



Operation and Maintenance Manual

C7.1 Generator Sets

T97 1-UP (C7.1 Generator

Set)

T99 1-UP (C7.1 Generator

Set)

T9T 1-UP (C7.1 Generator

Set)

T9W 1-UP (C7.1 Generator

Set)

Language: Original Instructions



Scan to find and purchase genuine Cat® parts and related
service information.



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.

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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 contains safety, operation instructions, lubrication, and maintenance information. This manual should be stored in or near the engine area in a literature holder or literature storage area. Read, study, and keep it with the literature and engine information.

English is the primary language for all Cat publications. The English used facilitates translation and consistency in electronic media delivery.

Some photographs or illustrations in this manual show details or attachments that may be different from your engine. Guards and covers may have been removed for illustrative purposes. Continuing improvement and advancement of product design may have caused changes to your engine which are not included in this manual. Whenever a question arises regarding your engine, or this manual, please consult with your Cat dealer for the latest available information.

Safety

This safety section lists basic safety precautions. In addition, this section identifies hazardous, warning situations. Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance, and repair on this product.

Operation

Operating techniques outlined in this manual are basic. They assist with developing the skills and techniques required to operate the engine more efficiently and economically. Skill and techniques develop as the operator gains knowledge of the engine and its capabilities.

The operation section is a reference for operators. Photographs and illustrations guide the operator through procedures of inspecting, starting, operating, and stopping the engine. This section also includes a discussion of electronic diagnostic information.

Maintenance

The maintenance section is a guide to engine care. The illustrated, step-by-step instructions are grouped by fuel consumption, service hours and/or calendar time maintenance intervals. Items in the maintenance schedule are referenced to detailed instructions that follow.

Use fuel consumption or service hours to determine intervals. Calendar intervals shown (daily, annually, etc.) may be used instead of service meter intervals if they provide more convenient schedules and approximate the indicated service meter reading.

Recommended service should be performed at the appropriate intervals as indicated in the Maintenance Interval Schedule. The actual operating environment of the engine also governs the Maintenance Interval Schedule. Therefore, under severe, dusty, wet, or freezing cold operating conditions, more frequent lubrication, and maintenance than is specified in the Maintenance Interval Schedule may be necessary.

The maintenance schedule items are organized for a preventive maintenance management program. If the preventive maintenance program is followed, a periodic tune-up is not required. The implementation of a preventive maintenance management program should minimize operating costs through cost avoidances resulting from reductions in unscheduled downtime and failures.

Maintenance Intervals

Perform maintenance on items at multiples of the original requirement. Each level and/or individual items in each level should be shifted ahead or back depending upon your specific maintenance practices, operation, and application. We recommend that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. We also recommend that a maintenance record be maintained as part of the engine's permanent record.

See the section in the Operation and Maintenance Manual, "Maintenance Records" for information regarding documents that are accepted as proof of maintenance or repair. Your authorized Cat dealer can assist you in adjusting your maintenance schedule to meet the needs of your operating environment.

Overhaul

Major engine overhaul details are not covered in the Operation and Maintenance Manual except for the interval and the maintenance items in that interval. Major repairs are best left to trained personnel or an authorized Cat dealer. Your Cat dealer offers various options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available from your Cat dealer. Consult with your dealer for information regarding these options.

Safety Section

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Safety Messages

SMCS Code: 1000; 7405

There may be several specific safety messages on your generator set. The exact location and a description of the safety messages are reviewed in this section. Become familiar with all safety messages.

Ensure that all the safety messages are legible. Clean the safety signs or replace the safety messages if the words cannot be read or if the illustrations are not visible. Use a cloth, water, and soap to clean the safety messages. Do not use solvents, gasoline, or other harsh chemicals. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the safety messages. The safety messages that are loosened could drop off the engine.

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

WARNING

Do not operate or work on this engine 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

Electrical backfeed into a utility's distribution system can cause property damage, severe injury, or death. Do not connect generator to a building's main switch has been used to isolate the building from the utility power system. For permanent installations, connection shall only be a double throw switch as to isolate the building from a utility power system. Consult a qualified technician for proper use and installation. Comply with all applicable laws and electrical codes.

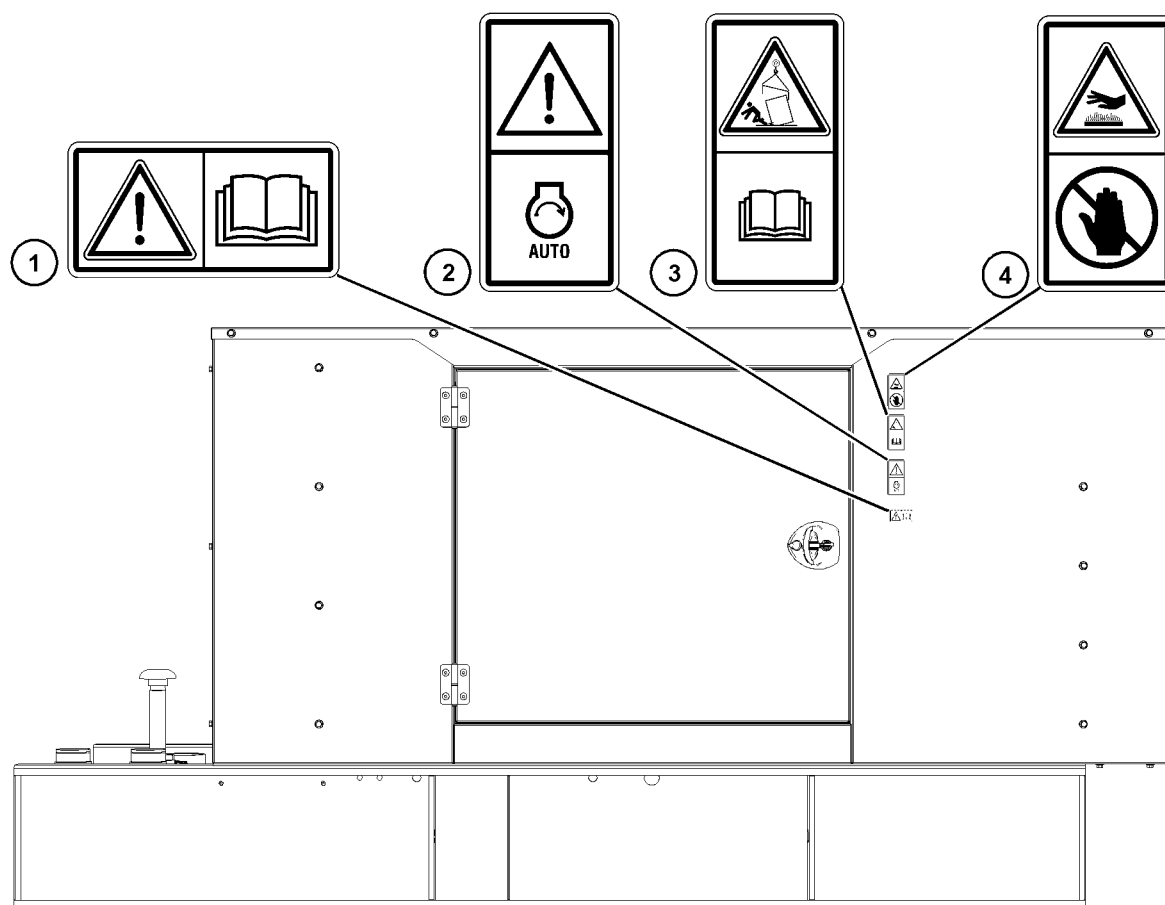


Illustration 1

Side view of the generator set

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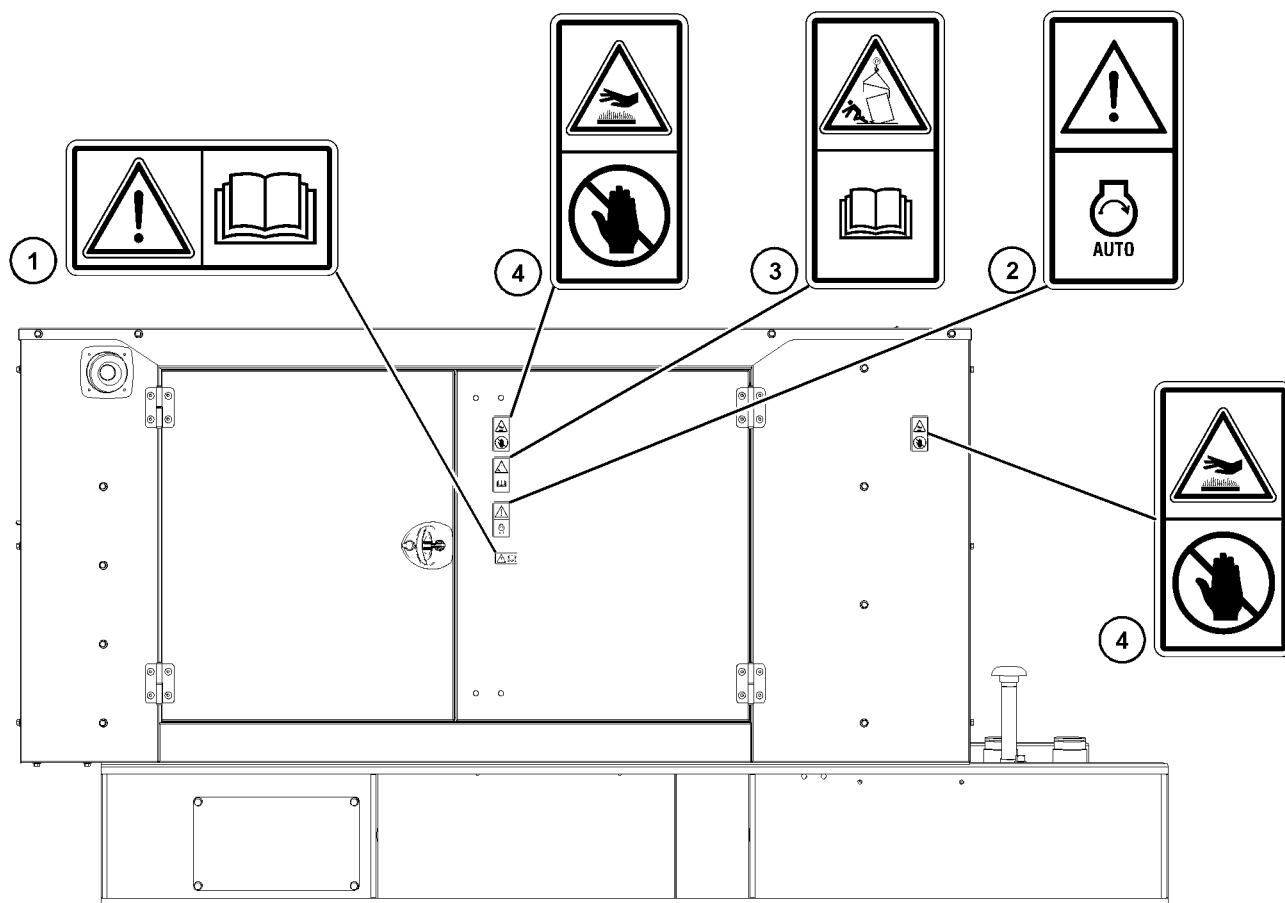


Illustration 2
View of the control panel

g06611729

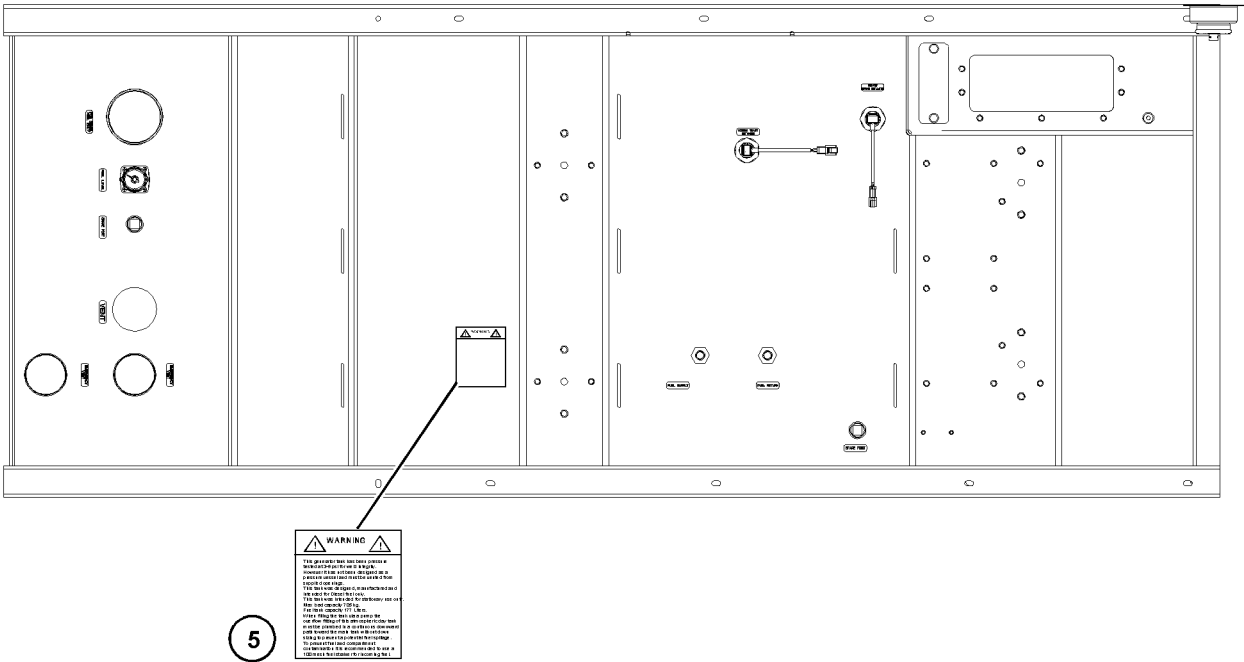


Illustration 3

g06618372

View of the fuel tank

Universal Warning (1)

This safety message is on both sides of the engine.



Illustration 4

g01370904

! WARNING

Do not operate or work on this equipment 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 serious injury or death.

Automatic Starting (2)

This safety message is on the sides of the enclosure and on the enclosure above the door for the control panel.



Illustration 5

g01392484

! WARNING

When the engine is in the AUTOMATIC mode, the engine can start at any moment. To avoid personal injury, always remain clear of the the engine when the engine is in the AUTOMATIC mode.

Crushing (3)

One safety message is on each side of the enclosure.

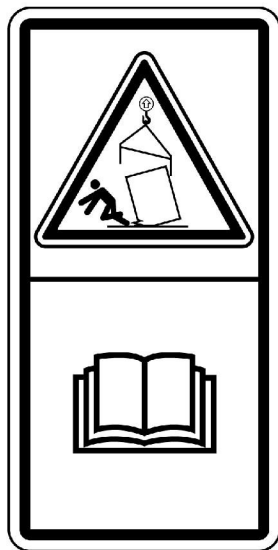


Illustration 6

g01433231

⚠ WARNING

Crushing Hazard! Improper lifting could cause serious injury or death. Follow the lifting instructions in the Operation and Maintenance Manual for safe lifting procedures.

Hot Surface (4)

This safety message is on the top of the enclosure and the sides of the enclosure.



Illustration 7

g01372256

⚠ WARNING

Hot parts or hot components can cause burns or personal injury. Do not allow hot parts or components to contact your skin. Use protective clothing or protective equipment to protect your skin.

Fuel Tank Vent (5)

This safety message is on the fuel tank next to the vent.

i08340590

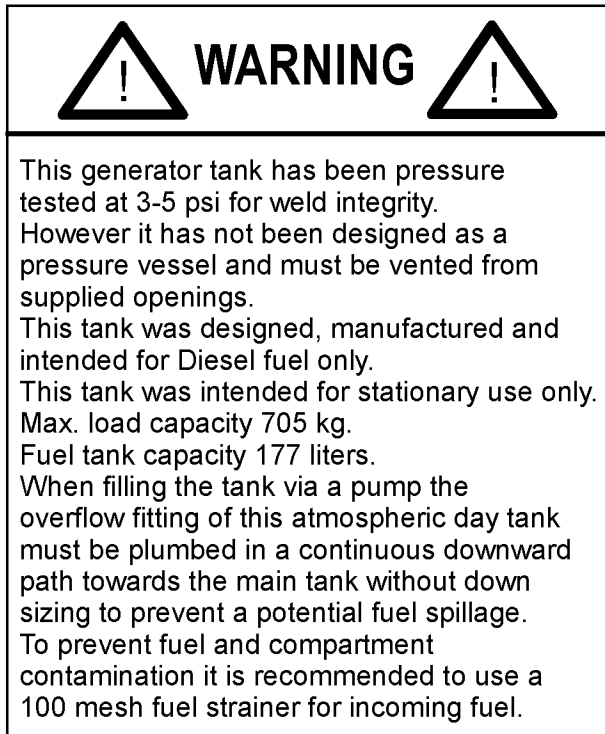


Illustration 8

g01175225

! WARNING

This generator tank has been pressure tested at 3-5 PSI for weld integrity.

However it has not been designed as a pressure vessel and must be vented from supplied openings.

This tank was designed, manufactured and intended for Diesel fuel only.

This tank was intended for stationary use only.

Max. load capacity 705 kg (1554 lb).

Fuel tank capacity 177 L (47 US gal).

When filling the tank via a pump the overflow fitting of this atmospheric day tank must be plumbed in a continuous downward path toward the main tank without downsizing to prevent a potential fuel spillage.

To prevent fuel and compartment contamination it is recommended to use a 100 mesh fuel strainer for incoming fuel.

General Hazard Information

SMCS Code: 1000; 4450; 7405

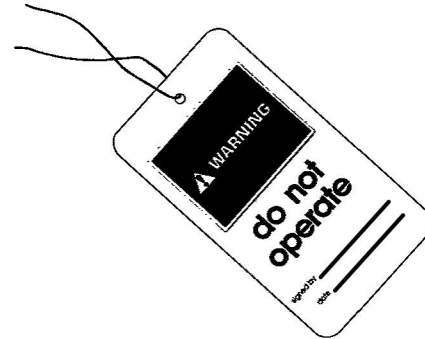


Illustration 9

g03838041

Attach a "Do Not Operate" warning tag to the start switch or controls before the engine is serviced or repaired. These warning tags (Special Instruction, SEHS7332) are available from your Cat dealer. Attach the warning tags to the engine and to each operator control station. When appropriate, disconnect the starting controls.

Do not allow unauthorized personnel on the engine, or around the engine when the engine is being serviced.

Cautiously remove the following parts. To help prevent spraying or splashing of pressurized fluids, hold a rag over the part that is being removed.

- Filler caps
- Grease fittings
- Pressure taps
- Breathers
- Drain plugs

Use caution when cover plates are removed. Gradually loosen, but do not remove the last two bolts or nuts that are located at opposite ends of the cover plate or the device. Before removing the last two bolts or nuts, pry the cover loose in order to relieve any spring pressure or other pressure.

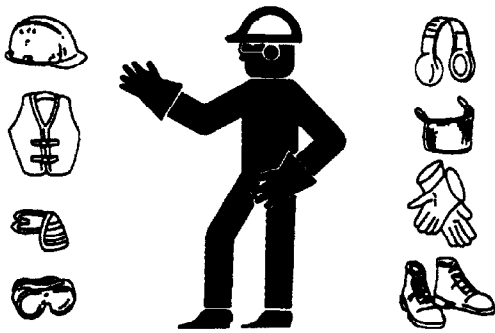


Illustration 10

g00702020

- Wear a hard hat, protective glasses, and other protective equipment, as required.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.
- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

Unless other instructions are provided, perform the maintenance under the following conditions:

- The engine is stopped. Ensure that the engine cannot be started.
- The protective locks or the controls are in the applied position.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.
- When starting a new engine, make provisions to stop the engine if an overspeed occurs. If an engine has not been started since service has been performed, make provisions to stop the engine if an overspeed occurs. Shutting down the engine may be accomplished by shutting off the fuel supply and/or the air supply to the engine.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.

- Start the engine with the operator controls. Never short across the starting motor terminals or the batteries. This method of starting the engine could bypass the engine neutral start system and/or the electrical system could be damaged.

Pressurized Air and Water

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

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

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. Always wear eye protection for cleaning the cooling system.

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 redeposited on hot surfaces.

Fluid Penetration

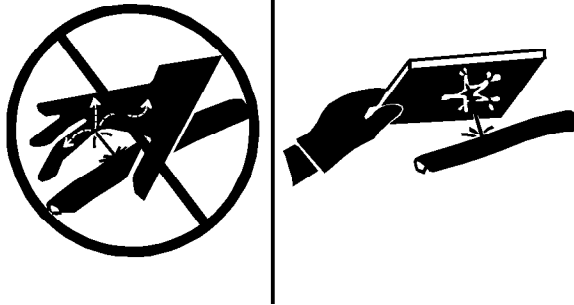


Illustration 11

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

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, NENG2500, "Cat Dealer Service Tool Catalog" or refer to Special Publication, PECJ0003, "Cat Shop Supplies and Tools Catalog" for tools and supplies suitable to collect and contain fluids on Cat products.

Dispose of all fluids according to local regulations and mandates.

Static Electricity Hazard when Fueling with Ultra-low Sulfur Diesel Fuel

The removal of sulfur and other compounds in ultra-low sulfur diesel fuel (ULSD fuel) decreases the conductivity of ULSD and increases the ability of ULSD to store static charge. Refineries may have treated the fuel with a static dissipating additive. Many factors can reduce the effectiveness of the additive over time. Static charges can build up in ULSD fuel while the fuel is flowing through fuel delivery systems. Static electricity discharge when combustible vapors are present could result in a fire or explosion. Ensure that the entire system used to refuel your machine (fuel supply tank, transfer pump, transfer hose, nozzle, and others) is properly grounded and bonded. Consult with your fuel or fuel system supplier to ensure that the delivery system complies with fueling standards for proper grounding and bonding.

WARNING

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

Lines, Tubes, and Hoses

Do not bend or strike high-pressure lines. Do not install lines, tubes, or hoses that are damaged.

Repair any fuel lines, oil lines, tubes, or hoses that are loose or damaged. Leaks can cause fires.

Inspect all lines, tubes, and hoses carefully. Do not use bare hands to check for leaks. Always use a board or cardboard for checking engine components for leaks. Tighten all connections to the recommended torque.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Wire that is exposed in reinforced hose
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

Ensure that all of the clamps, the guards, and the heat shields are installed correctly. Correct installation of these components will help to prevent these effects: vibration, rubbing against other parts and excessive heat during operation.

Inhalation

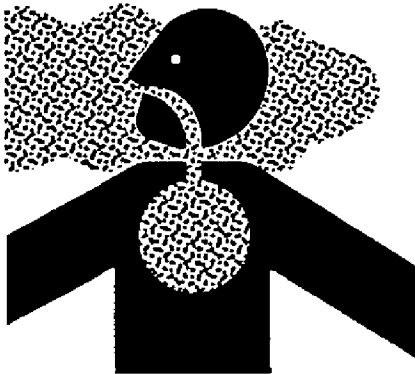


Illustration 12

g02159053

Exhaust

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

Hexavalent Chromium

Cat equipment and replacement parts comply with applicable regulations and requirements where originally sold. Caterpillar recommends the use of only genuine Cat replacement parts.

Hexavalent chromium has occasionally been detected on exhaust and heat shield systems on Cat engines. Although lab testing is the only accurate way to know if hexavalent chromium is, in fact, present, the presence of a yellow deposit in areas of high heat (for example, exhaust system components or exhaust insulation) may be an indication of the presence of hexavalent chromium.

Use caution if you suspect the presence of hexavalent chromium. Avoid skin contact when handling items that you suspect may contain hexavalent chromium, and avoid inhalation of any dust in the suspect area. Inhalation of, or skin contact with, hexavalent chromium dust may be hazardous to your health.

If such yellow deposits are found on the engine, engine component parts, or associated equipment or packages, Caterpillar recommends following local health and safety regulations and guidelines, utilizing good hygiene, and adhering to safe work practices when handling the equipment or parts. Caterpillar also recommends the following:

- Wear appropriate personal protective equipment (PPE).
- Wash your hands and face with soap and water prior to eating, drinking, or smoking, and also during rest room breaks, to prevent ingestion of any yellow powder.
- Never use compressed air for cleaning areas suspected of containing hexavalent chromium.
- Avoid brushing, grinding, or cutting materials suspected of containing hexavalent chromium.
- Obey environmental regulations for the disposal of all materials that may contain or have come into contact with hexavalent chromium.
- Stay away from areas that might have hexavalent chromium particles in the air.

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”.
- Obey environmental regulations for the disposal of asbestos.
- Stay away from areas that might have asbestos particles in the air.

Softwrap

Keep the engine room ventilation operating at full capacity. Wear a particulate respirator that has been approved by the National Institute of Occupational Safety and Health (NIOSH). Wear appropriate protective clothing in order to minimize direct contact. Use good hygiene practices and wash hands thoroughly after handling Softwrap material. Do not smoke until washing hands thoroughly after handling Softwrap material. Clean up debris with a vacuum or by wet sweeping. Do not use pressurized air to clean up debris.

Reference: The applicable material safety data sheets can be found at the following web site by searching using part number or the name:

[https://catmsds.cat.com/MSDSSearch/servlet/
cat.cis.ecs.
msdSearch.controller.
UserIdentificationDisplayServlet](https://catmsds.cat.com/MSDSSearch/servlet/cat.cis.ecs.msdSearch.controller.UserIdentificationDisplayServlet)

Dispose of Waste Properly

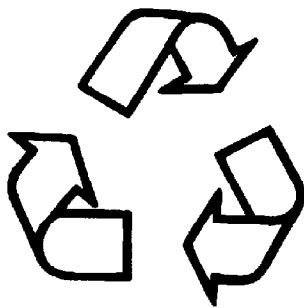


Illustration 13

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.

i04422525

Burn Prevention

SMCS Code: 1000; 4450; 7405

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 hydraulic 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 after the engine has stopped and the engine has been allowed to cool.

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 in order 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 lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

i04823639

Fire Prevention and Explosion Prevention

SMCS Code: 1000; 4450; 7405



Illustration 14

g00704000

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

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

A flash fire may result if the covers for the engine crankcase are removed within 15 minutes after an emergency shutdown.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result.

If the application involves the presence of combustible gases, consult your Cat dealer for additional information about suitable protection devices.

Remove all flammable materials such as fuel, oil, and debris from the engine. Do not allow any flammable materials to accumulate on the engine.

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

Do not expose the engine to any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil or fuel spray in a line, a tube, or a seal failure. Exhaust shields must be installed correctly.

Do not weld on lines or tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent prior to welding or flame cutting.

Wiring must be kept in good condition. Check all electrical wires daily. Ensure that all electrical wires are properly routed and securely attached. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Eliminate all wiring that is unattached or unnecessary. Do not use any wires or cables that are smaller than the recommended gauge. Do not bypass any fuses and/or circuit breakers.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and properly maintained battery cables will help to prevent arcing or sparking.

Inspect all lines and hoses for wear or for deterioration. Properly route all hoses. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Properly install all oil filters and fuel filters. The filter housings must be tightened to the proper torque.



Illustration 15

g00704059

Use caution when you are refueling an engine. Do not smoke while you are refueling an engine. Do not refuel an engine near open flames or sparks. Always stop the engine before refueling.



Illustration 16

g02298225

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.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

Improper jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions.

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

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

Fire Extinguisher

Make sure that a fire extinguisher is available. Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

Ether

WARNING

Do not use ether. This machine is equipped with glow plugs. Using ether can create explosions or fires that can cause personal injury or death. Read and follow the engine starting procedure in the Operation and Maintenance Manual.

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.

Repair any lines that are loose or damaged. Leaks can cause fires. Consult your Cat dealer for repair or for replacement parts.

Check lines, tubes, and hoses carefully. Do not use your bare hand to check for leaks. Use a board or cardboard to check for leaks. Tighten all connections to the recommended torque.

Replace the 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 ballooning.
- Flexible parts of the hoses are kinked.
- Outer covers have embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly in order to prevent vibration, rubbing against other parts, and excessive heat.

i08700004

i08162291

Crushing Prevention and Cutting Prevention

SMCS Code: 1000; 4450; 7405

Support the component properly when work beneath the component is performed.

Unless other maintenance instructions are provided, never attempt adjustments while the engine is running.

Stay clear of all rotating parts and of all moving parts. Leave the guards in place until maintenance is performed. After the maintenance is performed, reinstall the guards.

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

When objects are struck, wear protective glasses to avoid injury to the eyes.

Chips or other debris may fly off objects when objects are struck. Before objects are struck, ensure that no one will be injured by flying debris.

i04597969

Mounting and Dismounting

SMCS Code: 1000; 4450; 7405

Inspect the steps, the handholds, and the work area before mounting the unit. Keep these items clean and keep these items in good repair.

Mount the unit and dismount the unit only at locations that have steps and/or handholds. Do not climb on the engine, and do not jump off the engine.

Face the unit in order to mount the unit or dismount the unit. Maintain a three-point contact with the steps and handholds. Use 2 feet and one hand or use 1 foot and two hands. Do not use any controls as handholds.

Some units require access to the roof of the enclosure to perform maintenance. Do not stand on components which cannot support your weight. Use an adequate ladder or use a work platform. Secure the climbing equipment so that the equipment will not move.

Do not carry tools or supplies when you mount the engine or when you dismount the engine. Use a hand line to raise and lower tools or supplies.

Sound Information

SMCS Code: 1000

Sound Level Information for Products Required by the Applicable Regional Regulations

- **European Union Countries**
- **United Kingdom**
- **Eurasian Economic Union Countries**
- **Ukraine**
- **Countries that Adopt the “EU Directives”**

The information below applies to only the product configurations that contain regional product marking on or near the Product Identification Plate noted in the “Regional Product Marking” section of this manual.

Table 1

Sound Level		
Region	Engine Model	Maximum Guaranteed Value (GV) dB(A) ⁽¹⁾⁽²⁾
EU UK EEU Ukraine	C7.1	97

⁽¹⁾ Measured at 75% rated power per test method ISO 8528-10.

⁽²⁾ Maximum GV for generator set per engine model. Refer to the supplied DoC for individual generator set model GV.

The sound levels listed above include both measurement uncertainty and uncertainty due to production variation.

The product sound power level meets the criteria that are specified in the applicable regional regulation. For example:

- “European Directive 2000/14 EC” amended by “2005/88/EC”
- “United Kingdom 2001 No. 1701” amended by “2005 No. 3525”
- “Ukraine Technical Regulation of the Noise Emission in the Environment by Equipment for Use Outdoors”

The criteria are specified on the certificate of the conformance and the accompanying labels.

i05322934

High Pressure Fuel Lines

SMCS Code: 1274

WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

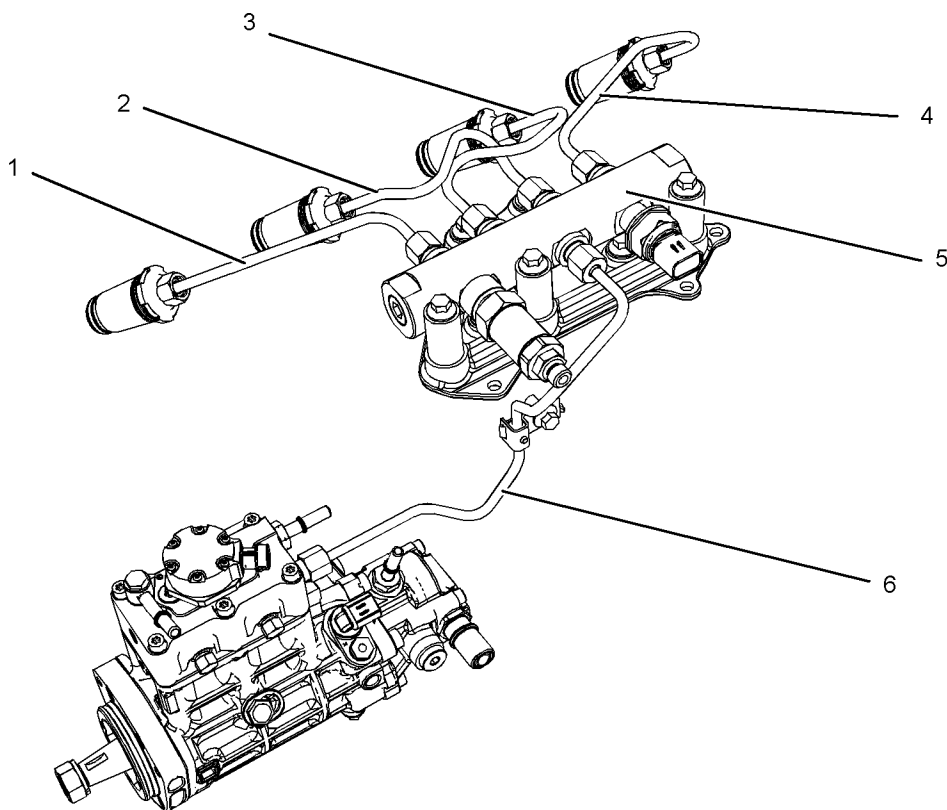


Illustration 17

g01425090

(1) High-pressure line
(2) High-pressure line

(3) High-pressure line
(4) High-pressure line

(5) High-pressure fuel manifold (rail)
(6) High-pressure line

The high-pressure fuel lines are the fuel lines that are between the high-pressure fuel pump and the high-pressure fuel manifold and the fuel lines that are between the fuel manifold and cylinder head. These fuel lines are different from fuel lines on other fuel systems.

The differences are as follows:

- The high-pressure fuel lines are constantly charged with high pressure.

- The internal pressures of the high-pressure fuel lines are higher than other types of fuel system.
- The high-pressure fuel lines are formed to shape and then strengthened by a special process.

Do not step on the high-pressure fuel lines. Do not deflect the high-pressure fuel lines. Do not bend or strike the high-pressure fuel lines. Deformation or damage of the high-pressure fuel lines may cause a point of weakness and potential failure.

Do not check the high-pressure fuel lines with the engine or the starting motor in operation. After the engine has stopped, allow 10 minutes to pass in order to allow the pressure to be purged before any service or repair is performed on the engine fuel lines.

Do not loosen the high-pressure fuel lines in order to remove air from the fuel system. This procedure is not required.

Visually inspect the high-pressure fuel lines before the engine is started. This inspection should be each day.

If you inspect the engine in operation, always use the proper inspection procedure in order to avoid a fluid penetration hazard. Refer to Operation and Maintenance Manual, "General Hazard Information".

- Inspect the high pressure for the following: damage, deformation, a nick, a cut, a crease, or a dent
- Do not operate the engine with a fuel leak. If there is a leak, do not tighten the connection in order to stop the leak. The connection must only be tightened to the recommended torque. Refer to Disassembly and Assembly Manual, "Fuel Injection Lines - Remove and Fuel Injection Lines - Install".
- If the high-pressure fuel lines are torqued correctly, and the high-pressure fuel lines are leaking, the high-pressure fuel lines must be replaced.
- Ensure that all clips on the high-pressure fuel lines are in place. Do not operate the engine with clips that are damaged, missing, or clips that are loose.
- Do not attach any other item to the high-pressure fuel lines.
- Loosened high-pressure fuel lines must be replaced. Also removed high-pressure fuel lines must be replaced. Refer to Disassembly and Assembly Manual, "Fuel Injection Lines - Install".

i04642173

Battery Information

SMCS Code: 1401

The servicing of batteries is to be performed or supervised by personnel knowledgeable of batteries and the required precautions. Keep unauthorized personnel away from batteries.

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

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

Generator set applications commonly use a constant charge such as a float charge during operation. The use of this type of constant charge shortens the life of the battery if the battery is not maintained properly. Using accessible batteries allows proper maintenance and service to the batteries.

The nominal system voltage for this generator set is 12V.

When replacing batteries, use the same number and 12 V.

WARNING

A battery presents a risk of electrical shock and high short circuit current.

The following precautions are to be observed when working on batteries:

- Remove watches, rings, or other metal objects.
- Use tools with insulated handles.
- Do not lay tools or metal parts on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals. Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating.
- Determine if the battery is inadvertently grounded. When inadvertently grounded, remove source of ground. Contact with any part of a grounded battery is capable of resulting in electrical shock. The risk of such shock is reduced when such grounds are removed during installation and maintenance (applicable to a generator not having a grounded supply circuit).

Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.

WARNING

A battery presents a risk of fire and explosion.

Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

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

A spark can cause the combustible gases that are produced by some batteries to ignite.

To help prevent sparks from igniting combustible gases that are produced by some batteries, the negative “-” jump-start cable should be connected last from the external power source to the negative “-” terminal of the starting motor. If the starting motor is not equipped with a negative “-” terminal, connect the jump-start cable to the engine block.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and properly maintained battery cables will help to prevent arcing or sparking.

Improper jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions. 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.

Lead-acid batteries present a risk of fire because they generate hydrogen gas. The following procedures are to be followed:

- DO NOT SMOKE when near batteries.
- DO NOT cause flame or spark in battery area.
- Discharge static electricity from body before touching batteries by first touching a grounded metal surface.

WARNING

A battery presents a potential burn hazard.

The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes and is toxic. The electrolyte is electrically conductive and corrosive.

The following procedures are to be observed:

- Do not open or mutilate the battery or batteries.

- Wear full eye protection and protective gloves and clothing.
- Where electrolyte contacts the skin, wash off immediately with water.
- Where electrolyte contacts the eyes, flush thoroughly and immediately with water and seek medical attention.
- Spilled electrolyte is to be washed down with an acid neutralizing agent. A common practice is to use a solution of 500 g (1 lb) bicarbonate of soda to 4 L (1 US gal) of water. The bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.
- Wash hands after touching the batteries and connectors.

Refer to Special Instruction, SEHS7633, “Battery Test Procedure” for additional instruction.

i08614835

Before Starting Engine

SMCS Code: 1000

NOTICE

For initial start-up of a new or rebuilt engine, and for start-up of an engine that has been serviced, make provision to shut the engine off should an overspeed occur. This may be accomplished by shutting off the air and/or fuel supply to the engine.

WARNING

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.

Inspect the engine for potential hazards.

Do not start the engine if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the start switch. Do not move any of the controls if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the controls.

Before starting the engine, ensure that no one is on, underneath, or close to the engine. Ensure that the area is free of personnel.

If equipped, ensure that the lighting system for the engine is suitable for the conditions. Ensure that all lights work properly, if equipped.

All protective guards and all protective covers must be installed if the engine must be started to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Do not bypass the automatic shutoff circuits. Do not disable the automatic shutoff circuits. The circuits are provided to help prevent personal injury. The circuits are also provided to help prevent engine damage.

See the Service Manual for repairs and for adjustments.

i08238394

Engine Starting

SMCS Code: 1000

WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

If a warning tag is attached to the engine start switch or to the controls, DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Start the engine from the operator's compartment or from the engine start switch.

Always start the engine according to the procedure that is described in the Operation and Maintenance Manual, "Engine Starting" topic in the Operation Section. Knowing the correct procedure will help to prevent major damage to the engine components. Knowing the procedure will also help to prevent personal injury.

To ensure that the jacket water heater (if equipped) and/or the lube oil heater (if equipped) is working correctly, check the water temperature gauge and the oil temperature gauge during the heater operation.

WARNING

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.

Note: The engine is equipped with an automatic device for cold starting for normal conditions of operation. If the engine will be operated in very cold conditions, then an extra cold starting aid may be required. Normally, the engine will be equipped with the correct type of starting aid for your region of operation.

The engines are equipped with a glow plug starting aid in each individual cylinder that heats the intake air to improve starting.

i01928905

Engine Stopping

SMCS Code: 1000

Stop the engine according to the procedure in the Operation and Maintenance Manual, "Engine Stopping (Operation Section)" in order to avoid overheating of the engine and accelerated wear of the engine components.

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. Do not use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

Stop the engine if an overspeed condition occurs during the initial start-up of a new engine or an engine that has been overhauled. This may be accomplished by shutting off the fuel supply to the engine and/or shutting off the air supply to the engine.

i08308014

Electrical System

SMCS Code: 1000; 1400

Check the electrical wires for wires that are loose or frayed. Tighten all loose electrical wires before the engine is operated. Repair all frayed electrical wires before the engine is started. See the Operation and Maintenance Manual, "Engine Starting" for specific starting instructions.

Grounding Practices

The electrical system for the engine must be properly grounded. Proper grounding is necessary for optimum engine performance and reliability. Improper grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to main bearings, to crankshaft bearing journal surfaces, and to aluminum components. Uncontrolled electrical circuit paths can also cause electrical noise.

The alternator, the starting motor, and all of the electrical systems **MUST** be grounded to the negative battery terminal.

For engines which have an alternator that is grounded to an engine component, a ground strap **MUST** connect that component to the negative battery terminal and the component **MUST** be electrically isolated from the engine.

A bus bar with a direct path to the negative “-” battery terminal is permissible and recommended for use for all components that require a negative “-” battery connection. The bus bar should be directly connected to the negative “-” battery terminal. A bonding cable should also be connected from the cylinder block to the bus bar on the negative “-” battery connection.

Use of a bus bar ensures that the Electronic Control Module (ECM) and all of the components that are connected to the ECM have a common reference point.

Grounding electrode terminal (Optional) - Listed (KDER) or (ZMVV), terminal. Located on the frame of the generator set (Bolted to the base framework) and sized as follows. Terminal should be labeled "Grounding Electrode Terminal".

Table 2

CB Current Rating (Amperes)	Grounding Electrode Terminal (AWG or kcmil) p copper
20–90	8 AWG
100–150	6 AWG
200	4 AWG
300	2 AWG
400	1/0 AWG
500–600	2/0 AWG
800–6000	3/0 AWG

i05322947

Engine Electronics

SMCS Code: 1000; 1900

 **WARNING**

Tampering with the electronic system installation or the OEM wiring installation can be dangerous and could result in personal injury or death and/or engine damage.

This engine has a comprehensive, programmable Engine Monitoring System. The Engine Control Module (ECM) is able to monitor the engine operating conditions. If any of the engine parameters extend outside an allowable range, the ECM will initiate an immediate action.

The following actions are available for engine monitoring control: **WARNING**, **DERATE** and **SHUTDOWN**. These engine monitoring modes are able to limit engine speed and/or the engine power.

Many of the parameters that are monitored by the ECM can be programmed for the engine monitoring functions. The following parameters can be monitored as a part of the Engine Monitoring System:

- Engine Coolant Level
- Engine Coolant Temperature
- Engine Oil Pressure
- Engine Speed
- Fuel Temperature
- Intake Manifold Air Temperature
- System Voltage

The Engine Monitoring package can vary for different engine models and different engine applications. However, the monitoring system and the engine monitoring control will be similar for all engines.

Note: Many of the engine control systems and display modules that are available for Caterpillar Engines will work in unison with the Engine Monitoring System. Together, the two controls will provide the engine monitoring function for the specific engine application. Refer to the Troubleshooting Manual for more information.

i08292380

Generator Isolating for Maintenance

SMCS Code: 4450

When you service an electric power generation set or when you repair an electric power generation set, follow the procedure below:

1. Stop the engine.

i07765321

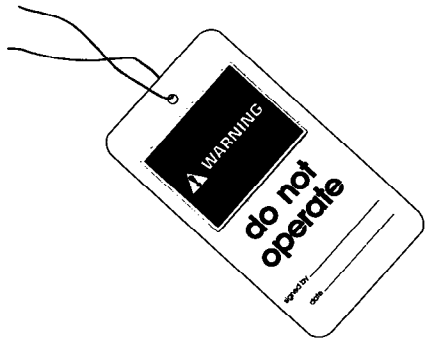


Illustration 18 g00104545

2. Attach a “DO NOT OPERATE” or similar warning tag to the engine prime mover starting circuit. Disconnect the engine starting circuit.
3. Disconnect the generator from the distribution system.
4. Lock out the circuit breaker. Attach a “DO NOT OPERATE” or similar warning tag to the circuit breaker. Refer to the electrical diagram. Verify that all points of possible reverse power flow have been locked out.
5. For the following circuitry, remove the fuses:
 - power
 - sensing
 - control
6. Attach a “DO NOT OPERATE” or similar warning tag to the generator excitation controls.
7. Remove the cover of the generator terminal box.
8. Use an audio/visual proximity tester to verify that the generator is de-energized. This tester must be insulated for the proper voltage rating. Follow all guidelines to verify that the tester is operational.
9. Determine that the generator is in a de-energized condition. Add ground straps to the conductors or terminals. During the entire work period, these ground straps must remain connected to the conductors and to the terminals.

Operation

SMCS Code: 4450

Limiting Conditions and Criteria

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

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

The Maintenance Interval Schedule in this Operation and Maintenance Manual describes limiting condition criteria that require repair or replacement for items (if equipped) such as alarms.

The Monitoring System (if equipped) describe in the Operation Section of this Operation and Maintenance Manual 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.

Table 3

System or Component Name	Limiting Condition	Criteria for Action	Required Action
Lines, tubes, and hoses	End fittings are damaged or leaking. 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.

(continued)

Safety Section
Operation

(Table 3, contd)

Battery cable	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.	Immediately replace damaged battery cables.
Safety messages	Appearance of safety message.	Damage to safety messages making messages illegible.	Replace the illustrations if illegible.
Audible warning devices (if equipped)	Sound level of audible warning.	Reduced or no audible warning present.	Immediately repair or replace audible warning devices not working properly.
Windows (if equipped)	Dirt, debris, or cracked windows	Dirt or debris obstructing operator visibility. Any cracked windows.	Clean windows if view is obstructed. Repair or replace cracked windows.
Cooling system	The coolant temperature is too high.	Monitoring system displays warning category 3.	Check the coolant level and check the radiator for debris. Refer to Operation and Maintenance Manual, Cooling System Coolant Level - Check. Refer to Operation and Maintenance Manual, Belts - Inspect/Adjust/Replace. Make any necessary repairs.

(Table 3, contd)

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.
Overall Generator Set	Service is required.	Monitoring system displays warning category 3	Stop the engine immediately. Contact your Cat dealer for service.

(continued)

Product Information Section

General Information

i08298335

Model View Illustrations

SMCS Code: 1000

The following model views display typical features of the generator sets that are described in this manual. The operator should become familiar with the locations of these items. Due to individual applications, your generator set may appear different from the illustrations.

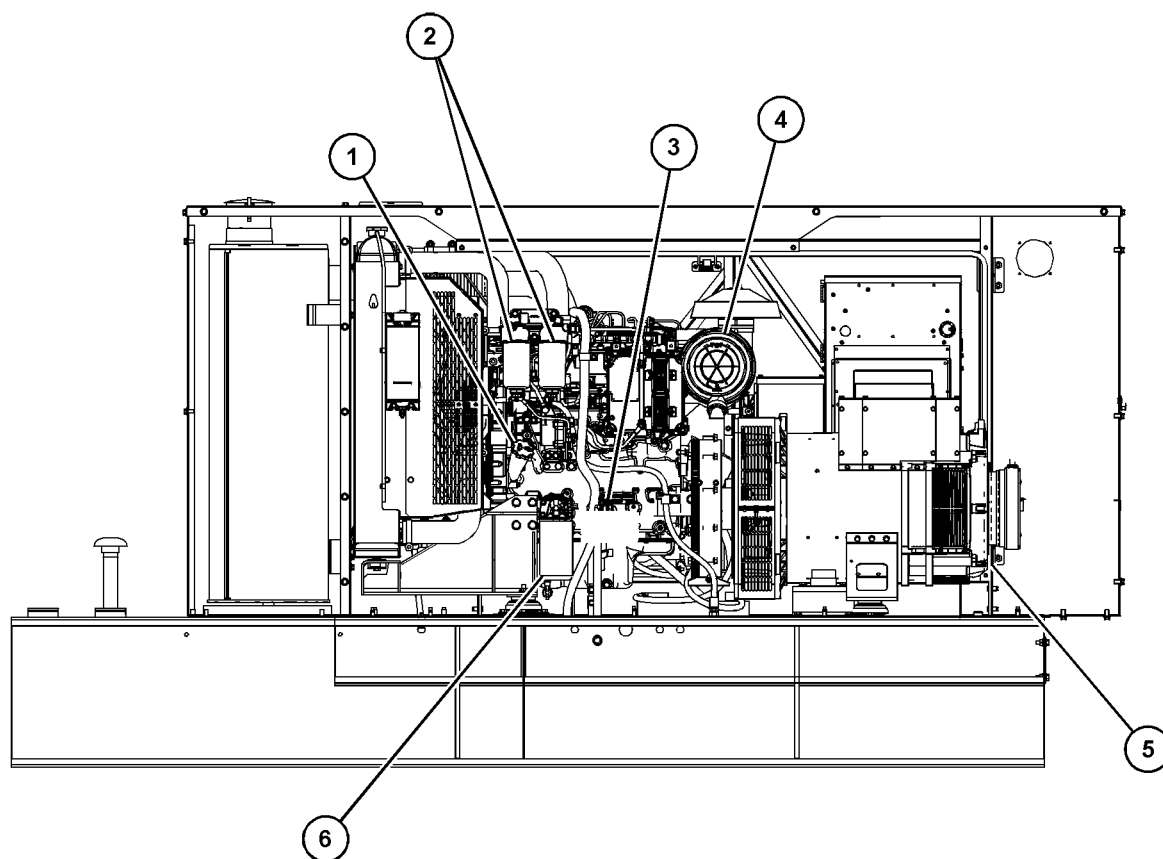


Illustration 19

g06618914

Typical example of a C4.4 generator set

(1) Engine Oil Filler Cap
(2) Engine Oil Filter

(3) Engine Oil Level Gauge (dipstick)
(4) Engine Air Cleaner

(5) Generator
(6) Fuel Filter

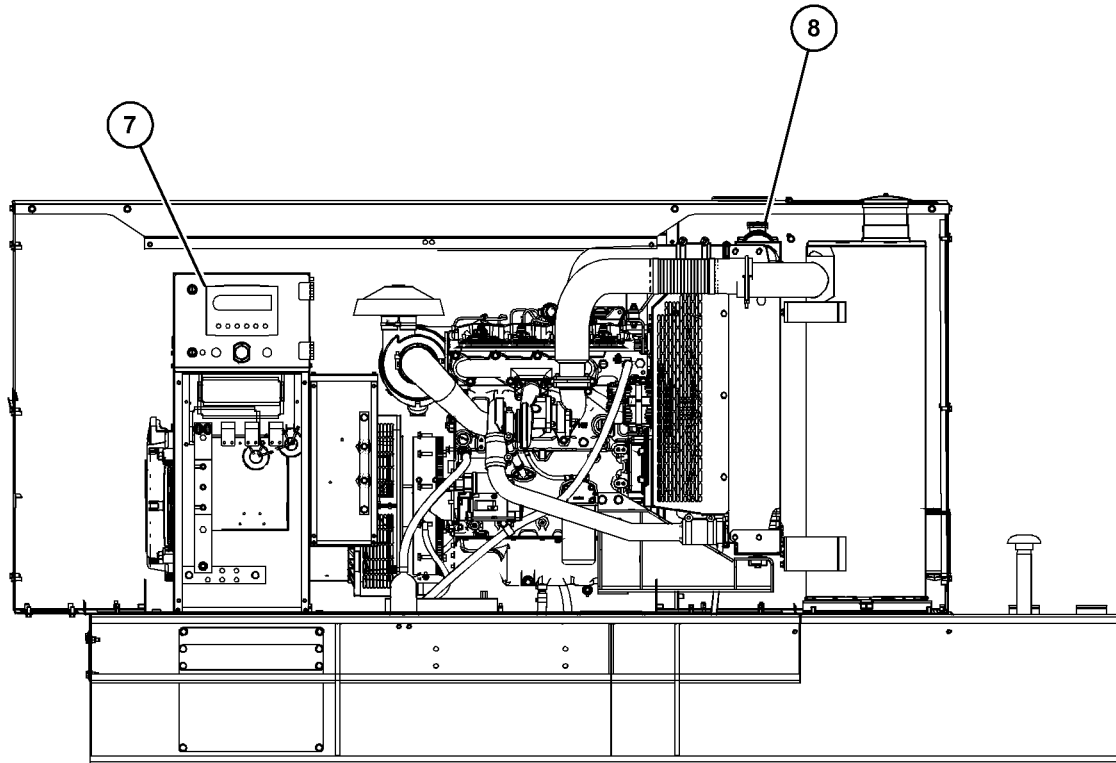


Illustration 20

g06618625

Typical example of a C4.4 generator set

(7) Control Panel

(8) Coolant Filler Cap

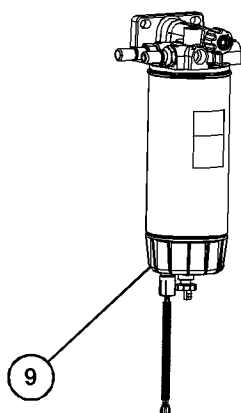


Illustration 21

g06618941

Water separator for C4.4 generator set

(9) Water Separator

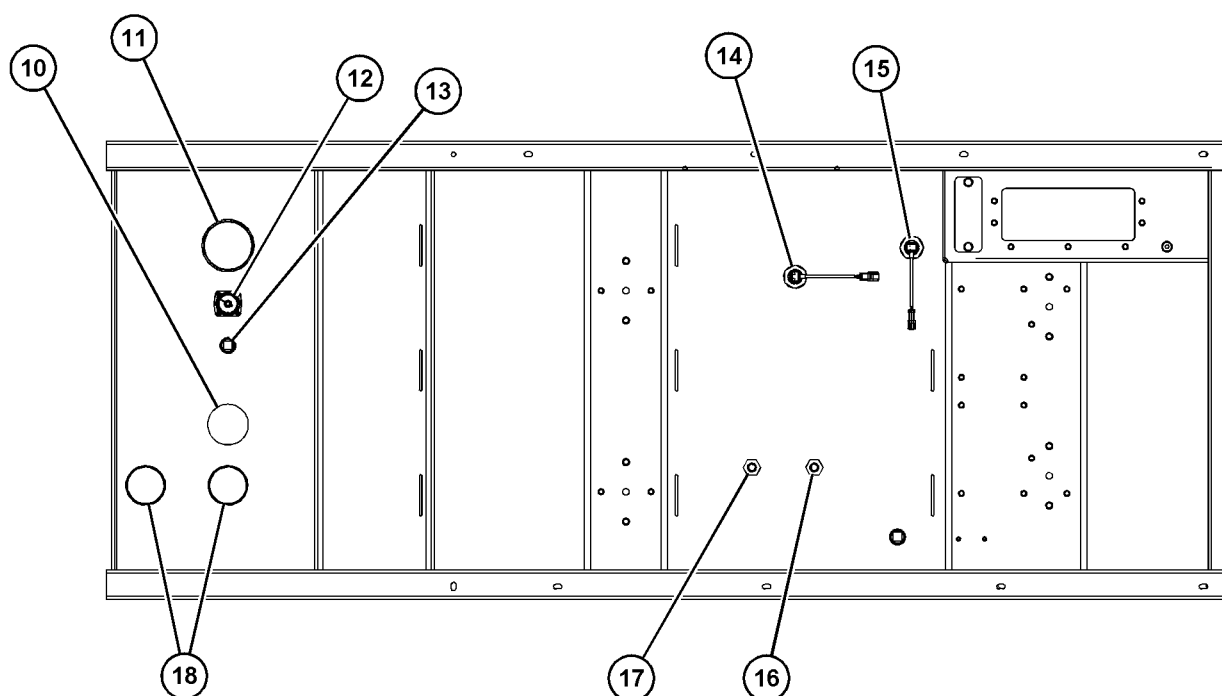


Illustration 22

g06618504

Top view of a fuel tank and base

Fuel tanks will vary. Items on the fuel tank have labels.

(10) Fuel Tank Vent
 (11) Diesel Fuel Port
 (12) Fuel Level Gauge

(13) Customer Port
 (14) Fuel Level Switch
 (15) Leakage Detector

(16) Fuel Return to Tank
 (17) Fuel Supply to Engine
 (18) Emergency Fuel Tank Vent

i08362205

Product Description

SMCS Code: 1000; 4450; 4491

C7.1 Generator Set Engine

The Cat C7.1 Generator Set Engine has the following characteristics.

- In-line six cylinder
- Four stroke cycle
- Turbocharged aftercooled

Engine Specifications

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right sides of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

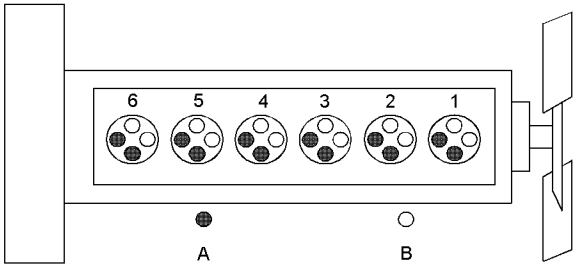


Illustration 23 g01127295

Cylinder and valve location

- (A) Exhaust valves
(B) Inlet valves

Table 4

C7.1 Engine Specifications	
Operating Range (rpm)	900 to 2800 ⁽¹⁾
Number of Cylinders	6 In-Line
Bore	105 mm (4.13 inch)
Stroke	135 mm (5.3 inch)
Aspiration	Turbocharged aftercooled
Compression Ratio	16.7:1
Displacement	7.01 L (428 inch ³)

(continued)

(Table 4, contd)

Firing Order	1-5-3-6-2-4
Rotation (flywheel end)	Counterclockwise

⁽¹⁾ The operating rpm is dependent on the engine rating, the application, and the configuration of the throttle.

Electronic Engine Features

The engine operating conditions are monitored. The Electronic Control Module (ECM) controls the response of the engine to these conditions and to the demands of the operator. These conditions and operator demands determine the precise control of fuel injection by the ECM. The electronic engine control system provides the following features:

- Engine monitoring
- Engine speed governing
- Control of the injection pressure
- Cold start strategy
- Automatic air/fuel ratio control
- Torque rise shaping
- Injection timing control
- System diagnostics

For more information on electronic engine features, refer to the Operation and Maintenance Manual, "Features and Controls" topic (Operation Section).

Engine Diagnostics

The engine has built-in diagnostics in order to ensure that the engine systems are functioning correctly. The operator will be alerted to the condition by a "Stop or Warning" lamp. Under certain conditions, the engine horsepower and the vehicle speed may be limited. The electronic service tool may be used to display the diagnostic codes.

There are three types of diagnostic codes: active, logged and event.

Most of the diagnostic codes are logged and stored in the ECM. For additional information, refer to the Troubleshooting Manual, "Diagnostic Code Cross Reference" topic.

The ECM provides an electronic governor that controls the injector output in order to maintain the desired engine rpm.

Engine Cooling and Lubrication

The cooling system consists of the following components:

- Gear-driven centrifugal water pump
- Water temperature regulator which regulates the engine coolant temperature
- Gear-driven rotor type oil pump
- Oil cooler

The engine lubricating oil is supplied by a rotor type oil pump. The engine lubricating oil is cooled and the engine lubricating oil is filtered. The bypass valve can provide unrestricted flow of lubrication oil to the engine if the oil filter element should become plugged.

Engine efficiency, efficiency of emission controls, and engine performance depend on adherence to proper operation and maintenance recommendations. Engine performance and efficiency also depend on the use of recommended fuels, lubrication oils, and coolants. Refer to this Operation and Maintenance Manual, "Maintenance Interval Schedule" for more information on maintenance items.

Generator Description

These brushless generators are used with the following loads: mixed loads of motors and lights, SCR-controlled equipment, computer centers, installations of communications and petroleum drilling applications. The elimination of the brushes in the field circuit reduces maintenance. The elimination of the brushes in the field circuit increases reliability. The elimination of brushes provides a higher degree of protection in potentially hazardous atmospheres.

The generator set packages can be utilized for standby power generation. The generator set packages can be used in land-based applications or marine applications.

The generators have four poles. The generators have 6 lead configurations. The generators can produce electrical power in 60 Hz applications.

Product Identification Information

i08700007

Plate Locations and Film Locations

SMCS Code: 1000; 4450

Cat engines are identified by serial numbers and by arrangement numbers. These numbers are shown on the engine serial number plate. Cat dealers need these numbers to determine the components that were included with the engine. Providing accurate numbers permits accurate identification of replacement part numbers.

Serial Number Plate

The engine serial number plate is on the left side of the engine block for all engine models in the series.

MODEL NUMBER	CAT CAT	CATERPILLAR CATERPILLAR	
PRODUCT IDENTIFICATION NUMBER			
			MADE IN
			PARTS ORDER

Illustration 24

g01422006

Typical Serial number plate

Emission Certification Film

Note: This information is pertinent in the united States and Canada.

Typical examples are shown.

IMPORTANT ENGINE INFORMATION		
Engine Family: #####12#### #####: #####12#### Engine Type: ##4#/ ##4# EPA Family: #####12####		 120R-###6## ell*97/68## #####16##### ##4#: #####15#####
Advertised kw: ##5## @ RPM:##4# Fuel Rate at adv. kW: ##5## mm3/stk Init. Timing: #####l#### Disp:##4#	MLIT ###7##	
Settings are to be made with engine at normal operating temperature with transmission in neutral. This engine conforms to ##4# U.S. EPA non - road and California off - road Regulations for large C.I. engines and is certified to operate on commercially available diesel fuel.		
Emission Control System: #####16#####	Valve Lash Cold (inch): Exhaust ##5## Inlet ##5##	#####l#### LABEL
Hanger No. #3#	Position ##4#	Label No. 3181A081

Illustration 25

g01350379

This label is installed on engines that comply with the laws on emissions from the EPA.

EMISSION CONTROL INFORMATION		CAT	Manufactured by Perkins Engines Co Ltd
ENGINE FAMILY : 5PKX04.4RG1 MODEL YEAR : 2005 ENGINE DISPLACEMENT: 4.40			
FOLLOWING INFORMATION APPLICABLE TO USA ONLY This non-road engine does not comply with either federal non-road or California off-road engine emission regulation requirements. Sale or installation of this engine can only be for STATIONARY ENGINE Use only as defined by CFR 40 PART 89.2			
Hanger No. 3	Position (79)	Label No. 3181A081	

Illustration 26

g01153881

This label is installed on engines that do not comply with the laws on emissions from the EPA.

Rating Plate

1 MANUFACTURED IN THE UNITED KINGDOM

2 GENERATING SET ISO 8528

3 MANUFACTURER

4 MODEL

SERIAL NUMBER XXXXXXXXXXXXXXXX

SALES ORDER REF. XXXXXXXX

5 YEAR OF MANUFACTURE 2010

AMBIENT TEMP 25

RATED POWER

STANDBY 88.0 kVA

70.4 kW

PRIME 80.0 kVA

64.0 kW

RATED VOLTAGE 400/230 V

PHASE 3

RATED POWER FACTOR 0.80 COS

RATED FREQUENCY 50 Hz

RATED CURRENT - STANDBY 127 A

RATED CURRENT - PRIME 115 A

RATED RPM 1500 rpm

ALTITUDE 152.4 m

ALTERNATOR CONNECTION S-STAR

ISO8528-3 RATING PR 500H TLO.875

ALTERNATOR ENCLOSURE 23 IP

INSULATING CLASS H

EXCITATION VOLTAGE 29 V

EXCITATION CURRENT 2 A

AVR R438C

8 MASS 1463 kg

6

This generator set is designed to operate in ambient temperatures up to 50 deg C and at higher altitudes
Please consult Dealer/Helpdesk for outputs available

Illustration 27

g06696484

- (1) Country of Origin
- (2) Name/designation
- (3) Manufacturer name
- (4) Model and serial number
- (5) Month and Year of Manufacture
- (6) Eurasian Economic Union Member
national language
- (7) Basic parameters/features
- (8) Mass

Regional Product Marking (If Equipped)

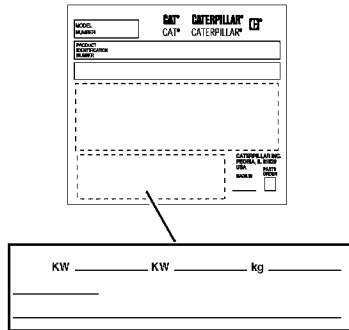


Illustration 28
Regional marking plate

This plate is positioned on the bottom-left side of the identification plate.

Note: The regional marking plate is on generator sets that are certified to the applicable requirements that were effective then.

Regional product marking may include one or more of the following:

-  CE mark
-  UKCA mark
-  EAC mark
-  Gulf Standardization Organization (GSO) mark
-  Ukraine mark

The following information may be stamped onto the regional marking plate. For quick reference, record this information in the spaces that are provided below.

- Engine Power Primary Engine (kW) _____
- Engine Power for other Engine (If Equipped) _____
- Typical Generator Set Operating Weight (kg) _____

- Year of Construction _____
- Generator Set Type _____

Eurasian Economic Union

The rating plate is placed on generator sets certified to the Eurasian Economic Union requirements effective at the time of market entry.

The Month and Year of Manufacture are on the identification plate.

Manufacturer Information

Manufacturer:

Caterpillar Inc.,
100 N.E. Adams Street
Peoria, Illinois 61629, USA

Entity authorized by the manufacturer at the territory of Eurasian Economic Union:

Caterpillar Eurasia LLC
75, Sadovnicheskaya Emb.
Moscow 115035, Russia

Sound Certification

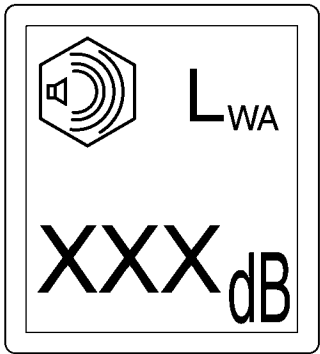


Illustration 29
Sound certification film

A typical example of this film is shown.

A certification film is used to verify the environmental sound certification on generator sets that are certified to the regional requirements. A film installed on your generator set will have a value. 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 the following sound test procedures:

- "ISO 6395"
- "European Union 2000/14/EC amended by 2005/88/EC"

Product Information Section

Plate Locations and Film Locations

- “United Kingdom 2001 No. 1701 amended by 2005 No. 3525”

Declaration of Conformity (Great Britain)

SMCS Code: 1000

Table 5

A Declaration of Conformity document was provided with the generator set if the product was manufactured to comply with specific requirements for the Great Britain. To determine the details of the applicable legislation, review the complete Declaration of Conformity provided with the product. The extract shown below from a Great Britain Declaration of Conformity for generator sets that are declared compliant to 2008 No. 1597 applies only to those generator sets originally "UKCA" marked by the manufacturer listed and which have not since been modified.

DECLARATION OF CONFORMITY

Manufacturer: Caterpillar Inc., 100 N.E. Adams Street, Peoria, Illinois 61629, USA

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

Standards & Regulations Manager Caterpillar France SAS
40 Avenue Leon-Blum 38000 Grenoble, France

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

Description:	Generic Denomination:	Power Generation Equipment
	Function:	Powered Generator
	Model/Type:	C7.1
	Serial Number:	
	Commercial Name:	Caterpillar

Fulfills all the relevant provisions of these regulations and/or other enactments as listed below:

Legislation	UK Approved Body	Document No.
2008 No. 1597		
2016 No. 1091		
2001 No. 1701 amended by 2005 No. 3525, Note (1)	Note (2)	

Note (1) Schedule-____ 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

Note (2) If applicable, information related to Approved Body.

Done at:

Signature

Date:

Name/Position

Note: The above information was correct as of May 2021, but may be subject to change. Refer to the individual declaration of conformity issued with the machine for exact details.

Declaration of Conformity (European Union)

SMCS Code: 1000

Table 6

An EU Declaration of Conformity document was provided with the machine if the machine was manufactured to comply with specific requirements for the European Union. To determine the details of the applicable Directives, review the complete EU Declaration of Conformity provided with the machine. The extract shown below from an 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 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 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:	Power Generation Equipment
	Function:	Power Generator
	Model/Type:	C7.1
	Serial Number:	
	Commercial Name:	Caterpillar

Fulfills all the relevant provisions of the following Directives

Directives	Notified Body	Document No.
2006/42/EC	N/A	
2014/30/EU	N/A	
2000/14/EC amended by 2005/88/EC, Note (1)	Note (2)	

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

Note (2) Notified body name and address

Done at:

Signature

Date:

Name/Position

Note: The above information was correct as of August 2021, but may be subject to change. Refer to the individual declaration of conformity issued with the product for exact details.

i05668052

Engine Identification

SMCS Code: 1000

The engines are identified by a serial number. This number is shown on a serial number plate that is mounted on the left-hand side of the engine block.

Caterpillar dealers need these numbers in order to determine the components that were included with the engine. Identifying the correct serial number permits accurate identification of replacement part numbers.

Operation Section

Lifting and Storage

i02472970

Product Lifting

SMCS Code: 7000; 7002

Lifting of Generator Sets

NOTICE

Never bend the eyebolts and the brackets. Only load the eyebolts and the brackets under tension. Remember that the capacity of an eyebolt is less as the angle between the supporting members and the object becomes less than 90 degrees.

When it is necessary to remove a component at an angle, only use a link bracket that is properly rated for the weight.

Use a hoist to remove heavy components. Use an adjustable lifting beam, if necessary. All supporting members (chains and cables) should be parallel to each other. The chains and cables should be perpendicular to the top of the object that is being lifted.

Some removals require lifting the fixtures in order to obtain proper balance and safety. Consult your Caterpillar dealer for information regarding fixtures for proper lifting of your complete package.

Lifting eyes are designed and installed for the specific arrangement. Alterations to the lifting eyes and/or the engine make the lifting eyes and the lifting fixtures obsolete. If alterations are made, ensure that proper lifting devices are provided. Consult your Caterpillar dealer for information regarding fixtures for proper engine lifting.

On some enclosed generator sets, it may be necessary to remove a top panel of the enclosure in order to access the lifting eye.



Illustration 30

g01034418

The lifting labels are located on the lifting eyes. These labels designate the proper lifting locations for the generator set. Some generator sets may be lifted at the base of the generator set and other generator sets may have a single lifting point on top of the generator set.

Engine Lifting with a Fuel Tank

Do not lift the unit with fuel in the fuel tank.

i02046791

Product Storage

SMCS Code: 7002

If the engine will not be started for several weeks, the lubricating oil will drain from the cylinder walls and from the piston rings. Rust can form on the cylinder liner surface, which will increase engine wear which can reduce engine service life.

To help prevent excessive engine wear, use the following guidelines:

- Complete all of the lubrication recommendations that are listed in this Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section).
- If freezing temperatures are expected, check the cooling system for adequate protection against freezing. See this Operation and Maintenance Manual, "Refill Capacities and Recommendations" (Maintenance Section).

If an engine is out of operation and if use of the engine is not planned, special precautions should be made. If the engine will be stored for more than one month, a complete protection procedure is recommended.

Your Caterpillar dealer will have instructions for preparing the engine for extended storage periods.

For more detailed information on engine storage, see Special Instruction, SEHS9031, "Storage Procedure for Caterpillar Products".

Generator Storage

For information on generator storage, see the literature that is provided by the OEM of the generator. Consult your Caterpillar dealer for assistance.

Installation

i08362181

Product Installation

SMCS Code: 1000; 1404; 4450; 7002

Receiving Inspection

If the generator is received during cold weather, allow the unit to reach room temperature before you remove the protective packing material. Warming the generator to room temperature will prevent the following problems:

- Water condensation on cold surfaces
- Early failures due to wet windings
- Early failures due to wet insulating materials

Unpacking

Moving the Generator

WARNING

Improper lift rigging can allow unit to tumble causing injury and damage.

NOTICE

Do not use the engine lifting eyes to remove the engine and generator together.

Unpack the equipment with care in order to avoid scratching painted surfaces. Move the unit to the mounting location. Follow the instructions under the "Product Lifting" topic. The hoist and the hoist cables should have a rating that is greater than the weight of the generator.

Storage

If the generator is not installed immediately, refer to the "Product Storage" topic for the proper considerations for storing the unit.

Location

The location of the generator must comply with all local regulations. The location of the generator must also comply with all special industrial regulations. Locate the generator in an area that meets the following requirements:

- Clean
- Dry

- Well ventilated
- Easily accessible for inspection and maintenance
- Open generator sets shall be installed and located in a manner that contact with people is minimized.

Do not obstruct air inlet openings. Do not obstruct discharge openings. Air flow must reach these openings. If the generator is exposed to harsh environmental conditions, the generator can be modified in the field in order to add filters and space heaters. In addition, a more rigid periodic maintenance schedule should be established.

Note: For further information concerning the installation of this generator set, see the appropriate Application and Installation Guide.

Underwriters Laboratories (UL) 2200

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for all Cat UL Listed stationary engine generator assembly models, that should be followed during installation, and maintenance of the generator and batteries.

Load Connections – Generator Set Output

For units equipped with a circuit breaker: Installer shall connect and size conductors based upon ampacities found in the 75° C (167° F) column within Table 310.15(B) of the "National Electrical Code", ANSI/NFPA 70". An ampacity of no less than 115 percent (115%) of the maximum rated circuit current during normal operating conditions shall be used. All conductor insulation shall be rated 90° C (194° F) or greater.

For units equipped with power terminal strips: UL Listed field wiring terminals shall be sized for the connection of a conductor having an ampacity based upon ampacities found in the 75° C (167° F) column within Table 310.15(B) of the "National Electrical Code", ANSI/NFPA 70". An ampacity of no less than 115 percent (115%) of the maximum rated circuit current during normal operating conditions shall be used. All conductor insulation shall be rated 90° C (194° F) or greater. Field wiring terminals shall be installed in accordance with tooling and instructions recommended by their manufacturer.

A field wiring terminal shall be sized for the connection of a conductor having an ampacity based on the 75° C (167° F) column of Table 310.15(B) of the "National Electrical Code", ANSI/NFPA 70", of no less than 115 percent of the maximum current that the circuit carries during rated conditions. All conductors shall be rated 90° C (194° F) or greater.

Installation Access:

This stationary engine generator assembly shall be installed so that access is restricted to only qualified service personnel who have been instructed of the reasons for the restrictions applied to the location, and about any precautions that must be taken. Access shall be by using a special tool, or lock and key, or other means of security and shall be controlled by the authority responsible for the location.

Batteries and Servicing:

This stationary engine generator assembly utilizes one battery to produce a nominal 12V DC power supply.

Battery servicing is to be performed or supervised by qualified personnel knowledgeable of batteries and the required precautions. Keep unauthorized and unqualified personnel away from batteries.

When replacing batteries, use the same number and the following type batteries: lead-acid, vented type.

Table 7

Engine	Number of Batteries	Battery Voltage	Connected In:	Minimum CCA Battery
C7.1	1	12 VDC	N/A	500

 WARNING

Do not dispose of battery or batteries in a fire. The battery is capable of exploding.

 WARNING

Do not open or mutilate the battery or batteries. Released electrolyte has been known to be harmful to the skin and eyes and to be toxic.

 WARNING

A battery presents a risk of electrical shock and high short circuit current. The following precautions are to be observed when working on batteries:

- **Remove watches, rings, or other metal objects**
- **Use tools with insulated handles**
- **Wear rubber gloves and boots**
- **Do not lay tools or metal parts on top of batteries**
- **Disconnect charging source prior to connecting or disconnecting battery terminals**
- **Determine the battery is not inadvertently grounded. When inadvertently grounded, remove the source of ground. Contact with any part of a grounded battery is capable of resulting in electrical shock. The risk of such shock is reduced when such grounds are removed during installation and maintenance (applicable to a generator not having a grounded supply circuit)**

Vented Batteries

The installation of the engine generator shall provide enough ventilation to ensure that gases generated by vented batteries during charging or caused by equipment malfunction are removed.

 WARNING

The electrolyte is a dilute sulfuric acid that is harmful to the skin and eyes. The electrolyte is electrically conductive and corrosive. The following procedures are to be observed:

- **Wear full eye protection and protective clothing**
- **Where electrolyte contacts the skin, wash electrolyte off immediately with water**
- **Where electrolyte contacts the eyes, flush thoroughly and immediately with water and seek medical attention**
- **Spilled electrolyte is to be washed down with an acid neutralizing agent. A common practice is to use a solution of 500 gram (1 lb) bicarbonate of soda to 4 L (1 US gal) of water. The bicarbonate of soda solution is to be added until the evidence of reaction (foaming) has ceased. The resulting liquid is to be flushed with water and the area dried.**

 WARNING

Lead-acid batteries present a risk of fire because lead-acid batteries generate hydrogen gas.

- **DO NOT SMOKE when near batteries**
- **DO NOT cause flame or spark in battery area**
- **Discharge static electricity from body before touching batteries by first touching a grounded metal surface.**

Exhaust System (Shipped Loose or Not Complete)

Exhaust piping and chimneys shall be designed, constructed, and installed in accordance with the "Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37".

Output Circuit Breaker Requirement

Installation of a UL 2200 Listed stationary engine generator assembly shipped without an installed output circuit breaker requires a UL Listed Circuit Breaker to be installed in the output circuit within 7.6 m (25 feet) of the stationary engine generator assembly.

Field Wiring – GCCP 1.2 Controller Interface

Installer shall use Class 1 wiring methods for all controller (customer) connections with following exception. Class 2 wiring methods shall be allowed for Class 2 controller interface wiring when Class 2 conductors are shielded with UL Listed/Recognized insulation sleeve or conduit rated to 600V for each individual circuit.

Features and Controls

i08194347

Battery Disconnect Switch (If Equipped)

SMCS Code: 1411

The battery disconnect switch and the engine start switch perform different functions. Turn off the battery disconnect switch to disable the entire electrical system. The battery remains connected to the electrical system when you turn off the engine start switch.

Turn the battery disconnect switch to the OFF position and remove the key when you service the electrical system or any other components.

Turn the battery disconnect switch to the OFF position and remove the key when the engine will not be used for an extended period. This procedure will prevent drainage of the battery.

NOTICE

Never move the battery disconnect switch to the OFF position while the engine is operating. Serious damage to the electrical system could result.

To ensure that no damage to the engine occurs, verify that the engine is fully operational before cranking the engine. Do not crank an engine that is not fully operational.

Perform the following procedure to check the battery disconnect switch for proper operation:

1. With the battery disconnect switch in the ON position, verify that electrical components are functioning. Verify that the hour meter is displaying information. Verify that the engine will crank.
2. Turn the battery disconnect switch to the OFF position.
3. Verify that the following items are not functioning: electrical components, hour meter, and engine cranking. If any of the items continue to function with the battery disconnect switch in the OFF position, consult your Caterpillar dealer.

i08484457

Control Panel

SMCS Code: 7451

Cat[®] GCCP 1.2 Module (If Equipped)

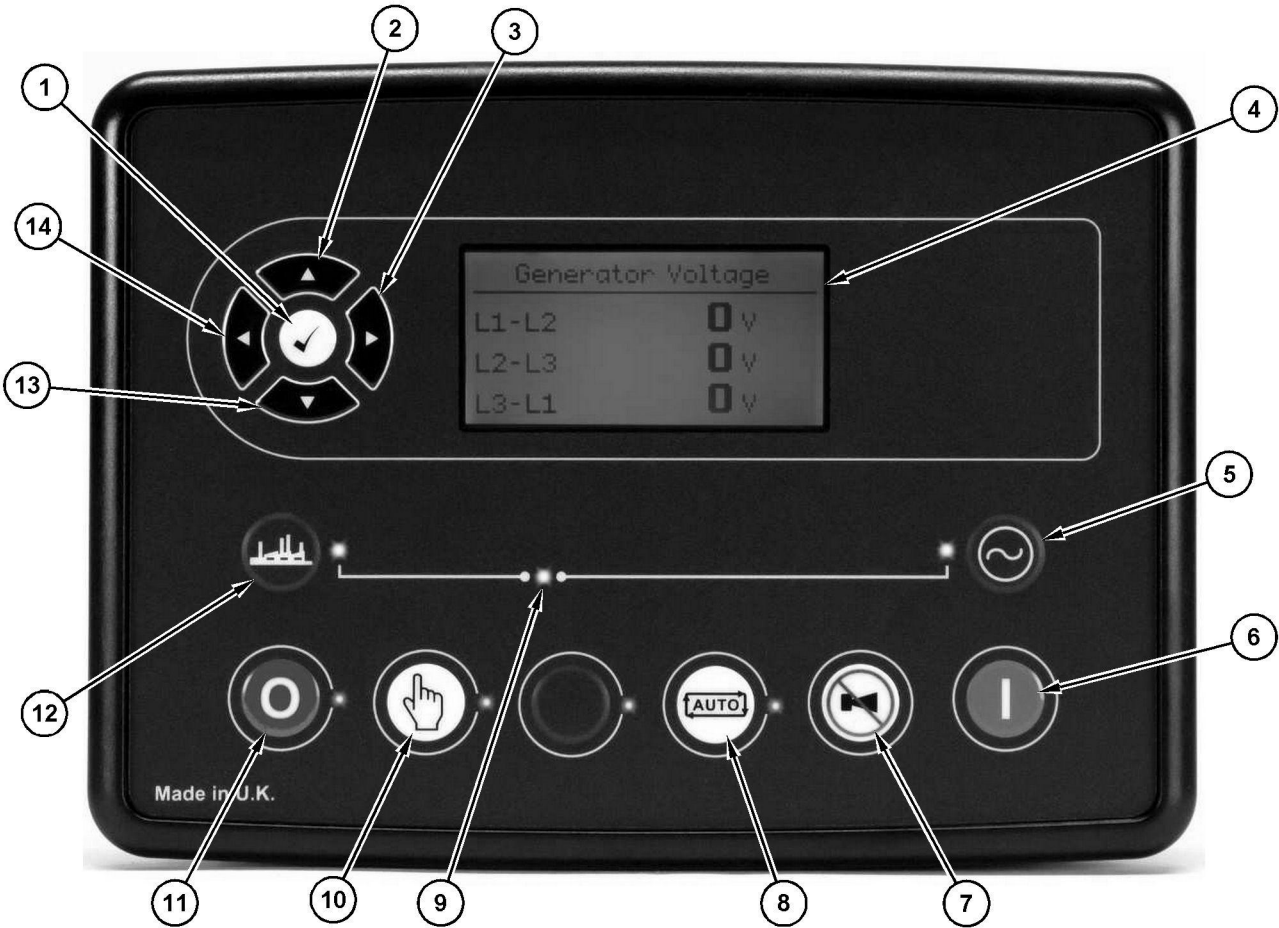


Illustration 31

g06686153

- (1) OK key
(2) Up key
(3) Right key
(4) Main status and instrument display
(5) Transfer to generator
- (6) Start
(7) Mute/lamp test
(8) Auto/test key
(9) Generator breaker LED (Light Emitting Diode)
- (10) Manual key
(11) Stop/Reset
(12) Open generator key
(13) Down key
(14) Left key

Function Keys

This section provides an overview of key functions for this control. For detailed information about this control module, refer to the OEM (Original Equipment Manufacture) manual.

OK Key (1) – OK key (1) is used during menu navigation to move forward (downward) through the menu/submenu structure. The key is also used during set point programming to save set points changes. Pressing OK key (1) during set point

programming causes set point changes to be saved to memory.

Up Key (2) – Up key (2) is used to navigate up through the various menus or monitoring screens. The key is also used during set point entry. During numeric data entry, the key is used to increment the digits (0-9). If the set point requires selection from a list, then the key is used to navigate up through the list.

Right Key (3) – Right key (3) is used during set point adjustment. During numeric data entry, the key is used to choose which digit is being edited. The key is also used during certain set point adjustments to select a check box or to deselect a check box. If a box has a check mark inside, then pressing the key will cause the check mark to disappear. If the box does not have a check mark inside, then pressing the key will cause a check mark to appear inside.

Main Status and Instrumentation Display (4) – Information from the DSE6310 is displayed on the main status and instrumentation display. Keys (1) - (5) are used to navigate through different menu screens. For further details, see Special Instruction, M0085763, "TCP 2000 & TCP 3000 Control Panel" Description of the Controls.

Transfer to Generator (5) – Operative in manual mode only. Normal breaker key control allows the operator to transfer the load to the generator. Alternative breaker key control. If mains is on load, pressing transfer to generator (5) key transfers the load to the generator. If generator is on load, pressing transfer to generator (5) key opens the generator breaker. If generator and mains are off load, pressing transfer to generator (5) key closes the generator breaker.

Start (6) – "Start" (6) key is only active in Stop/Reset mode. Pressing start (6) key in manual or test mode will cause the engine and run off load (manual) or on load (test). Pressing start (6) key while in Stop/Reset mode will turn on the CAN engine ECU (when correctly configured, and fitted to a compatible engine ECU).

Mute/Lamp Test (7) – Pressing mute/lamp test (7) key will silence the audible alarm if it is sounding, deactivate the Audible Alarm output, and illuminate all the indicator lamps as a test feature.

AUTO (8) – Pressing auto (8) key causes the module to enter the auto mode. Auto mode allows the module to control the function of the generator automatically. The module will monitor numerous start requests, and once a start request is made, the set will be automatically started, and placed on load. Once the generator is available, the mains is taken off load (Close generator output becomes inactive if used). Upon removal of the starting signal, the module will automatically transfer the load from the generator (Close generator output becomes inactive if used), and shut down the set observing the stop delay timer and cooling timer as necessary. The module will then await the next start event.

Generator Breaker LED (Light Emitting Diode) (9) – Operative in Manual mode only. Normal breaker key control allows the operator to transfer the load to the mains. Alternative breaker key control, if generator is on load, transfers the load to the mains. If mains is on load, open the mains breaker. If generator and mains are off load, close the mains breaker.

Manual (10) – Pressing manual (10) key allows manual control of the generator functions. Once in manual mode, the module will respond to start (6) key, start the engine, and run off load. If the engine is running off-load in manual mode and a remote start signal becomes present, the module will automatically instruct the changeover device to place the generator on load (Close Generator becomes active (if used)). Upon removal of the remote start signal, the generator remains on load until either selection of the stop/reset or auto modes. For further details, see Special Instruction, M0085763, "TCP 2000 & TCP 3000 Control Panel" Manual Operation.

Stop/Reset (11) – Pressing stop/reset (11) key causes the module to enter the Stop/Reset mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running, and the module is in Stop mode, the module will automatically instruct the changeover device to unload the generator (Close generator becomes inactive if used). The fuel supply de-energizes, and the engine comes to a standstill. Should a Remote Start Signal be present while operating in Stop/Reset mode, a remote start will not occur.

Transfer to Generator (12) – Operative in manual mode only. Normal breaker key control allows the operator to transfer the load to the generator. Alternative breaker key control. If mains is on load, pressing transfer to generator (12) key transfers the load to the generator. If generator is on load, pressing transfer to generator (12) key opens the generator breaker. If generator and mains are off load, pressing transfer to generator (12) key closes the generator breaker.

Down Key (13) – Down key (13) is used to navigate down through the various menus or monitoring screens. The key is also used during set point entry. During numeric data entry, the key is used to decrement the digits (0-9). If the set point requires selection from a list, then the key is used to navigate down through the list.

Left Key (14) – Left key (14) is used during set point adjustment. During numeric data entry, the key is used to choose which digit is being edited. The key is also used during certain set point adjustments to select a check box or to deselect a check box. If a box has a check mark inside, then pressing the key will cause the check mark to disappear. If the box does not have a check mark inside, then pressing the key will cause a check mark to appear inside.

Cat[®] GCCP 1.3 Modules (If Equipped)



Illustration 32

g06683880

Cat[®] GCCP 1.3 Module

- | | | |
|--|-------------------------------------|----------------------------|
| (1) Menu navigation buttons | (5) Alarm mute and lamp test button | (9) Stop/Reset mode button |
| (2) Module display / generator display | (6) Auto mode button | (10) Transfer to mains |
| (3) Close generator button | (7) Test mode | |
| (4) Start button | (8) Manual mode button | |



Illustration 33

g06683887

Cat® GCCP 1.3 Module

(11) Mains available LED
(12) Mains indicator LED

(13) Generator breaker LED
(14) Generator available LED

(15) Selected mode indicator LED

Control Push Buttons

Menu Navigation Button (1) – Menu navigation button (1) is used for navigating the instrumentation, event log, and configuration screens.

For detailed information, refer to Special Instruction, M0114493, “GCCP 1.2 Control Panel Operator Manual”.

Start Button (4) – Start button (4) is only active in the “Stop/Reset Mode”, “Manual Mode”, and “Test Mode”.

Pressing start button (4) in stop/reset mode, powers up the engine ECU but does not start the engine.

Pressing start button (4) in manual mode or test mode starts and runs the generator off load in manual mode or on load in test mode.

Alarm Mute/Lamp Test Button (5) – Alarm mute/lamp test button (5) puts the audible alarm in the

controller in silent mode. The button de-activates the audible alarm output (if configured) and illuminates all the LEDs on the fascia module as a lamp test function.

Auto Mode (6) – Pressing auto mode button (6) puts the module in auto mode. In auto mode, the module can control the function of the generator automatically.

The module monitors numerous start requests and when a start request is received, the set is automatically started. Once the generator is available, mains is taken off load and the generator is placed on load.

Upon removal of the starting signal, the module starts the return delay timer. Once the timer expires, the module takes the generator off load and place the mains on load.

The generator then continues to run during the cooling timer, until stopped. The module then waits for the next start event.

Manual Mode Button (8) – Pressing manual mode button (8) puts the module in manual mode. When in manual mode, the module responds to start button (4) to start the generator and run off load.

To place the generator on load, use the transfer to generator button (3). The module automatically instructs the changeover device to take the mains off load (“Close Mains Output” becomes inactive) and place the generator on load.

Use open generator button (3) to place the generator off load . The module automatically instructs the changeover device to take the generator off load and place the mains on load.

Additional digital inputs can be assigned to perform the functions.

If the engine is running off-load in manual mode and load signal becomes active, the module automatically instructs the changeover device to take mains off load. The generator is then placed on load.

Upon removal of the on load signal, the generator remains on load until either “Stop/Reset Mode” or “Auto Mode” is selected.

Stop/Reset Mode Button (9) – Pressing stop/reset mode button (9) puts the module in stop/reset mode. Pressing the button clears any alarm condition for which the triggering criteria has been activated. If the engine is running and the module is put into stop/reset mode, the module automatically instructs the generator off load (Close generator output becomes inactive if used).

The fuel supply de-energizes and the engine comes to a standstill. When in stop/reset mode, the generator remains at rest if any form of start signal is present.

Cat[®] GCCP 1.2 / 1.3 Expansion Module (If Equipped)



Illustration 34

g06472485

- (1) Eight configurable LEDs
- (2) Mute/lamp test

The DSE2548 output expansion module has the following features/characteristics:

- Eight configurable LEDs
- Works up to 1 km (0.6 miles) from the host controller
- 10 modules can be linked together to one host controller

ID Switch

The rotary ID switch is used to select the address of the DSE2548 expansion module, as the host control module can give instructions to several DSE2548 expansion modules at the same time.

Engine Starting

This section provides a quick start guide to the operation of the module. For further details, see OEM manual.

i05314112

Cold Weather Starting

SMCS Code: 1000; 1250; 1450; 1453; 1456; 1900

WARNING

Explosion hazard! Do not use ether! Using ether can create explosions or fires that can cause personal injury or death. Read and follow the starting procedure in the Operation and Maintenance Manual.

A jacket water heater is optional equipment on these models. Space heaters for the generator are optional equipment on these models. Use the jacket water heater and use the space heaters, as needed.

Note: Oil pan immersion heaters are not recommended for heating the engine oil. To ensure the compatibility of the components, only use equipment that is recommended by Caterpillar.

The heated water will help to keep the oil in the engine block warm enough to flow when the engine is started.

Maintain the proper level of electrolyte in the batteries. Keep the batteries fully charged.

To maximize the battery power, heat the battery compartment or store the batteries in a warm location. Typically, batteries only have 50 percent of the capability at -10°C (14°F) versus 27°C (80°F).

Extra battery capacity may be necessary for very cold temperatures.

Consult your Caterpillar dealer for more information on the starting aids that are available for cold weather starting.

i08484462

Starting the Engine (Cat^R GCCP 1.2/1.3 Control Module)

SMCS Code: 1000; 1450

Note: The following descriptions detail the sequences followed by a module containing the standard factory configuration. Always refer to your configuration sour for the exact sequences and timers observed by any particular module in the field.



Illustration 35

g06476771

(1) Manual mode button

(2) Start button

1. Press the “Manual Mode” button.

2. Press the “Start” button.

Note: If a digital input configured to “Panel Lock” is active, changing module modes is not possible. Viewing the instruments and event logs is not affected by “Panel Lock”.

For further details about module configuration, refer to For further details, see OEM manual.

WARNING

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.

WARNING

When the engine is in the AUTOMATIC mode, the engine can start at any moment. To avoid personal injury, always remain clear of the the engine when the engine is in the AUTOMATIC mode.

Before manually starting the engine, perform all of the procedures that are described in this Operation and Maintenance Manual, “Before Starting Engine”. Ensure that no one will be endangered before the engine is started and when the engine is started.

NOTICE

Do not engage the starting motor when flywheel is turning. Do not start the engine under load.

If the engine fails to start within 30 seconds, release the starter switch or button and wait two minutes to allow the starting motor to cool before attempting to start the engine again.

NOTICE

For initial start-up of a new or rebuilt engine, and for start-up of an engine that has been serviced, make provision to shut the engine off should an overspeed occur. This may be accomplished by shutting off the air and/or fuel supply to the engine.

i03640789

Starting with Jump Start Cables

SMCS Code: 1000; 1401; 1402; 1900

 WARNING

Improper jump start cable connections can cause an explosion resulting in personal injury.

Prevent sparks near the batteries. Sparks could cause vapors to explode. Do not allow jump start cable ends to contact each other or the engine.

If the installation is not equipped with a backup battery system, it may be necessary to start the engine from an external electrical source.

For information on troubleshooting the charging system, refer to Special Instruction, REHS0354, "Charging System Troubleshooting".

Many batteries which are considered unusable are still rechargeable. After jump starting, the alternator may not be able to fully recharge batteries that are severely discharged. The batteries must be charged to the proper voltage with a battery charger. For information on testing and charging, refer to the Special Instruction, SEHS7633, "Battery Test Procedure".

NOTICE

Use a battery that is sourced with the same voltage as the electric starting motor. Use **ONLY** equal voltage for jump starting. The use of higher voltage will damage the electrical system.

Do not reverse the battery cables. The alternator can be damaged. Attach the negative battery cable last and remove the negative battery cable first.

When an external electrical source is used to start the engine, turn the control switch on the generator set to the "OFF" position. Turn all electrical accessories OFF before attaching the jump start cables.

Ensure that the main power switch is in the OFF position before jump start cables are attached to the engine that is being started.

1. Turn the start switch on the stalled engine to the OFF position. Turn off all accessories.

2. Connect one positive end of the jump start cable to the positive cable terminal of the discharged battery. Connect the other positive end of the jump start cable to the positive cable terminal of the charging or starting source.
3. Connect one negative end of the jump start cable to the negative cable terminal of the charging or starting source. Connect the other negative end of the jump start cable to the stalled engine block or to the chassis ground. This procedure helps to prevent potential sparks from igniting combustible gases that are produced by some batteries.
4. Charge the batteries. The engine will not continue to run after starting if the batteries have not been charged.
5. Start the engine.
6. Immediately after the stalled engine is started, disconnect the jump start cables in reverse order.

Refer to the Electrical Schematic for your engine. Consult your Caterpillar dealer for more information.

i02386850

After Starting Engine

SMCS Code: 1000

After the engine has been installed or rebuilt, carefully monitor the engine in order to detect any unusual engine performance.

1. Ensure that the indicators are in the normal ranges.
2. Adjust the voltage and the frequency, if necessary.
3. Close the main circuit breaker in order to apply the load.
4. Continue to check the indicators and the generator.

Engine Operation

i06545704

Engine Operation

SMCS Code: 1000

Proper operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

The time that is needed for the engine to reach normal operating temperature can be less than the time needed for a walk-around inspection of the engine.

After the engine is started and after the engine reaches normal operating temperature, the engine can be operated at the rated rpm. The engine will reach normal operating temperature faster when the engine is at rated speed. The engine will reach normal operating temperature faster when the engine is at low-power demand. This procedure is more effective than idling the engine at no load. The engine should reach operating temperature in a few minutes.

Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

Engines rated for constant speed use are allowed to complete a starting sequence, an operation at a single constant speed, and a shutdown sequence. Every time the engine is run, each of these operations should occur only once. The starting sequence and shutdown sequence can include a short period of operation at the low idle speed for purposes of warming up and cooling down the engine or driven equipment. The emissions type approval is not valid for operation of a constant speed engine in a manner different from that described above.

i01432412

Fuel Conservation Practices

SMCS Code: 1000; 1250

The efficiency of the engine can affect the fuel economy. Caterpillar's design and technology in manufacturing provides maximum fuel efficiency in all applications. Follow the recommended procedures in order to attain optimum performance for the life of the engine.

- Avoid spilling fuel.

Fuel expands when the fuel is warmed up. The fuel may overflow from the fuel tank. Inspect fuel lines for leaks. Repair the fuel lines, as needed.

- Be aware of the properties of the different fuels. Use only the recommended fuels.
- Avoid unnecessary idling.

Shut off the engine rather than idle for long periods of time.

- Observe the service indicator frequently. Keep the air cleaner elements clean.
- Maintain a good electrical system.

One bad battery cell will overwork the alternator. This will consume excess power and excess fuel.

- Ensure that the belts are properly adjusted. The belts should be in good condition.
- Ensure that all of the connections of the hoses are tight. The connections should not leak.
- Ensure that the driven equipment is in good working order.
- Cold engines consume excess fuel. Utilize heat from the jacket water system and the exhaust system, when possible. Keep cooling system components clean and keep cooling system components in good repair. Never operate the engine without water temperature regulators. All of these items will help maintain operating temperatures.
- Settings for the fuel system and the limits for the operating altitude are stamped on the Engine Information Plate. If an engine is moved to a higher altitude, the settings must be changed by a Caterpillar dealer. Changing the settings will help to provide the maximum efficiency for the engine. Engines can be operated safely at higher altitudes, but the engines will deliver less horsepower. The fuel settings should be changed by a Caterpillar dealer in order to obtain the rated horsepower.

i00613522

Engine Warm-up

SMCS Code: 1000

1. Run the engine at low idle for three to five minutes, or run the engine at low idle until the jacket water temperature starts to rise.

More time may be necessary when the temperature is below -18°C (0°F).

2. Check all of the gauges during the warm-up period.
3. Perform another walk-around inspection. Check the engine for fluid leaks and air leaks.
4. Increase the rpm to the rated rpm. Check for fluid leaks and air leaks. The engine may be operated at full rated rpm and at full load when the jacket water temperature reaches 60°C (140°F).

Generator Operation

i05260776

Generator Operation

SMCS Code: 4450

Loading of the Generator

When a generator is installed or reconnected, be sure that the total current in one phase does not exceed the nameplate rating. Each phase should carry the same load. This allows the engine to work at the rated capacity. An electrical unbalance can result in an electrical overload and overheating if one phase current exceeds the nameplate amperage.

Allowable combinations of unbalanced loads are shown in Illustration 36. When you operate with significant single-phase loads, the combinations of single-phase load and three-phase load may be used. Such combinations should be located below the line on the graph.

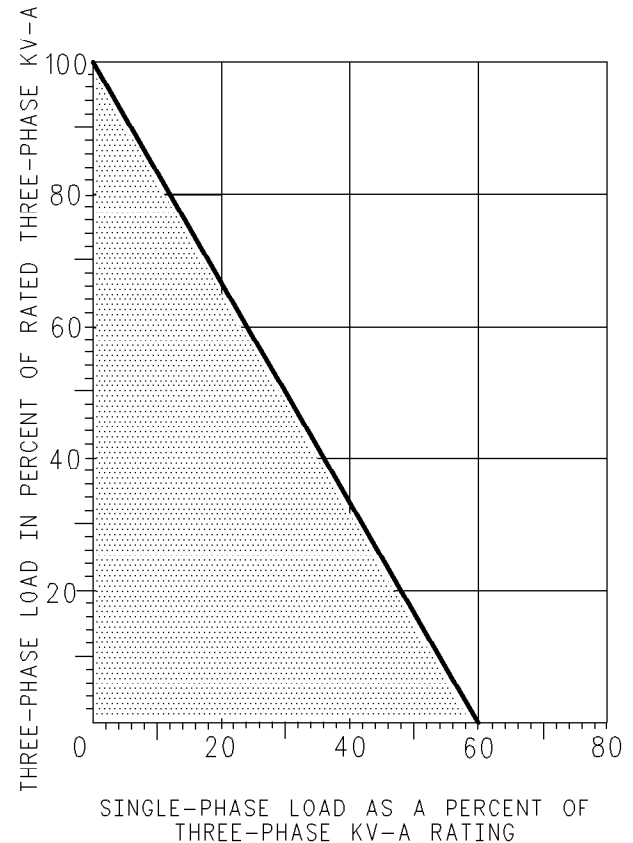


Illustration 36

g00627416

Allowable Combinations of Unbalanced Loads

Block Loading

The block loading is the instantaneous application of an electrical load to a generator set. This load may be anywhere from a moderate percentage of the rated load up to the rated load.

The block loading capability of a generator set depends on the following factors.

- Engine transient response
- Voltage regulator response
- Type of the voltage regulator
- Altitude of operation of the generator set
- Type of load
- The amount of load

If derating is required in order to block load, refer to ISO 3046 or SAE J1349 Standards. Also, reference Engine Data Sheet, LEKX4066, "Loading Transient Response" and Engine Data Sheet, LEKX4067, "Block and Transient Response".

Note: ISO stands for International Standards Organization.

Power Factor

The power factor is the ratio of apparent power to total power. The power factor is expressed as a decimal. The power factor represents that portion of the current which is doing useful work. The portion of current which is not doing useful work is absorbed in maintaining the magnetic field in motors or other devices. This current is called the reactive load. This current does not require engine power to be maintained.

In most applications, electric motors and transformers determine the power factor of the system. Induction motors usually have a power factor of 0.8 lagging. Incandescent lighting is a resistive load of about 1.0 power factor, or unity.

The power factor of a system may be determined by a power factor meter or by calculations. Determine the power requirement in kW by multiplying the power factor by the kVA that is supplied to the system. As the power factor goes up, the total current that is supplied to a constant power demand will go down. A 100 kW load that is at 0.8 power factor will draw more current than a 100 kW load that is at 0.9 power factor. A high-power factor will result in a full engine load at less than the generator rated amperage. A lower power factor increases the possibility of overloading the generator.

Note: The Caterpillar generators are rated at a power factor of 0.8 lagging unless the generator is specified otherwise.

Standby Generator Sets

Most standby units are automatic. Without an operator in attendance, standby units will perform the following functions: start, pick up the load, run and stop.

Standby units will not change the governor speed control or voltage level settings automatically. The governor speed and voltage level must be preset for the proper operation of that unit. Whenever the set is operated manually, ensure that the governor speed and the voltage level settings are set correctly for automatic operation. Check all switches for the proper setting. The Engine Control Switch should be in the AUTOMATIC position. Emergency Stop Switches should be in RUN position.

Excitation Systems

Refer to this Operation and Maintenance Manual, "Voltage Regulators" for information on excitation systems.

Low Idle Adjustment

The low idle is typically 1500 rpm. On 60 Hz units, low idle will be approximately 83 percent of the full load speed. On 50 Hz units, low idle will be approximately 70 percent of full load speed.

The low idle is set at the factory on generator sets with mechanical governors. The low idle should only be adjusted by your Caterpillar dealer if adjustment is required.

Note: Operating the electric set at low idle speed for an extended time will cause some voltage regulators to shut off. The electric set must be completely shut down. Then, the electric set must be restarted. This will allow the voltage regulator to resume output.

Generator Options

Space Heaters

The generator can be equipped with space heaters. The space heater is installed for operation in high humidity conditions. 120 V space heaters are available.

i08265810

Single Unit Operation

SMCS Code: 4450

Initial Start-Up

Measure the insulation resistance of each winding if the generator was exposed to the following conditions:

- Rapid changes in temperature
- Freezing
- Wet climate during shipment

- Wet climate during storage

Refer to this Operation and Maintenance Manual, "Insulation - Test".

Note: These tests should be conducted prior to any power connections or control connections that are being made.

Starting

1. Make all preliminary engine starting checks.
2. Be sure that the main circuit breaker or the line circuit breaker is open.
3. Start the engine. Allow the engine to warm up.
4. Adjust to the full load engine speed.
5. Close the main circuit breaker.
6. Apply the load. Do not try to apply the full load.
Apply the load in increments in order to maintain system frequency at a constant level.
7. Readjust the governor for rated frequency.
8. Adjust the voltage regulator in order to obtain the proper voltage.

For more detailed information on adjusting the voltage regulator, see this Operation and Maintenance Manual, "Voltage Regulators".

i05469037

Voltage Regulators

SMCS Code: 4467

D350 Digital Voltage Regulator

The purpose of this voltage regulator is to regulate alternators with a field current of less than 5A in continuous operations, and 10A maximum in the event of short-circuit for 10 seconds maximum.

The design is in accordance with mounting in a generator terminal box, or a control cabinet. At a minimum, following the local protection and safety standards is required, especially those standards specific to electrical installations for voltages of 300 VAC phase-to-neutral maximum.

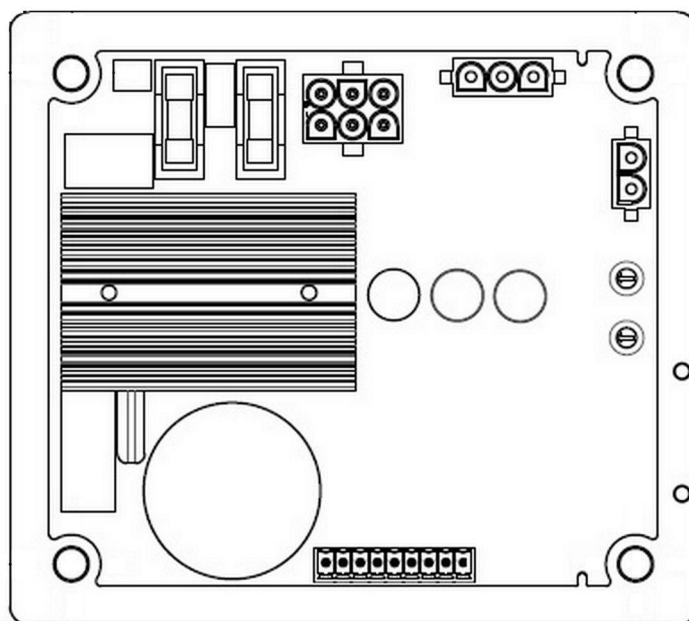
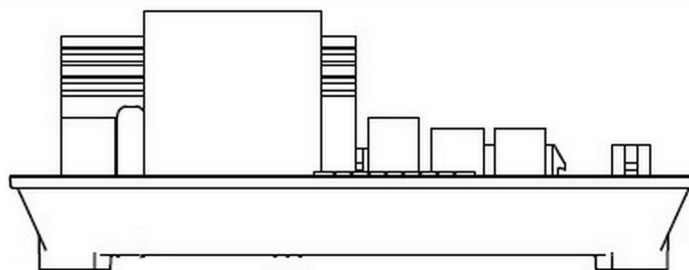


Illustration 37
D350

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Excitation

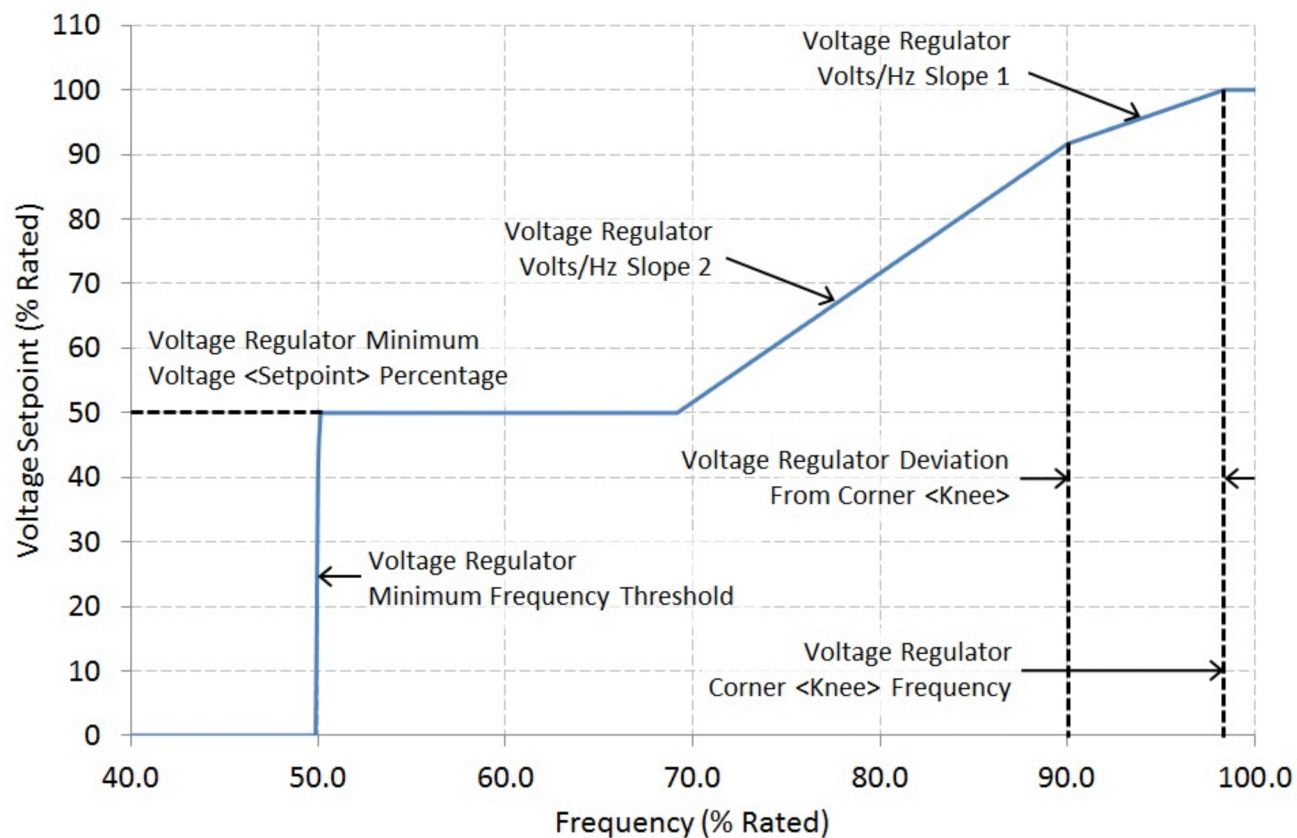


Illustration 39

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Under-frequency (loading) profile (In this example slope1 = 1.0 V/Hz, slope2 = 2.0 V/Hz)

Over-Excitation Protection

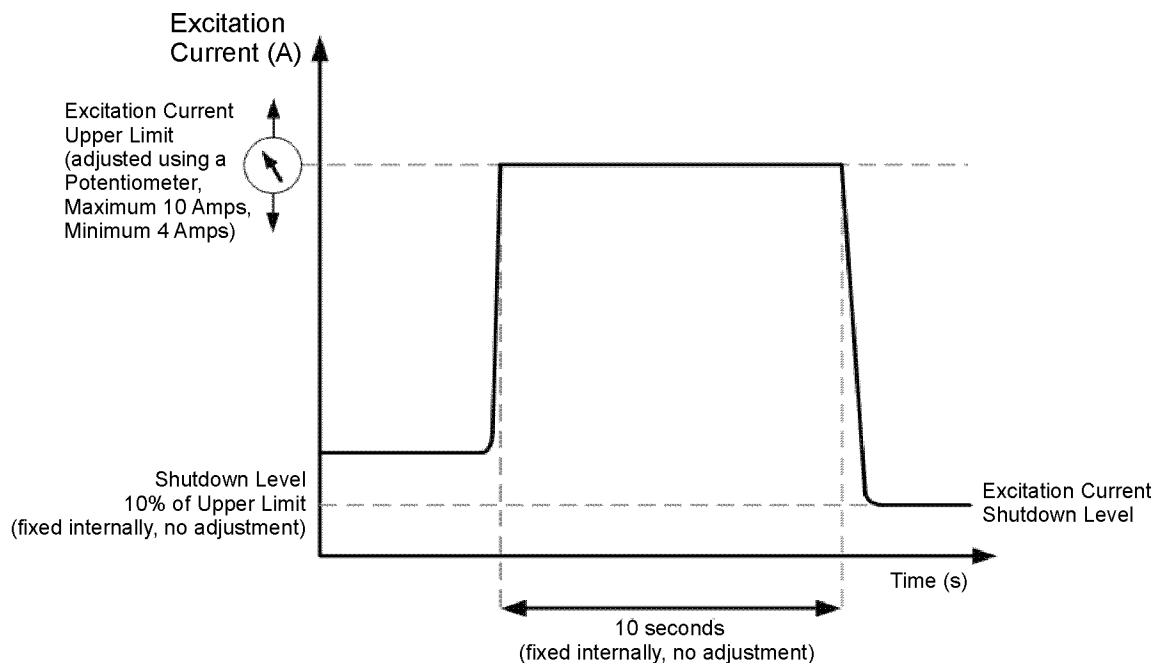


Illustration 40

g03457278

- If a short-circuit fault occurs at the generator terminals, the EM10 will allow the excitation current to rise to the upper limit value set by the adjustment potentiometer (maximum 10 Amps)
- The excitation current will be clamped at the upper limit value for 10 seconds (fixed internally)
- After 10 seconds, the excitation current is reduced to a value of 10% of the potentiometer setting

For more information about EM10, contact your Cat dealer.

Cold Weather Operation

i08230315

Fuel and the Effect from Cold Weather

SMCS Code: 1000; 1250; 1280

The following fuels are the grades that are available for Cat engines:

- No. 1
- No. 2
- Blend of No. 1 and No. 2

No. 2 diesel fuel is the most commonly used fuel. Either No. 1 diesel fuel or a blend of No. 1 and No. 2 is best suited for cold-weather operation.

Quantities of No. 1 diesel fuel are limited. No. 1 diesel fuels are available during the months of the winter in the colder climates. During cold-weather operation, if No. 1 diesel fuel is not available, use No. 2 diesel fuel, if necessary.

There are three major differences between No. 1 and No. 2 diesel fuel. No. 1 diesel fuel has the following properties:

- Lower cloud point
- Lower pour point
- Lower rating of kJ (BTU) per unit volume of fuel

When No. 1 diesel fuel is used, a decrease in power and in fuel efficiency may be noticed.

The cloud point is the temperature when a cloud of wax crystals begins to form in the fuel. These crystals can cause the fuel filters to plug. The pour point is the temperature when diesel fuel will thicken. The diesel fuel becomes more resistant to flow through fuel pumps and through fuel lines.

Be aware of these values when diesel fuel is purchased. Anticipate the average ambient temperature of the area. Engines that are fueled in one climate may not operate well if the engines are moved to another climate. Problems can result due to changes in temperature.

Before troubleshooting for low power or for poor performance in the winter, check the type of fuel that is being used.

When No. 2 diesel fuel is used, the following components provide a means of minimizing problems in cold weather:

- Starting aids

- Engine oil pan heaters
- Engine coolant heaters
- Fuel heaters
- Fuel line insulation

For more information on cold-weather operation, see Special Publication, SEBU5898, "Cold-Weather Recommendations".

i04369188

Fuel Related Components in Cold Weather

SMCS Code: 1000; 1250; 1280

Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after operating the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Draining the fuel tank will help prevent water and/or sediment from being pumped from the fuel storage tank and into the engine fuel tank. Drain the water and sediment from any fuel storage tank at the following intervals:

- Weekly
- Oil changes
- Refueling of the fuel tank

Fuel Filters

NOTICE

Do not fill the fuel filters with fuel before installing them. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

NOTICE

Caterpillar requires the use of a 4 micron (c) secondary fuel filter for the following reasons: to maximize fuel system life and to prevent premature wear out from abrasive particles in the fuel. Cat high efficiency fuel filters meet these requirements. Consult your Cat dealer for the proper part numbers.

When the engine is equipped with a primary filter/water separator, the primary filter/water separator must use a 10 micron filter to a 15 micron filter. The filters are becoming more critical as fuel injection pressures increase to 209 MPa (30000 psi) and higher psi. For more information on priming the fuel system, see the Operation and Maintenance Manual, "Fuel System - Prime" topic.

Fuel Heaters

Fuel heaters help to prevent fuel filters from plugging in cold weather due to waxing. A fuel heater should be installed in order for the fuel to be heated before the fuel enters the primary fuel filter.

Select a fuel heater that is mechanically simple, yet adequate for the application. The fuel heater should also help to prevent overheating of the fuel. High fuel temperatures reduce engine performance and the availability of engine power. Choose a fuel heater with a large heating surface. The fuel heater should be practical in size. Small heaters can be too hot due to the limited surface area.

Disconnect the fuel heater in warm weather.

Note: Only use fuel heaters that are controlled by the water temperature regulator or fuel heaters that are self-regulating. Fuel heaters that are not controlled by the water temperature regulator can heat the fuel in excess of 65° C (149° F). A loss of engine power can occur if the fuel supply temperature exceeds 37° C (100° F).

Note: Heat exchanger type fuel heaters should have a bypass provision in order to prevent overheating of the fuel when the engine operates in warm weather.

For further information on fuel heaters, consult your Cat dealer.

Engine Stopping

i01895736

The emergency stop button is in the OUT position for normal engine operation. Push the emergency stop button. The engine will not start when the button is locked. Turn the button clockwise in order to reset.

Stopping the Engine

i07911201

SMCS Code: 1000

Note: Individual applications will have different control systems. Ensure that the shutoff procedures are understood. Use the following general guidelines in order to stop the engine.

1. Remove the load from the engine. Reduce the engine speed (rpm) to low idle. Perform this procedure for five to six minutes in order to cool the engine.
2. After the cool down period, move the switch to the OFF position.

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Emergency Stopping

SMCS Code: 1000; 7418

NOTICE

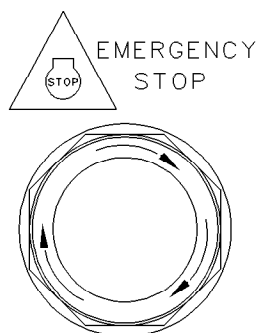
Emergency shutoff controls are for EMERGENCY use ONLY. DO NOT use emergency shutoff devices or controls for normal stopping procedure.

Ensure that any components for the external system that support the engine operation are secured after the engine is stopped.

NOTICE

Do not start the engine until the problem necessitating the emergency stop has been located and corrected.

Emergency Stop Button



Manual Stop Procedure

SMCS Code: 1000; 7418



Illustration 42

g06476789

(1) Stop/reset mode button

Note: If a digital input configured to “Panel Lock” is active, changing module modes is not possible. Viewing the instruments and event logs is not affected by “Panel Lock”.

For further details about module configuration, refer to OEM manual.

In “Stop/Reset Mode” the module removes the generator from load (if necessary) before stopping the generator set.

If the generator does not stop when requested, the “Fail to Stop” alarm is activated (subject to the setting of the “Fail to Stop” timer. To detect the engine at rest, the following must occur:

- Engine speed is zero as detected by the “CAN ECU”

- Generator AC voltage and frequency must be zero
- Engine charge alternator voltage must be zero
- Oil pressure sensor must indicate low oil pressure

When the engine has stopped and the module is in the “Stop/Reset Mode”, configuration files can be sent to the module from “DSE Configuration Suite PC software”. Entering the “Front Panel Editor” to change parameters is also possible.

Any latched alarms that have been cleared are reset when “Stop/Reset Mode” is entered.

The engine is not started when in “Stop/Reset Mode”. If start signals are given, the input is ignored until “Auto Mode” is entered.

When left in “Stop/Reset Mode” without pressing any buttons, no form of communication active/configured for “Power Save Mode”, the module enters “Power Save Mode”. To wake the module, press any of the DSE buttons.

i02327953

After Stopping Engine

SMCS Code: 1000

- Check the engine crankcase oil level. Maintain the oil level between the “ADD” and “FULL” marks on the “ENGINE STOPPED” side of the oil level gauge. Complete all of the lubrication recommendations that are listed in Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations”.
- If necessary, perform minor adjustments. Repair any leaks and tighten loose bolts.
- Note the service hour meter reading. Perform the maintenance that is in the Operation and Maintenance Manual, “Maintenance Interval Schedule”.
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

Note: Only use the antifreeze coolant solutions that are recommended in Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations”. Failure to follow the recommendations in Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations” can cause engine damage.

- Allow the engine to cool. Check the coolant level. Maintain the cooling system at 13 mm (0.5 inch) from the bottom of the pipe for filling.
- If freezing temperatures are expected, check the coolant for proper antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. See Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations”. Add the proper coolant/water mixture, if necessary.

Maintenance Section

Refill Capacities

i05834558

Refill Capacities

SMCS Code: 1000; 1348; 1395; 7560

Engine Oil

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications in order to find the capacity of the auxiliary oil filter.

Table 9

Engine Refill Capacities		
Compartment or System	Liters	Quarts
Crankcase Oil Sump ⁽¹⁾	17.4 L	18 qt

⁽¹⁾ These values are the approximate capacities for the crankcase oil sump (aluminum) which includes the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

Coolant

Table 10

Engine Refill Capacities		
Compartment or System	Liters	Quarts
Engine Only	9.5 L	10 qt
External System Per OEM ⁽¹⁾		

⁽¹⁾ The External System includes a radiator or an expansion tank with the following components: heat exchanger and piping. Refer to the OEM specifications. Enter the value for the capacity of the External System in this row.

i05265477

Fluid Recommendations

SMCS Code: 1280; 1348; 1395; 7560

Engine Oil

NOTICE

These recommendations are subject to change without notice. Contact your local Caterpillar dealer for the most up to date recommendations.

API Oils

The Engine Oil Licensing and Certification System by the American Petroleum Institute (API) is recognized by Caterpillar. For detailed information about this system, see the latest edition of the "API publication No. 1509". Engine oils that bear the API symbol are authorized by API.

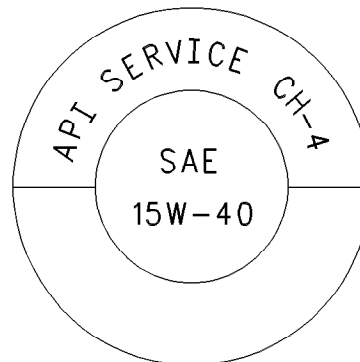


Illustration 43

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Typical API symbol

Diesel engine oils CC, CD, CD-2, and CE have not been API authorized classifications since January 1, 1996. Table 11 summarizes the status of the classifications.

Table 11

API Classifications	
Current	Obsolete
CI-4 ⁽¹⁾ , CH-4 ⁽¹⁾ , CG-4 ⁽²⁾ , CF-4 ⁽³⁾	CE
CF ⁽⁴⁾	CC, CD
CF-2 ⁽⁵⁾	CD-2 ⁽⁵⁾

- ⁽¹⁾ API CH-4 and CI-4 oils are acceptable if the requirements of Caterpillar's ECF-1 (Engine Crankcase Fluid specification-1) are met. CH-4 and CI-4 oils that have not met the requirements of Caterpillar's ECF-1 Specification may cause reduced engine life.
- ⁽²⁾ API CG-4 oils are acceptable for all Caterpillar diesel engines. When the API CG-4 oils are used, the oil drain interval should not exceed the standard oil drain interval for your engine.
- ⁽³⁾ API CF-4 oils are not recommended for this series of Caterpillar diesel engines. For all other commercial diesel engines, the oil drain interval should not exceed 50 percent of the standard oil drain interval for your engine with a maximum of 125 hours.
- ⁽⁴⁾ API CF oils are not recommended for this series of Caterpillar engines and smaller Direct Injection (DI) diesel engines.
- ⁽⁵⁾ API CF-2 and CD-2 oils are classifications for two-cycle diesel engines. Caterpillar does not sell engines that utilize the CD-2 and the API CF-2 oils.

Note: When oil meets more than one API classification, the applicable footnote is determined by the highest API classification that is met.

Example – An oil meets both the API CH-4 and the API CF oil classifications. In this case, the API CH-4 applies.

Cat DEO (Diesel Engine Oil)

Caterpillar Oils have been developed and tested in order to provide the full performance and service life that has been designed and built into Caterpillar Engines. Caterpillar Oils are currently used to fill diesel engines at the factory. These oils are offered by Caterpillar dealers for continued use when the engine oil is changed. Consult your Caterpillar dealer for more information on these oils.

Due to significant variations in the quality and in the performance of commercially available oils, Caterpillar makes the following recommendations:

- **Cat DEO (Diesel Engine Oil) (10W-30)**
- **Cat DEO (Diesel Engine Oil) (15W-40)**

Caterpillar multigrade DEO is formulated with the correct amounts of detergents, dispersants, and alkalinity in order to provide superior performance in Caterpillar Diesel Engines.

Caterpillar multigrade DEO is available in various viscosity grades that include SAE 10W-30 and SAE 15W-40. To choose the correct viscosity grade for the ambient temperature, see Table 12. Multigrade oils provide the correct viscosity for a broad range of operating temperatures.

Multigrade oils are effective in maintaining low oil consumption and low levels of piston deposits.

Caterpillar multigrade DEO can be used in other diesel engines and in gasoline engines. See the engine manufacturer's guide for the recommended specifications. Compare the specifications to the specifications of Caterpillar multigrade DEO. The current industry standards for Caterpillar DEO are listed on the product label and on the data sheets for the product.

Consult your Caterpillar dealer for part numbers and for available sizes of containers.

Note: Caterpillar SAE 15W-40 multigrade DEO exceeds the performance requirements for the following API classifications: CI-4, CH-4, CG-4, CF-4 and CF. The Caterpillar multigrade DEO exceeds the requirements of the Caterpillar specification that is ECF-1 (Engine Crankcase Fluid-1). The Caterpillar SAE 15W-40 multigrade DEO passes the following proprietary tests: sticking of the piston ring, oil control tests, wear tests and soot tests. Proprietary tests help ensure that Caterpillar multigrade oil provides superior performance in Caterpillar Diesel Engines. In addition, Caterpillar multigrade oil exceeds many of the performance requirements of other manufacturers of diesel engines. Therefore, this oil is an excellent choice for many mixed fleets. **True high performance oil is produced with a combination of the following factors: industry standard tests, proprietary tests, field tests and prior experience with similar formulations. The design and the development of Caterpillar lubricants that are both high performance and high quality are based on these factors.**

Note: Non-Caterpillar commercial oils are second choice oils.

Commercial Oils

Note: If Caterpillar Multigrade DEO is not used, use only commercial oils that meet the following classifications.

- API CH-4 multigrade oils and API CI-4 multigrade oils are acceptable if the requirements of Caterpillar's ECF-1 (Engine Crankcase Fluid specification-1) are met. CH-4 oils and CI-4 oils that have not met the requirements of Caterpillar's ECF-1 Specification may cause reduced engine life.
- API CG-4 multigrade oils are acceptable for all Caterpillar diesel engines. When the API CG-4 oils are used, the oil drain interval should not exceed the standard oil drain interval for your engine.
- API CF-4 multigrade oils are not recommended for this series of diesel engines. For all other smaller commercial diesel engines, the oil drain interval should not exceed 50 percent of the standard oil drain interval for your engine.

NOTICE

In selecting oil for any engine application, both the oil viscosity and oil performance classification/specification as specified by the engine manufacturer must be defined and satisfied. Using only one of these parameters will not sufficiently define oil for an engine application.

In order to make the proper choice of a commercial oil, refer to the following explanations:

API CI-4 – API CI-4 oils were developed in order to meet the requirements of high performance diesel engines that use cooled Exhaust Gas Recirculation (EGR). API CI-4 oils are acceptable if the requirements of Caterpillar's ECF-1 (Engine Crankcase Fluid specification-1) are met.

API CH-4 – API CH-4 oils were developed in order to protect low emissions diesel engines that use a 0.05 percent level of fuel sulfur. However, API CH-4 oils may be used with higher sulfur fuels. API CH-4 oils are acceptable if the requirements of Caterpillar's ECF-1 (Engine Crankcase Fluid specification-1) are met.

Note: CH-4 oils and CI-4 oils that have not met the requirements of Caterpillar's ECF-1 Specification may cause reduced engine life.

NOTICE

Failure to follow these oil recommendations can cause shortened engine service life due to deposits and/or excessive wear.

Note: Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for additional information that relates to lubrication for your engine.

Lubricant Viscosity Recommendations

The proper SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to Table 12 (minimum temperature) in order to determine the required oil viscosity for starting a cold engine.

Refer to Table 12 (maximum temperature) in order to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Note: Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

If ambient temperature conditions at engine start-up require the use of multigrade SAE 0W oil, SAE 0W-40 viscosity grade is preferred over SAE 0W-20 or SAE 0W-30.

Table 12

Engine Oil Viscosities for Ambient Temperatures		
	Ambient Temperature	
Viscosity Grade	Minimum	Maximum

(Table 12, contd)

SAE 0W-20	-40 °C (-40 °F)	10 °C (50 °F)
SAE 0W-30	-40 °C (-40 °F)	30 °C (86 °F)
SAE 0W-40	-40 °C (-40 °F)	40 °C (104 °F)
SAE 5W-30	-30 °C (-22 °F)	30 °C (86 °F)
SAE 5W-40	-30 °C (-22 °F)	50 °C (122 °F)
SAE 10W-30	-18 °C (0 °F)	40 °C (104 °F)
SAE 10W-40	-18 °C (0 °F)	50 °C (122 °F)
SAE 15W-40	-9.5 °C (15 °F)	50 °C (122 °F)

Note: Supplemental heat is recommended below the minimum recommended ambient temperature.

S·O·S Oil Analysis

Caterpillar has developed a tool for maintenance management that evaluates oil degradation and the tool also detects the early signs of wear on internal components. The Caterpillar tool for oil analysis is called S·O·S Oil Analysis and the tool is part of the S·O·S Services program. S·O·S Oil Analysis divides oil analysis into three categories:

- Wear Analysis
- Oil condition
- Additional tests

The wear analysis monitors metal particles, some oil additives, and some contaminants.

Oil condition uses infrared (IR) analysis to evaluate the chemistry of the oil. Infrared analysis is also used to detect certain types of contamination.

Additional tests are used to measure contamination levels from water, fuel, or coolant. Oil viscosity and corrosion protection can be evaluated, as needed.

Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" or contact your local Caterpillar dealer for additional information concerning the S·O·S Oil Analysis program.

Lubricating Grease

Caterpillar provides a range of moderate greases to extremely high performance greases in order to service the entire line of Caterpillar products that operate throughout the wide variety of climates. From this variety of Caterpillar grease products, you will find at least one of the Caterpillar greases that will satisfy the performance requirements for any machine or equipment application.

(continued)

Before selecting a grease for any application, the performance requirements must be determined. Consult the grease recommendations that are made by the OEM for the equipment when the equipment is operated in the expected conditions. Then, consult with your Caterpillar dealer for a list of greases and the following related characteristics.

- Performance specifications
- Available sizes of containers
- Part numbers

Always choose a grease that satisfies the recommendations that are specified by the equipment manufacturer for the application.

Note: If it is necessary to choose a single grease to use for all of the equipment at one site, always choose a grease that satisfies the requirements of the most demanding application.

Do not use the cost per pound as the only factor when you choose a grease. Use the grease that yields the lowest total cost of operation. The cost analysis should include the following factors:

- Parts
- Labor
- Downtime
- Cost of the grease

Greases that barely meet the minimum performance requirements can be expected to barely produce the minimum life of the parts.

Note: Take care when you change the type of grease. Take care when you change to a different supplier of grease. Some greases are not chemically compatible. Some brands of grease can not be interchanged. **If you are in doubt about the compatibility of the old grease and the new grease, purge all of the old grease from the joint.** Consult your supplier in order to determine if the greases are compatible.

Note: All Caterpillar brand of greases are compatible with each other.

Note: Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for additional information that relates to lubrication for your engine.

General Fuel Information

Diesel fuels that meet the Caterpillar Specification for Distillate Diesel Fuel are recommended. These fuels will help to provide maximum engine service life and performance. In North America, diesel fuel that is identified as No. 1-D or No. 2-D in "ASTM D975" generally meet the specifications. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

NOTICE

Operating with fuels that do not meet Caterpillar's recommendations can cause the following effects: starting difficulty, poor combustion, deposits in the fuel injectors, reduced service life of the fuel system, deposits in the combustion chamber and reduced service life of the engine.

Note: Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for the Caterpillar Specification for distillate fuel and for additional information that relates to fuel for your engine.

General Coolant Information

NOTICE

These recommendations are subject to change without notice. Contact your local Caterpillar dealer for the most up to date fluids recommendations.

NOTICE

Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE

If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

NOTICE

Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

Note: Air pockets can form in the cooling system if the cooling system is filled at a rate that is greater than 5 L (1.3 US gal) per minute.

After you drain the cooling system and after you refill the cooling system, operate the engine. Operate the engine without the filler cap until the coolant reaches normal operating temperature and the coolant level stabilizes. Ensure that the coolant is maintained to the proper level.

NOTICE

Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Refer to Special Instruction, SEBD0518, "Know Your Cooling System" and Special Instruction, SEBD0970, "Coolant and Your Engine" for more detailed information.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: overheating, leakage of the water pump, plugged radiators or heat exchangers and pitting of the cylinder liners.

These failures can be avoided with proper cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: water, additives and glycol.

Water

NOTICE

Never use water alone without Supplemental Coolant Additives (SCA) or without inhibited coolant. Water alone is corrosive at engine operating temperatures. Water alone does not provide adequate protection against boiling or freezing.

Water is used in the cooling system in order to transfer heat.

Distilled water or deionized water is recommended for use in engine cooling systems.

DO NOT use the following types of water in cooling systems: hard water, softened water that has been conditioned with salt and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in Table 13.

Table 13

Caterpillar Minimum Acceptable Water Requirements		
Property	Maximum Limit	ASTM Test
Chloride (Cl)	40 mg/L (2.4 grains/US gal)	"D512", "D4327"
Sulfate (SO ₄)	100 mg/L (5.9 grains/US gal)	"D516"
Total Hardness	170 mg/L (10 grains/US gal)	"D1126"
Total Solids	340 mg/L (20 grain/US gal)	"D1888"
Acidity	pH of 5.5 to 9.0	"D1293"

For a water analysis, consult one of the following sources:

- Caterpillar dealer
- Local water utility company
- Agricultural agent
- Independent laboratory

Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Pitting and erosion from cavitation of the cylinder liner
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically. This can be done by adding Supplemental Coolant Additives (SCA) to Diesel Engine Antifreeze/Coolant (DEAC) or by adding ELC Extender to Extended Life Coolant (ELC).

Additives must be added at the proper concentration. Overconcentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal

- Plugging of radiators, coolers, and small passages

Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Cavitation of the water pump and the cylinder liner

For optimum performance, Caterpillar recommends a 1:1 mixture of a water/glycol solution.

Note: Use a mixture that will provide protection against the lowest ambient temperature.

Note: 100 percent pure glycol will freeze at a temperature of -23°C (-9°F).

Most conventional heavy-duty coolants use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling. See Tables 14 and 15.

Table 14

Ethylene Glycol		
Concentration	Freeze Protection	Boil Protection
50 Percent	-36°C (-33°F)	106°C (223°F)
60 Percent	-51°C (-60°F)	111°C (232°F)

NOTICE

Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Table 15

Propylene Glycol		
Concentration	Freeze Protection	Anti-Boil Protection
50 Percent	-29°C (-20°F)	106°C (223°F)

To check the concentration of glycol, use the 1U-7298 Coolant/Battery Tester (Degrees Celsius) or use the 1U-7297 Coolant/Battery Tester (Degrees Fahrenheit). The testers give readings that are immediate and accurate. The testers can be used with ethylene or propylene glycol.

Coolant Recommendations

NOTICE

Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 specification. This type of coolant/antifreeze is made for light duty automotive applications.

The following two coolants are used in Caterpillar diesel engines:

Preferred – Caterpillar Extended Life Coolant (ELC) or a commercial extended life coolant that meets the Caterpillar EC-1 specification

Acceptable – Caterpillar Diesel Engine Antifreeze/Coolant (DEAC) or a commercial heavy-duty antifreeze/coolant that meets “ASTM D4985”, or “ASTM D6210” specifications

Caterpillar recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as an antifreeze/coolant.

Note: Caterpillar DEAC does not require a treatment with an SCA at the initial fill. A commercial heavy-duty antifreeze/coolant that meets “ASTM D4985” or “ASTM D6210” specifications MAY require a treatment with an SCA at the initial fill. These coolants WILL require a treatment with an SCA on a maintenance basis.

Refer to Special Publication, SEBU6251, “Caterpillar Commercial Diesel Engine Fluids Recommendations” for additional information that relates to coolant.

S·O·S Coolant Analysis

Table 16

Recommended Interval		
Type of Coolant	Level 1	Level 2
DEAC	Every 250 Hours	Yearly ⁽¹⁾
ELC	Not Required	Yearly

⁽¹⁾ The Level 2 Coolant Analysis should be performed sooner if a problem is identified by a Level 1 Coolant Analysis.

S·O·S Coolant Analysis (Level 1)

A coolant analysis (Level 1) is a test of the properties of the coolant.

The following properties of the coolant are tested:

- Glycol concentration for freeze protection and boil protection
- Ability to protect from erosion and corrosion
- pH
- Conductivity
- Visual analysis
- Odor analysis

The results are reported, and appropriate recommendations are made.

Refer to the Maintenance Interval Schedule in this Operation and Maintenance Manual, "Cooling System Coolant Sample (Level 1) - Obtain" for a sampling location and the maintenance interval for collecting the coolant samples.

S·O·S Coolant Analysis (Level 2)

A coolant analysis (Level 2) is a comprehensive chemical evaluation of the coolant. This analysis is also a check of the overall condition of the inside of the cooling system.

The S·O·S Coolant Analysis has the following features:

- Full coolant analysis (Level 1)
- Identification of the source of metal corrosion and of contaminants
- Water hardness
- Identification of buildup of the impurities that cause corrosion
- Identification of buildup of the impurities that cause scaling

The results are reported, and appropriate recommendations are made.

Refer to the Maintenance Interval Schedule in this Operation and Maintenance Manual, "Cooling System Coolant Sample (Level 2) - Obtain" for a sampling location and the maintenance interval for collecting the coolant samples.

Testing the engine coolant is important to ensure that the engine is protected from internal cavitation and from corrosion. The analysis also tests the ability of the coolant to protect the engine from boiling and from freezing. The S·O·S Coolant Analysis can be done at your Caterpillar dealer. Caterpillar S·O·S Coolant Analysis is the best way to monitor the condition of your coolant and your cooling system. S·O·S Coolant Analysis is a program that is based on periodic samples.

Refer to Special Publication, SEBU6251, "Caterpillar Commercial Diesel Engine Fluids Recommendations" for additional information.

Maintenance Recommendations

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General Maintenance Information

SMCS Code: 4450; 7000

Note: Read the warnings and read the instructions that are contained in the Safety Section of this manual. These warnings and instructions must be understood before you perform any operation or any maintenance procedures.

Rotating electric machines are complex structures that are exposed to the following forms of stress:

- mechanical
- electrical
- thermal
- environmental

These stresses may be of varying magnitudes. The electrical insulation systems are susceptible to damage that is caused by the stresses that are listed above. Exposure to these stresses may shorten the effective life of the electrical insulation system. Therefore, the service life of an electric machine will largely depend on the serviceability of the electrical insulation systems. An inspection program and a testing procedure are recommended. An inspection program and a testing procedure will ensure that the equipment is maintained in satisfactory condition. Maintaining the equipment will increase field reliability.

A regular maintenance and inspection program can provide an evaluation of the present condition of the equipment. A regular maintenance program and a regular inspection program can also reveal future problems. The frequency of this maintenance program will depend on the following factors:

- application
- environmental conditions
- experience level of the operator
- philosophy of the operator

A regular maintenance program is recommended. This program would involve the following steps:

- periodic disassembly
- knowledgeable visual examination of the equipment

- the application of electrical tests

Never perform a test over the rated potential. These tests can damage insulation that is contaminated or insulation that is in marginal condition. For more information, refer to "I.E.E.E. Standard 432-1992" or consult a Cat dealer.

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System Pressure Release

SMCS Code: 1250; 1300; 1350; 5050

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 engine. Allow the cooling system pressure cap to cool. Remove the cooling system pressure cap slowly to relieve pressure.

Fuel System

To relieve the pressure from the fuel system, turn off the engine.

High-Pressure Fuel Lines (If Equipped)

WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

The high-pressure fuel lines are between the high-pressure fuel pump and the high-pressure fuel manifold. The high-pressure fuel lines are also between the fuel manifold and cylinder head. These fuel lines are different from fuel lines on other fuel systems.

The following are the differences:

- The high-pressure fuel lines are constantly charged with high pressure.
- The internal pressures of the high-pressure fuel lines are higher than other types of fuel system.

Before any service or repair is performed on the engine fuel lines, perform the following tasks:

1. Stop the engine.

2. Wait for 10 minutes.

Do not loosen the high-pressure fuel lines to remove air pressure from the fuel system.

Engine Oil

To relieve pressure from the lubricating system, turn off the engine.

i08254042

Welding on Engines with Electronic Controls

SMCS Code: 1000

NOTICE

Because the strength of the frame may decrease, some manufacturers do not recommend welding onto a chassis frame or rail. Consult the OEM of the equipment or your Cat dealer regarding welding on a chassis frame or rail.

Proper welding procedures are necessary to avoid damage to the engine ECM, sensors, and associated components. When possible, remove the component from the unit and then weld the component. If removal of the component is not possible, the correct procedure must be followed. When welding on a unit that is equipped with a Cat Electronic Engine, the following is considered to be the safest procedure:

NOTICE

Do not ground the welder to electrical components such as the ECM or sensors. Improper grounding can cause damage to the drive train, the bearings, hydraulic components, electrical components, and other components.

Do not ground the welder across the centerline of the package. Improper grounding could cause damage to the bearings, the crankshaft, the rotor shaft, and other components.

Clamp the ground cable from the welder to the component that will be welded. Place the clamp as close as possible to the weld. This will help reduce the possibility of damage.

Note: Perform the welding in areas that are free from explosive hazards.

1. Stop the engine. Turn the switched power to the OFF position.
2. Disconnect the negative battery cable from the battery. If a battery disconnect switch is provided, open the switch.

3. Disconnect the J1/P1 and J2/P2 connectors from the ECM. Move the harness to a position that will not allow the harness to move back accidentally, and contact any of the ECM pins.
4. Disconnect any component with a microprocessor from the engine harness, such as:
 - Engine ECM
 - Product Link
 - Cell/Sat Radio
 - DOC Identity Modules

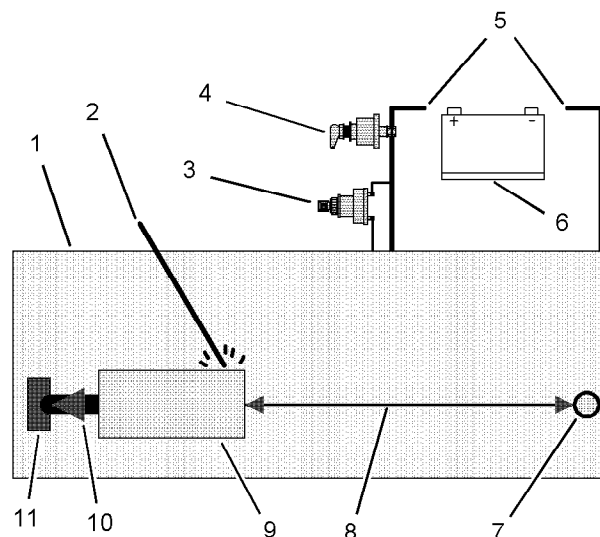


Illustration 44

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Use the example above. The current flow from the welder to the ground clamp of the welder will not damage any associated components.

- (1) Engine
- (2) Welding electrode
- (3) Keyswitch in the OFF position
- (4) Battery disconnect switch in the open position
- (5) Disconnected battery cables
- (6) Battery
- (7) Electrical/Electronic component
- (8) Minimum distance between the component that is being welded and any electrical/electronic component
- (9) The component that is being welded
- (10) Current path of the welder
- (11) Ground clamp for the welder

5. Connect the welding ground cable directly to the part that will be welded. Place the ground cable as close as possible to the weld. This location will reduce the possibility of welding current damage to bearings, hydraulic components, electrical components, and ground straps.

Note: If electrical/electronic components are used as a ground for the welder, current flow from the welder could severely damage the component. Current flow from the welder could also severely damage electrical/electronic components that are located between the welder ground and the weld.

6. Protect the wiring harness from welding debris and spatter.
7. Use standard welding practices to weld the materials.

i08699994

Maintenance Interval Schedule (Standby)

SMCS Code: 1000; 4450; 7500

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, including all adjustments, the use of proper lubricants, fluids, and filters. The user is also responsible for the replacement of components due to normal wear and aging. Failure to adhere to proper maintenance intervals and procedures may result in diminished performance of the product and/or accelerated wear of components. Use fuel consumption, service hours, or calendar time, **WHICH EVER OCCURS FIRST**, to determine the maintenance intervals. Products that operate in severe operating conditions may require more frequent maintenance. Before each consecutive interval is performed, all maintenance from the previous interval must be performed.

When Required

" Battery - Recycle"	79
" Battery - Replace"	79
" Battery or Battery Cable - Disconnect"	80
" Generator - Dry"	102
" Generator Load - Check"	104
" Generator Set - Test"	105
" Rotating Rectifier - Inspect/Test"	115

Every Week

" Alternator - Inspect"	79
" Battery Electrolyte Level - Check"	80
" Coolant Level - Check"	83
" Electrical Connections - Check"	86
" Engine Air Cleaner Service Indicator - Inspect"	88
" Engine Oil Level - Check"	89
" Fuel System Primary Filter/Water Separator - Drain"	98
" Fuel Tank Water and Sediment - Drain"	101

" Generator - Inspect"	102
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Every 500 Service Hours or 1 Year

" Engine Air Cleaner Element (Single Element) - Replace"	87
" Engine Oil and Filter - Change"	90

Every Year

" Alternator - Inspect"	79
" Belts - Inspect/Adjust/Replace"	80
" Coolant Sample (Level 2) - Obtain"	85
" Engine - Clean"	87
" Engine Mounts - Inspect"	89
" Engine Oil and Filter - Change"	90
" Engine Oil Sample - Obtain"	90
" Fuel System Primary Filter (Water Separator) Element - Replace"	97
" Fuel System Secondary Filter - Replace"	99
" Generator Set Vibration - Test/Record"	106
" Rotating Rectifier - Check"	113
" Starting Motor - Inspect"	115
" Water Pump - Inspect"	117

Every 3 Years

" Battery - Recycle"	79
" Battery - Replace"	79
" Coolant Extender (ELC) - Add"	83
" Coolant Temperature Regulator - Replace"	86

Every 6 Years

" Coolant (ELC) - Change"	81
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Overhaul

" Overhaul Considerations"	111
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Alternator - Inspect

SMCS Code: 1405-040

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and proper battery charging. Inspect the ammeter (if equipped) during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system. Make repairs, as required. Refer to the Service Manual.

Check the alternator and the battery charger for proper operation. If the batteries are properly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. The battery will not crank the engine, even if the engine is warm. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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Battery - Recycle

SMCS Code: 1401-561; 1401-005; 1401; 1401-535; 1401-510

Always recycle a battery. Never discard a battery. Return used batteries to one of the following locations:

- A battery supplier
- An authorized battery collection facility
- A recycling facility

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Battery - Replace

SMCS Code: 1401-510

WARNING

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.

Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.

WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

Note: Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

1. Turn the key start switch to the OFF position. Remove the key and all electrical loads.
2. Turn OFF the battery charger. Disconnect the charger.
3. Turn battery isolator switch to OFF position.
4. The NEGATIVE “-” cable connects the NEGATIVE “-” battery terminal to the ground plane. Disconnect the cable from the NEGATIVE “-” battery terminal.
5. The POSITIVE “+” cable connects the POSITIVE “+” battery terminal to the starting motor. Disconnect the cable from the POSITIVE “+” battery terminal.

Note: Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

6. Remove the used battery.
7. Install the new battery.

Note: Before the cables are connected, ensure that the key start switch is OFF.

8. Connect the cable from the starting motor to the POSITIVE “+” battery terminal.
9. Connect the cable from the ground plane to the NEGATIVE “-” battery terminal.

i08642360

Battery Electrolyte Level - Check

SMCS Code: 1401-535-FLV

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge to help prevent the battery from freezing. If batteries are properly charged, ammeter reading should be very near zero, when the engine is in operation.

WARNING

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

If the addition of water is necessary, use distilled water. If distilled water is not available, use clean water that is low in minerals. Do not use artificially softened water.
2. Check the condition of the electrolyte with the 245 - 5829 Coolant Battery Tester Refractometer.
3. Keep the batteries clean.

Clean the battery case with one of the following cleaning solutions:

- Use a solution of 0.1 kg (0.2 lb) baking soda and 1 L (1 qt) of clean water.
- Use a solution of Ammonium Hydroxide.

Thoroughly rinse the battery case with clean water.

Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps not to fit properly. Coat the clamps and the terminals with 5N - 5561 Silicone Lubricant, petroleum jelly or MPGM.

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Battery or Battery Cable - Disconnect

SMCS Code: 1401; 1402-029

WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal at the battery that goes to the start switch. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, the negative side of two batteries must be disconnected.
3. Tape the leads to help prevent accidental starting.
4. Proceed with necessary system repairs. Reverse the steps to reconnect all cables.

i05265358

Belts - Inspect/Adjust/Replace

SMCS Code: 1357-040; 1357-025; 1357-510

Inspection

To maximize the engine performance, inspect the belts for wear and for cracking. Replace belts that are worn or damaged.

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

If the belts are too loose, vibration causes unnecessary wear on the belts and pulleys. Loose belts may slip enough to cause overheating.

To check the belt tension accurately, Gauge 144 - 0235 Belt Tension Gauge should be used.

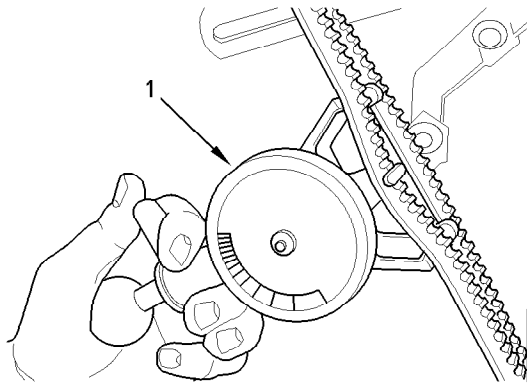


Illustration 45

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Typical example

(1) 144-0235 Belt Tension Gauge

Install the gauge (1) at the center of the belt between the alternator and the crankshaft pulley and check the belt tension. The correct tension for a new belt is 400 N (90 lb) to 489 N (110 lb). The correct tension for a used belt that has been in operation for 30 minutes or more at the rated speed is 267 N (60 lb) to 356 N (80 lb).

If twin belts are installed, check and adjust the tension on both belts.

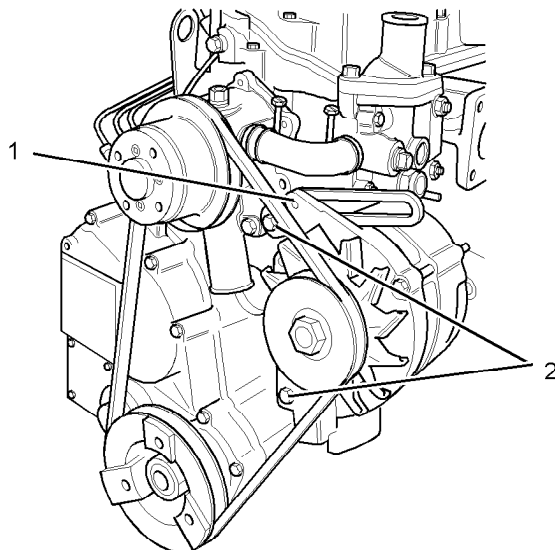
Adjustment

Illustration 46

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Typical example

(1) Adjusting bolt
(2) Mounting bolts

1. Loosen the mounting bolts (2) and the adjusting bolt (1).

2. Move the alternator in order to increase or decrease the belt tension.
3. Tighten the adjusting bolt (1). Tighten the mounting bolts (2). Refer to the Specifications Manual for the correct torque settings.

i05244392

Coolant (ELC) - Change**SMCS Code:** 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained.

Drain**⚠ WARNING**

Pressurized System: Hot coolant can cause serious burns. 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.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove the cooling system drain plugs. Allow the coolant to drain.

NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Cat dealer or consult Cat Dealer Service Tool Group:

Outside Illinois 1-800-542-TOOL
Inside Illinois 1-800-541-TOOL
Canada 1-800-523-TOOL

Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with clean water. Install the cooling system filler cap.
4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Specifications Manual, SENR3130, "Torque Specifications" for more information on the proper torques.

Fill

Note: Do not step on the roof of the enclosure to fill the radiator with coolant from outside of the enclosure. Use a funnel of adequate length and a safe platform to stand on while filling the radiator with coolant. Refer to this Operation and Maintenance Manual, "Mounting and Dismounting" for additional information to mount and dismount the enclosure safely. Filling the radiator with coolant from inside the enclosure is an alternative to filling the radiator from outside of the enclosure.

NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

1. Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
2. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for 1 minute in order to purge the air from the cavities of the engine block. Stop the engine.
3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).

4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old filler cap and install a new filler cap. If the gasket that is on the filler cap is not damaged, use a 9S-8140 Pressurizing Pump in order to pressure test the filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

i08397632

Coolant Extender (ELC) - Add

SMCS Code: 1352-544-NL

Cat ELC (Extended Life Coolant) does not require the frequent additions of any supplemental cooling additives which are associated with the present conventional coolants. The Cat ELC Extender will only be added one time.

NOTICE

Use only Cat Extended Life Coolant (ELC) Extender with Cat ELC.

Do NOT use conventional supplemental coolant additive (SCA) with Cat ELC. Mixing Cat ELC with conventional coolants and/or conventional SCA reduces the Cat ELC service life.

Check the cooling system only when the engine is stopped and cool.

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, NENG2500, "Cat Dealer Service Tool Catalog" or refer to Special Publication, PECJ0003, "Cat Shop Supplies and Tools Catalog" for tools and supplies suitable to collect and contain fluids on Cat products.

Dispose of all fluids according to local regulations and mandates.

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
2. If necessary, drain enough coolant from the cooling system in order to add the Cat ELC Extender.
3. Add Cat ELC Extender according to the requirements for the cooling system capacity. Refer to this Operation and Maintenance Manual, "Refill Capacities" or to this Operation and Maintenance Manual, "Fluid Recommendations" for more information.
4. Clean the cooling system filler cap. Inspect the gaskets on the cooling system filler cap. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.

i08302398

Coolant Level - Check

SMCS Code: 1395-082

Engines With a Coolant Recovery Tank

Note: The cooling system may not have been provided by Caterpillar. The following procedure is for typical cooling systems. Refer to the OEM information for the correct procedures.

Check the coolant level when the engine is stopped and cool.

1. Observe the coolant level in the coolant recovery tank. Maintain the coolant level to "COLD FULL" mark on the coolant recovery tank.

WARNING

Pressurized System: Hot coolant can cause serious burns. 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.

2. Loosen filler cap slowly in order to relieve any pressure. Remove the filler cap.
3. Pour the correct coolant mixture into the tank. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for information on the correct mixture and type of coolant. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for the cooling system capacity. Do not fill the coolant recovery tank above "COLD FULL" mark.

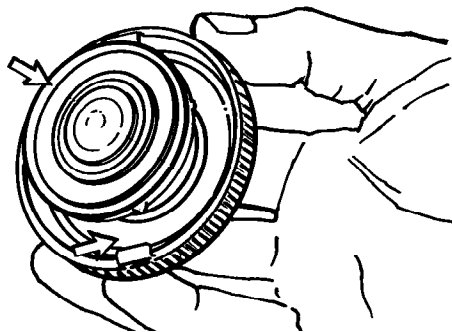


Illustration 47

g00103639

4. Clean filler cap and the receptacle. Reinstall the filler cap and inspect the cooling system for leaks.

Note: The coolant will expand as the coolant heats up during normal engine operation. The additional volume will be forced into the coolant recovery tank during engine operation. When the engine is stopped and cool, the coolant will return to the engine.

Engines Without a Coolant Recovery Tank

Check the coolant level when the engine is stopped and cool.

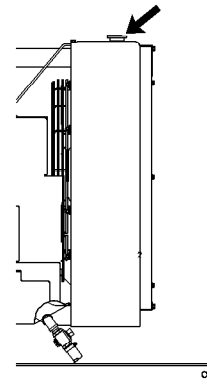


Illustration 48

g00285520

Cooling system filler cap

WARNING

Pressurized System: Hot coolant can cause serious burns. 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.

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the correct level in the sight glass.
3. Clean the cooling system filler cap and inspect the gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, install a new filler cap.
4. Inspect the cooling system for leaks.

i08312361

Coolant Sample (Level 1) - Obtain

SMCS Code: 1350-008; 1395-554; 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) obtained at the recommended interval 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. A Coolant Sample (Level 1) includes the following types of coolants:

- Commercial long life coolants that meet the Caterpillar Engine Coolant Specification -1 (Caterpillar EC-1)
- Cat DEAC (Diesel Engine Antifreeze/Coolant)
- Commercial heavy-duty coolant/antifreeze

Table 17

Recommended Interval		
Type of Coolant	Level 1	Level 2
Cat DEAC	Every 250 Hours ⁽¹⁾	Yearly ^{(1) (2)}
Cat ELC	Optional ⁽²⁾	Yearly ⁽²⁾

⁽¹⁾ This interval is the recommended interval for coolant samples for all conventional heavy-duty coolant/antifreeze. This interval is also the recommended interval for coolant samples of commercial coolants that meet the Cat EC-1 specification for engine coolant.

⁽²⁾ The Level 2 Coolant Analysis should be performed sooner if a problem is suspected or identified.

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.

Obtain the sample of the coolant as close as possible to the recommended sampling interval. To receive the full effect of S·O·S analysis, a consistent trend of data must be established. To establish a pertinent history of data, perform consistent samplings that are evenly spaced. Supplies for collecting samples can be obtained from your Cat 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 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 this Operation and Maintenance Manual, "Fluid Recommendations" or consult your Cat dealer.

i08397652

Coolant Sample (Level 2) - Obtain

SMCS Code: 1350-008; 1395-554; 1395-008; 7542

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.

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, NENG2500, "Cat Dealer Service Tool Catalog" or refer to Special Publication, PECJ0003, "Cat Shop Supplies and Tools 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, "Cooling System Coolant Sample (Level 1) - Obtain" for the guidelines for a proper sampling of the coolant.

Submit the sample for Level 2 analysis.

For additional information about coolant analysis, see Special Publication, SEBU7003, "Cat 3600 Series and C280 Series Diesel Engine Fluids Recommendations" or consult your Cat dealer.

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i07682906

Coolant Temperature Regulator - Replace

SMCS Code: 1355-510

Replace the water temperature regulator before the water temperature regulator fails. This replacement is a recommended preventive maintenance practice. Replacing the water temperature regulator reduces the chances for unscheduled downtime.

A water temperature regulator that fails in a partially opened position can cause overheating or overcooling of the engine.

A water temperature regulator that fails in the closed position can cause excessive overheating. Excessive overheating could result in cracking of the cylinder head or piston seizure problems.

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner.

NOTICE

Failure to replace your water temperature regulator on a regularly scheduled basis could cause severe engine damage.

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a water temperature regulator installed.

If the water temperature regulator is installed incorrectly, the engine may overheat, causing cylinder head damage. Ensure that the new water temperature regulator is installed in the original position. Ensure that the water temperature regulator vent hole is open.

Do not use liquid gasket material on the gasket or cylinder head surface.

Refer to Disassembly and Assembly, "Water Temperature Regulator - Remove and Install". Consult your Cat dealer for more information.

Note: If only the water temperature regulators are replaced, drain the coolant from the cooling system to a level that is below the water temperature regulator housing.

Electrical Connections - Check

SMCS Code: 4459-535



DANGER: Shock/Electrocution Hazard-Do not operate this equipment or work on this equipment 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 will result in serious injury or death.

Checking the electrical connections is an important part of the maintenance for the generator set. Improper connections may cause the generator set to malfunction.

Check all exposed electrical connections for tightness.

Check the following devices for loose mounting or for physical damage:

- Transformers
- Fuses
- Capacitors
- Lightning arresters

Check the connections for the following components:

- Load cables
- Cables for the generator
- Potential transformers
- Current transformers

Check all lead wires and electrical connections for proper clearance. Inspect all cables for chafing, abrasion, and corrosion. Repair any damaged wires prior to use.

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i05683393

Engine - Clean

SMCS Code: 1000-070

WARNING

Personal injury or death can result from high voltage.

Moisture could create paths of electrical conductivity.

Make sure the unit is off line (disconnected from utility and/or other generators), locked out and tagged "Do Not Operate".

NOTICE

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

NOTICE

Water or condensation can cause damage to generator components. Protect all electrical components from exposure to water.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

Note: Caution must be used in order to prevent electrical components from being damaged by excessive water when you clean the engine. Avoid electrical components such as the alternator, the starter, and the ECM.

Engine Air Cleaner Element (Single Element) - Replace

SMCS Code: 1051; 1054; 1054-510

WARNING

The high voltage that is produced by an operating generator set can cause severe injury or death. Before performing any maintenance or repairs, ensure that the generator will not start.

Place the engine control switch in the "OFF" position. Attach "DO NOT OPERATE" tags to all starting controls. Disconnect the batteries or disable the starting system. Lock out all switchgear and automatic transfer switches that are associated with the generator.

Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure before performing the following procedure.

NOTICE

Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

NOTICE

Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

Note: This type of air cleaner is only available on open generator sets.

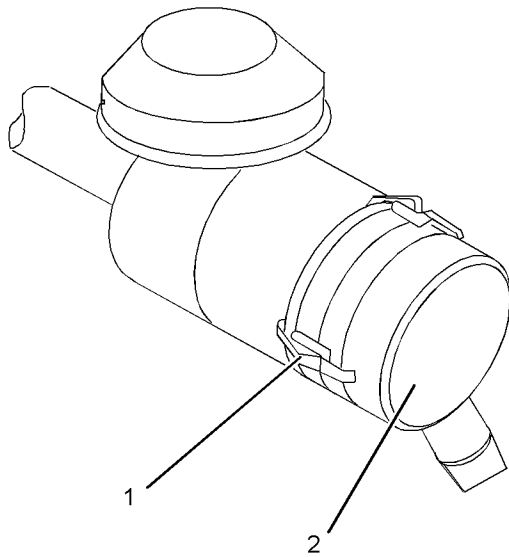


Illustration 49

g01197946

1. Unfasten latches (1). Remove cover (2).

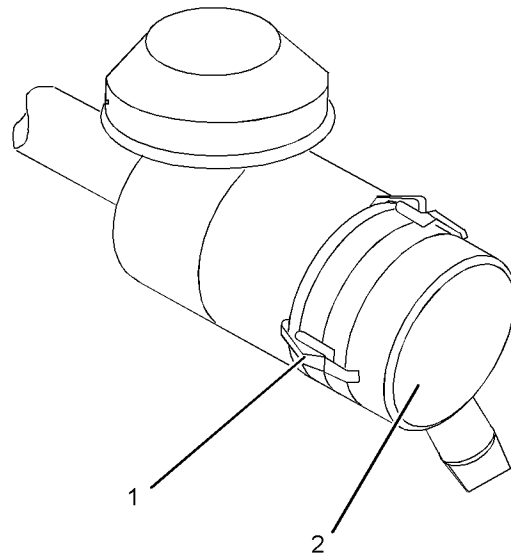


Illustration 51

g01197946

4. Install cover (2). Fasten latches (1).

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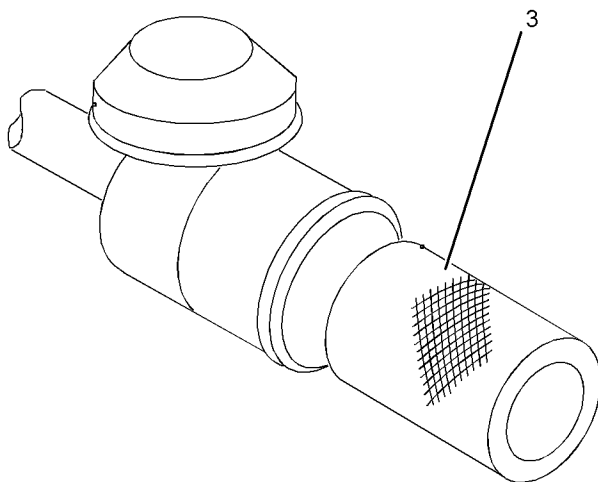


Illustration 50

g01197952

2. Remove air cleaner element (3).
3. Inspect the replacement element for the following items: damage, dirt and debris. Install a clean, undamaged air filter element (3). Make sure that the element is properly seated in the air cleaner housing.

Engine Air Cleaner Service Indicator - Inspect (If Equipped)

SMCS Code: 7452-040

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner housing or in a remote location.

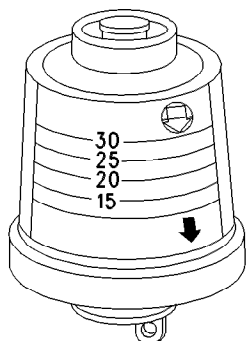


Illustration 52

g00103777

Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be plugged.

The service indicator may need to be replaced frequently in environments that are severely dusty, if necessary. Replace the service indicator annually regardless of the operating conditions. Replace the service indicator when the engine is overhauled, and whenever major engine components are replaced.

Note: When a new service indicator is installed, excessive force may crack the top of the service indicator. Tighten the service indicator to a torque of 2 N·m (18 lb in).

i02456872

Engine Mounts - Inspect

SMCS Code: 1152-040; 1152

Inspect the engine mounts for deterioration and for proper bolt torque. Engine vibration can be caused by the following conditions:

- Improper mounting of the engine
- Deterioration of the engine mounts

Any engine mount that shows deterioration should be replaced. Refer to Special Publication, SENR3130, "Torque Specifications" for the recommended torques. Refer to the OEM recommendations for more information.

i00623423

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 the skin.

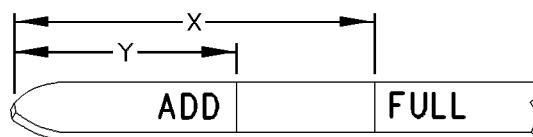


Illustration 53

g00110310

(Y) "ADD" mark. (X) "FULL" mark.

NOTICE

Perform this maintenance with the engine stopped.

1. Maintain the oil level between "ADD" mark (Y) and "FULL" mark (X) on oil level gauge (1). Do not fill the crankcase above "FULL" mark (X).

NOTICE

Operating your engine when the oil level is above the "FULL" mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i08397634

Engine Oil Sample - Obtain

SMCS Code: 1348-554-SM

In addition to a good preventive maintenance program, Caterpillar recommends using S·O·S oil analysis at regularly scheduled intervals. S·O·S oil analysis provides infrared analysis, which is required for determining nitration and oxidation levels.

Obtain the Sample and the Analysis

WARNING

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

Before you take the oil sample, complete the Label, PEEP5031 for identification of the sample. To help obtain the most accurate analysis, provide the following information:

- Engine model
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

Caterpillar recommends using the sampling valve to obtain oil samples. The quality and the consistency of the samples are better when the sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

The 169-8373 Fluid Sampling Bottle is recommended for use with the sampling valve. The fluid sampling bottle includes the parts that are needed for obtaining oil samples. Instructions are also provided.

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.

If the engine is not equipped with a sampling valve, use the 1U-5718 Vacuum Pump. The pump is designed to accept sampling bottles. Disposable tubing must be attached to the pump for insertion into the sump.

For instructions, see Special Publication, PEGJ0047, "How To Take A Good S·O·S Oil Sample". Consult your Cat dealer for complete information and assistance in establishing an S·O·S program for your engine.

i02293592

Engine Oil and Filter - Change

SMCS Code: 1318-510

WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the 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.

Dispose of all fluids according to local regulations and mandates.

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained correctly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

Drain the Engine Oil

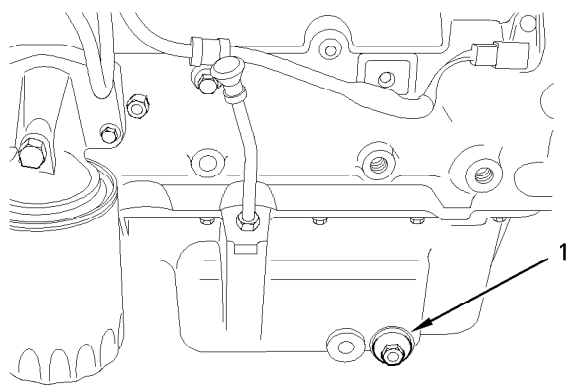


Illustration 54

g01003623

Oil drain plug

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug (1) in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed. If necessary, renew the O ring seal on the drain plug.

Some types of oil pans have oil drain plugs that are on both sides of the oil pan, because of the shape of the pan. This type of oil pan requires the engine oil to be drained from both plugs.

Replace the Spin-on Oil Filter

NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

1. Remove the oil filter with a 1U-8760 Chain Wrench.

Note: The following actions can be carried out as part of the preventive maintenance program.

2. Cut the oil filter open with a 175-7546 Oil Filter Cutter Gp. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings and cylinder heads.

Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter. Consult your Caterpillar dealer in order to arrange for a further analysis if an excessive amount of debris is found in the oil filter.

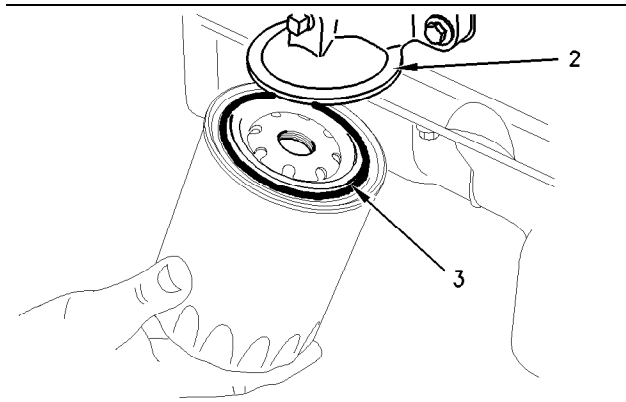


Illustration 55

g01003628

- (2) Filter head
(3) O ring seal

3. Clean the sealing surface of the oil filter head (2). Ensure that the union (not shown) in the oil filter head is secure.
4. Apply clean engine oil to the new oil filter seal (3).

NOTICE

Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

5. Install the oil filter. Tighten the oil filter until the oil filter seal contacts the cylinder block or the oil cooler. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

Replace the Element for the Oil Filter

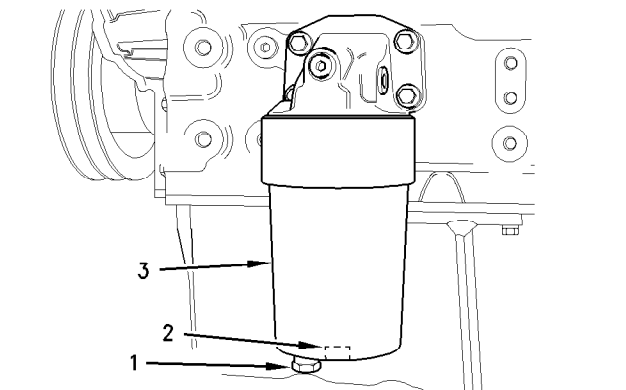


Illustration 56

g01003662

- (1) Drain plug
(2) Square hole
(3) Filter bowl

1. Place a suitable container under the oil filter. Remove the drain plug (1) and the seal, from the oil filter.
2. Locate a suitable wrench into the square hole (2) in order to remove the filter bowl (3).
3. Remove the filter bowl (3) and remove the element from the filter bowl. Clean the filter bowl.

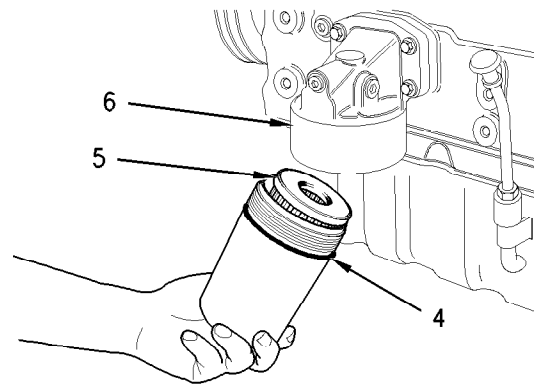


Illustration 57

g01003675

- (4) O ring seal
(5) Element
(6) Filter bowl

4. Install a new O ring (4) onto the filter bowl and lubricate the O ring with clean engine oil. Install the filter element (5) into the filter bowl.
5. Install the filter bowl into the oil filter head (6). Tighten the filter bowl to the following torque 25 N·m (18 lb ft).
6. Install a new seal onto the drain plug (1) and install the drain plug into the oil filter. Tighten the drain plug to the following torque 12 N·m (8 lb ft).

Note: Some engines may have a horizontally mounted oil filter. This oil filter has a drain plug that is located in the oil filter head.

Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to this Operation and Maintenance Manual , "Refill Capacities and Recommendations" for more information on lubricant specifications. Fill the crankcase with the correct amount of oil. Refer to this Operation and Maintenance Manual , "Refill Capacities" for more information on refill capacities.

NOTICE

If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

NOTICE

To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.
3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.

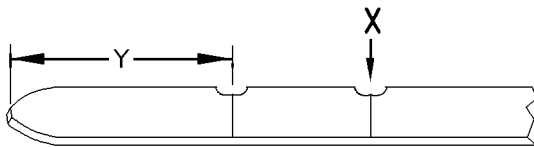


Illustration 58

g00998024

(Y) "ADD" mark. (X) "FULL" mark.

4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the oil level gauge.

i05677710

Engine Valve Lash - Inspect/Adjust

SMCS Code: 1102; 1102-025; 1102-535; 1105-535

The initial valve lash adjustment on new engines, rebuilt engines, or remanufactured engines is recommended at the first scheduled oil change. 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.

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.

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.

Ensure that the engine is stopped before measuring the valve lash. To obtain an accurate measurement, allow the valves to cool before this maintenance is performed.

Refer to Systems Operation, Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust" for more information.

i05677733

Fuel Injection Nozzles - Test/Exchange

SMCS Code: 1254-081; 1254; 1254-013

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

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 any disconnected fuel system components.

Fuel injection nozzles are subject to tip wear. Tip wear is a result of fuel contamination. Tip wear can cause the following problems:

- Increased fuel consumption
- Black smoke
- Misfire

- Rough running

Fuel Injection nozzles should be cleaned, inspected, tested, and replaced, if necessary. Refer to Special Instruction, SEHS7292 for using the 8S-2245 Injection Cleaning Tool Group. Consult your Caterpillar dealer about cleaning the fuel injection nozzle and testing the fuel injection nozzle.

NOTICE

Never wire brush or scrape a fuel injection nozzle. Wire brushing or scraping a fuel injection nozzle will damage the finely machine orifice. Proper tools for cleaning and testing the fuel injection nozzles can be obtained from Caterpillar dealers.

The following items are symptoms of a malfunction of the fuel injection nozzle:

- Abnormal engine operation
- Smoke emission
- Engine knock

Each fuel injection nozzle must be isolated one at a time in order to determine the malfunctioning fuel injection nozzle.

1. Start the engine.
2. Loosen each fuel line nut one at a time at the fuel injection pump. A cloth or similar material must be used in order to prevent fuel from spraying on the hot exhaust components. Tighten each nut before loosening the next nut.
3. A defective fuel injection nozzle may be identified when a fuel line nut is loosened and the following conditions are present:
 - The exhaust smoke is partially eliminated or the exhaust smoke is completely eliminated.
 - Engine performance is not affected.

A fuel injection nozzle that is suspected of being defective should be removed. A new fuel injection nozzle should be installed in the cylinder in order to determine if the removed fuel injection nozzle is defective.

Removal and Installation of the Fuel Injection Nozzles

For the removal and the installation of fuel injection nozzles, special tooling is required. Refer to the Service Manual for more information. Consult your Caterpillar dealer for assistance.

i06621306

Fuel Injector - Replace

SMCS Code: 1290-510

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

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 any disconnected fuel system components.

NOTICE

If a fuel injector is suspected of operating outside of normal parameters it should be removed by a qualified technician. The suspect fuel injector should be taken to an authorised agent for inspection.

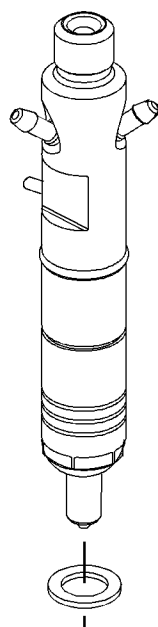


Illustration 59

g01347499

Typical fuel Injector

The fuel injectors should not be cleaned as cleaning with incorrect tools can damage the nozzle. The fuel injectors should be renewed only if a fault with the fuel injectors occurs. Some of the problems that may indicate that new fuel injectors are needed are listed below:

- The engine will not start or the engine is difficult to start.
- Not enough power
- The engine misfires or the engine runs erratically.
- High fuel consumption
- Black exhaust smoke
- The engine knocks or there is vibration in the engine.
- Excessive engine temperature

Refer to the appropriate Disassembly and Assembly manual for the removal and installation procedure.

Fuel System - Prime

SMCS Code: 1250-548; 1258-548

WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

Refer to Operation and Maintenance Manual , “General Hazard Information and High Pressure Fuel Lines” before adjustments and repairs are performed.

Note: Refer to Systems Operation, Testing and Adjusting, “Cleanliness of Fuel System Components” for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

Ensure that all adjustments and repairs are performed by authorized personnel that have had the correct training.

NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

If air enters the fuel system, the air must be purged from the fuel system before the engine can be started. Air can enter the fuel system when the following events occur:

- The fuel tank is empty or the fuel tank has been partially drained.
- The low-pressure fuel lines are disconnected.
- A leak exists in the low-pressure fuel system.
- The fuel filter has been replaced.

Hand Fuel Priming Pump

Use the following procedures in order to remove air from the fuel system:

1. Ensure that the fuel system is in working order.
Restore the fuel supply.

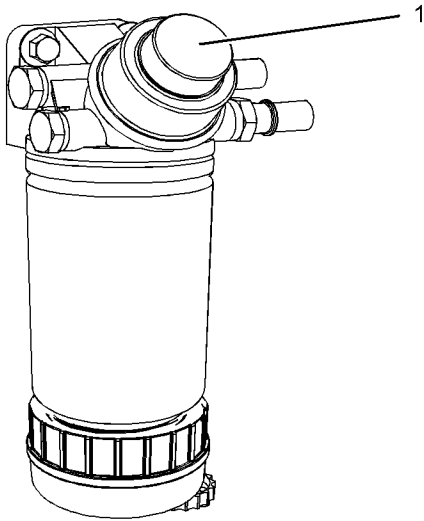


Illustration 60

g01448339

Typical example

2. Operate the fuel priming pump (1). Count the number of operations of the fuel priming pump. After 100 depressions of the fuel priming pump stop.
3. The engine fuel system should now be primed and the engine should now be able to start.

Note: Do not loosen the high-pressure fuel line in order to purge air from the fuel system. This procedure is not required.

4. Operate the engine starter and crank the engine. After the engine has started, operate the engine at low idle for a minimum of 5 minutes, immediately after air has been removed from the fuel system.

Note: Operating the engine for this time will help ensure that the fuel system is free of air.

After the engine has stopped, wait for 10 minutes in order to allow the fuel pressure to be purged from the high-pressure fuel lines before any service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and Assembly, "Fuel Injection Lines - Install".

If you inspect the engine in operation, always use the proper inspection procedure in order to avoid a fluid penetration hazard. Refer to Operation and Maintenance Manual, "General hazard Information".

Electric Fuel Priming Pump

1. Ensure that the fuel system is in working order. Restore the fuel supply.

NOTICE

The electric fuel priming pump will operate for 90 seconds. If necessary the electric fuel priming pump can be stopped during the 90 seconds of operation, by operation of the switch.

2. Turn the keyswitch to the "RUN" position. Operate the switch for the electric priming pump. After 100 seconds of the electric fuel priming pump operation, the fuel system will be primed and the electric fuel priming pump will turn off.
3. The engine should now be able to start.

Note: Do not loosen the high-pressure fuel line in order to purge air from the fuel system. This procedure is not required.

4. Operate the engine starter and crank the engine. After the engine has started, operate the engine at low idle for a minimum of 5 minutes, immediately after air has been removed from the fuel system.

Note: Operating the engine for this time will help ensure that the fuel system is free of air.

After the engine has stopped, wait for 10 minutes in order to allow the fuel pressure to be purged from the high-pressure fuel lines before any service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and Assembly, "Fuel Injection Lines - Install".

If you inspect the engine in operation, always use the proper inspection procedure in order to avoid a fluid penetration hazard. Refer to Operation and Maintenance Manual, "General hazard Information".

i05323036

Fuel System Primary Filter (Water Separator) Element - Replace

SMCS Code: 1260-510-FQ; 1263-510-FQ

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

Note: Refer to Testing and Adjusting Manual, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

NOTICE

Ensure that the engine is stopped before any servicing or repair is performed.

If your engine is equipped with high-pressure fuel lines you must wait for 10 minutes after the engine has stopped, in order to allow the fuel pressure to be purged from the high-pressure fuel lines before any service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and assembly Manual, "Fuel Injection Lines - Install".

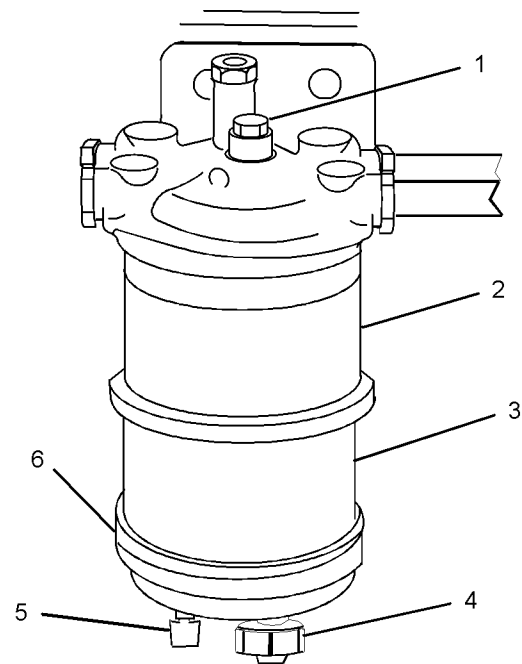


Illustration 61

g01118416

- (1) Screw
- (2) Element
- (3) Glass bowl
- (4) Sensor connection
- (5) Drain
- (6) Bottom cover

1. Turn the fuel supply valve (if equipped) to the OFF position.
2. Place a suitable container under the water separator. Clean the outside of the water separator.
3. Open the drain (5). Allow the fluid to drain into the container.
4. Tighten the drain (5) by hand pressure only.
5. Hold the element (2) and remove the screw (1). Remove the element and the glass bowl (3) from the base. Discard the old element.
6. Clean the glass bowl (4). Clean the bottom cover (6).
7. Install the new O ring seal. Install the bottom cover onto the new element. Install the assembly onto the base.
8. Install the screw (1) and tighten the screw to a torque of 8 N·m (6 lb ft).

9. Remove the container and dispose of the fuel safely.
10. Open the fuel supply valve.
11. Prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" for more information.

i05323045

Fuel System Primary Filter/ Water Separator - Drain

SMCS Code: 1260-543; 1263-543

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE

The water separator is not a filter. The water separator separates water from the fuel. The engine should never be allowed to run with the water separator more than half full. Engine damage may result.

NOTICE

The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

If your engine is equipped with high-pressure fuel lines you must wait for 10 minutes after the engine has stopped, in order to allow the fuel pressure to be purged from the high-pressure fuel lines before any service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and assembly Manual, "Fuel Injection Lines - Install".

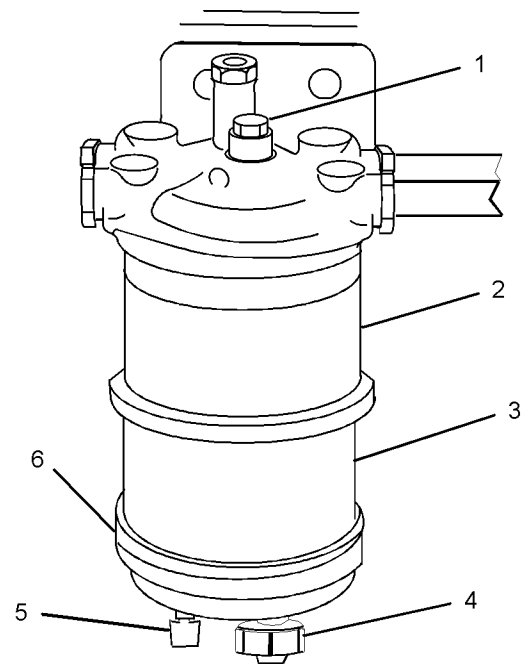


Illustration 62

g01118416

- (1) Screw
- (2) Element
- (3) Glass bowl
- (4) Sensor connection
- (5) Drain
- (6) Bottom cover

1. Place a suitable container below the water separator.
2. Open the drain (5). Allow the fluid to drain into the container.
3. When clean fuel drains from the water separator close the drain (5). Tighten the drain by hand pressure only. Dispose of the drained fluid correctly.

i08615255

Fuel System Secondary Filter - Replace

SMCS Code: 1261-510-SE

WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

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 any disconnected fuel system components.

If your engine is equipped with high-pressure fuel lines, you must wait for 60 seconds after the engine has stopped. This wait allows the fuel pressure to be purged from the high-pressure fuel lines before service or repair is performed on the engine fuel lines. If necessary, perform minor adjustments. Repair any leaks from the low-pressure fuel system and from the cooling, lubrication, or air systems. Replace any high-pressure fuel line that has leaked. Refer to Disassembly and assembly Manual, "Fuel Injection Lines - Install".

Element filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter to catch any fuel that might spill. Clean up any spilled fuel immediately.

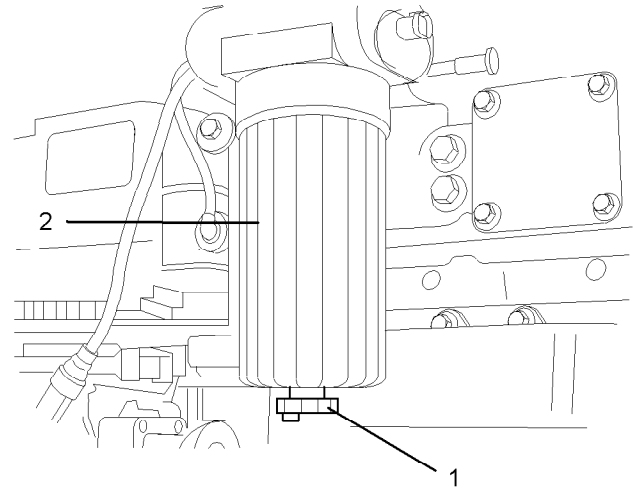


Illustration 63

g01010637

- (1) Drain
- (2) Filter bowl

1. Close the valves for the fuel lines (if equipped).
2. Clean the outside of the fuel filter assembly. Open the fuel drain (1) and drain the fuel into a suitable container.

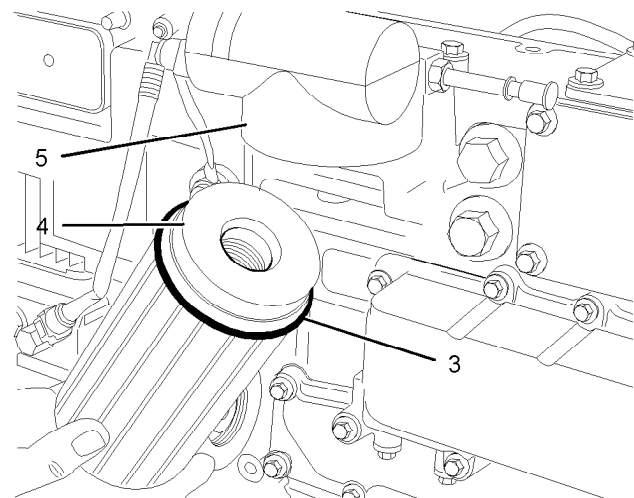


Illustration 64

g01010595

- (3) O ring seal
- (4) Element
- (5) Filter head

Maintenance Section
Fuel System Secondary Filter - Replace

3. Remove the filter bowl (2) from the filter head (5). Press the element (4). Rotate the element counterclockwise to release the element for the filter bowl and remove the element from the bowl. Discard the used element.
4. Remove the O ring (3) from the filter bowl and clean the filter bowl. Check that the threads of the filter bowl are not damaged.
5. Install a new O ring seal (3) to the filter bowl (2).
6. Locate a new filter element (4) into the filter bowl. Press the element and rotate the element clockwise to lock the element into the filter bowl.
7. Install the filter bowl (4) into the top of the filter head (5).
8. Tighten the filter bowl by hand until the filter bowl contacts the filter head. Rotate the filter bowl through 90 degrees.

Note: Do not use a tool to tighten the filter bowl.

9. Open the valves for the fuel lines (if equipped).

Spin-on filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter to catch any fuel that might spill. Clean up any spilled fuel immediately.

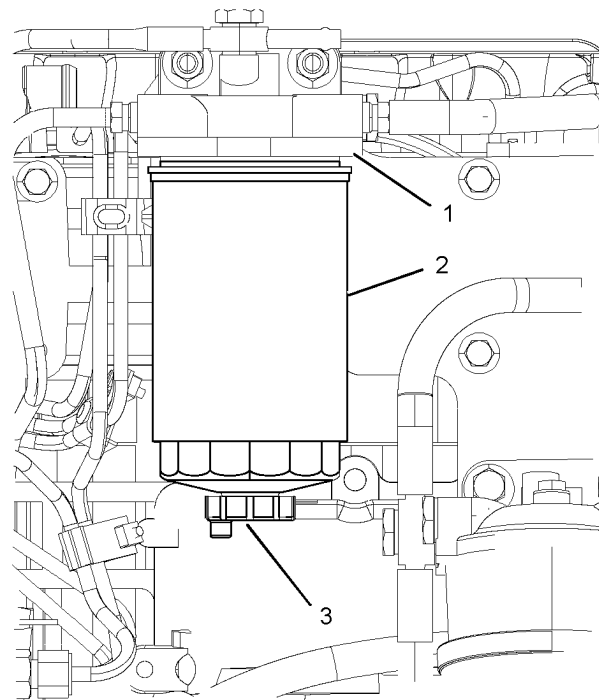


Illustration 65

g01121396

- (1) Spin-on filter
(2) Drain

1. Clean the outside of the fuel filter assembly. Open the fuel drain (3) and drain the fuel into a suitable container.
2. Use a suitable tool to remove the spin-on filter (2) from the filter head (1).
3. Ensure that the fuel drain (3) on the new spin-on filter is closed.

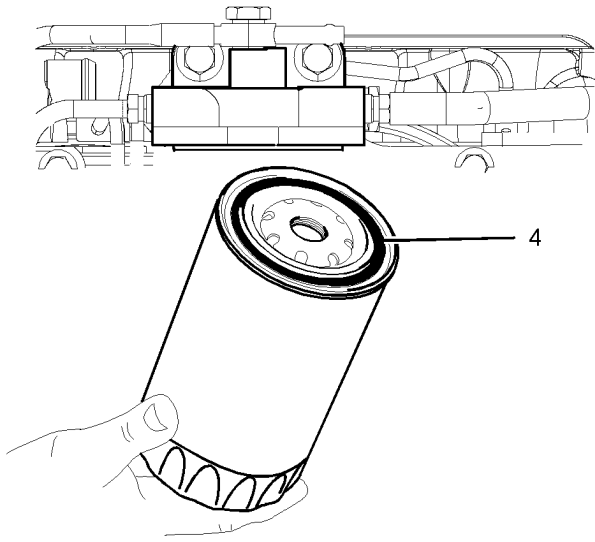


Illustration 66

g01121723

4. Lubricate the sealing ring (4) with clean fuel oil.
5. Install the spin-on filter (2) into the top of the filter head (1).
6. Tighten the spin-on filter by hand until the sealing ring contacts the filter head. Rotate the spin-on filter through 90 degrees.
7. Prime the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

i05260766

Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-M&S

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, NENG2500, "Cat Dealer Service Tool Catalog" or refer to Special Publication, PECJ0003, "Cat Shop Supplies and Tools Catalog" for tools and supplies suitable to collect and contain fluids on Cat products.

Dispose of all fluids according to local regulations and mandates.

Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system. Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

Drain the Water and the Sediment

Fuel tanks should incorporate some provision for draining water and draining sediment from the tank.

Check the fuel daily. Drain the water and sediment from the fuel tank after operating the engine. Drain the water and sediment from the fuel tank after the fuel tank has been filled. Allow 5 to 10 minutes before performing this procedure.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank during the following conditions:

- Weekly
- Oil change
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank. A four micron(c) absolute filter for the breather vent on the fuel tank is also recommended.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i08287069

Generator - Dry

SMCS Code: 4450-569

NOTICE

Do not operate the generator if the windings are wet. If the generator is operated when the windings are wet, damage can occur due to insulation breakdown.

When moisture is present or when moisture is suspected in a generator, the generator must be dried before being energized.

If the drying procedure does not restore the insulation resistance to an acceptable value, the winding should be reconditioned.

Note: For additional information, refer to Special Instruction, SEHS9124 .

Drying Methods

The following methods can be used for drying a generator:

- Self-circulating air method
- Oven method

NOTICE

Do not allow the winding temperature to exceed 85 °C (185.0 °F). Temperatures that are greater than 85 °C (185.0 °F) will damage the winding insulation.

Self-Circulating Air Method

Note: Disable the excitation before using this method.

Run the engine and disconnect the generator load. This action will help circulate air. Operate the generator space heaters.

Oven Method

Place the entire generator inside a forced air drying oven for 4 hours at 65 °C (149 °F).

NOTICE

Use a forced air type oven rather than a radiant type oven.

Radiant type ovens can cause localized overheating.

i08336866

Generator - Inspect

SMCS Code: 4450-040

WARNING

Personal injury or death can result from improper troubleshooting and repair procedures.

The following troubleshooting and repair procedures should only be performed by qualified personnel familiar with this equipment.

WARNING

The high voltage that is produced by an operating generator set can cause severe injury or death. Before performing any maintenance or repairs, ensure that the generator will not start.

Place the engine control switch in the "OFF" position. Attach "DO NOT OPERATE" tags to all starting controls. Disconnect the batteries or disable the starting system. Lock out all switchgear and automatic transfer switches that are associated with the generator.

Refer to Safety Section, "Generator Isolating for Maintenance" for information regarding the procedure to isolate the generator safely.

Proper maintenance of electrical equipment requires periodic visual examination of the generator and periodic visual examination of the windings. Proper maintenance of electrical equipment also requires appropriate electrical checks and appropriate thermal checks. Insulation material should be examined for cracks. The insulation material should be examined for accumulations of dirt and dust. If there is an insulation resistance value that is below normal, a conductive path may be present. This conductive path may be made of one of the following materials:

- Carbon
- Salt
- Metal dust
- Dirt that is saturated with moisture

These contaminants will develop a conductive path which may produce shorts. Cleaning is advisable if heavy accumulations of dirt can be seen or if heavy accumulations of dust can be seen. If excess dirt is the cause of a restriction in the ventilation, cleaning is also advisable. Restricted ventilation will cause excessive heating.

NOTICE

To avoid the possibility of deterioration to the generator windings, do not clean the generator unless there is visual, electrical, or thermal evidence that dirt is present.

If harmful dirt accumulations are present, various cleaning techniques are available. The cleaning procedure that is used may be determined by one of the items on the following list:

- The extent of the cleaning procedure that is being attempted
- The type of enclosure of the generator
- The voltage rating of the generator
- The type of dirt that is being removed

Cleaning (Assembled Generators)

NOTICE

Do not use water to clean the generator.

NOTICE

Do not use trichloroethane, perchloroethylene, trichloroethane, or any alkaline products to clean the generator.

Cleaning may be required at the point of installation. Complete disassembly of the generator may not be necessary or feasible. In this case, a vacuum cleaner should be used to pick up the following items: dry dirt, dust, and carbon. Cleaning the generator will prevent the spreading of these contaminants.

A small nonconductive tube may need to be connected to the vacuum cleaner. The small nonconductive tube will allow the vacuum cleaner to clean the surfaces that are not exposed. After dust is removed, use a small brush attached to the vacuum hose to remove dirt that is firmly attached to the surface.

After the initial cleaning with a vacuum, compressed air may be used to remove the remaining dust and dirt. Compressed air that is used for cleaning should be free of moisture and free of oil. Air pressure should be a maximum of 210 kPa (30 psi) to prevent mechanical damage to the insulation. If the above cleaning procedures are not effective, consult a Caterpillar dealer.

Cleaning (Disassembled Generators)

NOTICE

Do not use water to clean the generator.

NOTICE

Do not use trichloroethane, perchloroethylene, trichloroethane, or any alkaline products to clean the generator.

An initial insulation resistance check should be made on the generator to confirm electrical integrity. A minimum reading of 1 megohm would be expected with severely contaminated generators. A zero megohm reading may indicate an insulation breakdown. An insulation breakdown requires more than cleaning. An insulation breakdown requires repair.

Use the following for cleaning the stator, the rotor, the exciter, and the diode bridge:

- Toluene
- Benzene
- Cyclohexane

Avoid permitting the solvent to run into the slots. Apply the solvent with a brush. Use a sponge on the windings frequently to remove the debris. Dry the winding with a dry cloth. Allow the solvent to evaporate before reassembling the generator.

Allow the generator to dry at room temperature. Check the insulation resistance. The insulation resistance should now be normal. If the insulation resistance is not normal, repeat the procedure.

Note: For more information on drying methods, refer to Special Instructions, SEHS9124, "Cleaning and Drying of Electric Set Generators".

Note: For installation and maintenance of M17XXL4, M22XXL4, and M27XXL4 frames (If equipped) refer to Special Instruction, UENR8811, "Caterpillar M17XXL4, M22XXL4, M27XXL4 Low Voltage Alternator 4 Pole".

i08316370

Generator Bearing - Lubricate

SMCS Code: 4471-086

Note: For information on generator bearing service and bearing lubrication intervals, refer to "Special Instruction" REHS4892, "Generator Bearing Service".

i08265677

Generator Bearing Temperature - Test/Record

SMCS Code: 4471-081-TA

The monitoring of bearing temperature may prevent premature bearing failure. A generator set should never operate above the recommended set points. Keep records in order to monitor the changes in the temperature of the bearing.

Note: Measure the bearing temperature after the generator reaches normal operating temperature.

Infrared Thermometers

Bearing temperatures can also be recorded with the use of an infrared thermometer. Refer to Special Publication, NENG2500, "Caterpillar Dealer Service Tools Catalog" for various infrared thermometers. Follow the instructions that come with your infrared thermometer.

i08286680

Generator Load - Check

SMCS Code: 4450-535-LA



Personal injury or death can result from high voltage.

When power generation equipment must be in operation to make tests and/or adjustments, high voltage and current are present.

Improper test equipment can fail and present a high voltage shock hazard to its user.

Make sure the testing equipment is designed for and correctly operated for high voltage and current tests being made.

During normal operation, monitor the power factor and monitor generator loading.

When a three-phase generator is installed, ensure that the total current in any one phase does not exceed the nameplate rating. Or, when a three-phase generator is reconnected, ensure that the total current in any one phase does not exceed the nameplate rating. Each phase should carry the same load. Carrying the same load allows the three-phase generator to work at the rated capacity. If one-phase current exceeds the nameplate amperage, an electrical imbalance will occur. An electrical imbalance can result in an electrical overload and an electrical imbalance can result in overheating on three-phase generators. This imbalance is not applicable to single-phase generators.

The power factor can be referred to as the efficiency of the load. This power factor can be expressed as the ratio of kVA to actual kW. The power factor can be calculated by dividing kW by kVA. Power factor is expressed as a decimal. Power factor is used to mean the portion of current that is supplied to a system that is doing useful work. The portion of the current that is not doing useful work is absorbed in maintaining the magnetic field in motors. This current (reactive load) can be maintained without engine power.

i05731121

Generator Set - Test

SMCS Code: 4450-081

WARNING

Personal injury or death can result from high voltage.

When power generation equipment must be in operation to make tests and/or adjustments, high voltage and current are present.

Improper test equipment can fail and present a high voltage shock hazard to its user.

Make sure the testing equipment is designed for and correctly operated for high voltage and current tests being made.

When servicing or repairing electric power generation equipment:

- **Make sure the unit is off-line (disconnected from utility and/or other generators power service), and either locked out or tagged DO NOT OPERATE.**
- **Make sure the generator engine is stopped.**
- **Make sure all batteries are disconnected.**
- **Make sure all capacitors are discharged.**

Table 18

Required Tools		
Part Number	Part Description	Qty
6V - 7070	Digital Multimeter	1
-	12 VDC Battery	1
-	Potential Transformer	1

The generator set functional test is a simplified test that can be performed in order to determine if the generator is functional. The generator set functional test should be performed on a generator set that is under load.

The generator set functional test determines if the following statements happen:

- A phase voltage is being generated.
- The phase voltages are balanced.
- The phase voltages change relative to engine speed.

The generator set functional test consists of the following steps:

1. Stop the generator. Connect the potential transformer high voltage winding to the generator terminals (T1) and (T2). Connect the voltmeter to the low voltage winding. If two transformers are available, connect the high voltage winding of the second transformer to the generator terminals (T1) and (T3). Connect the secondary terminals that correspond to generator terminal (T2) of both transformers together.
2. Disconnect wires "E+" and "E-" from the voltage regulator. Disconnect the generator from the load.
3. Connect a 12 VDC automotive battery to wires "E+" and "E-".
4. Measure the AC voltage across the low voltage terminals of the transformer that correspond to the following generator terminals: "T1" and "T2", "T2" and "T3" and "T3" and "T1". Record the voltages.

i08707466

Generator Set Alignment - Check

SMCS Code: 7002-024

Upon installation, or when moved, the generator set must be checked for proper alignment. If the generator set is run at the full continuous rating, the alignment of the generator to the engine must be checked annually.

Properly maintain the alignment between the engine and the driven equipment to minimize the following problems:

- Bearing problems
- Vibration of the engine crankshaft
- Vibration of the driven equipment

Refer to the following information for more information about the alignment of the generator set:

- Special Instruction, SEHS7654, "Alignment - General Instructions"
- Special Instruction, SEHS7259, "Alignment of Single Bearing Generators"
- Special Instruction, REHS0177, "Alignment of the Close Coupled Two Bearing Generators"

Keep a record of the measurement of the alignment. The record may be used to check the trend of the alignment. The record may be used to analyze the trend of the alignment.

i08312485

Generator Set Vibration - Test/Record

SMCS Code: 4450-081-VI

NOTICE

Generator tests are to be performed by a trained Generator technician.

Check for vibration damage.

Vibration may cause the following problems:

- Coupling wear
- Loose fittings
- Fatigue of the metal components of the engine
- Cracks in the cabinet which surrounds the generator
- Cracks in welds
- Excessive noise
- Cracked insulation

The following areas are susceptible to vibration damage:

- Coupling for the generator set
- Generator bearings
- Stator output leads
- Protective sleeving
- Insulation
- Exposed electrical connections
- Transformers
- Fuses
- Capacitors
- Lightning arresters

When a generator set is installed, a vibration plot should be recorded to help in diagnosing potential problems. This vibration plot should be updated yearly. Update the vibration plot when the generator set is moved and when the engine is overhauled. This procedure will allow the trend of the vibration to be monitored and analyzed. A potential problem may be prevented by monitoring the trend of the vibration. If the vibration is approaching the limit of the specification of the component, the problem may be more imminent. Refer to Data Sheet, LEKQ4023, "Linear Vibration" for the allowable limits of vibration.

Caterpillar also recommends recording the vibration of the bearing at the generator bearing bracket.

If the vibration exceeds the EDS limits for vibration, check the alignment. Refer to this Operation and Maintenance Manual, "Generator Set Alignment - Check" for the alignment procedure.

Contact the Cat Dealer Service Tools group for information on ordering a vibration analyzer that will meet your needs.

i04863034

Generator Winding Insulation - Test

SMCS Code: 4453-081; 4454-081; 4457-081; 4470-081

WARNING

The high voltage that is produced by an operating generator set can cause severe injury or death. Before performing any maintenance or repairs, ensure that the generator will not start.

Place the engine control switch in the "OFF" position. Attach "DO NOT OPERATE" tags to all starting controls. Disconnect the batteries or disable the starting system. Lock out all switchgear and automatic transfer switches that are associated with the generator.

Table 19

TOOLS NEEDED		
Part Number	Tool	Quantity
142-5055	Insulation Tester Megohmmeter	1

WARNING

Personal injury or death can result from electrocution.

The megohmmeter is applying a high voltage to the circuit.

To avoid electrocution, do not touch the instrument leads without first discharging them. When finished testing also discharge the generator windings.

The following materials will cause the winding insulation to deteriorate: moisture, dust, grease and other foreign matter within the generator.

This deterioration reduces the resistance of the insulation. This test will measure the resistance of the winding insulation.

The insulation tester (megohmmeter) produces a high potential voltage between the test leads. During the test, a small amount of current flows. The tester converts this current to a resistance reading.

The insulation test is performed as part of periodic maintenance in order to detect the deterioration of the winding insulation. When there is a rapid decrease in the insulation resistance in a short amount of time, the generator needs to be cleaned.

Note: For information on generator cleaning, refer to Special Instruction, SEHS9124.

When generators have not been used recently, moisture can accumulate. Therefore, the insulation test should be performed on generators that have been idle. If moisture is known to exist, the windings must be dried prior to testing. Refer to Testing and Adjusting, "Generator - Dry".

The insulation test should be performed on generators that are being used for the first time. The insulation test should be performed more frequently in the following cases:

- The generator set is operating in a humid environment.
- The generator set is not protected from the elements in an enclosed area.
- The generator set has not been run under load for 3 months.

Note: The use of space heaters may be needed around the generator set in the following cases:

- The generator set has not been run under load for 3 months.
- The generator set is exposed to a sea water environment.
- The humidity is above 75 percent.
- A test result was below 3 megohms.

Recondition or replace the winding in the following cases:

- The measured insulation resistance falls below the specified amount. The cleanup procedure does not correct the discrepancy.
- The measured insulation resistance falls below the specified amount. The drying procedure does not correct the discrepancy.

The specified insulation resistance is an approximate value. The generator may be operated with less than the specified value. However, a generator that has a low winding insulation resistance will be more likely to have a failure.

WARNING

Personal injury or death can result from improper troubleshooting and repair procedures.

The following troubleshooting and repair procedures should only be performed by qualified personnel familiar with this equipment.

The insulation test gives accurate results only when the generator windings are free of moisture and the generator windings are at room temperature.

Each winding must have a minimum insulation resistance of 1 megohm.

Main Armature (Stator L4)

1. Remove the load from the generator by either of the following:
 - Open the line circuit breaker.
 - Open the following load connections: T1, T2, T3 and T0.

Prevent these wires from coming into contact with each other and prevent these wires from contacting ground.

2. Isolate the main armature (L4) from the voltage regulator by disconnecting the wires for voltage sensing. If generator lead (T0) is connected to the generator frame or ground, open the connection.
3. Connect one test lead of the insulation tester (megohmmeter) to the generator enclosure (ground).
4. Connect the other test lead of the insulation tester (megohmmeter) to generator lead (T0).
5. The insulation resistance must be 1 megohm or more.

Exciter Field (Stator L1)

1. Isolate exciter field (L1) from the voltage regulator by disconnecting wires 5+ and 6-. Prevent these wires from coming into contact with each other and prevent these wires from contacting ground.
2. Connect one test lead of the insulation tester (megohmmeter) to the generator enclosure (ground).
3. Connect one test lead of the insulation tester (megohmmeter) to exciter field lead (5+ or 6-).

4. Measure the resistance of the exciter field winding insulation to ground. The insulation resistance must be a minimum of 0.25 megohm (250000 ohms).

Exciter Armature (Rotor L2)

1. Isolate exciter armature (L2) from the rectifier circuit. Disconnect the three wires of the exciter armature from the rectifier blocks.
2. Connect one test lead of the insulation tester (megohmmeter) to the rotor shaft.
3. Connect one test lead of the insulation tester (megohmmeter) to any one exciter field lead.
4. The insulation resistance must be a minimum of 0.25 megohm (250000 ohms).

i08705302

Hoses and Clamps - Inspect/Replace

SMCS Code: 7554-040; 7554-510

Hoses and clamps must be inspected periodically and replaced at the recommended interval to ensure safe and continuous operation of the engine. Failure to replace a fuel hose at the recommended change interval may result in a hazardous situation. Take proper safety precautions before inspecting or replacing hoses and clamps.

Note: Always use a board or cardboard when the engine components are checked for leaks. Leaking fluid that is under pressure can cause serious injury or possible death. Leaks that are the size of a pin hole are included. Refer to Operation and Maintenance Manual, "General Hazard Information" for more information.

Note: Ensure that the hose is compatible with the application.

Inspect Tubes, Hoses, Bellows, and Clamps

Inspect all tubes and hoses for leaks that are caused by the following conditions. Replace any tube or hose which exhibits any of the following conditions. Failure to replace a tube or hose which exhibits any of the following conditions may result in a hazardous situation.

- Hoses which are cracked
- Hoses which are soft
- Outer covering that is chafed or cut

- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering
- Exhaust bellows for leaks or damage
- Hoses which exhibit signs of leakage which are not the result of loose couplings or clamps

Inspect all clamps for the following conditions. Replace any clamp which exhibits signs of any of the following conditions.

- Cracking
- Looseness
- Damage

Inspect all couplings for leaks. Replace any coupling which exhibits signs of leaks.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

Due to extreme temperature changes, the hose will heat set. Heat setting causes hose clamps to loosen which can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Replace hoses that are cracked or soft. Replace hoses that show signs of leakage. Replace hoses that show signs of damage. Replace hose clamps that are cracked or damaged. Tighten or replace hose clamps which are loose.

Replace the Hoses and the Clamps

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, NENG2500, "Cat Dealer Service Tool Catalog" or refer to Special Publication, PECJ0003, "Cat Shop Supplies and Tools Catalog" for tools and supplies suitable to collect and contain fluids on Cat products.

Dispose of all fluids according to local regulations and mandates.

Cooling System

WARNING

Pressurized System: Hot coolant can cause serious burns. 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.

WARNING

Personal injury can result from removing hoses or fittings in a pressure system.

Failure to relieve pressure can cause personal injury.

Do not disconnect or remove hoses or fittings until all pressure in the system has been relieved.

1. Stop the engine.
2. Allow the engine to cool.
3. Before servicing a coolant hose, slowly loosen the filler cap for the cooling system to relieve any pressure.
4. Remove the filler cap for the cooling system.

5. Drain the coolant from the cooling system to a level that is below the hose that is being replaced. Drain the coolant into a suitable clean container. The coolant can be reused.
6. Remove the hose clamps.
7. Disconnect the old hose.
8. Replace the old hose with a new hose.
9. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, "Torque Specifications" "Hose Clamps" for information about selecting and installing the proper hose clamps.
10. Refill the cooling system.
11. Clean the coolant filler cap. Inspect the gaskets on the filler cap. Inspect the gasket seat. Inspect the vacuum valve and seat for debris or damage. Replace the filler cap if the gaskets are damaged. Install the filler cap.
12. Start the engine. Inspect the cooling system for leaks.

Fuel System

WARNING

Personal injury can result from removing hoses or fittings in a pressure system.

Failure to relieve pressure can cause personal injury.

Do not disconnect or remove hoses or fittings until all pressure in the system has been relieved.

WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

NOTICE

Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque.

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 any disconnected fuel system components.

Note: High-pressure fuel lines may be installed between the high-pressure fuel pump and the fuel injectors. High-pressure fuel lines are constantly charged with high pressure. Do not check the high-pressure fuel lines with the engine or the starting motor in operation. Wait for 10 minutes after the engine stops before you perform any service or repair on high-pressure fuel lines. Waiting for 10 minutes will allow the pressure to be purged.

1. Drain the fuel from the fuel system to a level that is below the hose that is being replaced.
2. Remove the hose clamps.
3. Disconnect the old hose.

Note: When servicing fuel system, use cap/s or cover/s as required to protect the system and maintain fuel system cleanliness.

4. Replace the old hose with a new hose.
5. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, "Torque Specifications" "Hose Clamps" for information about selecting and installing the proper hose clamps.
6. Carefully inspect the engine for any spilled fuel. Make sure that no fuel remains on or close to the engine.

Note: Fuel must be added to the fuel system ahead of the fuel filter.

7. Refill the fuel system. Refer to this Operation and Maintenance Manual, "Fuel System - Prime" for information about priming the engine with fuel.
8. Start the engine. Inspect the fuel system for leaks.

Lubrication System **WARNING**

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

1. Drain the oil from the lubrication system to a level that is below the hose that is being replaced.
2. Remove the hose clamps.

3. Disconnect the old hose.
4. Replace the old hose with a new hose.
5. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, "Torque Specifications" "Hose Clamps" for information about selecting and installing the proper hose clamps.
6. Refill the lubrication system. Refer to this Operation and Maintenance Manual, "Engine Oil Level - Check" to ensure that the lubrication system is filled with the proper amount of engine oil.
7. Start the engine. Inspect the lubrication system for leaks.

Air System

Note: Boost leaks could result in excessive combustion temperatures.

1. Remove the hose clamps.
2. Disconnect the old hose.
3. Replace the old hose with a new hose.
4. Install hose clamps which have been inspected or install new hose clamps. Refer to Specifications, SENR3130, "Torque Specifications" "Hose Clamps" for information about selecting and installing the proper hose clamps.

Note: The bellows and the V-clamps that are used on the exhaust bellows should never be reused.

5. Start the engine. Inspect the air lines for leaks.

i01917577

Instrument Panel - Inspect

SMCS Code: 7451-040

Inspect the instrument panel for good condition. Perform the self test. All of the warning lamps should illuminate. If a warning lamp does not illuminate, replace the bulb immediately. If the alarm does not sound, investigate the problem and correct the problem.

Check the condition of all of the gauges. If a gauge is broken, repair the gauge or replace the gauge immediately.

Frequently monitor the gauges during normal operation.

Record the data in a log. Compare the new data to the data that was previously recorded. Comparing the new data to the recorded data will help to establish the trends of engine performance. A gauge reading that is abnormal may indicate a problem with operation or a problem with the gauge.

i02299454

Overhaul Considerations

SMCS Code: 7595-043

Reduced hours of operation at full load will result in a lower average power demand. A decreased average power demand should increase both the engine service life and the overhaul interval.

The need for an overhaul is generally indicated by increased fuel consumption and by reduced power.

The following factors are important when a decision is being made on the proper time for an engine overhaul:

- The need for preventive maintenance
- The quality of the fuel that is being used
- The operating conditions
- The results of the S·O·S analysis

Oil Consumption as an Overhaul Indicator

Oil consumption, fuel consumption, and maintenance information can be used to estimate the total operating cost for your Caterpillar engine. Oil consumption can also be used to estimate the required capacity of a makeup oil tank that is suitable for the maintenance intervals.

Oil consumption is in proportion to the percentage of the rated engine load. As the percentage of the engine load is increased, the amount of oil that is consumed per hour also increases.

The oil consumption rate (brake specific oil consumption) is measured in grams per kW/h (lb per bhp). The brake specific oil consumption (BSOC) depends on the engine load. Consult your Caterpillar dealer for assistance in determining the typical oil consumption rate for your engine.

When an engine's oil consumption has risen to three times the original oil consumption rate due to normal wear, an engine overhaul should be scheduled. There may be a corresponding increase in blowby and a slight increase in fuel consumption.

Overhaul Options

Before Failure Overhaul

A planned overhaul before failure may be the best value for the following reasons:

- Costly unplanned downtime can be avoided.
- Many original parts can be reused according to the standards for reusable parts.
- The engine's service life can be extended without the risk of a major catastrophe due to engine failure.
- The best cost/value relationship per hour of extended life can be attained.

After Failure Overhaul

Many options are available if a major engine failure occurs. An overhaul should be performed if the engine block or the crankshaft can be repaired.

If the engine block is repairable and/or the crankshaft is repairable, the overhaul cost should be less than the cost of a new engine with a similar exchange core.

This lower cost can be attributed to these aspects:

- Caterpillar dealer exchange components
- Caterpillar Inc. remanufactured exchange components

Overhaul Recommendation

To minimize downtime, Caterpillar Inc. recommends a scheduled engine overhaul by your Caterpillar dealer before the engine fails. This will provide you with the best cost/value relationship.

Note: Overhaul programs vary according to the engine application and according to the dealer that performs the overhaul. Consult your Caterpillar dealer for specific information about the available overhaul programs and about overhaul services for extending the engine life.

If an overhaul is performed without overhaul service from your Caterpillar dealer, be aware of the following maintenance recommendations.

Rebuild or Exchange

These components should be inspected according to the instructions that are found in various Caterpillar reusability publications. The Special Publication, SEBF8029 lists the reusability publications that are needed for inspecting the engine parts.

If the parts comply with the established inspection specifications that are expressed in the reusable parts guideline, the parts should be reused.

Parts that are not within the established inspection specifications should be dealt with in one of the following manners:

- Salvaging
- Repairing
- Replacing

Using out-of-spec parts can result in the following problems:

- Unscheduled downtime
- Costly repairs
- Damage to other engine parts
- Reduced engine efficiency
- Increased fuel consumption

Reduced engine efficiency and increased fuel consumption translates into higher operating costs. Therefore, Caterpillar Inc. recommends repairing out-of-spec parts or replacing out-of-spec parts.

Inspection and/or Replacement

The following components may not last until the second overhaul.

- Piston rings
- Thrust bearings
- Main bearings
- Connecting rod bearings
- Crankshaft seals
- Engine mounts
- Hoses

Caterpillar Inc. recommends the installation of new parts at each overhaul period.

Inspect these parts while the engine is disassembled for an overhaul.

Inspect the crankshaft for any of the following conditions:

- Deflection
- Damage to the journals
- Bearing material that has seized to the journals

Check the journal taper and the profile of the crankshaft journals. Check these components by interpreting the wear patterns on the following components:

- Rod bearing
- Main bearings

Note: If the crankshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the crankshaft.

Inspect the camshaft for damage to the journals and to the lobes.

Note: If the camshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the camshaft.

Inspect the following components for signs of wear or for signs of scuffing:

- Camshaft bearings
- Valve lifters

Testing

Test the following components during the overhaul.

- Fuel injection nozzles
- Fuel injection pump

Testing the fuel system during the overhaul will ensure that your engine operates at peak efficiency. Your Caterpillar dealer can provide these services and components in order to ensure that your fuel system is operating within the appropriate specifications.

Cleaning

Caterpillar Inc. recommends the use of Hydrosolv Liquid Cleaners. Table 20 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 20

HydrosolvLiquid Cleaners		
Part Number	Description	Size
1U-8812	Hydrosolv4165	4 L (1 US gallon)
1U-5490		19 L (5 US gallon)
8T-7570		208 L (55 US gallon)

(continued)

(Table 20, contd)

1U-8804	Hydrosolv100	4 L (1 US gallon)
1U-5492		19 L (5 US gallon)
8T-5571		208 L (55 US gallon)

For more information about coolant analysis, see your Caterpillar dealer.

i08265777

Rotating Rectifier - Check

SMCS Code: 4465-535

Check the exciter armature. Ensure that the rotating rectifier is tight. If a failure of a rectifier is suspected, proceed to the "Testing a Three-Diode Rectifier Block" section.

Obtain Coolant Analysis

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S·O·S Coolant Analysis (Level I). Further coolant analysis is recommended when the engine is overhauled.

For example, considerable deposits are found in the water jacket areas on the external cooling system, but the concentrations of coolant additives were carefully maintained. The coolant water probably contained minerals that were deposited on the engine over time.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S·O·S Coolant Analysis (Level II).

S·O·S Coolant Analysis (Level II)

An S·O·S Coolant Analysis (Level II) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S·O·S Coolant Analysis (Level II) provides the following information:

- Complete S·O·S Coolant Analysis (Level I)
- Visual inspection of properties
- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S·O·S Coolant Analysis (Level II) provides a report of the results of both the analysis and the maintenance recommendations.

Testing a Three-Diode Rectifier Block

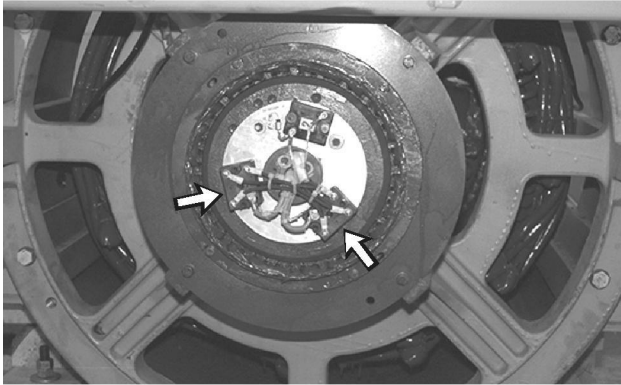


Illustration 67

g00610240

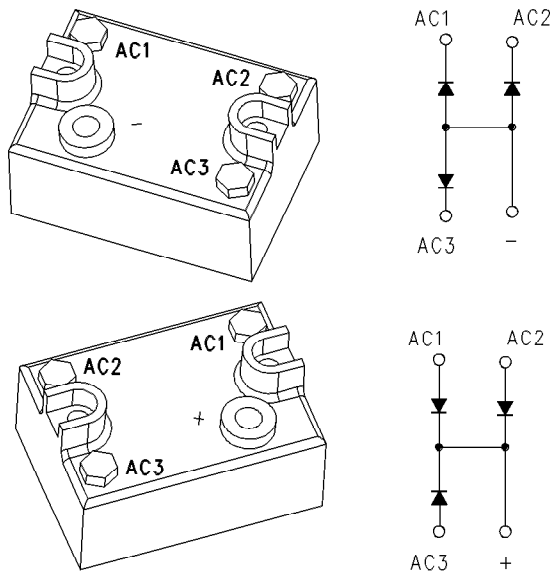


Illustration 68

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Three-Diode Rectifier Block (two pieces)

The following procedure tests all three diodes within a block. Check the positive rectifier block and the negative rectifier block. If any meter reading does not fall within the given ranges, replace the rectifier block.

1. Set the digital multimeter on the diode range.
Remove all leads from the rectifier block.

2. To test the negative rectifier block, follow these steps:

- a. Place the red test lead on the negative "-" terminal. Place the black test lead on the following rectifier terminals: "AC1" (3), "AC2" (4), and "AC3" (5). All readings on the meter should be between 0.4 and 1.0.

- b. Place the black test lead on the negative "-" terminal. Place the red test lead on the following rectifier terminals: "AC1" (3), "AC2" (4), and "AC3" (5). In all cases, the meter should read "OL" (overload).

3. To test the positive rectifier block, follow these steps:

- a. Place the red test lead on the positive "+" rectifier terminal. Place the black test lead on the following rectifier terminals: "AC1" (3), "AC2" (4), and "AC3" (5). In all cases, the meter should read "OL" (overload).

- b. Place the black test lead on the positive "+" rectifier terminal. Place the red test lead on the following rectifier terminals: "AC1" (3), "AC2" (4), and "AC3" (5). All readings on the meter should be between 0.4 and 1.0.

Note: A shorted diode can damage the exciter rotor. If a diode is shorted, check the exciter rotor. Refer to the Testing and Adjusting, "Winding - Test" and Testing and Adjusting, "Insulation - Test". Perform these tests.

Note: This rectifier block also contains varistor “CR7” . “CR7” can be checked by measuring the resistance between the positive “+” rectifier terminal and the negative “-” rectifier terminal. The resistance should be a minimum of 15000 ohms.

i04327496

Rotating Rectifier - Inspect/Test

SMCS Code: 4465-081; 4465-040

WARNING

The high voltage that is produced by an operating generator set can cause severe injury or death. Before performing any maintenance or repairs, ensure that the generator will not start.

Place the engine control switch in the “OFF” position. Attach “DO NOT OPERATE” tags to all starting controls. Disconnect the batteries or disable the starting system. Lock out all switchgear and automatic transfer switches that are associated with the generator.

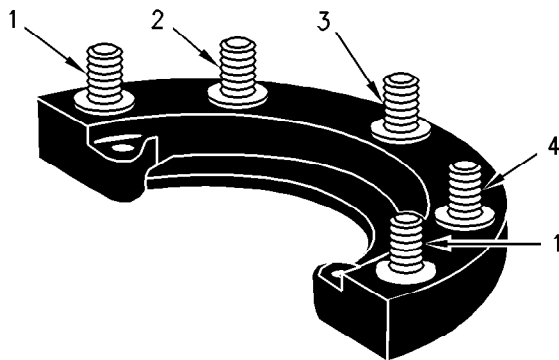


Illustration 69

g00992269

- (1) Positive DC terminal or Negative DC terminal
- (2) AC terminal
- (3) AC terminal
- (4) AC terminal

The following procedure tests all three diodes within a block. Check the positive rectifier block and the negative rectifier block. If any meter reading does not fall within the given ranges, replace the rectifier block.

1. Set the digital multimeter on the diode range. Remove all leads from the rectifier block.
2. To test the negative rectifier block, follow these steps:
 - a. Place the red test lead on the negative “-” terminal (1). Place the black test lead on the

following rectifier terminals: AC terminal (2), AC terminal (3) and AC terminal (4). All readings on the meter should be between 0.4 and 1.0.

- b. Place the black test lead on the negative “-” terminal (1). Place the red test lead on the following rectifier terminals: AC terminal (2), AC terminal (3) and AC terminal (4). In all cases, the meter should read “OL” (overload).

3. To test the positive rectifier block, follow these steps:

- a. Place the red test lead on the positive “+” rectifier terminal (1). Place the black test lead on the following rectifier terminals: AC terminal (2), AC terminal (3) and AC terminal (4). In all cases, the meter should read “OL” (overload).
- b. Place the black test lead on the positive “+” rectifier terminal (1). Place the red test lead on the following rectifier terminals: AC terminal (2), AC terminal (3) and AC terminal (4). All readings on the meter should be between 0.4 and 1.0.

Note: A shorted diode can damage the exciter rotor. If a diode is shorted, check the exciter rotor. Refer to the Testing and Adjusting, “Winding - Test” and Testing and Adjusting, “Insulation - Test”. Perform these tests.

i00651416

Starting Motor - Inspect

SMCS Code: 1451-040; 1453-040

Caterpillar Inc. recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for proper operation. Check the electrical connections and clean the electrical connections. Refer to the Service Manual for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

i08301604

Turbocharger - Inspect (If Equipped)

SMCS Code: 1052-040

A regular visual inspection of the turbocharger is recommended. If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can result in additional damage to the pistons, the valves, and the cylinder head.

NOTICE

Turbocharger bearing failures can cause large quantities of oil to enter the air intake and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of oil into a turbocharger under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is renewed.

A visual inspection of the turbocharger can minimize unscheduled downtime. A visual inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

Removal and Installation

Note: The turbochargers that are supplied are nonserviceable.

For options regarding the removal, installation, and replacement, consult your Cat dealer. Refer to the Disassembly and Assembly Manual, "Turbocharger - Remove and Turbocharger - Install" for further information.

Inspecting**NOTICE**

The compressor housing for the turbocharger must not be removed from the turbocharger for inspection or removed for the cleaning of the compressor.

1. Remove the tube assembly from the turbocharger exhaust outlet and remove the air intake tube assembly to the turbocharger. Visually inspect the tube assemblies for the presence of oil. Clean the interior of the tube assemblies in order to prevent dirt from entering during reassembly.
2. Check for obvious heat discoloration of the turbocharger. Check for any loose bolts or any missing bolts. Check for damage to the oil supply tube assembly and the oil drain tube assembly. Check for cracks in the housing of the turbocharger. Ensure that the compressor wheel can rotate freely.
3. Check for the presence of oil. If oil is leaking from the back side of the compressor wheel, there is a possibility of a failed turbocharger oil seal.

The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the tube assembly for the intake air (clogged air filters), which causes the turbocharger to slobber.

4. Inspect the bore of the housing of the turbine outlet for corrosion.
5. Fasten the air intake tube assembly and the exhaust outlet tube assembly to the turbocharger housing. Ensure that all clamps are installed correctly and that all clamps are tightened securely.

i00632301

Walk-Around Inspection

SMCS Code: 1000-040

Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the proper place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE

Accumulated grease and/or oil on an engine or deck is a fire hazard. Remove this debris with steam cleaning or high pressure water.

- Ensure that cooling lines are properly clamped and tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pump for coolant leaks.

Note: The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of water pump and the installation of water pump and/or seals, refer to the Service Manual for the engine or consult your Caterpillar dealer.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- Inspect the alternator belt and the accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from fuel tanks on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Inspect the engine-to-frame ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges which are cracked or can not be calibrated.

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

Note: The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and parts contract.

Visually inspect the water pump for leaks. Renew the water pump seal or the water pump if there is an excessive leakage of coolant. Refer to the Disassembly and Assembly Manual, "Water Pump - Remove and Install" for the disassembly and assembly procedure.

i02226958

Water Pump - Inspect

SMCS Code: 1361-040

A failed water pump may cause severe engine overheating problems that could result in the following conditions:

Reference Information Section

Customer Service

i08302979

Customer Assistance

SMCS Code: 1000; 4450

USA and Canada

When a problem arises concerning the operation or the service of an engine, the problem will normally be managed by the dealer in your area.

Your satisfaction is a primary concern to Caterpillar and to Cat dealers. If you have a problem that has not been handled to your complete satisfaction, follow these steps:

1. Discuss your problem with a manager from the dealership.
2. If your problem cannot be resolved at the dealer level, use the phone number that is listed below to talk with a Field Service Coordinator:

1-800-447-4986

The normal hours are from 8:00 to 4:30 Monday through Friday Central Standard Time.

3. If your needs have not been met still, submit the matter in writing to the following address:

Designated Compliance Officer Heavy-Duty and
Nonroad Engine Group 6403-J,
US Ave, NW, Washington,
DC 20460
Email address: complianceinfo@epa.gov.

Your problem may ultimately be solved at the dealership, using the dealership facilities, equipment, and personnel. Therefore, follow the steps in sequence when a problem is experienced.

Outside of the USA and of Canada

If a problem arises outside the USA and outside Canada, and if the problem cannot be resolved at the dealer level, consult the appropriate Cat office.

Latin America, Mexico, Caribbean
Caterpillar Americas Co.
701 Waterford Way, Suite 200
Miami, FL 33126-4670
USA
Phone: 305-476-6800
Fax: 305-476-6801

Europe, Africa, and Middle East
Caterpillar Overseas S.A.
76 Route de Frontenex
P.O. Box 6000
CH-1211 Geneva 6
Switzerland
Phone: 22-849-4444
Fax: 22-849-4544

Far East
Caterpillar Asia Pte. Ltd.
7 Tractor Road
Jurong, Singapore 627968
Republic of Singapore
Phone: 65-662-8333
Fax: 65-662-8302

China
Caterpillar China Ltd.
37/F., The Lee Gardens
33 Hysan Avenue
Causeway Bay
G.P.O. Box 3069
Hong Kong
Phone: 852-2848-0333
Fax: 852-2848-0440

Japan
Shin Caterpillar Mitsubishi Ltd.
SBS Tower
10-1, Yoga 4-Chome
Setagaya-Ku, Tokyo 158-8530
Japan
Phone: 81-3-5717-1150
Fax: 81-3-5717-1177

Japan
Caterpillar Power Systems, Inc.
SBS Tower (14th floor)
4-10-1, Yoga
Setagaya-Ku, Tokyo 158-0097
Phone: 81-3-5797-4300
Fax: 81-3-5797-4359

Australia and New Zealand
Caterpillar of Australia Ltd.
1 Caterpillar Drive
Private Mail Bag 4
Tullamarine, Victoria 3043
Australia
Phone: 03-9953-9333
Fax: 03-9335-3366

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Ordering Replacement Parts

SMCS Code: 4450; 7567

WARNING

When replacement parts are required for this product Caterpillar recommends using Caterpillar replacement parts or parts with equivalent specifications including, but not limited to, physical dimensions, type, strength and material.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

Quality Cat replacement parts are available from Cat dealers throughout the world. Cat dealer parts inventories are up to date. The parts stocks include all the parts that are normally needed to protect your Cat engine investment.

When you order parts, specify the following information:

- Part number
- Part name
- Quantity

If there is a question concerning the part number, provide your dealer with a complete description of the needed item.

When a Cat engine requires maintenance and/or repair, provide the dealer with all the information that is stamped on the Information Plate. This information is described in this Operation and Maintenance Manual (Product Information Section).

Discuss the problem with the dealer. Inform the dealer about the conditions of the problem and the nature of the problem. Inform the dealer about when the problem occurs. This information will help the dealer in troubleshooting the problem and solving the problem faster.

Reference Materials

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Maintenance Records

SMCS Code: 1000; 4450

Caterpillar recommends the retention of accurate maintenance records. Accurate maintenance records can be used for the following purposes:

- Determine operating costs.
- Establish maintenance schedules for other engines that are operated in the same environment.
- Show compliance with the required maintenance practices and maintenance intervals.

Maintenance records can be used for various other business decisions that are related to engine maintenance.

Maintenance records are a key element of a maintenance program that is managed. Accurate maintenance records can help your Cat dealer to fine-tune the recommended maintenance intervals to meet the specific operating situation. These recommendations should result in a lower engine operating cost.

Records should be kept for the following items:

Fuel Consumption – A record of fuel consumption is essential to determine when the load sensitive components should be inspected or repaired. Fuel consumption assists in determining overhaul intervals.

Service Hours – A record of service hours is essential to determine when the speed sensitive components should be inspected or repaired.

Documents – These items should be easy to obtain, and these items should be kept in the engine history file. All documents should show this information: date, service hours, fuel consumption, unit number, and engine serial number. The following types of documents should be kept as proof of maintenance or repair for warranty:

Keep the following types of documents as proof of maintenance for warranty. Also, keep these types of documents as proof of repair for warranty:

- Dealer work orders and itemized bills
- Owner repair costs
- Owner receipts
- Maintenance log

Maintenance Log

Table 21

[illegible]

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Reference Material

SMCS Code: 1000; 4450

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

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Decommissioning and Disposal

SMCS Code: 1000

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.

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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: _____

	<u>Dealer Contact</u>	<u>Phone Number</u>	<u>Hours</u>
Sales:	_____	_____	_____
Parts:	_____	_____	_____
Service:	_____	_____	_____

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