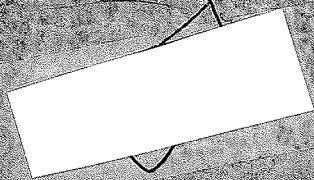


CATERPILLAR

SEBU5791-02



operation & maintenance

**3406 and 3406B
Industrial Engines**

90U1-UP

75Z1-UP

4TB1-UP




IMPORTANT SAFETY NOTICE

Most accidents involving engine operation 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.

Improper operation is dangerous and could result in injury or death.

READ AND UNDERSTAND ALL SAFETY PRECAUTIONS AND WARNINGS BEFORE OPERATING THIS ENGINE.

Basic safety precautions are outlined in the "Safety" Section of this Guide and in the description of operations where hazards exist. Warning decals have also been put on the engine to provide instructions and to identify specific hazards which, if not heeded, could cause bodily injury or death to you or other persons. These warnings in the Guide and on the engine decals are identified by the symbol 

Operations that may result only in engine damage are identified by CAUTION decals on the engine and in the Guide.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this Guide and on the engine are therefore not all inclusive. If an operation is not performed as specifically recommended by Caterpillar, you must satisfy yourself that it is safe for you and others. You should also ensure that the engine will not be damaged or made unsafe by the method of operation you choose.

WARNING

The proper and safe lubrication and maintenance procedures for this engine, recommended by Caterpillar, are outlined in the "Lubrication & Maintenance" Section of this Guide.

Improper performance of lubrication or maintenance procedures is dangerous and could result in injury or death. Read and understand the "Lubrication & Maintenance" Section before performing any lubrication or maintenance.

1730 Hours

Foreword

This guide contains operation instructions and lubrication and maintenance information.

The operation section is a reference for the new operator and a refresher for the experienced one. Read — study — and keep it handy.

Illustrations guide the operator through the correct procedures of checking, starting, operating and stopping the engine.

The maintenance section is a guide to equipment care. The illustrated, step-by-step instructions are grouped by servicing intervals. Topics without specific intervals are listed under "When Required." Topics in the "Lubrication and Maintenance Chart" are referenced to detailed instructions that follow.

Use the service meter to determine servicing intervals. Calendar intervals shown (daily, weekly, monthly, etc.) may be used instead of service meter intervals if they provide more convenient servicing schedules and approximate the indicated service meter reading.

Under extremely severe, dusty or wet operating conditions, more frequent lubrication than is specified in the "Lubrication and Maintenance Chart" may be necessary.

Perform service on topics at multiples of the original requirement. For example, at Every 500 Service Hours or 3 Months, also service those topics listed under Every 250 Service Hours or Monthly, Every 50 Service Hours or Weekly and Every 10 Service Hours or Daily.

Some photographs in this publication may show details or attachments that may be different from your engine.

Continuing improvement and advancement of product design may have caused changes to your engine which may not be covered in this publication. Each publication is reviewed and revised, as required, to update and include these changes in later editions.

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

Engine MOD. NO. 3406 PC

Engine Ser. No. 9049981

Generator Ser. NO. 48BH5234

Model SR4

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Table of Contents

Safety	2
Model Views	3
Before Starting	4
Starting the Engine	5
Operating the Engine	8
Stopping the Engine	10
Attachments	11
Maintenance Recommendations	18
Lubricants—Fuels—Coolants	19
Lubrication and Maintenance Chart	22
Refill Capacities	24
Every 10 Service Meter Units	25
Every 50 Service Meter Units	27
Every 125 Service Meter Units	29
Every 250 Service Meter Units	30
Every 500 Service Meter Units	34
Every 1000 Service Meter Units	37
Every 2000 Service Meter Units	38
When Required	44

Safety



THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY

To prevent personal injury, install guards over all exposed rotating parts.

Stop engine before adjusting or repairing engine of driven equipment.

Do not wear loose clothing whenever working around engines or machinery.

To prevent hearing damage, wear ear protective devices if working inside an enclosed engine room with engine running.

Wear protective glasses, clothing, hat, respirator or other protective items when necessary.

When using pressure air, wear protective face shield and clothing. Use 30 psi (20 kPa) maximum air for cleaning purposes.

Always inspect cooling system with engine stopped.

If equipped with jacket water cooling system, remove filler cap slowly to relieve pressure. Steam may cause personal injury.

Cooling system conditioner contains alkali, avoid contact with skin and eyes to prevent personal injury.

Do not smoke while refueling. Fumes from fuel are flammable.

Do not smoke when observing battery electrolyte level. Batteries give off flammable fumes.

Be sure engine room is properly ventilated.

Do not allow electrolyte solution to contact skin or eyes. Electrolyte solution is an acid.

Do not attempt repairs you do not understand. Follow instructions.

Replace or repair broken or damaged servicing equipment. Use proper tools.

Remove all tools, electrical cords and other loose items from the engine before starting.

Wipe up spilled oil, fuel or coolant.

Provide adequate and safe waste oil disposal.

Store oily rags in fireproof containers. DO NOT leave rags on engine.

Never store flammable liquids near the engine.

Insulate all electrical connections and disconnected wires.

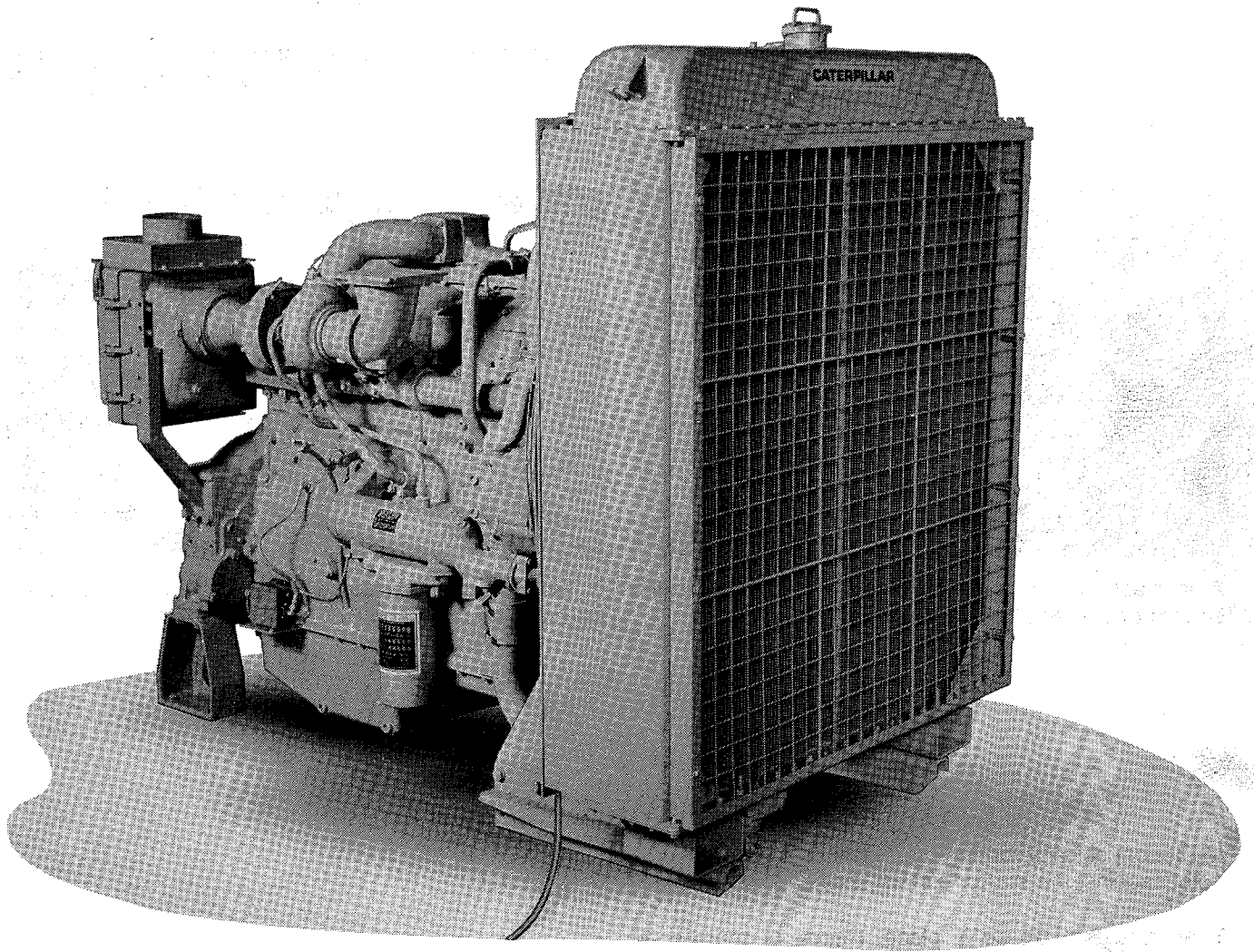
Disconnect and tape the battery ground lead before working on an engine to prevent accidental starting. Be sure an automatic start-stop system, if equipped, cannot operate and start the engine while working on it.

Never start an engine with the governor linkage disconnected.

When starting an engine after repair, make provisions for shutting off air supply, to stop engine, in case there is an overspeed on start up.

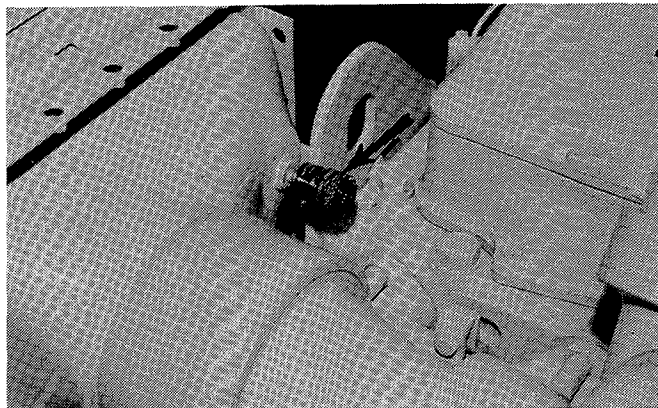
Always disconnect the engine starter circuit when working on the generator.

Model View



Before Starting

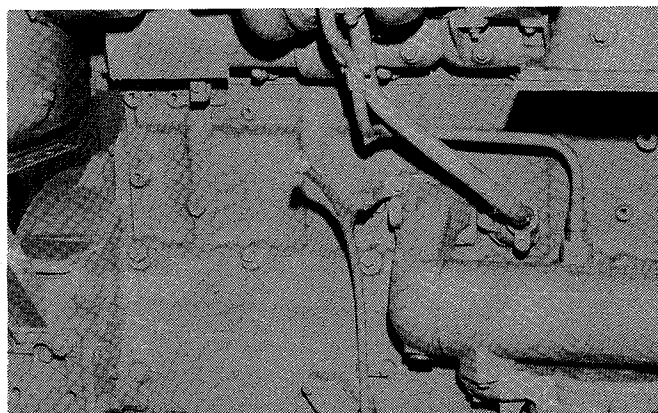
Perform required periodic maintenance before starting the engine. Make a "walk-around" inspection of the installation. It only takes a few minutes to correct minor discrepancies. This can prevent major repairs at a later date.



1. Inspect the air cleaner service indicator. If the red piston is locked in the raised position, service the air cleaner.



2. Inspect the coolant level. The level must be to the bottom of the radiator filler neck.



3. Measure the crankcase oil level. The oil level must be between ADD and FULL marks on the dipstick.

4. Disconnect any battery chargers that are not protected against the starter current drain.

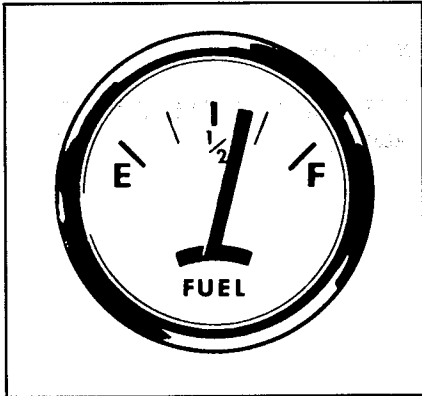
5. All guards must be in place. Repair or replace all guards that are damaged.

Starting the Engine

Gauges

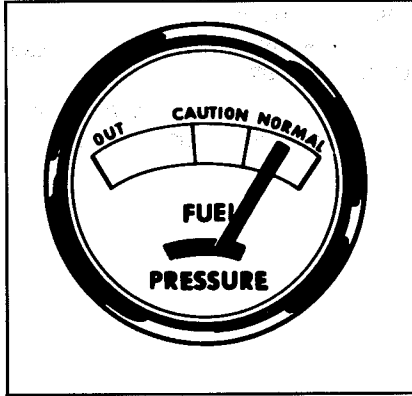
Gauges provide a "look" inside the engine. Be sure they are in good working order. You can determine what is "normal" operating range by observing the gauges over a

period of time. The cause of any sudden or significant change in the readings should be determined and corrected.



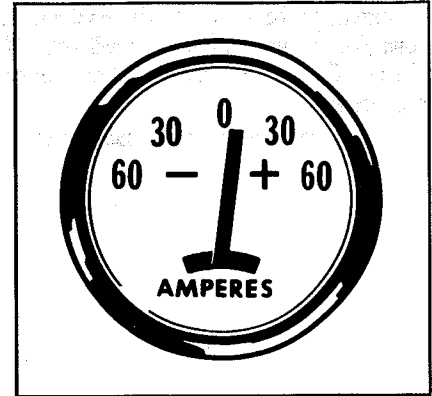
Fuel

Indicates the level of fuel in the tank. Electrically operated, it registers only when the key switch is ON.



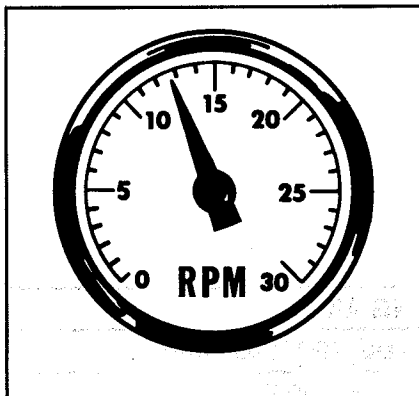
Fuel Pressure

Indicator should register in the NORMAL (green) range. When the filter element becomes clogged, the indicator moves to OUT (red) 20 psi (140 kPa). When indicator registers below 20 psi, wash the primary fuel filter and replace the secondary fuel filter element.



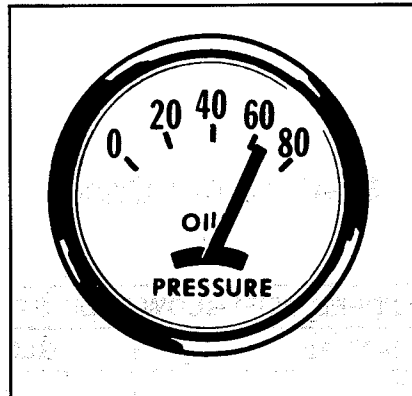
Ammeter

Indicates the rate of battery charge or discharge.



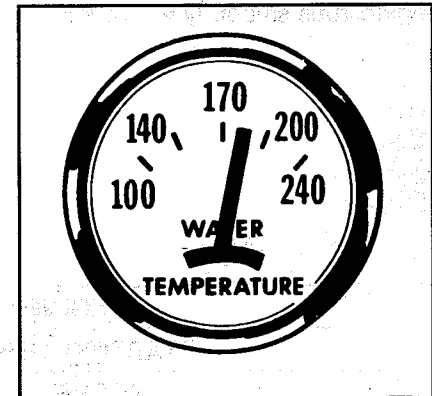
Tachometer

Indicates engine RPM.



Oil Pressure

Registers between 45 and 70 psi (310 and 480 kPa) when the engine is running at rated engine speed, with SAE 30 oil, at operating temperature. A lower pressure is normal at low idling speeds. If no pressure is indicated, stop the engine immediately.



Water Temperature

Normally registers between 170°F and 195°F (77°C and 90°C). Some-what higher temperatures may occur under certain conditions.

Starting the Engine

Engines Equipped With Glow Plug Starting Aid

WARNING

Starting fluid is volatile and must be stored away from heat and direct sunlight. If an aerosol container is used, follow the instructions on the container.

1. Remove the load from the engine.
2. Move throttle to low idle.
3. Turn the key switch to ON.
4. Turn the HEAT-START switch to HEAT or START, as indicated by the Starting Aid Chart.

5. After the indicated heat time, move the switch to the START position. If starting fluid is necessary, discharge the starting fluid capsule, or spray starting fluid into the air cleaner inlet. (If the engine fails to start within 30 seconds, release the starter switch. Wait 2 minutes to allow the starter motor to cool before using it again.)

6. As soon as the engine starts, allow the engine to idle 3 to 5 minutes or until the water temperature gauge has begun to rise. In cold temperature, turn the HEAT-START switch to the HEAT position until the engine runs smoothly at low idle.

7. Do not apply a load to the engine or increase engine speed, until the oil pressure registers on the gauge. (Oil pressure should raise to normal within 15 seconds after the engine starts.)

8. Operate the engine at low load until all systems reach operating temperatures. Check all gauges during the warm-up period.

Starting Aid Chart

ENGINES EQUIPPED WITH GLOW PLUG STARTING AID	
STARTING TEMPERATURE	GLOW PLUG HEATING TIME
ABOVE 60°F (16°C)	AS REQUIRED
BETWEEN 60°F AND 32°F (16°C AND 0°C)	1 MIN.
BETWEEN 32°F AND 0°F* (0°C AND -18°C)	2 MIN.
BELOW 0°F** (-18°C)	3 MIN.

*Use starting fluid sparingly if required.

**Heating of coolant and crankcase oil, use of starting fluid and/or use of extra battery capacity may be required.

Engines Not Equipped With Glow Plug Starting Aid

Caterpillar engines with direct injection (DI) are designed to start at temperatures above 10°F (-12°C) without using starting aids. If the temperature is below 10°F (-12°C), a starting aid may be necessary and/or crankcase oil may need to be heated. Jacket water heaters are often used to assist starting in cold temperatures.

1. Place the transmission in NEUTRAL (and disengage the flywheel clutch, if so equipped).
2. Do not apply the throttle when starting the engine.
3. Turn the starter switch to START. (If the engine fails to start within 30 seconds, release the starter switch. Wait 2 minutes to allow the starter motor to cool before using it again.)

4. As soon as the engine starts, allow the engine to idle for 3 to 5 minutes, or until the water temperature gauge begins to rise.

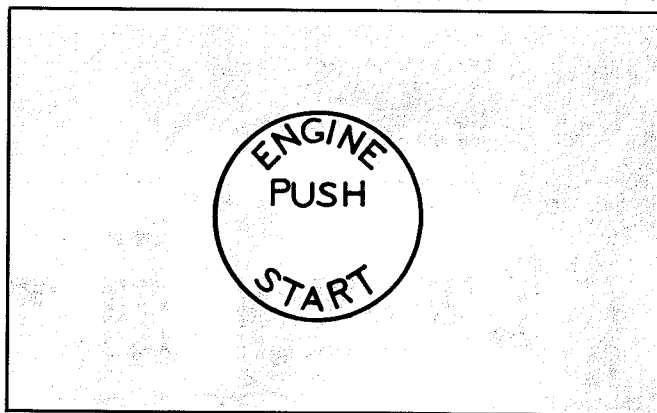
5. Do not apply a load to the engine or increase engine speed, until the oil pressure gauge indicates normal. (Oil pressure should raise within 15 seconds after the engine starts.)

6. Operate the engine at low load until all systems reach operating temperatures. Check all gauges during the warm-up period.

Air Start

1. Perform all of the electric starting preliminary checks.

2. Check the air supply. There must be 100 psi air pressure available.



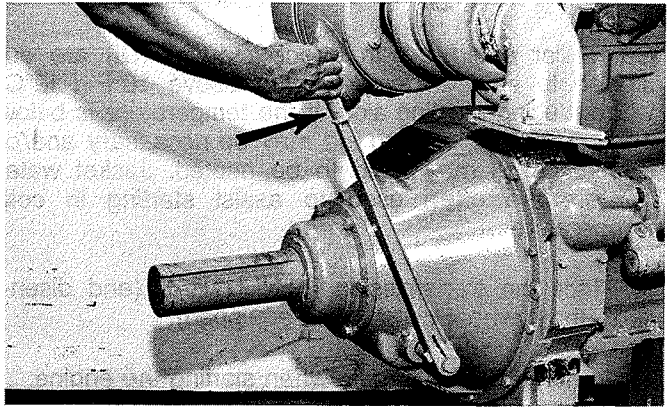
3. Push the Engine Start button in.

4. As soon as the engine starts, allow the engine to idle for 3 to 5 minutes, or until the water temperature gauge begins to rise.

Operating the Engine

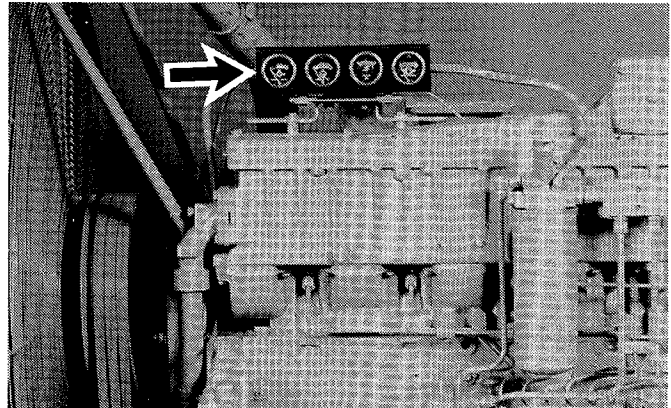
Driven Equipment Without Load

1. Move the governor control to half engine speed.



2. Engage the driven equipment with no load on the equipment.

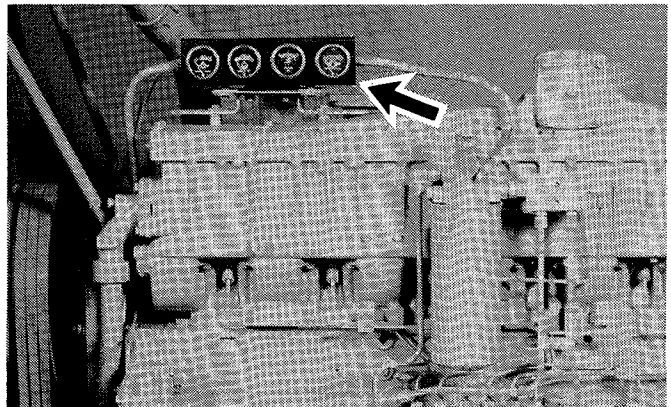
3. Move the governor control to high idle (full load).
4. Apply the load to the driven equipment.



5. Check the gauges.

Driven Equipment With Load

1. Move the governor control to half engine speed.
2. Move the governor control to high idle (full load).
3. Engage the loaded driven equipment.



4. Check the engine gauges.

Operating the Engine

Engine Operation

Full Load Operation

The governor control lever should remain in the full governed position while operating at full load.

Reduced Load Operation

If the load varies, or is cyclic, the governor usually will adjust the engine speed as required. If a slower constant speed is desired, move the governor control lever to desired speed position.

Prolonged operation at low idle or reduced load may cause oil consumption and carboning in the combustion chamber and result in poor performance and a loss of power. Every four hours, load the engine to clear carbon from the combustion chamber.

CAUTION

Be sure to increase engine speed before increasing the load.

No Load Operation

If the load is temporarily removed, engine speed may be reduced by manually moving the governor control. However, the engine may be operated at high idle without causing shortened engine life.

Stopping the Engine

CAUTION

Stopping the engine immediately after it has been working under load, can result in overheating and accelerated wear of the engine components. Follow the stopping procedure, outlined below, to allow the engine to cool. Excessive temperatures in the turbocharger centerhousing will cause oil coking problems.

1. Reduce engine speed to low idle.
2. Shift into NEUTRAL. On generators, open the main electrical circuit breaker.

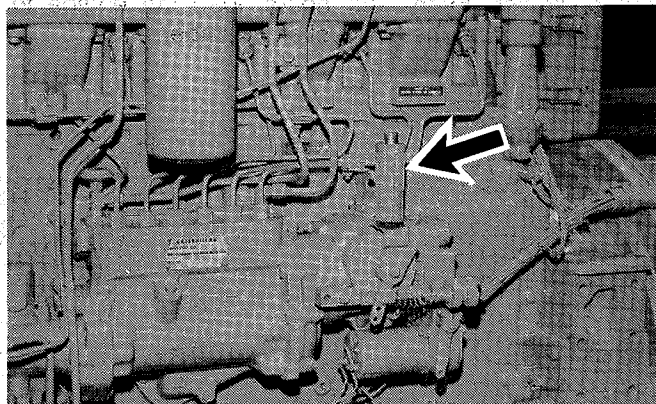
3. Increase engine speed to no more than half engine speed. Idle for at least five minutes to cool the engine.

4. Reduce engine speed to low idle.

5. Check the crankcase oil level while the engine is idling. Maintain the oil level between the ADD and FULL marks on the CHECK WITH ENGINE RUNNING side of the dipstick.

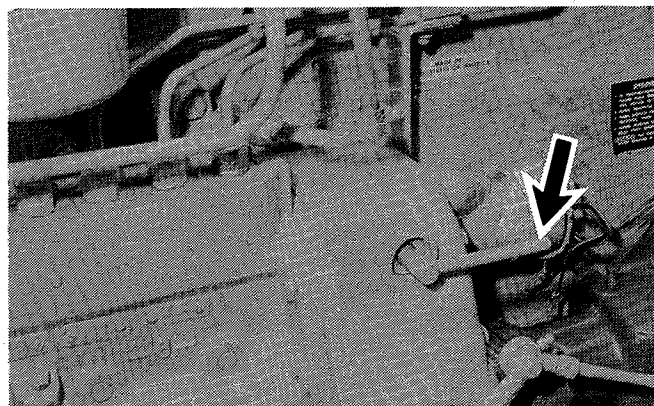
6. The engine may be stopped by using one of the following engine mounted controls:

To Stop the Engine:



Pull upward on the hand grip and move the control to the shutoff position.

Use the method below to stop your particular application.

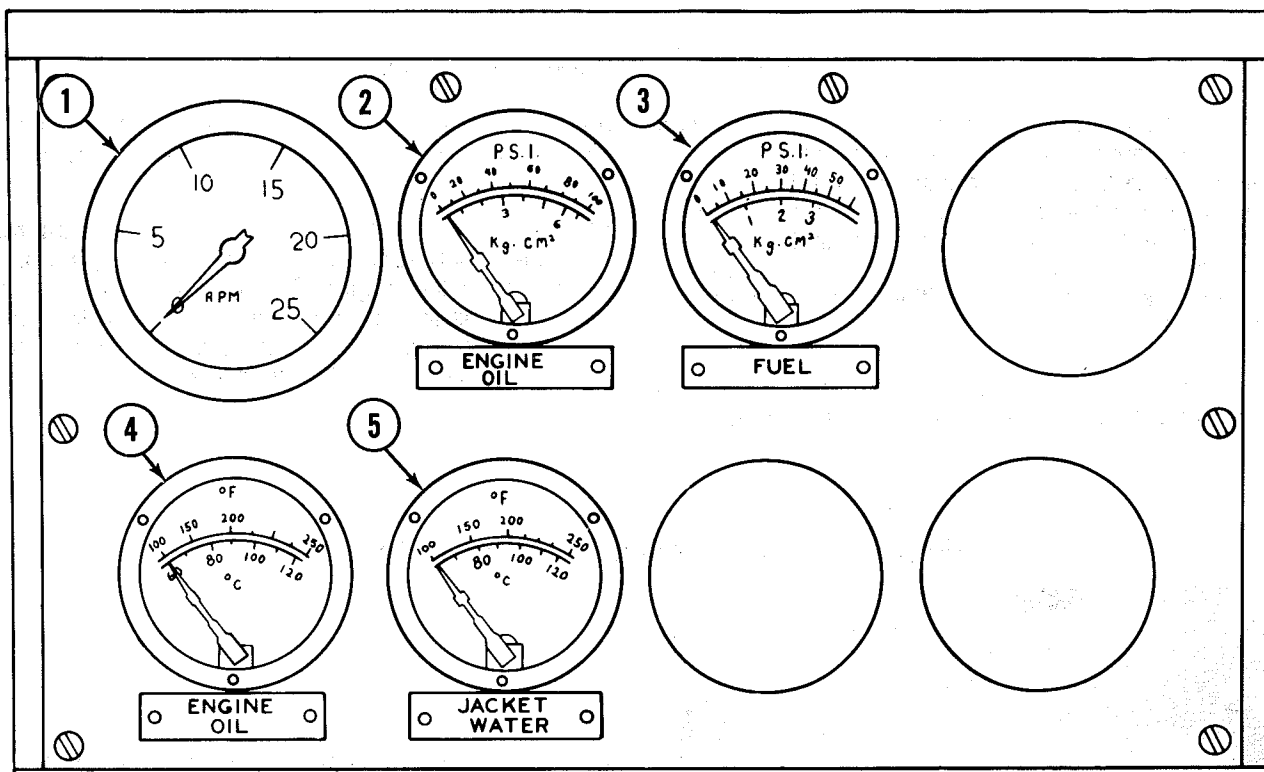


Move the lever forward against the stop; hold the lever in this position until the engine stops.

If a remote ON/OFF switch is used, move the switch to the OFF position.

Attachments

Premium Instrument Panel



1. Engine tachometer

2. Engine oil pressure

3. Fuel pressure

4. Engine oil temperature

5. Engine jacket water temperature

The tachometer ① monitors the engine RPM.

Oil pressure reading ② will be the greatest after starting the engine. Oil pressure will decrease as the engine warms while idling. As the engine speed is increased to the full load speed, oil pressure will increase into the NORMAL range and stabilize.

The fuel pressure gauge ③ indicates pressure of the filtered fuel. If the fuel filter gauge registers OUT, clean the primary fuel filter, if so equipped. Install new fuel filter elements.

The purpose of the oil is to lubricate all moving parts inside the engine and to cool (remove the heat from) the pistons, liners, and bearings. Gauge ④ indicates the engine oil temperature.

Gauge ⑤ monitors engine water temperature. This gauge may vary according to the load, but should never exceed the boiling temperature for the system being used.

Attachments

Emergency Shutoff Devices and Alarms

Alarms and Shutoff Devices

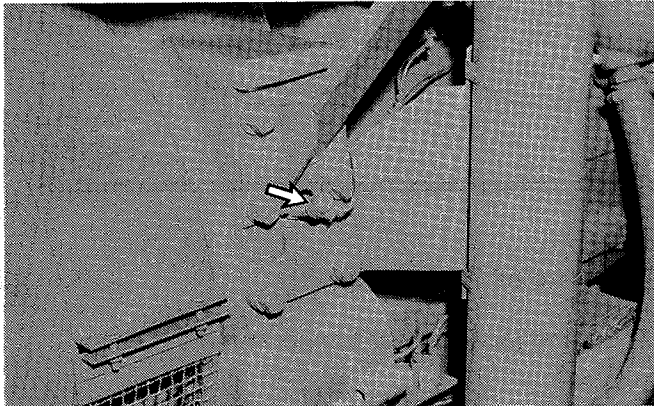
Alarm systems provide either an audible or a visual warning, or both, when certain abnormal operating conditions occur. These conditions can be low fuel supply, low oil pressure, or high engine coolant temperature. The alarm will be activated until the cause for the condition is corrected. The alarm sensor will then return to its normal position, and shut off the alarm circuit.

If no action is taken when the alarm is activated for lack of lubrication or coolant, the engine can be dam-

aged. To prevent this from occurring to unattended engines, shutoff devices should also be used.

At a slightly different temperature or pressure range than that which activates the alarm system, the shutoff device stops the engine. The Engine Failure Light on the control panel and one or more of the indicators will either light, or pop out to indicate the problem. Repairs must be made before starting is attempted.

Electronic Overspeed Shutoff Switch



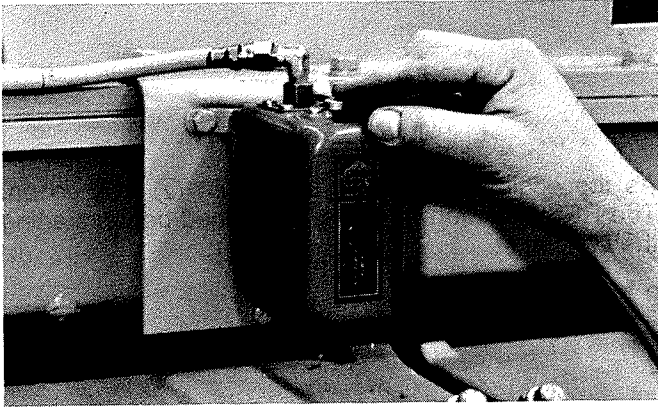
This switch uses a magnetic pickup mounted in the flywheel housing to sense engine speed.

Low Oil Pressure Shutoff Switch



This device is usually mounted on the side of the engine with oil lines connected to the switch. Low oil pressure closes the switch.

Attachments



Manually operated systems require resetting by pushing the button until it latches. After the engine starts and develops oil pressure, the oil pressure will push the button to the extended running position.

CAUTION

If the reset knob does not move to the extended position after the engine starts, the engine will not be protected by this switch.

If the button remains in the reset position, the engine oil pump is not developing normal oil pressure and a check should be made.

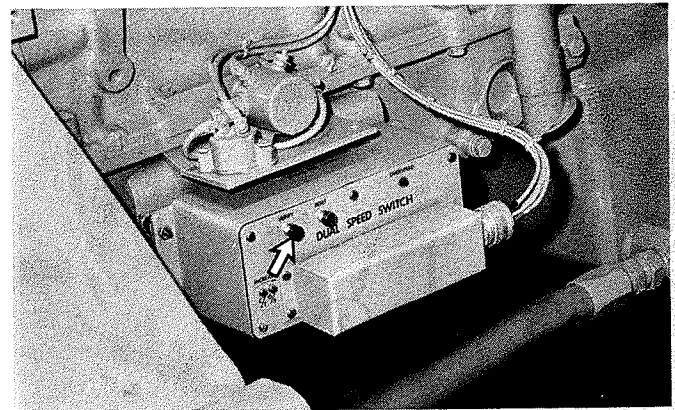
Automatic start-stop systems use a pressure switch which resets itself.

Overspeed Shutoff

Should the engine overspeed, the magnetic pick-up will close the circuit to the fuel shutoff solenoid and stop the engine.

The shutoff switch can be checked for proper operation at 75% overspeed condition:

1. Determine the full load RPM of the engine from the serial number plate.
2. Operate the engine at the speed shown in the OVERSPEED TEST RPM Column of the chart.



3. While maintaining test RPM, push and hold the VERIFY button. The engine should stop.

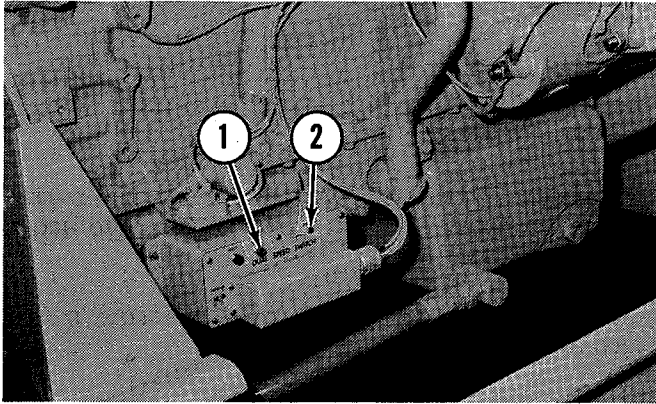
If the engine does not stop at the specified test RPM, contact your Caterpillar dealer.

OVERSPEED TEST		
FULL LOAD RPM	OVERSPEED TEST RPM	ACTUAL OVERSPEED RPM
1500	1328	1770
1800	1593	2124
2000	1770	2360
2200	1947	2596

The Overspeed Test RPM is slower than the Full Load RPM:

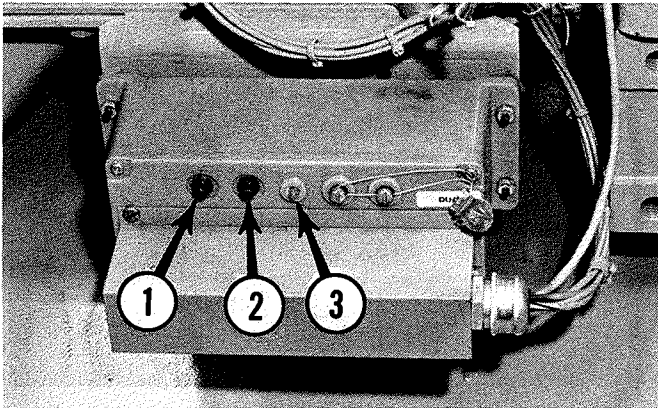
$$\text{FULL LOAD RPM} \times .885 = \text{OVERSPEED TEST RPM}$$

Attachments



As the engine stops, the yellow light ② will go on. The RESET button ① must be pushed before starting the engine.

Electronic Overspeed Shutoff Switch With Cranking Termination



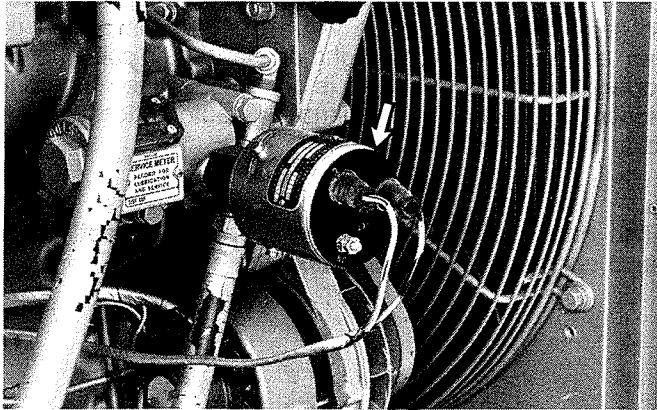
This switch has a 75% VERIFY button ①, a RESET button ② and an indicator light ③ similar to the speed switch. The operation of this portion of the switch is identical in all respects to the one just described.

In addition, this switch has a second sensing circuit. This prevents the starter pinion from remaining engaged in the flywheel at excessive RPM.

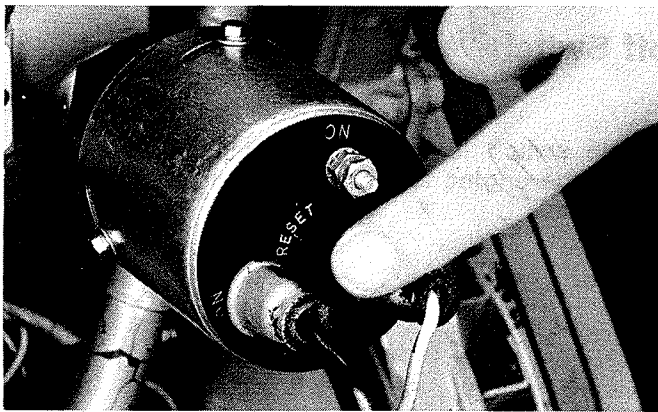
After the starting motor has cranked the engine, the pinion gear can remain engaged with the flywheel as engine speed increases. At 600 RPM, the magnetic pickup opens the circuit to the starter motor, which allows the pinion to disengage. The circuit remains open until the flywheel stops. This prevents energizing the starter motor again while the flywheel is turning.

Attachments

Overspeed Shutoff Switch (Electro-Mechanical)



This switch is mounted either on the tachometer drive or on the governor. Excessive engine speed closes the switch by centrifugal force.



To reset the switch, push the button marked RESET. The knob will remain down until the engine overspeeds.

Attachments

Alarm Switches

Alarm switches are set at a less critical temperature, pressure, or level limit than the comparable shutoff control. The alarm switch warns the operator that an unsafe operating condition is starting to occur. Corrective measures should be taken to avoid possible damage to the engine and/or a possible shutdown of the engine.

CAUTION

It could be hazardous to have the engine stop unexpectedly when engine power is needed. However, if the engine overspeeds, the engine must be stopped immediately.

When the preset temperature, pressure or fluid level occurs, the alarm switch will either turn on a light or an audible alarm. The light or alarm will continue to operate until the condition is corrected. When the condition is corrected the alarm will automatically reset and the light will turn off.

CAUTION

The cause of the shutdown must be investigated and corrected before starting the engine.

Alarm Shutoff Switch

A switch may be installed in the alarm circuit for silencing the alarm while the engine is stopped for repairs. Before starting be sure the switch is moved to the closed (ON) position and the warning lights are lit.

CAUTION

If the switch is left in the open (OFF) position when the engine is started, the engine will not be protected.

Testing Shutoff Devices and Alarms

Have all shutoff controls and alarms on the engine checked twice a year by your Caterpillar dealer.

only authorized personnel should conduct these checks.

It is important that these controls function properly. Their operating condition can only be checked by simulating extreme operating conditions under controlled testing procedures. To avoid damage to the engine,

Most control panels are equipped with a test switch. By turning the switch ON, all of the indicator lights can be checked for proper operation. Test the indicator lights periodically, replace burned out light bulbs immediately.

Attachments

Cranking Timer

There are two cranking timers which may be used on an Automatic Start-Stop generator set.

One type allows the engine to crank for 30 seconds. The second type cranks the engine up to 10 seconds

for as many as 5 successive starting attempts. If the engine does not start during the specified time period, the fuel will be shut off and a light will indicate a starting failure.

Cooling Timers

As the load is removed from the engine, the engine will continue to run for a period up to 5 minutes.

After the engine has cooled, the timer then stops the engine.

Engine Exerciser

At preset times, the exerciser will start, run and stop the engine. This ensures both proper lubrication of all engine parts and proper equipment operation when the standby unit is needed.

Become familiar with all instructions included with the equipment.

Maintenance Recommendations

Cooling

CAUTION

Never add coolant to an overheated engine; allow the engine to cool first.

Check specific gravity of antifreeze solution frequently in cold weather to assure adequate protection.

Coolant should be drained and replaced "Every 2000 Service Meter Units." With additions of Caterpillar Cooling System Conditioner or the use of Caterpillar Coolant Conditioner Elements as recommended, the drain period can be extended to Every 4000 Service Meter Units.

All water is corrosive at engine operating temperature. The cooling system should be protected with conditioner at all times regardless of concentration of antifreeze. This can be done by maintaining a 3% concentration of liquid Caterpillar Cooling System Conditioner or by using Caterpillar Coolant Conditioner Elements.

Never use both the liquid cooling system conditioner and coolant conditioner elements at the same time.

Do not use Caterpillar Cooling System Conditioner or Coolant Conditioner Elements with Dowtherm 209 Full-Fill coolant.

Whenever draining and refilling cooling system, always recheck the coolant level when the engine reaches normal operating temperature.

Filling at over 5 U.S. gallons (19 liters) per minute can cause air pockets in the cooling system.

Premix antifreeze solution to provide protection to the lowest expected ambient temperature. Pure undiluted antifreeze will freeze at -10°F (-23°C).

Operate with a thermostat in the cooling system all year-round. Cooling system problems can arise without a thermostat.

Electrical

CAUTION

When using jumper cables to start the engine, be sure to connect in parallel: POSITIVE (+) to POSITIVE (+) and NEGATIVE (-) to NEGATIVE (-).

When using external electrical source to start machine, turn disconnect switch off and remove key before attaching jumper cables. Insert key and turn disconnect switch on, before starting.

Scheduled Oil Sampling

Use Scheduled Oil Sampling to monitor the engines condition and maintenance requirements.

Each oil sample should be taken when the oil is hot, and well mixed, to insure a sample which is representative of the oil in the compartment.

Consult your Caterpillar dealer for complete information, and assistance in establishing a Scheduled Oil Sampling program for your equipment.

Fuel

CAUTION

Fill fuel tank at the end of each day of operation to drive out moisture laden air and to prevent condensation. Do not fill the tank to the brim. The fuel expands when it gets warm and may overflow.

Water and sediment should be drained from the fuel tank at the start of each shift or after the fuel tank has been filled and allowed to stand for 5 to 10 minutes.

Drain fuel tank of moisture and sediment as required by prevailing conditions.

After changing fuel filters, always bleed fuel system to remove air bubbles from system.

Air Intake

Check precleaner screen daily for accumulation of dust and debris.

Service air cleaners when RED band in indicator locks in visible position.

Lubricants—Fuels—Coolants

Lubricant Specifications

The abbreviations listed below follow S.A.E. J754 nomenclature. The classifications follow S.A.E. J183 classifications. The MIL specifications are U.S.A. Military Specifications. These definitions will be of assistance in purchasing.

Engine Oils (CD)

Use oils that meet Engine Service Classification CD (MIL-L-2104D) or CD/TO-2. Consult the "EMA Lubricating Oils Data Book," Form SEBU5939, for listing of CD oil brands.

Lubricating Grease (MPG)

Use Multipurpose-type Grease (MPG). NLGI No. 2 Grade is suitable for most temperatures. Use NLGI No. 1 or No. 0 Grade for extremely low temperatures.

Recommended Lubricant Viscosities										
For Use At Outside Temperatures From -30°C (-22°F) to $+50^{\circ}\text{C}$ ($+122^{\circ}\text{F}$)*										
Outside Temperature	$^{\circ}\text{C}$	-30	-20	-10	0	$+10$	$+20$	$+30$	$+40$	$+50$
Temperature	$^{\circ}\text{F}$	-22	-4	$+14$	$+32$	$+50$	$+68$	$+86$	$+104$	$+122$
Engine Crankcase CD	SAE SPC6W-20									
	SAE 6W-20									
	SAE 10W									
	SAE 10W-30									
	SAE 15W-40									
	SAE 30									
	SAE 40									
Outside Temperature	$^{\circ}\text{C}$	-30	-20	-10	0	$+10$	$+20$	$+30$	$+40$	$+50$
Temperature	$^{\circ}\text{F}$	-22	-4	$+14$	$+32$	$+50$	$+68$	$+86$	$+104$	$+122$

*When operating below -30°C (-22°F) refer to the Cold Weather Operation Guide, Form SEBU5898, available from your Caterpillar dealer.

Lubricants—Fuels—Coolants

Fuel Specifications

Types of Fuel

Caterpillar Engines have the ability to burn a wide variety of fuels. These fuels are divided into two general groups, Preferred and Permissible.

The Preferred Fuels provide maximum engine service life and performance. These are distillate fuels. They are commonly called fuel oil, furnace oil, diesel fuel, gas oil, or kerosene.

The Permissible Fuels are crude oils or blended fuels. Use of these fuels can result in high maintenance costs and reduced engine service life.

See Caterpillar Form Number SEHS7067 for a detailed summary of Preferred and Permissible Fuels and their specifications.

Cetane Requirement

The minimum cetane recommended for the engine:

1. (Precombustion Chamber Engine - 35 Cetane.)
2. (Direct Injection Engines - 40 Cetane.)

Fuel Cloud Point

Fuel waxing can plug the fuel filters in cold weather. The fuel cloud point must be below the temperature of the surrounding air to prevent filter waxing and power loss.

Fuel Sulfur Content

The percentage of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percentage of fuel sulfur (TBN as measured by the ASTM D-2896 method). Your oil supplier should be able to furnish the correct oils.

Coolant Specifications

Engine Coolant

Use a mixture of fill water antifreeze and conditioner.

Caterpillar Form Number SEBD0518 entitled "Know Your Cooling System" can provide more detailed specifications.

Fill Water

Always add conditioner to water. Never use plain water.

Acceptable water for use in the ethylene glycol-type antifreeze and water mixture is shown on the chart below:

Acceptable Water		
Water Content	50% Antifreeze 50% Water	Without Antifreeze
Chlorides	100 ppm or less	50 ppm or less
Sulfates	100 ppm or less	50 ppm or less
Hardness as CaCO ₃	200 ppm or less	100 ppm or less
Dissolved Solids	500 ppm or less	250 ppm or less
pH	6.5 or higher	6.5 or higher

ppm = parts per million

Antifreeze

Use ethylene glycol-type antifreeze. Use the correct amount to provide freeze protection to the lowest expected temperature.

Conditioner

Use Caterpillar Cooling System Conditioner or equivalent. Follow the instructions on the container.

On a new or reconditioned engine add 1 liter (1 quart) of Caterpillar Cooling System Conditioner, or equivalent, for each 30 liters (8 U.S. gallons) so that the cooling system will have a 3% to 6% concentration of conditioner.

If the engine is not equipped with spin-on Coolant Conditioner Elements, add .50 liter (1 pint) of Caterpillar Cooling System Conditioner for each 15 liters (4 U.S. gallons) of coolant used to maintain the 3% to 6%.

Cooling Conditioner Elements

Contact your Caterpillar dealer for the correct coolant conditioner element.

Lubrication and Maintenance Chart

Item	Service	Lubricant	Page No.
Every 10 Service Meter Units Or Daily			
① Engine Crankcase	Maintain level at FULL mark on dipstick	CD	25
② Fuel Tank	Drain moisture and sediment		25
③ Radiator	Inspect coolant level		25
④ Clutch Shift Collar	Lubricate 1 Fitting	MPG	26
⑤ Main Shaft Bearing	Maintain level at FULL mark on dipstick. DO NOT OVERFILL	CD	26
Every 50 Service Meter Units			
⑥ Zinc Rods	Replace rods if zinc is deteriorated		27
⑦ Batteries	Inspect electrolyte level.		
Every 125 Service Meter Units			
⑧ Shift Lever Bearings	Lubricate 2 Fittings	MPG	29
⑨ Pilot Bearing	Lubricate 1 Fitting	MPG	29
⑩ Main Shaft Bearing	Lubricate 1 Fitting	MPG	29
Every 250 Service Meter Units			
⑪ Engine Crankcase ⁽¹⁾	Change oil and filter		30
⑫ Alternator and fan drive belts	Inspect belt wear and adjustment		31
⑬ Fan Bearing	Lubricate 1 Fitting	MPG	34
⑭ Cooling System	Add conditioner or change filter element		34

Lubrication And Maintenance Chart

Item	Service	Lubricant	Page No.
Every 1000 Service Meter Units			
⑮ Woodward Governor	Lubricate 2 Fittings. Fill oil cup on top of motor	MPG	37
⑯ Protective Shutoff Control	Consult your Caterpillar dealer		37
⑰ Tachometer Drive	Lubricate 1 Fitting	MPG	37
Every 2000 Service Meter Units			
⑱ Engine Valve Lash	Measure valve lash		38
⑲ Cooling System	Change antifreeze solution		42
When Required			
⑳ Air Cleaner ⁽²⁾	Clean when RED band in indicator locks in visible position		44
㉑ Fuel System	Change filters when fuel gauge registers OUT with engine running		47
㉒ Fuel Tank	Drain water and sediment whenever engine misfires or frequent fuel filter replacement is required. Wash and oil filler cap		49
㉓ Cooling System	Drain and clean when engine overheats or solution is dirty		49
㉔ Air Starter	Fill the oiler jar—Empty the collector jar—Adjust the oiler feed		50
㉕ Power Coupling	Check adjustment—Adjust if necessary		51
㉖ Glow Plugs	Test glow plugs if a malfunction is suspected		52

(1) The percentage of sulfur in the fuel will affect the engine oil recommendations. If the fuel has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percentage of fuel sulfur (TBN as measured by the ASTM D-2896 method). Your oil supplier should be able to furnish the correct oils.

(2) The element can be cleaned approximately 4 times. Carefully inspect the element after each cleaning. If engine is not equipped with air cleaner service indicator, check element every 250 service meter units, or more often under dusty conditions. If after servicing the air cleaner, the exhaust smoke and/or loss of power continues, install a new element.

Refill Capacities (approximate)

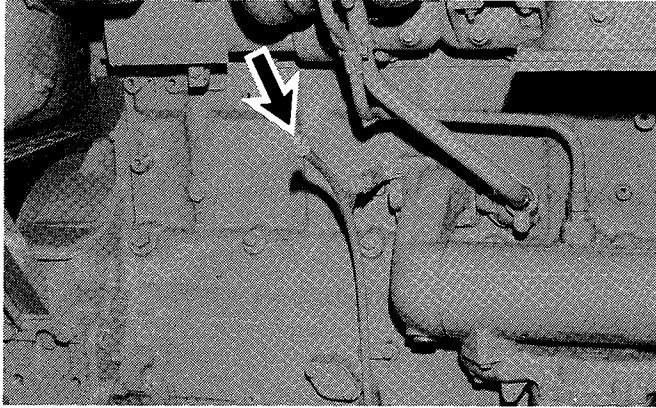
Approximate	U.S. Gal.	Im. Gal.	Liters
Cooling System	9.0	7.5	34.0
Engine Crankcase and Filter	9.0	7.5	34.0

Engine Specifications

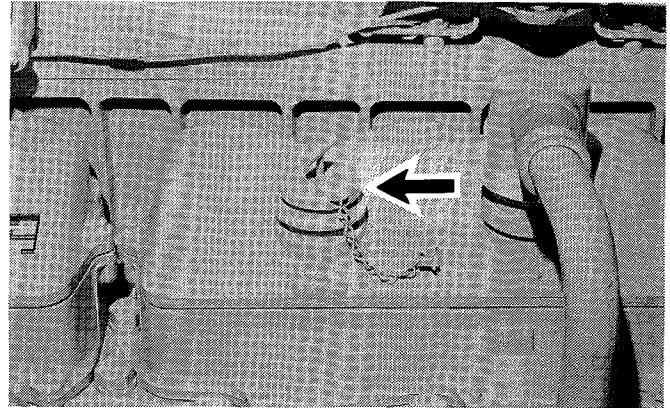
Number of Cylinders	6—in line
Bore	5.4 in. (137 mm)
Stroke	6.5 in. (165 mm)
Displacement	893 cu. in. (14.6 liters)
Firing Order	1-5-3-6-2-4
Rotation (viewed from flywheel)	Counterclockwise

Every 10 Service Meter Units or Daily

① Engine Crankcase



1. Measure the oil level with the engine running at low idle. The oil level must be between the ADD and the FULL marks on the dipstick.



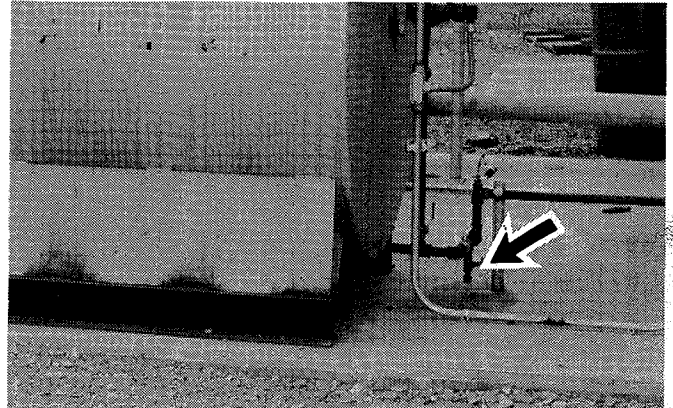
2. Add oil if necessary.

② Fuel Tank

CAUTION

Do not fill the tank to the top. Fuel expands when it gets warm and can overflow.

Fill the fuel tank at the end of the day to drive out moisture laden air.



Drain moisture and sediment from the fuel tank at the start of each shift or after the tank has been filled and allowed to stand for 5 or 10 minutes.

③ Radiator

⚠ WARNING

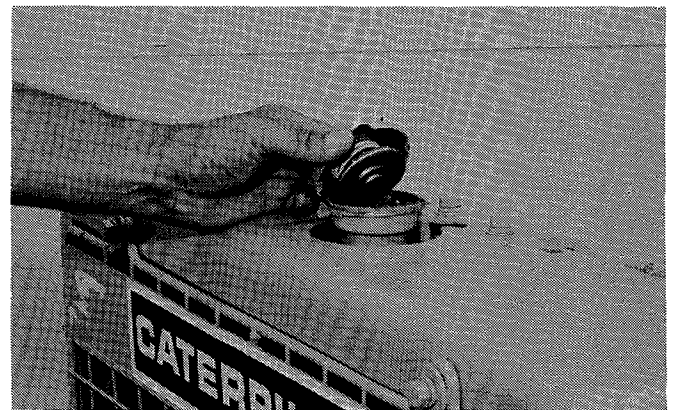
At Operating Temperature, engine coolant is hot and under pressure.

Steam can cause personal injury.

Check coolant level **ONLY** when engine is stopped and radiator cap is cool enough to touch with your hand.

Remove filler cap slowly to relieve pressure.

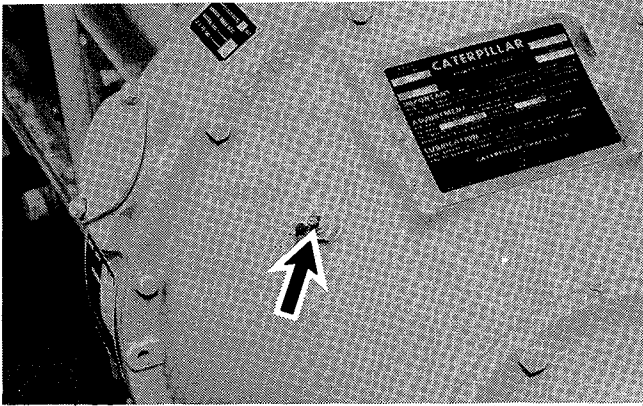
Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.



Inspect the coolant level. The level must be to the bottom of the filler neck.

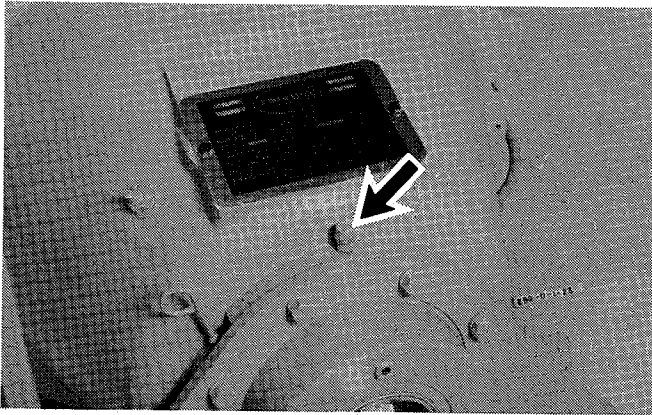
Every 10 Service Meter Units or Daily

④ Clutch Shift Collar



Lubricate 1 fitting.

⑤ Main Shaft Bearing - Heavy Duty Clutch With Oil Reservoir



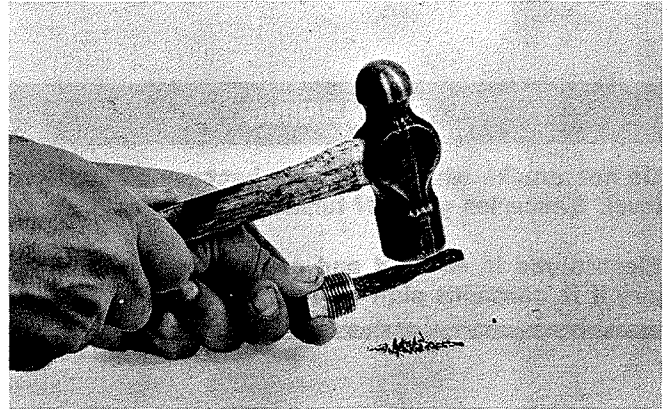
1. Measure the oil level with the engine stopped. Maintain the oil level at the FULL mark on the oil level gauge.

2. Add oil if necessary.

Every 50 Service Meter Units

⑥ Zinc Plugs - Salt Water Applications Only

1. Move the battery disconnect switch to the OFF position.
2. Remove all the zinc plugs. They are painted red for easy identification.



3. Tap the zinc rods lightly with a hammer. If the rod has deteriorated, or flakes when tapped, install a new zinc rod.

Installing New Zinc Rods



1. Unscrew or drill the existing rod from the plug base.
2. Install a new rod in the plug base.
3. Install the plug.

Every 50 Service Meter Units

⑦ Batteries

⚠ WARNING

Do not smoke when observing battery electrolyte level. Batteries give off fumes that can explode.

Electrolyte is an acid and can cause personal injury if it contacts skin or eyes.

1. Clean the top of the batteries and remove the fill caps. Observe electrolyte level.

2. Maintain the electrolyte level to the bottom of filler openings. Use distilled water.

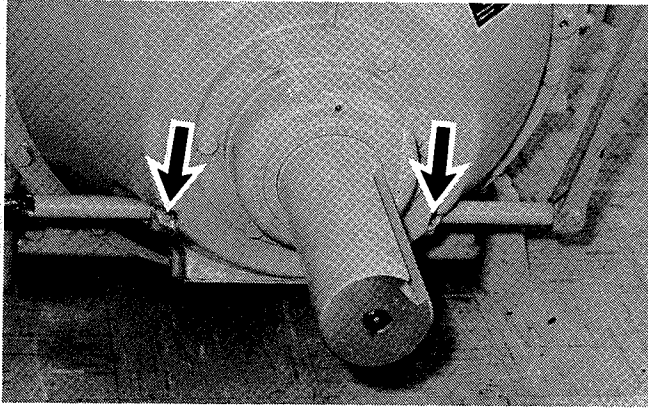


3. If the battery posts and cable clamps are corroded, clean them with a solution of baking soda and water.

4. Tighten the clamps and coat them and the battery posts with grease.

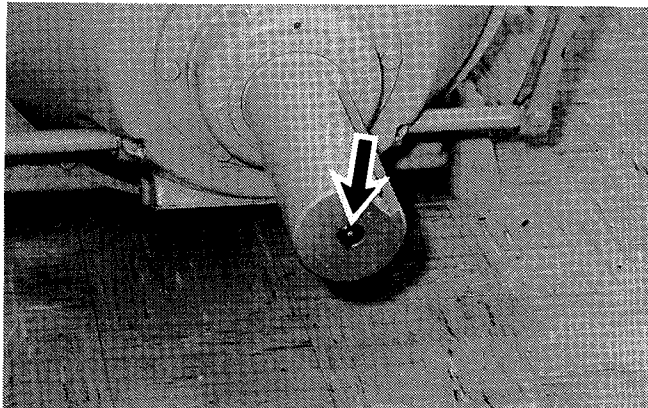
Every 125 Service Meter Units

⑧ Shift Lever Bearings



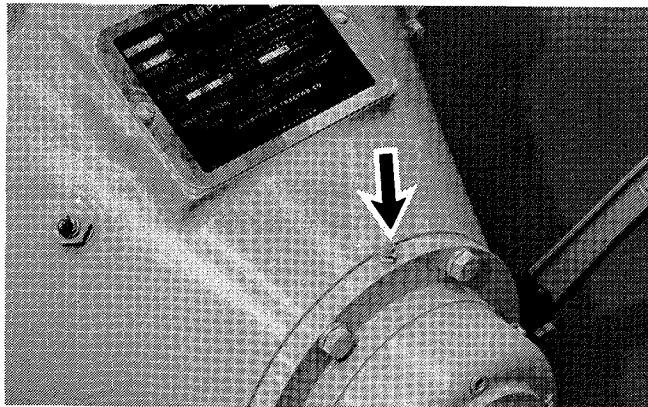
Lubricate 2 fittings; 1 fitting on each side of the clutch housing.

⑨ Pilot Bearing



Lubricate 1 fitting at the end of shaft.

⑩ Main Shaft Bearing



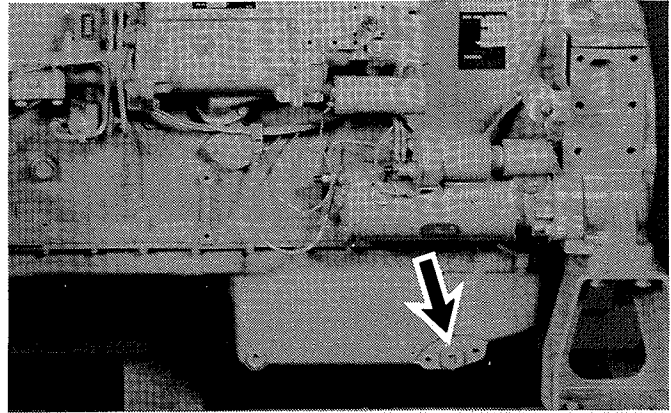
Lubricate 1 fitting on top-rear of housing.

Every 250 Service Meter Units

⑪ Engine Crankcase

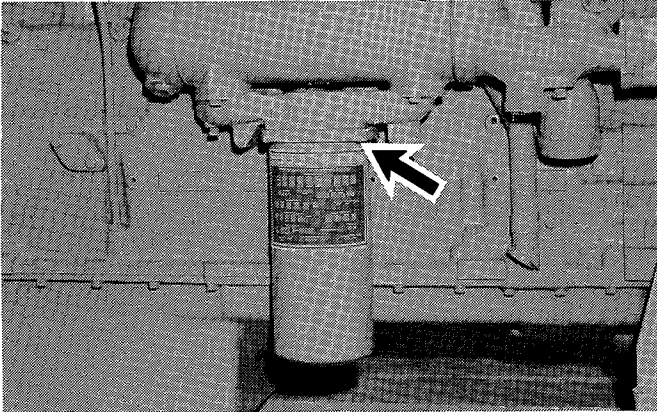
⚠ WARNING

Use caution when draining oil or changing filters. Hot oil or components can cause burns if they contact skin.

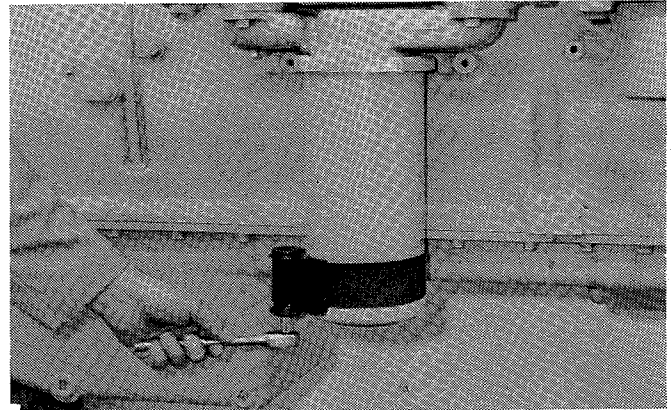


The engine must be stopped and the oil warm.

1. Remove the crankcase oil drain plug(s) and allow the oil to drain.



2. Wipe the dirt from the oil filter housing.

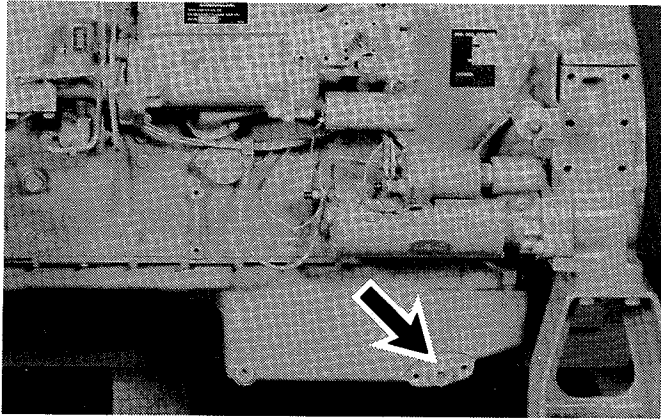


3. Remove and discard the filter.

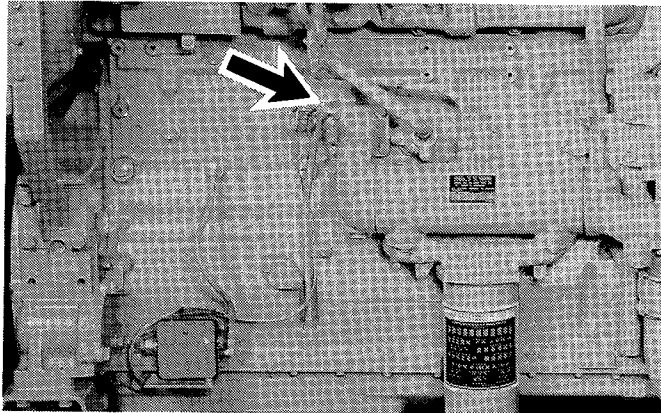
4. Clean the filter base. Make sure all of old gasket is removed.

5. Install the new filter. Hand tighten the filter an additional 3/4 turn after the gasket contacts the base.

When installing the new engine oil filter, coat the seal with a light coat of engine oil.



6. Clean the drain plug in clean non-flammable solvent and install it.



7. Fill the crankcase. See REFILL CAPACITIES.

8. Start and run the engine. Inspect for leaks. Reduce engine speed to low idle.

9. Maintain level to FULL mark on ENGINE RUNNING side of dipstick. Stop the engine.

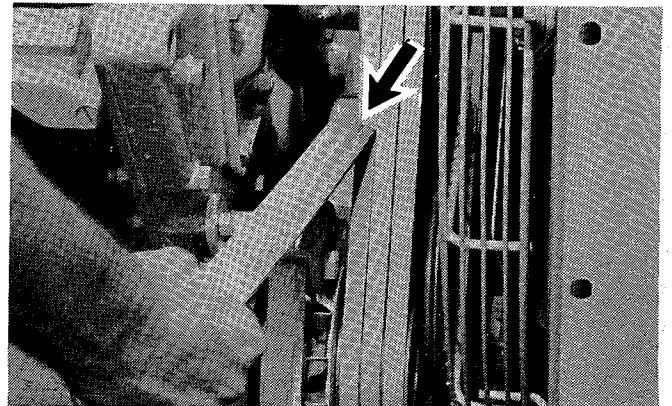
12 Alternator and Fan Drive Belts

1. Check the belts for excessive wear, fraying and cracking.

When belt replacement is necessary, belts must be replaced in complete matched sets. Never replace only one belt. The new belt will carry all the load and fail rapidly.

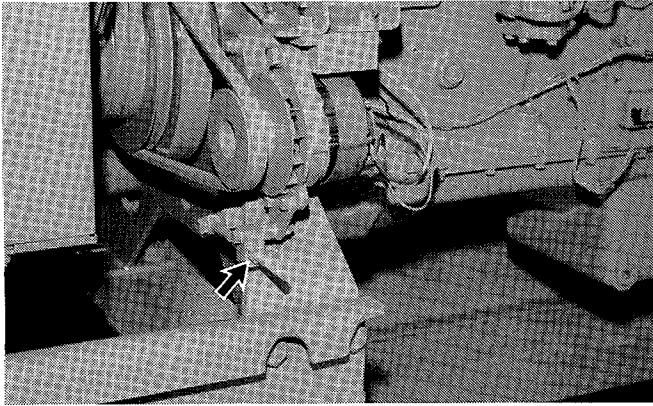
2. Apply a 25 pound (110 N) force to the belt, midway between the driving and driven pulley. Measure the belt deflection.

Proper belt deflection is 9/16 to 13/16" (14 to 20 mm). Adjust the belt tension as required.

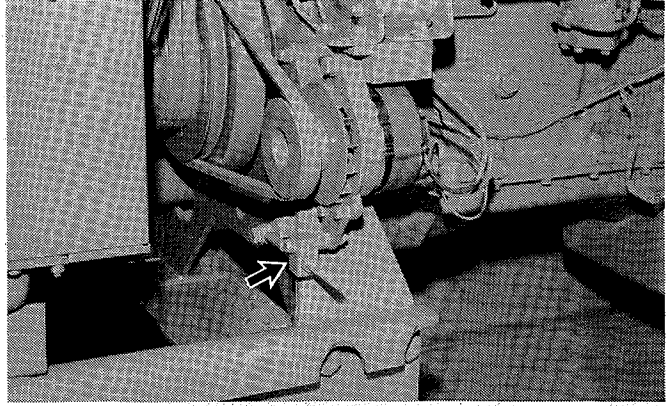


Every 250 Service Meter Units

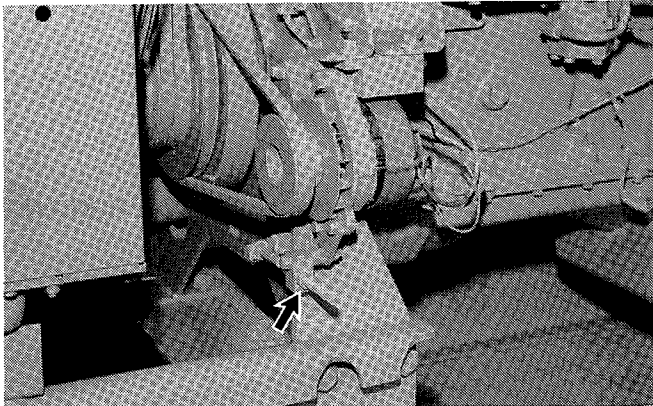
To Adjust Alternator Belts:



1. Loosen the locknut on the belt tightener rod.



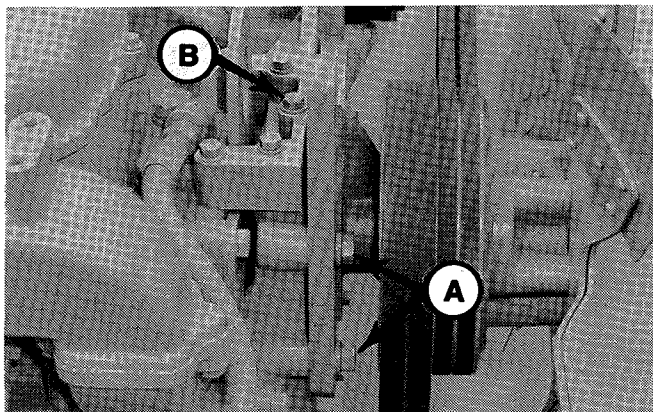
2. Turn the adjustment nut until correct belt deflection is obtained.



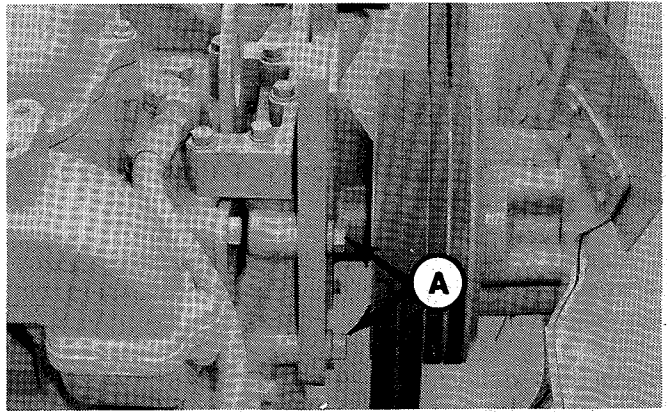
3. Tighten the locknut.

4. Check the belt adjustment.

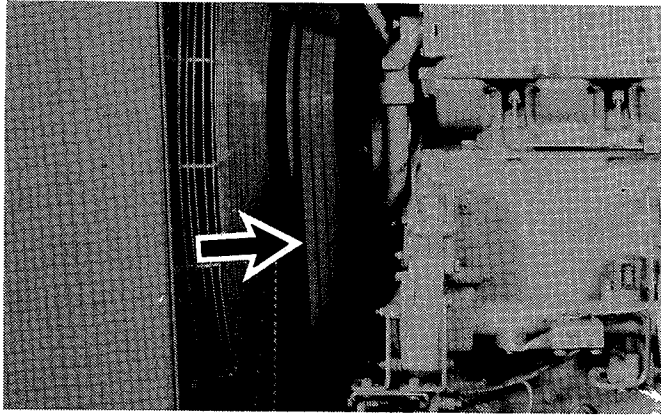
To Adjust Fan Drive:



1. Loosen the mounting bolts (A) and adjust with the adjusting bolt (B).



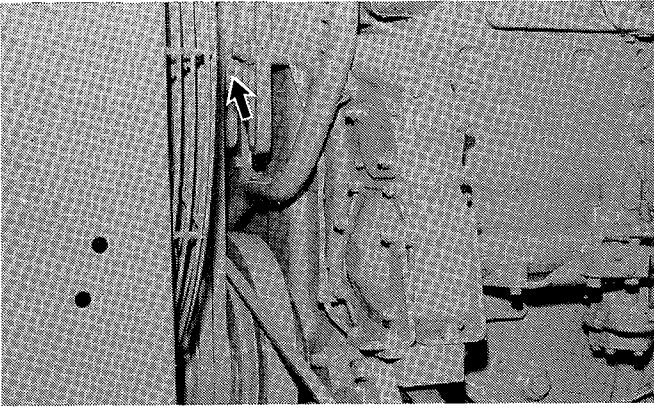
2. When properly adjusted, tighten the mounting bolts (A).



3. Check the belt adjustment.

Every 250 Service Meter Units

⑬ Fan Bearing



Lubricate 1 fitting.

⑭ Cooling System - If Not Equipped With Coolant Conditioner Element

WARNING

At Operating Temperature, engine coolant is hot and under pressure.

Steam can cause personal injury.

Check coolant level ONLY when engine is stopped and radiator cap is cool enough to touch with your hand.

Remove filler cap slowly to relieve pressure.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

CAUTION

All water is corrosive at engine operating temperature. Use either Caterpillar Cooling System Conditioner liquid, or the coolant conditioner element to treat either plain water or ethylene glycol anti-freeze solution. NEVER use both the liquid cooling system conditioner and the coolant conditioner element at the same time.

Do not use Caterpillar Cooling System Conditioner or Coolant Conditioner Elements with Dowtherm 209 Full-Fill coolant.



1. Loosen radiator cap slowly to relieve pressure, and remove filler cap.

It may be necessary, to drain enough coolant to allow for the addition of conditioner.

2. Add Caterpillar Cooling System Conditioner.
3. Inspect filler cap gasket. Replace if damaged.
4. Install radiator filler cap.

If Equipped With Coolant Conditioner Element

⚠ WARNING

At Operating Temperature, engine coolant is hot and under pressure.

Steam can cause personal injury.

Check coolant level ONLY when engine is stopped and radiator cap is cool enough to touch with your hand.

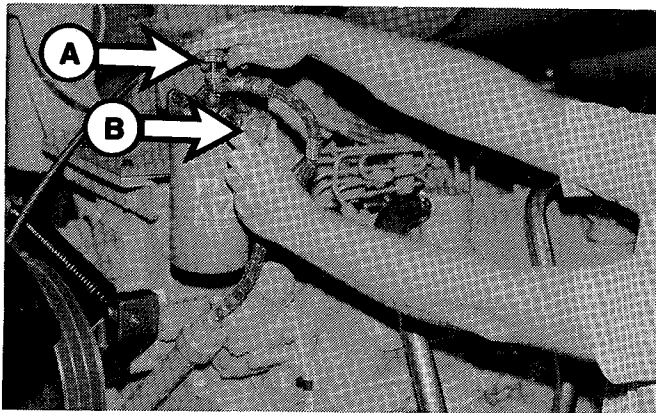
Remove filler cap slowly to relieve pressure.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

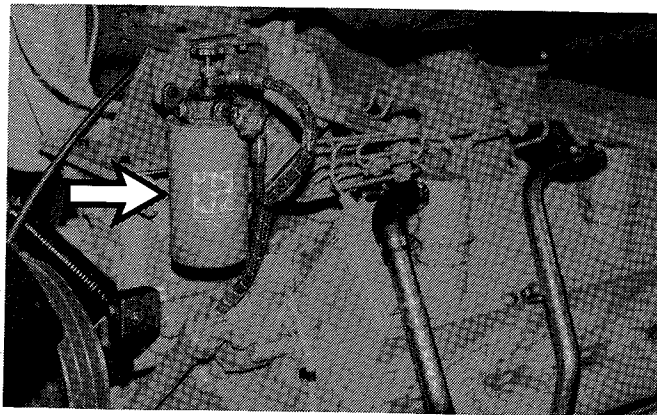
CAUTION

All water is corrosive at engine operating temperature. Use either Caterpillar Cooling System Conditioner liquid, or the coolant conditioner element to treat either plain water or ethylene glycol anti-freeze solution. NEVER use both the liquid cooling system conditioner and the coolant conditioner element at the same time.

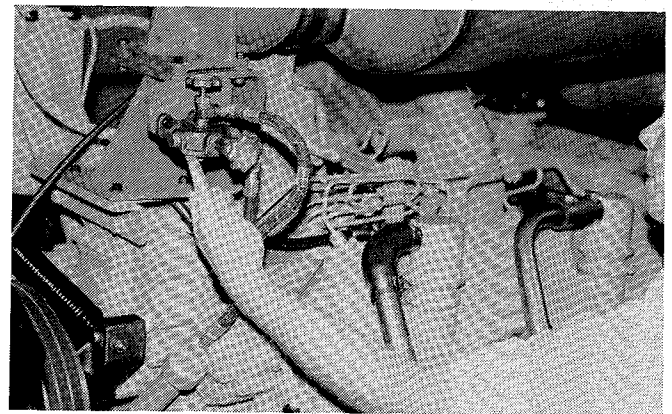
Do not use Caterpillar Cooling System Conditioner or Coolant Conditioner Elements with Dowtherm 209 Full-Fill coolant.



1. Close inlet valve (A) and outlet valve (B) in the filter base.



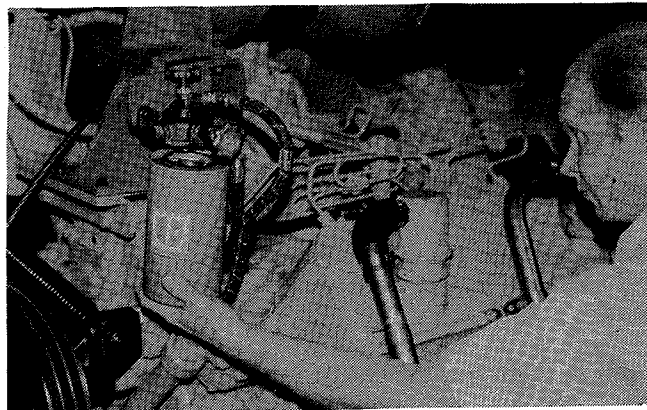
2. Remove the coolant conditioner element.



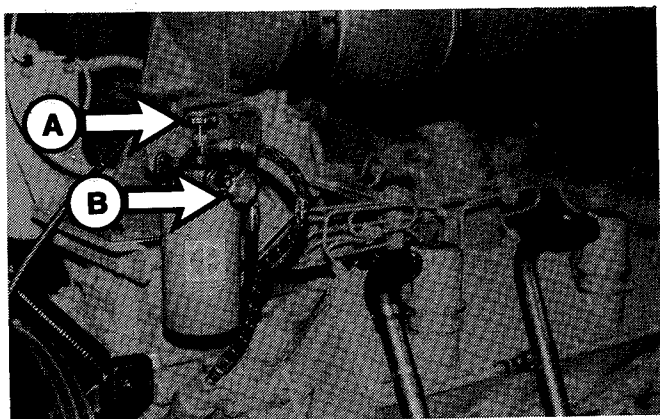
3. Clean the element mounting base. Make certain all of the old element gasket is removed.

Every 250 Service Meter Units

4. Coat the seal of the new element with a thin film of clean engine oil.



5. Install the element until the seal contacts the base. Then, tighten an additional 3/4 turn.

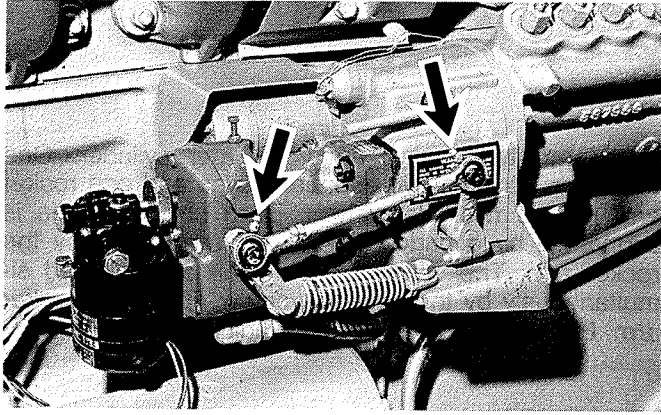


6. Open the inlet valve (A) and the outlet valve (B).

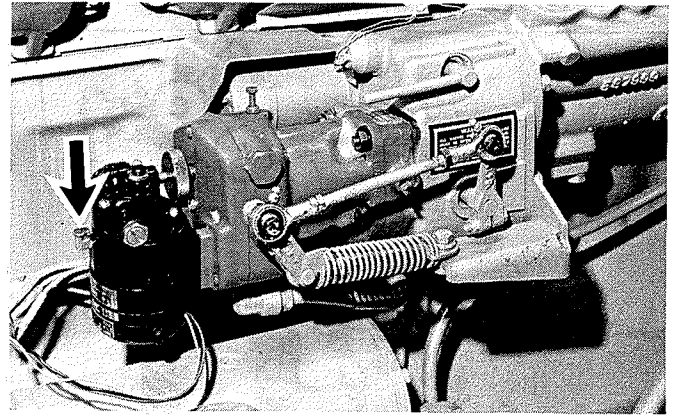
7. Start the engine and inspect for leaks.

Every 1000 Service Meter Units

⑮ Woodward Governor



1. Lubricate 2 fittings.



2. Fill the oil cup with clean engine oil.

⑯ Protective Shutoff Control

The shutoff controls should be periodically checked to ensure that if an adverse condition arises, the shutoff control will shut down the engine.

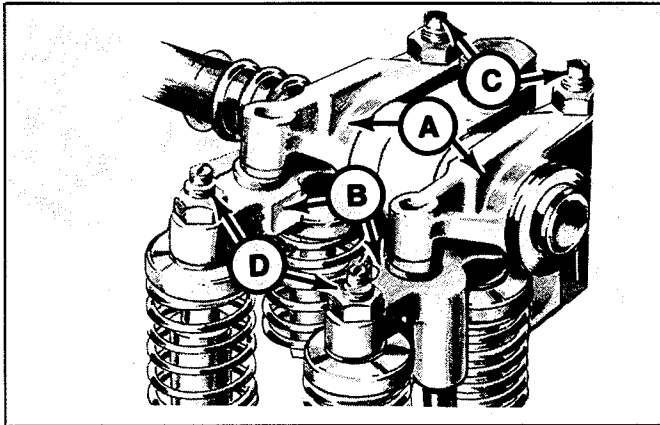
Have your Caterpillar dealer inspect the shut off controls.

⑰ Tachometer Drive - If Equipped

Lubricate 1 fitting.

Every 2000 Service Meter Units

18 Engine Valve Lash



There are two rocker arms **A**, per cylinder. One rocker arm for the two exhaust valves and one rocker arm for the two inlet valves. Each pair of valves is connected by a bridge **B**, which is actuated by the rocker arm. The valves in each pair are adjusted simultaneously by the adjusting screw **C**, in the rocker arm. Each bridge is adjusted by adjusting screw **D**.

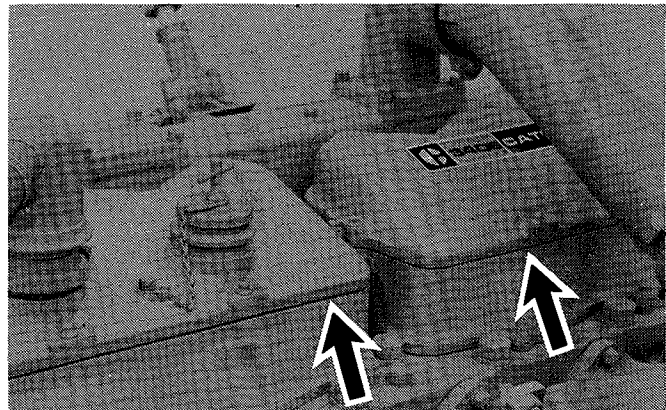
WARNING

To prevent possible injury, when rotating flywheel, do not use starter motor to turn flywheel. Engine may start.

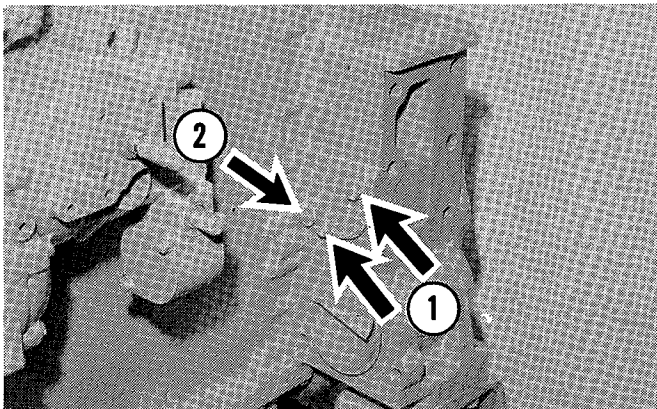
CAUTION

With the engine stopped and cold, inspect and adjust the bridge and valve adjustment. Always turn the flywheel in direction of normal rotation.

Valves must be closed for bridge and valve lash adjustment.



1. Clean the area around the valve covers. Remove the covers.



2. Remove the timing bolts **1**, and plug **2**. Remove cover.

3. Install engine turning tool, 5P7307 available from your Caterpillar dealer.

4. Turn the pinion to align the hole in the flywheel with the hole in the flywheel housing.

5. Install the timing bolt in the flywheel. This is the top bolt of the two bolts that secure the flywheel housing cover.

Bridge Adjustment

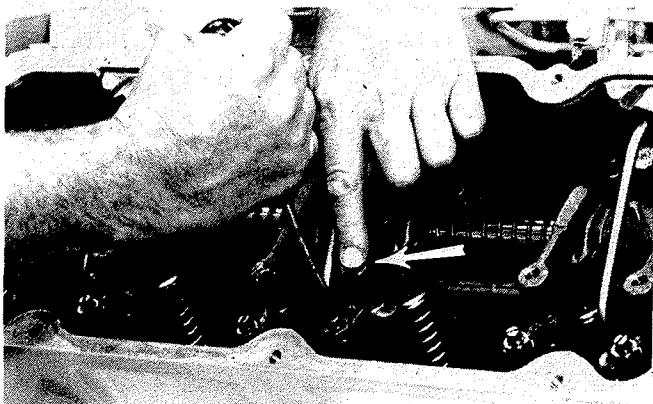
Adjustment of the bridge will be necessary only after grinding the valves or other work on the cylinder head is done.

Valves must be fully closed

If bridge was removed perform steps 1 and 2 that follow. If bridge was not removed, proceed to step 3.

1. Put engine oil on the bridge dowel in the cylinder head and in the bore in the bridge.

2. Install the bridge with the adjustment screw toward the exhaust manifold.

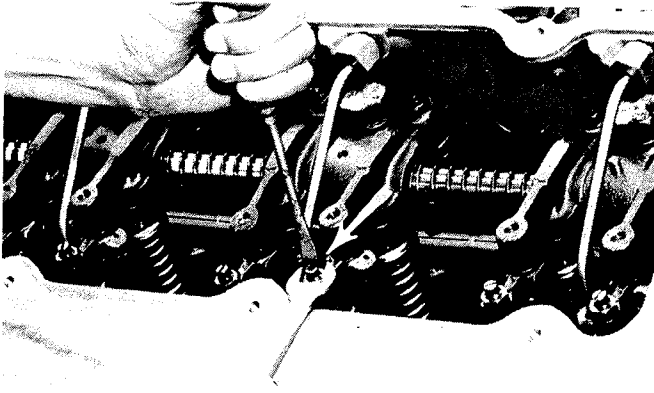


3. Back off adjusting the screw several turns (counterclockwise). Make sure it is not in contact with the valve stem.

4. Firmly press straight down on the rocker arm, above point of contact with bridge.

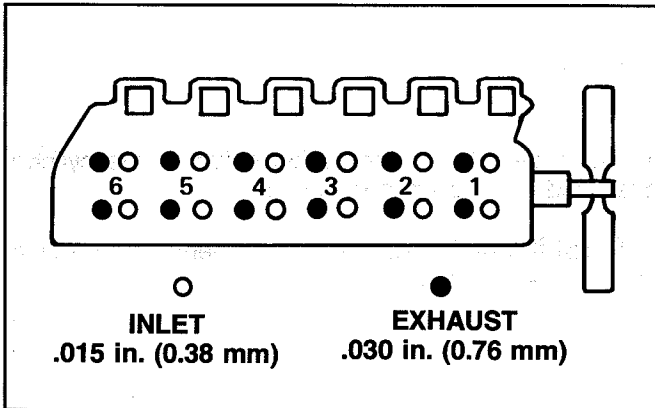
5. Turn the adjusting screw clockwise until contact is made with the valve stem. Turn the adjusting screw an additional 30° (one-twelfth turn).

Every 2000 Service Meter Units



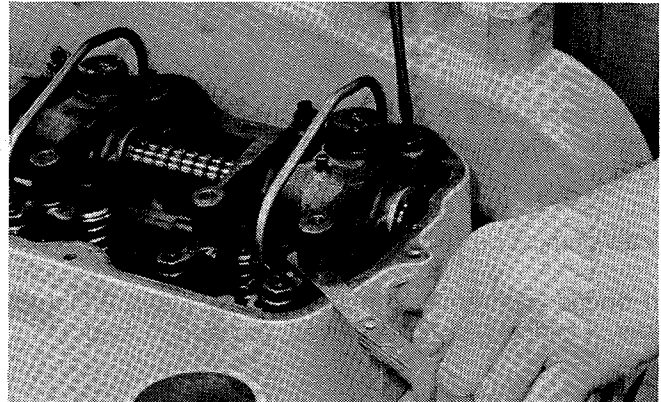
6. Hold the adjusting screw in this position. Tighten the locknut to 22 ± 3 lb. ft. (30 ± 4 N·m).

Valve Adjustment



7. Put engine oil at the point where the rocker arm makes contact with the bridge.

After checking the bridge adjustment, make the valve lash adjustment.

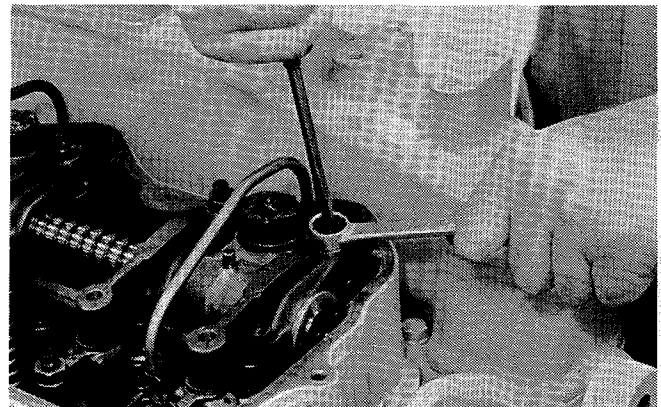


1. Put No. 1 piston at top dead center (TDC) on the compression stroke.

2. With No. 1 piston at top dead center (TDC) on compression, and timing bolt installed, measure lash between the bridge and rocker arm on exhaust valves for cylinders 1, 3, and 5. Inlet valves for cylinder 1, 2, and 4.

3. Adjust valves if necessary.

4. To adjust, loosen valve adjusting locknut. Turn adjusting screw to allow feeler gauge, of proper size, to pass between top of bridge and valve rocker arm.



5. Tighten adjusting screw locknut to 22 ± 3 lb. ft. (30 ± 4 N·m) and measure lash. Readjust if necessary.

6. Remove the timing bolt and turn the flywheel 360° in the direction of engine rotation. This will put No. 6 piston at top dead center (TDC), on the compression stroke. Install the timing bolt in the flywheel.

7. Adjust the valve clearance on exhaust valves for cylinder 2, 4, and 6. Adjust the inlet valves for cylinders 3, 5, and 6.

8. Tighten the valve adjusting screw locknut to 22 ± 3 lb. ft. (30 ± 4 N·m). Measure the lash. Readjust if necessary.

9. Remove the timing bolt from the flywheel.

10. Remove the engine turning tool.

11. Install the cover, bolts and plug.

Valve Rotation

Before the valve covers are installed, check the valves for rotation.

1. Mark a line on each valve retainer.

2. Start the engine and run at low idle.

3. Watch the line mark on each valve retainer.

Each valve retainer should turn slightly each time the valve closes. If they do not turn, contact your Caterpillar dealer.

4. Stop the engine.

5. Inspect the valve cover gaskets and install new ones if necessary.

6. Install rocker arm covers. Tighten bolts to 18 ± 5 lb. ft. (24 ± 7 N·m).

Every 2000 Service Meter Units

①9 Cooling System - Changing Antifreeze

WARNING

At Operating Temperature, engine coolant is hot and under pressure.

Steam can cause personal injury.

Check coolant level ONLY when engine is stopped and radiator cap is cool enough to touch with your hand.

Remove filler cap slowly to relieve pressure.

Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

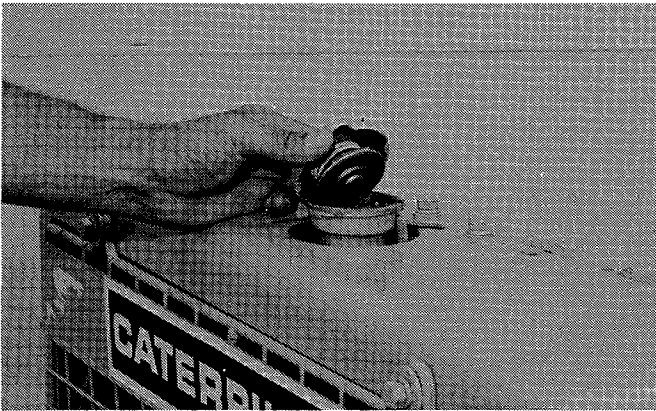
CAUTION

All water is corrosive at engine operating temperature. Use either Caterpillar Cooling System Conditioner liquid, or the coolant conditioner element to treat either plain water or ethylene glycol antifreeze solution. NEVER use both the liquid cooling system conditioner and the coolant conditioner element at the same time.

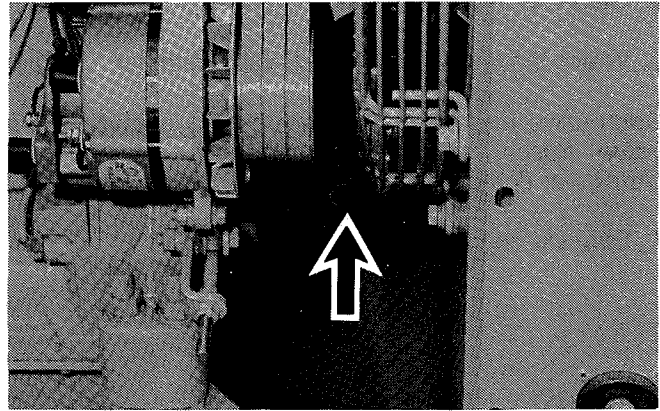
When changing antifreeze solution, replace the attachment coolant conditioner group maintenance filter element with the appropriate precharge filter element.

Do not use Caterpillar Cooling System Conditioner or Coolant Conditioner Elements with Dowtherm 209 Full-Fill coolant.

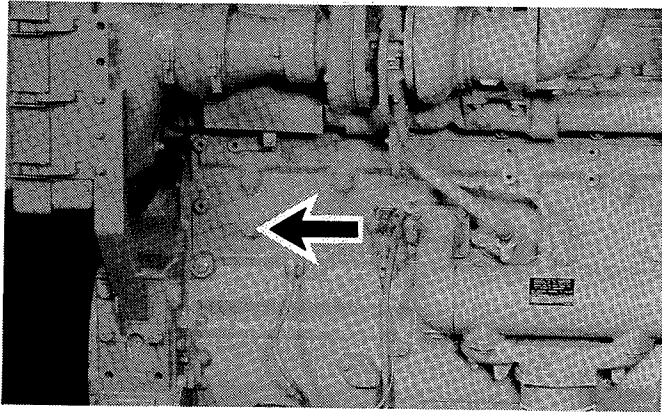
Never add coolant to an overheated engine; allow the engine to cool first.



1. Loosen the radiator cap slowly to release pressure. Remove the radiator cap.



2. Remove the radiator drain plug. Allow the coolant to drain.



3. Remove engine block drain plugs. Allow coolant to drain.

4. Clean the drain plugs.

5. Install the drain plugs.

Filling the Cooling System

1. Mix antifreeze to provide protection to the lowest expected ambient temperature.

Do not fill cooling system to the top. Allow for addition of conditioner.

2. To help avoid air pockets, add coolant slowly, at 5 U.S. gallons (19 liters) per minute or less. See REFILL CAPACITIES.

3. Add cooling system conditioner or proper precharge element.

4. Bring the coolant level to within 1/2 inch (1 cm) of the bottom of the fill pipe.

5. Start the engine with the radiator cap off. Add coolant, if necessary, when level stabilizes.

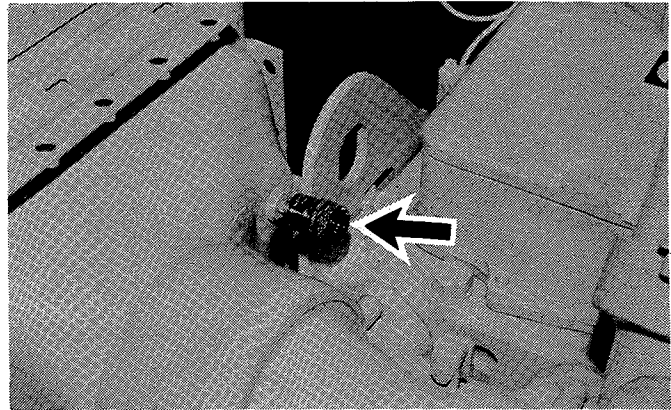
6. Stop the engine. Replace the radiator cap seal if damaged. Install the radiator cap.

When Required

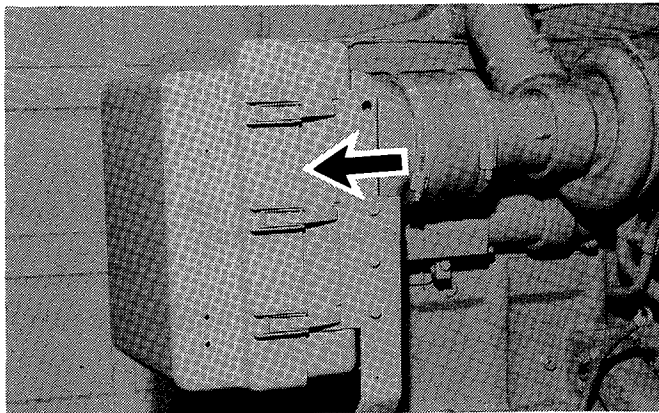
② Air Cleaner

CAUTION

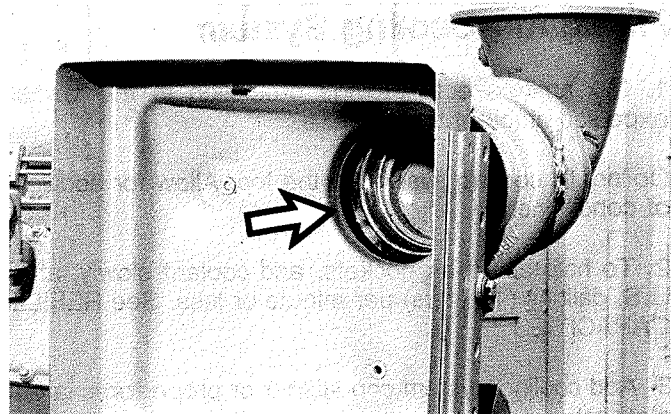
Service the air cleaner with the engine stopped.



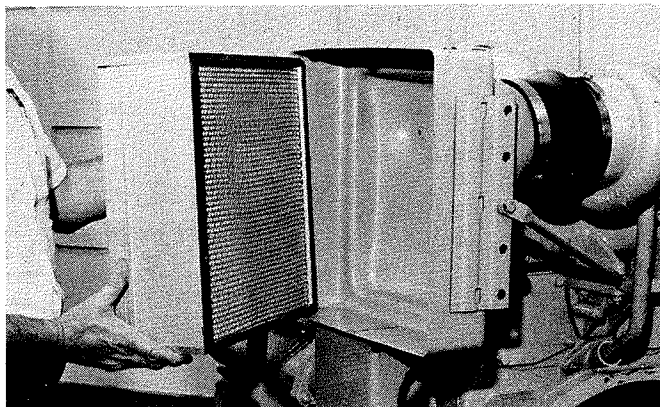
Service the air cleaner when the red band in the indicator locks in the visible position.



1. Remove the air cleaner cover and element.

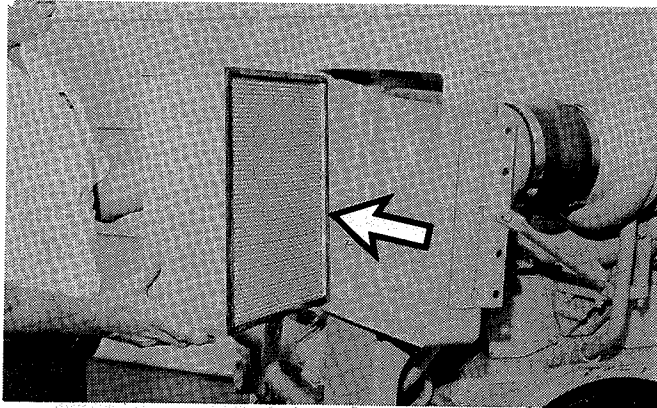


2. Cover the air inlet opening to prevent foreign objects from entering the engine.



3. Clean the inside of the filter housing.

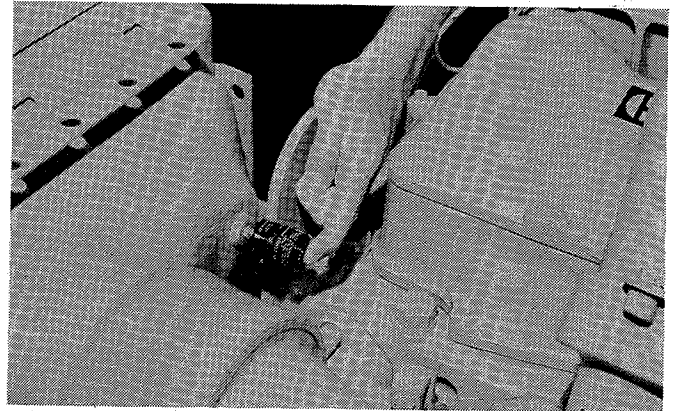
4. Remove the covering from the air inlet opening.



5. Install either a new or cleaned filter element.

6. Install the air cleaner cover.

CAUTION
Note the arrows on the side of the element that indicate the air flow.



7. Reset the service indicator by pushing on the reset button.

8. Clean the used air cleaner element. See Cleaning Filter Elements.

Cleaning Air Cleaner Elements

WARNING

When using pressure air, wear face shield and protective clothing. Maximum air pressure for cleaning purposes must be 30 psi (205 kPa).

CAUTION

When cleaning with pressure water, use 40 psi (280 kPa) maximum pressure to prevent element damage.

CAUTION

Do not clean elements by bumping or tapping them on hard objects.

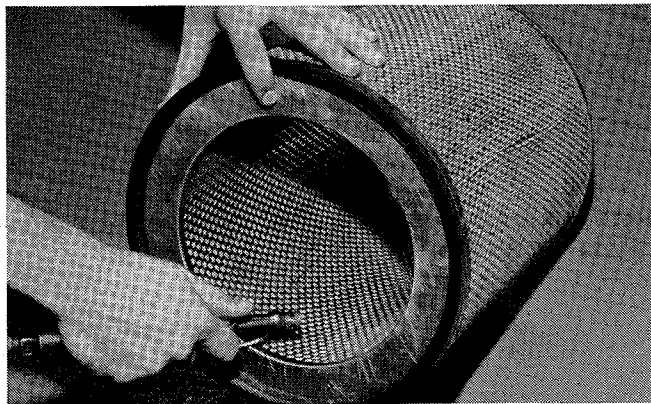
Inspect an element after cleaning. Do not use an element with damaged pleats, gaskets or seals.

Have spare elements on hand to use when cleaning used ones.

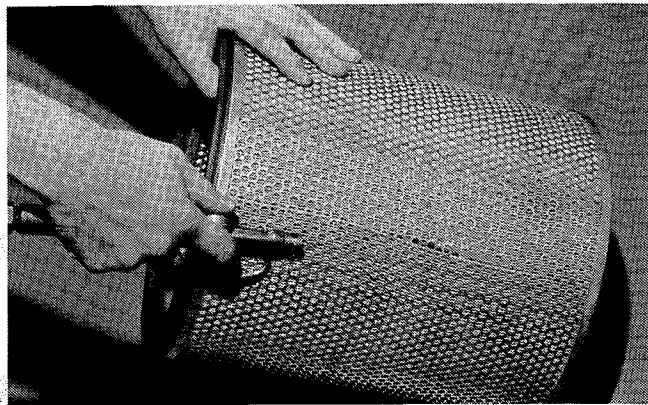
Panel type air cleaners can be cleaned in the same manner.

When Required

Pressure Air - 30 psi (205 kPa) Maximum



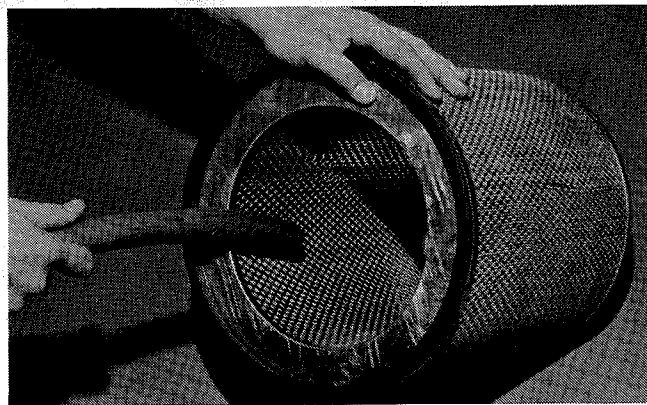
1. Direct the air along the complete length of each pleat on the CLEANEST side of the element.



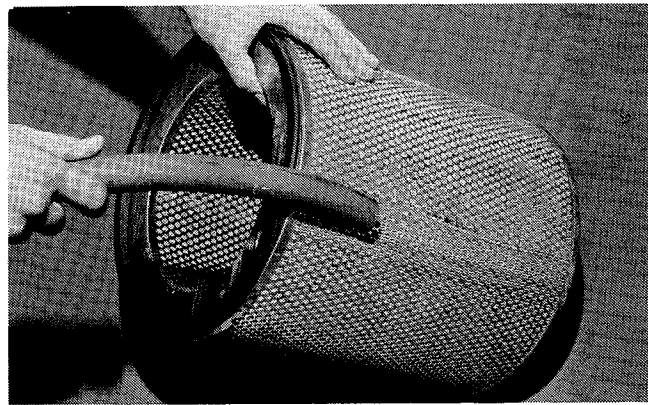
2. Blow the loosened dirt from the DIRTY side.

3. Direct the air from the CLEAN side through to the DIRTY side to remove dirt blown into pleating.

Water - 40 psi (280 kPa) Maximum



1. Direct the water along the complete length of each pleat, on the CLEAN side of the element.

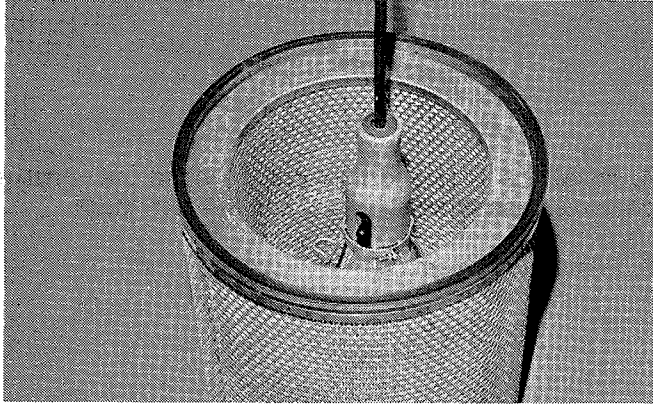


2. Direct the water along the complete length of each pleat on the DIRTY side of the element.

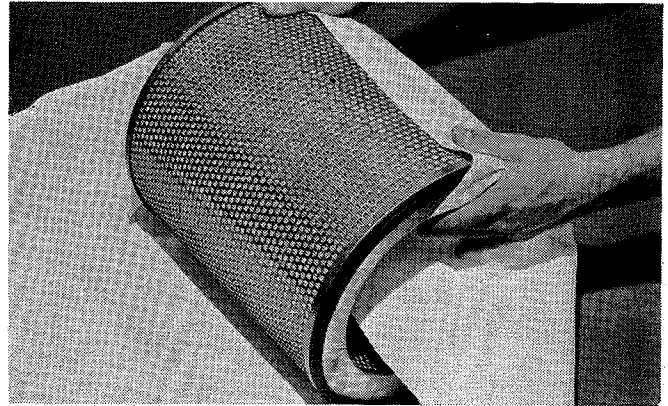
3. Rinse the CLEAN side of the element.

4. Allow the element to dry.

Inspecting Elements

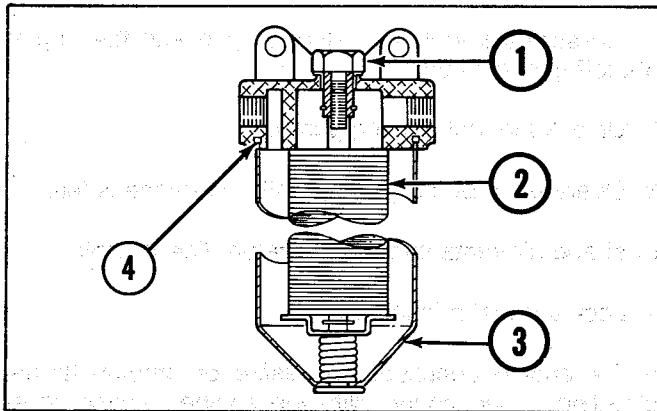


1. Insert a light inside a clean and dry element. Discard element if rips or tears are found.



2. Wrap and store good elements in a clean dry place.

②① Fuel System - Cleaning Primary Fuel Filter



1. Stop the engine and shut off the fuel supply valve from the fuel tank.

2. Loosen the retaining nut ① on the filter cover.

3. Lower the filter case ③ and element ②.

4. Remove the filter element from the case. Clean the element and case in nonflammable solvent.

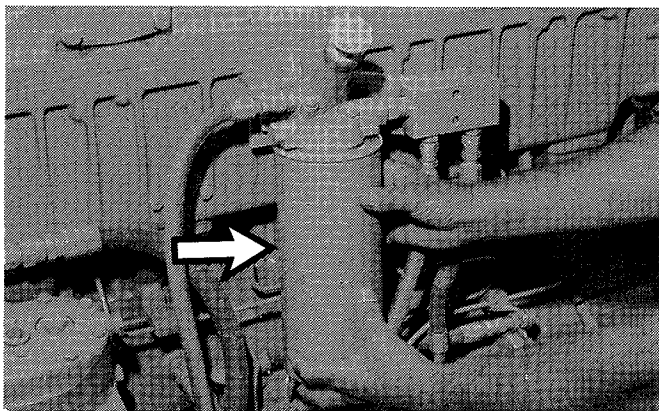
5. Reinstall the element in the case.

6. Inspect the seal ④. Use a new seal if the used one is damaged.

7. Install the element and case on the housing. Install the retaining nut.

8. Open the fuel supply valve.

Final Fuel Filters:

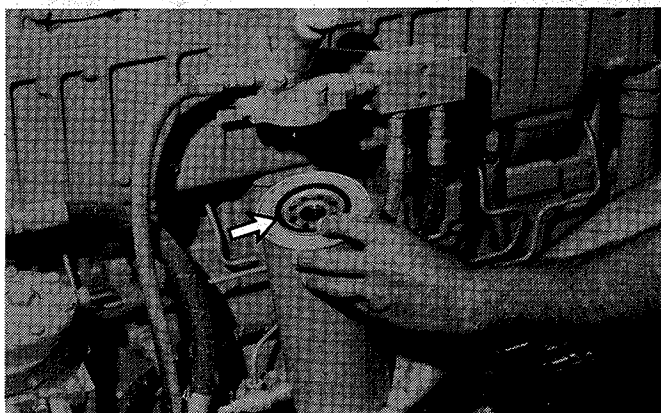


1. Remove the filter.

2. Clean the gasket sealing surface of the filter base.

CAUTION
Be sure all of the old gasket is removed.

When Required

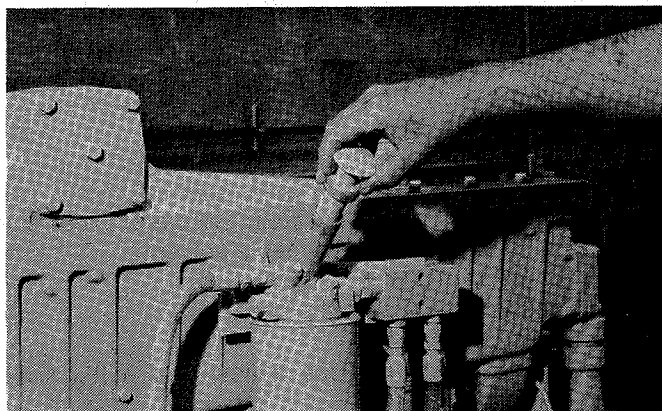


3. Lubricate the gasket of the new filter with clean fuel.

4. Install the filter and tighten it by hand until gasket contacts base, then tighten 1/2 to 3/4 turn more.

5. Prime the system.

To Prime the System:



1. Be sure the fuel line valve is open and the engine shutoff control is off.

2. Unlock the fuel priming pump.

3. Operate the priming pump until resistance is felt.

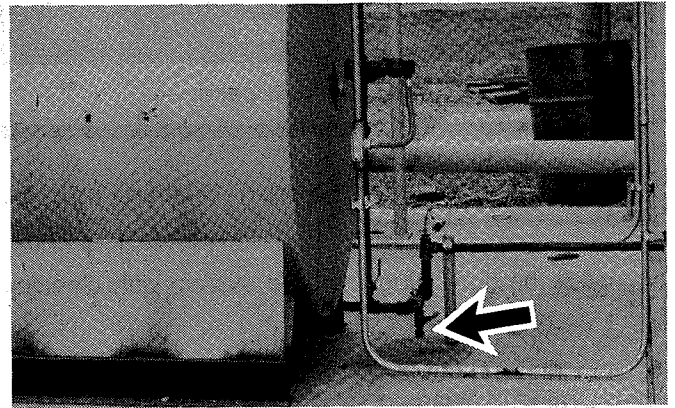
Fuel and air vents through the return line to tank.

4. Lock the fuel priming pump.

If the engine continues to misfire or smoke, further bleeding is necessary. With the engine running, loosen the fuel line nuts, one at a time, several times in succession and allow the fuel to run until free of air bubbles. Tighten the fuel line nuts.

22 Fuel Tank

Open the fuel tank drain valve. Allow the moisture and sediment to drain. Close the drain valve.



23 Cooling System - Cleaning

⚠ WARNING

At Operating Temperature, engine coolant is hot and under pressure.

Steam can cause personal injury.

Check coolant level ONLY when engine is stopped and radiator cap is cool enough to touch with your hand.

Remove filler cap slowly to relieve pressure.

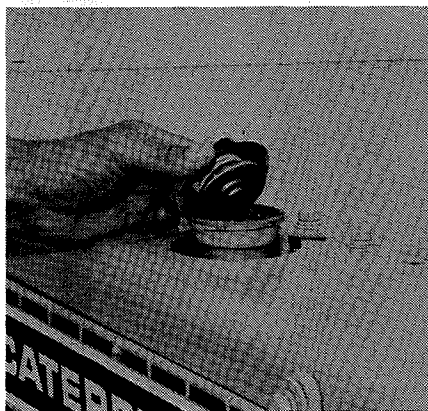
Cooling System Conditioner contains alkali. Avoid contact with skin and eyes to prevent personal injury.

CAUTION

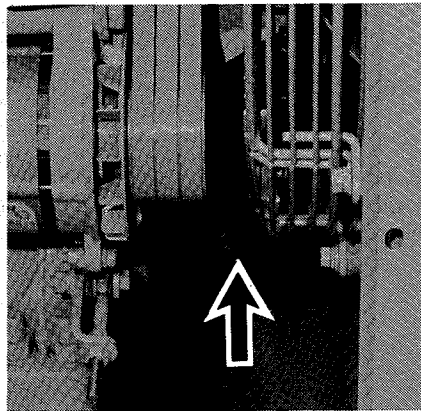
If the engine is to be stored in, or shipped to, an area with below freezing temperatures, the cooling system must either be protected to the lowest expected ambient temperature, or drained completely.

Never add coolant to an overheated engine, allow engine to cool first.

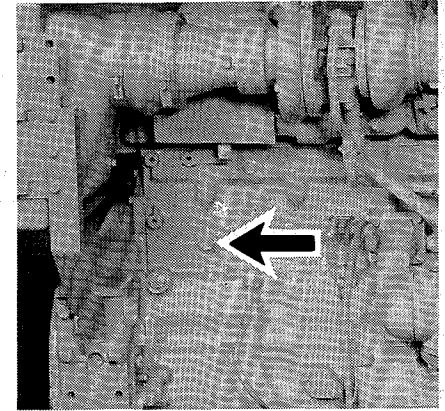
Do not use Caterpillar Cooling System Conditioner or Coolant Conditioner Elements with Dowtherm 209 Full-Fill coolant.



1. Loosen radiator cap slowly to release pressure and remove filler cap.



2. Remove radiator drain plug.



3. Remove engine block drain plugs.

When Required

⚠ WARNING

Use all cleaning solutions with care.

Most commercial cooling system cleaners may be used.

4. Install the drain plugs. Fill the system with cleaning solution⁽¹⁾.

5. Start and run the engine for 1/2 hour. Stop the engine. Drain the cleaning solution.

6. Flush the system with clean water until the draining water is clean. Do not run the engine while flushing.

7. Install all drain plugs. Fill the system with neutralizing solution⁽²⁾.

⁽¹⁾2 lb. Sodium Bisulfate (NaHSO_4) per 10 U.S. gallons (1 kilogram per 40 liters) water.

8. Start and run the engine for 10 minutes. Stop the engine and drain neutralizing solution.

9. Flush the system with clean water, until draining water is clean. Do not run the engine while flushing.

10. Install all drain plugs.

11. Mix antifreeze solution to provide protection to the lowest expected ambient temperature.

12. Add correct amount of Caterpillar Corrosion Conditioner, or equivalent, so that this cooling system will have a 3% concentration of conditioner. See the topic Lubricants—Fuels—Coolants.

13. Install coolant conditioner element, if equipped.

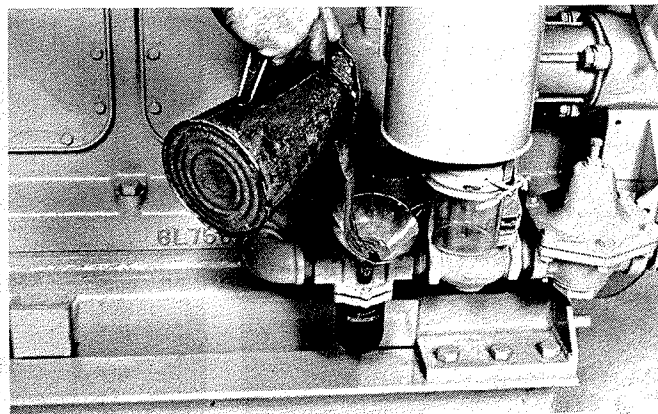
14. To help avoid air locks, add coolant slowly, at 5 U.S. gallons (19 liters) per minute or less.

⁽²⁾1/2 lb. Sodium Carbonate Crystals ($\text{Na}_2\text{CO}_3 \bullet 10 \text{H}_2\text{O}$) per 10 U.S. gallons (250 grams per 40 liters) water.

24 Air Starting Motor **Filling Motor Oiler**

The starting motor oiler lubricates the vanes of the motor, while the motor is operating.

When the oiler jar becomes half empty, remove the oil filler plug and fill the jar with clean oil. Refer to Lubrication and Maintenance Chart for proper oil.



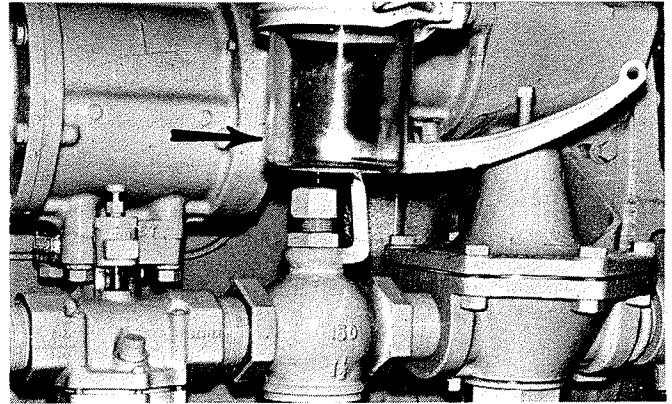
CAUTION

Never allow the jar to become empty. The starting motor will be damaged by lack of proper lubrication.

Emptying Oil Collector Jar

The collector jar collects both the oil after it has lubricated the starting motor vanes, and the moisture from the air.

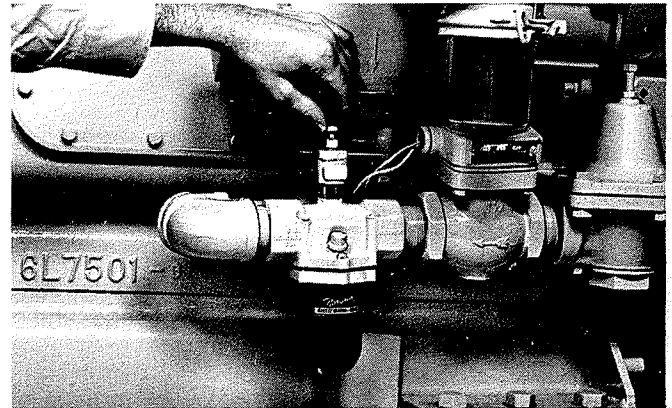
Empty the collector jar whenever it becomes half full.



Adjusting Oiler Feed

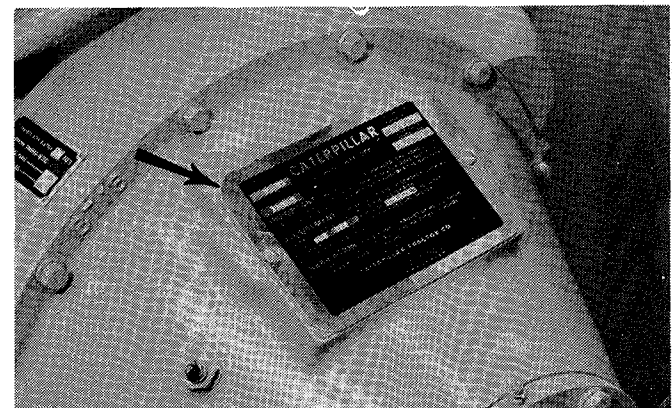
If necessary, adjust the oiler to release approximately four drops of oil per minute into the starting motor air stream.

1. Move the compression release lever to the START position, and move the governor control lever to the SHUT-OFF position.
2. Pull up on the air start control lever and crank the engine.
3. Count the drops of oil released per minute into the air stream.
 - a. Turn the valve needle (the uppermost knob the oiler) counterclockwise to increase the number of drops per minute.
 - b. Turn the valve needle clockwise to decrease the number of drops per minute.



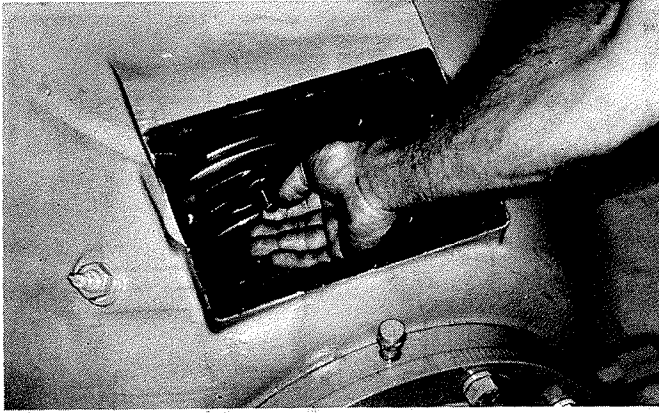
25 Power Coupling

The clutch should engage with a hard push and a distinct snap. If the engagement is "soft", adjust the clutch.



1. Stop the engine. Remove the clutch inspection cover.

When Required



2. Turn the clutch until the lock pin, engaged in the locking ring, is visible.

26 Glow Plugs

1. Disconnect the wire lead from the glow plug terminal on the HEAT-START switch.

2. Install an ammeter, with a capacity of over 75 amps, in a series between the disconnect lead and the terminal on the HEAT-START switch.

3. Turn the HEAT-START switch to HEAT and observe the ammeter.

Each 12 volt glow plug draws approximately 12.5 amperes. The ampere draw of one glow plug multiplied by 6 will be 75 amps. This will be the total ampere draw of the glow plugs for this engine.

3. Pull the lock pin out. Rotate the locking ring clockwise until the lock pin pops into the next notch.

4. Test the clutch adjustment. If still too "soft", rotate the ring to the next notch. If the adjustment is too tight, turn the ring back one notch.

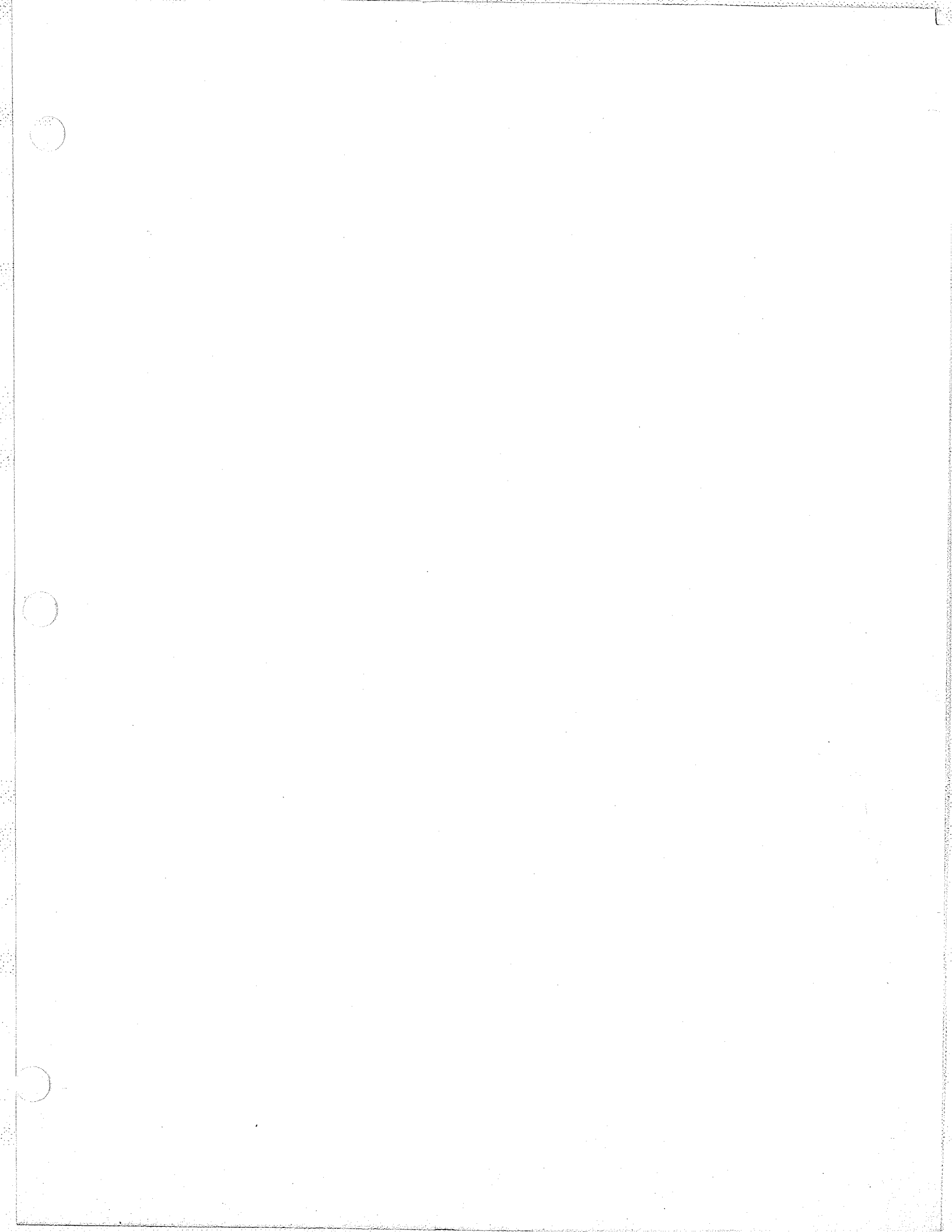
5. Install the cover.

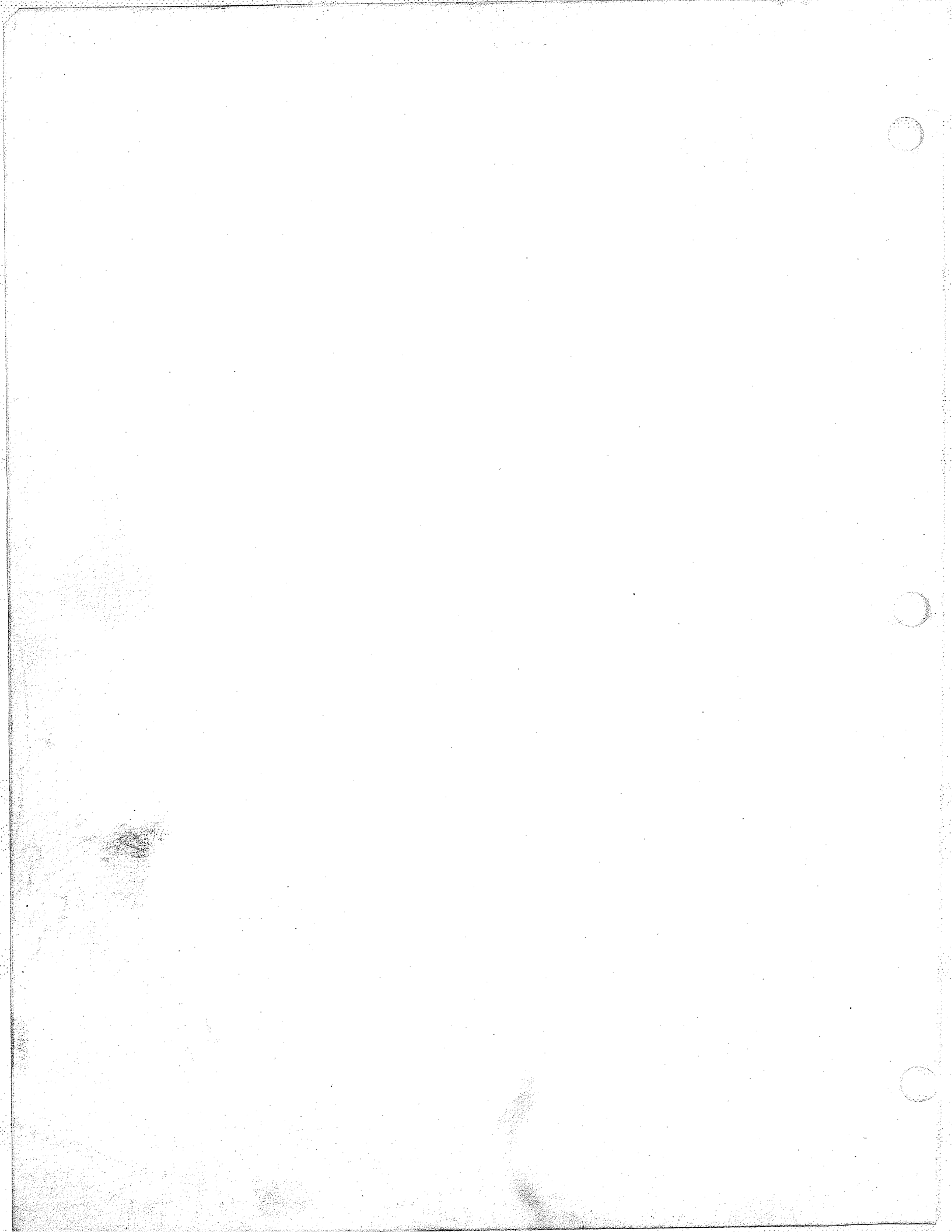
A low reading indicates one or more defective glow plugs.

4. If a defective glow plug is indicated, disconnect one glow plug lead at a time.

5. Turn the switch to the HEAT position. Observe the ammeter. Reconnect the lead.

6. The glow plug that does not change the reading on the ammeter when the switch is turned on, is the defective glow plug.





Caterpillar Warranty

INDUSTRIAL, AGRICULTURAL, AND MARINE ENGINES, MARINE TRANSMISSIONS AND ELECTRICAL POWER GENERATION PRODUCTS

This warranty applies to the following products delivered to the first user on or after January 1, 1982:

Caterpillar warrants new engines for industrial, agricultural, and marine applications, marine transmissions and electrical power generation products ("products") sold by it (except products installed in on-highway vehicles, in machines manufactured by Caterpillar or in marine pleasure craft sold in the United States of America, to which different warranties apply) to be free from defects in material and workmanship subject to the following provisions:

Warranty Period

The warranty period is 12 months (24 months for standby electric generators and mobile agricultural machines) starting from date of delivery to the first user.

Caterpillar Responsibilities

If a defect in material or workmanship is found during the warranty period Caterpillar will provide through a Caterpillar dealer or other source approved by Caterpillar:

- New or repaired parts at Caterpillar's choice.
- Reasonable and customary labor during normal working hours needed to make the warranty repair.
- Labor needed to disconnect and reconnect the product from its attached equipment, mounting, and support systems.
- Reasonable travel expenses if Caterpillar chooses to perform the repair in the field.
- Usual and customary parts shipping charges to the approved source.
- Lubricating oil, filters, antifreeze and other service items made unusable by the warranty failure.

User Responsibilities

User is responsible for:

- All costs for transporting the product or equipment in which the product is installed.
- Travel expenses for field repair of products in remote places.
- Premium or overtime labor costs.
- Any removal and installation costs beyond those required to disconnect and reconnect the product from its attached equipment, mounting, and support systems.
- Parts shipping charges in excess of those which are usual and customary.
- Costs to investigate performance complaints unless the problem is caused by a defect in Caterpillar material or workmanship.
- Giving timely notice of a warrantable failure and promptly making the product available for repair.

Limitations

- Caterpillar is not responsible for failures resulting from:
- Any use or installation which Caterpillar judges improper.
 - Attachments, accessory items and parts not sold or approved by Caterpillar.
 - Abuse, neglect and improper repair.
 - User's unreasonable delay in making the product available after notice, for product improvements ordered by Caterpillar.
 - Caterpillar does not warrant items sold by it which are warranted by another maker.

This warranty is expressly in lieu of any other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose. Remedies under this warranty are limited to the provision of material and services, as specified above. Caterpillar is not responsible for incidental or consequential damages.

As used in this warranty the term "Caterpillar" means Caterpillar Tractor Co. or one of its subsidiaries whichever last sold the product involved.

