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# Yanmar Gasoline Engines

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**John Deere Horizon Works**  
**CTM12 (16MA Y90)**

LITHO IN U.S.A.  
ENGLISH

This Component Technical Manual (CTM) contains necessary instructions to repair the engine and fuel and electrical systems. This manual also includes theory of operation, diagnostic, and testing procedures. For information on starting motors, alternators, power take-offs, and other miscellaneous accessories, order CTM-11 Engine Accessories.

Use this component technical manual in conjunction with the machine technical manual. An engine application listing in the Introduction (Group 00) identifies product-model/engine type-model relationship. See the machine technical manual for:

- Engine removal and installation.
- Gaining access to engine components.



This Safety-Alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!

When you see this symbol on your machine or in your manual, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.

## INTRODUCTION

This manual is part of a total service support program.

FOS MANUALS—REFERENCE

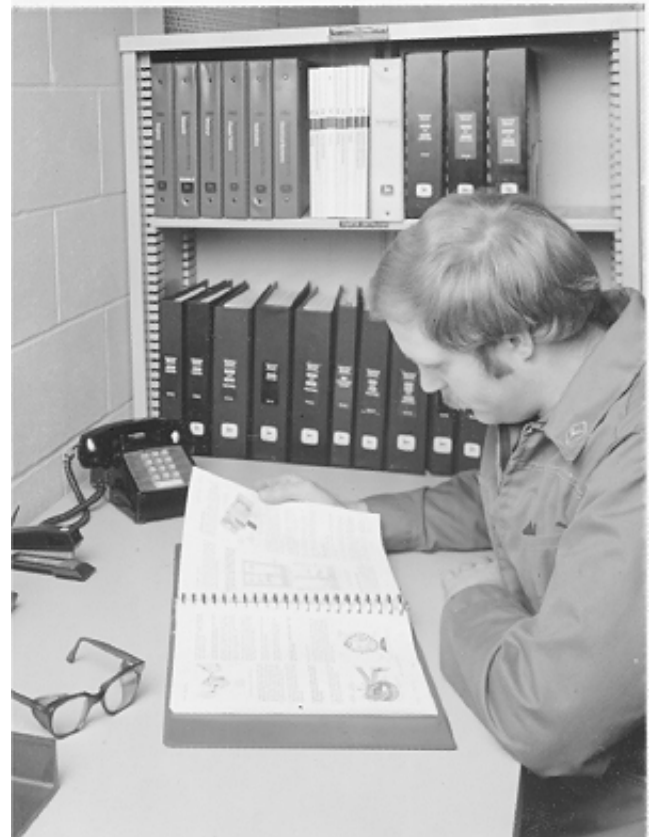
TECHNICAL MANUALS—MACHINE SERVICE

COMPONENT MANUALS—COMPONENT SERVICE

Fundamentals of Service (FOS) Manuals cover basic theory of operation, fundamentals of troubleshooting, general maintenance, and basic types of failures and their causes. FOS Manuals are for training new personnel and for reference by experienced technicians.

Technical Manuals are concise service guides for specific machines. Technical manuals are on-the-job guides containing only the vital information needed by an experienced service technician.

Component Technical Manuals are concise service guides for specific components. Component Technical Manuals are written as stand alone manuals covering multiple machine applications.



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-UN-23AUG88  
RW5559

O53.INTRO2 -19-03JUL85

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## FEATURES OF THIS TECHNICAL MANUAL

John Deere ILLUSTRATION format emphasizing illustrations and concise instructions in easy-to-use modules.

Emphasis on diagnosis, analysis, and testing so you can understand the problem and correct it.

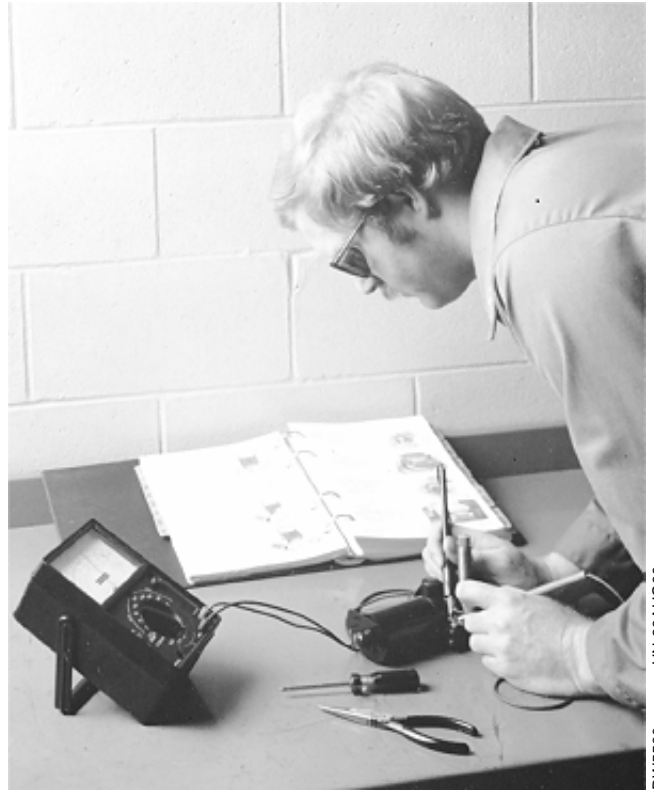
Diagnostic information presented with the most logical and easiest to isolate problems first to help you identify the majority of routine failures quickly.

Step-by-step instructions for teardown and assembly.

Summary listing at the beginning of each group of all applicable specifications, wear tolerances, torque values, essential tools, and materials needed to do the job.

An emphasis throughout on safety—so you do the job right without getting hurt.

This technical manual was planned and written for you—an experienced service technician. Keep it in a permanent binder in the shop where it is handy. Refer to it when you need to know correct service procedures or specifications.



-UN-23AUG88  
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O53,INTRO3 -19-07OCT85

## ABOUT THIS MANUAL

This Component Technical Manual (CTM-12) covers the recommended repair procedures for Yanmar Gasoline Engines removed from the machine.

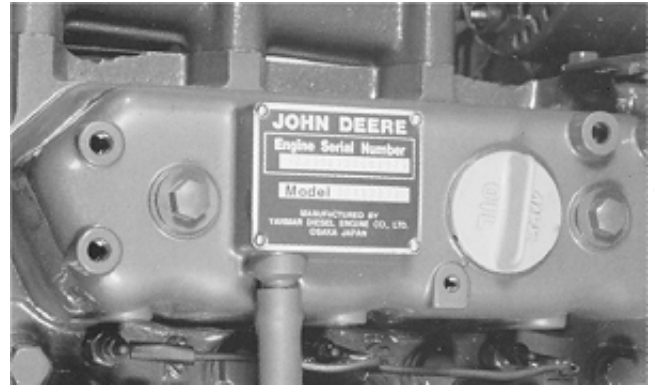
Some components may be serviced without removing the engine from the machine. You may want to determine the repair procedure before you remove the engine.

5M4,T1205,1 -19-25AUG87

### ENGINE SERIAL NUMBER PLATE

The engine serial number plate is located on the rocker arm cover.

Refer to the engine model designation on your engine's serial number plate to identify repair information covered in the Component Technical Manual.



M21,TM305,2 -19-21APR86

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M37502

### ENGINE APPLICATION CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

Consumer Products

Machine No.	Front Mowers Engine Model
F912 .....	3TG66UJ
F932 .....	3TG72UJ

Machine No.	Lawn and Garden Tractors Engine Model
322 .....	3TG66UJ

5M4,T1205,3 -19-12OCT87

**ENGLISH TORQUE SPECIFICATIONS**

NOTE: Wrench torque tolerance is  $\pm 20\%$ .

Bolt Diameter	Plain Head*		Three Radial Dashes*		Six Radial Dashes*	
	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m
1/4 in.	6	8	9	12	12	16
5/16 in.	10	14	18	24	25	34
3/8 in.	20	27	30	41	45	61
7/16 in.	30	41	50	68	70	95
1/2 in.	45	61	75	101	110	149
9/16 in.	70	95	110	150	155	210
5/8 in.	95	128	155	210	215	290
3/4 in.	165	225	270	365	385	520
7/8 in.	170	230	435	590	620	840
1 in.	255	345	660	895	930	1260

Torque figures indicated above and in the Specification Sections of this manual are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or cap screws unless otherwise specified in this manual.

\* Torque value for bolts and cap screws are identified by their head markings.

S11,2000,DD -19-11JUL85

**METRIC TORQUE SPECIFICATIONS**

*NOTE: Wrench torque tolerance is  $\pm 20\%$ .*

Bolt Diameter	Property Class 8.8*		Property Class 10.9*	
	lb-ft	N-m	lb-ft	N-m
M5	5	6	7	9
M6	8	10	11	15
M8	18	25	26	35
M10	37	50	52	70
M12	66	90	92	125
M16	166	225	229	310
M20	321	435	450	610
M24	554	750	775	1050

Torque figure indicated above and in the Specification Sections of this manual are valid for non-greased or non-oiled threads and heads unless otherwise specified. Therefore, do not grease or oil bolts or cap screws unless otherwise specified in this manual.

\* Torque value for bolts and cap screws are identified by their head markings.

S11,2000,DE -19-11JUL85



**ENGINE: 3TG72**

**GROUP 10—Valve Train and Camshaft**

<b>Item</b>	<b>Specification</b>
Valve Clearance . . . . .	0.2 mm (0.008 in.)
<b>Rocker Arm</b>	
Minimum Shaft O.D. . . . .	11.9 mm (0.469 in.)
Maximum Shaft Support I.D. . . . .	12.1 mm (0.476 in.)
Maximum Arm I.D. . . . .	12.1 mm (0.476 in.)
Maximum Shaft Clearance . . . . .	0.12 mm (0.005 in.)
Rocker Arm Assembly Cap Screw and Nut Torque . . . . .	25 N·m (225 lb-in.)
Rocker Arm Cover Nut Torque . . . . .	26 N·m 226 lb-in.)
<b>Push Rod</b>	
Maximum T.I.R. . . . .	0.3 mm (0.012 in.)
Minimum Length . . . . .	141 mm (5.55 in.)
<b>Cam Follower</b>	
Minimum O.D. . . . .	20.85 mm (0.821 in.)
Maximum Bore I.D. . . . .	21.10 mm (0.831 in.)
Maximum Clearance . . . . .	0.15 mm (0.006 in.)
<b>Camshaft</b>	
Maximum End Play . . . . .	0.5 mm (0.02 in.)
Maximum Gear Backlash . . . . .	0.2 mm (0.008 in.)
Minimum End Journals O.D. . . . .	39.84 mm (1.568 in.)
Minimum Intermediate Journals O.D. . . . .	39.81 mm (1.567 in.)
Minimum Lobe Height . . . . .	33.6 mm (1.323 in.)
Maximum Bushing I.D. . . . .	41.115 mm (1.619 in.)
Maximum Intermediate and Flywheel	
End Bores I.D. . . . .	40.075 mm (1.578 in.)
Maximum Journal Clearance . . . . .	0.18 mm (0.007 in.)
Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Gear Housing Cover Cap Screw Torque . . . . .	9 N·m (78 lb-in.)
Crankshaft Pulley Cap Screw Torque . . . . .	113 N·m (84 lb-ft)

**GROUP 15—Cylinder Head, Valves, and Manifolds**

<b>Item</b>	<b>Specification</b>
<b>Manifold</b>	
Exhaust Manifold Cap Screw Torque . . . . .	26 N·m (226 lb-in.)
Intake Manifold Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
<b>Cylinder Head</b>	
Maximum Valve Recession . . . . .	0.60 mm (0.024 in.)
Valve Spring Free Length (Approx.) . . . . .	36.9 mm (1.453 in.)
Valve Spring Test Length . . . . .	22.5 mm (0.866 in.)
@ Test Force . . . . .	299 N (67 lb)

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**ENGINE: 3TG72**

Item	Specification
Cylinder Head (continued)	
Minimum Valve Stem O.D. . . . .	6.90 mm (0.272 in.)
Exhaust Valve Angle . . . . .	45°
Intake Valve Angle . . . . .	30°
Maximum Valve Guide I.D. . . . .	7.08 mm (0.279 in.)
Valve Guide-to-Valve Stem Clearance: (Replace) . . . . .	0.15 mm (0.006 in.)
Valve Seat Width	
Intake . . . . .	1.43 mm (0.056 in.)
Exhaust . . . . .	1.73 mm (0.068 in.)
Valve Seat Angle	
Intake . . . . .	30°
Exhaust . . . . .	45°
Cylinder Head Flatness . . . . .	0.10 mm (0.004 in.)
Mill Cylinder Head No More Than . . . . .	0.2 mm (0.008 in.)
Valve Guide Height . . . . .	9 mm (0.354 in.)
Cylinder Head Cap Screw Torque	
In sequence (Lubricated) . . . . .	61 N·m (45 lb-ft)

**GROUP 20—Flywheel**

Item	Specification
Stub Shaft	
Maximum T.I.R. . . . .	0.2 mm (0.008 in.)
Flatness . . . . .	0.05 mm (0.002 in.)
Attaching Cap Screw Torque . . . . .	59 N·m (44 lb-ft)
Flywheel	
Flatness . . . . .	0.05 mm (0.002 in.)
Attaching Cap Screw Torque . . . . .	83 N·m (61 lb-ft)
Flywheel Housing	
Mounting Plate or Housing	
Cap Screw Torque . . . . .	49 N·m (36 lb-ft)
Starter-to-Mounting Plate	
Cap Screw Torque . . . . .	49 N·m (36 lb-ft)
Flywheel Housing or Shield	
Cap Screw or Nut Torque	
M10 . . . . .	49 N·m (36 lb-ft)
M8 . . . . .	26 N·m (226 lb-in.)
M12 Nut . . . . .	88 N·m (65 lb-ft)

5M4,T1206.2 -19-12OCT87

**ENGINE:3TG72**

GROUP 25—Connecting Rods and Pistons

Item	Specification
<b>Connecting Rod</b>	
Maximum Side Play . . . . .	0.8 mm (0.031 in.)
End-Cap Screw Torque . . . . .	23 N·m (200 lb-in.)
Maximum Bearing Clearance . . . . .	0.12 mm (0.005 in.)
Minimum Journal O.D. . . . .	39.93 mm (1.572 in.)
Maximum Bearing I.D. . . . .	40.07 mm (1.577 in.)
Maximum Bearing Clearance . . . . .	0.12 mm (0.005 in.)
<b>Piston</b>	
Maximum Ring Groove Clearance	
Top Ring . . . . .	0.25 mm (0.010 in.)
Second Ring . . . . .	0.25 mm (0.010 in.)
Oil Ring . . . . .	0.25 mm (0.010 in.)
Maximum Ring End Gap	
Top Ring . . . . .	1.25 mm (0.049 in.)
Second Ring . . . . .	1.25 mm (0.049 in.)
Oil Ring . . . . .	1.90 mm (0.075 in.)
Minimum Pin O.D. . . . .	20.9 mm (0.823 in.)
Maximum Pin Bushing I.D. . . . .	21.1 mm (0.831 in.)
Maximum Pin Bushing Clearance . . . . .	0.15 mm (0.006 in.)
Maximum Pin Bore I.D. . . . .	21.08 mm (0.830 in.)
Maximum Pin Bore Clearance . . . . .	0.10 mm (0.004 in.)
Minimum Piston O.D. . . . .	71.9 mm (2.831 in.)
Maximum Cylinder Bore I.D. . . . .	72.15 mm (2.841 in.)
Maximum Piston to Bore Clearance . . . . .	0.15 mm (0.006 in.)

GROUP 30—Crankshaft and Main Bearings

Item	Specification
<b>Crankshaft</b>	
Maximum End Play . . . . .	0.50 mm (0.020 in.)
Main Bearing Cap Screw Torque . . . . .	79 N·m (58 lb-ft)
Maximum Main Bearing Clearance . . . . .	0.12 mm (0.005 in.)
Oil Seal Case Cap Screw Torque	
Seal Case to Block . . . . .	11 N·m (96 lb-in.)
Oil Pan to Seal Case . . . . .	9 N·m (78 lb-in.)
Minimum Main Bearing Journal O.D. . . . .	43.93 (1.730 in.)
Maximum Main Bearing I.D. . . . .	40.07 mm (1.578 in.)

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**ENGINE:3TG72**

**GROUP 35—Gear Housing**

Item	Specification
Gear Housing Cap Screw Torque . . . . .	9 N·m (78 lb-in.)
Crankshaft Pulley Cap Screw Torque . . . . .	115 N·m (85 lb-ft)
<b>Timing Gear Backlash</b>	
Governor . . . . .	0.38 mm (0.015 in.)
Idler . . . . .	0.2 mm (0.008 in.)
Camshaft . . . . .	0.2 mm (0.008 in.)
Crankshaft . . . . .	0.2 mm (0.008 in.)
Oil Pump . . . . .	0.3 mm (0.012 in.)
<b>Timing Gear Wear Specifications</b>	
Idler Gear Bushing Diameter . . . . .	20.08 mm (0.791 in.)
Idler Shaft Diameter . . . . .	19.9 mm (0.783 in.)
Idler Shaft Oil Clearance . . . . .	0.1 mm (0.004 in.)

**GROUP 40—Lubrication System**

Item	Specification
<b>Oil Pump</b>	
Gear Backlash, Maximum . . . . .	0.30 mm (0.012 in.)
Rotor Recess, Maximum . . . . .	0.25 mm (0.010 in.)
Outer rotor-to-Pump Body Maximum Clearance . . . . .	0.25 mm (0.010 in.)
Inner Rotor-to-outer Rotor Maximum Clearance . . . . .	0.25 mm (0.010 in.)
Oil Pump Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
<b>Oil Pressure Regulating Valve</b>	
Valve Spring Free Length . . . . .	43.5—48.5 mm (1.7—1.9 in.)
Valve Spring Test Length . . . . .	27.5 mm (1.08 in.)
@ Test Force . . . . .	20.5 ± 3.1 N (9.6 ± 0.7 lb)
Oil Pressure Change Per 1 mm (0.039 in.) of Shim Thickness . . . . .	10.9 kPa (2 psi)
<b>Oil Pan</b>	
Strainer Tube Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Oil Pan-to-Block Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Oil Pan-to-Gear Housing Cover Torque . . . . .	9 N·m (78 lb-in.)

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**ENGINE: 3TG72**

GROUP 45—Cooling system

Item	Specification
Thermostat	
Begin Opening Temperature . . . . .	71° (160°F)
Fully Open Temperature . . . . .	85°C (184°F)
Housing Cover Cap Screw Torque . . . . .	20 N·m (180 lb-in.)
Water Pump	
Plate Screws Torque . . . . .	9 N·m (78 lb-in.)
Pulley Cap Screws Torque . . . . .	11 N·m (96 lb-in.)
Attaching Cap Screws . . . . .	26 N·m (226 lb-in.)
Alternator Belt Deflection . . . . .	13 mm (0.5 in.) at 107N (24 lb force) applied midway between pulleys.

GROUP 50—Carburetor

GROUP 55—Governor

Item	Specification
Governor Gear Backlash (New) . . . . .	0.11—0.30 mm (0.004—0.012 in.)
Governor Gear Backlash (Maximum) . . . . .	0.38 mm (0.015 in.)
Fuel Control Linkage Bore Maximum I.D. . . . .	8.15 mm (0.321 in.)
Governor Shaft Minimum Diameter . . . . .	7.90 (0.311 in.)
Governor Shaft Clearance (Maximum) (Bore I.D. Minus Shaft O.D.) . . . . .	0.18 mm (0.0071 in.)

GROUP 60—Starter

See Starter Specifications in this Group

GROUP 65—Alternator

See Alternator Specifications in this Group

GROUP 70—Ignition System

See Ignition System Specifications in this Group

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**ENGINE: 3TG66**

GROUP 10—Valve Train and Camshaft

Item	Specification
Valve Clearance . . . . .	0.2 mm (0.008 in.)
<b>Rocker Arm</b>	
Minimum Shaft O.D. . . . .	9.9 mm (0.390 in.)
Maximum Shaft Support I.D. . . . .	10.1 mm (0.398 in.)
Maximum Arm I.D. . . . .	10.1 mm (0.398 in.)
Maximum Shaft Clearance . . . . .	0.10 mm (0.004 in.)
Rocker Arm Assembly Cap Screw and Nut Torque . . . . .	25 N·m (225 lb-in.)
Rocker Arm Cover Nut Torque . . . . .	26 N·m (226 lb-in.)
<b>Push Rod</b>	
Maximum T.I.R. . . . .	0.3 mm (0.012 in.)
Minimum Length . . . . .	114 mm (4.49 in.)
<b>Cam Follower</b>	
Minimum O.D. . . . .	17.85 mm (0.703 in.)
Maximum Bore I.D. . . . .	18.1 mm (0.713 in.)
Maximum Clearance . . . . .	0.1 mm (0.004 in.)
<b>Camshaft</b>	
Maximum End Play . . . . .	0.5 mm (0.02 in.)
Maximum Gear Backlash . . . . .	0.2 mm (0.008 in.)
Minimum End Journals O.D. . . . .	35.84 mm (1.411 in.)
Minimum Intermediate Journals O.D. . . . .	35.81 mm (1.410 in.)
Minimum Lobe height . . . . .	29.7 mm (1.169 in.)
Maximum Bushing I.D. . . . .	36.115 mm (1.422 in.)
<b>Maximum Intermediate and Flywheel</b>	
End Bores I.D. . . . .	36.075 mm (1.421 in.)
Maximum Journal Clearance . . . . .	0.18 mm (0.007 in.)
Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Gear Housing Cover Cap Screw Torque . . . . .	9 N·m (78 lb-in.)
Crankshaft Pulley Cap Screw Torque . . . . .	113 N·m (84 lb-ft)

GROUP 15—Cylinder Head, Valves, and Manifolds

Item	Specification
<b>Manifold</b>	
Exhaust Manifold Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Intake Manifold Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
<b>Cylinder Head</b>	
Maximum Valve Recession . . . . .	0.50 mm (0.020 in.)
Valve Spring Free Length (Approx.) . . . . .	27.5 mm (1.083 in.)
Valve Spring Test Length . . . . .	17 mm (0.591 in.)
@ Test Force . . . . .	125 N (28 lb)

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**ENGINE: 3TG66**

Item	Specification
Cylinder Head (continued)	
Minimum Valve Stem O.D. . . . .	5.40 mm (0.213 in.)
Exhaust Valve Angle . . . . .	45°
Intake Valve Angle . . . . .	30°
Maximum Valve Guide I.D. . . . .	5.57 mm (0.219 in.)
Valve Guide-to-Valve Stem Clearance:	
(Replace) . . . . .	0.14 mm (0.006 in.)
Valve Seat Width	
Intake . . . . .	1.14 mm (0.042 in.)
Exhaust . . . . .	1.37 mm (0.054 in.)
Valve Seat Angle	
Intake . . . . .	30°
Exhaust . . . . .	45°
Cylinder Head Flatness . . . . .	0.10 mm (0.004 in.)
Mill Cylinder Head No More Than . . . . .	0.2 mm (0.008 in.)
Valve Guide Height . . . . .	7 mm (0.276 in.)
Cylinder Head Cap Screw Torque	
In Sequence (Lubricated) . . . . .	34 N·m (25 lb-ft)

**GROUP 20—Flywheel**

Item	Specification
Stub Shaft	
Maximum T.I.R. . . . .	0.2 mm (0.008 in.)
Flatness . . . . .	0.05 mm (0.002 in.)
Attaching Cap Screw Torque . . . . .	59 N·m (44 lb-ft)
Flywheel	
Flatness . . . . .	0.05 mm (0.002 in.)
Attaching Cap Screw Torque . . . . .	83 N·m (61 lb-ft)
Flywheel Housing	
Mounting Plate or Housing	
Cap Screw Torque . . . . .	49 N·m (36 lb-ft)
Starter-to-Mounting Plate	
Cap Screw Torque . . . . .	49 N·m (36 lb-ft)
Flywheel Housing or Shield	
Cap Screw or Nut Torque	
M10 . . . . .	49 N·m (36 lb-ft)
M8 . . . . .	26 N·m (226 lb-in.)
M12 Nut . . . . .	88 N·m (65 lb-ft)

5M4,T1206,7 -19-12OCT87

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**ENGINE: 3TG66**

GROUP 25—Connecting Rods and Pistons

Item	Specification
<b>Connecting Rod</b>	
Maximum Side Play . . . . .	0.8 mm (0.031 in.)
End-Cap Screw Torque . . . . .	23 N·m (200 lb-in.)
Maximum Bearing Clearance . . . . .	0.12 mm (0.0048 in.)
Minimum Journal O.D. . . . .	35.93 mm (1.415 in.)
Maximum Bearing I.D. . . . .	36.07 mm (1.420 in.)
Maximum Bearing Clearance . . . . .	0.12 mm (0.005 in.)
<b>Piston</b>	
Maximum Ring Groove Clearance	
Top Ring . . . . .	0.25 mm (0.010 in.)
Second Ring . . . . .	0.25 mm (0.010 in.)
Oil Ring . . . . .	0.25 mm (0.010 in.)
Maximum Ring End Cap	
Top Ring . . . . .	1.30 mm (0.051 in.)
Second Ring . . . . .	1.30 mm (0.051 in.)
Oil Ring . . . . .	1.80 mm (0.071 in.)
Minimum Pin O.D. . . . .	19.9 mm (0.783 in.)
Maximum Pin Bushing I.D. . . . .	20.1 mm (0.791 in.)
Maximum Pin Bushing Clearance . . . . .	0.15 mm (0.006 in.)
Maximum Pin Bore I.D. . . . .	20.08 mm (0.791 in.)
Maximum Pin Bore Clearance . . . . .	0.10 mm (0.004 in.)
Minimum Piston O.D. . . . .	65.88 mm (2.593 in.)
Maximum Cylinder Bore I.D. . . . .	66.12 mm (2.603 in.)
Maximum Piston To Bore Clearance . . . . .	0.15 mm (0.006 in.)

GROUP 30—Crankshaft and Main Bearings

Item	Specification
<b>Crankshaft</b>	
Maximum End Play . . . . .	0.30 mm (0.012 in.)
Main Bearing Cap Screw Torque . . . . .	54 N·m (40 lb-ft)
Maximum Main Bearing Clearance . . . . .	0.12 mm (0.005 in.)
Oil Seal Case Cap Screw Torque	
Seal Case to Block . . . . .	11 N·m (96 lb-in.)
Oil Pan to Seal Case . . . . .	9 N·m (78 lb-in.)
Minimum Main Bearing Journal O.D. . . . .	40.93 (1.611 in.)
Maximum Main Bearing I.D. . . . .	40.07 mm (1.578 in.)

5M4,T1206,8 -19-11SEP87

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**ENGINE: 3TG66**

**GROUP 35—Gear Housing**

Item	Specification
Gear Housing Cap Screw Torque . . . . .	9 N·m (78 lb-in.)
Crankshaft Pulley Cap Screw Torque . . . . .	115 N·m (85 lb-ft)
<b>Timing Gear Backlash</b>	
Governor . . . . .	0.38 mm (0.015 in.)
Idler . . . . .	0.2 mm (0.008 in.)
Camshaft . . . . .	0.2 mm (0.008 in.)
Crankshaft . . . . .	0.2 mm (0.008 in.)
Oil Pump . . . . .	0.3 mm (0.012 in.)
<b>Timing Gear Wear Specifications</b>	
Idler Gear Bushing Diameter . . . . .	20.08 mm (0.791 in.)
Idler Shaft Diameter . . . . .	19.9 mm (0.783 in.)
Idler Shaft Oil Clearance . . . . .	0.1 mm (0.004 in.)

**GROUP 40—Lubrication System**

Item	Specification
<b>Oil Pump</b>	
Gear Backlash, Maximum . . . . .	0.30 mm (0.012 in.)
Rotor Recess, Maximum . . . . .	0.25 mm (0.010 in.)
Outer rotor-to-Pump Body Maximum Clearance . . . . .	0.25 mm (0.010 in.)
Inner Rotor-to-Outer Rotor Maximum Clearance . . . . .	0.25 mm (0.010 in.)
Oil Pump Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
<b>Oil Pressure Regulating Valve</b>	
Valve Spring Free Length . . . . .	21.9—24.5 mm (0.86—0.96 in.)
Valve Spring Test Length . . . . .	14.7 mm (0.58 in.)
@ Test Force . . . . .	12 ± 1.8 N (2.7 ± 0.4 lb)
Oil Pressure Change Per 1 mm (0.039 in.) of Shim Thickness . . . . .	13.8 kPa (2 psi)
<b>Oil Pan</b>	
Strainer Tube Attaching Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Oil Pan-to-Block Cap Screw Torque . . . . .	11 N·m (96 lb-in.)
Oil Pan-to-Gear Housing Cover Torque . . . . .	9 N·m (78 lb-in.)

5M4,T1206,9 -19-12OCT87

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**ENGINE: 3TG66**

GROUP 45—Cooling system

Item	Specification
Thermostat	
Begin Opening Temperature . . . . .	71°C (160°F)
Fully Open Temperature . . . . .	85°C (184°F)
Housing Cover Cap Screw Torque . . . . .	9 N·m (78 lb-in.)
Water Pump	
Plate Screws Torque . . . . .	9 N·m (78 lb-in.)
Pulley Cap Screws Torque . . . . .	11 N·m (96 lb-in.)
Attaching Cap Screws . . . . .	26 N·m (226 lb-in.)
Alternator Belt Deflection . . . . .	13 mm (0.5 in.) at 107N (24 lb force) applied midway between pulleys.

GROUP 50—Carburetor

GROUP 55—Governor

Item	Specification
Governor Gear Backlash (New) . . . . .	0.11—0.30 mm (0.004—0.012 in.)
Governor Gear Backlash (Maximum) . . . . .	0.38 mm (0.015 in.)
Fuel Control Linkage Bore Maximum I.D. . . . .	8.15 mm (0.321 in.)
Governor Shaft Minimum Diameter . . . . .	7.90 (0.311 in.)
Governor Shaft Clearance (Maximum) (Bore I.D. Minus Shaft O.D.) . . . . .	0.18 mm (0.0071 in.)

GROUP 60—Starter

See Starter Specifications in this Group

GROUP 65—Alternator

See Alternator Specifications in this Group

GROUP 70—Ignition System

See Ignition System Specifications in this Group

5M4,T1206,10 -19-12OCT87

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**SERVICE EQUIPMENT AND TOOLS**

*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
Feeler Gauge	Measure valve clearance
Outside Micrometer	Measure engine components
Telescoping Gauge	Measure engine components
Valve Inspect Center	Measure pushrod TIR
Vernier Calipers	Measure pushrod length
Strap Wrench	Hold crankshaft pulley
13-Ton Puller Set	Remove crankshaft pulley
Magnetic Base with Adjustable Arm	To hold dial indicator
Dial Indicator	Measure gear and shaft end play
Magnetic Follower Holder Kit	To hold cam followers in place when removing camshaft
Bushing, Bearing, and Seal Driver Set	To service bushings, bearings, and oil seals
Press	To service camshaft gear

M21, TM310,1 -19-05FEB86

**OTHER MATERIAL**

Number	Name	Use
PT502	John Deere GASKET MAKER®	To seal camshaft plug
T43512	John Deere LOCTITE® Thread Lock and Sealer (Medium Strength)	Apply to threads of crankshaft pulley cap screw.
PT94	John Deere Form-In-Place Gasket (RTV rubber silicone sealant)	To seal gear case cover.

*GASKET MAKER is a trademark of the Permatex Corp.*

*LOCTITE is a trademark of the Loctite Corp.*

M21, TM310,2 -19-23JUL87

## SERVICE PARTS KITS

The following kits are available through your parts catalog:

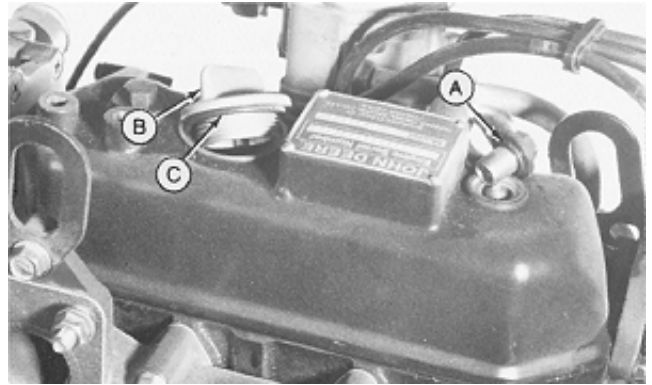
Cylinder Block Gasket Kit.

Cylinder Head Gasket Kit.

M21,TM310,3 -19-17MAR86

## REMOVE AND DISASSEMBLE ROCKER ARM COVER

1. Remove rocker arm cover.
2. Remove O-ring (A) from special nuts.
3. Remove oil fill cap (B) and O-ring (C).

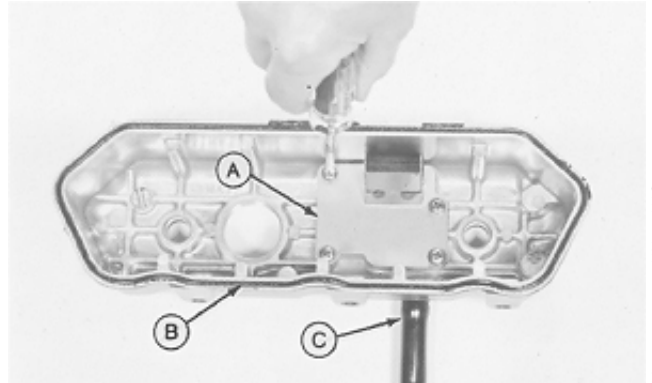


M46065 -UN-08JAN90

5M4,T1210,1 -19-11SEP87

4. Remove O-ring (B) and crankcase breather tube (C).
5. Remove four screws and lock washers to remove baffle (A).

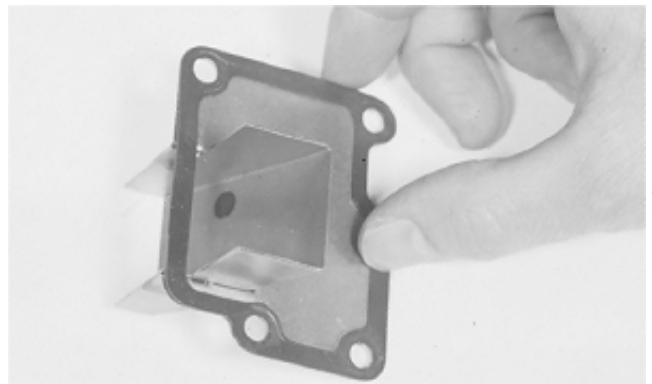
**A—Baffle**  
**B—O-Ring**  
**C—Crankcase Breather Tube**



M35328 -UN-29AUG88

5M4,T1210,2 -19-11SEP87

6. Remove gasket from baffle.

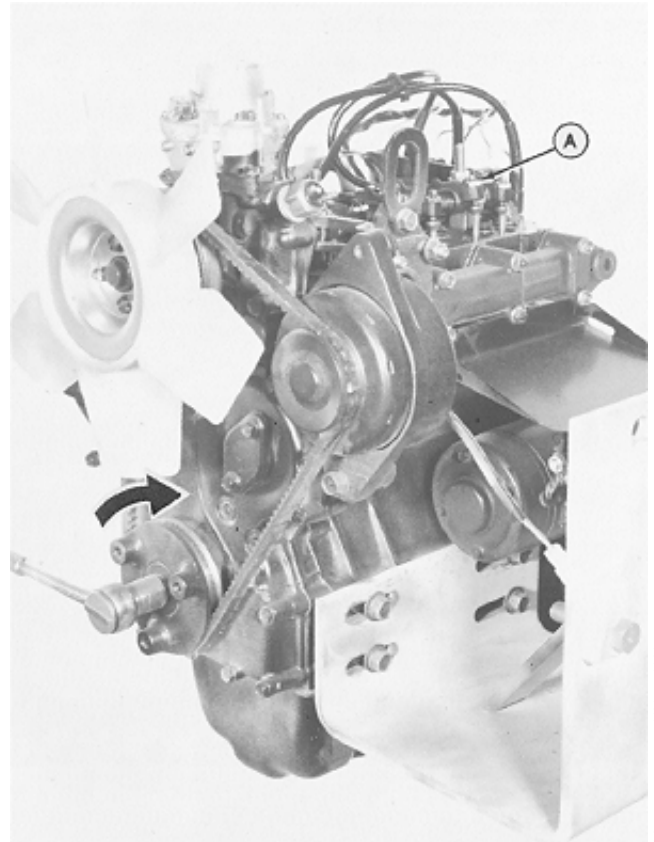


M35329 -UN-29AUG88

5M4,T1210,3 -19-12OCT87

## MEASURE AND ADJUST VALVE CLEARANCE

1. Turn crankshaft clockwise until No. 1 cylinder intake valve (A) opens.



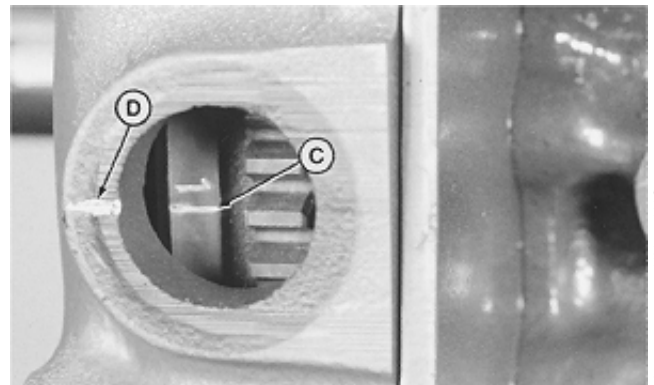
5M4,T1210,4 -19-12OCT87

M46066 -JUN-08JAN90

*NOTE: TDC—Top Dead Center (the piston at its highest point).*

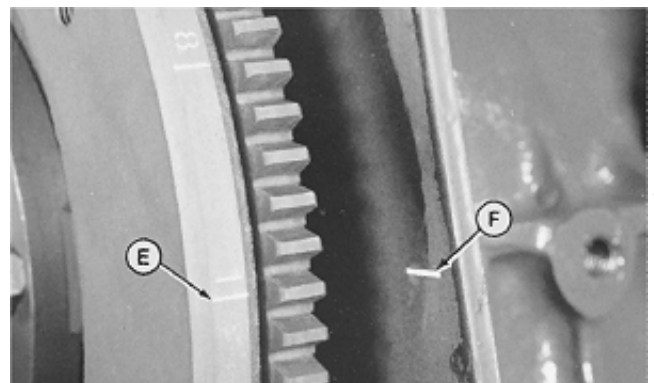
2. Remove flywheel housing plug. Continue turning crankshaft until No. 1 timing mark (C) on flywheel lines up with mark (D) on flywheel housing. (TDC on compression stroke.)

If equipped, remove flywheel shield. Continue turning crankshaft until No. 1 timing mark (E) on flywheel lines up with mark (F) on mounting plate. (TDC on compression stroke.)



3TG66 (Lawn Tractor)

M37500 -JUN-29AUG88



3TG66, 3TG72 (Front Mower)

M37501 -JUN-29AUG88

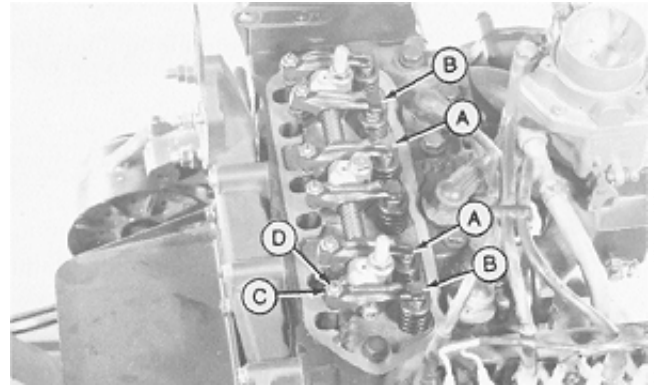
5M4,T1210,5 -19-12OCT87

3. Measure valve clearance.

**VALVE CLEARANCE SPECIFICATIONS**

Intake Valves (A) ..... 0.2 mm (0.008 in.)  
 Exhaust Valves (B) ..... 0.2 mm (0.008 in.)

4. To adjust valves (A and B), loosen nut (C) and turn adjusting screw (D) to proper clearance. Hold screw while tightening nut.



View From Flywheel End

-UN-08JAN90  
M46067

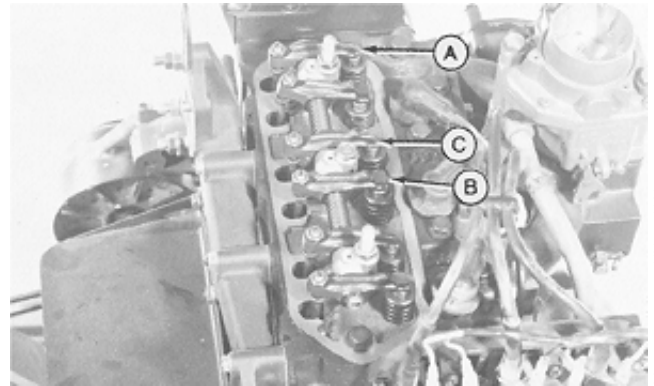
5M4,T1210,6 -19-12OCT87

5. To adjust remaining valves (A and B):

a. Turn crankshaft until No. 2 cylinder intake valve (C) opens.

Continue turning crankshaft to align the No. 2 timing mark on flywheel with mark on flywheel housing or mounting plate.

b. See Step 4 to adjust intake and exhaust valve. Adjust valves to 0.2 mm (0.008 in.).



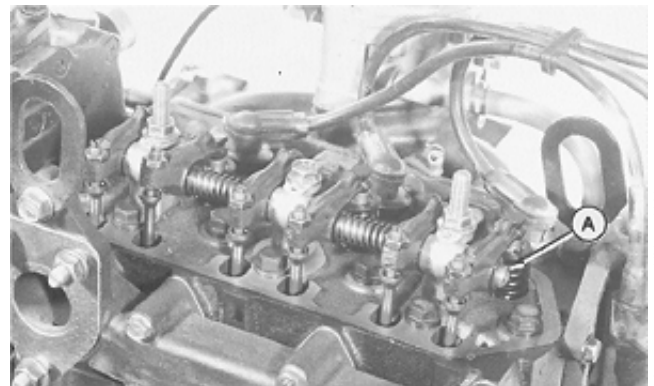
View From Flywheel End

-UN-12JAN90  
M46068

5M4,T1210,7 -19-12OCT87

**REMOVE AND DISASSEMBLE ROCKER ARM ASSEMBLY**

1. Remove rocker arm assembly (A).



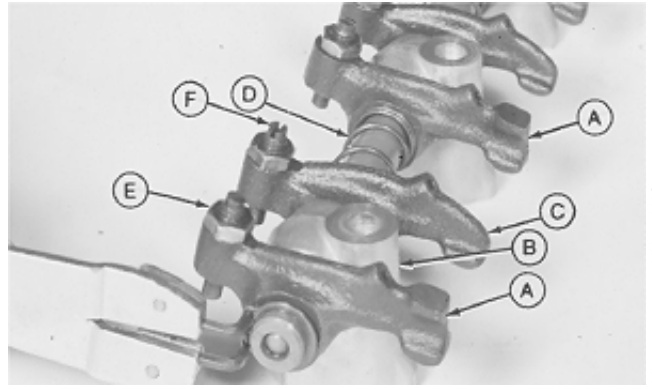
5M4,T1210,8 -19-11SEP87

-UN-08JAN90  
M46069

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4

2. Remove snap ring and parts (A—F).

- A—Exhaust Rocker Arm (2 used)
- B—Support
- C—Intake Rocker Arm
- D—Spring
- E—Nut (3 used)
- F—Adjusting Screw (3 used)



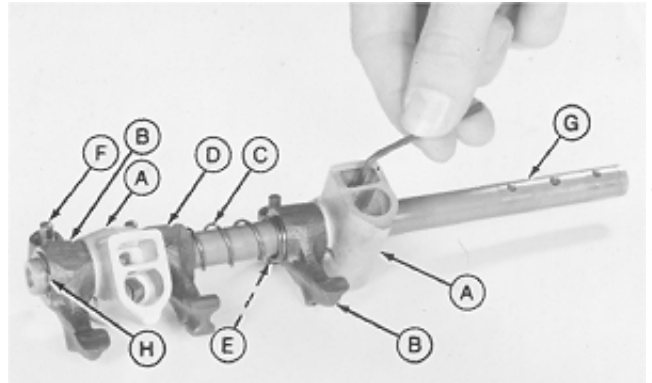
5M4,T1210,9 -19-12OCT87

M35260 -UN-29AUG88

10

3. Remove set screw and parts (A—H).

- A—Support
- B—Intake Rocker Arm
- C—Spring
- D—Exhaust Rocker Arm
- E—Nut
- F—Adjusting Screw
- G—Rocker Arm Shaft
- H—Snap Ring

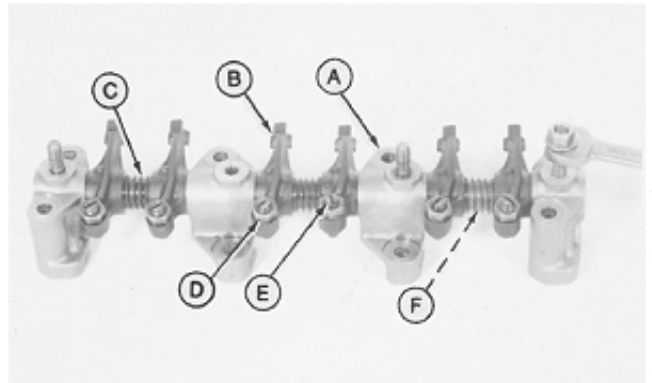


M21,TM310,16 -19-17FEB86

M35261 -UN-29AUG88

4. Remove three studs using two M8 nuts. Remove parts (A—F).

- A—Support (4 used)
- B—Rocker Arm (6 used)
- C—Spring (3 used)
- D—Nut (6 used)
- E—Adjusting Screw (6 used)
- F—Rocker Arm Shaft



5M4,T1210,10 -19-14SEP87

M37504 -UN-29AUG88

5. Measure rocker arm shaft outside diameter at each rocker arm location.

**ROCKER ARM SHAFT O.D. SPECIFICATION**

Engine	Wear Tolerance
3TG66 .....	9.9 mm (0.390 in.)
3TG72 .....	11.9 mm (0.469 in.)

If rocker arm shaft diameter is less than wear tolerance, replace shaft.



M35262 -UN-29AUG88

5M4,T1210,11 -19-05OCT87

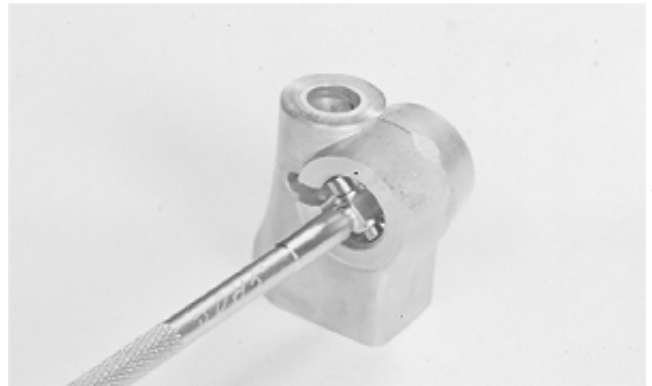
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6

6. Measure each rocker arm shaft support inside diameter.

**ROCKER ARM SHAFT SUPPORT I.D. SPECIFICATION**

Engine	Wear Tolerance
3TG66 .....	10.1 mm (0.398 in.)
3TG72 .....	12.1 mm (0.476 in.)

If rocker arm shaft support diameter exceeds wear tolerance, replace support.



M35263 -UN-29AUG88

5M4,T1210,12 -19-14SEP87

7. Measure each rocker arm inside diameter and determine rocker arm shaft clearance (rocker arm I.D. minus rocker arm shaft O.D.).

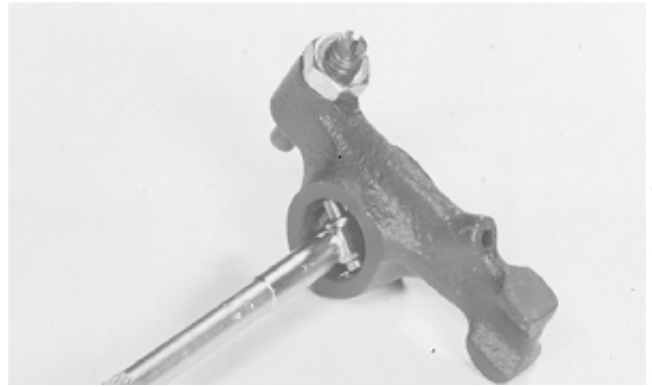
Inspect rocker arm to valve surface and adjusting screw for metal flakes or wear.

**ROCKER ARM SPECIFICATIONS**

Engine	Measurement	Wear Tolerance
3TG66	Arm I.D.	10.1 mm (0.398 in.)
3TG66	Shaft Clearance	0.10 mm (0.004 in.)
3TG72	Arm I.D.	12.1 mm (0.476 in.)
3TG72	Shaft Clearance	0.12 mm (0.005 in.)

If rocker arm bore diameter exceeds wear tolerance, replace rocker arm.

If shaft clearance exceeds wear tolerance, replace rocker arm shaft, rocker arm, or both.

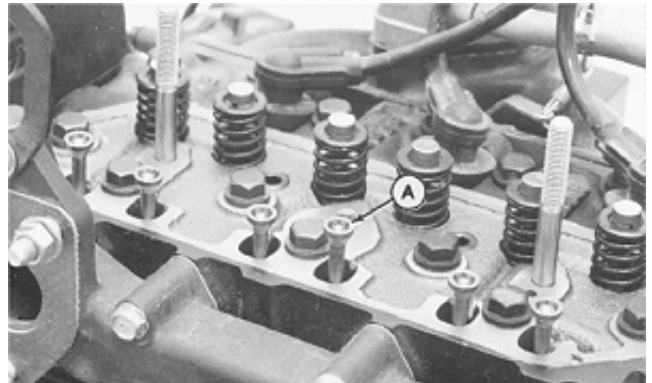


M35264 -UN-29AUG88

5M4,T1210,13 -19-14SEP87

**REMOVE AND INSPECT PUSHRODS AND CAM FOLLOWERS**

1. Remove pushrods (A).



M46070 -UN-08JAN90

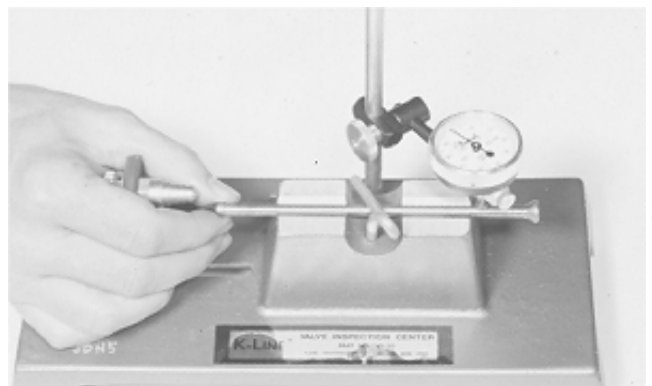
5M4,T1210,14 -19-12OCT87

2. Measure pushrod TIR (Total Indicator Runout) using Valve Inspection Center.

**SPECIFICATION**

Pushrod TIR (Max) . . . . . 0.30 mm  
(0.012 in.)

If pushrod TIR exceeds 0.30 mm (0.012 in.), replace it.



M35400 -UN-06SEP88

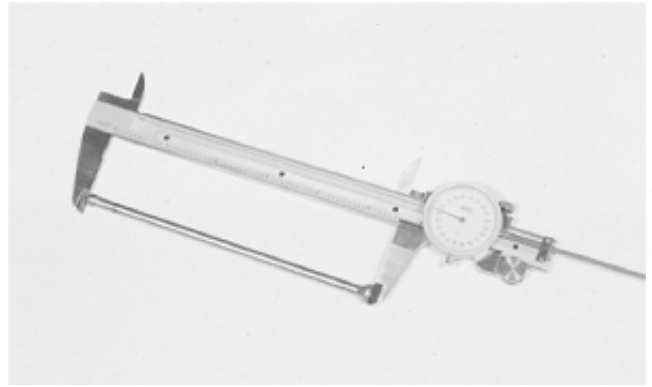
M21,TM310,22 -19-22APR86

3. Measure pushrod length.

**PUSHROD LENGTH SPECIFICATION**

Engine	Wear Tolerance
3TG66 .....	114 mm (4.49 in.)
3TG72 .....	141 mm (5.55 in.)

If pushrod length is less than wear tolerance, replace it.



5M4,T1210,15 -19-14SEP87

M35266 -UN-29AUG88

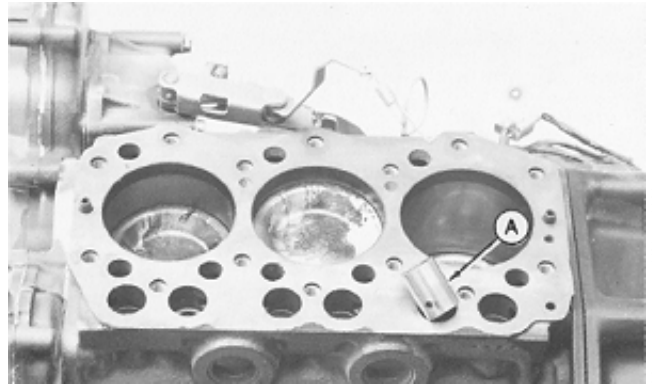
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4. Remove cylinder head. (See Group 15 in this manual).

**IMPORTANT: Cam followers must be installed in the same bores they were removed from.**

5. Put a mark on each cam follower and cylinder block bore to aid in assembly.

6. Remove cam followers (A).



5M4,T1210,16 -19-14SEP87

M46071 -UN-08JAN90

7. Measure cam followers outside diameter.

**CAM FOLLOWER O.D. SPECIFICATIONS**

Engine	Wear Tolerance
3TG66 .....	17.85 mm (0.703 in.)
3TG72 .....	20.85 mm (0.821 in.)

If cam follower diameter is less than wear tolerance, replace it.

8. Inspect cam follower-to-camshaft surface for uneven wear or damage; replace as necessary.



5M4,T1210,17 -19-12OCT87

M35268 -UN-29AUG88

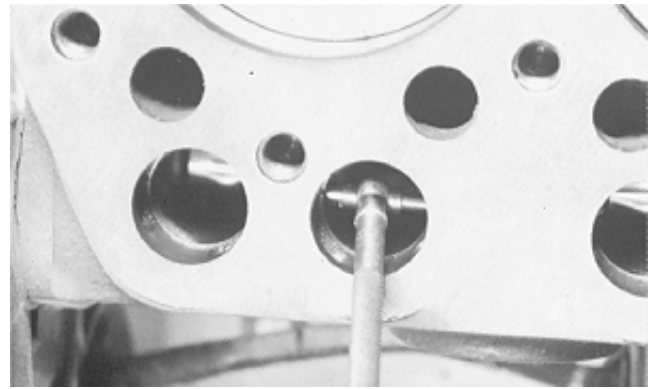
9. Measure cam follower bore inside diameter and determine cam follower clearance (cam follower bore I.D. minus cam follower O.D.).

**CAM FOLLOWER BORE SPECIFICATIONS**

Engine	Measurement	Wear Tolerance
3TG66	Bore I.D.	18.1 mm (0.713 in.)
3TG66	Clearance	0.1 mm (0.004 in.)
3TG72	Bore I.D.	21.00 mm (.823 in.)
3TG72	Clearance	0.15 mm (0.006 in.)

If cam follower bore diameter exceeds wear tolerance, replace cylinder block.

If cam follower clearance exceeds wear tolerance; replace cam follower, cylinder block or both.



M46072 -UN-08JAN90

5M4,T1210,18 -19-14SEP87

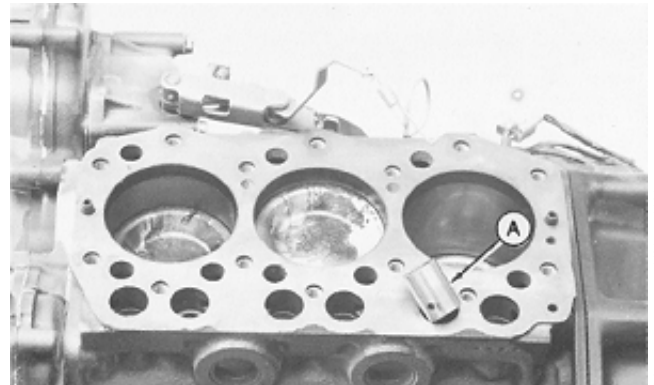
**INSTALL PUSHRODS AND CAM FOLLOWERS**

1. Put clean engine oil on cam followers.

**IMPORTANT: Cam followers must be installed in the same bores they were removed from.**

2. Install cam followers (A).

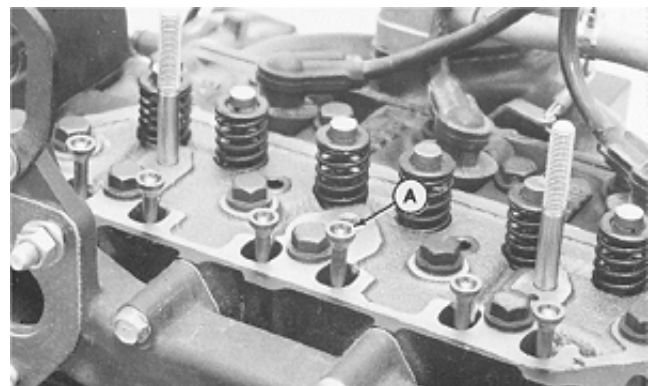
3. Install cylinder head. (See Group 15 in this manual.)



M46071 -UN-08JAN90

5M4,T1210,19 -19-14SEP87

4. Install the pushrods.



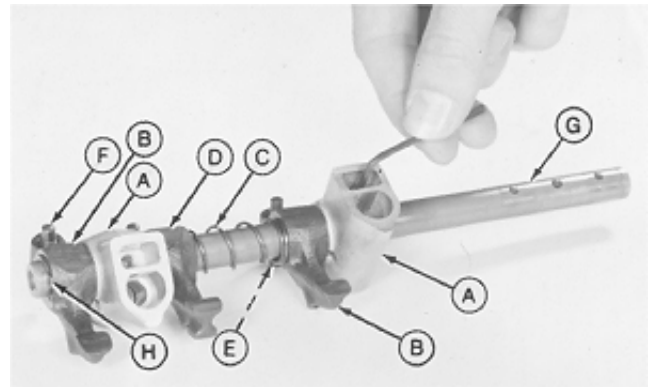
M46070 -UN-08JAN90

5M4,T1210,20 -19-14SEP87

## ASSEMBLE AND INSTALL ROCKER ARM ASSEMBLY

1. Install parts (A—H) on rocker arm shaft.
2. Align set screw hole in support with center hole in rocker arm shaft. Install and tighten set screw.

- A—Support (2 used)
- B—Intake Rocker Arm (2 used)
- C—Spring
- D—Exhaust Rocker Arm
- E—Nut (3 used)
- F—Adjusting Screw (3 used)
- G—Rocker Arm Shaft
- H—Snap Ring

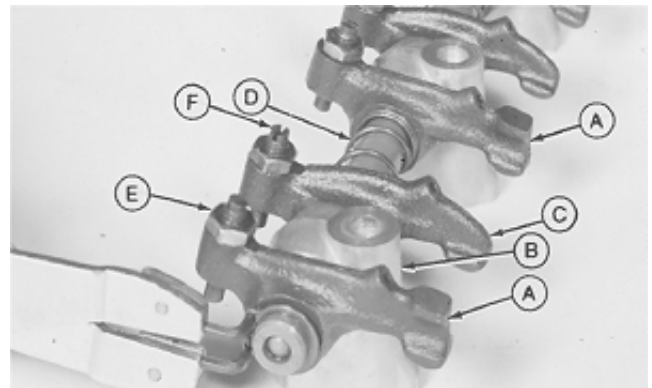


M35261 -UN-29AUG88

5M4,T1210,21 -19-14SEP87

3. Install parts (A—F) on rocker arm shaft.
4. Install snap ring.

- A—Exhaust Rocker Arm
- B—Support
- C—Intake Rocker Arm
- D—Spring
- E—Nut
- F—Adjusting Screw

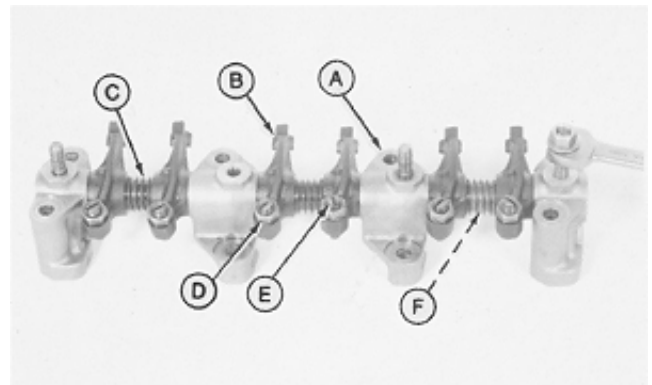


M35260 -UN-29AUG88

M21,TM310,30 -19-17FEB86

5. Install parts (A—F) on rocker arm shaft.
6. Align hole in each support with hole in rocker arm shaft. Install and tighten three studs using two M8 nuts.

- A—Support (4 used)
- B—Rocker Arm (6 used)
- C—Spring (3 used)
- D—Nut (6 used)
- E—Adjusting Screw (6 used)
- F—Rocker Arm Shaft



M37504 -UN-29AUG88

5M4,T1210,22 -19-14SEP87