

Product: EXCAVATOR

Model: 225 EXCAVATOR 76U

Configuration: 225 EXCAVATOR 76U00694-01199 (MACHINE) POWERED BY 3304 ENGINE

## Operation and Maintenance Manual 225 EXCAVATOR

Media Number -SEBU5789-00

Publication Date -01/06/1992

Date Updated -11/10/2001

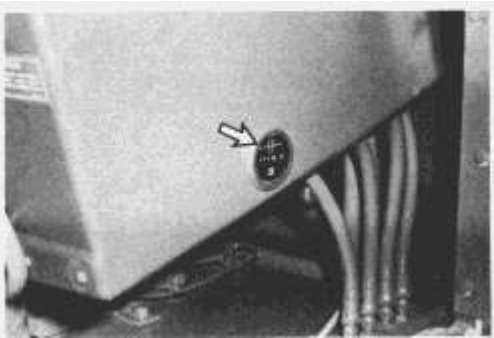
### Foreword

#### SMCS - 7606

This book is a guide to equipment care. The illustrated step-by-step instructions are grouped by servicing intervals; items without specific intervals are listed under "When Required." Items in the "Lubrication and Maintenance Chart" are referenced to detailed instructions that follow.

Use the service meter to determine servicing intervals. Calendar intervals (daily, weekly, monthly, etc.) shown may be used instead of service meter intervals if it provides more convenient servicing schedules and approximates 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.



Service Meter

Perform previous interval items at multiples of the original requirement. For example, at "Every 250 Service Hours or Monthly," also perform those items listed under "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 unit.

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

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

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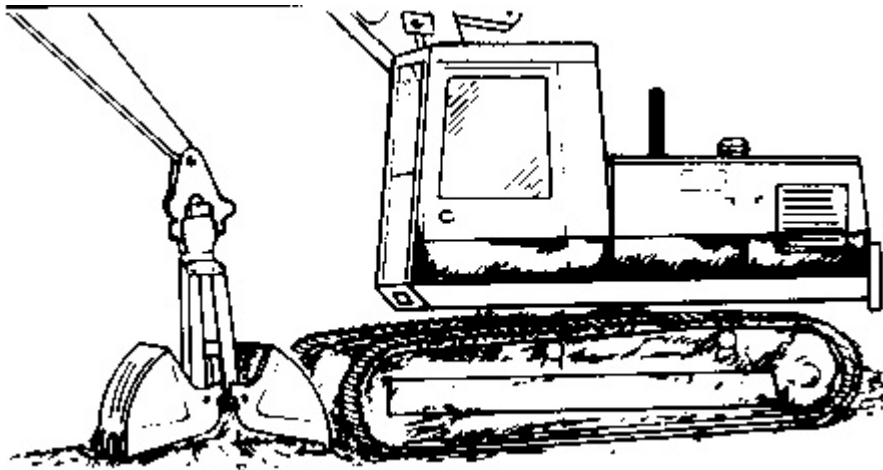
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### Safety

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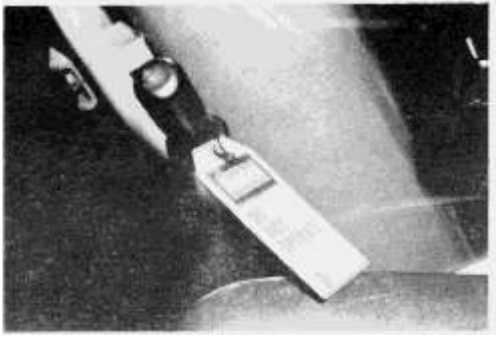


**Lower all equipment, engage the hydraulic and antitravel lock and stop the engine before performing maintenance on the machine, unless otherwise specified.**



Lower the clamshell in the open position.

Read the warning and service information provided on the machine. Follow servicing instructions carefully.



Do not start or operate the machine while it is being serviced. Attach a warning tag to the controls.

There are certain hazards which must be recognized as potential causes of personal injury. Be aware of these hazards and follow the recommendations which are listed below.

### **Avoid Crushing or Cutting**

Never attempt adjustments while the machine is moving or the engine is running.

Any implement can fall if a control is moved or a line breaks.

Support equipment when working beneath it. Do not depend on hydraulic cylinders to hold it up.

The fan blades will throw or cut any object or tool that falls or is pushed into them.

Know the weight limits of cable, chains, and slings before using them.

Wear gloves when handling cable. Do not use kinked or frayed cable; it is weakened.

Chips can fly from the object or hammer, when hammering on metal drifts, punches, or chisels. Wear protective glasses.

### **Burns**

The radiator and all lines to heaters or the engine contain hot water or steam. Check the coolant level only when the engine is stopped and the radiator cap is cool enough to touch with your hand.

Remove the radiator cap slowly to avoid burns. Allow the cooling system components to cool before draining the coolant.

Lubricants will be hot enough to cause serious burns after machine compartments are up to normal operating temperature. Allow the compartments to cool before draining.

At operating temperature the hydraulic system is pressurized by hot air in the top of the tank. Remove the hydraulic tank cap slowly to relieve tank pressure. Allow the tank to cool before draining.

### **Fire or Explosion**

Diesel fuel and all lubricants are flammable. Do not weld or torch cut, on pipes or tubes that contain oil. Clean them thoroughly with nonflammable solvent before welding or cutting.

Do not smoke when refueling.

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

Disconnect battery (turn disconnect switch OFF) when changing fuel filters or fuel/water separators. Drain fuel from fuel/water separator into a container before removing water separator retaining clamp.

To avoid fires, clean up oil spills and trash buildup. Steam clean the machine.

The vapor (hydrogen gas) from a charging battery is explosive. Do not smoke when checking batteries or working around batteries.

Tighten loose fluid fittings or connections.

Loose or damaged tubes, lines and hoses which leak can cause fires.

Tighten loose hose clamps or fasteners. Replace missing ones.

Check for misalignment of tubes, hoses, or items containing fluid. Reroute lines if necessary to prevent interference.

Look for loose, frayed, damaged, or disconnected wires.

Replace or tighten loose or missing mufflers or exhaust system parts.

A line, hose or seal failure can cause a fire. Shields which protect hot exhaust components from oil or fuel spray must be installed correctly.

Make sure all clamps, guards and heat shields are installed correctly to prevent vibration, rubbing against other parts, or excessive heat buildup during operation.

Store rags that have oil or flammable material on them in a container. Keep the container away from open fires, welding, or flame cutting areas.

To prevent jobsite fuel storage tanks from being struck by equipment being fueled, protect them with an embankment or steel post.

## **Handle Fluids Safely**

Cooling system conditioners contain alkali. Do not drink them or get them in your eyes.

Battery electrolyte is an acid and will harm skin and eyes.

Keep all lubricants stored in properly marked containers away from children.

Never put maintenance fluids in glass bottles or glasses that are within the reach of children.

## **Safety Equipment**

Wear a hard hat, protective shoes, and protective glasses when doing lubrication and maintenance work.

Limit air pressure to 205 kPa (30 psi) when cleaning with air.

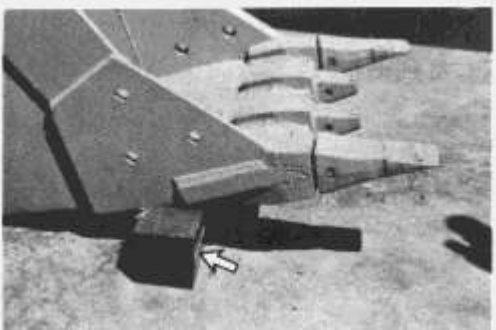
Never point an air nozzle at anyone.

Attach a "DO NOT OPERATE" or similar WARNING tag on the vehicle starter switch or controls when working on a machine.

Operate the engine only in a well ventilated area. In a closed area, vent exhaust fumes to the outside.



Use caution when removing caps, drain plugs, fittings, or pressure taps.



Block the bucket when changing teeth.



Use the steps, grab irons and walkways when mounting or moving around on the machine. Face the machine.

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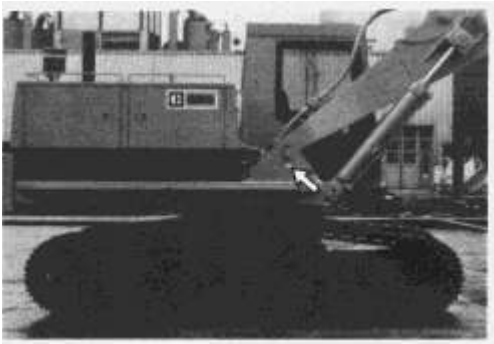
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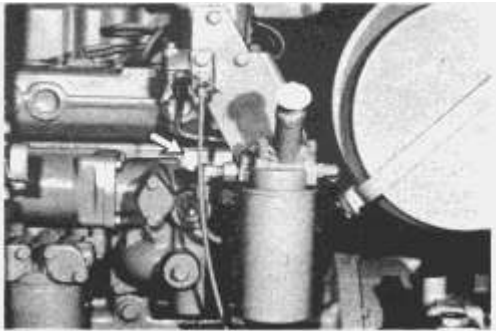
### Serial Number Locations

#### SMCS - 7606

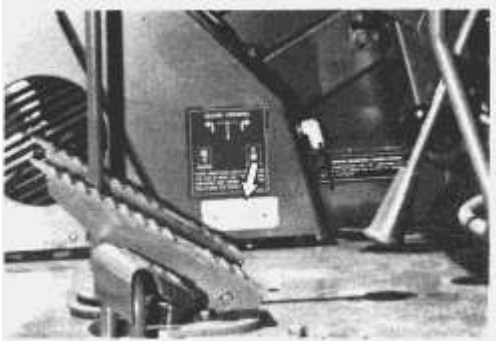
For quick reference, record your machine's serial numbers in the spaces provided below the photographs.



Frame Serial No. \_\_\_\_\_



Engine Serial No. \_\_\_\_\_



Engine and Frame Serial No.



Swing Bearing Serial No. \_\_\_\_\_

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# **Maintenance Recommendations**

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## **Cooling System**

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### **NOTICE**

**Never add coolant to an overheated engine. Allow the engine to cool first.**

**Measure the specific gravity of antifreeze solution frequently in cold weather to ensure adequate protection. Pure undiluted antifreeze will freeze at -23°C (-10°F).**

**When permanent-type antifreeze and water solutions are used in the cooling system, drain and replace the solution "Every 2000 Service Hours or Yearly." When additions of conditioner are made as recommended, the drain and refill period can be extended to "Every 4000 Service Hours or Two Years."**

**The cooling system should contain a 3% to 6% concentration of conditioner at all times, regardless of the concentration of antifreeze.**

**Use clean water that is low in scale-forming minerals - not softened water.**

**Do not use Caterpillar Cooling System Conditioner with Dowtherm 209 Full-Fill coolant. Follow the recommendations provided with the Dowtherm 209 Full-Fill coolant.**

**If the machine is shipped to or stored in an area with freezing temperatures, the cooling system must either be protected to the lowest expected outside temperatures or drained completely.**

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The engine cooling system is protected to -29°C (-20°F) with permanent-type antifreeze when shipped from the factory.

When draining and refilling the cooling system, start the engine with the radiator cap off. Allow the engine to reach operating temperature. Check the coolant level.

Premix antifreeze solution to provide protection to the lowest expected outside temperature.

Filling the cooling system at over a 19 liter/min (5 gpm) rate can cause air pockets in the cooling system.

When measuring the coolant level, inspect the fill cap gasket. Replace the cap if the gasket is damaged.

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

## **Fuel System**

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

Measure the fuel level with the dipstick in the fill opening.

Drain water and sediment from the fuel tank at the start of each shift or after the tank has been filled and allowed to stand 5 to 10 minutes. Drain moisture and sediment as required by prevailing conditions.

Drain water and sediment from the main fuel storage tank weekly. Also, drain the tank before it is refilled. This will help prevent water and sediment from being pumped into the machine fuel tank.

Always bleed the fuel system after changing fuel filters.

## **Hydraulic System**

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### **NOTICE**

**Make-up hydraulic fluid must mix with the fluid in the tank. Use only petroleum products unless the machine is equipped for use with special products.**

**Water or air in the hydraulic system can cause pump failure.**

**If the hydraulic oil is cloudy, water or air is entering the system. Purge and refill the system. Tighten the suction hose clamps and flanges. Consult your Caterpillar dealer for the correct purging instructions.**

**If hydraulic system drift is experienced, while operating at high outside temperatures, SAE30 hydraulic oil should be used.**

**SAE30 is not recommended if start-up temperatures will be below 4°C (40°F).**

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SAE30 hydraulic oil in high temperatures will minimize drift, and increase pump life at temperatures up to 55°C (125°F).

A mixture of 55% SAE40 and 45% SAE10W oil is the equivalent of SAE30.

The equivalent of SAE30 oil in the hydraulic system can be obtained by draining SAE10W oil from the tank, and replacing it with SAE40 oil.

**NOTE:** Retract as many hydraulic cylinders as possible.

Drain 320 liters (84 gal.) of SAE10W oil from the tank and replace it with SAE40 oil.

See "Hydraulic System" at "2000 Service Hours or Yearly" for hydraulic tank drain and refill instructions.

### **Engine Air Intake System**

Service the air cleaner when the indicator light goes on.

Inspect the air precleaner cup daily for accumulation of dust and debris.

### **Electrical System**

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#### **NOTICE**

**When using an external electrical source to start the machine, turn the disconnect switch off and remove the key before attaching the cable to the emergency starting receptacle.**

**When using booster cables, be sure to connect in parallel; POSITIVE (+) to POSITIVE (+) and NEGATIVE (-) to NEGATIVE (-).**

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### **Scheduled Oil Sampling**

Use scheduled oil sampling to monitor machine condition and maintenance requirements.

Each sample should be taken when the oil is hot and well mixed. This will ensure that the sample 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.

<b>Sampling Interval Chart</b>	
<b>Compartment</b>	<b>Interval</b>
Engine Crankcase	At Oil Change
Pump Drive	Every 500 Service Hours
Hydraulic System	Every 500 Service Hours

### General

Clean all plugs, fittings and caps before servicing.

### Bolt Torques for Ground Engaging Tools

<b>Bolt Size</b>	<b>Recommended Torque*</b>	
	<b>Inch</b>	<b>N·m</b>
5/8	265 ± 35	195 ± 25
3/4	475 ± 70	350 ± 50
7/8	765 ± 115	565 ± 85
1	1220 ± 150	900 ± 110

\*These values are applicable only to Caterpillar cutting edge bolts.

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# **Fuel, Coolant and Lubricant Specifications**

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## **Fuel Specifications**

### **Types of Fuel**

Caterpillar diesel 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. They 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 higher 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 number recommended for the engine is 40.

### **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.

A fuel heater attachment is available from your Caterpillar dealer. This can help keep heavier fuel above the cloud point temperature.

### **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 oil must have a TBN of 20 times the percentage of fuel sulfur. Your oil supplier should be able to furnish the correct oils.

## **Coolant Specifications (EC)**

Use a mixture of fill water, antifreeze and liquid cooling system 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.

Use water that is low in scale forming minerals - not softened water.

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

<b>Acceptable Water</b>		
<b>Water Content</b>	<b>50% or More Antifreeze</b>	<b>Less Than 50% Antifreeze</b>
Chlorides	100 ppm or less	50 ppm or less
Sulfates	100 ppm or less	50 ppm or less
Hardness as CaCO <sub>3</sub>	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 coolant freeze protection to the lowest expected outside temperature.

### **Conditioner**

Use Caterpillar Cooling System Conditioner or equivalent. Add enough conditioner to provide a 3% to 6% concentration in the coolant.

Use Caterpillar Liquid Cooling System Conditioner Part Numbers 6V3542 (.24 liter - 1/2 pt), 3P2044 (.95 liter - 1 qt) or 5P2907 (208 liters - 55 gal drum).

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### **NOTICE**

**Do not use Caterpillar Cooling System Conditioner with Dowtherm 209 Full-Fill coolant. Follow the recommendations provided with the Dowtherm Full-Fill coolant.**

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## **Lubricant Specifications**

The abbreviations listed below, except LO, 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. The recommended viscosities for this machine are found on the "Recommended Lubricants Viscosities" chart.

### **Engine Oils (CD)**

Use oils that meet Engine Service Classification CD (MIL-L-2104C).

Consult the EMA Lubricating Oil Data Book, Caterpillar Form Number SEBU5939, for a listing of CD engine oil brands.

The percentage of sulfur in the fuel will affect the engine oil recommendations. If the fuel being used has over 0.5% sulfur content, the CD engine oil must have a TBN of 20 times the percentage of fuel sulfur. Your oil supplier should be able to furnish the correct oils.

### **Lubricating Oils (LO)**

Engine Service Classification CC (MIL-L-2104B or MIL-L-46152) or CD.

### **Hydraulic Oils (HYDO)**

Use LO or industrial-type hydraulic oils that are certified by the supplier as having antiwear, antifoam, antirust and antioxidation additive properties for heavy duty use.

### **Lubricating Grease (MPG)**

Use Multipurpose-type Grease (MPG). Multipurpose-type grease which contains 3% to 5% molybdenum disulfide is preferred. NLGI No. 2 Grade is suitable for most temperatures. Use NLGI No. 1 or No. 0 Grade for extremely low temperatures.

## **Refill Capacities Chart**

The refill capacities given are approximate. Their use is not intended for exacting purposes such as billing. The amounts given are intended to be used as a guide when filling compartments or systems. Check the level as outlined in this guide to ensure the refill quantities are correct.

<b>Compartment or System</b>	<b>Liters</b>	<b>U.S. Gallons</b>	<b>Imperial Gallons</b>
Cooling System	22	5.75	5
Diesel Engine Crankcase	19	5	4.25
Diesel Fuel Tank	246	65	54.1
Hydraulic Tank	303	80	66.6
Pump Drive	5.7	1.5	1.2
Swing Drive	28	7.5	6.2
Swing Gear	11.4	3	2.5
Final Drives (each side)	11.4	3	2.5
Heavy Duty Final Drives (each side)	53	14	11.5
Clamshell Rotator Gear Drive	1.4	1.5 qt.	1.2 qt.

**Lubricant Viscosity Chart**

Recommended Lubricant Viscosities															
For Use At Outside Temperatures From -23°C (-10°F) to +49°C (+120°F)*															
Outside Temperature	°C	-23	-18	-12	-7	-1	+4	+10	+16	+21	+27	+32	+38	+43	+49
	°F	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120
Engine CD	SAE 10W														
	SAE 15W-40														
	SAE 30														
	SAE 40														
Hydraulic System HYDO	SAE 10W														
	SAE 15W-40														
	SAE 30														
Track Rollers and Idlers Clamshell Rotator Gear Drive CD	SAE 30														
Pump Drive CD	SAE 30														
	SAE 15W-40														
Swing Drive Final Drives LO	SAE 30														
Outside Temperature	°C	-23	-18	-12	-7	-1	+4	+10	+16	+21	+27	+32	+38	+43	+49
	°F	-10	0	+10	+20	+30	+40	+50	+60	+70	+80	+90	+100	+110	+120

\*See the Cold Weather Guide, Caterpillar Form Number SEBU5338, available from your Caterpillar dealer, when operating below -23°C (-10°F).



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# Lubrication and Maintenance Chart

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Item	Service	Lube.	Page
<b>When Required</b>			
Engine Air Cleaner	Service filters when the indicator lights with the engine running at high idle.		15
Fuel System	Replace fuel filter if engine lacks power.		19
Cooling System	Drain and clean the system if it is contaminated, if the engine overheats or if foaming occurs in the system — clean or replace the cap if coolant loss or overheating occurs.	EC	20
Starting Aid (ether) Cylinder	Replace the cylinder when it is empty.		22
Final Drives	Check oil level if leakage develops or is suspected — change oil at time of overhaul.	LO	23
Swing Gear Housing	Check the lubricant level if swing gear noise develops — drain water prior to freezing weather.	MPG	23
Swing Drive	Check the oil level if leakage develops or is suspected.	LO	24
Pump Drive	Check the oil level if leakage develops or is suspected.	CD	25
Hydraulic System	Replace filters if the hydraulic filter indicator lights — check the oil level if leakage develops or is suspected.	HYDO	26
Swing Brake	Adjust the brake if it does not prevent the upper structure from swinging against swing motor torque.		27
Track	Adjust when 25 to 40 mm (1 to 1 1/2 inch) of sag is not maintained.		27
Fuses	Check fuses if an electrical circuit does not function.		29
Windshield Washer and Wiper	Change wiper blades if worn or streaking — refill the washer bottle when empty.		30
Bucket Teeth and Side Cutters	Replace or rotate before the mounting surfaces become worn.		30
Clamshell Rotator Gear Drive	Check the oil level if leakage develops or is suspected — change oil at time of overhaul.	CD	32
Water Separator	Change the element when the inside of the element becomes contaminated.		32
<b>Every 10 Service Hours or Daily</b>			
① Cooling System	Check coolant level.	EC	34
② Engine Air Precleaner	Inspect — clean.		35
③ Engine Crankcase	Check oil level.	CD	35
④ Fuel Tank	Drain moisture and sediment.		36
⑤ Water Separator	Drain water.		37
⑥ Malfunction Warning System	Test.		37
Swing Bearing [Item ⑩]	Lubricate Every 10 Service Hours or Daily under severe operating conditions where mud, water and abrasive material may enter the bearings.	MPG	
Boom and Stick [Item ⑪]			
Backhoe Linkage and Bucket [Item ⑫]			
Clamshell Linkage and Bucket [Item ⑬]			

### Every 50 Service Hours or Weekly

⑦ Pump Drive	Check oil level.	CD	38
⑧ Hydraulic System	Check oil level.	HYDO	39
⑨ Batteries	Check electrolyte levels.		40
⑩ Swing Bearing	Lubricate 1 fitting.	MPG	41
⑪ Swing Drive	Check oil level.	LO	42
⑫ Boom and Stick	Lubricate 12 fittings.	MPG	42
⑬ Backhoe Linkage and Bucket	Lubricate 7 fittings.	MPG	43
⑭ Clamshell Linkage and Bucket	Lubricate 15 fittings.	MPG	44
⑮ Clamshell Rotator Gear Drive	Check oil level.	CD	45

### Every 250 Service Hours or Monthly

⑯ Engine Crankcase	Change oil and filters. 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. Your oil supplier should be able to furnish the correct oils.	CD	46
⑰ Fan and Alternator Belts	Inspect — adjust.		47
⑱ Fan Bearing	Lubricate 1 fitting.	MPG	48
⑲ Cooling System (Do not add conditioner monthly unless the engine has operated 250 hours).	Add cooling system conditioner.	EC	49

### Every 500 Service Hours or 3 Months

⑳ Hydraulic System	Change filter elements and wash screen.	HYDO	50
㉑ Fuel System	Service fuel filters — wash the fuel tank cap and strainer.		54
㉒ Seat Belt	Inspect — replace it at least every 3 years.		56
㉓ Engine Crankcase	Wash the breather.		57

### Every 2000 Service Hours or Yearly

㉔ Swing Gear	Inspect grease level.	MPG	58
㉕ Hydraulic System	Change oil — wash filler strainer — inspect suction hoses.	HYDO	58
㉖ Pump Drive	Change oil.	CD	61
㉗ Cooling System	Change coolant.	EC	62
㉘ Engine Valve Lash	Check — adjust.		64

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### When Required

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### Engine Air Cleaner - Service

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#### NOTICE

**Service the air cleaner only when the engine is stopped.**

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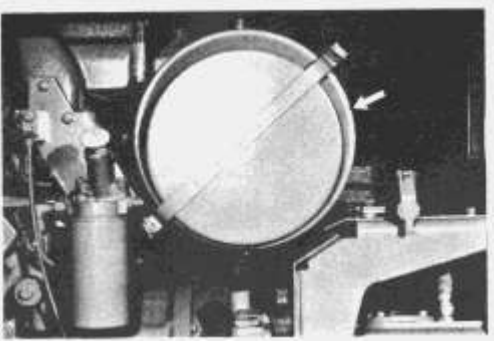


Service the air cleaner if the indicator light goes on with the engine running at high idle.



Open the right rear door for air cleaner access.

#### Primary Element



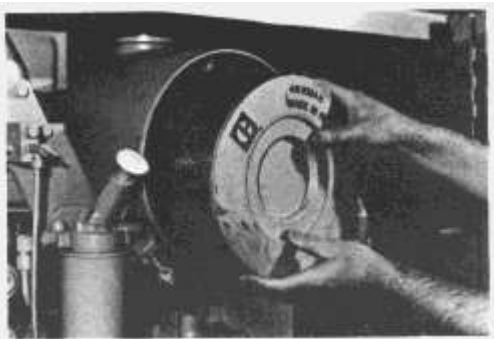
1. Remove the air cleaner cover.



2. Remove the primary filter element.



3. Clean inside the housing. Remove a tab from the secondary element.



4. Clean and inspect the primary element. See "Cleaning Primary Element." Install a clean element.



5. Clean and install the cover. Tighten the cover bolts finger tight to 4 N·m (3 lb ft).

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### NOTICE

**Do not use a tool to tighten the bolts.**

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If the amber light goes on after installing an element that has been cleaned 6 times, install another clean element.

The primary element should be replaced after being cleaned a maximum of 6 times. Replace the element at least once a year, even though it has not been cleaned 6 times.

If the amber indicator light goes on after installing a clean primary element, change the secondary element.

### Secondary Element

Replace the secondary element at the time the primary element is cleaned for the third time.

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### NOTICE

**Always replace the secondary element. Do not attempt to reuse by cleaning.**

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1. Open the right rear access door.



2. Remove the cover and primary element.



3. Remove the precleaner cap and cup. Wash them with soap and water. Allow them to dry.



4. Remove 8 nuts which secure the secondary element. Remove the element.



5. Cover the engine air inlet opening, clean inside the filter housing.

6. Replace the gasket between the engine air inlet pipe and the filter housing if it is damaged.



7. Uncover the engine air inlet opening and install a new secondary element. Install and tighten the nuts to  $25 \pm 7 \text{ N}\cdot\text{m}$  ( $20 \pm 5 \text{ lb ft}$ ).



8. Install the primary element and cover. Tighten the cover bolts finger tight to 4 N·m (3 lb ft).

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### NOTICE

**Do not use a tool to tighten the bolts.**

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9. Install the precleaner cup and cap. Close and secure the access door.

### Cleaning Primary Elements



**When using pressure air, wear a face shield and protective clothing. Use a maximum air pressure of 205 kPa (30 psi) for cleaning purposes.**

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### NOTICE

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

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

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