JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Walk-Behind Greensmower
180B, 220B, and 260B

TM2004 DEC05

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

Power Train

Handlebar and Controls

Brakes

Cutting Unit

Miscellaneous

Recognize Safety Information

MIF

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.

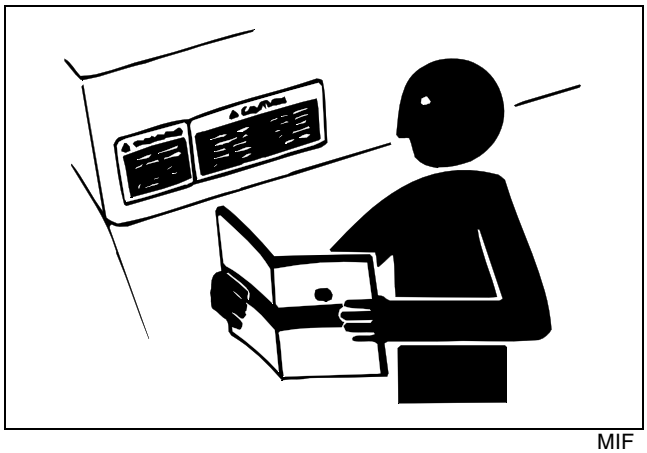
Follow recommended precautions and safe servicing practices.

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.

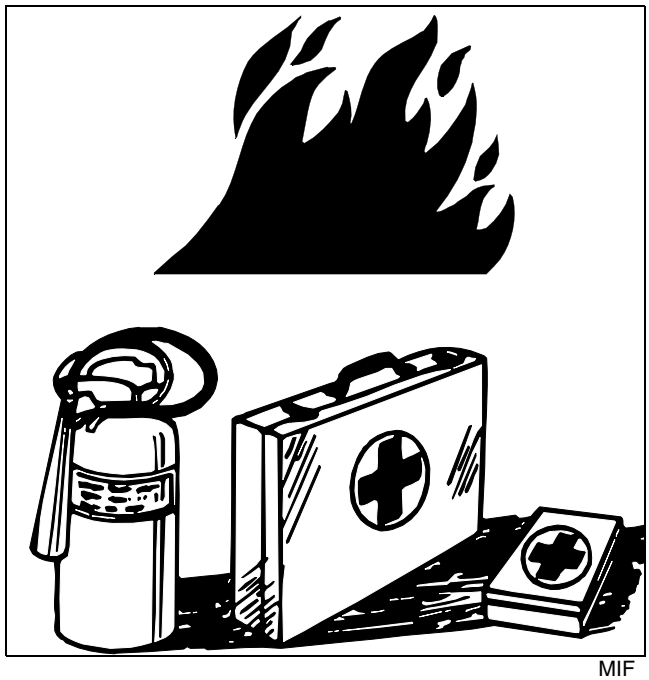
Replace Safety Signs



MIF

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

Be Prepared for Emergencies



MIF

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.

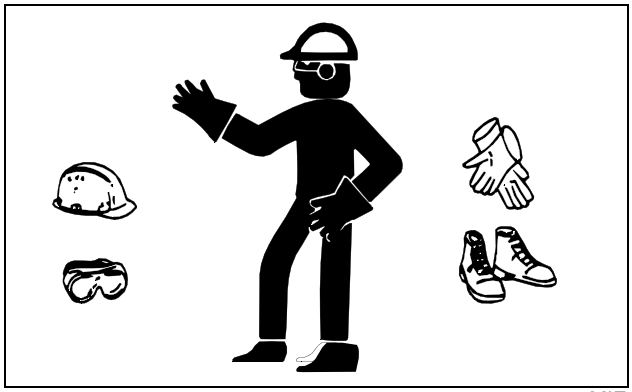
Do not store oily rags; they can ignite and burn spontaneously.

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.

Wear Protective Clothing



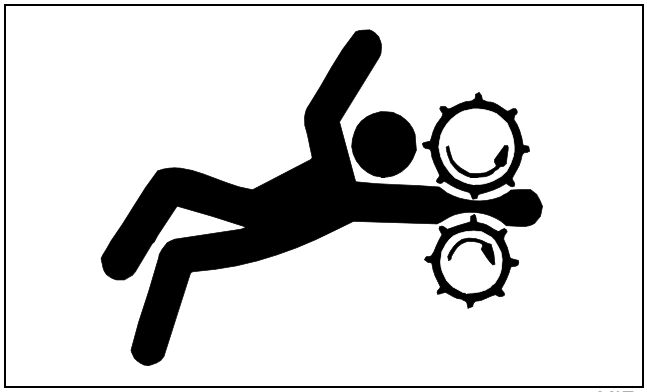
MIF

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



MIF

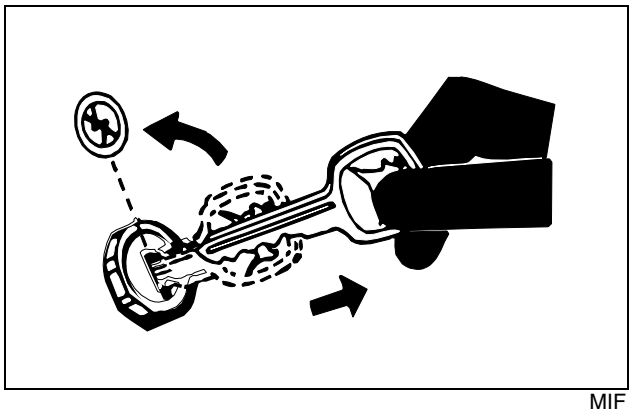
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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.

Park Machine Safely

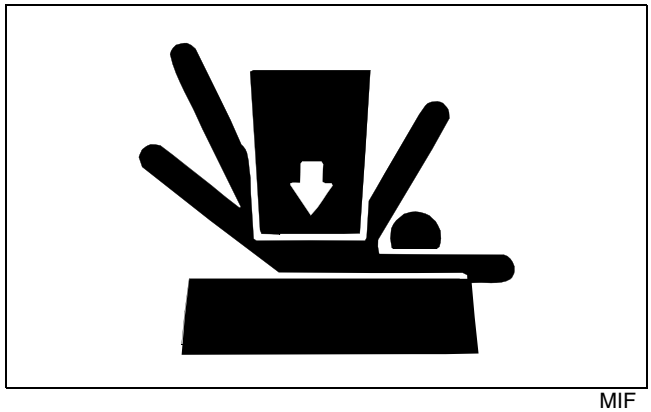


MIF

Before working on the machine:

1. Lower all equipment to the ground.
2. Stop the engine and remove the key.
3. Disconnect the battery ground strap.
4. Hang a “DO NOT OPERATE” tag in operator station.

Support Machine Properly and Use Proper Lifting Equipment



MIF

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

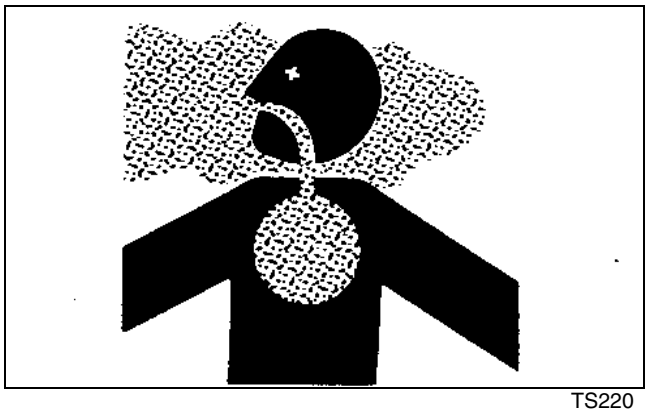
Before starting a job:

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.

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



TS220

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.

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.

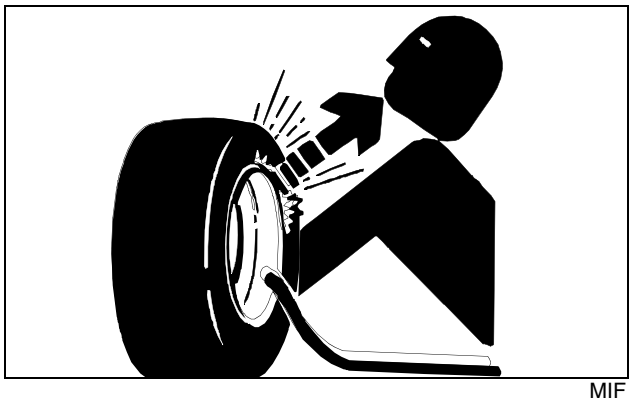
Avoid Harmful Asbestos Dust

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



MIF

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.

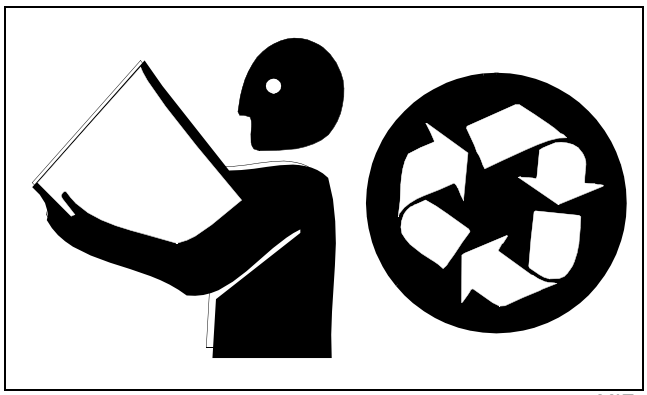
Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

Avoid Injury from Rotating Blades, Augers, and PTO Shafts

MIF

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

Handle Chemical Products Safely



MIF

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.

Dispose of Waste Properly

Improperly disposing of waste can threaten the environment and ecology. Potentially harmful waste used with John Deere equipment includes 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.

Live with Safety

MIF

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

Table of Contents

Specifications

Vehicle Specifications

NOTE: Specifications and design subject to change without notice.

Engine

Make	Honda
Type	Gasoline, 25° inclined cylinder
Model	GX120 K1LJD2
Aspiration	Natural
Cylinders	1
Displacement	118 cm^3 (7.2 cu in.)
Stroke/Cycle	4 cycle
Bore	60 mm (2.4 in.)
Stroke	42 mm (1.7 in.)
Compression Ratio	8.5:1
Slow Idle	1400 +220/-150 rpm
180B Fast Idle	3000 ± 150 rpm
220B and 260B Fast Idle	3450 ± 150 rpm
Timing	25° BTDC
Valving	Overhead valves
Lubrication	Splash
Cooling System	Forced air
Air Cleaner	Dual-element (silent) type
Carburetor	Float-type
Muffler	In-line
Engine Oil Capacity	0.6 L (0.63 qt)
Type of Starter	Recoil
Weight	15.5 kg (34.2 lb)

Fuel System

Fuel Tank Location	On engine
Fuel Tank Capacity	2.5 L (0.66 gal)
Fuel (Minimum Octane)	Unleaded gasoline, 87 octane
Fuel Delivery	Gravity
Carburetor	Float-type side draft
Fuel Filter	Screen

Electrical

Ignition	Transistorized magneto

Drive Train/Traveling Device

Traction Roller	Smooth surface, dual aluminium
Forward Traveling Speed	9.2 km/h (5.5 mph)
Mow Traveling Speed	5.5 km/h (3.4 mph)
Front Roller	Machined steel, solid or grooved

Brakes

Park Brake . . . . . **Band type, lever activated**

Cutting Unit

180B Cutting Width . . . . . **457 mm (18 in.)**
220B Cutting Width . . . . . **559 mm (22 in.)**
260B Cutting Width . . . . . **660 mm (26 in.)**
Cutting Height (Min, Standard 3.0 mm Bed Knife) . . . . . **3.2 mm (1/8 in.)**
Cutting Height (Min, Optional 2.5 mm Bed Knife) . . . . . **2.8 mm (7/64 in.)**
Cutting Height (Min, Optional 2.0 mm Bed Knife) . . . . . **2.0 mm (5/64 in.)**
Cutting Height (Max) . . . . . **22.2 mm (7/8 in.)**
Frequency of Clip (Standard) . . . . . **4.62 mm (0.182 in.)**
Frequency of Clip (Optional) . . . . . **4.04 mm (0.159 in.)**
Reel Diameter . . . . . **127 mm (5 in.)**
Reel Number of Blades (Standard) **11**
Reel Number of Blades (Optional - 220B) **9**
Reel Number of Blades (Optional - 260B) **7**
Reel Material . . . . . **Heat treated special alloy steel**
Grass Catcher . . . . . **Rotational molded polypropylene**

Weights and Dimensions

Weight (Less GTC and Wheels, with Grass Catcher)

180B . . . . . **91 kg (201 lb)**
220B . . . . . **100 kg (220 lb)**
260B . . . . . **107 kg (236 lb)**

Width

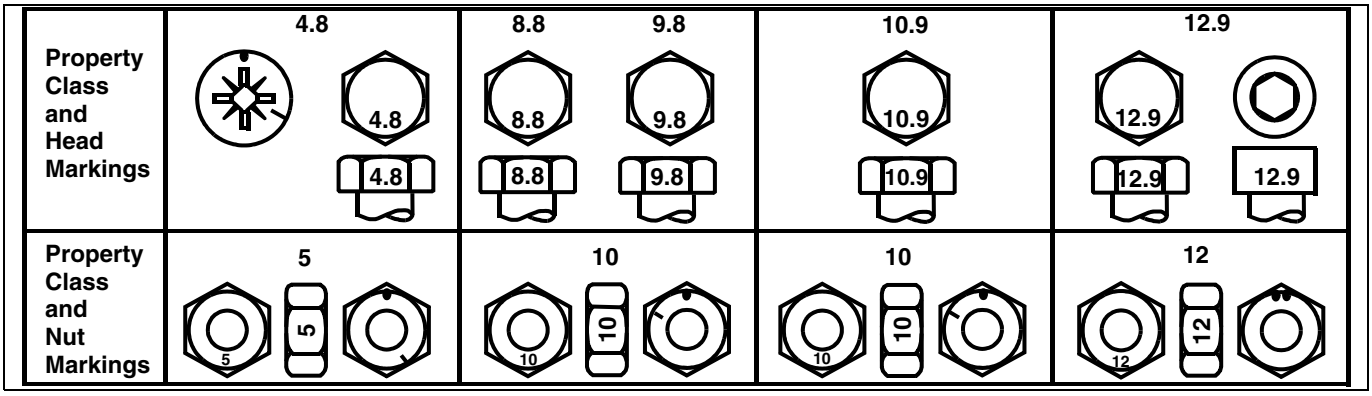
180B . . . . . **838 mm (33 in.)**
220B . . . . . **940 mm (37 in.)**
260B . . . . . **1041 mm (41 in.)**
Length . . . . . **1244 mm (49 in.)**
Height . . . . . **1016 mm (41 in.)**

Wheels and Tires

Size . . . . . **4.1/3.5-6 (2 pr) tubeless**
Pressure . . . . . **125-140 kPa (18-20 psi)**

Repair Information

Metric Fastener Torque Values



MIF (TS1163)

	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[1]		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

1. "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.

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

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

Fasteners should be replaced with the same class. 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.

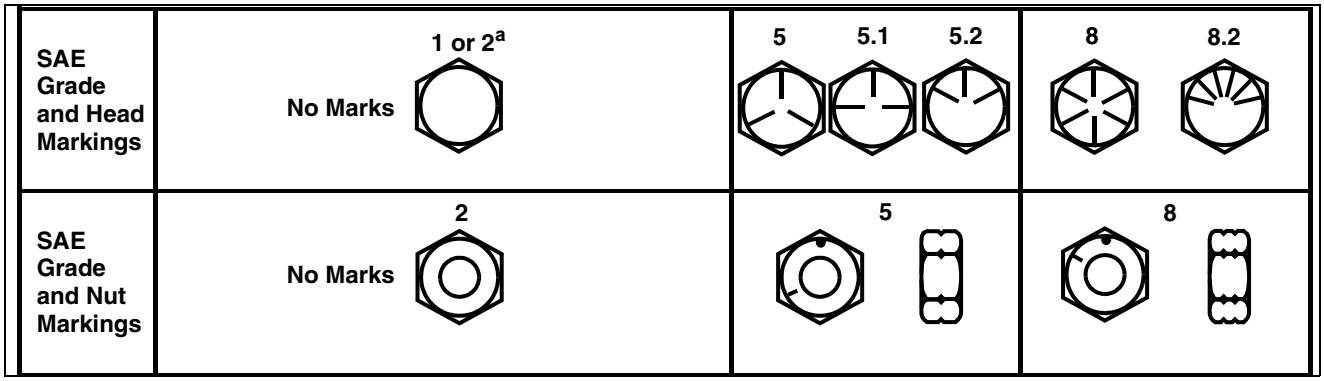
Tighten toothed or serrated-type lock nuts to the full torque value.

Reference: JDS-G200.

Metric Fastener Torque Values - Grade 7

Size	Steel or Gray Iron Torque		Aluminum Torque	
	N•m	lb-ft	N•m	lb-ft
M6	11	8	8	6
M8	24	18	19	14
M10	52	38	41	30
M12	88	65	70	52
M14	138	102	111	82
M16	224	165	179	132

Inch Fastener Torque Values



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	Grade 1				Grade 2[1]				Grade 5, 5.1 or 5.2				Grade 8 or 8.2			
	Lubricated[2]		Dry[b]		Lubricated[b]		Dry[b]		Lubricated[b]		Dry[b]		Lubricated[b]		Dry[b]	
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

1. "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.

2. "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.

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

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

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

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

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

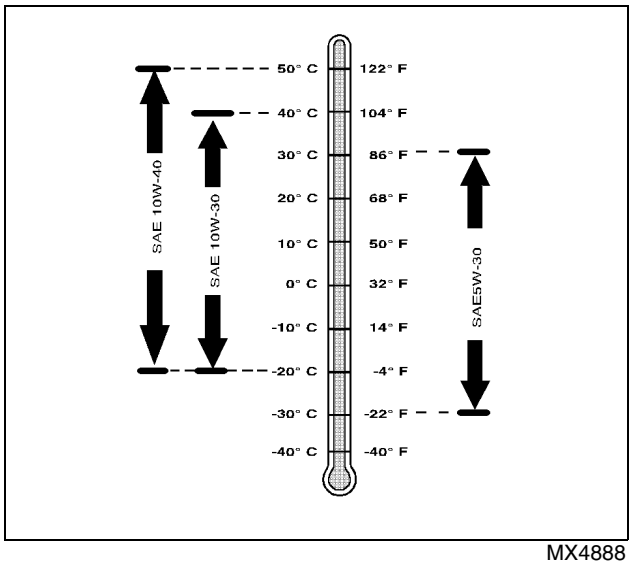
Reference: JDS-G200.

Oils and Lubricants

Engine Oil

Use oil viscosity based on the expected air temperature range during the period between oil changes.

The following John Deere oils are preferred:



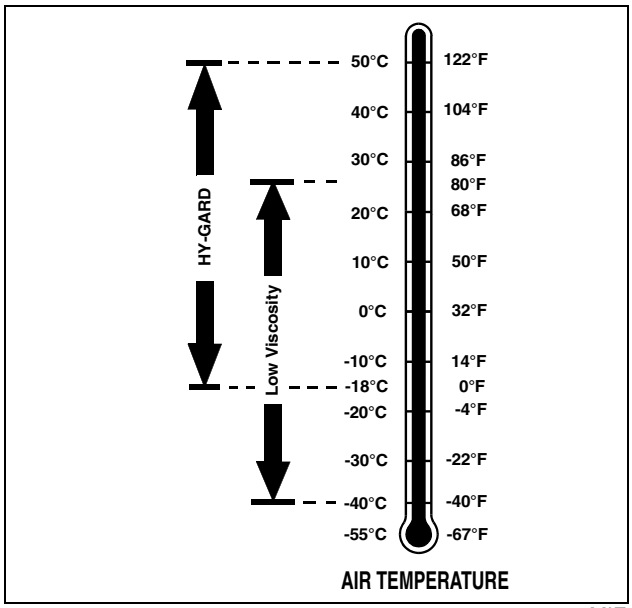
MX4888

- TURF-GARD®
- PLUS-4®

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

- API Service Classification SG or higher

Differential Gear Case Oil



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NOTE: Transaxle is filled with John Deere HY-GARD® (J20C) transmission oil at the factory. Do not mix oils.

Use only HY-GARD® (J20C) transmission oil.

Do not use type “F” automatic transmission fluid.

John Deere HY-GARD® (J20C) transmission oil is specially formulated to provide maximum protection against mechanical wear, corrosion, and foaming.

Grease

IMPORTANT: Avoid damage! Use recommended John Deere greases to avoid component failure and premature wear.

The recommended John Deere greases are effective within an average air temperature range of -29 to 135 degrees C (-20 to 275 degrees F).

If operating outside that temperature range, contact your Servicing dealer for a special-use grease.

The following greases are preferred (this may change for high speed applications such as cutting units):

- John Deere Multi-Purpose SD Polyurea Grease

If not using any of the preferred greases, be sure to use a general all-purpose grease with an NLGI grade No. 2 rating.

Wet or high speed conditions may require use of a special-use grease. Contact your Servicing dealer for information.

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.

Gasoline

Using Proper Fuel

Use regular grade unleaded fuel with an octane rating of 87 octane or higher. Fuel blends containing up to 10% ethanol or up to 15% MTBE reformulated fuel are acceptable. Do not use fuel or additives containing methanol as engine damage can occur.

Always use fresh, clean fuel that is purchased in a quantity that can be used within approximately 30 days, or add fuel stabilizer.

Fuel is blended to give best seasonal performance. To avoid engine performance problems such as hard starting or vapor lock, use in-season fuel. Use fuel during warm weather that was purchased during that season, and use fuel during cold weather that was purchased during that season.

Fuel can become stale in machines with engines that are used seasonally or infrequently during a season. Stale fuel can produce varnish and plug carburetor or injector components which can affect engine performance.

Keep fuel storage container tightly covered and in a cool area out of direct sunlight. Fuel can break down and degrade if not sealed properly or exposed to sun and heat.

Condensation may collect in the fuel tank because of a variety of operating or environmental conditions and, over time, may affect your machine's operation. Fill fuel tank at the end of daily use and store fuel in plastic containers to reduce condensation.

For best year-round performance and fuel-handling, add stabilizer to fuel immediately after fuel purchase. Such practice helps prevent engine performance problems and allows fuel storage in the machine all year without draining.

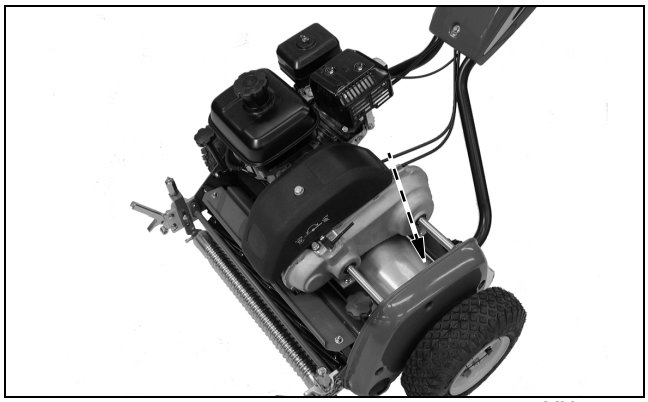
Serial Number Locations

Record Identification Numbers

When ordering parts or submitting a warranty claim, it is IMPORTANT that the machine product identification and component serial numbers are included.

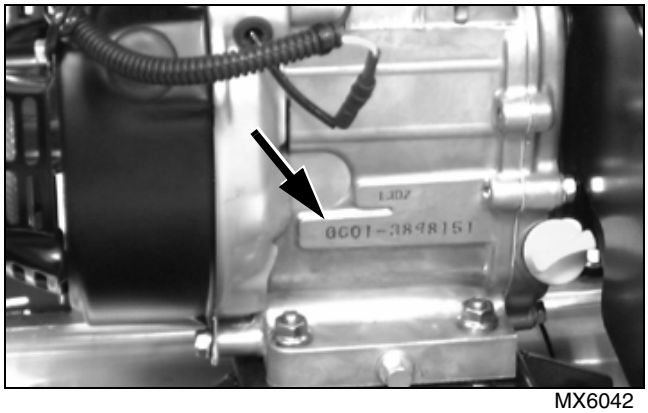
The location of the machine identification number and component serial numbers are shown.

Machine Identification Number



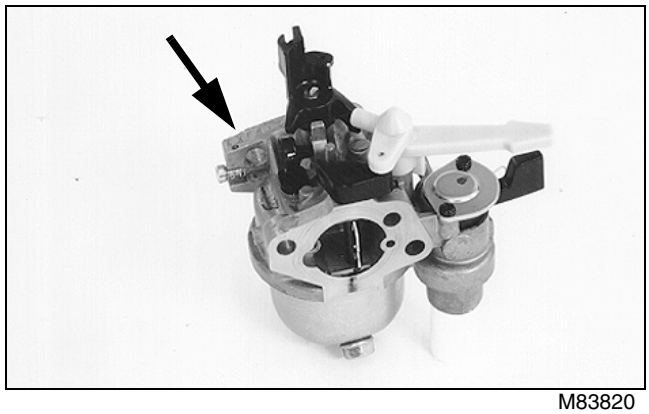
MX11251

Engine Serial Number



MX6042

Carburetor Identification Number



M83820

Operational Checkout

Operational Checkout Procedures

The procedures covered in this group are used to give a quick checkout of all the systems and components on the unit. These checkouts should be run to ensure proper operation after any extended storage, when the unit comes in for service and after repairs have been made on the unit. They can also be helpful in determining the value of the unit at trade-in time. The unit should be placed on a level surface to run checkout. All checkouts should be done and all the steps of each checkout should be followed.

Each checkout list:

- Conditions - How the unit should be set up for the checkout.
- Procedure - The specific action to be done.
- Normal - What should happen, or be heard, or seen.
- If Not Normal - Where to go if other tests or adjustments are needed.

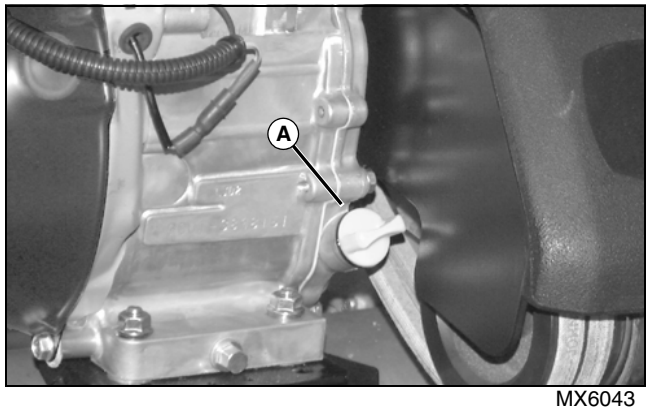
When performing the checkout, be sure to set your machine up to the test conditions listed and follow the sequence carefully. The “Normal” paragraph gives the result that should happen when performing the checkout. If the results are not normal, follow the instructions listed in the “If Not Normal” paragraph to determine the cause and repair the malfunction.

Engine Oil Level Check

Conditions

- Engine stopped.
- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Engine oil cold.
- Block placed under front roller to level machine/engine.

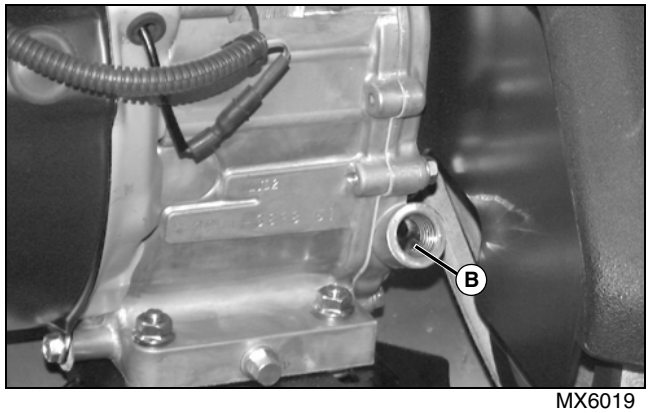
Procedure



MX6043

1. Before removing dipstick (A), clean around dipstick.
2. Remove dipstick and check oil level.

Normal



MX6019

Oil level (B) is to the outer edge of the oil filler neck.

If Not Normal

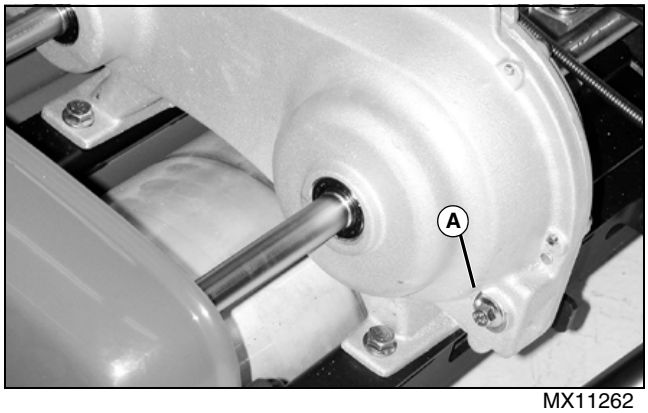
Oil level is below outer edge of oil filler neck: add oil. (See “Engine Oil” on page 12.)

Differential Gear Case Oil Level Check

Conditions

- Engine stopped.
- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Engine oil cold.
- Block placed under front roller to level machine/differential gear case.

Procedure



MX11262

1. Remove drain plug (A).
2. Observe oil level inside gear case.

Normal

Oil level is up to bottom of drain hole in gear case.

If Not Normal

- Oil level is below bottom of hole: add oil. (See “Differential Gear Case Oil” on page 12.)
- Oil level is above hole: drain excess oil until level is up to bottom of hole in gear case.

Throttle Lever Check

Conditions

- Machine parked on level surface.
- Operator presence bail engaged.
- Travel clutch disengaged.
- Park brake engaged.

Procedure

1. Start engine and run at slow idle (1400 +220/-150 rpm).

MX11234

2. Move throttle (A) from SLOW to FAST to SLOW positions.

Normal

- Engine must accelerate and decelerate SMOOTHLY without hesitation.
- Throttle lever should move freely, yet hold desired position.

If Not Normal

- Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)
- Adjust throttle lever tension. (See “Throttle Lever Tension Adjustment” on page 124.)

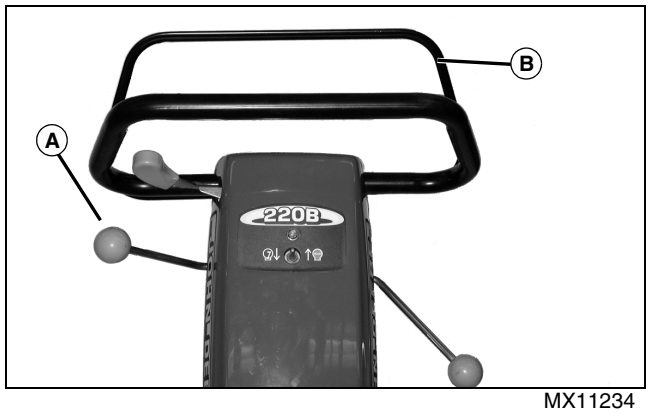
Operator Presence Bail Check

Conditions

- Engine running.
- Reel clutch in MOW position.
- Park brake disengaged.

Procedure

CAUTION: Avoid injury! Perform this check in a large, flat and open area away from people and/or stationary objects or structures.



MX11234

1. Hold operator presence bail (B) against handlebar.
2. Engage travel clutch lever (A).

Normal

- Transport drive (traction roller/transport wheels) should engage.
- Reel drive should engage.

If Not Normal

- Adjust operator presence bail. (See “Operator Presence Bail Adjustment” on page 124.)
- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)
- Repair power train as necessary. (See “Repair” on page 104.)

Procedure

Release operator presence bail.

Normal

- Transport drive (traction roller/transport wheels) should stop.
- Reel drive should stop.

If Not Normal

Adjust belt guide. (See “Drive Belt Guide Adjustment” on page 100.)

Park Brake Check

Conditions

- Engine running.
- Reel clutch in OFF position.
- Travel clutch disengaged.

Procedure

- Engage park brake.
- Run engine at low idle.
- Engage operator presence bail.
- Slowly engage travel clutch lever.

Result: Engine should stall with no movement of the mower.

If Not Normal

Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)

Travel Clutch Check

Conditions

- Engine running.
- Reel clutch in OFF position.
- Park brake disengaged.
- Operator presence bail engaged.

Procedure

CAUTION: Avoid injury! Perform this check in a large, flat and open area away from people and/or stationary objects or structures.

MX11234

Engage travel clutch lever (A).

Normal

Transport drive (traction roller/transport wheels) should engage.

If Not Normal

- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)
- Repair power train as necessary. (See “Repair” on page 104.)

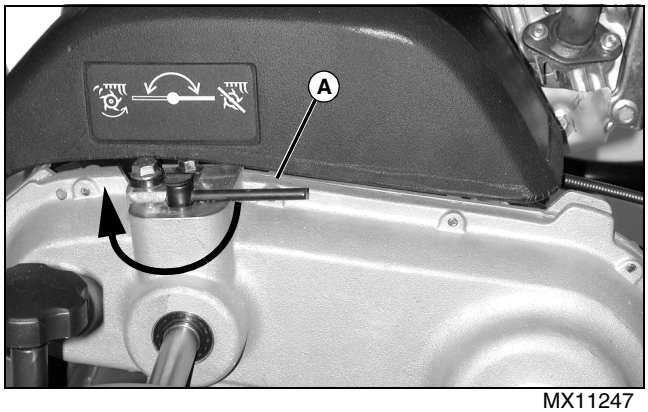
Reel Clutch Check

Conditions

- Engine stopped.
- Machine parked on level surface.
- Park brake disengaged.

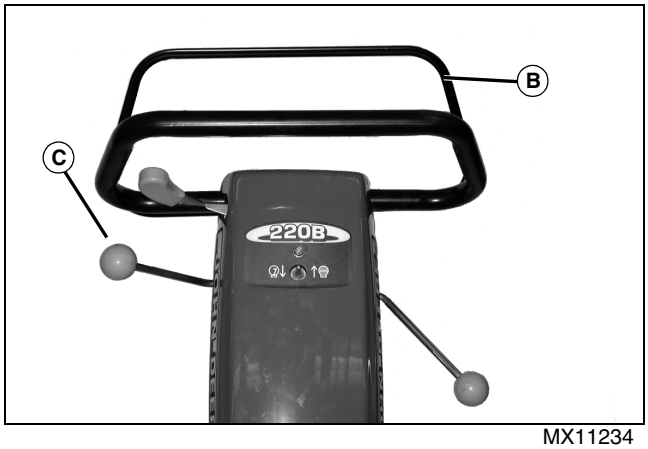
Procedure

CAUTION: Avoid injury! Perform this check in a large, flat and open area away from people and/or stationary objects or structures.



MX11247

1. Place reel clutch lever (A) in MOW position.
2. Start engine and run at slow idle (1400 +220/-150 rpm).



MX11234

3. Hold operator presence bail (B) against handlebar.
4. Engage travel clutch lever (C).

Normal

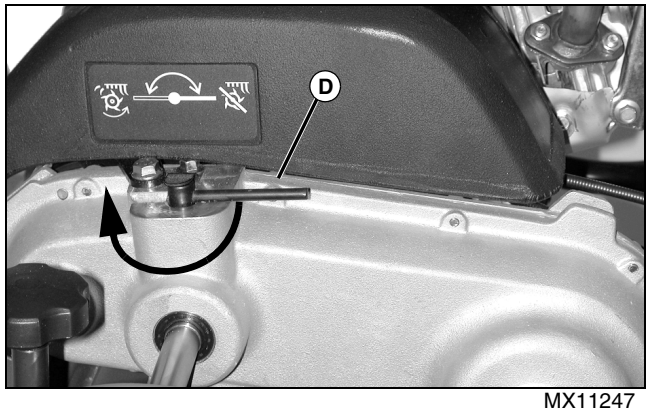
- Transport drive (traction roller/transport wheels) should engage.
- Reel drive should engage.

If Not Normal

- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)
- Repair power train as necessary. (See “Repair” on page 104.)

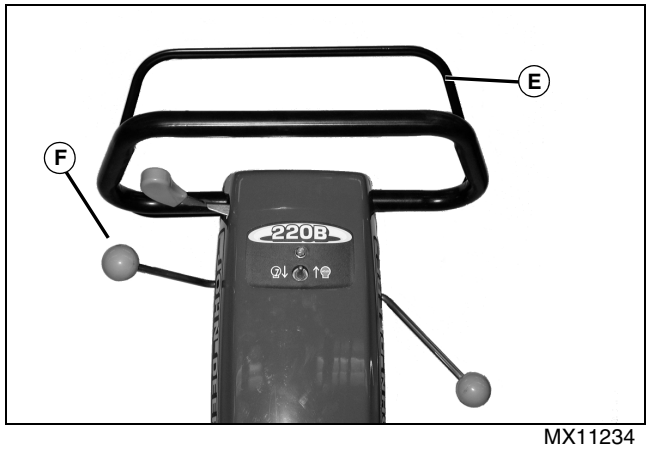
Procedure

1. Release operator presence bail.



MX11247

2. Place reel clutch lever (D) in MOW position.



MX11234

3. Hold operator presence bail (E) against handlebar.
4. Engage travel clutch lever (F).

Normal

- Transport drive (traction roller/transport wheels) should engage.
- Reel drive should not engage.

If Not Normal

- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)
- Repair power train as necessary. (See “Repair” on page 104.)

Table of Contents

ENGINE SPECIFICATIONS

Specifications

General Specifications

Make	Honda
Type	Gasoline, 25° inclined cylinder
Model	GX120 K1LJD2
Aspiration	Natural
Cylinders	1
Displacement	118 cm^3 (7.2 cu in.)
Stroke/Cycle	4 cycle
Bore	60 mm (2.4 in.)
Stroke	42 mm (1.7 in.)
Compression Ratio	8.5:1
Valving	Overhead valves
Lubrication	Splash
Cooling System	Forced air
Air Cleaner	Dual-element (silent) type
Carburetor	Float-type
Muffler	In-line
Engine Oil Capacity	0.6 L (0.63 qt)
Type of Starter	Recoil
Weight	15.5 kg (34.2 lb)

Test and Adjustment Specifications

Fast Idle

180B	3000 ± 150 rpm
220B and 260B	3450 ± 150 rpm

Slow Idle	1400 +200/-150 rpm
Cylinder Compression Pressure	586-834 kPa (85-121 psi)
Intake Valve Clearance	0.15 ± 0.02 mm (0.006 ± 0.001 in.)
Exhaust Valve Clearance	0.20 ± 0.02 mm (0.008 ± 0.001 in.)
Spark Plug Gap	0.7-0.8 mm (0.028-0.031 in.)

Ignition Coil

Air Gap	0.4 ± 0.2 mm (0.016 ± 0.008 in.)
Resistance (Primary Side)	0.8-1.0 ohm
Resistance (Secondary Side)	5.9-7.1 k-ohm

Repair Specifications

Engine

Engine Oil Capacity	0.6 L (0.63 qt)
Oil Drain Plug Torque	18 N•m (156 lb-in.)

ENGINE SPECIFICATIONS

Fuel Tank

Capacity	**2.5 L (0.66 gal)**
Mounting Cap Screw Torque	**10 N•m (84 lb-in.)**
Mounting Flange Nut Torque	**10 N•m (84 lb-in.)**
Fuel Filter Torque	**2 N•m (17 lb-in.)**

Muffler

Mounting Nut Torque	**24 N•m (204 lb-in.)**

Air Cleaner Assembly

Air Cleaner Wing Nut Torque	**9 N•m (78 lb-in.)**
Air Cleaner Housing Flange Nut Torque	**8.5 N•m (73 lb-in.)**

Carburetor

Float Height	**13.7 mm (0.54 in.)**
Sediment Cup Torque	**4 N•m (36 lb-in.)**

Flywheel

Flange Nut Torque	**75 N•m (54 lb-ft)**

Cylinder Head

Initial Cap Screw Torque	**12 N•m (102 lb-in.)**
Final Cap Screw Torque	**24 N•m (204 lb-in.)**
Maximum Cylinder Head Distortion	**0.10 mm (0.004 in.)**
Rocker Arm Pivot Bolt Torque	**24 N•m (204 lb-in.)**
Rocker Arm Pivot Lock Nut Torque	**10 N•m (84 lb-in.)**
Standard Valve Guide ID	**5.50 mm (0.217 in.)**
Valve Guide ID Wear Limit	**5.572 mm (0.2194 in.)**
Standard Valve Seat Width	**0.8 mm (0.03 in.)**
Valve Seat Width Wear Limit	**2.0 mm (0.08 in.)**

Valve Spring

Standard Free Length	**30.5 mm (1.20 in.)**
Free Length Wear Limit	**29.5 mm (1.16 in.)**

Intake Valve

Stem OD Standard	**5.48 mm (0.216 in.)**
Stem OD Wear Limit	**5.318 mm (0.2094 in.)**
Maximum Valve Stem Out-of-Round	**0.03 mm (0.001 in.)**
Head Diameter	**22 mm (0.87 in.)**

Exhaust Valve

Standard Stem OD	**5.44 mm (0.214 in.)**
Stem OD Wear Limit	**5.275 mm (0.2077 in.)**
Maximum Valve Stem Out-of-Round	**0.03 mm (0.001 in.)**
Head Diameter	**19 mm (0.75 in.)**

Crankcase Cover

Cap Screw Torque	12 N•m (108 lb-in.)
Camshaft Holder ID Standard	14.0 mm (0.55 in.)
Camshaft Holder ID Wear Limit	14.048 mm (0.5531 in.)

Piston

Connecting Rod Cap Screw Torque	12 N•m (9 lb-ft)
Standard Piston Skirt Standard OD	59.985 mm (2.3616 in.)
Standard Piston Skirt OD Wear Limit	59.845 mm (2.3561 in.)
0.25 mm (0.010 in.) Oversize Piston Skirt Standard OD	60.235 mm (2.3716 in.)
0.25 mm (0.010 in.) Oversize Piston Skirt OD Wear Limit	60.095 mm (2.3661 in.)
0.50 mm (0.020 in.) Oversize Piston Skirt Standard OD	60.485 mm (2.38 in.)
0.50 mm (0.020 in.) Oversize Piston Skirt OD Wear Limit	60.345 mm (2.3761 in.)
Piston-to-Cylinder Standard Clearance	0.015-0.050 mm (0.0006-0.0020 in.)
Piston-to-Cylinder Clearance Wear Limit	0.12 mm (0.005 in.)
1st and 2nd Compression Piston Ring Standard Thickness	1.5 mm (0.06 in.)
1st and 2nd Compression Piston Ring Thickness Wear Limit	1.37 mm (0.054 in.)
Oil Control Piston Ring Standard Thickness	2.5 mm (0.10 in.)
Oil Control Piston Ring Thickness Wear Limit	2.37 mm (0.093 in.)
Piston Ring Groove Standard Side Clearance	0.015-0.045 mm (0.0006-0.0018 in.)
Piston Ring Groove Side Clearance Wear Limit	0.15 mm (0.006 in.)
Top and 2nd Piston Ring Standard End Gap	0.2-0.4 mm (0.008-0.016 in.)
Top and 2nd Piston Ring End Gap Wear Limit	1.0 mm (0.04 in.)
Oil Control Piston Ring Standard End Gap	0.15-0.35 mm (0.006-0.014 in.)
Oil Control Piston Ring End Gap Wear Limit	1.0 mm (0.04 in.)
Piston Pin Standard OD	13.0 mm (0.51 in.)
Piston Pin OD Wear Limit	12.954 mm (0.510 in.)
Piston Pin Bore Standard ID	13.002 mm (0.5119 in.)
Piston Pin Bore ID Wear Limit	13.048 mm (0.5137 in.)
Piston-to-Piston Pin Bore Standard Clearance	0.002-0.014 mm (0.0001-0.0006 in.)
Piston-to-Piston Pin Bore Clearance Wear Limit	0.08 mm (0.003 in.)

Connecting Rod

Piston Pin Bushing Standard ID	13.005 mm (0.512 in.)
Piston Pin Bushing ID Wear Limit	13.07 mm (0.515 in.)
Standard Crankshaft Bearing Standard ID	26.02 mm (1.024 in.)
Standard Crankshaft Bearing ID Wear Limit	26.066 mm (1.0262 in.)
0.25 mm (0.010 in.) Undersize Crankshaft Bearing Standard ID	25.770-25.783 mm (1.0146-1.0151 in.)
0.25 mm (0.010 in.) Undersize Crankshaft Bearing ID Wear Limit	25.816 mm (1.0164 in.)
Connecting Rod-to-Crankshaft Journal Standard Clearance	0.040-0.063 mm (0.0016-0.0025 in.)
Connecting Rod-to-Crankshaft Journal Clearance Wear Limit	0.12 mm (0.005 in.)
Connecting Rod-to-Crankshaft Standard Side Clearance	0.1-0.7 mm (0.004-0.028 in.)
Connecting Rod-to-Crankshaft Side Clearance Wear Limit	1.1 mm (0.043 in.)

Camshaft

Cam Lobe Standard Height (Intake)	**27.7 mm (1.09 in.)**
Cam Lobe Height Wear Limit (Intake)	**27.45 mm (1.081 in.)**
Cam Lobe Standard Height (Exhaust)	**27.75 mm (1.093 in.)**
Cam Lobe Height Wear Limit (Exhaust)	**27.50 mm (1.083 in.)**
Journal Standard OD	**13.984 mm (0.5506 in.)**
Journal OD Wear Limit	**13.916 mm (0.5479 in.)**

Crankshaft

Connecting Rod Journal Standard OD	**25.98 mm (1.023 in.)**
Connecting Rod Journal OD Wear Limit	**25.92 mm (1.020 in.)**

Cylinder Block

Standard Piston Cylinder Bore Standard ID	**60.0 mm (2.36 in.)**
Standard Piston Cylinder Bore ID Wear Limit	**60.165 mm (2.3687 in.)**
0.25 mm (0.010 in.) Oversize Piston Cylinder Bore Standard ID	**60.25 mm (2.37 in.)**
0.25 mm (0.010 in.) Oversize Piston Cylinder Bore ID Wear Limit	**60.415 mm (2.3787 in.)**
0.50 mm (0.020 in.) Oversize Piston Cylinder Bore Standard ID	**60.5 mm (2.38 in.)**
0.50 mm (0.020 in.) Oversize Piston Cylinder Bore ID Wear Limit	**60.665 mm (2.3887 in.)**

Tools and Materials

Special or Essential Tools

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Pulse Tachometer	JT07270	Used to check/adjust engine slow and fast idle rpm.
Compression Gauge	JDM-59	Used to check engine compression.
Spark Tester	D-05351ST	Used to check overall condition of ignition system.
5.5 mm Valve Guide Driver Tool	JDG504	Used to remove and install valve guides.
5.5 mm Valve Guide Reamer	JDG1023	Used to ream valve guides.
PLASTIGAGE®	NA	Used to check connecting rod-to-crankshaft clearance.

Other Materials

Other Material

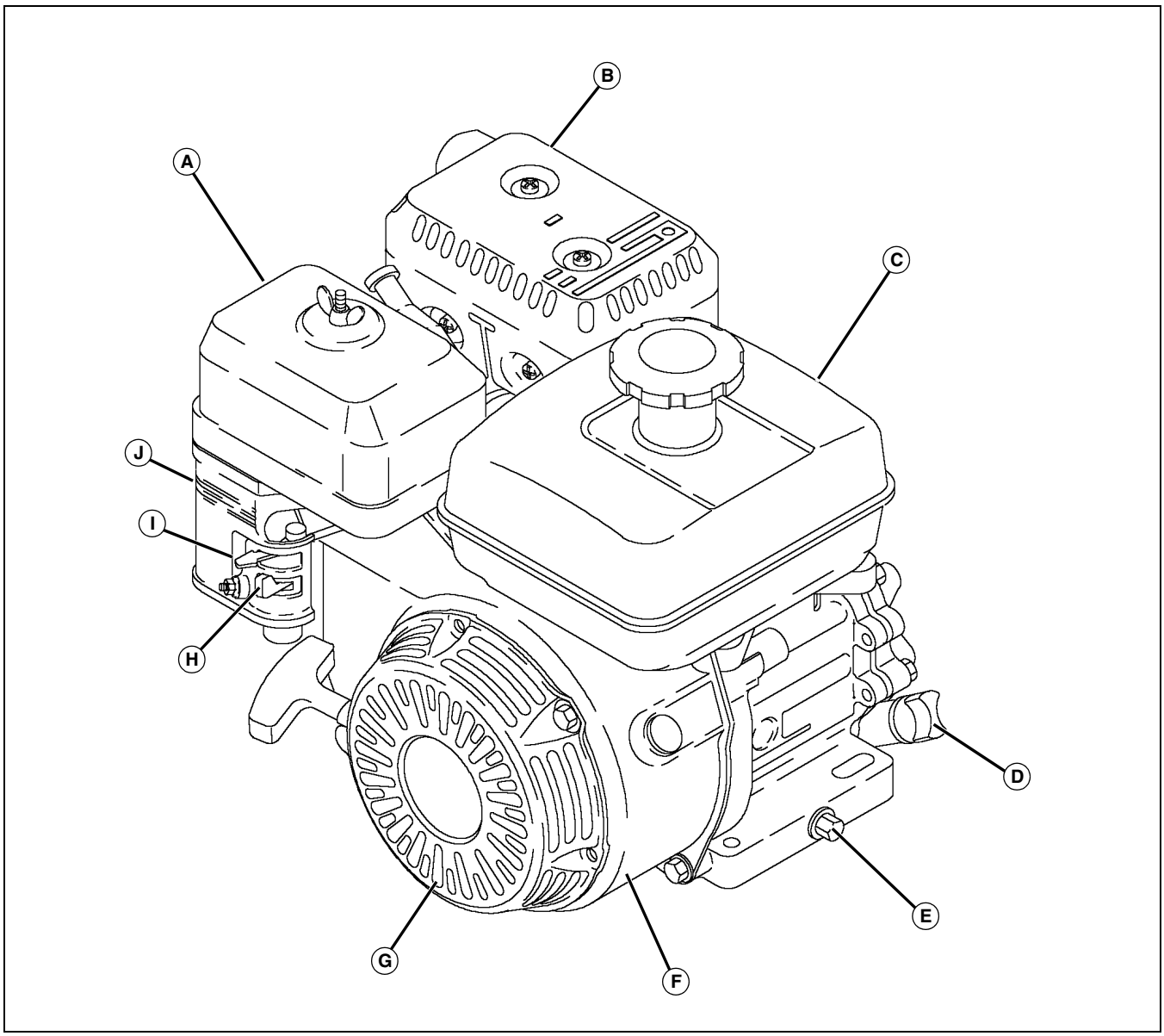
Part No.	Part Name	Part Use
M79292	MPG-2 Polymer Multipurpose Grease	Prevents parts from seizing. Apply to engine crankshaft.
NA	SCOTCH-BRITE™, Abrasive Sheet/Pad	Clean cylinder head.
NA	Stanisol (or Kerosene)	Finish ream valve guides.
NA	Prussian Blue Compound	Check valve seat contact.
NA	Lapping Compound	Lap valves into valve seats.
NA	Lithium-Based Grease	Pack oil seals.
NA	Zinc Oxide/Wood Alcohol	Check block for cracks.

Service Parts Kits

The following kits are available through your parts catalog:

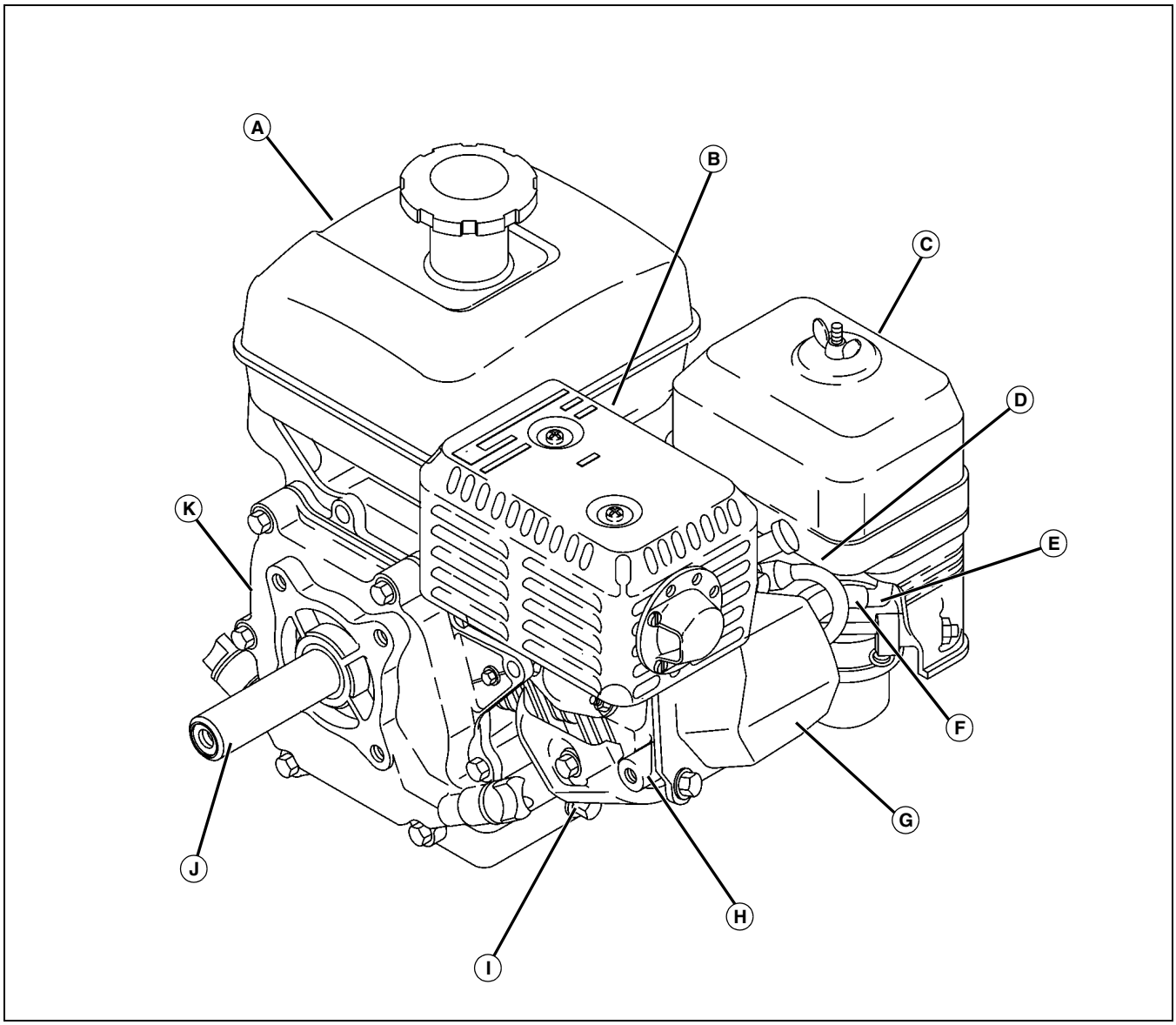
- Carburetor Assembly
- Carburetor Float Valve Kit
- Carburetor Float Kit
- Carburetor Drain Screw Kit
- Carburetor Float Chamber Screw Kit
- Carburetor Float Chamber Kit
- Carburetor Pilot Screw and Limiter Cap Kit
- Carburetor Pilot Jet Kit
- Carburetor Gasket Kit
- Engine Gasket Kit
- Piston Ring Kit (Standard)
- Piston Ring Kit (0.25 mm [0.010 in. oversize])
- Piston Ring Kit (0.50 mm [0.020 in. oversize])
- Piston (0.25 mm [0.010 in. oversize])
- Piston (0.50 mm [0.020 in. oversize])
- Connecting Rod (Standard)
- Connecting Rod (0.25 mm [0.010 in.] undersize)
- Governor Kit
- Cylinder Block

Component Location and Operation **External Engine Components**



MX6040

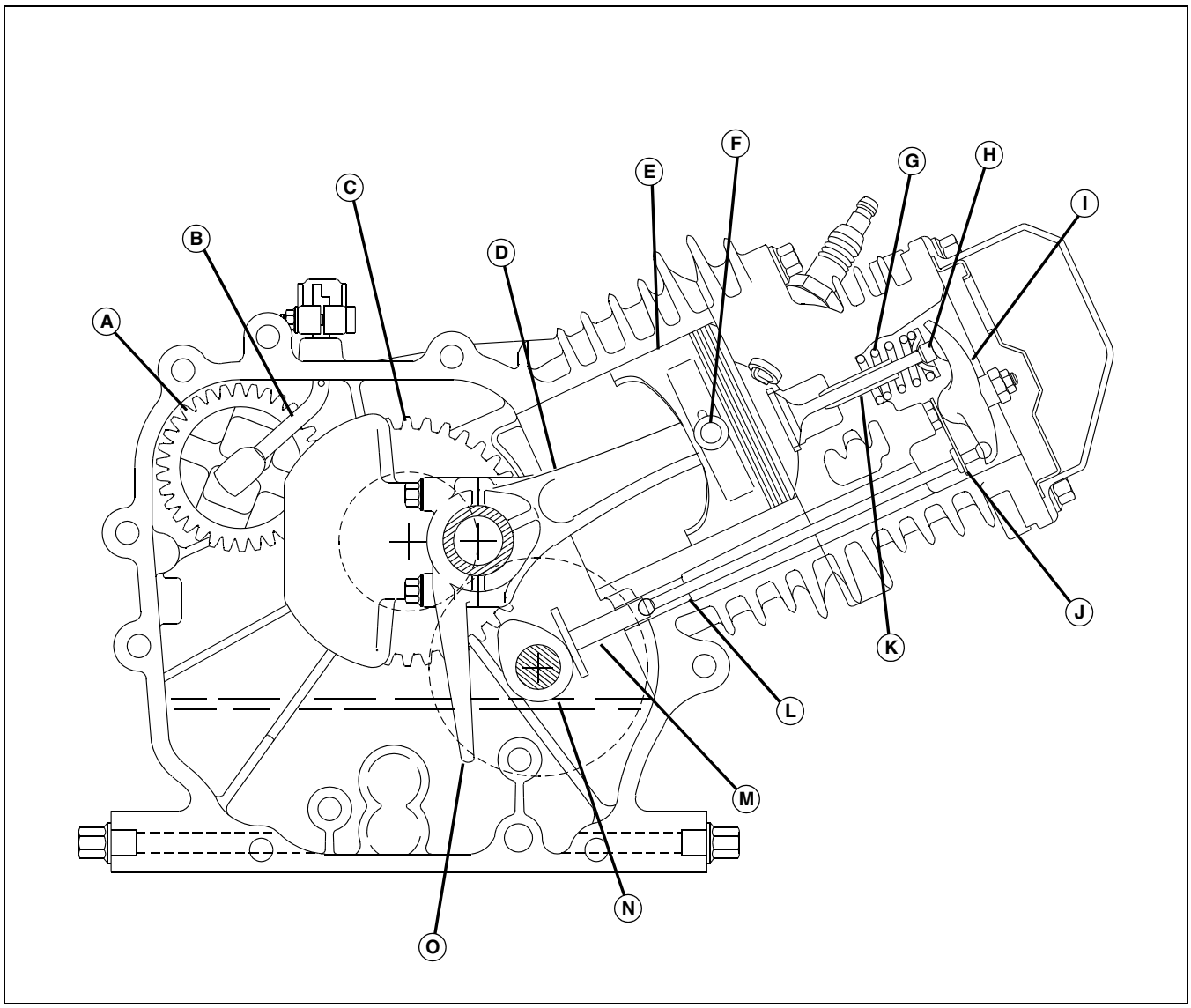
A - Air Cleaner
B - Muffler
C - Fuel Tank
D - Oil Dipstick
E - Oil Drain Plug
F - Blower Housing
G - Recoil Starter
H - Fuel Shutoff Lever
I - Choke Lever
J - Carburetor



MX6041

A - Fuel Tank
B - Muffler
C - Air Cleaner
D - Spark Plug Lead
E - Carburetor
F - Breather Hose
G - Rocker Arm Cover
H - Cylinder Head
I - Oil Drain Plug
J - PTO Output Shaft
K - Crankcase Cover

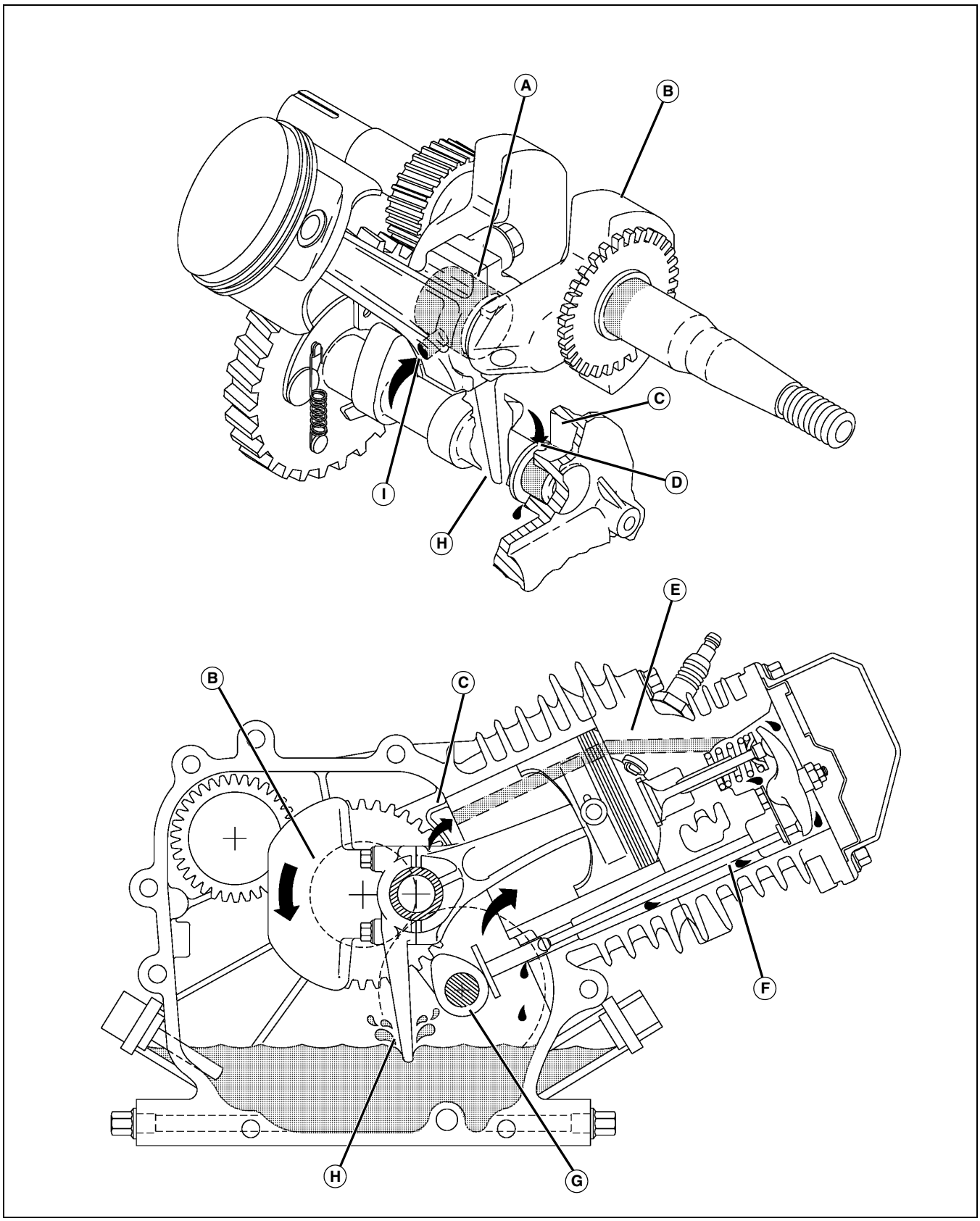
Internal Engine Components



MIF (M83928)

A - Governor Gear
B - Governor Shaft
C - Governor Drive Gear
D - Connecting Rod
E - Piston
F - Piston Pin
G - Valve Spring
H - Valve Rotator (Exhaust Valve Only)
I - Rocker Arm
J - Push Rod Guide
K - Valve Guide
L - Push Rod
M - Tappet
N - Camshaft
O - Connecting Rod Oil Dipper

Lubrication System Operation



MX6083

A - Connecting Rod Journal
B - Crankshaft
C - Well
D - Oil Supply Passage
E - Oil Supply Passage
F - Oil Return Passage
G - Camshaft
H - Oil Dipper
I - Oil Supply Passage

Function

To provide oil to lubricate internal engine components.

Theory of Operation

The Honda GX120 uses a “splash” lubrication system, and does not use an oil pump.

As the crankshaft turns, a dipper located on the connecting rod cap is immersed into the oil supply in the crankcase and “splashes” oil onto internal engine components including camshaft lobes, cylinder walls, tappets, piston pin and crankshaft ball bearings.

Oil for the connecting rod journal is supplied by a small passage on the underside of the connecting rod. Oil for the camshaft and PTO shaft journals are collected in “wells” located on the top of holders in the cylinder block and crankcase covers and routed to the journals by small passages.

Oil is supplied to the rocker arms, valves and pushrods by a passage in the cylinder block and head. Oil returns to the crankcase through a passage located between the tappets.

Cooling System Operation

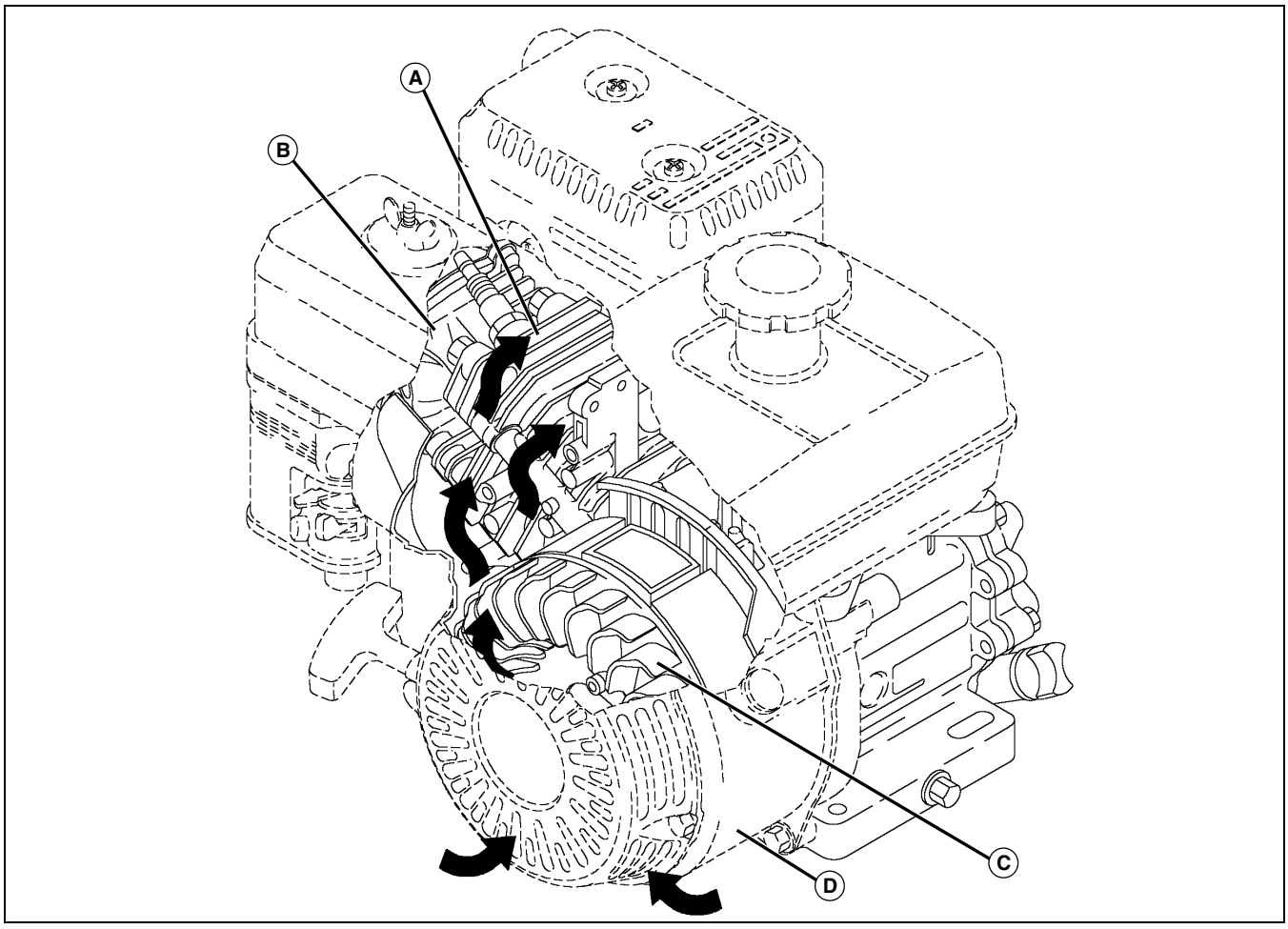
Function

To remove heat from the engine.

Theory of Operation

The engine is air-cooled with air flow provided by a fan mounted on the flywheel. When the engine is running, the fan draws air through the openings in the recoil starter cover. The blower housings then direct the air flow past the cooling fin on the cylinder head and block. Most of the cooling air flows directly over the valve area. This increased cooling capacity in the valve area helps to minimize valve sticking and seat wear due to overheating. The cooling fins are cast into the engine block and cylinder head to increase their surface area to allow more of the heat generated by the engine to be transferred to the cooling air.

It is important that the intake openings on the recoil starter and cooling fins on the cylinder block and cylinder head remain free of debris to ensure proper air flow. The engine covers should not be removed or altered, as cooling capacity will be reduced. Cylinder block and head cooling fins must remain clean to properly dissipate heat.



MX6085

A - Cooling Fins
B - Cylinder Head
C - Flywheel Fan
D - Blower Housing

Diagnostics

Engine Diagnosis

Symptom: Engine Cranks but Will Not Start.

(1) Does choke operate properly?

Yes - Go to step (2).

No - Repair choke.

(2) Is fuel in tank fresh, clean and of proper grade?

Yes - Go to step (3).

No - Replace fuel in tank and lines with fresh, clean fuel of proper grade.

(3) Remove spark plugs. Are the spark plug tips clear of any drops of fuel?

Yes - Go to step (4).

No - Possible incorrect use of choke. Clean spark plugs and set choke properly.

No - Check for plugged air cleaner.

No - Check float level for proper adjustment. (See "Float Level Adjustment" on page 50.)

(4) Is the correct spark plug installed and properly adjusted?

Yes - Go to step (5).

No - Install and properly adjust the correct spark plug.

(5) The ignition system should produce a steady, strong blue spark. (See "Spark Test" on page 39.) Is the spark weak or no spark at all?

Yes - Go to step (6).

No - Ignition system operation is satisfactory. Go to step (10).

(6) Disconnect yel/red wire connector leading to ignition coil. Test for infinite resistance between yel/red wire and engine ground with key switch in RUN position. Does meter show infinite resistance?

Yes - Go to step (7).

No - Repair short circuit as required.

(7) Does ignition coil test OK? (See "Ignition Coil Test" on page 54.)

Yes - Go to step (8).

No - Replace ignition coil.

Symptom: Engine Cranks but Will Not Start.

(8) Is air gap between ignition coil and flywheel adjusted properly? (See "Air Gap Adjustment" on page 54.)

Yes - Go to step (9).

No - Adjust air gap.

(9) Check flywheel for damage. Test that flywheel magnet has not become demagnetized. (See "Flywheel Magnet Test" on page 88.) Is flywheel in good condition?

Yes - Go to step (10).

No - Replace flywheel. (See "Flywheel Removal and Installation" on page 55.)

(10) Is cylinder compression within specification? (See "Cylinder Compression Pressure Test" on page 37.)

Yes - Go to step (11).

No - Repair or replace engine as necessary. (See "Engine Removal and Installation" on page 43.) (See "Cylinder Head and Valves Disassembly and Assembly" on page 57.) (See "Cylinder Head and Valves Inspection" on page 57.) (See "Analyze Piston Ring Wear" on page 71.)

(11) Is fuel flow from tank adequate?

Yes - Go to step (12).

No - Replace fuel filter. (See "Fuel Filter Removal and Installation" on page 42.)

(12) Is carburetor clean and free of any build-up in fuel and air passages? (See "Carburetor Removal and Installation" on page 46.)

No - Clean carburetor as necessary.

Symptom: Engine Malfunctions at Low RPM

(1) Is the correct spark plug installed and properly adjusted?

Yes - Go to step (2).

No - Install and properly adjust the correct spark plug.

(2) Is slow idle speed adjusted properly? (See "Slow Idle Speed Adjustment" on page 36.)

Yes - Go to step (3).

No - Adjust slow idle speed.

Symptom: Engine Malfunctions at Low RPM

(3) Is governor linkage operating properly? (See "Governor and Fast Idle Speed Adjustment" on page 36.)

Yes - Go to step (4).

No - Adjust governor linkage.

(4) Is choke operating properly?

Yes - Go to step (5).

No - Repair carburetor. (See "Carburetor Clean and Inspect" on page 49.)

(5) Does the ignition system produce a steady, strong blue spark. (See "Spark Test" on page 39.)

Yes - Go to step (6).

No - Follow "Results" of the spark test procedure.

(6) Is engine operating at normal temperature - engine not overheating?

Yes - Go to step (7).

No - Engine load may be excessive. Reduce engine load.

No - Clean cooling intake screen, engine shrouding, and cooling fins.

(7) Is cylinder compression within specification? (See "Cylinder Compression Pressure Test" on page 37.)

Yes - Go to step (8).

No - Repair or replace engine as necessary. (See "Engine Removal and Installation" on page 43.) (See "Cylinder Head and Valves Disassembly and Assembly" on page 57.) (See "Cylinder Head and Valves Inspection" on page 57.) (See "Analyze Piston Ring Wear" on page 71.)

(8) Are valves properly adjusted? (See "Valve Clearance Check and Adjustment" on page 38.)

Yes - Go to step (9).

No - Adjust valve clearance.

(9) Are carburetor and intake manifold flanges properly sealed - no air leaks?

Yes - Go to step (10).

No - Seal flanged surfaces as required. (See "Carburetor Removal and Installation" on page 46.)

Symptom: Engine Malfunctions at Low RPM

(10) Is carburetor clean and free of any build-up in fuel and air passages? (See "Carburetor Clean and Inspect" on page 49.)

No - Clean carburetor as necessary.

Symptom: Engine Malfunctions at High RPM

(1) Is the correct spark plug installed and properly adjusted?

Yes - Go to step (2).

No - Install and properly adjust the correct spark plug.

(2) Is choke operating properly?

Yes - Go to step (3).

No - Repair carburetor. (See "Carburetor Clean and Inspect" on page 49.)

(3) Is governor spring in good condition?

Yes - Go to step (4).

No - Replace governor spring.

(4) Is fast idle speed adjusted properly? (See "Governor and Fast Idle Speed Adjustment" on page 36.)

Yes - Go to step (5).

No - Adjust fast idle speed.

(5) Does the ignition system produce a steady, strong blue spark. (See "Spark Test" on page 39.)

Yes - Go to step (6).

No - Follow "Results" of the spark test procedure. Go to step (6) if problem continues.

(6) Does ignition coil test OK? (See "Ignition Coil Test" on page 54.)

Yes - Go to step (7).

No - Replace ignition coil(s).

(7) Is engine operating at normal temperature - engine not overheating?

Yes - Go to step (8).

No - Engine load may be excessive. Reduce engine load.

No - Clean cooling intake screen, engine shrouding, and cooling fins.

Symptom: Engine Malfunctions at High RPM

(8) Is cylinder compression within specification? (See "Cylinder Compression Pressure Test" on page 37.)

Yes - Go to step (9).

No - Repair or replace engine as necessary. (See "Engine Removal and Installation" on page 43.) (See "Cylinder Head and Valves Disassembly and Assembly" on page 57.) (See "Cylinder Head and Valves Inspection" on page 57.) (See "Analyze Piston Ring Wear" on page 71.)

(9) Are valves properly adjusted? (See "Valve Clearance Check and Adjustment" on page 38.)

Yes - Go to step (10).

No - Adjust valve clearance.

(10) Is fuel flow from tank adequate?

Yes - Go to step (11).

No - Replace fuel filter. (See "Fuel Filter Removal and Installation" on page 42.)

(11) Is float level in carburetor properly adjusted? (See "Float Level Adjustment" on page 50.)

Yes - Go to step (12).

No - Adjust float level.

(12) Are carburetor and intake manifold flanges properly sealed - no air leaks.?

Yes - Go to step (13).

No - Seal flanged surfaces as required. (See "Carburetor Removal and Installation" on page 46.)

(13) Is carburetor clean and free of any build-up in fuel and air passages? (See "Carburetor Clean and Inspect" on page 49.)

Yes - Go to step (14).

No - Clean carburetor as necessary.

(14) Is governor assembly in good condition with no binding?

No - Repair as necessary. (See "Governor Removal and Installation" on page 77.)

Symptom: Excessive Oil Consumption

(1) Is engine oil the correct viscosity for conditions?

Yes - Go to step (2).

No - Drain oil from engine and replace with oil of proper viscosity.

(2) Is engine filled with oil to proper level on the dipstick (crankcase not excessively full)?

Yes - Go to step (4).

No - Drain excessive engine oil.

(3) Is cylinder compression within specification? (See "Cylinder Compression Pressure Test" on page 37.)

Yes - Go to step (4).

No - Repair or replace engine as necessary. (See "Engine Removal and Installation" on page 43.) (See "Cylinder Head and Valves Disassembly and Assembly" on page 57.) (See "Cylinder Head and Valves Inspection" on page 57.) (See "Analyze Piston Ring Wear" on page 71.)

(4) Is the breather valve functioning properly?

Yes - Go to step (5).

No - Clean or replace breather valve. (See "Rocker Arm Cover Removal and Installation" on page 55.)

(5) Is the drain in the breather chamber clear of obstructions?

Yes - Go to step (6).

No - Clear obstructions from drain in breather chamber.

(6) Are the valve guides in good condition and not worn excessively?

Yes - Go to step (7).

No - Repair as necessary.

(7) Are the oil ring grooves clear of obstructions?

No - Clean oil ring grooves. (See "Piston and Connecting Rod Removal" on page 65.)

Symptom: Engine Overheats

(1) Is engine being operated under normal operating conditions?

Yes - Go to step (2).

No - Adjust mower operation to comply with normal operating conditions. (See owner's manual for more information.)

Symptom: Engine Overheats

(2) Is flywheel intake screen clear of debris?

Yes - Go to step (3).

No - Clean screen of debris.

(3) Are engine cooling shrouds in place?

Yes - Go to step (4).

No - Repair or replace shrouds as needed.

(4) Are flywheel fan and engine cooling fins free of obstruction and not damaged?

No - Clean or repair as necessary.

Symptom: Excessive Fuel Consumption

(1) Is choke operating properly?

Yes - Go to step (2).

No - Repair carburetor. (See “Carburetor Clean and Inspect” on page 49.)

(2) Is the correct spark plug installed and properly adjusted?

Yes - Go to step (3).

No - Install and properly adjust the correct spark plug.

(3) Remove spark plugs. Are the spark plug tips clear of any drops of fuel?

Yes - Go to step (4).

No - Check for plugged air cleaner.

No - Possible incorrect use of choke. Clean spark plugs and set choke properly.

No - Check float level for proper adjustment. (See “Float Level Adjustment” on page 50.)

(4) The ignition system should produce a steady, strong blue spark. (See “Spark Test” on page 39.) Is the spark weak or no spark at all?

Yes - Go to step (5).

No - The ignition system is operating satisfactorily. Go to step (6).

(5) Do ignition coils test OK? (See “Ignition Coil Test” on page 54.)

Yes - Go to step (6).

No - Replace ignition coil(s).

(6) Is cylinder compression within specification? (See “Cylinder Compression Pressure Test” on page 37.)

Symptom: Excessive Fuel Consumption

Yes - Go to step (7).

No - Repair or replace engine as necessary. (See “Engine Removal and Installation” on page 43.) (See “Cylinder Head and Valves Disassembly and Assembly” on page 57.) (See “Cylinder Head and Valves Inspection” on page 57.) (See “Analyze Piston Ring Wear” on page 71.)

(7) Is slow idle speed adjusted properly? (See “Slow Idle Speed Adjustment” on page 36.)

Yes - Go to step (8).

No - Adjust slow idle speed.

(8) Is fast idle speed adjusted properly? (See “Governor and Fast Idle Speed Adjustment” on page 36.)

Yes - Go to step (9).

No - Adjust fast idle speed.

(9) Are cylinder head cap screws properly torqued - not loose?

No - Torque cylinder head cap screws. (See “Cylinder Head and Valves Removal and Installation” on page 56.)

Tests and Adjustments

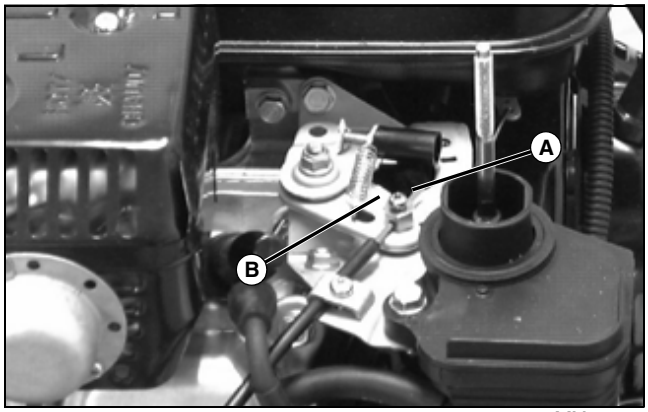
Throttle Cable Check and Adjustment

Reason

To make sure the throttle control lever allows full range of engine speeds.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Move throttle lever to SLOW idle position.



MX5999

Picture Note: Air Cleaner Removed for Photo Clarity Only

6. Loosen screw (B) and pull on cable end (A) to remove any slack.
7. Tighten screw (B).
8. Start engine and move throttle lever from SLOW to FAST to SLOW positions to verify operation.

Slow Idle Speed Adjustment

IMPORTANT: Avoid damage! DO NOT attempt to adjust the carburetor unless you are a factory trained technician with authorization to service CARB/EPA Certified Emissions Carburetors.

Reason

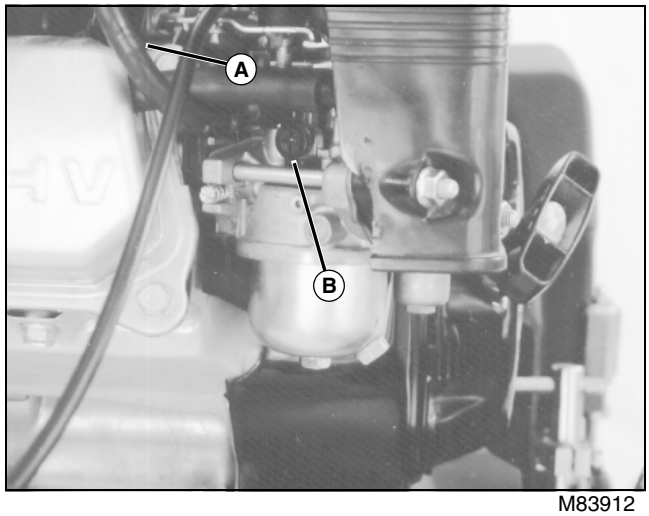
To ensure that the engine is running at proper slow idle rpm.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Pulse Tachometer	JT07270	Used to check/ adjust engine slow and fast idle rpm.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Start and run engine for five minutes to bring to operating temperature.
6. Move throttle to SLOW IDLE position.



M83912

7. Hold a JT07270 Digital Pulse Tachometer at spark plug lead (A).
8. Adjust slow idle adjustment screw (B) until the engine is running at specified slow idle speed.

Specifications

Slow Idle Speed . . . . . 1400 +200/-150 rpm

Governor and Fast Idle Speed Adjustment

Reason

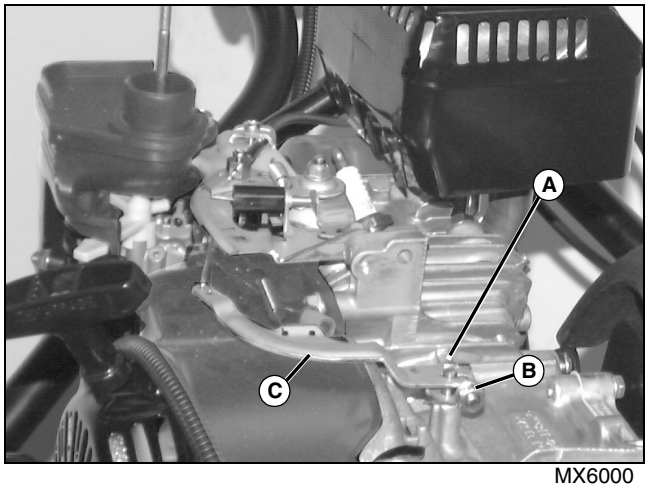
To ensure that the engine is running at proper fast idle rpm.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Pulse Tachometer	JT07270	Used to check/ adjust engine slow and fast idle rpm.

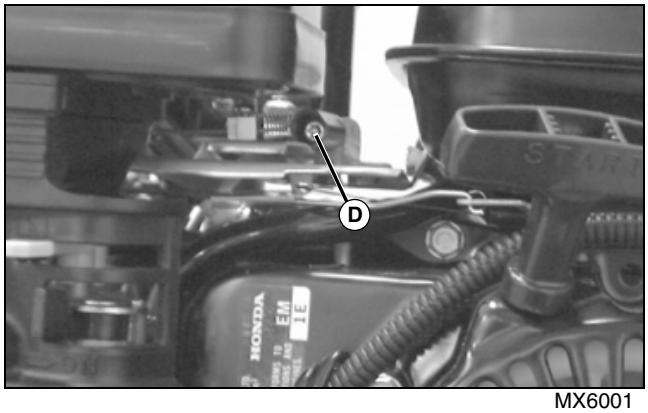
Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Remove fuel tank. (See “Fuel Tank Removal/Installation” on page 41.)



MX6000

6. Loosen governor arm nut (B) and move governor arm (C) to allow the throttle to open fully.
7. Rotate governor shaft (A) as far as it will go in the same direction. Tighten nut to secure arm on shaft.
8. Install fuel tank.
9. Start and run engine for five minutes to bring to operating temperature.
10. Move throttle to FAST IDLE position.
11. Hold a JT07270 Digital Pulse Tachometer at spark plug lead.



MX6001

12. Adjust fast idle adjustment screw (D) until the engine is running at specified fast idle speed.

Specifications

Fast Idle

180B. . . . . .3000 ± 150 rpm
220B and 260B . . . . . .3450 ± 150 rpm

Cylinder Compression Pressure Test

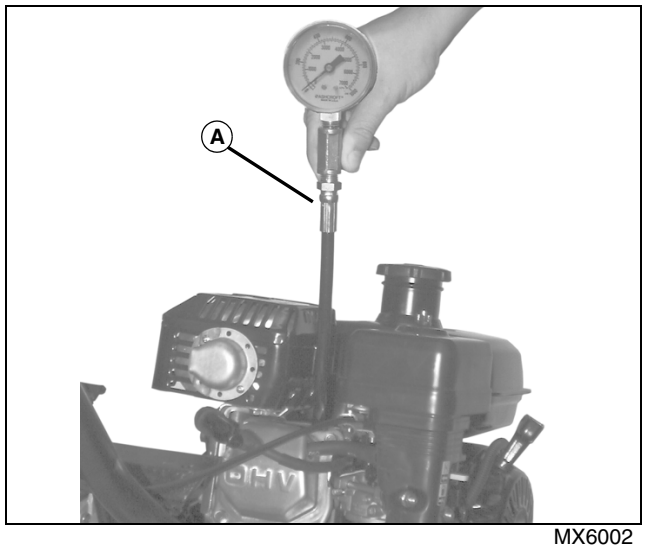
Reason

To determine the condition of the piston, rings, cylinder walls and valves.

Procedure

> **CAUTION: Avoid injury! Engine components are HOT. Be careful not to touch, especially the muffler, while making adjustments. Wear protective eye glasses and clothing.**

1. Run engine for five minutes to bring to operating temperature.
2. Park machine on a level surface.
3. Move RUN/OFF switch to OFF position.
4. Move travel clutch lever to NEUTRAL position.
5. Engage park brake.
6. Remove spark plug.



MX6002

7. Install compression gauge (A) in spark plug hole.
8. Ground high tension lead.
9. Move throttle control lever to FAST IDLE position.
10. Pull recoil starter (full strokes) several times and record highest gauge reading. Compare compression pressure reading to specification.

Results

NOTE: Specification listed is for an engine that has had sufficient time to allow rings to fully seat.

Compression that is lower than specifications on low hour machines probably does not indicate a problem.

- If above specifications, adjust valves and check fuel and air intake systems. Check exhaust for restriction.
- If below specifications, squirt clean engine oil into cylinder and repeat test (one squirt from oil can).
- If compression pressure DOES NOT increase after retest, check for leaking intake or exhaust valves, valve seats or cylinder head gasket. Replace parts as necessary.
- If compression pressure INCREASES after retest, check rings, piston, and cylinder bore for broken rings, scoring, wear, or damage. Replace parts as necessary.

Specifications

Cylinder Compression
Pressure . . . . . 586-834 kPa (85-121 psi)

Valve Clearance Check and Adjustment

Reason

To ensure proper opening and closing of the intake and exhaust valves.

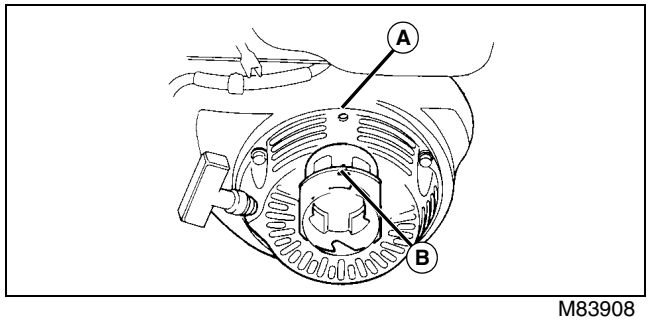
Special or Required Tools

Tool Name	Tool No.	Tool Use
Feeler Gauge (Blade Type)	NA	Used to measure intake and exhaust valve clearance.

Check Procedure

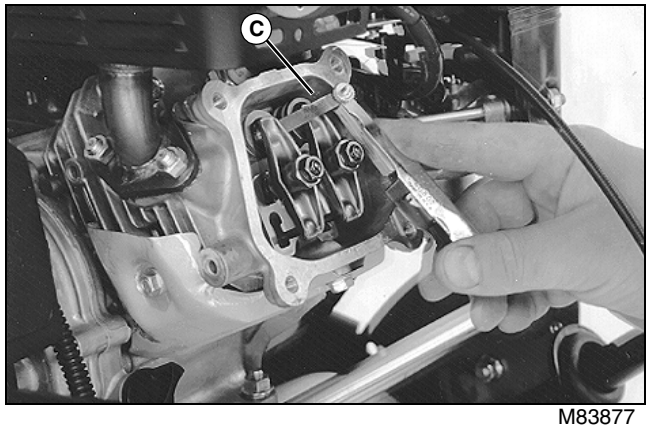
IMPORTANT: Avoid damage! Perform adjustment when engine is cold.

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position. Allow engine to cool.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Remove spark plug.
6. Remove rocker arm cover. (See “Rocker Arm Cover Removal and Installation” on page 55.)



M83908

7. Slowly pull recoil starter until piston is at top dead center (TDC) of compression stroke (both intake and exhaust valves will be closed). The triangular mark (B) on the starter pulley will align with the top hole (A) on the top dead center of the compression or exhaust stroke.



M83877

8. Use a blade-type feeler gauge (C) to measure valve clearance.

Check Procedure Results

If valve clearance does not meet the specifications, perform “Adjustment Procedure.”

Adjustment Procedure

M83876

1. Hold rocker arm pivot and loosen rocker arm lock nut (A).

2. Turn the rocker arm pivot to obtain specified clearance.

3. Retighten rocker arm pivot lock nut to specification while holding the rocker arm pivot.

4. Recheck clearance after tightening lock nut.

Specifications

Intake Valve
Clearance . . . . . 0.15 ± 0.02 mm (0.006 ± 0.001 in.)
Exhaust Valve
Clearance . . . . . 0.20 ± 0.02 mm (0.008 ± 0.001 in.)
Rocker Arm Pivot Lock Nut Torque . . 10 N•m (84 lb-ft)

Spark Test

Reason

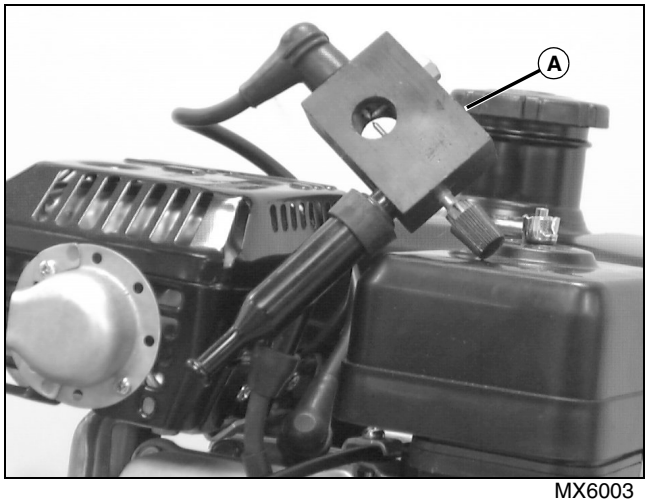
To test the overall condition of the ignition system.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Spark Tester	D-05351ST	Used to check overall condition of ignition system.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Remove high tension lead from spark plug.



MX6003

6. Connect D-05351ST Spark Tester (A) to spark plug.
7. Connect high tension lead to spark tester.

IMPORTANT: Avoid damage! DO NOT adjust spark tester gap beyond 5.0 mm (0.200 in.) (5 turns), as damage to ignition system could occur.

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

9. Pull recoil starter (full strokes) several times and watch spark at spark tester. If engine will start, watch spark with engine running. A steady, strong, blue spark should be observed.

Results

- If spark is weak, or no spark is present, install a new spark plug and repeat test.
- If spark is still weak, or no spark is present, run tests on individual components to find the cause of the malfunction.

Spark Plug Gap Adjustment

Reason

To ensure correct spark plug gap for maximum performance.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Feeler Gauge	NA	Used to measure spark plug gap.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position. Allow engine to cool.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.

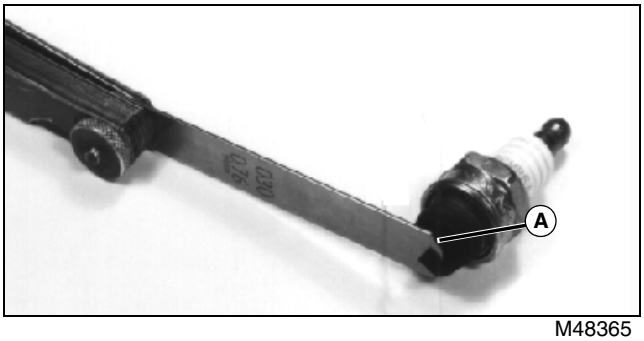
CAUTION: Avoid injury! Engine components are HOT. Be careful not to touch, especially the muffler, while making adjustments. Wear protective eye glasses and clothing.

5. Remove spark plug.

IMPORTANT: Avoid damage! DO NOT clean spark plug with sandpaper or abrasives. Engine scoring can result.

6. Scrape or wire brush deposits from spark plug.

7. Inspect plug for:
   - Cracked porcelain
   - Pitted or damaged electrodes



M48365

8. Check spark plug gap (A) using a feeler gauge. Set gap to 0.7-0.8 mm (0.028-0.031 in.).

9. Inspect sealing washer. Replace spark plug if necessary.

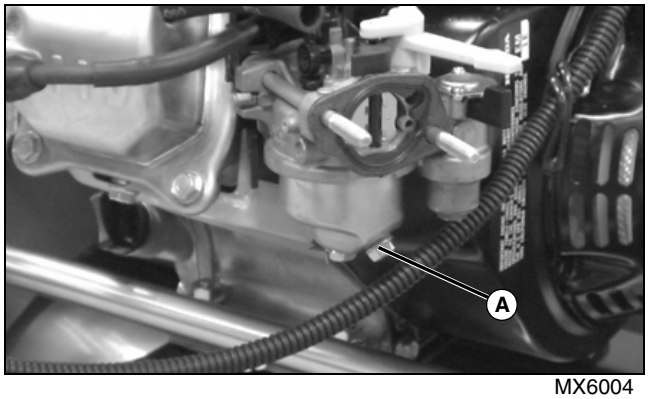
10. Install plug finger-tight until washer is seated. Using a spark plug wrench, tighten plug an additional 1/2 turn if a new plug (or 1/8-1/4 turn for a used plug) to compress washer.

Repair

Fuel Tank Removal/Installation

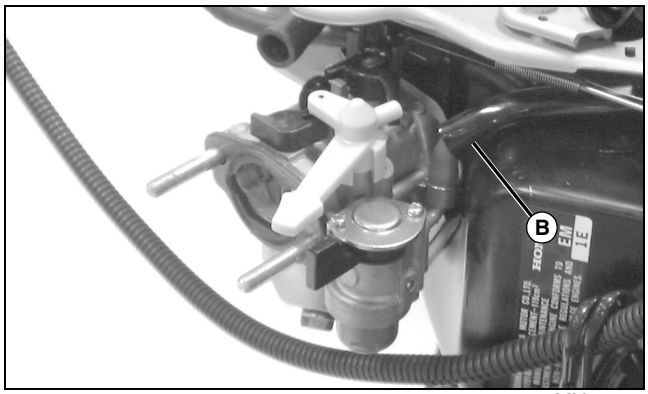
CAUTION: Avoid injury! Gasoline vapor is explosive. DO NOT expose to spark or flame. Serious personal injury can result.

1. Remove air cleaner assembly. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



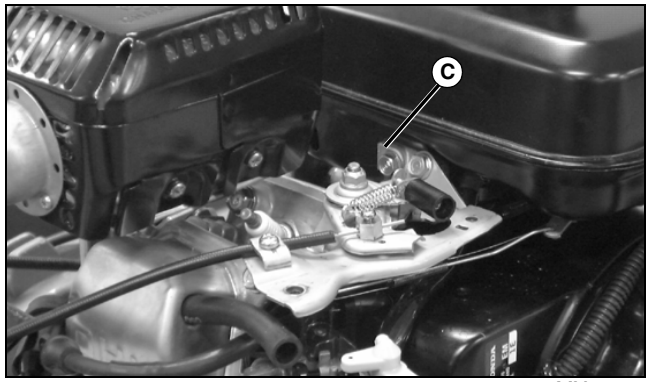
MX6004

2. Remove drain plug (A) and drain fuel into a properly marked container large enough to hold fuel tank capacity.



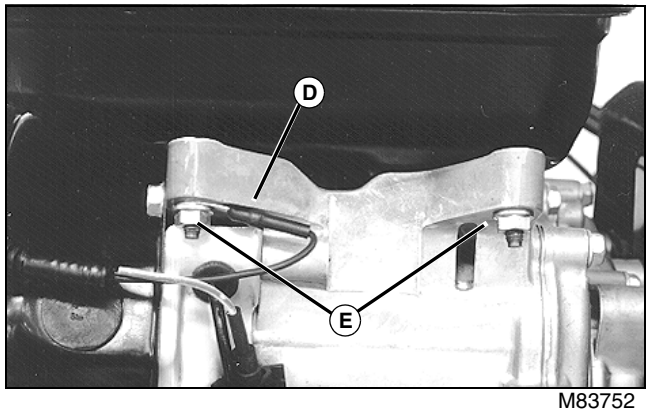
MX6005

3. Disconnect fuel line (B) at carburetor.



MX6006

4. Remove cap screw (C).



M83752

5. Remove two flange nuts (E) and ground wire (D).

6. Remove fuel tank.

7. Inspect fuel tank for signs of wear or damage. Replace if necessary.

8. Inspect fuel filter. Clean and/or replace if necessary. (See “Fuel Filter Removal and Installation” on page 42.)

Installation

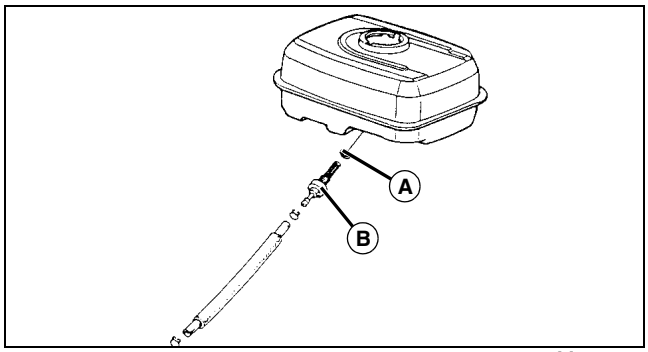
Installation is done in the reverse order of removal.

- Attach ground wire to the fuel tank stud (recoil starter side).
- Tighten cap screw and flange nuts to specification.
- Inspect for leaks. Repair leaks and wipe up spilled fuel before starting engine.

Specifications

Fuel Tank Capacity (Approx). . . . . 2.5 L (0.66 U.S. gal)
Fuel Tank Cap Screw and Flange Nut Torque . . . . . 10 N•m (84 lb-ft)

Fuel Filter Removal and Installation



M83753

1. Remove fuel tank. (See “Fuel Tank Removal/Installation” on page 41.)
2. Remove fuel line.
3. Remove fuel filter (B) with O-ring (A).
4. Clean and inspect fuel filter. Replace if necessary.

Installation

Installation is done in the reverse order of removal.

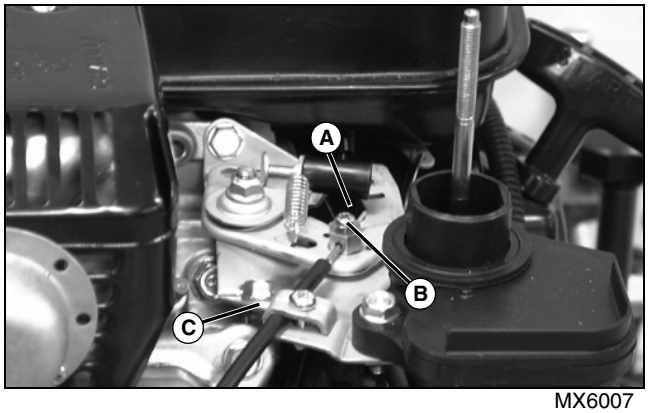
Tighten fuel filter to specification.

Specifications

Fuel Filter Torque . . . . . 2 N•m (17 lb-in.)

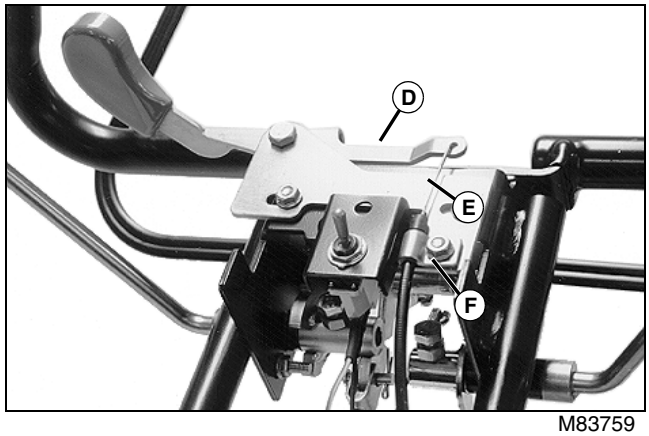
Throttle Cable Removal and Installation

1. Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)
2. Remove air cleaner cover and element. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



MX6007

3. Loosen clamp (C), screw (B) and remove cable (A) from throttle assembly.



M83759

4. Loosen clamp (F) and disconnect throttle cable (E) at throttle lever (D).

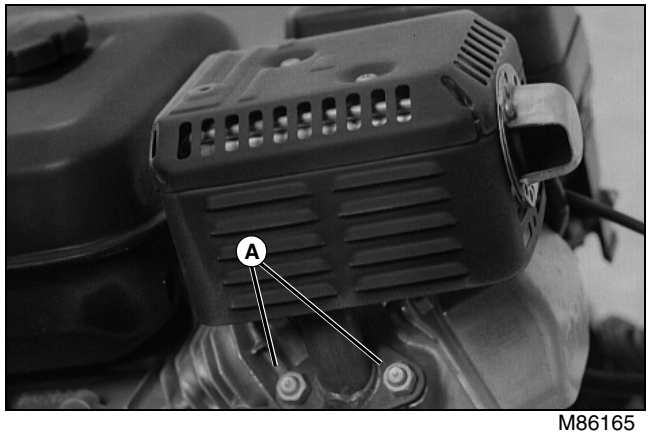
Installation

Installation is done in the reverse order of removal.

Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)

Muffler Removal and Installation

CAUTION: Avoid injury! To prevent possible burns, allow engine to cool before removing muffler.



M86165

1. Remove nuts and washers (A).
2. Remove muffler and gasket.

Installation

Installation is done in the reverse order of removal.

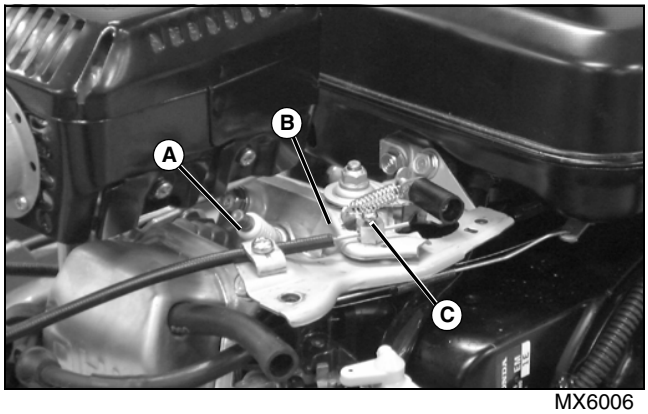
- Use new gasket for installation.
- Tighten mounting nuts to specification.

Specifications

Muffler Mounting Nut Torque . . . . . 24 N•m (204 lb-in.)

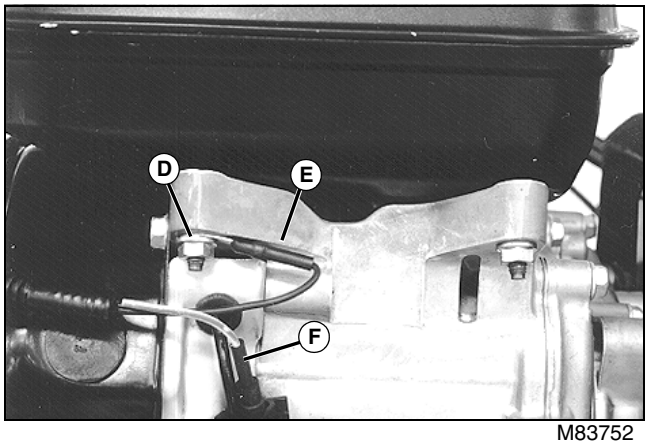
Engine Removal and Installation

1. Remove air cleaner cover and element. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



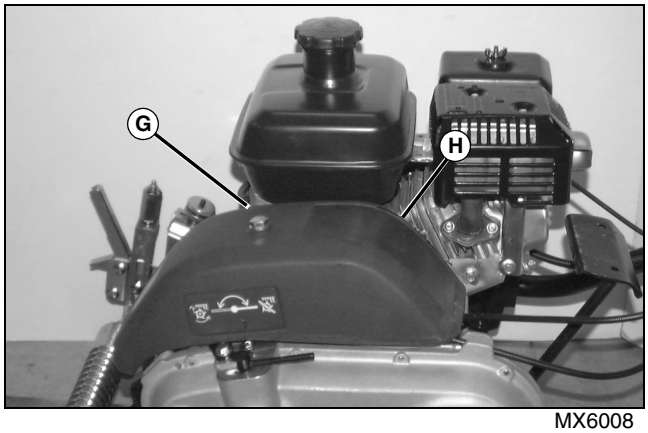
MX6006

2. Loosen clamp (A), screw (C) and remove throttle cable (B) from throttle assembly.



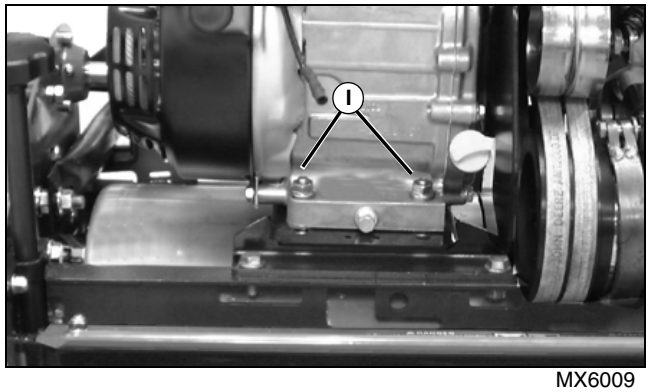
M83752

3. Remove nut (D) and RUN/OFF switch ground wire (E).
4. Disconnect RUN/OFF switch wiring lead (F).



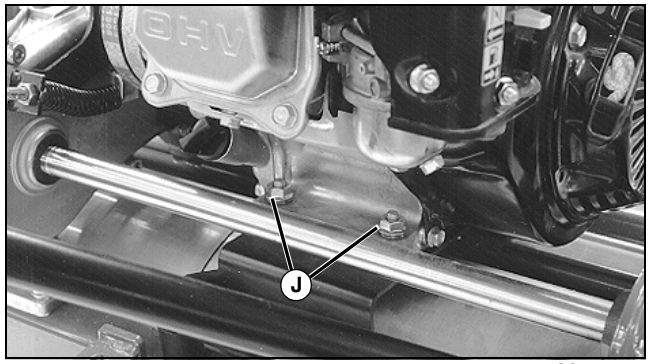
MX6008

5. Remove cap screw (G) and drive belt cover (H).



MX6009

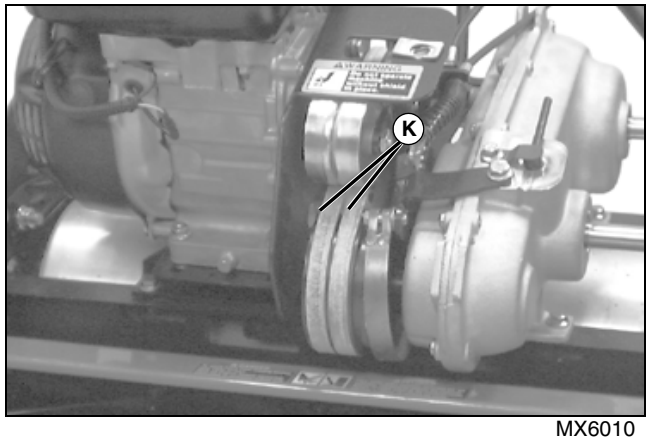
Picture Note: Front of Engine



M83761

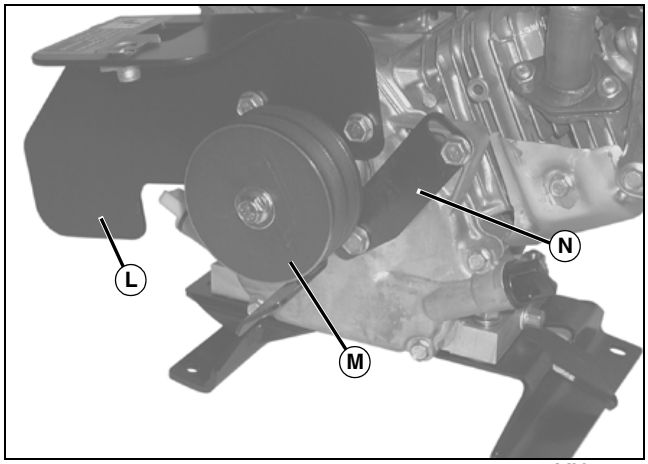
Picture Note: Rear of Engine

6. Remove front engine mounting bolts (I) and rear engine mounting bolts (J).



MX6010

7. Slide engine forward and remove drive belts (K).
8. Remove engine.



MX6073

9. If engine is to be repaired, remove:
   - Drive sheave (M).
   - Belt cover bracket (L).
   - Belt guide bracket (N).
10. If engine is to be repaired, remove drain plug and drain crankcase into container large enough to hold crankcase capacity.

Installation

NOTE: If the engine has been rebuilt (cylinder rebored or deglazed, etc.), the oil should be changed after the first 20 hours (maximum) of operation.

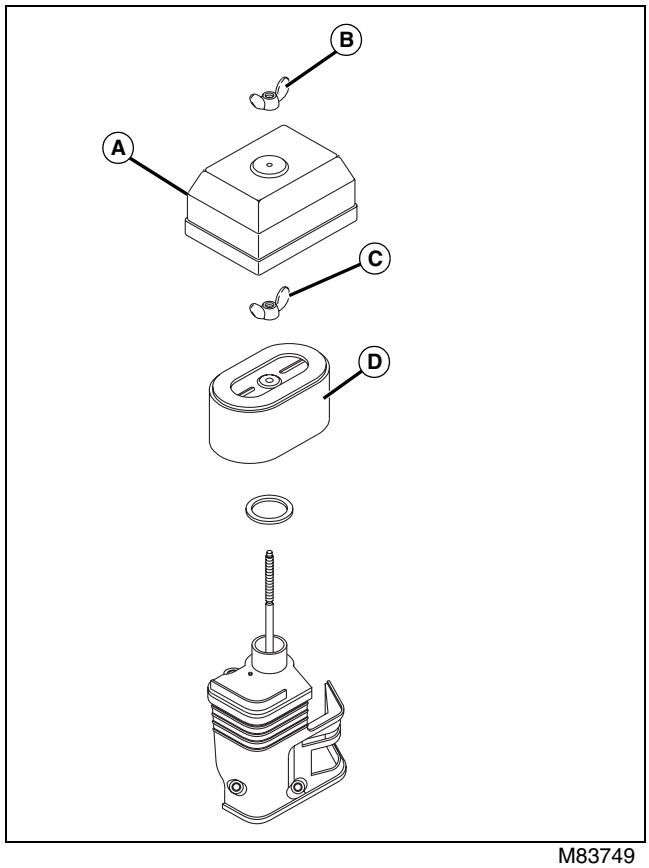
Installation is done in the reverse order of removal.

- Fill engine to proper level with oil of correct specifications. (See “Engine Oil” on page 12.)
- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)
- Adjust drive belt guide. (See “Drive Belt Guide Adjustment” on page 100.)
- Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)

Specifications

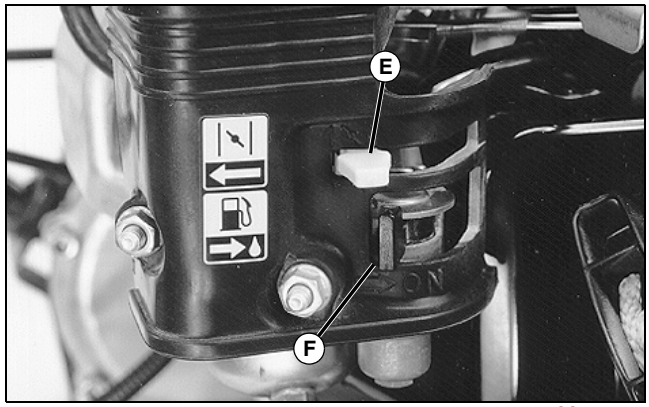
Crankcase Capacity (Approx) . . . . . 0.6 L (0.63 qt)

Air Cleaner Assembly Removal and Installation



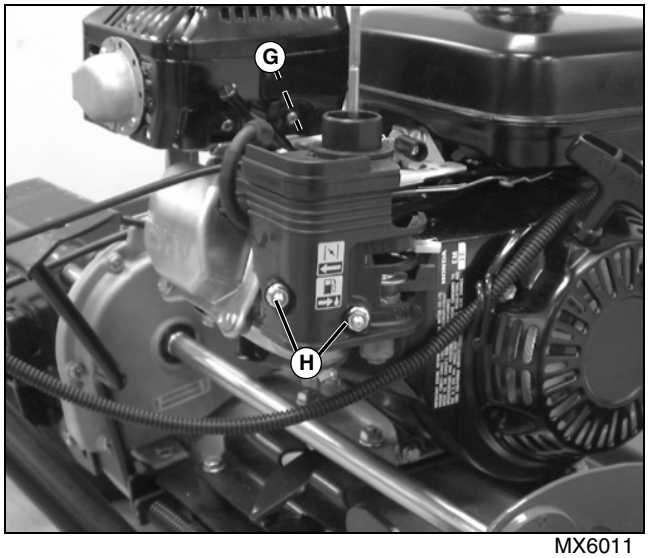
M83749

1. Remove wing nut (B) and cover (A).
2. Remove wing nut (C) and air cleaner (D).



M83775

3. Move fuel shutoff valve lever (F) to OFF position.
4. Move choke lever (E) to FULL CHOKE position.



MX6011

5. Remove two flange nuts (H).

6. Remove cap screw (G).

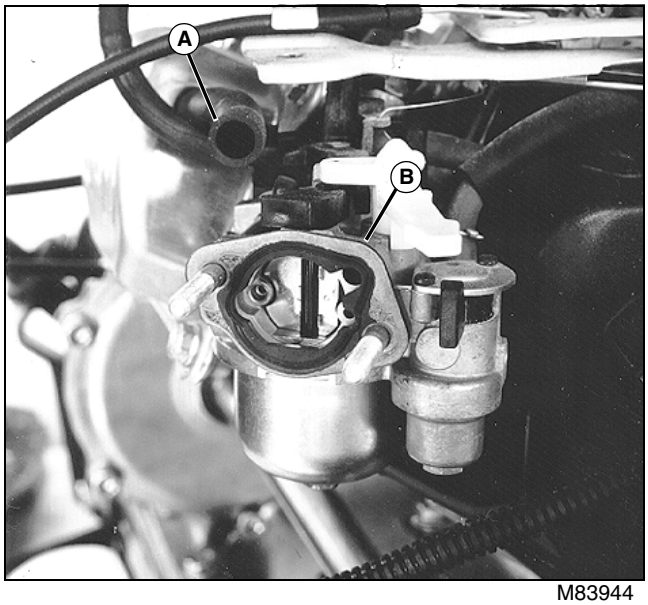
7. Remove air cleaner housing and gasket.

8. Inspect and clean air filter element. Replace if necessary. (See “Service of Air Cleaner” on page 45.)

9. Inspect gasket for damage. Replace if necessary.

Installation

Installation is done in the reverse order of removal.



M83944

- Install gasket as shown (B).
- Connect breather tube (A) to air cleaner housing.
- Tighten air cleaner element and cover wing nuts to specification.
- Tighten housing flange nuts to specification.

Specifications

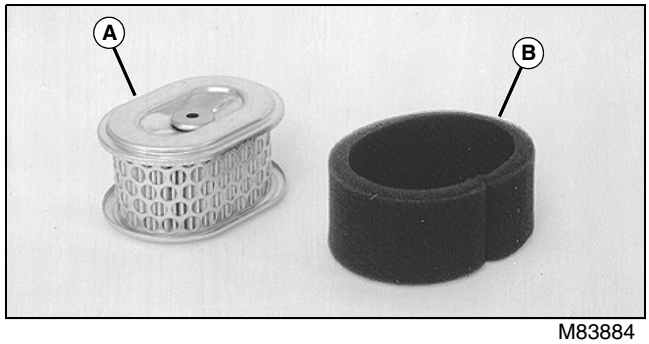
Air Cleaner Wing Nut Torque . . . . . 9 N•m (78 lb-in.)
Air Cleaner Housing Flange Nut Torque . . . . . 8.5 N•m (73 lb-in.)

Service of Air Cleaner

IMPORTANT: Avoid damage! Carefully remove air cleaner cover and elements. Inspect inside paper element and intake passage for signs of dust. If present, replace elements and test engine compression or inspect for damage.

Any time the air cleaner is removed, check for free choke plate operation during reassembly.

1. Remove air cleaner cover and element. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



M83884

2. Remove foam element (B) from paper element (A).

3. Wash foam element in warm soapy water, rinse and allow to dry throughly.

4. Apply 12-15 drops of clean engine oil to foam element. Squeeze out excess oil.

IMPORTANT: Avoid damage! DO NOT clean paper element with solvent or compressed air.

5. Gently tap paper element to remove dust.

6. Inspect paper element:

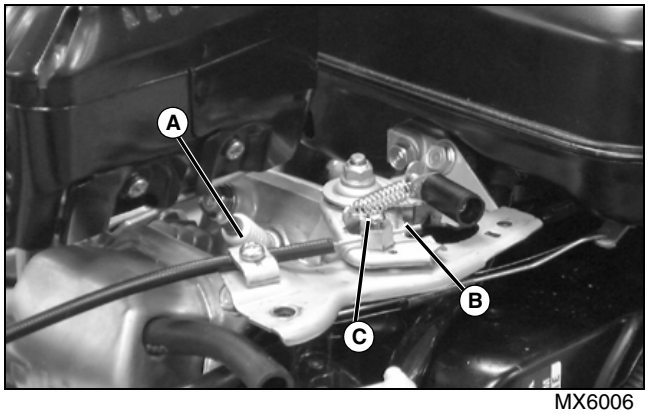
   - Element is still usable if you can see light through it and element appears clean.
   - Replace element if oily, dirty or damaged in any way.

7. Inspect cover and housing for damage. Replace parts as necessary.

8. Assemble and install air cleaner assembly.

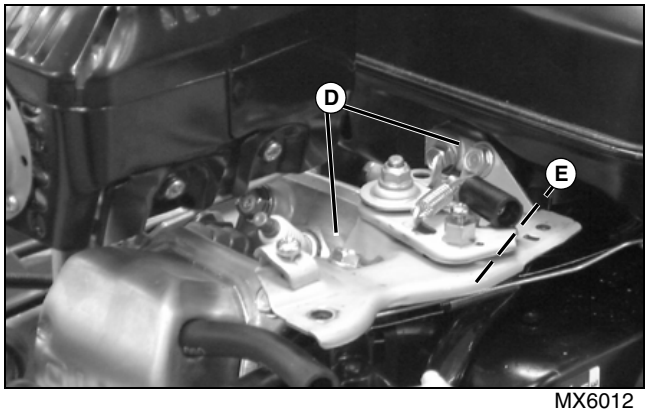
Throttle Plate Assembly Removal and Installation

1. Remove air cleaner assembly. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



MX6006

2. Loosen clamp (A), screw (C) and remove throttle cable (B) at throttle plate assembly.



MX6012

3. Disconnect governor spring (E).

4. Remove two cap screws (D).

5. Remove throttle plate assembly.

Installation

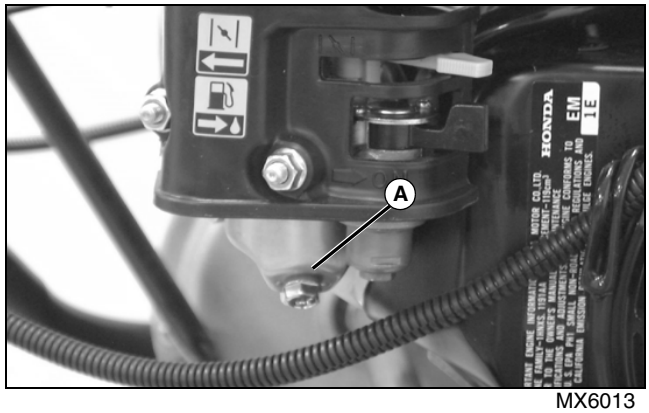
Installation is done in the reverse order of removal.

Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)

Carburetor Removal and Installation

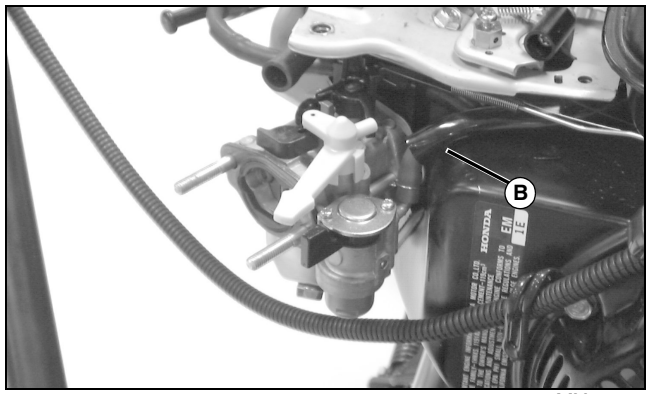
CAUTION: Avoid injury! Gasoline is extremely flammable. DO NOT smoke. Always work in a ventilated area away from open flame or spark producing equipment, this includes equipment that utilizes pilot lights.

1. Remove air cleaner assembly. (See “Air Cleaner Assembly Removal and Installation” on page 44.)



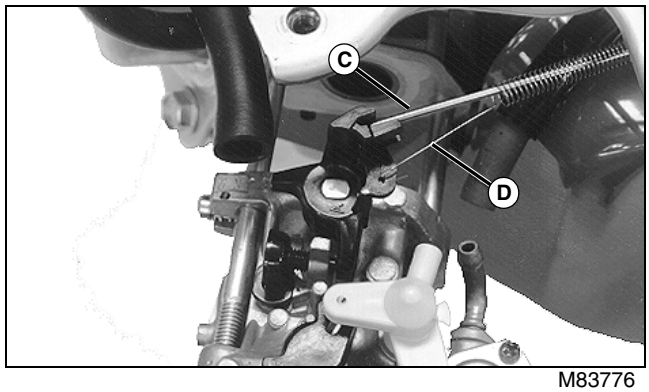
MX6013

2. Remove drain plug (A) and drain fuel into a properly marked container large enough to hold the fuel tank capacity.



MX6005

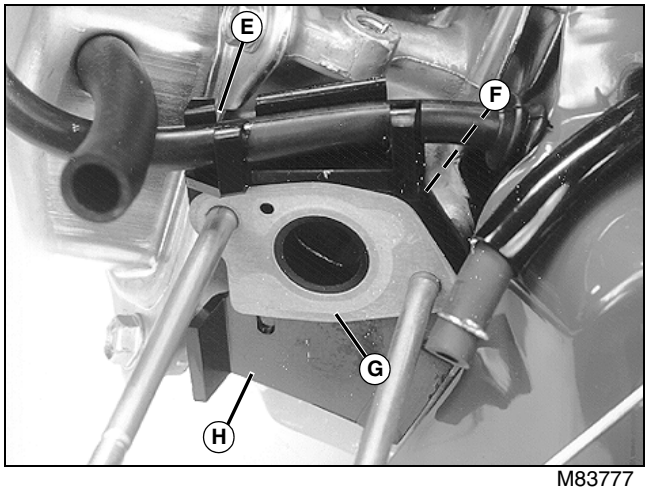
3. Disconnect fuel line (B) at carburetor.



M83776

4. Slide carburetor forward (away from engine) until slot aligns with governor linkage (C). Disconnect linkage (C) and spring (D).

5. Remove carburetor.



M83777

Picture Note: Throttle Plate Assembly Removed for Photo Clarity Only

6. Remove spark plug lead (E) from insulator (H).

7. Remove insulator (H), carburetor gasket (G) and insulator gasket (F).

Installation

Installation is done in the reverse order of removal.

- Use new gaskets for installation.
- Tighten air cleaner housing flange nuts to specification.
- Adjust engine slow idle speed. (See “Slow Idle Speed Adjustment” on page 36.)
- Adjust engine fast idle speed. (See “Governor and Fast Idle Speed Adjustment” on page 36.)

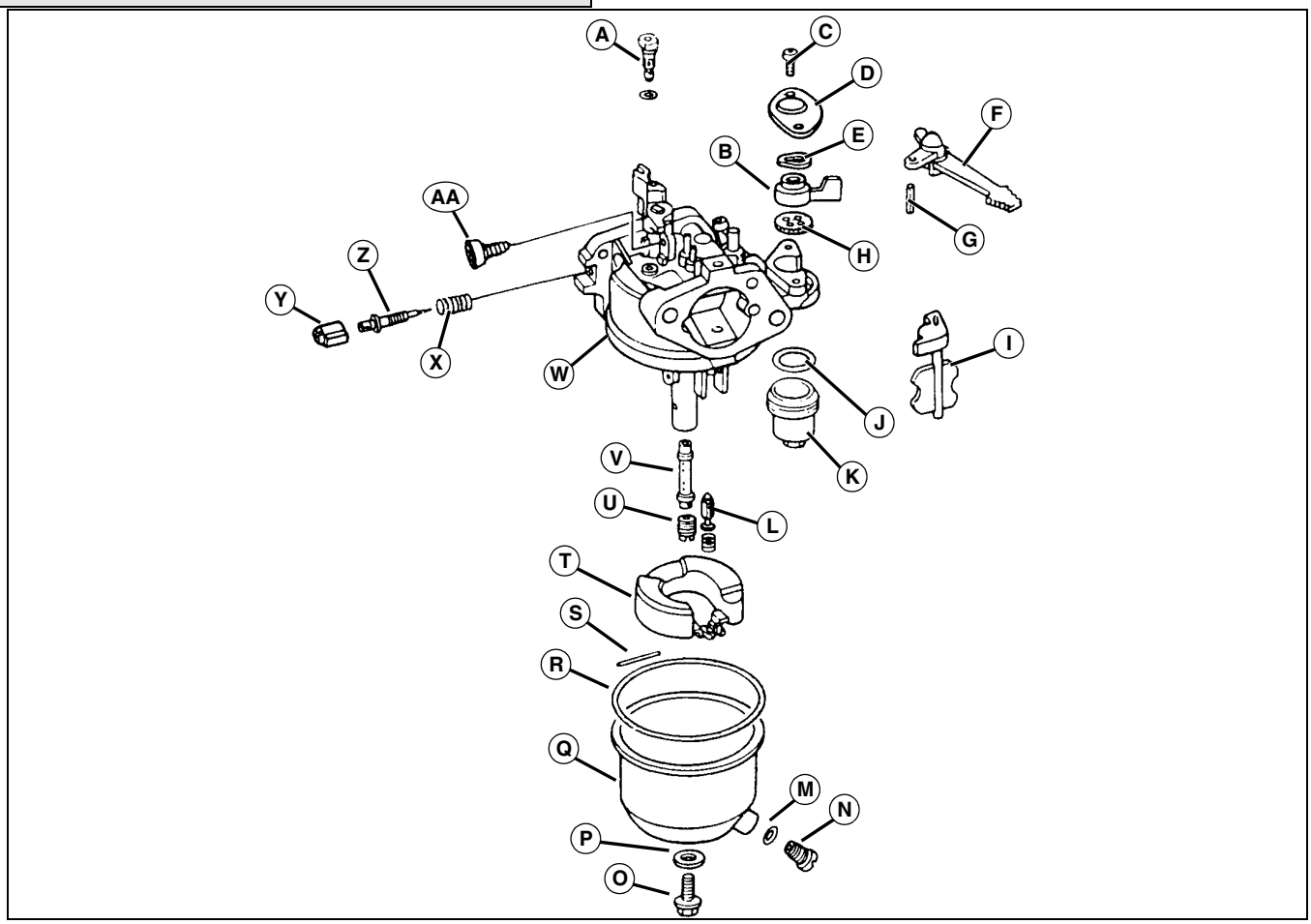
Specifications

Fuel Tank Capacity (Approx) . . . . . 2.5 L (0.66 U.S. gal)
Air Cleaner Housing Flange Nut Torque. . . . . 8.5 N•m (73 lb-in.)

Carburetor Disassembly and Assembly

CAUTION: Avoid injury! Gasoline is extremely flammable. DO NOT smoke. Always work in a ventilated area away from open flame or spark producing equipment, this includes equipment that utilizes pilot lights.

IMPORTANT: Avoid damage! DO NOT attempt to repair, replace jets, or adjust the engine emissions carburetor unless you are a factory trained technician with authorization to service CARB/EPA Certified Emissions Carburetors.



M83879

A - Pilot Jet
B - Fuel Valve
C - Screw (2 used)
D - Plate
E - Spring
F - Choke Lever
G - Pin
H - Packing
I - Choke Plate
J - Packing
K - Sediment Cup
L - Float Valve
M - Washer
N - Drain Screw
O - Screw
P - Washer
Q - Float Chamber
R - Gasket
S - Float Pin
T - Float
U - Main Jet
V - Main Nozzle
W - Carburetor Body
X - Spring
Y - Limiter Cap
Z - Pilot Screw
AA- Throttle Stop Screw

Carburetor Clean and Inspect

IMPORTANT: Avoid damage! DO NOT clean holes or passages with small drill bits or wire.

NOTE: If all rubber or plastic parts cannot be removed for cleaning, use a cleaning solvent with a high flash point that will not damage these parts when cleaning.

Leave pilot screw and limiter cap in place during cleaning. Removal of limiter cap requires breaking the pilot screw. Remove only if replacement of screw is required. If replacement is required, See "Pilot Screw and Limiter Cap Replacement" on page 49.

1. Remove rubber and plastic parts from carburetor. Soak all carburetor metal parts in a carburetor cleaning solution for 1/2 hour maximum.

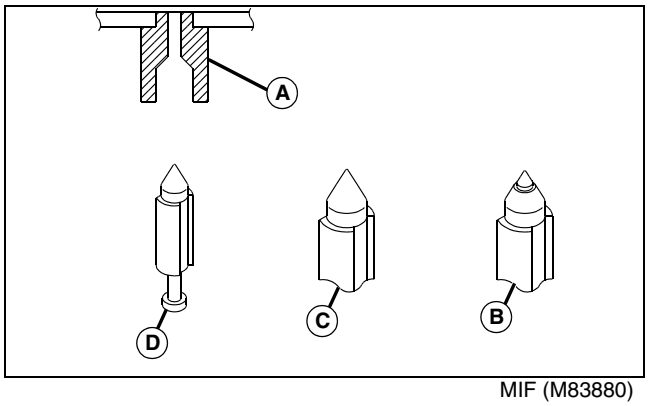
CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: Avoid damage! Rinse carburetor parts in warm water to neutralize corrosive action of cleaner on aluminum.

2. Rinse carburetor parts in warm water and dry with compressed air. DO NOT use rag or paper to dry parts; lint can plug holes and passages in carburetor.

3. Inspect all parts for wear or damage:

- Inspect the carburetor body for wear or damage. Verify all sealing surfaces and flanges are smooth and free of nicks and burrs. Replace as necessary.



MIF (M83880)

A - Valve Seat
B - Float Valve (Worn)
C - Float Valve (Good)
D - Float Valve

- Inspect float valve (D) and valve seat (A) for wear or damage. The tip should be smooth, without any grooves, scratches or tears. If worn or damaged, replace the float assembly and carburetor body as a set.
- Check float level height. (See "Float Level Adjustment" on page 50.)

Pilot Screw and Limiter Cap Replacement

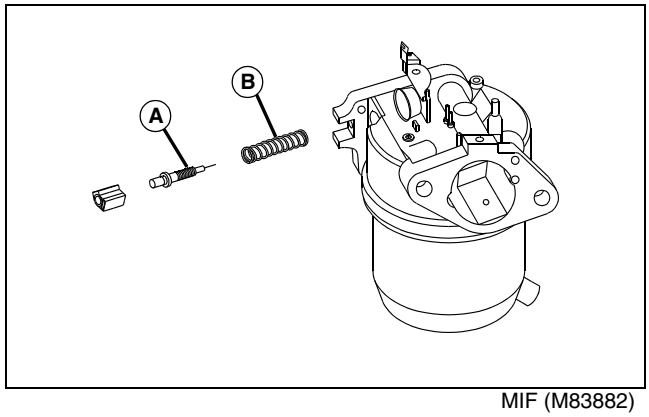
Other Material

Part No.	Part Name	Part Use
TY8311 (US) 660 (LOCTITE® TY15801 (Canada)	QUICK METAL®	Apply to inside of limiter cap before installation.

Procedure

NOTE: Removal of limiter cap requires breaking the pilot screw. Remove only if replacement of screw is required.

1. Remove broken pilot screw.

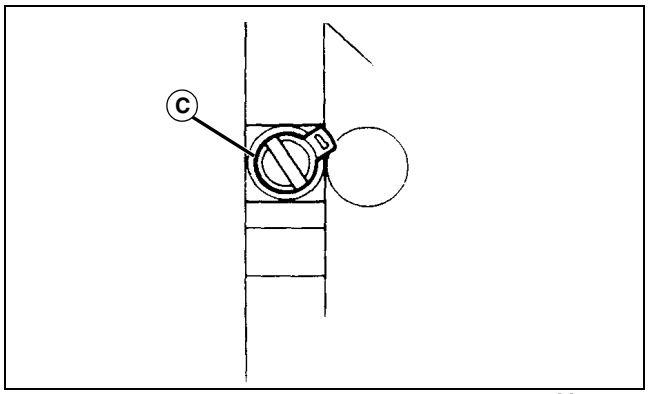


MIF (M83882)

2. Place spring (B) on pilot screw (A) and install screw in carburetor.

3. Turn pilot crew in (clockwise) until lightly seated, then turn out (counterclockwise) 1-5/8 turns.

IMPORTANT: Avoid damage! DO NOT allow the pilot screw to turn while installing limiter cap.



M83883

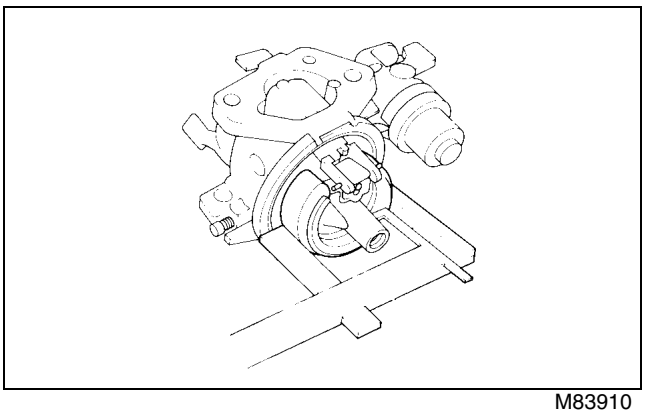
4. Apply LOCTITE 660 QUICK METAL to inside of limiter cap (C).

5. Install limiter cap on pilot screw.

Float Level Adjustment

1. Assemble carburetor (minus the float chamber).

2. Place carburetor with engine-side mounting flange down on a flat, level surface.



M83910

3. Measure the distance from the bottom of the float to the carburetor body with the float valve resting against the seat as shown. DO NOT compress the spring. Compare float height measurement to specification.

4. Replace the float and/or float valve if the measurement is out of specification.

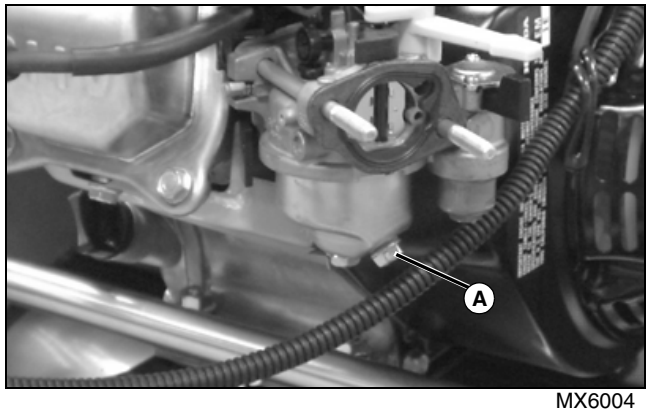
Specifications

Float Height. . . . . 13.7 mm (0.54 in.)

Blower Housing Assembly Removal and Installation

CAUTION: Avoid injury! Gasoline vapor is explosive. DO NOT expose to spark or flame. Serious personal injury can result.

1. Removal air cleaner assembly. (See “Air Cleaner Assembly Removal and Installation” on page 44.)

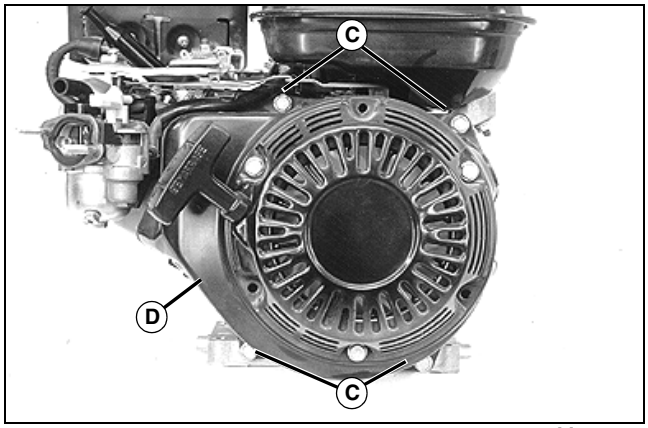


MX6004

2. Remove drain plug (A) and drain fuel into a properly marked container large enough to hold the fuel tank capacity.

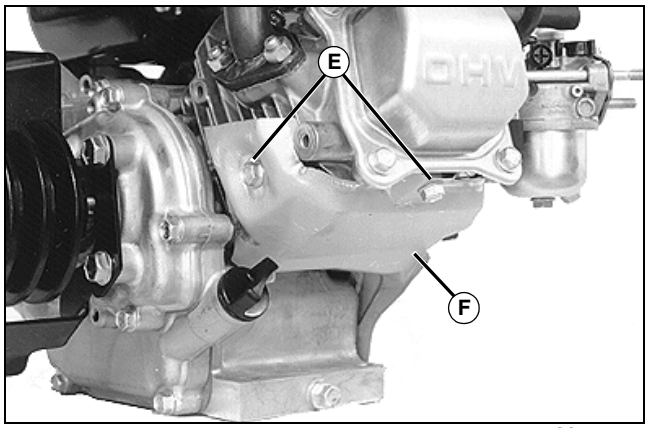
MX6005

3. Disconnect fuel line (B) at carburetor.



M83766

4. Remove four cap screws (C).
5. Remove blower housing (D).



M83767

6. Remove two cap screws (E).
7. Remove shield (F).

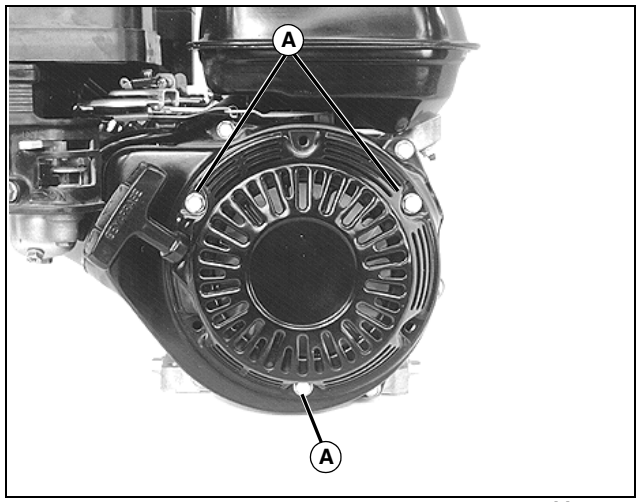
Installation

Installation is done in the reverse order of removal.

Specifications

Fuel Tank Capacity (Approx) . . . . . 2.5 L (0.66 U.S. gal)

Recoil Starter Removal/Installation



M83768

1. Remove three cap screws (A).
2. Remove recoil starter.

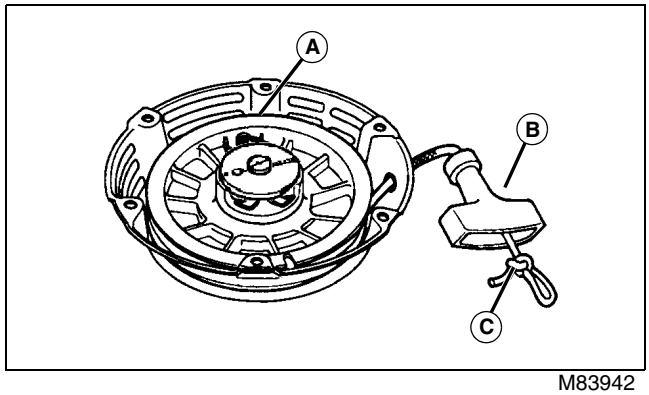
Installation

Installation is done in the reverse order of removal.

- Remove dirt and debris before installation.
- Position recoil starter for best starter grip location.

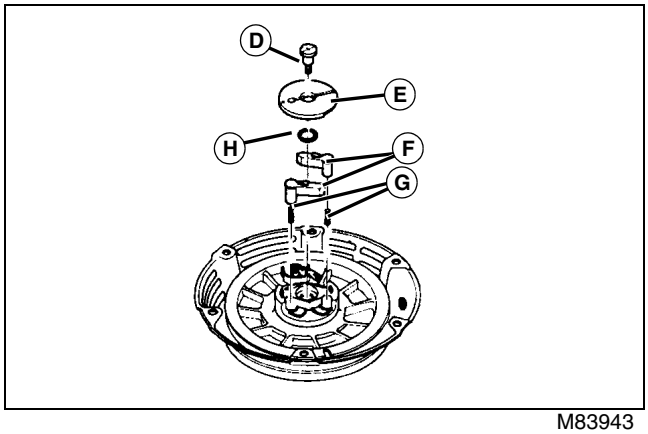
Recoil Starter Disassembly and Inspection

CAUTION: Avoid injury! Recoil spring is wound under tension. DO NOT let spring fly loose. Hold spring firmly in place while replacing. Wear safety glasses and gloves to protect yourself from possible injury.



M83942

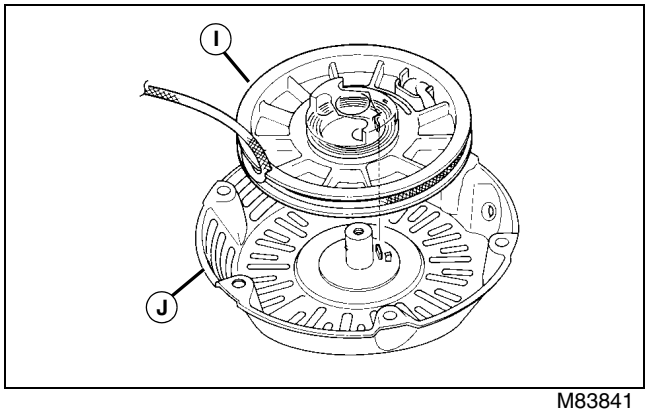
1. Hold reel (A) and carefully feed starter rope out until there is enough slack to untie knot (C).
2. Remove starter grip (B).
3. Hold reel and slowly allow the spring to relieve tension.



M83943

4. Loosen reel cover screw (D) and remove reel cover (E).

5. Remove snap ring (H), two ratchets (F) and two springs (G).



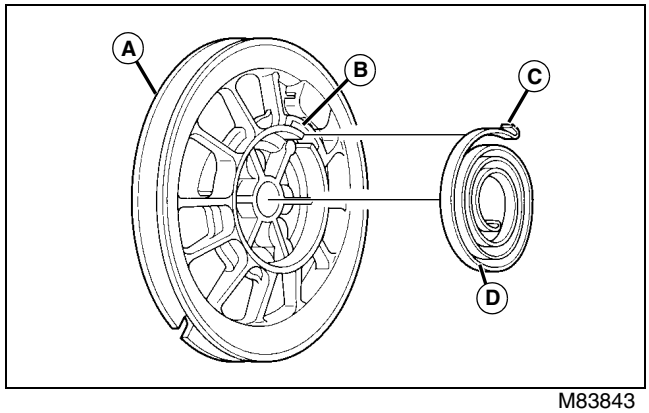
M83841

6. Remove the starter reel (I) and spring from the starter case (J).

7. Inspect all parts for wear or damage. Replace parts as necessary.

Recoil Starter Assembly

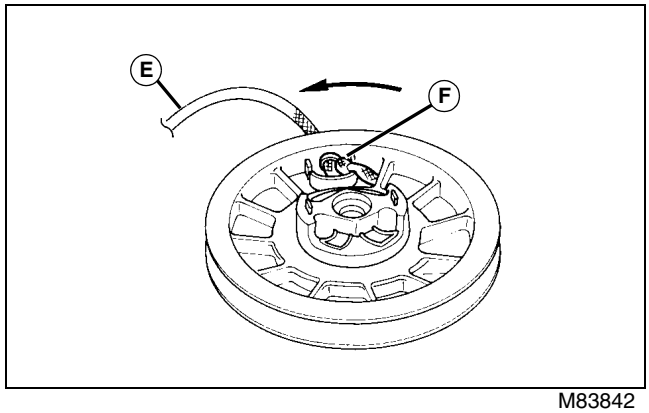
CAUTION: Avoid injury! Recoil spring is wound under tension. DO NOT let spring fly loose. Hold spring firmly in place while replacing. Wear safety glasses and gloves to protect yourself from possible injury.



M83843

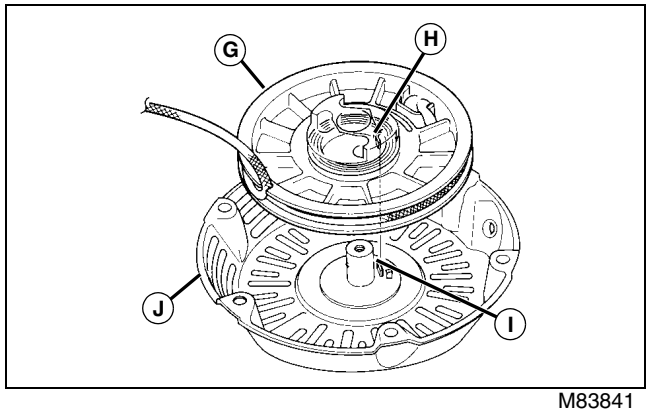
1. Insert hook (C) on outer side of spring (D) into groove (B) on inside of reel (A).

NOTE: Leave approximately 30 cm (12 in.) of rope outside starter reel.



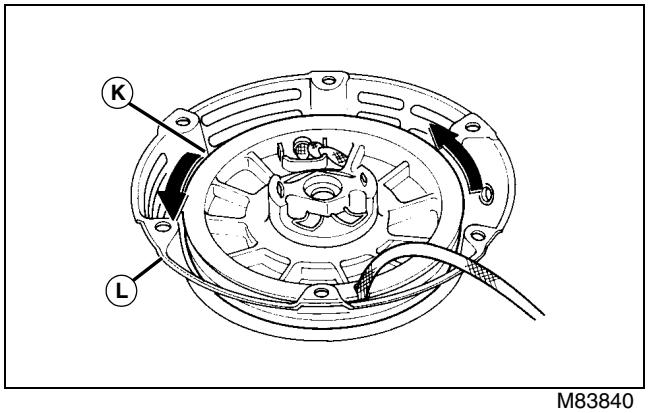
M83842

2. Route starter rope (E) through starter reel and tie a knot (F) as shown. Wind starter rope around reel in direction of arrow. Leave approximately 30 cm (12 in.) of rope outside starter reel.



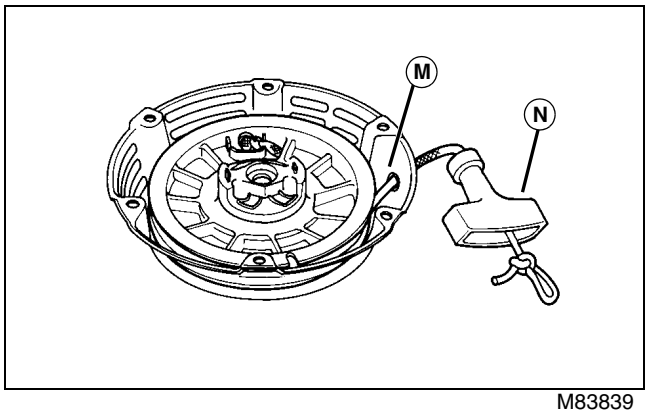
M83841

3. Install starter reel (G) on starter case (J) with spring inner hook (H) anchored to case tab (I).



M83840

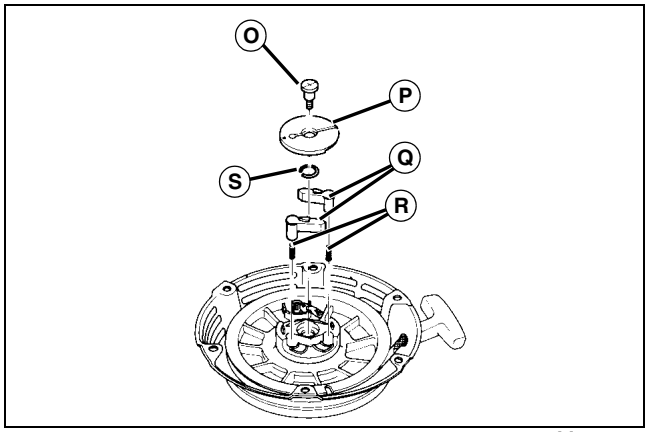
4. Hold starter case (L) and rotate starter reel (K) two revolutions in direction of arrow for preliminary winding.



M83839

5. Route starter rope through starter case rope guide (M) and pull outward.

6. Route starter rope through starter grip (N) and tie as shown.



M83838

7. Install ratchets (Q), springs (R), snap ring (S) and reel cover (P). Install and tighten reel cover screw (O).

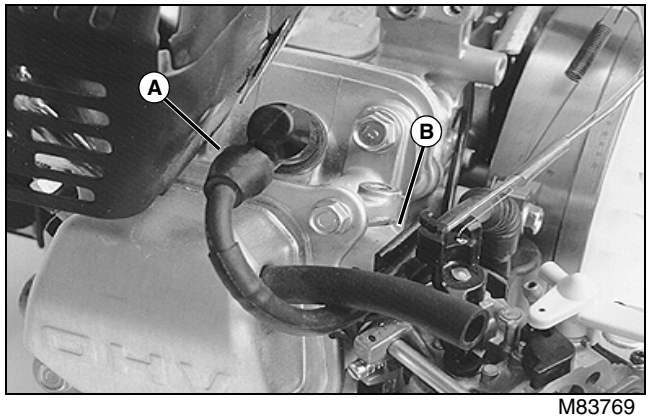
8. Check operation of the ratchet by pulling the starter rope several times.

Ignition Coil Removal and Installation

1. Remove fuel tank. (See “Fuel Tank Removal/Installation” on page 41.)

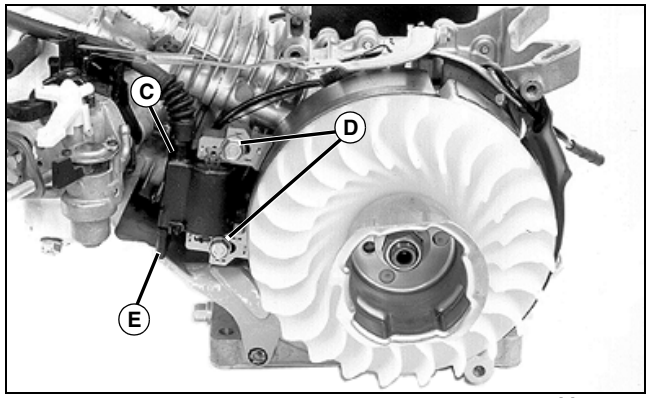
2. Remove blower housing. (See “Blower Housing Assembly Removal and Installation” on page 50.)

3. Remove throttle plate assembly. (See “Throttle Plate Assembly Removal and Installation” on page 45.)



M83769

4. Disconnect spark plug lead (A) from spark plug and remove lead from retainer (B).



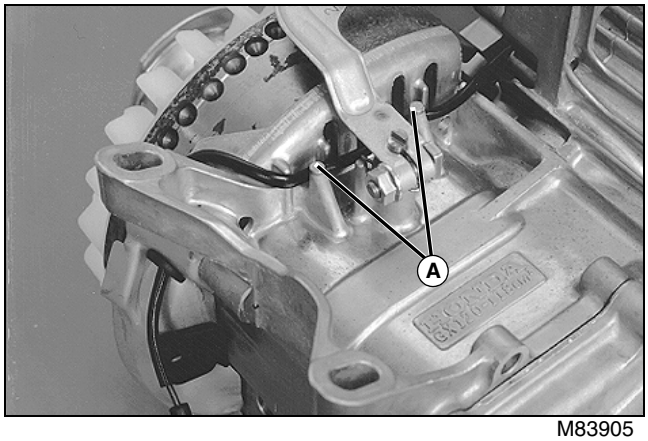
M83770

5. Disconnect ground wire (E).

6. Remove cap screws (D) and ignition coil (C).

Installation

Installation is done in the reverse order of removal.



M83905

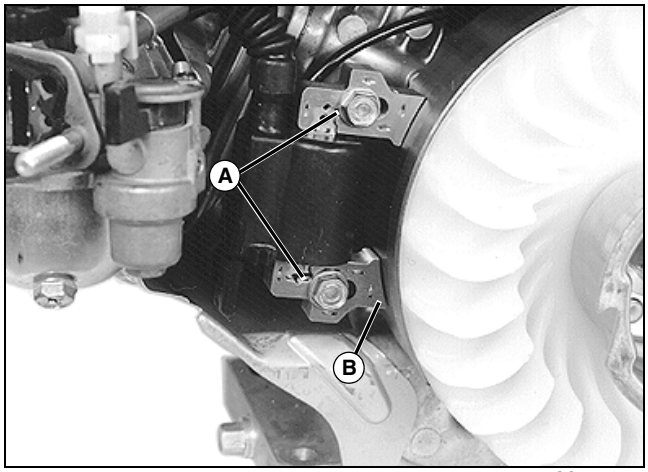
• Secure ignition wire into ribs (A) on crankcase and through grommet.

• Adjust air gap. (See “Air Gap Adjustment” on page 54.)

Air Gap Adjustment

1. Turn flywheel magnet away from ignition coil.

2. Loosen ignition coil mounting cap screws.



M83771

3. Insert a 0.4 mm (0.016 in.) feeler gauge between flywheel (B) and ignition coil.

4. Push ignition coil against flywheel and tighten mounting cap screws (A).

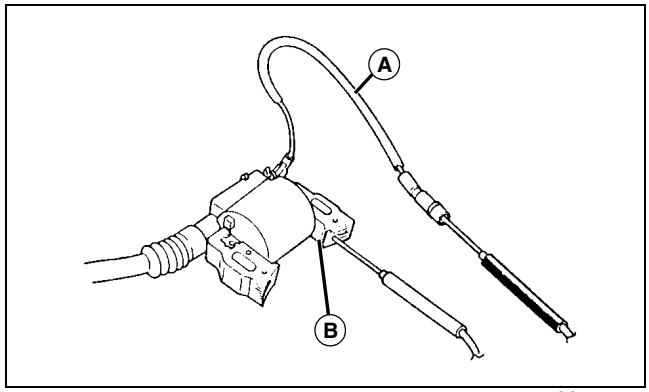
5. Turn flywheel to remove feeler gauge.

Specifications

Ignition Coil Air Gap. . . 0.4 ± 0.2 mm (0.016 ± 0.008 in.)

Ignition Coil Test

Primary Side

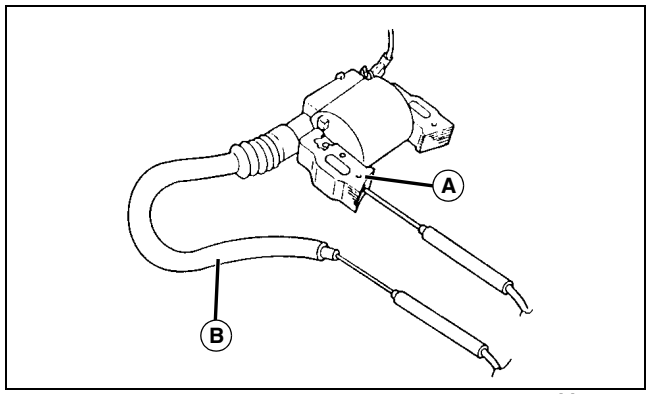


M83885

Measure resistance between ignition coil primary (black) lead (A) and iron core (B). Replace ignition coil if resistance is not within specification.

Secondary Side

NOTE: A false reading will be obtained if the spark plug cap is not removed.



M83886

1. Remove spark plug cap.

2. Measure resistance between the end of the spark plug lead (B) and iron core (A). Replace ignition coil if resistance is not within specification.

Specifications

Primary Side

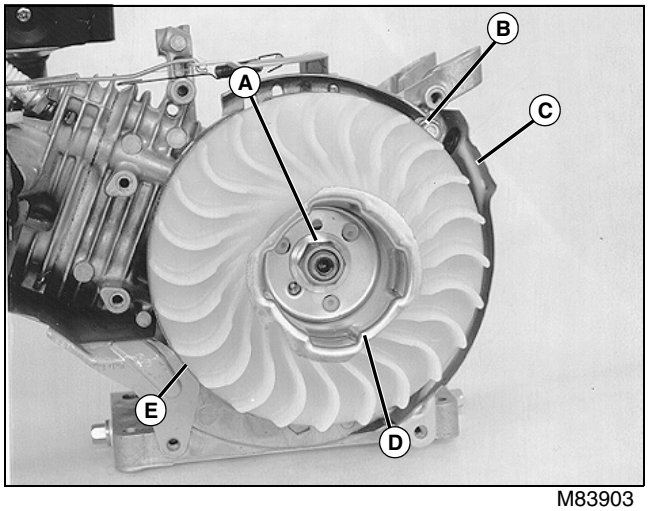
Ignition Coil Resistance . . . . . .0.8-1.0 ohms

Secondary Side

Ignition Coil Resistance . . . . . 5.9-7.1 k-ohms

Flywheel Removal and Installation

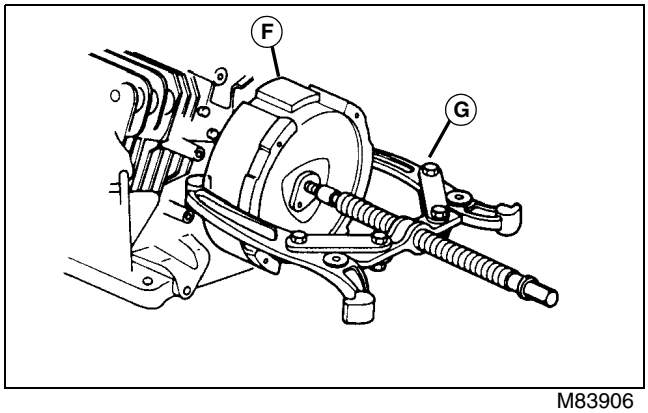
1. Remove ignition coil. (See “Ignition Coil Removal and Installation” on page 53.)



M83903

2. Remove cap screw (B) and shield (C).
3. Remove flywheel nut (A).
4. Remove starter pulley (D) and cooling fan (E).

IMPORTANT: Avoid damage! Use a puller to remove flywheel. Avoid attaching puller to the magnet sections. To avoid possible damage, DO NOT hit the flywheel with a hammer to loosen.

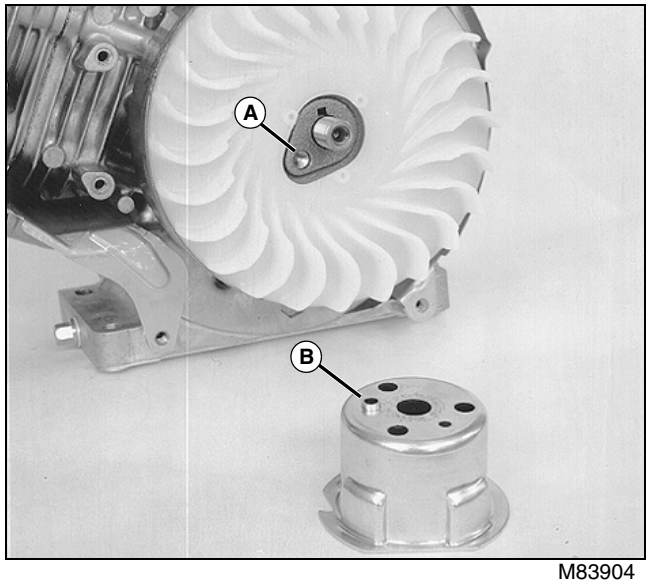


M83906

5. Using a puller (G), remove flywheel (F) and key.

Installation

Installation is done in the reverse order of removal.



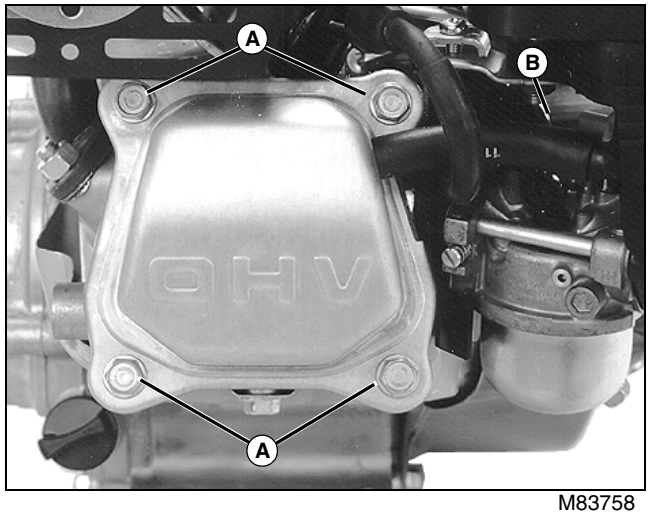
M83904

- Align lug (B) on starter pulley with hole (A) on flywheel.
- Tighten flywheel nut to specification.

Specifications

Flywheel Nut Torque . . . . . 75 N•m (54 lb-ft)

Rocker Arm Cover Removal and Installation



M83758

1. Remove four cap screws (A).
2. Disconnect breather tube (B) at air cleaner assembly.
3. Remove rocker arm cover and gasket.

Installation

Installation is done in the reverse order of removal.

- Remove gasket material for mating surfaces of head and rocker arm cover before installation.
- Use new gasket for installation.

Cylinder Head and Valves Removal and Installation

1. Remove carburetor. (See “Carburetor Removal and Installation” on page 46.)

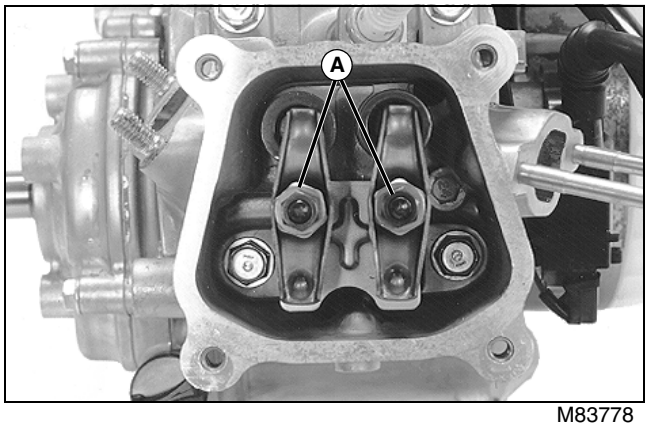
2. Remove throttle plate assembly. (See “Throttle Plate Assembly Removal and Installation” on page 45.)

3. Remove muffler. (See “Muffler Removal and Installation” on page 42.)

4. Remove blower housing. (See “Blower Housing Assembly Removal and Installation” on page 50.)

5. Remove rocker arm cover. (See “Rocker Arm Cover Removal and Installation” on page 55.)

6. Disconnect spark plug lead.

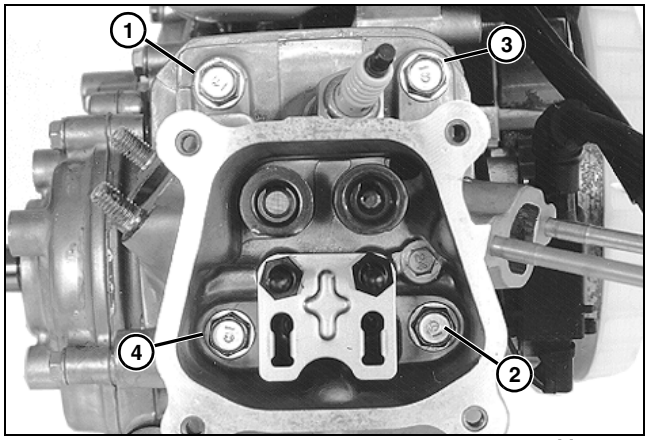


M83778

7. Remove rocker arm pivot lock nuts (A) and remove rocker arm pivots and rocker arms.

8. Remove push rods.

IMPORTANT: Avoid damage! Loosen cylinder head cap screws 1/4 turn at a time in the sequence shown to avoid warping the cylinder head.



M83780

9. Loosen cap screws in the sequence shown.

10. Remove head cap screws, cylinder head, and gasket.

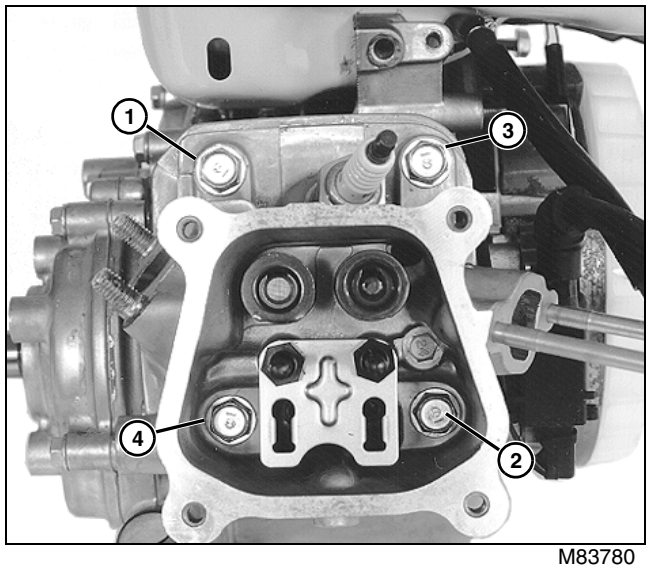
11. Disassemble and inspect cylinder head and valves. (See “Cylinder Head and Valves Inspection” on page 57.)

Installation

Installation is done in the reverse order of removal.

- Use new gaskets for installation.

IMPORTANT: Avoid damage! Torque should be applied in the sequence shown, in increments.



M83780

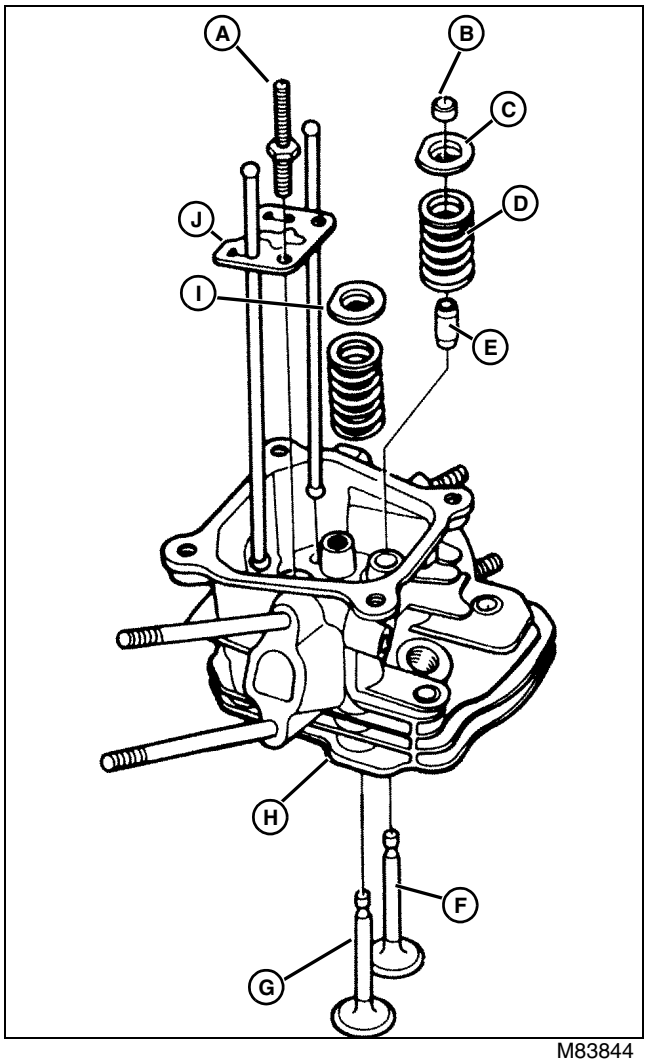
- Tighten cap screws in sequence shown to initial torque. Finish tightening cylinder head to final torque.

- Adjust valve clearance. (See “Valve Clearance Check and Adjustment” on page 38.)

Specifications

Cylinder Head Cap Screw
Initial Torque . . . . . 12 N•m (102 lb-in.)
Cylinder Head Cap Screw
Final Torque . . . . . 24 N•m (204 lb-in.)

Cylinder Head and Valves Disassembly and Assembly



M83844

A - Rocker Arm Pivot Bolt (2 used)
B - Valve Rotator (Exhaust Valve Only)
C - Retainer (Exhaust)
D - Valve Spring (2 used)
E - Valve Guide (2 used)
F - Exhaust Valve
G - Intake Valve
H - Cylinder Head
I - Retainer (Intake)
J - Push Rod Guide

- Inspect all parts for wear or damage. (See "Cylinder Head and Valves Inspection" on page 57.)

IMPORTANT: Avoid damage! If valve rotator is not installed, exhaust valve may drop into cylinder when engine is started.

- Apply a light coat of clean engine oil to intake and exhaust valve stems during assembly.
- Tighten rocker arm pivot cap screws to specification.

Specifications

Rocker Arm Pivot Cap
Screw Torque . . . . . 24 N•m (204 lb-in.)

Cylinder Head and Valves Inspection

Other Material

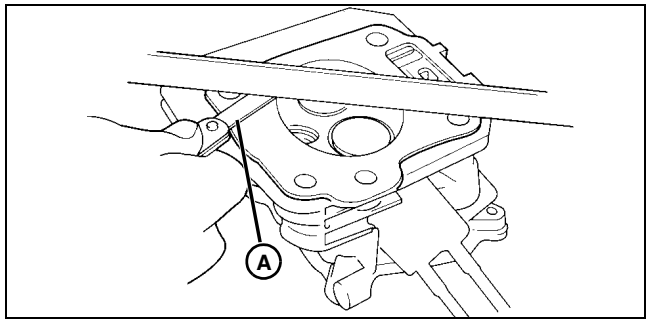
Part No.	Part Name	Part Use
NA	SCOTCH-BRITE™ Abrasive Sheet/Pad	Clean cylinder head.

Cylinder Head

1. Remove carbon deposits from combustion chamber using SCOTCH-BRITE abrasive pads or an equivalent.

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

2. Clean head with a suitable solvent and dry with compressed air.
3. Inspect head for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.

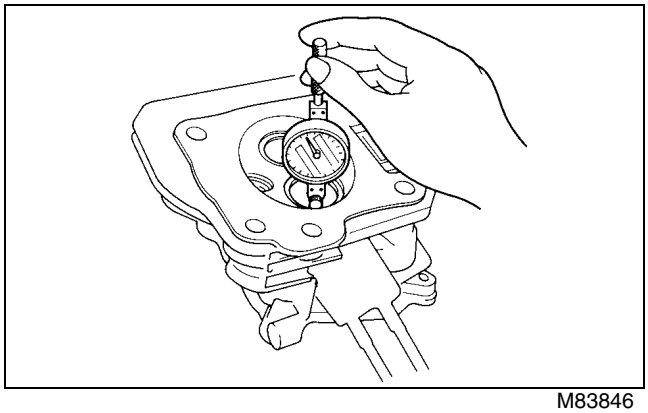


M83845

5. Use a straightedge and feeler gauge (A) to check head for distortion at several points around head. Replace head if distortion is greater than specification.

Valve Guides

1. Clean inside of valve guides with a valve guide cleaner.



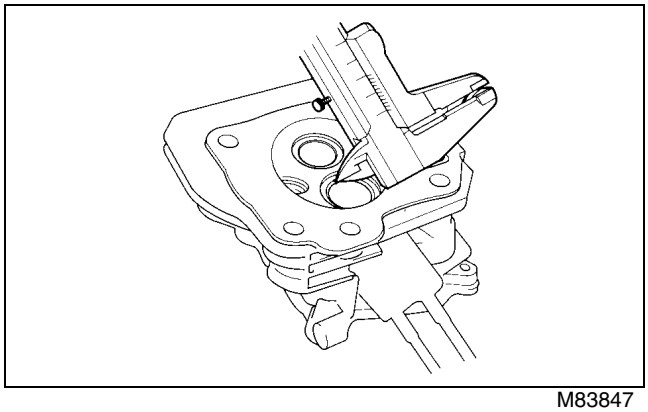
M83846

2. Measure inside diameter of valve guides. Compare valve guide measurement to specification. Replace valve guides if inside diameter is greater than wear limit. (See “Valve Guide Replacement” on page 59.)

3. Subtract the outside diameter of the valve stems from inside diameter of valve guides to determine guide-to-stem clearance.

4. If guide-to-stem clearance exceeds wear limit, determine if new guides would bring clearance within specifications. If so, replace guides. (See “Valve Guide Replacement” on page 59.) If guide-to-stem clearance would still exceed wear limit, replace both guides and valves.

Valve Seats

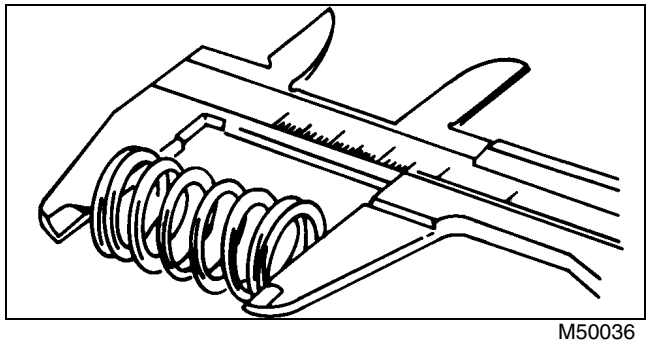


M83847

Measure valve seat width. Recondition valve seat if measurement is less than minimum specification or greater than maximum specification.

Valve Springs

1. Inspect springs for pitting, rust and burrs. Replace if necessary.



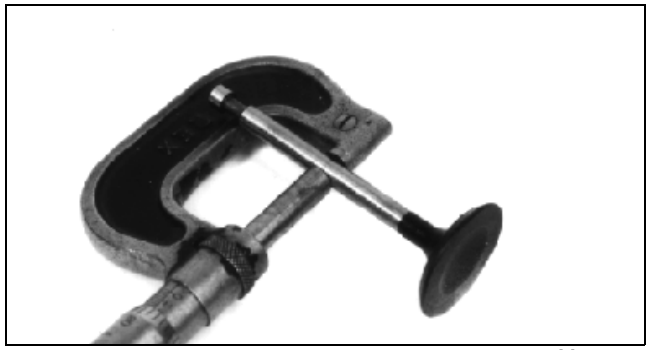
M50036

2. Measure spring free length. Replace spring if measurement is less than specification.

Intake and Exhaust Valves

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

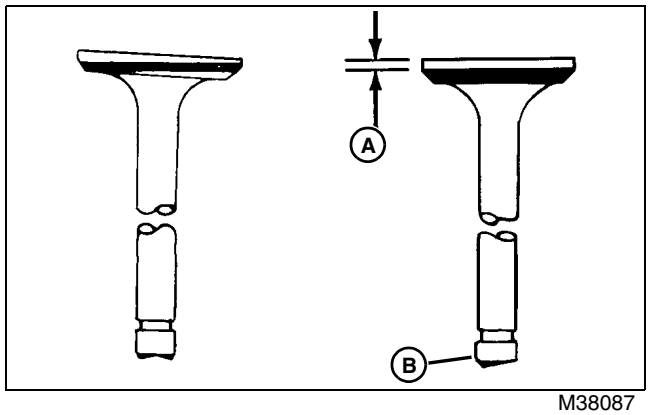
2. Inspect valve head, face and stem for defects. Replace if necessary.



M53961

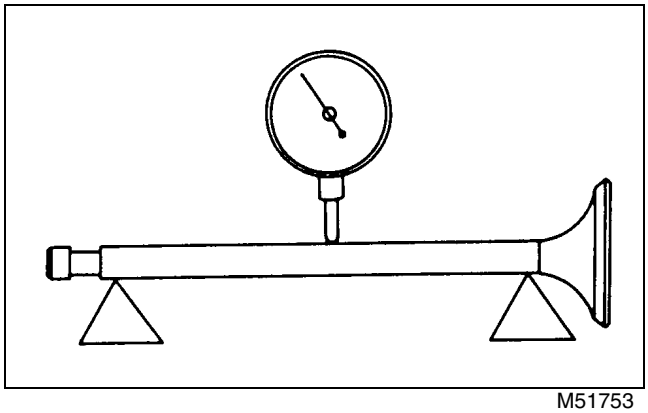
3. Measure outside diameter of intake valve stem. Replace if diameter is less than specification.

4. Measure outside diameter of exhaust valve stem. Replace if diameter is less than specification.



M38087

5. Replace warped valves or valves with a valve face margin (A) less than specification. Valve stem ends (B) should be ground square before checking valve-to-tappet clearance.



M51753

6. Check valve stem for bends using V-blocks and a dial indicator. Turn valve slowly and read variation on indicator. Replace valve if out-of-round is greater than specification.

Specifications

Cylinder Head Out-of-Flat (Max). . . . . 0.10 mm (0.004 in.)

Valve Guide ID. . . . . 5.50 mm (0.217 in.)
Valve Guide ID Wear Limit . . . . . 5.572 mm (0.2194 in.)

Intake Guide-to-Stem Clearance

Standard . . . . . 0.02-0.044 mm (0.0008-0.0017 in.)
Wear Limit . . . . . 0.10 mm (0.004 in.)

Exhaust Guide-to-Stem Clearance

Standard . . . . . 0.06-0.087 mm (0.0024-0.0034 in.)
Wear Limit . . . . . 0.12 mm (0.005 in.)

Valve Seat Width (Min) . . . . . 0.8 mm (0.03 in.)
Valve Seat Width (Max) . . . . . 2.0 mm (0.08 in.)
Valve Spring Free Length (Min) . . . . . 29.5 mm (1.16 in.)
Intake Valve Stem OD (Min) . . . . . 5.318 mm (0.2094 in.)
Exhaust Valve Stem OD (Min). . . . . 5.275 mm (0.2077 in.)
Valve Face Margin (Min). . . . . 0.60 mm (0.024 in.)
Valve Stem Out-of-Round (Max) . . . . . 0.03 mm (0.001 in.)

Valve Guide Replacement

Special or Required Tools

Tool Name	Tool No.	Tool Use
5.5 mm Valve Guide Driver	JDG504	Used to remove and install valve guides.
5.5 mm Valve Guide Reamer	JDG1023	Used to ream valve guides.

Other Material

Part No.	Part Name	Part Use
NA	Stanisol (or Kerosene)	Finish ream valve guides.

Procedure

1. Disassemble and thoroughly clean the cylinder head. (See “Cylinder Head and Valves Disassembly and Assembly” on page 57.)

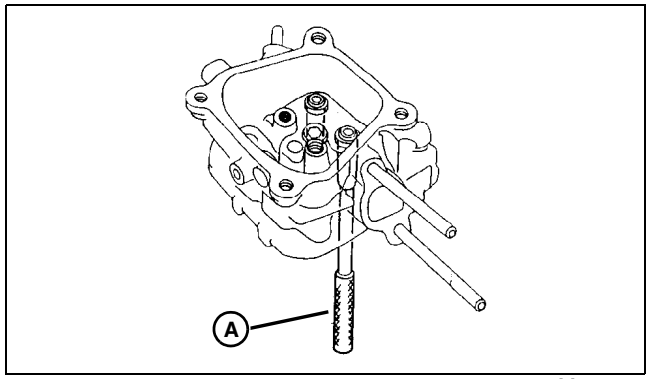
2. Chill the replacement valve guides in a freezer for about one hour prior to installation.

CAUTION: Avoid injury! To prevent possible burns, use heavy gloves when handling hot cylinder head.

IMPORTANT: Avoid damage! DO NOT heat cylinder head over 150°C (300°F). Excessive heat may loosen valve seats.

3. Using an oven, heat cylinder head to 150° C (300° F).

4. Remove cylinder head from oven and place on wood blocks with combustion chamber side up.

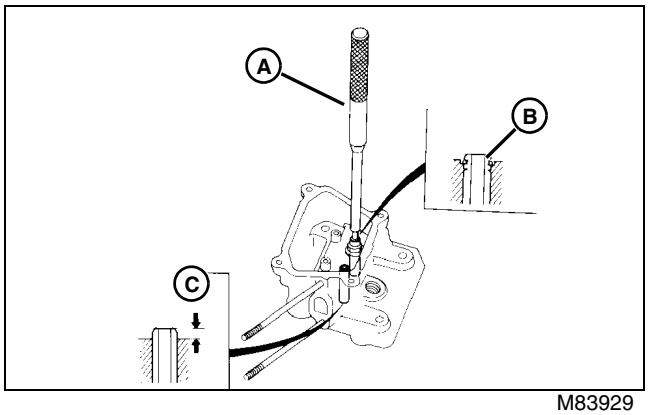


M83931

5. Using a JDG504 5.5 mm Valve Guide Driver (A), drive valve guides out from combustion chamber side.

6. Flip the cylinder head over (combustion chamber side down) and place on a flat, firm surface.

7. Remove valve guides from freezer as needed.

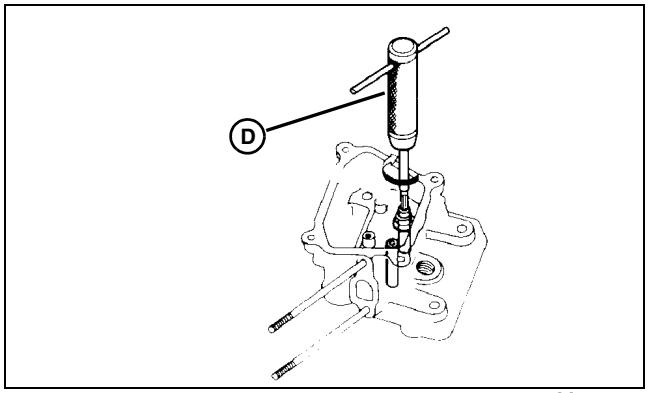


M83929

8. Install valve guides using a JDG504 Valve Guide Driver (A):

- Exhaust guide is correctly installed when clip (B) is fully seated against cylinder head casting.
- Install intake guide to specified depth (C) relative to cylinder head casting.

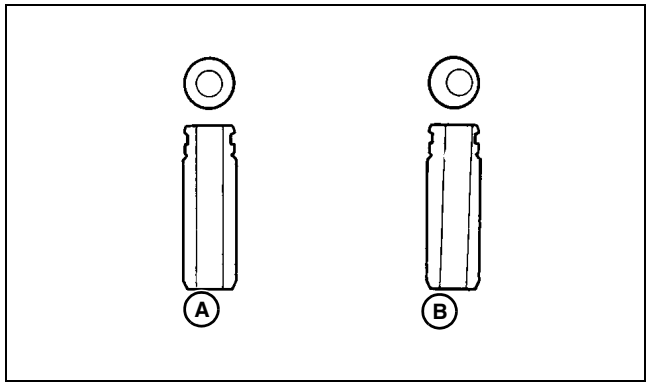
IMPORTANT: Avoid damage! Allow the cylinder head to cool to room temperature before reaming valve guides.



M83930

9. Coat JDG1023 5.5 mm Valve Guide Reamer (D) and valve guides with Stanisol or kerosene lubricant.

10.Rotate reamer clockwise through the valve guide. Continue rotating reamer while removing it from the valve guide.



M83914

A - Acceptable

B - Not Acceptable

11.Thoroughly clean cylinder head to remove any cutting residue.

12.Inspect valve guide bore; it should be straight, round and centered in the valve guide.

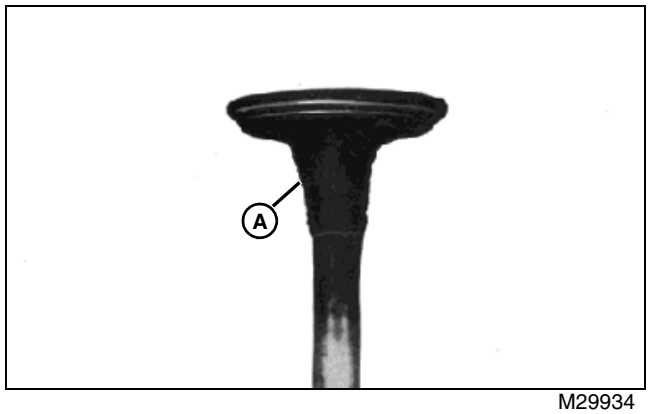
13.Insert valve and check operation. Valve should move smoothly in guide. If valve does not move smoothly, the guide may have been damaged during installation. Replace valve guide if necessary.

14.Recheck valve-to-guide clearance. (See “Cylinder Head and Valves Inspection” on page 57.)

Specifications

Valve Guide Installed Depth (Valve Guide Top-to-Cylinder Head Casting) . . . . . 3.0 mm (0.12 in.)

Analyze Valves



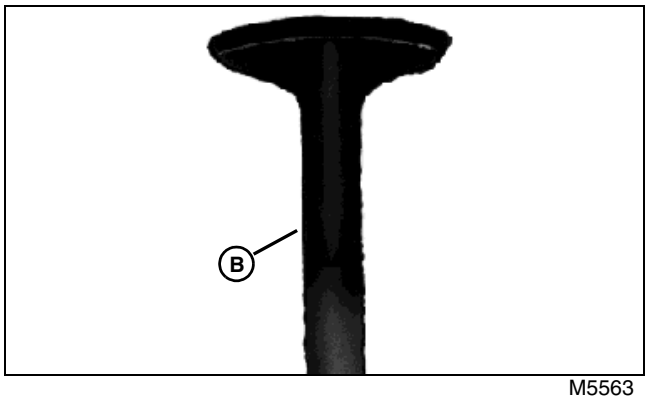
M29934

Lead deposits (A) on the intake valve are caused by exhaust gas leakage past the valve. This indicates that the valve is not seating properly.

IMPORTANT: Avoid damage! DO NOT grind the exhaust valve or valve life will be shortened.

Lap the valves after resurfacing the seat to correct this condition.

NOTE: Be sure to reset valve-to-tappet clearance after grinding valve seats.

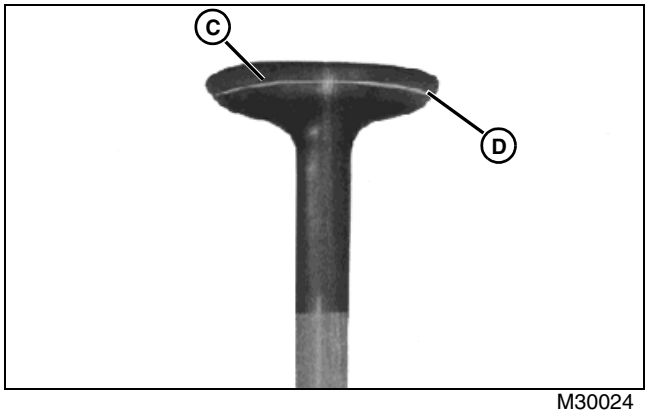


M5563

Valve stem corrosion (B) is caused by moisture in the engine. Moisture in the fuel/air mixture can condense inside the engine when the engine is stopped and cools down.

Valve corrosion can also occur during storage. Fogging or pouring oil in the combustion chamber before storing helps prevent valve corrosion.

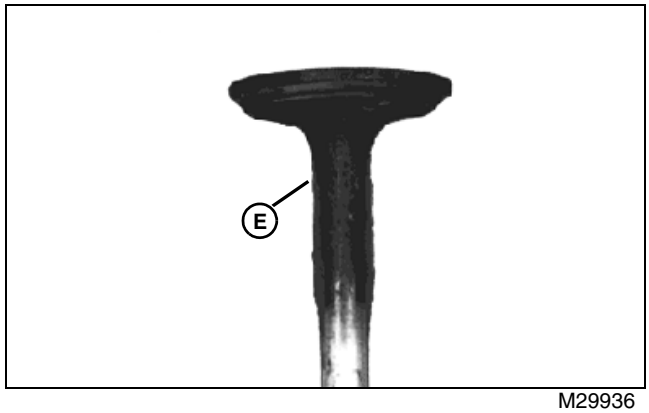
Corroded or pitted valves collect deposits and may cause sticking valves. Replace badly corroded or pitted valves.



M30024

Exhaust valves are designed to function in temperatures exceeding 2760°C (5000°F). However, when operating at high temperatures for long periods of time, valve burning may occur. Valves running too hot will show a dark discoloration of the valve stem into the area protected by the valve guide. Another indication is distortion of the valve margin (C) and valve face (D). Valve seat inserts may also begin to burn away.

Other causes for valves running hot are worn valve guides or valve springs, incorrect valve clearance, lean fuel-air mixture, and incorrect or overheated spark plug.



M29936

Using old or stale gasoline is a common cause for sticky valves.

This gummy deposit (E) can be seen on the valve. When this condition exists, the carburetor may also contain gummy deposits and will require cleaning.

Always use fresh gasoline and drain fuel tank, lines and carburetor before storing machine.

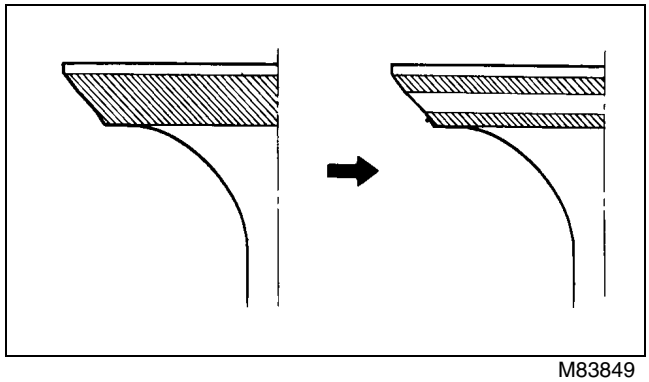
Recondition Valve Seats

Other Material

Part No.	Part Name	Part Use
NA	Prussian Blue Compound	Check valve seat contact.

1. Throughly clean the combustion chamber and valve seats to remove carbon deposits.

2. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.



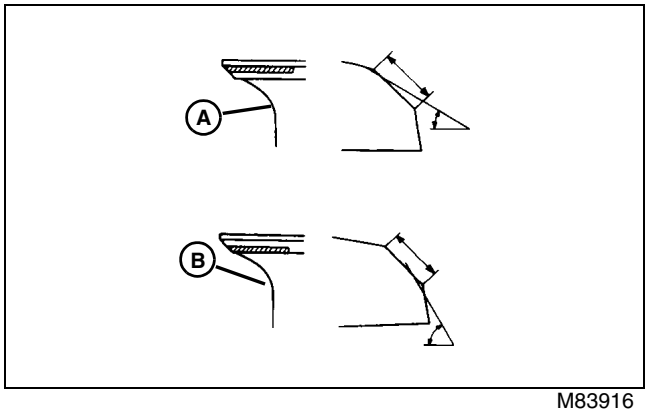
M83849

3. Apply a light coat of Prussian Blue or erasable felt-tipped marker ink to valve face.

4. Insert valve and snap it closed against seat several times. DO NOT rotate valve. Transferred marking compound will show any area that is not concentric.

IMPORTANT: Avoid damage! Turn cutter clockwise; DO NOT turn counterclockwise. Continue to turn cutter as you lift it off the valve seat.

5. To recondition seat, cut at a 45° angle to clean up seat.



M83916

A - Contact too High

B - Contact too Low

6. Use 30° or 60° cutters to narrow and adjust valve seats so that valve makes contact with the middle of the valve face.

- Use 30° cutter to remove material from top edge of seat (contact too high).
- Use 60° cutter to remove material from bottom edge of seat (contact too low).

7. Check valve seat width. If necessary, use a 45° cutter to adjust seat width.

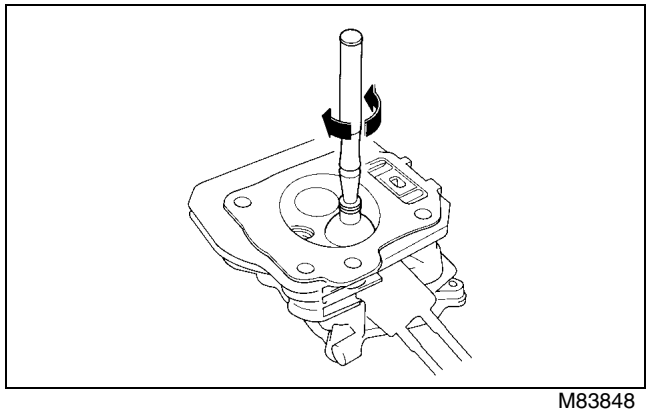
Lap Valves

Other Material

Part No.	Part Name	Part Use
NA	Lapping Compound	Lap valves into valve seats.

If valve seat does not make proper contact, lap the valve into the seat:

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



M83848

2. Grip head of valve with a vacuum cup tool and turn valve to lap valve to seat.

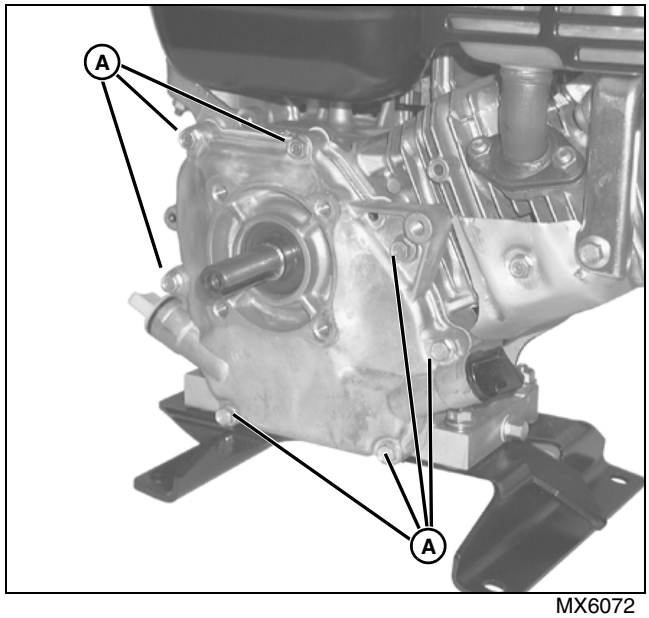
3. Lift valve from seat every 8 to 10 strokes. Lap until a uniform ring appears around the surface of the valve face.

4. Wash all parts in solvent to remove lapping compound. Dry parts.

5. Check position of lap mark on valve face. Lap mark must be on or near the center of valve face.

Crankcase Cover Removal and Installation

1. Remove drain plug and drain oil from crankcase into container of sufficient size to hold capacity.



MX6072

2. Remove seven cap screws (A) and crankcase cover.

Installation

Installation is done in the reverse order of removal.

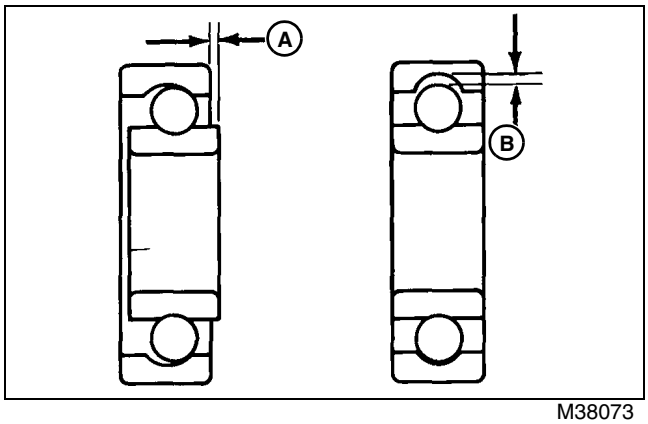
- Remove gasket material from mating surfaces before installation.
- Use new gasket for installation.
- Make sure two alignment pins are installed between engine and crankcase cover.
- Tighten cap screws to specification.

Specifications

Crankcase Capacity (Approx) . . . . . 0.6 L (0.63 qt)
Crankcase Cover Cap Screw Torque . . . . . 12 N•m (108 lb-in.)

Bearing and Oil Seal Replacement

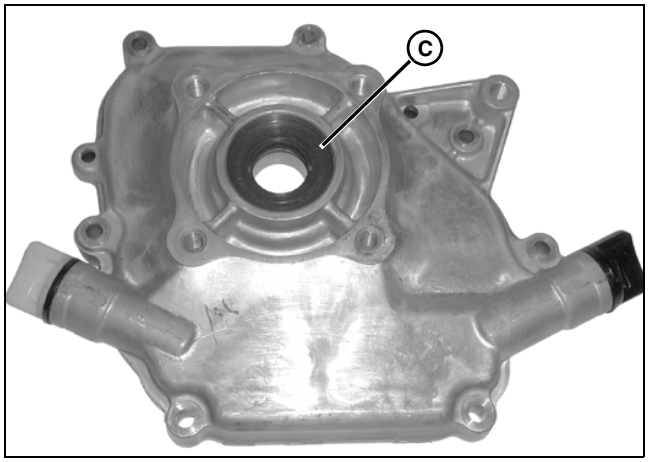
NOTE: Remove bearing only if replacement is required.

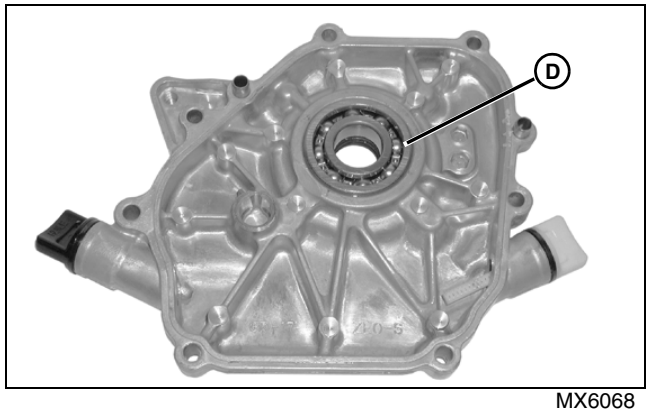


M38073

A - Axial Free Play
B - Radial Free Play

1. Spin bearing by hand and check for axial and/or radial free play. Replace bearing if it has excessive play or is noisy.



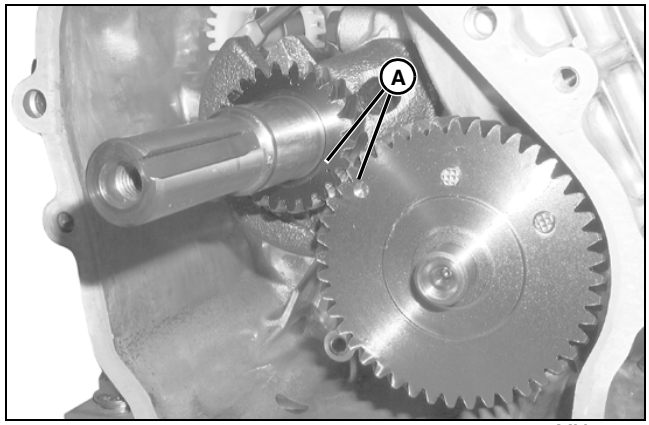


MX6068

2. Remove oil seal (C).
3. Drive bearing (D) out by using a driver set.
4. Apply a light coat of clean engine oil to bearing outer race.
5. Install bearing using driver set until fully seated against housing.
6. Install new oil seal.

Camshaft and Tappets Removal and Installation

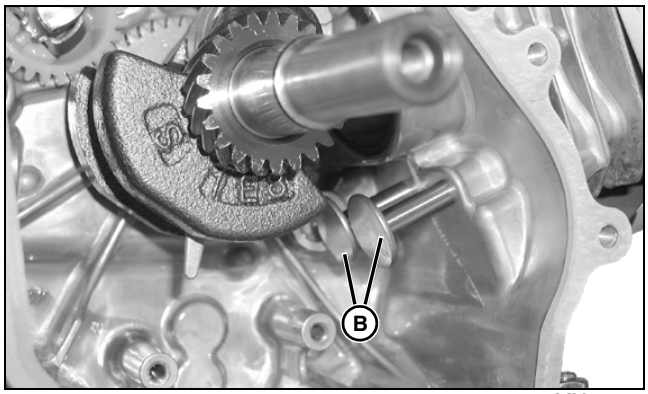
1. Remove cylinder head. (See “Cylinder Head and Valves Removal and Installation” on page 56.)
2. Remove crankcase cover. (See “Crankcase Cover Removal and Installation” on page 62.)



MX6069

3. Rotate camshaft until timing marks (A) align.
4. Remove and inspect camshaft. (See “Camshaft and Tappets Inspection” on page 64.)

IMPORTANT: Avoid damage! Tappets must be installed in the same bores from which they were removed.



MX6070

5. Mark each tappet (B) to aid in installation.

6. Remove and inspect tappets for wear or damage. Replace if necessary.

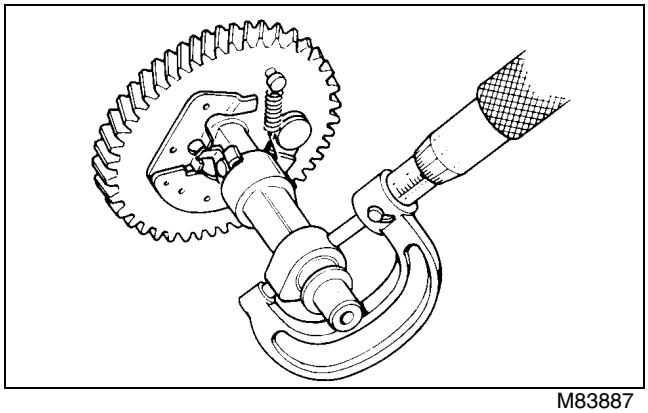
Installation

Installation is done in the reverse order of removal.

- Apply a light coat of clean engine oil to tappets and bores and install tappets in original bores.
- Apply a light coat of clean engine oil to camshaft lobes and journals.
- Align timing marks when installing camshaft.

Camshaft and Tappets Inspection

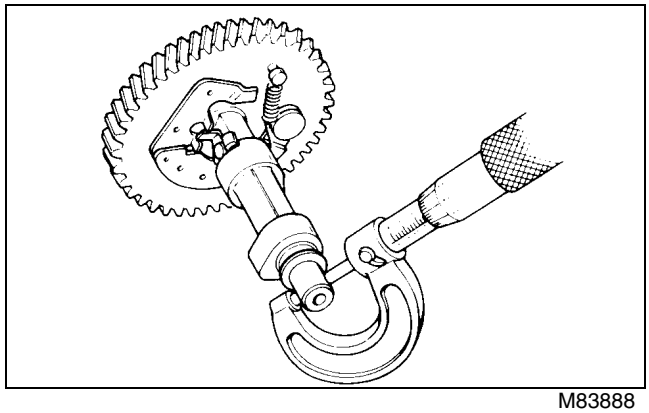
1. Inspect camshaft for wear or damage. Replace if necessary.



M83887

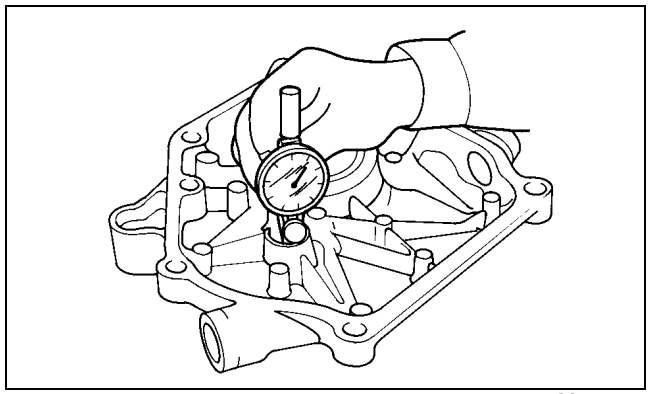
2. Measure cam intake lobe height. Replace camshaft if lobe height is less than specification.

3. Measure cam exhaust lobe height. Replace camshaft if lobe height is less than specification.



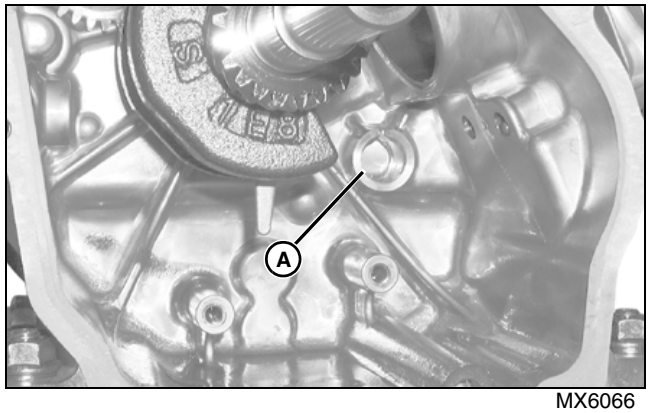
M83888

4. Measure flywheel side journal and PTO side journal diameter. Replace camshaft if either journal diameter is less than specification.



M83889

5. Measure inside diameter of camshaft holder in crankcase cover. Replace crankcase cover if diameter is greater than specification.



MX6066

6. Measure inside diameter of camshaft holder (A) in block. Replace block if diameter is greater than specification.

Specifications

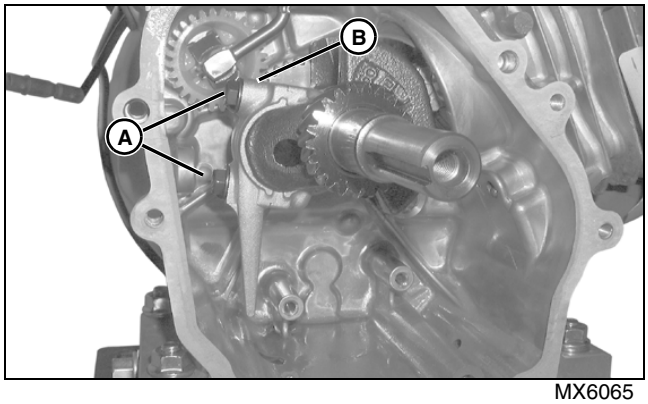
Cam Intake Lobe
Height (Min). . . . . 27.45 mm (1.081 in.)
Cam Exhaust Lobe
Height (Min). . . . . 27.75 mm (1.083 in.)
Flywheel Side Journal
Diameter (Min). . . . . 13.916 mm (0.5479 in.)
PTO Side Journal
Diameter (Min). . . . . 13.916 mm (0.5479 in.)
Camshaft Holder ID (Max) . . . . . 14.048 mm (0.5531 in.)

Piston and Connecting Rod Removal

1. Remove camshaft and tappets. (See “Camshaft and Tappets Removal and Installation” on page 63.)

2. Check cylinder bore for carbon and varnish ridges. These ridges can cause piston damage if not removed.

3. If necessary, remove ridge from top of cylinder bore using a ridge reamer.



MX6065

4. Turn crankshaft to expose connecting rod end cap (B).

5. Remove cap screws (A) and connecting rod cap.

6. Push piston and connecting rod assembly from cylinder bore.

7. Disassemble and inspect all parts for wear or damage. (See “Piston and Connecting Rod Disassembly” on page 66. See “Piston and Connecting Rod Inspection” on page 67.)

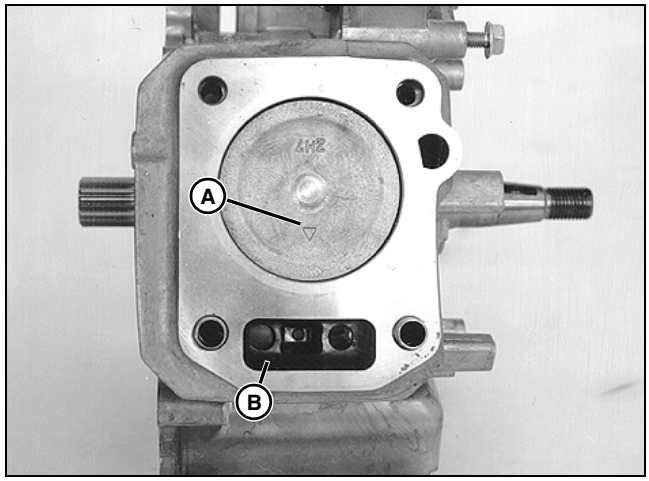
Piston and Connecting Rod Installation

1. Deglaze cylinder bore. (See “Deglaze Cylinder Bore” on page 76.)

2. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.

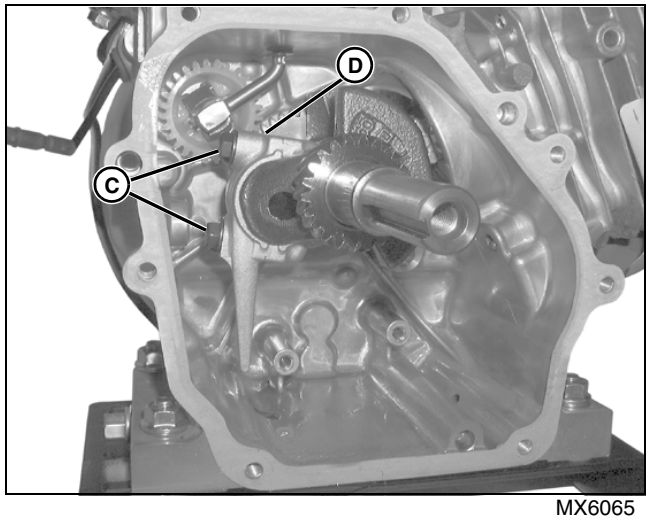
3. Apply a light coat of clean engine oil to piston and rings. Compress rings with a ring compressor.

4. Apply a light coat of clean engine oil to cylinder bore, connecting rod bearing surface and ring compressor.



M83824

5. Install piston and connecting rod assembly in cylinder bore with triangle mark (A) on piston facing the push rod opening (B).



MX6065

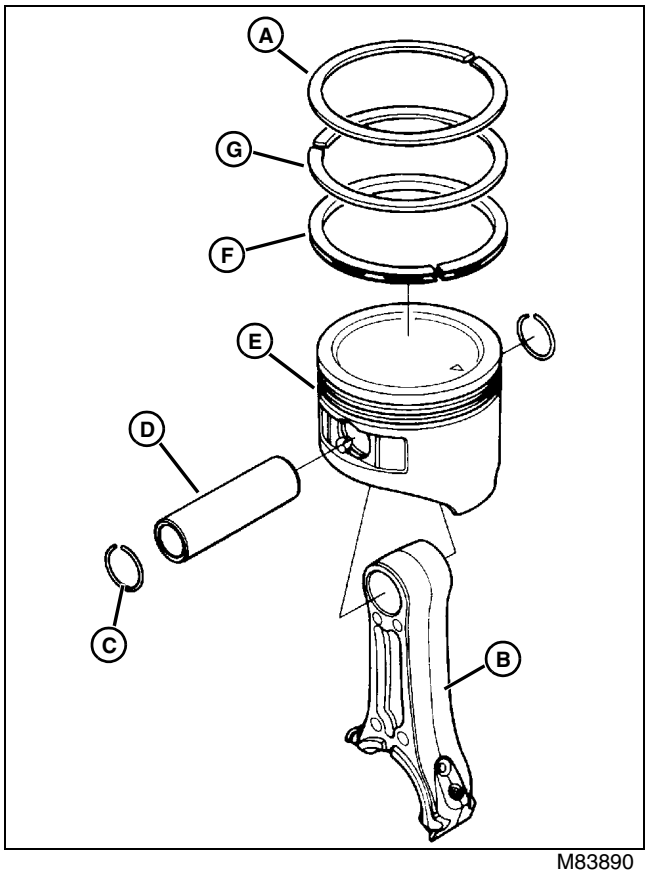
6. Install connecting rod cap (D) with dipper toward camshaft and ribs on cap and connecting rod aligned. Tighten cap screws (C) to specification.

7. Install camshaft and tappets, crankcase cover and cylinder head.

Specifications

Connecting Rod Cap
Cap Screw Torque . . . . . 12 N•m (108 lb-in.)

Piston and Connecting Rod Disassembly



M83890

A - 1st Compression Ring
B - Connecting Rod
C - Retaining Ring (2 used)
D - Piston Pin
E - Piston
F - Oil Control Ring
G - 2nd Compression Ring

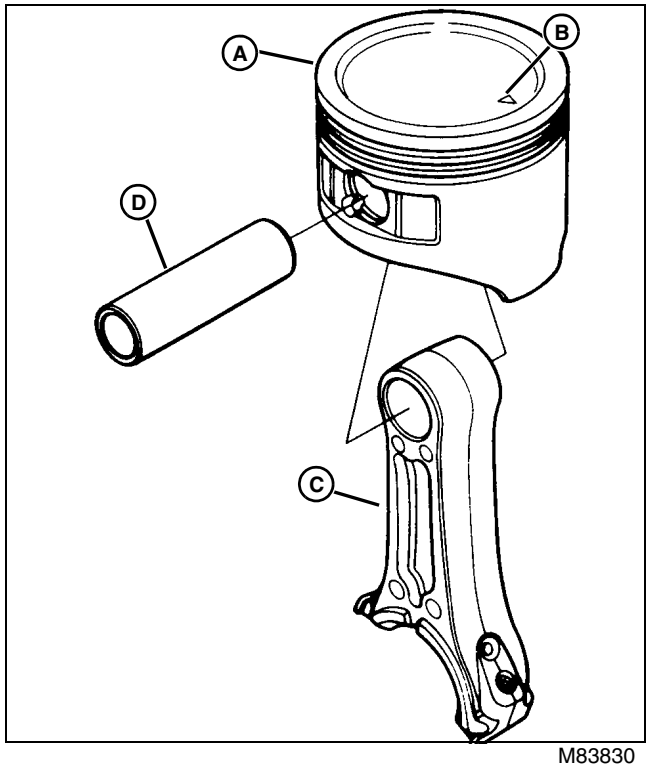
- Analyze piston and piston ring wear. (See “Analyze Piston Ring Wear” on page 71. See “Analyze Piston Wear” on page 72.)
- Remove piston rings using a piston ring expander.

IMPORTANT: Avoid damage! DO NOT reuse piston pin retaining rings. Always use new retaining rings for assembly.

- Inspect all parts for wear or damage. (See “Piston and Connecting Rod Inspection” on page 67.)

Piston and Connecting Rod Assembly

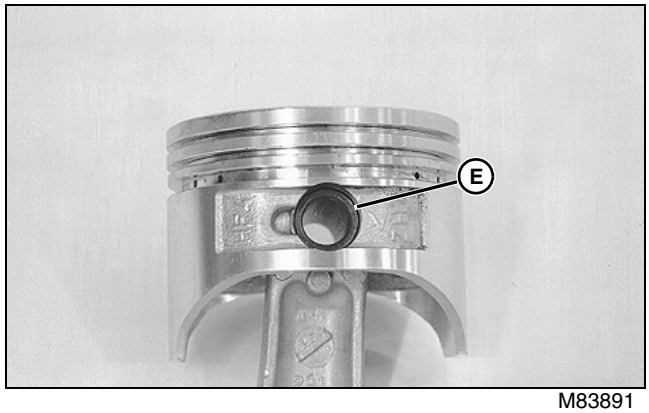
IMPORTANT: Avoid damage! DO NOT reuse piston pin retaining rings.



M83830

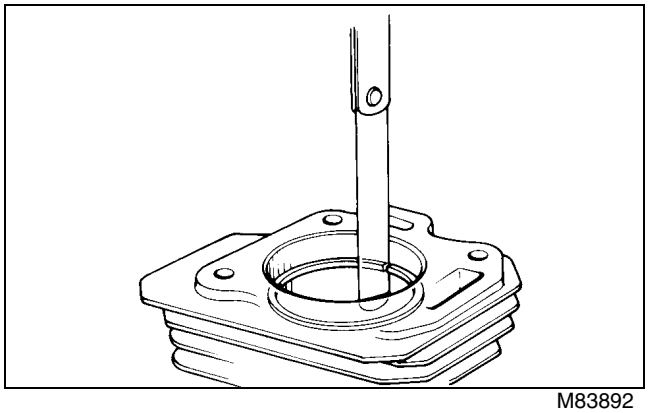
1. Install connecting rod (C) to piston (A) with long end of connecting rod toward triangle mark (B) on piston.
2. Apply a light coat of clean engine oil to piston pin (D) and connecting rod bearing.
3. Install piston pin.

IMPORTANT: Avoid damage! DO NOT align retaining ring gap with cutout in piston pin bore.



M83891

4. Install retaining ring (E) on each side by inserting one end in groove, and holding other end with a needle-nosed pliers, rotate the ring into place.



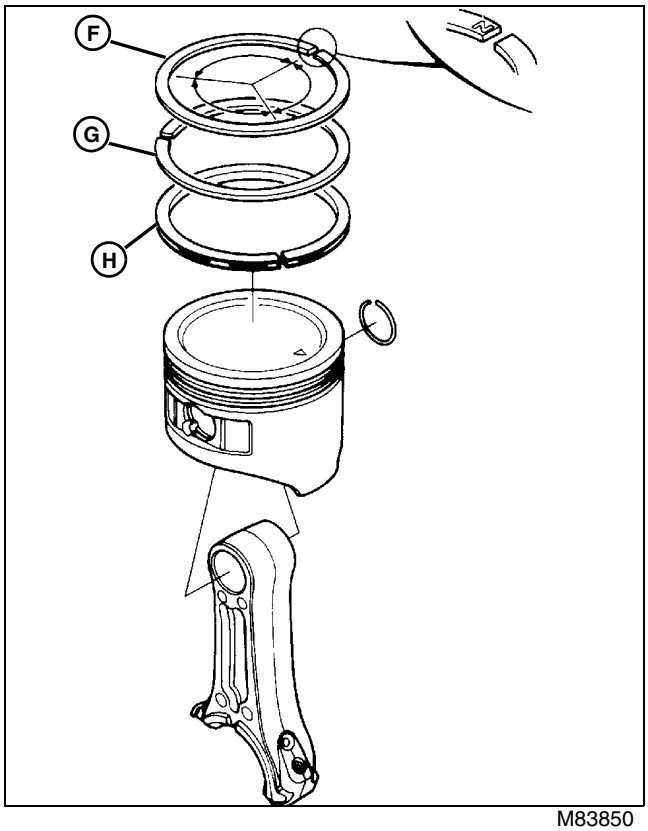
M83892

5. Before installing rings on piston, check ring end gap in cylinder bore. (See “Check Piston Ring End Gap” on page 71.)

IMPORTANT: Avoid damage! Install all rings with marking facing up.

Be sure that top and second compression rings are not interchanged.

DO NOT align any piston ring end gaps with piston pin bore.



M83850

6. Install oil control and compression rings:

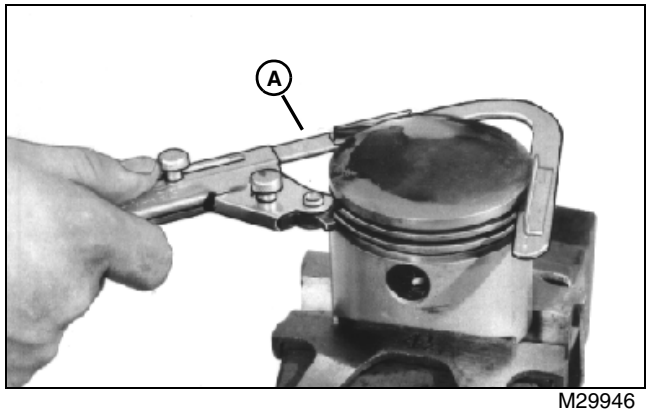
- Install oil control ring (H) in bottom groove with mark facing up. Position end gap approximately 45° away from triangle mark.
- Install 2nd compression ring (G) in middle grove with mark facing up. Position end gap approximately 120° away from end gap of oil control ring.
- Install 1st compression ring (chrome plated) (F) in top grove with mark facing up. Position end gap approximately 120° away from end gap of 2nd compression ring.

Piston and Connecting Rod Inspection

Piston

IMPORTANT: Avoid damage! DO NOT use a caustic cleaning solution or a wire brush to clean piston.

1. Remove all deposits from piston.

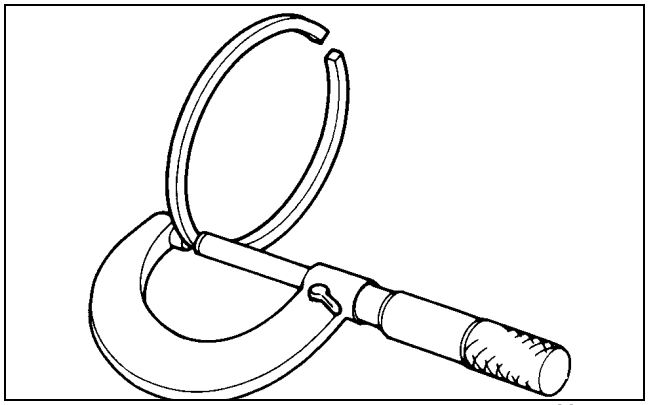


M29946

2. Clean carbon deposits from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it to carefully clean groove.

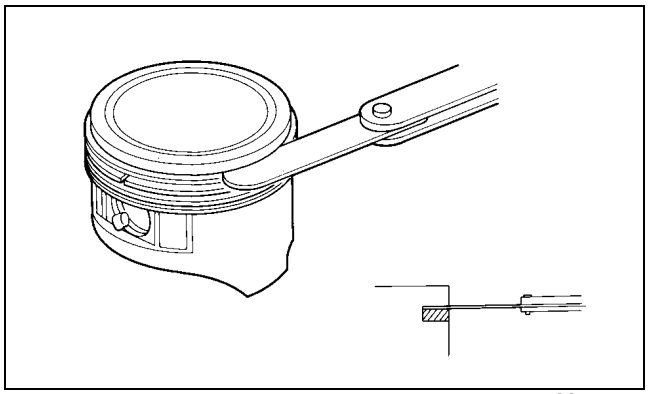
3. Check that all oil return passages in grooves are open.

4. Inspect piston for scoring or fractures. Replace piston if damaged.

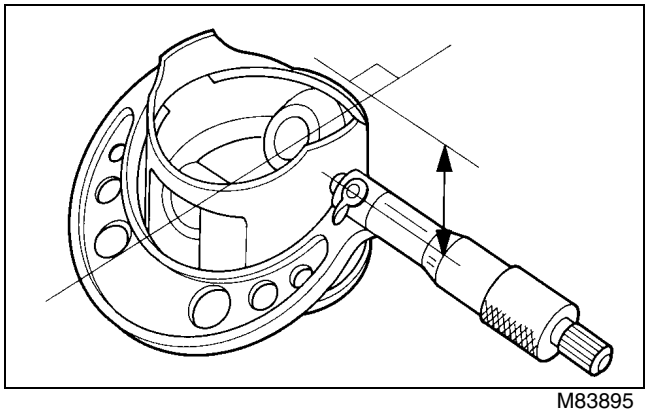

M83893

5. Measure 1st and 2nd compression ring thicknesses. Replace ring if measurement is less than specification.

6. Measure oil control ring thickness. Replace ring if measurement is less than specification.


M83894

7. Using new rings, check piston ring-to-groove clearance at several points around piston. Replace piston if any clearance is greater than specification.

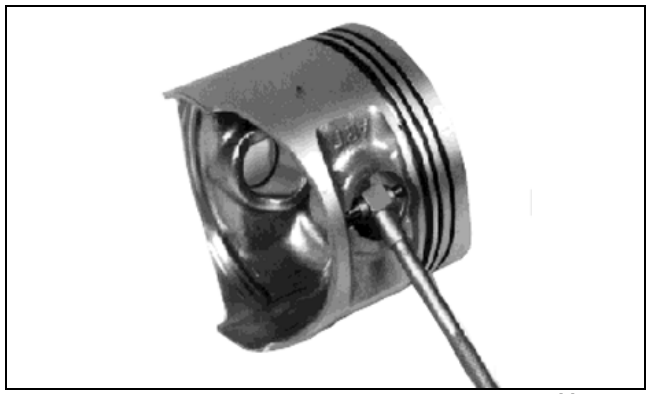

M83895

8. Measure piston outside diameter at a point 10 mm (0.4 in.) from the bottom of the skirt and 90° to the piston pin bore. Replace piston if outside diameter measures less than specifications.

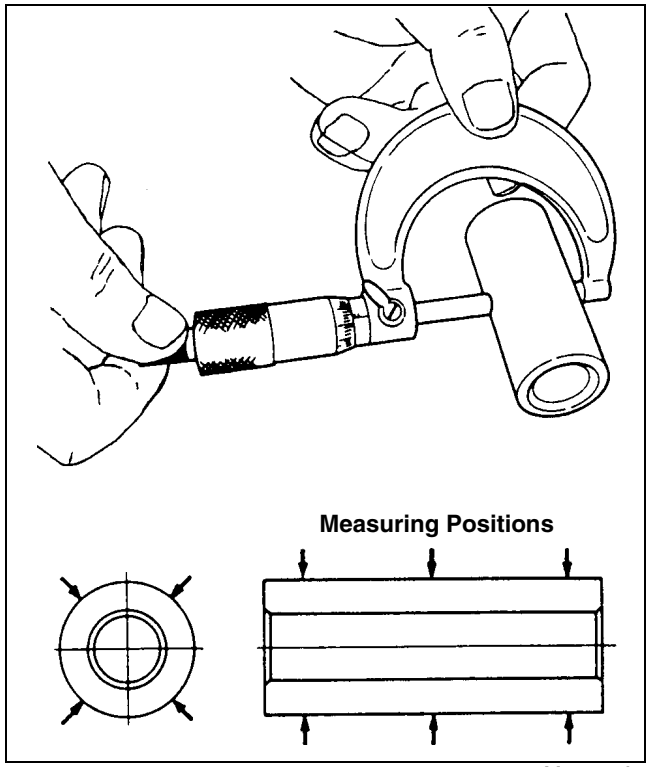
9. Measure cylinder bore diameter. (See “Cylinder Block Inspection” on page 75.)

10.Subtract piston outside diameter measurement from cylinder bore measurement to determine piston-to-cylinder bore clearance.

11.Replace piston and/or rebore cylinder block if clearance is greater than specification. (See “Rebore Cylinder Block” on page 77.)


M80427

12.Measure piston pin bore diameter in piston. Replace piston if measurement is greater than specification.



M82050A

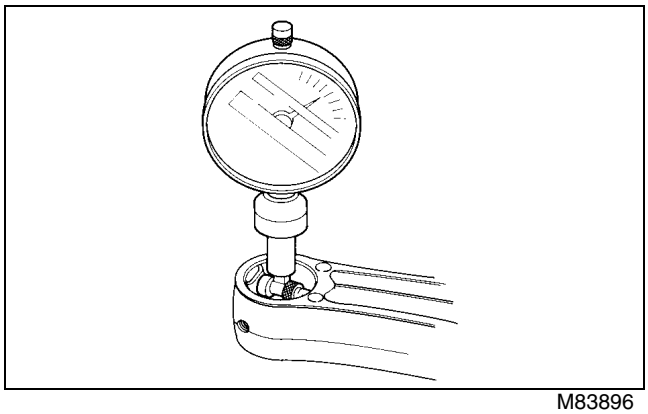
13.Measure piston pin diameter at six places. Replace pin if any measurement is less than specification.

14.Subtract piston pin outside diameter measurement from piston pin bore measurement to determine piston pin-to-bore clearance. Replace piston pin and/or piston if clearance is greater than specification.

Connecting Rod

1. Analyze crankshaft and connecting rod wear. (See “Analyze Crankshaft and Connecting Rod Wear” on page 74.)

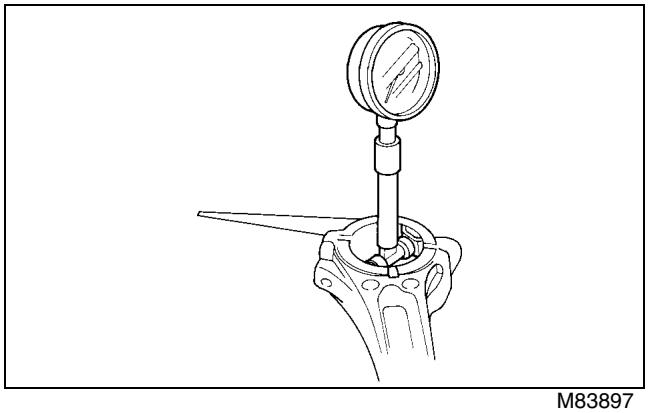
2. Clean and inspect connecting rod. Replace if scored or damaged.



M83896

3. Measure connecting rod piston pin bore. Replace connecting rod if measurement is greater than specification.

NOTE: If the engine has had a previous major overhaul, an undersized connecting rod may have been installed. A 0.25 mm (0.010 in.) undersize connecting rod is available.



M83897

4. Install connecting rod cap. Tighten cap screws to specification.

5. Measure connecting rod crankshaft bearing. Replace connecting rod if measurement is greater than specifications.

Specifications

NOTE: If the engine has had a previous major overhaul, an oversized piston may have been installed. Pistons and rings are available in 0.25 mm (0.010 in.) and 0.50 mm (0.020 in.) oversize.

1st Compression Ring
Thickness (Min) . . . . . 1.37 mm (0.054 in.)
2nd Compression Ring
Thickness (Min) . . . . . 1.37 mm (0.054 in.)
Oil Control Ring
Thickness (Min) . . . . . 2.37 mm (0.093 in.)
Piston Ring-to-Groove
Clearance (Max) . . . . . 0.15 mm (0.006 in.)
Piston-to-Cylinder Bore
Clearance (Max) . . . . . 0.12 mm (0.005 in.)
Piston Pin Bore
Diameter (Max) . . . . . 13.048 mm (0.5137 in.)
Piston Pin
Diameter (Min) . . . . . 12.954 mm (0.5100 in.)
Piston Pin-to-Bore
Clearance (Max) . . . . . 0.08 mm (0.003 in.)
Connecting Rod Piston
Pin Bore Diameter (Max) . . . . . 13.07 mm (0.515 in.)
Connecting Rod Cap
Cap Screw Torque . . . . . 12 N•m (108 lb-in.)

Piston OD Specifications (Wear Limit)

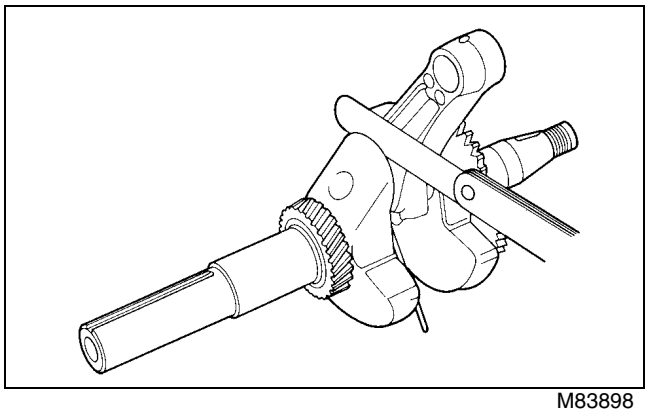
Standard Piston . . . . . 59.845 mm (2.3561 in.)
0.25 mm (0.010 in.)
Oversize Piston . . . . . 60.095 mm (2.3661 in.)
0.50 mm (0.020 in.)
Oversize Piston . . . . . 60.345 mm (2.3761 in.)

Crankshaft Bearing Diameter (Wear Limit)

Standard Crankshaft . . . . . 26.066 mm (1.0262 in.)
0.25 mm (0.010 in.)
Undersize Crankshaft . . . . . 25.816 mm (1.0164 in.)

Check Connecting Rod Side Play

1. Remove crankshaft from cylinder block. (See "Crankshaft Removal and Installation" on page 73.)



M83898

2. Install connecting rod on crankshaft. Tighten connecting rod cap screws to specification.

3. Measure connecting rod side clearance. Replace connecting rod and/or crankshaft if clearance is greater than specification.

Specifications

Connecting Rod Cap Screw Torque . . . . . 12 N•m (108 lb-in.)
Connecting Rod Side Clearance (Max) . . . . . 1.1 mm (0.043 in.)

Check Connecting Rod-to-Crankshaft Clearance

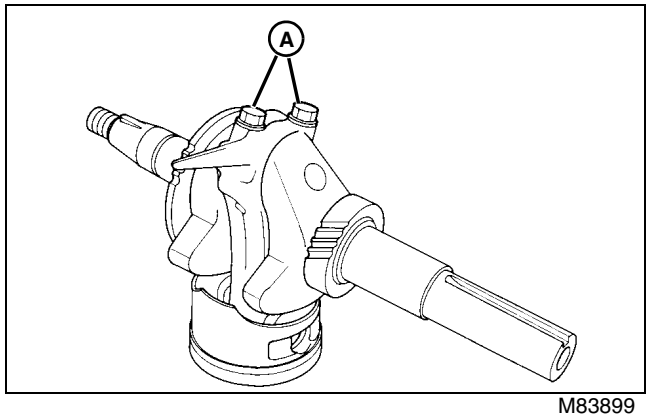
Special or Required Tools

Tool Name	Tool No.	Tool Use
PLASTIGAGE®	NA	Used to check connecting rod-to-crankshaft clearance.

1. Remove crankshaft from cylinder block. (See "Crankshaft Removal and Installation" on page 73.)

2. Clean all oil from crankshaft journal and connecting rod bearing surfaces.

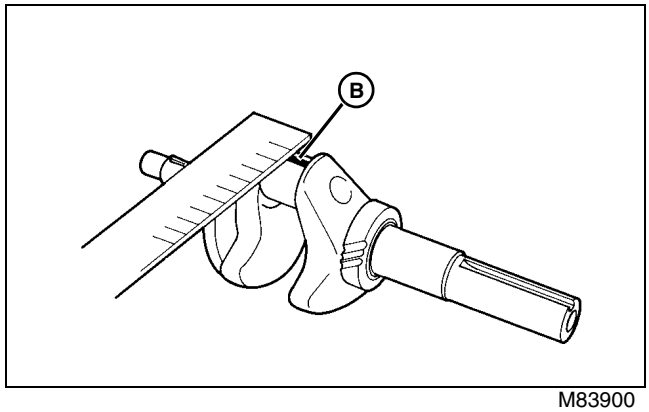
NOTE: DO NOT rotate crankshaft while PLASTIGAGE is in place.



M83899

3. Place a piece of PLASTIGAGE on the crankshaft journal, and install connecting rod and cap. Tighten connecting rod cap screws (A) to specification.

NOTE: If the engine has had a previous major overhaul, an undersized connecting rod may have been installed. A 0.25 mm (0.010 in.) undersize connecting rod is available.



M83900

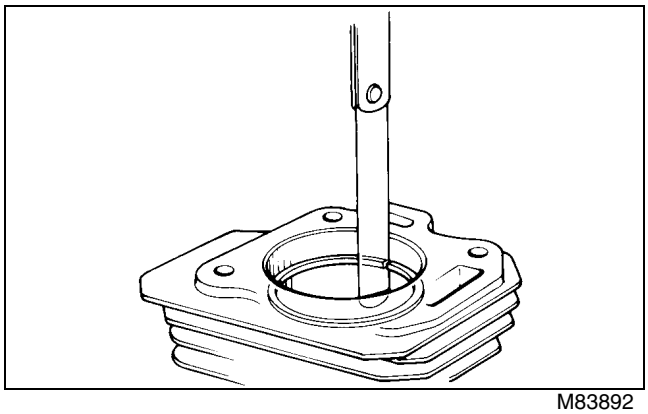
4. Remove cap and measure PLASTIGAGE (B). If clearance is greater than specification, replace connecting rod and recheck clearance.

5. If, after replacing connecting rod, clearance is still beyond specification, replace crankshaft.

Specifications

Connecting Rod Cap Screw Torque . . . . . 12 N•m (108 lb-in.)
Connecting Rod-to-Crankshaft Clearance (Max) . . . . . 0.12 mm (0.005 in.)

Check Piston Ring End Gap



M83892

1. Install each ring squarely in bore approximately 25.4 (1.00 in.) down from top of cylinder.

2. Measure end gap. Replace rings if end gap is greater than specification.

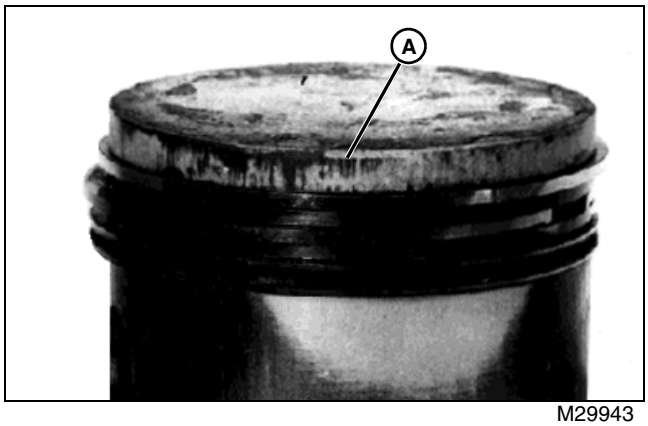
Specifications

Piston Ring End Gap (Max) . . . . . 1.0 mm (0.04 in.)

Analyze Piston Ring Wear

Rings of the wrong size or rings having improper end gaps will not conform to the shape of the cylinder. This results in high oil consumption and excessive blow-by.

Ring end gaps should be staggered on the piston during installation. (See “Piston and Connecting Rod Assembly” on page 66.) End gaps in alignment can also cause oil consumption and blow-by.

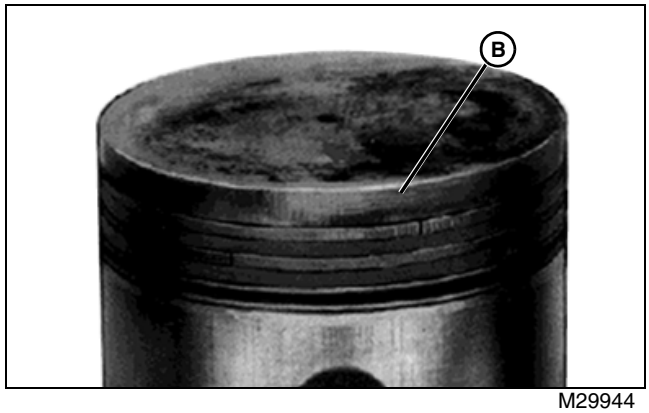


M29943

Light scuffing or scoring (A) of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of the piston.

When this condition exists, it is due to one or more of the following probable causes:

- Dirty cooling shroud and cylinder head.
- Lack of cylinder lubrication.
- Improper combustion.
- Wrong bearing or piston clearance.
- Too much oil in crankcase causing fluid friction.

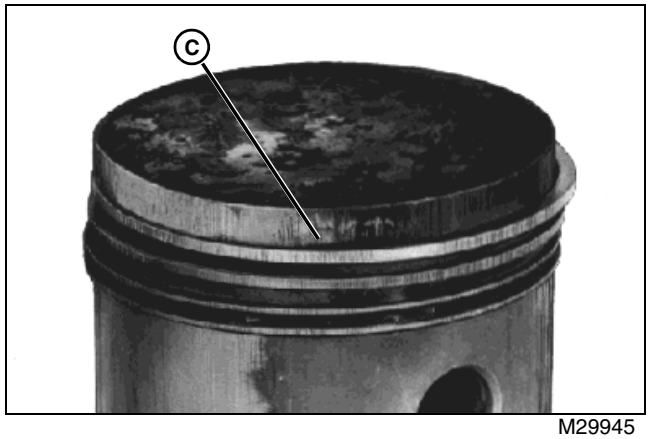


M29944

The engine operating at abnormally high temperature may cause varnish, lacquer or carbon deposits (B) to form in the piston ring grooves making the piston rings stick. When this happens, excessive oil consumption and blow-by will occur.

Engine overheating and ring sticking is usually caused by one or more of the following:

- Overloading.
- Incorrect ignition timing.
- Lean fuel mixture.
- Dirty cooling fins.
- Incorrect oil.
- Low oil supply.
- Stale fuel.

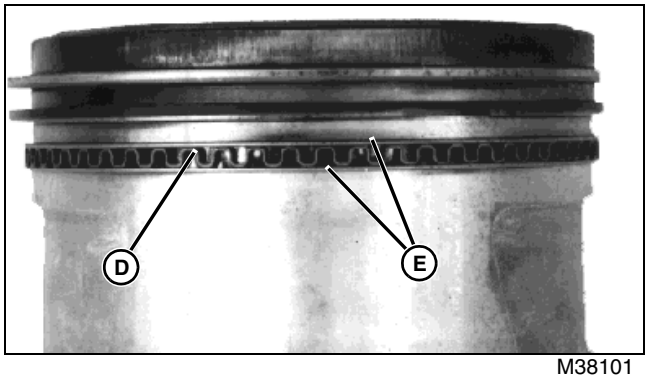


M29945

Vertical scratches (C) across the piston rings are due to an abrasive in the engine. Abrasives may be airborne, may have been left in the engine during overhaul, or may be loose lead or carbon deposits.

When this condition exists, check for one or more of the following:

- Damaged, collapsed or improperly installed air filter.
- Loose connection or damaged basket between air cleaner and carburetor.
- Air leak around carburetor-to-cylinder head gasket.
- Air leak around throttle shaft.
- Failure to properly clean cylinder bore after reconditioning engine.



M38101

Abrasive particles in engine oil cause scratches on side rails (E) of oil control ring. Inner spacer (D) wear or distortion may cause:

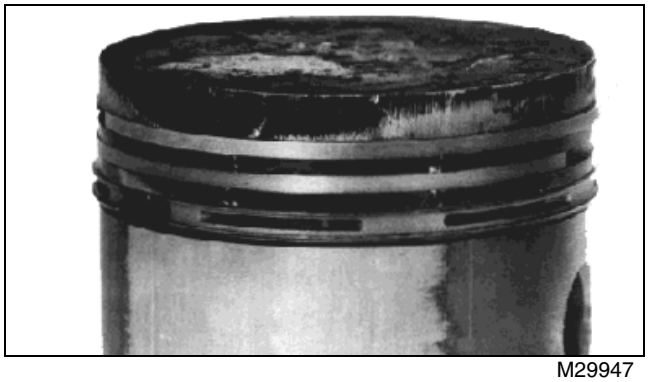
- High oil consumption.
- Increased deposits in combustion chamber.
- Sticking compression rings.

Increased oil consumption may be caused by:

- Worn side rails with low tension.
- Worn or distorted inner spacer.

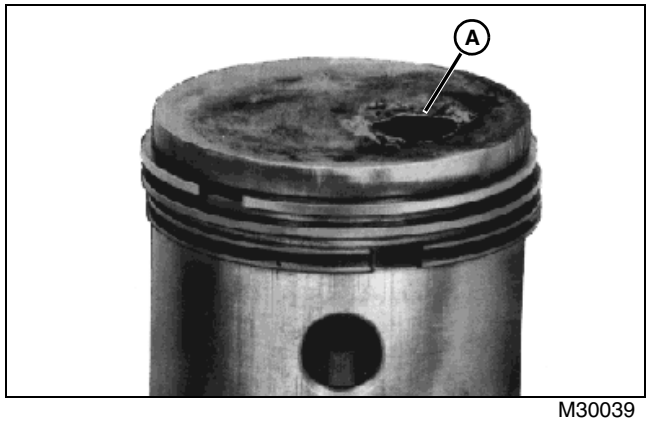
Analyze Piston Wear

Detonation is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called knock, spark knock or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.


M29947

The following is a list of possible causes for detonation.

- Pre-ignition.
- Lean fuel mixture.
- Low octane fuel.
- Advanced ignition timing.
- Engine lugging.
- Build-up of carbon deposits on piston or cylinder head, causing excessive compression.
- Wrong cylinder head or milling of head increasing compression ratio.

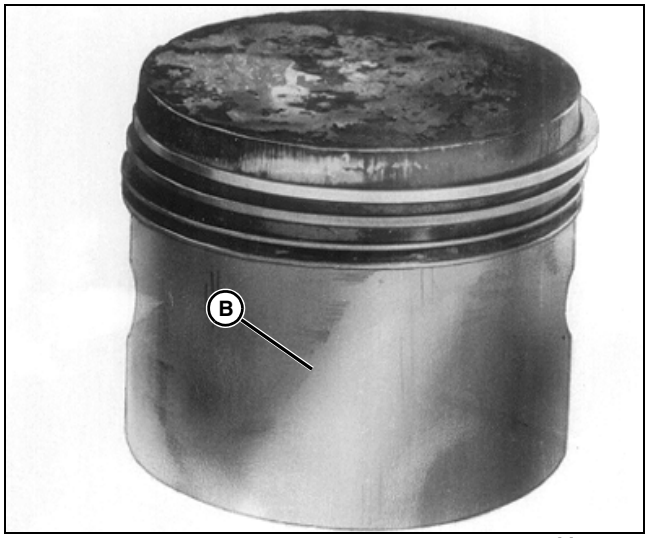


M30039

Pre-ignition is the igniting of the fuel-air mixture prior to regular ignition spark. Pre-ignition causes shock, resulting in pings, vibration, detonation and power loss. Severe damage (A) to piston, rings and valves results from pre-ignition.

Check the following for causes of pre-ignition:

- Internal carbon deposits.
- Incorrect spark plug (high heat range).
- Broken ceramic in spark plug.
- Sharp edges on valves.
- Sharp edges in combustion chamber.



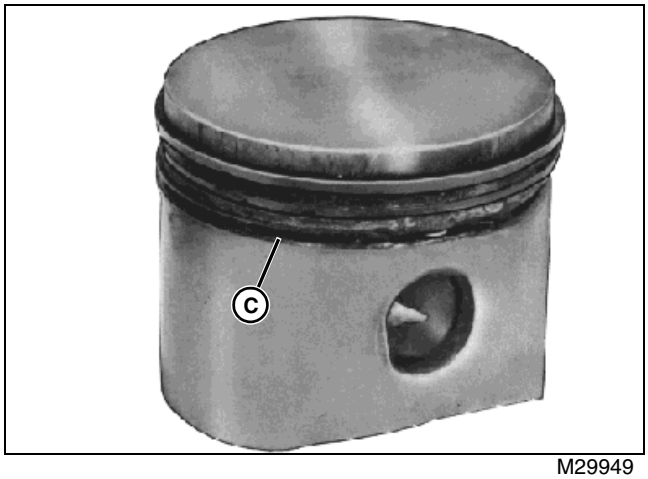
M29948

Check rod and piston alignment when piston shows a diagonal wear pattern (B) extending across the skirt of the piston. Contact with the cylinder wall shows on the bottom of the skirt at left and at the ring lands at the right.

A cylinder bored at an angle to the crankshaft can also cause improper ring contact with the cylinder.

This condition causes:

- Rapid piston wear.
- Uneven piston wear.
- Excess oil consumption.



M29949

A broken retaining ring caused the damage (C) shown.

Retaining rings loosen or break due to:

- Rod misalignment.
- Excessive crankshaft end play.
- Crankshaft journal taper.
- Weak retaining rings.
- Incorrectly installed retaining rings.

Inertia can cause a broken retaining ring to beat out the piston and cylinder, causing extensive damage.

Crankshaft Removal and Installation

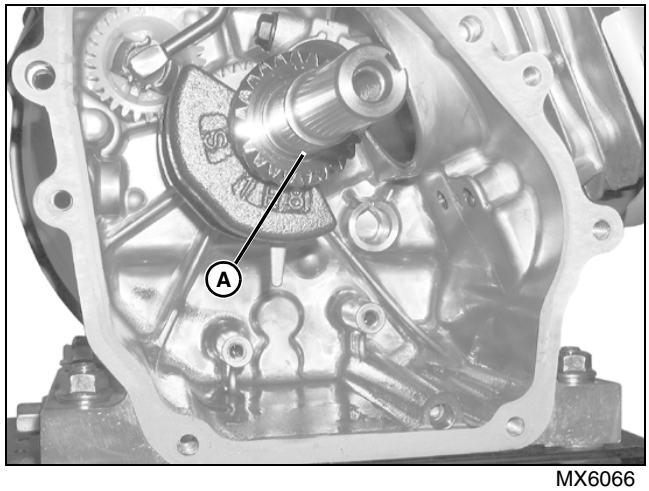
Other Material

Part No.	Part Name	Part Use
M79292	MPG-2 Polymer Multipurpose Grease	Prevents parts from seizing. Apply to engine crankshaft.

1. Remove flywheel. (See “Flywheel Removal and Installation” on page 55.)

2. Remove camshaft. (See “Camshaft and Tappets Removal and Installation” on page 63.)

3. Remove piston and connecting rod. (See “Piston and Connecting Rod Removal” on page 65.)



MX6066

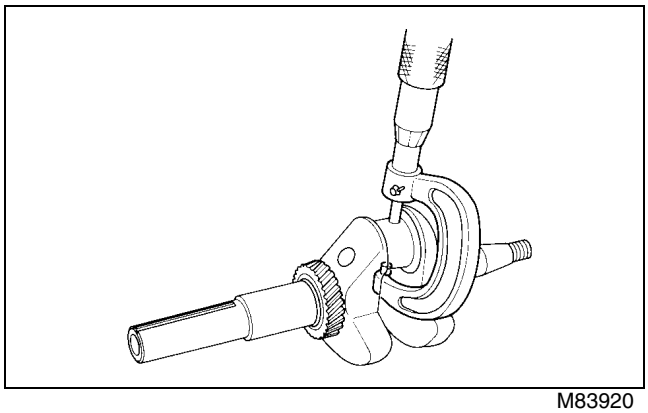
4. Remove crankshaft (A).

5. Inspect ball bearing in cylinder block. (See “Bearing Inspection and Replacement” on page 76.)

6. Inspect crankshaft for wear or damage. (See “Crankshaft Inspection” on page 74.)

Crankshaft Inspection

1. Analyze crankshaft and connecting rod wear. (See “Analyze Crankshaft and Connecting Rod Wear” on page 74.)



M83920

2. Measure connecting rod journal. Replace crankshaft if journal diameter is less than specification.

3. Check connecting rod-to-crankshaft clearance. (See “Check Connecting Rod-to-Crankshaft Clearance” on page 70.)

4. Check connecting rod side play. (See “Check Connecting Rod Side Play” on page 70.)

5. Inspect timing and governor drive gears for wear or damage. Replace if necessary. (See “Timing/Governor Gear Replacement” on page 74.)

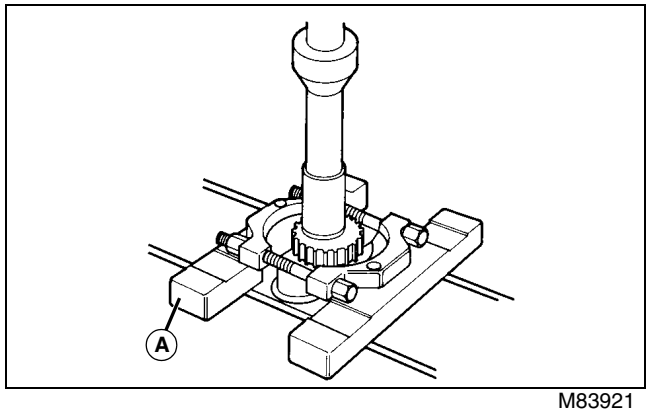
Specifications

Connecting Rod
Journal Diameter (Min). . . . . 25.92 mm (1.020 in.)

Timing/Governor Gear Replacement

NOTE: The removal/installation procedure is identical for both the timing and governor gears.

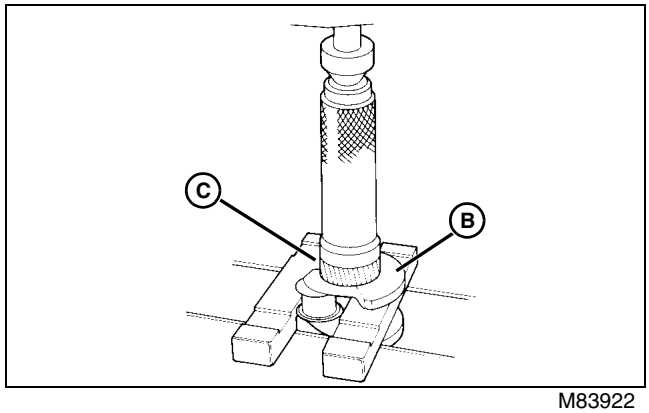
1. Mark a reference line on the timing/governor gear and crankshaft.



M83921

2. Using a knife-edged puller (A), press the gear off the crankshaft.

3. Using the old gear as a reference, mark the new gear in the same position as the old gear.



M83922

4. Support the crankshaft (B) as shown.

5. Place the gear (C) on the crankshaft and align the marks on the gear and crankshaft.

6. Using driver, press gear on crankshaft until fully seated.

Analyze Crankshaft and Connecting Rod Wear

Check connecting rod and cap for damage or unusual wear patterns.

Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize the crankshaft; the connecting rod and piston may both break causing other internal damage. Inspect block carefully before rebuilding engine.

Crankshaft and connecting rod damage can also result from:

- Engine run low on oil or without oil.
- Oil not changed regularly.
- Bearing cap installed incorrectly.

Cylinder Block Inspection

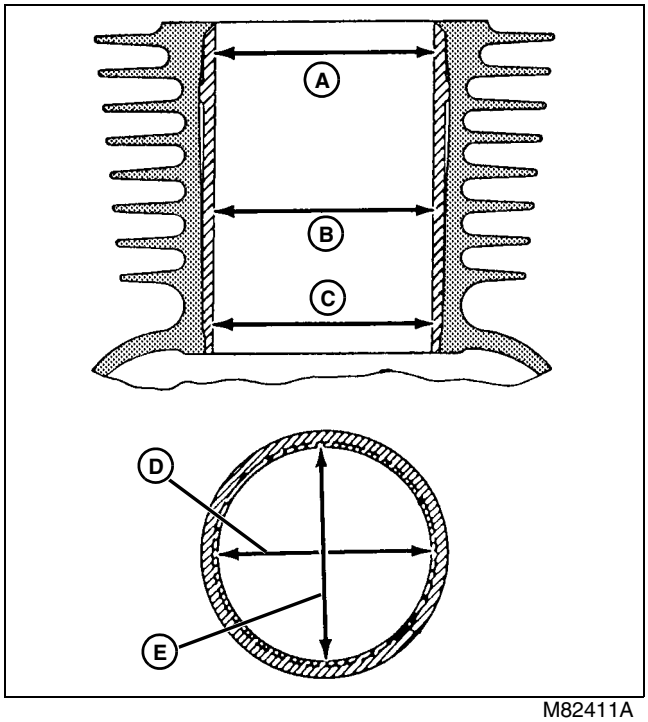
Other Material

Part No.	Part Name	Part Use
NA	Zinc Oxide/Wood Alcohol	Check block for cracks.

1. Clean block and check for cracks.

NOTE: Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light engine oil. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

A bare block is available for service.



M82411A

2. Measure cylinder bore diameter at three positions; top (A), middle (B) and bottom (C). At these three positions, measure in both directions; along the crankshaft centerline (E) and in the direction of crankshaft rotation (D).

Specifications

NOTE: If the engine has had a previous major overhaul, oversize pistons and rings may have been installed. Pistons are available in 0.25 mm (0.010 in.) and 0.50 mm (0.020 in.) oversize.

Cylinder Bore ID, Standard Piston

Standard . . . . . 60.0 mm (2.36 in.)
Wear Limit . . . . . 60.165 mm (2.3687 in.)

Cylinder Bore ID, 0.25 mm (0.010 in.) Oversize Piston

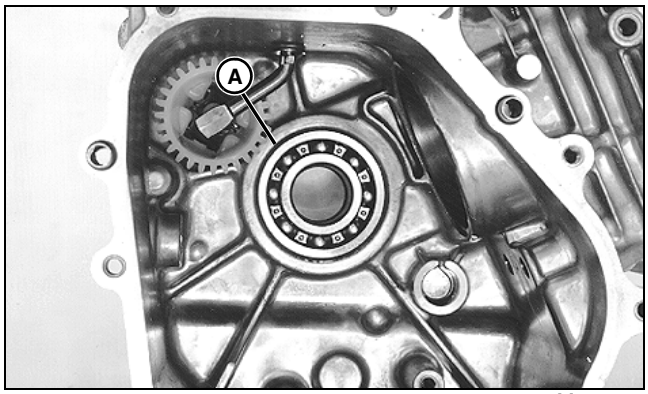
Standard . . . . . 60.25 mm (2.37 in.)
Wear Limit . . . . . 60.415 mm (2.3787 in.)

Cylinder Bore ID, 0.50 mm (0.020 in.) Oversize Piston

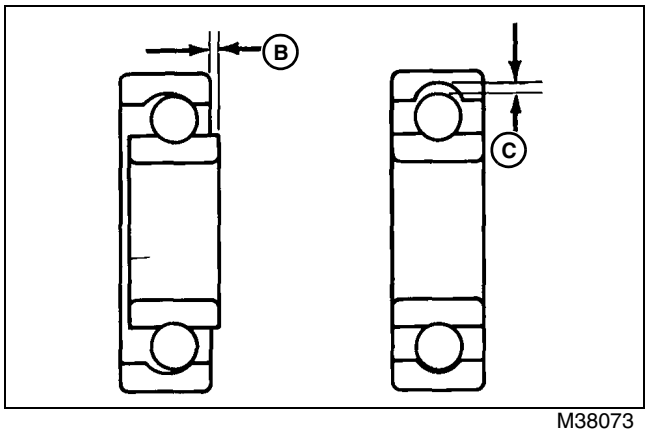
Standard . . . . . 60.5 mm (2.41 in.)
Wear Limit . . . . . 60.665 mm (2.3887 in.)

Bearing Inspection and Replacement

NOTE: Remove bearing only if replacement is required.



M83865



M38073

1. Spin bearing (A) by hand and check for axial (B) and/or radial (C) free play. Replace bearing if it has excessive play or is noisy.

2. Remove oil seal.

3. Remove bearing using a driver set.

4. Apply a light coat of clean engine oil to bearing outer race.

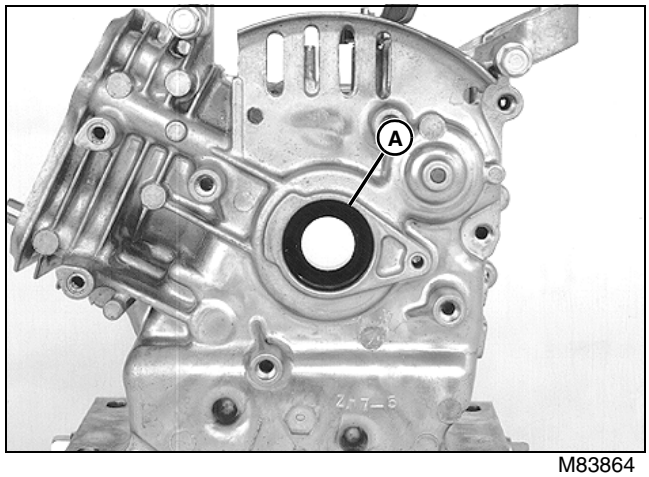
5. Install bearing using driver set until fully seated against crankcase casting.

6. Install new oil seal

Oil Seal Replacement

Other Material

Part No.	Part Name	Part Use
NA	Lithium-Based Grease	Pack oil seals.



M83864

1. Remove worn or damaged oil seal (A) using a screwdriver.

2. Pack lithium-based grease inside lips of seal.

3. Install seal with lip toward inside of crankcase using a seal driver set.

Deglaze Cylinder Bore

1. Deglaze cylinder bore using a rigid hone 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 walls.

3. Clean cylinder walls using clean white rags and warm soapy water. Continue to clean cylinder until white rags show no discoloration.

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

Rebore Cylinder Block

IMPORTANT: Avoid damage! Check stone for wear or damage. Use correct stone for the job.

NOTE: The cylinder can be rebored to use 0.25 mm (0.010 in.) and 0.50 mm (0.020 in.) oversize piston and rings. Have a reliable repair shop rebore the block, or use a drill press and honing tool.

Rebore cylinder with a honing tool to initial and final bore specifications.

1. Align center of bore to drill press center.

2. Lower and raise hone until end extends 20-25 mm (0.75-1.0 in.) past end of cylinder.

3. Adjust hone stones until they contact the narrowest point of the cylinder walls.

4. Coat the inside of cylinder with honing oil. Turn hone by hand. Adjust if too tight.

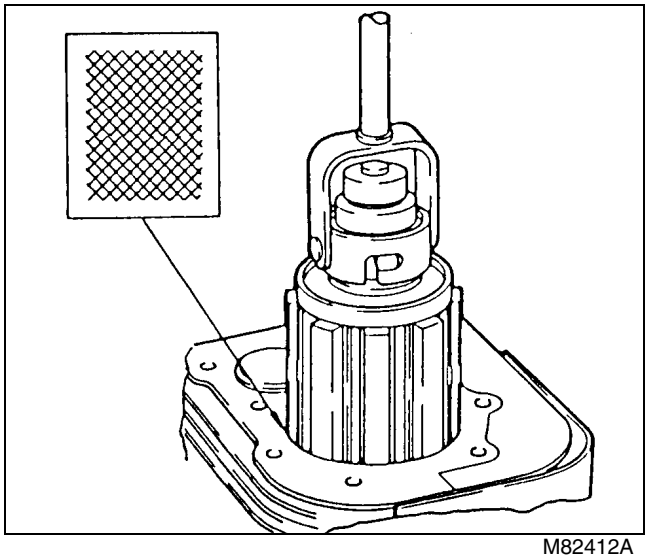
5. Run drill press between 200-250 rpm. Move hone up and down in cylinder approximately 20 times per minute.

NOTE: Measure bore when cylinder is cool.

6. Stop press and check cylinder diameter.

NOTE: Finish should not be smooth. It should have a 40°-60° crosshatch pattern.

7. Check bore for size, taper and out of round.



M82412A

8. If cylinder bore exceeds wear limit, rebore cylinder or replace block.

9. Hone the cylinder an additional 0.007-0.009 mm (0.0003-0.0004 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

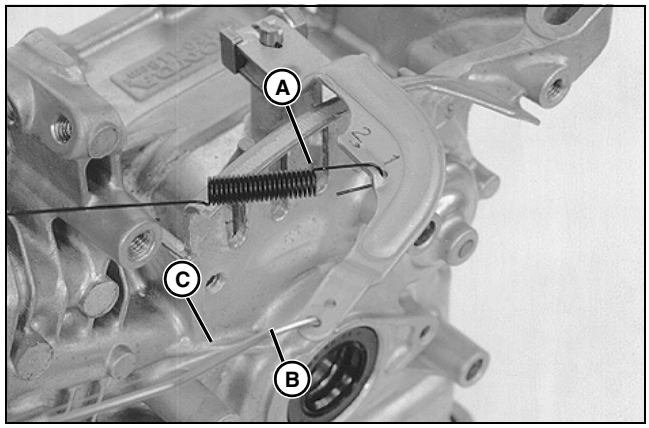
IMPORTANT: Avoid damage! DO NOT use gasoline, kerosene, or commercial solvents to clean cylinder bore. Solvents will not remove all abrasives from cylinder walls.

10. Clean cylinder walls using clean white rags and warm soapy water. Continue to clean cylinder until white rags show no discoloration.

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

Governor Removal and Installation

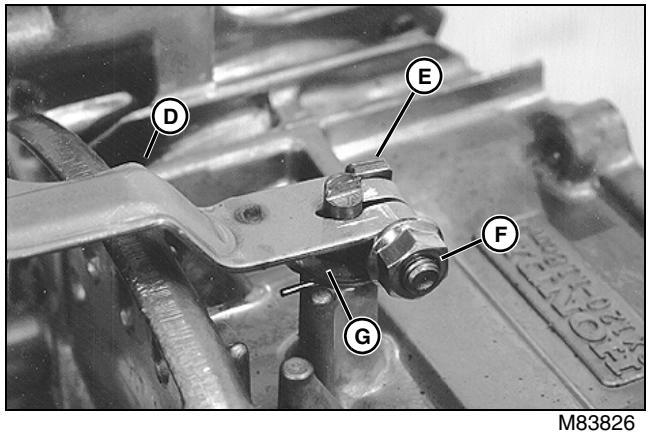
1. Remove crankshaft. (See “Crankshaft Removal and Installation” on page 73.)



M83902

2. Remove governor return spring (A).

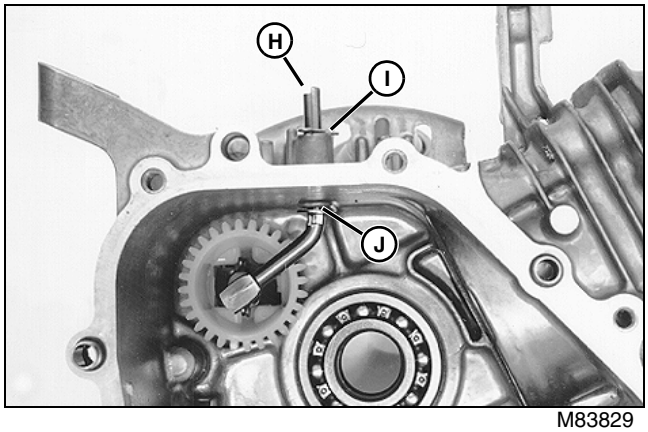
3. Remove linkage (B) and spring (C).



M83826

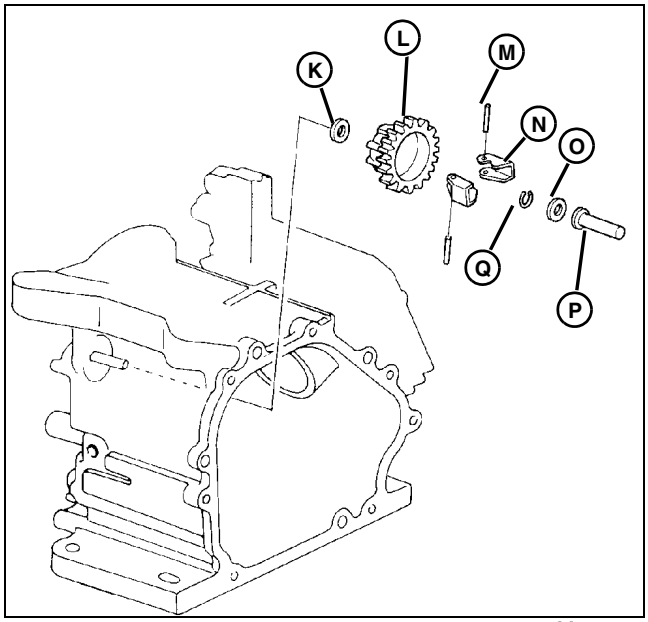
4. Remove nut (F) and cap screw (E).

5. Remove governor arm (D) and washer (G).



M83829

6. Remove clip (I), governor arm shaft (H), and washer (J).



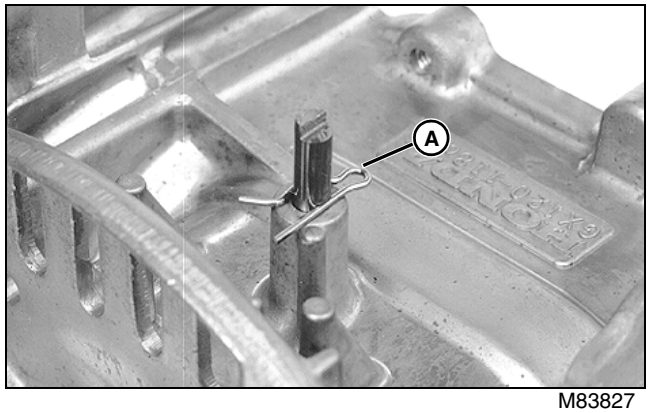
M83828

7. Spread governor weights (N) and remove slider (P).
8. Remove washer (O).
9. Remove clip (Q) and governor weight holder (L).
10. Remove washer (K).
11. Remove both pins (M) and weights (N) if necessary.
12. Inspect all parts for wear or damage. Replace parts as needed.

Installation

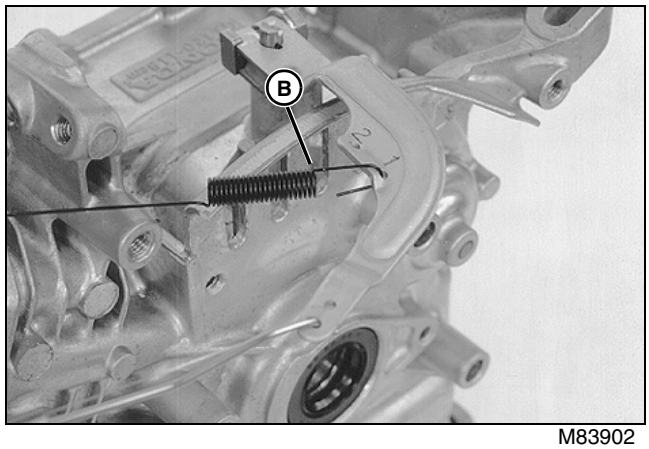
Installation is done in the reverse order of removal.

- Check to make sure governor weights move freely.
- Insert clip firmly into shaft groove.
- Check to make sure slider moves freely



M83827

- Position shaft over governor slider, and install clip (A) with straight side of clip against the groove in shaft.



M83902

- Install governor spring (B) in hole marked “1”.
- Adjust governor. (See “Governor and Fast Idle Speed Adjustment” on page 36.)

Table of Contents

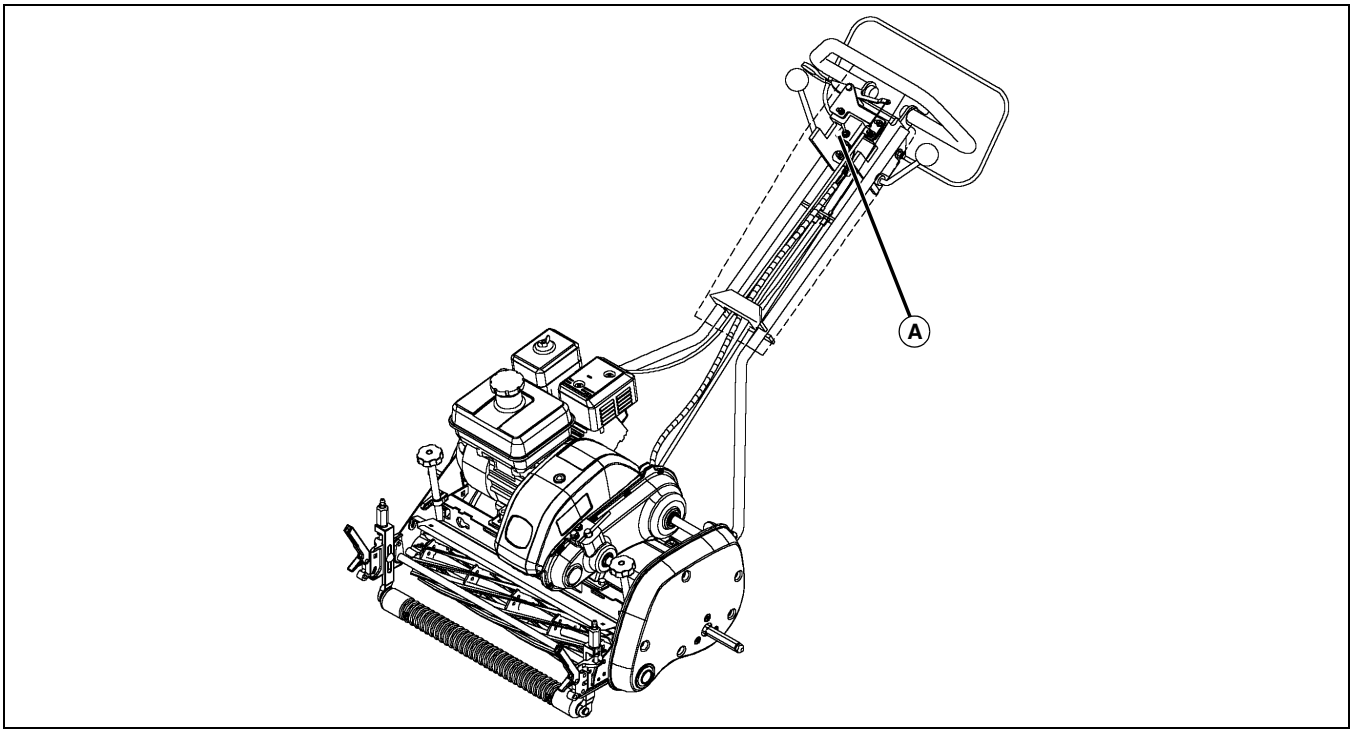
Theory and Diagnostic Information

Wire Color Abbreviation Chart

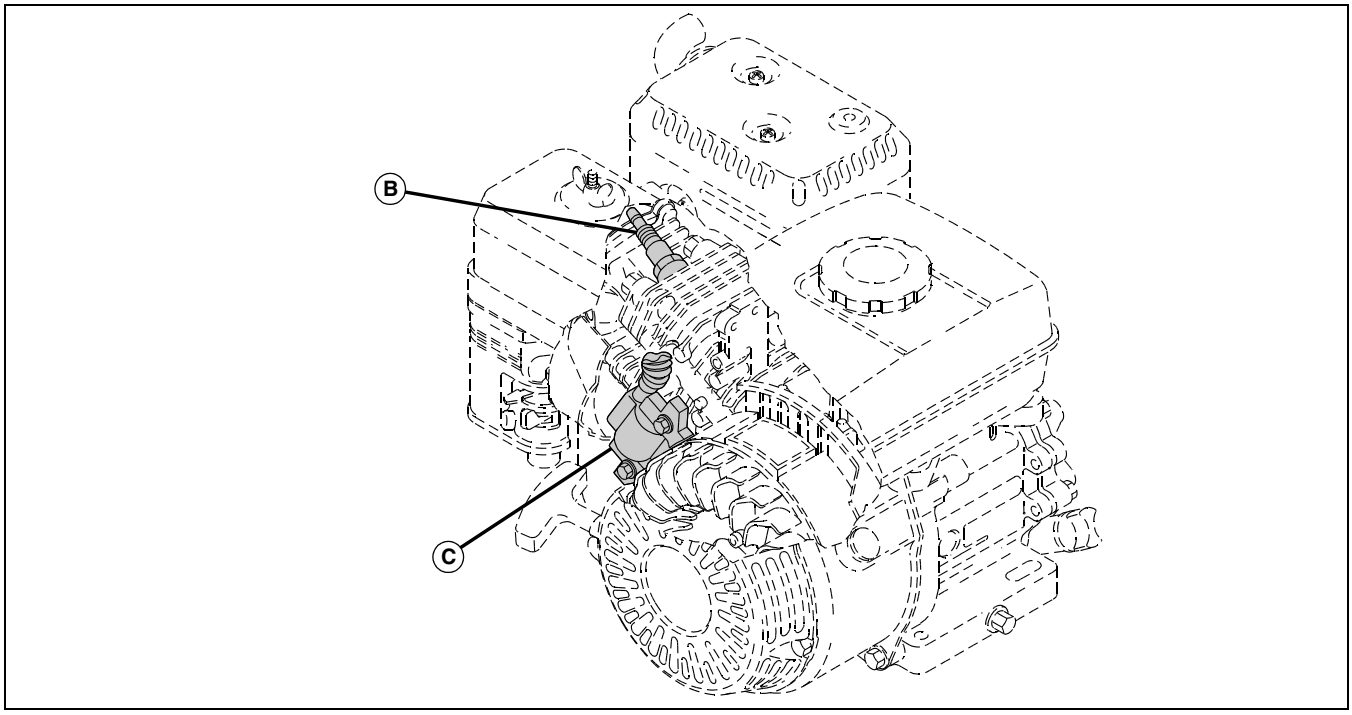
Blk	Black
Blu	Blue
Brn	Brown
Grn	Green
Gry	Gray
Org	Orange
Pnk	Pink
Pur	Purple
Red	Red
Tan	Tan
Wht	White
Yel	Yellow
Blk/Wht	Black/White
Blu/Wht	Blue/White
Brn/Wht	Brown/White
Brn/Yel	Brown/Yellow
Dk Blu	Dark Blue
Dk Brn/Lt Grn	Dark Brown/Light Green
Dk Brn/Red	Dark Brown/Red
Dk Brn/Yel	Dark Brown/Yellow
Dk Grn	Dark Green
Lt Blu	Light Blue
Lt Grn	Light Green
Org/Wht	Orange/White
Pnk/Blk	Pink/Black
Pur/Wht	Purple/White
Red/Blk	Red/Black
Red/Wht	Red/White
Wht/Blk	White/Black
Wht/Red	White/Red
Yel/Blk	Yellow/Black
Yel/Red	Yellow/Red
Yel/Wht	Yellow/White

Component Location and Operation

Component Location



MX6030

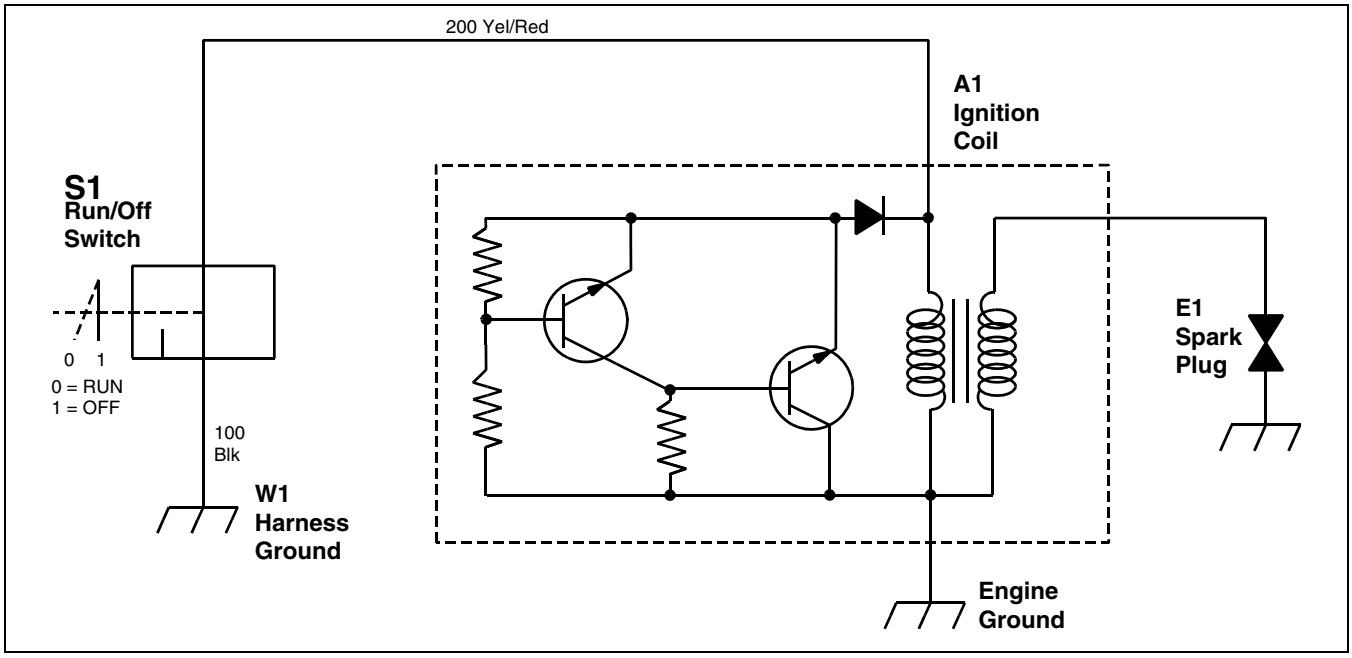


MIF (M83948)

A - S1 Run/Off Switch
B - E1 Spark Plug
C - A1 Ignition Coil

Electrical Schematics

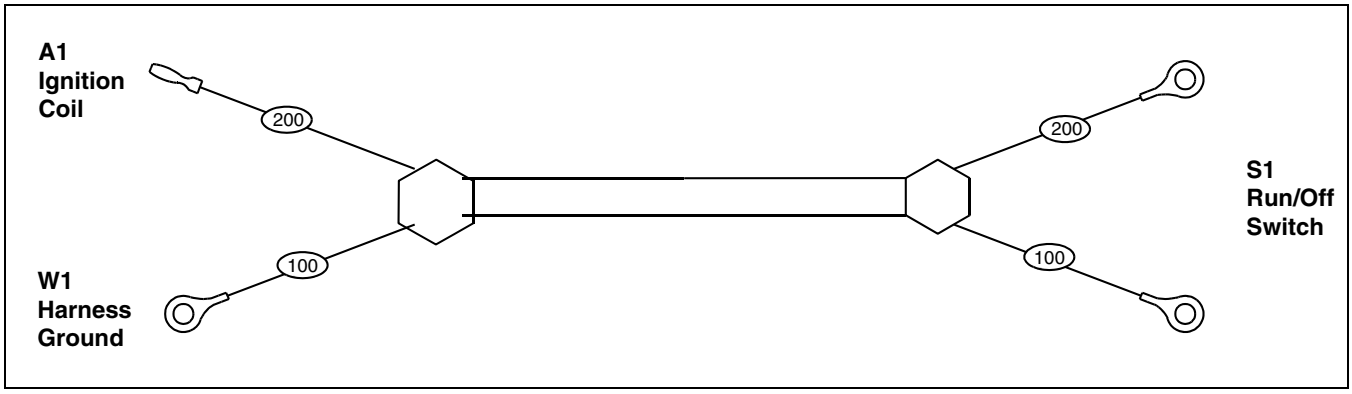
Main Schematic



MIF (M83932)

Wiring Harnesses

Main Wiring Harness



MIF (M83915)

Circuit Operation and Diagnosis

Ignition Circuit Operation

Function

To create a spark that ignites that fuel/air mixture in the engine.

Operating Conditions

- Run/Off switch in RUN position.

Theory of Operation

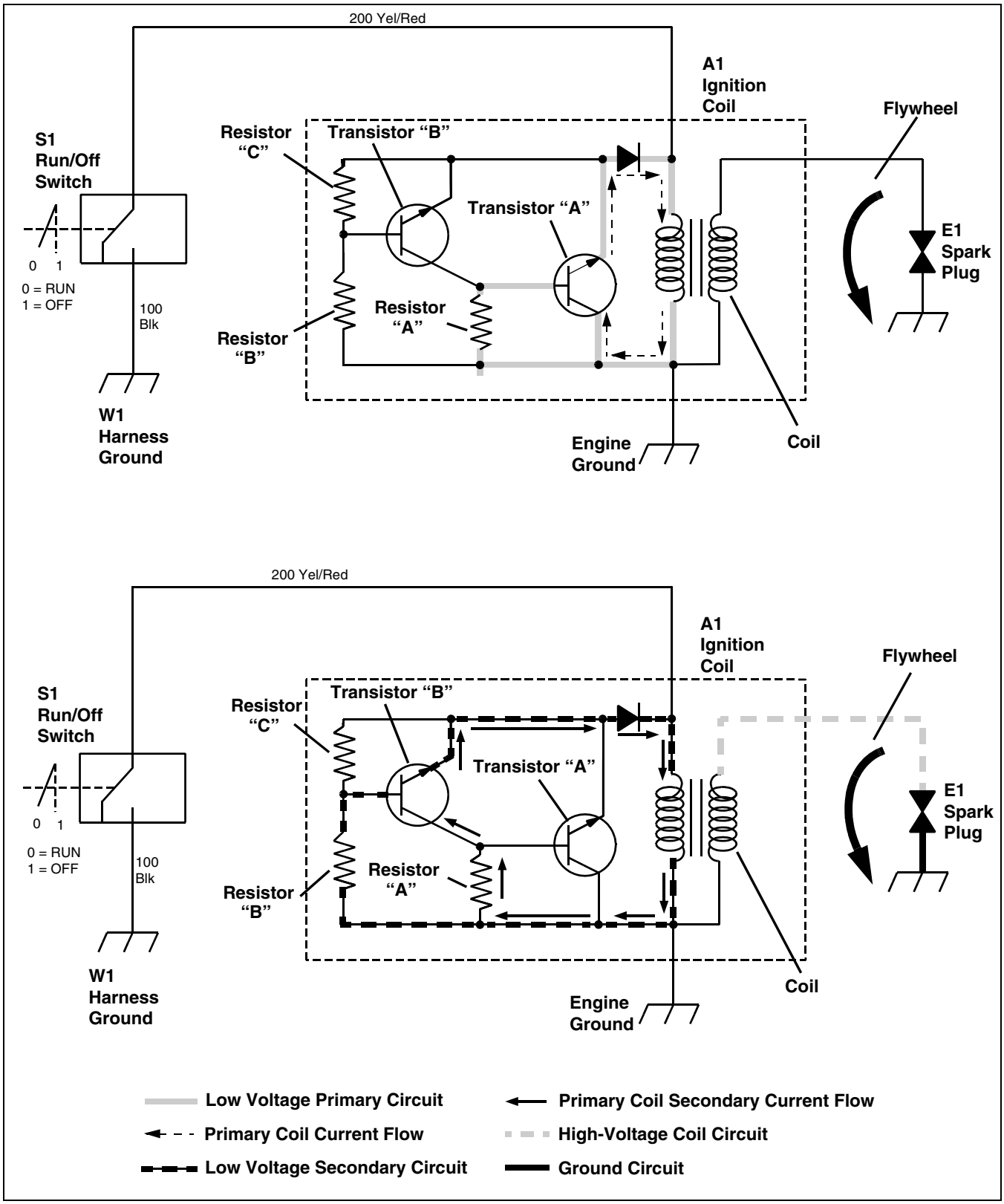
The ignition system is a transistor-controlled magneto design. There are no moving parts and there is no need for an external power source (battery). The power and triggering signal are both generated by a permanent magnet on the outside edge of the flywheel, and are therefore not adjustable. The engine is shut off by grounding the ignition coil through the Run/Off switch.

The ignition coil consists of an iron core with two sets of wires wound around it. As the flywheel turns, the permanent magnet on the flywheel aligns with the ignition coil and produces current in the primary coil by electro-magnetic induction.

In the initial stage low voltage current is produced. The low voltage current flows through resistor “A” to the base of transistor “A”, causing it to open and allows current to build in the primary coil windings (primary coil current flow). Resistor “B” has high resistance, so current will be prevented from flowing to the base of transistor “B”.

In the second stage (spark produced), the flywheel current flow is increased. The current can now flow through the resistor “B” to the base of transistor “B”. Transistor “B” is now energized which causes transistor “A” to open. Current then flows through transistor “B” (primary coil secondary current flow). A voltage of several hundred volts is then produced in the primary coil windings by electromagnetic induction.

The high voltage current flows through the coil wire to the spark plug. The voltage is now high enough to jump the spark plug gap and a spark is produced, igniting the fuel/air mixture in the cylinder.


200 Yel/Red
A1
Ignition
Coil
Flywheel
S1
Run/Off
Switch
Resistor
"C"
Transistor "B"
Transistor "A"
E1
Spark
Plug
0 1
0 = RUN
1 = OFF
100
Blk
Resistor
"A"
Resistor
"B"
W1
Harness
Ground
Engine
Ground
Coil
200 Yel/Red
A1
Ignition
Coil
Flywheel
S1
Run/Off
Switch
Transistor "B"
Resistor
"C"
Transistor "A"
E1
Spark
Plug
0 1
0 = RUN
1 = OFF
100
Blk
Resistor
"A"
Resistor
"B"
W1
Harness
Ground
Coil
Engine
Ground
Low Voltage Primary Circuit
Primary Coil Secondary Current Flow
Primary Coil Current Flow
High-Voltage Coil Circuit
Low Voltage Secondary Circuit
Ground Circuit

MIF (M83935)

Ignition Circuit Operation - Engine Shutting Off

Function

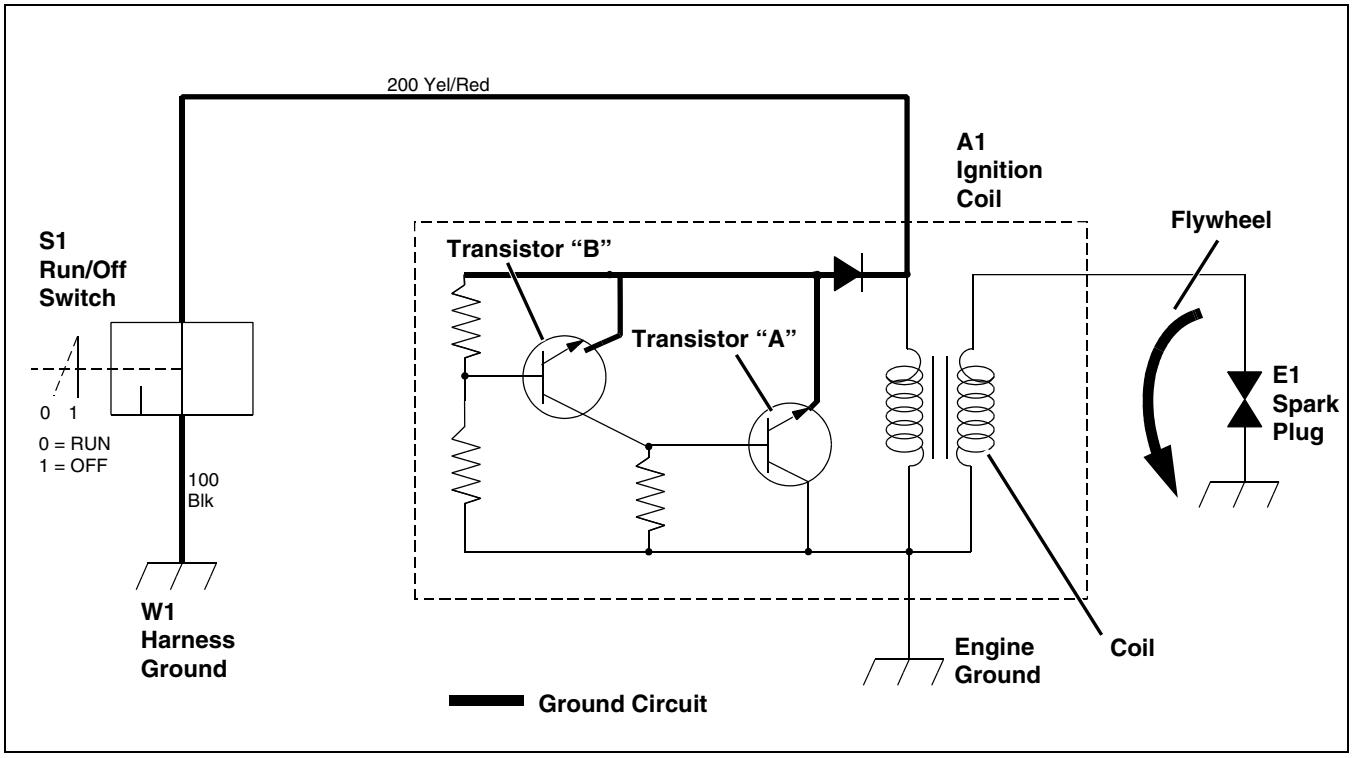
To shut the engine off by grounding the ignition coil through the Run/Off switch.

Operating Conditions

- Run/Off switch in OFF position.

Theory of Operation

When the Run/Off switch is moved to the OFF position, a path to ground is provided through the switch. This prevents voltage from building up in the coil primary windings, preventing a spark from being generated.



MIF (M83936)

Ignition Circuit Diagnosis

When diagnosing an ignition problem, isolate the magneto circuit from the ground circuit by disconnecting the Run/Off switch connectors. If the engine will not start, check the magneto circuit first and then the ground circuit. If the engine will not shut off, check the ground circuit first. Remember the engine is stopped by grounding the ignition coil through the Run/Off switch.

Test Conditions:

- Run/Off switch in RUN position.
- Travel clutch in NEUTRAL position.
- Check connection(s) for corrosion and looseness when checking/testing.

System: Ignition Circuit

(1) Perform spark test. (See "Spark Test" on page 39.) Does test produce a strong blue spark?

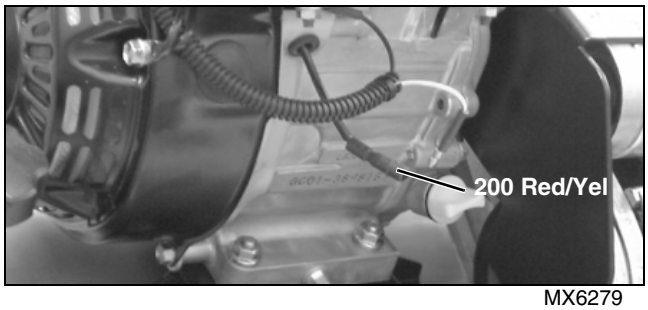
Yes -

No - No spark present. Test ignition coil. (See "Ignition Coil Test" on page 54.)

No - No spark present. Check armature air gap. (See "Air Gap Adjustment" on page 54.)

No - No spark present. Check flywheel magnet. (See "Flywheel Magnet Test" on page 88.)

No - Weak spark. Check spark plug condition and gap. (See "Spark Plug Gap Adjustment" on page 39.) If plug is good, continue checking ignition circuit.



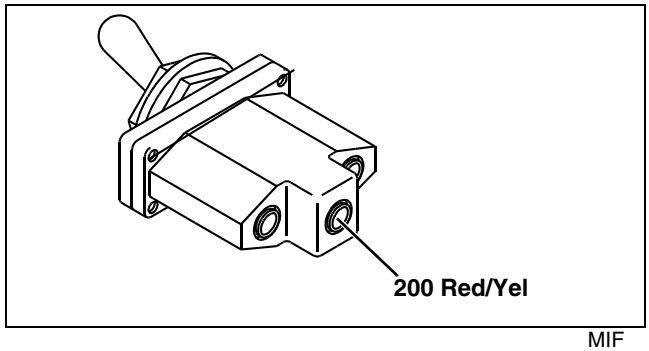
MX6279

(2) Ignition coil disconnected (wire 200 yel/red). Connect positive lead of ohmmeter to ignition coil. Is resistance 0.8-1.0 ohms?

Yes -

No - Check ignition coil. (See "Ignition Coil Test" on page 54.)

System: Ignition Circuit



MIF

(3) Run/Off switch in RUN position. Ignition coil connected to wire 200 red/yel. Measure resistance at Run/Off switch, terminal 2 (wire 200 red/yel). Is resistance 0.8-1.0 ohms?

Yes -

No - Test wire 200 red/yel and connections.

(4) Run/Off switch in the OFF position. Measure resistance at Run/Off switch, terminal 2 (wire 200 red/yel). Is resistance more than 0.1 ohms?

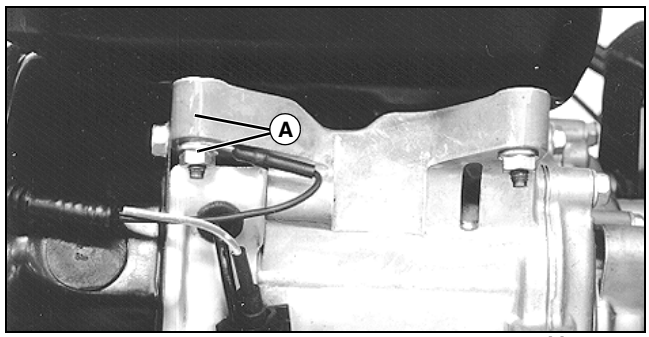
Yes -

No - Test ignition coil (A1). (See "Ignition Coil Test" on page 54.)

(5) Measure resistance at Run/Off switch, terminal 3 (wire 100 blk). Is resistance more than 0.1 ohms?

Yes -

No - Replace Run/Off switch.



M83752

(6) Measure resistance from ground screw to engine block. Is resistance (A) less than 0.1 ohms?

Yes - Test wire 100 blk and connections.

No - Clean connections between ground (wire 100 blk) and engine block.

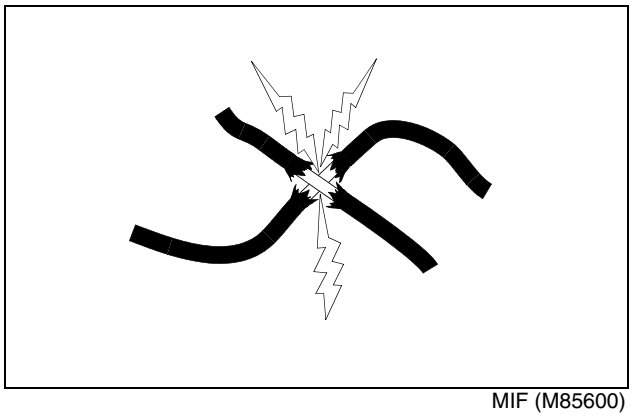
Tests

Common Circuit Tests

Shorted Circuit

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

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

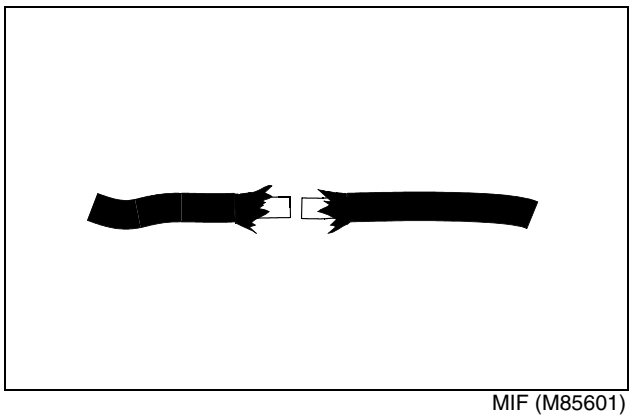


MIF (M85600)

High Resistance or Open Circuit

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

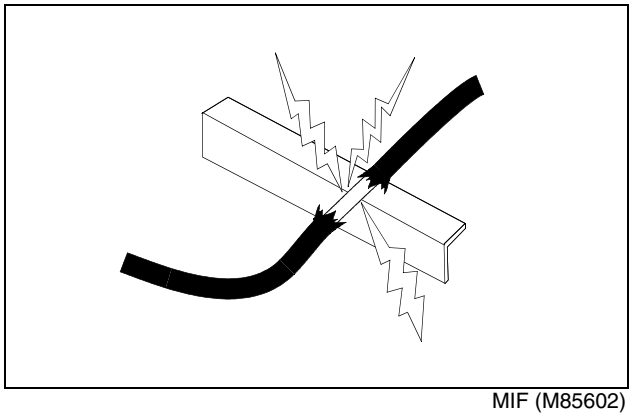
1. Check all terminals and grounds of the circuit for corrosion.
2. If terminals are not corroded or loose, the problem is in the component or wiring.



MIF (M85601)

Grounded Circuit

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



MIF (M85602)

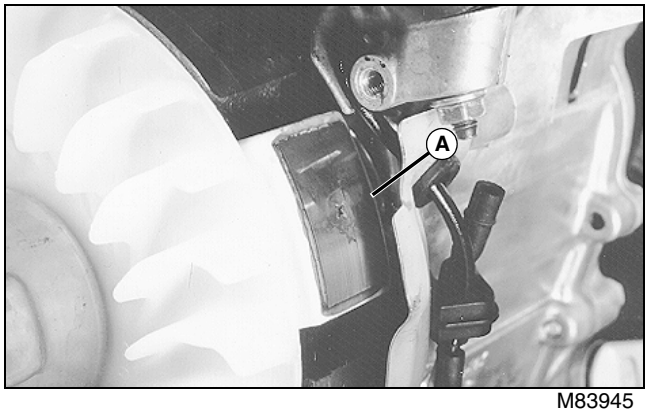
Flywheel Magnet Test

Reason

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

Procedure

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Engage park brake.
4. Remove blower housing. (See “Blower Housing Assembly Removal and Installation” on page 50.)



M83945

5. Hold a steel tool about 25 mm (1.0 in.) from flywheel magnet (A). The tool should be attracted by the magnet.

Results

Replace the flywheel if the magnet does not attract tool.

Run and Off Switch Test

Reason

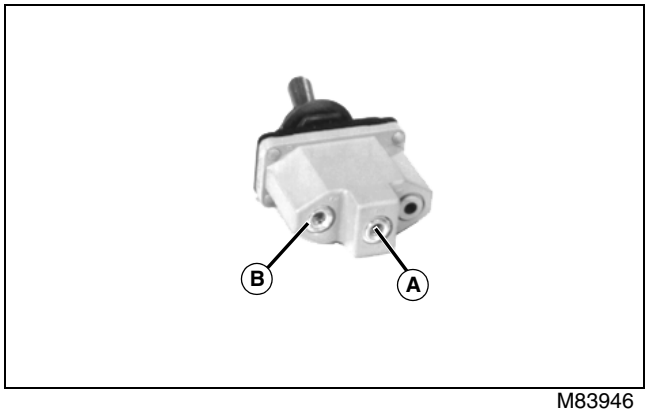
To make sure the Run/Off switch is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter (or Continuity Tester)	NA	Used to test switch terminals for continuity.

Procedure

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Engage park brake.
4. Disconnect wires from switch.



M83946

5. Move switch to RUN position.
6. Check continuity across terminals 2 (A) and 3 (B). There should be no continuity.
7. Move switch to OFF position.
8. Check continuity across terminals 2 (A) and 3 (B). There should be continuity.

Results

If continuity is not correct, replace switch.

Table of Contents

Specifications

Adjustment Specifications

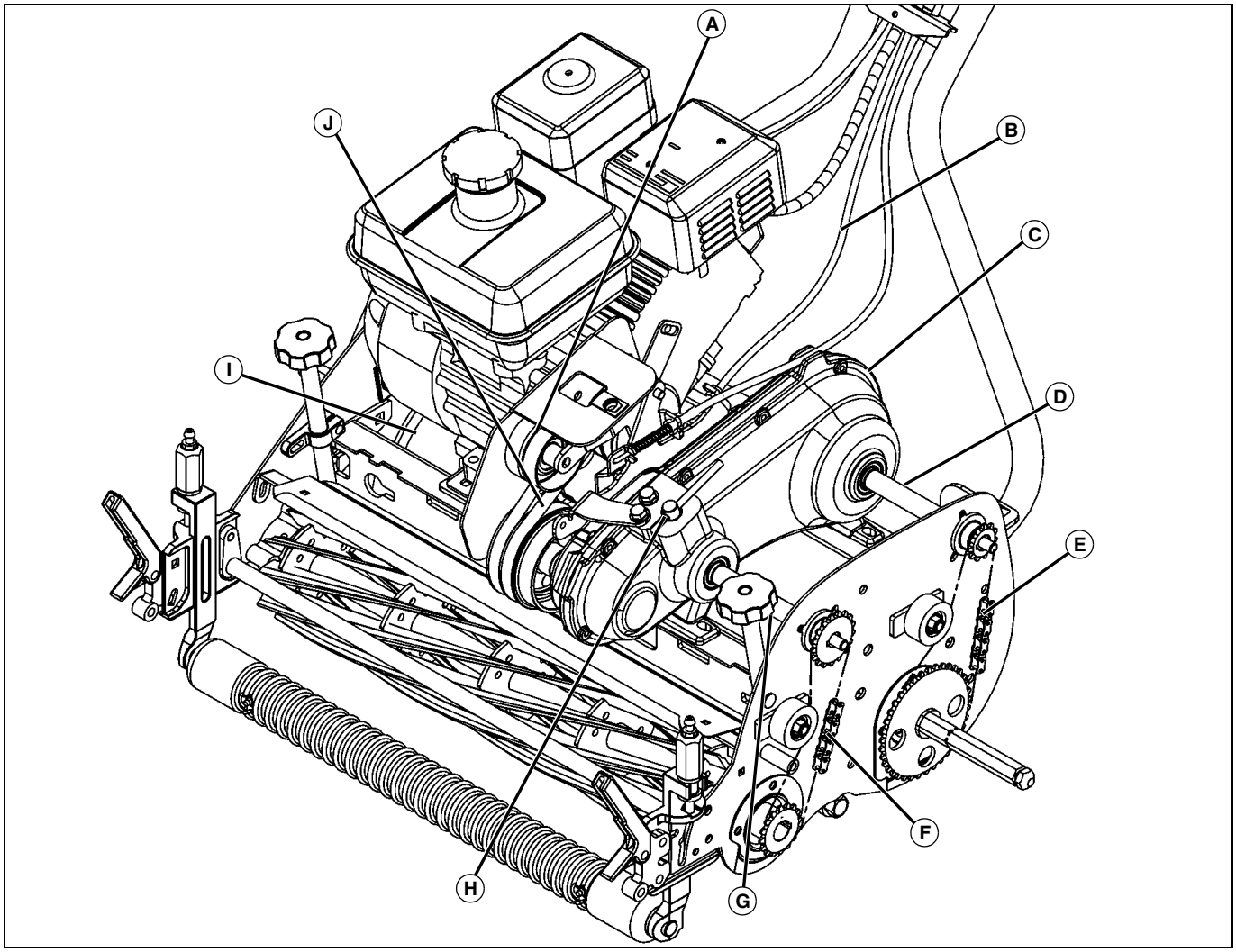
Drive Belt-to-Guide Clearance (Clutch ENGAGED)	1 mm (0.040 in.)
Front Roller Gap (Max, Check Each End)	0.1 mm (0.004 in.)
Traction Roller Drive Chain Deflection (Max at Mid Span Opposite Idler)	11 mm (0.43 in.)

Repair Specifications

Differential Gear Case Oil Capacity	0.4 L (0.4 qt)
Drive Control Cable Jam Nuts	11 N•m (96 lb-in.)
Traction Roller Eccentric Nut Torque	22 N•m (192 lb-in.)
Bearing Holder Cap Screw Torque	22 N•m (192 lb-in.)
Axle Sprocket Retaining Nut Torque	108 N•m (80 lb-ft)
Bed Knife Bracket Shoulder Bolt Torque	27 N•m (20 lb-ft)

Component Location and Operation

Drive Belt and Differential System



MX6093

- **A - Tension Idler**
- **B - Clutch Control Cable**
- **C - Differential Gear Case Assembly**
- **D - Output (Traction) Shaft (2 used)**
- **E - Traction Drive Chain (2 used)**
- **F - Reel Drive Chain**
- **G - Output (Reel) Shaft**
- **H - Reel Drive Clutch Lever**
- **I - Traction Roller Assembly**
- **J - Drive Belts**

Function

To transmit power to the reel and traction roller assembly. The differential assembly assists in turning.

Theory of Operation

The differential gear case is connected to the engine by two V-belts. When the travel clutch lever is moved to the ENGAGED position, the cable pulls the tension idler down against the belts, applying tension to the drive belts.

As tension is applied to the belts, the differential gear case input sheave/shaft turns and power is transferred to the traction roller assembly by way of a chain.

Output (traction) shafts connected to the differential transfer power to the traction roller assembly by way of chain drives on each side of the mower.

The traction roller assembly consists of two independently-driven aluminum rollers. As the mower is turned, the differential gear case differential allows the rollers to turn at different speeds, allowing the mower to turn smoothly.

The differential gear case also drives the cutting unit reel. The reel drive can be disengaged when transporting the mower by placing the reel drive clutch in the STOP position.

When the reel drive clutch is moved to the MOW position, a ramped clutch is engaged with the input shaft assembly, transferring power to the cutting reel by a chain drive.

Diagnostics

Machine Will Not Drive

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.

Symptom: Machine Will Not Drive

(1) Is park brake released?

Yes - Go to step (2).

No - Release park brake.

(2) Is drive sheave, drive sheave key and keyway in good operating condition?

Yes - Go to step (3).

No - Replace sheave and/or key.

(3) Are drive belts free from damage (broken, worn, frayed, glazed, or stretched)? Are drive belts loose without proper tension?

Yes - Go to step (4).

No - Replace drive belts. (See “Drive Belt Replacement” on page 104.)

(4) Do drive belts appear to be correctly tensioned?

Yes - Go to step (5).

No - Adjust drive belt(s) tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)

(5) Is differential gear case input shaft key in good condition and not damaged?

Yes - Go to step (6).

No - Key is missing or damaged. Replace key. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(6) Is differential gear case input shaft in good condition and not damaged?

Yes - Go to step (7).

No - Replace input shaft. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

Symptom: Machine Will Not Drive

(7) Are differential gear case output shafts in good condition and not damaged?

Yes - Go to step (8).

No - Replace output shaft(s). (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(8) Are traction drive chains in good condition and not damaged?

Yes - Go to step (9).

No - Replace drive chain(s).

(9) Are traction drive roller sprockets in good condition and not damaged? Are keys in place and not damaged?

Yes - Go to step (10).

No - Sprockets are damaged. Replace sprockets. (See “Models Equipped with Partial Hex Axle” on page 117.)

No - Keys are missing and/or damaged. Replace keys. (See “Models Equipped with Partial Hex Axle” on page 117.)

(10) Is differential gear case input shaft sprocket in good condition and not damaged?

Yes - Go to step (11).

No - Replace sprocket. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(11) Is differential gear case chain in good condition and not damaged?

Yes - Go to step (12).

No - Replace chain. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(12) Are differential gears in good condition and not damaged?

No - Replace differential gears. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

Noisy Operation

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.
- Engine cold.

Symptom: Noisy Operation

(1) Do traction drive chains have proper tension? Are chains properly lubricated?

Yes - Go to step (2).

No - Chains are loose. Tighten drive chains. (See “Traction Roller Drive Chain Tension Adjustment” on page 102.)

No - Chains need lubrication. Apply grease to chains. (See “Grease” on page 12.)

(2) Are traction roller assembly bearings in good operating condition?

Yes - Go to step (3).

No - Replace bearings. (See “Models Equipped with Partial Hex Axle” on page 117.)

(3) Is oil up to the bottom of the oil fill port?

Yes - Go to step (4).

No - Oil is low. Fill to correct level with oil meeting specifications. (See “Differential Gear Case Oil” on page 12.)

(4) Are differential gear case shaft (frame) bearings bearings in good operating condition?

Yes - Go to step (5).

No - Replace bearings. (See “Frame and Drive Covers” on page 173.)

(5) Are differential gears in good condition and not damaged or badly worn?

Yes - Go to step (6).

No - Replace differential gears. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(6) Are differential gear case assembly bearings (input and output shafts) in good operating condition?

No - Replace bearings. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

Machine Does Not Reach Full Ground Speed

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.

Symptom: Machine Does Not Reach Full Ground Speed

(1) Is park brake released?

Yes - Go to step (2).

No - Release park brake.

(2) Are drive belts free from damage (broken, worn, frayed, glazed, or stretched)? Are drive belts loose without proper tension?

Yes - Go to step (3).

No - Replace drive belts. (See “Drive Belt Replacement” on page 104.)

(3) Do drive belts appear to be correctly tensioned?

No - Adjust drive belt(s) tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)

Erratic Speed

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.

Symptom: Machine Speed is Erratic

(1) Are drive belts free from damage (broken, worn, frayed, glazed, or stretched)? Are drive belts loose without proper tension?

Yes - Go to step (2).

No - Replace drive belts. (See “Drive Belt Replacement” on page 104.)

(2) Do drive belts appear to be correctly tensioned?

Yes - Go to step (3).

No - Adjust drive belt(s) tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)

Symptom: Machine Speed is Erratic

(3) Do traction drive chains have proper tension? Are chains properly lubricated?

No - Chains are loose. Tighten drive chains. (See “Traction Roller Drive Chain Tension Adjustment” on page 102.)

Park Brake Does Not Hold Machine

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.

Symptom: Park Brake Will Not Hold

(1) Is park brake properly adjusted?

Yes - Go to step (2).

No - Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)

(2) Is brake band in good operating condition and not glazed or damaged?

No - Replace brake band. (See “Brake Band Replacement” on page 139.)

Traction Drive Pulls to One Side

Test Conditions:

- Machine parked on level surface.
- RUN/OFF switch in OFF position.
- Park brake disengaged.
- Travel clutch disengaged.

Symptom: Traction Drive Pulls to One Side

(1) Do traction drive chains have proper tension? Are chains in good operating condition?

Yes - Go to step (2).

No - Chains are loose. Tighten drive chains. (See “Traction Roller Drive Chain Tension Adjustment” on page 102.)

No - Replace drive chain(s).

Symptom: Traction Drive Pulls to One Side

(2) Are traction drive roller sprockets in good condition and not damaged? Are keys in place and not damaged?

Yes - Go to step (3).

No - Sprockets are damaged. Replace sprockets. (See “Models Equipped with Partial Hex Axle” on page 117.)

No - Keys are missing and/or damaged. Replace keys. (See “Models Equipped with Partial Hex Axle” on page 117.)

(3) Are differential gear case shaft (frame) bearings bearings in good operating condition?

Yes - Go to step (4).

No - Replace bearings. (See “Frame and Drive Covers” on page 173.)

(4) Are differential gear case assembly bearings (output shafts) bearings in good operating condition?

Yes - Go to step (5).

No - Replace bearings. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(5) Are differential gears in good condition and not damaged?

Yes - Go to step (6).

No - Replace differential gears. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(6) Are differential gear case output shaft sprocket(s) and/or key(s) in good operating condition?

No - Replace sprockets and/or keys.

Checks and Adjustments

Drive Belt Tension Check and Adjustment

Reason

When properly adjusted, with engine OFF and clutch in NEUTRAL, machine should move freely. With clutch ENGAGED, traction roller should not move.

When properly adjusted, with engine ON and set at low idle, brake OFF and clutch in NEUTRAL, machine should not move. With engine ON and set at low idle, brake OFF, clutch ENGAGED and holding machine by handlebars, transport wheels should spin on gravel or concrete surface. With engine ON, brake OFF, clutch ENGAGED, unit should propel itself up an incline.

Check Procedure

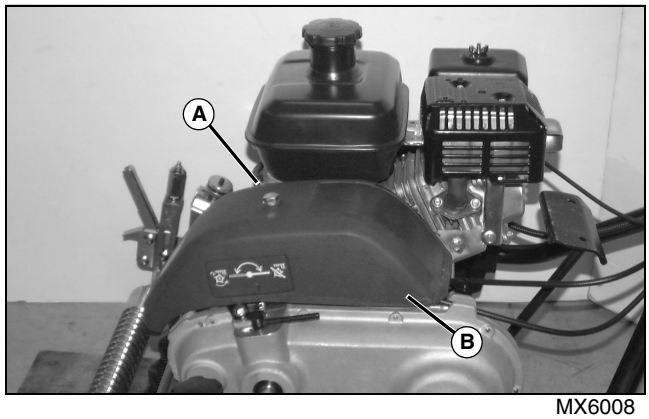
1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Pull the machine backward; transport wheels and roller should turn freely.
   - If transport wheels and roller turn freely, proceed to next step.
   - If transport wheels or roller do not turn, adjust belt tension.
5. Move clutch lever to ENGAGED position.
6. Pull the machine backward; transport wheels and roller should not turn.
   - If transport wheels or roller turn, or excessive force is required to engage clutch, adjust belt tension.
   - If transport wheels and roller do not turn, proceed to next step.
7. Move clutch lever to DISENGAGED position.
8. Start engine and run at low idle. The machine should not move forward. If it does, adjust belt tension.
9. With engine running at low idle, hold machine by the handlebars to prevent it from moving. Release the brake and engage the clutch.
   - If transport wheels spin on gravel or concrete, belt is properly adjusted.
   - If transport wheels will not spin on gravel or concrete, belt adjustment is required.

Adjustment Procedure

Depending on the results in the check procedure in the previous steps, either a COARSE or FINE adjustment might be required.

- A coarse adjustment involves movement of the engine. If the machine moves quickly in NEUTRAL or if the machine will not spin the tires, a coarse adjustment is likely to be required.
- A fine adjustment involves adjustment of the cable. If the machine creeps while running at low idle in NEUTRAL, a fine adjustment is likely to be adequate.

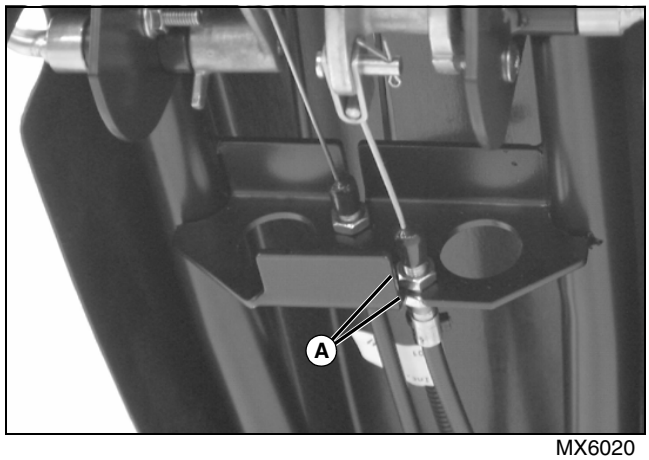
1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.



MX6008

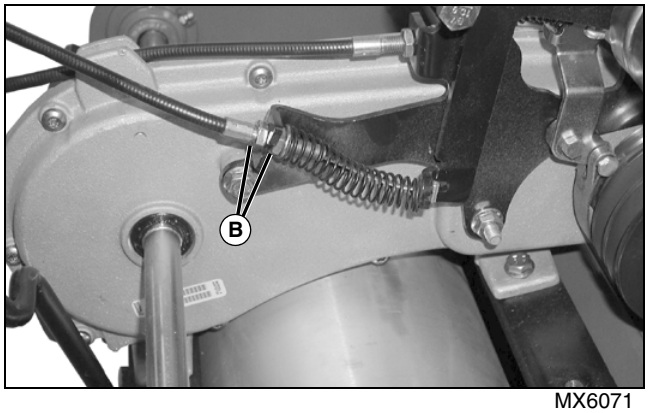
4. Remove cap screw (A) and drive belt cover (B).
5. Go to See “Determine Type of Adjustment Required” on page 98.

Determine Type of Adjustment Required

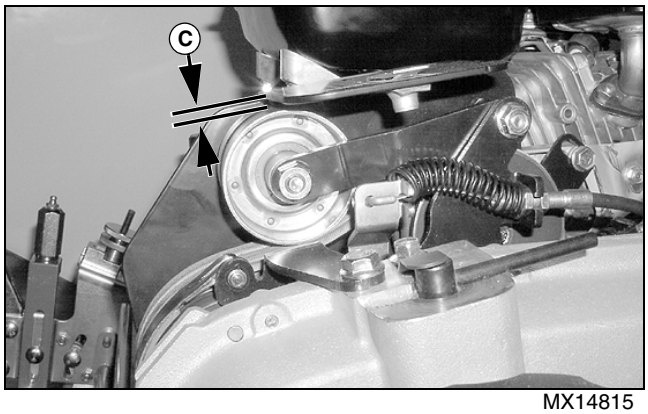


MX6020

1. Center jam nuts (A) on upper cable ferrule.

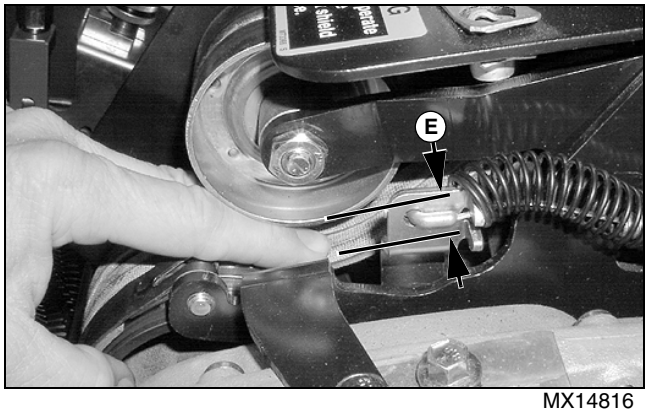


MX6071



MX14815

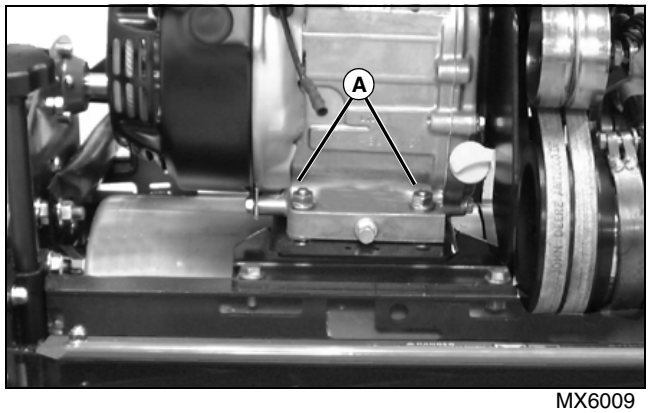
2. Adjust the lower cable anchor (B) to achieve 1-3 mm (0.039-0.118 in.) clearance (C) between the idler and the belt cover support.



MX14816

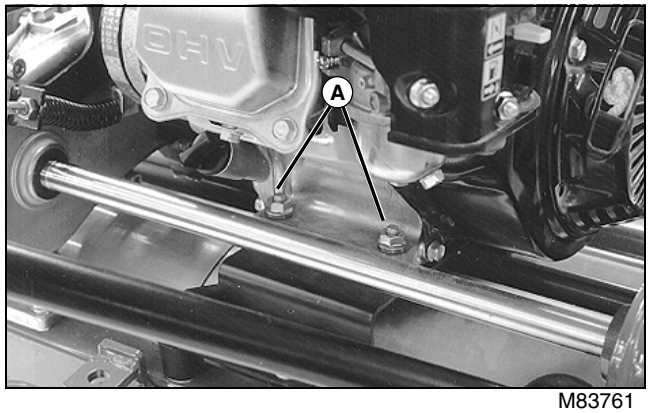
3. With the machine OFF, compress both drive belts. The distance (E) between the bottom of the idler and the top of the belt should be 12-18 mm (0.472-0.709 in.). If not, then proceed to “Coarse Adjustment Procedure” on page 99 If distance is correct, then proceed to “Fine Adjustment Procedure” on page 100

Coarse Adjustment Procedure



MX6009

Picture Note: Front of Engine



M83761

Picture Note: Rear of Engine

1. Loosen engine mounting bolts (A).

2. Slide engine forward (loosen belt) or rearward (tighten belt) to adjust belt tension until the distance between belts and idler is correct. (See “Determine Type of Adjustment Required” on page 98.)

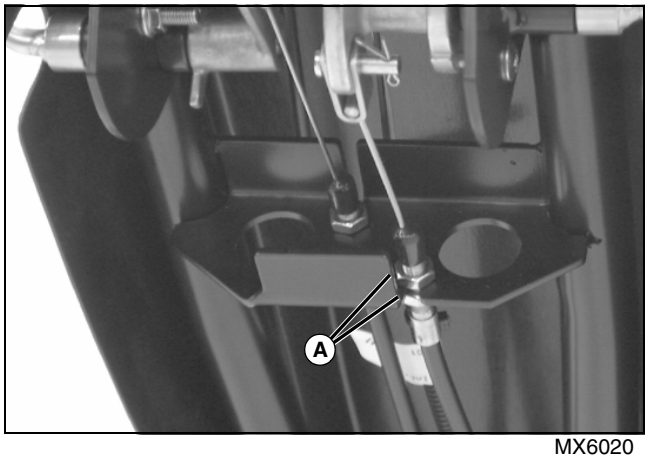
IMPORTANT: Avoid damage! Engine PTO sheave and differential gear case sheave MUST align.

3. Use a straightedge to verify that sheaves are aligned.

4. Tighten engine mounting bolts.

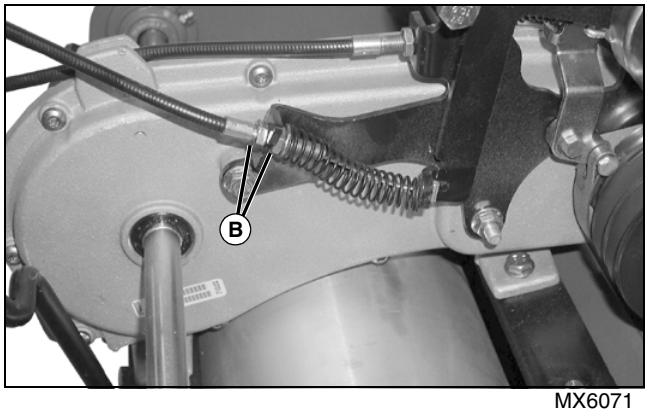
5. Go to “Fine Adjustment Procedure” on page 100.

Fine Adjustment Procedure



MX6020

1. Loosen upper cable jam nuts (A) and lengthen (decrease belt tension) or shorten (increase belt tension) ferrule length to change belt tension.
2. Tighten jam nuts to specification.
3. Repeat check procedure. (See “Check Procedure” on page 98.) If adjusting upper cable is not adequate, proceed to next step.
4. Center jam nuts (A) on upper cable ferrule.



MX6071

5. Loosen jam nuts (B).
6. Lengthen (decrease belt tension) or shorten (increase belt tension) ferrule length to change belt idler tension.
7. Repeat check procedure and readjust as necessary. (See “Check Procedure” on page 98.)
8. Install drive belt cover.

Specifications

Drive Control Cable Jam Nuts . . . . . 11 N•m (96 lb-in.)

Drive Belt Guide Adjustment

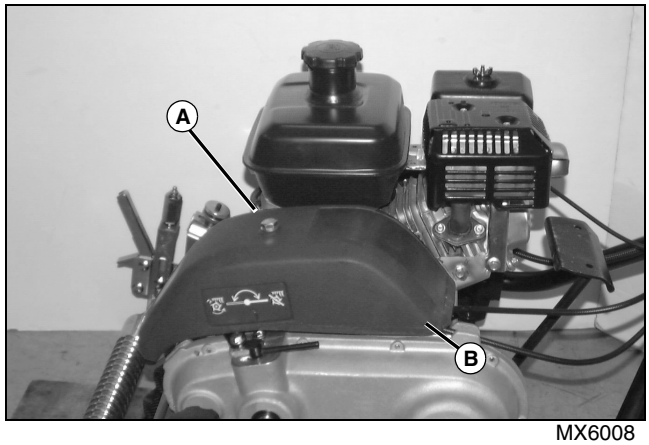
Reason

When properly adjusted, the belt guide prevents movement when the clutch is disengaged.

Procedure

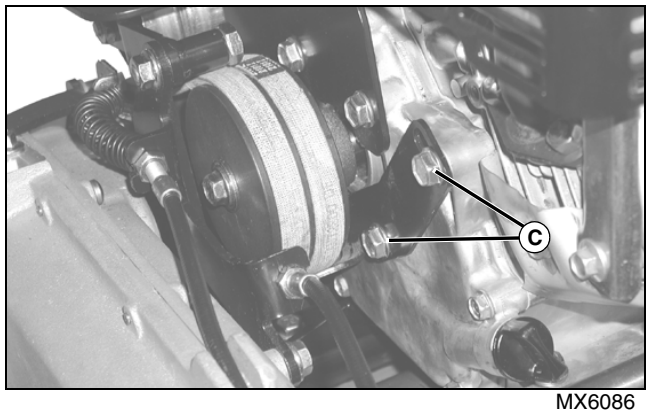
NOTE: The drive belt tension should be properly adjusted before adjusting belt guides. (See “Drive Belt Tension Check and Adjustment” on page 98.)

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to ENGAGED position.
4. Engage park brake.



MX6008

5. Remove cap screw (A) and drive belt cover (B).



MX6086

6. Loosen two cap screws (C), and adjust bracket until clearance between belt and guide is to specification.
7. Tighten guide mounting bolts.
8. Replace drive belt cover.

Specifications

Drive Belt-to-Guide Clearance . . . . . 1 mm (0.040 in.)

Traction Roller Adjustment

Reason

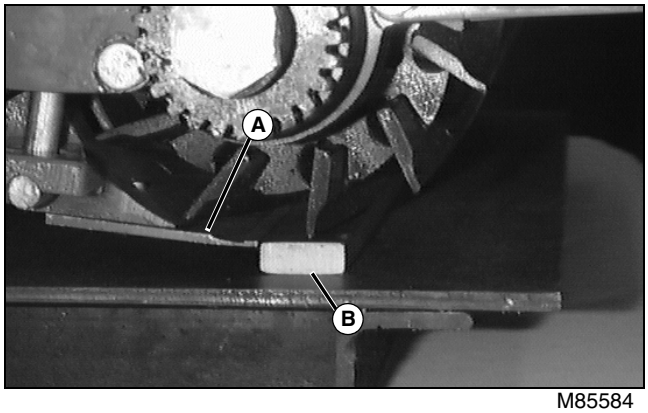
In order to ensure an even, level cut, the traction roller must be parallel to the reel.

Special or Required Tools

Tool Name	Tool No.	Tool Use
#006 Flat Bench Plate	NA	Used with feeler gauge to measure front roller gap.
Feeler Gauge Set (Blade Type)	NA	Used to measure gap at ends of front roller.

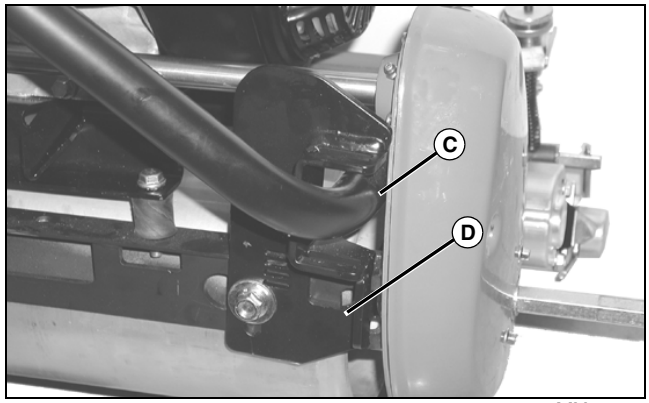
Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Remove grass catcher.
6. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)



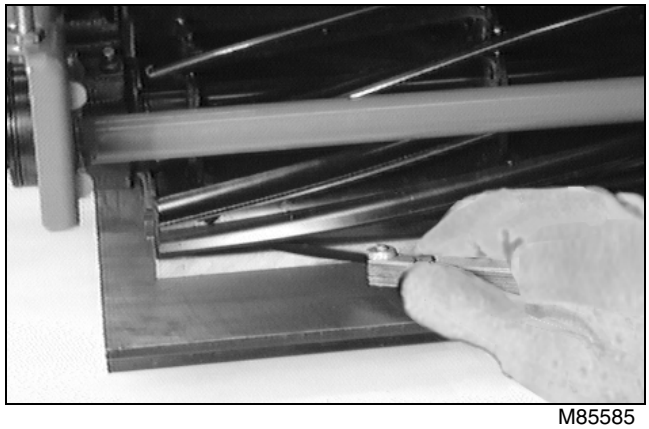
M85584

7. Place the machine on a flat bench plate so that the bed knife (A) contacts the rear edge of the support bar (B).

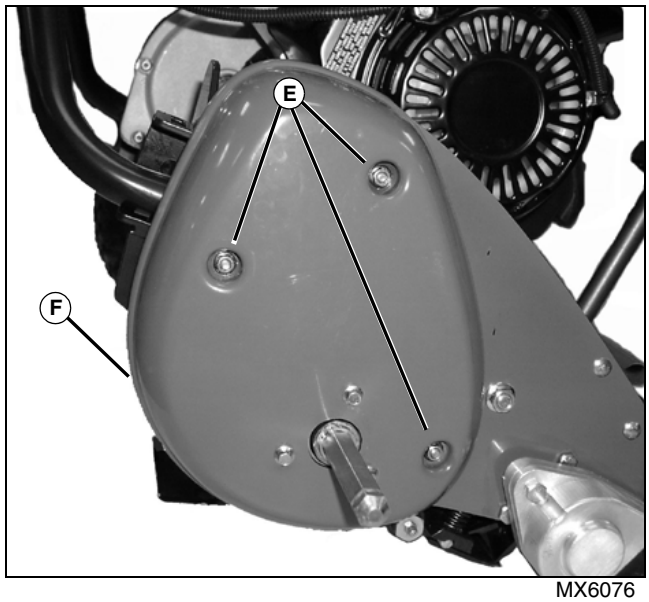


MX6088

8. Support handlebars (C) so that they are centered in each support bracket (D). DO NOT lift the traction roller off bench plate.

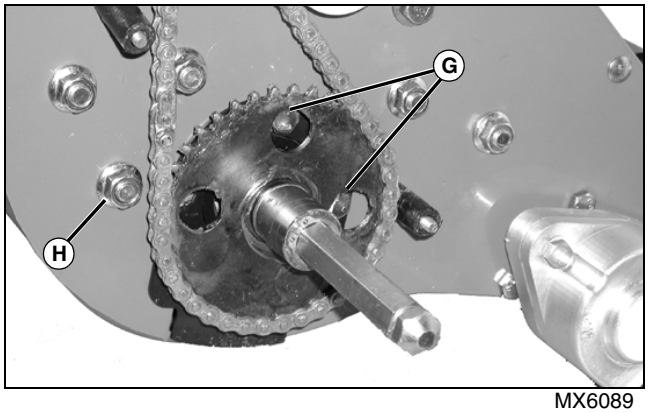

M85585

9. Check gap at each end of reel. If gap is within specification, no adjustment is necessary. If adjustment is required, proceed to next step.



MX6076

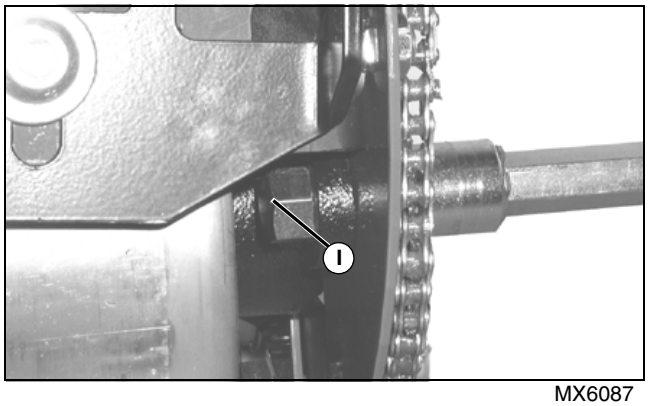
10.Remove flange nuts (E) and remove right drive cover (F).



MX6089

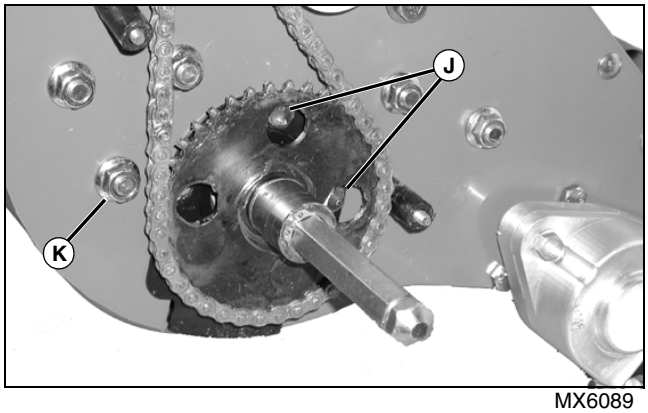
11.Rotate roller until holes in sprocket align with bearing holder cap screws (G). Loosen two cap screws.

12.Loosen nut (H) attached to eccentric screw.



MX6087

13.Position eccentric dot (I) at position as shown. Rotate eccentric until gap at ends of reel is less than specification.



MX6089

14.Tighten eccentric screw and nut (K) and bearing holder cap screws (J).

15.Install drive cover.

16.Install transport wheels and drive collars (if equipped). (See “Transport Wheel Removal and Installation” on page 172.)

Specifications

Front Roller Gap (Max, Check Each End) . . . . . 0.1 mm (0.004 in.)
Eccentric Screw and Nut Torque . . . 22 N•m (192 lb-in.)
Bearing Holder Cap Screw Torque . . 22 N•m (192 lb-in.)

Traction Roller Drive Chain Tension Adjustment

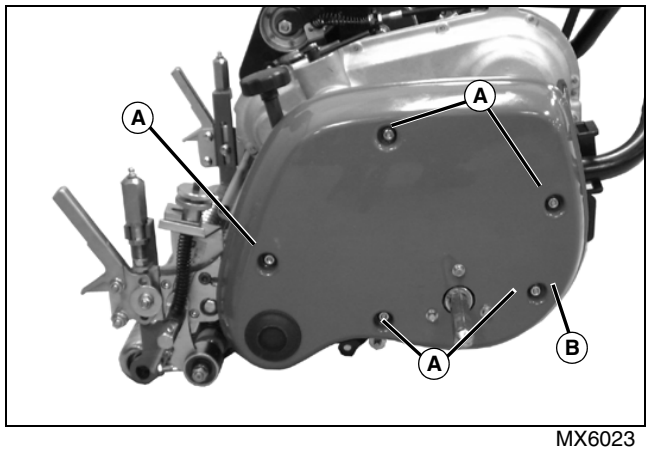
Reason

To maintain proper chain tension.

Procedure

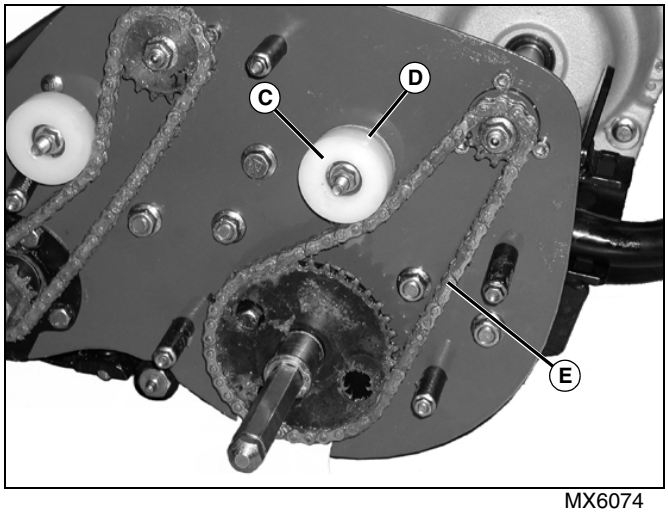
CAUTION: Avoid injury! Block machine securely before servicing or repairing.

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake
5. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)



MX6023

6. Remove five flange nuts (A) and remove left drive cover (B).



MX6074

7. Loosen nut (C) and reposition idler pulley (D) until chain (E) deflects to specification at mid span opposite idler.

8. Tighten cap screw.

9. Install cover and transport wheels (if equipped).

10. Repeat procedure for opposite side.

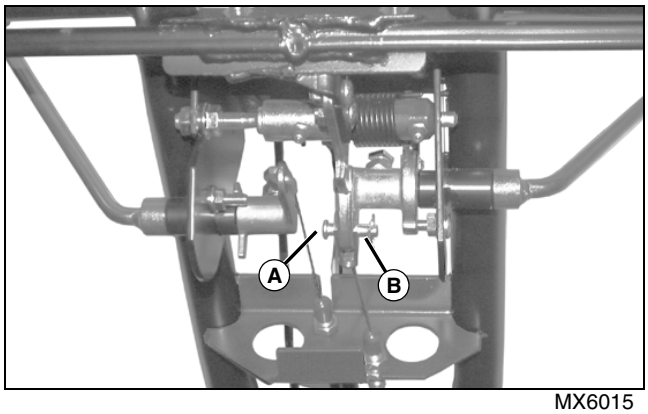
Specifications

Traction Roller Drive Chain Deflection (Max at Mid Span Opposite Idler) . . . . . 11 mm (0.43 in.)

Repair

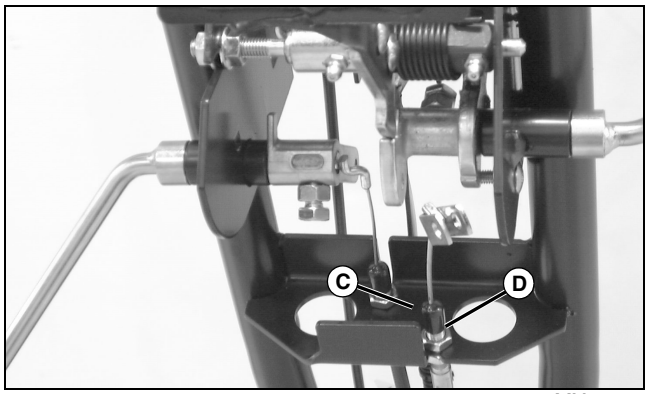
Clutch Control Cable Removal and Installation

1. Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)



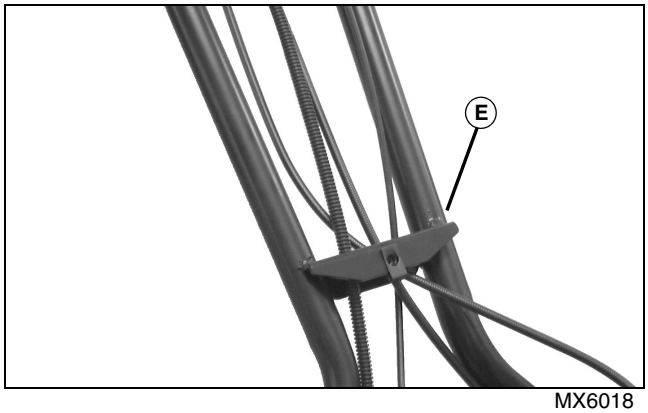
MX6015

2. Remove cotter pin (B) and pin (A).



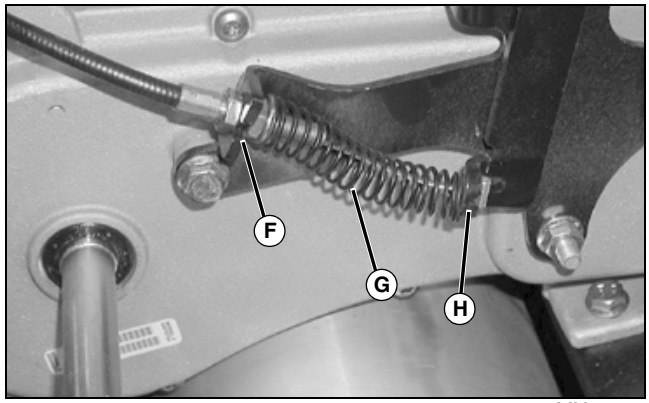
MX6017

3. Slide cap (C) off cable housing.
4. Remove top nut (D).
5. Pull cable back until cable housing clears slot.



MX6018

6. Route cable through slotted hole in lower handlebar bracket (E).



MX6071

7. Compress spring (G); disconnect clutch cable end (H) from bracket.
8. Remove spring.
9. Remove jam nut (F) and slide cable end from bracket.

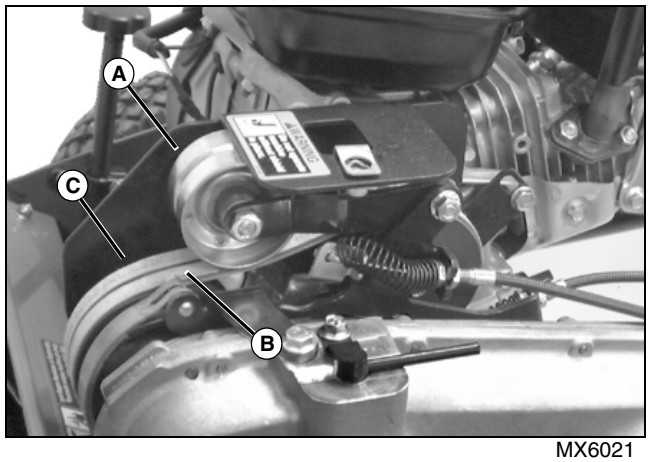
Installation

Installation is done in the reverse order of removal.

Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)

Drive Belt Replacement

1. Remove engine and belts. (See “Engine Removal and Installation” on page 43.)



MX6021

2. Install new belts on gear case sheaves (B and C).

NOTE: Belts must be routed UNDER tension idler (A).

3. Install engine on support and install belts on engine PTO sheaves. DO NOT tighten engine mounting bolts at this time.

IMPORTANT: Avoid damage! Engine PTO sheaves MUST align with gear case sheaves.

4. Move engine rearward to tighten belts.

5. Tighten engine mounting bolts.

6. Align belt guide. (See “Drive Belt Guide Adjustment” on page 100.)

7. Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)

Differential Gear Case Removal and Installation

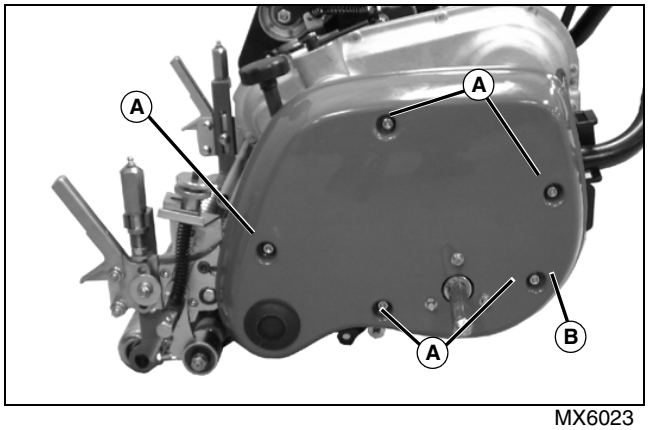
Removal

1. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)

2. Remove engine and belts. (See “Engine Removal and Installation” on page 43.)

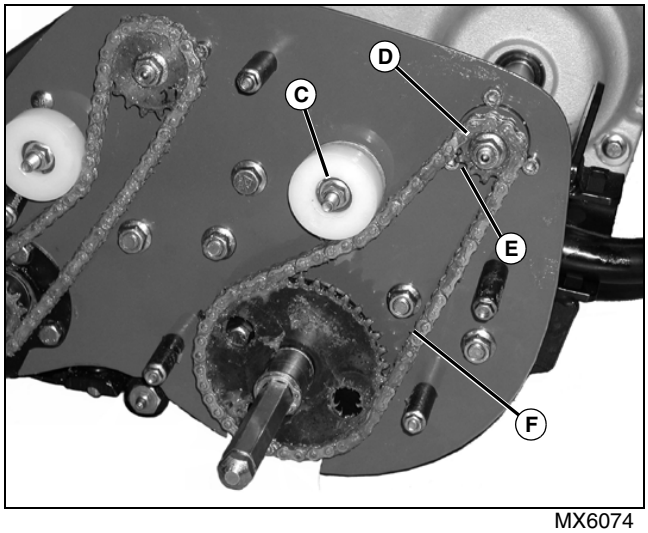
3. Disconnect clutch cable from gear case. (See “Clutch Control Cable Removal and Installation” on page 104.)

4. Disconnect park brake cable from gear case. (See “Park Brake Cable Replacement” on page 138.)



MX6023

5. Remove five flange nuts (A), and remove left drive cover (B).



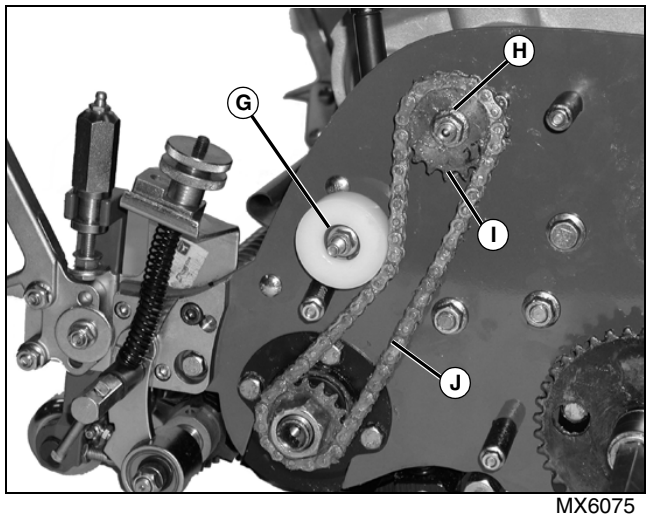
MX6074

6. Loosen nut (C) on idler pulley to release chain tension.

7. Remove nut (D) from output shaft.

8. Remove sprocket (E) and traction roller drive chain (F) as a unit.

9. Remove key from output shaft.



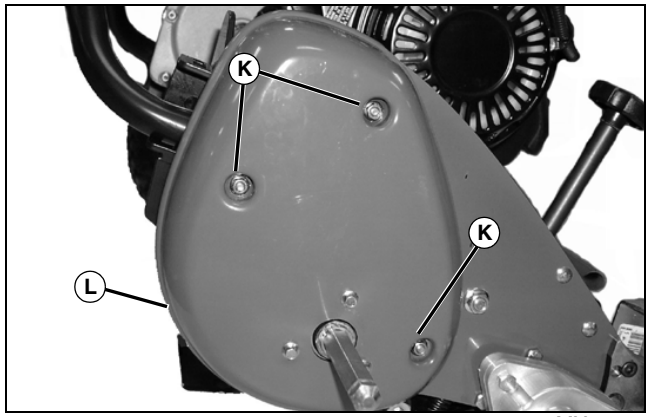
MX6075

10. Loosen nut (G) on idler pulley to release chain tension.

11. Remove nut (H) from output shaft.

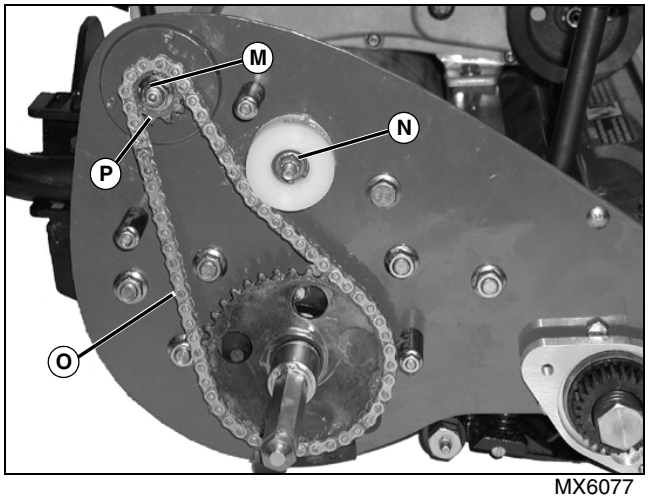
12. Remove sprocket (I) and traction roller drive chain (J) as a unit.

13. Remove key from output shaft.



MX6076

14. Remove three flange nuts (K) and right drive cover (L).



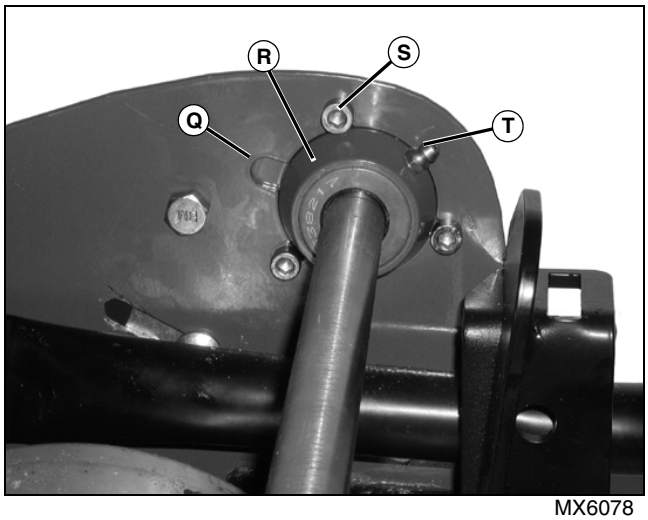
MX6077

15.Loosen nut (N) on idler pulley to release chain tension.

16.Remove nut (M) from output shaft.

17.Remove sprocket (P) and traction roller drive chain (O) as a unit.

18.Remove key from output shaft.

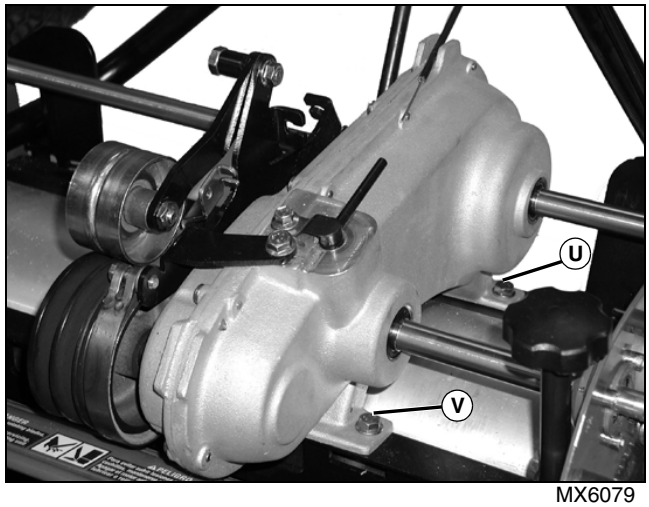


MX6078

19.Remove three allen screws (S) from right side plate.

20.Rotate bearing housing assembly (R) until grease fitting (T) aligns with notch (Q) in frame.

21.Remove right bearing housing assembly (R).



MX6079

22.Remove two front mounting cap screws (V).

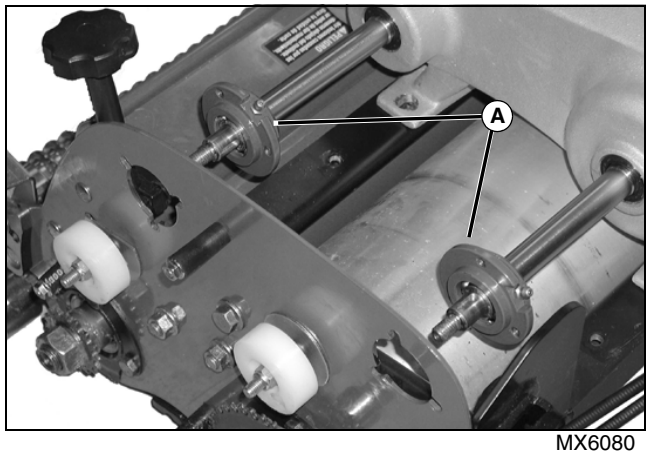
23.Remove two rear mounting cap screws (U).

24.Slide differential gear case assembly to the right and remove output shafts from left bearing housing assemblies.

Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! To aid in installation and prevent damage to bearings and seals, remove left side bearing housing assemblies (A) and install onto shafts before sliding differential gear case assembly into place.



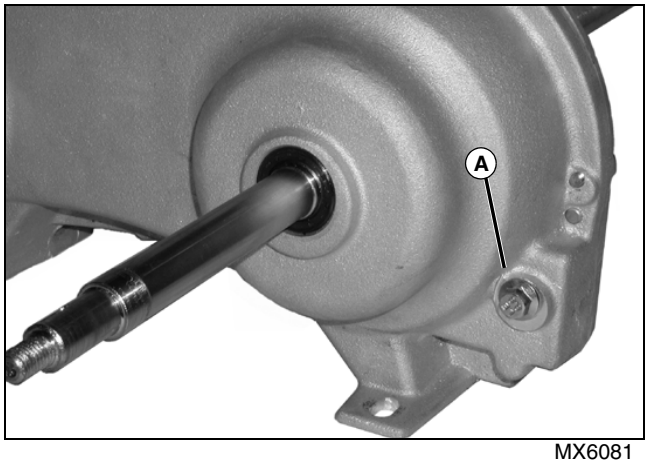
MX6080

- Fill differential gear case assembly with oil meeting specifications. (See “Differential Gear Case Oil” on page 12.)
- Adjust drive chain tension. (See “Traction Roller Drive Chain Tension Adjustment” on page 102.)
- Adjust drive belt tension. (See “Drive Belt Tension Check and Adjustment” on page 98.)

- Align belt guide. (See “Drive Belt Guide Adjustment” on page 100.)
- Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)
- Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)

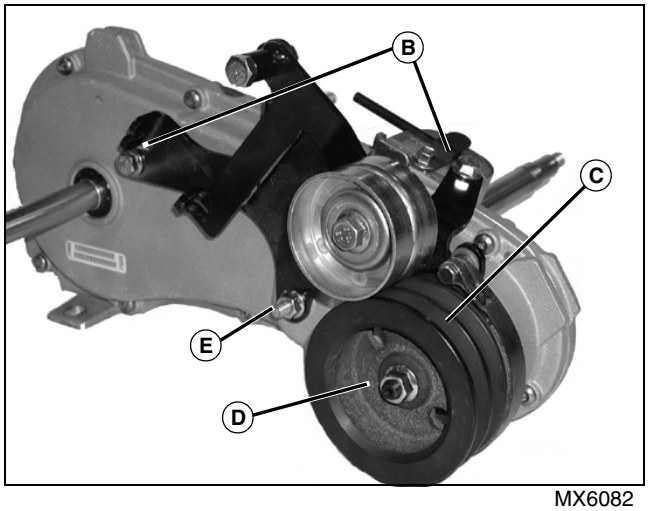
Differential Gear Case Disassembly and Inspection

NOTE: Differential gear case oil capacity is approximately 0.4 L (0.4 qt).



MX6081

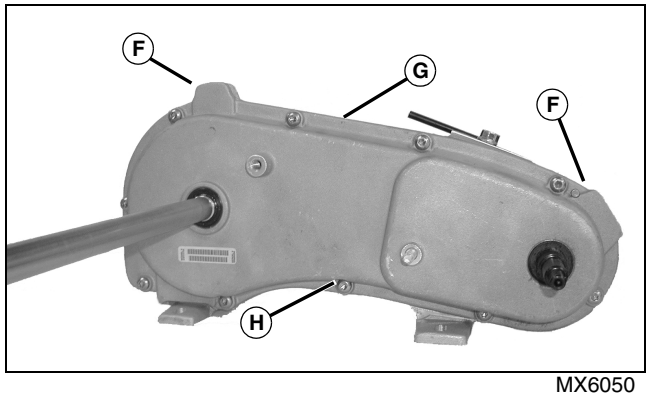
1. Remove drain plug (A) and drain oil into properly marked container.



MX6082

2. Remove nut (D) from pulley (C) and remove pulley and key.

3. Remove cap screws (B) and nut (E). and remove bracket with idler pulley from differential gear case.

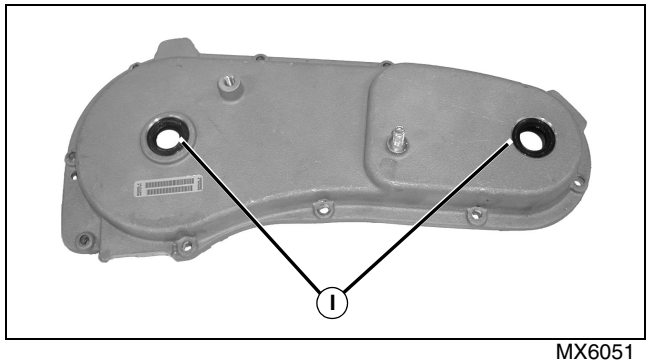


MX6050

4. Remove 10 screws (H).

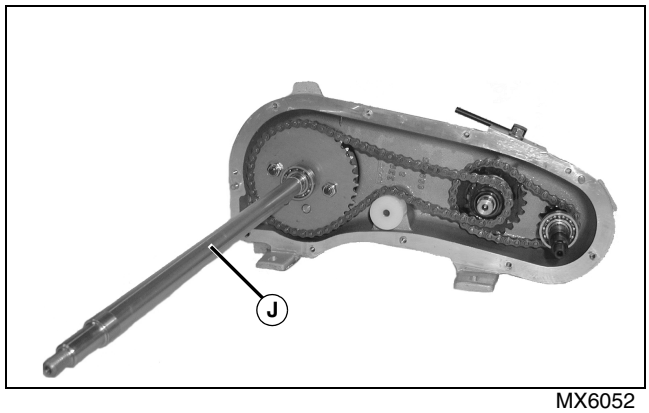
NOTE: Do not pry against gasket face of castings. Pry cover and case apart between tabs (F).

5. Remove cover (G).



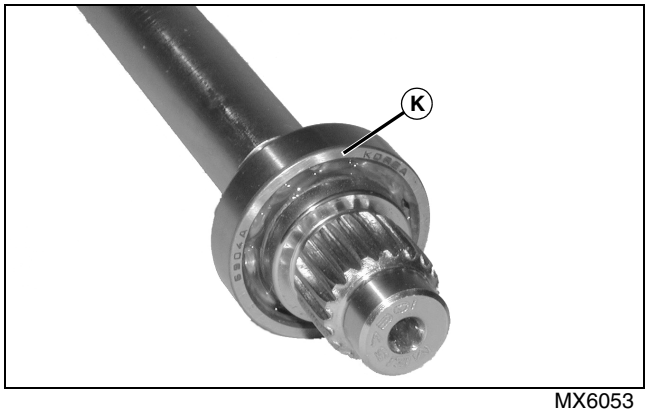
MX6051

6. Remove seals (I) from cover.



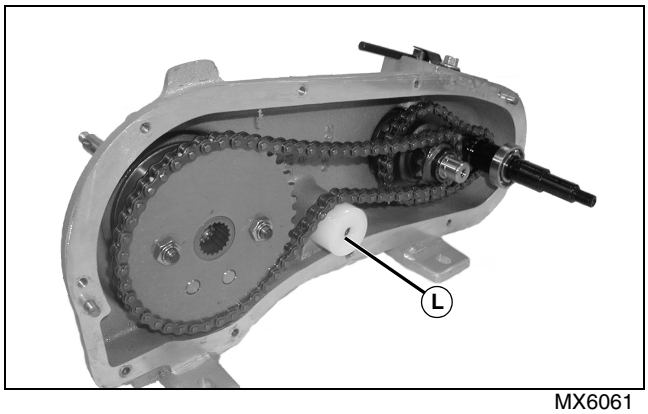
MX6052

7. Remove right output shaft (J).



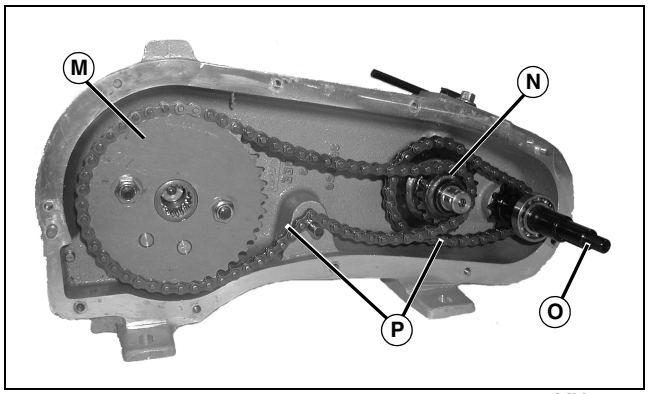
MX6053

8. Inspect bearing (K) from right output shaft. Replace bearing if worn or damaged.



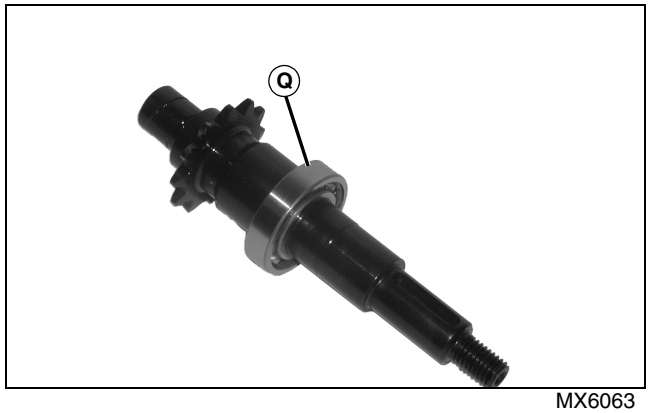
MX6061

9. Remove chain tensioner (L).



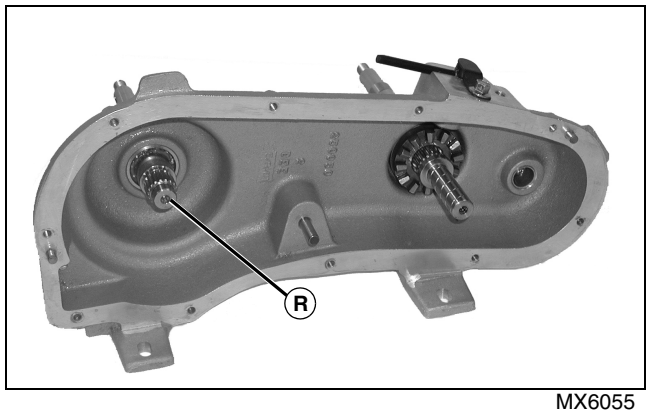
MX6054

10.Remove differential assembly (M), sprocket weldment (N), chains (P), and input shaft assembly (O) as a unit.



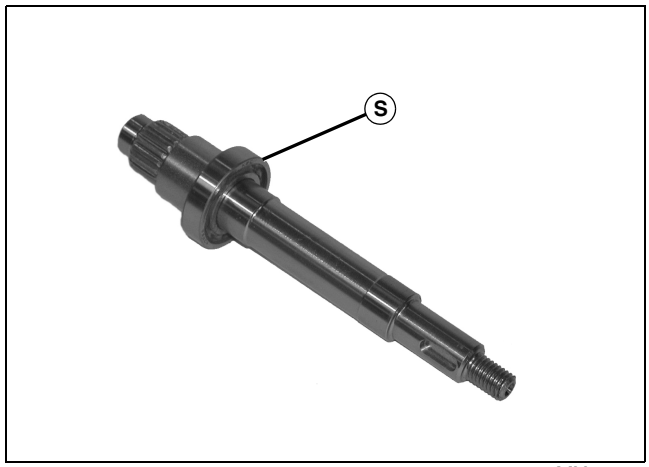
MX6063

11.Inspect bearing (Q) on input shaft assembly. Replace bearing if worn or damaged.



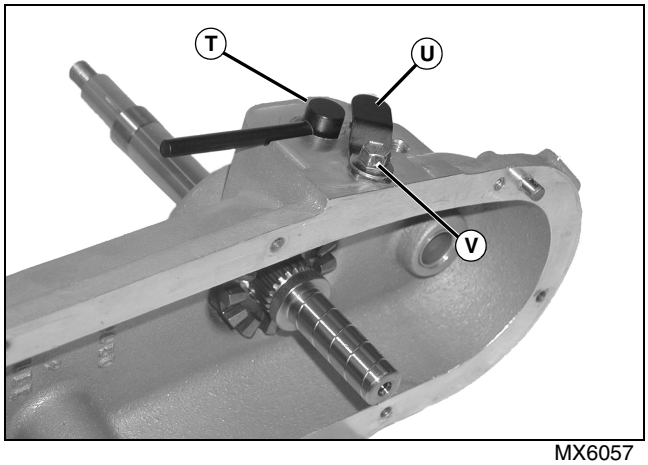
MX6055

12.Remove left output shaft (R).



MX6056

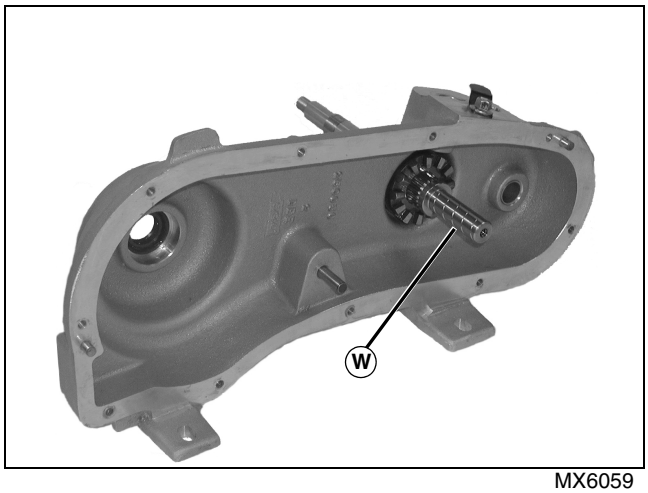
13.Inspect bearing (S) in left rear output shaft. Replace bearing if worn or damaged.



MX6057

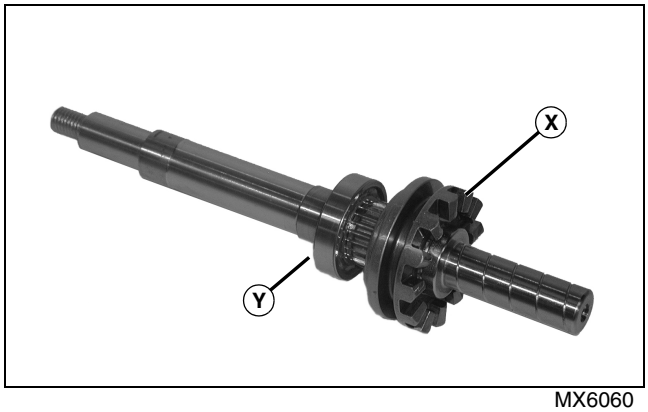
14.Loosen cap screw (V), move tab (U) and remove clutch handle (T).

15.Inspect O-ring and eccentric on reel clutch handle (T).



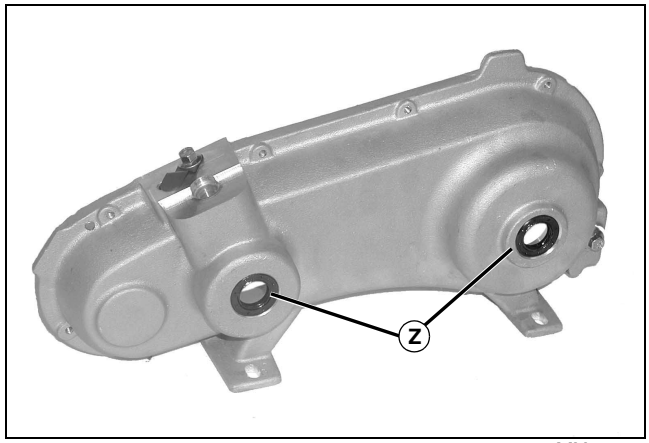
MX6059

16.Remove reel output shaft assembly (W).



MX6060

17.Remove bearing (Y) and shift collar (X) from reel output shaft.



MX6064

18.Remove seals (Z) from case.

19.Remove gasket material from mating surfaces.

CAUTION: Avoid injury! Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

20.Clean all metal parts with solvent and blow dry with compressed air.

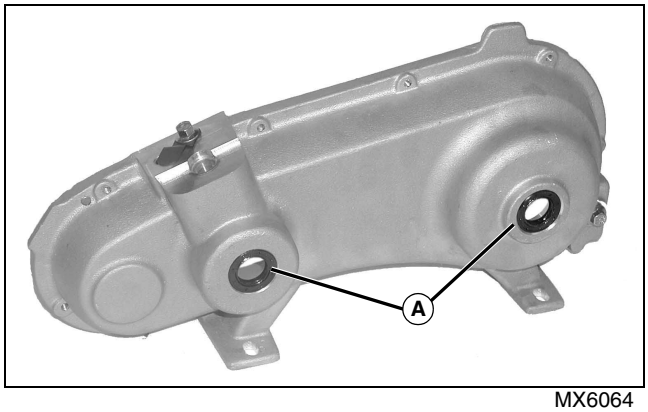
21.Inspect all parts for damage, nicks or unusual wear. Replace parts as necessary.

Differential Gear Case Assembly

IMPORTANT: Avoid damage! Always use new seals and O-rings. Damaged or used parts will leak.

NOTE: Lubricate all seals and O-rings with multi-purpose grease during installation.

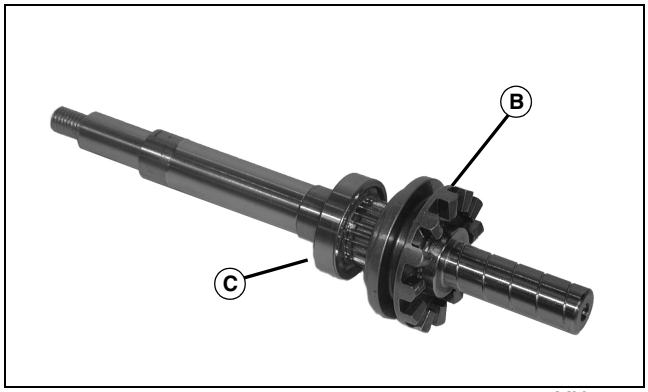
Apply clean oil to all internal parts during assembly. (See "Differential Gear Case Oil" on page 12.)



MX6064

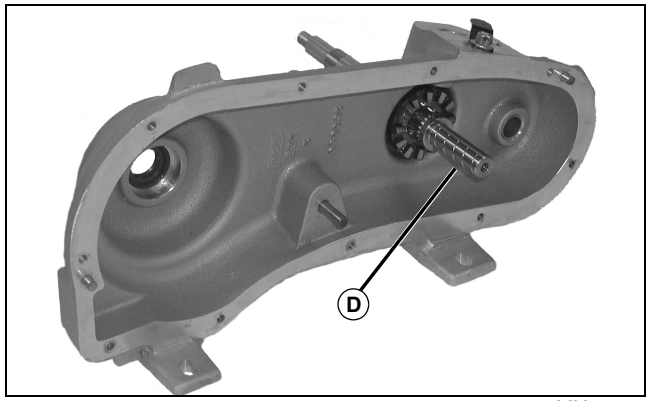
1. Install new seals (A).

NOTE: Make sure bearing is fully seated in housing.



MX6060

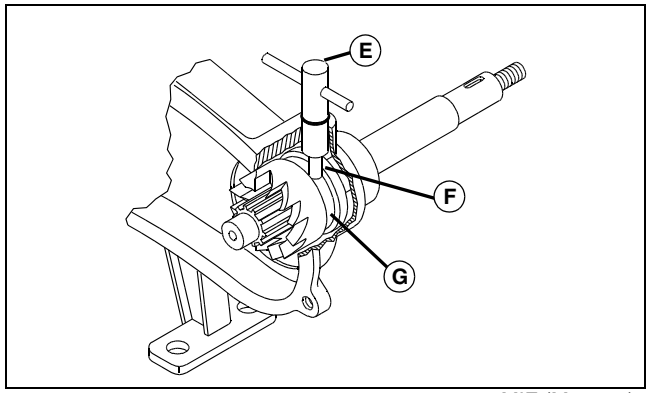
2. Install shift collar (B) and bearing (C) to reel output shaft.



MX6059

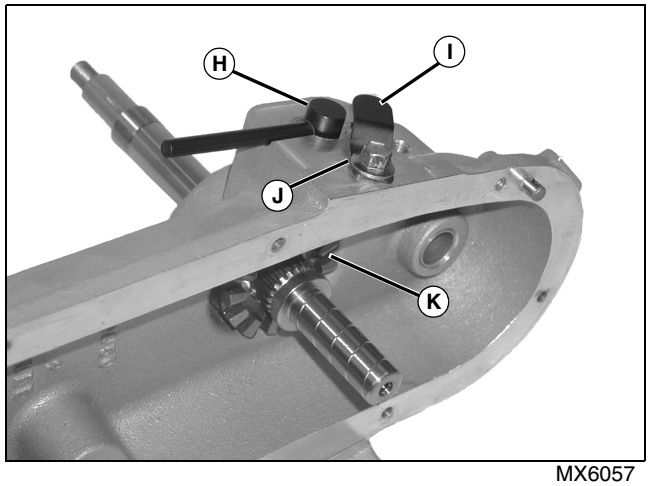
3. Install reel output shaft assembly (D).

NOTE: Align pin on reel clutch handle with groove in shift collar.



MIF (M83817)

4. Install reel clutch handle (E) with pin (F) in groove (G).

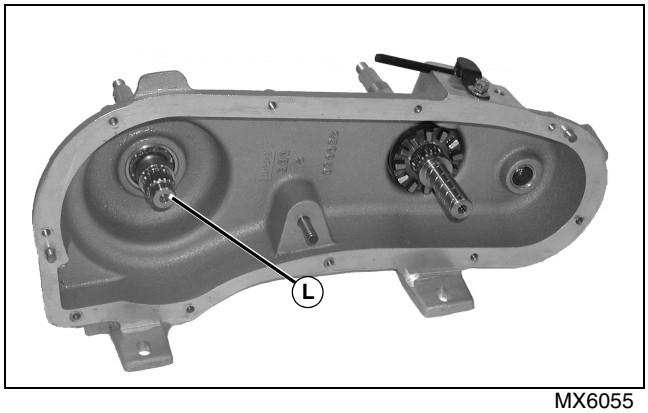


MX6057

5. Slide tab (I) directly over reel clutch handle (H) and tighten cap screw (J).

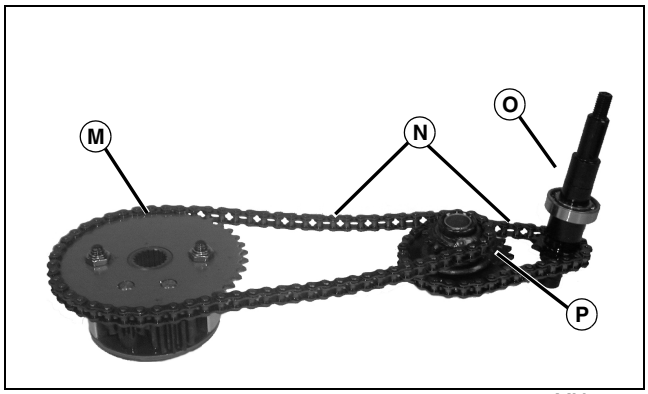
6. Rotate reel clutch handle to engage position and back to disengaged position several times to make sure shift collar (K) moves freely.

NOTE: Make sure left rear output shaft bearing is fully seated in housing.



MX6055

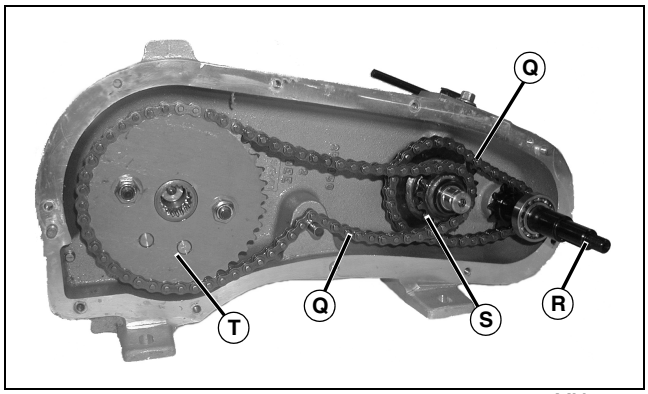
7. Install left rear output shaft (L).



MX6062

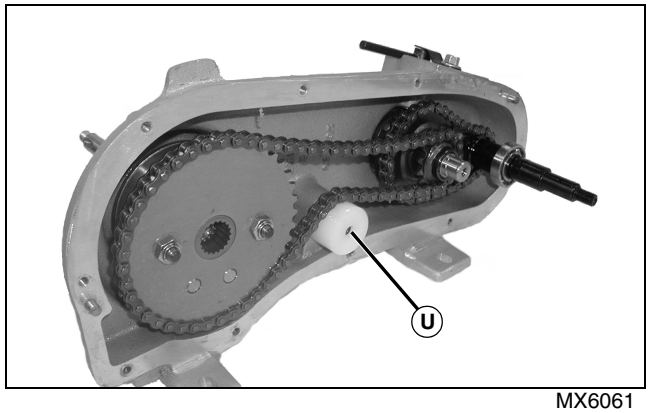
8. Place differential assembly (M), sprocket weldment (P), and input shaft assembly (O) on a bench and attach with both chains (N).

NOTE: Make sure input shaft with bearing is fully seated in differential gear case.



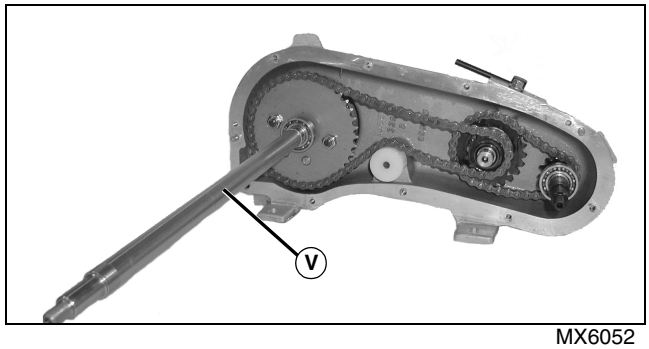
MX6054

9. Install differential assembly (T), sprocket weldment (S), chains (Q), and input shaft (R) as a unit into differential gear case.



MX6061

10.Install chain tensioner (U).

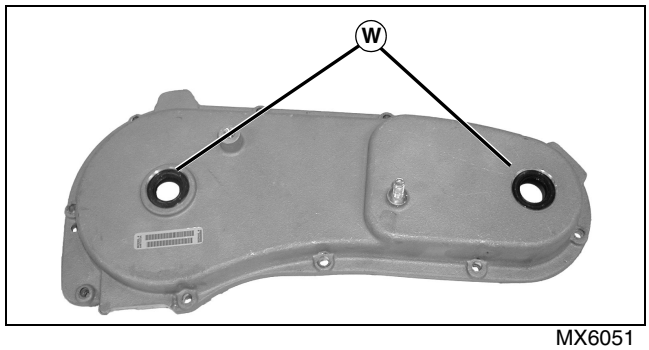


MX6052

11.Install right output shaft (V) into differential assembly.

12.Rotate input shaft assembly and make sure that entire assembly rotates freely.

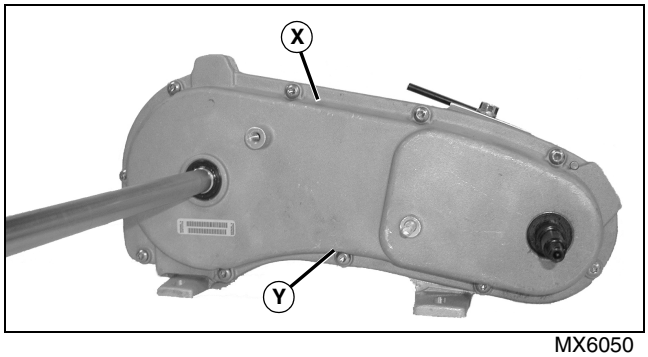
IMPORTANT: Avoid damage! Apply multipurpose grease to lips of seals and wrap ends of right output shaft and input shaft with tape to prevent damage to seal when installing cover.



MX6051

13.Install new seals (W) in cover.

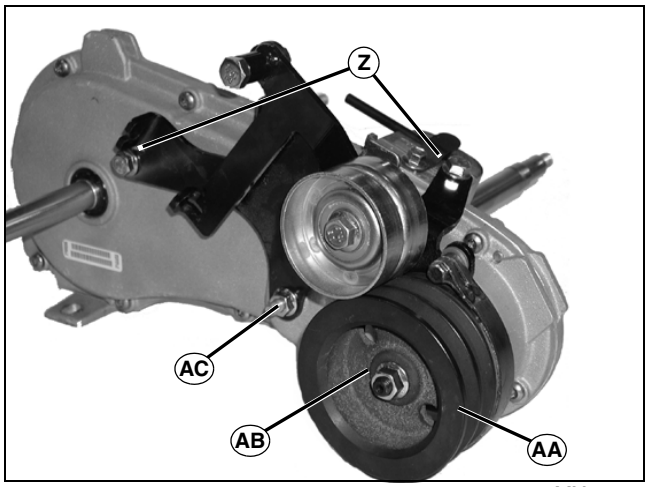
NOTE: Make sure that mounting holes are completely surrounded with gasket material before installing cover.



MX6050

14.Apply gasket material to mating surface of differential gear case (X).

15.Install cover and secure with 10 cap screws (Y).



MX6082

16.Install bracket with idler pulley assembly using two cap screws (Z) and one nut (AC).

17.Install input shaft key, pulley (AA) and tighten with nut (AB).

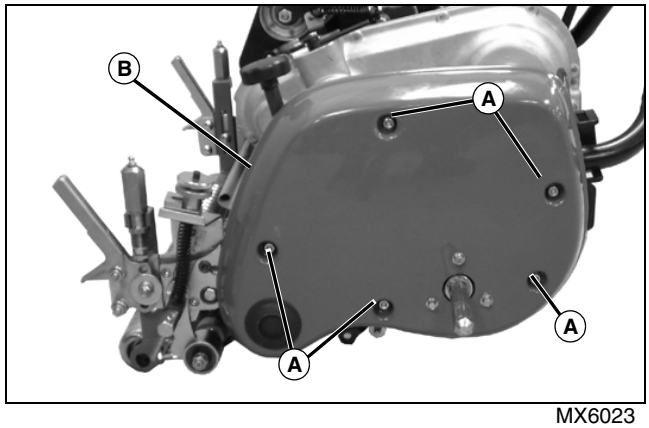
18.Fill differential gear case to proper level with oil meeting specifications. (See “Differential Gear Case Oil” on page 12.)

Traction Roller Assembly Removal and Installation

NOTE: Earlier models having snap rings retaining the sprocket to the hex axle shafts are shown throughout this procedure. The procedure for later models, that retain the sprockets with nuts, is similar.

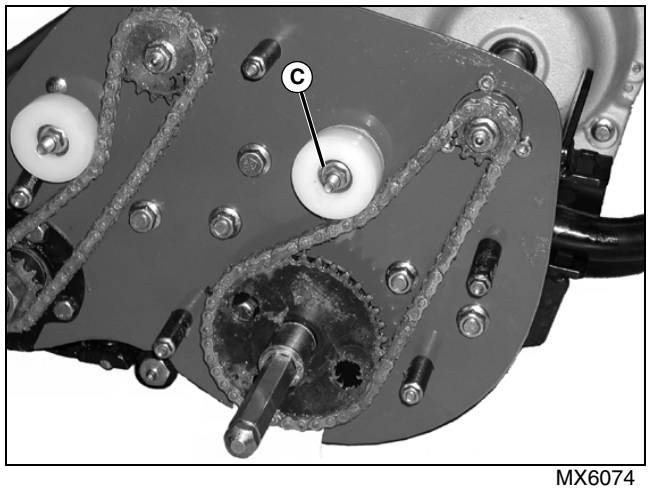
Later Models: If the sprocket nut is to be removed, hold axle shaft using a deep-well socket or box end wrench. (See “Models Equipped with Partial Hex Axle” on page 117 for more information.)

1. Remove transport wheels and drive collars (if equipped). (See “Transport Wheel Removal and Installation” on page 172.)



MX6023

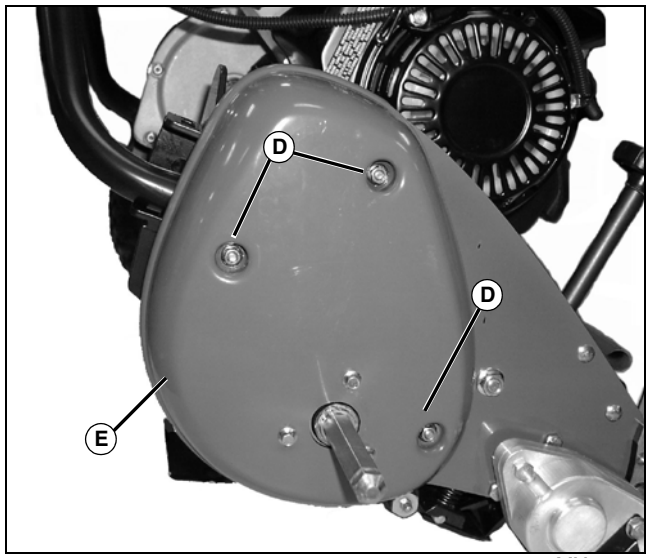
2. Remove five flange nuts (A) and remove left drive cover (B).



MX6074

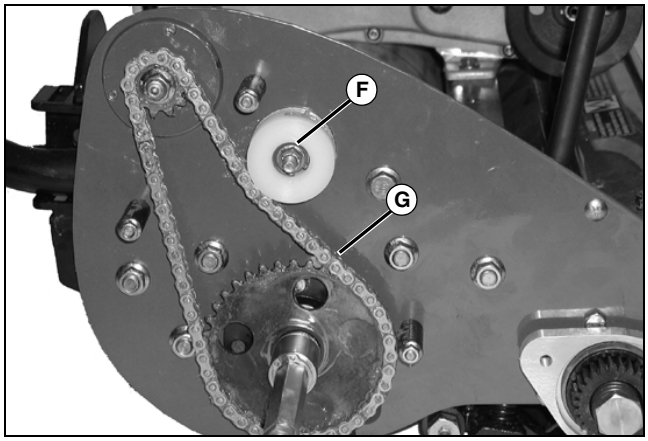
3. Loosen nut (C) on idler pulley to release chain tension.

4. Disconnect master link and remove traction roller drive chain.



MX6076

5. Remove three flange nuts (D) and cover (E).

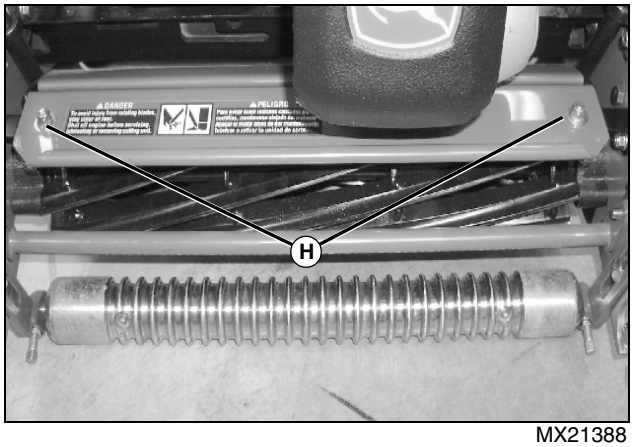


MX6077

Picture Note: Early model shown

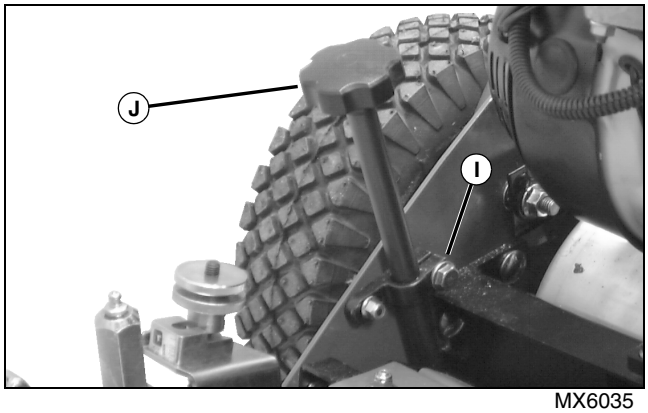
6. Loosen nut (F) on idler pulley to release chain tension.

7. Disconnect master link and remove traction roller drive chain (G).



MX21388

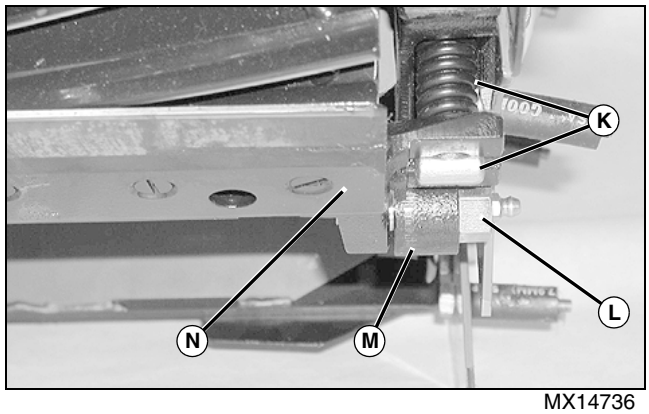
8. Loosen both reel shield cap screws (H).



MX6035

9. Loosen clamp screw (I) on both sides of mower. Loosen and remove bed knife adjusters (J).

NOTE: Bed knife bracket shoulder bolts are retained in housing brackets (M), and cannot be completely removed.

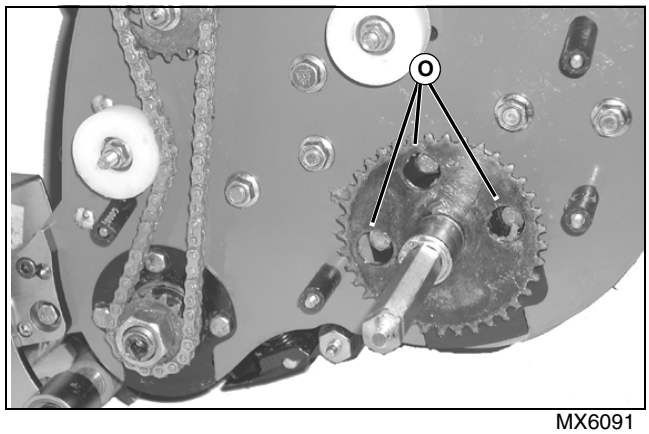


MX14736

10.Remove T-bolts and springs (K) on both sides.

11.Loosen shoulder bolts from both sides of bed knife support bracket. (L).

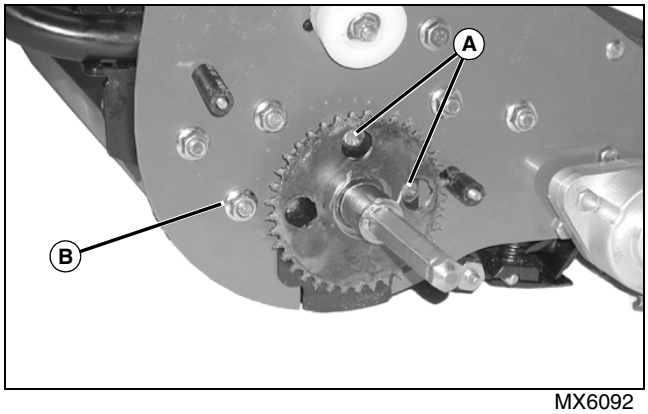
12.Remove bed knife support assembly bracket (N).



MX6091

Picture Note: Early model shown

13.**Left Side:** Rotate roller until holes in sprocket align with bearing holder cap screws (O). Remove three cap screws.



MX6092

Picture Note: Early model shown

14.**Right Side:** Rotate roller until holes in sprocket align with bearing holder cap screws (A). Remove two cap screws.

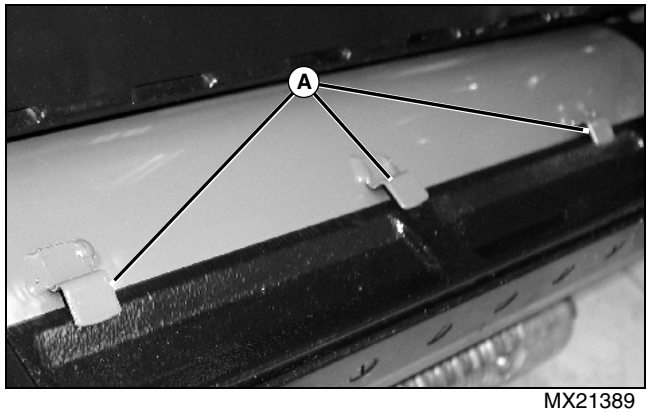
15.Remove bearing holder eccentric screw and nut (B).

16.Lift mower and remove traction roller assembly.

Installation

Installation is done in the reverse order of removal.

- Tighten bed knife bracket shoulder bolts to specification.
- Adjust traction roller. (See “Traction Roller Adjustment” on page 101.)
- Adjust drive chain tension. (See “Traction Roller Drive Chain Tension Adjustment” on page 102.)
- Adjust bed knife clearance. (See “Bed Knife-to-Reel Adjustment” on page 151.)



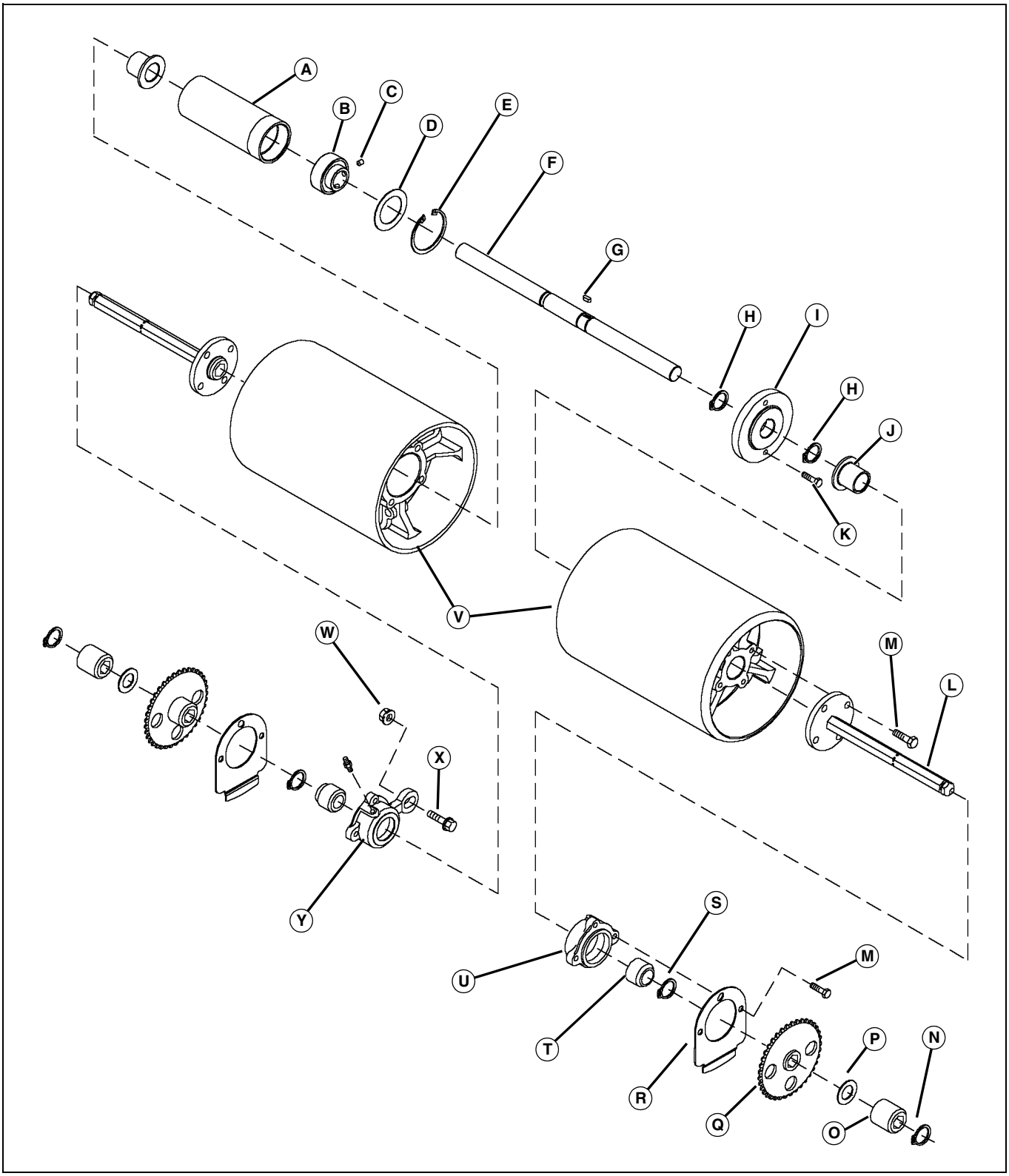
MX21389

- When installing bed knife support assembly make sure reel shield tabs are engaged (A).

Bed Knife Bracket Shoulder Bolt
Torque . . . . . 27 N•m (20 lb-ft)

Traction Roller Assembly Disassembly and Assembly

Models Equipped with Full Hex Axle



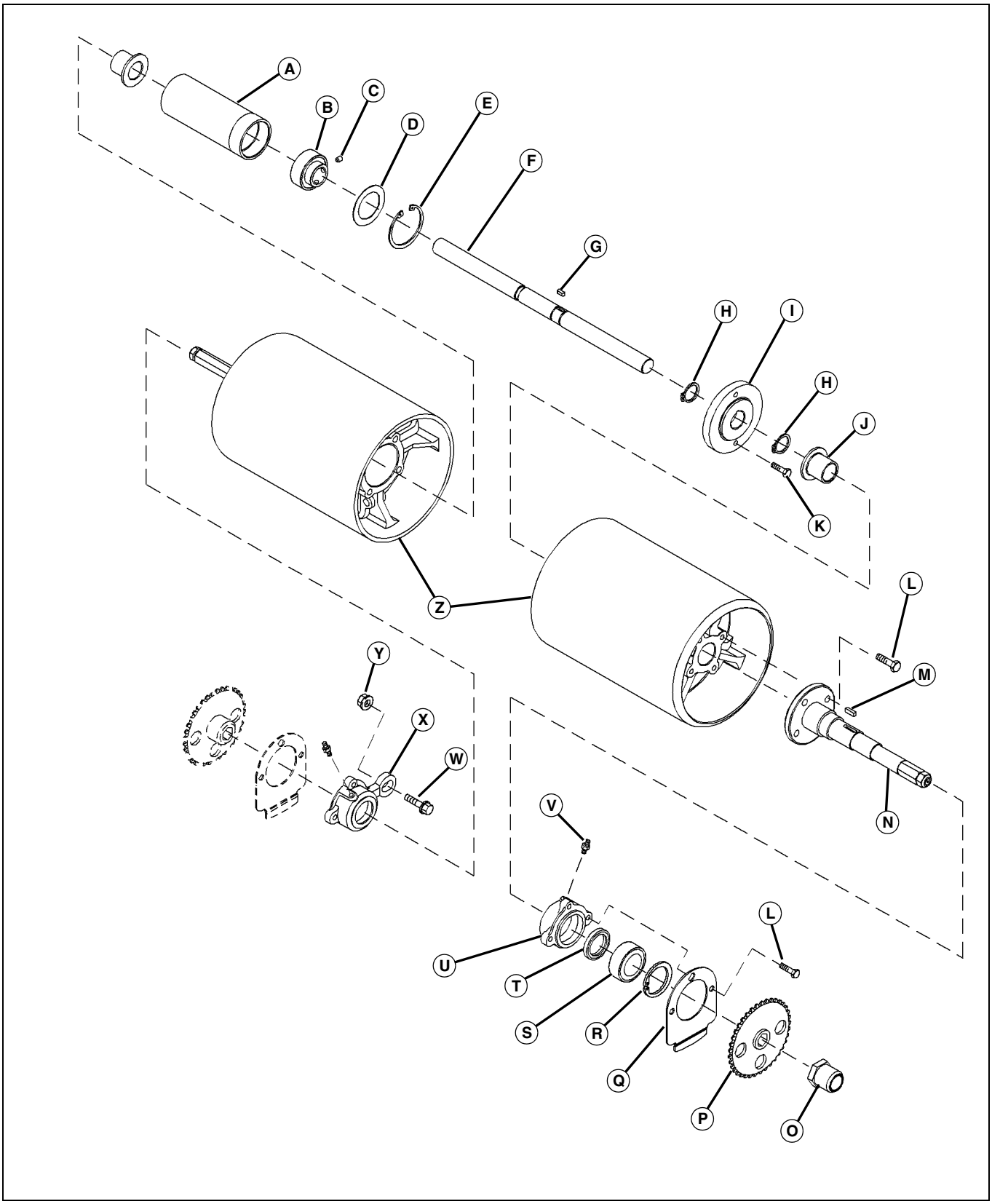
MX6084

A - Bushing
B - Bearing
C - Set Screw
D - Washer
E - Snap Ring
F - Shaft
G - Shaft Key
H - Snap Ring (2 used)
I - Flange
J - Bushing (2 used)
K - Screw (2 used)
L - Axle (2 used)
M - Cap Screw (13 used)
N - Snap Ring (2 used)
O - Spacer (2 used)
P - Washer (as required)
Q - Sprocket (2 used)
R - Cover (2 used)
S - Snap Ring (2 used)
T - Bearing (2 used)
U - Housing (2 used)
V - Roller (2 used)
W - Nut
X - Eccentric
Y - Housing

- Inspect all parts for wear or damage. Replace parts as necessary.

- Apply Non-Clay High Temperature EP Grease (North America) or Grease-Gard (Europe) to lubricate fittings and pack inside of tube.

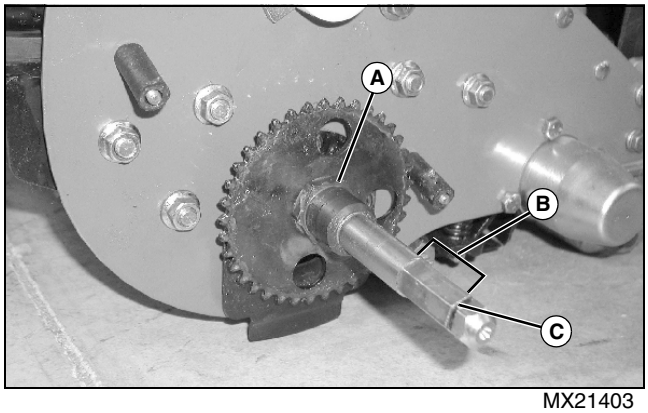
Models Equipped with Partial Hex Axle



MX21369

A - Bushing
B - Bearing
C - Set Screw
D - Washer
E - Snap Ring
F - Shaft
G - Shaft Key
H - Snap Ring (2 used)
I - Flange
J - Bushing (2 used)
K - Screw (2 used)
L - Cap Screw (13 used)
M - Key (2 used)
N - Axle (2 used)
O - Nut (2 used)
P - Sprocket (2 used)
Q - Cover (2 used)
R - Snap Ring (2 used)
S - Bearing (2 used)
T - Seal (2 used)
U - Housing, Left Side
V - Grease Fitting (2 used)
W - Eccentric
X - Housing, Right Side
Y - Nut
Z - Roller (2 used)

IMPORTANT: Avoid damage! Tip of axle is not strong enough to hold axle and can twist off when removing or installing sprocket retaining nut. Use a deep-well socket or box end wrench on portion of hex that drives the wheel to keep axle from turning.

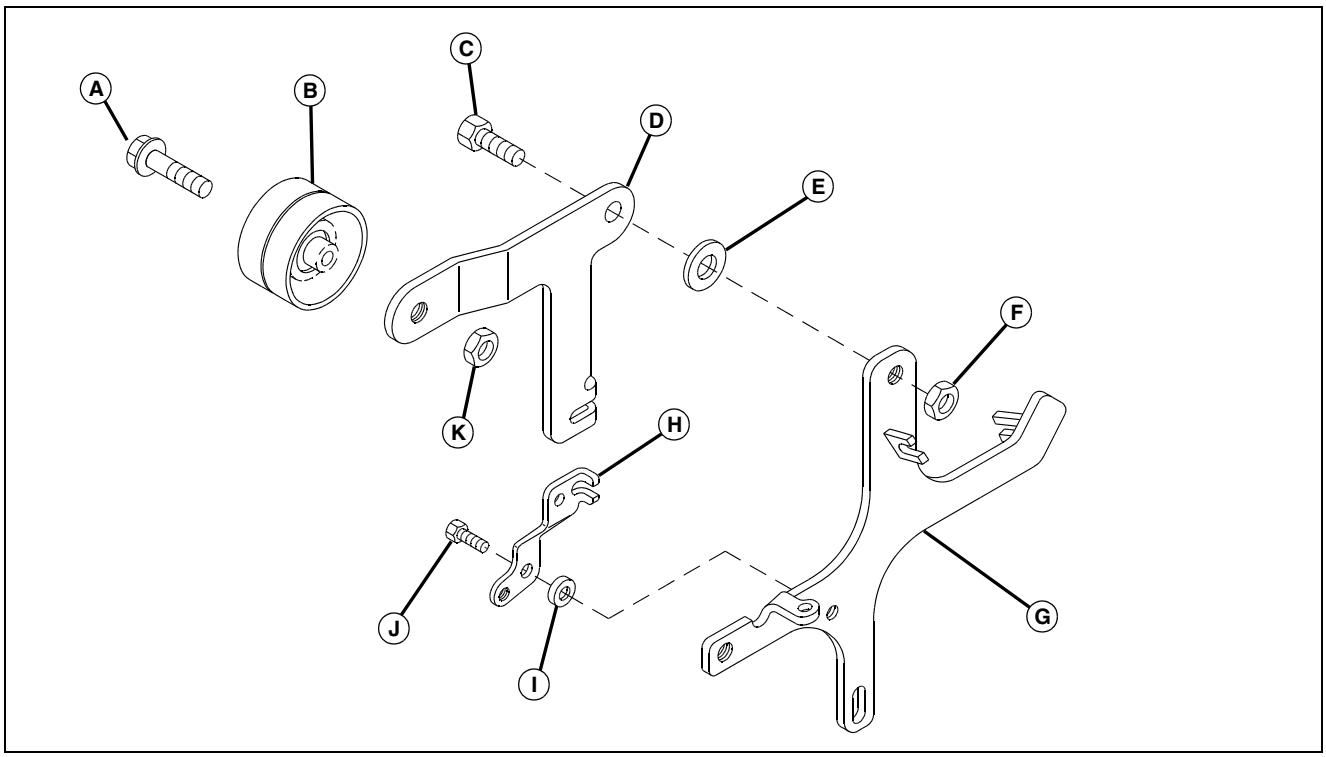


MX21403

- When removing or installing sprocket retaining nut (A), hold axle using a box end wrench or a deep-well socket that will contact the hex (B) on the sprocket side of the wheel retaining groove (C).
- Tighten axle sprocket retaining nut to specification.
- Inspect all parts for wear or damage. Replace parts as necessary.
- Apply Non-Clay High Temperature EP Grease (North America) or Grease-Gard (Europe) to lubricate fittings and pack inside of tube.

Axle Sprocket Retaining Nut
Torque . . . . . 108 N•m (80 lb-ft)

Drive Belt Idler Bracket Assembly



MIF (M83937)

A - Cap Screw
B - Idler
C - Cap Screw
D - Idler Arm
E - Washer
F - Nut
G - Idler Bracket
H - Arm
I - Washer
J - Cap Screw
K - Nut

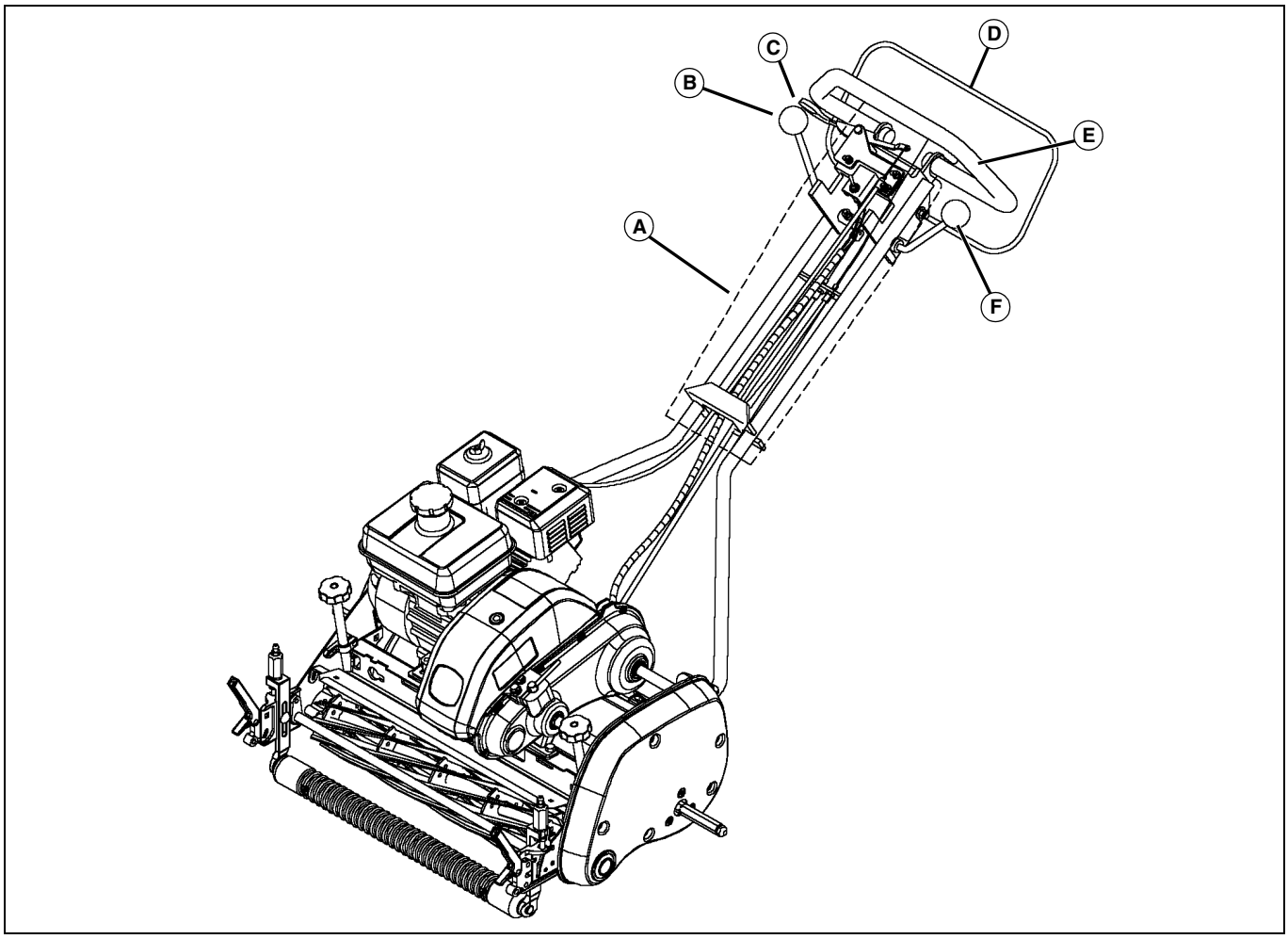
Inspect all parts for wear or damage. Replace parts as necessary.

Table of Contents

HANDLEBAR AND CONTROLS TABLE OF CONTENTS

Component Location

Controls



MX6030

A - Handlebar Cover
B - Clutch Control Lever
C - Throttle Lever
D - Operator Presence Bail
E - Handlebar
F - Park Brake Lever

Adjustments

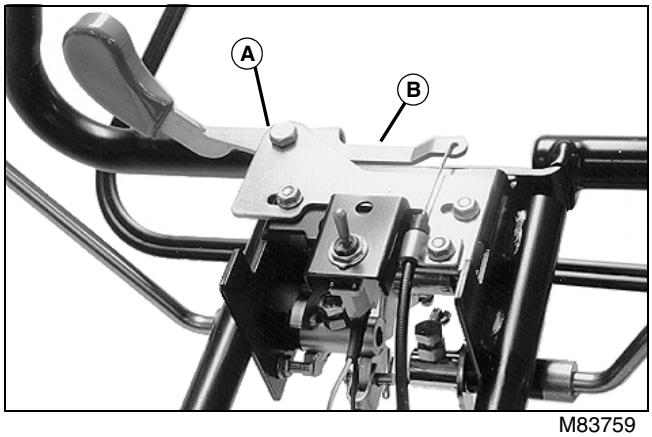
Throttle Lever Tension Adjustment

Reason

To apply enough tension to hold throttle position, yet allow easy throttle movement.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)



M83759

6. Using two wrenches, tighten or loosen the lock on throttle pivot bolt (A). At proper tension, the throttle should hold desired throttle setting during operation, yet allow easy movement of the throttle lever (B).
7. Install handlebar cover.

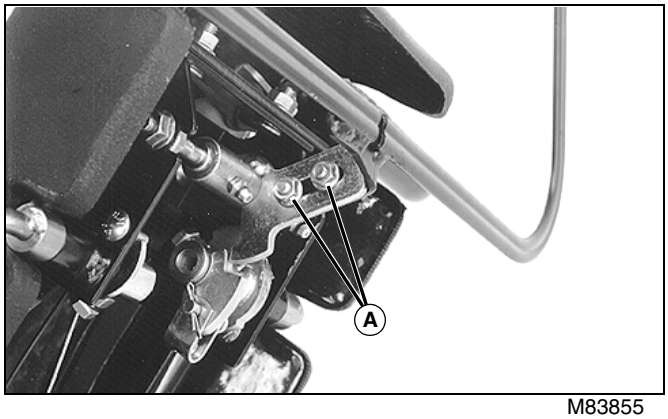
Operator Presence Bail Adjustment

Reason

To ensure that all moving parts are disengaged when bail is released.

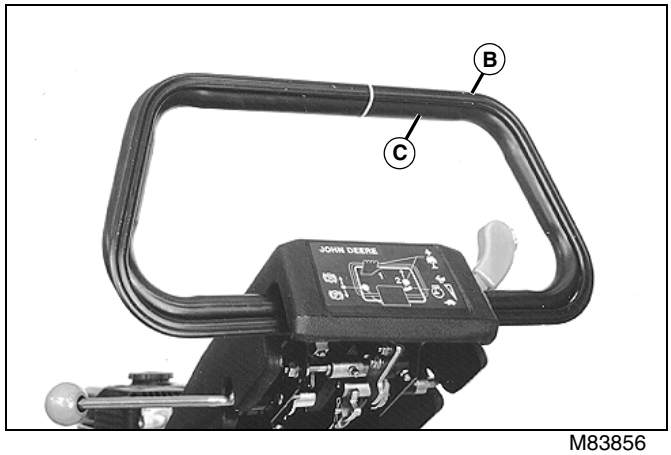
Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.



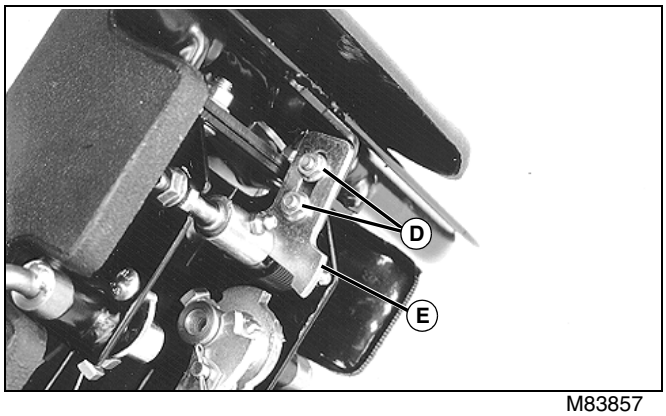
M83855

5. Loosen two nuts (A).



M83856

6. Secure operator presence bail (B) against handlebar (C).



M83857

7. Rotate engagement arm (E) upward as far as possible.
8. Tighten nuts (D).
9. Release operator presence bail.

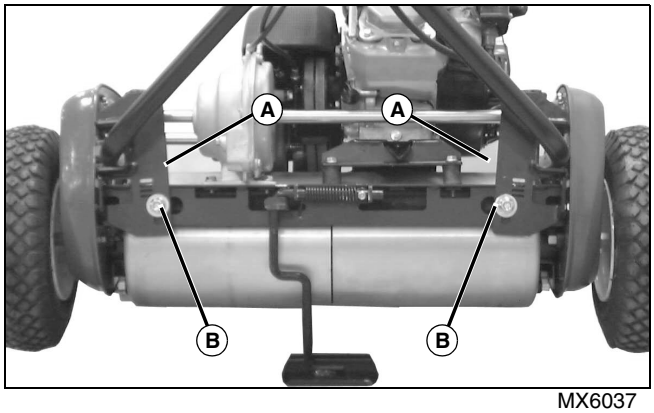
Handlebar Height Adjustment

Reason

To allow the operator to choose a comfortable handlebar height.

Procedure

1. Park machine on a level surface.
2. Move RUN/OFF switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.



MX6037

5. Loosen lock nuts (B) on each side of mower.

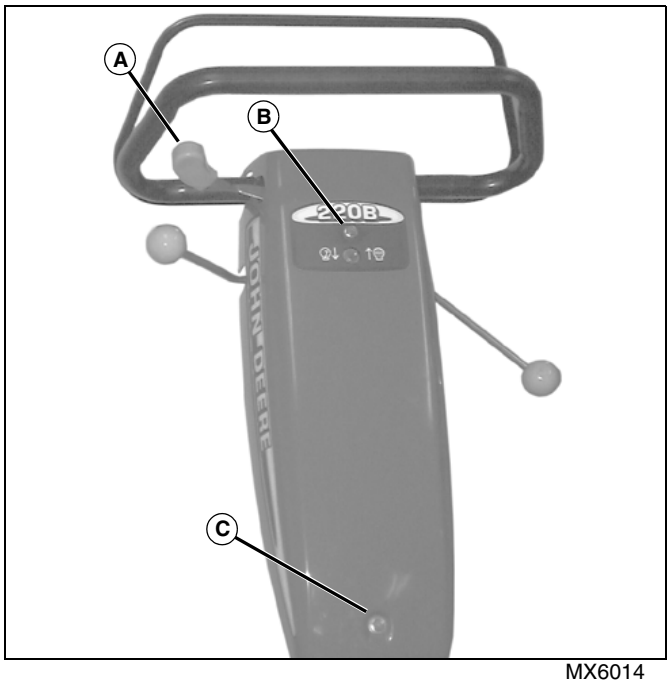
NOTE: Brackets MUST be straight up and down.

6. Adjust bracket (A) on each side of mower up or down as desired and tighten lock nuts (B).

Repair

Handlebar Cover Removal and Installation

Removal



MX6014

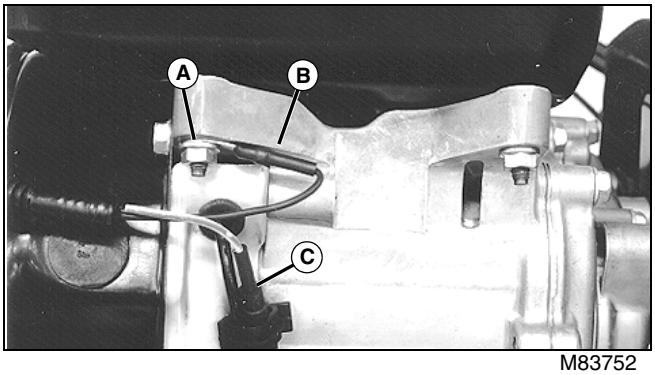
1. Move throttle lever (A) to FAST idle position.
2. Remove two cap screws and washer (B and C).
3. Remove cover.

Installation

Installation is done in the reverse order of removal.

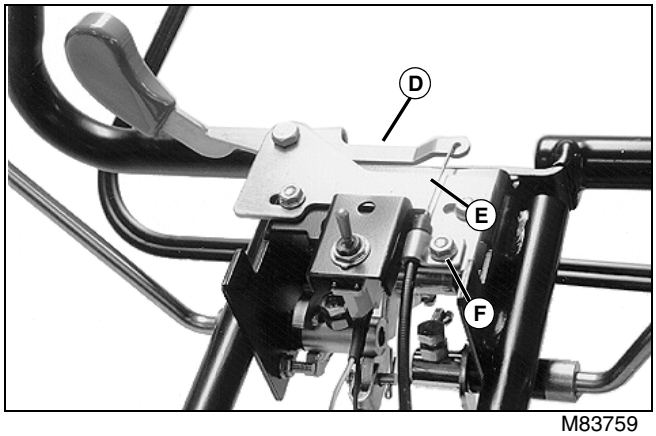
Handlebar Assembly Removal and Installation

1. Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)



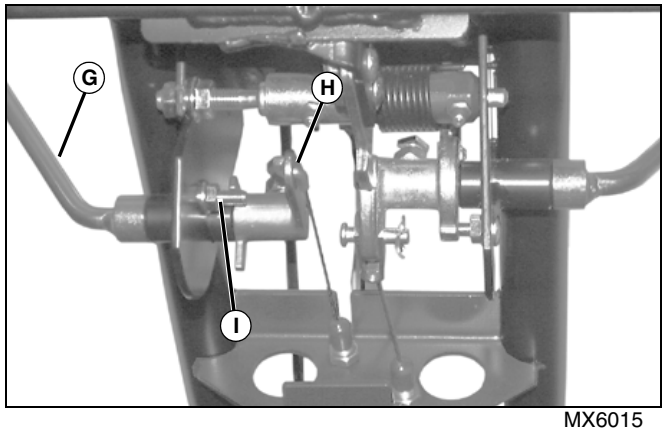
M83752

2. Disconnect RUN/OFF switch lead (C) at engine.
3. Remove nut (A) and ground wire (B).



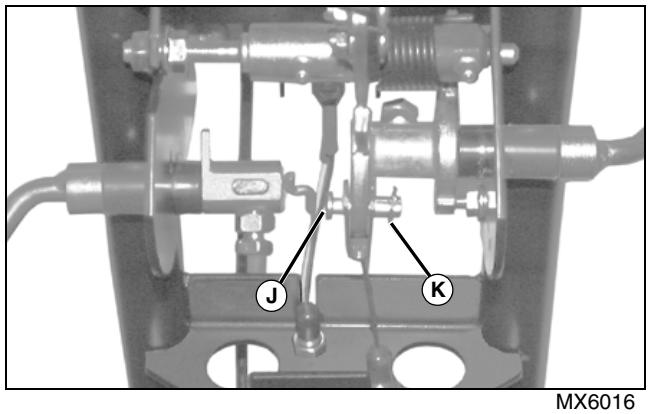
M83759

4. Loosen clamp (F) and disconnect throttle cable (E) at throttle lever (D).



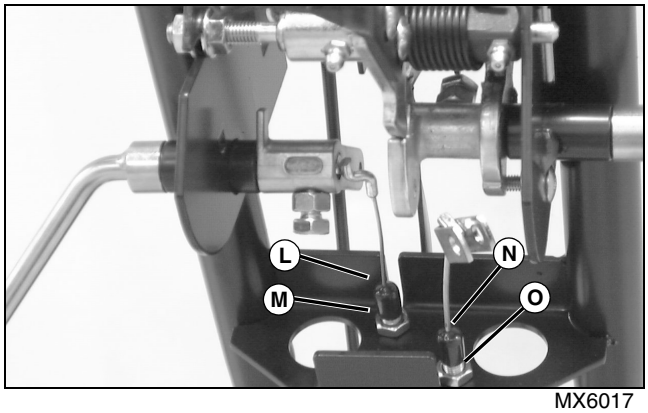
MX6015

5. Remove nut and carriage bolt (I).
6. Rotate brake lever (G) down.
7. Disconnect cable end (H) from lever.



MX6016

8. Remove cotter pin (K) and pin (J) from clutch control cable.



MX6017

9. Slide cap (L) off cable housing.

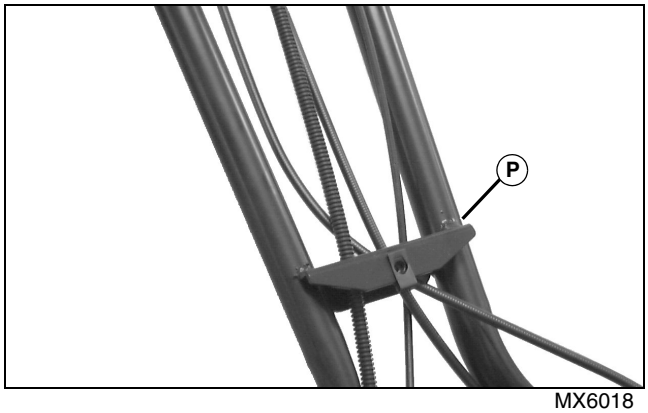
10. Remove top nut (M).

11. Pull cable back until brake cable housing clears slot.

12. Slide cap (N) off cable housing.

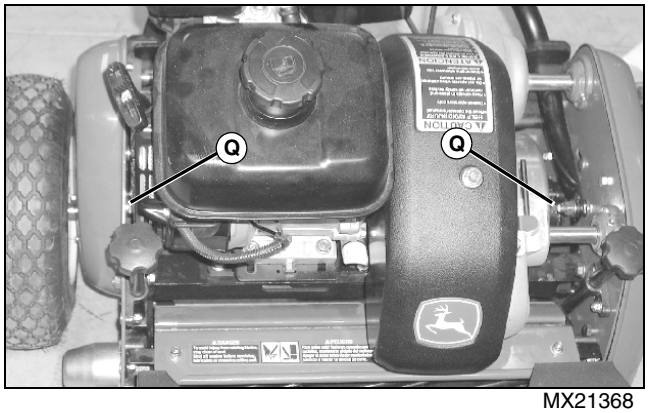
13. Remove top nut (O).

14. Pull cable back until clutch control cable housing clears slot.



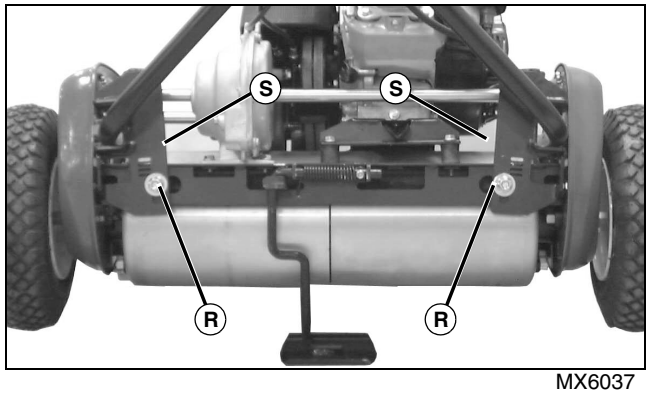
MX6018

15. Route cables through hole in lower handlebar bracket (P).



MX21368

16. Remove lock nuts (Q) from handle bar pivots.



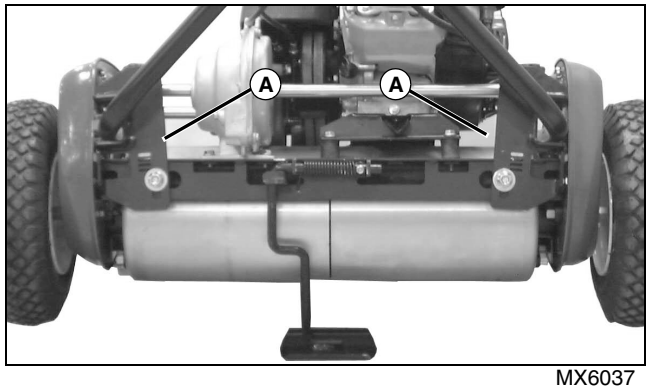
MX6037

17. Remove lock nut and washer (R) and bracket (S) from each side of mower.

18. Remove handle bars from pivots. Remove handlebar assembly.

Installation

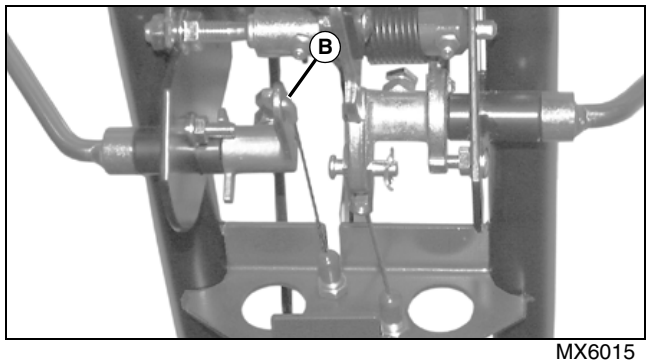
Installation is done in the reverse order of removal.



MX6037

- Adjust handlebar brackets (A) straight up and down before tightening.

IMPORTANT: Avoid damage! Hooked end of brake cable end MUST swing freely.



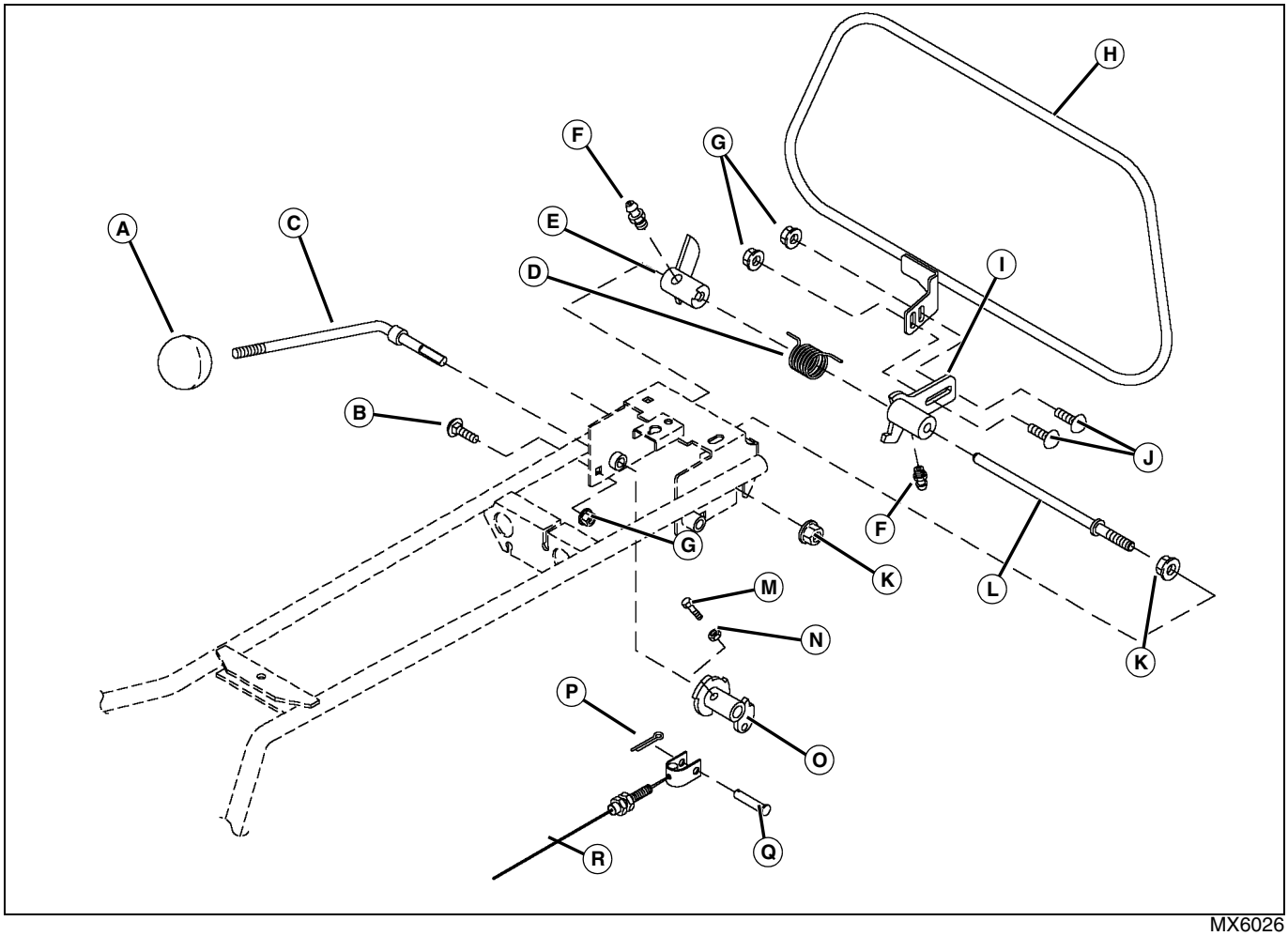
MX6015

- Apply multi-purpose grease to hook (B) on end of brake cable.
- Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)

• Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)

• Adjust clutch control cable. (See “Drive Belt Tension Check and Adjustment” on page 98.)

Clutch Control and Operator Presence Bail



MX6026

A - Knob
B - Bolt
C - Lever
D - Torsion Spring
E - Pawl
F - Lubrication Fitting (2 used)
G - Flange Nut (3 used)
H - Bail
I - Arm
J - Bolt (2 used)
K - Nut (2 used)
L - Stud
M - Cap Screw
N - Nut
O - Arm
P - Cotter Pin
Q - Pin
R - Cable

Removal

• Remove handlebar cover (See “Handlebar Cover Removal and Installation” on page 126.)

• Inspect all parts for wear or damage. Replace parts as necessary.

Installation

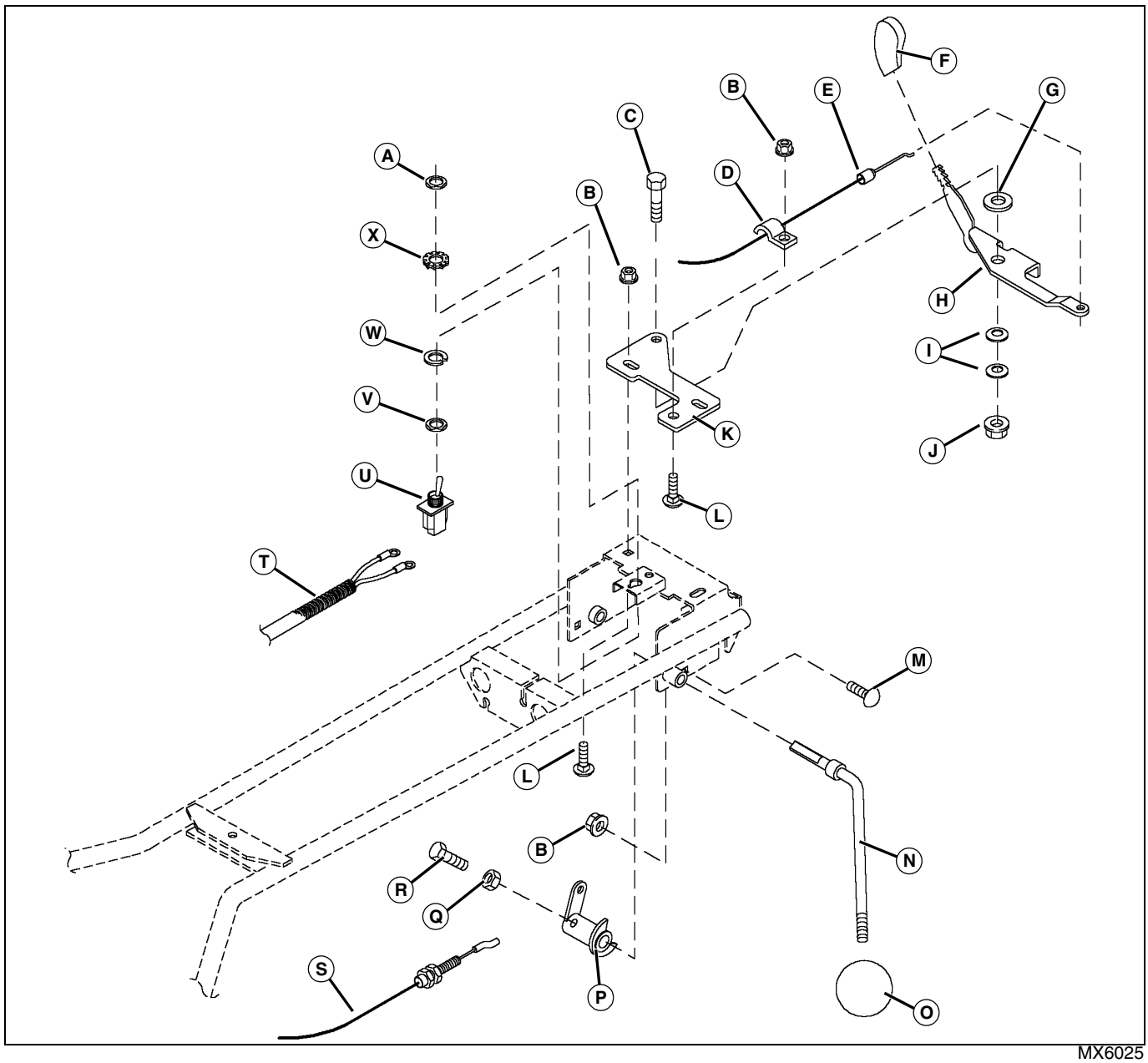
Installation is done in the reverse order of removal.

• Apply multi-purpose grease to lubrication fittings.

• Adjust clutch control cable. (See “Drive Belt Tension Check and Adjustment” on page 98.)

• Adjust operator presence bail. (See “Operator Presence Bail Adjustment” on page 124.)

Brake Control and Throttle Lever



MX6025

A - Nut
B - Flange Nut (3 used)
C - Cap Screw
D - Clamp
E - Throttle Cable
F - Knob
G - Fiber Washer
H - Throttle Lever
I - Spring Washer (2 used)
J - Lock Nut
K - Plate
L - Bolt (3 used)
M - Bolt
N - Lever
O - Knob
P - Arm
Q - Nut
R - Cap Screw
S - Brake Cable
T - Wiring Harness
U - RUN/OFF Switch
V - Washer (2 used)
W - Lock Washer
X - Lock Plate

Removal

- Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)
- Inspect all parts for wear or damage. Replace parts as necessary.

Installation

Installation is done in the reverse order of removal.

- Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)
- Adjust throttle cable. (See “Throttle Cable Check and Adjustment” on page 36.)
- Adjust throttle lever. (See “Throttle Lever Tension Adjustment” on page 124.)

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BRAKES TABLE OF CONTENTS

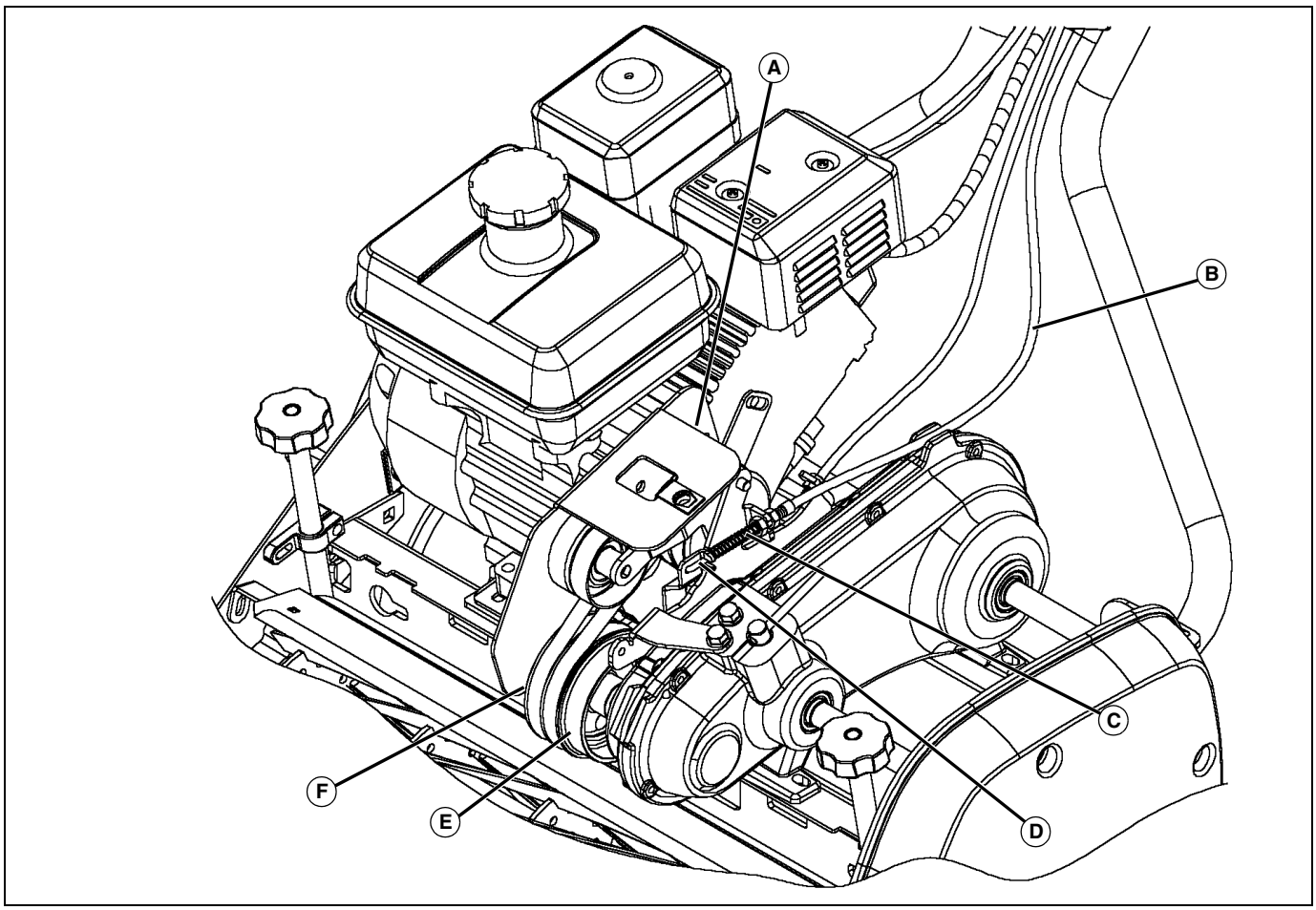
Specifications

Repair Specifications

Park Brake Cable Jam Nuts Torque	**11 N•m (96 lb-in.)**

Component Location and Operation

Brake System Operation



MX6029

A - Drive Belt Idler Bracket Assembly
B - Brake Cable
C - Return Spring
D - Actuator Arm
E - Brake Band
F - Differential Gear Case Input Sheave

Function

To provide a means of preventing the machine from moving when not in operation.

Theory of Operation

The park brake is a band type mounted on the differential gear case input sheave. When the park brake is engaged, the cable causes the brake band around the differential gear case input sheave to tighten and apply drag, preventing the power train from turning.

Diagnostics

Machine Will Not Move

Test Conditions:

- Machine parked on a level surface.
- Run/Off switch in OFF position.
- Travel clutch disengaged.
- Reel clutch in STOP position.
- Park brake released.

Symptom: Machine Will Not Move

(1) Is park brake lever released?

Yes - Go to step (2).

No - Release park brake.

(2) Is brake cable properly adjusted?

Yes - Go to step (3).

No - Adjust cable (See “Park Brake Check and Adjustment” on page 137.)

(3) Is brake cable return spring in good working order and not missing?

No - Replace return spring.

Brake Does Not Engage When Lever Engaged

Test Conditions:

- Machine parked on a level surface.
- Run/Off switch in OFF position.
- Travel clutch disengaged.
- Reel clutch in STOP position.
- Park brake released.

Symptom: Brake Will Not Engage

(1) Is brake cable properly adjusted and not broken nor binding?

Yes - Go to step (2).

No - Brake cable is not properly adjusted. Adjust brake cable. (See “Park Brake Check and Adjustment” on page 137.)

No - Brake cable is broken or binding. Replace brake cable. (See “Park Brake Cable Replacement” on page 138.)

Symptom: Brake Will Not Engage

(2) Is brake band/lining clean and in good operating condition?

Yes - Go to step (3).

No - Brake band/lining is worn. Adjust brake cable (See “Park Brake Check and Adjustment” on page 137.) If brake will still not engage after adjustment, replace brake band. (See “Brake Band Replacement” on page 139.)

No - Brake band/lining is contaminated. Clean brake drum and/or replace brake band. (See “Brake Band Replacement” on page 139.)

No - Brake band mounting hardware is loose or missing. Tighten and/or replace mounting hardware.

(3) Is actuator arm in good operating condition?

No - Replace actuator arm (See “Drive Belt Idler Bracket Assembly” on page 119.)

Brake Does Not Hold Machine

Test Conditions:

- Machine parked on a level surface.
- Run/Off switch in OFF position.
- Travel clutch disengaged.
- Reel clutch in STOP position.
- Park brake released.

Symptom: Brake Does Not Hold Machine

(1) Is brake cable properly adjusted?

Yes - Go to step (2).

No - Adjust brake cable. (See “Park Brake Check and Adjustment” on page 137.)

(2) Is brake band/lining clean and in good operating condition?

Yes - Go to step (3).

No - Brake band/lining is worn. Adjust brake cable (See “Park Brake Check and Adjustment” on page 137.) If brake will still not engage after adjustment, replace brake band. (See “Brake Band Replacement” on page 139.)

(3) Are traction drive chains in good operating condition and not broken or damaged?

Yes - Go to step (4).

No - Replace drive chain(s).

Symptom: Brake Does Not Hold Machine

(4) Are traction roller assembly sprockets in good operating condition and not damaged?

Yes - Go to step (5).

No - Replace sprocket(s). (See “Models Equipped with Partial Hex Axle” on page 117.)

(5) Are traction roller sprocket keys in good operating condition and not damaged?

Yes - Go to step (6).

No - Keys are damaged or missing. Replace key(s). (See “Models Equipped with Partial Hex Axle” on page 117.)

(6) Is the differential gear case assembly in good operating condition without internal damage?

Yes - Go to step (7).

No - Repair differential gear case assembly as necessary. (See “Differential Gear Case Disassembly and Inspection” on page 107.)

(7) Are differential gear case output shaft sprocket keys in good operating condition and not missing?

No - Replace keys.

Excessive Brake Wear

Test Conditions:

- Machine parked on a level surface.
- Run/Off switch in OFF position.
- Travel clutch disengaged.
- Reel clutch in STOP position.
- Park brake released.

Symptom: Excessive Brake Wear

(1) Is return spring in good operating condition and not broken or missing?

Yes - Go to step (2).

No - Replace return spring.

(2) Is brake cable properly adjusted?

No - Adjust brake cable. (See “Park Brake Check and Adjustment” on page 137.)

Checks and Adjustments

Park Brake Check and Adjustment

Reason

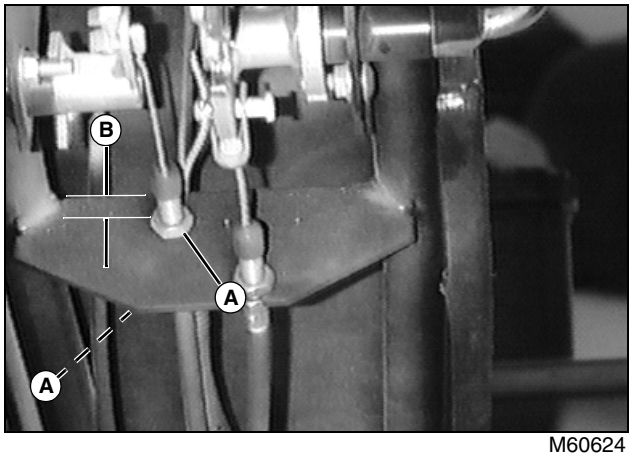
To ensure that the park brake holds the machine when engaged.

Check Procedure

1. Engage park brake.
2. Run engine at low idle.
3. Engage operator presence bail.
4. Slowly engage travel clutch lever.

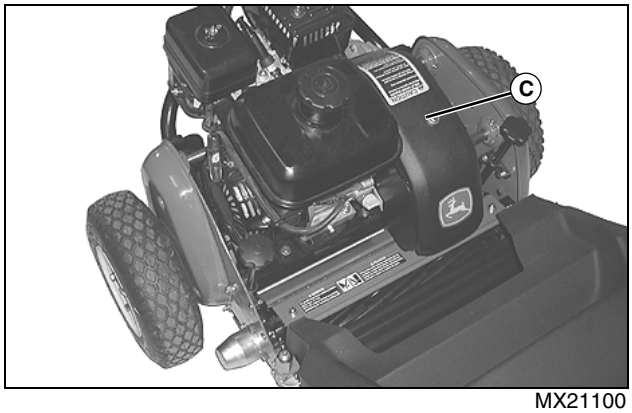
Result: Engine should stall with no movement of the mower.

Adjustment Procedure



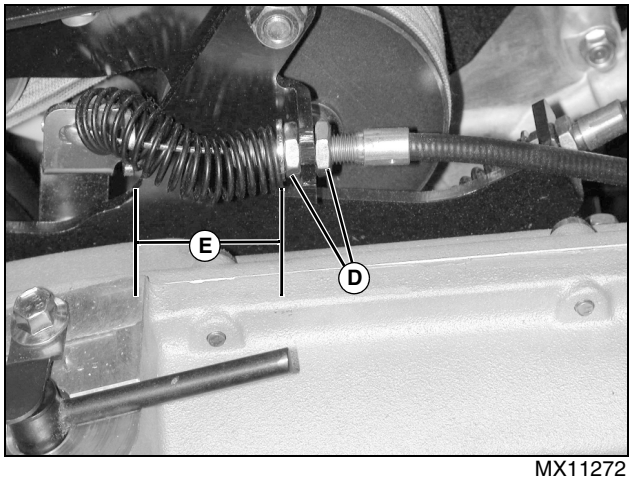
M60624

1. Loosen jam nuts (A) holding cable in handlebar.
2. Shorten ferrule length (B).
3. Tighten jam nuts to specification.
4. Repeat check procedure. If additional adjustment is required, go to next step.



MX21100

5. Remove cover by loosening bolt (C).



MX11272

6. Loosen jam nuts (D) holding brake cable near the brake.
7. Shorten ferrule length (E).
8. Tighten jam nuts (D).
9. Repeat check procedure.
10. If still not properly adjusted, repeat steps 6-9.
11. Install cover and tighten bolt.

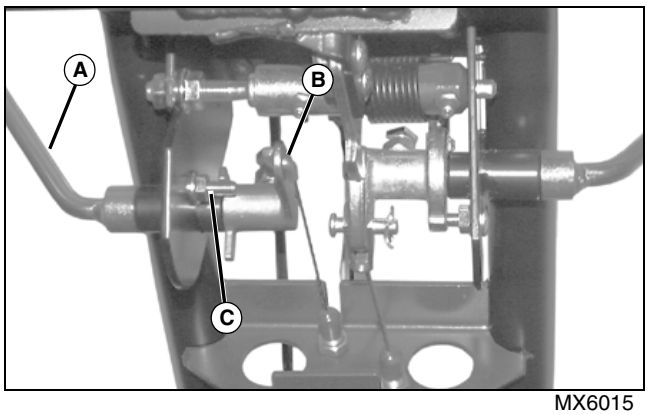
Specifications

Park Brake Cable Jam Nuts Torque . . 11 N•m (96 lb-in.)

Repair

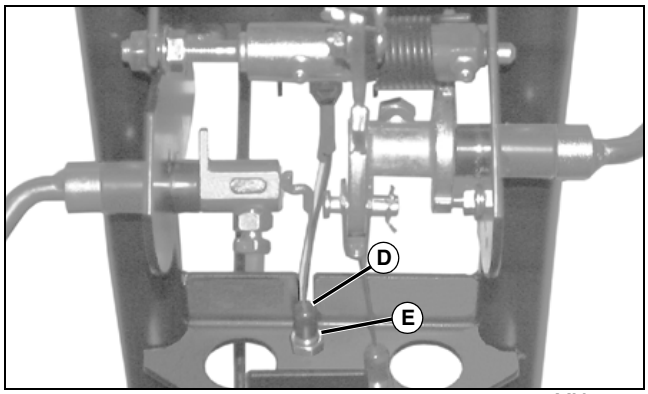
Park Brake Cable Replacement

1. Remove handlebar cover. (See “Handlebar Cover Removal and Installation” on page 126.)



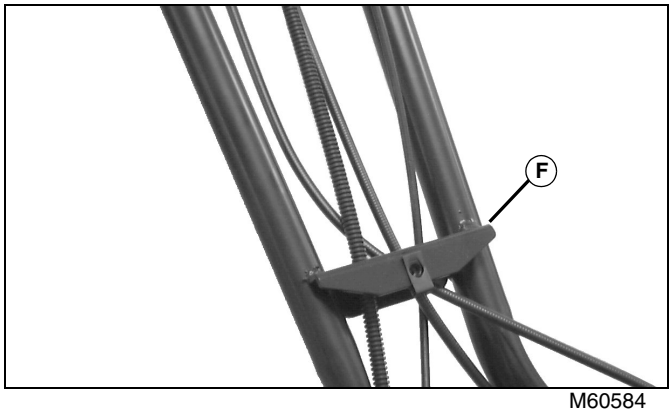
MX6015

2. Remove carriage bolt (C) and rotate brake lever (A) down.
3. Disconnect cable end (B) from lever.



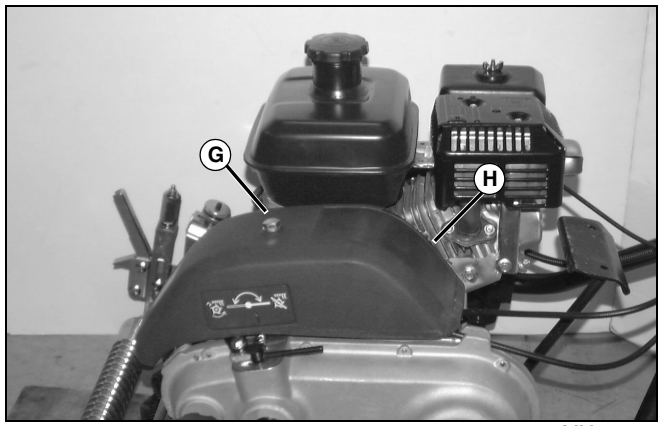
MX6016

4. Slide cap (D) off cable housing.
5. Remove top nut (E).
6. Pull cable back until cable housing clears slot.



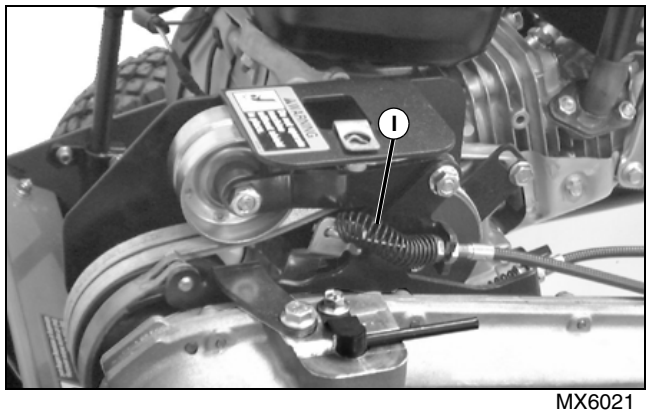
M60584

7. Route cable through slotted hole in lower handlebar bracket (F).



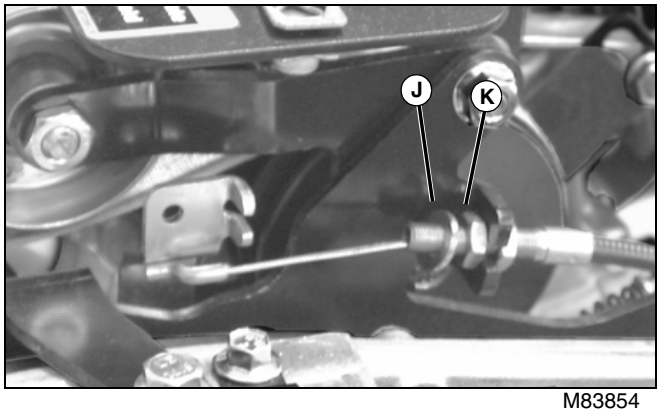
MX6008

8. Remove cap screw (G) and drive belt cover (H).



MX6021

9. Compress spring (I) and disconnect brake cable end from bracket.
10. Remove spring.



M83854

11.Remove jam nut (K) and washer (J) and slide cable from bracket.

Installation

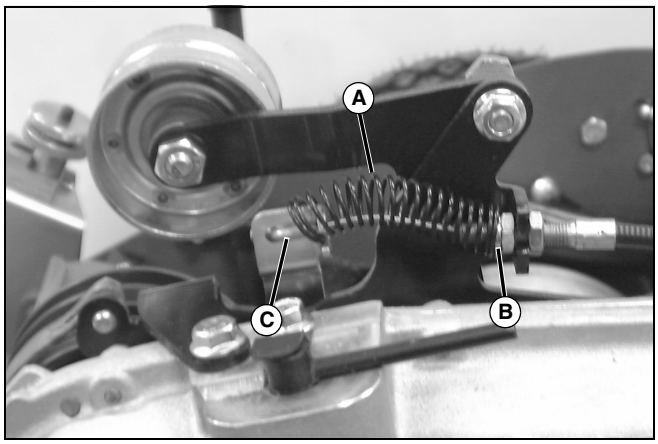
Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! Hooked end of brake cable and MUST swing freely.

- Apply multi-purpose grease to hooked end of brake cable.
- Adjust park brake. (See “Park Brake Check and Adjustment” on page 137.)

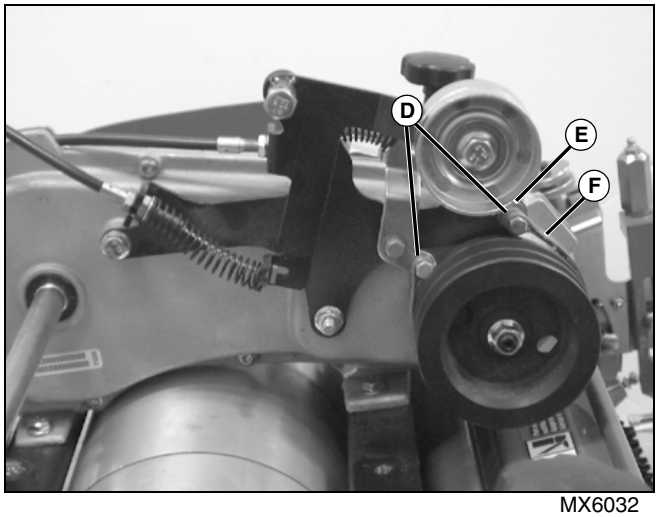
Brake Band Replacement

Removal



MX6031

1. Compress spring (A) and disconnect brake cable end (C) from bracket.
2. Remove spring.
3. Remove jam nut and washer (B) and slide cable from bracket.



MX6032

4. Remove cap screws (D) and washer (E).
5. Remove brake band (F).

Installation

Installation is done in the reverse order of removal.

CUTTING UNIT TABLE OF CONTENTS

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CUTTING UNIT TABLE OF CONTENTS

Specifications

General Specifications

Cutting Width

180B	457 mm (18 in.)
220B	559 mm (22 in.)
260B	660 mm (26 in.)
Cutting Height (Min, Standard 3.0 mm Bed Knife)	3.2 mm (1/8 in.)
Cutting Height (Min, Optional 2.5 mm Bed Knife)	2.8 mm (7/64 in.)
Cutting Height (Min, Optional 2.0 mm Bed Knife)	2.0 mm (5/64 in.)
Cutting Height (Max)	22.2 mm (7/8 in.)
Frequency of Clip (Standard)	4.62 mm (0.182 in.)
Frequency of Clip (Optional)	4.04 mm (0.159 in.)
Reel Diameter	127 mm (5 in.)
Reel Number of Blades (Standard)	11
Reel Number of Blades (Optional - 220B)	9
Reel Number of Blades (Optional - 260B)	7
Material	Heat-treated special alloy steel
Grass Catcher	Rotational molded polyethylene
Front Roller (Standard)	Machine grooved
Front Roller (Optional)	Smooth
Bed Knife Adjustment	Bed knife-to-reel

Options

Greens Tender Conditioner (Standard Spacing)	6.5 mm (0.26 in.)
Rotary Brush	Optional
Transport Kit	Optional
Light Kit	Optional

Adjustment Specifications

Bed Knife-to-Reel Clearance	0-0.025 mm (0-0.001 in.)
Rotary Brush Height (ABOVE Cutting Height)	1 mm (0.04 in.)
Greens Tender Conditioner (BELOW Cutting Height)	1 mm (0.04 in.)
Bed Knife-to-Shoe Screw Torque	(6.5 N•m) (58 lb-in.)

Repair Specifications

Bed Knife Top Surface	5° relief angle
Front Surface	15° relief angle
Reel	Spin grind 20° relief grind
Reel Shoulder Bolt Torque	62.4 N•m (46 lb-ft)
GTC Idler Gear Nut Torque	27 N•m (240 lb-in.)
GTC Gear Case Cover Bolt Torque	11 N•m (96 lb-in.)
GTC Gear Case Leaf Spring Bolt Torque	11 N•m (96 lb-in.)

Bed Knife Support

Mounting Screw Torque	6 N•m (53 lb-in.)

Tools and Materials

Special or Essential Tools

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Roller Bearing Puller	JDG795	Used to remove bearings from rollers.
Bearing Installer	JDG243 or JDG506	Used to install bearings.
Two-Bolt Gauge Bar	AMT2978	Used to perform height-of-cut, rear roller/bed knife, and greens tender conditioner adjustments.

Dealer Fabricated Tools

E32285

Special or Required Tools

Tool Name	Tool No.	Tool Use
2-in. or 4-in. Paintbrush[1]	NA	Used to apply backlapping compound.

1. Attach a piece of rubber hose to the paintbrush handle to extend its length.

Other Materials

Other Material

Part No.	Part Name	Part Use
M79292	MPG-2 Multipurpose Polymer Grease	Apply to engine crankshaft.
NA	Lapping Compound	Used in backlapping procedure.

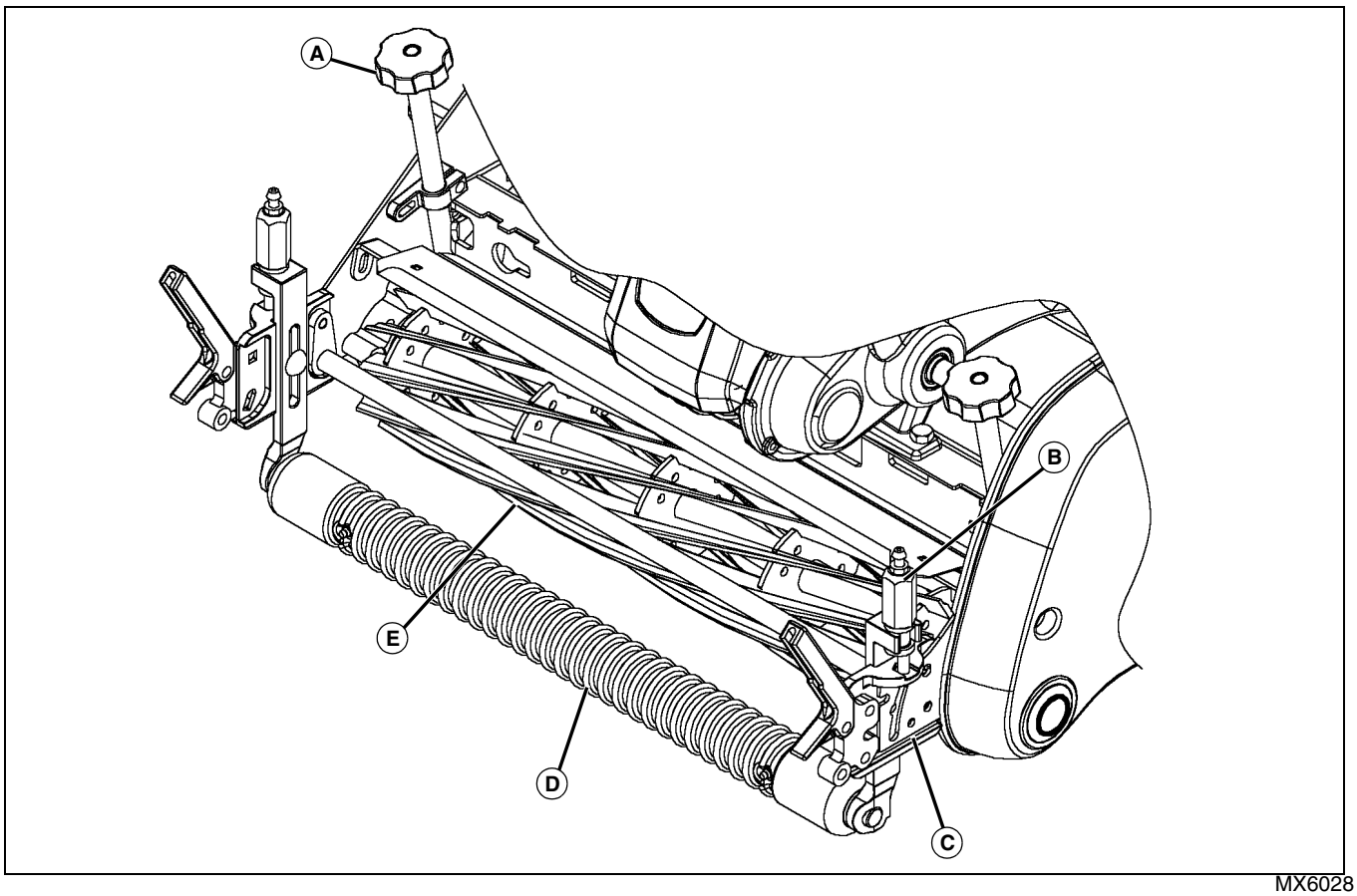
Service Parts Kits

The following kits are available through your parts catalog:

- Smooth Roller Kit
- Grooved Roller Kit
- Rotary Brush or Vertical Cutter Drive Kit
- GTC Kit
- Rotary Brush Kit

Component Location

Reel Mower



MX6028

A - Bed Knife-to-Reel Adjustment Knob
B - Front Roller Height Adjustment Knob
C - Bed Knife
D - Front Roller
E - Reel

Diagnosis

Reel Attachments Troubleshooting

Symptom: Marcelling

(1) Are the reel and bed knife sharp?

Yes - Go to step (2).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 151.)

(2) Is the correct number of reel blades being used for desired clip ratio (CR)?

No - Install reel with correct number of blades. (See “Performance Variables” on page 150.)

Symptom: Streaking

(1) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

Yes - Go to step (2).

No - Perform reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 151.)

(2) Are the reel and bed knife in good condition (no nicks, uneven wear, or distortions)?

No - Grind reel and bed knife. (See “Reel and Bed Knife Grinding” on page 148.)

Symptom: Height-of-Cut (HOC) Changes

(1) Is the grass dry enough for proper cutting (not too wet)?

Yes - Go to step (2).

No - Allow sufficient time for grass to dry before cutting.

(2) Is the roller clean (no grass or dirt collecting on the roller)?

Yes - Go to step (3).

No - Clean roller often.

(3) Is the condition of the soil good (not rough or changing)?

Yes - Go to step (4).

No - Use a smooth roller.

(4) Is the cutting unit floating properly?

Yes - Go to step (5).

No - See operator's manual.

Symptom: Height-of-Cut (HOC) Changes

(5) Are the roller clamp bolts tight?

Yes - Go to step (6).

No - Perform height-of-cut (HOC) Adjustment. (See “Cutting Height Adjustment” on page 155.)

(6) Are the rollers concentric (not out-of-round)?

Yes - Go to step (7).

No - Replace roller. (See “Front Roller Removal and Installation” on page 166.)

(7) Are the roller bearings in good condition (not worn)?

No - Replace roller bearings. (See “Bearing Replacement” on page 167.)

Symptom: Poor Quality of Cut

(1) Is the grass at an acceptable height (not too high)?

Yes - Go to step (2).

No - Mow grass more frequently.

(2) Are the reel and bed knife sharp?

Yes - Go to step (3).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 151.)

(3) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

No - Perform reel-to-bed knife adjustment. (See “Bed Knife-to-Reel Adjustment” on page 151.)

Symptom: Reel Does Not Rotate

(1) Is the machine operating properly?

Yes - Go to step (2).

No - See machine operator's manual.

(2) Is reel chain in good working condition and not broken?

Yes - Go to step (3).

No - Repair or replace chain as necessary.

(3) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

Yes - Go to step (4).

No - Perform reel-to-bed knife adjustment. (See “Bed Knife-to-Reel Adjustment” on page 151.)

Symptom: Reel Does Not Rotate

(4) Are the roller bearings in good condition (not worn or seized)?

No - Replace roller bearings.

Symptom: Unit Not Cutting

(1) Is the grass dry and height of the grass not too excessive?

Yes - Go to step (2).

No - Allow sufficient time for grass to dry and mow more frequently.

Symptom: Unit Not Cutting

(2) Are the engine and ground speeds correct?

Yes - Go to step (3).

No - Adjust engine speed to specification. (See operator's manual.) Adjust ground speed to conditions. (See “Performance Variables” on page 150.)

(3) Is the correct number of blades used for conditions?

Yes - Go to step (4).

No - Install reel with correct number of blades. (See “Performance Variables” on page 150.)

(4) Are the reel and bed knife sharp?

Yes - Go to step (5).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 151.)

(5) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

No - Perform reel-to-bed knife adjustment. (See “Bed Knife-to-Reel Adjustment” on page 151.)

Information

Reel and Bed Knife Relationship

Reel mowers are precision machines requiring daily maintenance to maintain the well-groomed appearance of turf grass. The scissor-like shearing action, that only a reel mower is capable of achieving, is only possible if the reel and bed knife are sharp and the bed knife-to-reel clearance is maintained.

Close examination of the bed knife-to-reel relationship reveals two square edges passing one another with approximately 0.025 mm (0.001 in.) clearance.

There are several reasons why this clearance is necessary.

When the reel is allowed to contact the bed knife, the square (sharp) edges of the reel and bed knife will roll over, becoming dull.

Contact between the reel and bed knife generates heat. Heat generated through this contact will distort the shape of the bed knife. Distortion causes the bed knife to draw closer to the reel, resulting in more rollover of the cutting surfaces and more heat generated in the bed knife.

Drag produced by an improperly adjusted cutting unit may result in an unacceptable clip ratio, undue strain on drive mechanisms and premature wear of the cutting unit.

Reel and Bed Knife Grinding

Reasons for grinding:

- To restore the cylindrical shape of a reel that has become cone-shaped due to improper adjustment of the bed knife-to-reel clearance or worn reel bearings.
- To restore the edge when the grass is not being cut across the entire length of the bed knife, evidenced by streaks of grass left after the mower has passed. Usually the result of nicked blades caused by hitting foreign objects in the grass.
- To restore the edge when the lack of frequent backlapping allowed the edge to be rounded beyond the capability of the backlapping procedure to restore the edge.
- To restore the edge when the bed knife-to-reel clearance has been improperly adjusted (reel contacting bed knife).

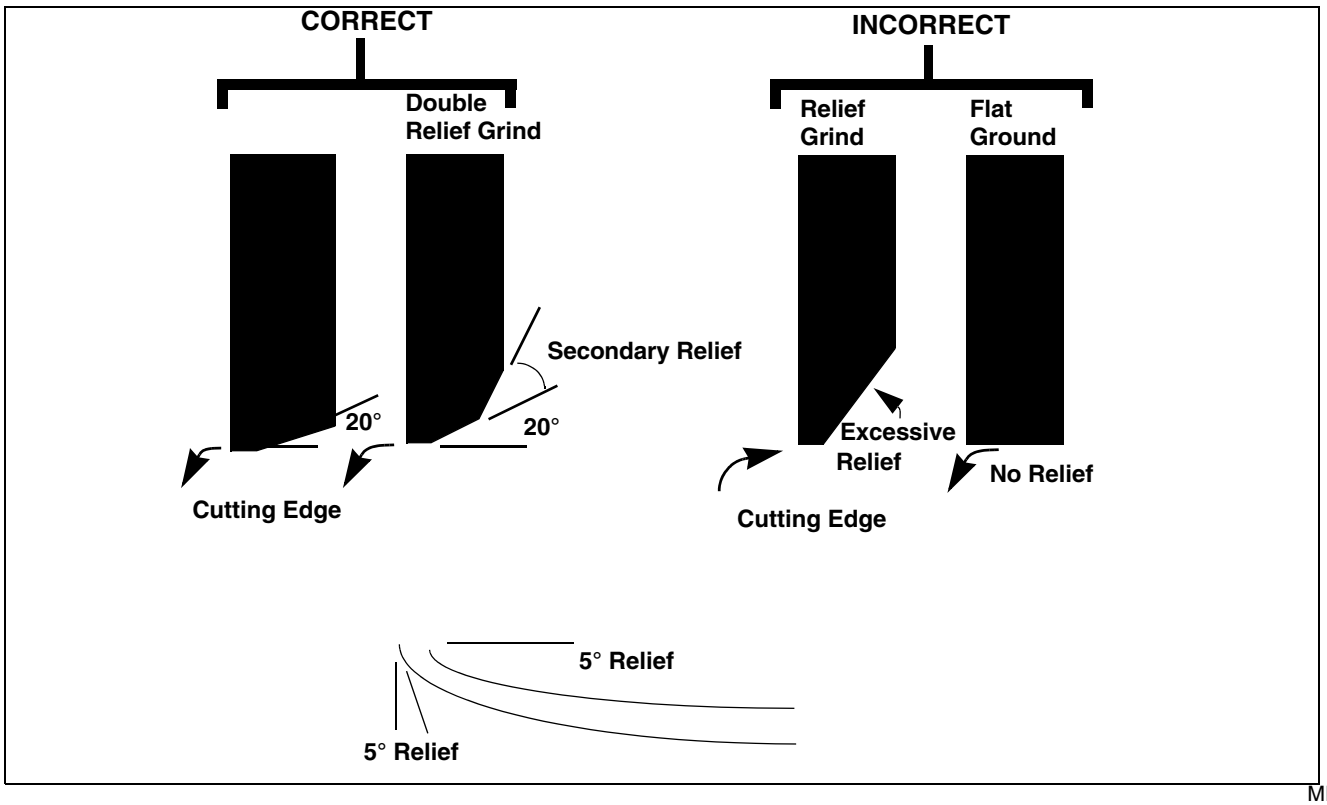
Cutting action begins as the bed knife positions the grass to be cut at the cutting edge. The reel then pulls the grass toward the bed knife where it is sheared by the cutting edges as they pass one another.

In order for the grass to be cut at the proper height, it must contact the bed knife at the cutting edge. This is accomplished by grinding a 5° relief angle on the front face of the bed knife. Without a relief angle, the blade of grass will contact the lower edge of the bed knife and be bent over at too much of an angle prior to being cut. In the case of mowing greens, where very small cuts are being taken, the reel may not capture the grass at all, and no grass will be cut.

Although some spin grinding machine manufacturers say backlapping is not necessary, John Deere recommends backlapping after spin grinding to remove burrs and rough edges left from the spin grinding procedure. Backlapping produces a honed edge that will cut the grass evenly and leave the tops of the grass with clean, straight edges.

It is important to note, dull cutting edges will tear rather than shear the grass drawn into the bed knife. This will shock the grass plant and retard its growth.

Relief Grinding



MIF

John Deere recommends Relief Grinding the reel and bed knife for these reasons:

- Reduced blade contact area, results in less friction, requiring less horsepower to drive the reel.
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade forming an angle (relief angle) to reduce the contact area of the cutting edges.
- Because of the relief grind, it is possible with backlapping, to true a reel (make it round) if a blade is 0.025-0.05 mm (0.001-0.002 in.) too high.

Backlapping Procedure

This procedure is used to maintain a sharp cutting edge between grindings. To determine if grinding is necessary, see “Reel and Bed Knife Grinding” on page 148.

Backlapping, when compared to grinding, removes a very small amount of metal, requires less time and will effect a smooth, clean cut.

The backlapping procedure is accomplished by spinning the reel backwards while applying special abrasive compounds to the reel.

Usually, course compounds are used initially, followed by a fine "tournament grade" abrasive for final honing. Recommended grits for greens and tees are 120, 180, and 220.

Recommended compounds for fairways are 60, 80, and 100 grit. Reel sharpening compounds should not be toxic, oily or greasy.

The cutting unit should be inspected, lightly backlapped, adjusted and checked every 20 hours of operation for a uniform cut along the complete length of the bed knife.

It is important that the adjustment allows the reel to turn freely without dragging against the bed knife. Metal-to-metal contact will generate heat, causing the reel to expand and intensifying the dragging that produces more heat.

Greens Tender Conditioner (GTC)

The conditioning process involves shallow vertical cutting. The blades are adjusted to cut runners and lift horizontal leaf material. It is important not to use a GTC for three days following top dressing. It is also important that frequent and thorough observations be performed or stress to the plants may occur. Stress has occurred when a yellow or brown tint is observed in the color of the grass.

Grass is conditioned initially with the blades set 0.8 mm (0.03 in.) below height-of-cut.

The green is then examined closely for inconsistencies or appearance of over-aggressiveness. GTC penetration should be decreased if indications are present.

After 1 to 2 hours the green is checked for stress. If visible stress is observed, GTC penetration is decreased to 0.25 mm (0.010 in.) below height-of-cut.

Conditioning is continued at this setting for three to five days checking frequently for signs of stress. If no stress is observed, GTC penetration is increased by 0.25 mm (0.010 in.) while observing every two to three days for signs of stress.

Stress is a cumulative result of many factors such as irrigation, temperature, humidity, chemical application etc. Conditioning aggressiveness will require adjustment and monitoring as these factors vary. Conditioning frequency may also need to be reduced in some cases.

Smooth Roller

The roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward.

A smooth roller is always used on the rear of a cutting unit to establish the cutting height range. A front roller used in conjunction with a rear roller is needed to achieve more exact cutting heights.

Grooved Roller

The grooved roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward. The main advantage in using a grooved roller rather than a smooth one comes when cutting long grass that is very wet. Grass that is wet will tend to stay down rather than spring up after the roller passes. Grooved rollers will not bend the grass over, allowing it to be cut rather than passed over.

Along with advantages come disadvantages. Because of the reduced contact area, inherent with a grooved roller, the roller may penetrate deeper into the soil (especially in wet conditions), lowering the effective cutting height and possibly scalping the turf. Serious consideration should be given to mowing greens with a smooth roller attached, especially when turf is very wet.

Performance Variables

Three performance variables that affect the quality of cut are:

- Number of reel blades (7, 9 or 11)
- Reel rpm (sprockets)
- Ground speed of machine (sprockets)

NOTE: When discussing performance variables, we must assume that other factors such as rate of growth, mowing frequency, soil fertility and equipment condition have been considered and are not affecting the quality of cut.

Terms to help understand performance variables:

Shear point - A single point of cutting contact between the cutting unit and the turf. Due to the reel mower design, there are an infinite number of shear points across the bed knife.

Clip Ratio (CR) - The forward distance traveled between successive cutting contacts at any one shear point.

Cutting Height (CH) - The distance above the soil line that grasses are clipped.

Since reel speed is directly coupled to ground speed the clip ratio (CR) is fixed at 4.62 mm (0.182 in.).

When cutting greens, marcelling will be noticeable if the clip ratio is greater than 6.35 mm (0.25 in.).

Between 6.35 mm (0.25 in.) and 5.08 mm (0.2 in.), marcelling is seldom a problem but marcelling may become noticeable. All models provide a standard clip ratio of 4.62 mm (0.182 in.). We feel that this is the optimum clip ratio. The reel speed can be increased to reduce the clip ratio to 4.04 mm (0.159 in.). However, reel and bed knife life will be reduced. Even more importantly, under certain environmental conditions, the lower clip ratio can result in turf damage. This damage will appear as a brown strip where the mower overlaps on each pass.

NOTE: To calculate mph, multiply 0.68148 x ft traveled/second. Another way to calculate speed is to measure off an 88 ft distance, record the length of time, in seconds, it takes to travel that distance and divide 60 by that time.

Checks and Adjustments

Traction Roller Adjustment Check

Reason

In order to ensure an even, level cut, the traction roller must be parallel to the reel.

Procedure

Check parallelism between traction roller and reel. (See “Traction Roller Adjustment” on page 101.)

Backlapping and Bed Knife-to-Reel Adjustment

It is best to think of backlapping and bed knife-to-reel adjustments as one procedure. Although backlapping removes only a small amount of metal, the clearance between the reel and bed knife increases due to backlapping and must be readjusted.

Another very important point to remember is that adjustments can only be successful if the frame integrity (straightness and strength) is maintained. Attaching bolts must be secure and bearings must be well lubricated and not worn.

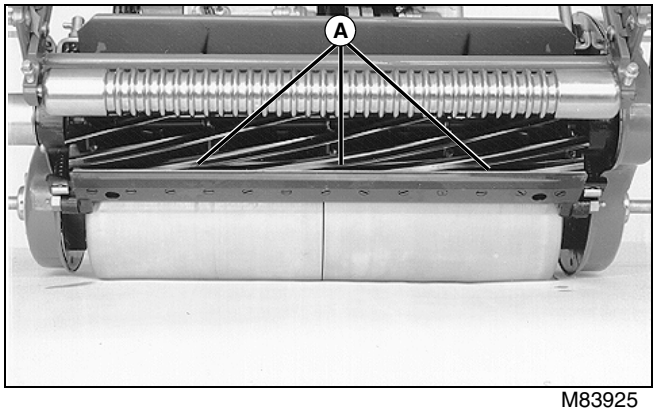
Reel and Bed Knife Inspection

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges. Never allow more than one person at a time to work on any one cutting unit. Never allow work to be accomplished on more than one cutting unit at the same time. Serious personal injury could result.

1. Visually inspect cutting unit for damage. Chipped paint, dents, or gouges may indicate the need for a closer look at the frame for distortion, broken weldments, or other damage that could prevent proper adjustment. Repair or replace parts as necessary.

2. Inspect for vertical or lateral movement in the reel or bearings supporting the reel. Repair or replace as necessary.

3. While rotating the reel in the reverse direction by hand, inspect each blade cutting edge for nicks, gouges, or distortion. Ensure the cutting edge land does not exceed more than 3/4 of the blade thickness. To restore the relief angle and cutting edge before continuing with this procedure, see “Reel and Bed Knife Grinding” on page 148.



M83925

4. Inspect the bed knife cutting edge (A) for nicks, gouges or distortion. Inspect leading edge of bed knife for relief to prevent catching of knife. A small relief or dub needs to be added after several backlappings.

5. Inspect the bed knife for uneven wear (indicated by uneven land width across the length of the bed knife). Ensure the cutting edge land does not exceed 3/4 of the cutting edge. Replace the bed knife if the cutting edge starts curling upward.

Bed Knife-to-Reel Adjustment

Reason

To ensure correct clearance between bed and reel knife.

Special or Required Tools

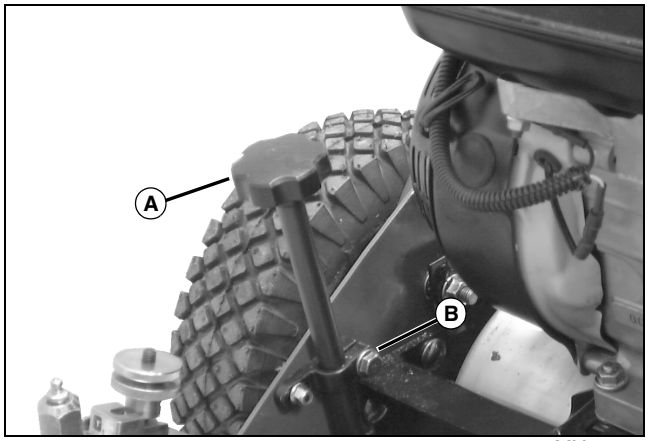
Tool Name	Tool No.	Tool Use
Feeler Gauge Set (Blade Type)	NA	Used to measure bed knife-to-reel clearance.

Procedure

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

NOTE: Reel must be free to turn by hand.

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Disengage reel clutch.
6. Remove grass catcher.



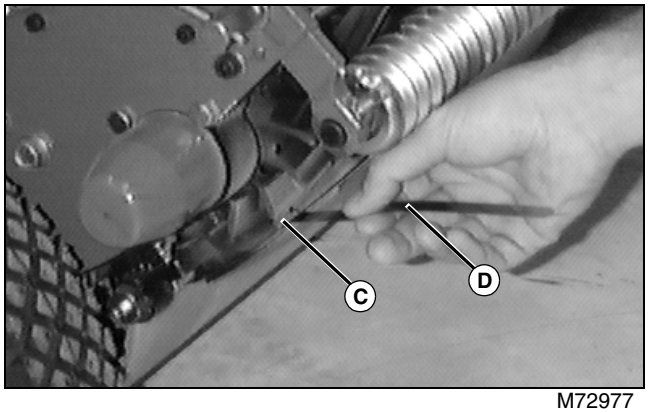
MX6035

7. Loosen clamp screw (B) on both sides of mower.

8. To adjust bed knife-to-reel clearance turn adjusting handle (A):

- Clockwise to decrease clearance.
- Counterclockwise to increase clearance.

IMPORTANT: Avoid damage! Always rotate reel in the reverse direction to avoid damaging or dulling the cutting edges or the reel or bed knife.

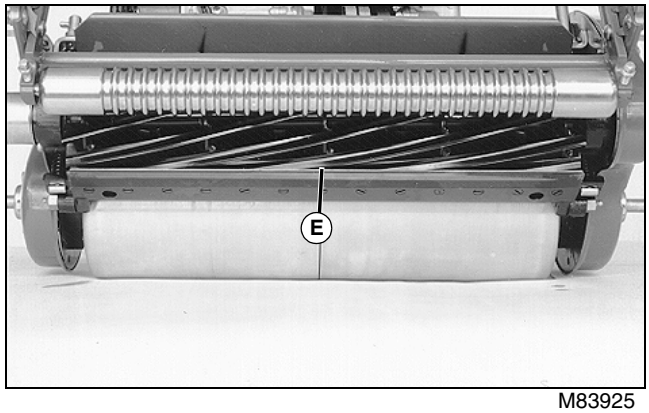


M72977

9. Inspect gap (C) along the entire length of the bed knife using a 0.05-mm (0.002-in.) feeler gauge (D):

- If the reel contacts the bed knife at any point, go to step 11.
- If the gap is large enough to allow the feeler gauge to pass between reel and bed knife, go to steps 12-13.

10. Slowly rotate the reel backwards and watch for contact between the reel and bed knife at the center of the bed knife. If contact is made, backlap the reel and bed knife to eliminate “frown” in bed knife or out-of-round condition of reel. (See “Backlapping Procedure” on page 149.)

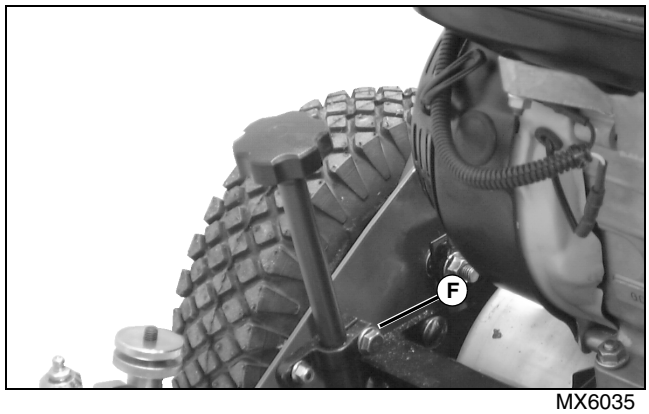


M83925

11. Measure the clearance at the center of bed knife (E). If clearance exceeds 0.05 mm (0.002 in.), backlap the reel and bed knife to eliminate “smile” in bed knife or out-of-round condition of reel. (See “Backlapping Procedure” on page 153.)

12. When properly adjusted and sharpened, each reel blade should cut a piece of paper held at 90° to the top surface of the bed knife along the entire length of the bed knife with specified clearance.

IMPORTANT: Avoid damage! DO NOT overtighten knife to reel. Overtightening can cause damage to knife or cutting edges.



MX6035

13. Tighten clamp screw (F) on both sides of mower.

Specifications

Bed Knife-to-Reel
Clearance . . . . . 0-0.025 mm (0-0.001 in.)

Backlapping Procedure

Reason

To ensure consistent cutting action.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Long-Handled Brush (Dealer Fabricated)	NA	Used to apply lapping compound to rotating reel.
Backlapping Unit	NA	Used to rotate reel during procedure.
3/8-in. Fine Thread Backlapping Cap Screw	19H2987	Used to connect socket extension and backlapping unit to reel shaft.

Procedure

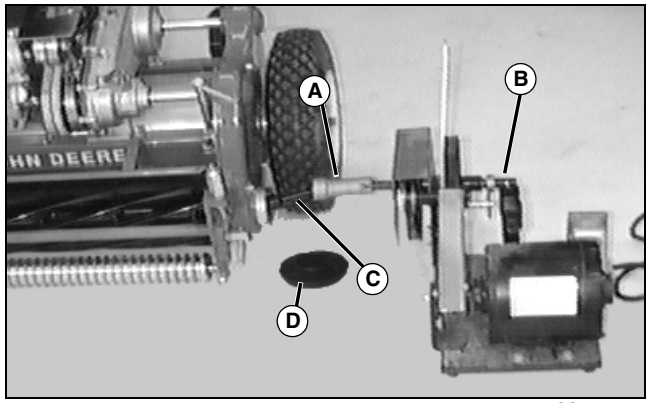
CAUTION: Avoid injury! Disengage greens tender conditioner before backlapping. Severe personal injury may result from rotating knives.

CAUTION: Avoid injury! Avoid injury from rotating blades. Keep hands and feet away from blades while machine is running. Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges. Never allow more than one person at a time, to work on any one cutting unit. Never allow work to be accomplished on more than one cutting unit at the same time. Serious personal injury could result.

IMPORTANT: Avoid damage! Backlap cutting reel routinely to prolong life of reel.

NOTE: The bed knife-to-reel contact should be adjusted before performing backlapping procedure. (See "Bed Knife-to-Reel Adjustment" on page 151.)

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Release operator presence bail to disengage reel drive.

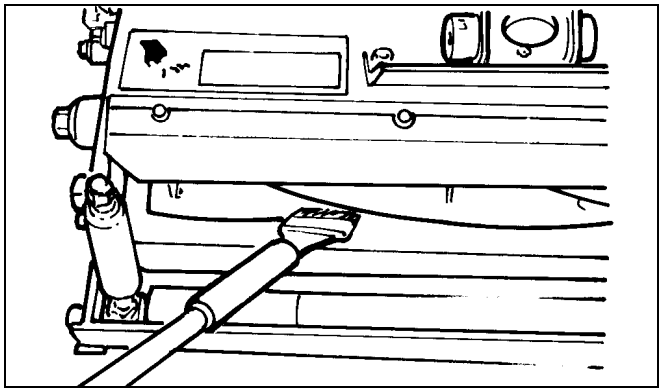


M60606

A - Socket Extension
B - Backlapping Unit
C - Backlapping Cap Screw
D - Cover

6. Remove reel shaft cover (D).
7. Screw 3/8-in. backlapping cap screw (C) into reel shaft.
8. Install socket extension (A) on backlapping cap screw.
9. Connect extension to backlapping unit (B).
10. Turn on backlapping motor. Make sure reel is running in reverse.

IMPORTANT: Avoid damage! Never operate cutting unit in the forward direction until abrasive compounds are removed from the cutting unit. The abrasive compound will dull the cutting edges.



M56482

11. Apply 120 grit compound to the rotating reel evenly from one side to the other and back again with a long- handled brush. (For instructions for making this tool, see "Dealer Fabricated Tools" on page 144.)
12. Allow the reel to spin until quiet. If desired, follow with a 220 grit compound to achieve a "Tournament Grade" finish.

CAUTION: Avoid injury! Never use pressure washers or steam cleaners to rinse the abrasives from the cutting unit. The abrasives may be forced past the seals and damage the bearings.

13.Rinse the lapping compound off the cutting unit with water and repeat the adjustment procedure before returning the unit to service. (See “Bed Knife-to-Reel Adjustment” on page 151.)

14.Add a relief, if needed, to the leading edge of the knife to prevent the edge from "catching" the reel and curling it up.

Reel Drive Chain Tension Adjustment

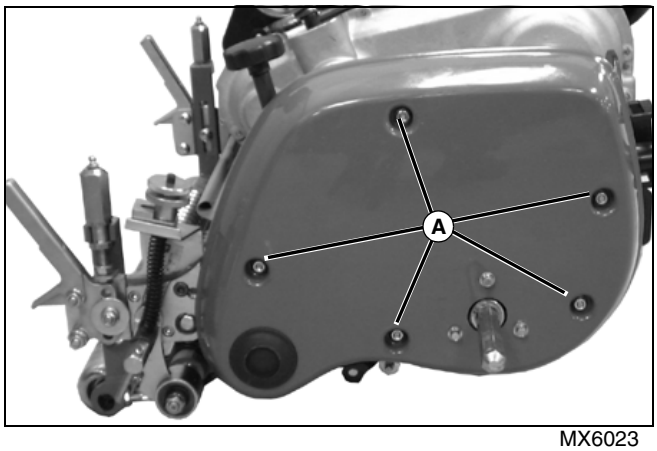
Reason

To maintain proper chain tension.

Procedure

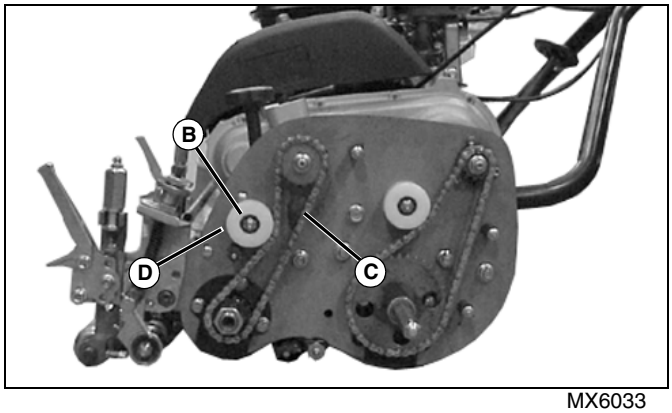
CAUTION: Avoid injury! Block machine securely before servicing or repairing.

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Disengage reel clutch.
6. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)



MX6023

7. Remove five flange nuts (A), spacers, and shoulder bolts, and remove left drive cover.



MX6033

8. Loosen cap screw (B) and reposition idler roller (D) until deflection of reel chain (C) at mid span opposite idler is to specification.
9. Tighten cap screw.
10.Install cover and transport wheels (if equipped).

Specifications

Reel Drive Chain Deflection . . . . . 12 mm (0.472 in.)

Cutting Height Adjustment

Reason

To set desired cutting height.

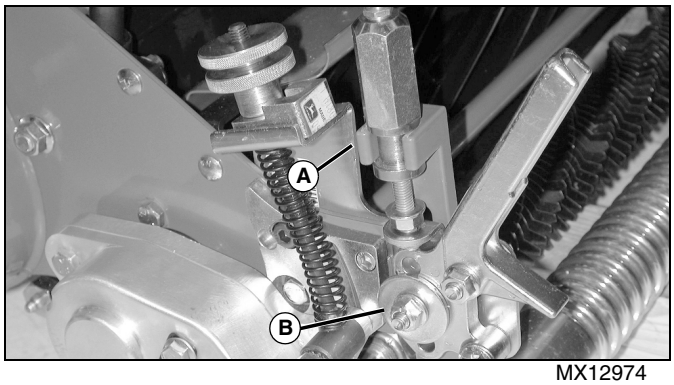
Special or Required Tools

Tool Name	Tool No.	Tool Use
Two-Bolt Gauge Bar	AMT2978	Used to perform height-of-cut, rear roller/bed knife, and greens tender conditioner adjustments.

Procedure

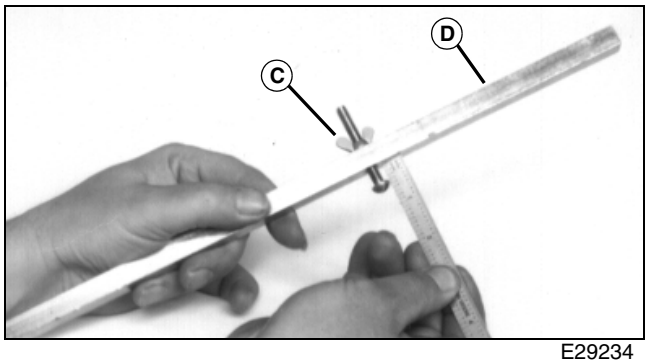
NOTE: The bed knife-to-reel adjustment MUST be performed before adjusting cutting height. (See "Bed Knife-to-Reel Adjustment" on page 151.)

1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.
4. Engage park brake.
5. Disengage reel clutch.



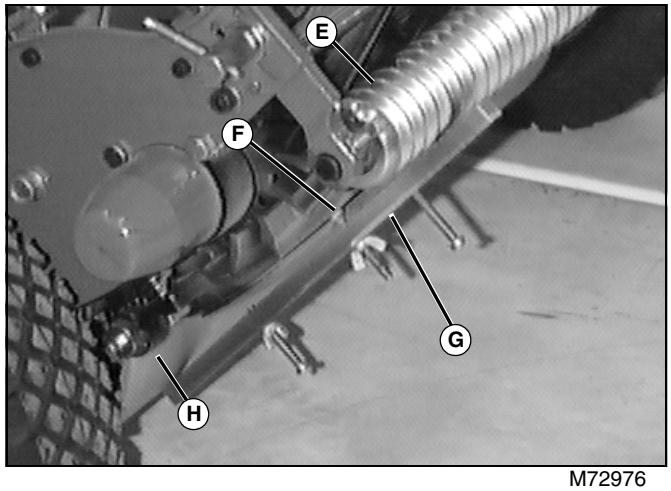
MX12974

6. Loosen flange nut (B) on both sides of mower until adjusting bracket (A) slides easily.

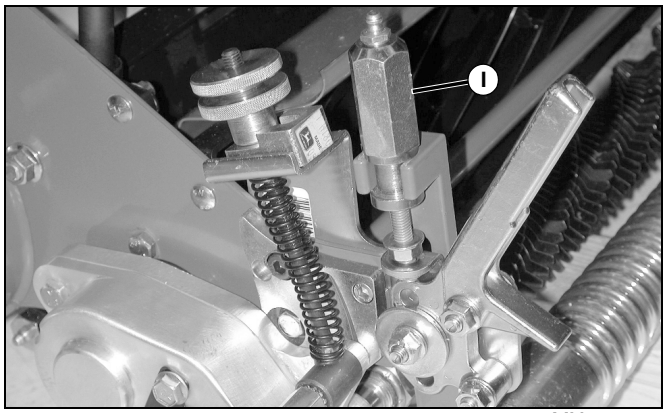


E29234

7. Loosen wing nut (C) and set gauge (D) to desired cutting height.



M72976



MX12974

8. Place gauge (G) against bottom of front roller (E) and traction roller (H) and bed knife cutting surface.
9. Adjust height of front roller up or down using adjusting knob (I).
10. Adjust height to gauge until knife makes firm contact with underside of screw head (F).
11. Repeat steps 8-10 for other side.
12. Recheck cutting height on both sides with gauge. Re-adjust if necessary.
13. Tighten flange nuts.

Optional Greens Tender Conditioner (GTC) and Rotary Brush Adjustment

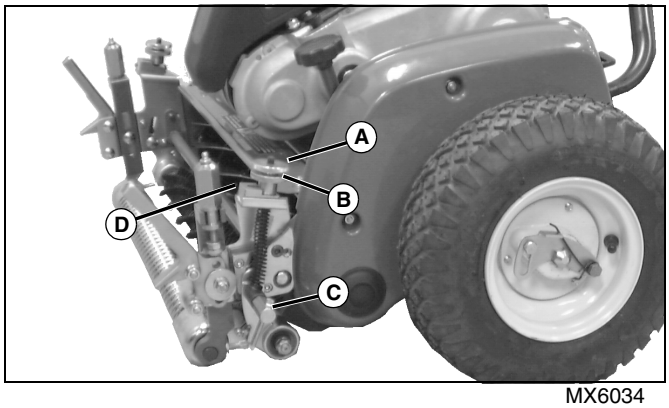
Reason

To ensure that the machine drives evenly when the rotary brush or greens tender conditioner (GTC) is engaged.

Procedure

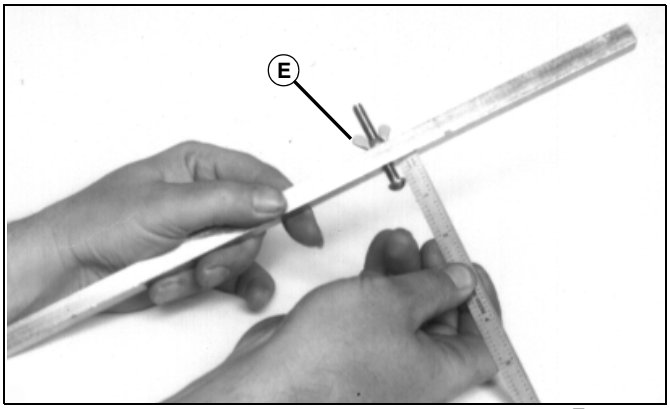
1. Park machine on a level surface.
2. Move Run/Off switch to OFF position.
3. Move travel clutch lever to NEUTRAL position.

4. Move reel clutch to STOP position.
5. Engage park brake.
6. Disengage greens tender conditioner (GTC).
7. Remove grass catcher.



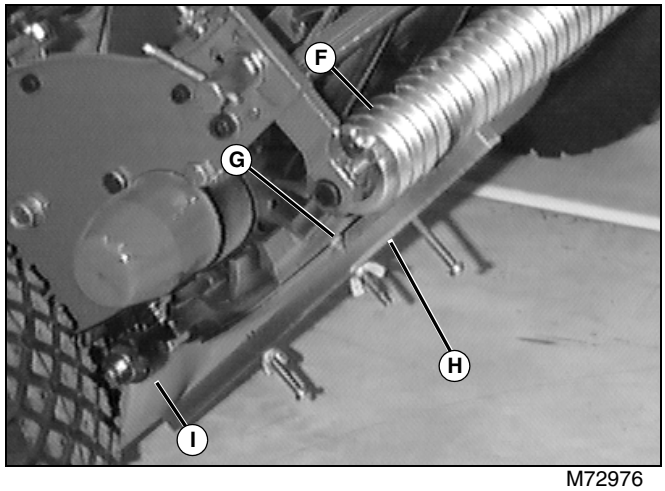
MX6034

8. Loosen T-handle (C).
9. Loosen jam knob (A).
10. Set adjusting knob (B) on lower step of sliding block (D).
11. Repeat procedure for other side.

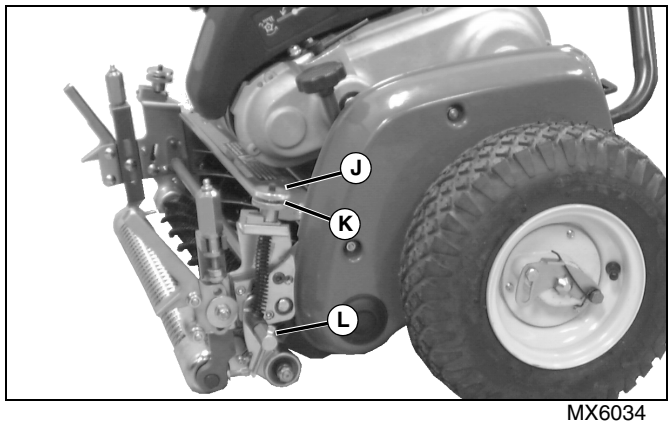


E29234

12. Measure from the top of screw head to the top of the gauge. Set to desired cutting height.
13. Loosen wing nut (E) and adjust the screw as follows:
    - **Rotary Brush:** 1 mm (0.04 in.) ABOVE cutting height.
    - **Greens Tender Conditioner:** 1 mm (0.04 in.) maximum BELOW cutting height.



M72976



MX6034

14. Place gauge (H) against bottom of front roller (F) and traction roller (I) and bed knife cutting surface.
15. Use adjusting knob (K) to set height on each side until GTC or rotary brush makes contact with screw head (G).
16. Tighten jam knob (J).
17. Repeat for other side.
18. Tighten T-handles (L).

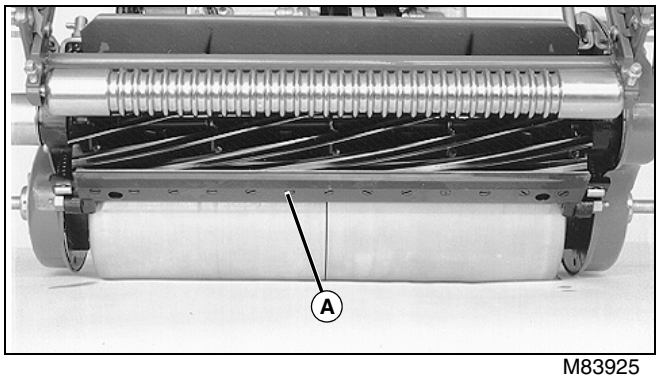
Repair

Bed Knife Removal and Installation

CAUTION: Avoid injury! Block machine securely before servicing or repairing.

Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

IMPORTANT: Avoid damage! DO NOT reuse screws if bed knife is removed.



M83925

1. Remove 13 bed knife screws (A) and bed knife.
2. Remove debris and corrosion from bottom surface of shoe. Check the bed knife mounting surface with a straightedge for distortion. Straighten or replace as necessary.

Installation

Installation is done in the reverse order of removal.

Install bed knife using new screws. Starting at the center screw, alternate tightening bed screws, working toward the ends of the knife. Tighten screws to specification.

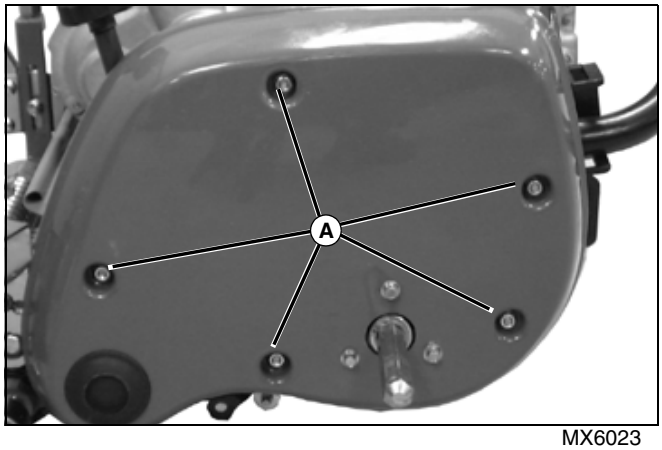
Specifications

Bed Knife Screw Torque . . . . . 6.5 N•m (58 lb-in.)

Reel Assembly Removal - Without Greens Tender Conditioner (GTC)

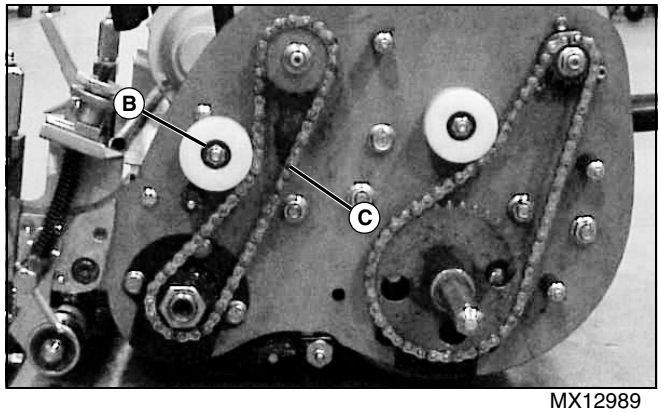
CAUTION: Avoid injury! Block machine securely before servicing or repairing.

1. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)



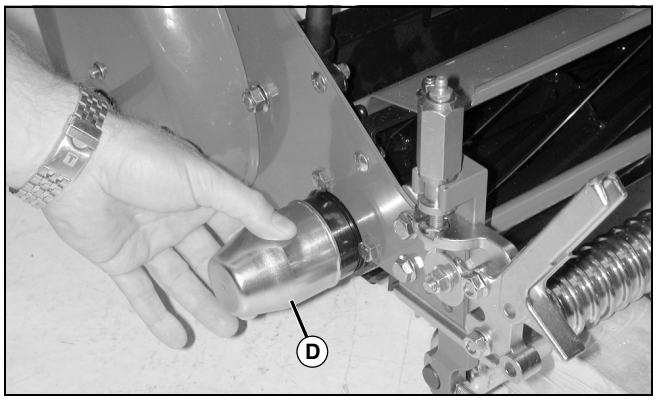
MX6023

2. Remove five flange nuts (A), spacers, and shoulder bolts, and remove left drive cover.



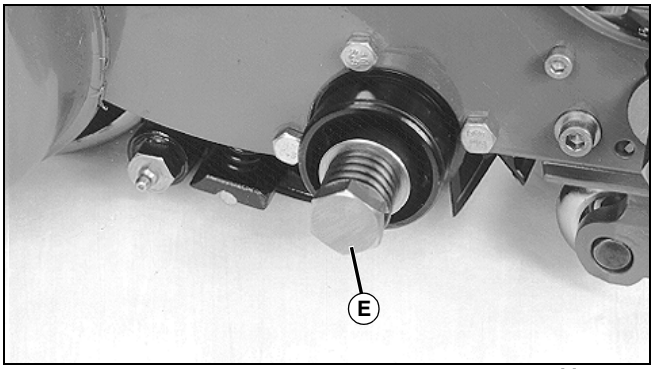
MX12989

3. Loosen cap screw (B) to release chain tension.
4. Disconnect master link and remove reel drive chain (C).



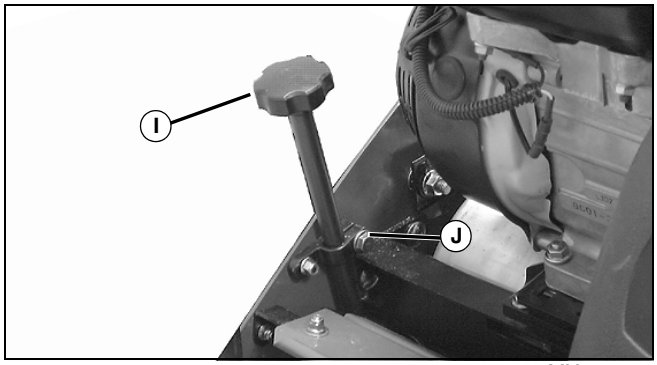
MX11270

5. Remove cap (D).



M83926

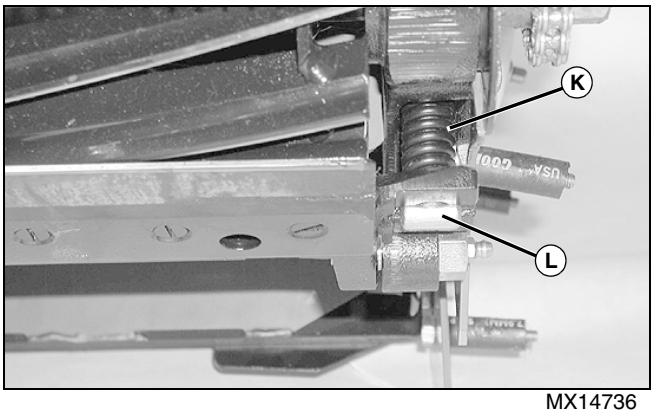
6. Remove shoulder bolt (E), spring, spacer, and collar.



MX14737

7. Loosen clamp screw (J) and remove bed knife adjusting handle (I) from both sides of mower.

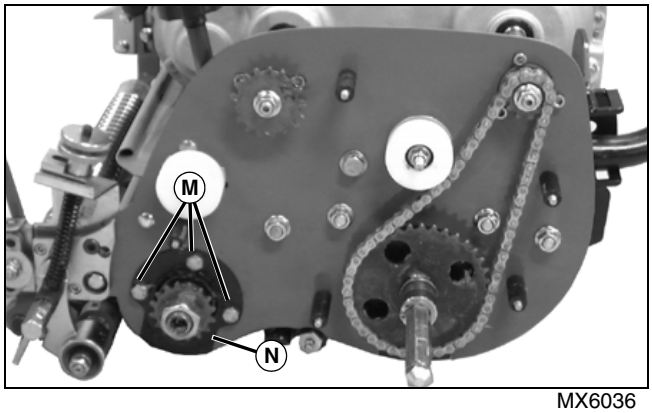
CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.



MX14736

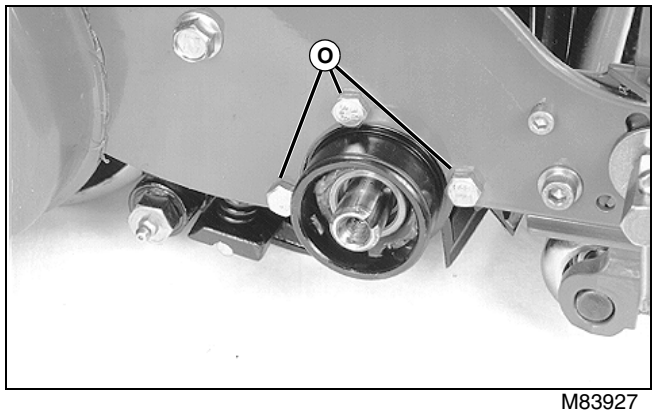
8. Remove T-bolt (L) and spring (K) from both sides of reel.

9. Rotate bed knife support downward.



MX6036

10. Remove three cap screws (M) and shield (N) from left bearing housing. Left end of reel will lower.



M83927

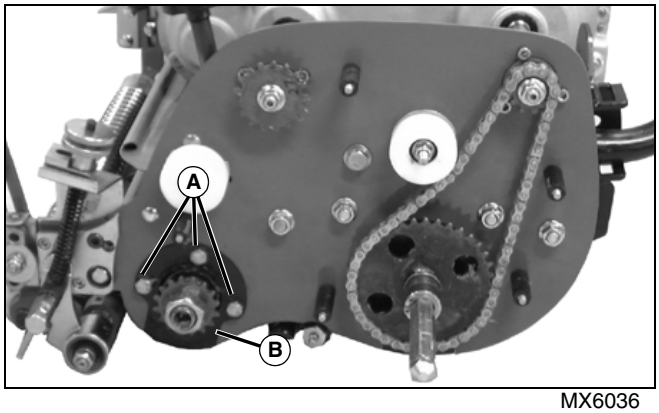
11. Remove three cap screws (O) from right bearing housing.

12. Remove reel assembly.

13. Inspect all parts for wear and damage. Replace parts as necessary. (See “Reel Assembly Disassembly and Inspection” on page 164.)

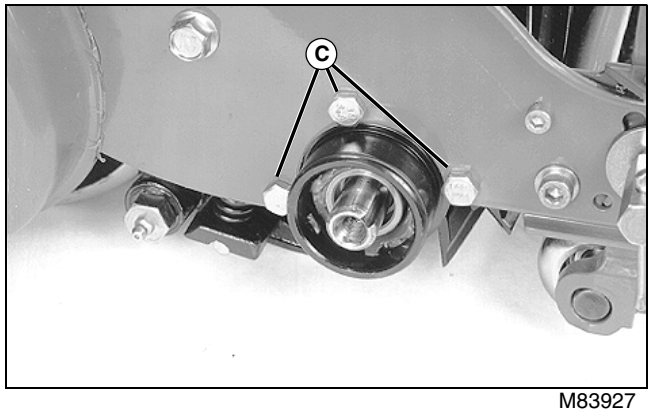
Reel Assembly Installation - Without Greens Tender Conditioner (GTC)

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.



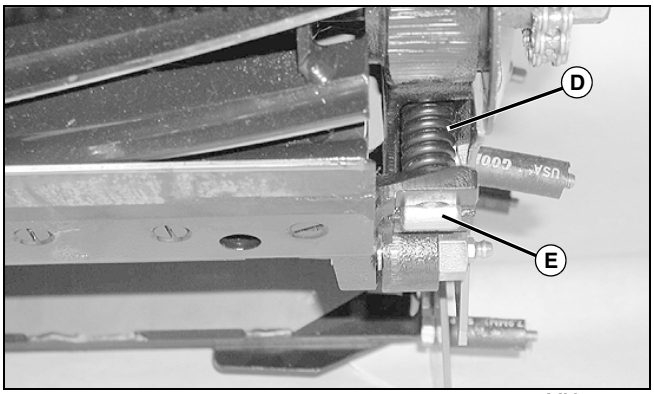
MX6036

1. Install reel assembly and shield (B) with three cap screws (A).



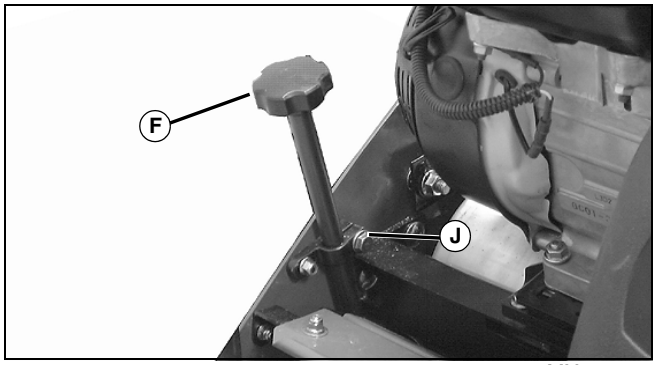
M83927

2. Install bearing housing using three cap screws (C).



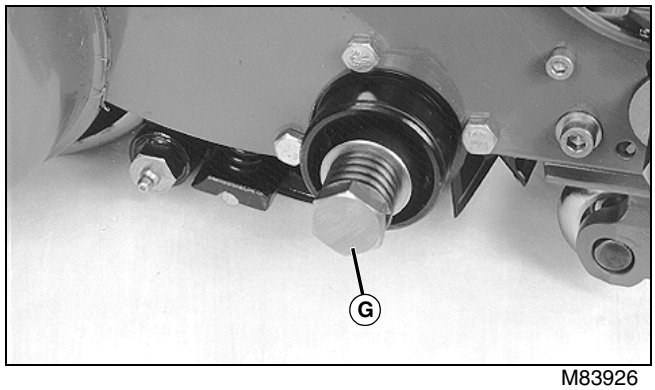
MX14736

3. Install spring (D) and T-bolt (E) on both sides of reel.



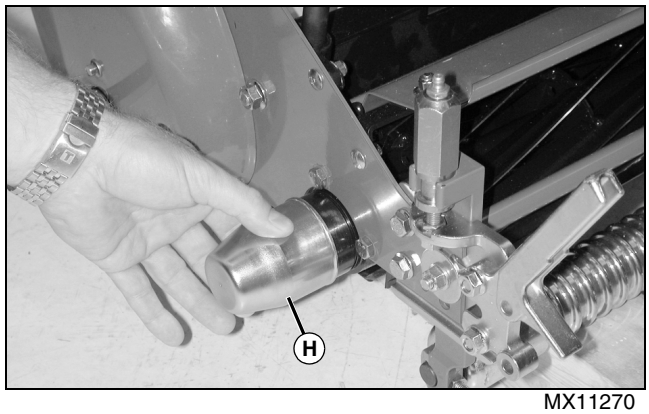
MX14737

4. Install adjusting handles (F).
5. Adjust handles until bed knife just clears reel.
6. Tighten clamp screws (F).



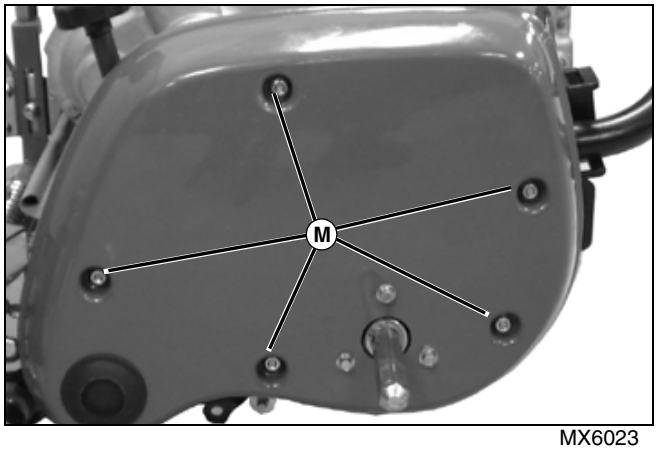
M83926

7. Install collar, spring, and shoulder bolt (G).



MX11270

8. Install cap (H).
9. Pry ends of reel from side to side and check end play. Reel must slide easily.
10. Lubricate both sides of reel.
11. Adjust reel drive chain tension. (See “Reel Drive Chain Tension Adjustment” on page 154.)
12. Lubricate drive chains. (See “Grease” on page 12.)



MX6023

13.Install left drive cover.

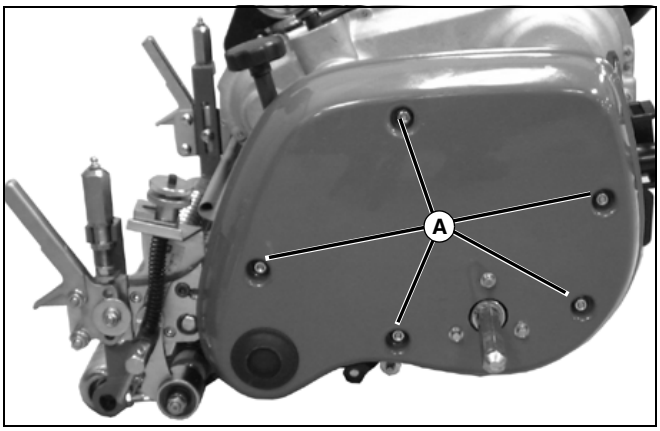
14.Tighten five flange nuts (M).

15.Adjust bed knife-to-reel clearance. (See “Bed Knife-to-Reel Adjustment” on page 151.)

16.Backlap reel. (See “Backlapping Procedure” on page 153.)

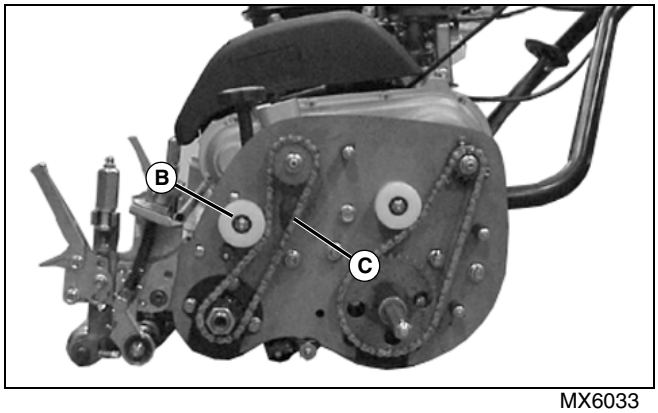
Reel Assembly Removal - With Greens Tender Conditioner (GTC)

1. Remove transport wheels. (See “Transport Wheel Removal and Installation” on page 172.)



MX6023

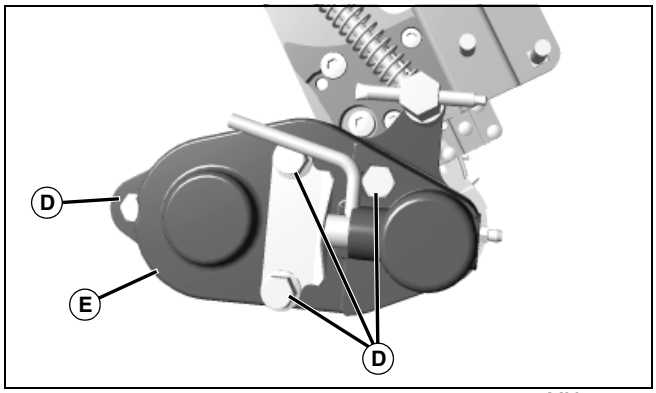
2. Remove five flange nuts (A), spacers, and shoulder bolts, and remove left drive cover.



MX6033

3. Loosen cap screw (B) to release chain tension.

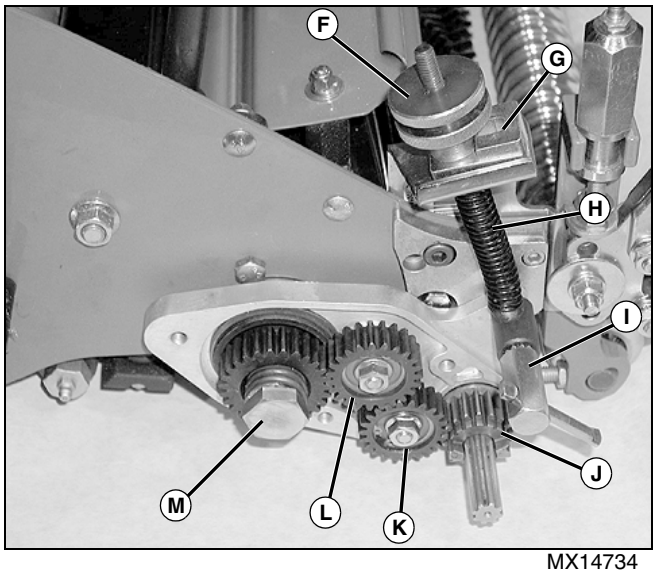
4. Disconnect master link and remove reel drive chain (C).



MX12982

5. Remove cap screws (D) and washers.

6. Remove gear case cover (E) with shift collar.



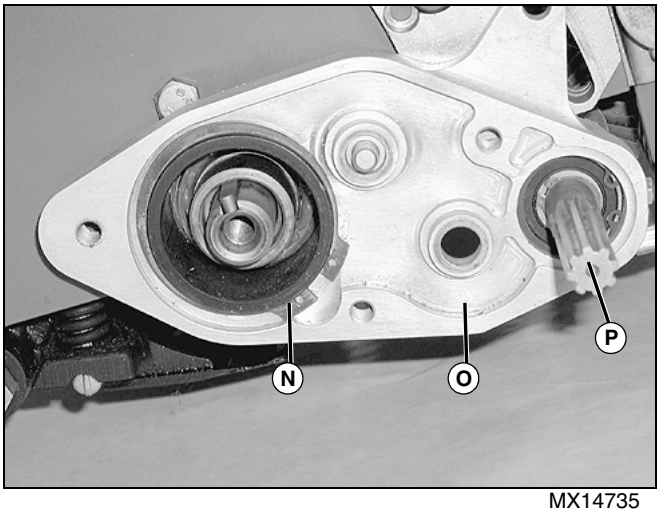
MX14734

7. Remove adjuster knobs (F), T-handle and lock washers (I), spring and threaded rod (H), and spacer (G) from both sides of machine.

8. Remove idler gears (K and L).

9. Remove gear and bushing (J).

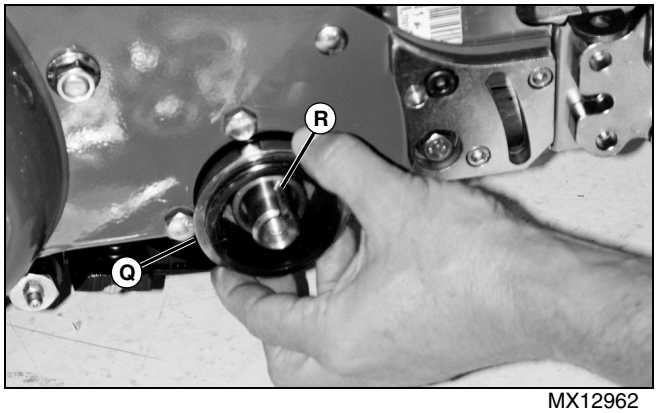
10.Remove shoulder bolt, spring, and gear (M).



MX14735

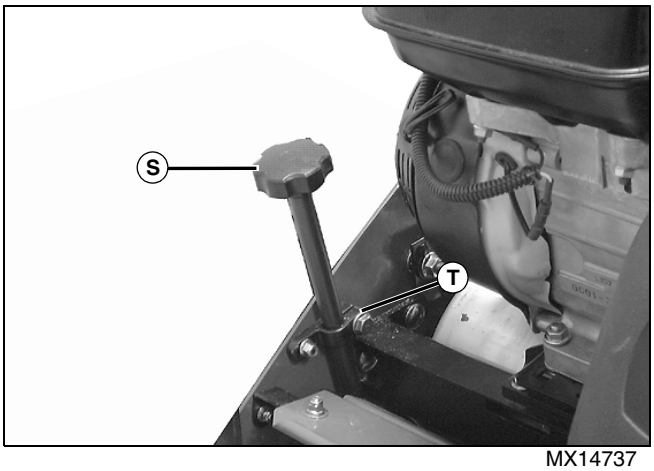
11.Remove snap ring (N)

12.Remove gear case (O) with GTC vertical cutter or brush (as equipped) (P).



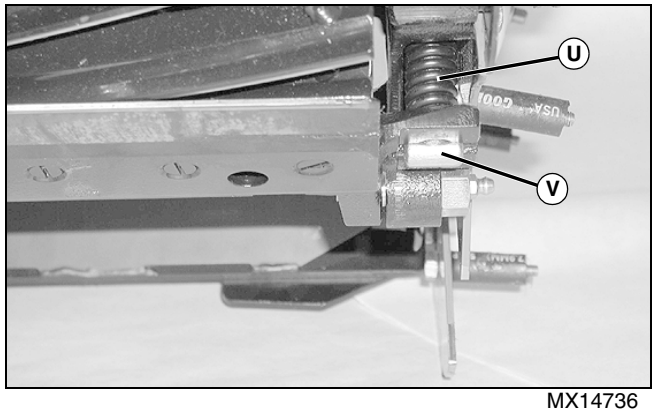
MX12962

13.Remove key (R) and collar (Q).



MX14737

14.Loosen clamp screw (T) and remove bed knife adjusting handle (S) from both sides of mower.

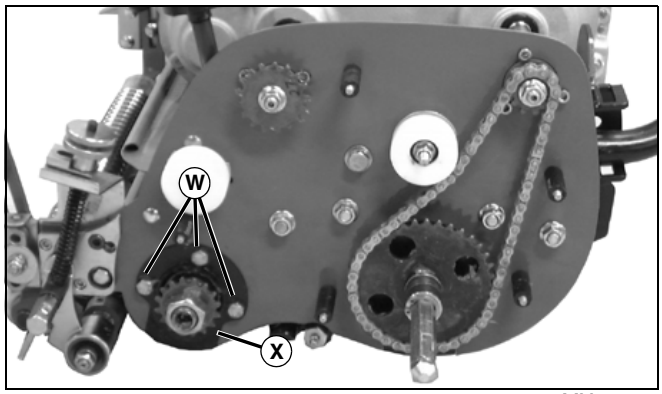


MX14736

15.Remove T-bolt (V) and spring (U) from both sides of mower.

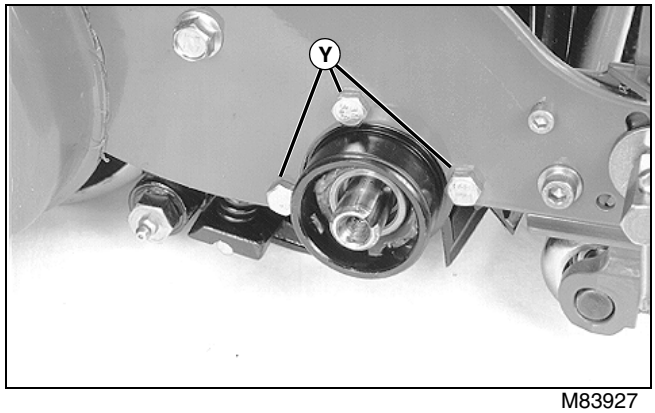
CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

16.Rotate bed knife support downward.



MX6036

17.Remove three cap screws (W) and shield (X) from left bearing housing. Left end of reel will lower.



M83927

18.Remove three cap screws (Y) from right bearing housing.

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

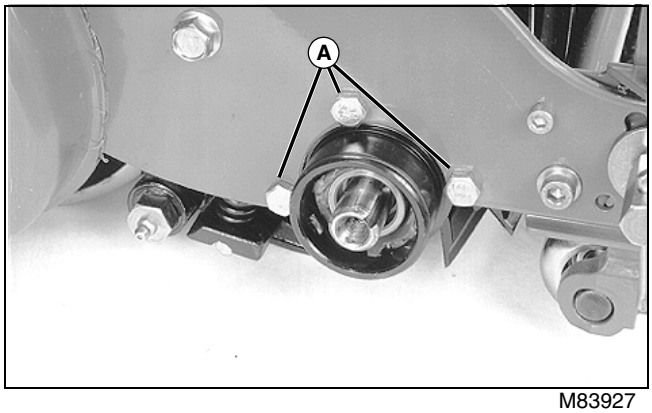
19.Remove reel assembly.

20.Inspect all parts for wear and damage. Replace parts as necessary. (See “Reel Assembly Disassembly and Inspection” on page 164.)

Reel Assembly Installation - With Greens Tender Conditioner (GTC)

Other Material

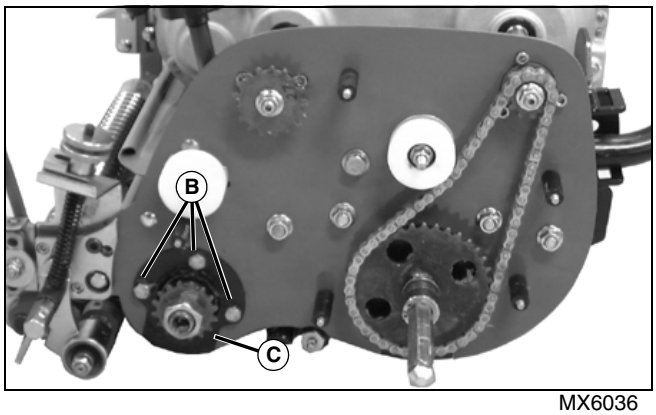
Part No.	Part Name	Part Use
TY6341	John Deere Multi-Purpose SD Polyurea Grease	Apply to GTC drive gears.



M83927

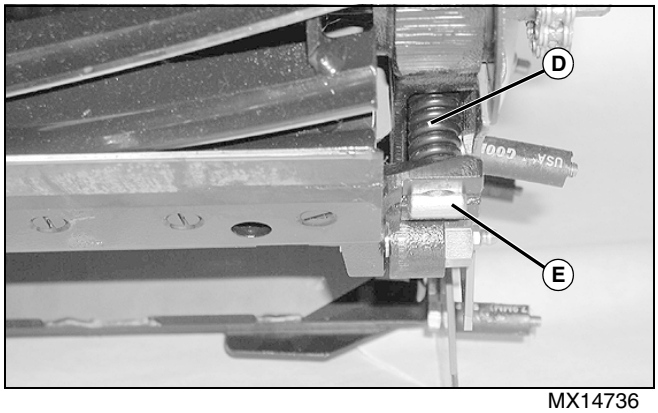
1. Install bearing housing using three cap screws (A).

CAUTION: Avoid injury! Always wear protective gloves when working on or near a reel or GTC. Serious personal injury can result from contact with sharp cutting edges.



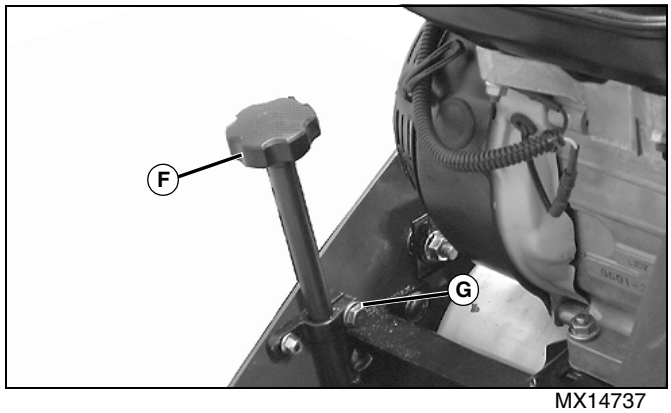
MX6036

2. Install reel assembly and shield (C) with three cap screws (B).



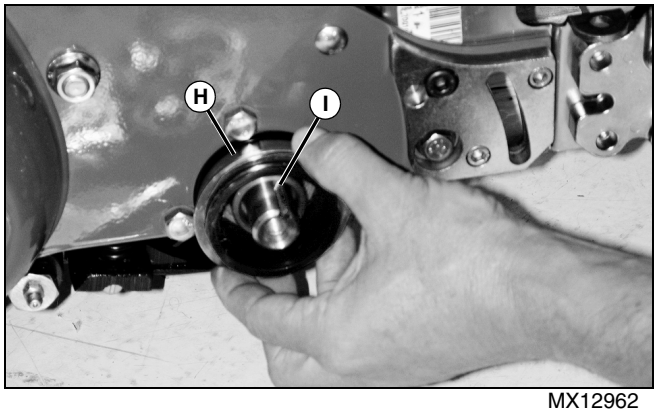
MX14736

3. Install spring (D) and T-bolt (E) on both sides of mower.



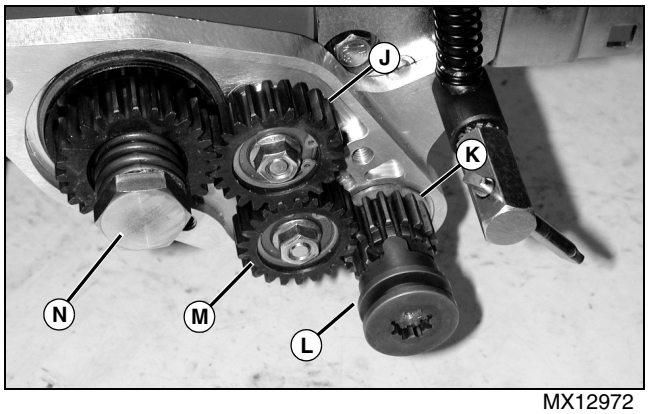
MX14737

4. Install adjusting handles (F).
5. Adjust handles until bed knife just clears reel.
6. Tighten clamp screws (G).



MX12962

7. Install collar (H) with flange away from mower frame. Install key (I).



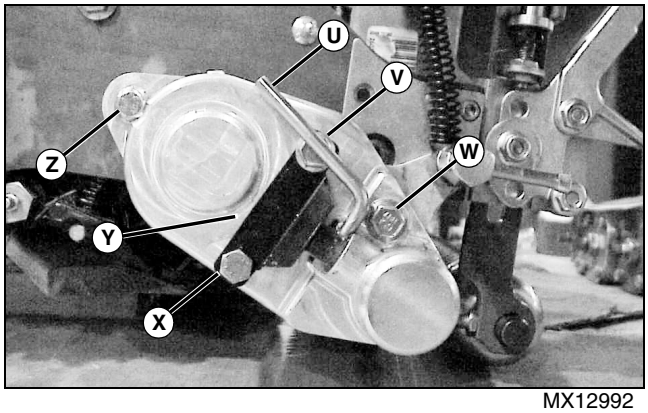
MX12972

8. Install gear, spring, and shoulder bolt (N).

9. Install gear (K).

10.Install larger idler gear (J) and smaller idler gear (M) and tighten to specification.

11.Install shift collar (L).



MX12992

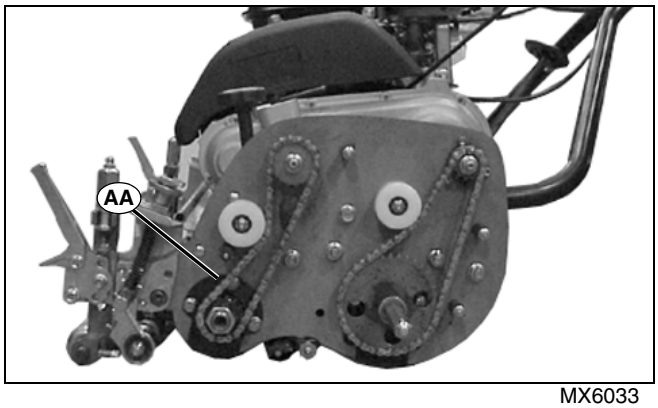
12.Install gasket and cover with 112 mL (8 oz) of polyurea multi-purpose grease around gears. Tighten the two cover bolts (W and Z) to specification.

NOTE: Place grease on the O-ring of handle (U).

Be sure to line up pin of the handle with slot on the shift collar.

13.Install handle (U) making sure it fits in groove of shift collar. Install leaf spring (Y). Install short bolt (M8 x 12) (V) and long bolt (M8 x 50) (X) with washer and tighten to specification.

14.Pry ends of reel from side to side and check end play. Reel must slide easily.

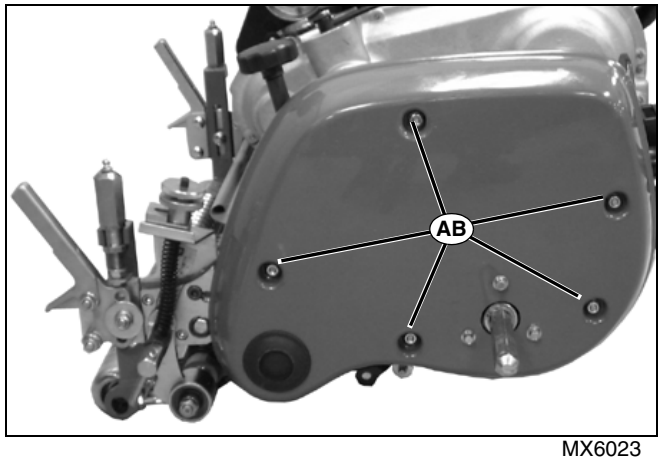


MX6033

15.Install reel drive chain (AA).

16.Adjust reel drive chain tension. (See “Reel Drive Chain Tension Adjustment” on page 154.)

17.Lubricate drive chains. (See “Grease” on page 12.)



MX6023

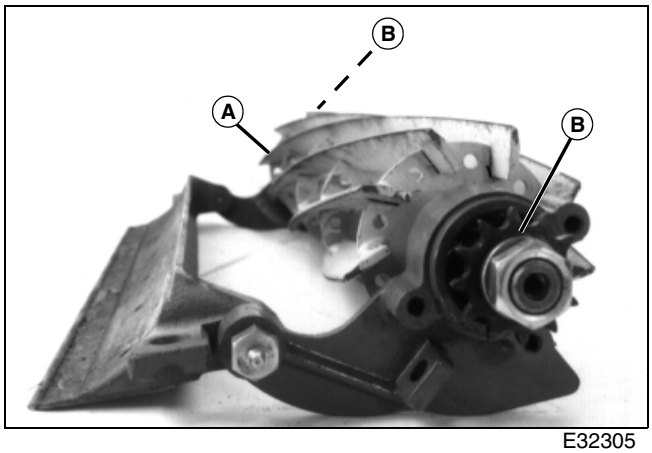
18.Install left drive cover and tighten nuts and bolts (AB).

19.Adjust bed knife-to-reel clearance. (See “Bed Knife-to-Reel Adjustment” on page 151.)

20.Backlap reel. (See “Backlapping Procedure” on page 153.)

Bearing Inspection

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.



E32305

NOTE: If one bearing and seal is being replaced, replace other side also.

Rotate reel (A) and inspect bearings (B) for roughness and ease of rotation. If reel binds or rotates roughly, replace bearing and seal. (See “Reel Assembly Disassembly and Inspection” on page 164.)

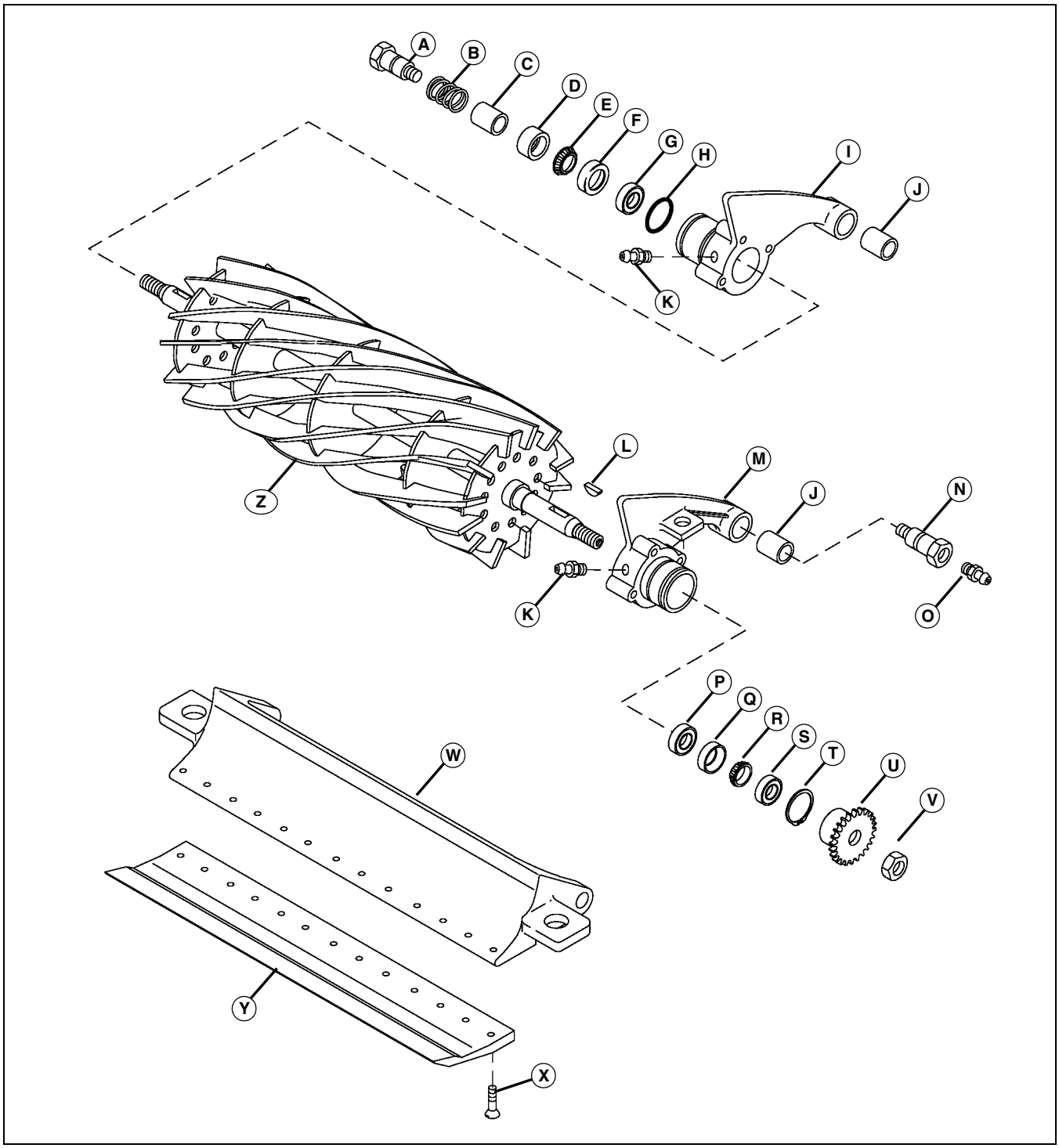
Specifications

Reel Shoulder Bolt Torque. . . . . 62.4 N•m (46 lb-ft)
GTC Idler Gear Nut Torque . . . . . 27 N•m (240 lb-in.)
GTC Gear Case Cover Bolt Torque . . 11 N•m (96 lb-in.)
GTC Gear Case Leaf Spring Bolt Torque . . . . . 11 N•m (96 lb-in.)

Reel Assembly Disassembly and Inspection

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

NOTE: If bearings and seal are to be replaced, replace both sides at the same time.



MX6027

A - Shoulder Bolt
B - Spring
C - Spacer (without GTC), Gear (with GTC)
D - Spacer
E - Bearing Cone
F - Bearing Cup
G - Seal
H - O-Ring
I - Housing
J - Bushing (2 used)
K - Lubrication Fitting (2 used)
L - Key
M - Housing
N - Shoulder Bolt
O - Lubrication Fitting

P - Seal
Q - Bearing Cup
R - Bearing Cone
S - Seal
T - Snap Ring
U - Sprocket
V - Nut
W - Shoe
X - Screw (13 used, torque to specifications)
Y - Bed Knife
Z - Reel

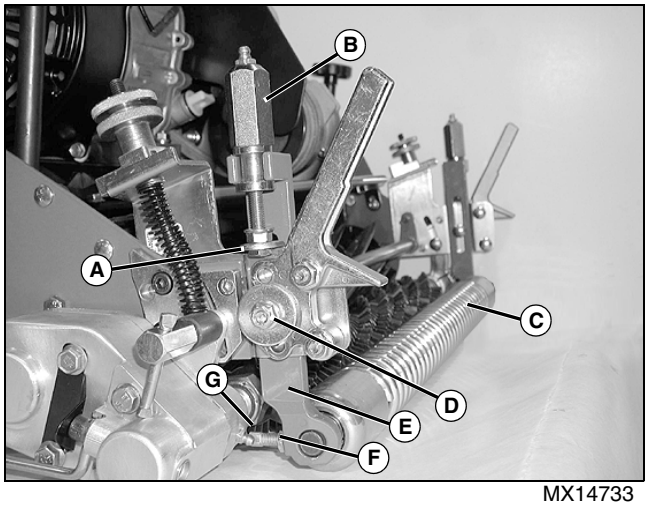
1. Inspect all parts for wear and damage. Replace parts as necessary.

2. Apply reel support grease to lubrication fittings. (See “Grease” on page 12.)

Specifications

Bed Knife-to-Shoe
Screw Torque . . . . . 6.5 N•m (58 lb-in.)

Front Roller Removal and Installation



MX14733

1. Remove jam nut (A).

2. Loosen jam nut (F) and set screw (G) at both ends of the roller.

NOTE: Only one roller bracket needs to be removed in order to remove the roller.

3. Remove lock nut, washer, and carriage bolt (D) from left or right side of machine.

4. Remove bracket (E) along with adjuster (B). Remove roller.

Installation

Installation is done in the reverse order of removal.

NOTE: DO NOT install set screws into holes in roller shaft.

- Center roller between brackets, install set screws and tighten jam nuts.

NOTE: DO NOT over-lubricate. Excess grease could fall from the mower during operation.

- Apply multi-purpose grease to grease fittings.
- Adjust cutting height. (See “Cutting Height Adjustment” on page 155.)

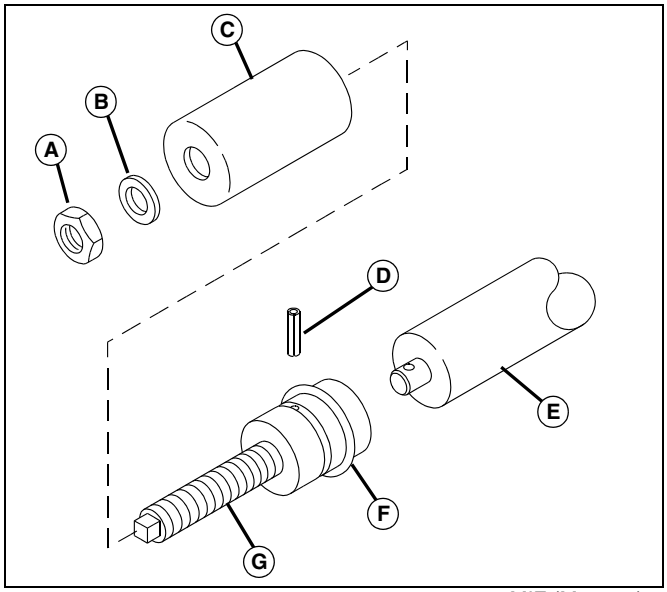
Bearing Replacement

NOTE: This procedure applies to both smooth and grooved rollers.

CAUTION: Avoid injury! Wear approved eye protection when using JDG795 Roller Bearing Puller.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Roller Bearing Puller	JDG795	Used to remove roller bearing.
Bearing Installer	JD243 or JD506	Used to install new roller bearings.
0.89 mm (0.035 in.) Feeler Gauge	NA	Used when installing bearings in smooth rollers.

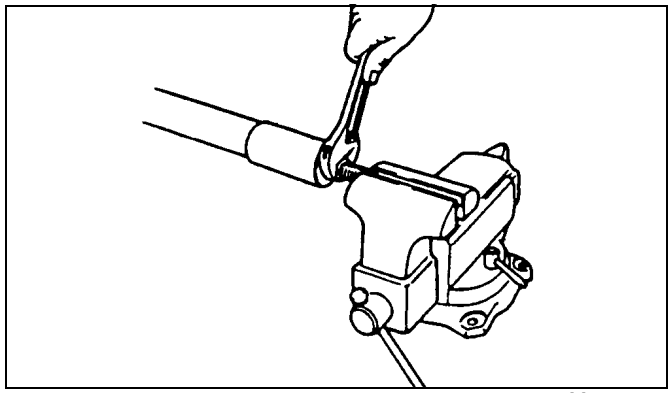


MIF (M83583)

A - Nut
B - Washer
C - Roller Sleeve
D - Pin
E - Roller
F - O-Ring
G - Threaded Puller

1. Attach threaded puller to the bearing by inserting the pin through the hole in the bearing shaft and puller. Slide the O-ring over the pin to keep it in position.

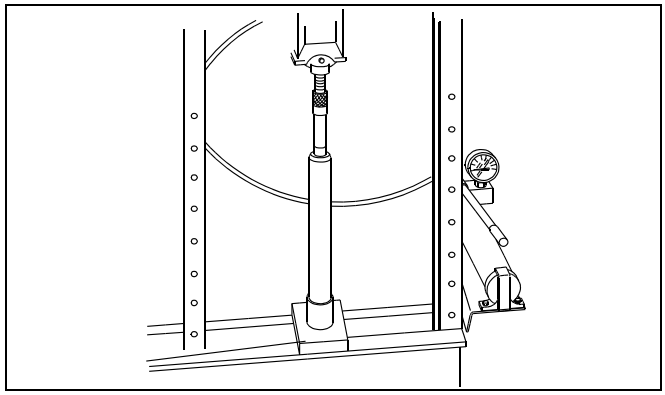
2. Slide roller sleeve over the threaded puller with the concave end of the roller sleeve against the end of the roller. Install flat washer and nut on threaded puller.



M83584

3. Clamp the hex end of the threaded puller in a vise or hold it with a wrench. Turn nut counterclockwise until the bearing is removed from the roller.

IMPORTANT: Avoid damage! DO NOT press on center shaft of bearing when installing bearing. Bearings will set and become tight. Bearings must only be installed by pressing on outside race of bearing.



MIF (M83586)

4. Position roller in a press using the roller sleeve to hold the roller while installing the bearing in the other end.

5. Position JD243 or JD506 Bearing Installer over the new bearing in the top end of the roller.

6. Press until bearing bottoms in roller.

Table of Contents

MISCELLANEOUS TABLE OF CONTENTS

Tools and Materials

Other Materials

Other Material

Part No.	Part Name	Part Use
TY6341	John Deere Multi-Purpose SD Polyurea Grease	Applied to frame and drive cover grease fittings.

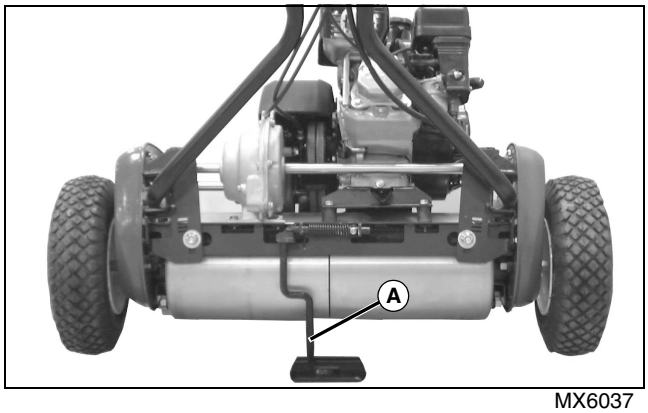
Service Parts Kits

The following kits are available through your parts catalog:

- Transport Wheel and Parking Stand Kit

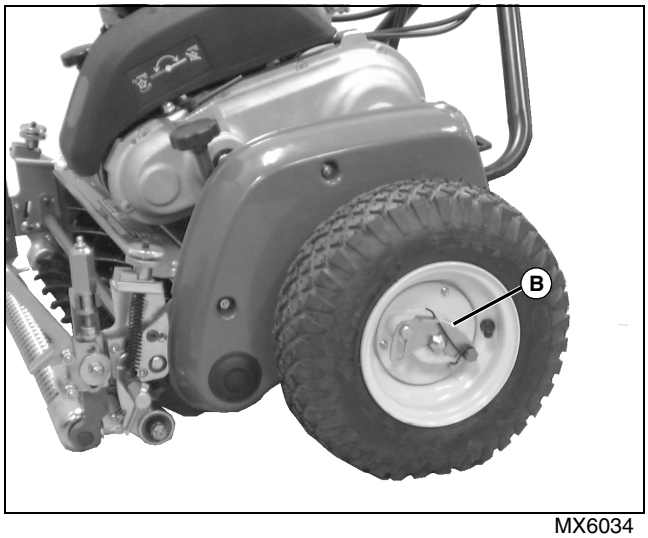
Repair

Transport Wheel Removal and Installation



MX6037

1. Place machine on stand (A).



MX6034

2. Release latch (B) and slide wheel from shaft. Repeat procedure for other side.

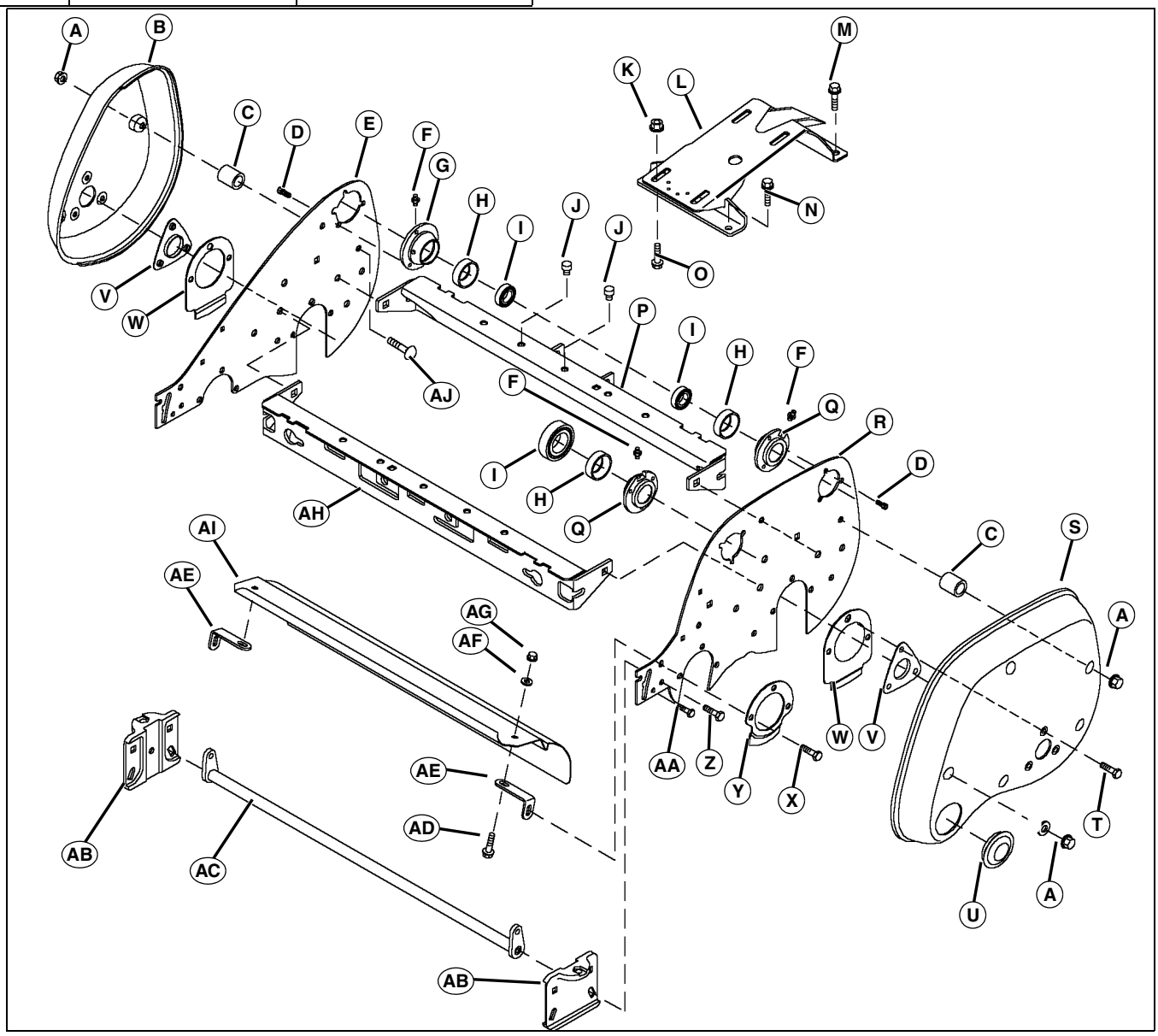
Installation

Installation is done in the reverse order of removal.

Frame and Drive Covers

Other Material

Part No.	Part Name	Part Use
TY6341	John Deere Multi-Purpose SD Polyurea Grease	Applied to frame and drive cover grease fittings.



MX6038

A - Flange Nut (8 used)
B - Right Cover
C - Spacer (8 used)
D - Screw (9 used)
E - Right Panel
F - Lubrication Fitting (3 used)
G - Bearing Housing
H - Ball Bearing (3 used)
I - Seal (2 used)
J - Support (2 used)
K - Flange Nut (4 used)
L - Base
M - Screw (2 used)
N - Screw (2 used)
O - Bolt (4 used)

P - Rear Crossbar
Q - Bearing Housing (2 used)
R - Left Panel
S - Left Cover
T - Screw (6 used)
U - Cap
V - Flange (2 used)
W - Cover (2 used)
X - Screw
Y - Cover
Z - Screw (2 used)
AA- Screw (2 used)
AB- Bracket (2 used)
AC- Rod
AD- Bolt (4 used)
AE- Bracket (2 used)
AF- Washer (4 used)
AG- Lock Nut (4 used)
AH- Front Crossbar
AI - Shield
AJ- Cap Screw (8 used)

- Inspect all parts for wear or damage. Replace parts as necessary.
- Apply John Deere Multi-Purpose SD Polyurea Grease to grease fittings.

S

T

V

W