JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Core Pulverizer
CP48

TM2098 JAN06

TECHNICAL MANUAL

JOHN DEERE

North American Version
Litho in U.S.A.

INTRODUCTION

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

Specifications and Information

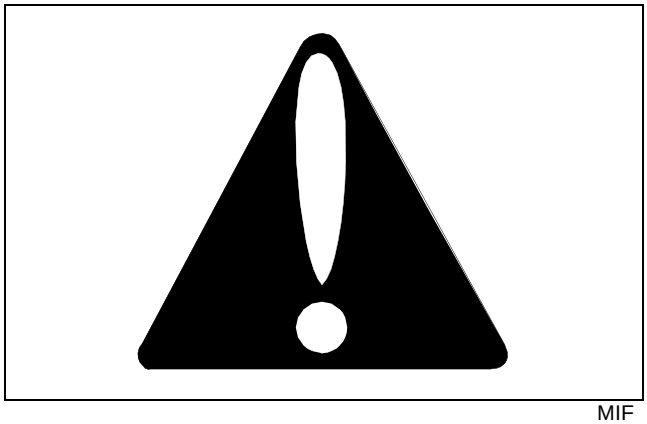
Engine

Electrical

Miscellaneous

INTRODUCTION

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.

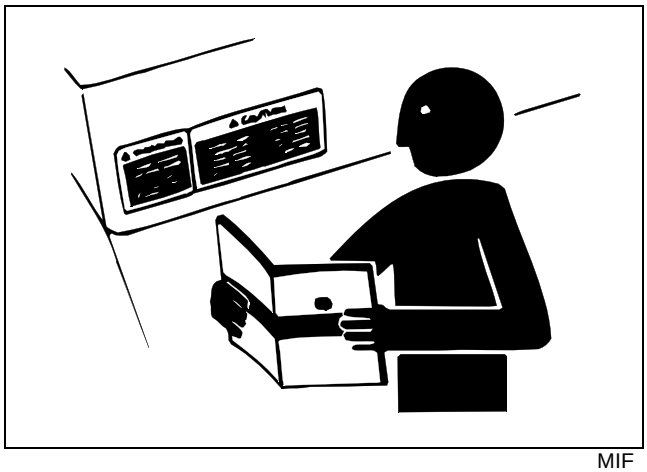
Follow recommended precautions and safe servicing practices.

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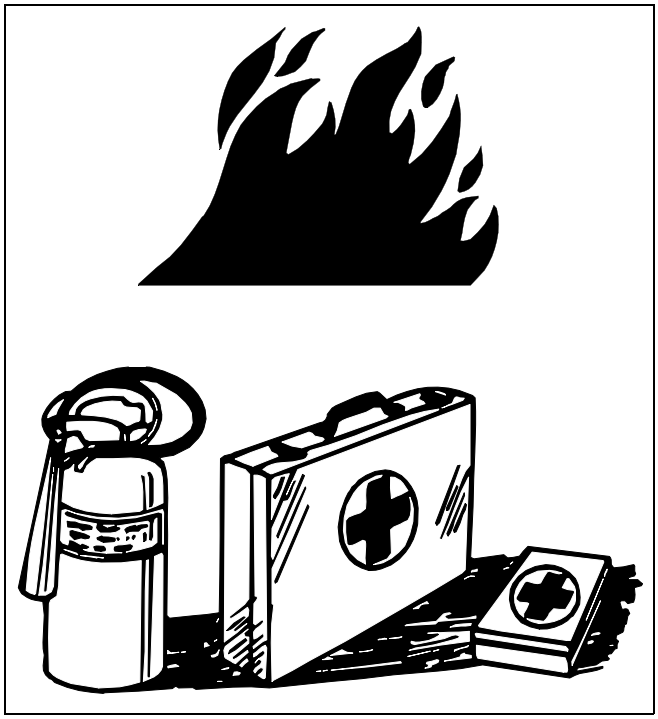
Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

Handle Fluids Safely - Avoid Fires

Be Prepared For Emergencies



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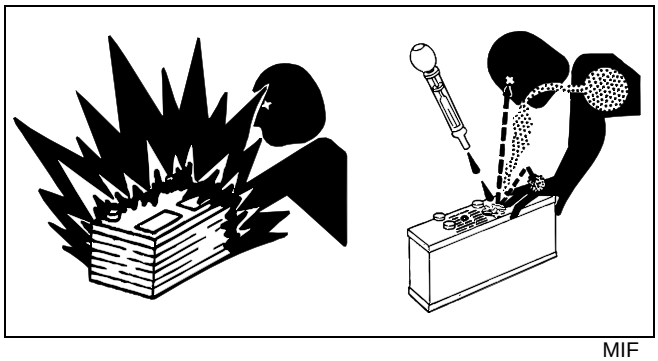
- When you work around fuel, do not smoke or work near heaters or other fire hazards.
- Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.
- Make sure machine is clean of trash, grease, and debris.
- Do not store oily rags; they can ignite and burn spontaneously.
- 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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Prevent Battery Explosions

- Keep sparks, lighted matches, and open flame away from the top of battery. Battery gas can explode.
- Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.
- Do not charge a frozen battery; it may explode. Warm battery to 16°C (60°F).

Prevent Acid Burns

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid acid burns by:

1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling or dripping electrolyte.
5. Use proper jump start procedure.

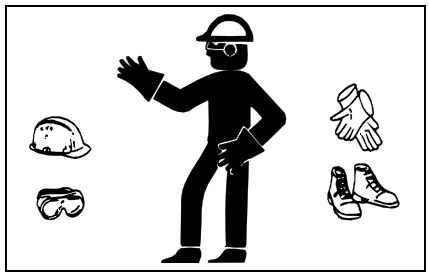
If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10 - 15 minutes.
4. Get medical attention immediately.

If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.

Wear Protective Clothing



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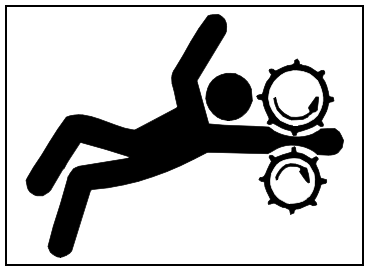
Wear close fitting clothing and safety equipment appropriate to the job.

Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

Service Machines Safely



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Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.

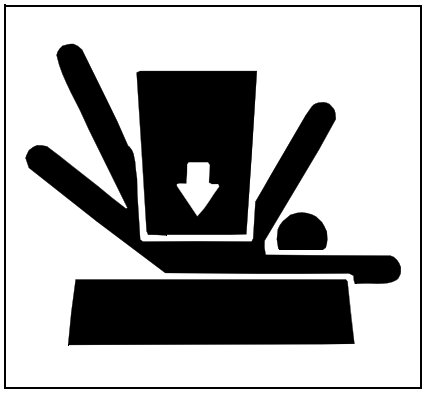
Use Proper Tools

Use tools appropriate to the work. Makeshift tools and procedures can create safety hazards. Use power tools only to loosen threaded parts and fasteners. For loosening and tightening hardware, use the correct size tools. **DO NOT** use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches. Use only service parts meeting John Deere specifications.

Parking Safely

1. Stop machine on a level surface, not on a slope.
2. Disengage pulverizer PTO.
3. Lock park brake.
4. Stop machine engine.
5. Remove key.
6. Wait for engine and all moving parts to stop before you leave the operator's station.
7. Stop pulverizer engine.
8. Close fuel shut-off valve on pulverizer and machine, if your machine is equipped.
9. Disconnect the negative battery cable or remove the spark plug wire (for gasoline engines) before servicing the machine.
10. Hang a "DO NOT OPERATE" tag in operator station and on pulverizer at engine controls.

Support Machine Properly And Use Proper Lifting Equipment



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If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load. Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

Lifting heavy components incorrectly can cause severe injury or machine damage. Follow recommended procedure for removal and installation of components in the manual.

Work In Clean Area

Before starting a job:

1. Clean work area and machine.
2. Make sure you have all necessary tools to do your job.
3. Have the right parts on hand.
4. Read all instructions thoroughly; do not attempt shortcuts.

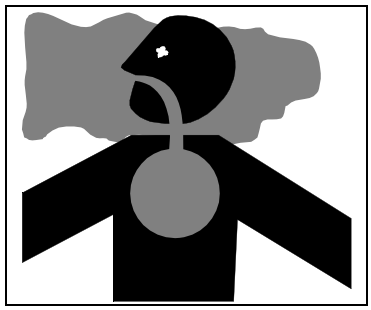
Using High Pressure Washers

Directing pressurized water at electronic/electrical components or connectors, bearings, hydraulic seals, fuel injection pumps or other sensitive parts and components may cause product malfunctions. Reduce pressure and spray at a 45 to 90 degree angle.

Illuminate Work Area Safely

Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

Work In Ventilated Area



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Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.

If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

Warning: California Proposition 65 Warning

Gasoline engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Remove Paint Before Welding Or Heating

Avoid potentially toxic fumes and dust. Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch. Do all work outside or in a well ventilated area. Dispose of paint and solvent properly. Remove paint before welding or heating: If you sand or grind paint, avoid breathing the dust. Wear an approved respirator. If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

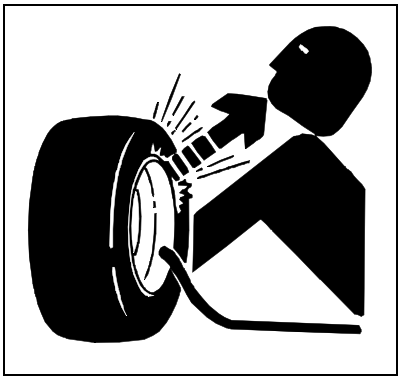
Avoid Harmful Asbestos Dust

Avoid breathing dust that may be generated when handling components containing asbestos fibers. Inhaled asbestos fibers may cause lung cancer.

Components in products that may contain asbestos fibers are brake pads, brake band and lining assemblies, clutch plates, and some gaskets. The asbestos used in these components is usually found in a resin or sealed in some way. Normal handling is not hazardous as long as airborne dust containing asbestos is not generated.

Avoid creating dust. Never use compressed air for cleaning. Avoid brushing or grinding material containing asbestos. When servicing, wear an approved respirator. A special vacuum cleaner is recommended to clean asbestos. If not available, apply a mist of oil or water on the material containing asbestos. Keep bystanders away from the area.

Service Tires Safely



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Explosive separation of a tire and rim parts can cause serious injury or death.

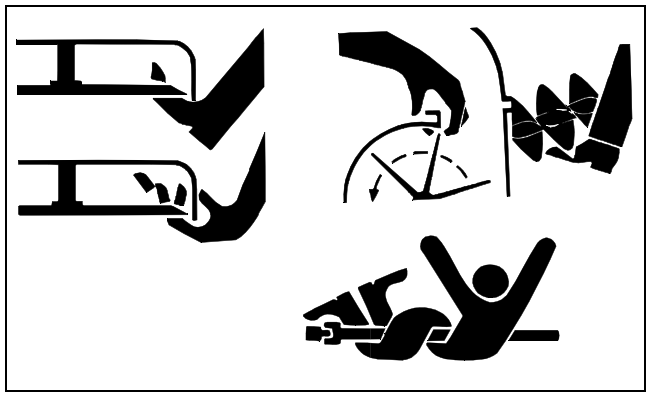
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

When inflating tires, use a clip-on chuck and extension hose long enough to allow you to stand to one side and NOT in front of or over the tire assembly. Use a safety cage if available.

Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

Avoid Injury From Rotating Blades, Augers And PTO Shafts



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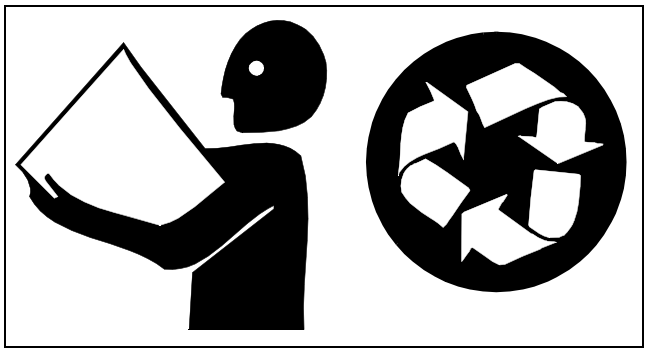
Keep hands and feet away while machine is running. Shut off power to service, lubricate or remove mower blades, augers or PTO shafts.

Dispose Of Waste Properly

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment include such items as oil, fuel, coolant, brake fluid, filters, and batteries. Use leakproof containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them. Do not pour waste onto the ground, down a drain, or into any water source. Inquire on the proper way to recycle or dispose of waste from your local environmental or recycling center, or from your John Deere dealer.

Handle Chemical Products Safely



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Direct exposure to hazardous chemicals can cause serious injury. Potentially hazardous chemicals used with John Deere equipment include such items as lubricants, coolants, paints, and adhesives.

A Material Safety Data Sheet (MSDS) provides specific details on chemical products: physical and health hazards, safety procedures, and emergency response techniques. Check the MSDS before you start any job using a hazardous chemical. That way you will know exactly what the risks are and how to do the job safely. Then follow procedures and recommended equipment.

Live With Safety

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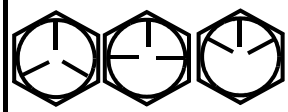
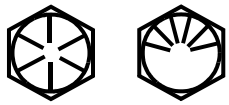
Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

Table of Contents

Fastener Torques

Inch Fastener Torque Values

SAE Grade and Head Markings	**No Marks**  **1 or 2[b]**	 **5 5.1 5.2**	 **8 8.2**		
SAE Grade and Nut Markings	**No Marks**  **2**	 **5**	 **8**		

	Grade 1				Grade 2b				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	
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
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 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 for assembly.

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

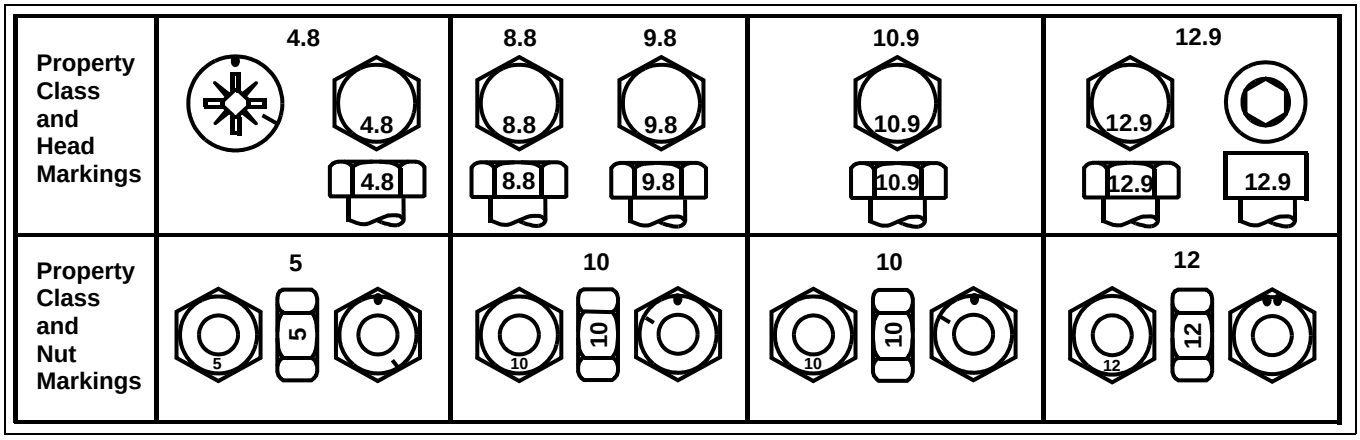
Fasteners should be replaced with the same grade. Make sure fastener threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

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*.

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.* Reference: JDS - G200

Metric Fastener Torque Values



	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

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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

General Information

Engine Oil

Use the appropriate oil viscosity based on the expected air temperature range during the period between recommended oil changes. Operating outside of these recommended oil air temperature ranges may cause premature engine failure.

The following John Deere oil is PREFERRED:

- TORQ - GARD SUPREME® - SAE 5W-30;
- PLUS - 50® - SAE 15W-40;

Other oils may be used if above John Deere oils are not available, provided they meet one of the following specifications:

- SAE 15W-40 - API Service Classification CH-4 or higher;
- SAE 10W-30 - API Service Classification CG-4 (4-cycle) or higher;

John Deere Dealers: You may want to cross-reference the following publications to recommend the proper oil for your customers:

- Module DX,ENOIL2 in JDS - G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual PI7032.

Engine Break - in Oil

IMPORTANT: Avoid damage! ONLY use a quality break-in oil in rebuilt or remanufactured engines for the first 5 hours (maximum) of operation. DO NOT use oils with heavier viscosity weights than SAE 5W-30 or oils meeting specifications API SG or SH, these oils will not allow rebuilt or remanufactured engines to break-in properly.

The following John Deere oil is PREFERRED:

- **BREAK - IN ENGINE OIL**.

John Deere BREAK - IN ENGINE OIL is formulated with special additives for aluminum and cast iron type engines to allow the power cylinder components (pistons, rings, and liners as well) to “wear-in” while protecting other engine components, valve train and gears, from abnormal wear. Engine rebuild instructions should be followed closely to determine if special requirements are necessary.

John Deere BREAK - IN ENGINE OIL is also recommended for non-John Deere engines, both aluminum and cast iron types.

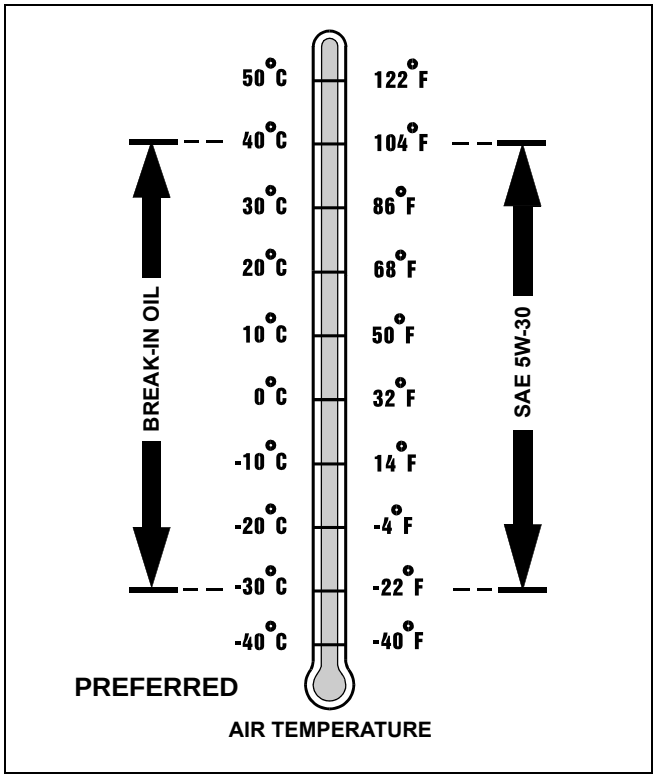
The following John Deere oil is **also recommended as a break-in engine oil**:

- TORQ - GARD SUPREME® - SAE 5W-30.

If the above recommended John Deere oils are not available, use a break-in engine oil meeting the following specification during the first 5 hours (maximum) of operation:

- SAE 5W-30 - API Service Classification SE or higher.

IMPORTANT: Avoid damage! After the break-in period, use the John Deere oil that is recommended for this engine.



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John Deere Dealers: You may want to cross-reference the following publications to recommend the proper oil for your customers:

- Module DX,ENOIL4 in JDS - G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual PI7032.

Alternative Lubricants

Conditions in certain geographical areas outside the United States and Canada may require different lubricant recommendations than the ones printed in this technical manual or the operator's manual. Consult with your John Deere Dealer, or Sales Branch, to obtain the alternative lubricant recommendations.

IMPORTANT: Avoid damage! Use of alternative lubricants could cause reduced life of the component.

If alternative lubricants are to be used, it is recommended that the factory fill be thoroughly removed before switching to any alternative lubricant.

Synthetic Lubricants

Synthetic lubricants may be used in John Deere equipment if they meet the applicable performance requirements (industry classification and/or military specification) as shown in this manual.

The recommended air temperature limits and service or lubricant change intervals should be maintained as shown in the operator's manual.

Avoid mixing different brands, grades, or types of oil. Oil manufacturers blend additives in their oils to meet certain specifications and performance requirements. Mixing different oils can interfere with the proper functioning of these additives and degrade lubricant performance.

Lubricant Storage

All machines operate at top efficiency only when clean lubricants are used. Use clean storage containers to handle all lubricants. Store them in an area protected from dust, moisture, and other contamination. Store drums on their sides. Make sure all containers are properly marked as to their contents. Dispose of all old, used containers and their contents properly.

Mixing Of Lubricants

In general, avoid mixing different brands or types of lubricants. Manufacturers blend additives in their lubricants to meet certain specifications and performance requirements. Mixing different lubricants can interfere with the proper functioning of these additives and lubricant properties which will downgrade their intended specified performance.

Chassis Grease

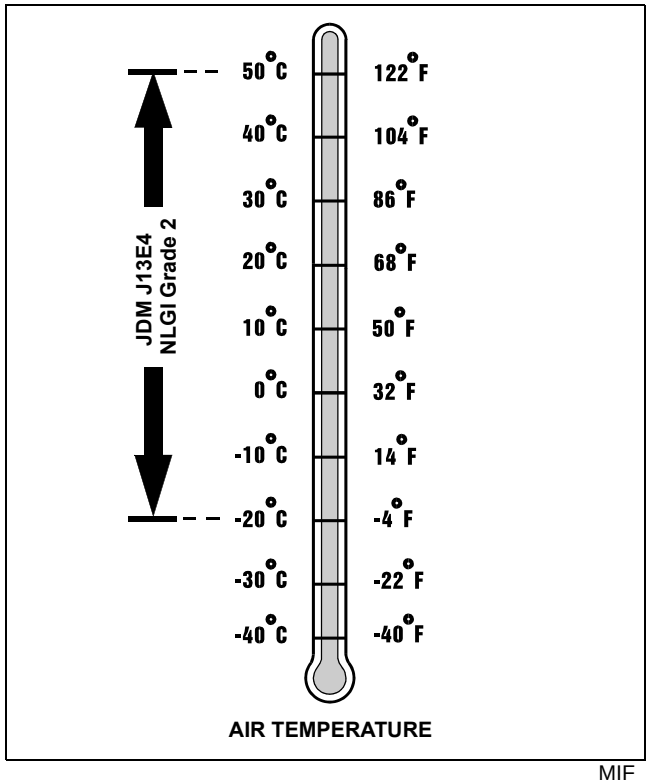
Use the following grease based on the air temperature range. Operating outside of the recommended grease air temperature range may cause premature failures.

The following John Deere grease is PREFERRED:

- NON-CLAY HIGH-TEMPERATURE EP GREASE® - JDM J13E4, NLGI Grade 2.
- Multi-Purpose SD Polyurea Grease
- Multi-Purpose HD Lithium Complex Grease

Other greases may be used if above preferred John Deere grease is not available, provided they meet the following specification:

- John Deere Standard JDM J13E4, NLGI Grade 2.



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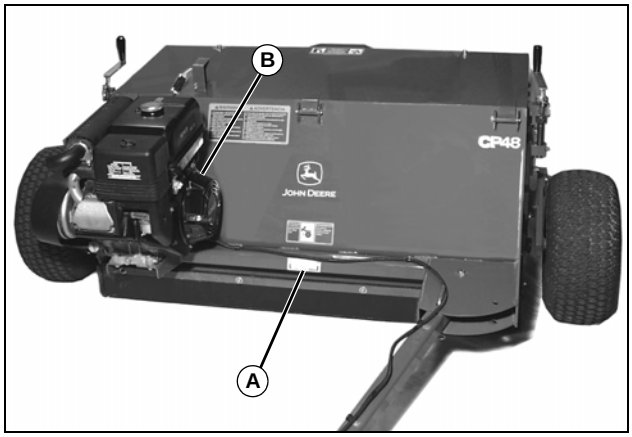
John Deere Dealers: You may want to cross-reference the following publications to recommend the proper grease for your customers:

- Module DX,GREA1 in JDS - G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual P17032.

Serial Number Locations

Identification Numbers

When ordering parts or submitting a warranty claim, it is IMPORTANT that the machine product identification number (PIN) and component serial numbers are included. The location of the PIN and component serial numbers are shown.



MX19825

Machine Product Identification Number (A)

Engine Serial Number (B)

ENGINE TABLE OF CONTENTS

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Specifications

General Specifications

Make	Kohler
Model	Command Pro 12 CS12RT
Peak Torque @ 2000 rpm	22.6 N•m (16.7 lb-ft)
High Engine RPM	3450 (±100)
Bore	85.0 mm (3.35 in.)
Stroke	63.0 mm (2.48 in.)
Displacement	360 cc (22 cu in.)
Cylinders	1
Stroke/Cycle	4
Valves	Overhead
Crankshaft Type	Horizontal (Counterbalanced)
Compression Ratio	8.1:1
Standard Compression Pressure (With ACR in Operation)	400 - 600 kPa (57 - 85 psi)
Compression Release	Automatic/Centrifugal
Cooling System	Air Cooled
Air Filter	Paper with Foam
Lubrication	Splash System
Starting	Recoil
Fuel Capacity	6.9 L (7.3 U.S qt)
Weight (Approximate)	31.9 kg (70.5 lb)
Oil Capacity	1.1 L (1.2 U.S. qt)
Angle of Operation (maximum) at Full Oil Level	20°
Spark Plug Type NGK	BPR4ES (13/16 in. hex)
Spark Plug Type Champion®	RN14YC (13/16 in. hex)
Spark Plug Type Champion®	RC14YC (5/8 in. hex)

Adjustment Specifications

Spark Plug Gap	0.76 mm (0.030 in.)
Ignition Module Air Gap	0.4 - 0.6 mm (0.015 - 0.023 in.)

Repair Specifications

Camshaft:	
End Play	0.05 mm (0.0020 in.)
Bore ID	15.965 - 15.990 mm (0.6285 - 0.6295 in.)
Bore ID - Maximum Wear LImit	15.95 mm (0.628 in.)
Camshaft Bearing Surface OD - Maximum Wear LImit	16.05 mm (0.649 in.)
Cam Lobe Lift - Intake and Exhaust	32.55 ± 0.05 mm (1.28 ± 0.002 in.)
Cam Lobe Diameter - Intake and Exhaust	26.08 ± 0.05 mm (1.03 ± 0.002 in.)

Connecting Rod:

Connecting Rod to Crankpin Running Clearance New. . . . . 0.016 - 0.046 mm (0.0006 - 0.0018 in.)
Connecting Rod to Crankpin Running Clearance Maximum Wear Limit . . . . . 0.1 mm (0.004 in.)
Connecting Rod to Crankpin Side Clearance . . . . . 0.20 - 0.65 mm (0.0079 - 0.0256 in.)
Connecting Rod to Piston Pin Running Clearance. . . . . 0.006 - 0.025 mm (0.0002 - 0.0001 in.)

Piston Pin End ID:

New . . . . . 20.006 - 20.020 mm (0.7867 - 0.7882 in.)
Maximum Wear Limit . . . . . 20.10 mm (0.791 in.)

Connecting Rod Journal End ID:

New . . . . . 36.000 - 36.015 mm (1.4173 - 1.4179 in.)
Maximum Wear Limit . . . . . 36.115 mm (1.4219 in.)

Crankshaft:

End Play (Free) . . . . . 0.04 mm (0.0015 in.)

Flywheel End Main Bearing Journal ID:

New . . . . . 80 mm (3.149 in.)
Maximum Wear Limit . . . . . 80.05 mm (3.1515 in.)

PTO End Main Bearing Journal ID:

New . . . . . 72 mm (2.834 in.)
Maximum Wear Limit . . . . . 72.05 mm (2.836 in.)

Connecting Rod Journal OD:

New . . . . . 35.969 - 35.984 mm (1.4161 - 1.4167 in.)
Maximum Wear Limit . . . . . 35.9 mm (1.4134 in.)

Crankshaft:

Runout (Either End) . . . . . 0.02 mm (0.0008 in.)
Limit (Either End) . . . . . 0.04 mm (0.0016 in.)

Cylinder Bore ID:

New . . . . . 85.00 - 85.02 mm (3.3465 - 3.3472 in.)
Maximum Wear Limit . . . . . 85.65 mm (3.372 in.)
Maximum Out of Round . . . . . 0.05 mm (0.002 in.)

Cylinder Head:

Maximum Out of Flatness . . . . . 0.1 mm (0.004 in.)

Governor Shaft:

Governor Shaft Position Exposed Length . . . . . 36.0 ± 0.6 mm (1.47 ± 0.023 in.)

Piston to Piston Pin:

Clearance . . . . . 0.004 - 0.020 mm (0.0002 - 0.0008 in.)

Piston Pin Bore ID:

New . . . . . 20.004 - 20.015 mm (0.7876 - 0.7880 in.)
Maximum Wear Limit . . . . . 20.03 mm (0.7886 in.)

Piston Pin OD:

New . . . . . 19.995 - 20.000 mm (0.7872 - 0.7874 in.)
Maximum Wear Limit . . . . . 19.98 mm (0.787 in.)

Ring to Groove Side Clearance:

Top Compression Ring . . . . . 0.04 - 0.08 mm (0.0016 - 0.003 in.)
Middle Compression Ring . . . . . 0.03 - 0.07 mm (0.0012 - 0.0028 in.)
Maximum Wear Limit . . . . . 0.1 mm (0.004 in.)

Ring End Gap:

Top Compression Ring . . . . . 0.25 - 0.4 mm (0.010 - 0.016 in.)
Middle Compression Ring . . . . . 0.25 - 0.4 mm (0.010 - 0.016 in.)
Oil Control Ring . . . . . 0.2 - 0.7 mm (0.0079 - 0.028 in.)

Piston Thrust Face OD:

New . . . . . 84.954 - 84.998 mm (3.3446 - 3.3464 in.)
Maximum Wear Limit . . . . . 84.898 mm (3.3424 in.)

Piston Thrust Face to Cylinder Bore Running Clearance . . . . . 0.002 - 0.066 mm (0.0001 - 0.0026 in.)

Intake Valve:

Head Diameter . . . . . 32.0 mm (1.26 in.)
Stem Diameter . . . . . 5.948 - 5.963 mm (0.2342 - 0.2348 in.)
Length . . . . . 88.1 mm (3.47 in.)
Face/Seat Width . . . . . 0.7 - 0.9 mm (0.0276 - 0.354 in.)
Face/Seat Limit . . . . . 1.4 mm (0.055 in.)
Face Seat Angle (Insert Area) . . . . . 90°
Valve Stem Bend Limit . . . . . 0.01 mm (0.0004 in.)
Valve Seat Contact Width (Standard) . . . . . 0.7 mm (0.03 in.)
Valve Seat Contact Width (Limit) . . . . . 1.7 mm (0.067 in.)

Intake Valve Guide ID:

New . . . . . 6.0 - 6.012 mm (0.2362 - 0.2367 in.)
Maximum Wear Limit . . . . . 6.10 mm (0.240 in.)
Valve Stem to Valve Guide Clearance. . . . . 0.037 - 0.064 mm (0.0015 - 0.0025 in.)

Exhaust Valve:

Head Diameter . . . . . **27.0 mm (1.06 in.)**
Stem Diameter . . . . . **5.940 - 5.955 mm (0.2339 - 0.2344 in.)**
Length . . . . . **87.9 mm (3.46 in.)**
Face/Seat Width . . . . . **0.7 - 0.9 mm (0.0276 - 0.0354 in.)**
Face/Seat Limit . . . . . **1.4 mm (0.055 in.)**
Face/Seat Angle (Insert Area) . . . . . **90°**
Valve Stem Bend Limit . . . . . **0.01 mm (0.0004 in.)**
Valve Seat Contact Width (Standard) . . . . . **0.7 mm (0.03 in.)**
Valve Seat Contact Width (Limit) . . . . . **1.7 mm (0.067 in.)**

Exhaust Valve Guide ID:

New . . . . . **6.0 - 6.012 mm (0.2362 - 0.2367 in.)**
Maximum Wear Limit . . . . . **6.0 mm (0.236 in.)**
Valve Stem to Valve Guide Clearance . . . . . **0.045 - 0.072 mm (0.0018 - 0.0028 in.)**

Valve Guide Reamer Size . . . . . **6.0 mm (0.236 in.)**
Intake Valve Minimum Lift . . . . . **2.7 mm (0.106 in.)**
Exhaust Valve Minimum Lift . . . . . **2.9 mm (0.114 in.)**
Nominal Valve Seat Angle . . . . . **45°**
Valve to Tappet Clearance (Cold) . . . . . **0.1 mm (0.004 in.)**

Torque Specifications

Air Cleaner:

Base Bolt Torque . . . . . **5 - 8 N•m (44 - 71 lb-in.)**
Base Nut Torque . . . . . **10 - 12 N•m (88 - 106 lb-in.)**

Carburetor:

Fuel Bowl Retaining Screw Torque . . . . . **9 N•m (79 lb-in.)**
Throttle/Choke Plate Screws . . . . . **1.5 - 2.5 N•m (13 - 22 lb-in.)**

Engine Block and Internal:

Closure Plate Fastener Torque . . . . . **30 N•m (265 lb-in.)**
Oil Drain Plug Torque . . . . . **20 N•m (177 lb-in.)**
Cylinder Head Bolt Torque . . . . . **50 N•m (36 lb-ft)**
Timing Drive Gear Mounting Bolt . . . . . **60 - 70 N•m (44 - 51 lb-ft)**
Connecting Rod Fastener Torque . . . . . **20 N•m (177 lb-in.)**

Flywheel:

Flywheel Retaining Screw Torque . . . . . **120 N•m (85 lb-ft)**

Governor:

Governor Lever Bolt Torque . . . . . **10 N•m (88.5 lb-in.)**

ENGINE SPECIFICATIONS

Ignition:

Spark Plug Torque	**20 N•m (177 lb-in.)**
Ignition Module Mounting Screws Torque	**10 N•m (88 lb-in.)**

Muffler:

Muffler Torque (Flange Nuts & Bracket Bolts)	**18 - 22 N•m (159 - 195 lb-in.)**

Retractable Starter:

Mounting Screws to Blower Housing Torque	**7 N•m (62 lb-in.)**
Retractable Starter Center Screw	**5 - 6 N•m (44 - 53 lb-in.)**
Retractable Starter Housing Mounting Screws	**5.5 N•m (48 lb-in.)**

Rocker Arm:

Stud Into Cylinder Head Torque	**10 N•m (88 lb-in.)**
Adjusting Jam Nut Torque	**7 N•m (62 lb-in.)**

Throttle Control:

Throttle Control Lever Fastener Torque	**9 - 11 N•m (80 - 97 lb-in.)**

Valve Cover:

Valve Cover Fastener Torque	**11 N•m (97 lb-in.)**

Tools and Materials

Special or Required Tools

Special or Required Tools

Tool Name	Tool No.	Tool Use
Compression Gauge	JDM59	Used to check engine compression.
Crankcase Vacuum Test Kit	JTO3503	Used to measure crankcase vacuum.
Valve Spring Compressor	JDM70	Used to remove and install valve springs.
Dial Indicator	Obtain Locally	Automatic compression relief test, valve inspection, and crankshaft end play
Digital Pulse Tachometer	JTO7270	Slow and/or fast idle adjustment
Photo Tachometer	JTO5719	Slow and/or fast idle adjustment
Spark Plug Ground	JDM74A5	Used to prevent accidental engine starting during tests.
Oil Pressure Test Adapter	JTO7262	Oil pressure test
Lapping Tool	Obtain Locally	Valve lapping
Flywheel Puller Kit	Obtain Locally	Flywheel Removal
Rocker Arm Spanner Wrench	Obtain Locally	Lifting Rocker Arms and Turning Flywheel
Water Manometer	JTO5690	Engine Crankcase Vacuum Test
Flywheel Holding Tool	Fabricate Locally	Flywheel Removal and Installation

Other Materials

Other Material

Part No.	Part Name	Part Use
M79792	MPG-2® Multipurpose Grease	Apply to engine crankshaft.
PT569	John Deere NEVER-SEEZ® Lubricant	Apply to crankshaft end.
TY9375/TY9480/LOCTITE® 592	Thread sealant (General Purpose) with TEFLON®	Apply to threads of oil pressure switch.
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head
TY15130/LOCTITE® 395	Form-n-Place Gasket	Rocker arm cover mating surfaces
T43512/TY9473/LOCTITE® 242	Thread Lock and Sealer (Medium Strength)	Apply to governor shaft and stator support bracket.

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LOCTITE® is a registered trademark of the Loctite Corp.

TEFLON® is a registered trademark of DuPont.

SCOTCH-BRITE® is a registered trademark of the 3M Co.

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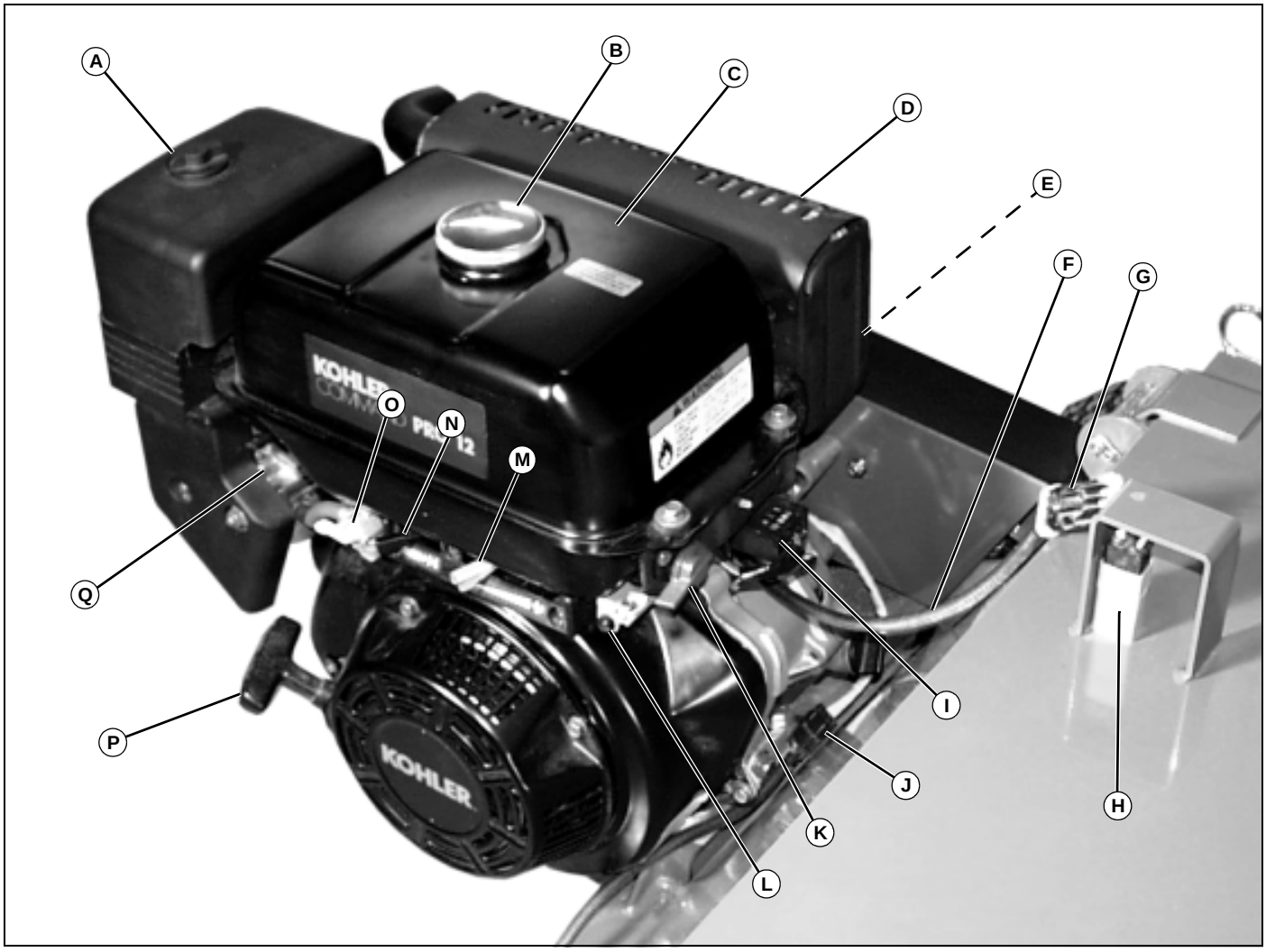
Component Location

Engine Components



MX19812

A - Air Cleaner Assembly
B - Fuel Filler Cap
C - Fuel Tank
D - Muffler
E - PTO Clutch
F - W4 Engine Interlock Wiring Harness
G - X3 Connector
H - Safety Switch
I - Oil Warning Module
J - X2 Connector
K - Ignition On/Off Switch
L - Oil Warning Light
M - Throttler Lever
N - Choke Lever
O - Fuel Shutoff Valve and Screen Assembly
P - Retractable Starter Handle
Q - Carburetor

Diagnostics

Engine Troubleshooting

- Remove spark plug and inspect.
- Perform a compression test on the engine.

Engine is hard to start

Symptom: Engine is hard to start

(1) Does the engine run but is hard to start?

Yes - Check for dirt or water in the fuel system.

Yes - Restricted fuel filter or clogged fuel line.

Yes - Loose or faulty wires or connections.

Yes - Faulty choke or throttle controls. Check carburetor adjustment.

Yes - Faulty spark plug or weak spark. Check ignition system.

Yes - Check for low compression. Check cylinder compression.

Yes - Faulty ACR mechanism. Test ACR.

Engine Does Not Start

Symptom: Engine does not start (fuel system).

(1) Ensure that there is adequate fuel in the tank.

Yes - Go to next step.

(2) Is fuel getting to the carburetor?

Yes - Go to next step.

No - Check fuel level in tank.

No - Fuel shut-off valve closed.

No - Restricted fuel cap vent.

No - Test fuel filter for restrictions.

No - Check the fuel line.

(3) Check the air filter for restrictions.

Symptom: Engine does not start (ignition system).

(1) Test for proper ignition spark. Is the spark good?

Yes - Faulty spark plug.

Yes - Go to next step.

No - Check the ignition coil air gap.

Symptom: Engine does not start (ignition system).

No - Loose wires or connections that short the kill terminal of the ignition module to ground.

(2) Test the ignition switch. Does it work correctly?

No - Repair or replace switch.

(3) Test the safety switch. Does it work correctly?

No - Repair or replace switch.

Symptom: Engine does not start (electrical system).

(1) Test the engine run - start switch. Is the switch good?

No - Repair or replace switch.

Yes - Go to next step.

(2) Check engine oil level and oil switch. Is the level OK and the switch functioning?

No - Add oil as needed or repair or replace switch.

Engine Runs Poorly

Start engine and run for 3 minutes to allow it to reach operating temperature.

Symptom: Engine runs poorly (idle control).

(1) Does the engine idle but stops?

Yes - The idle fuel adjusting needle is improperly set.

Yes - The idle speed adjusting screw is improperly set.

Yes - Check the engine for low compression.

Yes - Check the fuel supply for contamination.

(2) Place throttle lever in idle position. Does engine rpm decrease to normal idle speed?

No - Engine appears to be under load or engine rpm remains at high speed. Check governor adjustment. Check PTO clutch.

Engine oil problems

Symptom: Engine uses excessive amounts of oil.

(1) Does the engine consume excessive amounts of oil?

Yes - Incorrect viscosity or type of oil being used in engine.

Yes - The crankcase is overfilled.

Yes - Check the breather for clogging.

Yes - Worn or broken piston rings.

Yes - The cylinder bore is worn.

Yes - The valve stems and/or valve guides are worn.

(2) Does oil leak from seals or gaskets?

Yes - Check the crankcase breather for restrictions.

Yes - Loose or improperly tightened fasteners.

Yes - Piston blowby or leaky valves.

Yes - Check the exhaust for restrictions.

Engine Knocks

Symptom: Engine Knock

(1) Does the engine knock while running?

Yes - Excessive engine load.

Yes - Low crankcase oil level.

Yes - The fuel could be old, improper, or contaminated.

Yes - Check for internal engine wear.

Engine Overheats

Symptom: Engine is overheating

(1) Does the engine run but overheats?

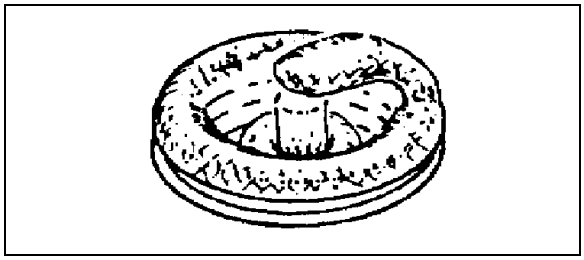
Yes - Check air intake/grass screen, cooling fins, or cooling shroud for clogs.

Yes - The crankcase oil level is either too high or too low.

No - The carburetor is faulty or set improperly.

Spark Plug Troubleshooting

Symptom: Poor engine performance



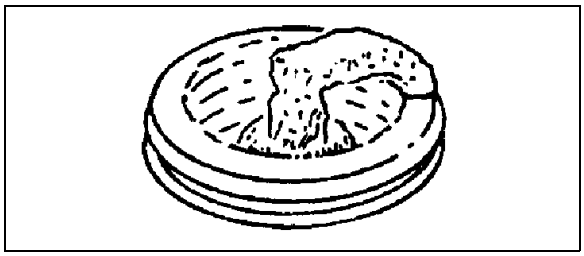
M91490

(1) Are there excessive deposits on the electrodes yet the electrodes aren't worn (Oxide Fouling)?

Yes - Inspect the combustion chamber for excessive deposits.

Yes - Inspect muffler and exhaust for clogging.

Yes - Verify that the air/fuel mixture is correct and that the recommended oils are used.

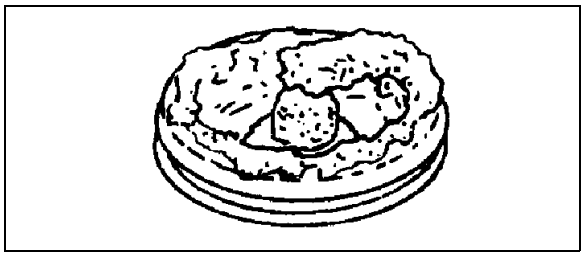


M91491

(2) Is the sparking gap shorted out by combustion particles fused between electrodes (Gap Bridging)?

Yes - Ensure that the recommended oils and/or fuels are used.

Yes - Inspect muffler and exhaust for clogging.



M91492

(3) Is the insulation tip black with a carbon layer over the entire nose and a damp oily film over the firing end (Wet Fouling)?

Yes - Engine may be running too rich. Check air/fuel mixture.

Yes - Check idle speed.

Symptom: Poor engine performance

Yes - Test ignition module.

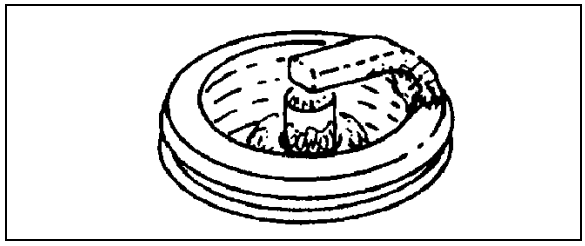
Yes - Check air filter for clogging.

Yes - Verify that the recommended oils are used.

Yes - The plug may be too cold for the type of work being performed.

Yes - The low speed jet may not be adjusted properly (too rich).

Yes - The idle speed may be too low.



M91493

(4) Is the electrode burned with the insulator tip color light grey or chalk white (Overheated)?

Yes - Inspect muffler and exhaust for clogging.

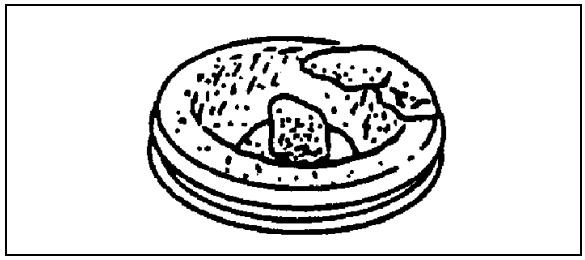
Yes - Check the cylinder fins for dirt. Clean as required.

Yes - Carburetor may be adjusted too lean.

Yes - Check for an air leak in the fuel line.

Yes - Inspect the carburetor for a ruptured fuel hose or filter diaphragm.

Yes - Ensure that the spark plug heat range is correct (too hot).



M91494

(5) Do the electrodes appear to be worn out?

Yes - This condition requires more voltage than the ignition system can produce. Replace with new plug of the same heat range.

Tests and Adjustments

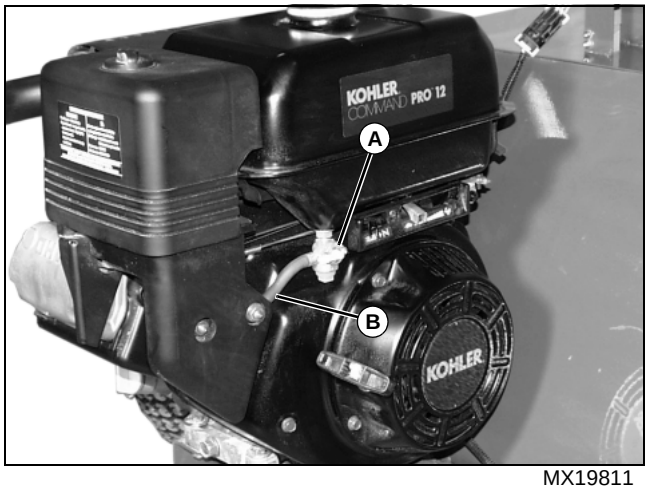
Fuel System Tests

NOTE: This engine uses a fixed jet MIKUNI carburetor. The fixed main jet carburetor is designed to deliver the correct air to fuel mixture to the engine under all operating conditions. The high idle mixture is set at the factory an cannot be adjusted. The low idle fuel adjusting needle is also set by the factory and normally does not need adjustment.

Fuel Flow Test

CAUTION: Avoid injury! Gasoline is explosive. Do not expose to flame or spark.

Procedure



MX19811

1. Turn fuel shut-off valve (A) to off position to prevent fuel flow.

IMPORTANT: Avoid damage! Ensure that container is clean if fuel is to be returned to the tank after test.

2. Disconnect fuel line from carburetor (B) and place in container.
3. Turn fuel shut off valve to the on position.
4. Fuel should flow freely into container.
5. Turn fuel shut-off valve to off position.
6. Pour captured fuel into tank.

If fuel flow is slow, check the following:

- Clean fuel screen.
- Check fuel lines, shut-off valve, fuel tank outlet, and fuel tank cap for restrictions.

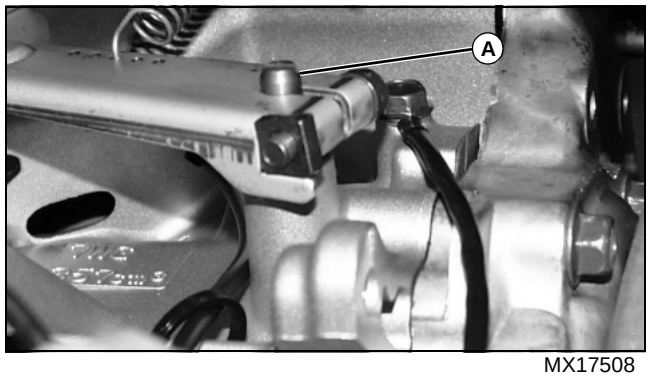
Governor Cross Shaft Position Adjustment

Reason:

To make sure the governor shaft contacts the flyweight plunger when the engine is stopped.

Procedure:

NOTE: The governor shaft is pressed into the closure plate to a specified height and normally should not require removal or servicing. The position is critical to proper operation of the governor gear and the entire governor assembly. If for any reason the mounted position of the governor shaft is changed, it must be reset to the specified height.



MX17508

1. Adjust governor shaft (A) so it protrudes 36.0 ± 0.6 mm (1.417 ± 0.023 in.) above the crankcase.

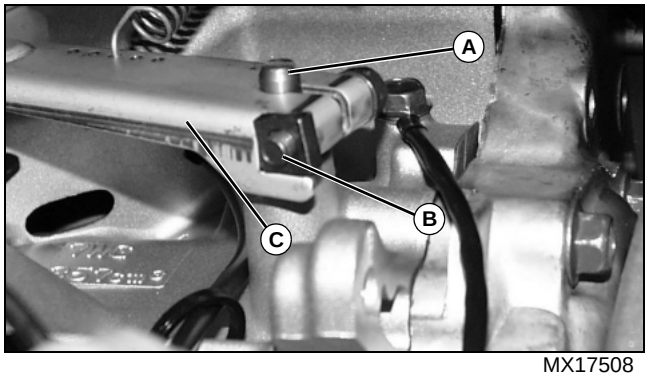
Governor Lever Adjustment

Reason:

Make this adjustment whenever the governor lever is loosened or removed from the cross shaft. To ensue proper setting, make sure the throttle linkage is connected to the governor lever and the carburetor throttle lever.

Procedure:

1. Close the fuel shut off valve.



MX17508

2. Loosen the governor lever mounting bolt (B).
3. Move the governor lever (C) clockwise until it stops.
4. Rotate the governor shaft (A) clockwise until it stops.
5. Hold both in this position and tighten the governor lever bolt.

- Tighten the bolt to 10 N•m (88 lb-in.).

Slow Idle Speed Adjustments

Reason:

To set engine slow idle mixture and rpm.

Equipment:

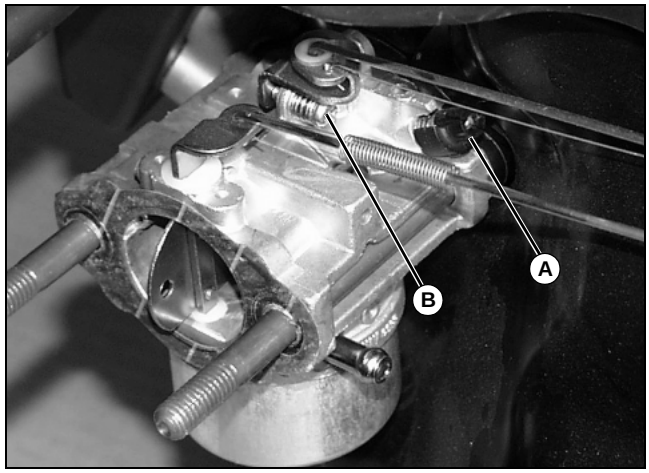
- JTO7270 Pulse Tachometer; or,
- JTO5719 Photo Tachometer

Procedure:

NOTE: Carburetor adjustments should only be made after the engine is warmed up.

The carburetor is designed to deliver the correct fuel to air mixture to the engine under all operating conditions. The high idle mixture is set at the factory and cannot be adjusted. The low idle fuel adjusting needle is also set at the factory and has a limiting cap. It normally does not need adjustment.

1. Start engine and run at half throttle for 5 to 10 minutes to warm up. The engine must be warm before making final settings.
2. When engine is at operating temperature, move throttle to the slow idle position.
3. Check the speed using a tachometer when engine is at operating temperature.



MX19677

Picture Note: Air cleaner assembly removed for clarity.

4. Turn the low idle fuel adjusting needle (A) in or out within the adjustment range to obtain the best low speed performance.
5. Set the low idle speed to specification by turning the low idle speed adjusting screw (B) in or out.

Specifications:

Slow Idle Speed . . . . . .2000 ± 150 rpm

Fast Idle Speed Adjustments

Reason:

To set engine fast idle rpm.

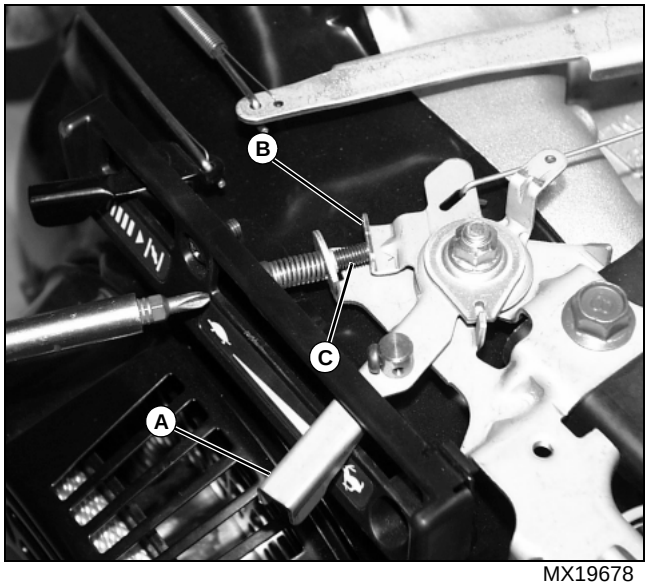
Equipment:

- JTO7270 Pulse Tachometer; or,
- JTO5719 Photo Tachometer

Procedure:

NOTE: Carburetor adjustments should only be made after the engine is warmed up.

1. Start engine and run at half throttle for 5 to 10 minutes to warm up. The engine must be warm before making final settings.
2. When engine is at operating temperature, move throttle to the high idle position.
3. Check the speed using a tachometer when engine is at operating temperature.



MX19678

Picture Note: Fuel tank removed for clarity.

4. Apply light pressure to throttle lever (A) to ensure the throttle stop (B) is contacting the throttle stop screw (C).

5. Turn the throttle stop screw in to decrease the high idle speed or out to increase the high idle speed.

Specifications:

High Idle Speed. . . . . 3450 ± 100 rpm

Cylinder Compression Test

Reason:

To determine condition of piston, piston rings, cylinder wall, valves, valve guides, gaskets, and seals.

Equipment:

- JDM59 Compression Gauge
- JDM74A5 Spark Plug Wire Test Tool

Procedure:

1. Run engine at idle for 5 minutes to reach operating temperature.

2. Stop engine.

CAUTION: Avoid injury! Engine components are hot. Be careful not to touch, especially the exhaust pipe or muffler, while making adjustments. Wear protective eyeglasses and clothing.

IMPORTANT: Avoid damage! Spark plug wire Must be grounded or ignition module could be damaged.

3. Disconnect spark plug wire and ground with JDM74A5 tool.

4. Remove spark plug and install JDM59 compression gauge.

5. Hold throttle in fast idle position and verify choke is off.

6. Crank engine until compression gauge stops rising.

7. If compression is low, remove compression gauge. Squirt clean engine oil into cylinder.

8. Repeat cylinder compression test procedure.

Results:

- Minimum compression should be 400 - 600 kPa (57 - 85 psi).
- If compression pressure increases after oil is put in cylinder, check rings, piston, and cylinder bore for wear or damage.
- If compression pressure is still low after oil is put in cylinder, check valves, valve seats, valve seals, and cylinder head gasket.

Crankcase Vacuum Test

Reason:

To measure the amount of crankcase vacuum to ensure that the crankcase is not pressurized. A pressurized crankcase will force oil to leak past the seals.

Equipment:

- JTO5697 U-Tube Manometer Test Kit; or,
- JT03503 Crankcase Vacuum Test Kit

Procedure:

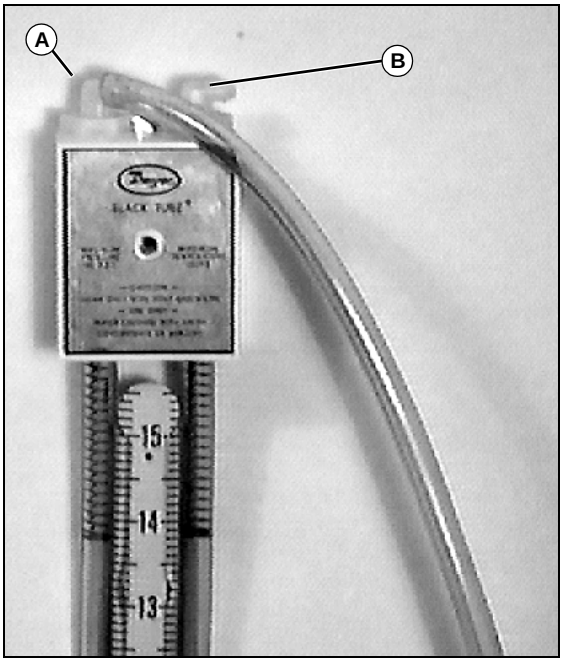
NOTE: Test must be run with the engine at normal operating temperature. If not, the test will be inaccurate. Do not use more than 3 ft. of manometer tubing. If a longer hose is used, the readings will be inaccurate.

1. Remove oil fill cap and check cap and O-Ring for cracks or damage. Replace as necessary.

2. Install appropriate size rubber plug in dipstick tube.

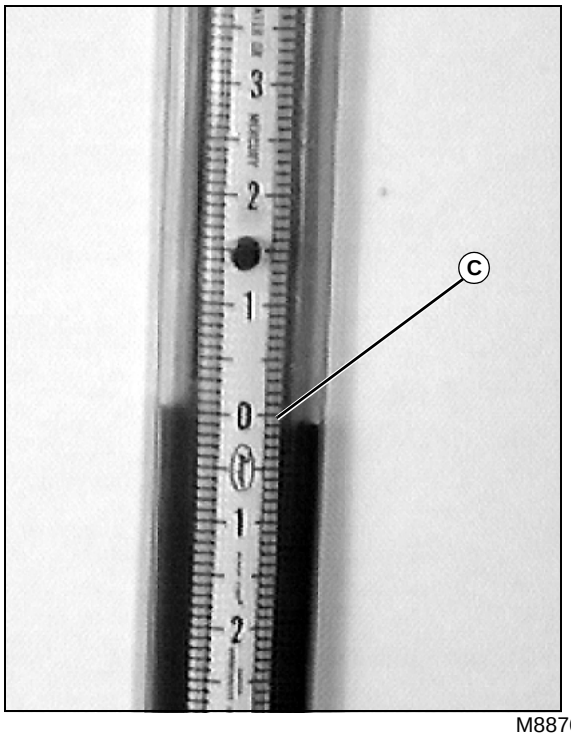
3. Insert barbed fitting in rubber plug so that clear line to fitting can be connected at a later step.

NOTE: Do not make connection between U-Tube manometer clear line and engine crankcase before engine is running or fluid in manometer could be drawn into crankcase.



M88761

4. Open top valves (A) and (B) one turn.

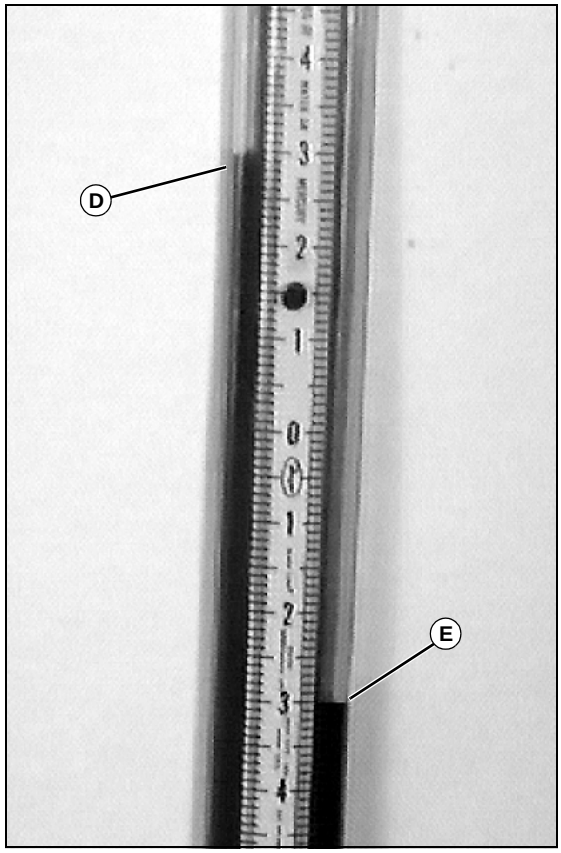


M88762

5. Zero out the manometer by sliding the ruled scale up or down so “0” (C) is located where water level on both sides is even.

6. Hold finger over rubber plug hole to keep oil from spraying out. Start engine, move throttle to fast idle and allow engine to reach operating temperature.

7. Quickly attach clear line from manometer to rubber plug in dipstick opening.



M88764

8. Record vacuum reading. Gauge should show a minimum vacuum of 10.2 cm (4 in.) of water movement. The reading is obtained by adding (D) and (E) water movement from “0” position.

NOTE: Repeat test at least three times for accuracy.

9. Remove line from manometer before stopping engine. Then remove dipstick hose connection and install oil check cap.

Automatic Compression Release (ACR) Check

Reason:

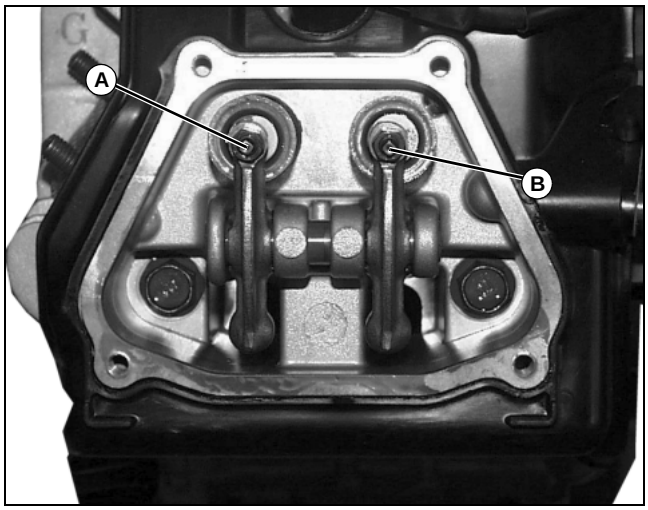
To determine if the automatic compression release is opening the exhaust valve.

Equipment:

- Dial Indicator

Procedure:

1. Remove the valve cover and spark plug. Rotate crankshaft slowly to observe ACR operation.



MX17518

2. The exhaust valve (A) must open briefly just after the intake valve (B) closes.

3. Use a dial indicator to measure exhaust valve ACR movement.

4. Install valve cover. See “Valve Cover/Breather Removal and Installation” on page 41.

- Exhaust valve ACR movement (minimum) 0.25 mm (0.01 in.).

Results:

If the exhaust valve does not open or depress properly, the automatic compression release tab is faulty and camshaft assembly must be replaced.

Valve Tappet Clearance Adjustment

Procedure:

NOTE: This adjustment should only be performed on a cold engine.

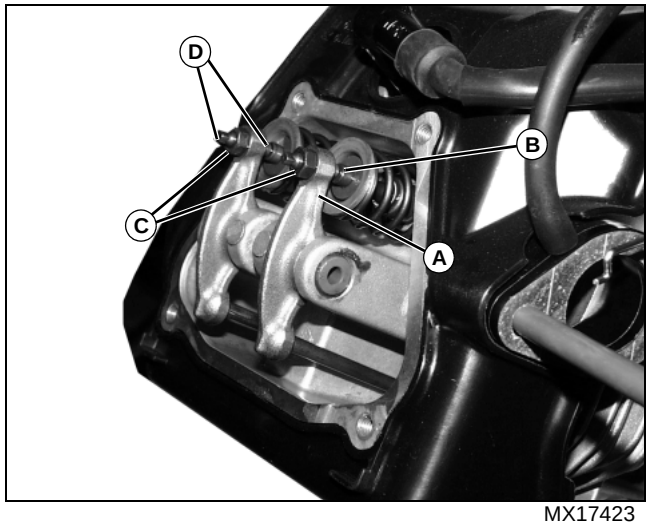
1. Remove air cleaner base assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Disconnect spark plug lead.

3. Remove spark plug. See “Spark Plug Removal and Installation” on page 34.

4. Remove valve cover. See “Valve Cover/Breather Removal and Installation” on page 41.

5. Rotate the flywheel until the piston is at TDC of the compression stroke.



MX17423

6. Insert a flat feeler gauge between the rocker arm (A) and the valve stem (B).

NOTE: The rocker arm must be held up when making adjustments.

7. Adjust the clearance as required by loosening the locknut (C) and turning the adjuster (D). Turn clockwise to decrease clearance and counterclockwise to increase clearance.

8. After clearance is set, tighten the locknut.

9. Gap and install a new spark plug.

10. Install the cylinder air shroud by matching the alignment slots on the ends with the corresponding raised grooves in the crankcase.

11. Position the spark plug lead within the corresponding cutout in the shroud.

12.Adjust both intake and exhaust valve clearances to 0.1 mm (0.004 in.).

13.Tighten locknuts to 7 N•m (62 lb-in.).

Repair

Air Cleaner Assembly Removal and Installation

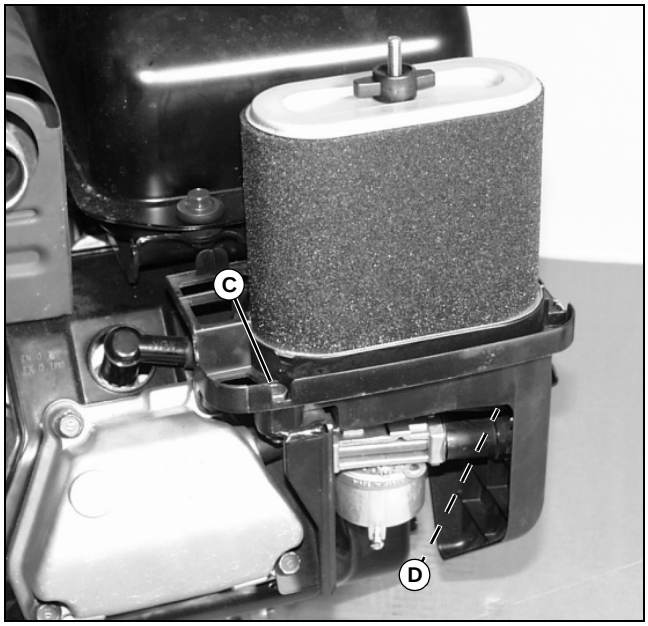
Removal:

MX19679

1. Remove the wing nut (A) securing air cleaner cover to air cleaner assembly.

2. Remove the air cleaner cover.

3. Remove the two nuts (B) securing the base to the carburetor mounting studs.



MX19680

4. Remove the bolt (C) securing the base to the mounting bracket.

5. Disconnect the breather hose (D) from the air cleaner base.

NOTE: The air filter assembly does not need to be removed to remove the air cleaner assembly.

6. Slide the air cleaner base off of the studs.

Cleaning:

IMPORTANT: Avoid damage! Do not wash the paper element or use pressurized air as this will damage the element. Replace a dirty, bent, or damaged element with a new one. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.

NOTE: every 50 hours of operation (more often under extremely dusty or dirty conditions), check the paper element. Replace the element as necessary. Remove and service the pre-cleaner.

1. Wash the pre-cleaner in warm water with detergent.

2. Rinse the pre-clean thoroughly until all traces of detergent are eliminated.

3. Squeeze out excess water (do not wring).

4. Allow the pre-cleaner to air dry.

5. Clean the paper air cleaner element by tapping the element to remove dust.

6. Replace the element if damaged, bent, or extremely dirty.

7. Handle new element carefully; do not use if the sealing surfaces are bent or damaged.

8. Check the air cleaner base and cover/housing assembly to ensure that they are not bent or damaged.

9. Make sure the air slots are open.

10. Saturate the pre-cleaner with new engine oil. Squeeze out all excess oil.

11. Install the foam damper and pre-cleaner over the paper element.

Installation:

IMPORTANT: Avoid damage! Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

NOTE: Before the air cleaner is reassembled make sure the rubber seal is in position on the stud. Also inspect the foam seal on the base of the filter element.

Installation is in the reverse of removal.

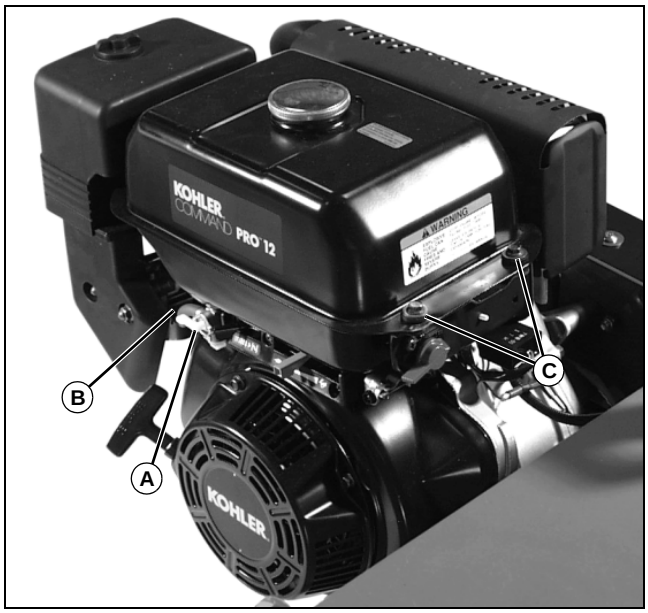
- Tighten the carburetor mounting nuts to 10 - 12 N•m (88 - 106 lb-in.).
- Tighten hex flange screw to 5 - 8 N•m (44 - 71 lb-in.).

Fuel Tank Removal and Installation

CAUTION: Avoid injury! Gasoline is extremely flammable and its vapors can explode if ignited. Spilled fuel could ignite if it comes in contact with hot parts. Allow engine to cool before servicing. Drain all fuel from the fuel tank before removing or installing.

Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.



MX19809

2. Close fuel shut off valve (A) and disconnect fuel line from carburetor inlet (B).

3. Route fuel line into a suitable container and open fuel shutoff valve to drain fuel from fuel tank.

4. Close fuel shut off valve.

5. Remove the two cap screws on each end (C) securing the fuel tank support brackets.

6. Remove the fuel tank.

Installation:

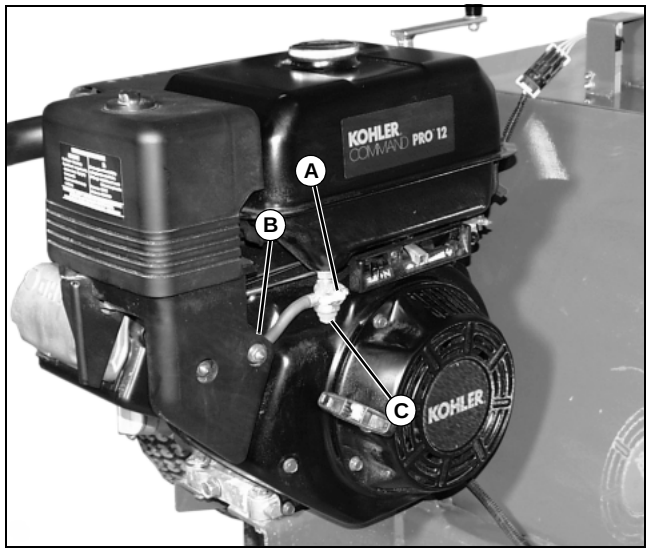
- Installation is in the reverse of removal.

Fuel Sediment Bowl Cleaning

CAUTION: Avoid injury! Gasoline is extremely flammable and its vapors can explode if ignited. Spilled fuel could ignite if it comes in contact with hot parts. Allow engine to cool before servicing.

Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.



MX19811

2. Close fuel shut off valve (A) and disconnect fuel line from carburetor inlet (B).

3. Route fuel line into a suitable container and open fuel shutoff valve to drain fuel from fuel tank.

4. Close fuel shut off valve.

5. Remove the fuel sediment bowl (C).

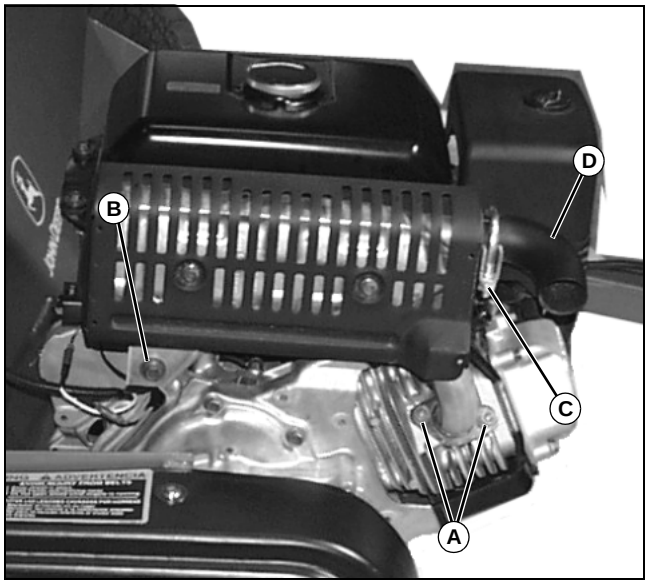
6. Clean the sediment bowl using carburetor cleaner to clean out any dirt or contamination.

Installation:

- Installation is in the reverse of removal.
- Ensure that fuel line retaining clips are securely in place and there are no leaks.

Muffler Removal and Installation

Removal:



MX19829B

1. Remove the hex flange nuts (A) from the exhaust studs at the engine muffler bracket.
2. Remove the muffler support nut (B) from the block.
3. Remove the muffler assembly from the exhaust outlet.
4. Remove exhaust gasket from outlet.
5. Remove the muffler clamp (C) and the exhaust elbow (D).

Installation:

1. Install a new gasket onto the exhaust studs.
2. Install the muffler assembly.
3. Install all fasteners finger tight.
4. Tighten the hex flange nuts (A) at the exhaust studs to 18 - 22 N•m (159 - 195 lb-in.).
5. Tighten the muffler support nut (B) to 18 - 22 N•m (159 - 195 lb-in.).
6. Install the exhaust elbow (D) and tighten the muffler clamp (C) to 18 - 22 N•m (159 - 195 lb-in.).

Spark Plug Removal and Installation

Procedure:

Engine misfire or starting problems are often caused by a spark plug that is in poor condition or has an improper gap setting.

Every 100 hours of operation, remove the spark plug, check its condition and reset gap, or replace it with a new plug as necessary.

1. Before removing the spark plug, clean the area around the base of the plug to keep dirt and debris out of the engine.

IMPORTANT: Avoid damage! Do not clean the spark plug with a machine that uses abrasive grit. Some grit could remain in/on the spark plug and enter the engine, causing extensive wear and damage.

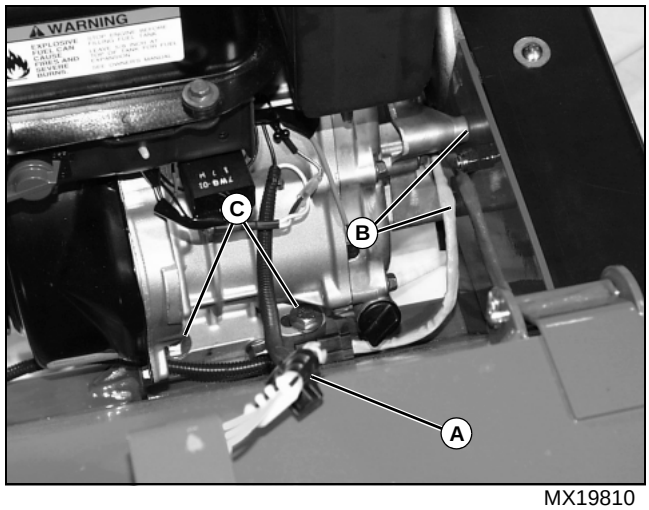
2. Remove the plug and check its condition. Replace the plug if worn or reuse is questionable. See “Spark Plug Troubleshooting” on page 25.
3. Check the gap using a wire feeler gauge. Adjust the gap by carefully bending the ground electrode.
4. Set the spark plug gap to 0.76 mm (0.030 in.).
5. Reinstall the spark plug into the cylinder head and tighten to 20 N•m (177 lb-in.).

Engine Removal and Installation

Removal:

CAUTION: Avoid injury! Gasoline is extremely flammable and its vapors can explode if ignited. Spilled fuel could ignite if it comes in contact with hot parts. Allow engine to cool before servicing. Drain all fuel from the fuel tank before removing or installing.

1. Drain fuel tank into a suitable container.
2. Remove the drive belt. See “Drive Belt Removal and Installation” on page 83 in the Miscellaneous Section.
3. Remove the PTO clutch assembly. See “PTO Clutch Removal and Installation” on page 83 in the Miscellaneous Section.



MX19810

4. Disconnect the engine interlock wiring harness (A) from the safety switch.

5. Remove the two engine side plate mounting bolts (B).

6. Remove four engine mounting bolts and nuts (C). (Two on each end.)

7. Remove engine from mounting plate.

Installation:

1. Install engine in reverse order of removal.

2. Adjust the drive belt tension.

3. Install the belt guard and secure with three screws.

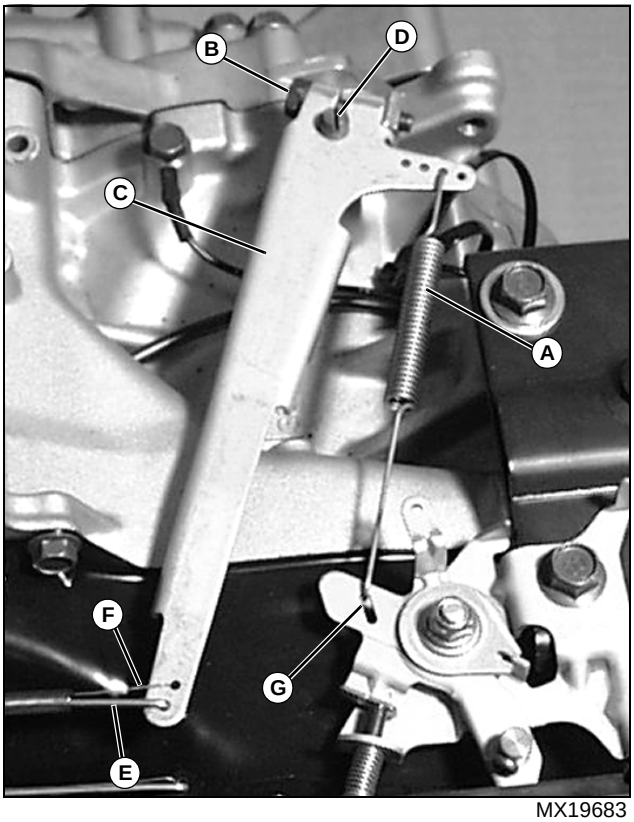
External Governor and Throttle Linkage Removal and Installation

Removal:

1. Remove air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Drain fuel tank into a suitable container.

3. Remove fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.



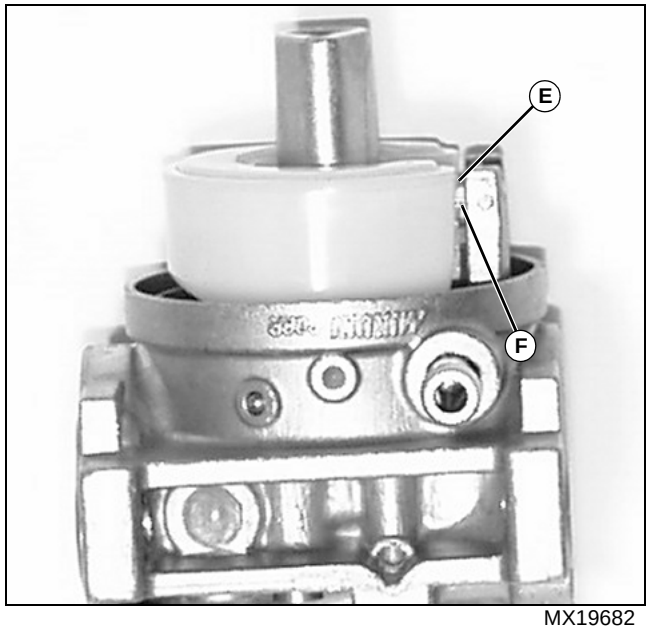
MX19683

4. Mark which hole location the governor spring (A) is in.

5. Loosen the hex flange screw (B) securing the governor lever (C) to the governor shaft (D).

6. Lift off the governor lever with throttle linkage (E) and dampening spring (F) attached.

7. Remove the governor spring from the throttle lever (G).



MX19682

8. Remove the throttle linkage (E) and dampening spring (F) from the carburetor throttle shaft.

9. Remove the throttle linkage and dampening spring from the governor lever.

Installation:

1. Connect the throttle linkage and dampening spring to the carburetor throttle shaft.

2. Connect the throttle linkage and dampening spring to the governor lever.

3. Install the governor lever onto the shaft. Do not tighten at this time.

NOTE: Installing the governor spring in the correct hole is critical for proper generator operation. If the spring is installed in the wrong location, the engine will not rotate at the proper rpm.

4. Connect the governor spring to the arm of the governor lever into the hole marked at disassembly.

5. Connect the governor spring to the arm of the governor lever into the hole marked at disassembly.

6. Connect the governor spring to the throttle lever.

7. Perform governor lever adjustment. See “Governor Lever Adjustment” on page 28.

8. Install fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.

9. Install air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

Carburetor Removal and Installation

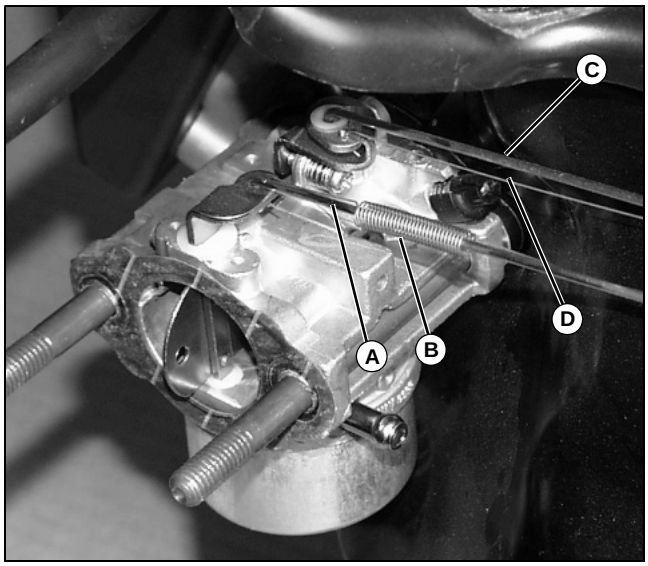
CAUTION: Avoid injury! Gasoline may be present in the carburetor and fuel system. Gasoline is extremely flammable and its vapors can explode if ignited. Keep sparks, open flames, and other sources of ignition away from the engine.

Removal:

1. Remove air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Close the fuel shutoff valve.

3. Remove fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.



MX19677

4. Disconnect the choke linkage (A) and dampening spring (B) from the choke shaft.

5. Slide the carburetor off of the mounting studs far enough to allow the carburetor to rotate and disconnect the throttle linkage (C) and dampening spring (D) from the throttle shaft.

6. Remove the spacer block and gaskets from the studs.

Installation:

Installation is in the reverse of removal.

- Be sure to install new carburetor spacer gaskets when installing.

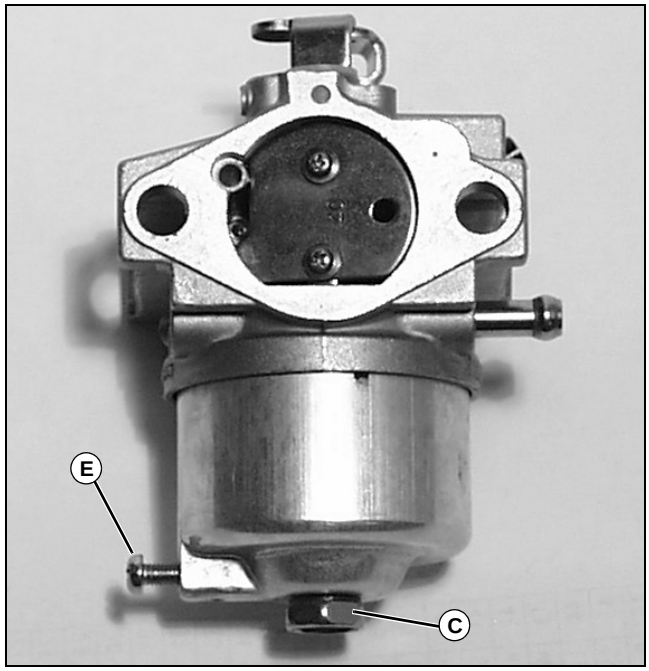
Carburetor Disassembly and Assembly

CAUTION: Avoid injury! Gasoline may be present in the carburetor and fuel system. Gasoline is extremely flammable and its vapors can explode if ignited. Keep sparks, open flames, and other sources of ignition away from the engine.

Procedure:

1. Remove carburetor assembly.

2. Clean all dirt and debris from exterior of carburetor.



MX19684

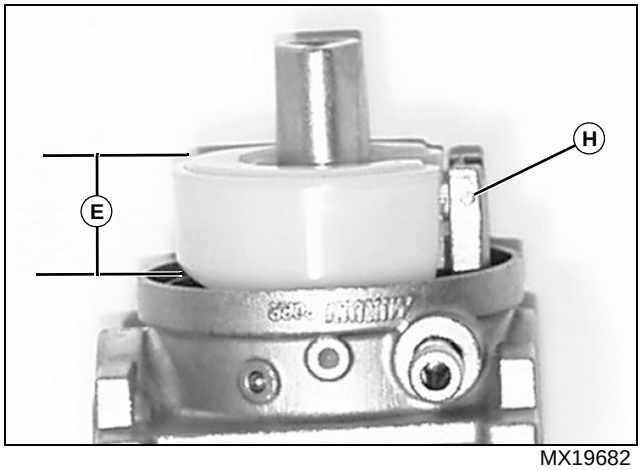
3. Remove the drain screw (E) from the float bowl and drain the fuel from the float bowl into a suitable container.

4. Remove the bowl retaining screw (F).

5. Carefully separate the bowl from the main body and remove the bowl gasket from the body.

IMPORTANT: Avoid damage! Do not bend the float in an attempt to reset the height. The correct float height is determined by the design of the inlet needle and float. There is no provision for physical adjustment.

6. Place the carburetor in an inverted position. Lift up the float so that the tip of the float valve lightly contacts the float arm.



MX19682

7. Measure the float height (G). The height should be 14.9 mm (0.59 in.).

8. If the float height is incorrect, use a float kit during assembly.

9. Grab the exposed end of the float pin (H) with a needle nose pliers and pull it out.

10.Lift out the float and inlet needle.

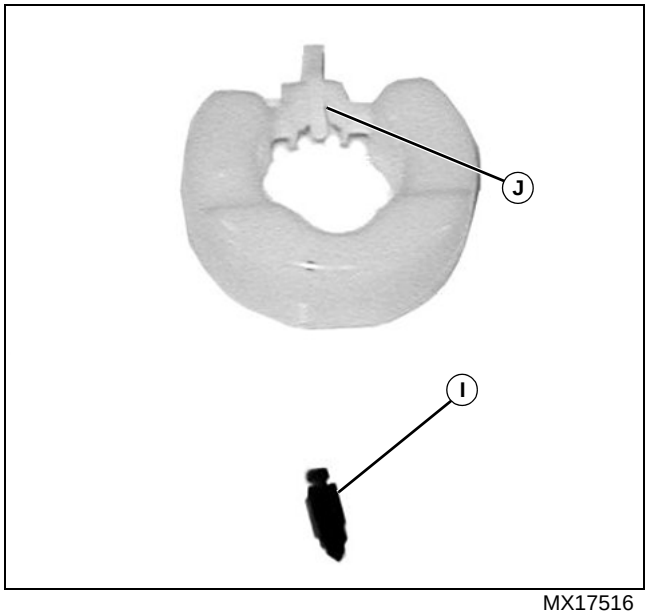
11.Slide the inlet needle and the clip off of the float tab.

12.Check components for wear, contamination, or damage.

13.Use carburetor cleaner to clean out any dirt or contamination.

14.Use a float kit if the inlet needle or float is damaged or worn.

15.If the inlet seat is damaged or worn, the carburetor must be replaced.



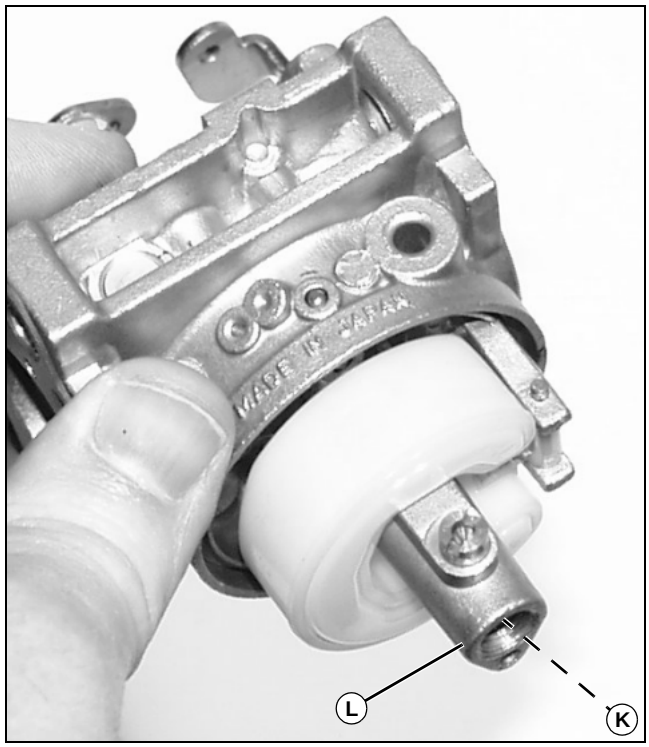
MX17516

16.After the parts have been cleaned or exchanged, slide the inlet needle (I) onto the float tab (J).

17.Install the float assembly into the carburetor and verify that the correct float height has been restored.

18.If there were gum or varnish deposits in the area of the inlet needle and seat, there is a good possibility that the main nozzle may also need cleaning before the bowl is installed.

NOTE: If the main nozzle does not turn easily, use carburetor cleaner to clean the exposed threads in the tower.

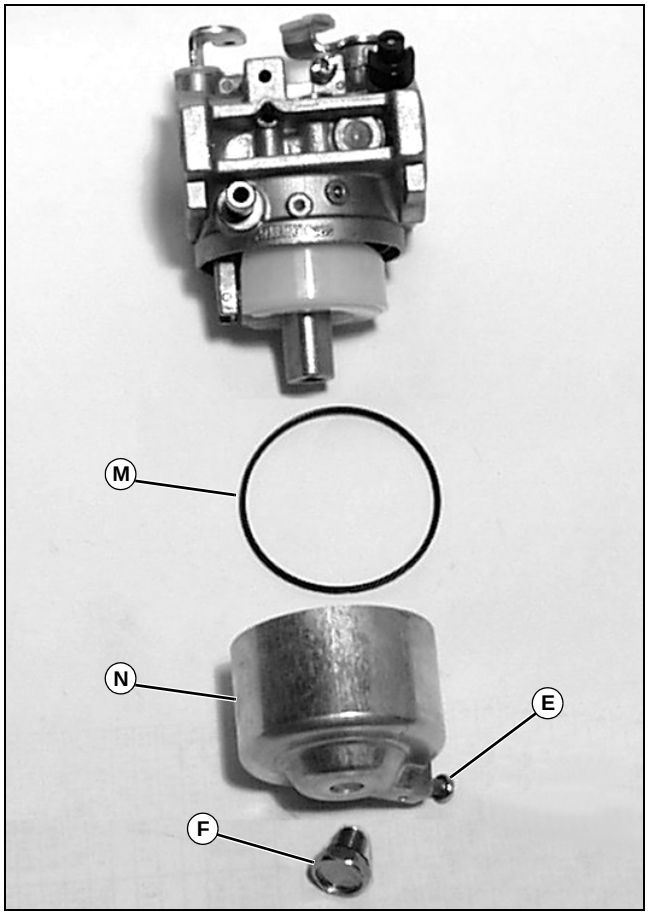


MX19685

19. Use a thin, flat blade screwdriver to remove the nozzle (K) from the tower (L).

20. Soak the nozzle in carburetor cleaner to remove any deposits and blow dry it with compressed air.

21. Install nozzle in the tower and thread it in until it bottoms.



MX19686

22.Install the bowl gasket (M) in groove in carburetor body.

23.Assemble the bowl (N) to the carburetor. Position the bowl so the drain screw (E) will be accessible after the carburetor is mounted to the engine.

24. Install the bowl retaining screw (F) and tighten to 9 N•m (79 lb-in.).

25. Install carburetor.

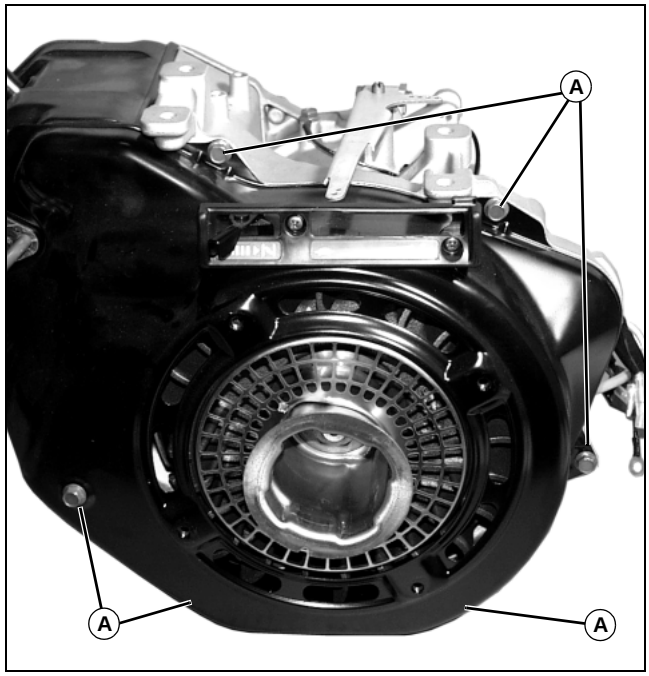
Blower Housing Removal and Installation

Removal:

1. Remove air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Close the fuel shutoff valve.

3. Remove fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.



MX19687

4. Remove the six hex flange screws (A) securing the blower housing.

5. Remove blower housing.

Installation:

Installation is in the reverse of removal.

- Tighten hex flange screws to 7 N•m (62 lb-in.).

Flywheel Removal, Inspection, and Installation

Removal:

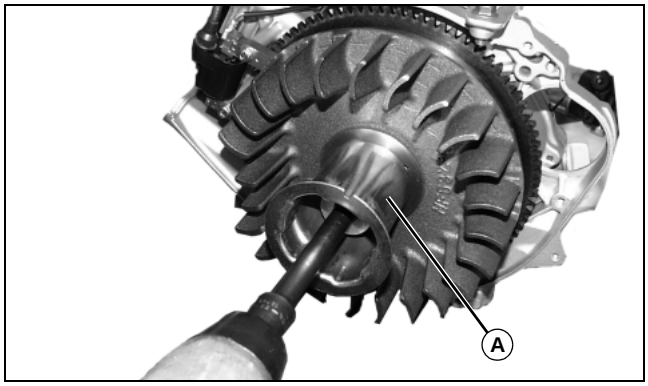
1. Remove air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Close the fuel shutoff valve.

3. Remove fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.

4. Remove ignition coil. See “Ignition Coil Removal and Installation” on page 40.

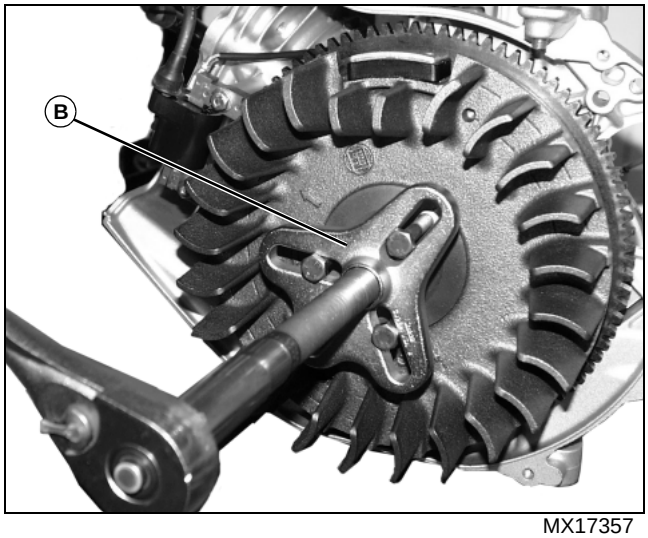
NOTE: An impact wrench should be used to loosen the flywheel retaining nut. A flywheel strap wrench or an approved holding tool may be used to hold the flywheel when loosening or tightening the flywheel retaining nut.



MX17358

5. Remove the flywheel nut, washer, and drive cup (A).

IMPORTANT: Avoid damage! Always use a puller to remove the flywheel from the crankshaft. Do not strike the flywheel or crankshaft as these parts could become cracked or damaged.

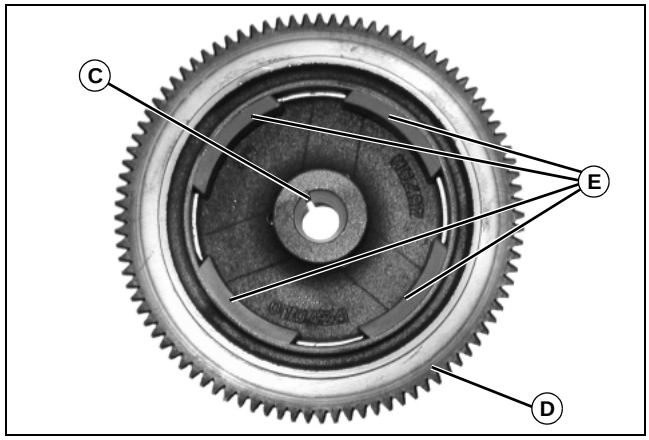


MX17357

6. Remove the flywheel from the crankshaft using a puller (B).

7. Remove the flywheel key from the keyway.

Inspection:



MX17363

1. Inspect the flywheel for cracks and the flywheel keyway (C) for damage. Replace flywheel if cracked.

2. Replace the flywheel, crankshaft, and the key if flywheel or crankshaft keyway is damaged.

3. Inspect the ring gear (D) for wear, cracks, or damage. Replace the flywheel if the ring gear is damaged.

4. Inspect the stator magnets (E) and ignition magnet for damage. Repair or replace as necessary.

Installation:

IMPORTANT: Avoid damage! Check that crankshaft end and flywheel hub are clean and free of lubricant, and flywheel key is installed properly in keyway. Improperly installed flywheel can cause machine damage and serious personal injury

1. Install the woodruff key into the keyway of the crankshaft.

2. Install the flywheel onto the crankshaft being careful not to shift the woodruff key.

3. Use a flywheel holding tool and torque wrench to tighten flywheel nut to 120 N•m (88 lb-ft).

Ignition Coil Removal and Installation

Removal

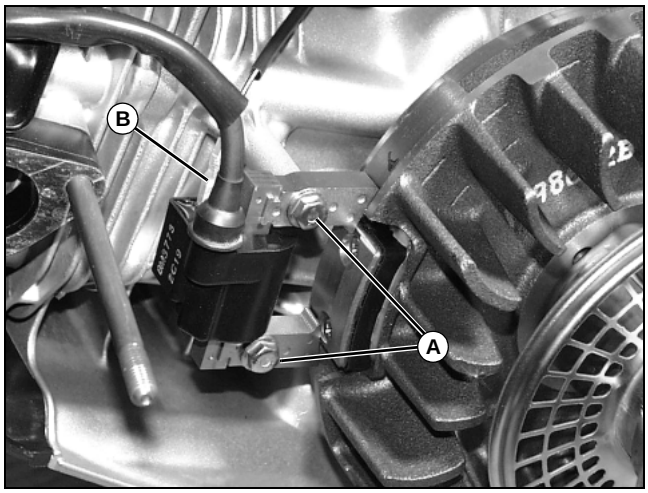
1. Remove air cleaner assembly. See “Air Cleaner Assembly Removal and Installation” on page 32.

2. Close the fuel shutoff valve.

3. Remove fuel tank assembly. See “Fuel Tank Removal and Installation” on page 33.

4. Remove blower housing. See “Blower Housing Removal and Installation” on page 38.

5. Remove spark plug cap from spark plug.



MX19675

6. Remove the two hex flange screws (A) securing the ignition module to the crankcase.

7. Remove ignition module kill wire (B).

8. Remove ignition module.

Installation:

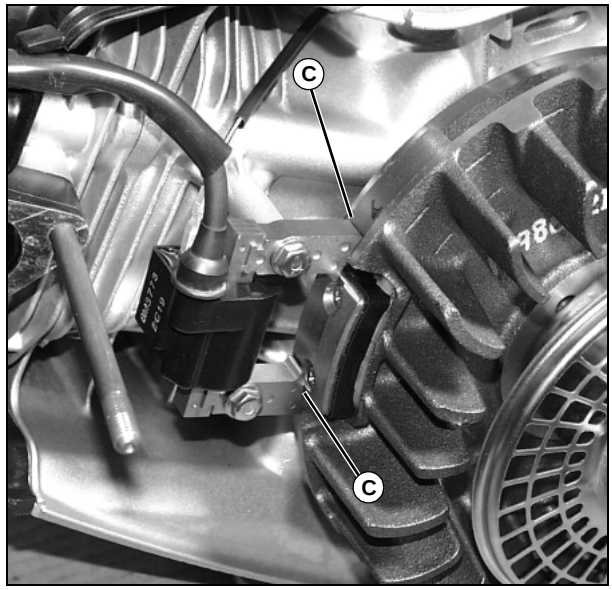
1. Turn the flywheel so the magnet is away from the location where the ignition module will be installed.

2. Install the ignition module loosely to the bosses with the two hex flange screws.

3. Move the module as far away from the flywheel as possible, then tighten the screws just enough to hold it in position.

4. Rotate the flywheel in a clockwise direction until the magnet is under the legs of the ignition module.

IMPORTANT: Avoid damage! The engine is very sensitive to this adjustment so both legs of the coil must have the same air gap.



MX19675

5. Select the 0.5 mm (0.020 in.) feeler gauge blade and insert it between the flywheel and coil legs (C).

6. Turn flywheel until magnet aligns with the legs of the ignition coil and feeler gauge spans both legs of coil and the flywheel magnet at the same time.

7. Allow the magnet to draw the module against the gauge.

8. Hold the coil in position and tighten the cap screws. Rotate the flywheel to remove the feeler gauge.

9. Starting with the lower cap screw, tighten ignition module mounting screws to 10 N•m (88 lb-in.).

10. Rotate the flywheel back and forth, checking to make sure the magnet does not strike the module.

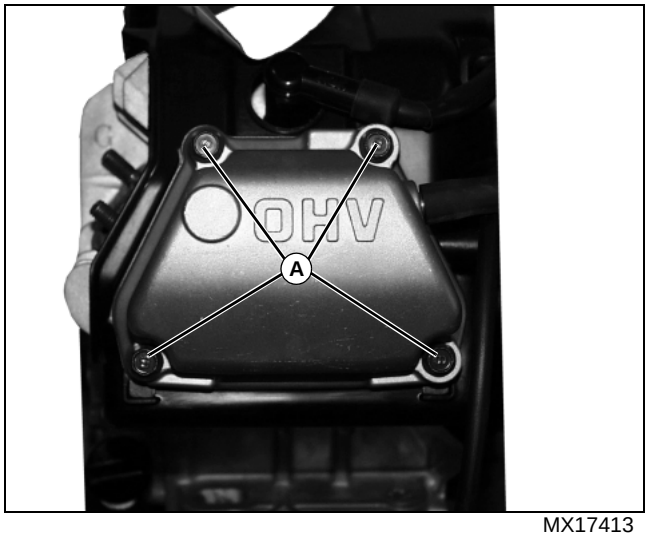
11.Connect ignition module kill wire to the coil terminal.

12.Connect the spark plug cap to the spark plug.

Valve Cover/Breather Removal and Installation

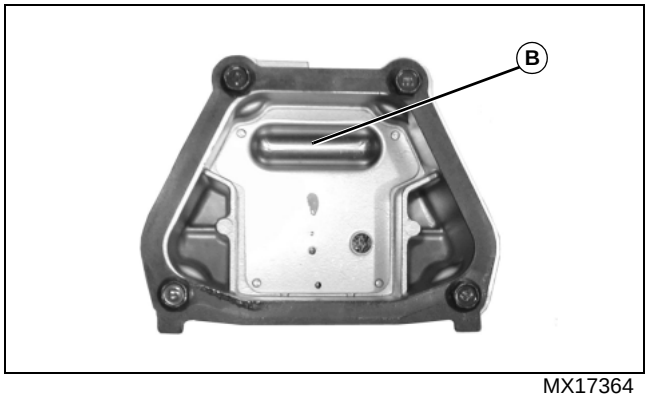
Removal:

1. Disconnect the breather hose from the valve cover.



MX17413

2. Remove the four hex flange screws (A) securing the valve cover.



MX17364

3. Remove the valve cover and gasket from the cylinder head. The breather assembly (B) is inside the valve cover.

Installation:

1. Install a new valve cover gasket onto the cylinder head.
2. Install the valve cover screws and tighten to 10 - 12 N•m (88 - 106 lb-in.).

Cylinder Head Removal and Installation

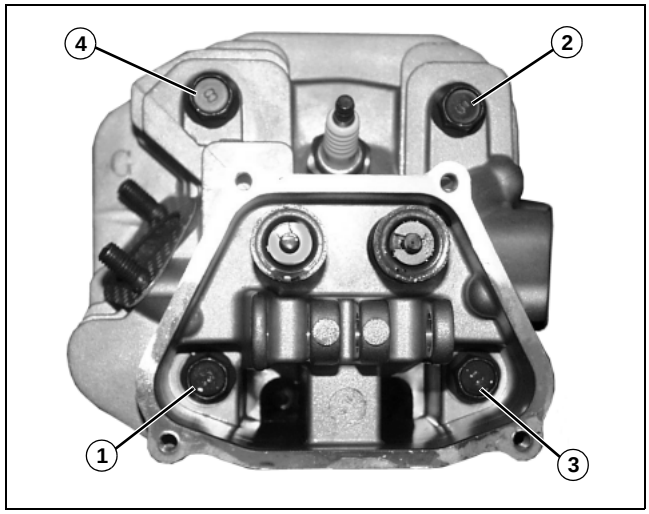
1. Remove valve cover. See “Valve Cover/Breather Removal and Installation” on page 41.

NOTE: The breather assembly is inside the valve cover.

2. Lift the air shroud from the cylinder head.
3. Remove the four hex flange screws securing cylinder head.
4. Remove cylinder head, dowel pins, and cylinder head gasket.

Cylinder Head Installation:

1. Check to make sure there are no nicks or burrs on the sealing surfaces of the cylinder head or crankcase.
2. Rotate the crankshaft to position the piston at TDC on the compression stroke.
3. Install the dowel pins into the recesses around the lower cylinder head bolt holes.
4. Install a new cylinder head gasket.



MX17535

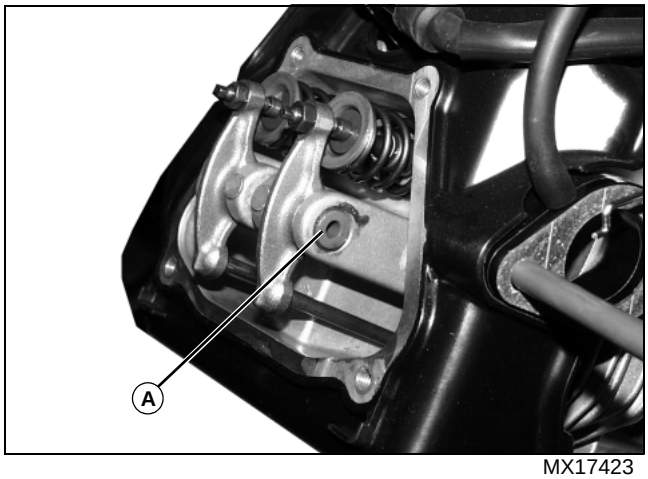
5. Install the cylinder head and start the four hex flange screws.
6. Tighten the screws in several increments using the sequence shown, to a final torque of 50 N•n (36 lb-ft).

Rocker Arm and Push Rod Removal and Installation

Removal:

1. Remove valve cover and gasket. See “Valve Cover/ Breather Removal and Installation” on page 41.

2. Turn crankshaft until piston is at its highest position on compression stroke until valves are closed and all valve spring pressure is off valve train.



MX17423

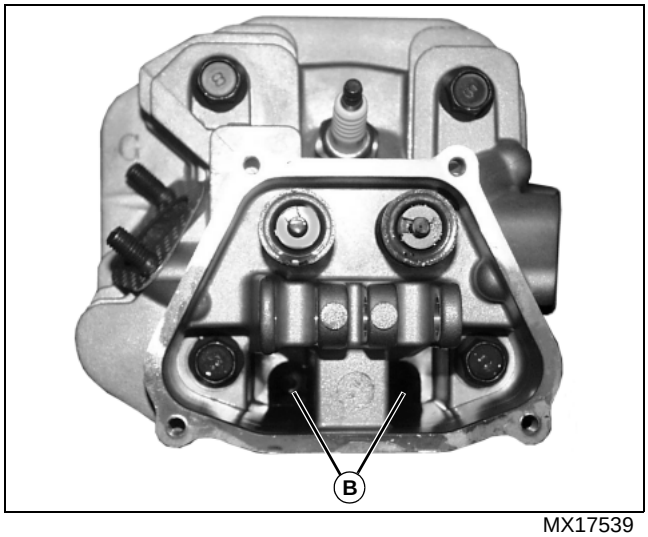
3. Holding rocker arms, slide rocker shaft (A) out of supports.

4. Remove rocker arms noting their positions.

5. Remove push rods, noting their positions.

Installation:

1. If cylinder head is on engine, ensure that the piston is at TDC with the cam lobes off of the valve tappets (TDC of compression stroke).



MX17539

2. Dip the push rods in clean engine oil and insert push rods into their respective locations (B).

3. Position rocker arm next to the rocker shaft boss, ensuring that the push rod is properly seated in the rocker arm.

4. Repeat for second rocker arm. Coat rocker arm shaft with fresh engine oil, insert it into cylinder head supports, and center the shaft so that it does not protrude out of either end of the supports.

Valve Removal, Inspection, and Installation

Removal:

1. Remove cylinder head. See “Cylinder Head Removal and Installation” on page 41.

2. Install valve spring compressor under valve retainer.

3. Compress valve spring and remove stem cap and retainer.

NOTE: If removing intake valve, valve stem seal will be removed with retainer.

4. Pull valve out by valve head and remove valve spring and valve spring compressor.

5. Repeat for second valve if necessary.

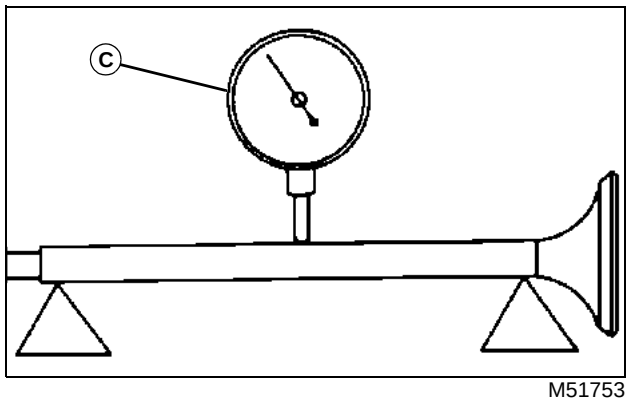
6. Inspect valve(s). See “Valve Inspection:” on page 42.

Valve Inspection:

1. Remove carbon from valve face, head, and stem with a power operated wire brush. Be sure that carbon is removed, not merely burnished.

2. Check valve for damage. If valve face is burned, pitted, or worn, grind valve to proper face angle. See “Valve Face Reconditioning” on page 43. If valve head margin is less than 0.794 mm (0.031 in.) after grinding, replace valve.

3. Grind valve stem end square if required.



M51753

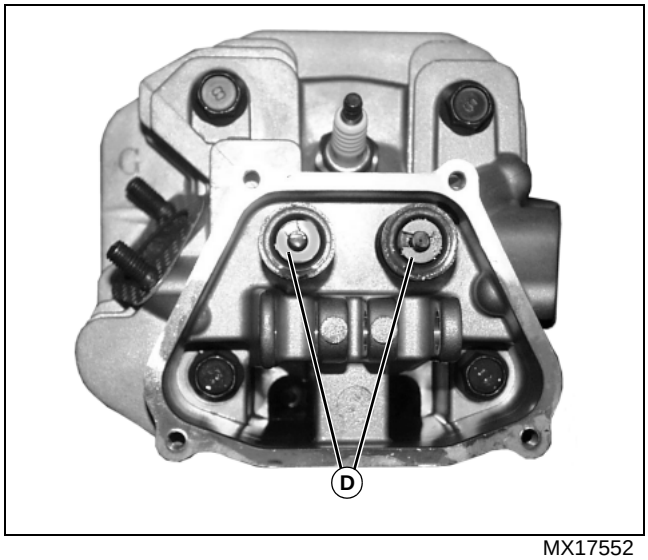
4. Check valve for out of round, bent, or warped conditions using a V-blocks and a dial indicator. Turn valve slowly and read variation on indicator (C). Replace valve if variation is greater than 0.01mm (0.0004 in.).

Installation:

1. Install valve spring into cylinder head.
2. Install valve caps onto valve springs.
3. Apply clean engine oil to valve stems.
4. Install valve into valve guide.

NOTE: If installing intake valve, be sure to reinstall the valve seal with retainer, if removed.

5. Install valve spring compressor under valve spring.
6. Compress spring until groove in valve stem is exposed.



MX17552

7. Lock each valve in place with a lock clip (D). Install lock clip with its rounded edges down.

IMPORTANT: Avoid damage! Valves must be adjusted when cylinder head is reinstalled to crankcase!

8. Reinstall rocker arms. See “Rocker Arm and Push Rod Removal and Installation” on page 42.

Valve Face Reconditioning

1. Remove all carbon from valve head and stem before attempting to grind face. Clean large carbon deposits with a wire wheel. Chuck valve stem in a drill press and spin valve while polishing stem and head with progressively finer grits of emery cloth until polished.

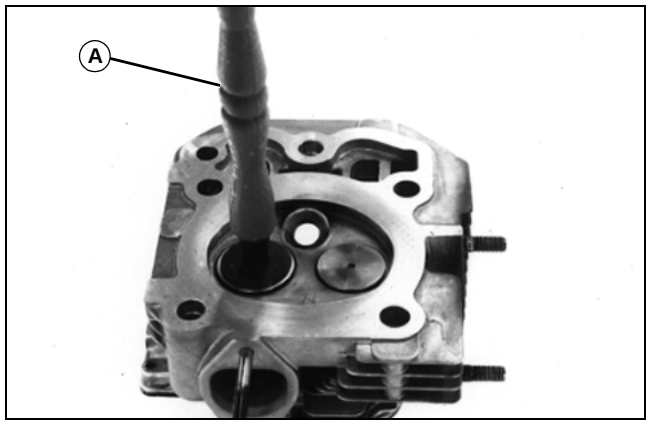
2. Valves should be ground on a valve grinder with stones that have been dressed to be flat. Use cooling lubricant to prevent overheating. Be sure valve is chucked in grinder straight. Only grind away enough material to smooth valve face around circumference of valve.

Valve Lapping

Lapping should only be done after grinding valve face and seat. See “Valve Face Reconditioning” on page 43.

NOTE: Lapping is not a substitute for a proper valve job.

1. Apply a small amount of lapping compound to valve face.



M52134

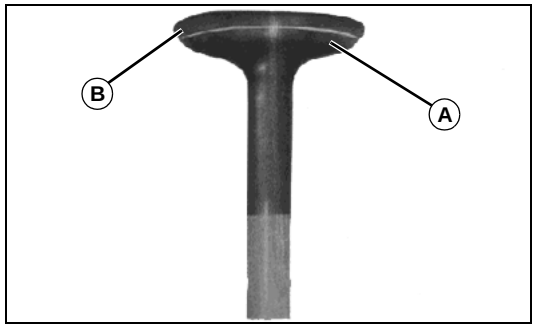
2. Insert valve in proper valve seat in head and turn using a vacuum cup tool (A).

3. Check valve every eight strokes until a uniform ring appears around the surface of the valve face.

4. Wash parts in solvent to remove lapping compound.

Valve Condition

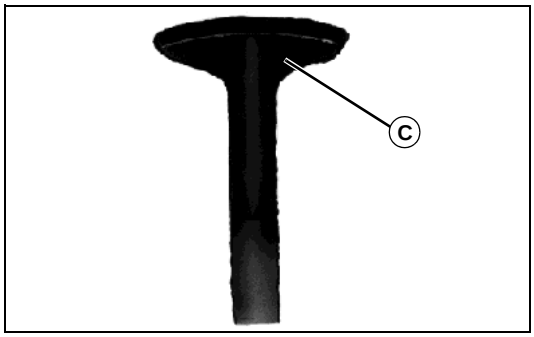
Normal:



M30024

This valve can be reconditioned and reused if the face (A) and margin (B) are in good condition. If a valve is worn to where the margin is less than 1 mm (0.04 in.), do not reuse it.

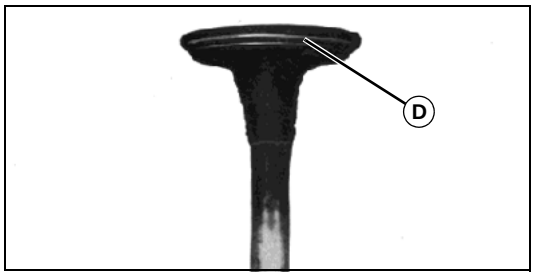
Bad Condition:



M5563

The valve depicted here should be replaced. The head (C) is warped, the margin is damaged, and it is too narrow. These conditions could be attributed to excessive hours or a combination of poor operating conditions.

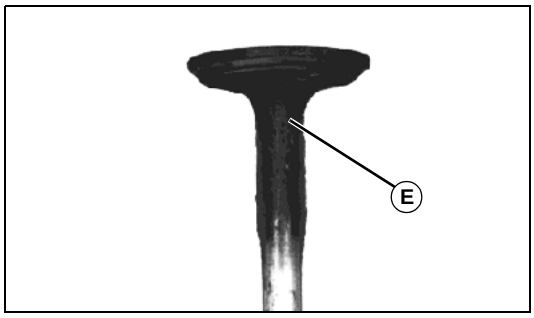
Coking:



M29934

Coking is normal on intake valves and is not harmful. If the seat (D) is good, the valve can be reused after cleaning.

Gum:



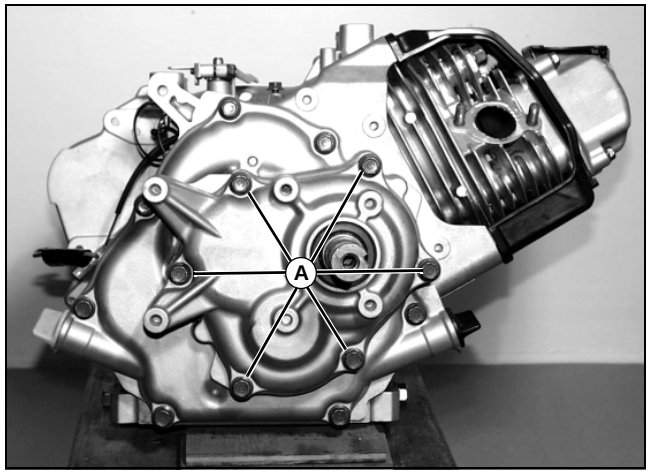
M29936

Gum deposits (E) usually result from using stale gasoline. Gum is a major cause of valve sticking. The valve guides may be reamed or replaced depending in their condition.

Gear Reduction Assembly Removal and Installation

Removal:

1. Drain engine oil into a suitable container.
2. Remove the PTO clutch.
3. remove any nicks or burrs from the output shaft.

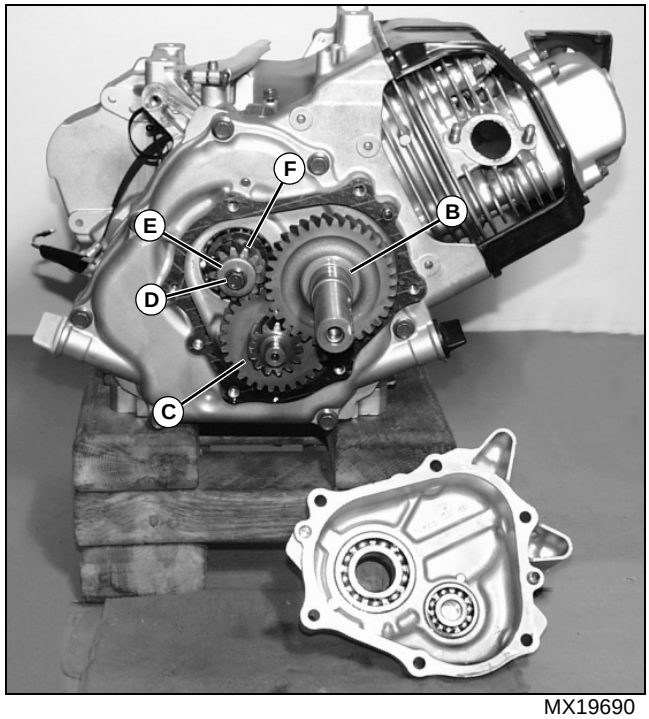


MX19689

4. Remove the six cap screws (A) securing the reduction cover to the closure plate.

NOTE: Output shaft and reduction gear shaft may come out with the reduction cover.

5. Pull the reduction cover off of the closure plate and output shaft.



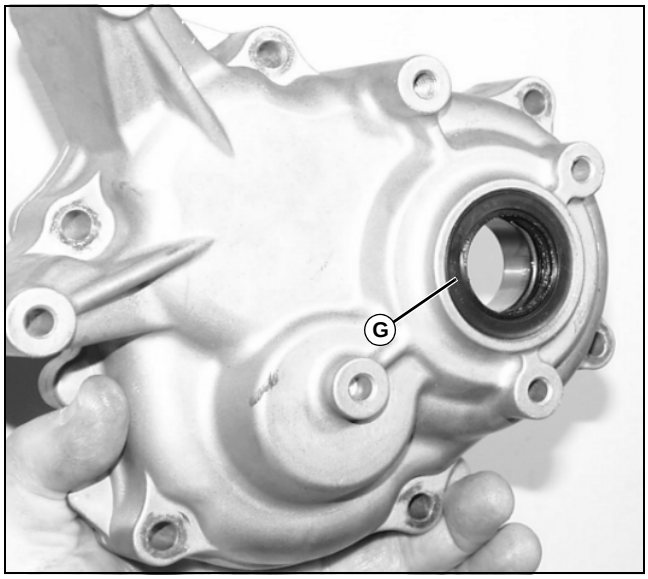
MX19690

6. Remove the output shaft (B) and reduction shaft (C).

7. Remove the cap screw (D), washer (E), and sprocket gear (F) from crankshaft.

8. Inspect the output shaft bearings and reduction shaft bearings for wear or damage. Replace as needed.

9. Use an internal bearing puller for the housing bearings. Use and arbor press to remove the remaining bearings.



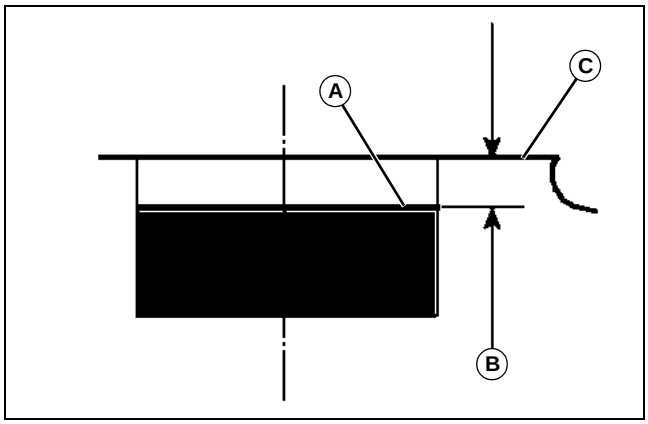
MX19691

10.Remove the output shaft seal (G) if either the inner or outer seal lip is damaged.

Installation:

1. Clean all components with solvent. Dry completely before installing onto engine.

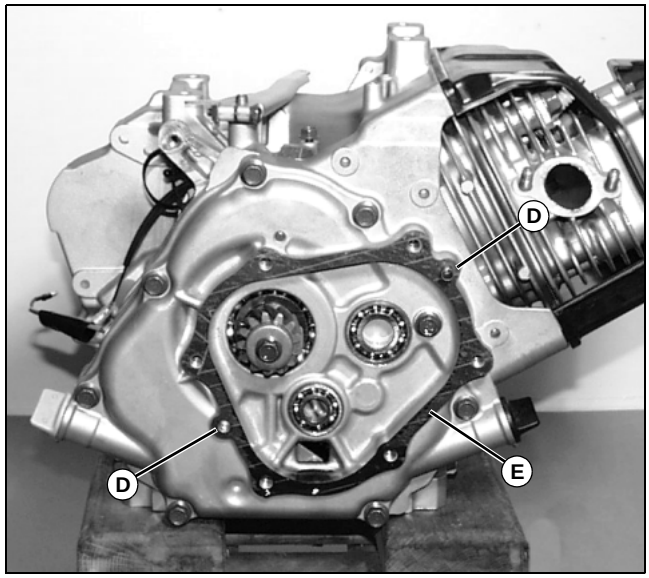
2. Lightly coat each component with clean engine oil before installation.



MX17446

3. If remove, install a new output shaft seal (A) to a depth (B) of 2 mm (0.079 in.) below the cover shoulder (C).

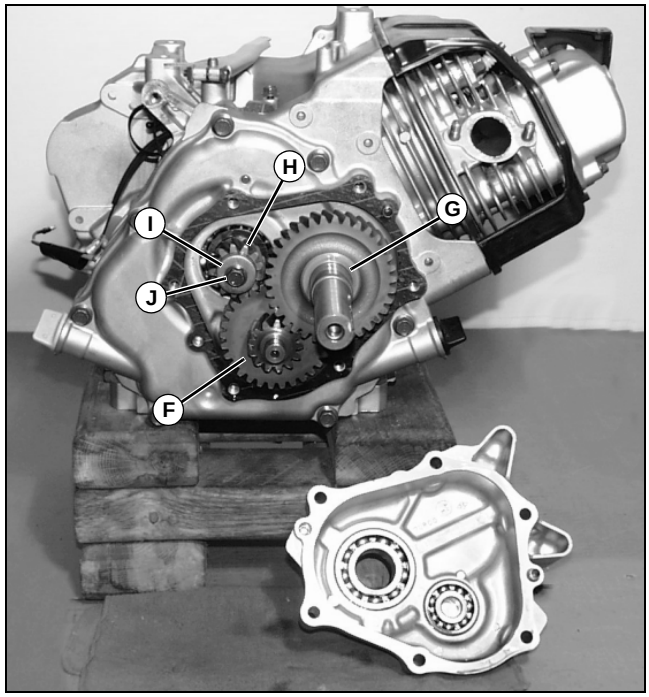
4. Ensure that the sealing surfaces of the reduction cover and closure plate are clean and free of nicks/burrs.



MX19692

5. Install the two dowel pins (D) into the closure plate.

6. Install the new reduction cover gasket (E) onto the dowel pins.

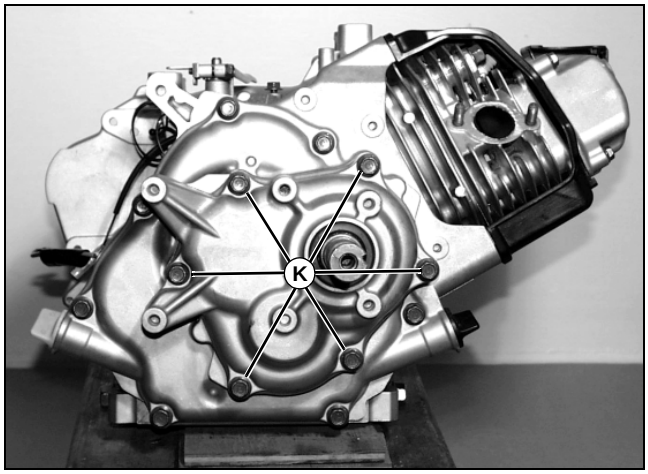


MX19690

7. Install the reduction gear (F) and output shaft (G).

8. Install the sprocket gear (H), washer (I), and cap screw (J), into crankshaft.

9. Slide the reduction cover on to output shaft, reduction shaft and dowel pins in the closure plate.

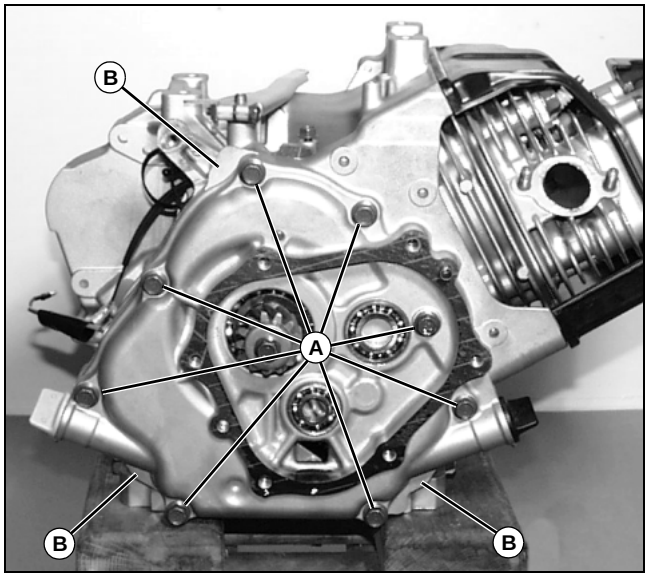


MX19689

10.Install and evenly tighten the six reduction cover cap screws (K) to 30 N•m (22 lb-ft).

Closure Plate Removal and Installation

Removal:



MX19692

1. Remove the eight cap screws (A) securing the closure plate to the crankcase.

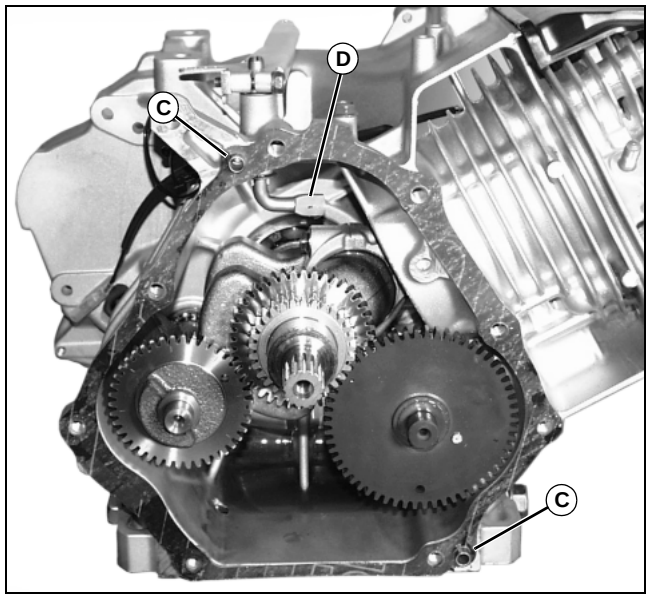
IMPORTANT: Avoid damage! Do not pry on the gasket surface of the crankcase or closure plate as this can cause damage and leakage.

2. Locate the pry/tap pads (B) on the closure plate. These areas permit separation of the closure plate from the crankcase with a flat screwdriver or by tapping with a plastic hammer.

Installation:

1. Ensure that the sealing surfaces of the crankcase and closure plate are clean and free of nicks/burrs.

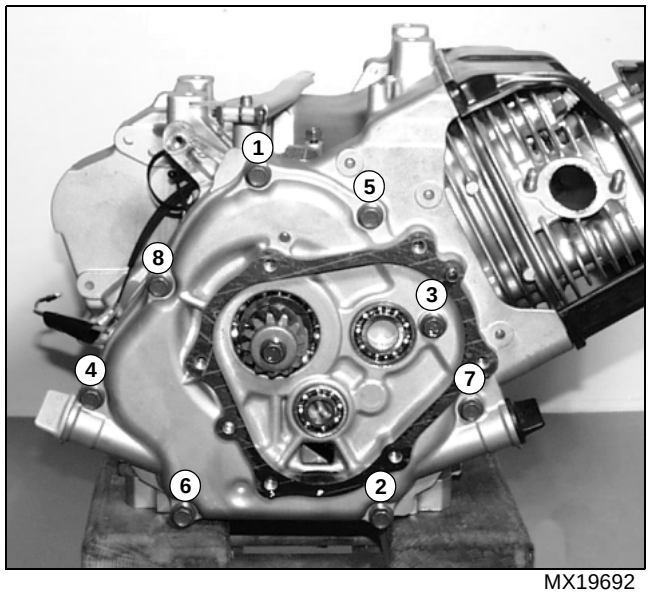
2. Install the two dowel pins into the crankcase.



MX19693

3. Install the new closure plate gasket (C) onto the dowel pins. Make sure that the governor lever (D) is facing towards the right (cylinder side).

4. Install the closure plate to the crankcase. Carefully seat the ends of the camshaft and balance shaft into their mating bearings. Rotate the crankshaft slightly to help engage the governor gear teeth.

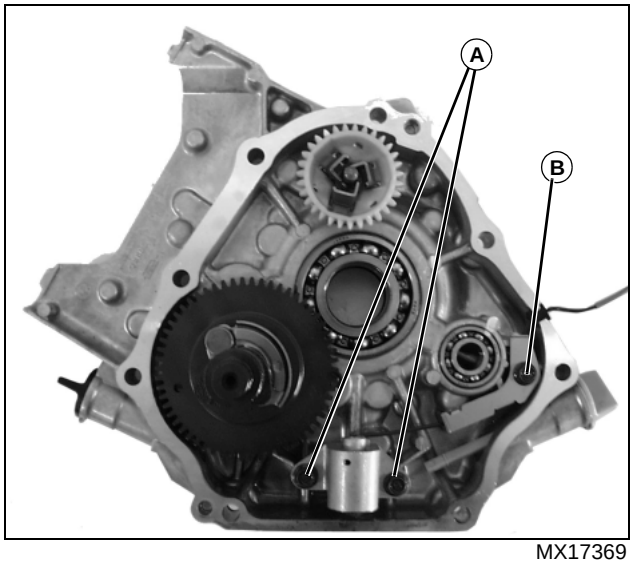


MX19692

5. Tighten the eight cap screws in the sequence shown to 30 N•m (22 lb-ft).

Oil Sensor Removal and Installation

Removal:



MX17369

1. Remove the two hex flange screws (A) mounting the oil sensor and the single screw (B) holding the wire shield in place.

2. Pull the grommet out of the cutout in the casting and remove the oil sensor. Note the routing of the wire.

Installation:

1. Mount the oil sensor into the closure plate using two hex flange screws.

2. Route the wire lead and seat the grommet into the cutout.

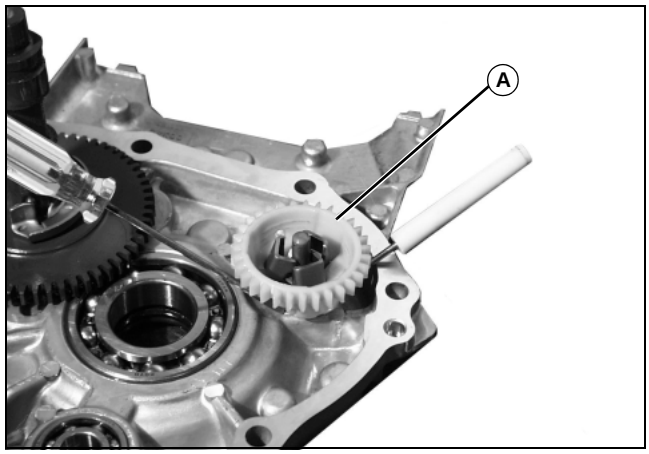
3. Install the shield for the wire lead and secure with a hex flange screw tightened to 10 N•m (88 lb-in.).

Governor Gear Removal and Installation

Removal:

IMPORTANT: Avoid damage! Do not pry against or nick/damage the gasket surface of the closure plate.

NOTE: The governor gear is held onto the governor gear shaft by a small retaining clip located near the center section of the gear, within the flyweight assemblies. The mounting of the governor gear also retains the governor regulating pin and thrust washer in place.

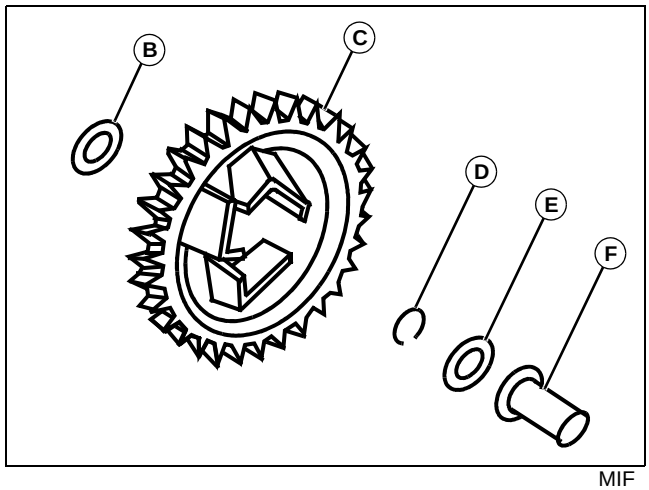


MX17372

1. Using two small screwdrivers, carefully apply upward pressure from beneath the gear (A) and against the bosses in the closure plate.

Installation:

NOTE: Before installation, clean and inspect all components for wear or damage.



MIF

1. Install one thrust washer (B) onto the governor shaft, followed by the governor gear/flyweight assembly (C).

2. Start the retaining clip (D) over the end of the shaft.

3. Raise the gear up on the shaft sufficiently to install the other thrust washer (E) and governor regulating pin (F) under the outer fingers of the flyweights.

4. Push the governor regulating pin down until the retaining ring locks into place in the shaft groove. Governor gear should now be retained on shaft and operate freely.

5. Check gear and flyweight operation.

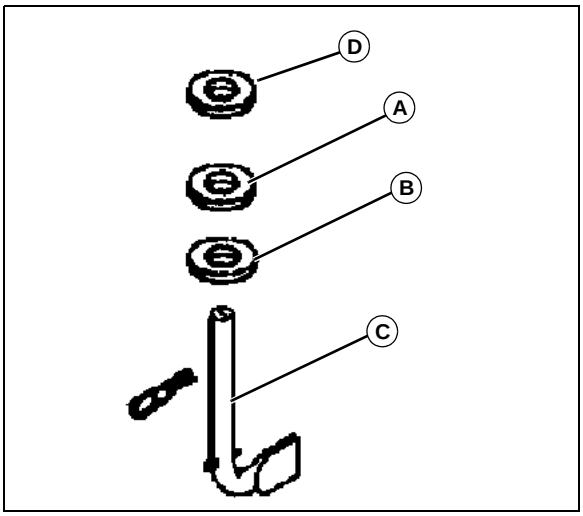
Governor Cross Shaft Removal and Installation

Removal:

1. Remove the hitch pin and plain washer from the governor cross shaft.

2. Remove the cross shaft out through the inside of the crankcase.

Installation:

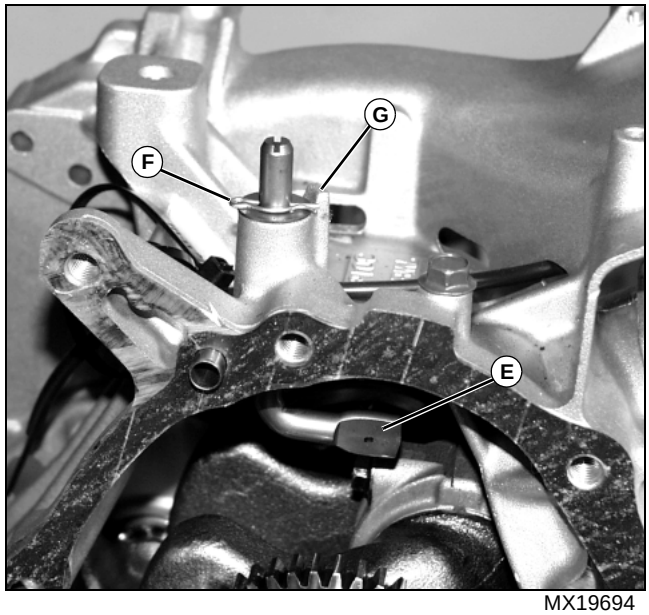


MX17529

1. Install the governor shaft seal (A), with the manufacturer's mark out, into the governor shaft bore in crankcase until flush with the top. A 13 mm (0.5 in.) OD seal driver or round stock may be used to install.

2. Install one thrust washer (B) onto the governor cross shaft (C) and insert up through the inside of the crankcase.

3. Install second flat washer (D) up onto top of shaft.



MX19694

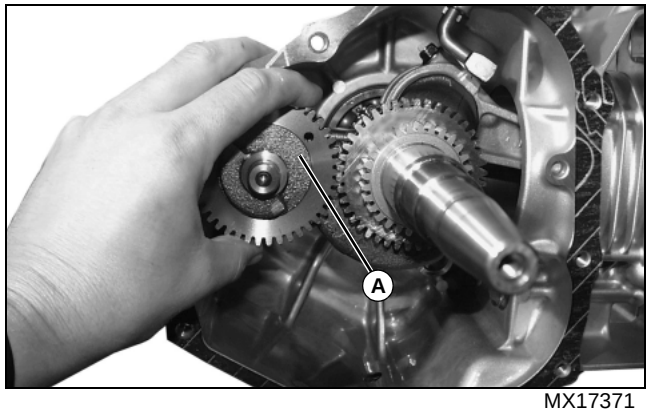
4. Position the shaft so the lower flat section (E) faces toward the cylinder.

5. Insert the hitch pin (F) so the end of the clip comes in contact with the raised section (G) of the housing boss, limiting the inward movement of the arm.

Balance Shaft Removal and Installation

Removal:

1. Align marks on balance shaft and crankshaft.

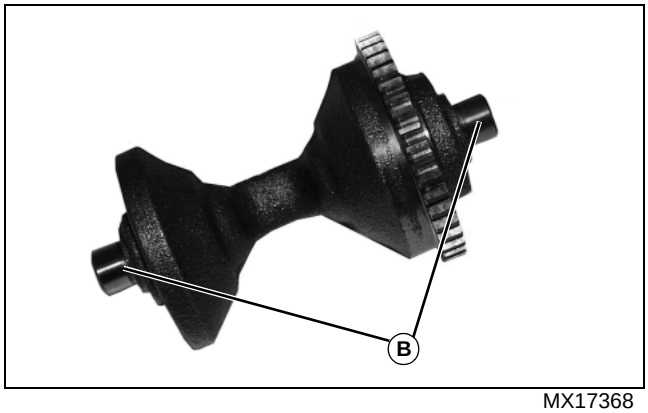


MX17371

2. Remove balance shaft (A).

NOTE: Camshaft, crankshaft, and balance shaft gears wear together as a set. If one is to be replaced, all must be replaced as a set.

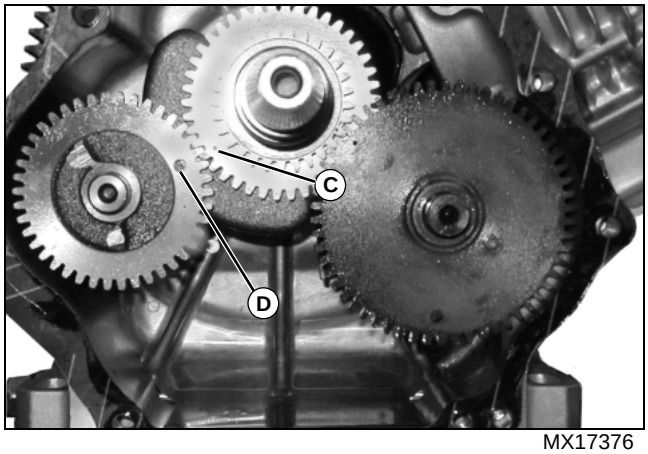
3. Inspect for cracks and broken teeth. Replace shaft if cracked or damaged.



MX17368

4. Inspect balance shaft journals (B) for wear. Replace if worn or damaged.

Installation:



MX17376

1. Position the crankshaft so the timing mark (C) on the larger crank gear is in the 8 o'clock position.

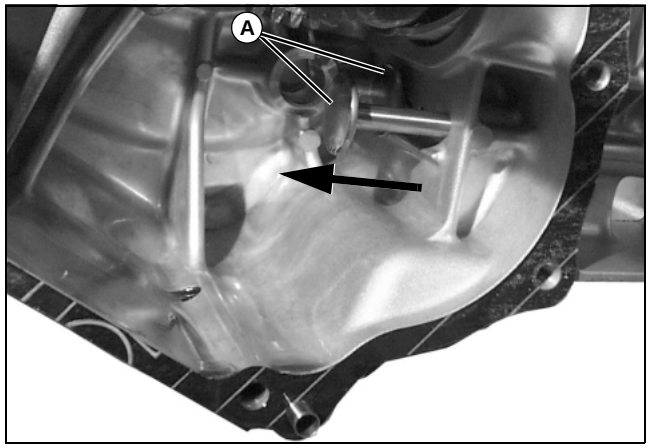
2. Install the balance shaft, aligning the timing mark (D) with the timing mark (C) on the larger crank gear.

Camshaft and Tappet Removal and Installation

Removal:

1. Rotate the camshaft until the lobes of the camshaft are off of the tappets (BTDC of the compression stroke).

2. Remove the camshaft from the crankcase.



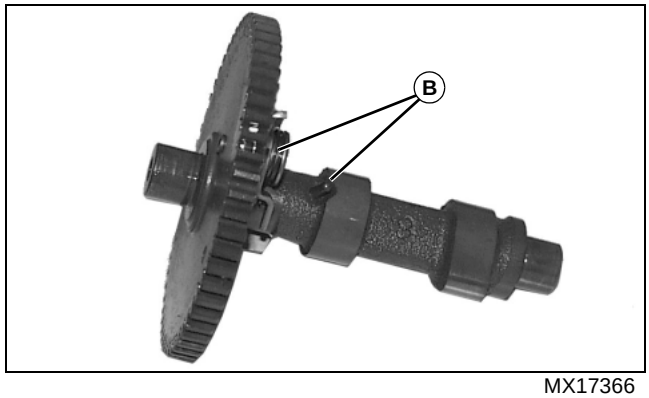
MX17370

3. Remove and mark the tappets (A) by sliding inwards towards the crankcase.

4. Inspect for scratching or wear.

Inspection:

NOTE: Camshaft, crankshaft, and balance shaft gears wear together as a set. If one is to be replaced, all must be replaced as a set.



MX17366

1. Inspect the gear teeth off the camshaft. If the teeth are badly worn, chipped, or some are missing, replacement of the camshaft will be necessary.

2. If unusual wear or damage is evident on either lobe or the mating tappet, the camshaft and both tappets must be replaced. Severely worn lobes may indicate serious valve train problems.

3. Check the condition and operation of the ACR mechanism (B).

Installation:

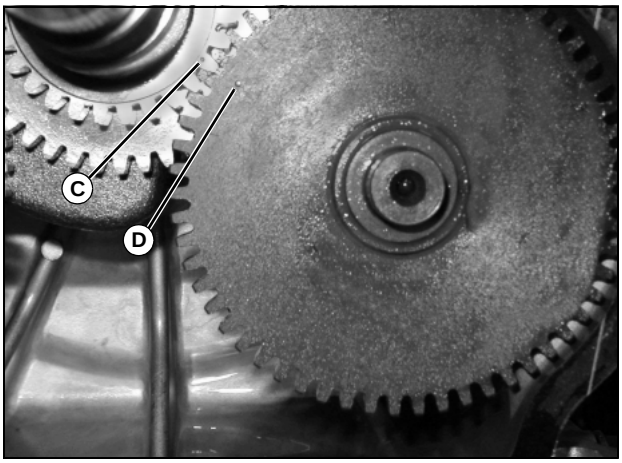
1. Identify the valve tappets as to their proper locations.

2. Lubricate the face and stem of each tappet with clean engine oil.

3. Install each tappet into their respective bores.

4. Lubricate the camshaft bearing surfaces and cam lobes as well as the camshaft bore in the crankcase with clean engine oil.

IMPORTANT: Avoid damage! The camshaft alignment mark is the small dimple on the gear face. If the camshaft is installed incorrectly, severe engine damage will result.



MX17375

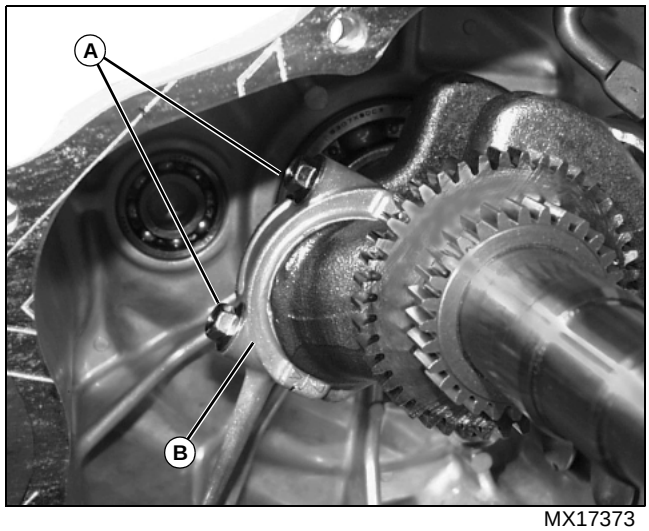
5. Rotate the crankshaft to TDC so the timing mark (C) on the crank gear (smaller gear) is in the 4 o'clock position.

6. Install the camshaft into the crankcase, aligning the camshaft timing mark (D) with the crankshaft timing mark (C).

Piston Removal and Installation

Removal:

IMPORTANT: Avoid damage! Use a ridge reamer to remove the carbon ridge from the top of the cylinder bore. The carbon ridge can damage the piston and piston rings.



MX17373

1. Remove connecting rod screws (A), and connecting rod cap (B).

IMPORTANT: Avoid damage! Remove piston assembly so connecting rod does not damage crankshaft journal or cylinder wall.

2. Remove piston assembly through top of cylinder bore.

3. Disassemble all components and inspect for wear or damage.

Assembly:

1. If new piston rings are to be installed, See "Piston Ring Installation" on page 51.

2. Clean carbon from all parts before assembly. Wipe clean engine oil on connecting rod and rod cap journals, cylinder wall, and piston rings and skirt before assembly.

3. If new piston rings are installed, de-glaze cylinder bore. See "Cylinder De-glazing" on page 52.

NOTE: Ensure that piston ring gaps are staggered 120° apart but do not align with oil ring side rail end gaps.

M87602

4. Install piston and connecting rod using ring compressor (C). Make sure stamping on the piston is facing down toward the base of the engine.

MX17534

5. Install connecting rod cap. Ensure that notches (D) on connecting rod and cap line up properly.

6. Install connecting rod cap screws.

7. Tighten cap screws to 20 N•m (177 lb-in.).

Piston Ring Installation

NOTE: Rings must be installed correctly. Ring installation instructions are usually included with new ring sets. Follow instructions carefully. Use a piston ring expander to install rings. Install the bottom (oil control) ring first and the top compression ring last.

1. Oil control ring (bottom groove):

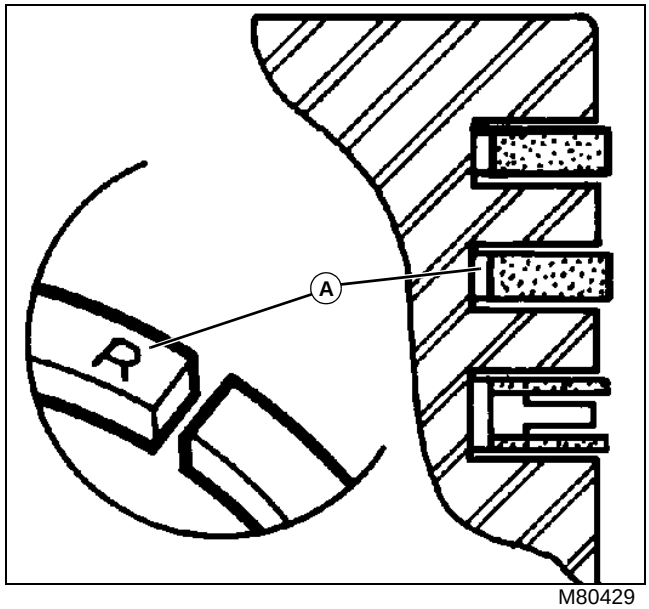
   a. Place the expander in the lowest groove. The ends of the expander must not butt. Do not allow the ends to overlap; incorrect tension and a loss of oil control will result.

   b. Place one end of a rail between the upper side of the expander and groove, and wind into position. Be careful that the end of the rail does not scratch the piston.

   c. Repeat this procedure with the second rail on the lower side of the expander.

   d. Position rail gaps 90° from the expander gap and 180° from each other.

   e. Check the assembly to ensure freedom of movement in the groove.



M80429

2. Middle compression ring:

   a. Locate and identify the compression ring with the “R” marking (A).

   b. Using a piston ring expander, install this ring in the middle groove with the “R” up towards the top of the piston.

3. Top compression ring:

   a. Using a piston ring expander, install the compression ring, with no markings, into the top groove. It is symmetrical in design, so it may be installed with either side up.

4. Stagger/position the two compression rings, so the end gaps are spaced 120° apart, as well as from the expander gap.

Measuring Piston to Bore Clearance

Before installing the piston into the cylinder bore, it is necessary that the clearance be accurately checked. This step is often overlooked, and if the clearances are not within specifications, engine failure will usually result.

NOTE: Do not use a feeler gauge to measure piston to bore clearance as it will result in inaccurate measurements. Always use a micrometer.

Use the following procedure to accurately measure the piston to bore clearance.

1. Use a micrometer and measure the diameter of the piston above the bottom of the piston skirt and perpendicular to the piston pin.

2. Use an inside micrometer, telescoping gauge, or bore gauge and measure the cylinder bore. Take the measurement approximately 40 mm (1.6 in.) below the top of the bore and perpendicular to the piston pin.

3. Piston to bore clearance is the difference between the bore diameter and the piston diameter.

Cylinder De-glazing

Procedure:

IMPORTANT: Avoid damage! If cylinder bore is to be de-glazed with crankshaft installed in engine, put clean shop towels over crankshaft to protect journal and bearing surfaces from any abrasives.

1. De-glaze cylinder bore using a rigid with a 220 to 300 grit stone.

2. Use hone as instructed by manufacturer to obtain a 45° crosshatch pattern.

IMPORTANT: Avoid damage! Do not use gasoline, kerosene, or commercial solvents to clean cylinder bore. Solvents will not remove all abrasives from cylinder wall.

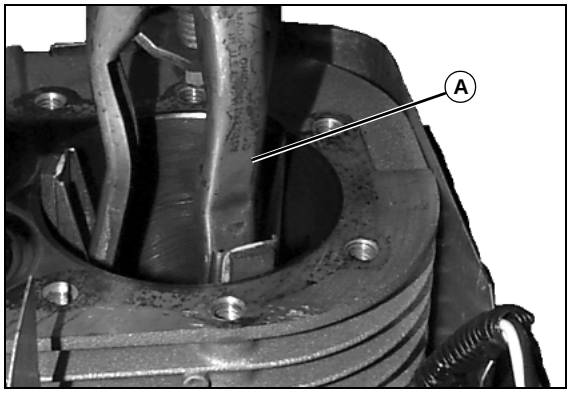
3. Remove excess abrasive residue from cylinder wall using a clean, dry rag. Clean cylinder wall using clean white rags and warm soapy water. Continue to clean cylinder until white rag shows no discoloration.

4. Dry cylinder wall and apply a light coat of clean engine oil.

Cylinder Resizing

Honing:

While most commercially available cylinder hones can be used with either portable drill or drill presses, the use of a low speed drill press is preferred as it facilitates more accurate alignment of the bore in relation to the crankshaft crossbore. Honing is best accomplished at a drill speed of about 250 rpm and 60 strokes per minute. After installing course stones in hone, proceed as follows:



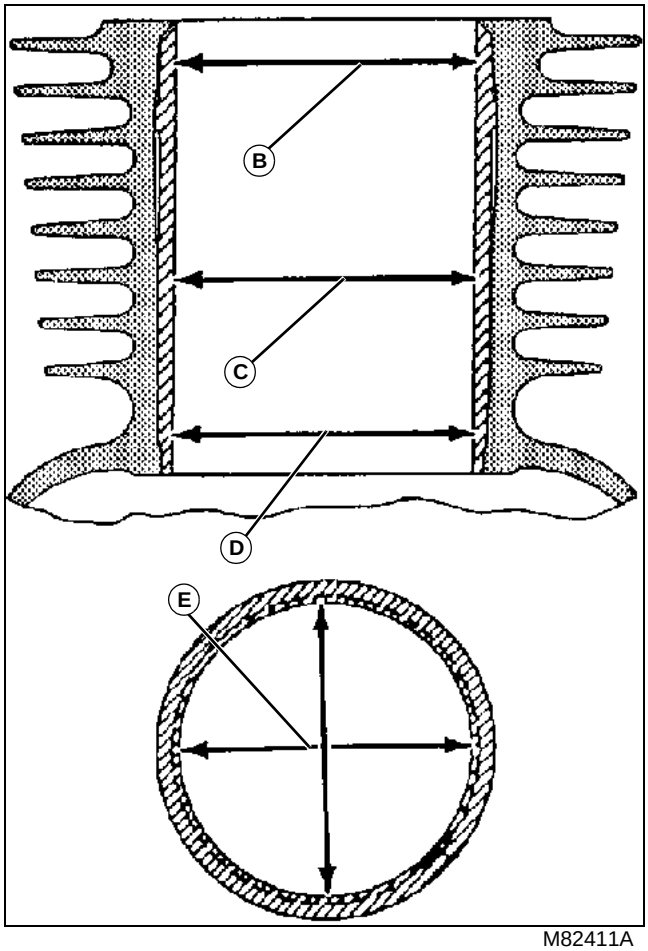
M87609

1. Lower hone (A) into bore and after centering, adjust so that the stones are in contact with the cylinder wall. Use of a commercial cutting/cooling agent is recommended.

NOTE: Keep in mind the temperatures caused by honing may cause inaccurate measurements. Make sure the bore is cool when measuring.

2. With the lower edge of each stone positioned even with the lowest edge of the bore, start drill and honing process. Move the hone up and down while resizing to prevent the formation of cutting ridges. Check the size frequently.

3. When the bore is within 0.064 mm (0.0025 in.) of desired size, remove the course stones and replace with burnishing stones. Continue with the burnishing stones until within 0.013 mm (0.0005 in.) of desired size and then use finish stones (220 - 280 grit) and polish to final size. A crosshatch should be observed if honing is done correctly. The crosshatch should intersect at approximately 20° off the horizontal. Too flat an angle could cause the rings to skip and wear excessively; too steep an angle will result in high oil consumption.



M82411A

4. After resizing, check the bore for roundness, taper, and size. Use an inside micrometer, telescoping gauge, or bore gauge to take measurements. The measurements should be taken at three locations in the cylinder - at the top (B), middle (C), and bottom (D). Two measurements should be taken (perpendicular to each other) (E) at each of the three locations.

Cleaning Cylinder Bore After Honing:

Proper cleaning of the cylinder walls following boring and/or honing is very critical to successful overhaul. Machining grit left in the cylinder bore can destroy an engine in less than one hour of operation after a rebuild.

The final cleaning operation should always be a thorough scrubbing with a brush and hot, soapy water. Use a strong detergent that is capable of breaking down the machining oil while maintaining a good level of suds. If the suds break down during cleaning, discard the dirty water and start again with more hot water and detergent. Following the scrubbing, rinse the cylinder with very hot, clear water. Dry it completely, and apply a light coating of clean engine oil to prevent rusting.

Crankshaft Removal, Inspection, and Installation

Removal:

1. After engine has been completely disassembled, carefully remove crankshaft from crankcase.

Inspection:

NOTE: Camshaft, crankshaft, and balance shaft gears wear together as a set. If one is to be replaced, all must be replaced as a set.

Inspect the gear teeth of the crankshaft. If the teeth are badly worn, chipped, or some are missing, replacement of the crankshaft will be necessary.

Inspect the crankshaft bearing surfaces for scoring, grooving, etc. Do not replace the main bearings unless they show signs of damage or are out of running clearance specifications. If the crankshaft turns easily and noiselessly, and there is no evidence of scoring, grooving, etc. on the races or bearing surfaces, the bearings can be reused. If not, See “Oil Seal and Bearing Removal and Installation” on page 54.

Inspect the crankshaft keyways. If worn or chipped, replacement of the crankshaft will be necessary.

Inspect the crank pin for score marks or metallic pickup. Slight score marks can be cleaned with crocus cloth soaked in oil. If wear limits are exceeded, it will be necessary to replace the crankshaft.

Installation:

1. Carefully slide the flywheel end of the crankshaft through the main ball bearing and seal.

Crankcase Inspection

1. Check all gasket surfaces to make sure they are free of gasket fragments. Use of a spray type gasket remover is recommended. Gasket surfaces must also be free of deep scratches or nicks.

2. Check the cylinder bore for wear, scoring, or vertical scratches. In severe cases, unburned fuel can cause scuffing and scoring of the cylinder wall as it washes the necessary lubricating oils off the piston and cylinder wall. As raw fuel seeps down the cylinder wall, the piston rings make metal to metal contact with the wall. Scoring of the cylinder wall can also be caused by localized hot spots resulting from blocked cooling fins or from inadequate or contaminated lubrication. Measure the cylinder bore using an inside micrometer or bore gauge. Compare readings with specifications. See “Measuring Piston to Bore Clearance” on page 52.

If the cylinder bore is badly scored, excessively worn, tapered, or out of round, resizing is necessary. Use a measuring device (inside micrometer, etc.) to determine the amount of wear, then select the nearest suitable oversize of either 0.25 mm (0.010 in.) or 0.50 mm (0.020 in.). Resizing to one of these over sizes will allow usage of the available oversize piston and ring assemblies.

Oil Seal and Bearing Removal and Installation

Removal:

NOTE: This procedure applies to all seals and bearings on the crankcase and reduction cover.

1. Remove the oil seal from the case.
2. Remove the bearing from the casing using a press.

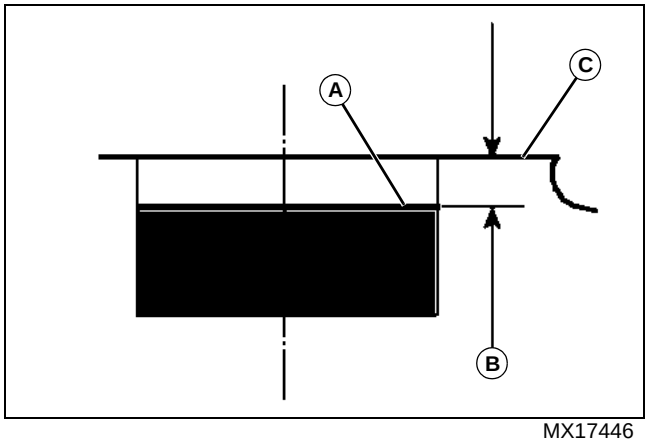
Installation:

NOTE: Oil the bearings liberally when installing.

1. Make sure that there are no nicks, burrs, or damage in the bores for bearings. The closure plate and crankcase must be clean.

NOTE: Install the bearings and oil seals with their manufacturer's marks or numbers visible, facing you.

2. Use a press to make sure the bearings are installed straight, into their respective bores, until fully seated.
3. Use a seal driver and install the crankshaft oil seals (manufacturer's numbers visible) into crankcase or reduction cover.
4. Apply a light coating of lithium grease to seal lips when installing.



MX17446

5. Install a new seal (A) to a depth (B) of 2 mm (0.079 in.) below the outer surface (C).

Retractable Starter Removal and Installation

Removal:

MX19695

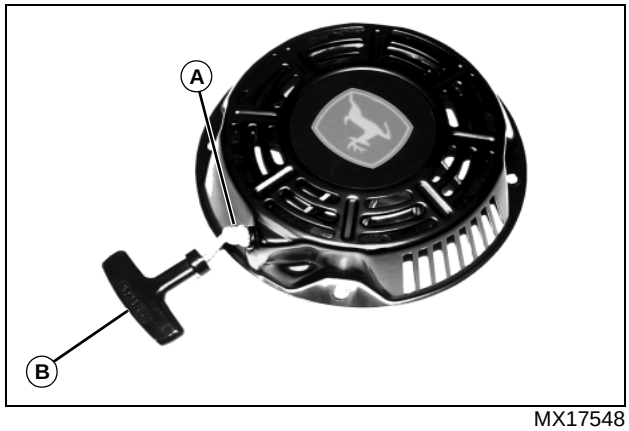
1. Remove the cap screws (A) securing the retractable starter to the blower housing.

Installation:

1. Install the retractable starter cap screws finger tight only.
2. Pull the rope handle out just far enough to engage the pawls, centering the starter to the drive cup. Hold in this position and tighten the cap screws to 7 N•m (62 lb-in.).

Retractable Starter Rope Replacement

1. Remove the starter from the engine blower housing. See "Retractable Starter Removal and Installation" on page 54.



MX17548

2. Pull the rope out a few inches and tie a temporary (slip) knot (A) in it to keep it from retracting into the starter.

3. Pull the knot end (B) out of the handle, untie the knot, and slide the handle off.

4. Hold the pulley firmly in place and untie the slip knot.

5. Allow the pulley to rotate slowly as the spring tension is released.

6. When all spring tension on the starter pulley is released, remove the rope from the pulley.

7. Tie a single knot in one end of the new rope.

8. Rotate the pulley counterclockwise to pre-tension the spring (approximately 5 full turns of pulley).

9. Rotate the pulley until the rope hole in the pulley is aligned with the rope guide bushing of the starter housing.

NOTE: Do not allow the pulley/spring to unwind.

10.Feed the unknotted end of the rope through the rope hole in the starter pulley and rope guide bushing of the housing.

MX17551

11. Tie a slip knot approximately 30 cm (12 in.) from the free end of rope. Hold the pulley firmly and allow it to rotate until the slip knot reaches the guide bushing of the housing (C).

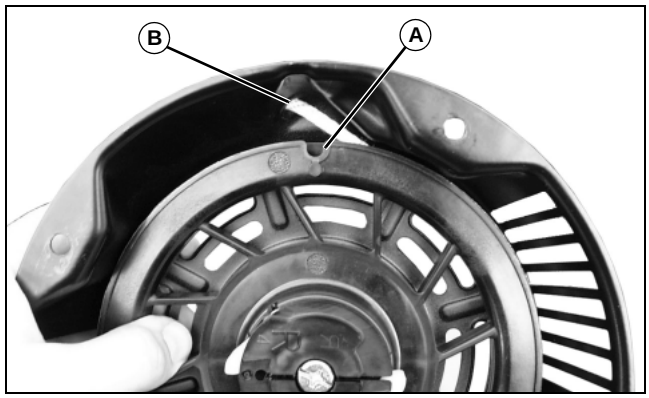
12. Slip the handle onto the rope. Tie a single knot at the end of the rope.

13. Untie the slip knot and pull on the handle until the rope is fully extended.

14. Slowly retract the rope into the starter. If the spring is properly tensioned, the rope will retract fully and the handle will stop against the starter housing.

Pawl Removal and Replacement

CAUTION: Avoid injury! Spring under tension! Do not remove the center screw from the starter until the spring tension is released. Removing the center screw before releasing spring tension, or improper starter disassembly, can cause the sudden and potentially dangerous release of the spring. Follow these instructions carefully to ensure personal safety and proper starter disassembly. Make sure adequate face protection is worn by all persons in the area.



MX17550

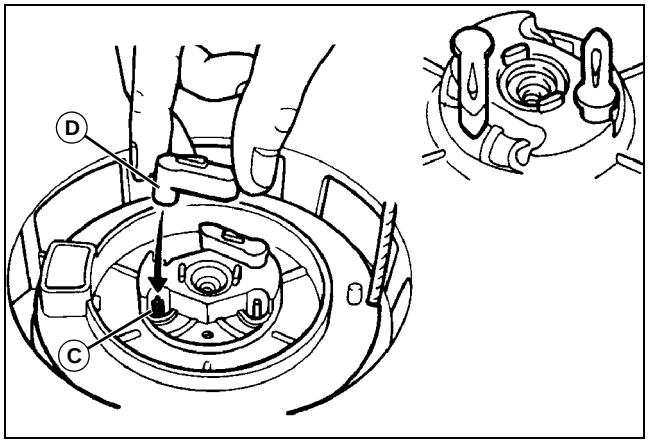
1. Rotate the pulley against spring tension until the cutout (A) in the pulley is adjacent to outlet in housing (B).

2. Lift up the slack in rope through the cutout and slowly pull pulley to unwind, releasing spring tension. Count the number of rotations for reassembly later.

3. Unscrew the center screw and lift off the drive plate. The center screw will be captured by the clip around the shoulder on the backside of plate.

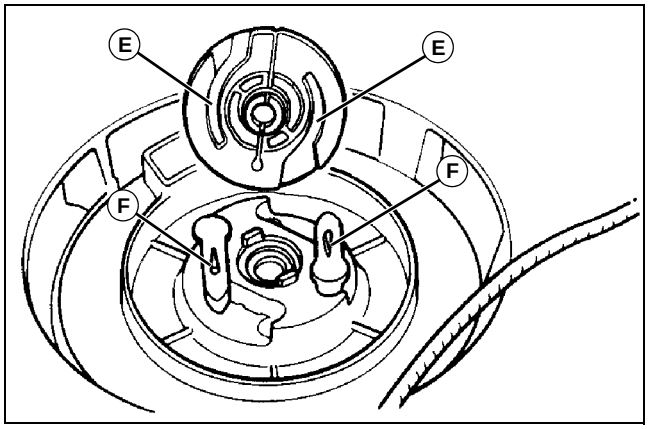
4. Note the positions of the pawls and pawl springs before removing. Remove parts from pulley.

5. Carefully inspect the components for wear, cracks, and/or damage. Replace all worn components.



MX19696

6. Install pawl springs (C) and pawls (D) onto pawl studs of pulley. All parts must be dry.



MX19697

7. Position the drive plate over the pawls, aligning the actuating slots (E) in the plate with the raised sections on each drive pawl (F).

8. Install the center screw.

9. Rotate the pulley by hand and check operation.

10.Hook the slack in rope into notch of pulley and rotate the pulley counterclockwise (viewed from pawl side) to re-tension the spring (approximately 5 full turns).

Recoil Spring, Pulley, and Housing Replacement

CAUTION: Avoid injury! Spring under tension! Do not remove the center screw from the starter until the spring tension is released. Removing the center screw before releasing spring tension, or improper starter disassembly can cause the sudden and potentially dangerous release of the spring. Follow these instructions carefully to ensure personal safety and proper starter disassembly. Make sure adequate face protection is worn by all persons in the area.

1. Release spring tension and remove the handle and starter rope. See “Retractable Starter Rope Replacement” on page 54.

2. Unscrew the center screw and lift off the drive plate. The screw will be captured within the plate by the clip on the backside.

3. Carefully note the positions of the pawls and pawl springs before removing them. Remove the parts from the starter pulley.

4. Rotate the pulley clockwise (1/2 to 1 full turn). This will ensure the spring is disengaged from the starter housing.

5. Carefully lift the pulley out of the recoil housing while reaching through the spokes of the pulley to keep the spring from coming out of the pulley.

6. Wearing adequate eye/face protection, carefully remove the spring from the pulley cavity,

7. Clean all parts including the starter spring cavity in pulley and recoil housing of all old grease and dirt.

8. Inspect all parts for wear or damage and replace as required.

Installation:

1. Generously lubricate the recoil spring with a commercially available bearing grease.

2. Engage the outer spring hook into the pulley “slit” opening, then carefully wind the spring counterclockwise into the drum of the pulley from larger to smaller diameter.

3. Carefully install pulley into recoil housing, engaging the spring hook with starter housing tab.

4. Rotating pulley counterclockwise slightly with assist engagement.

5. Install the pawl springs and pawls onto pawl studs of pulley.

6. Mount drive plate over pawls onto pulley, aligning the

actuating slots in plate with the raised sections on each drive pawl.

7. Rotate the pulley by hand to check operation.

8. Tension the spring and install the rope and handle. See “Retractable Starter Rope Replacement” on page 54.

9. Install the recoil starter to engine blower housing but do not fully tighten the mounting screws.

10. Pull out on recoil handle/rope to engage the pawls to the drive cup, hold engaged and tighten the mounting screws to 7 N•m (62 lb-in.).

Table of Contents

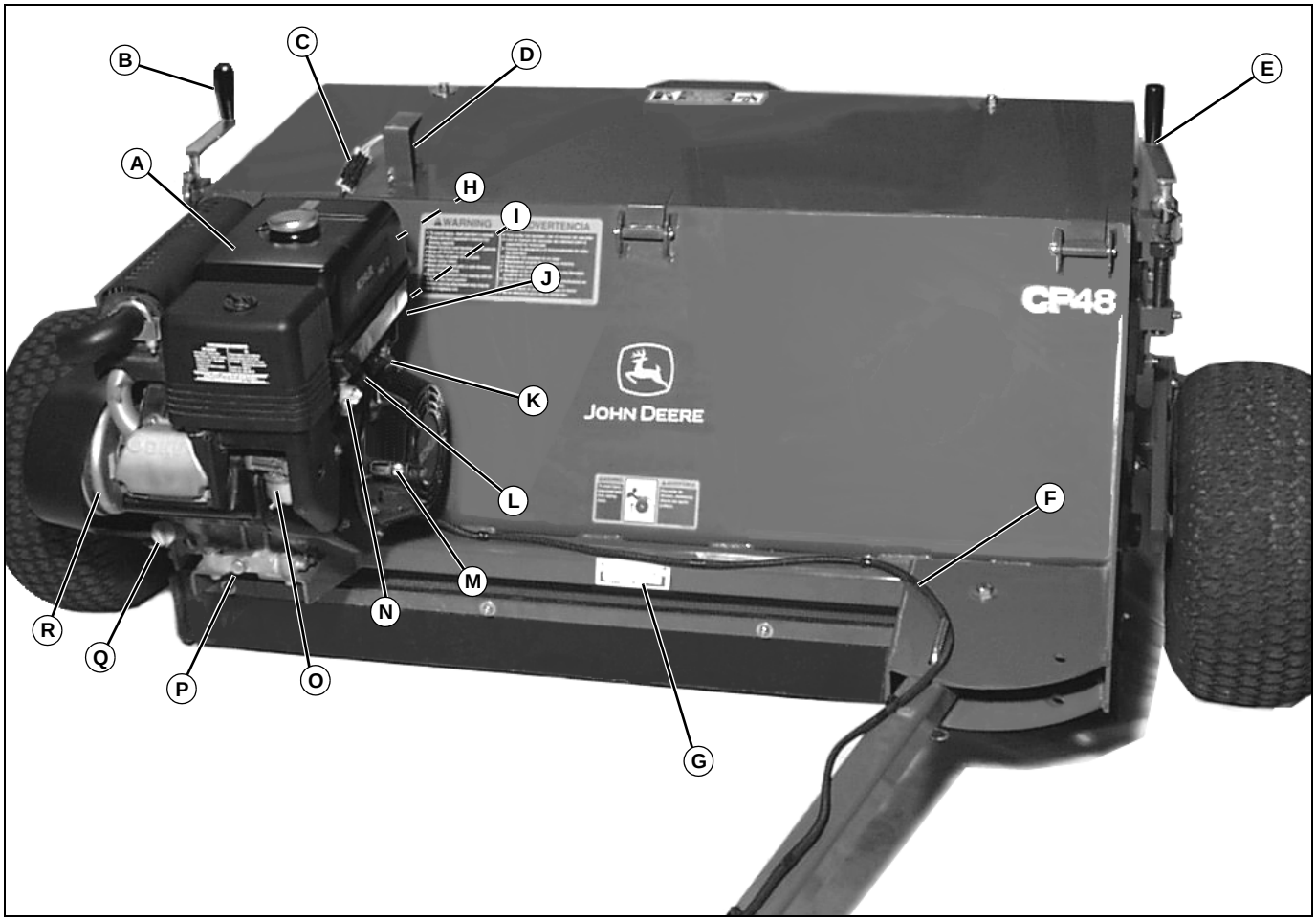
Specifications

General Specifications

Spark Plug Gap	**0.76 mm (0.030 in.)**
Spark plug torque	**20 N•m (177 lb-in.)**
Spark plug cap resistance	**4.0 - 6.0 k-ohms**
Laminations to Ground Terminal	**0.7 ohms**
Ground Terminal to Spark Plug Cap	**13.5 - 18.0 K-ohms**
Ground Terminal to Spark Plug Lead	**9.5 - 12.9 K-ohms**

Component Location

General



MX19825

R - PTO Clutch

A - Fuel Tank
B - Brush Height Adjustment Assembly (Right)
C - X3 Connector
D - Safety Switch
E - Brush Height Adjustment Assembly (Left)
F - W2 Machine Wiring Harness
G - Machine Identification Label
H - Oil Warning Module
I - Ignition On/Off Switch
J - Oil Warning Light
K - Throttle Lever
L - Choke Lever
M - Retractable Starter Handle
N - Fuel Shutoff Valve and Screen Assembly
O - Carburetor
P - Oil Drain Plug
Q - Oil Filler Cap

Schematics and Harnesses

Schematic And Wiring Harness Legend

Components

A1 - Oil Warning Module (SE2, W6)

E1 - Spark Plug (SE2, W6)

F1 - 15A Fuse (SE1, W4)

H1 - Oil Warning Light (SE2, W6)

S1 - PTO Switch (SE2, W2)

S2 - Safety Switch (SE2, W2)

S3 - Oil Switch (SE2, W6)

S4 - Ignition Switch (SE2, W6)

T1 - Ignition Module (SE2, W6)

Y1 - PTO Clutch (SE2, W1)

V1 - Diode (SE1, W2)

Connectors

X1 - W1 Tow Vehicle Wiring Harness to W2 Machine Wiring Harness (SE1, W1)

X2 - W2 Machine Wiring Harness to V1 Diode (SE1, W2)

X3 - W3 Engine Interlock Jumper Wiring Harness to W2 Machine Wiring Harness (SE2, W3)

X4 - W2 Machine Wiring Harness to Y1 PTO Clutch (SE1, W2)

X5 - W2 Machine Wiring Harness to T1 Ignition Module (SE2, W4)

X6 - W2 Machine Wiring Harness to Engine Ignition Switches (SE2, W4)

X7 - W4 Engine Wiring Harness to A1 Oil Warning Module (SE2, W4)

Wiring Harnesses

W1 - Tow Vehicle Wiring Harness (SE1)

W2 - Machine Wiring Harness (SE1)

W3 - Engine Interlock Jumper Wiring Harness (SE1)

W4 - Engine Wiring Harness (SE2)

W1 Tow Vehicle Wiring Harness Color Codes

Size/No./Color	Wire Connection Points
1.0 100 Blk	G1, X1
1.0 200 Red	G1, F1
1.0 205 Red	F1, S1
1.0 210 Red	S1, S1
1.0 500 Blu	S1, X1
1.0 505 Blu	S1, S1

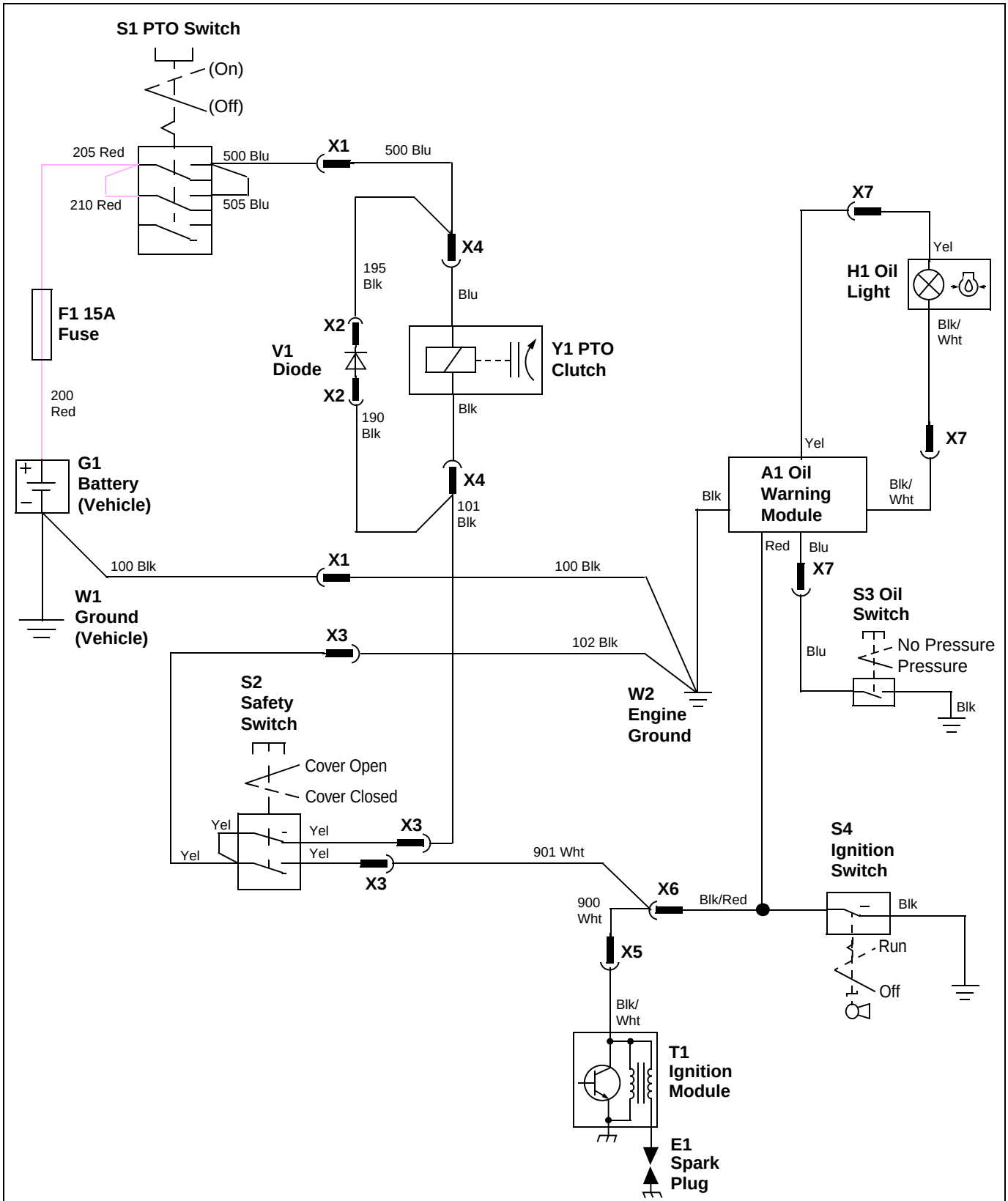
W2 Machine Wiring Harness Color Codes

Size/No./Color	Wire Connection Points
1.0 100 Blk	X1, W2
1.0 101 Blk	X3, X4
1.0 102 Blk	W2, X3
1.0 190 Blk	X4, V1
1.0 195 Blk	X4, V1
1.0 500 Blu	X1, X4
1.0 900 Wht	X5, X6
1.0 901 Wht	X6, X3

W3 Engine Interlock Jumper Wiring Harness Color Codes

Size/No./Color	Wire Connection Points
0.8 Yel	S3, X3
0.8 Yel	S3, X3
0.8 Yel	S3, X3
0.8 Yel	S3, S3

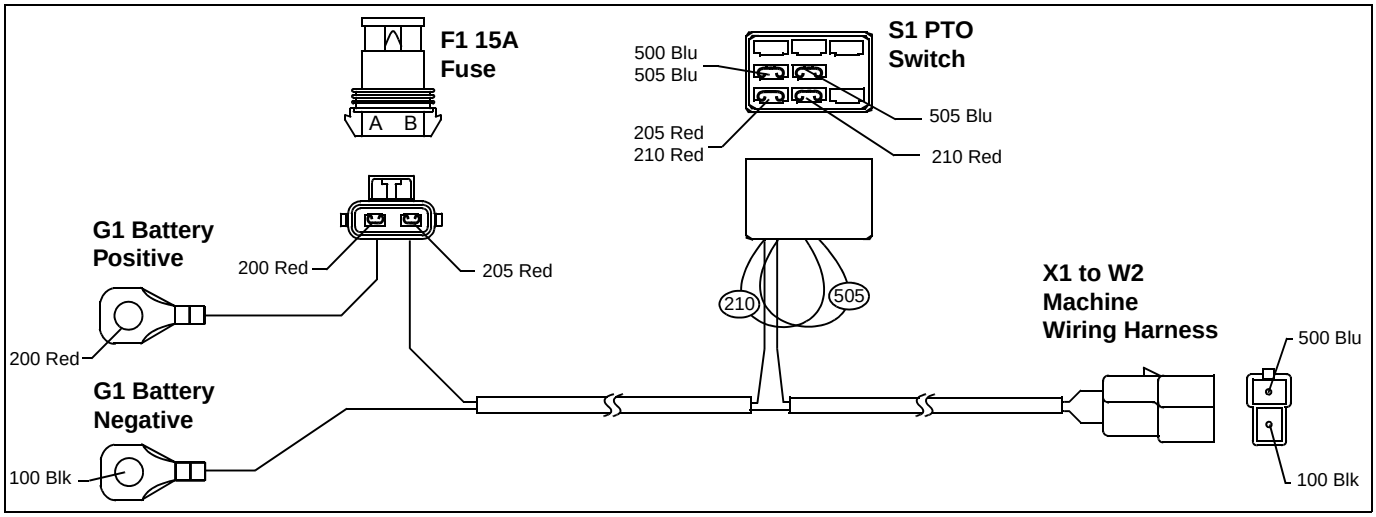
Main Electrical Schematic



SE1 - PTO Circuit	SE2 - Engine Ignition Circuit

MIF

W1 Tow Vehicle Wiring Harness



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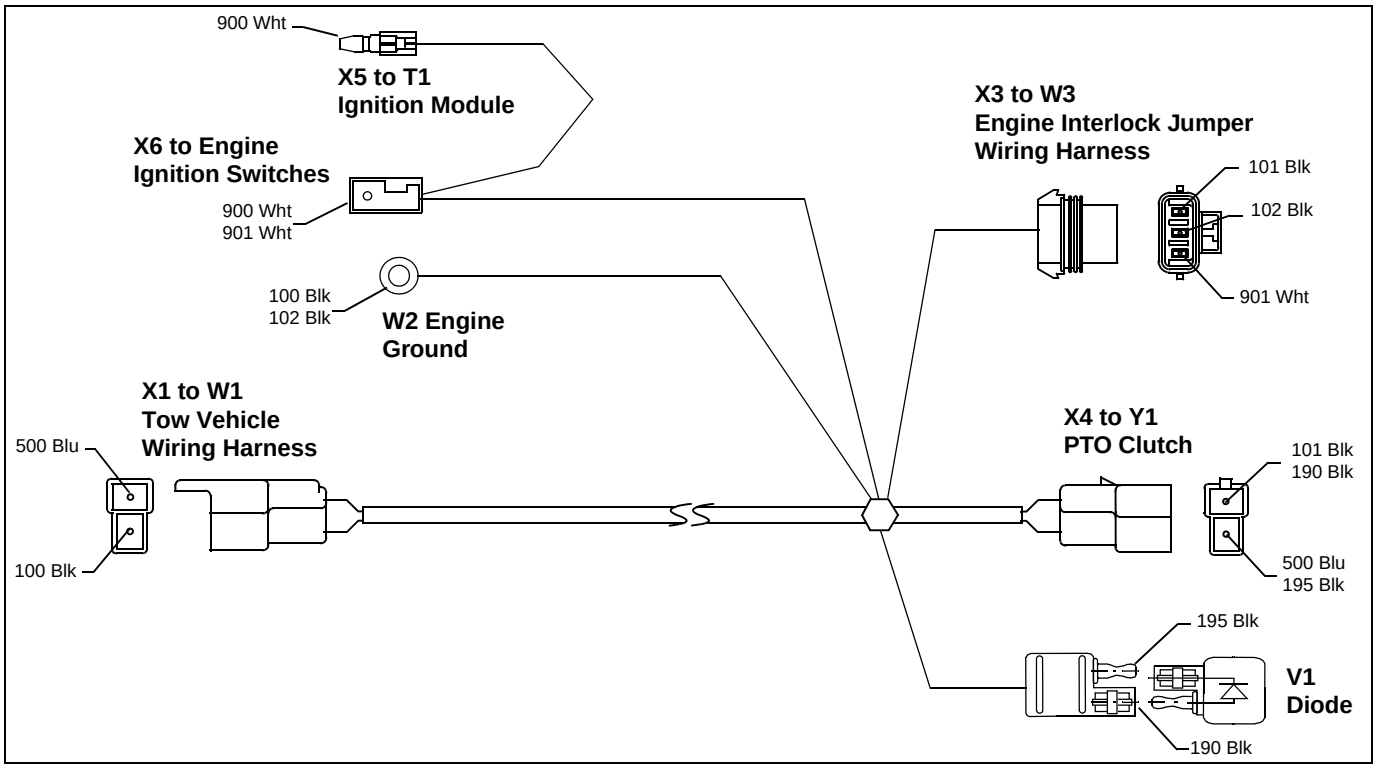
W2 Machine Wiring Harness



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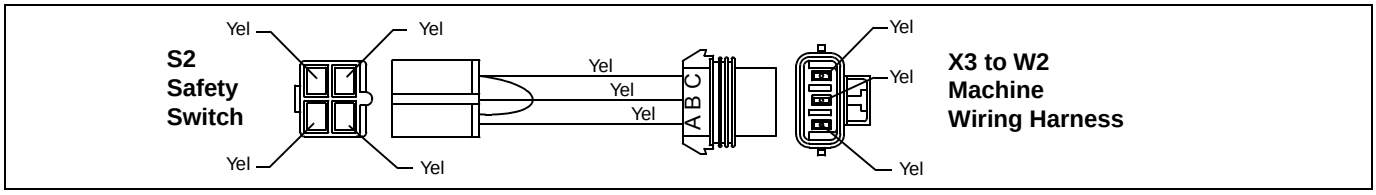
W3 Engine Interlock Jumper Wiring Harness



MIF

Operation and Diagnostics

Power Circuit Operation

Function:

To provide unswitched power to the operating controls.

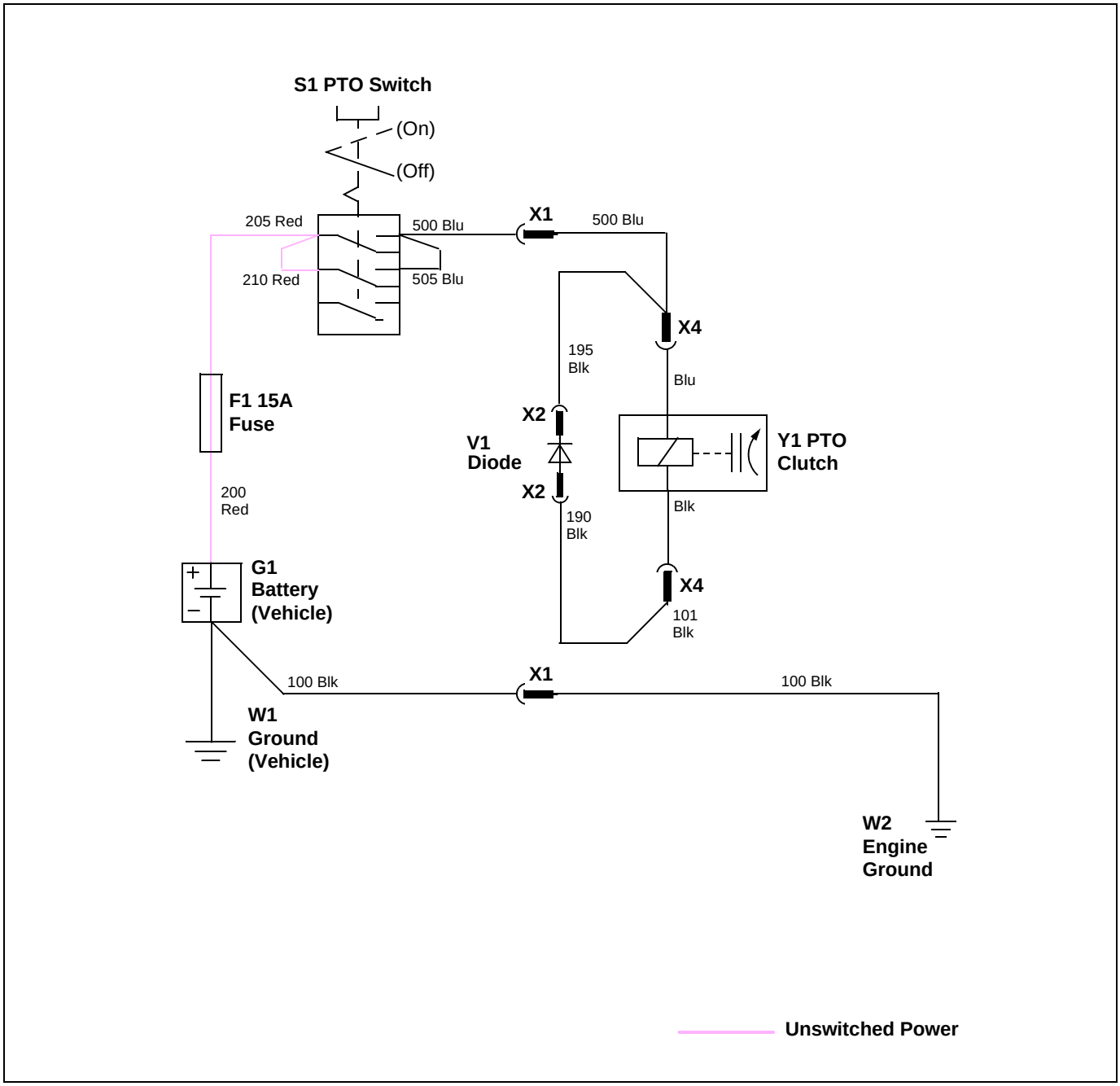
Operation:

Unswitched power is supplied by the vehicle battery to the machine circuits via the 200, 205, and 210 Red wires. This circuit is protected by the F1 fuse.

From the vehicle battery current flows through the 200 Red wire, F1 fuse, 205 and 210 Red wires to the S1 PTO switch.

The ground circuit is also unswitched and is completed using the 100 Blk wires.

Power Circuit Electrical Schematic



MIF

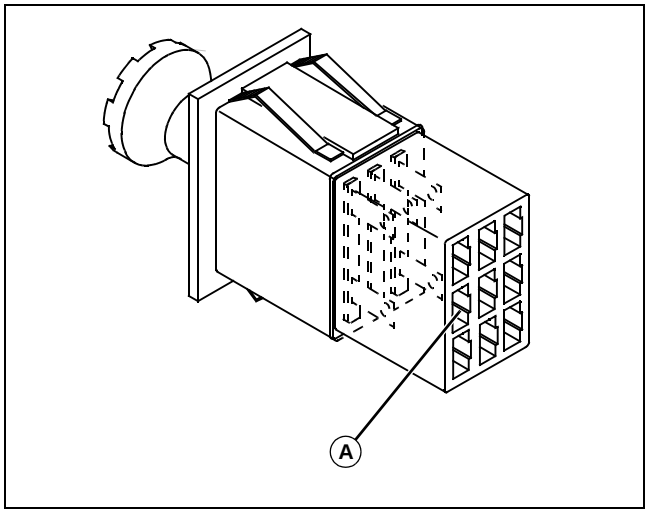
Power Circuit Diagnosis

Test Procedure A

Test Conditions:

- Vehicle parking brake locked.
- Vehicle key switch in off position.
- Machine PTO switch in off position.

System: Unswitched power circuit.



MIF

(1) Is battery voltage present at S1 PTO switch, 210 Red wire (A)?

Yes - Test complete.

No - Check F1 fuse. Check 200, 205, and 210 Red wires and connections. Test vehicle battery. Test complete.

PTO Circuit Operation

Function

To provide power to energize the PTO clutch.

Operation

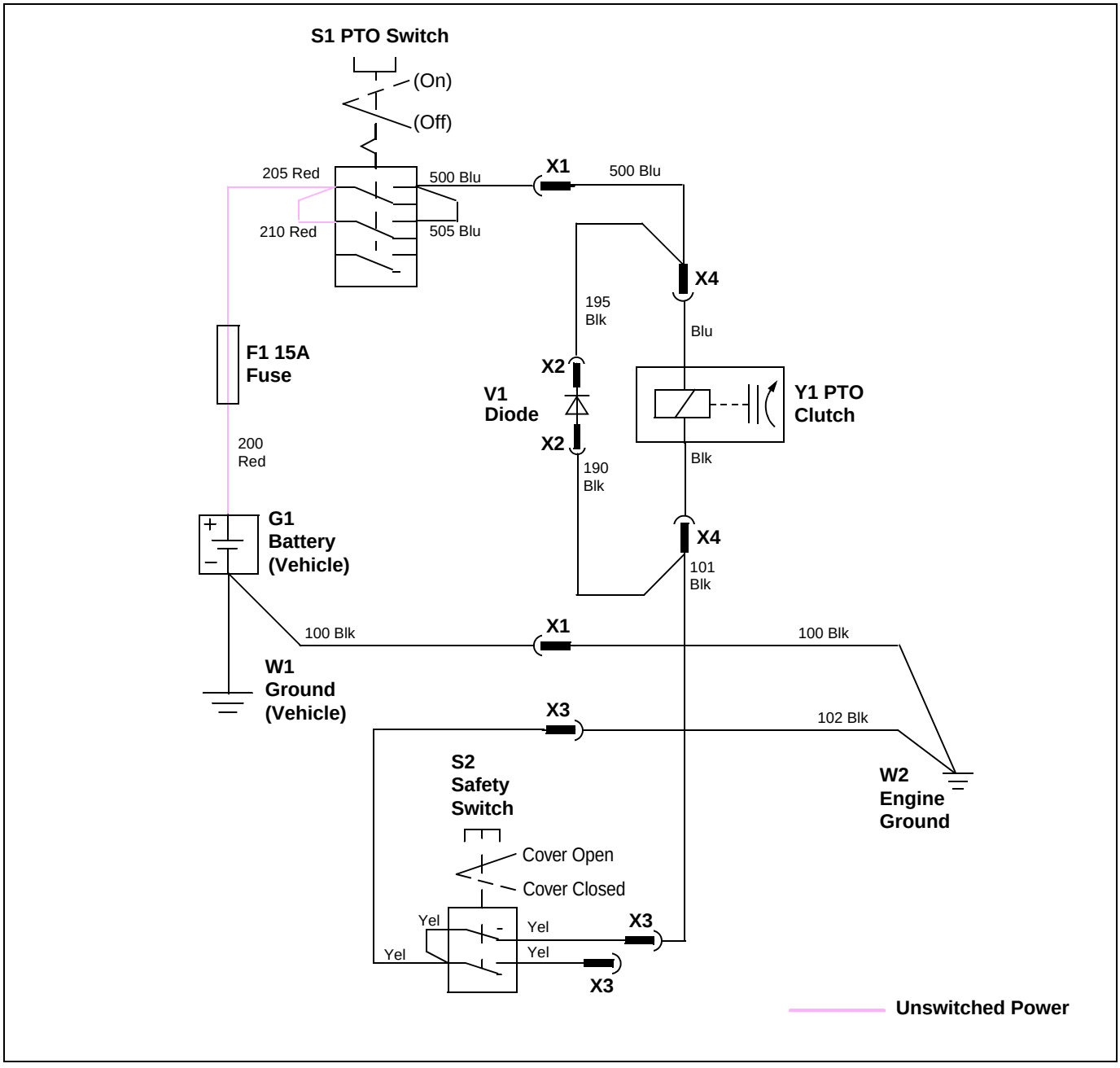
The unswitched power circuit provides power to the S1 PTO switch from the vehicle battery.

When the S1 PTO switch is in the on position, current flow from the vehicle battery using the 200 Red wire, F1 fuse, 205, and 210 Red wires to the S1 PTO switch. Current flows across the S1 PTO switch to the 500 Blu wires to the Y1 PTO clutch.

The ground for the Y1 PTO clutch is provided through the 101 Blk, S2 safety switch (cover closed), 102, and 100 Blk wires.

With the engine running and the PTO engaged, the brush and cutter heads will rotate.

PTO Circuit Electrical Schematic



MIF

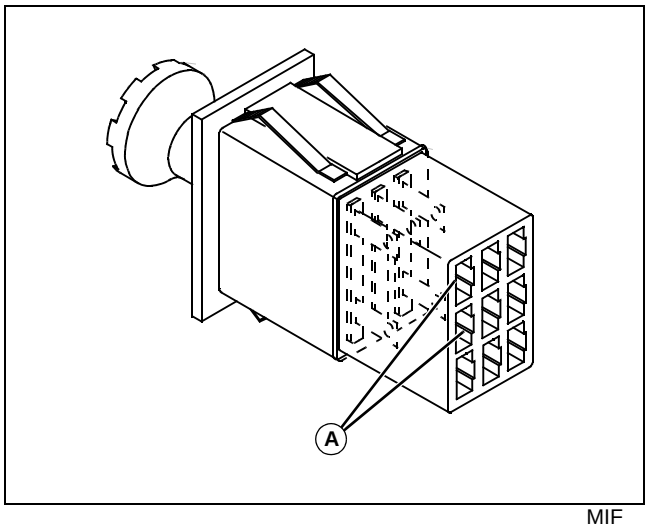
PTO Circuit Diagnosis

Test Procedure A

Test Conditions:

- Vehicle parking brake locked.
- Vehicle key switch in off position.
- Machine PTO switch in on position.
- Machine engine spark plug lead removed from spark plug.

System: PTO power supply circuit.



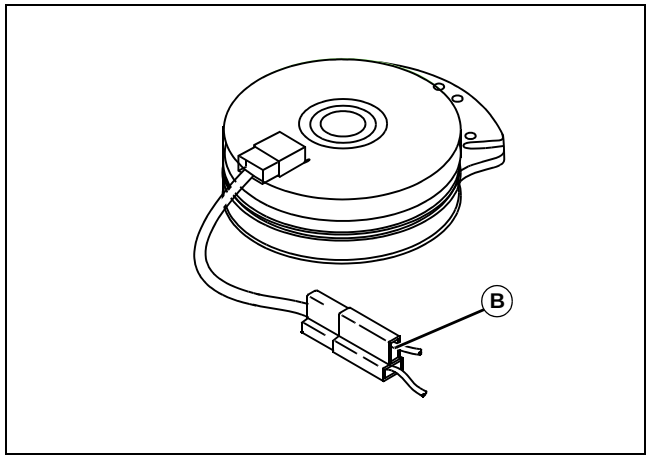
MIF

(1) Is battery voltage present at S1 PTO switch 205 and 210 Red wires (A)?

Yes - Go to step (2).

No - Test F1 fuse. Check 200, 205, and 210 Red wires and connections. Test vehicle battery. Go to step (2) to continue test.

System: PTO power supply circuit.

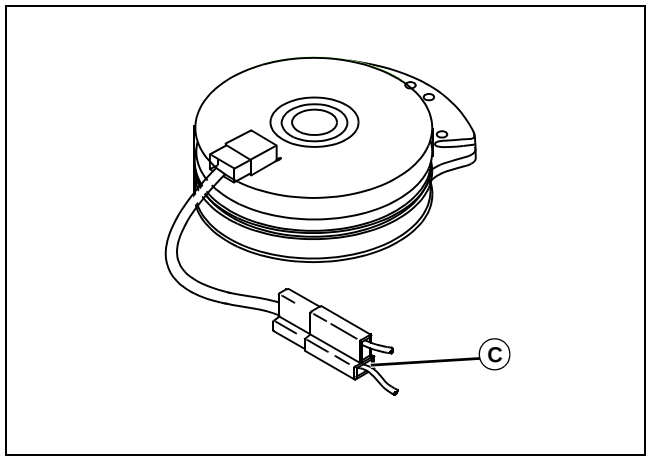


MIF

(2) Is battery voltage present at PTO clutch X4 connector (B)?

Yes - Go to step (3).

No - Check 500 Blu wires and connections. If ok, replace PTO switch. Go to step (3) to continue test.



MIF

(3) Is continuity to ground present at PTO clutch X4 connector (C)?

Yes - Go to step (1) of Test Procedure B to continue test.

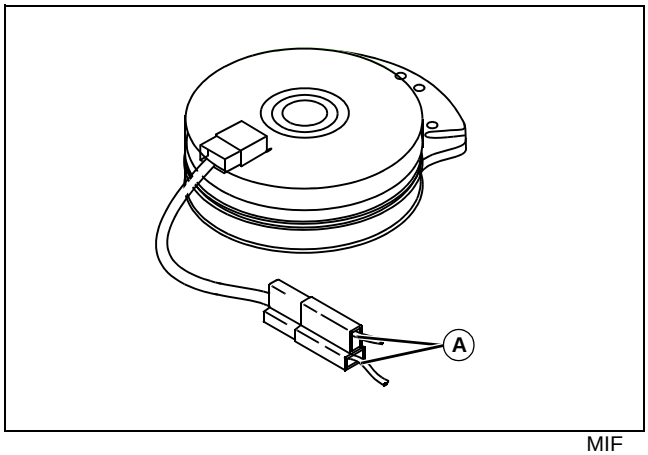
No - Check 100 and 102 Blk wires, S2 safety switch, and 101 Blk wires and connections. Go to step (1) of Test Procedure B to continue test.

Test Procedure B

Test Conditions:

- Vehicle parking brake locked.
- Vehicle key switch in off position.
- PTO switch in off position.
- Machine engine spark plug lead removed from spark plug.
- PTO clutch connector, X4, disconnected.

System: PTO clutch continuity.

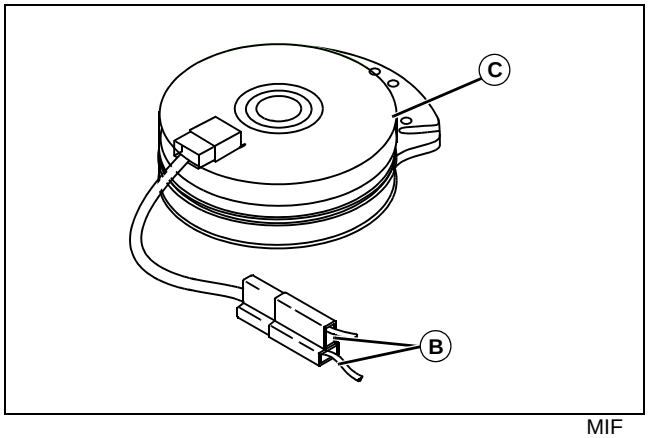


MIF

(1) Is 2.5 to 3.0 ohms resistance measured across the PTO clutch coil leads (A)?

Yes - Go to step (2).

No - Replace PTO clutch. Go to step (2) to continue test.



MIF

(2) Is infinite resistance measured from coil (B) to clutch body (C)?

Yes - Test complete.

No - Replace PTO clutch. Test complete.

Tests and Adjustments

PTO Switch Test

Reason:

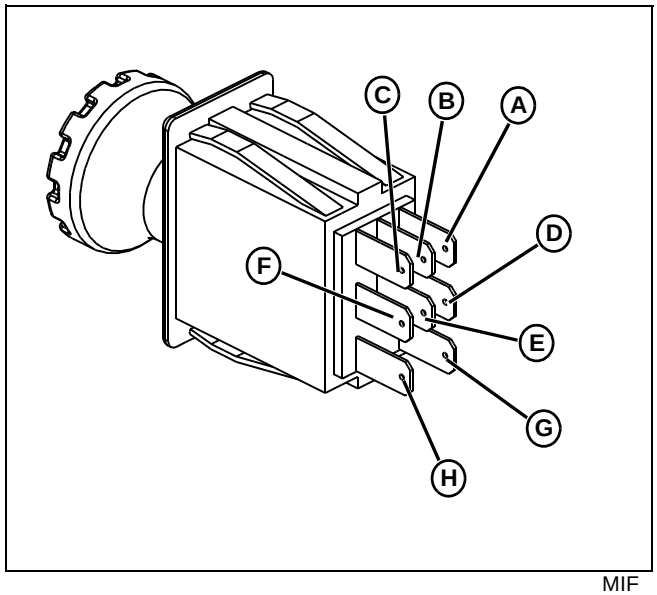
To verify PTO switch functions are operating properly.

Equipment:

- Ohmmeter or Continuity Tester

Procedure:

1. Park machine safely. See Parking Safely in the Safety Section.
2. Disconnect PTO switch connector.



MIF

3. Use an ohmmeter to test switch continuity in off and on positions.

PTO Switch Continuity:

Switch Position	Terminal Continuity
OFF	A and C
OFF	D and F
OFF	G and H
ON	A and B
ON	D and E

Results:

- All other possible combinations have infinite resistance. If any continuity is not correct, replace switch.

Safety Switch Test

Reason:

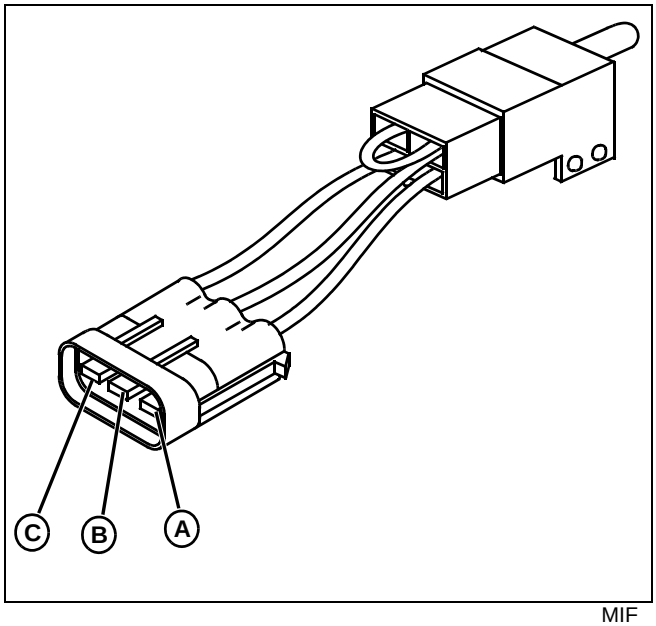
To verify safety switch is operating properly.

Equipment:

- Ohmmeter or Continuity Tester

Procedure:

1. Park machine safely. See Parking Safely in the Safety Section.
2. Disconnect safety switch connector.



MIF

3. Use an ohmmeter to test switch continuity in off and on positions.

Safety Switch Continuity:

Switch Position	Terminal Continuity
Switch plunger not pressed	A and B
Switch plunger pressed	B and C

Results:

- Switch is open (infinite resistance) when switch is depressed. If continuity is not correct, replace switch.

PTO Clutch Test

Reason:

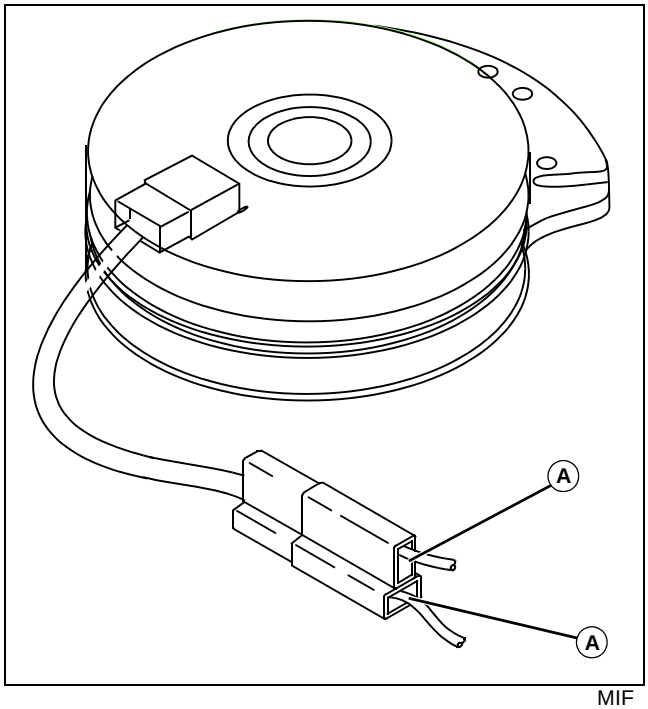
To check condition of PTO clutch coil.

Equipment:

- Ohmmeter
- JT05712 Current Gun

Procedure:

1. Park machine safely. See Parking Safely in the Safety Section.



MIF

2. Disconnect PTO clutch connector X18.
3. Set ohmmeter for 1x ohms scale.
4. Measure resistance across PTO clutch terminals (A).
5. Resistance should measure within specification. If resistance is not within specification, replace PTO clutch.

Results:

- Resistance should measure **2.5 - 3.0 ohms**.

Ignition On/Off Switch Test

Reason:

To verify engine ignition on/off switch is operating properly.

Equipment:

- Ohmmeter or Continuity Tester

Procedure:

1. Park machine safely. See Parking Safely in the Safely Section.
2. Trace the two black leads from the on/off switch to the connectors.
3. Disconnect the switch leads
4. Use an ohmmeter to test switch continuity in off and on positions.

Results:

- If continuity is not found in the off position, replace switch.
- If continuity is found in the on position, replace switch.

Engine Oil Switch Test

Reason:

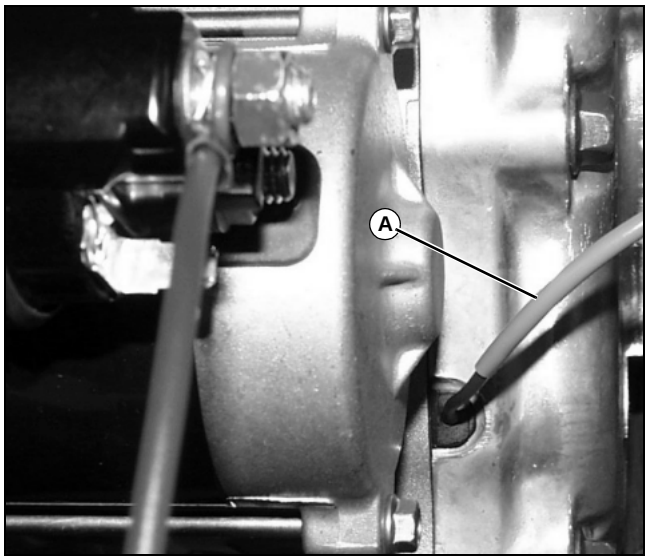
To ensure that the engine oil switch is working properly. The engine oil switch monitors the engine oil level with a float. If the engine oil drops below a predetermined level, the switch will provide a ground circuit for the engine ignition coil and eliminate current to the spark plug, thereby shutting off the engine.

Equipment

- Ohmmeter

Procedure:

1. Check engine oil level. Add oil if needed to bring it to the correct level.



MX17392

2. Disconnect lead wire to engine oil switch. Oil switch wire (A) will exit the engine near the PTO clutch.

3. Set VOM to the lowest ohms scale.

4. Check continuity between oil switch and suitable engine ground. There should be no continuity.

5. Drain the engine oil and check continuity between oil switch and suitable engine ground. There should be no more than 2 ohms of resistance. Replace switch as necessary.

Spark Test

Reason:

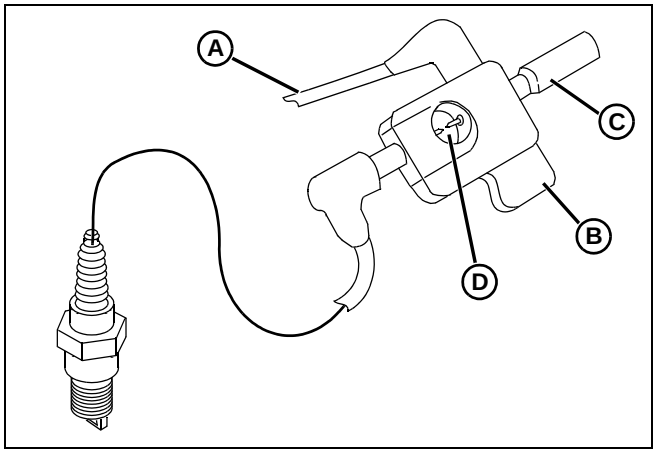
To check overall condition of ignition system.

Equipment:

- D-05351ST Spark Tester

Procedure:

1. Park machine safely. See Parking Safely in the Safety Section.



MIF

2. Remove high tension lead (A) from spark plug and connect to spark tester (B).

3. Connect spark tester lead to spark plug.

NOTE: Do not adjust spark tester gap beyond 5.0 mm (0.200 in.) as damage to ignition system components could occur.

4. Adjust spark tester gap to 4.2 mm (0.166 in.) with screw (C).

5. Turn ignition switch to on position and start engine.

6. Watch spark (D) at spark tester.

Results:

- If engine will start, watch spark with engine running. There should be a strong, steady, blue spark
- If spark is weak, or if no spark, install a new spark plug and test again.
- If spark is still weak, or still no spark, tests ignition armature.

Ignition Coil Air Gap Adjustment

Reason:

To adjust air gap between ignition coil and flywheel magnets to a specified tolerance needed for proper ignition timing and sufficient spark voltage.

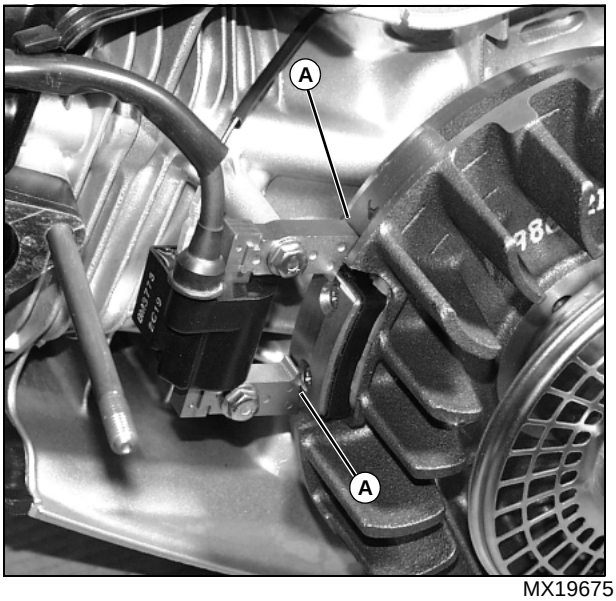
Equipment:

- Flat blade feeler gauge

Procedure:

1. Place engine switch in OFF position.
2. Remove flywheel housing.
3. Turn flywheel magnet away from coil.
4. Loosen ignition coil cap screws.

IMPORTANT: Avoid damage! The engine is very sensitive to this adjustment so both legs of the coil must have the same air gap.



MX19675

5. Select the 0.5 mm (0.020 in.) feeler gauge blade and insert it between the flywheel and coil legs (A).
6. Turn flywheel until magnet aligns with the legs of the ignition coil and feeler gauge spans both legs of coil and the flywheel magnet at the same time.
7. Allow the magnet to draw the module against the gauge.
8. Hold the coil in position and tighten the cap screws. Rotate the flywheel to remove the feeler gauge.
9. Tighten the lower screw first.
10. Rotate the flywheel back and forth, checking to make sure the magnet does not strike the module.

- Tighten the screws to 10 N•m (88 lb-in.).

Spark Plug Gap Adjustment

Reason:

To maintain the correct gap between the center electrode and the tab needed to produce a good spark.

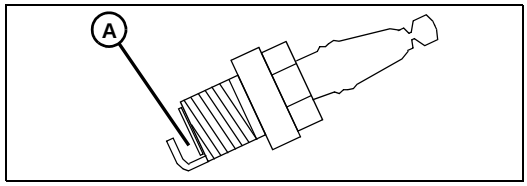
Equipment:

- 0.76 mm (0.030 in.) feeler gauge

Procedure:

IMPORTANT: Avoid damage! Do not clean spark plug with sand paper or abrasives. Engine scoring can result.

1. Scrape or wire brush deposits from spark plug.
2. Inspect spark plug for:
   - Cracked porcelain.
   - Pitted or damaged electrodes.



MIF

3. Check spark plug gap (A) using a feeler gauge. Set gap to specifications.
4. Install and tighten spark plug to specifications.

Specifications:

Spark Plug Gap . . . . . 0.76 mm (0.030 in.)

Spark plug torque . . . . . 20 N•m (177 lb-in.)

Spark Plug Cap Test

Spark plugs should not be burned, blistered, or have cracked insulator tips or badly eroded electrode.

Make sure the plug is correctly gapped.

Specifications:

Spark Plug Gap . . . . . 0.76 mm (0.030 in.)

NOTE: Bending center wire or hitting plug with gapping tool can break insulator.

Reason:

To determine if spark plug cap is defective.

Equipment:

- Ohmmeter

Procedure:

1. Park machine safely. See Parking Safely in the Safety Section.
2. Pull the insulator boot back off of spark plug cap.
3. Remove spark plug cap by unscrewing the cap from the lead.

M48364

4. Measure resistance across spark plug cap terminals. Resistance should be about the same as marked on the spark plug cap.

Specifications:

Spark plug cap resistance . . . . . 4.0 - 6.0 k-ohms

Results:

- If resistance does not meet specification, replace spark plug cap.

Ignition Coil Test

Reason:

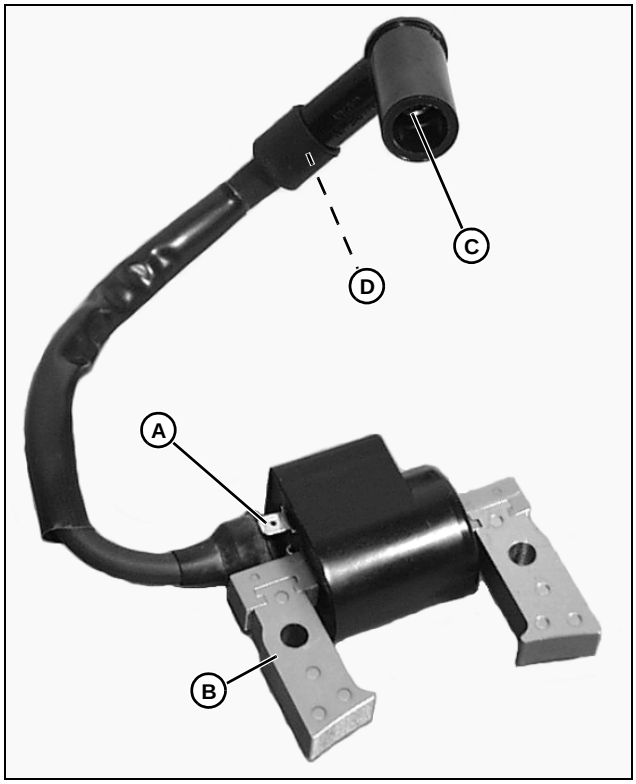
To determine condition of ignition coil windings.

Equipment:

- Ohmmeter

Procedure:

1. Remove ignition coil from engine.
2. Disconnect wires from ignition coil terminal.



MX19676

3. Measure resistance between ground terminal (A) and laminations (B).
4. Measure resistance between ground terminal (A) and spark plug cap (C).
5. Remove spark plug cap and measure resistance between ground terminal (A) and spark plug lead (D).

Specifications:

Laminations to Ground Terminal . . . . . 0.7 ohms

Ground Terminal to Spark Plug Cap 13.5 - 18.0 K-ohms

Ground Terminal to Spark Plug Lead . 9.5 - 12.9 K-ohms

Results:

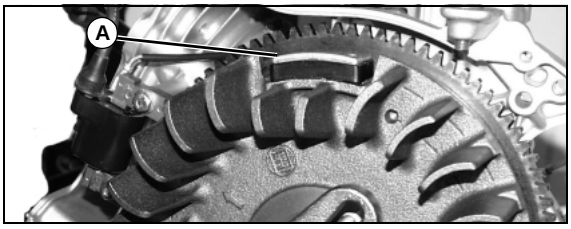
- If resistance does not meet specifications, replace the ignition coil.

Flywheel Magnet Test

Reason:

To make sure the flywheel magnet has enough force to induce current into ignition coil.

Procedure:



MX17357

1. Loosely hold a screwdriver blade about 25 mm (1.0 in.) from the magnet (A).

Results:

- Magnet should attract blade to it.
- If blade is not attracted to magnet, flywheel must be replaced.

Table of Contents

Specifications

General Specifications

Dimensions

Overall Height . . . . . 812.8 mm (32 in.)
Overall Width . . . . . 1905 mm (75 in.)
Pulverizing Width . . . . . 1219.2 mm (48 in.)
Length (including tongue) . . . . . 2438.4 mm (96 in.)
Length (without tongue) . . . . . 1193.8 mm (47 in.)

Tires (18x8.5-8 4 ply turf)

Recommended Operating Tire Pressure . . . . . 69-83 kPa (10-12 psi)
Maximum Tire Pressure . . . . . 152 kPa (22 psi)

Miscellaneous

Brush Sections 8
Spike Speed @3450 rpm . . . . . 1500-1600 rpm
Brush Speed @3450 rpm . . . . . 750-850 rpm

Recommended Lubricants

Engine Oil . . . . . API Service Classification SG or SF
Grease . . . . . John Deere Special Purpose HD Water Resistant
. . . . . John Deere Multi-Purpose HD Lithium Complex

(Specifications and design subject to change without notice.)

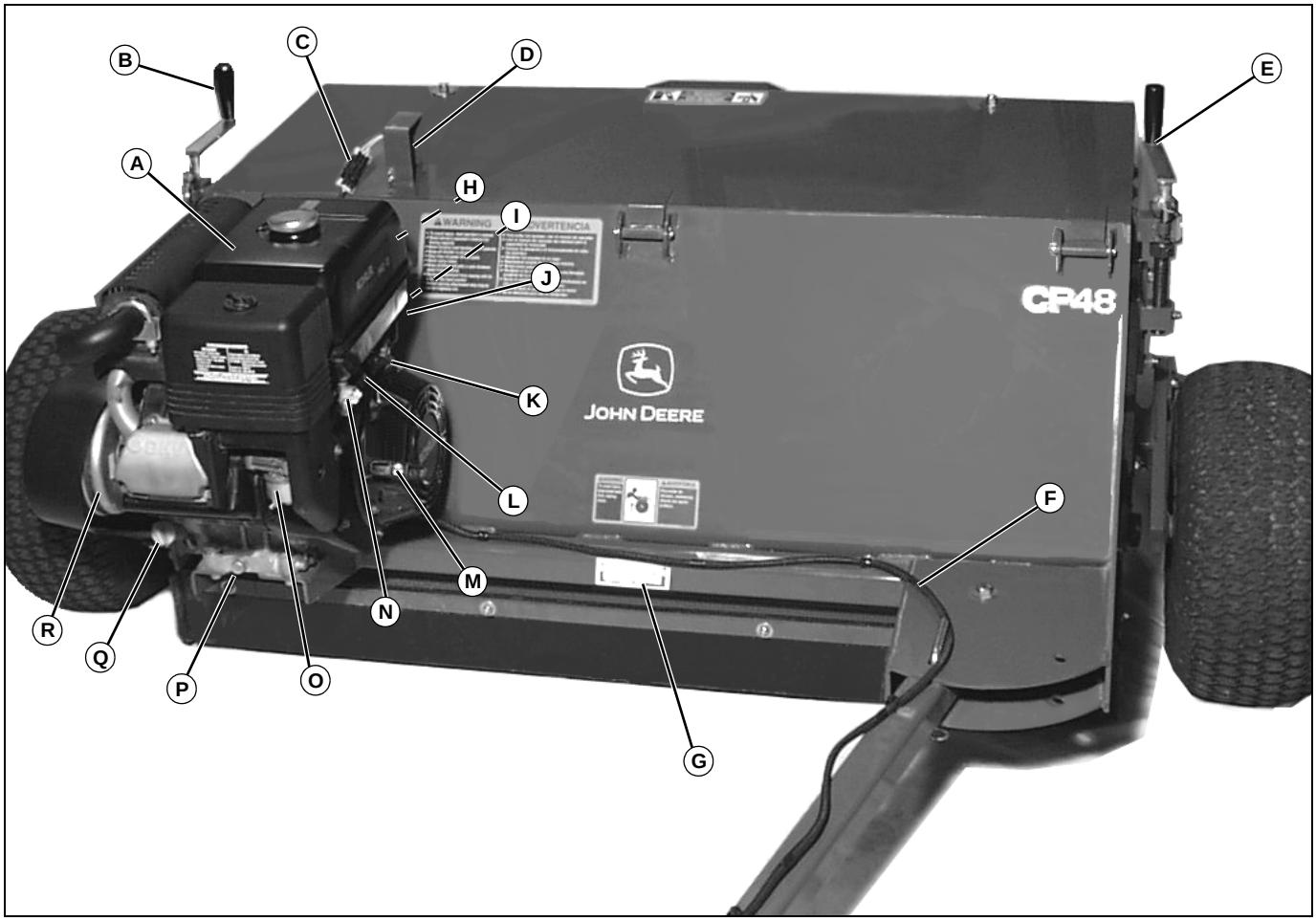
Torque Specifications

Specifications:

Spike Shaft Pulley Mounting Bolt . . . . . 85 N•m (62.7 lb-ft)
Bearing Flange Mounting Bolts . . . . . 35 N•m (25.8 lb-ft)
Cover Nuts . . . . . 44 N•m (32.4 lb-ft)
Secondary Shield Nuts . . . . . 20 N•m (14.7 lb-ft)
PTO Clutch Mounting bolt . . . . . 44 N•m (32.4 lb-ft)
Scraper Mounting Cap Screws . . . . . 25 N•m (18.4 lb-ft)
Wheel Mounting Cap Screws . . . . . 35 N•m (25.8 lb-ft)
T-block bolts . . . . . 85 N•m (62.7 lb-ft)
Guide bolts . . . . . 85 N•m (62.7 lb-ft)
Set Screw . . . . . 17 N•m (12.5 lb-ft)
Crank Nut . . . . . Snug then back 1/6 turn
Brush Mounting Bolts . . . . . 44 N•m (32.4 lb-ft)
Center Bearing Mounting Bolt. . . . . 35 N•m (25.8 lb-ft)
Skirt Mounting Cap Screws . . . . . 25 N•m (18.4 lb-ft)
Center Bearing Support Hardware with Spring . . . . . 6.8 - 9.5 N•m (5 - 7 lb-ft)

Component Location

General



MX19825

R - PTO Clutch

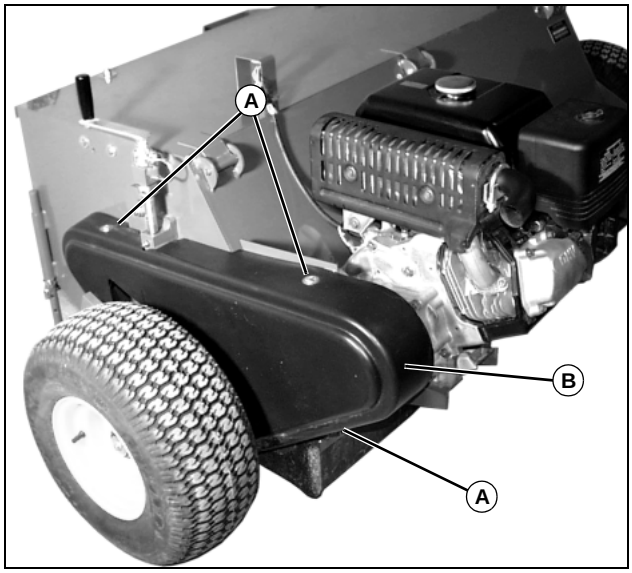
A - Fuel Tank
B - Brush Height Adjustment Assembly (Right)
C - X3 Connector
D - Safety Switch
E - Brush Height Adjustment Assembly (Left)
F - W2 Machine Wiring Harness
G - Machine Identification Label
H - Oil Warning Module
I - Ignition On/Off Switch
J - Oil Warning Light
K - Throttle Lever
L - Choke Lever
M - Retractable Starter Handle
N - Fuel Shutoff Valve and Screen Assembly
O - Carburetor
P - Oil Drain Plug
Q - Oil Filler Cap

Tests and Adjustments

Adjusting Drive Belt Tension

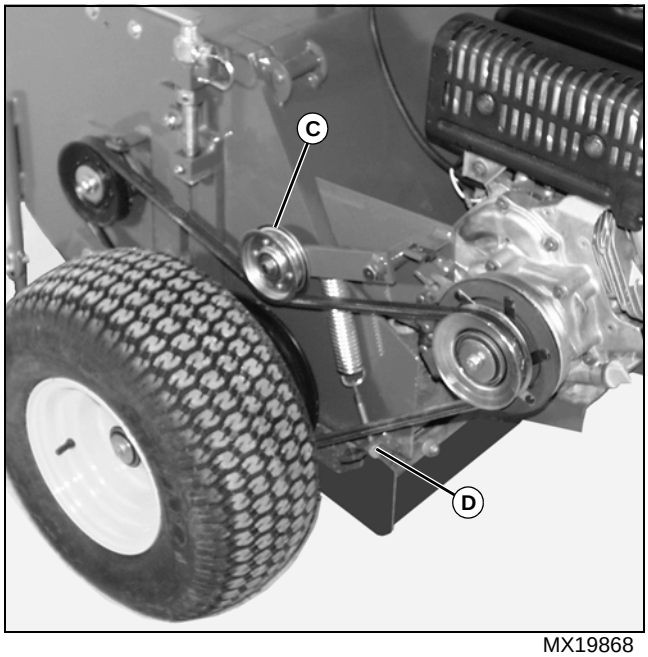
1. Park machine safely. (See Parking Safely in the SAFETY section.)

2. Check to be sure machine is level.



MX19807

3. Remove three screws (A) and belt guard (B) from machine.



MX19868

4. Connect a force gauge to idler pulley (C).

5. Measure the amount of force needed to move the idler pulley 2.54 cm (1.0 in.) in travel. Force should be between 36.3 kg (80 lbs) and 40.8 kg (90 lbs).

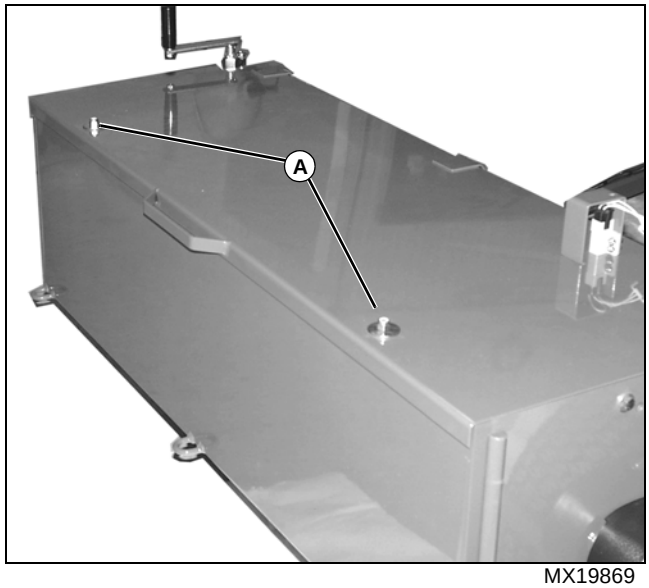
6. Adjust belt tension by turning the spring adjustment nut (D).

- If force is greater than 40.8 kg (90 lbs), turn the nut counterclockwise to release spring tension.
- If force is less than 36.3 kg (80 lbs), turn the nut clockwise to increase spring tension.

Center Bearing Support Spring Hardware Tension Adjustment

The center bearing support bolt torque should be checked every 25 hours of operation.

1. Park machine safely. (See Parking Safely in the SAFETY section.)



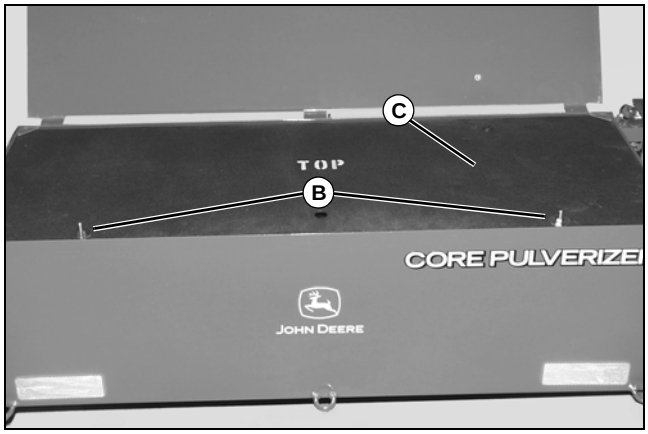
MX19869

2. Remove two locknuts and washers (A) using a 9/16 in. wrench. Open brush compartment lid.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

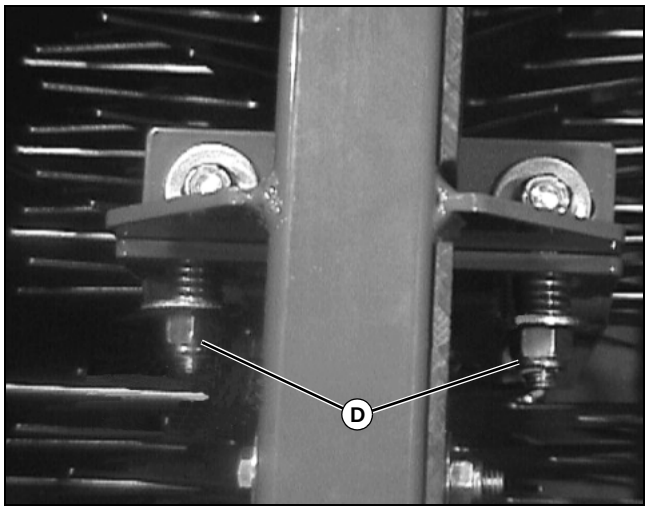
- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



MX19938

3. Remove two nuts and washers (B) using a 9/16 in. wrench. Remove secondary shield (C).

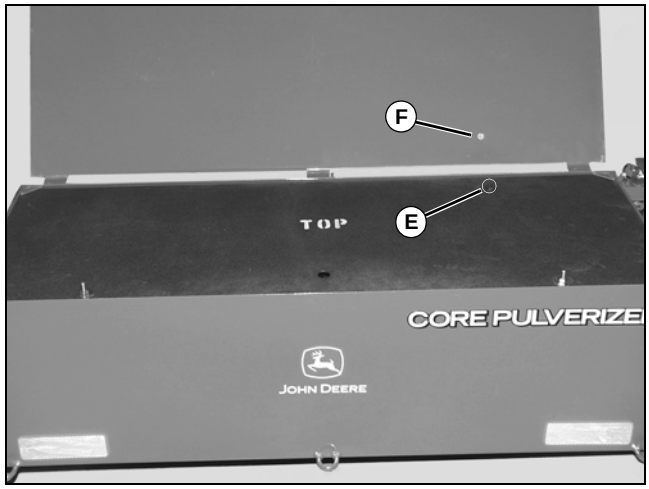


MX30118

4. Check the center bearing support spring bolt (D) torque.

5. The torque for the center bearing support hardware should be 6.8 - 9.5 N•m (5 - 7 lb-ft).

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

6. Install secondary shield with the word "Top" facing upward. Be sure bumper (E) is in position to activate safety switch (F). Install two nuts and washers.

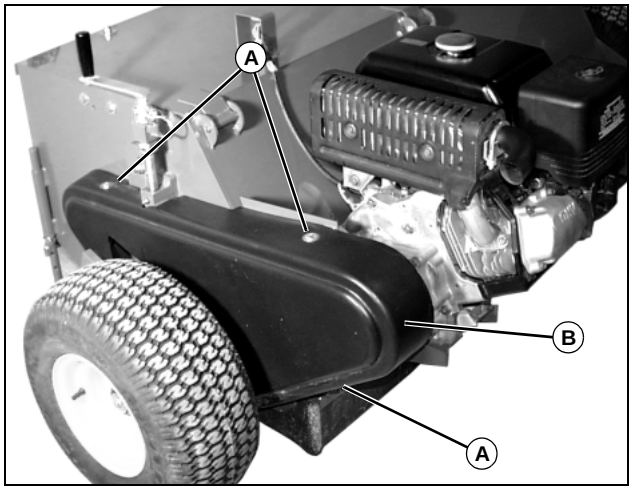
7. Close lid and install washers and locknuts on lid.

Repair

Drive Belt Removal and Installation

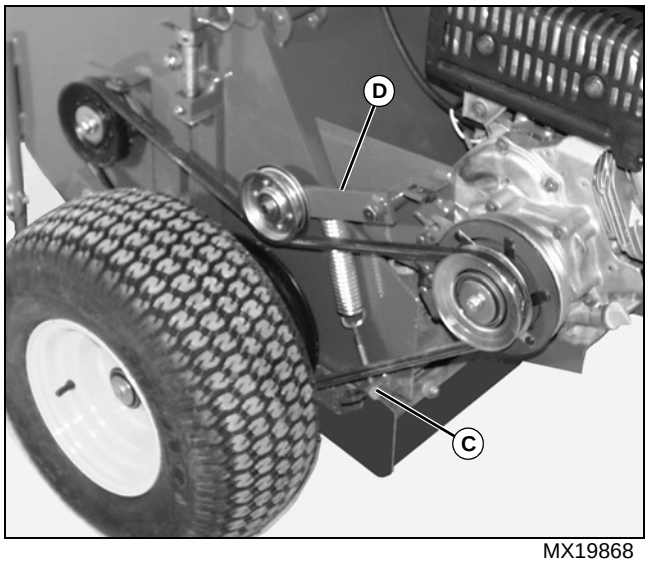
Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.)
2. Raise the belt end of the machine so that machine is level and wheel is approximately 2.5 cm (1.0 in.) off the ground.
3. Support with suitable jack stands.



MX19807

4. Remove three screws (A) and belt guard (B) from machine.



MX19868

5. Loosen the belt tension nut (C) to the end of the adjustment stud.
6. Pull up on the idler pulley arm (D) to relieve the belt tension and remove the drive belt. from pulleys.
7. Route the belt over the wheel to remove.

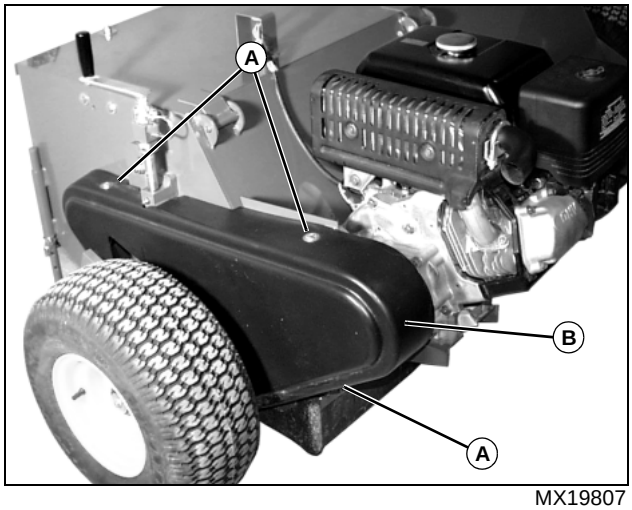
Installation:

1. Install the drive belt in reverse order of removal.
2. Adjust the drive belt tension.
3. Install and secure the belt guard.

PTO Clutch Removal and Installation

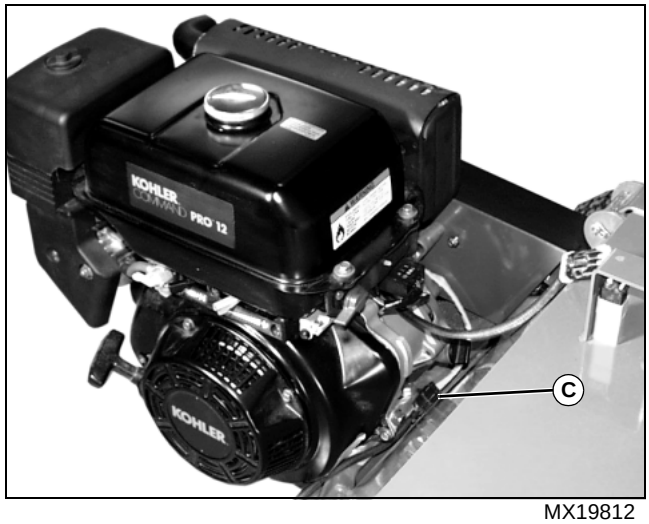
Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.)



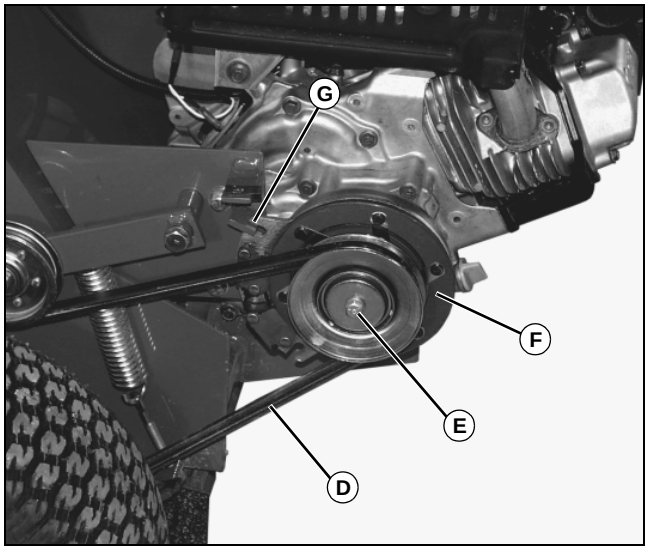
MX19807

2. Remove three screws (A) and belt guard (B) from right side of broom.



MX19812

3. Disconnect the PTO clutch connector (C).



MX19808

4. Remove the drive belt (D).

5. Remove cap screw (E) securing clutch assembly (F) to engine output shaft.

NOTE: Drive key is a part of the clutch. Do not attempt to remove key from clutch bore.

6. Remove the clutch assembly.

Installation:

1. Apply NEVER-SEEZ® lubricant to engine output shaft.
2. Verify clutch stop notch is engaged with stop tab (G).
3. Adjust the drive belt tension.
4. Install and secure the belt guard.

Specifications:

PTO Clutch Mounting bolt . . . . . 44 N•m (32.4 lb-ft)

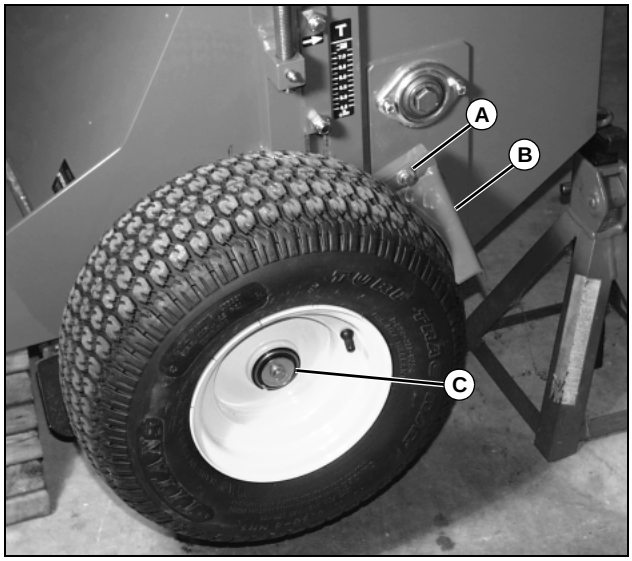
Wheel and Bearing Removal and Installation

Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.)

2. Raise the machine so that it is level and the wheels are approximately 2.5 cm (1.0 in.) off the ground.

3. Support with suitable jack stands.



MX30011

4. Remove the two capscrews, washers (A) and tire scraper (B).

5. Remove the wheel hub capscrew and washer (C).

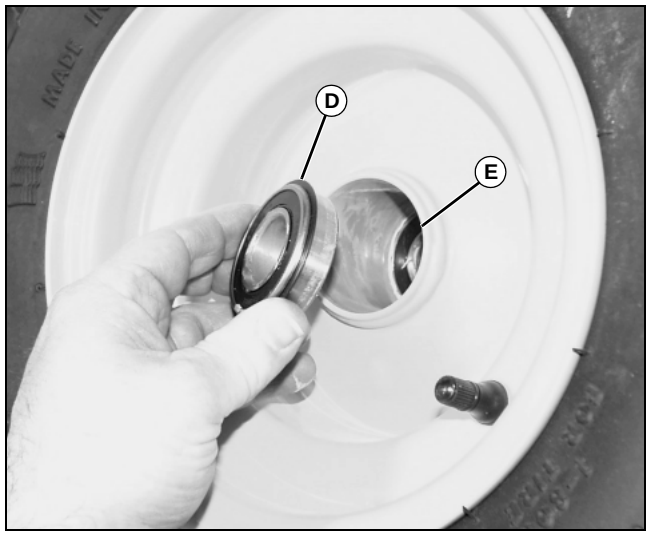
6. Remove the wheel.

7. Using an internal puller, pull the bearings out of the wheel hub.

Installation:

1. Installation is done reverse order of removal.

2. Apply NEVER-SEEZ® lubricant to axle shaft.



MX30012

3. Press the bearings in from each side until retaining ring (D) is flush with hub (E).

Specifications:

Scraper Mounting Cap Screws . . . . . 25 N•m (18.4 lb-ft)

Wheel Mounting Cap Screws . . . . . 35 N•m (25.8 lb-ft)

Spindle Plate Removal and Installation

Removal:

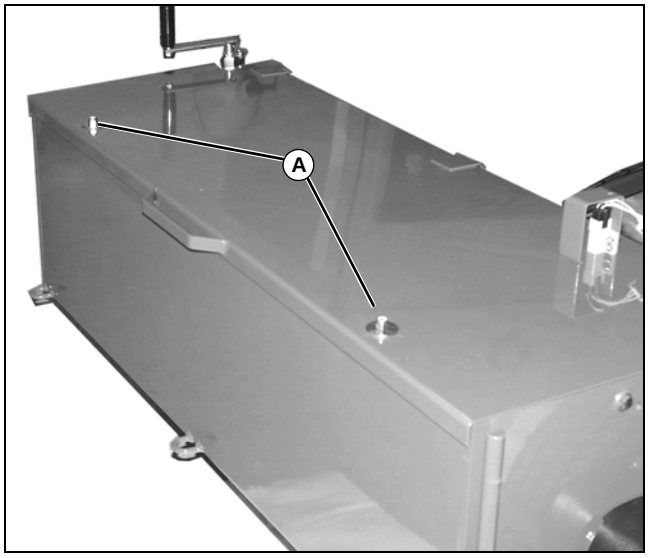
1. Park machine safely. (See Parking Safely in the SAFETY section.)

2. Raise the machine so that it is level and the wheels are approximately 2.5 cm (1.0 in.) off the ground.

3. Support with suitable jack stands.

4. Remove the wheel scraper.

5. Remove the wheel.



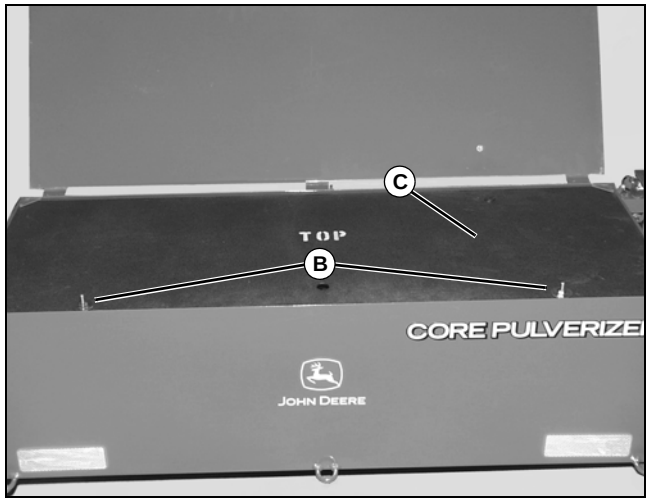
MX19869

6. Remove cover locknuts and washers (A). Open brush compartment cover.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

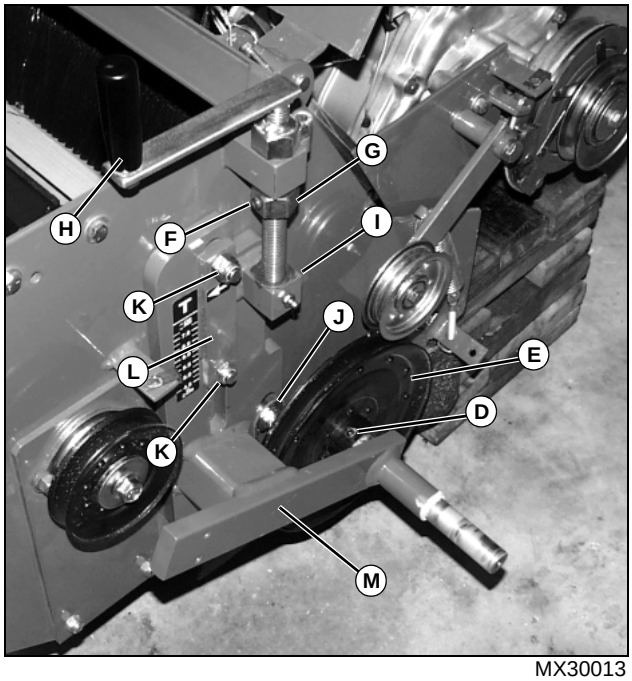
NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



MX19938

7. Remove nuts and washers (B). Remove secondary shield (C).

8. On the right side of the machine, remove the belt guard and the drive belt.

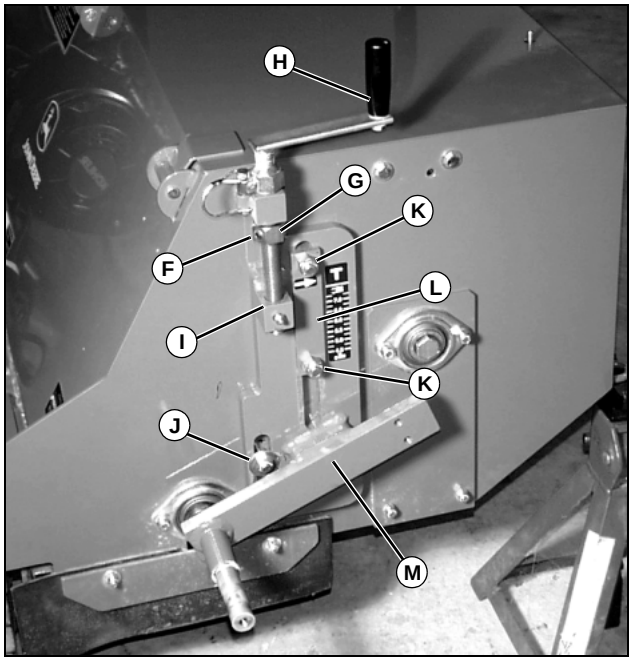


MX30013

Picture Note: Right Side

9. Loosen the set screws (D) securing the pulley (E) to the shaft.

10. Remove the pulley (E) from the shaft.



MX30014

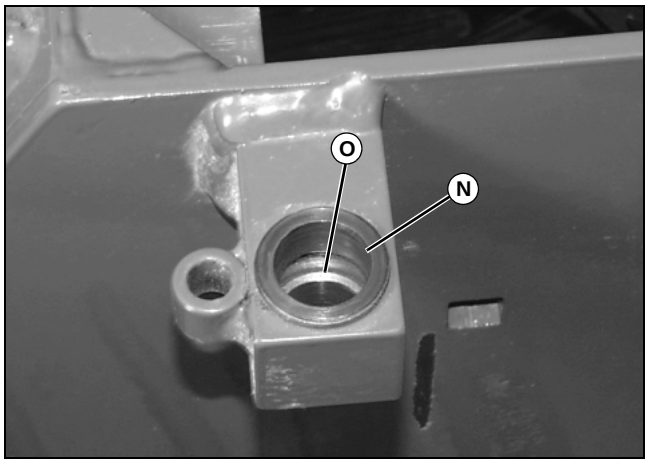
Picture Note: Left Side

11.Loosen the set screw (F).

12.Hold nut (G) and turn height adjustment crank handle (H) until it out of the spindle plate adjusting block (I).

13.Remove the guide bolt, washers and spacer (J).

14.Remove lock nuts (K), T-block (L), and spindle plate (M).



MX30015

15.Inspect flanged bushings (N) for wear or damage.

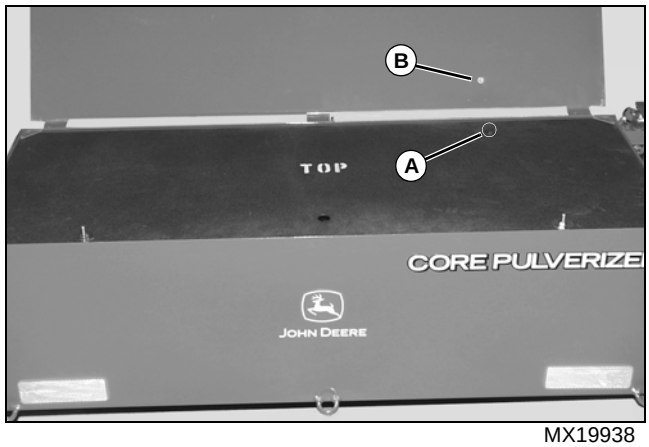
16.If replacement is needed, use a punch to drive the bushing out of the bushing block (O).

Installation:

1. Installation is done reverse order of removal.

2. Do not fully tighten the T-block bolts or the guide bolt until the adjustment crank handle has been screwed into the spindle plate adjusting block.

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

3. Install secondary shield with the word "Top" facing upward. Be sure bumper (A) is in position to activate safety switch (B). Install nuts and washers.

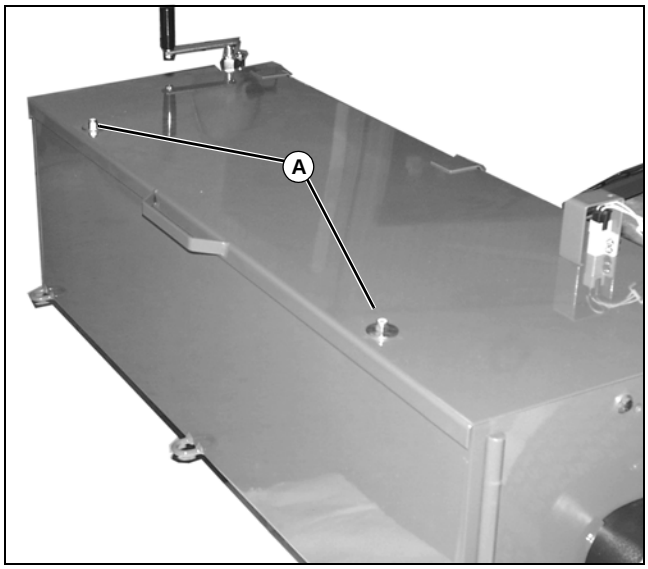
4. Close cover and install washers and locknuts.

Specifications:

T-block bolts	**85 N•m (62.7 lb-ft)**
Guide bolts	**85 N•m (62.7 lb-ft)**
Scraper Mounting Cap Screws	**25 N•m (18.4 lb-ft)**
Wheel Mounting Cap Screws	**35 N•m (25.8 lb-ft)**
Set Screw	**17 N•m (12.5 lb-ft)**
Crank Nut	**Snug then back 1/6 turn**
Cover Nuts	**44 N•m (33 lb-ft)**
Secondary Shield Nuts	**20 N•m (14.7 lb-ft)**

Replacing Brush Sections

1. Park machine safely. (See Parking Safely in the SAFETY section.)



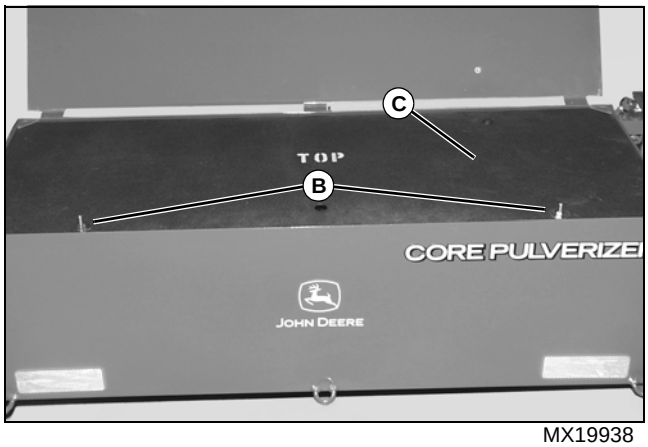
MX19869

2. Remove cover locknuts and washers (A). Open brush compartment cover.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

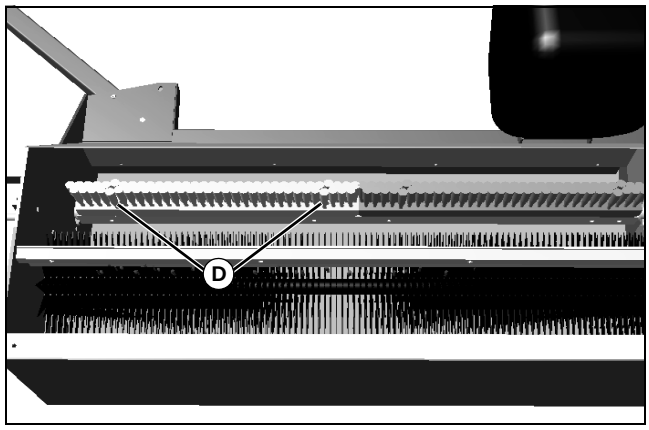
- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



MX19938

3. Remove nuts and washers (B). Remove secondary shield (C).



MX19871

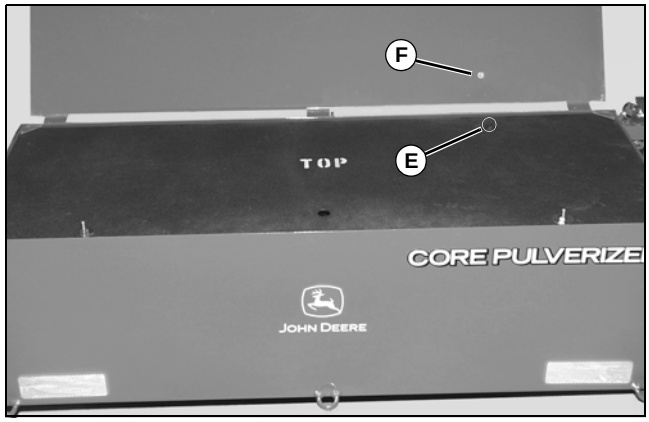
4. Remove and retain the attaching bolts (D) and lock nuts securing the brush section being replaced.

5. Remove and discard the brush section.

NOTE: It is normal for brushes to have contact with frame when new brushes are installed.

6. Position the new brush section on the brush spindle and align the mounting holes. Secure with the original hardware.

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

7. Install secondary shield with the word "Top" facing upward. Be sure bumper (E) is in position to activate safety switch (F). Install nuts and washers.

8. Close cover and install washers and locknuts.

Specifications:

Brush Mounting Bolts . . . . . 44 N•m (32.4 lb-ft)

Cover Nuts . . . . . 44 N•m (33 lb-ft)

Secondary Shield Nuts . . . . . 20 N•m (14.7 lb-ft)

Brush Shaft and Bearing Removal and Installation

Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.)

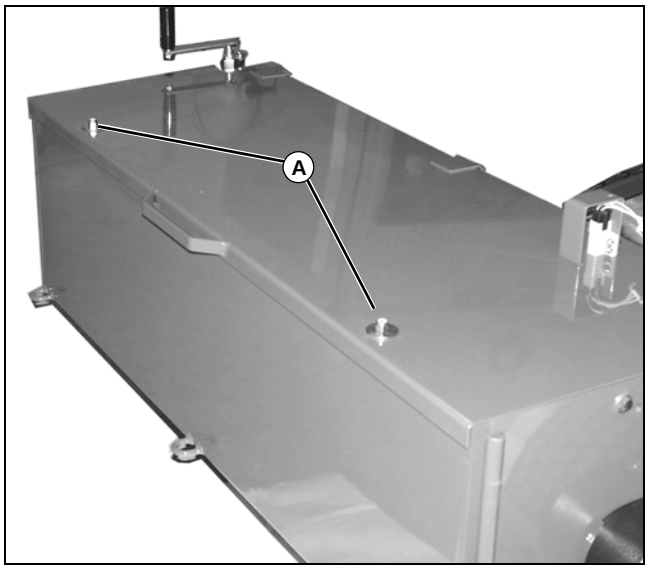
2. Raise the machine so that it is level and the wheels are approximately 15.24 cm (6.0 in.) off the ground.

3. Support with suitable jack stands.

4. Remove the wheel scraper.

5. Remove the wheel.

6. On the right side of the machine, remove the belt guard and the drive belt.



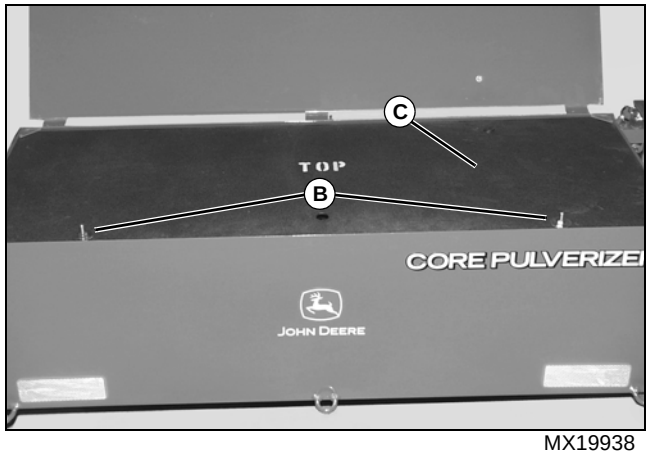
MX19869

7. Remove cover locknuts and washers (A). Open brush compartment cover.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



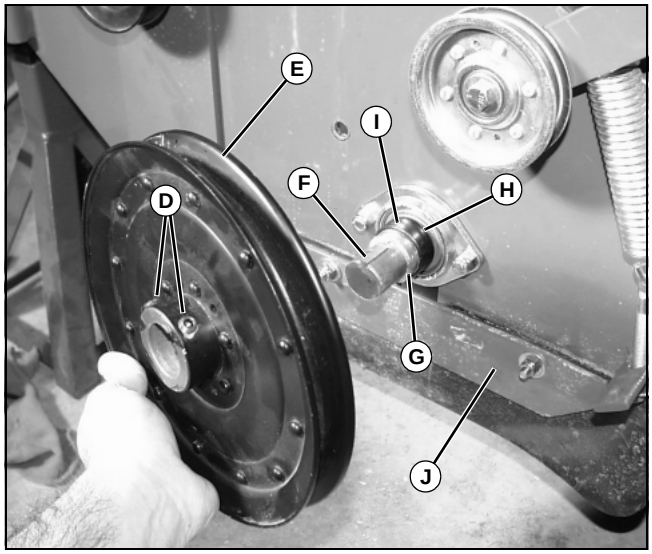
MX19938

8. Remove nuts and washers (B). Remove secondary shield (C).

NOTE: It is not necessary to remove the spindle plate on the left side of the machine.

9. Remove the right spindle plate.

10. On the left side of machine, adjust the spindle plate up to allow clearance for the bearing to be removed.



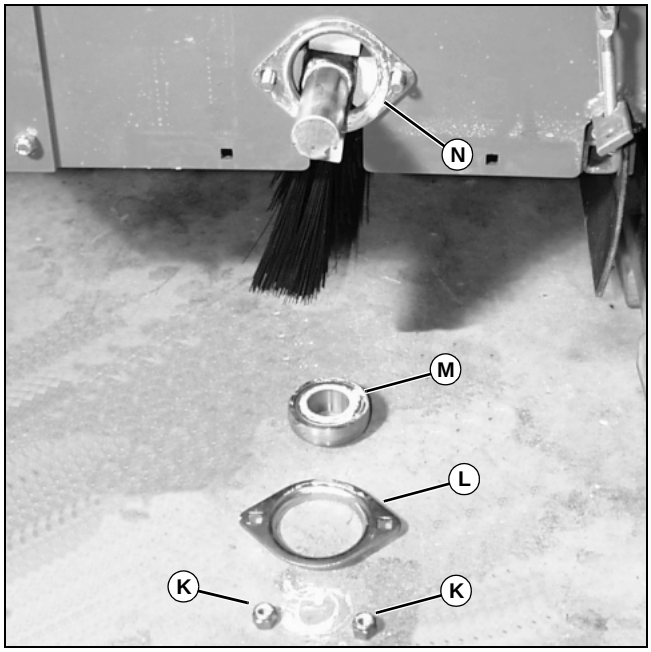
MX30016

11. Loosen the set screws (D) securing the pulley (E) to the shaft.

12. Remove the pulley (E), key (F), and spacer (G) from the shaft.

13. Loosen the set screw (H) and rotate the locking collar (I) and remove the locking collar from the shaft.

14. Remove the rubber skirt (J)



MX30017

15.Remove the locknuts (K) and outer bearing flange (L).

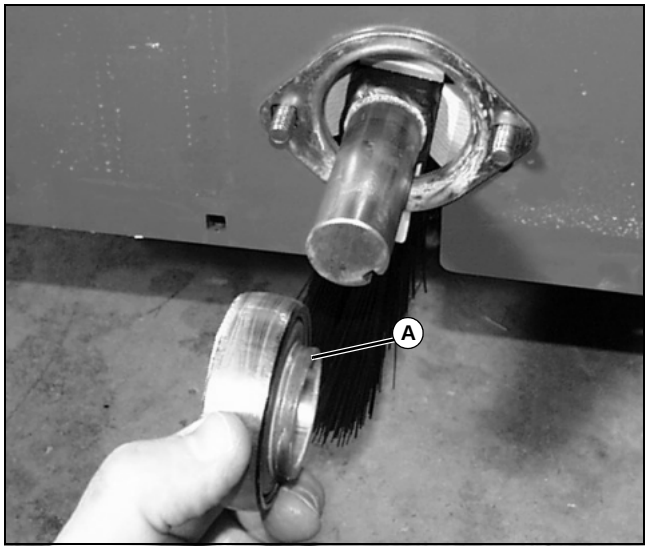
16.Lift slightly on the brush and pull the bearing (M) and inner bearing flange (N) off of the shaft and lower the brush to the ground. Repeat this for the other end of the shaft.

17.Pull the brush out from under the frame.

Installation:

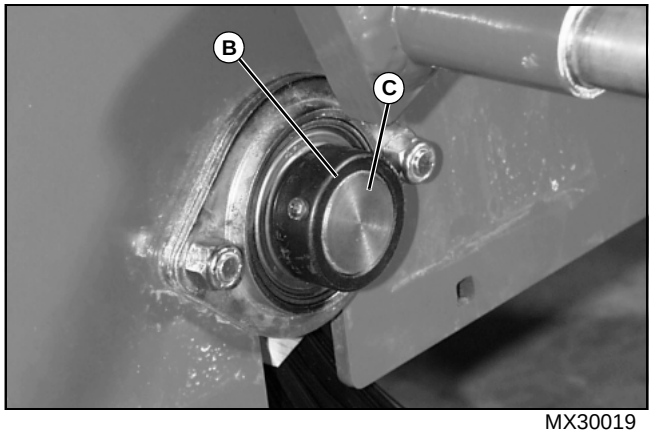
1. Installation is done reverse order of removal.

2. Lightly coat the shaft ends with NEVER-SEEZ® lubricant before assembly the bearings and pulley to the shaft.



MX30018

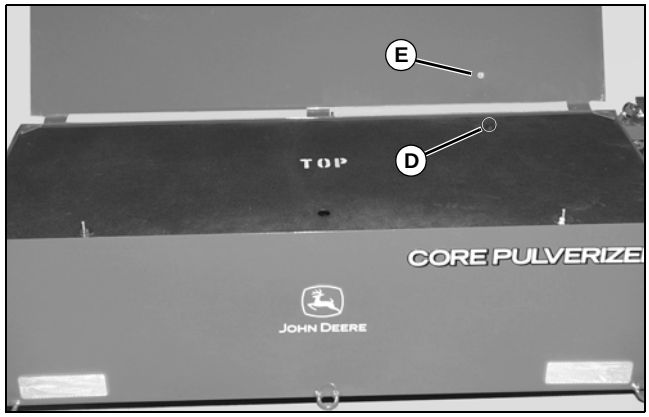
3. Install the bearing onto the shaft with the bearing collar (A) toward the outside.



MX30019

4. On the left side of machine, install the shaft into bearing and locking collar until the collar (B) is flush with the end of the shaft (C).

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

5. Install secondary shield with the word "Top" facing upward. Be sure bumper (D) is in position to activate safety switch (E). Install nuts and washers.

6. Close cover and install washers and locknuts.

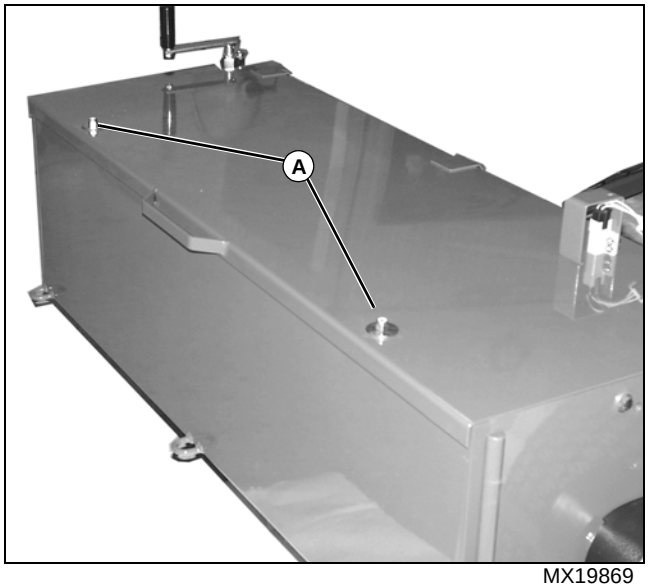
Specifications:

T-block bolts	**85 N•m (62.7 lb-ft)**
Guide bolts	**85 N•m (62.7 lb-ft)**
Scraper Mounting Cap Screws	**25 N•m (18.4 lb-ft)**
Wheel Mounting Cap Screws	**35 N•m (25.8 lb-ft)**
Skirt Mounting Cap Screws.	**25 N•m (18.4 lb-ft)**
Set Screws	**17 N•m (12.5 lb-ft)**
Crank Nut	**Snug then back 1/6 turn**
Bearing Flange Mounting Bolts	**35 N•m (25.8 lb-ft)**
Cover Nuts	**44 N•m (33 lb-ft)**
Secondary Shield Nuts	**20 N•m (14.7 lb-ft)**

Spike Shaft Outer Bearing Removal and Installation

Removal:

1. Park machine safely. (See Parking Safely in the SAFETY section.)
2. Raise brushes to transport position.
3. Remove the belt guard and the drive belt.



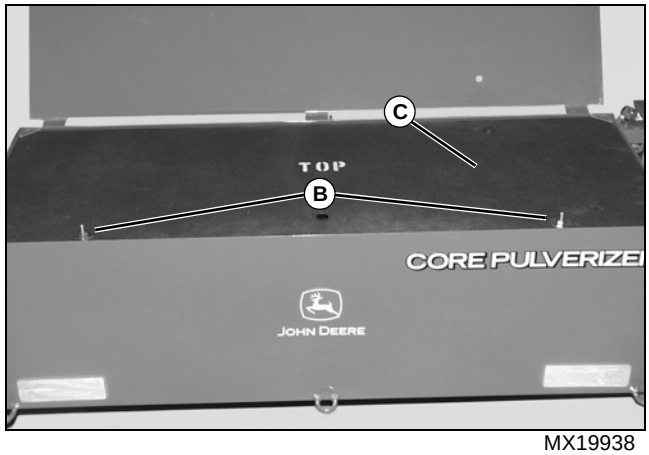
MX19869

4. Remove cover locknuts and washers (A). Open brush compartment cover.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

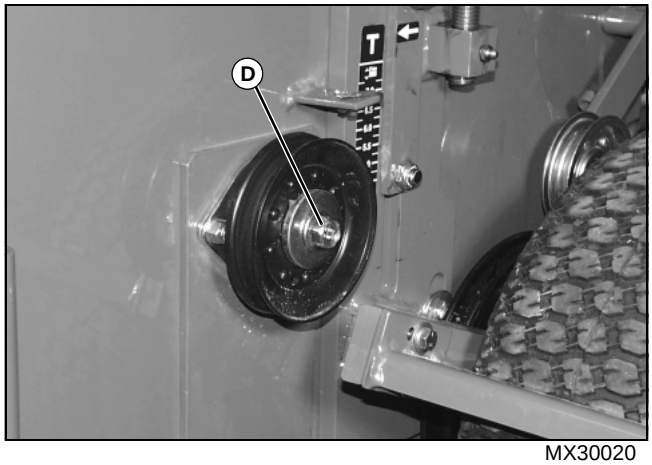
- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



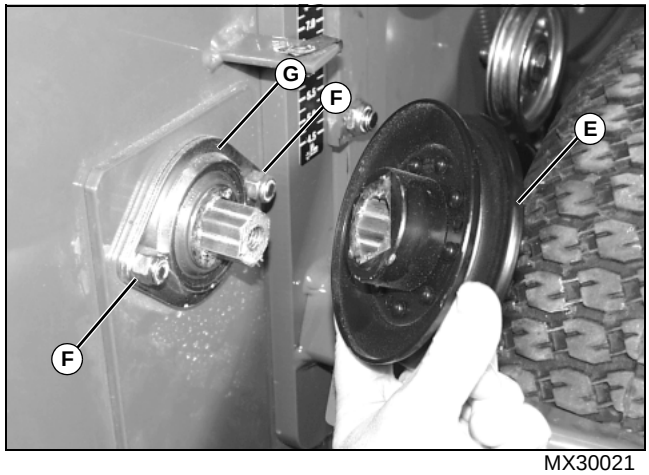
MX19938

5. Remove nuts and washers (B). Remove secondary shield (C).



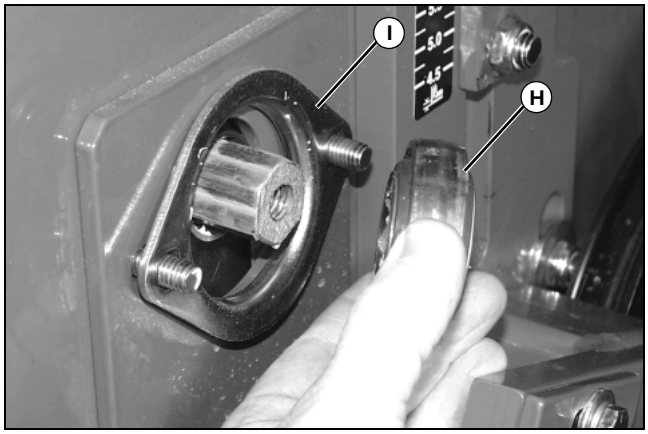
MX30020

6. Remove the pulley bolt (D) and washer from spike shaft.



MX30021

7. Remove the pulley (E) from the shaft.
8. Remove the locknuts (F) and outer bearing flange (G).



MX30022

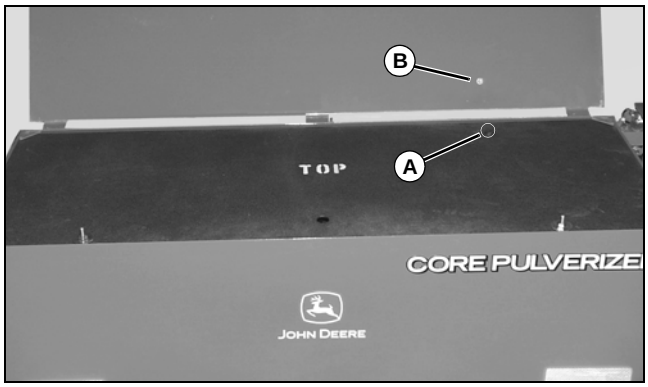
9. Lift slightly on the spike shaft and pull the bearing (H) and inner bearing flange (I) off of the shaft. Repeat this for the other end of the shaft.

Installation:

1. Installation is done reverse order of removal.

2. Lightly coat the shaft ends with NEVER-SEEZ® lubricant before assembly the bearings and pulley to the shaft.

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

3. Install secondary shield with the word "Top" facing upward. Be sure bumper (A) is in position to activate safety switch (B). Install nuts and washers.

4. Close cover and install washers and locknuts.

Specifications:

Pulley Mounting Bolt . . . . . 71 N•m (52 lb-ft)

Bearing Flange Mounting Bolts . . . . 35 N•m (25.8 lb-ft)

Cover Nuts . . . . . 44 N•m (33 lb-ft)

Secondary Shield Nuts . . . . . 20 N•m (14.7 lb-ft)

Center Bearing Support Hardware with Spring . . . . . 6.8 - 9.5 N•m (5 - 7 lb-ft)

Spike Shaft, Spike Blade, and Center Support Bearing Removal and Installation

Removing Spike Shaft Assembly:

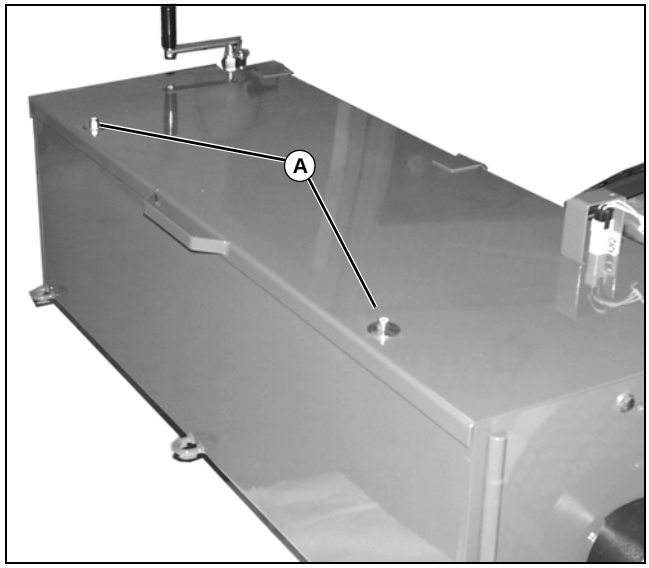
1. Park machine safely. (See Parking Safely in the SAFETY section.)

2. Raise brushes to transport position.

3. Raise the machine so that it is level and the wheels are approximately 15.24 cm (6.0 in.) off the ground.

4. Support with suitable jack stands.

5. Remove the belt guard and the drive belt.



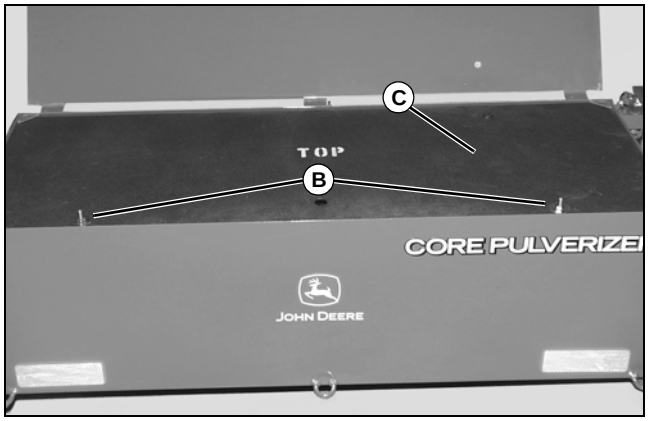
MX19869

6. Remove cover locknuts and washers (A). Open brush compartment cover.

CAUTION: Avoid injury! Spikes are extremely sharp and can cause injury:

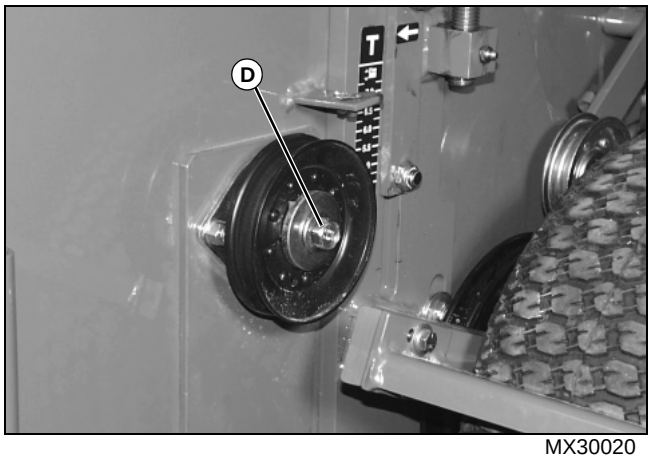
- **Be sure spike movement has stopped before removing secondary shield.**
- **Always wear gloves and use extreme caution when working in the spike area.**
- **Be sure secondary shield is installed at all times except when servicing brushes or spikes.**

NOTE: Secondary shield is required as a safety feature to avoid access to the pulverizing chamber prior to spike stoppage.



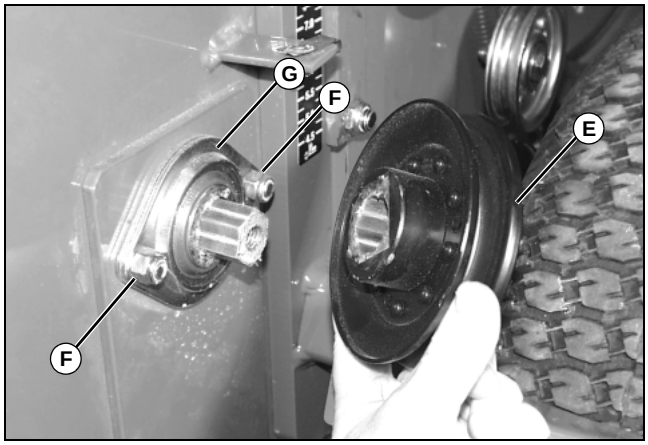
MX19938

7. Remove nuts and washers (B). Remove secondary shield (C).



MX30020

8. Remove the pulley bolt (D) and washer from spike shaft.

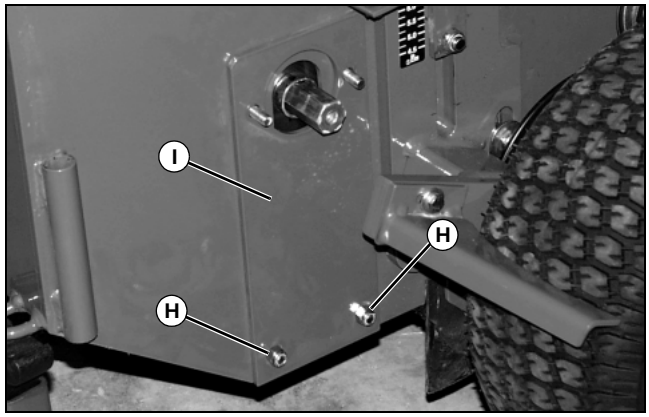


MX30021

9. Remove the pulley (E) from the shaft.

10. Remove the locknuts (F) and outer bearing flange (G).

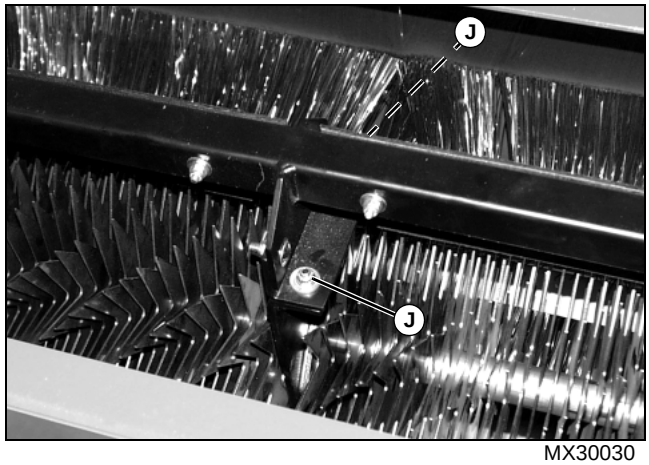
11. Remove the bearing and inner bearing flange from the shaft. Repeat this for the other end of the shaft.



MX30029

12. Remove the bolts (H) and slot cover plate (I) on each end of machine.

13. Support the spike shaft assembly with a suitable lifting device.

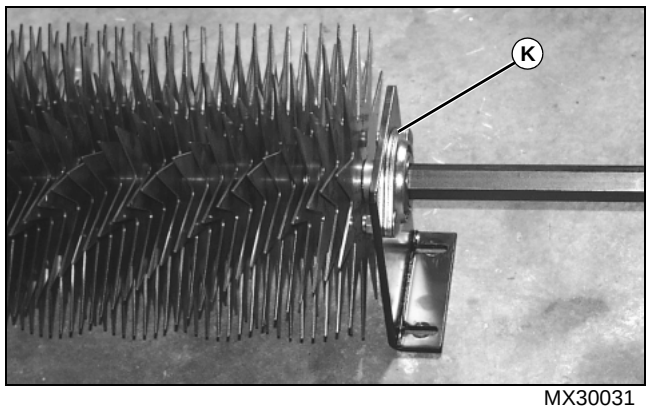


MX30030

14. Remove the center bearing plate mounting bolts (J) and lower the spike shaft assembly to the ground.

15. Slide the spike shaft assembly out from under the machine frame.

NOTE: If replacing spike blades, retain the spacers for use during assembly. The spike blades may be discarded.

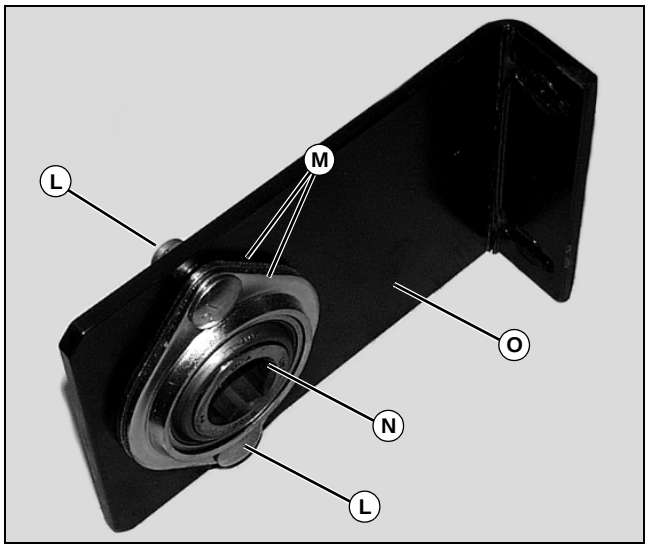


MX30031

16.Remove the spike blades and spacers until the center bearing assembly (K) can be remove.

17.Remove the center bearing assembly.

18.If replacing the spike blades, remove the remaining spike blades and spacers.



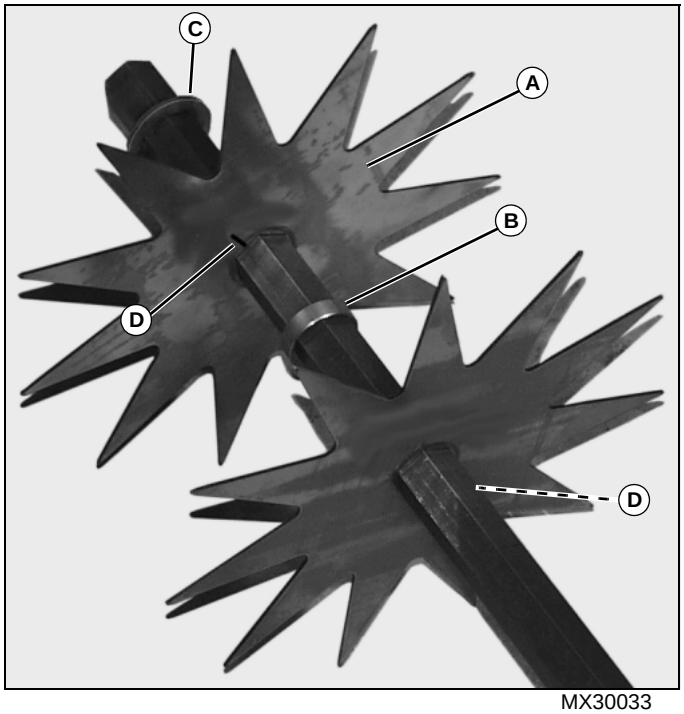
MX30032

19.Remove the bearing flange mounting bolts (L).

20.Disassemble the bearing flanges (M) from the bearing (N) and mounting plate (O).

Replacing Spike Blades

1. Remove and discard the spike blades while retaining the spacers for installation with the new spike blades.

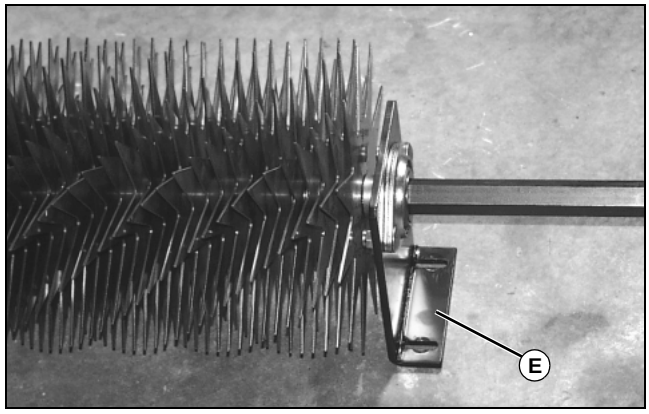


MX30033

2. Install the new spike blades on the shaft starting with a spike blade (A) followed by a spacer (B). Slide the first blade onto the shaft until tight against the stop washer (C).

3. Using the index mark (D) etched into each spike blade, rotate the second spike blade 180° and install the blade and spacer on the shaft.

4. Continue to install a spike blade and spacer set on the shaft, rotating the spike blade 180° each time until 43 sets of the spike blades and spacers are on the shaft.



MX30031

5. Install the center bearing and plate assembly with the mounting plate return flange (E) toward the pulley end of the shaft.

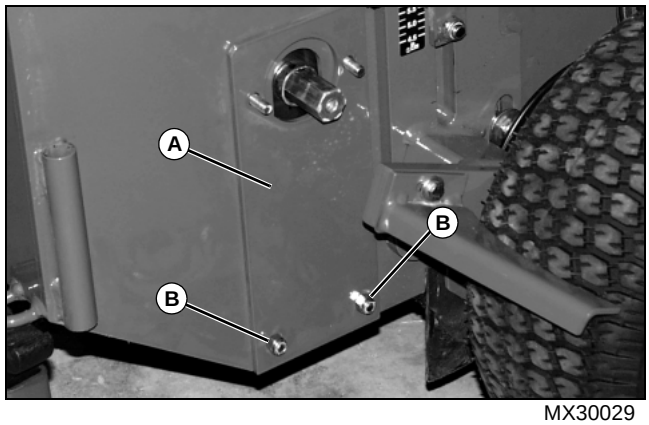
6. Continue to install a spike blade and spacer set on the shaft rotating the spike blade one flat each time until the remaining spike blades and spacers are on the shaft. The assembly will end with a spacer.

Installing Spike Shaft Assembly:

1. Installation is done reverse order of removal.

2. Position the shaft assembly under the machine frame with the pulley, (threaded) end of the shaft toward the right side of the machine.

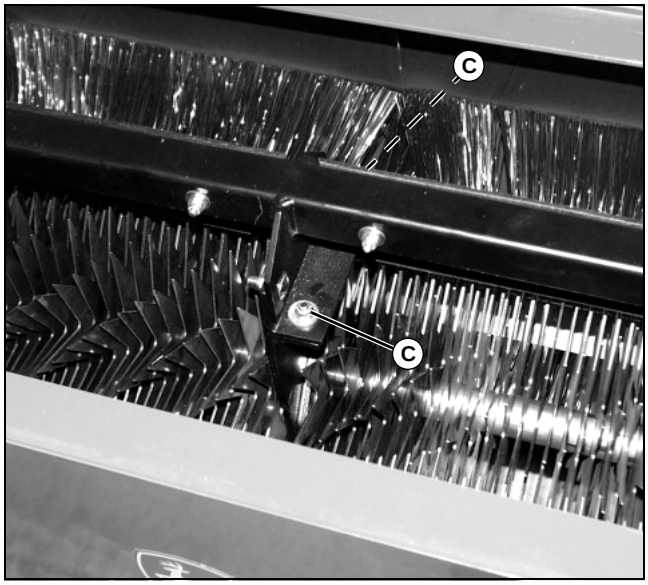
3. Using a suitable lift, raise the shaft assembly into the frame until the slot cover plates can be installed with the bottom bolts.



MX30029

4. Install the slot cover plate (A) on each end of machine and tighten the lower bolts (B) to specification.

5. Align the center bearing plate mounting holes with the inner frame rail mounting holes.



MX30030

6. Install the bolts (C) and tighten to specification.

7. Lightly coat the shaft ends with NEVER-SEEZ® lubricant before assembly the bearings and pulley to the shaft.

8. Install the bearing and flange assembly on each end of the machine and tighten the flange bolts to specification.

9. Install the pulley on the shaft and tighten the bolt to specification.

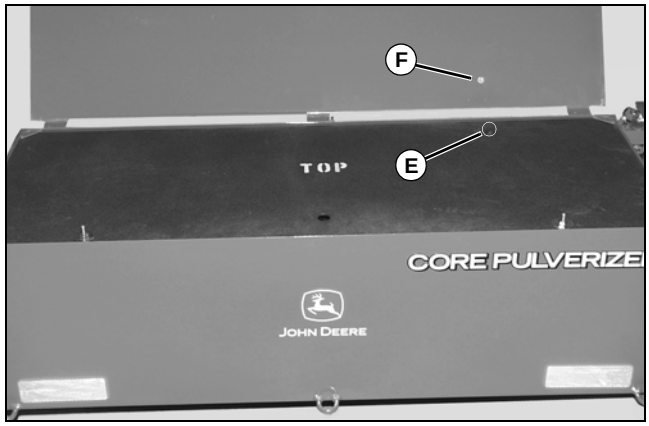
10.Install the drive belt and belt cover.

MX30118

11.Check the center bearing support spring bolt (D) torque.

12.The torque for the center bearing support hardware should be 6.8 - 9.5 N•m (5 - 7 lb-ft).

NOTE: Secondary shield must be installed with "Top" facing upward so bumper is in position to activate safety switch.



MX19938

13.Install secondary shield with the word "Top" facing upward. Be sure bumper (E) is in position to activate safety switch (F). Install nuts and washers.

14.Close cover and install washers and locknuts.

Specifications:

Pulley Mounting Bolt . . . . . 71 N•m (52 lb-ft)

Center Bearing Mounting Bolt . . . . . 25 N•m (18.4 lb-ft)

Bearing Flange Mounting Bolts . . . . 35 N•m (25.8 lb-ft)

Cover Nuts . . . . . 44 N•m (33 lb-ft)

Secondary Shield Nuts . . . . . 20 N•m (14.7 lb-ft)

Center Bearing Support Hardware with Spring . . . . . 6.8 - 9.5 N•m (5 - 7 lb-ft)

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