888P/888P4A EXCAVATOR
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THIS TABLE OF CONTENTS REPLACES DON 7-32911

Printed in England
June 1992

* Schematic Set Sections

Sectional Index

Sectional Index

2 ENGINE — SECTION NO.

Section

1001

SAFETY, GENERAL INFORMATION

AND TORQUE SPECIFICATIONS

J I Case

Don 8-86530

Printed in England
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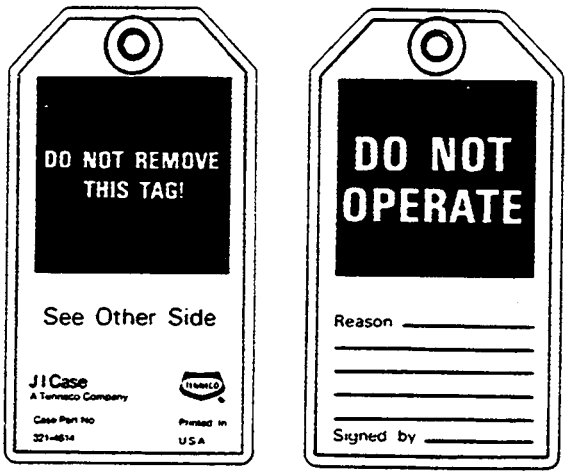
SAFETY

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 888P Excavators
(888P Serial Number: Prior to 6199)
(888P4A Serial Number: Prior to 7699)

J I Case

Lep 7-31291

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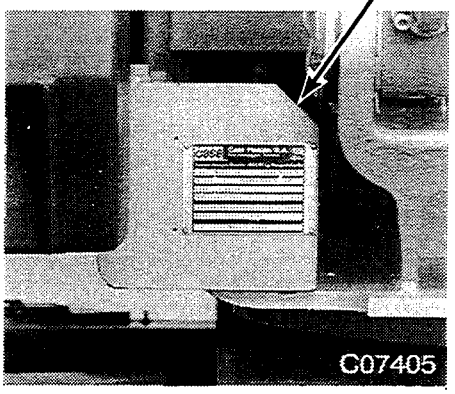
MODEL AND SERIAL NUMBERS

When ordering parts or when requesting information or assistance, always give the identification numbers of your machine.
Write the model and serial numbers of your machine on the lines below.

C14426A

Machine Model Number

Machine Serial Number



Engine Serial Number

High Pressure Pump Serial Number

Low Pressure Pump Serial Number

GENERAL SPECIFICATIONS

Capacities

Engine Oil Capacity (with filter change)	15.4 litres	3.38 gallons
Engine Cooling System (with cab heater)	19.2 litres	4.22 gallons
Fuel Tank	247 litres	54.34 gallons
Hydraulic Oil Reservoir Capacity	130 litres	28.6 gallons
Total Hydraulic System Capacity	205 litres	45.1 gallons
Swing Reduction Gear Capacity	3.5 litres	6.16 pints
Front Axle Capacity	16 litres	3.52 gallons
Rear Axle Capacity	21 litres	5.5 gallons
Axle Reduction Gear Housing Capacity (each)	2.5 litres	4.4 pints

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.*

Drive speed

Drive speed	23 Km/h	23 Kph

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	Maintenance Free
Engine Coolant Solution	refer to page 10
Engine Lubrication	refer to page 10
Hydraulic Oil	Case Poclain Hydraulic Excavator Fluid
Axle Lubricant	Gear Lubricant EP 80W 90
Gear Box Lubricant	Gear Lubricant EP 80W 90
Swing Reduction Gear Lubricant	Gear Lubricant EP 80W 90
Turntable Ring Gear Lubricant	Case IH molydisulfide grease
Grease Fitting Lubricant	Case IH molydusulfide grease

Hydraulic System

Engine no load governed speed	2140 to 2260 rpm
Engine idle speed	900 rpm

PRESSURE SETTINGS:		
Torque regulator valve (R.C) 120 L/mn Engine speed 2020 rpm at a pressure of	275 bar	3988 psi
Travel flow cut-off valve (A.D.LS2)	405 to 415 bar	5873 to 6018 psi
Attachment flow cut-off valve (A.D.LS1)	360 to 370 bar	5200 to 5365 psi
Load Sensing (L.S)	18 to 19 bar	261 to 276 psi
Attachment valve bank main relief valve	425 to 450 bar	6163 to 6525 psi
Circuit relief valves:		
Boom: raising	380 to 405 bar	5510 to 5873 psi
Boom: lowering	390 to 425 bar	5655 to 6163 psi
Bucket: opening, closing	380 to 405 bar	5510 to 5873 psi
Dipper: extension, retracting	380 to 405 bar	5510 to 5873 psi
Swing: right, left	350 to 360 bar	5075 to 5220 psi
Travel: forward drive, reverse drive	420 to 435 bar	6090 to 6308 psi
Stabilizers and dozer blade: lowering	380 to 400 bar	5510 to 5800 psi
Stabilizers and dozer blade: raising	360 to 390 bar	5220 to 5655 psi
P4A Excavator stabilizers: raising and lowering	380 to 400 bar	5510 to 5800 psi
Boom and dipper load holding valve	390 to 410 bar	5655 to 5945 psi
Boom and dipper safety valve	390 to 410 bar	5655 to 5945 psi
Low flow (clamshell swing)	130 to 150 bar	1885 to 2175 psi
Offset boom	180 to 200 bar	2610 to 2900 psi
Remote boom adjustment	180 to 200 bar	2610 to 2900 psi
Servo-unit pilot circuit	34 to 36 bar	493 to 522 psi
Travel pilot circuit	23 to 24 bar	334 to 348 psi
Stabilizer sequence:		
Stabilizer beam lowering	240 to 260 bar	3480 to 3770 psi
Stabilizer shoe closing	340 to 370 bar	4930 to 5365 psi
Dozer blade lowering sequence	340 to 360 bar	4930 to 5220 psi
Dozer blade ground pressure limiter	100 bar	1450 psi
Hydraulic drive motor regulation sequence	200 to 210 bar	2900 to 3045 psi
Stabilizer shoe opening pressure	80 to 120 bar	1160 to 1740 psi

Steering:		
Safety valve	175 to 185 bar	2538 to 2683 psi
Relief valves	200 to 220 bar	2900 to 3190 psi
Brake module make-and-break	120 to 160 bar	1740 to 2320 psi
Service brake pressure	45 to 60 bar	653 to 870 psi
Parking brake pressure	120 to 160 bar	1740 to 2320 psi
Accumulator pressure	65 bar	943 psi
Max. high pressure pump	255 L/mn	56.1 gpm
Flow setting valve rates:		
Boom, raising	168 to 175 L/mn	36.95 to 38.49 gpm
Boom, lowering	35 to 55 L/mn	7.6 to 12.9 gpm
Bucket, closing	140 to 150 L/mn	30.79 to 32.99 gpm
Bucket, opening	130 to 150 L/mn	28.59 to 32.99 gpm
Dipper, retracting	158 to 165 L/mn	34.75 to [illegible].29 gpm
Dipper, extension	150 to 165 L/mn	32.99 to [illegible].29 gpm
Travel, forward drive	166 to 170 L/mn	36.51 to 37.39 gpm
Travel, reverse drive	163 to 170 L/mn	35.85 to 37.39 gpm
Stabilizers and dozer blade: boom raising and lowering	45 to 55 L/mn	9.8 to 12.9 gpm
Stabilizers: shoe opening	18 to 22 L/mn	3.9 to 4.8 gpm
Stabilizers: shoe closing	45 to 55 L/mn	9.8 to 12.9 gpm
P4A excavator stabilizers: lowering	177 to 183 L/mn	38.93 to 40.25 gpm
P4A excavator stabilizers: raising	85 to 95 L/mn	18.69 to 20.89 gpm
Options	25 to 35 L/mn	5.49 to 7.6 gpm
Stabilizer shoe closing speed:		5 to 7 secondes
Thermostat controlled valve:		
Starts to close	40°C	106°F
Fully closed	50°C	126°F

Tires

(Model 888P - 888PL - 888P2A - 888P2AL)

Four wheels Fitted.....18 - 19.5 XF
Eight wheels Fitted.....10 - 22.5 or 10.00 - 20

(Model 888P4A)

Eight wheels Fitted.....10 - 22.5 XM37

Weights

Excavator with: monoblock boom, 2,10 m (83 inch) dipper and 760 L (1 cu.yd.) bucket:

Model 888P	13700 Kg	30140 lbs
Model 888PL	14300 Kg	31460 lbs
Model 888P2A	14500 Kg	31900 lbs
Model 888P2AL	15100 Kg	33220 lbs

Excavator with: adjustable boom, 2,10 m (83 inch) dipper and 760 L (1 cu.yd.) bucket:

Model 888P	14050 Kg	30910 lbs
Model 888PL	14650 Kg	32230 lbs
Model 888p2A	14850 Kg	32670 lbs
Model 888P2AL	15450 Kg	33990 lbs

Excavator with: offset boom, 2,10 m (83 inch) dipper and 760 L (1 cu.yd.) bucket:

Model 888P	14255 Kg	31361 lbs
Model 888PL	14855 Kg	32681 lbs
Model 888P2A	15055 Kg	33121 lbs
Model 888P2AL	15655 Kg	34441 lbs

Excavator with: articulated boom, 2,10 m (83 inch) dipper and 760 L (1 cu.yd.) bucket

Model 888P	14380 Kg	31636 lbs
Model 888PL	14980 Kg	32956 lbs
Model 888P2A	15180 Kg	33396 lbs
Model 888P2AL	15780 Kg	34716 lbs

Excavator with: boom, 3,90 m (154 inch) dipper and five-tine iron clamshell

Model 888P4A (only)	15800 Kg	34760 lbs

Excavator with: boom, 4,30 m (170 inch) dipper and five-tine iron clamshell

Model 888P4A (only)	15830 Kg	34826 lbs

ATTACHMENTS
Models 888P, 888PL, 888P2AL.
Boom (with dipper cylinder)

Monoblock	1085 Kg	2387 lbs
Adjustable	1435 Kg	3157 lbs
Offset	1640 Kg	3608 lbs
Articulated	1765 Kg	3883 lbs

Dipper (with yoke, rod and bucket cylinder)

1,60 m (63 inch)	655 Kg	1441 lbs
2,10 m (83 inch)	675 Kg	1485 lbs
2,70 m (106 inch)	765 Kg	1683 lbs
3,10 m (122 inch)	755 Kg	1661 lbs

Weights (Continued)

Model 888P4A.

Boom (with dipper cylinder)	830 Kg	1826 lbs
3.90 m (154 inch) dipper	390 Kg	858 lbs
4.30 m (170 inch) dipper	420 Kg	924 lbs

BUCKETS
Models 888P, 888PL, 888P2A, 888P2AL.
Trench bucket with ejector

Width	Weight
0.35 m (14 inch)	455 Kg (1000 lbs)
0.45 m (18 inch)	455 Kg (1000 lbs)

General purpose bucket

Width	Weight
0.60 m (24 inch)	405 Kg (890 lbs)
0.75 m (30 inch)	460 Kg (1010 lbs)
0.85 m (34 inch)	485 Kg (1070 lbs)
0.90 m (35 inch)	495 Kg (1090 lbs)
1.00 m (39 inch)	530 Kg (1165 lbs)
1.15 m (45 inch)	580 Kg (1275 lbs)
1.30 m (51 inch)	630 Kg (1386 lbs)

Ditchcleaning bucket with teeth

Width	Weight
2.40 m (95 inch)	520 Kg (1145 lbs)
1.80 m (71 inch)	550 Kg (1210 lbs)

Ditchcleaning bucket fitted with reversible blade (smooth or serrated)

Width	Weight
2.40 m (95 inch)	575 Kg (1265 lbs)
1.80 m (71 inch)	590 Kg (1300 lbs)

V - line bucket

Width	Weight
0.50 m (20 inch)	515 Kg (1135 lbs)

CLAMSHELLS
Models 888P, 888PL, 888P2A, 888P2AL.
Trench clamshell with ejector

Width	Weight
0.45 m (18 inch)	670 Kg (1470 lbs)
0.65 m (26 inch)	740 Kg (1630 lbs)

Earthmoving clamshell

Width	Weight
0.85 m (33 inch)	760 Kg (1670 lbs)
1.05 m (41 inch)	810 Kg (1780 lbs)

Weights (Continued)

Boring clamshell

Width	Capacity	Weight
1.20 m (47 inch)	160 L (3/16 cu.yd)	770 Kg (1690 lbs)

Models 888P - 888PL - 888P2A - 888P4A
Rehandling clamshell

Width	Weight
1.04 m (41 inch)	810 Kg (1780 lbs)
1.34 m (53 inch)	850 Kg (1870 lbs)
1.34 m (53 inch)	925 Kg (2040 lbs)

Beetroot clamshell

Width	Weight
1.57 m (62 inch)	1240 Kg (2730 lbs)
1.81 m (71 inch)	1305 Kg (2780 lbs)

Five-tine iron clamshell with detachable tine tips

Opening diameter	Weight
1.90 m (75 inch)	1100 Kg (2420 lbs)
1.90 m (75 inch)	1200 Kg (2640 lbs)

Five-tine iron clamshell

Opening diameter	Weight
2.00 m (79 inch)	1025 Kg (2260 lbs)

Five-tine wood clamshell

Opening diameter	Weight
2.50 m (98 inch)	830 Kg (1830 lbs)

Timber grab

Width	Opening	Capacity	Weight
0,70 m (28 inch)	2.75 m (110 inch)	1.2 m^2 (13 sq.ft)	990 Kg (2178 lbs)

RUNNING-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 11. Install new oil filters, after the engine has been rebuilt.

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

Running-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 Running-In.

During the Running-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
2	5 Minutes	2200 rpm	Full

Running-In Procedure For Rebuilt Engine (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

Running-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 Clycol

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% ethylen 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 temperature 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)

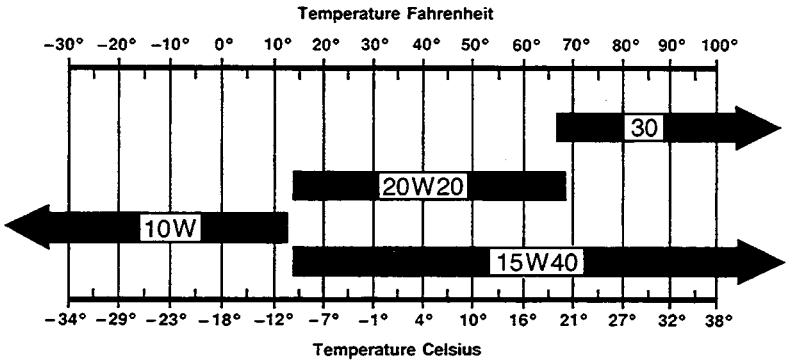
Engine Lubrication

Engine Oil Type

The SAE reference depends on climatic conditions. The degree of viscosity of the oil to use depends on the ambient temperature at the time of starting the engine.

ELF PERFORMANCE SUPER
Above 20°C (69°F).....SAE 30
Between -10°C and 20°C (14°F and 69°F).....SAE 20W20
Below -10°C (14°F).....SAE 10W
Above -10°C (14°F).....SAE 15W40

Ambient air temperature ranges



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GENERAL ENGINE SPECIFICATIONS

General

Make and Model	JI Case, 6T-590	
Type	6 cylinders, 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 pieces)	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	40 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

N°1 Compression	Key Stone Type (Barrel Face)
End Gap in 102.02 ID	0.40 to 0.70 mm
Maximum Service Limit	0.806 mm
Side Clearance	0.075 to 0.120 mm
Maximum Service Limit	0.15 mm
N°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
N°3 Oil Control Rings	Two pieces
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