880D EXCAVATOR
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CASE CORPORATION
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Reprinted

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Electrical Schematic
Hydraulic Schematic

1001

SAFETY RULES, SERVICE MANUAL INTRODUCTION, AND TORQUE SPECIFICATIONS

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Written In *Clear And Simple English*

CASE CORPORATION

8-42680

Printed in U.S.A.
Issued February 1985

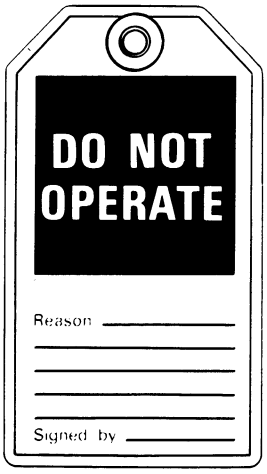
SAFETY RULES

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

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

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

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



780449

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

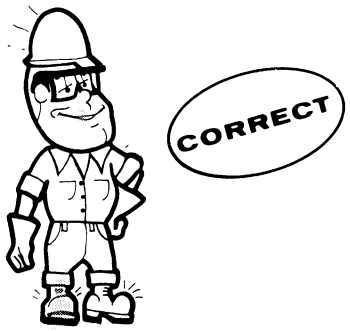
WARNING: *Operate tractor and equipment controls from the seat position only. Any other method could result in serious injury.* 48-55

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

WARNING: *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 responsibility to understand and follow manufacturer's instructions on machine operation, service, and to observe pertinent 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 separate parts, using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).* 46-13

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

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

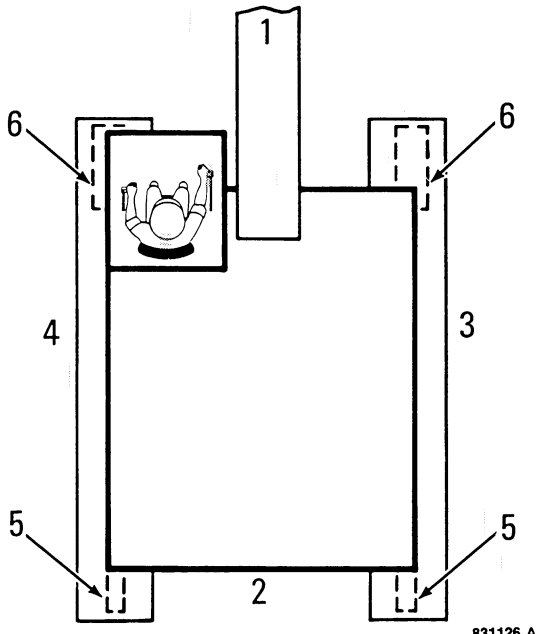
DANGER: *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. If you do not have an exhaust pipe extension, open the doors and get outside air into the area.* 48-56

SERVICE MANUAL INTRODUCTION

This service manual has been prepared with the latest service information available. Troubleshooting, removal, disassembly, inspection and instal lation procedures, and complete specifications and tightening references can be found in most sections. Some sections have drawings but no written procedure because the job is so easily done. This service manual is one of the most important tools available to the service technician.

Right, Left, Front, and Rear

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



1. *Front*
2. *Rear*
3. *Right Side*
4. *Left Side*
5. *Drive Sprocket*
6. *Idler Wheel*

Table of Contents

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

Page Numbers

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

Illustrations

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

Clear and Simple English

This manual is written in C.A.S.E. (Clear and Simple English). C.A.S.E. is easier to read than "regular" English because C.A.S.E. uses a small number of common words and has special rules for writing.

All sections written in C.A.S.E. are indicated by the symbol below.

Written In ***C**lear*
***A**nd*
***S**imple*
***E**nglish*

Special Tools

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

Order special tools from either of the following companies.

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

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

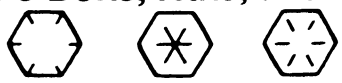
TORQUE SPECIFICATIONS - U.S. HARDWARE

Use the torques in this chart when special torques are not given. These torques apply to fasteners with both UNC and UNF threads as received from suppliers, dry, or when lubricated with engine oil. Not applicable if special graphites, moly-disulfide greases, or other extreme pressure lubricants are used.

Grade 5 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
1/4 in 6.4 mm	9-11	12-15	1.2-1.5
5/16 in 7.9 mm	17-21	23-28	2.4-2.9
3/8 in 9.5 mm	35-42	48-57	4.8-5.8
7/16 in 11.1 mm	54-64	73-87	7.5-8.8
1/2 in 12.7 mm	80-96	109-130	11.1-13.3
9/16 in 14.3 mm	110-132	149-179	15.2-18.2
5/8 in 15.9 mm	150-180	203-244	20.8-24.9
3/4 in 19.0 mm	270-324	366-439	37.3-44.8
7/8 in 22.2 mm	400-480	542-651	55.3-66.4
1.0 in 25.4 mm	580-696	787-944	80.2-96.2
1-1/8 in 28.6 mm	800-880	1085-1193	111-122
1-1/4 in 31.8 mm	1120-1240	1519-1681	155-171
1-3/8 in 34.9 mm	1460-1680	1980-2278	202-232
1-1/2 in 38.1 mm	1940-2200	2631-2983	268-304

Grade 8 Bolts, Nuts, and Studs



Size	Pound-Feet	Newton metres	Kilogram metres
1/4 in 6.4 mm	12-15	16-20	1.7-2.1
5/16 in 7.9 mm	24-29	33-39	3.3-4.0
3/8 in 9.5 mm	45-54	61-73	6.2-7.5
7/16 in 11.1 mm	70-84	95-114	9.7-11.6
1/2 in 12.7 mm	110-132	149-179	15.2-18.2
9/16 in 14.3 mm	160-192	217-260	22.1-26.5
5/8 in 15.9 mm	220-264	298-358	30.4-36.5
3/4 in 19.0 mm	380-456	515-618	52.5-63.0
7/8 in 22.2 mm	600-720	814-976	83.0-99.5
1.0 in 25.4 mm	900-1080	1220-1465	124-149
1-1/8 in 28.6 mm	1280-1440	1736-1953	177-199
1-1/4 in 31.8 mm	1820-2000	2468-2712	252-277
1-3/8 in 34.9 mm	2380-2720	3227-3688	329-376
1-1/2 in 38.1 mm	3160-3560	4285-4827	437-492

TORQUE SPECIFICATIONS - METRIC HARDWARE

Use the following torques when special torques are not given.

These values apply to fasteners with coarse threads as received from supplier, plated or unplated, or when lubricated with engine oil. These values do not apply if graphite or moly-disulfide grease or oil is used.

Grade 8.8 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
M4 0.15 in	2-3	3-4	0.3-0.4
M5 0.19 in	5-6	6.5-8	0.7-0.8
M6 0.23 in	8-9	10.5-12	1.1-1.2
M8 0.31 in	19-23	26-31	2.6-3.2
M10 0.39 in	38-45	52-61	5.3-6.2
M12 0.46 in	66-79	90-107	9.1-10.9
M14 0.55 in	106-127	144-172	14.7-17.6
M16 0.62 in	160-200	217-271	22.1-27.7
M20 0.78 in	320-380	434-515	44.2-52.5
M24 0.94 in	500-600	675-815	69.1-83.0
M30 1.17 in	920-1100	1250-1500	127-152
M36 1.40 in	1600-1950	2175-2600	221-270

Grade 10.9 Bolts, Nuts, and Studs

Size	Pound-Feet	Newton metres	Kilogram metres
M4 0.15 in	3-4	4-5	0.4-0.5
M5 0.19 in	7-8	9.5-11	1.0-1.1
M6 0.23 in	11-13	15-17.5	1.5-1.8
M8 0.31 in	27-32	37-43	3.7-4.4
M10 0.39 in	54-64	73-87	7.5-8.8
M12 0.46 in	93-112	125-150	12.9-15.5
M14 0.55 in	149-179	200-245	20.6-24.7
M16 0.62 in	230-280	310-380	31.8-38.7
M20 0.78 in	450-540	610-730	62.2-74.7
M24 0.94 in	780-940	1050-1275	108-130
M30 1.17 in	1470-1770	2000-2400	203-245
M36 1.40 in	2580-3090	3500-4200	357-427

Grade 12.9 Bolts, Nuts, and Studs

Usually the torque values specified for grade 10.9 fasteners can be used satisfactorily on grade 12.9 fasteners.

TORQUE SPECIFICATIONS - STEEL HYDRAULIC FITTINGS

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres	Kilogram metres
37 Degree Flare Fittings				
1/4 in 6.4 mm	7/16-20	6-12	8-16	0.8-1.7
5/16 in 7.9 mm	1/2-20	8-16	11-21	1.1-2.2
3/8 in 9.5 mm	9/16-18	10-25	14-33	1.4-3.5
1/2 in 12.7 mm	3/4-16	15-42	20-56	2.1-5.8
5/8 in 15.9 mm	7/8-14	25-58	34-78	3.5-8.0
3/4 in 19.0 mm	1-1/16-12	40-80	54-108	5.5-11.1
7/8 in 22.2 mm	1-3/16-12	60-100	81-135	8.3-13.9
1.0 in 25.4 mm	1-5/16-12	75-117	102-158	10.4-16.2
1-1/4 in 31.8 mm	1-5/8-12	125-165	169-223	17.3-22.8
1-1/2 in 38.1 mm	1-7/8-12	210-250	285-338	29.0-34.6

Tube OD Hose ID	Thread Size	Pound-Feet	Newton metres	Kilogram metres
Straight Threads with O-ring				
1/4 in 6.4 mm	7/16-20	12-19	16-25	1.7-2.6
5/16 in 7.9 mm	1/2-20	16-25	22-33	2.2-3.5
3/8 in 9.5 mm	9/16-18	25-40	34-54	3.5-5.5
1/2 in 12.7 mm	3/4-16	42-67	57-90	5.8-9.3
5/8 in 15.9 mm	7/8-14	58-92	79-124	8.0-12.7
3/4 in 19.0 mm	1-1/16-12	80-128	108-174	11.1-17.8
7/8 in 22.2 mm	1-3/16-12	100-160	136-216	13.8-22.1
1.0 in 25.4 mm	1-5/16-12	117-187	159-253	16.2-25.9
1-1/4 in 31.8 mm	1-5/8-12	165-264	224-357	22.8-36.5
1-1/2 in 38.1 mm	1-7/8-12	250-400	339-542	34.6-55.3

Split Flange Mounting Bolts			
Size	Pound-Feet	Newton metres	Kilogram metres
5/16-18	15-20	20-27	2.1-2.8
3/8-16	20-25	26-33	2.8-3.5
7/16-14	35-45	47-61	4.7-6.2
1/2-13	55-65	74-88	7.6-9.0
5/8-11	140-150	190-203	19.4-20.7

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1002

MAINTENANCE AND LUBRICATION

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Written In ***C**lear*
***A**nd*
***S**imple*
***E**nglish*

8-42240

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Issued April 1985

CASE CORPORATION

SYSTEMGARD™ TESTING SCHEDULE

Get samples of lubricants for Systemgard™ analysis at the intervals shown below. Follow the instructions with the Systemgard™ kits.

	Every 100 hours of operation	Every 500 hours of operation (at least three times yearly)
Engine	X	X
Hydraulic System		X
Swing Gearbox		X
Final Drive Transmission		X

RUN-IN PERIOD

During the first 20 hours of operation for a new machine, or a machine with a rebuilt engine, make sure you do the following:

1. Operate the machine with normal loads for the first 8 hours.
2. Keep the engine at normal operating temperatures.
3. Do not run the engine at idle speeds for long periods of time.
4. See the Run-In Maintenance Schedule on this page for additional information.

RUN-IN MAINTENANCE SCHEDULE

The following items are to be done during the Run-In Period and are in addition to the items in the Maintenance Schedule on the following page.

AFTER FIRST 20 HOURS OF OPERATION

Do the After Delivery Check ..... See the Operators Manual

WARNING: *When you adjust or service the machine, always follow the instructions in the operator's or service manual. If the engine must be running, always have an extra person help you. Do not leave the operator's seat while the engine is running. Failure to follow these instructions can cause injury.* *47-51-A*

MAINTENANCE SCHEDULE

The items in this maintenance schedule are at maximum intervals. If you are operating the machine under severe conditions (high temperatures, mud, dust, water, etc.), shorten the intervals.

EVERY 10 HOURS OF OPERATION OR EACH DAY, WHICHEVER OCCURS FIRST

Clean and replace all safety decals and instruction decals that cannot be read ..... Section 9221

Check the restriction indicator for the air cleaner ..... See Operators Manual

Check the engine oil level ..... See Operators Manual

Check the first stage fuel filter for water ..... See Operators Manual

Check the hydraulic reservoir oil level ..... Section 8201

Check the swing gearbox oil level ..... Section 9210

Check the drive brakes for correct operation ..... See Operators Manual

Check the swing brake for correct operation ..... See Operators Manual

Lubricate the turntable ring gear ..... Section 9216

Lubricate the boom, arm, and bucket pivots ..... See Operators Manual

Lubricate the Wrist-O-Twist pivot points (if equipped) ..... See Operators Manual

EVERY 50 HOURS OF OPERATION

Check coolant reservoir fluid level ..... See Operators Manual

Drain water from the fuel tank ..... See Operators Manual

Clean the air cleaner dust valve ..... See Operators Manual

Clean the remote reservoir breather for the swing gearbox ..... See Operators Manual

Lubricate the drive sprocket pillow blocks ..... See Operators Manual

Lubricate the turntable leveler pivot pins and cylinder pivot pins ..... See Operators Manual

Lubricate the turntable bearing (if equipped) ..... See Operators Manual

Lubricate the control pedal pivots ..... See Operators Manual

EVERY 250 HOURS OF OPERATION

Change the engine oil and replace the engine oil filters ..... See Operators Manual

Check the radiator fluid level ..... See Operators Manual

Check the battery fluid level ..... See Operators Manual

Check the torque of the turntable bearing mounting bolts ..... Section 9216

Check the final drive transmission oil level (each side) ..... See Operators Manual

Lubricate the 7 port hydraulic swivel ..... See Operators Manual

EVERY 500 HOURS OF OPERATION

Replace the fuel filters ..... See Operators Manual

Clean the hydraulic oil reservoir breather ..... See Operators Manual

Replace the hydraulic oil filter ..... Section 8201

Clean or replace the hydraulic oil screen ..... Section 8201

Clean the 140 mesh screen ..... Section 8201

EVERY 1000 HOURS OF OPERATION

Change the oil in each final drive transmission ..... See Operators Manual

Change the oil in the swing gearbox ..... Section 9210

Clean the batteries and the battery area ..... Section 4005

EVERY 2000 HOURS OF OPERATION OR EACH YEAR

Drain, flush, and fill the cooling system ..... See Operators Manual

Change the hydraulic oil and clean the filler screen ..... Section 8201

AS REQUIRED

Check the radiator for leaks and trash. Clean as required ..... See Operators Manual

Service the air cleaner if the red band in the restriction indicator is in full view ..... See Operators Manual

Check the track tension ..... Section 5503

Fill the windshield washer (if equipped) ..... See Operators Manual

FLUIDS AND LUBRICANTS CHART

ITEM	CAPACITY	SPECIFICATIONS
Fuel tank	75 gallons (284 litres)	See Operators Manual
Cooling system With heater Without heater	32 quarts (30.3 litres) 30 quarts (28.4 litres)	Use 50% ethylene glycol and 50% water above -34° F (-37° C).
Engine crankcase: With filter change	17 quarts (16.1 litres)	Multi-Viscosity lubricants are recommended for use in this engine. If multi-viscosity lubricants are not available, single viscosity lubricants can be used. Use only API CC/CD or CD oil. **MULTI-VISCOSITY LUBRICANTS** Above 30° F (-1° C) ..... SAE 20W-40 Above 10° F (-12° C) ..... SAE 15W-40 90° F (32° C) and below ..... SAE 10W-30 **SINGLE-VISCOSITY LUBRICANTS** 50° F and above ..... SAE 40 (10° C and above) 40° F and above ..... SAE 30 (5° C and above) 25° F to 70° F ..... SAE 20W20 (4° F to 21° C) 32° F and below ..... SAE 10W (0° C and below)
Hydraulic system System total Reservoir refill with filter change	43 gallons (163 litres) 19.7 gallons (74.6 litres)	Powergard TCH Fluid Alternate oil: C3 Hydraulic Fluid (SAE 20W)
Swing Gearbox	8.5 quarts (8.0 litres)	Loadgard final drive fluid or SAE 85W-140 API-GL-5 Gear Lubricant
Transmission Final drives (each)	8.5 quarts (8.0 litres)	
Turntable Ring Gear Teeth	As required	Symquip Spray Lube for open gears (OGLD-20) Case Part No. 331-437
Batteries	As required	Add drinking or distilled water.
Grease fittings	As required	Weargard molydisulfide grease.

Section

1010

GENERAL ENGINE SPECIFICATIONS

Written In *Clear And Simple English*

IMPORTANT: *This engine was made using the metric measurement system. All measurements and checks must be made with metric tools to make sure of an accurate reading when inspecting parts.*

CASE CORPORATION

Rac 8-27130

Printed in U.S.A.
May, 1985

ENGINE SPECIFICATIONS

General

Type	6 Cylinder, 4 Stroke Cycle, Valve-In-Head
Firing Order	1,5,3,6,2,4
Bore	102 mm
Stroke	120 mm
Piston Displacement	5.88 Litres
Compression Ratio	17.0 to 1
No Load Governed Speed	2345 to 2440 RPM
Rated Engine Speed	2305 to 2385 RPM
Engine Idle Speed	700 to 750 RPM
Valve Tappet Clearance (Exhaust)(Cold)	0.508 mm
(Intake)(Cold)	0.254 mm
Thermostat Operating Range	181°F to 203°F (83°C to 95°C)

Piston 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 Bearings	Steel Back Leaded Bronze

Main Bearings

Number of Bearings	7
Type of Bearings	Replaceable

Engine Lubricating System

Oil Pressure	42 to 54 PSI (290 to 372 kPa)(2.90 to 3.72 bar) with Engine Warm at Rated Engine Speed
Type of System	Pressure and Spray Lubrication
Oil Pump	Rotor Type
Oil Filter	Full Flow Turn-on Type
Oil Capacity (with filter)	16 Quarts (15 litres)
(without filter)	15 Quarts (14.3 litres)

Fuel System

Fuel Injection Pump	CAV
Pump Timing	Top Center
Fuel Injectors	Bosch 17 mm Opening Pressure (New) 3190 to 3310 PSI (21 994 to 22 822 kPa)(220 to 228 Bar)
Governor	Variable Speed, a Part of the Injection Pump
First Stage Fuel Filter	Turn on Type
Second Stage Fuel Filter	Turn on Type
Lift Pump	5 to 7 PSI (34 to 48 kPa)(0.34 to 0.48 Bar)

NOTE: The CASE CORPORATION reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

Section

1024

SPECIFICATION DETAILS

Written In *Clear And Simple English*

IMPORTANT: *This engine was made using the metric measurement system. All measurements and checks must be made with metric tools to make sure of an accurate reading when inspecting parts.*

CASE CORPORATION

Rac 8-26060

Printed in U.S.A.
October, 1984

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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. 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 for the 1896 tractor. Loosen the upper plug on the aftercooler to remove the air from the cooling system for the 2096 tractor.

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 Engines (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 (Agriculture Tractors)

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

Run-In Procedure (Construction Equipment)

For the first 8 hours, operate the engine at full throttle maintaining a normal load. DO NOT "baby" the engine, but avoid 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 SPECIFICATION DETAILS

Cylinder Block

	Metric Value
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	102.50 to 102.54 mm
1.00 mm Oversize Piston	
Machine Cylinder Bore to	103.00 to 103.04 mm

Service Cylinder Sleeve

Type	Dry, Can Be Replaced
Material	Cast Iron
Machine Cylinder Block Bore to	104.500 to 104.515 mm
Installation	Press Fit
Machine Sleeve Bore to:	
Standard Size Piston	102.00 to 102.04 mm
0.5 mm Oversize Piston	102.50 to 102.54 mm
1.0 mm Oversize Piston	103.00 to 103.04 mm

Piston

Type	Cam Ground
Material	Aluminum 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 mm Oversize Piston	102.373 to 102.387 mm
Minimum Service Limit	102.323 mm
1.0 mm 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 Pin

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

Piston Rings

No. 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
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 Rod

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 Valve

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 Valve

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
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

	U.S. Value	Metric Value
Aftercooler Bolts	18 lb ft	24 Nm (2.4 kgm)
Air Crossover Elbow to Intake Aftercooler	18 lb ft	24 Nm (2.4 kgm)
Alternator Bracket Bolts (Lower)	18 lb ft	24 Nm (2.4 kgm)
Alternator Bracket Bolts (Upper)	18 lb ft	24 Nm (2.4 kgm)
Alternator Retaining Bolt	18 lb ft	24 Nm (2.4 kgm)
Belt Tensioner Bracket Bolts	18 lb ft	24 Nm (2.4 kgm)
Belt Tensioner Retaining Bolt	32 lb ft	43 Nm (4.3 kgm)
Camshaft Retaining Bolts	18 lb ft	24 Nm (2.4 kgm)
Connecting Rod Bolts (Lubricate Threads With Engine Oil)	74 lb ft	100 Nm (10.0 kgm)
Exhaust Manifold Bolts	32 lb ft	43 Nm (4.3 kgm)
Fan Pulley Bracket Bolts	18 lb ft	24 Nm (2.4 kgm)
Fan Pulley Bolts	32 lb ft	43 Nm (4.3 kgm)
Flywheel Housing Bolts	45 lb ft	60 Nm (6.0 kgm)
Flywheel Retaining Bolts	101 lb ft	137 Nm (13.7 kgm)
Flywheel Housing Cover Bolts	18 lb ft	24 Nm (2.4 kgm)
Fuel Filter Inlet Bolt	24 lb ft	32 Nm (3.2 kgm)
Fuel Air Removal Bolt	4 lb ft	6 Nm (0.6 kgm)
Fuel Filter Inlet Nut	24 lb ft	32 Nm (3.2 kgm)
Fuel Line Fitting (High Pressure)	18 lb ft	24 Nm (2.4 kgm)
Fuel Line Fitting (Low Pressure)	18 lb ft	24 Nm (2.4 kgm)
Fuel Pump Plug with Bronze Washer	17 lb ft	23 Nm (2.3 kgm)
Front Cover Bolts	18 lb ft	24 Nm (2.4 kgm)
Front Housing Bolts	18 lb ft	24 Nm (2.4 kgm)

SPECIAL TORQUES (CONT'D)

	U.S. Value	Metric Value
Crankshaft Dampener Pulley	101 lb ft	137 Nm (13.7 kgm)
Cylinder Head Bolts	93 lb ft	126 Nm (12.6 kgm)
Injection Pump Drive Gear Nut	48 lb ft	65 Nm (6.5 kgm)
Injection Pump Lock Bolt	22 lb ft	30 Nm (3.0 kgm)
Injection Pump Retaining Nuts	18 lb ft	24 Nm (2.4 kgm)
Injection Pump Bracket Bolts	18 lb ft	24 Nm (2.4 kgm)
Injector Leak off Bolt	11 lb ft	15 Nm (1.5 kgm)
Injector Retaining Nut	44 lb ft	60 Nm (6.0 kgm)
Intake Manifold Bolts	18 lb ft	24 Nm (2.4 kgm)
Intake Manifold Plug	92 lb ft	125 Nm (12.5 kgm)
Engine Lift Bracket Bolts (Rear)	57 lb ft	77 Nm (7.7 kgm)
Main Bearing Bolts (Lubricate The Threads With Engine Oil)	129 lb ft	175 Nm (17.5 kgm)
Oil Fill Tube Bolts	32 lb ft	43 Nm (4.3 kgm)
Oil Pan Drain Plug	55 lb ft	75 Nm (7.5 kgm)
Oil Pan Heater Plug	90 lb ft	122 Nm (12.2 kgm)
Oil Pan Retaining Bolts	18 lb ft	24 Nm (2.4 kgm)
Oil Pump Retaining Bolts	18 lb ft	24 Nm (2.4 kgm)
Oil Inlet Tube Bolts	18 lb ft	24 Nm (2.4 kgm)
Oil Inlet Tube Brace	18 lb ft	24 Nm (2.4 kgm)
Oil Filter Housing Bolts	18 lb ft	24 Nm (2.4 kgm)
Rear Seal Retaining Bolts	7 lb ft	9 Nm (0.9 kgm)
Rocker Arm Bolts	18 lb ft	24 Nm (2.4 kgm)
Starter Retaining Bolts	32 lb ft	43 Nm (4.3 kgm)

SPECIAL TORQUES (CONT'D)

	U.S. Value	Metric Value
Tachometer Drive Retaining Bolts	2 lb ft	3 Nm (0.3 kgm)
Lifter Cover Bolts	18 lb ft	24 Nm (2.4 kgm)
Thermostat Housing Bolts	18 lb ft	24 Nm (2.4 kgm)
Timing Pin Retaining Bolts	4 lb ft	5 Nm (0.5 kgm)
Fuel Shutoff Solenoid	10 lb ft	15 Nm (1.5 kgm)
Turbocharger Mounting Bolts	24 lb ft	32 Nm (3.2 kgm)
Turbocharger Drain Tube Bolts	18 lb ft	24 Nm (2.4 kgm)
Turbocharger Oil Supply (Both Ends)	13 lb ft	17 Nm (1.7 kgm)
Turbine Housing Bolts	96 lb inch	11 Nm (1.1 kgm)
Center Housing to Back Plate Bolts	48 lb inch	6 Nm (0.6 kgm)
Compressor Housing Bolts	48 lb inch	6 Nm (0.6 kgm)
Compressor Lock Nut	120 lb inch	14 Nm (1.4 kgm)
Thrust Bearing Screws (Torx Head)	36 lb inch	5 Nm (0.5 kgm)
Water Pump Mounting Bolts	18 lb ft	24 Nm (2.4 kgm)
Coolant Inlet Bolts	32 lb ft	43 Nm (4.3 kgm)
Valve Cover Bolts	18 lb ft	24 Nm (2.4 kgm)