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SERVICE TRAINING

TECHNICAL PRESENTATION



793D (FDB) OFF-HIGHWAY TRUCKS

INTRODUCTION

NEW PRODUCT INTRODUCTION

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(NPI)

793D OFF-HIGHWAY TRUCKS

INTRODUCTION

CONTENT

This presentation provides new and different New Product Introduction (NPI) information for the 793D Off-highway Truck. This presentation may be used for self-paced and self-directed training.

OBJECTIVES

After learning the information in this presentation, the technician will be able to:

1. locate and identify the new components;
2. explain the operation of the new components in the systems; and
3. trace the flow of oil or air through the new systems.

REFERENCES

“793C Off-Highway Truck, (4AR, 4GZ, ATY) Comparison Information”	Download
“793C Update (4GZ, ATY) Off-Highway Truck”	SERV1722

Estimated Time: 8 Hours

Visuals: 59

Handouts: 1

Form: SERV7105-08

Date: 08/05

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NOTE: The Reference Materials have information on systems with no significant changes.

NOTES

793D OFF-HIGHWAY TRUCK INTRODUCTION



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1

INTRODUCTION

Shown is the right side of a 793D Truck. The 793D has a redesigned hydraulic system, an improved cooling package, an extended life power train, and a number of other changes to be covered in this presentation.

The machine weights, the payload ratings, the altitude de-rate, and the fuel efficiency will not change.

The following items are key new features:

- Increased speed
- Extra retarding
- Continuous rear axle filtration
- Horsepower increase
- Improved cooling package
- Extended wheel station life
- Hydraulically driven engine coolant fan
- Steering hydraulic system changes

NOTE: The "HYDRAULIC SCHEMATIC COLOR CODE" is located after the "CONCLUSION" of this presentation.

The following specifications are for the 793D Truck (dual slope body, no liners):

- Serial No. Prefix: FDB
- Empty weight: 144651 kg (318895 lbs.)
- Load carrying capacity: 218 metric tons (240 tons)
- Gross Machine Weight (GMW): 376488 kg (830000 lbs.)
- Length: 12.9 m (42.2 ft.)
- Width: 7.4 m (24.3 ft.)
- Height: 6.4 m (21 ft.)
- Gross Power: 1800 kW (2415 hp)

SIMILARITIES AND DIFFERENCES

FEATURES	DIFFERENT	SIMILAR	SAME
Machine Appearance			X
Operator's Station			X
Engine		X	
Power Train	X		
Steering	X		
Hydraulic System	X		
Maintenance Items		X	

Similarities and Differences

The chart above shows the similarities and differences between the earlier 793C Off-highway Truck and the updated 793D Off-highway Truck.



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ENGINE

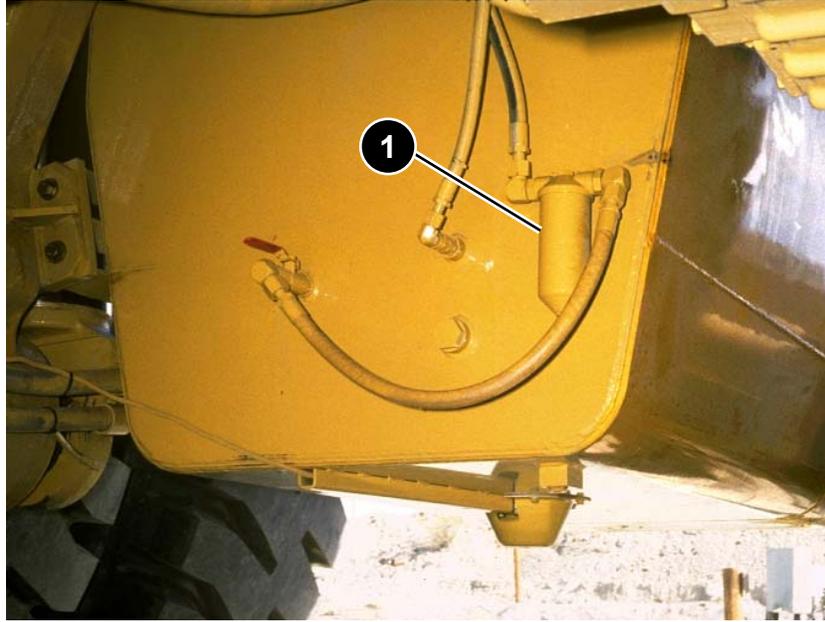
Shown is the right side of the 3516B Engine equipped with the Electronic Unit Injection (EUI), that is used in the 793D Off-highway Truck. The following items are the changes to the engine:

- 5% Gross Power increase to 1800 kW (2415 hp)
- 25% More Water Flow for Retarding
- Machine-mounted Hydraulically Driven Coolant Fan
- Air Cooled Engine ECM
- Relocated A/C Compressor

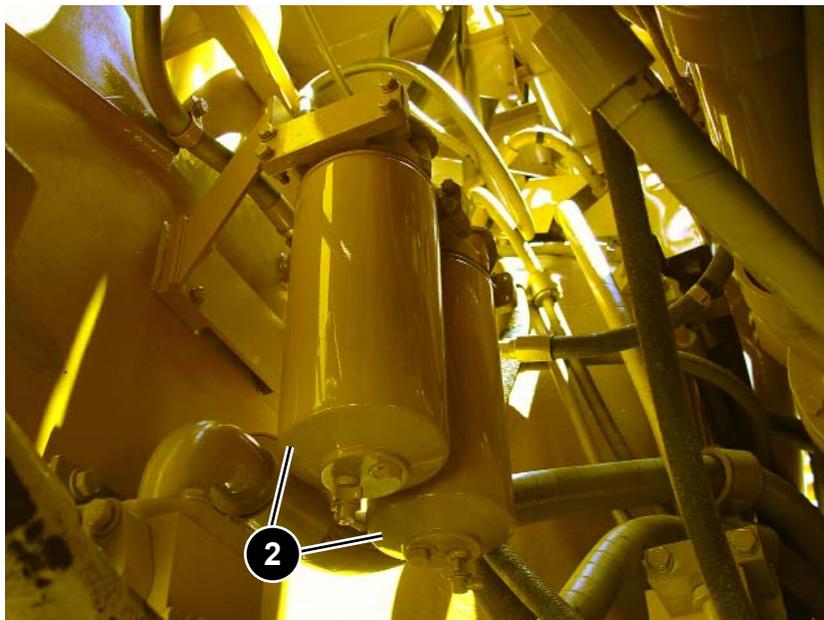


The engine performance specification for the 793D Truck is:

- Serial No. Prefix: 8WM
- Performance Spec: 0K5567
- Max Altitude: 2591 m (8500 ft.)
- Gross Power: 1800 kW (2415 hp)
- Full Load rpm: 1750
- High Idle rpm: 1960 ± 40
- Low Idle rpm: 700 ± 15



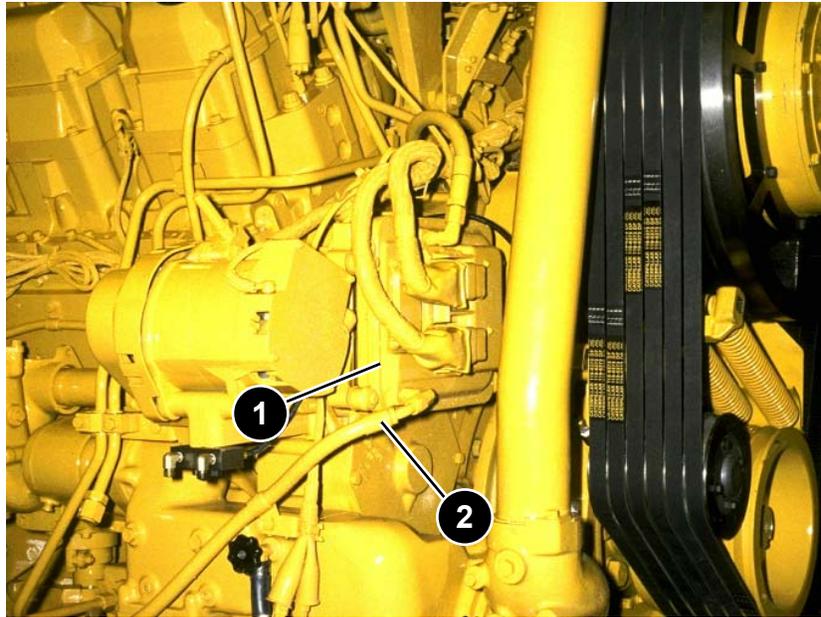
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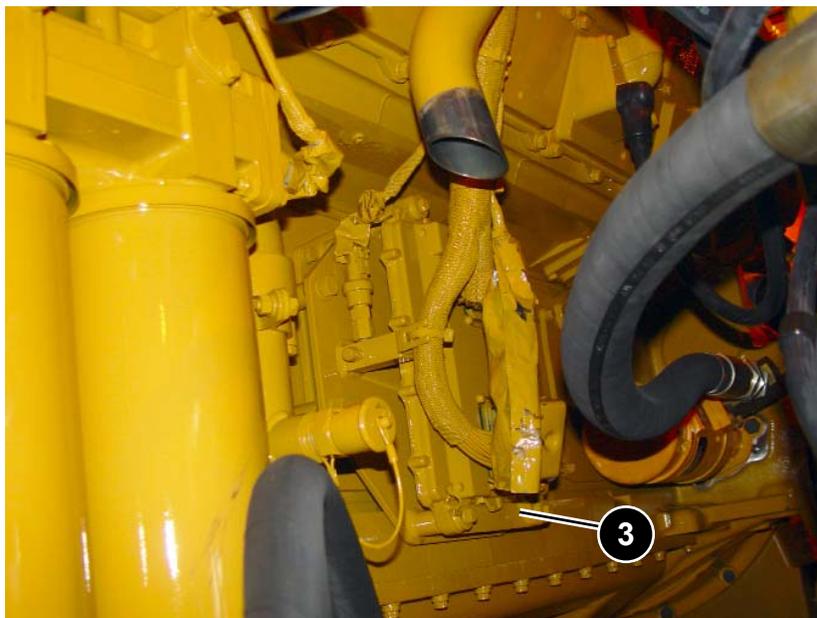
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Shown in the top visual is the primary fuel filter (1) on the 793C. This filter is mounted on the back side of the fuel tank. Fuel is pulled through the filter by the fuel transfer pump which is mounted on the right side of the engine.

The 793D, shown in the bottom visual, has two optional fuel/water separators (2) in place of the single primary filter as on the previous machine. These filters are mounted inside the right frame rail adjacent to the engine. A valve located on the bottom of the filter provides a means to drain water that has separated from the fuel.



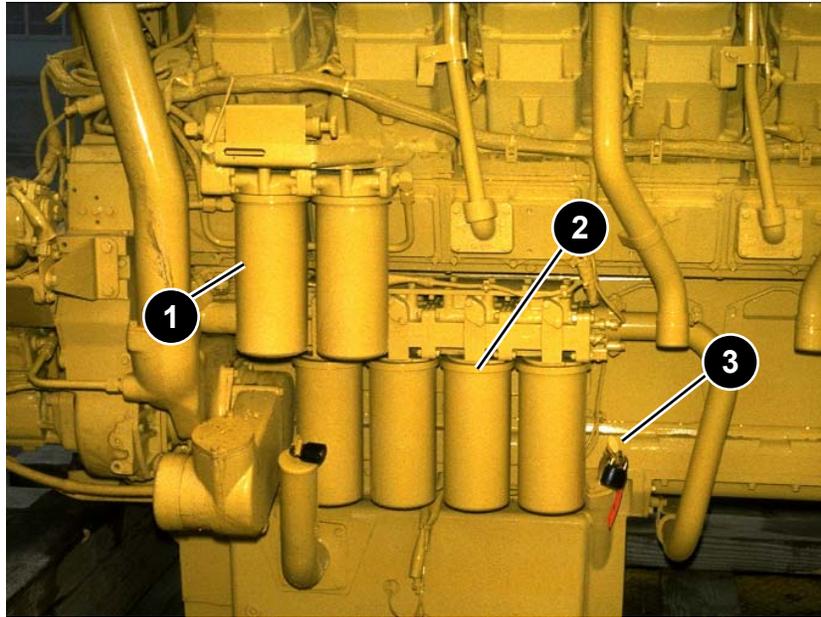
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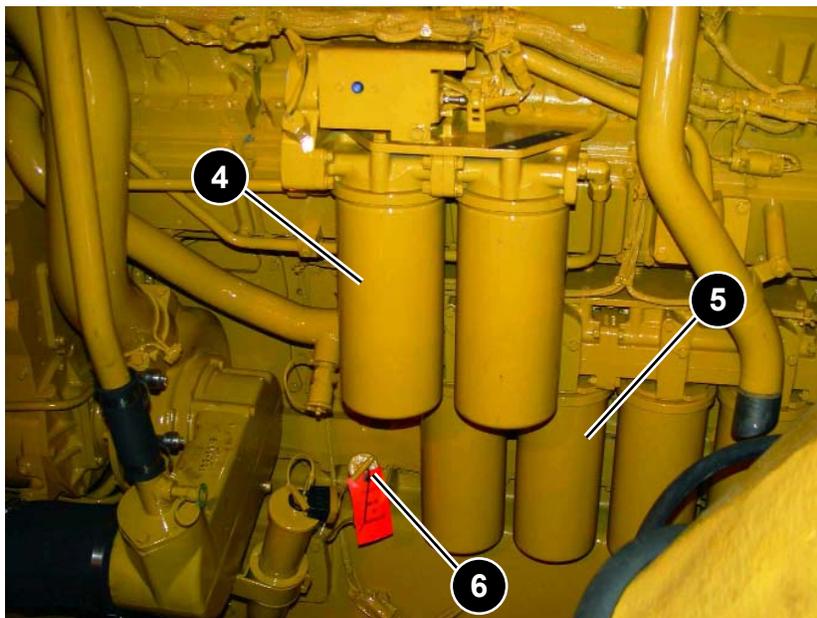
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The top visual of the 793C shows the Engine ECM (1) located on the right front corner of the 3516B. Fuel flowing through hose (2) is used to cool the Engine ECM. Fuel flows from the fuel transfer pump through the Engine ECM to the secondary fuel filters.

The bottom visual shows the Engine ECM (3) on the 793D located on the left side of the engine. Engine ECM (3) is air cooled, therefore the absence of fuel lines for cooling can be noted.



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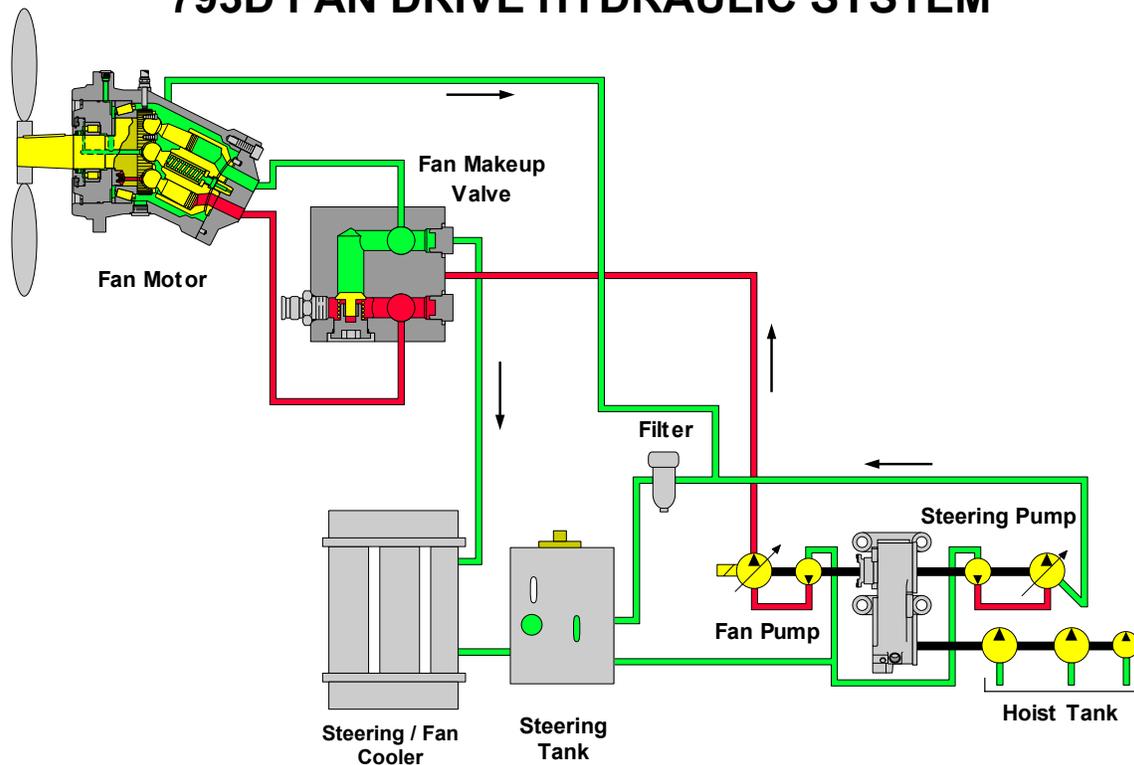


9

The 793C secondary fuel filters (1), engine oil filters (2), and engine oil dipstick (3) are shown in the top visual.

The 793D secondary fuel filters (4), engine oil filters (5), and engine oil dipstick (6) for the are shown in the bottom visual. The filters have been moved rearward one cylinder position. The engine oil dipstick has been moved to the center position on the engine oil pan.

793D FAN DRIVE HYDRAULIC SYSTEM



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Hydraulic Cooling Fan

The fan is hydraulically driven. A variable displacement piston-type pump provides oil flow to the fixed displacement motor. The hydraulic motor turns the fan blades. After flowing through the steering/fan cooler, the oil returns to the steering tank.

If supply oil to the fan stops suddenly, the fan and fan motor may continue to rotate because of the mass of the fan. The makeup valve allows oil to flow from the return side of the circuit to the supply side to prevent a vacuum in the supply lines.

The fan speed is determined by the amount of flow from the fan pump since the fan motor is a fixed displacement motor. The fan pump, which is a variable displacement pump, has a displacement solenoid that is controlled by the Brake ECM. Controlling the solenoid current subsequently controls the fan speed. The output to the solenoid is determined by the following inputs:

- Transmission lube temperature
- Torque converter lube temperature
- Brake temperature
- Brake cooling pump speed sensor
- Engine aftercooler temperature
- Ground speed
- Engine coolant temperature
- Engine cooling fan speed sensor



The cooling logic on the 793D controls two systems: the engine cooling fan system and the brake cooling system. The cooling logic requests temperature information from various controls over the CAT data link. This information is combined to determine the desired engine cooling fan speed and the desired brake cooling motor speed.

The engine cooling fan and the brake cooling motor could be ON, OFF, or MODULATED based on feed back to the Brake ECM. The cooling logic has the following modes of operation:

NO COOLING

Both the engine cooling fan and the brake cooling motor are turned OFF. They are both turning at minimum speed.

MODULATED COOLING

The engine cooling fan is modulated. If the brake temperatures are not high (hot) enough, then the brake cooling motor is modulated, as well. The brake diverter solenoid is de-energized.

BRAKE COOLING

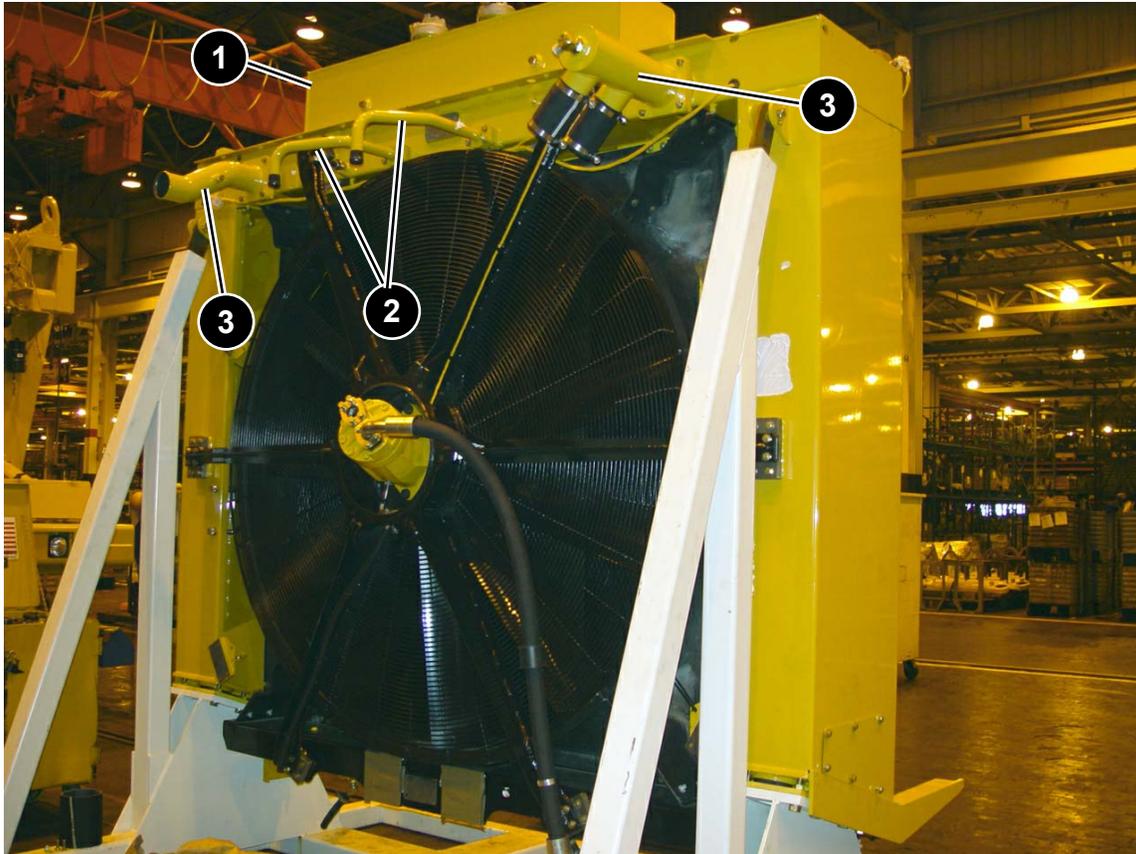
The engine cooling fan and the brake cooling motor at at maximum speed. The brake diverter solenoid is energized.

OTHER COOLING

Only the engine cooling fan is at maximum speed. The brake cooling motor is at minimum speed and the brake diverter solenoid is de-energized.

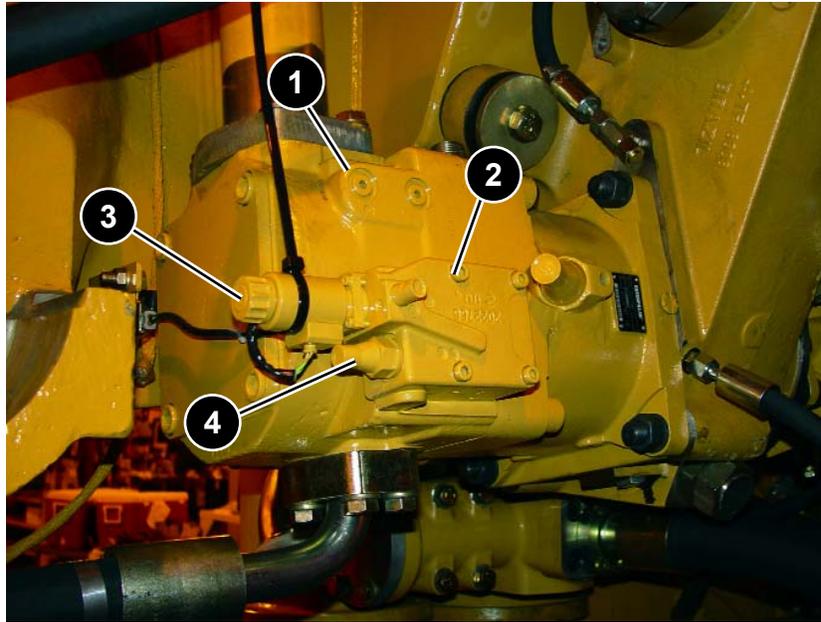
FULL COOLING

The engine cooling fan is at maximum speed. The brake cooling motor is at maximum speed and the brake diverter solenoid is energized, as well.

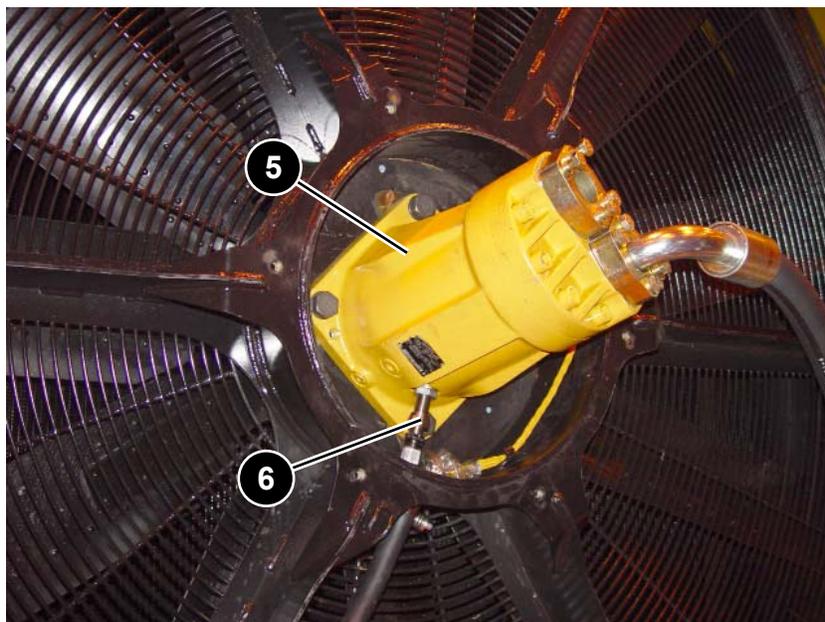


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Shown is the 793D truck radiator module. The shunt tank (1) can be seen on top of the radiator. Two smaller tubes (2) below the shunt tank provide a coolant supply to the jacket water pump and the aftercooler water pump. Most of the coolant flows to these two pumps from the radiator through two large tubes at the bottom of the radiator (not shown). Coolant returns to the radiator through the large tubes (3) in the radiator top tank. Coolant is supplied to the shunt tank (1) from the radiator top tank through some small hoses below the shunt tank (not shown).



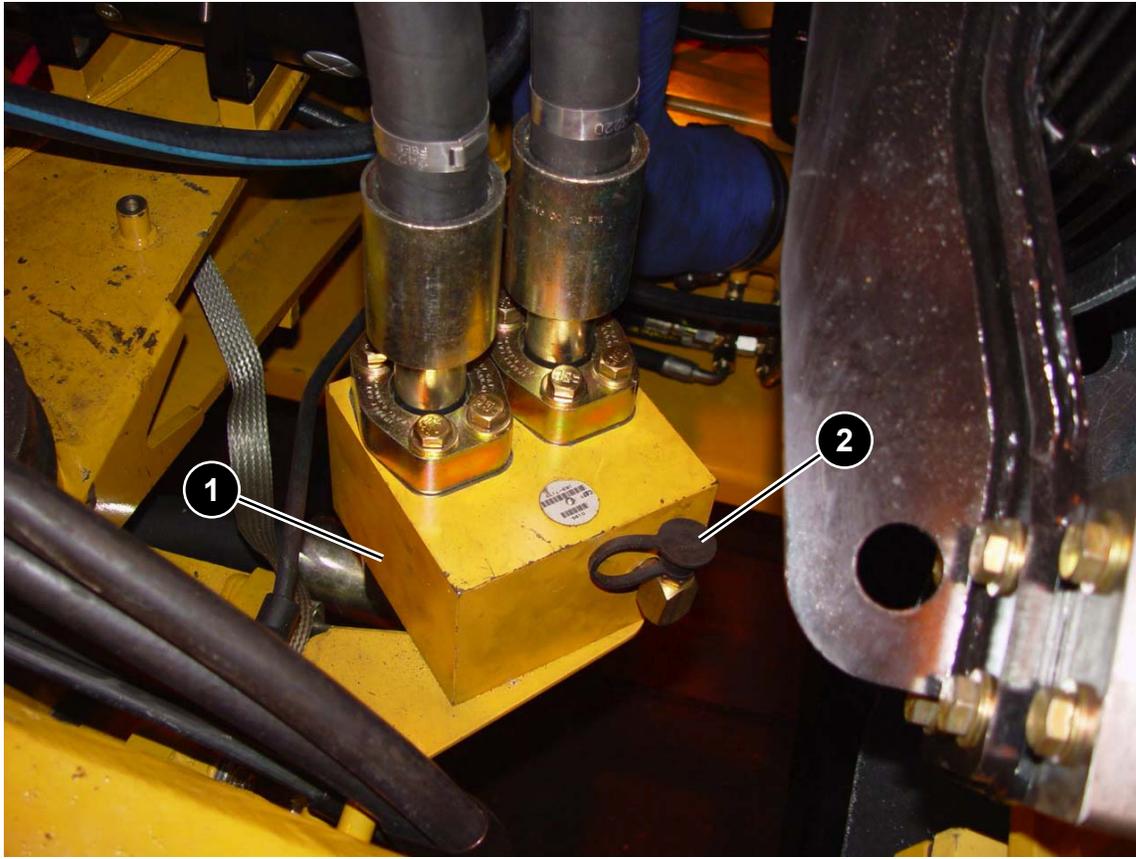
12



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The fan drive pump (1) is mounted to the front of the pump drive. The pump drive is located on the inside of the right frame rail. The Brake ECM controls the flow of oil from the fan drive pump by energizing the displacement solenoid (3). The pressure and flow compensator (2) contains the high pressure cut-off valve (4). The high pressure cut-off is an adjustable valve that controls the maximum pressure in the cooling fan system.

The fan drive motor (5) is mounted to the fan shroud behind the radiator. The fan speed sensor (6) is an input to the Brake ECM. The Brake ECM uses this input to match the fan speed to the proper cooling load.

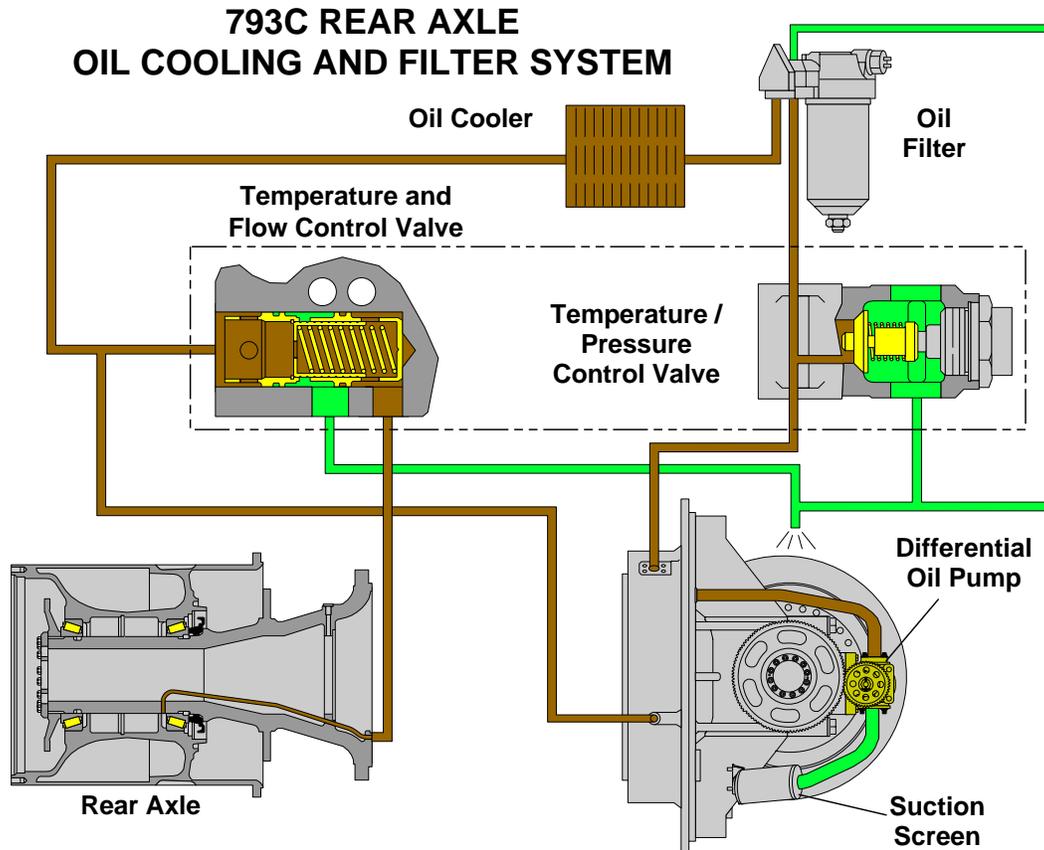


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Shown is the fan makeup valve (1). The fan makeup valve is located behind the lower right section of the radiator.

If supply oil to the fan stops suddenly, the fan and fan motor may continue to rotate due to the mass of the fan. Continued rotation of the fan motor would create a vacuum in the supply circuit between the fan pump and the fan motor. The fan makeup valve allows oil to flow from the return side of the circuit to the supply side to prevent a vacuum.

The fan drive pressure tap (2) is used to measure fan pump pressure. Fan pump pressure is adjusted at the high pressure cut-off valve on the fan pump. The pressure will vary depending on the desired fan speed controlled by the Brake ECM.



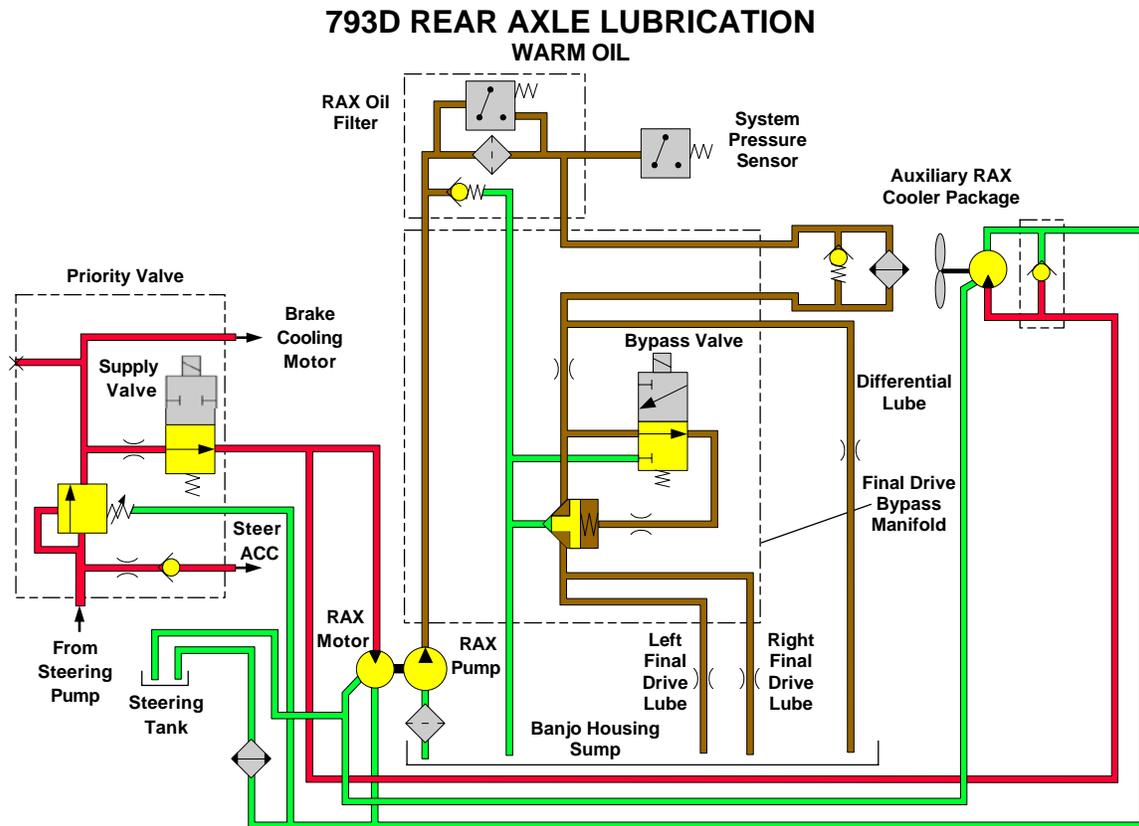
REAR AXLE COOLING AND FILTER SYSTEM

Shown is a schematic of the rear axle oil cooling and filter system for the 793C. The differential oil pump pulls oil from the bottom of the rear axle housing through a suction screen. Oil flows from the pump through a temperature and flow control valve located on top of the differential housing.

The temperature and pressure control valve, which is part of the temperature and flow control valve, prevents high oil pressure when the rear axle oil is cold. When the oil temperature is below 43°C (110°F), the valve is OPEN and allows oil to flow to the rear axle housing. When the oil temperature is above 43°C (110°F), the valve is CLOSED. The oil flows through the differential oil filter and the oil cooler (if equipped) to a flow control valve, which is also part of the temperature and flow control valve.

The temperature and pressure control valve is also the system main relief valve. If the pressure exceeds 690 kPa (100 psi), the temperature and pressure control valve will open to prevent high oil pressure to the oil filter.

The flow control valve distributes the oil flow to the rear wheel bearings and the differential bearings. At high ground speeds, excess oil flow is diverted to the axle housing to prevent overfilling the wheel bearing and final drive compartments.



The 793D has a continuous rear axle lubrication system. The system does not require that the truck be moving to provide flow, so the flow can be adjusted according to current conditions.

The engine driven steering pump supplies oil to the priority valve. The Brake ECM controls the supply valve based on the combination of feedback from a temperature sensor mounted in the bango housing and some basic information about the state of the machine. When the supply solenoid is de-energized, oil flow is directed to the rear axle (RAX) pump motor. When the supply solenoid is ON, oil flow is blocked to the RAX pump motor.

The RAX pump motor drives the RAX pump sending flow first to the RAX oil filter and then the final drive bypass manifold. If the machine is equipped with the auxiliary cooler, oil flows through the oil cooler before flowing to the bypass valve. An optional cooling fan is used to reduce the temperature of the lube oil.

The bypass solenoid valve either sends oil to both the final drive and the differential bevel gear, or bypasses the final drives. This bypass strategy prevents the final drives from receiving too much oil flow under certain conditions. The tubes to the final drives and bevel gear contain an orifice to balance flow throughout the system.

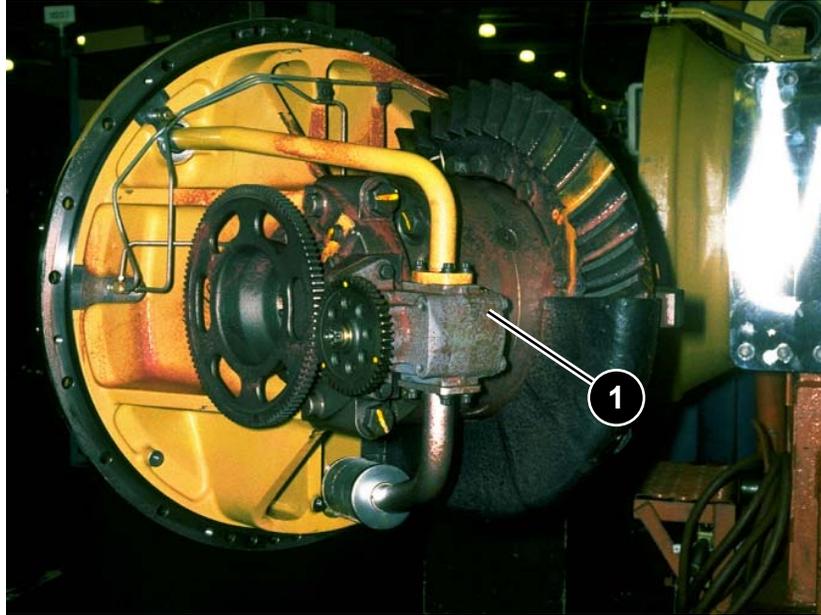
REAR AXLE LUBRICATION STRATEGY						
	Rear Axle Supply Solenoid			Final Drive Bypass Solenoid		
Rear Axle Oil Temperature	COLD < 25°F	COOL 25° F to 102°F	HOT > 102°F	COLD < 25°F	COOL 25° F to 102°F	HOT > 102°F
NOT Moving 0 MPH	OFF ON after 5 mins	OFF ON after 5 mins	OFF	ON	ON	OFF
Moving 0-22 MPH	ON	OFF	OFF	ON	ON	OFF
Moving Fast > 22 MPH	ON	OFF	OFF	ON	ON	5 mins ON 1 min OFF
Gear Limit	3rd	4th	NO			

Shown in this visual is the rear axle lubrication strategy for the 793D.

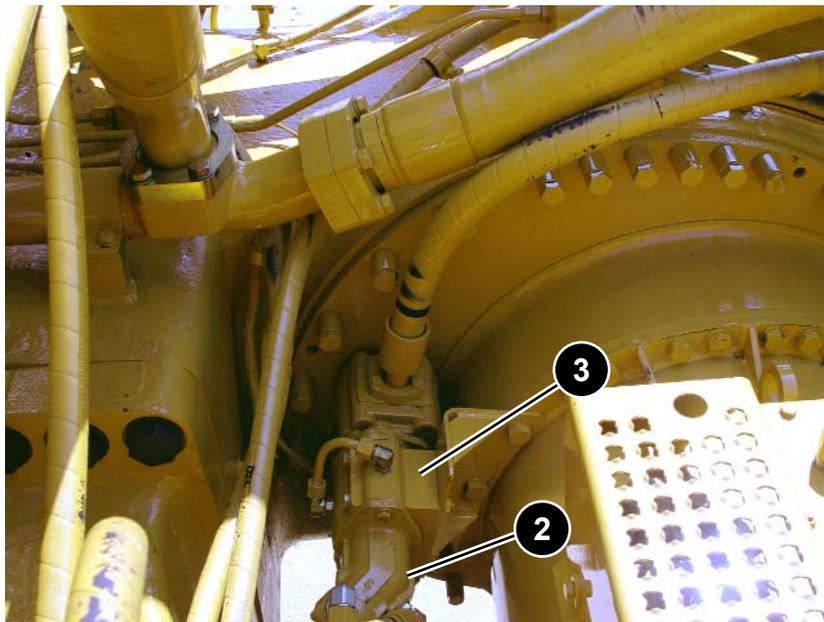
The main input that the Brake ECM uses to control the rear axle lube system is the temperature of the rear axle oil. This temperature, along with some basic information about the state of the machine, such as ground speed and engine speed, allows the Brake ECM to energize the rear axle supply solenoid and the final drive bypass solenoid. By energizing these two solenoids, the lube system can be turned ON or Off.

During startup, the system is turned ON to charge the lube system. There is no advantage to lubing the rear axle due to the high viscosity of the cold oil. Therefore, the system is turned OFF after 5 minutes when the lube oil is cold. If the machine is traveling greater than 22 MPH, the lube to the final drives is cycled ON and OFF. This cycling prevents filling the final drives due to centrifugal force by keeping only a small amount of oil in the final drives.

The temperature gear limit is used to limit the actual transmission gear to keep the machine from doing any high speed traveling until the differential oil has warmed up enough for the lube system to be effective.



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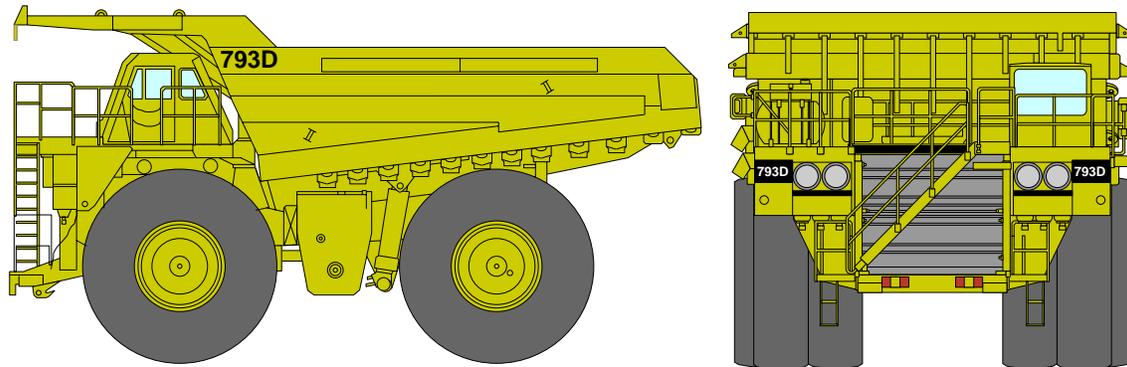


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Shown in the top visual is the 793C rear axle oil pump (1) that is driven by the differential. The differential is removed from the differential housing. Since the pump rotates only when the machine is moving, no oil flow is produced when the machine is stationary.

The pump drive motor (2) and the lube pump (3) for the 793D continuous rear axle lubrication system is shown in the bottom visual. This system provides a more consistent oil supply to wheel bearings and final drive assemblies providing longer component life.

STEERING SYSTEM



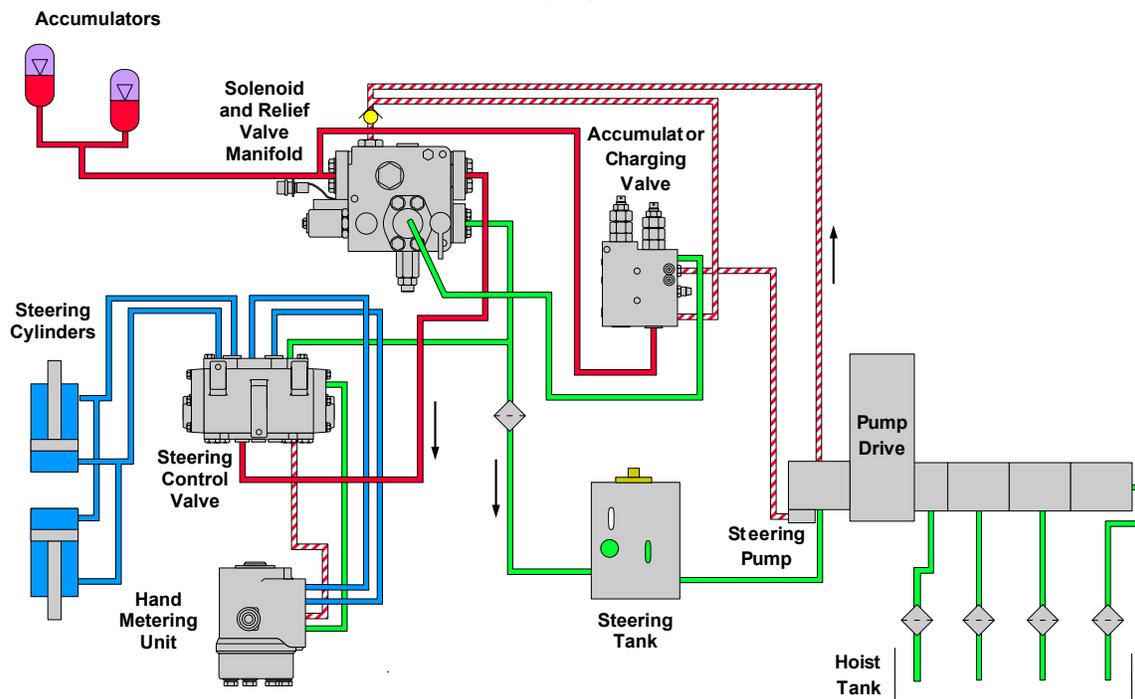
STEERING SYSTEM

This section of the presentation explains the operational changes in the steering system. The steering system uses hydraulic force to change the direction of the front wheels, similar to other Caterpillar off-highway trucks. The system has no mechanical connection between the steering wheel and the steering cylinders.

If the flow is interrupted while the truck is moving, the system incorporates a secondary steering system. Secondary steering is accomplished by accumulators which supply oil flow to maintain steering.

The steering cylinders, the steering valve, the solenoid and relief valve manifold, and the Hand Metering Unit (HMU) remain unchanged. The main changes involve the steering pump and the method of maintaining pressure in the steering system.

793C STEERING SYSTEM NO TURN



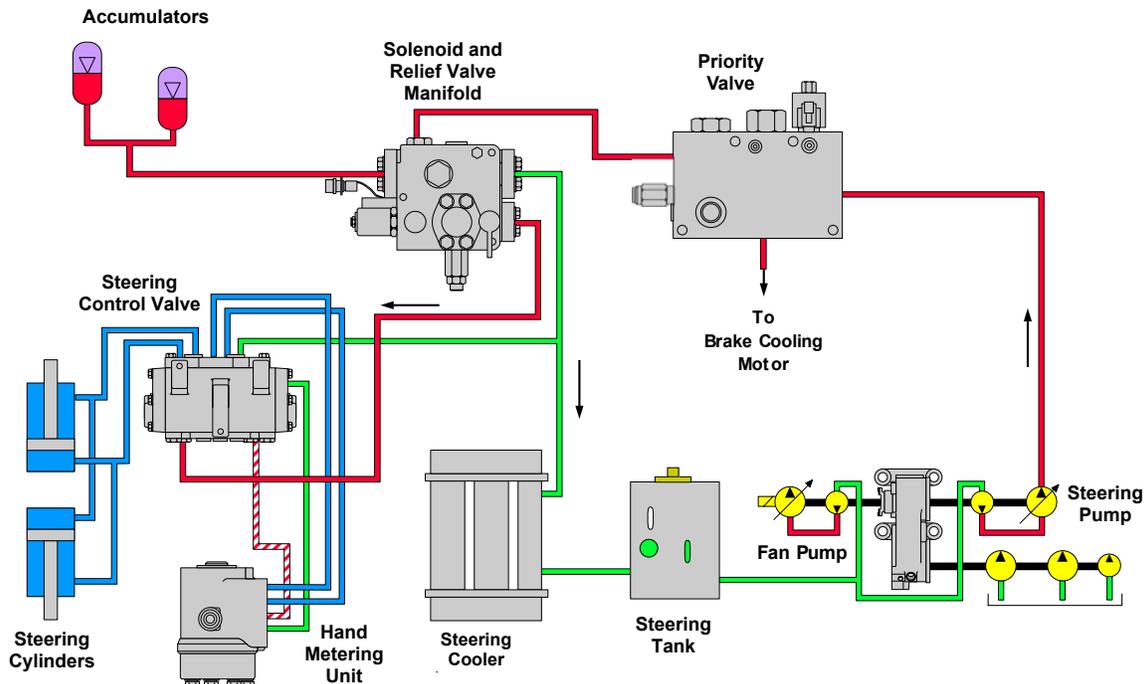
The steering system for the 793C in a no-turn situation is shown in this visual.

The steering pump receives oil from the steering tank located on the right side of the operators platform. Oil then flows to the solenoid and relief valve manifold located on the front frame cross member. The oil flow is then sent to the accumulators and the accumulator charging valve. The steering accumulators store hydraulic energy for the steering system. The accumulator charging valve controls the CUT-IN and CUT-OUT pressure for the steering pump. Once the steering accumulators are charged, the system will be in low pressure stand-by.

The solenoid and relief valve manifold also sends oil to the steering control valve. This valve controls the flow of oil to the steering cylinders which turn the front wheels and control the direction of the truck. The hand metering unit (HMU), which is connected to the opposite end of the steering column, directs pilot oil back to the steering control valve when the operator turns the steering wheel. This action causes the steering control valve to send oil to the steering cylinders to make a steering correction.

A small amount of oil continuously flows through the HMU back to the tank to keep the HMU at the same temperature as the rest of the steering system. All oil returning to the tank first flows through a return filter mounted inside the steering tank.

793D STEERING SYSTEM NO TURN

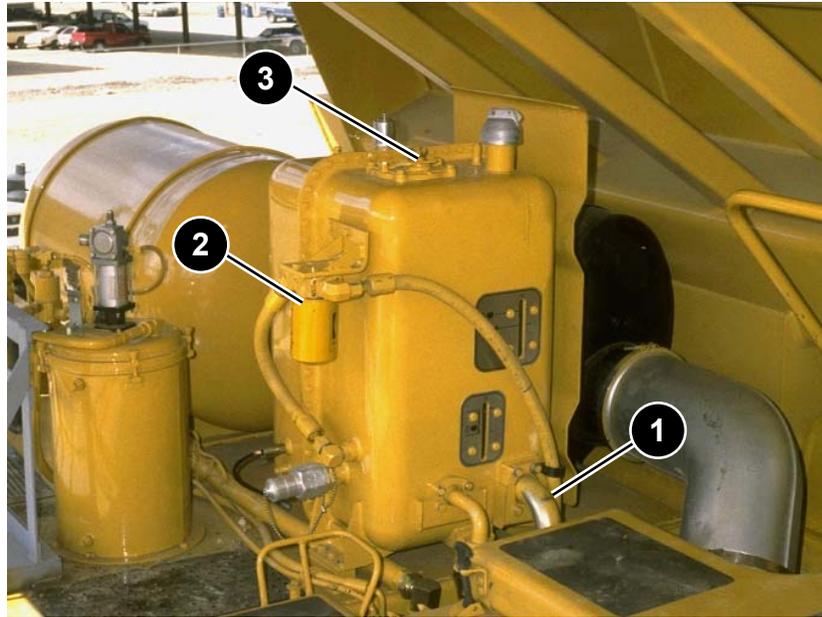


The above block diagram shows the steering system for the 793D. Although there are many similarities between this system and the previous system, there are several significant changes, as well.

The steering pump receives oil from a larger steering tank mounted on the operator's platform. Oil then flows to the priority valve. Flow is first used to satisfy the steering system. Once the steering system is satisfied, the priority valve allows flow for other systems such as the RAX motor and the brake cooling drive motor.

The components downstream of the priority valve operate the same as previously discussed on the 793C. A steering oil cooler has been added for oil returning to the steering tank. The steering tank also provides flow for the hydraulic fan pump.

The 793D steering system operates at maximum pressure, but minimum flow, once the demand of the system is met. On the 793C a signal was sent back to the steering pump (load sensing system) to put the pump in a low pressure and minimum flow state. The 793D is not a load sensing system.



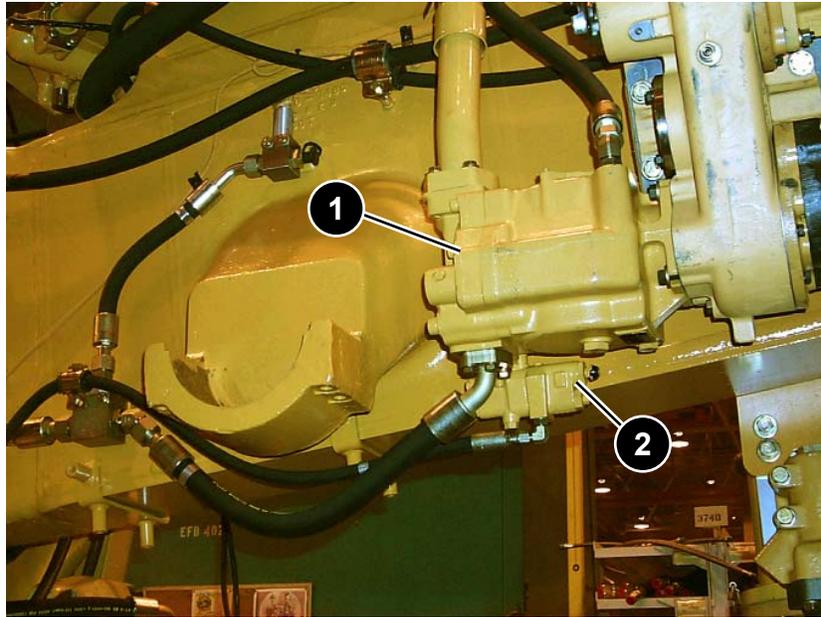
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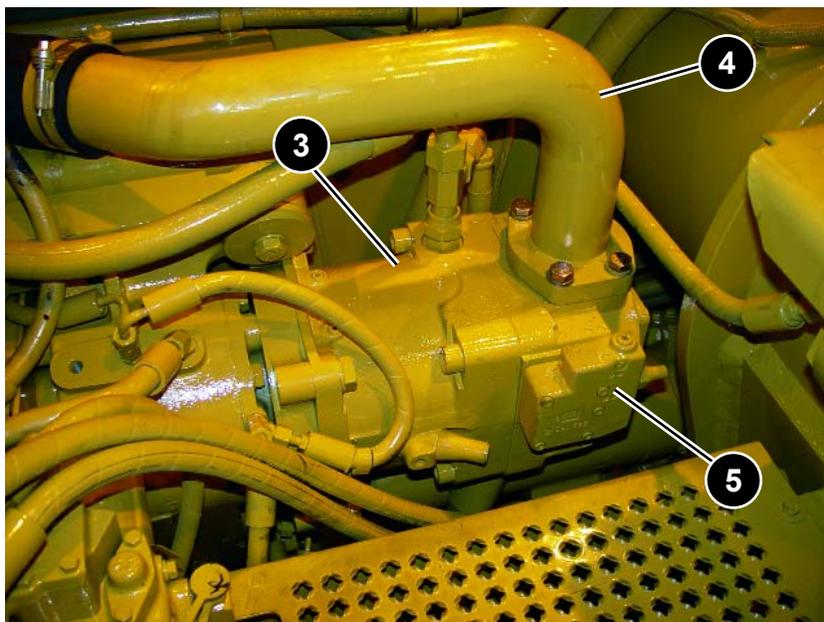
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The 793C steering tank is located on the right platform. This tank provides oil to a piston-type pump through hose (1). Case drain oil from the steering pump returns to the tank through filter (2). The remaining steering oil returns to the tank through the main steering filter (3).

The bottom visual shows the steering tank on the 793D. This tank supplies oil to the steering system, the engine cooling fan motor, the brake cooling oil drive motor, the RAX motor, and the RAX fan motor, if equipped. Due to the many systems being supplied, the tank is a higher capacity tank than the previous steering tank. Two case drain filters filter the return oil from the various piston motors and pumps.



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The top visual shows the 793C pressure compensated, piston-type pump (1). The steering pump contains a load sensing controller (2) that works with an accumulator charging valve to monitor and control steering pump output. When pressure in the accumulators decreases (CUT-IN), the pump upstrokes and charges the accumulators until the CUT-OUT pressure is reached.

Shown in the bottom visual is the steering pump (3) for the 793D. This pump is mounted on the backside of the pump drive behind the torque converter housing. Oil is supplied to the pump through tube (4) coming from the steering tank. Like the 793C, a load sensing controller (5) controls the pump output but without an external signal line. The pump supply is sent to the priority valve located on the upper frame, near the right front strut.