6076 Natural Gas Engines Serial Number (500000—)

JOHN DEERE

COMPONENT TECHNICAL MANUAL

6076 Natural Gas Engines Serial Number (500000—)

CTM82 (11JUN93) English

Deere Power Systems Group
CTM82 (11JUN93)

LITHO IN U.S.A.
ENGLISH

HANDLE FLUIDS SAFELY—AVOID FIRES

When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; they can ignite and burn spontaneously.

TS227 -UN-23AUG88

DX,FLAME -19-04JUN90

HANDLE NATURAL GAS SAFELY

Handle natural gas with care: it is highly flammable. Do NOT smoke while working on or around natural gas equipment.

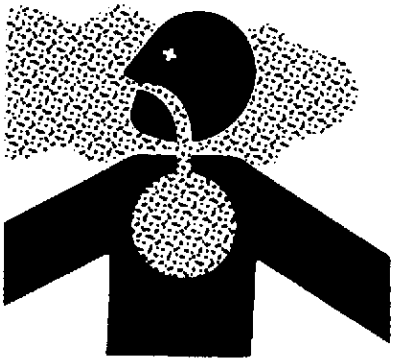
Natural gas fumes may cause sickness or death. Work in well ventilated area.

Shut off natural gas supply before servicing equipment.

Have a manual valve installed away from the engine to shut off gas supply in case of an emergency.

Prevent fires by keeping machine clean of accumulated trash, grease, and debris.

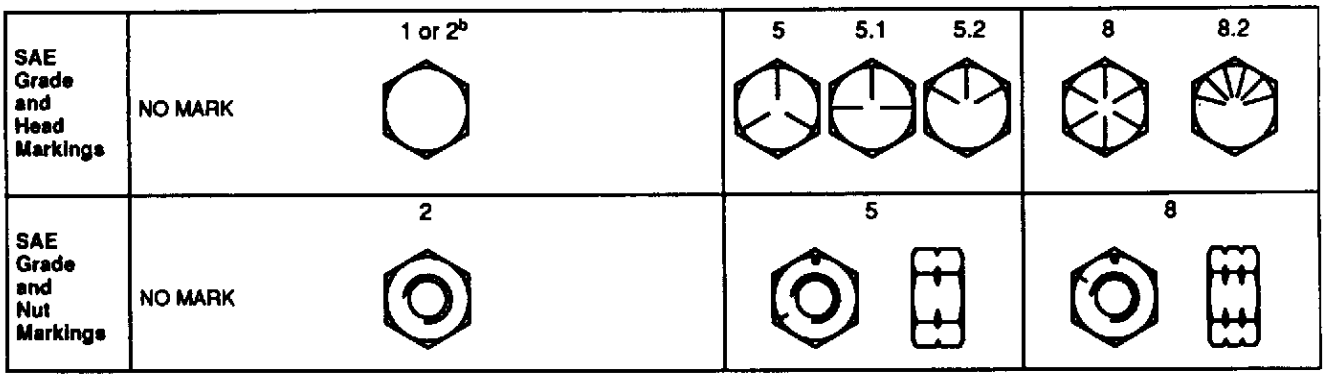
TS227 -UN-23AUG88



TS220 -UN-23AUG88

RG,NATGAS,SFTY -19-26FEB93

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES



TS1162 -19-04MAR91

Size	Grade 1				Grade 2[b]				Grade 5, 5.1, or 5.2				Grade 8 or 8.2			
	Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft	N·m	lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	215	160	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1-1/8	470	300	510	375	470	300	510	375	900	675	1150	850	1450	1075	1850	1350
1-1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1-3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1-1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original.

Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

[a] "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.

[b] Grade 2 applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. Grade 1 applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.

DX,TORQ1 -19-15MAR91

ENGINE COOLANT SPECIFICATIONS—CONTINUED

Liquid Coolant Conditioner (SCA)

3. Supplemental Coolant Additives (SCA's):

IMPORTANT: Ethylene glycol concentrate (antifreeze) DOES NOT contain sufficient additives to prevent liner erosion or pitting which could occur in wet-sleeve, heavy-duty engines. ALWAYS mix the coolant solution with a supplemental coolant additive such as John Deere Liquid Coolant Conditioner or spin-on coolant filter conditioner element.

CAUTION: John Deere Liquid Coolant Conditioner contains alkali. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Do not take internally. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call physician. KEEP OUT OF REACH OF CHILDREN.

• John Deere Liquid Coolant Conditioner

IMPORTANT: ALWAYS mix the 50/50 solution of ethylene glycol concentrate with quality water in a separate container BEFORE adding the SCA's. Then add solution to the radiator. NEVER pour cold water into a hot engine, as it may crack cylinder block or head.

John Deere Liquid Coolant Conditioner MUST be added at a rate of 3% (by volume) to the coolant solution. When adding John Deere Liquid Coolant Conditioner, follow the supplier's recommendations printed on the container.

John Deere Liquid Coolant Conditioner is available in the following sizes:

— RE23182 473 mL (16 oz) container
— RE35992 3.8 L (1 gal) container

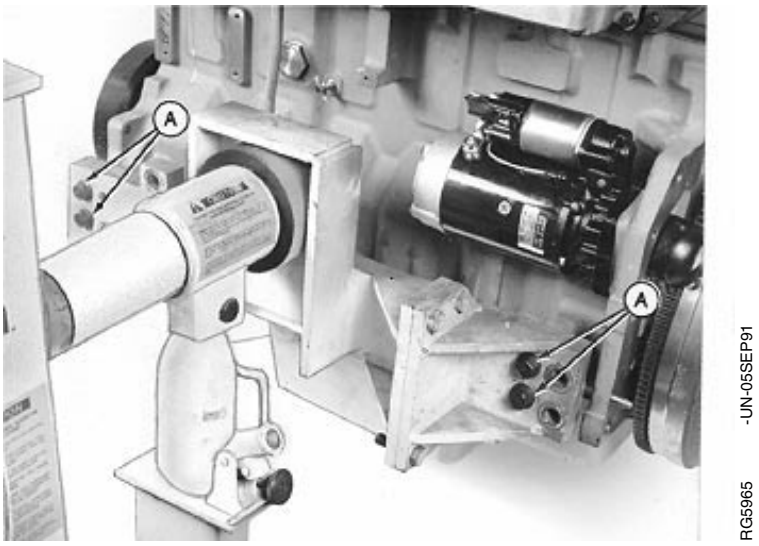
Contact your John Deere Parts Network for local availability.

IMPORTANT: John Deere Liquid Coolant Conditioner does NOT protect against freezing.

DO NOT over-concentrate coolant solutions with supplemental coolant additives, as this can cause silicate-dropout. When this happens, a gel-type deposit is created which retards heat transfer and coolant flow. DO NOT use soluble oil.

RG,COOL,REQ3A -19-14APR93

MOUNT ENGINE ON REPAIR STAND



NOTE: If starting motor is to be removed from engine, remove before mounting engine onto repair stand.

CAUTION: Never remove the overhead lifting equipment from the equipment until the engine is securely mounted to the stand and all mounting hardware is tightened to specified values. Always release the overhead lifting equipment slowly.

1. Mount the starter side of the engine to the engine adapter with four 5/8-11 UNC x 2-3/4 in. cap screws (A).

2. Tighten cap screws to 203 N·m (150 lb-ft).

3. Carefully remove lift sling from engine.

RG,CTM42,G3,2 -19-28OCT92

CYLINDER HEAD AND VALVES SPECIFICATIONS—CONTINUED

ITEM	SPECIFICATION	WEAR LIMIT
Valve Face Angle	19.25° ±0.25°	——
Valve Seat Angle	20° ±0.50°	——
Valve Seat Width:		
Exhaust	2.0—3.8 mm (0.79—0.150 in.)	——
Intake	1.4—3.8 mm (0.055—0.150 in.)	——
Valve Recess in Cylinder Head:		
Exhaust	0.68—1.20 mm (0.003—0.047 in.)	1.96 mm (0.077 in.)
Intake	2.56—3.08 mm (0.101—0.121 in.)	3.84 mm (0.151 in.)
Maximum Valve Seat Runout	0.051 mm (0.0020 in.)	——
Maximum Valve Face Runout	0.051 mm (0.0020 in.)	——
Cylinder Firing Order	1-5-3-6-2-4	——
Rocker Arm ID	19.07—19.10 mm (0.7507—0.7520 in.)	——
Rocker Arm Shaft OD	19.01—19.05 mm (0.7484—0.7500 in.)	——
Cylinder Head Reconditioning:		
Thickness of Head (Rocker Arm Cover Gasket Rail-to-Combustion Face)	155.45—155.71 mm (6.120—6.130 in.)	154.69 mm (6.09 in.)
Maximum Acceptable Head Out-of-Flat (Entire Length or Width)	0.102 mm (0.0040 in.)	——
Combustion Face Surface Finish (Surface Grind Only) (AA)	0.0015—0.0028 mm (60—110 micro-in.)	——
Maximum Wave Depth	0.008 mm (0.0003 in.)	——
Maximum Material Removal for Resurfacing Head	0.762 mm (0.0300 in.)	——

RG,CTM82,G05,2 -19-11JUN93

PRELIMINARY CYLINDER HEAD AND VALVE CHECKS

Make preliminary inspection of cylinder head and valve assembly during disassembly.

Look for the following conditions:

• Sticking Valves:

Carbon deposits on valve stem.
Worn valve guides.
Scored valve stems.
Warped valve stems.
Cocked or broken valve springs.
Worn or distorted valve seats.
Insufficient lubrication.

• Warped, Worn, or Distorted Valve Guides:

Lack of lubrication.
Cylinder head distortion.
Excessive heat.
Unevenly tightened cylinder head cap screws.

• Distorted Cylinder Head and Gasket Leakage:

Loss of cylinder head cap screw torque.
Broken cylinder head cap screw.
Overheating from low coolant level operation.
Insufficient liner standout.
Coolant leakage into cylinder causing hydraulic failure of gasket.
Leaking aftercooler.
Cracked cylinder head.
Cracked cylinder liner.
Damaged or incorrect gasket.
Overpowering or overfueling.
Damaged cylinder head or block surfaces.
Improper surface finish on cylinder head.
Improperly tightened cylinder head cap screws.
Faulty gasket installation (misaligned).

• Worn or Broken Valve Seats:

Misaligned valves.
Distorted cylinder head.
Carbon deposits on seats due to incomplete combustion.
Valve spring tension too weak.
Excessive heat.
Improper valve clearance.
Improper valve timing.
Incorrect valve or seat installed.

• Burned, Pitted, Worn, or Broken Valves:

Worn or distorted valve seats.
Loose Valve Seats
Worn valve guides.
Insufficient cooling.
Cocked or broken valve springs.
Improper engine operation.
Improper valve train timing.
Faulty valve rotators.
Warped or distorted valve stems.
“Stretched” valves due to excessive spring tension.
Warped cylinder head.
Bent push rods.
Carbon build-up on valve seats.
Rocker arm failure.
Incorrect valve or seat installed.
Incorrect piston-to-valve clearance.

• Improper Valve Clearance:

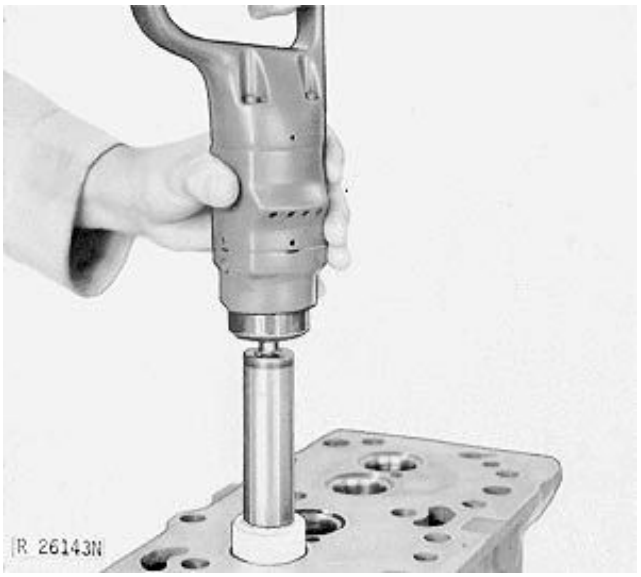
Inefficient use of fuel.
Engine starts harder.
Maximum engine power will not be achieved.
Shorter service life of valve train.
Greater chance for engine to overheat.

• Excessive Recession:

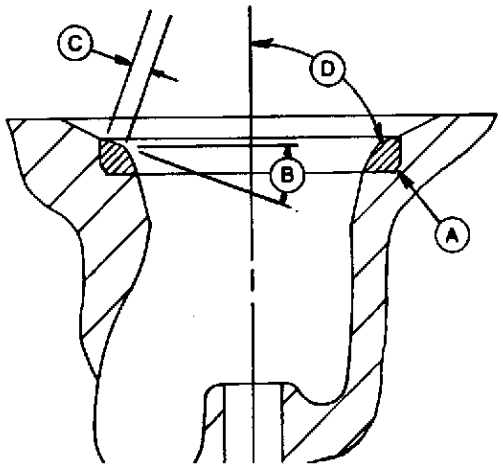
Worn valve guides.
Bent valves.
Debris passed through valve train.

RG,CTM8,G05,28 -19-28MAY93

GRIND VALVE SEATS



R26143N -UN-09DEC88



RG6567 -UN-21DEC92

A—Valve Seat Insert B—Seat Angle C—Seat Width D—Seat Runout

IMPORTANT: Valve seat grinding should only be done by experienced personnel familiar with equipment and capable of maintaining required specifications. ALWAYS keep work area clean when grinding valve seats.

Using JT05893 Heavy-Duty Seat Grinder Set, grind valve seats to obtain correct valve recess in cylinder head. (See MEASURE VALVE RECESS, earlier in this group.) Be sure valve guide bores are clean before grinding valve seats. (See CLEAN VALVE GUIDES, earlier in this group.)

A 120 grit stone MUST be used on both intake and exhaust valve seat inserts.

If valve seats need grinding, do not grind too long. Only a few seconds are required to recondition the average valve seat. Avoid the tendency to grind off too much. Do not use too much pressure. While grinding, support the weight of the dresser to avoid excessive pressure on the stone.

1. Check the seat width and contact pattern between the seat and valve with bluing. Seat width MUST BE maintained within specification. Use a vernier caliper or scale to measure seat width. Thoroughly clean seat area after grinding and replace valves and valve seat inserts as necessary.

NOTE: Valve seat width can be reduced with a narrowing stone. This will change the angle at the top of the seat and increase the diameter. If valve seat width is too narrow, valve may burn or erode. Varying the width changes the fine contact between valve face and seat.

2. ALWAYS measure valve seat runout after grinding using D11010KW Eccentrimeter.

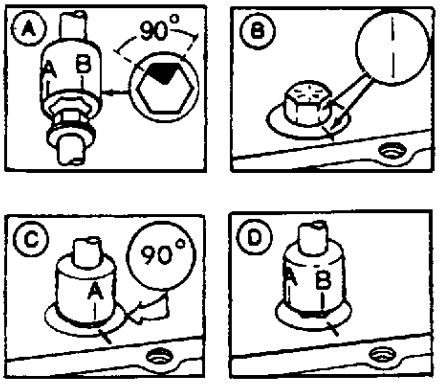
VALVE SEAT SPECIFICATIONS

Valve Seat Angle (B)	20° ±0.5°
Valve Seat Width (C):	
—Exhaust	2.0—3.8 mm (0.079—0.150 in.)
—Intake	1.4—3.8 mm (0.055—0.150 in.)
Max. Valve Seat Runout (D)	0.05 mm (0.002 in.)

IMPORTANT: Blend or radius all sharp edges after grinding valve seats. Always check valve recess in cylinder head after grinding as described later.

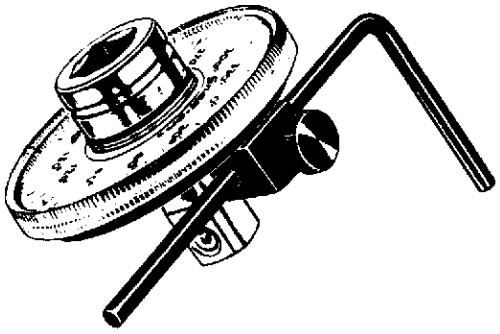
RG,CTM82,G05,12-19-11JUN93

TORQUE-TURN FLANGED-HEAD CYLINDER HEAD CAP SCREWS



RG5563 -UN-04JUL89

Line Scribe Method



RG5698 -UN-27AUG90

JT05993 Torque Angle Gauge

Refer to illustration in previous module for numerical location of cylinder head cap screws.

• Using line scribe method to TORQUE-TURN cylinder head cap screws:

After tightening cylinder head cap screws (in proper sequence) to 125 N·m (95 lb-ft), follow steps A—D below for each cap screw beginning with the No. 1 cap screw and sequentially proceed thru to No. 26.

Step A— Make a mark on socket and a second mark 90˚ (1/4 turn) counterclockwise from first mark on socket.

Step B— Make a reference mark next to cap screw on cylinder head.

Step C— Place socket on cap screw so that the first mark on socket aligns with mark on cylinder head.

Step D— Tighten cap screw 1/4 turn (90˚) until second mark on socket aligns with mark on cylinder head.

• Using JT05993 Torque Angle Gauge:

After tightening cylinder head cap screws (in proper sequence) to 125 N·m (95 lb-ft), follow directions provided with gauge and TORQUE-TURN each cap screw 90˚—100˚, beginning with cap screw No. 1 and sequentially proceed thru to No. 26.

5. Complete engine final assembly following procedures outlined later in this group.

IMPORTANT: Retorque of cylinder head cap screws after engine run-in is not required when using flanged-head cap screws and the recommended TORQUE-TURN tightening procedure.

RG,CTM6,G05,4 -19-28OCT92

CYLINDER BLOCK, LINERS, PISTONS, AND RODS SPECIFICATIONS

ITEM	SPECIFICATION	WEAR LIMIT
Cylinder Liner Height Above Block	0.025—0.102 mm	——
	(0.001—0.004 in.)	——
Maximum Piston Protrusion Above Block	0.051—0.787 mm	——
	(0.002—0.031 in.)	——
Piston Oil Control Ring-to-Groove Clearance	0.064—0.102 mm	0.165 mm
	(0.0025—0.0040 in.)	(0.0065 in.)
Piston Oil Control Ring End Gap No. 1	0.43—0.69 mm	——
	(0.017—0.027 in.)	——
No. 2	0.63—0.89 mm	——
	(0.025—0.035 in.)	——
Piston OD: —19.1 mm (0.75 in.) from Bottom of Skirt	115.771—115.789 mm	——
	(4.5579—4.5586 in.)	
Piston-to-Liner Clearance at Bottom of Skirt	0.076—0.124 mm	0.152 mm
	(0.0030—0.0049 in.)	(0.0060 in.)
Cylinder Liner ID	115.865—115.895 mm	——
	(4.5616—4.5628 in.)	——
Cylinder Liner OD	127.94—128.24 mm	——
	(5.037—5.049 in.)	——
Cylinder Liner Thickness	6.05—6.15 mm	——
	(0.238—0.242 in.)	——
Cylinder Liner Packing Step Dimension	1.45—1.55 mm	——
	(0.057—0.061 in.)	——
Cylinder Liner Maximum Taper	0.051 mm	——
	(0.0020 in.)	——
Cylinder Liner Maximum Out-of-Round	0.051 mm	——
	(0.0020 in.)	——
Cylinder Liner Counterbore Depth	8.105—8.155 mm	——
	(0.319—0.321 in.)	——

RG,CTM82,G10,1 -19-12APR93

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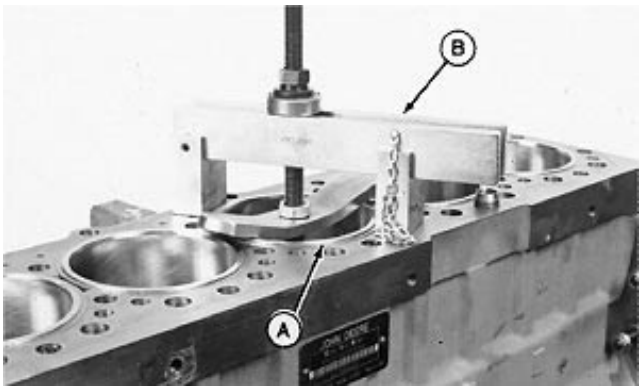
REMOVE CYLINDER LINERS

1. Remove cap screws and washers securing liners to cylinder block.

2. Number cylinder liners and mark fronts to assure correct assembly.

IMPORTANT: Keep matched pistons and liners together. Liners must be reinstalled in same cylinder bore.

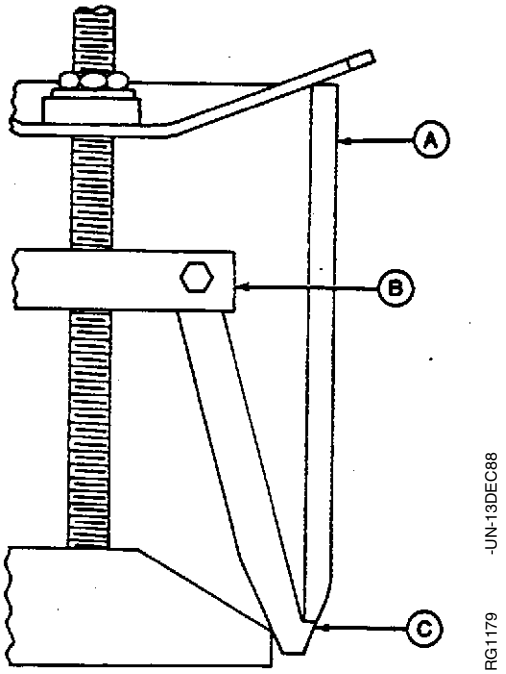
3. Use D01062AA or D01073AA Cylinder Liner Puller (B) to remove cylinder liner (A).



RG,CTM42,G10,4 -19-12APR93

IMPORTANT: When using D01062AA (or D01073AA) Cylinder Liner Puller (B) to remove liners (A), be sure jaw (C) of puller is correctly positioned before attempting to remove liner.

DO NOT over-tighten liner puller to remove liners. Doing so could easily break liners.



S11,0402,AK -19-02APR93

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INSPECT AND MEASURE CONNECTING ROD BEARINGS

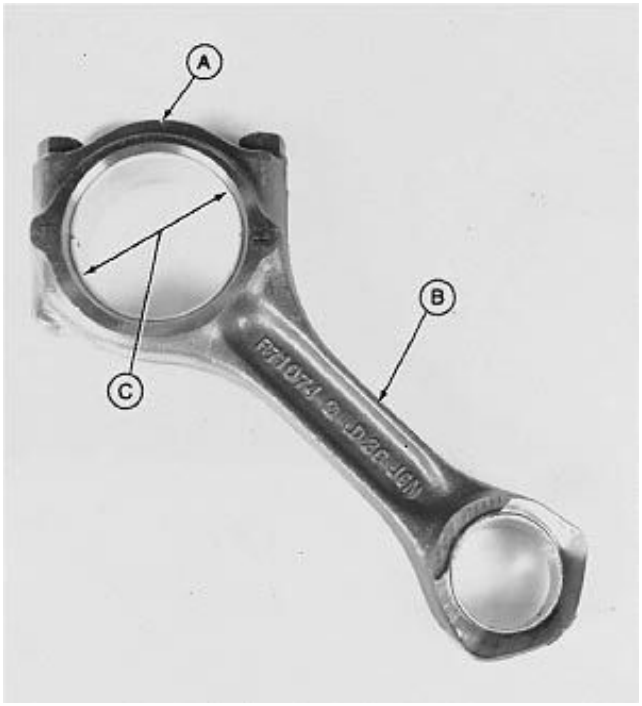
IMPORTANT: Never use new connecting rod cap screws when checking rod bearing ID. Use new cap screws only for final assembly of connecting rods.

Rod bearing-to-journal oil clearance can be checked with PLASTIGAGE, if rod is connected to crankshaft. If rod is out of engine, measure ID of connecting rod bearings and compare with OD of crankshaft journal.

1. With crankshaft removed, measure connecting rod journal OD at several points.

2. Install connecting rod cap (A) on rod (B) with bearings (C) in correct position.

3. Tighten rod cap-to-rod using TORQUE-TURN method. (See USE TORQUE-TURN METHOD FOR PROPER TORQUE, described later in this group.)



RG5705 -UN-01APR91

RG,CTM42,G10,40-19-29OCT92

4. Using an inside micrometer (A) measure ID of bearing.

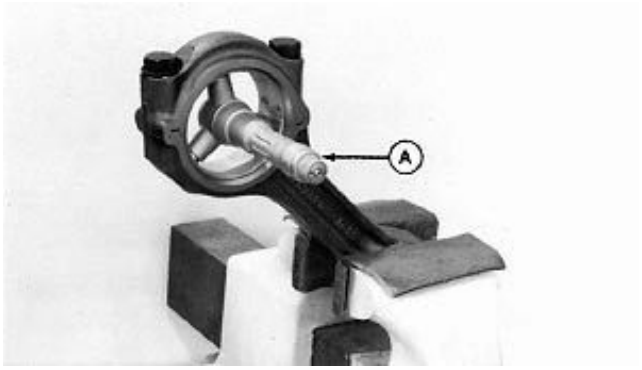
5. Subtract OD of crankshaft journals from ID of rod bearings to obtain oil clearance.

6. Compare measurements with the following specifications.

CONNECTING ROD BEARING AND JOURNAL SPECIFICATIONS

Crankshaft Journal OD	76.15—76.18 mm (2.9980—2.9992 in.)
Assembled Rod Bearing ID	76.21—76.26 mm (3.0005—3.0025 in.)
Oil Clearance (new parts)	0.030—0.110 mm (0.0012—0.0044 in.)
Wear Limit	0.152 mm (0.0060 in.)

7. Inspect connecting rod bearings for wear or damage. If bearings are worn or not within specification, replace both connecting rod bearing and rod pin bearing.



RG3824 -UN-13DEC88

S11,2010,JR -19-12APR93

2. Measure cam follower bore diameter at all bore locations. Record measurements by bore location.

CAMSHAFT FOLLOWER AND BORE SPECIFICATIONS

Cam Follower Bore ID	17.384—17.440 mm (0.6845—0.6865 in.)
Cam Follower OD	17.33—17.35 mm (0.682—0.683 in.)
Maximum Cam Follower-to-Bore Clearance	0.114 mm (0.0045 in.)

If any one cam follower bore is not within specification, install a new cylinder block.

S11,2010,JV -19-12APR93

3. Measure camshaft bore diameter at all locations and record readings. Compare measurements with specifications given in chart below:

CAMSHAFT BUSHING AND BORE SPECIFICATION

Camshaft Bushing Installed ID	67.076—67.102 mm (2.6408—2.6418 in.)
Camshaft Bushing Bore in Block	69.987—70.013 mm (2.7554—2.7564 in.)
Maximum Runout of Camshaft Bushing Bore in Block	0.038 mm (0.0015 in.)
New Camshaft Bushing-to-Journal Clearance	0.063—0.115 mm (0.0025—0.0045 in.)
Maximum Clearance	0.152 mm (0.0060 in.)

If camshaft bushing bore diameter in block is more than specified, install a new cylinder block.

RG5830 -UN-12AUG91

RG,CTM42,G10,22-19-29OCT92

11. Dip NEW cap screws and washers in clean engine oil. Make sure top of cap screws have oil on them also.

IMPORTANT: Using pneumatic wrenches to install cap screws may cause damage to the threads.

12. Initially tighten cap screw (A) to 27 N·m (20 lb-ft) before tightening the other cap screw.

13. Secondly, tighten all cap screws to 75 N·m (55 lb-ft).

14. Finally TORQUE-TURN all cap screws 90—100˚. (See USE TORQUE-TURN METHOD FOR PROPER TORQUE, described next in this group.)

RG5818 -UN-12AUG91

RG,CTM42,G10,16-19-29OCT92

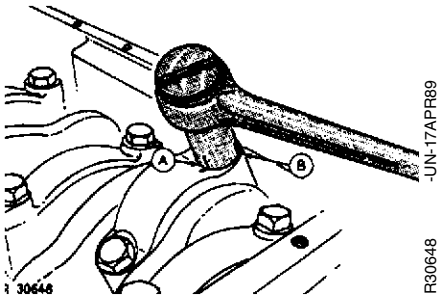
USE TORQUE-TURN METHOD FOR PROPER TORQUE

• Using line scribe method to TORQUE-TURN connecting rod cap screws:

1. After tightening cap screws to 75 N·m (55 lb-ft), mark connecting rod cap and socket (A).

2. Make a second mark on socket (B) 90˚ counterclockwise from the first mark.

3. Tighten 1/4 turn (90—100˚) clockwise until mark (B) is in line with reference mark on rod cap.



R30648 -UN-17APR89

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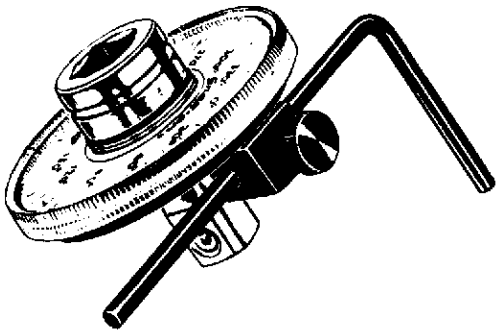
S11,2010,CE -19-02APR93

• Using JT05993 Torque Angle Gauge to TORQUE-TURN connecting rod cap screws:

1. After tightening cap screws to 75 N·m (55 lb-ft), follow directions provided with gauge and TORQUE-TURN each cap screw 90˚—100˚.



JT05993 Torque Angle Gauge

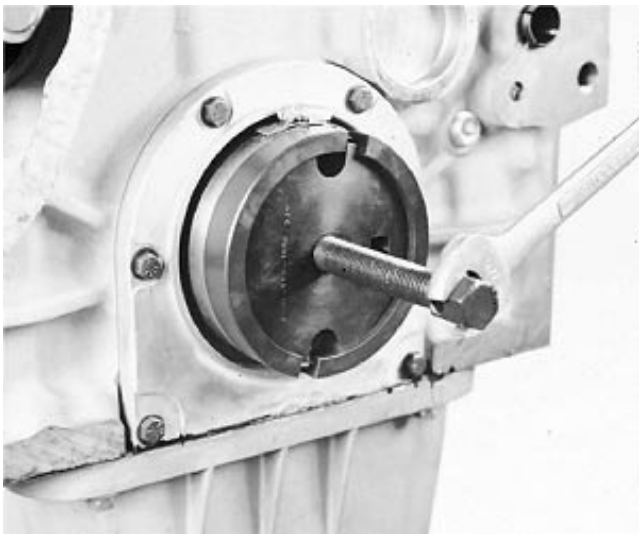
RG5698 -UN-27AUG90

RG,CTM6,G10,4 -19-22AUG91

4. Assemble JDG790 Rear Wear Sleeve Puller and position onto crankshaft flange with wear sleeve seated in jaws.

5. Securely tighten band clamp in groove on OD of jaws.

6. Tighten forcing screw with disc centered in crankshaft flange until wear sleeve is removed from crankshaft.



RG6468 -UN-26OCT92

RG,CTM42,G15,50-19-29OCT92

Clean OD of crankshaft flange with cleaning solvent, acetone, or any other suitable cleaner that will remove sealant. (Brake Kleen, Ignition Cleaner and Drier are examples of commercially available solvents that will remove sealant from flange.)

Look for nicks or burrs on wear ring surface and bore in flywheel housing. If necessary, use a polishing cloth.

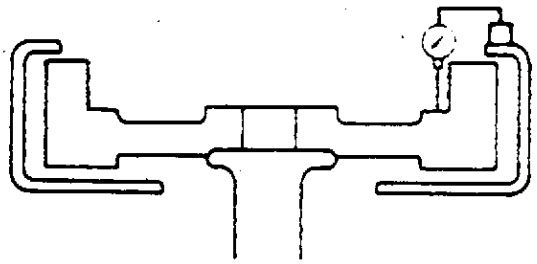
Finish cleaning by wiping flange with a clean rag. Any small nicks should be removed with 180-grit or finer polishing cloth.

Check oil seal housing runout as explained later in this group.

RG5822 -UN-12AUG91

RG,CTM42,G15,4 -19-29OCT92

CHECK FLYWHEEL FACE FLATNESS


R22213 -UN-14DEC88

1. Mount dial indicator base on flywheel housing. Position pointer to contact driving ring mounting surface. Do not allow pointer to contact driving ring mounting holes.

IMPORTANT: Maintain constant end pressure on crankshaft to hold shaft against thrust bearing when measuring flywheel face runout.

2. Rotate flywheel by turning crankshaft. Read total dial indicator movement. Resurface flywheel face or replace as required.

FLYWHEEL FACE FLATNESS SPECIFICATION

Maximum Variation	0.23 mm (0.009 in.)
Maximum Variation per 25 mm (1.0 in.) of Travel	0.013 mm (0.0005 in.)

S11,5005,AM -19-29OCT92

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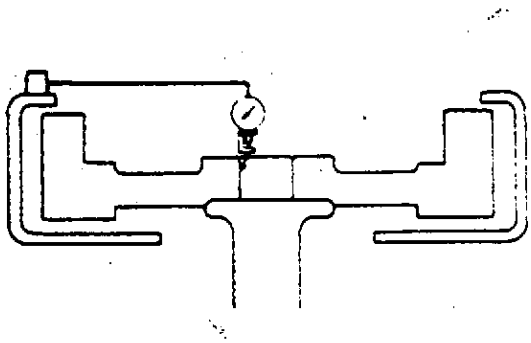
CHECK PILOT BEARING BORE CONCENTRICITY


R22214 -UN-14DEC88

1. Mount dial indicator on flywheel housing face and position pointer to contact ID of pilot bearing bore in flywheel.

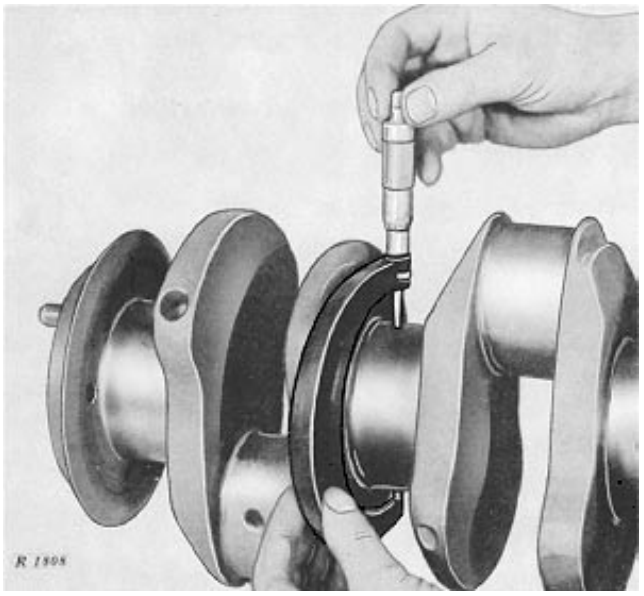
2. Rotate flywheel by turning crankshaft. Read total dial indicator movement.

BEARING BORE CONCENTRICITY SPECIFICATION

Maximum Variation	0.127 mm (0.005 in.)

S55,2015,M -19-29OCT92

4. Measure OD of all respective crankshaft journals at several points around journal.



CRANKSHAFT SPECIFICATIONS

OD of Main Bearing Journal	85.65—85.67 mm (3.372—3.373 in.)
Crankshaft-to-Main Bearing Oil Clearance	0.030—0.108 mm 0.0012—0.0042 in.)
Wear Limit	0.152 mm (0.0060 in.)

NOTE: If engine has previously had a major overhaul and undersized bearing inserts were used, above listed ID and OD dimensions may not be the same as those recorded. However, oil clearance should be within specifications.

Use crankshaft journal OD measurements to determine if journal is out-of-round or tapered.

CRANKSHAFT WEAR SPECIFICATIONS

Journal Taper per 25.4 mm (1.0 in.) Length	0.0025 mm (0.0001 in.)
Journal Out-of-Roundness	0.025 mm (0.0010 in.)

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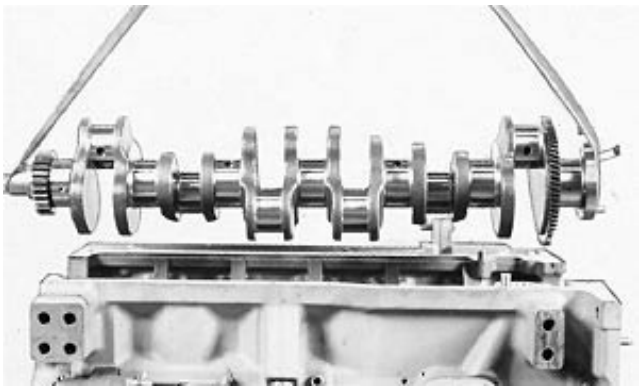
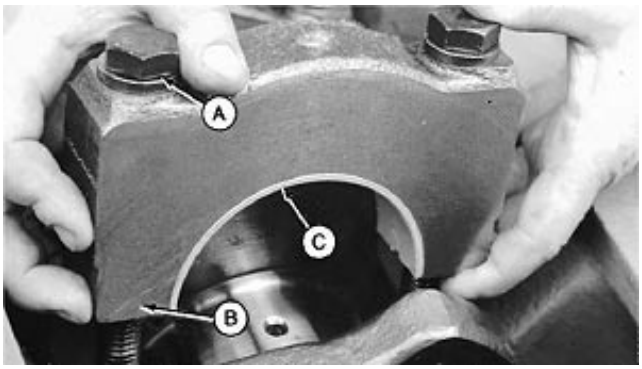
S11,0403,AD -19-03MAY93

INSTALL CRANKSHAFT





CAUTION: Crankshaft is heavy. Plan a proper lifting procedure to avoid injuries.

1. Carefully position crankshaft onto main bearing inserts using a hoist and lift sling.

2. Dip entire main bearing cap screws in clean engine oil and position them in the main bearing caps. Apply a liberal amount of oil to bearing inserts in caps.

3. Install each bearing cap (B), bearings (C), and cap screws with washer (A) with the recesses and tabs aligned in matching order. Make sure bearing tabs also match up before tightening cap screws.

NOTE: Make sure main bearing caps are installed on the bearing bosses from which they were removed. The numbers stamped on the caps should be on the same side as the numbers on the block. If there is an arrow on cap, arrow must be on the camshaft side of the block pointing towards the front of the engine. If bearing caps have been rebored, make sure bearing caps have numbers stamped on them.

IMPORTANT: Do not use pneumatic wrench to install main bearing cap screws, as damage may occur to threads.

4. Before tightening cap screws on main bearing caps, align upper and lower thrust flanges on main thrust bearings. Using a soft-face hammer, tap crankshaft to the rear and then to the front to line up thrust bearing flanges.

5. Tighten No.'s 1, 2, 3, 4, 6 and 7 main bearing cap screws to 68 N·m (50 lb-ft). Hand-tighten No. 5 main thrust bearing cap screws.

6. Gently pry crankshaft rearward and then forward to align thrust washers on No. 5 main thrust bearing.

NOTE: DO NOT PRY crankshaft on No. 5 main thrust bearing.

7. Tighten No. 5 main thrust bearing cap screws to 68 N·m (50 lb-ft).

8. Tighten all main bearing cap screws (including No. 5) to 203 N·m (150 lb-ft).

9. Turn crankshaft by hand. If it does not turn easily, disassemble parts and determine the cause.

10. Install connecting rod bearings and connecting rods caps. See INSTALL PISTONS AND CONNECTING RODS in Group 10.

11. Check crankshaft for 0.038—0.380 mm (0.0015—0.0150 in.) end play.

12. Install oil pump and check drive gear-to-crankshaft clearance. See INSTALL ENGINE OIL PUMP in Group 20.

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RG,CTM42,G15,22-19-03MAY93

SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

RG4950 -UN-23AUG88

Flywheel Turning Tool JDE81-1

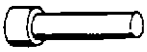
Rotate engine flywheel. Use with JDE81-4.

S53,JDE811 -19-07JUL89

RG5068 -UN-23AUG88

Timing Pin JDE81-4

Used to lock flywheel at "TDC" when timing engine and adjusting valves.

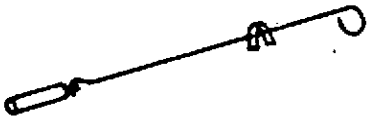


S53,JDE814,A -19-09SEP91

RG5073 -UN-23AUG88

Magnetic Follower Holder Kit D15001NU

Hold cam followers when removing or installing camshaft.



S53,D15001,NU -19-24APR92

Slide Hammer D01299AA

Used with JDG405 Camshaft Bushing Service Set and JDG606 Camshaft Bushing Adapter Set to service camshaft bushings.

RG78104H1 -UN-15DEC88

S53,D01299,AAA -19-09SEP91

Camshaft Bushing Service Set JDG405

Used with JDG606 Camshaft Bushing Adapter Set and D01299AA Slide Hammer to service camshaft bushings.

NOTE: JDE6 Service Set may be used along with JDG602 Adapter Set if JDG405 is not available.

RG4228 -UN-27JAN92

S53,JDG405,A -19-28APR92

INSPECT AND MEASURE CAMSHAFT FOLLOWERS

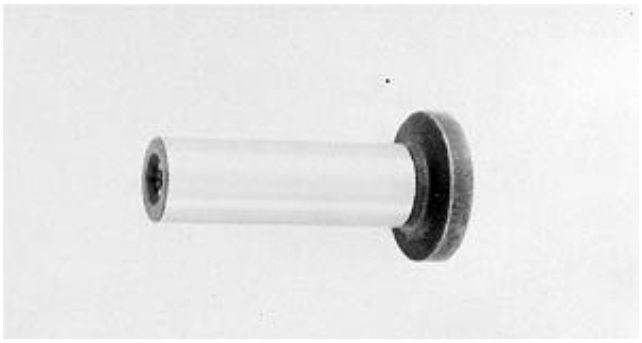
1. Inspect camshaft followers for uneven wear or damage. Also inspect corresponding camshaft lobe for wear or damage. Replace as necessary.

2. Measure follower OD and follower bore ID in cylinder block.

CAMSHAFT FOLLOWER AND BORE SPECIFICATIONS

Camshaft Follower OD	17.33—17.35 mm (0.682—0.683 in.)
Camshaft Follower Bore ID in Block	17.384—17.440 mm (0.6845—0.6865 in.)

Replace cam followers that are not within specification. Replace cylinder block if any one cam follower bore is not within specification.



RG2745 -UN-23FEB89

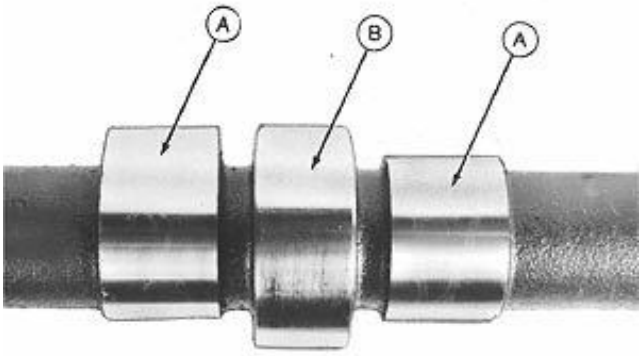
RG,CTM42,G16,19-19-29OCT92

VISUALLY INSPECT CAMSHAFT

1. Clean camshaft in solvent. Dry with compressed air.

2. Visually inspect camshaft lobes (A) and journals (B) for wear or damage. Replace as necessary. New camshaft followers can be used with old camshaft (if camshaft is serviceable). DO NOT reuse old cam followers with a new camshaft.

NOTE: Very light score marks may be found, but are acceptable if valve lift is within specification. Pitting or galling dictates replacement. (See CHECK VALVE LIFT earlier in this group.)



RG3500 -UN-06AUG91

RG,CTM42,G16,20-19-29OCT92

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OTHER MATERIAL

Name	Use
PERMATEX AVIATION (Form-A-Gasket No. 3) (TY6299)	To seal gasket surfaces.
LOCTITE 592 Pipe Sealant with TEFLON (TY9374/TY9375)	To seal oil pan elbow drain fitting.
High Temperature Grease (TY6343 or TY6347)	To lubricate oil pump components.

RG,CTM42,G20,1 -19-09OCT92

LUBRICATION SYSTEM SPECIFICATIONS

ITEM	SPECIFICATION
Oil Filter Bypass Valve Operating Pressure	210 kPa (2.1 bar) (30 psi)
Oil Pressure Regulating Valve Spring:	
Compressed Length	43.0 mm @ 66—74 N (1.69 in. @ 15—17 lb-force)
Free Length	85.0 mm (3.35 in.)
Oil Filter Bypass Valve Spring:	
Compressed Length	30.0 mm @ 64—78 N (1.18 in. @ 14—18 lb-force)
Free Length	44.0 mm (1.73 in.)
Oil Cooler Bypass Valve Spring:	
Compressed Length	30.0 mm @ 64—78 N (1.18 in. @ 14—18 lb-force)
Free Length	44.0 mm (1.73 in.)
Oil Pump:	
Crankshaft Gear-to-Oil Pump Drive Gear Minimum Backlash	0.08 mm (0.003 in.)
Pump Gear Backlash	0.33—2.00 mm (0.013—0.079 in.)
Oil Pump Drive Gear-to-Crankshaft Throw Minimum Clearance	0.38 mm (0.015 in.)
Maximum Drive Shaft End Play	0.15 mm (0.006 in.)
Maximum Drive Shaft Side Movement	0.17 mm (0.0065 in.)

RG,CTM42,G20,2 -19-07JUN93

INSPECT AND CLEAN OIL PUMP

1. Visually inspect oil pump for wear or damage.

2. Flush pump assembly internally with clean solvent to remove oil. Spin pump gears to help remove solvent.

3. Place oil pump on a work bench with pump-to-cylinder block mounting surface facing upward (same as when mounted on engine).

NOTE: Leave pump drive gear installed when making checks.

IMPORTANT: To help insure accurate wear measurements, be sure the oil pump is clean and faces the same way as when mounted on the cylinder block.

RG,CTM42,G20,18-19-09OCT92

CHECK DRIVE SHAFT END PLAY

1. Mount dial indicator with indicator plunger resting against end of pump drive shaft.

2. Move shaft toward and away from indicator.

If end play exceeds 0.15 mm (0.006 in.), there is excessive wear on pump cover and/or wear on end of pump drive gear.

Replace oil pump if end play exceeds 0.15 mm (0.006 in.).

RG5916 -UN-16AUG91

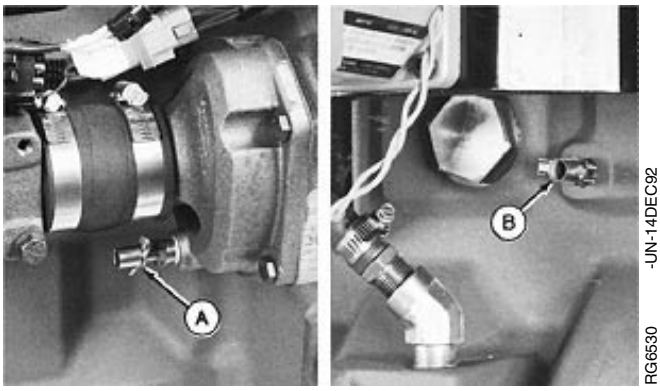
RG,CTM42,G20,19-19-09OCT92

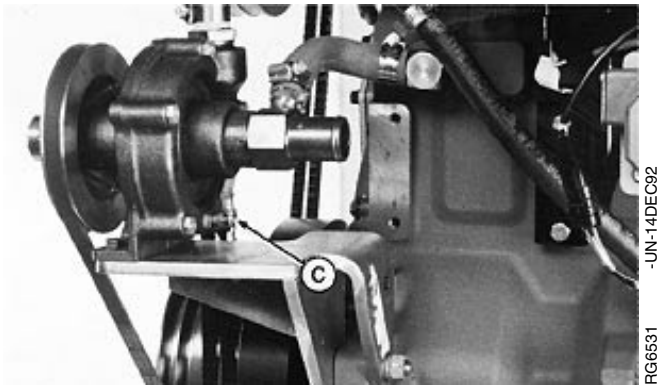
REMOVE ENGINE WATER PUMP

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns. Wait until engine coolant is cool enough to touch with bare hands before draining. Slowly loosen radiator cap to first stop to relieve pressure.

IMPORTANT: Water pump, block, and auxiliary water pump (if equipped) drain valves must be opened to completely drain both sides of the engine.

1. Open water pump drain valve (A), block drain valve (B), and auxiliary water pump drain valve (C) to drain coolant from engine.





RG,CTM82,G25,5 -19-12FEB93

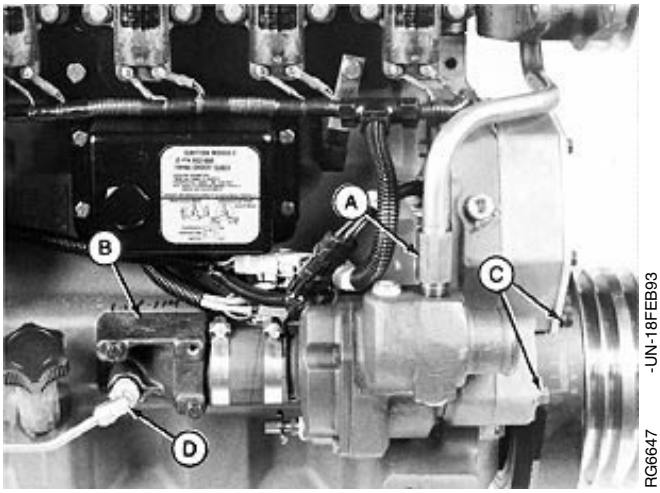
2. Remove fitting (A) and water bypass tube from water pump housing.

3. Remove turbocharger coolant supply line (D).

4. Remove water inlet manifold elbow (B) cap screws and water pump mounting cap screws (C).

NOTE: Oil dipstick may have to be removed to provide clearance for water pump removal. Rotate water pump inlet downward and lift inlet manifold elbow up between block and dipstick tube while sliding water pump to the rear. Some applications may be different.

5. Slide water pump nose out of cylinder block flange bore. Remove O-ring.



A—Water Bypass Tube Fitting
B—Water Inlet Manifold
C—Water Pump Mounting Cap Screws
D—Turbocharger Coolant Supply Line

RG,CTM82,G25,6 -19-23FEB93

REMOVE WATER MANIFOLD

1. Remove alternator adjusting strap from water manifold and remove alternator. Remove alternator support bracket from side of water manifold.

2. Remove water manifold-to-aftercooler hose (A) and and water manifold-to-auxiliary heat exchanger hose from fitting (B, shown removed).

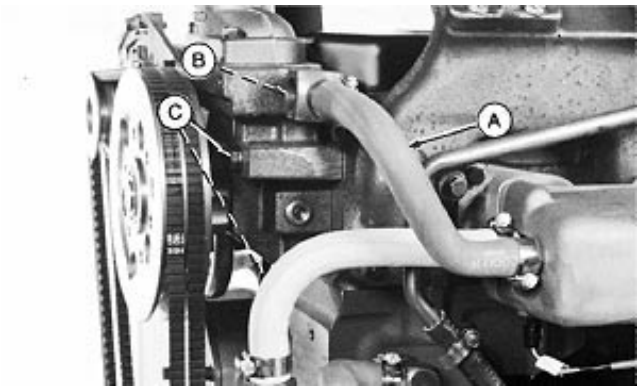
3. Remove “J” clamp from bypass tube (E). Remove bypass tube from water pump fitting and remove other end tube from water manifold.

4. Remove three water manifold-to-cylinder head cap screws (C) and remove water manifold assembly.

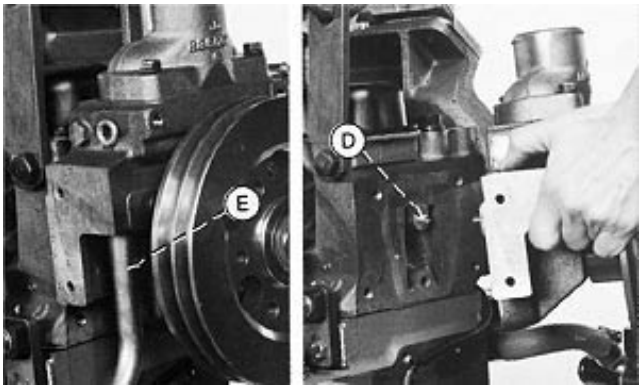
NOTE: Pull water manifold straight ahead (away from engine) approximately 6.4 mm (0.25 in.) to disengage from locator (spring) pin (D).

5. Remove and discard O-rings from bore of water manifold and from water pump fitting.

A—Water Manifold-to-Aftercooler Tube
B—Auxiliary Heat Exchanger Hose Fitting
C—Cap Screws
D—Locating Spring Pin
E—Bypass Pipe



RG6550 -UN-14DEC92



RG6551 -UN-14DEC92

RG,CTM82,G25,11-19-12APR93

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• Abnormally High Exhaust Temperatures

A fifth cause of turbocharger damage is abnormally high exhaust temperatures. Elevated exhaust temperatures cause coking of oil which can lead to bearing failure. Extreme over-temperature operation can cause wheel burst.

Over-temperature on a natural gas engine can result from a rich air/fuel mixture, overpowering the engine, or restricted air flow. With a rich air/fuel mixture or restricted air flow, the engine is burning more fuel than necessary to produce the desired power level. The excess energy exits through the exhaust system in the form of heat.

6076 Natural gas engines are lean-burn engines, so more air than necessary is available for combustion. Higher efficiency and lower exhaust temperatures will result with a leaner air/fuel mixture. The turbocharger center housing on natural gas engines is water-cooled to protect the turbocharger bearings from extreme exhaust temperatures.

If over-temperature operation is identified, check air inlet and exhaust systems, coolant lines, engine load, air/fuel adjustment, and ignition timing.

RG,CTM82,G30,4 -19-16FEB93

PRELUBE TURBOCHARGER

IMPORTANT: DO NOT spin the rotor assembly with compressed air. Damage to bearings can occur when using compressed air.

Fill oil return (drain) port with clean engine oil and spin rotating assembly by hand to properly lubricate bearings.

If turbocharger is to be stored for an extended period of time, lubricate internally and install protective covers on all openings.

RG5858 -UN-13AUG91

RG,CTM42,G30,34-19-29OCT92

REMOVE AND INSTALL 20 PSI CARBURETOR

CAUTION: Natural gas is highly flammable. DO NOT smoke while working on or near natural gas equipment. Natural gas fumes may cause sickness or death. Work in well ventilated area and shut off natural gas supply before servicing equipment.

Carburetor Removal:

1. Shut off gas supply at manual shut-off valve.

2. Loosen hose clamp and remove regulated supply line (A).

3. Disconnect balance tube (B). Disconnect throttle linkage (C).

4. Remove throttle valve-to-aftercooler intake adapter cap screws. Loosen support strap (D) cap screws on intake manifold and remove carburetor with throttle valve.

5. Plug air intake opening to keep debris out of system. Remove gasket (E) and clean mounting surface.

Carburetor Installation:

1. Place a new gasket on intake adapter. Apply grease to turbocharger adapter O-ring.

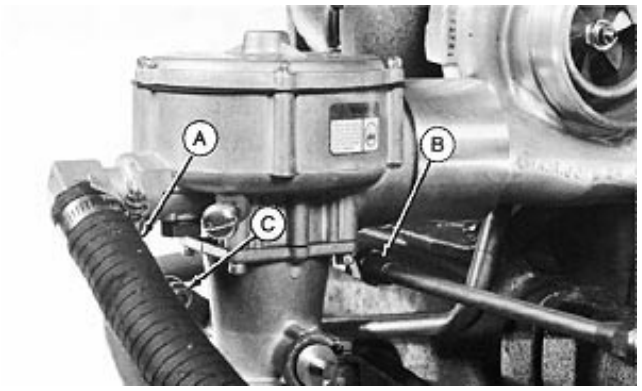
2. Apply LOCTITE 242 (TY9370/T43512) Thread Lock and Sealer to cap screw threads. Install throttle valve and carburetor assembly onto air intake adapter. Be sure carburetor inlet is properly seated in turbocharger adapter.

3. Install support straps. Tighten throttle valve-to-aftercooler intake adapter cap screws to 27 N·m (20 lb-ft). Tighten support strap-to-intake manifold cap screws to 15 N·m (11 lb-ft).

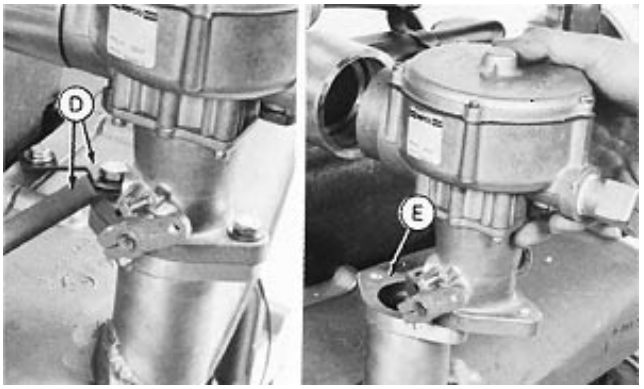
4. Connect throttle linkage and tighten securely.

5. Install balance tube and regulated supply line.

Refer to Group 115 for necessary adjustments.



RG6513 -UN-14DEC92



RG6514 -UN-14DEC92

A—Regulated Supply Line
B—Balance Tube
C—Throttle Linkage
D—Support Strap
E—Gasket

RG,CTM82,G35,6 -19-07JUN93

REMOVE AND INSTALL IGNITION TIMING SENSOR

1. Disconnect wiring (A).

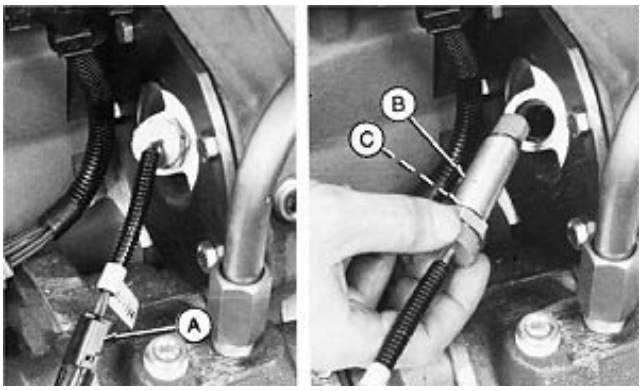
2. Remove ignition timing sensor (B) from ignition sensor plate.

3. Inspect O-ring (C). Replace if necessary.

IMPORTANT: DO NOT overtighten sensor. Sensor may be damaged during operation.

4. Install sensor. Tighten to 22 N·m (16 lb-ft).

5. Connect wiring harness.



RG6554 -UN-21DEC92

RG,CTM82,G40,6 -19-28MAY93

REMOVE AND INSTALL IGNITION SENSOR PLATE

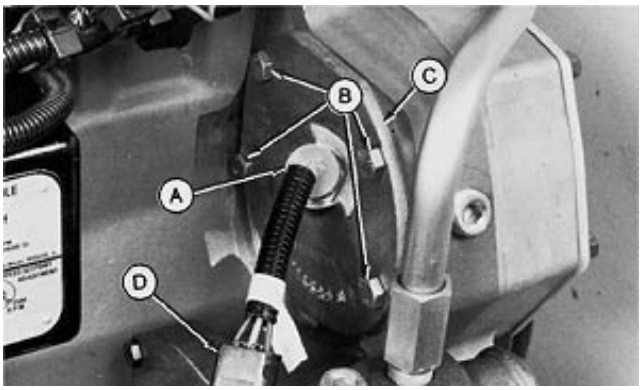
1. Remove ignition timing sensor (A). (See REMOVE AND INSTALL IGNITION TIMING SENSOR, earlier in this group.)

2. Remove cap screws (B), plate (C), and gasket. Discard gasket.

3. Clean gasket surfaces.

4. Install plate with new gasket. Tighten cap screws to 34 N·m (25 lb-ft).

5. Install ignition sensor. (See REMOVE AND INSTALL IGNITION TIMING SENSOR, earlier in this group.)



RG6741 -UN-30APR93

A—Ignition Sensor
B—Cap Screws
C—Sensor Plate
D—Wire Harness

RG,CTM82,G40,12-19-28MAY93

40 5

ALTITUDE COMPENSATION GUIDELINE

High elevations may affect engine performance. As a general rule, this guideline will apply.

One and one-half percent reduction in power rating per 300 m (1000 ft) rise in elevation above 183 m (600 ft). For every 5.5˚C (10˚F) above 25˚C (77˚F), a one percent reduction in power may be experienced. Engine may have to be defueled when a substantial percentage of operating time occurs at 2250 m (7500 ft) or higher.

As altitude increases, air gets thinner and engine runs richer; exhaust temperatures rise and power drops. Reduce load on engine and lean out A/F (Air/Fuel) mixture to keep exhaust temperatures at 1100˚F or below.

RG,CTM82,100,2 -19-28MAY93

PRELIMINARY ENGINE TESTING

Before tuning-up an engine, determine if a tune-up will restore operating efficiency. If in doubt, the following preliminary tests will help determine if the engine can be tuned-up. Choose from the following procedures only those necessary to restore the unit.

1. Perform compression test (See Group 105).

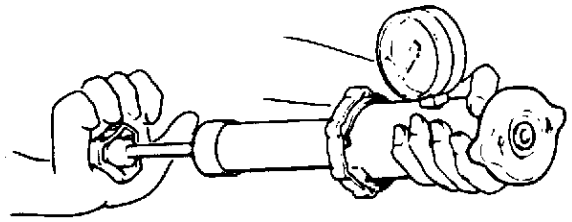
2. After engine has stopped for several hours, loosen crankcase drain plug and watch for any water to seep out. A few drops could be due to condensation, but any more than this would indicate problems which require engine repairs rather than just a tune-up.

3. With engine stopped, inspect engine coolant for oil film. With engine running, inspect coolant for air bubbles. Either condition would indicate problems which require engine repairs rather than just a tune-up.

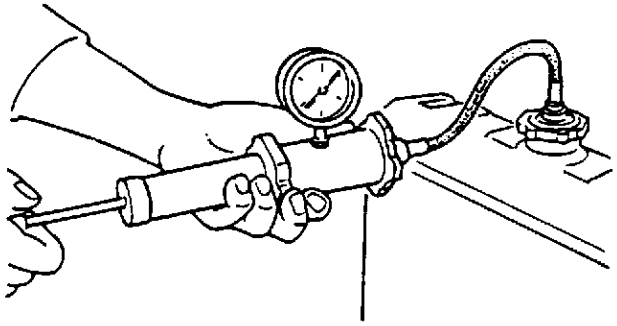
4. Perform a dynamometer test and record power output. See DYNAMOMETER TEST later in this group. Repeat dynamometer test after tune-up. Compare power output before and after tune-up.

S11,22010,BW -19-28MAY93

PRESSURE TEST COOLING SYSTEM AND RADIATOR CAP



RG6557 -UN-20JAN93



RG6558 -UN-20JAN93

CAUTION: Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

Test Radiator Cap:

1. Remove radiator cap and attach to an approved tester as shown.

2. Pressurize cap to 50 kPa (0.5 bar) (7 psi)*. Gauge should hold pressure for 10 seconds within the normal range if cap is acceptable.

If gauge does not hold pressure, replace radiator cap.

3. Remove the cap from gauge, turn it 180˚, and retest cap. This will verify that the first measurement was accurate.

Test Cooling System:

NOTE: Engine should be warmed up to test overall cooling system.

1. Allow engine to cool, then carefully remove radiator cap.

2. Fill radiator with coolant to the normal operating level.

IMPORTANT: DO NOT apply excessive pressure to cooling system, doing so may damage radiator and hoses.

3. Connect gauge and adapter to radiator filler neck. Pressurize cooling system to 50 kPa (0.5 bar) (7 psi)*.

4. With pressure applied, check all cooling system hose connections, radiator, and overall engine for leaks.

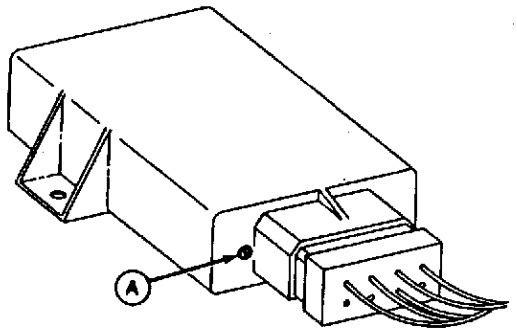
If leakage is detected, correct as necessary and pressure test system again.

If no leakage is detected, but the gauge indicated a drop in pressure, coolant may be leaking internally within the system or at the block-to-head gasket. Have your servicing dealer or distributor correct this problem immediately.

Test pressures recommended are for all Deere OEM cooling systems. On specific vehicle applications, test cooling system and pressure cap according to the recommended pressure for that vehicle.

RG18293,6 -19-13MAY93

ADJUST PYROMETER SHUTDOWN TEMPERATURE



RG6780 -UN-04JUN93

1. Remove pyrometer thermocouple from exhaust elbow.

2. Disconnect all wires from “S” terminal of safety reset switch, except for pyrometer shutdown signal wire.

3. Turn electrical power on and reset safety switch.

IMPORTANT: DO NOT overheat thermocouple. To avoid melting or damaging thermocouple, heat evenly over length of thermocouple probe.

4. While watching pyrometer gauge, slowly heat thermocouple until safety switch is tripped. Note temperature at which safety switch is tripped.

IMPORTANT: DO NOT exceed 649˚C (1200˚F) shutdown temperature. Higher exhaust temperatures may cause engine damage.

5. Turn pyrometer shutdown adjusting screw (A) clockwise to increase or counterclockwise to decrease shutdown temperature.

NOTE: Adjusting screw rate is approximately 33˚C (60˚F) per revolution of the adjusting screw.

6. Repeat steps 3, 4, and 5 as necessary to reach a 649˚C (1200˚F) shutdown temperature.

7. Install thermocouple probe in exhaust elbow.

8. Reconnect wires to “S” terminal of safety reset switch.

RG,CTM82,110,12-19-11JUN93

SPECIAL OR ESSENTIAL TOOLS

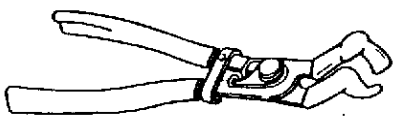
NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

RG6720 -UN-27APR93

Spark Plug Boot Puller Pliers JDG815

Used to remove and install spark plug boots.



RG,JDG815 -19-03MAY93

SERVICE EQUIPMENT AND TOOLS

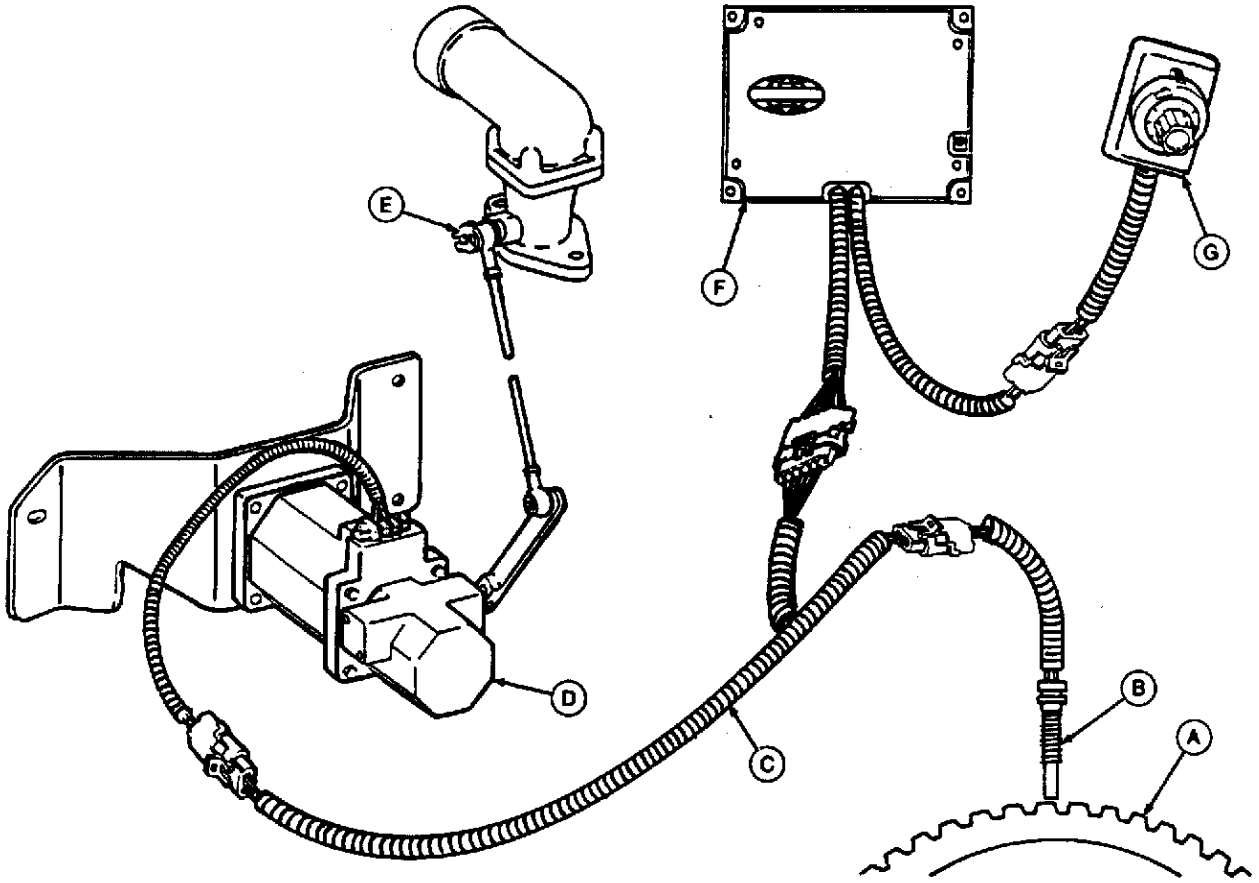
120
1

NOTE: Order tools from the U.S. SERVICEGARD™ Catalog or from the European Microfiche Tool Catalog (MTC). Some tools may be available from a local supplier.

Name	Use
Inductive Timing Light	Checking ignition timing and troubleshooting ignition system.
Multimeter (JT05791)	Checking voltage and resistance. Troubleshooting electrical system.
0—207 kPa (0—30 psi) Pressure Regulator and Gauge.	Pressurize Manifold Absolute Pressure (MAP) sensor.

RG,CTM82,120,1 -19-28MAY93

HOW THE ELECTRONIC GOVERNOR WORKS



A—Flywheel Ring Gear
B—Speed Sensor
C—Wiring Harness
D—Throttle Actuator
E—Throttle Valve
F—Governor Control Module
G—Remote Speed Potentiometer

The electronic governor is an all-speed governor that can be adjusted to operate in isochronous or droop mode. The governor consists of:

- Governor control module (F)
- Throttle actuator (D)
- Speed sensor (B)
- Remote speed potentiometer (speed dial) (G)
- Wiring Harness (C)

Desired engine speed is selected by adjusting the speed dial. As the dial is adjusted, voltage across the remote potentiometer changes. The governor translates this into “desired speed”.

The speed sensor in flywheel housing senses actual engine speed from flywheel ring gear (A) and sends a speed signal to the governor. The governor receives the signal and compares actual speed to desired speed. If actual speed is higher than desired, the governor sends a signal to throttle actuator to reduce opening of throttle valve (E) thereby reducing engine speed. If actual speed is lower than desired, the governor signals actuator to increase throttle opening thereby increasing engine speed.

Once the engine reaches desired speed, the governor regulates throttle valve to maintain constant speed. As engine load changes, engine speed is affected. The governor reacts to these speed changes and quickly adjusts throttle to bring engine back to desired speed. If the governor reacts too slowly or over-reacts, engine speed may oscillate above and below desired speed or may overshoot desired speed. The GAIN and INTEGRATION potentiometers can be adjusted to reduce or eliminate engine surging or overshoot.

RG,CTM82,120,11-19-28MAY93

DIAGNOSE ENGINE MALFUNCTIONS

CAUTION: DO NOT attempt to perform any gas repairs or plumbing changes if there is not a manual gas shut-off valve prior to any defective parts. Contact the local gas company for assistance.

Symptom	Problem	Solution
Engine cranks but will not start or hard to start	Improper starting procedure.	Review starting procedure.
	Slow starter speed.	Weak battery.
		Loose or corroded battery connections.
		Excessive resistance in starter circuit.
		Starter defective.
	Battery voltage too low to operate ignition system. Input voltage lower than 8VDC. (Only No. 5 cylinder fires while cranking.)	Check battery voltage.
		Check electrical system for cause of low voltage.
	Gas supply valve turned off.	Open manual supply valve.
	Loose spark plug wires.	Reinstall wires. Replace wires, if necessary.
	Water in spark plug wells.	Clean out wells. Replace plug wires, if necessary.
	Worn or bad spark plugs.	Clean and regap plugs, or replace if necessary.
	Wrong spark plug type.	Check for proper plug type.
	Electric shut-off valve not opening. (Listen to hear valve open when power is turned on.)	Check voltage and ground at connector. Replace valve if necessary. See Group 120.
	Gas supply pressure low.	Inspect supply line for damage, leakage, and recommended size.
		Check in-line gas filter for plugging. Replace filter if necessary.

Continued on next page

Symptom	Problem	Solution
Coolant temperature below normal	Faulty thermostat.	Remove and check thermostats.
	Faulty temperature gauge or sender.	Check gauge, sender, and connections.
Engine overheats [89˚C (192˚F) thermostats are standard.]	Low coolant level.	Fill radiator to proper level, check radiator and hoses for loose connections or leaks.
	Faulty radiator cap or leaking cooling system.	Pressure test radiator and cap. (See PRESSURE TEST COOLING SYSTEM AND RADIATOR CAP, in Group 105.)
	Loose or defective fan belts. (Radiator cooled engines only.)	Adjust belt tension. Replace as required.
	Low engine oil level.	Check oil level. Add oil as required.
	Cooling system needs flushing.	Flush cooling system. Check radiator or heat exchanger for plugging.
	Faulty thermostats.	Remove and check thermostats. (See INSPECT THERMOSTATS AND TEST OPENING TEMPERATURE, in Group 105.)
	Faulty temperature gauge or sender.	Check gauge and sender.
	Engine overloaded.	Reduce load on engine.
Exhaust temperature above 649˚C (1200˚F).	Air/fuel mixture too rich.	Adjust mixture. (See ADJUST AIR/FUEL MIXTURE, in Group 115.)
	Improper ignition timing. Too retarded.	See ADJUST IGNITION TIMING, in Group 120.
	Faulty carburetor.	Repair or replace carburetor.
	Engine overloaded.	Reduce load on engine.
	Engine misfiring.	See “Engine misses or vibrates under load”.
	Air intake restriction too high.	Check intake system. Replace air filter, if necessary.

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