CATERPILLAR®

SEBU7509-03
July 2001

Operation and Maintenance Manual

3500 Generator Sets

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. 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 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.

⚠ WARNING

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.

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. 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 the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

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. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

⚠ 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.

Table of Contents

Foreword

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 Caterpillar 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 Caterpillar 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 extremely 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 generally accepted as proof of maintenance or repair. Your authorized Caterpillar 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 Caterpillar dealer. Your Caterpillar dealer offers a variety of options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available from your Caterpillar dealer. Consult with your dealer for information regarding these options.

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.

Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

Safety Section

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Safety Signs and Labels

SMCS Code: 1000; 4450; 7405

There may be several specific safety signs on your engine. The exact location and a description of the safety signs are reviewed in this section. Please become familiar with all safety signs.

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

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

⚠ 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.

High Voltage

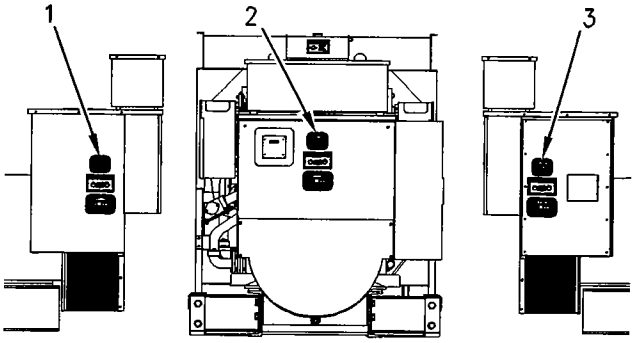
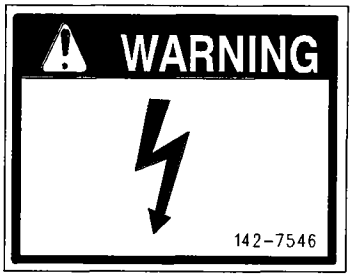


Illustration 1 g00737026

Locations of the warning label for high voltage

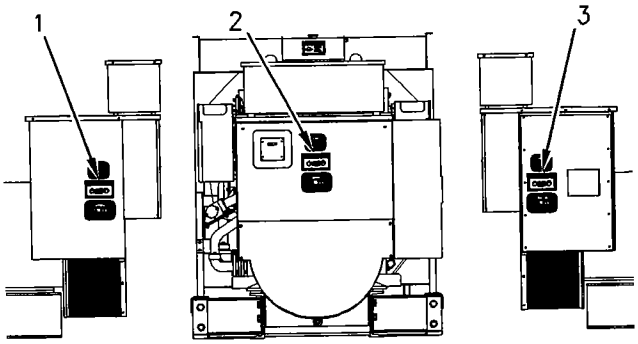
The warning label for high voltage is located on the following components: terminal box (1), customer connection box (2), and circuit breaker box (3).



g00308803

High voltage can cause electrical shocks. Electrical shocks can cause personal injury or death. Avoid contacting electrical components and wiring.

Automatic Starting

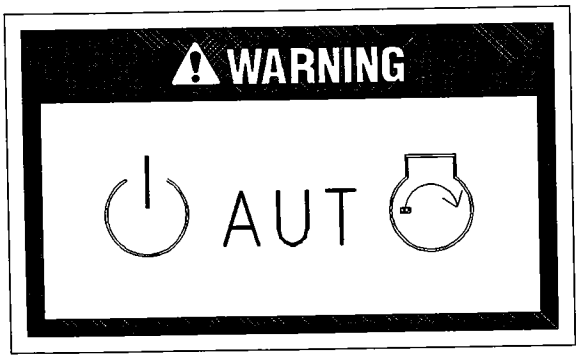


g00737028

Illustration 2

Locations of the warning label for automatic starting

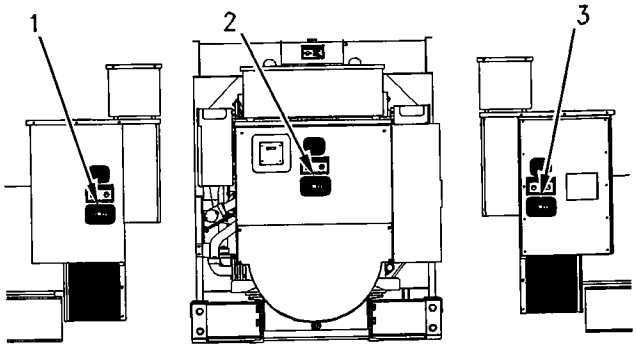
The warning label for automatic starting is located on the following components: terminal box (1), customer connection box (2), and circuit breaker box (3).



g00327883

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

Servicing the Engine and Reading the Manual

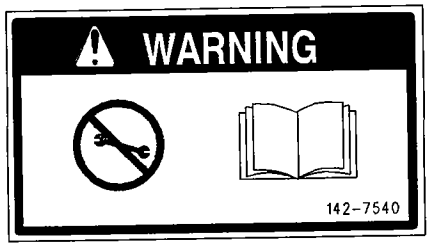


g00737029

Illustration 3

Locations of the warning label for servicing the engine and reading the manual

The warning label for servicing the engine and reading the manual is located on the following components: terminal box (1), customer connection box (2), and circuit breaker box (3).



g00308764

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.

Coolant Pressure and Hot Surface

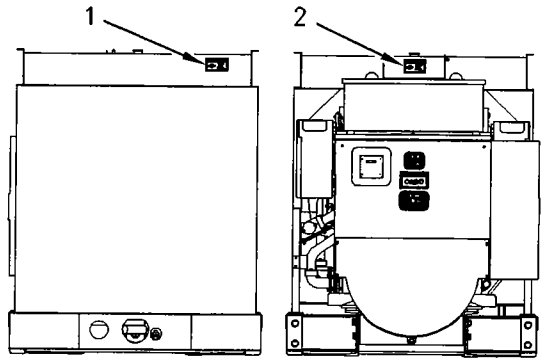
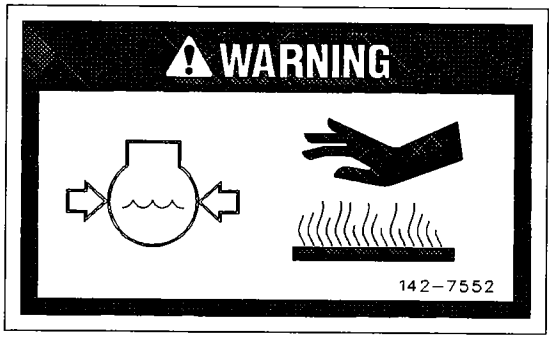


Illustration 4 g00737030

Locations of the warning label for coolant pressure and hot surface

The warning label for the coolant pressure and the hot surface is located near the top of the radiator on the front (1) and on the rear (2).



g00107971

When the engine is at operating temperature, the engine coolant is hot. The engine coolant is also under pressure. Allow cooling system components to cool before the cooling system is drained. Any contact with hot coolant or with steam can cause severe burns.

Hot Surface

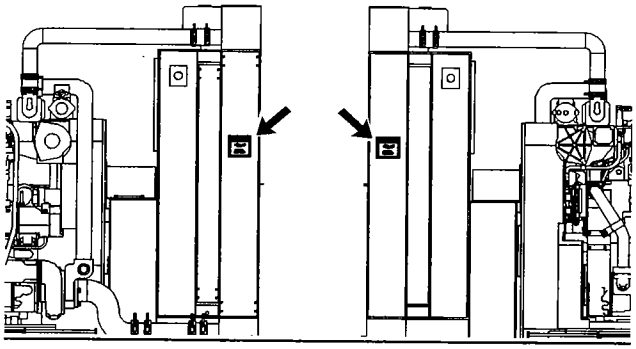


Illustration 5 g00328531

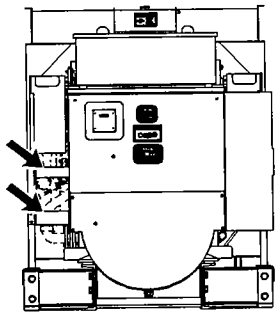
Locations of the warning label for hot surface

The warning label for the hot surface is located on each side of the radiator.

g00309705

When the engine is at operating temperature, the engine coolant is hot. Allow cooling system components to cool before the cooling system is drained. Any contact with hot coolant or with steam can cause severe burns.

Do Not Climb



g00327809

Illustration 6

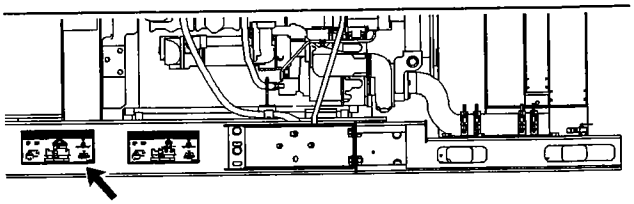
Locations of the warning label for do not climb

The warning label for do not climb is located on the crossbeams for the radiator.

g00327774

Do not climb on the crossbeams for the radiator. Personal injury may result. Use an adequate ladder or use an appropriate work platform for climbing.

Lifting the Generator Set

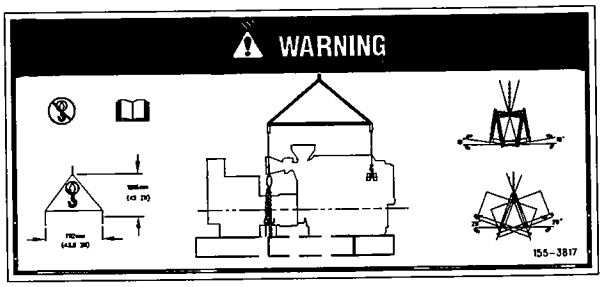


g00327805

Illustration 7

Location of the warning label for lifting the generator set

The warning label for lifting the generator set is located on the engine mounting rails.



g00329532

Before lifting the generator set, read this Operation and Maintenance Manual, "Engine Lifting" topic in the Operation Section.

If improper equipment is used to lift the generator set, injury and damage can occur. Use cables that are properly rated for the weight. Use a spreader bar and attach the cables according to the information on the warning label.

Engine Lifting

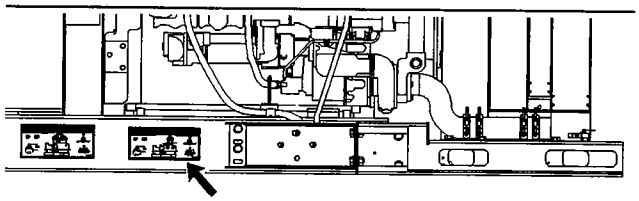
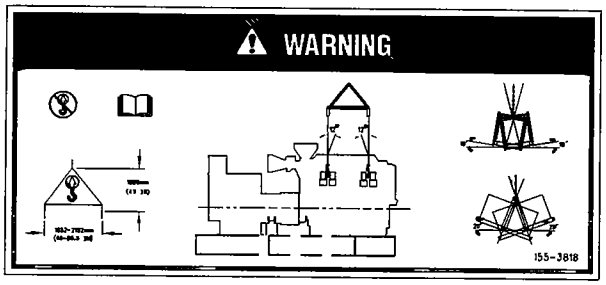


Illustration 8 g00329534

Location of the warning label for lifting the engine

The warning label for lifting the engine is located on the engine mounting rails.



g00329535

Before lifting the engine, read this Operation and Maintenance Manual, "Engine Lifting" topic in the Operation Section.

If improper equipment is used to lift the engine, injury and damage can occur. Use cables that are properly rated for the weight. Use a spreader bar and attach the cables according to the information on the warning label.

Diesel Fuel

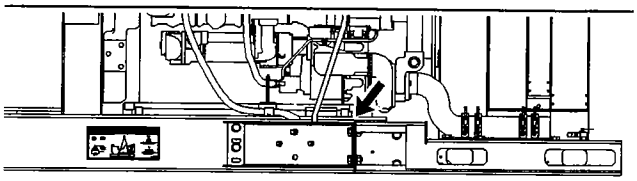
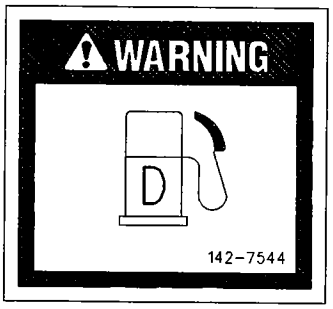


Illustration 9 g00327806

Location of the warning label for diesel fuel

The warning label for diesel fuel is located next to the fuel inlet on the diagonal support for the radiator. The diagonal support for the radiator is attached between the engine mounting rails.



g00309704

Use diesel fuel only in the engine. The use of gasoline can cause the following problems to occur: engine damage, personal injury, and possible death. Avoid spilling diesel fuel on hot engine components. Spilling diesel fuel on hot engine components can cause a fire. Personal injury or death can occur. Use extreme caution when you are filling the fuel tank with diesel fuel. Always wear protective clothing.

Electrical Distribution (Generator)

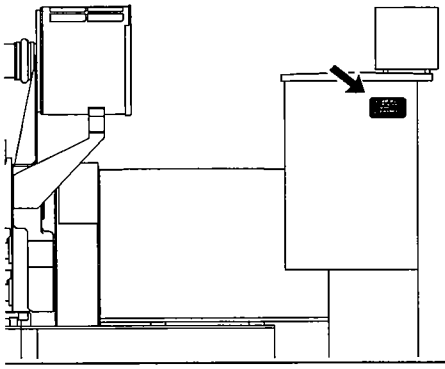
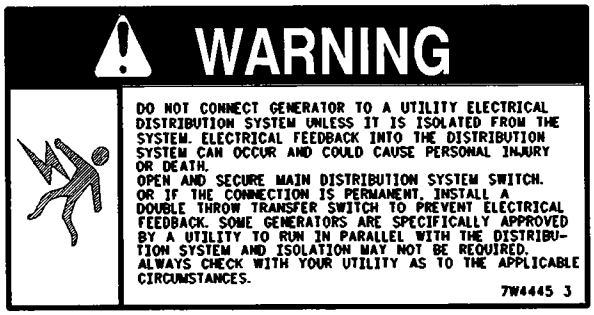


Illustration 10 g00305862

Location of the warning label for electrical distribution (generator)

The warning label for electrical distribution (generator) is located on the covers of the generator.



g00296980

WARNING

Do not connect generator to a utility electrical distribution system unless it is isolated from the system. Electrical feedback into the distribution system can occur and could cause personal injury or death.

Open and secure main distribution system switch, or if the connection is permanent, install a double throw transfer switch to prevent electrical feedback. Some generators are specifically approved by a utility to run in parallel with the distribution system and isolation may not be required. Always check with your utility as to the applicable circumstances.

Emergency Stop

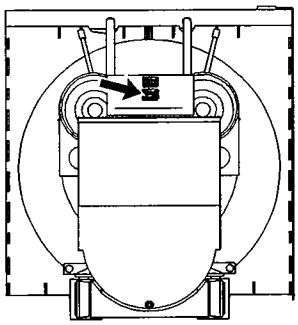
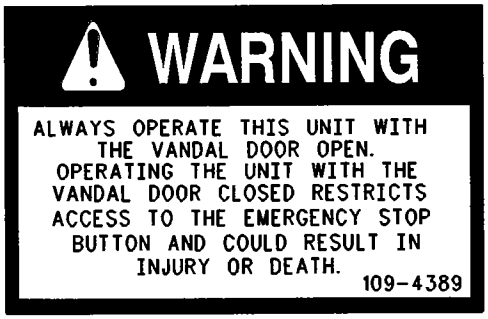


Illustration 11 g00305895

Location of the warning label for emergency stop

The warning label for emergency stop is located on the outside of the door of the control panel.



g00305896

WARNING

Always operate this unit with the vandal door open. Operating the unit with the vandal door closed restricts access to the emergency stop button and could result in injury or death.

Operation

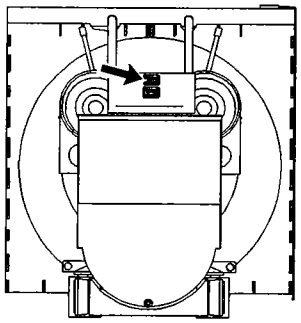
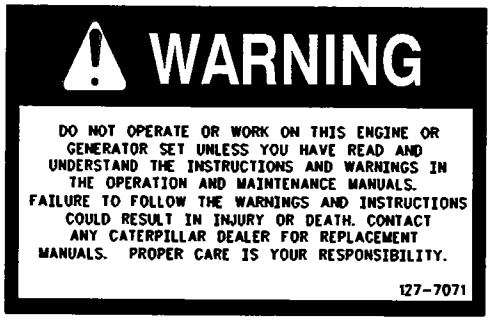


Illustration 12 g00306263

Location of the warning label for operation

The warning label for operation is located on the outside of the door of the control panel.



g00306265

WARNING

Do not operate or work on this engine or generator set unless you have read and understand the instructions and warnings in the Operation and Maintenance Manuals.

Failure to follow the warnings and instructions could result in injury or death. Contact any Caterpillar dealer for replacement manuals. Proper care is your responsibility.

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General Hazard Information

SMCS Code: 1000; 4450; 7405

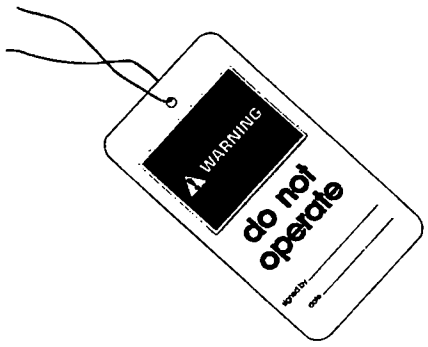


Illustration 13 g00104545

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

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

Engine exhaust contains products of combustion which may be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is in an enclosed area, vent the engine exhaust to the outside.

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.

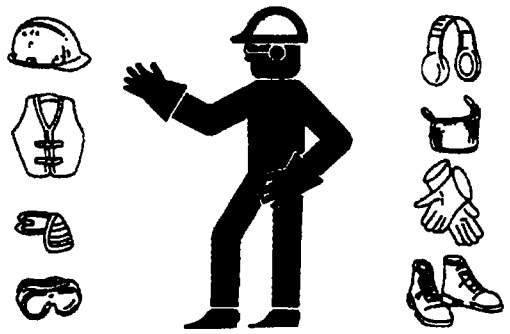


Illustration 14 g00702020

- 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.
- 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.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.

Pressure Air and Water

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

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

The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi). The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

Fluid Penetration

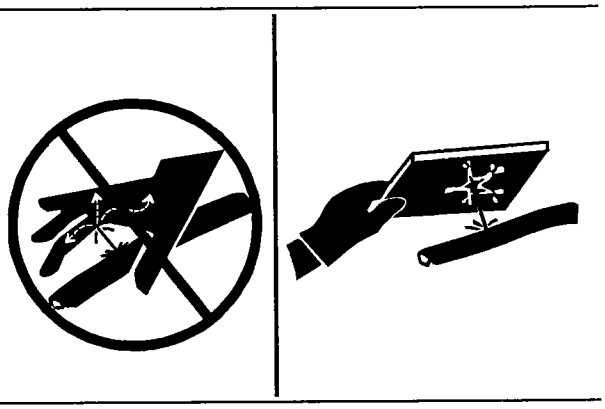


Illustration 15 g00687600

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

Containing Fluid Spillage

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

Refer to Special Publication, NENG2500, "Tools and Shop Products Guide" for the following items:

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

Obey all local regulations for the disposal of liquids.

Asbestos Information

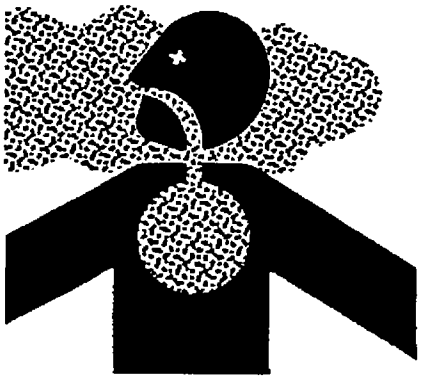


Illustration 16 g00702022

Caterpillar equipment and replacement parts that are shipped from Caterpillar are asbestos free. Caterpillar recommends the use of only genuine Caterpillar 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 usually 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.

Dispose of Waste Properly

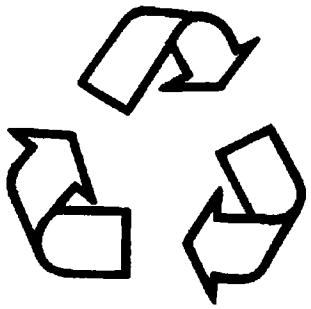


Illustration 17 g00706404

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.

i01225555

Burn Prevention

SMCS Code: 1000; 4450; 7405

Do not touch any part of an operating generator set. Allow the generator set to cool before any maintenance is performed on the generator set. Before any lines, fittings or related items are disconnected, relieve all pressure in the following systems: lubrication system, fuel system, and cooling system.

i01372254

Fire Prevention and Explosion Prevention

SMCS Code: 1000; 4450; 7405

Illustration 18 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 fifteen 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 Caterpillar 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 case of 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. All electrical wires must be properly routed and securely attached. Check all electrical wires daily. 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. The hoses must be properly routed. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Oil filters and fuel filters must be properly installed. The filter housings must be tightened to the proper torque.

Illustration 19 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.

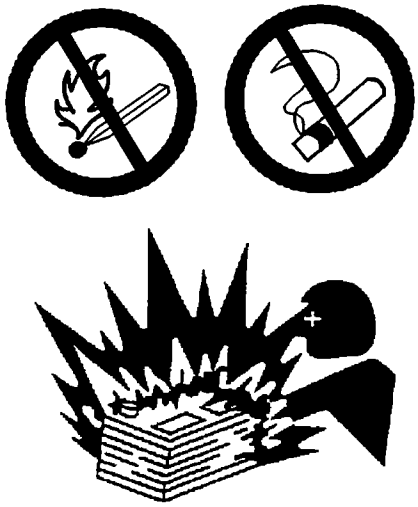


Illustration 20 g00704135

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. This 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

Ether is flammable and poisonous.

Use ether in well ventilated areas. Do not smoke while you are replacing an ether cylinder or while you are using an ether spray.

Do not store ether cylinders in living areas or in the engine compartment. Do not store ether cylinders in direct sunlight or in temperatures above 49 °C (120 °F). Keep ether cylinders away from open flames or sparks.

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

Do not spray ether into an engine if the engine is equipped with a thermal starting aid for cold weather starting.

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 Caterpillar 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 part 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. During engine operation, this will help to prevent vibration, rubbing against other parts, and excessive heat.

i01359666

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 in order 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.

i01377941

Mounting and Dismounting

SMCS Code: 1000; 4450; 7405

Generator sets in permanent installations may require the use of a ladder or a work platform in order to provide access for normal maintenance. The owner and/or the user is responsible for providing safe access that conforms to SAE J185 and/or local building codes.

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

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

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

Do not jump from an elevated platform. Do not jump from a ladder or stairs.

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 generator set or when you dismount the generator set. Use a hand line to raise and lower tools or supplies.

i01421840

Before Starting Engine

SMCS Code: 1000

Inspect the engine for potential hazards.

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

Ensure that the engine is equipped with a lighting system that is suitable for the conditions. Ensure that all lights work properly.

All protective guards and all protective covers must be installed if the engine must be started in order 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 in order to help prevent personal injury. The circuits are also provided in order to help prevent engine damage.

For the initial start-up of a new engine and for start-up of an engine that has been serviced, prepare to stop the engine if an overspeed occurs. This may be accomplished by shutting off the fuel and/or the air supply to the engine.

See the Service Manual for repairs and for adjustments.

i01103904

Engine Starting

SMCS Code: 1000

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 in order 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 this Operation and Maintenance Manual, "Engine Starting" topic (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 properly, check the water temperature gauge and the oil temperature gauge during the heater operation.

Engine exhaust contains products of combustion that can be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is started in an enclosed area, vent the engine exhaust to the outside.

Ether

Ether is poisonous and flammable.

Do not inhale ether, and do not allow ether to contact the skin. Personal injury could result.

Do not smoke while ether cylinders are changed.

Use ether in well ventilated areas.

Use ether with care in order to avoid fires.

Keep ether cylinders out of the reach of unauthorized persons.

Store ether cylinders in authorized storage areas only.

Do not store ether cylinders in direct sunlight or at temperatures above 49 °C (120 °F).

Discard the ether cylinders in a safe place. Do not puncture the ether cylinders. Do not burn the ether cylinders.

i01032808

Engine Stopping

SMCS Code: 1000

To avoid overheating of the engine and accelerated wear of the engine components, stop the engine according to this Operation and Maintenance Manual, "Engine Stopping" topic (Operation Section).

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.

On the initial start-up of a new engine or an engine that has been serviced, make provisions to stop the engine if an overspeed condition occurs. This may be accomplished by shutting off the fuel supply and/or the air supply to the engine.

i01470560

Electrical System

SMCS Code: 1000; 1400

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause the combustible gases that are produced by some batteries to ignite.

When the engine is started from an external source, follow this procedure: first, connect the positive "+" jump start cable from the external power source to the positive "+" battery terminal of the engine that is being started. Then connect the negative "–" jump start cable from the external power source to the negative "–" terminal of the starting motor. This will help to prevent sparks from igniting combustible gases that are produced by some batteries.

Check the electrical wires daily 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.

Grounding Practices

The electrical systems for the generator, the engine and the control systems must be properly grounded. Proper grounding is necessary for optimum 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 the surface of crankshaft journals, and to aluminum components. Uncontrolled electrical circuit paths can also cause electrical activity that may degrade the performance of the generator set's electronics.

The alternator and the starting motor must be grounded to the negative "–" battery terminal.

A ground plate with a direct path to the negative "–" battery terminal may be used as a common ground for the components of one engine system.

For engines with an alternator that is grounded to an engine component, a ground strap must connect that component to the negative "–" battery terminal. Also, that component must be electrically isolated from the engine.

The ground strap for the alternator must be of a size that is adequate for carrying the full charging current of the alternator.

i01489970

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.

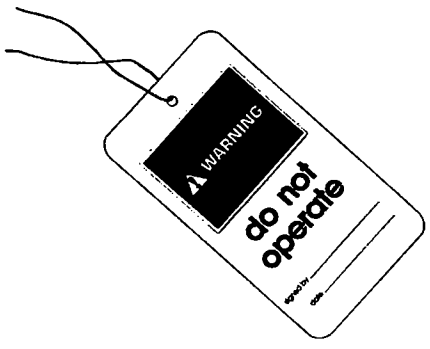


Illustration 21 g00104545

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 transformer's 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's terminal box.

8. Use an audio/visual proximity tester in order to verify that the generator is de-energized. This tester must be insulated for the proper voltage rating. Follow all guidelines in order 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.

Product Information Section

Model Views and Specifications

i01472513

Model View Illustrations

SMCS Code: 1000; 4450

The illustrations show typical features of the 3500 Series Generator Set Engines. The illustrations do not show all of the options that are available.

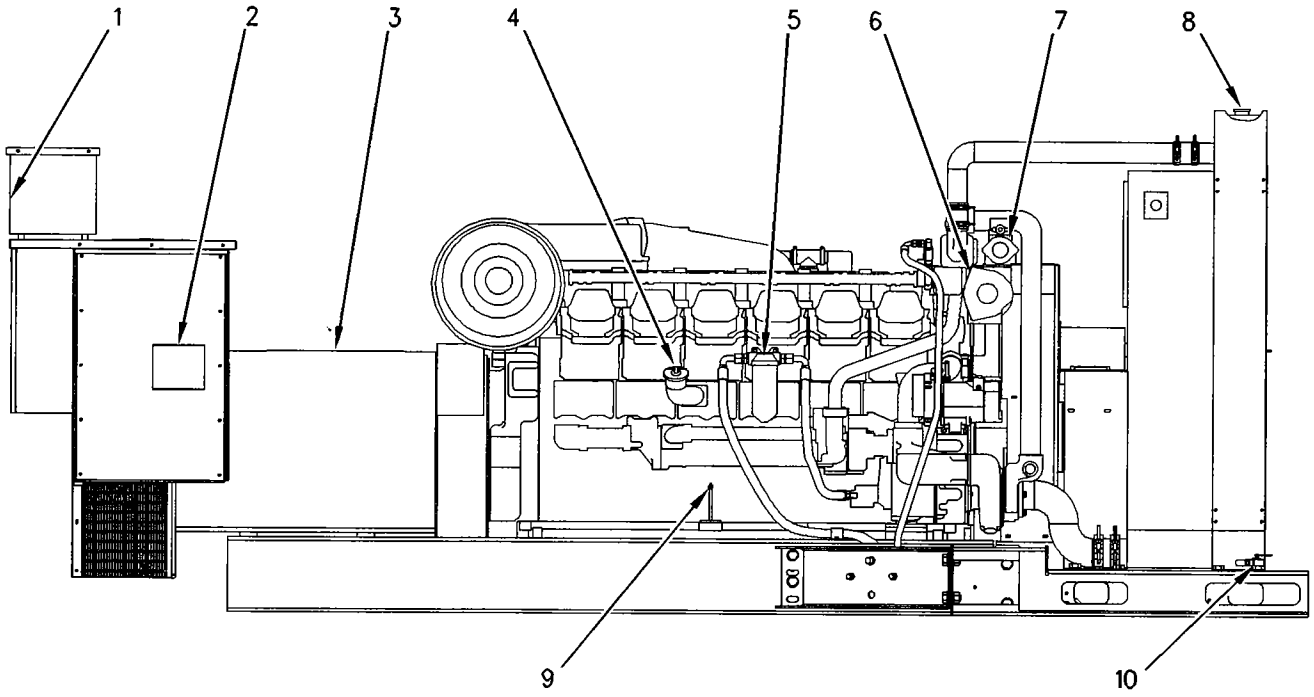
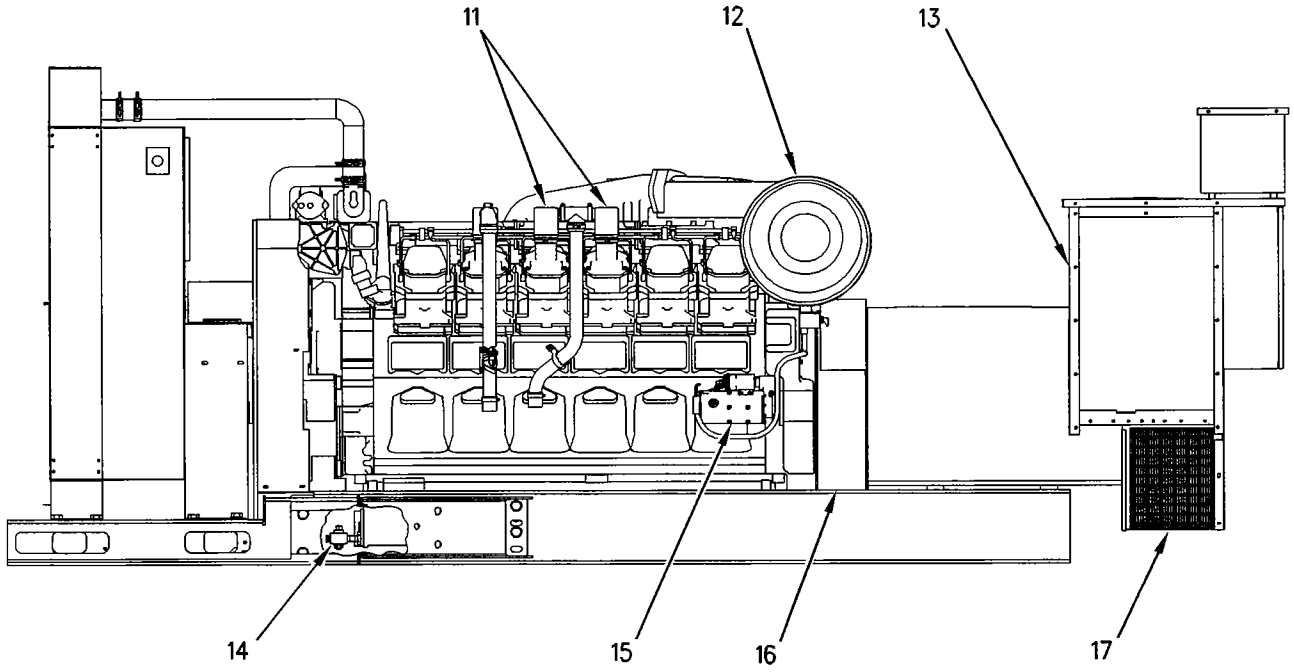


Illustration 22 g00767987

(1) Control panel
(2) Circuit breaker
(3) Generator
(4) Oil filler cap
(5) Primary fuel filter
(6) Oil filters
(7) Secondary fuel filter
(8) Radiator filler cap
(9) Oil level gauge
(10) Coolant drain



g00768013

Illustration 23

(11) Crankcase breathers
(12) Air cleaner
(13) Generator terminal box
(14) Oil drain
(15) Starting motor
(16) Exhaust cover (generator)
(17) Air inlet cover (generator)

i01472656

Product Description

SMCS Code: 1000; 4450

The 3500 Generator Sets consist of an engine, generator and control systems.

Description (Engine)

The 3500 Series Generator Set Engines includes an 8 cylinder engine, a 12 cylinder engine, and a 16 cylinder engine. These engines are four stroke cycle with direct injection. Each cylinder head has two inlet valves and two exhaust valves. The camshaft uses mechanical lifters and pushrods to actuate the rocker arms and valves.

The engines are supplied with fuel by direct fuel injection. An electronic governor and an actuator controls the fuel injection pump output in order to maintain the engine rpm that is selected by the operator.

Fuel is metered and pumped by a fuel injection pump to the fuel injection nozzles (one per cylinder). The automatic timing advance provides the best fuel injection timing over the full range of engine rpm.

Inlet air is filtered by the air cleaner. The air is compressed by the turbocharger before the air enters the cylinders. The turbocharger is driven by the engine exhaust. The standard engine is turbocharged and aftercooled. The coolant for the aftercooler is circulated by the jacket water pump.

The cooling system consists of the following components:

- Centrifugal pumps
- Four water temperature regulators which maintain the engine coolant temperature to 93 to 107 °C (200 to 225 °F)
- An oil cooler
- A radiator which incorporates a shunt system

The engine lubricating oil is cooled and the engine lubricating oil is filtered. The engine lubricating oil is supplied by a pump that is driven by a gear. If the oil viscosity is high or if the oil cooler and oil filter elements become plugged, bypass valves provide unrestricted flow of lubrication oil to the engine.

Engine efficiency and engine performance depend on adherence to proper operation and maintenance recommendations. Use the recommended fuels, lubrication oils, and coolant. Pay special attention to the air cleaner, to the fuel system, to the lubrication system, and to the cooling system maintenance. Refer to this Operation and Maintenance Manual, "Maintenance Interval Schedule" for more information on maintenance items.

Description (Generator)

The SR4B brushless generator can be used with the following loads: mixed loads of motors and lights, SCR-controlled equipment, computer centers, installations of communications, and petroleum drilling applications.

The generator set packages can be utilized for prime power generation or standby power generation.

SR4B generators are utilized in three-phase full-wave excitation and regulation. The generators are either four pole or six pole design with six lead configuration or twelve lead configuration depending on frame size. The generators are capable of producing electrical power in either 50 Hz or 60 Hz applications.

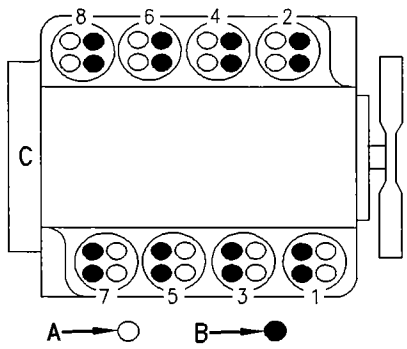
i01544400

Specifications

SMCS Code: 1000

Table 1

3500 Engine Specifications			
Item	**3508 Engine**	**3512 Engine**	**3516 Engine**
Rated Speed (rpm)	900 to 1800		
Idle Speed (rpm)	900		
Cylinders and arrangement	60 degree Vee 8	60 degree Vee 12	60 degree Vee 16
Bore	170 mm (6.7 inch)		
Stroke	190 mm (7.5 inch)		
Type	4 stroke cycle		
Compression ratio	13:1		
Aspiration	Turbocharged		
Method of cooling the turbocharged air	Jacket water aftercooling		
Displacement per cylinder	4.3 L (263 cu in)		
Total displacement	34.5 L (2105 cu in)	51.8 L (3158 cu in)	69.1 L (4210 cu in)
Rotation (flywheel)	Counterclockwise rotation (standard)		
Fuel	See this Operation and Maintenance Manual, "Fuel Recommendations" (Maintenance Section).		
Method of fuel injection	Mechanical fuel injectors		
Method of starting	Electric starting motor		
Maximum allowable back pressure	6.7 kPa (26.9 inches of H_2O)		
Maximum inlet air restriction	6.2 kPa (24.9 inches of H_2O)		
Air cleaners	Single element or Dual element		
Inlet valve lash	0.50 mm (0.020 inch)		
Exhaust valve lash	1.00 mm (0.040 inch)		

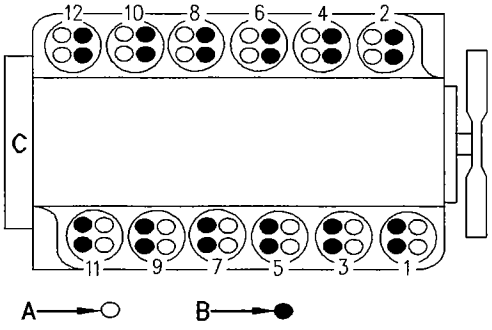


g00739600

Illustration 24

3508 Engine

(A) Inlet valve
(B) Exhaust valve
(C) Flywheel



g00749769

Illustration 25

3512 Engine

(A) Inlet valve
(B) Exhaust valve
(C) Flywheel

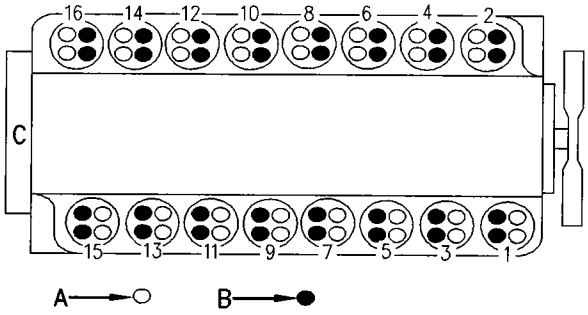


Illustration 26 g00749770

3516 Engine

(A) Inlet valve
(B) Exhaust valve
(C) Flywheel

Product Identification Information

i01460635

Plate Locations and Film Locations

SMCS Code: 1000; 4450

Engine Identification

Caterpillar engines are identified with serial numbers, with performance specification numbers, and with arrangement numbers. In some of the cases, modification numbers are used. These numbers are shown on the Serial Number Plate and the Information Plate that are mounted on the engine.

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

Serial Number Plate

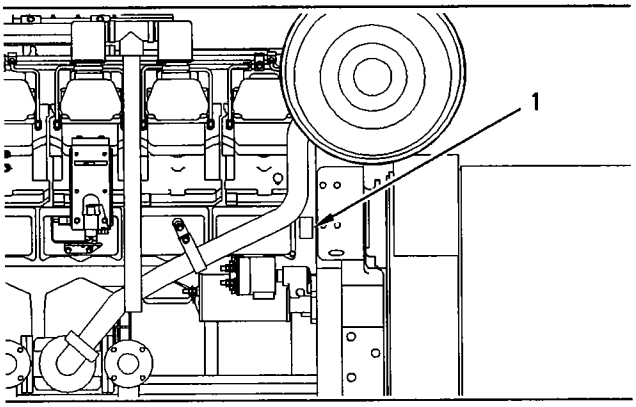


Illustration 27 g00735499

(1) Location of the Serial Number Plate

The Serial Number Plate is on the left side of the cylinder block near the rear of the engine.

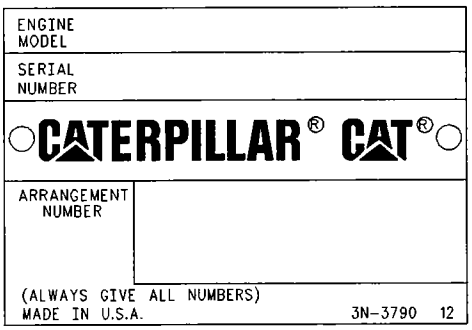


Illustration 28 g00123229

The following information is stamped on the Serial Number Plate: engine serial number, model, and arrangement number.

Information Plate

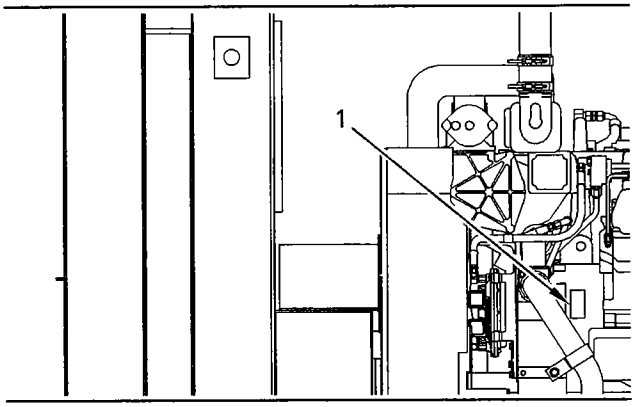


Illustration 29 g00735560

(1) Location of the Information Plate

The Information Plate is on the left side top surface of the cylinder block in front of the front cylinder head.

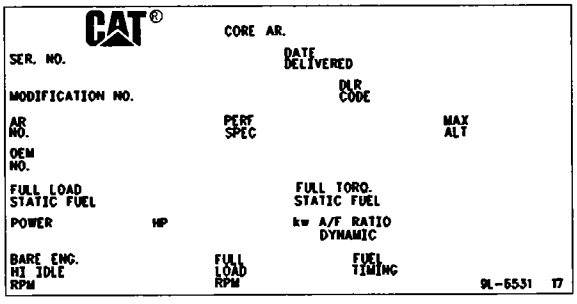


Illustration 30 g00102789

The following information is stamped on the Information Plate: engine's maximum altitude, horsepower, high idle, full load rpm, fuel settings, and other information.

Generator Identification

The generator identification and information plate is located on the left side of the generator.

When service is required, the information that is given on this plate should be used. The generator identification and information plate includes the following information: serial number, model number, and the rating of the generator set. The generator set consists of the engine and generator. All pertinent generator data is also included on the plate in order to provide the information that is necessary to order parts.

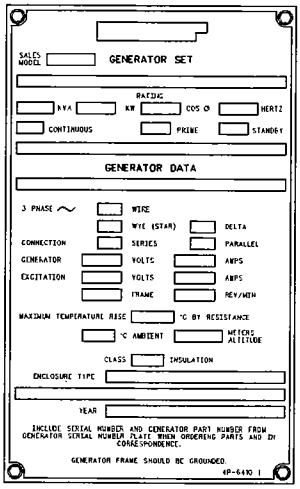


Illustration 31 g00572840

Generator Identification Plate

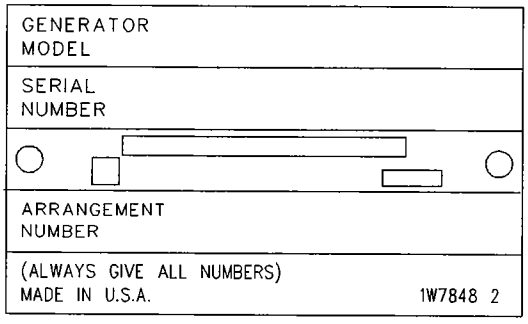


Illustration 32 g00601027

Serial Number Plate

Output Lead Wiring

All generator lead wiring information can be found on a decal that is located on the side panel of the generator's terminal box. If the generator is equipped with a circuit breaker, the decal may be found on the sheet metal of the circuit breaker panel.

i01498858

Emissions Certification Film

SMCS Code: 1000; 7405

CAT CATERPILLAR INC.

IMPORTANT ENGINE INFORMATION

SER NO. **SRM00001**

ENGINE MODEL 3516 DISPLACEMENT 69.0 L
VALVE LASH 0.50 mm INTAKE
1.00 mm EXHAUST
ENGINE FAMILY YCPXL69.0ERK
MAX. ADVERTISED POWER 1611 kW (2160) HP
MAX. RATED SPEED 1750 RPM
MAX. LOW IDLE SPEED 700 RPM
MAX. FUEL RATE @ MAX. kW 463 mm^3/STROKE
EXHAUST EMISSION CONTROL SYSTEM EM,DI,TC,ECM,CAC

THIS ENGINE CONFORMS TO 2000 U.S. EPA AND CALIFORNIA REGULATIONS LARGE NON-ROAD COMPRESSION-IGNITION ENGINES. THIS ENGINE IS CERTIFIED TO OPERATE ON COMMERCIALLY AVAILABLE DIESEL FUEL.

DATE OF MANUFACTURE (MONTH) 08 159-2455

The EPA/EU Emissions Certification Film (if applicable) is located either on the side, the top, or the front of the engine.

CAT CATERPILLAR INC.

INFORMATION IMPORTANTE SUR LE MOTEUR

NO SÉRIE **SRM00001**

MODÈLE MOTEUR 3516 DÉBIT 69.0 l
JEU SOUPAPES ADM. 0,50 mm
ÉCHAP. 1,00 mm
FAMILLE DE MOTEURS YCPXL69.0ERK
MAXI PUBLIÉS PUISSANCE 1611 kW (2160) HP
MAXI RÉGIME NOMINAL 1750 tr/mn
MAXI RÉGIME RALENTI 700 tr/mn
MAXI DÉBIT D'INJ. À PUIS. MAXI 463 mm^3/STROKE (PISTON)
DISPOSITIF ANTI-POLLUANT EM,DI,TC,ECM,CAC

CE MOTEUR EST CONFORME AUX RÉGLEMENTATIONS DE L'AGENCE AMÉRICAINE DE PROTECTION DE L'ENVIRONNEMENT (EPA) ET DE LA CALIFORNIE POUR LES GROS MOTEURS NON ROUTIERS À COMPRESSION-CONTACT. CE MOTEUR EST HOMOLOGUÉ POUR FONCTIONNER AVEC LE CARBURANT DIESEL DU COMMERCE.

DATE DE FABRICATION (MOIS) 08

L'autocollant d'homologation du dispositif antipollution EPA/EU (selon équipement) est situé soit sur le côté du moteur, soit sur le dessus du moteur, soit sur le devant du moteur.

Illustration 33 g00777800

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Reference Information

SMCS Code: 1000; 4450

Identification of the items in Table 2 may be required in order to obtain parts and service. Some of the information is on the engine Serial Number Plate and/or Information Plate. Locate the information for your engine. Record the information on the appropriate space in Table 2. Make a copy of this list for a record. Retain the information for future reference.

The top level part numbers in the Parts Manual for the engine are listed with the engine arrangement number. Occasionally, an arrangement may be slightly modified before the product is shipped from the factory. In these cases, a modification number indicates that the arrangement has been modified.

The packaging arrangement may also be called a pricing arrangement or a customer arrangement. This is the total package with attachments and options that are not included in the engine arrangement.

The performance specification can be used by your Caterpillar dealer with the Technical Marketing Information system. Before the generator set leaves the factory, the performance of the following components are tested: package, generator, and engine. Detailed performance data is recorded. The performance specification number can be used for obtaining the engine data. The performance data for the package and the generator can be ordered from your Caterpillar dealer.

Table 2

Reference Information	
Customer Designation	
Model (Generator Set)	
Serial Number (Generator Set)	
Arrangement Number (Generator Set)	
Model (Engine)	
Serial Number (Engine)	
Arrangement Number (Engine)	
Model (Generator)	
Serial Number (Generator)	
Arrangement Number (Generator)	
Generator Frame Size	
kW Rating	
Voltage Rating	
Generator Excitation	
Generator Air Inlet Filter	
Modification Number	
Packaging Arrangement	
Turbocharger	
Fuel Filter Element	
Engine Oil Filter	
Auxiliary Oil Filter Element	
Air Cleaner Element	
Fan Drive Belt	
Alternator Belt	
Capacity of the Lubrication System	
Capacity of the Cooling System	
Performance Specification Number	
Personality Module	
Low Idle rpm	
High Idle rpm	
Full Load rpm	
Power Rating	

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Generator Lead Connections

SMCS Code: 4450

Lead Numbering

The Wye (Star) configurations and the Delta configurations are the most common generator lead connections. The following three-phase connection diagrams illustrate the proper connection and lead identification.

The leads are numbered clockwise from the top and from the outside inward. The diagrams show lead numbering for the six and twelve lead generators.

Wye Configuration Diagrams

6 Lead

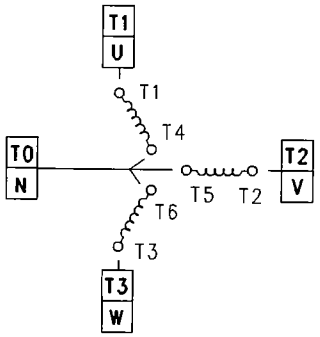

Illustration 34 g00611486

6 Lead Wye Configuration

Terminals T4, T5 and T6 become neutral connection when the terminals are tied together.

12 Lead

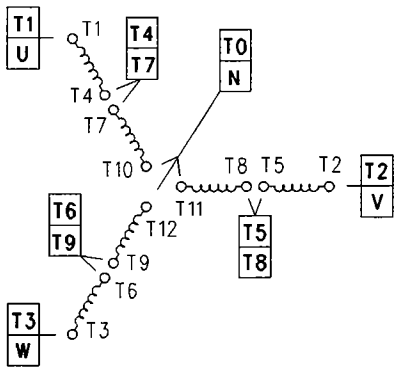

Illustration 35 g00661863

12 Lead Wye Configuration - High Voltage

Terminals T10, T11 and T12 become neutral connection when the terminals are tied together.

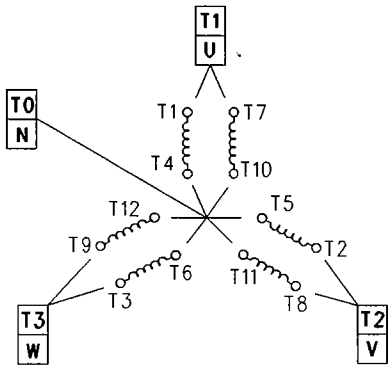

Illustration 36 g00611608

12 Lead Wye Configuration - Low Voltage

Terminals T10, T11 and T12 become neutral connection when the terminals are tied together.

Delta Configuration Diagrams

6 Lead

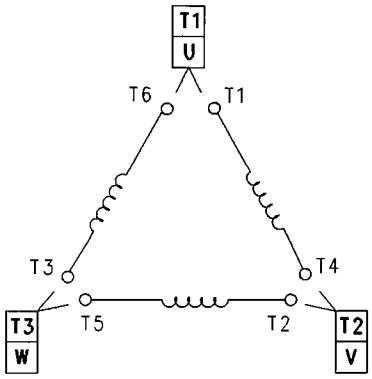

Illustration 37 g00669319

6 Lead Delta Configuration

12 Lead

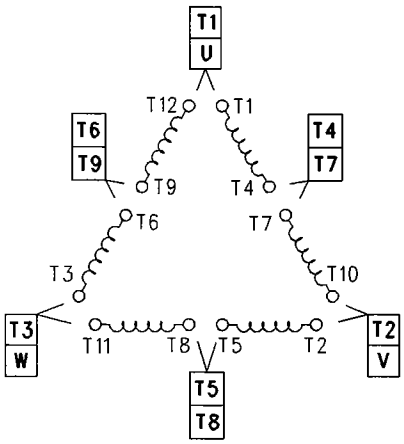

Illustration 38 g00669312

12 Lead Delta Configuration

Terminals T6 and T9 become the neutral connection when the terminals are tied together and grounded. This reflects the terminal T2 and T10 connection as the high phase.

Grounding the Frame

In any generator set installation, the frame of the generator must be positively connected to an earth ground. This connection is the first one that is made at the installation. This connection is the last one that should be removed. The ground connection must be flexible in order to avoid possible breakage in later operation.

Ground connection cable or straps should have at least the current carrying capacity of the largest line lead to the connected load. Joints in cables or straps must be clean, free of electrical resistance, and protected from possible oxidation. Bolted ground connection joints eventually oxidize. The joints are frequent sources of radio frequency interference (RFI). Silver soldered and bolted joints are electrically and mechanically sound.

Neutral Connections

The generators with grounded configuration usually have the neutral grounded when the generator is installed. However, there are some cases when definite measures can be taken in order to prevent ground faults on the load side. The purpose of the grounding of the neutral is to prevent load side equipment damage. The purpose of the grounding of the neutral is also to prevent harm to personnel.

If the neutral wire is grounded and one of the phase leads becomes grounded, the excessive current will open a load circuit breaker in order to isolate the fault. The excessive current will collapse the generator voltage, if the circuit breaker does not trip first. The result depends on the particular generator electrical characteristics, type of fault, and trip rating of the circuit breaker. An undervoltage device may be required in order to provide an adequate short circuit protection.

There are some instances in which it is undesirable to ground the neutral wire. An ungrounded generator neutral lead is acceptable in the applications in which definite measures have been taken in order to prevent grounds to the phase leads. An example of such measures are ground fault protective circuits. Ground fault protection requires that the entire group of distribution circuits should be studied and treated as a system. The owner should engage a certified and registered consultant if a new distribution system is being developed. The owner should also engage a certified and registered consultant if an existing system should be modified for the ground fault protection.

Neutral resistors and reactors may be added to the system for two reasons: to provide protection during faults and to limit neutral currents.

Single Units

In a three-phase, four-wire system, the neutral wire should be grounded according to local wiring codes.

In applications, in which definite measures are taken in order to prevent grounds to the load leads, an ungrounded neutral can be used. Be sure to check your local wiring codes.

Multiple Units

Operation of multiple generators in parallel, having all neutrals grounded, may result in the circulating current through the neutral connections. In order to eliminate the possibility of circulating currents, ground the neutral of only one generator. If multiple generators are alternated on line, a switch should be installed in the neutral ground circuit of each generator. In this case all neutral ground circuits except one can be opened. Be sure that one of the neutral ground circuits is closed.

Parallel to Utility

When a Wye (Star) connected generator is going to operate in parallel with a utility system (infinite bus) and when the secondary of the step-down transformer in the utility system is also a Wye connection, the following may happen. The grounding of both Wye neutrals may result in circulating currents through the neutrals. Also, the coordination of ground fault protection requires an entire system study. A study should be done by a certified and registered consultant who is familiar with generator systems. The study will determine which grounding method should be used.

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Voltage Connections

SMCS Code: 4450

Three-Phase Voltage Connections

The Wye (Star) Configuration for a 480 V generator and the Delta Configuration for a 240 V generator are given in the following diagrams.

The terminals must be connected securely. The terminals must also be insulated with a good quality electrical tape.