SEBU7884-29 (en-us)
June 2020

Operation and Maintenance Manual

16M Motor Grader

B9H 1-UP (16M)
R9H 1-UP (16M)

Language: Original Instructions

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards, including human factors that can affect safety. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you verify that you are authorized to perform this work, and have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

A non-exhaustive list of operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. You must not use this product in any manner different from that considered by this manual without first satisfying yourself that you have considered all safety rules and precautions applicable to the operation of the product in the location of use, including site-specific rules and precautions applicable to the worksite. If a tool, procedure, work method or operating technique that is not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that you are authorized to perform this work, and that the product will not be damaged or become unsafe by the operation, lubrication, maintenance or repair procedures that you intend to use.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Cat dealers have the most current information available.

NOTICE

When replacement parts are required for this product Caterpillar recommends using original Caterpillar® replacement parts.

Other parts may not meet certain original equipment specifications.

When replacement parts are installed, the machine owner/user should ensure that the machine remains in compliance with all applicable requirements.

In the United States, the maintenance, replacement, or repair of the emission control devices and systems may be performed by any repair establishment or individual of the owner's choosing.

Table of Contents

Foreword 4

Safety Section

Safety Messages 6
Additional Messages 15
General Hazard Information 20
Crushing Prevention and Cutting Prevention .. 23
Burn Prevention 23
Fire Prevention and Explosion Prevention 24
Fire Safety 27
Fire Extinguisher Location 28
Tire Information 28
Electrical Storm Injury Prevention 28
Before Starting Engine 29
Engine Starting 30
Before Operation 30
Visibility Information 31
Restricted Visibility 31
Operation 32
Parking 35
Slope Operation 35
Equipment Lowering with Engine Stopped 36
Sound Information and Vibration Information . 36
Operator Station 38
Guards (Operator Protection) 39

Product Information Section

General Information 40
Identification Information 42

Operation Section

Before Operation 47
Machine Operation 50
Engine Starting 116
Adjustments 119
Parking 120
Transportation Information 123
Jacking Location Information 127
Towing Information 128
Engine Starting (Alternate Methods) 132

Maintenance Section

Tire Inflation Information 135
Lubricant Viscosities and Refill Capacities ... 136
Maintenance Access 142
Maintenance Support 143
Maintenance Interval Schedule 147

Warranty Section

Warranty Information 224

Reference Information Section

Reference Materials 225

Index Section

Index 227

Foreword

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

WARNING – This product can expose you to chemicals including ethylene glycol, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to:

www.P65Warnings.ca.gov

Do not ingest this chemical. Wash hands after handling to avoid incidental ingestion.

WARNING – This product can expose you to chemicals including lead and lead compounds, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to:

www.P65Warnings.ca.gov

Wash hands after handling components that may contain lead.

Literature Information

This manual should be stored in the operator's compartment in the literature holder or seat back literature storage area.

This manual contains safety information, operation instructions, transportation information, lubrication information, and maintenance information.

Some photographs or illustrations in this publication show details or attachments that can be different from your machine. Guards and covers might have been removed for illustrative purposes.

Continuing improvement and advancement of product design might have caused changes to your machine which are not included in this publication. Read, study, and keep this manual with the machine.

Whenever a question arises regarding your machine, or this publication, please consult your Cat dealer for the latest available information.

Safety

The safety section lists basic safety precautions. In addition, this section identifies the text and locations of warning signs and labels used on the machine.

Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance, and repair on this machine.

Operation

The operation section is a reference for the new operator and a refresher for the experienced operator. This section includes a discussion of gauges, switches, machine controls, attachment controls, transportation, and towing information.

Photographs and illustrations guide the operator through correct procedures of checking, starting, operating, and stopping the machine.

Operating techniques outlined in this publication are basic. Skill and techniques develop as the operator gains knowledge of the machine and its capabilities.

Maintenance

The maintenance section is a guide to equipment care. The Maintenance Interval Schedule (MIS) lists the items to be maintained at a specific service interval. Items without specific intervals are listed under the "When Required" service interval. The Maintenance Interval Schedule lists the page number for the step-by-step instructions required to accomplish the scheduled maintenance. Use the Maintenance Interval Schedule as an index or "one safe source" for all maintenance procedures.

Maintenance Intervals

Use the service hour meter to determine servicing intervals. Calendar intervals shown (daily, weekly, monthly, etc.) can be used instead of service hour meter intervals if the calendar intervals provide more convenient servicing schedules and approximate the indicated service hour meter reading. Perform the recommended service at the interval that occurs first.

Under severe, dusty, or wet operating conditions, more frequent lubrication than is specified in the maintenance intervals chart might be necessary.

Perform service on items at multiples of the original requirement. For example, at every 500 service hours or 3 months, also service those items listed under every 250 service hours or monthly and every 10 service hours or daily.

Certified Engine Maintenance

Proper maintenance and repair are essential to keep the engine and machine systems operating correctly. As the heavy-duty off-road diesel engine owner, you are responsible for the performance of the required maintenance listed in the Owner Manual, Operation and Maintenance Manual, and Service Manual.

It is prohibited for any person engaged in the business of repairing, servicing, selling, leasing, or trading engines or machines to remove, alter, or to render inoperative, any emission-related device or element of design installed on or in an engine or machine that is in compliance with all applicable regulations of the intended country to which it has been shipped. Certain elements of the machine and engine such as the exhaust system, fuel system, electrical system, intake air system, and cooling system may be emission-related and should not be altered unless approved by Caterpillar.

Machine Capacity

Additional attachments or modifications may exceed machine design capacity which can adversely affect performance characteristics. Included would be stability and system certifications such as brakes, steering, and rollover protective structures (ROPS). Contact your Cat dealer for further information.

Product Identification Number

Effective First Quarter 2001 the Product Identification Number (PIN) has changed from 8 to 17 characters. To provide uniform equipment identification, construction equipment manufacturers are moving to comply with the latest version of the product identification numbering standard. Non-road machine PINs are defined by ISO 10261. The new PIN format will apply to all machines and generator sets. The PIN plates and frame marking will display the 17 character PIN. The new format will look like the following:

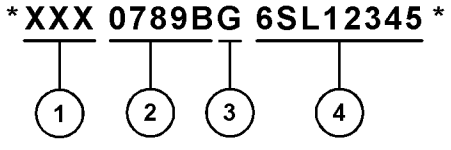

Illustration 1 g03891925

Where:

1. World Manufacturing Code (characters 1-3)

2. Machine Descriptor (characters 4-8)

3. Check Character (character 9)

4. Machine Indicator Section (MIS) or Product Sequence Number (characters 10-17). These were previously referred to as the Serial Number.

Machines and generator sets produced before First Quarter 2001 will maintain their 8 character PIN format.

Components such as engines, transmissions, axles, and work tools will continue to use an 8 character Serial Number (S/N).

Safety Section

i03998218

Safety Messages

SMCS Code: 7000

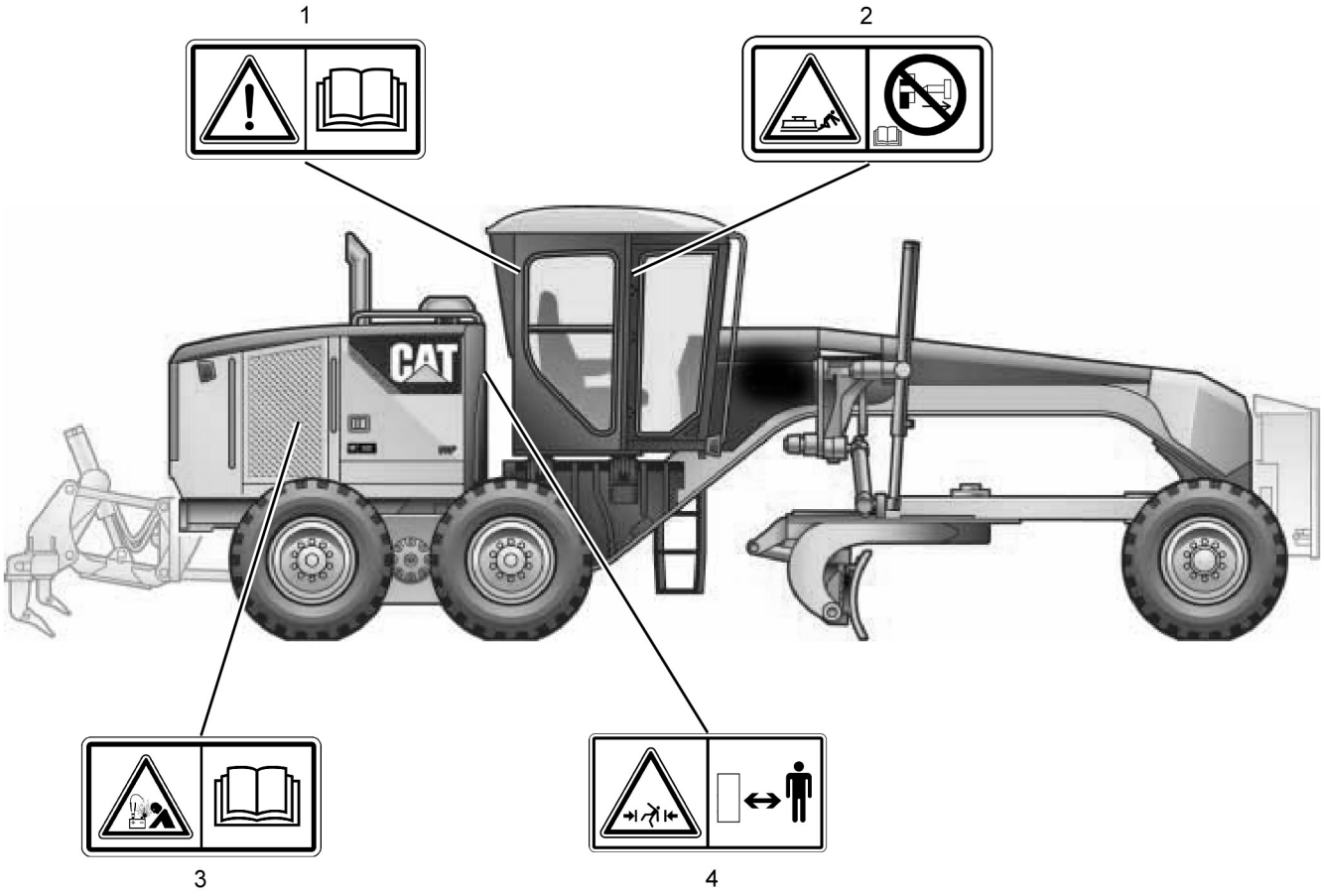

Illustration 2 g02175733

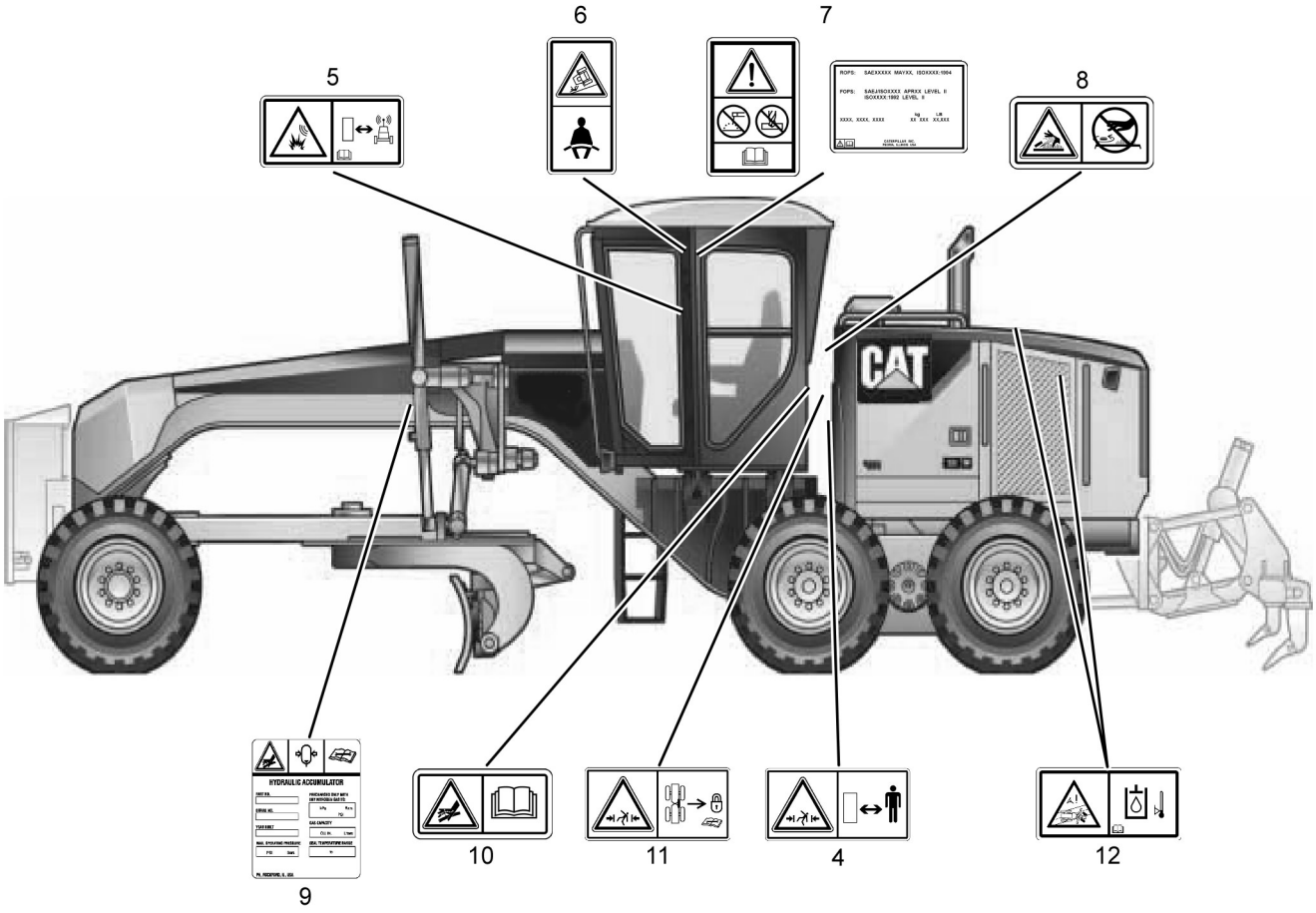

Illustration 3 g02175738

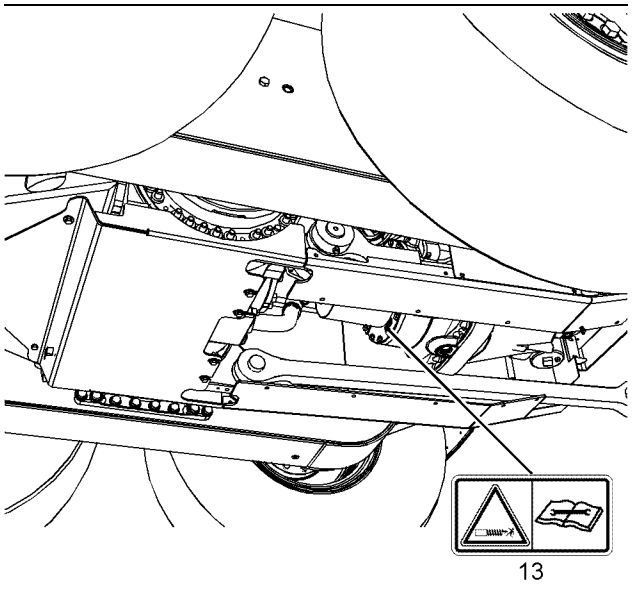

Illustration 4 g01637774

There are several specific safety messages on this machine. The exact location of the hazards and the description of the hazards are reviewed in this section. Please become familiarized with all safety messages.

Make sure that all of the safety messages are legible. Clean the safety messages or replace the safety messages if you cannot read the words. Replace the illustrations if the illustrations are not legible. When you clean the safety messages, use a cloth, water, and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the safety messages. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the safety message. Loose adhesive will allow the safety message to fall.

Replace any safety message that is damaged, or missing. If a safety message is attached to a part that is replaced, install a safety message on the replacement part. Any Caterpillar dealer can provide new safety messages.

Do Not Operate (1)

This safety message is located on the right side of the operator compartment.

Illustration 5 g01370904

WARNING

Do not operate or work on this machine unless you have read and understand the instructions and warnings in the Operation and Maintenance Manuals. Failure to follow the instructions or heed the warnings could result in injury or death. Contact any Caterpillar dealer for replacement manuals. Proper care is your responsibility.

Unplanned Blade Movement (2)

This safety message is positioned on the main switch panel on the right side of the operator compartment.

Illustration 6 g01379159

WARNING

Personal injury could result from sudden movement of the blade when the centershift lockpin is released. To prevent unexpected blade movement and possible injury, lower the blade to the ground before you unlock the centershift linkage. See the Operation and Maintenance manual for complete instructions before releasing the centershift lockpin.

Refer to centershift lock switch inOperation and Maintenance Manual, “Operator Controls” for more information.

Improper Connections For Jump Start Cables (3)

This safety message is positioned below the batteries inside the service center.

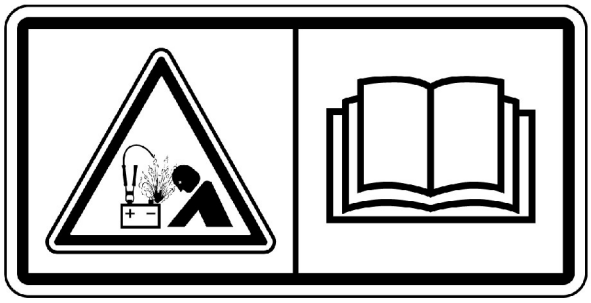

Illustration 7 g01370909

⚠ WARNING

Explosion Hazard! Improper jumper cable connections can cause an explosion resulting in serious injury or death. Batteries may be located in separate compartments. Refer to the Operation and Maintenance Manual for the correct jump starting procedure.

Refer to Operation and Maintenance Manual, “Engine Starting with Jump Start Cables” for more information.

No Clearance (4)

This safety message is positioned at the front right and the front left of the engine compartment.

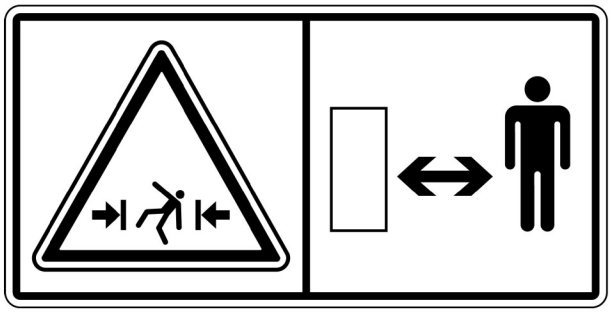

Illustration 8 g01371644

⚠ WARNING

Stay back a safe distance. No clearance for a person in this area when the machine turns. Severe injury or death from crushing could occur.

Product Link (5) (If Equipped)

This safety message is attached to the dash or to another area of the cab that is visible to the operator.

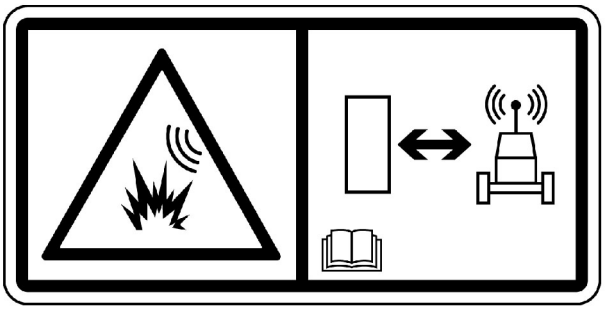

Illustration 9 g01370917

WARNING

This machine is equipped with a Caterpillar Product Link communication device. When electric detonators are used, this communication device should be deactivated within 12 m (40 ft) of a blast site for satellite-based systems and within 3 m (10 ft) of a blast site for cellular based systems, or within the distance mandated under applicable legal requirements. Failure to do so could cause interference with blasting operations and result in serious injury or death.

In cases where the type of Product Link module cannot be identified, Caterpillar recommends that the device be disabled no less than 12 m (40 ft) from the blast perimeter.

Seat Belt (6)

This safety message is located on the left side of the operator compartment.

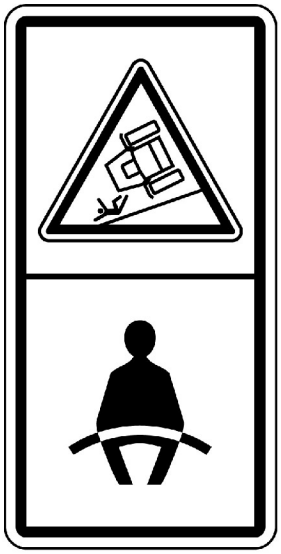

Illustration 10 g01371636

WARNING

A seat belt should be worn at all times during machine operation to prevent serious injury or death in the event of an accident or machine overturn. Failure to wear a seat belt during machine operation may result in serious injury or death.

Refer to Operation and Maintenance Manual, “Seat Belt” for more information.

Do Not Weld On The ROPS/FOPS Structure (7)

This safety message is positioned on the ROPS.

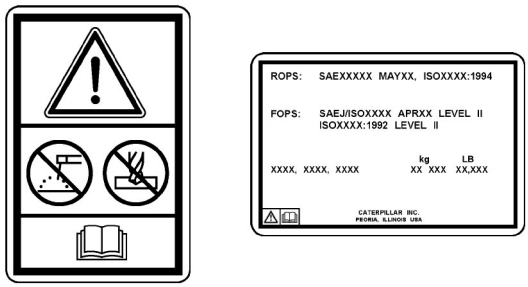

Illustration 11 g01211894

⚠ WARNING

Structural damage, an overturn, modification, alteration, or improper repair can impair this structure's protection capability thereby voiding this certification. Do not weld on or drill holes in the structure. This will void the certification. Consult your Cat dealer to determine this structure's limitations without voiding its certification.

This machine has been certified to the standards that are listed on the certification film. The maximum mass of the machine, which includes the operator and the attachments without a payload, should not exceed the mass on the certification film.

Refer to Operation and Maintenance Manual, “Guards (Operator Protection)” for more information.

Engine Coolant (8)

This safety message is positioned inside the cover for the radiator cap.

Illustration 12 g01371640

⚠ WARNING

Pressurized system! Hot coolant can cause serious burns, injury or death. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure. Read and understand the Operation and Maintenance Manual before performing any cooling system maintenance.

Refer to Operation and Maintenance Manual, “Cooling System Coolant Level - Check” for more information.

Accumulator (9)

This safety message is located on the blade cushion accumulator which is located on the left-hand side of the front frame.

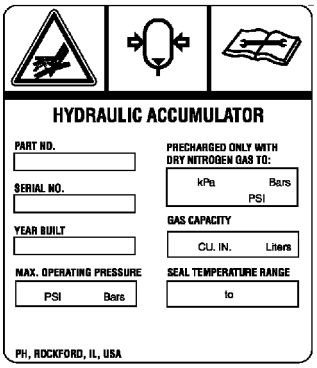

Illustration 13 g01325881

⚠ WARNING

High Pressure Cylinder.

Rapid discharging from disconnecting or disassembly can result in personal injury or death. See your Caterpillar dealer for tools and instructions for relieving pressure or charging. Precharge only with dry nitrogen gas.

Refer to Operation and Maintenance Manual, “Blade Cushion Accumulator - Check” for more information.

Accumulator (10)

This safety message is positioned on the brake accumulators. The brake accumulators are located at the rear of the cab.

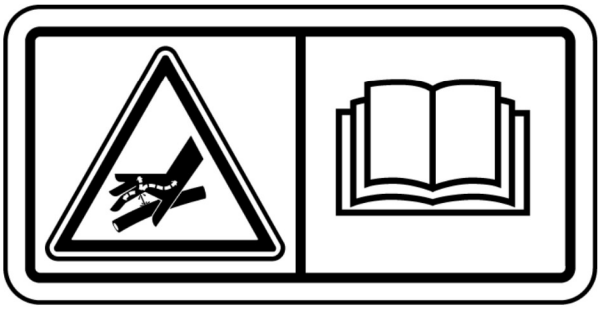

Illustration 14 g01371642

⚠ WARNING

Hydraulic accumulator contains gas and oil under high pressure. Improper removal or repair procedures could cause severe injury. To remove or repair, instructions in the service manual must be followed. Special equipment is required for testing and charging.

Refer to Operation and Maintenance Manual, “Brake Accumulator - Check” for more information.

No Clearance (11)

This safety message is positioned at the front left of the engine compartment.

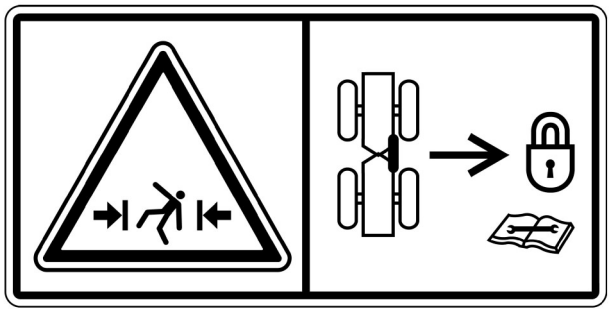

Illustration 15 g01371647

⚠ WARNING

Connect the steering frame lock between the front and the rear frames before lifting, transporting, or servicing the machine in the articulation area. Disconnect the steering frame lock and secure the steering frame lock before resuming operation. Severe injury or death could occur.

Hydraulic System Oil (12)

This safety message is positioned near the hydraulic tank filler cap and this safety message is located near the hydraulic tank sight gauge.

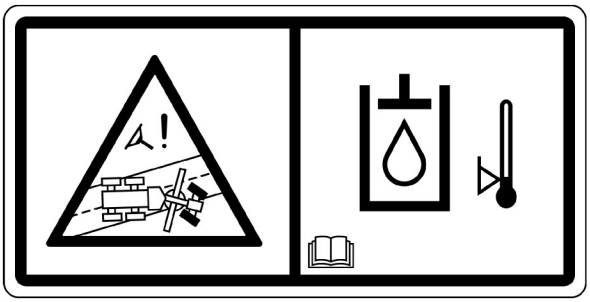

Illustration 16 g01637005

⚠ WARNING

If the incorrect hydraulic oil viscosity is installed and the machine is operated in cold temperatures, the machine hydraulic system may not respond at normal speeds. Sluggish machine control could result in injury or death. Use the correct oil viscosity for operating the machine in cold weather, and warm-up the machine before operating the machine in cold weather. See Operation and Maintenance Manual, "Engine and Machine Warm-Up" for more information on operation in cold temperatures. See Operation and Maintenance Manual, "Lubricant Viscosities" for the recommended oil viscosity. If the hydraulic oil needs to be changed, see Operation and Maintenance Manual, "Hydraulic System Oil - Change" for the procedure to change the hydraulic system oil.

Recoil Spring (13)

This safety message is positioned at the bottom of the parking brake housing.

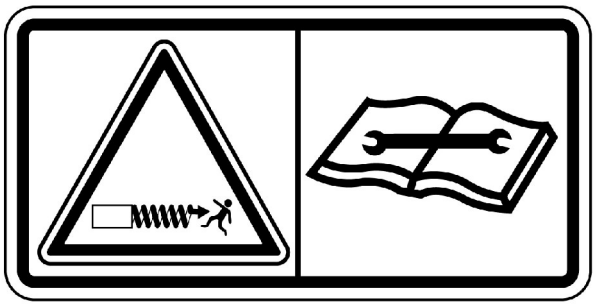

Illustration 17 g01379131

⚠ WARNING

This housing contains a highly compressed spring that can cause injury or death. Do not disassemble this parking brake housing until you have read and understand the correct procedure for disassembly in the Service Manual.

i03827651

Additional Messages

SMCS Code: 7000

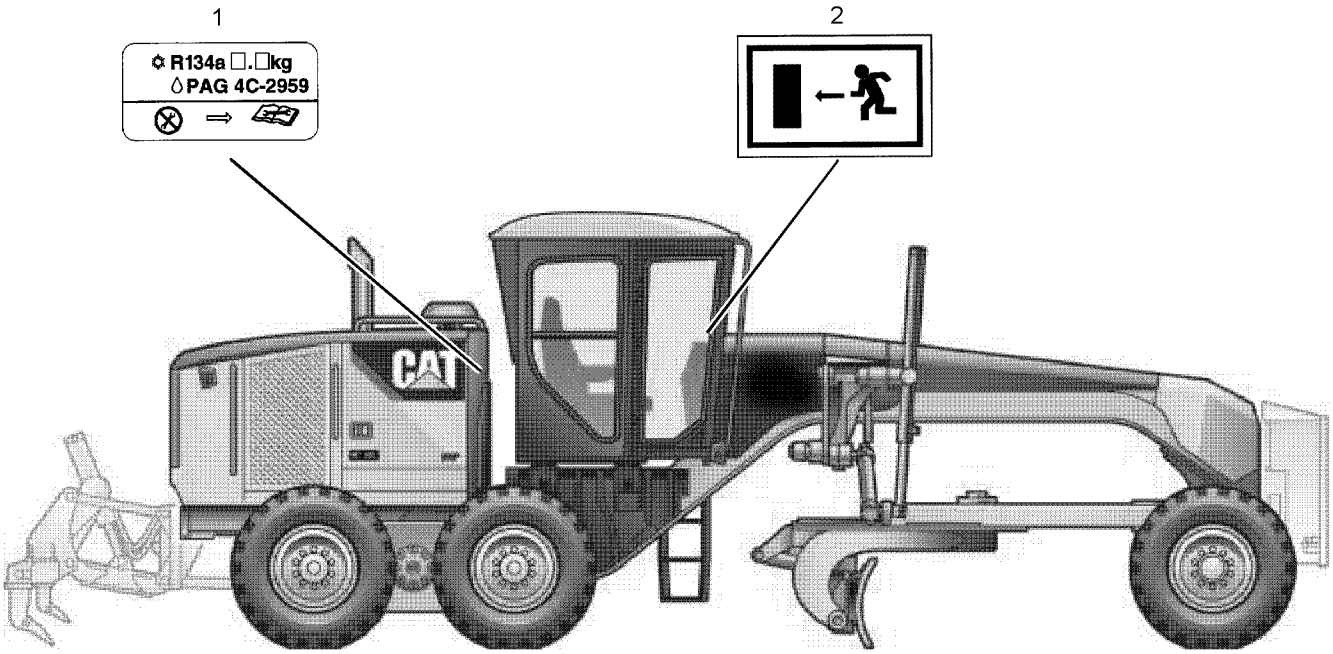

Illustration 18 g01959760

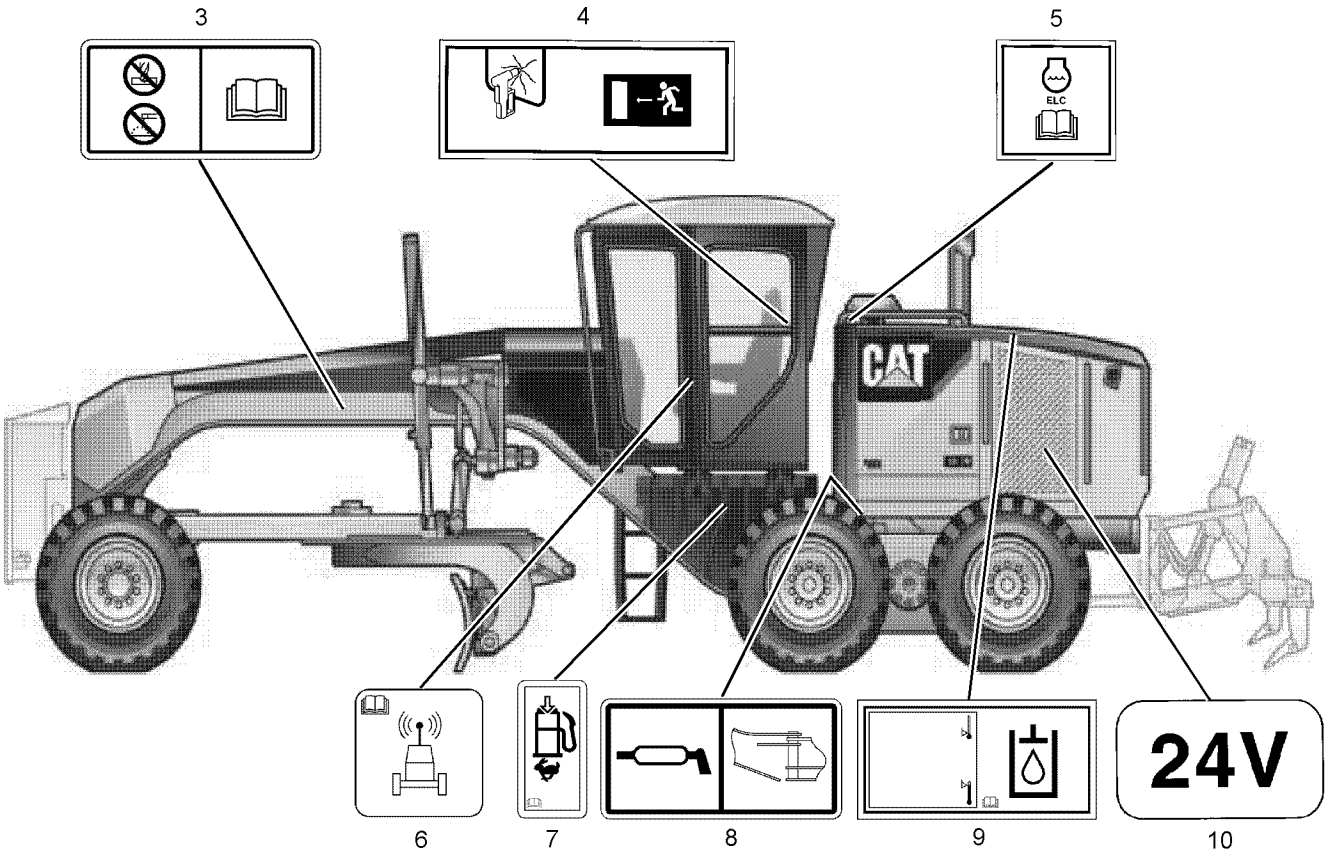

Illustration 19 g01960574

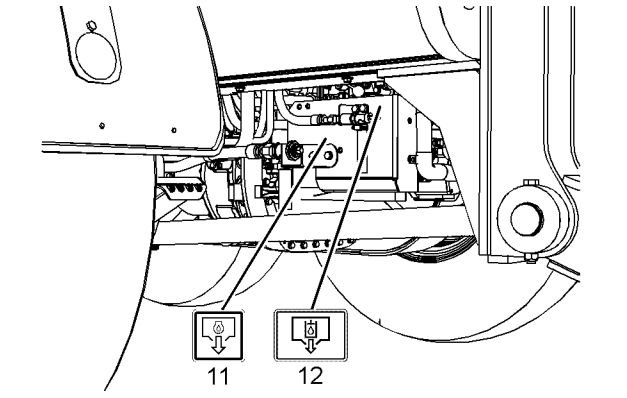

Illustration 20 g01960575

There are several specific messages on this machine. The exact location of the hazards and the description of the hazards are reviewed in this section. Please become familiarized with all messages.

Make sure that all of the messages are legible. Clean the messages or replace the messages if you cannot read the words. Replace the illustrations if the illustrations are not legible. When you clean the messages, use a cloth, water and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the messages. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the messages. Loose adhesive will allow the messages to fall.

Replace any message that is damaged, or missing. If a message is attached to a part that is replaced, install a message on the replacement part. Any Caterpillar dealer can provide new messages.

Air Conditioner (1)

This message is located inside the engine compartment near the hinges of the right front access door.

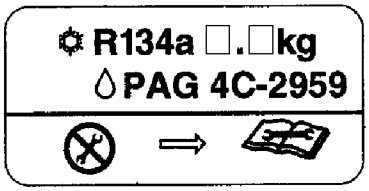

Illustration 21 g01959762

Read the service manual before you perform any maintenance on the air conditioner.

Alternate Exit (2)

This message is located on the door latch for the right door.

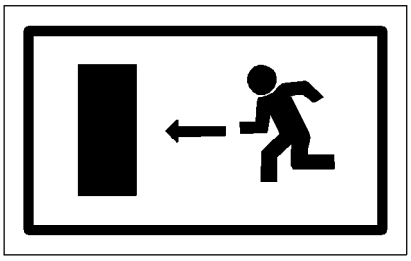

Illustration 22 g01002993

If the primary exit is blocked, exit the machine through the door on the right side of the machine.

Do Not Weld and Do Not Drill. (3)

This message is located on the left hand side of the front frame.

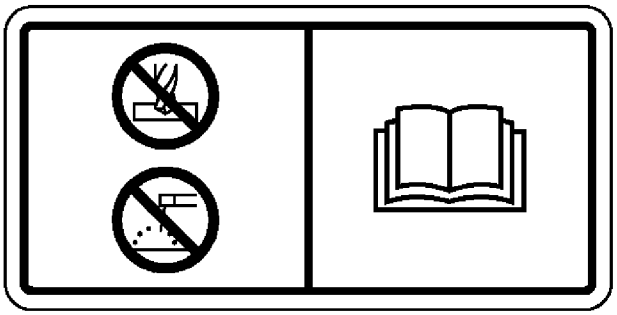

Illustration 23 g01175166

Do not weld or drill the frame. Refer to Operation and Maintenance Manual, “Guards (Operator Protection)” for more information.

Alternate Exit (4)

If your machine is equipped with a snow wing, this message is located on the left ROPS support at the rear of the operator's compartment.

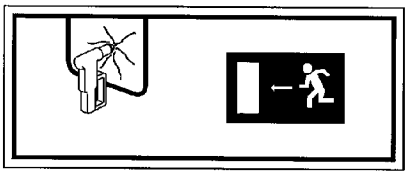

Illustration 24 g01911433

If the primary exits are blocked, use the hammer to break the window. Exit the machine through the window.

Cat Extended Life Coolant (ELC) (5)

This message is located on the underside of the radiator cap access cover on top of the engine compartment.

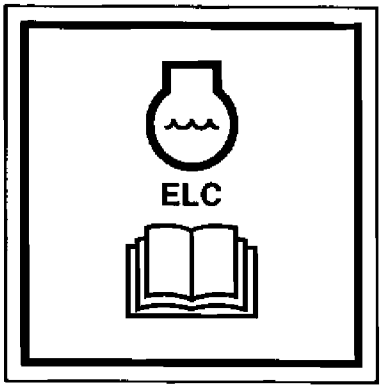

Illustration 25 g01132922

Refer to Operation and Maintenance Manual, “Cooling System Coolant (ELC) - Change” and Operation and Maintenance Manual, “Cooling System Coolant Extender (ELC) - Add” for more information.

Data Privacy (6)

Illustration 26 g01418953

This message is located in the cab on the left post.

Fuel Filler (7)

This message is located on the fuel tank near the fast fill fuel adapter.

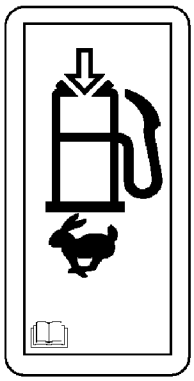

Illustration 27 g01175158

NOTICE
Use only a Caterpillar approved fast fill system to fuel machines. Over pressurization may cause tank deformation and fuel spillage.

Contact your Cat dealer for fast fill system availability.

Refer to Operation and Maintenance Manual, “Fuel System - Fill” for more information.

Articulation Bearing (8)

This message is located on the front left side of the top hitch assembly near the grease points for the articulation bearing.

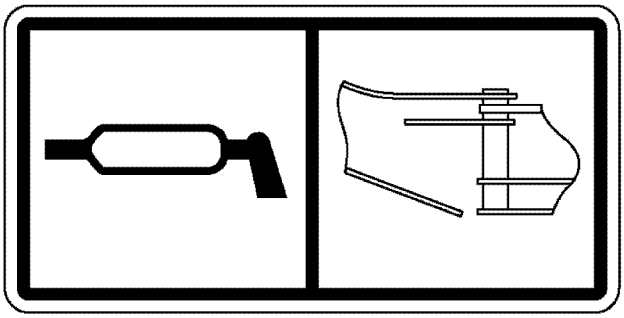

Illustration 28 g01261194

Hydraulic System Oil (9)

This message is located near the hydraulic tank filler cap. A grease pen may be used on the left hand side of this film to write down the current hydraulic oil viscosity.

Refer to Operation and Maintenance Manual, “Monitoring System” and Operation and Maintenance Manual, “Hydraulic System Oil - Change” for more information to ensure that the correct oil type is selected in Messenger .

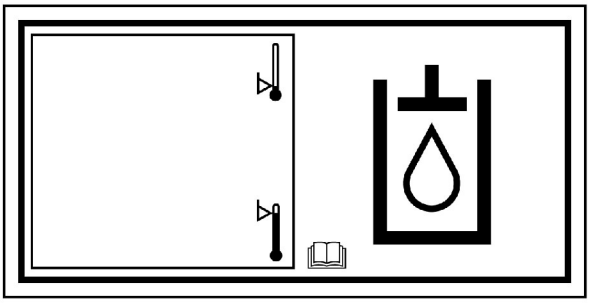

Illustration 29 g01637006

24 V (10)

This message is located near the auxiliary start receptacle.

Illustration 30 g01183244

Engine Oil Drain (11)

This message is located at the left rear of the machine near the drain valve for the engine oil.

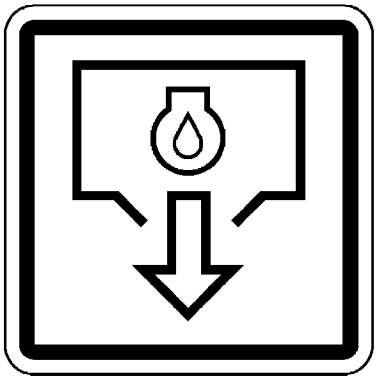

Illustration 31 g01161760

Hydraulic Tank Drain (12)

This message is located at the left rear of the machine near the drain valve for the hydraulic system.

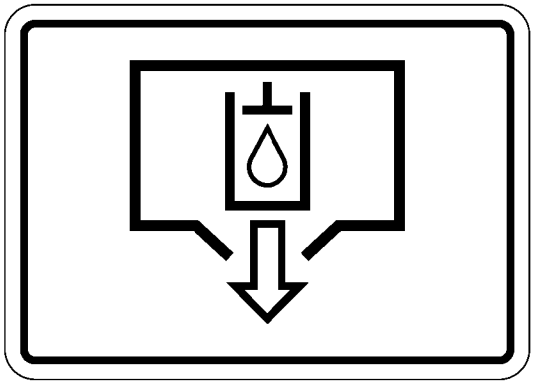

Illustration 32 g01261324

i07746355

General Hazard Information

SMCS Code: 7000

Illustration 33 g00104545

Typical example

Attach a “Do Not Operate” warning tag or a similar warning tag to the start switch or to the controls. Attach the warning tag before you service the equipment or before you repair the equipment. Warning tag SEHS7332 is available from your Cat dealer.

⚠ WARNING

Operating the machine while distracted can result in the loss of machine control. Use extreme caution when using any device while operating the machine. Operating the machine while distracted can result in personal injury or death.

Know the width of your equipment to maintain proper clearance when you operate the equipment near fences or near boundary obstacles.

Be aware of high-voltage power lines and power cables that are buried. If the machine comes in contact with these hazards, serious injury or death may occur from electrocution.

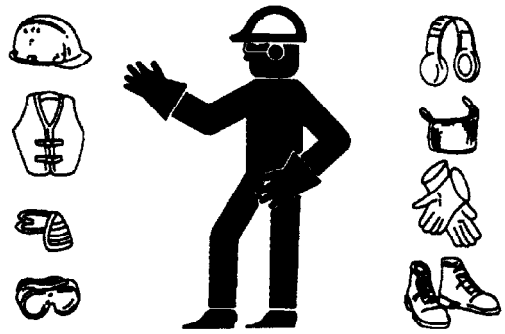

Illustration 34 g00702020

Wear a hard hat, protective glasses, and other protective equipment, as required.

Do not wear loose clothing or jewelry that can snag on controls or on other parts of the equipment.

Make sure that all protective guards and all covers are secured in place on the equipment.

Keep the equipment free from foreign material. Remove debris, oil, tools, and other items from the deck, from walkways, and from steps.

Secure all loose items such as lunch boxes, tools, and other items that are not a part of the equipment.

Know the appropriate work site hand signals and the personnel that are authorized to give the hand signals. Accept hand signals from one person only.

Do not smoke when you service an air conditioner. Also, do not smoke if refrigerant gas may be present. Inhaling the fumes that are released from a flame that contacts air conditioner refrigerant can cause bodily harm or death. Inhaling gas from air conditioner refrigerant through a lighted cigarette can cause bodily harm or death.

Never put maintenance fluids into glass containers. Drain all liquids into a suitable container.

Obey all local regulations for the disposal of liquids.

Use all cleaning solutions with care. Report all necessary repairs.

Do not allow unauthorized personnel on the equipment.

Unless you are instructed otherwise, perform maintenance with the equipment in the servicing position. Refer to Operation and Maintenance Manual for the procedure for placing the equipment in the servicing position.

When you perform maintenance above ground level, use appropriate devices such as ladders or man lift machines. If equipped, use the machine anchorage points and use approved fall arrest harnesses and lanyards.

Pressurized Air and Water

Pressurized air and/or water can cause debris and/or hot water to be blown out. The debris and/or hot water could result in personal injury.

When pressurized air and/or pressurized water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be reduced to 205 kPa (30 psi) when the nozzle is deadheaded and the nozzle is used with an effective chip deflector and personal protective equipment. The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

Avoid direct spraying of water on electrical connectors, connections, and components. When using air for cleaning, allow the machine to cool to reduce the possibility of fine debris igniting when re-deposited on hot surfaces.

Trapped Pressure

Pressure can be trapped in a hydraulic system. Releasing trapped pressure can cause sudden machine movement or attachment movement. Use caution if you disconnect hydraulic lines or fittings. High-pressure oil that is released can cause a hose to whip. High-pressure oil that is released can cause oil to spray. Fluid penetration can cause serious injury and possible death.

Fluid Penetration

Pressure can be trapped in the hydraulic circuit long after the machine has been stopped. The pressure can cause hydraulic fluid or items such as pipe plugs to escape rapidly if the pressure is not relieved correctly.

Do not remove any hydraulic components or parts until pressure has been relieved or personal injury may occur. Do not disassemble any hydraulic components or parts until pressure has been relieved or personal injury may occur. Refer to the Service Manual for any procedures that are required to relieve the hydraulic pressure.

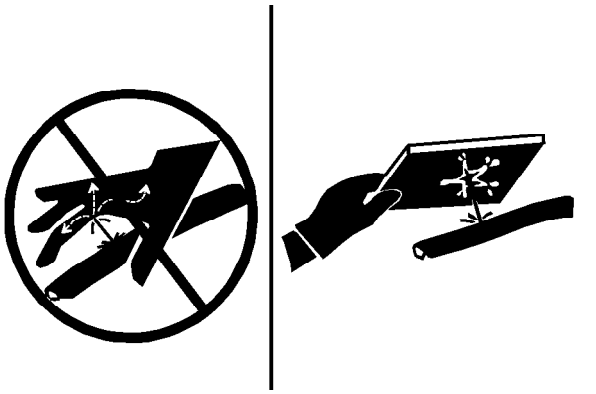

Illustration 35 g00687600

Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

Containing Fluid Spillage

Care must be taken in order to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the equipment. Prepare to collect the fluid with suitable containers before opening any compartment or disassembling any component that contains fluids.

Refer to Special Publication, NENG2500, “Cat dealer Service Tool Catalog” for the following items:

- Tools that are suitable for collecting fluids and equipment that is suitable for collecting fluids
- Tools that are suitable for containing fluids and equipment that is suitable for containing fluids

Obey all local regulations for the disposal of liquids.

Inhalation

Illustration 36 g02159053

Exhaust

Use caution. Exhaust fumes can be hazardous to your health. If you operate the machine in an enclosed area, adequate ventilation is necessary.

Asbestos Information

Cat equipment and replacement parts that are shipped from Caterpillar are asbestos free. Caterpillar recommends the use of only genuine Cat replacement parts. Use the following guidelines when you handle any replacement parts that contain asbestos or when you handle asbestos debris.

Use caution. Avoid inhaling dust that might be generated when you handle components that contain asbestos fibers. Inhaling this dust can be hazardous to your health. The components that may contain asbestos fibers are brake pads, brake bands, lining material, clutch plates, and some gaskets. The asbestos that is used in these components is bound in a resin or sealed in some way. Normal handling is not hazardous unless airborne dust that contains asbestos is generated.

If dust that may contain asbestos is present, there are several guidelines that should be followed:

- Never use compressed air for cleaning.
- Avoid brushing materials that contain asbestos.
- Avoid grinding materials that contain asbestos.
- Use a wet method in order to clean up asbestos materials.
- A vacuum cleaner that is equipped with a high efficiency particulate air filter (HEPA) can also be used.

- Use exhaust ventilation on permanent machining jobs.
- Wear an approved respirator if there is no other way to control the dust.
- Comply with applicable rules and regulations for the work place. In the United States, use Occupational Safety and Health Administration (OSHA) requirements. These OSHA requirements can be found in “29 CFR 1910.1001”. In Japan, use the requirements found in the “Ordinance on Prevention of Health Impairment due to Asbestos” in addition to the requirements of the Industrial Safety and Health Act.
- Obey environmental regulations for the disposal of asbestos.
- Stay away from areas that might have asbestos particles in the air.

Dispose of Waste Properly

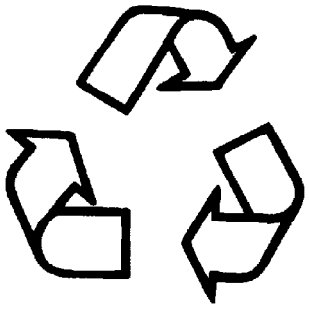

Illustration 37 g00706404

Improperly disposing of waste can threaten the environment. Potentially harmful fluids should be disposed of according to local regulations.

Always use leakproof containers when you drain fluids. Do not pour waste onto the ground, down a drain, or into any source of water.

i01359664

Crushing Prevention and Cutting Prevention

SMCS Code: 7000

Support the equipment properly before you perform any work or maintenance beneath that equipment. Do not depend on the hydraulic cylinders to hold up the equipment. Equipment can fall if a control is moved, or if a hydraulic line breaks.

Do not work beneath the cab of the machine unless the cab is properly supported.

Unless you are instructed otherwise, never attempt adjustments while the machine is moving or while the engine is running.

Never jump across the starter solenoid terminals in order to start the engine. Unexpected machine movement could result.

Whenever there are equipment control linkages the clearance in the linkage area will change with the movement of the equipment or the machine. Stay clear of areas that may have a sudden change in clearance with machine movement or equipment movement.

Stay clear of all rotating and moving parts.

If it is necessary to remove guards in order to perform maintenance, always install the guards after the maintenance is performed.

Keep objects away from moving fan blades. The fan blade will throw objects or cut objects.

Do not use a kinked wire cable or a frayed wire cable. Wear gloves when you handle wire cable.

When you strike a retainer pin with force, the retainer pin can fly out. The loose retainer pin can injure personnel. Make sure that the area is clear of people when you strike a retainer pin. To avoid injury to your eyes, wear protective glasses when you strike a retainer pin.

Chips or other debris can fly off an object when you strike the object. Make sure that no one can be injured by flying debris before striking any object.

i07746334

Burn Prevention

SMCS Code: 7000

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine. Relieve all pressure in the air system, in the oil system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings, or related items are disconnected.

Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the heaters or to the engine contain hot coolant.

Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check the coolant level only after the engine has been stopped.

Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly to relieve pressure.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

Oils

Hot oil and hot components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

Remove the hydraulic tank filler cap only after the engine has been stopped. The filler cap must be cool enough to touch with a bare hand. Follow the standard procedure in this manual to remove the hydraulic tank filler cap.

Batteries

The liquid in a battery is an electrolyte. Electrolyte is an acid that can cause personal injury. Do not allow electrolyte to contact the skin or the eyes.

Do not smoke while checking the battery electrolyte levels. Batteries give off flammable fumes which can explode.

Always wear protective glasses when you work with batteries. Wash hands after touching batteries. The use of gloves is recommended.

i07746336

Fire Prevention and Explosion Prevention

SMCS Code: 7000

Illustration 38 g00704000

General

All fuels, most lubricants, and some coolant mixtures are flammable.

To minimize the risk of fire or explosion, Caterpillar recommends the following actions.

Always perform a Walk-Around Inspection, which may help you identify a fire hazard. Do not operate a machine when a fire hazard exists. Contact your Cat dealer for service.

Understand the use of the primary exit and alternative exit on the machine. Refer to Operation and Maintenance Manual, “Alternative Exit”.

Do not operate a machine with a fluid leak. Repair leaks and clean up fluids before resuming machine operation. Fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. A fire may cause personal injury or death.

Remove flammable material such as leaves, twigs, papers, trash, and so on. These items may accumulate in the engine compartment or around other hot areas and hot parts on the machine.

Keep the access doors to major machine compartments closed and access doors in working condition in order to permit the use of fire suppression equipment, in case a fire should occur.

Clean all accumulations of flammable materials such as fuel, oil, and debris from the machine.

Do not operate the machine near any flame.

Keep shields in place. Exhaust shields (if equipped) protect hot exhaust components from oil spray or fuel spray in case of a break in a line, in a hose, or in a seal. Exhaust shields must be installed correctly.

Do not weld or flame cut on tanks or lines that contain flammable fluids or flammable material. Empty and purge the lines and tanks. Then clean the lines and tanks with a nonflammable solvent prior to welding or flame cutting. Ensure that the components are properly grounded in order to avoid unwanted arcs.

Dust that is generated from repairing nonmetallic hoods or fenders may be flammable and/or explosive. Repair such components in a well ventilated area away from open flames or sparks. Use suitable Personal Protection Equipment (PPE).

Inspect all lines and hoses for wear or deterioration. Replace damaged lines and hoses. The lines and the hoses should have adequate support and secure clamps. Tighten all connections to the recommended torque. Damage to the protective cover or insulation may provide fuel for fires.

Store fuels and lubricants in properly marked containers away from unauthorized personnel. Store oily rags and flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Illustration 39 g03839130

Use caution when you are fueling a machine. Do not smoke while you are fueling a machine. Do not fuel a machine near open flames or sparks. Do not use cell phones or other electronic devices while you are refueling. Always stop the engine before fueling. Fill the fuel tank outdoors. Properly clean areas of spillage.

Avoid static electricity risk when fueling. Ultra low sulfur diesel (ULSD) poses a greater static ignition hazard than earlier diesel formulations with a higher sulfur content. Avoid death or serious injury from fire or explosion. Consult with your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

Never store flammable fluids in the operator compartment of the machine.

Battery and Battery Cables

Illustration 40 g03839133

Caterpillar recommends the following in order to minimize the risk of fire or an explosion related to the battery.

Do not operate a machine if battery cables or related parts show signs of wear or damage. Contact your Cat dealer for service.

Follow safe procedures for engine starting with jump-start cables. Improper jumper cable connections can cause an explosion that may result in injury. Refer to Operation and Maintenance Manual, “Engine Starting with Jump Start Cables” for specific instructions.

Do not charge a frozen battery. This may cause an explosion.

Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas. Do not use cell phones or other electronic devices in battery charging areas.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter in order to check the battery charge.

Daily inspect battery cables that are in areas that are visible. Inspect cables, clips, straps, and other restraints for damage. Replace any damaged parts. Check for signs of the following, which can occur over time due to use and environmental factors:

- Fraying
- Abrasion
- Cracking
- Discoloration
- Cuts on the insulation of the cable
- Fouling
- Corroded terminals, damaged terminals, and loose terminals

Replace damaged battery cable(s) and replace any related parts. Eliminate any fouling, which may have caused insulation failure or related component damage or wear. Ensure that all components are reinstalled correctly.

An exposed wire on the battery cable may cause a short to ground if the exposed area comes into contact with a grounded surface. A battery cable short produces heat from the battery current, which may be a fire hazard.

An exposed wire on the ground cable between the battery and the disconnect switch may cause the disconnect switch to be bypassed if the exposed area comes into contact with a grounded surface. This may result in an unsafe condition for servicing the machine. Repair components or replace components before servicing the machine.

⚠ WARNING

Fire on a machine can result in personal injury or death. Exposed battery cables that come into contact with a grounded connection can result in fires. Replace cables and related parts that show signs of wear or damage. Contact your Cat dealer.

Wiring

Check electrical wires daily. If any of the following conditions exist, replace parts before you operate the machine.

- Fraying
- Signs of abrasion or wear
- Cracking
- Discoloration
- Cuts on insulation
- Other damage

Make sure that all clamps, guards, clips, and straps are reinstalled correctly. This will help to prevent vibration, rubbing against other parts, and excessive heat during machine operation.

Attaching electrical wiring to hoses and tubes that contain flammable fluids or combustible fluids should be avoided.

Consult your Cat dealer for repair or for replacement parts.

Keep wiring and electrical connections free of debris.

Lines, Tubes, and Hoses

Do not bend high-pressure lines. Do not strike high-pressure lines. Do not install any lines that are bent or damaged. Use the appropriate backup wrenches in order to tighten all connections to the recommended torque.

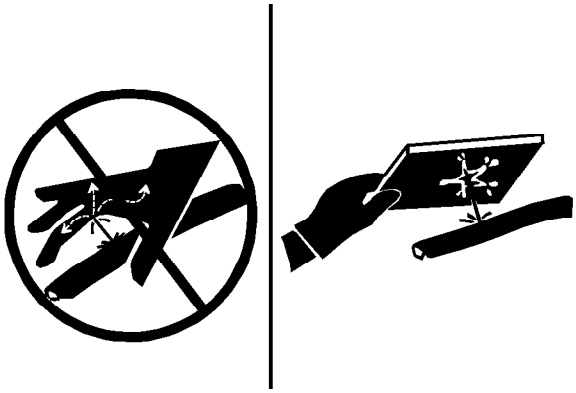

Illustration 41 g00687600

Check lines, tubes, and hoses carefully. Wear Personal Protection Equipment (PPE) in order to check for leaks. Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

Replace the affected parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are swelling or ballooning.
- Flexible parts of the hoses are kinked.

- Outer covers have exposed embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly. During machine operation, this will help to prevent vibration, rubbing against other parts, excessive heat, and failure of lines, tubes, and hoses.

Do not operate a machine when a fire hazard exists. Repair any lines that are corroded, loose, or damaged. Leaks may provide fuel for fires. Consult your Cat dealer for repair or for replacement parts. Use genuine Cat parts or the equivalent, for capabilities of both the pressure limit and temperature limit.

Ether

Ether (if equipped) is commonly used in cold-weather applications. Ether is flammable and poisonous.

Only use approved Ether canisters for the Ether dispensing system fitted to your machine, do not spray Ether manually into an engine, follow the correct cold engine starting procedures. Refer to the section in the Operation and Maintenance Manual with the label “Engine Starting” .

Use ether in ventilated areas. Do not smoke while you are replacing an ether cylinder.

Do not store ether cylinders in living areas or in the operator compartment of a machine. Do not store ether cylinders in direct sunlight or in temperatures above 49° C (120.2° F). Keep ether cylinders away from open flames or sparks.

Dispose of used ether cylinders properly. Do not puncture an ether cylinder. Keep ether cylinders away from unauthorized personnel.

Fire Extinguisher

As an additional safety measure, keep a fire extinguisher on the machine.

Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Follow the recommendations on the instruction plate.

Consider installation of an aftermarket Fire Suppression System, if the application and working conditions warrant the installation.

i07041871

Fire Safety

SMCS Code: 7000

Note: Locate secondary exits and how to use the secondary exits before you operate the machine.

Note: Locate fire extinguishers and how to use a fire extinguisher before you operate the machine.

If you find that you are involved in a machine fire, your safety and that of others on site are the top priority. The following actions should only be performed if the actions do not present a danger or risk to you and any nearby people. Assess the risk of personal injury and move away to a safe distance as soon as you feel unsafe.

Move the machine away from nearby combustible material such as fuel/oil stations, structures, trash, mulch, and timber.

Lower any implements and turn off the engine as soon as possible. If you leave the engine running, the engine will continue to feed a fire. The fire will be fed from any damaged hoses that are attached to the engine or pumps.

If possible, turn the battery disconnect switch to the OFF position. Disconnecting the battery will remove the ignition source in the event of an electrical short. Disconnecting the battery will eliminate a second ignition source if electrical wiring is damaged by the fire, resulting in a short circuit.

Notify emergency personnel of the fire and your location.

If your machine is equipped with a fire suppression system, follow the manufacturers procedure for activating the system.

Note: Fire suppression systems need to be regularly inspected by qualified personnel. You must be trained to operate the fire suppression system.

If you are unable to do anything else, shut off the machine before exiting. By shutting off the machine, fuels will not continue to be pumped into the fire.

If the fire grows out of control, be aware of the following risks:

- Tires on wheeled machines pose a risk of explosion as tires burn. Hot shrapnel and debris can be thrown great distances in an explosion.
- Tanks, accumulators, hoses, and fittings can rupture in a fire, spraying fuels and shrapnel over a large area.
- Remember that nearly all the fluids on the machine are flammable, including coolant and oils. Additionally, plastics, rubbers, fabrics, and resins in fiberglass panels are also flammable.

i03755313

Fire Extinguisher Location

SMCS Code: 7000

Do not weld a bracket on the Rollover Protective Structure (ROPS) in order to install the fire extinguisher. Also, do not drill holes in the ROPS in order to mount the fire extinguisher on the ROPS.

i06164462

Tire Information

SMCS Code: 7000

Explosions of air inflated tires have resulted from heat-induced gas combustion inside the tires. Explosions can be caused by heat that is generated by welding, by heating rim components, by external fire, or by excessive use of brakes.

A tire explosion is much more violent than a blowout. The explosion can propel the tire, the rim components, and the axle components from the machine. Stay out of the trajectory path. Both the force of the explosion and the flying debris can cause property damage, personal injury, or death.

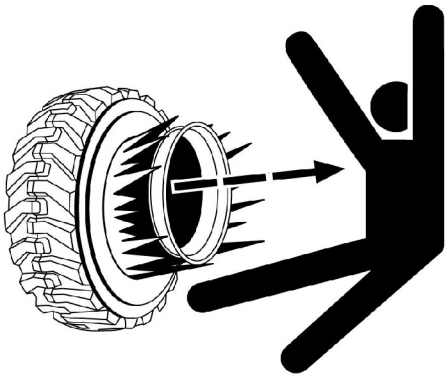

Illustration 42 g02166933

Typical example of tire is shown

Do not approach a hot or an apparently damaged tire.

Caterpillar recommends against using water or calcium as a ballast for the tires except in machines designed for this additional mass. For those applicable machines, the maintenance section will contain instructions on the correct tire inflation and filling procedures. Ballast, such as fluid in the tires, increases overall machine weight and may affect braking, steering, power train components, or the certification of the protective structure such as the ROPS. The use of tire/rim rust preventatives or other liquid additives is not required.

⚠ WARNING

Proper nitrogen inflation equipment, and training in using the equipment, are necessary to avoid over inflation. A tire blowout or rim failure can result from improper or misused equipment and personal injury or death can occur.

A tire blowout and/or rim failure can occur if the inflation equipment is not used correctly, due to the fact that a fully charged nitrogen cylinder's pressure is approximately 15000 kPa (2200 psi).

Dry nitrogen gas is recommended for inflation of tires. If the tires were originally inflated with air, nitrogen is still preferred for adjusting the pressure. Nitrogen mixes properly with air.

Nitrogen inflated tires reduce the potential of a tire explosion because nitrogen does not aid combustion. Nitrogen helps to prevent oxidation of the rubber, deterioration of rubber, and corrosion of rim components.

To avoid overinflation, proper nitrogen inflation equipment and training in the usage of the equipment are necessary. A tire blowout or a rim failure can result from improper equipment or from misused equipment.

When you inflate a tire, stand behind the tread and use a self-attaching chuck.

Servicing tires and rims can be dangerous. Only trained personnel that use proper tools and proper procedures should perform this maintenance. If correct procedures are not used for servicing tires and rims, the assemblies could burst with explosive force. This explosive force can cause serious personal injury or death. Carefully obey the specific instructions from your tire dealer.

i01122596

Electrical Storm Injury Prevention

SMCS Code: 7000

When lightning is striking in the vicinity of the machine, the operator should never attempt the following procedures:

- Mount the machine.
- Dismount the machine.

If you are in the operator's station during an electrical storm, stay in the operator's station. If you are on the ground during an electrical storm, stay away from the vicinity of the machine.

i03756097

Before Starting Engine

SMCS Code: 1000; 7000

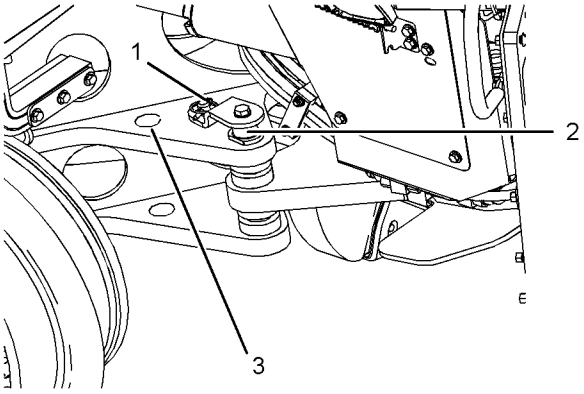

Illustration 43 g01301716

Remove pin (1). Remove the frame lock pin (2) from the frame. Store frame lock pin in storage bracket (3). Replace pin (1). Frame lock pin (2) must be removed in order to articulate the machine. Refer to Operation and Maintenance Manual, “Steering Frame Lock” for more information.

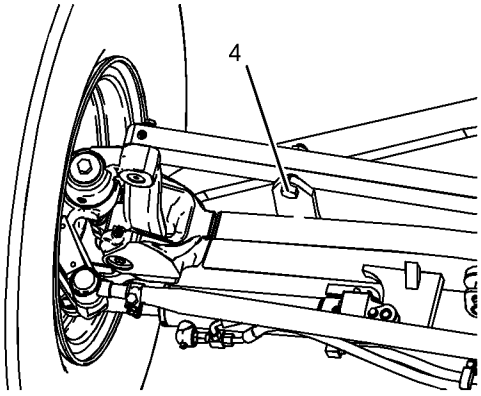

Illustration 44 g01153708

Remove wheel lean locking bolt (4) from the locked position.

NOTICE
Do not operate the machine with the wheel lean bolt in the locked position. Machine damage may occur.

Start the engine only from the operator's compartment. Never short across the starter terminals or across the batteries. Shorting could bypass the engine neutral start system. Shorting could also damage the electrical system.

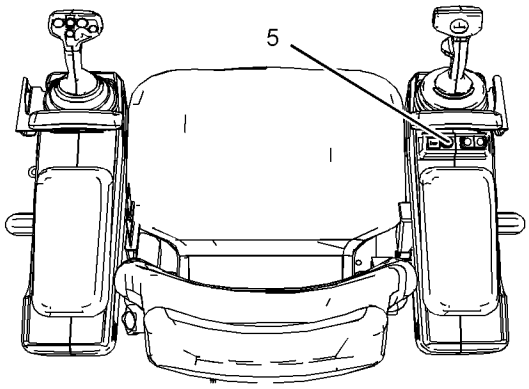

Illustration 45 g01323177

Depress the horn button (5) in order to make sure that the machine horn works properly.

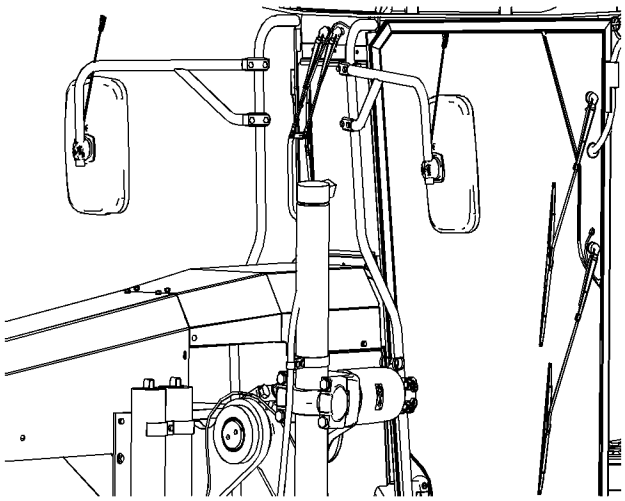

Illustration 46 g01323208

The mirrors on your machine may be different. Adjust the mirrors for the best operator vision. Adjust the inside mirror or the inside mirrors before you operate the machine. If the machine is equipped with outside mirrors, adjust the outside mirrors before you operate the machine. Refer to Operation and Maintenance Manual, “Mirror” for more information on the mirror adjustment.

Inspect the condition of the seat belt and the condition of mounting hardware. Replace any damaged parts and any worn parts. Regardless of appearance, replace the seat belt after three years of use. Do not use a seat belt extension on a retractable seat belt.

Adjust the seat in order to achieve full pedal travel when the operator's back is against the back of the seat.

Adjust the seat in order to achieve good posture.

Adjust the control pod height and adjust the control pod fore/aft position. Your elbow should be slightly ahead of your shoulder. Your wrist should be slightly below your elbow.

Make sure that the machine is equipped with a lighting system that is adequate for the job conditions. Make sure that all lights are working properly.

Before you start the engine or before you move the machine, make sure that no one is on the machine, underneath the machine, or around the machine. Make sure that there are no personnel in the area.

i06143800

Engine Starting

SMCS Code: 1000; 7000

If a warning tag is attached to the engine start switch or to the machine controls, do not start the engine. Also, do not move any machine controls.

1. Adjust the operator seat.

2. Fasten the seat belt.

3. Before you start the engine, check for the presence of bystanders or maintenance personnel. Ensure that all personnel are clear of the machine. Briefly sound the forward horn before you start the engine.

4. Engage the parking brake.

5. Place the transmission control switch in NEUTRAL.

6. Align the left-hand joystick relative to the position of the front wheels. Refer to Operation and Maintenance Manual, “Operator Controls - Joystick Steering Alignment” for more information.

7. Turn the engine start switch key to the ON position and allow all indicators and gauges to cycle. Once the gauges stop moving, the system check is complete.

Note: Do not start the engine until the electric engine preheat indicator (if equipped) has turned off. This indicator shows that the air inlet heater for the engine is ON.

8. Turn the engine start switch key to the START position in order to start the engine.

9. Release the engine start switch key when the engine starts.

10. Confirm steering control by actuating the steering control with the left joystick. If the steering is not engaged, the primary steering indicator and the secondary steering indicators will illuminate. Refer to Operation and Maintenance Manual, “Monitoring System” for more information. Realign the left joystick if necessary.

11. Disengage the parking brake.

12. Select your desired FORWARD or REVERSE direction and select your requested gear.

Diesel engine exhaust contains products of combustion which can be harmful to your health. Always start the engine in a ventilated area. Always operate the engine in a ventilated area. If you are in an enclosed area, vent the exhaust to the outside.

i02795956

Before Operation

SMCS Code: 7000; 7600

⚠ WARNING

Cold ambient temperatures could result in the loss of secondary braking capability due to inadequate hydraulic accumulator nitrogen precharge. The loss of the secondary braking system as well as the main hydraulic pressure will result in little or no braking capability and a potential for injury or death.

It is recommended to perform a brake accumulator check anytime the machine has been idle for longer than two hours below −25 °C (−13 °F). Refer to Operation and Maintenance Manual before performing any check of the brake accumulator.

Clear all personnel from the machine and from the area.

Clear all obstacles from the path of the machine. Beware of hazards such as wires, ditches, etc.

Make sure that all windows are clean. Secure the doors in the open position or in the shut position. Secure the windows in the open position or in the shut position.

For the best vision of the area that is close to the machine, adjust the rear view mirrors (if equipped).

Make sure that the machine horn, the backup alarm (if equipped) and all other warning devices are working properly.

Fasten the seat belt securely.

i07746368

Visibility Information

SMCS Code: 7000

Before you start the machine, perform a walk-around inspection in order to ensure that there are no hazards around the machine.

While the machine is in operation, constantly survey the area around the machine in order to identify potential hazards as hazards become visible around the machine.

Your machine may be equipped with visual aids. Some examples of visual aids are Closed Circuit Television (CCTV) and mirrors. Before operating the machine, ensure that the visual aids are in proper working condition and that the visual aids are clean. Adjust the visual aids using the procedures that are located in this Operation and Maintenance Manual. If equipped, the Work Area Vision System shall be adjusted according to Operation and Maintenance Manual, SEBU8157, “Work Area Vision System”. If equipped, the Cat Detect Object Detection shall be adjusted according to the Operation and Maintenance Manual, “Cat Detect Object Detection” for your machine.

It may not be possible to provide direct visibility on large machines to all areas around the machine. Appropriate job site organization is required in order to minimize hazards that are caused by restricted visibility. Job site organization is a collection of rules and procedures that coordinates machines and people that work together in the same area. Examples of job site organization include the following:

- Safety instructions
- Controlled patterns of machine movement and vehicle movement
- Workers that direct safe movement of traffic
- Restricted areas
- Operator training
- Warning symbols or warning signs on machines or on vehicles
- A system of communication
- Communication between workers and operators prior to approaching the machine

Modifications of the machine configuration by the user that result in a restriction of visibility shall be evaluated.

i03340444

Restricted Visibility

SMCS Code: 7000

The size and the configuration of this machine may result in areas that can not be seen when the operator is seated. Illustration 47 provides an approximate visual indication of areas of significant restricted visibility. Illustration 47 indicates restricted visibility areas at ground level inside a radius of 12.00 m (39.37 ft) from the operator on a machine without the use of optional visual aids. This illustration does not provide areas of restricted visibility for distances outside a radius of 12.00 m (39.37 ft).

This machine may be equipped with optional visual aids that may provide visibility to some of the restricted visibility areas. Refer to this Operation and Maintenance Manual, “Mirror” for more information on additional visibility. If your machine is equipped with cameras, refer to this Operation and Maintenance Manual, “Camera” for more information on additional visibility. For areas that are not covered by the optional visual aids, the job site organization must be utilized to minimize hazards of this restricted visibility. For more information regarding job site organization refer to Operation and Maintenance Manual, “Visibility Information”.

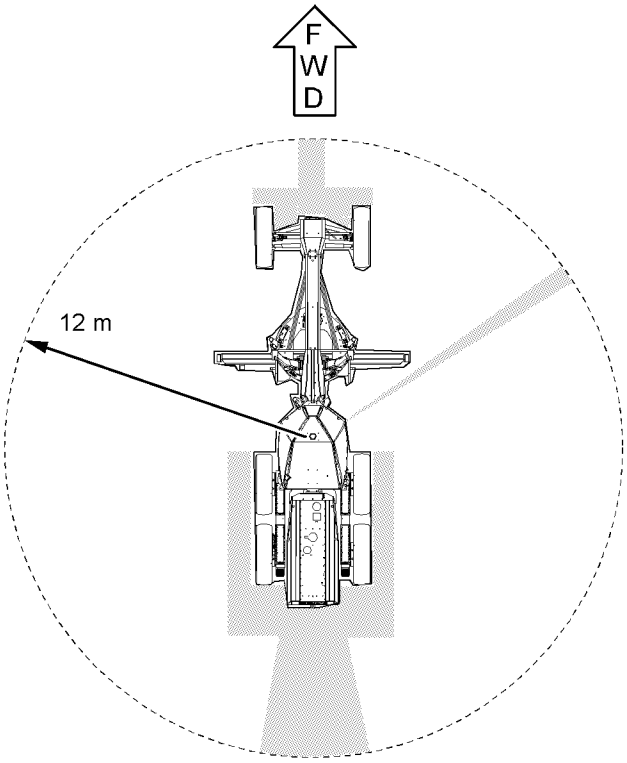

Illustration 47 g01716938

Note: The shaded areas indicate the approximate location of areas with significant restricted visibility.

i07784456

Operation

SMCS Code: 7000; 7600

Machine Operating Temperature Range

The standard machine configuration is intended for use within an ambient temperature range of −15° C (5° F) to 40° C (104° F). Special configurations for different ambient temperatures may be required. Consult your Caterpillar dealer for additional information on special configurations of your machine.

Machine Operation

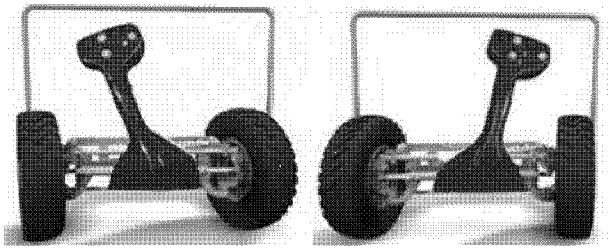

Illustration 48 g01717315

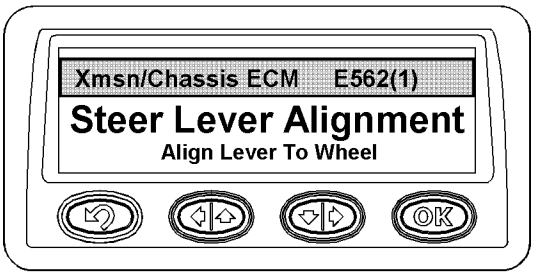

Illustration 49 g01717143

Note: For information on steering alignment refer to Operation and Maintenance Manual, “Operator Controls - Joystick Steering Alignment”.

Only operate the machine while you are in the seat. The seat belt must be fastened while you operate the machine. Only operate the controls while the engine is running.

Before you operate the machine, remove the wheel lean locking bolt from the wheel lean lock bracket. Make sure that the frame lock pin is stored in the unlocked position. Articulate the machine. The frame lock link must be removed in order to articulate the machine.

Note: With joystick steering, the position sensors for the steering cylinders limit the steering angle of the axle. This causes the axle stops to not make contact.

Do not use the wheel lean locking bolt and the wheel lean lock bracket in order to center the wheel lean of the machine.

While the ground is being graded, do not operate the machine with the doors open.

While you operate the machine slowly in an open area, check for proper operation of all controls and all protective devices.

Before you maneuver the machine, make sure that no personnel are between the machine and attachments.

Before you move the machine, make sure that no one will be endangered.

When you operate the machine and the worktool in an open area, check for proper operation of the controls and check for operation of the protective devices.

Do not allow riders on the machine while the machine is being operated.

Never use the work tool for a work platform.

Reduce engine speed when you maneuver in tight quarters or when you are going over a hill.

Do not operate the machine close to a cliff. Do not operate the machine near an excavation. Do not operate the machine near an overhang.

When you operate the machine downhill, use two transmission gears less than the transmission gear that is used when you operate the machine up the same hill.

Note: Caterpillar does not recommend that you shift to the NEUTRAL position when you operate the machine downhill. If you shift to the NEUTRAL position the machine may require additional braking effort that could accelerate wear of the service brake components.

Do not allow the engine to overspeed when you operate the machine downhill. If overspeed exists, use the service brake control to decrease the speed to a level that will allow you to downshift. Repeat this process until a stable speed is obtained. Before the engine is pushed beyond a dangerous speed level, the transmission will automatically upshift in order to keep the engine speed within a safe speed range. However, when the maximum gear is reached, the service brakes must be used to control the machine speed and the service brakes must be used to prevent the engine from overspeeding.

Carry attachments approximately 40 cm (15 inches) above ground level. Do not go close to the edge of a cliff, an excavation, or an overhang.

If the machine begins to sideslip downward on a grade, immediately remove the load and turn the machine downhill.

Avoid any conditions that can lead to tipping the machine. The machine can tip when you work on hills, on banks and on slopes. Also, the machine can tip when you cross ditches, ridges, or other unexpected obstructions.

Avoid operating the machine across the slope. When possible, operate the machine up the slopes and down the slopes.

When you operate the machine on a slope, use a low ground speed for maximum control of the machine. When you release the accelerator, there will be immediate reduction in engine rpm and ground speed.

When you operate on a slope, engage the differential lock control. When you operate on a slope, use the throttle lock and use the accelerator control.

On steeper slopes, shift the blade drawbar uphill toward the toe of the moldboard. Articulate the rear frame so the heavy engine frame is on the downhill side of the slope for added stability.

When you operate on a slope less than 2.5:1 start at the top of the slope. Cast the withdrawn material outside of the rear tandem tires to prevent the rear tires from sliding.

Maintain control of the machine. Do not overload the machine beyond the machine capacity.

Never straddle a wire cable. Never allow other personnel to straddle a wire cable.

Know the maximum dimensions of your machine.

Always keep the Rollover Protective Structure (ROPS) installed during machine operation.

Note any needed repairs during machine operation. Report any needed repairs.

Park Brake Override

You can override the steering alignment and you can override the parking brake interlocks in order to move the machine out of danger.

Note: A Warning Category 2S will occur during a park brake override. The alarm will deactivate once the transmission is returned to the NEUTRAL position or machine speed has been detected and the front wheels have been aligned to the left-hand joystick and the steering has become active.

In order to activate the park brake override, follow these steps:

- Push in the bottom of the parking brake switch in order to disengage the parking brake.
- Depress the transmission modulator control (inching pedal). If the left-hand joystick has not been aligned with the front wheels, the steering will not activate. The park brake will not release.
- Bring the machine to high idle by depressing the accelerator control.
- Position the left-hand joystick in the position you want the front wheels to align.
- Select the preferred direction on the transmission control switch.
- Slowly release the transmission modulator control (inching pedal). The park brake will now disengage and the machine will move in the direction that has been selected.
- The front wheels will automatically align to the same angle as the left-hand joystick when machine speed is detected. The steering will then become active.

Note: “1F” and “1R” are the only gears that are available to override the parking brake. Upshifting will not change the selected gear until the front wheels have been aligned to the left-hand joystick and the steering has become active.

Limiting Conditions and Criteria

Limiting conditions are immediate issues with this machine that must be addressed prior to continuing operation.

The Operation and Maintenance Manual, Safety Section describes limiting condition criteria for replacing items such as safety messages, seat belt and mounting hardware, lines, tubes, hoses, battery cables and related parts, electrical wires, and repairing any fluid leak.

The Operation and Maintenance Manual, Maintenance Interval Schedule describes limiting condition criteria that require repair or replacement for items (if equipped) such as alarms, horns, braking system, steering system, and rollover protective structures.

The Operation and Maintenance Manual, Monitoring System (if equipped) provides information on limiting condition criteria, including a Warning Category 3 that requires immediate shutdown of the engine.

The following table provides summary information on several limiting conditions found in this Operation and Maintenance Manual. The table provides criteria and required action for the limiting conditions listed. Each System or Component in this table, together with the respective limiting condition, describes a potential critical failure that must be addressed. Not addressing limiting conditions with required actions may, in conjunction with other factors or circumstances, result in a risk of personal injury or death. If an accident occurs, notify emergency personnel and provide location and description of accident.

Table 1

System or Component Name	Limiting Condition	Criteria for Action	Required Action
Line, tubes, and hoses	End fittings are damaged or leaking. Outer coverings are chafed or cut. Wires are exposed. Outer coverings are swelling or ballooning. Flexible parts of the hoses are kinked. Outer covers have exposed embedded armoring. End fittings are displaced.	Visible corrosion, loose, or damaged lines, tubes, or hoses. Visible fluid leaks.	Immediately repair any lines, tubes, or hoses that are corroded, loose, or damaged. Immediately repair any leaks as these may provide fuel for fires.
Electrical Wiring	Signs of fraying, abrasion, cracking, discoloration, cuts on the insulation	Visible damage to electrical wiring	Immediately replace damaged wiring
Battery cable(s)	Signs of fraying, abrasion, cracking, discoloration, cuts on the insulation of the cable, fouling, corroded terminals, damaged terminals, and loose terminals	Visible damage to battery cable(s)	Immediately replace damaged battery cables
Operator Protective Structure	Structures that are bent, cracked, or loose. Loose, missing, or damaged bolts.	Visible damage to structure. Loose, missing, or damaged bolts.	Do not operate machine with damaged structure or loose, missing, or damaged bolts. Contact your Cat dealer for inspection and repair or replacement options.
Seat Belt	Worn or damaged seat belt or mounting hardware	Visible wear or damage	Immediately replace parts that are worn or damaged.
Seat Belt	Age of seat belt	Three years after date of installation	Replace seat belt three years after date of installation
Safety Messages	Appearance of safety message	Damage to safety messages making them illegible	Replace the illustrations if illegible.
Audible Warning Device(s) (if equipped)	Sound level of audible warning	Reduced or no audible warning present	Immediately repair or replace audible warning devices not working properly.
Camera(s) (if equipped)	Dirt or debris on camera lens	Dirt or debris obstructing camera view	Clean camera before operating machine.
Cab Windows (if equipped)	Dirt, debris, or damaged windows	Dirt or debris obstructing operator visibility. Any damaged windows.	Clean windows before operating machine. Repair or replace damaged windows before operating machine.

(continued)

(Table 1, contd)

System or Component Name	Limiting Condition	Criteria for Action	Required Action
Mirrors (if equipped)	Dirt, debris, or damaged mirror	Dirt or debris obstructing operator visibility. Any damaged mirrors.	Clean mirrors before operating machine. Repair or replace damaged mirrors before operating machine.
Braking System	Inadequate braking performance	System does not pass Braking System - Test(s) included in Maintenance Section or in the Testing and Adjusting Manual	Contact your Cat dealer to inspect and, if necessary, repair the brake system.
Cooling System	The coolant temperature is too high.	Monitoring System displays Warning Category 3	Stop the engine immediately. Check the coolant level and check the radiator for debris. Refer to Operation and Maintenance Manual, Cooling System Coolant Level - Check. Check the fan drive belts for the water pump. Refer to Operation and Maintenance Manual, Belts - Inspect/Adjust/ Replace. Make any necessary repairs.
Engine Oil System	A problem has been detected with the engine oil pressure.	Monitoring System displays Warning Category 3	If the warning stays on during low idle, stop the engine and check the engine oil level. Perform any necessary repairs as soon as possible.
Engine system	An engine fault has been detected by the engine ECM.	Monitoring System displays Warning Category 3	Stop the engine immediately. Contact your Cat dealer for service.
Fuel System	A problem has been detected with the fuel system.	Monitoring System displays Warning Category 3	Stop the engine. Determine the cause of the fault and perform any necessary repairs.
Hydraulic Oil System	The hydraulic oil temperature is too high.	Monitoring System displays Warning Category 3	Stop the engine immediately. Check the hydraulic oil level and check the hydraulic oil cooler for debris. Perform any necessary repairs as soon as possible.
Steering System	A problem has been detected with the steering system. (If equipped with steering system monitoring.)	Monitoring System displays Warning Category 3	Move machine to a safe location and stop the engine immediately. Contact your Cat dealer to inspect and, if necessary, repair the steering system.
Overall Machine	Machine service is required.	Monitoring System displays Warning Category 3	Stop the engine immediately. Contact your Cat dealer for service.

i04733792

Parking

SMCS Code: 7000

Park the machine on a level surface. If you must park on a grade, chock the wheels of the machine.

Apply the transmission modulator control (inching pedal), for the 12M, 120M, 140M, 160M, 14M, and 16M, in order to stop the machine. Apply the service brake in order to stop the machine. Move the transmission control switch to the NEUTRAL position. Move the throttle control to the LOW IDLE position.

Engage the parking brake.

Lower all equipment to the ground. Activate any control locks.

Turn the engine start switch to the OFF position and remove the engine start switch key.

Always turn the battery disconnect switch to the OFF position before leaving the machine.

If the machine will not be operated for a month or more, remove the battery disconnect switch key.

i07746366

Slope Operation

SMCS Code: 7000

Machines that are operating safely in various applications depend on these criteria: the machine model, configuration, machine maintenance, operating speed of the machine, conditions of the terrain, fluid levels, and tire inflation pressures. The most important criteria are the skill and judgment of the operator.

A well trained operator that follows the instructions in the Operation and Maintenance Manual has the greatest impact on stability. Operator training provides a person with the following abilities: observation of working and environmental conditions, feel for the machine, identification of potential hazards and operating the machine safely by making appropriate decisions.

When you work on side hills and when you work on slopes, consider the following important points:

Speed of travel – At higher speeds, forces of inertia tend to make the machine less stable.

Roughness of terrain or surface – The machine may be less stable with uneven terrain.

Direction of travel – Avoid operating the machine across the slope. When possible, operate the machine up the slopes and operate the machine down the slopes. Place the heaviest end of the machine uphill when you are working on an incline.

Mounted equipment – Balance of the machine may be impeded by the following components: equipment that is mounted on the machine, machine configuration, weights, and counterweights.

Nature of surface – Ground that has been newly filled with earth may collapse from the weight of the machine.

Surface material – Rocks and moisture of the surface material may drastically affect the machine's traction and machine's stability. Rocky surfaces may promote side slipping of the machine.

Slippage due to excessive loads – This may cause downhill tracks or downhill tires to dig into the ground, which will increase the angle of the machine.

Width of tracks or tires – Narrower tracks or narrower tires further increase the digging into the ground which causes the machine to be less stable.

Implements attached to the drawbar – This may decrease the weight on the uphill tracks. This may also decrease the weight on the uphill tires. The decreased weight will cause the machine to be less stable.

Height of the working load of the machine – When the working loads are in higher positions, the stability of the machine is reduced.

Operated equipment – Be aware of performance features of the equipment in operation and the effects on machine stability.

Operating techniques – Keep all attachments or pulled loads low to the ground for optimum stability.

Machine systems have limitations on slopes – Slopes can affect the proper function and operation of the various machine systems. These machine systems are needed for machine control.

Note: Operators with lots of experience and proper equipment for specific applications are also required. Safe operation on steep slopes may also require special machine maintenance. Refer to Lubricant Viscosities and Refill Capacities in this manual for the proper fluid level requirements and intended machine use. Fluids must be at the correct levels to ensure that systems will operate properly on a slope.

i01329161

Equipment Lowering with Engine Stopped

SMCS Code: 7000

Before lowering any equipment with the engine stopped, clear the area around the equipment of all personnel. The procedure to use will vary with the type of equipment to be lowered. Keep in mind most systems use a high pressure fluid or air to raise or lower equipment. The procedure will cause high pressure air, hydraulic, or some other media to be released in order to lower the equipment. Wear appropriate personal protective equipment and follow the established procedure in the Operation and Maintenance Manual, “Equipment Lowering with Engine Stopped” in the Operation Section of the manual.

i04882532

Sound Information and Vibration Information

SMCS Code: 7000

Sound Level Information

The declared operator Equivalent Sound Pressure Level (Leq) is 72 dB(A) when “ANSI/SAE J1166 FEB 2008” is used to measure the value for an enclosed cab. This value is a work cycle sound exposure level. The cab was properly installed and maintained. The test was conducted with the cab doors and the cab windows closed. The engine cooling fan speed varied during the test.

Hearing protection may be needed when the machine is operated with an open operator station for extended periods or in a noisy environment. Hearing protection may be needed when the machine is operated with a cab that is not properly maintained or when the doors and windows are open for extended periods or in a noisy environment.

The declared average exterior sound pressure level is 78 dB(A) when the “SAE J88 FEB 2008- Constant Speed Moving Test” procedure is used to measure the value for the standard machine. The measurement was conducted under the following conditions: distance of 15 m (49.2 ft) and “the machine moving forward in an intermediate gear ratio”. The engine cooling fan speed varied during the test.

Sound Level Information for Machines in European Union Countries and in Countries that Adopt the “European Union Directives”

Note: The information below applies only to machines that have the CE mark on the PIN plate.

The static operator sound pressure level is 73 dB(A) when “ISO 6394:2008” is used to measure the value for an enclosed cab. The measurement was conducted with the cab doors and the cab windows closed. The cab was properly installed and maintained.

The dynamic operator sound pressure level is 73 dB (A) when “ISO 6396:2008” is used to measure the value for an enclosed cab. The measurement was conducted with the cab doors and the cab windows closed. The cab was properly installed and maintained.

The dynamic spectator sound pressure level is 108 dB(A) when “ISO 6395:2008” is used to measure the value for an enclosed cab. The measurement was conducted at 70% of the maximum engine cooling fan speed.

“The European Union Physical Agents (Vibration) Directive 2002/44/EC”

Vibration Data for Motor Graders

Information Concerning Hand/Arm Vibration Level

When the machine is operated according to the intended use, the hand/arm vibration of this machine is below 2.5 m/s^2.

Information Concerning Whole Body Vibration Level

This section provides vibration data and a method for estimating the vibration level for motor graders.

The expected vibration levels can be estimated with the information in Table 2 in order to calculate the daily vibration exposure. A simple evaluation of the machine application can be used. For typical operating conditions, use the average vibration levels as the estimated level. With an experienced operator and smooth terrain, subtract the Scenario Factors from the average vibration level in order to obtain the estimated vibration level. For aggressive operations and severe terrain, add the Scenario Factors to the average vibration level in order to obtain the estimated vibration level.

Table 2

"ISO Reference Table A - Equivalent vibration levels of whole body vibration emission for earthmoving equipment."							
Machine Type	**Typical Operating Activity**	**Vibration Levels (m/s2)**			**Scenario Factors (m/s2)**		
		X axis	**Y axis**	**Z axis**	**X axis**	**Y axis**	**Z axis**
Motor Graders	finish grading	0,41	0,48	0,38	0,22	0,26	0,14
	hard grading	0,61	0,64	0,78	0,21	0,21	0,30
	transfer	0,39	0,36	0,58	0,25	0,25	0,34

Note: Refer to "ISO/TR 25398 Mechanical Vibration - Guideline for the assessment of exposure to whole body vibration of ride on operated earthmoving machines" for more information about vibration.

Guidelines for Reducing Vibration Levels on Earthmoving Equipment

Vibration levels are influenced by many different parameters, such as: operator training, operator behavior, operator mode and stress, job site organization, job site preparation, job site environment, job site weather, job site material, machine type, quality of the seat, quality of the suspension system, attachments and condition of the equipment.

Properly adjust machines. Properly maintain machines. Operate machines smoothly. Maintain the conditions of the terrain. The following guidelines can help reduce the whole body vibration level:

1. Use the right type and size of machine, equipment, and attachments.

2. Maintain machines according to the manufacturers recommendations: tire pressures and brake and steering systems, controls, hydraulic system, and linkages.

3. Keep the terrain in good condition by performing the following items: remove any large rocks or obstacles, fill any ditches and holes and provide machines and schedule time in order to maintain the conditions of the terrain.

4. Keep the seat maintained and adjusted by doing the following: adjust the seat and suspension for the weight and the size of the operator and inspect and maintain the seat suspension and adjustment mechanisms.

5. Perform the following operations smoothly: steer, brake, accelerate and shift the gears.

6. Move the attachments smoothly.

7. Adjust the machine speed and the route in order to minimize the vibration level by doing the following: drive around obstacles and rough terrain and slow down when necessary to go over rough terrain.

8. Minimize vibrations for a long work cycle or a long travel distance by doing the following: use machines that are equipped with suspension systems, if no ride control system is available, reduce speed in order to prevent bounce and haul the machines between workplaces.

9. Less operator comfort may be caused by other risk factors. The following guidelines can be effective in order to provide better operator comfort: adjust the seat and adjust the controls in order to achieve good posture, adjust the mirrors in order to minimize twisted posture, provide breaks in order to reduce long periods of sitting, avoid jumping from the cab, minimize repeated handling of loads and lifting of loads and minimize any shocks and impacts during sports and leisure activities.

Consult your local Cat dealer for more information about machine features that minimize vibration levels. Consult your local Cat dealer about safe machine operation.

Use the following web site in order to find your local dealer:

Caterpillar, Inc.
www.cat.com

i07746362

Operator Station

SMCS Code: 7000

Any modifications to the inside of the operator station should not project into the operator space or into the space for the companion seat (if equipped). The addition of a radio, fire extinguisher, and other equipment must be installed so that the defined operator space and the space for the companion seat (if equipped) is maintained. Any item that is brought into the cab should not project into the defined operator space or the space for the companion seat (if equipped). A lunch box or other loose items must be secured. Objects must not pose an impact hazard in rough terrain or in the event of a rollover.

i07746359

Guards
(Operator Protection)

SMCS Code: 7000

There are different types of guards that are used to protect the operator. The machine and the machine application determine the type of guard that should be used.

A daily inspection of the guards is required in order to check for structures that are bent, cracked, or loose. Never operate a machine with a damaged structure.

The operator becomes exposed to a hazardous situation if the machine is used improperly or if poor operating techniques are used. This situation can occur even though a machine is equipped with an appropriate protective guard. Follow the established operating procedures that are recommended for your machine.

Rollover Protective Structure (ROPS), Falling Object Protective Structure (FOPS) or Tip Over Protection Structure (TOPS)

The ROPS/FOPS Structure (if equipped) on your machine is specifically designed, tested and certified for that machine. Any alteration or any modification to the ROPS/FOPS Structure could weaken the structure. This places the operator into an unprotected environment. Modifications or attachments that cause the machine to exceed the weight that is stamped on the certification plate also place the operator into an unprotected environment. Excessive weight may inhibit the brake performance, the steering performance and the ROPS. The protection that is offered by the ROPS/FOPS Structure will be impaired if the ROPS/FOPS Structure has structural damage. Damage to the structure can be caused by an overturn, a falling object, a collision, etc.

Do not mount items (fire extinguishers, first aid kits, work lights, etc) by welding brackets to the ROPS/FOPS Structure or by drilling holes in the ROPS/FOPS Structure. Welding brackets or drilling holes in the ROPS/FOPS Structures can weaken the structures. Consult your Cat dealer for mounting guidelines.

The Tip Over Protection Structure (TOPS) is another type of guard that is used on mini hydraulic excavators. This structure protects the operator in the event of a tipover. The same guidelines for the inspection, the maintenance and the modification of the ROPS/FOPS Structure are required for the Tip Over Protection Structure.

Other Guards (If Equipped)

Protection from flying objects and/or falling objects is required for special applications. Logging applications and demolition applications are two examples that require special protection.

A front guard needs to be installed when a work tool that creates flying objects is used. Mesh front guards that are approved by Caterpillar or polycarbonate front guards that are approved by Caterpillar are available for machines with a cab or an open canopy. On machines that are equipped with cabs, the windows should also be closed. Safety glasses are recommended when flying hazards exist for machines with cabs and machines with open canopies.

If the work material extends above the cab, top guards and front guards should be used. Typical examples of this type of application are listed below:

- Demolition applications
- Rock quarries
- Forestry products

Additional guards may be required for specific applications or work tools. The Operation and Maintenance Manual for your machine or your work tool will provide specific requirements for the guards. Refer to Operation Maintenance manual, "Demolition" for additional information. Consult your Cat dealer for additional information.

Product Information Section

General Information

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Specifications

SMCS Code: 7000

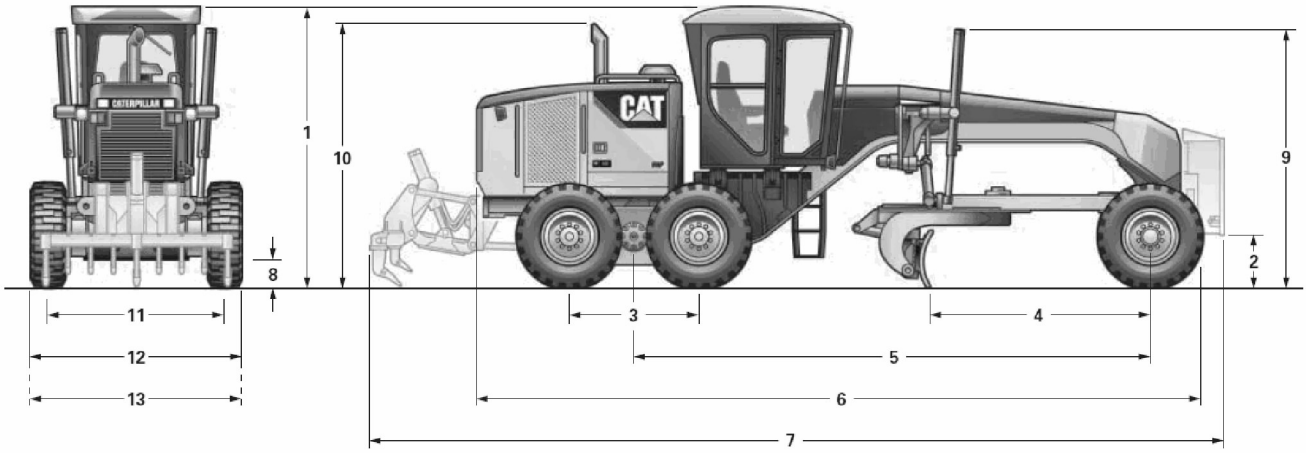


Illustration 50 g01944693

Approximate dimensions are shown. Dimensions will vary depending on the configuration and the options.

(1) 3703 mm (12 ft 2 inch)
(2) 688 mm (2 ft 3 inch)
(3) 1841 mm (6 ft 1 inch)
(4) 3069 mm (10 ft 1 inch)
(5) 6985 mm (22 ft 11 inch)
(6) 9963 mm (32 ft 7 inch)
(7) 11672 mm (38 ft 2 inch)
(8) 407 mm (1 ft 4 inch)
(9) 3088 mm (10 ft 2 inch)
(10) 3405 mm (11 ft 2 inch)
(11) 2509 mm (8 ft 3 inch)
(12) 3350 mm (11 ft 0 inch)
(13) 3350 mm (11 ft 0 inch) or 3542 mm (11 ft 7 inch) with optional Access Platform

The basic shipping specifications are listed in the following table:

Table 3

16M Motor Grader	
Engine	**C13 Acert Diesel Engine MHX1–Up**
Transmission	**Eight Forward Speeds Six Reverse Speeds DGY1–Up**
Approximate operating weight(1)	26060 kg (57452 lb)
Approximate CE plate weight (2)	30371 kg (66956 lb)

(continued)

(Table 3, contd)

16M Motor Grader	
Engine	**C13 Acert Diesel Engine MHX1–Up**
Transmission	**Eight Forward Speeds Six Reverse Speeds DGY1–Up**
Turning Radius, Outside Front Tires	8.9 m (29 ft 2inch)
Front Axle - Total Oscillation Per Side	32^0
Travel Speeds	**1F** 4.5 km/h (2.8 mph)

(continued)

(Table 3, contd)

16M Motor Grader	
Engine	**C13 Acert Diesel Engine MHX1–Up**
Transmission	**Eight Forward Speeds Six Reverse Speeds DGY1–Up**
	2F 6.3km/h (3.9 mph)
	3F 9 km/h (5.6 mph)
	4F 12.4 km/h (7.7 mph)
	5F 19.3 km/h (12 mph)
	6F 26.8 km/h (16.7 mph)
	7F 37 km/h (23 mph)
	8F 53.9km/h (33.5 mph)
	1R 3.6 km/h (2.2 mph)
	2R 6.8 km/h (4.2 mph)
	3R 9.8 km/h (6.1 mph)
	4R 15.2 km/h (9.5 mph)
	5R 29.3 km/h (18.2 mph)
	6R 42.6 km/h (26.5 mph)
Ripping Depth, Maximum	452 mm (1 ft 6 inch)
No engine derating required up to	4572 m (15000 ft)
Maximum Blade Position Angle	65^0

(1) This weight includes a full fuel tank and an operator
(2) This weight includes the base weight, a 90 kg (200 lb) operator, a full fuel tank, a ripper, a push plate, a belly guard, work lights, high bar lamps, sound suppression, and rear fenders.

Table 4

16M Motor Grader Weights	
Base Weight	**26060 kg (57452 lb)**
Push Plate, Counterweight	**835 kg (1841 lb)**
Ripper (Mount)	**318 kg (701 lb)**
Rear Ripper	2177 kg (4799 lb)
Ripper Tooth	65 kg (143 lb)
Sound Guard	124 kg (273 lb)
Transmission Guard	159 kg (350 lb)
High Bar Lamps	23 kg (51 lb)
Sound Suppression Group	11 kg (24 lb)

(continued)

(Table 4, contd)

16M Motor Grader Weights	
Base Weight	**26060 kg (57452 lb)**
Push Plate, Counterweight	**835 kg (1841 lb)**
Ripper (Mount)	**318 kg (701 lb)**
Rear Fenders	581 kg (1281 lb)
Right or Left Blade Extension	141 kg (311 lb)
European Union Arrangement	136 kg (300 lb)
Access Platform	748 kg (1649 lb)

Intended Use

The 16M Motor Grader is an earthmoving machine. The 16M is classified as a grader described in “ISO 6165:2001”. This is a self-propelled wheeled machine which has an adjustable blade positioned between the front and rear axles. This Motor Grader can also be fitted with a front mounted blade or a rear mounted ripper. This Motor Grader is intended for the following applications: use in grading, sloping, ditching, and scarifying of materials through a forward motion.

Application/Configuration Restrictions

Maximum approved operating weight is 35974 kg (79309 lb).

The cab structure is ROPS certified to ISO 3471:1994 for up to 35974 kg (79309 lb).

Maximum drawbar pull is 231307 N (52000 lb)

Parking brake holding capability on a grade is 20% grade.

Service brake holding capability on a grade is 25% grade.

Use only in environments with nonexplosive gases.

Identification Information

i06881923

Plate Locations and Film Locations

SMCS Code: 1000; 7000

The Product Identification Number (PIN) will be used to identify a powered machine that is designed for an operator to ride.

Cat products such as engines, transmissions, and major attachments that are not designed for an operator to ride are identified by Serial Numbers.

For quick reference, record the identification numbers in the spaces that are provided below the illustrations.

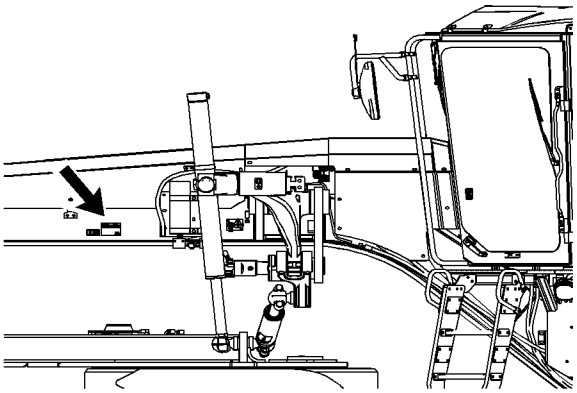


Illustration 51 g01299482

The Product Identification Number (PIN) is located on the left side of the main frame in front of the lift cylinder bracket. This plate will have the following information:

Model number_____

PIN_____

Engine model number_____

Engine serial number_____

Engine arrangement number_____

Transmission model number_____

Transmission serial number_____

Transmission arrangement number_____

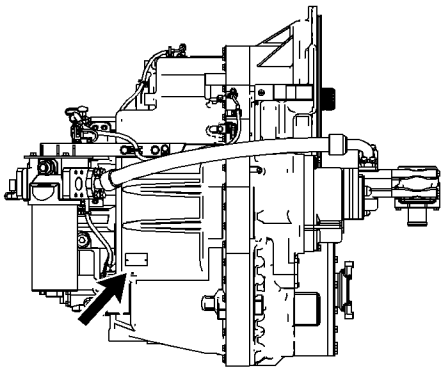


Illustration 52 g01299501

Transmission Serial Number_____

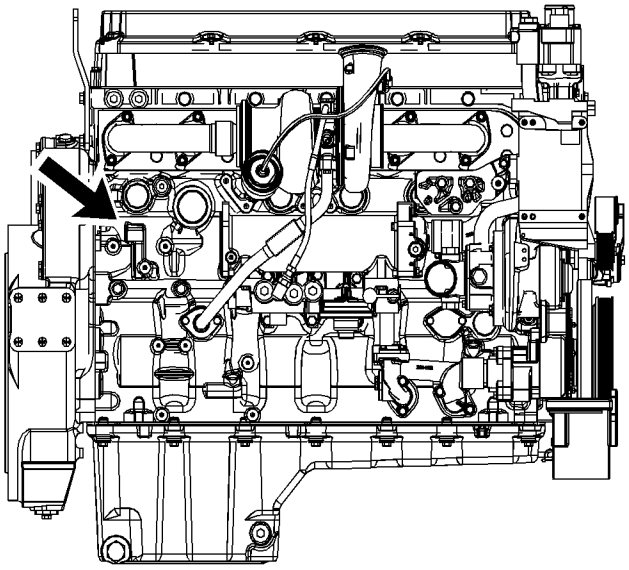


Illustration 53 g01299504

Serial Number _____

Engine Serial Number_____

Arrangement Number _____

Certification

Electromagnetic Emissions

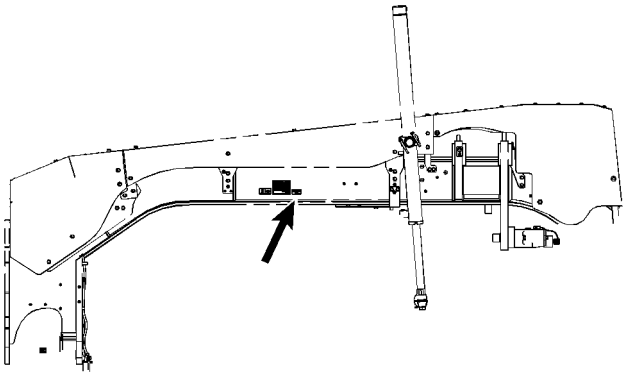


Illustration 54 g06153554

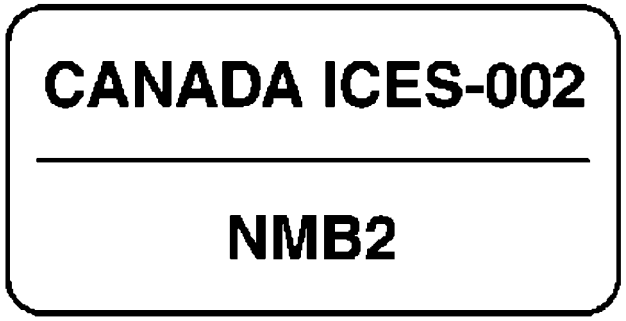


Illustration 55 g06063443

Note: This label is on machines that are going into Canada.

If equipped, this label is located next to the Pin plate. This label verifies that this product meets the Canadian requirements stated on the film.

ROPS/FOPS Structure

This message is positioned on the ROPS on the left side of the machine above the door.

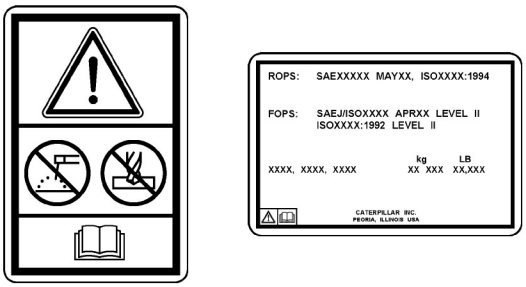


Illustration 56 g01211894

⚠ WARNING

Structural damage, an overturn, modification, alteration, or improper repair can impair this structure's protection capability thereby voiding this certification. Do not weld on or drill holes in the structure. This will void the certification. Consult your Cat dealer to determine this structure's limitations without voiding its certification.

This machine has been certified to the standards that are listed on the certification film. The maximum mass of the machine, which includes the operator and the attachments without a payload, should not exceed the mass on the certification film.

Refer to Operation and Maintenance Manual, “Guards (Operator Protection)” for more information.

European Union

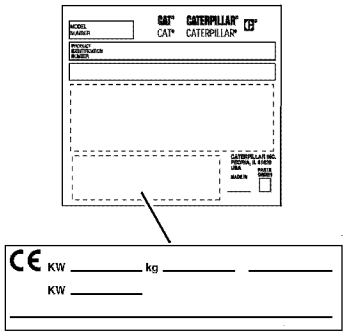


Illustration 57 g02010841

This plate is positioned on the bottom left side of the plate for the PIN.

Note: The CE plate is on machines that are certified to the European Union requirements that were effective at that time.

For machines compliant to 2006/42/EC, the following information is stamped onto the CE plate. For quick reference, record this information in the spaces that are provided below.

- Engine Power Primary Engine (kW)_____
- Engine Power for Additional Engine (If Equipped) _____
- Typical Machine Operating Weight for European Market (kg)_____
- Year of Construction_____
- Machine Type _____

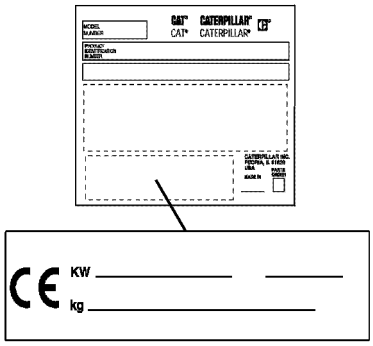


Illustration 58 g01120192

This plate is positioned on the bottom left side of the plate for the PIN.

Note: The CE plate is on machines that are certified to the European Union requirements that were effective at that time.

For machines compliant to 98/37/EC and 89/392/EEC, the following information is stamped onto the CE plate. For quick reference, record this information in the spaces that are provided below.

- Engine Power Primary Engine (kW)_____
- Typical Machine Operating Weight for European Market (kg)_____
- Year_____

For manufacturer name and address and the country of origin, see the PIN plate.

Sound

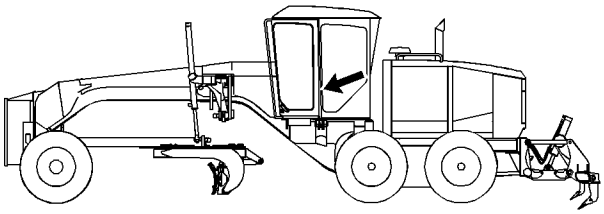


Illustration 59 g01073266

If equipped, this film is located on the ROPS support assembly to the left of the operator.

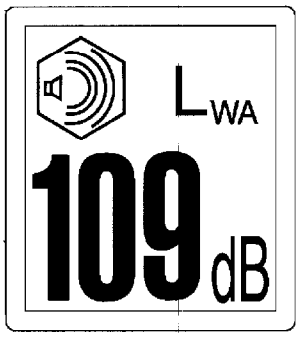


Illustration 60 g00933634

A typical example of this film is shown. Your machine may have a different value.

If equipped, the certification film is used to verify the environmental sound certification of the machine to the requirements of the European Union. The value that is listed on the film indicates the guaranteed exterior sound power level L_{WA} at the time of manufacture for the conditions that are specified in “EU 2000/14/EC”.

Product Link

If equipped, this message is used to verify the certification of the Product Link as an RF transmitter. The following specifications are provided to aid in ensuring compliance with all local regulations:

Table 5

Operating frequency range	148 to 150 MHz
Transmitter power	5-10 w

This message is located on the control group for the Product Link. The control group is located on the top of the cab.

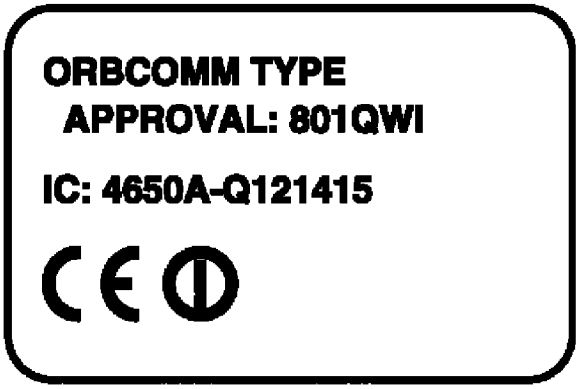


Illustration 61 g01261742

⚠ WARNING

This machine is equipped with a Caterpillar Product Link communication device. When electric detonators are used, this communication device should be deactivated within 12 m (40 ft) of a blast site for satellite-based systems and within 3 m (10 ft) of a blast site for cellular based systems, or within the distance mandated under applicable legal requirements. Failure to do so could cause interference with blasting operations and result in serious injury or death.

In cases where the type of Product Link module cannot be identified, Caterpillar recommends that the device be disabled no less than 12 m (40 ft) from the blast perimeter.

If the machine is required to work within 12 m (40 ft) of a blast site, power to the Product Link module must be disconnected.

Consult your Cat dealer with any questions that concern the operation of the Product Link in a specific country.

Machine Security System

If equipped, this message is used to verify the certification of the Machine Security System as an RF transmitter. The following specifications are provided to aid in ensuring compliance with all local regulations:

Table 6

Field strength(1)	16.12 dB micro-amp/meter
Operating frequency range	134.2 kHz
Operating time(2)	0.055 seconds (1/18 second)

(1) Field strength at 10 m
(2) The operating time is measured after the keyswitch is first activated.

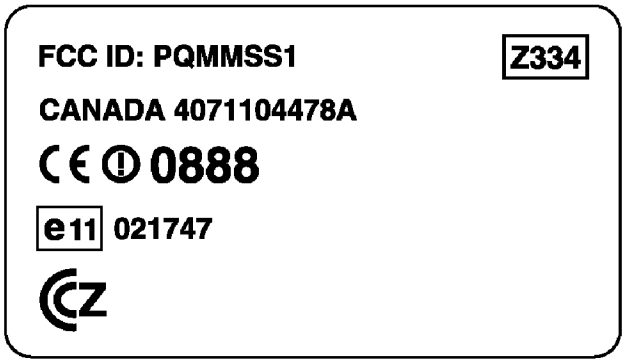


Illustration 62 g01261786

This message is located on the control group for the Machine Security System (MSS). The control group is located in the engine compartment.

Consult your Cat dealer with any questions that concern the operation of the MSS in a specific country.

i08085827

Emissions Certification Film

SMCS Code: 1000; 7000; 7405

Consult your Cat dealer for an Emission Control Warranty Statement.

The emission certification film is on the engine.

Declaration of Conformity

SMCS Code: 1000; 7000

Table 7

An EC or EU Declaration of Conformity document was provided with the machine if it was manufactured to comply with specific requirements for the European Union. In order to determine the details of the applicable Directives, review the complete EC or EU Declaration of Conformity provided with the machine. The extract shown below from an EC or EU Declaration of Conformity for machines that are declared compliant to "2006/42/EC" applies only to those machines originally "CE" marked by the manufacturer listed and which have not since been modified.

ORIGINAL EC or EU DECLARATION OF CONFORMITY

Manufacturer: CATERPILLAR INC., 100 N.E. ADAMS STREET, PEORIA, IL 61629, USA

Person authorized to compile the Technical File and to communicate relevant part (s) of the Technical File to the Authorities of European Union Member States on request:

Standards & Regulations Manager,Caterpillar France S.A.S,
40 Avenue Leon-Blum, 38000 Grenoble, France

I, the undersigned, _____, hereby certify that the construction equipment specified hereunder

Description:	Generic Denomination:	**Earth-moving Equipment**
	Function:	**Grader**
	Model/Type:	**16M**
	Serial Number:	
	Commercial Name:	**Caterpillar**

Fulfils all the relevant provisions of the following Directives

Directives	Notified Body	Document No.
2006/42/EC	N/A	
2000/14/EC amended by 2005/88/EC, Note (1)		
2004/108/EC	N/A	
2014/30/EU	N/A	

Note (1) Annex -_____ Guaranteed Sound Power Level -_____dB (A)
Representative Equipment Type Sound Power Level - _____dB (A)
Engine Power per ____-____ kW Rated engine speed - _____ rpm
Technical Documentation accessible through person listed above authorized to compile the Technical File

Done at: **Signature**

Date: **Name/Position**

Note: The above information was correct as of **July 2009**, but may be subject to change, please refer to the individual declaration of conformity issued with the machine for exact details.

Operation Section

Before Operation

i04021647

Mounting and Dismounting

SMCS Code: 7000

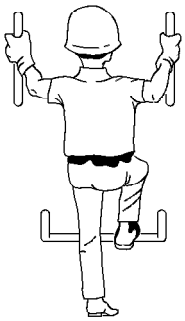


Illustration 63 g00037860
Typical example

Mount the machine and dismount the machine only at locations that have steps and/or handholds. Before you mount the machine, clean the steps and the handholds. Inspect the steps and handholds. Make all necessary repairs.

Face the machine whenever you get on the machine and whenever you get off the machine.

Maintain a three-point contact with the steps and with the handholds.

Note: Three-point contact can be two feet and one hand. Three-point contact can also be one foot and two hands.

Do not mount a moving machine. Do not dismount a moving machine. Never jump off the machine. Do not carry tools or supplies when you try to mount the machine or when you try to dismount the machine. Use a hand line to pull equipment onto the platform. Do not use any controls as handholds when you enter the operator compartment or when you exit the operator compartment.

Machine Access System Specifications

The machine access system has been designed to meet the intent of the technical requirements in “ISO 2867 Earth-moving Machinery – Access Systems”. The access system provides for operator access to the operator station and to conduct the maintenance procedures described in Maintenance section.

Alternate Exit

Machines that are equipped with cabs have alternate exits. For additional information, see Operation and Maintenance Manual, “Alternate Exit”.

i06143864

Daily Inspection

SMCS Code: 1000; 7000

For a maximum service life of the machine, complete a thorough walk-around inspection before you mount the machine and before you start the engine.

Inspect the area around the machine and under the machine. Look for loose bolts, trash buildup, oil, coolant leakage, broken parts, or worn parts.

Note: Watch closely for leaks. If you observe a leak, find the source of the leak and correct the leak. If you suspect a leak or you observe a leak, check the fluid levels more frequently.

Inspect the condition of the equipment and of the hydraulic components.

Inspect the circle for excessive play while raising the lift cylinders.

Check the condition of the tires. Adjust the inflation pressure, if necessary.

Check all oil levels, coolant levels, and fuel levels daily or as recommended in the Operation and Maintenance Manual, “Maintenance Interval Schedule”.

Remove any trash buildup and debris. Make all necessary repairs before you operate the machine.

Make sure that all covers and guards are securely attached.

Adjust the mirrors for the correct rear view of the machine.

Make sure that all indicators, lights. and flashers are working properly.

Make sure that the action light on the instrument panel is not flashing. Refer to Operation and Maintenance Manual, “Monitoring System” for more information.

Grease all of the fittings that need to be serviced on a daily basis.

Daily, perform the procedures that are applicable to your machine:

- Operation and Maintenance Manual, “Automatic Lubrication System Grease - Check”
- Operation and Maintenance Manual, “Backup Alarm - Test”
- Operation and Maintenance Manual, “Brakes, Indicators, and Gauges - Test”
- Operation and Maintenance Manual, “Circle Clearances - Check/Adjust”
- Operation and Maintenance Manual, “Circle Drive Pinion Teeth - Lubricate”
- Operation and Maintenance Manual, “Circle Top - Lubricate”
- Operation and Maintenance Manual, “Engine Air Precleaner - Clean”
- Operation and Maintenance Manual, “Engine Oil Level - Check”
- Operation and Maintenance Manual, “Fuel System Water Separator - Drain”
- Operation and Maintenance Manual, “Hydraulic System Oil Level - Check”
- Operation and Maintenance Manual, “Seat Belt - Inspect”
- Operation and Maintenance Manual, “Transmission and Differential Oil Level - Check”

Wheel Lean Locking Bolt

NOTICE
Do not operate the machine with the wheel lean bolt in the locked position. Machine damage may occur.

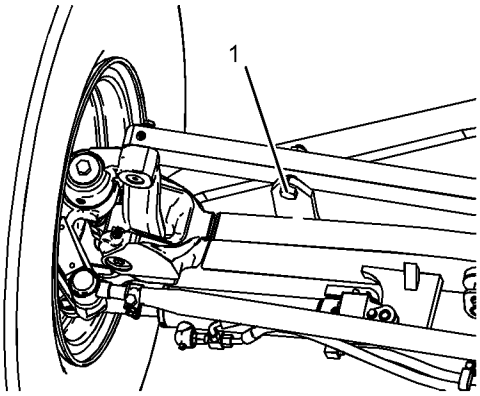


Illustration 64 g01956397

Remove wheel lean locking bolt (1) from the LOCKED position. The wheel lean locking bolt must be removed in order to lean the wheels.

i02601139

Steering Frame Lock

SMCS Code: 7506-FRM

⚠ WARNING

No clearance for person in this area when machine turns. Severe injury or death from crushing could occur.

The steering frame lock prevents the machine from articulating.

Before the machine is operated, frame lock pin (2) must be removed from the LOCKED position in order to articulate the machine.

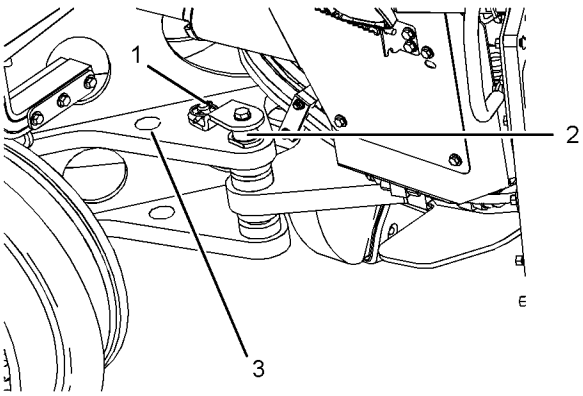


Illustration 65 g01301716

1. Pull out the frame lock pin after pulling pin(1).

Note: A locking pin may be installed on the bottom end of the frame lock pin. The locking pin must be removed before the frame lock pin can be pulled out.

2. Store the frame lock pin in storage bracket (3) after pulling pin(1).

3. Install the locking pin (if equipped).

Install frame lock pin (2) in the LOCKED position before you perform any of the following operations:

- Lift the machine.
- Transport the machine.
- Perform any work near the center of the machine.

1. Secure frame lock pin (2) in the LOCKED position with pin(1).

2. Secure the frame lock pin with the locking pin (if equipped).

Machine Operation

i03653350

Alternate Exit

SMCS Code: 7308; 7310

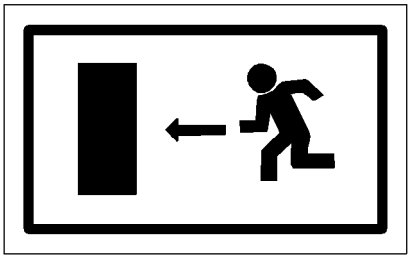


Illustration 66 g01002993

The door on the left side of the machine is the primary exit. The door on the right side of the machine is an option on this machine. If equipped, use the door on the right side of the machine as an alternate exit.

Note: If the machine is equipped with a snow wing, the door on the right side of the machine cannot be used as an alternate exit. Use the rear window as an alternate exit.

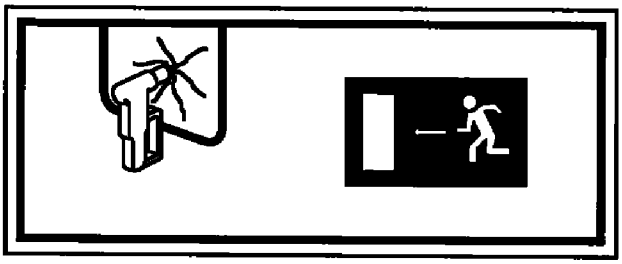


Illustration 67 g01299014

If the machine is equipped only with a single door, use the rear window as an alternate exit.

The hammer is located at the left rear of the ROPS. Use the hammer in order to break the window. Push out the window and exit the cab.

i02473975

Seat

SMCS Code: 7312

The operator's seat that is provided with this machine is in compliance with the appropriate class of “ISO 7096”.

Note: Adjust the seat for another operator or at the beginning of each shift.

The operator should be seated against the seat backrest. Adjust the seat so that the operator is allowed full travel of the foot controls.

Mechanical Suspension

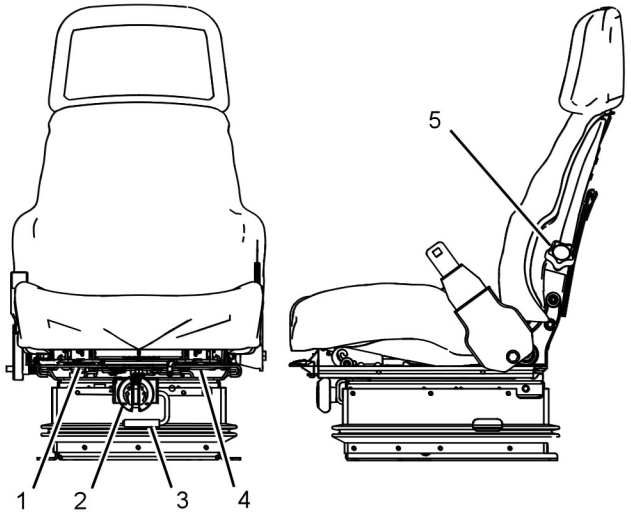


Illustration 68 g01067310

Backrest Adjustment Lever (1) – Push down on the lever for the seat backrest in order to adjust the angle of the seat backrest. Adjust the seat backrest to the desired position. Release the lever for the seat backrest in order to lock the seat backrest in position.

Weight Adjustment Knob (2) – Use the handle on the knob in order to adjust the seat to the weight of the operator. Turn the handle clockwise in order to increase the height of the seat. Turn the handle counterclockwise in order to decrease the height of the seat.

Seat Height Lever (3) – Pull up the seat height lever in order to adjust the seat upward or adjust the seat downward. Adjust the seat height to the desired position. Release the seat height lever in order to lock the seat in position.

Fore/Aft Lever (4) – Pull up on the fore/aft lever in order to move the seat forward or backward. Adjust the seat to the desired position. Release the fore/aft lever in order to lock the seat in position.

Lumbar Support Knob (5) – The lumbar support knob is located on the left rear side of the seat. Turn the lumbar support knob counterclockwise in order to increase the stiffness of the lumbar support. Turn the lumbar support knob clockwise in order to decrease the stiffness of the lumbar support.

Air Suspension

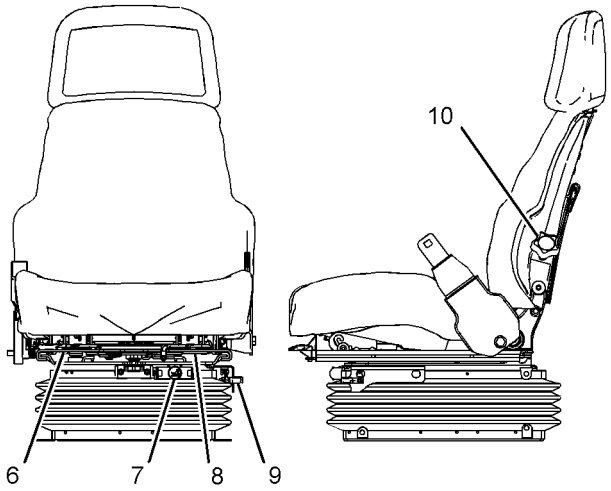


Illustration 69 g01067311

The air suspension seat has an air bag that controls the height of the seat and the weight adjustment of the seat. The amount of air that is in the air bag is determined by the operator. The pressure in the air bag is determined by the weight of the operator. This provides automatic weight adjustment. Damping is provided by shock absorber (9).

Backrest Adjustment Lever (6) – Pull up on the lever for the seat backrest in order to adjust the angle of the seat backrest. Adjust the seat backrest to the desired position. Release the lever for the seat backrest in order to lock the seat backrest in position.

Height Adjustment Knob (7) – To raise the seat, push in the knob. To lower the seat, pull out the knob.

Note: The operator must not change the height of the suspension so that the stroke is inadequate for the particular application. The suspension height must be changed if the seat bottoms out excessively or if the seat bounces too much to the maximum height.

Fore/Aft Lever (8) – Pull up on the fore/aft lever in order to move the seat forward or backward. Adjust the seat to the desired position. Release the fore/aft lever in order to lock the seat in position.

Lumbar Support Knob (10) – The lumbar support knob is located on the left rear side of the seat. Turn the lumbar support knob counterclockwise in order to increase the stiffness of the lumbar support. Turn the lumbar support knob clockwise in order to decrease the stiffness of the lumbar support.

i04200349

Seat Belt

SMCS Code: 7327

Note: This machine was equipped with a seat belt when the machine was shipped from Caterpillar. At the time of installation, the seat belt and the instructions for installation of the seat belt meet the SAE J386 and ISO 6683 standards. Consult your Cat dealer for all replacement parts.

Always check the condition of the seat belt and the condition of the mounting hardware before you operate the machine.

Seat Belt Adjustment for Non-Retractable Seat Belts

Adjust both ends of the seat belt. The seat belt should be snug but comfortable.

Lengthening the Seat Belt

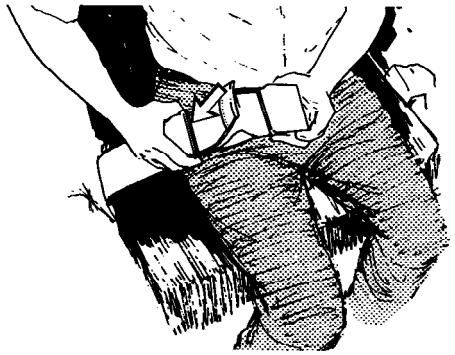


Illustration 70 g00100709

1. Unfasten the seat belt.

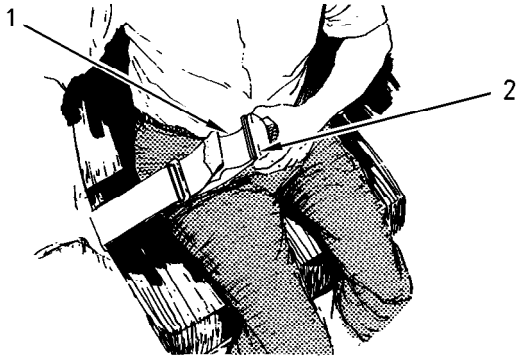


Illustration 71 g00932817

2. To remove the slack in outer loop (1), rotate buckle (2). This will free the lock bar. This permits the seat belt to move through the buckle.

3. Remove the slack from the outer belt loop by pulling on the buckle.

4. Loosen the other half of the seat belt in the same manner. If the seat belt does not fit snugly with the buckle in the center, readjust the seat belt.

Shortening the Seat Belt

Illustration 72 g00100713

1. Fasten the seat belt. Pull out on the outer belt loop in order to tighten the seat belt.

2. Adjust the other half of the seat belt in the same manner.

3. If the seat belt does not fit snugly with the buckle in the center, readjust the seat belt.

Fastening The Seat Belt

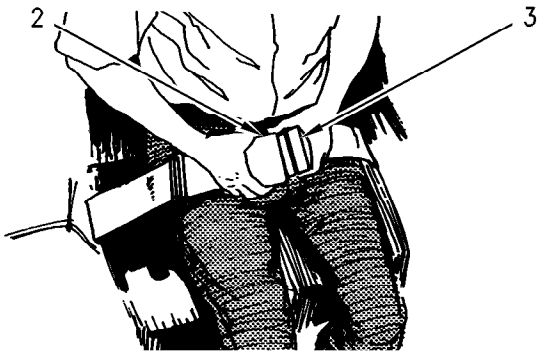


Illustration 73 g00932818

Fasten the seat belt catch (3) into the buckle (2). Make sure that the seat belt is placed low across the lap of the operator.

Releasing The Seat Belt

Illustration 74 g00100717

Pull up on the release lever. This will release the seat belt.

Seat Belt Adjustment for Retractable Seat Belts

Fastening The Seat Belt

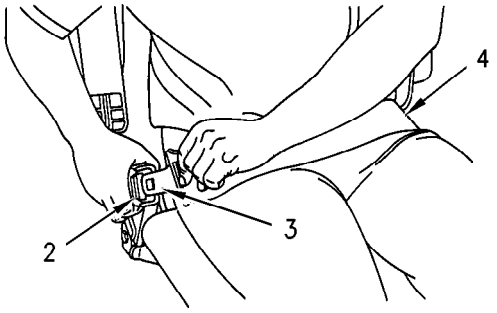


Illustration 75 g00867598

Pull seat belt (4) out of the retractor in a continuous motion.

Fasten seat belt catch (3) into buckle (2). Make sure that the seat belt is placed low across the lap of the operator.

The retractor will adjust the belt length and the retractor will lock in place. The comfort ride sleeve will allow the operator to have limited movement.

Releasing The Seat Belt

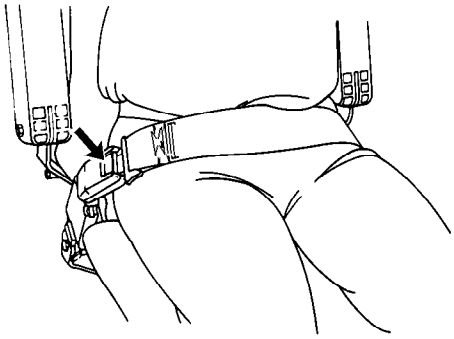


Illustration 76 g00039113

Push the release button on the buckle in order to release the seat belt. The seat belt will automatically retract into the retractor.

Extension of the Seat Belt

⚠ WARNING

When using retractable seat belts, do not use seat belt extensions, or personal injury or death can result.

The retractor system may or may not lock up depending on the length of the extension and the size of the person. If the retractor does not lock up, the seat belt will not retain the person.

Longer, non-retractable seat belts and extensions for the non-retractable seat belts are available.

Caterpillar requires only non-retractable seat belts to be used with a seat belt extension.

Consult your Cat dealer for longer seat belts and for information on extending the seat belts.

i05125870

Mirror
(If Equipped)

SMCS Code: 7319

⚠ WARNING

Adjust all mirrors as specified in the Operation and Maintenance Manual. Failure to heed this warning can lead to personal injury or death.

⚠ WARNING

Slips and falls can result in personal injury. Use the machines access systems when adjusting the mirrors. If the mirrors cannot be reached using the machine access systems follow the instructions found within the Operation and Maintenance Manual, “Mirror” in order to access the mirrors.

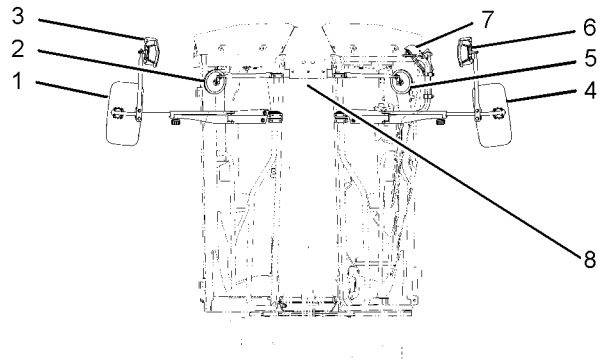


Illustration 77 g01976713

(1) Right Side Rear View Mirror
(2) Right Side Circular Rear View Mirror
(3) Right Side Front View Mirror
(4) Left Side Rear View Mirror
(5) Left Side Circular Rear View Mirror
(6) Left Side Front View Mirror
(7) Cab Rear View Mirror
(8) Cab Mirror

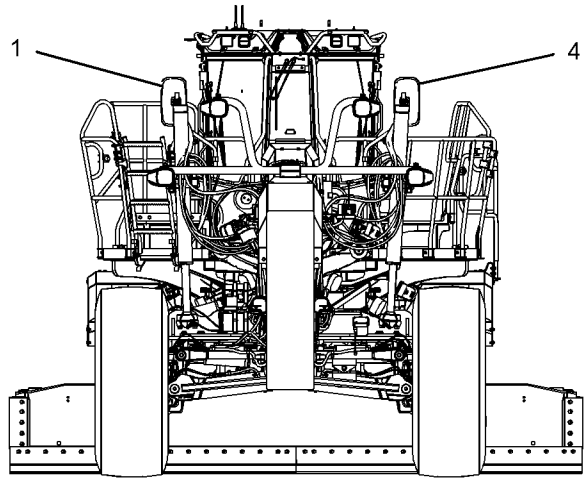


Illustration 78 g03286261

(1) Right Side Rear View Mirror (If Equipped)
(4) Left Side Rear View Mirror (If Equipped)

Mirrors provide additional visibility around your machine. Make sure that the mirrors are in proper working condition and that the mirrors are clean. Adjust all mirrors at the beginning of each work period and adjust the mirrors when you change operators.

Modified Machines or machines that have additional equipment or attachments may influence your visibility.

Mirror Adjustment

- Park the machine on a level surface.
- Stop the engine.

Note: You may need to use hand tools in order to adjust certain types of mirrors.

Right Side Rear View Mirror

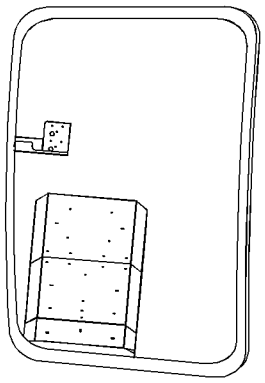


Illustration 79 g01976714

The mirror bracket is adjustable. Fully extend the right side rear view mirror bracket by turning the mirror bracket knob counterclockwise and fully extend the bracket. Turn the knob clockwise in order to secure the bracket. Adjust the right side rear view mirror (1) so the right side of the cab can be seen. Adjust the right side rear view mirror (1) so the top 100 mm (4 inch) of rear tire can be seen. Refer to illustration 79 . Also adjust the right side rear view mirror in order to see the following:

- See an object on the ground at a distance of 30 m (98 ft) to the rear of the motor grader.

Note: If equipped with the optional access platform, adjust the mirror so that the ground beside the fender can be seen.

Right Side Circular Rear View Mirror

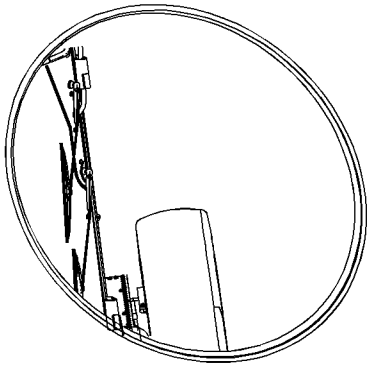


Illustration 80 g01699974

Adjust the right side circular rear view mirror (2) in order to see the full width of the right rear tire. Adjust the right side circular rear view mirror in order to see an object on the ground to the right and to the rear of the rear tire. Also adjust the right side circular rear view mirror in order to see the following:

- See an object4 m (13 ft 2 inch) from the right side of the center of the rear tire on the ground.

Right Side Front View Mirror

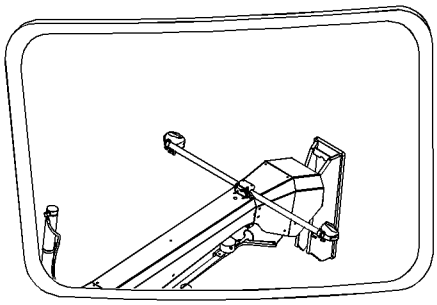


Illustration 81 g01976719

The right side front view mirror (3) is used in order to see the front of the machine and to the left of the machine.

Adjust the right side front view mirror (3) in order to see the following:

- The top of the front frame
- See an object on the ground 24 m (80 ft) to the left side of the left front tire.
- See an object 12 m (40 ft) to the front of the front left tire.

Left Side Rear View Mirror

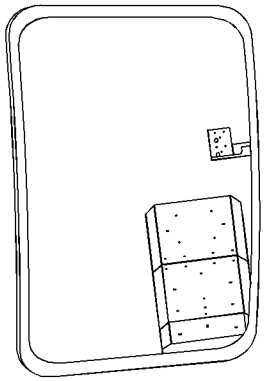


Illustration 82 g01976721

The mirror bracket is adjustable. Fully extend the left side rear view mirror bracket by turning the mirror bracket knob counterclockwise and fully extend the bracket. Turn the knob clockwise in order to secure the bracket. Adjust the left side rear view mirror (4) so the left side of the cab can be seen. Adjust the left side rear view mirror (4) so the top 100 mm (4 inch) of rear tire can be seen. Refer to illustration 82 . Also adjust the left side rear view mirror in order to see the following:

- See an object on the ground at a distance of 30 m (98 ft) to the rear of the motor grader.

Note: If equipped with the optional access platform, adjust the mirror so that the ground beside the fender and the rear ladder can be seen. The mirror should be adjusted to see the reflective tape when the ladder is lowered. When the ladder is raised, the reflective tape should not be seen in the mirror.

Left Side Circular Rear View Mirror

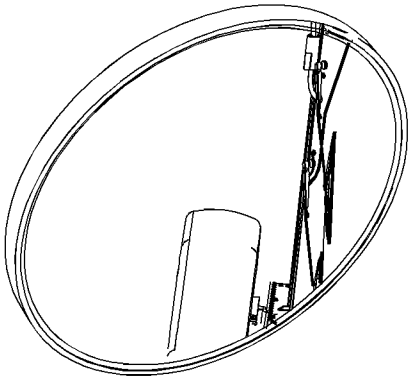


Illustration 83 g01699977

Adjust the left side circular rear view mirror (5) in order to see the full width of the left rear tire. Adjust the left side circular rear view mirror in order to see an object on the ground to the left and to the rear of the rear tire. Also adjust the left side circular rear view mirror in order to see the following:

- See an object 4 m (13 ft 2 inch) from the left side of the center of the rear tire on the ground.

Left Side Front View Mirror

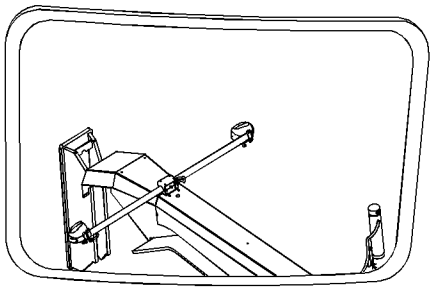


Illustration 84 g01976725

The left side front view mirror (6) is used in order to see the front of the machine and to the right of the machine.

Adjust the left side front view mirror (6) in order to see the following:

- The top of the front frame
- See an object on the ground 24 m (80 ft) to the right side of the right front tire.
- See an object 12 m (40 ft) to the front of the front right tire.

Cab Rear View Mirror

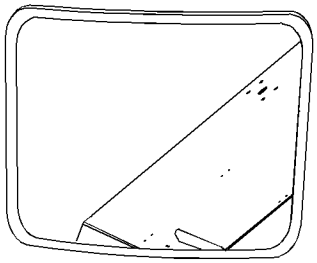


Illustration 85 g01976728

Adjust the cab rear view mirror (7) in order to see the following:

- An object on the ground 6 m (20 ft) rear from the enclosure outer edge and located in the center of the machine.
- See the top of the engine enclosure.

Cab Mirror

The cab mirror (8) can be adjusted to a position in order to allow the operator to see preferred areas around the machine during operations.

i05125213

Ladder
(If Equipped)

SMCS Code: 7254

WARNING

Crush hazard! Stay back a safe distance from the ladder when the ladder is being raised or lowered. Failure to stay back may result in injury or death.

WARNING

Do not ride on the ladder while the machine is moving. Riding the ladder while the machine is moving could result in injury or death.

NOTICE
Make sure that the area is free of obstacles before raising or lowering the ladder.

Machine travel with ladder lowered could result in contact with the ground or an obstacle resulting in damage to the ladder.

NOTICE
To avoid damage to the ladder during machine operation, keep the ladder in the raised position.

Primary Ladder

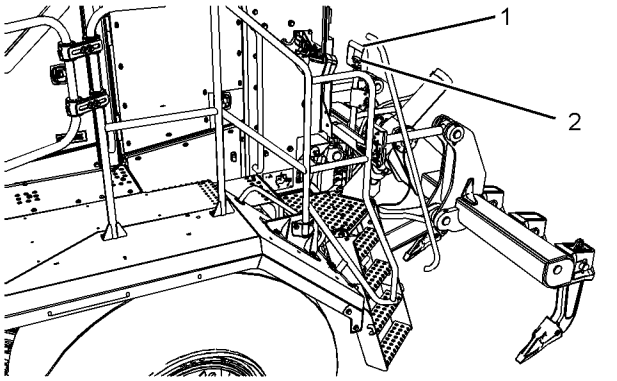


Illustration 86 g02927817

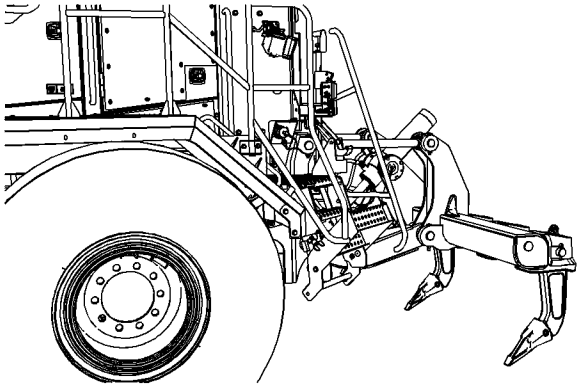


Illustration 87 g02927821

Ladder raised

The ladder is a retractable ladder that can be lowered close to the ground for mounting and dismounting the machine.

Note: Mirrors should be adjusted to see the reflective tape when the ladder is lowered. When the ladder is raised, the reflective tape should not be seen in the mirrors.

Push down on handle (1) to raise the bottom two steps of the ladder. Make sure that ladder is raised before starting the machine.

To lower the ladder, pull handle (2) to release the ladder.

Secondary Ladder

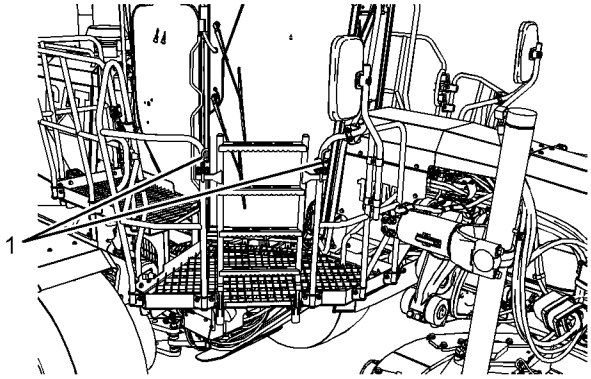


Illustration 88 g03285896

The secondary ladder is a foldable ladder that can be lowered close to the ground for mounting and dismounting the machine.

Remove the pins (1) and fold the ladder towards the ground. Reinstall the pins.

i06811930

Operator Controls

SMCS Code: 7300; 7451

Note: Your machine may not be equipped with all of the controls that are described in this topic.

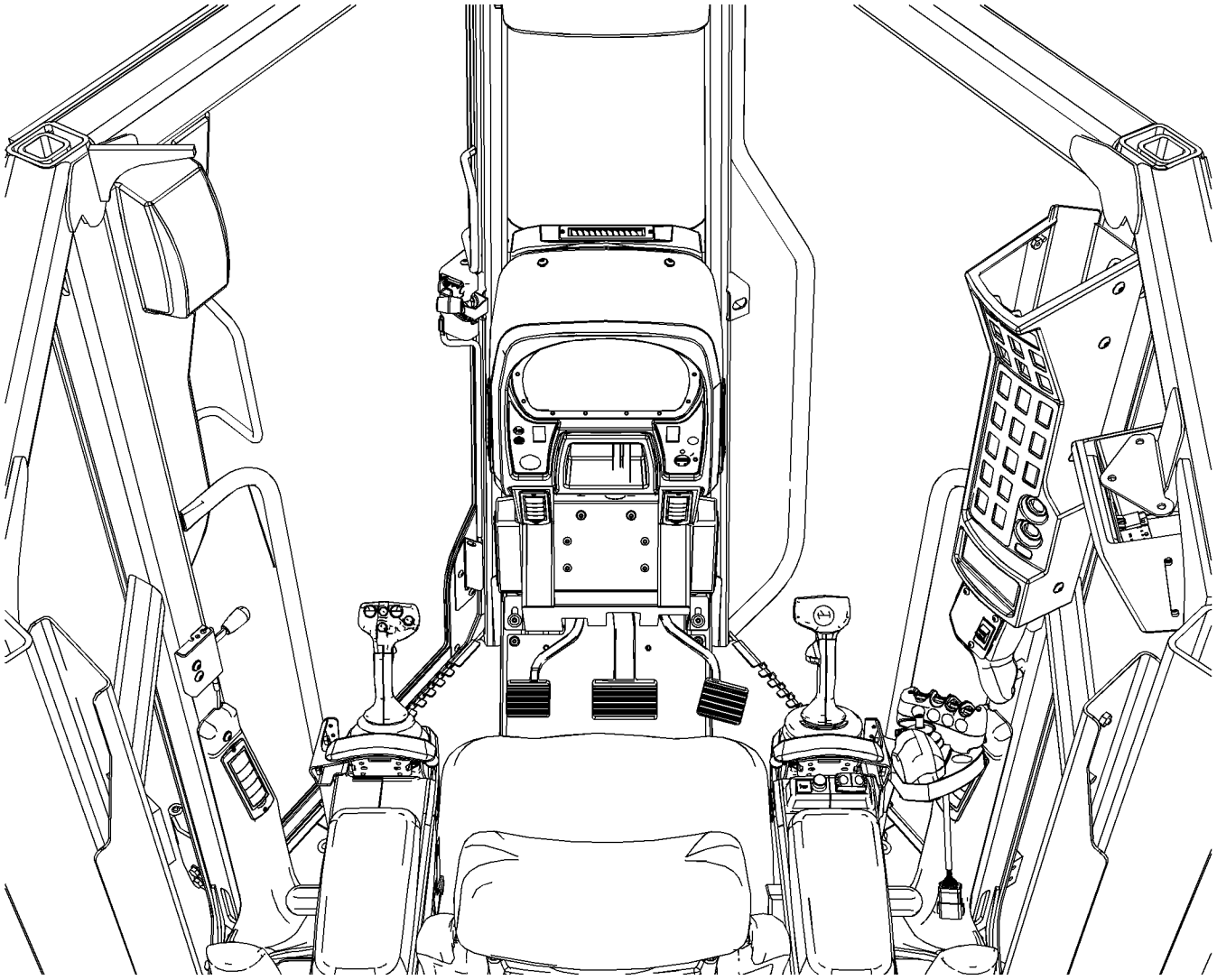


Illustration 89 g01414459
Overhead View

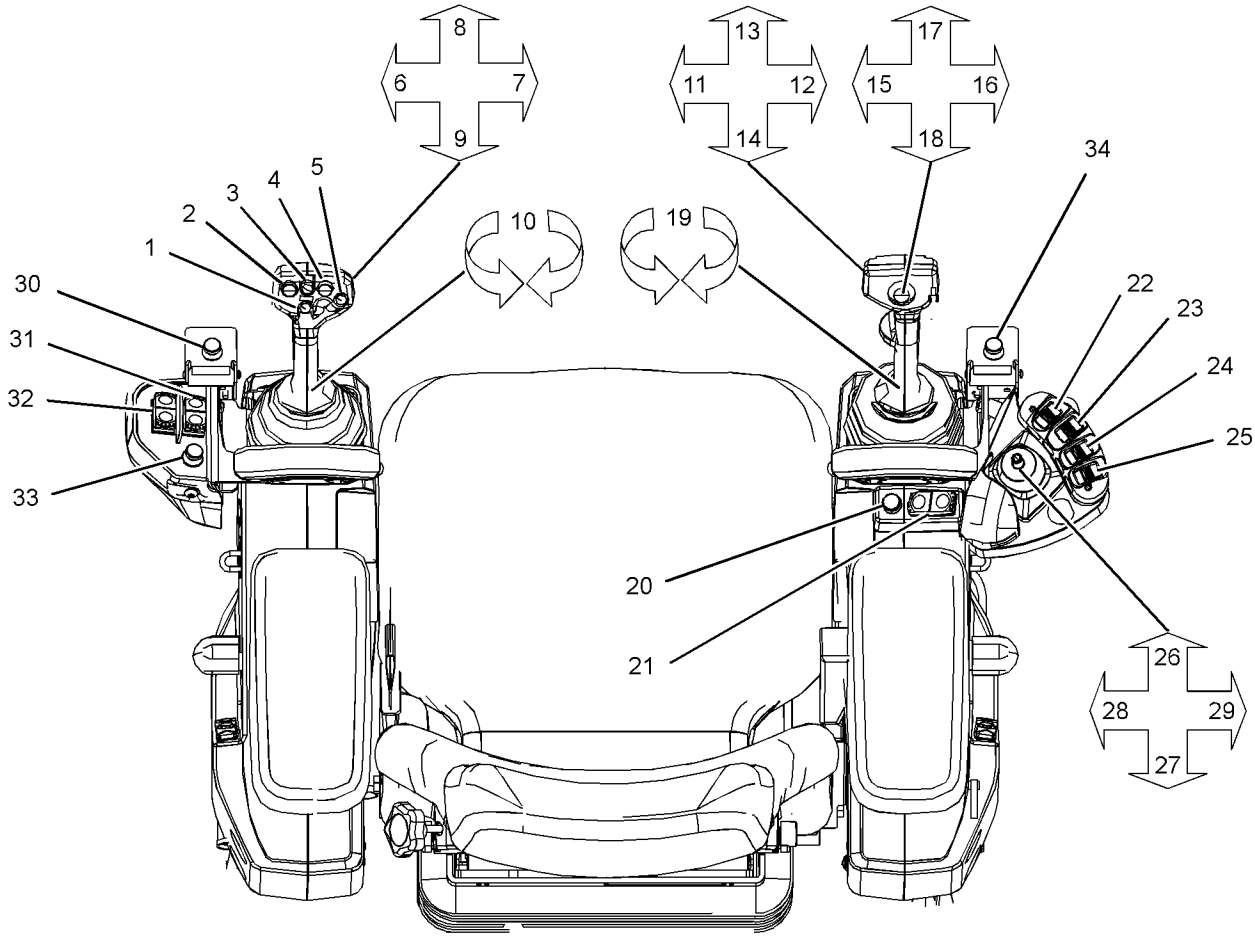


Illustration 90 g03721828

(1) Downshift switch
(2) Wheel lean control (left)
(3) Upshift switch
(4) Wheel lean control (right)
(5) Automatic articulation centering control
(6) Steer left
(7) Steer right
(8) Blade lower and blade float for left side
(9) Blade lift for left side
(10) Articulation control
(11) Blade sideshift control (left)
(12) Blade sideshift control (right)
(13) Blade lower and blade float for right side
(14) Blade lift for the right side
(15) Centershift control (left)
(16) Centershift control (right)
(17) Blade pitch control (forward)
(18) Blade pitch control (backward)
(19) Blade circle drive control
(20) Horn
(21) Turn signal switch
(22) Auxiliary pod control roller (lever 1)
(23) Auxiliary pod control roller (lever 2)
(24) Auxiliary pod control roller (lever 3)
(25) Auxiliary pod control roller (lever 4)
(26) Auxiliary pod mini joystick (lever 5)
(27) Auxiliary pod mini joystick (lever 5)
(28) Auxiliary pod mini joystick (lever 6)
(29) Auxiliary pod mini joystick (lever 6)
(30) Grade Control Auto/Manual switch (Left Side)
(31) Grade Control Increment/Decrement switch (Right Side)
(32) Grade Control Increment/Decrement switch (Left Side)
(33) Grade Control Side Shift Auto/Manual switch
(34) Grade Control Auto/Manual switch (Right Side)

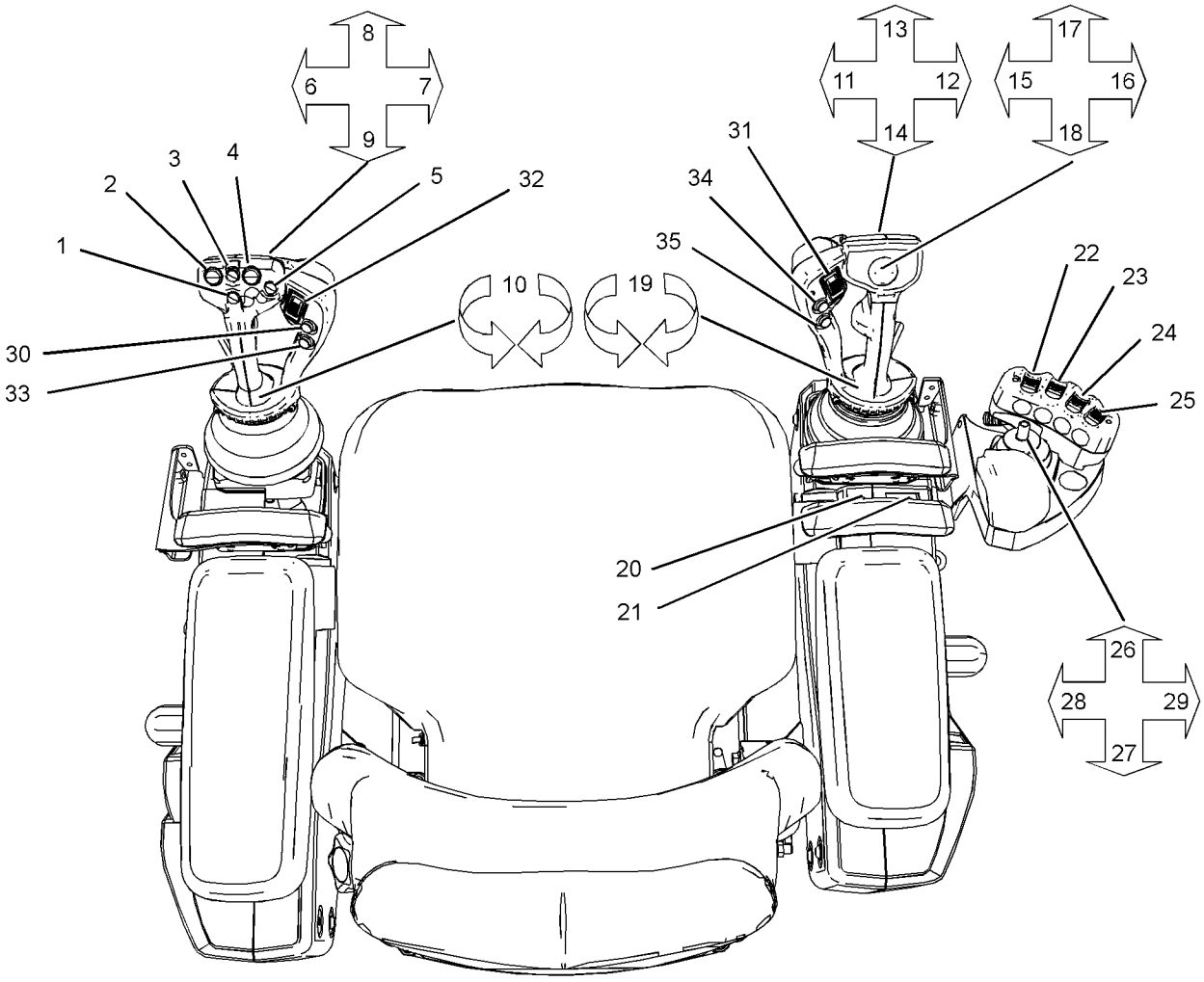


Illustration 91 g03722112

Advanced Control Joysticks with Grade Control (If Equipped)

(1) Downshift switch
(2) Wheel lean control (left)
(3) Upshift switch
(4) Wheel lean control (right)
(5) Automatic articulation centering control
(6) Steer left
(7) Steer right
(8) Blade lower and blade float for left side
(9) Blade lift for left side
(10) Articulation control
(11) Blade sideshift control (left)
(12) Blade sideshift control (right)
(13) Blade lower and blade float for right side
(14) Blade lift for the right side
(15) Centershift control (left)
(16) Centershift control (right)
(17) Blade pitch control (forward)
(18) Blade pitch control (backward)
(19) Blade circle drive control
(20) Horn
(21) Turn signal switch
(22) Auxiliary pod control roller (lever 1)
(23) Auxiliary pod control roller (lever 2)
(24) Auxiliary pod control roller (lever 3)
(25) Auxiliary pod control roller (lever 4)
(26) Auxiliary pod mini joystick (lever 5)
(27) Auxiliary pod mini joystick (lever 5)
(28) Auxiliary pod mini joystick (lever 6)
(29) Auxiliary pod mini joystick (lever 6)
(30) Grade Control Auto/Manual button (Left Side)
(31) Grade Control Increment/Decrement roller (Right Side)
(32) Grade Control Increment/Decrement roller (Left Side)
(33) Grade Control Side Shift Auto/Manual button
(34) Grade Control Auto/Manual button (Right Side)
(35) Grade Control Cross Slope Favorites

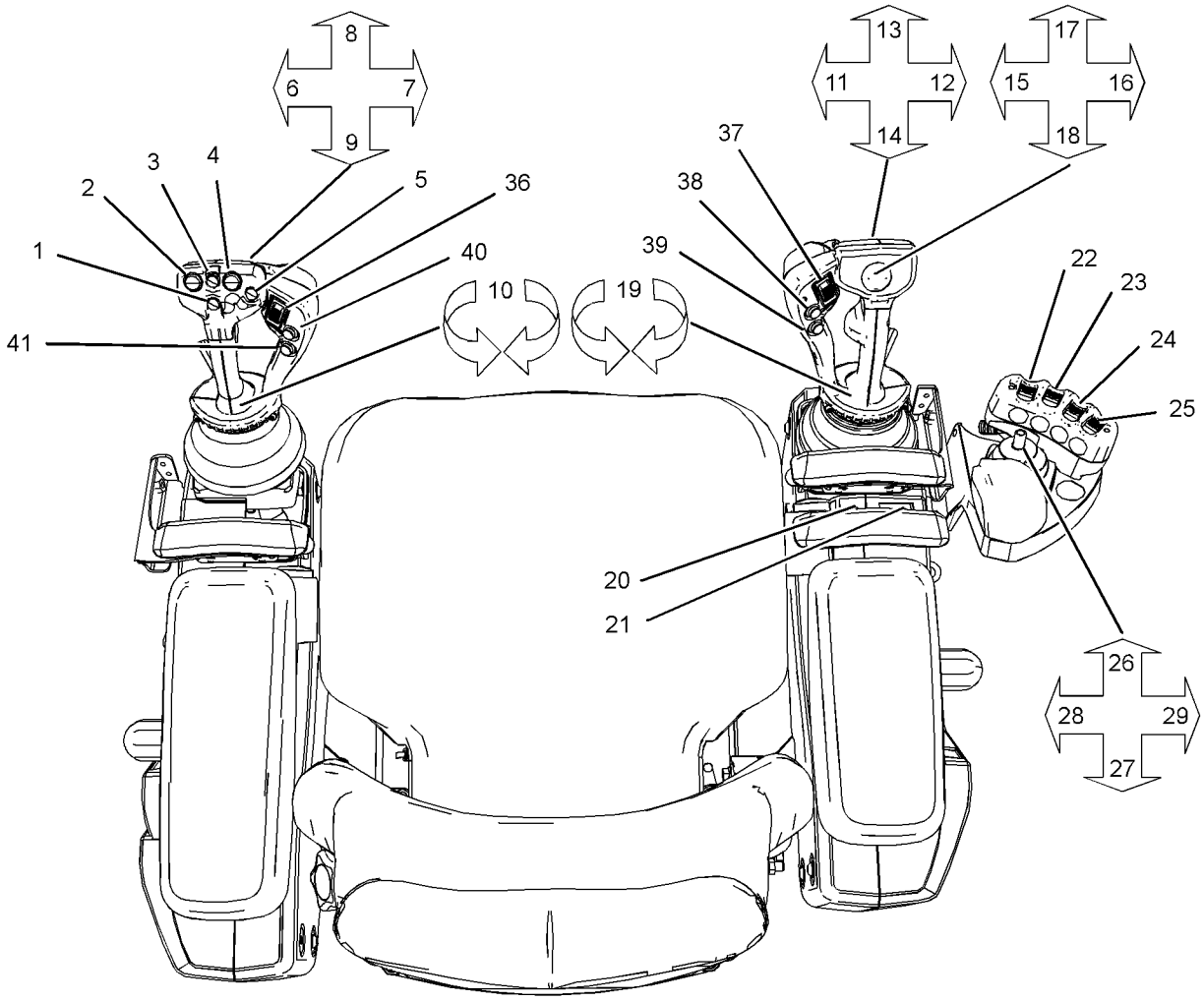


Illustration 92 g03723057

Advanced Control Joysticks with Auxiliary Controls (If Equipped)

(1) Downshift switch
(2) Wheel lean control (left)
(3) Upshift switch
(4) Wheel lean control (right)
(5) Automatic articulation centering control
(6) Steer left
(7) Steer right
(8) Blade lower and blade float for left side
(9) Blade lift for left side
(10) Articulation control
(11) Blade sideshift control (left)
(12) Blade sideshift control (right)
(13) Blade lower and blade float for right side
(14) Blade lift for the right side
(15) Centershift control (left)
(16) Centershift control (right)
(17) Blade pitch control (forward)
(18) Blade pitch control (backward)
(19) Blade circle drive control
(20) Horn
(21) Turn signal switch
(22) Auxiliary pod control roller (lever 1)
(23) Auxiliary pod control roller (lever 2)
(24) Auxiliary pod control roller (lever 3)
(25) Auxiliary pod control roller (lever 4)
(26) Auxiliary pod mini joystick (lever 5)
(27) Auxiliary pod mini joystick (lever 5)
(28) Auxiliary pod mini joystick (lever 6)
(29) Auxiliary pod mini joystick (lever 6)
(36) Auxiliary control roller (lever 8)
(37) Auxiliary control roller (lever 9)
(38) Float button
(39) Not Applicable
(40) Not Applicable
(41) Not Applicable

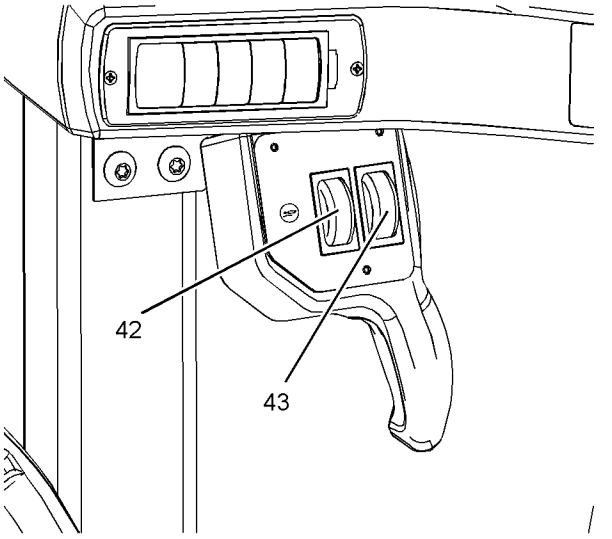


Illustration 93 g03724856

(42) Implement control roller (lever 6)
(43) Implement control roller (lever 7)

Note: When the machine is shipped from the factory with an attachment implement installed, the implement is assigned to a factory default auxiliary control lever. The following table lists the default control lever assignments for factory installed attachments.

Note: The auxiliary control levers are programmable. The auxiliary control levers must be programmed by an authorized Cat dealer.

Table 8

M-Series Motor Grader Auxiliary Hydraulic Factory Default Control Lever Assignments								
Attachments	Auxiliary Control Pod Levers						Stand-Alone Handle	Stand-Alone Handle
	Lever 1 (Float)	Lever 2	Lever 3	Lever 4 (Float)	Lever 5	Lever 6 (Float)	Lever 6 (Float)	Lever 7
Ripper								Ripper
Ripper, Plow							Plow Lift	Ripper
2 Function Wing, Plow, Ripper	Plow Lift				Wing Mast (Toe)	Wing Tilt 1		Ripper
2 Function Wing, 2 Function Plow, Ripper	Plow Lift	Dozer Angle			Wing Mast (Toe)	Wing Tilt 1		Ripper
2 Function Wing, 3 Function Plow, Ripper	Plow Lift	Dozer Angle	Dozer Angle		Wing Mast (Toe)	Wing Tilt 1		Ripper

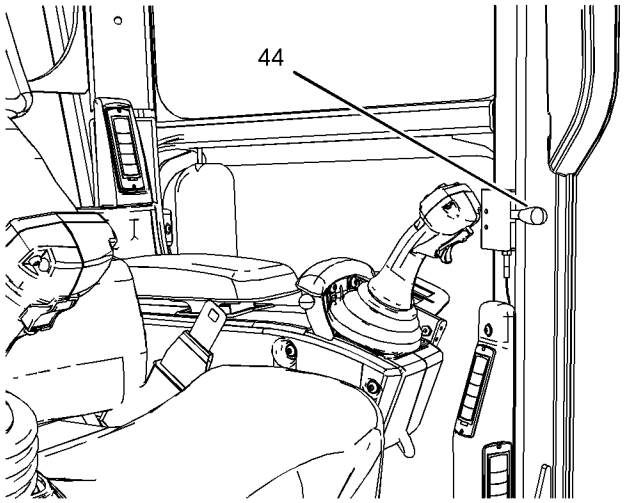


Illustration 94 g03724853

(44) Door release lever

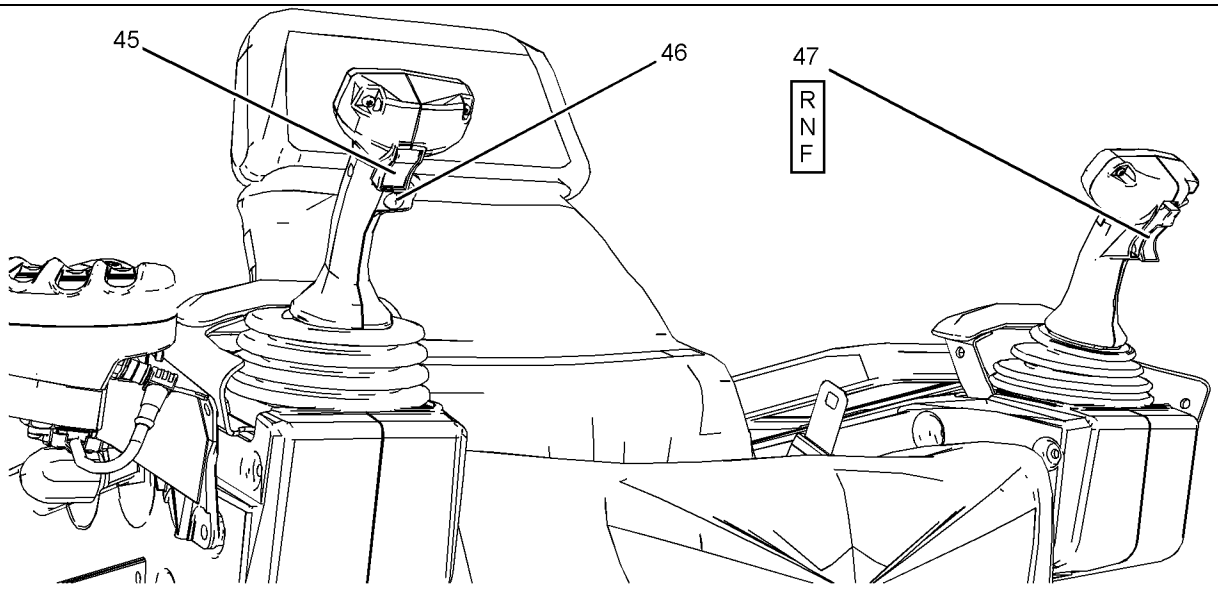


Illustration 95 g03724851

(45) Throttle resume/decel switch (46) Differential lock control (47) Transmission control switch

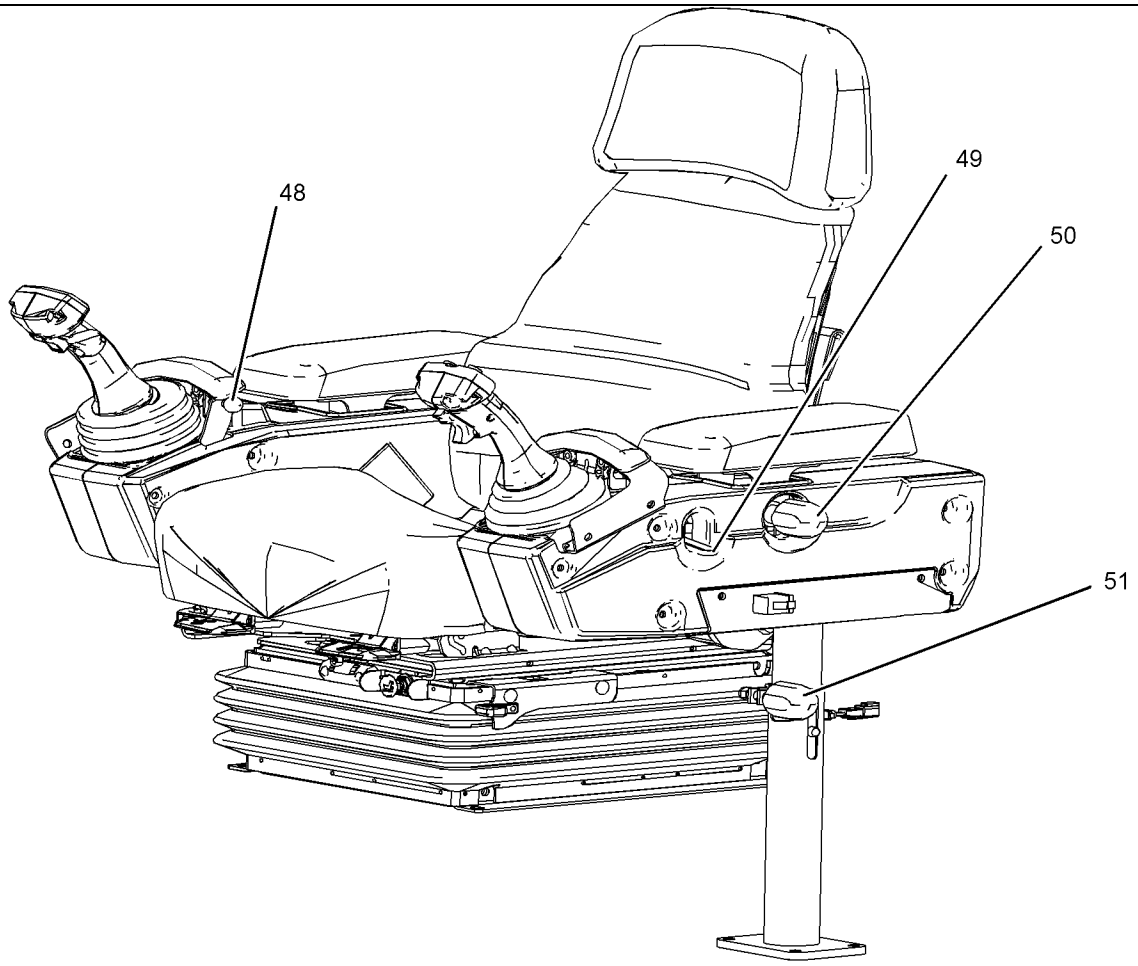


Illustration 96 g03724850

(48) Wrist rest height adjustment knob
(49) Control pod fore/aft adjustment lever
(50) Arm pad adjustment knob
(51) Control pod vertical adjustment knob/ switch

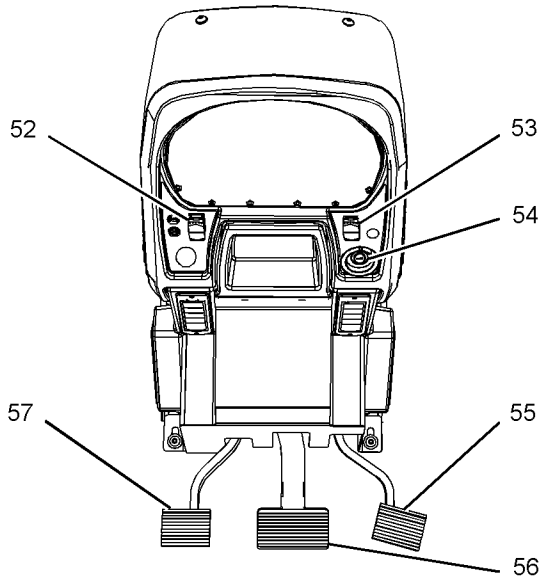


Illustration 97 g03724849

(52) Secondary steering test switch
(53) Parking brake switch
(54) Engine start switch
(55) Accelerator control
(56) Service brake control
(57) Transmission modulator control (Inching pedal)

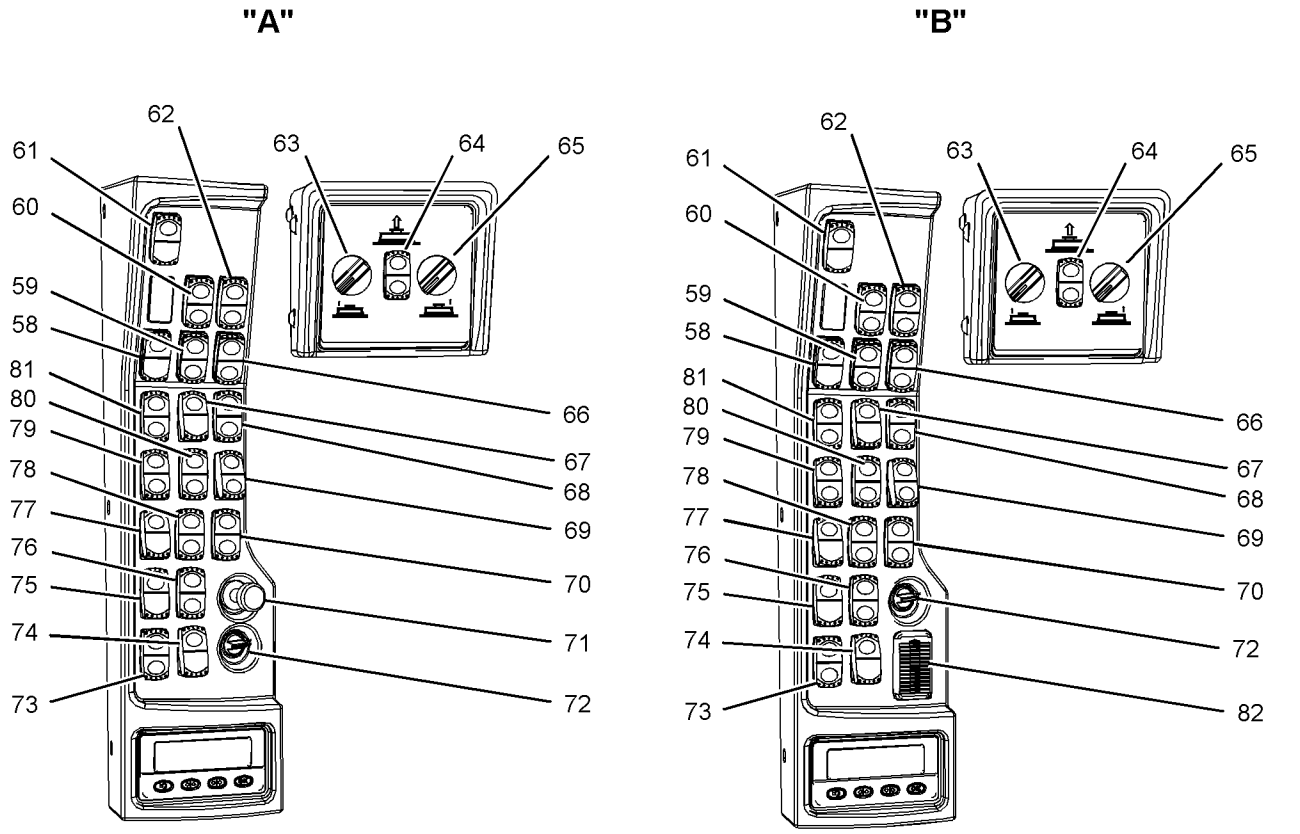


Illustration 98 g03724848

Type “A” and Type “B”

(58) Warning beacon switch
(59) Heated mirror switch
(60) Defroster fan switch
(61) Centershift lock switch
(62) Heated glass switch
(63) Left variable blade float
(64) Variable blade float switch
(65) Right variable blade float switch
(66) Compression brake switch
(67) Headlight dimmer switch
(68) Blade cushion switch
(69) Implement lockout switch
(70) Access platform light switch
(71) Cigar lighter (24 V)
(72) Power port (12 V)
(73) Throttle hold mode switch
(74) Throttle set/accel switch
(75) Hazard flasher switch
(76) Autoshift switch
(77) Snow wing light switch
(78) Auto differential lock switch
(79) Cab floodlight switch
(80) Front and rear work light switch
(81) Headlight and taillight switch
(82) Bluetooth Microphone

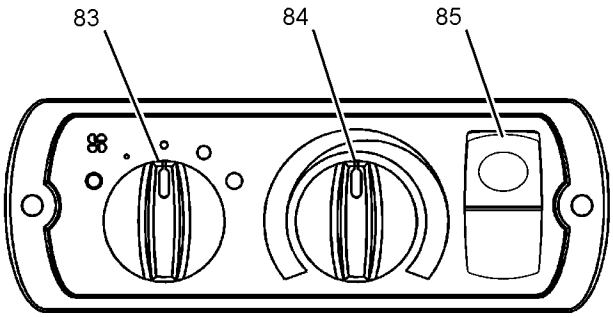


Illustration 99 g03724846

(83) Fan speed switch
(84) Temperature variable control
(85) Air conditioner switch

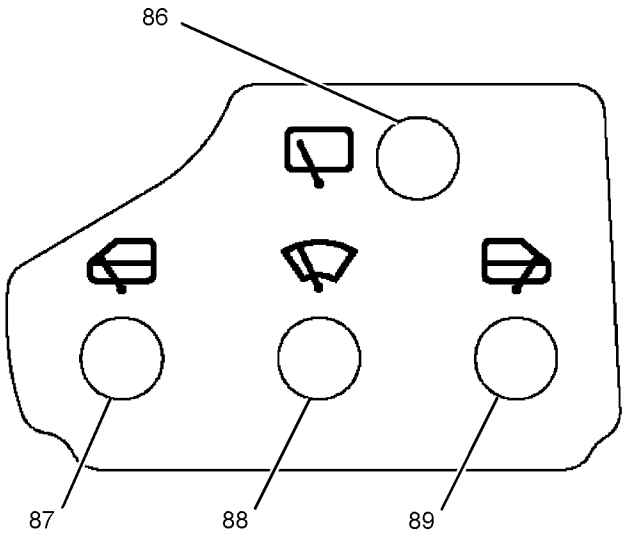


Illustration 100 g03724845

(86) Rear window wiper/washer
(87) Left door wiper/washer
(88) Front window wiper/washer
(89) Right door wiper/washer

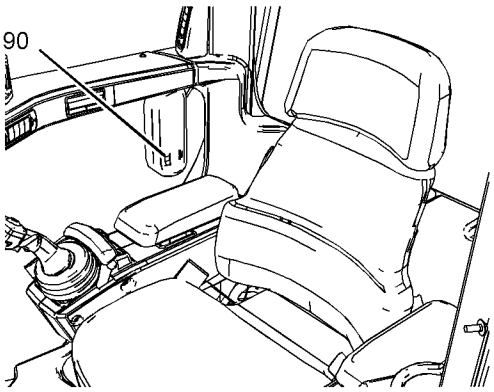


Illustration 101 g03724844

(90) Side window wiper/washer

Downshift Switch (1)

Downshift Switch – Depress switch in order to downshift the transmission to the desired forward speed or the desired reverse speed.

Wheel Lean Control (Left) (2)

Wheel Lean LEFT – In order to lean the wheels to the left, press wheel lean control (left) button. When you release the control button, the wheel lean will remain in the selected position.

Note: Wheel lean will deactivate when wheel lean control (left) button and wheel lean control (right) button are pressed at the same time. Wheel lean will activate once both control buttons are released.

Upshift Switch (3)

Upshift Switch – Depress switch in order to upshift the transmission to the desired forward speed or the desired reverse speed.

Wheel Lean Control (Right) (4)

Wheel Lean RIGHT – In order to lean the wheels to the right, press wheel lean control (right) button . When you release the control button, the wheel lean will remain in the selected position.

Note: Wheel lean will deactivate when wheel lean control (left) button and wheel lean control (right) button are pressed at the same time. Wheel lean will activate once both control buttons are released.

Automatic Articulation Centering Control (5)

Automatic Articulation (Centering) – Press and release control button in order to return the machine articulation to the CENTER (NEUTRAL) position. The machine articulation will gradually move the machine to the CENTER position.

Note: Automatic articulation (centering) can be canceled by performing either of the following operations:

- Press control button again.
- Manually select a specific articulation with the left-hand joystick.

Joystick Steering

NOTICE
The joystick steering system provides optimum control and ergonomic comfort. Allow appropriate time to familiarize yourself with the joystick steering controls at all speeds. It is important to maintain deliberate steering inputs and controlled steering inputs at all times.

Steer Left (6)

Steer LEFT – Move the left-hand joystick left in order to turn the front wheels to the left. When the joystick is released in the desired position, the front wheels will remain aligned with the joystick.

Steer Right (7)

Steer RIGHT – Move the left-hand joystick right in order to turn the front wheels to the right. When the joystick is released in the desired position, the joystick will remain in that position. The front wheels will remain aligned with the joystick.

Speed Sensitive Steering

This machine is equipped with speed sensitive steering. When the ground speed of the machine increases the maximum turning angle of the front wheels is reduced and allowable articulation is reduced. While steering, an increase in ground speed will cause a decrease in steering angle, without any joystick movement. A decrease in ground speed while steering will result in an increase in steering angle, without any joystick movement. In order to maintain a constant turn angle when you change ground speed, the joystick must be moved at a rate and a direction that corresponds to the rate of ground speed change.

When you operate this machine for the first time, care must be taken to obtain a feel of this steering rate change before you operate at high ground speeds, around obstacles or around other machinery.

Refer to Operation and Maintenance Manual, “Operator Controls - Articulation Control” for the relationship of articulation to ground speed.

Joystick Steering Alignment

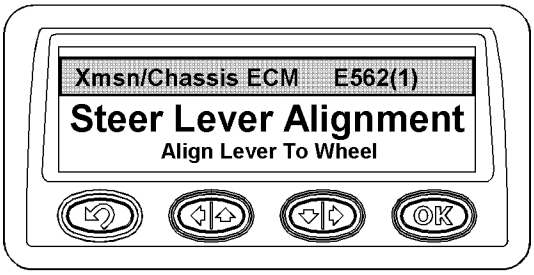


Illustration 102 g01717143

For the steering control to be active, the left-hand joystick must be aligned in relation to the steering angle of the front wheels. If the left-hand joystick is not aligned, the steering indicator will illuminate and an “Event” will be displayed on Messenger. Refer to illustration 102 . If the left-hand joystick is not aligned, you will be unable to steer. Disengage the parking brake or shift out of the NEUTRAL position unless the parking brake override required conditions have been met.

To align the left-hand joystick, perform the following:

1. The operator must be in the seat and the engine must be running.
2. Engage the parking brake switch.
3. Position the left-hand joystick relative to the position of the front wheels

4. Slowly move the joystick slightly left and/or right to activate the steering control. Only a small amount of slow joystick movement should be required. If needed, slowly expand your left or right movement. If the joystick is moved too quickly the steering control may not activate.

When you have properly aligned the left-hand joystick, the following will occur:

- The front wheels move with the movement of the left-hand joystick.
- The joystick alignment event disappears from the Messenger display. Refer to illustration 102 .
- The alert indicators for the steering system are not illuminated on the front dash.

Note: If the steering angle is at full left turn or full right turn, wheel lean may be required to align the steering.

Note: It is not recommended to sweep the left-hand joystick from the full left position to the full right position to align the steering.

5. After you obtain the steering joystick alignment, disengage the parking brake switch.

Note: To auto align the joystick, swipe the joystick from left to right, then right to left, and finally, left to right.

Secondary Steering

WARNING

If the secondary steering activates during operation, immediately park the machine in a safe location. Inspect the machine and correct the condition which made the use of the secondary steering necessary.

Do not continue to operate the machine using the secondary steering.

Personal injury or death can occur if steering is lost completely during operation.

WARNING

The machine's batteries must have a normal charge and the secondary steering electrical system must be in proper working condition. A low charge condition, or any defect in the battery, battery cells, or electrical circuit can cause loss of secondary steering and could result in personal injury and/or damage to the machine.

NOTICE

Once the secondary steering pump has been activated, it should remain on for no more than one minute. This should be sufficient time to safely steer the machine to a stop. When the machine is stopped, turn the engine start switch to the OFF position in order to turn off the secondary steering. Prolonged use of the secondary steering pump will cause the electric motor to overheat and eventually fail.

Secondary Steering System – This machine is equipped with a secondary steering system. The secondary steering system consists of the following components: an electric motor that drives the secondary steering pump and a secondary steering control. The secondary steering pump will activate automatically when the main pump loses pressure, such as an implement pump failure or engine failure. The secondary steering pump, however, will not activate when both the engine speed and the transmission output speed (TOS) equal zero.The secondary steering control will activate automatically when the primary steering control system fails.

The transition from the primary steering to the secondary steering will occur in less than one second. The transition will vary depending on the speed of the machine. As the machine speed increases, the transition time decreases. When the secondary steering system is activated, the steer wheels automatically align to the angle of the joystick. Maintain deliberate and controlled movement of the joystick inputs to maintain the desired direction of travel.

Note: Engine start switch must be in the ON position in order for this system to operate.

Note: If a problem exists with the primary steering system or the secondary steering system, an alert indicator and an action light come on and an action alarm sounds at a pulse rate.

Primary Steering System Indicator – This alert indicator will illuminate when there is any problem with the primary steering system.

Secondary Steering System Indicator – This alert indicator will be amber in color when the secondary steering system is active or the secondary steering system is being tested. The alert indicator will be red in color when a problem with the secondary steering system exists.

Blade Lift Modulation

You may select one of three modulation options, for blade lift only, in order to suit your operating style and/or your application. Based on your application or operating preferences, it may be desirable to change your blade lift modulation responsiveness.

Each modulation map provides the same maximum cylinder speed. The joystick input required to achieve the maximum cylinder speed varies between modulation maps.

Blade Modulation Selections

- Fine: This setting requires the greatest amount of joystick movement to provide a given blade lift movement. This setting allows precise control of the blade lift cylinder.
- Normal: This setting requires a shorter amount of joystick movement to provide a given blade lift movement. This setting allows the ease of fine blade lift modulation and still provides the use of a "bump" type input.
- Coarse: This setting provides the shortest amount of joystick movement to provide a given blade lift movement. This setting allows the use of the "bump" type input with minimal joystick movement.

When you start the machine the Messenger display will show the current blade modulation selection. Press the OK button to make the display disappear. The selection will also disappear after 30 seconds. To change the blade modulation selection refer to the Operation and Maintenance Manual, “Monitoring System - Messenger Display” for more information. Refer to graphics 103 , 104 , 105 and 106 for the blade modulation displays that can be found on the Messenger display.

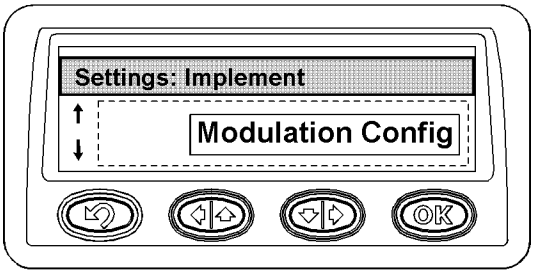


Illustration 103 g01922633

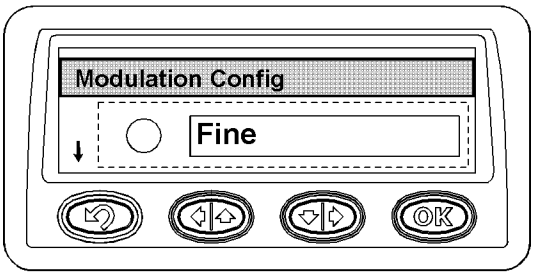


Illustration 104 g01922693

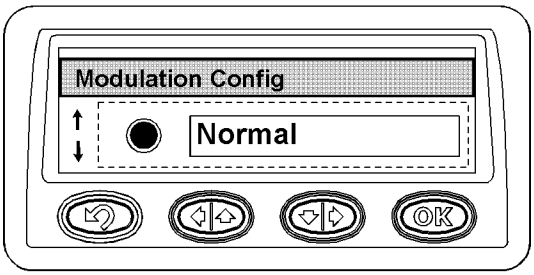


Illustration 105 g01922774

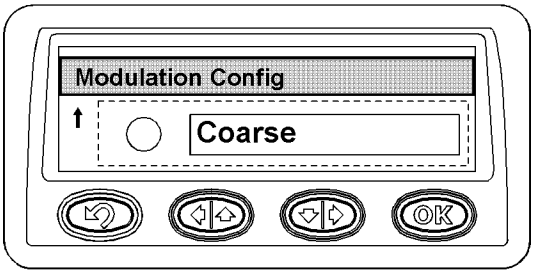


Illustration 106 g01922776

Blade Lower and Blade Float for the Left Side (8)

Blade LOWER – Push the left-hand joystick forward in order to lower the left end of the blade. When you release the joystick, the joystick will return to the HOLD position. The blade height will remain in the selected position.

Blade FLOAT – Push the left-hand joystick to the most forward DETENT position. When you release the joystick, the joystick will return to the HOLD position. The left side of the blade will remain in the FLOAT position until the joystick is moved forward or rearward.

Note: Extra effort may be necessary to push the left-hand joystick forward into the FLOAT (DETENT) position.

Blade Lift for the Left Side (9)

Blade LIFT – Pull the left-hand joystick rearward in order to raise the left end of the blade. When you release the joystick, the joystick will return to the HOLD position. The blade height will remain in the selected position.

Articulation Control (10)

Articulation RIGHT – In order to move the rear of the machine to the right, twist the left-hand joystick clockwise. When you release the joystick, the joystick will return to the HOLD position. The machine articulation will remain in the selected position.

Articulation LEFT – In order to move the rear of the machine to the left, twist the left-hand joystick counterclockwise. When you release the joystick, the joystick will return to the HOLD position. The machine articulation will remain in the selected position.

Note: When you operate the machine at 27 km/h (17 mph) or more you may not articulate past 5.5 degrees. If the machine is articulated 5.5 degrees you may not upshift past the six FORWARD position and you may not upshift past the five REVERSE position.

Blade Sideshift Control (Left) (11)

Blade Sideshift LEFT – Move the right-hand joystick left in order to sideshift the blade to the left. When you release the joystick, the joystick will return to the HOLD position. The blade sideshift will remain in the selected position.

Blade Sideshift Control (Right) (12)

Blade Sideshift RIGHT – Move the right-hand joystick right in order to sideshift the blade to the right. When you release the joystick, the joystick will return to the HOLD position. The blade sideshift will remain in the selected position.

Blade Lower and Blade Float for the Right Side (13)

Blade LOWER – Push the right-hand joystick forward in order to lower the right end of the blade. When you release the joystick, the joystick will return to the HOLD position. The blade height will remain in the selected position.

Blade FLOAT – Push the right-hand joystick to the most forward DETENT position. When you release the joystick, the joystick will return to the HOLD position. The right side of the blade will remain in the FLOAT position until the joystick is moved forward or rearward.

Note: Extra effort may be necessary to push the right-hand joystick forward into the FLOAT (DETENT) position.

Blade Lift for the Right Side (14)

Blade LIFT – Pull the right-hand joystick rearward in order to raise the right end of the blade. When you release the joystick, the joystick will return to the HOLD position. The blade height will remain in the selected position.

Centershift Control (Left) (15)

Centershift LEFT – In order to move the drawbar to the left, push the left side of the thumb button. When you release the thumb button, the thumb button will return to the HOLD position. The drawbar will remain in the selected position.

Centershift Control (Right) (16)

Centershift RIGHT – In order to move the drawbar to the right, push the right side of the thumb button. When you release the thumb button, the thumb button will return to the HOLD position. The drawbar will remain in the selected position.

Blade Pitch Control (Forward) (17)

Blade Pitch FORWARD – In order to pitch the blade forward, push the top of the thumb button. When you release the thumb button, the thumb button will return to the HOLD position. The blade pitch will remain in the selected position.

Blade Pitch Control (Backward) (18)

Blade Pitch BACKWARD – In order to pitch the blade backward, push the bottom of the thumb button. When you release the thumb button, the thumb button will return to the HOLD position. The blade pitch will remain in the selected position.

Implement Lockout Feature

Implement lockout is a feature that allows the customer to inhibit implement movement on an individual circuit basis. Implement lockout can help to prevent unintended implement movement during operation or possible misuse of the implements. Implement circuits included in this feature are: blade pitch, blade sideshift, wheel lean, centershift and articulation.

Note: The return-to-center functionality of the articulation circuit will remain active regardless of the configuration. If the articulation cylinders lose pressure over time, the return to center button will allow re-pressurization to prevent unintended movement about the articulation hitch. Implement Lockout configuration can be changed via Electronic Technician (ET). The default configuration for all circuits is “Not Locked Out” .

An implement service mode can be enabled in Messenger to allow repositioning of the implements without the use of Electronic Technician (ET). The engine must be running and parking brake engaged in order to enable this implement service mode. The parking brake cannot be disengaged until the implement service mode is disabled. Once the implement service mode is disabled, the implements will be re-locked. The implement service mode can be accessed in Messenger from the main menu, select settings, then select Implement, then select service mode.

Blade Circle Drive Control (19)

Circle Drive CLOCKWISE – In order to rotate the blade in a clockwise direction, twist the right-hand joystick clockwise. When you release the joystick, the joystick will return to the HOLD position. The blade circle will remain in the selected position.

Circle Drive COUNTERCLOCKWISE – In order to rotate the blade in a counterclockwise direction, twist the right-hand joystick counterclockwise. When you release the joystick, the joystick will return to the HOLD position. The blade circle will remain in the selected position.

Blade Rotation Angle Limit

The blade rotation angle limit feature provides a configurable rotation limit to prevent unintended contact of the blade with other components on the machine such as tires, ladders, etc. This feature can be enabled in Electronic Technician (ET), by configuring the “Blade Rotation Angle Limit Enable Status” . Once enabled, the blade rotation angle limit can be set between 0°and 160°, the blade rotation will be restricted to rotate in both directions up to the limit specified.

Note: The circle drive slip clutch will allow rotation of the blade outside of the configured limit if an external load is encountered that causes the slip clutch protection function. Once the blade is rotated back within the configured blade angle limits, the envelope of rotation will again be restricted.

Horn (20)

Horn – Depress button in order to sound the horn.

Turn Signal Switch (21)

Left Turn Signal – Push down on the left side of switch in order to activate the left turn signal. An indicator light will illuminate on the front dash. The left turn signal will remain on until the switch is manually returned to the MIDDLE position.

Right Turn Signal – Push down on the right side of switch in order to activate the right turn signal. An indicator light will illuminate on the front dash. The right turn signal will remain on until the switch is manually returned to the MIDDLE position.

Note: If the indicator lights do not illuminate, check the turn signals to ensure that the bulbs are working properly.

Auxiliary Pod (If Equipped)

If equipped, consult your Cat dealer for information regarding the specific configuration of your machine.

Auxiliary Pod Control Roller (Lever 1) (22)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Note: Roll the finger roller to the most forward DETENT position in order to place the implement in the FLOAT position. An indicator light will illuminate next to the finger roller. The implement will remain in the FLOAT position until the finger roller is moved forward or moved rearward.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Pod Control Roller (Lever 2) (23)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Pod Control Roller (Lever 3) (24)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Pod Control Roller (Lever 4) (25)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Note: Roll the finger roller to the most forward DETENT position in order to place the implement in the FLOAT position. An indicator light will illuminate next to the finger roller. The implement will remain in the FLOAT position until the finger roller is moved forward or moved rearward.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Pod Mini Joystick (Lever 5)

EXTEND – Push the mini joystick (26) forward in order to extend the implement cylinder. When you release the joystick, the joystick will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Push the mini joystick (27) rearward in order to retract the implement cylinder. When you release the joystick, the joystick will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Pod Mini Joystick (Lever 6)

RETRACT – Push the mini joystick (28) left in order to retract the implement cylinder. When you release the joystick, the joystick will return to the HOLD position. The implement will remain in the selected position.

EXTEND – Push the mini joystick (29) right in order to extend the implement cylinder. When you release the joystick, the joystick will return to the HOLD position. The implement will remain in the selected position.

Note: Push the mini joystick to the most right DETENT position in order to place the implement in the FLOAT position. An indicator light will illuminate on the mini joystick. The implement will remain in the FLOAT position until the joystick is moved right or moved left.

Cat ® Grade Control Cross Slope (If Equipped)

⚠ WARNING

Once the system is placed in automatic mode, blade movement may occur.

Ensure that all personnel are clear of the blade before you place the system in automatic mode.

Personal injury or death from crushing could occur.

The Cross Slope system is a high technology earthmoving tool that allows the operators to grade and fill with increased accuracy. The blade control system provides precise slope feedback to achieve accurate blade positioning.

Using Cross Slope

1. Disengage the parking brake.

2. Select the desired cross slope screen.

3. Set the desired cross slope.

4. Ensure that there is no articulation, the circle is centered, and no wheel lean.

5. Ensure the implements are not locked out.

6. Place the blade off the ground.

7. Place the desired side in “AUTO” mode.

8. Use the other joystick to control the height of the blade.

Grade Control Auto/Manual Switch (Left Side) (30) and Right Side (34)

Illustration 107 g02491536
Left Side

Illustration 108 g02491537
Right Side

Note: Cat ® Grade Control Cross Slope Auto/Manual Switch will always begin in the MANUAL control position

Press switch (30) to place the left side of the blade in AUTO control. Press switch (30) again to place the left side of the blade in the MANUAL position. An AUTO or MANUAL icon will be displayed on Messenger to indicate which control is being utilized.

Press switch (34) to place the right side of the blade in AUTO control. Press switch (34) again to place the right side of the blade in the MANUAL position. An AUTO or MANUAL icon will be displayed on Messenger to indicate which control is being utilized.

In the automatic state, the Cross Slope system controls one side of the blade to maintain the target cross slope. To enable the automatic control, all of the following conditions must be met:

- Parking brake must be disengaged

- Implements must be enabled
- No active diagnostics against any of the required inputs or outputs
- Operator must be present in the operator seat as indicated by the operator presence switch
- Display must be in one of the two cross slope screens

The manual state is the initial state of the system at power-up. Once the system is in automatic control, the manual state is activated by pressing and releasing the auto/manual switch. Other conditions that will cause the system to return to the manual state include:

- Vacating the operator seat, thus causing the operator presence switch to indicate the operator is not in the seat
- A diagnostic against a required input or output becomes active
- Implements are locked-out
- Navigating to any other screen except one of the two cross slope screens

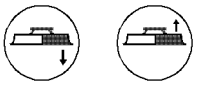
While in the automatic state, the operator has the ability to override the automatic controls with the joystick. This state is called “Suspended Automatic” state. Automatic control of the blade will resume once the operator releases the joystick.

If the right lift cylinder is under the automatic control of the Cross Slope system, and the operator issues a manual command to retract the right lift cylinder, the system will enter the suspend automatic state. When the suspend automatic state is active, the blade will react to the operator command. Once the operator releases the joystick, the system will return to the automatic state and the blade will automatically return to the target cross slope.

The inactive automatic state occurs when the operator attempts to enable the automatic controls by pressing and releasing the auto/manual switch while a condition is present that prevents the automatic controls from being enabled. An icon on Messenger will flash at a rate of two times per second if the controls enter the “Inactive Automatics” state. These conditions include:

- Parking brake is set
- Implements are locked-out
- Active diagnostic on a required input or output is present
- After running automatics with the transmission in Neutral for more than 60 seconds.
- Operator is not present, as detected by the operator presence switch
- One of the two slope screens is not displayed
- A level three diagnostic for the implement control occurs

Grade Control Increment/Decrement Switch (Right Side) (31)

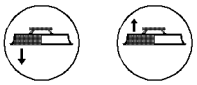


Increment/Decrement – Press the bottom of switch (31) in order to increase the target cross slope of the right side of the blade. Press the top of switch (31) in order to decrease the target cross slope of the right side of the blade.

Note: Pressing the top of switch (31) and (32) at the same time will switch the direction of the cross slope target.

Note: Pressing the bottom of switch (31) and (32) at the same time to set the target value to the current cross slope of the blade.

Grade Control Increment/Decrement Switch (Left Side) (32)



Increment/Decrement – Press the bottom of switch (32) in order to increase the target cross slope of the left side of the blade. Press the top of switch (32) in order to decrease the target cross slope of the left side of the blade.

Note: Pressing the top of switch (31) and (32) at the same time will switch the direction of the cross slope target.

Note: Pressing the bottom of switch (31) and (32) at the same time to set the target value to the current cross slope of the blade.

Grade Control Side Shift Auto/Manual Switch (33)

Side Shift Auto/Manual – This switch is only for use with AccuGrade 3D systems.

Cat® Grade Control Cross Slope Favorites (If Equipped) (35)

Cross slope favorites allows quick access to stored cross slope targets. To store a favorite, first reach your desired target number, then press and hold the cross slope favorites button for two seconds. “Target” will be highlighted on your display to show that the favorite has been stored successfully. Nine favorites may be stored at any give time. If, after you have saved nine favorites you desire to save another favorite, you can override one of your saved favorites to do so. Scroll through to a saved cross slope favorites, simply press and hold the cross slope favorites button for two seconds to override the previously stored favorite.

Auxiliary Control Roller (Lever 8) (If Equipped) (36)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Auxiliary Control Roller (Lever 9) (If Equipped) (37)

EXTEND – Roll finger roller forward in order to extend the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Roll the finger roller rearward in order to retract the implement cylinder. When you release the finger roller, the finger roller will return to the HOLD position. The implement will remain in the selected position.

Float Button (38)

Press the button to activate the float function, a green indicator will illuminate above the button to show that the float function has been activated. Press the button again to deactivate the float function. The green indicator will shut off to show that the float function has been deactivated.

Implement Control Roller (Lever 6) (If Equipped) (42)

Note: Consult your Cat dealer for information on specific configuration of your machine.

EXTEND – Roll thumb wheel downward in order to extend the implement cylinder. When you release the thumb wheel, the thumb wheel will return to the HOLD position. The implement will remain in the selected position.

Note: Roll the thumb wheel to the most downward DETENT position in order to place the implement in the FLOAT position. An indicator light will illuminate next to the thumb wheel. The implement will remain in the FLOAT position until the thumb wheel is moved upward or moved downward.

RETRACT – Roll the thumb wheel upward in order to retract the implement cylinder. When you release the thumb wheel, the thumb wheel will remain in the HOLD position. The implement will remain in the selected position.

Implement Control Roller (Lever 7) (If Equipped) (43)

EXTEND – Roll thumb wheel downward in order to extend the implement cylinder. When you release the thumb wheel, the thumb wheel will return to the HOLD position. The implement will remain in the selected position.

RETRACT – Roll the thumb wheel upward in order to retract the implement cylinder. When you release the thumb wheel, the thumb wheel will remain in the HOLD position. The implement will remain in the selected position.

Note: If Lever 7 is assigned to the ripper, a ripper autostow feature is available. To enable the autostow feature through the message display, navigate the “Settings” menu to the “Implement” section and enable “Ripper Autostow Status” . Refer to Operation and Maintenance Manual, “Monitoring System” for more information on the message display and menus. To activate autostow, first, place the implement lockout switch in the UNLOCK position. Flip the thumb wheel forward twice, quickly, and release. The ripper will then be placed in the stowed position. To cancel the autostow command, roll the thumb wheel either forward or rearward.

Door Release Lever (44)

Pull the lever in order to release the door from the locked position. There is one lever on the right door and one lever on the left door.

Throttle Resume/Decel Switch (45)

Throttle Resume/Decel Switch – Pull back trigger switch on the right-hand joystick in order to resume engine speed to the previously selected speed. The trigger switch will only resume the engine speed if the throttle hold mode switch is in the AUTOMATIC mode and the trigger switch will only resume the engine speed after the service brakes have been applied or the accelerator control is moved. The trigger switch also provides the following functions:

- By holding the trigger switch, engine speed will be decreased by approximately 100 rpm/sec.
- By bumping the trigger switch, engine speed will be decreased by 100 rpm increments.

Differential Lock Control (46)

NOTICE
To prevent damage to the differential, do not engage the differential lock control at high speeds.

Do not turn machine with differential lock engaged.

Do not engage the differential lock control while one wheel is spinning. Decrease engine rpm until the wheel stops spinning. Anticipate using the differential lock before wheel slippage occurs.

In areas of high resistance, it may be necessary to turn the machine slightly in order to aid in unlocking the differential lock. Decreasing the engine rpm may also be helpful.

LOCK – Push control button on the right-hand joystick in order to lock the differential. When the differential is locked, an indicator light will illuminate on the front dash.

Note: The differential lock will help to prevent wheel slippage. Use the differential lock when you grade on soft ground or on wet ground. Engage the differential lock only when the wheels are not slipping.

UNLOCK – Push control button again in order to unlock the differential.

Lock the differential in order to increase the traction, as required.

Make sure that the differential is unlocked when you turn the machine or when you articulate the machine. Also, make sure that the differential is unlocked when you are roading the machine.

NOTICE
Use of the differential lock when turning, articulating or roading may cause drive train component damage.

When one of the tandem wheels encounters loose surfaces or slippery surfaces, the differential lock will provide maximum traction at all times by eliminating wheel spin. Any excessive uncontrolled wheel spin can cause accelerated wear on certain components of the drive train. This is due to inadequate lubrication while the wheel is spinning.

Do not engage differential lock while one wheel is spinning. Decrease engine rpm until the wheel stops spinning. Anticipate using the differential lock before wheel slippage occurs.

When the differential lock control is in the AUTOMATIC mode the ECM will lock and/or unlock the differential based on certain machine conditions which include machine load and steer/articulation angle. The indicator for the differential lock will illuminate when the differential is locked. The feature will be disengaged when the machine is in the AUTOMATIC mode. and the gear setting is greater than 5F or 3R. Refer to Operation and Maintenance Manual, “Operator Controls - Auto Differential Lock Switch” for more information.

Transmission Control Switch (47)

FORWARD – From the NEUTRAL position, pull the bottom of trigger switch in order to move the machine forward. Use upshift switch on the left-hand joystick to upshift the transmission to the desired forward speed. Use downshift switch on the left-hand joystick to downshift the transmission to the desired forward speed.

NEUTRAL – Move trigger switch to the MIDDLE position in order to place the transmission in NEUTRAL.

REVERSE – From the NEUTRAL position, pull the top of trigger switch in order to move the machine in reverse. Use upshift switch on the left-hand joystick to upshift the transmission to the desired reverse speed. Use downshift switch on the left-hand joystick to downshift the transmission to the desired reverse speed.

Transmission Operation

Note: Under certain conditions, the transmission will neutralize and prevent engine stall when the service brakes are fully engaged and the inching pedal is not depressed. The tandem tires will stop rotating. The LCD display will display NEUTRAL as the actual gear, the operator requested gear will change to allow speed matched transmission re-engagement when the service brake is disengaged and the ground speed is greater than 6.5 km/h (4 mph). At ground speeds below 6.5 km/h (4 mph) the machine will remain in the NEUTRAL position until the transmission control switch is cycled to the NEUTRAL position and back to the operator requested gear.

The Power Shift Transmission has the following standard options:

- 8 forward gears
- 6 reverse gears
- Inching allows the operator to control the machine at infinitely variable low ground speeds when precise maneuverability is demanded.

The following methods may be used for shifting gears:

- Launching the machine from the NEUTRAL position
- Sequential speed shifting
- Shuttle shifting

Parking Brake Release

Before the operator can take control of the transmission the operator must perform the following sequence of interlock events:

1. The parking brake switch must be engaged.

2. The operator is present in the seat.

3. The transmission control switch is in the NEUTRAL position.

4. The left joystick is aligned with the front wheels. Refer to Operation and Maintenance Manual, “Operator Controls - Joystick Steering Alignment”.

To disengage the parking brake, push the bottom of the parking brake switch . The operator now has control of the machine.

⚠ WARNING

If the operator leaves the seat while the machine is registering Transmission Output Speed (TOS), the operator presence system will not respond. If there is no Transmission Output Speed (TOS), then the park brake will engage and all hydraulic inputs are locked out.

If the operator leaves the seat while the parking brake switch is disengaged and the machine is not moving, the parking brake will automatically engage. Once the operator returns to the seat, the operator will need to reset the parking brake switch before the machine will operate. Push the top of the parking brake switch and then push the bottom of the parking brake switch . If the steering joystick was moved, repeat steps 1 through 4 to disengage the parking brake.

If the machine needs to be moved quickly in an emergency, please refer to Operation and Maintenance Manual, “Operation” in the Safety Section of the manual.

Launching the machine from the NEUTRAL position

The operator can engage the transmission into gear by the following two methods:

- Automodulation
- Inching into gear

When automodulating into gear, the direction clutch will engage in a smooth and controlled manner. This machine launch method was developed to be performed at all engine speeds without shortening the life of the transmission. The transmission controller will use the initial gear as the selected gear for automodulation. If the initial gear is not desired, use the upshift switch or use the downshift switch to select the gear. Refer to Operation and Maintenance Manual, “Operator Controls - Initial gear” or Operation and Maintenance Manual, “Monitoring System - Messenger Display” for more information about initial gear. Unlike the autoshift, the initial gear is a standard function on all machine configurations.

Note: Gears one through four FORWARD and the gears one through threeREVERSE have been developed for automodulation use.

Note: Avoid automodulating into gear while the machine is under load. Repeated NEUTRAL to gear engagements under load may shorten the transmission clutch life.

Note: When automodulating into gear do not change the engine speed. If the engine speed is increased, the shift may result in a harsh engagement.

The transmission modulator control (inching pedal) may also be used to engage the transmission into gear. Before selecting the direction with the transmission control switch , fully depress the transmission modulator control (inching pedal) . After selecting the gear and after selecting the direction, release the transmission modulator control (inching pedal) slowly for the operator controlled clutch engagement. Refer to Operation and Maintenance Manual, “Operator Controls - Transmission Modulator Control (Inching Pedal)” for additional explanation.

Working Low Idle

Working low idle is a feature that provides an elevated low idle to help protect the drivetrain from high torsional loading caused by low engine speed machine operation. This feature can be enabled in Electronic Technician (ET), by configuring the “Machine Working Low Idle” status. When enabled, the machine will increase the low idle engine speed from 800 RPM to 1000 RPM when the machine is shifted from NEUTRAL to FORWARD or REVERSE. Once the machine is shifted back into NEUTRAL, the engine speed will return to the 800 RPM low idle after 5 seconds. When the transmission is neutralized using the inching pedal while in a gear, the low idle speed will remain at 1000 RPM.

Speed Matching

Speed Matching is a standard feature that limits the gears into which the transmission can be engaged based on the machine speed. This feature will help to protect the driveline components from excessive torques when transitioning from a neutralized state into a gear state. This feature also helps to prevent overspeed of internal transmission components by selecting the proper neutral state based on machine speed. Neutralized states of the transmission include both the cycling of the transmission control switch to the NEUTRAL position as well as neutralization by depressing the inching pedal.

This feature also limits the initial forward gear and initial reverse rear to 4F and 3R respectively.

Note: The autoshift feature functionality and neutralization functionality of the Anti-Stall feature will override the Speed Matching feature.

Limited Inching

Limited inching is a feature that inhibits inching pedal functionality in higher gears to help protect the drivetrain from excessive torque caused by using the inching pedal both in gear or while executing a shift. This feature can be enabled in Electronic Technician (ET), by configuring the “Inching Pedal Neutralizer Enable Status” . The limited inching feature allows full inching functionality in gears 1 through 3 FORWARD and REVERSE. In all other gears, inching commands that exceed 90% of the pedal travel for more than 2 seconds will result in neutralization of the transmission. All other inching commands in these gears will not be used by the ECM and the transmission cannot be modulated in these gears. The limited inching strategy works with the speed matching strategy to select the proper neutral state of the transmission based on machine speed and will re-engage the appropriate speed matched gear when the inching pedal is released.

Transmission Over Speed Protection Strategy

Overspeed protection is a feature that utilizes transmission shifts to help protect the engine from running at an overspeed condition. In addition, overspeed protection ensures that the transmission will never be shifted into a gear that would cause an overspeed condition.

The control will upshift the transmission by one gear when the transmission output speed reaches the overspeed up shift point for the current gear. The control does not limit the number of overspeed up shifts. If the transmission output speed continues to increase, the control will upshift, based on overspeed upshift points, until the transmission reaches the top gear.

The control will downshift the transmission by one gear when the actual gear is higher than the selected gear and the transmission output speed decreases below the overspeed downshift point.

Transmission Under Speed Protection Strategy

Underspeed protection automatically downshifts the transmission to the next lower gear when the machine is below 800 rpm and under load. The downshift will allow the engine to operate in a more appropriate speed range. If the engine continues below idle under load the underspeed protection will automatically downshift the transmission to the next lower gear after a one second delay. Once the engine speed has recovered to an acceptable level for at least 5 seconds, the transmission will begin to upshift to the original requested gear. The underspeed protection will not downshift the transmission to the NEUTRAL position. In order to avoid automatic downshifts, you operate the machine at or above 1000 rpm. If a directional shift is performed before the transmission has upshifted to original requested gear, the transmission will automatically upshift after the directional shift.

Anti-Stall Protection Strategy

Anti-stall is a feature that shifts the transmission into the NEUTRAL position to help protect the drivetrain from high torsional loading generated by low engine speed machine operation. This feature is enabled when engine speed drops below 575 rpm. The transmission will automatically shift into NEUTRAL to prevent continuous low engine speed machine operation and possible engine stall. “ENGINE UNDERSPEED: CYCLE FNR” will display on the LCD to indicate that the feature has been enabled. You must cycle the transmission control switch to re-engage the transmission.

Note: If an instantaneous load is encountered at low engine speed, it is still possible to stall the machine. To minimize enabling of this feature, the machine should be operated with engine speeds at or above 1000 rpm.

Sequential Speed Shifting

The Power-Shift function of the transmission allows the operator to adjust the transmission gear while the machine is in motion. The operator can obtain the optimal machine ground speed for the operation being performed by matching the transmission gear for the given engine speed. Use the upshift switch and use the downshift switch to adjust the transmission gear while you use the machine.

You can upshift the transmission at any engine speed, given the engine is capable of handling the load. No matter the number of shifts that are commanded at one time, there is a delay between the shifts to prevent a shift interruption. Anticipate the gear you need for the operation to prevent the transmission from stalling the engine due to the shift delay.

Depending on the gear, downshifting requires the engine to be at some speed less than full throttle before being executed to prevent the engine from overspeeding. The M-Series motor graders use Control Throttle Shifting (CTS) to control downshift gear requests. If the engine is at some speed above the inhibit point, Control Throttle Shifting (CTS) will automatically reduce the engine speed to allow the downshift. Upon shift completion, control of the engine speed will be given back to the operator. Similar to the upshifts, the downshifts are subject to a shift delay to prevent shift interruption.

Speed shifts can be performed in any loading condition, as speed shifts are automatically compensated for engine load. In order to lengthen the transmission clutch life and in order to prevent degradation of shift quality, the clutch modulation is adjusted according to load conditions. The compensated shifts minimize torque interruptions in order to maintain the load transfer during the transmission gear change.

Note: Do not utilize the transmission modulator control (inching pedal) when performing speed shifts. The Power-Shift transmission controls the clutch disengagement and the clutch engagement according to the requested shift.

Shuttle Shifting

Shuttle Shifting, also known as directional shifting, allows the operator to change the machine direction quickly and with minimal disruption to the ground surface being graded. The M-Series transmission precisely controls the engagement of the direction clutch for a smooth transition from one direction to the other. Control Throttle Shifting (CTS) is also utilized during the shuttle shift to maximize the shift. The following shifts are allowed:

Table 9

Shuttle Shift	Engine Speed Conditions for Shift	Operator Input
1F - 1R 1R - 1F	Entire engine speed range	Transmission Control Switch
2F - 2R 2R - 2F	Entire engine speed range	Transmission Control Switch
3F - 3R 3R - 3F	Entire engine speed range	Transmission Control Switch
4F - 3R 4R - 3F	< 1500rpm	Transmission Control Switch

To perform a shuttle shift, simply select the opposite direction from the current selection on the transmission control switch . The direction change must be done in one continuous motion, the transmission control switch should not be in the NEUTRAL position for greater than 0.2 seconds. If a shuttle shift is requested while operating in a gear higher than those described in the table above, the transmission controller will automatically downshift to a gear in the range of a shuttle shift.

Note: To prevent excessive transmission clutch wear, shuttle shifting is not recommended while using the ripper or while using the scarifier or while towing a heavy load. In these instances, either lift the implement sufficiently above the ground surface or bring the machine to a stop by using the transmission modulator control (inching pedal) and the service brake control before performing the shuttle shift.

Programmable Transmission Gear Settings

Initial Gear

One gear is available for each direction. The initial gear can be equal to or less than the maximum gear. The initial gear can be changed through Electronic Technician (ET) or Messenger when the machine is in NEUTRAL and Transmission Output Speed (TOS) is 0 rpm. Changes made by ET or Messenger are the new defaults at the time of the changes or after a power cycle. FORWARD and REVERSE do not need to be the same gear. If the initial gear is greater than the minimum autoshift gear the initial gear will be ignored when the autoshift is on. Refer to Operation and Maintenance Manual, “Operator Controls - Autoshift Switch” for additional information. Refer to Operation and Maintenance Manual, “Monitoring System - Messenger Display” for additional information.

Maximum Gear

One gear is available for each direction. The maximum gear can be changed through Electronic Technician (ET) when the machine is in NEUTRAL and Transmission Output Speed (TOS) is 0 rpm. Changes made by ET are the new defaults at the time of the changes or after a power cycle. FORWARD and REVERSE do not need to be the same gear. The range the maximum gear can be set to in the FORWARD position is between three and eight. The range the maximum gear can be set to in the REVERSE position is between three and six. Refer to Operation and Maintenance Manual, “Operator Controls - Autoshift Switch” for additional information. Refer to Operation and Maintenance Manual, “Monitoring System - Messenger Display” for additional information.

Wrist Rest Height Adjustment Knob (48)

Pull the knob in order to adjust the height of the wrist rest. Release the wrist rest height adjustment knob in order to lock the wrist rest in position.

Control Pod Fore/Aft Adjustment Lever (49)

Pull up on the fore/aft lever in order to move the control pod forward or backward. Release the fore/aft lever in order to lock the control pod in position.

Arm Pad Adjustment Knob (50)

Turn the knob counterclockwise in order to adjust the arm pad. Turn the knob clockwise in order to lock the arm pad in position.

Control Pod Vertical Adjustment Knob (51)

Turn the knob counterclockwise in order to adjust the height of the control pod. Turn the knob clockwise in order to lock the control pod in position.

Note: Your machine may be equipped with a switch that will adjust the height of the control pod. If equipped, the switch will be located towards the rear of the control pod on both the left and right side.

Control Pod Raise – Press the top of switch in order to raise the height of the control pod

Control Pod Lower – Press the bottom of switch in order to lower the height of the control pod.

Secondary Steering Test Switch (52)

Secondary Steering Test Switch – Switch allows the operator to manually test the operation of the secondary steering system. Refer to Operation and Maintenance Manual, "Secondary Steering - Test" for the proper procedure.

Parking Brake Switch (53)

⚠ WARNING

Personal injury could result from the sudden stop of the machine.

The parking brake is released using the powertrain oil. A loss of powertrain oil pressure (transmission pressure) will result in automatic engagement of the parking brake.

Correct the reason for the loss of oil pressure. The use of the parking brake to slow or stop the machine during regular operation will cause severe damage to the parking brake.

NOTICE
Do not engage the parking brake while the machine is moving unless the service brakes fail. The use of the parking brake as a service brake in regular operation will damage the parking brake. The use of the parking brake as a service brake could also result in possible damage to the transmission.

NOTICE
Moving the machine with the parking brake engaged will wear or damage the brake and/or transmission. If necessary, have the brake repaired before you operate the machine.

Note: Engage switch after the machine has stopped.

ENGAGE – Push in the top of the switch in order to engage the parking brake. The parking brake indicator will illuminate. Refer to Operation and Maintenance Manual, "Monitoring System" for further information.

DISENGAGE – Push in the bottom of the switch in order to disengage the parking brake. The parking brake indicator will go out. Refer to Operation and Maintenance Manual, "Monitoring System" for further information.

Engine Start Switch (54)

When you turn switch to the ON position, electrical power is supplied to the systems in the operator compartment.

OFF – When you insert the engine start switch key and when you remove the engine start switch key, the engine start switch must be in the OFF position. Also, turn the engine start switch to the OFF position in order to stop the engine.

ON – To activate the electrical circuits in the cab, insert the engine start switch key and turn the engine start switch clockwise to the ON position.

START – To start the engine, insert the engine start switch key and turn the engine start switch clockwise to the START position. When the engine start switch key is released, the engine start switch will return to the ON position.

Note: If the engine fails to start, return the engine start switch to the OFF position. This must be done before you attempt to start the engine again.

Machine Security System (If Equipped)

NOTICE
If equipped with a Caterpillar Machine Security System (MSS), this machine may not start under certain conditions. Read the following information and know your machine's settings. Your Caterpillar dealer can identify your machine settings.

Machine Security System (MSS) – Machines that are equipped with MSS can be identified by a decal that is located in the operator station. The MSS is designed to be a theft deterrent and/or the MSS will prevent the unauthorized operation of the machine.

Basic Operation

The MSS may be programmed to use a standard Cat key or an electronic key. The electronic key contains an electronic chip within the plastic housing for the key. Each key emits a unique signal to the MSS. The keys can be identified by a gray housing or a yellow housing. The MSS may have programmed settings that require an electronic key for starting during certain periods of time. The MSS may also have programmed settings that allow a standard Cat key to start the machine during certain periods of time.

Note: Ensure that you have only one electronic key near the exciter coil when you are attempting to start the machine. If there is more than one electronic key near the exciter coil, the MSS may not be able to read the key in engine start switch and the machine will not start.

When engine start switch is turned to the ON position, the ECM will read the unique ID that is stored in the electronic key. The ECM will then compare this ID to the list of authorized keys. The following table tells the operator the status for starting the machine. The status light is located near engine start switch .

Table 10

Green light	The key is authorized.
Red light	The key is not authorized.

Note: The MSS will not shut down the machine after the machine has started.

Security Management

The MSS has the capability to allow you to program the system to automatically activate at different time periods with different keys. The MSS can also be programmed to reject a specific electronic key after a selected date and time. When you turn the key to the OFF position and the MSS is active, you have a 30 second interval in order to restart the machine if you do not have an electronic key or if you do not have a valid key. Also if the machine stalls, there is a 30 second interval for restarting the machine if you do not have an electronic key or if you do not have a valid key. This 30 second interval is counted from the time of turning the key to the OFF position.

Note: Valid keys are able to start the machine at any time.

Note: Know your machines settings because the use of an electronic key is no guarantee that the machine can be restarted.

An expiration date can be set for each electronic key that is contained in the list of keys for the machine. The key will no longer start the machine when the internal clock in the security system passes the expiration date. Each entry in the list of keys can have a different expiration date.

Spare keys are available from your dealer. Before a key can operate the machine, the MSS must be set to accept that particular key. Consult your Cat dealer for information on additional features of the MSS.

Regulatory Compliance Section

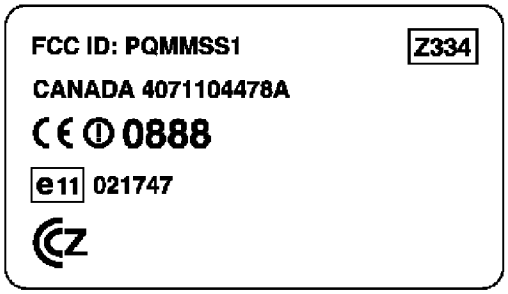
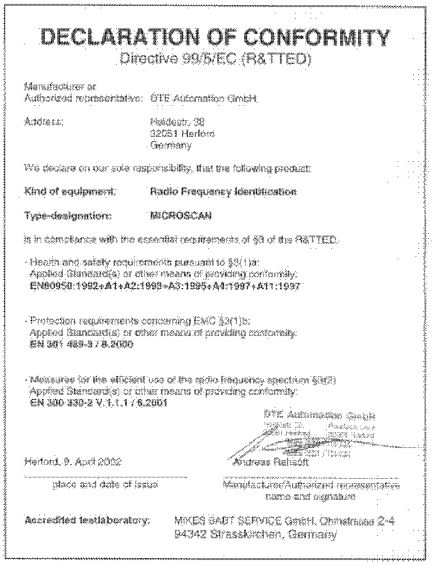


Illustration 109 g01438398

Consult your Cat dealer with any questions that concern the operation of the MSS in a specific country.



DECLARATION OF CONFORMITY
Directive 99/5/EC (R&TTED)

Manufacturer or
Authorized representative: GTE Automation GmbH

Address: Heidestr. 38
32051 Herford
Germany

We declare on our sole responsibility, that the following product:

Kind of equipment: Radio Frequency Identification

Type-designation: MICROSCAN

is in compliance with the essential requirements of §3 of the R&TTED.

- Health and safety requirements pursuant to §3(1)a:
Applied Standard(s) or other means of providing conformity:
EN60950:1992+A1+A2:1993+A3:1995+A4:1997+A11:1997

- Protection requirements concerning EMC §2(1)b:
Applied Standard(s) or other means of providing conformity:
EN 301 489-3 / 8.2000

- Measures for the efficient use of the radio frequency spectrum §3(2)
Applied Standard(s) or other means of providing conformity:
EN 300 330-2 V.1.1.1 / 6.2001

GTE Automation GmbH

Herford, 9. April 2002 — Andreas Reisdorf

place and date of issue — Manufacturer/Authorized representative name and signature

Accredited testlaboratory: MIKES BABT SERVICE GmbH, Ohmstrasse 2-4
94342 Strasskirchen, Germany

Illustration 110 g01438501

Accelerator Control (55)

Depress pedal in order to increase the engine speed. Release the pedal in order to decrease the engine speed. The engine will return to the setting of the throttle control when you release the pedal.

Service Brake Control (56)

Depress pedal in order to apply the service brakes. Use the service brake control for the following conditions:

- Reduce ground speed.
- Stop the machine - Just before the machine comes to a stop, you must also apply the transmission modulator control (inching pedal) or place the transmission control switch in the NEUTRAL position to prevent stalling of the engine.

To disengage the service brakes, release the pedal.

Note: Under certain conditions, the transmission will neutralize and prevent engine stall when the service brakes are fully engaged and the inching pedal is not depressed. The tandem tires will stop rotating. The LCD display will display NEUTRAL as the actual gear, the operator requested gear will change to allow speed matched transmission re-engagement when the service brake is disengaged and the ground speed is greater than 6.5 km/h (4 mph). At ground speeds below 6.5 km/h (4 mph) the machine will remain in the NEUTRAL position until the transmission control switch is cycled to the NEUTRAL position and back to the operator requested gear.

Transmission Modulator Control (Inching Pedal) (57)

The transmission modulator control (inching pedal) disengages the power to the wheels.

Depress inching pedal in order to decrease the power to the wheels. A sensor will monitor the position of the pedal. As the pedal is depressed, the hydraulic pressure to the direction clutches will vary. When the pedal is depressed completely, the power to the rear wheels will be disengaged.

The transmission modulator control (inching pedal) was designed and developed in order to be used in all loading conditions. The intent of the control was to provide the operator with the ability to vary the machine speed independent of engine speed for short durations. This becomes useful when the operator demands high controllability and maneuverability of the machine. Inching allows the operator to vary the machine ground speed while keeping engine speed high for quick implement response. Gears one through five FORWARD and the gears one through four REVERSE have been developed for modulator control (inching pedal) use.

If the inching function is used in high loading situations, the operator should pick the optimal gear to match the load condition. If the operator constantly experiences machine stall (no forward or reverse movement) while inching, the operator should downshift to the next available gear.

Note: To ensure maximum transmission clutch life, avoid prolonged use of the transmission modulator control (inching pedal) when moving heavy loads. Rather, try to select a gear that will provide the same machine ground speed that the transmission modulator control (inching pedal) allowed previously.

The transmission modulator control (inching pedal) can also be used to launch the machine into gear.

Note: Although direction changes can be performed with the transmission modulator control (inching pedal), the preferred method is to utilize Shuttle Shifting for machine direction changes. Shuttle Shifting ensures longer transmission clutch life and repeatable shift quality.

Note: Use of the transmission modulator control (inching pedal) is not to be used for shifting gears while the machine is moving. The use of the inching pedal during shifts may shorten the transmission clutch life and accelerate damage to the drive train.

Warning Beacon Switch (58)

Warning Beacon Switch (If Equipped) – Push in the top of switch in order to turn on the warning beacon lamp. Push in the bottom of the switch in order to turn off the warning beacon lamp.

Heated Mirror Switch (59)

Heated Mirror Switch (If Equipped) – Push in the top of switch in order to apply heat to the exterior mirrors. The heated mirrors will be operational when engine start switch is in the ON position. An indicator light on the switch will become active showing that the mirrors are being heated. The indicator light will deactivate after a set time in order to show that the mirrors are not being heated.

Defroster Fan Switch (60)

Defroster Fan – Push in the top of switch in order to operate the defroster fan at high speed. Push in the bottom of the switch in order to operate the defroster fan at low speed. Move the switch to the MIDDLE position in order to turn off the defroster fan.

Centershift Lock Switch (61)

Centershift Lock Switch – Push the bottom of switch in order to engage the centershift lock. Push the top of the switch in order to disengage the centershift lock.

⚠ WARNING

Personal injury could result from the sudden movement of the blade when the centershift lock-pin is released.

Before releasing the centershift lockpin be sure that all personnel are clear of the blade area, the circle and blade are centered under the machine and the blade has been lowered to the ground.

1. Use centershift control (left) and centershift control (right) in order to shift the drawbar. Move the drawbar in the desired direction and the desired position. Place the left side of the blade and the right side of the blade in FLOAT position in order to ground the moldboard.
2. Move switch to the DISENGAGED position. When the switch is in the DISENGAGED position, an indicator light will illuminate on the front dash.
3. If you want to move the link bar to the first hole on either side of center or to the second hole on either side of center, proceed to Step 3a. If you want to move the link bar to the third hole on either side of center or to the farthest hole on either side of center, proceed to Step 3c.
   a. Make sure that the left side of the blade and the right side of the blade are still in the FLOAT position. Move either centershift control (left) or centershift control (right) in the opposite direction that was used to position the drawbar in Step 1. As the centershift cylinder moves, the linkage will roll freely. Also, the link bar will move sideways.
   b. Continue with Step 4.
   c. Move the left side of the blade and the right side of the blade out of FLOAT position.
   d. Simultaneously, move centershift control (left) and lower the right side of the blade by moving the right-hand joystick forward. At the same time, raise the left side of the blade by moving the left-hand joystick backward.
4. Line up the centershift lock pin with the desired hole in the link bar. Use the indicator that is on the right lift arm to check the alignment.
5. Move switch to the ENGAGED position. The indicator light for the centershift lock will turn off when the centershift lock pin is engaged.

Note: If the indicator light for the centershift lock does not turn off, slightly move the link bar for the centershift in order to align the hole with the centershift lock pin.

6. Sideshift the link bar toward the desired direction. Use the blade lift cylinders in order to adjust the blade angle.

Heated Glass Switch (If Equipped) (62)

Heated Glass Switch (If Equipped) – Push in the top of switch in order to apply heat to the glass. The heated glass will be operational when engine start switch is in the ON position. An indicator light on the switch will become active showing that the glass is being heated. The indicator light will deactivate after a set time in order to show that the glass is not being heated.

Variable Blade Float

Left Variable Blade Float (63) – Adjust control anywhere between MINIMUM position (left) and MAXIMUM position (right). This will enable the operator to control the amount of lift force or float force that is applied to the working surface by the left side of the blade.

Variable Blade Float Switch (64) – Push in the top of switch in order to enable the variable blade float. Push in the top of switch again in order to disable the variable blade float.

Right Variable Blade Float (65) – Adjust control anywhere between MINIMUM position (left) and MAXIMUM position (right). This will enable the operator to control the amount of lift force or float force that is applied to the working surface by the right side of the blade.

While the blade is in the FLOAT position, the variable blade float will provide the ability to control the pressure of the hydraulic fluid for the blade lift cylinders. The pressure is controlled by left variable blade float control and right variable blade float control . The controlled pressure for the blade lift cylinders positively affects the weight of the following components: drawbar, circle and moldboard.

Note: The variable blade float will not apply a downward pressure above the weight that is provided by the following components: drawbar, circle and moldboard.

Compression Brake Switch (66)

Compression Brake – Push in the top of switch in order to put the compression brake in AUTOMATIC mode. Push in the bottom of switch in order to put the compression brake in OFF mode.

Note: It is recommended to operate the machine with the compression brake switch in the ON position.

The compression brake may be activated between gears four and eight FORWARD and between second and sixth REVERSE.

When switch is in the AUTOMATIC mode the compression brake will activate when the actual Engine Output Speed (EOS) is 200 rpm above the requested EOS.

Note: If the machine has reached 200 rpm above the requested EOS the requested the compression brake system will automatically activate between gears four and eight FORWARD to prevent engine overspeed. If the machine is between gears 1 and 3 FORWARD the transmission overspeed protection will activate and automatically shift the transmission to the next higher gear if the service brakes are not used. It is not recommended to allow the machine to reach the overspeed limits. The service brakes should be applied or a manual shift should be used to place the machine in gear four FORWARD or above depending on the grade. The compression brake may activate in second to sixth gear REVERSE. If the machine reaches overspeed in first gear REVERSE the transmission overspeed protection will activate and automatically shift the transmission to the next higher gear if the service brakes are not used. It is not recommended to allow the machine to reach the overspeed limits. The service brakes should be applied or a manual shift should be used to place the machine in the next higher gear.

The compression brake is a three phase system. The compression brake system will activate two cylinders to attempt to return the EOS to 50 rpm above the requested EOS. If the system is able to reach this request the system will be disabled. The system will be enabled if the EOS is 200 rpm above the requested EOS. If the compression brake is unable to maintain an rpm lower than 200 rpm over the requested EOS the compression brake system will activate an additional two cylinders until the maximum number of cylinders are active for the given gear.

Note: In fourth gear FORWARD up to four cylinders will be activate. In gears five through eight FORWARD up to six cylinders will be active. In second gear REVERSE up to two cylinders will be activate. In third gear REVERSE up to four cylinders will be activate. In gears three through six REVERSE up to six cylinders will be active.

When the autoshift switch is in the ON position and when the compression brake switch is in the AUTOMATIC mode the transmission will upshift before the compression brake activates until the maximum autoshift gear limit is reached.

When the autoshift switch is in the OFF position and when the compression brake switch is in the OFF position the compression will not operate until the maximum autoshift gear limit has been reached. The autoshift gear must be set to fourth gear FORWARD or higher for the compression brake to activate. If the autoshift is set to fourth gear FORWARD or higher the compression brake will activate when the EOS reaches 200 rpm above the requested EOS. If the autoshift gear is set to third gear FORWARD or the autoshift gear is set to second gear FORWARD the transmission will upshift to fourth gear FORWARD and the compression brake will activate.

When you operate the machine with the transmission control switch in any gear higher than third gear FORWARD or first gear REVERSE and the compression brake switch is in the OFF position and the EOS is 200 rpm above high idle EOS the compression brake will activate.

Note: The service brake does not affect the compression brake. The compression brake is recommended for long-term retarding.

The compression will deactivate if you depress the inching pedal and the compression brake will deactivate during a shift. If the throttle hold mode switch is in the MANUAL mode and you depress the inching pedal the compression brake will deactivate because the EOS will equal the throttle hold setting.

Headlight Dimmer Switch (67)

Headlight Dimmer Switch – Push in the top of switch in order to change the headlight beams to the high beam. Push in the bottom of the switch in order to change the headlight beams to the low beam.

Blade Cushion Switch (68)

Blade Cushion Switch (If Equipped) – Push in the top of switch in order to turn on the blade cushion. Push in the bottom of the switch in order to turn off the blade cushion.

Implement Lockout Switch (69)

Note: Before the implement controls will function, switch must be in the UNLOCK position. **Steering is not affected by the position of switch.**

LOCK – Push the top of the switch in order to lock out the implement controls.

UNLOCK – Push in the bottom of the switch in order to unlock the implement controls.

Access Platform Light Switch (If Equipped) (70)

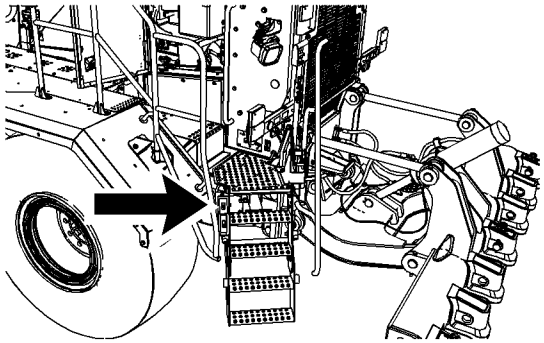


Illustration 111 g03299816

Access Platform Light Switch – Push in the top of switch in order to turn on the access platform lights. Push in the bottom of the switch in order to turn off the access platform lights. There is an additional platform access light switch. the switch is located on the outside of the machine near the access platform ladder on the left side of the machine.

Cigar Lighter (24 V) (71)

Lighter – Push the lighter inward and release the lighter. When the lighter is ready to use, the lighter will move outward. The lighter can also be used as a 24 v power receptacle.

Power Port (12 V) (72)

Power Port 12 V – The power port can be used to power 12 v automotive electrical equipment or accessories. Remove the cap before use.

Throttle Hold Mode Switch (73)

Throttle hold mode switch allows the operator to set the mode for the throttle hold function. The following modes can be selected: AUTOMATIC, OFF and MANUAL.

AUTOMATIC – Push in the top of switch in order to put the throttle control in AUTOMATIC mode. When the throttle control is in AUTOMATIC mode, the function of the throttle will be like a cruise control. Use accelerator control in order to achieve the desired engine speed. Push in the top of throttle set/accel switch in order to set the throttle at the current engine speed. Use throttle set/accel switch and/or throttle resume/decel switch in order to change the throttle setting.

The throttle setting of AUTOMATIC mode will be suspended and the engine speed will adjust to the setting of accelerator control if either of the following conditions occur:

- Accelerator control is moved more than 25 percent.
- The service brakes are applied.

Push in the throttle resume/decel switch in order to resume the preset engine speed.

The resume feature will be disabled if any of the following conditions occur:

- Switch is moved to the OFF mode.
- Switch is moved to the MANUAL mode.
- Engine start switch is moved to the OFF position.
- The engine is stalled.

Note: The indicator light for the throttle lock will be illuminated when the throttle setting is locked during AUTOMATIC mode.

MANUAL – Push in the bottom of switch in order to put the throttle control in MANUAL mode. Use accelerator control in order to achieve the desired engine speed. Push in the top of throttle set/accel switch in order to set the throttle at the current engine speed. Use throttle set/accel switch and/or throttle resume/decel switch in order to change the throttle setting.

The engine speed will increase if accelerator control is pressed past the throttle setting. When the accelerator control is released, the engine will return to the preset engine speed. The following conditions will not cause the throttle lock to disengage:

- The service brakes are applied.
- The accelerator control is moved.

The throttle lock will be disengaged if either of the following conditions occur:

- Switch is moved to the OFF mode.
- Engine start switch is moved to the OFF position.

The resume feature will not be available after the throttle lock is disengaged.

Note: The indicator light for the throttle lock will be illuminated when the throttle is locked during MANUAL mode.

OFF – Move switch to the MIDDLE position in order to put the throttle control in OFF mode. When switch is in the MIDDLE position, AUTOMATIC mode and MANUAL mode will not work. The throttle will only be operated by accelerator control .

Throttle Set/Accel Switch (74)

Throttle set/accel switch allows the operator to set the speed of the throttle. As required, move the switch in order to change the engine speed.

SET/ACCEL – When throttle hold mode switch is not in OFF mode, push the top of switch in order to set the engine speed. Push the top of switch again in order to increase the engine speed by 100 rpm. Push the top of switch and hold down the switch in order to increase the engine speed by 700 rpm/sec.

Note: For resuming speeds and decelerating speeds, refer to “Throttle Resume/Decel Switch (45)” for further information.

Hazard Flasher Switch (75)

Hazard Lights – Push in the top of switch in order to activate the hazard lights. Push in the bottom of the switch in order to turn off the hazard lights.

Autoshift Switch (76)

Autoshift Switch (If Equipped) – Move switch to the TOP position in order to turn on the autoshift transmission. Move the switch to the BOTTOM position in order to turn off the autoshift transmission. When the switch is in the ON position, the transmission will automatically shift within the maximum and minimum autoshift gears.

Note: In the event of the failure of a transmission solenoid, the machine is equipped with a limp home mode. The following procedure should be used in such a situation:

If any of the clutch solenoids fails to operate properly, the limp home mode will activate. If the current gear is affected by the clutch solenoid failure the transmission will automatically switch into the NEUTRAL position. If the current gear is not affected by the clutch solenoid failure the transmission will remain in the current gear. In order to test the gears that can be used select the gear and shift the transmission into the gear. If the transmission automatically shifts into the NEUTRAL position the selected gear is not available. You can utilize the upshift switch and you can utilize the downshift switch for the gears that have not been affected by the clutch solenoid failure, provided the gears are sequential.

Autoshift Operation

Minimum Autoshift Gear Limit

There is a minimum autoshift gear for each direction. The minimum autoshift gear can be equal to or less than the maximum autoshift gear, and equal to or less than the maximum gear. The minimum autoshift gear can be changed through Electronic Technician (ET) or Messenger when the machine is in NEUTRAL and Transmission Output Speed (TOS) is 0 rpm. Changes made by ET or Messenger are the new defaults at the time of the changes or after a power cycle. FORWARD and REVERSE do not need to be the same gear. The range the minimum autoshift gears can be set to in the FORWARD position is between one and five. The range the minimum autoshift gears can be set to in the REVERSE position is between one and four.

Maximum Autoshift Gear Limit

There is a maximum autoshift gear for each direction. The maximum autoshift gear can be equal to or less than the maximum gear. When the operating gear is within the autoshift range, the gear requested by the operator is the maximum autoshift gear. The maximum autoshift gear can be changed through ET or Messenger when the machine is in NEUTRAL and Transmission Output Speed (TOS) is 0 rpm. Changes made by ET or Messenger are the new defaults at the time of the changes or after a power cycle. FORWARD and REVERSE do not need to be the same gear. The range the maximum autoshift gears can be set to in the FORWARD position is between three and eight. The range the maximum autoshift gears can be set to in the REVERSE position is between three and six.

Note: The maximum autoshift gears for FORWARD and REVERSE can be changed using upshift switch and downshift switch . This requires the autoshift transmission to be turned on and the current gear to be equal to or within the range for the maximum and minimum autoshift gears. The maximum autoshift gear changes made with the upshift switch and the downshift switch will not become the new defaults.

ON Position

Note: The lowest gear of the range can be configured to be any gear from first gear through fifth gear for FORWARD and from first gear through fourth gear for REVERSE. The default lowest gear is third gear.

When autoshift switch is in the ON position and upshift switch is any gear that is greater than the minimum autoshift gear, the machine will upshift automatically to the gear that has been selected by the operator. Also, the transmission will downshift automatically when the autoshift switch is in the ON position and downshift switch is any gear that is less than the maximum autoshift gear.

1. Move autoshift switch to the ON position. The autoshift alert indicator will turn on.
2. Move upshift switch to the desired high end gear. This gear must be greater than the minimum autoshift gear. The transmission will upshift automatically. The upshift is based upon TOS.
3. Move downshift switch to the desired low end gear. This gear must be less than the maximum autoshift gear. The transmission will downshift automatically. The downshift is based upon TOS.

The autoshift alert indicator will flash when either of the following conditions exist:

- The machine is operating in a gear that is less than the minimum autoshift gear.
- Transmission control switch is in NEUTRAL.

OFF Position

The machine is controlled manually by the operator with autoshift switch in the OFF position. When the autoshift switch is in the OFF position, the transmission shifts when upshift switch or downshift switch is selected manually. The autoshift alert indicator is off.

OVERRIDE Function

The autoshift function will be overridden when downshift switch is moved below the minimum autoshift gear. The autoshift alert indicator will flash and the maximum autoshift gear is not changed.

The transmission will stay in the specified gear. The autoshift function can be enabled again by moving upshift switch to the minimum autoshift gear. The autoshift alert indicator will turn on and the transmission will engage the autoshift function.

Snow Wing Light Switch (77)

Note: When the snow wing lights are turned on, the taillights will automatically turn on.

Snow Wing Lights (If Equipped) – Push in the top of switch in order to turn on the snow wing lights. Push in the bottom of the switch in order to turn off the snow wing lights.

Auto Differential Lock Switch (78)

This is a two-position switch. The switch allows the operator to set the mode for the differential lock control. The following modes can be selected: AUTOMATIC and MANUAL.

AUTOMATIC – Push in the top of switch in order to put the differential lock control in AUTOMATIC mode. The switch will illuminate. When the differential lock control is in AUTOMATIC mode the differential will automatically lock and/or unlock based upon machine conditions. When the differential is locked, an indicator light will illuminate on the front dash.

Auto differential lock manual override allows the operator to manually apply the differential lock while in AUTOMATIC mode. Press the differential lock control to initiate the override. Once you have overridden AUTOMATIC mode, the differential lock will remain on until the following conditions exist:

- overall steering angle exceeds a predefined value
- Auto differential lock button is turned OFF
- transmission is shifted into a gear that does not allow auto differential lock
- faults on steering angle, actual gear, or articulation angle

Note: Pressing the differential lock control after the manual override is initiated will not turn OFF the differential lock. Manual override functions in gears 1F-4F and 1R-2R.

MANUAL – Push in the bottom of switch in order to put the differential lock control in MANUAL mode. Push control button on the right-hand joystick in order to lock the differential. When the differential is locked, an indicator light will illuminate on the front dash. Push control button again in order to unlock the differential. Refer to Operation and Maintenance Manual, “Operator Controls - Differential Lock Control” for more information.

When the differential lock control is in the AUTOMATIC mode the ECM will lock and/or unlock the differential based on certain machine conditions which include machine load and steer/articulation angle. The indicator for the differential lock will illuminate when the differential is locked. The feature will be disengaged when the machine is in the AUTOMATIC mode. and the gear setting is greater than 5F or 3R.

Cab Floodlight Switch (79)

Note: When the cab floodlights are turned on, the taillights will automatically turn on.

Cab Floodlights (If Equipped) – Push in the top of switch in order to turn on the cab floodlights. Push in the bottom of the switch in order to turn off the cab floodlights.

Front and Rear Work Light Switch (80)


Front and Rear Work Lights – Push in the top of switch in order to turn on the front and rear work lights. Move the switch to the MIDDLE position in order to turn off the front and rear work lights. Push in the bottom of the switch in order to turn on the front work lights only.

Headlight and Taillight Switch (81)


Headlights and Taillights – Push in the top of switch in order to turn on the headlights and taillights. Move the switch to the MIDDLE position in order to turn off the headlights and taillights. Push in the bottom of the switch in order to turn on the taillights only.

Bluetooth Microphone (82)

Bluetooth Microphone – If the machine is equipped with a radio that has Bluetooth available, it is possible to sync another Bluetooth device with the radio. Reference the radio manual for instructions on detecting and setting up the Bluetooth device.

Heating and Air Conditioning Controls

Fan Speed Switch (83)

Fan speed switch controls the four-speed blower fan motor.

OFF – Move the switch to this position in order to turn off the blower fan.

LOW – Move the switch to this position for a low fan speed.

MEDIUM – Move the switch to this position for a medium fan speed.

HIGH – Move the switch to this position for a high fan speed.

MAX – Move the switch to this position for the maximum fan speed.

Temperature Variable Control (84)

Temperature Variable Control – Adjust control anywhere between MINIMUM position (left) and MAXIMUM position (right). This will control the amount of cooling and the amount of heating.

Air Conditioner Switch (85)

Air Conditioner Switch – Push in the top of switch in order to operate the air conditioning system. Push in the bottom of the switch in order to turn off the air conditioning system.

Heating and Air Conditioning System Operation

The heating and air conditioning system can perform four functions:

Heating

Position fan speed switch to the desired speed. Adjust temperature variable control to the desired temperature.

Air Conditioning

Air Conditioning – Place air conditioner switch in the ON position. Position fan speed switch to the desired speed. Adjust temperature variable control to the desired temperature.

Pressurizing

When heating or cooling is not desired, pressurize the cab in order to prevent dust from entering.

Adjust temperature variable control to a comfortable temperature. Position fan speed switch to a speed that is needed to keep out the dust.

Defogging

Defogging – Place air conditioner switch in the ON position. Position fan speed switch to a speed that is needed to remove moisture from the air in the cab. This prevents moisture from forming on the window and the windows. Adjust temperature variable control until the moisture level is lowered.

Wiper/Washer Controls

Rear Window Wiper/Washer – Turn knob (86) clockwise in order to activate the window wiper. Turn the knob counterclockwise in order to turn off the window wiper. Depress the knob in order to activate the window washer. Spring force will return the knob when the knob is released.

Left Door Wiper/Washer – Turn knob (87) clockwise in order to activate the window wiper. Turn the knob counterclockwise in order to turn off the window wiper. Depress the knob in order to activate the window washer. Spring force will return the knob when the knob is released.

Front Window Wiper/Washer – Turn knob (88) clockwise in order to turn on the window wiper. Turn the knob counterclockwise in order to turn off the window wiper. Depress the knob in order to activate the window washer. Spring force will return the knob when the knob is released.

Right Door Wiper/Washer – Turn knob (89) clockwise in order to activate the window wiper. Turn the knob counterclockwise in order to turn off the window wiper. Depress the knob in order to activate the window washer. Spring force will return the knob when the knob is released.

Side Window Wiper/Washer Switch (If Equipped) – Push the bottom of the switch (90) in order to turn off the window wiper. Place the switch in the MIDDLE position in order to activate the window wiper. Push the top of the switch and hold the switch in order to activate the window washer and the window wiper. There is one switch on the right window and one switch on the left window.

Cab Vent Windows (If Equipped)

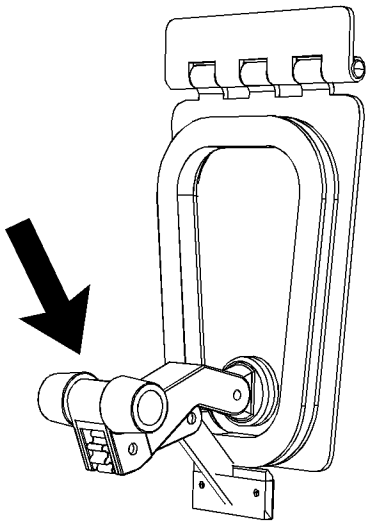


Illustration 112 g03375186

The cab vent windows is/are located in the rear of the cab on the left and right side (if equipped). Pull up and push out on the vent window handle to open the vent window. To close the vent window, pull in and push down on the handle.

When operating the machine in −4° C (25° F) or colder temperatures, open the vent windows to help reduce window fogging.

Note: To maintain a pressurized cab the vent windows must be closed.

Interior Dome Light

Interior Dome Light – Push the top of the switch in order to turn on the interior dome light. Push the bottom of the switch in order to turn off the interior dome light.

Cab Door

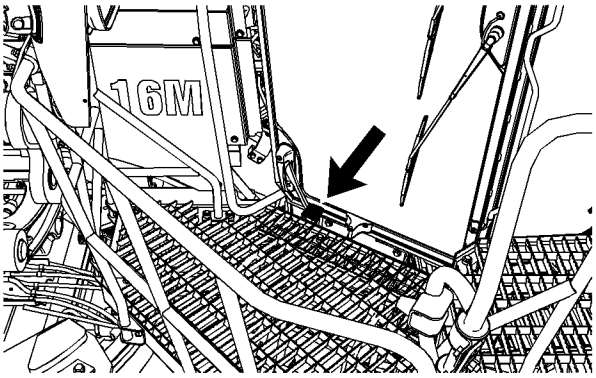


Illustration 113 g02992938

If your machine is equipped with the optional access platform, open the cab door with the foot pedal.

Engine Idle Shutdown

This function shuts down the engine after the operator is not operating the machine for a period of time. This function does not shut down other systems, such as the AC, which can run down the battery after idle shutdown. This function comes disabled from the factory but can be enabled or disabled by a Cat dealer technician. Engine Idle Shutdown may be required for local regulations.

The Engine Idle Shutdown (EIS) shuts down the engine if the following conditions are met:

- Engage the parking brake.
- The engine rpm is at low idle.
- Accelerator control is released.
- Regeneration is inactive.
- Engine coolant at operating temperature.
- The machine is not in all wheel drive creep position.
- The service brake control is released.
- Transmission is in NEUTRAL position.

- The implements are not active.
- Ground speed is 0 km/h (0 mph).

Note: If any service tests or calibrations are running the machine will not enter into engine idle shutdown.

Engine Idle Shutdown – The action lamp will illuminate and Messenger will display a message.

An operator can activate any of the controls listed above in order to cancel the shutdown. The recommended option for the operator is to use the service brake in order to cancel a shutdown.

i03860360

Battery Disconnect Switch

SMCS Code: 1411

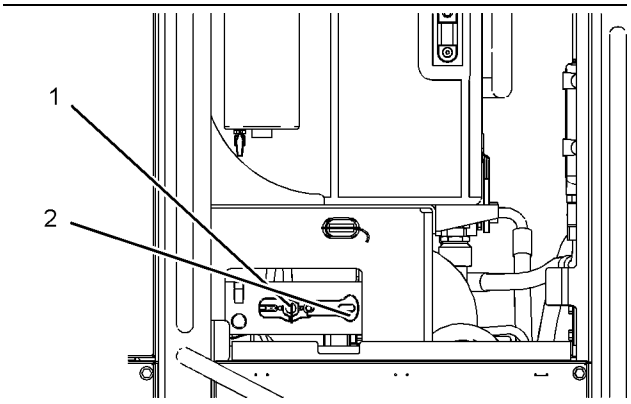


Illustration 114 g01299677

Battery disconnect switch (1) is on the left rear side of the engine compartment.

Battery Disconnect Switch – The battery disconnect switch can be used in order to disconnect the battery from the machine's electrical system. The key must be inserted into the battery disconnect switch before the battery disconnect switch can be turned.

ON – To activate the electrical system, insert the disconnect switch key and turn the battery disconnect switch clockwise. The battery disconnect switch must be turned to the ON position before you start the engine.

OFF – To deactivate the electrical system, turn the battery disconnect switch counterclockwise to the OFF position.

The battery disconnect switch and the engine start switch perform different functions. The entire electrical system is disabled when you turn the battery disconnect switch to the OFF position. The battery remains connected to the electrical system when you turn the engine start switch to the OFF position.

Turn the battery disconnect switch to the OFF position and remove the key when you service the electrical system or any other machine components. Lock out access to the battery disconnect switch by closing cover (2) and installing a padlock.

Turn the battery disconnect switch to the OFF position and remove the disconnect switch key after you operate the machine. This will prevent the battery from being discharged. The following problems can cause battery discharge:

- short circuits
- current draw via some components
- vandalism

NOTICE
Never move the battery disconnect switch to the OFF position while the engine is operating. Serious damage to the electrical system could result.

i02600137

Backup Alarm

SMCS Code: 7406

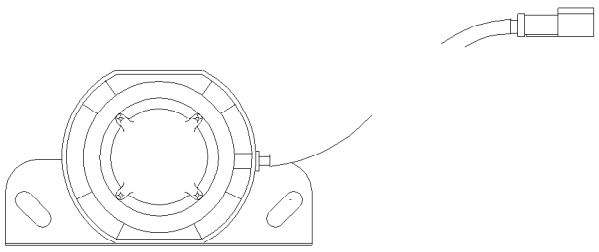


Illustration 115 g01043892

Backup Alarm – The alarm sounds when the transmission control switch is in the REVERSE position. The alarm alerts the people behind the machine that the machine is backing up.

The backup alarm is on the rear of the machine at the right side of the machine.

i04797662

Engine Shutdown Switch

SMCS Code: 7418-ZS

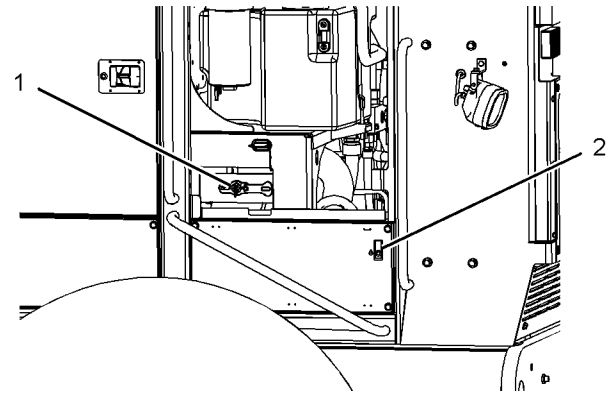


Illustration 116 g01176688

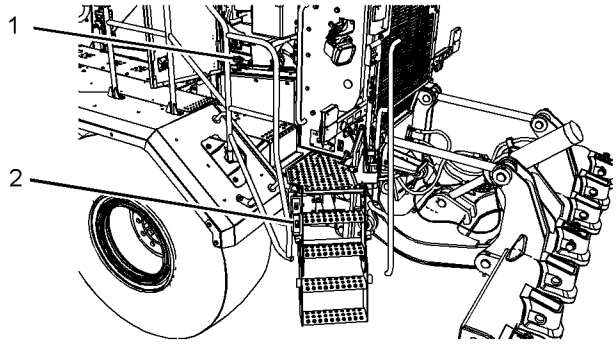


Illustration 117 g02916161

16M with Access Platform

If the engine needs to be stopped quickly, use engine shutdown switch (2).

ENGINE STOP – Lift the guard of the engine shutdown switch. Move the engine shutdown switch to the STOP position. Move the engine start switch key and battery disconnect switch key (1) to the OFF position. Remove the keys.

Note: The engine shutdown switch does not deactivate the machines electrical system.

ENGINE RUN – Lower the guard of the engine shutdown switch. The engine shutdown switch will be returned to the ON position.

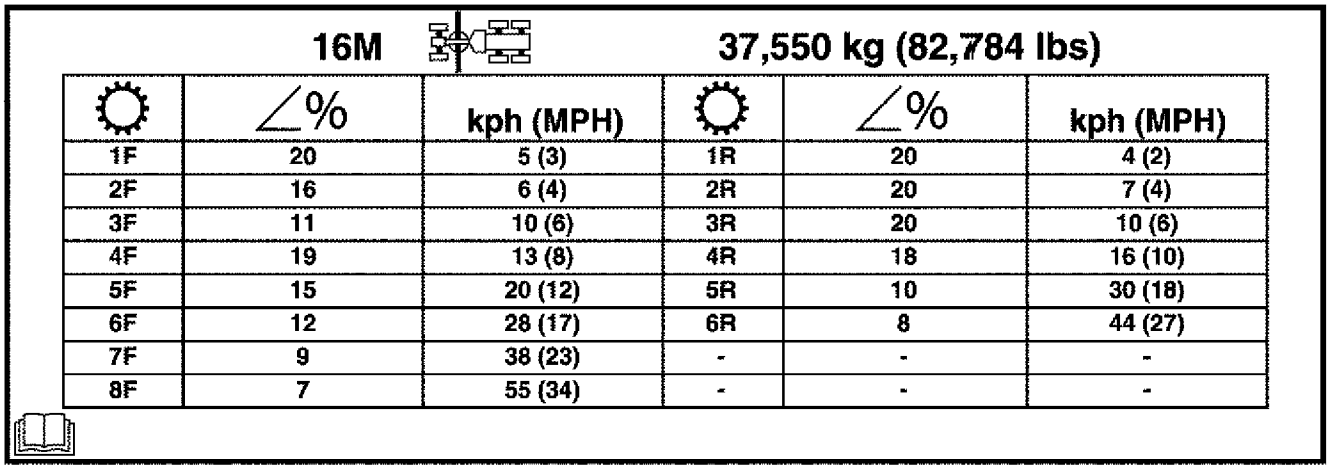
i05909580

Retarding

SMCS Code: 1000; 3121; 7000

Retarding Guidelines (Film)

NOTICE
Retarding performance charts provide an indication of the energy absorption capability of a given Motor grader power train on a specified continuous decline. Retarding performance charts serve to indicate the maximum transmission gear and maximum ground speed that should be used on a given grade. Retarding performance charts do not give an indication of the ability of the Motor Grader to stop. Retarding performance charts do not give an indication of the ability of the Motor Grader to remain stationary on the grade.



16M 37,550 kg (82,784 lbs)

	∠%	kph (MPH)		∠%	kph (MPH)
1F	20	5 (3)	1R	20	4 (2)
2F	16	6 (4)	2R	20	7 (4)
3F	11	10 (6)	3R	20	10 (6)
4F	19	13 (8)	4R	18	16 (10)
5F	15	20 (12)	5R	10	30 (18)
6F	12	28 (17)	6R	8	44 (27)
7F	9	38 (23)	-	-	-
8F	7	55 (34)	-	-	-

Illustration 118 g03721798

The film for retarding guidelines is located inside the cab.

Maximum Operating Weight – The maximum operating weight of a Motor Grader .

Selected Gear – The selected gear for descending down a grade.

Percentage Grade – The percentage value of the grade.

Retarding Information and Conditions

The retarding capabilities for each gear will vary depending on the following conditions: rolling resistance, load, tire size, and altitude. The retarder equipped is an engine compression brake which absorbs machine speed and uses it to compress and release air in the engine. Enabling the engine compression brake in order to allow the machine to automatically apply compression brake retarding as needed.

The transmission must be in the FORWARD or REVERSE position in order for the compression brake to engage. Refer to Operation and Maintenance Manual, “Operator Controls - Compression Brake” for more information. The retarder will not completely stop the machine and the retarder will not hold the machine stationary. The compression brake will not function if the inching pedal is fully pressed. For maximum retarder performance on a given grade, selection of the proper gear is essential for effective operation of the retarder system. When starting down a known grade, refer to the film for retarding guidelines in order to select the proper maximum gear limit. Select the proper maximum gear limit on the transmission control before you start down the grade. For more information refer to Operation and Maintenance Manual, “Operator Controls - Transmission Control”. When the film does not address the current conditions, use the following rule: the desired gear on a downgrade is two gears less than the gear that is required to go up the grade. If the machine builds up excessive speed during retarding, the engine can over speed and the transmission may upshift to protect the engine. If additional retarding is still needed, apply the service brake and choose a lower gear to maintain a constant vehicle speed. Continuous service brake use for retarding will damage the brake system.

i07202410

Monitoring System

SMCS Code: 7400; 7402; 7450; 7451

The Monitoring System is designed to alert the operator to an immediate problem with any of the machine systems that are monitored. The Monitoring System is also designed to alert the operator to an impending problem with any of the machine systems that are monitored. The monitoring system will also provide the operator with status information.

Indicators and Gauges

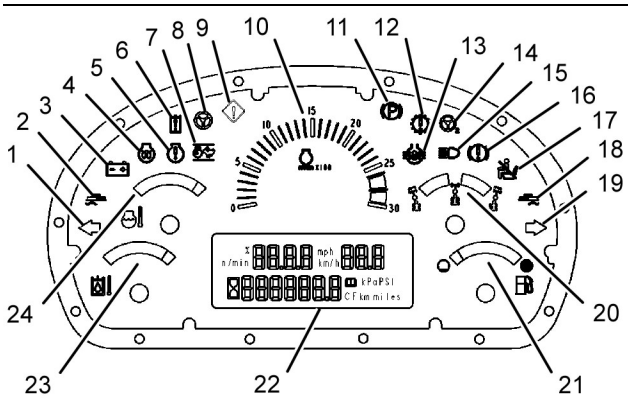


Illustration 119 g01256789

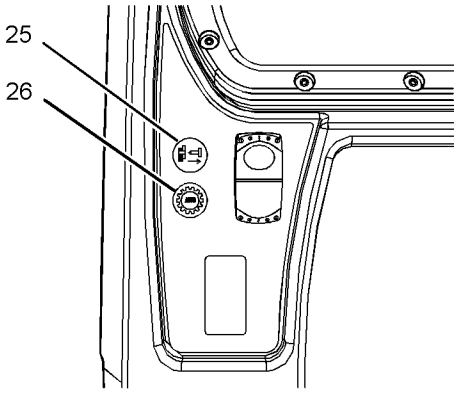


Illustration 120 g01289073

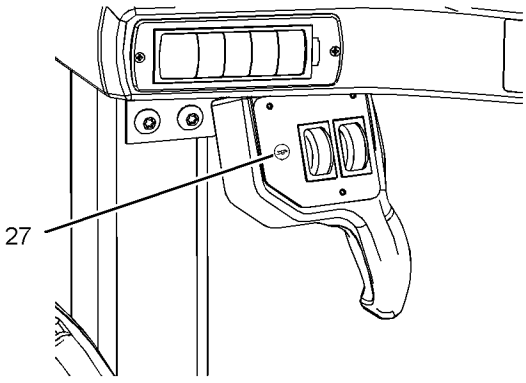


Illustration 121 g01365084

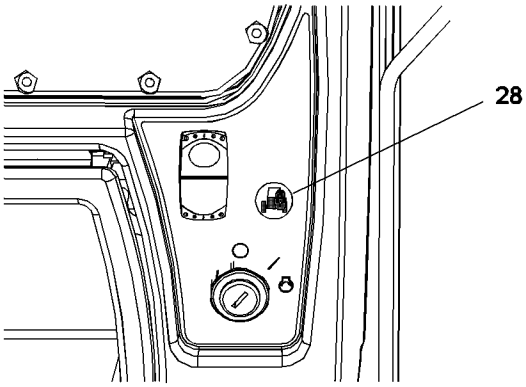


Illustration 122 g01324214

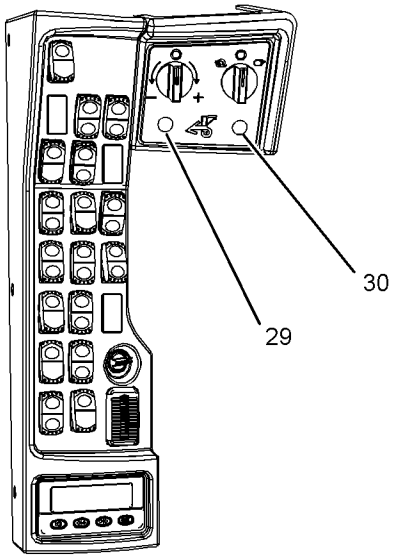


Illustration 123 g03506825

Left Turn Signal Indicator (1) – This indicator illuminates to show that the left turn signal is active.

Left Blade Float Indicator (2) – This indicator illuminates to show that the blade float is active for the left side of the blade.

Battery Charge Indicator (3) – This alert indicator will illuminate when there is a problem with machine system voltage or the alternator.

Electric Engine Preheat Indicator (4) (If Equipped) – This indicator illuminates to show that the air inlet heater for the engine is on.

Engine System Indicator (5) – This alert indicator illuminates to show that the engine has a problem. Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR9034 for the types of problems.

Implement System Indicator (6) – This alert indicator illuminates to show that a problem has occurred with the implement system. Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR9034 for the types of problems.

Throttle Lock Indicator (7) – This indicator is illuminated when the throttle lock feature is activated.

Primary Steering Indicator (8) – This alert indicator will illuminate when there is a problem with the primary steering system. Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR9034 for the types of problems.

Action Light Indicator (9) – This alert indicator illuminates to show that a problem has occurred with the machine. The action light will flash red when a level 2 warning or level 3 warning is active. If communication between the instrument cluster and the Messenger fails, the action lamp will flash amber. Do not operate the machine if the action lamp is flashing amber.

Analog Tachometer (10) – This tachometer displays the engine rpm during machine operation. The yellow range indicates that the engine is operating about 2600 rpm. The red range indicates that the engine is operating about 2800 rpm.

Parking Brake Indicator (11) – This alert indicator illuminates to show that the parking brake has been engaged. The indicator should go out when the parking brake is disengaged.

Transmission System Indicator (12) – This alert indicator illuminates to show that the transmission has a problem. Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR9034 for the types of problems.

Differential Lock Indicator (13) – This indicator illuminates to show that the differential lock is engaged.

Secondary Steering System Indicator (14) – This alert indicator will illuminate under the following conditions:

- The alert indicator will be red in color when a problem with the secondary steering system exists.
- The alert indicator will be amber in color when the secondary steering system is active or the secondary steering system is being tested.

⚠ WARNING

If the secondary steering activates during operation, immediately park the machine ina safe location. Inspect the machine and correct the condition which made the use of the secondary steering necessary.

Do not continue to operate the machine using the secondary steering.

Personal injury or death can occur if steering is lost completely during operation.

High Beam Indicator (15) – This indicator shows that the high beam for the headlights is active.

Brake System Indicator (16) – This alert indicator shows that there is a general fault in the brake system.

Operator Not Present Indicator (17) – This alert indicator illuminates to show that an operator is not present, as defined below.

A determination occurs to indicate if an operator is present. The result is provided as inputs to certain software features. If the determination indicates that an operator is not present, the following software features are affected:

Steering and Implement Lockout – All steering and implements functions are locked out.

Shifts Out of NEUTRAL – Shifts out of NEUTRAL are not allowed.

Releasing the Parking Brake – Transitions of the parking brake from ENGAGED to DISENGAGED are not allowed.

Note: To reactivate the affected features of the machine, the operator must be considered present.

Note: The parking brake is automatically engaged when the operator is not present.

The operator is considered to be present if any one of the following conditions are true:

- The operator switch in the seat detects an operator.
- Actual gear of the machine is not NEUTRAL.
- Transmission output speed is greater than zero.
- The transmission modulator control (inching pedal) is depressed.

Right Blade Float Indicator (18) – This indicator illuminates to show that the blade float is active for the right side of the blade.

Right Turn Signal Indicator (19) – This indicator illuminates to show that the right turn signal is active.

Articulation Angle Gauge (20) – This gauge indicates that the machine is articulated to the left or to the right. Refer to Operation and Maintenance Manual, “Operator Controls” for further information.

Fuel Level Gauge (21) – This gauge indicates the amount of fuel in the tank. The red range indicates that the fuel level is below 10 percent.

LCD Display (22) – This display is used to provide the following information: machine ground speed, actual gear and direction, operator requested gear and service hour meter.

Manual – The manual indicator will illuminate on the display if any diagnostic or events are active. Refer to the service manual to remedy the diagnostic or event.

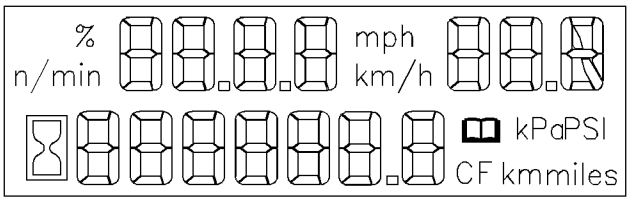


Illustration 124 g01324840

Hour meter mode

The hour meter mode will be displayed when the following occurs: the parking brake is engaged, the actual gear is in the NEUTRAL position, the machine speed is zero and the transmission modulator control (inching pedal) is pressed.

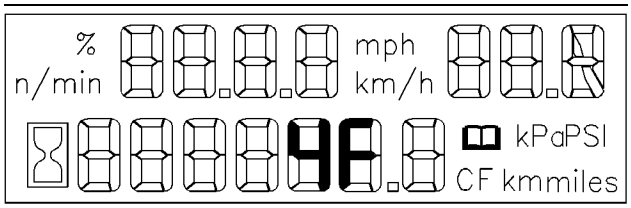


Illustration 125 g01324792

Operator requested forward gear mode

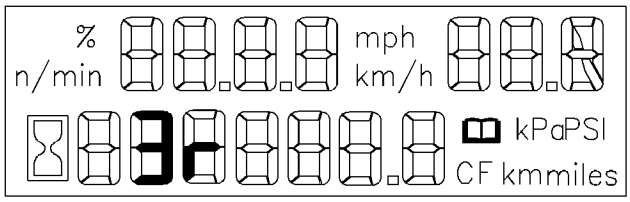


Illustration 126 g01324825

Operator requested reverse gear mode

The operator requested gear will be displayed when the transmission control switch is in the FORWARD position or in the REVERSE position.

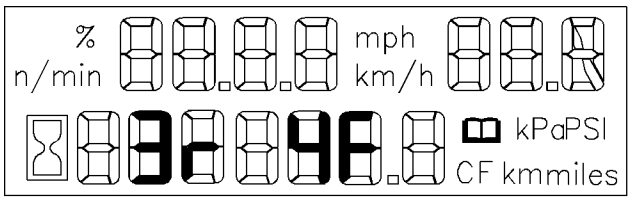


Illustration 127 g01324843

Operator requested forward gear and operator requested reverse gear mode

The operator requested forward gear and the operator requested reverse gear will be displayed when the transmission control switch is in the NEUTRAL position.

Hydraulic Oil Temperature Gauge (23) – This gauge indicates the hydraulic oil temperature. The red range indicates that the hydraulic oil temperature is above 93 °C (199 °F).

Coolant Temperature Gauge (24) – This gauge indicates the coolant temperature. The red range indicates that the coolant temperature is above 107 °C (225 °F).

Centershift Lock Indicator (25) – This indicator illuminates to show that the centershift lock is disengaged. Refer to Operation and Maintenance Manual, “Operator Controls” for further information.

Autoshift Transmission Indicator (26) (If Equipped) – This indicator illuminates to show that the autoshift function for the transmission is engaged. Refer to Operation and Maintenance Manual, “Operator Controls” for further information.

Implement Float Indicator (27) (If Equipped) – This indicator illuminates to show that the implement is in the FLOAT position. Refer to Operation and Maintenance Manual, “Operator Controls” for further information.

Machine Security System (MSS) Status Indicator (28) (If Equipped) – This indicator illuminates to show that machine operation was attempted by using an invalid key.

All Wheel Drive Indicator (29) (If Equipped) – This indicator will illuminate green when the all wheel drive system has been engaged.

All Wheel Drive System Fault Indicator (30) (If Equipped) – This indicator will illuminate red when there is a fault with the all wheel drive system.

Messenger Display

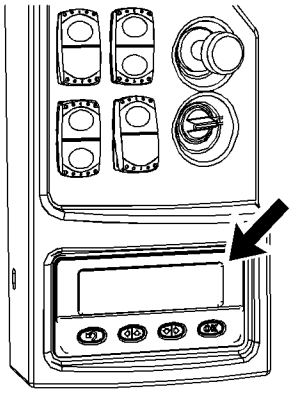


Illustration 128 g01255583

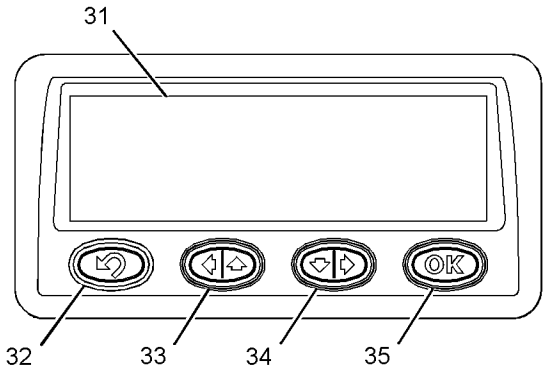


Illustration 129 g03506837

Digital Display Area (31) – This Messenger system shows information on digital display area.

Note: Do not operate the machine if information that is shown on digital display area (29) is not operating properly.

Back Button (32) – Use this button to return to information that was previously shown on digital display area .

Scroll Up/Left Button (33) – This button is used to scroll up through information that is shown on the digital display area. The button can also be used to scroll to the left through information that is shown on the digital display area.

Scroll Down/Right Button (34) – This button is used to scroll down through information that is shown on the digital display area. The button can also be used to scroll to the right through information that is shown on the digital display area.

OK Button (35) – After you have made selections with the scroll up/left button and with the scroll down/right button, use this button to confirm those selections.

Performance Menu

The default information that is displayed for the Messenger system is the “PERFORMANCE” menu.

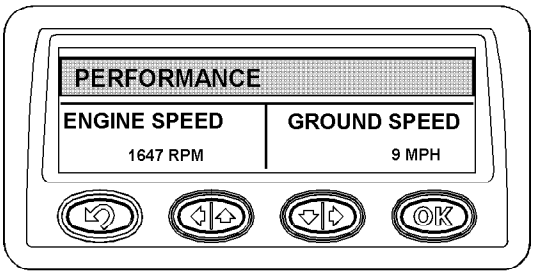


Illustration 130 g01054560

Typical display

The following options are available through the “PERFORMANCE” menu:

“ENGINE SPEED” – When you scroll to this option, the display will show the engine RPM.

“MPH (GROUND SPEED)” – When you scroll to this option, the display will show the ground speed in Miles per Hour (mph) or in Kilometers per Hour (km/h).

“ENGINE COOLANT TEMPERATURE” – When you scroll to this option, the display will show the engine coolant temperature in degrees Fahrenheit (°F) or in degrees Celsius (°C).

“ARTICULATION ANGLE” – When you scroll to this option, the display will show the degree of the angle at the articulation pivot point.

“FUEL LEVEL” – When you scroll to this option, the display will show the amount of fuel that is remaining as a percentage of a full tank.

“HYD OIL TEMP” – When you scroll to this option, the display will show the hydraulic oil temperature in degrees Fahrenheit (°F) or in degrees Celsius (°C).

“DESIRED GEAR” – When you scroll to this option, the display will show the gear that is selected on the operator controls.

“ACTUAL GEAR” – When you scroll to this option, the display will show the gear that is currently engaged in the transmission.

“TOS” – When you scroll to this option, the display will show the transmission output speed.

“TRANSMISSION OIL TEMPERATURE” – When you scroll to this option, the display will show the transmission oil temperature in degrees Fahrenheit (° F) or in degrees Celsius (°C).

“IMPLEMENT LOCKOUT SWITCH POSITION” – When you scroll to this option, the display will show the position of the implement lockout.

“IMPLEMENT PILOT SUPPLY SOLENOID” – When you scroll to this option, the display will show the status of the implement pilot supply solenoid.

“BLADE LEFT LIFT CYLINDER FLOAT STATUS” – When you scroll to this option, the display will show the status of the blade left lift cylinder float.

“BLADE RIGHT LIFT CYLINDER FLOAT STATUS” – When you scroll to this option, the display will show the status of the blade right lift cylinder float.

“SECONDARY STEERING SYSTEM TEST STATUS” – When you scroll to this option, the display will show the status of the secondary steering system test.

“SECONDARY STEERING REQUEST SIGNAL STATUS” – When you scroll to this option, the display will show the status of the secondary steering request signal.

“HYDRAULIC OIL TYPE” – When you scroll to this option, the display will show the type of hydraulic oil that is in the machine.

“STEERING OIL TEMPERATURE” – When you scroll to this option, the display will show the temperature of the oil in the steering circuit.

“POWERTRAIN FILTER BYPASS STATUS” – When you scroll to this option, the display will show the status of the power train filter bypass.

“TRANSMISSION MODULATOR CONTROL (INCHING PEDAL) POSITION” – When you scroll to this option, the display will show the position of the transmission modulator control (inching pedal).

Totals Menu

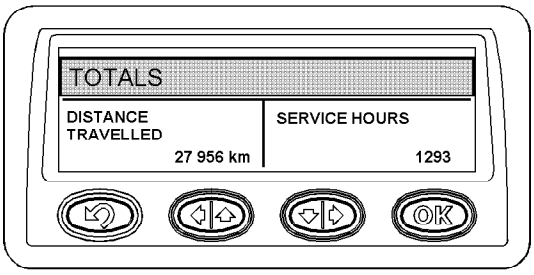


Illustration 131 g01054562

Typical display

The following options are available through the “TOTALS” menu:

Lifetime Totals

“FORWARD DISTANCE TRAVELLED” – When you scroll to this option, the display shows the total forward distance that the machine has traveled in miles or in kilometers.

“REVERSE DISTANCE TRAVELLED” – When you scroll to this option, the display shows the total reverse distance that the machine has traveled in miles or in kilometers.

“TOTAL FUEL” – When you scroll to this option, the display shows the total amount of fuel that has been consumed by the machine.

“SERVICE HOURS” – When you scroll to this option, the display shows the total amount of service hours of the machine.

Trip Totals

Note: You can reset the trip value to zero from each of these screens.

“TOTAL FUEL” – When you scroll to this option, the display will show the total fuel usage since the trip total has been reset.

“SERVICE HOURS” – When you scroll to this option, the display will show the total service hours since the trip total has been reset.

Trip Reset

“CLEAR TRIP TOTALS” – When you scroll to this option, you can reset the trip total values.

Settings Menu

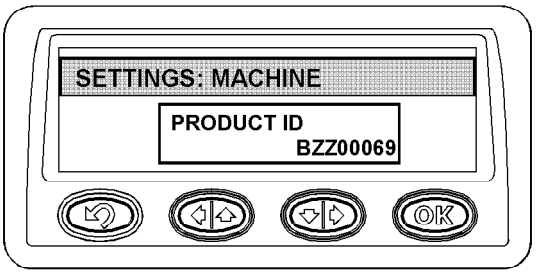


Illustration 132 g01098326

Typical display

The following options are available through the "SETTINGS" menu:

Monitoring System

"LANGUAGE" – Select this option to change the language that is shown on the display. Only certain languages are available. If the desired language is not available, contact your local Caterpillar dealer.

"UNITS" – Select this option to choose the desired measurement system.

"CONTRAST ADJUST" – Select this option to adjust the contrast of the display. This will improve the visibility of the information. The display provides a bar graph for viewing adjustments.

"BACKLIGHT ADJUST" – Select this option to adjust the brightness of the following items: Messenger digital display area, switch lights, and instrument panel lights. This will improve the visibility of the information. The display provides a bar graph for viewing adjustments.

Note: For the "BACKLIGHT" option, the headlights and/or taillights must be ON.

Machine

"PRODUCT ID" – Select this option to view the product identification number.

"EQUIPMENT ID" – Select this option to view the equipment ID number.

Transmission

"GEAR SELECTION" – When you scroll to this option, the display will show the gear of the transmission.

"TRANSMISSION INITIAL FORWARD GEAR" – When you scroll to this option, the display will show the initial forward gear.

"TRANSMISSION INITIAL REVERSE GEAR" – When you scroll to this option, the display will show the initial reverse gear.

"TRANSMISSION MINIMUM FORWARD AUTOSHIFT GEAR" – When you scroll to this option, the display will show the autoshift minimum forward gear.

"TRANSMISSION MINIMUM REVERSE AUTOSHIFT GEAR" – When you scroll to this option, the display will show the autoshift minimum reverse gear.

"TRANSMISSION MAXIMUM FORWARD AUTOSHIFT GEAR" – When you scroll to this option, the display will show the autoshift maximum forward gear.

"TRANSMISSION MAXIMUM REVERSE AUTOSHIFT GEAR" – When you scroll to this option, the display will show the autoshift maximum reverse gear.

"TRANSMISSION OIL TYPE" – When you scroll to this option, the display will show the viscosity of the oil.

Cat TDTO SAE 0W-20 – When you scroll to this option, the display will show the Cat TDTO SAE 0W-20 oil type.

Cat TDTO SAE 0W-30 – When you scroll to this option, the display will show the Cat TDTO SAE 0W-30 oil type.

Cat TDTO SAE 5W-30 – When you scroll to this option, the display will show the Cat TDTO SAE 5W-30 oil type.

Cat TDTO SAE 10W – When you scroll to this option, the display will show the Cat TDTO SAE 10W oil type.

Cat Arctic TDTO – When you scroll to this option, the display will show the Cat Arctic TDTO oil type.

Cat TDTO-TMS – When you scroll to this option, the display will show the Cat TDTO-TMS oil type.

Cat TDTO SAE 30 – When you scroll to this option, the display will show the Cat TDTO SAE 30 oil type.

Cat TDTO SAE 50 – When you scroll to this option, the display will show the Cat TDTO SAE 50 oil type.

Autolube (If Equipped)

"AUTOLUBE INTERVAL" – When you scroll to this option, the display will show the autolube interval setting.

"AUTOLUBE DURATION" – When you scroll to this option, the display will show the autolube duration.

Implement

“MODULATION CONFIG” – When you scroll to this option, the display will show the blade lift modulation.

“MODULATION CONFIG FINE” – When you scroll to this option, the display will show the blade lift modulation selection.

“MODULATION CONFIG NORMAL” – When you scroll to this option, the display will show the blade lift modulation selection.

“MODULATION CONFIG COARSE” – When you scroll to this option, the display will show the blade lift modulation selection.

“AUXILIARY POD ENABLE STATUS” – When you scroll to this option, the display will show the status of the auxiliary pod.

“ACCUGRADE ENABLE STATUS” – When you scroll to this option, the display will show the status of the Accugrade .

“SERVICE MODE” – When you scroll to this option, the display will show the status of the implement service mode.

Service

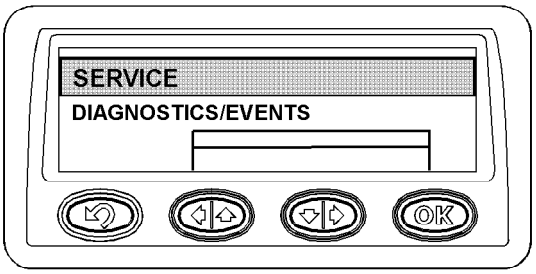


Illustration 133 g01054566
Typical display

The following options are available through “SERVICE” :

Diagnostics/Events

Note: The following options have password protection. You must enter a password to change the settings.

“VIEW DIAGNOSTICS” – Select this option to view the diagnostics/events that are logged by the monitoring system.

System Parameters

The following system parameters are for “MONITORING SYSTEM” :

“BATTERY VOLTAGE” – When you scroll to this option, the battery voltage is displayed.

“FUEL LEVEL” – When you scroll to this option, the fuel level is displayed.

“ALTERNATOR STATUS” – When you scroll to this option, the status of the alternator is displayed.

The following system parameters are for “ENGINE” :

“ACTUAL ENGINE RPM” – When you scroll to this option, the engine RPM is displayed.

“DESIRED ENGINE RPM” – When you scroll to this option, the desired engine speed is displayed.

“ENGINE OIL PRESSURE” – When you scroll to this option, the engine oil pressure is displayed.

“ENGINE COOLANT TEMP” – When you scroll to this option, the coolant temperature is displayed.

“FUEL TEMP” – When you scroll to this option, the fuel temperature is displayed.

Note: The “FUEL TEMP” option is only available on the following machines: 14M, 16M, and 24M.

“FUEL PRS” – When you scroll to this option, the fuel pressure is displayed.

“AIR PRS” – When you scroll to this option, the intake manifold air pressure is displayed.

Note: The “AIR PRS” option is only available on the following machines: 120M and 12M.

“AIR TEMP” – When you scroll to this option, the intake manifold air temperature is displayed.

“ATMOSPHERIC PRS” – When you scroll to this option, the atmospheric pressure is displayed.

“TURBO INLET PRS” – When you scroll to this option, the turbocharger inlet pressure is displayed.

“TURBO OUTLET PRS” – When you scroll to this option, the turbocharger outlet pressure is displayed.

Note: The “TURBO OUTLET PRS” option is only available on the following machines: 140M, 160M, 14M, 16M, and 24M.

“BOOST PRS” – When you scroll to this option, the turbocharger boost pressure is displayed.

Note: The “BOOST PRS” option is only available on the following machines: 140M, 160M, 14M, 16M, and 24M.

“FUEL POS” – When you scroll to this option, the volume of fuel delivery at the injector is displayed.

Note: The “FUEL POS” option is only available on the following machines: 14M, 16M, and 24M.

“DELIVERED FUEL VOLUME” – When you scroll to this option, the volume of fuel delivery at the injector is displayed.

Note: The “FUEL VOLUME” option is only available on the following machines: 120M, 140M, 160M, and 12M.

“THROTTLE POSITION” – When you scroll to this option, the throttle position is displayed.

The following system parameters are for “TRANSMISSION” :

“DESIRED GEAR” – When you scroll to this option, the display will show the gear that is selected on the operator controls.

“ACTUAL GEAR” – When you scroll to this option, the actual gear that is engaged in the transmission is displayed.

“CHARGE FILTER” – When you scroll to this option, the status of the charge filter bypass line for the transmission is displayed.

“TRANSMISSION MODULATOR CONTROL (INCHING PEDAL) POS” – When you scroll to this option, the position of the transmission modulator control (inching pedal) is displayed.

“TOS” – When you scroll to this option, the transmission output speed is displayed.

“TRANS OIL TEMP” – When you scroll to this option, the transmission oil temperature is displayed.

The following system parameters are for “STEERING” :

“STEERING CONTROL POS” – When you scroll to this option, the position of the steering control is displayed.

“STEERING DUTY CYCLE” – When you scroll to this option, the status of the steering signal for the duty cycle is displayed.

“LEFT CYL EXT” – When you scroll to this option, the position of the left steering cylinder is displayed.

“RIGHT CYL EXT” – When you scroll to this option, the position of the right steering cylinder is displayed.

“SECONDARY STEERING POS” – When you scroll to this option, the position of the secondary steering test switch is displayed.

“SECONDARY STEERING TEST” – When you scroll to this option, the status of the test for the secondary steering system is displayed.

“SECONDARY STEERING SIGNAL” – When you scroll to this option, the status of the command signal for the secondary steering is displayed.

“SECONDARY STEERING RELAY” – When you scroll to this option, the status of the secondary steering relay is displayed.

The following system parameters are for “IMPLEMENT” :

“HYD OIL TEMP” – When you scroll to this option, the hydraulic oil temperature is displayed.

“HYD OIL PRS” – When you scroll to this option, the main hydraulic pump oil pressure is displayed.

“LOCKOUT POS” – When you scroll to this option, the position of the implement lockout switch is displayed.

“PILOT SUPPLY” – When you scroll to this option, the status of the implement pilot supply solenoid is displayed.

“BLADE LEFT LIFT POS” – When you scroll to this option, the lift position for the left side of the blade is displayed.

“BLADE LEFT LIFT CYL” – When you scroll to this option, the status of the blade float function for the left lift cylinder is displayed.

“BLADE RIGHT LIFT POS” – When you scroll to this option, the lift position for the right side of the blade is displayed.

“BLADE RIGHT LIFT CYL” – When you scroll to this option, the status of the blade float function for the right lift cylinder is displayed.

“WHEEL LEFT LEAN POS” – When you scroll to this option, the WHEEL LEAN (LEFT) position is displayed.

“WHEEL RIGHT LEAN POS” – When you scroll to this option, the WHEEL LEAN (RIGHT) position is displayed.

“PITCH FORWARD POS” – When you scroll to this option, the PITCH FORWARD position is displayed.

“PITCH BACKWARD POS” – When you scroll to this option, the BLADE PITCH BACKWARD position is displayed.

“SIDESHIFT POS” – When you scroll to this option, the position of the blade sideshift is displayed.

“CIRCLE LEFT SIDESHIFT POS” – When you scroll to this option, the left position of the circle drawbar is displayed.

“CIRCLE RIGHT SIDESHIFT POS” – When you scroll to this option, the right position of the circle drawbar is displayed.

“CIRCLE DRIVE POS” – When you scroll to this option, the position of the circle drive is displayed.

“ARTICULATION POS” – When you scroll to this option, the position of the articulation joint is displayed.

“AUTO ARTICULATION POS” – When you scroll to this option, the status of the automatic articulation centering control is displayed.

The following system parameters are for “BRAKE” :

“PARK BRAKE SWITCH” – When you scroll to this option, the status of the parking brake switch is displayed.

“PARK BRAKE SOLENOID” – When you scroll to this option, the status of the parking brake solenoid is displayed.

“PARK BRAKE PRS SWITCH” – When you scroll to this option, the status of the parking brake pressure switch is displayed.

“PARK BRAKE” – When you scroll to this option, the parking brake engaged or the parking brake disengaged status is displayed.

“SERVICE BRAKE” – When you scroll to this option, the status of the service brake pedal is displayed.

The following system parameters are for “ALL WHEEL DRIVE (IF EQUIPPED)” :

“RIGHT MOTOR SPD” – When you scroll to this option, the right all wheel drive motor speed is displayed.

“LEFT MOTOR SPD” – When you scroll to this option, the left all wheel drive motor speed is displayed.

“AWD MODE” – When you scroll to this option, the status of the all wheel drive mode is displayed.

“AWD SWITCH” – When you scroll to this option, the status of the all wheel drive switch is displayed.

“LEFT DESIRED RATIO” – When you scroll to this option, the left desired ratio is displayed.

“LEFT GEAR RATIO” – When you scroll to this option, the left gear ratio is displayed.

“RIGHT DESIRED RATIO” – When you scroll to this option, the right desired ratio is displayed.

“RIGHT GEAR RATIO” – When you scroll to this option, the right gear ratio is displayed.

“LEFT CLUTCH PRESSURE” – When you scroll to this option, the left clutch pressure is displayed.

“RIGHT CLUTCH PRESSURE” – When you scroll to this option, the right clutch pressure is displayed.

“AWD STATUS” – When you scroll to this option, the status of the all wheel drive system is displayed.

“HYDRAULIC OIL TEMP” – When you scroll to this option, the display will show the hydraulic oil temperature in degrees Fahrenheit (°F) or in degrees Celsius (°C).

System Test

“SYSTEM SELF TEST” – When you scroll to this option, the status of the self test is displayed.

System Information

The following system information is for “ENGINE” :

“ENGINE SERIAL #” – When you scroll to this option, the engine serial number is displayed.

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

The following system information is for “TRANSMISSION/CHASSIS” :

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

The following system information is for “MONITORING SYSTEM” :

“EQUIPMENT ID #” – When you scroll to this option, the equipment identification number is displayed.

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

The following system information is for “IMPLEMENT SYSTEM” :

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

The following system information is for “IMPLEMENT CONTROL 2 SYSTEM AND IMPLEMENT CONTROL 3 SYSTEM (IF EQUIPPED)” :

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

Refer to Systems Operation, Troubleshooting, Testing and Adjusting, RENR9034 for further information.

The following system information is for “ALL WHEEL DRIVE SYSTEM (IF EQUIPPED)” :

“ECM SERIAL #” – When you scroll to this option, the ECM serial number is displayed.

“ECM PART #” – When you scroll to this option, the ECM part number is displayed.

“SW PART #” – When you scroll to this option, the software part number is displayed.

“SW RELEASE DATE” – When you scroll to this option, the release date of the software is displayed.

“SW DESCRIPTION” – When you scroll to this option, the description of the software is displayed.

Service Test

MANUAL LUBE MODE TEST – When you scroll to this option, the display will show the option to begin the manual lube mode test.

The following service test is for “STEERING DEAD ENGINE” :

Note: Refer to Operation and Maintenance Manual, “Towing the Machine - Dead Engine” for more information.

“NEXT” – When you scroll to this option, the display will show the option to begin the steering dead engine test.

Before the test for steering the dead engine is performed, the machine must meet the following conditions:

- No warnings for the primary steering
- No warnings for the secondary steering
- No warnings for the implement systems
- The engine must be off.
- The transmission must be in the NEUTRAL position.
- The engine speed must be zero.
- The parking brake must be engaged.
- The operator must be present.
- The implements must be locked.

The following system information is for “STEERING DEAD ENGINE” .

“ABORT” – When you scroll to this option, the display will show the option to end the steering dead engine test.

“NEXT” – When you scroll to this option, the display will show the option to continue the steering dead engine test.

“CALIBRATION INITIALIZING” – When you scroll to this option, the display will show that the steering dead engine test has started.

When the test begins, you can use the joystick to move the front wheels. The secondary steering pump will be activated for a maximum of ten seconds. To cancel the test, press the “ABORT” button on the Messenger or turn the keyswitch to the OFF position.

Calibration

The following calibration is for “TRANSMISSION FILL CALIBRATION” :

“TRANSMISSION FILL CALIBRATION” – When you scroll to this option, the display will show the option to begin the transmission fill calibration.

Note: The transmission fill calibration is an automated method that is used to find the ideal hydraulic fill conditions for each individual clutch. The transmission fill calibration could take up to 45 minutes to complete.

Tattletale

“TATTLETALE MODE ACTIVE” – When you scroll to this option, the display will show that the tattletale mode is active. Press the “OK” button to reset machine ground speed, oil temperature, engine coolant temperature, engine speed, articulation angle, and fuel level.

“OIL TEMP” – When you scroll to this option, the display will show the oil temperature. Press the “OK” button to reset the oil temperature.

“ENGINE COOLANT TEMP” – When you scroll to this option, the display will show the engine coolant temperature. Press the “OK” button to reset the engine coolant temperature.

“ENGINE SPEED” – When you scroll to this option, the display will show the engine speed. Press the “OK” button to reset the engine speed.

“ARTICULATION ANGLE” – When you scroll to this option, the display will show the degree of the angle at the articulation pivot point. Press the “OK” button to reset the articulation angle.

“FUEL LEVEL” – When you scroll to this option, the display will show the fuel level. Press the “OK” button to reset the fuel level.

Cat ® Grade Control with Cross Slope (If Equipped)

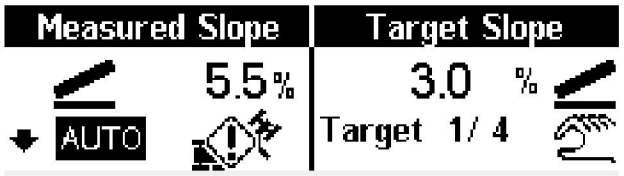


Illustration 134 g06251738

Cross Slope Display Icons

Positive Slope – Right side of blade is higher than the left side of the blade (positive slope or zero).

Negative Slope – Left side of blade is higher than the right side of the blade.

AUTO – The side of the screen where this icon is shown indicates the side of the blade that is under the control of the Cat grade control system. This icon will flash at a rate of two times per second if the controls enter the “Inactive Automatics” state.

No AUTO – This icon is shown if there is a condition which renders automatic controls unavailable.

Manual – The side of the screen where this icon is shown indicates the side of the blade that was previously controlled by the grade system. The operator can now use the “Inc/Dec” switch to adjust the target cross slope for the “Manual” side.

Articulation – This icon is displayed with a flashing exclamation point if the machine articulation angle is too great. When the articulation angle is too great, the Cross Slope system may have excessive error. Once the machine returns to within the specified threshold, the icon will turn off completely.

Mainfall/Blade Slope Angle – Mainfall and blade slope angle sensors.

Blade Rotation – Blade rotation sensor.

Machine Articulation – Machine articulation sensor.

Calibration 1 – First step in calibration.

Calibration 2 – Second step in calibration.

Calibration 3 – Third step in calibration.

Cross Slope Display Screens

The following may be displayed through the “Cross Slope” menu.

Measured Slope/Target Slope – Scroll to this screen to display the desired and actual cross slope.

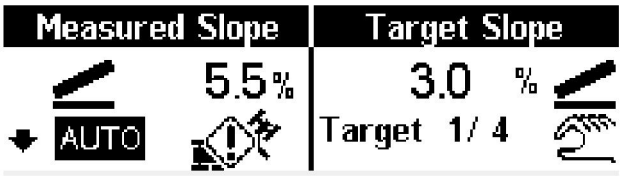


Illustration 135 g06251738

Measured Slope – Scroll to this option to display the actual cross slope.

Illustration 136 g06251744

Valve Speed – Scroll to this option to display and adjust the valve speed.

Illustration 137 g06251805

Grade Control Offset – Scroll to this option to display and adjust the amount of increment or decrement adjustment.

Illustration 138 g06251806

Max Number Of Targets – Scroll to this option to display and adjust the number of targets available for preset values.

Illustration 139 g06251807

Cross Slope Sensors – Scroll to this option to display the measured blade slope, rotation angle, mainfall, and articulation.

Illustration 140 g06251808

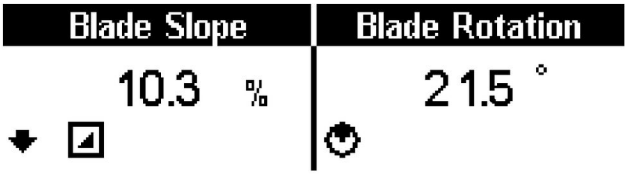


Illustration 141 g06251809

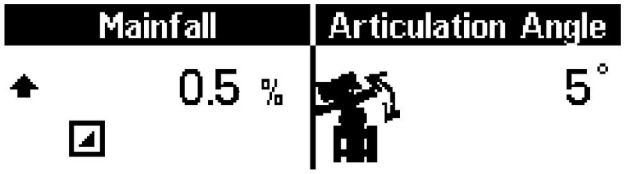


Illustration 142 g06251810

Cross Slope Settings – The following Cross Slope settings can be changed in the display:

Cross Slope Settings

Valve Speed Setting – From the Cross Slope screen, press the down key to display the “Valve Speed” and press “OK” .

Illustration 143 g06251811

Illustration 144 g06251812

This setting determines how quickly the Auto side of the moldboard reacts for a given elevation correction to the Manual side of the moldboard. The factory default setting is 50% which is nominal for most applications and an adequate starting speed for beginning operation. However, as material type, particle size and surface quality changes, this setting can be adjusted for better performance. General rule of thumb is, the smoother and more consistent the material and/or surface, the faster the valve speed %. Typically, below 45% is too slow and above 70% is too fast.

When you scroll to this option, the display will show the current valve speed. The valve speed may be adjusted by pressing the left or right button. Press “OK” and use the “Back” button to exit the “Valve Speed” menu.

Grade Control Offset – From the Cross Slope screen, press the down key to display the “Grade Control Offset” and press OK.

Illustration 145 g06251813

Illustration 146 g06251814

This setting determines the amount of increment (increase) or decrement (decrease) adjustment for each time the thumb roller (31) or (32) is used to change the Target Slope Value. The factory default is 0.1%. Depending on the application, it may be more efficient to change this to 0.5% or 1.0%. For example, to smoothly transition from a 4% crown slope to a 0% bridge approach slope or driveway, you may change the Offset Adjustment 1.0% to allow for a quicker transition, using the thumb rollers (31) or (32) to change the Target Slope Value while operating in Auto mode.

After selecting this option, the display will show the current offset adjustment %. The offset adjustment % may be changed by pressing the up or down button. Press “OK” and use the “Back” button to exit the “Grade Control Offset” menu.

Max Number Of Targets – From the Cross Slope screen, press the down key to display the “Max No Target” and press “OK” .

Illustration 147 g06251815

Illustration 148 g06251816

This setting determines the number of targets available for preset values.

After selecting this option, scroll down to highlight the number of targets desired. Press “OK” and use the “Back” button to exit the “Max Number of Targets” menu.

Cross Slope End-User License Agreement

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3.3 CTCT reserves all rights not expressly granted by this Agreement.

Illustration 149 g01126563

Cross Slope Calibration (If Equipped)

This section lists the calibrations required for the Cross Slope system. Calibration is performed when the system is set up and if a sensor is replaced or the desired cross slope does not match the actual cross slope.

Angle Sensors Calibration

Note: This process calibrates both of the angle sensors on the machine in one procedure. The operator must be seated and buckled into the machine. Ensure that everyone in the area is aware of the calibration.

⚠ WARNING

Do not operate or work on this machine unless you have read and understand the instructions and warnings in the Operation and Maintenance Manual. Failure to follow the instructions or heed the warnings could result in injury or death. Contact any Caterpillar dealer for replacement manuals. Proper care is your responsibility.

⚠ WARNING

Personal injury or death can result from sudden machine movement.

Sudden movement of the machine can cause injury to persons on or near the machine.

To prevent injury or death, make sure that the area around the machine is clear of personnel and obstructions before moving the machine to perform the test that follows.

Perform the following procedure:

1. Position the machine on smooth, flat, and solid ground with no articulation, circle centered, blade side shift centered, no wheel lean, and the parking brake set.

2. Select the “Service” option from the main menu. Inside the service menu, select the “Calibrations” option. Next, inside calibrations select the “Cross Slope Sensors” option.

Illustration 150 g06251817

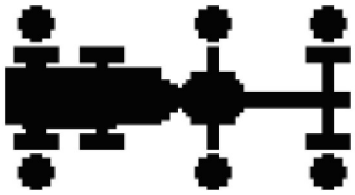

Illustration 151 g02181743

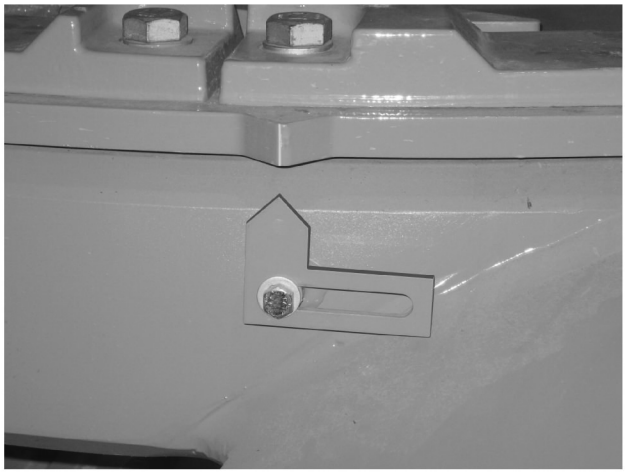

Illustration 152 g02509325

3. Rest the blade on the ground perpendicular to the frame using the pointer shown in Illustration 152 . When the top and bottom of the circle are aligned, the blade is perpendicular to the machine. Command the blade into the “Float” state and set the parking brake. Mark the locations of the following components indicated by the filled circles on the display: blade, front tires, and rear tires. Press the right arrow button to calibrate the reference angles and proceed.

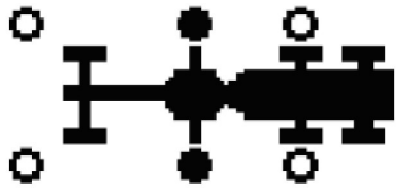

Illustration 153 g02178867

4. Raise the blade to a suitable elevation turn off the parking brake, and turn around the machine 180 degrees. Position the machine so that the blade is aligned with the blade marks created in the previous step. Rest the blade on the ground and command the blade into the “Float” state and set the parking brake. Press the right arrow button to calibrate the blade slope sensor and proceed.

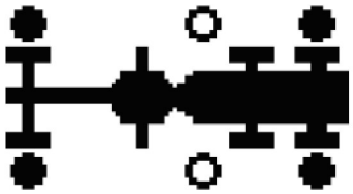

Illustration 154 g02178868

5. Raise the blade to a suitable elevation. Turn off the parking brake and move the machine forward so that the front and rear wheels are aligned with the marks established in Step 3. Rest the blade on the ground and command the “Float” state and set the parking brake. Press the right arrow button to calibrate the main fall sensor and complete the calibration.

6. Operator may press the “OK” button to confirm the action of calibrating the sensors.

Functional Test

⚠ WARNING

If the action alarm does not sound during this test or machine monitoring displays are not functioning, do not operate the machine until the cause has been corrected. Machine operation with faulty action alarms or displays could result in injury or death as any Warning Category 3 notifications will not be relayed to the operator.

To ensure the proper operation of the Caterpillar Monitoring System, check the system daily.

The battery disconnect switch must be in the ON position.

When you turn the engine start switch from the OFF position to the ON position, the Caterpillar Monitoring System will perform an automatic self-diagnostic test.

The self-diagnostic test verifies that the outputs (gauges, alert indicators, and alarms) are operating correctly.

When you turn the engine start switch to the ON position, the following systems are tested for approximately one second: alert indicators, gauges, and LCD display.

The gauges must go to the far right positions. All alert indicators must come on momentarily. All segments of the LCD display must come on momentarily. The action alarm must sound.

Warning Categories

The Monitoring System provides three warning categories. The first warning category requires only operator awareness. The second warning category requires a change to machine operation or the performance of maintenance to the system. The third warning category requires immediate shutdown of the machine.

Warning Category 1

In this category, only the alert indicator comes on. This category alerts the operator that the machine system needs attention.

Warning Category 2

In this category, the alert indicator and the action light come on. This category requires a change in machine operation. The Messenger system will display a message. If action is required, an instruction will be listed.

Warning Category 2S

In this category, the alert indicator and the action light come on and the action alarm sounds at a steady rate. This category requires an immediate change in machine operation. The Messenger system will display a message. If action is required, the instruction will be listed.

Warning Category 3

In this category, the alert indicator and the action light come on and the action alarm sounds at a pulse rate. This category requires immediate shutdown of the machine to prevent injury or death. This category requires immediate shutdown of the machine to prevent severe damage to the machine. The Messenger system will display a message. If action is required, the instruction will be listed.

Note: Do not operate the machine if the Monitoring System is not working or if the Monitoring System fails the self-diagnostic test at start-up. Stop the machine immediately if the following conditions occur:

- The alert indicator turns on.
- The action light indicator is flashing amber.
- The action alarm sounds at a pulse rate.
- The LCD Display is blank.

Engage the parking brake and stop the engine. Investigate the cause of the problem.

Do not operate the machine until the cause of the problem has been corrected.

i08001446

Product Link

SMCS Code: 7490; 7606

Note: Your machine may be equipped with the Cat ® Product Link™ system.

The Cat Product Link communication device utilizes cellular and/or satellite technology to communicate equipment information. This information is communicated to Caterpillar, Cat dealers, and Caterpillar customers. The Cat Product Link communication device uses Global Positioning System (GPS) satellite receivers.

The capability of two-way communication between the equipment and a remote user is available with the Cat Product Link communication device. The remote user can be a dealer or a customer.

Data Broadcasts

Data concerning this machine, the condition of the machine, and the operation of the machine is being transmitted by Cat Product Link to Caterpillar and/or Cat dealers. The data is used to serve the customer better and to improve upon Cat products and services. The information transmitted may include: machine serial number, machine location, and operational data, including but not limited to: fault codes, emissions data, fuel usage, service meter hours, software, and hardware version numbers and installed attachments.

Caterpillar and/or Cat dealers may use this information for various purposes. Refer to the following list for possible uses:

- Providing services to the customer and/or the machine
- Checking or maintaining Cat Product Link equipment
- Monitoring the health of the machine or performance
- Helping maintain the machine and/or improve the efficiency of the machine
- Evaluating or improving Cat products and services
- Complying with legal requirements and valid court orders
- Performing market research
- Offering the customer new products and services

Caterpillar may share some or all the collected information with Caterpillar affiliated companies, dealers, and authorized representatives. Caterpillar will not sell or rent collected information to any other third party and will exercise reasonable efforts to keep the information secure. Caterpillar recognizes and respects customer privacy. For more information, please contact your local Cat dealer.

Operation in a Blast Site for Product Link Radios

⚠ WARNING

This equipment is equipped with a Cat® Product Link communication device. When electric detonators are being used for blasting operations, radio frequency devices can cause interference with electric detonators for blasting operations which can result in serious injury or death. The Product Link communication device should be deactivated within the distance mandated under all applicable national or local regulatory requirements. In the absence of any regulatory requirements Caterpillar recommends the end user perform their own risk assessment to determine safe operating distance.

Refer to your products Operation and Maintenance Manual Supplement, “Regulatory Compliance Information” for more information.

For information regarding the methods to disable the Cat Product Link communication device, please refer to your specific Cat Product Link manual listed below:

- Operation and Maintenance Manual, SEBU8142, “ Product Link - PL121, PL321, PL522, and PL523”
- Operation and Maintenance Manual, SEBU8832, “ Product Link PLE702, PLE602, PLE601, PL641, PL631, PL542, PL240, PL241, PL243, PL141, PL131, PL161, PL083 and PL042 Systems”

Note: If no radio disable switch is installed and the equipment will be operating near a blast zone, a Product Link radio disable switch may be installed on the equipment. The switch will allow the Cat Product Link communication device to be shut off by the operator from the equipment control panel. For more details and installation procedures, refer to the following:

- Special Instruction, REHS7339, “Installation Procedure for Product Link PLE640 Systems”
- Special Instruction, REHS8850, “Installation Procedure for the Elite Product Link PLE601, PLE641, and PLE631 Systems”
- Special Instruction, SEHS0377, “Installation Procedure for the Product Link PL131, PL141, and PL161 Systems”
- Special Instruction, REHS9111, “Installation Procedure for the Pro Product Link PL641 and PL631 Systems”
- Special Instruction, M0098124, “Installation Procedure for Pro Product Link PL243 Systems”
- Special Instruction, M0109130, “Installation Procedure for Product Link PL683 and PL783 Systems”

Engine Starting

i05958975

Engine Starting

SMCS Code: 1000; 7000

⚠ WARNING

Diesel engine exhaust contains products of combustion which may be harmful to your health

Always start and operate the engine in a well-ventilated area and, if in an enclosed area, vent the exhaust to the outside.

1. Adjust the operator seat.

2. Fasten the seat belt.

3. Before you start the engine, check for the presence of bystanders or maintenance personnel. Ensure that all personnel are clear of the machine. Briefly sound the forward horn before you start the engine.

4. Engage the parking brake.

5. Place the transmission control switch in NEUTRAL.

6. Turn the engine start switch key to the ON position and allow all indicators and gauges to cycle. Once the gauges stop moving, the system check is complete.

Note: Do not start the engine until the electric engine preheat indicator (if equipped) has turned off. This indicator shows that the air inlet heater for the engine is ON.

7. Turn the engine start switch key to the START position in order to start the engine.

8. Release the engine start switch key when the engine starts.

9. Confirm steering control by actuating the steering control with the left joystick. If the steering is not engaged the primary steering indicator and the secondary steering indicators will illuminate. Refer to Operation and Maintenance Manual, “Monitoring System” for more information. Realign the left joystick if necessary.

10. Disengage the parking brake.

11. Select your desired FORWARD or REVERSE direction and select your requested gear.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking again.

When the temperature is below −18°C (0°F), the use of optional cold weather starting aids is recommended. A coolant heater, a fuel heater, a jacket water heater, or extra battery capacity may be required.

Before you operate the machine in temperatures below −23°C (−10°F), consult your Caterpillar dealer or refer to Special Publication, SEBU5898, “Cold Weather Recommendations for All Caterpillar Machines”.

i04021019

Engine and Machine Warm-Up

SMCS Code: 1000; 7000

NOTICE
Keep engine speed low until the engine oil pressure registers on the gauge or the engine oil pressure indicator light goes out. If it does not register or the light does not go out within ten seconds, stop the engine and investigate the cause before starting again. Failure to do so, can cause engine damage.

NOTICE
Always run the engine at low idle for at least ten minutes before performing any other operations in cold conditions to protect your engine and to protect your transmission.

NOTICE
When you operate the machine in ambient temperatures below 4° C (40° F), cooler covers are recommended to maintain normal hydraulic operating temperatures. When the ambient temperature is above 4° C (40° F), the cooler covers are not required.

Hydraulic System

⚠ WARNING

The steering circuit temperature monitoring system, if equipped, will alert you when reduced steering performance is detected due to cold temperatures. Failure to respond to this warning could result in injury or death. Ensure that the hydraulic oil type installed in the machine is matched to the hydraulic oil type setting in Messenger.

Note: Do not operate the machine unless the hydraulic oil temperature is equal to or greater than the temperature listed in table 11 based upon the hydraulic oil viscosity installed on the machine and viewable in Messenger. Refer to Operation and Maintenance Manual, “Monitoring System” for more information on Messenger.

Initial Machine Start

1. When the steering oil temperature is equal to or less than the temperature listed in table 11 , you will receive a Level 2 warning. Messenger will display “Cold Steering Oil, Warm Oil” . The warning will clear when the hydraulic oil temperature is equal to or greater than the temperature listed in table 12 .
2. Observe the hydraulic oil temperature on the Messenger display. If Messenger displays “Cold Steering Oil, Warm Oil” , warm the hydraulic oil by following the instructions below:
   a. Cycle all implement and steering controls in order to allow warm oil to circulate through all hydraulic cylinders and through all hydraulic lines.

   Note: If the hydraulic functions are sluggish, additional time may be required for warm-up.

Table 11

Oil Viscosity Grade			
SAE 30 Cat TDTO-TMS	SAE 10W SAE 5W-30 SAE 5W-40	Cat BIO SAE 0W-30 SAE 0W-40	SAE 0W-20
14° C (57° F)	0° C (32° F)	−6° C (21° F)	−16° C (3° F)

Table 12

Oil Viscosity Grade			
SAE 30 Cat TDTO-TMS	SAE 10W SAE 5W-30 SAE 5W-40	Cat BIO SAE 0W-30 SAE 0W-40	SAE 0W-20
20° C (68° F)	5° C (41° F)	0° C (32° F)	−11° C (12° F)

Recommended Warm-Up Procedure for the Hydraulic Oil

1. Make sure that the area is clear of personnel and equipment.
2. Place the transmission control switch in the NEUTRAL position, and engage the parking brake.
3. Run the engine for 5 minutes at LOW IDLE prior to performing the following procedure in order to protect the engine and the transmission.
4. Perform the following operations simultaneously at either HIGH IDLE or LOW IDLE. A faster warm-up time will be achieved if the operations are performed with the engine at HIGH IDLE.
   - Stall the wheel lean cylinders in either direction by using the buttons that are located on the left joystick.
   - Rotate the circle by twisting the right joystick left or right.
   - The right joystick can also be used to shift the moldboard sideways. Lean the joystick to the right in order to move the moldboard right. Lean the joystick to the left in order to move the moldboard left.

Note: Use caution not to damage the tires with the blade.

5. Exercise all of the machines implement cylinders and all of the steering cylinders in order to circulate the warm oil into the remaining cylinders.

Optional Warm-Up Procedure for the Hydraulic Oil with Blade Float

1. Engage the parking brake.
2. Place the implement lockout switch in the UNLOCK position.
3. Initiate blade float for the left side of the blade or initiate blade float for the right side of the blade.

Note: Blade float may also be initiated on both sides of the blade simultaneously.

Note: Once the above conditions have been met, you do not need to be present as the blade float will remain active. The Hydraulic Oil Warm-Up Mode will be activated.

4. To disable the Hydraulic Oil Warm-Up Mode, disable the blade float and place the implement lockout switch in the LOCK position. Refer to Operation and Maintenance Manual, “Operator Controls” for more information regarding blade float.

Lower Power Train

NOTICE
Always run the engine at low idle for at least ten minutes before performing any other operations in cold conditions to protect your engine and to protect your transmission.

If the ambient temperature is cold and the power train oil needs to be warmed, use the procedure below:

1. Move the equipment forward and backward for several meters (yards) in order to exercise the transmission and the power train. Exercise the machine for several minutes.

2. Operate under a light load until the systems reach normal operating temperatures.

3. During machine operation, frequently look at the alert indicators and the gauges.

Steering Oil Temperature Monitoring System

⚠ WARNING

The steering circuit temperature monitoring system, if equipped, will alert you when reduced steering performance is detected due to cold temperatures. Failure to respond to this warning could result in injury or death. Ensure that the hydraulic oil type installed in the machine is matched to the hydraulic oil type setting in Messenger.

The purpose of the system is for alerting the operator of performance changes due to steering system oil temperature. The system includes multiple alert levels that are used to inform the operator to warm the steering system hydraulic oil. Also, these alerts may inform the operator to downshift to ensure optimal steering performance.

When the machine is in NEUTRAL, 1F/R or 2F/R and the steering system oil temperature drops below the temperatures that are listed in Table 11 , the operator will receive a Level II warning. Messenger will display “Cold Steering Oil, Warm Oil” . The recommended action is warming the hydraulic oil above the temperature in Table 11 in order to clear the alarm. Refer to Operation and Maintenance Manual, “Engine and Machine Warm-Up” for instructions on warming the oil.

When the machine is in gear 3F/R or higher, there are two possible warnings. The first warning is a Level I warning. Messenger will display “Cold Steering Oil, Warm Oil” . The operator should then plan to cycle steering when it is convenient. The second warning is a Level II warning. Messenger will display “Cold Steering Oil, Downshift” . The operator should then reduce gear and cycle the steering when convenient.

The steering system oil temperature should be warmed above the temperatures in Table 13 in order to avoid warnings about “Cold Steering Oil” in any selected gear.

Table 13

Oil Viscosity Grade			
SAE 30	SAE 10W SAE 5W-30 SAE 5W-40	Cat BIO SAE 0W-30 SAE 0W-40	SAE 0W-20
25° C (77° F)	8° C (47° F)	4° C (39° F)	-4° C (25° F)

Adjustments

i02096607

Moldboard Blade

SMCS Code: 6151

Horizontal Adjustment of the Blade

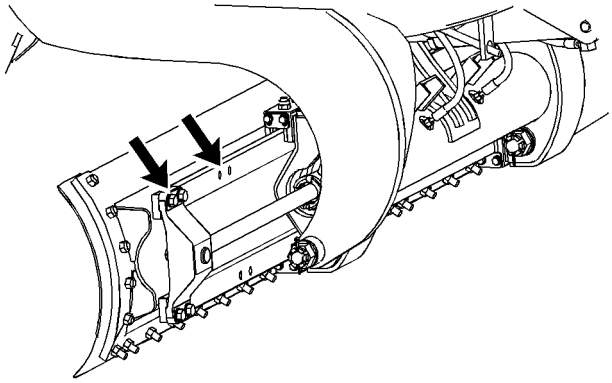

Illustration 155 g01068955

1. Sideshift the blade in the desired direction of the adjustment.

2. Lower the blade to the ground.

3. Loosen the bolts that secure the cylinder rod end bracket to the moldboard. Remove the four bolts and remove the four lockwashers.

4. Position cylinder rod in order to align the bolt holes that are in the bracket with the alternate holes that are in the moldboard.

5. Install the four lockwashers. Install the four bolts and tighten the bolts.

Parking

i06812537

Stopping the Machine

SMCS Code: 7000

Park on a level surface. If it is necessary to park on a grade, chock the wheels securely.

1. Decrease the engine speed.

2. Reduce ground speed.

3. Stop the machine – Just before the machine comes to a stop, you must also apply the transmission modulator control (inching pedal) or place the transmission control switch in the NEUTRAL position to prevent stalling of the engine.

4. Place the transmission control switch in the NEUTRAL position.

5. Engage the parking brake.

6. Lower the attachments to the ground. Apply a slight downward pressure.

The motor grader is equipped with primary, secondary, and tertiary braking systems. The primary braking system is the combination of both the left side and right side braking circuits. These circuits are both controlled by the service brake control valve. In the event of a malfunction in one of the two circuits, the remaining circuit acts as the secondary braking system. The service brake control valve controls flow to both the left and right service brakes and balances flow between the sides; this valve provides a linkage between the primary and secondary brake systems. The tertiary braking system is the parking brake.

In the event of a service brake system malfunction, the parking brake can be applied to bring the machine to a stop. Note that the parking brake is a spring actuated/non-modulated brake. The brake will fully apply; the operator should prepare for a sudden stop. It is not recommended to apply the parking brake while the machine is in motion except in an emergency situation. If the parking brake is applied in such a situation, it must be inspected and tested before the machine is returned to service.

Warm Storage

When the ambient temperature is less than 0° C (32° F), each implement circuit must be operated multiple times within in full range of motion before a machine is brought from a cold environment into a warm shop. This will flush warm oil through the hydraulic circuits and prevent hydraulic system component damage as the oil warms back up.

1. Make sure that the machine is clear of personnel and equipment.

2. Place the transmission control in the NEUTRAL position and engage the parking brake.

3. Bring the engine to high idle, to circulate the oil through the machine faster.

4. Be sure to operate the following implements. Cycle each implement at least five times.

- Steering
- Wheel lean
- Centershift
- Blade shift
- Blade tip
- Circle drive
- Blade lift
- Ripper (if equipped)
- Articulation of the Machine

Note: Take care not to damage the machine while moving the blade.

i02591054

Stopping the Engine

SMCS Code: 1000; 7000

NOTICE
Stopping the engine immediately after it has been working under load, can result in overheating and accelerated wear of the engine components.

Refer to the following procedure, to allow the engine to cool, and to prevent excessive temperatures in the turbocharger housing (if equipped), which could cause oil coking problems.

1. Park the machine on level ground. Refer to Operation and Maintenance Manual, “Stopping the Machine” for the recommended procedure.

2. In order to allow the engine to gradually cool, operate the engine at low idle for five minutes.

3. Turn the engine start switch to the OFF position and remove the engine start switch key.

i04797666

Stopping the Engine if an Electrical Malfunction Occurs

SMCS Code: 1000; 7000

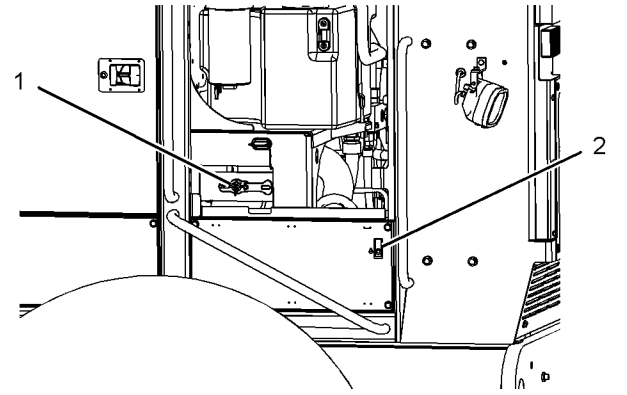

Illustration 156 g01176688

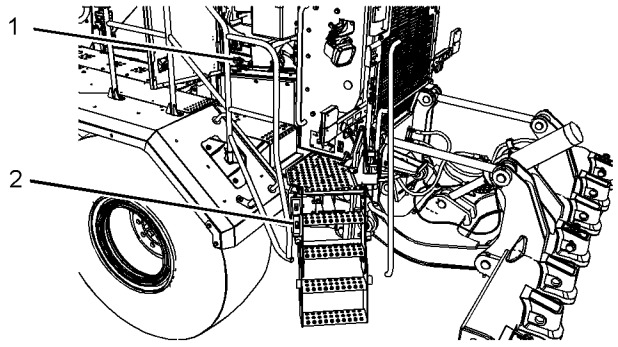

Illustration 157 g02916161

16M with Access Platform

Turn the engine start switch to the OFF position. Remove the key.

If the engine does not stop, lift the guard of engine shutdown switch (2). Move the engine shutdown switch to the STOP position.

Move battery disconnect switch key (1) to the OFF position. Remove the key.

Do not operate the machine again until the malfunction has been corrected.

i02582985

Equipment Lowering with Engine Stopped

SMCS Code: 7000

⚠ WARNING

Be sure all personnel are clear of the equipment while the equipment is being lowered.

Failure to stay clear of the equipment while the equipment is being lowered may result in personal injury.

Note: If the engine is inoperable and any of the equipment has not been lowered to the ground, use the following method to lower the equipment to the ground.

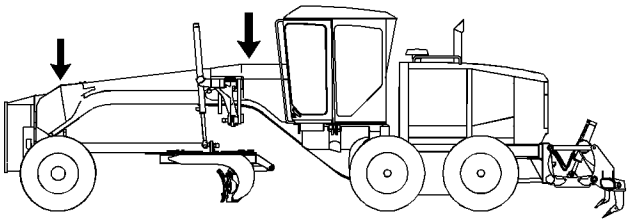

Illustration 158 g01293763

The relief valves are located on the implement control valves. The implement control valves are located on top of the front frame.

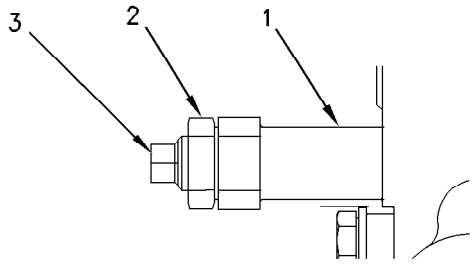

Illustration 159 g00947592

Hold relief valve (1) and loosen locknut (2). Slowly turn hex cap (3) counterclockwise until the equipment is lowered to the ground.

Note: Do not allow the equipment to lower too quickly.

After the equipment has been lowered to the ground, remove the cartridge assembly for the relief valve. Replace the cartridge assembly with a new cartridge assembly or adjust the relief setting. Refer to Testing and Adjusting, “Relief Valves (Implement) - Test and Adjust”.

i03832351

Leaving the Machine

SMCS Code: 7000

1. Use the steps and the handholds when you get off the machine. Face the machine and use both hands. Make sure that the steps are clear of debris before you dismount.

2. Inspect the engine compartment for debris. Clean out any debris and paper in order to avoid a fire.

3. Remove all flammable debris in order to reduce a fire hazard. Dispose of all debris properly.

4. Always turn the battery disconnect switch to the OFF position before leaving the machine.

5. If the machine will not be operated for a month or more, remove the battery disconnect switch key.

6. Install all covers and all vandalism protection locks.

Transportation Information

i05130872

Shipping the Machine

SMCS Code: 7000; 7500

Investigate the travel route for overpass clearances. Make sure that there is adequate clearance for the machine that is being transported. This is especially important for machines that are equipped with a ROPS, with a FOPS, with a cab, or with a canopy.

Remove ice, snow, or other slippery material from the loading dock and from the truck bed before you load the machine onto the transport machine. Removing ice, snow, or other slippery material will help to prevent the machine from slipping in transit.

Note: Obey all laws that govern the characteristics of a load (height, weight, width, and length). Observe all regulations that govern wide loads.

If equipped with the optional access platform, remove the primary ladder on the rear of the machine.

Remove the ether starting aid cylinder, if equipped.

When you move the machine to a colder climate, make sure that the cooling system has the proper antifreeze.

1. Before you load the machine, chock the trailer wheels or the rail car wheels.

2. When the machine is positioned, connect the frame lock link. The frame lock link will hold the front frame and the rear frame rigid. Also, connect the wheel lean locking bolt. The wheel lean locking bolt will hold the front wheels in the upright position.

3. Lower all attachments to the floor of the transport machine. Move the transmission control switch to the NEUTRAL position.

4. Engage the parking brake.

5. Stop the engine.

6. Turn the engine start switch to the OFF position. Remove the engine start switch key.

7. Turn the battery disconnect switch to the OFF position. Remove the disconnect switch key.

8. Lock the doors and the access covers. Attach any vandalism protection covers. For machines equipped with the optional access platform, the cab door can be locked using a padlock that is secured to the cab door foot pedal.

9. Chock the tires. Secure the machine with tie-downs.

NOTICE
Rotation of the turbocharger without engine operation can result in damage to the turbocharger.

Cover the exhaust opening or secure the rain cap in order to prevent the turbocharger from windmilling in transit.

Perform a walk-around inspection and measure the fluid levels in the various compartments.

Travel at a moderate speed. Observe all speed limitations when you are roading the machine.

Consult your Cat dealer for shipping instructions for your machine.

i06982063

Roading the Machine

SMCS Code: 7000; 7500

WARNING

The steering circuit temperature monitoring system, if equipped, will alert you when reduced steering performance is detected due to cold temperatures. Failure to respond to this warning could result in injury or death. Ensure that the hydraulic oil type installed in the machine is matched to the hydraulic oil type setting in Messenger.

Before you road a machine, consult your tire dealer for recommended tire pressures and for speed limitations.

Limitations for TON-kilometer per hour (TON-mile per hour) must be obeyed. Consult your tire dealer for the speed limit of the tires that are used.

When you travel for long distances, schedule stops in order to allow the tires and the components to cool. Stop for 30 minutes after every 40 km (25 miles) or after every hour. Consult your local tire dealer for machines that are equipped with “L4/L5” tires.

Inflate the tires to the correct pressure.

Use a self-attaching inflation chuck and stand behind the tire tread during the tire inflation. See the Operation and Maintenance Manual, “Tire Inflation Information” section for more information.

Perform a walk-around inspection to ensure the machine is in safe operating condition.

Check with the proper officials in order to obtain the required licenses and authorization.

If your machine is equipped with the fold down tail lights fold down the tail lights before roading.

Travel at a moderate speed. Observe all speed limitations when you road the machine.

Place the implement lockout switch in the LOCK position to prevent unintended implement movements.

Do not operate the machine with the doors open under high speed applications.

Machine operation in cold ambient conditions may cause the steering system oil temperature to fall below the tank temperature. This can cause a reduction in steering performance. When you operate the machine for an extended period of straight roading these conditions may occur.

Reduce engine speed when you maneuver in tight quarters or when you are going over a hill.

Do not operate the machine close to a cliff. Do not operate the machine near an excavation. Do not operate the machine near an overhang.

When you operate the machine downhill, use two transmission gears less than the transmission gear that is used when you operate the machine up the same hill.

Note: Caterpillar does not recommend that you shift to the NEUTRAL position when operating the machine downhill. If you shift to the NEUTRAL position, the machine may require additional braking effort that could accelerate wear of the service brake components.

Do not allow the engine to overspeed when operating the machine downhill. If overspeed exists, use the service brake control to decrease the speed to a level that will allow you to downshift. Repeat this process until a stable or controlled speed is obtained. Before the engine is pushed beyond a dangerous speed level, the transmission will automatically upshift in order to keep the engine speed within a safe speed range. However, when the maximum gear is reached, the service brakes must be used to control the machine speed and the service brakes must also be used to prevent the engine from overspeeding.

Note: For more information on warning categories refer to Operation and Maintenance Manual, “Engine and Machine Warm-Up”.

i05298687

Lifting and Tying Down the Machine

SMCS Code: 7000; 7500

⚠ WARNING

A machine may shift if improper procedures or equipment are used for lifting and tying down for transport. Ensure that proper equipment and procedures are used for lifting and tying machines down for transport. If a machine shifts it could cause personal injury or death.

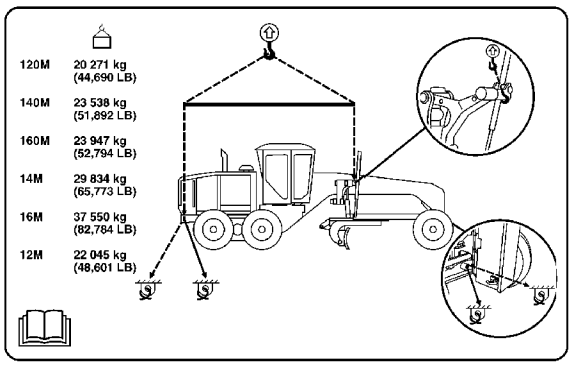

Illustration 160 g03329747

12M
S/N: B921–Up

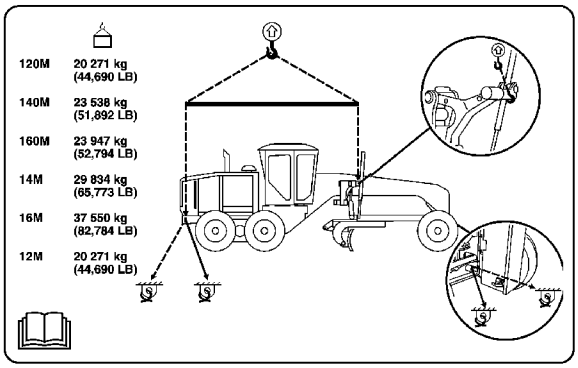

Illustration 161 g03364236

12M
S/N: B9F1–Up
and
S/N: B9R1–Up

NOTICE
Improper lifting or tiedowns can allow load to shift and can cause injury and damage.

Note: The machine shipping weight that is listed is the weight of the most common configuration of the machine. If attachments have been installed on your machine, the weight of your machine and the center of gravity of your machine may vary.

See Operations and Maintenance Manual, “Specifications” for the weight of the machine.

Lifting Point – In order to lift the machine, attach the lifting devices to the lifting points.

Tie-Down Point – In order to tie down the machine, attach the tie-downs to the tie-down points.

Lifting the Machine

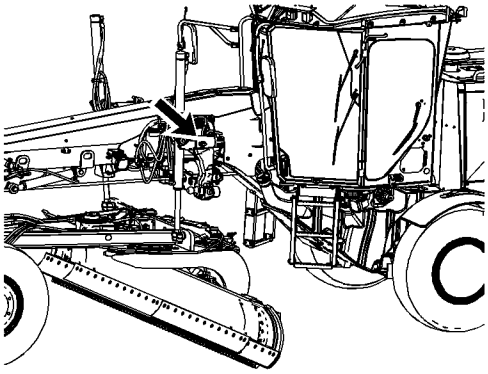

Illustration 162 g01680893
Typical Example Shown

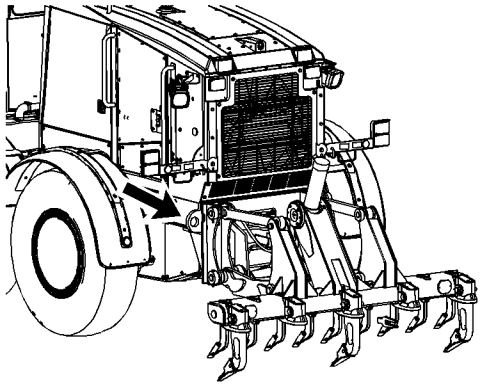

Illustration 163 g01680586

Use properly rated cables and properly rated slings to lift the machine.

Position the crane or the lifting device in order to lift the machine in a level position.

The width of the spreader bar must be sufficient to prevent the lifting cables or the lifting straps from contacting the machine.

1. Engage the parking brake before you attach a lifting device to the machine.
2. Install the frame lock pin prior to lifting the machine.
3. Wrap two lifting cables around the lift arm of the machine. The lift arms are located near the blade lift cylinders. There is one arm on each side of the front of the machine. The lifting areas are identified by a label that shows a hook. Refer to illustration 162 .
4. Attach two lifting cables to the rear of the machine. There is one lifting eye on each side of the rear of the machine. The lifting eyes are identified by a label that shows a hook. Refer to illustration 163 .

Note: If equipped with the optional access platform on the 16M, remove the primary ladder on the left rear of the machine to access the lifting eyes.

5. Connect the four lifting cables to the spreader bars. The spreader bars must be centered over the machine.
6. If equipped, secure any attachments.
7. Lift the machine. Move the machine to the desired position.
8. Secure the machine at the tie-down positions. The positions are identified on the machine by a label.

Refer to Operation and Maintenance Manual, “Shipping the Machine” for shipping instructions for your machine.

Tying Down the Machine

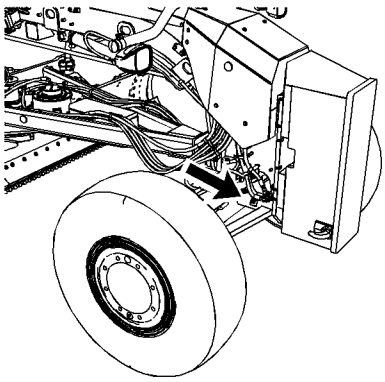

Illustration 164 g01680582
Typical Example Shown

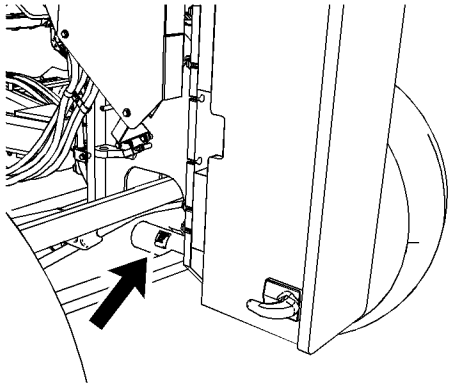

Illustration 165 g01957057
Typical Example Shown

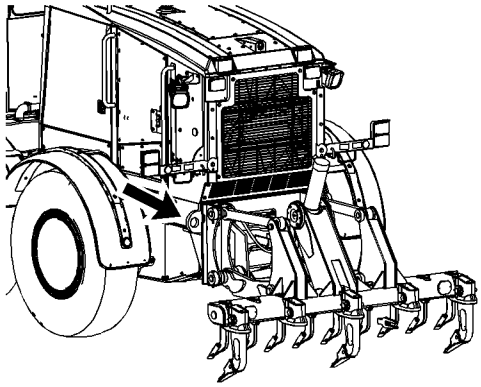

Illustration 166 g01680586

Use properly rated cables and properly rated slings to tie down the machine.

1. Position the machine on the trailer.

2. Install the frame lock pin.

3. Engage the parking brake.

4. Lower the blade to the floor of the transport machine. Lower all attachments to the floor of the transport machine.

5. Turn the engine start switch to the OFF position.

6. Turn the battery disconnect switch to the OFF position.

7. Attach four tie-down cables to the front of the machine. The front axle tube is used as the front tie-down point. The tie-downs are identified by a label that shows a tie-down position. Refer to illustration 165 .

Note: The four tie-down cables must secure the front of the machine.

8. Attach four tie-down chains to the rear of the machine. There is one tie-down eye on each side of the rear of the machine. The tie-down eyes are identified by a label that shows a tie-down position. Refer to illustration 166 .

Note: The four tie-down chains must secure the rear of the machine.

9. Add additional tie-downs if necessary.

10. Chock the wheels.

11. Obey all laws that govern the characteristics of a load (height, weight, width, and length). Observe all regulations that govern wide loads.

Note: Consult your Cat dealer for shipping instructions for your machine.

Jacking Location Information

i05833097

Jacking Locations

SMCS Code: 7000

⚠ WARNING

Personal injury or death can result from improper lifting or blocking.

When a jack is used to lift the machine, stand clear of the area. Use a jack that is rated for the correct capacity to lift the machine. Install blocks or stands before performing any work on the machine.

Front of the Machine

Before the front of the machine is raised, verify the following information:

- The transmission is in the NEUTRAL position.
- Engage the parking brake.
- The wheel lean locking bolt is in the front axle.
- The frame lock pin is installed.
- The rear tires are chocked.
- The jack is sufficiently sized for the weight of the machine. See Operation and Maintenance Manual, “Specifications” for the weight of the machine.

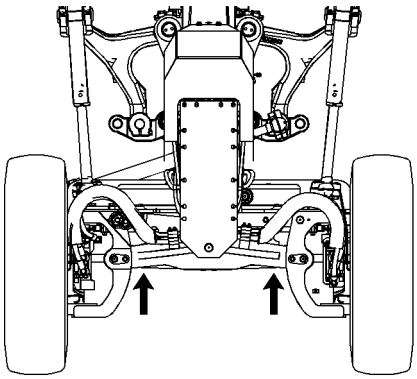

Illustration 167 g01112402

Typical Example Shown

The location for jacking up the front of the machine is under the front axle.

Rear of the Machine

Before the rear of the machine is raised, verify the following information:

- The transmission is in the NEUTRAL position.
- The wheel lean locking bolt is in the front axle.
- The frame lock pin is installed.
- The front tires are chocked.
- The jack is sufficiently sized for the weight of the machine. See Operation and Maintenance Manual, “Specifications” for the weight of the machine.

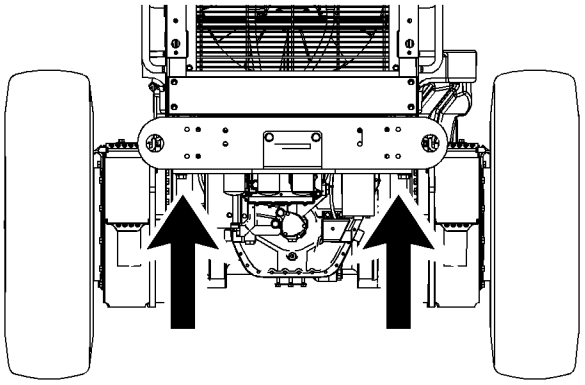

Illustration 168 g01112403

The location for jacking up the rear of the machine is under the main frame on the rear of the machine.

Towing Information

i06715187

Towing the Machine

SMCS Code: 7000

⚠ WARNING

Improper hookup and towing is dangerous and could result in injury or death to yourself or others.

The towing connection must be rigid, or towing must be done by two machines of the same size as the towed machine. If two machines are used, connect a machine on each end of the towed machine.

If only one machine is used for towing, that machine must be larger than the towed machine.

Be sure that all necessary repairs and adjustments have been made before a machine that has been towed to a service area is put back into operation.

Follow the recommendations that are listed below in order to perform the towing procedure.

This machine is equipped with brakes that are applied by hydraulic pressure. The brakes are released by springs. The parking brake must be disengaged before towing the machine. If the parking brake is engaged, the machine cannot be moved.

NOTICE
Towing of a disabled machine with the engine stopped may cause transmission damage. The transmission will not have lubrication.

Do not tow a disabled machine any farther than is necessary to provide for a convenient location for repairs.

These towing instructions are for moving a disabled machine for a short distance at low speed. Move the machine at a speed of 2 km/h (1.2 mph) or less to a convenient location for repair. These instructions are only for emergencies. Always haul the machine if long distance moving is required.

Shielding must be provided on both machines. Shielding will protect the operator if the tow line or the tow bar breaks.

Do not allow an operator to be on the machine that is being towed unless the operator can control the steering and/or the braking.

Before you tow the machine, make sure that the tow line or the tow bar is in good condition. Make sure that the tow line or the tow bar has enough strength for the towing procedure that is involved. The strength of the towing line or of the tow bar should be at least 150 percent of the gross weight of the towing machine. This is true for a disabled machine that is stuck in the mud and for towing on a grade.

Keep the tow line angle to a minimum. Do not exceed a 30 degree angle from the straight ahead position.

Quick machine movement could overload the tow line or the tow bar. Quick machine movement could cause the tow line or the tow bar to break. Gradual, steady machine movement will be more effective.

Normally, the towing machine should be as large as the disabled machine. Make sure that the towing machine has enough brake capacity, enough weight, and enough power. The towing machine must be able to control both machines for the grade that is involved and for the distance that is involved.

Provide sufficient control and sufficient braking when you are moving a disabled machine downhill. This may require a larger towing machine or additional machines that are connected to the rear. This will prevent the machine from rolling away out of control.

All situation requirements cannot be listed. Minimal towing machine capacity is required on smooth, level surfaces. When you are on inclines or on surfaces in poor condition, maximum towing machine capacity is required.

Attach the towing device and the machine before you release the brakes. If equipped, disengage the front wheel drive.

Consult your Cat dealer for towing a disabled machine.

Retrieval, Push, and Pull Locations

Retrieval Locations

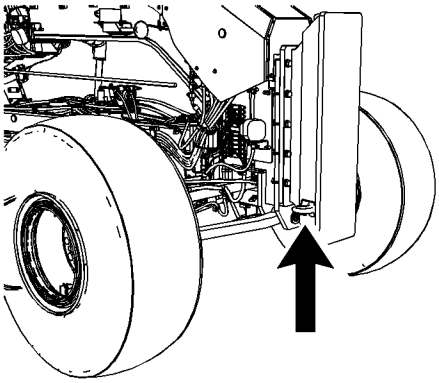

Illustration 169 g03649470

Use the front tow hook as a retrieval point for machines that are equipped with a push plate and the tow hook. If your machine is not equipped with the push plate and tow hook, use the rear retrieval point as a retrieval point.

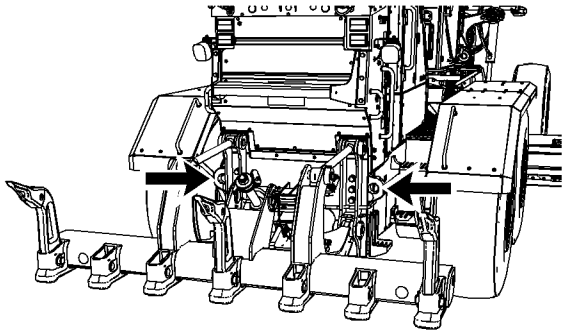

Illustration 170 g03649472

Use the retrieval loops on the rear of the machine as a retrieval point for all machines.

Note: Ensure that the center ripper tip is stored with the tip facing away from the machine. Storing the tip facing towards the cab, may result in damage to the ripper cylinder.

Push Locations

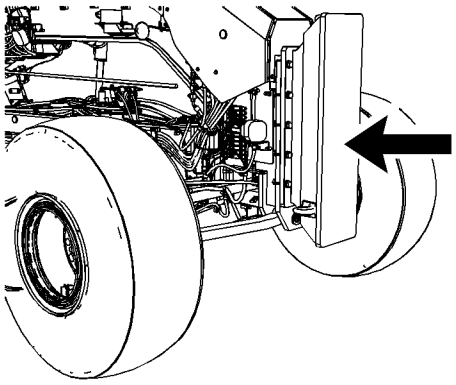

Illustration 171 g03649478

Use the center line of the push plate as a push point for machines that are equipped with a push plate. If your machine is not equipped with the push plate and tow hook, it is not recommended to use the front of the machine as a push point.

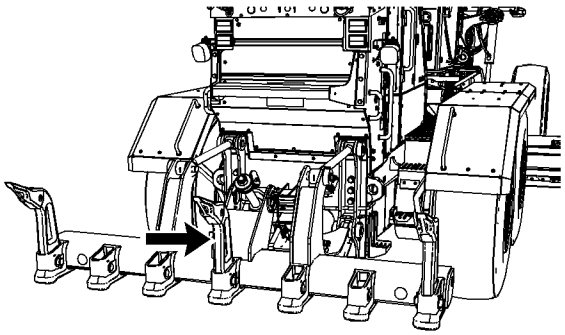

Illustration 172 g03649481

Use the ripper center, that is fully raised, as a push point on the rear of the machine on machines that are equipped with a ripper. If your machine is not equipped with a ripper, do not use the rear of the machine as a push point.

Note: Ensure that the center ripper tip is stored with the tip facing away from the machine. Storing the tip facing towards the cab, may result in damage to the ripper cylinder.

Pull Locations

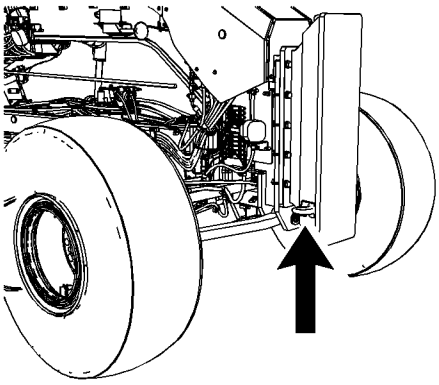

Illustration 173 g03649470

Use the front tow hook as a pull point for machines that are equipped with a push plate and the tow hook. If your machine is not equipped with the push plate and tow hook, do not use the front of the machine as a pull point.

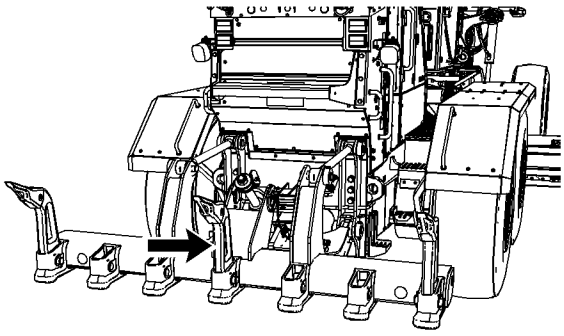

Illustration 174 g03649483

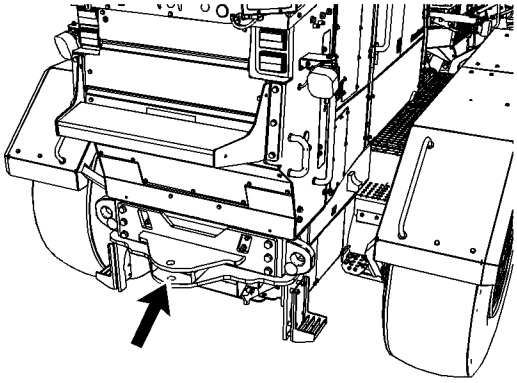

Illustration 175 g03649484

Use the center shank pocket of the ripper at level position as a pull point on machines that are equipped with a ripper. For machines that are not equipped with a ripper, use the tow hitch pin as a pull point.

Note: Ensure that the center ripper tip is stored with the tip facing away from the machine. Storing the tip facing towards the cab, may result in damage to the ripper cylinder.

Running Engine

If the engine is running, the machine can be towed for a short distance under certain conditions. The power train and the steering system must be operable.

1. Place the transmission control switch in the NEUTRAL position.
2. Raise the attachments off the ground.

Dead Engine

If the engine is dead, perform the following steps before towing the machine.

NOTICE
Towing of a disabled machine with the engine stopped may cause transmission damage. The transmission will not have lubrication.

Do not tow a disabled machine any farther than is necessary to provide for a convenient location for repairs.

1. Activate the secondary steering pump on the stopped machine. Refer to Operation and Maintenance Manual, “Monitoring System” for activation of the secondary steering pump. You can steer the machine while the secondary steering pump is on. The secondary steering pump will be activated for a maximum of 10 seconds. While the secondary steering pump is activated you can use the joystick to align the front wheels of the machine.

2. Remove the drive shaft that is located between the differential and the transmission. Consult your Cat dealer or refer to Disassembly and Assembly Manual, “Drive Shaft - Remove and Install” for removal and installation of the drive shaft.

⚠ WARNING

When the driveshaft is removed, the machine has NO parking brake. The machine can roll and cause personal injury or death.

Block the wheels securely so that the machine cannot move.

If the brakes are in good operating condition, the machine has limited wheel brake ability.

The towing connection must be rigid, or towing must be done by two machines of the same size or larger than the towed machine. Connect a machine on each end of the towed machine.

3. Fasten the tow line or the tow bar.

4. Remove the wheel blocks. Tow the machine slowly. Do not tow the machine faster than 2 km/h (1.2 mph).

⚠ WARNING

Be sure all necessary repairs and adjustments have been made before a machine that has been towed to a service area is put back into operation. Failure to make all necessary repairs and adjustments can cause personal injury or death.

Engine Starting (Alternate Methods)

i04390262

Engine Starting with Jump Start Cables

SMCS Code: 1000; 7000

⚠ WARNING

Never "hotwire" or short across the starter terminals! Hotwiring or shorting across the starter terminals could bypass the engine neutral start system, damage the electrical system, and result in unexpected machine motion or behavior. This could cause personal injury or death.

⚠ WARNING

Failure to properly service the batteries may cause personal injury.

Prevent sparks near the batteries. They could cause vapors to explode. Do not allow the jump start cable ends to contact each other or the machine.

Electrolyte is an acid and can cause personal injury if it contacts the skin or eyes.

Always wear eye protection when starting a machine with jump start cables.

Improper jump start procedures can cause an explosion resulting in personal injury.

When using jumper cables, always connect the positive (+) jumper cable to the positive (+) battery terminal first. Next, connect the negative (-) jumper cable to the frame away from the batteries. Follow the procedure in the Operation and Maintenance Manual.

Jump start only with an energy source of the same voltage as the stalled machine.

Turn off all lights and accessories on the stalled machine. Otherwise, they will operate when the energy source is connected.

NOTICE
Ensure that the machine that is used as an electrical source does not touch the stalled machine. This could prevent damage to engine bearings and electrical circuits.

Turn on the disconnect switch on the electrical source. This will help to prevent damage to electrical components on the stalled machine.

This machine has a 24 volt starting system. Use only equal voltage for jump starting. Use of a higher voltage will damage the electrical system.

Severely discharged maintenance free batteries will not fully recharge from the alternator alone after you jump start the machine. The batteries must be charged to the proper voltage with a battery charger. Many batteries that are considered to be unusable can still be recharged.

Refer to Special Instruction, SEHS7633, “Battery Test Procedure” for complete information about testing and about charging. This document is available from your Caterpillar dealer.

NOTICE
When starting a stalled machine using jump-start cables or an auxiliary power source, do not make the positive connection at the alternator “B” terminal. Damage to the alternator can occur. Always connect the cables to the appropriate battery posts.

When auxiliary start receptacles are not available, use the following procedure:

1. On the stalled machine, place the transmission control switch in the NEUTRAL position. Engage the parking brake on the stalled machine. Lower the equipment to the ground.
2. Turn the engine start switch on the stalled machine to the OFF position. Turn off all accessories.
3. Turn the battery disconnect switch on the stalled machine to the ON position.
4. Move the machine that is being used as an electrical source near the stalled machine so that the jump-start cables reach the stalled machine. **Do not allow the machines to contact each other.**
5. Stop the engine of the machine that is being used as an electrical source. If you are using an auxiliary power source, turn off the charging system.
6. Ensure that battery caps on both machines are tight and correctly placed. Ensure that batteries in the stalled machine are not frozen.

7. The positive ends of the jump-start cable are red. Connect one positive end of the jump-start cable to the positive cable terminal of the discharged battery. Some machines have battery sets.

Note: Batteries that are in series may be in separate compartments. Use the terminal that is connected to the starter solenoid. This battery or battery set is normally on the same side of the machine as the starting motor.

Do not allow the positive cable clamps to contact any metal except the battery terminals.

8. Connect the other positive end of the jump-start cable to the positive cable terminal of the electrical source.

9. Connect one negative end of the jump-start cable to the negative cable terminal of the electrical source.

In 24 V battery systems, the negative cable terminal of the electrical source is connected to the battery disconnect switch in the same battery set that is used in Step 8.

10. Finally, connect the other negative end of the jump-start cable to the frame of the stalled machine. Do not connect the jump-start cable to the battery post. Do not allow the jump-start cables to contact the battery cables, the fuel lines, the hydraulic lines, or any moving parts.

11. Start the engine of the machine that is being used as an electrical source or energize the charging system on the auxiliary power source.

12. Wait at least 2 minutes before you attempt to start the stalled machine. This will allow the batteries in the stalled machine to partially charge.

13. Attempt to start the stalled engine. See Operation and Maintenance Manual, “Engine Starting” in the Operation Section for the correct starting procedure.

14. Immediately after you start the stalled engine, disconnect the jump-start cables in reverse order.

i02355758

Engine Starting with Auxiliary Start Receptacle

SMCS Code: 1000; 7000

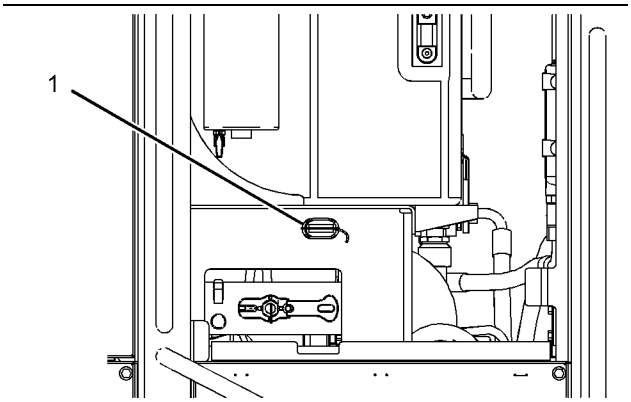

Illustration 176 g01176745

Auxiliary start receptacle (1) is located on the left side of the machine in the engine compartment.

Two cable assemblies are also available in order to jump start the stalled machine from another machine that is also equipped with this receptacle or with an auxiliary power pack. Your Caterpillar dealer can provide the correct cables for your application.

1. Move the transmission control of the stalled machine into the NEUTRAL position. Engage the parking brake. Lower the attachment to the ground. Move all controls to the HOLD position.

2. Turn the engine start switch on the stalled machine to the OFF position. Turn off all accessories.

3. On the stalled machine, turn the battery disconnect switch to the ON position. Refer to Operation and Maintenance Manual, “Battery Disconnect Switch” for the proper location on your machine.

4. Move the machine that is being used as a power source so that the auxiliary starting cables can reach the stalled machine. **Do not allow the machines to contact each other.**

5. Stop the engine on the machine that is being used as a power source. If you are using an auxiliary power source, turn off the charging system.

6. Remove the dust covers on auxiliary start receptacle (1).

7. On the stalled machine, connect the appropriate auxiliary starting cable to auxiliary start receptacle (1).

8. Connect the other end of the auxiliary starting cable to the auxiliary start receptacle that is on the power source.

9. Start the engine on the machine that is being used as a power source. If you are using an auxiliary power source, energize the charging system on the auxiliary power source.

10. Wait for a minimum of two minutes while the batteries in the stalled machine partially charge.

11. Attempt to start the stalled engine. Refer to Operation and Maintenance Manual, “Engine Starting” for the proper starting procedure for your machine.

12. Immediately after you start the stalled engine, disconnect the auxiliary starting cable from the power source.

13. Disconnect the other end of the auxiliary starting cable from the stalled machine.

14. Install the dust covers on auxiliary start receptacle (1).

Note: Severely discharged batteries will not fully recharge from the alternator alone after you jump start the machine. The batteries must be charged to the proper voltage with a battery charger. Many batteries that are considered to be unusable can still be recharged.

Maintenance Section

Tire Inflation Information

i02096880

Tire Inflation with Nitrogen

SMCS Code: 4203

Caterpillar recommends the use of dry nitrogen gas for tire inflation and for tire pressure adjustments. This includes all machines with rubber tires. Nitrogen is an inert gas that will not aid combustion inside the tire.

⚠ WARNING

Proper nitrogen inflation equipment, and training in using the equipment, are necessary to avoid over inflation. A tire blowout or rim failure can result from improper or misused equipment and personal injury or death can occur.

A tire blowout and/or rim failure can occur if the inflation equipment is not used correctly, due to the fact that a fully charged nitrogen cylinder's pressure is approximately 15000 kPa (2200 psi).

There are other benefits to using nitrogen in addition to reducing the risk of an explosion. The use of nitrogen for tire inflation lessens the slow oxidation of the rubber. Use of nitrogen also slows gradual tire deterioration. This is especially important for tires that are expected to have a long service life of at least four years. Nitrogen reduces the corrosion of rim components. Nitrogen also reduces problems that result from disassembly.

⚠ WARNING

A tire blowout or a rim failure can cause personal injury.

Use a self-attaching inflation chuck and stand behind the tread when inflating a tire, to prevent personal injury.

Note: Do not set the tire inflation equipment regulator higher than 140 kPa (20 psi) over the recommended tire pressure.

Use 6V-4040 Inflation Group or an equivalent inflation group to inflate tires with a nitrogen gas cylinder.

Reference: For tire inflation instructions, refer to Special Instruction, SMHS7867, “Nitrogen Tire Inflation Group”.

For nitrogen inflation, use the same tire pressures that are used for air inflation. Consult your tire dealer for operating pressures.

i01708825

Tire Shipping Pressure

SMCS Code: 4203; 7500

Pressures for each application may need to be varied from the pressures that are shown. The pressures should always be obtained from the tire supplier. As shown, the tire inflation pressure is cold inflation shipping pressure.

Table 14

Size	Ply Rating or Strength Index	Shipping Pressure	
		kPa	psi
18.00-25(1)	16	241	35
23.50-26	16	241	35
18.00R25	Two Star	310	45
23.50R25	Two Star	310	45

(1) Standard tire, ply rating and inflation pressure

i02610518

Tire Inflation Pressure Adjustment

SMCS Code: 4203

Always obtain the proper tire inflation pressures and maintenance recommendations for the tires on your machine from your tire supplier. The tire pressure in a warm shop area 18° to 21°C (65° to 70°F) will significantly change when you move the machine into freezing temperatures. If you inflate the tire to the correct pressure in a warm shop, the tire will be underinflated in freezing temperatures. Low pressure shortens the life of a tire.

Reference: When you operate the machine in freezing temperatures, refer to Special Publication, SEBU5898, “Cold Weather Recommendations for All Caterpillar Machines” in order to adjust tire inflation pressures.

Lubricant Viscosities and Refill Capacities

i07818111

Lubricant Viscosities

SMCS Code: 1000; 7000; 7581

General Information for Lubricants

When you are operating the machine in temperatures below −20°C (−4°F), refer to Special Publication, SEBU5898, “Cold-Weather Recommendations”. This publication is available from your Cat dealer.

For cold-weather applications where transmission oil SAE 0W-20 is recommended, Cat TDTO Cold Weather is recommended.

Refer to the “Lubricant Information” section in the latest revision of the Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for a list of Cat engine oils and for detailed information. This manual may be found at Safety.Cat.com.

The footnotes are a key part of the tables. Read ALL footnotes that pertain to the machine compartment in question.

Selecting the Viscosity

To select the proper oil for each machine compartment, refer to the "Lubricant Viscosity for Ambient Temperature" table. Use the oil type AND oil viscosity for the specific compartment at the proper ambient temperature.

The proper lubricant viscosity grade is determined by the minimum outside temperature when the machine is started. The proper lubricant viscosity grade is also determined by the maximum outside temperature while the machine is operated. Use the column on the table that is designated “Min” to determine the lubricant viscosity grade that is required when you start a cold machine and when you operate a cold machine. Use the column on the table that is designated “Max” to select the lubricant viscosity grade when you operate the machine at the highest temperature that is anticipated. When you start the machine, use the oil with the highest lubricant viscosity that is allowed for the temperature.

Machines that are continuously operated should use the oils with a higher viscosity in the final drives and differentials to maintain the highest possible oil film thickness. Refer to “General Information for Lubricants” article, “Lubricant Viscosities” tables, and any associated footnotes. Consult your Cat dealer if additional information is needed.

NOTICE
Not following the recommendations found in this manual can lead to reduced performance and compartment failure.

Engine Oil

Caterpillar oils have been developed and tested to provide the full performance and life that has been designed and built into Cat engines.

Cat DEO-ULS multigrade and Cat DEO multigrade oils are formulated with the correct amounts of detergents, dispersants, and alkalinity to provide superior performance in Cat diesel engines where recommended for use.

Note: SAE 10W-30 is the preferred viscosity grade for the 3116, 3126, C7, C-9, and C9 diesel engines when the ambient temperature is between -18° C (0° F) and 40° C (104° F).

Table 15

Lubricant Viscosities for Ambient Temperatures						
Compartment or System	Oil Type and Performance Requirements	Oil Viscosities	°C		°F	
			Min	Max	Min	Max
Engine Crankcase for all Machines	Cat DEO-ULS Cold Weather	SAE 0W-40	−40	40	−40	104
	Cat DEO-ULS SYN Cat DEO SYN	SAE 5W-40	−30	50	−22	122
	Cat DEO-ULS Cat DEO	SAE 10W-30	−18	40	0	104
	Cat DEO-ULS Cat DEO	SAE 15W-40	−9.5	50	15	122

When fuels of sulfur level 0.1 percent (1000 ppm) or higher are used, Cat DEO-ULS may be used if an oil analysis program is followed. Base the oil change interval on the oil analysis.

Other Oil Applications

Refer to the “Lubricant Information” section in the latest revision of the Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for a list of Cat engine oils and for detailed information. This manual may be found at Safety.Cat.com.

Cat HYDO Advanced fluids are the preferred oils for use in Cat machines hydraulic systems.

Cat HYDO Advanced fluids have a 100% increase in the standard oil drain interval for machine hydraulic systems (4000 hours or 2 years versus 2000 hours or 1 year) over second and third choice oils when you follow the maintenance interval schedule for oil filter changes and for oil sampling that is stated in the Operation and Maintenance Manual for your particular machine. 6000 hour or 3 years oil drain intervals are possible when using S·O·S Services oil analysis. Consult your Cat dealer for details. When switching to Cat HYDO Advanced fluids, cross contamination with the previous oil should be kept to less than 10%.

For the Tandem Drive of all machines except the 24M, add 0.015 L (0.015 qt) of 1U-9891 oil additive per 1 L (1 qt) of oil. **Do not add 1U-9891 oil additive to the 24M Motor Grader.**

Table 16

Motor Graders Lubricant Viscosities for Ambient Temperatures						
Compartment or System	Oil Type and Performance Requirements	Oil Viscosity Grade	°C		°F	
			Min	Max	Min	Max
Transmission, Differential, and Final Drive	Cat TDTO Cat TDTO-TMS Cat Cold-Weather TDTO Cat TO-4, Cat TO-4M	SAE 0W-20	−40	10	−40	50
		SAE 10W	−20	10	−4	50
		SAE 30	0	35	32	95

(continued)

(Table 16, contd)

Motor Graders Lubricant Viscosities for Ambient Temperatures						
Compartment or System	**Oil Type and Performance Requirements**	**Oil Viscosity Grade**	**°C**		**°F**	
			Min	**Max**	**Min**	**Max**
		SAE 50	10	50	50	122
		Cat TDTO-TMS	−20	43	−4	110
Tandem Drive and Wheel Spindle Bearings	**Cat TDTO Cat TDTO-TMS Cat Cold-Weather TDTO Cat TO-4, Cat TO-4M**	SAE 0W-20	−40	10	−40	50
		SAE 10W	−20	20	−4	68
		SAE 30	−10	40	14	104
		SAE 50	10	50	50	122
		Cat TDTO-TMS	−20	43	−4	109
All Wheel Drive Gearbox	**Cat TDTO Cat TO-4**	SAE 50	−15	50	5	122
Circle Drive except 16M, and 24M Series	**Cat Synthetic GO**	SAE 75W-140	−30	45	−22	113
	Cat GO (Gear Oil)	SAE 80W-90	−20	40	−4	104
		SAE 85W-140	−10	50	14	122
	API GL-5 gear oil	SAE 75W-90	−30	40	−22	104
		SAE 90	0	40	32	104
Motor Graders Circle Drive for 16M and 24M	**Cat FDAO Syn Cat FD-1**	Cat FDAO Syn	−15	50	5	122
		SAE 50	-10	32	14	90
		SAE 60	-10	50	14	122
Hydraulic Systems for M Series Motor Graders	**Cat Cold-Weather DEO-ULS Cat Cold-Weather TDTO**	SAE 0W-20	−40	40	−40	104
		SAE 0W-40	−25	40	−13	104
		SAE 0W-30	−25	40	−13	104
	Cat HYDO Advanced 10	SAE 10W	−15	40	5	104
	Cat HYDO Advanced 30	SAE 30	20	50	68	122
	Cat BIO HYDO Advanced	BIO HYDO Advanced	−25	40	−13	104

Grease Applications

Table 17

Type of Cat Grease								
Application Point	Typical Load and Speed	Load Factor	Ambient Temperature Range				NLGI Grade	Grease Type
			° C		° F			
			Min	Max	Min	Max		
Articulation Bearings, Articulation Pins, Blade Lift Cylinder Socket, Centershift Cylinder Socket, Fan Drive Belt Tightener, Pump Drive Shaft Slip Spline	High	Ditching, fill spreading, spreading base material, ripping, heavy road maintenance, snow plowing.	−35	40	−31	104	1	Cat Ultra 5Moly Grease
			−30	50	−22	122	2	
	Medium	Average road maintenance, road mix work, scarifying, snow plowing.	−20	40	−4	104	2	Cat Advanced 3Moly Grease
	Low	Finish grading, light maintenance, road travel.	−30	40	−22	104	2	Cat Multipurpose Grease
Fan Drive Bearings			−20	40	−4	104	2	Cat High-Speed Ball Bearing Grease

Table 18

Recommended Grease for the Autolube System				
Compartment or System	Grease Type	NLGI Grade	°C	°F
			Min	Min
Cat Autolube System	Cat 3 Moly Grease	NLGI Grade 2	−18	0
	Cat Ultra 5 Moly	NLGI Grade 2	−7	20
		NLGI Grade 1	−18	0
		NLGI Grade 0	−29	−20
	Cat Arctic Platinum	NLGI Grade 0	−43	−45
	Cat Desert Gold	NLGI Grade 2	2	35

Reference: Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for additional information about grease. This manual may be found on the Web at Safety.Cat.com.

Diesel Fuel Recommendations

Diesel fuel must meet Caterpillar Specification for Distillate Fuel and the latest revisions of “ASTM D975-09a” and “EN 590” to ensure optimum engine performance. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for the latest fuel information and for Caterpillar fuel specification. This manual may be found on the Web at Safety.Cat.com.

The preferred fuels are distillate fuels. These fuels are commonly called diesel fuels, furnace oil, gas oil, or kerosene. These fuels must meet the Caterpillar Specification for Distillate Fuel For Off-Highway Diesel Engines. Diesel fuels that meet the Caterpillar will help provide maximum engine service life and performance. This manual may be found on the Web at Safety.Cat.com.

Misfueling with fuels of high sulfur level can have the following negative effects:

- Reduce engine efficiency and durability.
- Increase the wear.
- Increase the corrosion.
- Increase the deposits.
- Lower fuel economy

- Shorten the time period between oil drain intervals (more frequent oil drain intervals).
- Increase overall operating costs.
- Negatively impact engine emissions

Failures that result for the use of improper fuels are not Caterpillar factory defects. Therefore, the cost of repairs would not be covered by a Caterpillar warranty.

Caterpillar does not require the use of ULSD in non-road and machine applications that are not Tier 4/ Stage IIIB/ Stage IV certified engines and are not equipped with aftertreatment devices. Follow operating instructions and fuel tank inlet labels, if available to ensure that the correct fuels are used.

Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more details about fuels, lubricants. This manual may be found at Safety.Cat.com.

Fuel Additives

Cat Diesel Fuel Conditioner and Cat Fuel System Cleaner are available for use when needed. These products are applicable to diesel and biodiesel fuels. Consult your Cat dealer for availability.

Biodiesel

Biodiesel is a fuel that can be made from various renewable resources that include vegetable oils, animal fat, and waste cooking oil. Soybean oil and rapeseed oil are the primary vegetable oil sources. To use any of these oils or fats as fuel, the oils or fats are chemically processed (esterified). The water and contaminants are removed.

U.S. distillate diesel fuel specification “ASTM D975-09a” includes up to B5 (5 percent) biodiesel. Currently, any diesel fuel in the U.S. may contain up to B5 biodiesel fuel.

European distillate diesel fuel specification “EN 590” includes up to B5 (5 percent) and in some regions up to B7 (7 percent) biodiesel. Any diesel fuel in Europe may contain up to B5 or in some regions up to B7 biodiesel fuel.

Note: Up to B20 biodiesel blend level is acceptable for use in Motor Grader engines. The use of biodiesel may result in early degradation of seals and hoses within the fuel delivery system.

Note: The diesel portion used in the biodiesel blend must be Ultra Low Sulfur Diesel (ULSD) fuel 0.0015 percent (≤15 ppm (mg/kg)) or less per “ASTM D975-09a”. In Europe the diesel fuel portion used in the biodiesel blend must be sulfur free diesel ULSD 0.0010 percent (≤10ppm (mg/kg) or less per “EN 590”. The final blend must have (≤15 ppm (mg/kg)) sulfur or less.

When biodiesel fuel is used, certain guidelines should be followed. Biodiesel fuel can influence the engine oil, aftertreatment devices, non-metallic components, fuel system components, and others. Biodiesel fuel has limited storage life and has limited oxidation stability. Follow the guidelines and requirements for engines that are seasonally operated and for standby power generation engines.

To reduce the risks associated with the use of biodiesel, the final biodiesel blend and the biodiesel fuel must meet specific blending requirements.

All of the guidelines and requirements are provided in the latest revision of Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations”. This manual may be found at Safety.Cat.com

Coolant Information

The information provided in this “Coolant Recommendation” section should be used with the “Lubricants Information” provided in the latest revision of Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations”. This manual may be found at Safety.Cat.com.

The following two types of coolants may be used in Cat diesel engines:

Preferred – Cat ELC (Extended Life Coolant)

Acceptable – Cat DEAC (Diesel Engine Antifreeze/ Coolant)

NOTICE
Never use water alone as a coolant. Water alone is corrosive at engine operating temperatures. In addition, water alone does not provide adequate protection against boiling or freezing.

i05768222

Capacities (Refill)

SMCS Code: 1000; 7000; 7560

The refill capacities will vary depending on the service procedures and conditions.

Note: Observe all sight gauges and all level indicators in order to ensure that the systems and/or compartments are refilled to the proper levels.

Table 19

Approximate Refill Capacities			
Compartment or System	**Liters**	**US gal**	**Imp gal**
Engine Crankcase	30	7.9	6.6
Transmission and Differential Housing	100	26.4	22
Hydraulic Tank	64	16.9	14.1
Cooling System	49	12.9	10.8
Fuel Tank	534	141.1	117.5
Tandem Drive Housing for each side (1)	127	33.5	27.9
Circle Drive Housing	10	2.6	2.2
Front Wheel Spindle Bearing Housing	0.9	.24	.19

(1) Add 2 L (2 qt) of 1U-9891 Oil Additive for each tandem drive housing.

Refer to Operation and Maintenance Manual, “Lubricant Viscosities” for information regarding the correct lubricants.

i07445339

S·O·S Information

SMCS Code: 1000; 7000; 7542

S·O·S Services is a highly recommended process for Cat customers to use in order to minimize owning and operating cost. Customers provide oil samples, coolant samples, and other machine information. The dealer uses the data in order to provide the customer with recommendations for management of the equipment. In addition, S·O·S Services can help determine the cause of an existing product problem.

Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluid Recommendations” for detailed information concerning S·O·S Services.

The effectiveness of S·O·S Services is dependent on timely submission of the sample to the laboratory at recommended intervals.

Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” for a specific sampling location and a service hour maintenance interval.

Consult your Cat dealer for complete information and assistance in establishing an S·O·S program for your equipment.

Maintenance Access

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Access Doors and Covers

SMCS Code: 7251; 7263; 7273

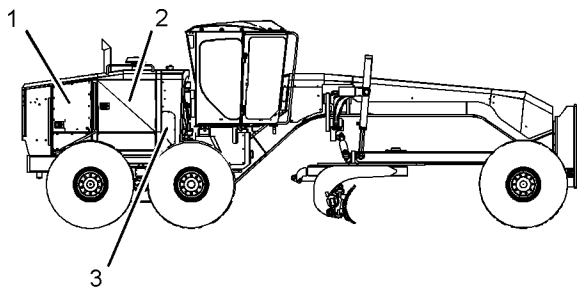

Illustration 177 g01176765

Right side view

Opening access door (1) will allow access to the following items:

- The batteries
- The circuit breakers
- The radiator drain valve

Opening access door (2) will allow access to the following item:

- The coolant sampling valve
- The engine oil sampling valve
- The refrigerant compressor

Removing access cover (3) will allow access to the following item:

- The engine drive belt

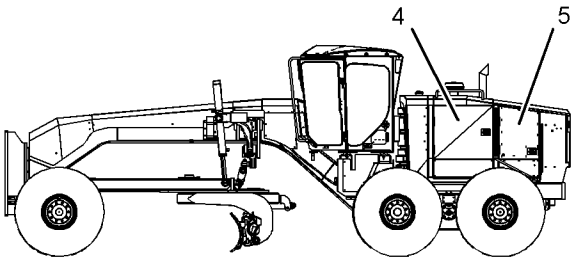

Illustration 178 g01176786

Left side view

Opening access door (4) will allow access to the following items:

- The coolant tank
- The engine air filters
- The engine crankcase breather
- The engine oil filler
- The engine oil filter
- The engine oil level gauge
- The ether cylinder (if equipped)
- The fuel and water separator
- The secondary fuel filter
- The transmission breather
- The transmission oil level gauge/fill cap
- The water temperature regulator

Opening access door (5) will allow access to the following items:

- The battery disconnect switch
- The auxiliary start receptacle
- The hydraulic tank sight gauge
- The hydraulic tank return filter

Maintenance Support

i06173273

System Pressure Release

SMCS Code: 1250-553-PX; 1300-553-PX; 1350-553-PX; 3000-553-PX; 4250-553-PX; 4300-553-PX; 5050-553-PX; 6700-553-PX; 7540-553-PX

Coolant System

⚠ WARNING

Pressurized system: Hot coolant can cause serious burn. To open cap, stop engine, wait until radiator is cool. Then loosen cap slowly to relieve the pressure.

To relieve the pressure from the coolant system, turn off the machine. Allow the cooling system pressure cap to cool. Remove the cooling system pressure cap slowly in order to relieve pressure.

Fuel System

To relieve the pressure from the fuel system, turn off the machine.

Hydraulic System

⚠ WARNING

Personal injury can result from hydraulic oil pressure and hot oil.

Hydraulic oil pressure can remain in the hydraulic system after the engine has been stopped. Serious injury can be caused if this pressure is not released before any service is done on the hydraulic system.

Make sure all of the attachments have been lowered, oil is cool before removing any components or lines. Remove the oil filler cap only when the engine is stopped, and the filler cap is cool enough to touch with your bare hand.

Fan/Brake Circuit

To relieve the pressure from the fan/brake circuit, turn off the machine. Apply the service brake pedal to the floor for one second and release the pedal completely for 9 seconds, for a minimum of 15 applications. Do not assume that all of the pressure is removed from the circuit because the brake pedal does not have resistance. Remove the pressure when you work on any part of the fan/brake circuit.

Steering Circuit

To relieve the pressure from the steering circuit, turn off the machine. The steering valve has enough leakage to allow for oil to return to the tank. Wait 10 minutes before you open the steering system, this will allow any residual pressure to drain into the tank.

Implement Circuit

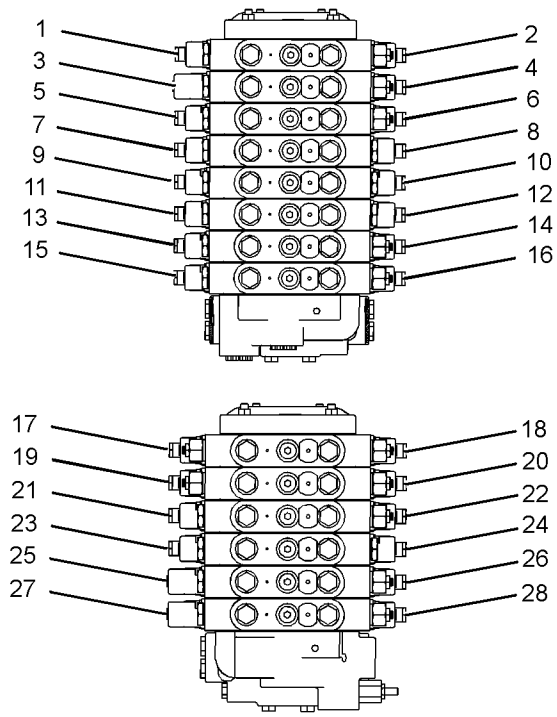

Illustration 179 g01423186

Blade Lift, Plow Lift, and Wing Lift with Float

Push the right-hand joystick to the most forward DETENT position and push the left-hand joystick to the most forward DETENT position. When you release either joystick, the joysticks will return to the HOLD position. The right side of the blade will remain in the FLOAT position until the joystick is moved forward or rearward and the left side of the blade will remain in the FLOAT position until the joystick is moved forward or rearward. The lock valves (3), (25), (27), and (19) will be forced open and the pressurized oil will return to the hydraulic tank. Rest the blade on the ground in the FLOAT position for thirty seconds. Turn the machine to the OFF position. Wait at least ten minutes before you open the blade lift relief lines (26) and (28) if the machine is equipped with the blade cushion accumulators. If the machine cannot be started or the blade float is not working properly refer to Operation and Maintenance Manual, “System Pressure Release - Side Shift, Blade Tip” for the blade lift circuit. If the machine cannot be started or the blade float is not working properly refer to Operation and Maintenance Manual, “System Pressure Release - Wing Lift and Wing Tilt without Float” for the wing tilt circuit.

Wheel Lean, Circle Drive, Center Shift and Articulation

Turn the wheel lean lock valves (7) and (8) three times counterclockwise slowly. Turn the circle drive lock valves (9) and (10) three times counterclockwise slowly. Turn the center shift lock valves (11) and (12) three times counterclockwise slowly. Turn the articulation lock valves (23) and (24) three times counterclockwise slowly. Allow the pressure to be relieved. Remove the lock valves from the valve bank. Check the valves for damage. Reseal the valve and reinstall the valve into the valve bank.

Side Shift, Blade Tip, Mid-Mount Scarifier, Plow Angle, and Ripper

In order to relieve pressure on the rod end side of the valve for the side shift, turn out the entire line relief valve (14) three times counterclockwise. Allow the pressure to be relieved. Remove the line relief valve from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

In order to relieve pressure on the head end side of the valve for the side shift, turn out the lock valves (13) three times counterclockwise. Allow the pressure to be relieved, and then turn out the valve. Replace the seals.

In order to relieve pressure on the rod end side of the valve for the blade tip, turn out the entire line relief valve (16) three times counterclockwise. Allow the pressure to be relieved. Remove the line relief from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

In order to relieve pressure on the head end side of the valve for the blade tip, turn out the lock valves (15) three times counterclockwise. Allow the pressure to be relieved, and turn out the valve. Replace the seals.

In order to relieve pressure on the rod end side of the valve for the mid-mount scarifier, turn out the line relief valve (6) three times counterclockwise. Allow the pressure to be relieved. Remove the line relief from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

In order to relieve pressure on the head end side of the valve for the mid-mount scarifier, turn out the lock valves (5) three times counterclockwise. Allow the pressure to be relieved, and then turn out the valve. Replace the seals.

In order to relieve pressure on the rod end side of the valve for the plow angle, turn out the line relief valve (2) three times counterclockwise. Allow the pressure to be relieved. Remove the line relief from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

In order to relieve pressure on the head end side of the valve for the plow angle, turn out the lock valves (1) three times counterclockwise. Allow the pressure to be relieved, and turn out the valve. Replace the seals.

In order to relieve pressure on the rod end side of the valve for the ripper, turn out the line relief valve (22) three times counterclockwise. Allow the pressure to be relieved. Remove the line relief from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

In order to relieve pressure on the head end side of the valve for the ripper, turn out the lock valves (21) three times counterclockwise. Allow the pressure to be relieved, and turn out the valve. Replace the seals.

Wing Lift and Wing Tilt without Float

Turn the wing lift lock valves (17) and (18) three times counterclockwise slowly. Turn the wing tilt lock valves (19) and (20) three times counterclockwise slowly. Allow the pressures to be relieved. Remove the lock valves from the valve bank. Check the valve for damage. Reseal the valve and reinstall the valve into the valve bank.

Engine Oil System

To relieve the pressure from the engine oil system, turn off the machine.

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Welding on Machines and Engines with Electronic Controls

SMCS Code: 1000; 7000

Do not weld on any protective structure. If it is necessary to repair a protective structure, contact your Cat dealer.

Proper welding procedures are necessary to avoid damage to the electronic controls and to the bearings. When possible, remove the component that must be welded from the machine or the engine and then weld the component. If you must weld near an electronic control on the machine or the engine, temporarily remove the electronic control to prevent heat related damage. The following steps should be followed to weld on a machine or an engine with electronic controls.

1. Turn off the engine. Place the engine start switch in the OFF position.
2. If equipped, turn the battery disconnect switch to the OFF position. If there is no battery disconnect switch, remove the negative battery cable at the battery.

NOTICE
Do NOT use electrical components (ECM or sensors) or electronic component grounding points for grounding the welder.

3. Clamp the ground cable from the welder to the component that will be welded. Place the clamp as close as possible to the weld. Make sure that the electrical path from the ground cable to the component does not go through any bearing. Use this procedure to reduce the possibility of damage to the following components:
   - Bearings of the drive train
   - Hydraulic components
   - Electrical components
   - Other components of the machine
4. Protect any wiring harnesses and components from the debris and the spatter which is created from welding.
5. Use standard welding procedures to weld the materials together.

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Prepare the Machine for Maintenance

SMCS Code: 1000; 7000

1. Move the machine to a dry, level, solid surface that is free of any debris.

Note: The surface must be solid enough to support the weight of the machine and any tooling that is used to support the machine.

2. Put the machine in park. Refer to Operation and Maintenance Manual, “Operator Controls” for more information.
3. Lower all the machine implements to the ground. Refer to Operation and Maintenance Manual, “Operator Controls” for more information.
4. Ensure that the pressure is released from any closed system that will be opened during the maintenance procedure. Refer to Operation and Maintenance Manual, “System Pressure Release” for more information.

This machine is equipped with lockout controls to suit the following types of machine maintenance.

Maintenance with the Engine Running

For maintenance that requires the engine to be running, perform the following:

1. Run the engine at an idle.

2. Deactivate the implements by using the hydraulic lockout switch. Refer to Operation and Maintenance Manual, “Operator Controls” for more information.

Maintenance without the Engine Running

For maintenance that does not require the engine to be running, perform the following:

1. Move the engine start switch to the OFF position. Refer to Operation and Maintenance Manual, “Operator Controls” for more information.

Maintenance with Electrical System Disabled

For maintenance that requires the electrical system to be disabled, perform the following:

1. Move the engine start switch to the OFF position. Refer to Operation and Maintenance Manual, “Operator Controls” for more information.

2. Move the battery disconnect switch to the OFF position. Refer to Operation and Maintenance Manual, “Battery Disconnect Switch” for the proper procedure.

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Maintenance Interval Schedule

SMCS Code: 1000; 7000

Ensure that all safety information, warnings, and instructions are read and understood before any operation or any maintenance procedures are performed.

The user is responsible for the performance of maintenance. All adjustments, the use of proper lubricants, fluids, filters, and the replacement of components due to normal wear and aging are included. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components.

Products that operate in severe operating conditions or that experience abnormally high fuel consumption, may require more frequent maintenance. Refer to the maintenance procedure for any other exceptions that may change the maintenance intervals.

Note: Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

The following guidelines should be followed if the service hours are not met:

Items listed between 10 and 100 service hours should be performed at least every 3 months.

Items listed between 250 and 500 service hours should be performed at least every 6 months.

Items listed between 1000 service hours and 2500 service hours should be performed at least every year.

When Required

“ Automatic Lubrication System Grease - Add“ . . 149
“ Blade Lift Cylinder Socket - Check/Adjust/ Replace“ 151
“ Brake Accumulator - Check“ 152
“ Cab Air Filter - Clean/Replace“ 155
“ Centershift Cylinder Socket - Check/Adjust/ Replace“ 157
“ Circle Clearances - Check/Adjust“ 158
“ Circuit Breakers - Reset“ 162
“ Cooling Cores - Clean“ 163
“ Cutting Edges and End Bits - Inspect/ Replace“ 171
“ Display and Camera - Clean“ 171
“ Drawbar Ball and Socket End Play - Check/ Adjust“. 172
“ Engine Air Filter Element - Clean/Replace“ 174
“ Engine Compartment - Clean“ 177
“ Ether Starting Aid Cylinder - Replace“ 182
“ Film (Product Identification) - Clean“ 183
“ Fuel System - Fill“ 191
“ Fuel System - Prime“. 192
“ Fuel Tank Water and Sediment - Drain“ 195
“ Fuses - Replace“ 196
“ Fuses - Replace“ 198
“ Lubrication Pump Oil - Fill“ 204
“ Oil Filter - Inspect“ 208
“ Ripper Tip - Inspect/Replace“ 210
“ Window Washer Reservoir - Fill“ 222

Every 10 Service Hours or Daily

“ Automatic Lubrication System Grease - Check“ 149
“ Backup Alarm - Test“ 150
“ Brakes, Indicators and Gauges - Test“. 154
“ Circle Drive Pinion Teeth - Lubricate“. 162
“ Circle Top - Lubricate“ 162
“ Cooling System Coolant Level - Check“. 167
“ Engine Oil Level - Check“ 177
“ Fuel System Water Separator - Drain“. 194
“ Hydraulic System Oil Level - Check“ 202
“ Seat Belt - Inspect“ 211
“ Transmission and Differential Oil Level - Check“ 219

Every 100 Service Hours

“ Articulation Bearings - Lubricate“ 149
“ Axle Oscillation Bearings - Lubricate“. 150
“ Blade Lift Cylinder Socket - Lubricate“. 152
“ Centershift Cylinder Socket - Lubricate“. 157
“ Centershift Lock Bar - Clean/Lubricate“. 158
“ Drawbar Ball and Socket - Lubricate“. 172

“ Kingpin Bearings - Lubricate“ 203
“ Ripper Cylinder Bearings - Lubricate“ 209
“ Secondary Steering - Test“ 212
“ Steering Cylinder Ends and Tie Rods - Lubricate“ 213
“ Tandem Drive Oil Level - Check“ 214
“ Tire Inflation - Check“ 215
“ Wheel Lean Bearings - Lubricate“ 221

Initial 250 Service Hours (or at first oil change)

“ Circle Drive Oil - Change“ 161

Every 250 Service Hours

“ Engine Oil Sample - Obtain“ 178
“ Moldboard Wear Strip - Inspect/Adjust/Replace“ 205

Every 500 Service Hours

“ Belts - Inspect/Adjust/Replace“. 151
“ Braking System - Test“ 155
“ Cooling System Coolant Sample (Level 1) - Obtain“ 168
“ Engine Oil and Filter - Change“. 178
“ Engine Shutdown Switch - Check“ 181
“ Fuel System Filter - Replace“ 193
“ Fuel Tank Cap and Strainer - Clean“ 195
“ Hydraulic System Oil Sample - Obtain“ 202
“ Lubrication Pump Oil Level - Check“ 204
“ Oil Filter (Implement Controls) - Replace“ 207
“ Tandem Breather - Clean/Replace“ 213
“ Tandem Drive Oil Sample - Obtain“ 215
“ Wheel Bearing Oil Level (Front) - Check“ 221
“ Wheel Bearing Oil Sample (Front) - Obtain“ . . . 221

Every 1000 Service Hours

“ Frame and Body - Inspect“ 184
“ Oil Filter (Hydraulic Tank Return) - Replace“ . . . 206
“ Rollover Protective Structure (ROPS) - Inspect“. 210
“ Transmission and Differential Oil Filter and Screens - Replace/Clean“ 217
“ Transmission and Differential Oil Sample - Obtain“ 219

Every 2000 Service Hours

“ Battery or Battery Cable - Inspect/Replace“. . . . 150
“ Circle Drive Oil - Change“ 161
“ Cooling System Coolant Sample (Level 2) - Obtain“ 169
“ Cooling System Pressure Cap - Clean/Replace“ 170
“ Crankshaft Vibration Damper - Inspect“. 170
“ Lubrication Pump Oil - Change“ 203
“ Tandem - Check“ 213
“ Tandem Drive Oil - Change“ 213
“ Transmission and Differential Oil - Change“ . . . 215
“ Wheel Bearing Oil (Front) - Change“ 220

Every 2500 Service Hours

“ Electronic Unit Injector - Inspect/Adjust“ 173
“ Engine Valve Lash - Check“ 181
“ Engine Valve Rotators - Inspect“ 182

Every 3 Years

“ Seat Belt - Replace“. 211

Every 4000 Service Hours

“ Spindle - Inspect“. 213

Every 6000 Service Hours

“ Brake Discs - Check“. 154
“ Cooling System Coolant Extender (ELC) - Add“ 166
“ Hydraulic System Oil - Change“ 200

Every 12 000 Service Hours

“ Cooling System Coolant (ELC) - Change“ 165
“ Rim - Inspect“. 208

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Articulation Bearings - Lubricate

SMCS Code: 7057-086-BD

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the articulation bearings. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe all the fittings before you apply lubricant through the fittings. The fittings for the articulation bearings are located on the left side of the rear frame.

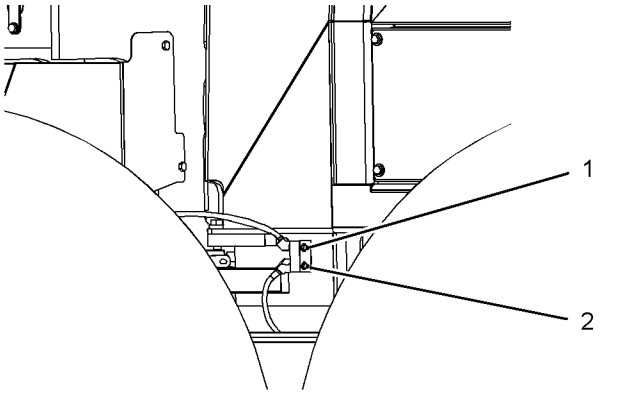

Illustration 180 g01177124

Location 1

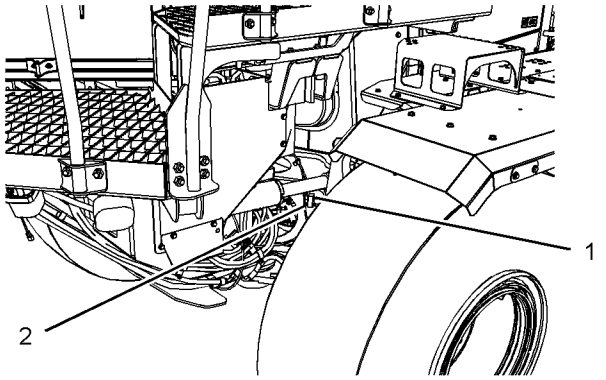

Illustration 181 g03266940

Location 2

Note: The articulation bearings could be located in one of two spots. Check your machine for the correct location.

The upper articulation bearing has one fitting (1). The lower articulation bearing has one fitting (2). In order to lubricate the articulation bearings, apply the appropriate lubricant through each fitting.

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Automatic Lubrication System Grease - Add

SMCS Code: 7540-538; 7540

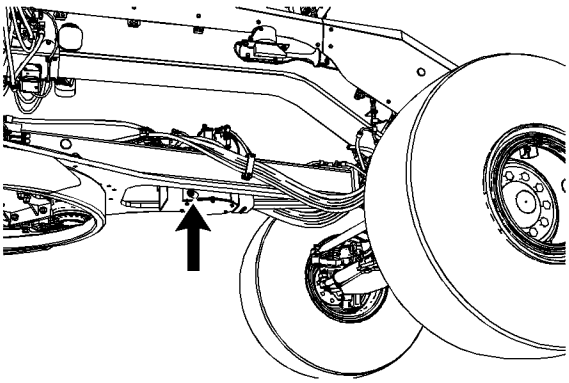

Illustration 182 g03832727

Fill the grease reservoir that is located on the autolube pump.

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Automatic Lubrication System Grease - Check

SMCS Code: 7540-535

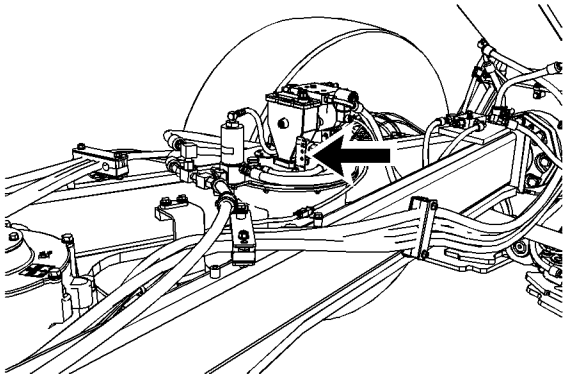

Illustration 183 g03832740

Maintain the grease level plunger between “FULL” and “LO LEVEL” . If the reservoir requires additional grease, add grease at the fill point.

i02356767

Axle Oscillation Bearings - Lubricate

SMCS Code: 3268; 4313

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the axle oscillation bearings. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

The lubrication fittings are located in the front of the front axle and in the rear of the front axle. Wipe the fittings before you apply lubricant to the fittings.

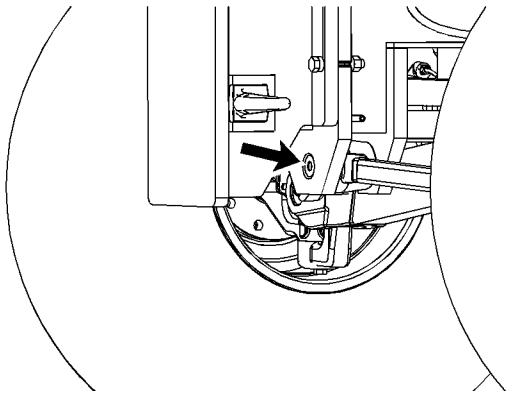

Illustration 184 g01177171

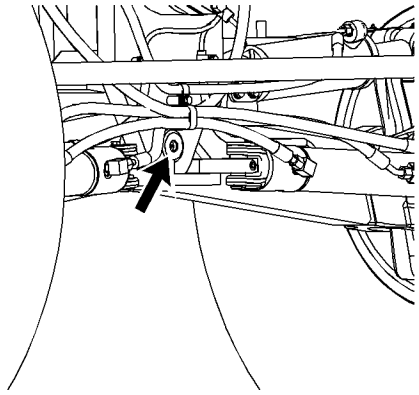

Illustration 185 g01177172

In order to lubricate the axle oscillation bearings, apply the appropriate lubricant to the fittings.

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Backup Alarm - Test

SMCS Code: 7406-081

The backup alarm is on the rear of the machine.

In order to test the alarm for proper functioning, turn the engine start switch to the ON position.

Apply the service brake. Disengage the parking brake. Move the transmission control switch to a REVERSE position.

The backup alarm should start to sound immediately. The alarm alerts the personnel behind the machine that the machine is backing up. The backup alarm will continue to sound until the transmission control switch is moved to the NEUTRAL position or to any FORWARD position.

i06687962

Battery or Battery Cable - Inspect/Replace

SMCS Code: 1401-040; 1401-510; 1402-510; 1402-040

1. Turn the engine start switch key to the OFF position. Turn all the switches to the OFF position.
2. Turn the key for the battery disconnect switch to the OFF position. Remove the key.
3. Disconnect the negative battery cable at the battery disconnect switch. The battery disconnect switch is connected to the machine frame.

Note: Do not allow the disconnected battery cable to contact the battery disconnect switch or the machine.

4. Disconnect the negative battery cable from the battery.
5. Disconnect the positive battery cable from the battery.
6. Inspect the battery terminals for corrosion. Ensure the battery is clean and free of dirt/debris. Check the battery vents to ensure they free of debris/ blockage. Inspect the batteries for any other signs of leakage or damage; replace parts as necessary.
7. Inspect the battery hold down hardware to ensure it is tight and positioned properly. The batteries should be properly restrained to prevent movement.

8. Inspect the all power cables for wear or damage (includes alternator cables, secondary steering motor cables, relay connections, and battery cables). Look for any signs of rubs with adjacent components, cracking of the insulation, heat damage to the insulation, etc. Ensure all terminal boots are in place and secure. Check all terminal connections to ensure connections are tight, clean, and free of corrosion. Replace/repair any damaged, worn, or missing components as necessary.

9. Connect the positive battery cable at the battery.

10. Connect the negative battery cable at the battery.

11. Connect the battery cable at the battery disconnect switch.

12. Install the key for the battery disconnect switch. Turn the battery disconnect switch to the ON position.

i06204482

Belts - Inspect/Adjust/Replace

SMCS Code: 1357-025; 1357-510; 1357-040

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

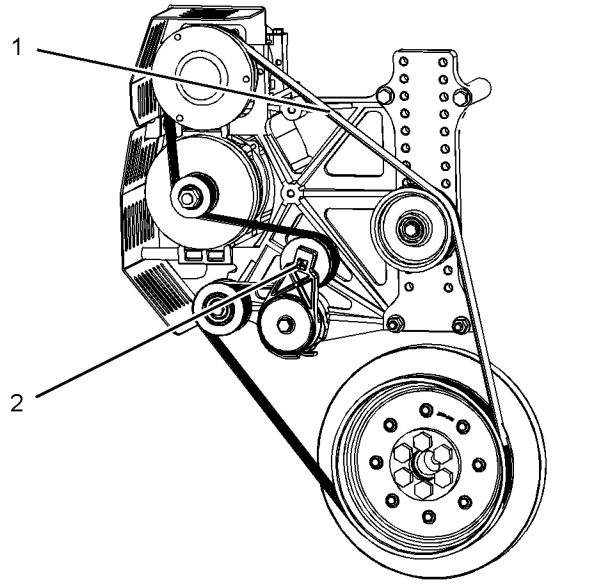

Illustration 186 g01177534

Inspect

1. Stop the engine.

2. Open the engine access door on the right side of the machine.

3. Inspect the condition of belt (1).

Note: Removal of the alternator guard is not necessary to inspect the belt.

4. Replace the belt if any of the following conditions exist:

- excessive cracking
- excessive wear
- excessive damage

5. Inspect the free arm stop of belt tensioner (2). The free arm stop must be aligned with the black line which is on the decal of the belt tensioner. If the free arm stop is in the red area, replace the belt.

Replace/Adjust

1. Release the tension on belt (1). Insert a 12.7 mm (0.50 inch) ratchet into the square hole in belt tensioner (2) and pry the belt tensioner in a counterclockwise direction.

2. Remove the belt.

Note: Removal of the alternator guard is not necessary to remove the belt.

3. Install the new belt around the pulleys.

4. Inspect the free arm stop of the belt tensioner. The free arm stop must be aligned with the black line which is on the decal of the belt tensioner.

5. Check the belt tension after 30 minutes of operation.

Note: The break-in period for the belt is considered to be 30 minutes.

i07927855

Blade Lift Cylinder Socket - Check/Adjust/Replace

SMCS Code: 5102-535; 5102-510; 5102-025; 5103-535; 5103-025; 5103-510

1. Rotate the blade. Position the blade at an angle of 90 degrees to the frame. Lower the blade to the ground.

2. Operate the blade lift cylinders. Observe the socket. If the socket moves without blade movement, adjustment is necessary.

3. Extend the cylinder to support the blade on the ground. Slightly pull up the cylinder to release the pressure on the cap.

4. Shut down the engine.

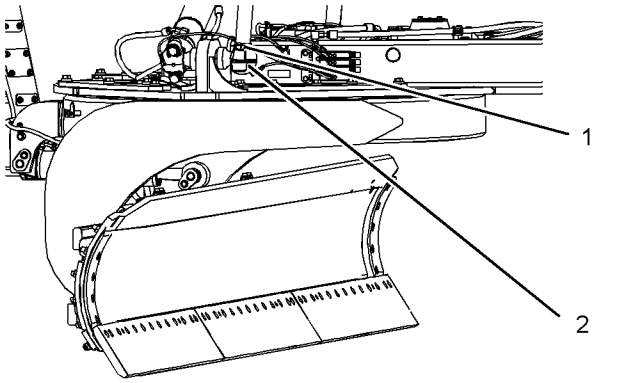

Illustration 187 g03833677
Typical example shown

5. Remove bolts (1) from cap (1). Remove cap (2).

6. Start the engine and retract the cylinder to remove the insert. Stop the engine.

7. Install two new inserts.

8. Start the engine and extend the cylinder until it fits on the drawbar ball. Stop the engine.

9. Add the proper number of shims between the socket/cap and the insert flange to remove any gap.

10. Install the cap. Install the bolts and tighten the bolts.

Note: The purpose of the shims is not to provide the ball stud interface the ability to adjust but to account for the tolerance between the socket/cap and the inset flange. The shims allow the load to be properly transferred through the hydraulic cylinder to the insert to the ball system. Improper shimming can lead to deformation of the insert, binding of the interface, and damage/failure of the insert/ball stud. If no shims remain, install new inserts. Install two shims on each side of the inserts. Add additional shims, as needed.

i02357743

Blade Lift Cylinder Socket - Lubricate

SMCS Code: 5102-086; 5103-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the blade lift cylinder socket. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe all the fittings before you apply lubricant to the fittings.

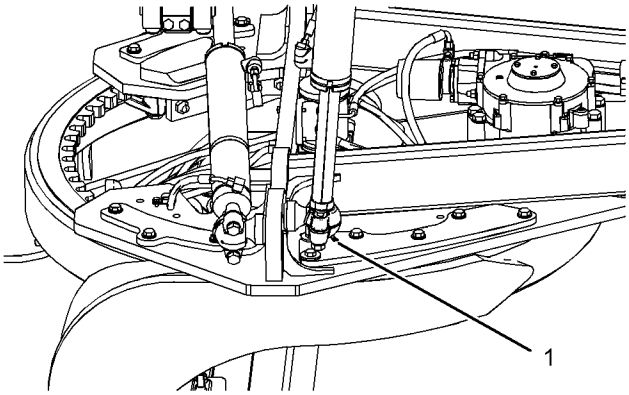

Illustration 188 g01177821

There are two blade lift cylinders.

Each blade lift cylinder socket has one fitting (1). In order to lubricate the blade lift cylinder sockets, apply the appropriate lubricant to each fitting.

i07988672

Brake Accumulator - Check

SMCS Code: 4263-535

⚠ WARNING

Cold ambient temperatures could result in the loss of secondary braking capability due to inadequate hydraulic accumulator nitrogen precharge. The loss of the secondary braking system as well as the main hydraulic pressure will result in little or no braking capability and a potential for injury or death.

It is recommended to perform a brake accumulator check anytime the machine has been idle for longer than two hours below −25 °C (−13 °F). Refer to Operation and Maintenance Manual before performing any check of the brake accumulator.

⚠ WARNING

Pressurized System!

Hydraulic accumulators contain gas and oil under high pressure. DO NOT disconnect lines or disassemble any component of a pressurized accumulator. All gas pre-charge must be removed from the accumulator as instructed by the service manual before servicing or disposing of the accumulator or any accumulator component.

Failure to follow the instructions and warnings could result in personal injury or death.

Only use dry nitrogen gas to recharge accumulators. See your Cat dealer for special equipment and detailed information for accumulator service and charging.

1. Move the engine start switch to the ON position.

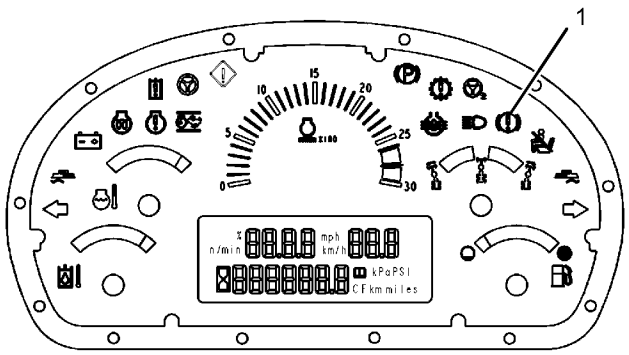

Illustration 189 g01257893

Note: Alert indicator (1) will illuminate if the brake system is not at the normal operating pressure.

2. Start the engine and run the engine for one minute in order to increase the accumulator pressure. Alert indicator (1) should turn off. Stop the engine.

3. Apply the service brake pedal and release the service brake pedal in order to decrease the accumulator pressure. Apply the service brake pedal and release the service brake pedal for a minimum of three applications, until alert indicator (1) illuminates.

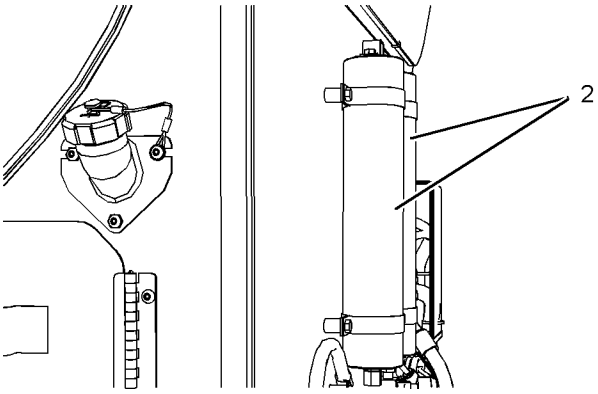

Illustration 190 g01296741

4. If alert indicator (1) illuminates with less than three applications of the service brake pedal, measure the nitrogen precharge pressure of accumulators (2). Consult Systems Operation, Testing and Adjusting, “Brake Accumulator - Test and Charge” for the following information:

- The correct checking procedure
- The correct filling procedure
- The recommended pressure

Your Caterpillar dealer has the appropriate tools for measuring the precharge pressure of the brake accumulators.

Note: Only use dry nitrogen gas to recharge the brake accumulators.

i07313773

Brake Discs - Check

SMCS Code: 4251-535; 4255-535; 4255; 4255-082; 4267-535

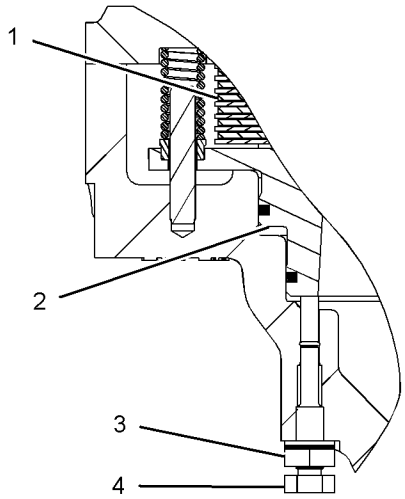

Illustration 191 g03321593

Cut-away of the brakes

(1) Brake pack
(2) Piston
(3) Nut
(4) Compensator

Note: This test is only valid when piston (2) is fully compressed against brake pack (1).

Check

1. Lower all implements to the ground, set the parking brake, shut off the engine, and chock the rear wheels.

2. Depress the brake pedal to compress piston (2) fully against brake pack (1).

3. Loosen nut (3) completely, until the nut contacts the head of compensator (4).

4. Turn in compensator(4) by hand until the compensator (4) contacts piston (2).

Note: If compensator (4) can be turned in completely and does not contact piston (2), then brake pack (1) must be replaced. If compensator (4) contacts piston (2), proceed to the Adjust procedure.

Note: If compensator (4) contacts piston (2) in fewer than two turns, then the brake plates may be warped.

Adjust

1. Back off compensator (4) by two turns.

2. Hold compensator (4) in position from Step 1.

3. Tighten the nut (3) to 50 ± 10 N·m (37 ± 7 lb ft).

i02514369

Brakes, Indicators and Gauges - Test

SMCS Code: 4251-081; 4267-081; 4269-081; 7000-081; 7450-081; 7490-081

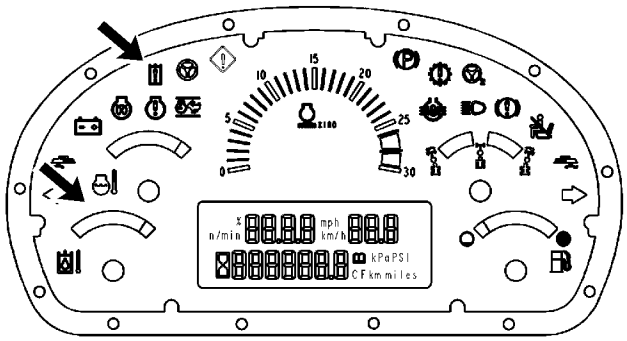

Illustration 192 g01257920

Look for broken lenses on the gauges, broken indicator lights or broken switches, etc.

Start the engine. Run the engine until the gauges have stabilized.

Look for inoperative gauges.

Turn on all of the machine lights. Check for proper operation.

Sound the horn.

Move the machine forward and test the service brakes. If the service brakes do not function properly, refer to Operation and Maintenance Manual, “Braking System - Test”.

Stop the engine.

Make any needed repairs before you operate the machine.

i04149149

Braking System - Test

SMCS Code: 4251-081; 4267-081

Service Brake Holding Ability Test

Make sure that the area around the machine is clear of personnel and clear of obstacles.

Test the service brake on a dry level surface.

Note: A 50 m (164 ft) area is required to conduct the test.

Fasten your seat belt before you test the brakes.

Use the following test in order to determine whether the service brake is functional. This test is not intended to measure the maximum holding ability of the service brake.

1. Start the engine. Raise the blade slightly. Engage the transmission modulator control (inching pedal). Select the SECOND SPEED FORWARD position on the transmission. Disengage the parking brake. Disengage the transmission modulator control (inching pedal).
2. Set the throttle hold mode switch to the MANUAL position. Push the top of the throttle set/accel switch in order to set the engine speed to high idle.
3. Engage the service brake control.
4. Reduce the engine speed to 1500 rpm. Disengage the service brake control in order to recover the engine rpm.

Note: If the service brake control does not reduce the engine rpm the friction material for the brake may require replacement. The new friction material for the brake may require conditioning for maximum performance. Consult your Cat dealer or see Special Instruction, SEHS9187 for the procedure for conditioning.

5. Reduce the engine speed to low idle. Stop the machine. Place the transmission in the NEUTRAL position. Engage the parking brake control. Lower the blade to the ground and lower the ripper to the ground. Stop the engine.

Parking Brake Holding Ability Test

⚠ WARNING

Personal injury can result if the machine moves while testing.

It the machine begins to move during test, reduce the engine speed immediately and engage the service brake control.

NOTICE
If the machine moved while testing the parking brake, consult your Caterpillar dealer.

Have the dealer inspect and, if necessary repair the parking brake before returning the machine to operation.

Be sure that the area around the machine is clear of personnel and clear of obstacles.

Test the parking brake on a hard dry surface.

Fasten the seat belt before you test the parking brake.

Use the following test to determine whether the parking brake is functional. This test is not intended to measure the maximum holding ability of the parking brake.

1. Position the machine on a slope of 20 percent.
2. Engage the parking brake control. Release the service brake control. The wheels should not rotate. If the wheels rotate, engage the service brake control.

i05919968

Cab Air Filter - Clean/Replace

SMCS Code: 7311-070-FI; 7311-510-FI; 7342-070; 7342-510

NOTICE
An air recirculation filter element plugged with dust will result in decreased performance and service life to the air conditioner or cab heater.

To prevent decreased performance, clean the filter element, as required.

Note: Service frequency must be sufficient to prevent cab air filter plugging. Plugged filters result in dust infiltration into the cab and poor operator ventilation.

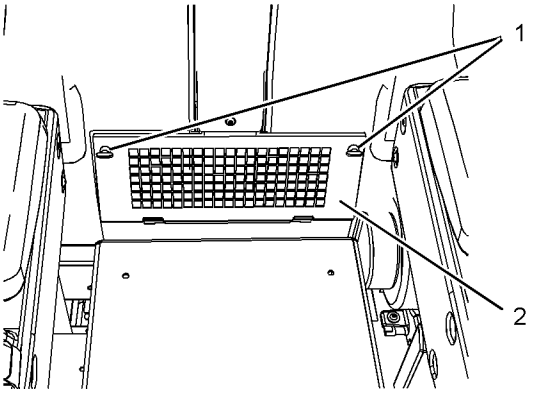

Illustration 193 g01299060

The operator seat has been removed for ease of viewing.

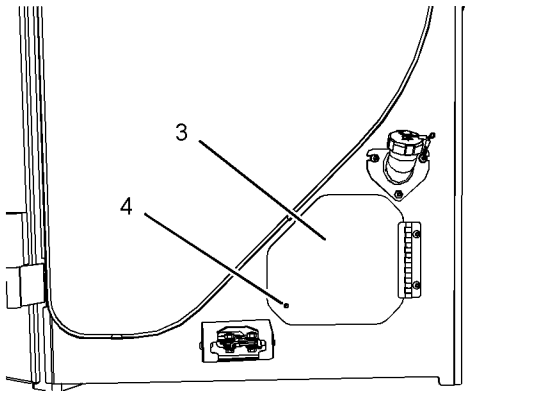

Illustration 194 g01323235

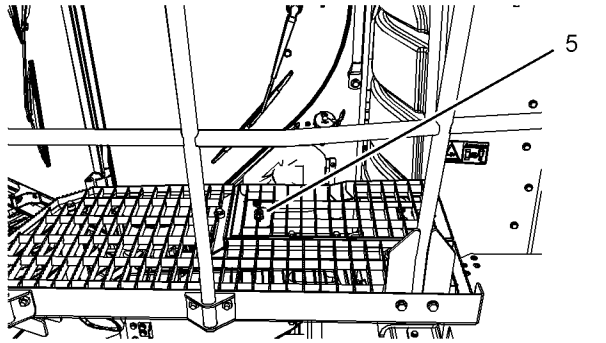

Illustration 195 g02917775

Closed

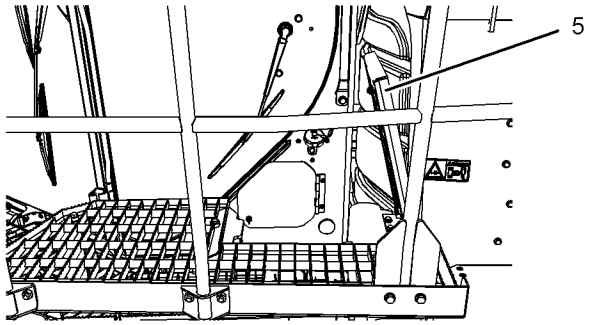

Illustration 196 g02917781

Open

The inside cab air filter is located behind the operator seat. The outside cab air filter is located behind access cover (3).

For a machine equipped with the optional access platform, access panel (5) must be opened to access the access cover (3).

Note: Clean the cab air filters more often in dusty conditions.

Inside Filter

1. Turn thumb screws (1) counterclockwise in order to remove the thumb screws.
2. Remove filter cover (2).
3. Remove the filter element. Clean the filter element with pressure air or wash the filter element in warm water and in a nonsudsing household detergent.
4. Rinse the filter element in clean water. Thoroughly air dry the filter element.
5. After you clean the filter element, inspect the filter element. Do not use a filter element with damaged pleats or a damaged seal. If the filter element is damaged, replace the filter element.
6. Install the filter element.
7. Install filter cover (2).
8. Turn thumb screws (1) clockwise in order to install the thumb screws.

Outside Filter

1. Turn thumb screw (4) counterclockwise in order to remove the thumb screw.
2. Open access cover (3).

3. Remove the filter element. Clean the filter element with pressure air or wash the filter element in warm water and in a nonsudsing household detergent.

4. Rinse the filter element in clean water. Thoroughly air dry the filter element.

5. After you clean the filter element, inspect the filter element. Do not use a filter element with damaged pleats or a damaged seal. If the filter element is damaged, replace the filter element.

6. Install the filter element.

7. Close access cover (3).

8. Turn thumb screw (4) clockwise in order to install the thumb screw.

i07927859

Centershift Cylinder Socket - Check/Adjust/Replace

SMCS Code: 5223-025; 5223-023; 5223-535

1. Rotate the blade. Position the blade at an angle of 90 degrees to the frame. Lower the blade to the ground.

2. Operate the blade lift cylinders. Observe the socket. If the socket moves without blade movement, adjustment is necessary.

3. Extend the cylinder to support the blade on the ground. Slightly pull up the cylinder to release the pressure on the cap.

4. Shut down the engine.

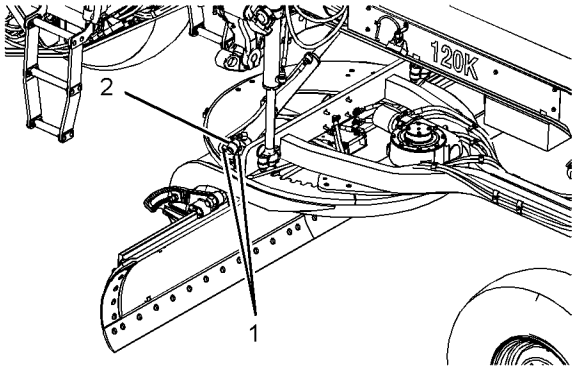

Illustration 197 g02220817
Typical example shown

5. Remove bolts (1) from cap (2). Remove cap (2).

6. Start the engine and retract the cylinder to remove the insert. Stop the engine.

7. Install two new inserts.

8. Start the engine and extend the cylinder until it fits on the drawbar ball. Stop the engine.

9. Add the proper number of shims between the socket/cap and the insert flange to remove any gap.

10. Install the cap. Install the bolts and tighten the bolts.

Note: The purpose of the shims is not to provide the ball stud interface the ability to adjust but to account for the tolerance between the socket/cap and the inset flange. The shims allow the load to be properly transferred through the hydraulic cylinder to the insert to the ball system. Improper shimming can lead to deformation of the insert, binding of the interface, and damage/failure of the insert/ball stud. If no shims remain, install new inserts. Install two shims on each side of the inserts. Add additional shims, as needed.

i02590306

Centershift Cylinder Socket - Lubricate

SMCS Code: 5223-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the centershift cylinder socket. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe all the fittings before you apply lubricant through the fittings.

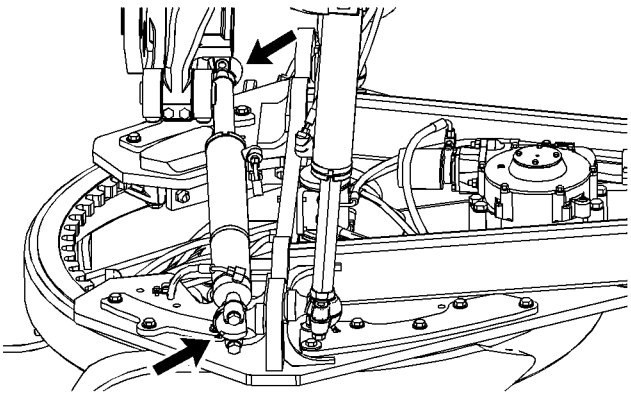

Illustration 198 g01177951

There are two centershift cylinder sockets. Each centershift cylinder socket has one fitting.

Apply the appropriate lubricant through the fittings in order to lubricate the centershift cylinder sockets.

i02358151

Centershift Lock Bar - Clean/ Lubricate

SMCS Code: 5221-070; 5221-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the centershift lock bar. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

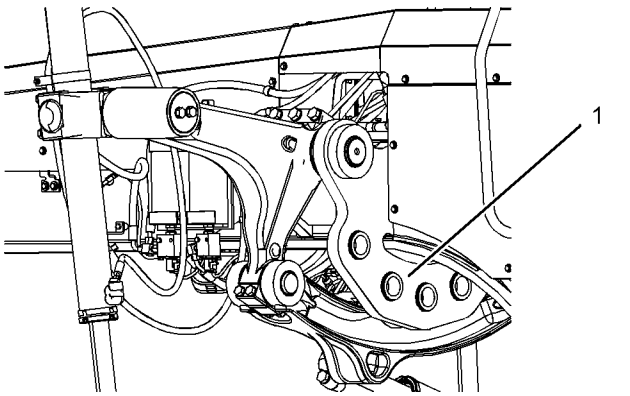

Illustration 199 g01177997

Centershift lock bar (1) is located under the front frame and above the circle.

Clean the dirt, the lubricant and the rust from the holes in the centershift lock bar.

Apply the appropriate lubricant to the holes in the centershift lock bar.

i07192342

Circle Clearances - Check/ Adjust

SMCS Code: 6152-025; 6152-535; 6153-535; 6153-025; 6154-025; 6154-535; 6155-535; 6155-025

Reference: For more information, refer to CATU1682, “Circle Clearances - Check/Adjust (Circle Pinion and Circle Teeth) 16M Motor Grader Operation and Maintenance” on Caterpillar Channel1

https://channel1.mediaspace.kaltura.com/media/Circle+Clearances+-+Check+Adjust+(Circle+Pinion+and+Circle+Teeth)+16M+Motor+Grader+Operation+and+Maintenance/1_hrea3ghg

Note: A CWS login is required to access Caterpillar Channel1.

Note: In order to improve the accuracy for all adjustments, remove debris and abrasive material from the entire blade circle.

Circle Pinion and Circle Teeth

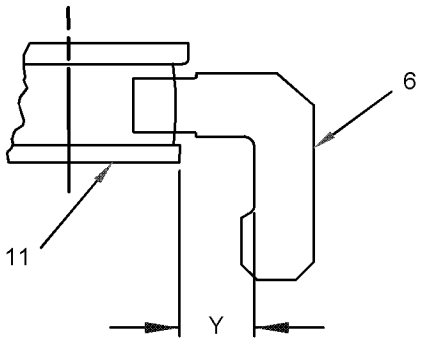

Illustration 200 g01141365

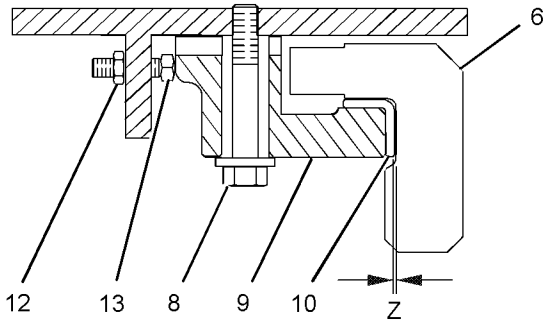

Illustration 201 g01142613

Note: The engagement of circle pinion (11) and the circle teeth is affected by the adjustment of circle shoes (9).

Note: The blade circle and drawbar adjustments are affected by the adjustment of the circle shoes and replacement of the circle shoe wear strips. Any adjustment to the circle shoes and circle shoe wear strip replacement must be done prior to shimming of the wear strips on the top of the circle.

1. Rotate the blade. Place the blade at an angle of 90 degrees to the frame.
2. Lower the blade to the ground.

3. Apply the service brake as you slowly inch the machine in a forward direction. This will hold a light load between shoe wear strips (10) for the front circle shoes and blade circle (6).

4. Engage the parking brake. Stop the engine.

5. Measure clearance (Y) that is between the bottom flange of the circle pinion and the inner machined surface of the blade circle. If the clearance is not within 60.0 to 63.0 mm (2.36 to 2.48 inch), then adjust the clearance.

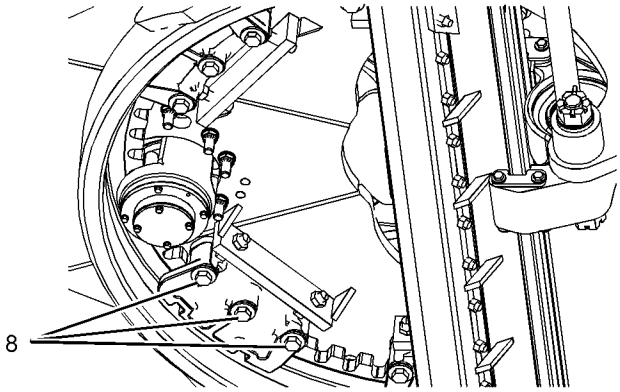

Illustration 202 g01179503

6. In order to inspect the shoe wear strips, remove shoe mounting fasteners (8).

Note: Remove each circle shoe (9) one at a time.

7. Inspect the shoe wear strips one at a time. Measure the thickness of the shoe wear strips on both contact sides. Replace the shoe wear strips if there is uneven wear. The shoe wear strips should be in complete contact at all points with the blade circle. If any wear strip is not in complete contact with the blade circle, replace the wear strip.

8. Install shoe mounting fasteners (8). Tighten all shoe mounting fasteners.

9. Loosen the shoe mounting fasteners by one quarter turn. Loosen locknuts (12).

Note: Adjust the front circle shoes one at a time. Adjust the clearance equally for each front circle shoe.

10. Turn adjusting bolts (13) inward or turn adjusting bolts (13) outward in order to attain 60.0 to 63.0 mm (2.36 to 2.48 inch).

Note: If the circle shoes are moved outward, it may be necessary to slowly inch the machine in a forward direction in order to place a light load between the wear strips for the front circle shoes and the blade circle.

11. After adjustments have been made to any circle shoe, check the circle shoes for proper clearance. If you cannot attain the correct clearance measurement due to worn front shoe wear strips, replace the worn shoe wear strips. Then, repeat Step 10.

12. Tighten the shoe mounting fasteners and locknuts for the front circle shoes.

Note: The adjusting bolts must be tight against the circle shoes before you tighten the mounting fasteners and the locknuts.

13. Set all of the circle shoes (front, side, and rear) to contact the blade circle. There will be no clearance between the circle shoes and the blade circle.

14. When the pinion clearance is set and the front circle shoes are in contact with the blade circle, measure distance (Z) between each wear strip and the blade circle. The clearance should be a maximum of 0.8 mm (0.03 inch).

15. Tighten all shoe mounting fasteners (8) to a torque of 900 ± 100 N·m (660 ± 74 lb ft).

16. Tighten locknuts (12) to a torque of 570 ± 80 N·m (420 ± 59 lb ft).

Note: After all the adjustments have been performed, the blade circle must rotate freely without binding.

17. Lubricate the circle pinion and the circle teeth. Refer to Operation and Maintenance Manual, “Circle Drive Pinion Teeth - Lubricate” for the proper procedure.

Blade Circle and Drawbar

Reference: For more information, refer to CATU1681, “Circle Clearances - Check/Adjust (Blade Circle and Drawbar) 16M Motor Graders Operation and Maintenance” on Caterpillar Channel1

https://channel1.mediaspace.kaltura.com/media/Circle+Clearances+-+Check+Adjust+(Blade+Circle+and+Drawbar)+16M+Motor+Graders+Operation+and+Maintenance/1_aesdo99m

Note: A CWS login is required to access Caterpillar Channel1.

Note: The circle pinion and circle teeth adjustment procedure will affect the adjustment of wear strips on the top of the circle. Any adjustment of the circle shoes or replacement of circle shoe wear strip must be done prior to adjustment of the wear strips on the top of the circle.

1. Rotate the blade. Place the blade at an angle of 90 degrees to the frame.

⚠ WARNING

Personal injury or death can result from blade falling.

2. Lift the blade 10 mm (0.39 inch) off the ground.

3. Engage the parking brake. Stop the engine.

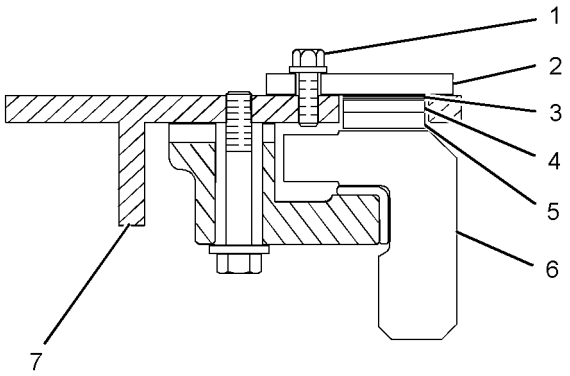

Illustration 203 g01142372

4. Remove plate retainer bolts (1) and remove retainer plates (2).

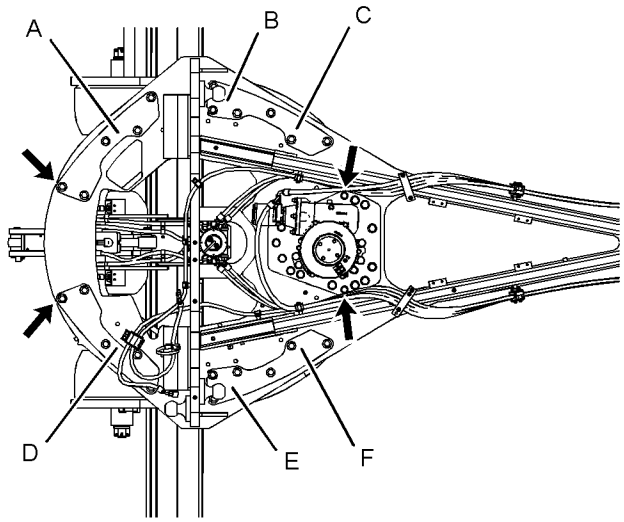

Illustration 204 g03828073

5. Reinstall two bolts in the drawbar without the retainer plates. Remove the two pusher bolts near the circle drive. Reinstall the pusher bolts into drawbar (7) without the spacers. Refer to Illustration 204 for the correct locations. This ensures that blade circle (6) is properly seated on the circle shoes.

6. Remove shims (3), spacer plates (4), and drawbar wear strips (5).

7. Inspect the wear strips. Inspect the drawbar. Measure the thickness of the drawbar wear strips. Replace the wear strips if there is uneven wear. The wear strips should be in complete contact at all points with the blade circle. If any wear strip is not in complete contact with the blade circle, replace the wear strip.

8. If the wear strips can be reused, switch wear strip (A) with wear strip (C). Switch wear strip (D) with wear strip (F). This will help keep the wear on the wear strips even.

9. Reinstall the wear strips, spacer plates, and the shims. Install shims until the shims are flush with the top surface of the drawbar.

10. Remove the two rear bolts separately. Immediately after removing one of the bolts, install the corresponding retainer plate. Install all of the retainer plates and bolts.

Note: The shims must not be on the top surface of the drawbar before the retainer plates are installed. The shims must be within the inside of the pocket.

11. Remove the two pusher bolts from the drawbar. Reinstall the pusher bolts with the spacers.

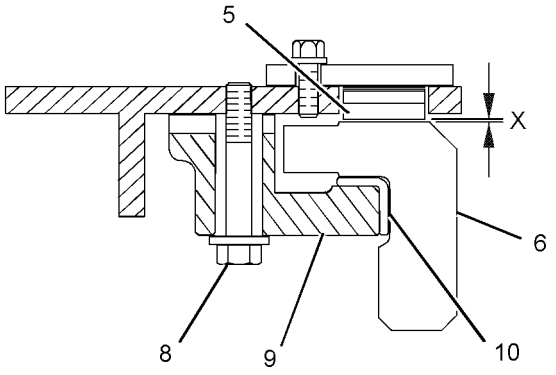

Illustration 205 g01142608

12. Measure clearance (X) between the top of blade circle (6) and the bottom of drawbar wear strips (5). Maintain a maximum clearance of 0.5 mm (0.02 inch).

Note: Make sure that shoe wear strips (10) are completely seated in circle shoes (9). Shoe mounting fasteners (8) must be tight.

Note: After all the adjustments have been performed, the blade circle must rotate freely without binding.

13. Lubricate the blade circle and the drawbar. Refer to Operation and Maintenance Manual, “Circle Top - Lubricate” for the proper procedure.

i05768249

Circle Drive Oil - Change

SMCS Code: 5207-510-OC

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Clean the area around the drain plug and clean the area around the check/fill plug before you remove the plugs.

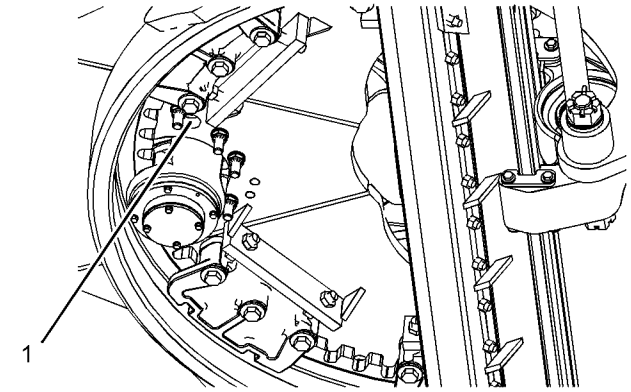

Illustration 206 g01179507
Bottom view of the blade circle

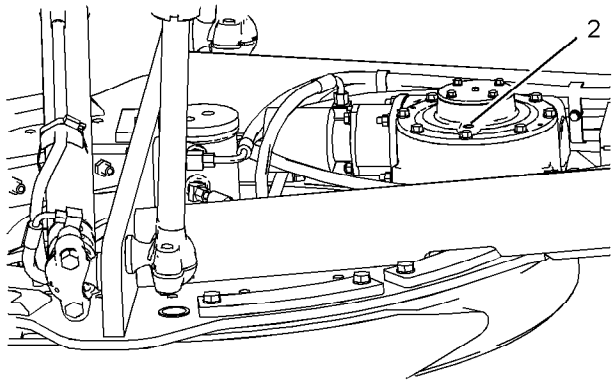

Illustration 207 g01070350
Top view of the blade circle

1. Start the engine. Operate the circle for several minutes to mix the circle drive oil. Stop the engine.

2. Remove check/fill plug (2). Remove drain plug (1). Allow the oil to drain into a suitable container.

3. Clean the drain plug and install the drain plug.

4. Fill the circle drive housing with final drive and axle oil. See Operation and Maintenance Manual, “Capacities (Refill)” and Operation and Maintenance Manual, “Lubricant Viscosities”.

5. Clean the check/fill plug and install the check/fill plug.

6. Start the engine. Operate the machine for a few minutes. Check the circle drive housing for leaks.

7. Stop the engine. Remove the check/fill plug and check the oil level. Maintain the oil level to the bottom of the filler opening. If necessary, add oil.

8. Install the check/fill plug.

i02597508

Circle Drive Pinion Teeth - Lubricate

SMCS Code: 5207-086-PI

⚠ WARNING

Contact with a moving attachment may cause injury or death.

Avoid contact with a moving attachment when lubricating or maintaining the attachment.

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the blade circle. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

The circle drive pinion teeth are located under the circle drive housing.

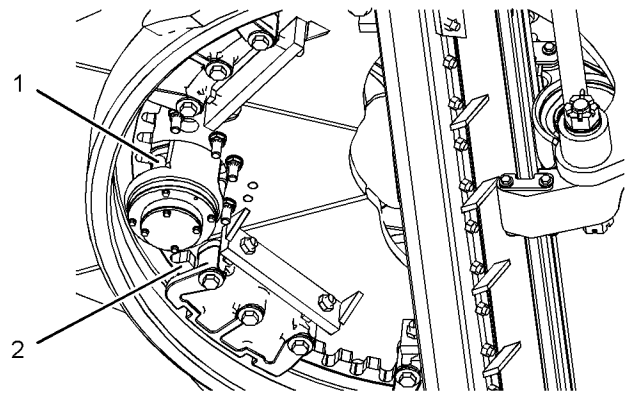

Illustration 208 g01179489

1. Clean the dirt and the old lubricant from circle drive pinion teeth (1) and from blade circle (2).

2. Apply the appropriate lubricant to circle drive pinion teeth (1) and blade circle (2).

i02590369

Circle Top - Lubricate

SMCS Code: 6154-086-TP

1. Park the machine on a level surface and engage the parking brake.

2. Stop the engine. Lower the blade and any attachments to the ground.

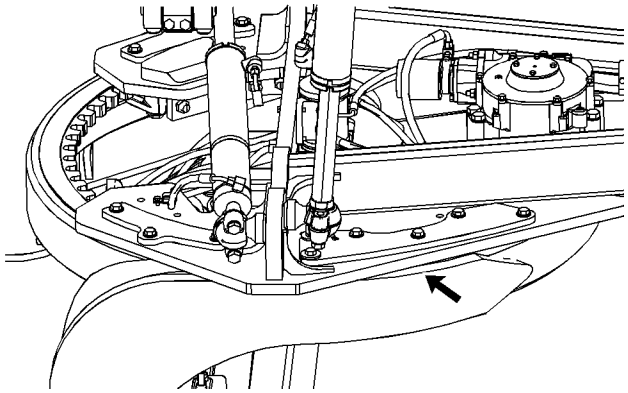

Illustration 209 g01296825

3. Apply a dry film lubricant to the 5 mm (0.2 inch) gap between the circle and the drawbar yoke. Apply the dry film lubricant around the entire circle. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” “Dry Film Lubricant” for further information.

i02360618

Circuit Breakers - Reset

SMCS Code: 1417-529; 1420-529

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Circuit Breaker Resets – Push the buttons inward in order to reset the circuit breakers. If the system is working properly, the buttons will remain depressed. If the buttons do not stay depressed, check the appropriate electrical circuit.

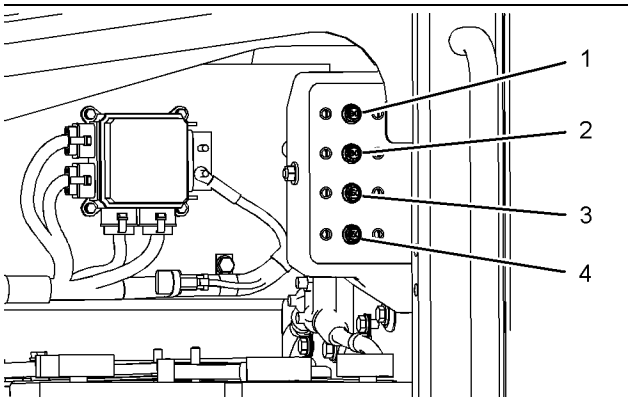

Illustration 210 g01179527

The circuit breaker resets are located in the right rear compartment of the machine.

Load Circuit Breaker (1) – The load circuit breaker feeds power to the fuses in the cab that are continuously on. The load circuit breaker is 80 amp.

Main Circuit Breaker (2) – The main circuit breaker feeds power to the fuses in the cab that are turned on with the ignition key. The main circuit breaker is 80 amp.

Alternator Circuit Breaker (3) – The alternator circuit breaker is 150 amp. This circuit breaker is standard.

Power Circuit Breaker (4) – The power circuit breaker feeds power to the power distribution bus bar and attached components. The power circuit breaker is 150 amp.

i06205423

Cooling Cores - Clean

SMCS Code: 1353-070

Condenser (Refrigerant)

NOTICE
If excessively dirty, clean condenser with a brush. To prevent damage or bending of the fins, do not use a stiff brush.

Repair the fins if found defective.

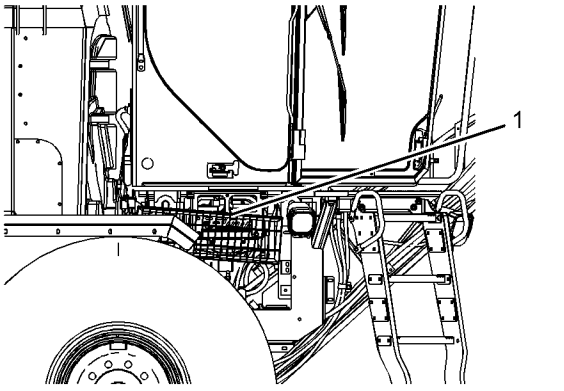

Illustration 211 g01415953

Refrigerant condenser (1) is located under the cab of the machine.

1. Inspect the condenser for debris. If necessary, clean the condenser.
2. Use clean water in order to wash off all dust and dirt from the condenser.

Note: In order to aid in cleaning, an additive that provides degreasing may be applied. The additive must not contain ammonia.

Note: If a pressure washer is used, the nozzle of the pressure washer must be no closer than 18 inches and the nozzle must be at a right angle in order to avoid damage.

Evaporator and Heater Coils

The evaporator and heater coils are located under the seat in the cab.

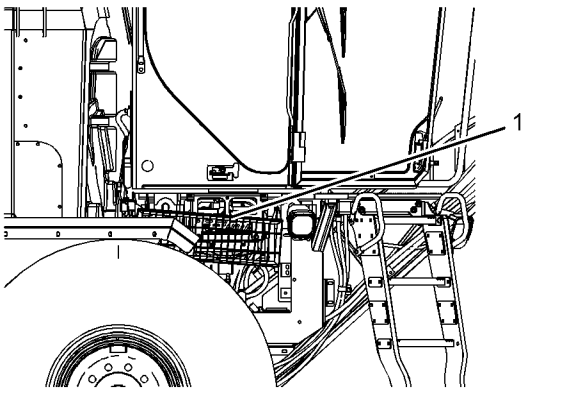

Illustration 212 g01414723

1. Remove the access cover (1).

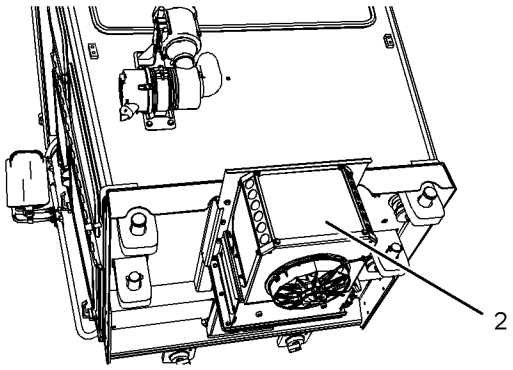

Illustration 213 g01378280

2. Remove the bolts from the modular unit (2). There are four bolts on each side of the modular unit.

3. Slide the modular unit along the rails.

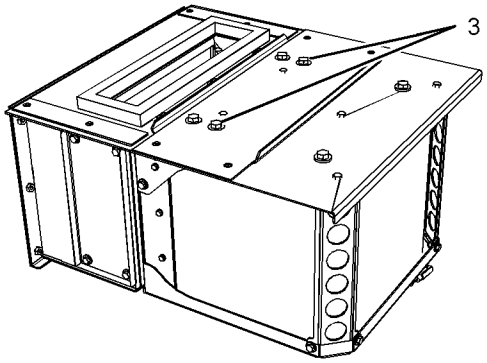

Illustration 214 g01378285

4. Install links to the bolts (3).

5. Attach a strap to the links. Lift the modular unit and remove the modular unit.

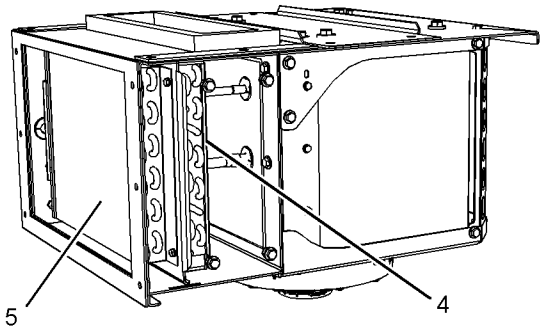

Illustration 215 g01378287

6. Clean the evaporator coil (4) and clean the heater coil (5). If necessary, replace both coils.

7. Install the modular unit.

8. Install the access cover.

Note: If you are operating the machine under harsh conditions or with the cab door open, you may have to clean the coils more often.

Radiator and Radiator Core

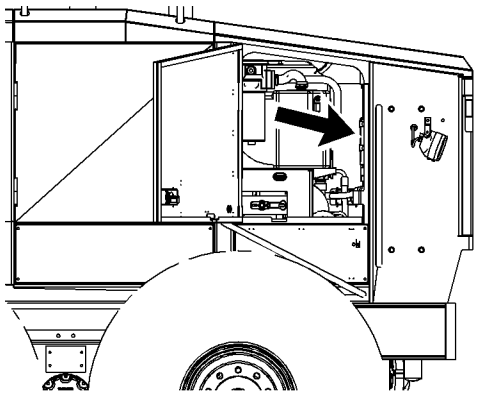

Illustration 216 g01185647

1. Open the access panel on the left rear of the machine. Open the access panel on the right rear of the machine.

2. Remove the four bolts that hold the top radiator to the frame assembly. Remove the two bolts that hold the bottom radiator to the frame assembly.

Note: The bolts are located on the left side of the engine compartment near the rear of the machine.

3. Swing the radiators approximately 76 mm (3 inches) toward the front of the machine.

Note: The hinges that allow the radiators to swing are located on the right side of the engine compartment near the rear of the machine.

4. Remove any dirt from the area around the radiators. Remove any debris from the area around the radiators.

5. Swing the radiators approximately 76 mm (3 inches) toward the rear of the machine.

6. Install the six bolts in order to secure the radiators to the frame assembly.

7. Close the left access panel and the right access panel.

Note: You can use compressed air, high-pressure water, or steam to remove dust and other debris from the radiator core. However, the use of compressed air is preferred. See Special Publication, SEBD0518, “Know Your Cooling System” for the complete procedure for cleaning the radiator core.

i02637904

Cooling System Coolant (ELC) - Change

SMCS Code: 1350-044-NL; 1395-044-NL

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove cooling system pressure cap slowly to relieve pressure only when engine is stopped and cooling system pressure cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Coolant Additive contains alkali. Avoid contact with skin and eyes.

NOTICE
Do not change the coolant until you read and understand the material in the Cooling System Specifications section.

NOTICE
Mixing ELC with other products reduces the effectiveness of the coolant and shortens coolant life. Use only Caterpillar products or commercial products that have passed the Caterpillar EC-1 specifications for premixed or concentrate coolants. Use only Caterpillar Extender with Caterpillar ELC. Failure to follow these recommendations could result in the damage to cooling systems components.

If ELC cooling system contamination occurs see the topic Extended Life Coolant (ELC) in the Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations”.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

If the coolant in the machine is changed to Extended Life Coolant from another type of coolant, see Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” “Extended Life Coolant (ELC) Cooling System Maintenance”.

If the coolant is dirty or if you observe any foaming in the cooling system, change the coolant before the recommended interval.

It is important to replace the thermostat in order to avoid any unexpected failure of the thermostat. This is a good preventive maintenance practice that reduces the chances of unscheduled downtime. Failure to replace the thermostat on a regularly scheduled basis could cause severe engine damage.

Note: If you are only replacing the thermostat, drain the coolant from the cooling system so that the level of the coolant is below the thermostat housing.

Always operate Caterpillar engines with a thermostat because these engines have a shunt design cooling system.

Note: Thermostats can be reused if the thermostats meet certain test specifications. The tested thermostats must not be damaged and the tested thermostats must not have an excessive buildup of deposits.

1. Stop the engine and allow the engine to cool.

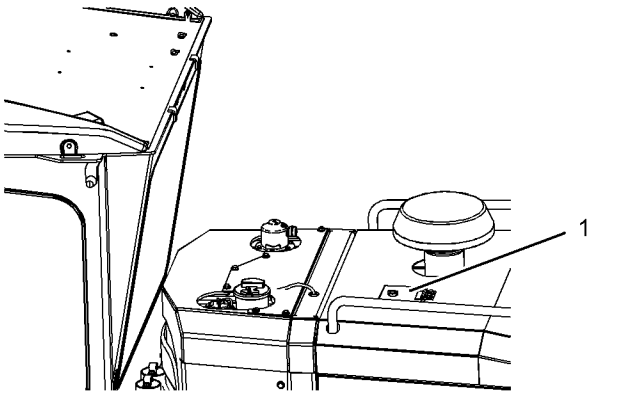

Illustration 217 g01322604

2. Open cover (1).

3. Clean the area around the cooling system pressure cap of any dirt or debris. This must be done before the cooling system pressure cap can be removed.

4. Slowly remove the cooling system pressure cap in order to relieve pressure.

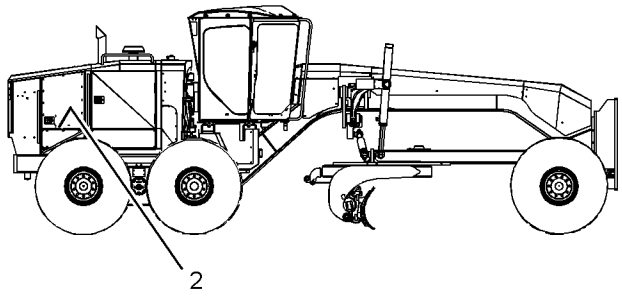

Illustration 218 g01179604

5. Open drain valve (2). The drain valve is located on the water line at the lower right rear of the machine. Allow the coolant to drain into a suitable container.

6. Flush the cooling system with clean water until the draining water is transparent.

7. Close the drain valve.

8. Add the Extended Life Coolant. Refer to Operation and Maintenance Manual, “Capacities (Refill)”.

Note: Make sure that the cooling system pressure cap is removed for Steps 9 through 10.

9. Start the engine and run the engine until the thermostat opens and the coolant level stabilizes.

10. Maintain the coolant level between the “FULL” mark and the “ADD” mark on the coolant tank.

11. Install the cooling system pressure cap. Close cover (1).

12. Check the radiator for any external leaks. Check for air bubbles in the radiator.

13. Stop the engine.

i02637922

Cooling System Coolant Extender (ELC) - Add

SMCS Code: 1352-538-NL

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove cooling system pressure cap slowly to relieve pressure only when engine is stopped and cooling system pressure cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Coolant Additive contains alkali. Avoid contact with skin and eyes.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

When a Caterpillar Extended Life Coolant (ELC) is used, an extender must be added to the cooling system. See the Operation and Maintenance Manual, “Maintenance Interval Schedule” for the proper service interval. The amount of extender is determined by the cooling system capacity.

1. Stop the engine and allow the engine to cool.

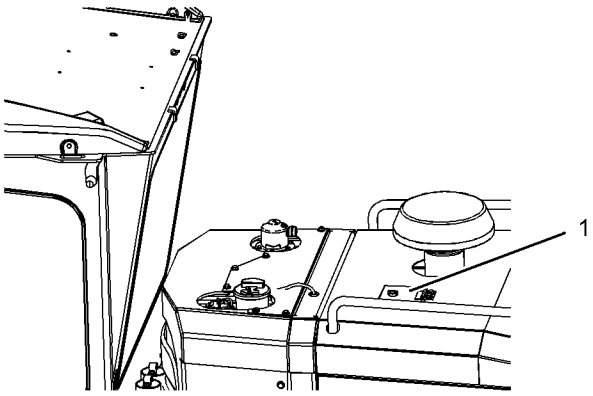

Illustration 219 g01322604

2. Open cover (1).

3. Clean the area around the cooling system pressure cap of any dirt or debris. This must be done before the cooling system pressure cap can be removed.

4. Remove the cooling system pressure cap slowly in order to relieve the pressure.

5. Drain some coolant from the radiator into a suitable container. This will allow space for additional cooling system coolant extender.

6. In order to add cooling system coolant extender, refer to the Special Publication, SEBU6250, “Extended Life Coolant (ELC)”. Refer to the table for the correct amount of Caterpillar Extended Life Coolant (ELC) Extender that is needed to be added to the cooling system.

7. Install the cooling system pressure cap. Close the cover.

i02637944

Cooling System Coolant Level - Check

SMCS Code: 1350-535-FLV

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

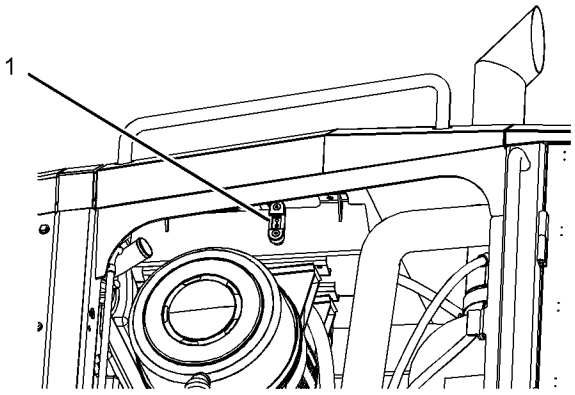

Illustration 220 g01179715

1. Maintain the coolant level so that coolant is visible in sight gauge (1).

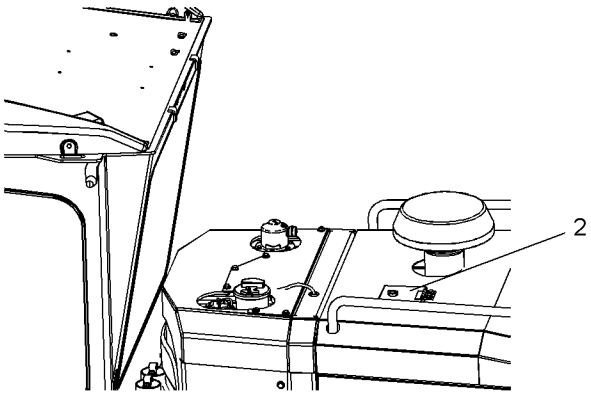

Illustration 221 g01322651

2. If necessary, add the appropriate coolant mixture.

3. Open cover (2).

4. Clean the area around the filler cap of any dirt or debris. This must be done before the filler cap can be removed.

5. Remove the filler cap slowly in order to relieve pressure.

6. Add coolant through the filler tube.

7. Install the filler cap. Close the cover.

i05035221

Cooling System Coolant Sample (Level 1) - Obtain

SMCS Code: 1350-008; 1395-008; 7542

Note: Obtaining a Coolant Sample (Level 1) is optional if the cooling system is filled with Cat ELC (Extended Life Coolant). Cooling systems that are filled with Cat ELC should have a Coolant Sample (Level 2) that is obtained at the recommended interval that is stated in the Maintenance Interval Schedule.

Note: Obtain a Coolant Sample (Level 1) if the cooling system is filled with any other coolant instead of Cat ELC. This includes the following types of coolants:

- Commercial long life coolants that meet the Caterpillar Engine Coolant Specification -1 (Caterpillar EC-1)
- Cat Diesel Engine Antifreeze/Coolant (DEAC)
- Commercial heavy-duty antifreeze/coolant

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Always use a designated pump for oil sampling, and use a separate designated pump for coolant sampling. Using the same pump for both types of samples may contaminate the samples that are being drawn. This contaminate may cause a false analysis and an incorrect interpretation that could lead to concerns by both dealers and customers.

Note: Level 1 results may indicate a need for Level 2 Analysis.

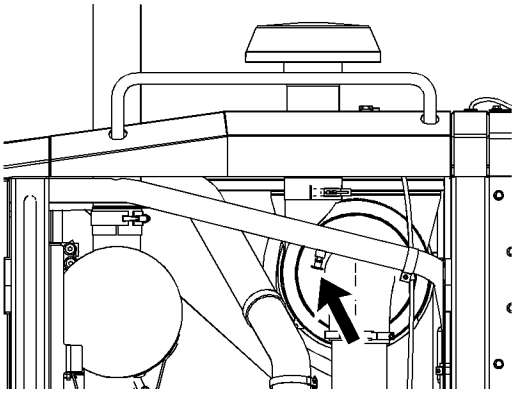

Illustration 222 g01179755
Type 1

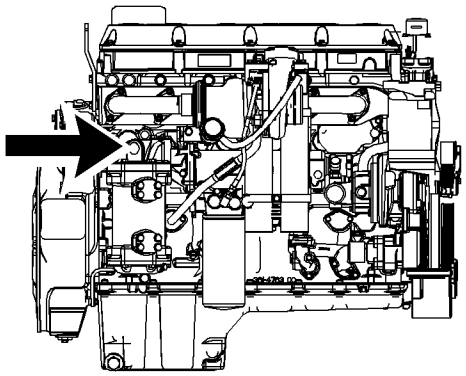

Illustration 223 g03205778

Type 2

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Obtain the sample of the coolant as close as possible to the recommended sampling interval. In order to receive the full effect of S·O·S coolant analysis, you must establish a consistent trend of data. In order to establish a pertinent history of data, perform consistent samplings that are evenly spaced. Supplies for collecting samples can be obtained from your Caterpillar dealer.

Use the following guidelines for proper sampling of the coolant:

- Complete the information on the label for the sampling bottle before you begin to take the samples.
- Keep the unused sampling bottles stored in plastic bags.
- Obtain coolant samples directly from the coolant sample port. You should not obtain the samples from any other location.
- Keep the lids on empty sampling bottles until you are ready to collect the sample.
- Place the sample in the mailing tube immediately after obtaining the sample in order to avoid contamination.
- Never collect samples from expansion bottles.
- Never collect samples from the drain for a system.

Submit the sample for Level 1 analysis.

For additional information about coolant analysis, see Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” or consult your Cat dealer.

i07927863

Cooling System Coolant Sample (Level 2) - Obtain

SMCS Code: 1350-008; 1395-008; 7542

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Always use a designated pump for oil sampling, and use a separate designated pump for coolant sampling. Using the same pump for both types of samples may contaminate the samples that are being drawn. This contaminate may cause a false analysis and an incorrect interpretation that could lead to concerns by both dealers and customers.

Note: Ensure that the engine is warmed up to operating temperature and running to obtain the sample.

As an alternative to "Live Sampling", take sample using vacuum extraction. This sampling method requires a vacuum pump.

Reference: Special Publication, PEHP6001, “How To Take A Good Oil Sample”.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Obtain the sample of the coolant as close as possible to the recommended sampling interval. Supplies for collecting samples can be obtained from your Caterpillar dealer.

Refer to Operation and Maintenance Manual, “Cooling System Coolant Sample (Level 1) - Obtain” for the guidelines for proper sampling of the coolant.

Submit the sample for Level 2 analysis.

Refer to Special Publication, SEBU6250, “S·O·S Oil Analysis” for information that pertains to obtaining a sample of the hydraulic oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the hydraulic oil.

i02637952

Cooling System Pressure Cap - Clean/Replace

SMCS Code: 1382-510; 1382-070

⚠ WARNING

Personal injury can result from hot coolant, steam and alkali.

At operating temperature, engine coolant is hot and under pressure. The radiator and all lines to heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove filler cap slowly to relieve pressure only when engine is stopped and radiator cap is cool enough to touch with your bare hand.

Do not attempt to tighten hose connections when the coolant is hot, the hose can come off causing burns.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes.

The cooling system pressure cap is located in the center front of the hood.

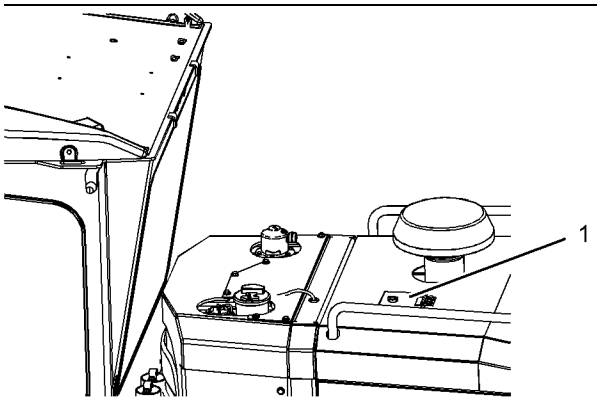

Illustration 224 g01322604

1. Open cover (1).
2. Clean the area around the pressure cap of any dirt or debris. This must be done before the pressure cap can be removed.
3. Remove the pressure cap slowly in order to relieve pressure.
4. Inspect the cap and the cap seal for damage, deposits, and foreign material. Clean the cap with a clean cloth. Replace the cap if the cap is damaged.
5. Install the cap. Close the cover.

i02361229

Crankshaft Vibration Damper - Inspect

SMCS Code: 1205-040

Damage to the vibration damper or failure of the vibration damper will increase torsional vibrations. These vibrations will result in damage to the crankshaft and to the other engine components. A deteriorating vibration damper will cause excessive gear train noise at variable points in the speed range.

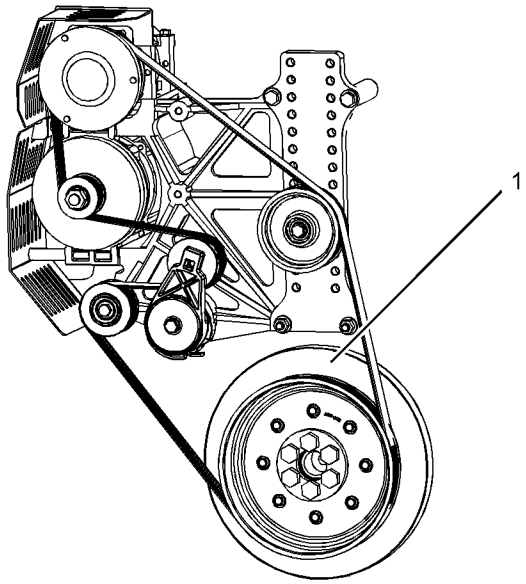

Illustration 225 g01179820

Caterpillar recommends replacing vibration damper (1) for any of the following reasons:

- The engine has had a failure because of a broken crankshaft.
- The S·O·S analysis detected a worn crankshaft front bearing.
- The S·O·S analysis detected a large amount of gear train wear that is not caused by a lack of oil.
- Fluid leakage is detected during inspection.
- The housing is damaged.

Refer to Disassembly and Assembly, “Vibration Damper and Pulley - Remove and Install” for the procedure to remove the damper and for the procedure to install the damper.

The vibration damper can be used again if none of the above conditions are found or if the vibration damper is not damaged.

Note: Consult your Caterpillar dealer for further information.

i03653685

Cutting Edges and End Bits - Inspect/Replace
(Includes Overlays)

SMCS Code: 6801-040; 6801-510; 6804-040; 6804-510

⚠ WARNING

Personal injury or death can result from the blade falling.

Block the blade before changing blade tips.

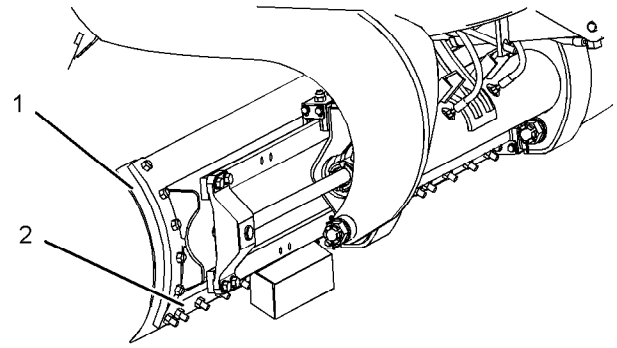

Illustration 226 g01071858

End bits (1) and/or cutting edges (2) may be damaged. The end bits and/or the cutting edges may be worn excessively. Replace the end bits and/or the cutting edges, as needed.

1. Place blocks under the blade. Lower the blade onto the blocks. Do not block up the blade too high. Just use enough blocks so that the end bits and the cutting edges can be removed.
2. Remove the end bits and/or the cutting edges.
3. Install new end bits and/or new cutting edges.
4. Raise the blade and remove the blocks.

i02730438

Display and Camera - Clean
(If Equipped with Work Area Vision System)

SMCS Code: 7347-070; 7348-070

In order to maintain sufficient vision, keep the Work Area Vision System (WAVS) camera lens and the display clean.

Display

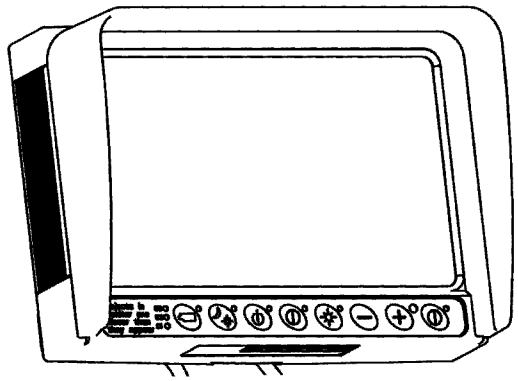

Illustration 227 g01223034
WAVS display

Use a soft, damp cloth in order to clean the display. The display has a soft plastic surface that can be easily damaged by an abrasive material. **The display is not sealed. Do not immerse the display with liquid.**

Camera

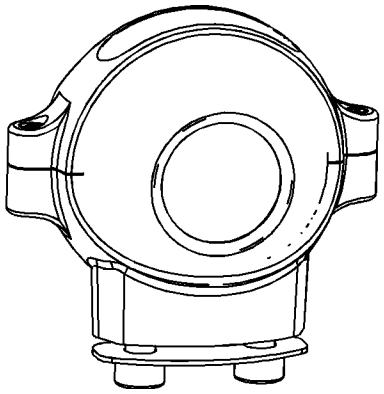

Illustration 228 g01223051
The WAVS camera is located on the rear of the machine on the engine enclosure.

Use a damp cloth or water spray in order to clean the camera lens. The camera is a sealed unit. The camera is not affected by high pressure spray.

The camera is equipped with an internal heater to help counteract the effects of condensation, snow, or ice.

Note: For more information on WAVS, refer to Operation and Maintenance Manual, SEBU8157, “Work Area Vision System”.

i04001021

Drawbar Ball and Socket - Lubricate

SMCS Code: 6170-086; 6171-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the drawbar ball and socket. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe the fitting before you apply lubricant through the fitting.

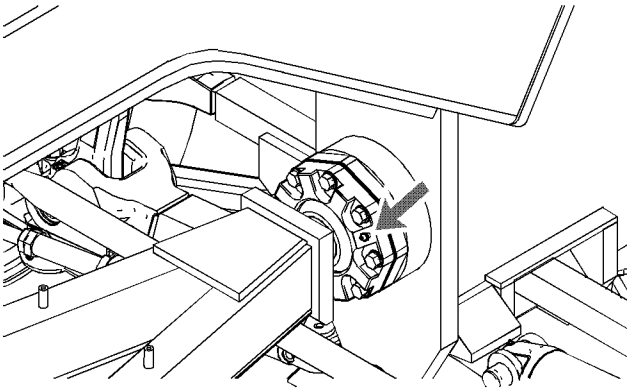

Illustration 229 g01110906
Typical Example Shown

Apply the appropriate lubricant through the fitting in order to lubricate the drawbar ball and socket.

i04001025

Drawbar Ball and Socket End Play - Check/Adjust

SMCS Code: 6170-025; 6170-535; 6171-025; 6171-535

Check

1. Rotate the blade so that the blade is placed at an angle of 90 degrees to the frame. Lower the blade to the ground.
2. While you maintain a light load between the ball and the socket, inch the machine slowly to the rear. Stop the machine and shut off the engine.

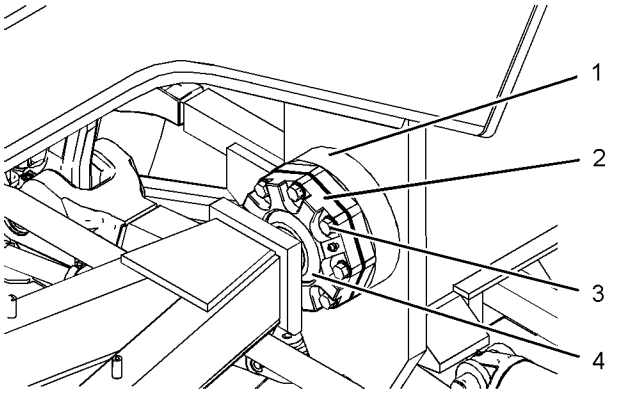

Illustration 230 g01297226
Typical Example Shown

3. On the drawbar ball and socket, measure the end play that is between ball (4) and cap (2). The cap fastens the drawbar ball and socket to the adapter. The end play should be 0.6 ± 0.2 mm (.02 ± .01 inch).

4. Adjust the end play, if necessary.

Adjust

1. Support the drawbar and support the circle.

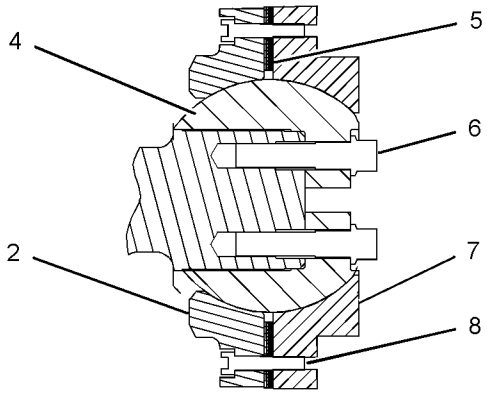

Illustration 231 g01297228
Cutaway view of the drawbar ball and socket

2. Remove bolts (3) that fasten the drawbar to bolster (1). Move the drawbar backward or move the machine forward.

3. Remove capscrews (8) from cap (2). The cap fastens the drawbar ball and socket to adapter (7). Remove the adapter.

4. As required, remove shims (5) or install the shims in order to attain an end play of 0.6 ± 0.2 mm (.02 ± .01 inch).

5. Install capscrews (8) in cap (2). Rotate the cap of the socket by hand. The socket should rotate freely on ball (4) of the drawbar.

6. Check the torque on bolts (6) that fasten ball (4) to the drawbar. The correct torque is 500 ± 65 N·m (370 ± 50 lb ft).

7. Install the drawbar ball and socket to bolster (1). Tighten bolts (3) to a torque of 540 ± 25 N·m (400 ± 18 lb ft).

i01649392

Electronic Unit Injector - Inspect/Adjust

SMCS Code: 1251-040; 1251-025; 1290-040; 1290-025

⚠ WARNING

Be sure the engine cannot be started while this maintenance is being performed. To prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting the unit injectors.

The electronic unit injectors use high voltage. Disconnect the unit injector enable circuit connector in order to prevent personal injury. Do not come in contact with the injector terminals while the engine is running.

NOTICE
Only qualified service personnel should perform this maintenance. Refer to the Systems Operation/Testing and Adjusting Manual, “Valve Lash and Valve Bridge Adjustment” article or consult your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

The initial adjustment to the unit injector is recommended at the initial 500 hour interval. The unit injector adjustment should then be made at every 2000 hour interval. The operation of Caterpillar engines with improper adjustments of the electronic unit injector can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

i06173834

Engine Air Filter Element - Clean/Replace

SMCS Code: 1054-510; 1054-070

Primary Element

NOTICE
Service the air cleaner only with the engine stopped. Engine damage could result.

Note: Use caution when removing and installing an air filter. Make sure not to damage the inner tube within the air filter housing. Also make sure that air filters are installed properly so that the air filters function properly.

Service the air cleaner filter element when the Check Engine alert indicator is activated. The indicator is located inside the cab. The alert indicator will activate when there is an inlet air restriction, and the display will provide a message regarding the specific problem. Refer to Operation and Maintenance Manual, "Monitoring System" for further information.

1. Open the access door for the air filter housing. Refer to Operation and Maintenance Manual, "Access Doors and Covers".

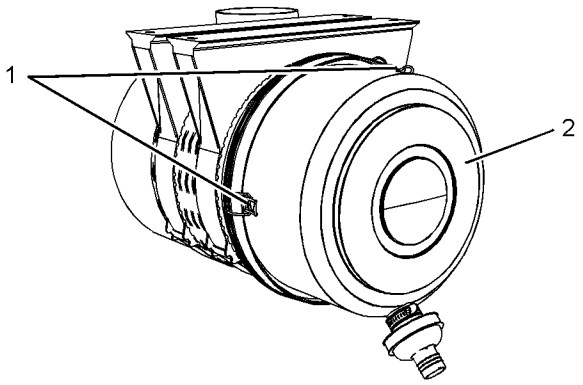

Illustration 232 g02281853

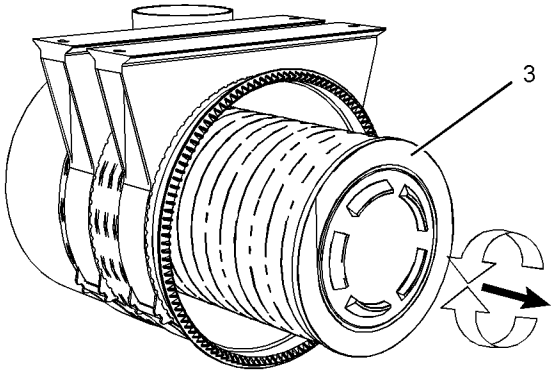

Illustration 233 g02281873

2. Unlock wire fasteners (1) and remove cover (2).

3. Remove primary filter element (3) from the air filter housing, turning slightly counterclockwise.

4. Clean the inside of the air filter housing with a damp cloth. Ensure that the secondary air filter element is fully seated against the back of the canister.

5. Install a clean primary air filter element. Install the cover for the air filter housing. Ensure that the discharge valve that is attached to the cover is located on the bottom when installing the cover.

Note: If the cover is not positioned correctly or no filter element has been installed, the wire fasteners will not fully lock.

Note: Under no circumstance should the inner support tube, that is permanently fixed to the air filter housing, be removed. The support tube is essential for proper operation of the air filter.

Note: Refer to "Cleaning Primary Air Filter Elements".

6. Close the access door.

If the alert indicator activates after starting the engine or the exhaust smoke is still black after installation of a clean primary filter element, install a new primary filter element. If the alert indicator remains activated, replace the secondary element.

Cleaning Primary Air Filter Elements

NOTICE
Caterpillar recommends certified air filter cleaning services available at participating Caterpillar dealers. The Caterpillar cleaning process uses proven procedures to assure consistent quality and sufficient filter life.

Observe the following guidelines if you attempt to clean the filter element:

Do not tap or strike the filter element in order to remove dust.

Do not wash the filter element.

Use low pressure compressed air in order to remove the dust from the filter element. Air pressure must not exceed 207 kPa (30 psi). Direct the air flow up the pleats and down the pleats from the inside of the filter element. Take extreme care in order to avoid damage to the pleats.

Do not use air filters with damaged pleats, gaskets, or seals. Dirt entering the engine will cause damage to engine components.

The primary air filter element can be used up to six times if the element is properly cleaned and the element is properly inspected. When the primary air filter element is cleaned, check for rips or tears in the filter material. The primary air filter element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

NOTICE
Do not clean the air filter elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets, or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the primary air filter elements before cleaning. Inspect the air filter elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air filter elements.

There are two common methods that are used to clean primary air filter elements:

- Pressurized air
- Vacuum cleaning

Pressurized Air

Pressurized air can be used to clean primary air filter elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

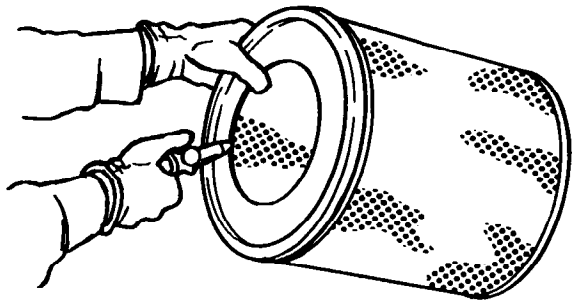

Illustration 234 g00281692

Note: When the primary air filter elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air filter element. Dirt could be forced further into the pleats.

Vacuum Cleaning

Vacuum cleaning is another method for cleaning primary air filter elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Inspecting the Primary Air Filter Elements

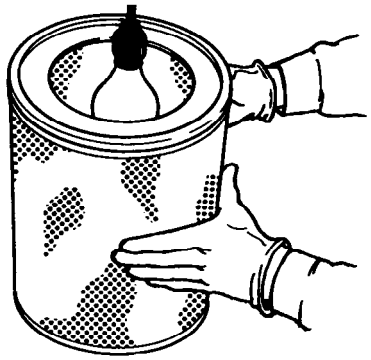

Illustration 235 g00281693

Inspect the clean, dry primary air filter element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air filter element. Rotate the primary air filter element. Inspect the primary air filter element for tears and/or holes. Inspect the primary air filter element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air filter element to a new primary air filter element that has the same part number.

Do not use a primary air filter element that has any tears and/or holes in the filter material. Do not use a primary air filter element with damaged pleats, gaskets or seals. Discard damaged primary air filter elements.

Storing Primary Air Filter Elements

If a primary air filter element that passes inspection will not be used, the primary air filter element can be stored for future use.

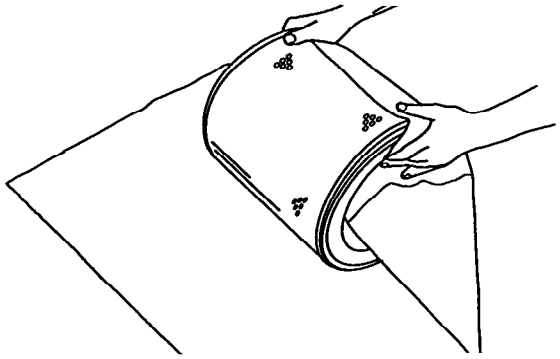

Illustration 236 g00281694

Do not use paint, a waterproof cover, or plastic as a protective covering for storage. An air flow restriction may result. To protect against dirt and damage, wrap the primary air filter elements in Volatile Corrosion Inhibited (VCI) paper.

Place the primary air filter element into a box for storage. For identification, mark the outside of the box and mark the primary air filter element. Include the following information:

- Date of cleaning
- Number of cleanings

Store the box in a dry location.

Secondary Element

NOTICE
Always replace the secondary element. Do not attempt to reuse it by cleaning. Engine damage could result.

Note: Use caution when removing and installing an air filter. Make sure not to damage the inner tube within the air filter housing. Also make sure that air filters are installed properly so that the air filters function properly.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Note: Replace the engine air filter secondary element when you service the engine air filter primary element for the third time. Replace the secondary element if the exhaust smoke remains black and a clean primary element has been installed. Also, replace the secondary element if the element has been in service for 1 year.

1. Open the access door for the air filter housing. Remove the air cleaner cover and the primary element.

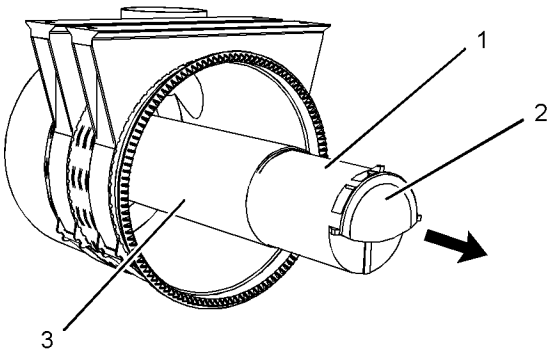

Illustration 237 g02282454

2. Remove the secondary element (1). Pull the secondary from the inner support tube (3) using the outer grip (2) of the element.

Note: Under no circumstance should the inner support tube, that is permanently fixed to the air filter housing, be removed. The support tube is essential for proper operation of the air filter.

3. Cover the air inlet opening. Clean the inside of the air cleaner housing.

4. Uncover the air inlet opening. Install a new secondary element.

5. Install the primary element and the air cleaner cover.

6. Close the access door.

i01404793

Engine Compartment - Clean

SMCS Code: 1000-070; 1000-070-CPA

NOTICE
Before spraying the engine compartment with high pressure water turn off the engine and allow the engine to cool. Do not spray water directly on a hot fuel injection pump or damage may occur.

Use a commercially available engine degreaser in order to clean the engine compartment. Use caution and minimize the water around bearings and electrical connections.

i02591800

Engine Oil Level - Check

SMCS Code: 1348-535-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Do not under fill or overfill engine crankcase with oil. Either condition can cause engine damage.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Clean the area around the oil level gauge and clean the area around the oil filler cap before you remove the oil level gauge and before you remove the oil filler cap.

1. Open the front left access door.

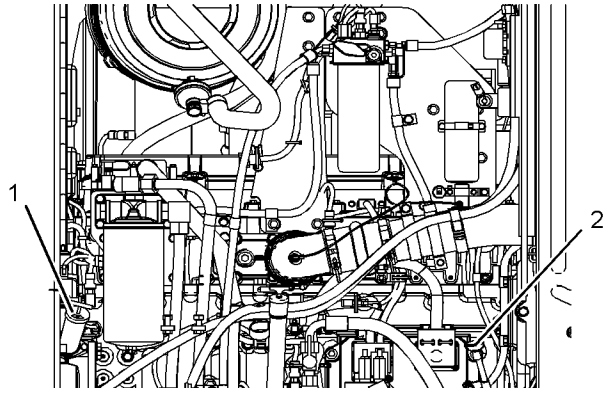

Illustration 238 g01297425

2. Before starting the engine, check oil level gauge (2). Maintain the oil level between the marks on the oil level gauge.

3. If necessary, remove oil filler cap (1) in order to add oil.

4. Clean the oil filler cap and install the oil filler cap.

5. Close the access door.

i02591827

Engine Oil Sample - Obtain

SMCS Code: 1348-008; 7542

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

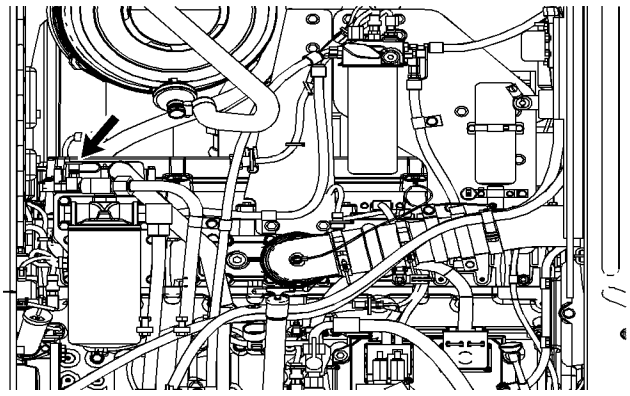

Illustration 239 g01297456

The sampling valve for the engine oil is located on the left side of the engine compartment.

Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” “S·O·S Services Oil Analysis” for information that pertains to obtaining a sample of the engine oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the engine oil.

i02591832

Engine Oil and Filter - Change

SMCS Code: 1308-510; 1348-044

Selection of the Oil Change Interval

NOTICE
A 500 hour engine oil change interval is available, provided that the operating conditions and recommended multigrade oil types are met. When these requirements are not met, shorten the oil change interval to 250 hours, or use an S·O·S Services oil sampling and analysis program to determine an acceptable oil change interval.

If you select an interval for oil and filter change that is too long, you may damage the engine.

Caterpillar oil filters are recommended.

Recommended multigrade oil types are listed in Table 20 . Do not use single grade oils.

Abnormally harsh operating cycles or harsh environments can shorten the service life of the engine oil. Arctic temperatures, corrosive environments, or extremely dusty conditions may require a reduction in engine oil change intervals from the recommendations in Table 20 . Also refer to Special Publication, SEBU5898, “Cold Weather Recommendations”. Poor maintenance of air filters or of fuel filters requires reduced oil change intervals. See your Caterpillar dealer for more information if this product will experience abnormally harsh operating cycles or harsh environments.

Table 20

Engine Oil Change Intervals[1]				
Multigrade Oil Type	Operating Conditions			
			Severe	
	Normal[2]	High Load Factor[3]	Fuel Sulfur from 0.3% to 0.5%[4]	Altitude above 1830 m (6000 ft)
Cat DEO Preferred	500 hr	500 hr	500 hr	250 hr[6]
Cat ECF-1 11.0 minimum TBN[4] Preferred	500 hr	500 hr	500 hr	250 hr[6]
Cat ECF-1 TBN[4] below 11.0	500 hr	500 hr	250 hr[5]	250 hr[6]
API CG-4	500 hr	250 hr[5]	250 hr[5]	250 hr[6]

(1) The traditional oil change interval for engines is 250 hours. The standard oil change interval in this machine is 500 hours, if the operating conditions and recommended oil types that are listed in this table are met. Improvements in the engine allow this engine oil change interval. This new standard interval is not permitted for other machines. Refer to the applicable Operation and Maintenance Manuals for the other machines.

(2) Normal conditions include these factors: Fuel sulfur below 0.3%, altitude below 1830 m (6000 ft) and good air filter and fuel filter maintenance. Normal conditions do not include high load factor, harsh operating cycles, or harsh environments.

(3) High load factors can shorten the service life of your engine oil. Continuous heavy load cycles and very little idle time result in increased fuel consumption and oil contamination. These factors deplete the oil additives more rapidly. If the average fuel consumption of your machine exceeds 36 L (9.5 US gal) per hour, follow the “High Load Factor” recommendations in Table 20 . To determine average fuel consumption, measure average fuel consumption for a period of 50 to 100 hours. If the application of the machine is changed, the average fuel consumption may change.

(4) For sulfur content above 0.5%, refer to Special Publication, SEBU6250, “Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines”.

(5) In order to verify an oil change interval of 500 hours, refer to “Program A” below.

(continued)

(Table 20, contd)
(6) Use “Program B” below to determine an appropriate interval.

Adjustment of the Oil Change Interval

Note: Your Caterpillar dealer has additional information on these programs.

Program A

Verification for an Oil Change Interval of 500 Hours

This program consists of three oil change intervals of 500 hours. Oil sampling and analysis is done at 250 hours and 500 hours for each of the three intervals for a total of six oil samples. The analysis includes oil viscosity and infrared (IR) analysis of the oil. If all of the results are satisfactory, the 500 hour oil change interval is acceptable for the machine in that application. Repeat Program A if you change the application of the machine.

If a sample does not pass the oil analysis, take one of these actions:

- Shorten the oil change interval to 250 hours.
- Proceed to Program B.
- Change to a preferred oil type in Table 20 .

Program B

Optimizing Oil Change Intervals

Begin with a 250 hour oil change interval. The oil change intervals are adjusted by increments. Each interval is adjusted an additional 50 hours. Periodic oil sampling and analysis is done during each interval. The analysis includes oil viscosity and infrared (IR) analysis of the oil. Repeat Program B if you change the application of the machine.

If an oil sample does not pass the analysis, shorten the oil change interval, or change to a preferred multigrade oil type in the listing above.

Procedure for Changing the Engine Oil and Filter

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Do not under fill or overfill engine crankcase with oil. Either condition can cause engine damage.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Park the machine on a level surface and engage the parking brake. Stop the engine.

Note: Drain the crankcase while the oil is warm. This allows waste particles that are suspended in the oil to drain. As the oil cools, the waste particles will settle to the bottom of the crankcase. The particles will not be removed by draining the oil and the particles will recirculate in the engine lubrication system with the new oil.

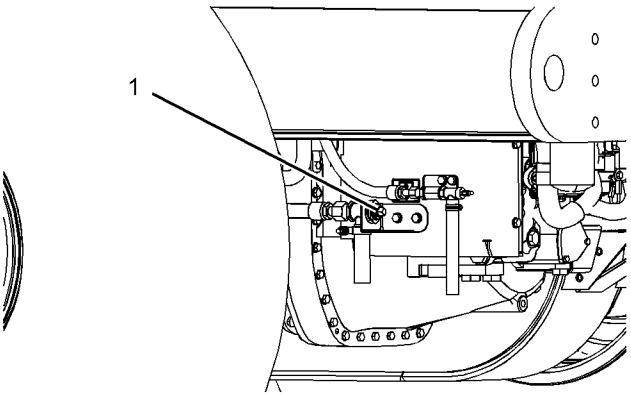

Illustration 240 g01184842

1. Open crankcase drain valve (1). Allow the oil to drain into a suitable container.
2. Close crankcase drain valve (1).

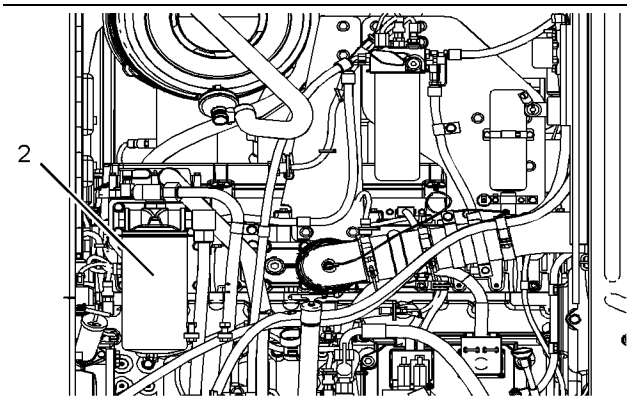

Illustration 241 g01297470

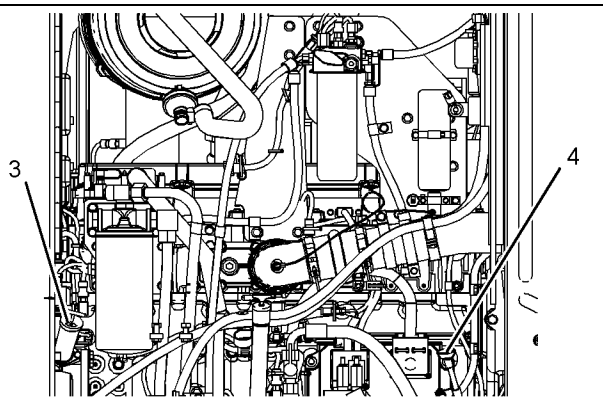

Illustration 242 g01297471

3. Clean the area around engine oil filter (2) before you remove the engine oil filter. Remove the engine oil filter with a strap type wrench. Refer to Operation and Maintenance Manual, “Oil Filter - Inspect”.

4. Clean the base of the engine oil filter housing. Make sure that all of the old filter gasket is removed.

5. Apply a thin film of engine oil to the gasket of the new engine oil filter.

6. Install the new engine oil filter by hand until the seal of the engine oil filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

Note: There are rotation index marks on the engine oil filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the engine oil filter, use the rotation index marks as a guide.

7. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

Note: You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

8. Clean the area around oil filler cap (3) before you remove the oil filler cap. Clean the area around oil level gauge (4) before you remove the oil level gauge. Remove the oil filler cap. Fill the crankcase with new oil. See Operation and Maintenance Manual, “Capacities (Refill)”. Clean the filler cap and install the filler cap.

9. Start the engine and allow the oil to warm. Check the engine for leaks.

10. Check the oil level. If necessary, add oil. Refer to Operation and Maintenance Manual, “Engine Oil Level - Check” for more information.

11. Stop the engine. Close the left side access door for the engine compartment on the machine.

i05134430

Engine Shutdown Switch - Check

SMCS Code: 7418-535-ZS

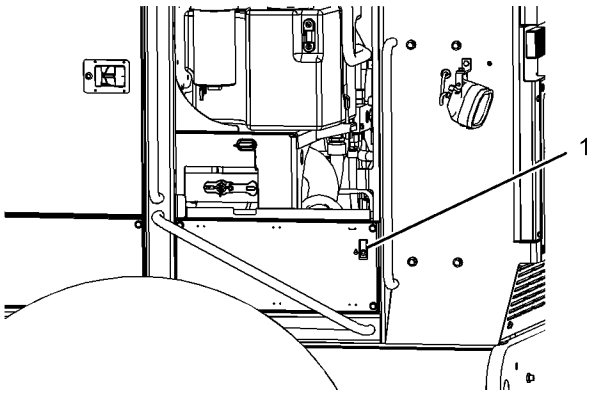

Illustration 243 g01438856

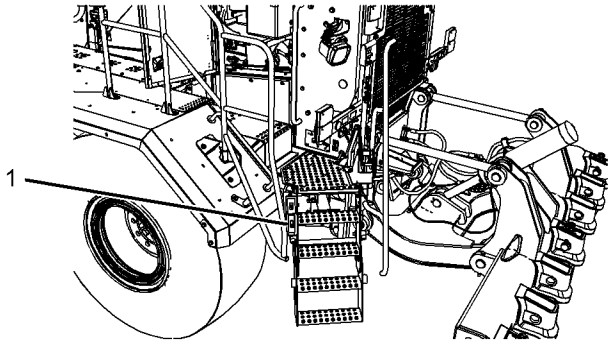

Illustration 244 g03292699

16M with Access Platform

The engine shutdown switch (1) is located on the left rear of the machine.

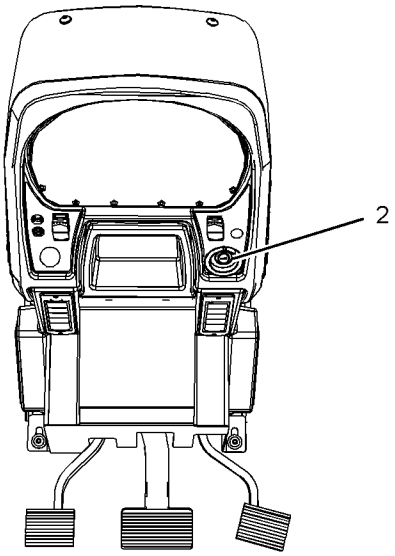

Illustration 245 g01438849

1. While the engine is running, move the engine shutdown switch (1) to the STOP position. The engine will shut down.

2. Move the engine shutdown switch (1) to the RUN position.

3. Turn the engine start switch (2) to the OFF position.

4. Restart the engine.

i04093750

Engine Valve Lash - Check

SMCS Code: 1105-535

⚠ WARNING

Ensure that the engine cannot be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.

NOTICE
Only qualified service personnel should perform this maintenance. Refer to the Systems Operation/Testing and Adjusting Manual, “Valve Lash and Valve Bridge Adjustment” article or consult your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

The adjustment is necessary due to the initial wear of the valve train components and to the seating of the valve train components.

This maintenance is recommended by Caterpillar as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

Ensure that the engine is stopped before you measure the valve lash. To obtain an accurate measurement, allow the valves to cool before you perform this maintenance.

Remove the cover in order to access the rear of the engine. Check the valve lash. For the correct adjustment procedure, refer to Systems Operation, Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust”.

i07716330

Engine Valve Rotators - Inspect

SMCS Code: 1109-040

⚠ WARNING

When inspecting the valve rotators, protective glasses or face shield and protective clothing must be worn, to help prevent being burned by hot oil or spray.

NOTICE
A valve rotator which does not operate properly will accelerate valve face wear and valve seat wear and shorten valve life. If a damaged rotator is not replaced, valve face guttering could result and cause pieces of the valve to fall into the cylinder. This can cause piston and cylinder head damage.

Engine valve rotators rotate the valves when the engine runs. This rotation deters deposits from building up on the valves and the valve seats.

Perform the following steps after the engine valve lash is set, but before the valve covers are installed:

1. Install camera that can be viewed on a remote display.
2. Start the engine and operate the engine at low idle.
3. Via the display. Observe the top surface of each valve rotator. The valve rotators should turn slightly when the valves close.
4. If a valve fails to rotate, consult your Caterpillar dealer for service.

i02598842

Ether Starting Aid Cylinder - Replace

SMCS Code: 1456-510-CD

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

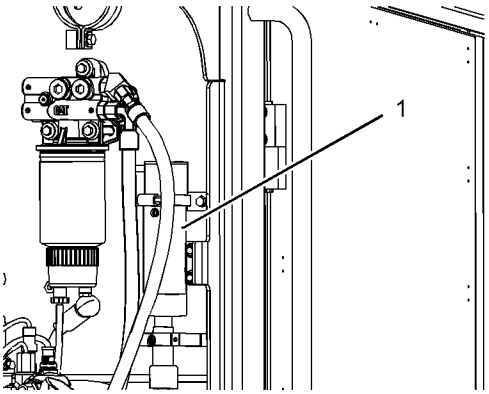

Illustration 246 g01185037

1. Open the right side access door.
2. Loosen the retaining clamp on ether starting aid cylinder (1). Remove the empty ether starting aid cylinder. Properly discard the empty ether starting aid cylinder.
3. Remove the used gasket. Install the new gasket that is provided with each new ether starting aid cylinder.
4. Install the new ether starting aid cylinder. Tighten the ether starting aid cylinder hand tight. Tighten the retaining clamp on the ether starting aid cylinder securely.
5. Close the access door.

i07681009

Film (Product Identification) - Clean

SMCS Code: 7405-070; 7557-070

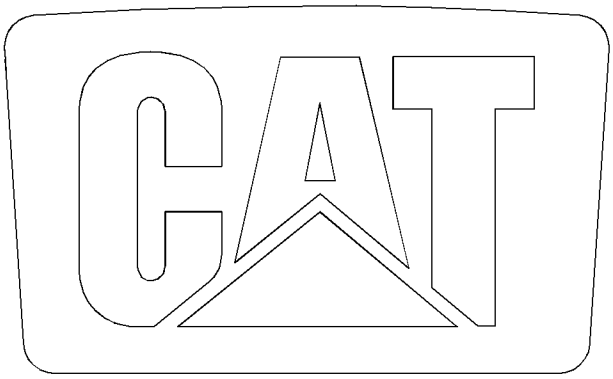

Illustration 247 g02174985

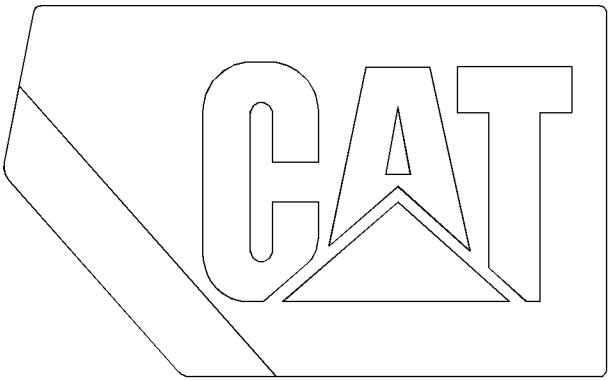

Illustration 248 g02175297

Illustration 249 g06394021

Typical example of the Product Identification Films.

Cleaning of the Films

Make sure that all of the product identification films are legible. Make sure that the recommended procedures are used in order to clean the product identification films. Ensure that all the product identification films are not damaged or missing. Clean the product identification films or replace the films.

Hand Washing

Use a wet solution with no abrasive material that contains no solvents and no alcohol. Use a wet solution with a “pH” value between 3 and 11. Use a soft brush, a rag, or a sponge in order to clean the product identification films. Avoid wearing down the surface of the product identification films with unnecessary scrubbing. Ensure that the surface of the product identification films is flushed with clean water and allow the product identification films to air dry.

Power Washing

Power washing or washing with pressure may be used in order to clean product identification films. However, aggressive washing can damage the product identification films.

Excessive pressure during power washing can damage the product identification films by forcing water underneath the product identification films. Water lessens the adhesion of the product identification film to the product, allowing the product identification film to lift or curl. These problems are magnified by wind. These problems are critical for the perforated film on windows.

To avoid lifting of the edge or other damage to the product identification films, follow these important steps:

- Use a spray nozzle with a wide spray pattern.
- A maximum pressure of 83 bar (1200 psi)
- A maximum water temperature of 50° C (120° F)
- Hold the nozzle perpendicular to the product identification film at a minimum distance of 305 mm (12 inch).

- Do not direct a stream of water at a sharp angle to the edge of the product identification film.

i05918772

Frame and Body - Inspect

SMCS Code: 3250-040; 3260-040; 3268-040; 7000-040; 7050-040; 7051-040; 7113-040; 7258-040

All earthmoving equipment is prone to a high degree of wear. Regular inspections for structural damage are necessary .Regular inspections can minimize the risk of accidents and can reduce down time.

The interval between these inspections depends on the following factors:

- The age of the machine
- The severity of the application
- The condition of the haul road
- The amount of routine servicing that has been carried out
- The operator skill and technique

These inspections should be carried out at intervals no longer than 1000 service hours. Older machines, or machines that are operating in severe applications will require more frequent inspections.

If the machine has been involved in a collision, or if the machine has been involved in any accident, the machine must be inspected thoroughly. Inspect the machine regardless of the date of the last inspection.

The machine must be clean before the machine is inspected.

Proper repair of frames and structures requires specific knowledge of the following subjects:

- Materials that have been used to manufacture the frame members
- Frame member construction
- Repair techniques that are recommended by the manufacturer

Consult your Cat dealer if repairs are necessary. Your Cat dealer is qualified to carry out repairs on your behalf.

All repairs should be carried out by a Cat dealer. If you carry out your own repairs, contact your Cat dealer for advice about proper repair techniques.

The primary method of inspection for this procedure is visual inspection. Examine components for any gouging, paint cracking around welds, voids or fractures within or near any welds, or other obvious signs of damage. Paint cracking along a weld is not a definite sign of the presence of a crack but is an indication that damage may be present. Magnetic particle or dye penetrant methods may be used to confirm the existence of any cracks.

Ripper

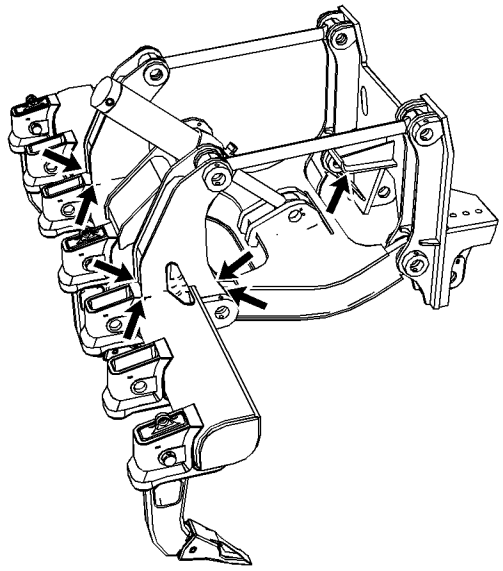

Illustration 250 g03725069

Inspect the ripper stop welded to the frame backing plate for signs of damage. Bending of the plates or cracks in the welds can develop when the machine is impacted from the rear or pushed with the ripper in the raised position. Inspect the welds at the corners of the upper link brackets for any signs of cracking (eight locations). Inspect the ripper pins/joints for signs of wear or loosening of the pins. Inspect ripper teeth for extreme wear.

Tandem

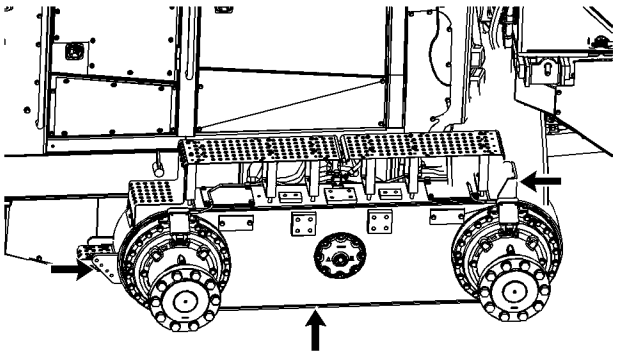

Illustration 251 g03725071

Inspect tandem housing for signs of obvious damage. Inspect the lower horizontal welds on the tandem case for any cracks; oil seepage along these weld seams would indicate a crack is present. Inspect the two seams on each tandem on both sides of the machine (a total of four locations). If rear fenders are mounted to the machine, inspect the front and rear fender mounts for cracking or damage, updated fender mounts are shown for reference.

Rear Frame

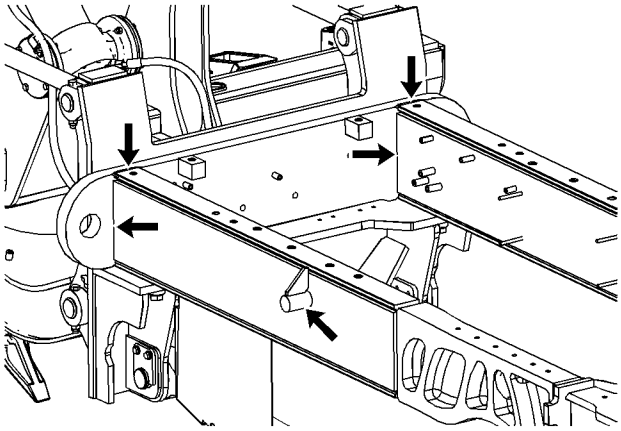

Illustration 252 g03725287

Inspect rear frame. Starting at the rear, examine the welds between the rear rails and the bumper for signs of cracking. If possible inspect all four sides of the joint on both sides of the frame, this will be difficult with the ripper installed. Inspect the tandem oscillation stops for signs of damage or weld cracking. If any deficiencies are noted, inspect the corresponding blocks on the tandems.

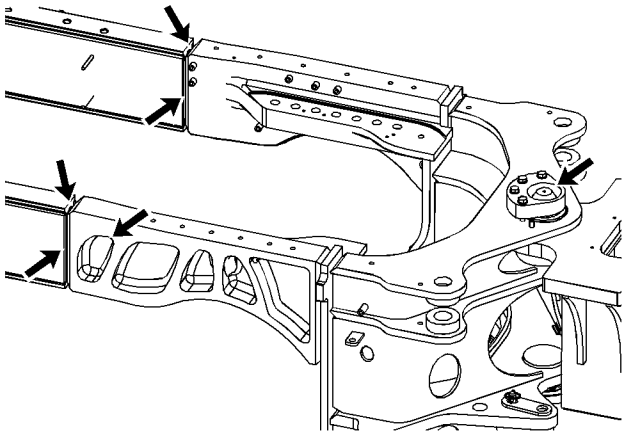

Illustration 253 g03725291

Inspect the rear frame welds between the rear rails and cast rails on both sides of the frame as shown. Examine the rearmost pocket in the casting for any signs of cracks, again both sides of the frame. Inspect the top articulation pin retainer bolts for any signs of loosening or sheared or missing bolts. Deficiencies to this bolted joint can indicate articulation hitch/bearing wear or damage to the top frame plate.

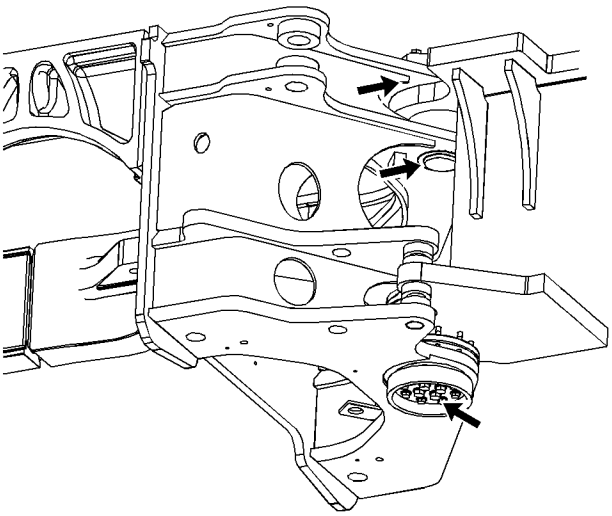

Illustration 254 g03725292

Inspect the weld toes on the wrapper plates near the top frame plate on both side of the frame. Inspect the lower bushing in the upper hitch pin joint for any signs of movement or walking out of the bushing. Inspect the pin retainer on the lower articulation pin for any signs of loose or missing bolts.

Articulation Lock Pin

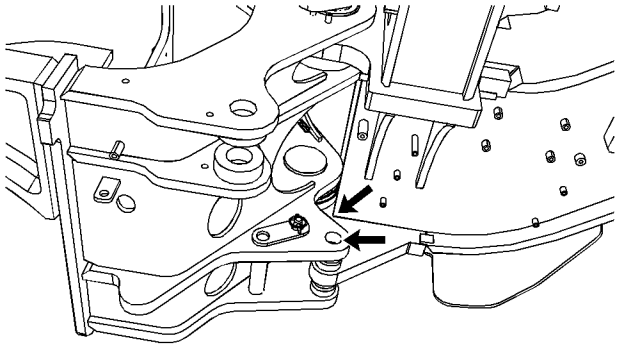

Illustration 255 g03725294

Inspect the articulation lock pin bores for signs of damage. Holes should allow the locking pin to fit without excessive play. The bores should not be elongated and no deformation or damage to the plates should be present. Inspect the front frame lower side plate to bottom plate weld toes for any signs of cracking. The articulation locking pin should be present in the stored position.

Front Frame

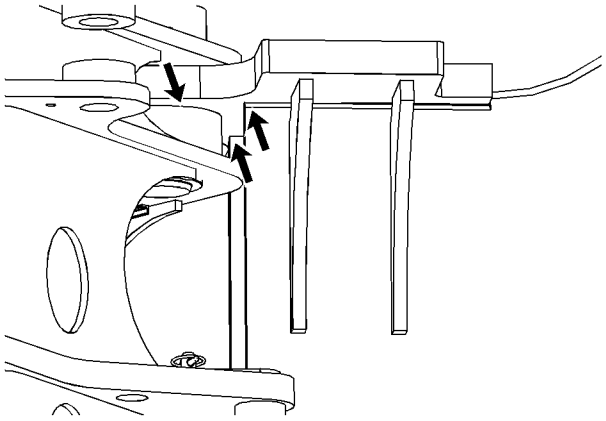

Illustration 256 g03725296

Inspect the side plate to top plate welds at the rear of the front frame (both sides of frame). Inspect weld between the front frame top plate and circular plate welded to the bottom of the top plate.

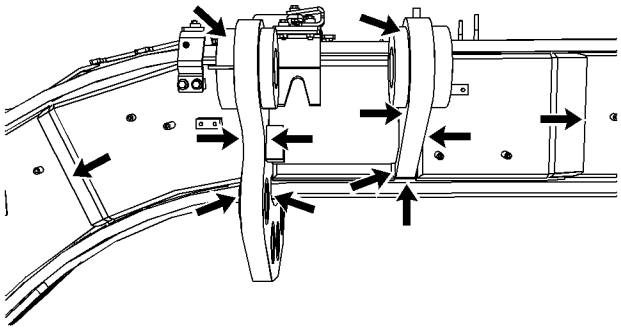

Illustration 257 g03725303

Inspect the front frame centershift. The vertical welds on both ends of the front and rear fish plates (both sides of the frame) should be inspected for cracks. Inspect all welds around the front and rear centershift plates, again on both sides of the frame. If cracks are found, inspect the adjacent parent material for any signs of cracking to include the frame top and bottom plates.

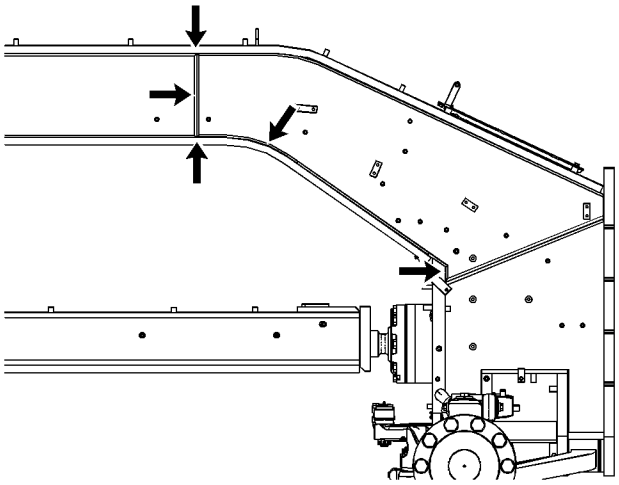

Illustration 258 g03725307

Inspect vertical weld on the front frame side plate as well as the adjacent top and bottom plate welds in the vicinity of the vertical weld for any signs of cracking. Inspect the side plate to bottom plate weld where the frame curves down toward the bolster. Examine the transition area at the rear side of the bolster for signs of cracking. Both sides of the frame should be inspected.

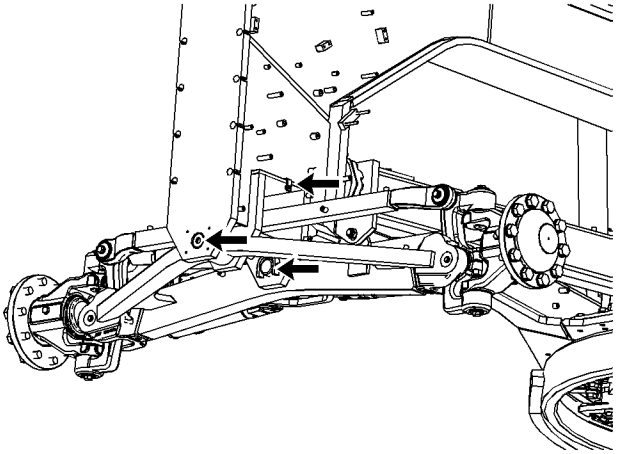

Illustration 259 g03725311

Inspect the front frame above the link bar. Damage to the frame in this area indicates possible link bar issues or damage to the front axle oscillation stops. Inspect the bolster pins for signs of movement, there should be no relative motion between the bolster pins and the front frame. The pin retainer bolts should be snug and U-shaped plates that retain the pins welded firmly in place. If the bolster pins are moving in the frame bores, retainer plates may need to be rewelded/repaired, pins replaced, and possibly the bolster pin bores in the front frame repaired/line bored.

Front Axle

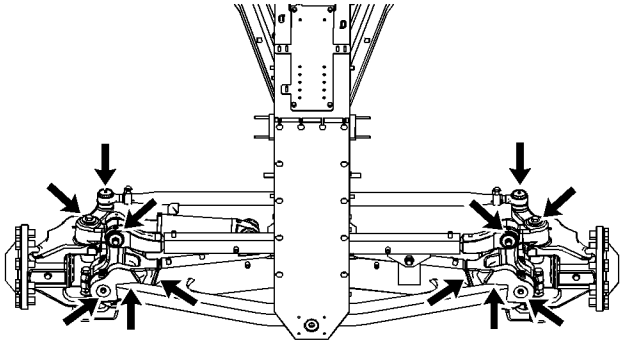

Illustration 260 g03725314

Inspect the front axle weldment where the front gussets connect to the main axle body. Inspect the welds that wrap around the main axle body for signs of cracks. Inspect all motion joints on the front axle for presence of grease. Apply a force to the tie rod ends in an upward/downward motion, no play should be noticed in this joint. Ensure that tie rod boots are present and undamaged.

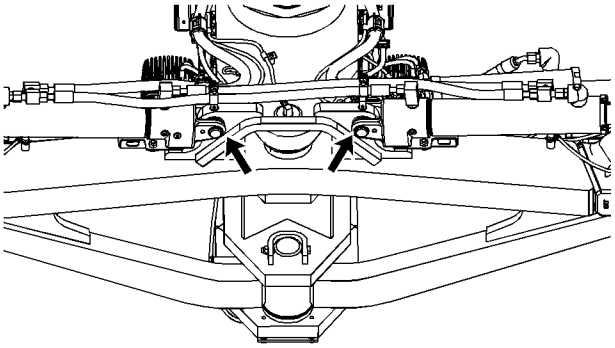

Illustration 261 g03725320

Inspect inboard steering cylinder mounts and pins for any signs of damage. Pin retention bolts should be tight. Inspect the spherical bearings for any cracking in the bearing cages or other damage. If the spherical bearings are damaged, inspect the bores in the axle body where they are installed for any signs of yielding or damage.

Drawbar

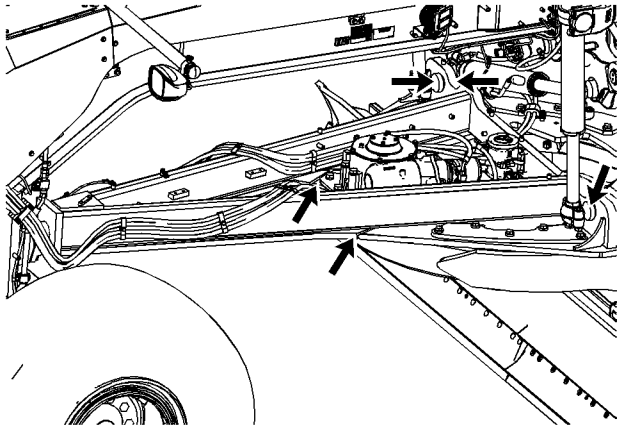

Illustration 262 g03725325

Inspect draft ball welds on drawbar (all three). Inspect drawbar beam to divider plate welds on both sides of drawbar. Inspect welds on drawbar bottom plate just in front of circle. Note, the newer style drawbar with reoriented weld seams is shown. Older drawbars will have welds that run side to side underneath the drawbar beams and a possible reinforcement plate may be installed. All welds on the reinforcement plate should also be inspected if that component is present. Note. If the reinforcement plate is not present, do not install this additional component. Also, if weld cracks were present, inspect the drawbar beams near the welds for any possible cracking. Inspect circle drive mounting bolts for any signs of loosening. If loose bolts are shown, inspect condition of threaded holes.

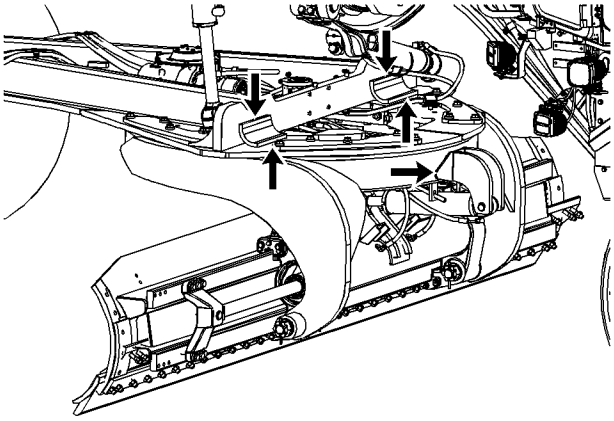

Illustration 263 g03725327

Inspect welds on gussets on rear side of the drawbar for cracking. Inspect weld on tip cylinder mounting bracket on rear of circle

Blade and Circle

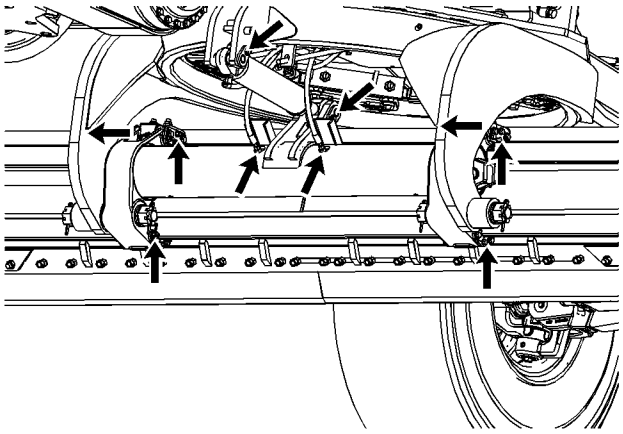

Illustration 264 g03725329

Inspect welds at rear of circle where gussets are welded to blade beams. Note that the welds stop 25 mm (1 inch) from the end of the gussets. Observe tip cylinder pins for any signs of loosening or cracking of the flag pins. Inspect the moldboard bracket on the tube where the fittings for the sideshift cylinder protrude, there should be no cracking or gouging along the perimeter of the circular cutouts. Observe the eight retainer plates for the moldboard wear strips, these retainer plates should not come into contact with the moldboard rails and all mounting hardware should be present. Inspect the cutting edges for excessive wear.

i04458478

Fuel System - Fill

SMCS Code: 1250-544

⚠ WARNING

Personal injury or death may result from failure to adhere to the following procedures.

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Clean up all leaked or spilled fuel. Do not smoke while working on the fuel system.

Turn the disconnect switch OFF or disconnect the battery when changing fuel filters.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Reference: See Operation and Maintenance Manual, “Capacities (Refill)” for the capacity of the fuel tank for your machine.

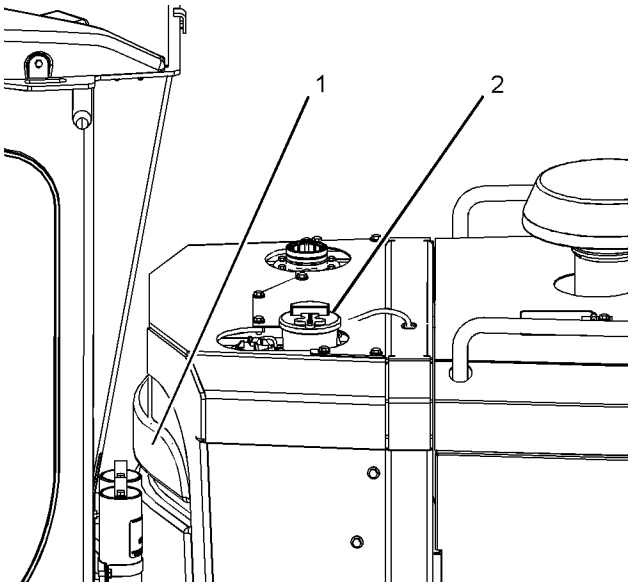

Illustration 265 g01322668

1. Clean filler cap (2) and the surrounding area.

2. Remove the filler cap.

3. Fill fuel tank (1) with fuel.

4. Install the filler cap.

Note: Prime the fuel system. See Operation and Maintenance Manual, “Fuel System - Prime” for more information.

Machines that are Equipped with a Fast Fill Fuel Arrangement

NOTICE
Use only a Caterpillar approved fast fill system to fuel machines. Over pressurization may cause tank deformation and fuel spillage.

Contact your Cat dealer for fast fill system availability.

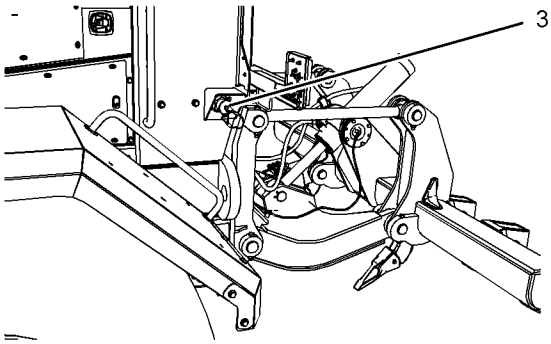

Illustration 266 g02643919

1. Park the machine on a level surface and engage the parking brake.

2. Remove dust cover (3), if equipped and clean the fast fill adapter.

Note: The maximum fuel flow rate for the fast fill fuel arrangement is 375 L/min (100 US gpm).

3. Fill the fuel tank through the fast fill fuel adapter.

4. Install the dust cover.

Note: Prime the fuel system. See Operation and Maintenance Manual, “Fuel System - Prime” for more information.

i02096133

Fuel System - Prime

SMCS Code: 1250-548

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

1. Turn the engine start switch to the ON position. Leave the engine start switch in the ON position for two minutes.

2. Verify that the water separator is full of fuel.

3. If the water separator is not full of fuel, turn the engine start switch OFF and then turn the engine start switch ON. This will cycle the fuel priming pump again.

4. When the water separator is full of fuel, attempt to start the engine. If the engine starts and the engine runs rough or the engine misfires, operate at low idle until the engine is running smoothly. If the engine cannot be started, or if the engine continues to misfire or smoke, repeat Step 1.

i06205417

Fuel System Filter - Replace

SMCS Code: 1261; 1261-510

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Turn the disconnect switch OFF when draining and/or removing any fuel system components.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

NOTICE
Do not fill the fuel filters with fuel before installing the fuel filters. The fuel will not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Primary Filter (Water Separator) Element

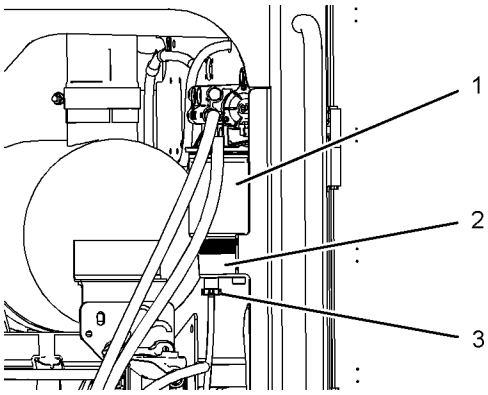

Illustration 267 g01185159

The primary fuel filter is located inside the engine compartment on the left side of the machine.

1. In order to drain the primary fuel filter, open drain valve (3) on water separator bowl (2). The water separator bowl is under primary fuel filter (1). Catch the fuel in a suitable container.

2. Remove primary fuel filter (1) and water separator bowl (2). Clean the filter housing base.

3. Remove the water separator bowl from the primary fuel filter.

Note: Check the water separator bowl for damage. Reuse the water separator bowl if no damage is present.

4. Clean the water separator bowl and clean the groove for the O-ring. Wash the water separator bowl in a clean nonflammable solvent. Use pressure air to dry the water separator bowl.

5. Lubricate the O-ring with clean diesel fuel or lubricate the O-ring with clean motor oil. Place the O-ring in the groove on the water separator bowl.

6. Install the clean water separator bowl onto a new filter by hand.

7. Apply clean diesel fuel to the seal of the new filter.

8. Install the new filter hand tight until the seal of the filter contacts the filter mounting base. Note the position of the index marks on the filter in relation to a fixed point on the filter mounting base.

Note: There are rotation index marks on the filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the filter, use the rotation index marks as a guide.

9. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide for tightening the filter. For non-Caterpillar filters, use the instructions that are provided with the filter.

Note: You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

10. Prime the fuel system. See Operation and Maintenance Manual, “Fuel System - Prime” for the proper procedure.

Note: The secondary fuel filter should also be changed at this time. See Operation and Maintenance Manual, “Fuel System Secondary Filter - Replace” for further instructions.

11. Start the engine and check for leaks.

12. Close the access door.

Secondary Filter

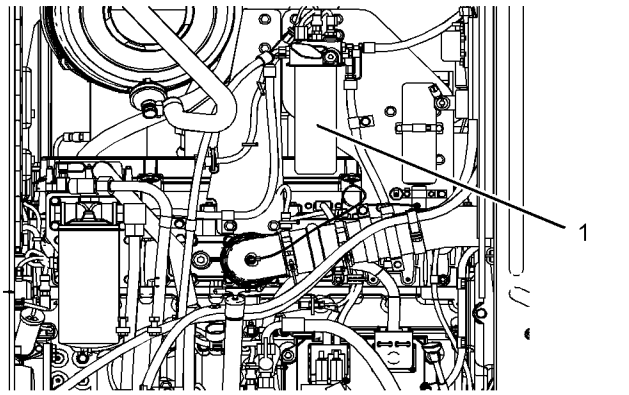

Illustration 268 g01297547

The secondary fuel filter is located inside the engine compartment on the left side of the machine.

1. Remove secondary fuel filter (1).

2. Drain the fuel from the secondary fuel filter into a suitable container.

3. Clean the mounting base for the secondary fuel filter. Make sure that you remove all of the old seal.

4. Apply clean diesel fuel to the seal of the new filter.

5. Install the new filter by hand until the seal of the filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter base.

Note: There are rotation index marks on the filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the filter, use the rotation index marks as a guide.

6. Tighten the filter according to the instructions that are printed on the filter. Use the index marks as a guide. For non-Caterpillar filters, use the instructions that are provided with the filter.

Note: You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

7. Prime the fuel system. See Operation and Maintenance Manual, “Fuel System - Prime” for the proper procedure.

8. Close the access door.

i02596440

Fuel System Water Separator - Drain

SMCS Code: 1263-543

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Turn the disconnect switch OFF when draining and/or removing any fuel system components.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

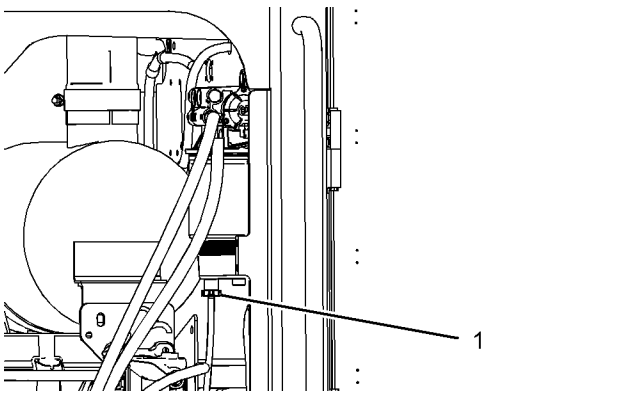

Illustration 269 g01185232

The fuel system water separator is located inside the engine compartment on the left side of the machine.

1. Open drain (1) and allow the water and sediment to drain into a suitable container.
2. Close the drain.
3. Close the access door.

i02598829

Fuel Tank Cap and Strainer - Clean

SMCS Code: 1273-070-STR; 1273-070-Z2

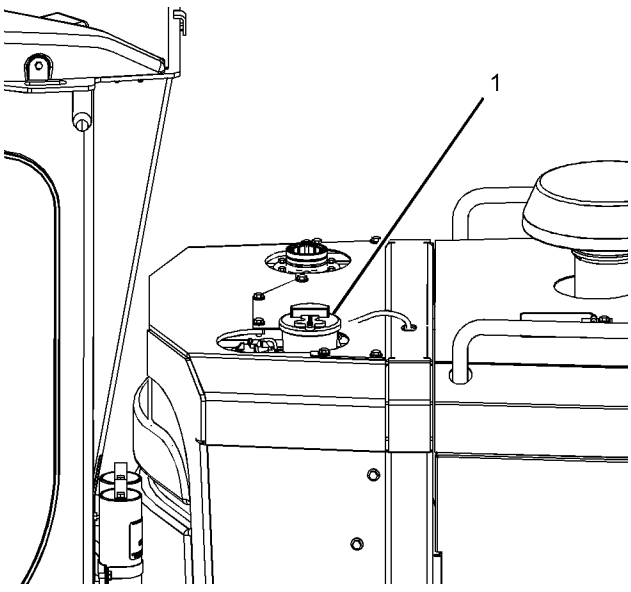

Illustration 270 g01322676

1. Clean fuel tank cap (1) and the surrounding area.
2. Remove the fuel tank cap and disassemble the fuel tank cap.
3. Inspect the seal on the fuel tank cap for damage. If the seal is damaged, replace the seal. Lubricate the seal on the fuel tank cap.
4. Replace the elements on the fuel tank cap.
5. Remove the strainer from the filler opening.
6. Wash the strainer in clean nonflammable solvent.
7. Install the strainer.
8. Assemble the fuel tank cap and install the fuel tank cap.

i02596432

Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-MAS

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Turn the disconnect switch OFF when draining and/or removing any fuel system components.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

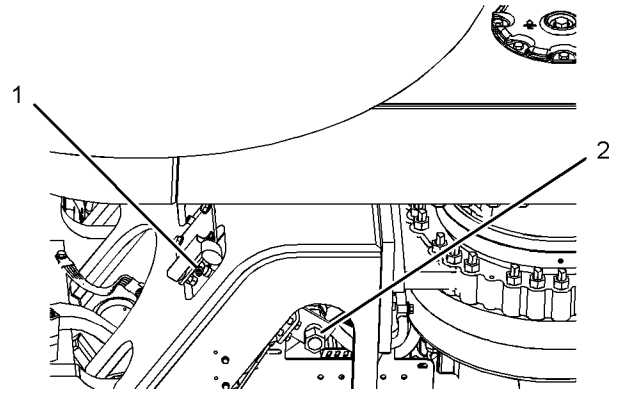

Illustration 271 g01185369

Drain valve (1) is located behind the left tandem housing.

1. Open the drain valve. Drain the water and sediment into a suitable container.
2. Close the drain valve.

Note: If you need to flush the fuel sump, use drain valve (2).

i04818269

Fuses - Replace

SMCS Code: 1417-510

S/N: B9H1–Up

S/N: R9H1–829

Fuses – Fuses protect the electrical system from damage that is caused by overloaded circuits. Replace the fuse if the element is separated. Check the circuit if the element is separated in a new fuse. Repair the circuit.

NOTICE
Replace the fuses with the same type and size only.

If it is necessary to replace fuses frequently, an electrical problem may exist. Consult your Caterpillar dealer.

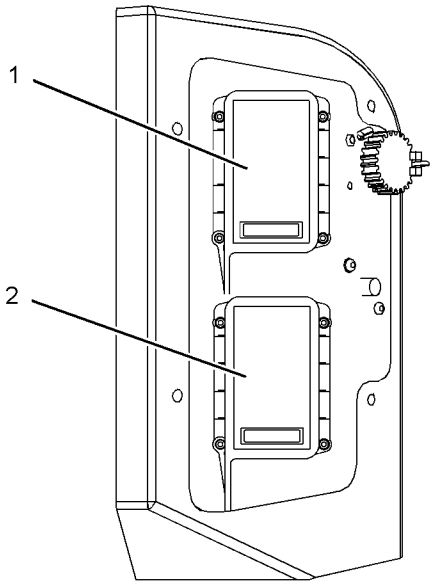

Illustration 272 g01265895

There are two fuse panels. The fuse panels are positioned to the left side of the operator on the cab floor.

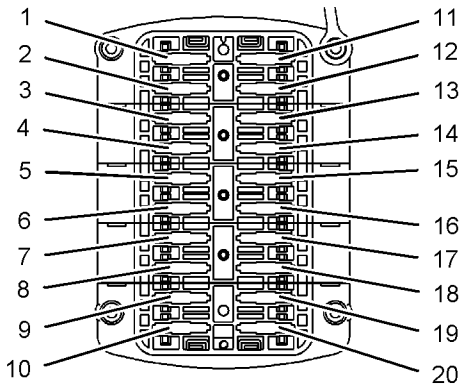

Illustration 273 g01113131

Fuse panel (1)

Spare (1) – 15 amp

Spare (2) – 10 amp

Implement Control 2 (3) – 15 amp

Horn (4) – 10 amp

Backlight (5) – 10 amp

Monitoring (6) – 10 amp

All Wheel Drive (AWD) Controller (7) – 15 amp

Spare (8) – 10 amp

Implement Control 3 (9) – 15 amp

Spare (10) – 10 amp

Lighter (11) – 10 amp

Radio (12) – 15 amp

Communication Radio (13) – 20 amp

Product Link (14) – 10 amp

Dome Lamp (15) – 10 amp

Implement Control (16) – 15 amp

Steering (17) – 10 amp

Secondary Condenser Fan (18) – 15 amp

Air Filter (19) – 15 amp

Primary Condenser Fan (20) – 15 amp

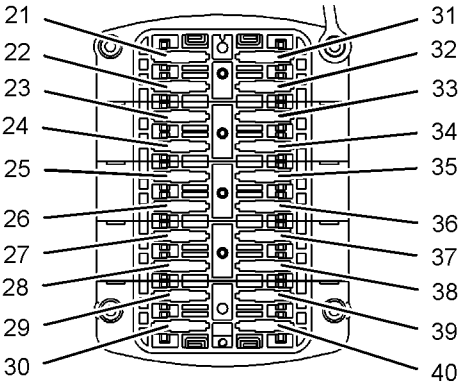

Illustration 274 g01114786

Fuse panel (2)

Front Window Wiper and Rear Window Wiper (21) – 15 amp

Side Window Wiper (22) – 15 amp

Turn Signals (23) – 10 Amp

Primary Blade Work Lights (24) – 15 amp

Work Area Vision System (WAVS) (25) – 10 amp

Heating and Air Conditioning System (26) – 15 amp

Beacon (27) – 10 amp

Defrost Fan (28) – 10 amp

Secondary Blade Work Lights (29) – 10 amp

Rear Work Lights (30) – 15 amp

Heated Mirror (31) – 10 amp

Autolube System (32) – 10 amp

Right Door Wiper (33) – 15 amp

Backup Alarm (34) – 10 amp

Cab Floodlights (35) – 15 amp

Centershift and Blade Cushion (36) – 10 amp

Sensor Power (37) – 10 amp

Seat (38) – 15 amp

Differential Lock (39) – 10 amp

Left Door Wiper (40) – 15 amp

i05944290

Fuses - Replace

SMCS Code: 1417-510

S/N: R9H830–Up

Fuses – Fuses protect the electrical system from damage that is caused by overloaded circuits. Replace the fuse if the element is separated. Check the circuit if the element is separated in a new fuse. Repair the circuit.

NOTICE
Replace the fuses with the same type and size only.

If it is necessary to replace fuses frequently, an electrical problem may exist. Consult your Caterpillar dealer.

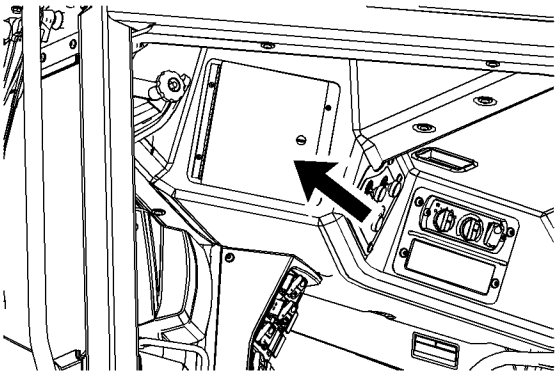

Illustration 275 g02302374
Cab Fuse Block Location

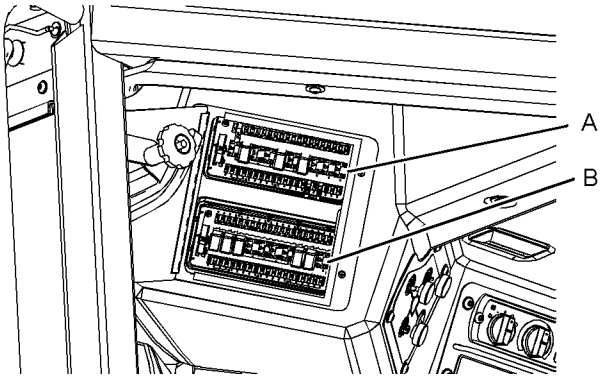

Illustration 276 g02302377
Cab Fuse Block A & B

Fuse Block “A”

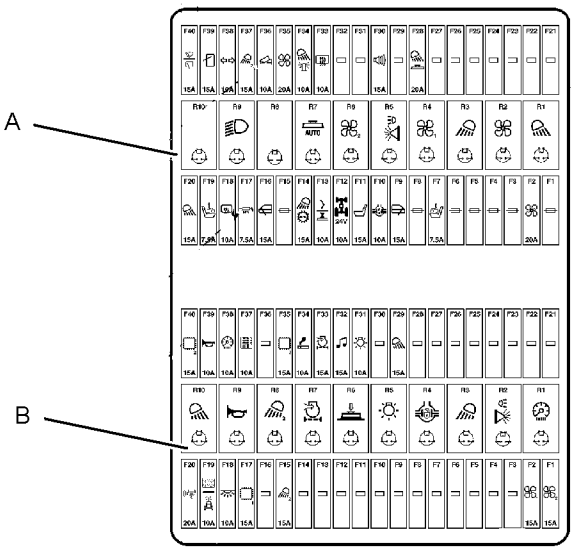

Illustration 277 g03732930

Fuse Block A & B Film

Fast Speed Blower (F2) – 20 amp

LH Armrest Adjust Motor (F7) – 7.5 amp

LH Door Wiper (F9) – 15 amp

Differential Lock (F10) – 10 amp

Seat (F11) – 15 amp

Sensor Power (F12) – 10 amp

Centershift/Blade Cushion (F13) – 10 amp

Cab Front Flood/Autoshift (F14) – 15 amp

RH Door Wiper (F16) – 15 amp

Quick Lube (F17) – 7.5 amp

Heated Mirror (F18) – 10 amp

RH Armrest Adjust Motor (F19) – 7.5 amp

Rear Worklights (F20) – 15 amp

Blade Worklights(F28) – 20 amp

Backup Alarm(F30) – 15 amp

Defrost Fan (F33) – 10 amp

Snow Wing Floodlight/Beacon (F34) – 10 amp

HVAC (F35) – 20 amp

Work Area Vision System (F36) – 10 amp

Blade Worklights (F37) – 15 amp

Turn Signals (F38) – 10 amp

Side Wipers (F39) – 15 amp

Front/Rear Wipers (F40) – 15 amp

Rear Floodlight (R1) – Relay

HVAC Blower (R2) – Relay

Blade Floodlight (R3) – Relay

HVAC Blower 1 (R4) – Relay

LH Position (R5) – Relay

HVAC Blower 2 (R6) – Relay

AccuGrade (R7) – Relay

Headlamps (R9) – Relay

Fuse Block “B”

HVAC Blower 2(F1) – 15 amp

HVAC Blower 1 (F2) – 15 amp

Front Floodlight (F15) – 15 amp

Implement ECM #1 (F17) – 15 amp

Dome Lamp (F18) – 10 amp

VIMS/Product Link (F19) – 10 amp

Communication Radio Converter (F20) – 20 amp

Rear Floodlight (F29) – 15 amp

Dimmer (F31) – 10 amp

Radio Converter (F32) – 15 amp

Powered Air Cleaner (F33) – 15 amp

Cigar Lighter (F34) – 10 amp

Implement ECM #3 (F35) – 15 amp

Monitoring (F37) – 10 amp

Backlight (F38) – 10 amp

Forward Horn (F39) – 10 amp

Implement ECM #2 (F40) – 15 amp

Backlight (R1) – Relay

RH Position (R2) – Relay

Cab Front Floodlight (R3) – Relay

Differential Lock (R4) – Relay

Dimmer (R5) – Relay

Blade Cushion (R6) – Relay

Powered Air Cleaner (R7) – Relay

Cab Front Floodlight #2 (R8) – Relay

Horn (R9) – Relay

Dimmer (R10) – Relay

i06205428

Hydraulic System Oil - Change

SMCS Code: 5050-044; 5056-044; 5095-044

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

The standard Cat HYDO Advanced oil provides a 100% increase in the standard hydraulic oil change interval for Motor Grader hydraulic systems (4000 hours or 2 years versus 2000 hours or 1 year) over second and third choice oils - when following the maintenance interval schedule for oil filter changes and for oil sampling that is stated in the Operation and Maintenance Manual for your particular machine. 6000 hour or 3 year oil drain intervals are possible when using S·O·S Services oil analysis. Contact your Cat dealer for details.

Note: Non-Hydo Advanced hydraulic oils have a hydraulic oil change interval of 2000 hours or 1 year. By performing S·O·S oil analysis, the hydraulic oil change interval may be extended to 4000 Service Hours or 2 Years.

Note: S·O·S oil analysis must be performed at every 500 hours or 3 months in order to extend the hydraulic oil change interval. The results from the S·O·S oil analysis will determine if the hydraulic oil change interval may be extended. If S·O·S oil analysis is not available, the hydraulic oil change interval must remain at the minimum change interval determined by the type of hydraulic oil used. Refer to the Operation and Maintenance Manual, “S·O·S Information” for more information.

Operate the machine until the oil is warm.

Park the machine on a level surface with the front wheel straight ahead. Lower all attachments to the ground. Apply a slight downward pressure to the attachments. Center the articulation of the machine and install the frame lock pin. The frame lock pin must move freely in the frame. Move the front wheels to vertical and install the wheel lean locking bolt. Engage the parking brake. Stop the engine.

The hydraulic system oil tank is positioned behind the left rear access door on the machine.

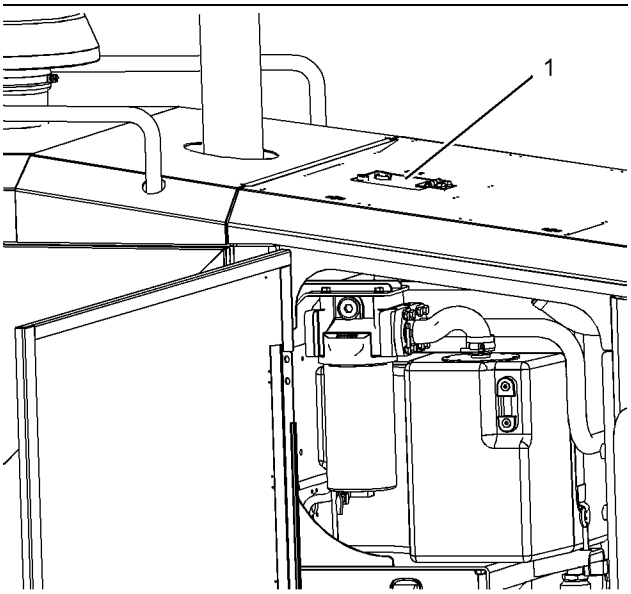

Illustration 278 g01185452

1. Open cover (1).
2. Clean the area around hydraulic oil filler cap of any dirt or debris. This must be done before the hydraulic oil filler cap can be removed.
3. Slowly remove the hydraulic oil filler cap in order to relieve the tank pressure.

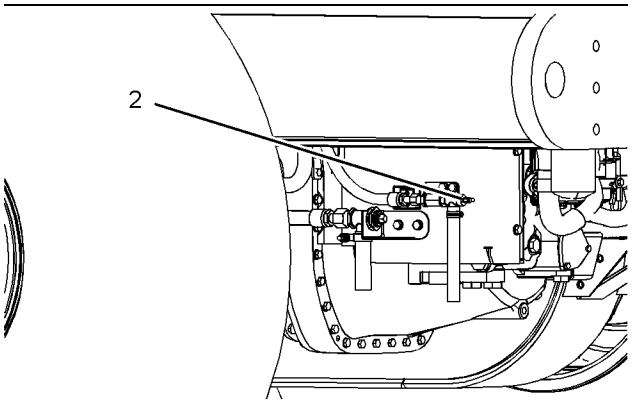

Illustration 279 g01185464

4. Open drain valve (2). Drain the oil into a suitable container.

5. Close the drain valve. Clean the area around the drain valve.

6. Replace the filters for the hydraulic system oil. Refer to the following procedures:

- Operation and Maintenance Manual, “Oil Filter (Hydraulic Tank Return) - Replace”
- Operation and Maintenance Manual, “Oil Filter (Implement Controls) - Replace”

7. Remove the filler screen from the filler tube in the hydraulic oil tank. Wash the filler screen in clean nonflammable solvent. Allow the filler screen to dry.

8. Install the filler screen.

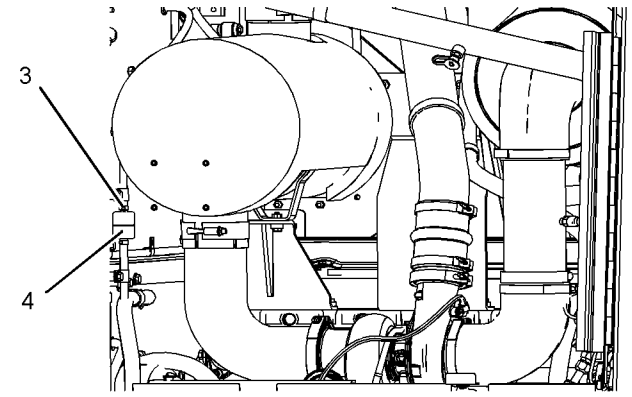

Illustration 280 g01297582

9. Loosen hose clamp (3) on each side of breather (4) and remove breather (4).

10. Wash the breather in clean nonflammable solvent.

11. Install the clean breather, and reattach the hose. Tighten the hose clamps.

12. Fill the hydraulic system oil tank. Refer to the following topics:

- Operation and Maintenance Manual, “Lubricant Viscosities”
- Operation and Maintenance Manual, “Capacities (Refill)”

Note: Confirm that the oil type that is added is the same oil type that is shown in Messenger. Confirm that the oil type is noted on the hydraulic system oil film.

13. Inspect the filler cap gasket. If the filler cap gasket is damaged, replace the filler cap gasket.

14. Install the hydraulic oil filler cap.

15. Start the engine. Run the engine for a few minutes.

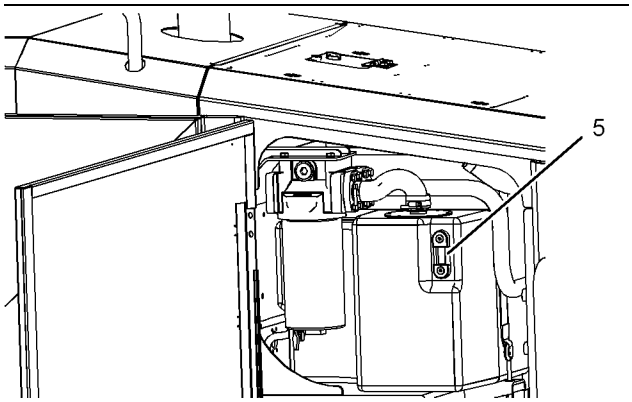

Illustration 281 g01185500

16. Maintain the oil level above the “MIN” mark on sight gauge (5). If necessary, add oil through the filler tube.

Note: The oil must be free from bubbles. If there are bubbles in the oil, then air is entering the hydraulic system. Inspect the suction hoses and inspect the clamps.

17. Stop the engine.

18. If necessary, tighten any loose clamps and tighten any loose connections. Replace any damaged hoses.

If an alternate hydraulic oil viscosity is desired, consult your local Cat dealer for this service so that a proper hydraulic system flush is completed and the proper oil type is configured in Messenger.

i03827246

Hydraulic System Oil Level - Check

SMCS Code: 5050-535-FLV; 5056-535-FLV; 5095-535-FLV; 7479-535

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

Operate the machine until the oil is warm.

Park the machine on a level surface with front wheels straight ahead. Lower all attachments to the ground. Apply a slight downward pressure to the attachments. Center the articulation of the machine and install the frame lock pin. The frame lock pin must move freely in the frame. Move the front wheels to vertical and install the wheel lean bolt. Engage the parking brake. Stop the engine.

The hydraulic tank sight gauge is positioned on the left side of the machine.

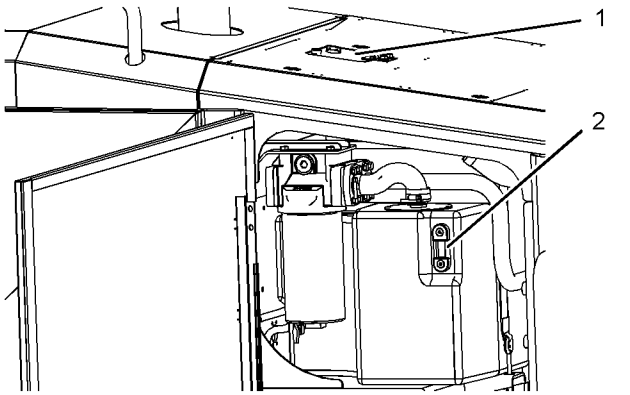

Illustration 282 g01185529

1. Operate the machine until the oil is warm.

2. Park the machine on a level surface with the front wheels straight ahead.

3. Lower all attachments to the ground. Apply a slight downward pressure to the attachments.

4. Center the articulation of the machine and install the frame lock pin. The frame lock pin must move freely in the frame.

5. Move the front wheels to vertical and install the wheel lean locking bolt.

6. Engage the parking brake. Stop the engine.

7. Maintain the oil level above the “MIN” mark on sight gauge (2).

8. If necessary, add oil. Clean the area around hydraulic oil filler cap (1) of any dirt or debris. This must be done before the hydraulic oil filler cap can be removed.

Note: Confirm that the oil type added is the same oil type shown in Messenger and on the hydraulic system oil film.

9. Slowly remove the hydraulic oil filler cap in order to relieve the tank pressure.

10. Add oil through the filler tube.

11. Clean the hydraulic oil filler cap and install the hydraulic oil filler cap.

i02837501

Hydraulic System Oil Sample - Obtain

SMCS Code: 5050-008-OC; 7542

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

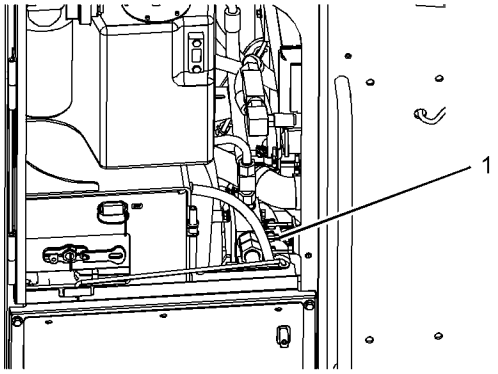

Illustration 283 g01414749

Hydraulic oil sampling valve (1) is located on the left rear of the machine.

Refer to Special Publication, SEBU6250, “S·O·S Services Oil Analysis” for information that pertains to obtaining a sample of the hydraulic oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the hydraulic oil.

i04093709

Kingpin Bearings - Lubricate

SMCS Code: 4314-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the kingpin bearings. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe all the fittings before you apply lubricant through the fittings.

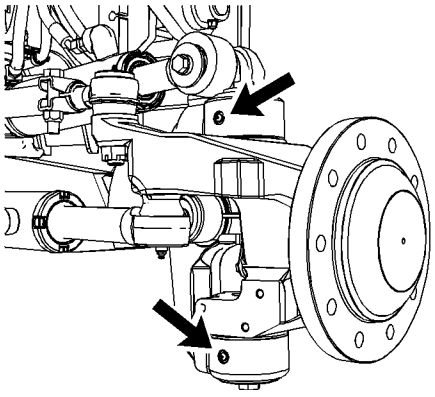

Illustration 284 g01267710

The wheel has been removed for ease of viewing.

Each front wheel has two kingpins. Each kingpin has two fittings. Apply the appropriate lubricant through the fittings in order to lubricate the kingpin bearings.

i06149238

Lubrication Pump Oil - Change (Autolube)

SMCS Code: 7516-044-OC

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Operate the machine until the oil is warm.

The autolube system reservoir is positioned on the front of the machine.

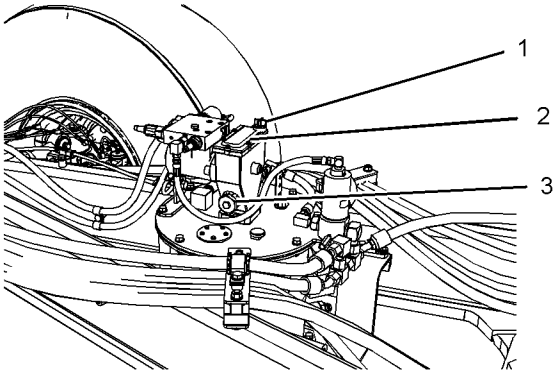

Illustration 285 g03647060

1. Clean the area around the reservoir of any dirt or debris. This must be done before the reservoir cap can be removed.
2. Slowly remove the reservoir cap in order to relieve the tank pressure.
3. Open drain valve (3). Drain the oil into a suitable container.
4. Close the drain valve. Clean the area around the drain valve.

5. Fill the autolube reservoir (2).

6. Install the reservoir cap.

7. Start the engine. Run the engine for a few minutes.

8. Maintain the oil level above the hole on the oil level gauge (1). If necessary, add oil.

Note: The oil must be free from bubbles. If there are bubbles in the oil, then air is entering the system.

i06158540

Lubrication Pump Oil - Fill
(Autolube)

SMCS Code: 7516-544-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Clean the area around the oil level gauge before you remove the oil level gauge.

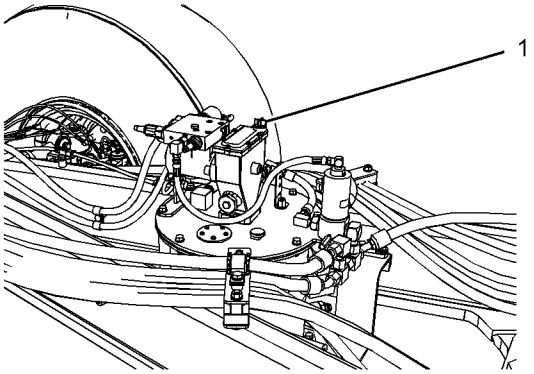

Illustration 286 g03646936

1. Clean the area around the oil level gauge (1) before you remove the oil level gauge.

2. Remove the oil level gauge (1).

3. Fill the reservoir with oil.

4. Install the oil level gauge (1).

i06158552

Lubrication Pump Oil Level - Check
(Autolube)

SMCS Code: 7516-535-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the machine. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Clean the area around the oil level gauge before you remove the oil level gauge.

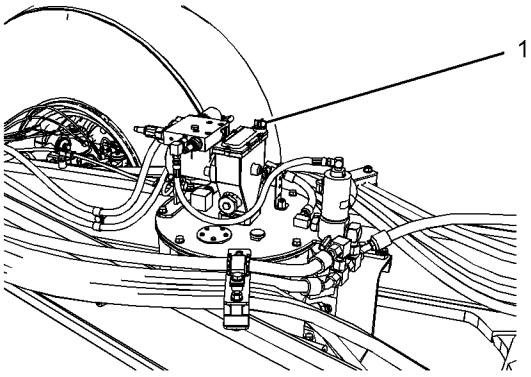

Illustration 287 g03646936

1. Before starting the engine, check oil level gauge (1). Maintain the oil level at the hole in the oil level gauge.

i07926888

Moldboard Wear Strip - Inspect/Adjust/Replace

SMCS Code: 6174-040; 6174-510; 6174-025

Type 1

1. Rotate the blade. Position the blade at an angle of 90 degrees to the frame. Lower the blade to the ground. Engage the parking brake. Stop the engine.

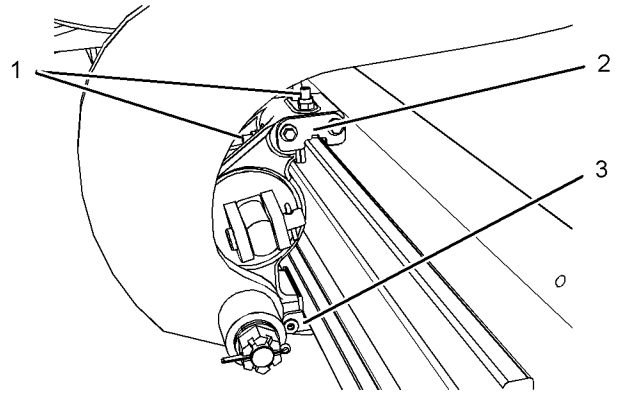

Illustration 288 g01298017

2. Visually inspect the wear strips through the cutout feature that is provided on top retaining plate (2) and bottom retaining plate (3). If the wear strips are worn close to the moldboard, replace the wear strips.

3. Remove top retaining plate (2) and bottom retaining plate (3).

4. Loosen the locknuts on set screws (1).

5. Start the engine. Raise the blade, sideshift the blade around a quarter of the travel limit. Stop the engine.

6. Measure the clearance between the wear strips and the blade.

7. Start the engine and repeat steps 5 and 6 until the blade reaches the travel limit.

8. Tighten the set screws in order to obtain 0.13 to 0.89 mm (0.005 inch to 0.035 inch) clearance between the moldboard rail and the wear strips at the location of minimum clearance.

9. Tighten the locknuts on the set screws. Refer to Specifications, SENR3130, “Torque Specifications” for the recommended torque.

10. Install the top retaining plate and install the bottom retaining plate.

11. Repeat Steps 2 through 10 for the opposite side of the moldboard.

Note: Keeping the wear strips adjusted to specifications regularly will prolong life of components.

Type 2

1. Start the engine. Rotate the blade. Position the blade at an angle of 90 degrees to the frame. Lower the blade to 10 mm (0.40 inch) above the ground. Engage the parking brake. Stop the engine.

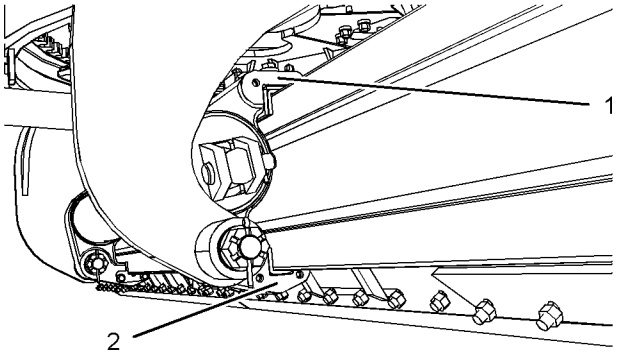

Illustration 289 g03648001

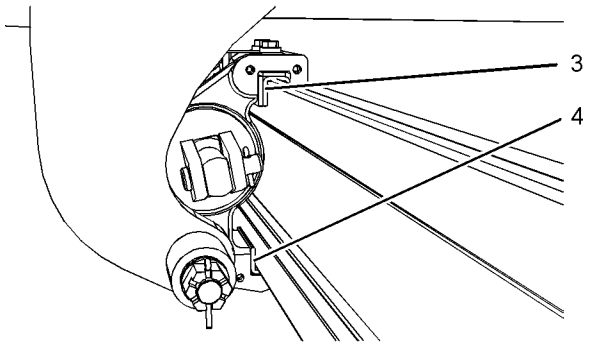

Illustration 290 g03648005

Wear Strip (Top) (3)

Wear Strip (Bottom) (4)

2. Remove top retaining plates (1) and bottom retaining plates (2). Visually inspect the wear strips. If the wear strips are worn close to the moldboard, replace the wear strips.

3. Remove the top wear strips and shims if needed and only install new wear strips at this time. When wear strip (3) is installed, the longer end of wear strip (3) should be installed in the position that is shown in illustration 290 .

Note: Make sure that the wear strip is installed as depicted in illustration 290 .

4. Start the engine. Lower the blade to the ground with slight pressure.

5. Stop the engine.

6. Remove the bottom wear strips if needed and install new wear strips. When wear strip (4) is installed, the longer end of wear strip (4) should be installed in the position that is shown in illustration 290 .

Note: Make sure that the wear strip is installed as depicted in illustration 290 .

7. Install the retaining plates.

8. Start the engine and raise the blade.

9. Sideshift the blade through the entire limit of travel. Measure the clearance between the wear strips and the blade. This will allow you to determine the location of the minimum clearance.

10. Stop the engine.

11. Remove the top retaining plates.

12. Install shims between the moldboard rail and the wear strips at the location of minimum clearance. Add shims in order to provide a clearance of 0.13 mm to 0.90 mm (.005 inch to .035 inch).

Note: The shims that are required should be divided evenly between the upper wear strips and the lower wear strips.

13. Install top retaining plates.

i02375393

Oil Filter (Hydraulic Tank Return) - Replace

SMCS Code: 5068-510

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Park the machine on a level surface with front wheels straight ahead. Lower all attachments to the ground. Apply a slight downward pressure to the attachments. Center the articulation of the machine and install the frame lock pin. The frame lock pin must move freely in the frame. Move the front wheels to vertical and install the wheel lean bolt. Engage the parking brake. Stop the engine.

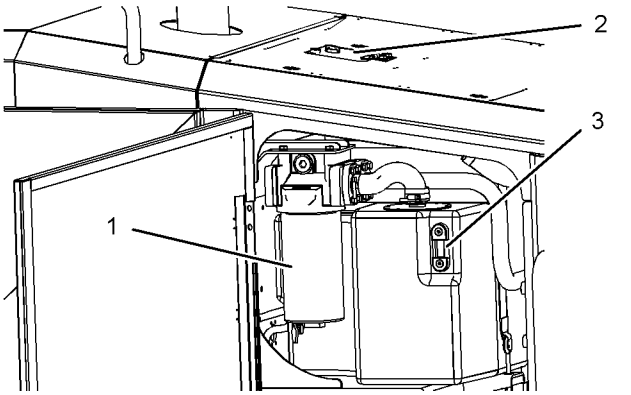

Illustration 291 g01185517

1. Open cover (2).

2. Clean the area around the hydraulic oil filler cap of any dirt or debris. This must be done before the hydraulic oil filler cap can be removed.

3. Slowly remove the hydraulic oil filler cap in order to relieve the tank pressure.

4. Clean the area around filter (1). This must be done before the filter can be removed.

5. Remove the filter with a strap type wrench. See Operation and Maintenance Manual, “Oil Filter - Inspect”. Discard the used filter properly.

6. Clean the filter base. Check for any pieces of the seal from the old filter. Remove any pieces of the seal from the old filter.

7. Apply a thin coat of clean hydraulic oil to the seal of the new filter.

8. Install the new filter by hand until the seal of the new filter contact the base. Note the position of the index marks on the filter in relation to a fixed point on the filter mounting base.

Note: There are rotation index marks on the filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the filter, use the rotation index marks as a guide.

9. Tighten the oil filter according to the instructions that are printed on the filter. Use the index marks as a guide for tightening the oil filter. For non-Caterpillar filters, use the instructions that are provided with the filter.

Note: You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

10. Maintain the hydraulic oil level above the “MIN” mark on sight gauge (3).

11. Inspect the filler cap gasket. If the filler cap gasket is damaged, replace the filler cap gasket. Install the hydraulic oil filler cap.

i02375452

Oil Filter (Implement Controls) - Replace

SMCS Code: 5068-510

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Park the machine on a level surface with front wheels straight ahead. Lower all attachments to the ground. Apply a slight downward pressure to the attachments. Center the articulation of the machine and install the frame lock pin. The frame lock pin must move freely in the frame. Move the front wheels to vertical and install the wheel lean bolt. Engage the parking brake. Stop the engine.

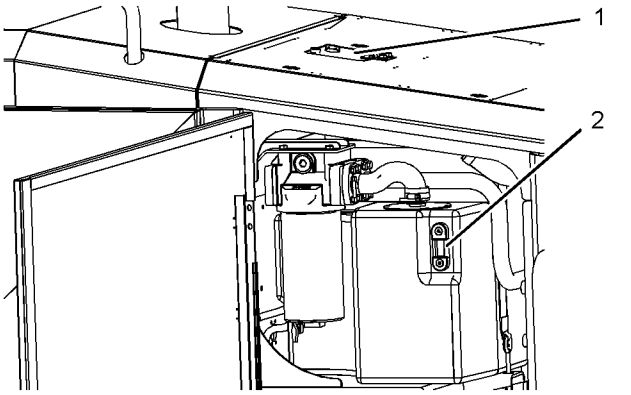

Illustration 292 g01185529

1. Open cover (1).

2. Clean the area around the hydraulic oil filler cap of any dirt or debris. This must be done before the hydraulic oil filler cap can be removed.

3. Slowly remove the hydraulic oil filler cap in order to relieve the tank pressure.

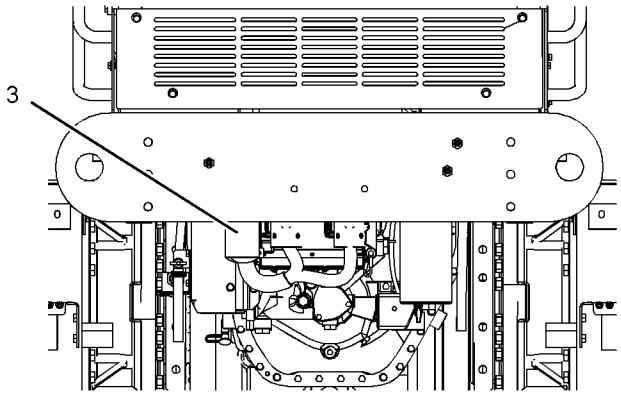

Illustration 293 g01185577

4. Clean the area around filter (3). This must be done before the filter can be removed.

5. Remove the filter with a strap type wrench. See Operation and Maintenance Manual, “Oil Filter - Inspect”. Discard the used filter properly.

6. Clean the filter base. Check for any pieces of the seal from the old filter. Remove any pieces of the seal from the old filter.

7. Apply a thin coat of clean hydraulic oil to the seal of the new filter.

8. Install the new filter by hand until the seal of the new filter contacts the base. Note the position of the index marks on the filter in relation to a fixed point on the filter mounting base.

Note: There are rotation index marks on the filter that are spaced 90 degrees or 1/4 of a turn away from each other. When you tighten the filter, use the rotation index marks as a guide.

9. Tighten the oil filter according to the instructions that are printed on the filter. Use the index marks as a guide for tightening the oil filter. For non-Caterpillar filters, use the instructions that are provided with the filter.

Note: You may need to use a Caterpillar strap wrench, or another suitable tool, in order to turn the filter to the amount that is required for final installation. Make sure that the installation tool does not damage the filter.

10. Maintain the hydraulic oil level above the “MIN” mark on sight gauge (2).

11. Inspect the filler cap gasket. If the filler cap gasket is damaged, replace the filler cap gasket. Install the hydraulic oil filler cap.

i02106227

Oil Filter - Inspect

SMCS Code: 5068-040

Inspect a Used Filter for Debris

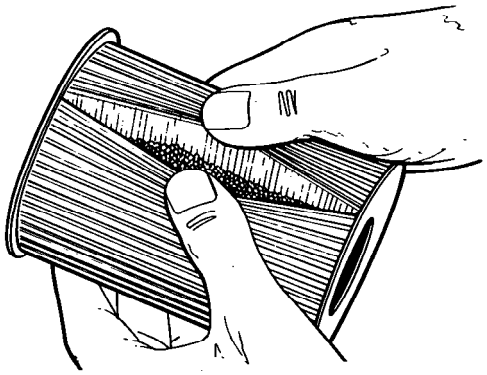

Illustration 294 g00100013

The element is shown with debris.

Use a filter cutter to cut the filter element open. Spread apart the pleats and inspect the element for metal and for other debris. An excessive amount of debris in the filter element can indicate a possible failure.

If metals are found in the filter element, a magnet can be used to differentiate between ferrous metals and nonferrous metals.

Ferrous metals can indicate wear on steel parts and on cast iron parts.

Nonferrous metals can indicate wear on the aluminum parts of the engine such as main bearings, rod bearings, or turbocharger bearings.

Small amounts of debris may be found in the filter element. This could be caused by friction and by normal wear. Consult your Caterpillar dealer in order to arrange for further analysis if an excessive amount of debris is found.

Using an oil filter element that is not recommended by Caterpillar can result in severe engine damage to engine bearings, to the crankshaft, and to other parts. This can result in larger particles in unfiltered oil. The particles could enter the lubricating system and the particles could cause damage.

i06155952

Rim - Inspect

SMCS Code: 4209-040

Note: Inspect the rim whenever a tire is dismounted.

Note: Consult your tire dealer for dismounting the tires from the rims.

Visual Inspection

Inspect the following components of the rim assembly:

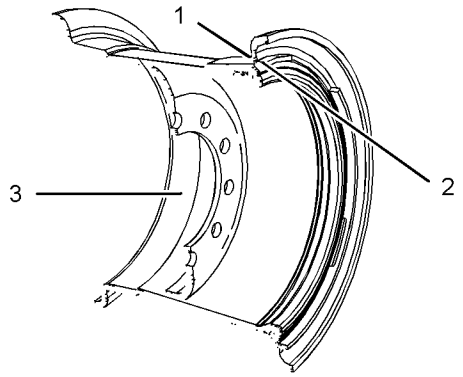

Illustration 295 g03833085

Flange and Bead Seat Band (1) – Inspect the flange and bead seat band for the following: wear, corrosion, cracks and fretting.

Lock Ring (2) – Inspect the lock ring for the following: wear, corrosion, cracks, flat spots and warping. When the lock ring is not assembled, the two ends of the lock ring must overlap each other.

Rim Assembly (3) – Inspect the rim assembly for the following: wear, corrosion, cracks and fretting. This includes the inspection of the inner flange which is integral to the rim assembly.

Magnetic Particle Inspection

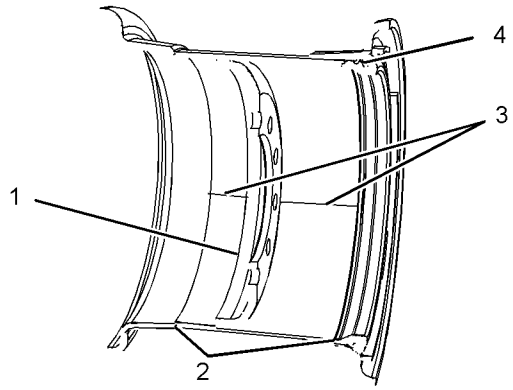

Illustration 296 g03833086

Typical example

Cutaway view of the rim assembly

1. Perform a magnetic particle inspection of the following high stress areas of the rim:

- (1) Welds on the rim disc
- (2) Welds around the circumference of the rim base
- (3) Butt welds
- (4) Contact areas with the lock ring and the groove for the lock ring

For more information on magnetic particle inspection, refer to Guideline For Reusable Parts And Salvage Operations, SEBF8148, “General Salvage and Reconditioning Techniques” or consult your Caterpillar dealer.

Do not reuse rim components that are cracked, worn, damaged, or pitted from corrosion. For more information on the reusability of the rim components, consult your Cat dealer.

i07432664

Ripper Cylinder Bearings - Lubricate

SMCS Code: 5352-086; 6325-086

Note: All machines do not require the ripper to be lubricated. If no grease fittings are present on your ripper, lubrication is not necessary. If grease fittings are present, lubricate the ripper as described below.

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the ripper cylinder bearings. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe all the fittings before you apply lubricant through the fittings.

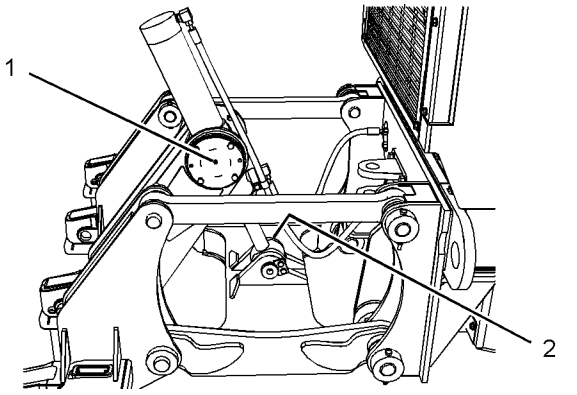

Illustration 297 g01287430

Fitting (1) is on each side of the trunnion. Apply the appropriate lubricant through each fitting to lubricate the trunnion.

Fitting (2) is mounted on the left side rod end of the ripper cylinder. Apply the appropriate lubricant through the fitting to lubricate the rod end of the ripper cylinder.

i05662563

Ripper Tip - Inspect/Replace

SMCS Code: 6808-040; 6808-510

⚠ WARNING

Personal injury or death can result from the ripper falling.

Block the ripper before changing teeth.

⚠ WARNING

Retainer pin, when struck with force, can fly out and cause injury to nearby people.

Make sure the area is clear of people when driving retainer pins.

To avoid injury to your eyes, wear protective glasses when striking a retainer pin.

Inspect the ripper tips. Replace the ripper tips if the tips are damaged or the tips are worn excessively.

1. Block up the ripper to a height that is adequate for the removal of the tips.

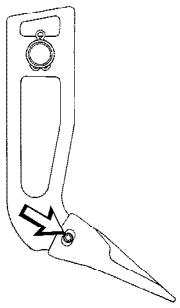

Illustration 298 g00110460

2. Drive out the retainer pin from the retainer side of the ripper tip. Remove the ripper tip and the retainer.

3. Clean the adapter, the retainer pin, and the retainer. Install the retainer in the groove.

4. Install the new ripper tip over the retainer.

5. From the opposite side of the retainer, drive the retainer pin through the ripper tip, through the adapter, and through the retainer.

6. Repeat Step 2 through Step 5 in order to replace additional ripper tips.

7. Raise the ripper. Remove the block. Lower the ripper to the ground.

i02377082

Rollover Protective Structure (ROPS) - Inspect

SMCS Code: 7323-040; 7325-040

NOTICE
Do not attempt to straighten the ROPS structure. Do not repair the ROPS by welding reinforcement plates to the structure.

If there are any cracks in the welds, in the castings, or in any metal section of the ROPS, consult your Caterpillar dealer for repairs.

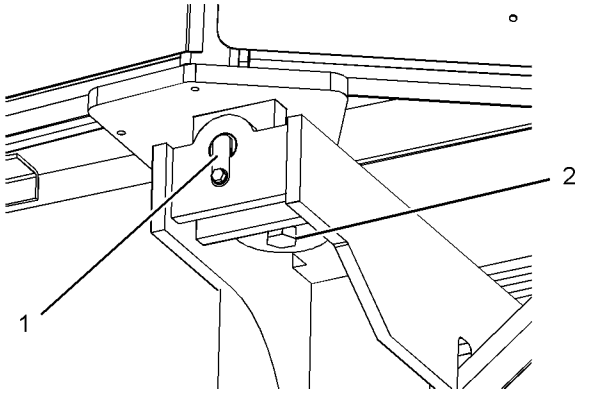

Illustration 299 g01186059

1. There are four retaining pins for the ROPS. Two retaining pins are located on each side of the cab.

2. Inspect retaining pins (1). Inspect the keeper bolts. Replace any damaged keeper bolts or any missing keeper bolts with only original equipment parts.

3. Inspect the ROPS for any loose bolts or any damaged bolts. Replace any damaged bolts or any missing bolts with only the original equipment parts. Tighten four mounting bolts (2). Refer to Specifications, SENR3130, “Torque Specifications” for the recommended torque.

4. When you operate the machine on a rough surface, the ROPS may rattle or the ROPS may make a noise. If the ROPS rattles or if the ROPS makes a noise, replace the ROPS mounting supports.

i04423622

Seat Belt - Inspect

SMCS Code: 7327-040

Always inspect the condition of the seat belt and the condition of the seat belt mounting hardware before you operate the machine. Replace any parts that are damaged or worn before you operate the machine.

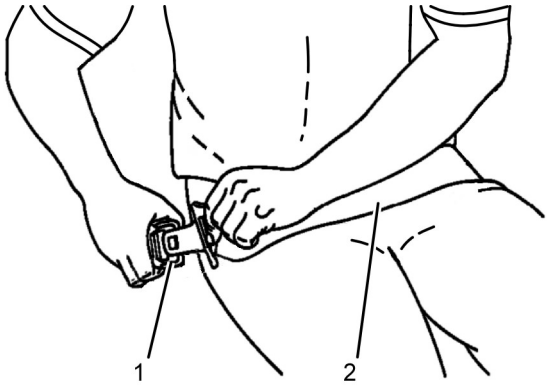

Illustration 300 g02620101

Typical example

Inspect buckle (1) for wear or for damage. If the buckle is worn or damaged, replace the seat belt.

Inspect seat belt (2) for webbing that is worn or frayed. Replace the seat belt if the webbing is worn or frayed.

Inspect all seat belt mounting hardware for wear or for damage. Replace any mounting hardware that is worn or damaged. Make sure that the mounting bolts are tight.

If your machine is equipped with a seat belt extension, also perform this inspection procedure for the seat belt extension.

Contact your Cat dealer for the replacement of the seat belt and the mounting hardware.

Note: The seat belt should be replaced within 3 years of the date of installation. A date of installation label is attached to the seat belt retractor and buckle. If the date of installation label is missing, replace belt within 3 years from the year of manufacture as indicated on belt webbing label, buckle housing, or installation tags (non-retractable belts).

i06891605

Seat Belt - Replace

SMCS Code: 7327-510

The seat belt should be replaced within 3 years of the date of installation. A date of installation label is attached to the seat belt retractor and buckle. If the date of installation label is missing, replace belt within 3 years from the year of manufacture as indicated on belt webbing label, buckle housing, or installation tags (non-retractable belts).

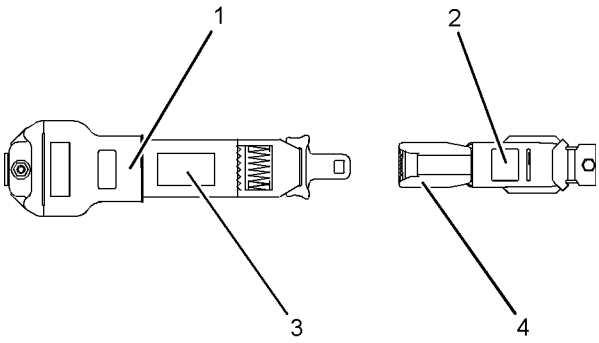

Illustration 301 g01152685

Typical Example

(1) Date of installation (retractor)
(2) Date of installation (buckle)
(3) Year of manufacture (tag) (fully extended web)
(4) Year of manufacture (underside) (buckle)

Consult your Cat dealer for the replacement of the seat belt and the mounting hardware.

Determine age of new seat belt before installing on seat. A manufacture label is on belt webbing and imprinted on belt buckle. Do not exceed install by date on label.

Complete seat belt system should be installed with new mounting hardware.

Date of installation labels should be marked and affixed to the seat belt retractor and buckle.

Note: Date of installation labels should be permanently marked by punch (retractable belt) or stamp (non-retractable belt).

If your machine is equipped with a seat belt extension, also perform this replacement procedure for the seat belt extension.

i04160689

Secondary Steering - Test

SMCS Code: 4300-081-SST

⚠ WARNING

Personal injury or death can occur if steering is lost completely during operation.

Do not continue to operate the machine using the secondary steering.

If the secondary steering activates during operation, immediately park the machine in a safe location. Inspect the machine and correct the condition which made the use of the secondary steering necessary.

The test for the secondary steering verifies that the supplemental steering pump and the secondary steering valves are functioning.

Note: Before the test for the secondary steering is performed, the machine must meet the following conditions:

- The engine must be operating.
- The left-hand joystick must be aligned to the steering angle of the front wheels.
- The parking brake must be engaged.
- The transmission control switch must be in NEUTRAL.
- The area around the front wheels must be clear of obstacles and of personnel.

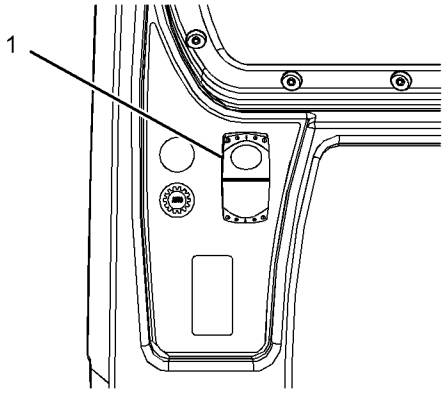

Illustration 302 g01257946

1. Push the top of switch (1) and hold. This is the TEST position.

Verify that alert indicator (2) is on and amber in color throughout the test. Verifying that the alert indicator is on ensures that the test is actually being activated. If the alert indicator (2) does not illuminate amber, verify that the initial conditions have been met and that the switch is operating properly.

Note: In order to protect the secondary steering pump, the secondary steering test will shut off if switch (1) is held in the TEST position for more than 10 seconds. If the secondary steering test shuts off, alert indicator (2) will not be amber in color.

2. While switch (1) is held in the TEST position and alert indicator (2) is on and amber in color, provide the following steering inputs with the left-hand joystick:

- Steer left
- Steer center
- Steer right

Verify that the movement of the front wheel aligns with each steering input.

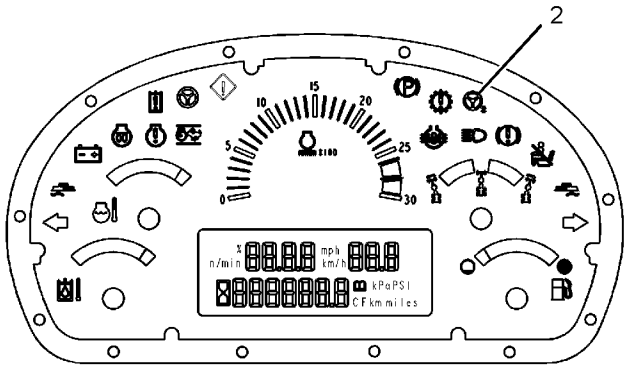

Illustration 303 g01257960

3. If the alert indicator is not illuminated after the test, the test was successful and the steering performance was normal.

Note: If the alert indicator is red in color, the test has failed. The warning level that is issued will provide instructions that must be followed.

Refer to the troubleshooting section in Specifications, Systems Operation, Troubleshooting, Testing and Adjusting, RENR8472 for further information.

i08115634

Spindle - Inspect

SMCS Code: 4205-040

For more information, refer to “Reuse and Salvage Guidelines” SEBF9317, “Reusability & Crack Inspection of Front & Rear Wheel Spindles on 14, 16, 18, & 24 Motor Graders Used in Mining Applications” for complete procedure.

i04001045

Steering Cylinder Ends and Tie Rods - Lubricate

SMCS Code: 4303-086-BD; 4318-086

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the cylinder ends and the tie rods. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wipe the fittings before you apply lubricant through the fittings.

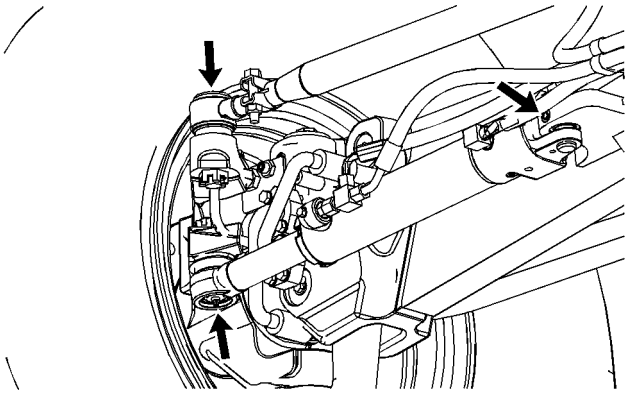

Illustration 304 g01142294

Typical Example Shown

Both steering cylinders have two fittings. Both tie rods have one fitting. Apply the appropriate lubricant through the fittings in order to lubricate the cylinder ends and the tie rods.

i08137581

Tandem - Check

SMCS Code: 4062-535

For more information, refer to Testing and Adjusting, RENR8482, “14M and 16M Motor Graders”, “Tandem - Check" for complete procedure.

i02605942

Tandem Breather - Clean/ Replace

SMCS Code: 4062-070-BRE; 4062-510-BRE

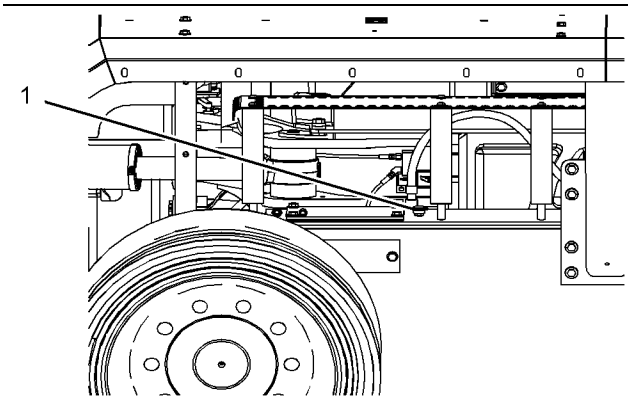

Illustration 305 g01304638

The tandem breathers are located on the top of each tandem. The tire has been removed for ease of viewing.

1. Remove a plate from the walkway that is located on top of the tandem drive housings. This must be done in order to access breathers (1) on the top of the tandem drive housings.
2. Clean the area around the breathers of any dirt or debris. This must be done before the breathers are removed.
3. Remove breather (1) from both tandems.
4. Wash the breathers in clean, nonflammable solvent.
5. Use pressure air to dry the breathers.
6. Install the breathers in both tandems.

Note: Replace the breathers if the breathers are damaged.

7. Install the plate to the walkway.

i02593825

Tandem Drive Oil - Change

SMCS Code: 4071-510

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

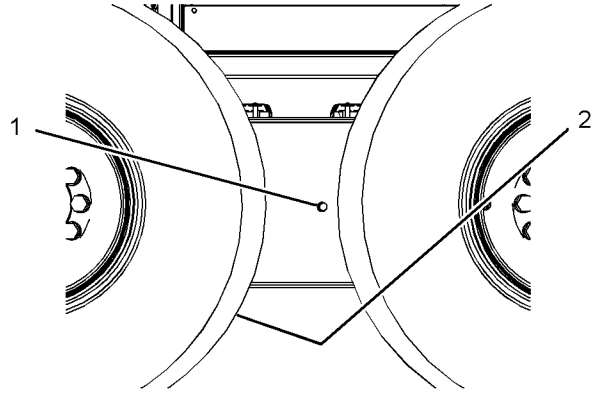

Illustration 306 g01298140

1. Clean the surface area around oil check plug (1).

2. Remove drain plug (2). Remove the oil check plug. Allow the oil to drain into a suitable container.

Note: When you change the tandem drive oil, use diesel fuel in order to clean the housing of the sludge and flush the housing of the sludge.

3. Clean the drain plug and install the drain plug.

4. Remove a plate from the walkway that is located on top of the tandem drive housing. This must be done in order to access one of the covers on the top of the tandem drive housing.

5. Clean the area around one of the covers of any dirt or debris. This must be done before the cover is removed.

6. Remove a cover from the top of the tandem drive housing. Fill the tandem drive housing with new oil. Refer to the following topics:

- Operation and Maintenance Manual, “Lubricant Viscosities”
- Operation and Maintenance Manual, “Capacities (Refill)”

7. Clean the cover and install the cover on the top of the tandem drive housing.

8. Install the plate to the walkway.

9. Clean the oil check plug and install the oil check plug.

10. Start the engine. Operate the machine for a few minutes. Check the tandem drive housing for leaks.

11. Stop the engine. Remove the oil check plug.

12. Check the oil level. Maintain the oil level to the bottom of the opening for the oil check plug. Add oil, if necessary.

13. Install the oil check plug.

14. Repeat Step 1 through Step 13 for the other side of the machine.

i05927183

Tandem Drive Oil Level - Check

SMCS Code: 4071-535

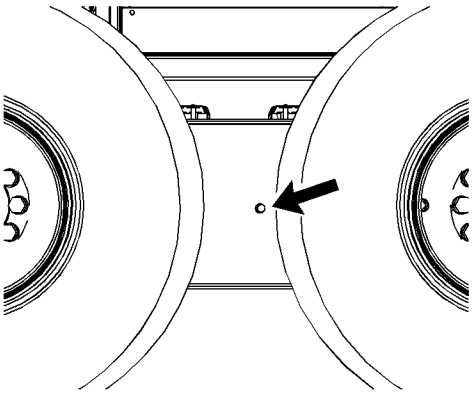

Illustration 307 g01298219

1. Clean the surface area around the oil check plug.

2. Loosen the oil check plug. If oil start to come out, the oil level is sufficient.

3. Maintain the oil level at or above the bottom of the opening for the oil check plug. If additional oil is necessary, perform the following Steps:

a. Remove a plate from the walkway that is located on top of the tandem drive housing. Removing the plate must be done in order to access one of the covers on the top of the tandem drive housing.

b. Clean the area around one of the covers of any dirt or debris. Cleaning the area must be done before the cover is removed.

c. Remove a cover from the top of the tandem drive housing. Fill the tandem drive housing with new oil. Refer to the following topics:

- Operation and Maintenance Manual, “Lubricant Viscosities”
- Operation and Maintenance Manual, “Capacities (Refill)”

d. Clean the cover and install the cover on the top of the tandem drive housing.

e. Install the plate to the walkway.

4. Clean the oil check plug and install the oil check plug.

i02772093

Tandem Drive Oil Sample - Obtain

SMCS Code: 4071-008

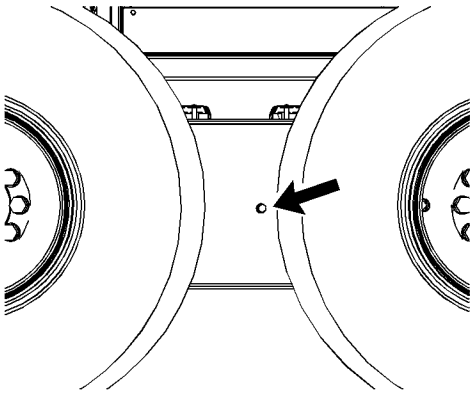

Illustration 308 g01298219

1. Clean the surface area around the oil check plug.

2. Remove the oil check plug in order to obtain an oil sample.

3. Clean the oil check plug and install the oil check plug.

Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” “S·O·S Services Oil Analysis” for information that pertains to obtaining a sample of the tandem drive oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the tandem drive oil.

i00149440

Tire Inflation - Check

SMCS Code: 4203-535-PX; 4203-535-AI

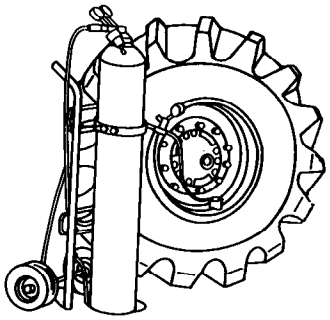

Illustration 309 g00103147

Measure the air pressure on each tire. Consult your tire dealer for the correct load rating and for the correct operating pressures.

If necessary, inflate the tires. Refer to the following additional information about tire inflation:

- Operation and Maintenance Manual, “Tire Inflation with Nitrogen”
- Operation and Maintenance Manual, “Tire Shipping Pressure”
- Operation and Maintenance Manual, “Tire Inflation Pressure Adjustment”

i02662932

Transmission and Differential Oil - Change

SMCS Code: 3080-510; 3258-510-OC

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

Clean the area around the differential drain plug and the area around the transmission drain plug. Refer to Illustration 310 for the location of drain plugs. Clean the area around the oil level gauge/fill cap. Refer to Illustration 311 for the location of the oil level gauge/fill cap.

Operate the engine until the transmission oil and the differential oil are warm. Park the machine on a level surface and engage the parking brake. Lower the blade and apply slight down pressure to the blade. Stop the engine.

Note: Drain the transmission case and drain the differential case while the oil is warm. This allows waste particles that are suspended in the oil to drain. As the oil cools, the waste particles will settle to the bottom of the case. The particles will not be removed by draining the oil and the particles will recirculate in the lubrication system with the new oil.

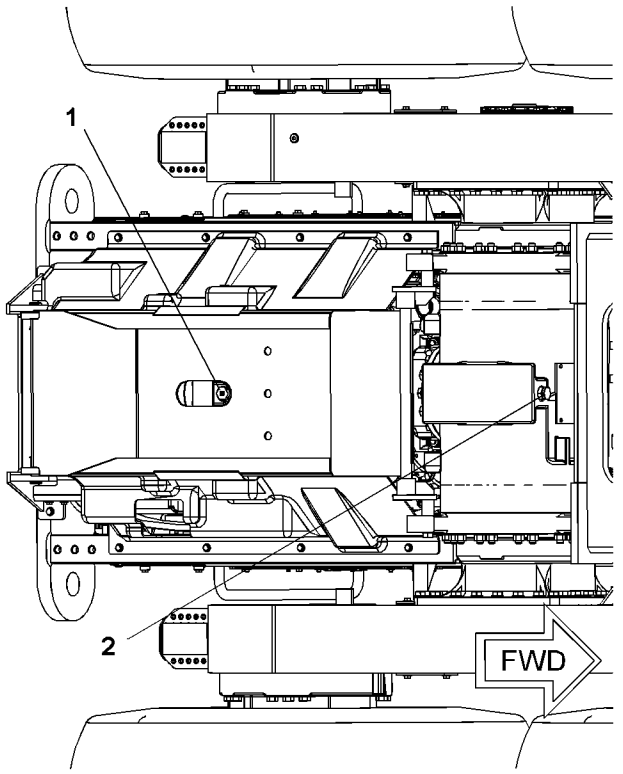

Illustration 310 g01297734
Bottom View

1. Remove transmission drain plug (1) and remove differential drain plug (2). Drain the oil into a suitable container.
2. Change the filter element and clean the screens. Refer to Operation and Maintenance Manual, “Transmission and Differential Oil Filter and Screens - Replace/Clean” for the proper procedure.
3. Clean the drain plugs and install the drain plugs.
4. Open the front left access door.

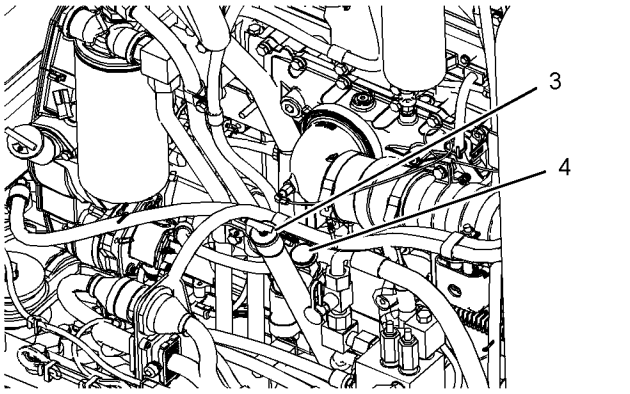

Illustration 311 g01297736

5. Fill the transmission case and the differential case with oil through oil level gauge/fill cap (3). Refer to the following topics:

- Operation and Maintenance Manual, “Lubricant Viscosities”
- Operation and Maintenance Manual, “Capacities (Refill)”

6. Remove transmission breather (4) and discard the transmission breather. Install a new transmission breather.

7. Start the engine and run the engine at low idle. Inspect the transmission and differential components for leaks.

8. Engage the transmission modulator control (inching pedal). Slowly operate the transmission in order to circulate the oil.

9. With the engine at low idle, maintain the oil level between the marks on the oil level gauge. If necessary, add oil through oil level gauge/fill cap (3).

10. Stop the engine.

11. Close the access door.

i07927841

Transmission and Differential Oil Filter and Screens - Replace/Clean

SMCS Code: 3030-070-Z3; 3030-510-Z3; 3067-510; 3067-070; 3258-510-FI; 3258-510-Z3; 3258-070-Z3; 3258-070-FI

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

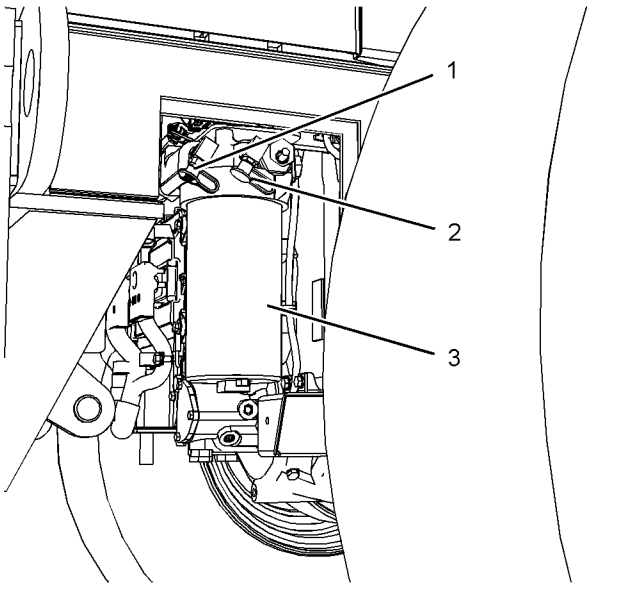

Illustration 312 g01271420
Cutaway view

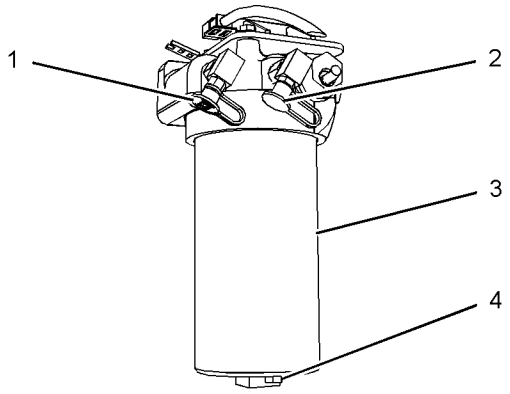

Illustration 313 g01271423

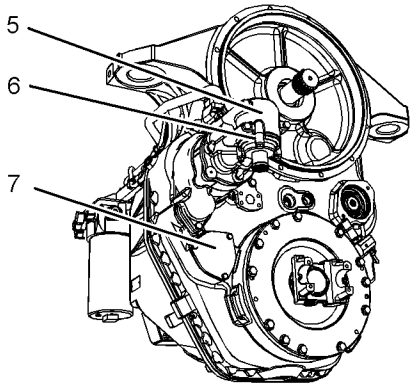

Illustration 314 g01440673

1. Remove drain plug (4) on transmission oil filter housing (3). Allow the oil to drain into a suitable container.

2. Loosen oil sampling valve (1) or pressure test port (2) in order to vent the transmission oil filter housing.

3. Remove the transmission oil filter housing.

4. Remove the used element and discard the used element.

5. Clean the transmission oil filter housing with a clean, nonflammable solvent.

6. Clean the base of the transmission oil filter housing.

7. Insert a new filter element into the transmission oil filter housing.

8. Replace the filter housing base seal.

9. Install the transmission oil filter housing.

10. Install drain plug (4) in transmission oil filter housing (3).

11. Remove the three bolts of the cover for magnetic screen (6). Slowly remove the cover from the housing (5) for the magnetic screen. Allow the oil to drain into a suitable container.

12. Remove the magnetic screen tube assembly.

13. Separate the magnet and the tube assembly from the screen. Wash the screen and the tube assembly in clean, nonflammable solvent. Allow the screen to dry and allow the tube assembly to dry.

NOTICE
Do not drop or rap magnets on hard objects, or damage can result. Replace damaged magnets.

14. Clean the magnet with a cloth or clean the magnet with a firm brush. Allow the magnet to dry.

15. Install the magnet and the tube assembly into the screen.

16. Install the screen.

17. Inspect the cover seals. If the cover seals are damaged, replace the cover seals.

18. Install the covers and tighten the bolts.

19. Repeat steps 11 through 18 for the transmission suction screen (7).

20. Start the engine.

21. With the parking brake engaged, run the engine at low idle in order to circulate the transmission oil.

22. Stop the engine.

23. Inspect all of the transmission components for leaks.

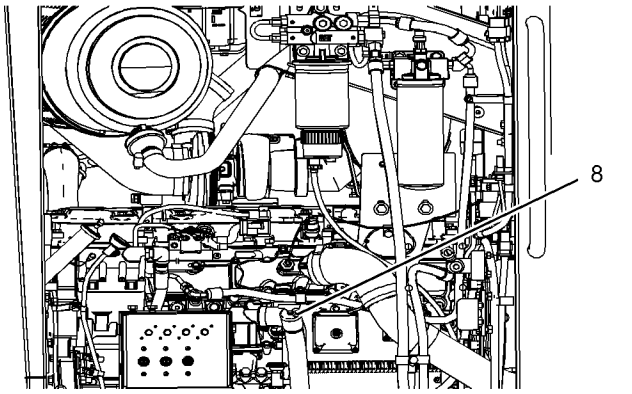

Illustration 315 g01441716

24. Clean the area around oil level gauge/fill cap (8).

25. Fill the oil, adjust if the level is not between the marks on the oil level gauge. If necessary, adjust the quantity. Run the engine at low idle for a few seconds and stop the engine.

26. Check the oil level. If not between the marks, repeat steps 24 and 25.

i07927845

Transmission and Differential Oil Level - Check

SMCS Code: 3030-535-FLV; 3080-535-FLV; 3258-535-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

Refer to Operation and Maintenance Manual, “Access Doors and Covers” for the location of the service points.

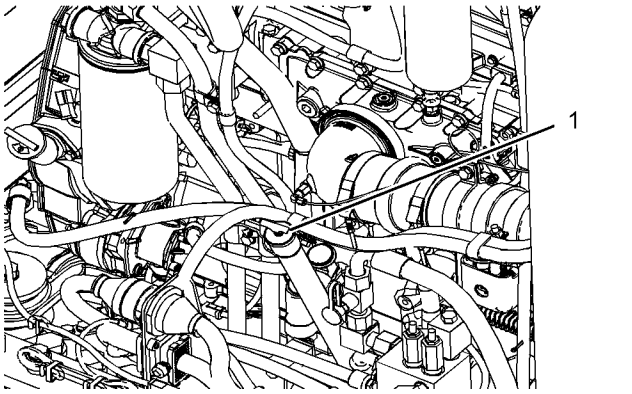

Illustration 316 g01297772

1. Warm up the machine.

2. Stop the engine.

3. Open the front left access door.

4. Clean the area around oil level gauge/fill cap (1).

5. With the oil at an operating temperature of 90° C (195° F), maintain the oil level between the marks on oil level gauge/fill cap (1). If necessary, add oil.

6. Close the access door.

i07927849

Transmission and Differential Oil Sample - Obtain

SMCS Code: 3006-008; 3030-008; 3080-008; 3258-008; 7542

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

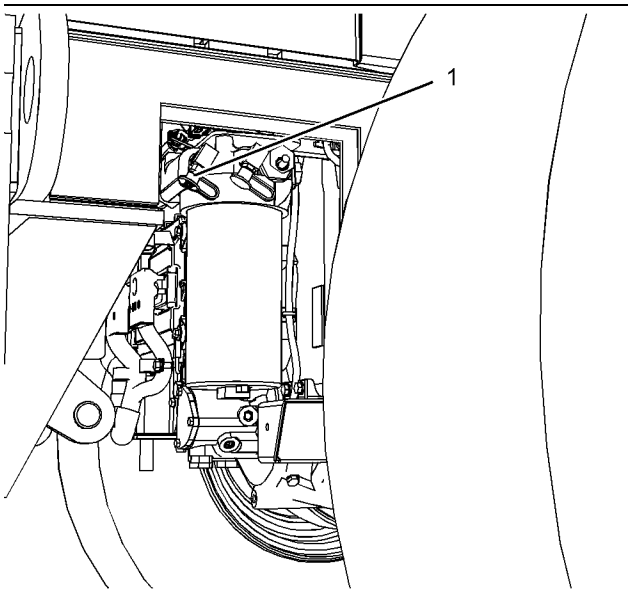

Illustration 317 g01271753

Sampling valve (1) for the transmission and differential oil is on the transmission filter. The transmission filter is on the right, rear of the transmission.

Refer to Special Publication, SEBU6250, “S·O·S Services Oil Analysis” for information that pertains to obtaining a sample of the transmission and differential oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the transmission and differential oil.

Note: As an alternative to “Live Sampling” , take sample using vacuum extraction. This sampling method requires a vacuum pump. Ensure that the transmission oil is warmed up to operating temperature. Shut down engine before obtaining the sample.

i02837506

Wheel Bearing Oil (Front) - Change

SMCS Code: 4205-044; 4208-044; 4234-044; 7551-044-WHL

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

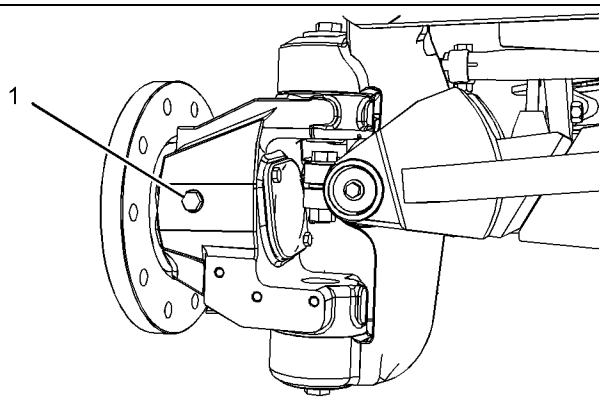

Illustration 318 g01414751

The wheel has been removed for ease of viewing.

The front wheel bearings are located on the inner side of each front wheel. Check/fill plug (1) is located on the housings of each front wheel bearing.

1. Clean the surface around the check/fill plug.
2. Remove the check/fill plug.
3. Use a 1U-7683 Suction Gun in order to remove the oil from the housing for the wheel bearing.
4. Add oil to the housing for the wheel bearing until the oil level is at the bottom of the opening for the check/fill plug. Refer to the following topics:
   - Operation and Maintenance Manual, “Lubricant Viscosities”
   - Operation and Maintenance Manual, “Capacities (Refill)”
5. Install the check/fill plug.
6. Repeat Step 1 through Step 5 for the other wheel bearing.

i02837509

Wheel Bearing Oil Level (Front) - Check

SMCS Code: 4205-535-FLV; 4208-535-FLV; 4234-535-FLV; 7551-535-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

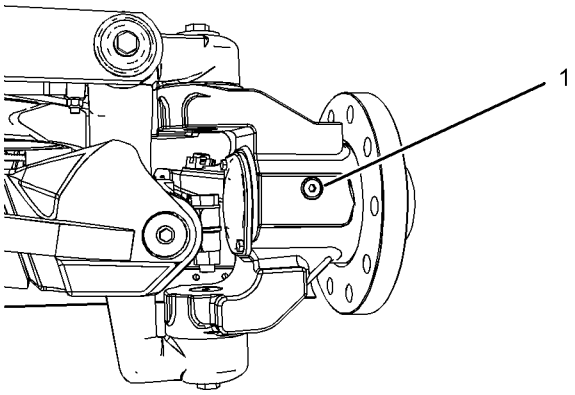

Illustration 319 g01299786

The wheel has been removed for ease of viewing.

1. Clean the surface around check/fill plug (1).

2. Remove the check/fill plug.

3. Maintain the oil level to the bottom of the opening for the check/fill plug. If necessary, add oil.

4. Install the check/fill plug.

5. Repeat Step 1 through Step 4 for the other wheel bearing.

i05924362

Wheel Bearing Oil Sample (Front) - Obtain

SMCS Code: 4205-008; 4234-008; 7542

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact skin.

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Refer to Special Publication, PERJ1017, “Dealer Service Tool Catalog” for tools and supplies suitable to collect and contain fluids on Cat ® products.

Dispose of all fluids according to local regulations and mandates.

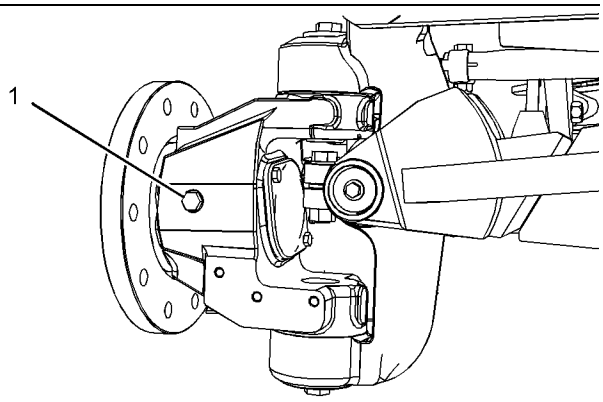

Illustration 320 g01414751

The wheel has been removed for ease of viewing.

The wheel bearing sample plug (1) is located on the inner side of each front wheel of the machine.

Refer to Special Publication, SEBU6250, “S·O·S Services Oil Analysis” for information that pertains to obtaining a sample of the oil. Refer to Special Publication, PEHP6001, “How To Take A Good Oil Sample” for more information about obtaining a sample of the hydraulic oil.

After sample has been obtained, ensure that oil is at proper level. Refer to Operation and Maintenance Manual, “Wheel Bearing Oil Level (Front) - Check”.

i06175474

Wheel Lean Bearings - Lubricate

SMCS Code: 5225-086-BD

Note: Caterpillar recommends the use of 5% molybdenum grease for lubricating the wheel lean bearings. Refer to Special Publication, SEBU6250, “Caterpillar Machine Fluids Recommendations” for more information on molybdenum grease.

Wheel Lean Bearings

Wipe the fittings before you apply lubricant through the fittings.

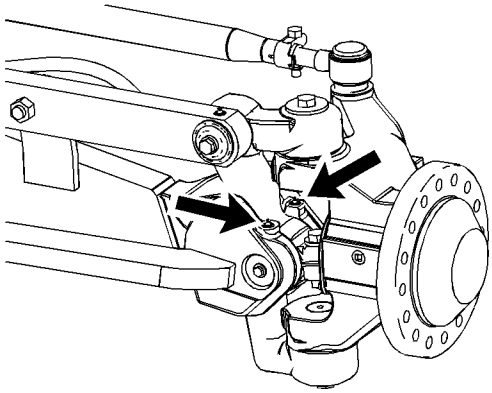

Illustration 321 g01299841

Typical Example Shown

The wheel has been removed for ease of viewing.

Each front wheel has two fittings. Apply the appropriate lubricant to the fittings in order to lubricate the wheel lean bearings.

Wheel Lean Bar Bearings

Wipe the fittings before you apply lubricant through the fittings.

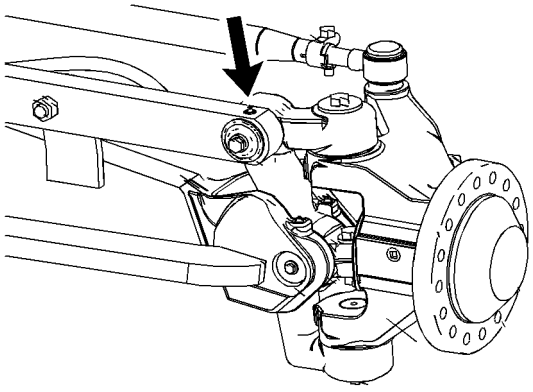

Illustration 322 g01113822

The wheel has been removed for ease of viewing.

Each front wheel has one fitting. Apply the appropriate lubricant through the fittings in order to lubricate the wheel lean bar bearings.

Wheel Lean Cylinder Bearings

Wipe the fittings before you apply lubricant through the fittings.

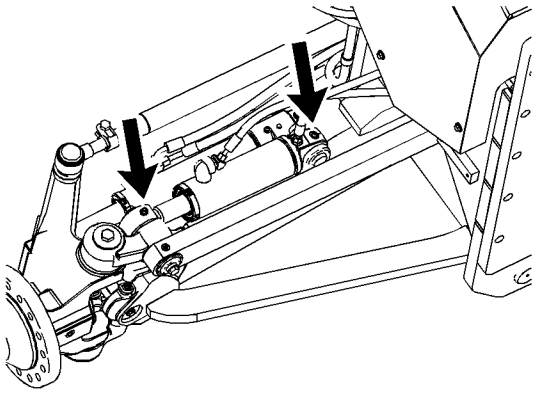

Illustration 323 g01299845

The wheel has been removed for ease of viewing.

The right front wheel has two fittings on the wheel lean cylinder. Apply the appropriate lubricant through the fittings in order to lubricate the wheel lean cylinder bearings.

i02639345

Window Washer Reservoir - Fill

SMCS Code: 7306-544-KE

NOTICE
Use Caterpillar nonfreezing window washer solvent or a commercially available windshield washer fluid in order to prevent freezing of the windshield washer system.

The windshield washer reservoir is positioned in the seat support to the left of the operator's seat. The level of windshield washer fluid can be viewed through the reservoir.

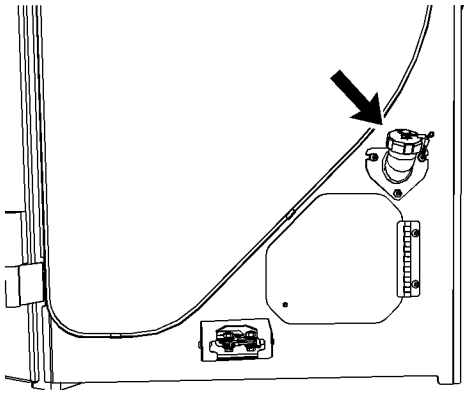

Illustration 324 g01323517

1. Clean the filler cap and the surrounding area.
2. Remove the filler cap for the windshield washer reservoir.

3. Fill the window washer reservoir with window washer solvent through the filler cap opening.

4. Install the filler cap.

Note: The window washer nozzles can be adjusted so that the window washer solvent will be sprayed in the desired direction.

Warranty Section

Warranty Information

i06044323

Emissions Warranty Information

SMCS Code: 1000

The certifying engine manufacturer warrants to the ultimate purchaser and each subsequent purchaser that:

1. New non-road diesel engines and stationary diesel engines less than 10 liters per cylinder (including Tier 1 and Tier 2 marine engines < 37 kW, but excluding locomotive and other marine engines) operated and serviced in the United States and Canada, including all parts of their emission control systems (“emission related components”), are:

a. Designed, built, and equipped so as to conform, at the time of sale, with applicable emission standards prescribed by the United States Environmental Protection Agency (EPA) by way of regulation.

b. Free from defects in materials and workmanship in emission-related components that can cause the engine to fail to conform to applicable emission standards for the warranty period.

2. New non-road diesel engines (including Tier 1 and Tier 2 marine propulsion engines < 37 kW and Tier 1 through Tier 4 marine auxiliary engines < 37 kW, but excluding locomotive and other marine engines) operated and serviced in the state of California, including all parts of their emission control systems (“emission related components”), are:

a. Designed, built, and equipped so as to conform, at the time of sale, to all applicable regulations adopted by the California Air Resources Board (ARB).

b. Free from defects in materials and workmanship which cause the failure of an emission-related component to be identical in all material respects to the component as described in the engine manufacturer's application for certification for the warranty period.

3. New non-road diesel engines installed in construction machines conforming to the South Korean regulations for construction machines manufactured after January 1, 2015, and operated and serviced in South Korea, including all parts of their emission control systems (“emission related components”), are:

a. Designed, built, and equipped so as to conform, at the time of sale, with applicable emission standards prescribed in the Enforcement Rule of the Clean Air Conservation Act promulgated by South Korea MOE.

b. Free from defects in materials and workmanship in emission-related components that can cause the engine to fail to conform to applicable emission standards for the warranty period.

The aftertreatment system can be expected to function properly for the lifetime of the engine (emissions durability period) subject to prescribed maintenance requirements being followed.

A detailed explanation of the Emission Control Warranty that is applicable to new non-road and stationary diesel engines, including the components covered and the warranty period, is found in a supplemental Special Publication. Consult your authorized Cat dealer to determine if your engine is subject to an Emission Control Warranty and to obtain a copy of the applicable Special Publication.

Reference Information Section

Reference Materials

i07422648

Reference Material

SMCS Code: 1000; 7000

Additional literature regarding your product may be purchased from your local Cat dealer or by visiting publications.cat.com. Use the product name, sales model, and serial number to obtain the correct information for your product.

publications.cat.com

i07743978

Decommissioning and Disposal

SMCS Code: 1000; 7000

When the product is removed from service, local regulations for the product decommissioning will vary. Disposal of the product will vary with local regulations.

Improperly disposing of waste can threaten the environment. Obey all local regulations for the decommissioning and disposal of materials.

Utilize appropriate personal protective equipment when decommissioning and disposing product.

Consult the nearest Cat dealer for additional information. Including information for component remanufacturing and recycling options.

i03648768

Caterpillar Approved Work Tools

SMCS Code: 6700

Only use Caterpillar approved work tools on this machine.

Note: Do not use a Caterpillar work tool on a machine that is not approved by Caterpillar.

Note: The weights provided in Operation and Maintenance Manual, “Tire Shipping Pressure” include the weight of the machine and any work tools that are attached. Ensure that the tires are appropriate for the particular work tool.

Table 21

Caterpillar Approved Work Tools for Motor Graders						
Work Tool	**120M**	**12M**	**140M**	**160M**	**14M**	**16M**
Ripper	A	A	A	A	A	A
Rear Scarifier	A	NR	NR	NR	NR	NR
Mid Mount Scarifier	A	A	A	A	NR	NR
Front Lift Group	A	A	A	A	A	A
Front Mount Scarifier (1)	A	A	A	A	A	NR
Front Angle Blade (1)	A	A	A	A	A	NR
Front Straight Blade (1)	A	A	A	A	A	A
Front Straight Blade (2)	A	A	A	A	NR	NR
One Way Plow (1)	A	A	A	A	A	NR
Reversible Plow (1)	A	A	A	A	A	NR
V Plow (1)	A	A	A	A	A	NR
Plow Hook	A	A	A	A	A	NR
Snow Wing	A	A	A	A	A	NR
Push Block	A	A	A	A	A	A

(1) For use with the front lift group.
(2) Does not require the front lift group.

A – The machine performance is acceptable with this work tool.

NR – This work tool is not recommended for use on this machine.

Index

A

Access Doors and Covers 142
Additional Messages 15
Adjustments 119
Alternate Exit 50
Articulation Bearings - Lubricate 149
Automatic Lubrication System Grease - Add 149
Automatic Lubrication System Grease - Check 149
Axle Oscillation Bearings - Lubricate 150

B

Backup Alarm 93
Backup Alarm - Test 150
Battery Disconnect Switch 93
Battery or Battery Cable - Inspect/Replace 150
Before Operation 30, 47
Before Starting Engine 29
Belts - Inspect/Adjust/Replace 151
  Inspect 151
  Replace/Adjust 151
Blade Lift Cylinder Socket - Check/Adjust/Replace 151
Blade Lift Cylinder Socket - Lubricate 152
Brake Accumulator - Check 152
Brake Discs - Check 154
  Adjust 154
  Check 154
Brakes, Indicators and Gauges - Test 154
Braking System - Test 155
  Parking Brake Holding Ability Test 155
  Service Brake Holding Ability Test 155
Burn Prevention 23
  Batteries 24
  Coolant 23
  Oils 24

C

Cab Air Filter - Clean/Replace 155
  Inside Filter 156
  Outside Filter 156
Capacities (Refill) 140
Caterpillar Approved Work Tools 225
Centershift Cylinder Socket - Check/Adjust/Replace 157
Centershift Cylinder Socket - Lubricate 157
Centershift Lock Bar - Clean/Lubricate 158
Circle Clearances - Check/Adjust 158
  Blade Circle and Drawbar 159
  Circle Pinion and Circle Teeth 158
Circle Drive Oil - Change 161
Circle Drive Pinion Teeth - Lubricate 162
Circle Top - Lubricate 162
Circuit Breakers - Reset 162
Cooling Cores - Clean 163
  Condenser (Refrigerant) 163
  Evaporator and Heater Coils 163
  Radiator and Radiator Core 164
Cooling System Coolant (ELC) - Change 165
Cooling System Coolant Extender (ELC) - Add 166
Cooling System Coolant Level - Check 167
Cooling System Coolant Sample (Level 1) - Obtain 168
Cooling System Coolant Sample (Level 2) - Obtain 169
Cooling System Pressure Cap - Clean/Replace 170
Crankshaft Vibration Damper - Inspect 170
Crushing Prevention and Cutting Prevention 23
Cutting Edges and End Bits - Inspect/Replace (Includes Overlays) 171

D

Daily Inspection 47
  Wheel Lean Locking Bolt 48
Declaration of Conformity 46
Decommissioning and Disposal 225
Display and Camera - Clean (If Equipped with Work Area Vision System) 171
  Camera 172
  Display 172
Drawbar Ball and Socket - Lubricate 172
Drawbar Ball and Socket End Play - Check/Adjust 172
  Adjust 173
  Check 172

E

Electrical Storm Injury Prevention 28
Electronic Unit Injector - Inspect/Adjust 173
Emissions Certification Film 45
Emissions Warranty Information 224

Engine Air Filter Element - Clean/Replace ... 174
Primary Element ... 174
Secondary Element ... 176
Engine and Machine Warm-Up ... 116
Hydraulic System ... 116
Lower Power Train ... 118
Steering Oil Temperature Monitoring System ... 118
Engine Compartment - Clean ... 177
Engine Oil and Filter - Change ... 178
Adjustment of the Oil Change Interval ... 179
Procedure for Changing the Engine Oil and Filter ... 179
Selection of the Oil Change Interval ... 178
Engine Oil Level - Check ... 177
Engine Oil Sample - Obtain ... 178
Engine Shutdown Switch ... 94
Engine Shutdown Switch - Check ... 181
Engine Starting ... 30, 116
Engine Starting (Alternate Methods) ... 132
Engine Starting with Auxiliary Start Receptacle ... 133
Engine Starting with Jump Start Cables ... 132
Engine Valve Lash - Check ... 181
Engine Valve Rotators - Inspect ... 182
Equipment Lowering with Engine Stopped ... 36, 121
Ether Starting Aid Cylinder - Replace ... 182

F

Film (Product Identification) - Clean ... 183
Cleaning of the Films ... 183
Fire Extinguisher Location ... 28
Fire Prevention and Explosion Prevention ... 24
Battery and Battery Cables ... 25
Ether ... 27
Fire Extinguisher ... 27
General ... 24
Lines, Tubes, and Hoses ... 26
Wiring ... 26
Fire Safety ... 27
Foreword ... 4
California Proposition 65 Warning ... 4
Certified Engine Maintenance ... 5
Literature Information ... 4
Machine Capacity ... 5
Maintenance ... 4
Operation ... 4
Product Identification Number ... 5
Safety ... 4
Frame and Body - Inspect ... 184
Articulation Lock Pin ... 187
Blade and Circle ... 191
Drawbar ... 190
Front Axle ... 189
Front Frame ... 188
Rear Frame ... 186
Ripper ... 185
Tandem ... 185
Fuel System - Fill ... 191
Machines that are Equipped with a Fast Fill Fuel Arrangement ... 192
Fuel System - Prime ... 192
Fuel System Filter - Replace ... 193
Primary Filter (Water Separator) Element ... 193
Secondary Filter ... 194
Fuel System Water Separator - Drain ... 194
Fuel Tank Cap and Strainer - Clean ... 195
Fuel Tank Water and Sediment - Drain ... 195
Fuses - Replace ... 196, 198
Fuse Block “A” ... 199
Fuse Block “B” ... 199

G

General Hazard Information ... 20
Containing Fluid Spillage ... 22
Dispose of Waste Properly ... 23
Fluid Penetration ... 21
Inhalation ... 22
Pressurized Air and Water ... 21
Trapped Pressure ... 21
General Information ... 40
Guards ... 39
Guards (Operator Protection)
Other Guards (If Equipped) ... 39
Rollover Protective Structure (ROPS), Falling Object Protective Structure (FOPS) or Tip Over Protection Structure (TOPS) ... 39

H

Hydraulic System Oil - Change ... 200
Hydraulic System Oil Level - Check ... 202
Hydraulic System Oil Sample - Obtain ... 202

I

Identification Information ... 42
Important Safety Information ... 2

J

Jacking Location Information 127
Jacking Locations 127
Front of the Machine 127
Rear of the Machine 127

K

Kingpin Bearings - Lubricate 203

L

Ladder (If Equipped) 56
Primary Ladder 57
Secondary Ladder 57
Leaving the Machine 122
Lifting and Tying Down the Machine 124
Lubricant Viscosities 136
Biodiesel 140
Coolant Information 140
Diesel Fuel Recommendations 139
Engine Oil 136
Fuel Additives 140
General Information for Lubricants 136
Grease Applications 139
Other Oil Applications 137
Selecting the Viscosity 136
Lubricant Viscosities and Refill Capacities ... 136
Lubrication Pump Oil - Change (Autolube) ... 203
Lubrication Pump Oil - Fill (Autolube) 204
Lubrication Pump Oil Level - Check (Autolube) 204

M

Machine Operation 50
Maintenance Access 142
Maintenance Interval Schedule 147
Every 10 Service Hours or Daily 147
Every 100 Service Hours 147
Every 1000 Service Hours 148
Every 12 000 Service Hours 148
Every 2000 Service Hours 148
Every 250 Service Hours 148
Every 2500 Service Hours 148
Every 3 Years 148
Every 4000 Service Hours 148
Every 500 Service Hours 148
Every 6000 Service Hours 148
Initial 250 Service Hours (or at first oil change) 148
When Required 147
Maintenance Section 135
Maintenance Support 143
Mirror (If Equipped) 53
Mirror Adjustment 54
Moldboard Blade 119
Horizontal Adjustment of the Blade 119
Moldboard Wear Strip - Inspect/Adjust/ Replace 205
Type 1 205
Type 2 205
Monitoring System 96
Functional Test 113
Indicators and Gauges 96
Messenger Display 100
Warning Categories 113
Mounting and Dismounting 47
Alternate Exit 47
Machine Access System Specifications 47

O

Oil Filter - Inspect 208
Inspect a Used Filter for Debris 208
Oil Filter (Hydraulic Tank Return) - Replace . 206
Oil Filter (Implement Controls) - Replace 207
Operation 32
Limiting Conditions and Criteria 33
Machine Operating Temperature Range 32
Machine Operation 32
Operation Section 47
Operator Controls 57
Accelerator Control (55) 84
Access Platform Light Switch (If Equipped) (70) 87
Arm Pad Adjustment Knob (50) 81
Articulation Control (10) 71
Auto Differential Lock Switch (78) 90
Automatic Articulation Centering Control (5) 68
Autoshift Switch (76) 88
Auxiliary Control Roller (Lever 8) (If Equipped) (36) 76
Auxiliary Control Roller (Lever 9) (If Equipped) (37) 76
Auxiliary Pod (If Equipped) 73
Blade Circle Drive Control (19) 72
Blade Cushion Switch (68) 87
Blade Lift for the Left Side (9) 71
Blade Lift for the Right Side (14) 72
Blade Lift Modulation 70

Blade Lower and Blade Float for the Left Side (8) ... 71
Blade Lower and Blade Float for the Right Side (13) ... 71
Blade Pitch Control (Backward) (18) ... 72
Blade Pitch Control (Forward) (17) ... 72
Blade Rotation Angle Limit ... 72
Blade Sideshift Control (Left) (11) ... 71
Blade Sideshift Control (Right) (12) ... 71
Bluetooth Microphone (82) ... 90
Cab Door ... 92
Cab Floodlight Switch (79) ... 90
Cab Vent Windows (If Equipped) ... 92
Cat ® Grade Control Cross Slope (If Equipped) ... 74
Cat ® Grade Control Cross Slope Favorites (If Equipped) (35) ... 76
Centershift Control (Left) (15) ... 72
Centershift Control (Right) (16) ... 72
Centershift Lock Switch (61) ... 85
Cigar Lighter (24 V) (71) ... 87
Compression Brake Switch (66) ... 86
Control Pod Fore/Aft Adjustment Lever (49) ... 81
Control Pod Vertical Adjustment Knob (51) ... 81
Defroster Fan Switch (60) ... 85
Differential Lock Control (46) ... 77
Door Release Lever (44) ... 77
Downshift Switch (1) ... 67
Engine Idle Shutdown ... 92
Engine Start Switch (54) ... 82
Float Button (38) ... 76
Front and Rear Work Light Switch (80) ... 90
Hazard Flasher Switch (75) ... 88
Headlight and Taillight Switch (81) ... 90
Headlight Dimmer Switch (67) ... 87
Heated Glass Switch (If Equipped) (62) ... 86
Heated Mirror Switch (59) ... 85
Heating and Air Conditioning Controls ... 90
Horn (20) ... 73
Implement Control Roller (Lever 6) (If Equipped) (42) ... 76
Implement Control Roller (Lever 7) (If Equipped) (43) ... 76
Implement Lockout Feature ... 72
Implement Lockout Switch (69) ... 87
Interior Dome Light ... 92
Joystick Steering ... 68
Joystick Steering Alignment ... 68
Parking Brake Switch (53) ... 82
Power Port (12 V) (72) ... 87
Secondary Steering ... 69
Secondary Steering Test Switch (52) ... 82
Service Brake Control (56) ... 84
Snow Wing Light Switch (77) ... 89
Throttle Hold Mode Switch (73) ... 87
Throttle Resume/Decel Switch (45) ... 77
Throttle Set/Accel Switch (74) ... 88
Transmission Control Switch (47) ... 77
Transmission Modulator Control (Inching Pedal) (57) ... 84
Turn Signal Switch (21) ... 73
Upshift Switch (3) ... 67
Variable Blade Float ... 86
Warning Beacon Switch (58) ... 85
Wheel Lean Control (Left) (2) ... 67
Wheel Lean Control (Right) (4) ... 67
Wiper/Washer Controls ... 91
Wrist Rest Height Adjustment Knob (48) ... 81
Operator Station ... 38

P

Parking ... 35, 120
Plate Locations and Film Locations ... 42
Certification ... 43
Prepare the Machine for Maintenance ... 145
Maintenance with Electrical System Disabled ... 146
Maintenance with the Engine Running ... 146
Maintenance without the Engine Running ... 146
Product Information Section ... 40
Product Link ... 114
Data Broadcasts ... 114
Operation in a Blast Site for Product Link Radios ... 114

R

Reference Information Section ... 225
Reference Material ... 225
Reference Materials ... 225
Restricted Visibility ... 31
Retarding ... 94
Retarding Guidelines (Film) ... 94
Retarding Information and Conditions ... 95
Rim - Inspect ... 208
Magnetic Particle Inspection ... 209
Visual Inspection ... 208
Ripper Cylinder Bearings - Lubricate ... 209
Ripper Tip - Inspect/Replace ... 210

Roading the Machine 123
Rollover Protective Structure (ROPS) - Inspect 210

S

S·O·S Information 141
Safety Messages 6
  Accumulator (10) 13
  Accumulator (9) 12
  Do Not Operate (1) 9
  Do Not Weld On The ROPS/FOPS Structure (7) 11
  Engine Coolant (8) 12
  Hydraulic System Oil (12) 14
  Improper Connections For Jump Start Cables (3) 9
  No Clearance (11) 13
  No Clearance (4) 10
  Product Link (5) (If Equipped) 10
  Recoil Spring (13) 14
  Seat Belt (6) 11
  Unplanned Blade Movement (2) 9
Safety Section 6
Seat 50
  Air Suspension 51
  Mechanical Suspension 50
Seat Belt 51
  Extension of the Seat Belt 53
  Seat Belt Adjustment for Non-Retractable Seat Belts 51
  Seat Belt Adjustment for Retractable Seat Belts 53
Seat Belt - Inspect 211
Seat Belt - Replace 211
Secondary Steering - Test 212
Shipping the Machine 123
Slope Operation 35
Sound Information and Vibration Information 36
  Sound Level Information 36
  Sound Level Information for Machines in European Union Countries and in Countries that Adopt the “European Union Directives” 37
  “The European Union Physical Agents (Vibration) Directive 2002/44/EC” 37
Specifications 40
  Application/Configuration Restrictions 41
  Intended Use 41
Spindle - Inspect 213
Steering Cylinder Ends and Tie Rods - Lubricate 213
Steering Frame Lock 48
Stopping the Engine 120
Stopping the Engine if an Electrical Malfunction Occurs 121
Stopping the Machine 120
  Warm Storage 120
System Pressure Release 143
  Coolant System 143
  Engine Oil System 145
  Fuel System 143
  Hydraulic System 143

T

Table of Contents 3
Tandem - Check 213
Tandem Breather - Clean/Replace 213
Tandem Drive Oil - Change 213
Tandem Drive Oil Level - Check 214
Tandem Drive Oil Sample - Obtain 215
Tire Inflation - Check 215
Tire Inflation Information 135
Tire Inflation Pressure Adjustment 135
Tire Inflation with Nitrogen 135
Tire Information 28
Tire Shipping Pressure 135
Towing Information 128
Towing the Machine 128
  Dead Engine 130
  Retrieval, Push, and Pull Locations 129
  Running Engine 130
Transmission and Differential Oil - Change 215
Transmission and Differential Oil Filter and Screens - Replace/Clean 217
Transmission and Differential Oil Level - Check 219
Transmission and Differential Oil Sample - Obtain 219
Transportation Information 123

V

Visibility Information 31

W

Warranty Information 224
Warranty Section 224
Welding on Machines and Engines with Electronic Controls 145

Wheel Bearing Oil (Front) - Change..... 220
Wheel Bearing Oil Level (Front) - Check 221
Wheel Bearing Oil Sample (Front) - Obtain .. 221
Wheel Lean Bearings - Lubricate..... 221
Wheel Lean Bar Bearings..... 222
Wheel Lean Bearings 222
Wheel Lean Cylinder Bearings..... 222
Window Washer Reservoir - Fill..... 222

Product and Dealer Information

Note: For product identification plate locations, see the section “Product Identification Information” in the Operation and Maintenance Manual.

Delivery Date: _____

Product Information

Model: _____

Product Identification Number: _____

Engine Serial Number: _____

Transmission Serial Number: _____

Generator Serial Number: _____

Attachment Serial Numbers: _____

Attachment Information: _____

Customer Equipment Number: _____

Dealer Equipment Number: _____

Dealer Information

Name: _____ Branch: _____

Address: _____

_____

_____

	Dealer Contact	Phone Number	Hours
Sales:	_____	_____	_____
Parts:	_____	_____	_____
Service:	_____	_____	_____