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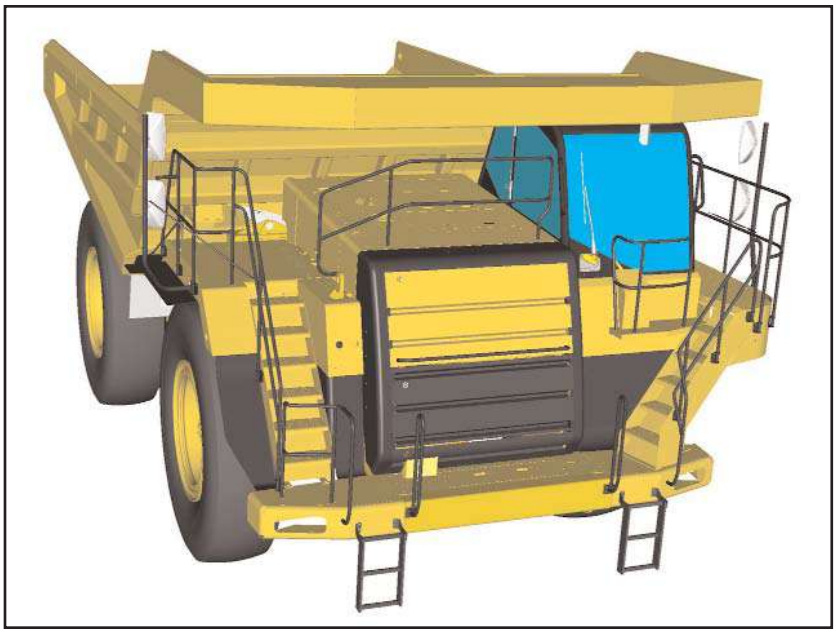
GLOBAL SERVICE LEARNING

TECHNICAL PRESENTATION



777F (JRP)
OFF-HIGHWAY TRUCKS

New Product Introduction
(NPI)

777F (JRP) OFF-HIGHWAY TRUCKS

AUDIENCE

Level II - Service personnel who understands the principles of machine system operation, diagnostic equipment, and procedures for testing and adjusting.

CONTENT

This presentation provides new and different New Product Introduction (NPI) information for the 777F Off-Highway Trucks. 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. located and identify the new components
2. explain the operation of the new components in the systems
3. trace the flow of oil or air through the new systems

REFERENCES

"777D Update (AGC) Off-highway Truck	SERV1721

Estimated Time: 8 hrs
Illustrations: 90
Handouts: 1
Form: SERV7106-04
Date: 04/06

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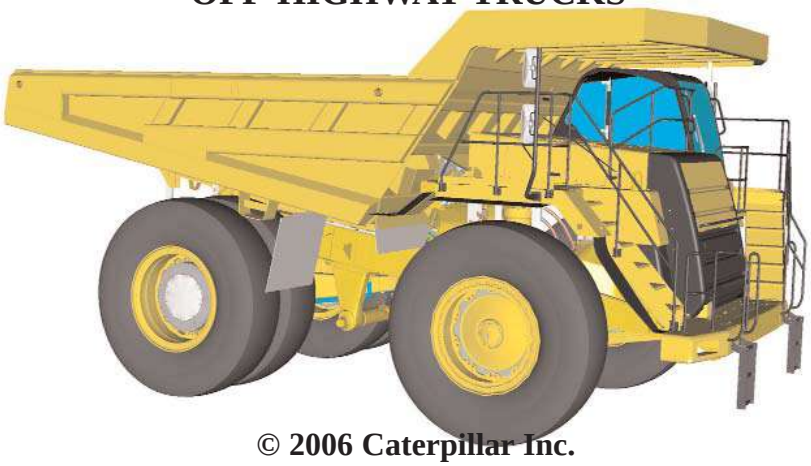
NOTES

777F (JRP)

OFF-HIGHWAY TRUCKS



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INTRODUCTION

Shown is the right side of the 777F Truck.

Key new features include:

- ECPC transmission
- Access systems
- Heated mirrors
- Cab
- VIMS Advisor
- Hydraulic brakes
- Tier 2 compliant C32 ACERT engine and cooling system

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

Specifications for the 777F Truck are:

- Serial No. Prefix: JRP
- Empty weight: 48581 kg (107104 lbs.)
- Load carrying capacity: 90 metric tons (100 tons)
- Gross Machine Weight (GVW): 163293 kg (360000 lbs.)
- Width: 6.05 m (19.8 ft.)
- Height: 5.03 m (16.5 ft.)
- Gross Power: 758 kW (1016 hp)

SIMILARITIES AND DIFFERENCES

FEATURES	DIFFERENT	SIMILAR	SAME
Machine Appearance	X		
Operator's Station	X		
Engine	X		
Power Train	X		
Hoist System		X	
Steering System		X	
Brake System	X		
Monitoring System	X		
Air System	X		
Maintenance Items		X	

2

Similarities and Differences

The hoist system and steering system function similar to the 777D. The rest of the machine systems have significant changes.

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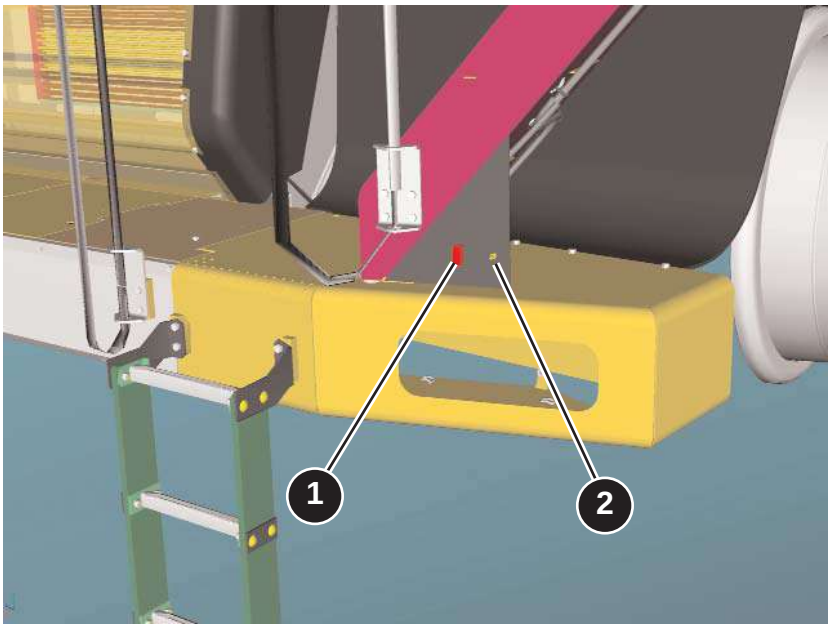
OPERATOR'S STATION

The operator's station for the 777F Off-highway trucks has changed from the previous 777D.

The machine controls are displayed in the following text.



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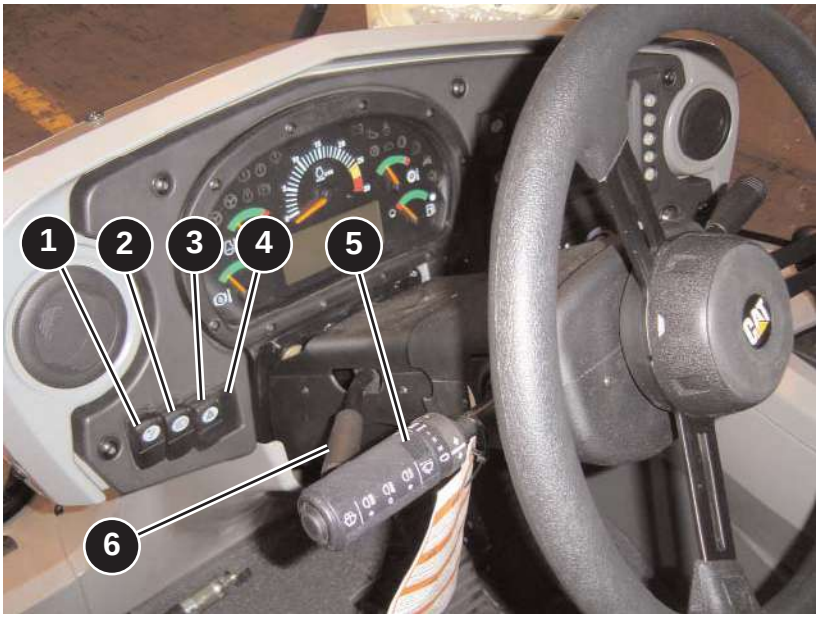
Machine Controls

The engine shutdown switch (1) is used for stopping the engine from the ground.

The switch (2) is used for turning on the stairway lights.



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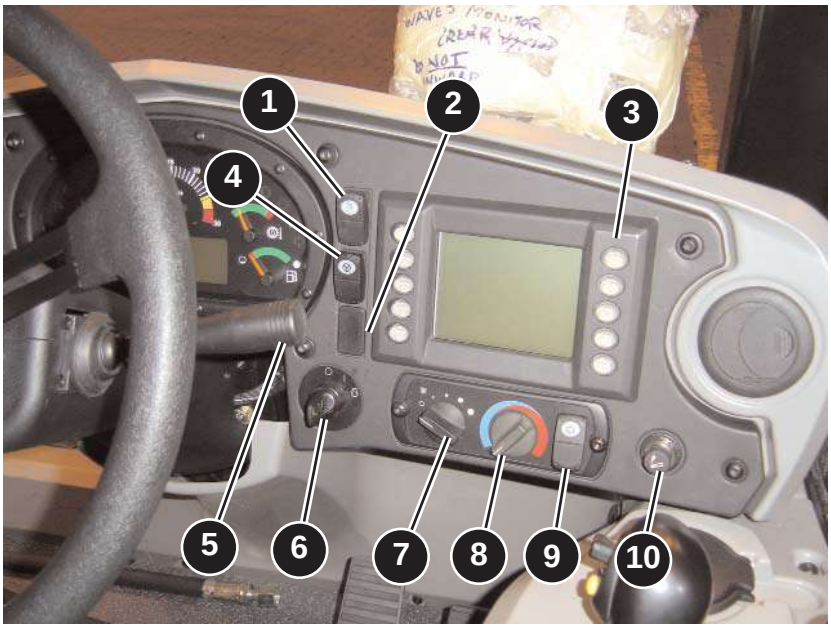
Located on the left side of the dash are:

- Dash panel switch for access lights (1)
- Head lamp switch (2)
- Hazard switch (3)
- Panel light intensity switch (4)
- Intermittent wiper/washer, turn signal control and dimmer switch (5)
- Telescopic/tilt steering column adjustment lever (6)



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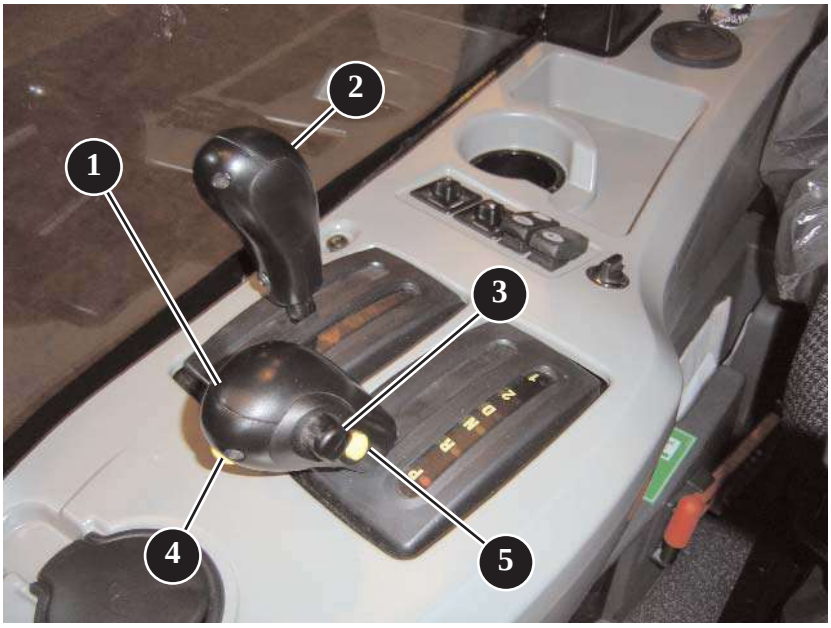
Located on the right side of the dash are:

- Automatic retarder control (1)
- Front Brake switch (2). The front brake switch allows the operator to turn the front brakes on or off. This switch should be in the on position during normal operation. The dry front brakes are optional.
- Advisor system (3)
- Secondary steering and parking brake release switch (4). Normally, when this switch is depressed, the steering system receives secondary steering oil and the parking brake release oil flows to the tank. When the brake release diverter (towing) valve spool is shifted, this switch will also release the parking brakes and provide hoist pilot oil for lowering the body on trucks with a dead engine. This switch also serves as a manual engine pre-lube.
- Manual retarder control lever (5)
- Engine key start switch (6)
- Fan speed switch (7)
- Temperature variable knob (8)
- Air conditioning on/off switch (9)
- Cigarette lighter (10). The cigarette lighter socket receives a 24 volt power supply. A 12 volt power supply and an additional 24 volt supply are provided behind the buddy seat.



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To the right of the operator's seat is a console which contains the transmission shift lever (1) and the body hoist lever (2).

The transmission has SEVEN speeds FORWARD and ONE REVERSE.

The top gear limit and body up gear limit are controlled by the Transmission/Chassis ECM. The top gear limit and the body up gear limit are programmable using Electronic Technician. The top gear limit can be changed from FIRST to SEVENTH. The body up gear limit can be changed from FIRST to THIRD.

The shift lever lock button (3) must be pushed in before the shift lever can be moved from "P" - PARK, "R" - REVERSE, "N" - NEUTRAL and from "D" - DRIVE to "N" - NEUTRAL.

The parking brakes are engaged whenever the shift lever is in the "P" - PARK position.

Placement of the shift lever in the "1" - FIRST or "2" - SECOND gear positions will engage only that gear and will not allow automatic upshift or downshift. This feature will allow the operator to hold the lower gears when operating in poor underfooting.

Placement of the shift lever in the "D" - DRIVE position will enable upshift and downshift. The top gear is selected by use of the momentary buttons in the shifter handle. The top button (4) will shift the top gear selection to the next higher gear through seventh gear. The bottom button (5) will shift the top gear selection to the next lower gear through first gear. The selected top gear and the actual gear will be displayed on the Messenger display.

→

The hoist system is electronically controlled. The hoist control lever (1) activates the four positions of the hoist control valve. The four positions are: RAISE, HOLD, FLOAT, and LOWER.

A fifth position of the hoist valve is called the SNUB position. The operator does not have control over the SNUB position. The body up switch controls the SNUB position of the hoist valve. When the body is lowered, just before the body contacts the frame, the Transmission/Chassis ECM signals the hoist solenoids to move the hoist valve spool to the SNUB position. In the SNUB position, the body float speed is reduced to prevent hard contact of the body with the frame. SNUB can be adjusted using Electronic Technician.

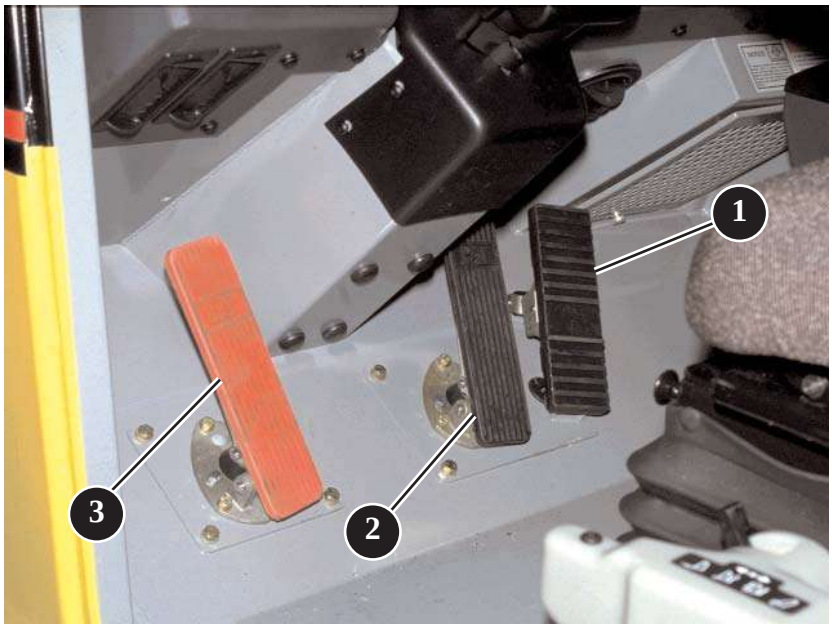
The truck should normally be operated with the hoist lever in the FLOAT position. Traveling with the hoist in the FLOAT position will make sure the weight of the body is on the frame and body pads and not on the hoist cylinders. The hoist valve will actually be in the SNUB position.

If the transmission is in REVERSE when the body is being raised, the hoist lever sensor is used to shift the transmission to NEUTRAL. The transmission will remain in NEUTRAL until:

1. the hoist lever is moved into the HOLD or FLOAT position; and
2. the shift lever has been cycled into and out of NEUTRAL.

The hoist lever is also used to start a new TPMS cycle.

NOTE: *If the truck is started with the body raised and the hoist lever in FLOAT, the lever must be moved into HOLD and then FLOAT before the body will lower.*



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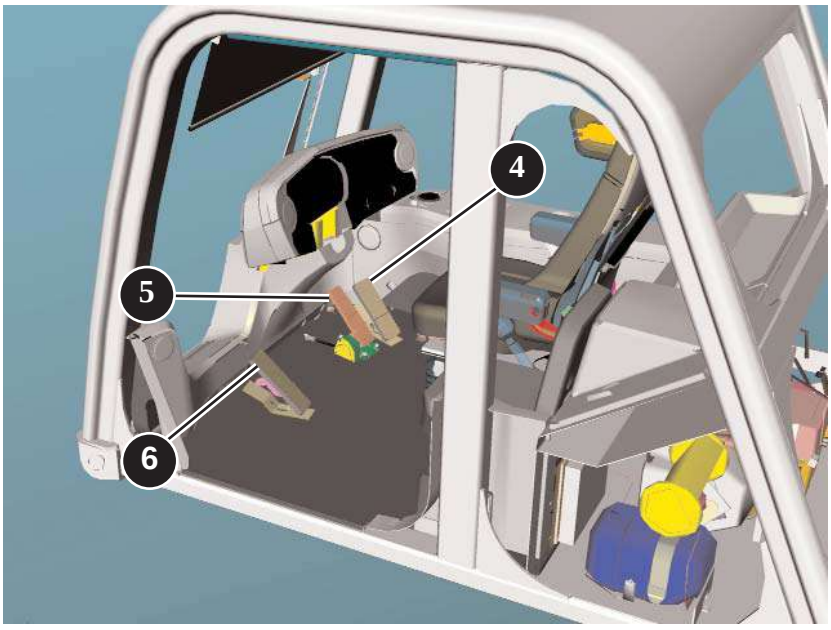

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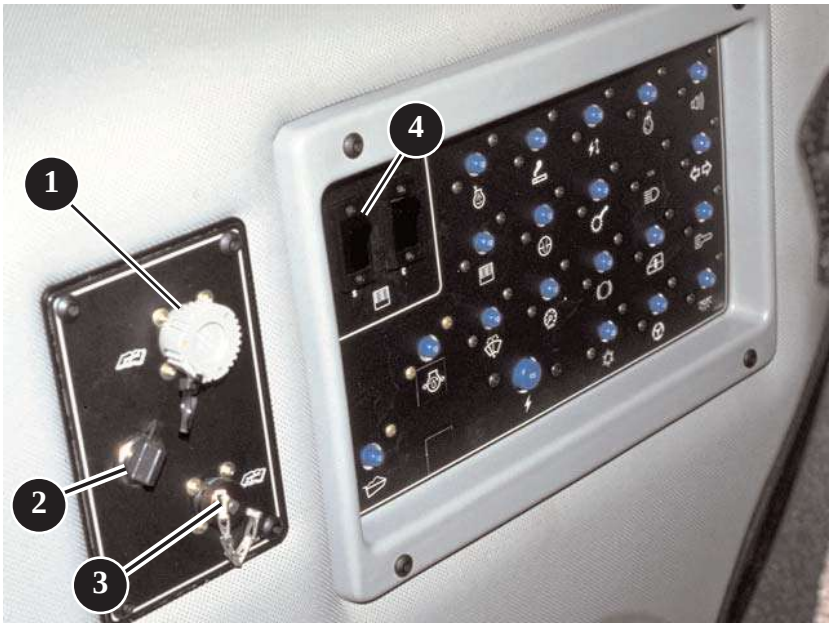
Shown are the control pedals on the floor of the 777D. The throttle pedal (1) has a position sensor attached that sends a signal to the Engine ECM. The service brake pedal (2) applies the brakes to all four wheels if the front brake ON/OFF switch is in the ON position. The secondary brake pedal (3) is used to apply the parking brakes in the rear and the service brakes on the front wheels.

Shown in the lower visual are the pedals on the floor of the 777F. Although the throttle pedal (4) has changed, the sensor remains the same. The service brake pedal (5) is used for primary braking for the machine. The secondary brake pedal (6) is used to apply the parking brakes in the event of a primary braking system failure.



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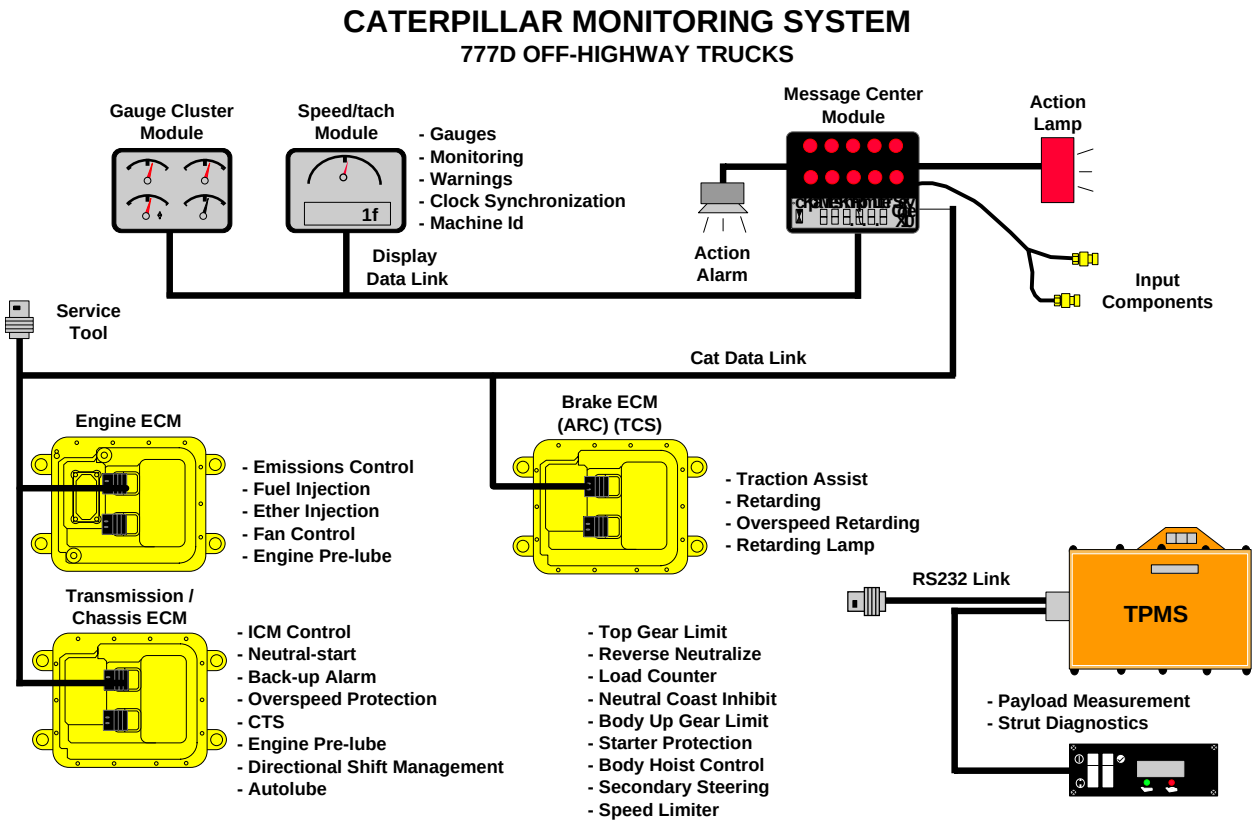
Shown in the top visual is the fuse panel for the 777D. This panel contains the CAT Data Link connector (1), a 12 Volt power port (2), and the Truck Payload Monitor System (TPMS) diagnostic connector. The two service switches (4) for accessing the Caterpillar Monitoring System have been eliminated with the Machine Monitor System.

Shown in the bottom visual is the fuse panel for the 777F. Provided is a 12 Volt power supply (5) and a diagnostic port (6) for product link. Automotive style fuses have replaced the previous screw in type fuses.

A laptop computer with the TPMS software can be hooked up to connector (8).

With ET software installed on a laptop computer, diagnostic codes and programming can be preformed by hooking to connector (7).



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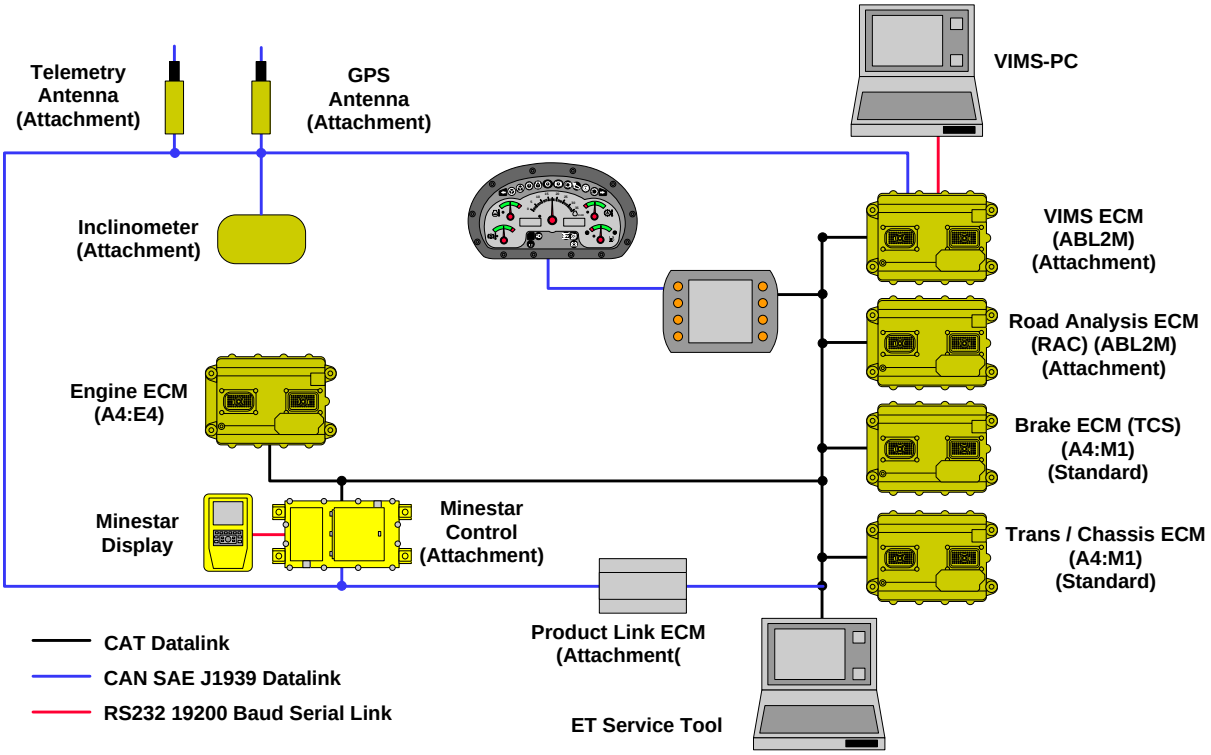
Monitoring System

The Caterpillar Monitoring System on the 777D is a flexible, modular monitoring system that includes: a message center module, various switches and sensors, an action lamp, and an action alarm.

The "heart" of the system is the message center module where information is received from switches and sensors and other ECM's over the CAT Data Link. The information is processed by the message center module, then activates various output components.

The Truck Payload Monitoring System (TPMS) is an optional system that can be installed on the trucks to monitor and record production data such as payload and cycle times. The TPMS is not on the CAT Data Link and requires a separate communication port for downloading and viewing the production information.

100T ELECTRONIC SYSTEM BLOCK DIAGRAM



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The Machine Monitor System on the 777F trucks conveys the machine status, communicated from the other ECM's, to the operator. The Machine Monitor System includes an Instrument Cluster, an Advisor Display, an Engine ECM, a Transmission/Chassis ECM, and a Brake ECM

The Instrument Cluster is a cab display that shows the operator the status of various machine parameters as well as alerts the operator of specific machine conditions. The Instrument Cluster is driven by the Messenger Display via the Controller Area Network (CAN) Data Link. The Messenger Display is standard and has an optional Truck Payload Management System.

The Advisor Display (optional) is an LCD module with eight operator actuated push buttons which will allow the operator to access menus to display machine status along with diagnostics, events, and TPMS data. The Advisor can also be used to set desired values for various machine functions and come standard with the Truck Payload Management System.

The 777F monitoring system can also have the following attachments: Minestar, Vims, RAC, Product Link, Inclinometer, Telemetry antenna, and GPS antenna.

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Shown is the Instrument Cluster (1) located in the center of the front dash panel. Eighteen dash indicators, five analog gauges, and the two digital displays are visible.

The five parameters monitored by the analog gauges are (bottom left to right):

- Brake oil temperature
- Engine coolant temperature
- Engine speed
- Torque Converter oil temperature
- Fuel Level

Alert indicators from left to right

- Left turn signal
- Throttle lock
- Primary steering loss
- Secondary Steering engaged

→

- Check engine
- Park brake engaged
- Brake system check
- Power train system check
- Action lamp
- Charging system
- Body up
- Machine lockout active
- Transmission in reverse
- High beam
- Retarder engaged
- Traction control system engaged
- Machine immobilizer
- Right turn signal

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Shown above is the Caterpillar Advisor graphical display module. It is located on the right side of the dash. It is the operator and Technician's interface with the Caterpillar Monitoring and Display System. Information is displayed on a backlit LCD display screen.

The top portion of the screen is called the "Top Banner" and it displays vital machine information at all times. The Top Banner may display different information from machine to machine, depending on the model and the attachments that are installed.

At the right of the display screen is a column of five User Interface buttons. These buttons are used to navigate through the numerous Advisor screens, to make menu selections, or to enter data. The five buttons, from top to bottom, are:

- LEFT/UP Arrow Button (1) - This button is used for screen navigation or data entry. It can be used:
  - to scroll up a vertical list or scroll left across a horizontal list;
  - to decrease a setting value, such as decreasing brightness/contrast.

- DOWN/RIGHT Arrow Button (2)- This button is also used for screen navigation or data entry. It can be used:
  - to scroll down a vertical list or scroll right across a horizontal list;
  - to increase a setting value, such as increasing brightness/contrast.

- BACK Button (3) - This button is used:
  - to go up one level in a stair-step (hierarchical) menu structure, or to return to the previous screen, much the same as the BACK Button is used in Windows Internet Explorer™;
  - as a backspace, or cancel key when the operator or serviceman wishes to delete entered characters.

- HOME Button (4)- This button is used to return to the home menu screen, regardless of what screen is currently displayed.

- OK Button (5) - This button is used:
  - to make selections from a screen;
  - to confirm an entry, such as a password, or for saving an operator profile entry.

Navigation through the menus and sub-menus is accomplished by using the ARROW Buttons to highlight the desired selection, then pressing the OK Button. The ARROW Buttons are also used to highlight a mode or to set a parameter. Pressing the OK Button selects that option. (Example: Choosing either "Enabled" or "Disabled" for the FLOAT option in the Implement Settings menu.)

NOTE: *The column of five buttons at the left of the display screen currently have no function.*

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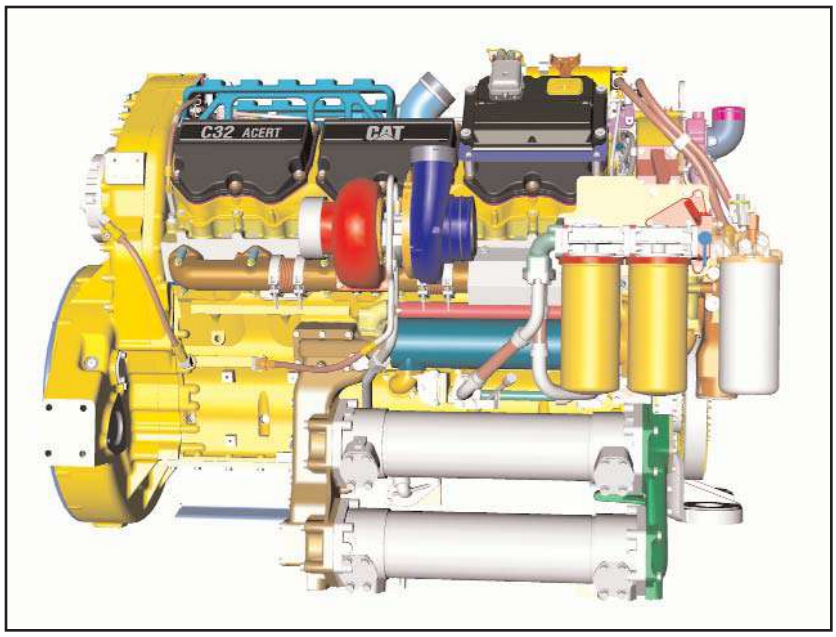
Shown in the visual four switches and a power port.

- Port (1) is a 12 volt power supply.
- Rocker switch (2) will raise the engine idle if the throttle position sensor has failed.
- Rocker switch (3) controls the heated mirrors
- Switch (4) has been removed
- Switch (5) has been removed



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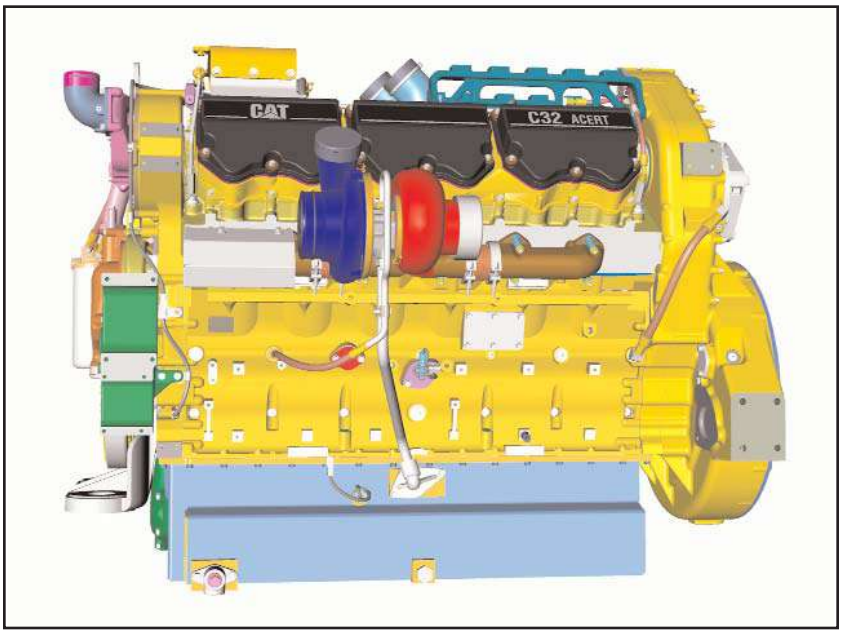

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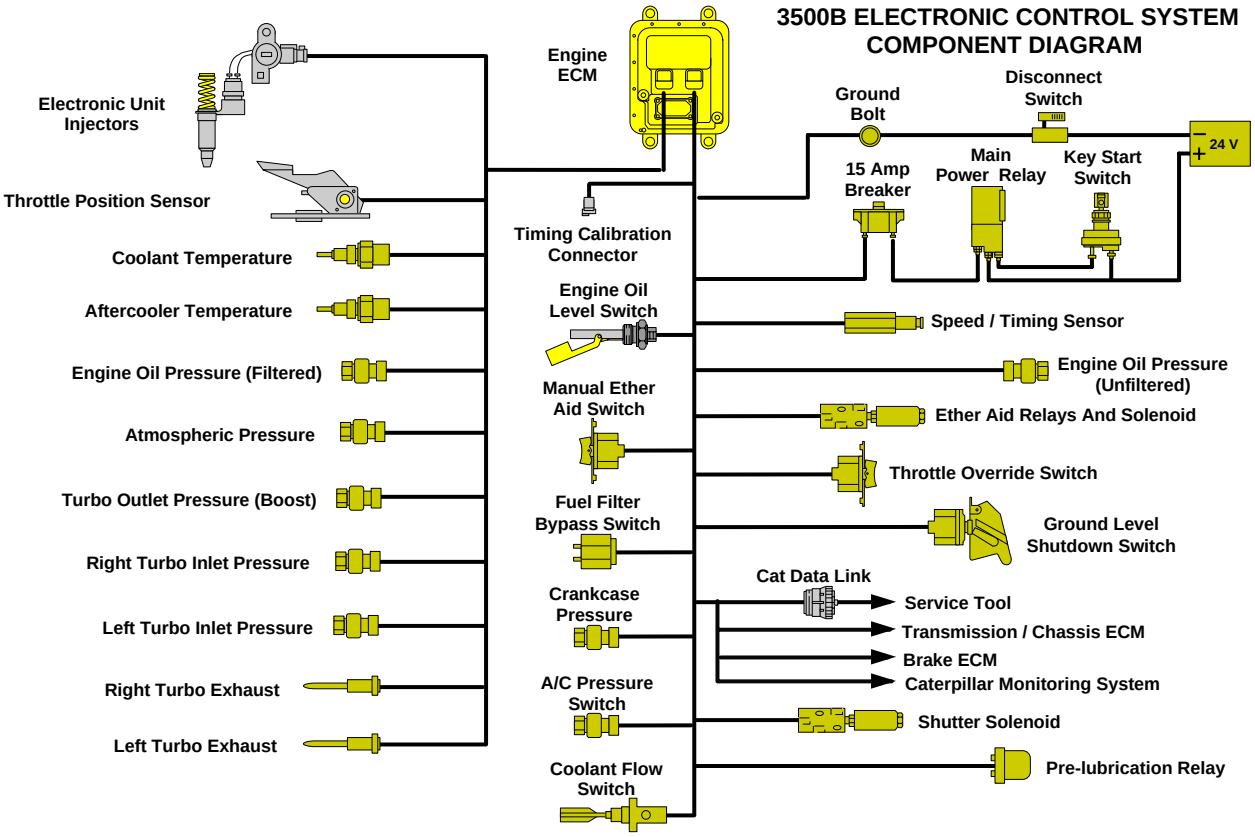
ENGINE

The top visual shows the right side of the new C32 engine used in the 777F trucks. The bottom visual shows the left side of the new C32 engine. The 777F truck engines are designed to meet the US Environmental Protection Agency (EPA) Tier II emissions regulations as well as European Stage 2 regulations.

The engine performance specification for the 777F truck is:

- Serial No. Prefix: LJW
- Performance Spec: 0K5981
- Gross Power: 758 kW (1,016 hp)
- Full Load rpm: 1750
- High Idle rpm: 1938 ± 10
- Low Idle rpm: 650
- Overspeed: 2800 rpm
- Fuel system: MEUI
- Max torque produced: 1300 rpm



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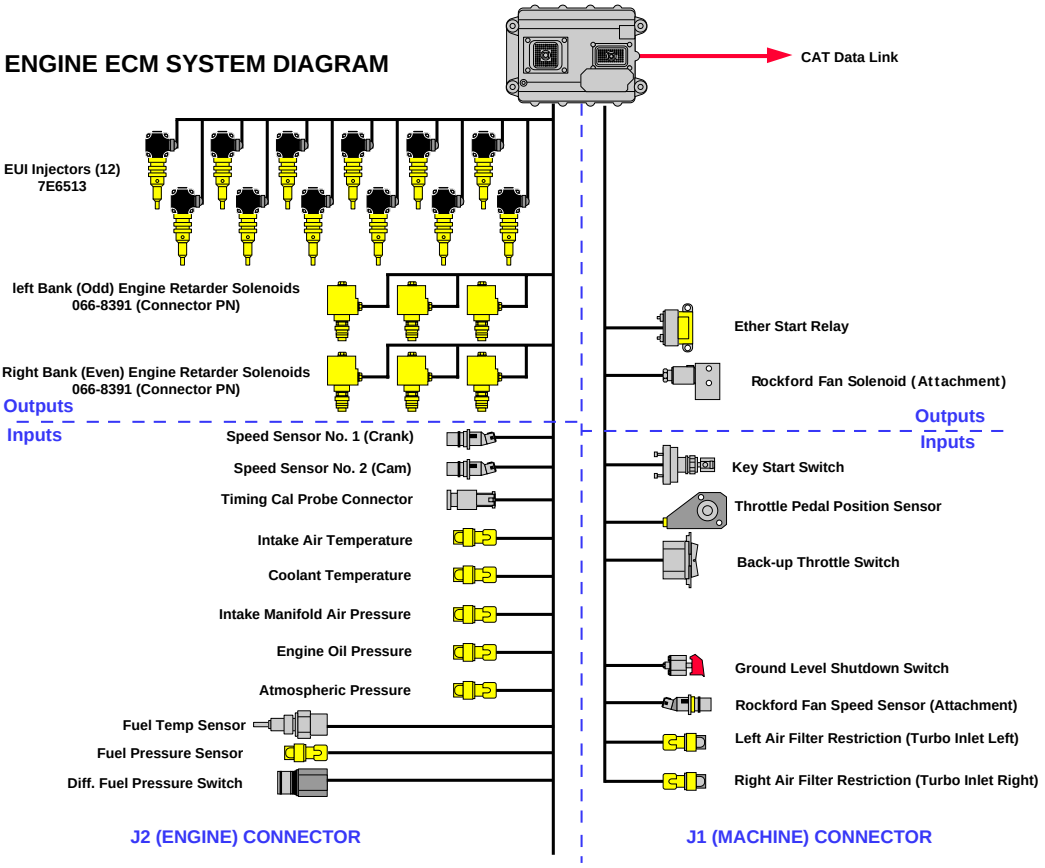
Shown is the electronic control system component diagram for the 3508B used on the 777D. Fuel injection is controlled by the Engine Electronic Control Module (ECM). Other systems controlled by the Engine ECM include:

- Ether injection
- Engine start function
- Engine oil pre-lubrication

The Engine ECM, located on top of the engine, has two 40-pin style connectors. The Engine ECM is cooled by fuel. Fuel flows from the fuel transfer pump through the ECM to the secondary fuel filters.

Occasionally, changes are made to the internal software that controls the performance of the engine. These changes can be made by using the WinFlash program that is part of the laptop software program Electronic Technician (ET).



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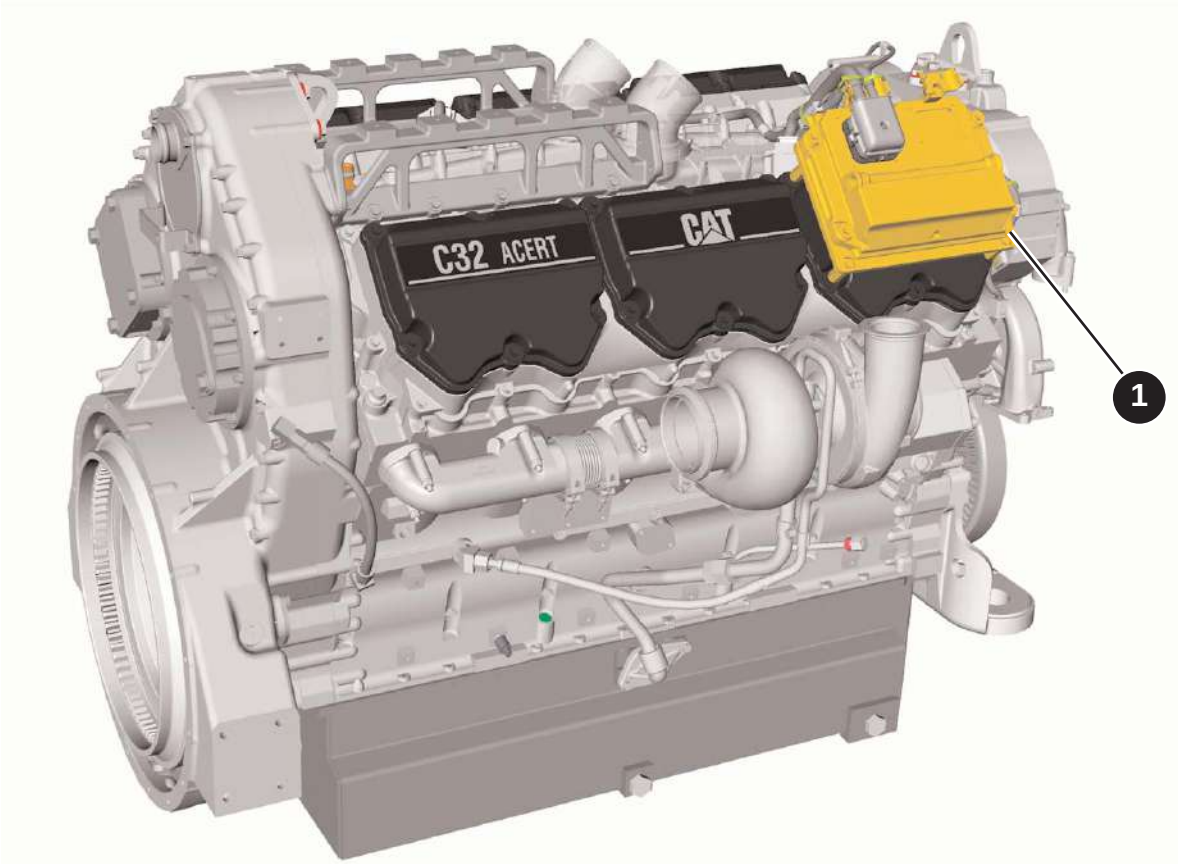
Shown is the electronic control system component diagram for the C32 ACERT engines used in the 777F Off-highway trucks. Fuel injection is controlled by the Engine Electronic Control Module (ECM).

Many electronic signals are sent to the Engine ECM by sensors, switches, and senders. The Engine ECM analyzes these signals and sends signals to various output components. Output components can be relays, lamps, other controls, or solenoids. For example, based on the various input signals, the Engine ECM determines when and for how long to energize the injector solenoids. When the injector solenoids are energized determines the timing of the engine. How long the solenoids are energized determines the engine speed.



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The Engine ECM (1) is located on the right side of the engine. The Engine ECM controls several systems. Those systems include:

- Ether starting aid
- Engine start function
- Engine oil pre-lubrication
- Variable speed Rockford fan
- Engine retarding
- Engine derate

The Engine ECM has 120-pin connector and 70-pin connector. The connectors are identified as "J1" and "J2." Be sure to identify which connector is the J1 or J2 connector before performing diagnostic tests.

Occasionally, Caterpillar will make changes to the internal software that controls the performance of the engine. These changes can be performed by using the WinFlash program that is part of the laptop software program Electronic Technician (ET). ET is used to diagnose and program the electronic controls used in Off-highway Trucks. If using the WinFlash program, a "flash" file must be obtained from Caterpillar and uploaded to the ECM.

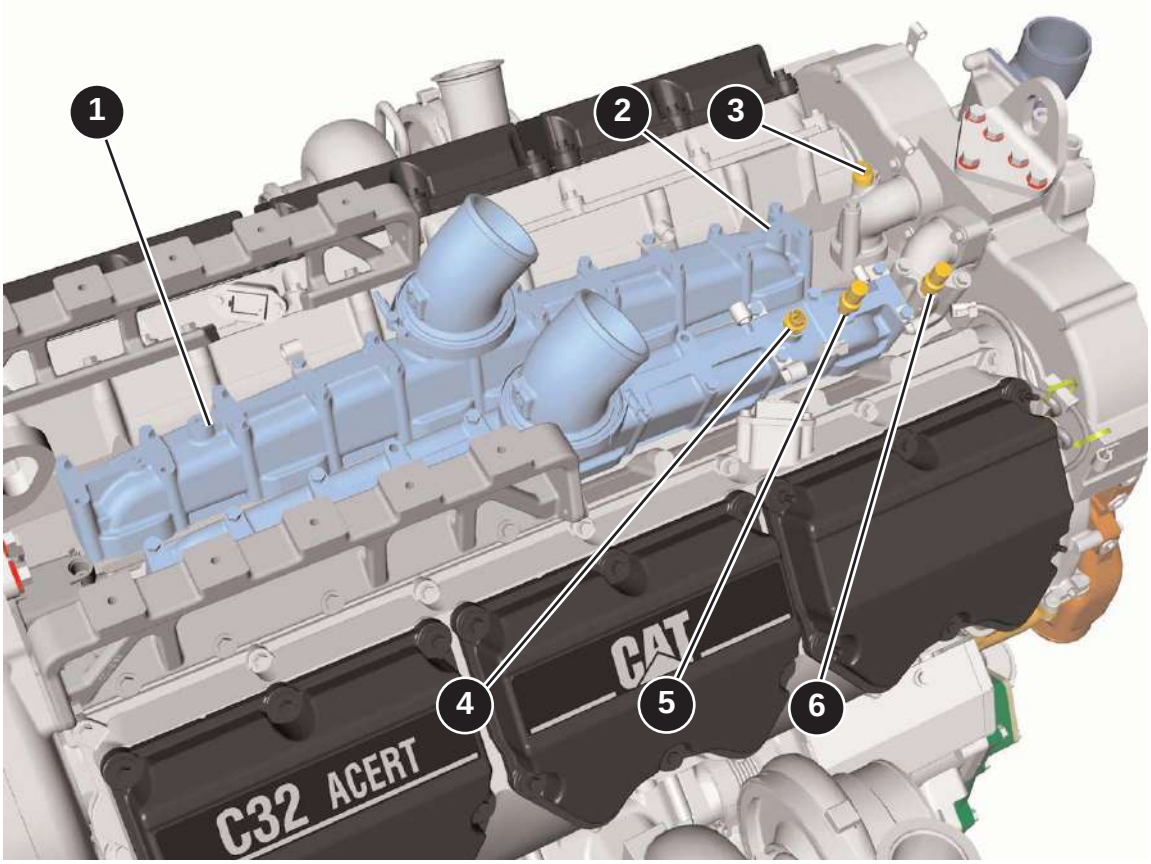
A 2-pin timing calibration connector is located next to the Engine ECM. If the engine requires timing calibration, a timing sensor (magnetic pickup) is installed in the flywheel housing and connected to the timing calibration connector.

Using the Caterpillar ET service tool, the timing calibration is performed automatically. This step is performed to avoid instability and ensures that no backlash is present in the timing gears during the calibration process.

Timing calibration improves fuel injection accuracy by correcting for any slight tolerances between the crankshaft, timing gears, and timing wheel.

Timing calibration is normally performed after the following procedures:

- ECM replacement
- Cam or crank sensor replacement
- Timing wheel replacement



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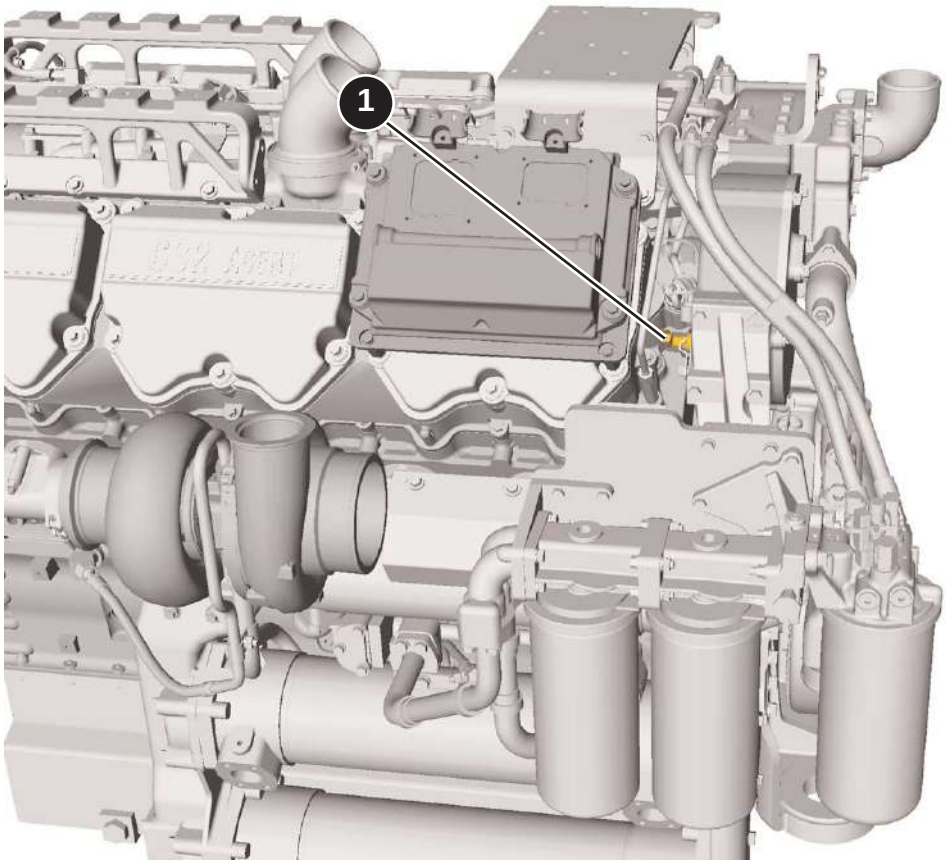
Intake air temperature sensor (1) and (4) are located on top of the engine. Sensor (1) is located toward the left rear and sensor (4) is located toward the front right side. The intake air temperature sensor is an analog sensor that is monitored by the engine ECM. The ECM monitors intake air temperature for derating the engine at high temperatures, for engine shutdown at high temperatures, and for signaling the monitoring system in the event of a problem.

The turbo outlet pressure sensors (2) and (5) are used for calculating boost.

The coolant temperature sensor (3) is located on top of the engine toward the front left side. The coolant temperature sensor is an analog sensor that is monitored by the engine ECM. When the coolant temperature get to high, the engine ECM will signal the monitoring system to display a warning.

The atmospheric pressure sensor (6) is located on top of the engine toward the front right side. The atmospheric pressure sensor is a digital sensor that is monitored by the engine ECM. The ECM monitors atmospheric pressure for the following: altitude derate, air inlet restriction derate, and calibration reference for other sensors.



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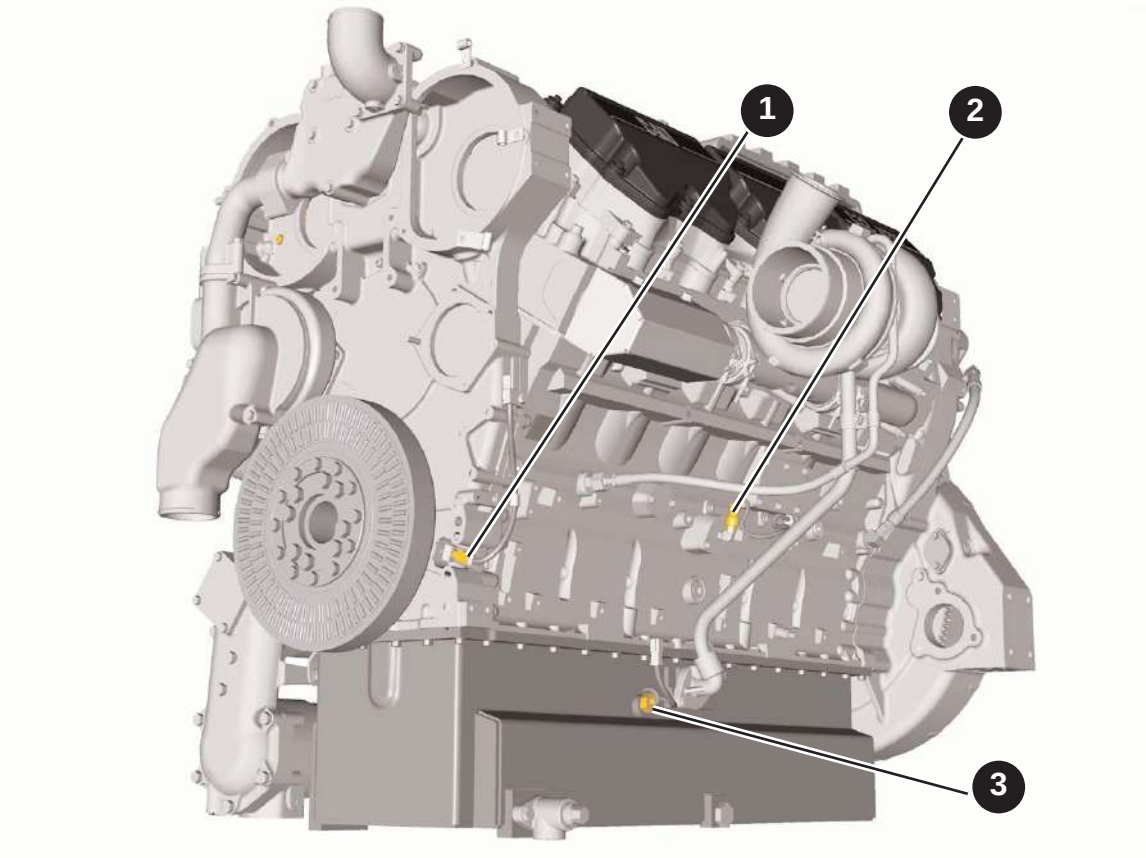
The cam speed/timing sensor (1) is located on the right side of the engine in the back side of the timing gear housing behind the primary fuel filter. This sensor is used as a backup for the crank speed/timing sensor. If the crank speed/timing sensor fails, the cam speed/timing sensor allows for continuous operation.



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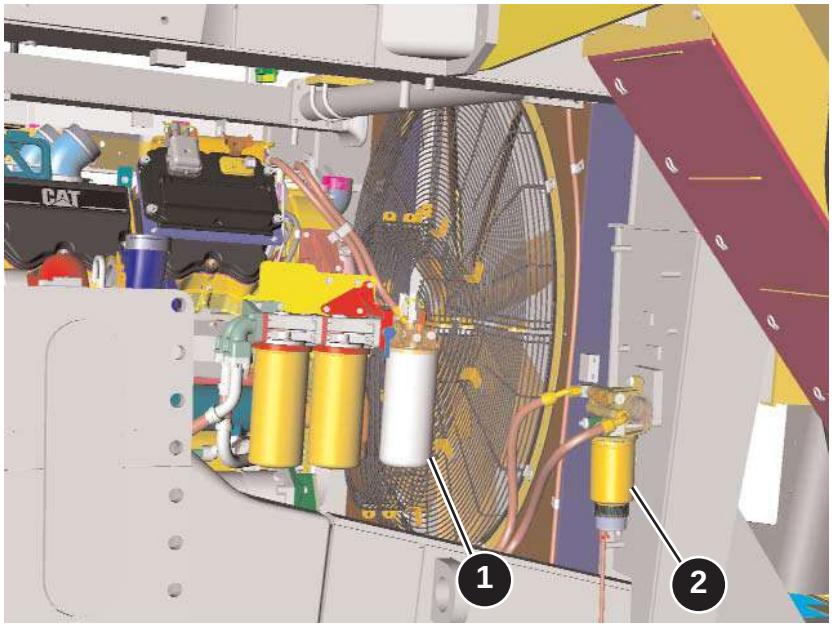
The crankshaft speed/timing sensor (1) is located on the lower left of the engine toward the front side. This sensor measures engine speed and timing for control of the timing and delivery of fuel to each of the engine's cylinders. Sensing engine speed allows engine speed governing, fuel limiting, and fuel injection timing. If the crank speed/timing sensor fails, the cam speed/timing sensor allows for continuous operation.

The oil pressure sensor (2) is located on the left side of the engine. The oil pressure sensor is an analog sensor that is monitored by the Engine ECM. When the oil pressure drops to low, the engine ECM will signal the monitoring system to display a warning. The ECM will also log an event that requires a factory password to clear.

The switch (3) monitors the oil level in the pan.



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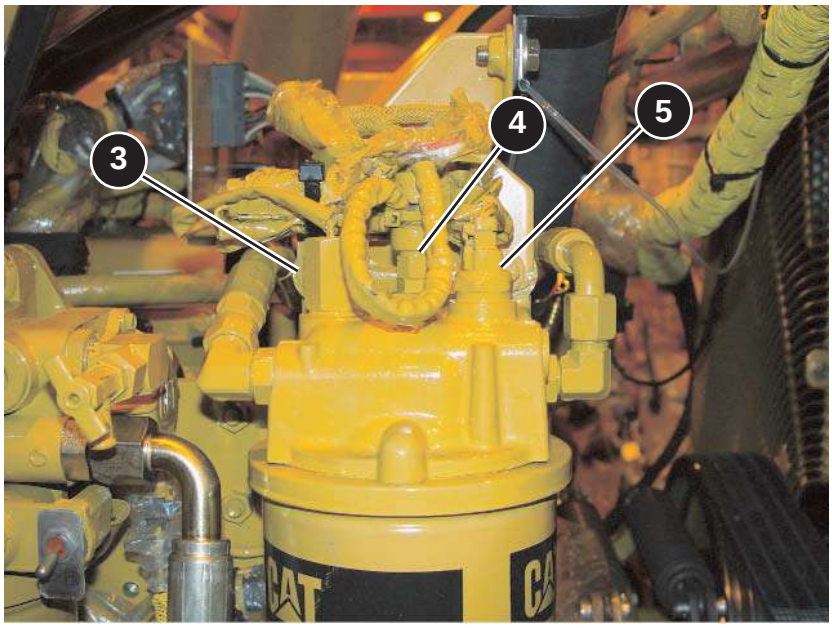

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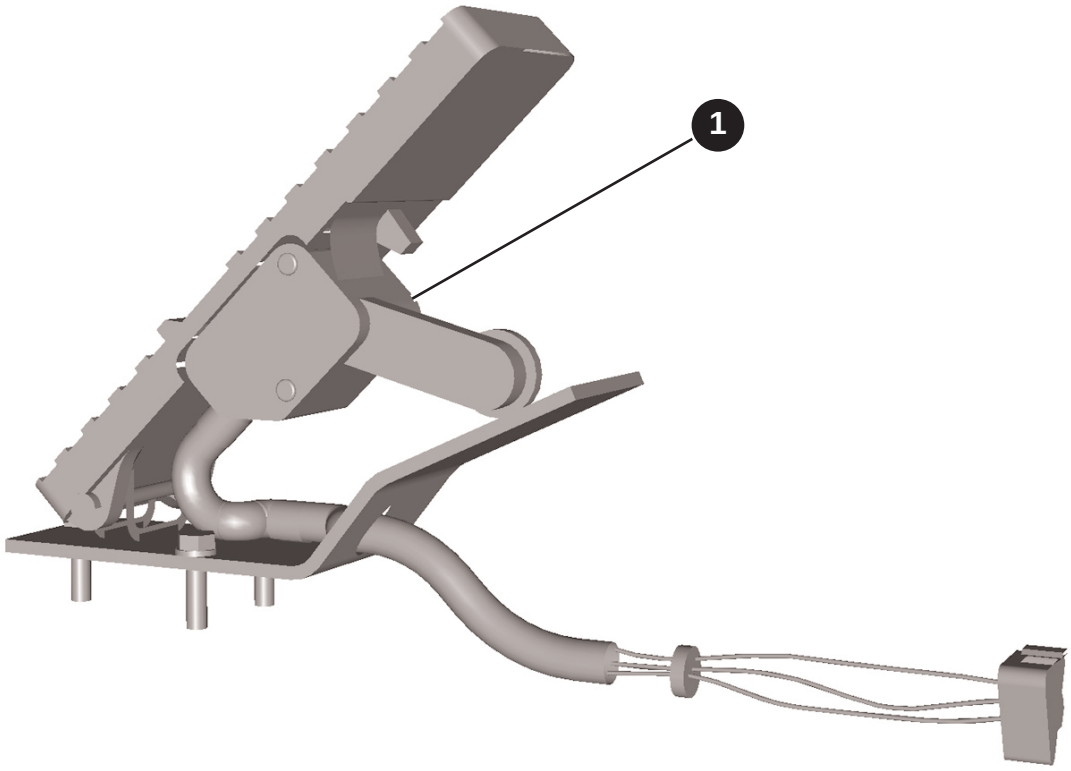
Shown in the top visual is the secondary fuel filter (1) and primary fuel filter (2).

Shown in the lower visual is the differential fuel pressure switch (3) located in the top of the secondary fuel filter housing on the right side of the engine. This switch will indicate restriction in the fuel filter. A warning will be sent by the Engine ECM to the Machine Monitor System.

The fuel pressure sensor (4) is located in the top of the secondary fuel filter housing on the right side of the engine. This sensor is used to monitor fuel pressure.

The engine fuel temperature sensor (5) is located in the top of the secondary fuel filter housing on the left side of the engine. The Engine ECM uses the fuel temperature measurement to make corrections to the fuel rate and maintain power regardless of fuel temperature (within certain parameters). This feature is called "Fuel Temperature Compensation."



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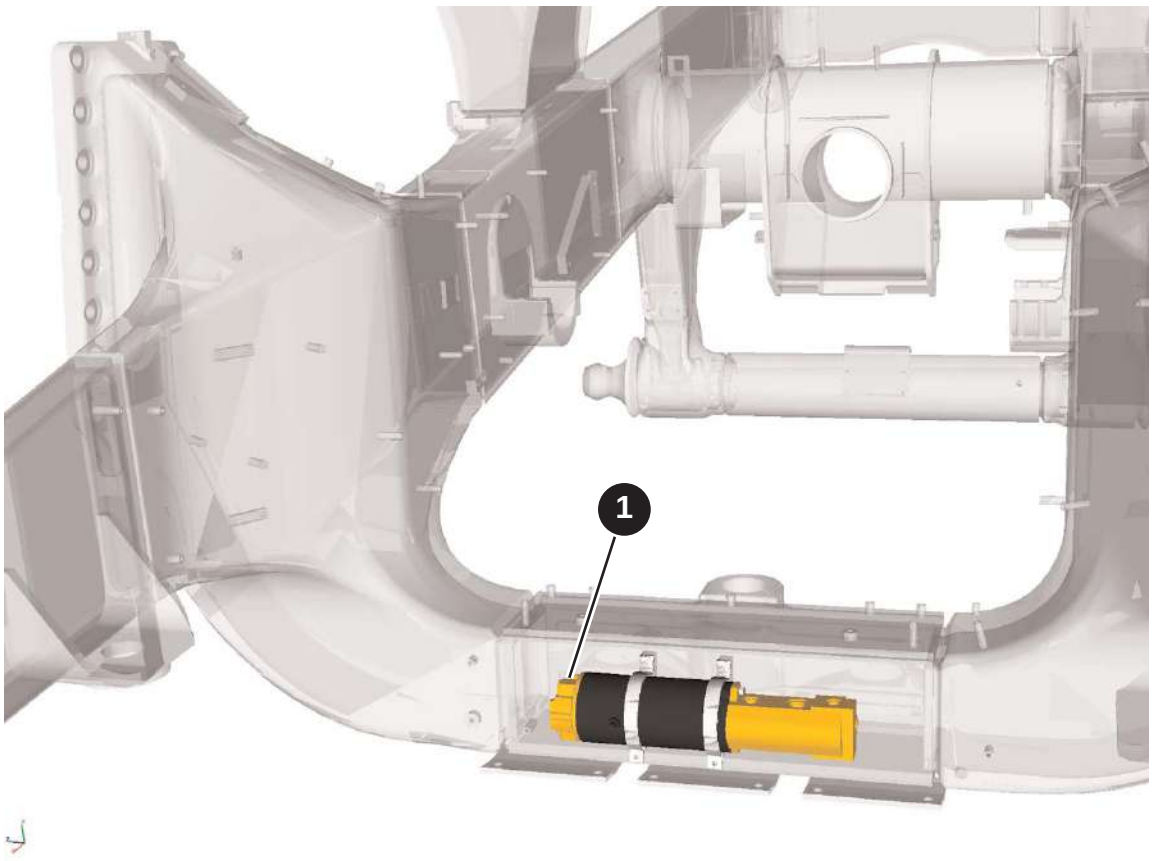
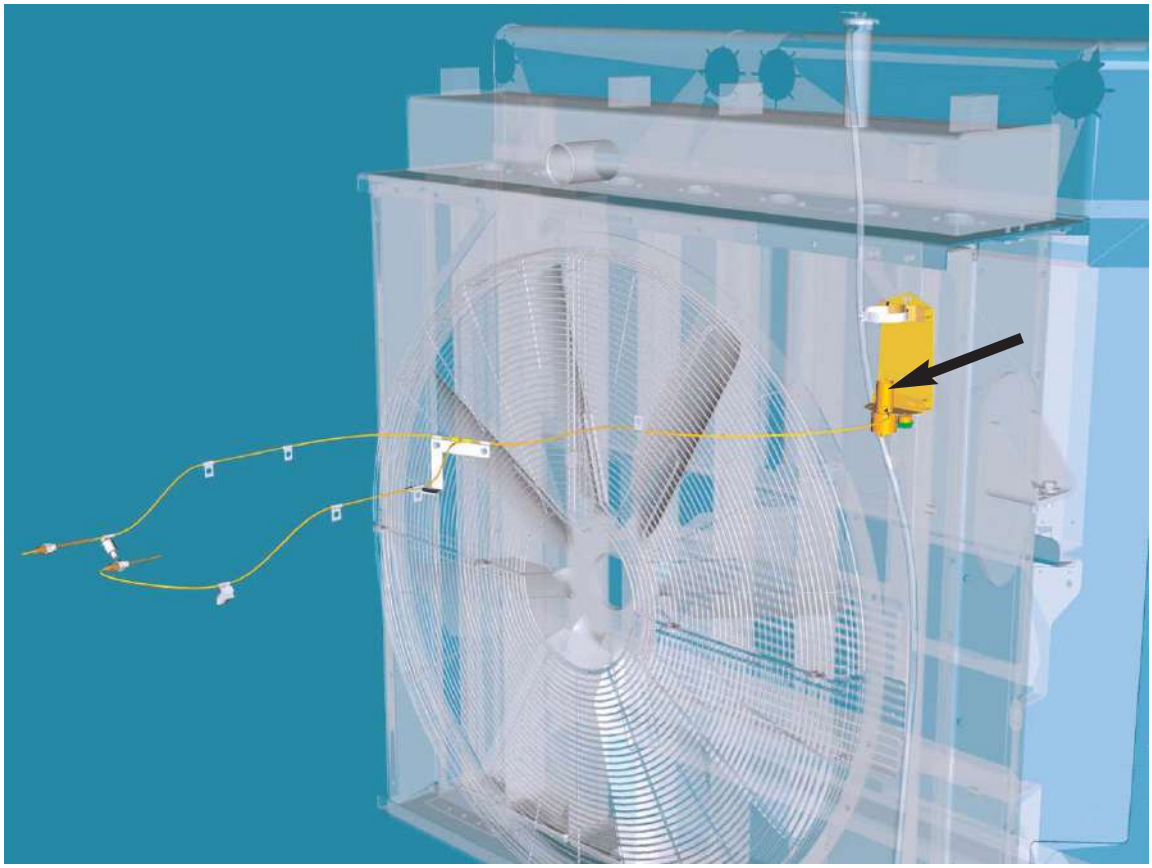
The throttle position sensor (1) provides the desired throttle position to the Engine ECM. The throttle position sensor is located behind the throttle pedal in the cab.



29

Shown is the pre-lube pump (1) for the 777F trucks. The pre-lube pump is located on the front of the crossmember that supports the front struts. The pump is used for both engine pre-lube and Quick EVAC.



30

If the truck is equipped with an ether start system (arrow), the Engine ECM will automatically inject ether from the ether cylinder during cranking. The amount of automatic ether injection depends on the engine oil or jacket water coolant temperature. The Engine ECM sends a duty cycle signal to the ether injection relay. The maximum duty cycle is 50%. A 50% duty cycle will pulse the ether relay ON three seconds and OFF three seconds. The maximum ether delivery is ten 3-second shots per minute. Each shot delivers 6 ml (.2 oz) of ether.

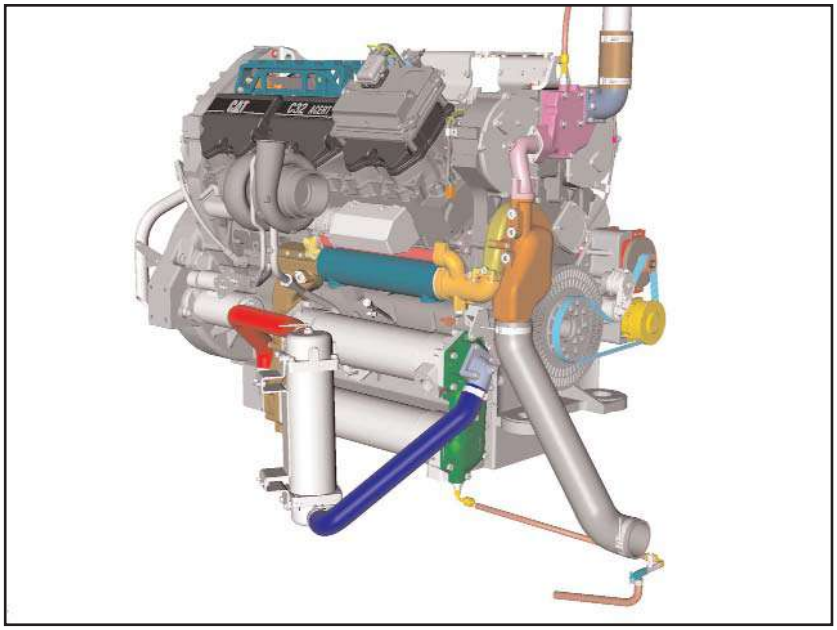
The Engine ECM will energize the ether injection relay only if:

- Engine oil temperature is below 0° C (32° F).
- Engine coolant temperature is below 0° C (32° F)--back-up for oil temperature.
- Engine speed is below 500 rpm.

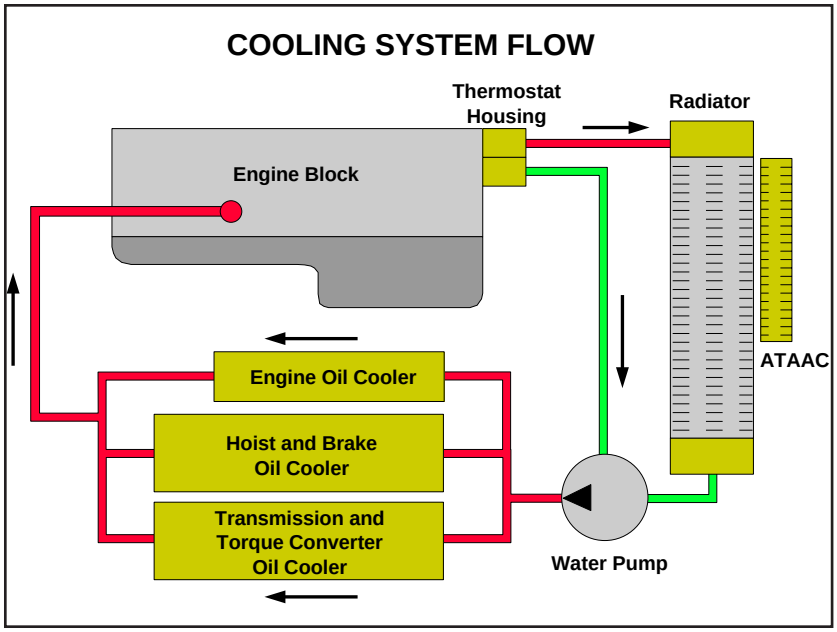
A laptop computer with the Electronic Technician (ET) software installed can be connected to the machine to turn the ether injection system ON or OFF.

The operator can also inject ether manually with the ether switch in the cab on the center console. The manual ether injection duration is 3 seconds and delivers 6ml (.2 oz) of ether each time the switch is depressed. The manual mode is disabled when engine speed is above 1200 rpm or engine oil temperature is above 10° C (50° F).

NOTE: *The manual start aid (ether) switch is a dealer installed option.*



31

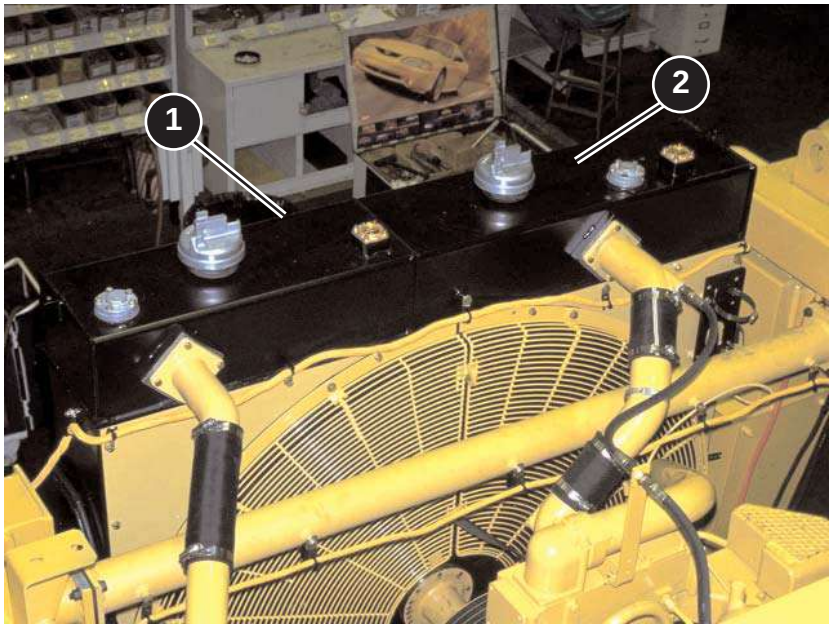


32

Cooling System

Shown in the top visual is the cooling system for the 777F. The cooling systems for the 777F and 777D are similar. The flow of coolant through the system is the same, however the components are located in different locations due to a new engine on the 777F.

Shown in the lower visual is the flow of coolant through the cooling system for the 777F. These trucks use a conventional radiator core. Coolant flows from the pump through the coolers and into the engine block. Coolant flows through the engine block and the cylinder heads. From the cylinder heads, the coolant returns to the temperature regulators and either goes directly to the water pump through the bypass tubes or to the radiator.



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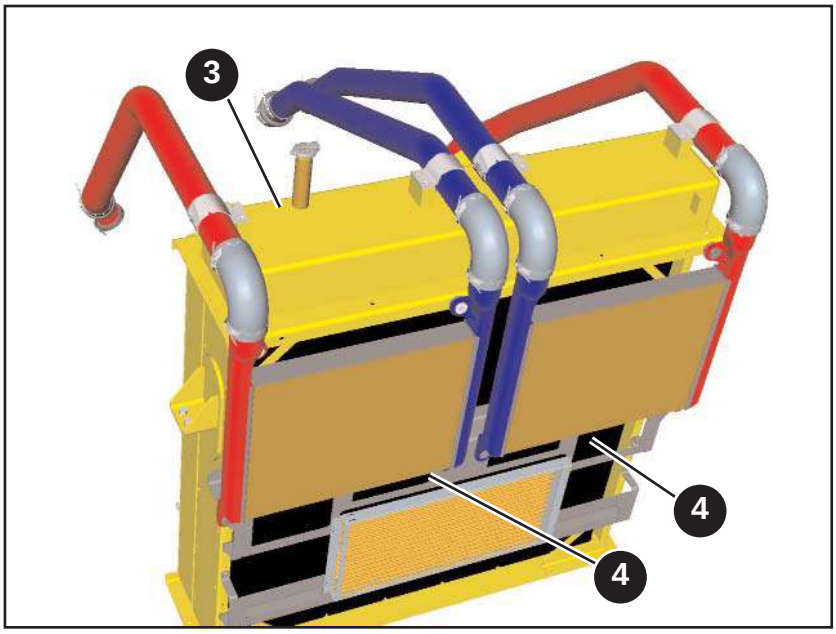


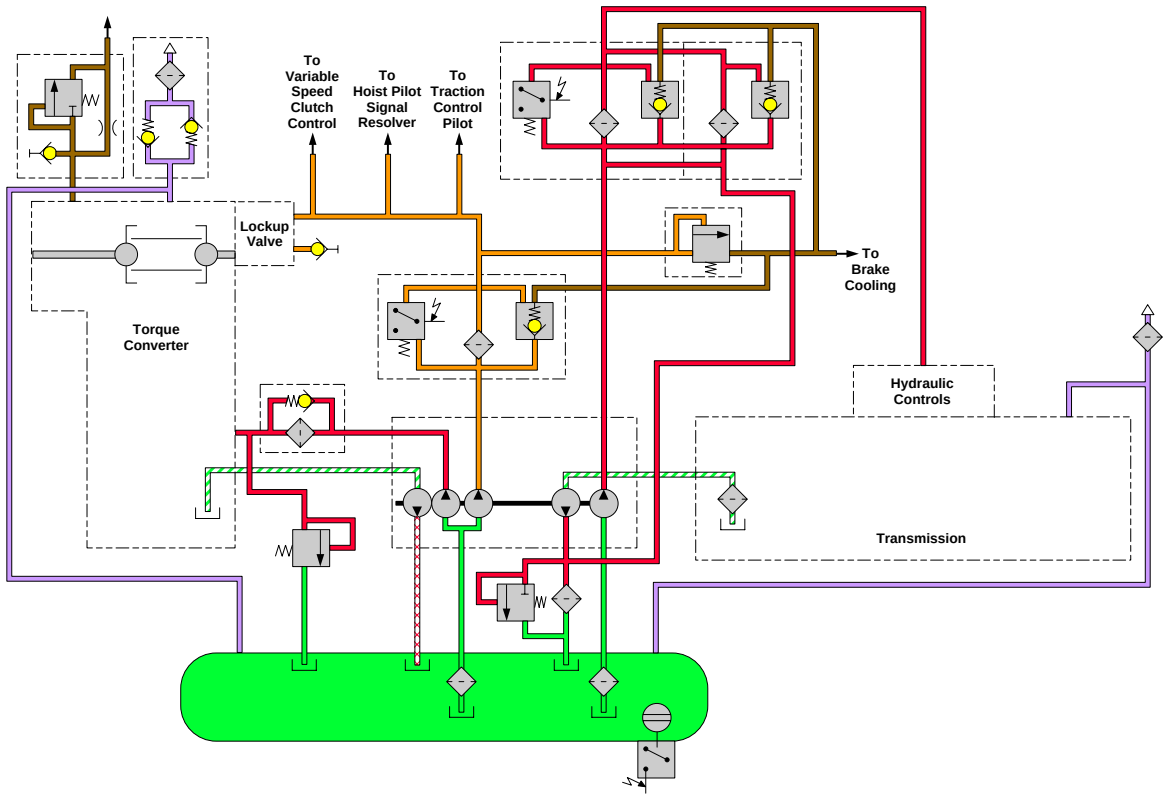
34

Shown in the top visual is the cooling package of the 777D. The cooling package is divided into two systems. The two systems are the jacket water cooling system (2) and the aftercooler system (1).

Shown in the bottom visual is the Next Generation Modular Radiator (NGMR) (3) for the 777F trucks.

Also shown is the ATAAC (4) which is mounted in front of the radiator. Intake air is cooled after being compressed by the turbocharger before being routed to the engine combustion chamber.

POWER TRAIN HYDRAULIC SYSTEM



35

POWER TRAIN HYDRAULIC SYSTEM

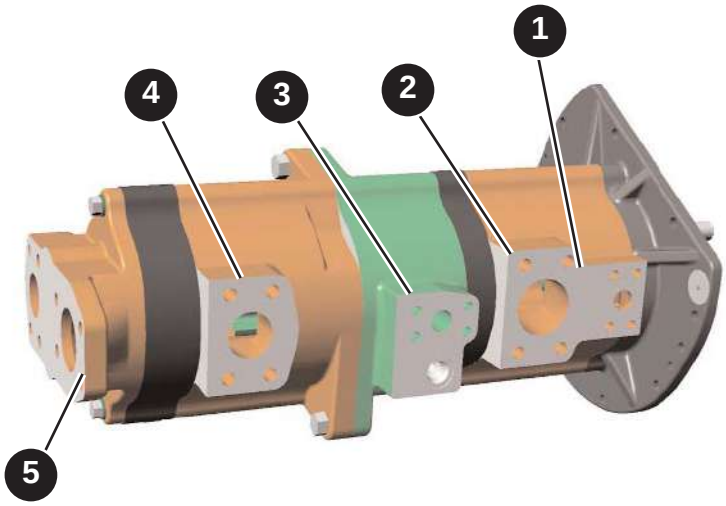
Shown is the transmission and torque converter hydraulic system for the 777F. A five section pump is located at the rear of the torque converter housing. One section scavenges oil from the bottom of the torque converter case and returns the oil to the hydraulic tank. The second section pumps charge oil to the torque converter. The third section provides pilot oil to the following circuits:

- Lockup valve
- Variable speed fan clutch control
- Hoist pilot signal resolver
- Traction control

The fourth section scavenges oil from the transmission sump and pumps it to the following locations:

- Transmission filters
- Transmission oil cooler

The fifth section supply charging oil to the transmission control valves.



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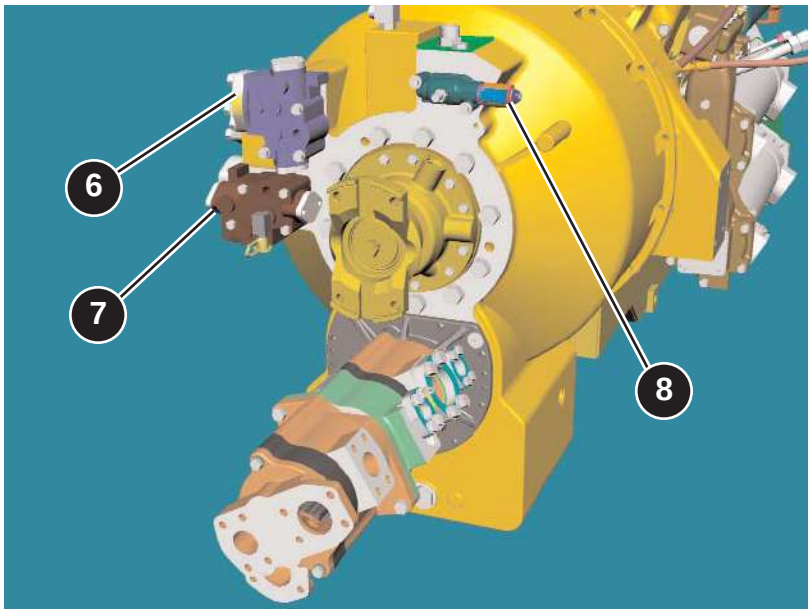


37

Power Train Components

Shown in the top visual is the new five section gear pump. The gear pump is a different design then the previous 777D. The gear pumps are for the following circuits:

-Torque converter scavenge (1)

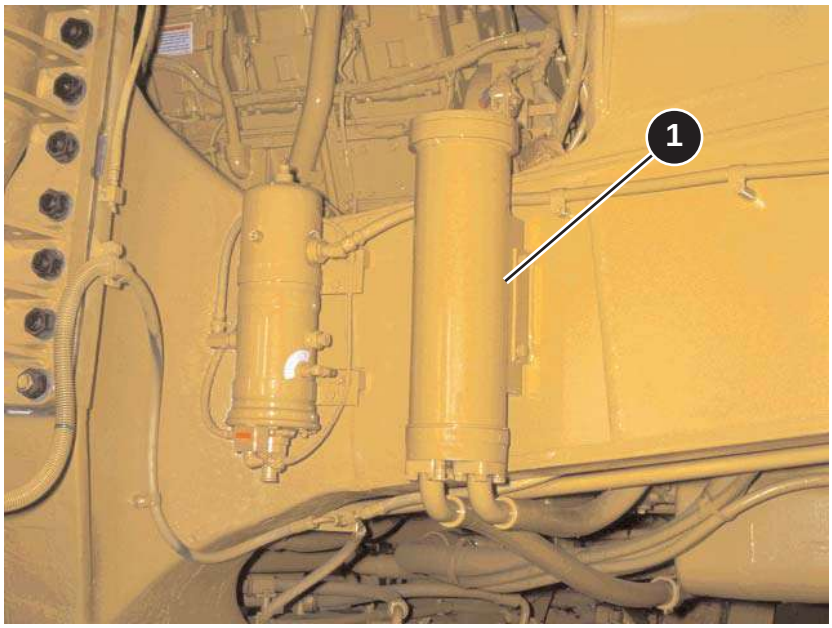
-Torque converter charge (2)

-Lockup clutch valve pilot circuit (3)

-Transmission scavenge (4)

-Transmission charge (5)

Shown in the lower visual are some of the torque converter system components for the 777F. The torque converter systems are similar between the 777D and 777F. The torque converter inlet relief valve (6) and the outlet relief valve (7) will function the same. The lockup clutch valve (8) on the 777F is now an ECPC valve.



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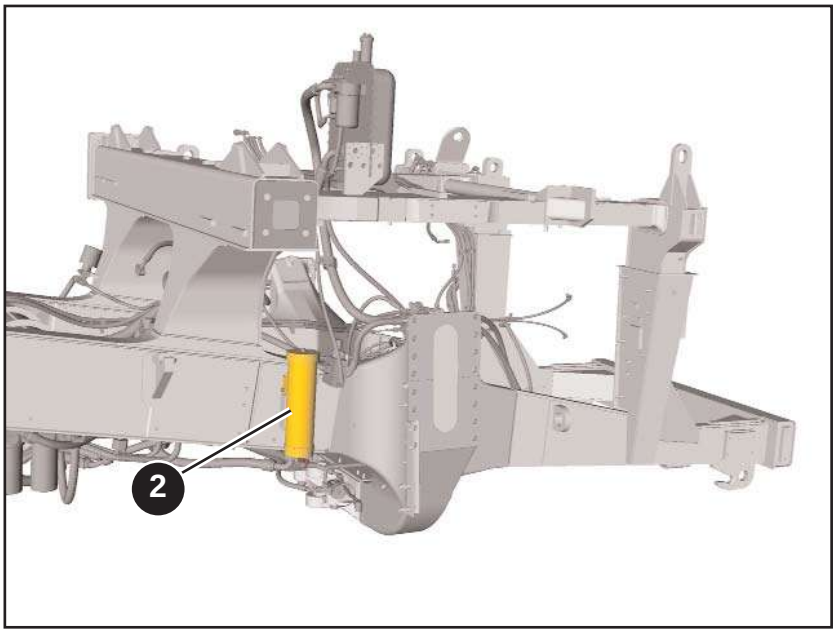
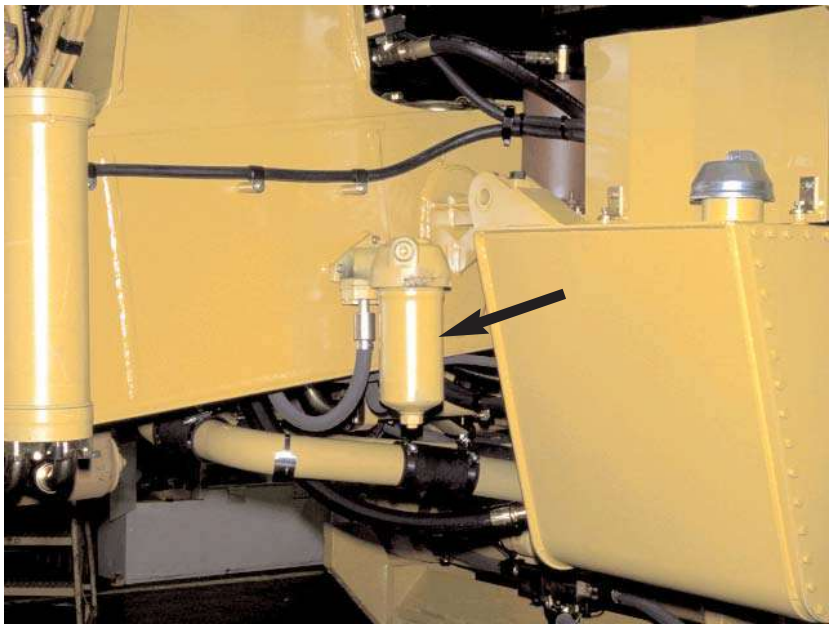


39

Shown in the top visual is the 777D torque converter charging filter (1). The charging filter is located on the left frame rail, behind the left front tire.

Shown in the bottom visual is the 777F torque converter charging filter (2). The charging filter is located on the right frame rail, behind the right front tire.



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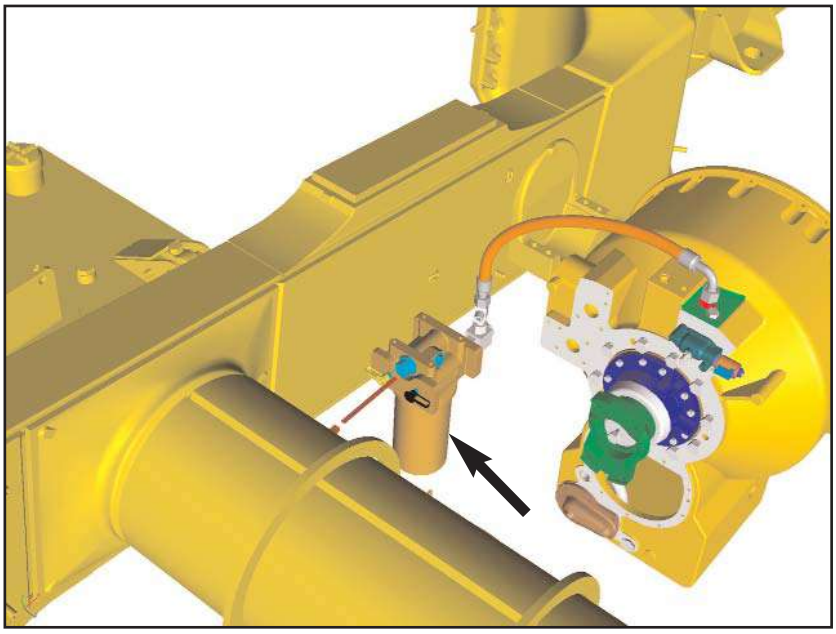
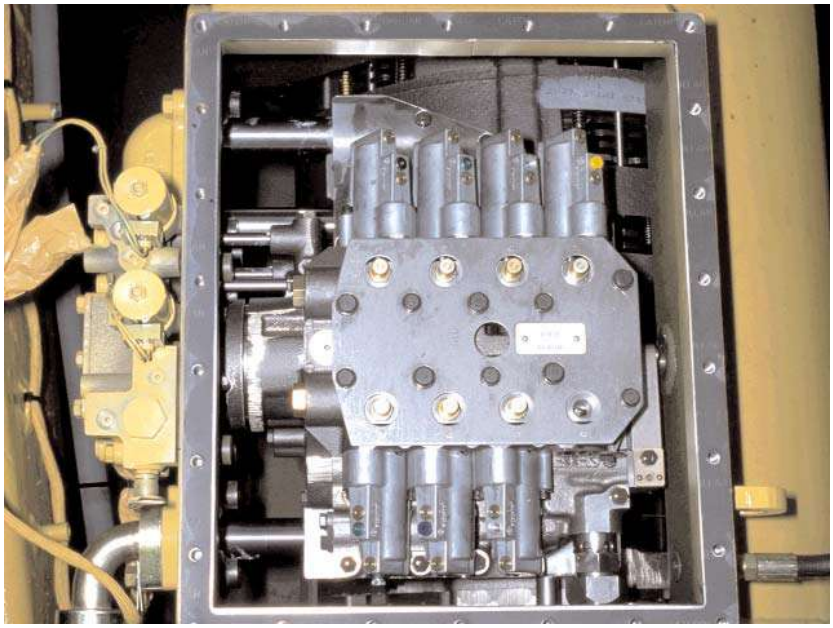


41

Shown in the top visual is the park brake release filter for the 777D. Oil flows from the parking brake release filter to the parking brake release valve. Oil then flows from the parking brake release valve to the lockup clutch valve. The park brake release filter is located in front of the hydraulic tank on the left side of the frame.

Shown in the bottom visual is the lockup clutch valve filter for the 777F. Filtered pump oil flows directly to the ECPC type lockup clutch valve. The filter is located inside of the left frame rail. The filter has a bypass switch. The bypass switch provides an input signal to the Caterpillar Monitoring System, which informs the operator if the filter is restricted. The filter housing has an S.O.S tap and a pressure tap.



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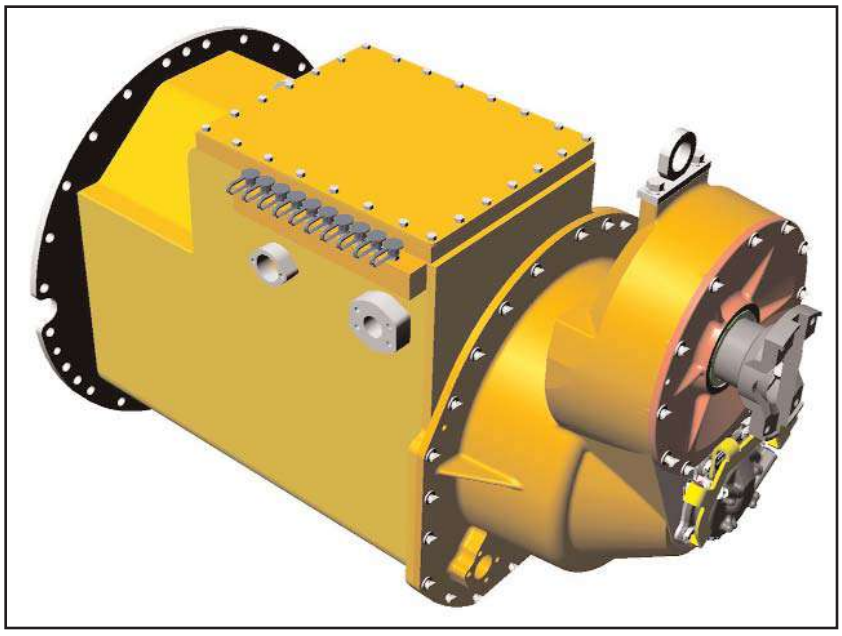
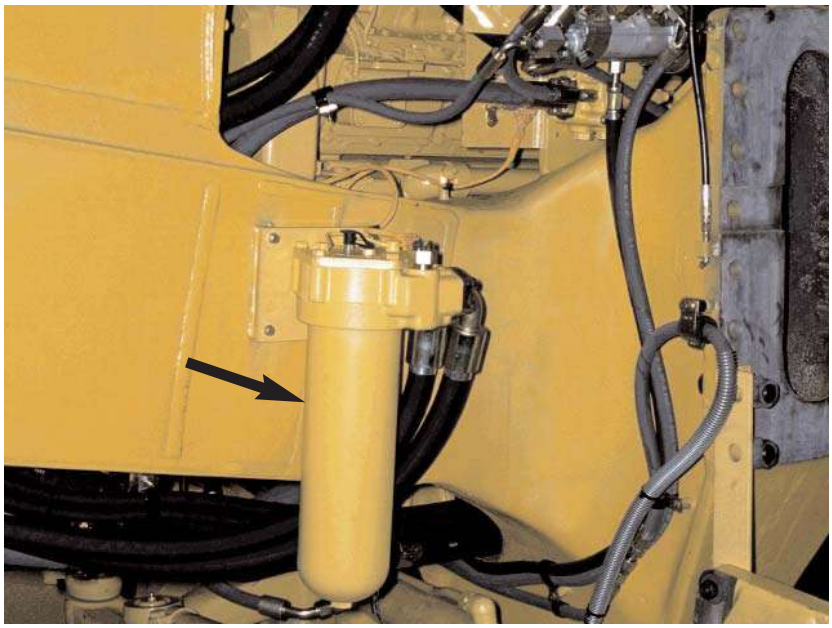


43

Shown in the top visual is the 777D ICM controlled transmission. A cover has to be removed in order to check the pressure on this ICM system.

Shown in the bottom visual is the 777F ECPC transmission. This new transmission has pressure taps located on the outside of the transmission. This feature will aid in preventing contamination from entering the transmission as well as saving time when checking the pressures on the 777F transmission.



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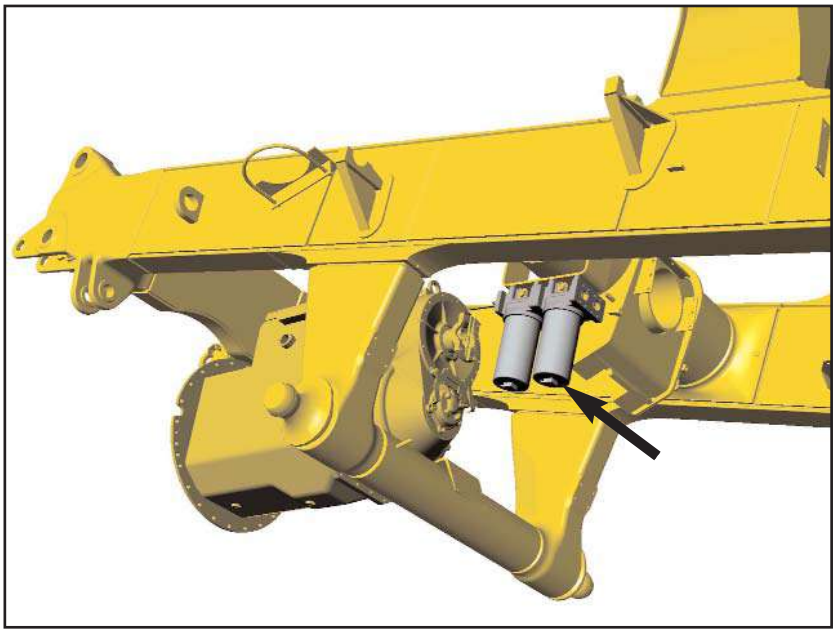
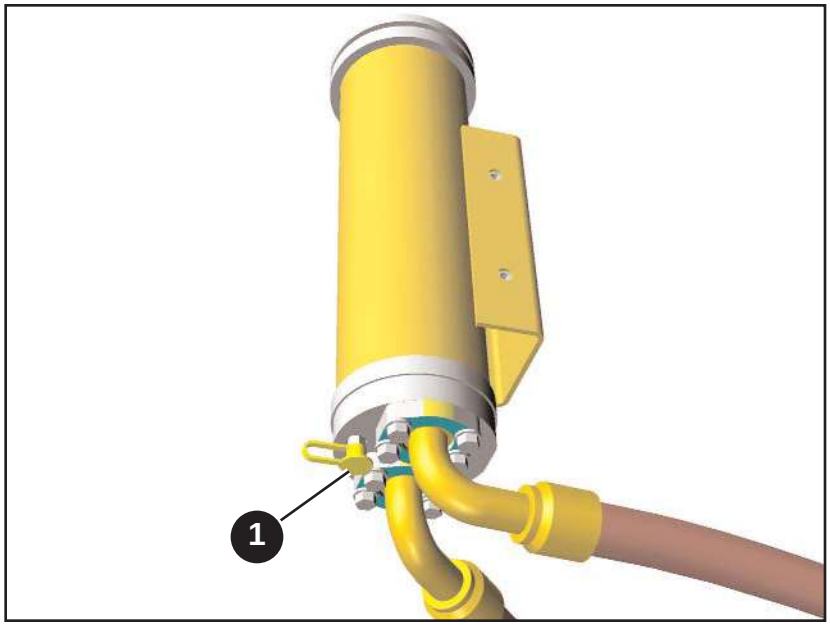


45

Shown in the top visual is the 777D transmission charge filter. The 777D has a single filter located on the outside of the frame behind the right front tire.

Shown in the bottom visual is the 777F transmission charge filters. The 777F has two filters mounted on the cross member on the right side of the machine. The rear filter housing has an S•O•S tap and a pressure tap. The rear filter housing also has a bypass switch. The bypass switch provides an input signal to the Caterpillar Monitoring System, which informs the operator if the filter is restricted.



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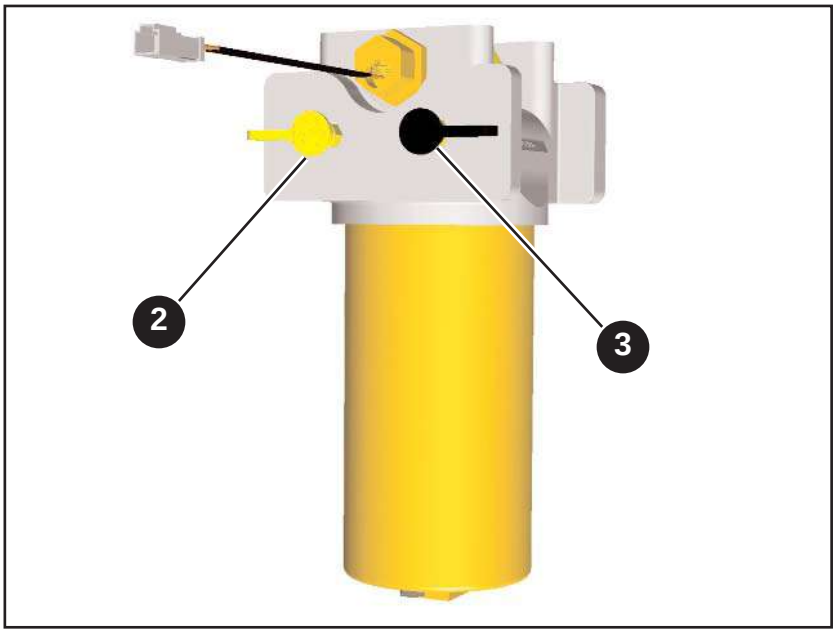
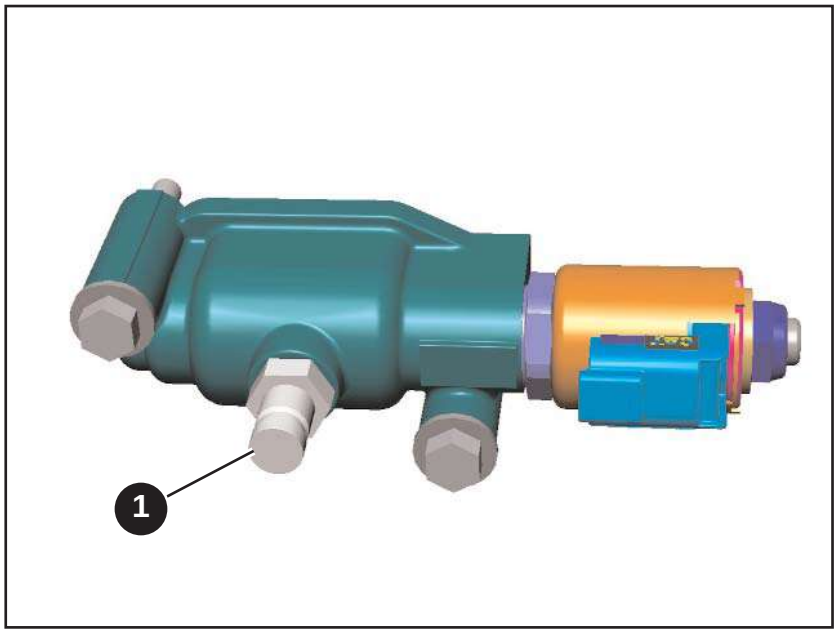


47

Shown in the top visual is S•O•S port (1) located on the torque converter filter. Port (1) draws a sample from the outlet of the filter.

Shown in the lower visual is the torque converter lockup clutch filter. Port (2) is an S•O•S port. Port (3) is a pressure tap. The pressure indicated at tap (3) is pump pressure for the lockup clutch pilot circuit.



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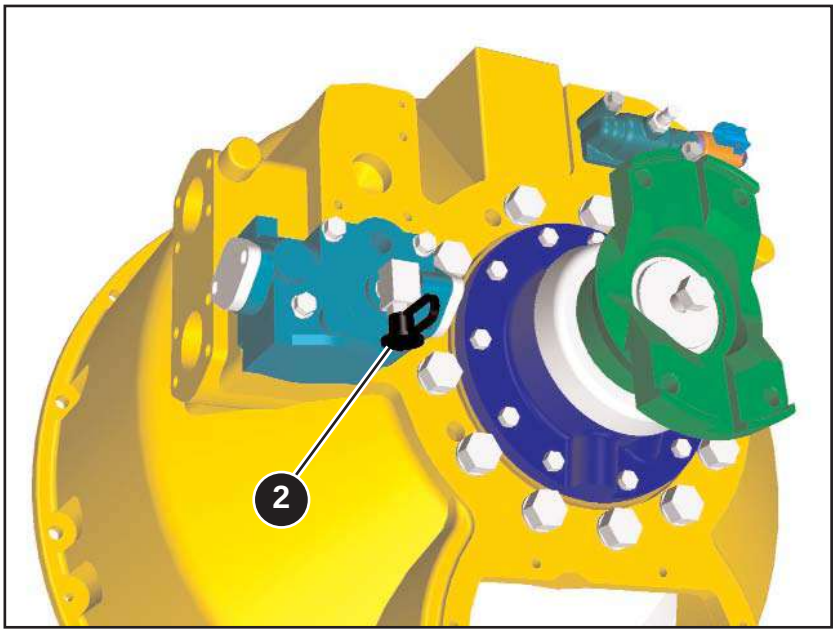
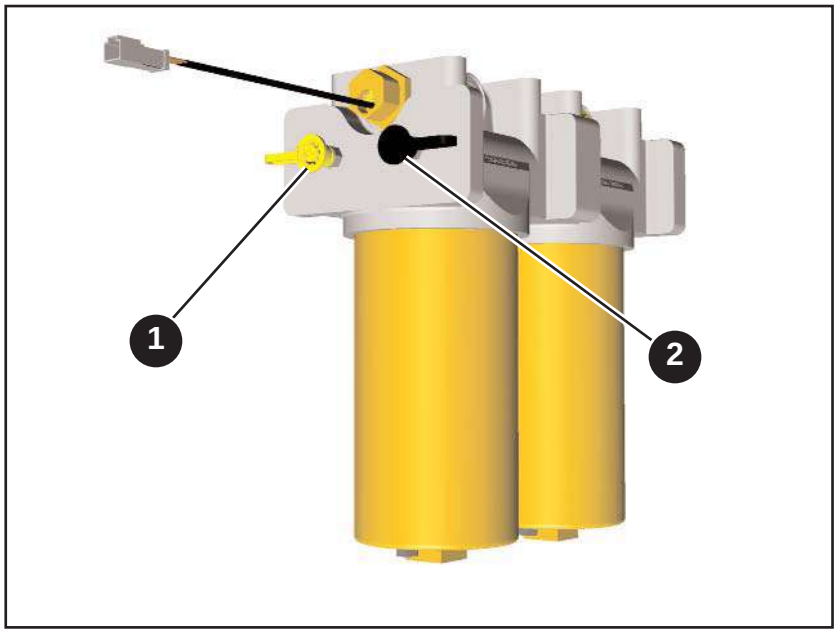


49

Shown in the top visual is pressure tap (1) for the lockup clutch valve. The pressure indicated at tap (1) is the pressure in the lockup clutch.

Shown in the lower visual is the pressure tap (2) for the outlet relief valve. The pressure indicated at tap (2) is the pressure inside the torque converter.



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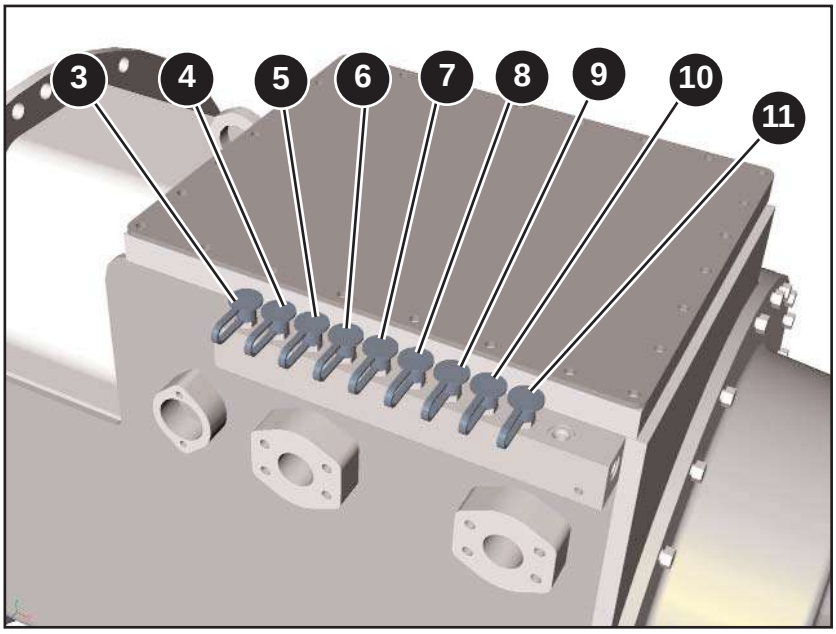
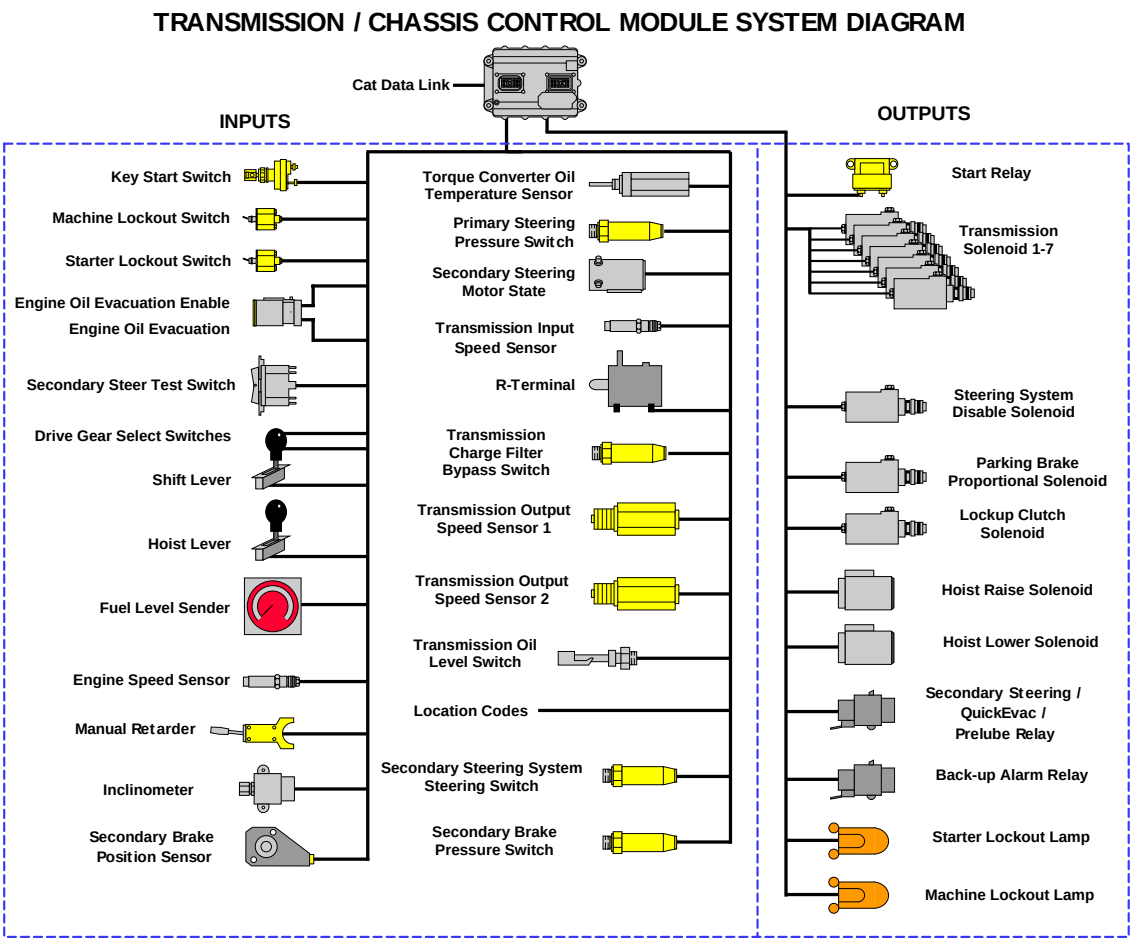


51

Shown in the top visual are the transmission charge filters. Port (1) is an S•O•S port. Port (2) is a pressure tap. The pressure indicated at tap (2) is charge pressure for the transmission control valves.

Shown in the lower visual are the transmission control valve pressure taps. The taps are as follows:

Lube oil pressure can be checked at tap (3).
System pressure can be checked at tap (4).
Clutch 6 pressure can be checked at tap (5).
Clutch 5 pressure can be checked at tap (6).
Clutch 7 pressure can be checked at tap (7).
Clutch 4 pressure can be checked at tap (8).
Clutch 3 pressure can be checked at tap (9).
Clutch 2 pressure can be checked at tap (10).
Clutch 1 pressure can be checked at tap (11).



52

Power Train Electronic Control System

Shown in this visual are the inputs and outputs for the 777F trucks.

The purpose of the Transmission/Chassis ECM is to determine the desired transmission gear and energize solenoids to shift the transmission up or down as required based on information from both the operator and machine. This Transmission/Chassis ECM also controls all the hoist functions.

The Transmission/Chassis ECM receives information from various input components such as the shift lever switch, Transmission Output Speed (TOS) sensors, and the transmission gear switch.

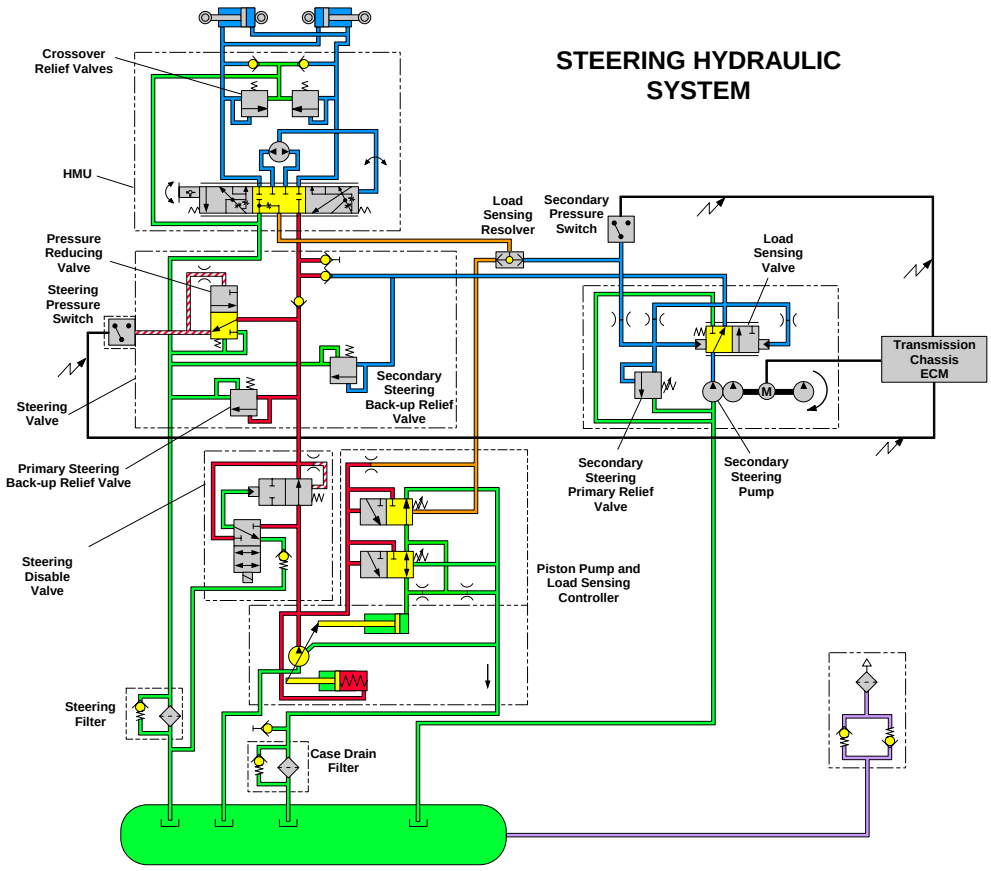
Based on the input information, the Transmission/Chassis ECM determines whether the transmission should upshift, downshift, engage the lockup clutch, or limit the transmission gear. These actions are accomplished by sending signals to various output components.

Output components include the upshift, downshift, and lockup solenoids; the back-up alarm, and others.

The Engine ECM, the Machine Monitor System, and the Transmission/Chassis ECM all communicate with each other through the CAT Data Link. Communication between the electronic controls allows the sensors of each system to be shared. Many additional benefits are provided, such as Controlled Throttle Shifting (CTS). CTS occurs when the Transmission/Chassis ECM tells the Engine ECM to reduce or increase engine fuel during a shift to lower stress to the power train.

The Transmission/Chassis ECM is also used to control the hoist system. The hoist lever sensor sends duty cycle input signals to the Transmission/Chassis ECM. Depending on the position of the sensor and the corresponding duty cycle, the Transmission/Chassis ECM will signal the Transmission/Chassis ECM. The Transmission/Chassis ECM will energize one of the solenoids located on the hoist valve..

The Electronic Technician (ET) Service Tool can be used to perform several diagnostic and programming functions.



53

STEERING SYSTEM

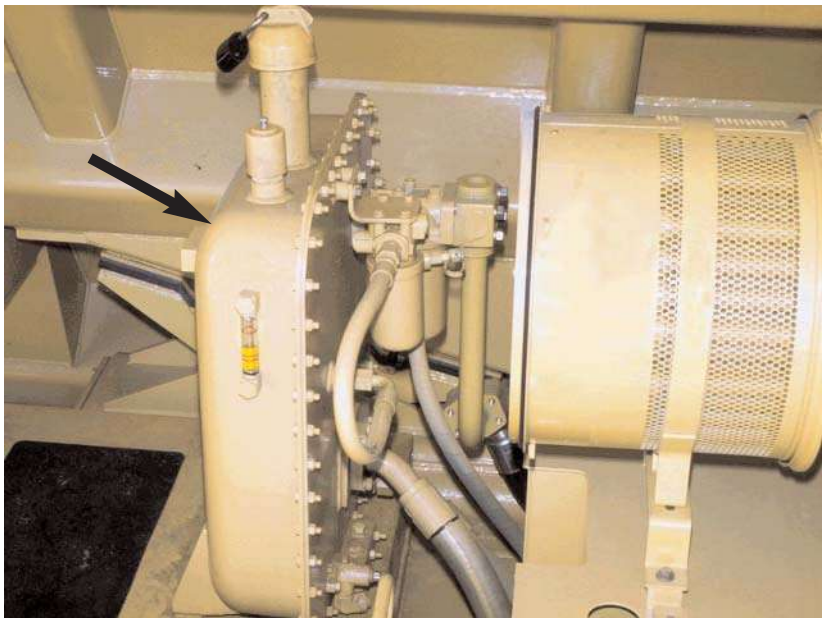
This schematic shows the steering hydraulic system for the 777F trucks. The steering system on the 777F is similar to the 777D with a few exceptions:

- Adding the steering disable solenoid valve
- Location of components has changed

When energized, the steering disable solenoid valve stops the oil flow coming from steering pump. This prevents the front wheels from turning to allow servicing to be conducted safely in the front wheel area.

The steering system uses a load sensing, pressure compensated pump. Minimal horsepower is used by the steering system when the truck is traveling in a straight path. Steering hydraulic horsepower requirements depend on the amount of steering pressure and flow required by the steering cylinders.

Steering oil flows from the pump to the steering disable solenoid valve. Oil then flows from the steering disable valve to the steering valve located on the frame behind the right front suspension cylinder. The flow of oil continues from the steering valve to the HMU which meters flow to the steering cylinders. The faster the HMU is turned, the higher the flow sent to the steering cylinders, and the faster the wheels will change direction.



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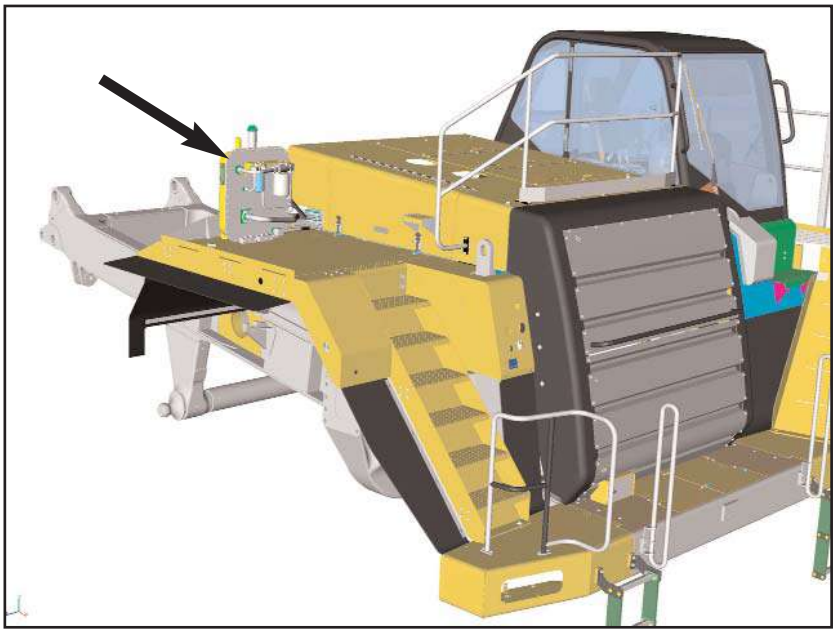
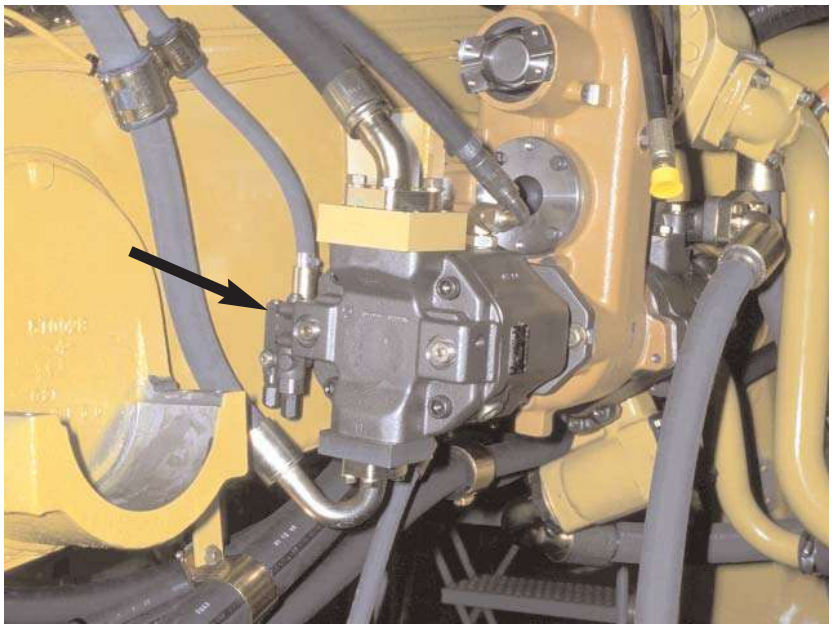


55

Shown in the top visual is the 777D steering system tank. The tank is located on the right platform.

Shown in the lower visual is the 777F steering system tank. The tank is located on the right platform. The 777F steering tank functions the same as the the 777D steering tank.



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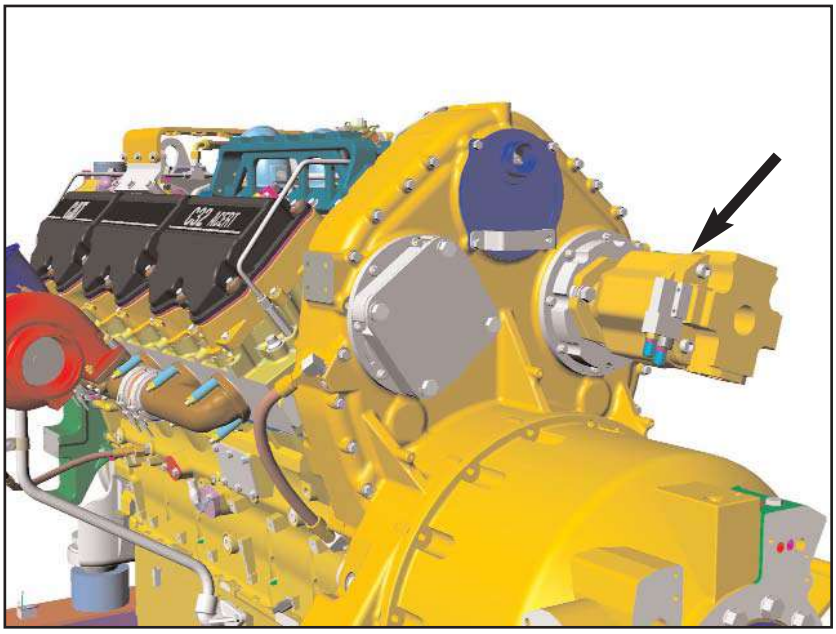
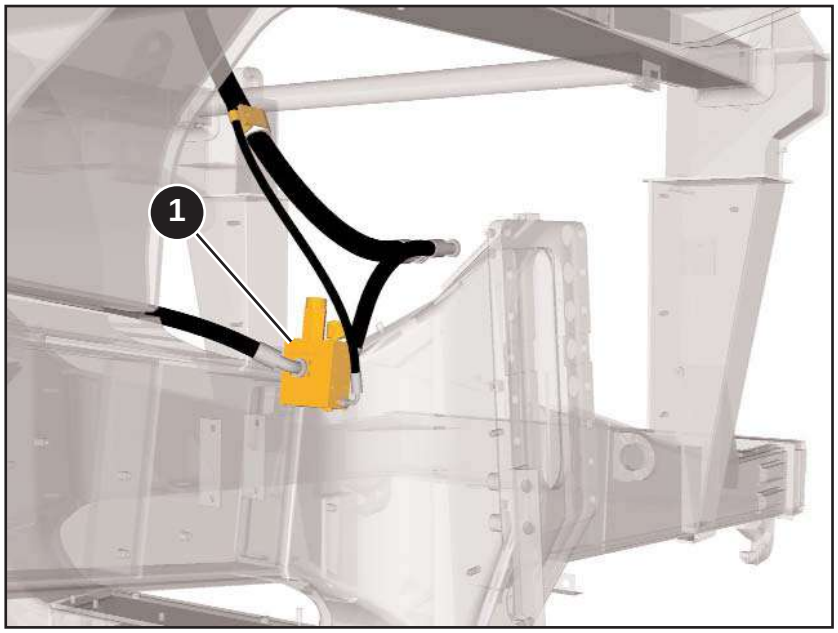


57

Shown in the top visual is the steering pump for the 777D. The steering pump has changed locations.

Shown in the lower visual is the steering pump for the 777F. The steering pump is now mounted on the back of the new C32 ACERT engine. The steering pump is still a load sensing, pressure compensated, piston-type pump.



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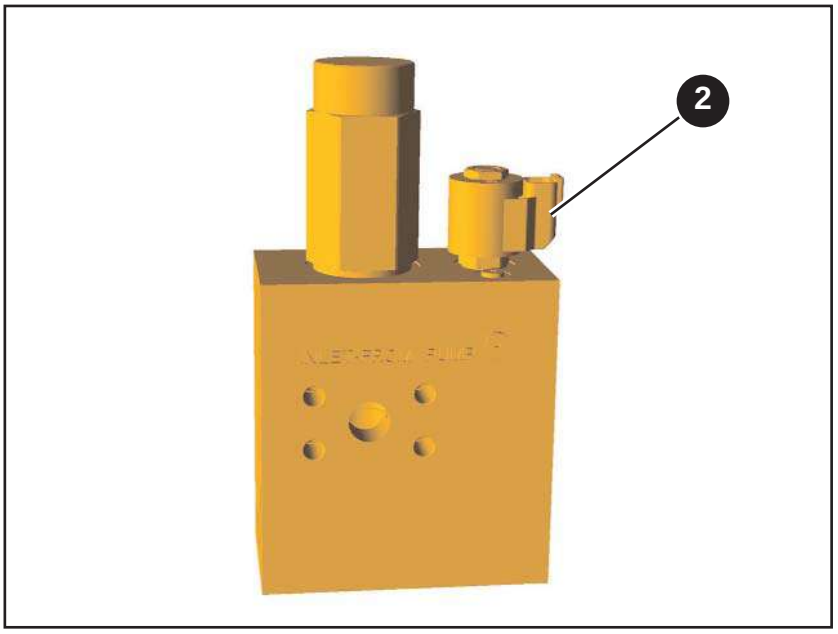
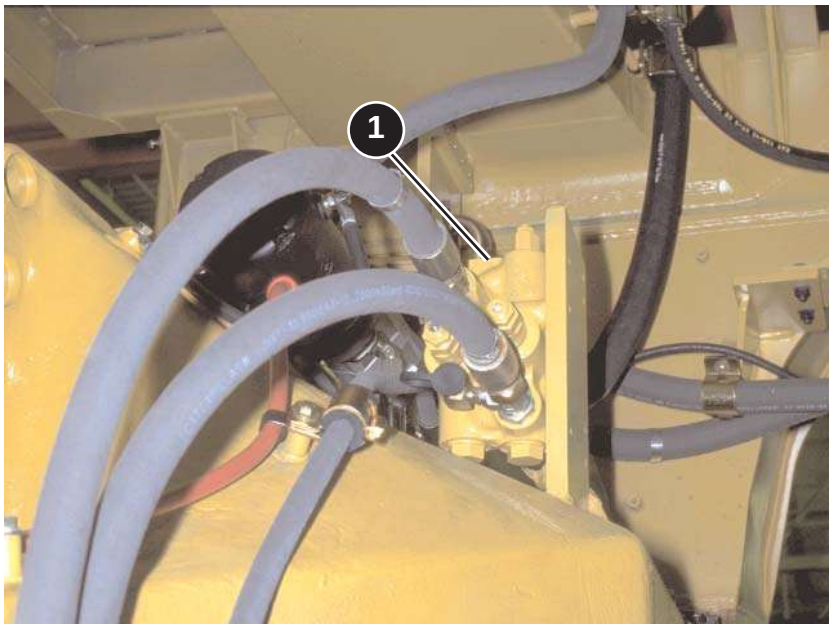


59

The steering disable valve (1) is located behind the shock on the right frame rail.

When the steering disable solenoid valve (2) is energized, the flow from the steering to the steering valve is blocked by the steering disable valve (1). This allows servicing behind the front wheels with the machine running.

When the machine lockout switch, located under a panel on the left stair way, is toggled a signal is sent to the Transmission/Chassis ECM. The Transmission/Chassis ECM energizes the steering disable solenoid. Now the machine can be serviced behind the front wheels safely.



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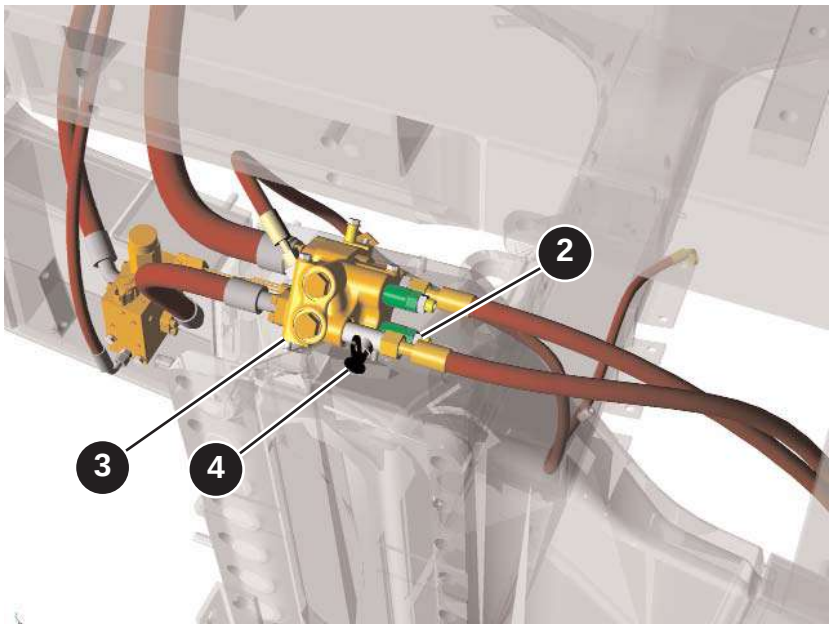
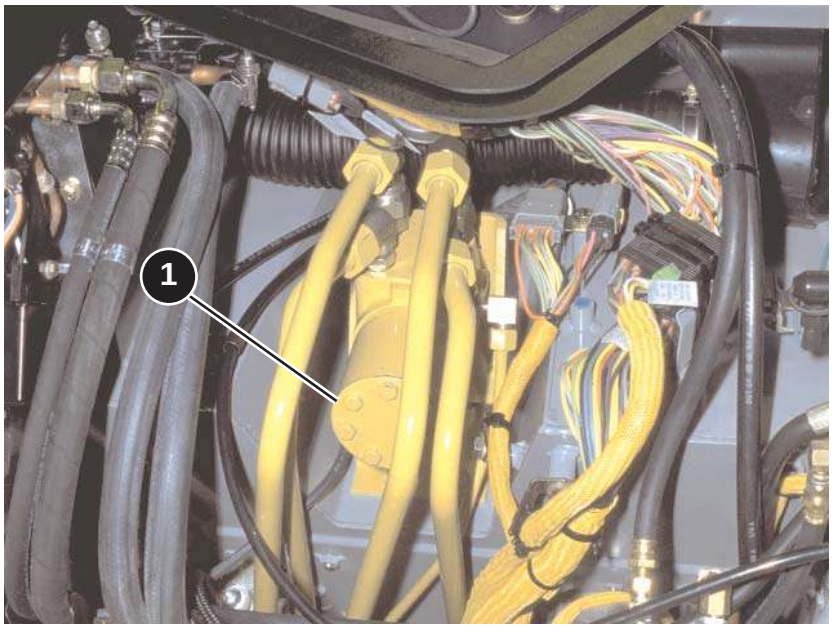


61

Shown in the top visual is the steering valve (1) for the 777D.

Shown in the lower visual is the steering valve (3) for the 777F. The 777F uses the same steering valve as the 777D. The steering valve is located in the same place however the steering valve is mounted differently. The pressure tap (3) checks the pressure in the supply line to the HMU. If the supply oil pressure to the HMU is below specification, the relief valve (2) many need to be adjusted.



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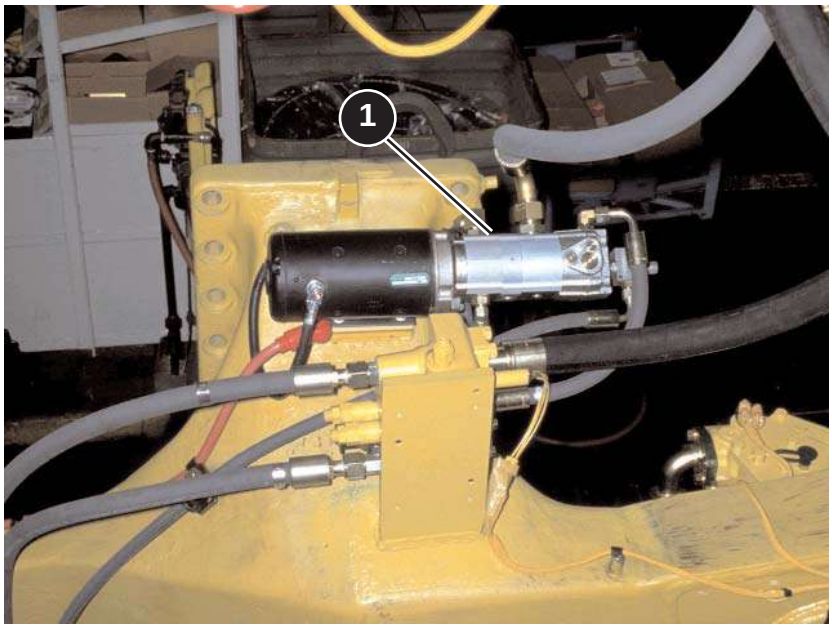
63

Shown in the top visual is the HMU (1) for the 777D.

Shown in the lower visual is the HMU (2) for the 777F. The HMU will function the same and is in the same general location. The HMU for the 777F will be easier to service due to the redesigned walkways.



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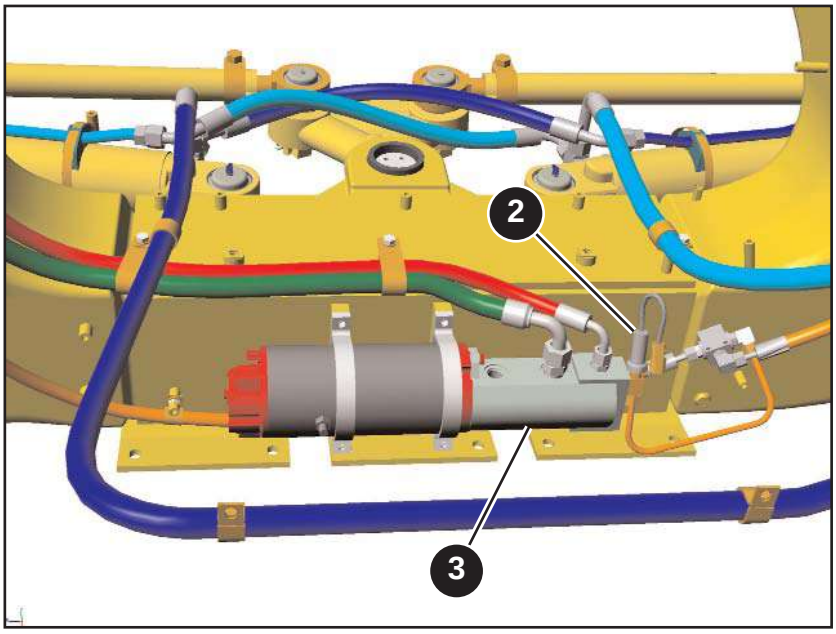
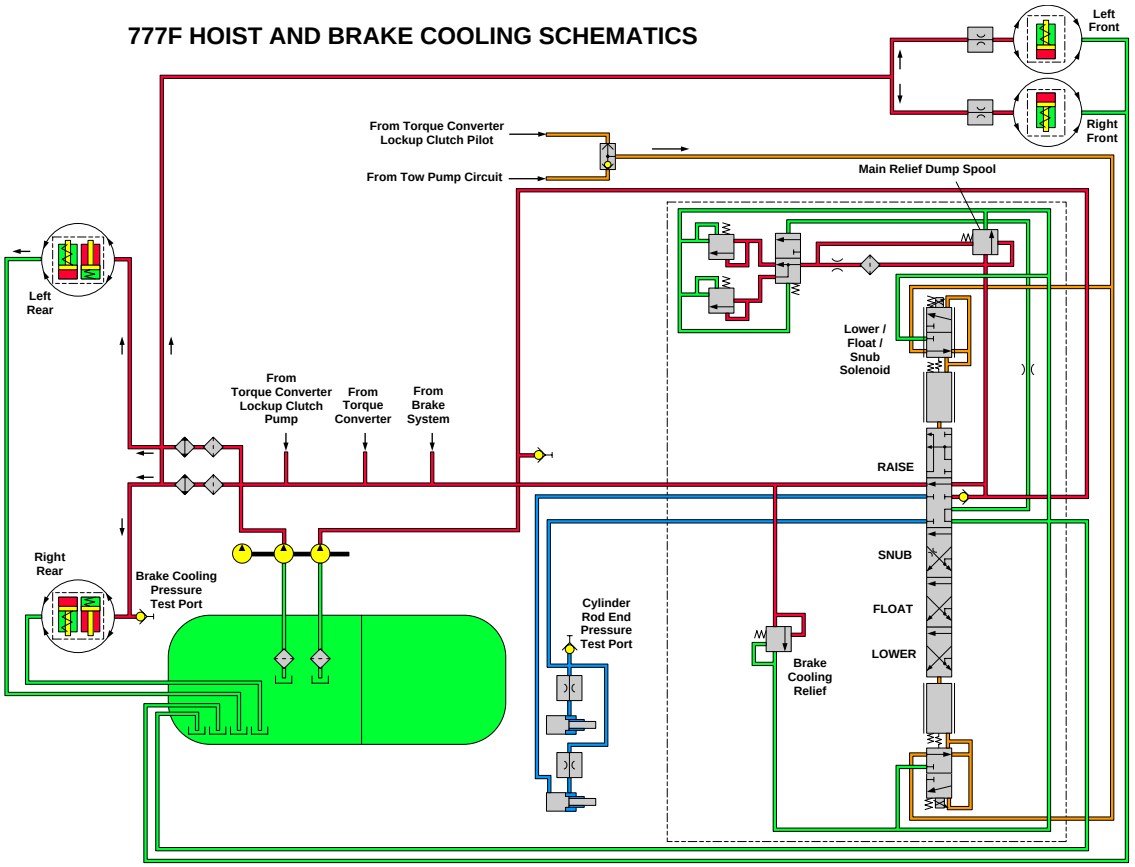


65

Shown in the top visual is the electric secondary steering pump (1) on the 777D.

Shown in the lower visual is the electric secondary steering pump (3) on the 777F. The pump and motor are the same as the 777D however the location has changed. The pump and motor are now located on the front crossmember. The secondary pressure switch (2) is also mounted next to the secondary steering pump. The pressure switch (2) detects if the wheels are being turned via the steering wheel when secondary steering is applied. When the wheel is turned in a secondary steering condition, the pressure switch (2) will signal the Transmission/Chassis ECM and the QuickEvac function will be disabled.



66

HOIST HYDRAULIC SYSTEM

On the 777F, the hoist pump receives supply oil from the hydraulic tank through the suction screen located in the rear of the tank. Oil flows from the hoist pump to the hoist valve.

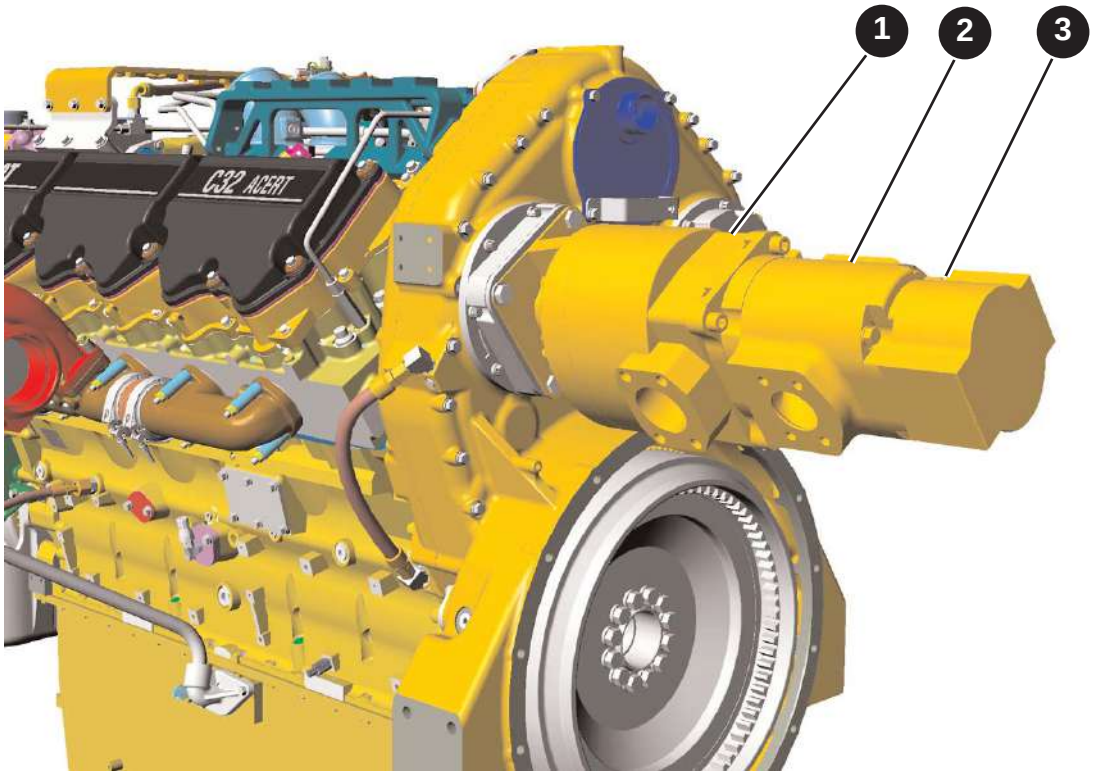
The hoist valve uses lockup clutch pilot oil as the pilot oil to shift the directional spool inside the hoist control valve. Oil flows from the lockup clutch gear pump to both ends of the hoist control valve. Pilot pressure is always present at both ends of the directional spool. Two solenoid valves are used to drain the pilot oil from the ends of the directional spool which then allows the spool to shift.

The electric tow pump can also be used to send pilot oil to the hoist control valve. If the bed needs to be lowered with a dead engine, the tow pump will provide the pilot oil through a resolver valve

When the hoist control valve is in the HOLD, FLOAT, or SNUB position, all the hoist pump oil flows through the hoist and brake oil cooler located on the right side of the engine. Excess oil from the brake system joins the hoist pump oil and also flows to the oil cooler. Oil flows from the oil cooler, through the rear brakes, and returns to the hydraulic tank through the return screen.

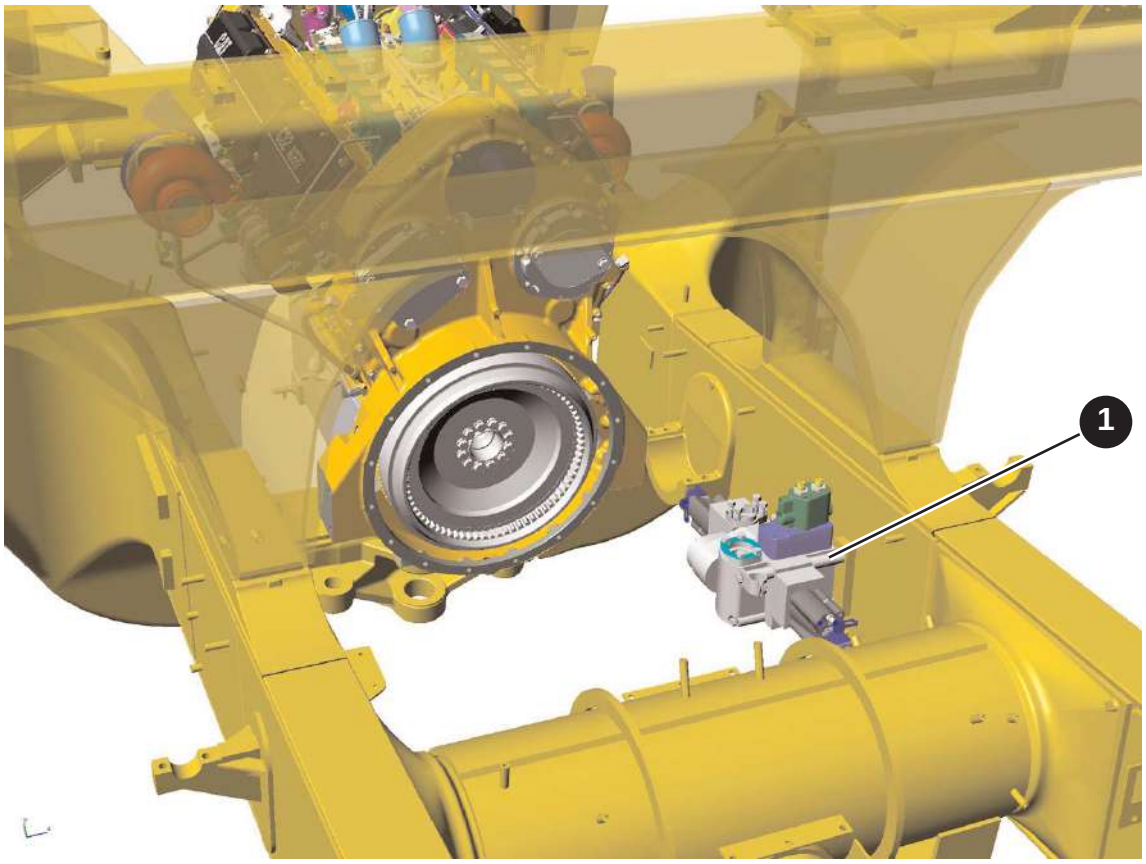
An oil cooler relief valve is located in the hoist control valve. The relief valve limits the brake oil cooling pressure when the hoist control valve is in the HOLD, FLOAT, or SNUB position.

The main difference between the previous truck and the 777F is the elimination of the brake release valve from the hoist hydraulic system. The hoist valve now receives pilot oil from the lockup clutch supply oil circuit. The brake release function is handled by the brake system on the 777F trucks and will be discussed later in this document.



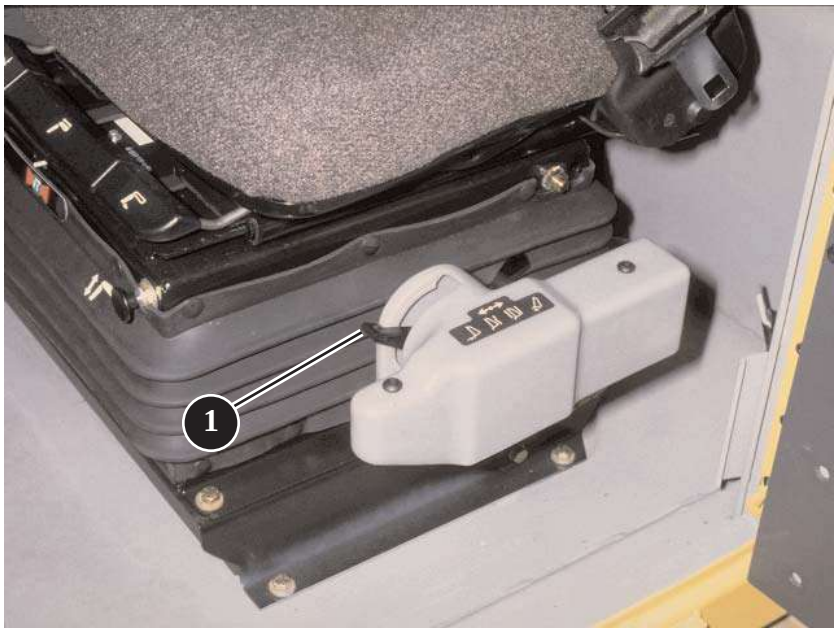
67

Shown in the visual is the new location of the hoist pump (1). The hoist pump is a gear type pump and is attached to the brake cooling pump (2) and the brake charging pump (3). The hoist pump is now driven by the gears at the back of the engine.



68

Shown in the visual is the new location of the hoist control valve (1). The valve (1) is located behind the engine on the right side of the frame. The valve (1) will function the same as the hoist control valve on the 777D.

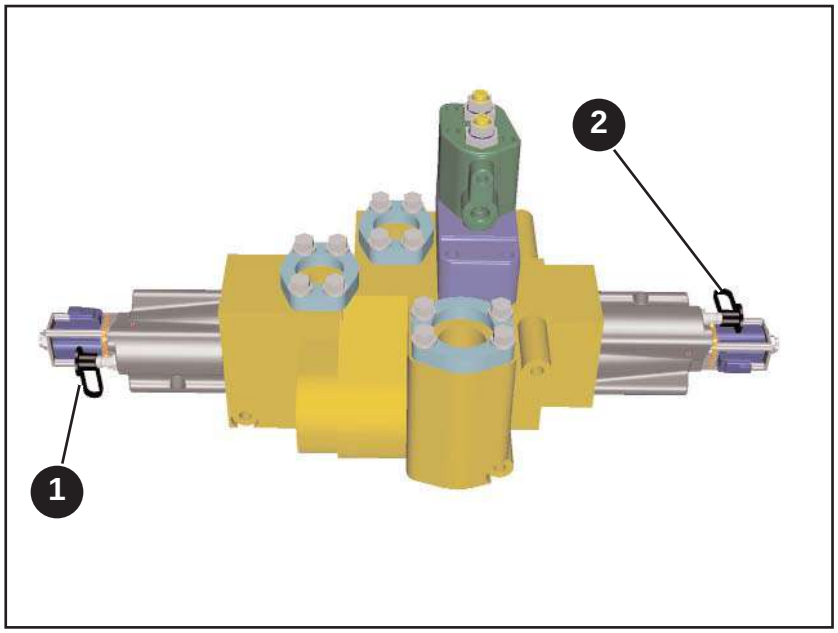


69

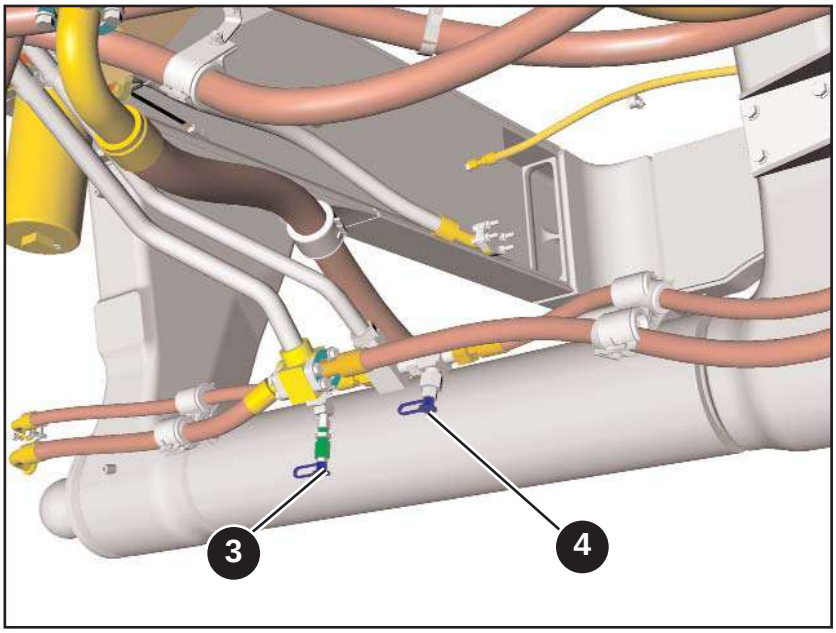
70

The top visual shows the hoist control lever for the 777D (1) trucks. The lower visual shows the hoist control lever for the 777F (2). The function of these levers are the same.

The operator controls the hoist lever. The four positions of the hoist lever are RAISE, HOLD, FLOAT, and LOWER. The hoist lever controls a Pulse Width Modulated (PWM) position sensor mounted to the lower end of the hoist lever. The PWM sensor sends duty cycle input signals to the Transmission/Chassis ECM. Depending on the position of the sensor and the corresponding duty cycle, one of the two solenoids located on the hoist valve is energized.



71



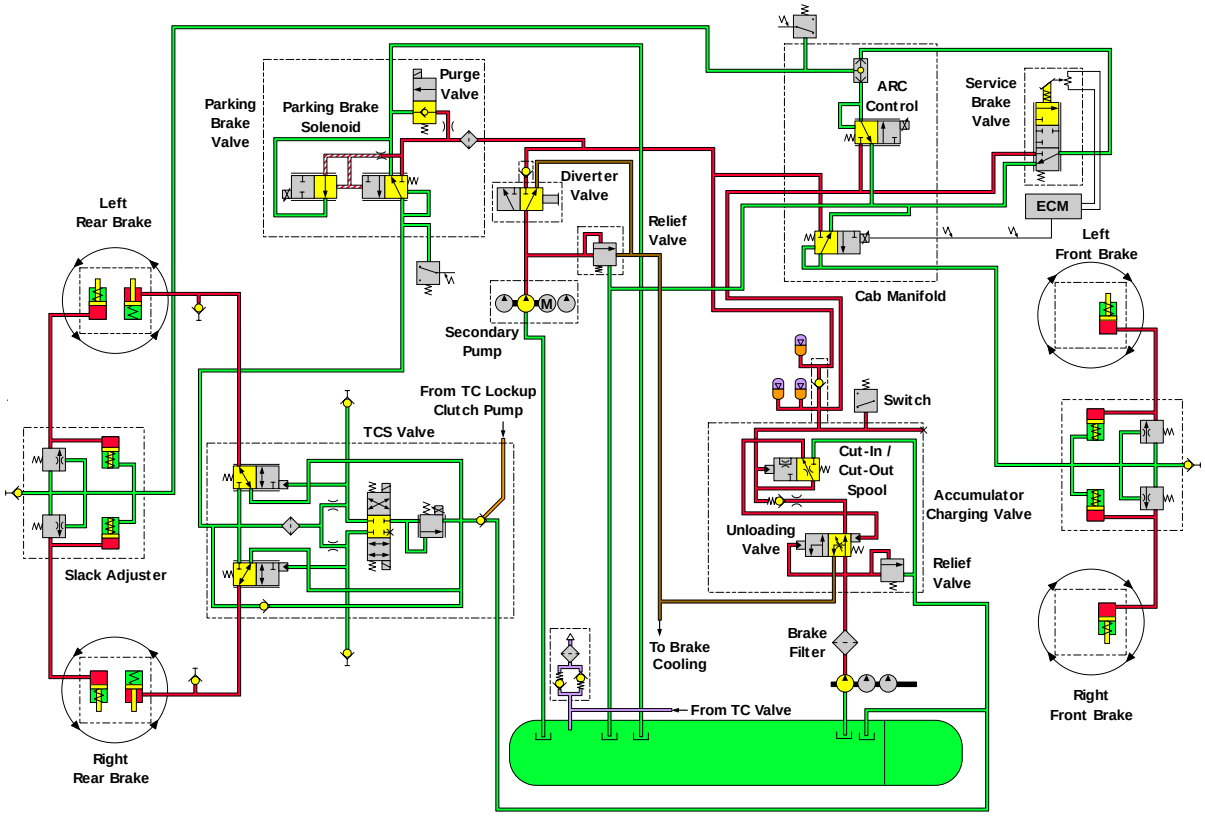
72

Pressure Taps For The Hoist System

Shown in the top visual are the pressure taps for the hoist control valve. The pressure tap (1) checks the pilot pressure for the hoist lower solenoid. The pressure tap (2) checks the pilot pressure of the raise solenoid.

Shown in the lower visual are the pressure taps for the hoist cylinders. These pressure taps are located on the cross-tube between the lower hoist cylinder mounts. The pressure tap (3) checks the pressure of the cylinder lower circuit. The pressure tap (4) checks the pressure of the cylinder raise circuit.

BRAKE HYDRAULIC SYSTEM



73

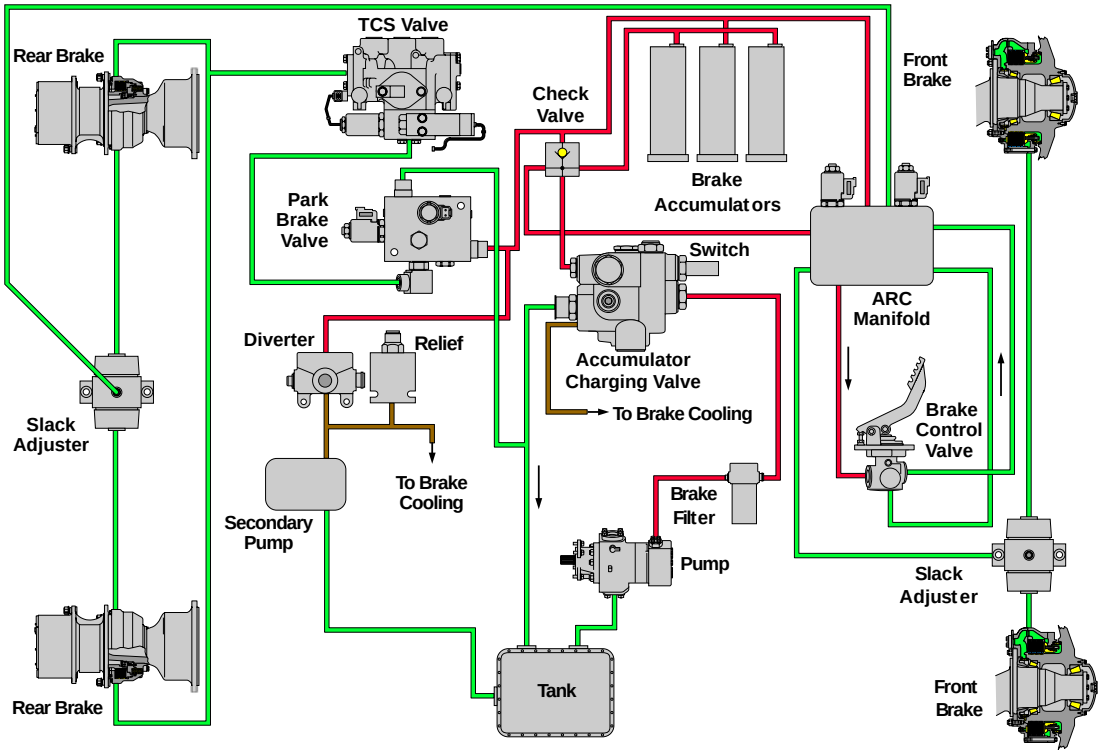
BRAKE SYSTEM

Two separate brake systems are used on the 777F. The two brake systems are the service/retarder brake system and the parking/secondary brake system.

The parking/secondary brakes are spring engaged and hydraulically released. The service/retarder brakes are hydraulically engaged and spring released.

The brakes on the 777F are completely hydraulically operated as compared to the 777D brakes which were air over hydraulic. The air system found on the previous model trucks has been completely removed.

BRAKE SYSTEM



74

Shown is the hydraulic brake system for the 777F trucks.

This block diagram shows the major components of the brake system. The brakes are hydraulic unlike the previous machines which had an air over oil system. The front and rear brakes are oil cooled internal wet disc type brakes. The 777F can also be ordered with an optional caliper type front brake system.

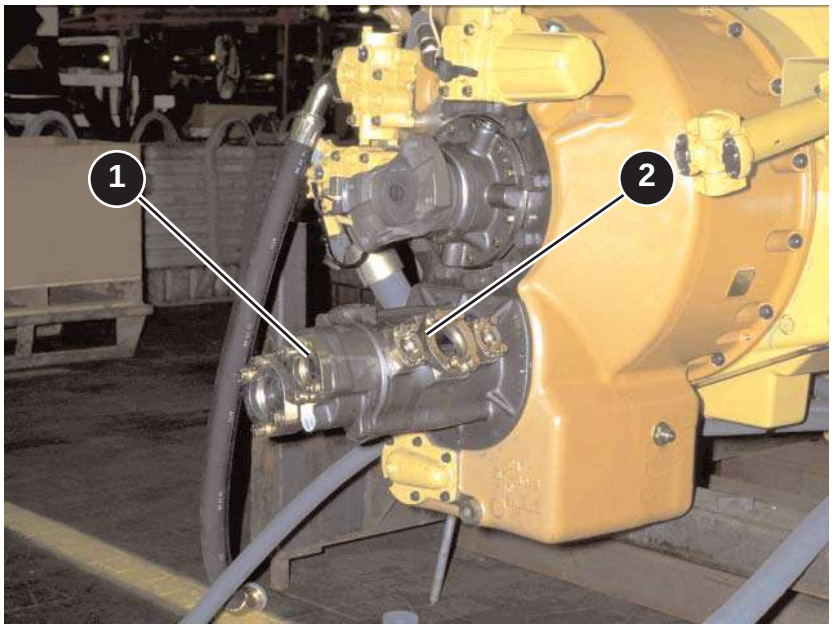
Oil is drawn from the hydraulic tank by the brake section of the combination implement/brake pump. Oil flows through the brake filter to the accumulator charging valve. The accumulator charging valve directs supply oil to the other components. The accumulator charging valve also controls the CUT-IN and CUT-OUT pressure. When the accumulators are charged, the charging valve will direct access pump flow to brake cooling.

After leaving the service brake accumulator, oil flows through the ARC (Automatic Retarder Control) manifold to the service brake control valve. The service brake control valve directs pump flow to the rear service brakes to stop the truck.

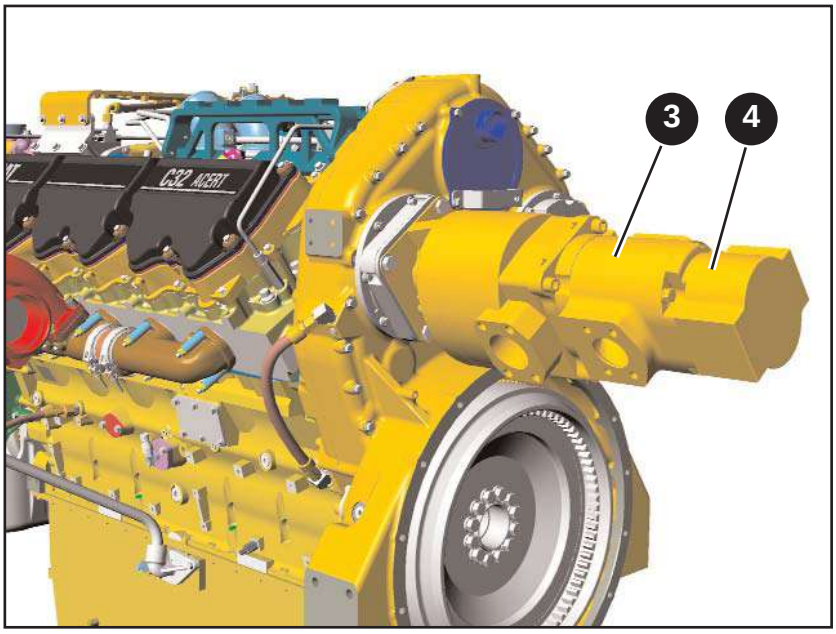
The front brakes are only engaged when the brake ECM energizes the front brake ARC solenoid. The front brakes receive supply oil from the parking brake accumulator.

After leaving the parking brake accumulator, oil flows to the parking brake valve, the towing diverter valve, and the ARC solenoid. When the parking brake is activated, the supply oil for releasing the parking brake is diverted to tank. When the parking brake solenoid is energized (parking brake released), the parking brake valve sends oil through the Traction Control System (TCS) valve which then releases the parking brakes. The parking brakes are spring applied and pressure released.

The diverter valve, under normal operation, should be closed and allows no oil to flow past. If the truck is to be towed with a dead engine, the diverter valve must be shifted manually. When manually shifted, the diverter valve diverts oil flow from the electric brake retract pump to the parking brake valve and the ARC solenoid for the front brakes.



75



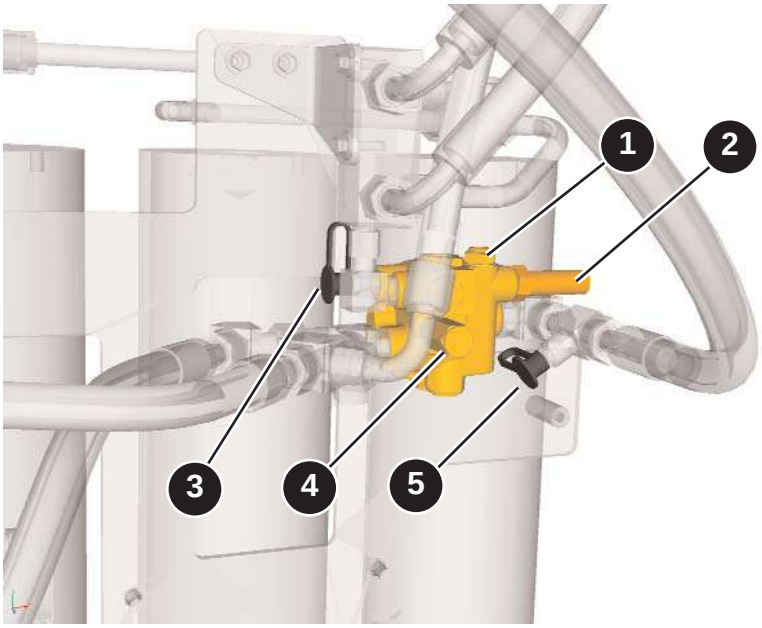
76

Shown in the top visual is the parking brake release pump (2) and the brake oil cooling pump (1) for the 777D. With the removal of the air over hydraulic brake system, the brake pumps are no longer mounted in this location.

Shown in the lower visual is the new location of the brake charging pump (4) and the brake oil cooling pump (3). This set of pumps is mounted on the left rear side of the engine. The 777F brake system is charged by the gear pump (4) which supplies oil to the accumulator charging valve. The oil cooling pump (3) pumps oil to the oil coolers before the oil travels to the front and rear brakes for brake cooling.

77

The brake system filter (arrow) is located on the left outer frame rear next to the left rear strut mount. The brake system filter has a bypass switch.



78

The accumulator charging valve (1) is located on the left side of the frame by the brake accumulators This valve directs oil to the brake accumulators, brake cooling, and the tank. Once the accumulators are charged, the excess oil flow is sent to cool the brakes before returning to the tank.

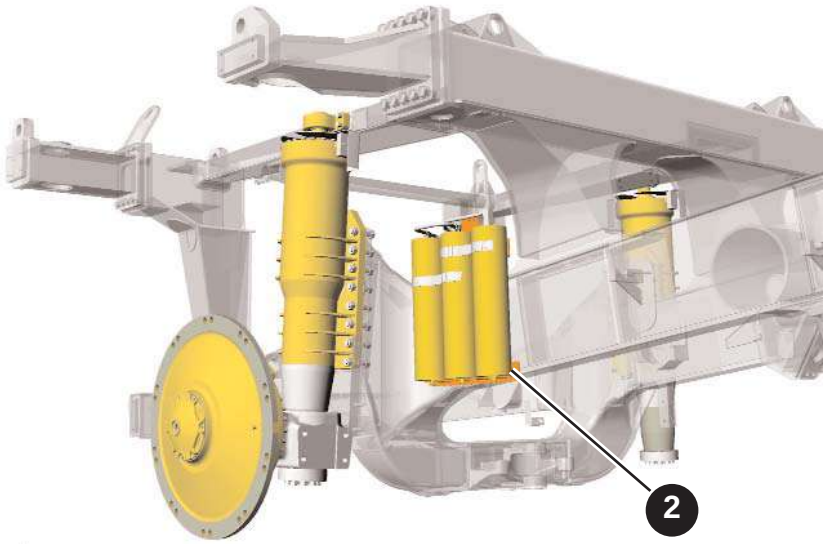
The Brake ECM monitors the pressure in the service brake accumulators with pressure switch (2). If the pressure in the service brake accumulators are low, pressure switch (2) will open and the Brake ECM will signal the monitoring system to turn on the brake system-check indicator

Pressure tap (3) is used to check the oil pressure in the service brake accumulators. Pressure tap (5) is used to check the charge oil pressure from the pump.

The accumulator charging valve contains a CUT-IN/CUT-OUT spool. Once the maximum brake system pressure is reached, the spool will shift and send the excess flow to brake cooling. As the system pressure continues to drop to the CUT-IN pressure setting, the spool will shift again and the system will charge to the CUT-OUT pressure setting. This process will continue to repeat as often as needed to keep the brake system fully charged. The CUT-IN/CUT-OUT pressure is checked at pressure tap (3).

The relief valve (4) setting is set slightly higher than the CUT-OUT pressure setting. In the event that the CUT-IN/CUT-OUT valve spool fails, the relief valve will protect the system from extreme pressure. Relief valve (4) can only be tested on a hydraulic test bench.

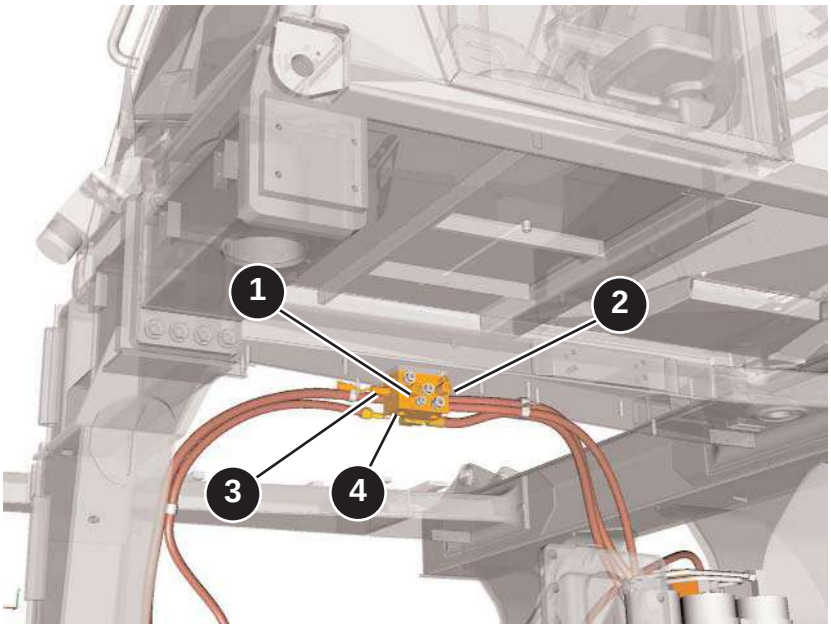
If the charge oil pressure is low at pressure tap (5), or the brake system never reaches the proper CUT-OUT pressure, check relief valve (4). If relief valve (4) is set properly and the brake system is not reaching the specified CUT-OUT pressure, replace the accumulator charging valve. The CUT-IN/CUT-OUT spool is not adjustable.



79

Shown in the visual are the three brake accumulators for the 777F. The accumulators (2) are charged by the brake charging pump and supply the required oil flow to disengage the front and rear brakes. The outer accumulators are for the rear service brakes. The middle accumulator is for the parking brake and front service brakes.

A check valve in the circuit between the parking accumulator and the rear service accumulators allows only the parking brake accumulator to be filled when using the secondary electric pump. This allows the parking brake to be released by using the secondary electric pump.

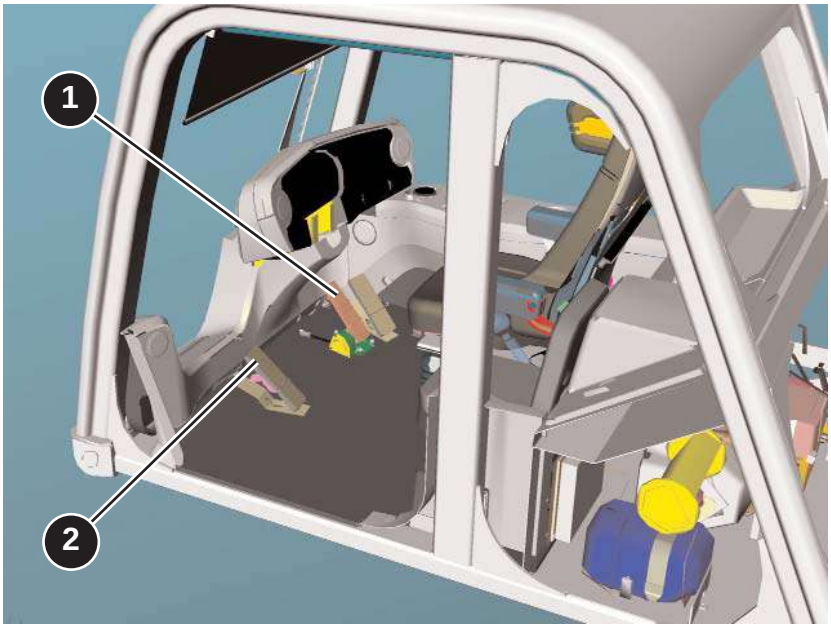


80

The cab brake manifold (4) is mounted under the cab on the left upper frame. This manifold contains the ARC control solenoid (2) for the rear brakes and the ARC control solenoid (1) for the front brakes.

The ARC control solenoid is part of the ARC system. The ARC system uses the rear service brakes and the front oil cooled brakes to automatically control the speed of the truck.

Also shown is the service brake pressure switch (3). This switch sends a signal to the Brake ECM whenever the service brakes are applied. The Brake ECM will use the signal from pressure switch (3) to turn on the brake lights. In a low pressure situation, the Brake ECM will signal the monitoring system to activate the brake system-check indicator.

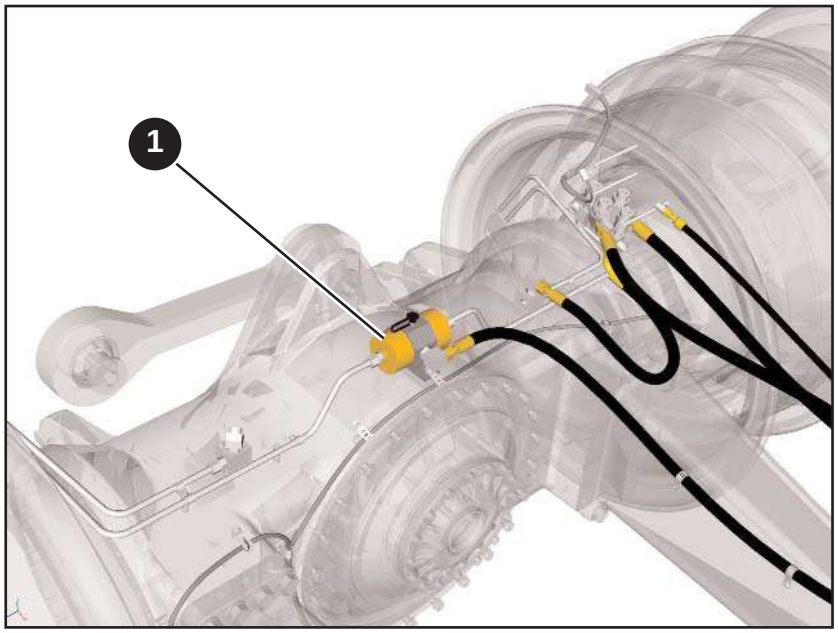


81

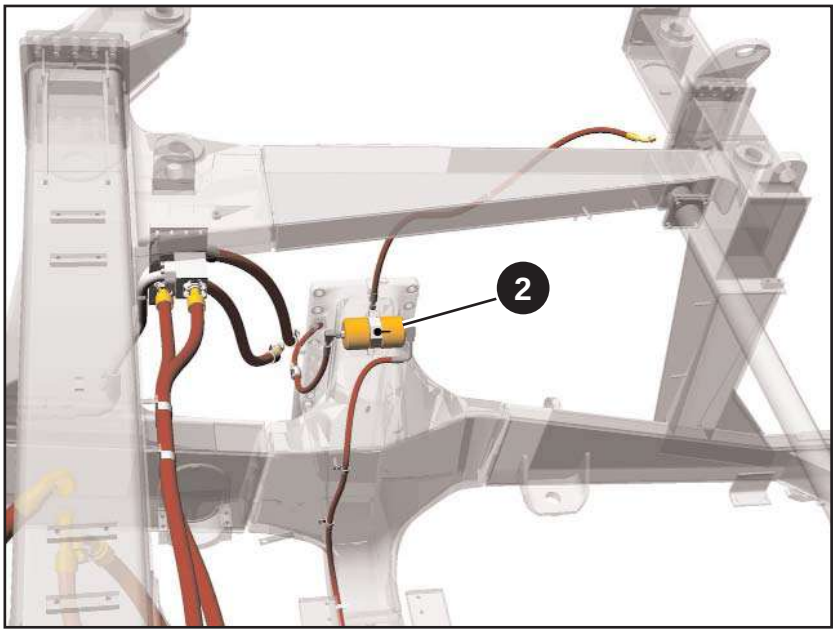
The service brake valve (1) is mounted in the floor of the operator's cab.

When the service brake pedal is depressed, the internal spool directs oil flow to the rear service brakes.

The secondary brake pedal (2) is used to apply the parking brakes if the service brakes are not responding. The secondary brake pedal sends an electrical signal to the parking brake solenoid.



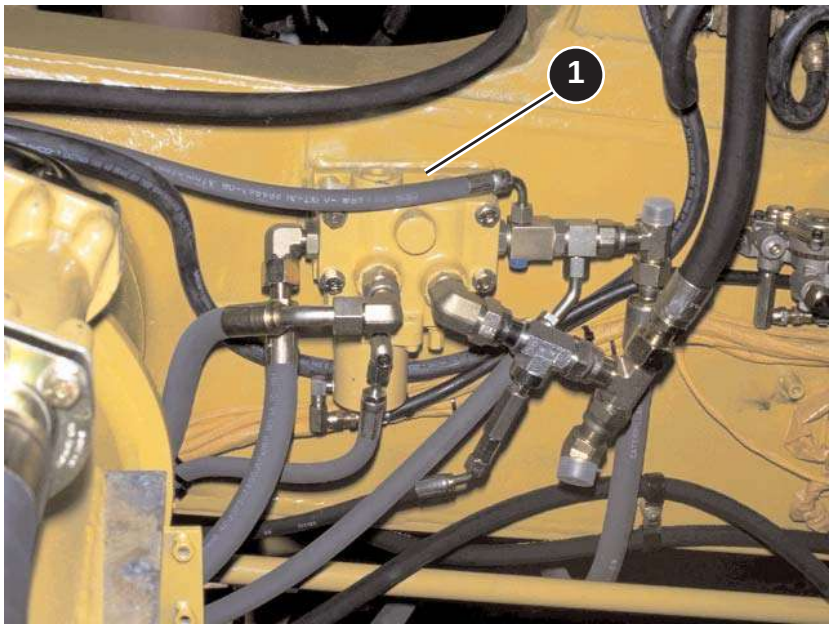
82



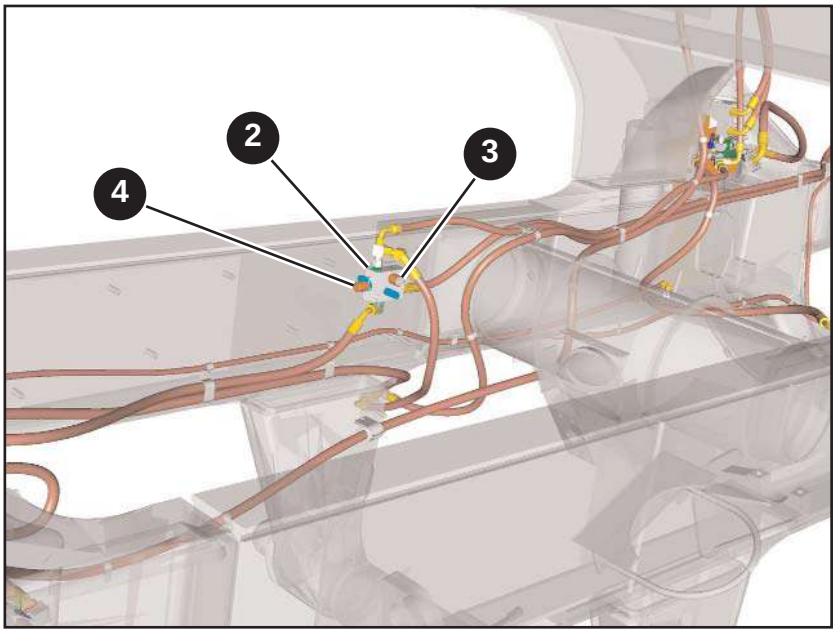
83

The 777F has two slack adjusters. The top visual is of the rear slack adjuster (1). The rear slack adjuster is located above the rear differential. The slack adjuster maintains a consistent feel and application of the brakes as the brake discs wear.

The lower visual is of the front slack adjuster (2). The front slack adjuster is located on the left strut frame support. The slack adjuster maintains a consistent feel and application of the brakes as the brake discs wear.



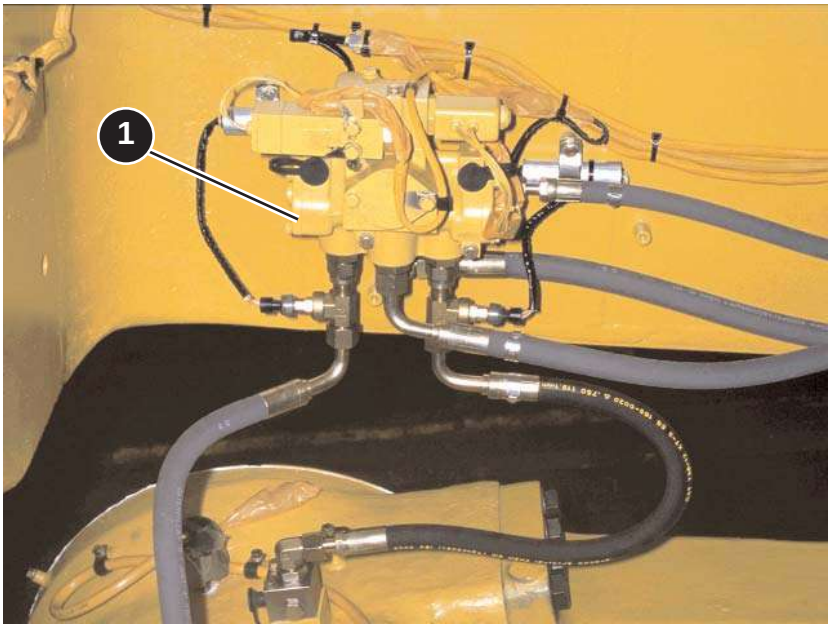
84



85

The top visual shows the parking brake release valve (1) for the 777D which is mounted on the inside left frame just in front of the middle cross member. This valve uses an air signal to direct oil flow from the parking brake pump to release the parking brakes.

The lower visual shows the parking brake valve (2) for the 777F which is located on the inside left frame rail behind the middle cross member. The parking brake release valve no longer works off pressurized air. This valve receives oil flow from the parking brake accumulator. Contained within the valve is a parking brake solenoid valve (3) and a purge solenoid valve (4). When the solenoid is energized, the parking brake valve directs oil flow through the TCS valve to the rear parking brake. There are no parking brakes on the front wheels. When the machine is shut down, the purge solenoid is energized and the purge valve drains the brake accumulators to tank.

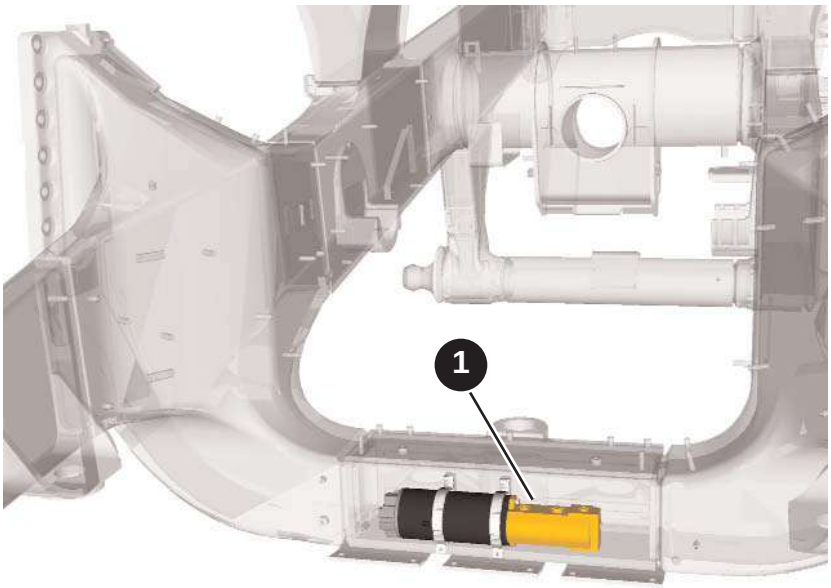


86

The TCS valve (1) is located inside the left frame rail toward the rear of the machine.

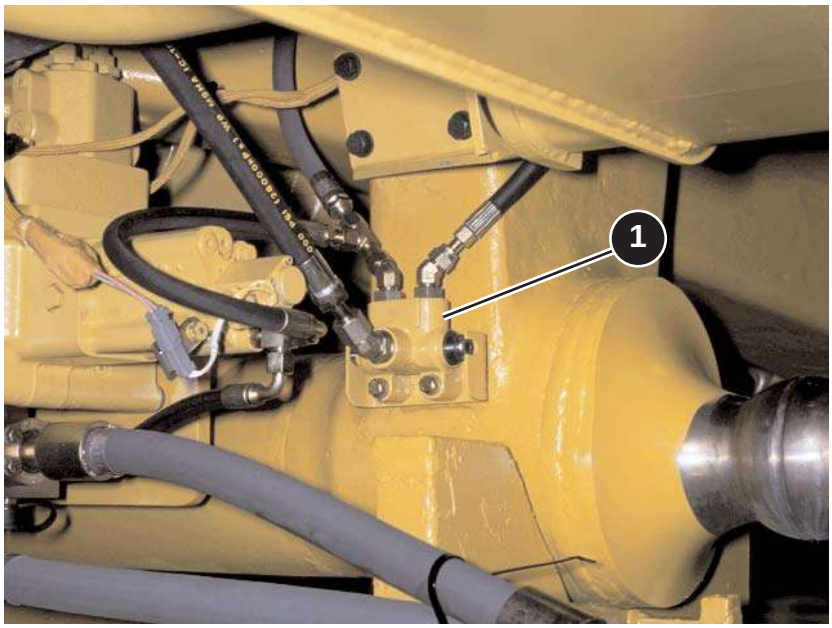
Parking brake oil flows through this valve before flowing to the parking brake in the rear wheel stations.

This valve remains unchanged from previous model trucks.

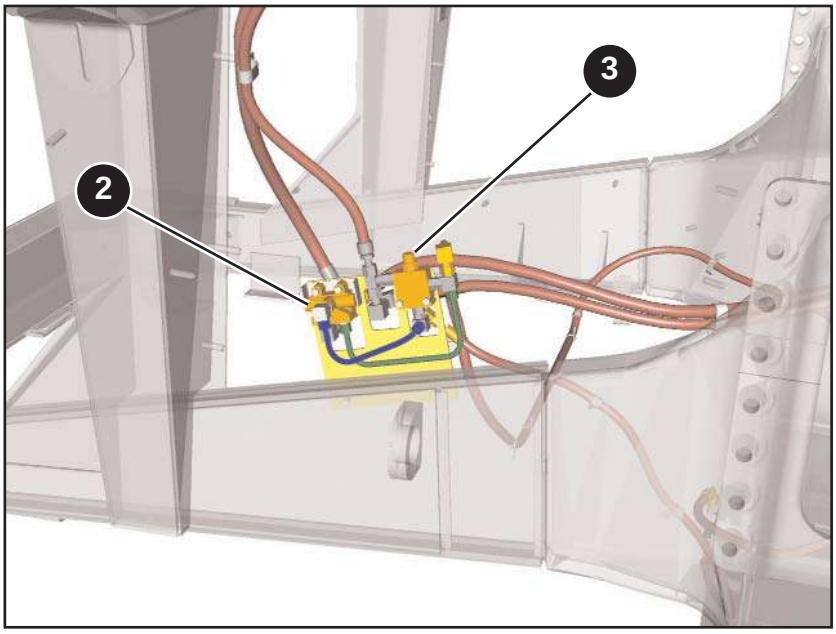


87

Shown in the visual is the brake retract section (1) of the electric pump. The brake retract pump is located on the front cross member that supports the front struts. Brake retract pump is an electric pump that when energized sends oil flow to the diverter (towing) valve and the tow pump relief valve. If the diverter valve is closed, the unused oil will flow to the pilot circuit for the hoist control valve.



88



89

Shown in the top visual is the diverter (towing) valve (1) for the 777D. The diverter valve is located on the left hoist cylinder frame support.

Shown in the lower visual is the diverter (towing) valve (2) for the 777F. The diverter valve functions the same however has changed locations. The diverter valve for the 777F is now located on the left frame rail in front of the left front strut. The diverter valve must be manually shifted before towing.

Once the valve is shifted, oil flow from the electric secondary pump is directed to the parking brake valve to release the parking brake. The relief valve (3) limits the maximum pressure when using the towing pump.

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CONCLUSION

This presentation has provided New Product Information (NPI) for the Caterpillar 777F Off-highway Trucks.

HYDRAULIC SCHEMATIC COLOR CODE

- Black - Mechanical Connection. Seal
- Dark Gray - Cutaway Section
- Light Gray - Surface Color
- White - Atmosphere or Air (No Pressure)
- Purple - Pneumatic Pressure
- Yellow - Moving or Activated Components
- Cat Yellow - (Restricted Usage) Identification of Components within a Moving Group
- Brown - Lubricating Oil
- Green - Tank, Sump, or Return Oil
- Green / White Stripes - Scavenge / Suction Oil or Hydraulic Void
- Red - High Pressure Oil
- Red / White Stripes - 1st Pressure Reduction
- Red Crosshatch - 2nd Reduction in Pressure
- Pink - 3rd Reduction in Pressure
- Red / Pink Stripes - Secondary Source Oil Pressure
- Orange - Pilot, Charge or Torque Converter Oil
- Orange / White Stripes - Reduced Pilot, Charge, or TC Oil Pressure
- Orange / Crosshatch - 2nd Reduction in Pilot, Charge, or TC Oil Pressure
- Blue - Trapped Oil

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HYDRAULIC SCHEMATIC COLOR CODE

This illustration identifies the meanings of the colors used in the hydraulic schematics and cross-sectional views shown throughout this document.

HYDRAULIC SCHEMATIC COLOR CODE


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Dark Gray - Cutaway Section


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Identification of Components
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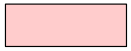
Pink - 3rd Reduction in Pressure


Red / Pink Stripes - Secondary Source Oil Pressure


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