CATERPILLAR®

SEBU8245-05

# Operation and Maintenance Manual

## C18 MARINE ENG Marine Engine

**S/N T2P1-UP**



*Use the bookmarks for navigation inside of the manual*

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**Operation and Maintenance Manual**
**C18 MARINE ENG Marine Engine**

**Media Number -SEBU8245-05**

**Publication Date -01/08/2013** **Date Updated -05/08/2013**

# Foreword

# Literature Information

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

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

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

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

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

# Safety

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

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

# Operation

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

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

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

# Maintenance

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

## Maintenance Intervals

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

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

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

# 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.**

# Certified Engine Maintenance

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

It is prohibited for any person engaged in the business of repairing, servicing, selling, leasing, or trading engines or machines to remove, alter, or render inoperative any emission related device or element of design installed on or in an engine or machine that is in compliance with the regulations (40 CFR Part 89). Certain elements of the machine and engine such as the exhaust system, fuel system, electrical system, intake air system and cooling system may be emission related and should not be altered unless approved by Caterpillar.

# Machine Capacity

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

## Caterpillar Product Identification Number

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

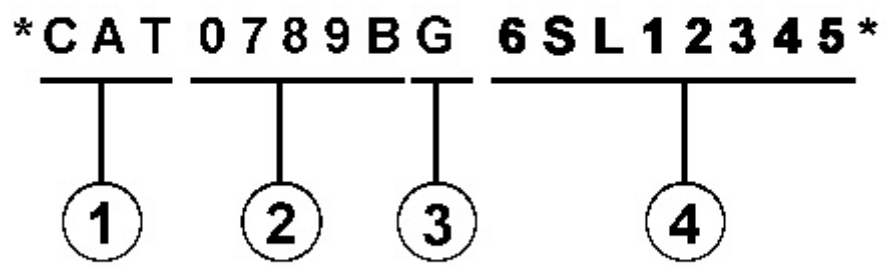


Illustration 1 g00751314

Where:

1. Caterpillar's World Manufacturing Code (characters 1-3)

2. Machine Descriptor (characters 4-8)

3. Check Character (character 9)

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

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

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

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# After Starting Engine

**SMCS -** 1000

**Note:** In temperatures from 0 to 60 °C (32 to 140 °F), the warm-up time is approximately five minutes. In temperatures below 0 °C (32 °F), additional warm-up time may be required.

**Note:** Ensure that the self-test for the monitoring system is completed before you operate the engine under load.

1. Operate the engine at low idle rpm for five minutes. Perform these checks during the warm-up:
   - Check for any fluid leaks and for any air leaks.
   - Check all the gauges.

   Observe the gauges and record the data frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. This will also help detect abnormal operating developments. Investigate any significant changes in the readings.
2. After the engine has idled for five minutes and the inspections have been made, increase the engine speed to 1/2 rated rpm.

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**NOTICE**

**To avoid engine overheating and possible engine damage, ensure that water discharge is visible at the sea water outlet and/or the water flow is not restricted.**

**If the water flow is restricted and/or water discharge is not visible at the sea water outlet, follow the recommended procedure.**

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3. Observe the water discharge at the sea water outlet. If water discharge is not visible or the water flow is restricted, perform the following procedure:

    a. Stop the engine immediately.

    b. Inspect the inlet screen and the sea water strainer for debris. Remove any debris that is found.

    c. Inspect the cooling system and the auxiliary water pumps for evidence of leaks.

4. Check for any fluid leaks and for any air leaks.

5. Perform any necessary repairs before you operate the engine.

6. After the inspections have been made, move the throttle control to the idle position and proceed with operation.

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# Engine Air Cleaner Service Indicator - Inspect

**SMCS -** 7452-040

A service indicator may be mounted on the air cleaner element or in a remote location.

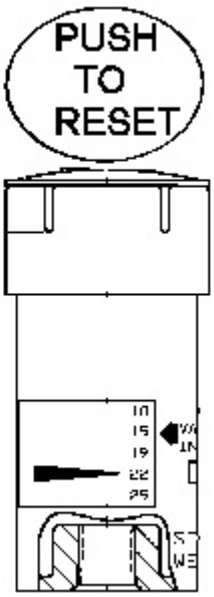


Illustration 1 g01640336

Typical air cleaner service indicator

Some engines may be equipped with a different service indicator.

Observe the service indicator. Clean the air cleaner element or replace the air cleaner element when the following conditions occur:

- The yellow diaphragm enters the red zone.

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# Fire Prevention and Explosion Prevention

**SMCS -** 1000; 7405

Illustration 1 g00704000

Use of personal protection equipment (PPE) may be needed.

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

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

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 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.

All fluids that are captured in the fluid spill containment basin should be cleaned up immediately. Failure to clean up spilled fluids can cause a fire. Fire may cause personal injury and property damage.

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 from a failed line, tube, or seal. 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. Properly route and securely attach all electrical wires. 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. 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 all fuel filters. The filter housings must be tightened to the proper torque.

Illustration 2 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.

**Note:** 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 content. Avoid death or serious injury from fire or explosion. Consult your fuel or fuel system supplier to ensure that the delivery system is in compliance with fueling standards for proper grounding and bonding practices.

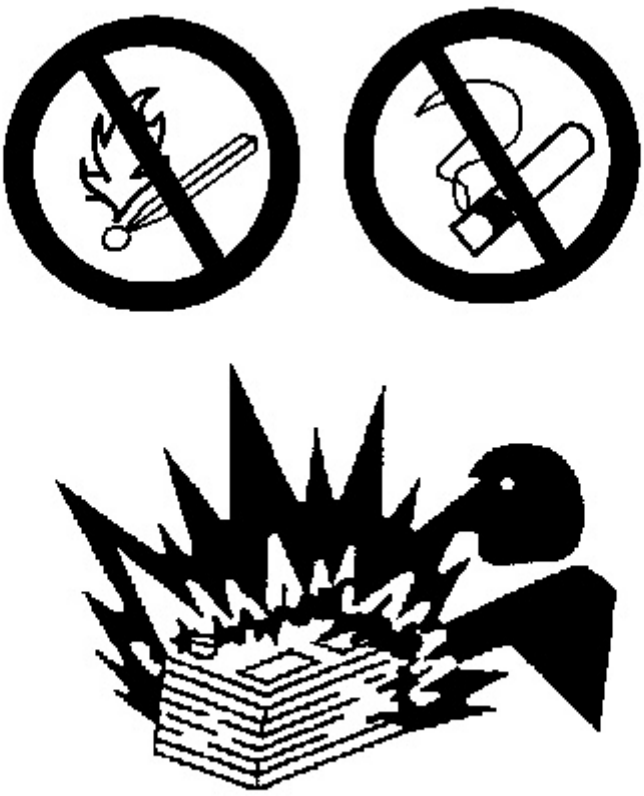

Illustration 3 g02298225

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

Do not use ether as a starting aid. Refer to this Operation and Maintenance Manual, "Starting the Engine" for information about starting the engine.

# 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.
- Portions 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.

Diesel Engines

| | |
|---|---|
| ABS | Agco-Sisu |
| Akasaka | Baudouin |
| BMW | Bukh |
| Caterpillar | CHN 25/34 |
| Cummins | Daihatsu |
| Detroit | Deutz |
| Doosan-Daewoo | Fiat |
| Ford | GE |
| Grenaa | Guascor |
| Hanshin | Hatz |
| Hino | Honda |
| Hyundai | Isotta |
| Isuzu | Iveco |
| John-Deere | Kelvin |
| Kioti | Komatsu |
| Kubota | Liebherr |
| Lister | Lombardini |
| MAK | MAN B&W |
| Mercedes | Mercruiser |
| Mirrlees BS | Mitsubishi |
| MTU | MWM |
| Niigata | Paxman |
| Perkins | Pielstick |
| Rolls / Bergen | Ruggerini |
| Ruston | Scania |
| Shibaura | Sisu-Valmet |
| SKL | Smit-Bolnes |
| Sole | Stork |
| VM-Motori | Volvo |
| Volvo Penta | Westerbeke |
| Wichmann | Yanmar |

Machinery

| | |
|---|---|
| ABG | Airman |
| Akerman | Ammann |
| Astra | Atlas Copco |
| Atlas Weyha. | Atlet |
| Bell | Bendi |
| Bigjoe | Bobcat |
| Bomag | BT |
| Carelift | Case |
| Caterpillar | Cesab |
| Challenger | Champion |
| Claas | Clark |
| Combilift | Crown |
| Daewoo-Doosan | Demag |
| Deutz-Fahr | Dressta |

Machinery

| | |
|---|---|
| Drott | Dynapack |
| Extec | Faun |
| Fendt | Fiat |
| Fiatallis | Flexicoil |
| Furukawa | Gehl |
| Genie | Grove-gmk |
| Halla | Hamm |
| Hangcha | Hanix |
| Hanomag | Hartl |
| Haulpack | Hiab |
| Hidromek | Hino truck |
| Hitachi | Hyster |
| Hyundai | IHI |
| Ingersoll-rand | JCB |
| JLG | John-Deere |
| Jungheinrich | Kalmar |
| Kato | Kioti |
| Kleeman | Kobelco |
| Komatsu | Kramer |
| Kubota | Lamborghini |
| Landini | Liebherr |
| Linde | Link-belt |
| Manitou | Massey-Ferg. |
| Mccormick | MDI-Yutani |
| Mitsubishi | Moxy |
| Mustang | Neusson |
| New-Holland | Nichiyu |
| Nissan | OK |
| OM-Pimespo | others-tech |
| Pel-Job | PH-mining |
| Poclain | Powerscreen |
| Same | Samsung |
| Sandvik | Scania |
| Schaefer | Schramm |
| Sennebogen | Shangli |
| Shibaura | Steiger |
| Steinbock | Steyr |
| Still | Sumitomo |
| Super-pac | Tadano |
| Takeuchi | TCM |
| Terex | Toyota |
| Valpadana | Venieri |
| Versatile | Vogele |
| Volvo | Weidemann |
| Wirtgen | Yale |
| YAM | Yanmar |

SEBU8422-16

CATERPILLAR®

# Operation and Maintenance Manual

## C32 Generator Set

**S/N: JAZ1-UP**

*Use the bookmarks for navigation inside of the manual*

**Operation and Maintenance Manual**
**C32 Generator Set**
**Media Number -SEBU8422-16** **Publication Date -01/09/2015** **Date Updated -27/10/2015**

s00037353

# 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 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 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 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 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 Cat 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.**

**Operation and Maintenance Manual**
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# Safety Messages

**SMCS -** 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 of the safety messages are legible. Clean the safety messages 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 Cat dealer can provide new safety messages.

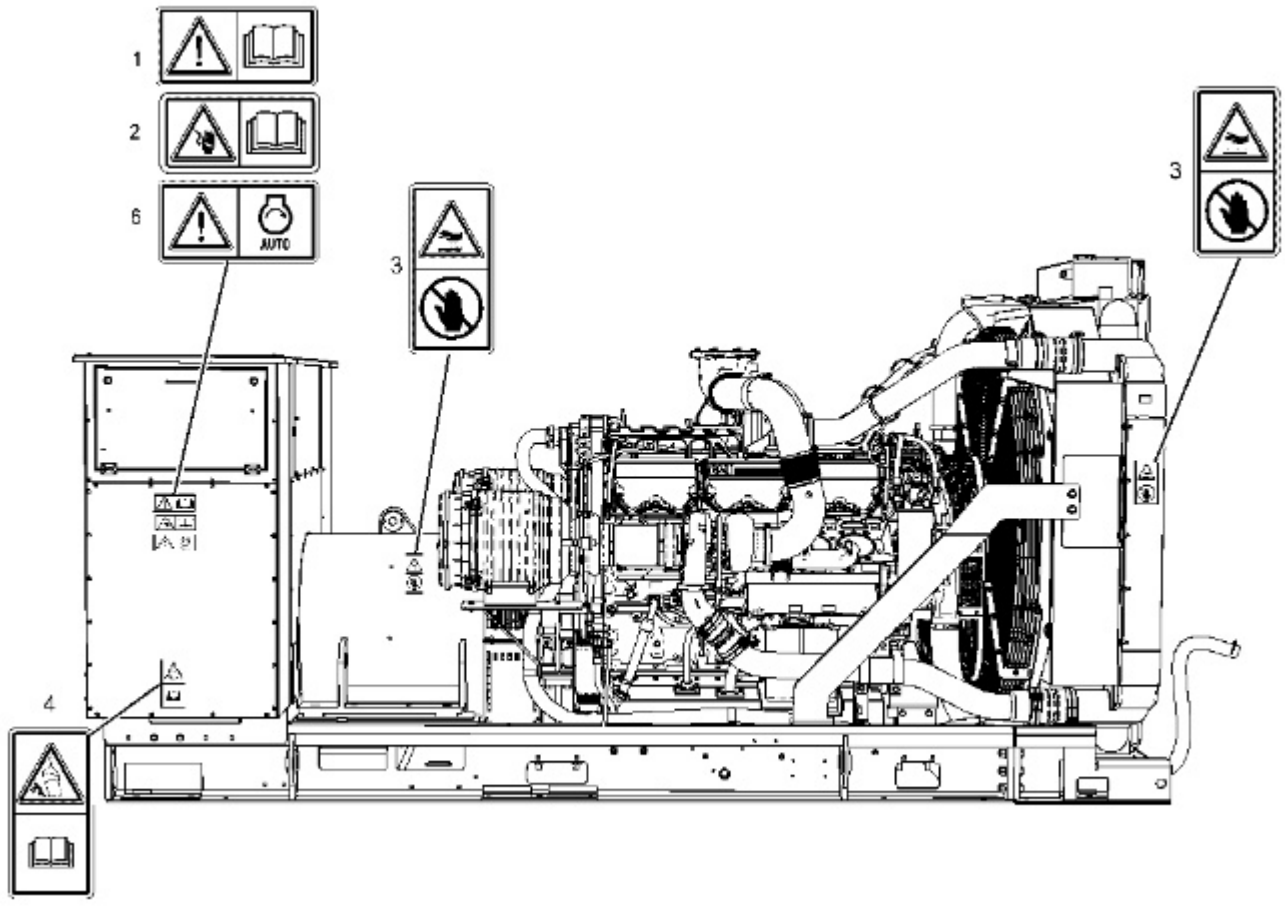


Illustration 1 g03792717

**Operation and Maintenance Manual**
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i05264116

# Battery Charger - Check

**SMCS -** 1401-535

# Checking Before Start-Up

Check the battery charger for proper operation. If the batteries are properly charged, the needle of the ammeter will register near "0" (zero).

The battery charger must not produce excessive current during start-up. Alternatively, the charger must be automatically disconnected for start-up. If the engine has an alternator, the charger must be automatically disconnected during start-up and during engine operation.

## Charging the Battery

**WARNING**

**Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operated. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can be the result.**

Perform the following procedure to charge the battery:

1. Ensure that the charger is turned OFF.
2. Adjust the voltage of the charger in order to match the voltage of the battery.
3. Connect the POSITIVE "+" lead of the charger to the POSITIVE "+" battery terminal. Connect the NEGATIVE "-" lead of the charger to the NEGATIVE "-" battery terminal.
4. Turn ON the battery charger.

### Overcharging of Batteries

Overcharging reduces the service life of batteries. Use a battery charger that will not overcharge the battery. DO NOT charge the battery if the meter of the battery charger is in the RED zone.

Overcharging is indicated by the following symptoms:

- The battery is warm to the touch.

- A strong odor of acid is present.
- The battery emits smoke or a dense vapor (gas).

Perform one of the following procedures if the battery shows symptoms of overcharging:

- Reduce the rate of charging by a significant amount. Complete the charging at the reduced rate.
- Turn OFF the charger.

Table 1 describes the effects of overcharging on different types of batteries.

Table 1

| Effects of Overcharging Batteries | |
|---|---|
| **Type of Battery** | **Effect** |
| Cat General Service Batteries<br>Cat Premium High Output Batteries | All of the battery cells have a low level of electrolyte. |
| | When the plates of the battery are inspected through the filler holes, the plates may appear to be warped. This is caused by an excessive temperature. |
| | The battery may not pass a load test. |
| Cat Maintenance Free Batteries | The battery may not accept a charging current. |
| | The battery may not pass a load test. |

## Checking After Stopping

Ensure that the battery charger is connected properly. Observe the meter of the charger. Record the amperage.

For additional information, refer to Special Instruction, SEHS9124, "Cleaning and Drying of Electric Set Generators".

## Recommended Periodic Insulation Test Procedure

**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.**

1. Take the generator out of service.
2. Visually inspect the generator for moisture. If moisture exists, do not perform this insulation test. Dry the unit first. Refer to Special Instruction, SEHS9124, "Cleaning and Drying of Electric Set Generators".
3. Inspect the installation. Determine the equipment that will be tested by the **9U-6003** Megohmmeter .
4. Discharge the capacitance of the windings.
5. Disconnect "T0" from ground.
6. Disconnect the regulator sensing lead wires: "20", "22" and "24".
7. Connect the megohmmeter RED lead to ground.
8. Connect the megohmmeter BLACK lead to "T0".
9. For units that are 600 V or less, set the voltage to 500 V. For units that are more than 600 V, set the voltage to 1000 V.
10. Use the 30/60 Time Resistance Method:
    a. Apply voltage.
    b. Observe the readings at 30 seconds. Observe the readings at 60 seconds.
    c. Record the 60 second reading. This reading must be corrected for temperature.
    d. Record temperature.
    e. Record humidity.
    f. Remove voltage.
11. Evaluate the readings. The actual value of the resistance may vary greatly between generators. For

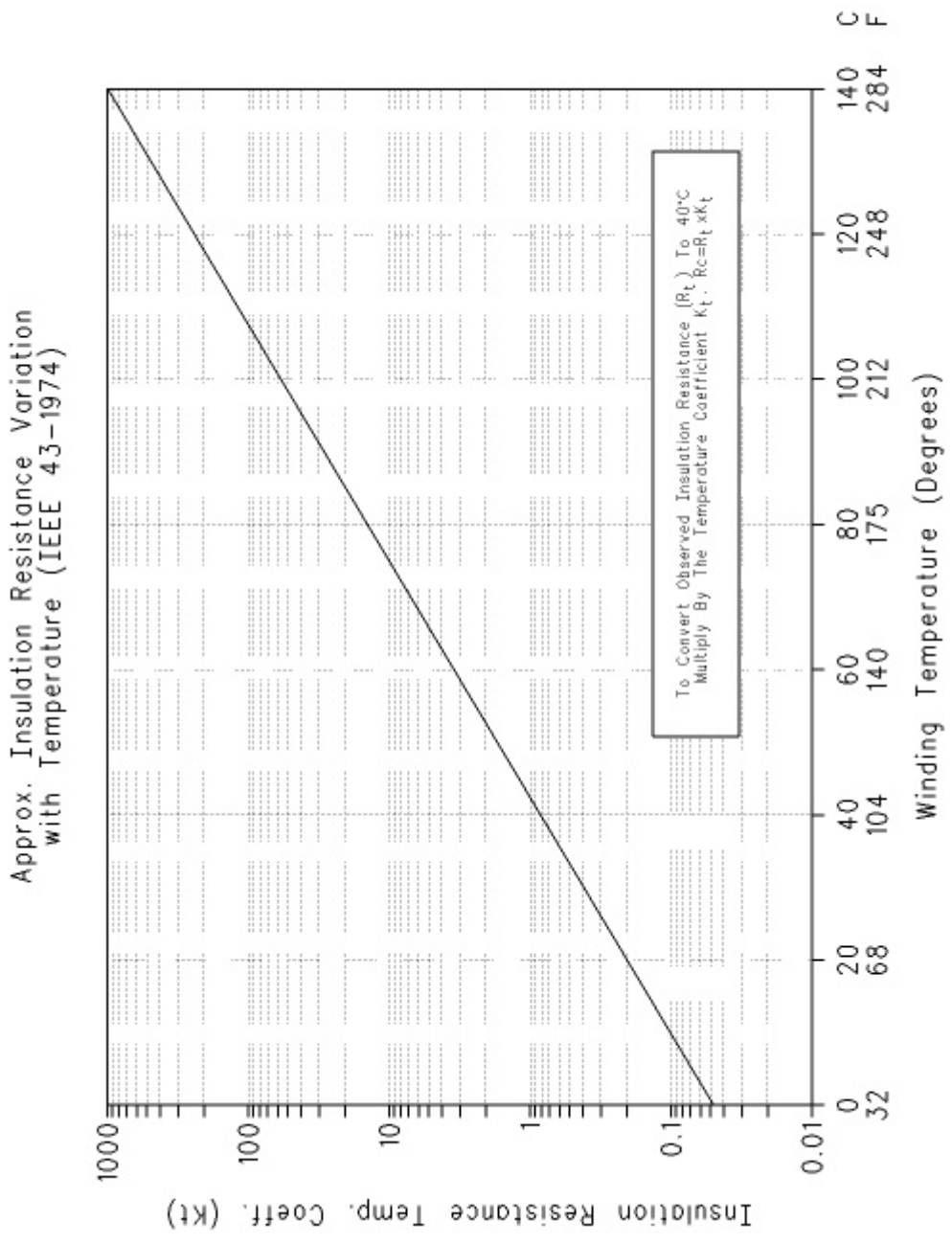
this reason, the insulation condition must be evaluated. Base this evaluation on the comparison between the 60 second resistance readings and the readings that were taken on previous dates. These two readings must be taken under similar conditions. If a 60 second resistance reading has a 50% reduction from the previous reading, the insulation may have absorbed too much moisture.

Switch the megohmmeter to the "OFF" position. This position will discharge the megohmmeter leads. Disconnect the megohmmeter leads.

**Note:** The results from the insulation resistance checks indicate when cleaning and/or repairing is becoming critical. Generally, insulation resistance will vary greatly with temperature. Therefore, always test at the same temperature and humidity. Refer to Illustration 1.

Engine Serial Number

Generator Serial Number



| Diesel Engines | |
|---|---|
| ABS | Agco-Sisu |
| Akasaka | Baudouin |
| BMW | Bukh |
| Caterpillar | CHN 25/34 |
| Cummins | Daihatsu |
| Detroit | Deutz |
| Doosan-Daewoo | Fiat |
| Ford | GE |
| Grenaa | Guascor |
| Hanshin | Hatz |
| Hino | Honda |
| Hyundai | Isotta |
| Isuzu | Iveco |
| John-Deere | Kelvin |
| Kioti | Komatsu |
| Kubota | Liebherr |
| Lister | Lombardini |
| MAK | MAN B&W |
| Mercedes | Mercruiser |
| Mirrlees BS | Mitsubishi |
| MTU | MWM |
| Niigata | Paxman |
| Perkins | Pielstick |
| Rolls / Bergen | Ruggerini |
| Ruston | Scania |
| Shibaura | Sisu-Valmet |
| SKL | Smit-Bolnes |
| Sole | Stork |
| VM-Motori | Volvo |
| Volvo Penta | Westerbeke |
| Wichmann | Yanmar |

| Machinery | |
|---|---|
| ABG | Airman |
| Akerman | Ammann |
| Astra | Atlas Copco |
| Atlas Weyha. | Atlet |
| Bell | Bendi |
| Bigjoe | Bobcat |
| Bomag | BT |
| Carelift | Case |
| Caterpillar | Cesab |
| Challenger | Champion |
| Claas | Clark |
| Combilift | Crown |
| Daewoo-Doosan | Demag |
| Deutz-Fahr | Dressta |

| Machinery | |
|---|---|
| Drott | Dynapack |
| Extec | Faun |
| Fendt | Fiat |
| Fiatallis | Flexicoil |
| Furukawa | Gehl |
| Genie | Grove-gmk |
| Halla | Hamm |
| Hangcha | Hanix |
| Hanomag | Hartl |
| Haulpack | Hiab |
| Hidromek | Hino truck |
| Hitachi | Hyster |
| Hyundai | IHI |
| Ingersoll-rand | JCB |
| JLG | John-Deere |
| Jungheinrich | Kalmar |
| Kato | Kioti |
| Kleeman | Kobelco |
| Komatsu | Kramer |
| Kubota | Lamborghini |
| Landini | Liebherr |
| Linde | Link-belt |
| Manitou | Massey-Ferg. |
| Mccormick | MDI-Yutani |
| Mitsubishi | Moxy |
| Mustang | Neusson |
| New-Holland | Nichiyu |
| Nissan | OK |
| OM-Pimespo | others-tech |
| Pel-Job | PH-mining |
| Poclain | Powerscreen |
| Same | Samsung |
| Sandvik | Scania |
| Schaefer | Schramm |
| Sennebogen | Shangli |
| Shibaura | Steiger |
| Steinbock | Steyr |
| Still | Sumitomo |
| Super-pac | Tadano |
| Takeuchi | TCM |
| Terex | Toyota |
| Valpadana | Venieri |
| Versatile | Vogele |
| Volvo | Weidemann |
| Wirtgen | Yale |
| YAM | Yanmar |

SEBU7845-13

# Operation and Maintenance Manual

## 3508B, 3512B, 3512C, 3516B and 3516C Auxiliary Engines, Generator Set Engines, and Generator Sets

**S/N: S2B1-UP (3508B engine)**
**S/N: S2H1-UP (3512B engine)**



*Use the bookmarks for navigation inside of the manual*

CATERPILLAR®

**Operation and Maintenance Manual**
**3508B, 3512B, 3512C, 3516B and 3516C Auxiliary Engines, Generator Set Engines, and Generator Sets**

**Media Number -SEBU7845-13** **Publication Date -01/04/2014** **Date Updated -29/04/2014**

# 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.**

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# Safety Messages

**SMCS -** 1000; 7405

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

Ensure that all of the safety messages are legible. Clean the safety messages or replace the safety messages if the words cannot be read or if the illustrations are not visible. Use a cloth, water, and soap for cleaning 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 of 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.

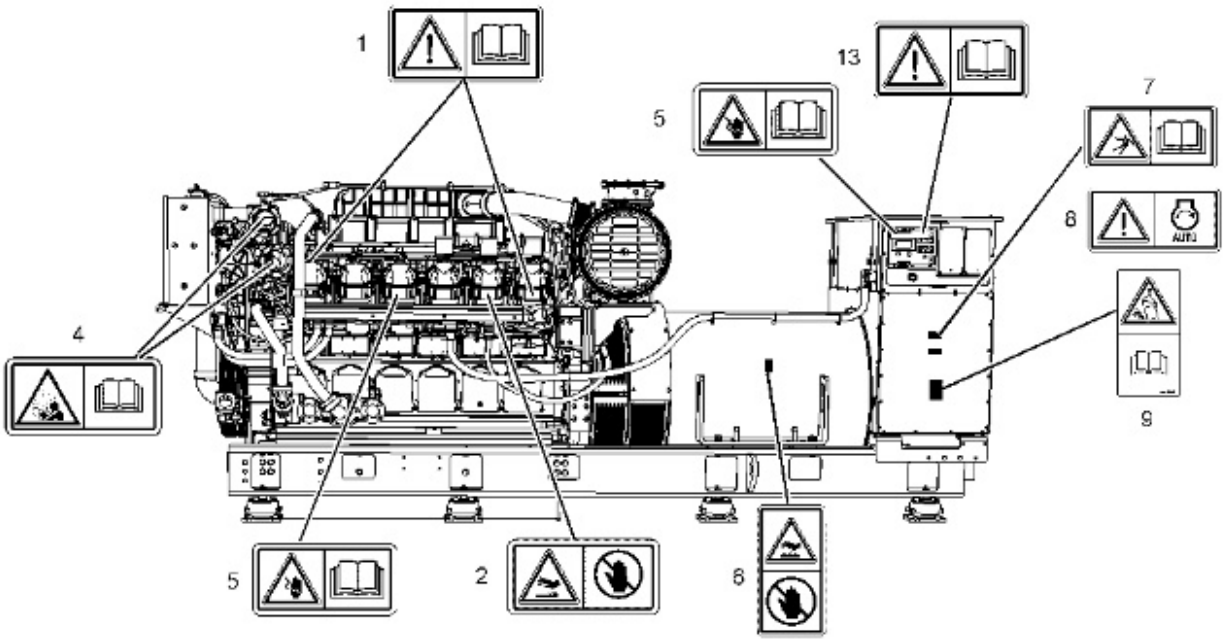


Illustration 1 g01917673

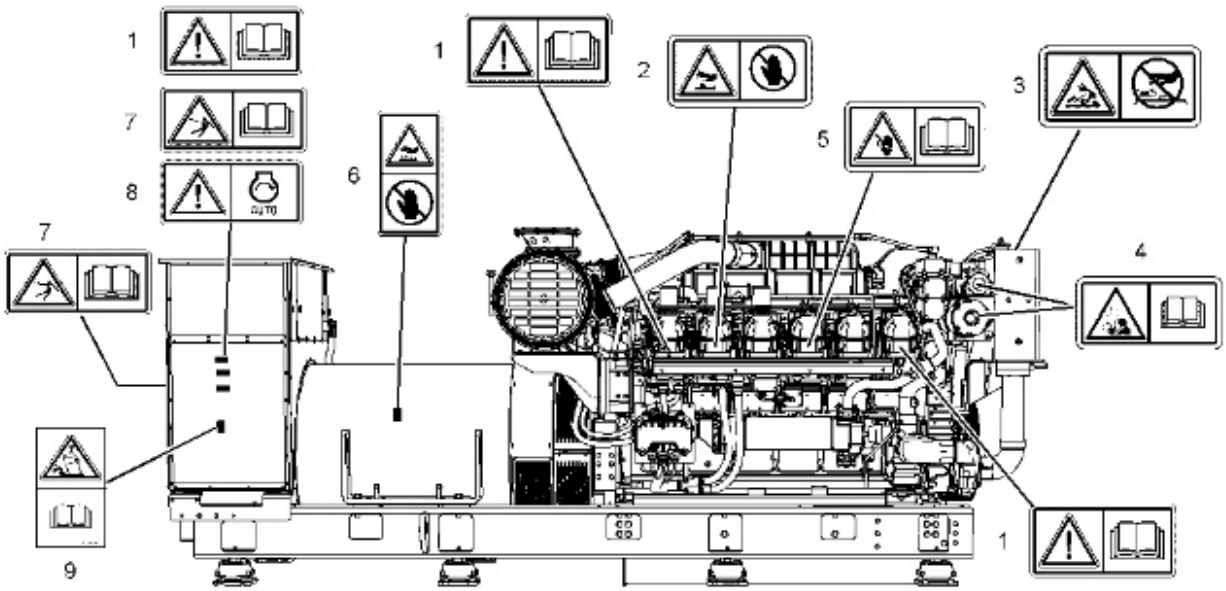


Illustration 2 g01931433

### Universal Warning (1)

The universal safety message is located on the cylinder heads at the front and rear of the engine.

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# Air Shutoff - Test - Engines That Are Equipped with ADEM II or ADEM III Engine Control Modules

**SMCS** - 1078-081

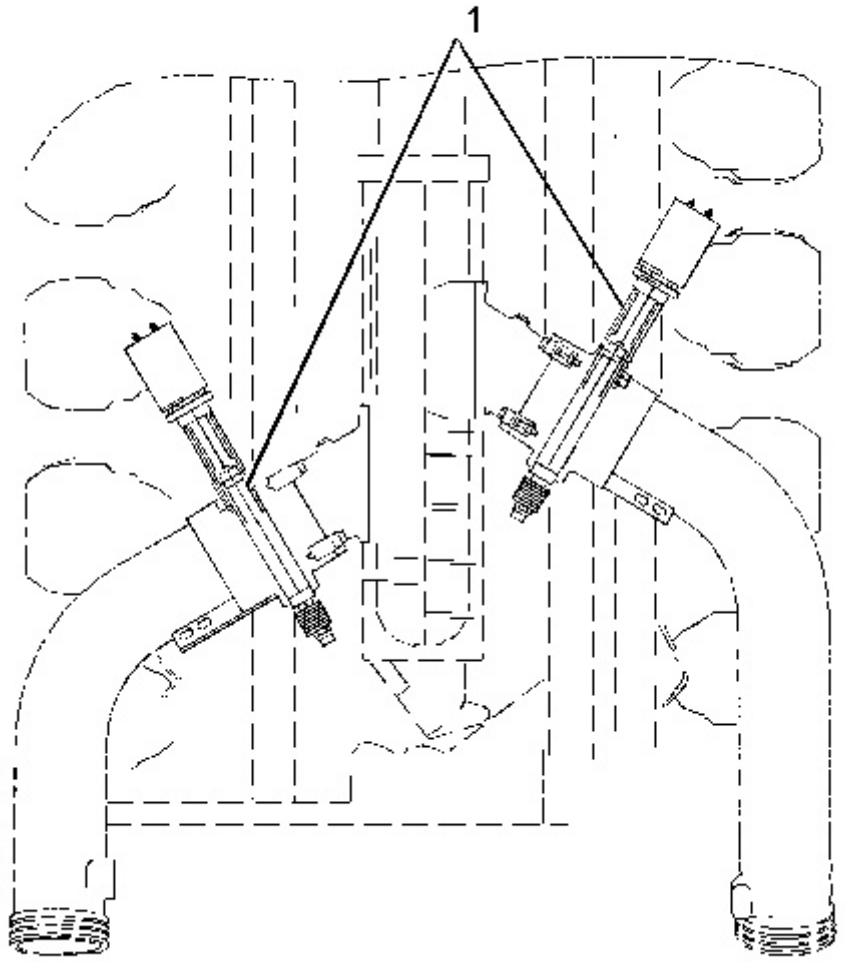


Illustration 1 g01285348

Typical air shutoffs on a 3500B engine

(1) Air shutoffs

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# Rotating Rectifier - Check

**SMCS** - 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.

# Testing a Three-Diode Rectifier Block

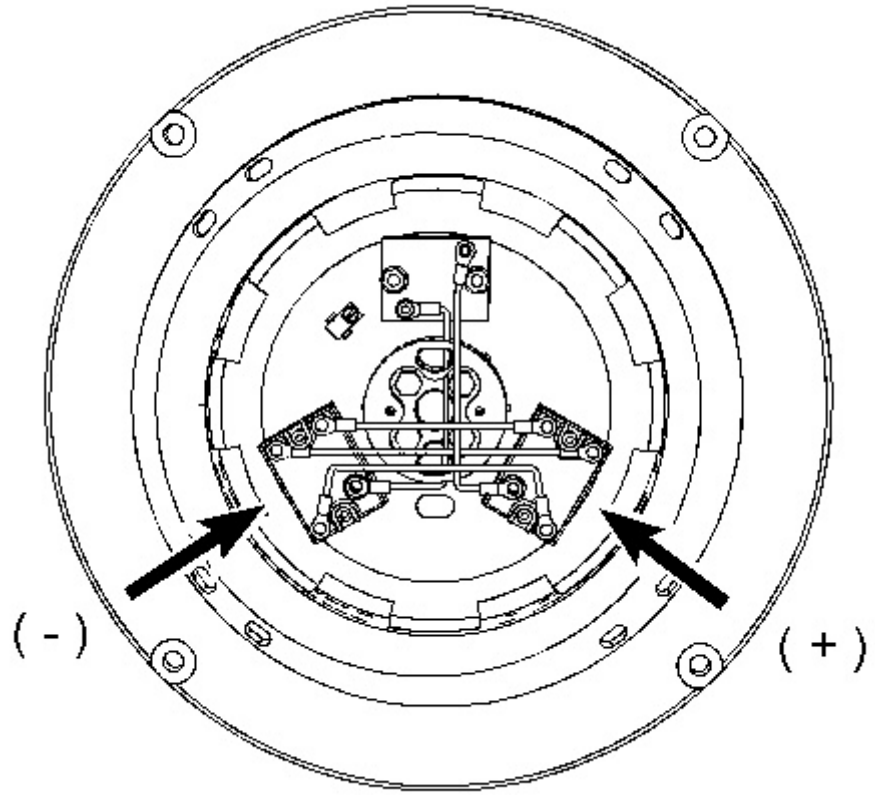


Illustration 1 g01933975

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# Glossary

**SMCS** - 4450

**Actuate** - Actuation relates to putting something in motion.

**Alternating Current (AC)** - Alternating Current is an electric current that reverses direction at regular intervals. The intervals are (50 times per second in 50 Hz or 60 times per second in 60 Hz).

**Anode** - An anode is the positive end of a diode or an anode is the positive end of a rectifier.

**Blocking Rectifier** - A blocking rectifier permits direct current flow in only one direction.

**Bolted** - A bolted device uses a bolt to hold two or more parts together.

**Bridge** - A bridge is a circuit that is used to measure small quantities of current, voltage, or resistance.

**Bridge Rectifier** - A bridge rectifier is a circuit that is used to change alternating current (AC) to direct current (DC).

**Buildup** - A buildup is a gradual increase in voltage.

**Cathode** - A cathode is the negative end of a diode or a cathode is the negative end of a rectifier.

**Capacitance** - Capacitance is the ability to store an electrical charge.

**Capacitor** - A capacitor is a device that will store an electrical charge.

**Circuit Breaker** - A circuit breaker is an automatic switch that is used to open a circuit.

**Circulating Current** - Circulating current is the flow of current between two or more generators that are working in parallel. Circulating current is also the flow of current between two or more generators that are parallel with a utility line.

**Conduct** - Conducting relates to allowing the flow of current.

**Constant Voltage Regulation** - Constant Voltage Regulation is one of the two methods of voltage regulation. In order to maintain the line voltage, Constant voltage regulators allow the field to be forced to the saturation point. This process allows the engine to be overloaded. On large block load applications, the engine may not recover.

**Continuity** - Continuity provides a path for current flow.

**Control** - A control is a device that controls another device. A control is also a circuit that controls a device.

**Cross Current Compensation** - Cross current compensation is a method that is used for reactive power equalization.

**Current Transformer (CT)** - A current transformer is used to step down higher line current.

**Direct Current (DC)** - Direct current is current flow that moves in only one direction in a given circuit.

**Damping** - Damping refers to decreasing the amplitude of a signal.

**DEAC** - Diesel Engine Antifreeze/Coolant

**De-energized** - A de-energized input refers to stopping the current that is going to a component.

**Distribution Winding** - Distribution windings go from one end of the core to the other end of the core. These windings are arranged in groups that are located in several slots.

**Droop** - Droop refers to a decrease.

**Excitation** - Excitation is controlled direct current (DC) that is used to make a magnetic field.

**Energized** - An energized input refers to activating a device.

**Electrostatic Charge** - Electrostatic charge is electricity that is caused by induced voltage and stored charge.

**Exciter** - An exciter supplies direct current (DC) to the field windings of the generator.

**Field** - A field is a magnetic line of force that surrounds a conductor. This force is caused by current flow in the conductor.

**Field Windings** - Field windings are many turns of wire that are wrapped around an iron core. When direct current (DC) flows through the field windings, a magnetic field is produced. This magnetic field is comparable to the magnetic field of a bar magnet.

**Flashing** - Flashing is a process of putting direct current from an external source into the field windings. This process causes the generator to produce an output voltage.

**Flux** - Flux is magnetic lines of force.

**Frequency** - Frequency is the number of cycles that are completed in a one second period. The unit of frequency is the Hertz (Hz). 1 Hz is equal to 1 cycle per second.

**Full-Wave Rectifier** - A full-wave rectifier changes the positive phase and the negative phase of alternating current to direct current.

**Gain** - Gain relates to the ratio of input magnitude to output magnitude.

**Gate** - A gate is an electronic part of a controlled rectifier (thyristor).

**Generate** - The production of electricity.

**Grounded** - A device is grounded by making a connection to ground. A device could also be grounded by making a connection to a component that is connected to ground.

**Hertz (Hz)** - Hertz is the unit of measurement for frequency. 1 Hz is equal to 1 cycle per second.

**Humidity** - Humidity is the water content that is present in the air.

**Impedance** - Impedance is the resistance to alternating current.

**Impulse Modulation** - Impulse modulation changes the following characteristics of a wave: amplitude, frequency and phase. Impulse modulation is accomplished by impressing one wave on another wave that has constant properties.

**Induce** - Induce refers to the transfer of power from one device to another device. The transfer is done via a magnetic field or via an electric field.

**Interference** - Interference is an unwanted mixture of electrical signals. Interference is associated with electrical noise.

**Internally Excited (IE)** - Is an excitation system based on two auxiliary windings integrated into the main stator winding suppling power to the voltage regulator only.

**Instrumentation** - Instrumentation is a group of instruments that are used for measuring a system function.

**Insulated** - An insulated device is a device that is covered with a nonconductive material.

**kVA** - Abbreviation for Kilovolt Amperes. kVA is a term that is used when electrical devices are rated. In order to calculate the kVA rating of a device, multiply the rated output (amperes) by the rated operating voltage.

**KVAR** - Kilovolt Amperes Reactive is abbreviated as KVAR. KVAR is associated with the reactive power that flows in a power system. Reactive power does not load the generator set engine. Reactive power will cause thermal loss in the generator.

**KVAR Regulation** - KVAR Regulation is one of the two methods that are used to regulate the reactive power output. Regardless of the generator real power output, the voltage regulator causes the generator to produce a constant value of KVAR. In this case, the power factor of the generator will change when the real power output changes. KVAR regulation is used when the generator is connected in parallel with an infinite bus (utility). KVAR regulation is used when changing the system voltage is not possible.

**Kilowatts (kW)** - Kilowatt is the electrical rating of the generator. 1 kW equals 1000 W. Actual power is measured in kilowatts.

**Lead** - A lead is a wire.

**Line Voltage** - Line voltage is the output voltage of the generator that is measured between the generator leads (phases).

**Lock In** - Lock in occurs when a contact closes in order to keep a device in an energized state.

**Lock Out** - Lockout occurs when a contact opens in order to keep a device in a de-energized state.

**Magnetic** - A magnetic device is a device that has the characteristics of a magnet.

**Magnification** - Magnification refers to the enlargement of an item.

**Module** - A module is an assembly of electronic components and electronic circuits.

**Moisture** - Moisture is the presence of water.

**Open Crankcase Ventilation (OCV)** - A method to remove oil mist from engine fumes, and return the liquid oil back to the pan. OCV uses a specific type of filter

**Oscillation** - Oscillation is the flow of electricity that periodically changes direction and/or magnitude.

**Permanent Magnet (PM)** - A permanent magnet supplies the initial magnetism that is required to start a PMPE generator.

**Permanent magnet pilot excited (PMPE)** - A PMPE generator receives power for the voltage regulator from a pilot exciter. A PMPE generator consists of a permanent magnet and a pilot exciter.

**PF Regulation** - PF Regulation is one of the two ways to regulate the reactive power output. PF regulation is used when the generator is connected in parallel with an infinite bus (utility). PF regulation is used when controlling the system voltage is not possible.

**Phase Winding** - A phase winding is a group of generator stator coils. Electric power for one phase of the load is induced in the phase winding.

**Polarity** - Polarity is the positive characteristics or the negative characteristics of two poles.

**Power Factor (PF)** - Power factor is the ratio of apparent power (kVA) to total power (kW). The power factor represents the portion of the current that is doing useful work. Power factor is expressed as a decimal number between 0 and 1.

**Pulsating** - Pulsating relates to the characteristics of current that are like mechanical vibration.

**Radio Suppression** - Radio suppression reduces the amplitude of radio frequency interference.

**Reactive Droop Compensation** - Reactive Droop Compensation is one of the two methods that are used for reactive power equalization. In reactive droop compensation, the voltage regulator causes an individual generator output to change in proportion to the reactive current. This reactive current is measured with a current transformer.

**Reactive Power** - Reactive power flows back and forth between the inductive windings of the generator. These windings are part of the electrical load. The reactive power does not perform any useful work in the electrical load. The reactive power only applies load to the generator. This limits the capacity of the generator .

**Reciprocating** - Reciprocating motion is motion that first moves in a straight line in one direction. The direction of this motion then varies by 180 degrees.

**Rectifier** - A rectifier is a diode circuit that converts alternating current (AC) to direct current (DC).

**Regenerative Power** - Regenerative power works against primary power.

**Reset** - A reset returns a switch to a ready condition. In addition, a reset returns a circuit to a ready condition.

**Residual Magnetism** - Residual magnetism is a small amount of magnetism that is remaining in a device after excitation is removed.

**RFA** - An RFA is a rotating field assembly.

**Rotating Rectifier** - A rotating rectifier is mounted to a plate on a generator shaft. This plate then rotates with the generator shaft.

**Rotor** - A rotor is the rotating windings of a generator.

**Saturable Reactor** - A saturable reactor has characteristics that are like a valve. As the load changes, a valve opens in order to give more current to the output. A valve closes in order to give less current to the output.

**Saturated** - A device has been saturated when the device has been magnetized in excess. When saturation occurs, a large increase in current results in a small increase in magnetic force.

**SCR** - An SCR is a silicon controlled rectifier. An SCR is a semiconductor.

**SE** - An SE generator is a self-excited generator. An SE generator uses a small part of the generator output to provide excitation current back to the generator. An SE generator uses residual magnetic field for start-up.

**Semiconductor** - A semiconductor is a component such as one of the following components: a transistor, a diode and a thyristor. Semiconductors have electrical characteristics that are between a conductor and insulation.

**Series Boost** - A series boost is an attachment that allows generator output to continue for a short time during a line failure. This process allows the circuit breaker to trip in sequence.

**Short** - A short is an undesired electrical connection that exists between two or more components.

**Shutdown** - A shutdown occurs when the engine is stopped. This shutdown can occur manually or this shutdown can occur automatically.

**Simultaneous** - A simultaneous occurrence refers to two actions that happen at the same time.

**Solid-State** - A solid-state component is an electrical component that has no moving parts.

**Stator** - A stator is the windings of a generator that do not rotate.

**Surge** - A surge is a sudden increase in voltage or current.

**Tap** - A tap is a connection at the midpoint of a circuit. From this tap, power is taken from the circuit.

**Transfer** - A transfer refers to moving something from one point to another point. A transfer also refers to converting something from one state to another state.

**Transient Peak Voltage** - A transient peak voltage is a high voltage condition of limited duration.

**Turn-on** - When a device is turned on, the device is activated or the device is started.

**Varistor** - A varistor is a device that loses resistance as voltage increases.

**Voltage Droop Resistor** - A voltage droop resistor is a variable resistor. This resistor is used to control the change of voltage. The change of voltage can occur when a generator is paralleled with another generator. The change of voltage can also occur when the generator is paralleled with a utility.

**Voltage Level Rheostat** - A voltage level rheostat gives a range of control that is used when the voltage output level is adjusted.

**Voltage Regulator** - A voltage regulator is a circuit that senses the output voltage of the generator. The field coil current is automatically adjusted in order to maintain the desired output.

**Voltage Spike** - A voltage spike is a brief high voltage.

**Volts per Hertz Regulation** - Under block loading conditions, the Volts per Hertz Regulation provides fast recovery. This regulation maintains close voltage control over the normal load range. This regulation also produces a rapid response of the generator set. This control is maintained by matching the generator output to the engine performance.

**Windings** - Windings are layers of wire on a core.

**Wiring** - Wiring relates to the wires of a circuit.

**Wound** - Wound refers to being circled.

| Diesel Engines | |
|---|---|
| ABS | Agco-Sisu |
| Akasaka | Baudouin |
| BMW | Bukh |
| Caterpillar | CHN 25/34 |
| Cummins | Daihatsu |
| Detroit | Deutz |
| Doosan-Daewoo | Fiat |
| Ford | GE |
| Grenaa | Guascor |
| Hanshin | Hatz |
| Hino | Honda |
| Hyundai | Isotta |
| Isuzu | Iveco |
| John-Deere | Kelvin |
| Kioti | Komatsu |
| Kubota | Liebherr |
| Lister | Lombardini |
| MAK | MAN B&W |
| Mercedes | Mercruiser |
| Mirrlees BS | Mitsubishi |
| MTU | MWM |
| Niigata | Paxman |
| Perkins | Pielstick |
| Rolls / Bergen | Ruggerini |
| Ruston | Scania |
| Shibaura | Sisu-Valmet |
| SKL | Smit-Bolnes |
| Sole | Stork |
| VM-Motori | Volvo |
| Volvo Penta | Westerbeke |
| Wichmann | Yanmar |

| Machinery | |
|---|---|
| ABG | Airman |
| Akerman | Ammann |
| Astra | Atlas Copco |
| Atlas Weyha. | Atlet |
| Bell | Bendi |
| Bigjoe | Bobcat |
| Bomag | BT |
| Carelift | Case |
| Caterpillar | Cesab |
| Challenger | Champion |
| Claas | Clark |
| Combilift | Crown |
| Daewoo-Doosan | Demag |
| Deutz-Fahr | Dressta |

| Machinery | |
|---|---|
| Drott | Dynapack |
| Extec | Faun |
| Fendt | Fiat |
| Fiatallis | Flexicoil |
| Furukawa | Gehl |
| Genie | Grove-gmk |
| Halla | Hamm |
| Hangcha | Hanix |
| Hanomag | Hartl |
| Haulpack | Hiab |
| Hidromek | Hino truck |
| Hitachi | Hyster |
| Hyundai | IHI |
| Ingersoll-rand | JCB |
| JLG | John-Deere |
| Jungheinrich | Kalmar |
| Kato | Kioti |
| Kleeman | Kobelco |
| Komatsu | Kramer |
| Kubota | Lamborghini |
| Landini | Liebherr |
| Linde | Link-belt |
| Manitou | Massey-Ferg. |
| Mccormick | MDI-Yutani |
| Mitsubishi | Moxy |
| Mustang | Neusson |
| New-Holland | Nichiyu |
| Nissan | OK |
| OM-Pimespo | others-tech |
| Pel-Job | PH-mining |
| Poclain | Powerscreen |
| Same | Samsung |
| Sandvik | Scania |
| Schaefer | Schramm |
| Sennebogen | Shangli |
| Shibaura | Steiger |
| Steinbock | Steyr |
| Still | Sumitomo |
| Super-pac | Tadano |
| Takeuchi | TCM |
| Terex | Toyota |
| Valpadana | Venieri |
| Versatile | Vogele |
| Volvo | Weidemann |
| Wirtgen | Yale |
| YAM | Yanmar |