W14 LOADER

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J I Case
A Tenneco Company

TENNECO

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Section 1010

GENERAL ENGINE SPECIFICATIONS W14 LOADER

THE MODEL AND ENGINE SERIAL NUMBER IS STAMPED ON A PLATE LOCATED ON THE SIDE OF THE ENGINE ABOVE THE CRANKING MOTOR.

DIESEL ENGINES

General

Type	4 Cylinder, 4 Stroke Cycle, Valve-in-Head
Firing Order	1-3-4-2
Bore	4-5/8 Inches
Stroke	5 Inches
Piston Displacement	336 Cubic Inches
Compression Ratio	16.5 to 1
No Load Governed Speed	2330 to 2370 RPM
Rated Engine Speed	2200 RPM
Engine Idling Speed	725 to 775 RPM
Exhaust Valve Rotators	Positive Type
*Valve Tappet Clearance (Exhaust) (Hot)	.020 Inch (Cold) .025 Inch
(Intake)	(Hot and Cold) .015 Inch

*Hot Settings Are Made After the Engine Has Operated At Thermostat Controlled Temperature For At Least Fifteen Minutes.

Cranking Motor	24 Volt Negative Ground
Thermostat Operating Range	175°F. to 202°F.

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 Bearings	Replaceable Precision Steel Back, Copper-Lead Alloy Liners

Engine Lubricating System

Oil Pressure	45 to 60 Pounds 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
Engine Oil Capacity (without filter change)	10 U.S. Quarts
(with filter change)	11 U.S. Quarts

Fuel System

Fuel Injection Pump	Robert Bosch, Type PES Multiple Plunger
Pump Timing	31 Degrees Before Top Dead Center (Port Closing)
Fuel Injectors	Pencil Type (Opening Pressure 3200 PSI)
Fuel Transfer Pump	Plunger Type, Integral Part of Injection Pump
Governor	Variable Speed, Fly-Weight Centrifugal Type, Integral Part of Injection Pump
1st Stage Fuel Filter	Full Flow Spin on Type
2nd Stage Fuel Filter	Full Flow Spin on Type

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RUN-IN INSTRUCTIONS

Engine Lubrication

Fill the engine crankcase with CASE HDM oil and install new engine oil filters, after an engine has been rebuilt.

NOTE: *Use a SERIES 3 DS or CD SERVICE CLASSIFICATION oil that has the correct viscosity rating for ambient air temperature, if CASE HDM oil is not used.*

Change the engine oil while the engine is hot and replace the engine oil filters, after the first 20 hours of operation.

Change the engine oil and filters at the given intervals, after the 20 hours, as found in the Operator's Manual.

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 make sure of the control of 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	**10 Minutes	1000 RPM	Not Any
2	**10 Minutes	1800 RPM	Not Any
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	Tighten the cylinder head bolts to the torque that is found in Section 2015 of the service manual.		

* According to normal dynamometer scale load at rated speed for the specific vehicle model. Decrease this scale load as shown.

** The best run-in procedure will constantly change the throttle between 750 to 1000 RPM, for the first 10 minutes and from 1000 to 1800 RPM, for the next 10 minutes. The purpose of this changing RPM is to change the lubrication and coolant flow.

*** 30 minutes at 3/4 load is a minimum amount of time the engine can be run. It is best that when possible, the engine (especially a turbocharged diesel) must 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.

Run-In Procedure For Rebuilt Engines (Without A Dynamometer)

STEP	TIME	ENGINE SPEED	LOAD
1	*10 Minutes	1000 RPM	Not Any
2	*10 Minutes	1800 RPM	Not Any
3	30 Minutes	2/3 Rated RPM	Light Load
4	1 Hour	Full RPM (not over 2000 RPM)	80 to 90%
5	Tighten the cylinder head bolts to the torque that is found in Section 2015 of the service manual.		

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

Run-In Procedure

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

DETAILED ENGINE SPECIFICATIONS

Cylinder Sleeves

	U.S. Value	Metric Value
Type	Wet, Can Be Replaced	
Material	Cast Iron	
ID of Sleeve	4.6250 to 4.6263"	117.475 to 117.508 mm
Maximum Service Limit	4.6283"	117.559 mm
Sleeve Out of Round (Installed in Block)	0.002"	0.0508 mm
Maximum Service Limit	0.002"	0.0508 mm
Taper (Installed in Block)	0.001"	0.0254 mm
Maximum Service Limit	0.002"	0.0508 mm
Clearance at Bottom of Piston, 90 Degree to Piston Pin	0.0052 to 0.0075"	0.1321 to 0.1905 mm
Maximum Service Limit	0.010"	0.254 mm

Piston with 1.62" (41.15 mm) Pin Bore

Type	Cam Ground	
Material	Aluminum Alloy	
OD at Bottom, 90 Degree to Piston Pin	4.6188 to 4.6198"	117.3175 to 117.3429 mm
Minimum Service Limit	4.6178"	117.2921 mm
ID of Piston Pin Bore	1.6251 to 1.6253"	41.2775 to 41.2826 mm
Maximum Service Limit	1.6258"	41.2953 mm
Width of 1st Ring Groove	0.097 to 0.098"	2.464 to 2.489 mm
Maximum Service Limit	0.0985"	2.502 mm
Width of 2nd Ring Groove	0.097 to 0.098"	2.464 to 2.489 mm
Maximum Service Limit	0.0985"	2.502 mm
Width of 3rd Ring Groove	0.188 to 0.189"	4.775 to 4.801 mm
Maximum Service Limit	0.190"	4.826 mm

Piston with 1.80" (45.72 mm) Pin Bore

Type	Cam Ground	
Material	Aluminum Alloy	
OD at Bottom, 90 Degree to Piston Pin	4.6188 to 4.6198"	117.3175 to 117.3429 mm
Minimum Service Limit	4.6178"	117.2921 mm
ID of Piston Pin Bore	1.8001 to 1.8005"	45.7225 to 45.7327 mm
Maximum Service Limit	1.8010"	45.7454 mm
Width of 1st Ring Groove	Not Measureable	
Width of 2nd Ring Groove	Not Measureable	
Width of 3rd Ring Groove	0.188 to 0.189"	4.775 to 4.801 mm
Maximum Service Limit	0.190"	4.826 mm

Piston Pin for Piston with 1.62" (41.15 mm) Pin Bore

Type	Floats	
OD of Pin	1.6244 to 1.6246"	41.2598 to 41.2648 mm

Piston Pin for Piston with 1.80" (45.72 mm) Pin Bore

Type	Floats	
OD of Pin	1.7994 to 1.7996"	45.7048 to 45.7098 mm

Piston Rings

	U.S. Value	Metric Value
Number One Compression (Top)	Rectangular Type	
End Gap in 4.625" (117.475 mm) ID sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	0.0035 to 0.005"	0.089 to 0.127 mm
Maximum Service Limit	0.006"	0.152 mm
Number One Compression (Top)	Keystone Type	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	Not Measureable	
Number Two Compression (Intermediate)	Rectangular Type	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.013 to 0.023"	0.330 to 0.584 mm
Maximum Service Limit	0.028"	0.711 mm
Side Clearance	0.003 to 0.005"	0.076 to 0.127 mm
Maximum Service Limit	0.006"	0.152 mm
Number Two Compression (Intermediate)	Keystone Type	
End Gap in 4.625" (117.475 mm) ID Sleeve	0.015 to 0.025"	0.381 to 0.635 mm
Maximum Service Limit	0.030"	0.762 mm
Side Clearance	Not Measureable	
Number Three Oil Control Ring (Bottom)	Two Piece	
Width	0.1860 to 0.1865"	4.7244 to 4.7371 mm
End Gap in 4.625" (117.475 mm) ID Sleeve	0.016 to 0.026"	0.406 to 0.660 mm
Maximum Service Limit	0.031"	0.787 mm
Side Clearance	0.0015 to 0.003"	0.038 to 0.076 mm
Maximum Service Limit	0.0035"	0.089 mm

Connecting Rod for Piston with 1.62" (41.15 mm) Pin Bore

Bushing	Replaceable	
Bushing ID, Installed (Ream to Size)	1.6254 to 1.6258"	41.2852 to 41.2953 mm
Maximum Service Limit	1.6265"	41.3131 mm
Bearing Liners	Replaceable	
Bearing Liner Width	1.586 to 1.596"	40.284 to 40.538 mm
Bore ID without Liners	2.9003 to 2.9013"	73.6676 to 73.6930 mm
Bearing Oil Clearance	0.0013 to 0.0038"	0.033 to 0.0965 mm
Maximum Service Limit	0.0043"	0.1092 mm
Undersize Bearings for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm
Side Clearance	0.007 to 0.016"	0.178 to 0.406 mm

Connecting Rod for Piston with 1.80" (45.72 mm) Pin Bore

Bushing	Replaceable	
Bushing ID, Installed (Ream to Size)	1.8004 to 1.8008"	45.7302 to 45.7403 mm
Maximum Service Limit	1.8015"	45.7581 mm
Bearing Liners	Replaceable	
Bearing Liner Width	1.586 to 1.596"	40.284 to 40.538 mm
Bore ID without Liners	3.1503 to 3.1513"	80.176 to 80.043 mm
Bearing Oil Clearance	0.0013 to 0.0038"	0.033 to 0.0965 mm
Maximum Service Limit	0.0043"	0.1092 mm
Undersize Bearings for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm
Side Clearance	0.007 to 0.016"	0.178 to 0.406 mm

Crankshaft with 3" (76.2 mm) Main Bearing Journals

	U.S. Value	Metric Value
Type	Forged, Heat Treated and Balanced	
End Play, Number Three Main Bearing Cap	0.003 to 0.015"	0.076 to 0.381 mm
Thrust Bearing, Standard Thickness	0.184 to 0.186"	4.674 to 4.724 mm
Thrust Bearing, Oversize Thickness for Service	0.190 to 0.192"	4.826 to 4.877 mm
Connecting Rod Journal Width	1.9975 to 2.0025"	50.7365 to 50.8635 mm
Connecting Rod Journal, Standard OD	2.748 to 2.749"	69.799 to 69.825 mm
0.010" (0.254 mm) OD Undersize, Grind to	2.738 to 2.739"	69.545 to 69.571 mm
0.020" (0.508 mm) OD Undersize, Grind to	2.728 to 2.729"	69.291 to 69.317 mm
0.030" (0.762 mm) OD Undersize, Grind to	2.718 to 2.719"	69.037 to 69.063 mm
Connecting Rod Journal Maximum Taper	0.0005"	0.0127"
Connecting Rod Journals Out of Round	0.0005"	0.0127 mm
Main Bearing Liners	Replaceable	
Main Bearing Liner Width, 1st, 3rd and 5th	2.1515 to 2.1615"	54.648 to 54.9021 mm
Main Bearing Liner Width, 2nd and 4th	1.151 to 1.161"	29.235 to 29.489 mm
Main Bearing Oil Clearance	0.0016 to 0.0046"	0.0406 to 0.1168 mm
Maximum Service Limit	0.005"	0.127 mm
Undersize Main Bearing Liners for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm
Main Bearing Journal, Standard OD	2.998 to 2.999"	76.149 to 76.175 mm
0.010" (0.254 mm) OD Undersize, Grind to	2.988 to 2.989"	75.895 to 75.921 mm
0.020" (0.508 mm) OD Undersize, Grind to	2.978 to 2.979"	75.641 to 75.667 mm
0.030" (0.762 mm) OD Undersize, Grind to	2.968 to 2.969"	75.387 to 75.413 mm
Main Bearing Journal Bore ID without Liners	3.191 to 3.192"	81.051 to 81.077 mm
Main Bearing Journal Width		
2nd and 4th	1.555 to 1.570	39.497 to 39.878 mm
3rd	2.623 to 2.627"	66.624 to 66.726 mm
5th	2.6175 to 2.6325"	66.4845 to 66.8655 mm

Crankshaft with 3.5" (88.9 mm) Main Bearing Journals

Type	0.003 to 0.015"	0.076 to 0.381 mm
Thrust Bearing, Standard Thickness	0.155 to 0.157"	3.937 to 3.988 mm
Thrust Bearing, Oversize Thickness for Service	0.161 to 0.163"	4.089 to 4.140 mm
Connecting Rod Journal Width	1.9775 to 2.0025"	50.2285 to 50.8635 mm
Connecting Rod Journal, Standard OD	2.998 to 2.999"	76.149 to 76.175 mm
0.010" (0.254 mm) OD Undersize, Grind to	2.988 to 2.989"	75.895 to 75.921 mm
0.020" (0.508 mm) OD Undersize, Grind to	2.978 to 2.979"	75.641 to 75.667 mm
0.030" (0.762 mm) OD Undersize, Grind to	2.968 to 2.969"	75.387 to 75.413 mm
Connecting Rod Journal Maximum Taper	0.0005"	0.0127 mm
Connecting Rod Journal Out of Round	0.0005"	0.0127 mm
Main Bearing Liners	Replaceable	
Main Bearing Liner Width, 1st, 3rd and 5th	2.1515 to 2.1615"	54.6481 to 54.9021 mm
Main Bearing Liner Width, 2nd and 4th	1.214 to 1.224"	30.836 to 31.089 mm
Main Bearing Oil Clearance	0.0016 to 0.0046"	0.0406 to 0.1168 mm
Maximum Service Limit	0.005"	0.127 mm
Undersize Main Bearing Liners for Service	0.002, 0.010, 0.020, 0.030"	0.051, 0.254, 0.508, 0.762 mm

Crankshaft with 3.5" (88.9 mm) Main Bearing Journals (Continued)

	U.S. Value	Metric Value
Main Bearing Journal, Standard OD	3.498 to 3.499"	88.849 to 88.875 mm
0.010" (0.254 mm) OD Undersize, Grind to	3.488 to 3.489"	88.595 to 88.621 mm
0.020" (0.508 mm) OD Undersize, Grind to	3.478 to 3.479"	88.341 to 88.367 mm
0.030" (0.762 mm) OD Undersize, Grind to	3.468 to 3.469"	88.087 to 88.113 mm
Main Bearing Journal Bore ID without Liners	3.691 to 3.692"	93.751 to 93.777 mm
Main Bearing Journal Width		
2nd and 4th	1.618 to 1.633"	41.097 to 41.478 mm
3rd	2.561 to 2.565"	65.049 to 65.151 mm
5th	2.5855 to 2.6005"	65.6717 to 66.0527 mm

Camshaft

Type	Parabolic	
Bushings	Four, Replaceable	
Bushing Lubrication	Under Pressure	
ID of Bushings	2.2484 to 2.2514"	57.1094 to 57.1856 mm
Maximum Service Limit	2.2524"	57.2110 mm
Bushing Width		
1st (Front)	1.646 to 1.666"	41.808 to 42.316 mm
2nd and 3rd	1.4275 to 1.4475"	36.2585 to 36.7665 mm
4th	1.1462 to 1.1662"	29.1135 to 29.6215 mm
OD of Each Bearing Surface	2.2460 to 2.2470"	57.0484 to 57.0738 mm
Minimum Service Limit	2.2455"	57.0357 mm
Thrust Washer Thickness	0.1225 to 0.1275"	3.1115 to 3.2385 mm
Minimum Service Limit	0.1215"	3.0861 mm
Thrust Plunger Spring:		
Free Length	3.6250"	92.075 mm
OD of Spring	0.406"	10.312 mm
Compress to 2.750" (69.85 mm)	45 to 55 lbs.	200 to 245 N

Valve Push Rod Lifters

OD of Lifter Stem, Standard	0.8097 to 0.8102"	20.566 to 20.579 mm
OD of Lifter Stem, Oversize for Service	0.8190 to 0.8195"	20.803 to 20.815 mm
ID of Block Bore, Standard	0.8118 to 0.8130"	20.620 to 20.650 mm
Maximum Service Limit	0.8135"	20.663 mm
ID of Block Bore, Oversize for Service	0.8215 to 0.8225"	20.866 to 20.891 mm

Gear Train

Backlash	U.S. Value	Metric Value
Crankshaft Gear to Camshaft Gear	0.004 to 0.011"	0.1016 to 0.2794 mm
Idler Drive Gear to Idler Gear	0.003 to 0.010"	0.0762 to 0.2540 mm
Idler Gear to Fuel Pump Gear	0.004 to 0.012"	0.1016 to 0.3048 mm
Crankshaft Gear to Oil Pump Idler Gear	0.006 to 0.011"	0.1524 to 0.2794 mm
Crankshaft Gear to Fuel Pump Gear	0.027" max.	0.6858 mm max.
OD of Idler Gear Shaft	1.7325 to 1.7330"	44.0055 to 44.0182 mm
ID of Idler Gear Bushing	1.7345 to 1.7355"	44.0563 to 44.0817 mm
Maximum Service Limit	1.7375"	44.132 mm
Idler Gear Thrust Washer Thickness	0.061 to 0.063"	1.5494 to 1.6002 mm
Idler Gear Lateral Movement	0.002 to 0.012"	0.051 to 0.305 mm

Oil Pump and Two Gear Balancer

Positive Displacement Pump	Gear Type	
Pump Gears to Cover Clearance	0.005" max.	0.127 mm max.
Backlash		
Crankshaft Gear to Counterweight Gear	0.008 to 0.013"	0.203 to 0.330 mm
Counterweight Gear to Counterweight Gear	0.005 to 0.013"	0.127 to 0.330 mm
Counterweight Shaft Bushing Wear	0.007" max.	0.178 mm max.
Relief Valve Spring		
Free Length	2.06"	52.324 mm
Wire Diameter	0.071"	1.803 mm
OD of Spring	0.680"	17.272 mm
Number of Coils	12	12
Compress to 1.252" (31.801 mm)	17.25 to 19.05 lbs.	77 to 85 N

Oil Pump and Three Gear Balancer

Positive Displacement Pump	Gear Type	
Pump Gears to Cover Clearance	0.005" max.	0.127 mm max.
Backlash		
Crankshaft Gear to Counterweight Gear	0.008 to 0.13"	0.203 to 0.330 mm
Counterweight Gear to Counterweight Gear	0.005 to 0.013"	0.127 to 0.330 mm
Counterweight Gear and Drive Gear Bushing Wear	0.007" max.	0.178 mm max.
Relief Valve Spring		
Free Length	3.00"	76.2 mm
Wire Diameter	0.062"	1.575 mm
OD of Spring	0.515"	13.081 mm
Number of Coils	25	25
Compress to 1.68" (42.67 mm)	13.5 to 15.5 lbs.	60 to 69 N

Oil Pump, Front Mounted

	U.S. Value	Metric Value
Positive Displacement Pump	Gear Type	
Backlash		
Pump Gear to Crankshaft Gear	0.006 to 0.011"	0.1524 to 0.2794 mm
Pump Gears to Body Radial Clearance	0.0005 to 0.004"	0.013 to 0.102 mm
Pump Gears to Pump Cover Clearance	0.0015 to 0.005"	0.038 to 0.127 mm
Oil Pressure at High Idle, Hot Oil	40 to 65 PSI	276 to 448 kPa
Relief Valve Spring		
Number of Coils	11	11
Wire Diameter	0.080"	2.032 mm
Minimum ID	0.469"	11.913 mm
Free Length	2.00"	50.8 mm
Compress to 1.252" (31.801 mm)	23.8 to 25.6 lbs.	106 to 114 N
Relief Valve Cup Plug Depth	0.327"	8.306 mm

Cylinder Head

Warpage	0.005"	0.127 mm

Exhaust Valve

Tappet Clearance	0.025"	0.635 mm
Face Angle	44 Degrees	44 Degrees
Face Run-Out	0.002" max.	0.051 mm max.
OD of Head	1.745 to 1.755"	44.323 to 44.577 mm
OD of Stem	0.402 to 0.403"	10.211 to 10.236 mm
Minimum Service Limit	0.4018"	10.206 mm
OD of Taper at 4.2675" (108.395 mm)	0.401 to 0.402"	10.185 to 10.211 mm
Minimum Service Limit	0.4008"	10.180 mm
Length	6.4195 to 6.4405"	163.055 to 163.589 mm
Insert Seat Angle	45 Degrees	45 Degrees
Seat Contact Width	0.0775 to 0.100"	1.9685 to 2.540 mm
Seat Run-Out	0.002"	0.051 mm
Insert Height	0.313 to 0.316"	7.950 to 8.026 mm
OD of Insert	1.9455 to 1.9465"	49.4157 to 49.4411 mm
ID of Insert	1.571 to 1.577"	39.903 to 40.056 mm

Intake Valve

Tappet Clearance	0.015"	0.381 mm
Face Angle	44 Degrees	44 Degrees
Face Run-Out	0.002" max.	0.051 mm
OD of Stem	0.402 to 0.403"	10.211 to 10.236 mm
Minimum Service Limit	0.4018"	10.206 mm
OD of Head	1.995 to 2.005"	50.673 to 50.927 mm
Length	6.4195 to 6.4405"	163.055 to 163.589 mm
Seat Angle	45 Degrees	45 Degrees
Seat Contact Width	0.0750 to 0.0975"	1.905 to 2.477 mm
Seat Run-Out	0.002" max.	0.051 mm
Insert Height (If Equipped)	0.2775 to 0.2825"	7.0485 to 7.1755 mm
OD of Insert (If Equipped)	2.099 to 2.100"	53.315 to 53.340 mm
ID of Insert (If Equipped)	1.805 to 1.815"	45.847 to 46.101 mm

Intake and Exhaust Valve Guides

	U.S. Value	Metric Value
Length	3.219"	81.763 mm
OD of Guide	0.7510 to 0.7515"	19.075 to 19.088 mm
ID of Guide (Installed and Reamed)	0.4045 to 0.4055"	10.274 to 10.300 mm
Maximum Service Limit	0.4065"	10.325 mm
Protrusion Above Cylinder Head	0.953"	24.206 mm

Valve Spring

Free Length	2.18"	55.372 mm
Number of Coils	7.25	7.25
Wire Diameter	0.192"	4.877 mm
Compress Spring to 1.484" (37.694 mm), Valve Open	153 to 167 lbs.	681 to 743 N
Compress Spring to 1.937" (49.200 mm), Valve Closed	50.5 to 60.5 lbs.	225 to 269 N

Rocker Arm Assembly

OD of Shaft	0.872 to 0.873"	22.149 to 22.174 mm
ID of Arm Bore	0.8745 to 0.8755"	22.212 to 22.238 mm
Shaft Assembly Lateral Movement (Both Ends)	0.010 to 0.030"	0.254 to 0.762 mm
Shaft Spring		
Number of Working Coils	4	4
Wire Diameter	0.080"	2.032 mm
Compress Spring to 1.562" (39.675 mm)	8.5 to 11.5 lbs.	38 to 51 N
Lubrication	Engine Oil, Camshaft Metering	
Shaft Oil Holes	Toward Valve Side of Engine	
	Shaft Can Not Be Turned	

Intake Valve Timing

Valve Timing ..... With the Number One Intake Valve to Rocker Arm Clearance Set at 0.015" (0.381 mm) and the Dial Indicator on the Number One Valve Retainer, 0.053" (1.346 mm) Movement of the Valve From the Seat (Clockwise Pulley Rotation) Will Give One Complete Revolution Plus 7 Degrees after TC Timing Indication on the Crank Pulley.

Special Torques

	U.S. Value	Metric Valve
Camshaft Nut - With Lock Washer	95 to 105 ft. lbs.	129 to 142 Nm (12.9 to 14.2 kgm)
- With Hardened Washer	195 to 205 ft. lbs.	264 to 278 Nm (26.4 to 27.8 kgm)
Connecting Rod Bolts (Add Lubrication to Threads and Under Bolt Heads with 30W Oil)	95 to 105 ft. lbs.	129 to 142 Nm (12.9 to 14.2 kgm)
Crankshaft Pulley Bolt	100 to 110 ft. lbs.	136 to 149 Nm (13.6 to 14.9 kgm)
Crankshaft Pulley Nut	125 to 135 ft. lbs.	169 to 183 Nm (16.9 to 18.3 kgm)
Crankshaft Main Bearing Bolts	145 to 155 ft. lbs.	197 to 210 am (19.7 to 21.0 kgm)
- With Hardened Washers	200 to 210 ft. lbs.	271 to 285 Nm (27.1 to 28.5 kgm)
Oil Cooler Outlet Cover Screws	35 to 42 ft. lbs.	48 to 51 mm (4.8 to 5.1 kgm)
Cylinder Head Bolts	200 to 210 ft. lbs.	271 to 285 Nm (27.1 to 28.5 kgm)
Cylinder Head Cover Stud Nuts	8 to 10 ft. lbs.	11 to 14 Nm (1.1 to 1.4 kgm)
Flywheel to Crankshaft Bolts Without Hardened Washers	180 to 190 ft. lbs.	244 to 258 Nm (24.4 to 25.8 kgm)
With Hardened Washers	230 to 250 ft. lbs.	312 to 339 Nm (31.2 to 33.9 kgm)
Intake and Exhaust Manifold Studs	25 to 30 ft. lbs.	34 to 41 Nm (3.4 to 4.1 kgm)
Exhaust Manifold Hex Nuts	25 to 30 ft. lbs.	34 to 41 Nm (3.4 to 4.1 kgm)
Intake Manifold Hex Nuts - Standard	25 to 30 ft. lbs.	34 to 41 Nm (3.4 to 4.1 kgm)
- Heavy	35 to 42 ft. lbs.	48 to 57 Nm (4.8 to 5.7 kgm)
Oil Pan Capscrews	15 to 20 ft. lbs.	20 to 27 Nm (2.0 to 2.7 kgm)
Oil Pan Drain Plug	29 to 31 ft. lbs.	39 to 42 Nm (3.9 to 4.2 kgm)

Special Torques (Continued)

	U.S. Value	Metric Value
Oil Pump Inlet Connector	105 to 115 ft. lbs.	142 to 156 Nm (14.2 to 15.6 kgm)
Oil Pump Inlet Tube Nut	95 to 105 ft. lbs.	129 to 142 Nm (12.9 to 14.2 kgm)
Rocker Arm Adjusting Screw Locknut	20 to 25 ft. lbs.	27 to 34 Nm (2.7 to 3.4 kgm)
Rocker Arm Bracket Stud Nut or Bolt	40 to 45 ft. lbs.	54 to 61 Nm (5.4 to 6.1 kgm)
Water Pump and Fan Shaft Nut - Standard	60 to 70 ft. lbs.	81 to 95 Nm (8.1 to 9.5 kgm)
- Crownlock	45 to 50 ft. lbs.	61 to 68 Nm (6.1 to 6.8 kgm)
Balancer Mounting Bolts - Grade 5	80 to 96 ft. lbs.	108 to 130 Nm (10.8 to 13.0 kgm)
- Grade 8	110 to 132 ft. lbs.	149 to 179 Nm (14.9 to 17.9 kgm)
Balancer Counterweight Set Screws	70 to 80 ft. lbs.	95 to 108 Nm (9.5 to 10.8 kgm)

GENERAL TORQUE SPECIFICATION TABLE (Revised 11-73)

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.		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	
Inches	Millimeters	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	6.35	9	11	12.2	14.9	12	15	16.3	20.3
5/16	7.94	17	20.5	23.1	27.8	24	29	32.5	39.3
3/8	9.53	35	42	47.5	57.0	45	54	61.0	73.2
7/16	11.11	54	64	73.2	86.8	70	84	94.9	113.9
1/2	12.70	80	96	108.5	130.2	110	132	149.2	179.0
9/16	14.29	110	132	149.2	179.0	160	192	217.0	260.4
5/8	15.88	150	180	203.4	244.1	220	264	298.3	358.0
3/4	19.05	270	324	366.1	439.3	380	456	515.3	618.3
7/8	22.23	400	480	542.4	650.9	600	720	813.6	976.3
1	25.40	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

Section 1050

MAINTENANCE

AND

LUBRICATION

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MAINTENANCE CHART

CAUTION: The following chart is based on maximum intervals. If machine operates in severe conditions, service more often.

INTERVAL	SERVICE	INSTRUCTIONS
Run-In: Every Two Hours Until Stabilized	Torque wheel nuts 380-420 foot-pounds, dry threads. Torque axle mounting bolts 380-460 foot-pounds, dry threads.	
Run-In: After First 20 Hours	Change engine oil Change engine oil filter. Check drive belt tension. Torque bucket pin bolts 75 foot-pounds, dry threads.	 Section 23 Section 7014 and 8016
Every 10 Hours Or Daily	Grease frame pivot points. Grease loader pivot points. Grease rear axle trunnion pivot points. Check engine oil level. Check radiator coolant level. Drain air reservoir. Visually inspect transfer pump sediment bowl for water. If found, drain water from bowl, fuel filters and fuel tank. Check machine and ground under machine for signs of leaks.	 Section 31
Every 50 Hours Or Weekly, Whichever Comes First	Check master brake cylinder. Check transmission oil level. Drain Sediment bowl. Check hydraulic reservoir oil level. Grease front shaft support bearing. Grease steering cylinder pivots. Grease drive shaft universals & slip spline. Check battery fluid level.	 Section 6012 Section 4011 Section 8014

INTERVAL	SERVICE	INSTRUCTIONS
Every 100 Hours	Clean spark arresting muffler.	
Every 150 Hours	Change engine oil.	
Every 250 Hours	Grease equipment control levers.	
	Check front and rear axle oil levels.	Section 6020
	Clean alcohol evaporator intake filter.	Section 7020
Every 300 Hours	Change engine oil filter.	Section 23
Every 500 Hours	Change first and second stage fuel filters and fuel transfer pump filter.	Section 31
	Check drive belt tension.	Section 7014 and 8016
	Drain water from fuel tank.	
	Clean electric fuel pump filter.	
Every 1000 Hours Or Yearly, Whichever Comes First	Change hydraulic oil.	Section 4011
	Change hydraulic reservoir outlet filter.	Section 4011
	Change transmission oil.	Section 6012
	Change transmission filter.	Section 6012
	Clean transmission suction strainer.	Section 6012
	Clean transmission breather.	Section 6012
	Change front and rear axle oil.	Section 6020
	Clean air compressor cylinder head (by dealer only)	Section 7014
Every 2000 Hours Or Yearly, Whichever Comes First	Clean and refill cooling system.	
	Disassemble and clean alcohol evaporator and replace all gaskets (by dealer only).	Section 7020
Every 3000 Hours	Rebuild/replace air compressor (by dealer only).	Section 7014
As Required	Service air cleaner when restriction indicator shows red signal band.	Section 2051
	After wheel has been removed for servicing and reinstalled, check wheel nut torque every two hours until stabilized. Torque 380-420 foot-pounds.	
	Each time bucket is removed and reinstalled, torque bucket pin bolts 75 foot-pounds, dry threads. After 20 hours, check torque and if necessary retorque to 75 foot-pounds.	

FLUIDS AND LUBRICANTS

COMPONENT	CAPACITY		SPECIFICATIONS
	U. S.	Metric	
Fuel tank	38 gals.	144 liters	No. 2 diesel fuel
Cooling system	28 qts.	27 liters	1/2 high boiling point, permanent antifreeze; 1/2 water (protects down to -34° F.)
Engine crankcase: Without filter change With filter change	10 qts. 11 qts.	9,4 liters 10,4 liters	Engine oil: Case HDM Oil CD - Commercial class D (Series 3, MIL-L-45199) Above 32° F. - SAE 30 10° to 50° F. - SAE 20W Below 32° F. - SAE 10W
Brake master cylinders			SAE J1703c brake fluid
Equipment and steering hydraulic system: System total Reservoir refill	21 gals. 16 gals.	80 liters 61 liters	Case TCH Fluid. Alternate oils: Tenneco Hytrans Fluid. Engine oil - SD - Service class D or CA - Commercial class A. Above 32° F. - SAE 10W. Below 32° F. - SAE 5W.
Axles: Each center bowl Each wheel end	9-1/2 qts. 3 pts.	9 liters 1,4 liters	Case FDL -15° F. (-26° C) and above Alternate oils: Hypoid Gear Oil, API-GL-5 SAE 90 or SAE 80W/90 -15° F. (-26° C) and above SAE 80W - -15° F. (-26° C) to +70° F. (+21° C) SAE 75W - -40° F. (-4° C) to +35° F. (+2° C)
Pressure fittings			No. 2 moly-disulfide grease Alternate: Multipurpose lithium-soap base grease.
Alcohol evaporator	1 pt.	0,5 liters	Clean wood alcohol.
Transmission-converter: System total Transmission refill	9 gals. 7-1/2 gals.	34 liters 28 liters	Case TCH Fluid. Alternate oils: Type C-2 transmission hydraulic fluid such as Tenneco Hytrans Fluid.

Section
2001

ENGINE DIAGNOSIS

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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. IGNITION

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

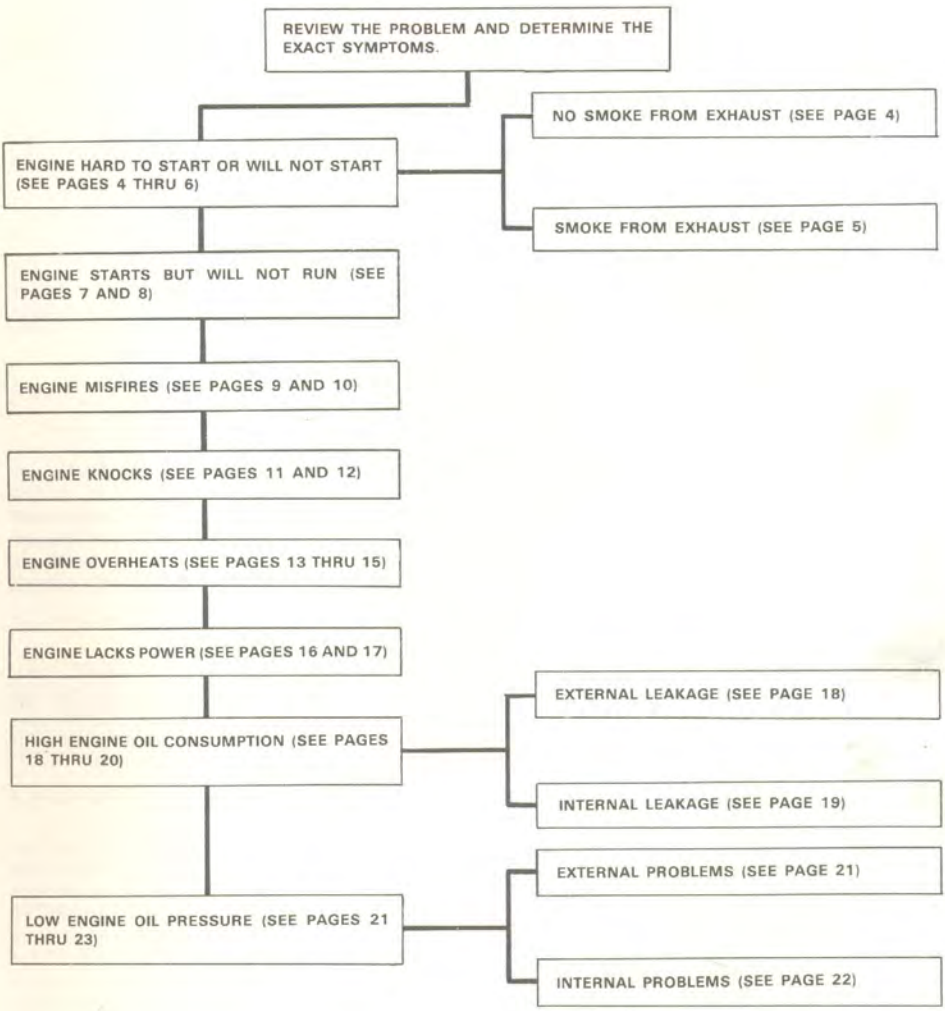
1. FUEL. Fuel system problems can be present anywhere from the fuel tank, through the filters and injection pump as well as the injectors. Correct injection pump timing is important in the overall fuel system performance.

2. 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.

3. IGNITION. Ignition 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 ignition.

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 progressively 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, air compressor, water pump or hydraulic pump.

4. Fuel Supply Shut Off or No Fuel

Check that fuel tank shutoff 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, lose 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 or contaminated fuel can cause the unit not to run, or to have preignition and detonation 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. Remove cap from front of injection pump to see if rack moves when throttle lever is moved.

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.

ENGINE HARD TO START OR WILL NOT START

SMOKE FROM EXHAUST

1. 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 problem 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, worn rod or crank bearings, oil pump, air compressor, water pump or hydraulic pump.

2. 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.

3. Low Compression

Low compression on several cylinders makes the engine hard to start and also does not generate enough heat to properly fire on all cylinders and continue running. Make a compression check on the engine.

4. Final Air Filter Plugged

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

5. Fuel Injection Nozzles Malfunctioning

Low cracking pressure, improper spray pattern, or plugged spray orifice will affect proper combustion in engine cylinders. Remove and test the fuel injection nozzles.

6. Engine Timing Incorrect

Combustion will not occur in the cylinder at the correct moment (degrees BTDC) if the engine timing is incorrect. This can cause preignition or detonation and serious damage to the engine. Check for proper engine timing.

7. Piston Rings Worn

As piston rings become worn, they lose tension and ability to seal and wipe lubricating 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.

8. Valve Push Rods Bent

Bent push rods will affect valve operation and not allow cylinders to get a full charge of fuel and air, or not exhaust properly. This can usually be distinquished by excessive valve tappet noise. Remove cylinder covers and check for bent push rods.

9. Clogged Fuel Filter

Check and service fuel filters.

10. 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, lose nozzle, or broken stud.

11. Tune-up Specifications Wrong

Check engine and unit serial number plates for correct specifications when performing engine tune-up.

12. Piston and Sleeves Scuffed and Scored

Scuffing starts as a very small surface disturbance of torn out metal particle. This helps break down lubrication which increases heat and spreads the scuffing to adjacent areas. Scuffing and scoring are caused by malfunctioning of the lubrication system or cooling system, incorrect timing, detonation, preignition, lugging or overloading, improperly fitted parts, and improper break-in procedure. Remove piston assemblies and inspect.

Suggest:

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first, and then click the above link

to download the complete manual.

Thank you so much for reading

ENGINE HARD TO START OR WILL NOT START

SMOKE FROM EXHAUST (Cont'd)

13. Cylinder Head Gasket Blown

A blown cylinder head gasket will cause one or two cylinders to lose power and cause an engine miss. It can also cause cooling system pressure to rise and blow engine coolant out the radiator overflow. Take a compression test to help determine a defective head gasket or, remove thermostats and fan belts, run engine, and check for gas bubbles rising in coolant in the water manifold.

14. Piston Ring Installation Faulty or Broken Rings

Many times piston rings are installed wrong, upside down, wrong size, or expanders are cut-off on three piece oil rings and overlapping the expander. Be sure to carefully read instructions before installing piston rings. Damaged rings can cause scoring of the pistons and sleeves and cause the engine to use oil.

15. Valves sticking

Sticking valves can be caused by improper replacement of valve guides, no lubrication, rust vapors, bent valves, or carbon. A sticking valve will cause an engine miss and the valve could also hit the piston causing internal damage.

16. Wrong Fuel or Contaminated Fuel

Wrong fuel or contaminated fuel can cause the unit not to run or to have preignition and detonation causing serious damage to the engine. Drain fuel tank and refill with correct fuel.

17. Injection Pump Malfunction

A malfunctioning injection pump will usually under-fuel the engine. Adjust or replace the injection pump.

18. Fuel Injection Line Cracked.

A cracked, chaffed or damaged fuel injector line will allow the fuel to escape externally and not inject fuel into the cylinder. This will cause an engine miss and low horsepower. Leaking fuel from a damaged injector line can easily be seen.