JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Gator Utility Vehicles
Turf Gator

TM1686 NOVEMBER 2003

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 (FE290D)

Electrical

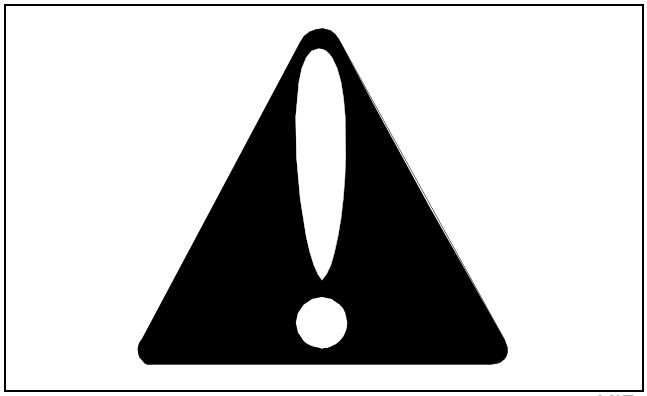
Power Train

Steering

Brakes

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.

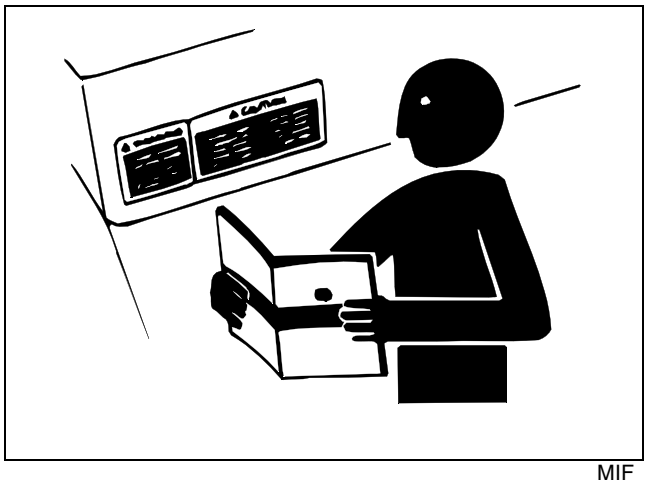
Follow recommended precautions and safe servicing practices.

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

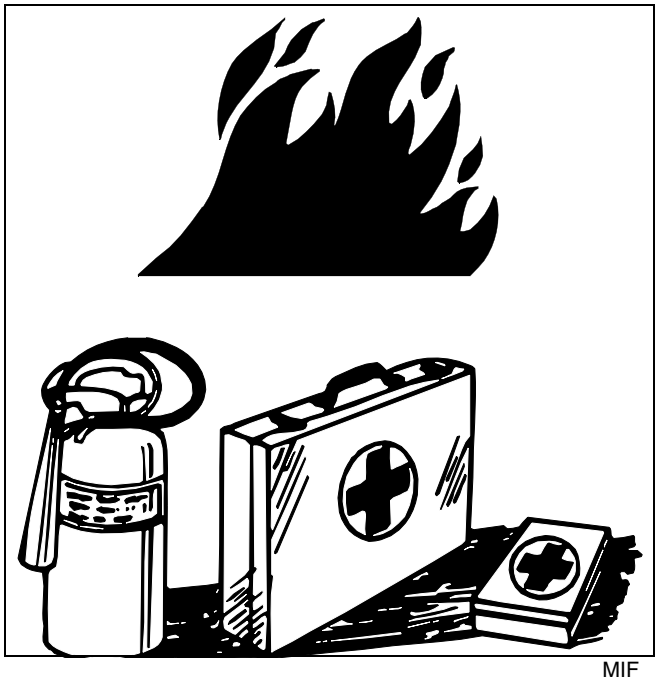


MIF

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

Handle Fluids Safely - Avoid Fires

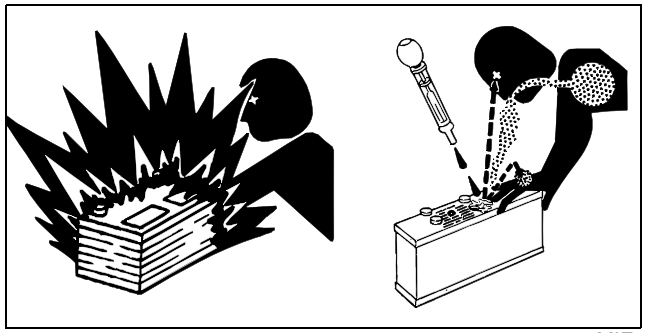
Be Prepared For Emergencies



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.

Use Care In Handling and Servicing Batteries



MIF

Prevent Battery Explosions

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

Prevent Acid Burns

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

Avoid acid burns by:

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

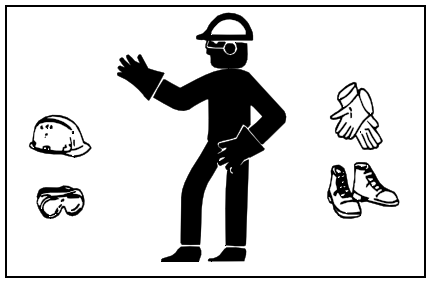
If you spill acid on yourself:

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

If acid is swallowed:

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

Wear Protective Clothing



MIF

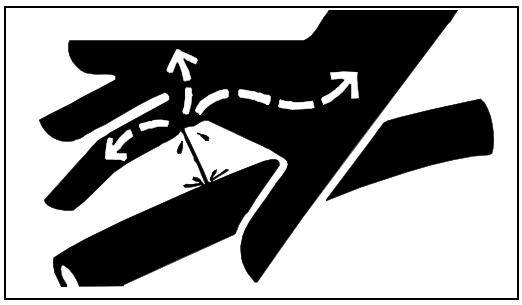
Wear close fitting clothing and safety equipment appropriate to the job.

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.

Use Care Around High-pressure Fluid Lines

Avoid High-Pressure Fluids



MIF

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid injury from escaping fluid under pressure by stopping the engine and relieving pressure in the system before disconnecting or connecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

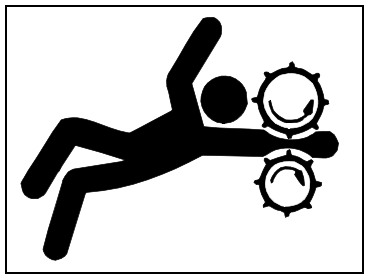
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A.

Avoid Heating Near Pressurized Fluid Lines

MIF

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials. Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area.

Service Machines Safely



MIF

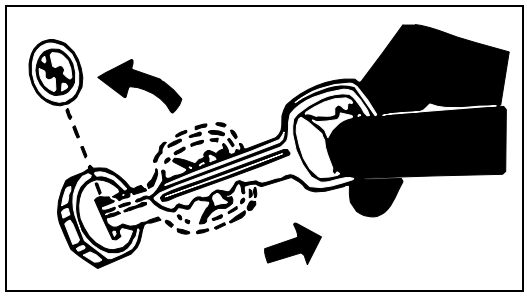
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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

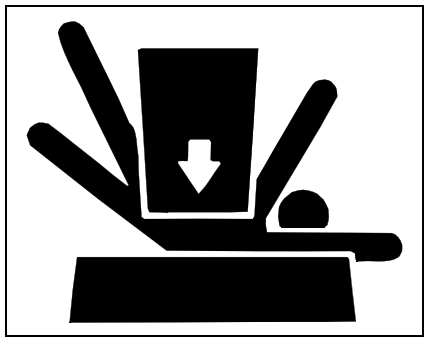


MIF

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.

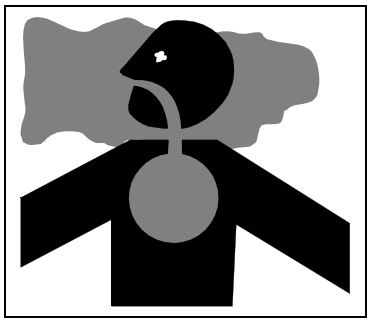
Using High Pressure Washers

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

Illuminate Work Area Safely

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

Work In Ventilated Area



MIF

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

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

Warning: California Proposition 65 Warning

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

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

Remove Paint Before Welding or Heating

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

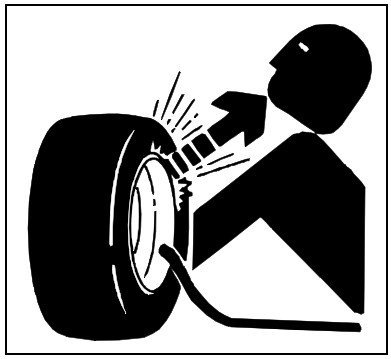
Avoid Harmful Asbestos Dust

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

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

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

Service Tires Safely



MIF

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

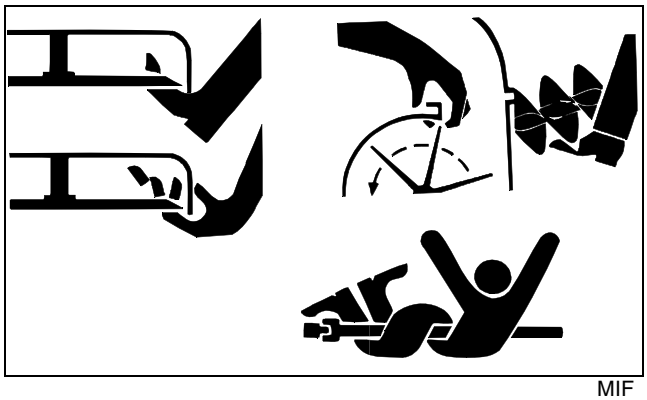
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

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.

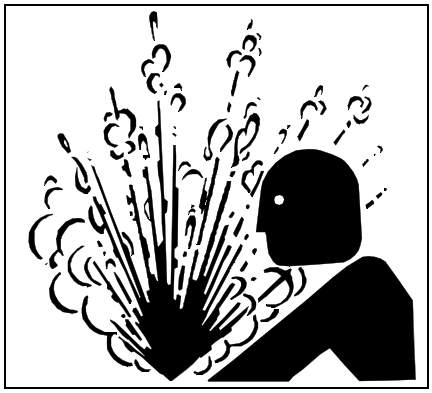
Avoid Injury From Rotating Blades, Augers and PTO Shafts



MIF

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

Service Cooling System Safely

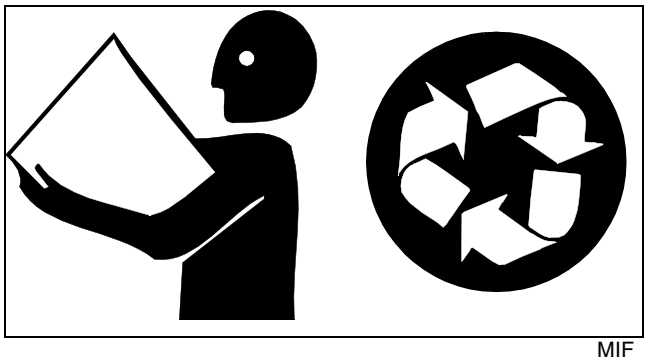


MIF

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

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

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

Live With Safety

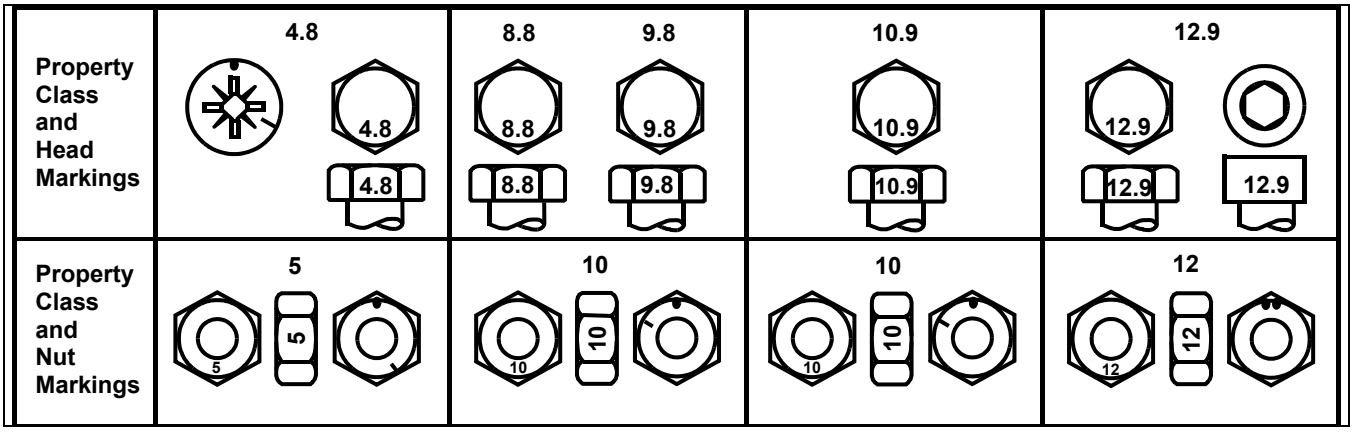
MIF

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

Table of Contents

Fastener Torques

Metric Fastener Torque Values



MIF

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

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

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

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

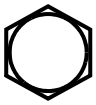
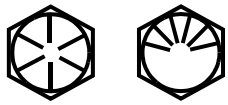
When bolt and nut combination fasteners are used, torque values should be applied to the NUT instead of the bolt head.

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

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

Reference: JDS - G200.

Inch Fastener Torque Values

SAE Grade and Head Markings	No Marks 		
SAE Grade and Nut Markings	No Marks 		

MIF

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

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

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

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

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

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

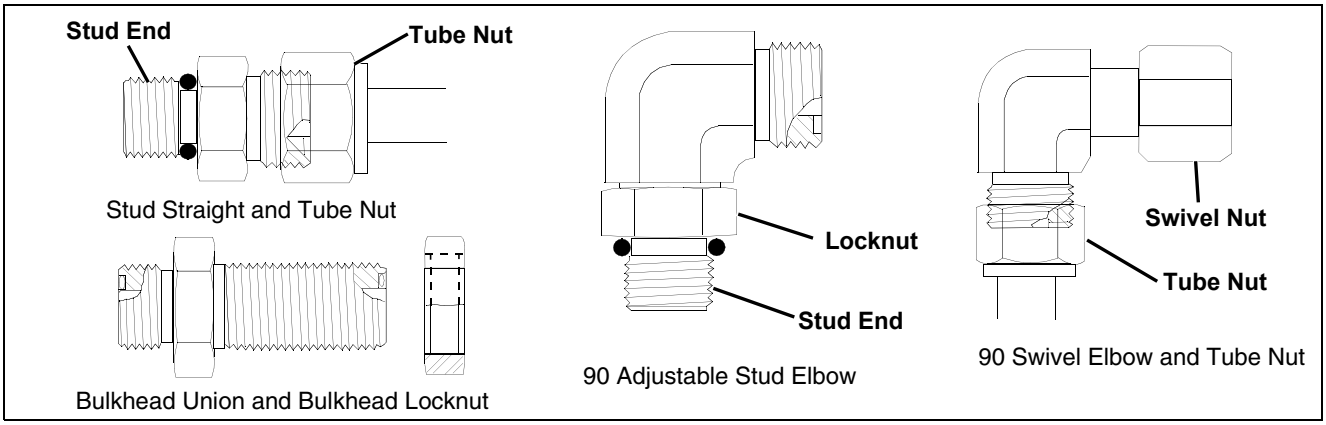
a *“Lubricated” means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. “Dry” means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication*.

b *“Grade 2” applies for hex cap screws (Not Hex Bolts) up to 152 mm (6 in.) long. “Grade 1” applies for hex cap screws over 152 mm (6 in.) long, and for all other types of bolts and screws of any length.*

Reference: JDS - G200

O-Ring Seal Service Recommendations

Face Seal Fittings With Inch Stud Ends Torque

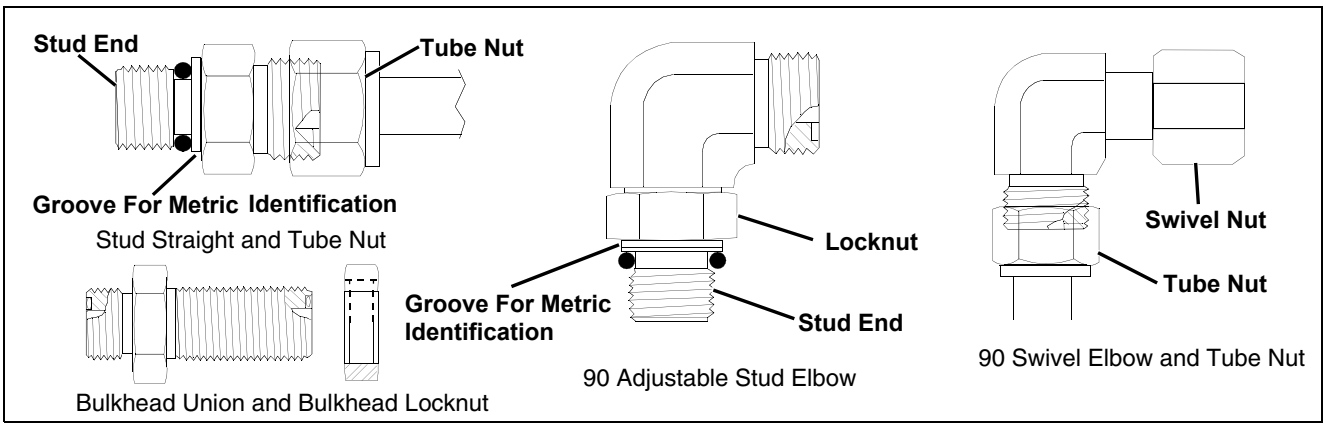


MIF

Nominal Tube OD/Hose ID				Face Seal Tube/Hose End					O-Ring Stud Ends		
Metric Tube OD	Inch Tube OD			Thread Size	Tube Nut/ Swivel Nut Torque		Bulkhead Lock Nut Torque		Thread Size	Straight Fitting or Lock Nut Torque	
mm	Dash Size	in.	mm	in.	N•m	lb-ft	N•m	lb-ft	in.	N•m	lb-ft
5	-3	0.188	4.76						3/8-24	8	6
6	-4	0.250	6.35	9/16-18	16	12	12	9	7/16-20	12	9
8	-5	0.312	7.94						1/2-20	16	12
10	-6	0.375	9.52	11/16-16	24	18	24	18	9/16-18	24	18
12	-8	0.500	12.70	13/16-16	50	37	46	34	3/4-16	46	34
16	-10	0.625	15.88	1-14	69	51	62	46	7/8-14	62	46
19	-12	0.750	19.05	1-3/16-12	102	75	102	75	1-1/16-12	102	75
22	-14	0.875	22.22	1-3/16-12	102	75	102	75	1-3/16-12	122	90
25	-16	1.000	25.40	1-7/16-12	142	105	142	105	1-5/16-12	142	105
32	-20	1.25	31.75	1-11/16-12	190	140	190	140	1-5/8-12	190	140
38	-24	1.50	38.10	2-12	217	160	217	160	1-7/8-12	217	160

NOTE: Torque tolerance is +15%, -20%

Face Seal Fittings With Metric Stud Ends Torque

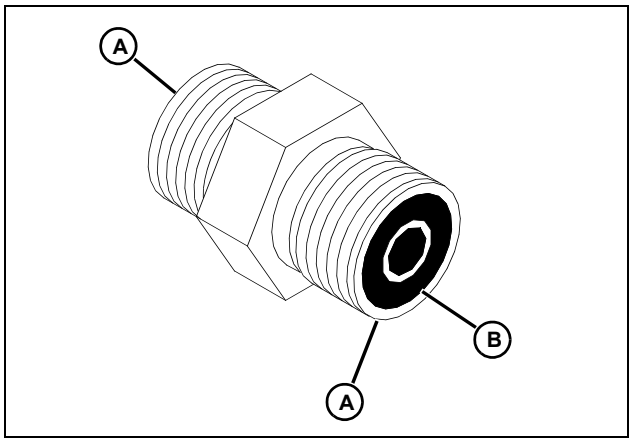


MIF

Nominal Tube OD/Hose ID				Face Seal Tube/Hose End						O-Ring Stud Ends, Straight Fitting or Lock Nut					
Metric Tube OD	Inch Tube OD			Thread Size	Hex Size	Tube Nut/ Swivel Nut Torque		Bulkhead Lock Nut Torque		Thread Size	Hex Size	Steel or Gray Iron Torque		Aluminum Torque	
mm	Dash Size	in.	mm	in.	mm	N•m	lb-ft	N•m	lb-ft	mm	mm	N•m	lb-ft	N•m	lb-ft
6	-4	0.250	6.35	9/16-18	17	16	12	12	9	M12X1.5	17	21	15.5	9	6.6
8	-5	0.312	7.94												
										M14X1.5	19	33	24	15	11
10	-6	0.375	9.52	11/16-16	22	24	18	24	18	M16X1.5	22	41	30	18	13
12	-8	0.500	12.70	13/16-16	24	50	37	46	34	M18X1.5	24	50	37	21	15
16	-10	0.625	15.88	1-14	30	69	51	62	46	M22X1.5	27	69	51	28	21
	-12	0.750	19.05	1-3/16-12	36	102	75	102	75	M27X2	32	102	75	46	34
22	-14	0.875	22.22	1-3/16-12	36	102	75	102	75	M30X2	36				
25	-16	1.000	25.40	1-7/16-12	41	142	105	142	105	M33X2	41	158	116	71	52
28										M38X2	46	176	130	79	58
32	-20	1.25	31.75	1-11/16-12	50	190	140	190	140	M42X2	50	190	140	85	63
38	-24	1.50	38.10	2-12	60	217	160	217	160	M48X2	55	217	160	98	72

NOTE: Torque tolerance is +15%, -20%

O-Ring Face Seal Fittings



MIF

1. Inspect the fitting sealing surfaces (A). They must be free of dirt or defects.

2. Inspect the O-ring (B). It must be free of damage or defects.

3. Lubricate O-rings and install into groove using petroleum jelly to hold in place during assembly.

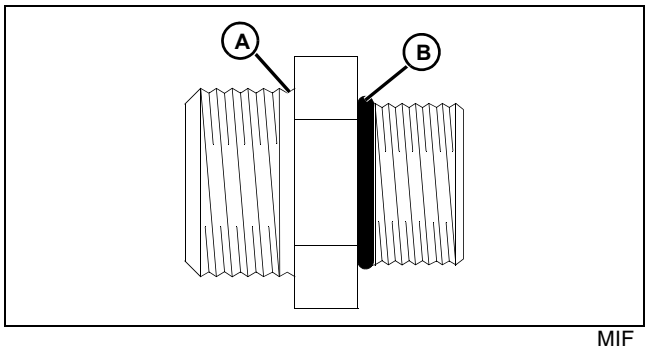
4. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.

IMPORTANT: Avoid damage! DO NOT allow hoses to twist when tightening fittings. Use two wrenches to tighten hose connections; one to hold the hose, and the other to tighten the swivel fitting.

5. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting.

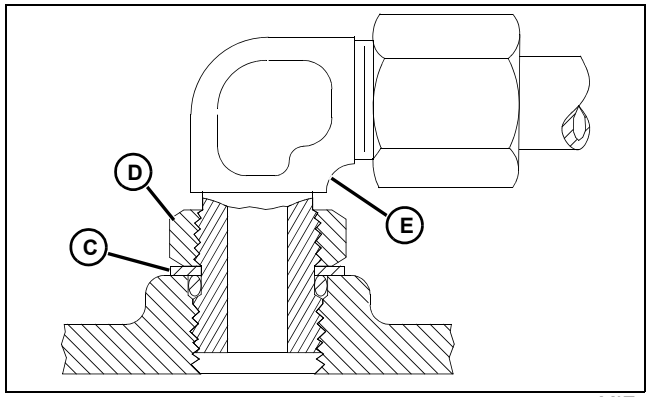
O-Ring Boss Fittings

1. Inspect boss O-ring boss seat. It must be free of dirt and defects. If repeated leaks occur, inspect for defects with a magnifying glass. Some raised defects can be removed with a slip stone.



MIF

2. Put hydraulic oil or petroleum jelly on the O-ring (B). Place electrical tape over the threads to protect O-ring from nicks. Slide O-ring over the tape and into the groove (A) of fitting. Remove tape.



MIF

3. For angle fittings, loosen special nut (D) and push special washer (C) against threads so O-ring can be installed into the groove of fitting.

4. Turn fitting into the boss by hand until special washer or washer face (straight fitting) contacts boss face and O-ring is squeezed into its seat.

5. To position angle fittings (E), turn the fitting counter-clockwise a maximum of one turn.

6. Tighten straight fittings to torque value shown on chart. For angle fittings, tighten the special nut to value shown in the chart while holding body of fitting with a wrench.

Straight Fitting Or Special Nut Torques

Thread Size	Torque[a]		Number of Flats[b]
	N•m	lb-ft	
3/8-24 UNF	8	6	2
7/16-20 UNF	12	9	2
1/2-20 UNF	16	12	2
9/16-18 UNF	24	18	2
3/4-16 UNF	46	34	2
7/8-14 UNF	62	46	1-1/2
1-1/16-12 UN	102	75	1
1-3/16-12 UN	122	90	1
1-5/16-12 UN	142	105	3/4
1-5/8-12 UN	190	140	3/4
1-7/8-12 UN	217	160	1/2

[a]Torque tolerance is ± 10 percent.

[b]To be used if a torque wrench cannot be used. After

tightening fitting by hand, put a mark on nut or boss; then tighten special nut or straight fitting the number of flats shown.

Metric Fastener Torque Value - Grade 7 (Special)

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)

General Information

Gasoline

4 - Cycle Engines

CAUTION: Avoid Injury! Gasoline is HIGHLY FLAMMABLE, handle it with care. DO NOT refuel machine while: indoors, always fill gas tank outdoors; machine is near an open flame or sparks; engine is running, STOP engine; engine is hot, allow it to cool sufficiently first; smoking. Help prevent fires: fill gas tank to bottom of filler neck only; be sure fill cap is tight after fueling; clean up any gas spills IMMEDIATELY; keep machine clean and in good repair - free of excess grease, oil, debris, and faulty or damaged parts; any storage of machines with gas left in tank should be in an area that is well ventilated to prevent possible igniting of fumes by an open flame or spark, this includes any appliance with a pilot light. To prevent fire or explosion caused by STATIC ELECTRIC DISCHARGE during fueling:•ONLY use a clean, approved POLYETHYLENE PLASTIC fuel container and funnel WITHOUT any metal screen or filter.

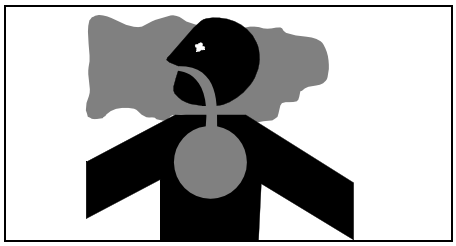
To avoid engine damage:

- DO NOT mix oil with gasoline;
- **ONLY use clean, fresh unleaded gasoline with an octane rating (anti-knock index) of 87 or higher**;
- fill gas tank at the end of each day's operation to help prevent condensation from forming inside a partially filled tank;
- keep up with specified service intervals.

Use of alternative oxygenated, gasohol blended, unleaded gasoline is acceptable as long as:

- the ethyl or grain alcohol blends DO NOT exceed 10% by volume or
- methyl tertiary butyl ether (MTBE) blends DO NOT exceed 15% by volume

RFG (reformulated) gasoline is acceptable for all machines designed for use of regular unleaded fuel. Older machines (that were designed for leaded fuel) may see some accelerated valve and seat wear.



MIF

IMPORTANT: Avoid damage! 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.

Gasoline Storage

IMPORTANT: Avoid damage! Keep all dirt, scale, water or other foreign material out of gasoline.

Keep gasoline stored in a safe, protected area. Storage of gasoline in a clean, properly marked (“UNLEADED GASOLINE”) POLYETHYLENE PLASTIC container WITHOUT any metal screen or filter is recommended. DO NOT use de-icers to attempt to remove water from gasoline or depend on fuel filters to remove water from gasoline. Use a water separator installed in the storage tank outlet. BE SURE to properly discard unstable or contaminated gasoline. When storing the machine or gasoline, it is recommended that you add **John Deere Gasoline Conditioner and Stabilizer (TY15977)** or an equivalent to the gasoline. BE SURE to follow directions on container and to properly discard empty container.

4 - Cycle Gasoline Engine Oil

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

The following John Deere oils are PREFERRED:

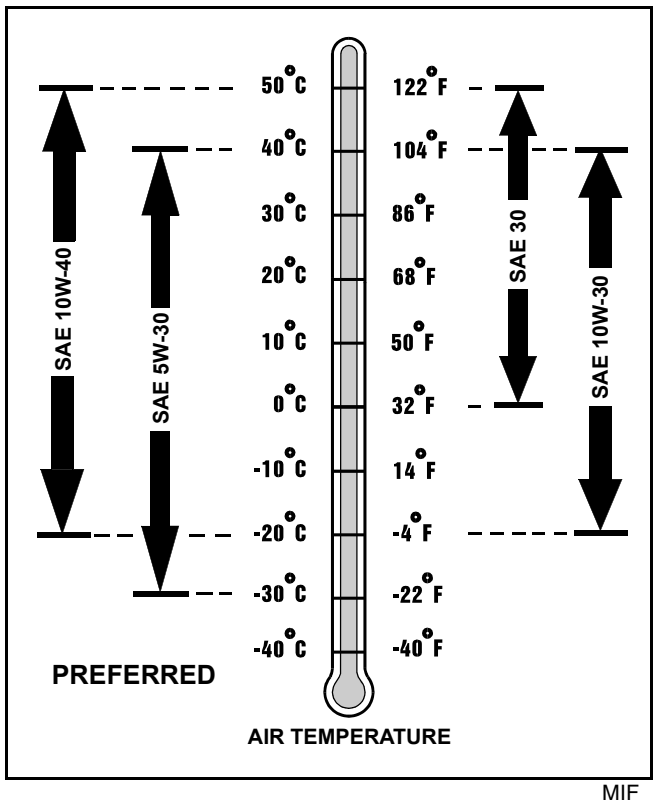
- **PLUS - 4® - SAE 10W-40**;
- **TORQ - GARD SUPREME® - SAE 5W-30**.

The following John Deere oils are **also recommended**, based on their specified temperature range:

- **TURF - GARD® - SAE 10W-30;**
- **PLUS - 4® - SAE 10W-30;**
- **TORQ - GARD SUPREME® - SAE 30.**

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

- SAE 10W-40 - API Service Classifications SG or higher;
- SAE 5W-30 - API Service Classification SG or higher;
- SAE 10W-30 - API Service Classifications SG or higher;
- SAE 30 - API Service Classification SC or higher.



MIF

Break-In Engine Oil - 4-Cycle Gasoline

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

The following John Deere oil is PREFERRED:

- **BREAK - IN ENGINE OIL**.

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

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

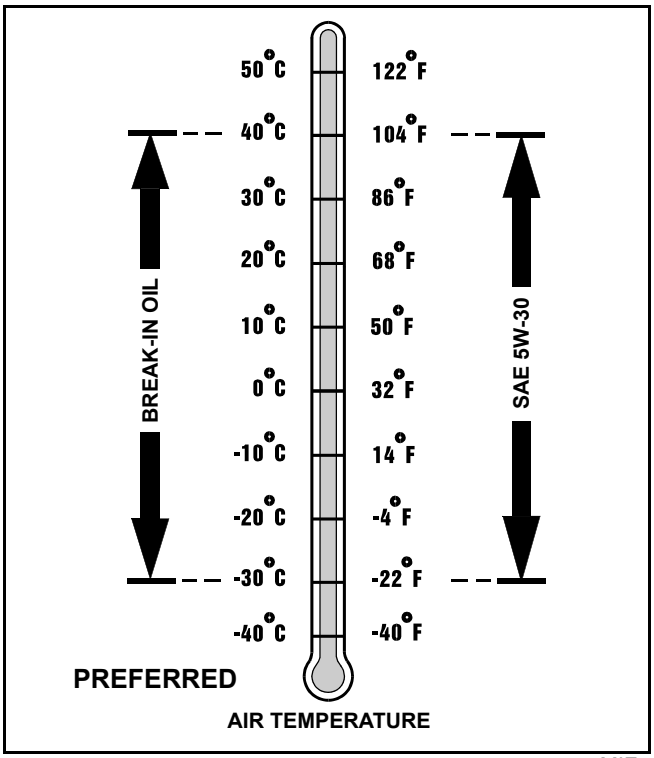
The following John Deere oil is **also recommended**:

- **TORQ - GARD SUPREME® - SAE 5W-30.**

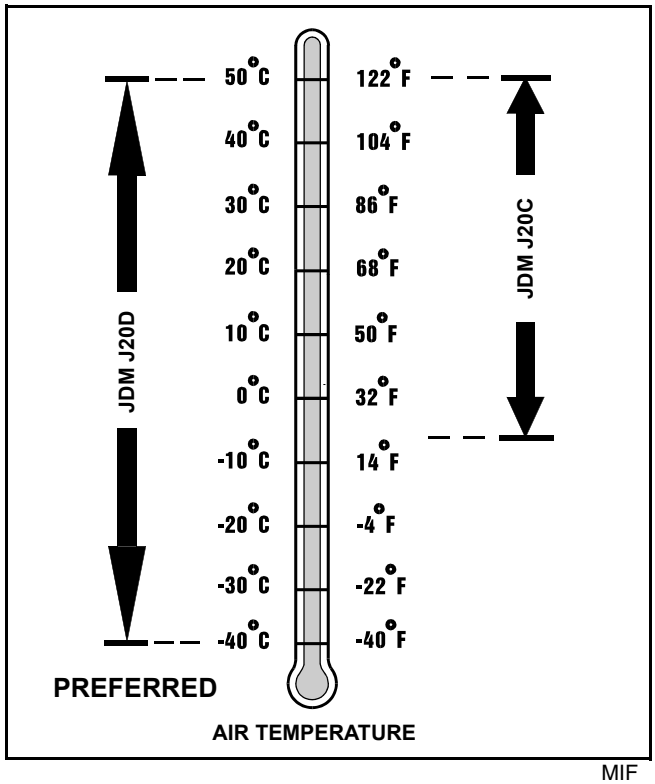
If the above recommended John Deere oils are not available, use a break-in engine oil meeting the following specification during the first **5 hours (maximum)** of operation:

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

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



MIF



MIF

Hydrostatic Transmission and Hydraulic Oil

Use the appropriate oil viscosity based on these air temperature ranges. Operating outside of these recommended oil air temperature ranges may cause premature hydrostatic transmission or hydraulic system failures.

IMPORTANT: Avoid damage! Mixing of LOW VISCOSITY HY - GARD® and HY - GARD® oils is permitted. DO NOT mix any other oils in this transmission. DO NOT use engine oil or "Type F" (Red) Automatic Transmission Fluid in this transmission. DO NOT use BIO-HY-GARD® in this transmission.

The following John Deere transmission and hydraulic oil is **PREFERRED**:

- **LOW VISCOSITY HY-GARD® - JDM J20D**.

The following John Deere oil is also recommended if above preferred oil is not available:

- **HY-GARD® - JDM J20C.**

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

- John Deere Standard JDM J20D;
- John Deere Standard JDM J20C.

Gear Case Oil

Use the appropriate oil viscosity based on the air temperature ranges. Operating outside of these recommended oil air temperature ranges may cause premature gear case failure.

IMPORTANT: Avoid damage! ONLY use a quality oil in this gear case. DO NOT mix any other oils in this gear case. DO NOT use BIO-HY-GARD® in this gear case.

The following John Deere gear case oil is PREFERRED:

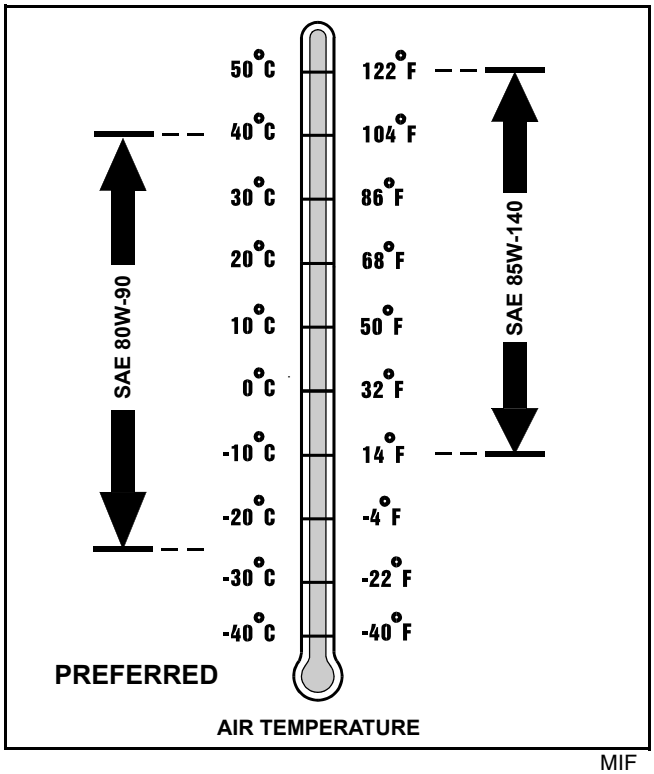
- **GL-5 GEAR LUBRICANT® - SAE 80W-90.**

The following John Deere gear case oil is also recommended if above preferred oil is not available:

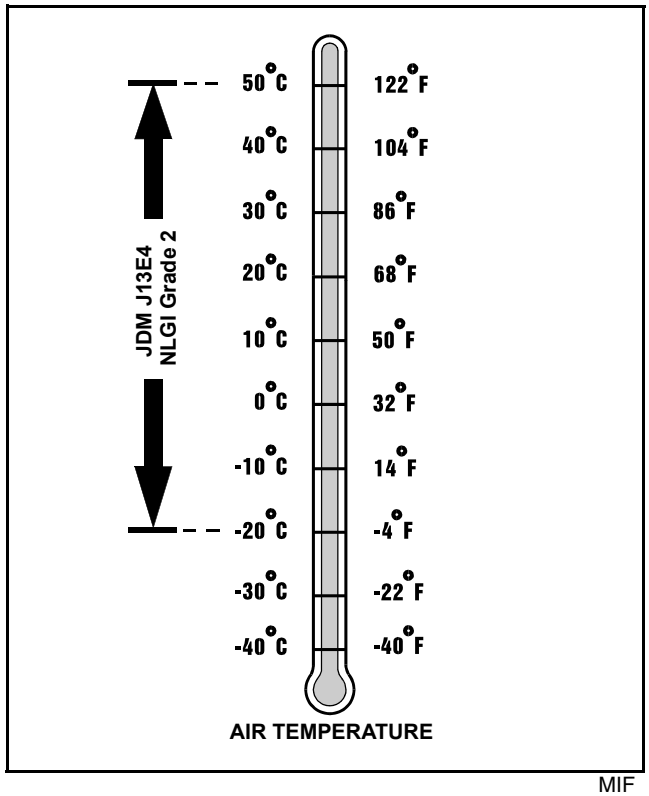
- **GL-5 GEAR LUBRICANT® - SAE 85W-140.**

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

- API Service Classification GL - 5.



MIF



MIF

Gear Transmission Grease

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

IMPORTANT: Avoid damage! ONLY use a quality gear grease in this transmission. DO NOT mix any other greases in this transmission. DO NOT use any BIO - GREASE in this transmission.

The following John Deere gear grease is PREFERRED:

- **NON-CLAY HIGH-TEMPERATURE EP GREASE®** - JDM J13E4, NLGI Grade 2.

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

- John Deere Standard JDM J13E4, NLGI Grade 2.

Alternative Lubricants

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, unless otherwise stated on lubricant label.

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.

Oil Filters

IMPORTANT: Avoid damage! Filtration of oils is critical to proper lubrication performance. Always change filters regularly.

The following John Deere oil filters are PREFERRED:

- AUTOMOTIVE AND LIGHT TRUCK ENGINE OIL FILTERS.

Most John Deere filters contain pressure relief and anti-drainback valves for better engine protection.

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

- ASTB Tested In Accordance With SAE J806.

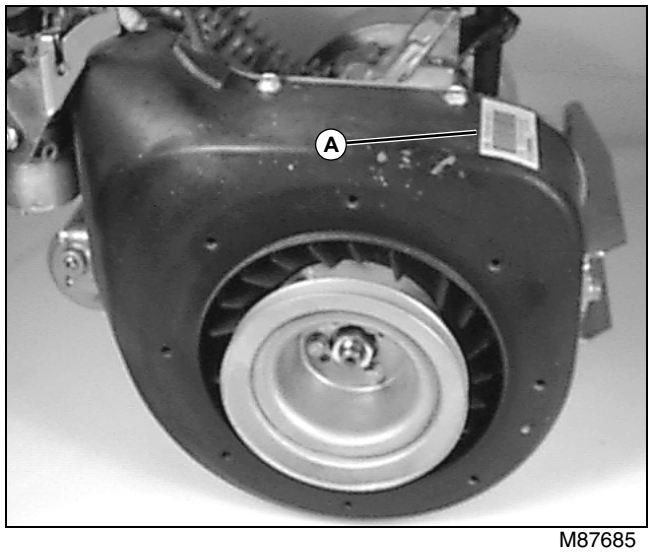
Serial Number Locations

Product Serial Number

M99930

The product identification number (A) is located on the frame below the right seat.

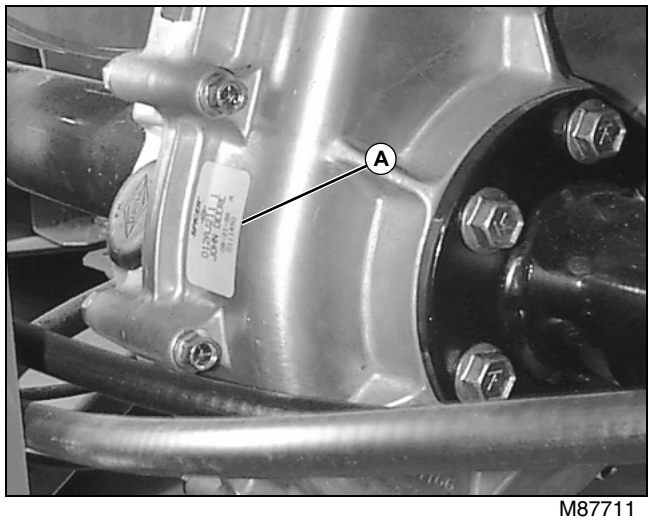
Engine (FE290D) Serial Number Location



M87685

Engine serial number (A) can be located on the blower housing.

Transaxle Serial Number Location



M87711

The product identification number (A) is located on the transaxle case.

ENGINE - GAS TABLE OF CONTENTS

Table of Contents

ENGINE - GAS SPECIFICATIONS

Specifications

General Specifications

Make	Kawasaki
Model	FE290D-AS15
Type	4-cycle gas/Air cooled
Power	7.46 kW (10 hp)
Cylinders	1
Cycles	4
Bore	78 mm (3.070 in.)
Stroke	60 mm (2.360 in.)
Displacement	286 cm3 (17.5 cu-in.)
Oil Capacity (with filter)	1.4 L (3.0 pt)

Test and Adjustment Specifications

Engine:

Spark Plug Gap (NGK BPR5ES-10)	0.8 mm (0.032 in.)
Ignition Coil Air Gap	0.3 mm (0.12 in.)
Oil pressure (minimum)	314 kPa (46 psi)
Oil filter bypass valve opening pressure	78 - 118 kPa (11.3 - 17.0 psi)
Compression pressure at operating temperature (minimum)	393 kPa (57 psi)
Compression pressure at operating temperature (maximum)	965 kPa (140 psi)
Crankcase vacuum (minimum)	25 mm (1 in.) water movement
Intake and exhaust valve clearance (cold)	0.125 ± 0.025 mm (0.005 ± 0.001 in.)
Intake and exhaust valve adjustment interval	300 hrs
Valve clearance adjusting nut torque	20 N•m (180 lb-in.)
Auto Compression Release minimum lift	0.6 mm (0.023 in.)
Auto Compression Release standard lift	1.2 mm (0.047 in.)
Auto Compression Release release rpm	600 ± 100 rpm
Breather reed valve tip air gap	0.2 mm (0.008 in.)
Valve cover cap screw torque	6 N•m (53 lb-in.)

Fuel/Air System:

Fuel Pump	
Minimum Pressure	6.12 kPa (0.9 psi)
Minimum Flow	80 ml (2.7 oz) in 15 seconds
Carburetor SLOW idle mixture screw initial setting (PIN -12700) with no limiter cap	1-3/8 Turns
Throttle control arm SLOW idle stop screw setting	1125 ± 75 rpm
Carburetor SLOW idle stop screw setting	50 rpm less than throttle control arm SLOW idle stop screw setting
Throttle control arm FAST idle stop screw setting (S.N. - 345211)	3750 ± 100 rpm
Throttle control arm FAST idle stop screw setting (S.N. 345212-)	3850 ± 75 rpm
Fuel tank check valve (PIN -14950) maximum opening pressure	3 kPa (0.4 psi)

Repair Specifications

Miscellaneous Repair Specifications

Breather Maximum Air Gap	0.20 mm (0.008 in.)
Flywheel Nut Torque	85 N•m (63 lb-ft)
Primary Clutch to Engine Cap Screw Torque	50 ± 13 N•m (37 ± 4 lb-ft)
Starter Generator Sheave Nut Torque	90 N•m (66 lb-ft)
Engine Sheave Bolts Torque	15 N•m (11 lb-ft)

Cylinder Head Assembly

Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque	
First	18 N•m (159 lb-in.)
Second	21 N•m (186 lb-in.)
Final	24 N•m (212 lb-in.)
Spark Plug Torque	25 N•m (221 lb-in.)

Rocker Arm:

Minimum Shaft OD	11.95 mm (0.470 in.)
Maximum Bearing ID	12.07 mm (0.475 in.)

Push Rod:

Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs:

Valve Clearance	0.127 mm (0.005 in.)
Valve Seat Width	0.50 - 1.10 mm (0.020 - 0.043 in.)
Intake and Exhaust Valves	
Maximum Bend	0.03 mm (0.0012 in.)
Minimum Valve Face Margin	0.060 mm (0.024 in.)
Valve Stem OD (Wear Limit)	
Intake Valve	6.930 mm (0.2728 in.)
Exhaust Valve	6.915 mm (0.2722 in.)
Valve Guides	
Maximum Guide ID	7.065 mm (0.2781 in.)
Finished (Reamed) ID	7.00 - 7.015 mm (0.2756 - 0.2762 in.)
Valve Springs Minimum Free Length	32.75 mm (1.289 in.)
Valve Seat - Recondition	
Valve Face Angle	45°
Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°
Valve Seat Angle	45°
Valve Seating Surface Width	0.50 - 1.10 mm (0.020 - 0.043 in.)

Crankcase:

Cover Mounting Cap Screw Torque	26 N•m (230 lb-in.)
Oil Drain Plug Torque	21 N•m (186 lb-in.)
Maximum Crankcase Main Bearing ID	30.08 mm (1.184 in.)
End Play	0.09 - 0.22 mm (0.004 - 0.009 in.)
Crankshaft Oil Seal Depth (PTO End)	4 mm (0.158 in.)

Governor Mounting Shaft Height (Top of Shaft-to-Cover)	32.2 - 32.8 mm (1.267 - 1.291 in.)
Governor Shaft Oil Seal Depth	1.42 mm (0.056 in.)

Camshaft:

Minimum Cam Lobe Height	32.70 mm (1.287 in.)
Minimum PTO and Flywheel Side Journal OD	22.93 mm (0.903 in.)
Maximum Cylinder Block and Cover Bearing ID	23.06 mm (0.908 in.)

Crankshaft:

Maximum Total Indicated Runout	0.05 mm (0.002 in.)
Minimum Main Bearing Journal OD	29.92 mm (1.178 in.)
Minimum Connecting Rod Journal OD	
Standard	35.43 mm (1.395 in.)
Undersized	34.93 mm (1.375 in.)
Crankshaft Bearing	
Standard	35.57 mm (1.400 in.)
Undersized	35.07 mm (1.380 in.)

Reciprocating Balancer:

Link Rod

Minimum Journal OD	46.86 mm (1.845 in.)
Maximum Small End ID	12.06 mm (0.475 in.)
Maximum Large End ID	47.12 mm (1.855 in.)
Bushing Depth	1.00 mm (0.040 in.)

Support Shaft

Maximum Bearing ID	26.10 mm (1.027 in.)
Minimum Shaft OD	25.93 mm (1.021 in.)

Piston and Rings:

Maximum Ring Groove Clearance	
First Compression Ring	0.16 mm (0.006 in.)
Second Compression Ring	14 mm (0.005 in.)
Oil Ring Assembly	Not Measured
Maximum Ring End Gap	
Compression Rings	120 mm (0.047 in.)
Oil Ring Assembly	Not Measured
Maximum Piston Pin Bore ID	19.03 mm (0.749 in.)
Minimum Piston Pin OD	18.98 mm (0.747 in.)
Piston OD, Standard	77.85 - 77.87 mm (3.0649 - 3.0657 in.)
Piston OD, Oversized (0.50 mm (0.020 in.)	78.35 - 78.37 mm (3.0849 - 3.0857 in.)

Connecting Rod:

Maximum Crankshaft Bearing ID	
Standard	35.57 mm (1.400 in.)
Undersized	35.07 mm (1.380 in.)
Maximum Piston Pin Bearing ID	19.06 mm (0.750 in.)
End-Cap Screw Torque	20 N•m (177 lb-in.)

Cylinder Bore ID:

Standard Size Bore

Standard	**77.98 - 78.00 mm (3.070 - 3.071 in.)**
Wear Limit	**78.07 mm (3.074 in.)**
Out-of-Round (Maximum)	**0.056 mm (0.0022 in.)**

0.50 mm (0.020 in.) Oversize Bore

Standard	**78.46 - 78.48 mm (3.089 - 3.090 in.)**
Wear Limit	**78.55 mm (3.093 in.)**

Oil Pump

Maximum Outer Rotor Bearing Depth	**10.17 mm (0.400 in.)**
Maximum Outer Rotor Shaft Bearing ID	**40.77 mm (1.605 in.)**
Minimum Outer Rotor Shaft OD	**40.47 mm (1.596 in.)**
Minimum Outer Rotor Thickness	**9.92 mm (0.391 in.)**
Minimum Relief Valve Spring Free Length	**19 mm (0.748 in.)**
Maximum Rotor Shaft Bearing ID	**12.77 mm (0.503 in.)**
Minimum Rotor Shaft OD	**12.63 mm (0.497 in.)**

Special or Essential Tools

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Tachometer	JT05719	Slow idle and fast idle speed adjustment.
Fuel Pump Pressure Test Kit	JDG356	Fuel pump pressure test.
Carburetor Test Kit	JDZ25-2	Fuel tank check valve test.
Compression Gauge Spark Plug Test Tool	JDM59 JDM-74A-5	Cylinder compression test, and Valve clearance adjustment.
Pressure Gauge Assembly Hose Assembly Connector 1/8” BSP Thread	JT05577 JT03017 JT03349	Oil pressure test.
Valve Spring Compressor	JDM70	Cylinder head disassembly and assembly.
Valve Guide Driver Tool	JDG504	Replace valve guides.

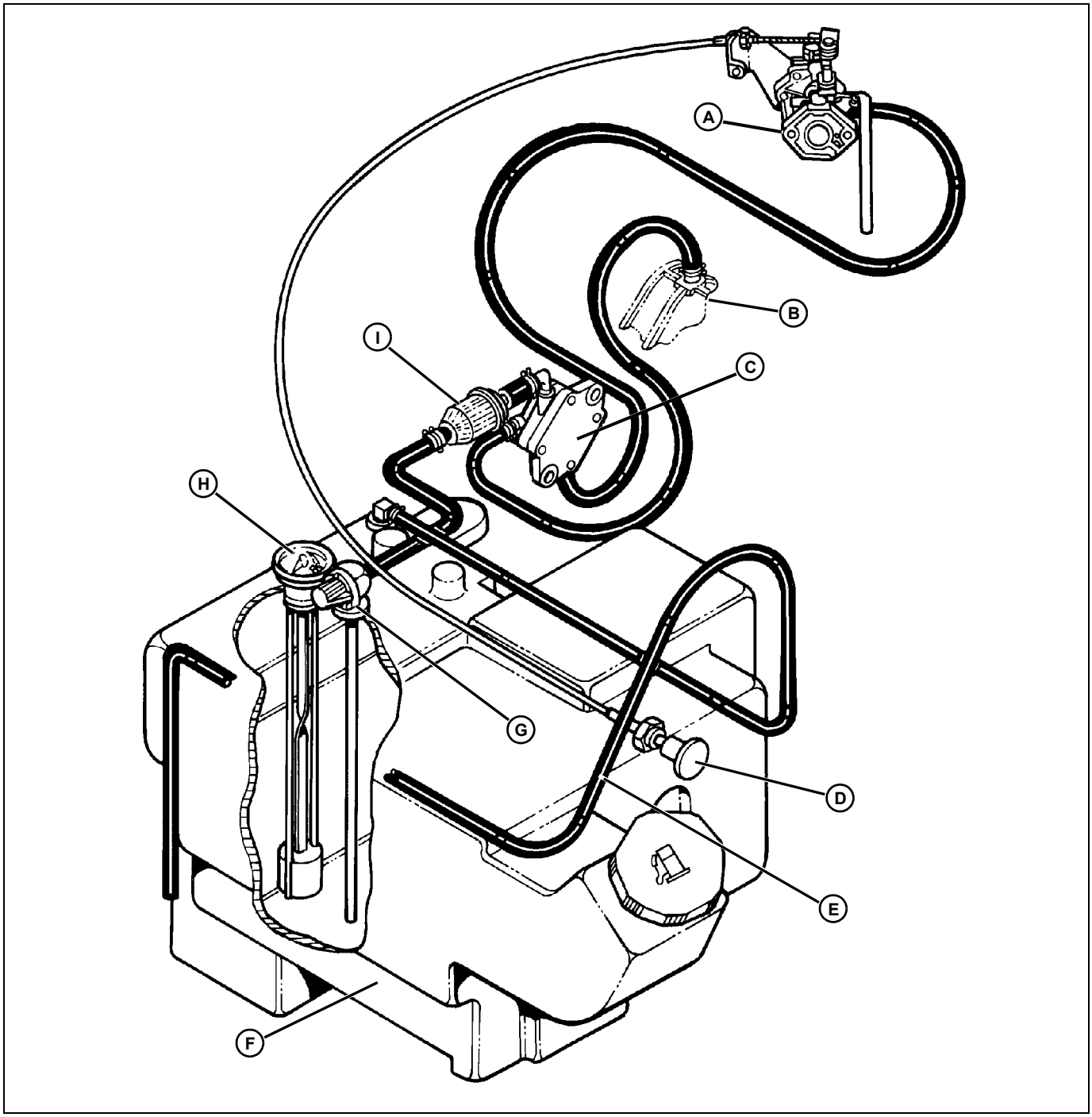
Other Materials

Other Material

Part No.	Part Name	Part Use
	SCOTCH-BRIGHT® Abrasive Sheets/Pads	Clean cylinder head.
	Valve Guide Cleaner	Clean valve guides.
	Stanisol or Kerosene	Finish ream valve guide.
	Prussion Blue Compound	Check valve seat contact.
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.
	Mineral Spirits	Clean electric starter armature.

Component Location

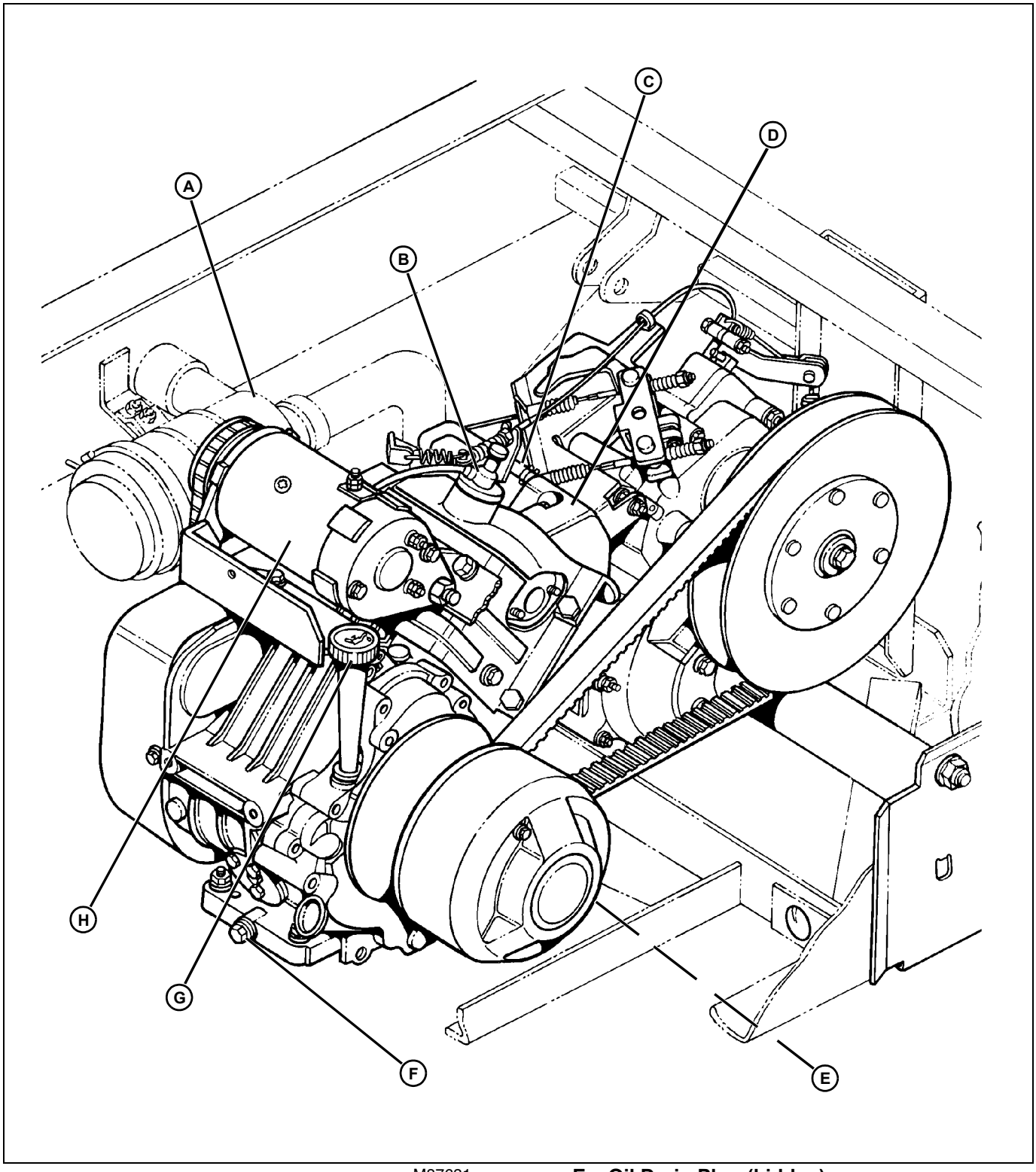
Fuel System



M87629

A - Carburetor Assembly
B - Engine Crankcase
C - Fuel Pump Assembly
D - Choke Cable Assembly
E - Fuel Tank Vent Hose Assembly
F - Fuel Tank Assembly
G - Shutoff Valve (older model)
H - Fuel Tank Gauge
I - In-line Fuel Filter

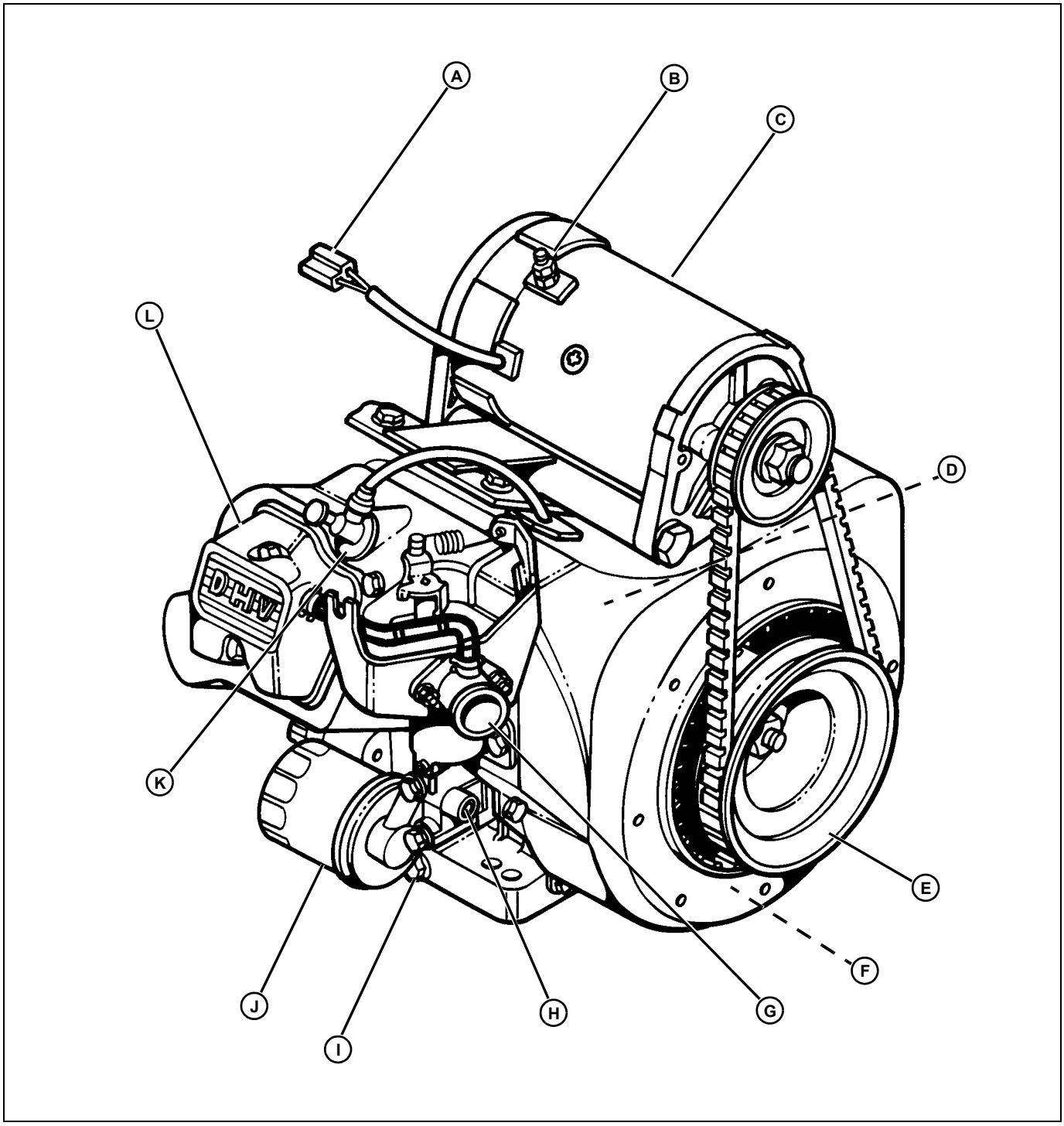
Engine Component Location



M87631

A - Air Filter Assembly
B - Spark Plug Cap
C - Breather Reed Valve Assembly
D - Intake and Exhaust Valves
E - Oil Drain Plug (hidden)
F - Oil Drain Plug
G - Crankcase Vacuum Test Port
H - Starting Motor Generator

Engine Component Location



M87762

A - Voltage Regulator Connector
B - +12 VDC Terminal
C - Starting Motor/Generator
D - Ignition Coil
E - Flywheel Sheave
F - Flywheel
G - Carburetor Air Intake
H - Oil Pressure Test Port
I - Oil Drain Plug
J - Oil Filter
K - Spark Plug Cap
L - Intake and Exhaust Valve Cover

Diagnostics

Engine Troubleshooting Guide

CAUTION: Avoid Injury! The engine may start to rotate at any time. Keep hands away from moving parts when testing.

NOTE: To test specific electrical components, see Electrical Section and refer to either Diagnostics or Tests & Adjustments for further guidance.

Test Conditions:

- Operator On Seat
- Brake On

Symptom: Engine Doesn't Crank

(1) Are battery cables loose or dirty?

Yes - Tighten or clean.

No - Go to next step.

(2) Is battery fully charged? See "Battery Test" on page 104 in the Electrical section.

No - Charge battery. See "Charge Battery" on page 105 in the Electrical section.

Yes - Go to next step.

(3) Is key switch working correctly?

Yes - Go to next step.

No - Test switch. See "Cranking Circuit Operation," for the appropriate machine, in the Electrical section. Replace as needed.

(4) Has engine seized?

Yes - See Engine Repair Section.

No - Go to next step.

(5) Is starting motor or solenoid defective?

Yes - Repair or replace. See "Starting Motor Solenoid Test" or "Starting Motor No-Load Amperage and RPM Test" in the Electrical section.

CAUTION: Avoid injury! Keep spark plug as far away from the plug hole as possible. Gasoline spray from the open cylinders may be ignited by ignition spark and cause an explosion or fire.

Symptom: Engine Hard To Start

(1) Is there a strong blue spark?

Yes - Go to step 3.

No - Replace spark plug. Recheck for spark and go to next step.

(2) Is there a strong blue spark?

Yes - Check engine starting.

No - Check if sparks are produced between high tension lead and ignition block. Check high tension lead, ignition coil air gap.

(3) Check compression. See "Automatic Compression Release (A.C.R.) Test" on page 37. Is compression sufficient?

Yes - Make starting attempts a number of times, remove spark plug and observe electrodes. Go to next step.

No - Go to step 5.

(4) After starting attempts, are spark plug electrodes wet?

Yes - Check for excessive use of choke, plugged air cleaner, float bowl level too high.

No - Check fuel tank and lines.

(5) Compression is low?

Yes - Check piston rings and cylinder for wear. See "Piston and Connecting Rod" on page 57. Inspect cylinder head. See "Cylinder Head Inspection and Replacement" on page 52.

Symptom: Engine Runs Erratically

(1) Is fuel delivery correct? See "Fuel Pump Pressure And Flow Test" on page 35.

Yes - Check for plugged air/fuel passages in carburetor. See "Carburetor Disassembly and Assembly" on page 48.

No - Check for contamination, or an air or vapor lock in the fuel tank and lines. Check tank check valve (PIN -14950), shut off valve, fuel filter and pump.

Symptom: Engine Malfunctions At Low Speed

(1) Is unusual smoke emitted out of muffler?

Yes - Check choke. See "Choke Cable Adjustment" on page 31.

No - Go to next step.

Symptom: Engine Malfunctions At Low Speed

(2) Does engine rpm drop or engine stall at a certain point when throttle is gradually opened by hand?

Yes - Plug in carburetor interior, clean carburetor. See “Carburetor Disassembly and Assembly” on page 48.

No - Go to next step.

(3) Is air sucked through carburetor or intake manifold flanges?

Yes - Tighten manifold flange nuts or replace damaged gasket.

No - Go to next step.

(4) Are valve clearances set correctly? See “Valve Clearance Adjustment” on page 37.

No - Adjust valves.

Symptom: Oil Consumption Is Excessive

(1) Check compression. See “Automatic Compression Release (A.C.R.) Test” on page 37. Is compression sufficient?

Yes - Check for oil leaks, high oil level, plugged oil ring groove, oil seals, clogged breather valve, plugged drain back hole in breather, incorrect oil viscosity.

No - Check for worn, stuck or broken piston rings, or worn cylinder bore.

Starting Motor Troubleshooting Guide

CAUTION: Avoid Injury! The engine may start to rotate at any time. Keep hands away from moving parts when testing.

IMPORTANT: Avoid damage! If starting motor does not stop by turning ignition switch to Off position, disconnect negative (-) lead from battery as soon as possible.

NOTE: To test specific electrical components, see Electrical Section and refer to either Diagnostics or Tests & Adjustments for further guidance.

Symptom: Starter Does Not Rotate

(1) Is there a click sound from starter solenoid?

Yes - Repair starting motor. See “Starting Motor/ Generator Inspection and Test” on page 68.

Symptom: Starter Does Not Rotate

No - Check that all starting conditions are met. Go to next step.

(2) Are battery cables loose or dirty?

Yes - Tighten or clean.

No - Go to next step.

(3) Is battery fully charged? See “Battery Test” on page 104 in the Electrical section.

No - Charge battery. See “Charge Battery” on page 105 in the Electrical section.

Yes - Go to next step.

(4) Is key switch working correctly?

Yes - Go to next step.

No - Test switch. See “Cranking Circuit Operation,” for the appropriate machine, in the Electrical section. Replace as needed.

(5) Has engine seized?

Yes - See Engine Repair Section.

Symptom: Starter Rotates Slowly

(1) Are battery cables loose or dirty?

Yes - Tighten or clean.

No - Go to next step.

(2) Is battery fully charged? See “Battery Test” on page 104 in the Electrical section.

Yes - Go to next step.

No - Charge battery. See “Charge Battery” on page 105 in the Electrical section.

(3) Has engine seized?

Yes - See Engine Repair Section.

No - Go to next step.

(4) Is starting motor or solenoid defective?

Yes - Repair or replace. See “Starting Motor Solenoid Test” or “Starting Motor No-Load Amperage and RPM Test” in the Electrical section.

Tests and Adjustments

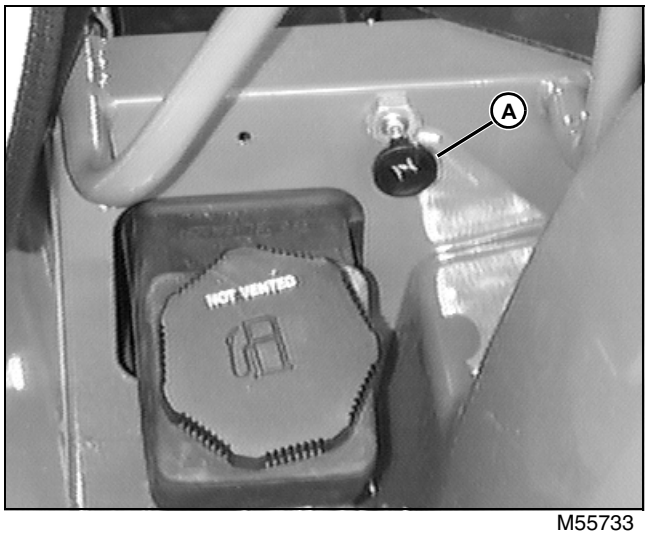
Choke Cable Adjustment

Reason:

To get full choke operation.

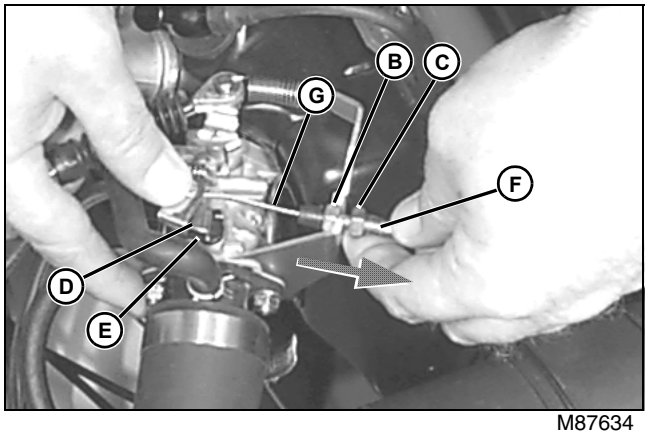
Procedure:

1. Park machine on level surface, turn key switch off.
2. Lock transaxle in neutral (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.
3. Lock park brake.



M55733

4. Be sure choke knob (A) is in off (released) position.



M87634

5. Loosen jam nuts (B and C).
6. Hold tab (D) against stop (E).
7. Pull choke cable conduit (F) away to remove all slack in cable (G).
8. Snug jam nuts.
9. Turn jam nut (C) one to two additional turns counterclockwise to ensure choke closure.
10. Tighten jam nut (B).
11. Pull choke knob slightly as you watch choke arm of the carburetor. Choke arm should respond as soon as the slight free play of cable and anchor barrel is removed.
12. Move choke linkage through full range of motion to be sure choke opens and closes fully and linkage moves smoothly from stop-to-stop.

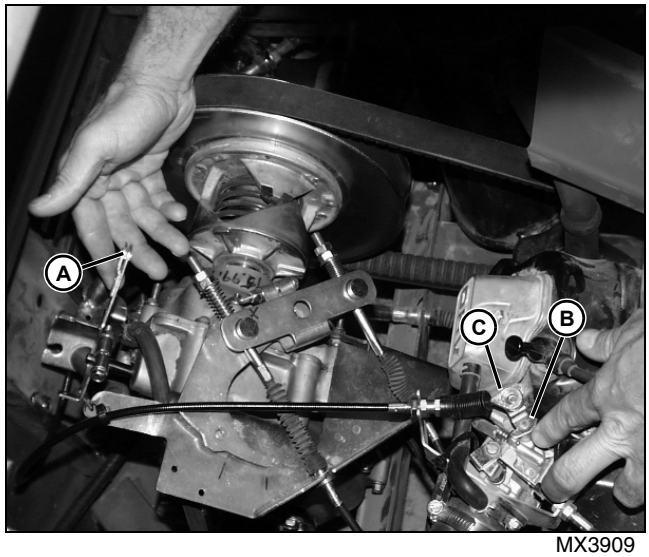
Adjust Governor Cable

NOTE: Perform the following adjustments in order
Governor Cable
Throttle Pedal Cable
Throttle Pedal Stop
to ensure the proper throttle operation.

Reason:

The purpose of the adjustment is to ensure that when the governor arm is up against its stop that the throttle butterfly is in the wide open throttle position.

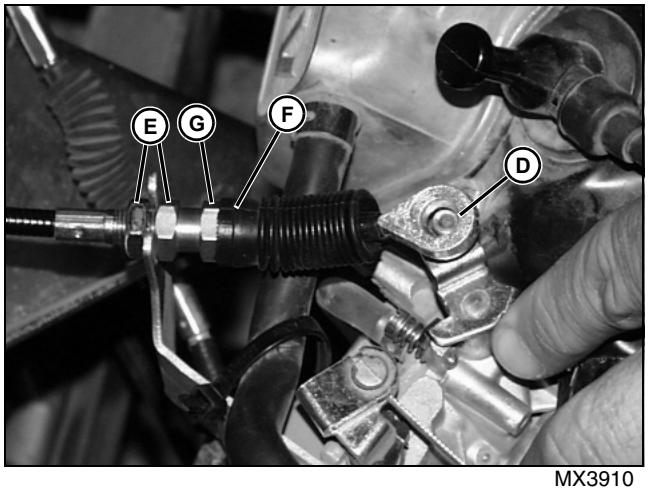
Procedure:



MX3909

1. Rotate governor arm (A) up (clockwise) until it stops.
2. Push carburetor butterfly (B) to wide open.
3. Slowly raise eyelet (C) off butterfly. Eyelet should drag slightly at the front edge (D) as you remove it.

NOTE: The eyelet position should not be adjusted too tightly. When the eyelet is removed from the butterfly and just resting on top of it, the two should be misaligned by less than one half of the eyelet hole. If the alignment is off by one-half of the hole or more the adjustment is too tight.



MX3910

4. Adjust nuts (E) to achieve correct eyelet position.

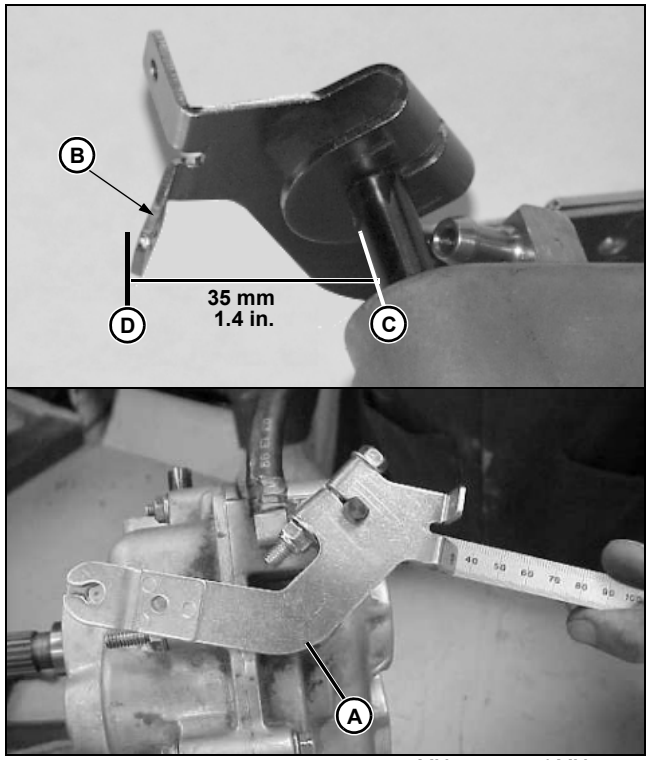
5. Slide rubber boot (F) over the first nut (G) in the double nut assembly.

Adjust Governor Arm

IMPORTANT: Avoid damage! Governor arm must be accurate or governor will hunt or not be sensitive enough.

1. If removed, install governor arm onto the transaxle, but do not tighten bolt in place.

NOTE: This procedure is for early models. Later models are not adjustable. Early models can be identified by the bend (A) in the governor arm. Later models have less bend and the transaxle shift arm is "T" shaped. See "Adjust Throttle Pedal Cable" on page 32 for graphics showing old and new style shift arms.



MX3908a and MX3381

Picture Note: Vent hose removed for clarity.

2. Bend the tab (B) that the throttle pedal cable hooks to using a pliers, so distance from the outer diameter of the shaft (C) to the outer edge (D) of the bracket measures exactly 35 mm (1.4 in.) Take care not to bend or distort anywhere else on the bracket.

3. Remove the bracket from transaxle before installing transaxle into vehicle.

Adjust Throttle Pedal Cable

NOTE: Perform the following adjustments in order
Governor Cable
Throttle Pedal Cable
Throttle Pedal Stop
to ensure the proper throttle operation.

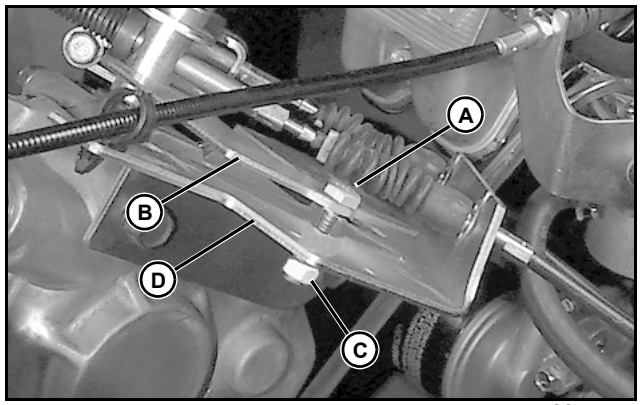
Reason:

To ensure throttle cable is adjusted correctly, and that throttle pedal movement provides full travel of carburetor linkage.

Procedure:

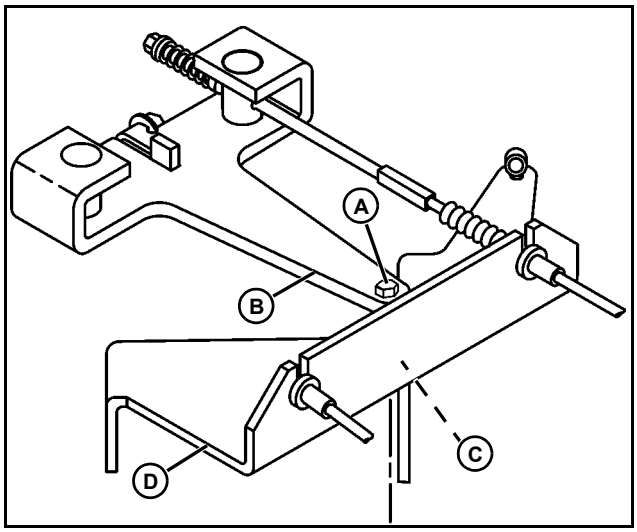
CAUTION: Avoid injury! To avoid injury, turn engine off and remove key when completing throttle arm adjustments.

1. Park machine on level surface, turn key switch off.



M87843

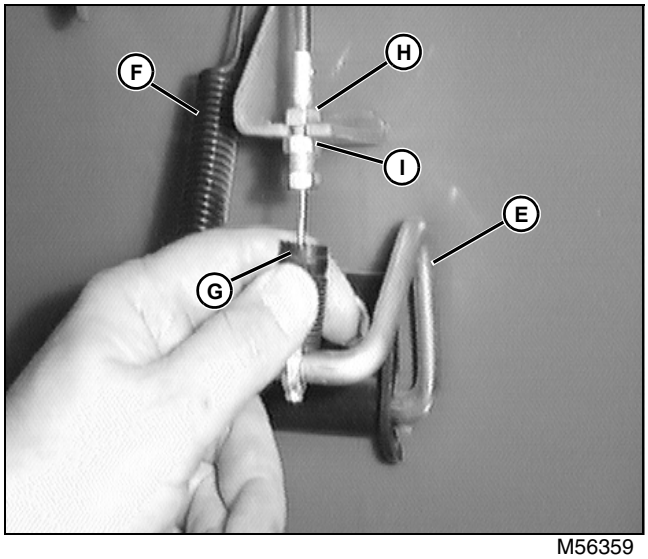
Picture Note: Early Models



MX1440

Picture Note: Late Models

2. Lock transaxle in neutral by inserting a 6 mm (1/4 in.) bolt (A) through the shift linkage (B) and add a nut (C) under bracket (D).



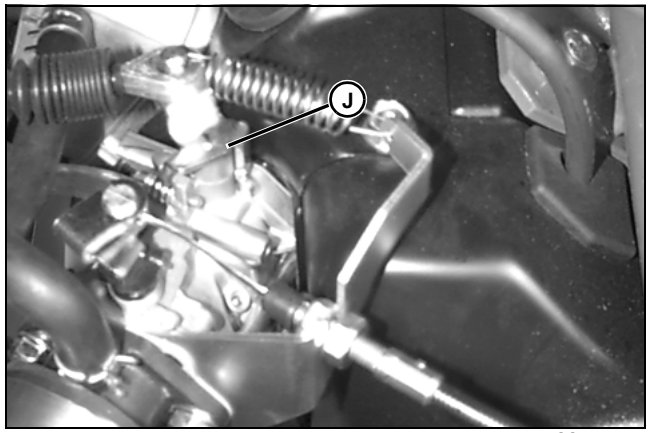
M56359

3. Check that throttle pedal rod is resting against front panel at (E), and return spring (F) is in place.

4. Pull rubber boot (G) down out-of-the-way.

5. Loosen jam nut (H).

6. Turn adjusting nut (I) until following settings are achieved and then tighten jam nut (H).



M87637

7. When pressing on throttle pedal, the ignition switch should engage first and then the butterfly (J) should immediately move to open.

Adjust Throttle Pedal Stop

NOTE: Perform the following adjustments in order
Governor Cable
Throttle Pedal Cable
Throttle Pedal Stop
to ensure the proper throttle operation.

Reason:

To adjust throttle pedal stop, and limit pedal travel, preventing excessive engine RPM's.

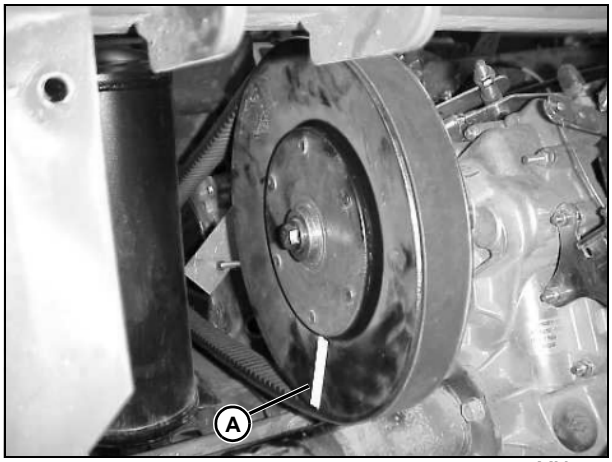
Equipment:

- Photo Tachometer

Procedure:

1. Verify that transmission is still locked in neutral.

NOTE: The RPM reading will be measured from the secondary clutch with a photo tachometer



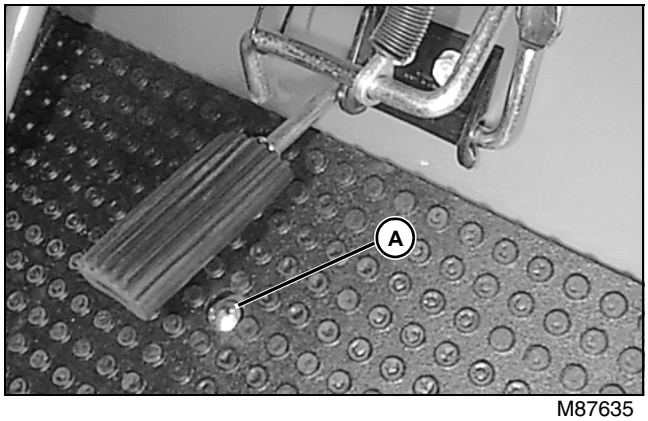
MX3380

2. Install reflective tape (A) on the secondary clutch. It may be necessary to apply black paint to the outside of clutch for reflective tape to allow photo tachometer to read the reflective tape.

3. Using a lift or floor jack raise rear end of unit and support machine in the raised position.

4. Turn key on and fully depress the foot pedal. Run unit at least 45 seconds to allow RPM's to stabilize.

5. A reading of 3600 ± 50 RPM (S/N 8279-) is desired with pedal fully depressed. For early models with a 13.25:1 transaxle ratio, the reading should be 3500 ± 50 RPM.



M87635

6. Adjust position of pedal stop (A) to achieve desired reading.

7. Remove nut and bolt locking transaxle in neutral.

8. Lower vehicle to ground.

Check/Adjust Clutch Center Distance

Purpose:

To check the center distance between the primary and secondary clutches for proper performance.

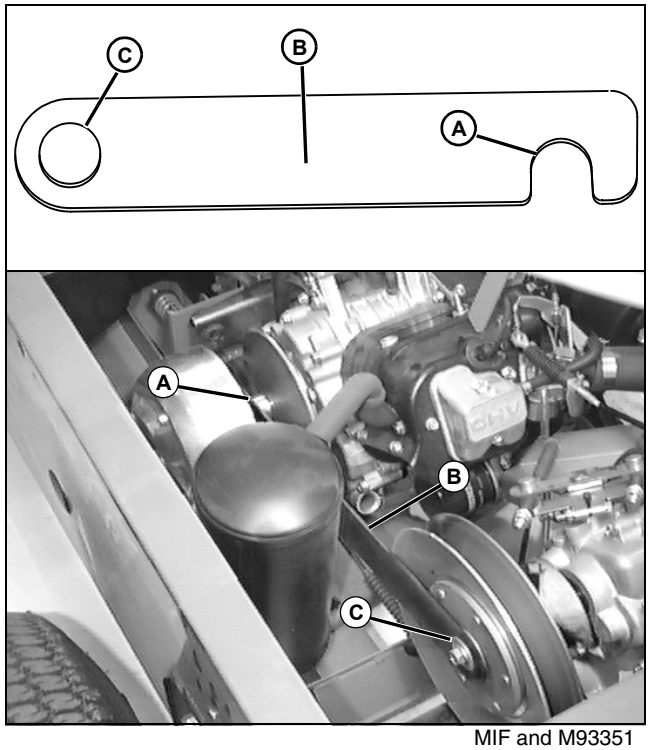
If the center distance is too long (gauge does not quite get to the secondary clutch bushing), more shims are required. If this situation is not corrected, the drive belt may drop into secondary clutch and wear on the rivets.

If the center distance is too short (gauge goes past the secondary clutch bushing), less shims are required. If this situation is not corrected, performance will suffer.

Procedure:

The center distance gauge is designed to set the center distance between the primary and secondary clutches to 446.4 mm (17.58 in.).

NOTE: When verifying center distance, an incorrect reading will occur if the gauge is installed on the secondary clutch and then forced over the primary clutch.



MIF and M93351

1. Position open end (A) of clutch center distance gauge (B) over the primary clutch shaft.

2. Position gauge closed end (C) over the washer on secondary clutch. Check that the closed end easily seats completely over washer on secondary clutch.

Results:

- If the center distance gauge easily seats completely over washer on secondary clutch, the center distance is set correctly.
- If the center distance gauge does not easily seat completely over washer on secondary clutch, the center distance needs to be adjusted.
- Adjust the center distance between clutches by adjusting the number of shims between the snubber isolator and the engine snubber bracket. See “Engine Installation” on page 44.
- Verify center distance again by placing the center distance gauge on the primary clutch first and verify that the closed end of the gauge easily slips onto the secondary clutch bearing.

Fuel Pump Pressure And Flow Test

Reason:

To check output pressure and flow rate of fuel pump.

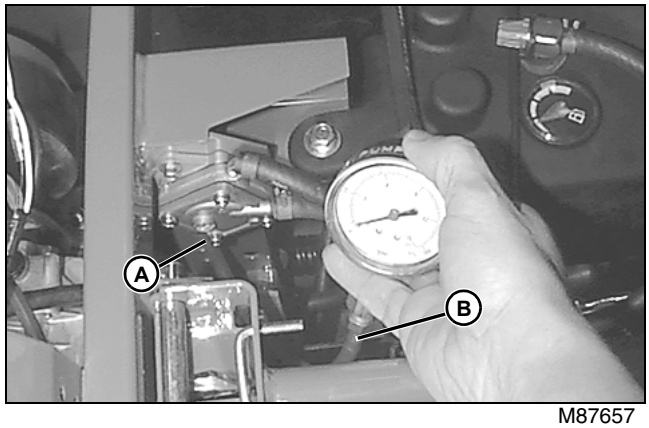
Equipment:

- JDG356 Pressure Gauge
- Graduated container

Procedure:

1. Lock transaxle in neutral (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.
2. Park brake locked, wheels blocked.
3. Run engine at slow idle for one minute to fill carburetor with fuel.
4. Turn engine off.

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

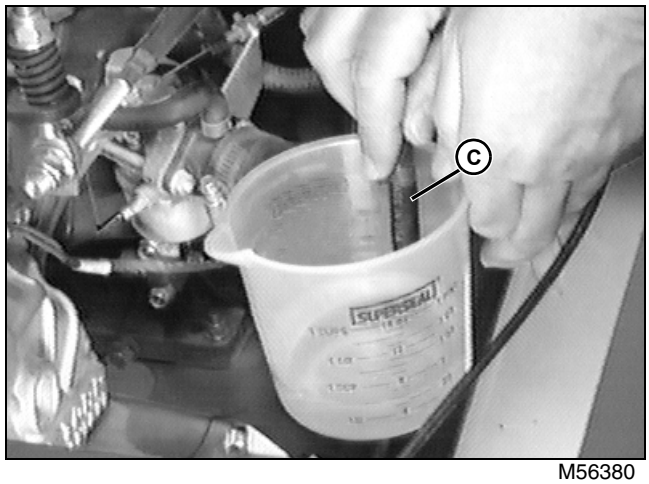


M87657

5. Disconnect hose from fuel pump outlet (A).
6. Plug hose end.
7. Connect JDG356 Pressure Gauge hose (B) to fuel pump outlet.
8. Run engine at fast idle for 15 seconds, record pressure reading. Minimum pressure 6.12 kPa (0.9 psi).
9. Turn engine off.
10. Remove pressure gauge, connect pump outlet hose and clamp.

Results:

- If fuel pressure is below minimum specification, check fuel pump filter, in-line filter, hoses, and fuel shutoff valve for debris or restrictions. Repeat test.
- If pressure still below minimum specification, replace fuel pump.
- Run engine for one minute to fill carburetor.
- Turn engine off.



M56380

- Disconnect carburetor inlet hose (C) from carburetor, put end in graduated container.
- Run engine at fast idle for 15 seconds, stop engine. Check fuel. Minimum flow 80 ml (2.7 oz) in 15 seconds.

Results:

- If fuel flow below minimum specification, check fuel pump filter, in-line filter, hoses, and fuel shutoff valve for debris or restrictions. Repeat test.
- If fuel flow is still below minimum specification, replace fuel pump.

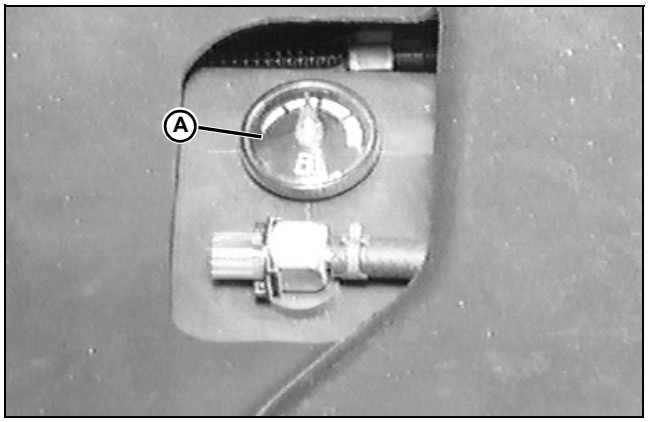
Fuel Tank Gauge Test

Reason:

To ensure gauge is indicating actual fuel level in tank.

Procedure:

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



M55773

2. Check fuel level (A).
3. Add fuel, check fuel level (A).
4. If indicator does not move, replace gauge.

Cylinder Compression Test

Reason:

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

Equipment:

- JDM-59 Compression Gauge
- JDM-74A-5 Spark Plug Wire Test Tool

Procedure:

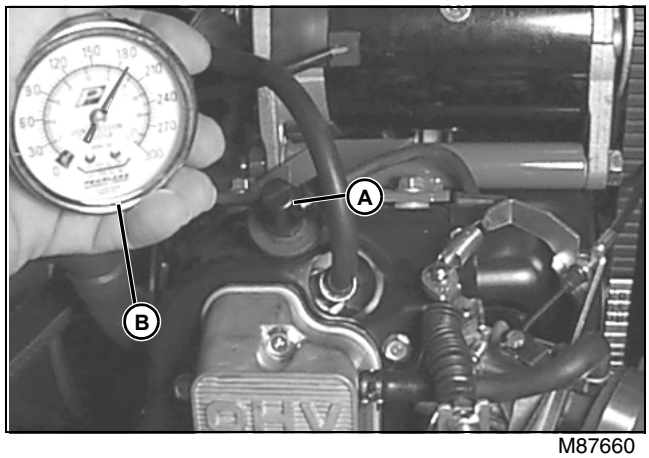
1. Park machine on level surface, turn key switch off.
2. Lock transaxle in neutral (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.
3. Block wheels.

NOTE: The starter will crank the engine at 650 ± 50 rpm. This may not be fast enough to disengage the automatic compression release mechanism, and compression test will not show actual compression.

4. Run engine at medium idle for five minutes to reach operating temperature.
5. Turn engine off.

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

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



M87660

6. Disconnect spark plug wire (A), and ground wire to prevent accidental starting.
7. Remove spark plug, and install JDM-59 Compression Gauge (B).
8. Hold throttle pedal in fast idle position, and make sure choke is off.
9. Crank engine.

NOTE: Starter must crank engine at approximately 700 rpm for accurate test results. Make sure battery is fully charged.

10. If compression is low, remove compression gauge. Squirt clean engine oil onto cylinder.
11. Repeat cylinder compression test procedure.

Results:

- Minimum compression should be 393 kPa (57 psi).
- If compression pressure increases after oil is put into cylinder, check rings, piston and cylinder bore for wear or

damage.

• If compression pressure is still low check valves, valve seats, valve seals, and cylinder head gasket.

Valve Clearance Adjustment

Reason:

To check and adjust valve clearance.

Equipment:

- JDM-74A-5 Spark Plug Wire Test Tool
- Flat bladed feeler gauge

Procedure:

IMPORTANT: Avoid damage! Make this adjustment when engine is cold.

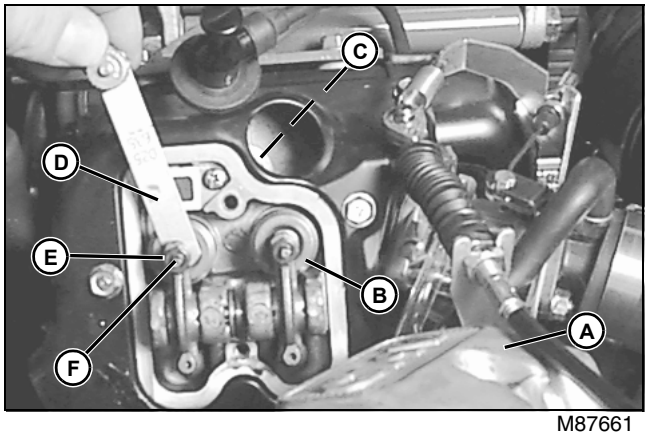
1. Park machine on level surface, turn key switch off.

2. Lock transaxle in neutral, (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.

3. Lock park brake.

IMPORTANT: Avoid damage! Spark plug wire must be grounded or electronic ignition could be damaged.

4. Disconnect spark plug wire, ground with JDM-74A-5 tool. Remove spark plug.



M87661

5. Remove valve cover (A).

6. Find piston TDC (Top Dead Center) of compression stroke as follows:

- Turn crankshaft counterclockwise until intake valve (B) opens.
- Put a long, small diameter, wooden dowel into spark plug hole (C), and rest it on top of the piston.
- Continue to turn crankshaft counterclockwise until dowel is at highest point. The piston is at TDC of compression stroke.
- When piston is at TDC, both intake and exhaust valve rocker arms will be loose.
- If either or both rocker arms are tight, the piston is on the exhaust stroke and the crankshaft must be turned counterclockwise another revolution (360 degrees).

NOTE: Proper valve clearance is critical to the correct operation of the compression release system.

7. Use a flat feeler gauge (D) to check that valve clearance is 0.125 mm (0.005 in.).

8. To adjust valve clearance, loosen lock nut (E) and turn adjusting screw (F) to correct clearance.

9. Hold adjusting screw stationary while tightening lock nut to 20 N•m (180 lb-in.).

10. Recheck valve clearance, readjust if necessary.

11. Repeat procedure for other valve.

12. Install spark plug and spark plug lead.

13. Install and tighten valve cover to 6 N•m (53 lb-in.).

While valve cover is removed, perform Automatic Compression Release Test.

Automatic Compression Release (A.C.R.) Test

Reason:

To verify automatic compression release (A.C.R.) mechanism operation.

Procedure:

IMPORTANT: Avoid damage! Exhaust valve clearance must be set properly before this test is performed. See “Valve Clearance Adjustment”.

1. Park machine on level surface, turn key switch off.

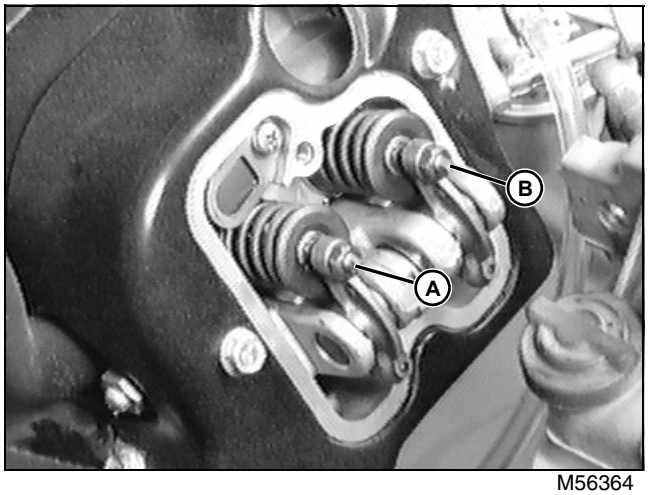
2. Lock transaxle in neutral, (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.

3. Lock park brake.

IMPORTANT: Avoid damage! Spark plug wire must be grounded or electronic ignition could be damaged.

4. Rotate crankshaft counterclockwise slowly, watch exhaust valve.

Results:



M56364

- Exhaust valve (A) must lift briefly, after intake valve (B) closes.
- If A.C.R. lift movement not within specifications, See “Automatic Compression Release” on page 56.

A.C.R. lift
Minimum . . . . . 0.6 mm (0.024 in.)
Maximum . . . . . 1.65 mm (0.065 in.)

Oil Pressure Test

Reason:

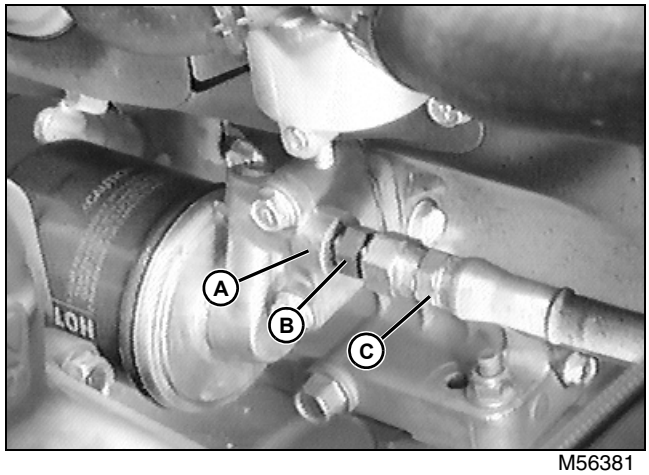
To determine condition of lubrication system.

Equipment:

- JTO5577 Pressure Gauge Assembly
- JTO3017 Hose Assembly
- JTO3349 Connector—1/8” BSP Thread

Procedure:

1. Park machine on level surface, turn key switch off.
2. Lock transaxle in neutral, (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.
3. Block wheels.
4. Check engine oil level. Fill to full mark, if necessary.



M56381

5. Remove plug from filter housing (A).
6. Install straight fitting (B) and hose plus gauge (C).
7. Run engine at medium idle for five minutes to reach operating temperature.
8. Run at fast idle. Oil pressure minimum 314 kPa (46 psi).

Results:

If oil pressure is below specification, inspect following:

- If equipped with oil filter kit, check if plugged and replace.
- Oil pressure relief valve for broken or weak spring, stuck or damaged valve.
- Oil pump suction screen or oil passages plugged.
- Oil pump worn or damaged.
- Excessive wear of connecting rod and main bearings.
- Remove hose, gauge, and straight fitting. Install plug using John Deere Pipe Sealant with TEFLON (medium strength), or equivalent, on plug threads.

Crankcase Vacuum Test

Reason:

To determine operation of breather, condition of seals, gaskets, rings, piston, and cylinder wall.

Equipment:

- JTO5703 Barb Fitting
- JTO5699 Line
- JTO5698 U-Tube Manometer

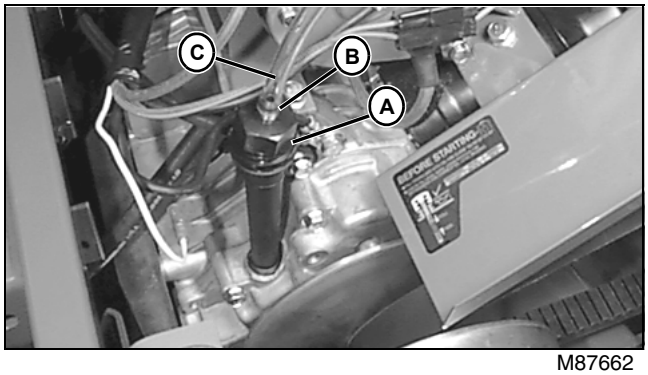
Procedure:

1. Park machine on level surface, turn key switch off.
2. Lock transaxle in neutral, (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train

Section.

3. Block wheels.

4. Remove dipstick.

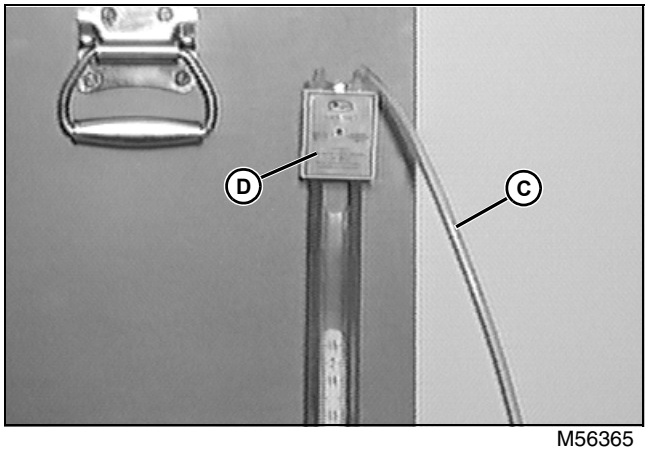


M87662

5. Put barbed fitting (B) and clear tube (C) into plug (A).

6. Push plug (A) in dipstick hole until tight.

IMPORTANT: Avoid damage! Do not make connection between manometer, and engine line, before the engine is running! Fluid in manometer could be drawn into crankcase. Do not turn engine off until line has been disconnected from manometer.



M56365

7. Attach U-tube/scale assembly (D) to side of tool box. Open valves on top of manometer, and zero out scale to fluid level in tubes.

8. Run engine at slow idle.

9. Connect clear tube (C) to either barbed fitting on manometer.

10. Run engine at fast idle.

11. Manometer minimum vacuum 25 mm (1.0 in.) water.

12. Run engine at slow idle. Do not turn engine off.

13. Disconnect clear tube (C) from manometer.

14. Turn engine off.

15. Remove plug and install dipstick.

Results:

If crankcase vacuum less than specification, check:

- Make sure engine is fully warmed up.
- Breather reed valve clearance and condition.
- Seals and gaskets for leakage.
- Valve cover gasket for leakage.
- Rings, piston, and cylinder walls for wear or damage.
- Valve and valve seats for wear or damage.
- Head warpage.

Air Intake System Check

Reason:

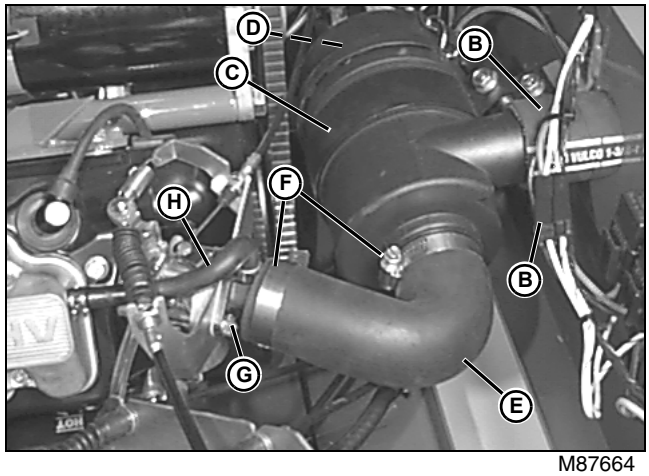
Check air intake system for leaks or restrictions.

Procedure:

1. Park machine on level surface, turn key switch OFF.
2. LOCK park brake.
3. Remove seats and shrouding.

NOTE: Use compressed air and/or a long hooked rod when trying to remove dust or debris from inside channel.

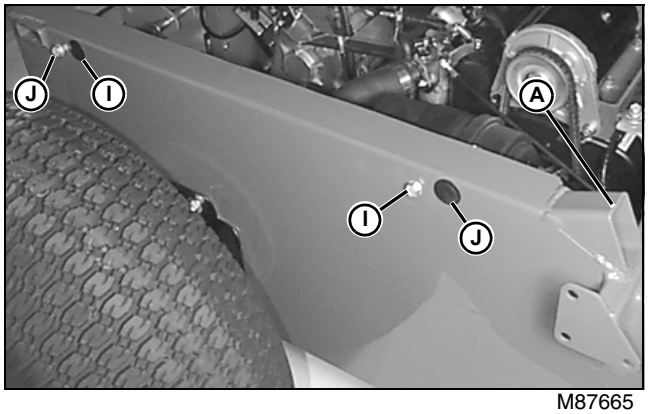
4. Check for:
   - air intake channel (A) clear of dust or restrictions.



M87664

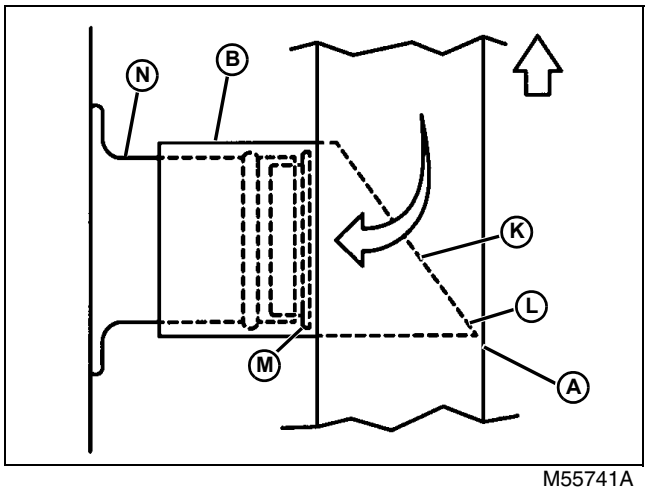
- frame hose (B) not cracked, damaged or leaking.
- air filter canister (C) not cracked or leaking.
- rubber debris boot not cracked or leaking.
- air filter element(s) (D) not missing, plugged, torn, distorted, or damaged.
- air intake hose (E) not cracked, cut, or leaking.

- hose clamps (F) in good shape and tight.
- adapter (G) not cracked, or loose.
- breather hose (H) not cracked, cut, or leaking.



M87665

5. Be sure cap screws (I) and plugs (J) are installed.



M55741A

Picture Note: Top View

6. Install frame hose (B) so angled edge (K) faces to front of machine and tip (L) just touches inside edge of frame (A) without being bent.

7. Install canister mounting strap on top side of mounting bracket. Remember that spring goes on-top-of mounting strap. Tighten spring lock nut until two threads of long cap screw are exposed. Do not collapse spring completely.

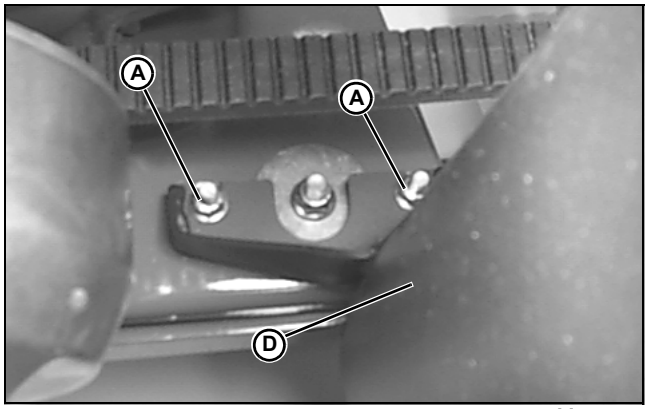
8. Insert air restrictor (M) into canister inlet tube (N) and insert inlet tube inside frame hose (B).

Repair

Muffler Removal and Installation

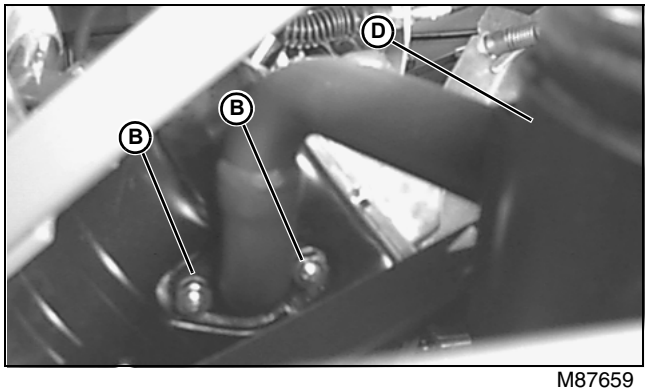
CAUTION: Avoid injury! Muffler may be hot. Allow to cool before removing.

NOTE: Tailpipe extension and spark arrestor may be installed on machine tailpipe as a kit to eliminate after bang.



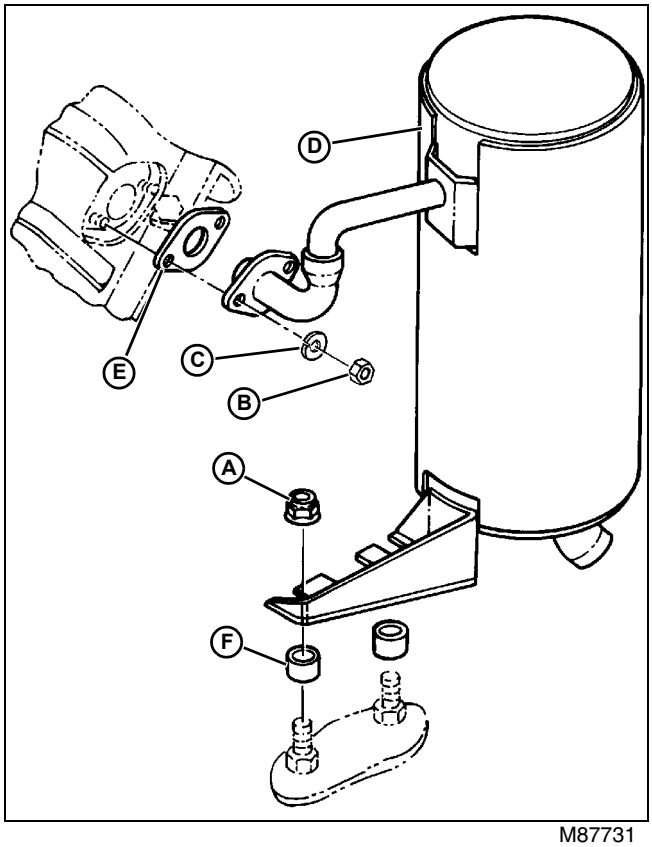
M87666

1. Loosen frame bracket mount flange lock nuts (A) approximately half way up threads on frame mount bolts.



M87659

2. Remove engine mount nuts (B) and lock washers (C).



M87731

3. Pull muffler (D) straight out from engine and remove muffler.

4. Replace gasket (E).

5. Loosely install muffler to engine, and muffler to frame bracket.

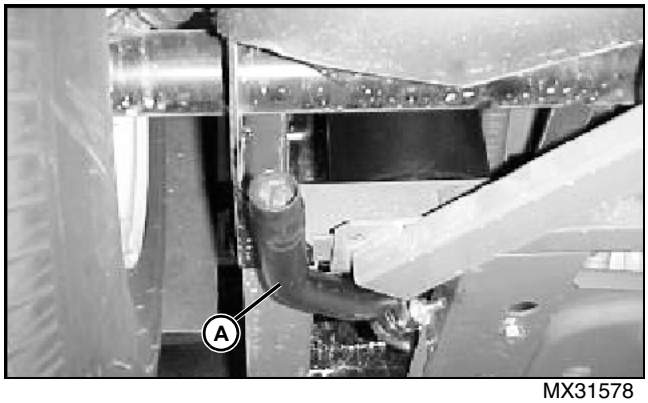
6. Install lock washers and nuts on engine mount bolts and tighten to 25 ± 3 N•m (18 ± 2 lb-ft).

7. Tighten muffler frame mount locking flange nuts 37 ± 8 N•m (27 ± 5 lb-ft).

Tail Pipe Extension Installation:

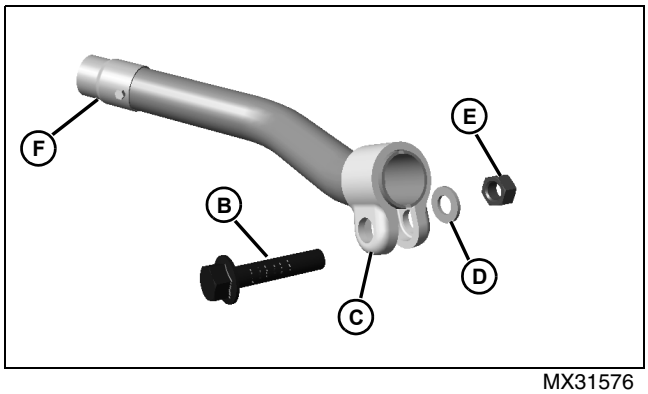
1. Measure 32 mm (1.25 in.) from end of tailpipe and scribe a line.

2. If necessary, install tailpipe extension to scribed line using a soft mallet. Tap on clamp flanges to install extension, not back end of extension.



MX31578

3. Install tailpipe extension (A) to allow maximum ground clearance and clearance to frame. Tailpipe extension should be pointing toward rear and parallel to the ground.



MX31576

4. Install bolt (B) through the welded clamp (C), washer (D) and secure with lock nut (E).

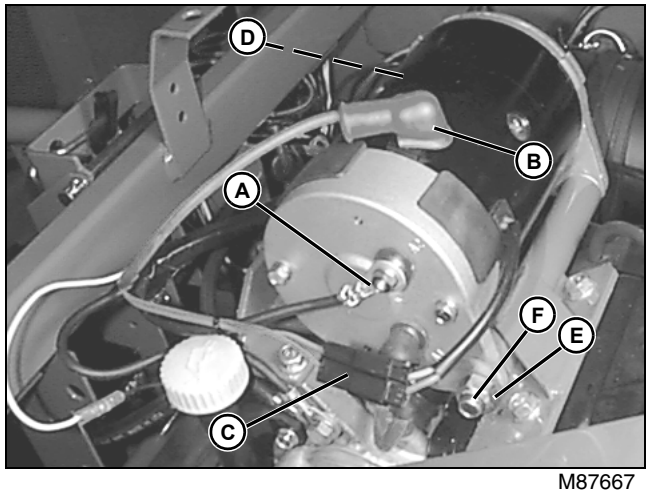
NOTE: Do not operate without spark arrestor (F). The spark arrestor is necessary for the elimination of after band.

5. Tighten to 40 N•m (30 lb-ft).

Starting Motor/Generator Removal and Installation

Removal

1. Disconnect battery negative (–) cable and positive (+) cable.



M87667

2. Disconnect negative cable (A) from starting motor/generator.

3. Pull back boot cover and disconnect positive cable (B) from starting motor/generator.

4. Disconnect field coil connector (C).

5. Remove belt tensioning cap screw (D) and locking flange nut.

6. Loosen nut (E).

7. Move starting motor/generator downward, and remove belt.

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

9. Remove starting motor/generator.

Installation

1. Installation is done in reverse order of removal.

2. Install starting motor/generator. Install cap screw (F) and nut (E). Do not tighten.

3. Install belt. Install cap screw (D) and locking flange nut.

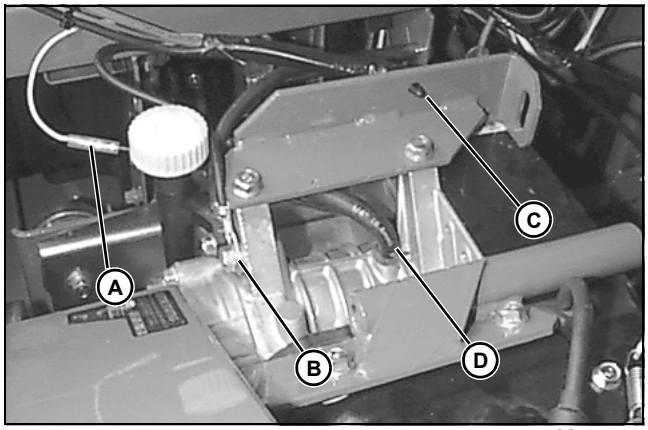
4. Tension belt and tighten cap screw (D) and locking flange nut. Tighten cap screw (F) and nut (E) to 85 N•m (63 lb-ft).

5. Connect wires (A and B). Plug in connection (C).

6. Connect positive (+) and negative (–) battery cables.

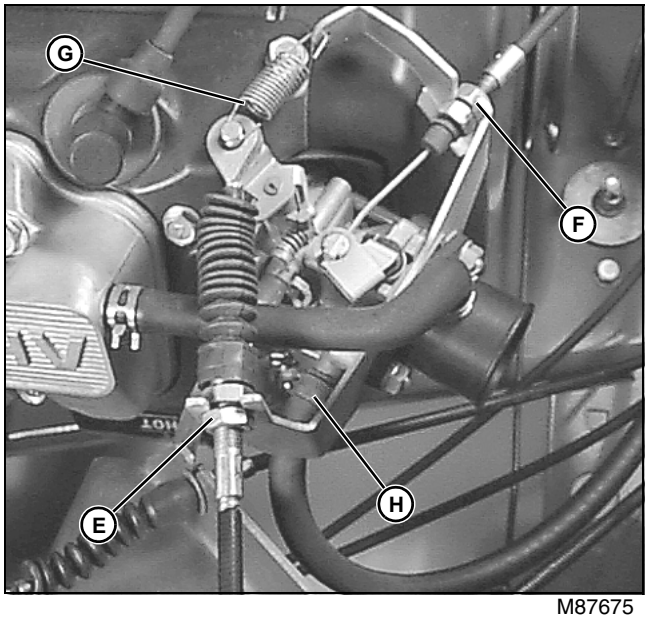
Engine Removal

1. Disconnect battery negative (-) cable.
2. Remove air cleaner-to-engine hose and air cleaner.
3. Remove starting motor/generator and belt.
4. Remove muffler and drive belt.



M87674

5. Disconnect engine (single, white) wiring harness connector (A).
6. Remove ground wiring lead cap screw (B), move battery negative cable and ground wiring lead.
7. Disconnect wiring harness molded plug (C) from starting motor/generator bracket.
8. Slide hose clamp (D) up fuel pump vacuum hose and disconnect hose.

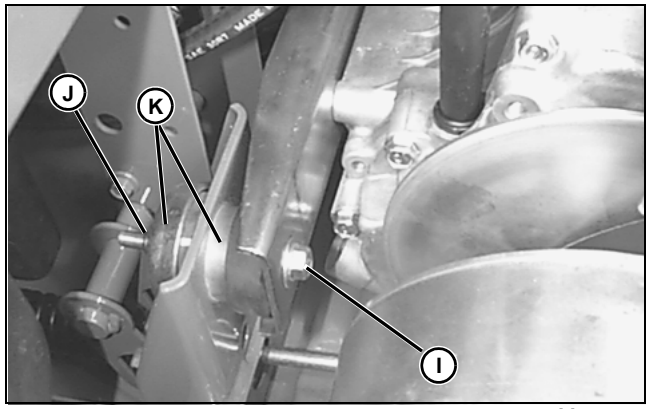


M87675

9. Loosen locking nuts (E and F)
10. Lift spring end (G) off of choke arm.
11. Disconnect choke control and accelerator cables.
12. Reconnect spring (G).

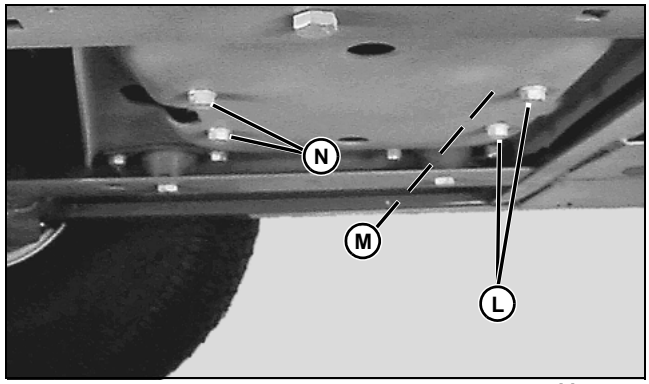
CAUTION: Avoid injury! Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

13. Disconnect fuel supply hose (H) and plug hose end.



M87668

14. Remove mounting cap screw (I), washer, locking flange nut (J) and spacers (K) from front engine mount.



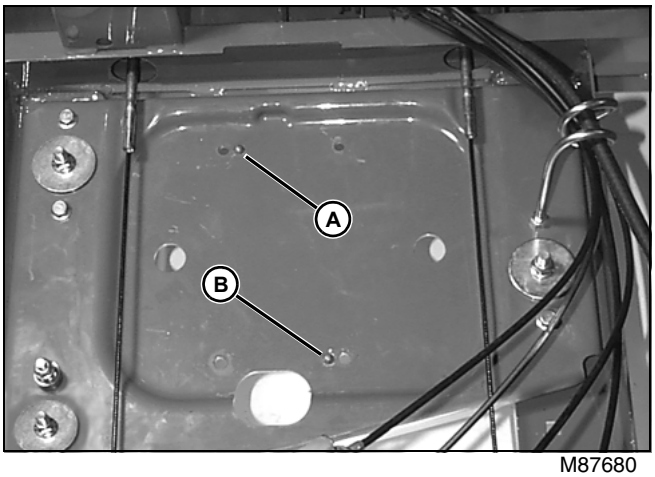
M87669

15. Remove two cap screws (L) and strap (M) with pal nuts from front of engine.
16. Remove two cap screws (N) and locking flange nuts from rear of engine.

NOTE: Removal of drive clutch is necessary only if engine repair is needed. See "Primary Clutch Removal" on page 126 in Power Train section.

17. Remove engine.

Engine Installation

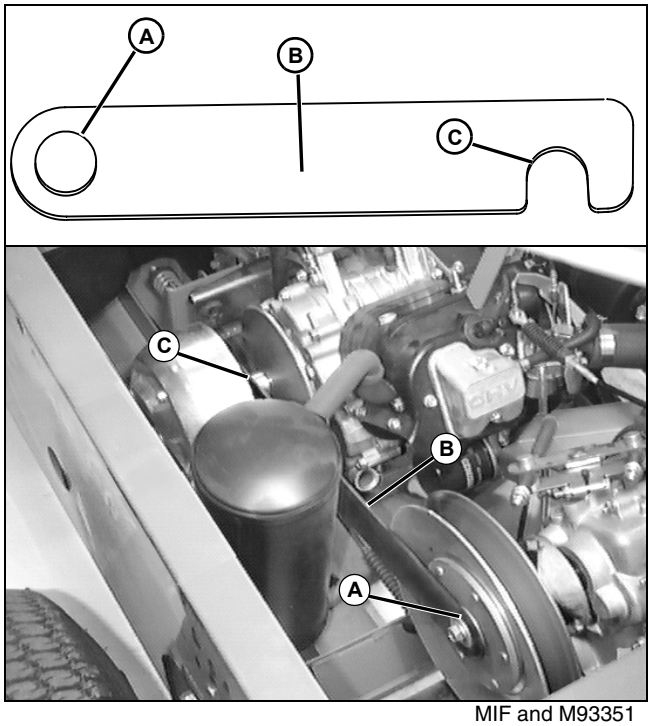


M87680

1. Set engine in frame so that indents (A) at left front and (B) at right rear fit into pockets in engine base.
2. Install and tighten mounting bolts to 37 N•m (27 lb-ft).
3. Center the distance between the clutches.

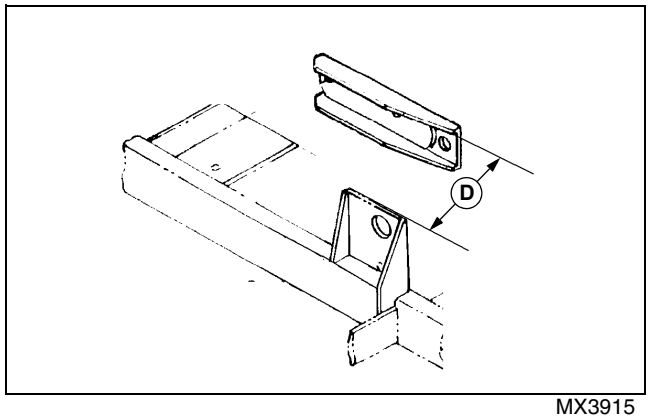
NOTE: The center distance gauge is designed to set the center distance between the primary and secondary clutches to 446.4 mm (17.58 in.).

When verifying center distance, an incorrect reading will occur if the gauge is installed on the secondary clutch and then forced over the primary clutch.



MIF and M93351

4. Position closed end (A) of clutch center distance gauge (B) over washer on secondary clutch.
5. Position gauge open end (C) over the primary clutch shaft. Make sure closed end is seated completely over washer on secondary clutch.



MX3915

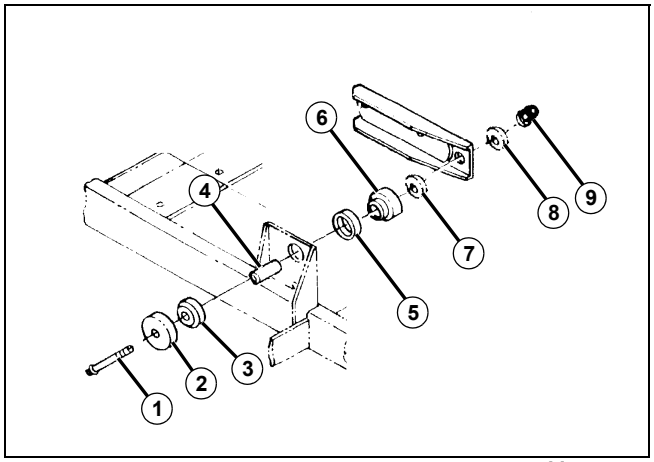
6. Determine the number of shim washers required when assembling the snubber isolators to maintain the center distance by accurately measuring gap (D) between frame and engine bracket and using the following chart. Gap can be best measured using an inside calipers.

Gap is defined as the distance between the frame and engine snubber brackets when the center distance Tool (JD1175-1-1) is in place and properly positioning the engine relative to the secondary clutch. Snubber parts are not in place at this time.

7. Shim washers used are 24H1291 and 24H1313. The 24H1291 washer is 2.8 mm thick and would be on the unit as it comes from the factory…there will be 0, 1 or 2 of these in the unit. One 24H1291 thick washer is also included with the kit. The 24H1313 washer is 1.5 mm thick and four of these are included in the kit.

IMPORTANT: Avoid damage! If the center distance is too long (gauge does not quite get to the secondary clutch bushing), more shims are required. If this situation is not corrected, the drive belt may drop into secondary clutch and wear on the rivets.
If the center distance is too short (gauge goes past the secondary clutch bushing), less shims are required. If this situation is not corrected, performance will suffer.

8. Remove center distance gauge from machine.



M93317a

9. Install the hardware and isolators as shown above. It will be necessary to pry the engine bracket away from the frame bracket to insert (5), (6), and shim washer(s) (7).

10.Tighten isolator hardware to 37 ± 7 N•m (27 ± 5 lb-ft).

11.Verify center distance again by placing the center distance gauge on the primary clutch first and verify that the closed end of the gauge easily slips onto the secondary clutch bearing. Remove or add shims as necessary.

12.Install spacers, washer, capscrew and locking flange nut in front engine mount. Tighten to 50 N•m (37 lb-ft).

13.Fill engine with proper oil.

14.Connect electrical wires and harness connector.

15.Install starting motor/generator and belt and reconnect electrical wires. Tighten generator to adjustment bracket nut to 37 N•m (27 lb-ft).

16.Install drive belt and muffler. Tighten muffler to engine nuts to 25 N•m (18.4 lb-ft). Tighten muffler to engine isolator nuts to 37 N•m (27 lb-ft).

17.Install breather and fuel hoses.

18.Install air filter.

19.Connect choke and throttle cables.

20.Connect battery cables.

21.Adjust choke and throttle cables. See “Choke Cable Adjustment” on page 31, and See “Adjust Throttle Pedal Cable” on page 32.

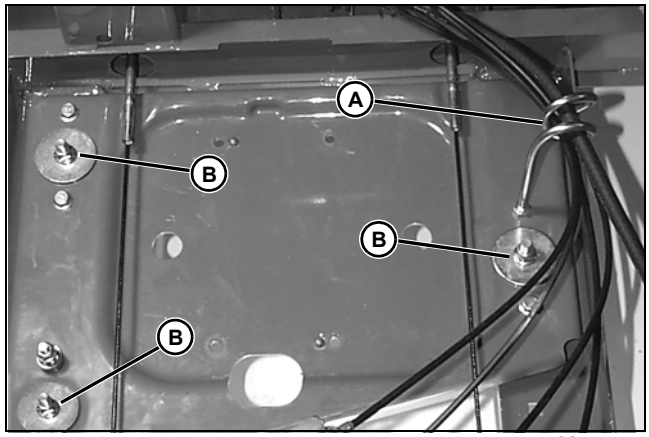
Engine Oil Capacity:

Without filter . . . . . 1.1 L (2.33 pt)
With filter . . . . . 1.4 L (3.0 pt)

Engine Isolation Plate Removal and Installation

Removal:

1. Remove engine. See “Engine Removal” on page 43.



M87680

Picture Note: Older Model Shown

2. Carefully remove cables and fuel line from bracket (A). Newer models do not use bracket (A), but use a clamp (C).

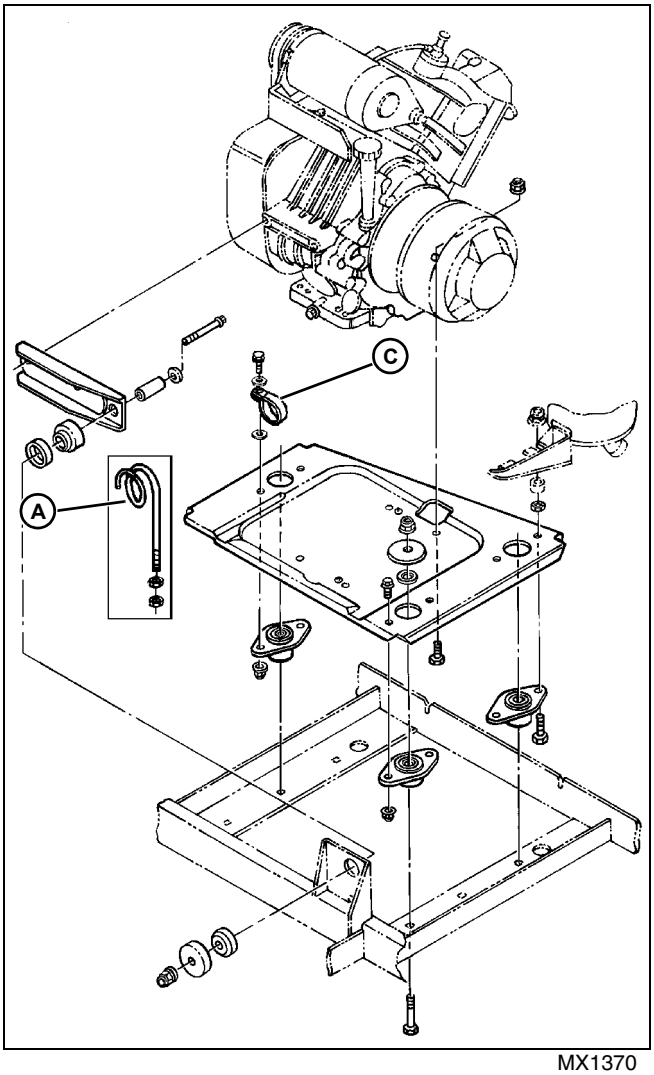
3. Remove three lock nuts and cap screws (B).

4. Slide isolation plate to side of vehicle and drop side of isolation plate down. Remove isolation plate.

Installation:

Installation is done in reverse order of removal.

NOTE: When installing isolation plate, it is necessary to establish the center distance between clutches. See “Check/Adjust Clutch Center Distance” on page 34.



MX1370

Specifications

Engine Mounting Capscrews . 37 ± 7 N•m (27 ± 5 lb-ft)
Isolator Plate Mounting Capscrews . . 37 N•m (27 lb-ft)

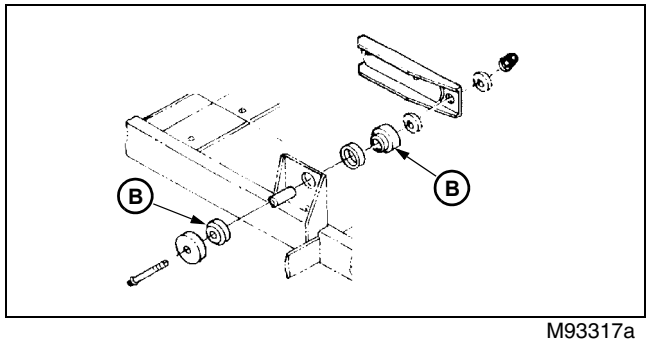
Engine Isolator Mount Replacement

1. Remove muffler and air cleaner assembly.

MX3906

2. Remove two rear cap screws securing seat base cover (A) to frame. Prop seat base cover up with a block of wood to provide access to snubber isolators.

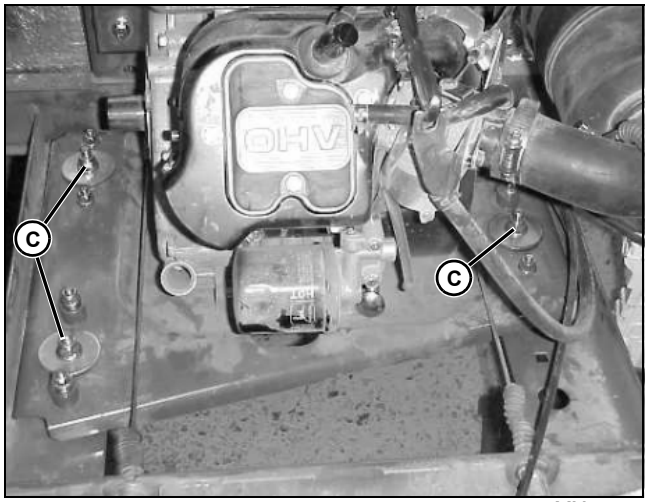
NOTE: A small washer is resting on top of the engine mounts. Retain washer for use with the new engine mount.



M93317a

3. Remove snubber isolators (B) and hardware.

IMPORTANT: Avoid damage! Avoid damage! When raising engine mounting plate be careful not to damage brake cable rods on front side of engine.



MX3388

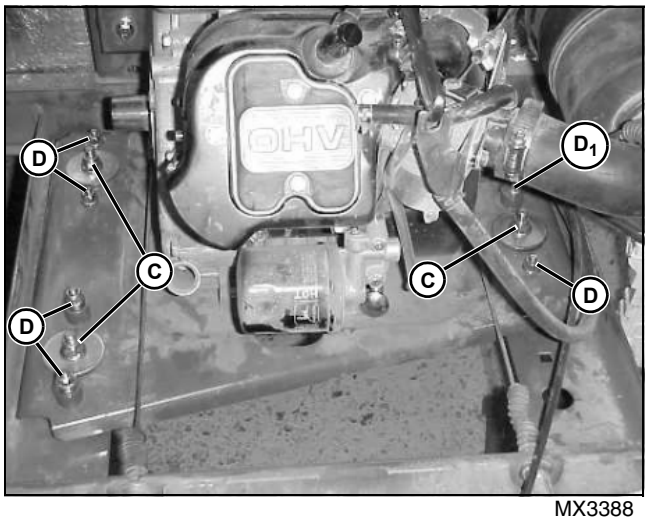
4. Remove the three center nuts (C) (15 mm wrench), large washers, small washers and cap screws (16 mm wrench) that are holding the engine plate to the main frame.

CAUTION: Avoid injury! Avoid injury! Fingers could be pinched or severely injured when replacing engine mounts, if the engine is not securely supported.

5. Slightly raise the engine and engine mounting plate using a safe lifting device to gain access to engine isolator mounts. Support engine using jack stands.

6. Replace engine mounts:

NOTE: Nut (D1) also secures a pigtail bracket or hose clamp containing the fuel lines and several cables.

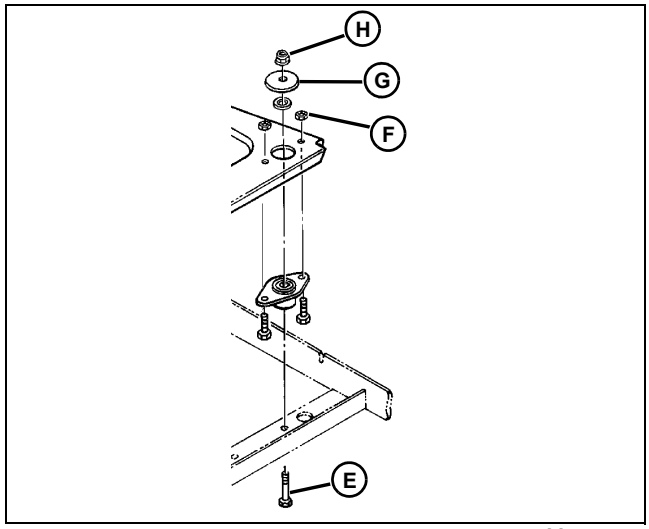


MX3388

7. Remove two nuts (D & D1) attaching each engine mount. Retain hardware. Replace engine mounts as necessary.

8. Install engine mounts using original hardware. Be sure to secure the cable/fuel line bracket at nut (D1).

9. Lower engine onto frame.



M87763a

10.Loosely install original center cap screws (E), small washers (F), large washers (G), and nuts (H).

11.With all engine mounts in place, tighten nuts (H) to 37 N•m (27 lb-ft.).

12.If removed, install primary clutch in reverse order of removal. Tighten clutch bolt to 40 ± 8 N•m (24 - 35 lb-ft.).

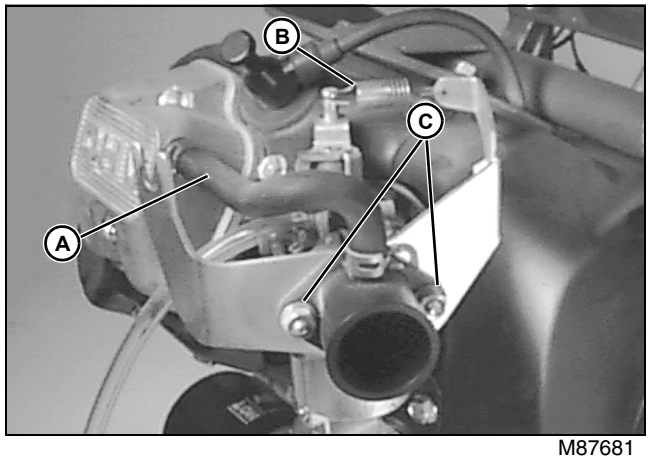
13.Install air cleaner.

Carburetor Removal and Installation

Removal

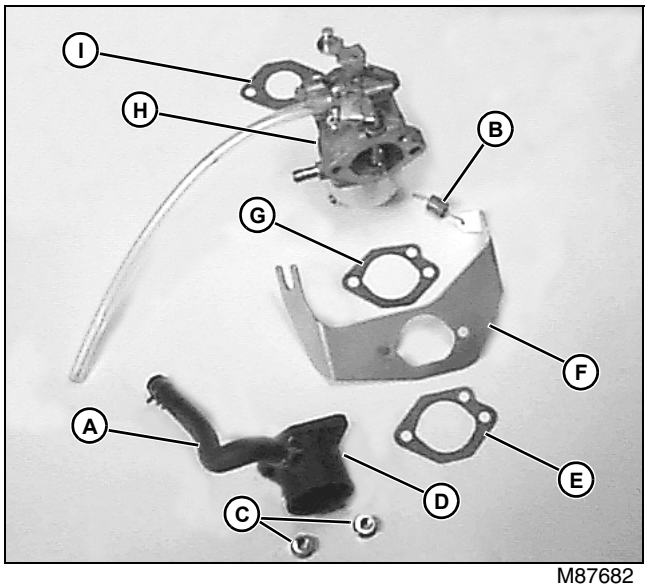
CAUTION: Avoid injury! Gasoline vapor is explosive. Do not expose to spark or flame. Serious personal injury can result.

1. Drain float bowl.



M87681

2. Remove breather hose (A) and spring (B).



M87682

3. Remove two flange nuts (C), air intake duct (D), gasket (E), bracket (F), gasket (G), carburetor (H), and gasket (I).

Installation

- Installation is done in reverse order of removal.
- Install gasket, carburetor, gasket, bracket, gasket and air intake duct.
- Install two flange nuts.

Carburetor Disassembly and Assembly

CAUTION: Avoid injury! Do not attempt to rebuild or adjust carburetor unless you are a factory trained technician with authorization to service California Air Resources Board / Environmental Protection Agency (CARB/EPA) Certified engines.

IMPORTANT: Avoid damage! To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.
Do not clean holes or passages with drill bits or wire.

- Soak body and all parts, except gaskets, float, needle valve and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.
- Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

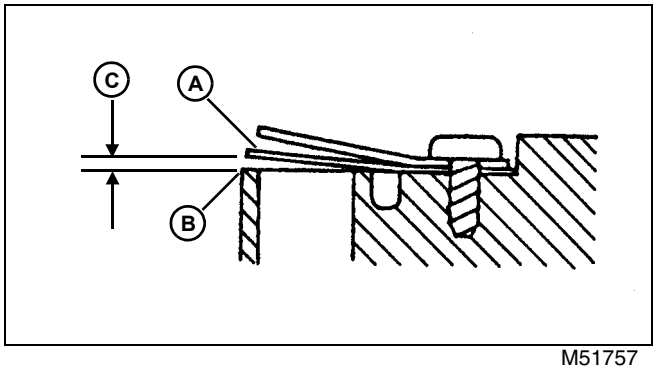
IMPORTANT: Avoid damage! Rinse carburetor body in warm water to neutralize corrosive action of cleaner.

- Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts. Lint may plug holes or passages.

NOTE: Float is plastic. The float cannot be adjusted. Replace if necessary.

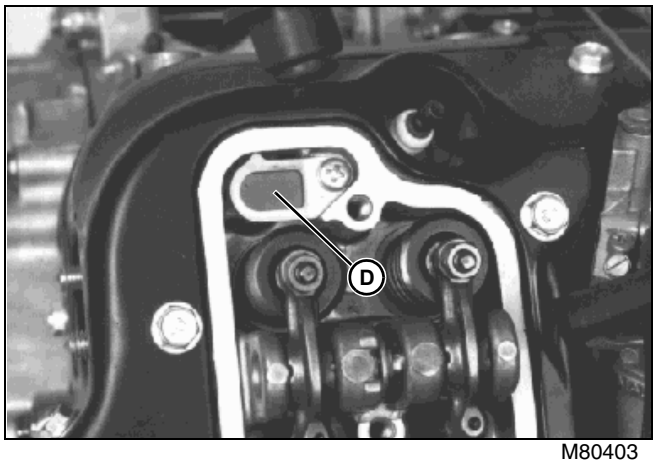
Crankcase Breather Inspection

1. Remove rocker arm cover and gasket.



M51757

2. Measure air gap between reed valve (A) and valve seat (B) at valve tip. Replace reed valve if gap is greater than 0.20 mm (0.008 in.) (C).

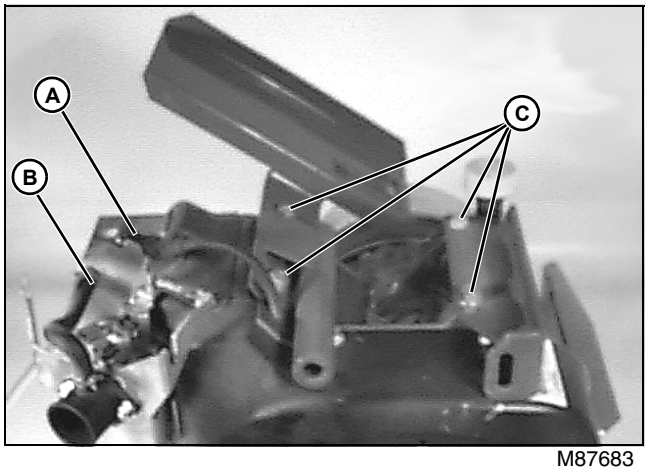


M80403

3. Remove breather valve assembly (D).
4. Inspect all parts for wear or damage. Replace as necessary.
5. Inspect valve seating surface. Surface must be free of nicks or burrs.
6. Install breather assembly.
7. Install rocker arm cover and gasket.

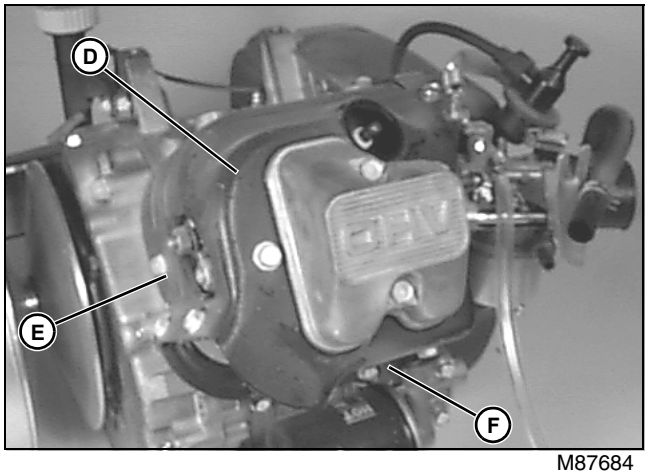
Blower Housing Removal and Installation

Removal



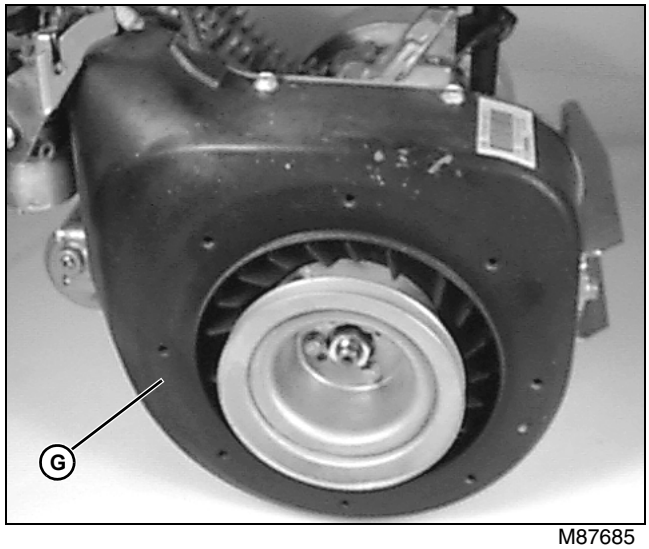
M87683

1. Disconnect spark plug lead (A) and breather hose (B).
2. Remove four cap screws and starting motor/generator brackets (C).



M87684

3. Remove six cap screws attaching blower housing section (D) and remove section.
4. Remove three cap screws attaching blower housing section (E) and remove section.
5. Remove three cap screws attaching blower housing section (F) and remove section.



M87685

6. Remove six cap screws attaching blower housing section (G) and remove section.

Installation

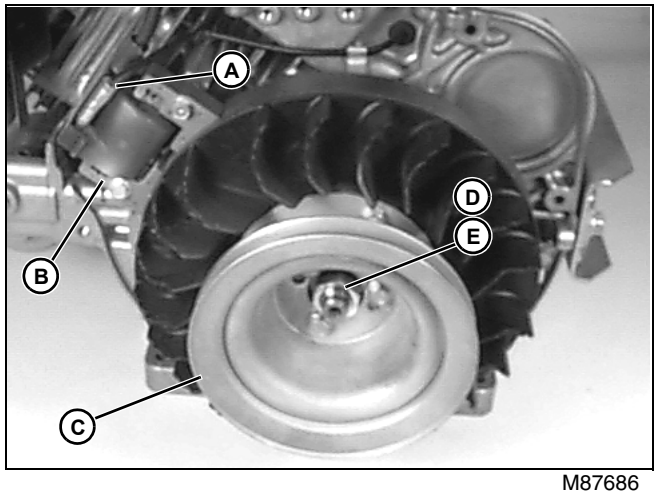
- Installation is done in reverse order of removal.
- Tighten generator adjustment bracket and generator pivot bracket to engine cap screws to 25 N•m (18.5 lb-ft).

Primary Clutch Removal and Installation

See “Primary Clutch Removal” on page 126 in Power Train section.

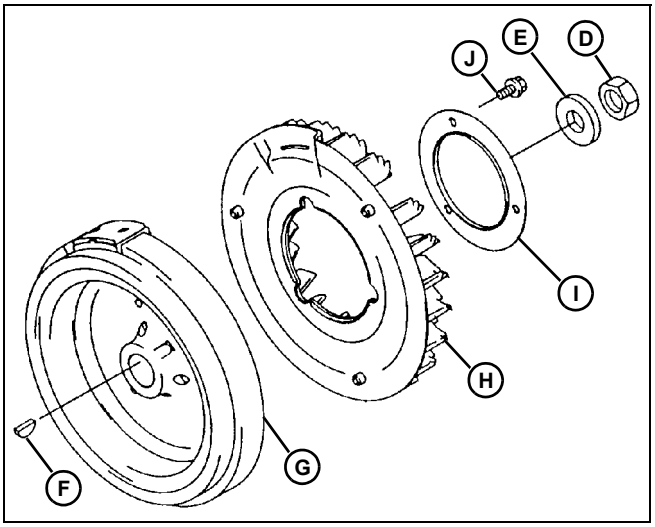
Flywheel Removal and Installation

Removal



M87686

1. Disconnect ignition wire (A) to coil, and remove coil (B).
2. Remove three cap screws and belt sheave (C).



M87728

3. Hold flywheel, and remove nut (D) and washer (E).
4. Remove flywheel using a puller set.
5. Remove shaft key (F).

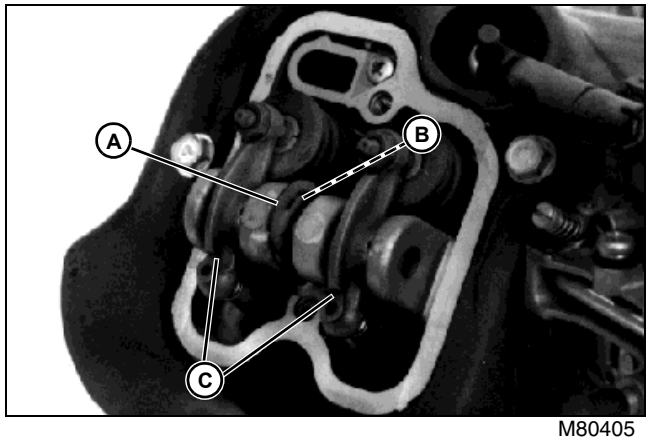
Engine FE290D-AS15 has assembled flywheel including cast flywheel (G), attached fan (H) and plate (I) and cap screws (J) (M6 X 10).

Installation

- Installation is done in reverse order of removal.
- Install washer (E) with concave side toward flywheel.
- Tighten flywheel nut (D) to 85 N•m (63 lb-ft).
- Install belt sheave and three cap screws. Tighten cap screws to 15 N•m (11 lb-ft).
- Install ignition coil. See “Armature With Coil Removal and Installation” on page 67.

Rocker Arm Removal and Installation

1. Remove rocker arm cover and gasket.
2. Turn crankshaft until piston is at its highest position in compression stroke until both valves are closed and all valve spring pressure is off of valve train.



M80405

3. Remove E-clip (A) from rocker shaft.
4. Remove rocker shaft, washer (B) and rocker arms (C).

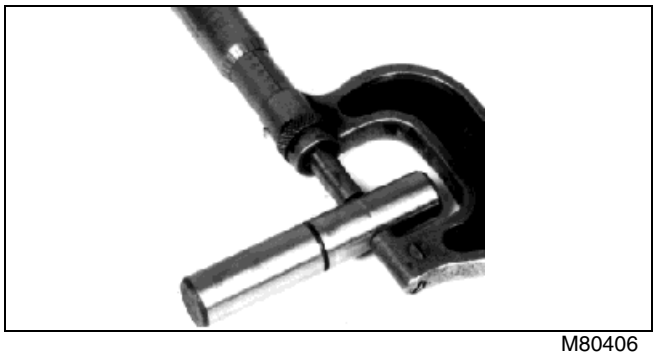
IMPORTANT: Avoid damage! Push rods must be installed in the same locations from which they were removed.

5. Put a mark on each push rod and cylinder head bore to aid in installation.
6. Remove push rods.

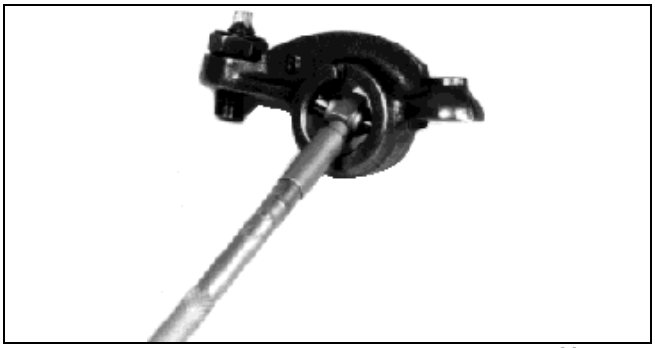
Installation is done in reverse order of removal.

- Check valve clearance when complete and adjust as needed. See “Valve Clearance Adjustment” on page 37.

Rocker Arm Inspection

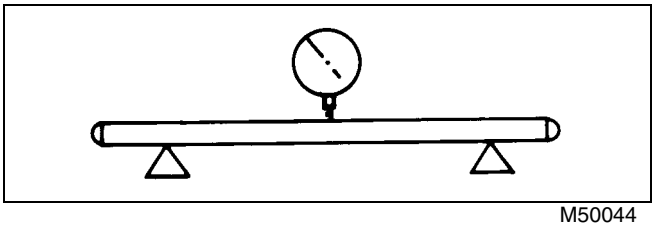

M80406

1. Measure outside diameter of rocker shaft. Replace shaft if OD is less than specification.



M80407

2. Measure inside diameter of rocker arms. Replace arms if ID is greater than specification.



M50044

3. Inspect push rods for bend using V-blocks and a dial indicator. Replace push rod if bend is greater than specification.

Specifications:

Rocker Shaft OD (minimum) . . . . . 11.95 mm (0.470 in.)
Rocker Arm ID (maximum) . . . . . 12.07 mm (0.475 in.)
Push Rod Bend (maximum). . . . . 0.30 mm (0.012 in.)

Cylinder Head Removal and Installation

Removal:

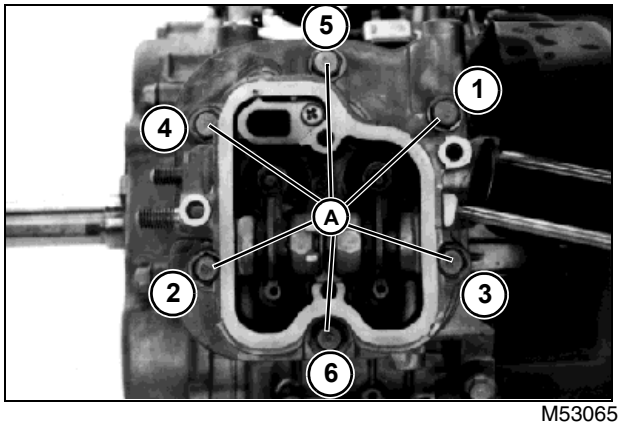
1. Remove blower housing, carburetor, rocker arm assembly, and spark plug.

2. Remove cap screws, cylinder head assembly and gasket.

3. Disassemble and inspect cylinder head and valves.

Installation:

1. Install a new gasket and cylinder head assembly.



M53065

2. Install cap screws (M8 x 45) (A), and tighten finger tight.

3. Tighten cap screws, in the sequence shown, in three stages of gradually-increasing torque.

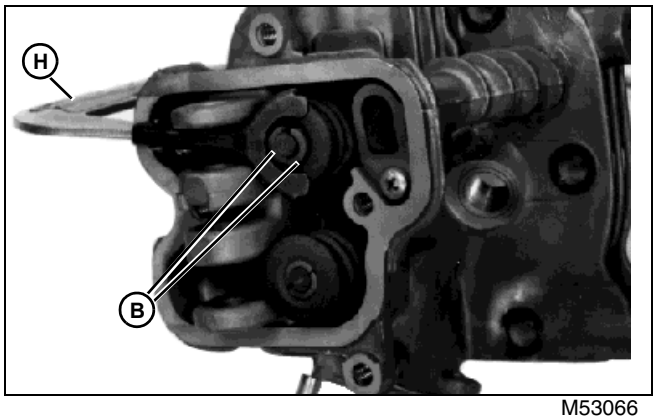
4. Install spark plug and tighten to 20 N•m (177 lb-in.).

5. Install rocker arm assembly, carburetor and blower housing.

Torque Specifications:

First . . . . . 18 N•m (159 lb-in.)
Second . . . . . 21 N•m (186 lb-in.)
Final. . . . . 24 N•m (212 lb-in.)

Cylinder Head Disassembly and Assembly

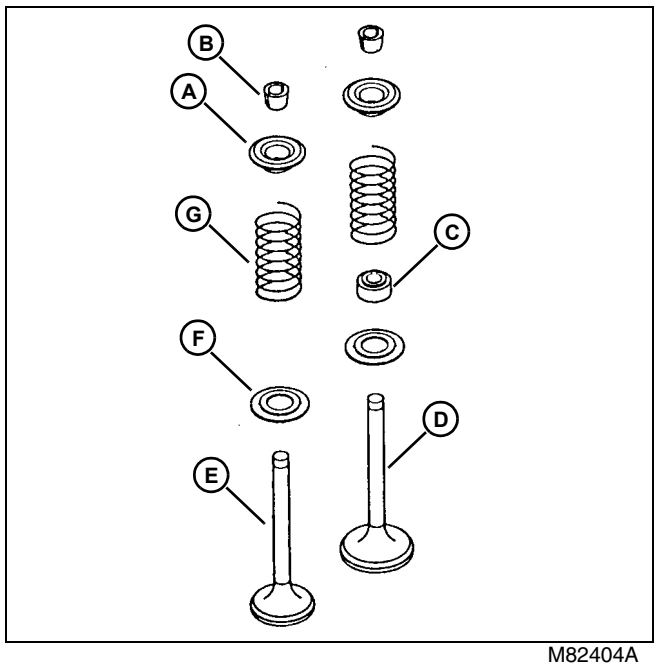


M53066

1. Compress valve springs using JDM70 Valve Spring Compressor (H) and remove collet halves (B).

IMPORTANT: Avoid damage! Spring seat for intake valve can only be removed with valve stem seal. Removal of seat or seal damages stem seal. If seal is not damaged, do not remove it.

2. Inspect intake valve stem seal for wear or damage.



M82404A

A - Retainer
B - Collet Halves
C - Stem Seal
D - Intake Valve
E - Exhaust Valve
F - Seat
G - Spring

3. Apply clean engine oil on intake and exhaust valve stems during assembly.

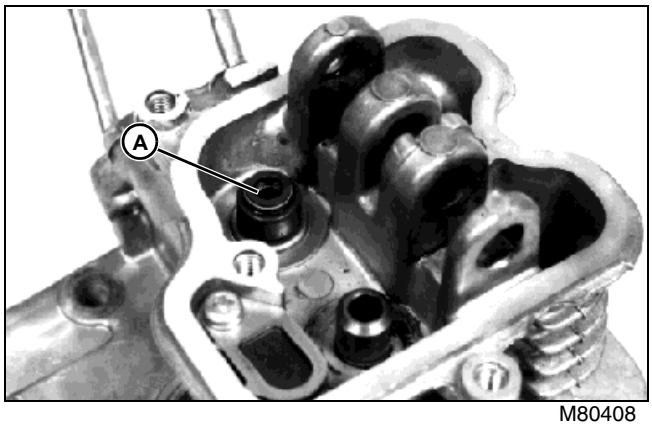
4. Install springs with smaller pitch end toward cylinder head.

5. After each valve has been assembled, tap on top of valve stem with a plastic hammer to seat retainer.

Cylinder Head Inspection and Replacement

Before inspection, thoroughly clean all components of carbon or dirt using solvent and SCOTCH-BRITE abrasive pads or an equivalent.

Intake Valve Stem Seal:



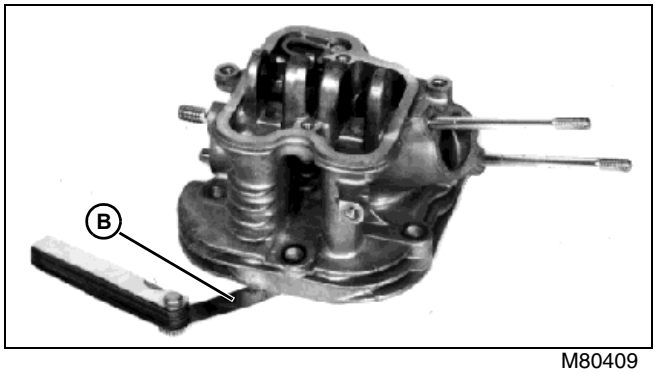
M80408

1. Inspect stem seal (A) for wear or damage. Remove stem seal using a screwdriver.

Cylinder Head:

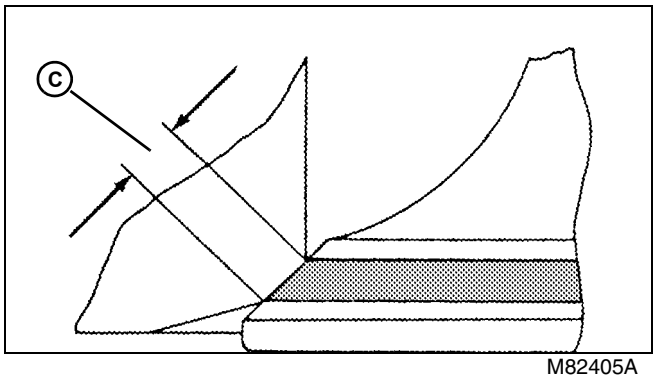
1. Inspect for cracks or broken cooling fins.

2. Check that oil drain back passages are not plugged.



M80409

3. Put head on a surface plate. Check for distortion at several points around head with feeler gauge (B). If distortion greater than 0.05 mm (0.002 in.), replace.

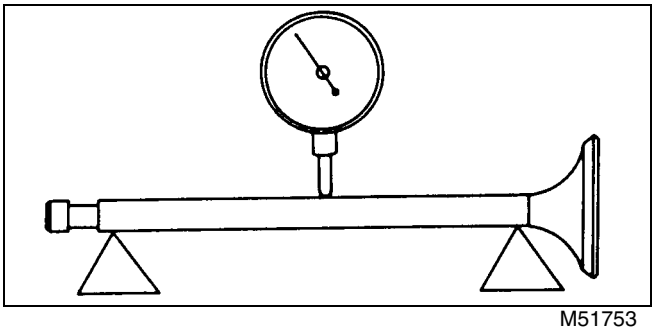


M82405A

4. Measure valve seat width. Inspect valve seat for wear or damage. If valve seat width is not within 0.50 - 1.10 mm (0.020 - 0.043 in.) (C), recondition valve seats.

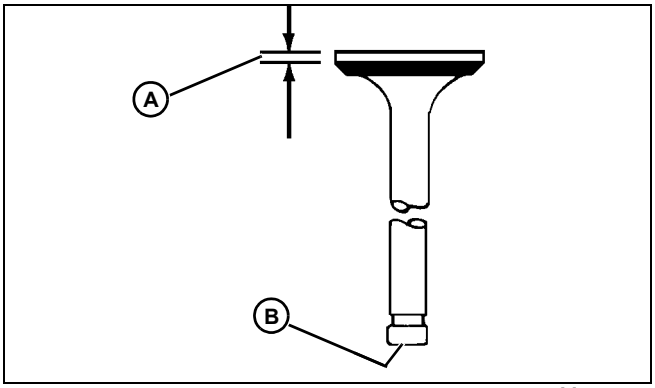
Intake and Exhaust Valves:

1. Analyze valves.



M51753

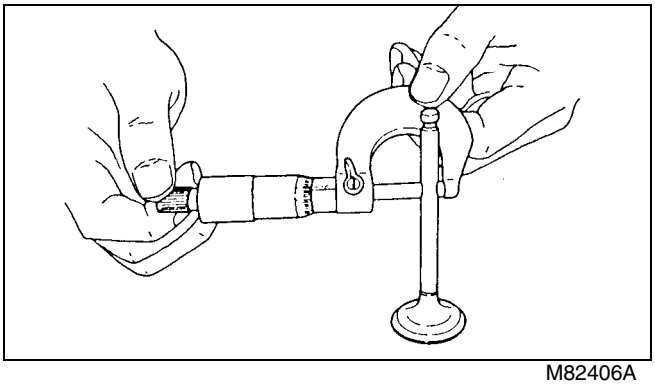
2. Inspect valve stem for bend using v-blocks and dial indicator. Turn valve slowly and read variation on indicator. If variation is greater than 0.03 mm (0.0012 in.) replace valve.



M38087

3. Remove carbon from valve head, face and stem. Check for defects. Measure face margin. If margin less than 0.60 mm (0.024 in.) (A), replace.

4. Check valve stem end (B) for uneven wear. If stem ends are uneven, grind ends square.



M82406A

5. Measure valve stem diameter in two directions at right angles, at four different positions. Replace if measurement is less than specifications.

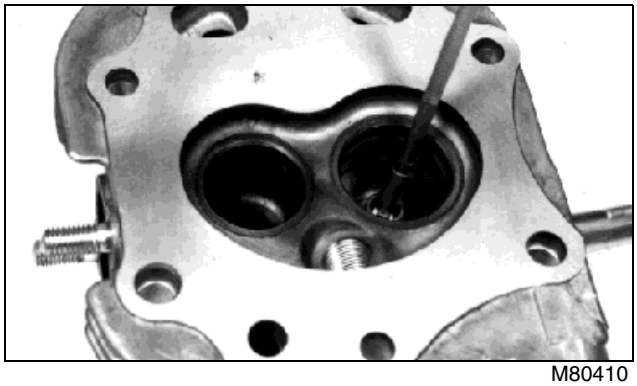
Specification:

Valve Stem OD (Wear Limit):

Intake Valve. . . . . 6.930 mm (0.2728 in.)
Exhaust Valve . . . . . 6.915 mm (0.2722 in.)

Valve Guides:

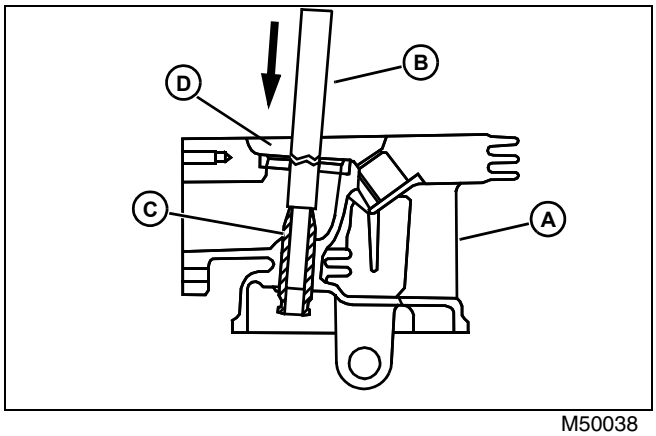
1. Clean valve guides using a valve guide brush and cleaner.



M80410

2. Measure inside diameter of valve guide bushings. If ID is greater than 7.065 mm (0.2781 in.), replace bushings.

To Replace Bushings:



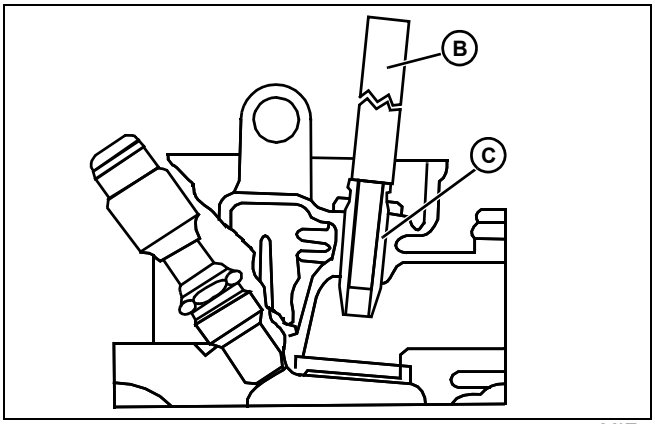
M50038

1. Invert cylinder head (A) and insert JDG504 Valve Guide Driver (B) into valve guide (C).

2. Drive valve guide out through top of cylinder head.

3. Clean carbon deposits from valve guide port (D).

NOTE: Place valve guide in dry ice before installation.



MIF

4. Install new bushing with JDG504 Valve Guide Driver. Drive in from top of cylinder head until bottom of groove on outside of guide is even with top of cylinder head.

5. Ream inside diameter of valve guide bushings with Stanisol or kerosene lubricant and 7 mm valve guide reamer. Ream bushings to finished ID of 7.00 - 7.015 mm (0.2756 - 0.2762 in.).

Valve Springs:

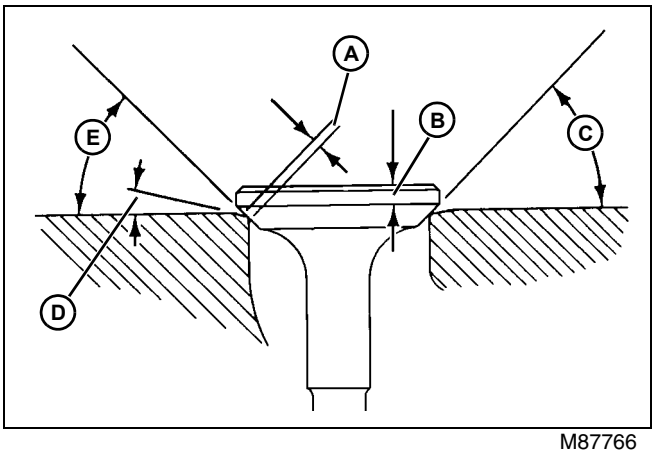
1. Measure spring free length. Replace spring if measurement is less than 32.75 mm (1.289 in.).

Recondition Valve Seats

1. 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.

2. To recondition valve seat, cut at 45° angle to clean up seat. Cut narrowing angle at 30°. Finish cut at 45° to establish seating surface width.

3. Cut valve seating surface as close as possible to specifications.



M87766

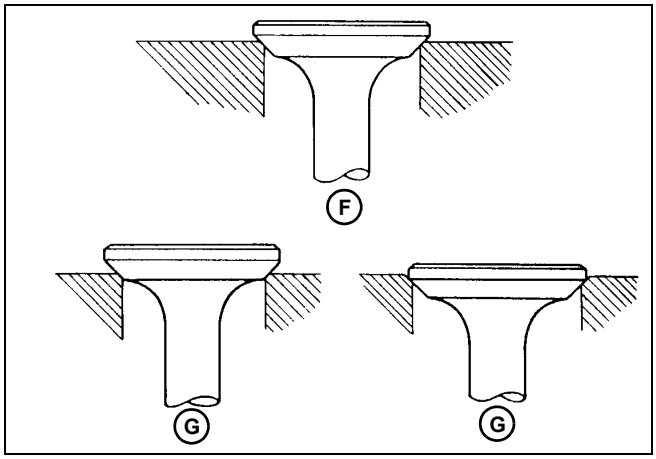
A - Valve Seating Surface Width
B - Valve Margin
C - Valve Face Angle
D - Valve Narrowing Angle
E - Valve Seat Angle

4. Lap valves to seats after refacing.

5. Center valve seat on valve face, note correct and incorrect positions.

6. Check seat for good contact:

- Apply a coat of Prussian Blue Compound to the valve face.
- Insert the valve and “snap” it closed against the seat several times.



M18615

- The valve seating surface should show good contact all the way around (F). If seat does not make proper contact (G), lap valves to seats.

Specifications:

Valve Seating Surface Width	**0.50 - 1.10 mm (0.020 - 0.043 in.)**
Valve Seat Angle	**45°**
Valve Face Angle	**45°**
Valve Margin	**0.60 mm (0.020 in.)**
Valve Narrowing Angle	**30°**

Lap Valves

1. If seat does not make proper contact, lap valve in seat.

2. Apply small amount of fine lapping compound to face of valve.

3. Grip top of valve with a vacuum cup tool. Turn valve to lap valve to seat.

4. Lift valve from seat every eight to ten strokes. Lap until uniform ring appears around surface of valve face.

M50041

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

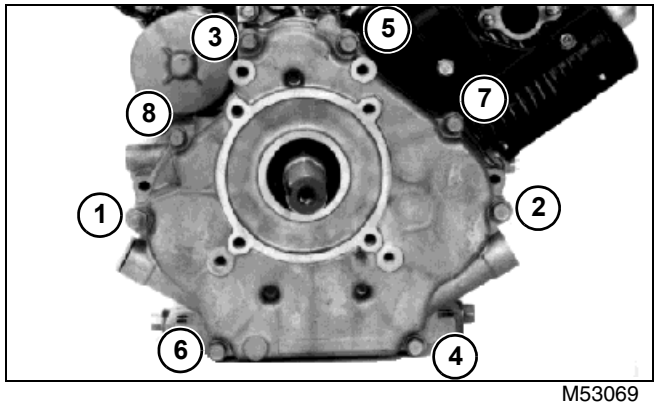
6. Check position of lap mark on valve face. Lap mark must be on or near center of valve face.

Crankcase Cover Removal and Installation

1. Remove drain plug and drain crankcase.

2. Remove crankcase cover and gasket.

NOTE: Do not force cover. Gears must mesh for proper positioning.



M53069

3. Install short end of mounting stud into block.

4. Tighten cap screws to specification using sequence shown.

Specifications:

Crankcase capacity (approximate):

Without filter . . . . . 1.1 L (2.3 pt)

With filter . . . . . 1.4 L (3.0 pt)

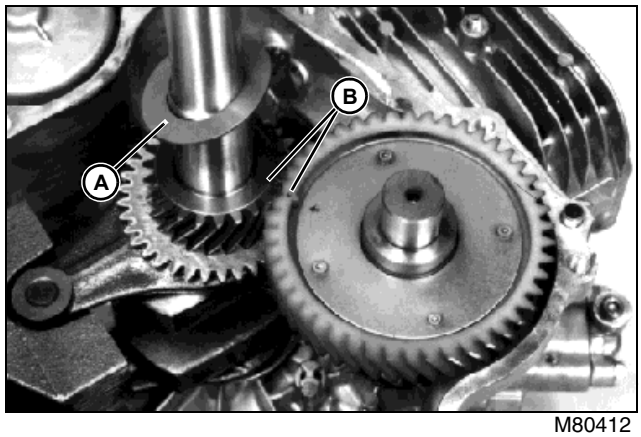
Torque Specifications:

Mounting Stud . . . . . 26 N•m (230 lb-in.)

Mounting Cap Screws . . . . . 26 N•m (230 lb-in.)

Oil Drain Plug . . . . . 21 N•m (186 lb-in.)

Camshaft Removal and Installation



M80412

1. Remove crankcase cover and crankshaft shim(s) (A).

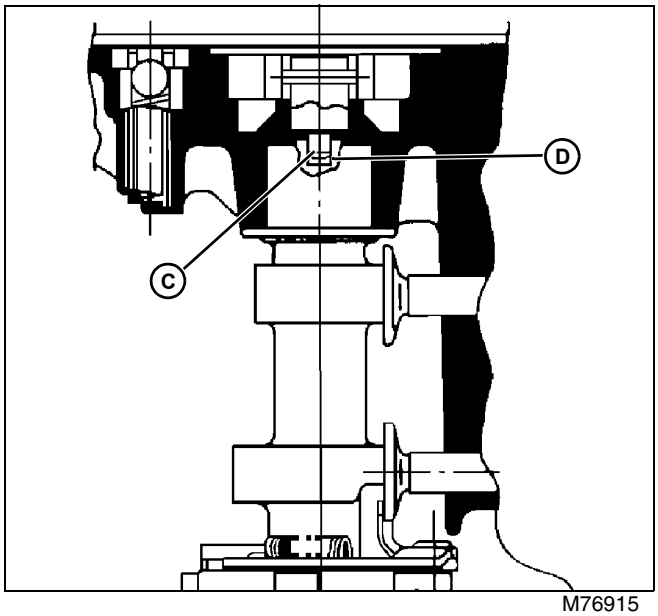
IMPORTANT: Avoid damage! Turn engine upside down and align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (B) align.

3. Remove camshaft.

Installation is done in reverse order of removal.

CAUTION: Avoid Injury! Be sure and remove the oil pump before camshaft installation. If the oil pump tang (C) does not fit into the slot (D) in the end of the camshaft, serious engine damage will result



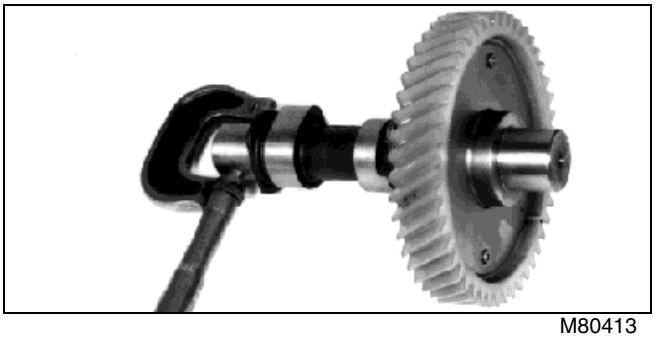
M76915

4. Apply clean engine oil to camshaft lobes, journals, and tappet guides before installation.

Camshaft Inspection

1. Inspect camshaft for worn or broken teeth.

NOTE: Camshaft and tappets are a matched set. Replace both, if necessary.

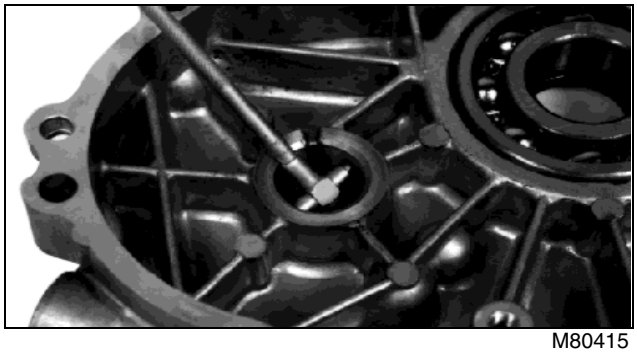


M80413

2. Measure side journal diameters and lobe height. If measurements are less than specifications, replace.

M80414

3. Measure camshaft bearing diameter in cylinder block. If bearing ID is greater than 23.06 mm (0.908 in.), replace block.



M80415

4. Measure camshaft bearing diameter in crankcase cover. If bearing ID is greater than 23.06 mm (0.908 in.), replace cover.

Camshaft Specifications (Wear Limit):

PTO and Flywheel Side

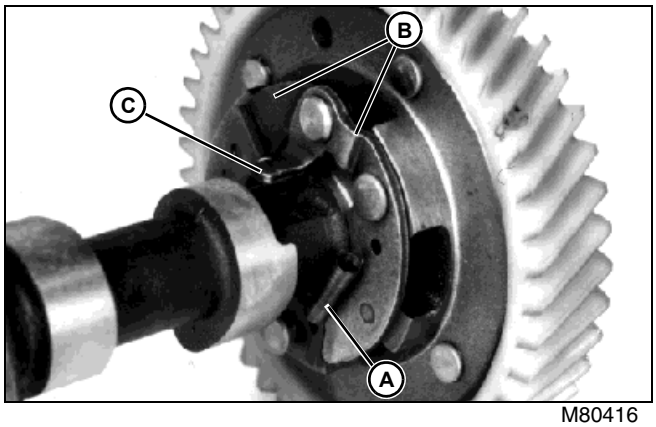
Journal OD . . . . . 22.93 mm (0.903 in.)
Cam Lobe Height . . . . . 32.70 mm (1.287 in.)

Automatic Compression Release

Inspection/Replacement:

1. Remove camshaft. See “Camshaft Removal and Installation” on page 55.

2. Inspect A.C.R. mechanism for wear or damage.



M80416

3. Inspect spring (A) for wear or damage. Replace if necessary.

4. Move weights (B) by hand to check for proper operation. Check that top of tab (C) is slightly above cam lobe when weights are pulled fully outward. Tab should drop below cam lobe when weights are fully retracted.

CAUTION: Avoid Injury! Be sure to remove the oil pump before camshaft installation. If the oil pump tang does not fit into the slot in the end of the camshaft, serious engine damage will result. See “Camshaft Removal and Installation”.

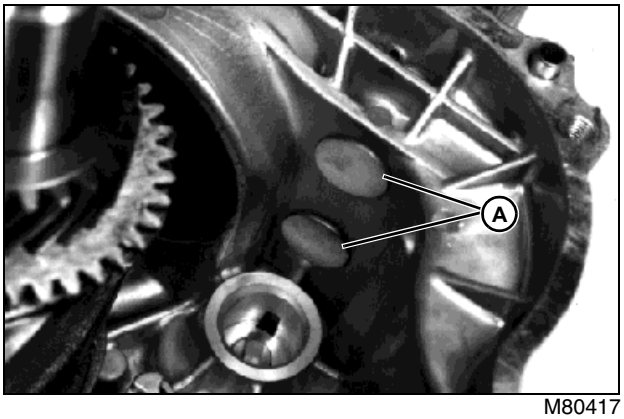
5. Replace camshaft assembly if A.C.R. does not operate properly.

Tappets Inspection and Replacement

1. Remove camshaft. See “Camshaft Removal and Installation” on page 55.

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

2. Put a mark on each tappet and cylinder block bore to aid in installation.



M80417

3. Remove tappets (A). Inspect tappets for wear or damage.

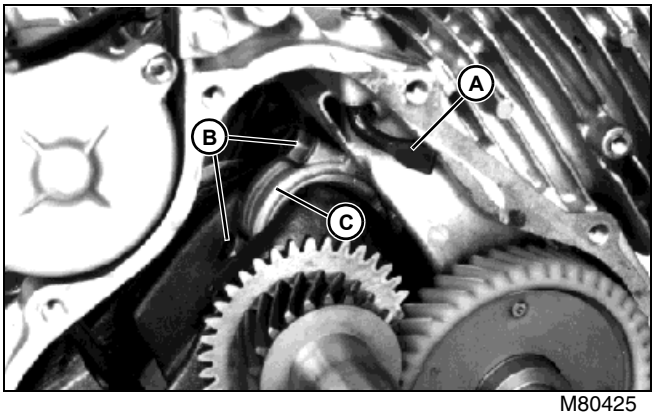
4. Apply clean engine oil to tappets and bores.

Piston and Connecting Rod

Removal and Installation:

1. Remove cylinder head.

2. Remove crankcase cover.



M80425

3. Loosen governor arm nut and rotate governor shaft (A) 180°.

4. Remove carbon and varnish from top of cylinder bore with a ridge reamer, if necessary.

5. Remove cap screws (B) and connecting rod cap (C).

6. Push piston and connecting rod from cylinder bore.

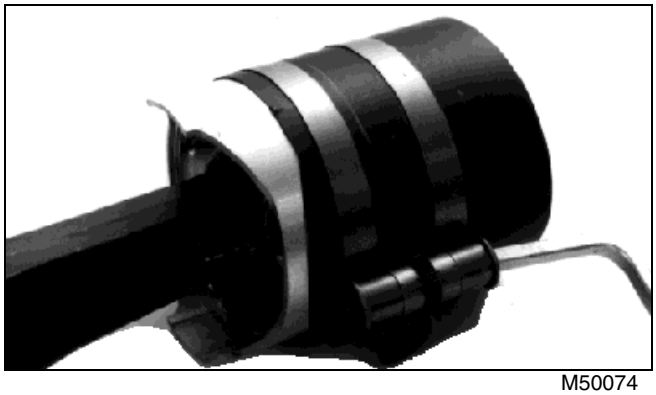
7. Disassemble and inspect all parts for wear or damage.

   - Apply clean engine oil on all parts during installation.

8. If new piston rings installed, deglaze cylinder.

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

10. Compress piston rings with a ring compressor.


M50074

11. Install piston and connecting rod assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.

12. Install connecting rod cap and cap screws. Tighten cap screws to 20 N•m (177 lb-in.).

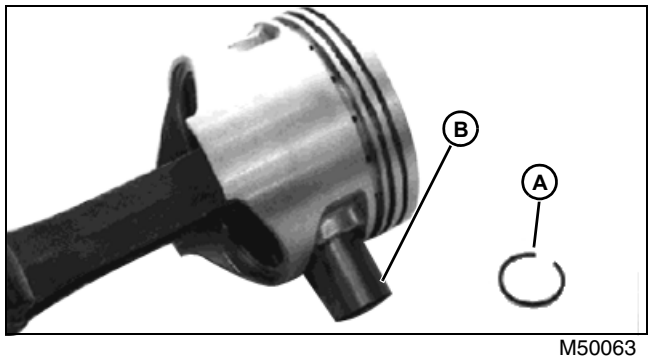
13. Rotate governor shaft 180° and tighten nut.

14. Install crankcase cover and cylinder head.

Disassembly:

1. Analyze piston and piston ring wear.

2. Remove piston rings using a piston ring expander.



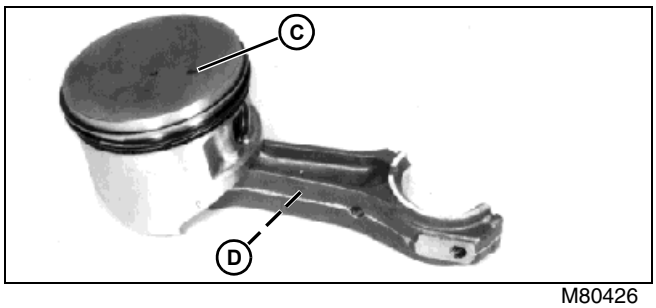
M50063

3. Remove circlip (A), piston pin (B) and connecting rod.

4. Inspect all parts for wear or damage.

Assembly:

1. Apply clean engine oil to all parts during assembly.

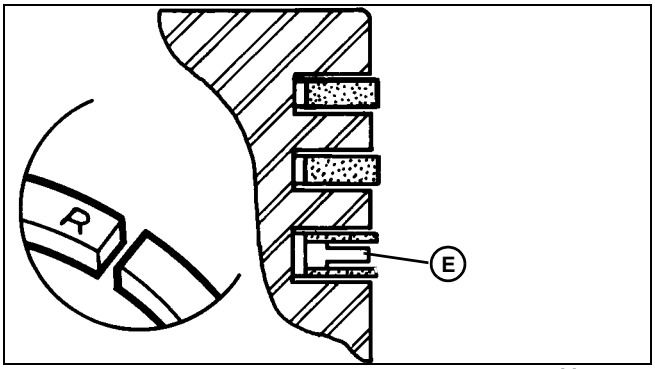


M80426

2. Assemble piston to rod with arrow mark (C) on piston

opposite “MADE IN JAPAN” (D) on rod.

3. Install piston pin and circlip.



M80429

4. Oil ring is an assembly. Install spacer (E), then side rails in bottom ring groove of piston. Put side rail end gaps 180° apart.

5. Install compression rings with R or NPR mark facing up.

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

Inspection:

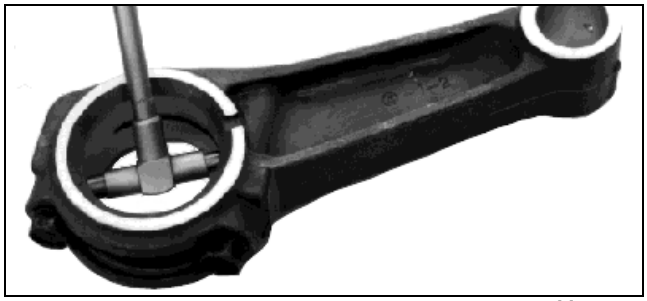
1. Inspect all parts for wear or damage.

2. Measure crankshaft connecting rod journal diameter.

3. Analyze connecting rod and crankshaft wear.

4. Install connecting rod cap. Tighten cap screws to 20 N•m (177 lb-in.).

NOTE: If engine has had a previous overhaul, undersized rod may have been installed, 0.50 mm (0.020 in.) undersize rod is available.



M50066

5. Measure connecting rod crankshaft bearing and piston pin bearing diameters.

Connecting Rod Bearing ID (Wear Limit):

Crankshaft Bearing Standard . . . . 35.57 mm (1.400 in.)

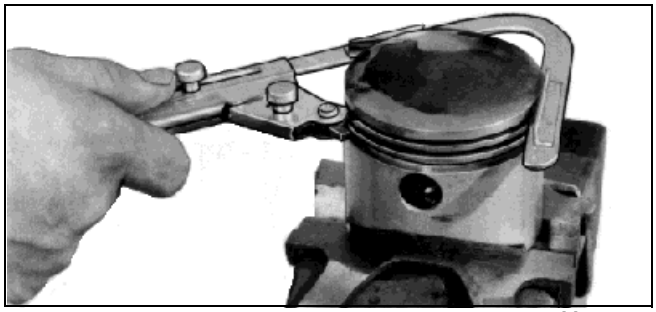
Undersized . . . . . 35.07 mm (1.380 in.)

Piston Pin Bearing . . . . . 19.06 mm (0.750 in.)

NOTE: Replace connecting rod if either measurement is greater than specifications.

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

6. Remove all deposits from the piston.



M29946

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

8. Check that oil return passages in the grooves are open.

M38102

9. Measure piston ring groove clearance. Measure several places around piston.

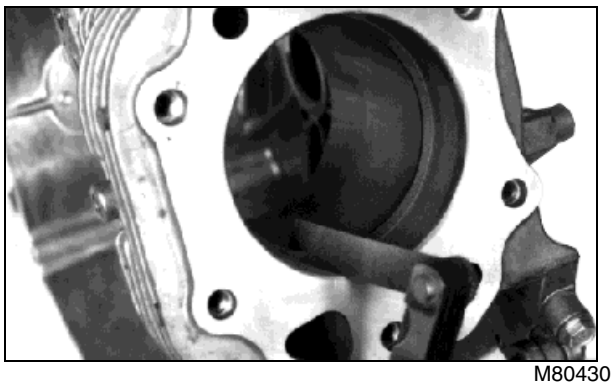
Piston Ring Groove Clearance (Wear Limit):

First Compression Ring . . . . . 0.16 mm (0.006 in.)

Second Compression Ring . . . . . 0.14 mm (0.005 in.)

Oil Ring Assembly . . . . . Not Measured

NOTE: Replace piston if clearance is greater than specification.



M80430

10.Measure piston ring end gap. Push ring into cylinder bore, using a piston, until ring is approximately 25.4 mm (1 in.) down from top of cylinder bore.

Piston Ring End Gap (Wear Limit):

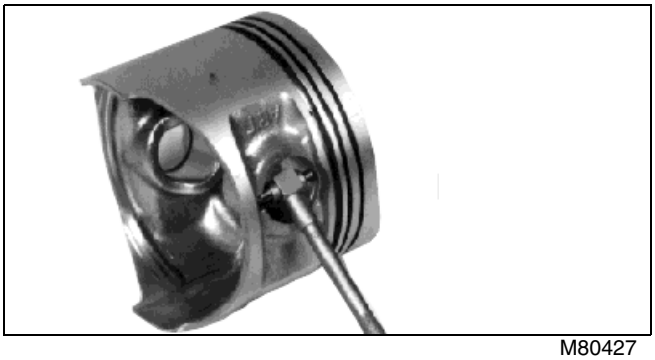
Compression Rings . . . . . 1.20 mm (0.047 in.)

Oil Ring Assembly . . . . . .Not Measured

NOTE: Replace ring if end gap is greater than specifications.

M50064

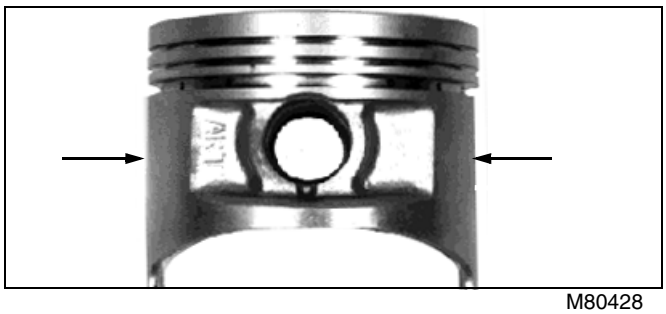
11.Measure piston pin diameter. Replace pin if diameter is less than 18.98 mm (0.747 in.).



M80427

12.Measure piston pin bore diameter. Replace piston if diameter is greater than 19.03 mm (0. 749 in.).

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



M80428

13.Measure piston diameter perpendicular to piston pin bore.

Piston OD:

Standard . . . . . 77.85 - 77.87 mm (3.0649 - 3.0657 in.)

Oversize 0.50 mm
(0.020 in.). . . . . 78.35 - 78.37 mm (3.0849 - 3.0857 in.)

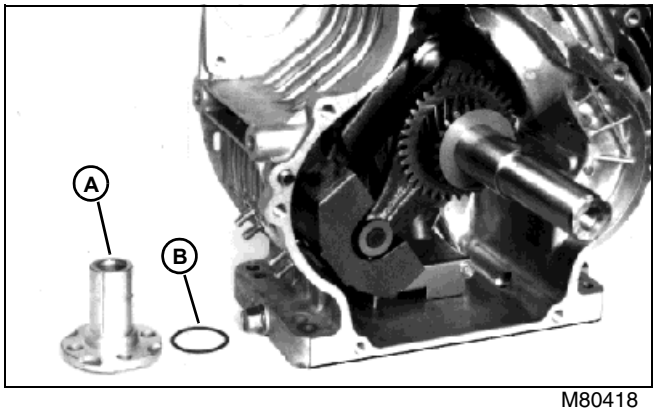
NOTE: Replace piston if diameter not within specifications.

14.Measure cylinder bore diameter. See “Cylinder Bore ID:” on page 63.

Reciprocating Balancer

Removal and Installation:

1. Remove flywheel, camshaft, and piston.
2. Remove four nuts, support shaft (A) and O-ring (B).
3. Remove crankshaft with balancer assembly.



M80418

4. Disassemble and inspect balancer assembly.
5. Inspect oil seals.

Installation is done in reverse order of removal.

1. Cover keyway on flywheel end of crankshaft with tape to prevent damage to oil seal when installing assembly.

2. Apply clean engine oil to crankshaft bearing surfaces and all components during assembly.

3. Check and adjust crankshaft end play.

Disassembly/Assembly:

1. Inspect crankshaft for wear or damage.

2. Inspect balancer assembly for wear or damage.

3. Apply clean engine oil on all components during assembly.

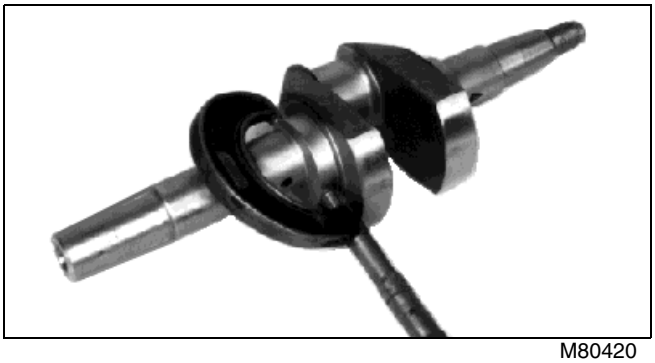
4. Install collar with flat face toward link rod.

5. Install governor drive gear with chamfered face toward link rod.

6. Install crank gear with flat face toward governor drive gear.

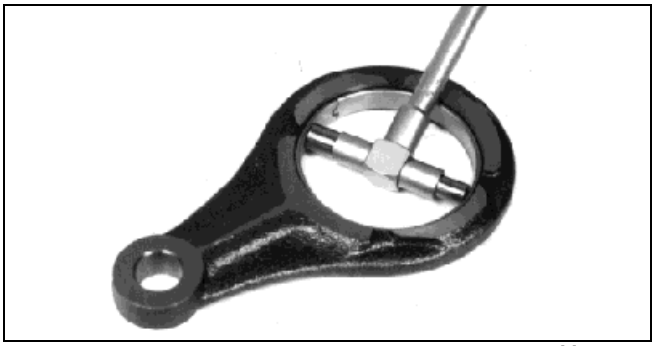
Inspection/Replacement:

1. Clean and inspect all parts for wear or damage. Replace as necessary.



M80420

2. Measure link rod journal diameters on crankshaft. If journal OD is less than 46.86 mm (1.845 in.), replace crankshaft.

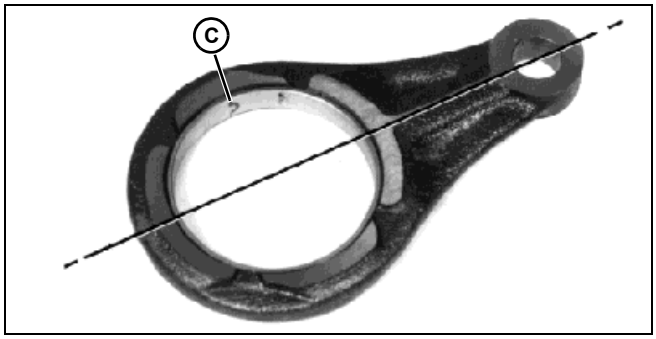


M80421

3. Measure inside diameter of link rod bearings. If link rod small end ID is more than 12.06 mm (0.475 in.), replace link rod. If link rod large end ID is more than 47.12 mm (1.855 in.), replace link rod bushing.

To replace link rod bushing:

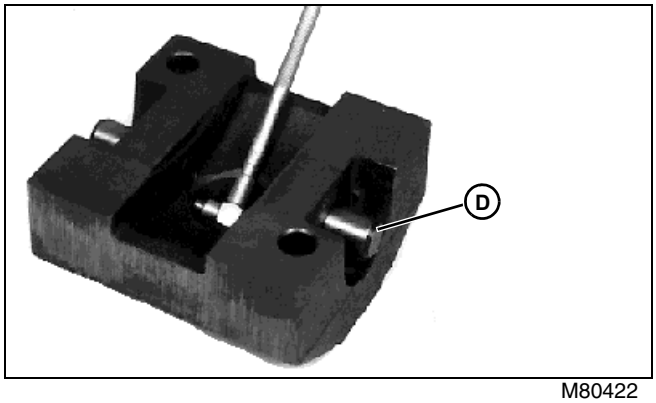
1. Replace bushing using a driver set and a press.



M80424

2. Install bushing with seam (C) at a 90° angle to rod centerline.

3. Install bushing 1.00 mm (0.040 in.) below link rod surface.



M80422

4. Measure support shaft bearing diameter in balancer weight. If bearing ID is more than 26.10 mm (1.027 in.), replace balancer weight.

5. Inspect wrist pins (D) for wear or damage.

M80423

6. Measure support shaft diameter. If shaft OD is less than 25.93 mm (1.021 in.), replace shaft.

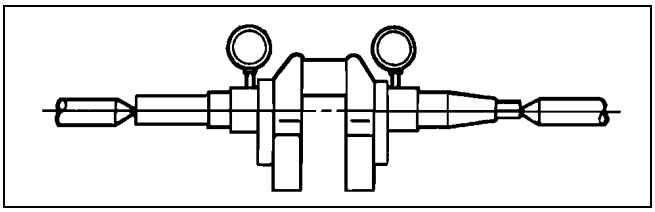
Crankshaft Removal and Installation

1. Check crankshaft end play.
2. Remove balancer.
3. Remove balancer assembly from crankshaft.
4. Inspect crankshaft for wear or damage.

Installation is done in reverse order of removal.

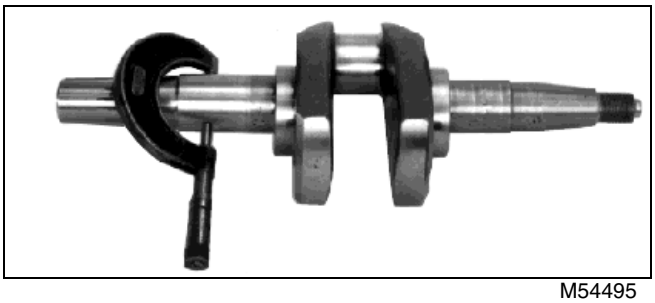
Crankshaft Inspection

1. Analyze crankshaft and connecting rod wear.



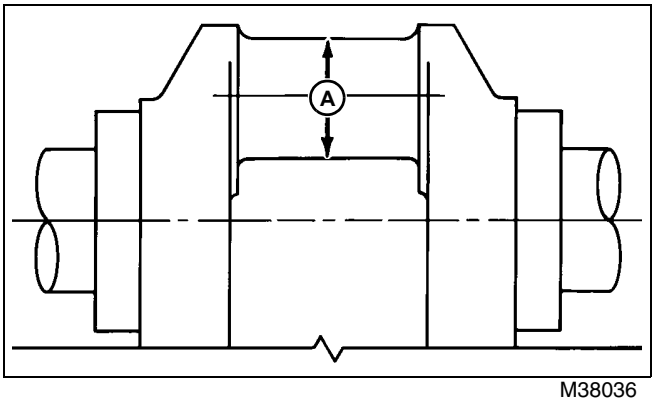
M80432

2. Inspect crankshaft for bend. Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators to measure maximum total indicated runout (TIR). If TIR is greater than 0.05 mm (0.002 in.), replace crankshaft.



M54495

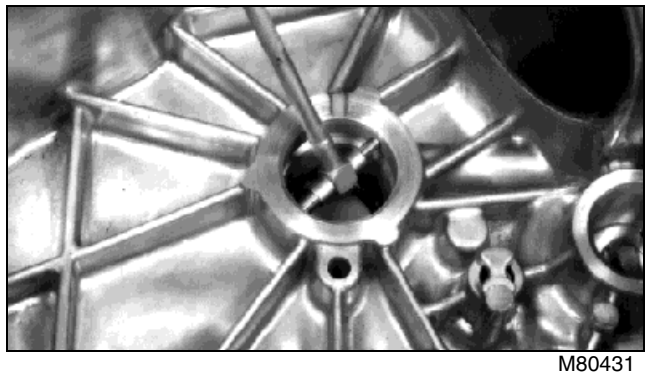
3. Measure crankshaft main bearing journal diameters. If either journal OD is less than 29.92 mm (1.178 in.), replace crankshaft.



M38036

4. Measure connecting rod journal diameter (A).

NOTE: If engine has had a previous overhaul, connecting rod journal may have been resized for undersized rod. 0.50 mm (0.020 in.) undersize rod available.



M80431

5. Measure crankshaft main bearing diameter in crankcase. Replace crankcase if diameter is greater than 30.08 mm (1.184 in.).

6. Inspect crankshaft main ball bearing in crankcase cover for wear or damage:

- Remove crankcase cover oil seal.
- Remove bearing using a driver set.
- Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
- Spin bearing check for axil and radial free play.
- Replace bearing if it is noisy or has too much play.
- Install bearing flush to inside of crankcase cover using a driver set.

Results:

- If standard journal diameter is less than specifications, have journal ground undersized by a qualified machine shop. Before sending for grinding, inspect journal radii for cracks.
- If undersized journal diameter is less than specifications, replace crankshaft.

Specifications:

Connecting Rod Journal OD (Wear Limit):

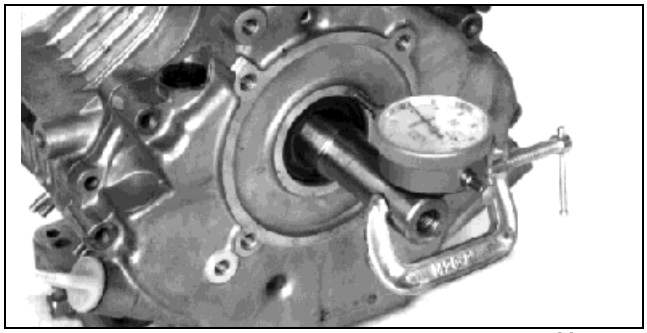
Standard . . . . . 35.43 mm (1.395 in.)
Undersized . . . . . 34.93 mm (1.375 in.)

Crankshaft End Play Check

1. Fasten dial indicator to crankshaft and position indicator tip on crankcase cover.

2. Move crankshaft in and out, then pull crankshaft as far as it can go.

3. Zero the dial indicator.



M80433

4. Push crankshaft in as far as possible. If end play is not within 0.09 - 0.22 mm (0.004 - 0.009 in.), adjust end play.

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.

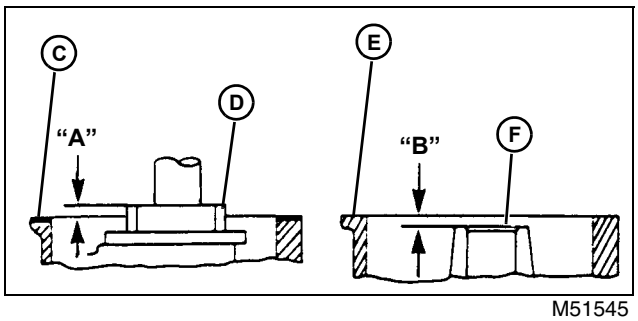
When the rod and cap seize to the crankshaft, the connecting rod and piston may both break causing other internal damage. Inspect block carefully before rebuilding engine.

Crankshaft and connecting rod damage can result from:

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

Crankshaft End Play Adjustment

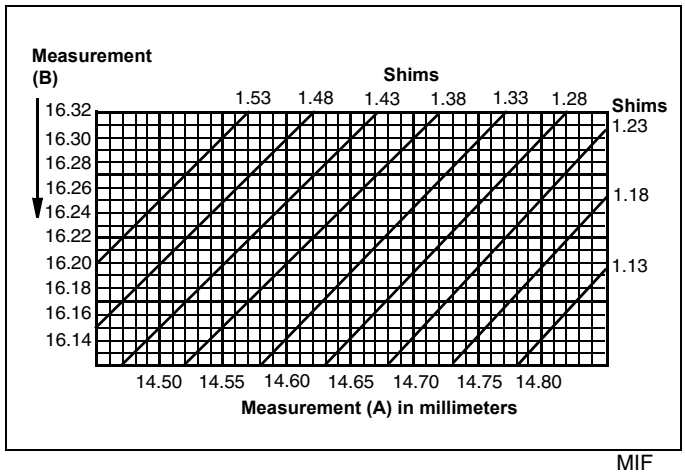
1. Remove crankcase cover.



M51545

2. With gasket (C) installed on crankcase, measure from gasket surface to crankshaft gear surface (D). Record this measurement as "A".

3. Measure from crankcase cover mounting face (E) to PTO bearing end (F). Record this measurement as "B".



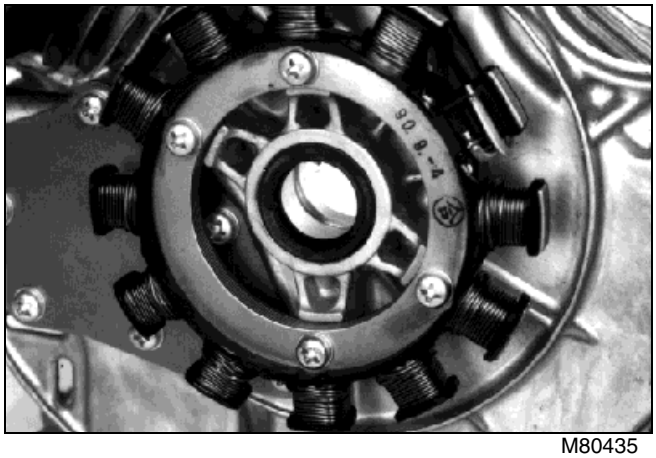
MIF

4. Locate measurements on appropriate table. Follow lines to where recorded measurements intersect. Choose the next smaller shim from the table.

5. Install shim(s) on end of crankshaft.

Crankshaft Oil Seal - Flywheel End Replacement

1. Remove crankshaft.



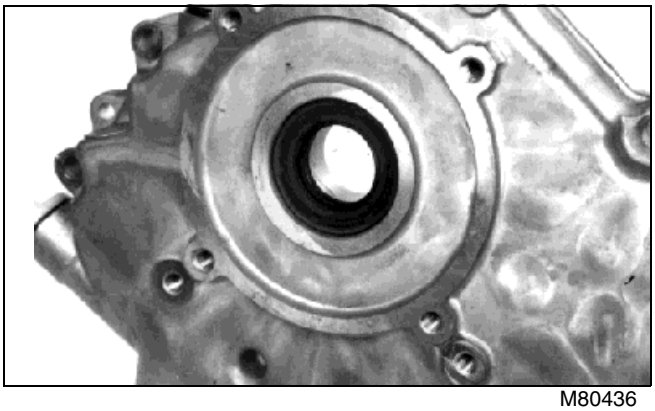
M80435

2. Remove worn or damaged seal using a screwdriver. Install seal with lip toward inside of engine using a driver set. Press in seal until flush with hub.

3. Pack lithium base grease inside lips of seal.

Crankshaft Oil Seal - PTO End Replacement

1. Remove crankcase cover.



M80436

2. Remove worn or damaged seal using a screwdriver. Install seal with lip toward inside of cover using a driver set. Press in seal 4 mm (0.158 in.) below cover flange surface.

3. Pack lithium base grease inside lips of seal.

Cylinder Block Inspection

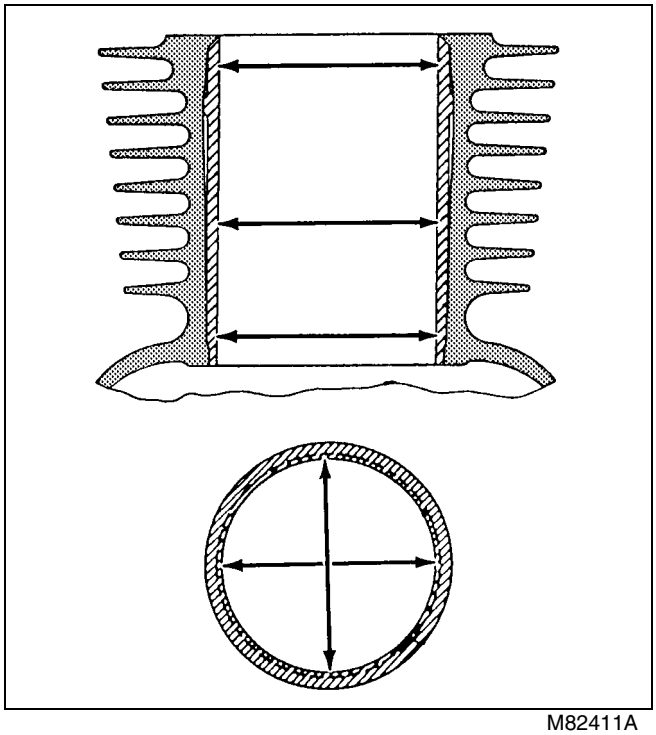
1. Remove crankshaft.

2. Clean and check block for cracks.

3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.

4. Wipe areas 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 cracks found.

NOTE: A bare block is available for service.



M82411A

5. Measure cylinder bore diameter at three positions; top, middle and bottom. At these three positions, measure in both directions; along crankshaft center line and direction of crankshaft rotation.

NOTE: If engine has had a previous overhaul, oversize piston/ rings may have been installed.

Results:

- If cylinder bore exceeds wear limit, replace cylinder block or have cylinder rebored.
- If cylinder is rebored, oversize pistons and rings must be installed. Pistons and rings are available in 0.25, 0.50 and 0.75 mm (0.010, 0.020 and 0.030 in.) oversize.

Cylinder Bore ID:

Standard Size Bore:
Standard . . . . . 77.98 - 78.00 mm (3.070 - 3.071 in.)
Wear Limit. . . . . 78.07 mm (3.074 in.)
Out-of-Round (Maximum) . . . . . 0.056 mm (0.0022 in.)
0.50 mm (0.020 in.) Oversize Bore:
Standard . . . . . 78.46 - 78.48 mm (3.089 - 3.090 in.)
Wear Limit. . . . . 78.55 mm (3.093 in.)

Cylinder Deglazing

IMPORTANT: Avoid damage! If cylinder bores are to be deglazed with crankshaft installed in engine, put clean shop towels over crankshaft to protect journal and bearing surfaces from any abrasives.

1. Deglaze cylinder bores using a rigid hone with 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 bores. Solvents will not remove all abrasives from cylinder walls.

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

Cylinder Reboring

NOTE: Cylinder block can be rebored to use 0.50 mm (0.020 in.) oversize pistons and rings.

1. Align center of bore to drill press center.

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

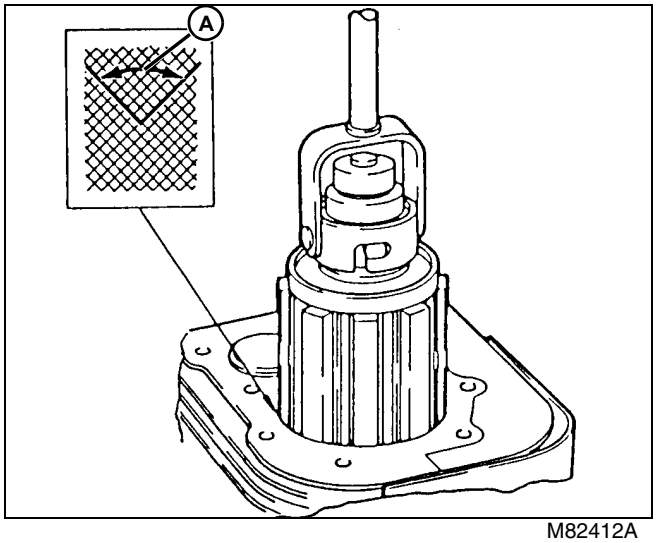
2. Adjust hone so lower end is even with lower end of cylinder bore.

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

4. Coat cylinder with honing oil. Hone should turn by hand. Adjust if too tight.

5. Run drill press at about 250 RPM. Move hone up and down in cylinder approximately 20 times per minute.

NOTE: Measure bore when cylinder is cool.



M82412A

6. Stop press and check cylinder diameter.

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

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

8. Hone the cylinder an additional 0.028 - 0.030 mm (0.0011 - 0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: Avoid damage! Do not use solvents to clean cylinder bore. Solvents will not remove all metal particles and abrasives produced during honing.

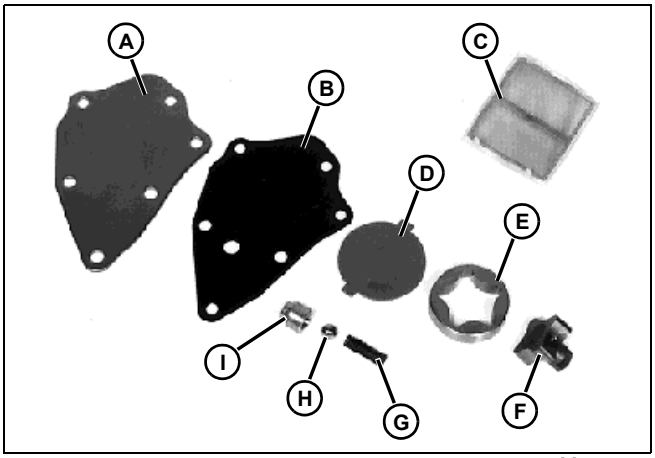
9. Clean cylinder thoroughly using warm soapy water until clean white rags show no discoloration.

10. Dry cylinder and apply engine oil.

Oil Pump Disassembly and Assembly

1. Remove stator, pump cover, gasket, rotor, outer rotor, rotor shaft, relief valve, check ball and spring.

NOTE: To inspect or clean oil screen, remove crankcase cover. See "Crankcase Cover Removal and Installation" on page 55.



M80438

A - Pump Cover
B - Gasket
C - Oil Screen
D - Rotor Cover
E - Outer Rotor
F - Rotor Shaft
G - Spring
H - Check Ball
I - Relief Valve

2. Inspect all parts for wear or damage.

Assembly is done in reverse order of disassembly.

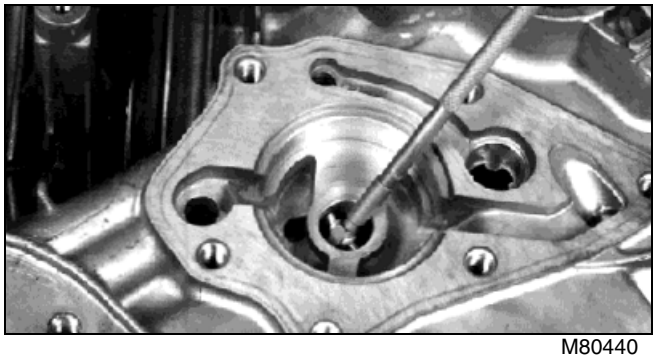
- Apply clean engine oil on all internal parts during assembly.

Oil Pump Inspection

Clean and inspect all parts for wear or damage.

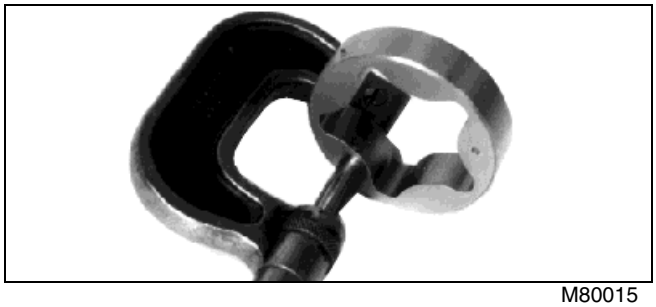
m80439

- Measure rotor shaft diameter. If shaft OD is less than 12.63 mm (0.497 in.), replace both shaft and outer rotor.



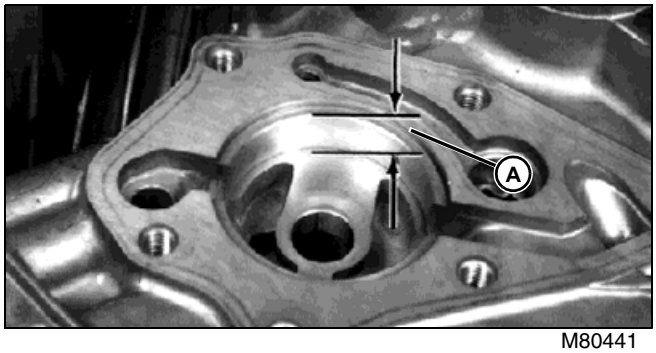
M80440

- Measure rotor shaft bearing. If bearing ID is greater than 12.77 mm (0.503 in.), replace cylinder block.



M80015

- Measure thickness of outer rotor. If thickness is less than 9.92 mm (0.391 in.), replace both outer rotor and rotor shaft.

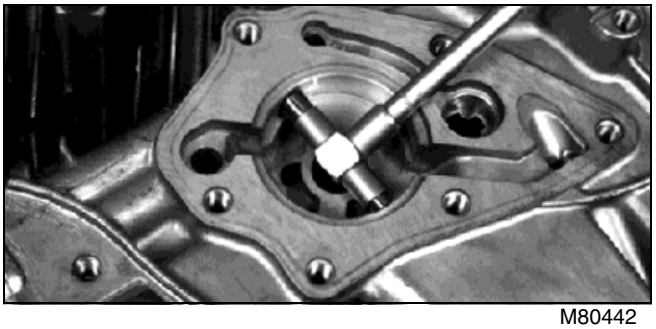


M80441

- Measure outer rotor bearing depth. If depth is greater than 10.17 mm (0.400 in.) (A), replace cylinder block.

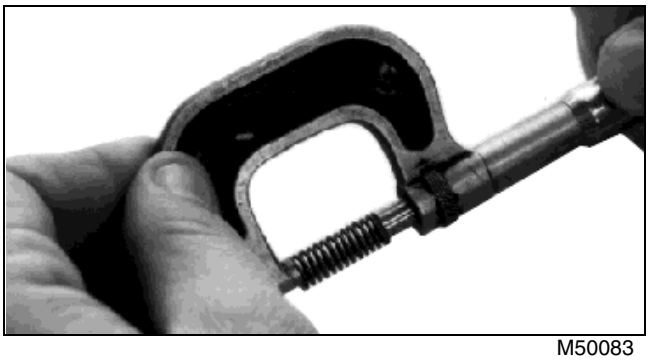
M80017

- Measure outer rotor diameter. If shaft OD is less than 40.47 mm (1.596 in.), replace both rotor and rotor shaft.



M80442

• Measure outer rotor bearing. If bearing ID is greater than 40.77 mm (1.605 in.), replace cylinder block.

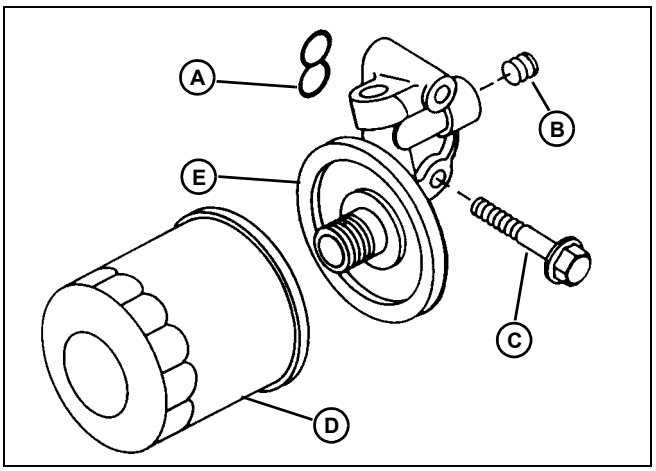


M50083

• Measure relief valve spring free length. Replace spring if measurement is less than 19 mm (0.748 in.).

Oil Filter Manifold Removal and Installation

NOTE: Not all engines are equipped with oil filter manifold

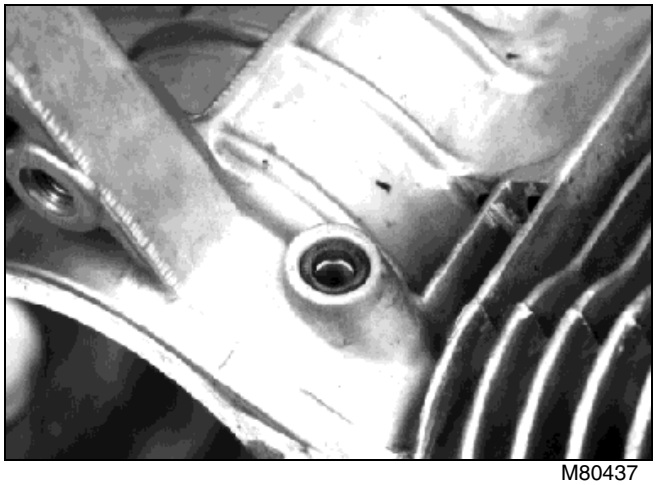


M80443

A - Gasket
B - Plug
C - Mounting Cap Screw (2) M6 X 40
D - Oil Filter
E - Oil Filter Manifold

Governor Shaft Oil Seal Replacement

1. Remove governor shaft.



M80437

2. Remove worn or damaged seal using a screwdriver. Install seal with lip toward inside of engine using a driver set. Press in seal 1.42 mm (0.056 in.) below flange surface.
3. Pack lithium base grease inside lips of seal.

Governor Inspection and Replacement

1. Remove crankcase cover.

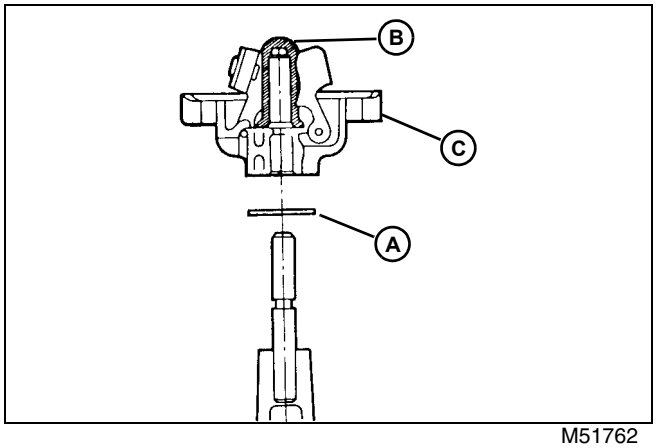
IMPORTANT: Avoid damage! Removal damages governor. If not damaged, do not remove.

2. Inspect governor for wear or damage.

To replace governor:

• Remove governor with a screwdriver.

• If shaft is removed, press back into cover until it protrudes 32.2 - 32.8 mm (1.267 - 1.291 in.).



M51762

• Install washer (A) and sleeve (B) onto governor gear.

• Install governor gear (C) onto shaft. Push down on governor assembly until it snaps into place.

Governor Shaft Inspection and Replacement

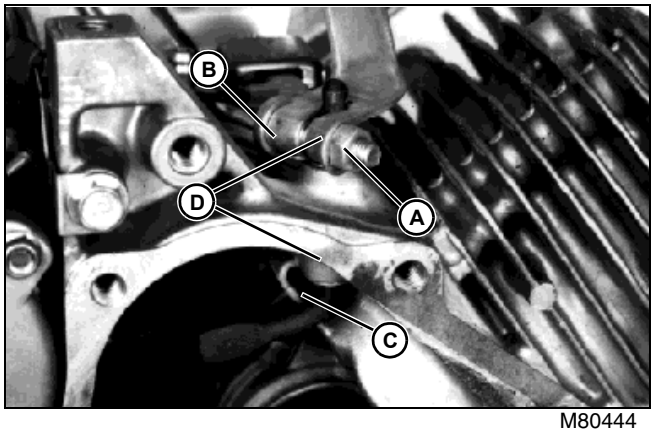
NOTE: It is not necessary to remove governor shaft unless seal is leaking or shaft is damaged.

1. Remove crankcase cover.

2. Inspect governor shaft for wear or damage. Replace if necessary.

To replace governor shaft:

- Scribe a mark across shaft and lever to aid installation.

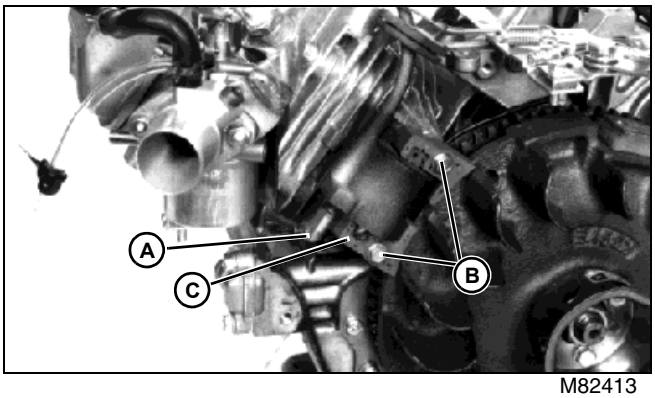


M80444

- Loosen nut (A) on governor lever.
- Remove retaining pin (B), governor shaft (C) and washers (D).
- Install washers, shaft and pin.
- Align marks made during removal and tighten nut.

Armature With Coil Removal and Installation

1. Remove blower housing.



M82413

2. Disconnect wiring lead (A).

3. Remove cap screws (B) and armature with coil (C).

4. Install armature with coil. Leave mounting cap screws loose.

5. Connect wiring lead.

6. Adjust armature air gap. Tighten cap screws.

7. Install blower housing.

Coil Air Gap Adjustment:

1. Turn flywheel magnet away from armature.

M87727

2. Insert a 0.30 mm (0.012 in.) feeler gauge blade (D) between flywheel and armature.

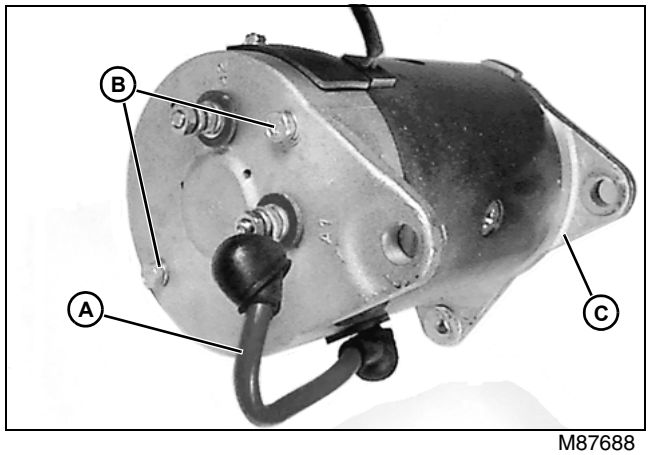
3. Push armature against flywheel and tighten mounting cap screws.

4. Turn flywheel to remove feeler gauge blade.

Starting Motor/Generator Disassembly and Assembly

Disassembly

1. Remove starting motor/generator from engine. See “Starting Motor/Generator Removal and Installation” on page 42.



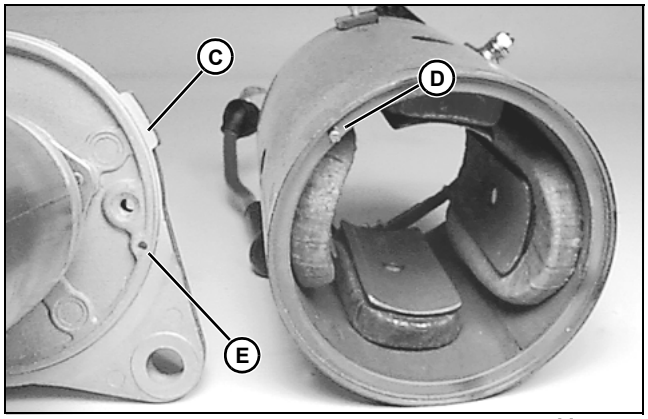
M87688

2. Disconnect jumper wire (A) from end of starting motor/generator.

3. Remove two long cap screws (B) and end plate.

4. Remove four rubber dust caps.

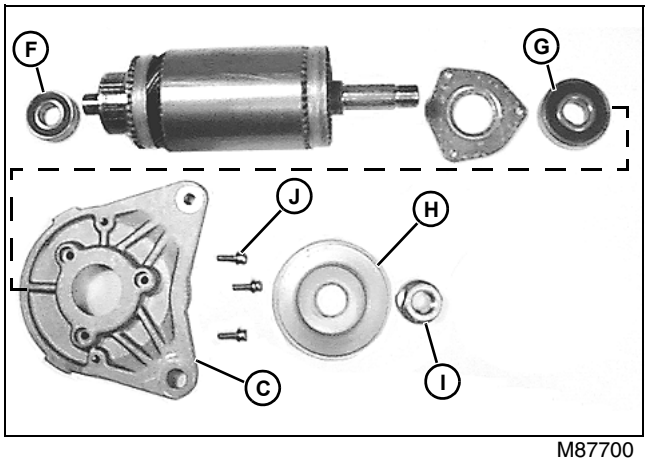
NOTE: Alignment pin (D) and hole (E) for each end plate.



M87694

5. Remove opposite end plate (C) and armature assembly.

6. Inspect and test brushes, field coils and armature.



M87700

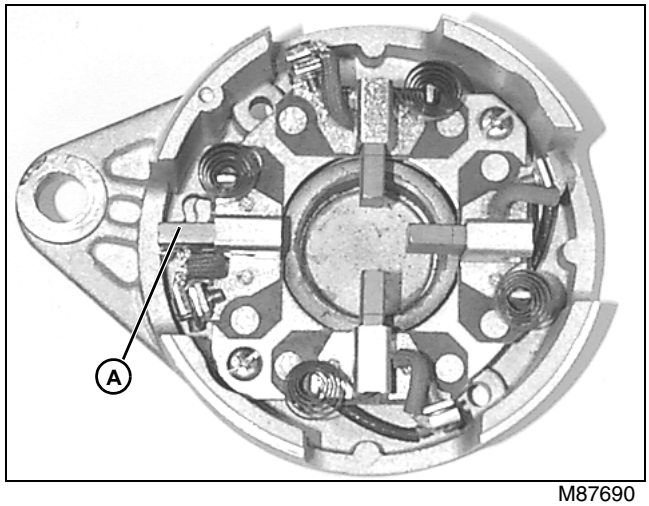
7. Inspect bearings (F and G) on armature. Replace as needed. For bearing (G):

- Clamp belt sheave (H) in vise.
- Using impact wrench, remove nut (I).
- Remove belt sheave (H).
- Remove three machine screws (J) and end plate (C).
- Press armature shaft out of bearing.
- Install new bearing and assemble in reverse order.

Assembly

1. Assembly is done in reverse order of disassembly.

2. Install armature and end plate assembly. Ensure alignment pin seats into alignment hole.



M87690

3. Hold each brush spring (A) back and slide each brush out so spring is tensioned against brush side instead of brush end.

4. Seat end plate with brushes. Ensure bearing seats into end plate and alignment pin seats into alignment hole.

5. Install and tighten two long cap screws.

6. Slide brushes into position against armature. Ensure brush springs seat over ends of brushes.

7. Install four rubber dust caps.

8. Install belt sheave. Tighten nut to 90 N•m (66 lb-ft).

9. Connect jumper wire to A1, tighten nut and fit rubber boot over connection.

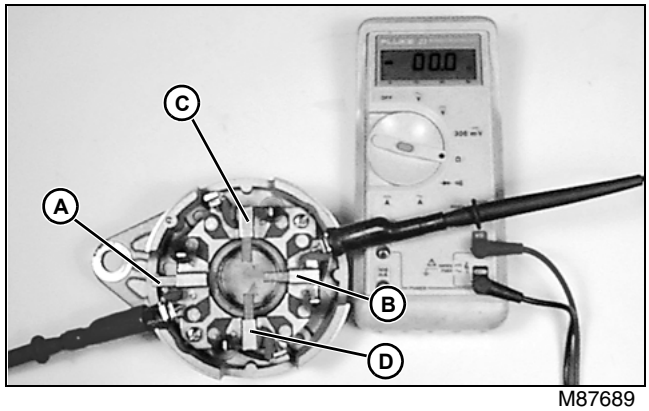
10. Install starting motor/generator in engine compartment.

Starting Motor/Generator Inspection and Test

NOTE: Test all components using an ohmmeter.

1. Measure brush lengths. If any one brush length is less than 19 mm (0.75 in.), replace all four brushes.

2. Test brushes and end plate wiring.



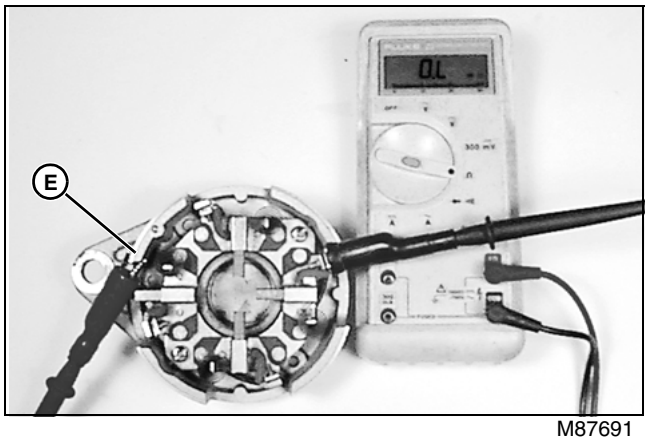
M87689

3. Check for continuity between brushes (A and B). There

should be 0.1 ohm or less resistance.

4. Check for continuity between brushes (C and D). There should be 0.1 ohm or less resistance.

5. Check for continuity between brushes (A and C). There should be NO continuity.



M87691

6. Check for continuity between each of the brushes and end plate (E). There should be NO continuity.

7. If continuity exists in any other combination, or fails to exist where stated:

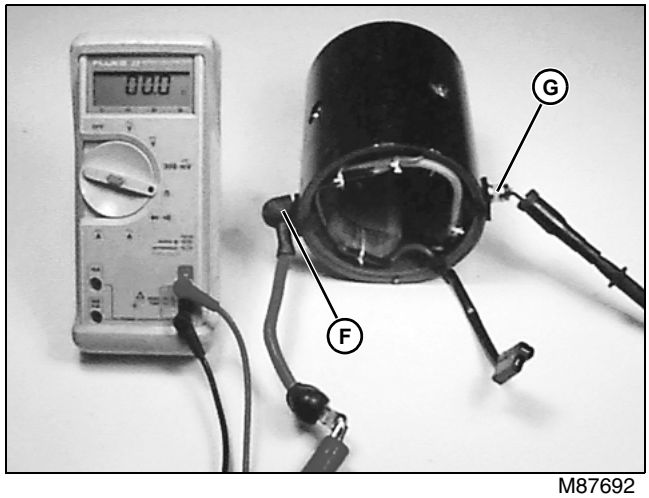
- Check wires and insulation. Rebuild or replace brush holder plate assembly as needed.
- Test for open circuits in armature wiring.

M87695

8. Check for continuity between commutator bars. If test shows no continuity, there is an open circuit:

- Replace armature.

9. Test field coil windings for open circuit and shorted circuits.

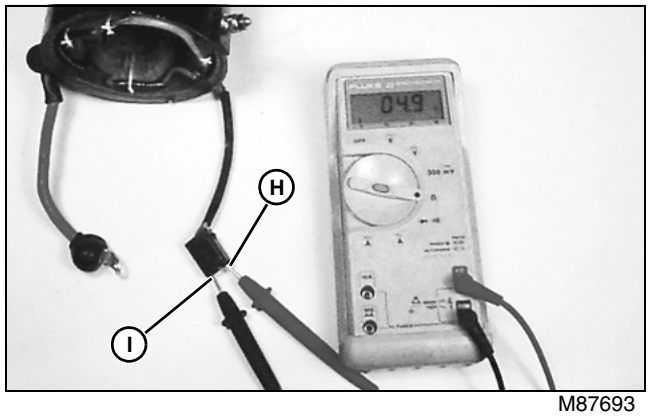


M87692

10.Check for continuity through starting motor coils at F1 and F2 wiring studs (F and G). There should be 0.1 ohm or less resistance.

- Check for continuity from F or G to housing. There should be NO continuity.
- If continuity exists to housing, or fails to go through coils:
- Replace field coil assembly.

11.Test field generator windings for open circuit and shorted circuits.



M87693

- Check for continuity through generator coils at DF connector (H and I). There should be approximately 5.0 ohms of resistance.
- Check for continuity from (H) or (I) to housing. There should be NO continuity.

12.If continuity exists to housing, or fails to go through coils:

- Replace coil assembly.

ELECTRICAL TABLE OF CONTENTS

Table of Contents

General Information

Operation and Diagnostics

The operation and diagnostics stories divide the electrical system into individual circuits by function. Each circuit is isolated from the main wiring schematic and only shows the components that are used in it. The story contains information on function, operating conditions, and theory of operation. The circuit schematics are drawn with the components in the operating position, with the power, or battery positive, into them across the top and the ground, or battery negative, across the bottom.

Diagnostic Information

The diagnostic procedures is used to test the complete circuit regardless of the problem or complaint. Select a symptom or system from the quick check or troubleshooting chart and follow the test procedures under that heading.

The diagnostic procedure lists:

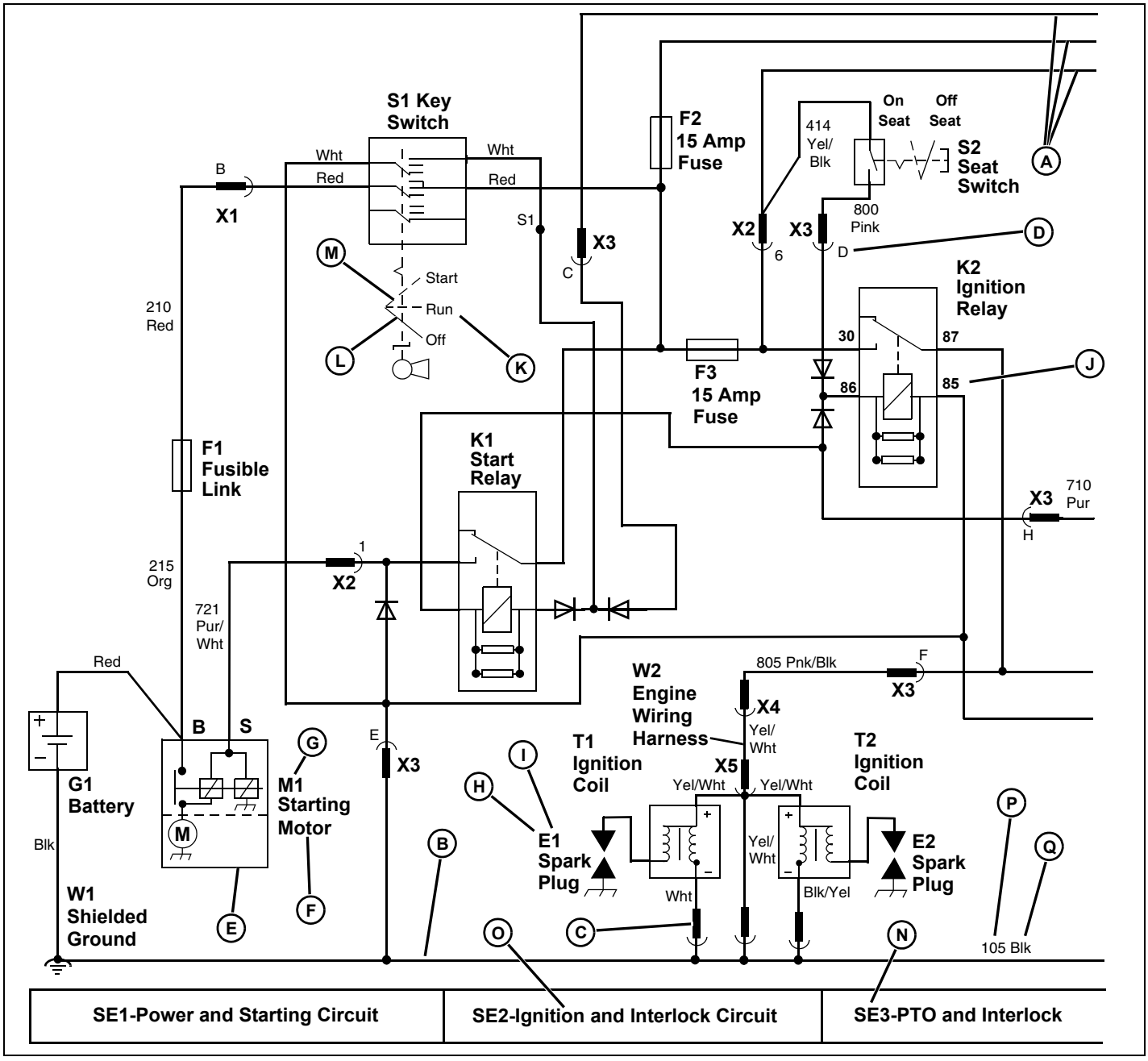
- Test conditions
- Test sequence
- Test location
- Normal reading
- Check or test to perform if reading is not normal

When performing the test or check, be sure to set your machine up to the test conditions listed and follow the sequence carefully. The middle “NORMAL” column gives the reading or condition that should be obtained when performing the test or check. If the results of the test or check are not normal, perform the test, check, or adjustment listed in the third “IF NOT NORMAL” column to repair the malfunction. The detailed tests or adjustments referred to in the “IF NOT NORMAL” column are located at the end of that group. The system diagram that accompanies each test procedure is drawn to resemble machine components. The key number on the art matches the number in the “TEST LOCATION” column and the leader line points to the exact point the test is to be made.

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 Blue	**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**

Reading Electrical Schematics



The schematic is made up of individual circuits laid out in a sequence of related functions. It is formatted with all power wires (A) across the top and all ground wires (B) across the bottom. Current flow is generally from top to bottom through each circuit and component. All components are shown in the off position. The diagram does not list connector (C) information unless needed to avoid confusion. If the connector is shown, the number next to it is the terminal pin location (D) in the connector.

Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

The identifying letter is always the same for a specific component, but the identifying numbers are numbered consecutively from upper left to lower right. The terminal designation (J) is placed directly outside the symbol next to the connecting wire path. Switch positions (K) are also placed directly outside the symbol. The solid line (L) shows the position the switch is currently in and dash lines (M) represent other switch positions.

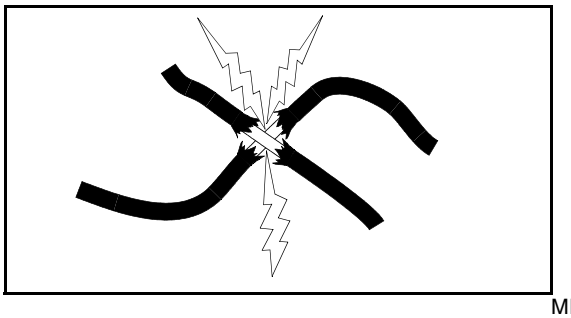
Each circuit is identified at the bottom of the drawing by a section number (N) and section name (O).

The circuit number (P) and wire color (Q) of the wires are shown directly next to the wire path.

The same component name and identification code are used consistently on all diagrams in this section. Components can be easily cross-referenced.

Common Circuit Tests

Shorted Circuit:



MIF

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

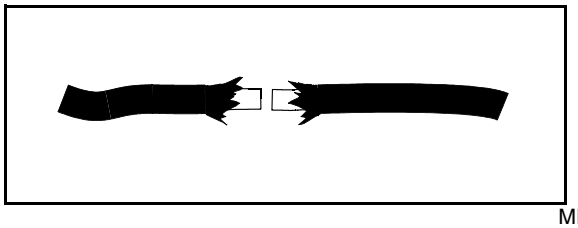
1. Turn component switch on.

2. Start at the controlling switch of the component that should not be operating.

3. Follow the circuit and disconnect wires at connectors until component stops operating.

4. Shorted or improper connections will be the last two wires disconnected.

High Resistance or Open Circuit:



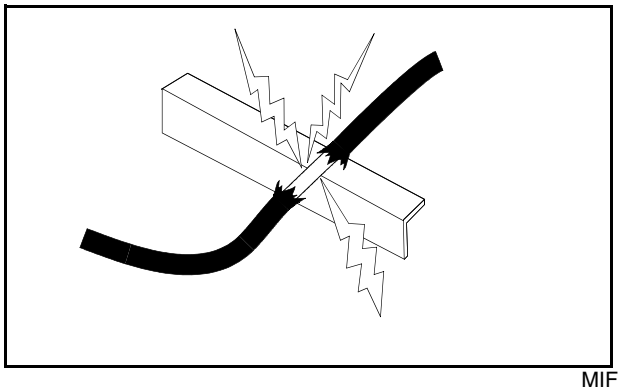
MIF

1. 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:

2. Check all terminals and grounds of the circuit for corrosion.

3. If terminals are not corroded or loose, the problem is in the component or wiring.

Grounded Circuit:



MIF

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

Conductors for 12 Volt Circuits

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

ELECTRICAL SPECIFICATIONS

Specifications

Battery:

Voltage	12
BCI group	U-1
CCA rating (Amps at 0° F)	340
Reserve capacity (minutes)	41
Specific gravity	1.225 or above
Electrolyte required fill (approximately)	1.9 L (2.0 qt)
Load test (minimum)	340 amps for 15 seconds

Ignition:

Primary coil resistance	0.67 - 1.10 ohms
Secondary (Plug wire and core)	6 - 10 ohms
Air gap	0.3 mm (0.012 in.)

Spark Plug:

Type	NGK BPR5ES-10
Gap	0.8 mm (0.032 in.)
Torque	25 N•m (221 lb-in.)

Starting Motor/Generator:

Type	Starter / Generator
Starter amp draw (on vehicle)	51 amps at 750 rpm
Starter no-load amp draw (free running)	6 amps (max.) at 2500 rpm
Generator regulated amperage/voltage	Up to 43 amp at 14.5 ± 0.5 volts
Generator unregulated voltage	18 VAC

Lighting:

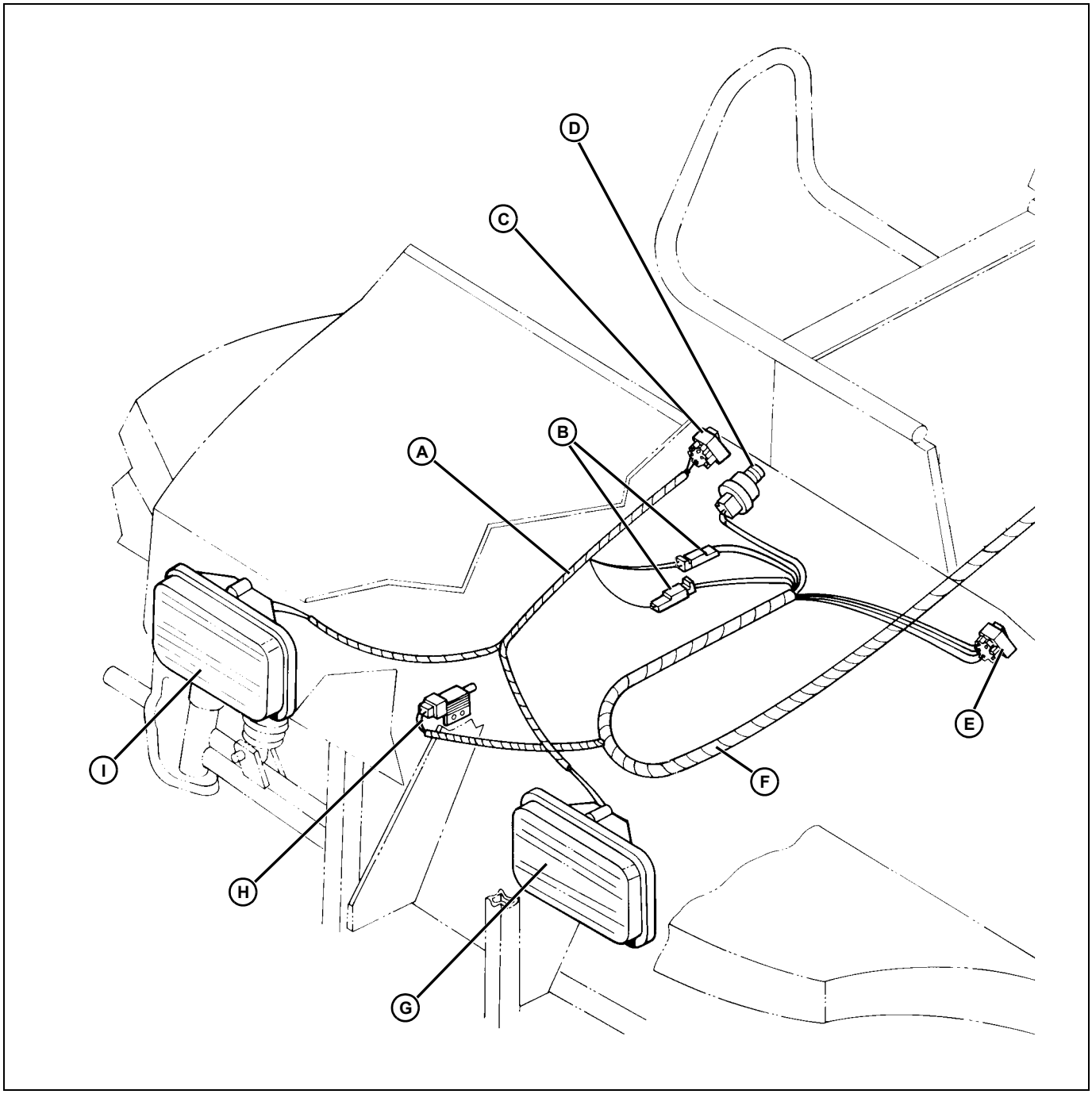
Headlights (halogen)	37.5 watts
Tail/Brake Lights	21 watts
Position Lights	10 watts
Front /Rear Turn Lights	21 watts

Neutral Start Switch:

Neutral (depressed)	Continuity
In Gear (released)	No Continuity

Component Location

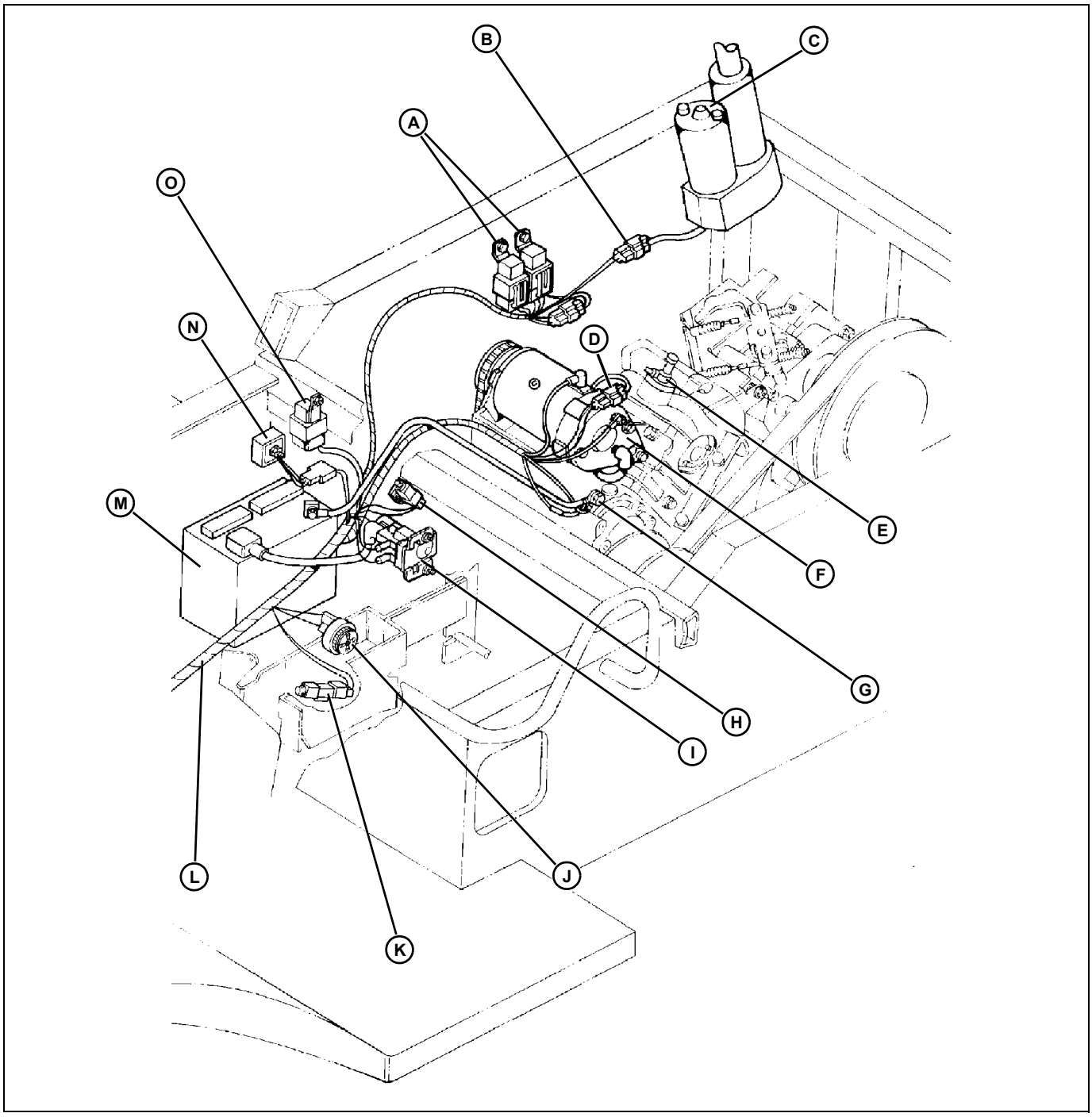
Electrical Components



M87610

A - W4 Standard Headlight Harness
B - X4 / X5
C - S5 Light Switch
D - S2 Key Switch
E - S6 Cargo Box Lift Switch (Optional)
F - W1 Main Wiring Harness
G - E2 Headlight
H - S3 Foot Throttle Switch
I - E2 Headlight

ELECTRICAL COMPONENT LOCATION



M87611

A - K1 and K2 Cargo Box Lift Relays (Optional)
B - W17 Cargo Box Lift Wiring Harness (Optional)
C - M2 Cargo Box Lift Motor (Optional)
D - X2
E - E1 Spark Plug
F - G2 Starting Motor/Generator
G - W1 Ground
H - S3 Park Brake Switch
I - K1 Starter Solenoid
J - H1 In Reverse Alarm
K - S1 Reverse Switch
L - W1 Main Wiring Harness
M - G1 Battery
N - N1 Voltage Regulator
O - K2 Magneto Run Relay

Schematics and Harnesses

Electrical Schematic and Wiring Harness Legend

Components:

E1 - Spark Plug (SE3, W1)

E2 - Right Headlight (SE5, W1; SE5, W4)

E3 - Left Headlight (SE5, W1; SE5, W4)

F1 - Fusible Link (SE1, W1)

G1 - Battery (SE1, W1)

G2 - Starting Motor/Generator (SE3, W1)

H1 - In Reverse Alarm (SE1, W1)

K1 - Starter Solenoid (SE1, W1)

K2 - Magneto Run Relay (SE1, W1)

N1 - Voltage Regulator (SE2, W1)

S1 - Reverse Switch (SE1, W1)

S2 - Key Switch (SE1, W1)

S3 - Foot Throttle Switch (SE1, W1)

S4 - Park Brake Switch (SE3, W1)

S5 - Light Switch (SE5, W1)

S6 - Cargo Box Lift Switch (SE6, W1)

T1 - Magneto Ignition Coil (SE3, W1)

W1 - Shielded Ground (SE1, W1)

Connectors:

X1 - W1 Main Wiring Harness to Hour Meter (Optional) (SE1, W1)

X2 - W1 Main Wiring Harness to G2 Starting Motor/ Generator (SE3, W1)

X3 - W1 Main Wiring Harness to W2 Engine Wiring Harness (SE3, W1)

X4 - W1 Main Wiring Harness to W3 Standard Headlight Wiring Harness (SE5, W1; SE5, W3)

X5 - W1 Main Wiring Harness to W3 Standard Headlight Wiring Harness (SE5, W1; SE5, W3)

X6 - W1 Main Wiring Harness to S6 Cargo Box Lift Switch (SE6, W1)

X7 - W1 Main Wiring Harness to W4 Cargo Box Lift Wiring Harness (SE6, W1)

X8 - W1 Main Wiring Harness to Auxiliary Power (Optional) (SE6, W1)

Electrical Section Wiring Harness Legend:

W1 - Main Wiring Harness

W2 - FE290D–AS15 Engine Wiring Harness

W3 - Standard Headlight Wiring Harness

W4 - Cargo Box Lift Wiring Harness

W5 - Light and Horn Wiring Harness

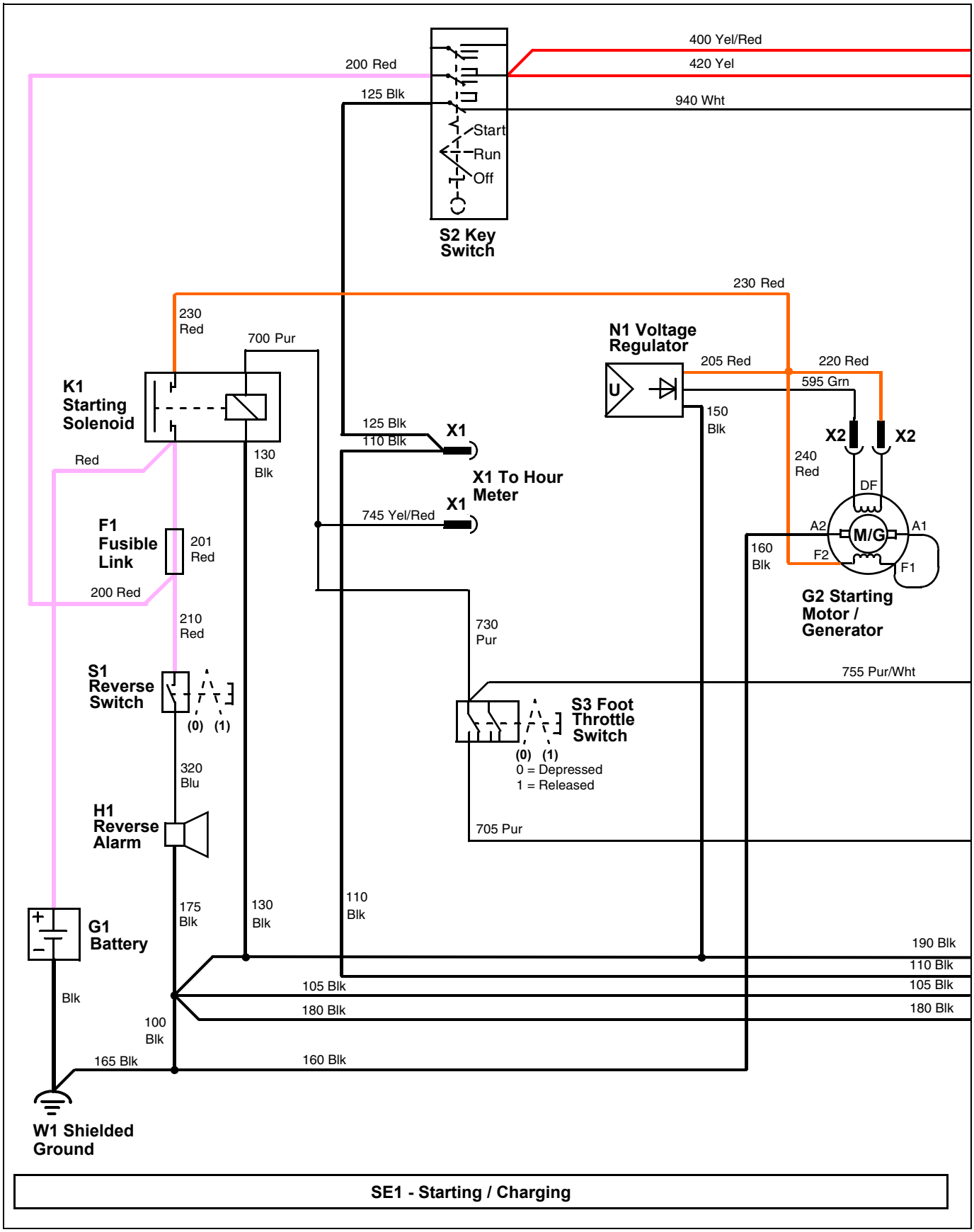
W6 - Rear Position/Brake/Turn Wiring Harness (Left)

W7 - Rear Position/Brake/Turn Wiring Harness (Right)

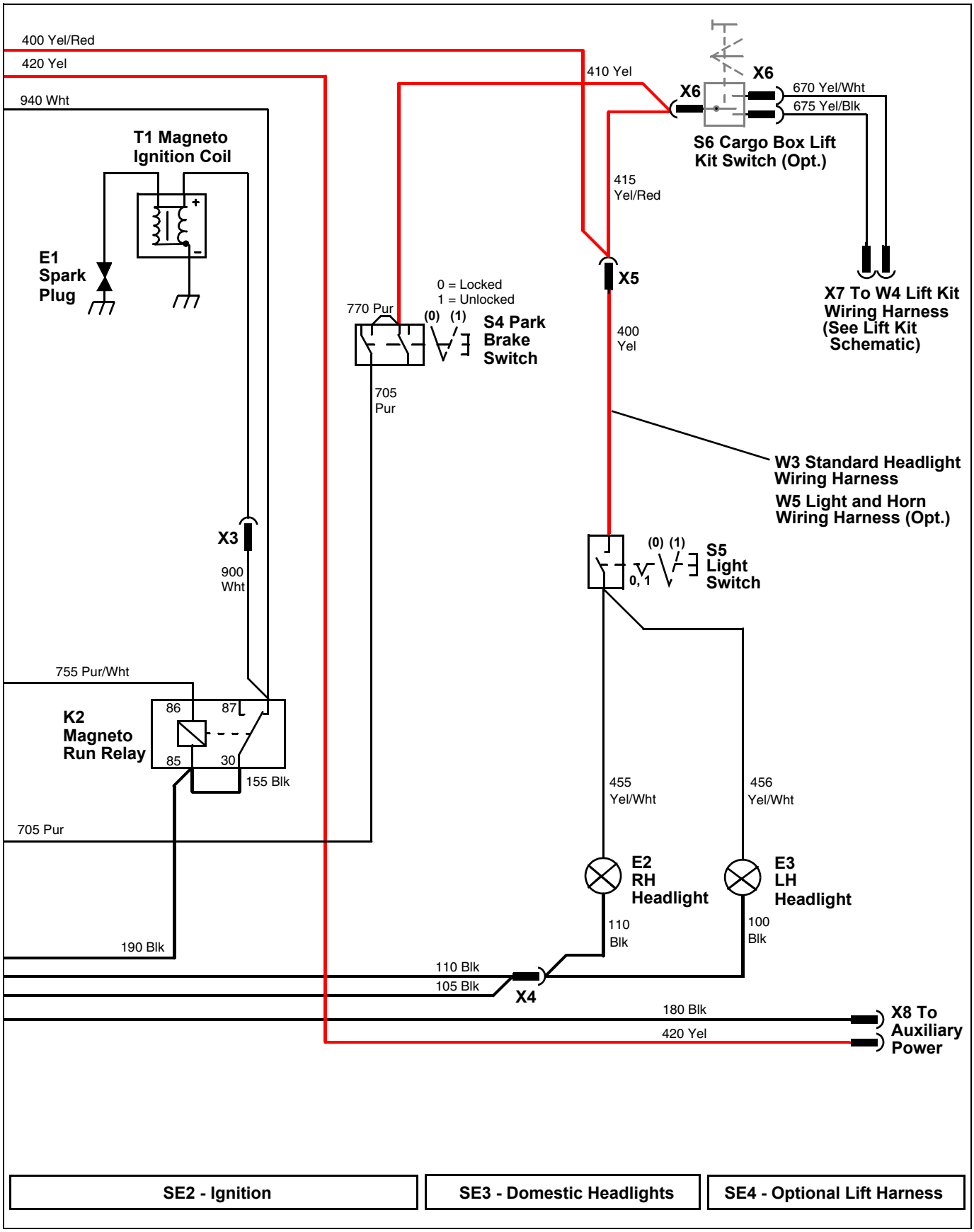
W8 - Front Position/Turn Wiring Harness (Left and Right)

W9 - Headlight Adaptor Wiring Harness (Domestic Use Only)

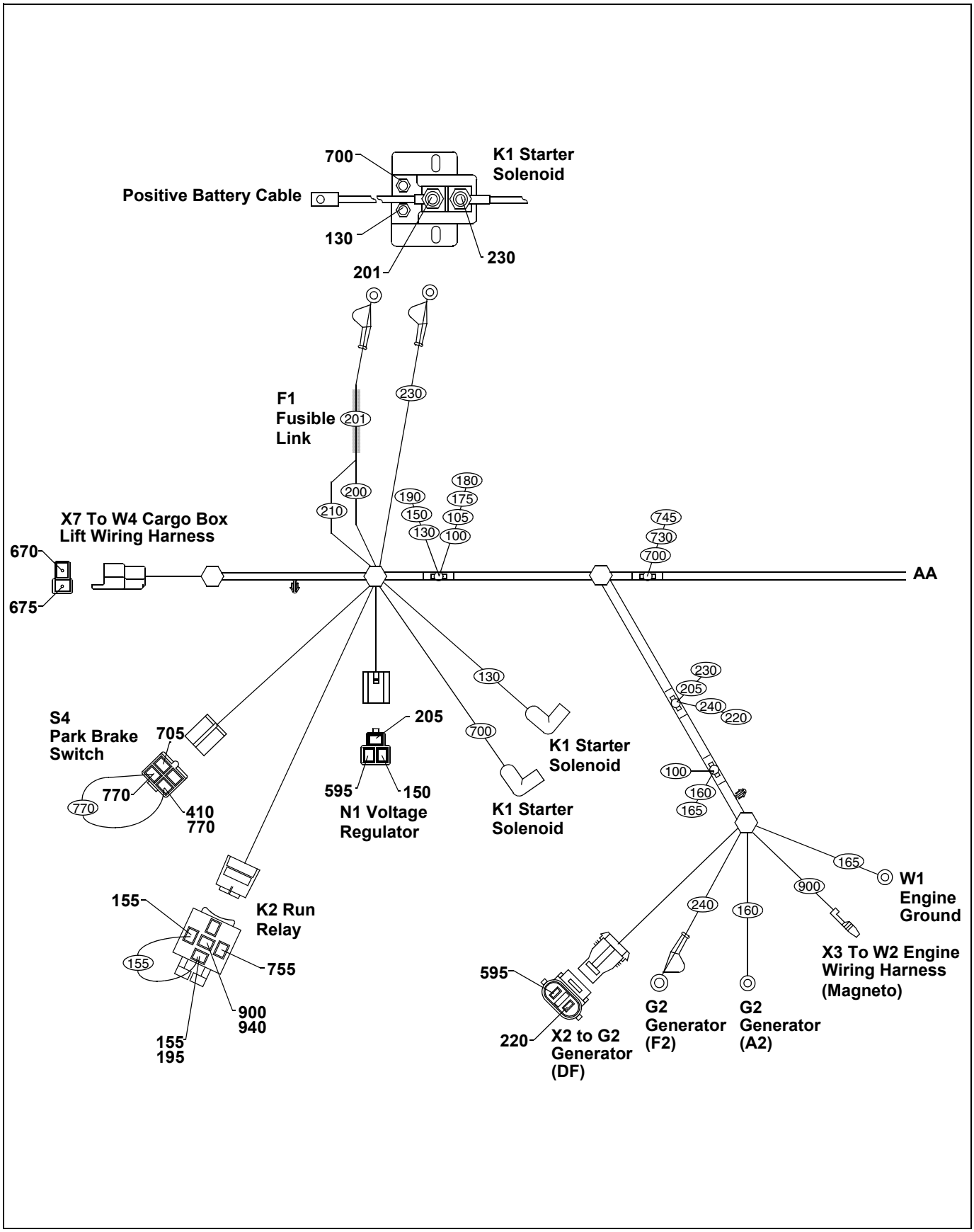
W1 Main Electrical Schematic (1 of 2)



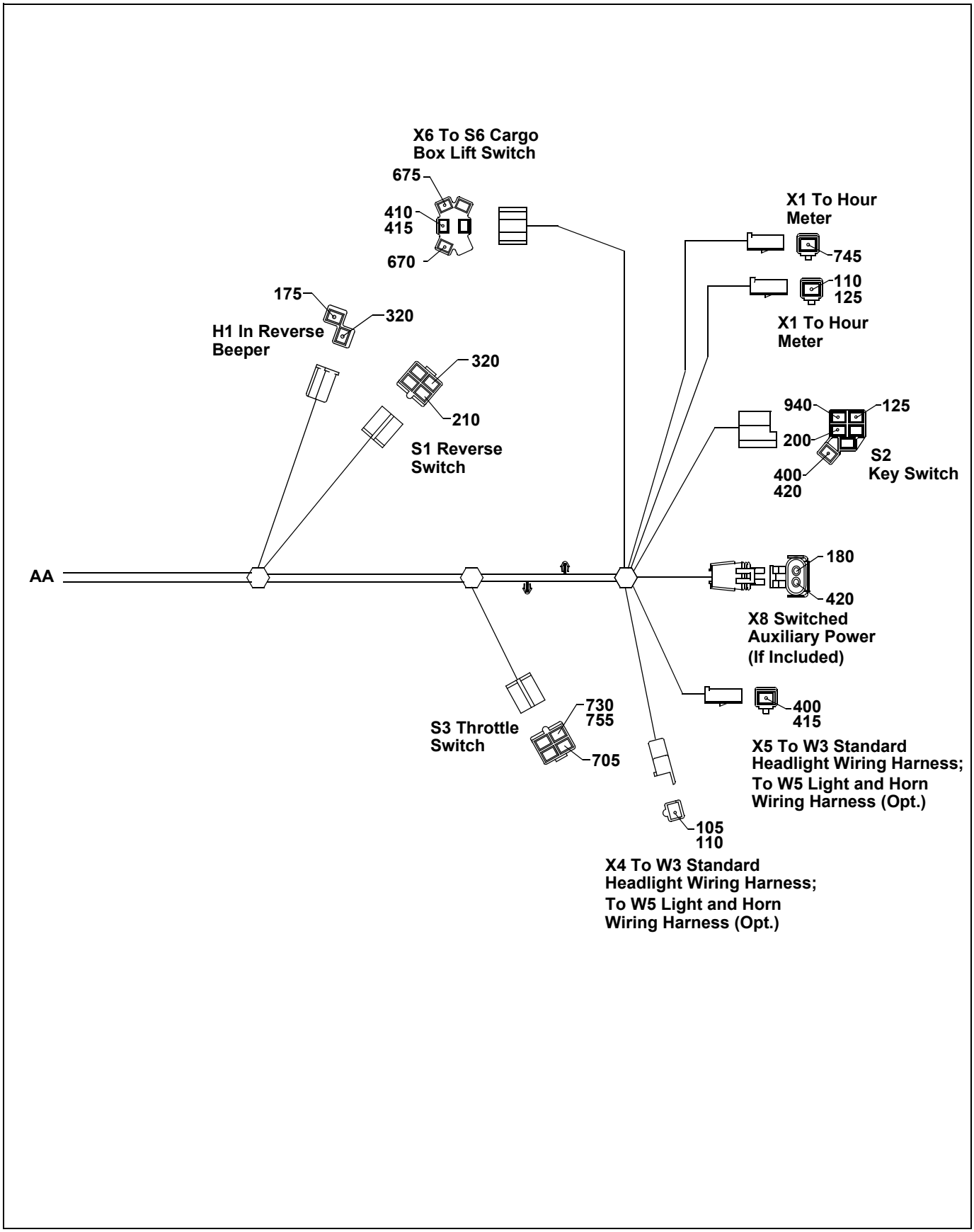
W1 Main Electrical Schematic (2 of 2)



W1 Main Wiring Harness (1 of 2)



W1 Main Wiring Harness (2 of 2)



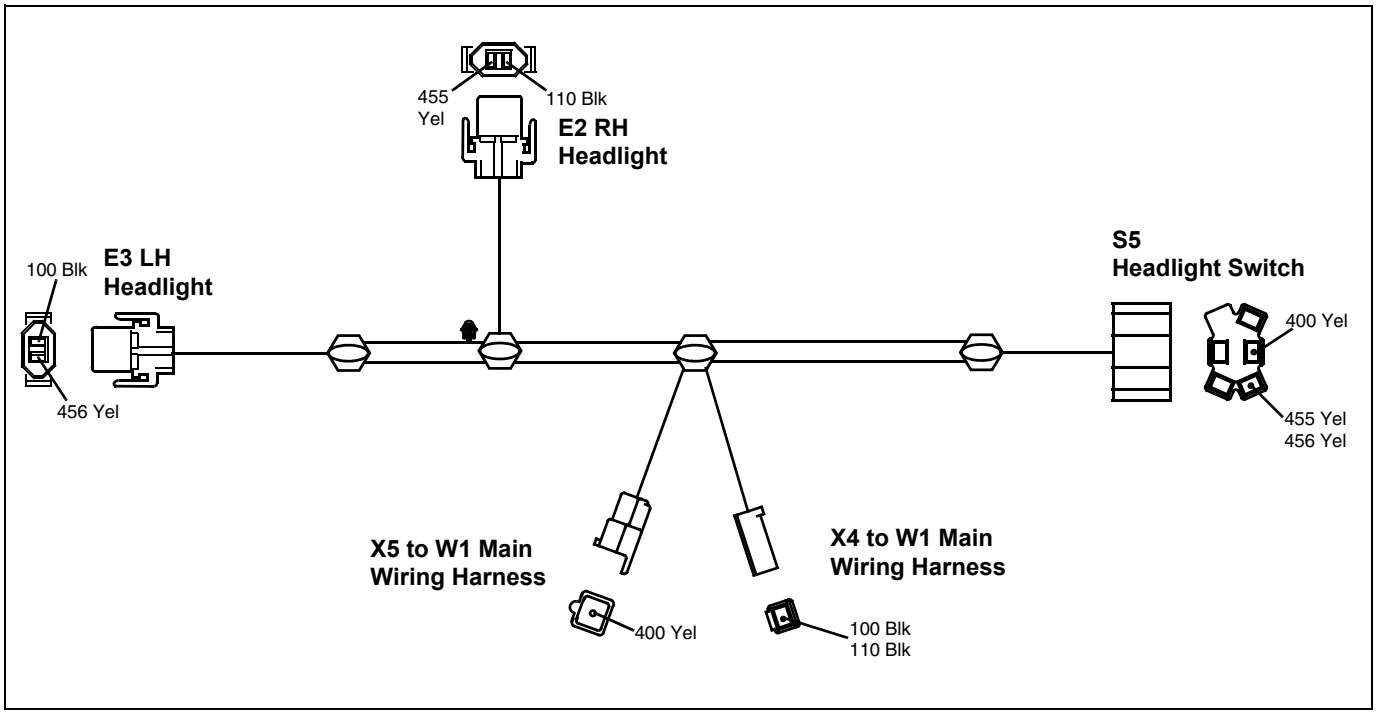
W1 Main Wiring Harness Wire Color Code

Size / No. / Color	Termination Points
5.0 100 Blk	160 and 165 Splice, 105, 130, 150, 175, 180 and 190 Splice
0.8 105 Blk	Solder 100, X4
0.8 110 Blk	X1, X4
0.8 125 Blk	S2, X1
0.8 130 Blk	K1, W1 Gnd
1.0 150 Blk	N1, 100 Blk
0.8 155 Blk	K2, K2 jumper
8.0 160 Blk	G2, 100 Blk
8.0 165 Blk	100 and 160 Splice, W1 Engine Gnd
0.8 175 Blk	H1, 100 Blk
2.0 180 Blk	X8, 100 Blk
0.8 190 Blk	K2, 100 Blk
0.8 195 Blk	K3, K2
2.0 200 Red	F1, S2
0.5 201 Fuse Link	K1, 200 and 210 Red
1.0 205 Red	230 Red, N1
0.8 210 Red	F1, S1
0.8 220 Red	230 Red, X2 (G2)
8.0 230 Red	K1, Splice 205, 220 and 240 Red
8.0 240 Red	230 Red, G2
0.8 320 Blu	S1, H1
1.0 400 Yel/Red	S2, X5
1.0 410 Yel	X6 (S6), S4
1.0 415 Yel/Red	X5, X6 (S6)
1.0 420 Yel	S2, X8
1.0 595 Grn	X2 (G2), N1
0.8 670 Yel/Wht	X6 (S6), X7
0.8 675 Yel/Blk	X6 (S6), X7
0.8 700 Pur	730/745 Pur, K1
1.0 705 Pur	S4, S3
0.8 730 Pur	700/745 Pur, S3
0.8 745 Yel/Red	700/730 Pur, X1
0.8 755 Pur/Wht	S3, K2
0.8 770 Pur	S4, S4 jumper
0.8 900 Wht	X3, K2
0.8 940 Wht	S2, K2

W2 Engine Wiring Harness

MIF

W3 Standard Headlight Wiring Harness



MIF

Operation and Diagnostics

Power Circuit Operation

Function:

Provides unswitched power to the primary components whenever the battery is connected.

Operating Conditions, Unswitched Circuits:

Voltage must be present at the following components with the key switch in the OFF position:

- Battery Positive Terminal
- In Reverse Switch
- “B” Terminal of Key Switch

The positive battery cable connects the battery to the starter solenoid. The starter solenoid bolt is used as a tie point for the rest of the electrical system.

The battery cables and the starter solenoid tie point connections must be good for the vehicle electrical system to work properly.

The ground cable connection is equally important as the positive cable. Proper starting operation depends on these cables and connections to carry the high current for its operation.

The connection between the starter solenoid and key switch is fused by a fusible link. This is a short piece of wire that is designed to fail if current load is too high or a short occurs. It protects the wiring harness from damage.

Switched Power:

Voltage must be present at the following components with the key switch in the RUN position, and the park brake ON:

- “A” and “S1” Terminals of Key Switch
- Light Switch
- Cargo Box Lift Switch Connector
- Park Brake Switch
- Auxiliary Power Connector

These circuits are controlled by the key switch and are protected by the fusible link.

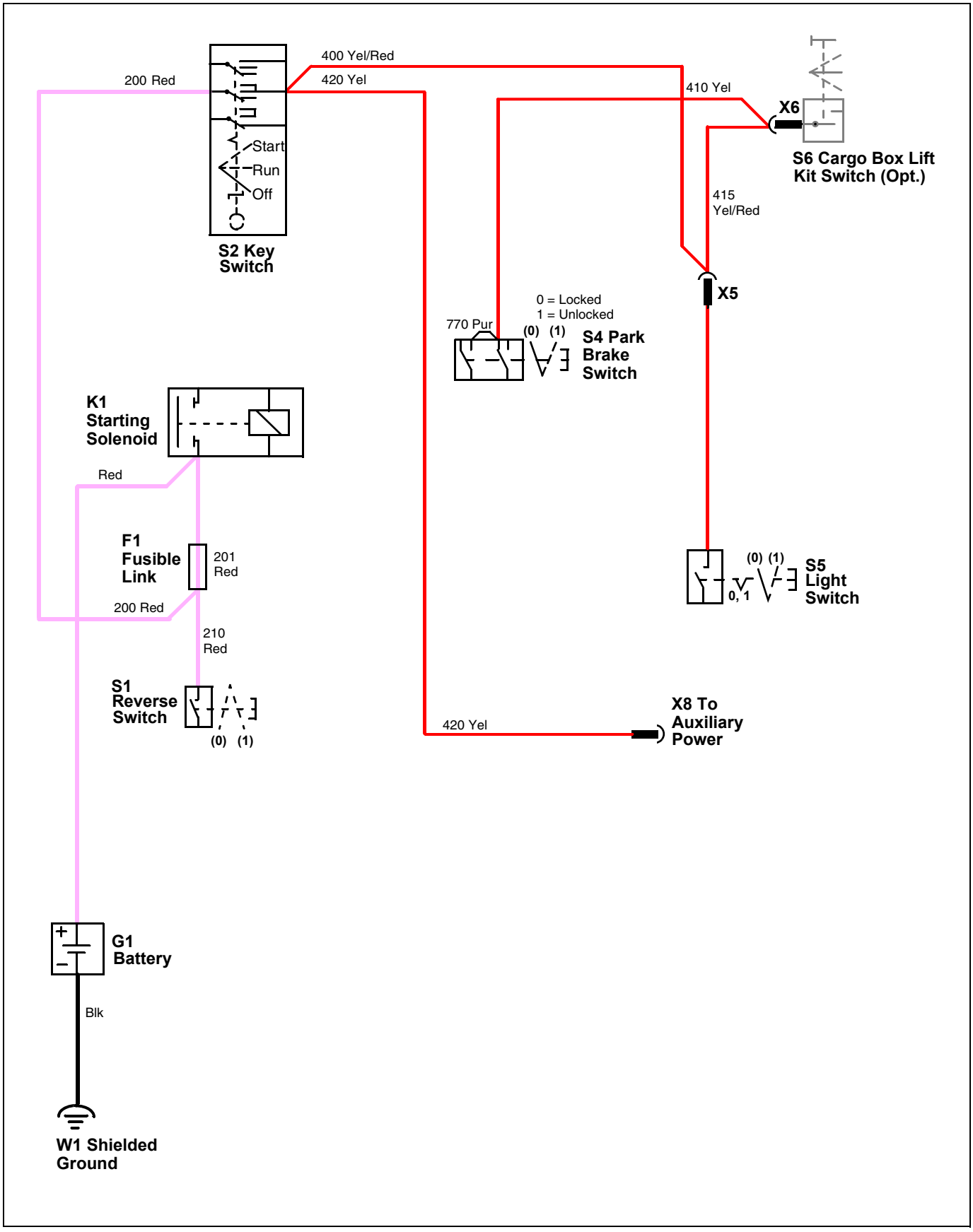
Voltage should be present at the foot throttle switch with the park brake OFF.

Lighting and Lift Power Circuits:

See the appropriate schematics and diagnostic procedure for these circuits.

The positive wires for these kits are also connected to the starting motor/generator bolt. These leads also contain fusible links to protect the wiring harnesses.

Power Circuit Schematic



Power Circuit Diagnosis

Power Circuit Unswitched Power

Test Conditions:

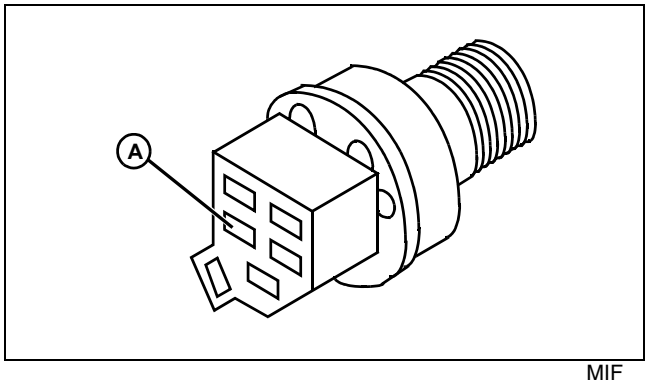
- Key switch in OFF position

System: Power Circuit Unswitched Power

(1) Is voltage at the G1 battery positive post between 11.8 - 13.2 VDC?

Yes - Go to next step.

No - Test the battery. Go to next step.

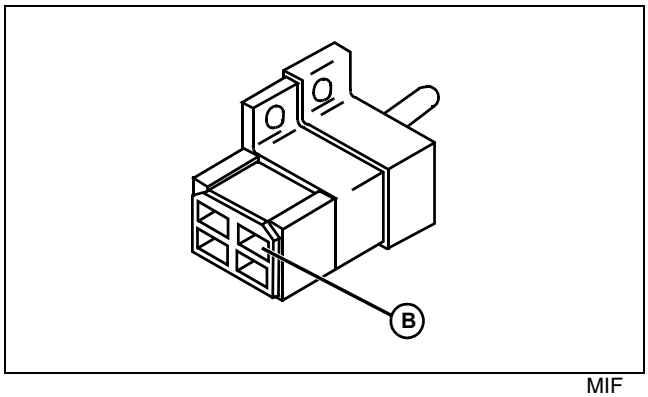


MIF

(2) Is battery voltage present at S2 key switch - 200 Red wire (A)?

Yes - Go to next step.

No - Test F1 fusible link. Check 200 Red wire connections. Go to next step.



MIF

(3) Is battery voltage present at S1 reverse switch - 210 Red wire (B)?

Yes - Test complete.

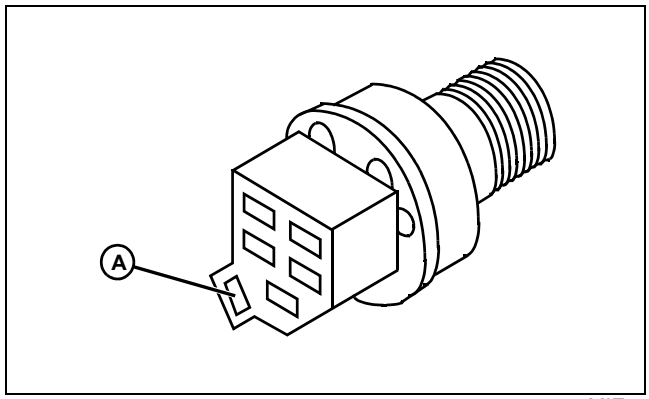
No - Test F1 fusible link. Check 210 Red wire connections.

Power Circuit Switched Power

Test Conditions:

- Key switch in run position
- Park Brake locked

System: Power Circuit Switched Power

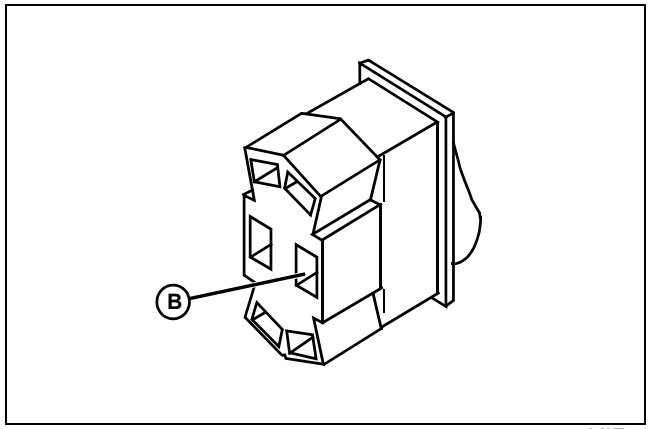


MIF

(1) Is battery voltage present at S2 key switch - 400 Yel/Red and 420 Yel wires (A)?

Yes - Go to next step.

No - Replace key switch. Go to next step.



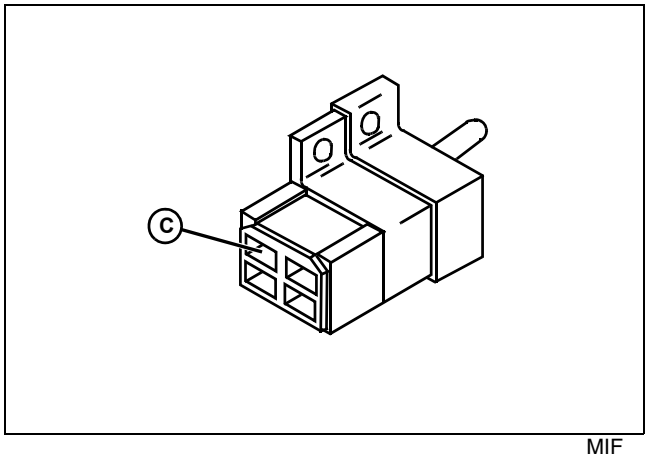
MIF

(2) Is battery voltage present at S5 light switch - 400 Yel wire (B)?

Yes - Go to next step.

No - Check 400 Yel/Red and 400 Yel wires and connections. If ok, replace key switch. Go to next step.

System: Power Circuit Switched Power



MIF

(3) Is battery voltage present at S4 park brake switch - 410 Yel wire (C)?

Yes - Test complete.

No - Check 400, 415 Yel/Red and 410 Yel wires and connections. If ok, replace key switch. Test complete.

Cranking Circuit Operation

Function:

To energize the starter solenoid and engage the starting motor/generator which cranks the engine.

Operating Conditions:

To crank the engine using the foot throttle the key switch must be in the run position, the park brake must be unlocked and the foot throttle must be depressed closing the contacts in the foot throttle switch.

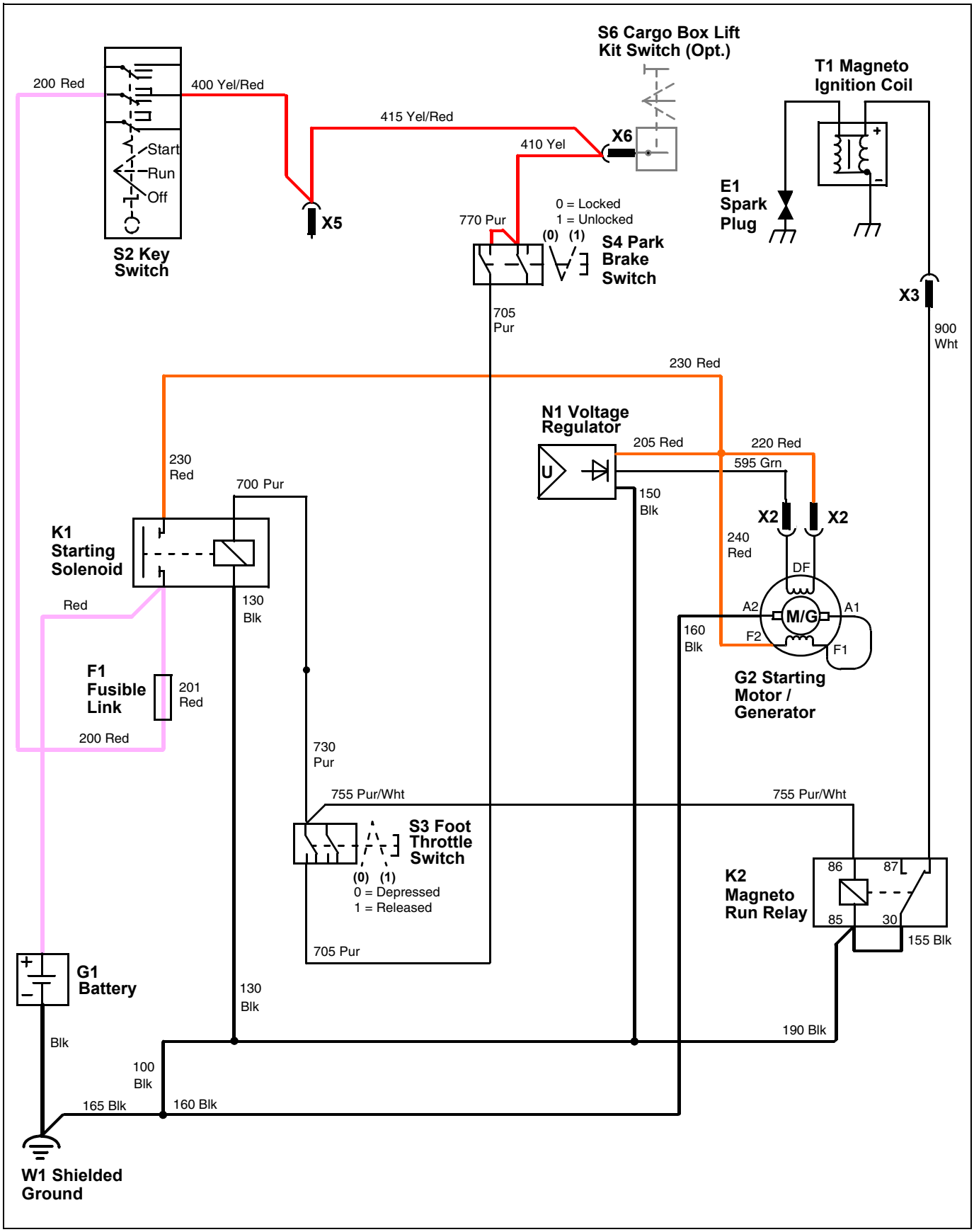
Foot Throttle Switch Theory of Operation:

Current flows from the battery through F1 fusible link to the key switch. With key switch in the run position current flows through the key switch, through 400 Yel/Red, 415 Yel/Red and 410 Yel/Red wires to the park brake switch. With the park brake unlocked, current flows through the park brake switch and 705 Pur wire to the foot throttle switch.

When the foot throttle is depressed, the switch closes and current flows through the switch contacts, and 730 Pur and 700 Pur wires to the starter solenoid coil.

With the starter solenoid coil energized, high current from the battery flows through the solenoid contacts, and 230 Red and 240 Red wires to the starting motor/generator causing it to turn and crank the engine.

Cranking Circuit Schematic



MIF

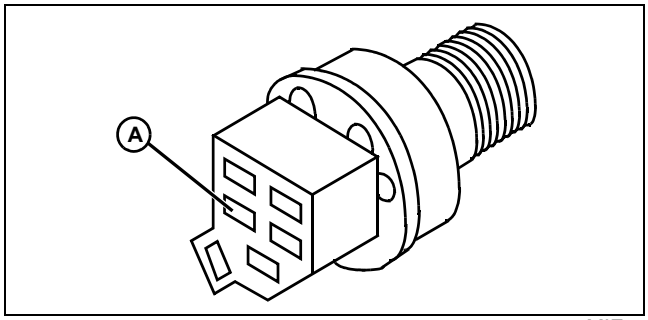
Cranking Circuit Diagnosis

Cranking Circuit Unswitched Power

Test Conditions:

- Key switch in off position
- Park brake locked
- Spark plug disconnected
- Transmission in neutral

System: Cranking Circuit Unswitched Power

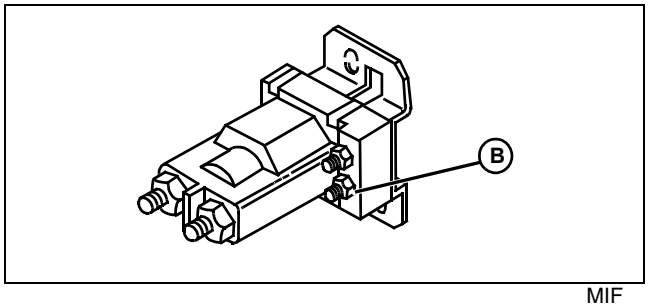


MIF

(1) Is battery voltage present at S2 key switch - 200 Red wire (A)?

Yes - Go to next step.

No - Test F1 fusible link. Check 200 Red wire connections. Go to next step.



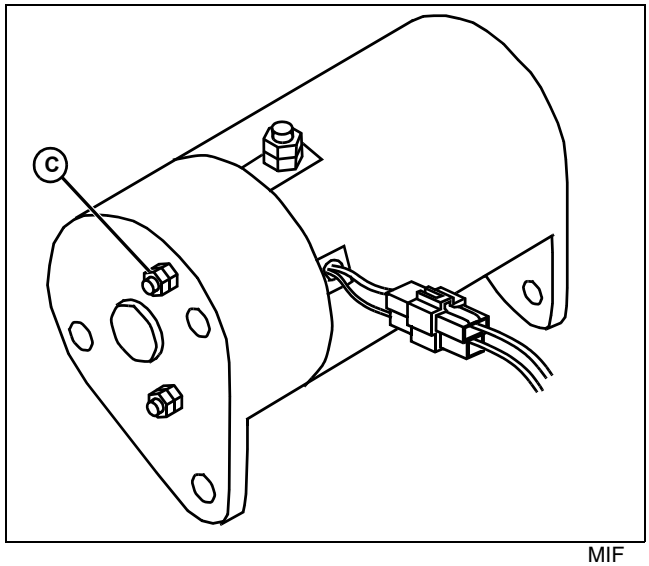
MIF

(2) Is continuity to ground present at K1 starting solenoid - 130 Blk wire (B)?

Yes - Go to next step.

No - Check 130, 100, and 165 Blk wires and connections. Go to next step.

System: Cranking Circuit Unswitched Power



MIF

(3) Is continuity to ground present at G2 starting motor/generator - A2 terminal, 160 Blk wire (C)?

Yes - Test complete.

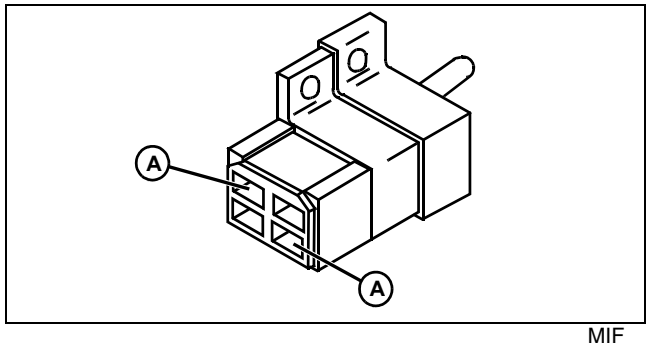
No - Check 230 and 240 Red wires and connections. If ok, replace starting solenoid. Go to next step.

Cranking Circuit Switched Power

Test Conditions:

- Key switch in run position
- Park brake unlocked
- Spark plug disconnected
- Transmission in neutral

System: Cranking Circuit Switched Power



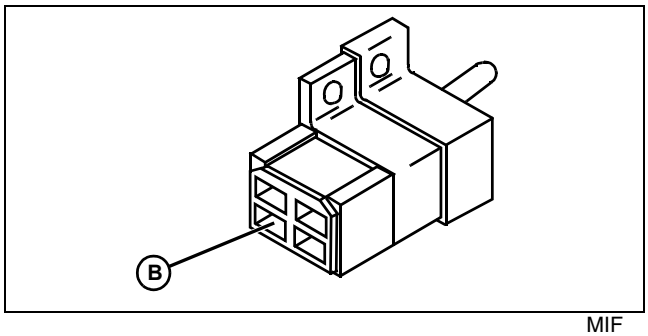
MIF

(1) Is battery voltage present at S4 park brake switch - 770 Pur and 410 Yel wires (A)?

Yes - Go to next step.

System: Cranking Circuit Switched Power

No - Check park brake switch adjustment. Check 770 Pur, 410 Yel, 415 Yel/Red and 400 Yel/Red wires and connections. If ok, replace key switch. Go to next step.



MIF

(2) Is battery voltage present at S3 foot throttle switch - 705 Pur wire (B)?

Yes - Test complete.

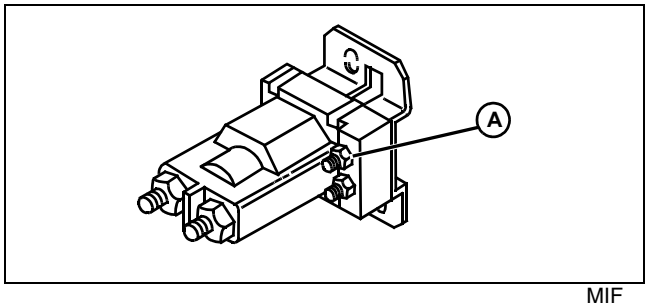
No - Check 705 Pur wire and connections. If ok, replace park brake switch.

Foot Throttle Switched Power

Test Conditions:

- Key switch in run position
- Park brake unlocked
- Spark plug disconnected
- Transmission in neutral
- Throttle pedal depressed

System: Foot Throttle Switched Power



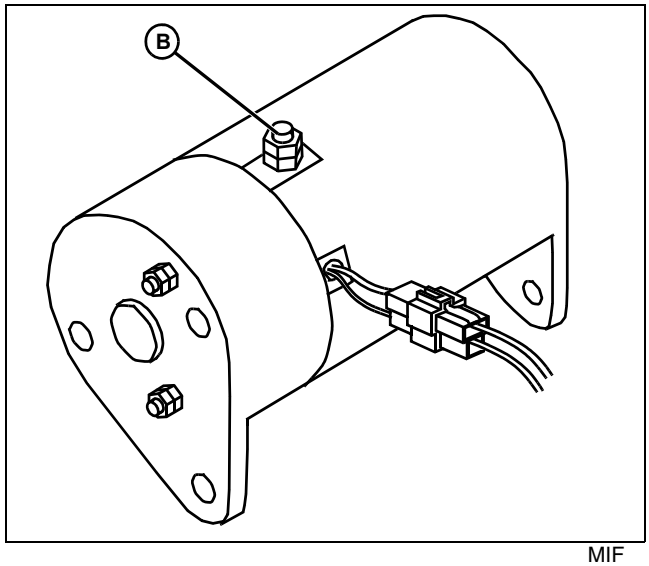
MIF

(1) Is battery voltage present at K1 starting solenoid - 730 and 700 Pur wires (A)?

Yes - Go to next step.

No - Check foot throttle switch adjustment. Check 730 and 700 Pur wires and connections. If ok, replace foot throttle switch. Go to next step.

System: Foot Throttle Switched Power



MIF

(2) Is battery voltage present at G2 starting motor/ generator - F2 terminal, 240 Red wire (B) with starting motor turning engine?

Yes - Test complete.

No - Check 230 and 240 Red wires and connections. If ok, replace starting solenoid. Test complete.

Ignition Circuit Operation

Function:

To create a spark at the correct time that ignites the fuel/air mixture in the cylinder. To ground the system to keep the engine from starting or to shut off the engine.

Operating Conditions:

To produce a spark, the key switch must be in the RUN position, the park brake must be OFF, and the foot throttle switch must be DEPRESSED.

System Operation:

The ignition system is a transistor-controlled magneto design. Ignition timing is controlled by the transistor and is not adjustable. The engine is shut off by grounding the ignition coil. With the ignition coil grounded, a spark cannot be produced.

Placing the key switch in the RUN position eliminates one path to ground for ignition current.

When the magneto run relay is energized, the relay contacts open and the second path to ground for ignition current is eliminated. When both paths are eliminated a spark can be produced.

The magneto run relay can be energized under the following conditions:

- Key switch in RUN position
- Park brake DISENGAGED (OFF)
- Foot throttle pedal DEPRESSED

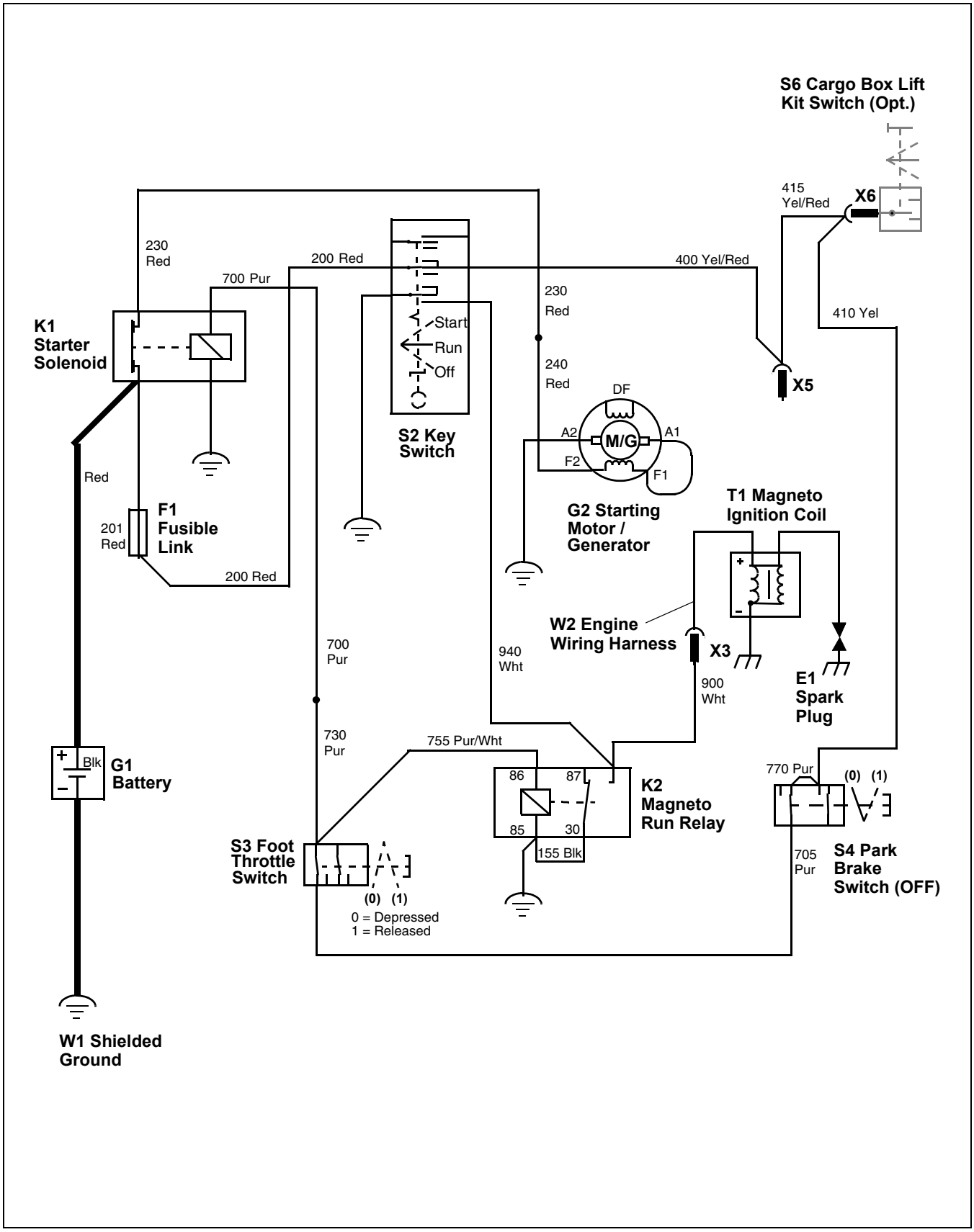
As the flywheel turns, (See “Cranking Circuit Operation” on page 90.) a magnet in the flywheel starts to align with the ignition coil and produces current in the primary windings by electromagnetic induction. The low voltage current flows to ignition module. The ignition module controls the current flow in the primary windings of the ignition coil.

In the spark stage (spark produced), the flywheel magnet is fully aligned with the ignition coil and high voltage (maximum current) is induced in the primary coil. This high voltage current causes the ignition module to ground the primary coil windings. The sudden reduction of current flow, induces high voltage current in the secondary coil. The high voltage current flows through the ignition coil wire to the spark plug. The voltage is now high enough to jump the spark plug gap and a spark is produced.

If the park brake is ENGAGED, the foot throttle switch is open (Drivers foot off throttle), or the key switch is placed in the OFF position the magneto run relay is deenergized. With the magneto run relay deenergized, ground is provided for the ignition coil and the engine will shut off.

If the key switch is placed in the OFF position, ground is provided for the ignition coil and the engine will shut off.

Ignition Circuit Schematic

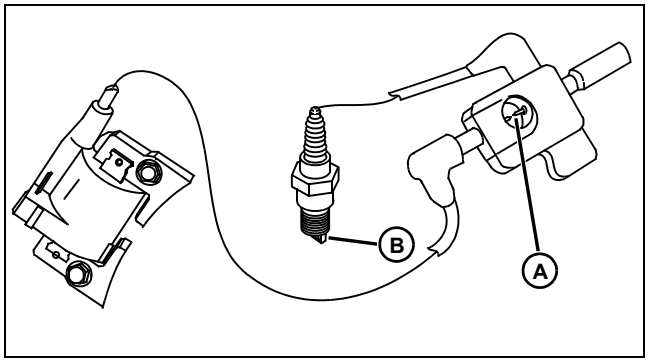


Ignition Circuit Diagnosis

Test Conditions:

- Key switch in RUN position
- Park brake OFF
- Foot throttle switch CLOSED (pedal depressed)

System: Ignition Circuit



(1) Is there a hot blue spark in the spark tester (A)?

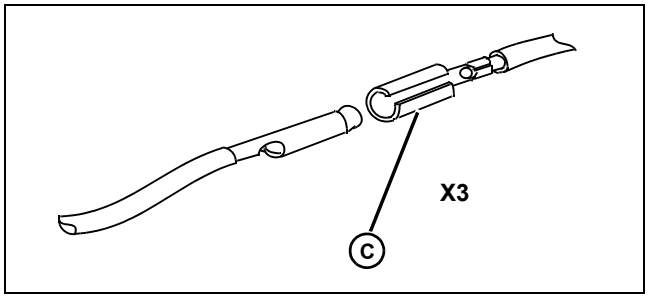
Yes - Check spark plug. Go to next step.

No - Test ignition coil. Check armature air gap. Check for grounded primary lead. Check for leaking or grounded secondary plug wire.

(2) Is the spark plug (B) fouled and does it have an incorrect spark gap?

Yes - Replace spark plug. Adjust air gap.

No - Go to next step.

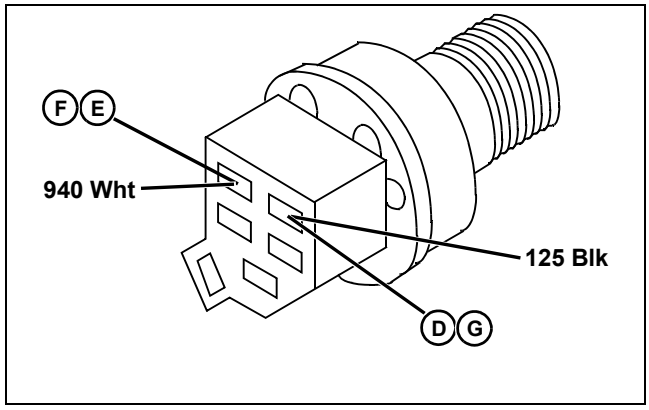


(3) Disconnect engine connector (C). Is there a spark present at tester?

Yes - Go to next step.

No - Continue testing ignition circuit through key switch.

System: Ignition Circuit



(4) Is there continuity between key switch connector (D) and engine connector, with no continuity to ground?

Yes - Go to next step.

No - Check 125, 110, 105, 100 and 165 Blk wires and connections.

(5) Is there continuity between key switch connector (E) and magneto run relay, with no continuity to ground?

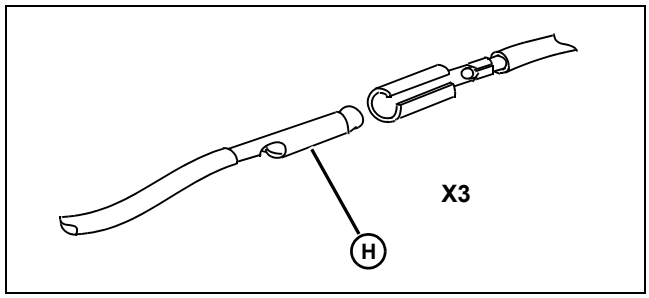
Yes - Go to next step.

No - Check 940 Wht wire and connections. See “Cranking Circuit Operation” on page 90.

(6) Is there continuity between key switch connector 940 Wht wire (F) and 125 Blk wire (G) with he key switch in the RUN position?

Yes - Replace key switch.

No - Go to next step.

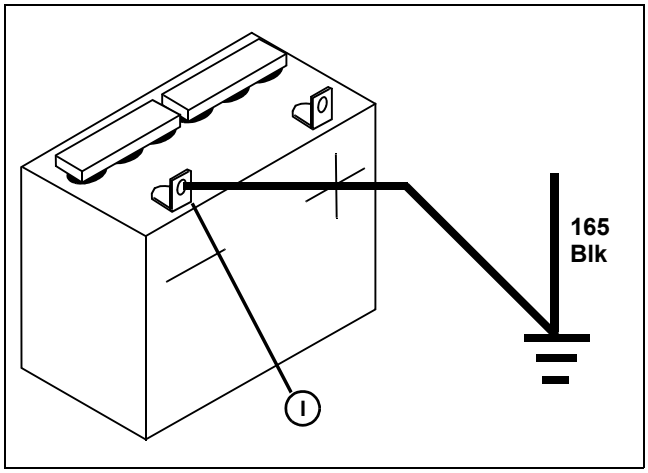


(7) Is there continuity between X3 connector (H) and magneto run relay, with no continuity to ground?

Yes - Go to next step.

No - Check 900 Wht wire and connections.

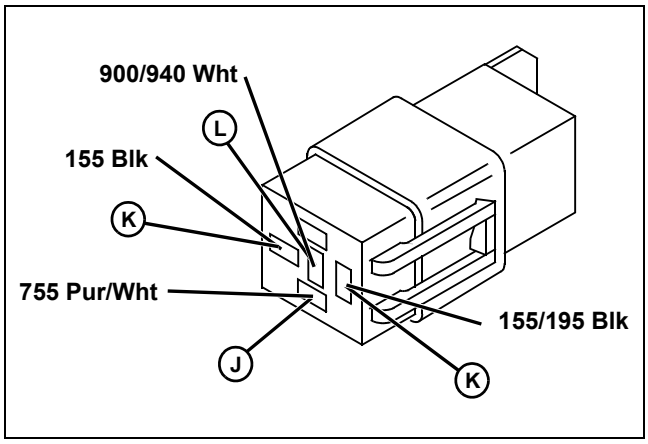
System: Ignition Circuit



(8) Is there continuity from battery negative post (I) to ground?

Yes - Go to next step.

No - Clean connections or replace negative battery cable.



(9) Is there battery voltage at magneto run relay (J)?

Yes - Go to next step.

No - Check 755 Pur wire and connections. See “Cranking Circuit Diagnosis” on page 92.

(10) Is there continuity to ground at each end of the 155 Blk jumper wire (K)?

Yes - Go to next step.

No - Check 155 Blk wire and connections.

(11) Is there continuity from magneto run relay (L) to ground?

Yes - End of tests.

System: Ignition Circuit

No - Replace magneto run relay.

Charging Circuit Operation

Function:

To maintain battery voltage between 11.8 and 13.2 volts.

Operating Conditions:

The engine must be running for the charging system to operate.

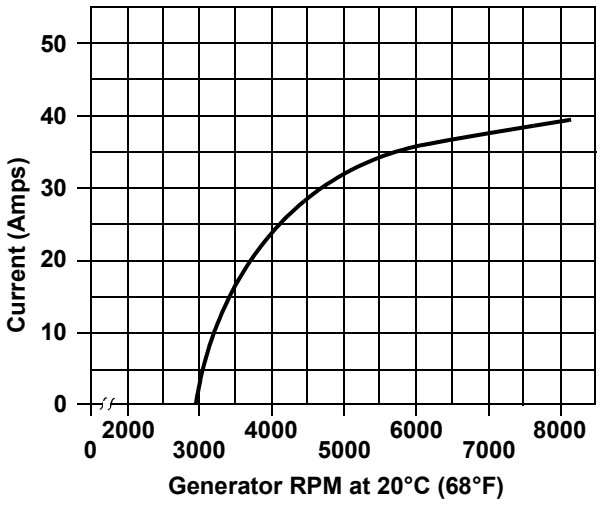
System Operation:

The charging system is a rotor and stator design. Charging output is controlled by a voltage regulator.

With the engine running, battery current flows from battery positive terminal to starting motor/generator terminals DF and F2, and voltage regulator.

The 205 Red wire allows the voltage regulator to monitor battery voltage. When voltage drops below 14.4 VDC, the voltage regulator electronically closes the charging coil ground circuit (595 Grn to regulator, and 160, 100 and 165 Blk wires to ground. With the charging coil ground circuit closed current is induced in the charging circuit coils and flows through 220 and 230 Red wires and starter solenoid to the positive (+) battery terminal.

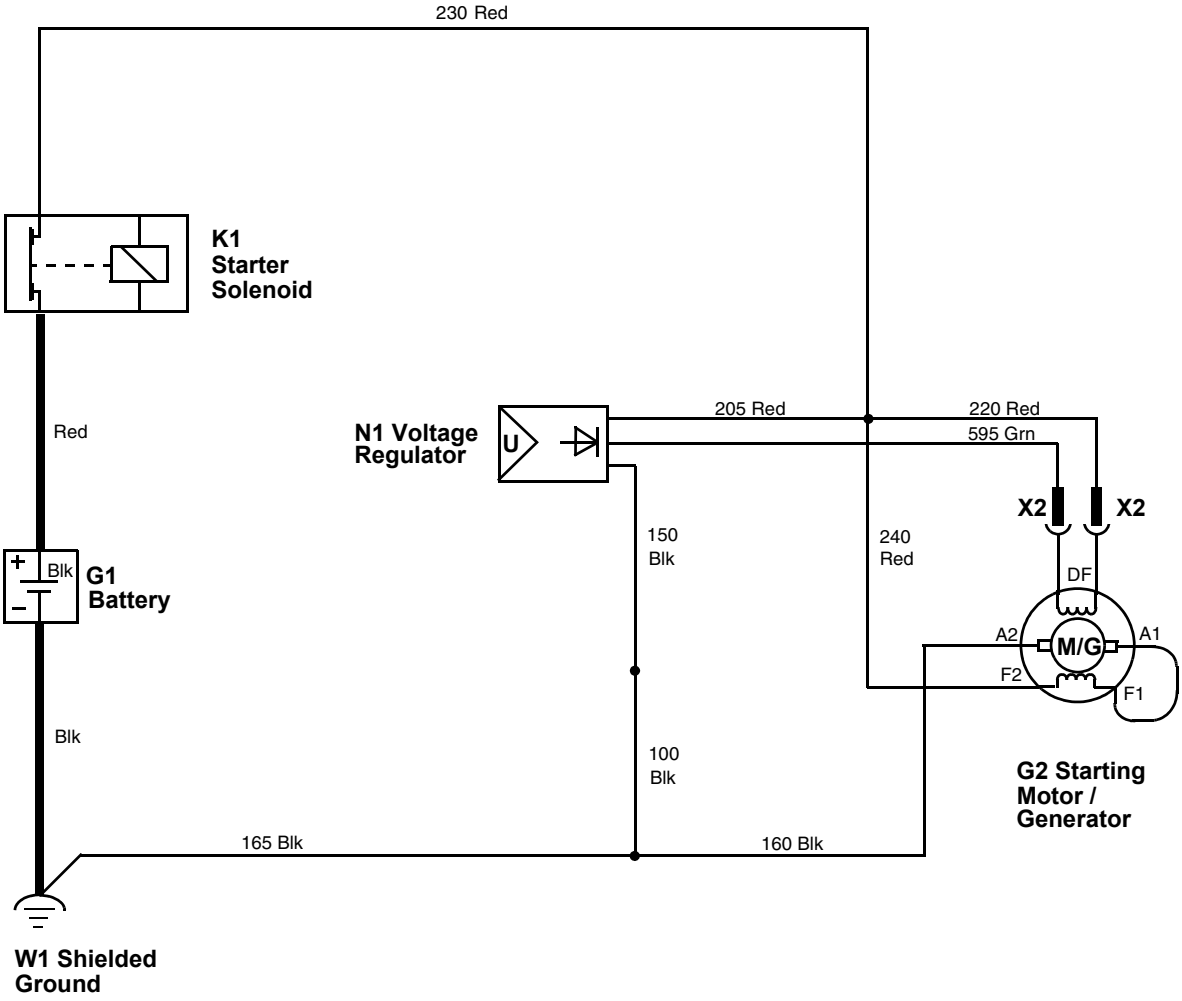
NOTE: The variable amperage output of the generator is speed dependent (See Table). Up to 2950 rpm (1270 Engine RPM) the starting motor/generator draws amperage from the battery. Above 2950 rpm the starting motor/generator charges the battery.



When the battery is fully charged, the voltage regulator stops current flow to the battery.

The ground circuit provides a path to ground for the voltage regulator and starting motor/generator.

Charging Circuit Electrical Schematic

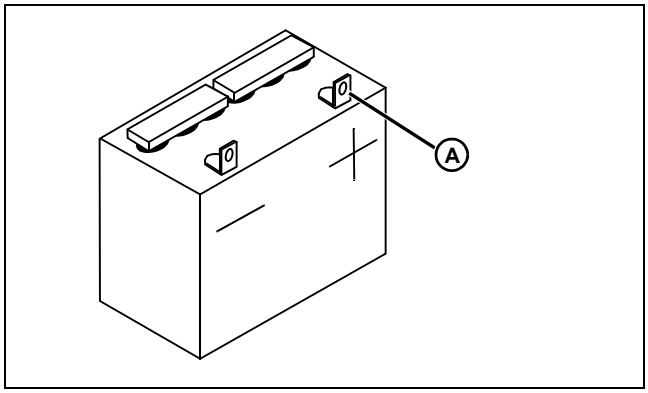


Charging Circuit Diagnosis

Test Conditions:

- Machine parked safely
- Key switch OFF

System: Charging Circuit



(1) Is there 11.8 to 13.2 volts at the battery positive terminal (A)?

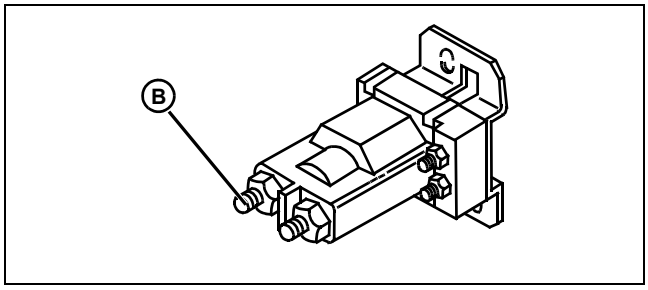
Yes - Go to next step.

No - Test battery. See “Battery Test” on page 104.

Test Conditions:

- Wheels blocked
- Park brake OFF
- Transmission LOCKED in neutral (use 6mm bolt and nut). See “Transaxle Neutral Lock” on page 121 in the Power Train section.
- Engine running at high idle.

System: Charging Circuit

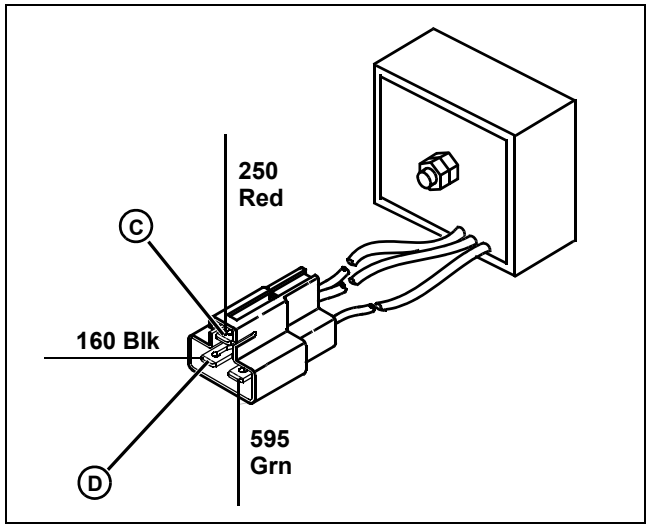


(1) Is there a minimum 14.4 ±0.5 VDC at the starter solenoid 230 Red wire connector (B)?

Yes - Go to next step.

System: Charging Circuit

No - Check starter solenoid. See “Cranking Circuit Diagnosis” on page 92.



(2) Is there a minimum 14.4 ± 0.5 VDC at the voltage regulator 230 Red wire connector (C)?

Yes - Go to next step.

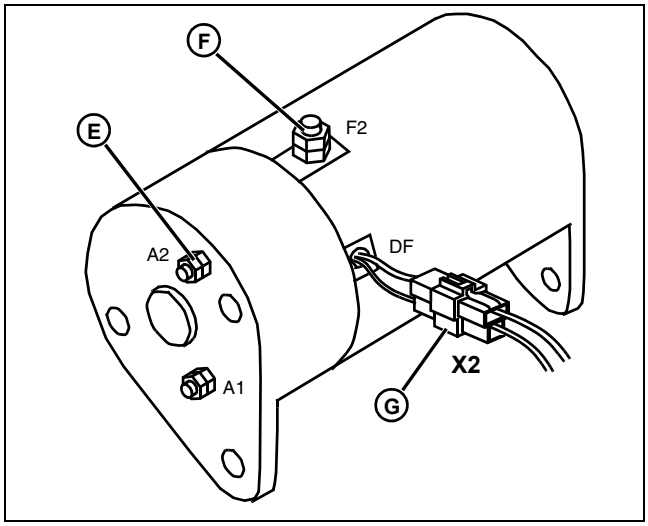
No - Check 205 and 230 Red wires and connections.

(3) Is there greater than 0 volts and less than 0.2 volts at the voltage regulator 160 Blk wire connector (D)?

Yes - Go to next step.

No - Greater than 0.2 volts: Check battery cable to engine ground and connections. Check 160, 100 and 165 Blk wires and connections. Replace voltage regulator.

System: Charging Circuit



(4) Is there greater than 0 volts and less than 0.2 volts at the starting motor/generator A2 160 Blk wire connector (E)?

Yes - Go to next step.

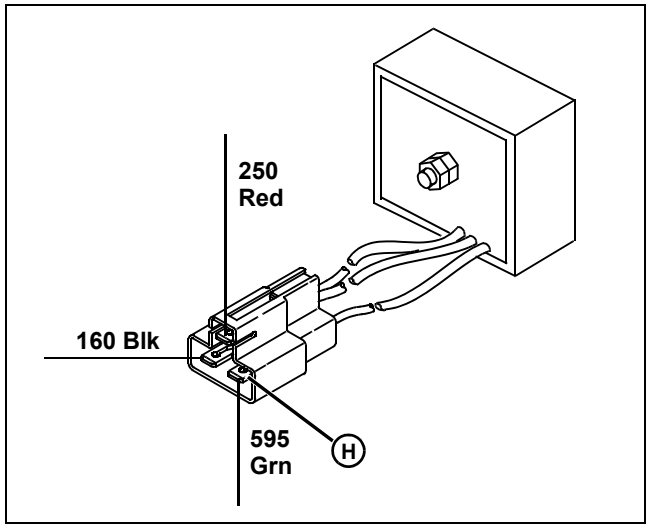
No - Check 240 Red wire and connections. Check 160 Blk wire and connections.

(5) Is there a minimum 14.4 ± 0.5 VDC at the starting motor/generator F2 240 Red wire connector (F)?

Yes - Go to next step.

No - Check starting motor/generator cable connector X2 (G): Check 220 Red wire and connections. Check 595 Grn wire and connections. Test starting motor/generator. See “Starting Motor No-Load Amperage and RPM Tests” on page 108.

System: Charging Circuit



(6) Is there greater than 0 volts and less than 12.0 volts at the voltage regulator 595 Grn wire connector (H)?

Yes - End of tests.

No - Check 595 Grn wire and connections. Replace voltage regulator.

Standard Headlight Circuit Operation

NOTE: If the Light and Horn kit option is added, the new wiring harness plugs into the W1 main wiring harness connectors (X5 and X4). The original domestic light wiring harness is removed.

Function:

Provides power to the headlights.

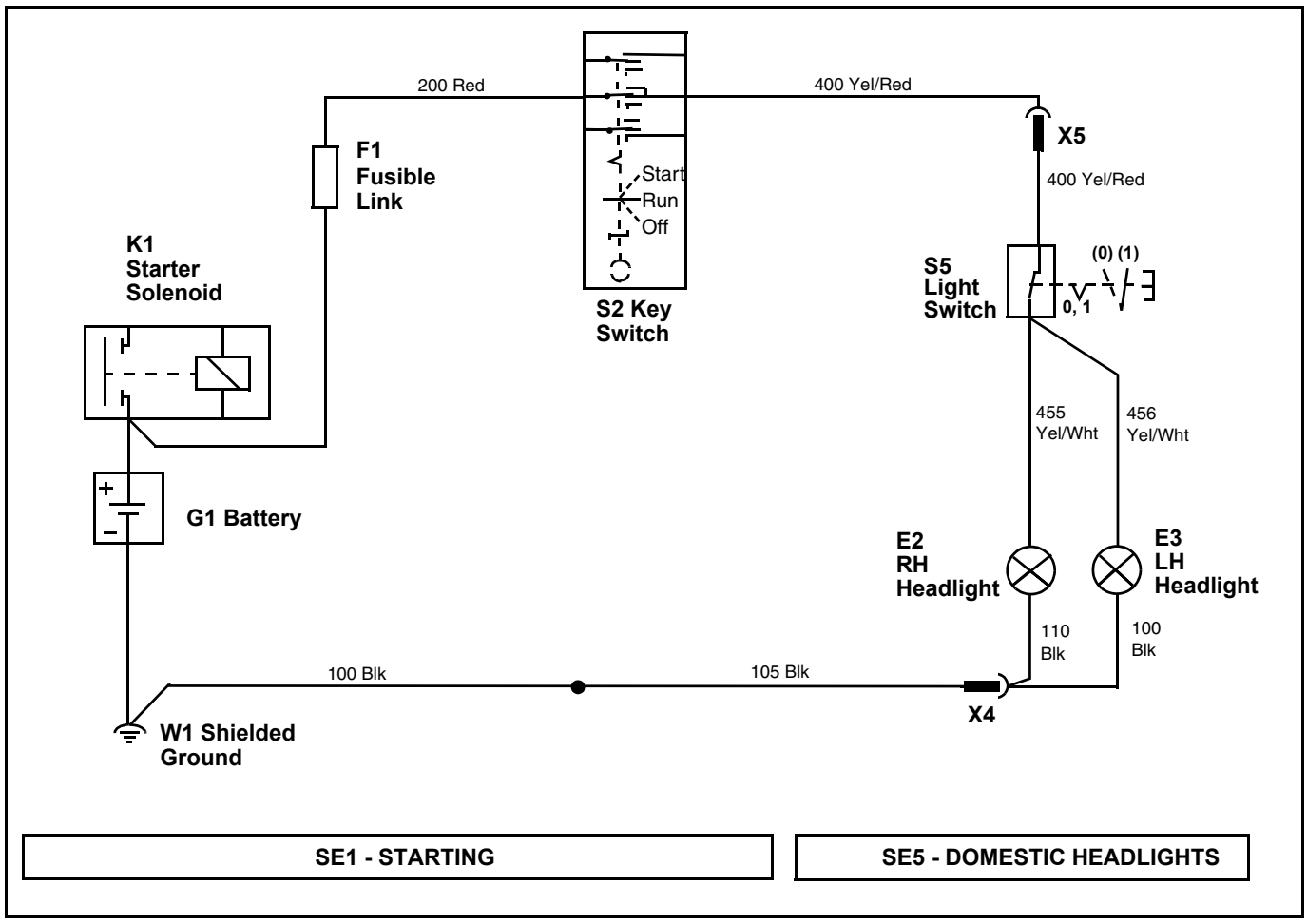
Operating Conditions:

The key switch must be in the RUN position.

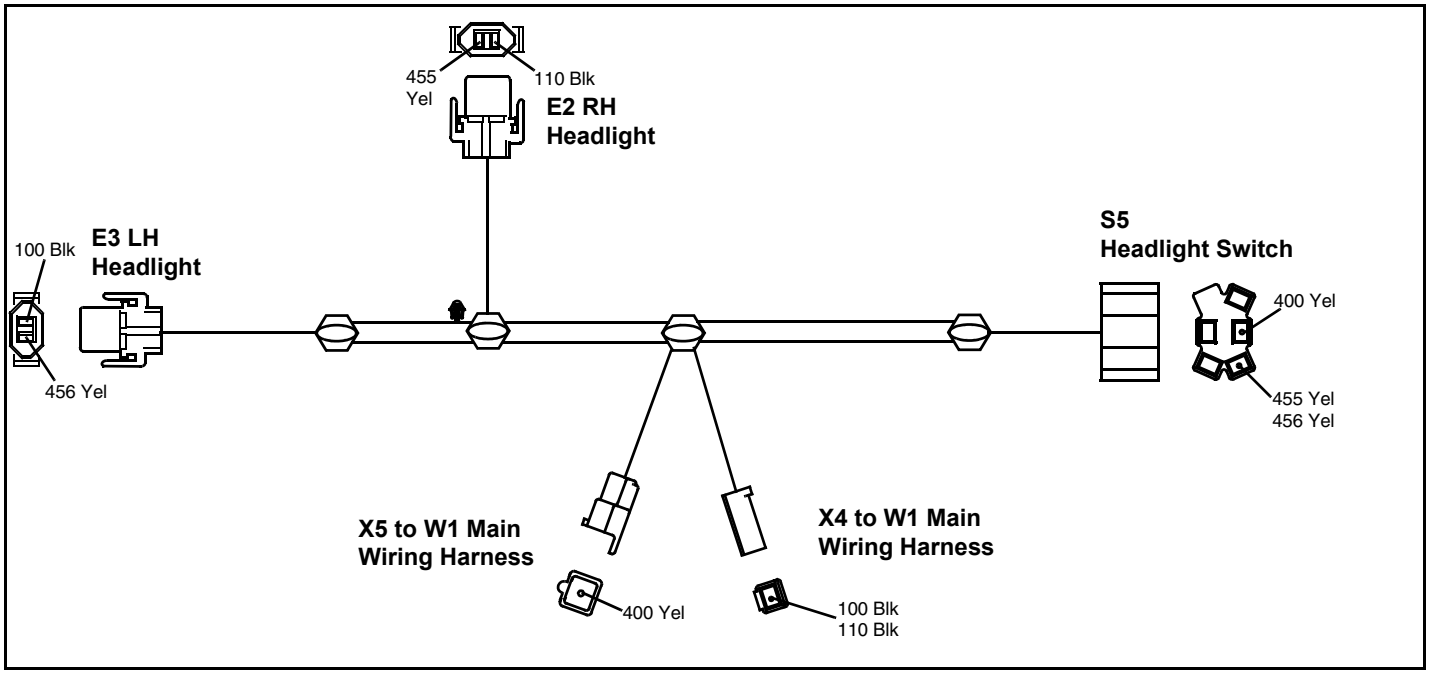
Theory of Operation:

The W3 standard headlight wiring harness is attached to the W1 main wiring harness. Power from the headlight harness connector (X5) is connected to the light switch. Current than flows from the light switch to the headlights. Ground circuit is obtained through the headlight harness connector (X4) and 105 and 100 Blk wires to engine ground.

Standard Headlight Electrical Schematic



Standard Headlight Wiring Harness

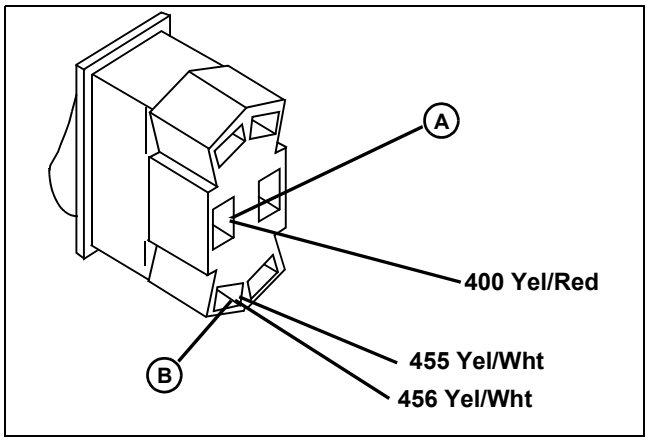


Standard Headlight Circuit Diagnosis

Test Conditions:

- Key switch in the RUN position.
- Park brake ENGAGED
- Light switch ON

System: Headlight Circuit



(1) Is there battery voltage at the headlight switch 400 Yel/Red wire (A)?

Yes - Go to next step.

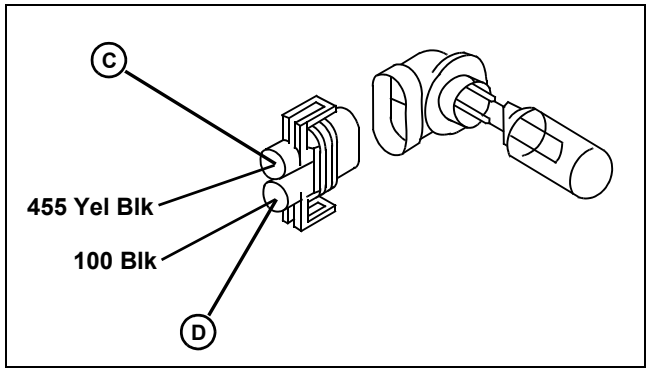
No - See “Power Circuit Diagnosis” on page 88. Check connection at headlight switch.

System: Headlight Circuit

(2) Is there battery voltage at headlight switch 455 and 456 Yel/Wht wires (B)?

Yes - Go to next step.

No - Check switch is in ON position. Replace switch.



(3) Is there battery voltage at LH headlight 455 Yel/Wht wire (C)?

Yes - Go to next step.

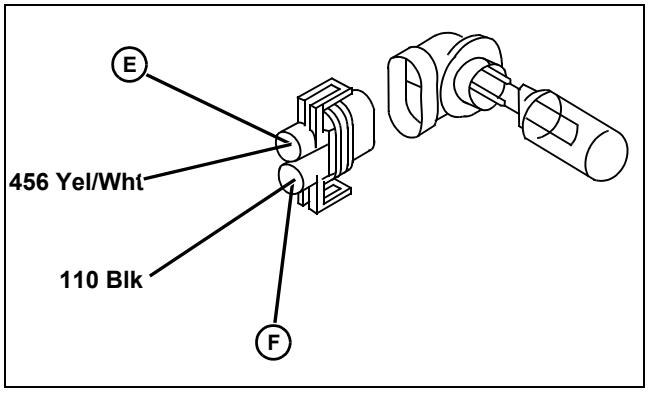
No - Check 455 Yel/Wht wire and connections.

(4) Is there greater than 0 volts and less than 0.2 volts at LH headlight 100 Blk wire (D)?

Yes - Go to next step.

No - Greater than 0.2 volts: Check harness connector (X4) and 100 Blk wires and connections.

System: Headlight Circuit



(5) Is there battery voltage at RH headlight 456 Yel/Wht wire (C)?

Yes - Go to next step.

No - Check 456 Yel/Wht wire and connections.

(6) Is there greater than 0 volts and less than 0.2 volts at RH headlight 110 Blk wire (D)?

Yes - End of tests.

No - Greater than 0.2 volts: Check harness connector (X4) and 110 Blk wire and connections.

Tests and Adjustments

Battery Test

Reason:

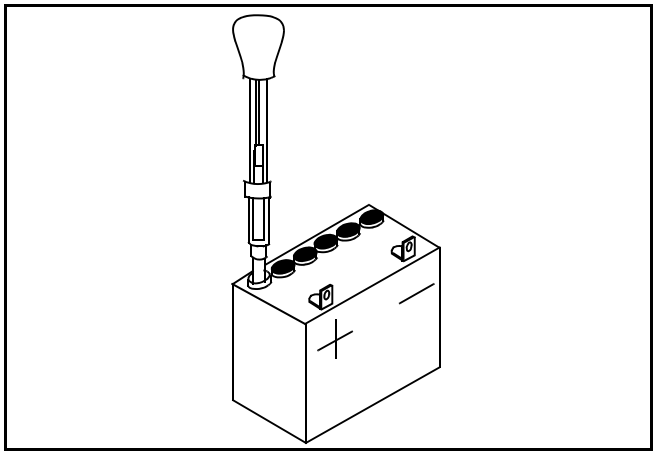
To check condition of battery and determine battery voltage.

Equipment:

- Hydrometer
- Voltmeter or JTO5685 Battery Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Park brake LOCKED and cargo box RAISED.
3. Remove seats and operator's station black plastic shroud.
4. Clean cable ends, battery terminals and top of battery.
5. Remove battery to workbench.
6. Inspect battery terminals and case for breakage or cracks.
7. Check electrolyte level in each battery cell. Add clean, soft water as needed. If water was added, charge battery for 20 minutes at 10 amps.
8. Remove surface charge by placing a small load on the battery for 15 seconds.



9. Use an hydrometer to check for a **minimum specific gravity of 1.225 with less than 50 point variation in each cell.**

Results:

- if all cells less than 1.175, charge battery at 10 amp rate (see Charge Battery);
- If all cells less than 1.225 with less than 50 point variation, charge battery at 10 amp rate (see Charge

Battery);

- If all cells more than 1.225 with less than 50 point variation, load test battery (see Battery Load Test);
- If more than 50 point variation, replace battery.
- Use a voltmeter or JTO5685 Battery Tester to check for a **minimum battery voltage of 12.4 volts.**

Results:

- If battery voltage less than 12.4 VDC, charge battery (see Charge Battery);
- If battery voltage more than 12.4 VDC, test specific gravity (see Step 9);
- Install battery.

Charge Battery

Reason:

To increase battery charge after battery has been discharged.

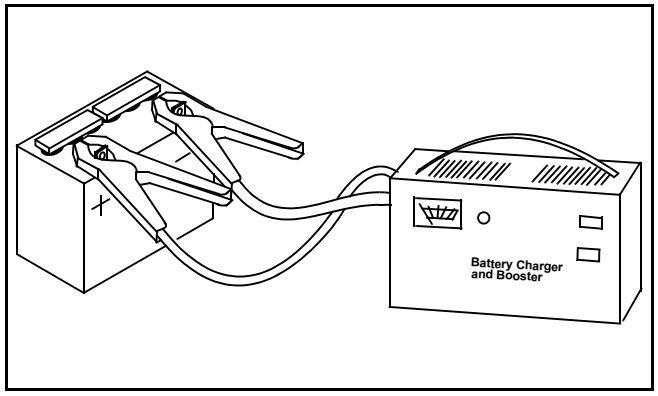
Equipment:

- Battery charger (variable rate)

Procedure:

NOTE: See "Battery Test" in this group before charging battery.

1. Park machine on level surface and turn key switch OFF.
2. Park brake LOCKED and cargo box RAISED.
3. Remove seats and operator's station black plastic shroud.
4. Clean cable ends, battery terminals and top of battery.
5. Remove battery to workbench.



6. Connect variable rate charger to battery.

NOTE: Maximum charge time at boost setting is 10 minutes. Allow additional 5 minutes for each 10 degrees below 70° F.

7. Start charger at SLOW rate. Increase charge rate ONE setting at a time. Check charger ampmeter after 1 minute at each setting. Maintain 10 amp charge rate. Use boost setting as necessary.
8. Check if battery is accepting a 10 amp charge after 10 minutes at boost setting.

Results:

- If battery WILL NOT accept 10 amp charge after 10 minutes at boost setting, replace battery;
- If battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did NOT need water, go to Steps 10 and 11;
- If battery is accepting 10 amp charge after 10 minutes at boost setting, but battery DID need water or all cells were BELOW 1.175, go to Steps 9 and 10.
- Set charger at 15-25 amps.

IMPORTANT: Avoid damage! Decrease charge rate if battery gases or bubbles excessively or becomes too warm to touch.

- Check specific gravity after 30 minutes (60 minutes for maintenance-free battery).

Results:

- If MORE THAN 50 point variation between cells, replace battery;
- If LESS THAN 50 point variation between cells, go to Steps 11 and 12.

NOTE: If battery was discharged at slow or unknown rate, charge at 10-15 amps for 6-12 hours. (Maintenance-free battery: 12-24 hours.) If battery was discharged at fast rate, charge at 20-25 amps for 2-4 hours. (Maintenance-free battery: 4-8 hours.)

- Continue to charge battery until specific gravity is **1.230 – 1.265 points.**
- Load test battery. See "Battery Load Test".
- Install battery.

Battery Load Test

Reason:

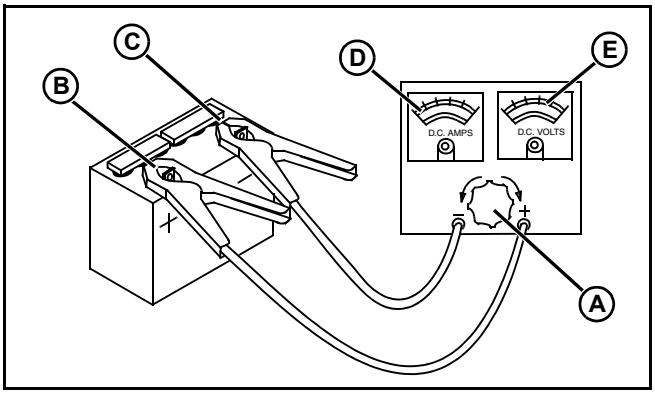
To check condition of battery under load.

Equipment:

- JTO5685 Battery Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Park brake LOCKED and cargo box RAISED.
3. Remove seats and operator's station black plastic shroud.
4. Clean cable ends, battery terminals and top of battery.
5. Remove battery to workbench.



6. Turn load knob (A) counterclockwise to OFF position.
7. Connect tester positive cable (red) to battery positive (+) terminal (B).
8. Connect tester negative cable (black) to battery negative (–) terminal (C).
9. **Turn load knob (A) of tester clockwise (in) until amperage reading (D) is equal to:**
   - **cold cranking amperage rating of battery (use blue scale).**

   —or—
   - **three times ampere hour rating (use black scale).**
10. **Hold for 15 seconds and turn load knob (A) of tester counterclockwise (out) into OFF position.**
11. Repeat Steps 9 and 10 above and read condition of battery at DC Volts scale (E).

Results:

- If battery DOES NOT pass test and has NOT been charged, charge battery and retest (see Charge Battery).
- If battery DOES NOT pass the test and HAS BEEN charged, replace the battery.

Starter Solenoid Test

Reason:

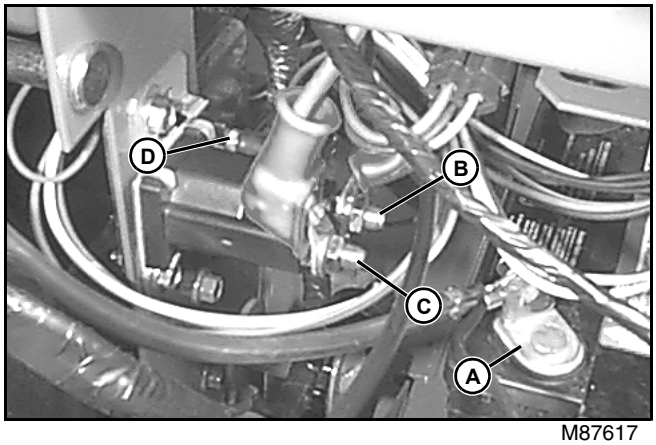
To determine if starter solenoid defective.

Equipment:

- Volt Ohm Meter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Transaxle LOCKED in NEUTRAL. (Use a 6 mm bolt and nut.) See "Transaxle Neutral Lock" on page 121 in Power Train section.
3. Wheels blocked and park brake OFF.
4. Disconnect and ground spark plug lead.
5. Park brake LOCKED and cargo box RAISED.
6. Remove seats and operator's station black plastic shroud.
7. Remove rubber boot from starter solenoid connectors.



M87617

8. Connect VOM to negative (–) battery terminal (A) and terminal (B) of starter solenoid. Check for battery voltage.

Results:

- No battery voltage - See "Power Circuit Diagnosis" on page 88. Check battery (+) terminal and starter solenoid terminal (B) for loose connections. Clean any corrosion.
- Battery voltage - go to next step.
- Connect VOM to negative (–) battery terminal (A) and terminal (C) of starter solenoid. Turn ignition key to RUN position, DEPRESS throttle pedal and check for battery voltage.

Results:

- **Battery voltage – Starter solenoid is not defective.**
- **No battery voltage – go to next step.**

• Connect VOM to negative (–) battery terminal (A) and terminal (D) (Pur wire) of starter solenoid. Turn ignition key to RUN position, DEPRESS throttle pedal and check for battery voltage.

Results:

• No battery voltage - See “Cranking Circuit Diagnosis” on page 92. Check 130 Blk wire and connections between starter solenoid and frame ground.

• Battery voltage - Starter solenoid defective. Replace solenoid.

Starting Motor Loaded Amperage Draw Test

Reason:

To determine the amperage required to crank the engine and check starting motor operation under load.

Equipment:

• JTO5685 Battery Tester

Procedure:

1. Park machine on flat surface and turn key switch OFF.

2. Transaxle LOCKED in NEUTRAL. (Use a 6 mm bolt and nut.) See “Transaxle Neutral Lock” on page 121 in Power Train section.

3. Wheels blocked and park brake OFF.

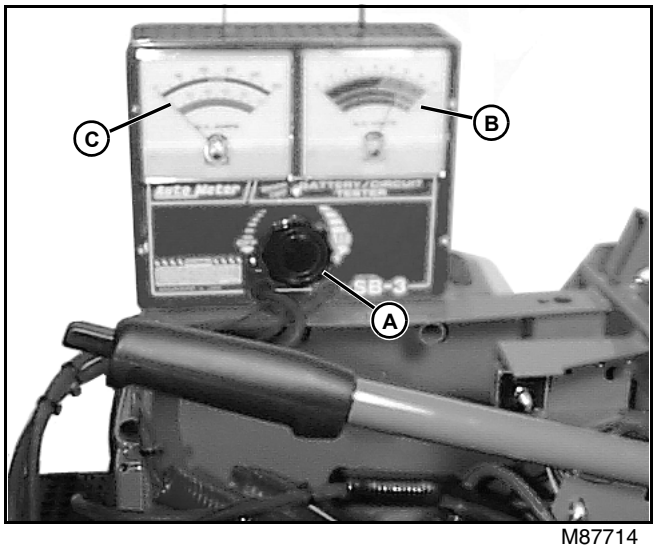
4. Remove seats and operator’s station black plastic shroud.

5. Cargo box RAISED.

6. Test system ground connections and battery (see Ground Circuit Test and Battery Load Test).

7. Disconnect and ground spark plug lead.

IMPORTANT: Avoid damage! Turn load knob (A) fully counterclockwise (out) into OFF position before making any test connections.



M87714

8. Connect JTO5685 Battery Tester to battery.

9. Crank engine—read and record voltage on DC voltage scale (B) of battery tester.

10. Turn key switch to OFF position.

IMPORTANT: Avoid damage! Perform following procedure within 15 seconds to prevent damage to tester and/or machine components.

11. Turn load knob (A) clockwise (in) until DC voltage (B) reads the same as when cranking.

12. Read and record DC amperage (C).

13. Turn load knob (A) completely counterclockwise (out) into OFF position.

Results:

• **Maximum starting motor draw should be 51 amps at 750 rpm.**

• If amperage is above specification, perform Starting Motor No-Load Amperage and RPM Test to determine if starting motor is binding or damaged.

• If starting motor is good, check internal engine components for binding, wear, or damage.

Starting Motor No-Load Amperage and RPM Tests

Reason:

To determine if starting motor is binding or has excessive amperage draw under no-load.

Equipment:

- Fluke Multi-Meter (Set to 10 Amp DC scale)
- JDM71 Vibration Tachometer or JT07270 Digital Pulse Tachometer

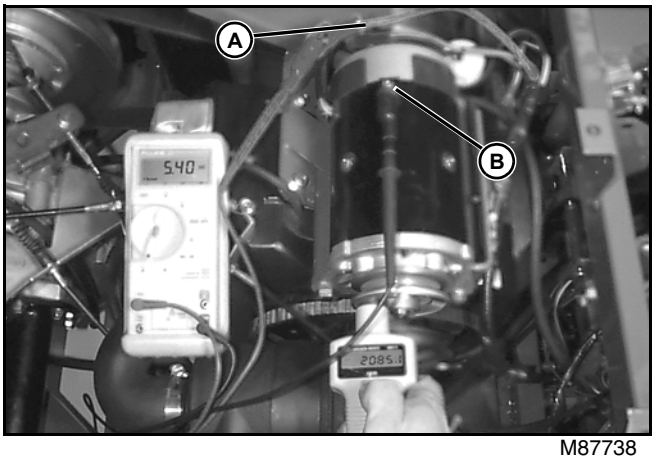
Procedure:

NOTE: Check that battery is fully charged and of proper size to ensure accuracy of test.

1. Park machine on flat surface and turn key switch OFF.
2. Transaxle LOCKED in NEUTRAL. (Use a six mm bolt and nut.) See “Transaxle Neutral Lock” on page 121 in Power Train section.
3. Wheels blocked and park brake OFF.
4. Cargo box RAISED.
5. Remove belt between starting motor/generator and engine sheaves.
6. Disconnect 12 VDC (240 Red) wire from starting motor/generator (F2) terminal.

IMPORTANT: Avoid damage! When connecting wires and meter, ensure connections are not touching any surface where a ground short may occur. Wrap connections with electrical tape if necessary.

7. Connect Fluke Multi-Meter in series with 240 Red wire (A) and starting motor/generator (F2) terminal (B).



M87738

8. Use reflective tape on starting motor/generator pulley and JTO5719 Photo Tachometer to measure starting motor/generator rpm’s.

NOTE: Fluke Multi-Meter set at 10Amp DC scale for following tests.

9. Turn ignition switch to RUN position and depress throttle pedal to start starting motor/generator.
10. Measure and record starting motor/generator amperage draw and rpm’s.

Results:

- a good starting motor should have **a maximum amperage reading of six amps and a minimum rotational reading 1000 rpm.**
- If amperage reading is above six amps or starting motor rpm is less than 2050, check for binding or seized bearings, sticky brushes, and dirty or worn commutator.
- Repair or replace starting motor/generator.

Spark Test

Reason:

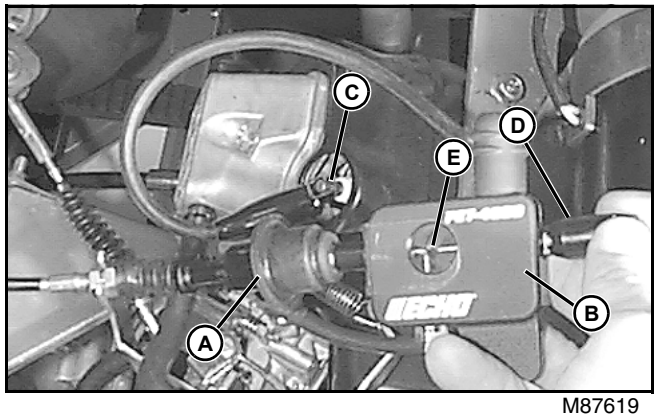
To check overall condition of ignition system.

Equipment:

- D-05351ST — Spark Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Transaxle LOCKED in NEUTRAL. (Use a six mm bolt and nut.) See “Transaxle Neutral Lock” on page 121 in Power Train section.
3. Wheels blocked and park brake OFF.
4. Cargo box RAISED.



M87619

5. Remove high tension lead (A) from spark plug and connect to spark tester (B).
6. Connect spark tester lead to spark plug (C).
7. Adjust spark tester gap to **4.2 mm (0.166 in.)** with screw

(D).

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

8. Turn key switch to RUN position and start engine.

9. Watch spark (E) at spark tester.

Results:

- If engine will start, watch spark with engine running. There should be a strong, steady, blue spark.
- If spark is weak, or if no spark, install a new spark plug and test again.
- If spark is still weak, or still no spark, run tests on individual components to find cause of malfunction.

Spark Plug Cap Test

Reason:

To determine if spark plug cap is defective.

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Park brake ON.
3. Cargo box RAISED.
4. Disconnect spark plug cap.

M56818

5. Measure resistance across spark plug cap terminals.

Results:

- Resistance should be **approximately 5000 ohms**, the same as marked on the spark plug cap.
- If resistance DOES NOT meet specification, replace spark plug cap.

Park Brake Switch Test

Reason:

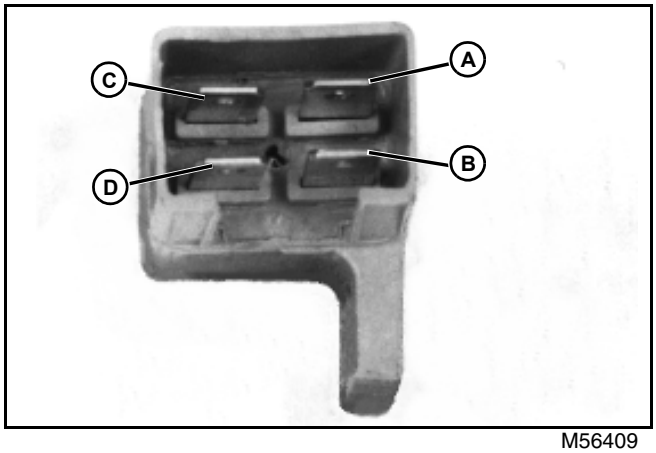
To ensure the park brake switch has continuity when switch plunger DEPRESSED (park brake OFF).

Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Remove seats, and operator's station black plastic shroud.
3. Disconnect harness connector from park brake switch.



M56409

4. Check continuity between connectors (A and B (yellow)).

Results:

- there should BE continuity between terminals (A and B) when plunger is RELEASED (Park brake ON),
- there should NOT BE continuity between terminals (A and B) when plunger is DEPRESSED (Park brake OFF).
- If continuity is NOT correct, replace switch.
- Check continuity between connectors (C and D).

Results:

- there should NOT BE continuity between terminals (C and D) when plunger is RELEASED (Park brake ON),
- there should BE continuity between terminals (C and D) when plunger is DEPRESSED (Park brake OFF).
- If continuity is NOT correct, replace switch.

Light Switch Test

Reason:

To make sure the light switch terminals have continuity when the light switch is **ON**.

Equipment:

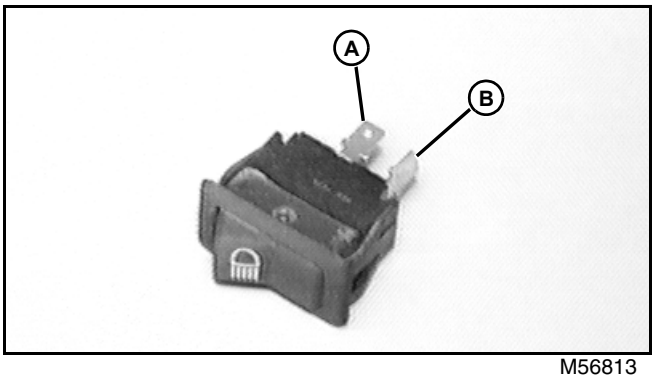
- Ohmmeter or Continuity Tester

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Lock park brake.

NOTE: You may want to remove front hood for easy access to dash panel electrical components.

3. Disconnect light switch connector.



M56813

4. Move light switch to the ON and then the OFF position. Check continuity between terminals (A and B).

Results:

- **Terminals should have continuity with switch ON.**
- **Terminals should NOT have continuity with switch OFF.**
- If continuity is NOT correct, replace light switch.

Key Switch Test

Reason:

To verify key switch functions are operating properly.

Equipment:

- Ohmmeter or Continuity Tester

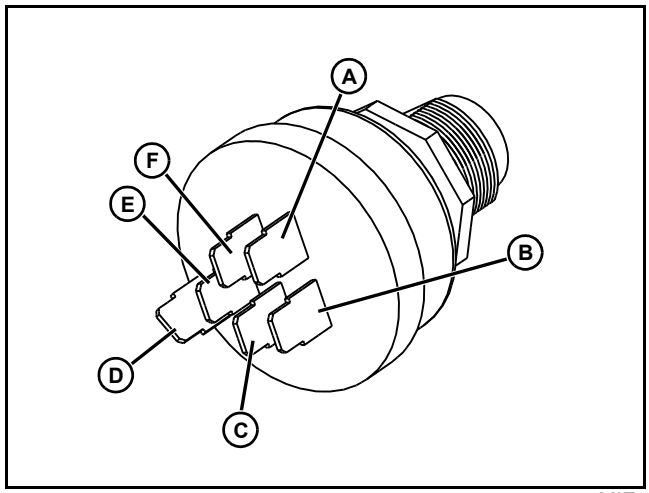
Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Lock park brake.

NOTE: You may want to remove front hood for easy access to dash panel electrical components.

3. Disconnect key switch connector.

NOTE: DO NOT refer to markings stamped on terminals. Identify terminals by art keys ONLY. Terminal combinations other than those listed in chart should NOT have continuity.



MIF

4. Use an ohmmeter to test switch continuity in OFF, RUN, and START positions.

Key Switch Continuity:

Switch Position	Terminal Continuity
OFF	A and B
RUN	C and D
START	C and D, E and F

Results:

- If any continuity is NOT correct, replace switch.

Flywheel Magnet Test

Reason:

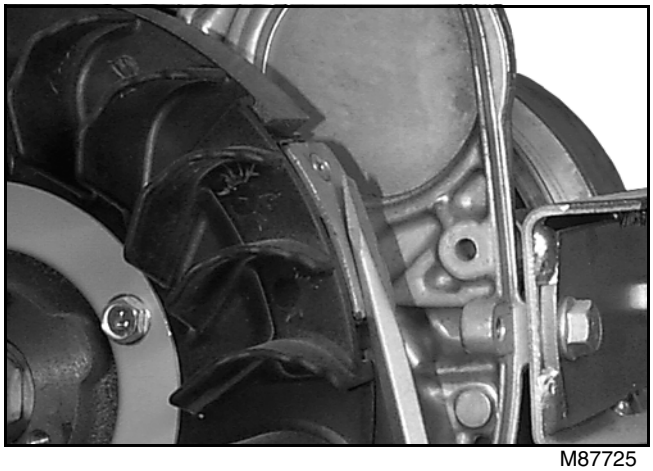
To make sure flywheel magnet(s) have enough force to induce current into ignition coil.

Equipment:

- Screwdriver

Procedure:

1. Park machine on level surface and turn key switch OFF.
2. Park brake ON.
3. Cargo box RAISED.
4. Remove flywheel blower housing from engine.



M87725

5. Loosely hold screwdriver blade about 25 mm (1.0 in.) away from magnet.

Results:

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

Electrical System Amperage Draw Tests

Reason:

To measure amperage draw of electrical components when battery has a discharge problem.

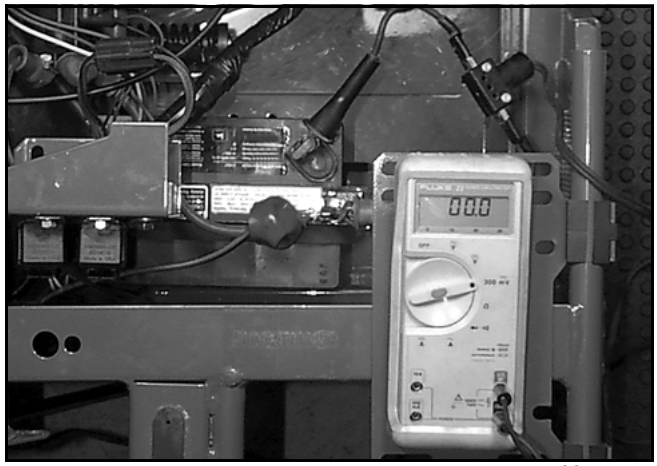
NOTE: The battery will discharge if operating several electrical components at the same time with the engine at low idle.

Equipment:

- Fluke Multi-Meter (Set to 300 mV scale)
- JTO5792 Ammeter Shunt Assembly
- JDM71 Vibration Tachometer or JT07270 Digital Pulse Tachometer

Procedure:

1. Turn key switch to OFF position.
2. Lock park brake.
3. Transaxle LOCKED in NEUTRAL. (Use a six mm bolt and nut.) See “Transaxle Neutral Lock” on page 121 in Power Train section.
4. Remove seats and black plastic shroud.



M87844

5. Disconnect battery positive cable.
6. Connect ammeter shunt to battery positive cable and battery positive terminal.
7. Connect ammeter shunt to multimeter volts connection and set meter to 300 mV scale.
8. Turn key switch to ON position. DO NOT start engine.
9. Turn one component ON at a time and measure amperage draw. Several components can be ON to measure total amperage draw to match a specific operating condition that a battery discharge occurs.

The following tables show approximate charging output and component amperage draw.

NOTE: Fluke Multi-Meter set at 300 mV scale for following tests.

Component Amperage Draw:

NOTE: * Tests apply only to Optional Kits.

Results:

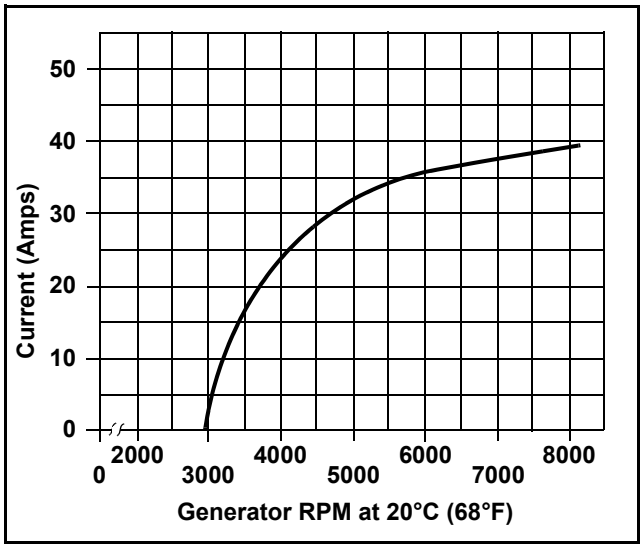
- If component amperage draw exceeds generator output, the battery will discharge. Either reduce amperage draw or do not let engine idle for extended period of time.

NOTE: Disconnect and ground spark plug wire for next test.

- Disconnect and ground spark plug wire.
- Measure amperage draw while turning engine over.

Generator Output

1. Connect spark plug wire.
2. Use reflective tape on starting motor/generator pulley and JTO5719 Photo Tachometer to measure starting motor/generator rpm’s.



Results:

- As starting motor/generator RPM is increased or decreased, measured amperage should follow curve in table shown above.

Ground Circuit Tests

Reason:

To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Equipment:

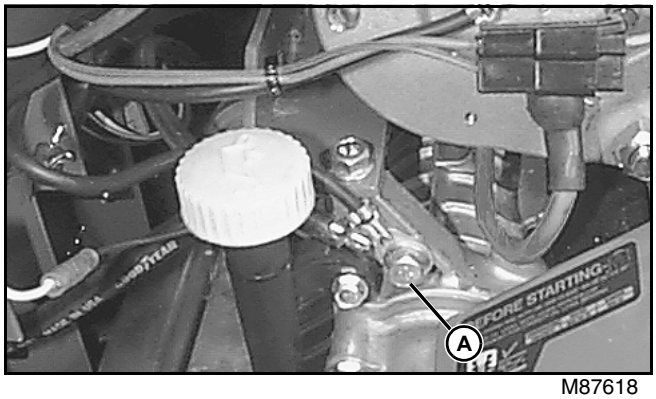
- Ohmmeter or Voltmeter

The voltmeter method checks ground connections under load.

Procedure Using Ohmmeter:

1. Park machine on level surface and turn key switch OFF position.
2. Park brake LOCKED.
3. Cargo box RAISED.

NOTE: DO NOT use the frame as ground connection point. The frame is isolated from battery or engine ground. Use either the battery negative (–) terminal or the engine harness ground (A).



M87618

4. Connect ohmmeter negative (black) lead to negative terminal of battery. Put meter positive (red) lead on negative terminal of battery and record reading.
5. Put meter red lead on ground terminal of circuit or component to be tested that is closest to the battery negative terminal. **Resistance reading must be very close to or the same as the battery negative terminal reading. Work backwards from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohms.** The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. **Maximum allowable resistance in the circuit is 0.1 ohms.** Check both sides of connectors closely as disconnecting and connecting may temporarily solve problem.

Procedure Using Voltmeter:

1. Park machine on level surface and turn key switch ON.
2. Park brake LOCKED.
3. Cargo box RAISED.
4. Connect voltmeter negative (black) lead to negative terminal of battery.
5. Put meter positive (red) lead on ground terminal of circuit or component to be tested. Be sure the component circuit is activated (key on, switches closed) so voltage will be present at the component. Record voltage. **Voltage must be greater than 0 but less than 1 volt.** Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results:

- If voltage is 0, the component is open.
- If voltage is greater than 1 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

Table of Contents

Specifications

General Specifications

Drive Belt Width (new) . . . . . Approximately 30.2 mm (1.19 in.)
Drive Belt Width (minimum). . . . . 27 mm (1.063 in.)

Secondary Clutch Spring Torsion Standard Wrap:

Brown Spring . . . . . 22 - 40 N (5 - 9 lb)
Green Spring. . . . . 62 - 80 N (14 - 18 lb)

Transaxle:

Transaxle Capacity. . . . . 0.61 - 0.10 L (1.25 - 1.50 US pt)
Transaxle Oil . . . . . .J20C Hy-Gard

Repair Specifications

Torques:

Axle to Frame Carriage Bolts . . . . . 87 ± 17 N•m (52 - 76 lb-ft)
Axle Case to Transaxle . . . . . 40 ± 6 N•m (25 - 35 lb-ft)
Drum Brake Assembly to Axle Case. . . . . 23 ± 3 N•m (15 - 19 lb-ft)
Rear Wheel to Axle Case . . . . . 23 ± 3 N•m (15 - 19 lb-ft)
Primary Clutch to Engine Cap Screw . . . . . 40 ± 8 N•m (24 - 35 lb-ft)
Driven Clutch to Transaxle Cap Screw. . . . . 75 ± 7 N•m (50 - 60 lb-ft)
Differential to Ring Gear Cap Screws and Nuts . . . . . 80 ± 5 N•m (55 - 63 lb-ft)
Differential to Ring Gear Cap Screws and Nuts . . . . . 80 ± 5 N•m (55 - 63 lb-ft)
Transaxle Case Half Cap Screws . . . . . 15 N•m (110 lb-in.)

Transaxle:

Input Shaft End Play. . . . . 0.05 - 0.20 mm (0.002 - 0.008 in.)

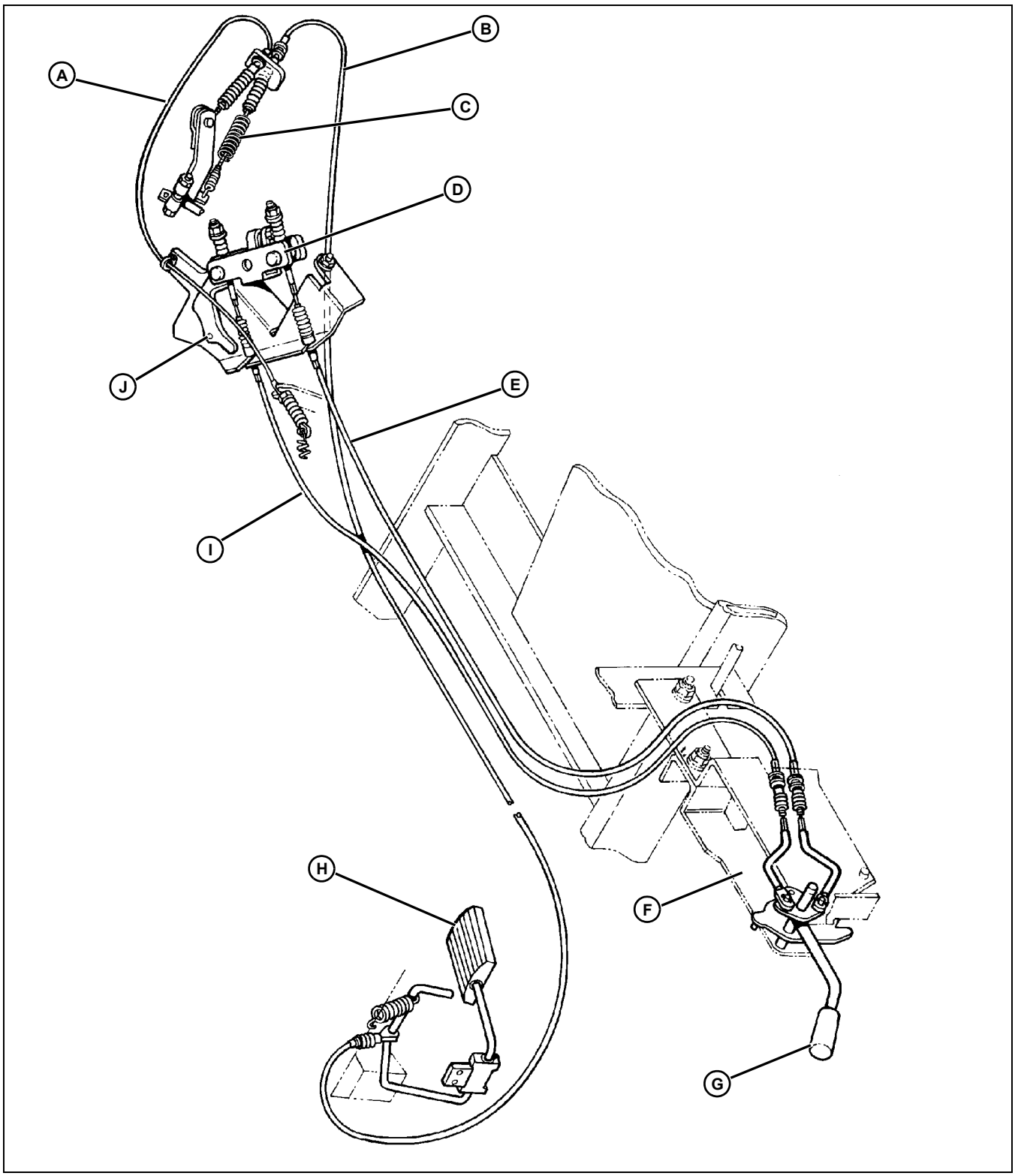
Other Materials

Other Material

Part No.	Part Name	Part Use
TY15130 #595	John Deere Form-in-Place Gasket	Seal mating surfaces of transaxle
TY16285/#7649	Cure primer	Clean sealing surfaces
TY6333	Moly High Temperature EP Grease	Apply to splines of axle
TY9370 /T43512/ #242	Thread Lock and Sealer (Medium Strength)	To seal threads on control valve screws, spool detent, and small plugs

Component Location

Cable Components

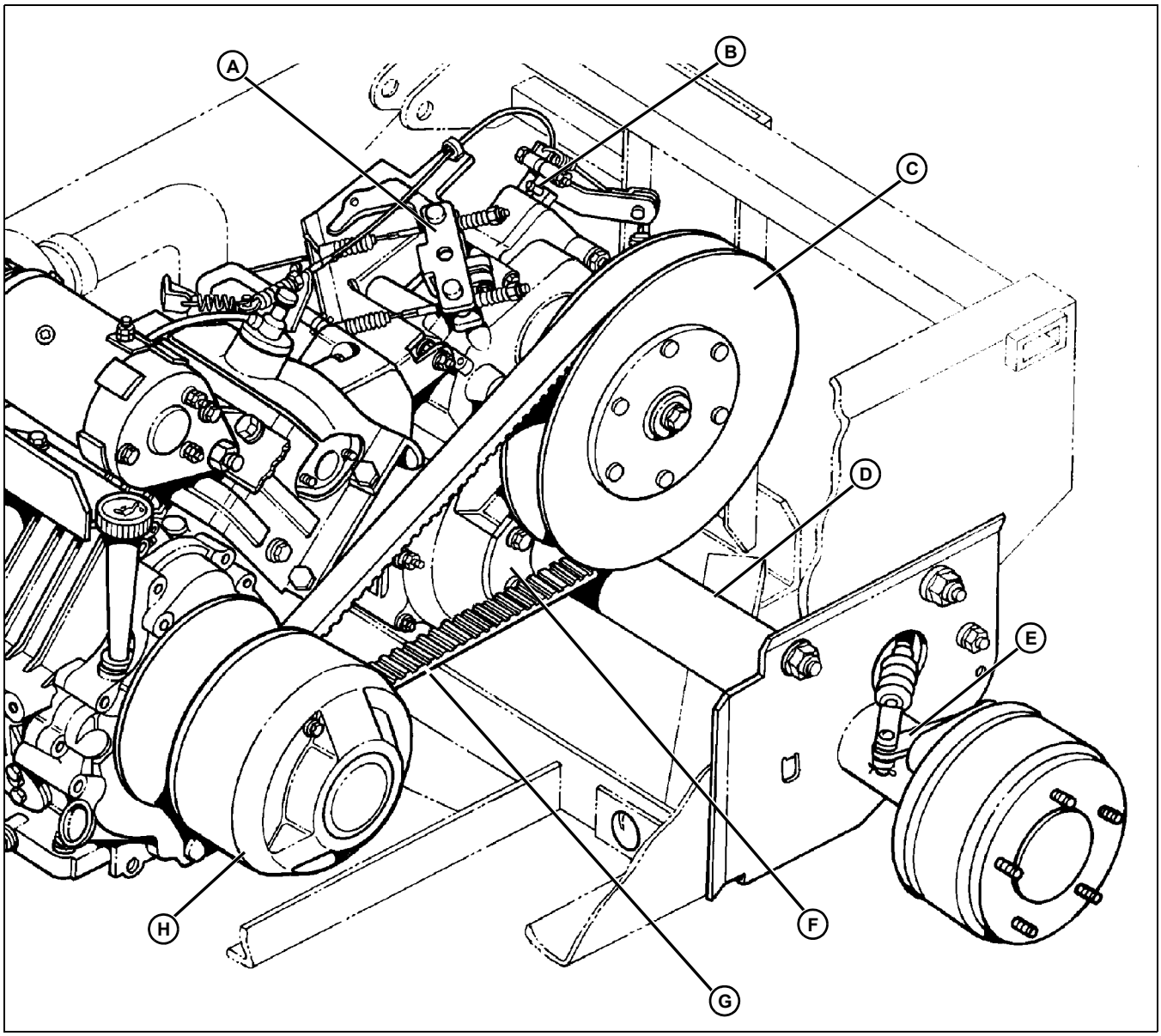


MX1372

A - Governor Cable
B - Pedal to Transaxle Cable
C - Compression Spring
D - Shift Linkage
E - Reverse Cable
F - Shift Quadrant
G - Shift Lever

H - Pedal
I - Forward Cable
J - Neutral Lock (Alignment Hole)

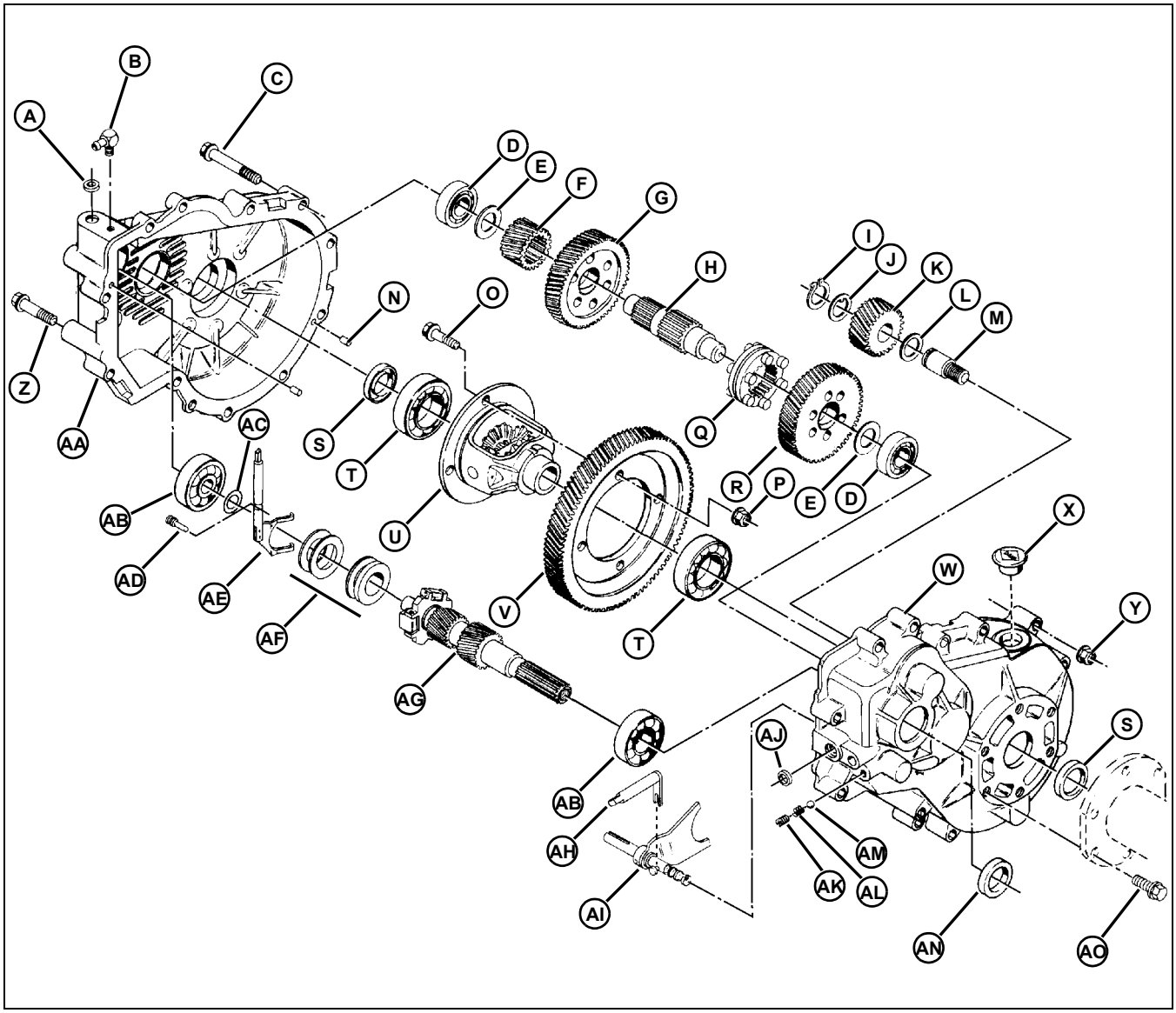
Drive Components



M87768

A - Shift Linkage
B - Governor Shaft
C - Secondary Clutch
D - Axle Housing
E - Brake Arm
F - Transaxle
G - Drive Belt
H - Primary Clutch

Transaxle Components



M87840

A - Seal, Governor Shaft**
B - Fitting, 90° Elbow
C - Screw, Flange Head (Long)
D - Bearing
E - Washer
F - Gear, Splined Pinion
G - Gear, Final Drive
H - Shaft, Drive Gears
I - C-Clip
J - Washer, Tabbed*
K - Gear, Reverse Idler
L - Washer*
M - Support Bearing
N - Pin, Alignment
O - Screw, Flange Head Socket
P - Nut, Flange Head
Q - Lock Collar Assembly
R - Gear, Final Drive
S - Seal, Oil
T - Bearing
U - Differential Assembly
V - Gear, Ring
W - Transaxle Housing, LH
X - Plug, Rubber
Y - Nut, Lock
Z - Screw, Flange Head (Short)
AA- Transaxle Housing RH
AB- Bearing, Input Shaft
AC- Shim(s)
AD- Screw, Retaining**
AE- Governor Shaft Assembly**

AF- Actuating Sleeve Assembly

AG- Input Shaft and Governor (Backing Plate) Assembly

AH- Rod, Shift Assembly

AI - Lock Fork Assembly

AJ- Seal, Actuator Shaft

AK- Set Screw***

AL- Spring***

AM- Ball Bearing***

AN- Seal, Input Shaft

AO- Screw, Flange Head

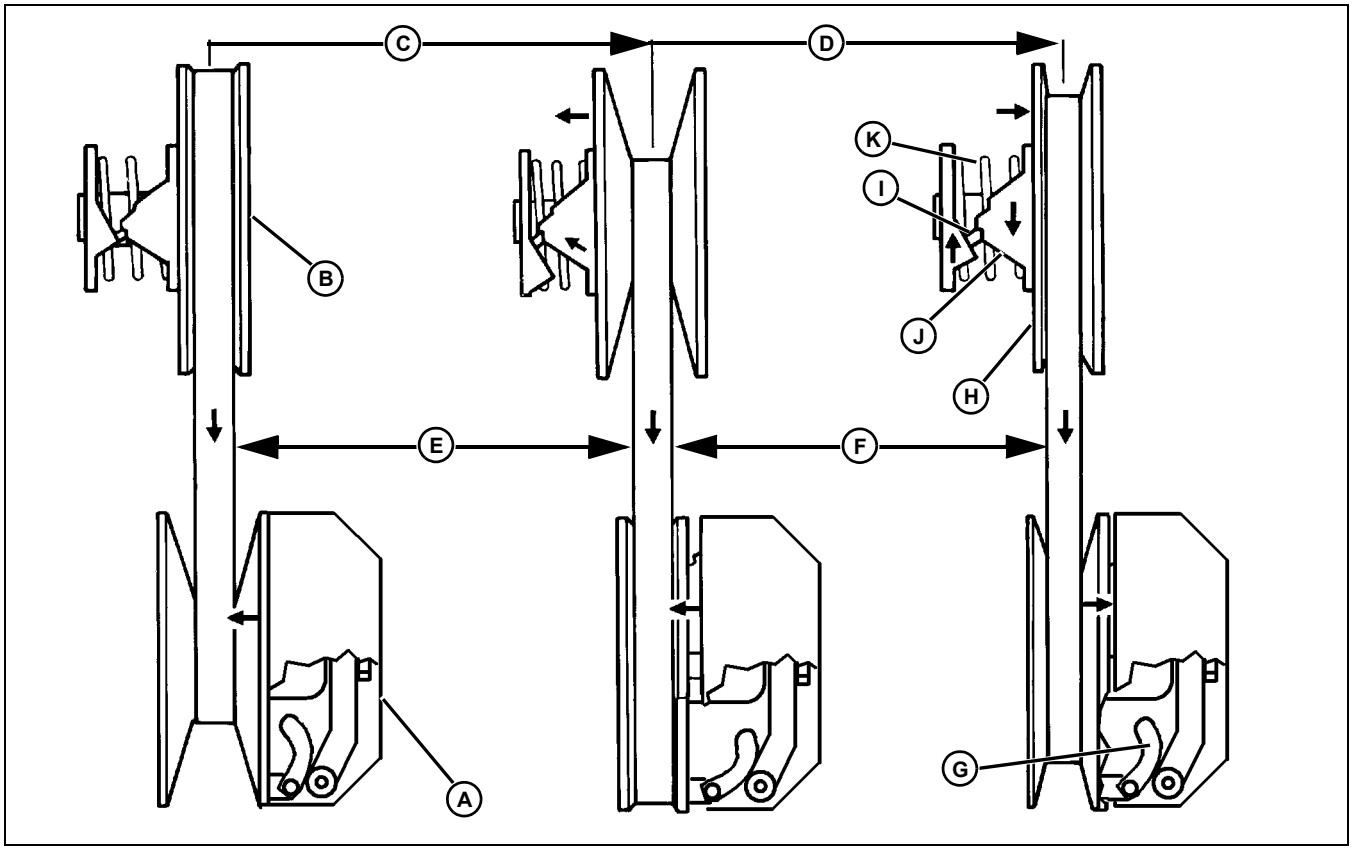
* Included in Thrust Washer Kit

** Included in Governor Actuator Kit

*** Included in Detent Kit

Theory of Operation

Clutch Operation



M56089

Theory of Operation:

The variable clutch system is speed and load sensitive. The primary (A) and secondary (B) clutches work together, automatically up-shifting (C) and back-shifting (D). This shifting changes the ratio between the clutches, allowing the engine to operate at optimum efficiency, at the peak of its power curve.

The primary clutch is engine speed sensitive, and is mounted on the engine crankshaft. It operates on the principle of centrifugal force. The secondary clutch, mounted on the transaxle input shaft, is load sensitive to the rear drive wheels.

Engagement RPM, Minimum Load, Low Output Speed (E):

Primary clutch sheaves are moving closer together, just starting to move drive belt. Drive belt is running at the top of secondary clutch. A high ratio between the clutches exist, similar to a low gear, as long as there is a minimum load.

High Engine RPM, Light Load, High Output Speed (F):

As engine speed increases, centrifugal forces of the flyweights (G) force the primary clutch to up-shift, moving the drive belt to outer pulley diameter, overcoming secondary clutch spring. Drive belt then is pulled deep in secondary clutch giving a low ratio, similar to a high gear.

High Engine RPM, Increasing Load, Lower Output Speed:

Back-shifting occurs as a load is encountered, such as a hill or soft terrain. The stationary side of the secondary clutch resists forward movement of the wheels, at the same time, torque from the drive belt moves the moveable sheave (H) up the ramp. The ramp buttons (I), ramp (J), and spring (K) forces the belt to the outside diameter of the secondary clutch, and overcomes centrifugal forces of the primary clutch causing the back-shifting.

Transaxle Component Location and Operation

Function:

The transaxle provides:

- a means for shifting into forward and reverse;
- differential action between axles for turning.

Neutral (LOCKED IN Position):

When locked into neutral (see Transaxle Neutral Lock below) the shift lever centers the shift collar between the forward drive gear, and reverse drive gear, so they are not engaged. The input shaft rotates freely, not transferring power to the reduction gear shaft.

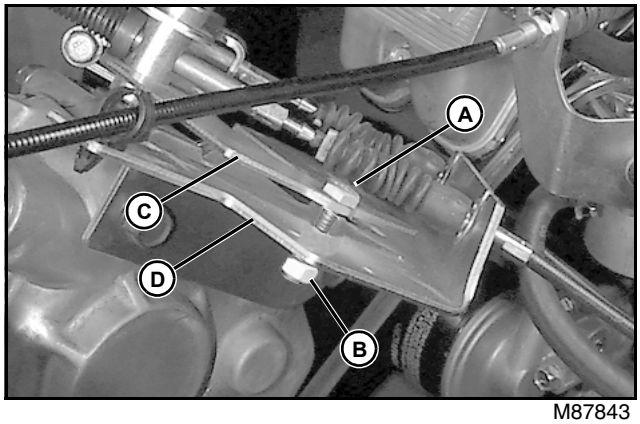
Forward Power Flow:

When shifted into the forward position the shift collar engages the forward drive gear. Power is transmitted through the reduction gear shaft that is in constant mesh with the differential gear. The differential gear and housing rotate and transfer power through the bevel pinion and side gears to the axles.

Reverse Power Flow:

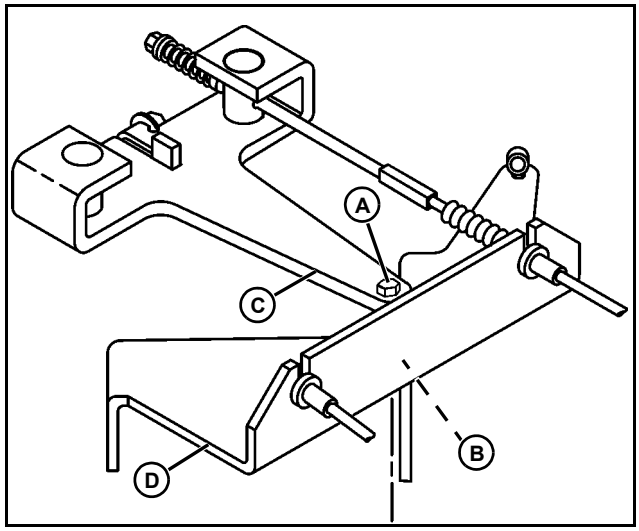
When shifted into reverse, the shift collar engages the reverse drive gear, that transmits power through the reduction gear shaft that is in constant mesh with the differential gear. Power is then transferred through the differential to the axle.

Transaxle Neutral Lock



M87843

Early Models



MX1440

Late Models

There is NO Neutral Position on the shift lever. To LOCK transaxle in NEUTRAL a 6 mm bolt (A) and nut (B) or 1/4” bolt and nut are used in the shift linkage (C) located on top of the transaxle. For testing purposes, or towing, a 6 mm or 1/4” bolt is inserted through the shift linkage, an added nut and the shift linkage bracket (D). The nut prevents shearing pressure from moving the bolt away from a vertical position.

DO NOT tow vehicle without installing 6 mm bolt and nut.

Diagnostics

Drive System Diagnosis

Test Conditions:

- Front wheels blocked
- Rear wheels jacked off floor
- Engine OFF

System: Drive Train

(1) Is the drive belt in good condition?

Yes - Go to next step.

No - Replace drive belt.

(2) Do the rear axles rotate smoothly and quietly with no free play in axles, bearings or housings?

Yes - Go to next step.

No - Check axles and housings. Check axle couplers.

(3) Are the brakes dragging?

Yes - Adjust brakes. See “Brake Adjustment” on page 167in the Brake section.

No - Go to next step.

Test Conditions:

- Front wheels blocked
- Rear wheels jacked off floor
- Engine running

System: Drive Train

(1) Does the transaxle shift smoothly into forward and reverse and stay in gear during operation?

Yes - Go to next step.

No - Shut off engine and allow engine to cool. Adjust shift linkage. See “Transaxle Shift Cable Adjustment” on page 123. Retest.

Test Conditions:

- Wheels blocked
- Transaxle LOCKED in Neutral. See “Transaxle Neutral Lock” on page 121.
- Engine running

System: Drive Train

(1) Is the primary clutch disengaged with the engine running?

Yes - Go to next step.

No - Check engine idle rpm. Adjust idle to specification if needed. If engine rpm is to specification, repair or replace clutch.

Test Conditions:

- Wheels blocked
- Transaxle LOCKED in Neutral. See “Transaxle Neutral Lock” on page 121.
- Engine running
- Accelerate engine to 1600 rpm

System: Drive Train

(1) Does the primary clutch engage drive belt at 600 - 700 engine rpm?

Yes - Go to next step.

No - Check drive belt, replace as necessary. Repair or replace primary clutch.

Test Conditions:

- Wheels blocked
- Transaxle LOCKED in Neutral. See “Transaxle Neutral Lock” on page 121.
- Engine running at fast idle

System: Drive Train

(1) Does the primary clutch movable sheave move toward the stationary sheave?

Yes - Go to next step.

No - Repair or replace primary clutch.

(2) Do the secondary clutch sheaves separate?

Yes - Go to next step.

No - Repair or replace secondary clutch.

(3) With the secondary clutch fully up-shifted, do the primary clutch sheaves close completely? Note: the drive belt will not ride at the top of the primary clutch sheaves when they are fully closed.

Yes - End of tests.

System: Drive Train

No - Check center distance between clutches. See “Check/Adjust Clutch Center Distance” on page 34 in the Engine section. Repair or replace drive and/or secondary clutches.

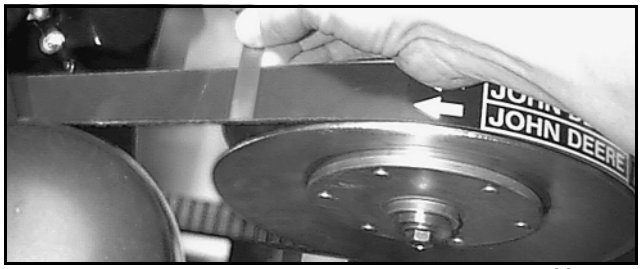
Tests and Adjustments

Drive Belt Check

Reason:

To check drive belt wear and condition of drive belt.

Procedure:



M87739

1. Measure drive belt width. Drive belt must not be less than **27 mm (1-1/16 in.).**

2. Check drive belt condition. Drive belt must not be cracked. Some amount of glazing is normal.

Results:

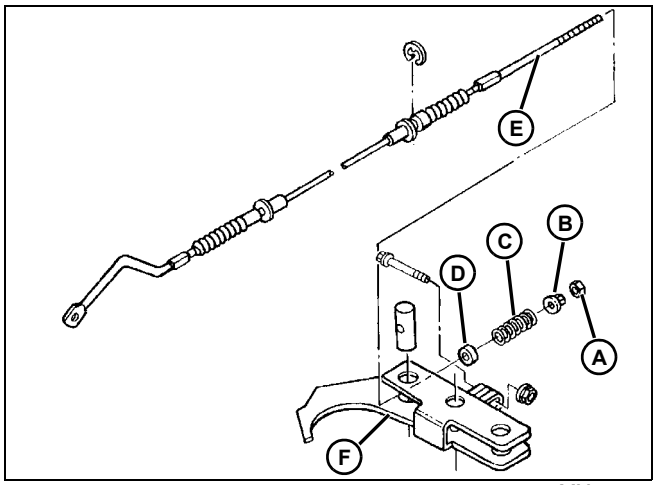
- If drive belt less than specification, replace.
- If drive belt is within specification, and there is a performance complaint, check primary clutch and secondary clutch. See “Drive System Diagnosis” on page 122.

Transaxle Shift Cable Adjustment

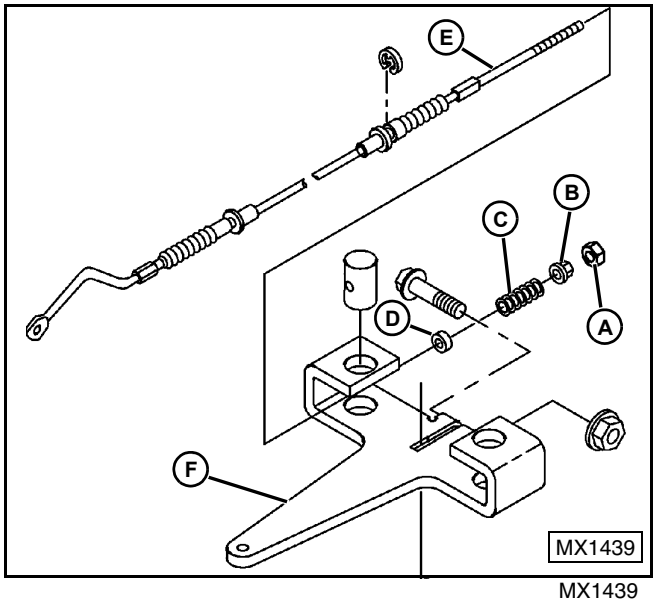
Reason:

To insure both forward and reverse gears will be completely engaged.

Procedure:



MX3911



MX1439

1. Remove jam nut (A), nut (B), and install new springs (C) on shift cable rods (E) against original spacer (D). Install nut (B) onto first few threads of rod.

2. Push shift lever in operator’s station down into forward position.

NOTE: To assure that the gears are NOT engaged while holding the transaxle shift arm in the forward position, rotate the secondary clutch by hand until the transaxle pops into gear and then note the position of the transaxle shift arm. This will give a reference point to help determine the lever position when the gears are NOT aligned. Ensure that the NOT aligned position is

achieved.

3. Make sure that the shift arm (F) is rotated in the forward direction but that the gears are NOT engaged.

4. Hold the shift cable with clamps to avoid twisting while tightening the adjusting nut (B) until the forward spring is completely compressed. DO NOT continue to tighten the nut beyond the point where the operators station shift lever starts to move.

5. Rotate secondary clutch by hand until the shift arm pops into gear.

6. Move the shift lever to the reverse position, but gears are NOT engaged.

7. Hold the shift cable with clamps to avoid twisting while tightening the adjusting nut (A) until the reverse spring is completely compressed. DO NOT continue to tighten the nut beyond the point where the operators station shift lever starts to move.

8. To test that adjustment was done correctly, move shift lever into forward then rotate secondary clutch by hand and check that it pops in gear when aligned. Repeat for reverse.

9. Install jam nuts (A) on both rods, and tighten against adjusting nuts to lock in place.

Engagement And Full Up–Shift Check

Reason:

To determine if the engine and drive train are operating at peak performance.

CAUTION: Avoid Injury! 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.

Conditions:

- Cargo box raised.
- Indoor testing - rear wheels off ground and vehicle supported safely on jack-stands.
- Front wheels blocked.
- Tachometer displaying engine speed.
- Engine throttle cable set correctly. See “Adjust Throttle Pedal Cable” on page 32 in Engine section.
- Drive belt width at or above minimum specification.
- Engine warmed up.

Procedure:

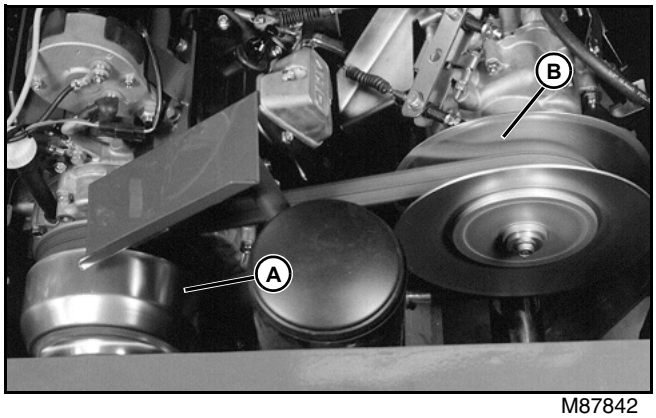
1. Place transaxle in forward gear with park brake off.

CAUTION: Avoid Injury! Rear wheels will rotate during test. Keep clear!

2. Block front wheels. Raise rear wheels slightly off ground with axles safely supported on jack stands.

3. Start engine.

4. Slowly increase engine rpm. Observe engine rpm when clutch starts to engage and move drive belt.



M87842

5. Accelerate from idle to wide-open-throttle and back to idle several times. Watch drive belt for a smooth transition from bottom to top of primary clutch (A). Watch closely for any hesitation or engine surging.

6. When approaching idle, watch for a positive disengagement from drive belt.

NOTE: On clutches with some hours of use, system may not disengage as smoothly due to primary clutch spring taking a set and other wear in the drive components.

7. Shut off engine.

Results:

- Clutch should slowly start to engage and move drive belt between 600–700 rpm. Drive belt should be riding high in primary clutch (A) and low in secondary clutch (B).
- If clutch has harsh engagement, erratic transition, hesitation, or clutch noise (chirping); perform primary clutch lubrication. Check primary clutch for flyweights binding, pivot pins worn, flat spots on rollers or rollers sticking, and no groove in sheave. Repair or replace primary clutch.
- If engine is surging; check engine and governor performance.
- Smooth engagement and transition (up-shift), primary clutch is good. Go to “Secondary Clutch Back-Shifting Check”.

Secondary Clutch Back-Shifting Check

Reason:

To determine condition of secondary clutch and back-shifting performance.

Conditions:

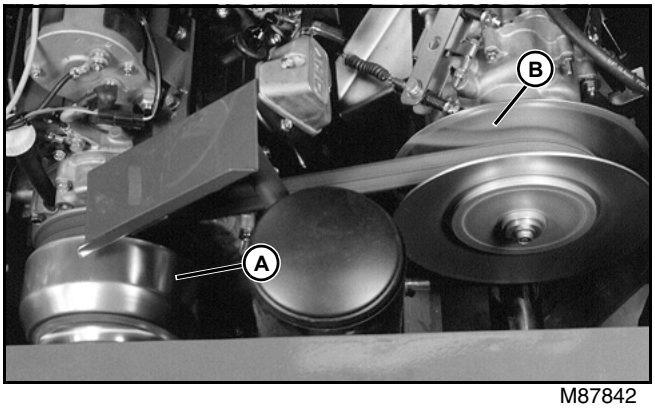
- Cargo box raised.
- Indoor testing - rear wheels off ground and vehicle supported safely on jack-stands.
- Front wheels chocked.
- Tachometer displaying engine speed.

Procedure:

CAUTION: Avoid Injury! Rear wheels will rotate during test. Keep clear!

1. Rear wheels off ground at least one in. and axles safely supported on jack stands. Block front wheels.
2. Transaxle in forward and park brake OFF. Start engine.
3. Operate engine at wide open throttle.

Results:



M87842

- Engine and wheel speed should remain at constant speed. Drive belt should be riding high in primary clutch (A) and low in secondary clutch (B).

Procedure:

1. Momentarily load power train by slowly applying foot brake until back-shift is made.
2. Quickly observe engine speed, then release brake.

Results:

- Clutches should back-shift as brake is increased.
- Drive belt should not squeal or slip.
- If clutches do not back-shift completely (belt is at top of driven clutch), See “Secondary Clutch Spring Torsion Check” below.
- Check secondary clutch for complete up-shift. Check for load on drive train, such as an engaged brake or failed axle bearings. See “Brake Adjustment” on page 167 in the Brake section.
- Engine throttle should open 100%.

Secondary Clutch Spring Torsion Check

Reason:

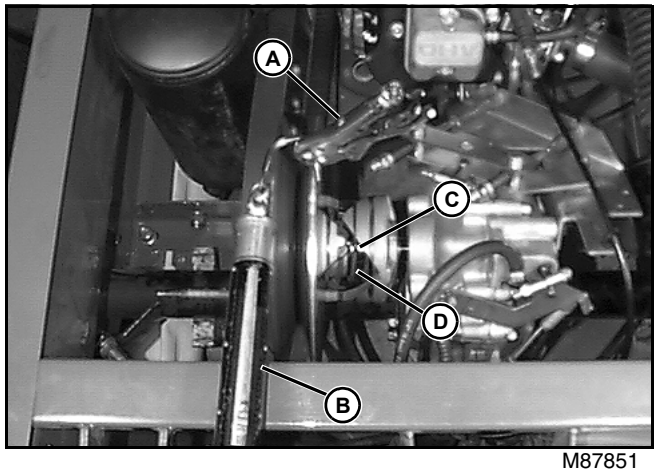
Verify condition and spring adjustment of secondary clutch.

Conditions:

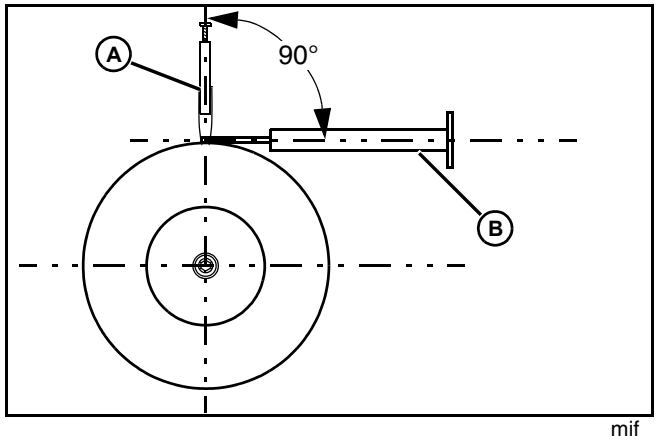
- Transmission in gear.
- Park brake set.
- Drive belt removed.

Procedure:

IMPORTANT: Avoid damage! Do not damage sheave when clamping locking pliers. Use protective strips of brass or aluminum.



M87851



mif

1. Clamp locking pliers (A) to movable (inboard) sheave.

2. Using spring scale (B) hooked into jaw of locking pliers as close to sheave edge as possible, measure the force required to rotate the movable sheave. Force measurement is taken while returning cam to closed position right before buttons (C) touch.

Specification:

Standard Wrap Brown Spring . . . . . 22 - 20 N (5 - 9 lb)
Standard Wrap Green Spring . . . . 62 - 80 N (14 - 18 lb)

NOTE: Standard torsion spring (D) installation sets spring tab in hole "2" in moveable sheave half. Due to variations in the spring rate of the torsion spring, the spring tab may be factory set in holes "1" or "3".

Results:

- Spring force within specification; secondary clutch is OK.

Check engine rpm and performance.

- Spring force less than specification, up-shift will be faster and engine load greater, reducing engine rpm and response time. Check spring position, set spring tab in next higher number hole, (i.e. move from hole "2" to "3") and re-check spring force. Replace spring if still not within specifications.

- Spring force higher than specification, up-shift or acceleration will be slower, reducing engine load, increasing engine rpm and response time. Check spring position, set spring tab in next lower number hole, (i.e. move from hole "2" to "1") and recheck spring force. Replace spring if still not within specifications.

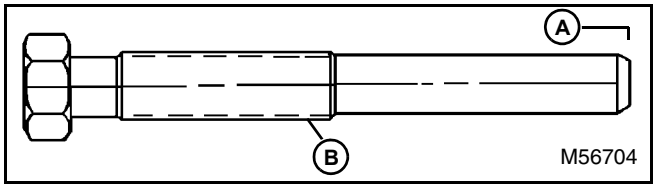
Repair

Primary Clutch Removal

IMPORTANT: Avoid damage! Lightly grease (A) end of puller (B) to help prevent puller wear. To prevent clutch thread damage, DO NOT thread bolt in any farther than necessary to remove clutch.

1. Remove black plug in front of rear tire on left side of frame.

2. Remove drive belt.



M56704

3. Remove plastic plug from clutch cover.

4. Remove clutch mounting bolt and washers.

5. Use JDG813-1A Clutch Removal Tool (B). Thread puller into clutch and against crankshaft. Tighten until clutch pops free from crankshaft taper.

NOTE: An air impact wrench works well to remove the primary clutch.

6. Install clutch in reverse order of removal. Tighten clutch bolt to 40 ± 8 N•m (24 – 35 lb-ft).

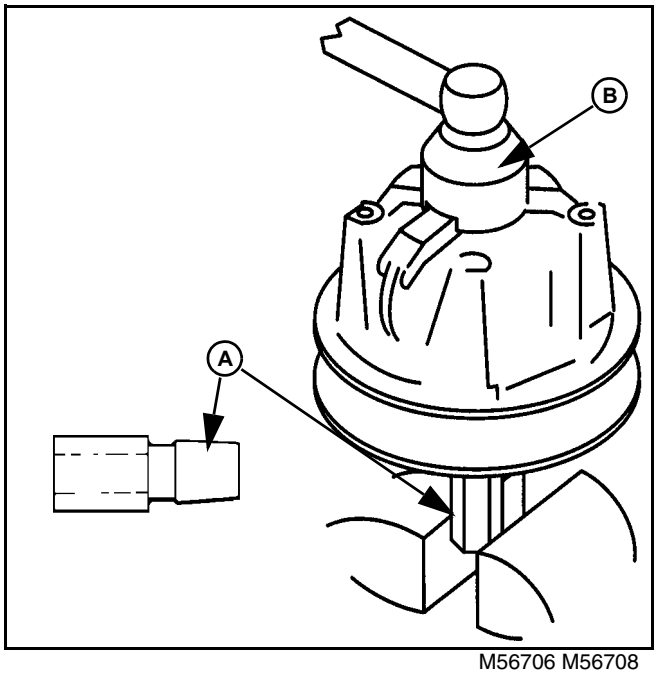
Primary Clutch Repair

1. Remove clutch cover bolts. Remove cover. (Cover should pop off; do not pry on cover.)

2. Install JDG813-3 Tapered Holding Tool (A) and retain it with a M10 X 1.5 X 150 mm hex-head bolt.

3. Place an index mark on the spider and movable sheave with black marker.

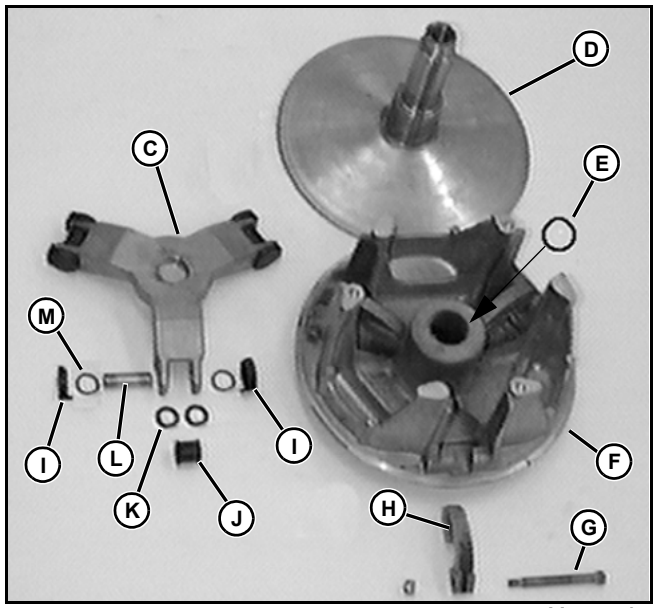
IMPORTANT: Avoid damage! Always use JDG813-2 Spanner Wrench (B) to remove spider. Unequal pressure on clutch towers could cause stress fractures or break them off. A medium strength thread lock is used on spider threads.



M56706 M56708

4. Use JDG813-2 Spanner Wrench (B) to remove spider.

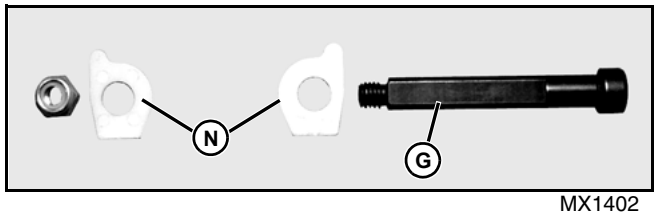
NOTE: If buttons (I) or rollers (J) are excessively worn, order button and roller replacement kit AM130222.



M56707A

5. Replace pivot bolt (G) if worn through plating. Check cam weight (H) for binding.

NOTE: 14.2 mm wide cam weights (H) have plastic thrust washers (N) inserted on each side of the cam weight.



MX1402

6. Check for flat spots or binding of spider rollers (J). Replace as necessary.

7. Use a medium strength thread lock on the spider threads during assembly. Tighten to 136 ± 13 N•m (100 ± 10 lb-ft).

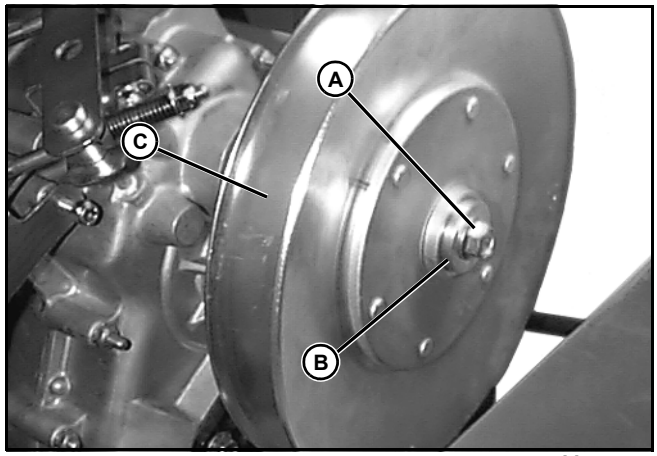
Secondary Clutch Removal and Installation

1. Remove drive belt.

2. Hold clutch with a strap wrench, and remove cap screw (A) and bushing (B).

3. Tap on inside of clutch with a rubber mallet.

4. Remove secondary clutch (C).



M87754

5. Installation is done in the reverse order of removal.

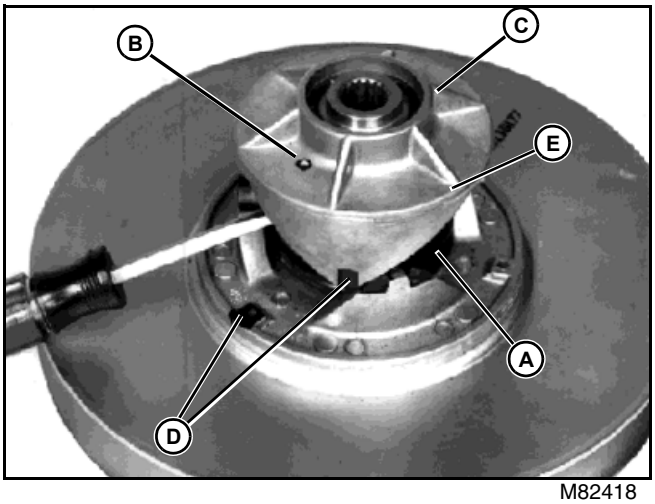
- Apply Moly High Temperature EP Grease, or equivalent, to splines of transaxle input shaft.
- Install new mounting cap screw or apply Thread Lock and Sealer to original cap screw. New cap screw will have Thread Lock applied.
- Tighten cap screw to 75 ± 7 N•m (50 – 60 lb-ft).

Secondary Clutch Disassembly

1. Release tension on spring (A) by prying spring out of hole (B) in cam.

2. Remove set screw (C).

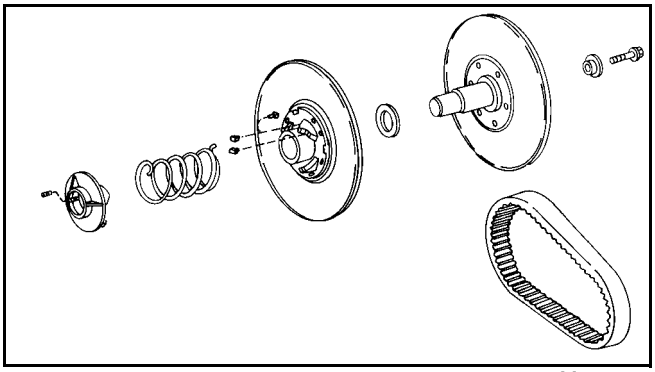
NOTE: Cam is press fit on shaft. Use a three-jaw puller and an impact wrench, at low speed, to remove cam from shaft.



M82418

3. Place alignment marks (D) on cam (E) and movable sheave to aid in assembly.

CAUTION: Avoid Injury! Hold cam securely to prevent sudden spring release.


M87753

4. Remove cam using a three-jaw puller and impact wrench.

NOTE: Before removing spring, mark the hole on the sheave that the spring tab is installed in (i.e 1, 2, 3 or 4).

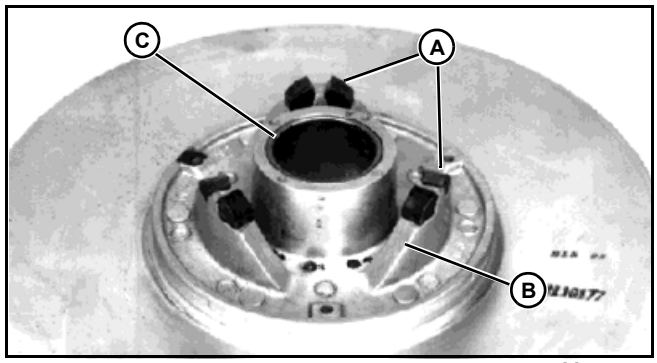
5. Remove spring, movable sheave and spacer from shaft.

NOTE: Ramp buttons are mounted with tabs on backside. Tabs are interference fit into holes on face of ramps. Remove buttons only if replacement is necessary.

Secondary Clutch Inspection

1. Inspect six ramp buttons (A) for wear or cracks. To replace buttons:

- Apply heat to movable sheave ramp (B) until button mounting tabs release from holes in ramp. Pull off buttons.
- If button mounting tabs break off inside holes in ramp, remove tabs using a drill bit.
- Install ramp button tabs into ramp holes. If tabs are loose, apply thread lock and sealer (medium strength) on tabs.

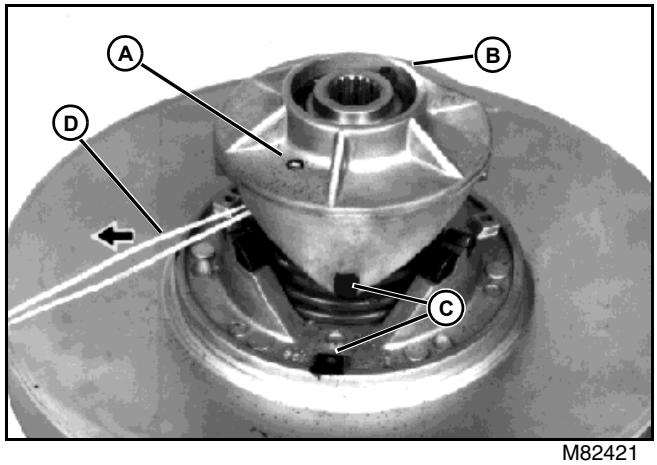


M82422

2. Inspect bushing (C) for wear or damage. Replace movable sheave if necessary.

Secondary Clutch Assembly

1. Install spacer and movable sheave on fixed sheave.



M82421

2. Install spring. Insert spring tab into previously marked hole (A) in movable sheave. Place cam on spring.

3. Align set screw bores (B) and alignment marks (C). Press cam on shaft until it stops.

4. Apply thread lock and sealer (medium strength) to threads of set screw and install.

5. Pry spring away from cam and loop a piece of string (D) around top spring tab. Pull on string until tab seats in hole in cam.

6. Re-check spring torsion. See “Secondary Clutch Spring Torsion Check” on page 125.

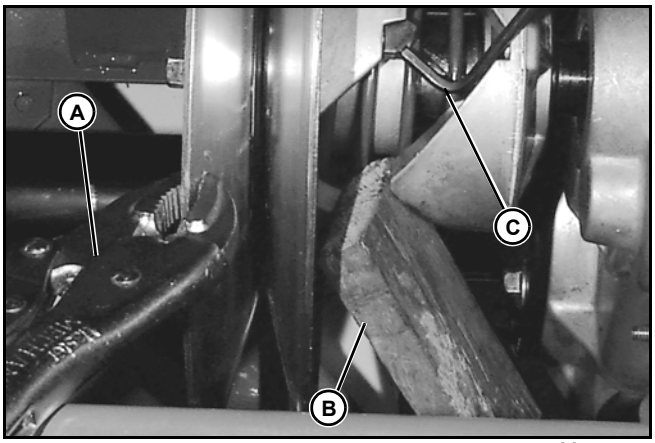
Replace Ramp Buttons (Clutch Mounted On Machine

1. Remove drive belt.

2. Install locking pliers (A) on outer edge of fixed sheave half. Rotate sheave until pliers contact frame and prevent sheave from turning.

3. Turn moveable sheave until buttons are away from ramps. Install small block of wood (B) between other ramps and buttons to hold sheave half in position.

CAUTION: Avoid Injury! Prevent burns. Hold allen wrench with locking pliers.



M87740

4. Clamp long end of 2 mm (0.078 in.) allen wrench (C) into locking pliers. Heat short end of allen wrench until red. Insert wrench into center of ramp button as plastic melts.

5. Hold wrench in place until plastic hardens.

6. Twist and pull on allen wrench to remove ramp button.

7. Install new ramp buttons. Push ramp button straight in with a screwdriver by prying against cam.

- If button is loose, apply thread lock and sealer (medium strength) on mounting tabs.

8. Re-check the distance between the clutches. See “Check/Adjust Clutch Center Distance” on page 34 in the Engine section.

Transaxle Removal and Installation

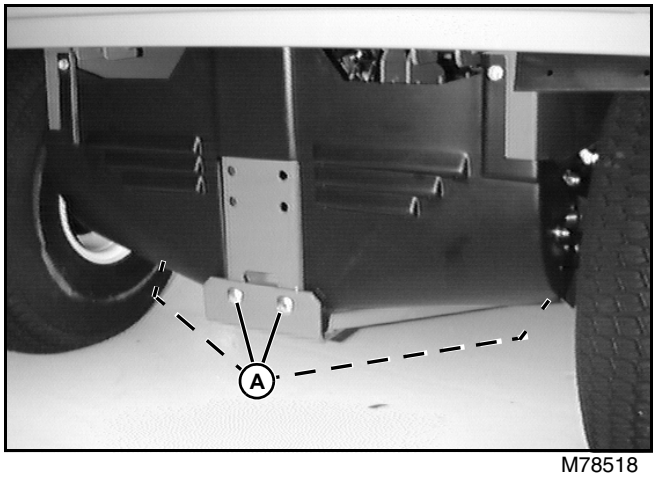
Removal:

1. Park machine on level surface and turn key switch OFF.

2. Park brake lever in released position, and front wheels BLOCKED.

3. Remove cargo box, cargo box lift, and drive belt.

4. Remove black plastic shroud from rear of machine.



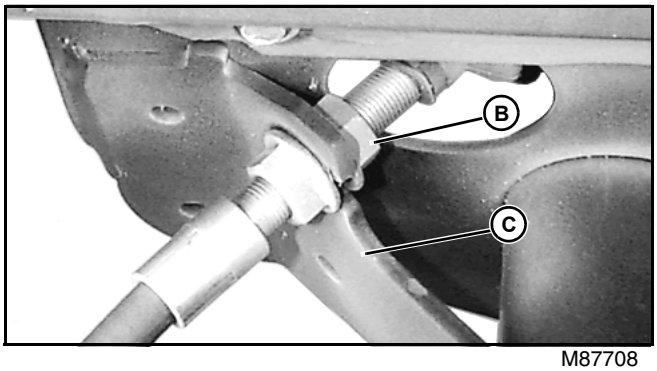
M78518

5. Remove four bolts (A) and lower rear frame cross member from frame.

6. Remove secondary clutch. See “Secondary Clutch Removal and Installation” on page 127.

NOTE: When raising vehicle with jackstands, ensure placement will not interfere with transaxle removal later. Do not place jackstands under axles or transaxle.

7. Use jack stands or hoist to raise rear wheels at least 25 mm (1.0 in.) off ground.

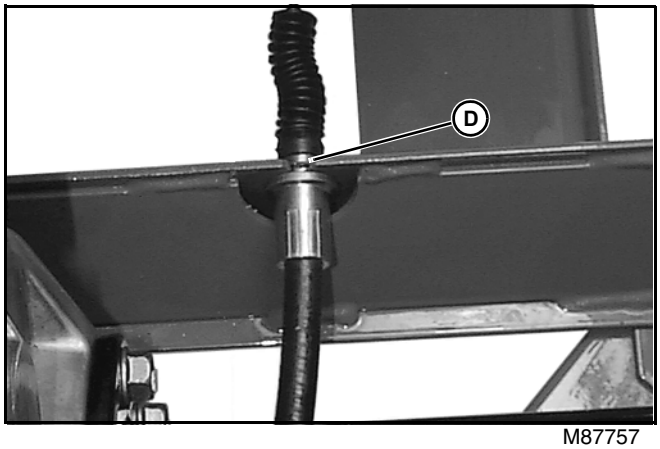


M87708

Left Hand Side Shown

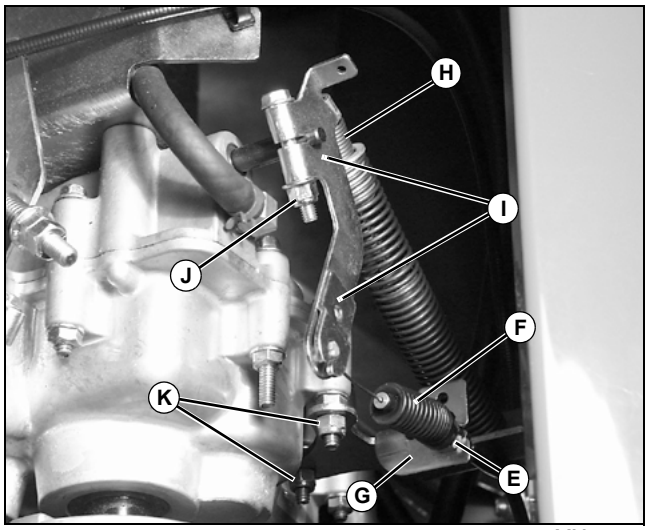
8. Loosen jam nut (B) on wheel brake cable and pull cable from axle case bracket (C).

9. Remove cotter pin and headed pin from brake arm.



M87757

10.Remove c-clip (D) from wheel brake cable and remove cable from frame.



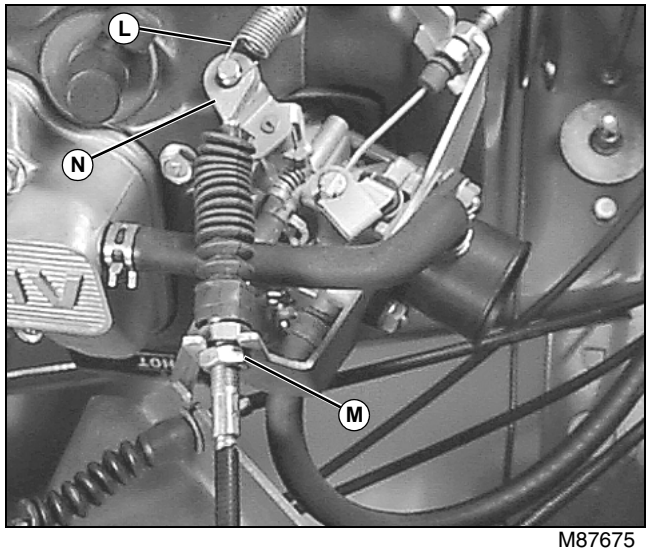
MX1385

11.For new cables, loosen nut (E) fastening governor cable (F) to cable support bracket (G). (For old cables, remove E-Clip fastening the cable (F) to the cable support bracket (G).)

12.Disconnect governor cable (F) and throttle pedal cable (spring) (H) from governor arm (I).

13.Loosen nut (J) on governor arm and remove governor arm from transaxle.

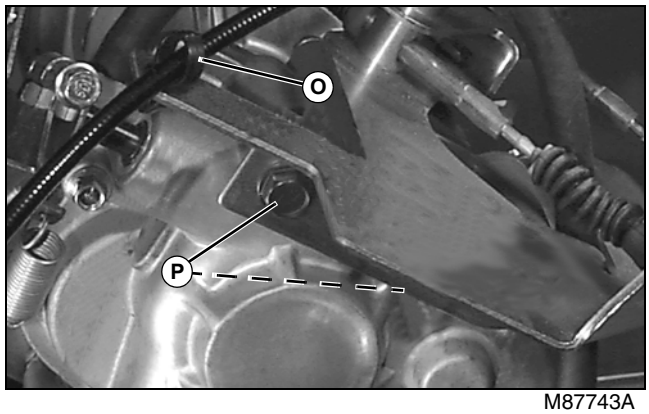
14.Remove locking nuts (K) securing cable support bracket (G) and pull bracket away from transaxle.



M87675

15.Gently unhook spring (L) from carburetor butterfly.

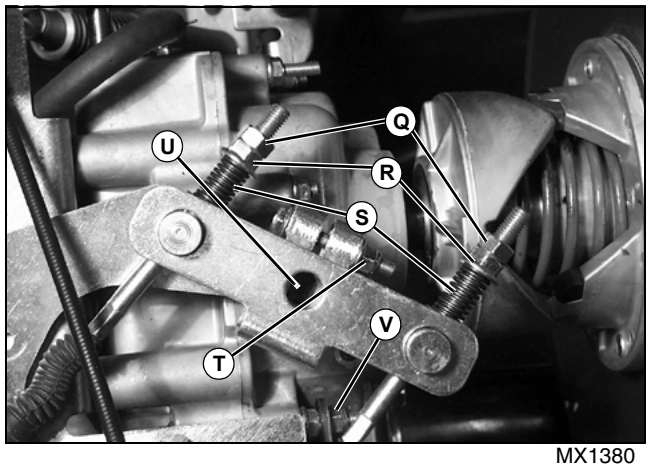
16.Loosen jam nut (M). Lift governor cable eyelet (N) off butterfly.



M87743A

17.Remove governor cable retainer (O) from shift cable support bracket.

18.Remove two mounting bolts (P) from RH side of shift cable support bracket.



MX1380

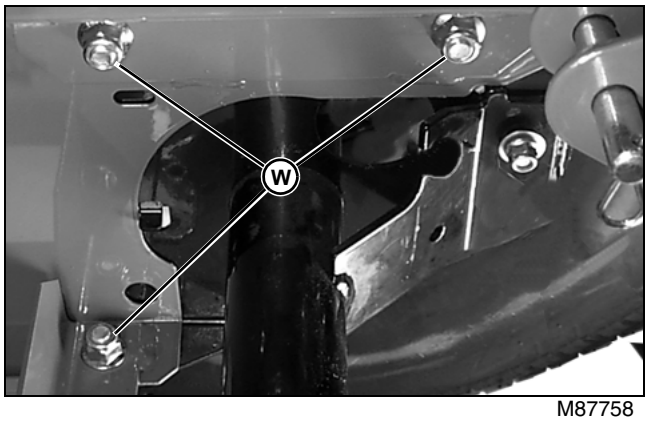
19.Loosen jam nuts (Q) and lock nuts (R) on each shift rod to back off on spring compression on both springs (S).

20.Loosen locking nut (T) holding shift arm to transaxle actuator shaft (U) and remove shift arm (with shift cables and cross pins in place) from transaxle.

21.Remove locking nut (V) holding shift cable bracket to LH side of transaxle.

22.Remove both shift arm and shift cable support bracket (with cables still attached) from transaxle.

23.Install a sling attached to a hoist around the transaxle to support the assembly before removing the transaxle mounting hardware.



M87758

Right Hand Side Shown

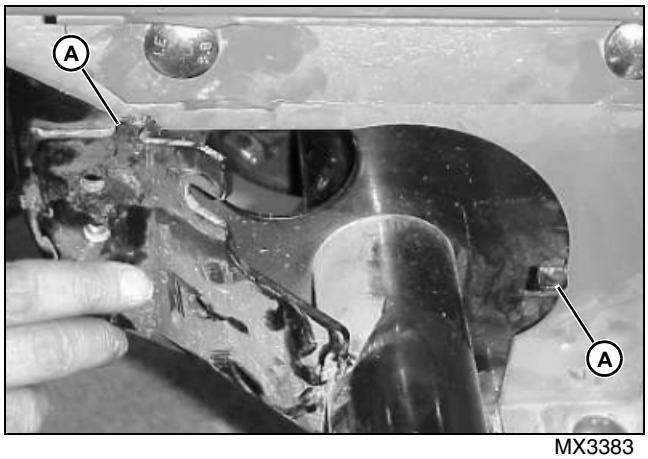
24.Remove three lock nuts (W) from carriage bolts holding each wheel axle case to frame.

25.Slowly lower transaxle to ground and remove from vehicle.

Installation:

NOTE: When installing transaxle back into vehicle, the brake cables must be routed under the axle tubes.

1. Place transaxle on floor jack and using a safe lifting device, raise into position at rear frame.

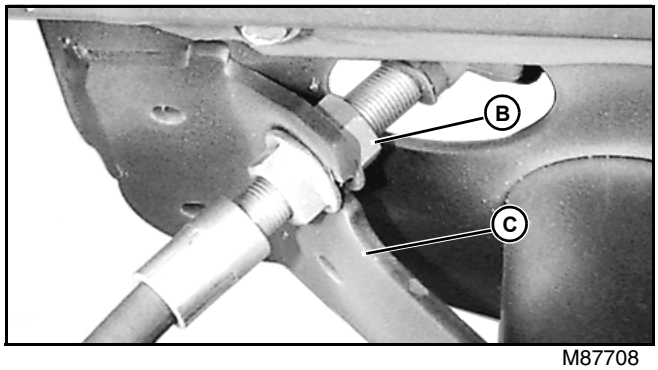


MX3383

2. Maneuver the transaxle so that the side plates are on the outside of the frame. Use a pry bar and floor jack to help slide plates on outside of frame. Both locating tabs (A) must be contacting the frame for the transaxle to be properly installed.

3. Install mounting hardware and tighten to 87 N•m (64 lb-ft).

4. Install lower rear cross member and secure with original hardware. Tighten to 87 N•m (64 lb-ft).

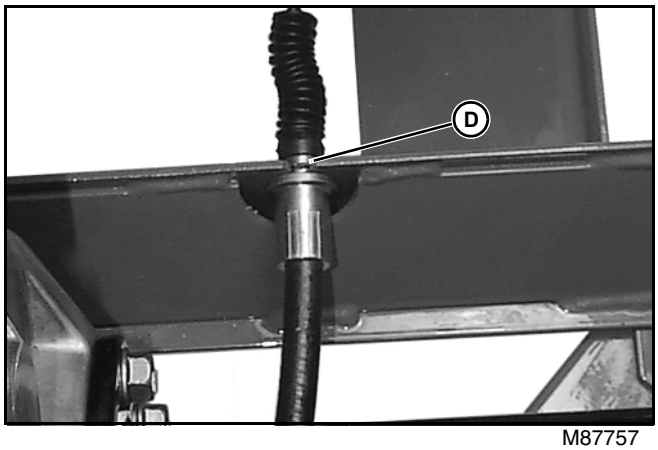


M87708

Left Hand Side Shown

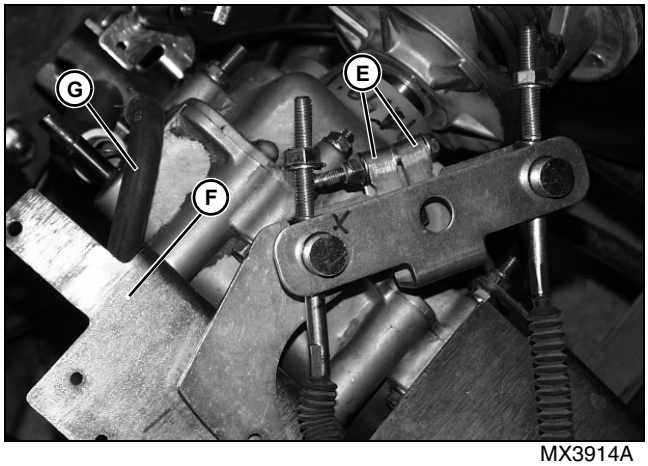
5. Install wheel brake cable to case bracket (C), and tighten jam nut (B) on cable.

6. Install headed pin and cotter pin on brake arm.



M87757

7. Install cable to frame and c-clip (D) to wheel brake cable.



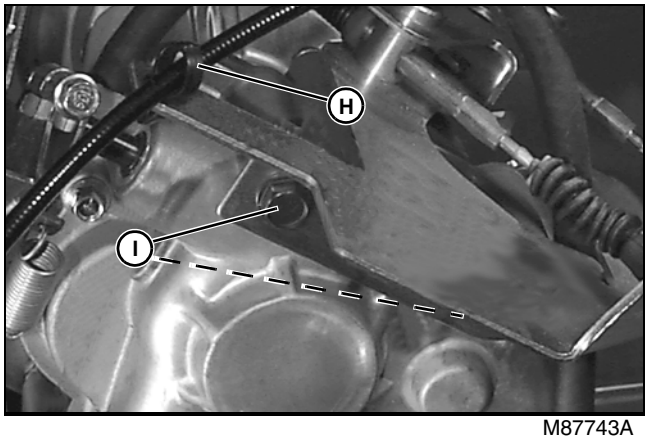
MX3914A

8. Pry apart tabs (E) of shift arm.

IMPORTANT: Avoid damage! Avoid Damage! Do not hammer on shift arm. Damage could result inside transaxle.

9. Install shift arm and shift cable support bracket (F).

10. Route vent tube (G) as shown.



M87743A

11. Install two capscrews (I) attaching shift cable support bracket to transaxle.

12. Install eyelet retainer on governor cable and insert eyelet (H) into mounting hole on shift cable support bracket.

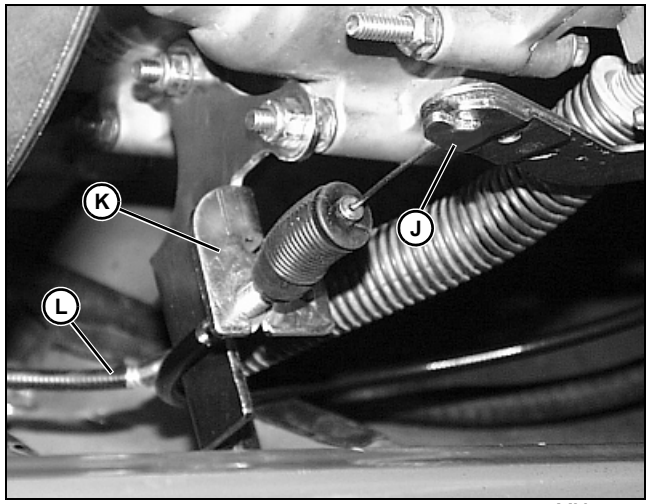
13. Install governor arm.

IMPORTANT: Avoid damage! Avoid Damage! Do not hammer on governor arm. Damage could result inside transaxle.

14. Route the throttle pedal cable and cable support bracket to the left side of the transaxle, under the left hand axle tube. Hook cable onto modified tab on governor arm.

15. Fasten cable support bracket to transaxle with original hardware.

16. Install governor cable.



MX3913

17. Slide governor cable into cable support bracket (K).

18. Install barrel end into governor arm (J).

19. Secure cable to bracket. Slide rubber boot on cable over the first nut in the double nut assembly.

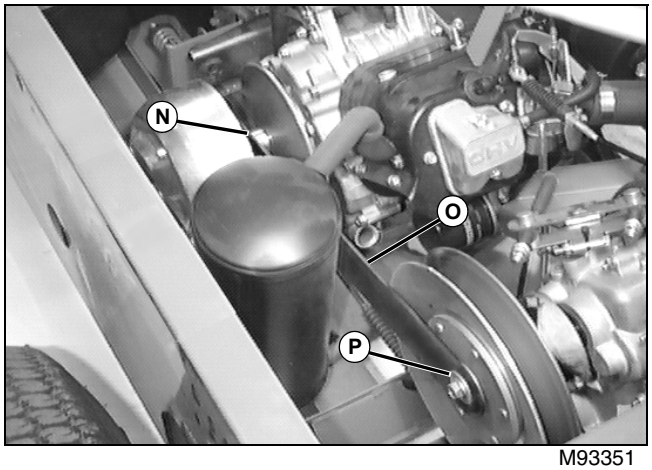
20. Route the cable so that it is behind the throttle pedal cable (L) as shown above.

MX3387

21. Install eyelet end of cable on carburetor butterfly.

22. Slide cable into bracket (M).

23. Install secondary clutch assembly. See “Secondary Clutch Removal and Installation” on page 127.

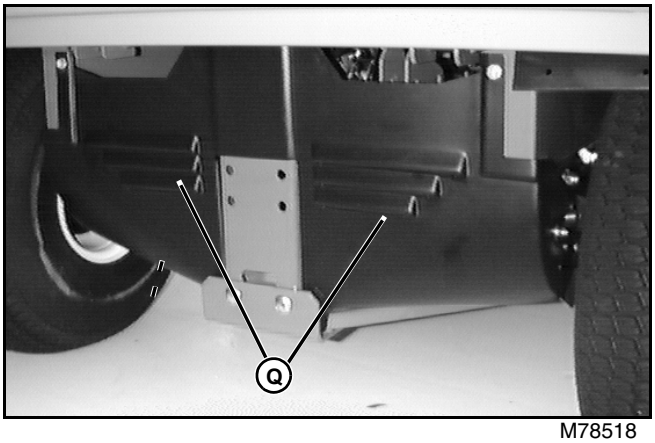


M93351

24.Position open end (N) of clutch center distance gauge (O) over the primary clutch shaft.

25.Position gauge closed end (P) over the washer on secondary clutch. Check that the closed end is easily seats completely over washer on secondary clutch. If not, set correct clutch center distance. See “Check/Adjust Clutch Center Distance” on page 34 in the Engine section.

26.Install drive belt on clutches.



M78518

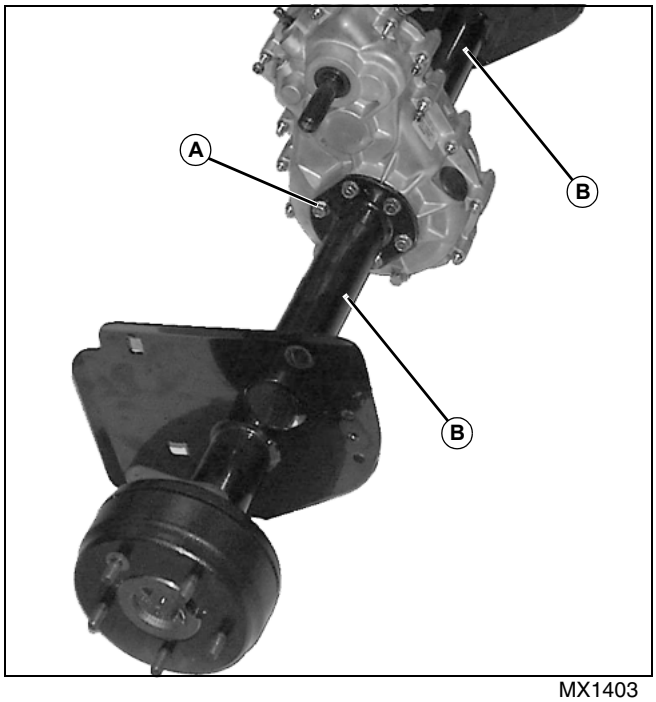
27.Install black plastic shroud (Q) to rear of machine.

28.Adjust governor cable. See “Adjust Governor Cable” on page 31 in Engine section.

29.Check center distance between clutches. See “Check/Adjust Clutch Center Distance” on page 34 in the Engine section.

Transaxle Disassembly and Inspection

Disassembly:



MX1403

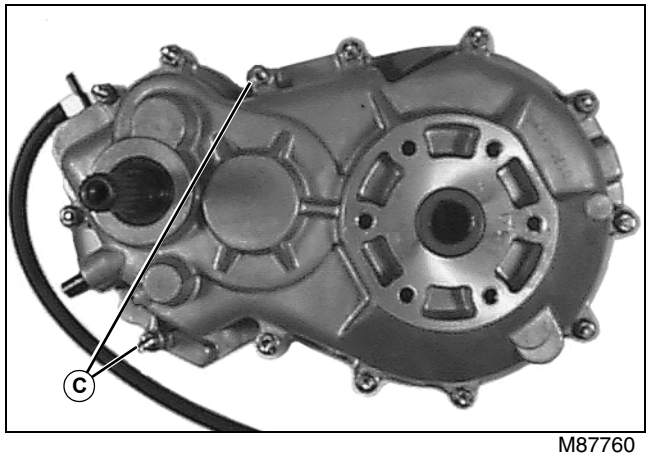
1. Remove transaxle assembly. See “Transaxle Removal and Installation” on page 129.

2. Position a drain pan under the transaxle. Remove transaxle fill plug. Rotate transaxle over and drain oil.

3. Install fill plug.

4. Remove cap screws (A) holding axle tubes (B) to transaxle assembly.

NOTE: Depending upon the work being performed, the axle tubes may be left on the transaxle and the transaxle separated at the case seam. If doing a complete transaxle tear down, the axle tubes should be removed first.



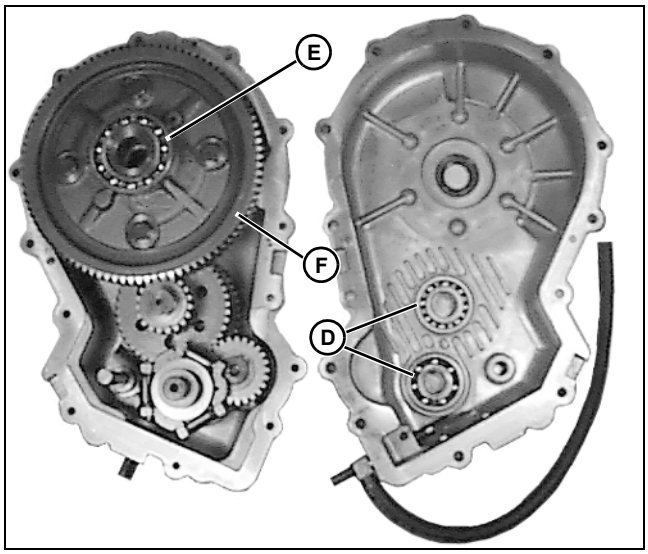
M87760

5. Mark two holes (C) for long cap screws.

6. Remove 13 lock nuts and cap screws.

7. Tap seam of case with a plastic hammer or pry apart at pry points and separate case halves. Drain any remaining oil.

Inspection:



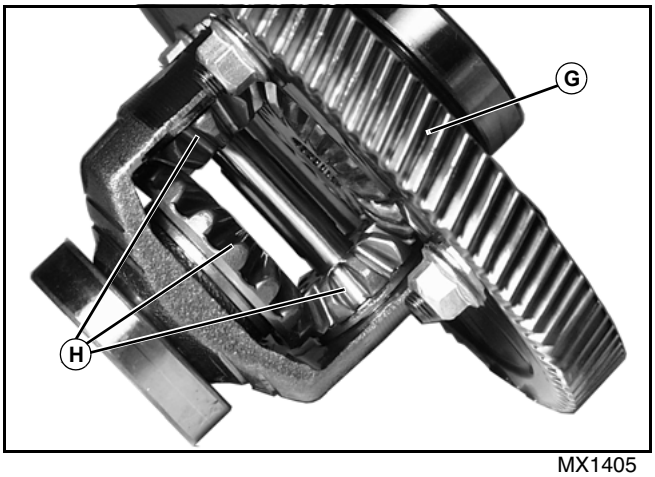
M87761

1. Inspect bearings (D). If either bearing is pitted, corroded, discolored or does not rotate freely, replace bearing.

NOTE: Main bearing may remain in case half or come out of case half during separation and remain on ring gear.

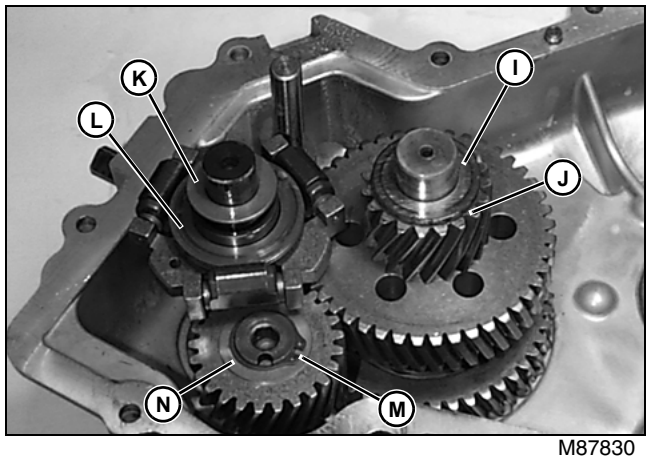
2. Remove and inspect main bearing (E). If bearing is pitted, corroded, discolored or does not rotate freely, replace bearing.

3. Remove and inspect ring gear (F) with attached differential assembly:



MX1405

- ring gear teeth (G) (93) are all in good condition;
- differential gears (H) turn freely and teeth are in good condition;
- if any wear or damage is evident, disassemble differential assembly, See “Differential Disassemble and Inspection” on page 137, and replace necessary parts.



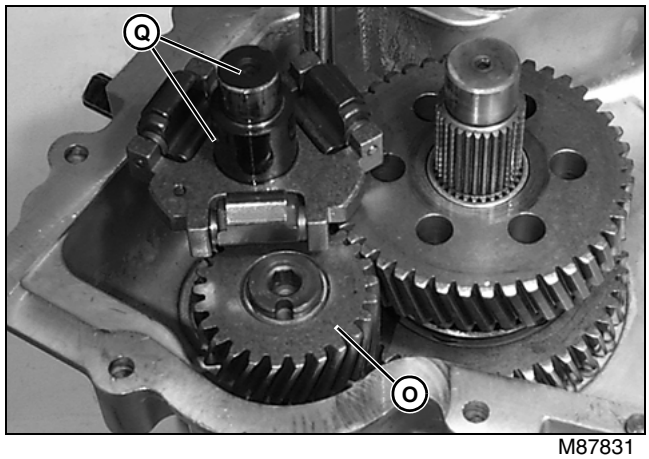
M87830

4. Remove washer (I) and splined gear (J).

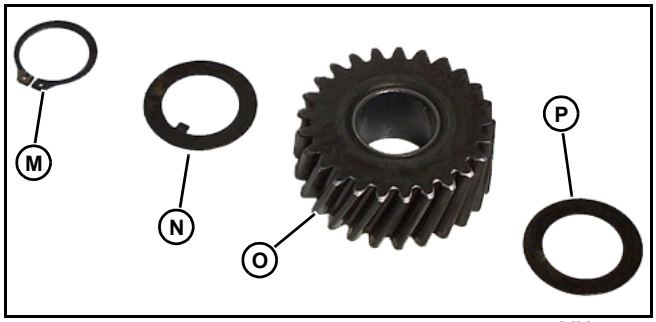
5. Remove shim (K) and actuating sleeve assembly (L).

6. Inspect actuating sleeve assembly needle bearings for discoloration, missing bearings and freedom of movement. Replace as necessary.

7. Remove snap ring (M) and tabbed washer (N) under snap ring.

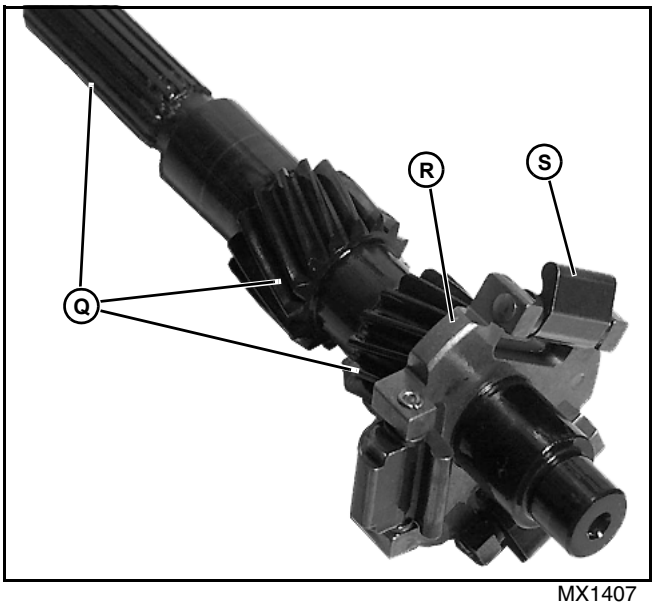


M87831



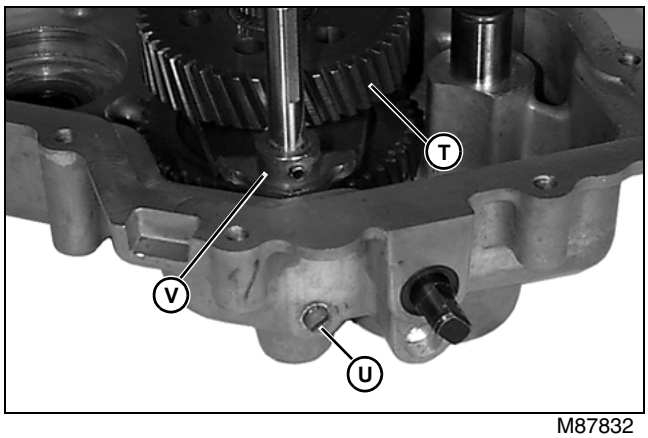
MX1406

8. Remove reverse idler gear (O), washer (P) and input shaft (Q).



MX1407

9. Inspect input shaft splines and teeth (Q), governor shaft plate (R), and governor flyweights (S) for wear or parts not moving freely. Replace entire plate or shaft, if defective.



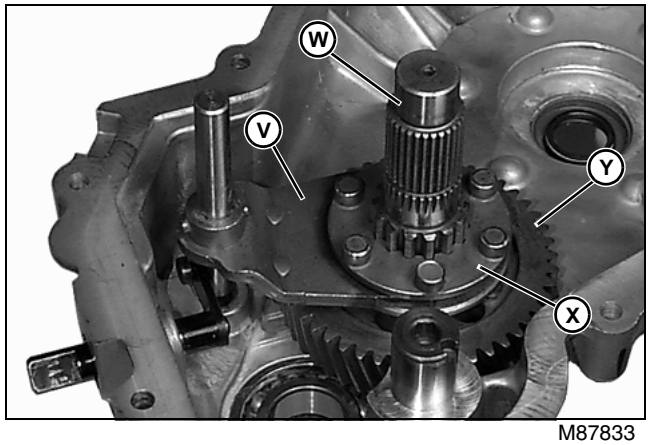
M87832

10.Remove reverse drive gear (T).

IMPORTANT: Avoid damage! To be able to maintain the initial detente ball and spring settings when reassembling the transaxle, it is imperative that the set screw is backed out exactly two 2 full turns.

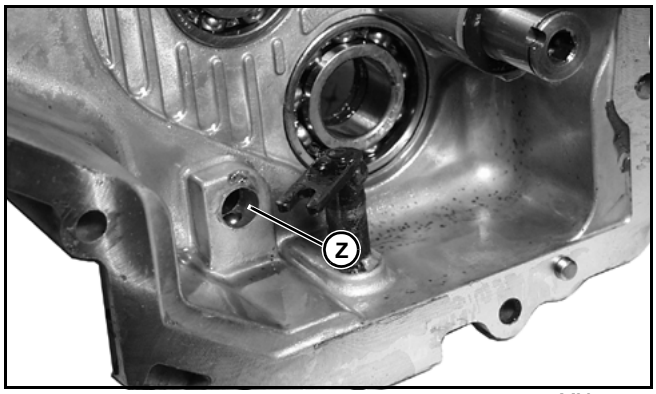
11.Back out set screw (U) two turns. (Set screw is holding detente ball and spring against shifter fork (V).) Tip casing so that the slotted end of the set screw is facing down, to prevent the ball and spring from falling out.

IMPORTANT: Avoid damage! The transaxle case must be held in the tipped position to maintain the ball in place when removing the shift fork assembly.



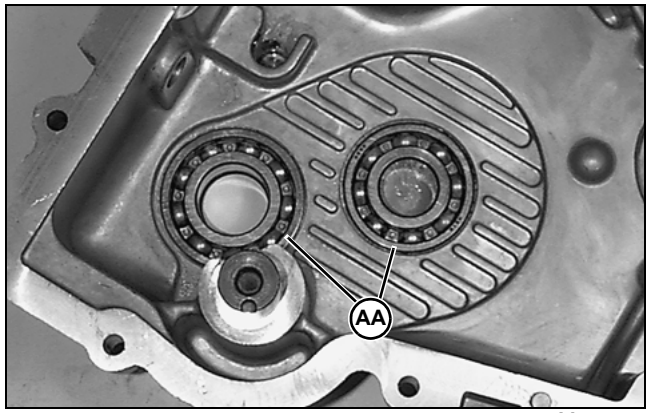
M87833

12.Remove gear shaft (W), gear selector (X), forward gear (Y), washer below gear and shift fork (V). Inspect parts for wear or damage, and replace if necessary.



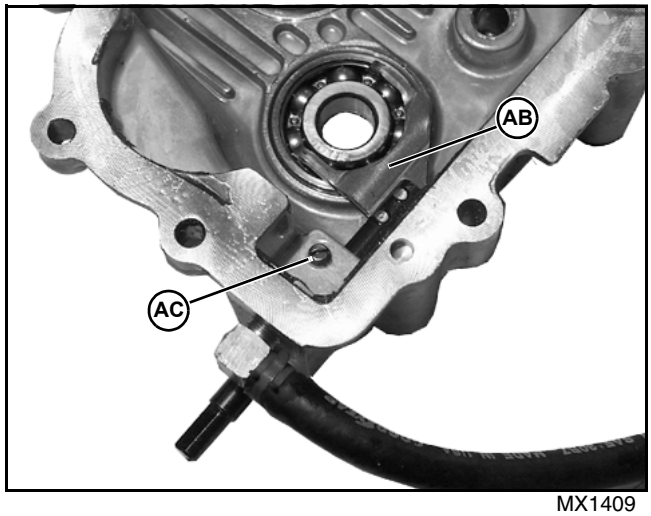
MX1404

13.Insert a small diameter deep well socket into hole (Z) where shift fork was removed from to prevent the ball from moving.



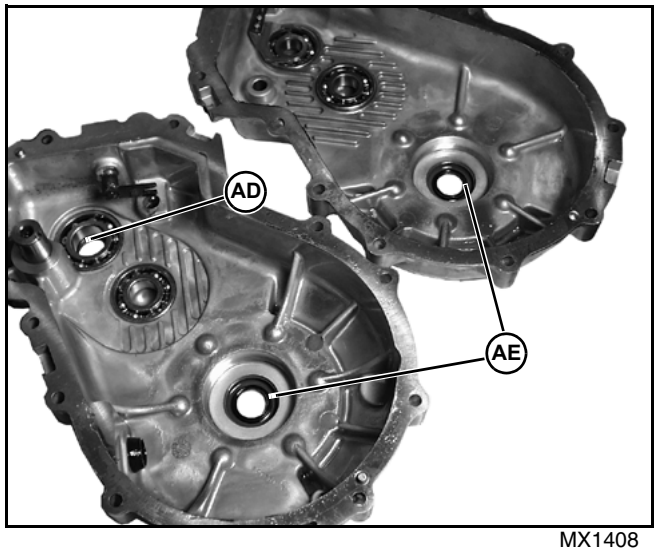
M87834

14.Inspect bearings (AA) in case half. If either bearing is pitted, corroded, discolored or does not rotate freely, replace bearing.



MX1409

15.Inspect governor actuator assembly (AB) by removing set screw (AC) and inspecting assembly for damage or wear.

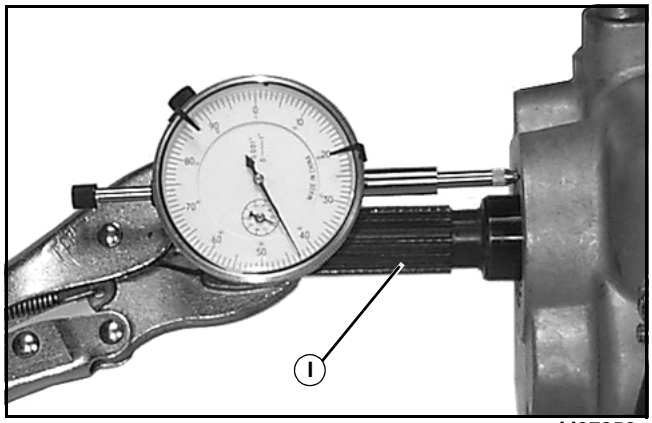


MX1408

16.Inspect input shaft seal (AD) and both axle seals (AE). Replace as necessary.

17.Re-install input shaft.

18.Temporarily install other half of transaxle cover.



M87852

19.Check input shaft end play by installing or clamping a dial indicator on input shaft (I) with pointer against transaxle case.

20.Move input shaft in and out. Record measurements.

NOTE: Nine sizes (.015, .03, .035, .04, .045, .05, .055, .06, and .065 inch) of shims are provided with the kit. Only ONE shim will be used.

21.Install the appropriate size shim on the input shaft (between input shaft shoulder and internal transaxle input shaft bearing) which ensures end play is within specification.

22.Remove transaxle cover, input shaft and selected shim.

23.Assemble transaxle. See “Transaxle Assembly” on page 138.

24.Install transaxle. See “Transaxle Removal and Installation” on page 129.

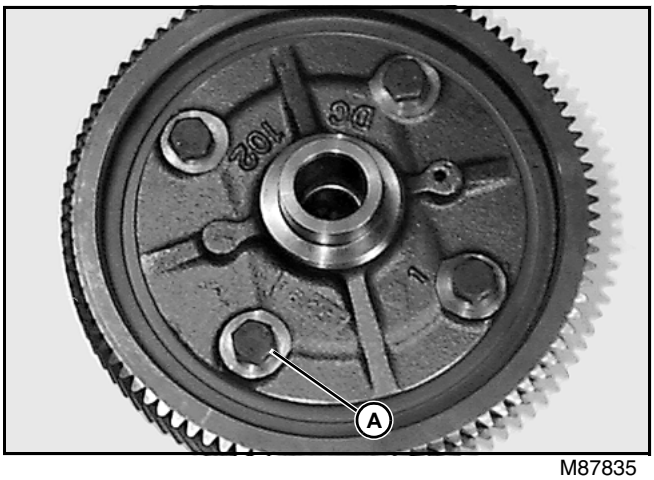
Specification:

End Play . . . . . 0.05 - 0.20 mm (0.002 - 0.008 in.)

Differential Disassemble and Inspection

1. Remove ring gear and differential from transaxle. See “Transaxle Disassembly and Inspection” on page 133.

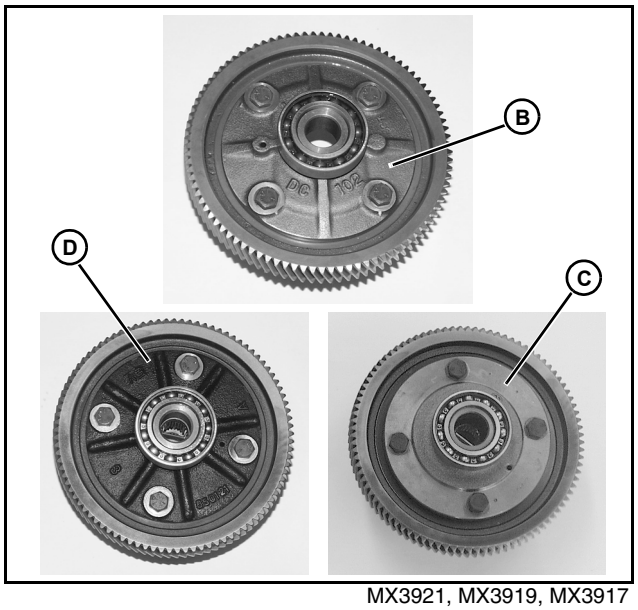
IMPORTANT: Avoid damage! If only replacing cap screws/nuts, replace one bolt and nut at a time.



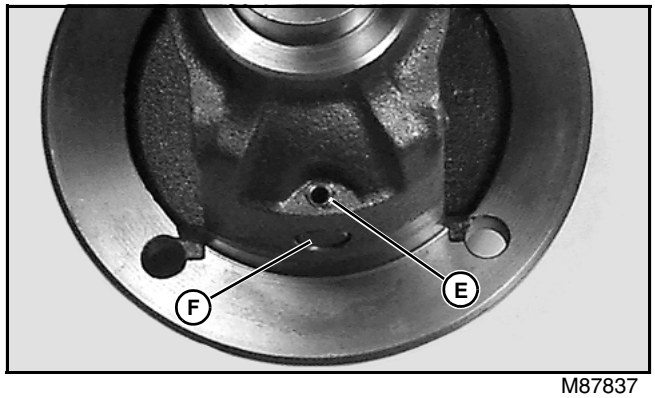
M87835

2. Secure differential housing in a vise and loosen and remove four cap screws (A) and nuts securing differential housing to ring gear.

NOTE: There are several different differential versions: four rib construction (B), eight rib construction (D) or no rib construction (entire circumference machined) (C).

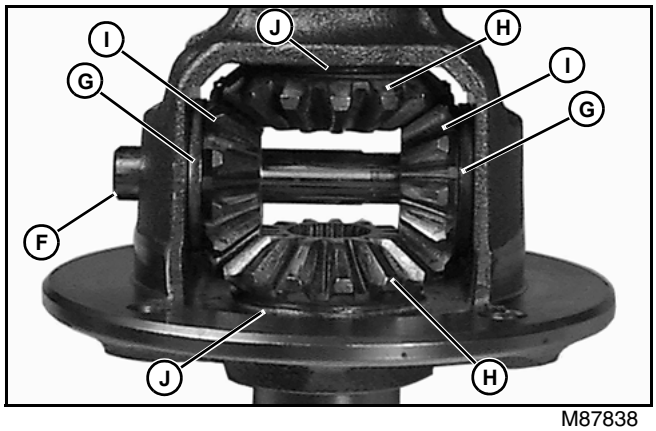


MX3921, MX3919, MX3917



M87837

3. Using a drift punch, drive rolled pin (E) far enough through differential housing to allow cross shaft (F) to be removed.

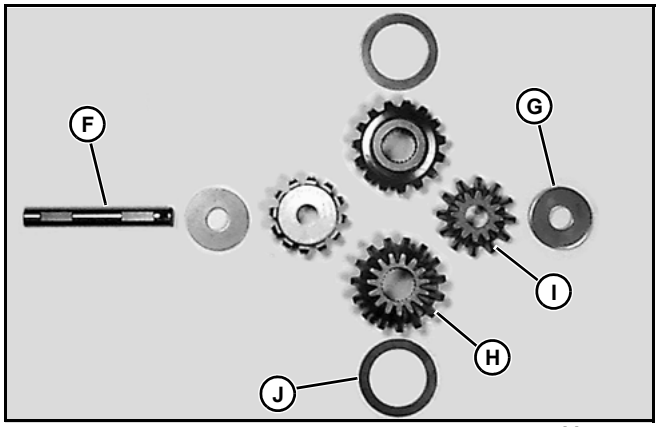


M87838

4. Remove cross shaft (F), and washers (G).

5. Rotate bevel pinion gears (H) and remove cross shaft bevel pinion gears (I).

6. Remove bevel pinion gears (H) and thin washers (J).



M87839

7. Inspect bevel pinion gears (H), cross shaft bevel pinion gears (I), shaft (C), and washers (G) for wear, corrosion, discoloration, and damaged teeth (12 and 15 teeth). Replace differential assembly as necessary.

8. Reassemble differential by installing thin washers (J)

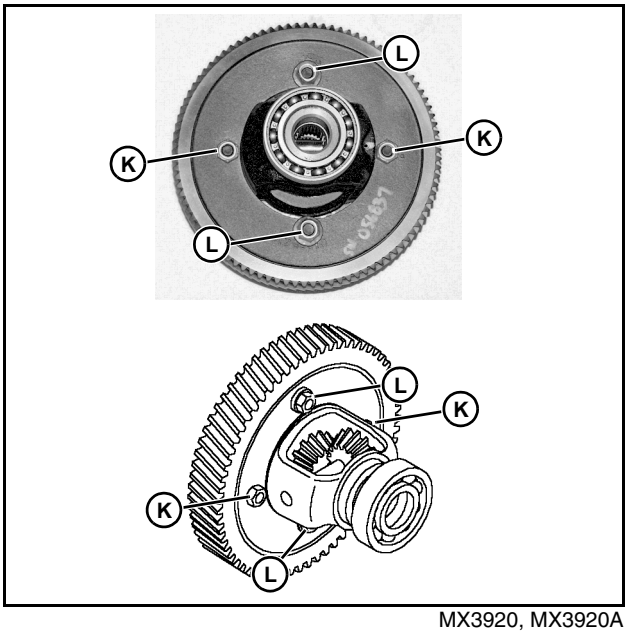
and larger pinion gears. Insert smaller cross shaft pinion gears from opposite sides and rotate larger pinion gears to roll cross shaft pinion gears into position.

9. Insert large washers and cross shaft.

10.Drive rolled pin into position to hold cross shaft.

11.Install differential into ring gear.

12.Fasten bolts with lock nuts.

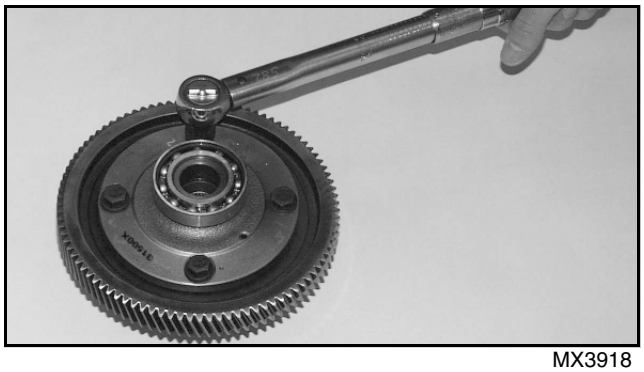


MX3920, MX3920A

13.For eight rib differential assemblies, use two hex head nuts at positions (K) adjacent to differential housing wall and two flange head lock nuts at positions (L) adjacent to the open area.

- For no rib and four rib assemblies, use flange head lock nuts in all bolt locations.

IMPORTANT: Avoid damage! To ensure proper torque, install torque wrench on bolt head , as the nut contacts a rough surface and can result in a distorted torque value.



MX3918

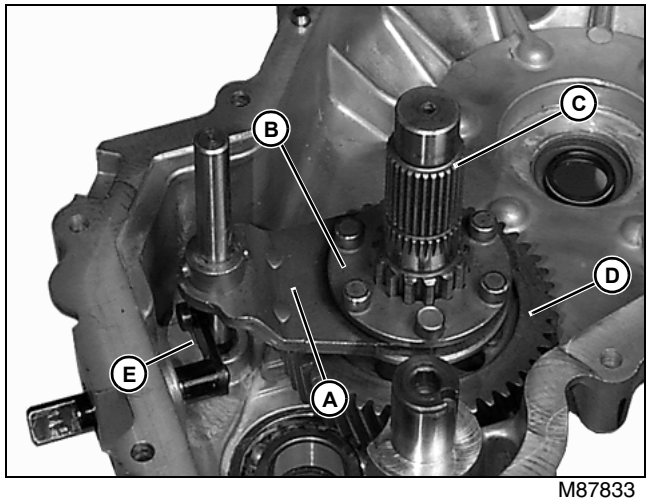
14.Install four cap screws and nuts and tighten with the wrench applied to the bolt head to 80 ± 5 N•m (59 ± 4 lb-ft).

Transaxle Assembly

Assembly:

NOTE: Lubricate all internal parts with clean oil during assembly.

1. Apply multipurpose grease on inside lips of axle seals.



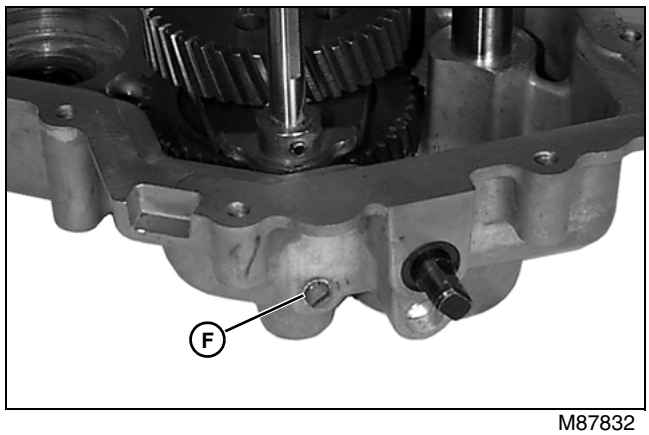
M87833

2. Install washer and forward drive gear (D), shift fork (A), gear selector (B) and drive gear shaft (C) with the splined end up. Be careful to keep ball in place when installing shift fork.

3. Rotate actuator shaft fork (E) up and then place shift fork and gear selector onto drive gear shaft. Ensure correct actuator shaft fork (E) alignment with shift fork.

4. Rotate gear selector (B) until pins align with holes in forward gear.

5. Fully seat shift fork assembly shaft into transaxle case half. The shifter is now in forward gear.



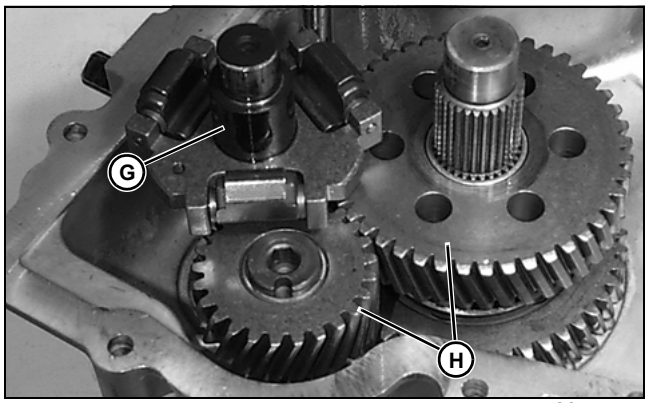
M87832

6. Check detente ball position:

- If the detente ball and spring has remained in place, turn set screw (F) in two full turns to initial setting.
- If the detente ball has dislodged from transaxle case,

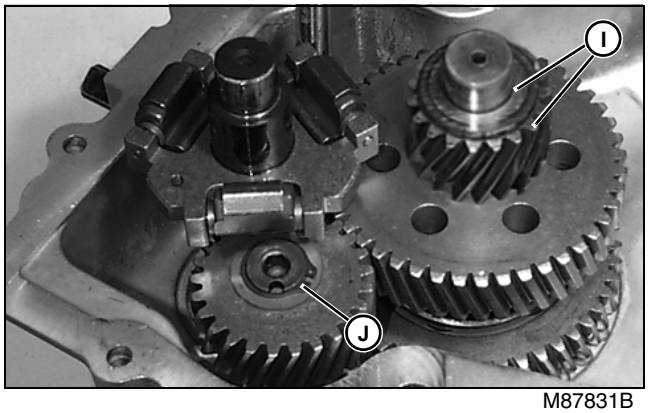
remove set screw (F) and spring. From the outside case, insert ball and then spring and completely turn in set screw (take care not to over tighten). With the shifter in gear, back out set screw 1-3/4 turns.

NOTE: Input shaft (G) and gears (H) need to be installed simultaneously.



M87831

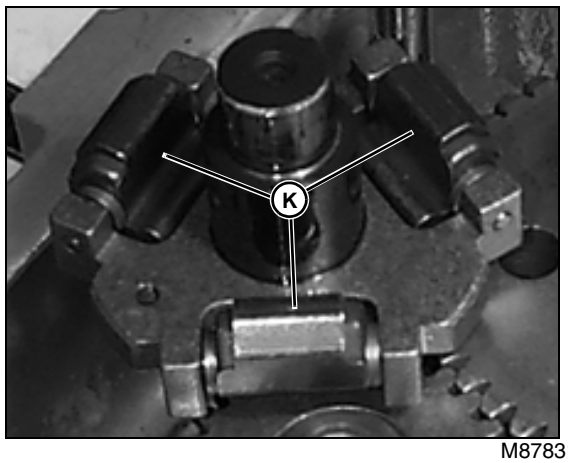
7. Partially install input shaft (G) and then install gears (H). Ensure input shaft is fully seated and gears mesh.



M87831B

8. Install splined gear and washer (I).
9. Install tabbed washer and snap ring (J).

IMPORTANT: Avoid damage! Rotate governor flyweights to the up position as shown below before installing actuating sleeve assembly or unit will NOT operate.

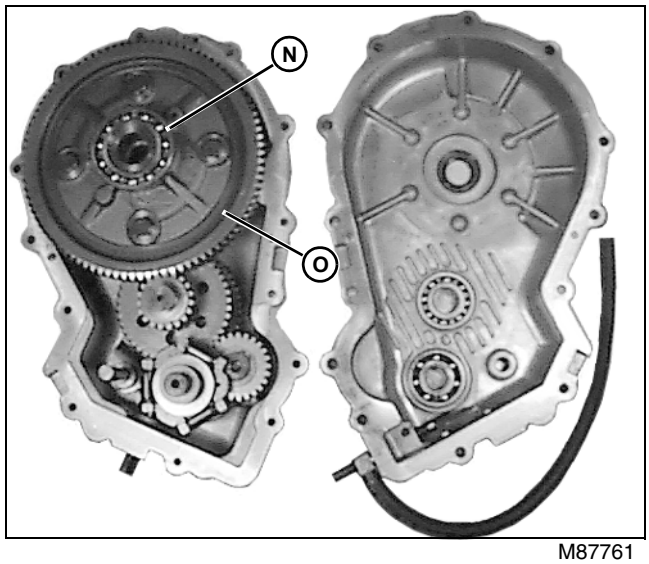


M87831A

10. Rotate governor flyweights (K) to the up position as shown.

M87830

11. Install actuating sleeve assembly (L), with thrust washer end outward, and shim (M) on input shaft.



M87761

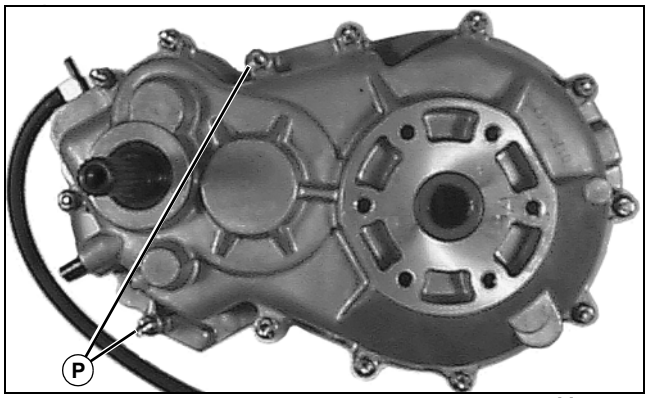
12. Install ring gear and differential assembly (O).
13. Seat axle bearing (N) on ring gear and differential

assembly.

IMPORTANT: Avoid damage! Allow sealant to cure at least 30 minutes before filling transaxle with oil.

14.Clean mating surfaces of transaxle case halves using Clean and Cure Primer. Apply a coat of Rigid Form-In-Place Gasket (T43514).

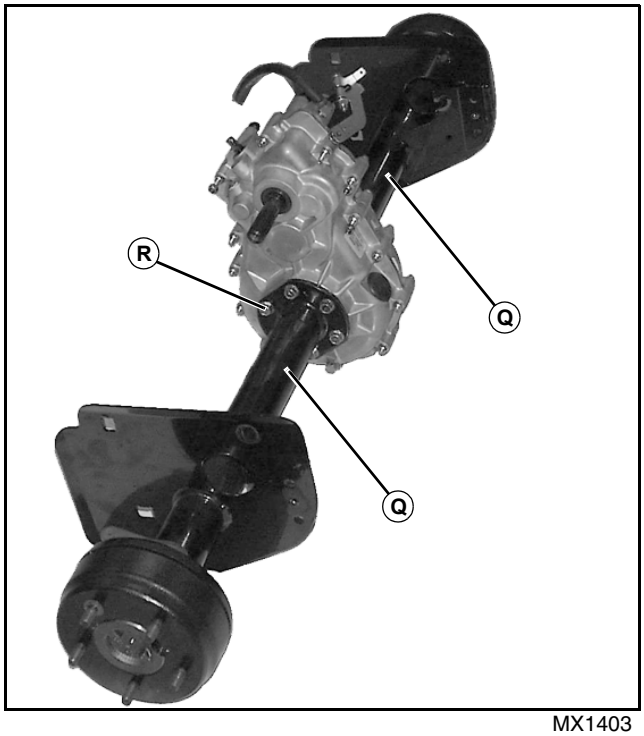
NOTE: Remember to install the two longer cap screws (P) in the position shown below.



M87760

15.Assemble case halves. Install 13 cap screws and tighten to 15 N•m (110 lb-in.).

NOTE: Apply Moly High Temperature EP Grease, or an equivalent, to splines of axle shaft before installation of axle tubes.



MX1403

16.Install axle tubes (Q) and cap screws (R) onto transaxle assembly.

17.Tighten cap screws to 41 ± 6 N•m (25 – 35 lb-ft).

18.Install transaxle and axle assembly back into the unit. See “Transaxle Removal and Installation” on page 129.

19.Add John Deere Hy-Gard oil into transaxle until the oil is 2” below the fill hole, approximately 0.6 L (20 oz).

Drive Axle Removal and Installation

Removal:

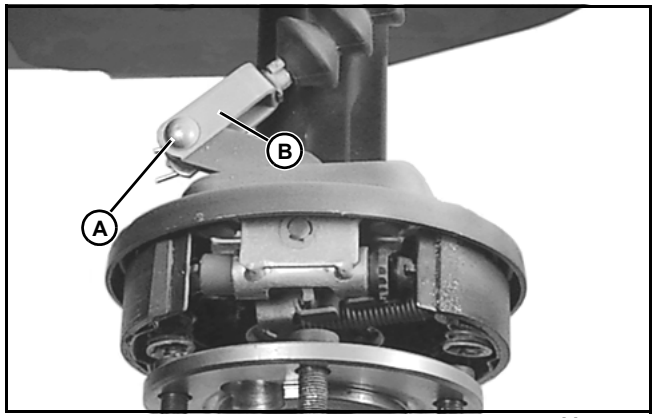
1. Park vehicle on a flat surface; LOCK transaxle in NEUTRAL. See “Transaxle Neutral Lock” on page 121.

2. Block front wheels.

3. Loosen rear wheel tire lugs.

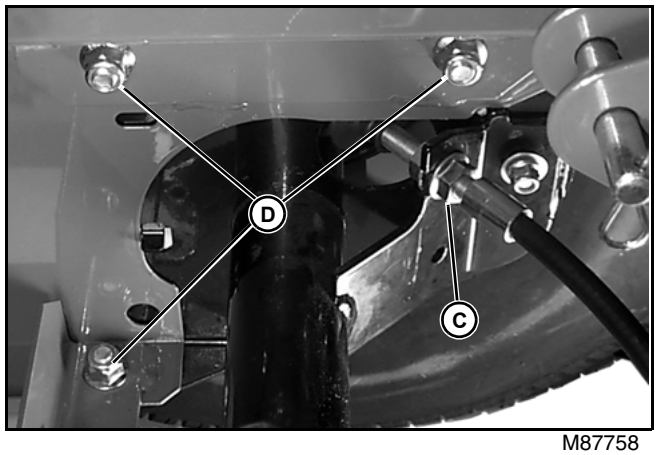
4. Raise frame so rear wheels are 2.5 – 5.0 cm (1 – 2 in.) off of ground and frame is safely supported.

5. Remove rear wheels and brake drum.



M87709

6. Remove hair clip and drilled pin (A) from brake arm clevis (B).



M87758

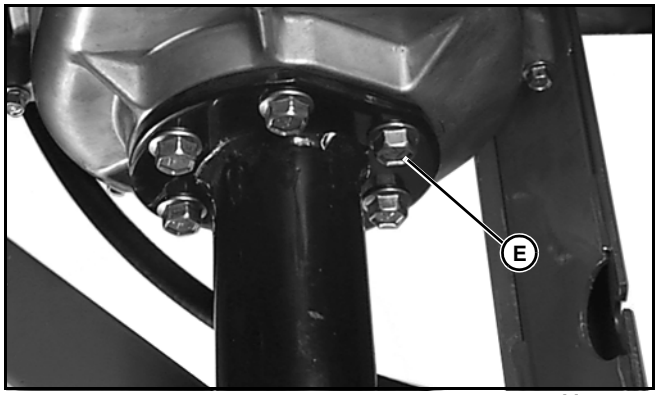
7. Loosen jam nut (C) and disconnect brake cable housing from axle bracket.

8. Remove three lock nuts (D) from carriage bolts holding

RH wheel axle case to frame.

9. Remove transaxle and axle tubes. See “Transaxle Removal and Installation” on page 129.

NOTE: When removing the drive axle, it should be removed with the transaxle attached, then remove the independent axle tubes.



M87759

10.Remove six cap screws (E) holding axle tube(s) to transaxle.

Installation is in the reverse order of removal.

1. Apply Moly High Temperature EP Grease, or an equivalent, to splines of axle shaft before installation.

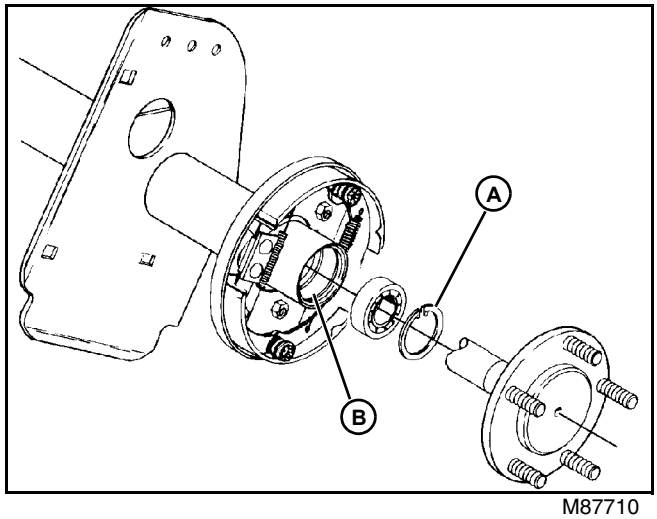
2. Tighten cap screws to transaxle to 41 ± 6 N•m (25 - 35 lb-ft).

3. Tighten carriage bolts securing axle housing to frame to 87 ± 17 N•m (52 - 76 lb-ft).

4. Install rear wheels with tire stem toward outside of Gator. Tighten rear wheel mounting cap screws to 88 N•m (65 lb-ft).

Drive Axle Disassembly

1. Pull rear wheel and axle case from transaxle.



M87710

2. Using right angle compression ring pliers, remove C-clip (A) from groove (B) in axle housing.

3. Using a soft faced hammer, drive axle out of axle housing from splined (transaxle) end.

NOTE: Bearing is press fit onto axle shaft. Remove bearings only if replacement is necessary. Do not reuse bearings.

4. Inspect axle bearing for corrosion, wear and freedom of movement. Replace bearing as necessary.

5. To replace bearing:

- Remove bearing from axle shaft using a knife-edge puller and a press.
- Install bearing on axle using a driver set, only pressing on inside race of bearing.

Assembly:

Assembly is done in the reverse order of disassembly.

Table of Contents

STEERING TABLE OF CONTENTS

Specifications

Service and Adjustment Specifications

Lubrication Interval:

Spindle Grease Fitting and Kingpin . . . . . .Every 25 hours (severe conditions)
. . . . . Every 50 hours (normal conditions)

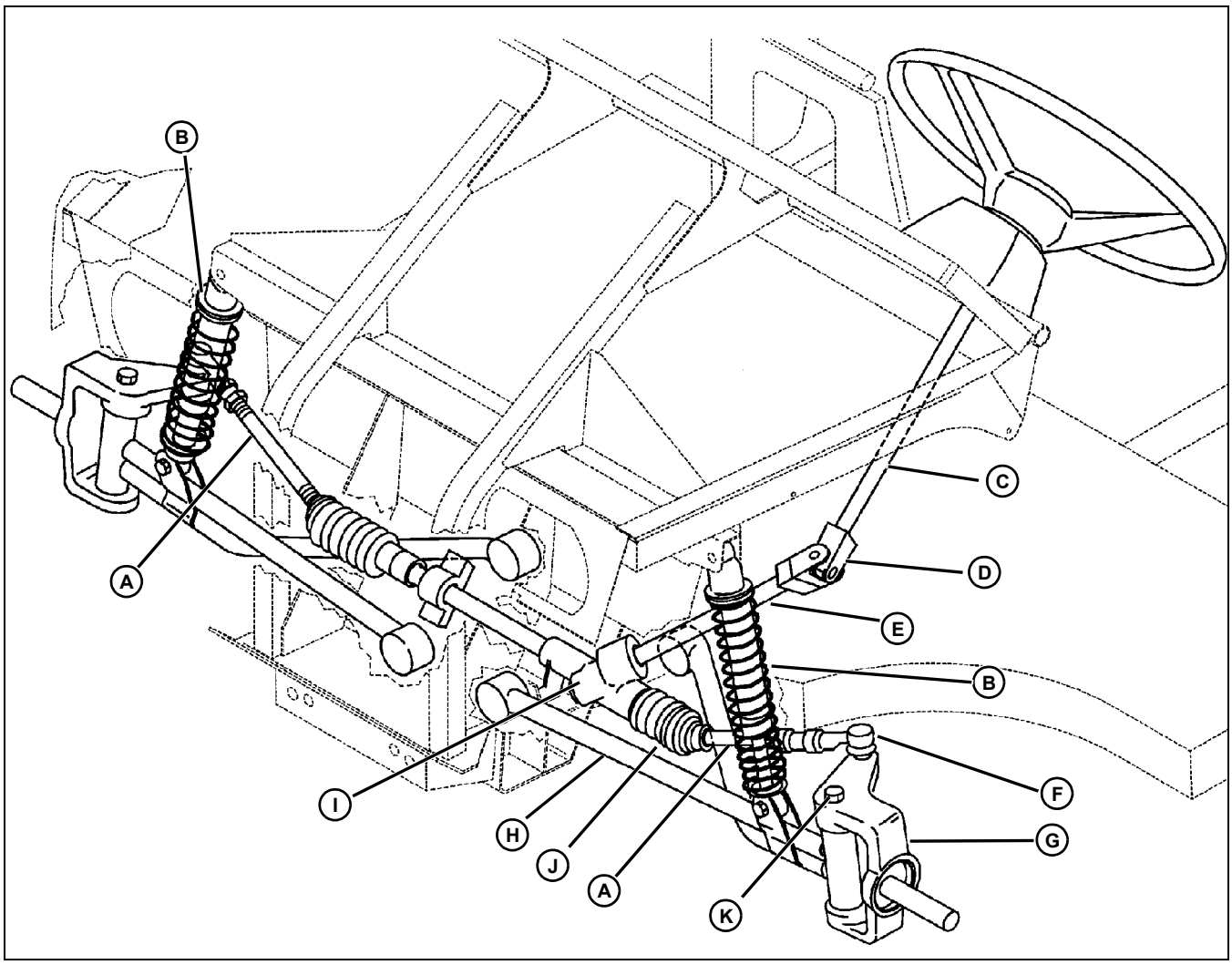
Toe-In Adjustment

Front-to-Rear Difference . . . . . Front is 4 ± 3 mm (0.16 ± 0.12 in.) less than rear at axle height

Torque Specifications

Shock Absorber Lock Nuts . . . . . 80 N•m (60 lb-ft)
King Pin Bolts - M10. . . . . 73 N•m (54 lb-ft)
King Pin Bolts - M12. . . . . 130 N•m (96 lb-ft)
A-Arm Assembly Lock Nuts . . . . . 90 N•m (105 lb-ft)
A-Arm Spindle Cap Screws and Lock Nuts - 10mm x 170mm Cap Screw . . . . . 60 N•m (46 lb-ft)
A-Arm Spindle Cap Screws and Lock Nuts - 12mm x 173mm Cap Screw . . . . . 130 N•m (95 lb-ft)
Rack and Pinion Assembly Lock Nuts . . . . . 70 N•m (40 lb-ft)
Rubber Boot Assembly Tie Straps . . . . . .Snug Only - boot must not turn with tie rod when tie rod is adjusted
Front Wheel Bolts. . . . . 88 ± 10 N•m (65 ± 7 lb-ft)
Tie Rod Lock Nuts . . . . . 50 N•m (37 lb-ft)
Tie Rod Jam Nuts . . . . . 70 N•m (52 lb-ft)
Steering Wheel Nut. . . . . Snug Only
Steering Shaft U-Joint Assembly Cap Screw - 8mm Cap Screw
Early Models . . . . . 38 N•m (28 lb-ft)
Steering Shaft U-Joint Assembly Cap Screw - 10mm Cap Screw
Later Models . . . . . 70 N•m (52 lb-ft)

Component Location **Steering Component Location**



MX0597

A - Tie Rod
B - Shock Absorber
C - Upper Steering Shaft
D - Steering Shaft U-Joint
E - Lower Steering Shaft
F - Tie Rod End
G - Spindle Assembly
H - A-Arm
I - Rack and Pinion
J - Rubber Boot
K - King Pin Bolt

Diagnostics

Troubleshooting

Symptom: Steering pulls in one direction

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

No - Go to next step.

(6) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(7) Have the wrong size tire(s) been installed?

Yes - Replace with correct size tires.

No - Go to next step.

(8) Are the tires out of round or have improper air pressure?

Yes - Inflate to proper air pressure. Replace tire(s) as needed.

No - Go to next step.

Symptom: Steering pulls in one direction

(9) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(10) Are the A-arm bushings worn, or is A-arm bent?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(11) Are the shock absorber mounts bent, or have worn, loose, broken, or missing hardware?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

Symptom: Steering wanders

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

Symptom: Steering wanders

No - Go to next step.

(6) Is the steering shaft u-joint worn or cap screw loose?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(7) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(8) Have the wrong size tire(s) been installed?

Yes - Replace with correct size tires.

No - Go to next step.

(9) Are the tires out of round or have improper air pressure?

Yes - Inflate to proper air pressure. Replace tire(s) as needed.

No - Go to next step.

(10) Are the steering wheel or shaft splines worn or stripped?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(11) Is the steering wheel nut loose, stripped, or missing?

Yes - Tighten or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(12) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(13) Are the A-arm bushings worn, or is A-arm bent?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

Symptom: Steering wanders

No - Go to next step.

(14) Are the shock absorber mounts bent, or have worn, loose, broken, or missing hardware?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

Symptom: Steering shimmies or vibrates

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

No - Go to next step.

(6) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(7) Have the wrong size tire(s) been installed?

Yes - Replace with correct size tires.

No - Go to next step.

Symptom: Steering shimmies or vibrates

(8) Are the tires out of round or have improper air pressure?

Yes - Inflate to proper air pressure. Replace tire(s) as needed.

No - Go to next step.

(9) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(10) Are the A-arm bushings worn, or is A-arm bent?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(11) Do shock absorbers have leaks or broken springs?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

(12) Are the shock absorber mounts bent, or have worn, loose, broken, or missing hardware?

Yes - Repair or replace as needed. See Miscellaneous Section.

No - Go to next step.

Symptom: Wheel bearing noise

(1) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

Symptom: Steering hard left or right or both

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

Symptom: Steering hard left or right or both

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

No - Go to next step.

(6) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(7) Have the wrong size tire(s) been installed?

Yes - Replace with correct size tires.

No - Go to next step.

(8) Are the tires out of round or have improper air pressure?

Yes - Inflate to proper air pressure. Replace tire(s) as needed.

No - Go to next step.

(9) Are the steering wheel or shaft splines worn or stripped?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(10) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

Symptom: Steering hard left or right or both

No - Go to next step.

(11) Is the rubber boot cracked or torn?

Yes - Replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

Symptom: Steering locks in hard left or right turn

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

No - Go to next step.

(6) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(7) Is the rubber boot cracked or torn?

Yes - Replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

Symptom: Steering wheel pulls upward

(1) Is the steering shaft u-joint worn or cap screw loose?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(2) Is the steering wheel nut loose, stripped, or missing?

Yes - Tighten or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(3) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

Symptom: Steering wheel spins freely

(1) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(2) Is the steering shaft u-joint worn or cap screw loose?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(3) Are the steering wheel or shaft splines worn or stripped?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(4) Is the steering wheel nut loose, stripped, or missing?

Yes - Tighten or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

Symptom: Steering wheel spins freely

(5) Is the steering shaft to rack and pinion assembly snap ring dislodged or missing?

Yes - Install or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

Symptom: Noise during turns or over rough terrain

(1) Are the spindles, king pins, or king pin A-frame bearings worn?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do spindles, king pins, or king pin A-frame bearings require lubrication?

Yes - Lubricated as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(3) Is the rack and pinion assembly worn or broken?

Yes - Repair or replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(4) Are the tie rods bent or loose?

Yes - Repair or replace as needed. See “Tie Rod End Replacement” on page 155.

No - Go to next step.

(5) Is toe-in out of specification?

Yes - Adjust toe-in as needed. See “Toe-In Adjustment” on page 154.

No - Go to next step.

(6) Is the steering shaft u-joint worn or cap screw loose?

Yes - Repair or replace as needed. See “Steering Wheel and Shaft Removal and Installation” on page 155.

No - Go to next step.

(7) Are wheel bearing worn or lost lubrication?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

Symptom: Noise during turns or over rough terrain

No - Go to next step.

(8) Is the rubber boot cracked or torn?

Yes - Replace as needed. See “Steering Assembly Removal and Installation” on page 156.

No - Go to next step.

(9) Are the A-arm bushings worn, or is A-arm bent?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(10) Do shock absorbers have leaks or broken springs?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

(11) Are the shock absorber mounts bent, or have worn, loose, broken, or missing hardware?

Yes - Repair or replace as needed. See Miscellaneous Section.

No - Go to next step.

(12) Are the shock absorber installed upside down?

Yes - Install in proper direction. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

Symptom: Front steering suspension weak or unstable

(1) Are the A-arm bushings worn, or is A-arm bent?

Yes - Repair or replace as needed. See “Spindle Shaft and Bushing Removal and Installation” on page 156.

No - Go to next step.

(2) Do shock absorbers have leaks or broken springs?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

Symptom: Front steering suspension weak or unstable

(3) Are the shock absorber mounts bent, or have worn, loose, broken, or missing hardware?

Yes - Repair or replace as needed. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

(4) Are the shock absorber installed upside down?

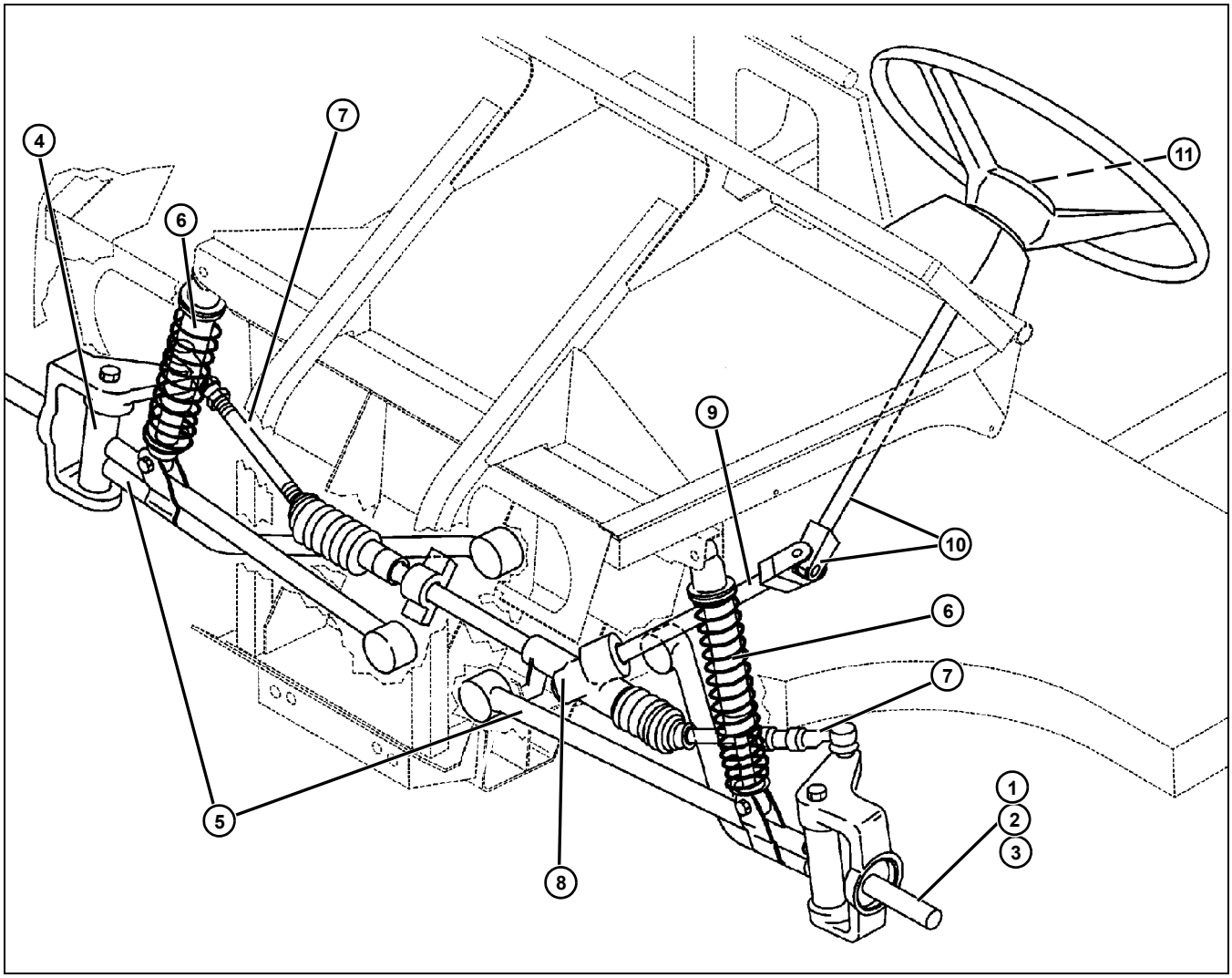
Yes - Install in proper direction. See “Shock Absorber Replacement” on page 176 in the Miscellaneous section.

No - Go to next step.

Steering Troubleshooting Test Points

Test/Check Point	Normal	If Not Normal
1. Rims	Runout less than 3 mm (0.12 in.)	Replace rims.
	Wheel bolts tight	Tighten to specification.
2. Tires	Runout less than 10 mm (0.4 in.)	Remount or replace tires.
	Tires properly inflated	Inflate tires to proper pressure.
3. Wheel bearings and bushings	Wheels rotate freely without rough spots	Replace rims.
4. Spindle and kingpin assemblies	Assemblies tight and turn smoothly	Tighten assemblies.
	King pins properly greased	Replace assemblies.
		Grease.
5. A-arm assemblies	Fastened securely	Tighten lock nuts to 90 N•m (66 lb-ft).
	Assemblies not bent	Replace A-arm assemblies.
	Pivot bushing not worn or binding	Replace bushings.
6. Shock absorbers	Installed and tightened properly	Tighten lock nuts to specification.
	Operate smoothly and not leaking	Replace shock absorbers.
7. Tie rods and tie rod ends	Jam nuts tight, tie rod ends tight, and toe-in adjusted properly	Adjust toe-in and tighten jam nuts to 70 N•m (52 lb-ft) and lock nuts to 50 N•m (37 lb-ft).
	Tie rods straight, not worn	Replace components as necessary.
8. Rack ‘n’ pinion assembly	Assembly fastened securely	Tighten assembly to 70 N•m (52 lb-ft).
	Operates from stop-to-stop smoothly with little effort	Replace assembly.
9. Lower steering shaft	Fastened securely to rack ‘n’ pinion assembly	Fasten securely.
	Straight	Replace shaft.

Test/Check Point	Normal	If Not Normal
10. Upper steering shaft and U-joint	U-joint fastened securely	Tighten U-joint cap screw to specification.
	Operates smoothly. Shaft splines good	Replace upper steering shaft and U-joint.
11. Steering wheel and leaping deer emblem	Installed properly, nut snug	Install and tighten properly.
	No cracks or breaks, splines good	Replace components as necessary.



MX0597

Tests and Adjustments

Toe-In Adjustment

Reason:

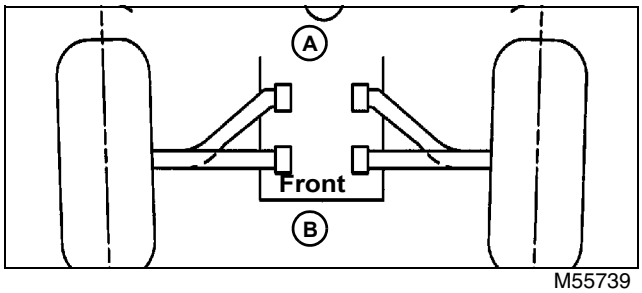
To prevent tire wear and steering wander.

Test Procedure:

1. Park machine safely with park brake locked.

NOTE: Toe-in cannot be correctly adjusted with the front wheels off the surface, an uneven surface, or any weight or load on machine.

2. Turn steering wheel until front drivers-side tire aligns with drivers-side rear tire(s). Use straight 2 x 4 or piece of angle iron for guide.



M55739

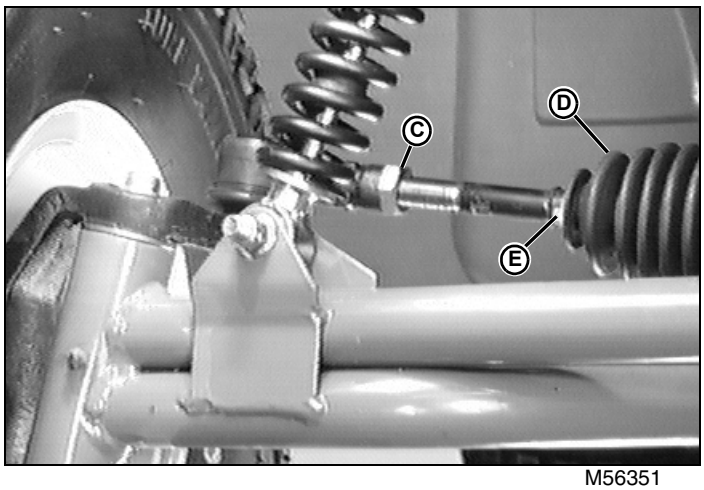
Picture Note: Viewed from top down.

3. At hub height and center of tire tread, measure rear distance (A) and front distance (B).

4. Compare measurement to specification.

Front-to-Rear Difference
. . . . . Front is 4 ± 3 mm (0.16 ± 0.12 in.) less than rear

Adjustment Procedure:



M56351

Picture Note: Right side shown.

1. Loosen jam nut (C).

NOTE: The rubber boot (D) may turn with the tie rod if boot clamp (E) is too tight. If this happens, loosen clamp enough to allow the rubber boot to remain stationary.

2. Turn tie rod until front to rear measurement is within specification.

3. Tighten jam nut.

Front-to-Rear Difference
. . . . . Front is 4 ± 3 mm (0.16 ± 0.12 in.) less than rear

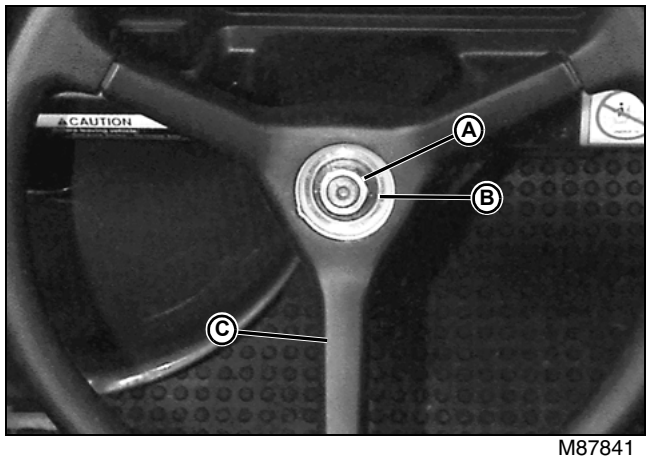
Steering Wheel Adjustment

Reason:

To position steering wheel properly.

Procedure:

1. Park machine safely with park brake locked.
2. Turn steering wheel to right or left steering stop.
3. Turn wheel to other stop while counting number of turns.
4. Turn wheel back 1/2 of total turns counted.



M87841

5. Proper position of steering wheel is as shown with spokes at approximately 2, 6, and 10 o'clock.

6. If wheel is not correct, remove leaping deer emblem, nut (A), and washer.

7. Without moving steering shaft, remove steering wheel.

8. Align steering wheel on splines (B) so bottom spoke (C) points to 6 o'clock.

9. Install washer and nut, tighten until snug only.

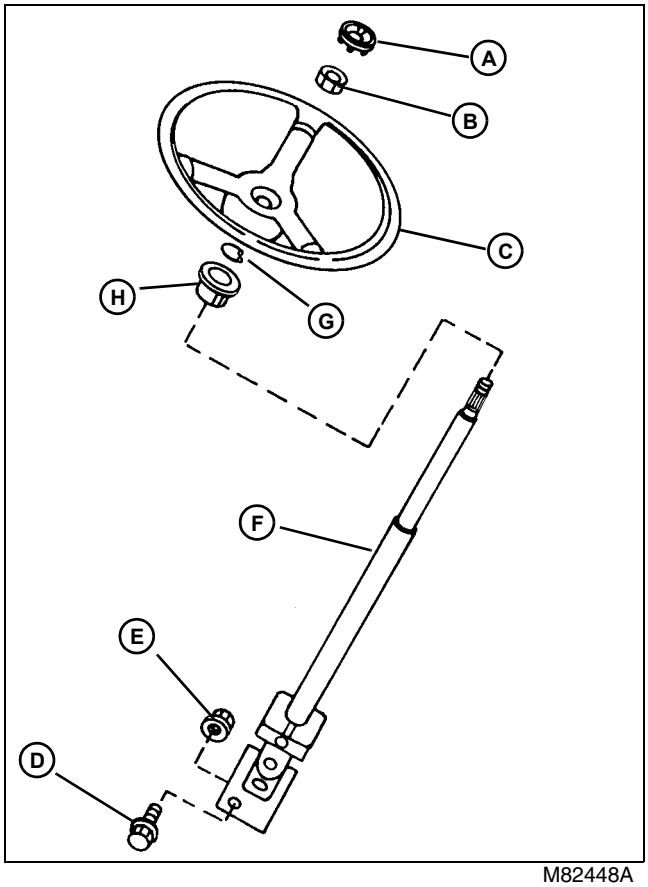
10. Install leaping deer emblem.

Repair

Steering Wheel and Shaft Removal and Installation

Removal:

1. Park machine safely with park brake locked.



M82448A

2. Remove cap (A), lock nut (B), and steering wheel (C).
3. Remove U-joint cap screw (D) and nut (E).
4. Pull up on steering shaft (F). Remove snap ring (G).
5. Remove shaft (F) and bushing (H).
6. Inspect all parts for wear or damage. Replace as necessary.

Installation:

1. Installation is done in the reverse order of removal.
2. Tighten U-joint cap screw to torque specification.

U-Joint Cap Screw Torque Specifications:

8mm Cap Screw Early Models
(SN -005580) . . . . . 40 N•m (30 lb-ft)

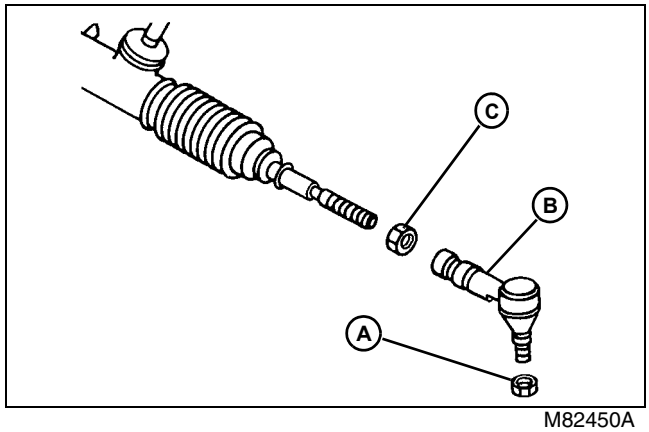
10mm Cap Screw Later Models
(SN 005581-) . . . . . 73 N•m (54 lb-ft)

Tie Rod End Replacement

Removal:

1. Park machine safely with park brake locked.
2. Remove front wheel.

NOTE: Tie rod end is a tapered bore fit into spindle. Use a ball joint fork or puller to ease removal.



M82450A

3. Remove tie rod end lock nuts (A) and disconnect tie rod ends from spindles.
4. Remove tie rod end (B).

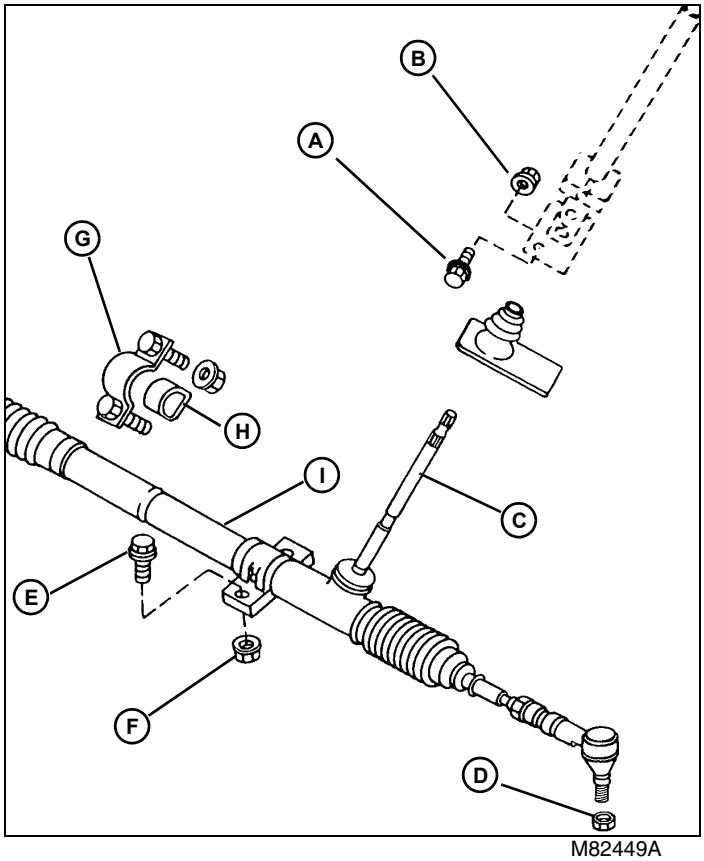
Installation:

1. Install new tie rod end. Position spindle shaft 90° to machine and turn wheel on other side to straight position.
2. Turn tie rod end until tapered end fits into arm of spindle.
3. Tighten lock nut (B) to **50 N•m (37 lb-ft)**.
4. Adjust toe-in.
5. Tighten jam nut (C) to **70 N•m (52 lb-ft)**.

Steering Assembly Removal and Installation

Removal:

1. Park machine safely with park brake locked.



M82449A

2. Remove front wheels.
3. Remove U-joint cap screw (A) and lock nut (B).
4. Pull up on steering wheel to disconnect U-joint from lower steering shaft (C).
5. Remove tie rod end lock nuts (D) and disconnect tie rod ends from spindles.
6. Remove mounting cap screws (E) and lock nuts (F).
7. Loosen the mounting bracket (G) and isolator (H).
8. Remove nine mounting screws and washers from left-hand fender.
9. Remove steering assembly (I) from left-hand side of machine.
10. Inspect all parts for wear or damage. Replace as necessary.

Installation:

1. Installation is done in the reverse order of removal.
2. Adjust toe-in.
3. Tighten cap screws to specification.

Torque Specifications:

Tie Rod End Lock Nut . . . . . 50 N•m (37 lb-ft)
U-Joint Cap Screw - 8 mm. . . . . 38 N•m (28 lb-ft)
U-Joint Cap Screw - 10 mm. . . . . 73 N•m (54 lb-ft)
Mounting Lock Nuts. . . . . 70 N•m (52 lb-ft)

Spindle Shaft and Bushing Removal and Installation

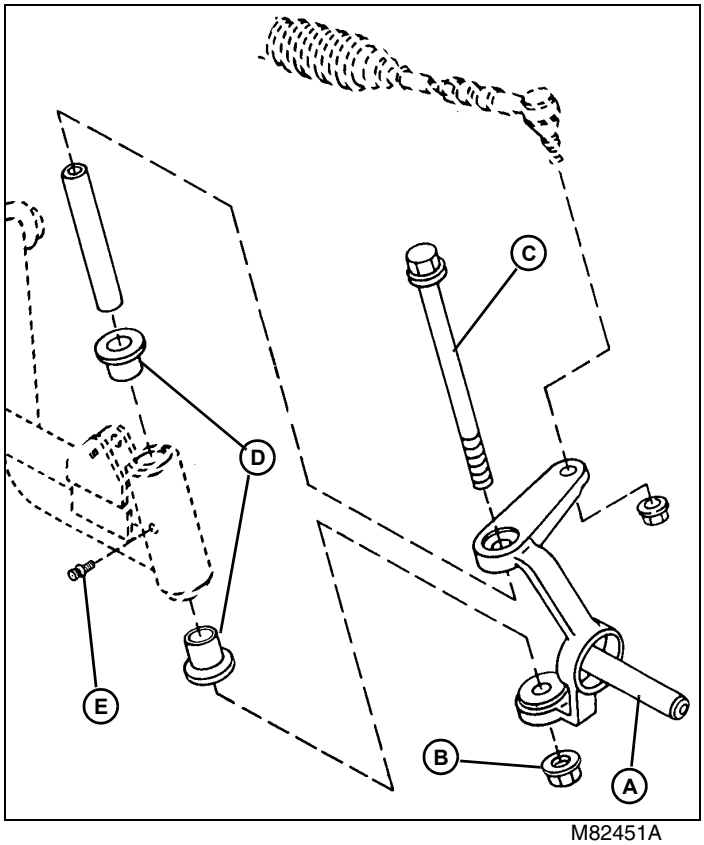
The steering spindle design was changed by increasing the material thickness and the king pin hole diameter to improve spindle strength. The improved spindle design was included at serial number:

W004X2T06544–

Below these serial numbers the spindles should be replaced as a set. Above these serial numbers, one spindle can be replaced at a time.

Removal:

1. Park machine safely with park brake locked.
2. Remove tire.



M82451A

3. Disconnect tie rod end from spindle shaft (A).
4. Remove lock nut (B) and cap screw (C).
5. Remove spindle shaft.

6. Replace bushings (D).

7. Bushings are press fit into the a-arm. Use an inside puller set to remove bushings, and a driver set to install bushings.

Installation:

1. Installation is done in the reverse order of removal.
2. Apply multipurpose grease to lubrication fitting (E).
3. Tighten lock nut (B) to specification.

Torque Specifications:

10 mm x 170 mm cap screw . . . . . 73 N•m (54 lb-ft)

12 mm x 173 mm cap screw . . . . . 130 N•m (95 lb-ft)

Table of Contents

BRAKES TABLE OF CONTENTS

Specifications

Torque Specifications

Driven Clutch Mounting Cap Screw . . . . . 73 N•m (54 lb-ft)
Axle to Frame Round Head Bolts . . . . . 87 N•m (64 lb-ft)
Axle to Transaxle Cap Screws. . . . . 41 N•m (30 lb-ft)
Brake Assembly to Axle Case . . . . . 23 N•m (17 lb-ft)
Rear Wheel to Axle . . . . . 88 N•m (65 lb-ft)

General Specifications

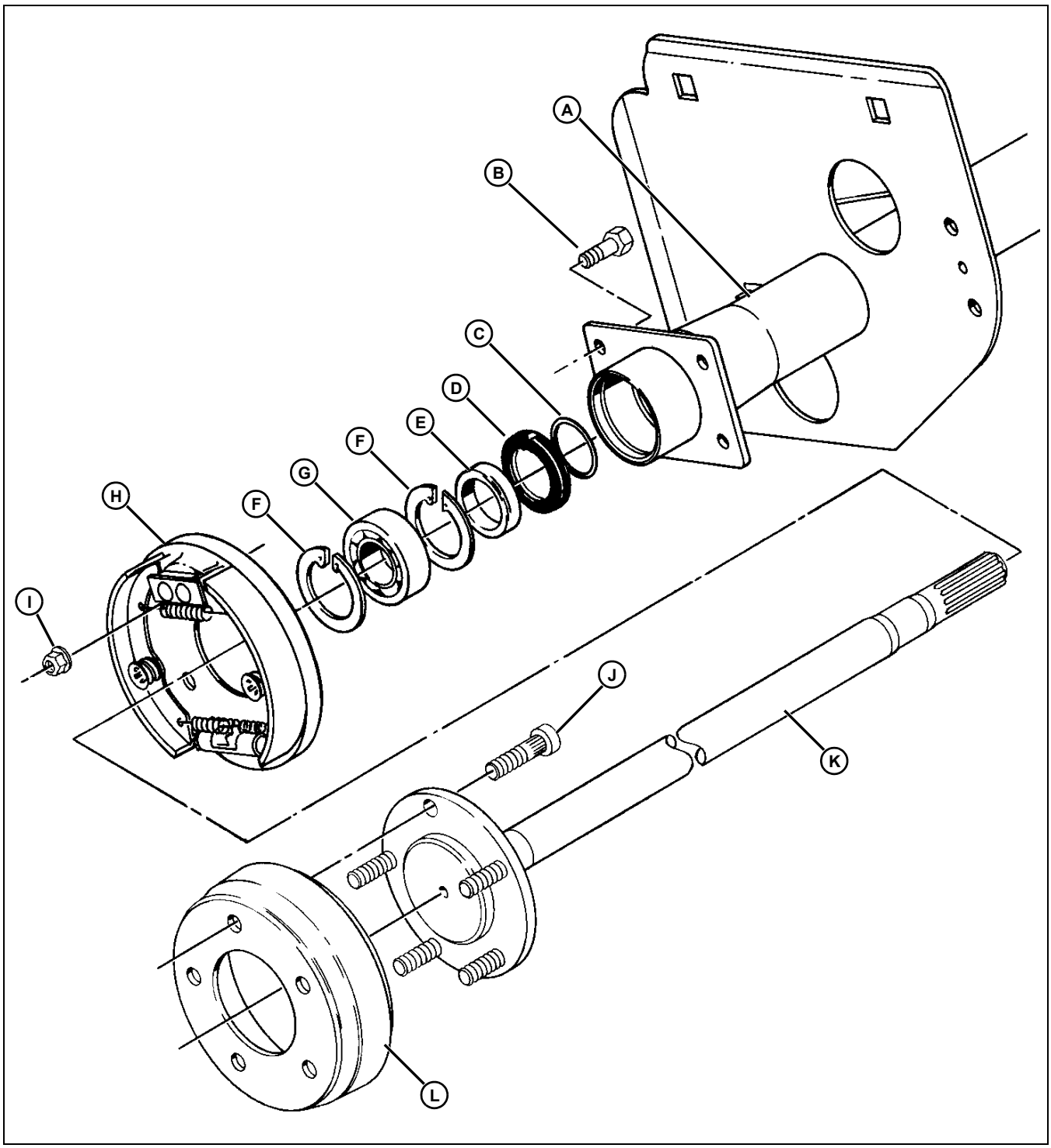
Brake Lining Thickness (minimum) . . . . . 1 mm (0.04 in.)

Other Materials

Other Material

Part No.	Part Name	Part Use
TY15130 #595	John Deere Form-in-Place Gasket	Seal mating surfaces of transaxle
TY16285/#7649	Cure primer	Clean sealing surfaces
TY6333	Moly High Temperature EP Grease	Apply to splines of axle
AM128979	High Friction Brake Shoe Kit	Improved braking performance

Component Location **Rear Axle Components**

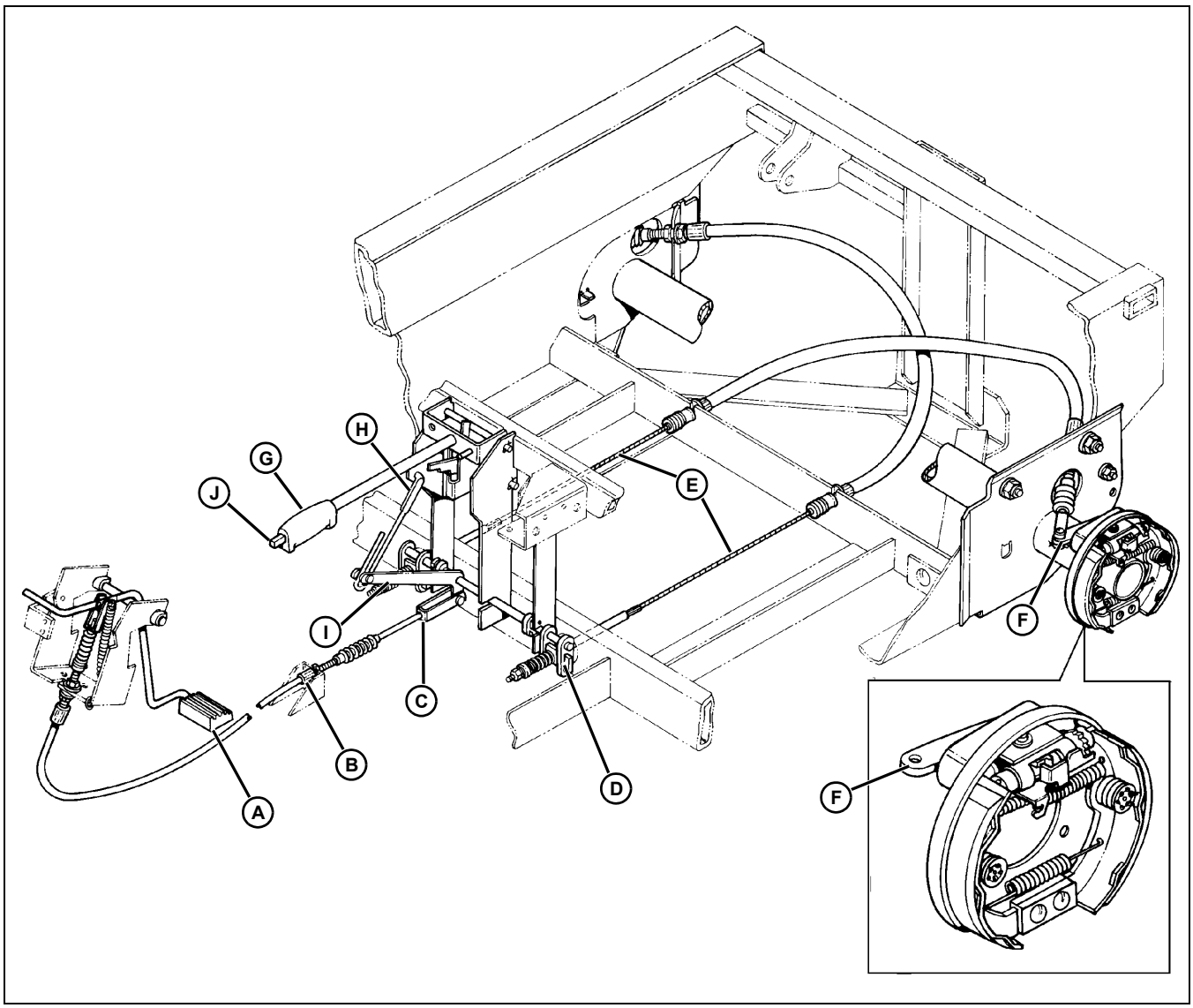


M94888

A - Axle Housing Tube Assembly
B - Cap Screw (4 used)
C - Retaining Ring
D - Oil Seal
E - Wheel Bearing Retainer
F - Snap Ring
G - Ball Bearing
H - Brake Assembly
I - Lock Nut
J - Wheel Studs (5 used)
K - Left Axle
L - Brake Drum

Theory of Operation

Brake Operation



M87648

Function:

To provide a means of stopping the unit and also prevent movement when not in use.

Theory Of Operation:

When the brake pedal (A) is depressed, the brake cable anchor (B) pulls U-bracket (C) and mid-frame brake arms (D) forward. Mid-frame brake arms pull left and right side brake cables (E) which pull brake arms (F) rearward. When brake arms are pulled rearward the brake shoes are forced against the inside of the brake drum.

The friction between the brake shoes and brake drums slows or stops rear wheel rotation.

When the park brake lever (G) is raised into its locked position, the slotted rod (H) pulls the park brake arm (I) up and the mid-frame brake arms (D) forward. From hereon, everything works the same as action from the brake pedal. To release the park brake lever, first raise the lever slightly, then depress the release button (J) and lower lever all-the-way.

Diagnostics

Brake System Checks

Test Conditions:

- Operator in seat.
- Engine running at operating temperature.
- Minimum of 50 feet of open and flat pavement away from any people.
- Shift lever in forward or reverse.

System: Brakes Operation

(1) Does the machine stop aggressively, with rear wheels locking, when brakes applied?

Yes - Go to next step.

No - Check linkage and brake components for adjustment, binding, wear or damage. If needed, install high co-efficient friction brake shoe kit.

(2) Does the brake pedal depress smoothly and with little effort?

Yes - Go to next step.

No - Check linkage and brake components for binding, wear or damage.

Test Conditions:

- Key switch in OFF position.
- Shift lever LOCKED in Neutral. See “Transaxle Neutral Lock” on page 121 in Powertrain section.

System: Brakes

(1) Are the brake pedal components, hardware and springs worn, damaged, loose broken or missing?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Are the mid-frame cable, rubber boots and load springs worn, damaged, loose broken or missing?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Are the rear wheel drum brakes worn or damaged and is the linkage adjusted properly and not worn or damaged?

Yes - Adjust linkage and brake adjuster pawl. Repair or replace as necessary.

System: Brakes

(4) Is the park properly adjusted and the linkage not worn or damaged?

Yes - End of checks.

No - Repair or replace as necessary.

Brake System Diagnosis

Test Conditions:

- Operator in seat.
- Engine running at operating temperature.
- Minimum of 50 feet of open and flat pavement away from any people.
- Shift lever in forward or reverse.

Symptom: Brakes Will Not Engage, Show Poor Response, Binding, or Brake Effort Excessive

(1) Is the brake pedal bent, binding or worn?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(6) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(7) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Symptom: Brakes Will Not Engage, Show Poor Response, Binding, or Brake Effort Excessive

Yes - Repair or replace as necessary.

Symptom: Brakes Engagement Too Aggressive

(1) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Brakes Will Not Release

(1) Is the brake pedal bent, binding or worn?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake pedal return spring stretched or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Is the brake linkage freeplay incorrect?

Symptom: Brakes Will Not Release

Yes - Repair or replace as necessary.

No - Go to next step.

(6) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(7) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(8) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Park Brake Will Not Engage

(1) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Is the park brake lever, locking pawl, slotted rod, or park brake arm bent, binding, worn, or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(6) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Park Brake Will Not Release

(1) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the park brake lever, locking pawl, slotted rod, or park brake arm bent, binding, worn, or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Park Brake Will Not Hold

(1) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the park brake lever, locking pawl, slotted rod, or park brake arm bent, binding, worn, or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Brakes Noisy or Chattering

(1) Is the brake pedal bent, binding or worn?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake pedal return spring stretched or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Are the mid-frame brake springs misadjusted, collapsed or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(5) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(6) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Excessive Brake Wear

(1) Is the brake pedal bent, binding or worn?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake pedal return spring stretched or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

Symptom: Excessive Brake Wear

(5) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(6) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(7) Is the park brake lever, locking pawl, slotted rod, or park brake arm bent, binding, worn, or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

(8) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Symptom: Brake Pedal Travel Excessive

(1) Is the brake pedal stop plate worn or misadjusted?

Yes - Repair or replace as necessary.

No - Go to next step.

(2) Is the brake cable misadjusted, stretched, or binding?

Yes - Repair or replace as necessary.

No - Go to next step.

(3) Is the brake linkage freeplay incorrect?

Yes - Repair or replace as necessary.

No - Go to next step.

(4) Is the mid-frame brake arm linkage loose, misadjusted, binding, worn or broken?

Yes - Repair or replace as necessary.

No - Go to next step.

No - Go to next step.

(5) Are the mid-frame to wheel cables misadjusted, stretched, worn or binding?

Yes - Repair or replace as necessary.

Tests and Adjustments

Brake Adjustment

Reason:

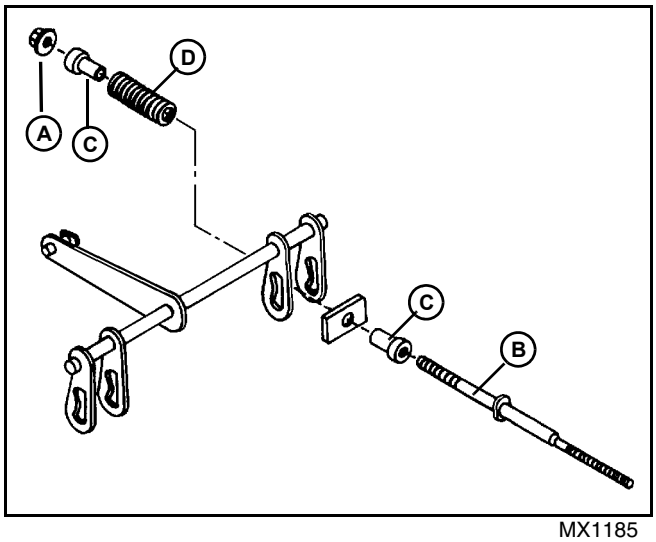
To ensure brake pedal cable, and park brake cable are adjusted properly.

Procedure:

NOTE: The front end of the brake cables need to be adjusted before the rear end of the brake cables.

Rear Cable Front End Adjustment:

1. Park machine on level surface and turn key switch OFF.
2. Shift lever in NEUTRAL and park brake lever in released position, and front wheels BLOCKED.
3. Raise cargo box.



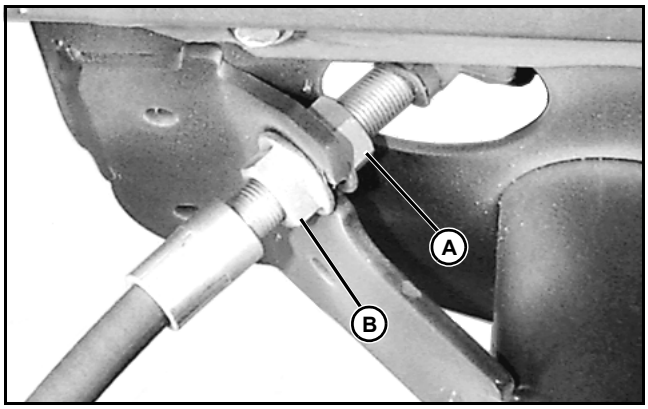
MX1185

4. Tighten nut (A) onto linkage (B) completely until the ends of sleeves (C) make contact inside spring (D). This sets a predetermined preload on the spring. Repeat for second cable.

Rear Cable Rear End Adjustment:

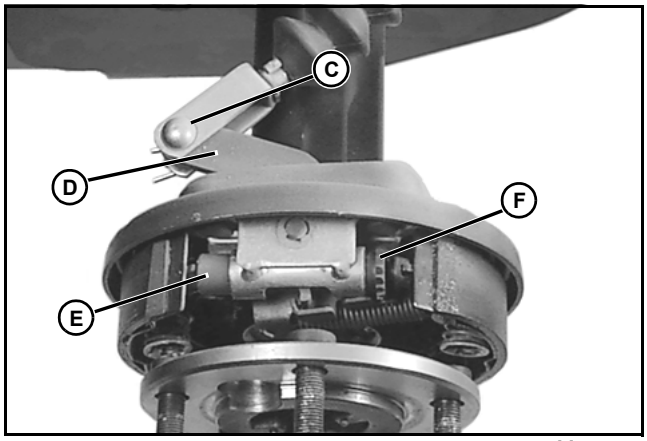
1. Use jack stands or hoist to raise rear wheels at least 25 mm (1.0 in.) off ground.
2. Remove rear wheel and brake drum. Clean out brake drum and brake mechanism with air (30 – 40 psi).

NOTE: If brake cable is being replaced, DO NOT attach cable to brake pedal at this time. Attach cable only at mid-frame mounting and rear brake arm clevis pin.



M87708

3. Loosen flange nuts (A) and (B) on rear brake cable housing.



M87709

4. Remove clevis pin (C).

5. Move brake arm (D) back until free play is removed, but before there is movement of brake piston (E).

6. Adjust flange nuts (A and B) until holes are aligned and clevis pin (C) drops in freely.

7. Tighten flange nuts (A and B) without changing the setting.

8. Rotate star wheel (F) until shoes are close to drum (when installed).

9. Install brake drum and check for drag. If necessary, remove brake drum and repeat step 8.

10.Install wheel.

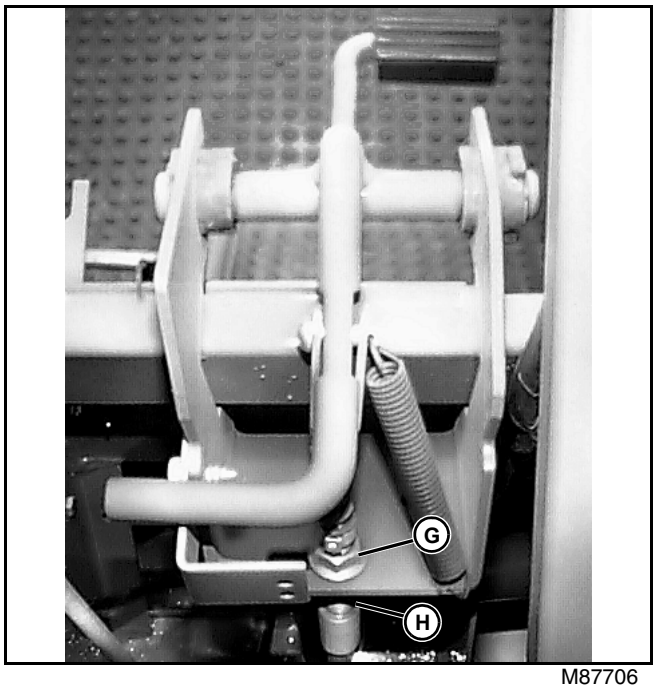
11.Repeat steps for opposite rear wheel.

NOTE: This completes the park brake adjustment procedure. If brake cable has been replaced or brake pedal linkage needs adjustment, complete "Front Cable Adjustment".

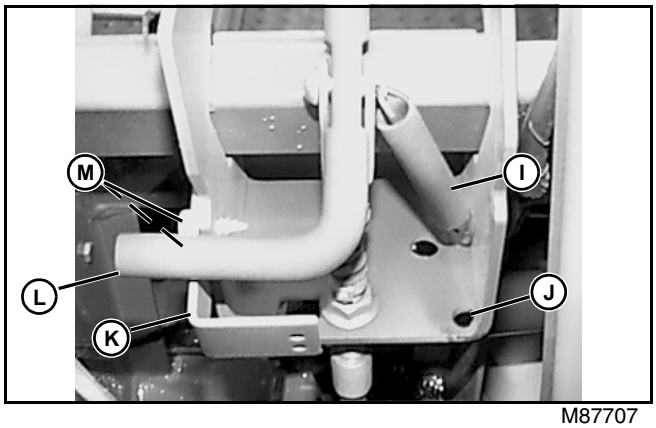
Front Cable Adjustment:

IMPORTANT: Avoid damage! DO NOT allow brake cable to slip out of slot or cable may become kinked. Hold cable in slot by holding cable below lower nut (H) when loosening top nut (G).

NOTE: Brake pedal freeplay is necessary to prevent any preload of brake linkage. If stop plate (K) is adjusted too high, brakes will be preloaded. If stop plate (K) is adjusted too low, return spring (I) pressure, will kink brake cable.



M87706



M87707

1. Loosen screws (M) of stop plate (K). Adjust stop plate up to reduce amount of freeplay in brake pedal. *Apply only enough up force to stop plate to take up freeplay. Do not start actuating brake. There should be maximum freeplay travel of 4 mm (0.16 in.).*

2. Hold stop plate (K) while tightening screws (M).

NOTE: If light and horn kit is installed, stop plate (K) will have a switch fastened to it. Stop plate must be positioned so switch is aligned with bottom of brake pedal rod (L). Be sure brake pedal rod contacts switch plunger (plunger depressed) but does not contact the switch body.

3. Install brake pedal return spring (I) in hole (J).

Repair

Brake Shoe Removal and Installation

Removal:

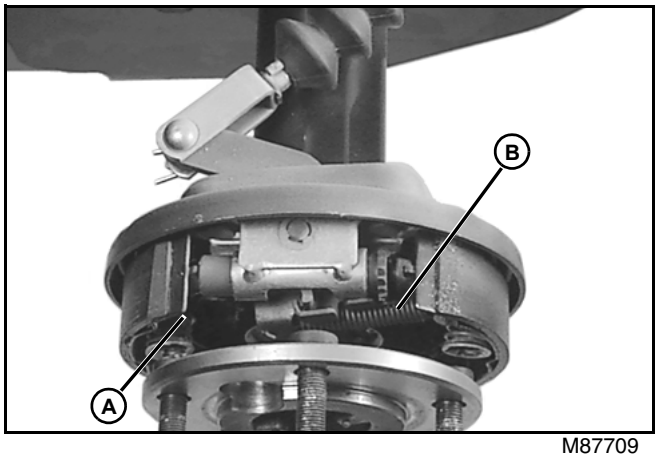
1. Park machine on level surface and turn key switch OFF.

2. Transaxle LOCKED in NEUTRAL (Use a 6 mm bolt and nut.). See “Transaxle Neutral Lock” on page 121 in Power Train Section.

3. Place park brake lever in released position, and front wheels BLOCKED.

4. Use jack stands or hoist to raise rear wheels at least 25 mm (1.0 in.) off ground.

5. Remove five lug nuts, rear wheel and brake drum.

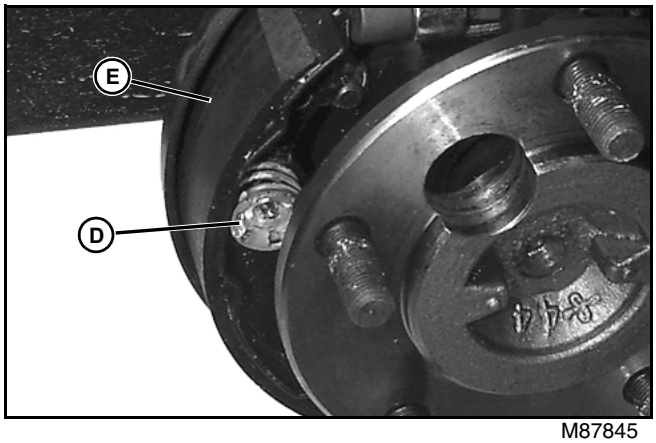


M87709

6. Disconnect front end of top brake shoe spring (A).

7. Disconnect front end of adjuster spring (B).

8. Disconnect bottom brake shoe spring (C).



M87845

9. Remove front brake shoe hold down clip and spring (D). Remove front brake shoe (E).

10. Remove rear brake shoe hold down clip and spring (F). Remove rear brake shoe (G) and springs, if still attached.

NOTE: Self adjuster housing is not removable. Brake plate (I) must be removed from axle housing to remove brake adjustment arm (J) and pin (K).

11. Service and inspect self adjuster (H) and plungers.

Installation:

1. Install front and rear plungers. Front plunger is flat faced and slotted. Slot must be oriented horizontally.

NOTE: Ensure front plunger slot is fully seated.

2. Install rear brake shoe (G), hold down spring (F) and clip. Ensure clip is rotated 90° during installation and fully seated.

3. Slide top brake shoe spring (A) under self adjuster housing and connect end to rear brake shoe.

4. Place front brake shoe (E) in position.

5. Install hold down spring (D) and clip. Ensure clip is rotated 90° during installation and fully seated.

NOTE: Ensure brake shoes are in correct position with top of rear brake shoe seated in slot of self adjuster screw (H).

6. Connect both ends of top brake shoe spring (A).

7. Install bottom brake shoe spring (C).

8. Connect rear end of adjuster spring (B) to rear brake shoe, position spring under brake adjustment arm (J) housing, and connect adjuster spring to brake adjustment arm.

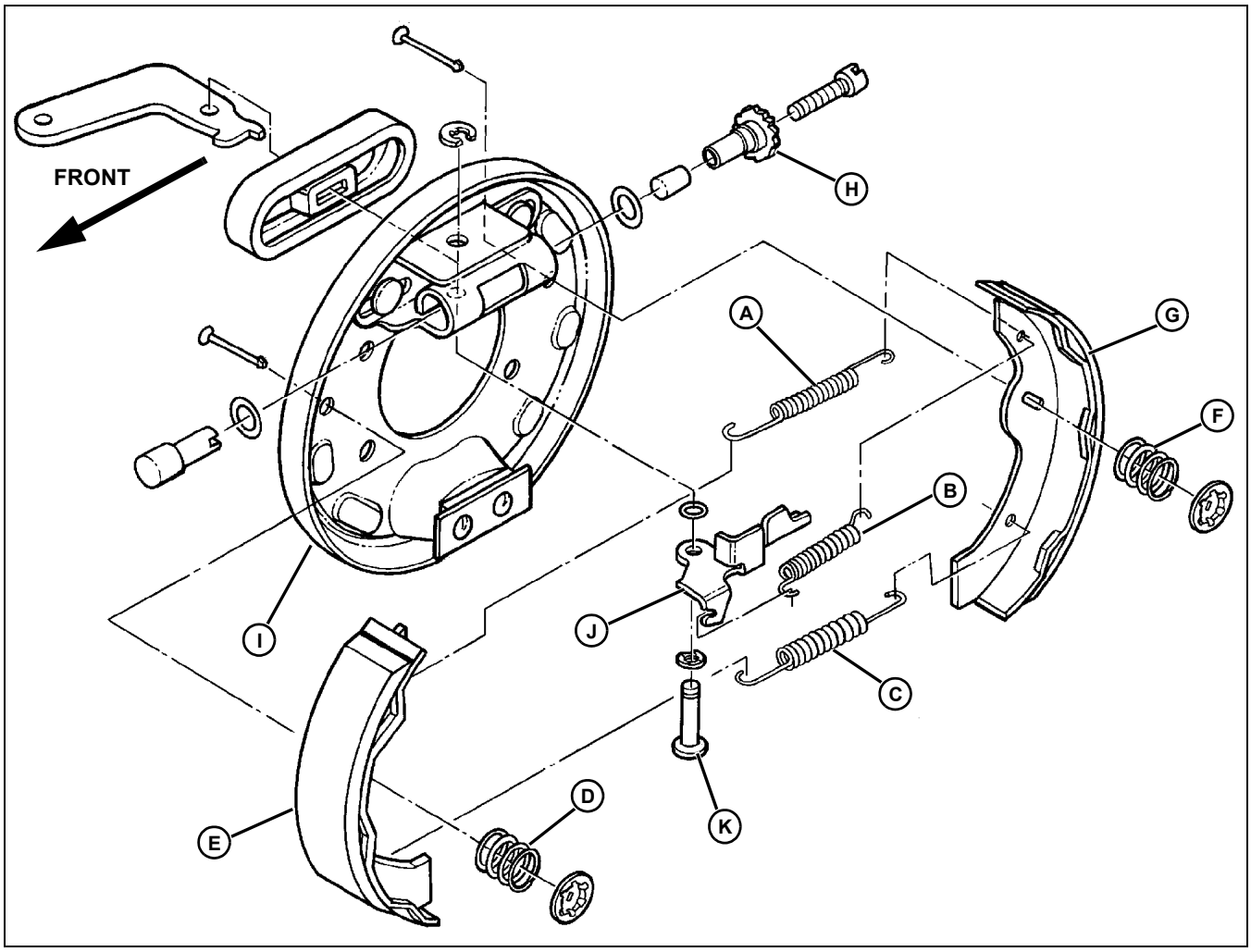
9. Check brake shoes for correct positioning, freedom of movement and seating against top self adjustor plungers.

10. Install brake drum, wheel and lug nuts. Snug lug nuts.

11. Lower vehicle to ground and tighten lug nuts to

88 N•m (65 lb-ft).

12.Adjust brakes. See “Brake Adjustment” on page 167.



M87713

Left Brake Assembly Shown

Table of Contents

MISCELLANEOUS TABLE OF CONTENTS

Specifications

Torque Specifications

Shock Absorber

Mounting Lock Nut	**70 N•m (52 lb-ft)**

A-Arm

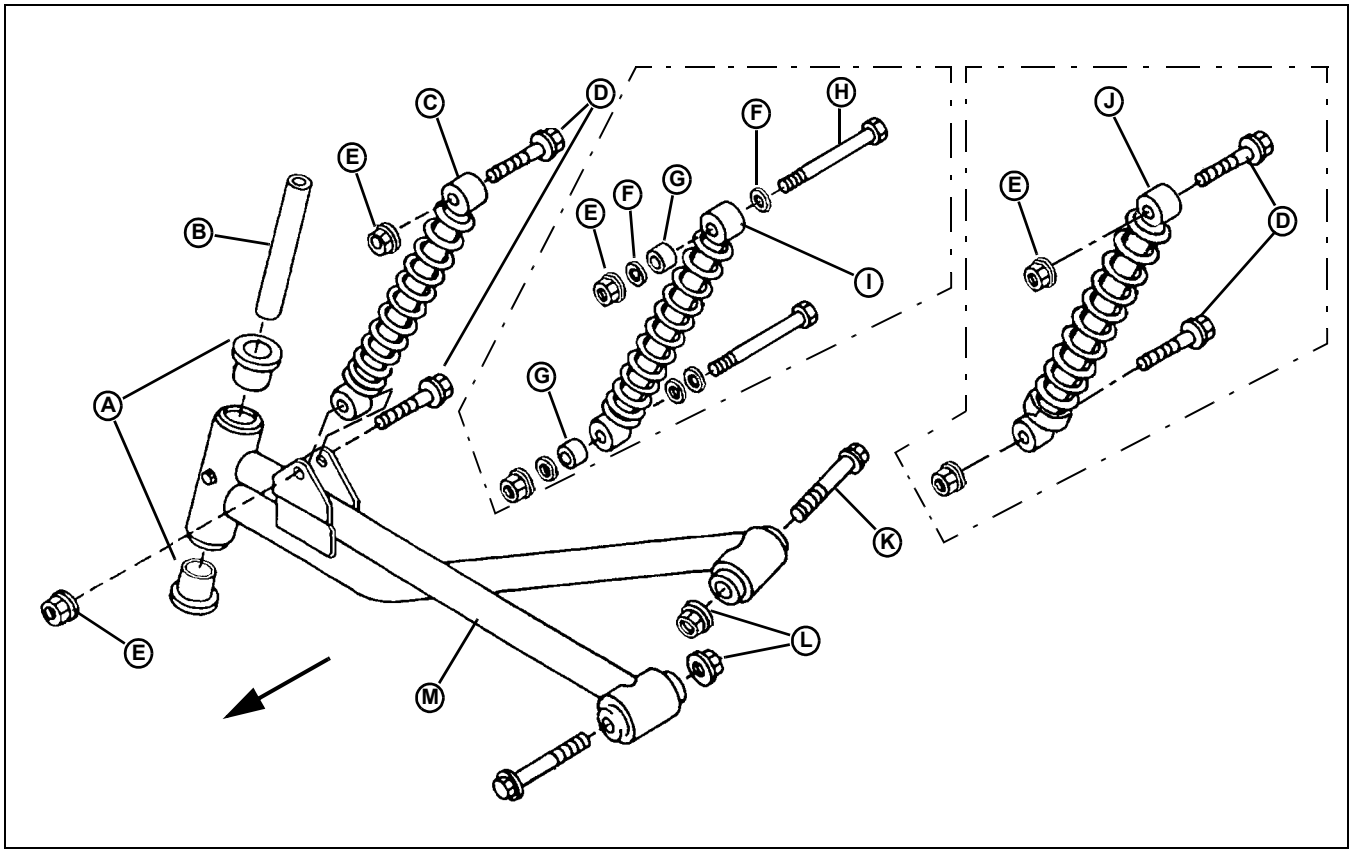
Shock Absorber to A-Arm Lock Nut	**70 N•m (52 lb-ft)**
A-Arm to Frame Lock Nut	**90 N•m (67 lb-ft)**

Wheels

Front Wheel Mounting Cap Screws	**88 N•m (65 lb-ft)**

Component Location

A-Arm Components



MX1400

Picture Note: Right Side A-Arm Shown

A - Bushing (2 used)
B - King Pin
C - Shock Absorber
D - Mounting Cap Screw (M10x40)
E - Lock Nut (M10)
F - Washer*
G - Spacer*
H - Mounting Cap Screw (M10x100) Replaces part D*
I - Original Style Heavy Duty Suspension Kit Shock Absorber (2nd shock added to each side) *Included in kit
J - New Style Heavy Duty Suspension Adjustable Shock Absorber Kit (Replaces standard shock on each side)
K - Mounting Cap Screw (M12x90)
L - Lock Nut (M12) (2 used)
M - A-Arm

Tests and Adjustments

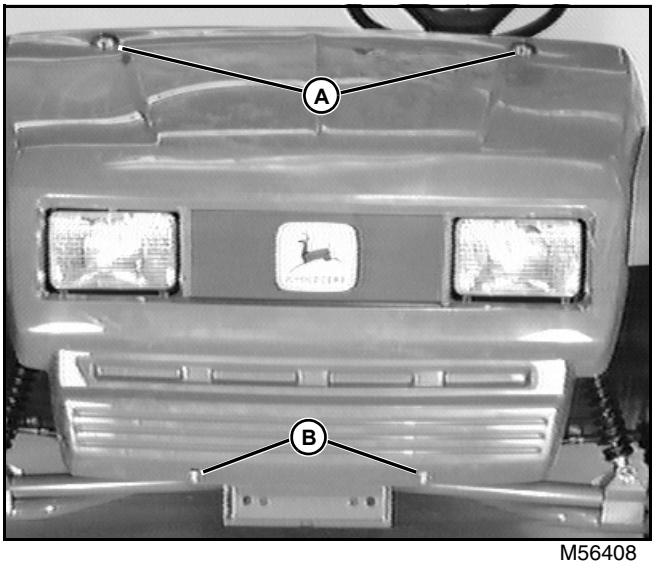
Hood Adjustment

Reason:

To position hood so openings for the headlights are centered around headlights.

Procedure:

1. Park machine on level surface, turn key switch OFF, place shift lever in NEUTRAL, and lock park brake.



M56408

2. Loosen top cap screws (A) and (B).

IMPORTANT: Avoid damage! Hood MUST NOT touch headlights or vibration may cause headlights to fail.

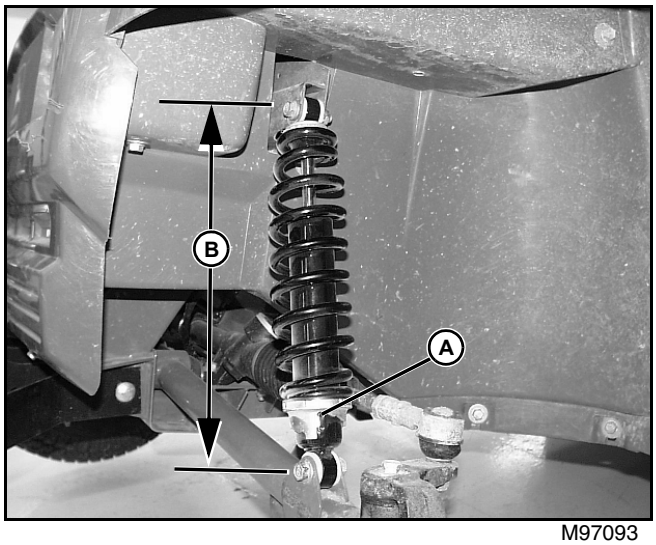
3. *Adjust hood so openings around headlights are equal.*

4. Tighten bottom cap screws (B), then tighten top cap screws (A).

5. Make sure hood has not shifted during tightening. Adjust again, if necessary.

Heavy Duty Suspension Shock Ride Height and Spring Preload Adjust (Optional)

1. Ensure all tires are inflated to 41 kPa (6 psi).

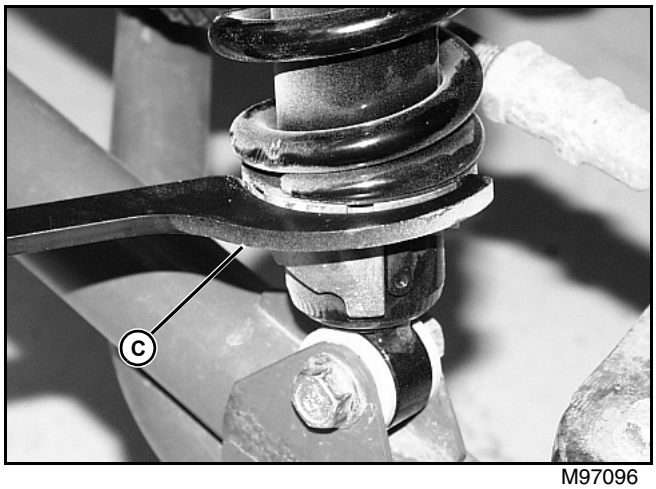


M97093

2. Measure center of bolt head to center of bolt head (B) on each shock and average the two dimensions.

IMPORTANT: Avoid damage! The cam position (A) on each shock needs to be the same to maintain a stable ride.

3. If average dimension is less than 305 mm (12 in.), adjust the cam to provide more spring preload. DO NOT exceed 315 mm (12-3/8 in.).



M97096

4. Use the adjusting wrench (C) to adjust the shock up to 5 levels of adjustment. Each level of the adjustment is approximately 3 mm (1/8 in.) more spring preload.

5. Drive to allow settling and setting in of the shocks, then check measurements. Adjust if necessary.

Repair

Shock Absorber Replacement

Removal:

1. Park machine on level surface, turn key switch OFF, place shift lever in NEUTRAL, and lock park brake.

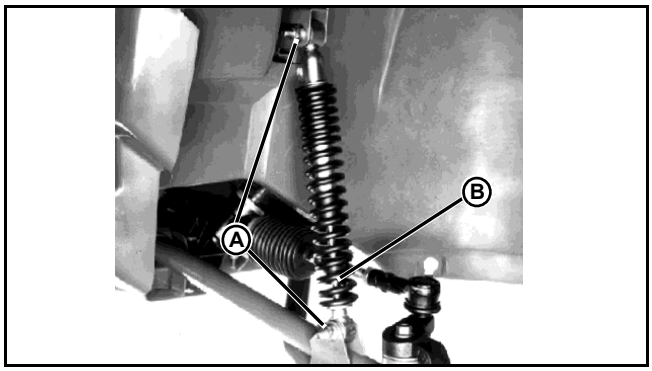
2. Remove front wheel. See “Front Wheel Removal and Installation” on page 177.

3. Remove top and bottom mounting lock nuts and cap screws.

4. Remove shock absorber.

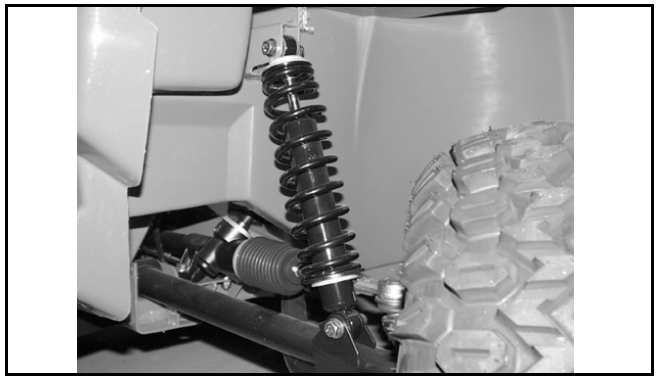
Standard Shock Absorber Installation:

NOTE: Original (plated) shocks must be installed so rod end (B) is down. New (black) shocks must be installed so rod end is up.



M82452

Standard Shock Absorber Mounting (Old Style)



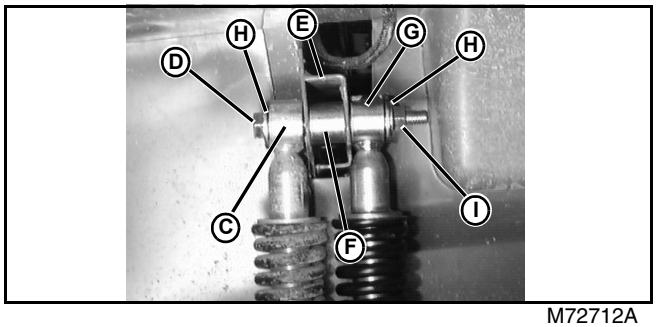
MX1465

Standard Shock Absorber Mounting (New Style)

1. Install new shock, cap screws and lock nuts.

2. Tighten standard shock absorber mounting lock nuts (M10 x 50) (A) to 70 N•m (52 lb-ft).

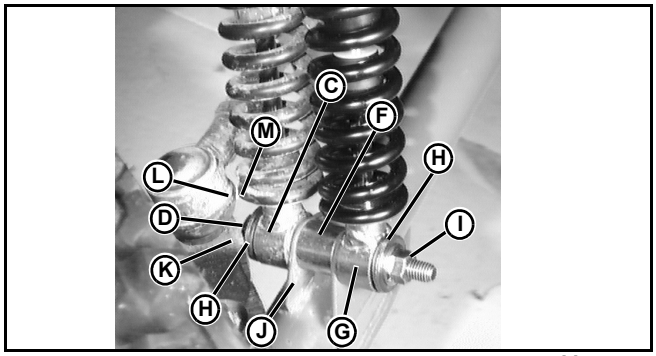
Heavy Duty Shock Installation (Old Style):



M72712A

Upper Mounting

1. Install one 30 mm washer and original shock (C) on one M10 x 100 bolt (D).



M72713

Lower Mounting

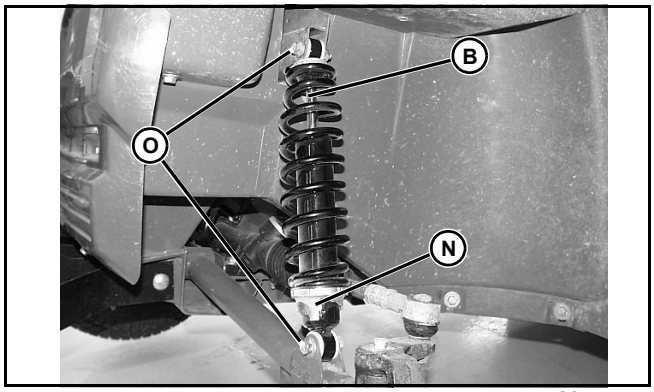
2. Insert the bolt (D) through the rear side of the upper shock bracket (E). Add one spacer (F), one new shock (G), and one 30 mm washer (H) to bolt as shown. Fasten all with one M10 nut (I).

3. For lower mounting, start with two or three washers (H) to one M10 x 100 bolt (D). Insert the bolt through the original shock (C), lower shock bracket (J), one spacer (F), new shock (G), and one 30 mm washer (H) as shown above. Fasten all with one M10 nut (I) and tighten snugly.

4. Turn the wheel to the outside as far as it will go. The axle spindle (K) should stop against the washers (H). Verify that the tie rod end (L) does NOT contact the shock spring (M). To maintain the shortest turning radius possible, the gap between the shock spring and tie rod must be minimal. Adjust the washers at the bolt head (D) accordingly to achieve the minimal gap.

5. Tighten Old Style Heavy Duty Shock Absorber mounting lock nuts (M10 x 100) (C) to 70 N•m (52 lb-ft).

Heavy Duty Adjustable Shock Absorber Installation:



M97093

1. Install new shocks, leaving in lowest spring preload setting (N), with rod end up (B).

2. Install cap screw and lock nuts (O). Tighten mounting lock nuts to 70 N•m (52 lb-ft).

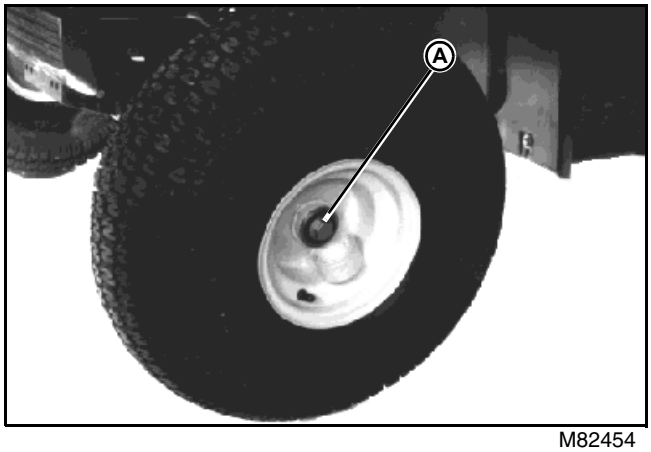
3. Drive machine for five to ten minutes to allow for setting in or settling of shocks. Adjust shock ride height and adjust spring preload.See “Heavy Duty Suspension Shock Ride Height and Spring Preload Adjust (Optional)” on page 175.

Front Wheel Removal and Installation

Removal:

1. Raise and support machine.

2. Remove hub cap.



M82454

3. Remove mounting cap screw (A).

4. Tap on backside of wheel rim with a soft-faced mallet to remove wheel.

5. Inspect and replace bearings, if necessary.

Installation:

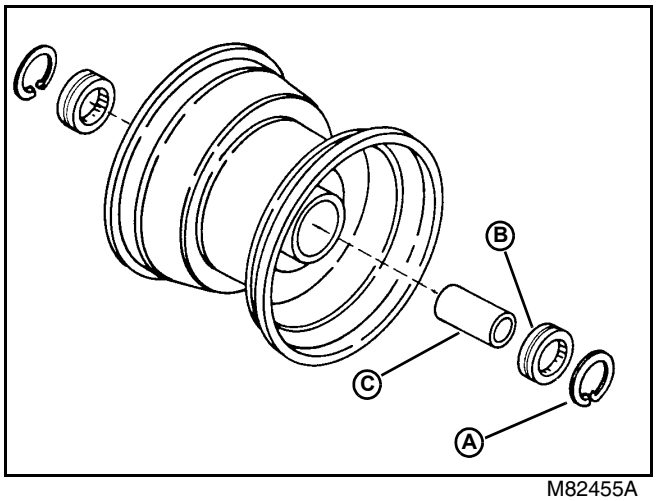
Installation is done in the reverse order of removal.

- Apply multipurpose grease to spindle shaft before installing wheel.
- Install front wheel with stem toward the outside of machine.
- Tighten mounting cap screw to 88 N•m (65 lb-ft).

Front Wheel Bearing Replacement

Removal:

1. Remove front wheel.



M82455A

2. Remove retaining ring (A).

3. Remove bearing (B) on one side using an inside puller and slide hammer.

NOTE: Bearings are press fit in wheel .

4. Remove bearing on opposite end using a driver set.

Installation:

Installation is done in the reverse order of removal.

- Pack inside of rim with multipurpose grease before installing spacer (C) and bearings.

Rear Wheel Removal and Installation

Removal:

1. Raise and support machine.

2. Remove hub cap.

3. Remove five lug nuts.

4. Remove wheel.

Installation:

Installation is done in the reverse order of removal.

- Tighten five lug nuts to 88 N•m (65 lb-ft).

A-Arm Removal and Installation

The A-arm design was changed by lowering the spindle weldments to improve steering geometry and raise the front of the Gator. The improved A-arm design was made at serial numbers:

- W004X2T06544–

Below these serial numbers the A-arms should be replaced as a set. Above these serial numbers, one A-arm can be replaced at a time.

Removal:

NOTE: If replacing A-Arm, remove spindle shaft and bushings. See "Steering Assembly Removal and Installation" on page 156 in the Steering section.

1. Remove front wheel.

2. Remove shock absorber mounting cap screw and lock nut. See "Front Wheel Removal and Installation" on page 177.

3. Remove mounting cap screws (K), lock nuts (L) and A-Arm (M).

Installation:

Installation is done in the reverse order of removal.

NOTE: Shock Absorber should be in place to provide proper orientation of A-arm when tightening mounting hardware.

- Tighten shock absorber to A-arm mounting lock nuts to 70 N•m (52 lb-ft).

- Tighten A-arm to frame mounting lock nuts (L) to 90 N•m (67 lb-ft).

INDEX

P

R

S

T

U

V

W