888 Turntable Leveler Crawler Excavator

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Reprinted

CASE CORPORATION Don 8-88642 Printed in England
June 1990

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Section

1001

SAFETY, GENERAL INFORMATION AND TORQUE SPECIFICATIONS

CASE CORPORATION

Don 8-86530

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June 1989

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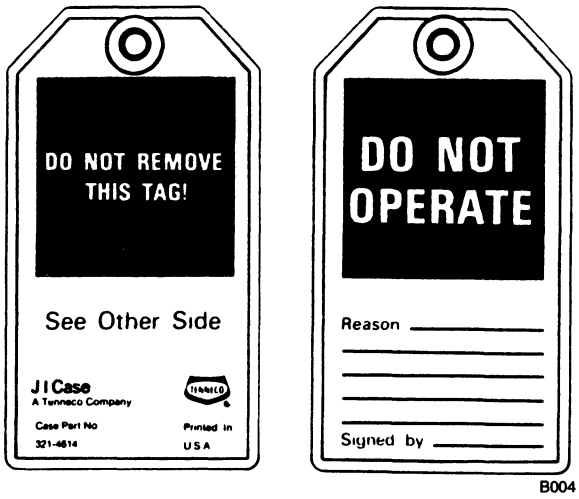
SAFETY

This symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED. The message that follows the symbol contains important information about safety. Carefully read the message. Make sure you fully understand the causes of possible injury or death. 1 1 C

To prevent injury always follow the Warning, Caution and Danger notes in this section and throughout the manual.

Put the warning tag shown below on the key for the keyswitch when servicing or repairing the machine. One warning tag is supplied with each machine. Additional tags Part Number 331-4614 are available from your service parts supplier.



B004

WARNING: Read the operator's manual to familiarize yourself with the correct control functions. 46 27

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

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

WARNING: Before starting engine, study Operator's Manual safety messages. Read all safety signs on machine. Clear the area of other persons. Learn and practice safe use of controls before operating.
It is your responsibilty to understand and follow manufacturers instructions on machine operation, service, and to observe pertinant laws and regulations. Operator's and Service Manuals may be obtained from your J.I.Case dealer 45 2

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

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: 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

CAUTION: Lower all attachments to the ground or use stands to safely support the attachments before you do any maintenance or service. 49 11

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 seperate 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

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

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: Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this Service Manual. 40 10

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. Open the doors and get outside air into the area. 48 56

DANGER: When the battery electrolyte is frozen, the battery can explode if (1), you try to charge the battery, or (2), you try to jump start and run the engine. To prevent the battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions, you or others in the area can be injured. 48 35

DANGER: Batteries contain acid and explosive gas. Explosions can result from sparks, flames or wrong cable connections. To connect the jumper cables correctly to the battery of this machine see the Operator's Manual. Failure to follow these instructions can cause serious injury or death.

GENERAL INFORMATION

CLEANING

Clean all metal parts except bearings, in mineral spirits or by steam cleaning. Do not use caustic soda for steam cleaning. After cleaning dry, and put oil on all parts. Clean oil passages with compressed air. Clean bearings in kerosene, dry the bearings completely and put oil on the bearings.

INSPECTION

Check all parts when the parts are disassembled. Replace all parts that have wear or damage. Small scoring or grooves can be removed with a hone or crocus cloth. Complete visual inspection for indications of wear, pitting and the replacement of parts necessary will prevent early failures.

BEARINGS

Check bearings for easy action. If bearings have a loose fit or rough action replace the bearing. Wash bearings with a good solvent or kerosene and permit to air dry. DO NOT DRY BEARINGS WITH COMPRESSED AIR.

NEEDLE BEARINGS

Before you press needle bearings in a bore always remove any metal protrusions in the bore or edge of the bore. Before you press bearings into position put petroleum jelly on the inside and outside diameter of the bearings.

GEARS

Check all gears for wear and damage. Replace gears that have wear or damage.

OIL SEALS, O-RINGS AND GASKETS

Always install new oil seals, o-rings and gaskets. Put petroleum jelly on seals and o-rings.

SHAFTS

Check all shafts that have wear or damage. Check the bearing and oil seal surfaces of the shafts for damage.

SERVICE PARTS

Always install genuine Case service parts, when ordering refer to the Parts Catolog for the correct part number of the genuine Case replacement items. Failures due to the use of other than genuine Case replacement parts are not covered by warranty.

LUBRICATION

Only use the oils and lubricants specified in the Operator's or Service Manual. Failures due to the use of non specified oils and lubricants are not covered by warranty.

STANDARD TORQUE DATA FOR NUTS AND BOLTS

Where no special torque data is specified, the following torque figures should be applied. Threads should be lubricated with engine oil or chassis grease.

TORQUE SPECIFICATIONS ± 10%									
SIZE	GRADE 8.8			GRADE 10.9			GRADE 12.9		
	lb-ft	Nm	kg/m	lb-ft	Nm	kg/m	lb-ft	Nm	kg/m
5 mm	4	5.5	0.56	5.5	7.5	0.76	6.6	9	0.92
6 mm	6.6	9	0 92	9.2	12.5	1.27	11	15	1.53
8 mm	16.5	22.5	2 3	23	31.5	3.2	26.5	36	3.67
10 mm	32	44	4.5	45	62	6.3	55	75	7.65
12 mm	57	77.5	7.9	81	110	11.2	95	130	13.2
14 mm	88	120	12.2	125	170	17.3	155	210	21 4
16 mm	140	190	19.4	195	265	27	236	320	32.6
18 mm	192	260	26.5	269	365	37.2	320	435	44.3
20 mm	273	370	37.7	383	520	53	457	620	63.2
22 mm	369	500	51	516	700	71.4	619	840	85.6
24 mm	471	640	65.2	665	900	92	796	1080	110
27 mm	702	950	97	996	1350	137.7	1195	1620	165.2
30 mm	955	1300	132.5	1328	1800	183.6	1593	2160	220.3

TORQUE DATA FOR HYDRAULIC FITTINGS

FITTINGS, CONNECTIONS AND PLUGS

Diameter x Pitch	Newton / Metres	Pounds / Feet	Kilogram / Metres
10 mm x 1	20	14.5	2
12 mm x 1.5	35	26	3.6
14 mm x 1.5	45	33.2	4.6
16 mm x 1.5	60	44	6.1
18 mm x 1.5	70	51	7.1
22 mm x 1.5	100	73	10.2
27 mm x 2	200	147	20.4
33 mm x 2	280	207	28.6
42 mm x 2	380	281	38.8

NUTS FOR TUBES AND HOSES

Diameter x Pitch	Newton / Metres	Pounds / Feet	Kilogram / Metres
16 mm x 1.5	20	14.5	2
18 mm x 1.5	35	26	3.6
20 mm x 1.45	45	33.2	4.6
24 mm x 1.5	60	44	6 1

FLANGES

Diameter x Pitch	Newton / Metres	Pounds / Feet	Kilogram / Metres
8 mm x 1.5	28	21	2.9
10 mm x 1.5	55	41	5.6
12 mm x 1.75	90	67	9.2
14 mm x 2	145	107	14.8
16 mm x 2	230	170	23.5

Section

1002

SPECIFICATIONS

For 888 Turntable Leveler Crawler Excavators

CASE CORPORATION

Don 7-32362

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GENERAL SPECIFICATIONS

Capacities

Engine Oil Capacity (without filter change)	14.4 litres	3.80 US gallons
Engine Oil Capacity (with filter change)	15.4 litres	4 US gallons
Engine Cooling System (with cab heater)	19.2 litres	5.07 US gallons
Fuel Tank	247 litres	65 US gallons
Hydraulic Oil Tank Capacity	130 litres	34.3 US gallons
Total Hydraulic System Capacity	155 litres	40.9 US gallons
Final Drive Transmission Capacity (each side)	1.7 litres	1.76 US quarts
Swing Reduction Gear Capacity	3.5 litres	3.70 US quarts
Track Front Idlers	0.25 litres	0.26 US quarts
Track Lower Rollers	0.26 litres	0.28 US quarts

NOTE: *These capacities are only a guide to the quantities. Always use the dipstick, sight gauge or level plug to make sure that fluid levels are correct.*

Drawbar Pull

Drawbar Pull	140112 N	31500 lb

Drive Speed

Drive Speed	3.50 kph	2.17 mph

Electrical System

Type of System ..... 24 volts, negative ground

Alternator
- Manufacturer ..... Bosch
- Output ..... 28 volts at 45 amperes
- Resistance of rotor winding ..... 9.0 ohms
- Resistance of stator winding ..... 0.22 ohms
- Minimum brush length ..... 14 mm (0.55 inch)

Batteries
- Number of batteries required 2
- Voltage of each battery ..... 12 volts
- Reserve capacity ..... 160 minutes
- Cold cranking capacity at -17°C (0°F) ..... 800 amperes
- Load for capacity (load) test ..... 400 amperes

Starter Motor
- Manufacturer ..... Bosch
- No load test at 27°C (80°F)
  - volts ..... 23 volts
  - current draw ..... 85 amperes maximum
  - armature speed ..... 7000 rpm minimum
- Brush length ..... 8.5 mm (0.3125 inch) minimum
- Armature run-out ..... 0.03 mm (0.001 inch) maximum
- Commutator diameter ..... 42.5 mm (1.74 inch) minimum
- Armature end play ..... 0.05 to 0.4 mm (0.002 to 0.15 inch)

Fluids and Lubricants

Batteries	add drinking or distilled water
Engine Coolant Solution	refer to page 8
Engine Lubrication	refer to page 8
Fuel	refer to the entry on this page
Hydraulic Oil	Case hydraulic excavator fluid (MS 1230)
Final Drive Transmission Lubricant	Case IH 135-H EP gear lubricant or a gear lubricant API GL-5 (SAE 85W-140)
Swing Reduction Gear Lubricant	Case IH 135-H EP (gear lubricant) or a gear lubricant API GL-5 (SAE 85W-140)
Track Roller and Front Idler Lubricant	Case IH No. 1 Single Grade engine oil SAE 80
Turntable Ring Gear Lubricant	Case IH molydisulfide grease
Grease Fitting Lubricant	Case IH molydisulfide grease

Fuel

Use a good grade of Number Two diesel fuel.

Specifications for Acceptable Number Two Diesel Fuel:

API Gravity (minimum)		34
Flash Point (minimum)	60°C	140°F
Cloud Point (Wax Appearance Point) (maximum)	-2°C	-5°F
Pour Point (maximum)	-26°C	-15°F
Distillation Temperature, 90% Point	282 to 338°C	540 to 640°F
Viscosity at 38°C (100°F)		
Centistokes		2.0 to 4.3
Saybolt Seconds Universal		32 to 40
Cetane Number (minimum)	43 (45 to 55 for winter or high altitudes)	
Water and Sediment by Volume (maximum)		0.05 of 1%
Sulfur by Weight (maximum)		0.50 of 1%
Copper Strip Corrosion (maximum)		Number 2
Ash by Weight (maximum)		0.01 of 1%

Hydraulic System

High Pressure Pump
The high pressure pump comprises two bodies:
One body with an variable flow for the attachment and travel hydraulic circuits,

Maximum flow at 2000 rpm: attachment hydraulic circuit	170 l/min	45 US gpm
travel hydraulic circuit	250 l/min	66 US gpm

One body with a fixed flow for the upperstructure swing and for travel hydraulic circuits,

Maximum flow at 2000 rpm:	56 l/min	15 US gpm
(total flow for travel)	306 l/min	81 US gpm

Low Pressure Pump
Comprises one body with a fixed flow for the servo-steering hydraulic circuits,

Maximum flow at 2000 rpm:	24 l/min	6.3 US gpm
Operating pressure	28 Bar	406 psi

Flow Setting Times

Boom Up	4 to 4.3 seconds
Dipper In	4.8 to 5 seconds
Bucket In	3.3 to 3.6 seconds

Flow Setting Valve Rates (cylinder large chamber):

Boom raising	168 to 175 l/min	44.3 to 46.2 US gpm
Boom lowering	33 to 55 l/min	9.2 to 14.5 US gpm
Bucket opening	130 to 150 l/min	34.3 to 39.6 US gpm
Bucket closing	140 to 150 l/min	37 to 39.6 US gpm
Dipper extension	150 to 165 l/min	39.6 to 43.5 US gpm
Dipper retracting	158 to 165 l/min	41.7 to 43.5 US gpm
Right-hand travel in forward drive	122 to 130 l/min	32.2 to 34.3 US gpm
Left-hand travel in forward drive	122 to 130 l/min	32.2 to 34.3 US gpm
Right and left-hand travel in forward drive	224 to 260 l/min	64.4 to 68.6 US gpm
Offset backhoe	25 to 35 l/min	6.6 to 9.2 US gpm
Hydraulic Oil Test Temperature	50°C	120°F

Pressure Settings

Attachment Flow Cut-off Valve	360 to 370 Bar	5221 to 5366 psi
Attachment Valve Bank Main Relief Valve	435 to 445 Bar	6309 to 6454 psi
Torque Regulator Valve, 120 l/min (31.6 US gpm) engine speed 2020 rpm at a pressure of	275 Bar	3988 psi
Load Sensing Valve	18 to 20 bar	261 to 290 psi
Travel Flow Cut-off Valve	405 to 415 Bar	5874 to 6019 psi

Circuit Relief Valves:

Boom : raising	380 to 405 Bar	5511 to 5874 psi
Boom : lowering	400 to 435 Bar	5801 to 6309 psi
Bucket : opening, closing	380 to 405 Bar	5511 to 5874 psi
Dipper : extension, retracting	380 to 405 Bar	5511 to 5874 psi
Swing . right, left	350 to 360 Bar	5076 to 5221 psi
Travel : forward drive, reverse drive	420 to 435 Bar	6091 to 6309 psi
Boom and Dipper Anti-Drift Valve	390 to 410 Bar	5656 to 5946 psi
Boom and Dipper Safety Valve	390 to 410 Bar	5656 to 5946 psi
Low Flow (Clamshell Swing)	130 to 150 Bar	1885 to 2175 psi
High Flow (Clamshell Swing) See NIT 3060	180 to 200 Bar	2610 to 2900 psi
Offset boom	180 to 200 Bar	2610 to 2900 psi
Adjustment boom	180 to 200 Bar	2610 to 2900 psi
Turntable Leveler	345 to 355 Bar	5002 to 5147 psi

Counter Rotation Valve		
Reduction Pressure	14 to 20 Bar	275 to 290 psi
Selector Sequence Pressure	14.5 to 15.5 Bar	210 to 224 psi
Thermostat Controlled Valve		
Starts to Close	40°C	104°F
Fully Closed	50°C	122°F
Track Speed		
7 Revolutions	70 to 76 seconds	

Tracks, Rollers and Idlers

Track Tension	260 to 280 mm	10.2 to 11.1 inch
Maximum Pin and Bushing Wear Over Four Links	703 mm	27.7 inch
Maximum Link Wear	86.6 mm	3.41 inch
Maximum Track Shoe Wear	12 mm	0.47 inch
Maximum Spacer Wear	46.5 mm	1.83 inch
Maximum Idler Wear	35 mm	1.37 inch
Minimum Diameter on Track Roller	137 mm	5.39 inch

Weights

Operating Weight	16988 kg	37374 lb
Counterweight	3550 kg	7810 lb
Engine	512 kg	1130 lb
Attachments		
480 cm (189 inch) Boom with Dipper Cylinder	1085 kg	2387 lb
210 cm (83 inch) Dipper with Links and Bucket Cylinder	675 kg	1485 lb
270 cm (106 inch) Dipper with Links and Bucket Cylinder	765 kg	1683 lb
Buckets		
60 cm (24 inch) Bucket	405 kg	840 lb
75 cm (30 inch) Bucket	460 kg	1010 lb
85 cm (34 inch) Bucket	485 kg	1070 lb
95 cm (35 inch) Bucket	495 kg	1090 lb
100 cm (39 inch) Bucket	530 kg	1170 lb
115 cm (46 inch) Bucket	580 kg	1280 lb
130 cm (51 inch) Bucket	630 kg	1385 lb
Cylinders		
Boom Cylinder (each)	106 kg	234 lb
Dipper Cylinder	162 kg	356 lb
Bucket Cylinder	106 kg	234 lb

RUN-IN INSTRUCTIONS

Engine Lubrication

Fill the engine crankcase with CD service classification oil that has the correct viscosity rating for the ambient air temperature. Refer to Engine Lubrication on page 8. Install new oil filters, after the engine has been rebuilt.

Run-In Procedure For Rebuilt Engine

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

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

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

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

Run-In Procedure For Rebuilt Engine (With A Dynamometer)

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

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

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

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

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

Run-In Procedure

For the first 8 hours, operate the engine at full throttle maintaining a normal load. DO NOT "baby" the engine, but avoid converter or hydraulic stall. The engine must not be "lugged" below the rated engine rpm (Do not stall the engine more than 10 seconds).

Engine Cooling System

Coolant Solution ..... Ethylene Glycol

IMPORTANT: *When using ethylene glycol coolant solutions, always have a minimum of 50% ethylene glycol coolant in the system. Do not put more than 50% ethylene glycol in the cooling system unless the ambient air temperature will be less than -36°C (-34°F). More than 50% decreases heat transfer and will cause the engine surface temperture to be higher than normal.*

Thermostat ..... Starts to open at 82°C (180°F)
Fully open at 94°C (201°F)
Radiator Cap ..... 1.03 Bar (15 psi)

Engine Lubrication

Engine Oil Type

Case IH No. 1 engine oil is recommended for use in the Case engine. Case IH engine oil will lubricate the engine under all operating conditions. If Case IH No.1 Multi-Viscosity engine oil is not available, Case IH No. 1 Single Grade engine oil can be used.

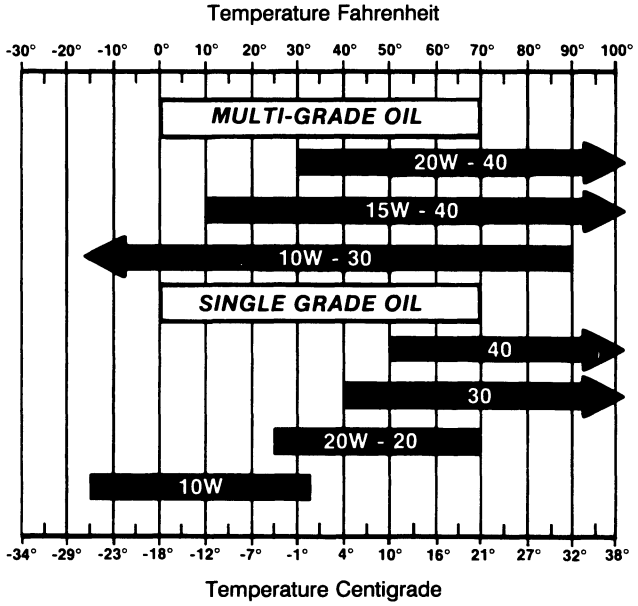
If Case IH No. 1 Multi-Viscosity or Single Grade engine oil is not available, use only oil meeting API engine oil service category CD.

See the chart below for recommended viscosity at ambient air temperature ranges.

NOTE: *DO NOT put performance additives or other oil additive products into the engine crankcase.*

Engine Lubrication Oil Viscosity

AMBIENT AIR TEMPERATURE RANGES



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GENERAL ENGINE SPECIFICATIONS

General

Make and Model	JI Case, 6T-590
Type	6 cylinder, turbocharged 4 stroke cycle
Horsepower	145 at 2000 rpm 108 kw at 2000 rpm
Firing Order	1, 5, 3, 6, 2, 4
Bore and Stroke	102 mm x 120 mm
Piston Displacement	5880 cm^3
Compression Ratio	17.5 to 1
Valve Tappet Clearance	
Exhaust (Cold)	0.508 mm
Intake (Cold)	0.254 mm
Engine Speeds	
No Load Governed Speed	2140 to 2280 rpm
Rated Engine Speed	2000 rpm
Stall Speed, Full Load (minimum)	2040 rpm
Engine Idle Speed	900 rpm

Pistons and Connecting Rods

Rings per Piston	3
Number of Compression Rings	2
Number of Oil Rings (two piece)	1
Type of Pins	Full Float
Type of Bearings	Steel Back Leaded Bronze

Main Bearings

Number of Bearings	7
Type of Bearings	Replaceable

Engine Lubricating System

Type of System	Pressure and Spray Lubrication
Oil Pressure (when engine warm and operating at rated speed)	2.07 to 3.45 Bar 30 to 50 psi
Oil Pump	Rotor Type
Oil Filter	Full Flow Turn-on Type
Oil Capacity	
(with filter change)	15.4 litres 16 US quarts
(without filter change)	14.4 litres 15 US quarts

Fuel System

Fuel Injection Pump		Bosch
Pump Timing		Top Dead Center
Fuel Injectors		Bosch 17 mm
Opening Pressure (New)	231 to 253 Bar	3350 to 3670 psi
Opening Pressure (Used)	221 to 250 Bar	3200 to 3625 psi
Maximum Pressure Difference	10.34 Bar	150 psi
Number of Orifices		4
Spray Orifice Size		0.29 mm
Governor		Variable Speed, Part of the Injection Pump
First Stage Fuel Filter		Turn-on Type
Second Stage Fuel Filter		Turn-on Type
Lift Pump	0.34 to 0.48 Bar	5 to 7 psi

DETAILED ENGINE SPECIFICATIONS

Cylinder Block

Type	Non-Sleeved
Material	Cast Iron
ID of Cylinder	102.00 to 102.04 mm
Maximum Service Limit	102.116 mm
Cylinder Out of Round (Maximum)	0.038 mm
Cylinder Taper (Maximum)	0.076 mm
0.5 mm Oversize Piston	
Machine Cylinder Bore to	102.40 to 102.44 mm
Hone Cylinder Bore to	102.50 to 102.54 mm
1.00 mm Oversize Piston	
Machine Cylinder Bore to	102.900 to 102.960 mm
Hone Cylinder Bore to	103.00 to 103.04 mm

Service Cylinder Sleeves

Type	Dry, Can Be Replaced
Material	Cast Iron
Machine Cylinder Block Bore to	104.485 to 104.515 mm
Installation	Press Fit
Hone Cylinder Bore to	102.00 to 102.10 mm

Pistons

Type	Cam Ground
Material	Aluminium alloy
OD at 12 mm From the Bottom, 90 Degrees From Piston Pin	
Standard Size Piston	101 873 to 101.887 mm
Minimum Service Limit	101.823 mm
0.5 Oversize Piston	102.373 to 102.387 mm
Minimum Service Limit	102.323 mm
1.00 Oversize Piston	102.873 to 102.887 mm
Minimum Service Limit	102.823 mm
ID of Piston Pin Bore	40.006 to 40.012 mm
Maximum Service Limit	40.025 mm
Width of 1st Ring Groove (Top)	2.465 to 2.485 mm
Width of 2nd Ring Groove (Intermediate)	2.425 to 2.445 mm
Width of 3rd Ring Groove (Oil Ring)	4.040 to 4.060 mm
Protrusion Above Cylinder Block (Maximum)	0.660 mm

Piston Pins

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

Piston Rings

No. 1 Compression 6T-590 Engine	Key Stone Type (Barrel Face)
End Gap in 102.02 ID	0.40 to 0.70 mm
No. 1 Compression 6T-590 Engine	Rectangular Type (Barrel Face)
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.075 to 0.120 mm
Maximum Service Limit	0.15 mm
No. 2 Compression	Rectangular Type (Taper Face)
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.075 to 0.120 mm
Maximum Service Limit	0.15 mm
No. 3 Oil Control Rings	Two Piece
End Gap in 102.02 ID	0.25 to 0.55 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.130 mm

Cylinder Head

Warpage (Maximum)	0.20 mm

Lifters

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

Connecting Rods

Bushing	Steel Backed Leaded Bronze
Bushing ID Installed (Ream to Size)	40.053 to 40.067 mm
Maximum Service Limit	40.092 mm
Bearing Liners	Replaceable
Journal ID Without Bearing Liners	72.987 to 73.013 mm
Bearing Oil Clearance	0.038 to 0.116 mm
Maximum Service Limit	0.129 mm
Side Clearance	0.100 to 0.300 mm
Maximum Service Limit	0.330 mm
Connecting Rod Bend (Maximum)	
Without Bushing	0.200 mm
With Bushing	0.150 mm
Connecting Rod Twist (Maximum)	
Without Bushing	0.500 mm
With Bushing	0.300 mm

Crankshaft

Type	Hardened Steel, Balanced
Main Bearing Liners	Replaceable
Crankshaft End Clearance	0.137 to 0.264 mm
Center Main Bearing Thrust Surface Thickness	2.50 mm
Connecting Rod Journal	
OD, Standard	68.987 to 69.013 mm
Maximum Service Limit	68.962 mm
0.25 mm OD Undersize, Grind to	68.737 to 68.763 mm
Maximum Service Limit	68.712 mm
0.50 mm OD Undersize, Grind to	68.487 to 68.513 mm
Maximum Service Limit	68.462 mm
0.75 mm OD Undersize, Grind to	68.237 to 68.263 mm
Maximum Service Limit	68.212 mm
1.00 mm OD Undersize, Grind to	67.987 to 68.013 mm
Maximum Service Limit	67.962 mm
Connecting Rod Journal Maximum Taper	0.013 mm
Journals Out of Round Maximum	0.050 mm
Undersize Main Bearing Liners For Service	0.25, 0.50, 0.75 and 1.00 mm
Main Bearing Oil Clearance	0.041 to 0.119 mm
Maximum Service Limit	0.140 mm
Main Bearing Journal	
OD, Standard	82.987 to 83.013 mm
Maximum Service Limit	82.962 mm
0.25 mm OD Undersize, Grind to	82.737 to 82.763 mm
Maximum Service Limit	82.712 mm
0.50 mm OD Undersize, Grind to	82.487 to 82.513 mm
Maximum Service Limit	82.462 mm
0.75 mm OD Undersize, Grind to	82.237 to 82.263 mm
Maximum Service Limit	82.212 mm
1.00 mm OD Undersize, Grind to	81.987 to 82.013 mm
Maximum Service Limit	81.962 mm
Main Bearing Journal Bore ID No Liners	87.982 to 88.018 mm
Maximum Service Limit	88.031 mm
Main Journal Width	
1st, 2nd, 3rd, 5th and 6th	37.424 to 37.576 mm
4th	37.475 to 37.525 mm
Connecting Rod Journals Width	38.950 to 39.050 mm

Camshaft

Type	Hardened Iron
Bushing (Front Only)	1, Replaceable
Bushing Lubrication:	
Front Bushing	Pressure Lubricated
Intermediate	Pressure Lubricated
Rear	Pressure Lubricated
Oil Clearance	0.076 to 0.152 mm
ID of No. 1 Bushing (Installed)	54.107 to 54.133 mm
Maximum Service Limit	54.146 mm
ID of No. 1 Oversize (57.36 to 57.40 mm OD) Service Bushing	54.107 to 54.133 mm
Maximum Service Limit	54.146 mm
ID of No. 2, 3, 4, 5 and 6 Service Bushing	54.107 to 54.133 mm
Maximum Service Limit	54.146 mm
Width of No. 1 Bushing	25.15 to 25.65 mm
Width of No. 2, 3, 4, 5 and 6 Service Bushing	17.75 to 18.25 mm
Camshaft Bushing Journal OD	53.987 to 54.013 mm
Minimum Serviceable Limit	53.962 mm
Camshaft Bore Diameter in Block	
No. 1 Bushing	57.222 to 57.258 mm
No. 1 Oversize Bushing, Machine to	57.722 to 57.758 mm
No. 2, 3, 4, 5 and 6 Less Bushings	54.107 to 54.133 mm
No. 2, 3, 4, 5 and 6 Oversize for Bushings, Machine to	57.222 to 57.258 mm
Camshaft Thrust Thickness	9.42 to 9.58 mm
Minimum Service Limit	9.34 mm
Camshaft Thrust Clearance	0.130 to 0.340 mm
Maximum Service Limit	0.470 mm

Turbocharger

Horizontal Travel of Turbine Shaft	0.10 to 0.16 mm

Gear Train

Backlash:	
Crankshaft Gear to Camshaft Gear	0.08 to 0.33 mm
Crankshaft Gear to Idler Gear	0.08 to 0.33 mm
Camshaft to Fuel Pump Gear	0.08 to 0.33 mm
Idler Gear to Oil Pump	0.08 to 0.33 mm
Camshaft to Auxiliary	0.08 to 0.33 mm
Maximum Service Limit (All Gears)	0.45 mm

Rocker Arm Assembly

OD of Shaft	18.963 to 18.975 mm
Minimum Service Limit	18.938 mm
ID of Arm Bore	19.000 to 19.026 mm
Maximum Service Limit	19.051 mm
Lubrication	Pressure From Oil Gallery

Intake Valves

Tappet Clearance (Cold)	0.254 mm
Face Angle	29 Degrees
Face Run-Out	0.038 mm
Valve Head Edge Thickness, Minimum	1.50 mm
Length	128.84 to 129.46 mm
OD of Stem	7.960 to 7.980 mm
Minimum Service Limit	7.940 mm
OD of Head	44.870 to 45.130 mm
Seat Angle	30 Degrees
Seat Contact Width	1.32 to 1.92 mm
Seat Run-Out	0.10 mm
Insert Height	6.84 to 6.96 mm
OD of Insert	47.063 to 47.089 mm
ID of Insert	Tapered
Valve Recession Below Head Surface	0.99 to 1.52 mm
Maximum Service Limit	1.52 mm
ID of Valve Guide Bore	8.019 to 8.039 mm
Maximum Service Limit	8.089 mm

Exhaust Valves

Tappet Clearance (Cold)	0.508 mm
Face Angle	44 Degrees
Face Run-Out	0.038 mm
Valve Head Edge Thickness, Minimum	1.50 mm
OD of Head	41.870 to 42.130 mm
OD of Stem	7.960 to 7.980 mm
Minimum Service Limit	7.940 mm
Length	128.74 to 129.36 mm
Insert Seat Angle	45 Degrees
Seat Contact Width	1.47 to 2.07 mm
Seat Run-Out	0.10 mm
Insert Height	6.65 to 6.77 mm
OD of Insert	43.713 to 43.739 mm
ID of Insert	Tapered
Valve Recession Below Head Surface	0.99 to 1.52 mm
Maximum Service Limit	1.52 mm
ID of Valve Guide Bore	8.019 to 8.039 mm
Maximum Service Limit	8.089 mm

Valve Springs

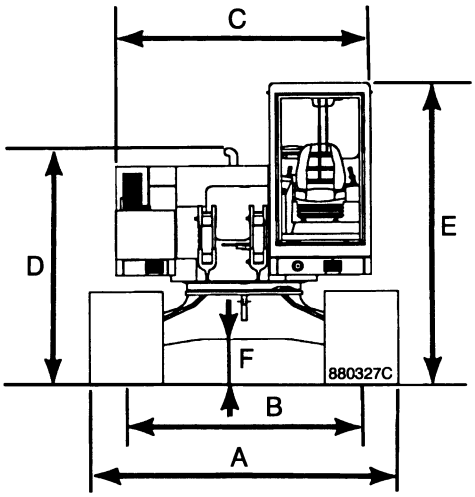
Free Length	55.63 mm
Total Coils	7.25 mm
Wire Diameter	4.830 to 4.930 mm
Compressed to 38.53 mm	(Valve Open) 785 to 839 N
Maximum Service Limit	765 N
Compressed to 49.25 mm	(Valve Closed) 285 to 321 N
Minimum Service Limit	270 N

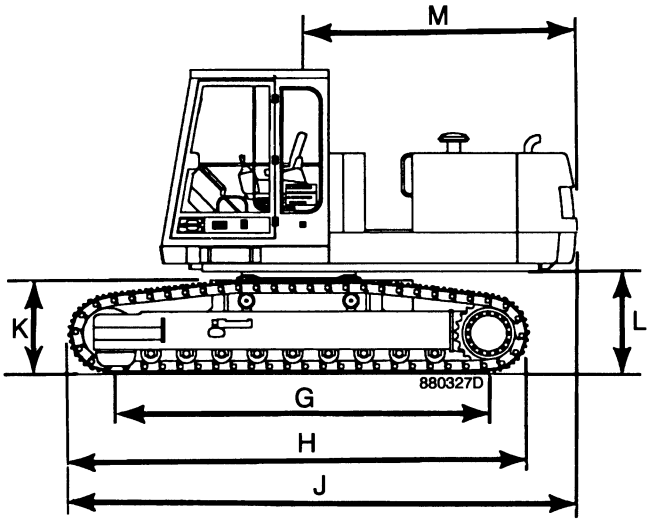
SPECIAL TORQUES

Alternator Bracket Bolts (Lower)	24 Nm	18 lb ft
Alternator Bracket Bolts (Upper)	24 Nm	18 lb ft
Alternator Retaining Bolt	24 Nm	18 lb ft
Belt Tensioner Bracket Bolts	24 Nm	18 lb ft
Belt Tensioner Retaining Bolt	43 Nm	32 lb ft
Camshaft Retaining Bolts	24 Nm	18 lb ft
Center Housing to Back Plate Bolts	6 Nm	4.5 lb ft
Connecting Rod Bolts (Lubricate Threads With Engine Oil)	100Nm	74 lb ft
Coolant Inlet Bolts	43 Nm	32 lb ft
Crankshaft Dampener Pulley	137 Nm	101 lb ft
Cylinder Head Bolts	126 Nm	93 lb ft
Engine Lift Bracket Bolts (Rear)	77Nm	57 lb ft
Exhaust Manifold Bolts	43 Nm	32 lb ft
Fan Pulley Bracket Bolts	24 Nm	18 lb ft
Fan Pulley Bolts (Grade 8.8)	24 Nm	18 lb ft
Fan Pulley Bolts (Grade 10.9)	34 Nm	25 lb ft
Flywheel Housing Bolts	60 Nm	45 lb ft
Flywheel Housing Cover Bolts	24 Nm	18 lb ft
Flywheel Retaining Bolts	137 Nm	101 lb ft
Front Cover Bolts	24 Nm	18 lb ft
Front Housing Bolts	24 Nm	18 lb ft
Fuel Air Removal Bolt	6 Nm	4.5 lb ft
Fuel Filter Inlet Bolt	32 Nm	24 lb ft
Fuel Filter Inlet Nut	32 Nm	24 lb ft
Fuel Line Fitting (High Pressure)	24 Nm	18 lb ft
Fuel Line Fitting (Low Pressure)	24 Nm	18 lb ft
Fuel Pump Plug with Bronze Washer	23 Nm	17 lb ft
Fuel Shutoff Solenoid	15 Nm	11 lb ft

Injection Pump Drive Gear Nut	65 Nm	48 lb ft
Injection Pump Lock Bolt	30 Nm	22 lb ft
Injection Pump Retaining Nuts	24 Nm	18 lb ft
Injection Pump Bracket Bolts	24 Nm	18 lb ft
Injector Leak off Bolt	15 Nm	11 lb ft
Injector Retaining Nut	60 Nm	45 lb ft
Intake Manifold Bolts	24 Nm	18 lb ft
Intake Manifold Plug	125 Nm	92 lb ft
Lifter Cover Bolts	24 Nm	18 lb ft
Main Bearing Bolts (Lubricate The Threads With Engine Oil)	175 Nm	129 lb ft
Oil Fill Tube Bolts	43 Nm	32 lb ft
Oil Filter Housing Bolts	24 Nm	18 lb ft
Oil Inlet Tube Bolts	24 Nm	18 lb ft
Oil Inlet Tube Brace	24 Nm	18 lb ft
Oil Pan Drain Plug	75 Nm	55 lb ft
Oil Pan Heater Plug	122 Nm	90 lb ft
Oil Pan Retaining Bolts	24 Nm	18 lb ft
Oil Pump Retaining bolts	24 Nm	18 lb ft
Rear Seal Retaining Bolts	9 Nm	7 lb ft
Rocker Arm Bolts	24 Nm	18 lb ft
Starter Retaining Bolts	43 Nm	32 lb ft
Tachometer Drive Retaining Bolts	3 Nm	2 lb ft
Thermostat Housing Bolts	24 Nm	18 lb ft
Thrust Bearing Screws (Torx Head)	5 Nm	4 lb ft
Timing Pin Retaining Bolts	5 Nm	4 lb ft
Turbine Housing Bolts	11 Nm	8.5 lb ft
Turbocharger Drain Tube Bolts	24 Nm	18 lb ft
Turbocharger Mounting Bolts	32 Nm	24 lb ft
Turbocharger Oil Supply (Both Ends)	17 Nm	13 lb ft

GENERAL DIMENSIONS





A	2.57 m	8 ft 5 inch
B	1.97 m	6 ft.5 inch
C	2.44 m	8 ft 0 inch
D	2.40 m	7 ft 9 inch
E	2.91 m	9 ft 6 inch
F	0.45 m	1 ft 5 inch
G	3.03 m	9 ft 10 inch
H	3.82 m	12 ft 5 inch
J	4.31 m	14 ft 2 inch
K	0.89 m	2 ft 9 inch
L	1.06 m	3 ft 5 inch
M	2.40 m	7 ft 9 inch