480D and 480LL
TABLE OF CONTENTS

CASE CORPORATION
9-69260
July 1981
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Section

1001

SAFETY RULES
SERVICE MANUAL INTRODUCTION
AND
TORQUE SPECIFICATIONS

Written In *Clear*
And
Simple
English

CASE CORPORATION

9-69260
July 1981

PRINTED IN U.S.A.

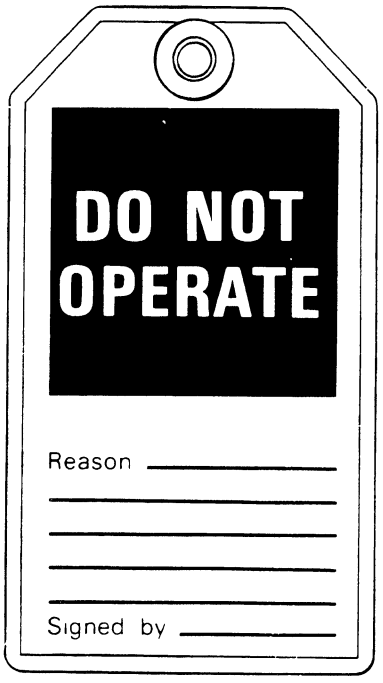
SAFETY RULES

This Symbol Shows Important Information About Safety In This Manual. When You See This Symbol, Carefully Read The Information That Follows and Understand The Possible Causes of Injury Or Death. 1-1-A

IMPORTANT: To prevent personal injury on job, follow the Warning, Caution, and Danger notes in this section and other sections throughout this manual. Follow the instructions carefully.

The procedures recommended and shown in this manual are good, effective service methods. However, all possible procedures and service hazards may not be covered. Therefore, if you use a tool or procedure not recommended, you must make sure that the method you select is a safe method.

Put the warning tag shown below on the key for the key switch when you are servicing or repairing this machine. One warning tag is on every new machine. You can buy additional warning tags, part number 331-4614, from Service Parts Supply.



780449

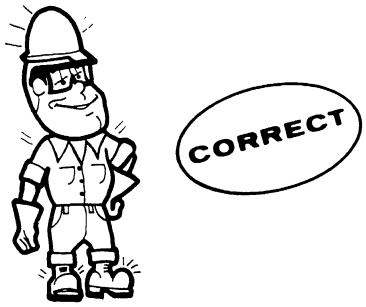
WARNING: *Read operator's manual to familiarize yourself with control lever functions.* 46-27

DANGER: *Before you move the backhoe boom to either side, make sure that all persons are out of the way. A swinging boom can crush.* 48-54

WARNING: *Operate tractor and equipment controls from the seat position only. Any other method could result in serious injury.* 48-55

WARNING: *This is a one man machine, no riders allowed.* 35-8

WARNING: *If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hat, safety shoes, ear protection, eye or face protection, heavy gloves and reflector clothing.* 45-3-A

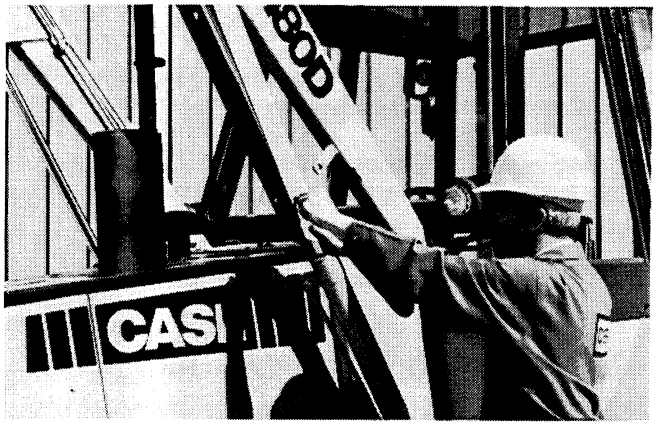


DANGER: *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. If you do not have an exhaust pipe extension, open the doors and get outside air into the area.* 48-56

WARNING: *When working in the area of the fan belt with the engine running, avoid loose clothing if possible, and use extreme caution.* 35-4

WARNING: *Operate controls from the operator's seat only.*

WARNING: *Whenever the bucket must be raised to aid in servicing, block the loader arms in place with lift cylinder safety strut or a suitable safety stand.* 23-7-A

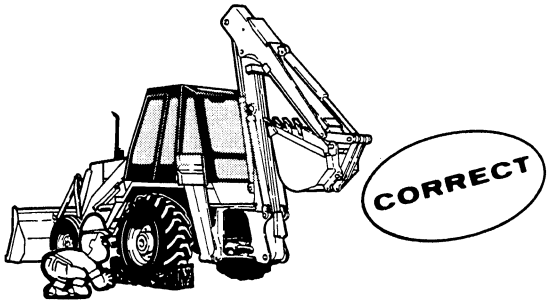


Lift Cylinder Safety Strut

CAUTION: *Use suitable floor (service) jacks or chain hoists to raise wheels off the floor. Always block machine in place with suitable safety stands.* 40-7

CAUTION: *Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this service manual.* 40-10

WARNING: *Locate the machine on level ground and block the wheels securely before working under the machine. Failure to follow the above procedure can result in personal injury.* 46-77



CAUTION: *When servicing or repairing the machine, keep the shop floor and operator's compartment and steps free of oil, water, grease, tools, etc. Use an oil absorbing material and/or shop cloths as required. Use safe practices at all times.* 40-8

CAUTION: *Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetrate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks; use a piece of cardboard or wood.* 40-6-A

CAUTION: *When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and a steel head hammer.* 46-17

CAUTION: *When using a hammer to remove and install pivot pins or separate parts, using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).* 46-13

WARNING: *When doing checks and tests on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure.* 47-44

WARNING: *When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, make sure all people are out of the way.* 47-45

WARNING: *Use insulated gloves or mittens when working with hot parts.* 47-41A

SERVICE MANUAL INTRODUCTION

This service manual has been prepared with the latest service information available. Troubleshooting, removal, disassembly, inspection and installation procedures, and complete specifications and tightening references can be found in most sections. Some sections have drawings without a written procedure because the job is so easily done. This service manual is one of the most important tools available to the service technician.

Right-Hand and Left-Hand

The terms right-hand and left-hand and front and rear as used in this manual indicate the right and left sides, and front and rear of the machine as seen from the operator's seat for correct operation of the machine or attachment.

Text

If the service manual is for more than one machine or different models of components (planetary axles, gear boxes, control valves, etc.) the procedures have the steps necessary to service each model.

Table of Contents

A Table of Contents is in the front of this manual. The Table of Contents shows the main divisions and the sections that are in each division. The individual sections, where necessary, have a Table of Contents on the second page of that section.

Page Numbers

All page numbers are made of two numbers separated by a dash, such as 4002-9. The number before the dash is the section number. The number following the dash is the page number in that section. Page numbers will be found at the upper right or left of each page.

Illustrations

Illustrations are put as near as possible to the text and are to be used as part of the text.

Torque Specifications

The most common grades of fasteners (bolts, nuts, and screws) used on Case machines are grade 5 and grade 8. See page 1001-5 for torque specifications and identification marks.

The specifications in this section are standard torque values and are to be used on all fasteners during assembly and installation unless special torque values are shown in a section.

P.I.N., Serial and Model Numbers

When replacement parts are needed, it can be necessary to give the parts department one or all of the numbers. The model number is normally found on the Product Identification Number plate or Serial Number plate.

The Product Identification Number (P.I.N.) and serial numbers will be found in the following locations.

Machine - The Product Identification Number plate is to the left of the operator manual box.

Engine - A serial number plate is on the right-hand side of the engine above the starter.

Mounted Equipment - A serial number plate or a stamped serial number is on some backhoes, dozers, rippers, etc.

Components - A serial number plate is on many components such as starters, alternators, pumps, etc.

Classification of Lubricants

The Society of Automotive Engineers (SAE), the American Petroleum Institute (API), and the National Lubricating Grease Institute (NLGI) put oil and grease in classifications and grades according to temperature and use.

Engine Oil

The SAE number is the viscosity of engine oils; for example, SAE 30, a single viscosity oil. SAE 10W30 is a variable viscosity oil.

The API classification (SD, CD, etc.) is the oil performance in terms of engine usage. Only oil specified in Section 1002 can be used. These oils have the needed chemical additives to give maximum engine protection. Both the SAE grade and API classification must be found on the container.

Gear Lubricant and Grease

Gear lubricant and grease for each application is specified in Section 1002.

Special Tools

Special tools are needed to remove and install, disassemble and assemble, check and adjust some component parts of this machine. Some special tools can be easily made locally and the necessary information to make the tool is in this service manual. Other special tools are more difficult to make locally and are available from Service Tools in the U.S. and from Jobborn Manufacturing in Canada. Use these tools according to the instructions in this service manual for your personal safety and to do the job correctly.

Order special tools from either of the following companies:

Service Tools
P.O. Box 314
Owatonna, Minnesota 55060

Jobborn Manufacturing Co.
97 Frid Street
Hamilton, Ontario L8P 4M3
Canada

TORQUE SPECIFICATIONS

Grade 5 Bolts, Nuts and Studs (Dry Threads)

Thread size	Pound-Feet	Newton metres
1/4-20 NC	5-10	7-13
1/4-28 NF	10-15	13-20
5/16-18 NC	15-20	20-27
5/16-24 NF	15-20	20-27
3/8-16 NC	25-35	34-47
3/8-24 NF	30-40	41-54
7/16-14 NC	45-55	61-74
7/16-20 NF	50-60	68-81
1/2-13 NC	65-85	88-15
1/2-20 NF	80-100	108-135
9/16-12 NC	100-120	135-163
9/16-18 NF	110-130	149-176
5/8-11 NC	135-165	183-223
5/8-18 NF	160-200	316-271

Thread size	Pound-Feet	Newton metres
3/4-10 NC	235-285	319-386
3/4-16 NF	270-330	366-447
7/8-9 NC	360-440	488-597
7/8-14 NF	395-490	536-664
1-8 NC	520-640	705-867
1-12 NF	575-705	780-955
1-1/8-7 NC	720-820	976-1111
1-1/8-12 NF	790-970	1071-1315
1-1/4-7 NC	1010-1240	1370-1681
1-1/4-12 NF	1115-1365	1512-1850
1-3/8-6 NC	1315-1610	1783-2182
1-3/8-12 NF	1510-1850	2047-2508
1-1/2-6 NC	1745-2135	2366-2894
1-1/2-12 NF	1880-2420	2549-3281

Grade 8 Bolts, Nuts and Studs (Dry Threads)

Thread size	Pound-Feet	Newton metres
1/4-20 NC	10-15	13-20
1/4-28 NF	15-20	20-27
5/16-18 NC	20-30	27-40
5/16-24 NF	25-30	34-40
3/8-16 NC	40-50	54-67
3/8-24 NF	45-55	61-74
7/16-14 NC	60-80	82-108
7/16-20 NF	70-90	95-122
1/2-13 NC	100-120	136-162
1/2-20 NF	110-130	149-176
9/16-12 NC	135-165	183-223
9/16-18 NF	155-190	210-257
5/8-11 NC	200-240	271-325
5/8-18 NF	215-265	292-359

Thread size	Pound-Feet	Newton metres
3/4-10 NC	340-420	461-569
3/4-16 NF	380-460	515-623
7/8-9 NC	540-660	732-894
7/8-14 NF	595-725	807-982
1-8 NC	810-990	1098-1342
1-12 NF	900-1100	1220-1491
1-1/8-7 NC	1150-1400	1559-1898
1-1/8-12 NF	1295-1585	1756-2148
1-1/4-7 NC	1640-2000	2224-2711
1-1/4-12 NF	1800-2200	2440-2982
1-3/8-6 NC	2140-2620	2901-3552
1-3/8-12 NF	2450-3000	3322-4067
1-1/2-6 NC	2845-3475	3857-4711
1-1/2-12 NF	3200-3900	4339-4880

TORQUE SPECIFICATIONS FOR STEEL HYDRAULIC FITTINGS

Dash Size	Tube O.D. Hose I.D.	Thread Size	37 Degree Flare		Straight Thread With O-ring	
			Pound-Feet	Newton metres	Pound-Feet	Newton metres
4	1/4 inch	7/16-20	6-12	8-16	12-19	16-25
5	5/16 inch	1/2-20	8-16	11-21	16-25	22-33
6	3/8 inch	9/16-18	10-25	14-33	25-40	34-54
8	1/2 inch	3/4-16	15-42	20-56	42-67	57-90
10	5/8 inch	7/8-14	25-58	34-78	58-92	79-124
12	3/4 inch	1-1/16-12	40-80	54-108	80-128	108-174
14	7/8 inch	1-3/16-12	60-100	81-135	100-160	136-216
16	1 inch	1-5/16-12	75-117	102-158	117-187	159-253
20	1-1/4 inches	1-5/8-12	125-165	169-223	165-264	224-357
24	1-1/2 inches	1-7/8-12	210-250	285-338	250-400	339-542

Split Flange Mounting Bolts (Grade 5, Dry Threads)

Thread Size	Pound-Feet	Newton metres
5/16-18 NC	15-20	20-27
3/8-16 NC	20-25	26-33
7/16-14 NC	34-35	47-61
1/2-13 NC	55-65	74-88
5/8-11 NC	140-150	190-203

Section 1002

MAINTENANCE AND LUBRICATION

Written In *Clear And Simple English*

9-69260
July 1981

PRINTED IN U.S.A.

CASE CORPORATION

MAINTENANCE CHART

This chart shows maximum service intervals for the correct maintenance of the machine. Some operating conditions will make it necessary to shorten the service intervals.

INTERVAL	SERVICE	INSTRUCTIONS
After the first 2 hours of operation, new machine only	Tighten the wheel bolts.	See Section 6229.
After the first 10, 20, 50, 100, and 200 hours of operation, new machine only	Tighten the mounting nuts for the backhoe.	See Section 9100.
After the first 20 hours of operation, new machine only	Do the After Delivery Check.	See the Operators Manual.
Every 10 hours of operation or each day, whichever occurs first	Lubricate the loader and backhoe pivot points.	
	Lubricate the Extendahoe dipper, if equipped.	See Section 9100
	Lubricate the three point hitch pivot points, if equipped.	
	Lubricate the front axle pivot points.	
	Check the level of the engine oil.	
	Check the level of the coolant in the radiator.	
	Check the level of the hydraulic oil.	See Section 8002.
	Clean the dust cup for the air cleaner, if equipped.	See Section 2007.
	Check the level of the oil in the power shuttle transmission.	See Section 6202.
	Clean or replace all safety and instruction decals that cannot be read.	See Section 9202.
Every 100 hours of operation	Lubricate the tie rod pivots.	
	Lubricate the rear axle bearings.	
	Lubricate the brake lever pivots.	
	Lubricate the parking brake cross shaft.	
	Lubricate the brake pedal pivots.	
	Lubricate the parking brake cable.	

INTERVAL	SERVICE	INSTRUCTIONS
Every 100 hours of operation, continued	Lubricate the seat post.	
	Change the engine oil.	
	Check the level of the oil in the transaxle.	See Section 6212.
	Check the level of the oil in the brake master cylinder.	See Section 7106.
	Check the level of the fluid in the battery.	See Section 4005.
	Clean the spark arrester muffler.	See Section 2007.
Every 200 hours of operation	Replace the engine oil filter.	
	Check the tension of the drive belts.	See Section 4007.
	Clean the battery.	
	Tighten the mounting nuts for the backhoe.	See Section 9101.
Every 500 hours of operation	Lubricate the universal joints of the drive shaft.	
	Lubricate the drive coupling for the hydraulic pump.	See Section 8005.
	Replace the fuel filters.	See Section 3010.
	Lubricate the front wheel bearings.	See Section 5021.
	Inspect the ROPS cab or ROPS canopy.	See Section 9061.
	Replace the hydraulic filter.	See Section 8002.
	Check the engine valve adjustment.	See Section 2015.
	Lubricate the loader control pivot points.	
	Clean hydraulic reservoir breather.	
	Lubricate the backhoe control pivot points.	
Every 1000 hours of operation or two times a year, whichever occurs first	Change the hydraulic oil.	See Section 8002.
	Change the oil in the power shuttle transmission.	See Section 6202.
	Check injection nozzles and adjust, if necessary.	See Section 3013.
	Clean the screen for the power shuttle transmission.	See Section 6202.
	Change the oil for the transaxle.	See Section 6213.
	Drain water and sediment from fuel tank.	

INTERVAL	SERVICE	INSTRUCTIONS
Every 2000 hours of operation or each year, whichever occurs first	Change the coolant in the radiator. Clean the cooling system.	See Fluids and Lubricants Chart.
As necessary	Service the air cleaner filters when the air filter warning lamp is illuminated.	See Section 2007.
	Replace the hydraulic filter when the warning lamp for the hydraulic filter is illuminated during operation.	See Section 8002.
	When a wheel is removed and installed, tighten the bolts for the wheel every two hours until the torque does not change.	See Section 6229.
	After the backhoe has been installed, check the tightness of the mounting nuts every two hours until the nuts stay tight.	
	Replace the ether can for the ether injection system.	
	Adjust the parking brake.	See Section 7106.

FLUIDS AND LUBRICANTS

COMPONENT	CAPACITY		SPECIFICATIONS
	U.S.	Metric	
Fuel tank	23.5 gallons	89 litres	See Operators Manual
Engine crankcase			
Without filter change	6 quarts	5.7 litres	Case HDM Oil
With filter change	7 quarts	6.6 litres	API Classification CD Above 32° F (0° C) .....SAE 30 10 - 50° F (-12° - 10° C) .....SAE 20W20 Below 32° F (0° C) .....SAE 10W
Hydraulic reservoir	11 gallons	41 litres	Case TCH Fluid Alternate oil: Engine oil SC, service class C Above 32° F (0° C) .....SAE 20 Below 32° F (0° C) .....SAE 10W **NOTE:** Do not mix engine oil and TCH Fluid.
Power shuttle transmission	8 quarts	7.6 litres	Case TCH Fluid
Transaxle	20 quarts	18.9 litres	Case FDL Final Drive Lube Alternate oil: Gear Lubricant (API-GL-4) Above 0° F (-18° C) .....SAE 90 Below 0° F (-18° C) .....SAE 80
Engine cooling system			
With heater	18 quarts	17 litres	Mix an ethylene glycol coolant with water for the lowest outside temperature that is expected. The mixture must be at least 50%50.
Without heater	14 quarts	13.2 litres	
Battery	As required		Add drinking water or distilled water.
Grease fittings	As required		No. 2 Molydisulfide grease
Wheel bearings	As required		Wheel bearing grease
Brake master cylinder (See Note)	As required		Case TCH Fluid Alternate oil: Automatic transmission fluid (ATF) such as Dexron II.
Parking brake cable	As required		Lubriplate 105 grease.

NOTE: DO NOT use brake fluid in the brake system of this machine. Use the oil shown under Specifications only. Brake fluid will cause damage to the brake system.

Section

1010

GENERAL ENGINE SPECIFICATIONS

188BD DIESEL ENGINES

Written In *Clear And Simple English*

CASE CORPORATION

Rac 8-23060

Printed in U.S.A.
January, 1981

General

Type	4 Cylinder, 4 Stroke Cycle, Valve-In-Head
Firing Order	1-3-4-2
Bore	3-13/16 Inches (96.84 mm)
Stroke	4-1/8 Inches (104.78 mm)
Piston Displacement	188 Cubic Inches (3 081 cm^3)
Compression Ratio	17 to 1
No Load Governed Speed	2230 to 2270 RPM
Rated Engine Speed	2100 RPM
Engine Idling Speed	700 to 750 RPM
Valve Tappet Clearance (Exhaust)	(Cold) 0.014 Inch (0.356 mm)
(Intake)	(Cold) 0.012 Inch (0.305 mm)

Piston And Connecting Rods

Rings Per Piston	3
Number Of Compression Rings	2
Number Of Oil Rings	1
Type Pins	Full Floating Type
Type Bearing	Replaceable Precision, Steel Back, Copper-Lead Alloy Liners

Main Bearings

Number Of Bearings	5
Type Bearing	Replaceable Precision, Steel Back, Copper-Lead Alloy Liners

Engine Lubricating System

Crankcase Capacity (Without Filter Change)	6 Quarts (5.7 litres)
(With Filter Change)	7 Quarts (6.7 litres)
Oil Pressure	50 to 70 PSI (345 to 483 kPa)(3.45 to 4.83 bar) With Engine Warm And Operating At Rated Engine Speed
Type System	Pressure And Spray Circulation
Oil Pump	Gear Type
Oil Filter	Full Flow Spin On Type

Fuel System

Fuel Injection Pump	Roosa-Master
Pump Timing	7 Degrees Before Top Center
Fuel Injectors	Pencil type, Opening Pressure (New) 3150 to 3250 PSI (21 719 to 22 409 kPa)
Fuel Transfer Pump	Vane Type, Integral Part Of Injection Pump
Governor	Variable Speed, Fly-Weight Centrifugal Type, Integral Part Of Injection Pump
1st Stage Fuel Filter	Spin On Type
2nd Stage Fuel Filter	Spin On Type

NOTE: The 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.

Section
1027

DETAILED SPECIFICATIONS

188 Diesel Engines

FRACTION to DECIMAL to MILLIMETER CONVERSION TABLE

Fraction	Decimal	MM	Fraction	Decimal	MM	Fraction	Decimal	MM
1/64	.0156	0.397	23/64	.3593	9.128	45/64	.7031	17.859
1/32	.0312	0.794	**3/8**	**.3750**	**9.525**	23/32	.7187	18.256
3/64	.0468	1.191	25/64	.3906	9.922	47/64	.7343	18.653
1/16	.0625	1.587	13/32	.4062	10.319	**3/4**	**.7500**	**19.050**
5/64	.0781	1.984	27/64	.4218	10.716	49/64	.7656	19.447
3/32	.0937	2.381	7/16	.4375	11.113	25/32	.7812	19.844
7/64	.1093	2.778	29/64	.4531	11.509	51/64	.7968	20.240
1/8	**.1250**	**3.175**	15/32	.4687	11.906	13/16	.8125	20.637
9/64	.1406	3.572	31/64	.4843	12.303	53/64	.8281	21.034
5/32	.1562	3.969	**1/2**	**.5000**	**12.700**	27/32	.8437	21.431
11/64	.1718	4.366	33/64	.5156	13.097	55/64	.8593	21.828
3/16	.1875	4.762	17/32	.5312	13.494	**7/8**	**.8750**	**22.225**
13/64	.2031	5.159	35/64	.5468	13.890	57/64	.8906	22.622
7/32	.2187	5.556	9/16	.5625	14.287	29/32	.9062	23.019
15/64	.2343	5.953	37/64	.5781	14.684	59/64	.9218	23.415
1/4	**.2500**	**6.350**	19/32	.5937	15.081	15/16	.9375	23.812
17/64	.2656	6.747	39/64	.6093	15.478	61/64	.9531	24.209
9/32	.2812	7.144	**5/8**	**.6250**	**15.875**	31/32	.9687	24.606
19/64	.2968	7.541	41/64	.6406	16.272	63/64	.9843	25.003
5/16	.3125	7.937	21/32	.6562	16.669	**1**	**1.0000**	**25.400**
21/64	.3281	8.334	43/64	.6718	17.065			
11/32	.3437	8.731	11/16	.6875	17.462			

INCH to MILLIMETER CONVERSION TABLE

Inch	MM	Inch	MM	Inch	MM	Inch	MM
1	25.400	6	152.000	10	254.000	60	1,524.000
2	50.800	7	177.800	20	508.000	70	1,778.000
3	76.200	8	203.200	30	762.000	80	2,032.000
4	101.600	9	228.600	40	1,016.000	90	2,286.000
5	127.000	10	254.000	50	1,270.000	100	2,540.000

Rac. 9-78675

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TABLE OF CONTENTS

RUN-IN-INSTRUCTIONS

Engine Lubrication

When the engine rebuild is complete, fill the engine crankcase with Case HDM oil and install new engine oil filter. **NOTE:** If Case HDM oil is not used, use only a Series 3 DS or CD Service Classification oil that has the proper viscosity rating for prevailing air temperature. Refer to vehicle Operators Manual.

After the first 20 hours of operation, change the engine oil while the engine is hot and replace the the engine oil filter. DO NOT DRAIN OIL UNTIL THE ENGINE HAS BEEN OPERATED 20 HOURS.

Change the engine oil and filter at the recommended intervals thereafter as outlined in the Operator's Manual.

Break-In Procedure for Rebuilt Engines (With a Dynamometer)

The following procedure must be implemented when using a PTO dynamometer to break-in the engine. The dynamometer will insure control of the engine load at each speed and will eliminate over stressing new parts during break-in.

During the break-in, continually check the oil pressure, coolant level, and coolant temperature.

STEP	TIME	ENGINE SPEED	DYNAMOMETER SCALE LOAD*
1	**10 Minutes	1000 RPM	None
2	**10 Minutes	1800 RPM	None
3	20 Minutes	1800 RPM	1/3
4	20 Minutes	1800 RPM	1/2
5	***30 Minutes	100 RPM below rated speed	3/4
6	Retorque the cylinder head bolts using the procedure described in Section 2015 of this service manual.		

*Based upon normal dynamometer scale load at rated speed for the particular vehicle model. Reduce this scale load as indicated.

**The most ideal break-in procedure would be to constantly vary the throttle between 750 to 1000 RPM for the first 10 minutes and from 1000 RPM to 1800 RPM for the next 10 minutes. The purpose of this changing RPM is to vary the lubrication and coolant flow.

***30 minutes at 3/4 load is a minimum amount of time the engine should be run. It is recommended that whenever possible the engine (especially turbocharged diesels) should be run for four (4) hours or more at the above speed and load before checking the full engine horsepower or before using the engine for heavy field work.

Break-In Procedure for Rebuilt Engines (Without a Dynamometer)

STEP	TIME	ENGINE SPEED	LOAD
1	*10 Minutes	1000 RPM	None
2	*10 Minutes	1800 RPM	None
3	30 Minutes	2/3 Rated RPM	Light Load
4	1 Hour	Full RPM (not over 2000 RPM)	80 to 90%
5	Retorque the cylinder head bolts using the procedure described in Section 2015 of this service manual.		

*If engine must then run at or near full load to operate the machine - for first hour remove load and run at high idle for a few minutes at 15 minute intervals.

Run-In Procedure (Agricultural Tractors)

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 shifting to a lower gear. The engine must not be "lugged" below its Rated Engine RPM during the early hours of life.

Run-In Procedure (Construction Equipment)

For the first 8 hours, operate the engine at full throttle maintaining a normal load. DO NOT baby the engine, but avoid prolonged converter or hydraulic stall. Engine must not be "lugged" below its Rated Engine RPM (Do not exceed 10 seconds of stall).

Run-In Procedure (Power Units)

For the first 1/2 hour, operate engine at 2/3 rated RPM with a light load or no load. For the next (1) hour, run engine at 80 to 90% load at rated RPM (but not over 2000 RPM). Then full load and rated RPM as required in application.

DETAILED ENGINE SPECIFICATIONS

Cylinder Sleeves

	U.S. Value	Metric Value
Type	Replaceable Wet	
Material	Cast Iron	
I.D. of sleeve	3.8125 to 3.8115″	96.838 to 96.812mm
Maximum Serviceable Limit	3.8165″	96.939mm
Sleeve out-of-round (installed in block)	.001″ max.	.025mm
Maximum Serviceable Limit	.004″	.102mm
Taper (installed in block)	.001″	.025mm
Maximum Serviceable Limit	.004″	.102mm
Clearance to bottom of piston skirt, 90° to piston pin	.0035 to .0055″	.090 to .140mm
Maximum Serviceable Limit	.0100″	.254mm
Sleeve Protrusion above cylinder block (Max.)	.005″	.127mm

Piston

Type	Cam ground	
Material	Aluminum Alloy	
O.D. at bottom of skirt, 90° to piston pin	3.807 to 3.808″	96.698 to 96.723mm
Minimum Serviceable Limit	3.806″	96.672mm
I.D. of piston pin bore including wear	1.2500 to 1.2508″	31.750 to 31.770mm
Width of 2nd ring groove	.097 to .098″	2.464 to 2.489mm
Maximum Serviceable Limit	.100″	2.540mm
Width of 3rd ring groove	.1885 to .1895″	4.788 to 4.813mm
Maximum Serviceable Limit	.1915″	4.864mm

Piston Rings

No. 1 Compression	Chrome Grooved Keystone	
End gap in 3.8125 I.D. (96.838mm I.D.) sleeve	.015 to .025″	.381 to .635mm
Maximum Serviceable Limit	.035″	.889mm
No. 2 Compression	Rectangular Grooved Back	
End gap in 3.8125 I.D. (96.838mm I.D.) sleeve	.015 to .025″	.381 to .635mm
Maximum Serviceable Limit	.035″	.899mm
Side Clearance	.0035 to .0055″	.090 to .140mm
Maximum Serviceable Limit	.008″	.203mm

Piston Rings (Cont'd)

	U.S. Value	Metric Value
No. 3 Oil Control Ring	Three Piece	
End gap in 3.8125 I.D. (96.838mm I.D.) sleeve	.015 to .055"	.381 to 1.397mm
Maximum Serviceable Limit	.065"	1.651mm
Side clearance	.000 to .008"	.000 to .203mm
Maximum Serviceable Limit	.010"	.254mm

Piston Pin

Type	Full Floating	
O.D. of pin	1.2495 to 1.2498"	31.737 to 31.745mm
Fit in piston	.0002 to .0010"	.005 to .025mm
Fit in rod bushing	.0004 to .0015"	.010 to .038mm

Connecting Rod

Bushing	Replaceable Bronze	
Bushing I.D. installed (ream to size)	1.2502 to 1.2504"	31.755 to 31.760mm
Maximum Serviceable Limit	1.2510"	31.775mm
Bearing liners	Replaceable	
Rod width at crank end	1.3035 to 1.3055"	33.109 to 33.160mm
Journal I.D. without bearing liners	2.1870 to 2.1875"	55.550 to 55.563mm
Bearing oil clearance	.0010 to .0040"	.025 to .102mm
Undersize bearings for service	.002,.010,.020,.030"	.051,.254,.508,.762mm
Side clearance	.005 to .011"	.127 to .279mm

Crankshaft

Type	Hardened Steel Balanced	
Main bearing liners	Replaceable	
End play, center main bearing cap	.001 to .015"	.025 to .381mm
Center main bearing thrust surface thickness	.1025 to .1045"	2.603 to 2.654mm
Connecting rod journal std. O.D.	2.0605 to 2.0615"	52.337 to 52.362mm
.002" (.051mm) O.D. undersize, grind to	2.0585 to 2.0595"	52.286 to 52.311mm
.010" (.254mm) O.D. undersize, grind to	2.0505 to 2.0515"	52.083 to 52.108mm
.020" (.508mm) O.D. undersize, grind to	2.0405 to 2.0415"	51.289 to 51.854mm
.030" (.762mm) O.D. undersize, grind to	2.0305 to 2.0315"	51.575 to 51.600mm
Connecting rod journal maximum taper	.001"	.025mm
Journals out-of-round	.0005"	.013mm
Undersize main bearing liners for service	.002,.010,.020,.030"	.051,.254,.508,.762mm
Main bearing oil clearance	.0012 to .0042"	.031 to .107mm

Crankshaft (Cont'd)

	U.S. Value	Metric Value
Main bearing journal std. O.D.	2.8730 to 2.8740″	72.974 to 73.000mm
.002″ (.051mm) O.D. undersize, grind to	2.8710 to 2.8720″	72.923 to 72.949mm
.010″ (.254mm) O.D. undersize, grind to	2.8630 to 2.8640″	72.720 to 72.746mm
.020″ (.508mm) O.D. undersize, grind to	2.8530 to 2.8540″	72.466 to 72.492mm
.030″ (.762mm) O.D. undersize, grind to	2.8430 to 2.8440″	72.212 to 72.238mm
Main bearing journal bore I.D. without liners	3.066 to 3.067″	77.876 to 77.902mm
Main journal width between cheeks:		
2nd and 4th	1.185 to 1.189″	30.099 to 30.201mm
3rd	1.3740 to 1.3770″	34.900 to 34.976mm
5th	1.745 to 1.755″	44.32 to 44.58mm
Connecting rod journals width between cheeks	1.3105 to 1.3145″	33.287 to 33.388mm

Camshaft

Type	Parabolic	
Bushings	5, Replaceable	
Bushing Lubrication:		
Front bushing	Pressure lubricated from oil pump	
Intermediate bushing	Gravity flow lubricated	
Rear bushing	Pressure lubricated with rear oil metering.	
Oil clearance	.002 to .007″	.051 to .178mm
I.D. of bushing installed	1.752 to 1.753″	44.501 to 44.526mm
Maximum Serviceable Limit	1.755″	44.577mm
Bushing width:		
1st (front)	1.213 to 1.223″	30.810 to 31.064mm
2nd, 3rd and 4th	.490 to .500″	12.446 to 12.700mm
5th (rear)	1.213 to 1.223″	39.810 to 31.064mm
O.D. of each bearing surface	1.749 to 1.750″	44.425 to 44.450mm
Minimum Serviceable Limit	1.748″	44.399mm
Thrust washer thickness	.147 to .149″	3.734 to 3.785mm
Minimum Serviceable Limit	Maintain end clearance	
Camshaft end play	Taken up by thrust washer	
Camshaft end clearance	.003 to .007″	.076 to .178mm

Valve Push Rod Lifters

Material	Hardened Steel	
Type	Mushroom	
O.D. of lifter stem	.5605 to .5610″	14.237 to 14.249mm
I.D. of block bore, including wear	.5625 to .5650″	14.287 to 14.351mm

Gear Train

	U.S.Value	Metric Value
Backlash:		
Crankshaft gear to camshaft gear	.0002 to .006″	.005 to .152mm
Camshaft gear to idler gear	.0004 to .006″	.010 to .152mm
Idler gear to fuel pump gear	.0005 to .007″	.013 to .178mm
Crankshaft gear to oil pump gear	.002 to .008″	.051 to .203mm
Crankshaft gear to fuel pump gear	.0005 to .019″	.013 to .483mm
O.D. of idler gear shaft	1.3745 to 1.3755″	34.912 to 34.938mm
Minimum Serviceable Limit	1.3740″	34.900mm
I.D. of idler gear with bushing	1.376 to 1.377″	34.950 to 34.976mm
Maximum Serviceable Limit	1.377″	34.976mm
Idler gear thrust washer shims	.005,.006,.007,.009″	.127,.152,.178,.229mm
Idler gear end play	.003″	.076mm

Oil Pump

Positive displacement pump	Gear Type	
Backlash, pump gear to crankshaft gear	.002 to .008″	.051 to .203mm
Drive gear to pump body maximum clearance	.0035 to .010″	.089 to .254mm
Pump gears to body radial maximum clearance	.002 to .008″	.051 to .203mm
Pump gears to pump cover maximum clearance	.0015 to .008″	.038 to .203mm
Oil pressure	50 to 75 PSI	344.7 to 482.6 kPa
Relief valve spring:		
Free length	2.125″	53.975mm
Compressed 1.44″ (36.58mm)	18 to 19 lbs.	8.16 to 8.62 kg

Cylinder Head

Warpage (Max.)	.006″	.152mm

Intake Valve

Tappet clearance (COLD and HOT)	.012″	.305mm
Face angle	44°	44°
Face run-out (max.)	.002″	.051mm
Length	6.339 to 6.364″	161.011 to 161.646mm
O.D. of stem	.3409 to .3419″	8.659 to 8.684mm
Minimum Serviceable Limit	.3399″	8.634mm
O.D. of head	1.599 to 1.609″	40.615 to 40.869mm
Seat angle	45°	45°
Seat contact width	.0704″ to .1057″	1.788 to 2.685mm
Seat run-out (max.)	.002″	.051mm

Exhaust Valve

	U.S. Value	Metric Value
Tappet clearance (COLD and HOT)	.014″	.356mm
Face angle	44⁰	44⁰
Face run-out (max.)	.002″	.051mm
O.D. of head	1.398 to 1.408″	35.509 to 35.763mm
O.D. of stem	.3399 to .3409″	8.634 to 8.659mm
Minimum Serviceable Limit	.3389″	8.608mm
Length	6.340 to 6.364″	161.036 to 161.646mm
Insert seat angle	45⁰	45⁰
Seat contact width	.0608 to .0962″	1.544 to 2.443mm
Seat run-out (max.)	.002″	.051mm
Insert height	.2475 to .2525″	6.286 to 6.413mm
O.D. of insert	1.4495 to 1.4505″	36.817 to 36.843mm
I.D. of insert	1.245 to 1.255″	31.623 to 31.877mm

Intake Valve Guides

Length	3.250″	82.550mm
O.D.	.6565 to .6575″	16.675 to 16.701mm
I.D. (installed and reamed)	.3429 to .3439″	8.710 to 8.735mm
Maximum Serviceable Limit	.3449″	8.761mm
Protrusion above cylinder head	.875″	22.225mm
Valve stem clearance in guide	.001 to .003″	.025 to .076mm
Maximum Serviceable Limit	.004″	.102mm

Exhaust Valve Guides

Length	3.125″	79.375mm
O.D.	.6565 to .6575″	16.675 to 16.701mm
I.D. (installed and reamed)	.3429 to .3439″	8.710 to 8.735mm
Maximum Serviceable Limit	.3449″	8.761mm
Protrusion above cylinder head	.875″	22.225mm
Valve stem clearance in guide	.002 to .004″	.051 to .102mm
Maximum Serviceable Limit	.005″	.127mm

Valve Spring

Free length	2.375″	60.325mm
Total coils	8.25	
Wire diameter	.162″	4.115mm
I.D.	.958 to .978″	24.333 to 24.841mm
Compressed to 1.521″ (38.63mm) (valve open)	110 to 118 lbs.	49.90 to 53.52 kg
Compressed to 1.875″ (47.63mm) (valve closed)	53 to 59 lbs.	24.04 to 26.76 kg

Rocker Arm Assembly

	U.S. Value	Metric Value
O.D. of shaft	.622 to .623″	15.799 to 15.824mm
I.D. of arm bore	.624 to .626″	15.850 to 15.900mm
Shaft spring:		
Free length	2.5″	63.500mm
Compressed to 1.75″ (44.45mm)	7.5 to 8.5 lbs.	3.40 to 3.86 kg
Lubrication	Engine oil, camshaft metering	
Shaft oil holes	Toward valve side of engine. Shaft cannot be rotated.	

SPECIAL TORQUES

Engine

	U.S. Value	Metric Value
Camshaft nut	80 to 90 ft. lbs.	109 to 122 Nm
Camshaft thrust plate mounting bolt	17 to 20 ft. lbs.	23 to 27 Nm
Connecting rod nuts	45 to 50 ft. lbs.	61 to 68 Nm
Crankshaft nut	125 to 135 ft. lbs.	169 to 183 Nm
Crankshaft pulley bolt	54 to 64 ft. lbs.	73 to 87 Nm
Cylinder head studs w/flange nuts (1/2")	90 to 100 ft .lbs.	122 to 136 Nm
Cylinder head cover stud nuts (3/8")	4 to 6 ft. lbs.	5 to 8 Nm
Cylinder head bolts (Gr. 8, 12 pt. hd.)	105 to 115 ft. lbs.	142 to 156 Nm
Cylinder head stud nuts (1/2")	95 to 105 ft. lbs.	129 to 142 Nm
Engine oil filter	Install until gasket contacts filter head, then hand tighten 1/2 turn. Loosen filter approximately 1 full turn and retighten until gasket contact is made, then hand tighten an additional 1/2 to 3/4 turn.	
Fan mounting bolts	35 to 42 ft. lbs.	48 to 57 Nm
Fuel pump drive gear nut	40 to 50 ft. lbs.	54 to 68 Nm
Flywheel to crankshaft bolt	65 to 70 ft. lbs.	88 to 95 Nm
Idler gear journal mounting bolts	35 to 42 ft. lbs.	48 to 57 Nm
Intake manifold (Aluminum) stud nuts	30 to 35 ft. lbs.	41 to 48 Nm
Intake and Exhaust Manifold stud nuts	25 to 30 ft. lbs.	34 to 41 Nm
Main bearing cap bolts	90 to 100 ft. lbs.	122 to 136 Nm
Oil pan capscrews (stamped steel)	10 to 12 ft. lbs.	14 to 16 Nm
Oil pan capscrews (cast iron)	24 to 28 ft. lbs.	33 to 38 Nm
Oil pan to seal retainer	15 to 20 ft. lbs.	20 to 27 Nm
Oil pan drain plug	29 to 31 ft. lbs.	39 to 42 Nm
Oil pump cover capscrews	6 to 8 ft. lbs.	8 to 11 Nm
Oil seal retainer bolts (Grade 8)	12 to 15 ft. lbs.	16 to 20 Nm
Oil pump suction tube nut	95 to 105 ft. lbs.	129 to 142 Nm
Rocker arm bracket bolts	25 to 30 ft. lbs.	34 to 41 Nm
Timing gear housing bolts	25 to 30 ft. lbs.	34 to 41 Nm
Water pump mounting bolts	25 to 30 ft. lbs.	34 to 41 Nm
Water pump body-to-cyl. mounting bolts	35 to 42 ft. lbs.	48 to 57 Nm

GENERAL TORQUE SPECIFICATION TABLE (Revised 2-74)

USE THE FOLLOWING TORQUES WHEN SPECIAL TORQUES ARE NOT GIVEN

NOTE: These values apply to fasteners as received from supplier, dry, or when lubricated with normal engine oil They do not apply if special graphited or moly-disulphide greases or other extreme pressure lubricants are used. This applies to both UNF and UNC threads

SAE Grade No.		2				5				8 *			
Bolt head identification marks as per grade NOTE: Manufacturing Marks Will Vary													
Bolt Size		Torque Foot Pounds		Torque Newton-Meters		Torque Foot Pounds		Torque Newton-Meters		Torque Foot Pounds		Torque Newton-Meters	
Inches	Millimeters	Min.	Max.	Min.	Max.	Min	Max	Min.	Max.	Min.	Max.	Min.	Max
1/4	6 35	5	6	6.8	8.13	9	11	12.2	14.9	12	15	16.3	20.3
5/16	7 94	10	12	13.6	16.3	17	20.5	23.1	27.8	24	29	32.5	39.3
3/8	9 53	20	23	27.1	31.2	35	42	47.5	57.0	45	54	61.0	73.2
7/16	11.11	30	35	40.7	47.4	54	64	73.2	86.8	70	84	94.9	113.9
1/2	12 70	45	52	61.0	70.5	80	96	108.5	130.2	110	132	149.2	179.0
9/16	14 29	65	75	88.1	101.6	110	132	149.2	179.0	160	192	217.0	260.4
5/8	15.88	95	105	128.7	142.3	150	180	203.4	244.1	220	264	298.3	358.0
3/4	19.05	150	185	203.3	250.7	270	324	366.1	439.3	380	456	515.3	618.3
7/8	22.23	160	200	216.8	271.0	400	480	542.4	650.9	600	720	813.6	976.3
1	25.40	250	300	338.8	406.5	580	696	786.5	943.8	900	1080	1220.4	1464.5
1-1/8	25.58					800	880	1084.8	1193.3	1280	1440	1735.7	1952.6
1-1/4	31 75					1120	1240	1518.7	1681.4	1820	2000	2467.9	2712.0
1-3/8	34.93					1460	1680	1979.8	2278.1	2380	2720	3227.3	3688.3
1-1/2	38 10					1940	2200	2630.6	2983.2	3160	3560	4285.0	4827.4

* Thick nuts must be used with Grade 8 bolts

NOTE: The Case Corporation 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.

Section 2001

ENGINE DIAGNOSIS

188 and 207 Diesel Engines

CASE CORPORATION Rac. 9-78875 PRINTED IN U.S.A.

GENERAL INFORMATION

Before making any repairs or adjustments on an engine, a mechanic or technician must properly diagnose the trouble.

Locating the trouble and repairing it is only part of the job, a technician must find and eliminate the cause of the trouble as well. Too many repairs are made with no thought to removing the causes that made the repair necessary.

For any engine to start or perform properly, three main requirements must be present:

1. FUEL
2. COMPRESSION
3. COMBUSTION

When any of these requirements are not present or limited by some mechanical reason, the engine will not start and will fail to operate properly throughout the power range.

FUEL. Fuel system problems can be present anywhere from the fuel tank, through the filters and injection pump as well as the injectors. Correct injection pump timing is important in the overall fuel system performance.

COMPRESSION. Compression on an engine is related to the ''breathing function''. Proper compression is affected by the air cleaner condition, muffler restriction, valve condition and operation including proper valve adjustment, cylinder head gaskets, condition of sleeves, rings, pistons, camshaft, and camshaft timing.

COMBUSTION. Combustion is the result of adequate compression to develop enough heat in the air charge on the compression stroke to fire the fuel being injected into the engine cylinders. Proper spray pattern and atomization of the fuel by the injector is very important. Timing the fuel injection pump to the engine to a precise degree BTDC is a vital requirement for proper combustion.

The engine diagnosis contained in the following pages covers many trouble symptoms, the causes, and what will be necessary to repair or eliminate the problem. Under each symptom are listed the most common and reoccuring problems progessing to the not so common problems. Locate your problem symptom in the diagnosis chart and refer to the pages listed for the probable causes and remedies.