect the entire area of the radiator and the charge air cooler for obstructed airflow using a light source.

Note

The charge air cooler may have to be removed to properly clean the radiator.

2. Clean the radiator and charge air cooler, as necessary.

H—Check Radiator and Charge Air Baffles

Note

Missing or damaged baffles can cause heated engine compartment air to re-circulate through the radiator, causing an overheating condition.

1. Check the condition of the baffles between the radiator and the charge air cooler.
2. Check the condition of the baffles between the charge air cooler and the bus body.
3. Replace or repair baffles, as necessary.

I—Check Hydraulic Fan Circuit Pressure

Check hydraulic fan circuit pressure with engine temperature between 205 and 210° Fahrenheit.

There are two methods for checking the pressure.

Method 1

Warning

Do not exceed maximum pressure ratings for the system. Bodily injury can occur.

1. Install a test fitting in hydraulic line H and pressure gauge that will function from 0 to 4000 PSI.
2. Start the engine and accelerate to full RPM while observing the pressure gauge.
3. Compare the pressure with the specifications. See Table 2—Hydraulic Cooling System Performance Rear Engine.
   - If the pressure reading is low, the HFDS is at fault. Go to Step J—Check Fan Speed.
   - If the pressure reading is correct and the fan speed appears to be correct, this is an indication that the overheating is in the cooling system. Refer to Section 040—Cooling System.

Method 2

Note

This procedure bypasses the thermovalve and should cause fan to run at full speed and full system pressure.

1. Disconnect hydraulic line G from fan motor control valve.
2. Install a pressure gauge that will function from 0 to 4000 PSI in port P on the fan motor control valve.
3. Start the engine and accelerate to full RPM while observing the pressure gauge.
4. Compare the pressure with the specifications. See Table 2—Hydraulic Cooling System Performance HDRE.
   - If the pressure is low, the HFDS is at fault. Go to Step J—Check Fan Speed.
   - If the pressure reading is correct and fan speed appears to be correct, it is an indication the overheating is in the cooling system. Refer to Section 040—Cooling System and specific manufacturer's troubleshooting guide.

J—Check Fan Speed

Note

Fan should run at full TPM with engine temperature above 205°, provided the engine is at full RPM.

Check fan speed with engine temperature between 205° and 210° Fahrenheit.

1. Start engine and accelerate to full RPM.
2. Check the fan RPM with a Phototach. Compare with specification. See Table 2—Hydraulic Cooling System Performance Rear Engine.

If the fan speed is within specification, the HFDS is not at fault.

3. Check the engine cooling system to determine overheating. Refer to Section 040—Cooling System and specific engine manufacturer's troubleshooting guide.

If the fan does not run at full TPM, one of the following is at fault:

- *Thermovalve*
- *Hydraulic Pump*
- *Priority Flow Divider Valve*
- *Fan Motor Control Valve*
- *Fan Circuit Relief Valve*
- *Fan Motor*

Check fan speed with engine temperature below 200° Fahrenheit.

Warning

The test valve must be capable of withstanding 5000 PSI and designed for hydraulic test purposes. The use of improper test equipment can cause serious injury.

1. Disconnect hydraulic lines E and F. See Figure BB—Hydraulic Fan Drive Circuit from the thermovalve.

Note

Make sure the valve is in the full open position.

2. Connect hydraulic lines E and F to A hydraulic cut off test valve.
3. Start engine and accelerate to full RPM.
4. Observe the fan speed using a Phototach while slowly closing the cut off valve.
   - If fan speed reaches full RPM, the thermovalve is defective. See Table 1—Troubleshooting.
   - If the fan does not run at full TPM with the test valve closed completely off, the fault is in one of the following areas.
     - Hydraulic Pump
     - Priority Flow Divider Valve
     - Fan Motor Control Valve
     - Fan Circuit Relief Valve
     - Fan Motor

K—Test the Hydraulic System

Caution

Clean and lubricate all parts before assembly.

Note

Careful disassembly, cleaning and reassembly of the flow divider valve may resolve the problems. Fine emery cloth dipped in a cleaning solvent may be used to polish spool valves. All spool valves should move freely through the bore inside the valve body.

1. Install 0 to 30 GPM flow meter in H line.
2. Start engine and accelerate slowly to full RPM and observe GPM. See Table 2—Hydraulic Cooling System Performance Rear Engine.
   - If GMP is within specifications, go to Step FF.
   - If the GPM is low, stop engine and install a power steering analyzer in H line (the steering circuit supply line). Refer to Section 120—Steering.
3. Start engine and accelerate to full RPM, and observe the GPM in the power steering circuit.
   - If GPM is within specification, the pump is at fault. See Table 2—Hydraulic Cooling System Performance Rear Engine.
   - Replace or repair pump.
   - If GMP is higher than specified, the priority flow divider valve is at fault.
4. After replacing or repairing the flow divider, recheck steering system and

hydraulic fan drive system flow rates and fan speed. Compare data with specifications. See Table 2—Hydraulic Cooling System Performance Rear Engine.

➢If systems are not within specification, proceed with troubleshooting.
➢If the GPM is within specification, one of the following is at fault.

1. Fan Motor Control Valve (FMCV). Repair or replace the FMCV.
2. Fan Circuit Relief Valve (FCRV). Repair or replace the FCRV.
3. Fan Motor. Disassemble and inspect the fan motor for internal damage. Replace or repair.

Cummins 8.3, Rear Engine Bus, Pump (31.5 cc), Motor + S53 (16.8), Trim RPM (2200)			
Engine Speed RPM	Pump Flow GPM	Motor/Fan Speed RPM	System Pressure PSI
700	0.90	178	13
850	1.99	395	64
1000	3.09	613	155
1150	4.19	831	285
1300	5.29	1049	453
1450	6.39	1267	661
1600	7.49	1484	908
1750	8.59	1702	1194
1900	9.68	1920	1519
2050	10.78	2138	1883
2200	11.88	2200	1994
2225	12.06	2200	1994
2250	12.25	2200	1994
2275	12.43	2200	1994
2300	12.61	2200	1994
2325	12.80	2200	1994
2350	12.98	2200	1994
2375	13.16	2200	1994
2400	13.34	2200	1994
User Input			
1818	9.08	1801	1336

Table 1—Fan Speed vs Engine Speed Cummins ISB—Rear Engine

Data Reflects 885 Pump and Motor Performance											
Kysor Fan BBC #1855634											
Engine	**Pump Disp C.I.**	**Motor Disp C.I.**	**Idle RPM**	**Drive Ratio**	**Gov'd RMP**	**No Load RPM**	**Relief PSI**	**Max Fan RPM**	**P/S GPM**	**Max GPM**	**Fan RPM Idle**	**Eng RPM Trim**
ISB	**1885854**	**1964923**										
190	1.92	1.03	800	1:1	2600	2800	2030	2240	4.3	20.5	320	2130
195-275	1.92	1.03	800	1:1	2500	2700	2030	2240	4.3	19.7	320	2130
ISC	**1885854**	**1964931**										
215-250LT	1.92	1.03	800	1:1	2400	2600	2175	2400	4.3	19	320	2240
250-	1.92	1.03	800	1:1	2200	2400	2175	2400	4.3	17.6	320	2240

275HT												
ISC	**0001051**	**1964931**										
300	216	103	800	1:1	2200	2400	2175	2400	4.3	22.4	451	1991
3126b	**1964980**	**1964931**										
190-210	1.57	1.03	700	1:1	2500	2640	2175	2400	N/A	15.8	824	2030
250-300	1.57	1.03	700	1:1	2400	2640	2175	2400	N/A	15.8	824	2030
JD 8.1	**1855543**	**1964923**										
250	1.57	1.03	700	.96:1	2200	2424	2030	2240	N/A	14	797	1968

Table 2—Hydraulic Cooling System Performance, Rear Engine

Hydraulic Flushing Procedures

The hydraulic flushing procedures should be used whenever component failures have accrued in the system.

Caution

Failure to thoroughly flush and clean all areas of the hydraulic system after a failure may cause repeat failure of the same component.

1. Remove the hydraulic pump, fan motor and all hoses.
2. Disassemble, inspect and clean any component that is to be used again.
3. Flush all hydraulic hoses.
4. Flush the thermovalve.
5. Remove the filter inside the reservoir.
6. Flush the reservoir and install a new filter.
7. Remove the stop bolt in the bottom of the steering gear and the steering circuit pressure relief valve. Refer to Section 120—Steering.
8. Place chocks at the rear wheels.
9. Lift the front axle off the ground.
10. Turn the steering wheel to full turn left and right four times.
11. Clean the stop bolt and pressure relief valve.
12. Install the stop bolt and relief valve.
13. Install all removed components and hoses.
14. Fill the hydraulic reservoir with 10W/30W Haveoline oil.

Note

Oil level must be maintained in the sight glass while the engine is running.

15. Start and run the engine for 30 seconds.
16. Stop the engine and refill the reservoir.
17. Repeat Steps 14 and 15 until oil level is maintained in sight glass.
18. Restart the engine.
19. Disconnect the electrical circuit at the charge air override solenoid valve. This will cause the fan to run at a moderate speed.
20. Run the engine at approximately 1500 RPM.
21. Reconnect and disconnect the electrical charge air override circuit 3 times.
22. Place chocks at the rear wheels.
23. Jack the front axle off the ground.
24. Turn the steering wheel to full turn left and right four times.
25. Run the engine for 10 minutes and repeat steps 21 and 24.
26. Stop the engine.
27. Drain the oil from the reservoir.
28. Remove the filter from the reservoir.
29. Install a new filter.
30. Fill the reservoir with 10W/30W oil.
31. Inspect the total hydraulic system for leaks.
32. Test drive the bus.

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