

480C LOADER BACKHOE SERVICE MANUAL

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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

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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 Operator's 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
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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	44°	44°
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	45°	45°
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				Torque				Torque			
		Foot Pounds		Newton-Meters		Foot Pounds		Newton-Meters		Foot Pounds		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 1050

MAINTENANCE AND LUBRICATION

CASE CORPORATION

C. E. Div. 9-66025
August 1976

PRINTED IN U.S.A.

FLUIDS AND LUBRICANTS

COMPONENTS	CAPACITY		SPECIFICATIONS
	U.S.	Metric	
Fuel tank	22 gallons	83 litres	Refer to Operator's Manual.
Engine crankcase Without filter change	6 quarts	5.7 litres	Case HDM oil Engine oil, class CD, Above 32° F (0° C) SAE 30 10°-50° F (-12°-10° C) . . . SAE 20W Below 32° F (0° C) SAE 10W
With filter change	7 quarts	6.6 litres	
Hydraulic system (approx.) Loader/backhoe	23 gallons	87 litres	Case TCH Fluid Alternate oil Engine oil, SD or CA Above 32° F (0° C) SAE 10W Below 32° F (0° C) SAE 5W Type C-2 transmission/hydraulic fluid such as Tenneco Hytrans Fluid.
Loader only	15 gallons	57 litres	
Loader/three point hitch	19 gallons	72 litres	
Three point hitch only	14 gallons	53 litres	
Reservoir refill	11.5 gallons	43 litres	
Power steering system Reservoir refill	3 quarts 1 quart	2.8 litres 0.9 litre	Case TCH Fluid.
Mechanical shuttle	2 quarts	1.9 litres	Case TCH Fluid.
Transaxle	20 quarts	19 litres	Case FDL gear lubricant or lubri- cant meeting API-GL-4, specification Above 0° F (-18° C) SAE 90 Below 0° F (-18° C) SAE 80
Grease fittings	As required		No. 2 moly disulfide grease.
Front wheel bearings	As required		No. 2 wheel bearing grease.
Cooling system	21 quarts	19.8 litres	Mix ethylene glycol type antifreeze and water for lowest anticipated temperature.
Battery	As required		Add colorless, odorless drinking water.
Brake master cylinders	As required		DOT 3 brake fluid.

MAINTENANCE CHART

NOTE: This chart is based on maximum service intervals. If operating in severe working conditions, service more often.

INTERVAL	SERVICE	INSTRUCTIONS
Run-in period. Every two hours until stable	Torque front and rear wheel bolts to 115-130 foot-pounds (157-176 N m). Torque transaxle mounting bolts to 250-300 foot-pounds (339-407 N m). Torque swing cylinder trunnion plate mounting bolts to 520-640 foot-pounds (732-867 N m). Torque drive shaft cap screws to 20-24 foot-pounds (27-32 N m).	
Run-in period after first 20 hours	Change engine oil and filter. Change hydraulic oil filter. Check fan belt tension.	Section 4002 Section 8007
Every 10 hours of operation or daily, whichever occurs first	Grease loader pivot points. Grease backhoe pivot points. Grease extendable dipper, if so equipped. Grease three point hitch, if so equipped. Grease front axle pivot. Grease front axle king pins. Grease shuttle control bellcrank. Check engine oil level. Check hydraulic oil level. Check radiator coolant level. Clean air cleaner dust cup. Check the machine and the ground under it for signs of leaks. Check injection pump sediment bowl for water. If bowl has water, drain fuel tank, first stage fuel filter and sediment bowl.	Section 2051

INTERVAL	SERVICE	INSTRUCTIONS
Every 100 hours of operation	Change engine oil. Grease rear axle bearings. Grease seat post. Grease brake pedals and clutch shaft. Grease brake pedals and clutch shaft on mechanical shuttle machines. Check tire condition and pressure. Check battery fluid level. Check transaxle oil level. Check mechanical shuttle oil level. Check power steering oil level. Clean spark arresting muffler if so equipped.	Section 6229 Section 8005 Section 2051
Every 200 hours of operation	Change engine oil filter. Check fan belt tension.	Section 2555 Section 8007
Every 500 hours of operation	Grease universal joints. Lubricate hydraulic pump shaft. Replace fuel filters. Check brake master cylinder fluid level. Repack front wheel bearings. Inspect Roll-Over Protection Structure. Change hydraulic oil filter. Clean hydraulic reservoir breather.	Section 6222 Section 4005 Section 3010 Section 5021 Section 9061 Section 4002 Section 4002
Every 1000 hours of operation or once a year, whichever occurs first	Change hydraulic oil. Replace power steering oil filter. Change mechanical shuttle oil. Change transaxle oil. Clean transaxle breather.	Section 4002 Section 5005

INTERVAL	SERVICE	INSTRUCTIONS
Every 2000 hours of operation or once a year, whichever occurs first	Drain, flush and refill cooling system.	Section 2050
As required	<p>After a wheel has been removed and installed, check bolt torque every two hours until stable.</p> <p>Service air filter element whenever restriction warning light remains on with engine running at full throttle.</p> <p>Change hydraulic oil filter whenever restriction warning light remains on.</p>	<p>Section 2051</p> <p>Section 4002</p>

Section 1051

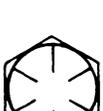
TORQUE SPECIFICATIONS

CASE CORPORATION

C. E. Div. 9-66025
August 1976

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U.S. AND METRIC TORQUE SPECIFICATIONS**Grade 5 Bolts, Nuts and Studs (Dry Threads)**

Thread size	Ft-lbs	N m		Thread size	Ft-lbs	N m
1/4"-20 NC	5-10	7-13		3/4"-10 NC	235-285	319-386
1/4"-28 NF	10-15	13-20		3/4"-16 NF	270-330	366-447
5/16"-18 NC	15-20	20-27		7/8"-9 NC	360-440	488-597
5/16"-24 NF	15-20	20-27		7/8"-14 NF	395-490	536-664
3/8"-16 NC	25-35	34-47		1"-8 NC	520-640	705-867
3/8"-24 NF	30-40	41-54		1"-12 NF	575-705	780-955
7/16"-14 NC	45-55	61-74		1-1/8"-7 NC	720-820	976-1111
7/16"-20 NF	50-60	68-81		1-1/8"-12 NF	790-970	1071-1315
1/2"-13 NC	65-85	88-115		1-1/4"-7 NC	1010-1240	1370-1681
1/2"-20 NF	80-100	109-135		1-1/4"-12 NF	1115-1365	1512-1850
9/16"-12 NC	100-120	135-163		1-3/8"-6 NC	1315-1610	1783-2182
9/16"-18 NF	110-130	149-176		1-3/8"-12 NF	1510-1850	2047-2508
5/8"-11 NC	135-165	183-223		1-1/2"-6 NC	1745-2135	2366-2894
5/8"-18 NF	160-200	216-271		1-1/2"-12 NF	1880-2420	2549-3281

Grade 8 Bolts, Nuts and Studs (Dry Threads)

Thread size	Ft-lbs	N m		Thread size	Ft-lbs	N m
1/4"-20 NC	10-15	13-20		3/4"-10 NC	340-420	461-569
1/4"-28 NF	15-20	20-27		3/4"-16 NF	380-460	515-623
5/16"-18 NC	20-30	27-40		7/8"-9 NC	540-660	732-894
5/16"-24 NF	25-30	34-40		7/8"-14 NF	595-725	807-982
3/8"-16 NC	40-50	54-67		1"-8 NC	810-990	1098-1342
3/8"-24 NF	45-55	61-74		1"-12 NF	900-1100	1220-1491
7/16"-14 NC	60-80	82-102		1-1/8"-7 NC	1150-1400	1559-1898
7/16"-20 NF	70-90	95-122		1-1/8"-12 NF	1295-1585	1756-2148
1/2"-13 NC	100-120	136-162		1-1/4"-7 NC	1640-2000	2224-2711
1/2"-20 NF	110-130	149-176		1-1/4"-12 NF	1800-2200	2440-2982
9/16"-12 NC	135-165	183-223		1-3/8"-6 NC	2140-2620	2901-3552
9/16"-18 NF	155-190	210-257		1-3/8"-12 NF	2450-3000	3322-4067
5/8"-11 NC	200-240	271-325		1-1/2"-6 NC	2845-3475	3857-4711
5/8"-18 NF	215-265	292-359		1-1/2"-12 NF	3200-3900	4339-4880

U.S. AND METRIC TORQUE SPECIFICATIONS

Hydraulic Fittings (Steel)

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

Split Flange Mounting Bolts (Grade 5, Dry Threads)

Flange Size	Thread Size	Torque	
		Ft-lbs	N m
1/2"	5/16"-18 NC	15-20	20-25
3/4"	3/8"-16 NC	20-25	26-33
1"	3/8"-16 NC	20-25	26-33
1-1/4"	7/16"-14 NC	35-45	47-61
1-1/2"	1/2"-13 NC	45-55	61-74
2"	1/2"-13 NC	55-65	74-88
2-1/2"	1/2"-13 NC	80-90	104-122
3"	5/8"-11 NC	140-150	190-203

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Section 2001

**ENGINE DIAGNOSIS
188 and 207 Diesel Engines**

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.

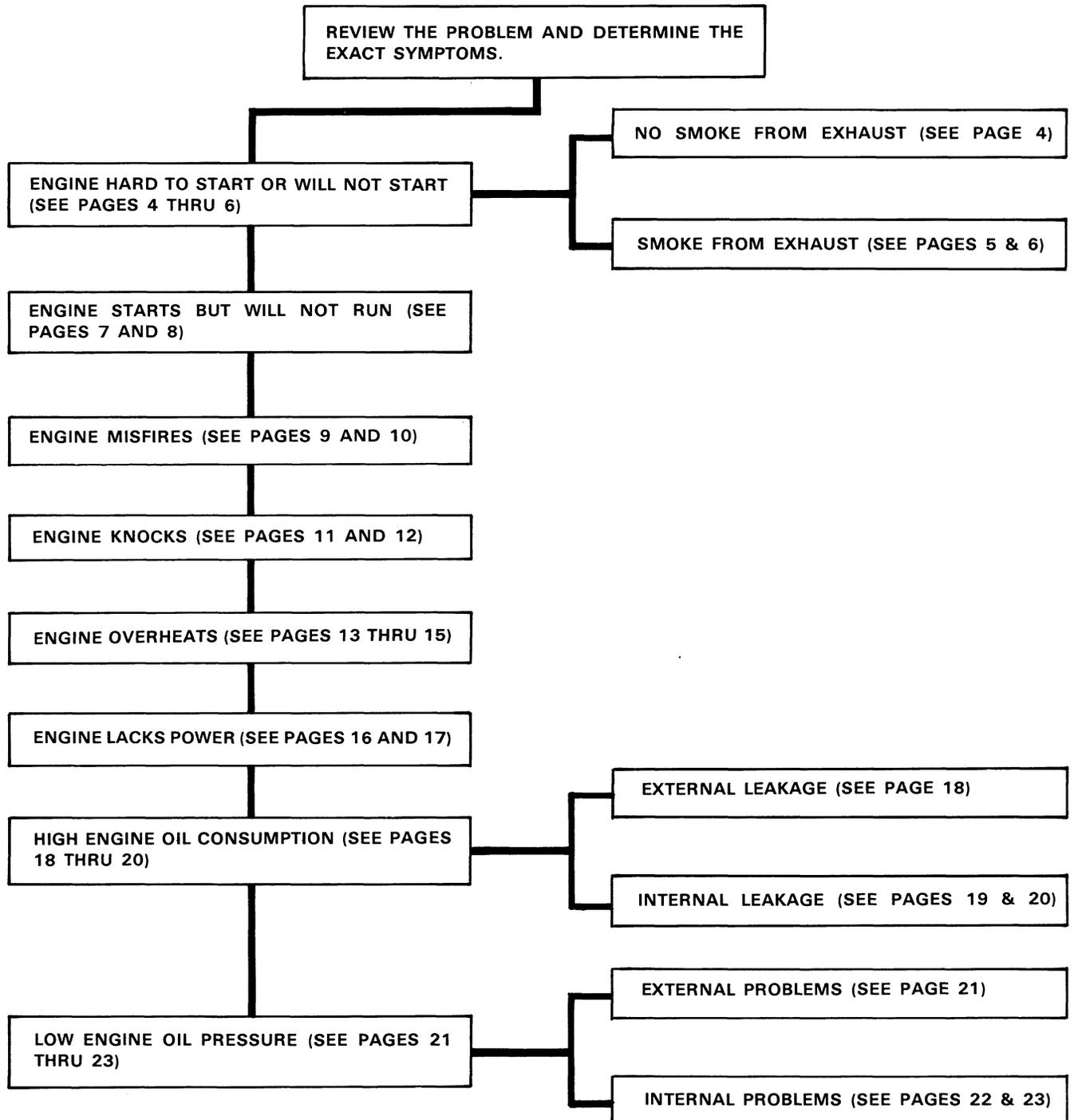
FUEL. Fuel system problems can be present anywhere from the fuel tank, through the filters and injection pump as well as the injectors. Correct injection pump timing is important in the overall fuel system performance.

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 reoccurring problems progressing 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.

ENGINE DIAGNOSIS CHART



ENGINE HARD TO START OR WILL NOT START

No Smoke From Exhaust

1. Fuel Shut-Off Not Open Completely.

Improper cable adjustment, damaged cable, cable slipping in clamps, misadjusted or inoperative solenoid will not completely return fuel shut-off lever to open position. Check lever to be sure it is opening completely. A partially opened lever limits the amount of fuel to the injection pump and results in low engine horsepower.

2. Final Air Filter Plugged

A dirty filter will cause rich fuel mixture and low engine power. Check filter restriction indicator and service final air filter if required.

3. Slow Cranking Speed

Starter must crank engine 200 to 300 RPM in order to ignite the diesel fuel. Check engine RPM while cranking. If cranking is slow, check starter amperage draw to help determine the following defective areas: batteries, cables, solenoid and starting motor.

Slow cranking speed can be caused by the following internal and external engine defects: scuffing and scoring of pistons and sleeves, improper crankshaft or camshaft end play, defective rod or crank bearings, oil pump, water pump, hydraulic pump or air compressor.

4. Fuel Supply Shut-Off or No Fuel

Check that fuel tank shut-off valve is open. Check fuel supply in tank.

5. Air In Fuel System

Bleed fuel system until fuel flows steadily with no bubbles. Check for air leaks at fittings between tank and fuel pump.

6. Camshaft Damaged

A sheared key in the cam drive gear or a broken cam shaft will throw valve timing out of sequence affecting engine operation. Remove cylinder head cover and check valve timing in reference to crankshaft timing marks with a dial indicator.

7. Fuel Injection Nozzle Not Seated In Head.

A nozzle that is not seated in the cylinder head will let compression leak by and not produce enough heat to fire the injected fuel. Check for damaged nozzle gasket or seals, loose nozzle, or broken stud.

8. Fuel Line Plugged

A fuel line plugged with dirt will not let fuel through to the injection pump. Remove line at fuel filters and check for fuel flow through line.

9. Clogged Fuel Filter

Check and service fuel filters.

10. Wrong Fuel or Contaminated Fuel

Wrong fuel (low centane) or contaminated fuel (water and dirt) can cause the engine not to run or to have pre-combustion, causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

11. Sticking Rack Control

A sticking rack control will not let the fuel injection pump accept any fuel.

12. Piston Rings Worn

As piston rings become worn, they lose tension and ability to seal and wipe lubrication oil off cylinder walls. Take a compression test to determine piston ring condition. If readings are low, squirt a small amount of oil into the cylinder and retest. If compression comes up because the oil helps the rings seal, it will be necessary to install new piston rings and possibly sleeve and pistons.

13. Injection Pump Malfunction

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump. A common cause is a sheared key on the injection pump drive, preventing fuel to be delivered to injectors. Adjust or replace the injection pump.