JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Trail Buck Utility ATV
500, 650, 650EX and 650EXT

TM2160 JANUARY 2004

TECHNICAL MANUAL

JOHN DEERE

North American Version
Litho in U.S.A.

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Manual Description

This technical manual is written for an experienced technician and contains sections that are specifically for this product. It is a part of a total product support program.

The manual is organized so that all the information on a particular system is kept together. The order of grouping is as follows:

- Table of Contents
- Specifications and Information
- Identification Numbers
- Tools and Materials
- Component Location
- Schematics and Harnesses
- Theory of Operation
- Operation and Diagnostics
- Diagnostics
- Tests and Adjustments
- Repair
- Other

NOTE: Depending on the particular section or system being covered, not all of the above groups may be used.

The bleed tabs for the pages of each section will align with the sections listed on this page. Page numbering is consecutive from the beginning of the Safety section through the last section.

We appreciate your input on this manual. If you find any errors or want to comment on the layout of the manual please contact us.

Safety
Technical Data
Engine
Electrical
Drive Train
Steering
Suspension
Brakes
Body / Frame

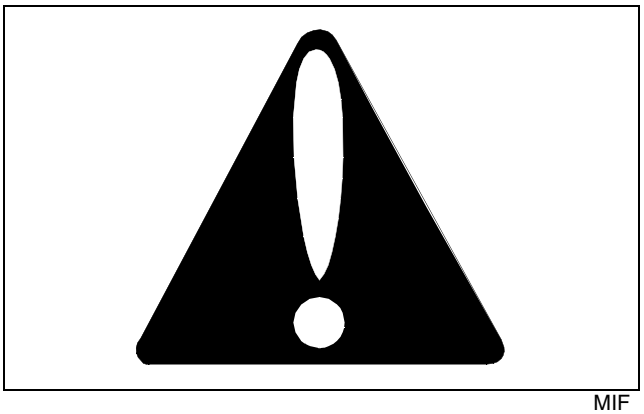
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Recognize Safety Information



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This is the safety-alert symbol. When you see this symbol on your machine or in this manual, be alert to the potential for personal injury.

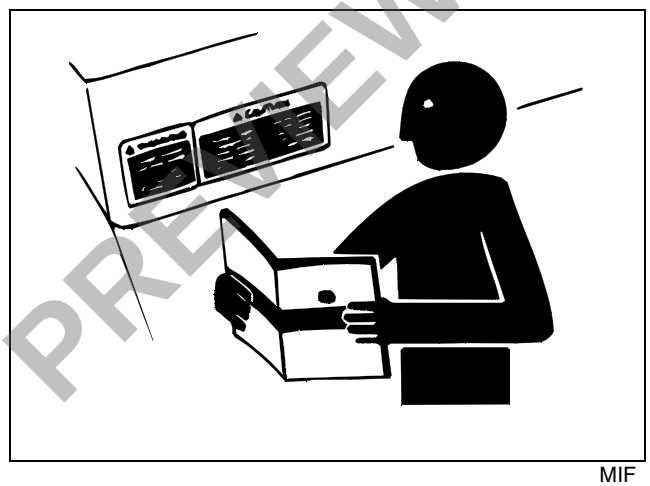
Follow recommended precautions and safe servicing practices.

Understand Signal Words

A signal word - DANGER, WARNING, or CAUTION - is used with the safety-alert symbol. DANGER identifies the most serious hazards.

DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

Replace Safety Signs

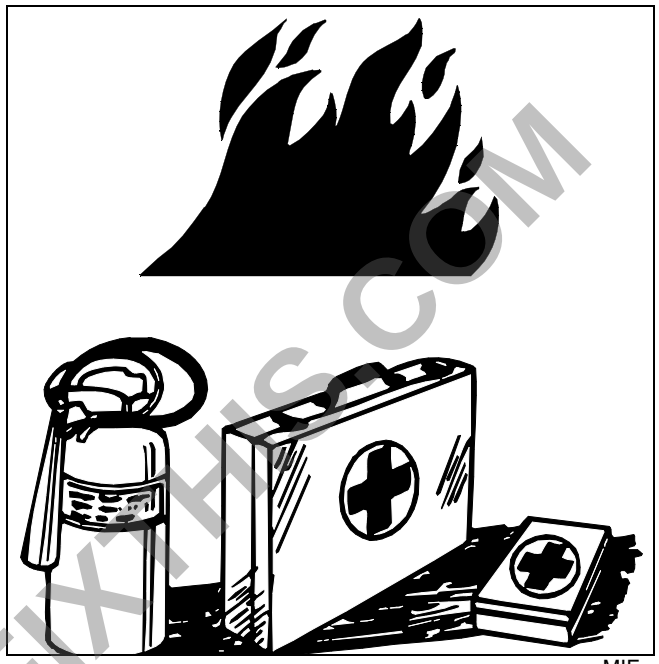


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Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

Handle Fluids Safely - Avoid Fires

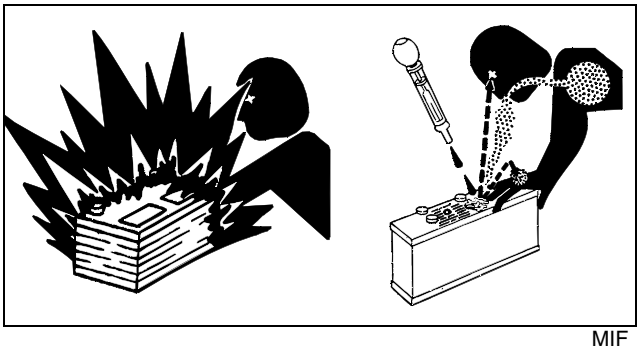
Be Prepared For Emergencies



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- 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.
- Be prepared if a fire starts.
- Keep a first aid kit and fire extinguisher handy.
- Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Use Care In Handling and Servicing Batteries



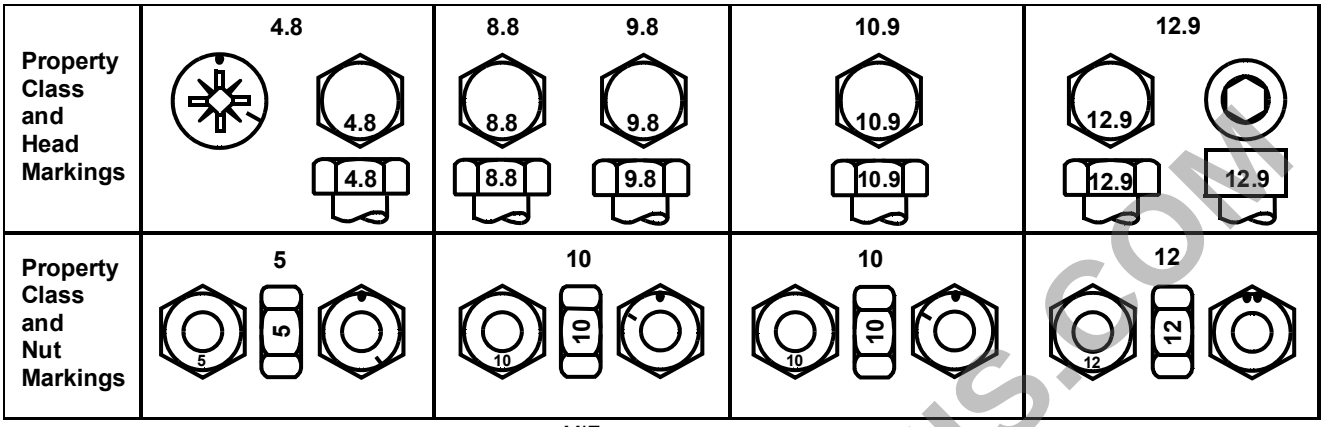
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Fastener Torques

Metric Fastener Torque Values



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	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated a		Dry a		Lubricated a		Dry a		Lubricated a		Dry a		Lubricated a		Dry a	
SIZE	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
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	109
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

DO NOT use these hand torque values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only and include a ±10% variance factor. Check tightness of fasteners periodically. DO NOT use air powered wrenches.

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

Fasteners should be replaced with the same grade. Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

When bolt and nut combination fasteners are used, torque values should be applied to the NUT instead of the bolt head.

Tighten toothed or serrated-type lock nuts to the full torque value.

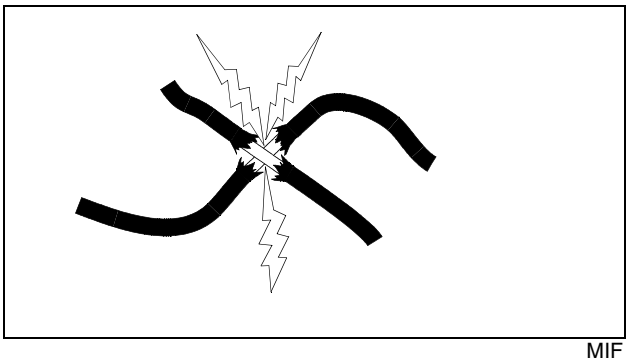
a *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication*.

Reference: JDS - G200.

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Common Circuit Tests

Shorted Circuit:

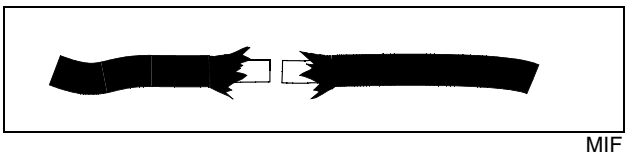


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A shorted circuit may result in the wrong component operating (i.e. improper wire-to-wire contact). To test for a shorted or improperly wired circuit:

1. Turn component switch on.
2. Start at the controlling switch of the component that should not be operating.
3. Follow the circuit and disconnect wires at connectors until component stops operating.
4. Shorted or improper connections will be the last two wires disconnected.

High Resistance or Open Circuit:

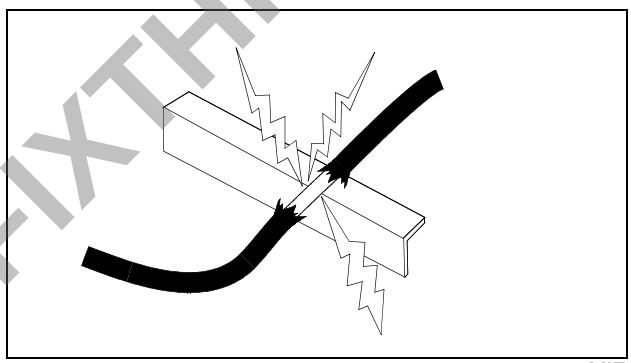


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High resistance or open circuits usually result in slow, dim or no component operation (i.e. poor, corroded, or disconnected connections). Voltage at the component will be low when the component is in operation. To test for high resistance and open circuits:

1. Check all terminals and grounds of the circuit for corrosion.
2. If terminals are not corroded or loose, the problem is in the component or wiring.

Grounded Circuit:



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Grounded circuits usually result in no component operation or a blown fuse.

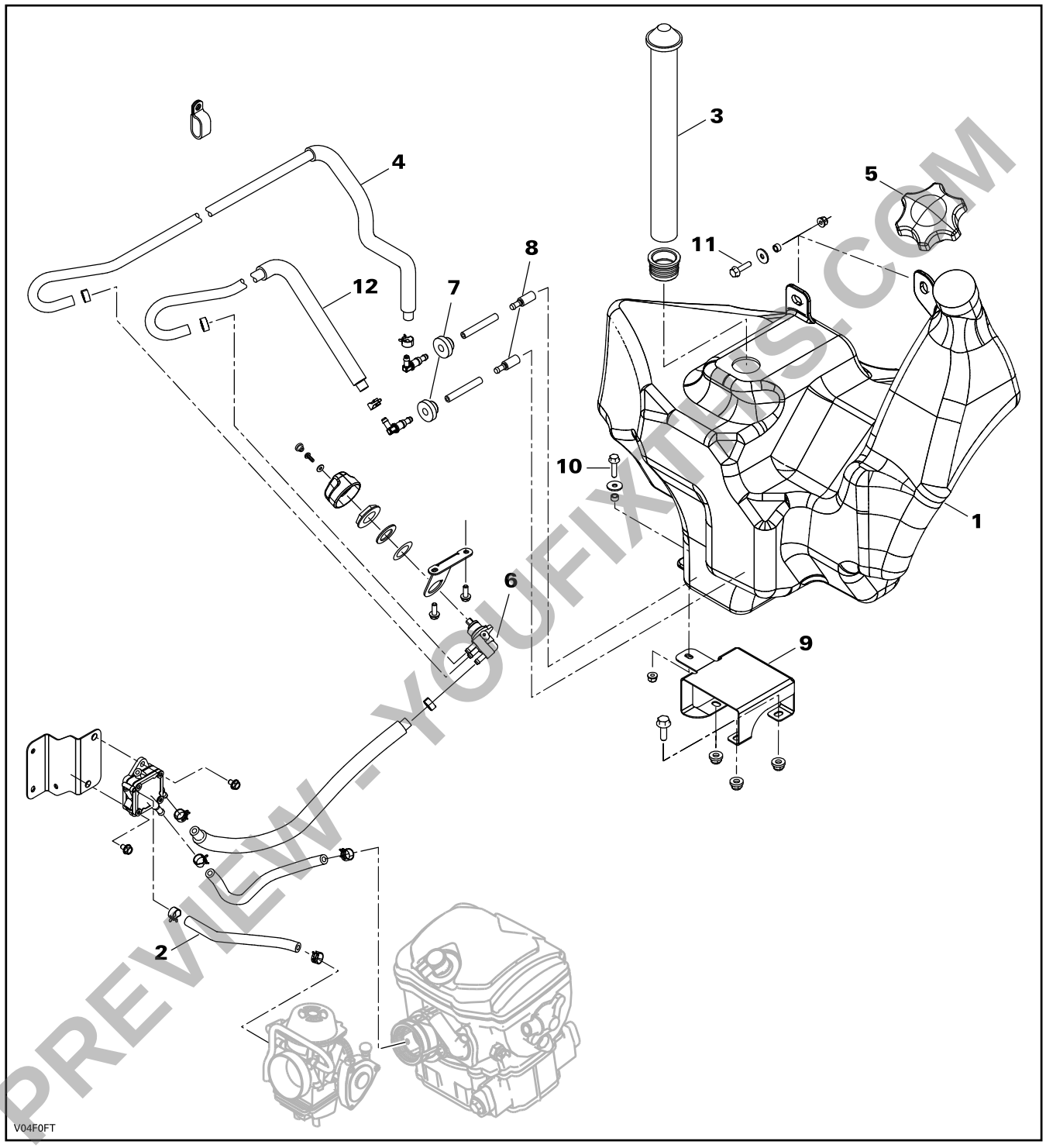
Conductors for 12 Volt Circuits

Stranded Conductors For 12 Volt Circuits						
SAE Wire Size (Gauge)	20	18	16	14	12	10
Metric Wire Size (mm)	0.5	0.8	1.0	2.0	3.0	5.0
Typical stranding	7 X 28	16 X 30	19 X 29	19 X 27	19 X 25	19 X 23
Minimum Conductor Area In Circular Mils	1072	1537	2336	3702	5833	9343

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Fuel Circuit **Fuel System Components**



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Tongue (included with rear rack weight) . . . . . 14 kg (30 lb)

Torque Specifications

Engine Torque Specifications

Engine Support . . . . . 24 N•m (17 lb-ft)
Engine Mount . . . . . 48 N•m (35 lb-ft)
Spark Plug . . . . . 18 N•m (159 lb-in.)
Oil Filter Screw . . . . . 9 N•m (80 lb-in.)
Dipstick Tube Screw . . . . . 9 N•m (80 lb-in.)
Magneto Cover Bolts . . . . . 9 N•m (80 lb-in.)
Starter Bolts . . . . . 9 N•m (80 lb-in.)
Vehicle Speed Sensor . . . . . 9 N•m (80 lb-in.)
Starter RED (+) Cable . . . . . 6 N•m (53 lb-in.)
Rotor Nut . . . . . 150 N•m (111 lb-ft)
Stator Bolt . . . . . 9 N•m (80 lb-in.)
Trigger Coil Bolt . . . . . 9 N•m (80 lb-in.)

Cooling Torque Specifications

Radiator Mount Screw/Nut . . . . . 9 N•m (80 lb-in.)
Thermostat Housing . . . . . 9 N•m (80 lb-in.)
Thermostat Bleeding Screw . . . . . 9 N•m (80 lb-in.)
Temperature Sensor . . . . . 17 N•m (151 lb-in.)
Water Pump Housing . . . . . 9 N•m (80 lb-in.)
Fan Mount Screw/Nut . . . . . 4.5 N•m (40 lb-in.)
Temperature Sender On Radiator . . . . . 11 N•m (97 lb-in.)

Exhaust Torque Specifications

Exhaust Nut . . . . . 11 N•m (97 lb-in.)
Heat Shield Screws . . . . . 10 N•m (89 lb-in.)

Lubrication Torque Specifications

Engine Drain Plug . . . . . 39 N•m (29 lb-ft)
Engine Oil Strainer Cover . . . . . 9 N•m (80 lb-in.)
Oil Pump Housing . . . . . 9 N•m (80 lb-in.)
Oil Pressure Regulator Pump . . . . . 11 N•m (97 lb-in.)
Oil Pressure Switch . . . . . 9 N•m (80 lb-in.)

Cylinder and Head Torque Specifications

Breather . . . . . 6 N•m (53 lb-in.)
Valve Cover . . . . . 9 N•m (80 lb-in.)
Rocker Arm Shaft Screw . . . . . 20 N•m (15 lb-ft) +90° rotation
Cylinder Head Screw M6 . . . . . 17 N•m (150 lb-in.)
Cylinder Head Screw M11 . . . . . 50 N•m (37 lb-ft) +90° rotation
Intake Adaptor . . . . . 21 N•m (16 lb-ft)
Camshaft Timing Gear . . . . . 9 N•m (80 lb-in.)
Chain Guide . . . . . 9 N•m (80 lb-in.)
Chain Tensioner Housing . . . . . 9 N•m (80 lb-in.)
Chain Tensioner Plug . . . . . 5 N•m (44 lb-in.)

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Diagnostics

Cooling System

The following charts are provided to help in diagnosing the probable source of troubles. It should be used as a guideline. This section pertains to engine mechanical components only. Some related problems can come from other systems such as ignition system, fuel system etc. and have an impact on the engine. Ensure to check the other systems prior to concluding that the engine is in fault.

Symptom: High Engine Operating Temperatures

(1) Check coolant level. Coolant less than recommended level?

Yes - Refill (refer to “Cooling System”).

No - Go to next step.

(2) Check temperature sensor for electrical/ mechanical failure. Temperature sensor defective?

Yes - Replace.

No - Go to next step.

(3) Check thermostat. Thermostat defective?

Yes - Replace thermostat.

No - Go to next step.

(4) Check gasket underneath water pump. Is there leakage in water pump cover area?

Yes - Retighten screws or replace gasket.

No - Go to next step.

(5) Check leak indicator hole (water pump housing area MAG side) if coolant leaks. Coolant leaking from leak indicator hole means a damaged rotary seal inside magneto cover.

Yes - Replace both rotary seal and oil seal (refer to “Cooling System” and “Magneto System”).

No - Go to next step.

(6) Check coolant bleeding screw on thermostat housing. Screw loose/missing and/or gasket ring is missing/broken?

Yes - Retighten/add screw and replace gasket ring.

No - Go to next step.

(7) Check condition of hoses and hose clamps fixation. Hoses are brittle and/or hard? Hose clamps are loose?

Yes - Replace hoses, retighten clamps.

No - Go to next step.

Symptom: High Engine Operating Temperatures

(8) Check condition of impeller located on the water pump shaft. Impeller wings broken and/or impeller thread is damaged?

Yes - Replace.

No - Go to next step.

(9) Check coolant drain screw on water pump housing MAG side (marked “Drain”). Copper ring on drain screw leaks?

Yes - Retighten screw and/or replace copper gasket ring.

No - Go to next step.

(10) Check cylinder head and/or cylinder base gasket. Worn out gasket(s) is (are) causing water leakage?

Yes - Replace gasket(s) and refill with coolant and oil (refer to “Cooling/Lubrication System” and Specifications" section).

No - Go to next step.

(11) Check intermediate gear(s) behind magneto cover. Worn out and/or broken gear(s) is (are) causing less coolant supply?

Yes - Replace worn out and/or broken gear(s) (refer to “Lubrication/Magneto System”).

Magneto System

Symptom: No Spark

(1) Check engine stop switch position. Is engine stop switch in OFF position?

Yes - Go to next step.

No - Place engine stop switch to RUN position

(2) Check battery. Is the battery charge level low, or has electrical failure?

Yes - Charge or replace battery.

No - Go to next step.

(3) Check condition of fuse(s). Are fuse(s) faulty?

Yes - Replace.

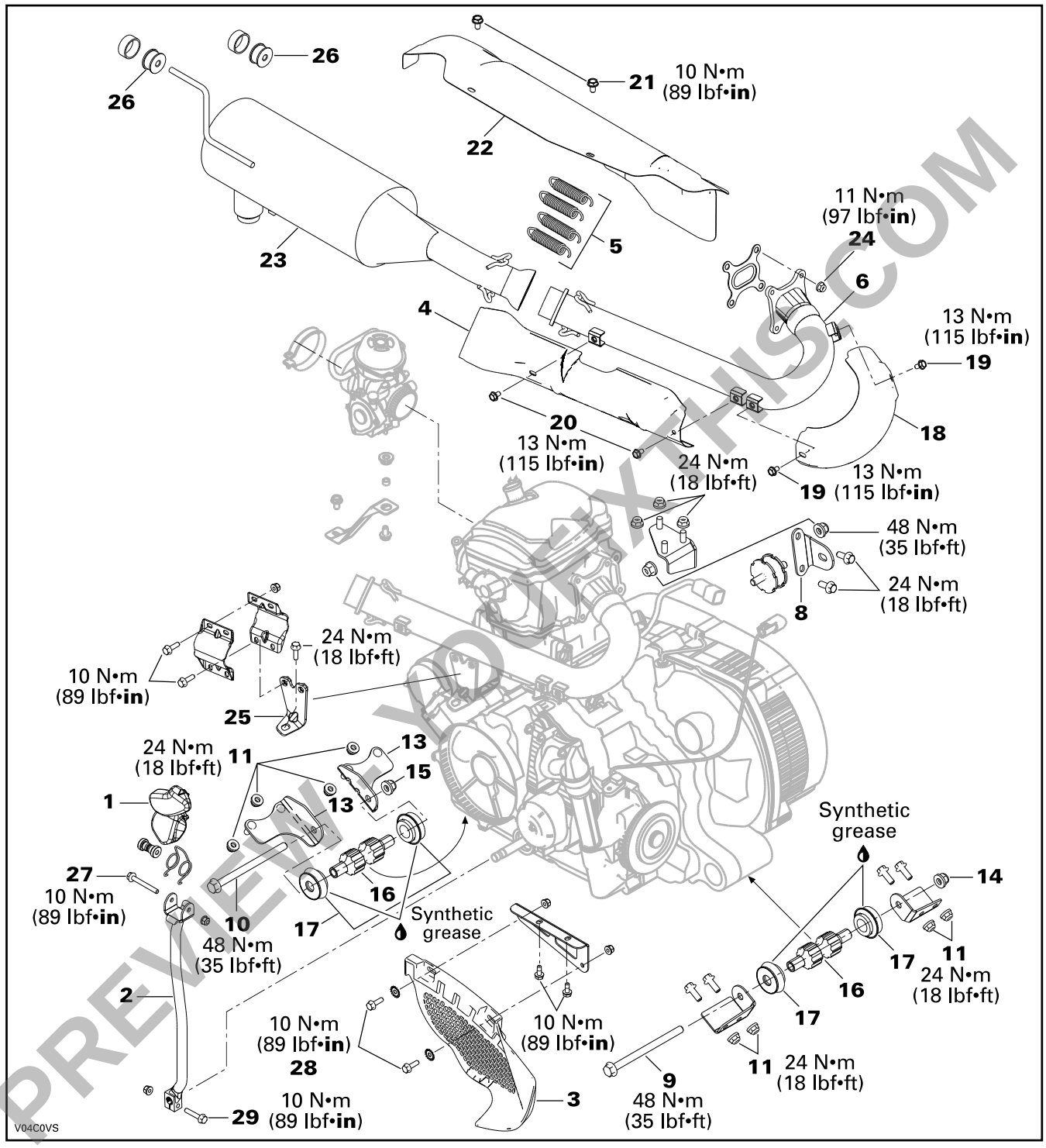
No - Go to next step.

(4) Check ignition coil for damage and/or electrical failure. Ignition coil damaged? Connector is corroded or ignition coil shows electrical failure? Wire harness is brittle or hard (no connection)?

Yes - Replace ignition coil. Clean spark plug area and replace ignition coil. Replace harness.

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Repair **Component Location**



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Engine Removal

Vehicle and Engine Preparation:

Place vehicle at workstation that will have access to an engine-lifting hoist. Then start with initial preparation of vehicle by doing the following.

Remove seat.

Disconnect BLACK (-) cable from battery, then RED (+) cable.

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Symptom: No Spark

No - Go to next step.

(5) Check spark plug electrode condition. Gap is too big or spark plug condition is bad?

Yes - Readjust gap (refer to Specifications" section). Diagnose spark plug condition and replace it (refer to “Ignition System”).

No - Go to next step.

(6) Check spark plug cable and ignition wire. Cable and/or ignition wire is (are) damaged and/or shows electrical failure?

Yes - Replace damaged part(s).

No - Go to next step.

(7) Check ignition coil for damage and/or electrical failure. Is ignition coil damaged and/or resistance value out of specification (refer to Specifications" section)? Is connector corroded or ignition coil shows electrical failure? Is wire harness brittle or hard (no connection)?

Yes - Replace ignition coil. Clean connector area and/or replace ignition coil. Replace harness.

No - Go to next step.

(8) Check trigger coil on magneto for damage and/or electrical failure. Sensor shows electrical failure and/or damages? Connector is corroded? Resistance value is out of specification (refer to Specifications" section)?

Yes - Replace magneto. Clean and reconnect. Replace magneto.

No - Go to next step.

(9) Check wire harness for cracks or other damages. Harness shows electrical failure and/or other damages?

Yes - Replace wire harness and/or damaged wire section.

No - Go to next step.

(10) Check magneto for damage and/or electrical failure. Radial position of rotor wrong due to a broken woodruff key? Connector on magneto is damaged and/or has electrical failure? Coating on stator winding is damaged? Resistance value is out of specification (refer to Specifications" section)?

Yes - Replace woodruff key. Repair and clean contacts of connector. Replace magneto.

(11) Check electronic module. Module shows electrical failure or damages? Connectors are corroded? Electronic module has bad ground to the vehicle frame?

Symptom: No Spark

Yes - Replace electronic module. Clean and reconnect. Clean metal surface for good ground.

Lubrication

Symptom: Low or No Oil Pressure/High Oil Consumption

(1) Check oil level and search for leakage on crankcase and/or defective seals. Crankcase is leaking due to damage?

Yes - Rebuild engine with new crankcase and gasket parts. Use a high quality oil (refer to Specifications" section).

No - Go to next step.

(2) Incorrect oil being used?

Yes - Use a high quality oil (refer to Specifications" section).

No - Go to next step.

(3) Crankcase is leaking due to loose screws?

Yes - Retighten screws with recommended torque.

No - Go to next step.

(4) Sealing rings, O-rings and/or gaskets are brittle and/or hard or damaged?

Yes - Replace damaged parts

No - Go to next step.

(5) Check oil filter for contamination. Oil filter clogged?

Yes - Replace oil filter and oil at the same time. Use a high quality oil (refer to Specifications" section).

No - Go to next step.

(6) Check oil pressure regulator valve (spring) function. Valve spring damaged (valve always open)? Valve stays open in crankcase PTO due to contamination (metallic particles)?

Yes - Replace spring. Clean and/or repair valve piston.

No - Go to next step.

(7) Check oil drain plug on engine bottom. Plug is loose and/or gasket ring is missing?

Yes - Retighten the plug and/or place gasket ring.

No - Go to next step.

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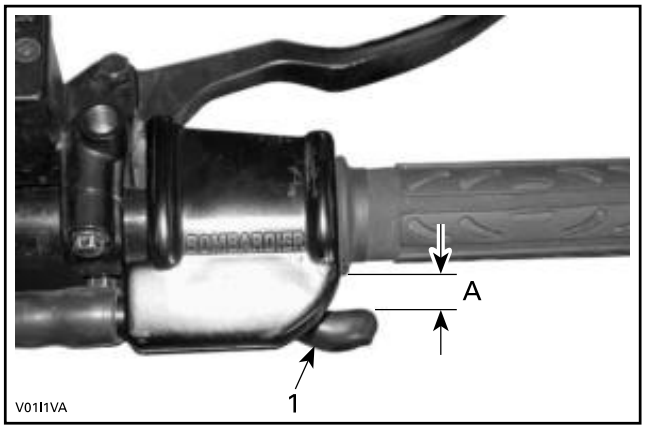
(preliminary adjustment) and choke.

Slide rubber protector back to expose throttle cable adjuster.

Loosen lock nut then turn the adjuster to obtain correct throttle lever free play.

NOTE: Measure throttle free play at the tip of throttle lever.

Tighten lock nut and reinstall protector.



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A - Throttle Lever (1)

B - 3 to 6 mm (1/8 to 7/32 in.) (A)

With the transmission lever on PARK position, start the engine. Check if the throttle cable is adjusted correctly by turning handlebar fully right then fully left. If the engine RPM increases, readjust the throttle lever free play. Before readjusting, check the cable routing.

Choke Cable

Removal:

NOTE: To ease reinstallation, take note cable routing.

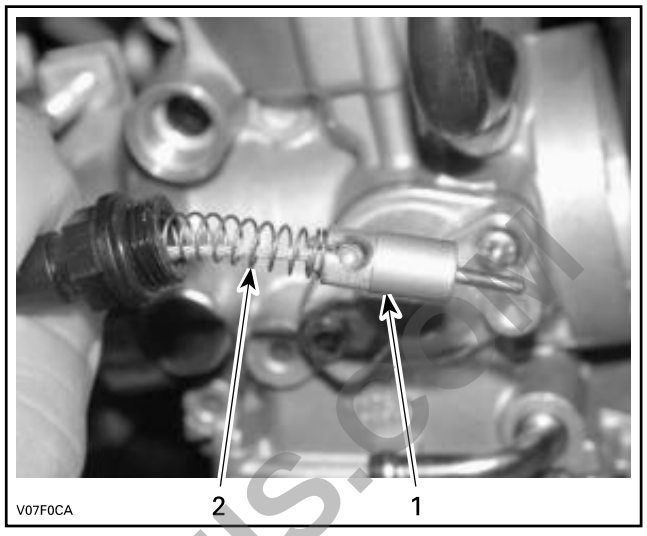
Carburetor Side:

Remove the LH side panel.

Unscrew choke plastic nut from carburetor.

Pull choke cable to remove choke plunger from carburetor.

Remove the choke plunger and its spring.



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Typical

A - Choke Plunger (1)

B - Choke Plunger Spring (2)

Handlebar Side:

Push the choke lever on FULL position.

Underneath multi-function switch, align the choke cable end with the lever slot then remove the cable.



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Typical

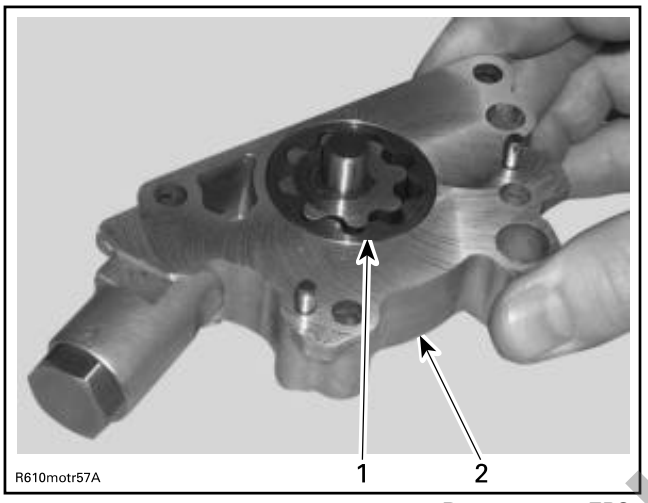
Remove the retaining spring to remove the choke cable from housing.

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A - Oil Pump Gear (1)
B - Dowel Pins (2)
C - Suction Side of the Oil Pump
D - Oil Outlet to the Bypass of the Oil Filter (4)
E - Outlet from the Engine Oil Pressure Regulator Valve (5)

- needle pin no. 27
- oil pump shaft assembly no. 24
- oil pump housing no. 20.



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A - Oil Pump Shaft Assembly (1)
B - Oil Pump Housing (2)

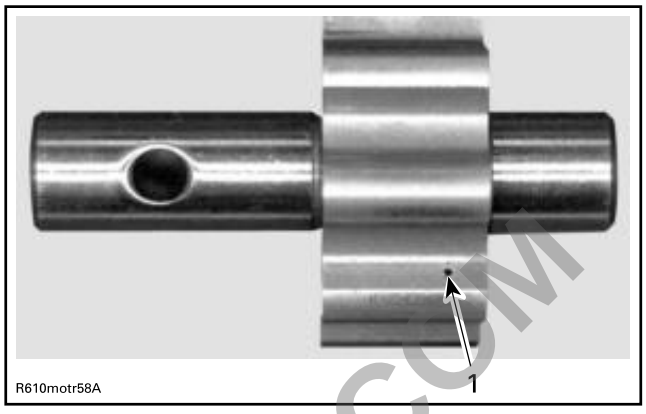
Inspection:

Inspect oil pump shaft assembly, housing and cover for marks or other damages.

Replace O-ring no. 30 if brittle or hard. This O-ring is located on the oil pump housing.

Replace gasket no. 31 if brittle or hard. This gasket is located on the crankcase MAG side behind intermediate gear no. 18.

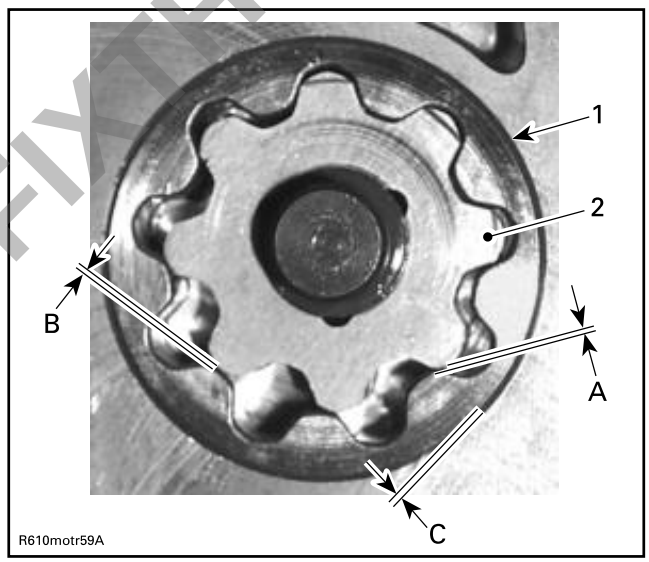
Check inner rotor for corrosion pin-holes or other damages. If so, replace oil pump shaft assembly. Ensure to also check oil pump housing and cover. If damaged, replace the complete oil pump assembly.



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A - Pittings on the Teeth (1)

Using a feeler gauge, measure the clearance between inner and outer rotors.



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A - Outer Rotor (1)
B - Inner Rotor (2)

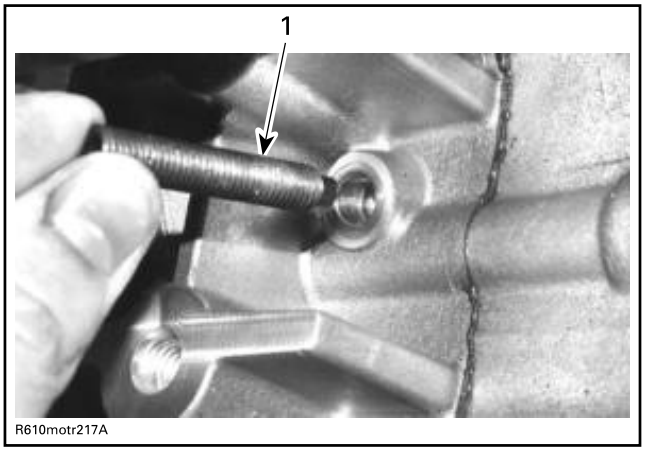
Outer And Inner Rotors Clearance Mm (in.)	
Service Limit	
A	0.25 mm (0.009 in.)
B	
C	

If clearance between inner and outer rotors exceeds the tolerance, replace oil pump shaft assembly. Ensure to also check oil pump housing and cover. If damaged, replace the complete oil pump assembly.

If clearance between outer rotor and its bore in oil pump exceeds the tolerance, replace the complete oil pump assembly.

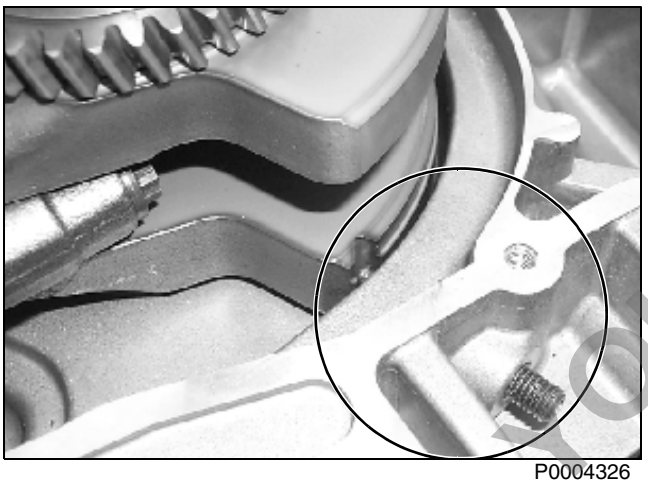
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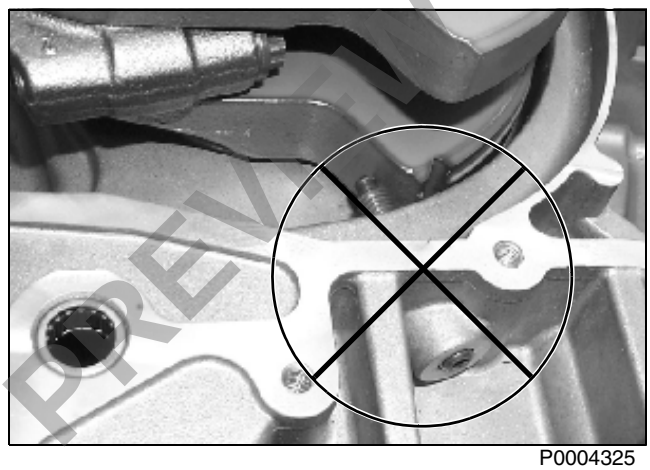
R610motr217a2.EPS

A - Crankshaft Locking Bolt (1)



P0004326

Proper Way to Lock Crankshaft



P0004325

Wrong Way to Lock Crankshaft

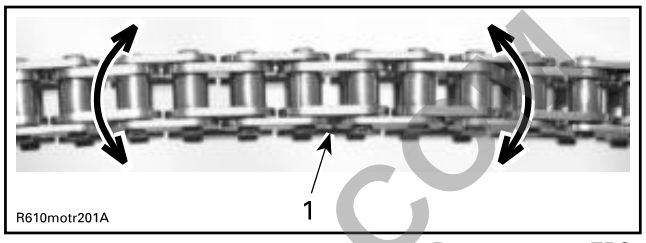
NOTE: At piston TDC, the printed marks on the camshaft timing gear have to be parallel to cylinder head base.

Timing Chain

Inspection:

Check chain condition for wear and rollers condition.

Check timing chain for excessive radial play.



R610motr201a2.EPS

A - Timing Chain (1)

If chain is excessively worn or damaged, replace it as a set (camshaft timing gear and timing chain).

Removal:

Remove:

- engine from vehicle
(refer to REMOVAL AND INSTALLATION)
- cylinder head cover
- chain tensioner
- magneto cover and rotor
(refer to MAGNETO SYSTEM)
- output shaft (refer to GEARBOX).

Installation:

The installation is essentially the reverse of the removal procedure but, pay attention to the following details.

Ensure to perform proper valve timing. Lock crankshaft and camshaft at TDC (refer to CYLINDER AND HEAD).

Install chain then, adjust chain tension (refer to CYLINDER AND HEAD).

IMPORTANT: Avoid damage! Improper valve timing will damage engine components.

Chain Tensioner Guide

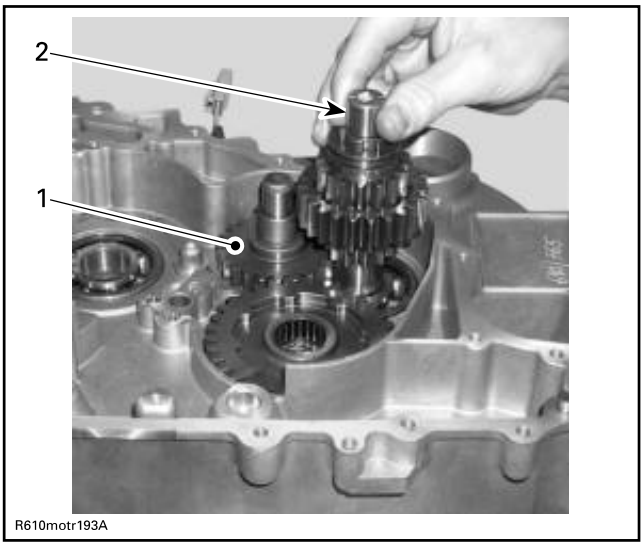
Removal:

Remove:

- valve cover (refer to CYLINDER AND HEAD)
- breather (refer to CYLINDER AND HEAD)
- chain tensioner
(refer to CYLINDER AND HEAD)
- camshaft timing gear

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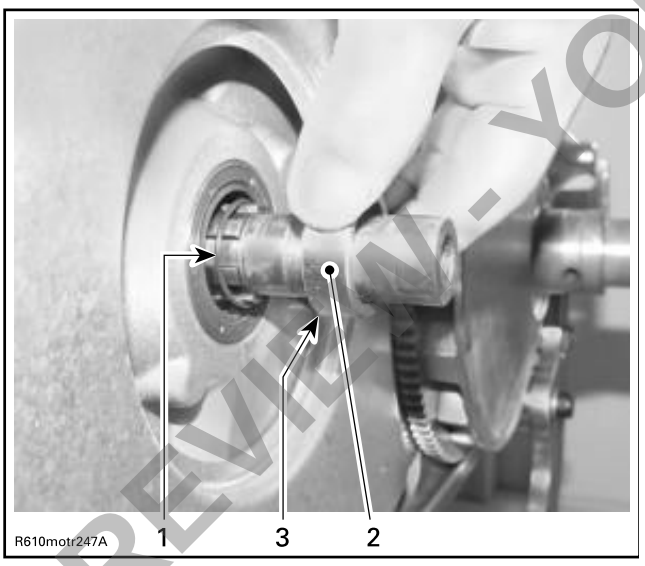


R610motr193a2.EPS

A - Intermediate Gear (1)

B - Main Shaft (2)

IMPORTANT: Avoid damage! Place O-ring no. 32 including distance sleeve no. 33 right away. Chamfered bore of distance sleeve has to face the engine.



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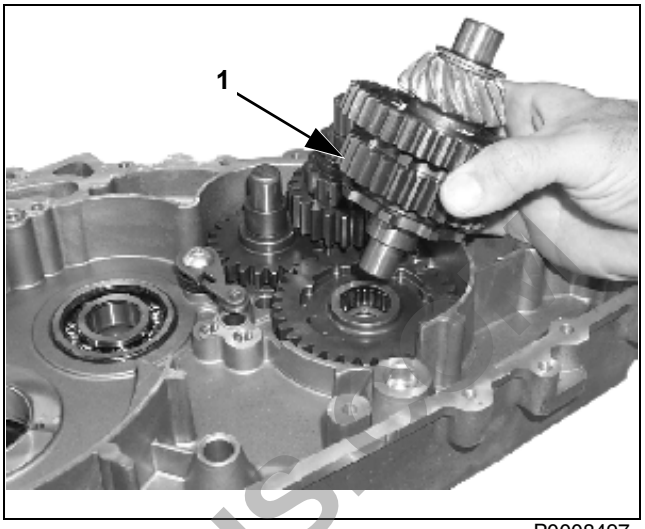
Main Shaft End PTO Side

A - O-Ring (1)

B - Distance Sleeve (2)

C - Main Shaft End PTO Side (3)

Install bevelled gear shaft no. 25 with sliding gear no. 26.

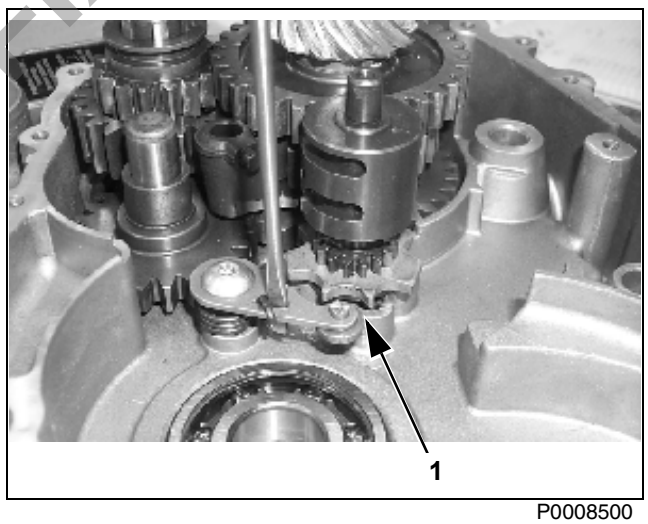


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A - Sliding Gear no. 26 (1)

Install shift fork no. 16.

Insert a flat screwdriver in the slot of index lever no. 11. Turn screwdriver clockwise and install shift drum on neutral position as per the following illustration.

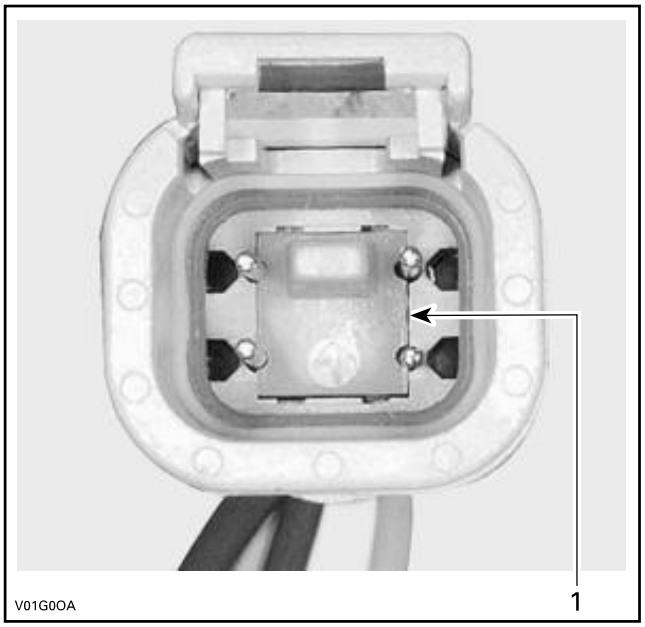


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A - Neutral Position (1)

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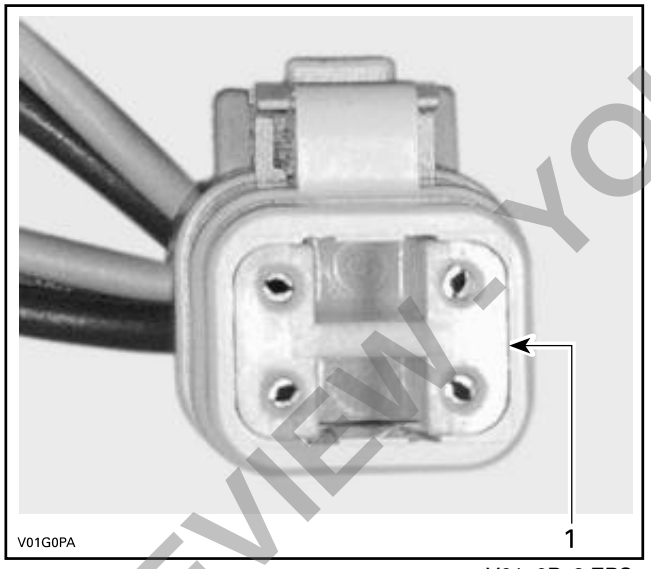
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Female Housing

A - Female Lock (1)



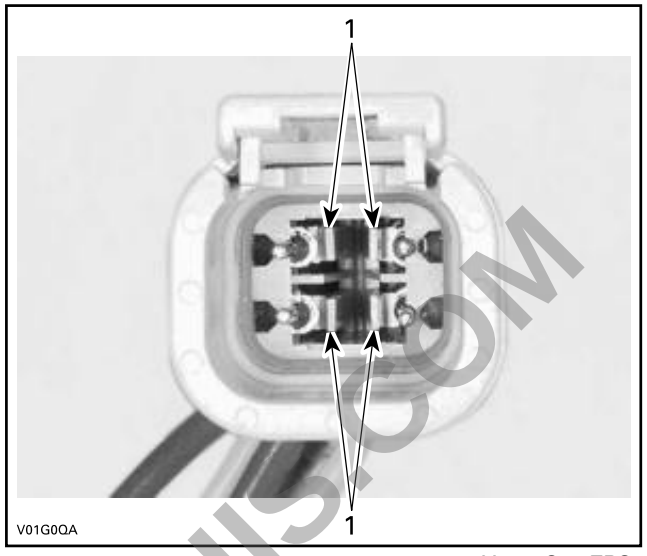
V01g0Pa2.EPS

Male Housing

A - Male Lock (1)

NOTE: Before extraction, push wire forward to relieve pressure on retaining tab.

- Insert a 4.8 mm (0.189 in) wide screwdriver blade inside the front of the contact cavity.
- Pry back the retaining tab while gently pulling wire back until contact is removed.



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Female Connector Housing

A - Retaining Tab (1)

To install:

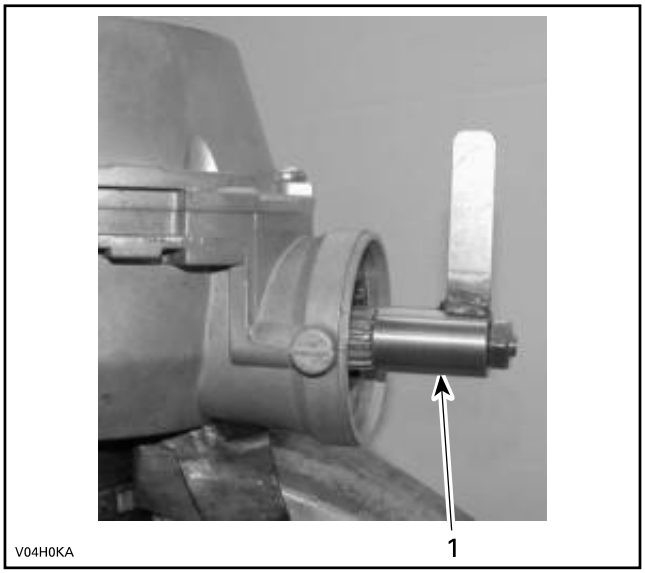
- For insertion of signal contact, make sure the lock is removed.
- Insert contact into appropriate circuit cavity and push as far as it will go.
- Pull back on the contact wire to be sure the retention fingers are holding the contact.
- After all required contacts have been inserted, the lock must be installed.

IMPORTANT: Avoid damage! Never apply dielectric grease on contacts in plug connector. The use of dielectric grease will make the seal swollen and move out of the connector. Do not lubricate.

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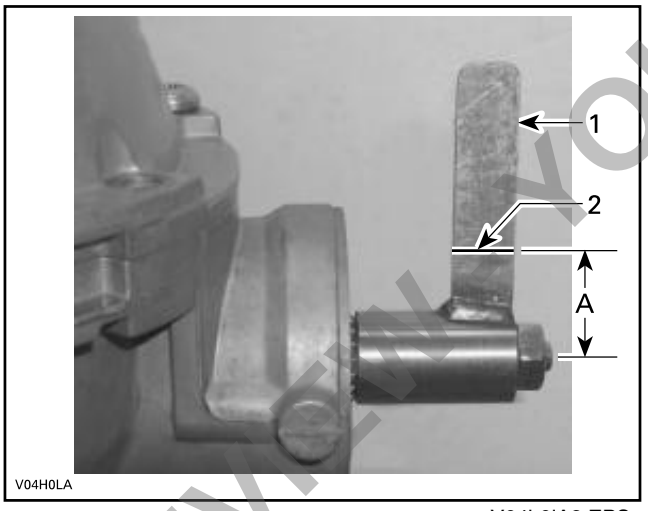
gear.



V04h0kA2.EPS

A - Backlash Measurement Tool (1)

From center of bolt, measure 25.4 mm (1 in) and scribe a mark on the tab.



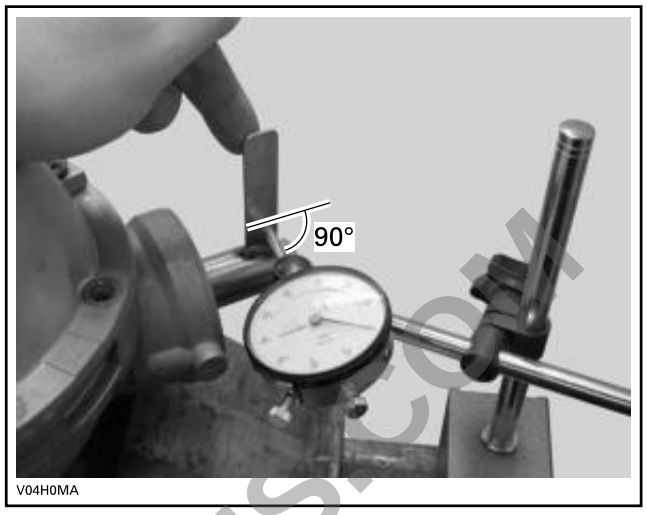
V04h0lA2.EPS

A - Tab of Backlash Measurement Tool (1)
B - Mark on Tab (2)
C - 25.4 mm (1 in.) (A)

NOTE: This measure is equal to the radius of pinion gear and is used where no specification is available.

Position the dial indicator tip against the tab at a 90-degree angle and right on the previously scribed mark.

Gently move the pinion shaft back and forth.



V04h0mA2.EPS

The reading on the dial indicator gives the backlash.

To be acceptable, the backlash must be between 0.102 and 0.356 mm (0.004 and 0.014 in).

If the backlash is not within specifications, disassemble the differential and reposition the shims of the ring gear carrier accordingly in order to move it either closer to or further away from the pinion.

The backlash is adjusted by moving shims from one end of the ring gear carrier to the other as required.

IMPORTANT: Avoid damage! Never eliminate any shims, simply move them from one end to the other to be able to move the ring gear carrier either closer to or further away from the pinion in order to get the correct backlash.

Moving ring gear carrier closer to the pinion will decrease backlash. Moving it further away from the pinion will increase backlash.

Re-assemble the differential and check the backlash again. Repeat the procedure until the backlash is within specifications.

After obtaining the proper backlash, do the final re-assembly.

Disassembly:

Ring Gear Carrier/Ring Gear Removal:

To change ring gear carrier no. 21 or ring gear no. 22:

- Unscrew the drain plug no. 23 and empty differential.
- Unscrew the TORX screws no. 24, then separate half housings.
- Extract ring gear carrier with ring gear out of half housing.
- Unscrew Allen socket screws no. 25 then separate ring

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