9010 Excavator
Service Manual

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Reprinted

Bur 7-45720

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9010 Excavator
Service Manual

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SECTION INDEX - GENERAL

Bur 7-45730

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Section

1001

STANDARD TORQUE SPECIFICATIONS FOR 9000 SERIES EXCAVATORS

Bur 7-44790

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TORQUE SPECIFICATIONS - DECIMAL HARDWARE

Use the torques in this chart when special torques are not given. These torques apply to fasteners with both UNC and UNF threads as received from suppliers, dry, or when lubricated with engine oil. Not applicable if special graphites, molydisulfide greases, or other extreme pressure lubricants are used.

Grade 5 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres
1/4 in	9-11	12-15
5/16 in	17-21	23-28
3/8 in	35-42	48-57
7/16 in	54-64	73-87
1/2 in	80-96	109-130
9/16 in	110-132	149-179
5/8 in	150-180	203-244
3/4 in	270-324	366-439
7/8 in	400-480	542-651
1.0 in	580-696	787-944
1-1/8 in	800-880	1085-1193
1-1/4 in	1120-1240	1519-1681
1-3/8 in	1460-1680	1980-2278
1-1/2 in	1940-2200	2631-2983

Grade 8 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres
1/4 in	12-15	16-20
5/16 in	24-29	33-39
3/8 in	45-54	61-73
7/16 in	70-84	95-114
1/2 in	110-132	149-179
9/16 in	160-192	217-260
5/8 in	220-264	298-358
3/4 in	380-456	515-618
7/8 in	600-720	814-976
1.0 in	900-1080	1220-1465
1-1/8 in	1280-1440	1736-1953
1-1/4 in	1820-2000	2468-2712
1-3/8 in	2380-2720	3227-3688
1-1/2 in	3160-3560	4285-4827

NOTE: *Use thick nuts with Grade 8 bolts.*

TORQUE SPECIFICATIONS - METRIC HARDWARE

Use the following torques when specifications are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil. These values do not apply if graphite or molydisulfide grease or oil is used.

Grade 8.8 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres
M6	6-7	8-9
M8	14-17	20-23
M10	29-34	39-46
M12	50-59	68-80
M16	128-149	173-202
M20	249-291	337-393
M22	342-399	464-541
M24	431-503	584-681
M27	637-743	864-1008
M30	863-1007	1170-1365
M33	1180-1377	1600-1867
M36	1977-2307	2680-3127
M42	2434-2840	3300-3850
M45	3054-3563	4140-4830
M48	3658-4268	4960-5787
M52	4757-5549	6450-7525
M56	5908-6893	8010-9345
M64	8925-10413	12100-14117

Grade 10.9 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres
M6	8-10	11-13
M8	20-24	28-32
M10	41-47	55-64
M12	71-83	96-112
M16	178-208	242-282
M20	350-408	475-554
M22	481-561	652-761
M24	606-707	821-958
M27	900-1050	1220-1423
M30	1217-1420	1650-1925
M33	1667-1945	2260-2637
M36	2124-2478	2880-3360
M39	2773-3235	3760-4387
M42	3422-3992	4640-5413
M45	4293-5009	5820-6790
M48	5141-5998	6970-8132
M52	6690-7805	9070-10582
M56	8334-9723	11300-13183
M64	12612-14714	17100-19950

Grade 12.9 Bolts, Nuts, and Studs

Usually the torque values specified for grade 10.9 fasteners can be used satisfactorily on grade 12.9 fasteners.

TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres
37 Degree Flare Fittings			
1/4 in 6.4 mm	7/16-20	6-12	8-16
5/16 in 7.9 mm	1/2-20	8-16	11-22
3/8 in 9.5 mm	9/16-18	10-25	14-34
1/2 in 12.7 mm	3/4-16	15-42	20-57
5/8 in 15.9 mm	7/8-14	25-58	34-79
3/4 in 19.0 mm	1-1/16-12	40-80	54-108
7/8 in 22.2 mm	1-3/16-12	60-100	81-135
1.0 in 25.4 mm	1-5/16-12	75-117	102-158
1-1/4 in 31.8 mm	1-5/8-12	125-165	169-223
1-1/2 in 38.1 mm	1-7/8-12	210-250	285-338

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres
Straight Threads with O-ring			
1/4 in 6.4 mm	7/16-20	12-19	16-26
5/16 in 7.9 mm	1/2-20	16-25	22-34
3/8 in 9.5 mm	9/16-18	25-40	34-54
1/2 in 12.7 mm	3/4-16	42-67	57-91
5/8 in 15.9 mm	7/8-14	58-92	79-124
3/4 in 19.0 mm	1-1/16-12	80-128	108-174
7/8 in 22.2 mm	1-3/16-12	100-160	136-216
1.0 in 25.4 mm	1-5/16-12	117-187	159-253
1-1/4 in 31.8 mm	1-5/8-12	165-264	224-357
1-1/2 in 38.1 mm	1-7/8-12	250-400	339-542

Split Flange Mounting Bolts*		
Size	Pound-Feet	Newton metres
5/16-18	15-20	20-27
3/8-16	20-25	27-34
7/16-14	35-45	47-61
1/2-13	55-65	74-88
5/8-11	140-150	190-203

***NOTE:** *Use standard metric hardware torque for metric split flange mounting bolts.*

TORQUE SPECIFICATIONS - O-RING FACE SEAL FITTINGS

Nom. SAE Dash Size	Tube OD	Thread Size	Pound-Feet	Newton metres	Thread Size	Pound-Feet	Newton metres
		O-ring Face Seal End			O-ring Boss End Fitting or Lock Nut		
-4	1/4 in 6.4 mm	9/16-18	10-12	14-16	7/16-20	17-20	23-27
-6	3/8 in 9.5 mm	11/16-16	18-20	24-27	9/16-18	25-30	34-41
-8	1/2 in 12.7 mm	13/16-16	32-40	43-54	3/4-16	45-50	61-68
-10	5/8 in 15.9 mm	1-14	46-56	62-76	7/8-14	60-65	81-88
-12	3/4 in 19.0 mm	1-3/16-12	65-80	90-110	1-1/16-12	85-90	115-122
-14	7/8 in 22.2 mm	1-3/16-12	65-80	90-110	1-3/16-12	95-100	129-136
-16	1.0 in 25.4 mm	1-7/16-12	92-105	125-140	1-5/16-12	115-125	156-169
-20	1-1/4 in 31.8 mm	1-11/16-12	125-140	170-190	1-5/8-12	150-160	203-217
-24	1-1/2 in 38.1 mm	2-12	150-180	200-254	1-7/8-12	190-200	258-271

Section 1002

FLUIDS AND LUBRICANTS

Bur 7-45590

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NOTE: The J I Case Company reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

CAPACITIES AND LUBRICANT SPECIFICATIONS

Fuel Tank
- Capacity ..... 63.4 U.S. gallons (240 litres)
- Type of fuel ..... See Diesel Fuel on page 6

Engine Oil Capacity
- Capacity with filter change ..... 11.6 U.S. quarts (11 litres)
- Type of Lubricant ..... Case IH Engine Oil, see Engine Lubrication on page 5

Engine Cooling System
- Capacity ..... 5 U.S. gallons (18.9 litres)
- Type of coolant ..... Use a mixture of 55% ethylene glycol and 45% water. If lowest ambient temperature will be below -34°F (1.11°C) adjust the mixture.

Hydraulic Reservoir
- Tank capacity ..... 21.9 U.S. gallons (83 litres)
- System capacity ..... 41.4 U.S. gallons (157 litres)
- Type of fluid ..... See Hydraulic Oil Chart on page 4

Swing Gearbox
- Capacity ..... 1.8 U.S. quarts (1.7 litres)
- Type of lubricant ..... Case IH 135H EP Gear Lube

Swing Ring Gear
- Capacity ..... 22 pounds (10 kg)
- Type of lubricant ..... Case No. 2 Lithium Grease

Turntable Bearing
- Capacity ..... As required
- Type of lubricant ..... Case No. 2 Lithium Grease

Final Drives
- Capacity ..... 2.8 U.S. quarts (2.5 litres)
- Type of lubricant ..... Case IH 135H EP Gear Lube

Track Roller
- Capacity ..... 5.3 ounces (160 cc)
- Type of lubricant ..... Shell Rimula Oil No. 30 or equivalent to API Class CD, SAE 30

Carrier Roller
- Capacity ..... 3.6 ounces (110 cc)
- Type of lubricant ..... Shell Rimula Oil No. 30 or equivalent to API Class CD, SAE 30

Idler Wheel
- Capacity ..... 4.6 ounces (140 cc)
- Type of lubricant ..... Shell Rimula Oil No. 30 or equivalent to API Class CD, SAE 30

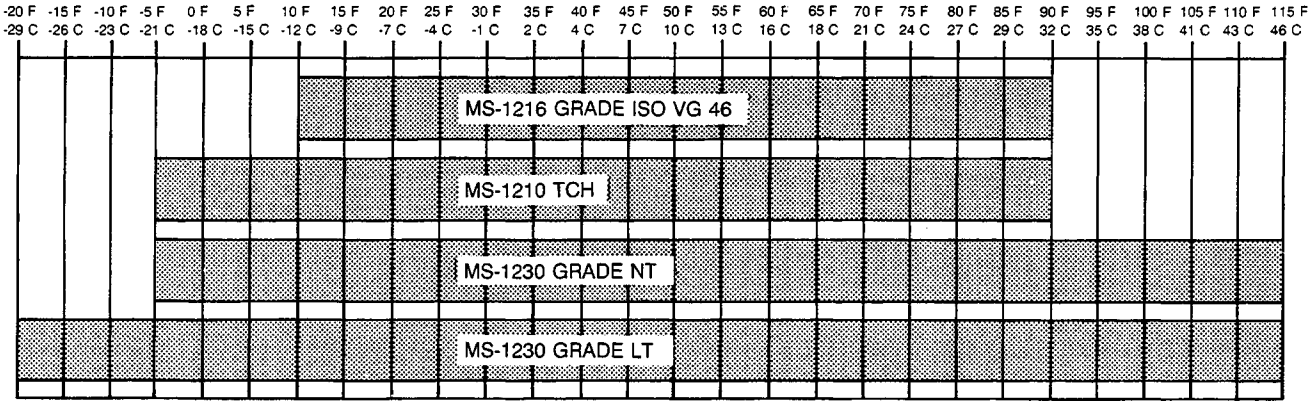
Track Adjustment Cylinder
- Capacity ..... As required
- Type of lubricant ..... Case No. 2 Lithium Grease

Grease Fitting
- Type of lubricant ..... Case No. 2 Lithium Grease

Batteries
- Capacity ..... As required
- Type of lubricant ..... Use drinking or distilled water

HYDRAULIC OIL CHART

Use only hydraulic oils meeting Case specifications of equivalent AW (anti-wear) hydraulic oils.



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NOTE: *Case specification MS-1210 TCH Fluid is used in place of ISO VG 32 (-5° to +65°F) and ISO VG 46 (+10° to +90°F).*

Case specifications MS-1230 Grade NT or Grade LT is used in place of ISO VG 32 (-5° to +65°F), ISO VG 46 (+10° to +90°F), ISO VG 100 (+30° to 115°F), and MS-1210 TCH.

ENGINE LUBRICATION

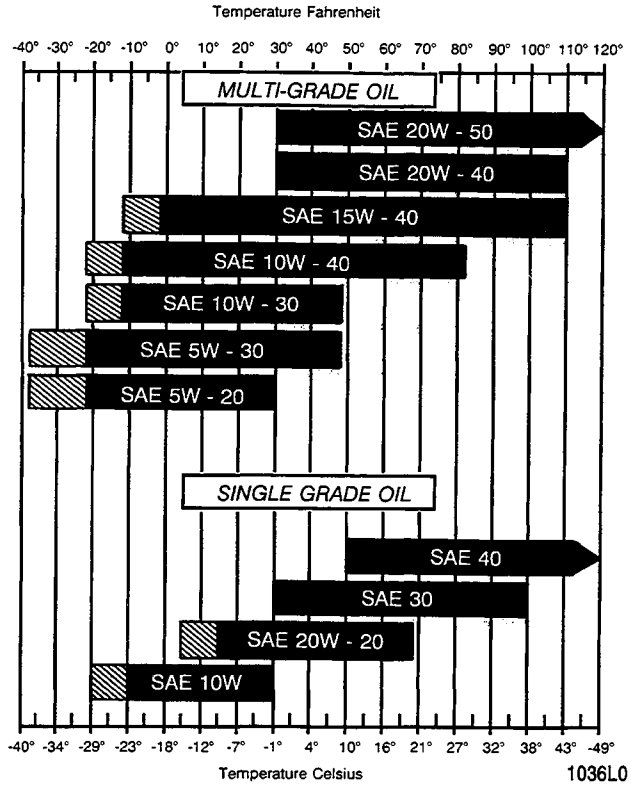
Engine Oil Selection

Case No. 1 Engine Oil is recommended for use in your Case Engine. Case Engine Oil will lubricate your engine correctly under all operating conditions.

If Case No. 1 Multi-Viscosity or Single Grade Engine Oil is not available, use only oil meeting API engine oil service category CE.

NOTE: *Do not put Performance Additives or other oil additive products in the engine crankcase. The oil change intervals given in this manual are according to tests with Case lubricants.*

Oil Viscosity/Temperature Ranges



NOTE: *Use of an engine oil pan heater or an engine coolant heater is required when operating temperatures are in the crosshatched area.*

DIESEL FUEL

Use No. 2 diesel fuel in the engine of this machine. The use of other fuels can cause the loss of engine power and high fuel consumption.

In very cold temperatures, a mixture of No. 1 and No. 2 diesel fuels is temporarily permitted. See the following Note.

NOTE: *See your fuel dealer for winter fuel requirements in your area. If the temperature of the fuel lowers below the cloud point (wax appearance point), wax crystals in the fuel will cause the engine to lose power or not start.*

The diesel fuel in this machine must meet the specifications in the chart below or Specification D975-81 of the American Society for Testing and Materials.

Fuel Storage

If you keep fuel in storage for a period of time, you can get foreign material or water in the fuel storage tank. Many engine problems are caused by water in the fuel.

Keep the fuel storage tank outside and keep the fuel as cool as possible. Remove water from the storage container at regular periods of time.

Fill the fuel tank at the end of the daily operating period to prevent condensation in the fuel tank.

Specifications for Acceptable No. 2 Diesel Fuel

API gravity, minimum	34
Flash point, minimum	140°F (60°C)
Cloud point (wax appearance point), maximum	-5°F (-20°C) See Note above
Pour point, maximum	-15°F (-26°C) See Note above
Distillation temperature, 90% point	540 to 640°F (282 to 338°C)
Viscosity, at 100°F (38°C)	
Centistokes	2.0 to 4.3
Saybolt Seconds Universal	32 to 40
Cetane number, minimum	43 (45 to 55 for winter or high altitudes)
Water and sediment, by volume, maximum	0.05 of 1%
Sulfur, by weight, maximum	0.50 of 1%
Copper strip corrosion, maximum	No. 2
Ash, by weight, maximum	0.01 of 1%

Engine fuel is flammable and can cause a fire or an explosion. Do not fill the fuel tank or service the fuel system near an open flame, welding, burning cigars, cigarettes, etc.

SECTION INDEX - ENGINES

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Section

2001

ENGINE REMOVAL AND INSTALLATION

Bur 7-46680

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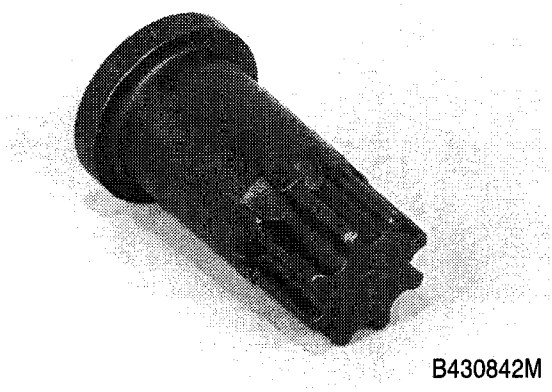
NOTE: The J I Case Company reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

SPECIFICATIONS

Cooling system capacity	5 U.S. gallons (18.9 litres)
Special torques	
Bolts that hold the engine mounts to the frame	195 to 231 pound-feet (264 to 313 Nm)
Cap screws that hold the rear engine mounts to the engine	71 to 83 pound-feet (96 to 112 Nm)
Cap screws that hold the front engine mounts to the engine	71 to 83 pound-feet (96 to 112 Nm)
Cap screws that hold the fan and the spacer to the engine	38 to 45 pound-feet (51 to 61 Nm)
Cap screws that hold the hydraulic pump to the flywheel housing	48 to 56 pound-feet (65 to 76 Nm)
Weight of the hydraulic pump	201 pounds (91 kg)
Weight of the engine	772 pounds (350 kg)

SPECIAL TOOLS



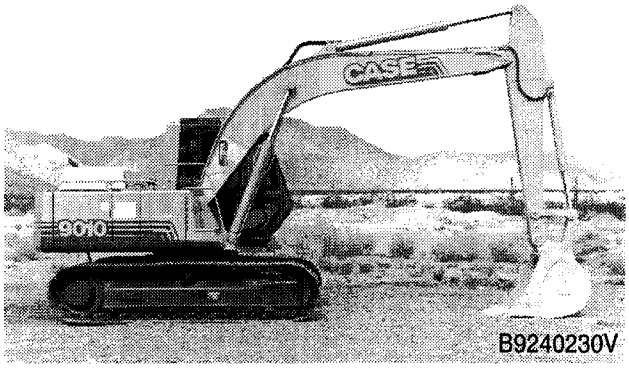
B430842M

CAS-1690 Tool used to rotate the flywheel.

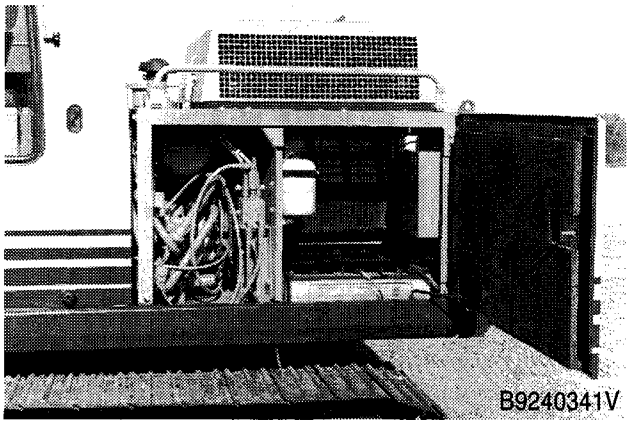
ENGINE

Removal

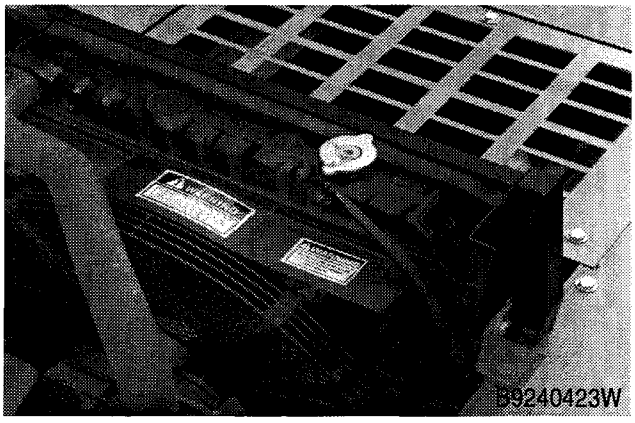
1. Park the machine on a hard level surface. Lower the tool to the floor and stop the engine.



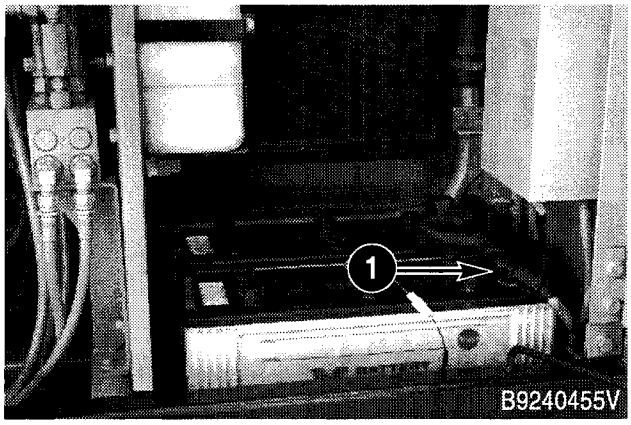
2. Open the access doors over the engine and on each side of the engine compartment. Remove the access covers from under the engine and the radiator.



3. Make sure that the engine is cool and remove the radiator cap. Open the drain valve and drain the cooling system. The cooling system holds 5 U.S. gallons (18.9 litres) of coolant.



4. Remove the access cover for the batteries and disconnect the ground cable.



1. Ground Cable

5. Remove the muffler and the mounting bracket for the muffler.

6. Disconnect the hose for the air cleaner from the turbocharger.

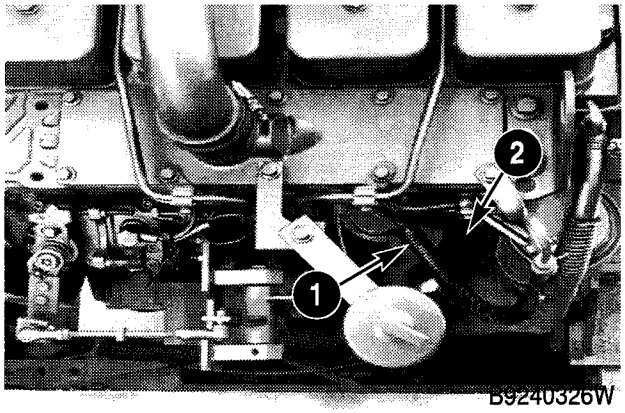
7. Disconnect the top (3) and bottom (4) radiator hoses from the radiator.

8. Disconnect the hose (2) for the coolant reservoir from the radiator.

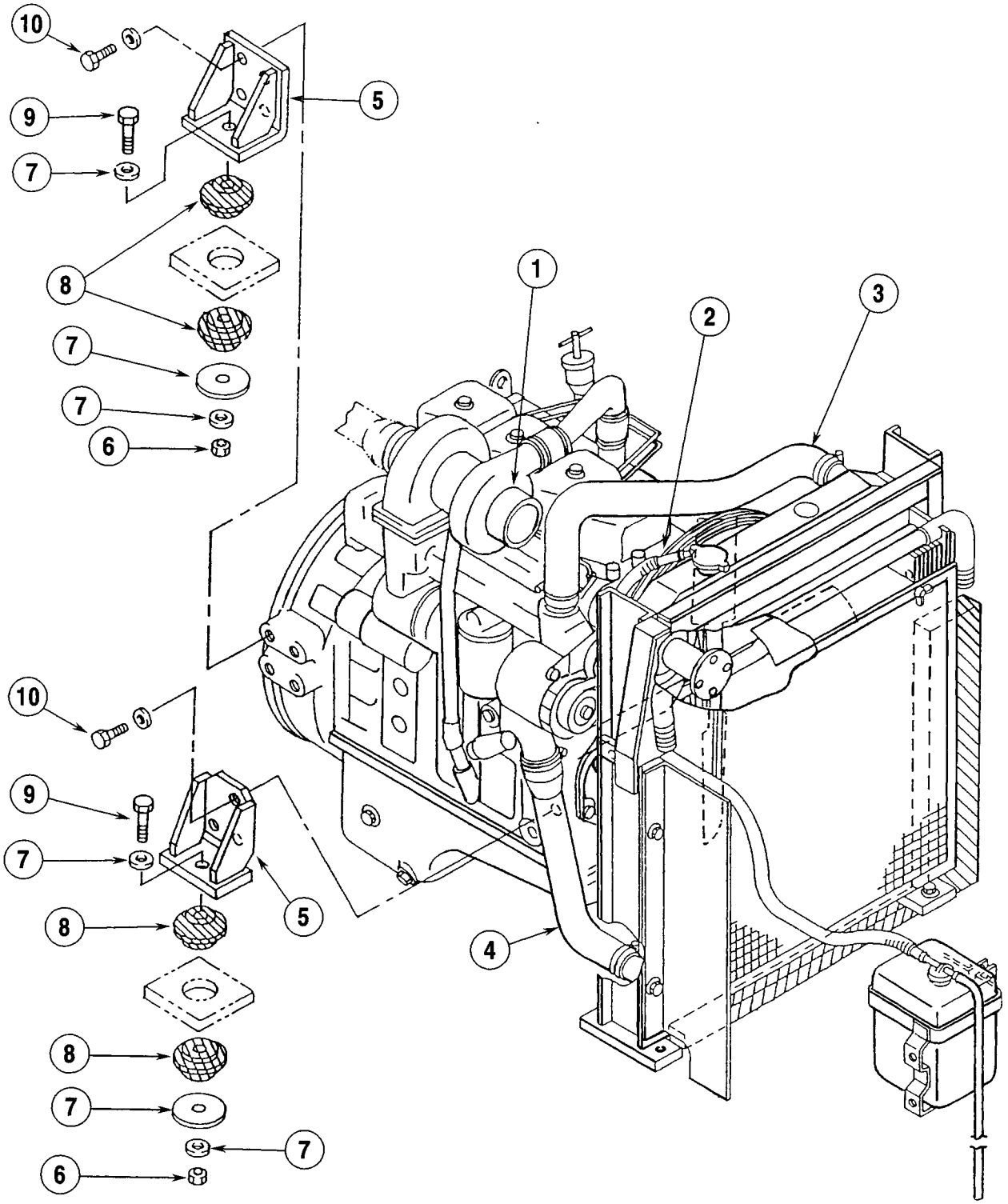
9. Remove the fan guard and the fan shroud from the radiator.

10. Remove the cap screws and hardware that hold the fan and the spacer to the engine.

11. Disconnect the fuel supply hose and the fuel return hose. Install a plug in each hose.

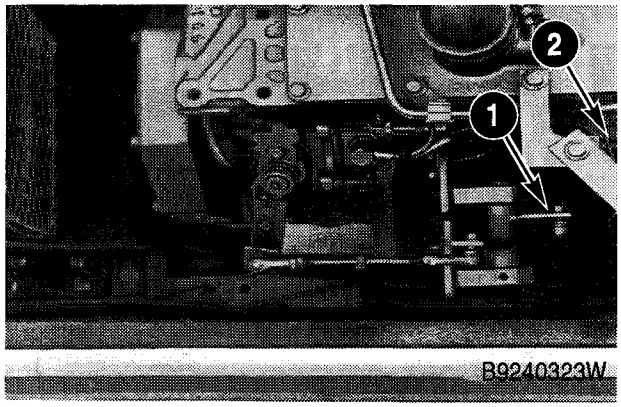


1. Supply Hose *2. Return Hose*



1. *Disconnect Hose for Air Cleaner Here*
2. *Hose for the Coolant Reservoir*
3. *Top Radiator Hose*
4. *Bottom Radiator Hose*
5. *Engine Mounting Bracket*
6. *Self-Locking Nut*
7. *Washer*
8. *Insulator*
9. *Tighten to 195 to 231 pound-feet (264 to 313 Nm)*
10. *Tighten to 71 to 83 pound-feet (96 to 112 Nm)*

12. Disconnect the throttle cable from the bellcrank at the bracket on the engine. If the machine is equipped with ether start, disconnect the tube from the fitting in the intake manifold.



1. Disconnect Throttle Cable Here *2. Tube for Ether Start*

13. Put identification tags on the wiring harness, wires and cables connected to the engine for correct assembly. Disconnect the wiring harness, wires and cables from the engine.

14. Disconnect the hoses for the heater from the engine. Install a plug in each hose.

15. Disconnect the ground strap from the engine.

16. Connect acceptable lifting equipment to the lifting eyes on the engine. The weight of the engine is 772 pounds (350 kg).

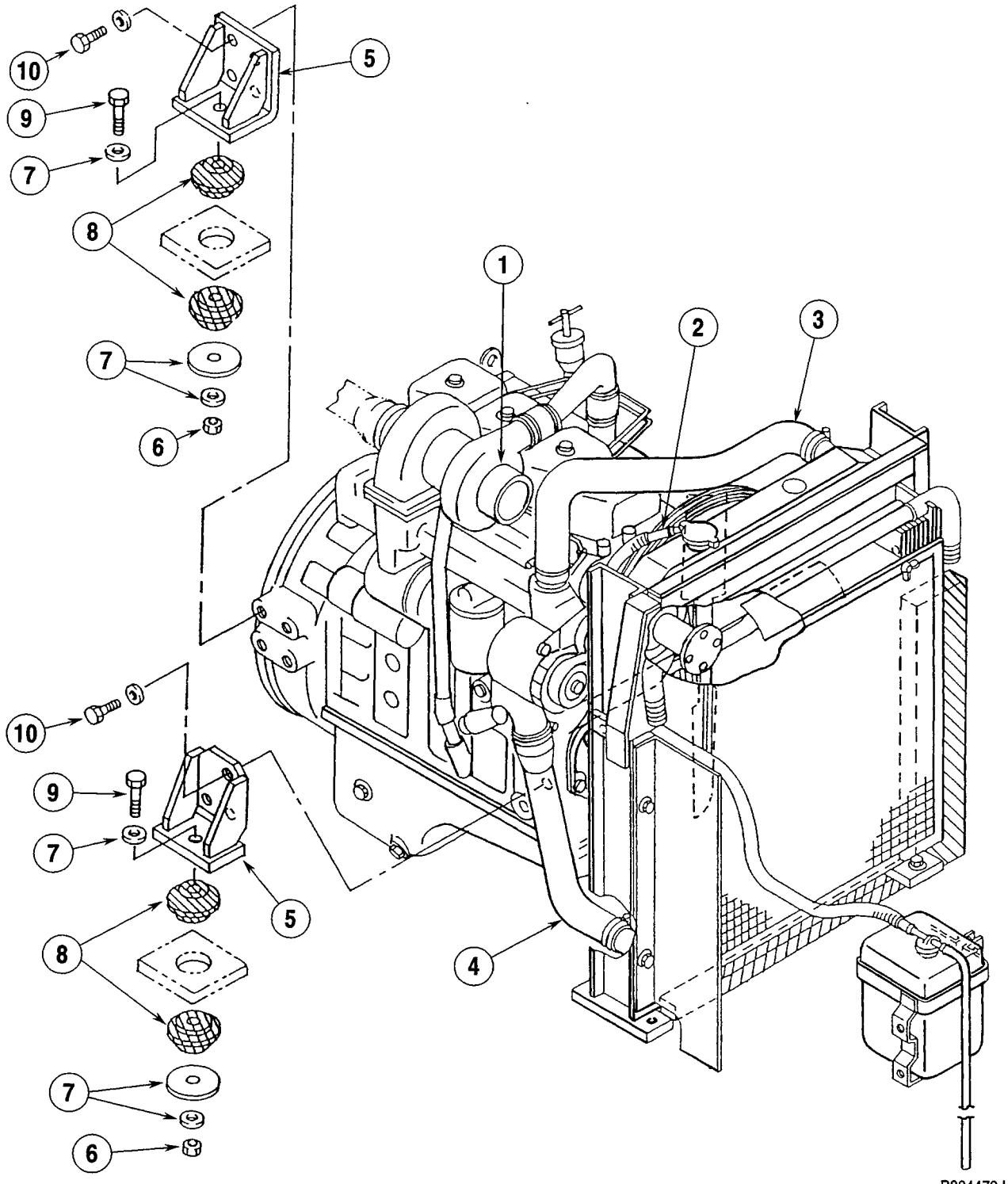
17. Connect a lifting sling to the hydraulic pump. The weight of the hydraulic pump is 201 pounds (91 kg). Remove the cap screws and hardened washers that hold the hydraulic pump to the flywheel housing.

18. Separate the hydraulic pump from the flywheel housing and disengage the splined shaft of the hydraulic pump from the splined hub in the coupling. The coupling and the drive plate will stay with the flywheel.

19. Remove the self-locking nuts (6), washers (7), insulators (8), and bolts (9) that hold the engine mounting brackets (5) to the frame.

20. Make sure that all hoses, tubes, cables, wires, and wiring harnesses are out of the way.

21. Lift the engine and remove the engine from the machine.



1. *Disconnect Hose for Air Cleaner Here*
2. *Hose for the Coolant Reservoir*
3. *Top Radiator Hose*
4. *Bottom Radiator Hose*
5. *Engine Mounting Bracket*
6. *Self-Locking Nut*
7. *Washer*
8. *Insulator*
9. *Tighten to 195 to 231 pound-feet (264 to 313 Nm)*
10. *Tighten to 71 to 83 pound-feet (96 to 112 Nm)*

Installation

Installation is the reverse sequence of removal.

1. Check the condition of the insulators for the engine mounts. If the insulators are damaged, install new insulators.

2. Use the CAS-1690 tool to rotate the flywheel and align the splined hub in the coupling with the splined shaft of the hydraulic pump.

3. Tighten the bolts that hold the engine mounting brackets to the frame to the torque specifications shown on page 3.

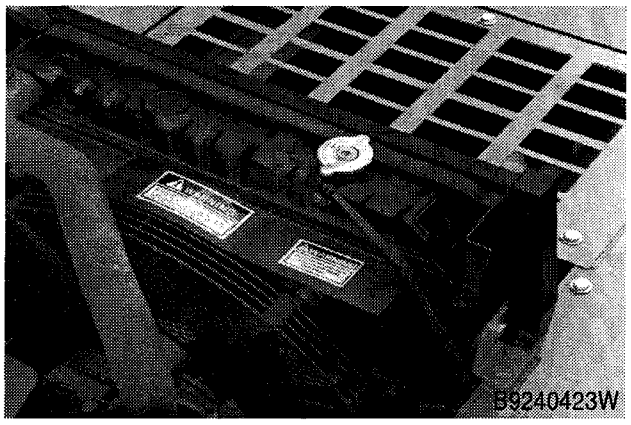
4. Tighten the cap screws that hold the hydraulic pump to the flywheel housing to the torque specifications shown on page 3.

5. Tighten the cap screws that hold the fan and the spacer to the engine to the torque specifications shown on page 3.

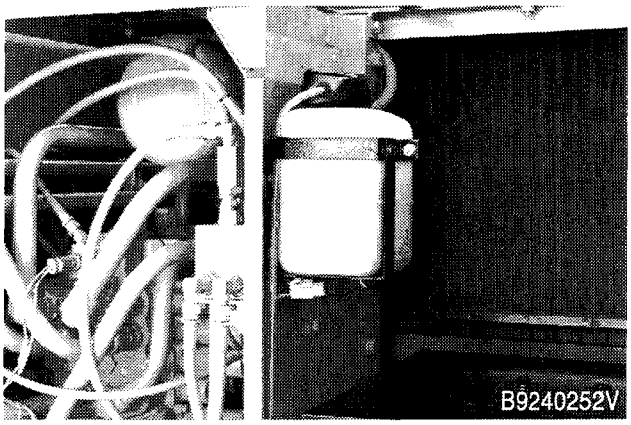
6. Do the following procedure to bleed the air from the cooling system.

   A. Close the drain valve on the radiator. Fill the radiator with coolant and fill the coolant reservoir to the fill neck. If new coolant is being installed, the coolant must be 55% ethylene glycol and 45% water.

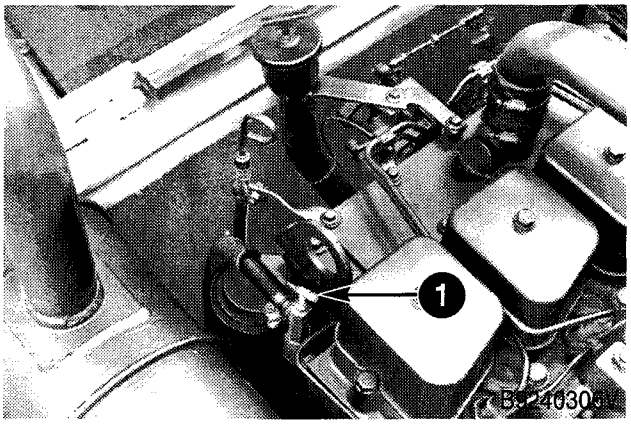
   B. Install and tighten the radiator cap.



C. Install and tighten the cap for the coolant reservoir.



D. Close the shutoff valve for the heater at the top rear of the engine.



1. Shutoff Valve

E. Start and run the engine at low idle for one minute.

F. Stop the engine. Fill the radiator with coolant again and fill the coolant reservoir again.

G. Cover the outside of the radiator core (the side away from the fan) with cardboard.

H. Start and run the engine at high idle. Look at the water temperature gauge. When the water temperature gauge indicates normal operating temperature (4th or 5th amber bar illuminated), open the shutoff valve for the heater.

I. Continue to run the engine until the last amber bar illuminates, then remove the cardboard from the radiator.

J. Reduce the engine speed to low idle. Continue to run the engine at low idle for 30 seconds.

K. Stop the engine and let the coolant cool.

L. When the radiator feels COLD, remove the radiator cap and the cap for the coolant reservoir.

M. Fill the radiator with coolant. Install and tighten the radiator cap.

N. Fill the coolant reservoir with coolant to the FULL mark. Install the cap for the coolant reservoir.

2002

Section

2002

RADIATOR REMOVAL AND INSTALLATION

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NOTE: The J I Case Company reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

SPECIFICATIONS

Cooling System capacity ..... 5 U.S. gallons (18.9 litres)

Special torques

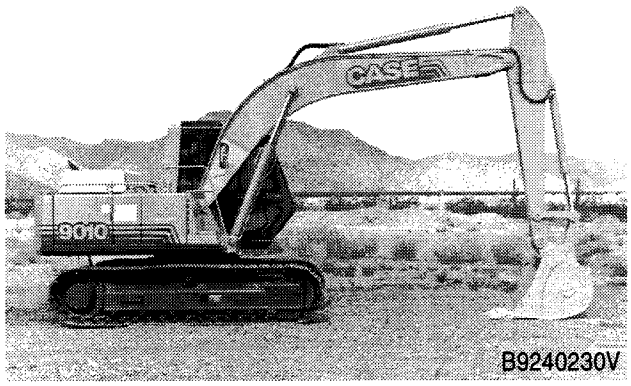
Cap screws that hold the fan and spacer to the engine ..... 38 to 45 pound-feet (51 to 61 Nm)

Weight of the radiator ..... 117 pounds (53 kg)

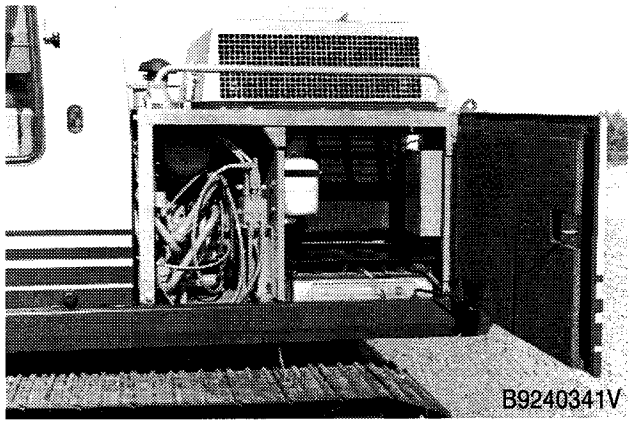
RADIATOR

Removal

1. Park the machine on a hard level surface. Lower the tool to the floor and stop the engine.



2. Open the access doors over the engine and on the left side of the engine compartment. Remove the access cover from under the radiator.



3. Make sure that the engine is cool and remove the radiator cap. Open the drain valve and drain the cooling system. The cooling system holds 5 U.S. gallons (18.9 litres) of coolant.

4. Disconnect the top and bottom radiator hoses from the radiator.

5. Disconnect the hose for the coolant reservoir from the radiator.

6. Remove the fan guard and the fan shroud from the radiator.

7. Remove the cap screws and hardware that hold the fan and the spacer to the engine. Remove the fan and the spacer.

8. Connect acceptable lifting equipment to the radiator. The weight of the radiator is 117 pounds (53 kg).

9. Remove the hardware that holds the radiator to the frame.

10. Remove the radiator from the machine.

Installation

Installation is the reverse sequence of removal.

1. If the foam baffles were removed from the radiator, install new foam baffles.

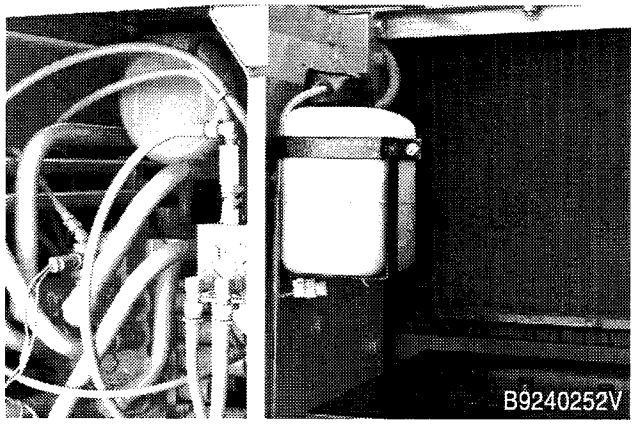
2. Tighten the cap screws that hold the fan and the spacer to the engine to the torque specifications shown on page 2.

3. Do the following procedure to bleed the air from the cooling system.

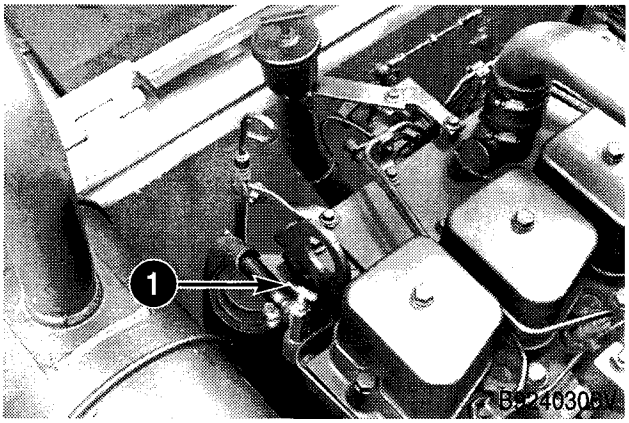
   A. Close the drain valve on the radiator. Fill the radiator with coolant and fill the coolant reservoir to the fill neck. If new coolant is being installed, the coolant must be 55% ethylene glycol and 45% water.

   B. Install and tighten the radiator cap.

   C. Install and tighten the cap for the coolant reservoir.



   D. Close the shutoff valve for the heater at the top rear of the engine.



1. Shutoff Valve

   E. Start and run the engine at low idle for one minute.

   F. Stop the engine. Fill the radiator with coolant again and fill the coolant reservoir again.

   G. Cove the outside of the radiator core (the side away from the fan) with cardboard.

   H. Start and run the engine at high idle. Look at the water temperature gauge. When the water temperature gauge indicates normal operating temperature (4th or 5th amber bar illuminated), open the shutoff valve for the heater.

   I. Continue to run the engine until the last amber bar illuminates, then remove the cardboard from the radiator.

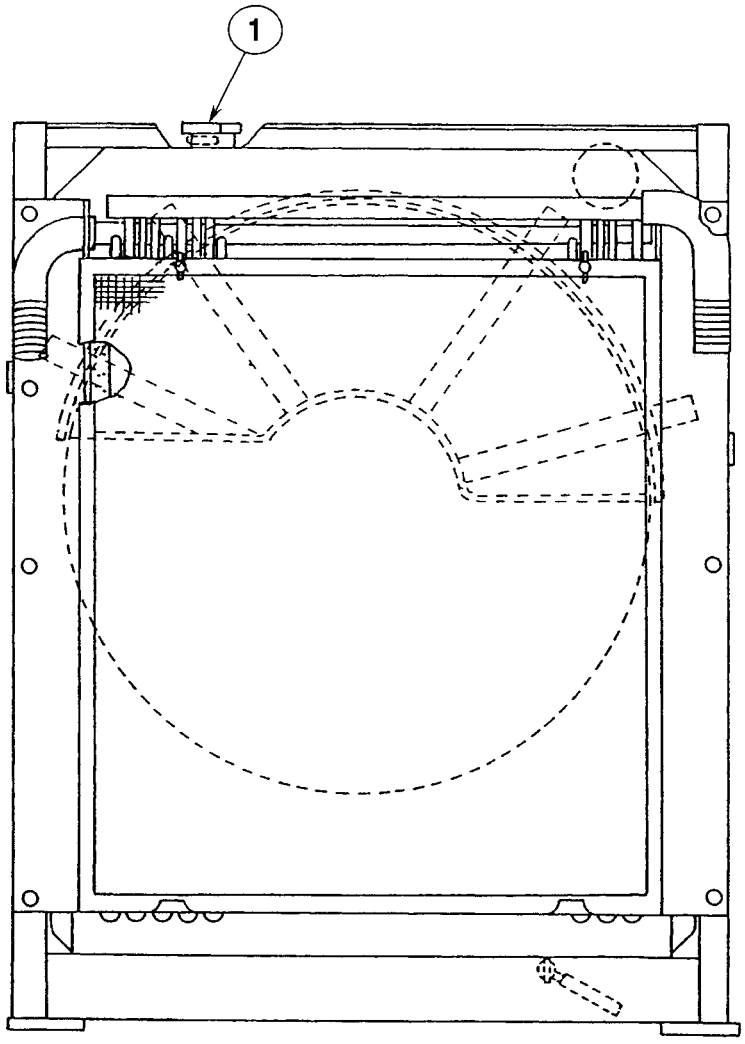
   J. Reduce the engine speed to low idle. Continue to run the engine at low idle for 30 seconds.

   K. Stop the engine and let the coolant cool.

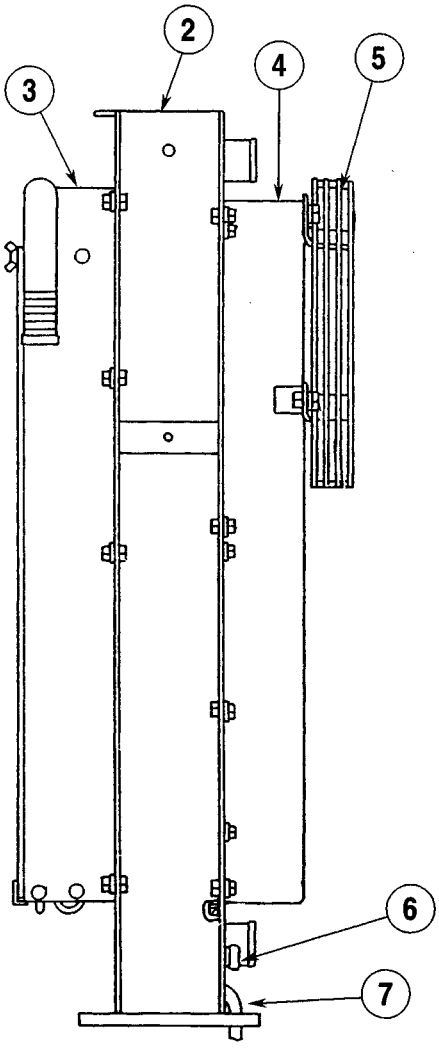
   L. When the radiator feels COLD, remove the radiator cap and the cap for the coolant reservoir.

   M. Fill the radiator with coolant. Install and tighten the radiator cap.

   N. Fill the coolant reservoir with coolant to the FULL mark. Install the cap for the coolant reservoir.



Front View of Oil Cooler and Radiator



Side View of Oil Cooler, Radiator, Frame, Fan Shroud, and Fan Guard

B924474J

1. *Radiator Cap*
2. *Radiator and Frame*
3. *Oil Cooler*
4. *Fan Shroud*
5. *Fan Guard*
6. *Drain Valve*
7. *Drain Hose*

Section

2402

SPECIFICATION DETAILS

4-390 Diesel Engine

IMPORTANT: *This engine was made using the metric measurement system. All measurements and checks must be made with metric tools to make sure of an accurate reading when inspecting parts.*

CASE CORPORATION

Rac 8-24163

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June, 1983 (Revised February, 1992)

TABLE OF CONTENTS

RUN-IN INSTRUCTIONS

Engine Lubrication

Fill the 4-390 engine crankcase with CC/SF, CD/SF, CE/SF or CF-4 service classification oil. Use the correct viscosity rating for the ambient air temperature. Install new oil filters after the engine is rebuilt.

Fill the 4T390 and the 4TA 390 engine crankcase with CE/SF or CF-4 service classification oil. Use the correct viscosity rating for the ambient air temperature. Install new oil filters after the engine is rebuilt.

Run-In Procedure for Rebuilt Engine

Step 1 Disconnect the wire to the electric shut-off on the injection pump so that the engine will not start. Crank the engine for 30 seconds until there is oil pressure, then reconnect the wire.

Step 2 Remove the air from the cooling system at the temperature sending unit.

Step 3 Run the engine at 1000 RPM minimum load for 5 minutes and check for oil leaks.

Step 4 During the Run-In, continue to check the oil pressure, coolant level, and coolant temperature.

Run-In Procedure for Rebuilt Engines (with a Dynamometer)

The following procedure must be followed when using a PTO dynamometer to Run-In the engine. The dynamometer will control the engine load at each speed and will remove stress on new parts during Run-In.

During the Run-In, continue to check the oil pressure, coolant level and coolant temperature.

STEP	TIME	ENGINE SPEED	DYNAMOMETER SCALE LOAD
1	5 Minutes	1000 RPM	50
2	5 Minutes	1100 RPM	1/2
3	5 Minutes	2200 RPM	Full

Run-In Procedure for Rebuilt Engines (without a Dynamometer)

STEP	TIME	ENGINE SPEED	LOAD
1	5 Minutes	1000 RPM	No Load
2	5 Minutes	1100 RPM	Light Load
3	5 Minutes	2200 RPM	Light Load

Run-In Procedure (Agriculture Equipment)

For the first 8 hours of field operation stay one gear lower than normal. For the next 12 hours DO NOT "lug" the engine. Prevent "lugging" by moving the lever to a lower gear. The engine must not be "lugged" below the rated engine RPM during early hours of life.

Run-In Procedure (Construction Equipment)

For the first 8 hours, operate the engine at full throttle maintaining a normal load. Avoid converter or hydraulic stall. The engine must not be "lugged" below the Rated Engine RPM (Do not stall the engine more than 10 seconds).

IDENTIFICATION MARKS

Crankshaft

Letter N = Nitroc Hardened, crankshaft must be rehardened to a minimum hardness of 450 HV 0.2 rockwell any time the crankshaft has been reconditioned.

Cylinder Block

Letter X = The cylinder block has been refaced and up to 0.25 mm has been removed. Use a thicker head gasket (two notches).

Letter XX = The cylinder block has been refaced and up to 0.50 mm has been removed. Use a thicker head gasket (three notches).

Cylinder Head

Letter G = Thermostat passage in cylinder did not need to be machined.

Letter M = Thermostat passage in cylinder head was machined.

Letter V = Valve seats have been machined.

Letter X = The cylinders in the cylinder block have been bored oversize. Use a head gasket with oversize cylinder holes (one notch). This gasket is used for standard replacement, 0.5 mm oversize and 1.0 mm oversize bore.

Letter XX = The cylinder block has been refaced and up to 0.25 mm has been removed use a thicker head gasket (two notches).

Letter XXX = The cylinder block has been refaced and up to 0.50 mm has been removed. Use a thicker head gasket (three notches).

Numbers = RH rear corner of cylinder head indicates the amount of material removed from the cylinder head.

ENGINE SPECIFICATION DETAILS

Cylinder Block

	Metric Value
Type	Non-Sleeved
Material	Cast Iron
ID of Cylinder	102.00 to 102.04 mm
Maximum Service Limit	102.116 mm
Cylinder Out of Round (Maximum)	0.038 mm
Cylinder Taper (Maximum)	0.076 mm
0.5 mm Oversize Piston	
Machine Cylinder Bore to	102.40 to 102.44 mm
Hone to (Finished Diameter)	102.50 to 102.54 mm
1.00 mm Oversize Piston	
Machine Cylinder Bore to	102.90 to 102.94 mm
Hone to (Finished Diameter)	103.00 to 103.04 mm
Warpage (Maximum)	0.075 mm
Maximum Material Removal	0.50 mm

Service Cylinder Sleeve

Type ..... Dry, Can Be Replaced
Material ..... Cast Iron
Machine Cylinder Block Bore to ..... 104.485 to 104.515 mm
Installation ..... Press Fit
Machine Sleeve Bore to:
- Standard Size Piston (Finished Diameter) ..... 102.00 to 102.04 mm
- 0.5 mm Oversize Piston
  - Machine Cylinder Bore to ..... 102.40 to 102.44 mm
  - Hone to (Finished Diameter) ..... 102.50 to 102.54 mm
- 1.0 mm Oversize Piston
  - Machine Cylinder Bore to ..... 102.90 to 102.94 mm
  - Hone to (Finished Diameter) ..... 103.00 to 103.04 mm

Piston

Type ..... Cam Ground
Material ..... Aluminum Alloy
OD at 12 mm From the Bottom, 90 Degrees Piston Pin
- Standard Size Piston ..... 101.873 to 101.887 mm
  - Minimum Service Limit ..... 101.823 mm
- 0.5 mm Oversize Piston ..... 102.373 to 102.387 mm
  - Minimum Service Limit ..... 101.323 mm
- 1.0 mm Oversize Piston ..... 102.873 to 102.887 mm
  - Minimum Service Limit ..... 102.823 mm

ID of Piston Pin Bore ..... 40.006 to 40.012 mm
- Maximum Service Limit ..... 40.025 mm

Width of 1st Ring Groove (Top) ..... 2.465 to 2.485 mm
Width of 2nd Ring Groove (Intermediate) ..... 2.425 to 2.445 mm
Width of 3rd Ring Groove (Oil Ring) ..... 4.040 to 4.060 mm
Protrusion Above Cylinder Block (Maximum) ..... 0.660 mm
Protrusion Above Cylinder Block (Minimum) ..... 0.280 mm

Piston Pin

Type ..... Full Float
OD of Pin ..... 39.997 to 40.003 mm
- Minimum Service Limit ..... 39.990 mm

Piston Rings

No. 1 Compression 4T-390 Engine	Key Stone Type (Barrel Face)
End Gap in 102.02 ID	0.4 to 0.70 mm
No. 1 Compression 4-390 Engine	Rectangular Type (Barrel Face)
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.075 to 0.120 mm
Maximum Service Limit	0.15 mm
No. 2 Compression	Rectangular Type (Tapper Face)
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.075 to 0.120 mm
Maximum Service Limit	0.15 mm
No. 3 Oil Control Rings	Two Piece
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.130 mm

Cylinder Head

Warpage (Maximum)	0.20 mm
Maximum Material Removal	1.00 mm
Minimum Head Height	93.75 mm
Engines Manufactured in U.S.A.:	
Prior to Engine Serial Number 45511034	Injector Nozzle 9 mm
Engine Serial Number 45511034 and After	Injector Nozzle 7 mm
Engines Manufactured in Darlington England:	
Prior to Engine Serial Number 21092870	Injector Nozzle 9 mm
Engine Serial Number 21092870 and After	Injector Nozzle 7 mm
Engines Manufactured in Neuss Germany:	
Prior to Engine Serial Number 52107489	Injector Nozzle 9 mm
Engine Serial Number 52107489 and After	Injector Nozzle 7 mm

Lifters

Material	Hardened Iron
OD of Lifter	15.961 to 15.977 mm
Minimum Service Limit	15.960 mm
Bore Diameter in Block	16.000 to 16.030 mm
Maximum Service Limit	16.055 mm