SERV1804
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GLOBAL SERVICE LEARNING

TECHNICAL PRESENTATION

994F WHEEL LOADER

INTRODUCTION

Service Training Meeting Guide (STMG)

994F WHEEL LOADER - INTRODUCTION
MEETING GUIDE 804

AUDIENCE

Service personnel who understand the principles of machine systems operation, diagnostic equipment, and testing and adjusting procedures.

CONTENT

This presentation describes the location of the basic components on the engine, and the operation of the power train, implement, steering, and brake systems for the 994F Wheel Loader.

OBJECTIVES

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

1. locate and identify the major components in the engine, power train, implement, steering, and brake systems;
2. explain the operation of each component in the power train, implement, steering, and brake systems; and
3. trace the flow of oil through the power train, implement, steering, and brake systems.

REFERENCES

994F Wheel Loader Specalog	AEHQ5460
994F Wheel Loader Service Manual	RENR2500
994F Wheel Loader Parts Book	SEBP2793
Video "994F Wheel Loader - Introduction"	SEVN4643
TIM "992G Wheel Loader - Steering and Brake Systems "	SERV2632-01

PREREQUISITES

Interactive Video Course "Fundamentals of Mobile Hydraulics"	TEMV9001
Interactive Video Course "Fundamentals of Machine Electronics"	TEMV9002

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NOTES

1

INTRODUCTION

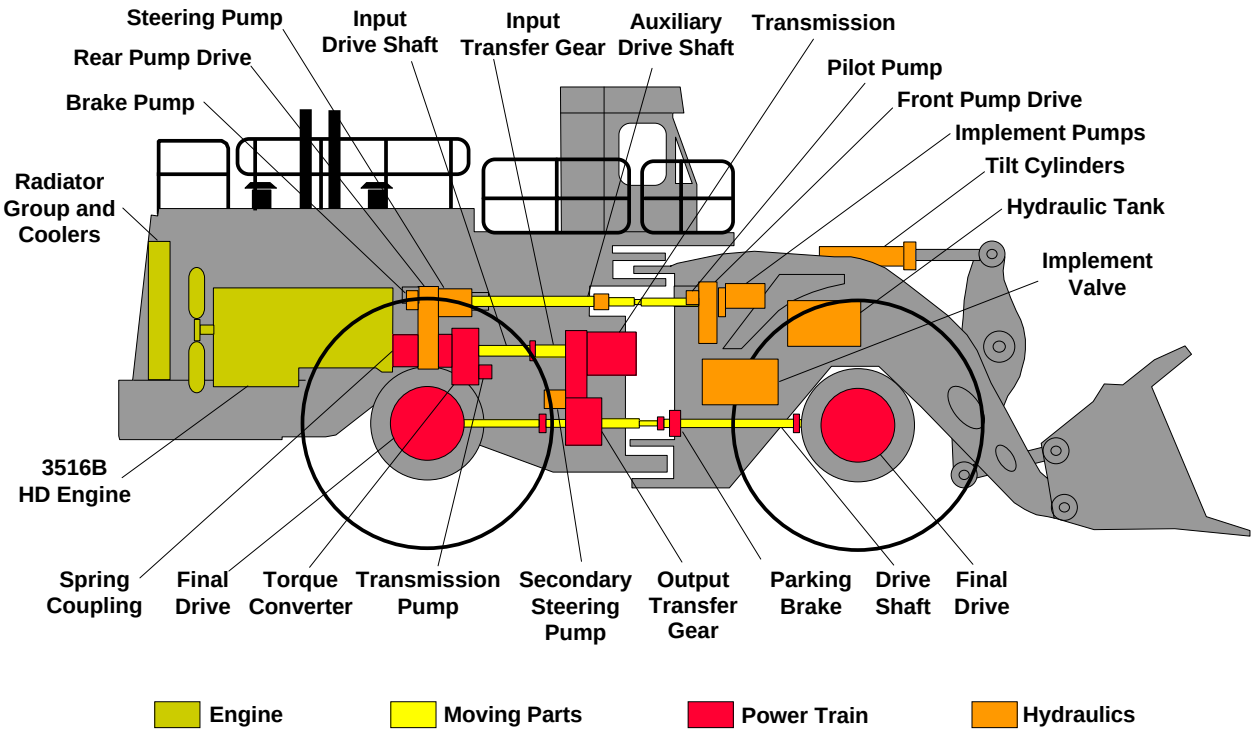
This presentation discusses the component locations and systems operation of the 994F Wheel Loader. Basic engine and machine component locations will be discussed. Also, the operation of the power train, the implement hydraulics, the steering, and the braking system's component location will be covered.

The 994F Wheel Loader is the largest wheel loader in the Caterpillar product line. The loading capacity is matched with the 785 Off-highway Truck (Standard Machine), the 789 Off-highway Trucks (High Lift) and 793 Off-highway Truck (Super High Lift). The new 994F Super High Lift can be equipped with a 35.9 cubic meter (47 cubic yard) coal application bucket.

The 994F Wheel Loader operating weight is approximately 160,200 Kg (429, 300 lbs) for a Standard Machine, 160,800 Kg (430,900 lbs) for the High Lift, and 174,300 Kg (467,000 lbs) for the Super High Lift.

The serial number prefix for the 994F Wheel Loader is 442.

994F WHEEL LOADER
COMPONENT LOCATION



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Component Location

This illustration shows the basic component locations on the 994F. The component locations on the 994F are basically the same as the 994D but are restated as a reminder.

Power for the 994F is supplied by the 3516B High Displacement (HD) engine. The engine is connected to the rear pump drive with a spring coupling. Power flows from the rear pump drive to the torque converter, to the input drive shaft, and through the input transfer gear to the transmission. Power from the transmission flows through the output transfer gears to the drive shafts, to the bevel gears in the differentials, and then to the double reduction final drives.

The 994F also has an auxiliary drive shaft that turns the front pump drive. The front pump drive is located in the loader frame.

The secondary steering pump is splined to the output transfer gears. The secondary steering pump is ground driven.

SIMILARITIES AND DIFFERENCES

FEATURES	DIFFERENT	SIMILAR	SAME
Machine Appearance			X
Operator's Station		X	
Engine	X		
Transmission		X	
Implement Hydraulic System	X		
Steering System		X	
Brake System		X	
Monitoring System		X	
Maintenance Items		X	

3

Similarities and Differences

This illustration compares the basic features of the 994F Wheel Loader to the previous 994D Wheel Loader.

The machine appearance and the implement hydraulic system are basically the same as the 994D with the addition of a variable displacement piston pump in tandem with the center fixed displacement piston pump on the front pump drive.

The main relief pressures have been increased from 30400 kPa (4400 psi) on the 994D to 32775 kPa (4750 psi) on the 994F. The 994F is equipped with a 3516B HD EUI as compared to the 3516B EUI in the 994D. The new engine delivers 1,436 horsepower. This is an increase of 14%. The 994F features new turbochargers, high-capacity air filters, and dual 80-amp alternators.

Access to the implement pump case drain filters and the transmission and torque converter filters has improved from the previous version of the 994D. The 994F is installed with a lift linkage position sensor supporting in the cab control of the variable lift kickouts. Also, the 994F is equipped with remote pressure taps for the various hydraulic systems.

The 994F has both starter and transmission lockout switches and an engine shutoff switch at ground level for easy access. Also, the 994F has the optional Oil Renewal System (ORS) which offers a means to reduce the amount of oil changes and increased machine availability.

The power train difference between the 994F and 994D is the removal of the free wheel stator and the torque converter outlet relief valve. The 994F power train is now equipped with two additional air-to-oil coolers in order to increase cooling of the power train system. The 994F has a fully modulated impeller clutch torque converter with flexibility of reducing rimpull using the left brake pedal. The pedal fully modulates the rimpull through the range of 100% to 35%. Also, the 994F power train has remote pressure taps installed.

The braking system on the 994F has increased circuit pressure and now features a split control system.

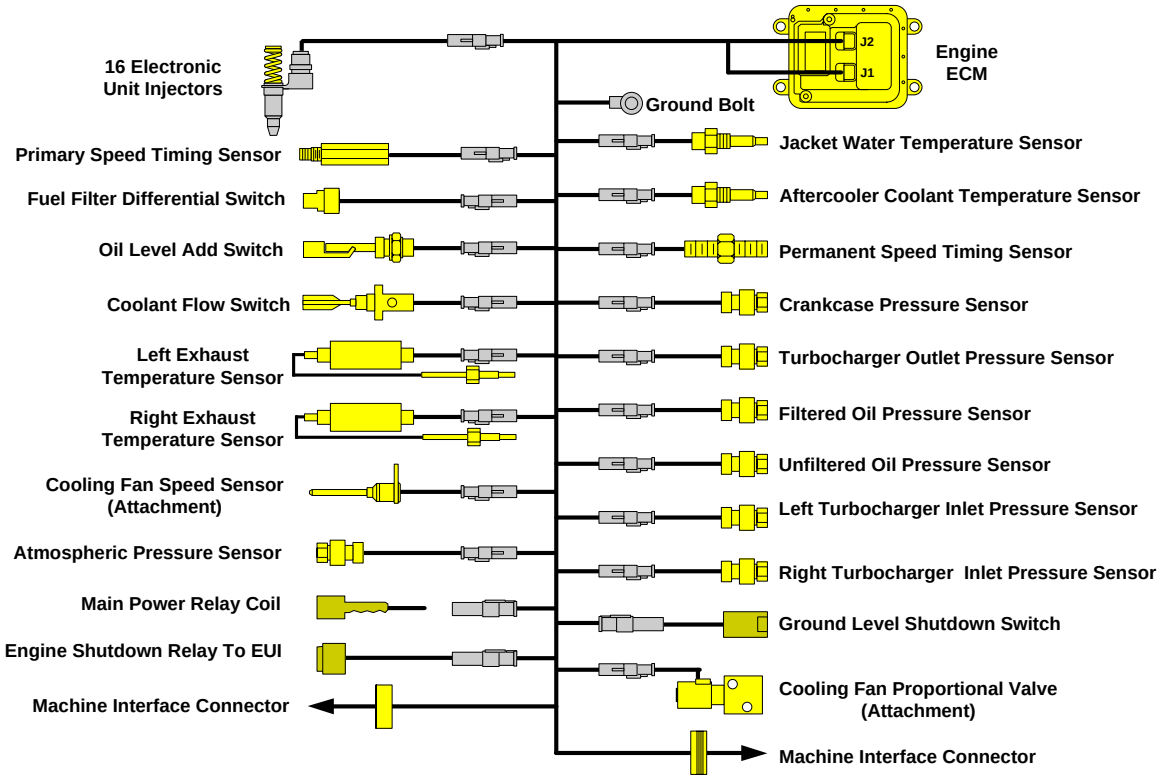
The operator station on the 994F has a larger cab with an approximate 75dBa sound level. A Caterpillar seat with state of the art suspension is installed. Also, the cab has a trainer seat with a padded seat and back. The new cab has 50% more glass area increasing visibility. The 994F retains the Steering and Transmission Integrated Control (STIC) power train which enables the operator to use small movements of a single hand to steer the machine and make direction/gear changes.

The maintenance items on the 994F are similar to the 994D. The major changes in the maintenance are access to the filters on the 994F.

The 994F is equipped with the latest Vital Information Management System (VIMS) that is similar to the 994D.

NOTE: *For more information on the VIMS refer to the VIMS Service Manual RENR6318*

994F BASIC ENGINE BLOCK DIAGRAM



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ENGINE ELECTRICAL BLOCK DIAGRAM

This block diagram of the engine electrical system shows the components that are mounted on the engine which provide input signals to and receive output signals from the Engine Electronic Control Module (ECM).

Based on the input signals, the Engine ECM energizes the injector solenoid valves to control fuel delivery to the engine, and energizes the cooling fan proportional solenoid valve to adjust pressure to the optional cooling fan clutch.

The two machine interface connectors provide electrical connections from the engine to the machine including the Cat Data Link.

Some of the components connected to the Engine ECM through the machine interface connectors are: the throttle pedal position sensor, the throttle lock switches, the throttle lock enabled indicator, the right brake pedal switch, the ether start control solenoid, and the ground level shutdown switch.

Input Components:

Primary speed timing sensor - The speed timing sensor sends a fixed voltage level signal to the Engine ECM in order to determine the engine speed, direction, and timing.

Oil level switch - The oil level switch (lower) is a float type switch mounted in the side of the engine oil sump. The Engine ECM monitors the engine oil level switch to alert the operator when the oil level is low.

Coolant flow switch - The coolant flow switch mounts in the coolant passage near the engine coolant pump. When the coolant is flowing past the switch the paddle moves and closes the switch contacts. The Engine ECM alerts the operator when there is no coolant flow while the engine is running.

Exhaust temperature sensors - The exhaust temperature sensors communicate the exhaust temperature to the Engine ECM.

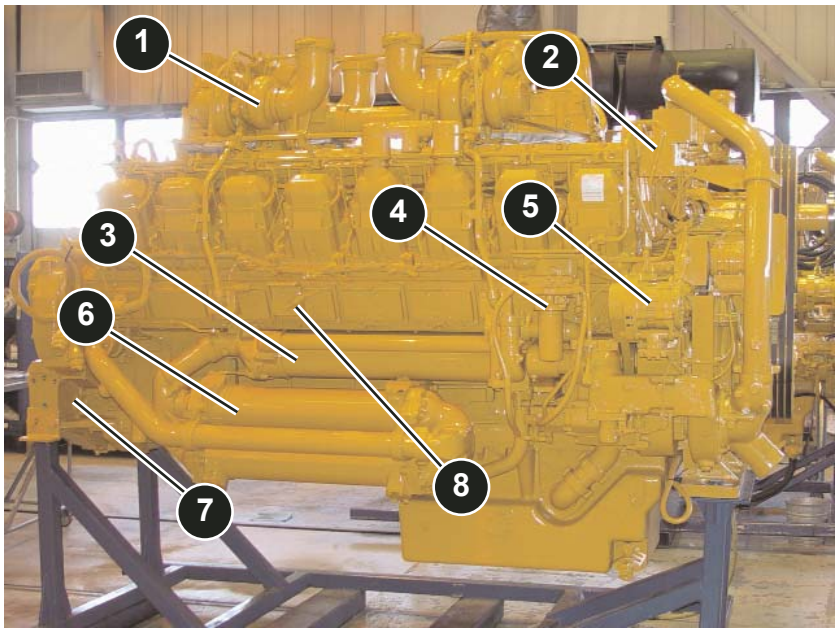
Permanent speed timing sensor, cooling fan speed sensor (if equipped), - These speed sensors are passive speed sensors that provide a signal similar to a sine wave that varies in amplitude and frequency as speed increases. The permanent speed timing calibration sensor monitors the speed and position of the flywheel.

Jacket water temperature sensor, aftercooler coolant temperature sensor - These temperature sensors are analog temperature sensors that provide a signal to the Engine ECM.

Crankcase, atmospheric, turbocharger outlet, filtered and unfiltered oil, left and right turbocharger inlet pressure sensors - These sensors are analog sensors that provide a voltage signal to the Engine ECM. The signal varies to a level that corresponds with a calibrated pressure. The Engine ECM calibrates the pressure sensors to the atmospheric pressure when the key start switch is moved to the ON position for 10 seconds without the engine running.

Fuel filter differential switch - The fuel filter differential switch is a pressure switch. The contacts open when there is a restriction in the fuel line from the secondary fuel filters.

> ***Note:*** *The cooling fan proportional valve and the cooling fan speed sensor are attachments. The valve and the sensor are installed with the variable speed cooling fan system (Rockford Fan System).*



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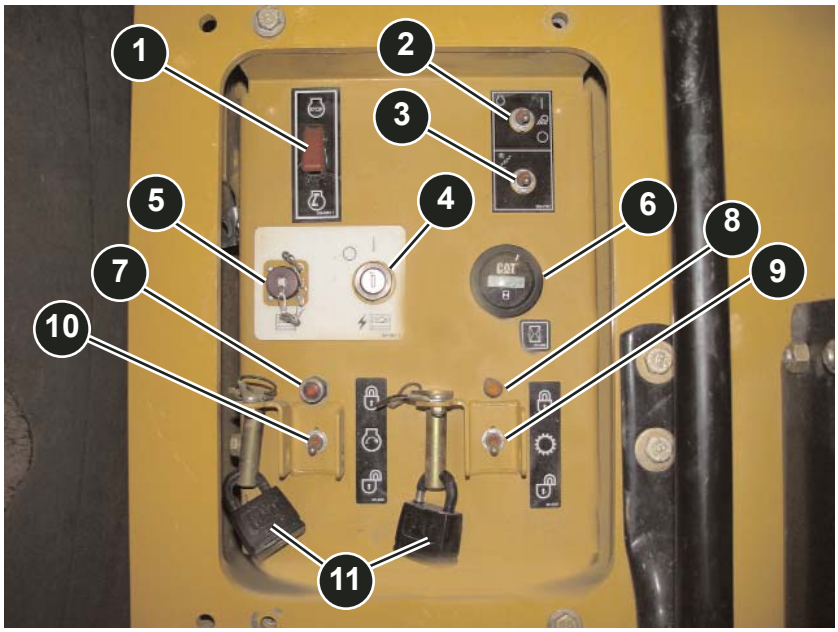
Engine Right Side

This view shows the right side of the engine that is accessed from the left side of the machine.

Components which can be seen are:

- Turbocharger (1)
- Coolant regulator housing (2)
- Engine oil cooler (3)
- Electric fuel priming pump filter (4)
- Alternator (5)
- Transmission cooler (coolant-to-oil) (6)
- Permanent speed timing sensor (7)
- Crankcase pressure sensor (8)



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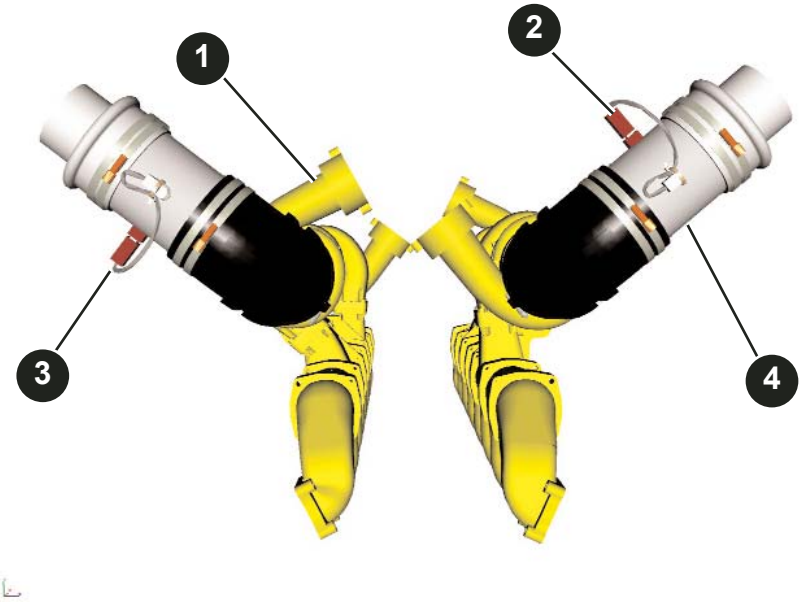
This illustration shows the machine controls that are located at the rear of the machine.

The following is a list of the ground level components:

- Ground level shutdown (1)
- Hood lamp (2)
- Ground level stair lamp (3)
- VIMS key switch (4)
- VIMS serial download port (5)
- Hour meter (6)
- Start lockout indicator (7)
- Transmission lockout LED (8)
- Transmission lockout switch (9)
- Start lockout switch (10)
- Locks (11)



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Turbocharger Inlet Pressure Sensor

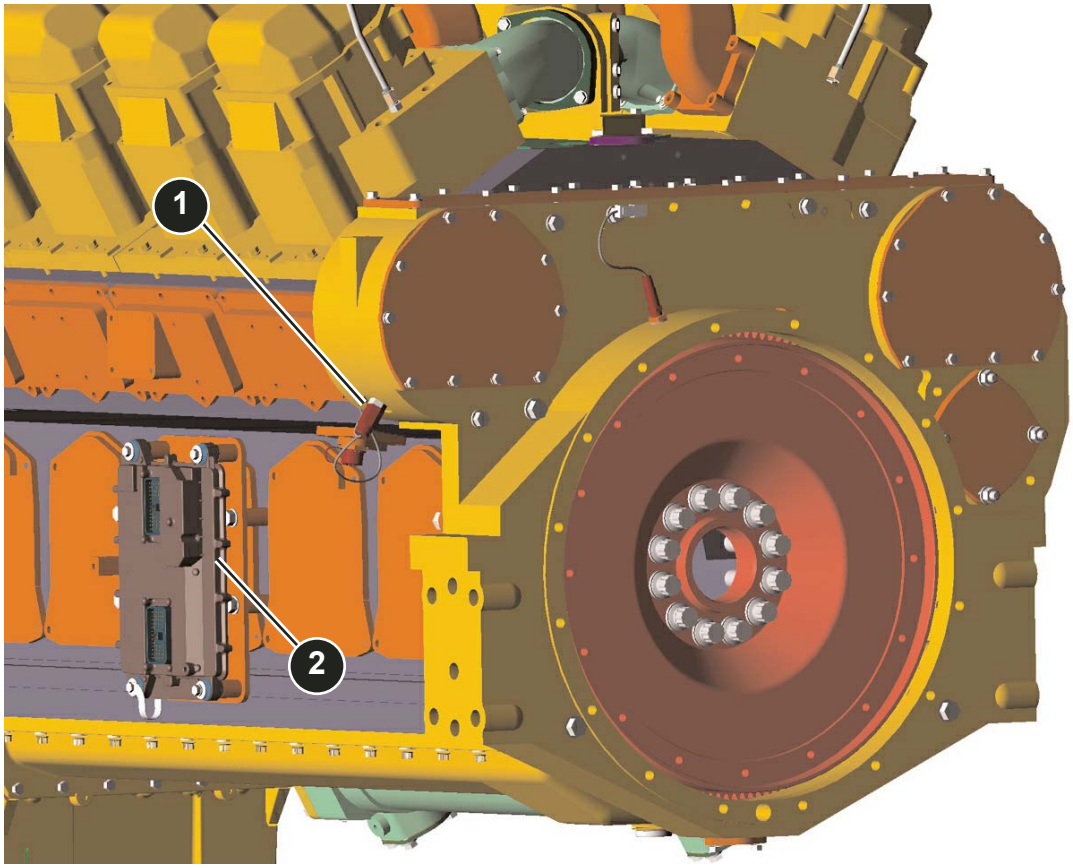
This illustration shows the left turbocharger inlet pressure sensor (2) and right turbocharger inlet pressure sensor (3). The illustration shows the sensors on the turbochargers (1) that are installed on the front of the engine (located toward the rear of the machine). These analog sensors read the pressure in the turbo inlets and send a corresponding signal to the Engine ECM. The left turbocharger inlet pressure sensor (2) and the right turbocharger inlet pressure sensor (3) communicate with the Engine ECM. The Engine ECM provides an input to the VIMS module informing the operator of an air filter restriction.

When an air filter becomes plugged and restricts air available for combustion resulting in elevated exhaust temperatures, the Engine ECM sends a signal to the injectors to decrease the flow of fuel.

The Engine ECM receives signals from the turbocharger inlet pressure sensors and determines inlet air restriction by subtracting the turbocharger inlet air pressure that is measured by the turbocharger inlet air pressure sensors from the atmospheric air pressure.

The Engine ECM derates the power by 1% when the inlet air restriction reaches 6.5 kPa (25 inches of water). This derate will increase at a rate of 2% kPA of restriction until the maximum derate of 20% is reached. The engine will default to a maximum derate of 20% if the Engine ECM detects a fault in the circuits for the left or right turbocharger inlet pressure sensors.

Also shown are the inlet tubes (4).



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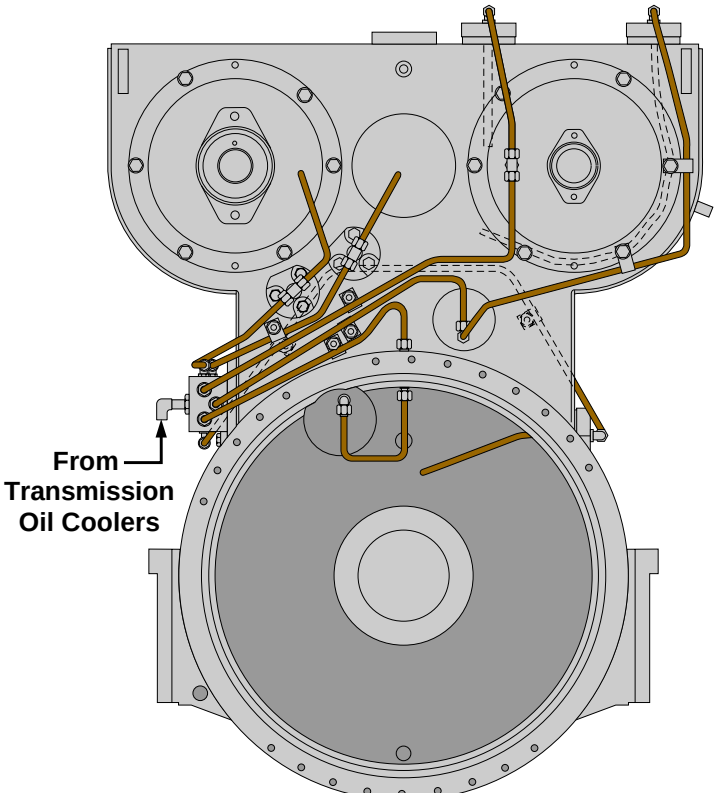
Primary Speed Timing Sensor

The primary speed timing sensor (1) is positioned near the rear of the left camshaft. The sensor signals the speed, direction, and the position of the camshaft by counting the passing teeth and measuring the gaps between the teeth on the timing wheel that is mounted on the camshaft. The primary speed timing sensor receives has an input voltage of 12 VDC.

If the Engine ECM does not receive an input signal from the sensor, the engine will not start.

Also shown is the Engine ECM (2).

REAR PUMP DRIVE LUBRICATION



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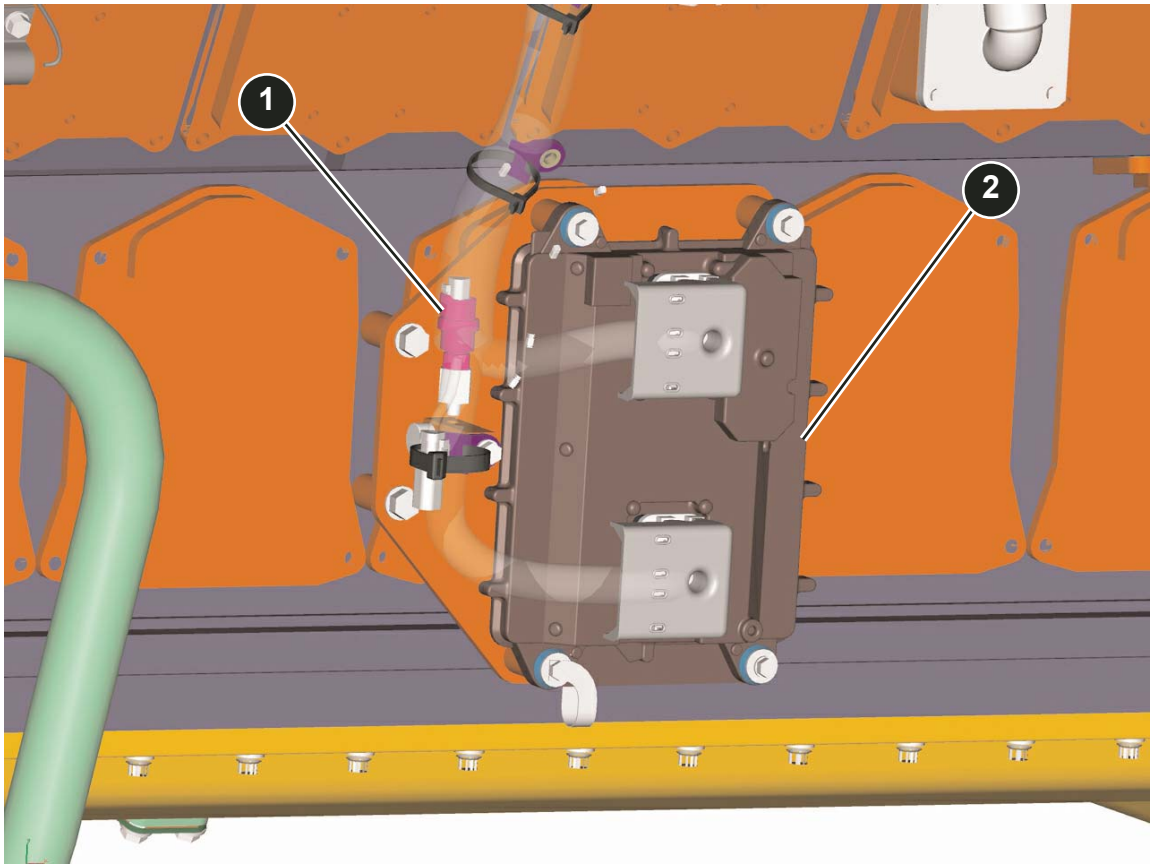
Rear Pump Drive Lubrication

The rear pump drive is attached to the engine and drives the steering pumps, brake pump, the steering and brake cooling pump, and the brake cooling pump. The rear pump drive is lubricated with oil from the torque converter outlet that has been cooled by air-to-oil coolers or the coolant-to-oil coolers. The oil lubricates the bearings and gears in the rear pump drive.



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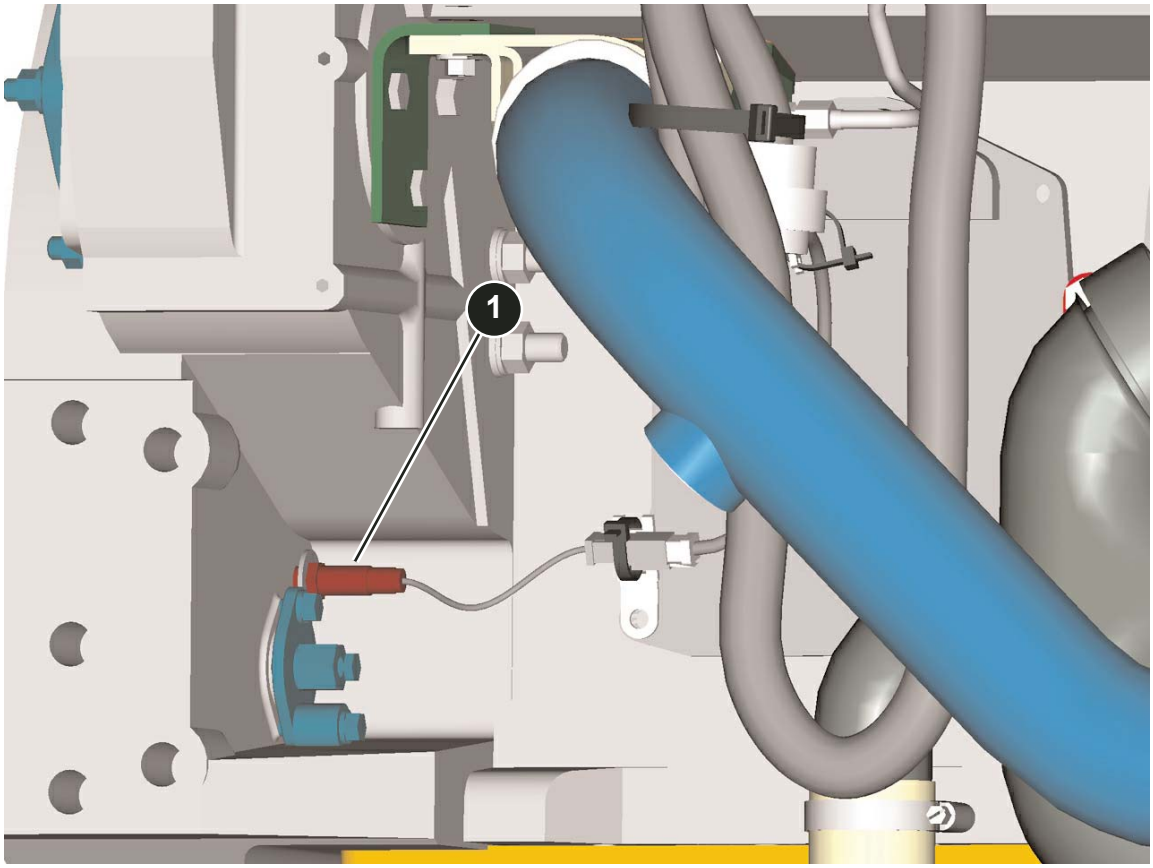
Atmospheric Pressure Sensor

The atmospheric pressure sensor (1) is located towards the rear of the machine next to the Engine ECM (2). The Engine ECM uses the atmospheric sensor as a reference for calculating boost pressure, and air filter restriction. The sensor also is used to supply information to the Engine ECM to derate the engine at high altitudes. The atmospheric pressure sensor uses 5 VDC that is supplied by the Engine ECM.

The sensor is used for altitude derate. If the machine is operating above 10,000 feet, the engine will derate 1% for every kPa of atmospheric pressure below 70 kpa or 3% per 1,000 foot increments above 10,000 feet.

If the Engine ECM detects a loss of the signal from the atmospheric pressure sensor, the ECM will derate the engine to a maximum derate of 24%. The Engine ECM uses the atmospheric pressure sensor as a reference when calibrating the pressure sensors.

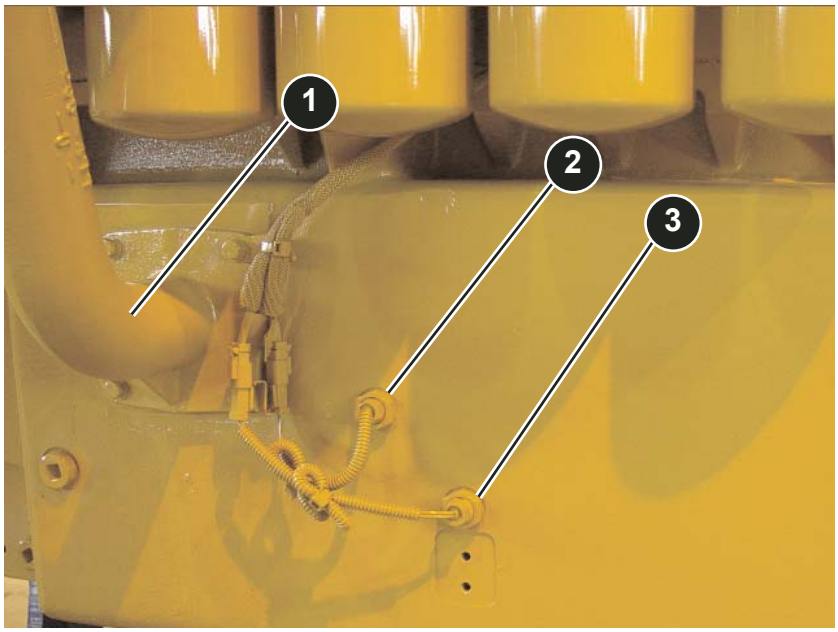
The pressure sensor calibration receives an auto calibration enable command 10 seconds after ECM power-up. The auto calibration will occur when auto calibration is enabled and engine speed is 0 rpm. All pressure sensors will be sampled at 30 msec. The calibration function will then perform a 2 second average on the individual sensors for calibration.



11

Permanent Speed Timing Sensor

The permanent speed timing sensor is used for timing calibration through Electronic Technician (ET). The permanent speed timing sensor is located on the left side of the machine and installed in the torque converter housing.



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This illustration shows two engine oil level switches. Oil level switch (3) communicates with the Engine ECM. This switch opens the circuit when the oil level is below the necessary level. Oil level switch (2) communicates with the VIMS module. The oil level switch (2) signals that oil should be added to the engine. If the machine is equipped with the optional Oil Renewal System (ORS), level switch (2) will disable the ORS when the oil level is low.

Also shown is the engine oil filler tube (1).