# LT133, LT155 & LT166 Lawn Tractors

# TECHNICAL MANUAL

**John Deere**
**Worldwide Commercial and**
**Consumer Equipment Division**

**TM1695 (20Sep00)**
**Replaces TM1695 (15Sep98)**

**Litho in U.S.A**

M85699

M85700

M85701

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
- General Diagnostic Information
- Specifications
- Electrical Wiring Harness Legend
- Component Location
- System Schematic
- Wiring Harness
- Troubleshooting Chart
- Theory of Operation
- Diagnostics
- Tests & Adjustments
- Repair

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

Each section will be identified with a symbol rather than a number. The groups and pages within a section will be consecutively numbered.

We appreciate your input on this manual. To help, there are postage paid post cards included at the back. If you find any errors or want to comment on the layout of the manual please fill out one of the cards and mail it back to us.

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. The right is reserved to make changes at any time without notice.

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Safety
Specifications and Information
Kohler Engines
Briggs & Stratton Engine
Electrical
Power Train (Gear)
Power Train (Hydrostatic)
Steering
Brakes
Attachments
Miscellaneous
M

# SAFETY

## RECOGNIZE SAFETY INFORMATION

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.

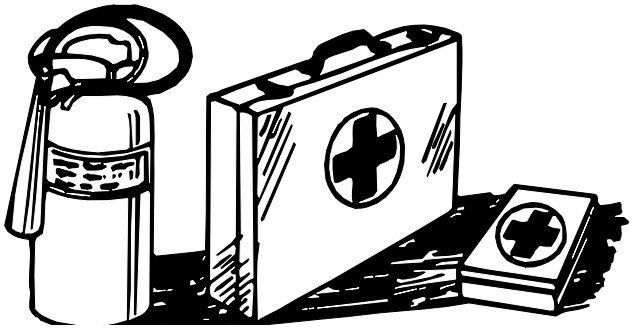
DANGER or WARNING safety signs are located near specific hazards. General precautions are listed on CAUTION safety signs. CAUTION also calls attention to safety messages in this manual.

## REPLACE SAFETY SIGNS

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



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.

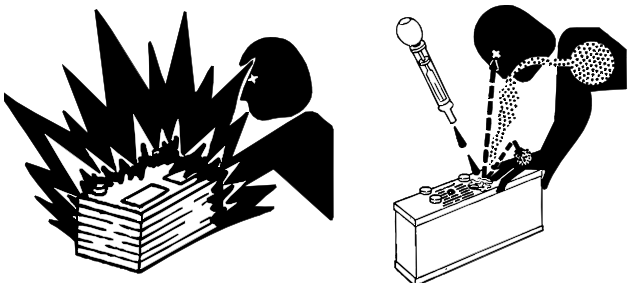
Do not store oily rags; they can ignite and burn spontaneously.

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



### 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:**

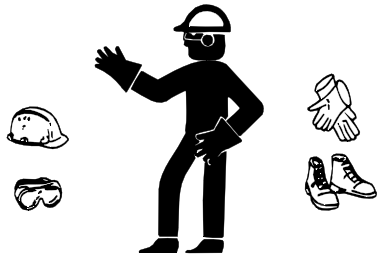
1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10_15 minutes.
4. Get medical attention immediately.

- **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.

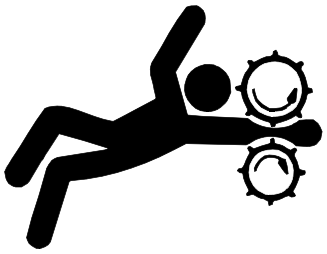
## USE SAFE SERVICE PROCEDURES

### WEAR PROTECTIVE CLOTHING



Wear close fitting clothing and safety equipment appropriate to the job.
Prolonged exposure to loud noise can cause impairment or loss of hearing. Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.
Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.

### SERVICE MACHINES SAFELY

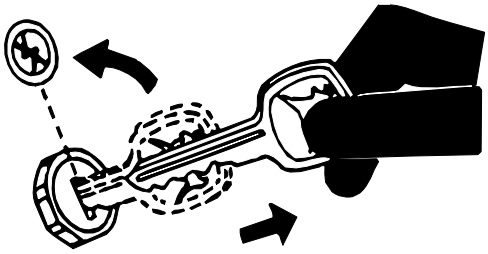


Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.

### 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.

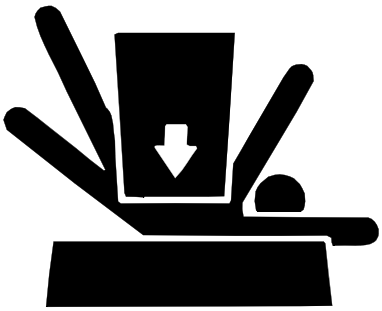
## PARK MACHINE SAFELY



**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



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.

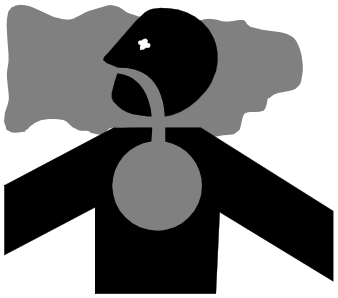
## USING HIGH PRESSURE WASHERS

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



Engine exhaust fumes can cause sickness or death. If it is necessary to run an engine in an enclosed area, remove the exhaust fumes from the area with an exhaust pipe extension.
If you do not have an exhaust pipe extension, open the doors and get outside air into the area.

## WARNING: CALIFORNIA PROPOSITION 65 WARNING

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

## REMOVE PAINT BEFORE WELDING OR HEATING

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

## AVOID HARMFUL ASBESTOS DUST

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

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

## SERVICE TIRES SAFELY

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

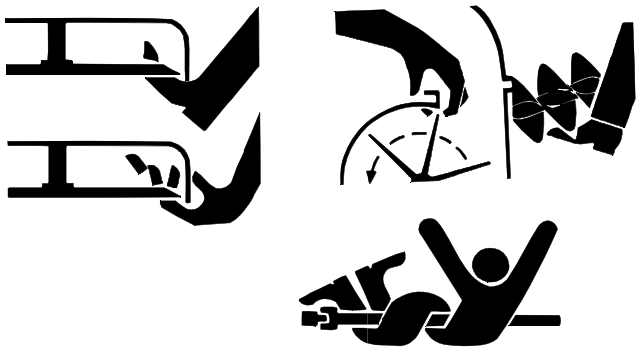
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

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.

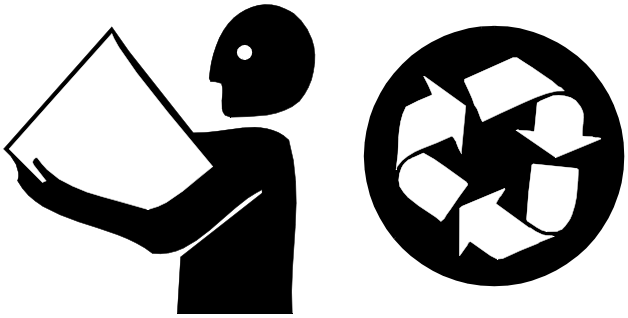
Check wheels for low pressure, cuts, bubbles, damaged rims or missing lug bolts and nuts.

## AVOID INJURY FROM ROTATING BLADES, AUGERS AND PTO SHAFTS



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

## HANDLE CHEMICAL PRODUCTS SAFELY



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

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

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# GENERAL VEHICLE SPECIFICATIONS

## ENGINE SPECIFICATIONS

### KOHLER ENGINES—LT133 and LT155

| | |
|---|---|
| Make | Kohler |
| Model / Model Number: | |
| LT133 | Command LT / CV13S-21525 |
| LT155 | Command 15 QT / CV15S-41562 |
| Power: | |
| LT133 | 9.7 kW (13.0 hp) |
| LT155 | 11.2 kW (15.0 hp) |
| Displacement: | |
| LT133 | 398 $cm^3$ (24.3 cu-in.) |
| LT155 | 426 $cm^3$ (26.0 cu-in.) |
| Cylinders | 1 |
| Stroke/Cycle | 4 |
| Valves | Overhead Valves |
| Lubrication | Pressurized |
| Oil Filter | Single Element, Full Flow, Spin-On Filter |
| Crankcase Capacity (With Filter) | 1.8 L (1.9 qt) |
| Without Filter | 1.4 L (1.5 qt) |
| Cooling System | Air Cooled |
| Air Cleaner | Paper with outer foam element |
| Muffler | Horizontal discharge below frame |
| Spark Plug Gap | 1.0 mm (0.040 in.) |

### BRIGGS & STRATTON—LT166

| | |
|---|---|
| Make | Briggs & Stratton |
| Series | Vanguard V-Twin |
| Type | 916928 Gasoline |
| Model | 303777 |
| Horsepower | 11.9 kW (16.0 hp) |
| Displacement | 480 $cm^3$ (29.3 cu. in.) |
| Cylinders | 2 |
| Stroke/Cycle | 4 |
| Valves | Overhead Valves |
| Lubrication | Pressurized |
| Oil Filter | Full Flow Filter (w/o By-Pass Valve) |
| Crankcase Capacity (With Filter) | 1.5 L (1.6 qt) |
| Without Filter | 1.4 L (1.5 qt) |
| Cooling System | Air Cooled |
| Air Cleaner | Paper with outer foam element |
| Muffler | Horizontal discharge below frame |
| Spark Plug Gap | 1.0 mm (0.040 in.) |

## ELECTRICAL

| | |
|---|---|
| Ignition | Electronic Capacitor Discharge Ignition (CDI) |
| Type of Starter | Bendix |
| Charging System | Flywheel Alternator |

**FUEL SYSTEM**

| | |
|---|---|
| Aspiration | Natural |
| Fuel Tank Location | Rear |
| Fuel Tank Capacity | 7.5 L (2.0 gal) |
| Fuel Type (minimum octane) | Unleaded Gasoline, 87 Octane |
| Fuel Delivery | Float-Type Side Draft Carburetor |
| Fuel Filter | Replaceable In-Line |
| Fuel Filler Opening/Location | 7.6 cm (3 in.) Diameter/Left Rear Fender |

**Battery:**

| | |
|---|---|
| Voltage | 12 |
| BCI group | U-1 |
| CCA rating (Amps At -18°C (0°F) | 160 |
| Reserve capacity (Minutes At 25 Amps) | 20 |
| Specific gravity (Minimum) | 1.225 points |
| Electrolyte required fill (Approximate) | 1.9 L (2.0 qt) |
| Load test (Minimum) | 255 amp for 15 seconds |

**POWER TRAIN SPECIFICATIONS**

**Gear Transaxle:**

| | |
|---|---|
| Make | Dana |
| Model | Spicer Heavy-Duty 4360 Transaxle |
| Type | Five-Speed/Linear Shift |
| Ground Speeds (At Fast Idle—3350 rpm) and Gear Ratios: | |
| 1st Gear | 2.5 km/hr (1.6 mph)—61.67:1 |
| 2nd Gear | 3.3 km/hr (2.1 mph)—46.67:1 |
| 3rd Gear | 5.2 km/hr (3.2 mph)—30.00:1 |
| 4th Gear | 6.6 km/hr (4.1 mph)—23.48:1 |
| 5th Gear | 8.5 km/hr (5.3 mph)—18.46:1 |
| Reverse | 3.9 km/hr (2.4 mph)—40.00:1 |
| Brake Type | Single, External Brake Disc With Dual Friction Pucks |
| Lubrication—Input Shaft Needle Bearings | Unirex® N3 Grease Only (M120263) |
| Lubrication—Transaxle | Shell Darina® D Grease Only (AM119608) |
| Capacity—Transaxle | 0.64 kg (1.406 lbs) |

**Hydrostatic Transaxle:**

| | |
|---|---|
| Drive Train | Belt Drive Transaxle with foot-controlled variable speed drive |
| Model | Tuff Torq® K51 Transaxle |
| Travel Speed-Forward | 0-8.8 km/h (0-5.5 mph) |
| Travel Speed-Reverse | 0-4.7 km/h (0-3.0 mph) |
| Brake type | Single, Internal Wet Disc Brake |

**PTO Drive:**

| | |
|---|---|
| Type | V-Belt |
| Clutch Type | Mechanical |
| Control | Lever on Dash |

**STEERING**

| | |
|---|---|
| Type | Sector and Pinion |
| Turning Radius | 38.1 cm (15 in.) |

**IMPLEMENT LIFT**

| | |
|---|---|
| Lift System | Manual |
| Lift Lever Location | Left-hand side of hood |

**TIRES**

| | |
|---|---|
| Size-Front | 15 x 6.00 - 6 |
| Size-Rear | 20 x 10.00 - 8 |
| Pressure-Front (with mower) | 83 kPa (12 psi) |
| Pressure-Rear (with mower) | 55 kPa (8 psi) |

**NET WEIGHT (NO FUEL)**

| | |
|---|---|
| LT133 with 38” deck | 206.8 kg (455 lbs) |
| LT155 with 38” deck | 213.6 kg (470 lbs) |
| LT155 with 42” deck | 215.9 kg (475 lbs) |
| LT166 with 42” deck | 215.9 kg (475 lbs) |
| LT166 with 46” deck | 220.5 kg (485 lbs) |

**38 INCH MOWER DECK**

| | |
|---|---|
| Type | Rotary - Convertible |
| Cutting Blade | Two—76 x 5 x 496 mm (3 x 0.2 x 19.5 in.) |
| Blade Cutting Edge | .30 ± 5° Angle |
| Overall Cutting Width | 96.5 cm (38 in.) |
| Cutting Settings | Thirteen: 25—102 mm (1.0—4.0 in.) |

**42 INCH MOWER DECK**

| | |
|---|---|
| Type | Rotary—Double Spindles, Mulching |
| Blade Cutting Edge | .30 ± 5° Angle |
| Overall Cutting Width | 106.8 cm (42 in.) |
| Cutting Settings | Thirteen: 25—102 mm (1.0—4.0 in.) |

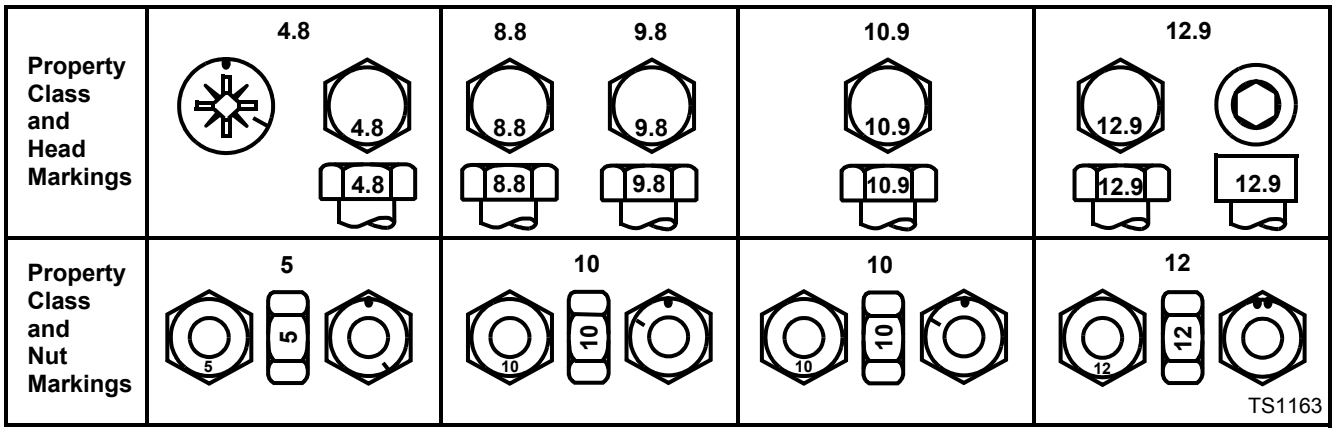
**46 INCH MOWER DECK**

| | |
|---|---|
| Type | Rotary - Convertible |
| Cutting Blade | Three—50.8 x 5 x 407.4 mm (2 x 0.2 x 16 in.) |
| Blade Cutting Edge | .30 ± 5° Angle |
| Overall Cutting Width | 116.8 cm (46 in.) |
| Cutting Settings | Thirteen: 25 mm—102 mm (1.0—4.0 in.) |

**48C INCH MOWER DECK**

| | |
|---|---|
| Type | Rotary - Convertible |
| Cutting Blade | Three—50.8 x 5 x 407.4 mm (2 x 0.2 x 16 in.) |
| Blade Cutting Edge | .30 ± 5° Angle |
| Overall Cutting Width | 121.9 cm (48 in.) |
| Cutting Settings | Thirteen: 25 mm—102 mm (1.0—4.0 in.) |

# METRIC FASTENER TORQUE VALUES




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

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

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

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

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

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

[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

## METRIC FASTENER TORQUE VALUE—GRADE 7

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

# INCH FASTENER TORQUE VALUES

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

TS1162

| | Grade 1 | | | | Grade 2[b] | | | | 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

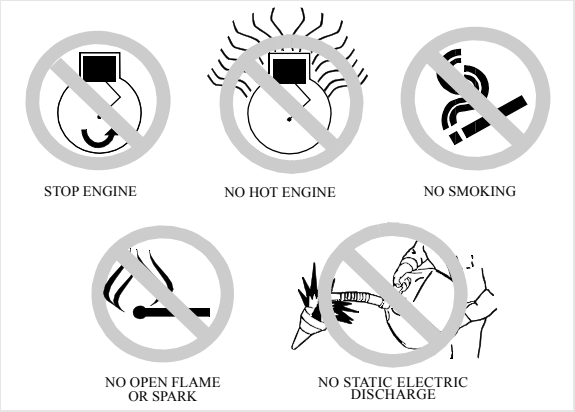
# GASOLINE

## ⚠ CAUTION

**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:**

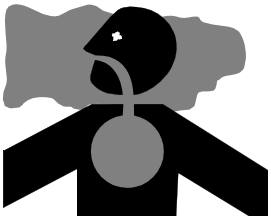
- **ONLY use a clean, approved POLYETHYLENE PLASTIC fuel container and funnel WITHOUT any metal screen or filter**

**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



**IMPORTANT: DO NOT use METHANOL gasolines because METHANOL is harmful to the environment and to your health.**

## ⚠ WARNING

**<u>California Proposition 65 Warning:</u> 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: 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 unit 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.

# LUBRICANTS

## ENGINE OIL - KOHLER ENGINE

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

The following John Deere oil is **PREFERRED**:

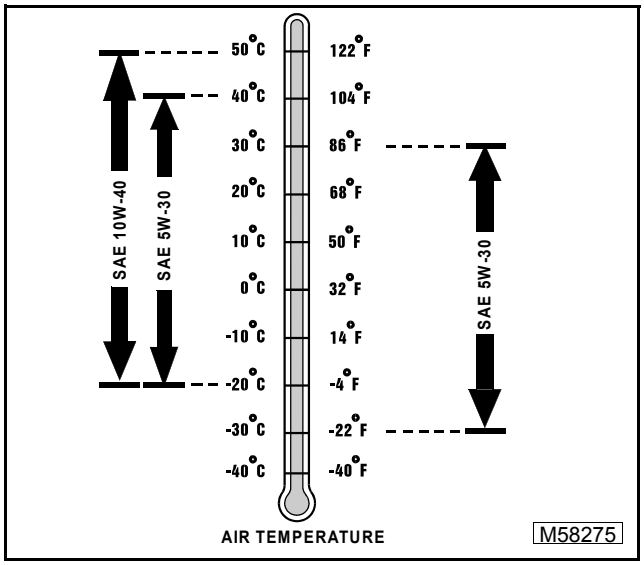
- **PLUS–4®—SAE 10W-40**
- **TURF–GARD®—SAE 10W-30**

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

- **TORQ–GARD SUPREME®—5W-30**

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

- SAE 5W-30—API Service Classification SJ or higher;
- SAE 10W-30—API Service Classification SJ or higher;
- SAE 30—API Service Classification SJ or higher.
- CCMC Specification G4 or higher.




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

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

## ENGINE OIL - BRIGGS & STRATTON ENGINE

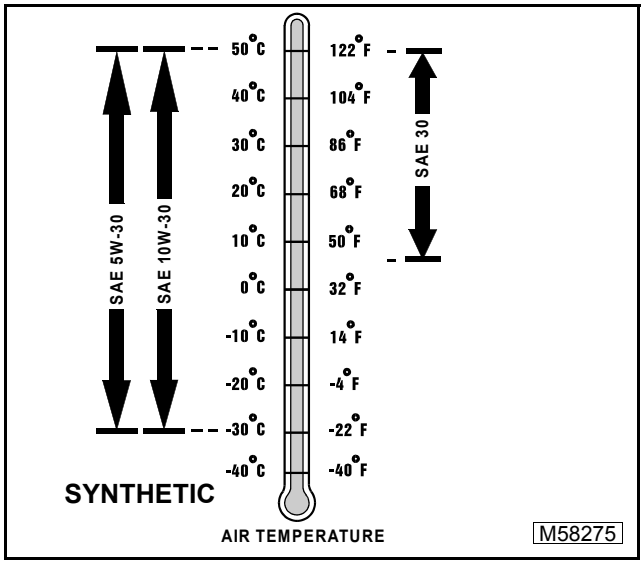
Use the appropriate oil viscosity based on the expected air temperature range during the period between recommended oil changes. Operating outside of these recommended oil air temperature ranges may cause premature engine failure.

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

- **TURF–GARD®—SAE 10W-30**
- **PLUS–4®—SAE 10W-30**
- **TORQ–GARD SUPREME®—SAE30**

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

- SAE 5W-30—API Service Classification SJ or higher;
- SAE 10W-30—API Service Classification SJ or higher;
- SAE 30—API Service Classification SJ or higher.
- CCMC Specification G4 or higher.




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

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

## ENGINE BREAK–IN OIL

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

The following John Deere oil is **PREFERRED**:

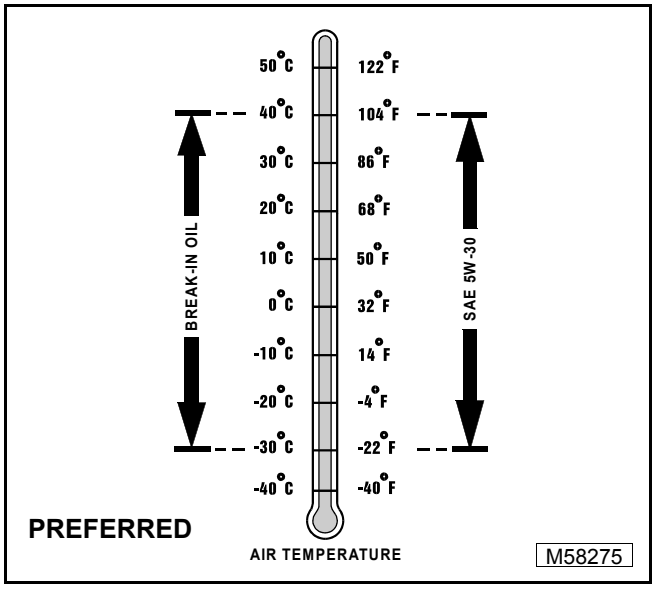
- **BREAK–IN ENGINE OIL**.

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

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

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

- **TORQ–GARD SUPREME®—SAE 5W-30.**



**PREFERRED**

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 SJ or higher.
- SAE 5W-30—CCMC Specification G4 or higher.

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

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

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

## ANTI-CORROSION GREASE

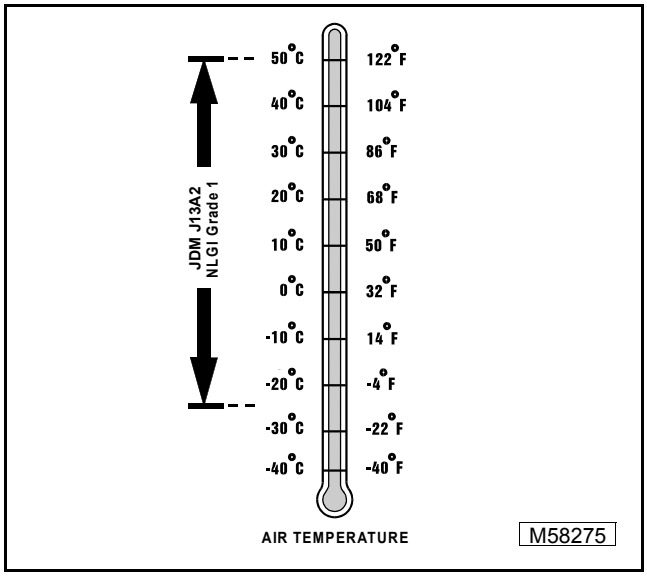
This anti-corrosion grease is formulated to provide the best protection against absorbing moisture, which is one of the major causes of corrosion. This grease is also superior in its resistance to separation and migration.

The following anti-corrosion grease is **PREFERRED**:

- **DuBois MPG-2® Multi-Purpose Polymer Grease—M79292.**

Other greases may be used if they meet or exceed the following specifications:

- John Deere Standard JDM J13A2, NLGI Grade 1.




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

- Module DX,GREA1 in JDS–G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lubrication Sales Manual PI7032.

## ALTERNATIVE LUBRICANTS

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

**IMPORTANT: Use of alternative lubricants could cause reduced life of the component.**

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

## SYNTHETIC LUBRICANTS

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

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

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

## LUBRICANT STORAGE

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

## MIXING OF LUBRICANTS

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

## CHASSIS GREASE

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

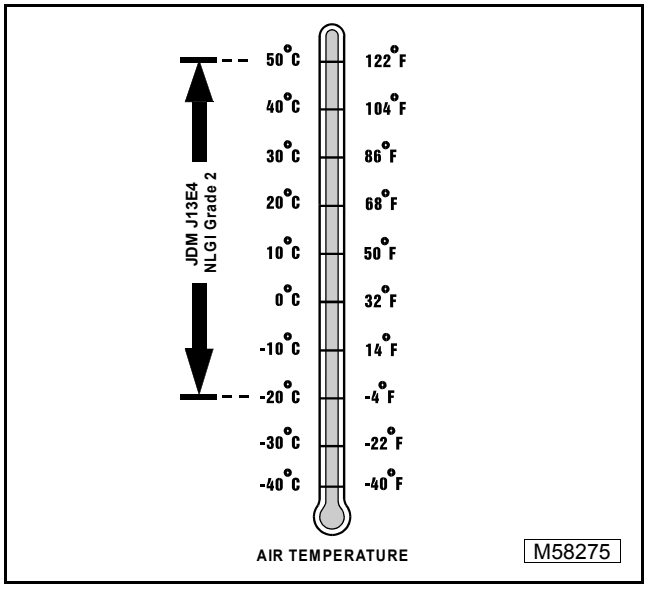
**IMPORTANT: ONLY use a quality grease in this application. DO NOT mix any other greases in this application. DO NOT use any BIO–GREASE in this application.**

The following John Deere grease is **PREFERRED**:

- **HIGH-TEMPERATURE EP GREASE®—JDM J13E4, NLGI Grade 2.**
- **GREASE–GARD™—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.




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

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

## 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 case failure.

**IMPORTANT: ONLY use a quality greases in this gear case. DO NOT mix any other greases in this gear case. DO NOT use any BIO–HY–GARD® in this gear case.**

**ONLY** use the following **PREFERRED** grease as the **input shaft needle bearing** lubricant:

- **Unirex N3 Grease®—M120263**

Other greases may be used as the input shaft needle bearing lubricant if they meet or exceed the following specification:

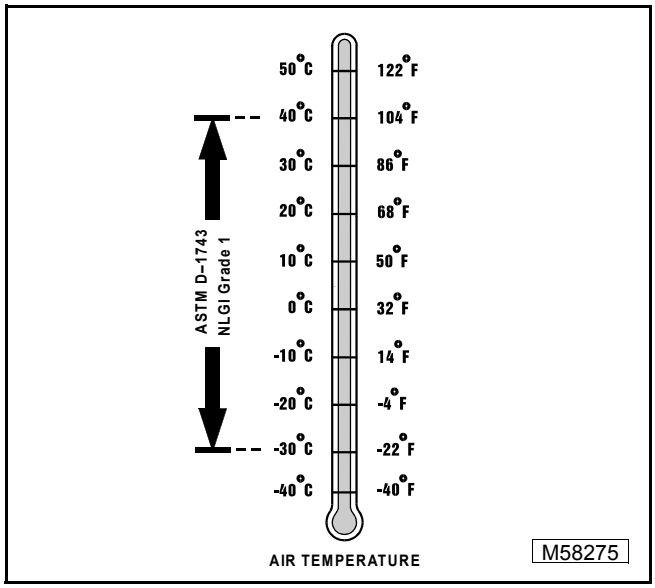
- ASTM D–1743, NLGI Grade 1

**ONLY** use the following **PREFERRED** grease as the **gear housing** lubricant:

- **Shell Darina D Grease®—AM119608**

Other greases may be used as the gear housing lubricant if they meet or exceed the following specification:

- ASTM D–1743, NLGI Grade 1




## HYDROSTATIC TRANSMISSION 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 failure.

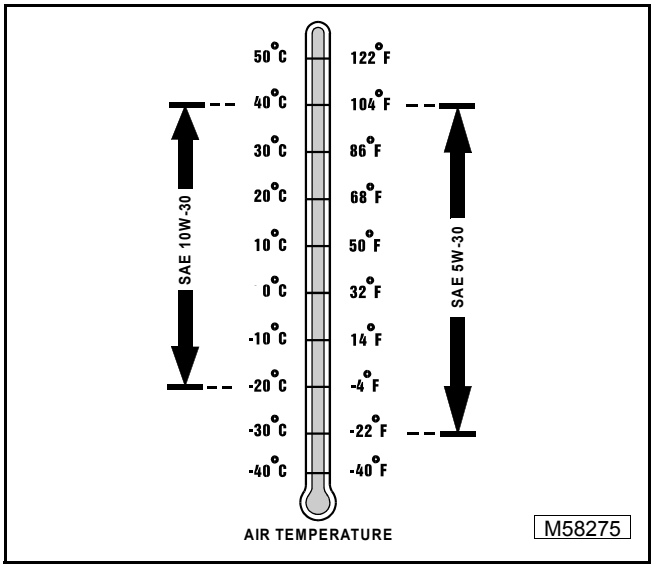
**IMPORTANT: ONLY use a quality 10W-30 SYNTHETIC engine oil in this transmission. Mixing of two viscosity grade oils is NOT RECOMMENDED. DO NOT use BIO–HY–GARD® in this transmission.**

The following oil is **RECOMMENDED:**

- **TURF-GARD® 10W-30**
- PLUS4® 10W-30

Use only oils that meet the following specifications:

- API Service Classifications SG or higher.
- CCMC Specifications G4 or higher.



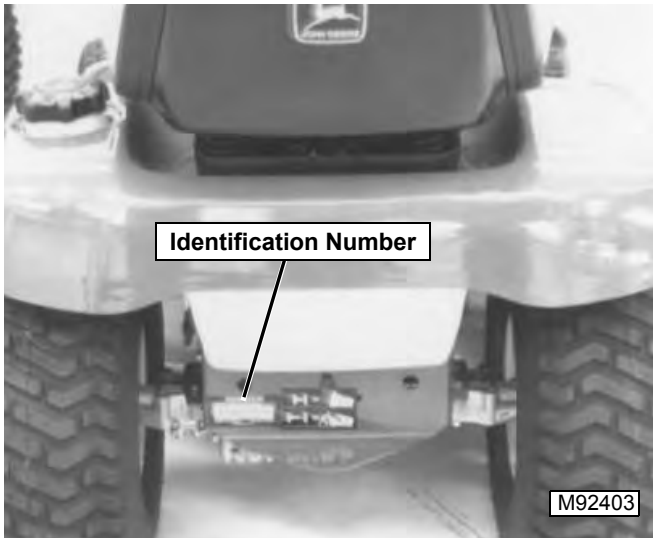

**John Deere Dealers:** You may want to cross-reference the following publications to recommend the proper oil for your customers:

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

# SERIAL NUMBER LOCATION

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

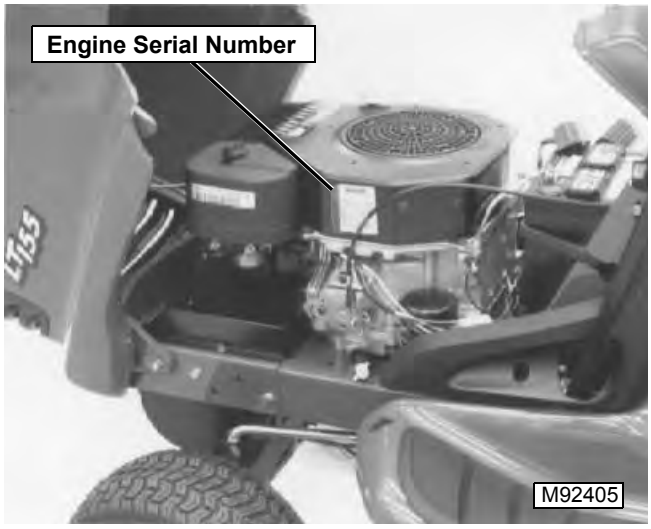
### Machine Product Identification Number



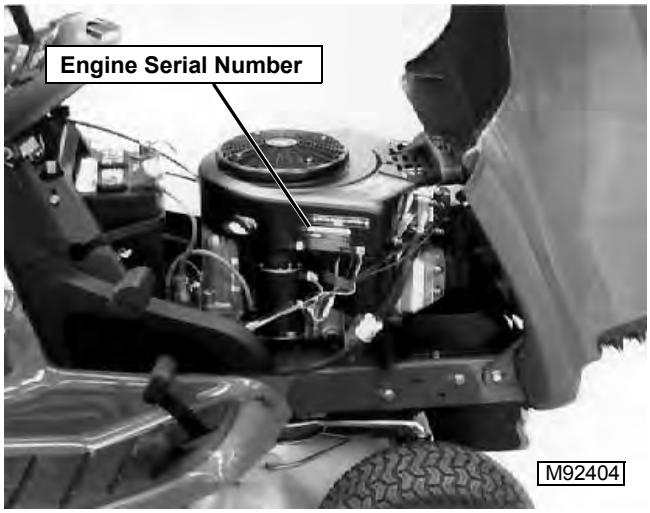

(S/N –125000)

(S/N 125001–) Located below front of operators seat.

### Engine Serial Number—LT133/LT155




### Engine Serial Number—LT166




### Transaxle Serial Number

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# SPECIFICATIONS

## GENERAL SPECIFICATIONS—LT133 (13 hp) & LT 155 (15 hp)

Make . . . . . Kohler
Model / Model Number:
LT133. . . . . Command LT / CV13S-21525
LT155. . . . . Command 15 QT / CV15S-41562
Power:
LT133. . . . . 9.7 kW (13.0 hp)
LT155. . . . . 11.2 kW (15.0 hp)
Displacement:
LT133. . . . . 398 $cm^3$ (24.3 cu-in.)
LT155. . . . . 426 $cm^3$ (26.0 cu-in.)
Cylinders . . . . . 1
Stroke/Cycle . . . . . 4
Valves . . . . . Overhead Valves
Bore:
LT133. . . . . 87 mm (3.43 in.)
LT155. . . . . 90 mm (3.60 in.)
Stroke (All). . . . . 67 mm (2.64 in.)
Compression Ratio . . . . . 2:1 Cranking—8.5:1 Running
Compression Release. . . . . Automatic/Centrifugal
Crankshaft Type . . . . . Vertical (counterbalanced)
Lubrication. . . . . Pressurized Gerotor Pump 0—413 kPa (0—60 psi)
Oil Filter. . . . . Single Element, Full Flow, Spin-On Filter
Crankcase Capacity (With Filter) . . . . . 1.8 L (1.9 qt)
Without Filter . . . . . 1.4 L (1.5 qt)
Cooling System. . . . . Air Cooled
Air Cleaner . . . . . Paper with outer foam element
Muffler . . . . . Horizontal discharge below frame
Slow Idle . . . . . 1700 ± 25 rpm
Fast Idle (Domestic) . . . . . 3400 ± 25 rpm
Maximum Angle of Operation (With Full Crankcase):
Continuous (All Directions) . . . . . 20°
Intermittent (All Directions) . . . . . 35°
Fuel Filter . . . . . Replaceable (In-Line Type)
Fuel Shut-Off Solenoid (Optional). . . . . Replaceable (Below Carburetor Float Bowl)
Weight . . . . . 39.54 kg (87 lbs)

## TESTS & ADJUSTMENTS SPECIFICATIONS

**Engine:**

Spark Plug Gap. . . . . 1.0 mm (0.040 in.)
Valve Adjustment. . . . . None (hydraulic lifters)
Oil Pressure (Minimum at 1250 rpm) . . . . . 124 kPa (18 psi)
Crankcase Vacuum (Minimum At Operating Temp.) . . . 102 mm (4 in.) Water Movement
Automatic Compression Release Minimum Lift (Engine Cold) . . . . . 0.25 mm (0.01 in.)

**Fuel/Air System:**

Carburetor Slow Idle Mixture Screw Initial Setting . . . . . Lightly Seat, Then 1Turn Out
Slow Idle Speed . . . . . 1700 ± 25 rpm
Fast Idle Speed . . . . . 3400 ± 25 rpm

# REPAIR SPECIFICATIONS

**Cylinder Head:**

Cylinder Head Flatness (Maximum Warpage) . . . . . 0.076 mm (0.003 in.)

**Push Rod:**

Maximum Bend . . . . . 0.76 mm (0.030 in.)

**Valves and Valve Lifters:**

Hydraulic Lifter Clearance . . . . . 0.0124—0.0501 mm (0.0005—0.0020 in.)
Intake Valve-to-Guide Clearance . . . . . 0.038—0.076 mm (0.0015—0.0030 in.)
Intake Valve Stem OD . . . . . 6.982—7.000 mm (0.2749—0.2756 in.)
Exhaust Valve Stem OD . . . . . 6.970—6.988 mm (0.2744—0.2751 in.)
Exhaust Valve-to-Guide Clearance . . . . . 0.050—0.088 mm (0.0020—0.0035 in.)
Intake Valve Guide ID:
- New . . . . . 7.038 —7.058 mm (0.2771—0.2779 in.)
- Maximum . . . . . 7.134 mm (0.2809 in.)

Exhaust Valve Guide ID:
- New . . . . . 7.038—7.058 mm (0.2771—0.2779 in.)
- Maximum . . . . . 7.159 mm (0.2819 in.)

Valve Guide Reamer:
- Standard . . . . . 7.048 mm (0.2775 in.)
- Oversize (0.25 mm) . . . . . 7.298 mm (0.2873 in.)

Intake Valve Lift (Minimum—Engine Cold) . . . . . 8.96 mm (0.353 in.)
Exhaust Valve Lift (Minimum—Engine Cold) . . . . . 9.14 mm (0.360 in.)
Valve Face Angle . . . . . 45°
Valve Seat Angle . . . . . 44.5°

**Rocker Arms:**

Rocker Arm ID
- New . . . . . 15.837—16.127 mm (0.63—0.64 in.)
- Wear Limit . . . . . 15.727 mm (0.619 in.)

**Rocker Shaft:**

Rocker Shaft OD
- New . . . . . 15.837—16.127 mm (0.63—0.64 in.)
- Wear Limit . . . . . 15.727 mm (0.619 in.)

**Crankshaft:**

End Play . . . . . 0.0575—0.4925 mm (0.0023—0.0194 in.)
Crankshaft Bore ID (Crankcase Half):
- New . . . . . 44.965—45.003 mm (1.7703—1.7718 in.)
- Maximum . . . . . 45.016 mm (1.7723 in.)
- Clearance (New) . . . . . 0.03—0.09 mm (0.0012—0.0035 in.)

Crankshaft Bore (Oil Pan Half):
- New . . . . . 44.965—45.003 mm (1.7703—1.7718 in.)
- Maximum . . . . . 45.016 mm (1.7723 in.)
- Clearance (New) . . . . . 0.03—0.09 mm (0.0012—0.0035 in.)

Main Bearing Journal OD (Flywheel End):
- New . . . . . 44.913—44.935 mm (1.7682—1.7691 in.)
- Minimum . . . . . 44.84 mm (1.765 in.)
- Maximum Taper . . . . . 0.022 mm (0.0009 in.)
- Maximum Out-of-Round . . . . . 0.025 mm (0.0010 in.)

Main Bearing Journal OD (Oil Pan End):
- New . . . . . 41.915—41.935 mm (1.6502—1.6510 in.)
- Minimum . . . . . 41.86 mm (1.648 in.)
- Maximum Taper . . . . . 0.020 mm (0.0008 in.)
- Maximum Out-of-Round . . . . . 0.025 mm (0.0010 in.)

Connecting Rod Journal OD:
- New . . . . . 38.958—38.970 mm (1.5338—1.5343 in.)
- Minimum . . . . . 38.94 mm (1.5328 in.)
- Maximum Taper . . . . . 0.012 mm (0.0005 in.)
- Maximum Out-of-Round . . . . . 0.025 mm (0.0010 in.)

Crankshaft Total Indicated Runout (TIR):
- PTO End (In Engine) . . . . . 0.15 mm (0.0059 in.)
- Entire Crankshaft (In Bench V-Blocks) . . . . . 0.10 mm (0.0039 in.)

**Camshaft:**

End Play (with shims) . . . . . 0.076—0.127 mm (0.003—0.005 in.)

Clearance . . . . . 0.025—0.063 mm (0.0010—0.0025 in.)

Bore ID:
- New . . . . . 20.000—20.025 mm (0.7874—0.7884 in.)
- Maximum . . . . . 20.038 mm (0.7889 in.)

Bearing OD:
- New . . . . . 19.962—19.975 mm (0.7859—0.7864 in.)
- Minimum . . . . . 19.959 mm (0.7858 in.)

**Balance Shaft:**

End Play . . . . . 0.0575—0.3625 mm (0.0023—0.0143 in.)

Clearance . . . . . 0.025—0.063 mm (0.0009—0.0025 in.)

Bore ID:
- New . . . . . 20.000—20.025 mm (0.7874—0.7884 in.)
- Maximum . . . . . 20.038 mm (0.7889 in.)

Balance Shaft Bearing OD:
- New . . . . . 19.962—19.975 mm (0.7859—7864 in.)
- Minimum . . . . . 19.959 mm (0.7858 in.)

**Cylinder Bore, Piston and Rings:**

Cylinder Bore ID: (13 hp)
- New . . . . . 87.000—87.025 mm (3.4252—3.4262 in.)
- Maximum . . . . . 87.063 mm (3.4277 in.)

Cylinder Bore ID: (15 hp)
- New . . . . . 90.000—90.025 mm (3.5433—3.5443 in.)
- Maximum . . . . . 90.63 mm (3.5681 in.)

Maximum Out-of-Round . . . . . 0.12 mm (0.0047 in.)

Maximum Taper . . . . . 0.05 mm (0.0020 in.)

Piston-To-Pin Clearance . . . . . 0.006—0.017 mm (0.0002—0.0007 in.)

Piston Pin Bore ID:
- New . . . . . 19.006—19.012 mm (0.7483—0.7485 in.)
- Maximum . . . . . 19.025 mm (0.7490 in.)

Piston Pin OD:
- New . . . . . 18.995—19.000 mm (0.7478—0.7480 in.)
- Minimum . . . . . 18.994 mm (0.74779 in.)

Top Compression Ring-To-Groove Side Clearance
- 13 hp . . . . . 0.040—0.105 mm (0.0016—0.0041 in.)
- 15 hp . . . . . 0.060—0.105 mm (0.0023—0.0041 in.)

Middle Compression Ring-To-Groove Side Clearance
- 13 hp . . . . . 0.040—0.072 mm (0.0016—0.0028 in.)
- 15 hp . . . . . 0.040—0.085 mm (0.0015—0.0002 in.)

Oil Control Ring-To-Groove Side Clearance
13 hp . . . . . 0.551—0.675 mm (0.0217—0.0266 in.)
15 hp . . . . . 0.176—0.026 mm (0.0069—0.0010 in.)
Top and Center Compression Ring End Gap
New Bore:
13 hp . . . . . 0.3—0.5 mm (0.012—0.020 in.)
15 hp . . . . . 0.27—0.51 mm (0.010—0.020 in.)
Used Bore (Maximum)
All . . . . . 0.77 mm (0.030 in.)
Piston Thrust Face OD:
New:
13 hp . . . . . 86.941—86.959 mm (3.4229—3.4236 in.)
15 hp . . . . . 89.951—89.969 mm (3.5413—3.5420 in.)
Minimum:
13 hp . . . . . 86.814 mm (3.4179 in.)
15 hp . . . . . 89.824 mm (3.5363 in.)
Piston Thrust Face-To-Cylinder Bore Clearance
New:
13 hp . . . . . 0.041—0.044 mm (0.0016—0.0017 in.)
15 hp . . . . . 0.031—0.043 mm (0.0012—0.0016 in.)

**Connecting Rod:**

Crankshaft (Big End) Clearance
New . . . . . 0.030—0.055 mm (0.0012—0.0022 in.)
Maximum . . . . . 0.07 mm (0.0025 in.)
Side . . . . . 0.18—0.41 mm (0.007—0.016 in.)
Piston Pin Clearance . . . . . 0.015—0.028 mm (0.0006—0.0011 in.)
Piston Pin End ID:
New . . . . . 19.015—19.023 mm (0.7486—0.7489 in.)
Maximum . . . . . 19.036 mm (0.7495 in.)

**Governor:**

Crankcase Control Arm Bore ID:
New . . . . . 6.025—6.050 mm (0.2372—0.2382 in.)
Maximum . . . . . 6.063 mm (0.2387 in.)
Control Arm OD:
New . . . . . 5.975—6.000 mm (0.2352—0.2362 in.)
Minimum . . . . . 5.962 mm (0.2347 in.)
Crankcase Bore-To-Control Arm Clearance . . . 0.025—0.075 mm (0.0010—0.0030 in.)
Gear Shaft OD:
New . . . . . 5.990—6.000 mm (0.2358—0.2362 in.)
Minimum . . . . . 5.977 mm (0.2353 in.)
Gear Shaft-To- Gear Bore Clearance . . . . . 0.015—0.140 mm (0.0006—0.0055 in.)

# TORQUE SPECIFICATIONS (Alphabetical)

*NOTE: Use appropriate torque wrench which will read within the inch pound range given, or convert inch pounds to foot pounds as follows: Inch-pounds ÷ 12 = Foot-pounds*

- Air Cleaner Base Nut . . . . . 10 N•m (88 lb-in.)
- Cylinder Head Cap Screw . . . . . 41 N•m (30 lb-ft)
- Connecting Rod Cap Screws:
  - 8 mm Straight Shank Bolt . . . . . 22 N•m (200 lb-in.)
  - Step Down Shank Bolt . . . . . 14 N•m (130 lb-in.)
  - 6 mm Straight Shank Bolt . . . . . 11 N•m (100 lb-in.)
- Engine Mounting Cap Screws . . . . . 32 N•m (24 lb-ft)
- Fan Cap Screw . . . . . 10 N•m (88 lb-in.)
- Flywheel Cap Screw . . . . . 68 N•m (50 lb-ft)
- Fuel Pump/Cover Screw:
  - New Installation (Thread Forming) . . . . . 9.0 N•m (80 lb-in.)
  - Replacement . . . . . 7 N•m (65 lb-in.)
- Fuel Bowl Nut . . . . . 4 N•m (35 lb-in.)
- Governor Control Panel Screw . . . . . 10 N•m (88 lb-in.)
- Ignition Module Screw
  - New Installation (Thread Forming) . . . . . 6 N•m (55 lb-in.)
  - Replacement . . . . . 4 N•m (35 lb-in.)
- Muffler Nut . . . . . 24 N•m (216 lb-in.)
- Oil Filter . . . . . 7 N•m (65 lb-in.)
- Oil Filter Drain Plug . . . . . 8 N•m (72 lb-in.)
- Oil Pan Cap Screw . . . . . 24 N•m (216 lb-in.)
- Oil Pump Cover Screw
  - New Installation (Thread Forming) . . . . . 6 N•m (55 lb-in.)
  - Replacement . . . . . 4 N•m (35 lb-in.)
- Rocker Arm Pivot Cap Screw . . . . . 14 N•m (124 lb-in.)
- Spark Plug . . . . . 40 N•m (30 lb-ft)
- Stator Cap Screw . . . . . 4 N•m (35 lb-in.)
- Valve Cover Cap Screw
  - New Installation (Thread Forming) . . . . . 11 N•m (95 lb-in.)
  - Replacement . . . . . 7 N•m (65 lb-in.)

# SPECIAL OR REQUIRED TOOLS

| Tool | Purpose |
|---|---|
| JDG705 Reaming Tool | Valve guide |
| 6.4 mm (0.25 in.) Drill Bit | Throttle and choke adjustment |
| Dial Indicator | Automatic compression relief test, Valve inspection |
| JTO5719 Photo Tachometer | Slow idle adjustment |
| JT035029 Cylinder Leak Tester | Cylinder leak test |
| JTO5697 U-Tube Manometer Test Kit; or, JT03503 Crankcase Vacuum Test Kit | Crankcase vacuum check |
| JT07262 Oil Pressure Test Adapter w/ O-ring (required ONLY on engines without test ports)<br>JT05847 Connector<br>JT03017 Hose Assembly<br>JT03262 Coupler<br>JT07034 Gauge, 0 – 700 kPa (0 – 100 psi) | Oil pressure test |
| Lapping Tool | Valve lapping |

## TROUBLESHOOTING

| Problem or Symptom / Check or Solution | Engine cranks but will not start or starts hard | Engine will not stay running or runs rough | Engine stalls frequently | Engine backfires | Engine surges, uneven or uncontrolled rpm | Engine misses | Low power under load | Engine has no spark | Engine will not crank | Exhaust black, engine floods or burns rich | Exhaust smoke blue or high oil consumption | Engine has low oil pressure | Fuel in oil | Engine overheats | Excessive engine noise or vibration |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spark plug fouled or incorrect gap. Incorrect spark plug. | ● | ● | ● | | ● | ● | ● | ● | | ● | | | ● | ● | |
| Defective ignition components. | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | |
| Starter worn. Cranking rpm too slow, cables corroded, battery weak.<br>Engine overloaded. | ● | ● | ● | | | | ● | | ● | | | ● | | ● | ● |
| Fuel tank outlet restricted, shut-off valve not fully open, fuel filter or line restricted. Fuel stale, contains water, or wrong type. | ● | ● | ● | | ● | ● | ● | | | ● | ● | | | | |
| Air filter element plugged or oil soaked. | ● | ● | ● | | ● | ● | ● | | | ● | | | ● | | |
| Choke, throttle, or governor linkage worn / out of adjustment. Carburetor set too rich. | ● | ● | ● | ● | ● | ● | ● | | ● | ● | | | ● | ● | |
| Carburetor worn, contaminated with debris or varnish. Passages plugged. Wrong jets or adjusted too lean. | ● | ● | ● | ● | ● | ● | ● | | | | | | ● | | |
| Carburetor, intake manifold, or cylinder head gaskets leaking. | ● | ● | ● | ● | ● | ● | ● | | | | | | | ● | ● |
| Low compression: worn piston, rings, cylinder, valves. Warped head. | ● | ● | ● | | ● | ● | ● | | | | ● | ● | ● | ● | ● |
| Valve clearance incorrect. Burned or warped valves and seats. Defective springs. | ● | ● | ● | ● | ● | ● | ● | | | | | | | ● | ● |
| Engine oil viscosity or level incorrect. Engine oil filter restricted.<br>Oil pump worn or passages obstructed. | ● | ● | | | | | ● | | ● | | | ● | | ● | ● |
| Engine gaskets or seals leaking. | ● | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | ● | ● |
| Crankcase breather restricted, reed valve damaged, clearance incorrect, or drain hole plugged. | ● | ● | ● | | ● | | ● | | ● | | ● | ● | | ● | |
| Valve guides or seals worn or leaking. Valve stems worn. | ● | ● | ● | ● | ● | ● | ● | | | | ● | | | ● | ● |
| Worn, stuck, or broken piston rings. Cylinder bore worn. Check compression and vacuum. | ● | ● | ● | ● | ● | ● | ● | | | | ● | ● | ● | ● | ● |
| Connecting rod or crankshaft bearings worn. Internal wear limits out of specification. | ● | ● | ● | | ● | | ● | | | | | ● | | ● | ● |
| Engine mounting hardware loose or broken. | | | | | ● | | ● | | | | | | | | ● |

## TROUBLESHOOTING (Continued)

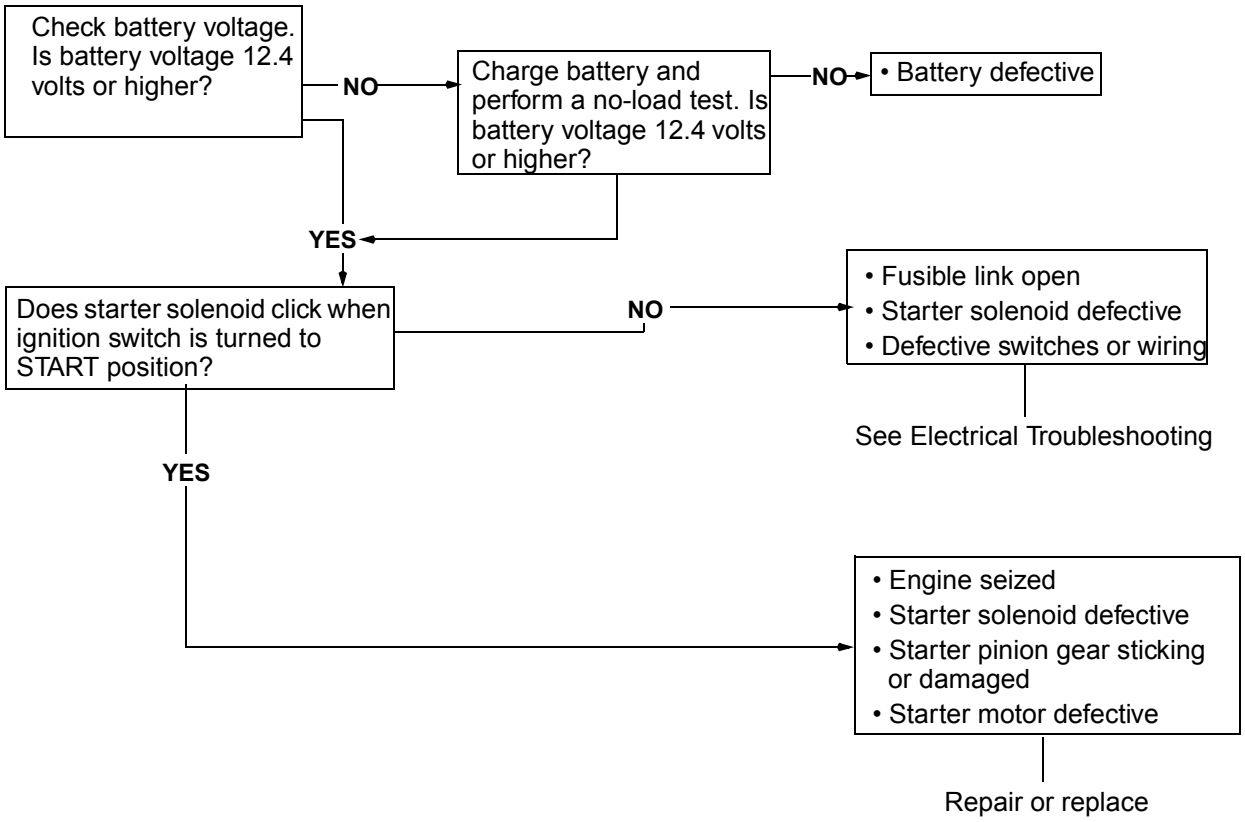
| Check or Solution / Problem or Symptom | Fuel overflows carburetor vent | Engine stops when hot | Engine races or runs one speed | Engine clatters | Engine won't run | White smoke on start-up | Engine runs slow & clicks | Engine runs on after shutdown | Engine won't shut off |
|---|---|---|---|---|---|---|---|---|---|
| Dirt in carburetor. Float sticking Clean carb, replace filter, check float | ● | | | | | | | | |
| Vapor lock. Check temperature of fuel system. Clear vent in top of fuel cap | | ● | | | ● | | | | |
| Fuel shutoff valve closed | | | | | ● | | | | |
| Move governor shaft with engine running, check for resistance | | | ● | | | | | | |
| Lifter is collapsed | | | | ● | ● | | | | |
| Lifter is stuck in bore | | | | ● | ● | | | | |
| Water in fuel bowl of carburetor | | | | | ● | ● | | | |
| Engine RPM too low; automatic compression release still on Adjust low idle speed | | | | ● | | | ● | | |
| Inspect ignition switch and ground | | | | | | | | ● | ● |
| Inspect engine ground cable | | | | | | | | ● | ● |
| Adjust idle speed to specs. Move throttle to idle before shutdown | | | | | | | | ● | |
| Inspect piston, valves, cylinder head & exhaust for high carbon build-up | | | | | | | | ● | |

## ENGINE TROUBLESHOOTING
## Engine Will Not Crank

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

**⚠ CAUTION**

**BE AWARE! The engine may start to rotate at any time. Keep hands away from all moving parts when testing.**



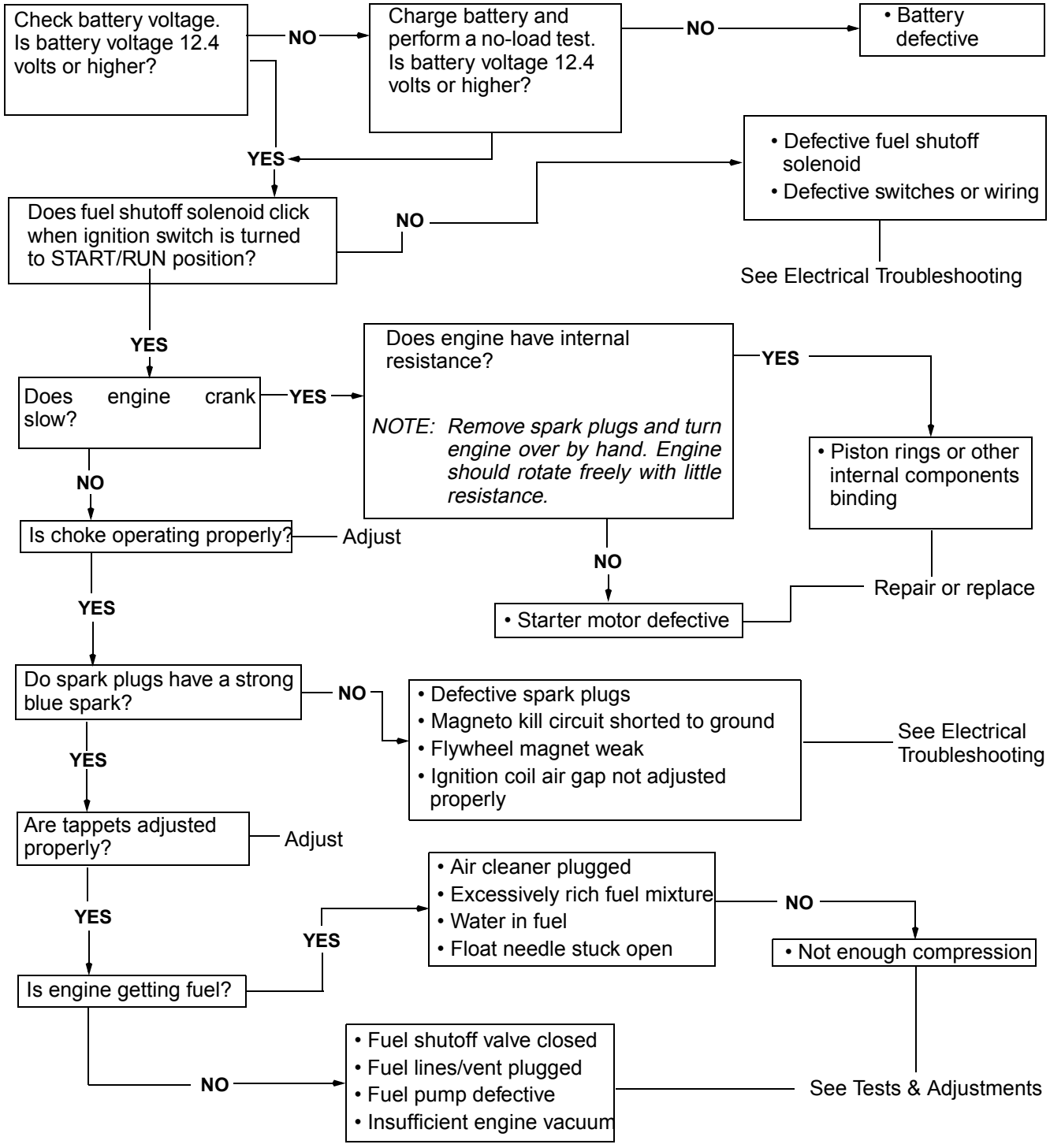
## Engine Cranks But Will Not Start

**⚠ CAUTION**

**DO NOT rotate engine with starter if the spark plugs are removed. Gasoline spray from the open cylinders may be ignited by ignition spark and cause an explosion or fire.**

**IMPORTANT: Perform a visual inspection first to determine if battery cables are tight and not corroded and if the battery is of sufficient size to turn the engine over at minimum cranking speed of 350 rpm.**

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



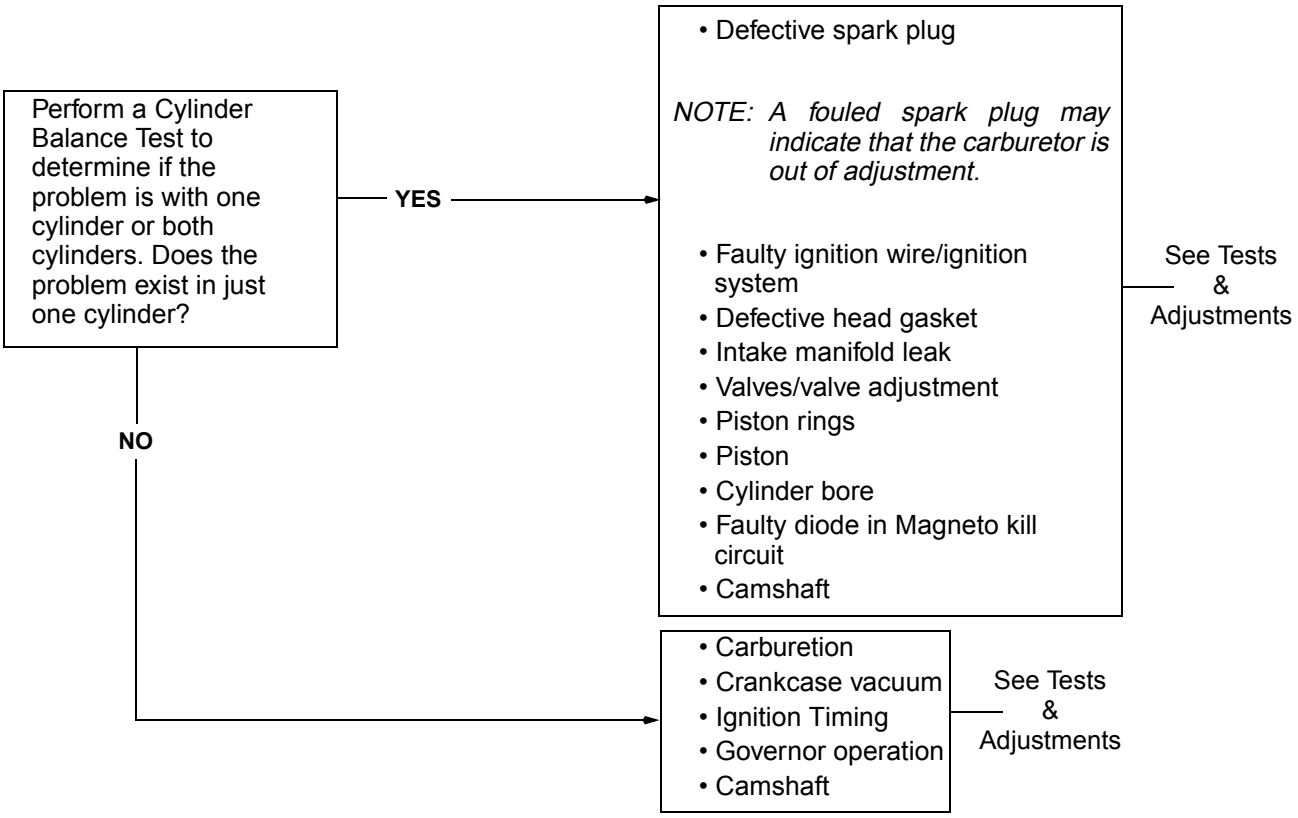
## Engine Runs Erratically/Loss Of Power

**IMPORTANT: Before proceeding, inspect the mower deck and belts for binding in the spindle assemblies or belts that are too tight/loose. A loose belt like a loose blade can cause a backlash effect that will counteract engine cranking effort. Excessive drive belt tension may cause premature bearing wear or result in bearing seizure. Grass clippings that build up near the cutting blades can cause excessive resistance and heat build-up that causes problems with the engine's ability to turn the blades at a constant speed. Low lubricant levels in the spindles will build-up heat causing excessive resistance for the engine to deal with.**

**There is a diode in-line in the magneto kill wire coming from each ignition module. This diode prevents feedback from one module to the other. Without these diodes, one magneto could fire the coil for the other magneto. If a diode fails in one of the magneto kill wires, that coil could be fired by the other module. The result may be similar to that of an erratic running engine.**

**A twin cylinder engine may run adequately on one cylinder as long as the power required for the application does not exceed the power produced by the one cylinder.**

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



# TESTS AND ADJUSTMENTS

## THROTTLE CABLE ADJUSTMENT

**Reason:**

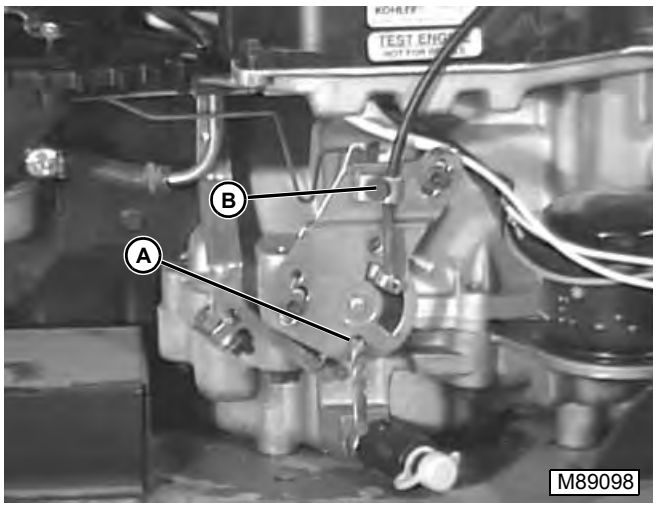
To make sure the throttle cable moves the throttle and choke control lever through its full range of movement.

**Equipment:**

- 6.4 mm (0.25 in.) Drill Bit

**Procedure:**

1. Move throttle lever to FAST idle position.




2. Align hole in throttle control lever with hole (A) in throttle control plate. Put a **6.4 mm (0.25 in.)** drill bit through holes to keep the throttle control lever from moving. Be sure drill bit is perpendicular to the throttle control plate.
3. Loosen cap screw (B) and pull throttle cable housing tight. Tighten cap screw.
4. Remove drill bit.
5. Move throttle lever to the full choke position. Make sure throttle lever is held up against throttle plate. Choke should be fully closed.
6. Move throttle lever through full range to be sure linkage is not binding.

## CHOKE ADJUSTMENT

**Reason:**

To make sure the choke plate is fully closed when the throttle lever is in the full choke position. Correct adjustment also makes sure choke is completely open in the fast idle position.

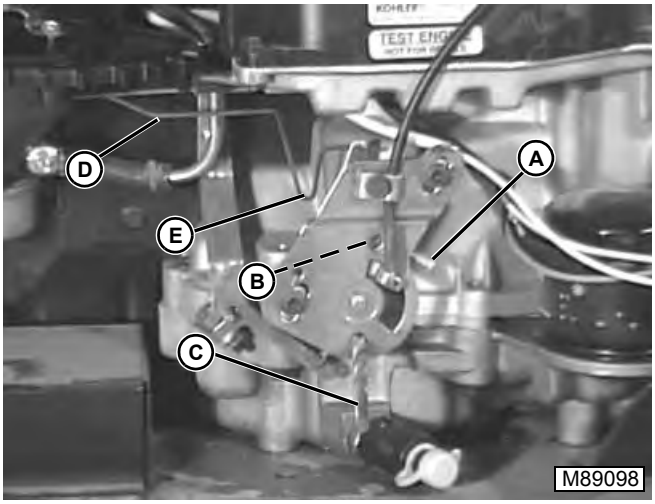
**Equipment:**

- 6.4 mm (0.25 in.) Drill Bit

**Procedure:**

*NOTE: Adjust throttle cable before adjusting choke.*

1. Move throttle lever to CHOKE position then back to FAST idle position.




2. Align hole in throttle control lever with hole in throttle control plate. Put a **6.4 mm (0.25 in.)** drill bit (C) through holes to keep the throttle control lever from moving. Be sure drill bit is perpendicular to the throttle control plate.
3. Turn screw (A) counterclockwise until screw does not contact the choke control lever (B).
4. Turn screw clockwise until screw just touches the choke control lever.
5. Remove drill bit.
6. Move throttle lever to full choke position.
7. Try to move choke rod (D) forward (choke rod should not move). If the choke rod moves forward, the choke plate is not fully closed. Carefully bend the choke rod at Vee bend (E) until the choke plate is fully closed.
8. Move throttle lever to be sure choke linkage is not binding.

## GOVERNOR ADJUSTMENT

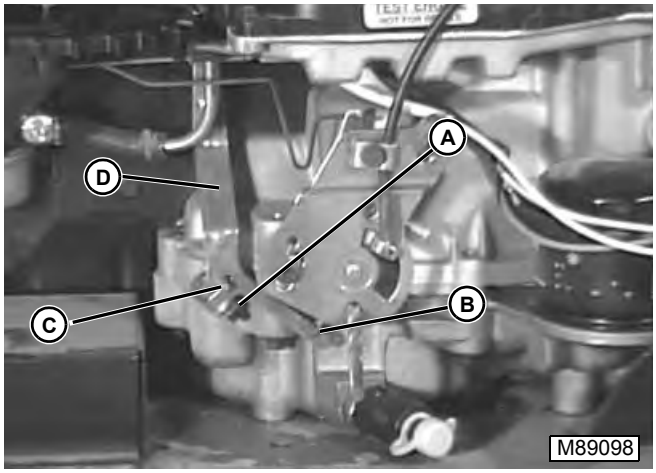
**Reason:**

To make sure the governor shaft contacts the fly-weight plunger when the engine is stopped.

*NOTE: Adjust throttle cable before adjusting governor linkage.*

**Procedure:**

1. Move throttle lever to FAST idle position.




2. Loosen nut (A).
3. Hold top of governor arm (D) toward carburetor. Turn governor shaft (C) counter-clockwise until it stops. Hold governor shaft and tighten nut.
4. Move throttle lever through full range to be sure linkage is not binding.
5. Governor spring (B) should be installed in the hole closest to governor shaft. If governor is not responding properly, replace spring and readjust fast idle speed. If spring did not correct the problem, repair governor.

## FAST IDLE SPEED ADJUSTMENT

**Reason:**

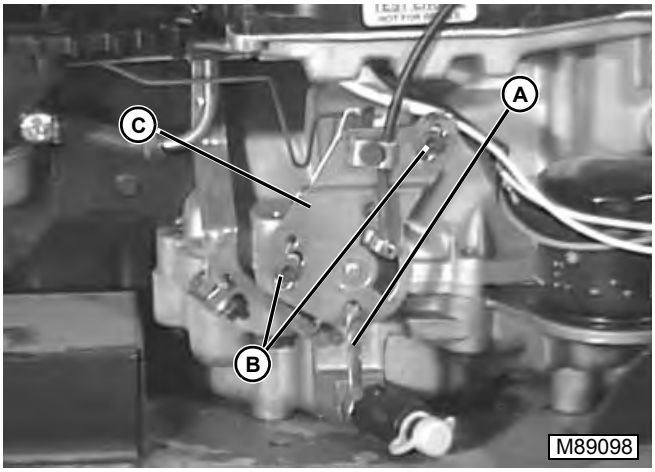
To set engine fast idle rpm.

**Equipment:**

- JTO5719 Photo Tachometer

**Procedure:**

1. Move transaxle shift lever to NEUTRAL position. Engage park brake.




2. Put reflective tape on blower housing screen.
3. Start and run engine at MEDIUM idle for five minutes.

**⚠ CAUTION**

**Engine will be HOT. Be careful not to burn skin.**

4. Move throttle lever to FAST idle position.
5. Align holes of throttle lever and throttle control plate with **6.4 mm (0.25 in.)** drill bit (A). This keeps the throttle control lever from moving during adjustment. Be sure drill bit is perpendicular to the throttle control plate.
6. Use a photo tachometer to check engine rpm at the blower housing screen.

**Specifications:**

**Fast idle speed setting . . . . . 3400 ± 25 rpm**
**Control panel screw torque. . . . . 10 N•m (88 lb-in.)**

**Results:**

- If fast idle speed does not meet the specifications, loosen cap screws (B)
- Move throttle control plate (C) upward to increase rpm or downward to decrease rpm
- Hold the throttle control plate and tighten cap screws

## SLOW IDLE SPEED ADJUSTMENT

**Reason:**

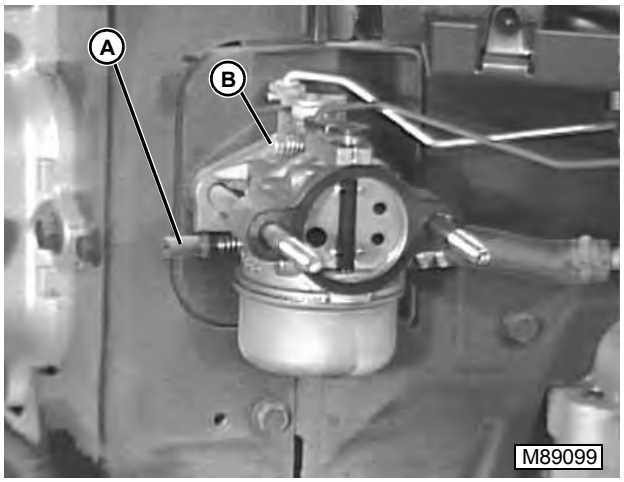
To set engine slow idle mixture and rpm.

**Equipment:**

- JTO5719 Photo Tachometer

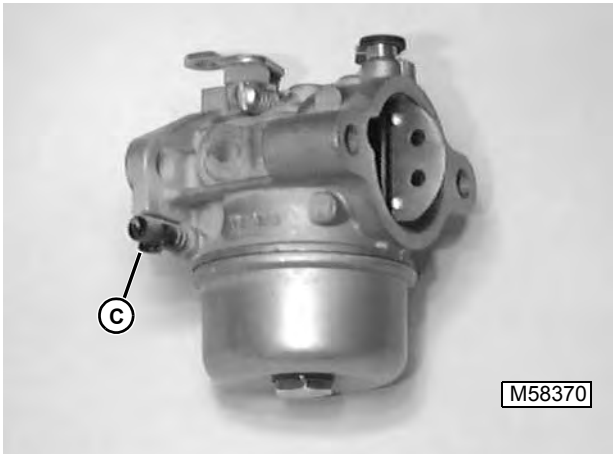
**Procedure:**

1. Move transaxle to NEUTRAL. Engage park brake.




**IMPORTANT: Forcing the idle mixture screw tight will damage the needle and seat. Air cleaner removed for photo, DO NOT remove for tests.**

2. Put reflective tape on blower housing screen.




3. No preliminary adjustment is required for black limiter slow idle mixture screw (C), this is pre-set by manufacturer.
4. Start and run engine at MEDIUM idle for five minutes.
5. Move throttle lever to SLOW idle position.
6. Use a photo tachometer to check engine rpm at the blower housing screen.
7. Turn SLOW idle stop screw (B) in either direction until specified SLOW idle speed is reached.
8. Turn slow idle mixture screw (C) in either direction until a maximum slow idle speed is reached. It may be necessary to adjust SLOW idle stop screw (B) again.

**Specification:**

**SLOW idle stop screw setting. . . . . 1700 ± 25 rpm**

*NOTE: For high altitude operation above 4000 feet, use high altitude carburetor kit, to prevent over rich fuel mixture and black exhaust smoke.*

## CYLINDER LEAK TEST

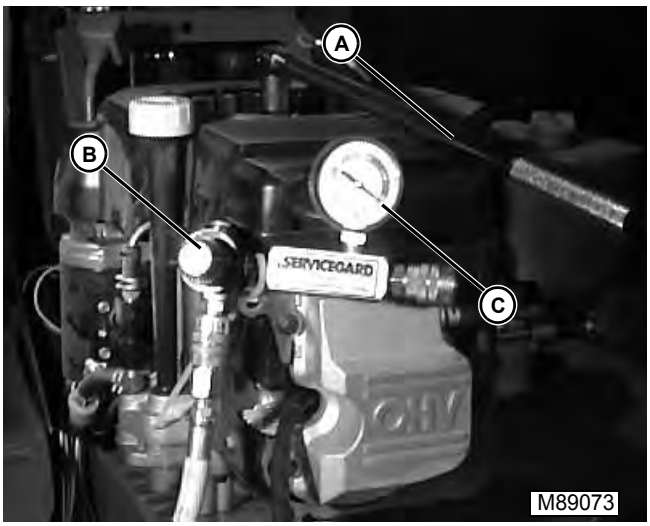
**Reason:**

To check pressure capacity of piston rings and cylinder bore for efficient engine operation.

**Equipment:**

- JT035029 Cylinder Leak Tester

**Connections:**




**Procedure:**

1. Warm engine to operating temperature.
2. Move transaxle shift lever to NEUTRAL. Engage park brake.
3. Pry off the flywheel screen and use a breaker bar (A) on the flywheel nut to hold the flywheel in position when performing the test.

4. Remove spark plug and install hose fitting.
5. Bring the piston to Top Dead Center (TDC) with both valves closed.
6. Attach an air source regulated at 85—95 psi to the tester.
7. Rotate the calibration knob (B) to bring the needle into the set range (C).
8. Connect the leak tester to the hose fitting and record reading.

**Results:**

- Leakage should not exceed 25%, if so, listening at the carburetor (intake valve), oil filler (piston rings) or muffler (exhaust valve) for escaping air will provide clues as to where to investigate for problems.

## AUTOMATIC COMPRESSION RELEASE (ACR) CHECK

**Reason:**

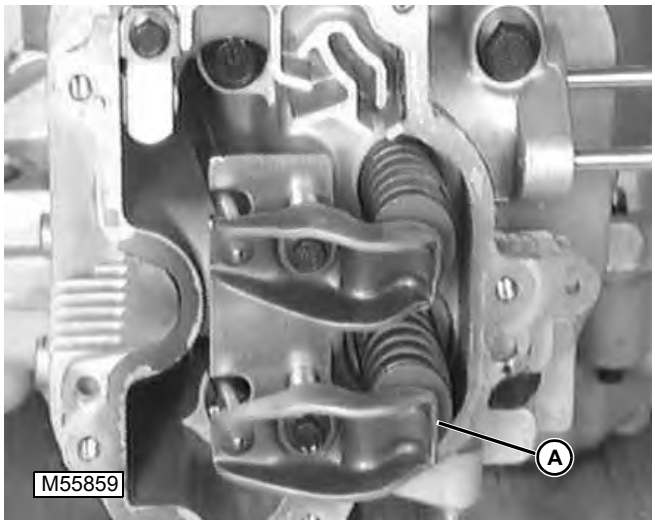
To determine if the automatic compression release is opening the exhaust valve.

**Equipment:**

- Dial Indicator

**Procedure:**

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




2. The exhaust valve (A) must open (depress) briefly just after the intake valve closes.
3. Use a dial indicator to measure exhaust valve ACR movement.
4. Install rocker cover, see “Remove and Install Cylinder Head” in the Repair group.

**Specification:**

**Exhaust valve ACR movement**
**Minimum . . . . . 0.25 mm (0.01 in.)**

**Results:**

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

## CRANKCASE VACUUM TEST

**Reason:**

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

**Equipment:**

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

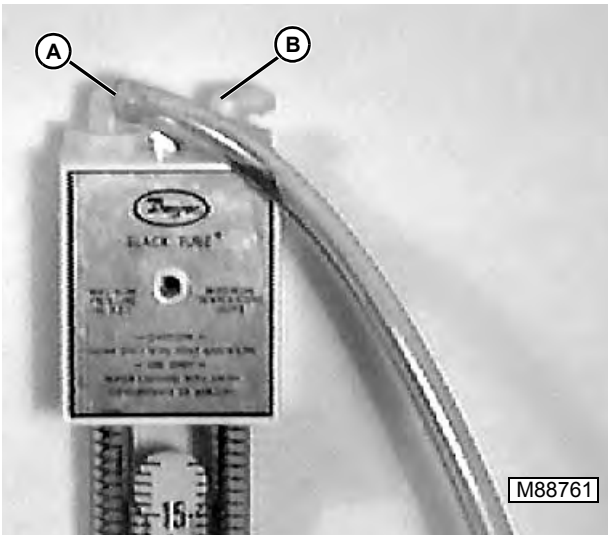
**Procedure 1:**

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

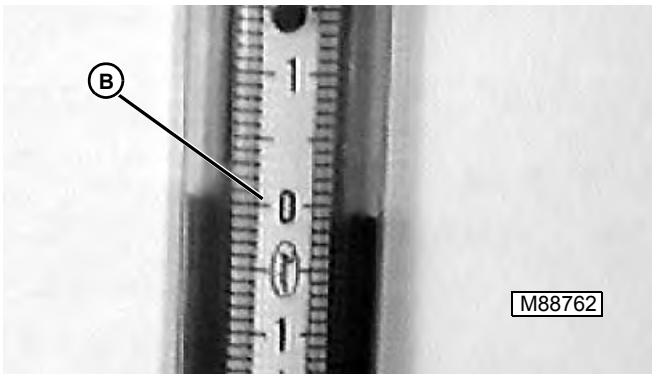
1. Park machine on level surface.
2. Raise engine hood and remove dipstick. Check dipstick/oil fill cap and o-ring for cracks or damage, replace as necessary.
3. Install appropriate size rubber plug in dipstick tube.
4. Insert barbed fitting in rubber plug so that clear line to fitting (A) can be connected at a later step.

**IMPORTANT: DO NOT make connection between U-Tube Manometer clear line and engine crankcase BEFORE engine is running or fluid in manometer could be drawn into crankcase.**

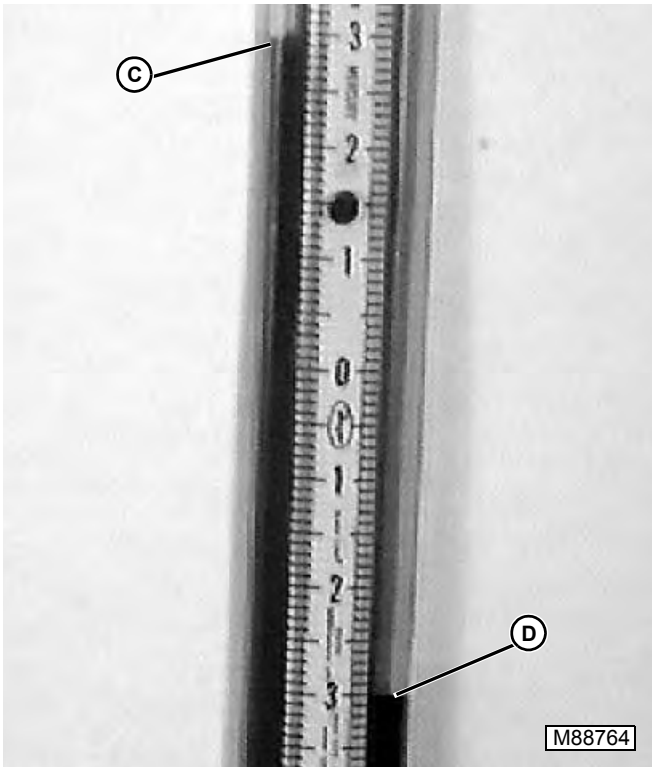
5. Attach manometer magnets to a solid metal surface.




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




7. Zero out the manometer by sliding the ruled scale up or down so “0” (B) is located where water level on both sides is even.
8. Hold finger over rubber plug hole to keep oil from spraying out. Start engine, move the throttle lever to fast idle (3400 rpm) and allow engine to reach operating temperature.
9. Quickly attach clear line from manometer to rubber plug in dipstick opening.




Example: 3 + 3 = 6 in. of vacuum

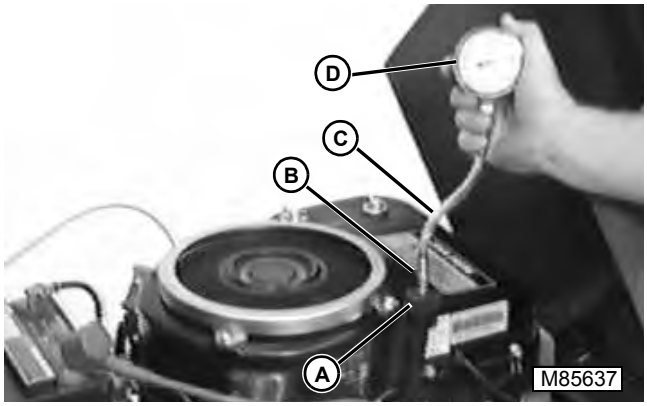
10. Record vacuum reading. Gauge should show a **minimum vacuum of 10.2 cm (4 in.) of water movement**. The reading is obtained by adding (C) and (D) water movement from “0” position.

**IMPORTANT: Repeat test at least three times for accuracy. To repeat test, remove the manometer tube from top of manometer at “A”. DO NOT remove manometer tube from engine. Perform step #7 then reattach manometer tube to side “A”. Continue with step #10.**

11. Remove line from manometer before stopping engine. Then remove dipstick hose connection and install dipstick.

**Procedure 2:**

1. Park machine on level surface.
2. Raise engine hood and remove dipstick. Check dipstick/oil fill cap and o-ring for cracks or damage, replace as necessary.
3. Install appropriate size rubber plug (A) in dipstick tube.
4. Insert barbed fitting (B) in rubber plug so that clear line (C) to fitting can be connected at a later step.




**IMPORTANT: DO NOT make connection between test gauge and rubber plug BEFORE engine is running at FAST idle or gauge damage may result.**

**After test reading is made, DO disconnect test gauge WHILE engine is running at FAST idle to prevent damage to gauge.**

5. Hold finger over rubber plug hole to keep oil from spraying out. Start engine, move the throttle lever to fast idle (3400 rpm) and allow engine to reach operating temperature.
6. Connect gauge (D), clear line, and barbed fitting to rubber plug.
7. Record crankcase vacuum reading. Gauge should show a **minimum vacuum of 10.2 cm (4 in.) of water movement**.
8. Disconnect barbed fitting, clear line, and gauge from rubber plug while engine is running at FAST idle. Hold finger over rubber plug hole to keep oil from spraying out.
9. Move throttle to SLOW idle and turn engine OFF.
10. Remove rubber plug and install dipstick.

**Specification:**

**Minimum crankcase**
**Vacuum at 3400 rpm . . . . . 10.2 cm (4 in. water)**

**Results:**

If crankcase vacuum does not meet specification, check the following:

*NOTE: A new engine may have low vacuum readings due to the fact that the rings are not seated.*

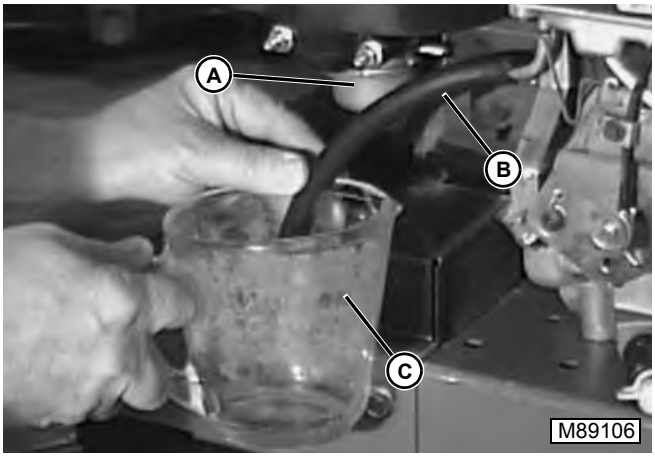
- Breather reed valve clearance and condition
- Seals and gaskets for leakage
- Rocker arm cover O-ring for leakage
- Rings, piston, and cylinder bore for wear or damage

# FUEL FLOW TEST

**Equipment:**

- Proper Fuel Container

**Procedure:**




1. Clamp fuel line (B) or turn off fuel shut-off valve, if equipped, to prevent fuel flow.

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

2. Disconnect fuel line from carburetor (A) and place in container (C).
3. Release clamp on fuel line (B) or turn on fuel shut-off valve, if equipped.
4. Crank engine, fuel should flow freely into container (C).
5. Clamp line or close fuel shut-off valve to install fuel line on carburetor (A).
6. Pour captured fuel into tank.

**Results:**

If fuel flow is slow, check the following:

- Replace fuel filter
- Check fuel lines, fuel pump, shut-off valve (if equipped), fuel tank outlet, and fuel tank cap for restrictions

# OIL PRESSURE TEST

**Reason:**

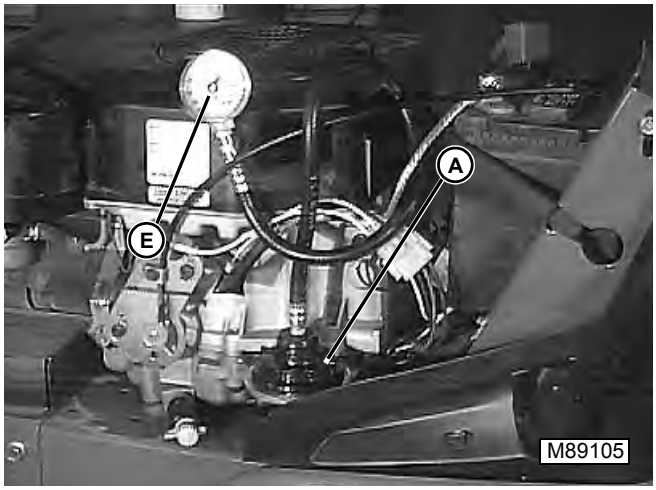
To verify that the engine has enough oil pressure to lubricate the internal engine components.

**Equipment:**

- JT07262 Oil Pressure Test Adapter w/ O-ring (required ONLY on engines without test ports)
- JT05847 Connector
- JT03017 Hose Assembly
- JT03262 Coupler
- JT07034 Gauge, 0 - 700 kPa (0 - 100 psi)

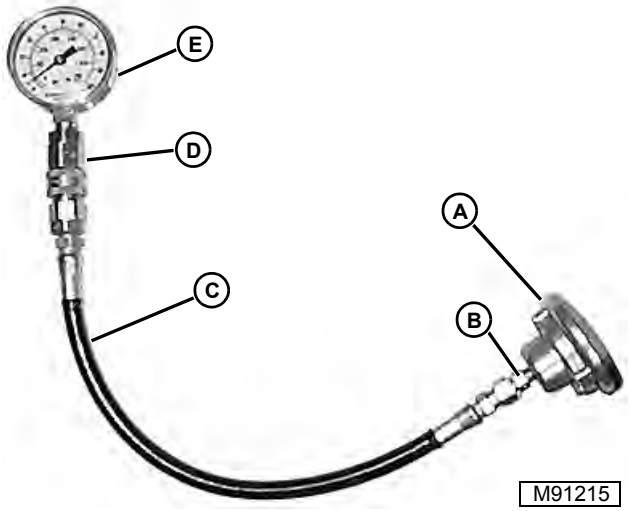
*NOTE: The connector, hose assembly, coupler, and gauge are found in other SERVICEGARD™ test kits. The connector pipe thread (NPT) also matches the oil pressure switch port on early Kohler engines.*

**Procedure:**




**Test Procedure At Oil Filter Base:**

1. Perform test procedure with engine level.
2. Stop engine.
3. Disconnect spark plug wire and allow engine to cool.
4. Drain engine oil from oil filter.
5. Remove oil filter and wipe filter base clean.
6. Install pre-assembled adapter (A), connector (B), hose assembly (C), coupler (D), and gauge (E) on to oil filter base. ONLY hand-tighten adapter to oil filter base.
7. Check crankcase oil level and adjust to full mark.




8. Monitor oil pressure during cranking, if oil pressure is **below 28 kPa (4 psi)—STOP engine immediately** and correct cause before continuing.
9. Connect spark plug wire.
10. Warm-up engine by running at MEDIUM idle for five minutes.

**⚠ CAUTION**

**Engine components are HOT. DO NOT touch with bare skin. Wear protective eye glasses and clothing.**

11. Record oil pressure readings at SLOW and FAST idle.
12. Stop engine and allow to cool.
13. Remove adapter, connector, hose assembly, coupler, and gauge.
14. Install new oil filter.
15. Run engine for 30 seconds and stop engine.
16. Check crankcase oil level and adjust to full mark.

**Results:**

- If oil pressure readings are not within **69 kPa (10.0 psi) – 517 kPa (75.0 psi**) at FAST idle, inspect and/or replace the following:

–Oil pump assembly. See “OIL PUMP DISASSEMBLY AND INSPECTION”.

–Oil suction screen.

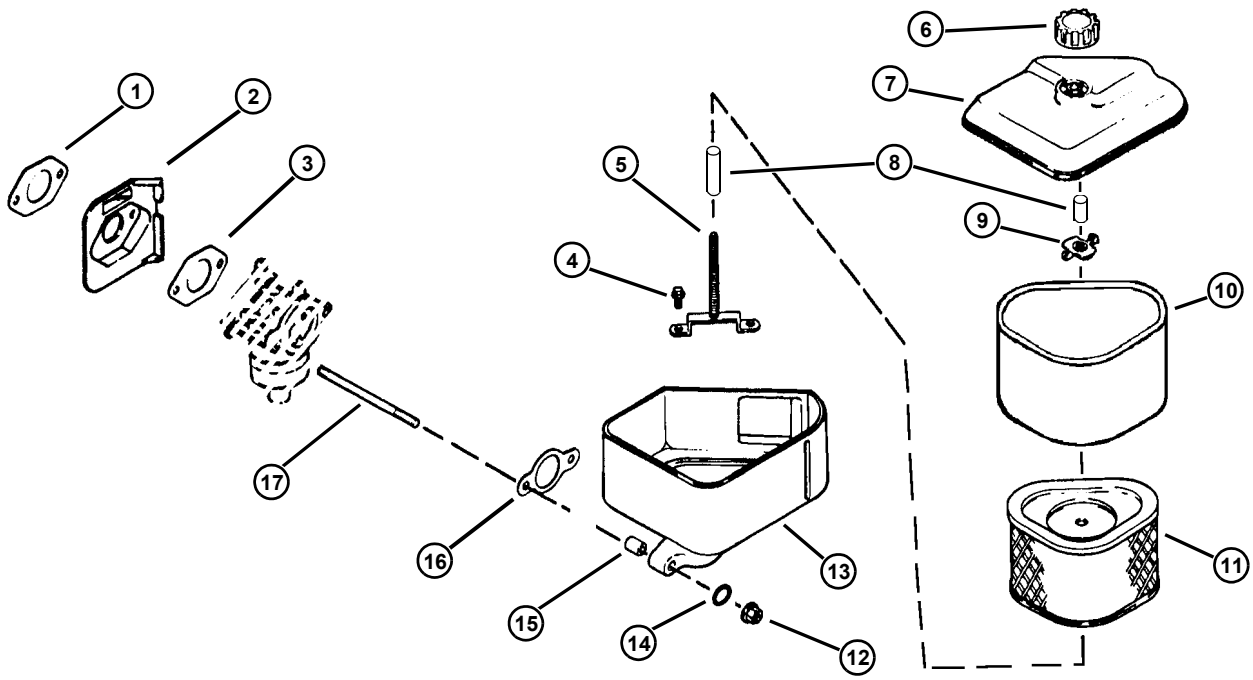
–Oil passages

–Bearing wear

–Oil Seals

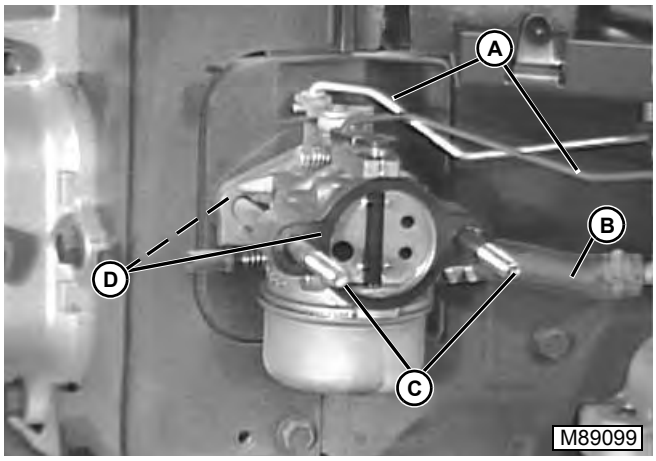
# FUEL & AIR REPAIR

## AIR INTAKE SYSTEM COMPONENTS




1. Gasket
2. Shield
3. Gasket
4. Stud Retaining Screw (Use thread lock and sealer)
5. Stud (Remove studs to remove carburetor)
6. Knob
7. Cover
8. Rubber Seal
9. Wing Nut
10. Foam Element
11. Paper Element
12. Nut (Tighten to **10 N•m (88 lb-in.)**
13. Air Cleaner Housing
14. Washer (Used on stud without electrical eyelet of grounding lead)
15. Sleeve
16. Gasket
17. Stud

## CARBURETOR REMOVAL/ INSTALLATION




**⚠ CAUTION**

**Gasoline is explosive. Do not expose to flame or spark. Serious injury can result.**

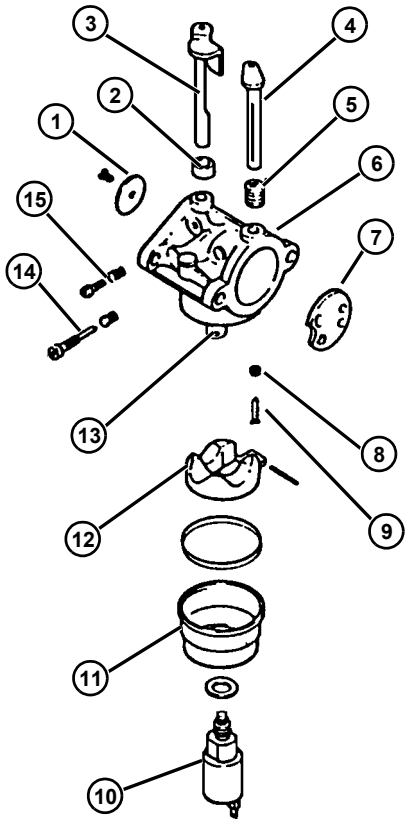
**Procedure:**

1. Turn ignition switch OFF and disconnect battery negative (–) ground cable.
2. Pinch fuel line (B) to block fuel flow or turn fuel shut-off valve (if equipped) to OFF position, then disconnect fuel line (B) and solenoid wire (if optional fuel shut-off solenoid is installed).
3. Remove air filter assembly (shown on previous page) and carburetor, DO NOT damage threads of studs (C).
4. Disconnect linkage rods (A) from carburetor levers.
5. Remove and discard gaskets (D), install new ones.
6. Connect linkage rods (A) and install carburetor, studs (C), and air filter assembly.
7. Connect solenoid wire (if installed), and fuel line (B)—open fuel line or turn fuel shut-off valve (if installed) to ON position.
8. Adjust carburetor, see Test and Adjustments earlier in this section.

**Specification:**

**Air Filter Assembly Nuts . . . . . 10 N•m (88 lb-in.)**

## CARBURETOR INSPECTION




| | | |
|---|---|---|
| 1. Throttle Plate | 6. Body | 11. Float Bowl |
| 2. Seal | 7. Choke Plate | 12. Float |
| 3. Throttle Shaft | 8. Inlet Seal | 13. Main Jet |
| 4. Choke Shaft | 9. Needle | 14. Fuel Screw |
| 5. Choke Spring | 10. Fuel Shut-Off Solenoid (Optional) | 15. Idle Screw |

**⚠ CAUTION**

**Gasoline is explosive. Do not expose to flame or spark. Serious injury can result. DO NOT expose them to flame or spark. Follow the cleaner manufacture's warnings and instructions on its proper and safe use. Never use gasoline as a cleaning agent.**

**Procedure:**

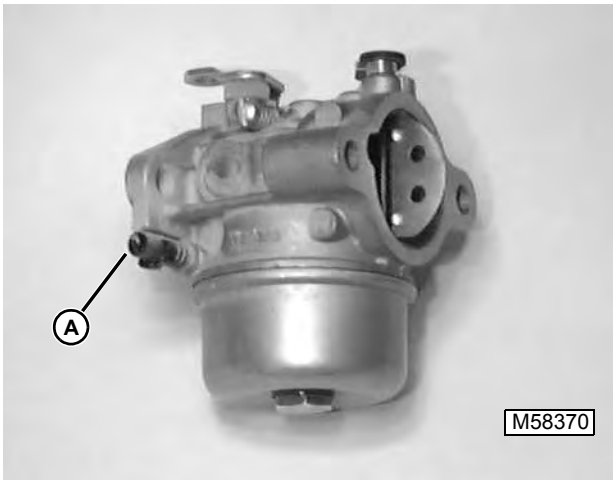
1. Disassemble bowl, float, inlet needle, low idle mixture screw and spring.

**IMPORTANT: Further disassembly of carburetor is not required for general cleaning. Further disassembly will require replacing parts with new parts. DO NOT soak carburetor in carburetor cleaner when fiber, rubber or foam gaskets are still installed. Cleaner may damage these components.**

2. Clean carburetor using pressurized carburetor cleaner and compressed air. Clean out all passages.
3. DO NOT remove idle port welch plug unless absolutely necessary. To remove, pierce with sharp tool. Clean chamber. Install new plug using a flat tool about the same size as plug. Flatten plug but do not force below the surface of the cavity.
4. If inlet seat was leaking or damaged it can be replaced by pulling it out with a drill bit or screw. Always replace with new parts. Press in new seat until it bottoms in bore.
5. If throttle and choke plates were removed, use a high strength thread lock and sealer on the small retaining screws. Install screws slightly loose. Apply pressure on shafts to center plates in bore, then tighten screws.

*NOTE: High altitude jet is available.*

6. Main jet can be pressed out. Replace with new jet. Press new jet in until flush with surface.
7. Low idle mixture screw has a precision taper. If screw is grooved, bent or broken, this may indicate seat damage and carburetor may need to be replaced.
8. On standard carburetors, to set preliminary adjustment for idle mixture screw—**turn clockwise until LIGHTLY seated and back-out (counterclockwise) one full turn**.




New Emissions Carburetor

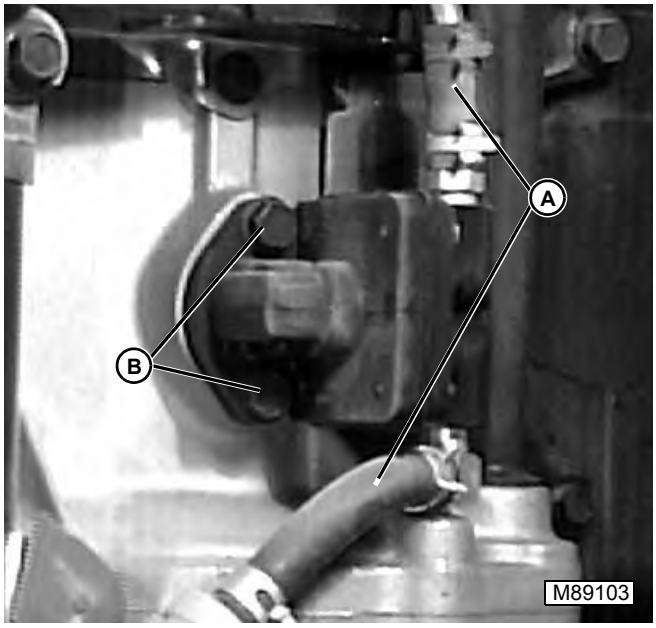
9. On new emissions carburetors, no preliminary adjustment is required for idle mixture screw (A), this is pre-set by manufacturer—**only turn screw (limited to maximum 1/4 turn in either direction) until specified slow idle speed is obtained.**
10. Perform Slow Idle Speed Adjustment. See “SLOW IDLE SPEED ADJUSTMENT”.

# ENGINE REPAIR

## FUEL PUMP REMOVAL/ INSTALLATION

**Procedure:**

1. Close fuel shut-off (if equipped), or pinch fuel line shut.




2. Disconnect fuel lines (A).
3. Remove bolts (B) from fuel pump.
4. Install components in reverse order of removal.

**Specifications:**

**New installation (Thread forming) 9.0 N•m (80 lb-in.)**
**Replacement. . . . . 7.0 N•m (65 lb-in.)**

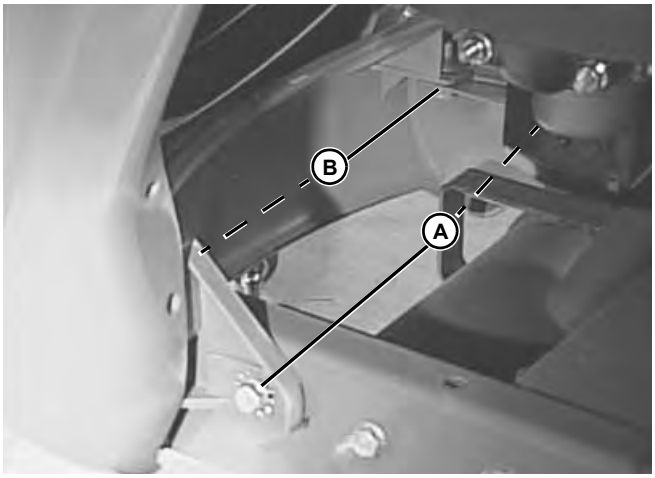
## ENGINE REMOVAL/INSTALLATION

**Conditions:**

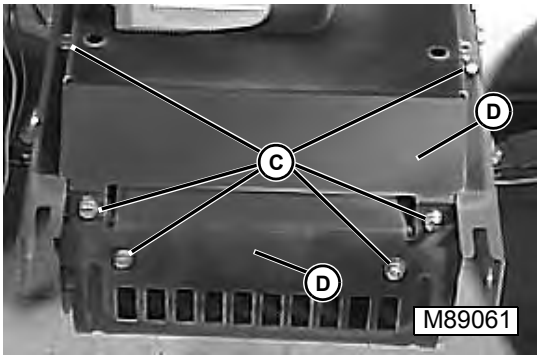
- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Mower deck removed

**Procedure:**

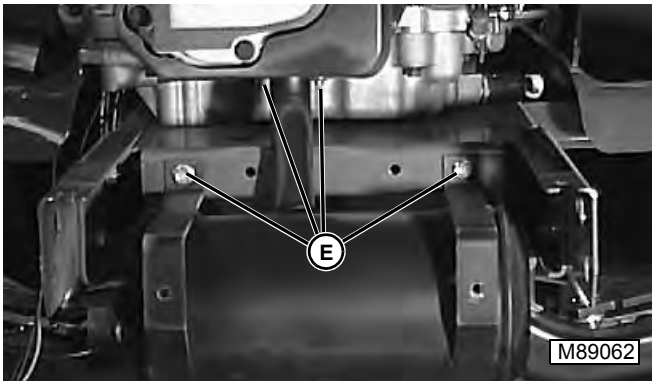
1. Raise hood, disconnect battery, headlight connector, and spark plug lead.




2. Remove two bolts (A) securing the hood to the left and right frame side rails. Loosen the two bolts (B) securing the hood to the upper side of the left and right side rails. Remove hood.



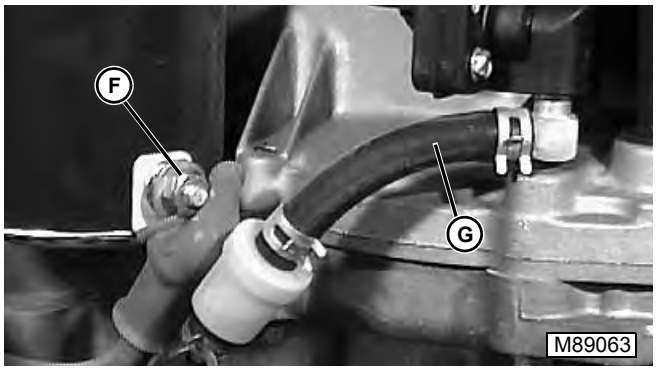

3. Remove six bolts (C) and remove heat shields (D).



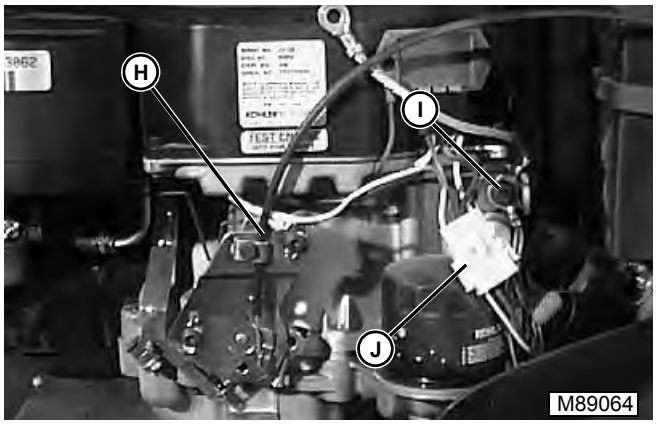

4. Remove muffler, four bolts (E).

## ⚠ CAUTION

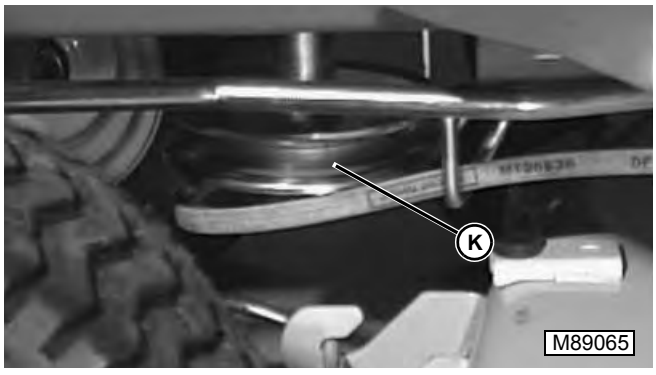
**Gasoline is explosive. Do not expose to flame or spark. Serious injury can result. Store in a properly marked, safe container. Wipe-up any spills IMMEDIATELY.**




5. Disconnect starter lead (F) and fuel line (G).




6. Disconnect throttle cable (H) engine ground wires (I) and engine connector (J).




7. Remove mower drive belt (K).

*NOTE: It is not necessary to completely remove drive belt to remove engine.*

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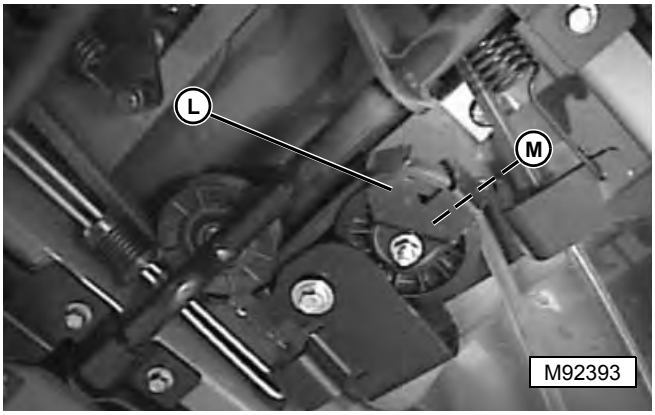
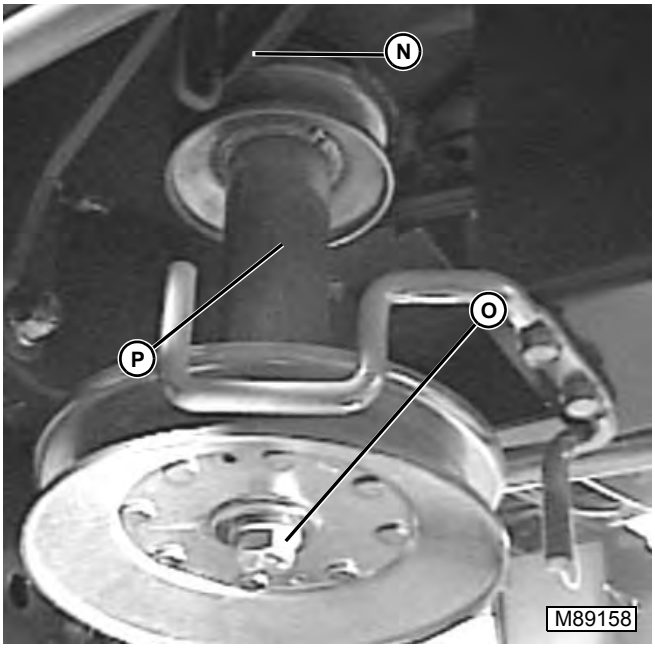


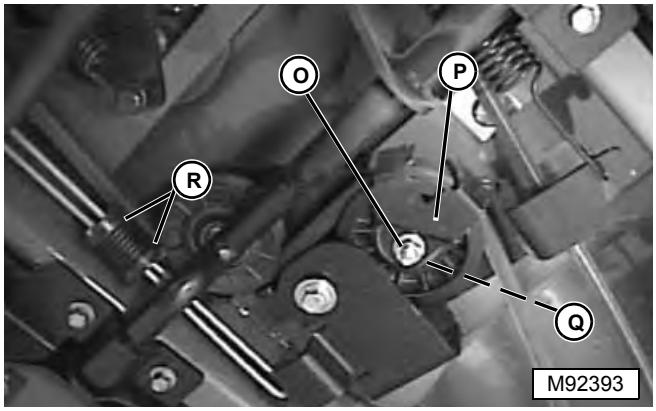

8. Remove belt guide nut and belt guide (L).
9. Loosen idler nut (M) and slide idler forward until belt can be removed from double sheave.



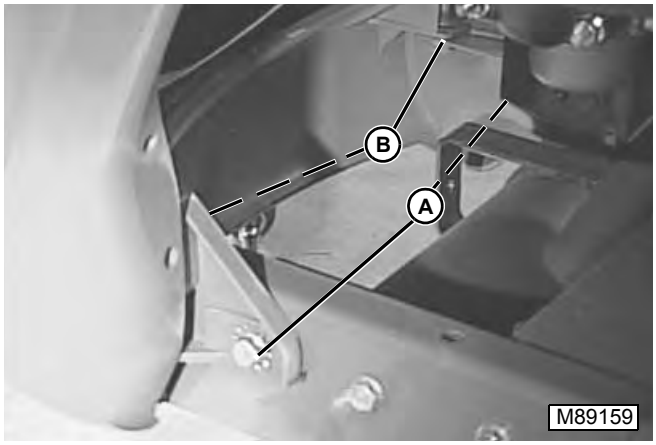

10. Remove engine drive belt (N) from double sheave.
11. Remove sheave nut (O) and double sheave (P).
12. Remove four (4) engine mounting bolts and remove engine.

**Installation:**

1. Install engine and tighten four (4) engine mounting bolts to **32 N•m (24 lb-ft)**.
2. Install double sheave and drive belt. Tighten to **75 N•m (55 lb-ft)**.




3. Slide belt idler (O) rearward until distance between plastic caps of compression spring (R) is **32.5 mm (1.28 in.)**.
4. Tighten idler nut (Q) to **26 N•m (19 lb-ft.)**.
5. Install belt guide (P).
6. Inspect muffler flange for flatness. Install muffler, new gasket, and shield. Tighten muffler bolts to **24 N•m (18 lb-ft.)**.
7. Connect and adjust throttle cable.
8. Connect fuel line and adjust carburetor.
9. Make all electrical wiring connections, including spark plug lead and battery.



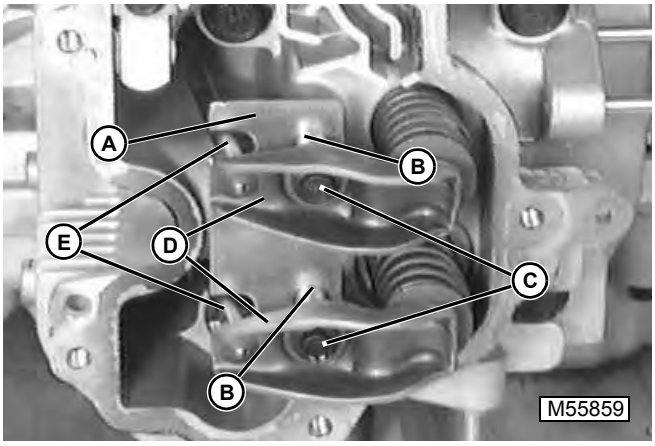

10. Slide hood into position and install bolts (A). Lightly tighten fasteners so that the hood can be moved forward or backward for alignment.

11. Lower hood into the locked position and align hood as shown (C), tighten bolts (B), then raise hood and tighten bolts (A).

## ROCKER ARMS REMOVAL/ INSTALLATION

**Procedure:**

1. Remove valve cover.




**IMPORTANT: Mark push rods for assembly in original locations.**

2. Remove cap screws (C) and pivot ball spacers (B).
3. Remove rocker arms (D).
4. Remove push rods (E).
5. Remove splash plate (A).
6. Inspect and replace components as necessary.
7. Install components in reverse order of removal.

**Specifications:**

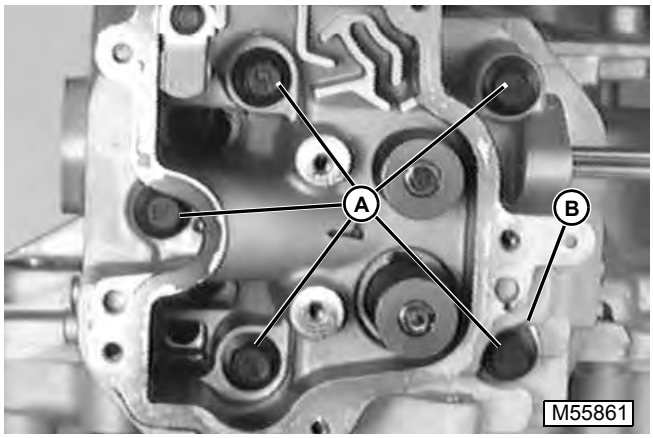
**Rocker Arm Pivot Cap Screws . . 14 N•m (124 lb-in.)**
**Push Rod Bend (maximum) . . . 0.76 mm (0.030 in.)**

## CYLINDER HEAD REMOVAL/ INSTALLATION

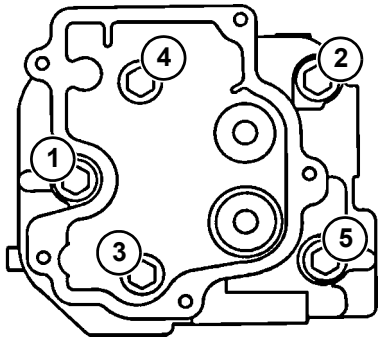
**Procedure:**

**IMPORTANT: Engine must be cold before removing cap screws to avoid warping aluminum cylinder head.**

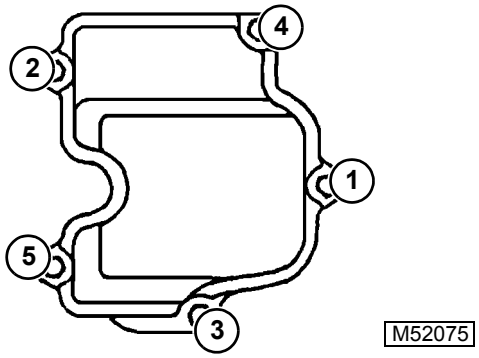
*NOTE: Cylinder head can be serviced without removing engine from tractor.*




1. Remove cap screws (A), spacer (B) and cylinder head. Discard gasket and clean head and block.
2. Install new gasket with cylinder head, cap screws and spacer. Following tube instructions, apply an approved room temperature vulcanizing (RTV) silicone sealant to bottom surface of bolt heads.




3. Tighten cylinder head cap screws in **7 N•m (62 lb-in.)** increments in sequence illustrated, to **41 N•m (30 lb-ft)**.
4. Install push rods and rocker arms.



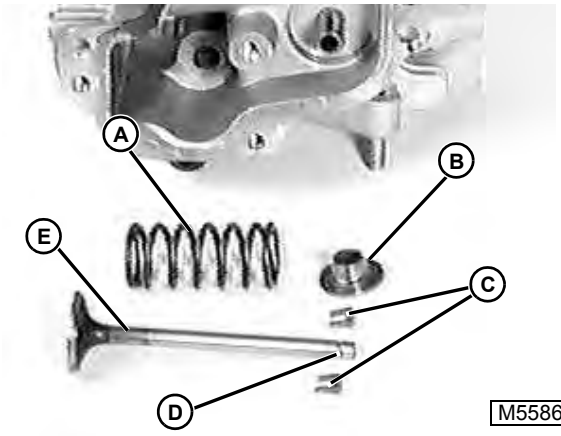

5. Clean valve cover and install using RTV silicone sealant between mating surfaces. Tighten valve cover cap screws, in sequence illustrated.

**Specifications:**

**Cylinder Head Cap Screws . . . . . 41 N•m (30 lb-ft)**
**Rocker Arm Pivot Cap Screws . . 14 N•m (124 lb-in.)**
**Valve Cover Cap Screws . . . . . 7.0 N•m (65 lb-in.)**

## VALVES AND SPRINGS REMOVAL/ INSTALLATION

**Procedure:**




**IMPORTANT: Make sure keepers are seated in valve stem groove (D).**

1. Compress intake and exhaust springs using an appropriate size spring compressor.
2. Remove keepers (C), spring caps (B), springs (A), and valves (E).
3. Install valve components.
4. Compress spring and install keepers in grooves (D).
5. Install rocker arm assembly and cylinder head in reverse order.

## CYLINDER HEAD INSPECTION

**Procedure:**

1. Remove carbon deposits and clean gasket surface with SCOTCH-BRITE® abrasive or equivalent.
2. Inspect head for cracks or damage. Make sure oil drain port is open.

3. Put head on a **flat** surface plate. Check for distortion at several points with a feeler gauge. Replace head if distorted beyond specification.

**Specification:**

**Cylinder Head Warpage (max.) 0.076 mm (0.003 in.)**

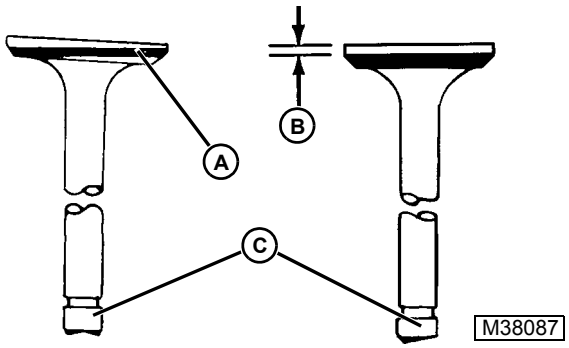
## VALVES INSPECTION

**Special or Required Tools:**

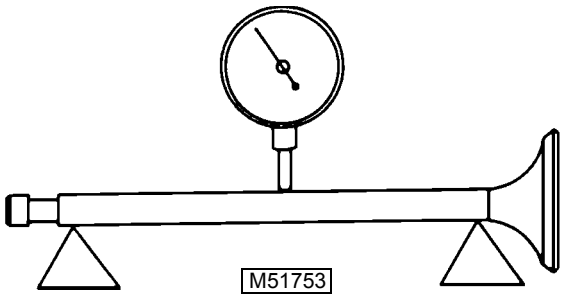
- Dial Indicator

**Procedure:**

1. Remove carbon from valve head, face, and stem.
2. Check valve for cracks or damage.




3. Replace warped valves (A) or valves with less than serviceable margin (B). Valve stem ends (C) should be square, not worn uneven as shown.




4. Inspect valve stems for bends using V-blocks and dial indicator. Turn valve slowly and read variation. Replace if variation is greater than specification.

**Specification:**

**Valve Stem Bend (maximum)**

**. . . . . 0.076 mm (0.003 in.)**

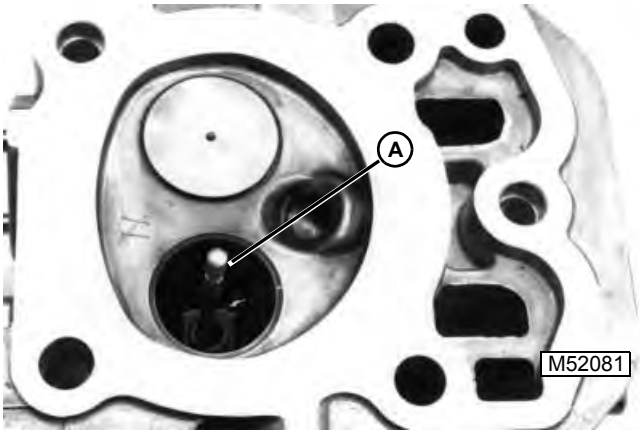
## VALVE GUIDES INSPECTION

**Special or Required Tools:**

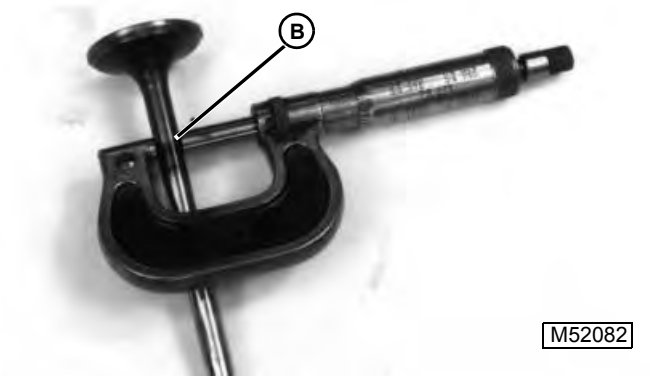
- JDG705 Reaming Tool

**Procedure:**

1. Clean inside of valve guide. Standard valve guide reamer can be used.




2. Measure inside diameter of guide with gauge (A).



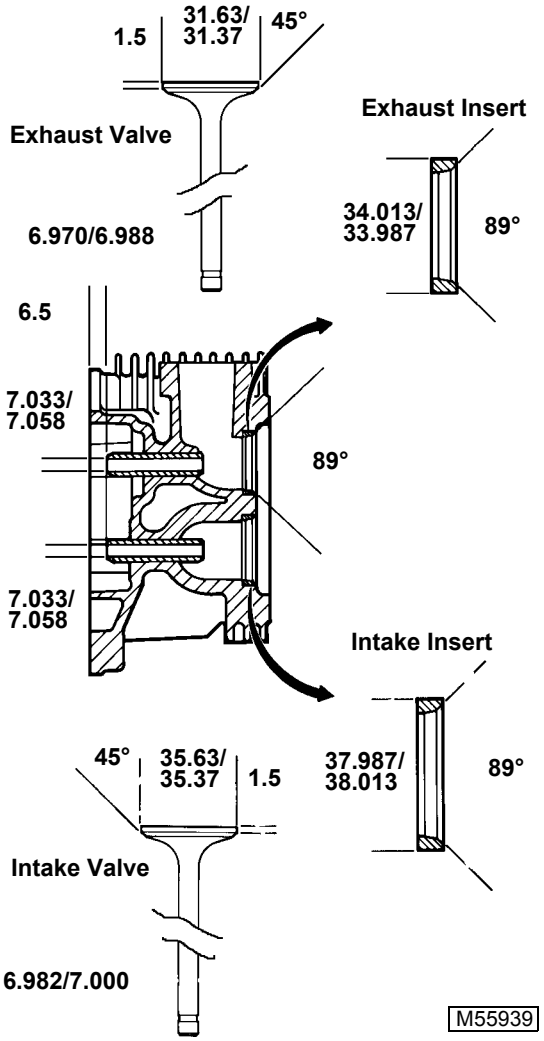

3. Measure outside diameter of valve stem (B).
4. An oversize valve is available. Replace valve if stem-to-guide clearance is too great.

**IMPORTANT: If guide is reamed oversized, an oversize valve must be installed.**

5. Use oversize reaming tool (JDG705) to ream guide, if necessary.
6. Replace cylinder head if inside diameter of guide is greater than oversize specification.

# VALVE SEATS RECONDITION

**Procedure:**




1. Inspect valve seats.
2. Replace cylinder head if seats are warped or distorted beyond reconditioning.
3. Reface pitted or worn seats as shown in drawing.
4. Lap valves after refacing
5. Check seat for good contact using Prussian Blue Compound.

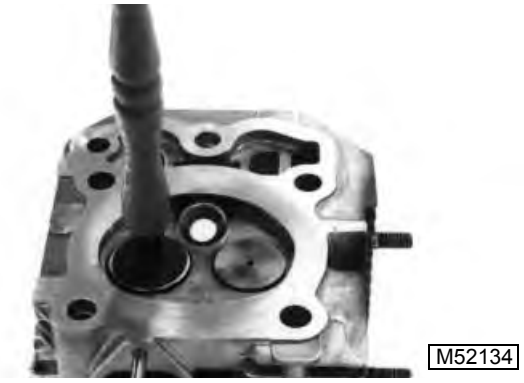
## VALVES LAP

**Special or Required Tools:**

- Lapping Tool

**Procedure:**

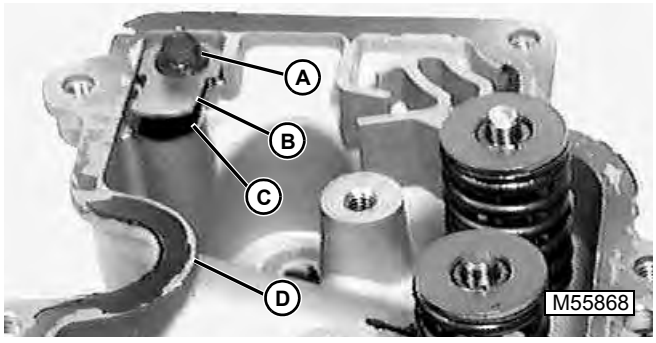
**IMPORTANT: Valves and seats should be lapped if they do not make good contact.**


M52134

1. Apply light coat of lapping compound to valve face, then turn valve in seat using vacuum cup tool.
2. Check valve every eight strokes until a uniform ring appears around surface of valve face.
3. Wash parts in solvent to remove lapping compound.
4. Check position of lap mark on face–lap mark must be on or near center of valve face.

## BREATHER INSPECTION

**Procedure:**



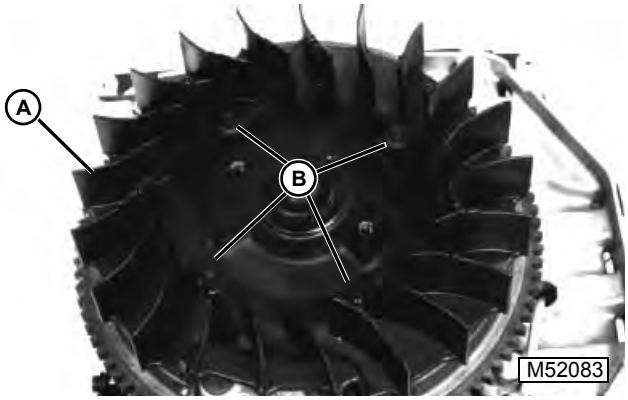
M55868

1. Remove cap screw (A), plate (B), and reed (C).
2. Check that breather opening is clear.
3. Replace reed if it does not lie flat on casting.
4. Clean mating surface of any sealant residue (D).

## FLYWHEEL REMOVAL/ INSTALLATION

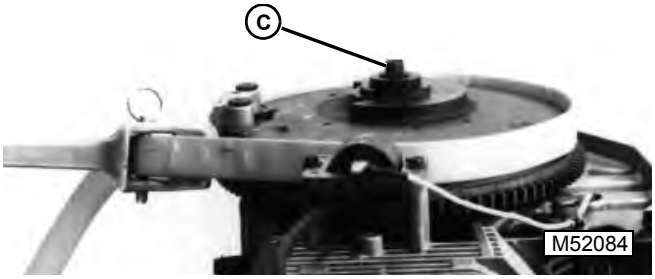
**Procedure:**

1. Remove blower housing sheet metal.



M52083

2. Remove four fan cap screws and washers (B) and fan (A).



M52084

3. Hold flywheel with strap wrench. Remove cap screw (C).

M52085

4. Remove flywheel using a puller.

*NOTE: Flywheel and magnets are not serviceable.*

5. Inspect flywheel for cracks, chips, and broken teeth. Replace as necessary.
6. Inspect for sheared or partially sheared key, replace as necessary.

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

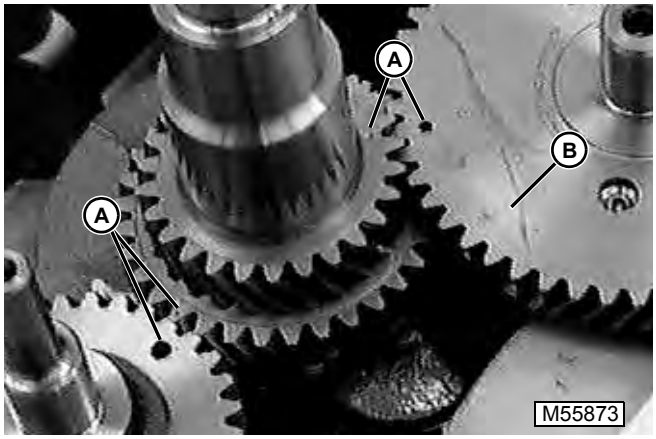
7. Install flywheel and key on crankshaft.
8. Hold flywheel with strap wrench. Tighten cap screw (Ca) to specification.
9. Check ignition module air gap. See “ADJUST IGNITION MODULE AIR GAP”, in theTests and Adjustments Group of the Electrical Section.

**Specification:**

**Flywheel Cap Screw. . . . . 68 N•m (50 lb-ft.)**

## CAMSHAFT REMOVAL/ INSTALLATION

**Procedure:**




1. Rotate crankshaft to align two sets of marks (A).
2. Remove camshaft (B).
3. Inspect camshaft closely, replace as necessary.
4. Coat entire camshaft with engine oil.
5. Install camshaft with four timing marks (A) aligned.
6. Check camshaft end play.
7. If not within specification, use appropriate shims from Camshaft Shim Kit (D), shown in photo M58327.
8. Align flat surface of balancer shaft with bore flat of oil pump inner rotor gear as you install oil pan.
9. Install push rods, rocker arm assembly, and valve cover, see those procedures earlier in this section.

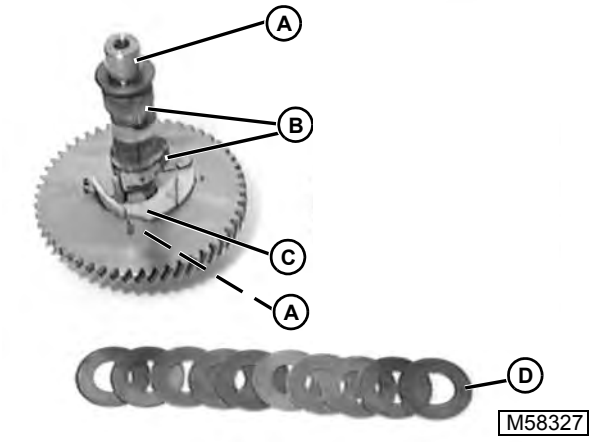
**Specification:**

**Camshaft**

**End Play . . . . . 0.076—0.127 mm (0.003—0.005 in.)**

## CAMSHAFT INSPECTION

**Procedure:**




1. Inspect camshaft for worn or broken teeth.
2. Measure journals (A) at both ends. Replace camshaft if measurements do not meet specifications.

**Camshaft Journal Specifications:**

**O.D. (New) 19.962—19.975 mm (0.7859—0.78.64 in.)**

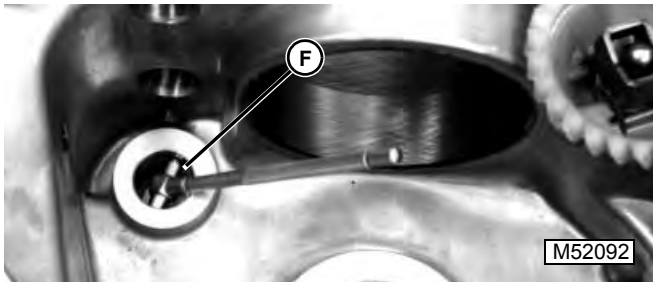
**O.D. (Max. Wear Limit) . . . . . 19.959 mm (0.7858 in.)**

3. Inspect lobes (B). Replace camshaft if lobes show excessive wear.
4. Inspect ACR mechanism (C). Replace spring if necessary and check that weight moves freely.

5. Measure camshaft bore (E) in oil pan.
6. Subtract journal OD. from bore ID. to determine clearance with camshaft journal. Replace if not within specifications.

**Camshaft Bearing Bore Specifications:**

**Oil Pan Camshaft Bore**
**(New): . . . . 20.000—20.025 mm (0.7874—0.7844 in.)**
**(Max. Wear Limit) . . . . . 20.038 mm (0.7889 in.)**
**Camshaft to Bore**
**Clearance . . . 0.025—0.063 mm (0.0010—0.0025 in.)**




7. Measure camshaft bore (F) in crankcase.
8. Subtract journal OD. from bore ID. to determine clearance with camshaft journal. Replace if not within specification.

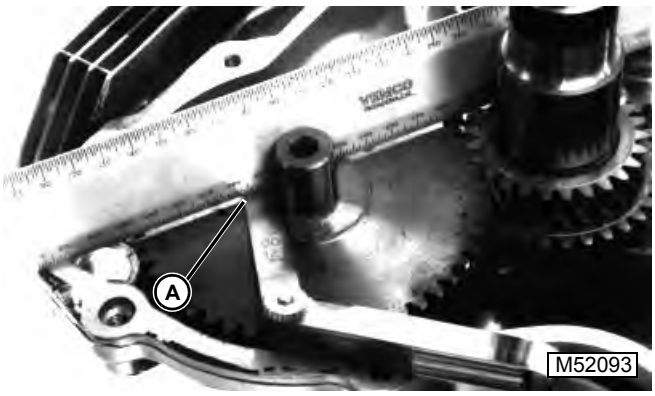
**Camshaft Bearing Bore Specifications:**

**Crankcase Camshaft Bore**
**(New) . . . . . 20.000—20.025 mm (0.7874—0.7844 in.)**
**(Max. Wear Limit) . . . . . 20.038 mm (0.7889 in.)**
**Camshaft to Bore**
**Clearance . . . 0.025—0.063 mm (0.0010—0.0025 in.)**

## CAMSHAFT END PLAY MEASUREMENT

**Procedure:**

1. Check that camshaft is seated in crankcase bore.




2. Measure play (A) between camshaft and straight edge (spanning crankcase) using flat feeler gauge.
3. Use shims from Shim Kit (D) as necessary until end play is within specification.

**Camshaft End Play Specification:**
**Maximum (with shims)**
**. . . . . 0.076 – 0.127 mm (0.003 – 0.005 in.)**

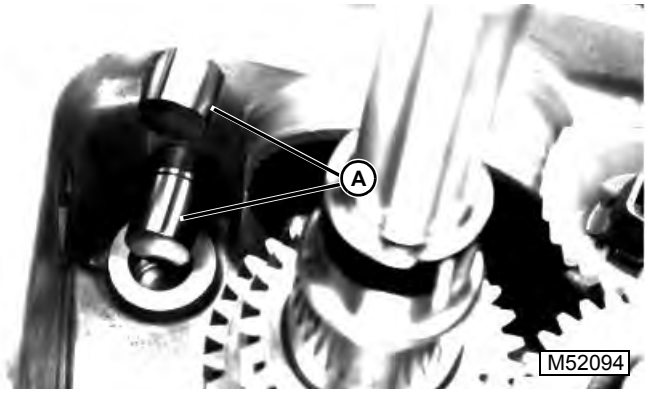
**Shim Thickness Range:**
**White . . . . . 0.692 – 0.730 mm (0.0273 – 0.0288 in.)**
**Blue . . . . . 0.743 – 0.781 mm (0.0293 – 0.0308 in.)**
**Red . . . . . 0.794 – 0.832 mm (0.0313 – 0.0328 in.)**
**Yellow . . . . . 0.845 – 0.883 mm (0.0333 – 0.0348 in.)**
**Green. . . . . 0.895 – 0.994 mm (0.0352 – 0.0368 in.)**
**Gray . . . . . 0.946 – 0.984 mm (0.0373 – 0.0388 in.)**
**Black . . . . . 0.997 – 1.035 mm (0.0393 – 0.0408 in.)**

## HYDRAULIC VALVE LIFTERS REMOVAL/INSTALLATION

**Procedure:**

1. Remove camshaft.

**IMPORTANT: Used lifters are mated to their camshaft lobes. Mark them for installation in the correct bore.**

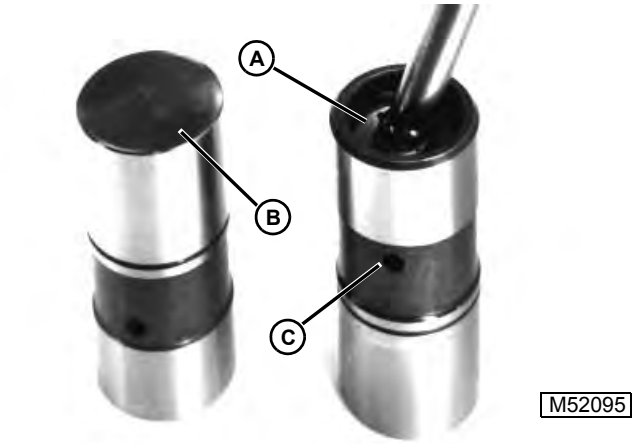



2. Remove lifters (A).
3. Inspect lifters for wear, replace as necessary.
4. Coat lifters with engine oil and install in correct bore.
5. Install camshaft.

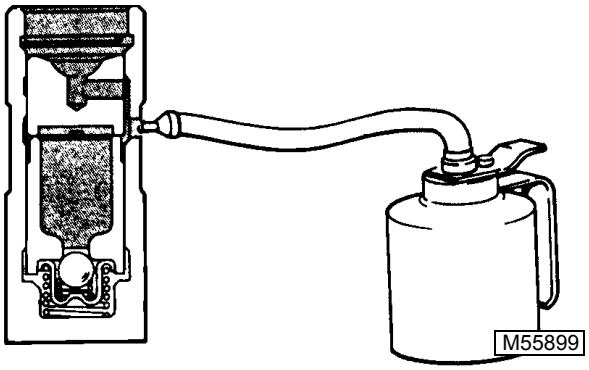
## HYDRAULIC VALVE LIFTERS INSPECTION

**Procedure:**

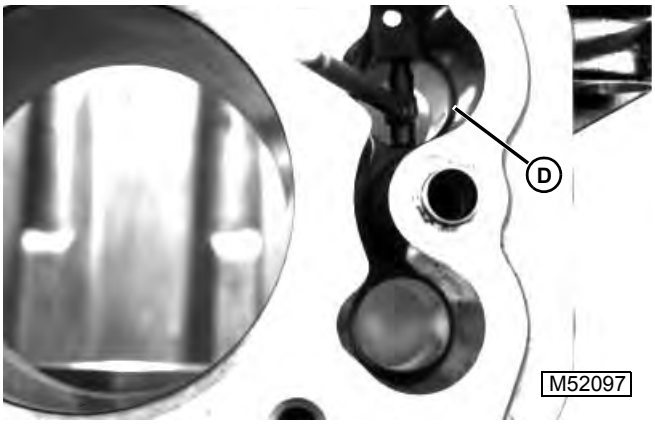
**IMPORTANT: Damaged or worn lifters usually indicate a damaged camshaft. Check camshaft before replacing lifters.**




1. Inspect lifter face (B) for wear. Face should be flat and smooth.
2. Use push rod to depress plunger (A). Plunger should offer resistance but move smoothly.
3. Check that oil hole (C) is clear to inner piston.
4. Measure outside diameter of lifter.
5. Replace lifters that are worn or damaged.




*NOTE: When installing new lifters, make sure lifters are full of oil. Submerse lifters in oil and use old push rod to pump lifter several times to purge air and fill with oil, or force oil into lifter with oil can (shown above), until lifter feels solid. Reassemble engine and allow ten minutes for lifters to bleed down. Crank engine over by hand and check for compression. If no compression exists or engine cannot be turned, lifters have not bled down, and may have trapped air inside. Wait ten minutes more to allow lifters to bleed down.*



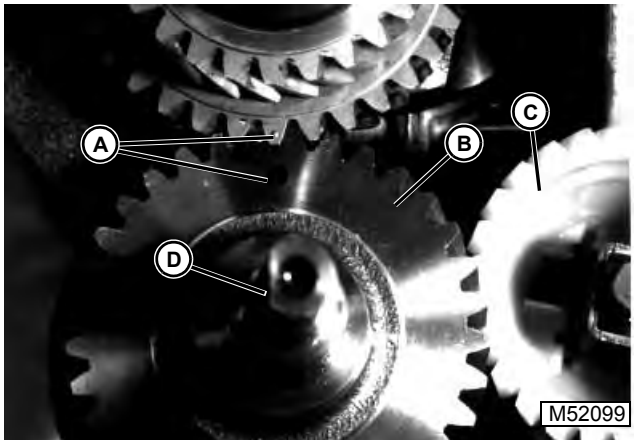

6. Measure inside diameter of crankcase lifter bore (D).
7. Subtract lifter OD from bore ID to determine if clearance is not within specification. Replace components as necessary.

**Specification:**

**Valve Lifter To Bore Clearance (maximum) . . . . . 0.0124—0.0501 mm (0.0005—0.0020 in.)**

## BALANCER SHAFT REMOVAL/ INSTALLATION

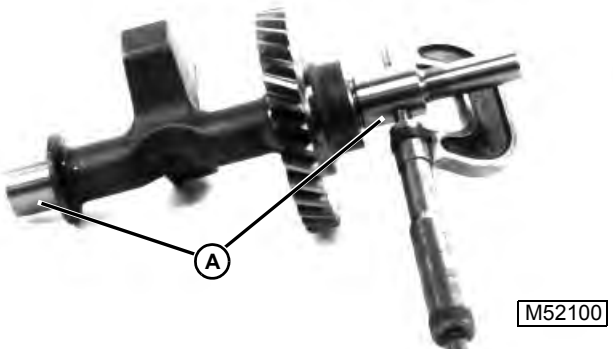
**Procedure:**




1. Align marks (A) on balancer shaft and crankshaft.
2. Remove balancer shaft (B).
3. Inspect balancer shaft, replace as necessary.
4. Align marks (A) and install balancer shaft (B) so it also aligns with governor gear (C).
5. Remember, when installing oil pan, be sure to align flat (D) of balancer shaft with bore flat of oil pump inner rotor gear.

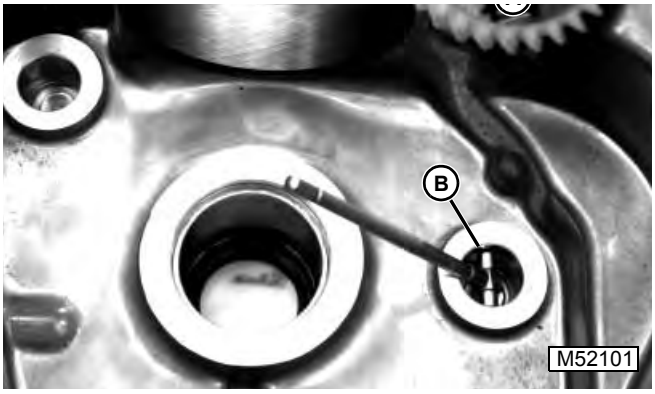
## BALANCER SHAFT INSPECTION

**Procedure:**




1. Inspect shaft for cracks and broken teeth. Replace shaft if cracked or damaged.
2. Measure journals (A). Replace if not within specification.

**Balancer Shaft Journal OD Specifications**
**New . . . . . 19.962—19.975 mm (0.7859—0.7864 in.)**
**Minimum . . . . . 19.959 mm (0.7858 in.)**




3. Measure balancer shaft bore (B) in crankcase.
4. Subtract journal OD from bore ID to determine clearance with balancer shaft journal. Replace crankcase if measurements are not within specifications.

**Balancer Shaft Crankcase Bore Specifications:**
**ID (New). . . 20.000—20.025 mm (0.7874—0.7884 in.)**
**Wear Limit. . . . . 20.038 mm (0.7889 in.)**

**Balancer Shaft to Crankcase Bore Clearance . . . . . 0.025—0.063 mm (0.0009—0.0025 in.)**

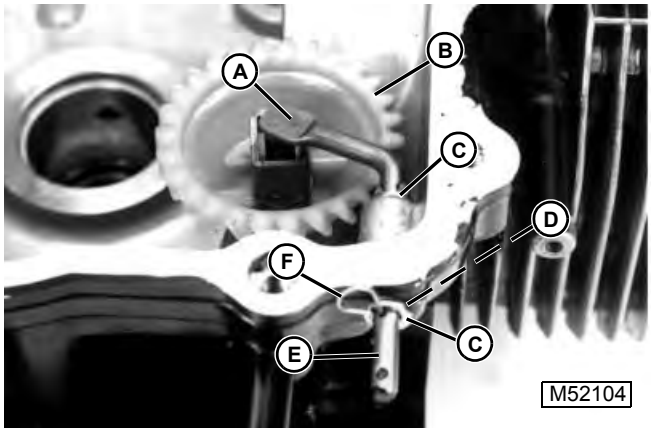
5. Measure balancer shaft bore (C) in oil pan.
6. Determine clearance with balancer shaft journal. Replace oil pan if measurements not within specifications.

**Balancer Shaft Oil Pan Bore Specifications:**
**ID (New). . . 20.000—20.025 mm (0.7874—0.7884 in.)**
**Maximum. . . . . 20.038 mm (0.7889 in.)**

**Balancer Shaft to Crankcase Bore Clearance . . . . . 0.025—0.063 mm (0.0009—0.0025 in.)**

## GOVERNOR REMOVAL/ INSTALLATION

**Procedure:**




1. Remove governor lever (not shown) from end of control arm (E).
2. Remove spring clip (F), washers (C), and governor control arm (A) from inside of crankcase.
3. Remove and discard seal (D).

*NOTE: Check governor shaft/gear assembly, if plastic gear, flyweight assembly, flyweight cap, and/or shaft are damaged, the complete assembly must be replaced.*

4. Inspect governor shaft/gear assembly (B), replace as necessary. See “REPLACE GOVERNOR SHAFT/GEAR ASSEMBLY”, later in this group.
5. Install governor shaft/gear assembly.
6. Install new seal (D) using suitable driver.
7. Install control arm, washers, and clip.
8. Install lever (not shown).

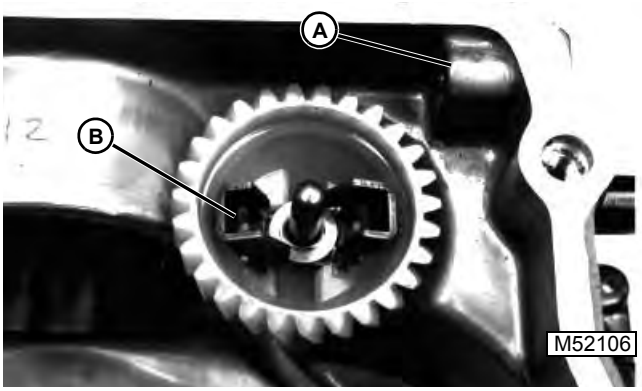
## GOVERNOR INSPECTION

**Procedure:**

1. Measure outside diameter of control arm shaft. Replace if not within specification.

**Governor Control Arm Specifications**

**OD (New) . . . . 5.975—6.000 mm (0.2352—0.2362 in.)**
**Wear Limit . . . . . 5.962 mm (0.2347 in.)**




2. Measure inside diameter of crankcase bore (A).

**Governor Control Arm Crankcase Bore Specs**

**ID (New) . . . . . 6.025—6.050 mm (0.2372—0.2382 in.)**
**Maximum . . . . . 6.063 mm (0.2387 in.)**

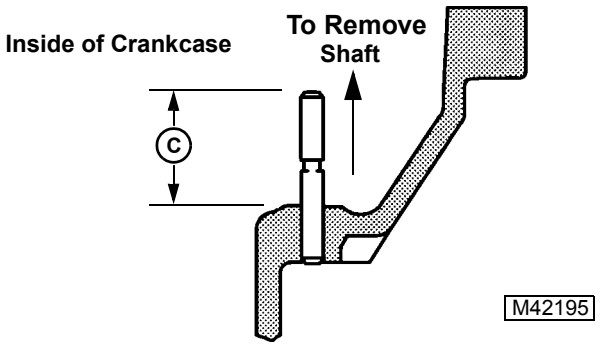
3. Determine governor control arm shaft-to-bore clearance. Replace governor shaft/gear assembly as necessary.

**Governor Control Arm-to-Crankcase Bore Spec**

**Clearance . . . 0.025—0.075 mm (0.0010—0.0030 in.)**

4. Inspect flyweights (B) for proper operation and free movement. Replace governor shaft/gear assembly as necessary.

**IMPORTANT: DO NOT remove governor shaft with vise-grips or pliers, damage to case may result.**




5. With a small punch, CAREFULLY drive governor shaft toward inside of crankcase to remove it.
6. From inside of crankcase, install new governor shaft/gear assembly by pressing or lightly tapping shaft into crankcase bore to specified height (C).

**Governor Gear Shaft Specifications:**

**Height (C) . . . 32.639—32.842 mm (1.285—1.293 in.)**
**Diameter (New). . . . . 5.990—6.000 mm (0.2358—0.2362 in.)**
**Diameter (Minimum). . . . . 5.977 mm (0.2353 in.)**

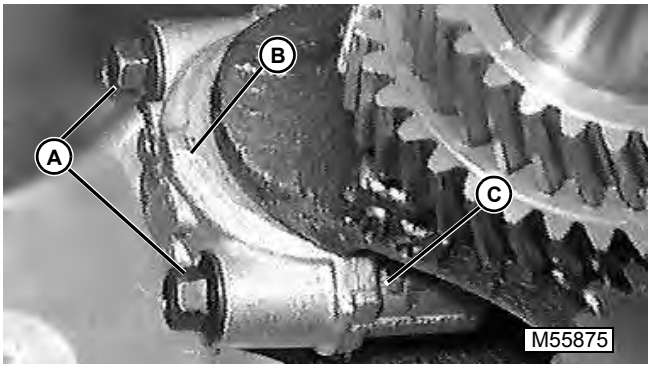
## PISTON ASSEMBLY REMOVAL

**Procedure:**

1. Remove balance shaft, and camshaft.

**IMPORTANT: Remove carbon ridge, if present, from cylinder before removing piston.**

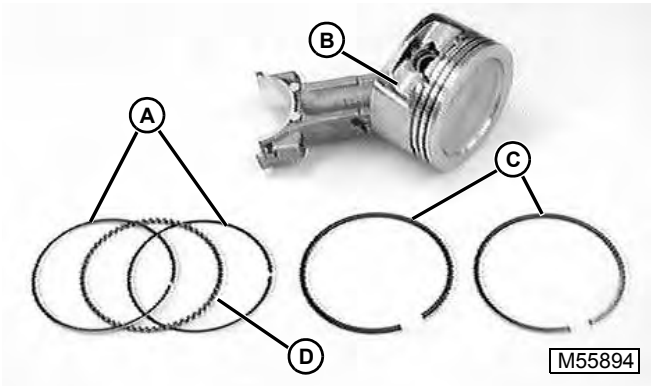
2. Remove carbon ridge, if present at top of cylinder, using a ridge reamer.



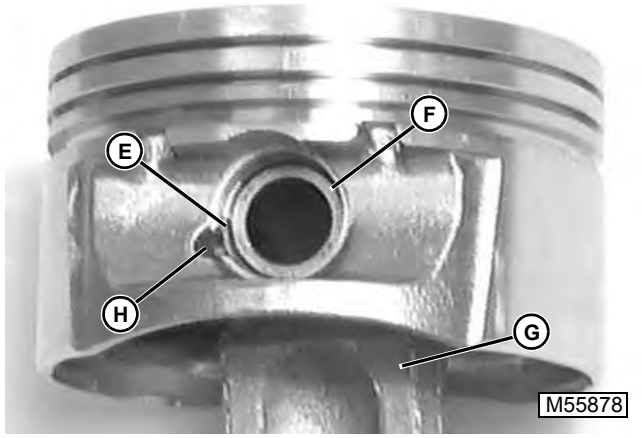

3. Remove cap screws (A) to remove cap (B) from connecting rod (C).
4. Remove piston assembly through top of cylinder.
5. Inspect piston assembly, see following two topics.

## PISTON ASSEMBLY DISASSEMBLE

**Procedure:**




1. Remove compression rings (C) from piston (B) using ring expander.
2. Remove rails (A).
3. Remove spacer (D).

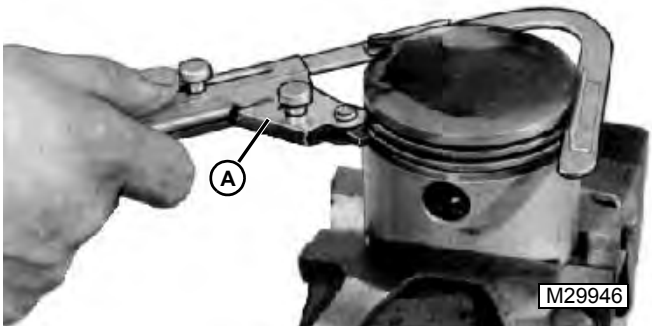



4. Remove retaining rings (E) by prying at indent (H).
5. Use wooden dowel to remove pin (F) from piston and connecting rod (G).
6. Inspect parts.

## PISTON INSPECTION

**Procedure:**

1. Carefully remove piston rings.



**IMPORTANT: Do not use caustic cleaners or wire brush to clean aluminum piston. Piston damage can result.**

2. Clean piston. Inspect for scoring or fractures.
3. Clean carbon from grooves using ring groove tool (A).

## PISTON RING END GAP MEASUREMENT

**Procedure:**

**IMPORTANT: If new rings are to be installed, deglaze cylinder so rings will seat properly. See "DEGLAZE CYLINDER BORE", later in this section.**

1. Use a clean or new piston to push piston compression ring squarely into bore, to a point where it normally runs.

2. Measure end gap (A).
3. Remove ring and file ends squarely until gap meets specification. Rings with too large a gap must be replaced. If one piston ring needs replaced, all must be replaced as a set.

**Specifications:**

**Piston Ring End Gap (New Bore):**
**13 hp . . . . . 0.3—0.5 mm (0.012—0.020 in.)**
**15 hp . . . . . 0.27—0.51 mm (0.010—0.020 in.)**
**Piston Ring End Gap (Used Bore) (Max):**
**All. . . . . 0.77 mm (0.030 in.)**

## PISTON RING SIDE CLEARANCE MEASUREMENT

**Procedure:**

1. Measure piston ring side clearance (A) as shown at several points around piston.
2. Replace piston if measurements exceed clearance specifications.

**Specifications:**

**Piston Ring-To-Groove Side Clearance**

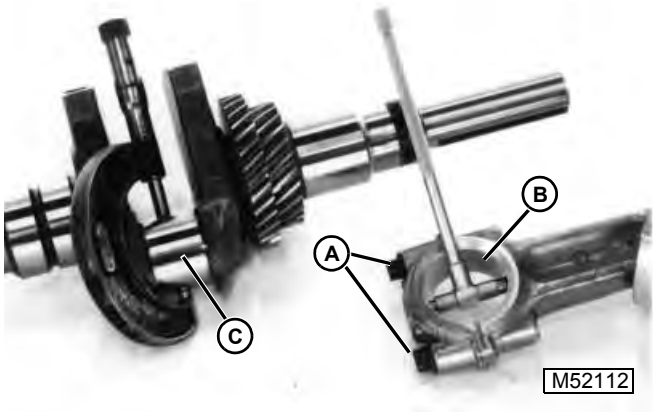
**Top Compression Ring**
**13 hp . . . . . 0.040—0.105 mm (0.0016—0.0041 in.)**
**15 hp . . . . . 0.060—0.105 mm (0.0023—0.0041 in.)**

**Middle Compression Ring**
**13 hp . . . . . 0.040—0.072 mm (0.0016—0.0028 in.)**
**15 hp . . . . . 0.040—0.085 mm (0.0015—0.0033 in.)**

**Oil Control Ring**
**13 hp . . . . . 0.551—0.675 mm (0.0217—0.0266 in.)**
**15 hp . . . . . 0.176—0.026 mm (0.0069—0.0010 in.)**

# PISTON ASSEMBLY MEASUREMENT

**Procedure:**




*NOTE: Connecting rod is available 0.25 mm (0.010 in.) undersize.*

1. Tighten cap screws (A) to specification.
2. Measure inside diameter of connecting rod (B).
3. Measure outside diameter of crankshaft journal (C).
4. Determine connecting rod-to-crankshaft clearance.

Replace parts that are not within specifications.

**Crankshaft Specifications:**

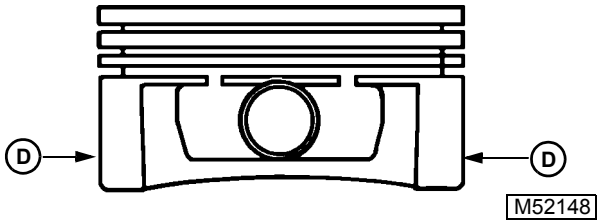
**Connecting Rod Journal OD**
**New . . . . 38.958—38.970 mm (1.5338—1.5343 in.)**
**Wear Limit. . . . . 38.94 mm (1.5328 in.)**
**Taper (maximum) . . . . . 0.012 mm (0.0005 in.)**
**Out-Of-Round (max). . . . . 0.025 mm (0.0010 in.)**

**Crankshaft-to-Connecting Rod Clearance**
**New . . . . . 0.030—0.055 mm (0.0012—0.0022 in.)**
**Maximum. . . . . 0.07 mm (0.0025 in.)**

**Connecting Rod Specifications:**

**Piston Pin End ID**
**New . . . . 19.015—19.023 mm (0.7486—0.7489 in.)**
**Maximum. . . . . 19.036 mm (0.7495 in.)**
**Piston Pin OD.**
**New . . . . . 18.995—19.00 mm (0.7478—0.7480 in.)**
**Minimum . . . . . 18.994 mm (0.74779 in.)**

**Connecting Rod Cap Screws Torque:**
**8 mm Straight Shank . . . . . 23 N•m (200 lb-in.)**
**Step Down Shank. . . . . 14 N•m (130 lb-in.)**
**6 mm Straight Shank . . . . . 11 N•m (100 lb-in.)**




5. Measure diameter of piston at a point (D), **6 mm (0.25 in.)** from skirt bottom and perpendicular to piston pin.

**Specifications:**

**Piston Thrust Face OD**
**New:**
**13 hp . . . 86.941—86.959 mm (3.4229—3.4236 in.)**
**15 hp . . . 89.951—89.969 mm (3.5413—3.5420 in.)**
**Minimum:**
**13 hp . . . . . 86.814 mm (3.4179 in.)**
**15 hp . . . . . 89.824 mm (3.5363 in.)**

6. Measure cylinder bore.
7. Replace piston and/or rebore cylinder block if not within specifications.

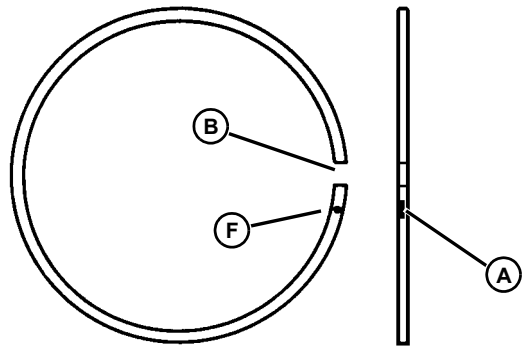
**Piston Specifications:**

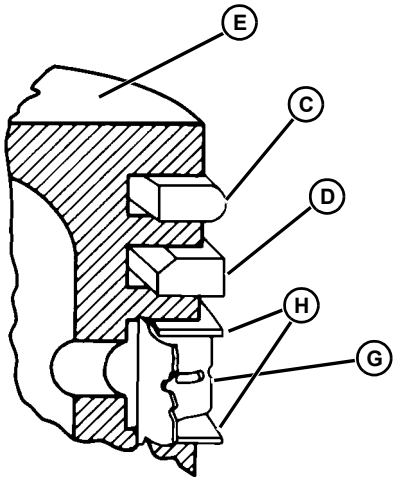
**Thrust Face to Cylinder Bore Clearance**
**New:**
**13 hp . . . . . 0.041—0.044 mm (0.0016—0.0017 in.)**
**15 hp . . . . . 0.031—0.043 mm (0.0012—0.0016 in.)**
**Piston Pin Bore ID**
**New . . . . 19.006—19.012 mm (0.7483—0.7485 in.)**
**Maximum. . . . . 19.025 mm (0.7490 in.)**

# PISTON ASSEMBLY

**Procedure:**

**IMPORTANT: Side of ring marked TOP faces top of piston with Dykem stripe (A) to left of end gap (B). Top compression ring (C) has a blue Dykem stripe. Bottom compression (D) ring has a pink Dykem stripe.**

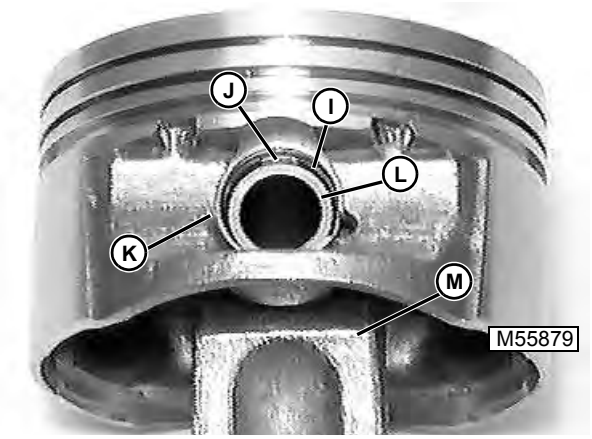



M55898

1. Install rings as shown on piston (E) using ring expander.
   - Compression ring gaps (B) should be staggered 120°
   - Note shape of compression rings and install as shown
   - Compression rings should be installed with “Pip” mark (F) up and Dykem strip (A) to left of ring gap
   - Install oil ring spacer (G) first. Make sure that its ends do not overlap
   - Stagger end gasp of oil rails (H) 180° apart
   - Rings should turn freely in grooves

*NOTE: Install piston pin before retaining ring to prevent possible scoring of bore.*




M55879

**IMPORTANT: Retaining rings (I) should be installed with end gap (J) pointing up.**

2. Install one piston pin retaining ring (I) in groove of piston bore (K).
3. Install pin (L) through piston bore (K) and connecting rod (M). Pin should install easily with thumb pressure.
4. Install remaining retaining ring (I) in opposite side.

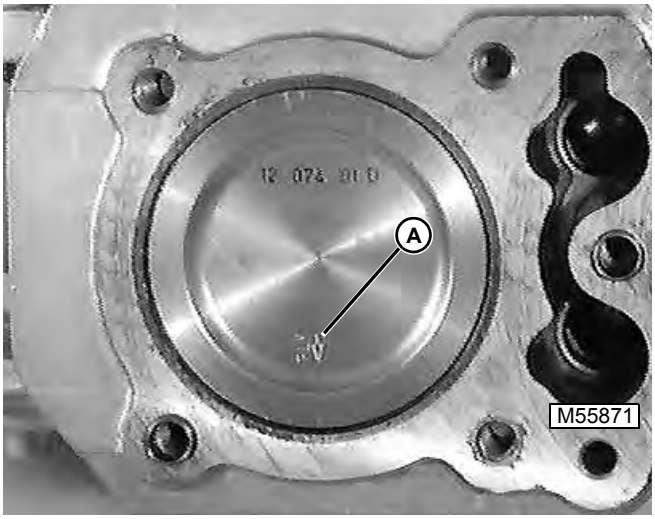
# PISTON INSTALLATION

**Special or Required Tools:**

- Piston Ring Compression Tool

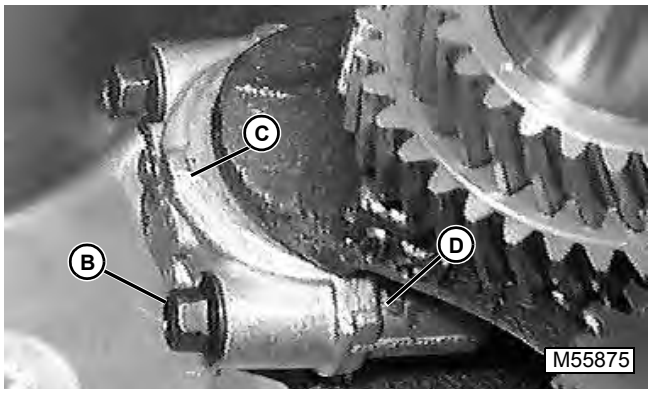
**Procedure:**

1. Install piston rings so piston ring end gaps are staggered 120° apart.
2. Coat cylinder, piston skirt, rod, and cap bearing surfaces with oil.
3. Compress rings with ring compressor tool.




M55871

4. Install piston with FLY mark (A) toward flywheel side of crankcase. Use wooden dowel to push piston into bore.




5. Fasten connecting rod (D) and cap (C) to crankshaft.
6. Tighten cap screws (B) to specification.
7. Check connecting rod to crankshaft side clearance. Replace if not within specification.
8. Install balance shaft, camshaft, oil pan, and cylinder head. See appropriate procedures in this section.

**Connecting Rod Specifications:**

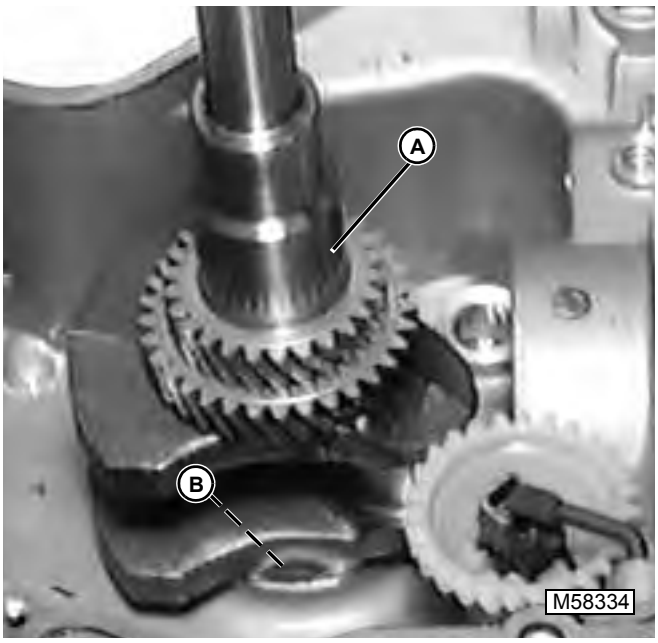
**Cap Screw Torque:**
**8 mm Straight Shank . . . . . 23 N•m (200 lb-in.)**
**Step Down Shank. . . . . 14 N•m (130 lb-in.)**
**6 mm Straight Shank . . . . . 11 N•m (100 lb-in.)**

**Side Clearance . . . 0.18—0.41 mm (0.007—0.016 in.)**

## CRANKSHAFT REMOVAL/ INSTALLATION

**Procedure:**

1. Remove camshaft and balancer assemblies.

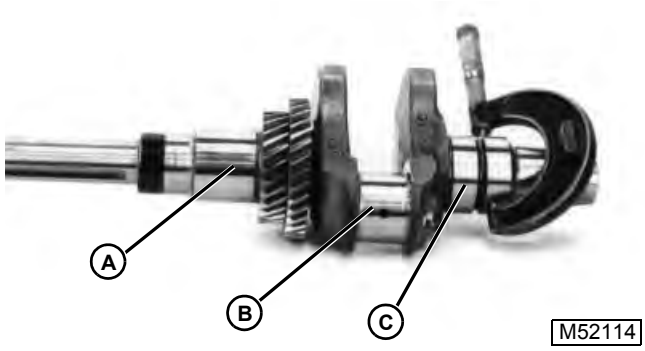



2. Remove and inspect crankshaft (A).
3. Install new seals (B) in crankcase and oil pan.
4. Install crankshaft carefully, DO NOT damage seals.

## CRANKSHAFT AND MAIN BEARING INSPECTION

**Procedure:**

1. Inspect for cracks or chipped teeth.

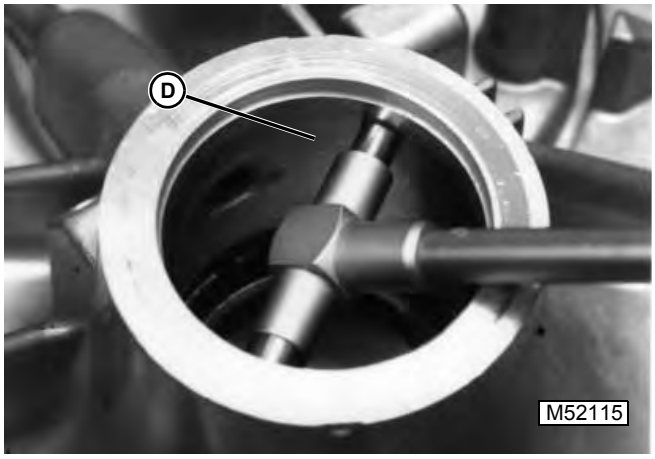



2. Check crankshaft alignment, see next heading.
3. Measure journals (A), (B), and (C).

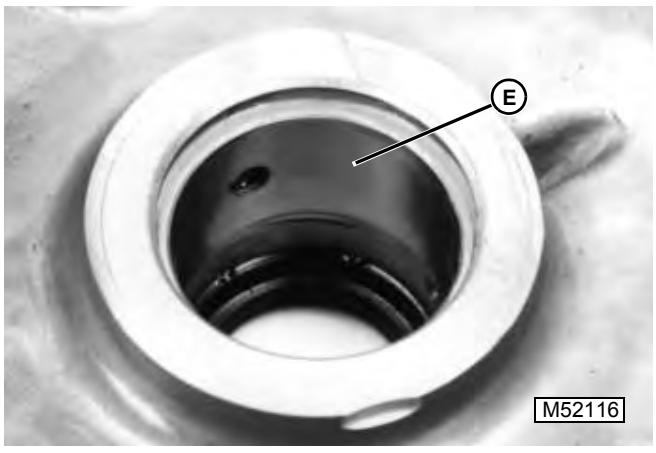
Replace crankshaft if bent, damaged, or not within specifications.

**Crankshaft Bearing Journal Specifications:**

**Oil Pan End Main Journal OD:**
**New . . . . 41.915—41.935 mm (1.6502—1.6510 in.)**
**Minimum . . . . . 41.86 mm (1.648 in.)**
**Taper (maximum) . . . . . 0.020 mm (0.0008 in.)**
**Out-of-Round (maximum) . 0.025 mm (0.0010 in.)**
**Flywheel End Main Journal OD:**
**New . . . . 44.913—44.935 mm (1.7682—1.7691 in.)**
**Minimum . . . . . 44.84 mm (1.765 in.)**
**Taper (maximum) . . . . . 0.022 mm (0.0009 in.)**
**Out-of-Round (maximum) . 0.025 mm (0.0010 in.)**
**Connecting Rod Journal OD:**
**New . . . . 38.958—38.970 mm (1.5338—1.5343 in.)**
**Minimum . . . . . 38.94 mm (1.5328 in.)**
**Taper (maximum) . . . . . 0.012 mm (0.0005 in.)**
**Out-of-Round (maximum) . 0.025 mm (0.0010 in.)**




4. Measure inside diameter of crankshaft main bearing bore (D) in oil pan.



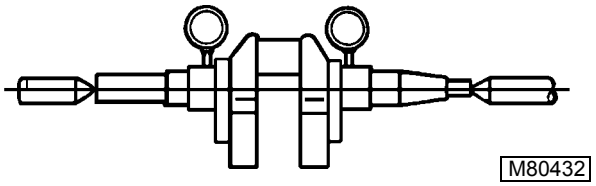

5. Measure inside diameter of crankshaft main bearing bore (E) in crankcase.
6. Subtract journal OD from bore ID to determine if clearance is within specifications. Replace parts if not within specifications.

**Crankshaft Sleeve Bearing Bore Specifications:**

**Oil Pan & Crankcase Main Bearing Bore ID**
**. . . . . 44.965—45.003 mm (1.7703—1.7718 in.)**
**Main Bearing Bore-to-Crankshaft Clearance**
**. . . . . 0.03—0.09 mm (0.0012—0.0035 in.)**

## CRANKSHAFT ALIGNMENT

**Procedure:**




In alignment jig:

- Rotate crankshaft slowly. Dial indicators (A) measure maximum Total Indicated Runout (TIR).

In engine:

- Rotate crankshaft slowly. Measure TIR at oil pan end of crankshaft using dial indicator.

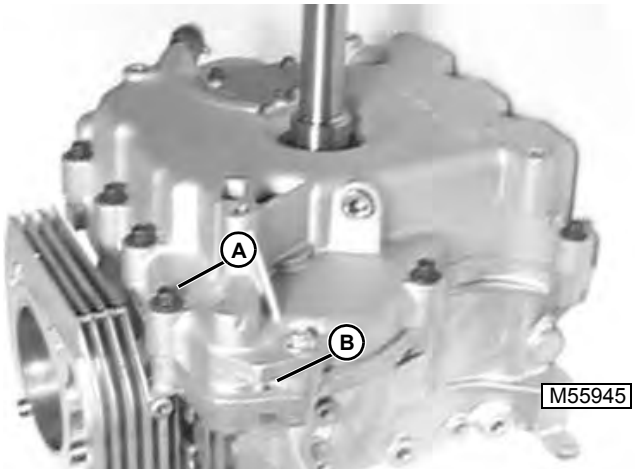
Replace crankshaft if not within specification.

**Specifications:**

**Crankshaft Maximum TIR**
**In Alignment Jig . . . . . 0.10 mm (0.0039 in.)**
**In Engine . . . . . 0.15 mm (0.0059 in.)**

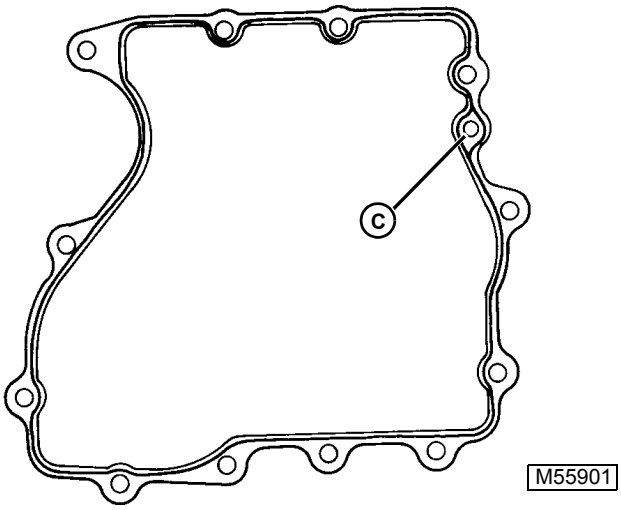
## OIL PAN REMOVAL/INSTALLATION

**Procedure:**




*NOTE: Do not pry on gasket surface when removing oil pan from crankcase.*

1. Remove cap screws (A).
2. Pry oil pan from crankcase using flat blade screwdriver on splitting tabs (B).
3. Clean mating surfaces of crankcase and oil pan.
4. Replace crankshaft seals. See “OIL PAN SEAL REMOVAL/INSTALLATION”, and “CRANKCASE OIL SEAL REMOVAL/INSTALLATION”.

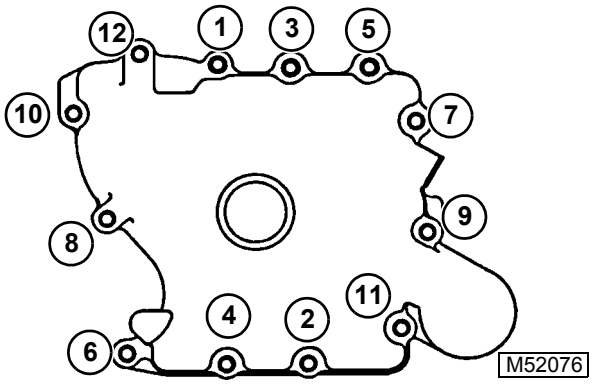



**IMPORTANT: DO NOT get sealant in oil passage (C). Apply just enough to seal both sides of oil passage when case halves are fastened together.**

5. Apply 1.6 mm (1/16 in.) bead of RTV silicone sealant to oil pan flange. DO NOT block oil passage (C).
6. Apply grease to inside lip of crankshaft main bearing seal.
7. Install oil pan over crankshaft carefully to avoid damaging main bearing seal.

**IMPORTANT: Be sure to align flats of balancer shaft and oil pump inner rotor when installing oil pan.**

8. Install oil pan onto crankcase.



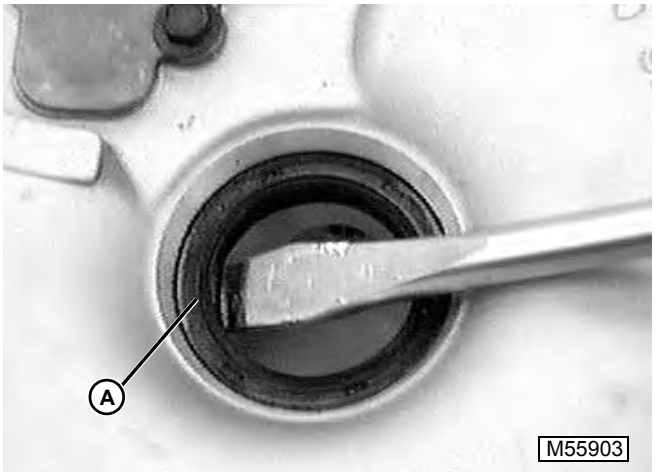

9. In sequence shown, tighten oil pan cap screws to specification.

**Specification:**

**Oil Pan Cap Screws . . . . . 24 N•m (216 lb-in.)**

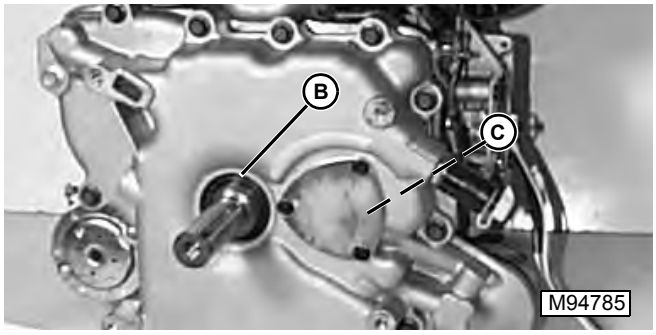
## OIL PAN SEAL REMOVAL/ INSTALLATION

**Procedure:**




**IMPORTANT: DO NOT damage pan bore when removing seal.**

1. Remove and discard seal (A).
2. When replacing crankshaft seals, apply a thin film of LOCTITE® or equivalent to the OD of seal.




3. Using a suitable driver and disc (B), install new oil seal to specification.

**Specification:**

**Oil Pan Seal Depth**

**. . . . . 2.49—2.98 mm (0.098—0.117 in.)**

**or until its top surface is flush with machined bore opening.**

4. Apply grease to inside lip of seal to aid installation.

**IMPORTANT: Be sure to align flats (C) of balancer shaft and oil pump inner rotor when installing oil pan. Prepare and install oil pan. See "OIL PAN SEAL REMOVAL/INSTALLATION", Steps 3–9.**

## CRANKCASE OIL SEAL REMOVAL/ INSTALLATION

**Procedure:**

**IMPORTANT: DO NOT damage crankcase bore when removing seal.**

1. Remove and discard crankcase oil seal (A).
2. When replacing crankshaft seals, apply a thin film of LOCTITE® 598 or equivalent to the OD of seal.
3. Using a suitable driver and disc, install new oil seal to specification.

**Specification:**

**Crankcase Seal Depth . . . . . 4.0 mm (0.157 in.)**

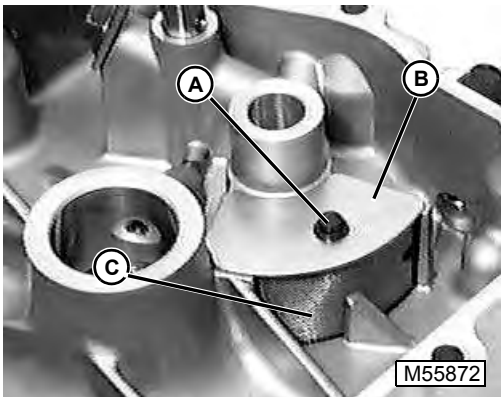
**or until its top surface is flush with machined bore opening.**

**IMPORTANT: Coat inside seal lip with grease to aid installation. Install crankshaft carefully to avoid damaging seal.**

4. Carefully install crankshaft seal.

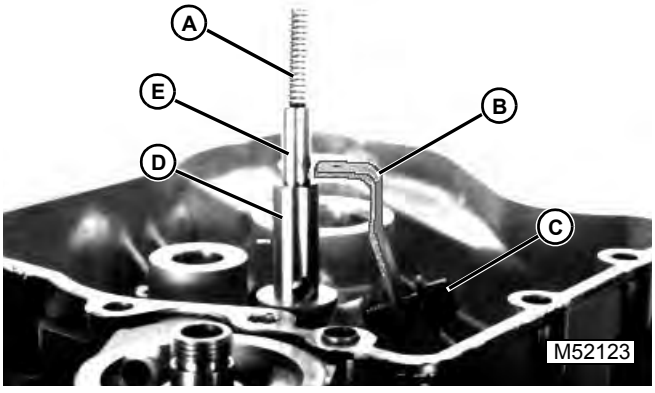
## OIL PICKUP INSPECTION

**Procedure:**




1. Remove cap screw (A) and plate (B) to remove pickup screen (C).
2. Clean screen with approved solvent. Replace if damaged.
3. Install screen, plate, and cap screw.
4. Install oil pan.

## OIL PUMP RELIEF VALVE INSPECTION



1. Loosen cap screw (C) and retainer (B) to gain access to individual components.
2. Remove and measure spring (A), replace if not to specification.

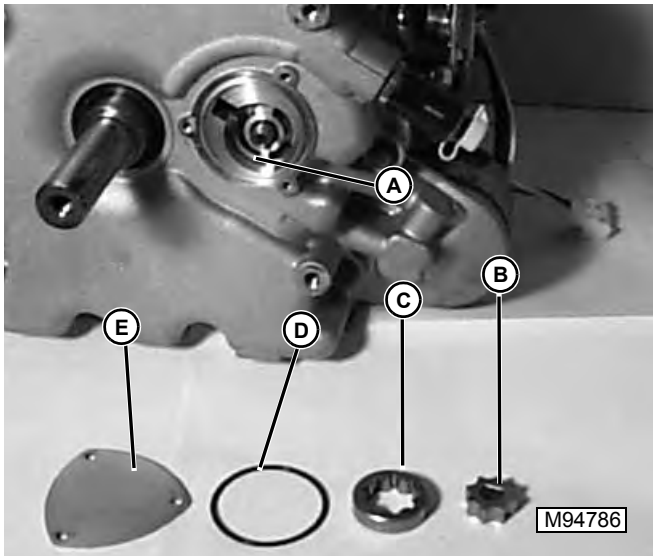
**Specifications:**

**Relief Valve Spring Free Length . . . . . 25.1968 mm (0.992 in.)**

3. Inspect spring, piston (E), and body (D). Replace parts that are damaged or worn.
4. Install components with retainer and cap screw.
5. Install oil pan.

## OIL PUMP INSTALLATION

**Procedure:**




1. Remove cover (E), O-ring (D), pump outer rotor (C), and pump inner rotor (B).
2. Inspect rotor, pump, and inside surface of cavity (A) for scoring, discoloration, and wear.
3. Replace parts as necessary.
4. Lubricate parts (A, B, and C) with engine oil. Install in cavity.
5. Install O-ring and cover. Tighten cap screws to specification.

**Oil Pump Cover Cap Screw Torque Specifications:**

**New Oil Pan (Thread Forming) . . 6.0 N•m (55 lb-in.)**
**Used Oil Pan (Threads Cut). . . . . 4.0 N•m (35 lb-in.)**
**Oil Pump Cover-to-Rotor Clearance:. . . . . 0.076 mm (0.003 in.)**

## CYLINDER BLOCK REMOVAL/ INSTALLATION

**Procedure:**

All components must be removed from block before inspection or machine work can be performed.

## CYLINDER BLOCK INSPECTION

**Procedure:**

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

5. Measure cylinder bore inside diameter at six places; two measurements 90° apart at top, middle, and bottom of ring travel.
6. Measure piston outside diameter perpendicular to piston pin bore.

*NOTE: Pistons and rings are available 0.25 and 0.50 mm (0.010 and 0.020 in.) oversize.*

Replace block or bore cylinder to accept larger piston if clearance exceeds specification.

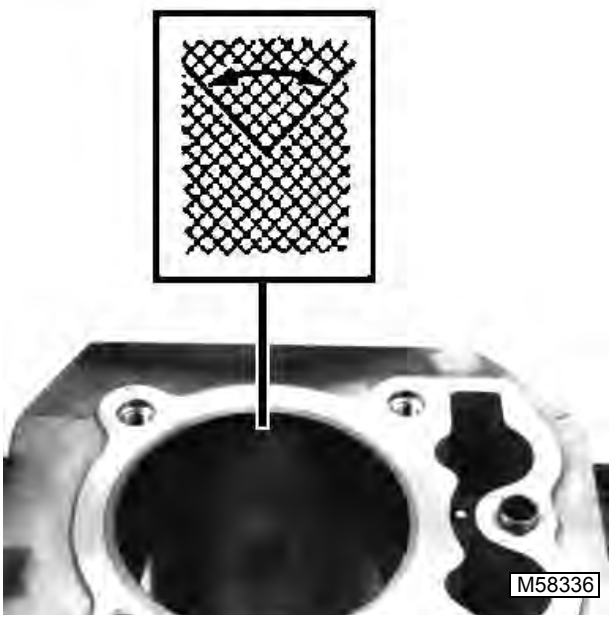
**Specifications:**

**Cylinder Bore:**
**13 hp**
**New . . . . 87.000—87.025 mm (3.4252—3.4262 in.)**
**Maximum. . . . . 87.063 mm (3.4277 in.)**
**15 hp**
**New . . . . 90.000—90.025 mm (3.5433—3.5443 in.)**
**Maximum. . . . . 90.063 mm (3.5681 in.)**
**Out-of-Round (maximum) . . . . 0.12 mm (0.0047 in.)**
**Taper (maximum) . . . . . 0.05 mm (0.0020 in.)**
**Piston-to-Cylinder Clearance**
**13 hp . . . . . 0.041—0.044 mm (0.0016—0.0017 in.)**
**15 hp . . . . . 0.031—0.043 mm (0.0012—0.0016 in.)**

## CYLINDER BORE DEGLAZING

**IMPORTANT: Remove crankshaft and internal engine components when deglazing cylinder. Abrasives can cause engine damage.**

1. Use the appropriate size flex-hone to deglaze cylinder bore.

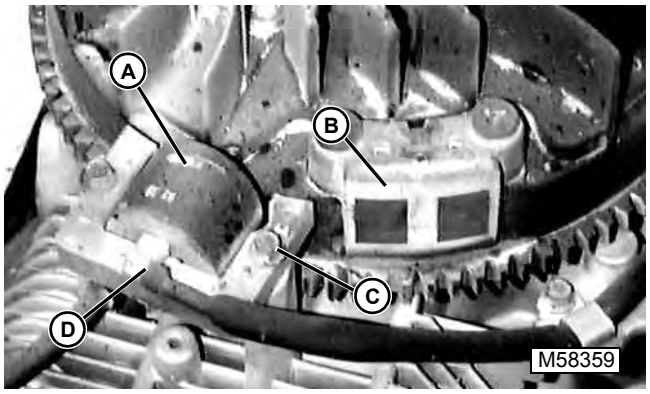



2. Deglaze cylinder bore using flex-hone to obtain **23—33°** crosshatch pattern.
3. Clean abrasive residue from cylinder using warm soapy water until clean white rags show no discoloration.
4. Dry cylinder and apply engine oil.

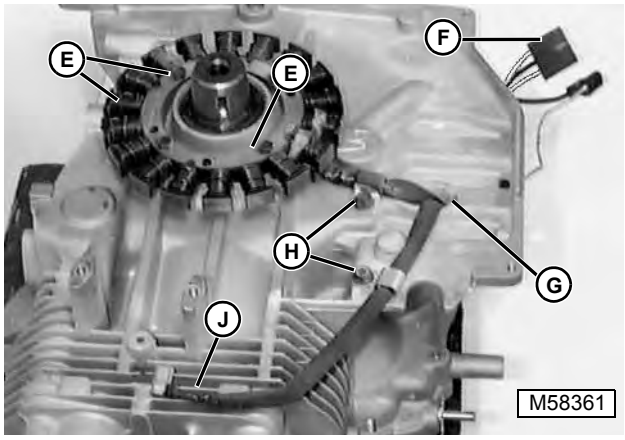
**Specification:**

**Deglaze Crosshatch Pattern . . . . . 23—33°**

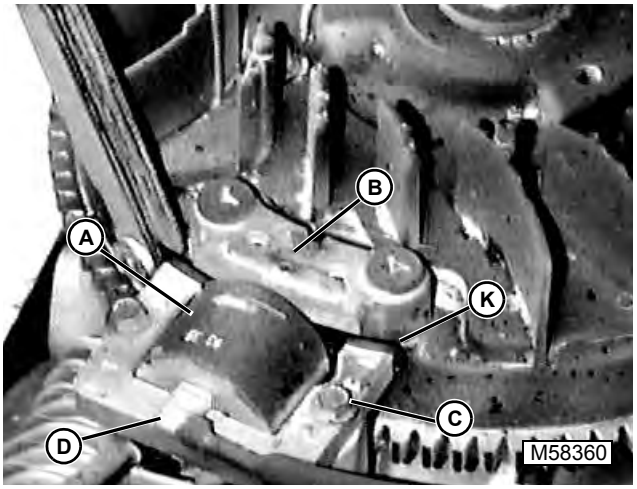
## STATOR & IGNITION MODULE REMOVAL/INSTALLATION




1. Turn flywheel magnet (B) away from ignition module (A).
2. Disconnect wire (D) from terminal.
3. Remove cap screws (C) and ignition module.
4. Remove flywheel.




5. Remove two white stator wires from connector (F).
6. Remove clamps (H).
7. Remove cap screws and stator (E).
8. Inspect for damage.
9. Thread stator wires through hole in (G) crankcase and install in connector (F). Fasten clamps (H).
10. Install stator. Tighten cap screws to specification.
11. Install flywheel and tighten cap screw to specification.
12. Rotate magnet away from module mount. Install module loosely.




13. Align flywheel magnet (B) with mounting posts for ignition module.
14. Place **0.25 mm (0.01 in.)** feeler gauge blade (K) or shim stock across magnet face.

**IMPORTANT: Ensure flywheel magnet (B) is centered on ignition module (A) so all three poles of the ignition module are properly gapped from the flywheel magnet.**

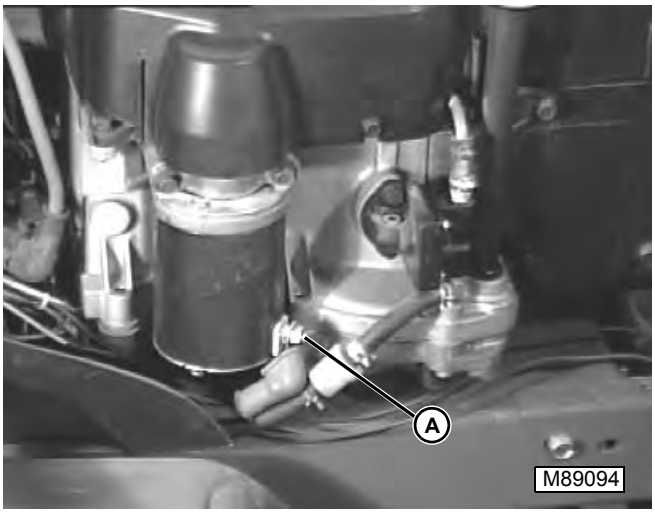
15. Position ignition module (A) so all three poles mate with the feeler gauge blade (K) and its two mounting holes align with mounting posts.
16. Install and tighten cap screws to specification.
17. Remove feeler gauge and connect wire (D) to terminal.

**Specifications:**

**Ignition module air gap . . . . . 0.25 mm (0.01 in.)**
**Module cap screws . . . 5.1 ± 1.1 N•m (45 ± 10 lb-in.)**
**Stator cap screws . . . . . 4 N•m (35 lb-in.)**
**Flywheel cap screw . . . . . 68 N•m (50 lb-ft)**

## STARTING MOTOR REMOVAL/ INSTALLATION

1. Disconnect battery negative terminal (–).

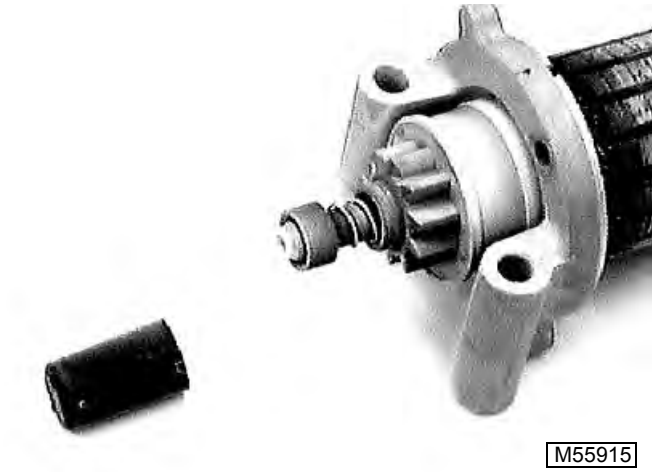



2. Disconnect battery terminal (A) from starting motor.
3. Remove bolts securing starting motor to engine.

**Installation:**

4. Position starting motor on engine and install starting motor retaining bolts. Tighten bolts to **24 N·m (18 lb-ft)**.
5. Connect battery cable to starting motor and reconnect battery negative cable.

## STARTING MOTOR DRIVE REPLACEMENT




1. Remove starting motor. Remove dust cover.
2. Compress retainer and remove stop clip.
3. Disassemble bendix drive.

4. Replace with new bendix drive kit.

## STARTING MOTOR BRUSH REPLACEMENT & ARMATURE TEST

**IMPORTANT: Starting motor armature should be tested anytime the starting motor is disassembled.**

1. Mark or scribe top and bottom end caps to frame for reassembly.
2. Remove long cap screws and separate top end cap and armature from frame and bottom end cap (brush holder).

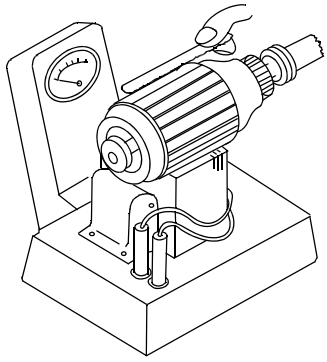
3. Clean contact points of negative brushes. Using an ohmmeter, check for continuity between brushes and end cap. Replace brushes if no continuity is indicated.

4. Clean stud terminal, if threads are stripped replace stud.
5. Replace insulator if cracked.
6. Clean contact points of positive brushes. Using an ohmmeter, check for no continuity between positive brushes and end cap and stud terminal and end cap. Replace brushes if continuity is indicated.

**IMPORTANT: Use mineral spirits only to clean armature windings.**

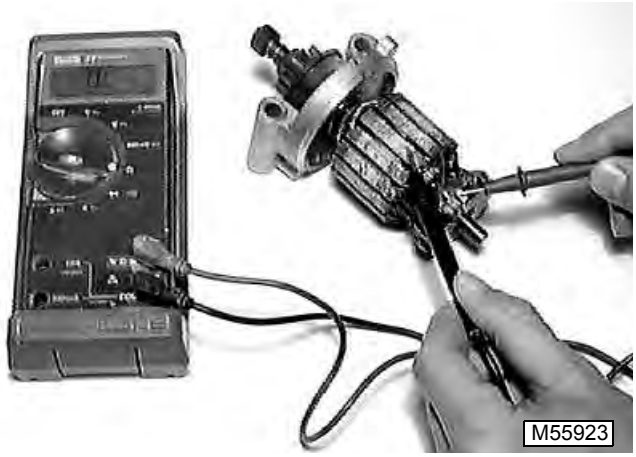
*NOTE: If commutator is grooved or damaged, turn it on a lathe or replace it.*

7. Clean commutator of armature with crocus cloth. DO NOT use emery cloth.

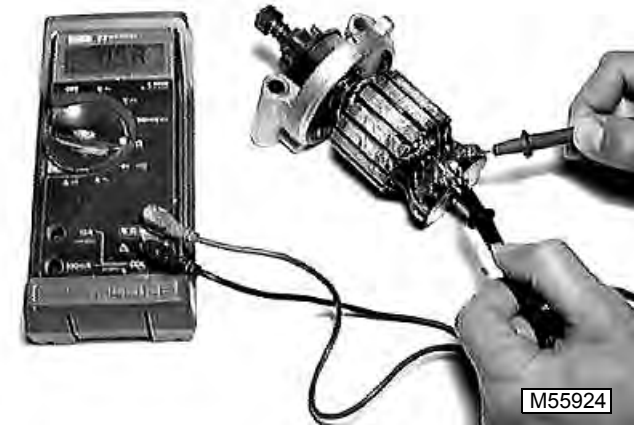


8. Rotate armature on a growler while holding a steel strip (hacksaw blade) on armature. Strip will vibrate in area that is shorted.

*NOTE: Shorts between bars are sometimes caused by dirt or copper between bars. Clean and retest before replacing armature.*




9. Check for grounded windings using an ohmmeter. If any continuity is indicated the winding is grounded and must be replaced.




*NOTE: Armature windings are connected in parallel, each bar must be tested.*

10. Check for open windings with an ohmmeter. If no continuity is indicated, there is an open circuit and armature must be replaced.
11. Match upper case marks and carefully assemble top end cap and armature in frame.

12. Compress brushes into brush holders of bottom end cap using two thin screwdrivers.

13. Match lower case marks and carefully assemble starting motor so brushes rest on commutator. Remove screwdrivers carefully.
14. Install long cap screws and tighten evenly.

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# SPECIFICATIONS

## GENERAL SPECIFICATIONS—LT166

| | |
|---|---|
| Make | Briggs & Stratton |
| Series | Vanguard V-Twin |
| Type | 916928 Gasoline |
| Model | 303777 |
| Horsepower | 11.9 kW (16.0 hp) |
| Displacement | 480 $cm^3$ (29.3 cu in.) |
| Cylinders | 2 |
| Stroke/Cycle | 4 |
| Valves | Overhead Valves |
| Bore | 68 mm (2.68 in.) |
| Stroke | 66 mm (2.60 in.) |
| Lubrication | Pressurized 0 – 344 kPa (10 – 50 psi) |
| Oil Filter | Full Flow Filter (w/o By-Pass Valve) |
| Crankcase Capacity (With Filter) | 1.5 L (1.6 U.S. qt) |
| Without Filter | 1.4 L (1.5 U.S. qt) |
| Cooling System | Air Cooled |
| Air Cleaner | Paper with outer foam element |
| Muffler | Horizontal discharge below frame |
| Aspiration | Normal |
| Fuel Filter | Replaceable (In-Line Type) |

## TESTS & ADJUSTMENTS SPECIFICATIONS

| | |
|---|---|
| Valve Clearance | 0.10 – 0.16 mm (0.004 – 0.006 in.) |
| Valve Guide Depth | 0.7 mm (0.281 in.) |
| Slow Idle | 1750 ± 100 rpm |
| Fast Idle | 3350 ± 50 rpm |
| Oil Pump Operating Pressure | 10 – 50 psi |

## REPAIR SPECIFICATIONS

| | |
|---|---|
| Spark Plug Gap | 1.0 mm (0.040 in.) |

**Valves:**

| | |
|---|---|
| Valve Guide Standard Dimension | 6.01 – 6.02 mm (0.236 – 0.237 in.) |
| Wear Limit | 6.05 mm (0.238 in.) |
| Valve Stem Standard Dimension | |
| Intake | 5.94 – 5.96 mm (0.234 – 0.235 in.) |
| Exhaust | 5.94 – 5.95 mm (0.234 – 0.235 in.) |
| Valve stem Wear Limit | |
| Intake | 5.92mm (0.233 in.) |
| Exhaust | 5.91mm (2.328 in.) |
| Valve Seat Width | 1.2 – 1.6 mm (0.047 – 0.062 in.) |
| Valve Margin (minimum) | 0.4 mm (0.016 in.) |
| Valve Face Angle | 45° |
| Valve Seat Narrowing Angle | 30° |

**Cylinder Bore, Pistons and Rings:**

| | |
|---|---|
| Cylinder Bore Standard Dimension | 68 – 68.025 mm (2.677 – 2.678 in.) |

Wear Limit . . . . . 68.065 mm (2.6795 in.)
Piston Pin Standard Dimension . . . . . 17.07 – 17.08 mm (0.672 – 0.673 in.)
Wear Limit . . . . . 17.06 mm (0.672 in.)
Piston Pin Bore Standard Dimension . . . . . 17.09 – 17.1 mm (0.673 – 0.674 in.)
Wear Limit . . . . . 17.12 mm (0.674 in.)
Ring End Gap Standard Dimension . . . . . 0.20 – 0.40 mm (0.008 – 0.016 in.)
Wear Limit . . . . . 0.76 mm (0.030 in.)
Compression Ring Groove Wear Limit (New Ring Installed). . . . . 0.10 mm (0.004 in.)
Oil Ring Groove Clearance Wear Limit (New Ring Installed) . . . . . 0.20 mm (0.008 in.)

**Connecting Rod and Crankshaft:**

Connecting Rod Crankpin Standard Dimension . 37.06 – 37.08 mm (1.459 – 1.460 in.)
Wear Limit . . . . . 37.12 mm (1.461 in.)
Connecting Rod Piston Pin Bearing Std. Dimension 17.09 – 17.1 mm (0.672 – 0.673 in.)
Wear Limit . . . . . 17.12 mm (0.674 in.)
Crankshaft PTO Journal Standard Dimension . . . 34.96 – 34.97 mm (1.376 – 1.377 in.)
Wear Limit . . . . . 34.92 mm (1.375 in.)
Crankshaft Magneto Journal Standard Dimension 29.98 – 30.00 mm (1.180 – 1.181 in.)
Wear Limit . . . . . 29.94 mm (1.179 in.)
Magneto Bearing Standard Dimension . . . . . 30.10 – 30.12 mm (1.185 – 1.186 in.)
Wear Limit . . . . . 30.08 mm (1.184 in.)
PTO Bearing Standard Dimension . . . . . 35.04 – 35.05 mm (1.379 – 1.380 in.)
Wear Limit . . . . . 35.07 mm (1.381 in.)
Crankshaft Crankpin Journal Standard Dimension . 37.0 – 37.02 mm (1.456 – 1.457 in.)
Wear Limit . . . . . 36.95 mm (1.455 in.)
Crankshaft End Play . . . . . 0.08 – 0.40 mm (0.003 – 0.015 in.)
Cam Gear PTO Journal Standard Dimension . . . . 19.94 – 19.96 mm (0.785 – 0.786 in.)
Wear Limit . . . . . 19.92 mm (0.784 in.)
Cam Gear Magneto Journal Standard Dimension 15.95 – 15.97 mm (0.628 – 0.629 in.)
Wear Limit . . . . . 15.93 mm (0.627 in.)
Cam Lobe Standard Dimension . . . . . 30.33 – 30.53 mm (1.194 – 1.202 in.)
Wear Limit . . . . . 30.25 mm (1.191 in.)
Cam Bearing (Magneto Side) Standard Dimension 16.0 – 16.025 mm (0.630 – 0.631 in.)
Wear Limit . . . . . 16.08 mm (0.633 in.)
Cam Bearing (PTO Side) Standard Dimension. . . . 20.0 – 20.02 mm (0.787 – 0.788 in.)
Wear Limit . . . . . 20.04 mm (0.789 in.)

## TORQUE SPECIFICATIONS (Alphabetical)

Alternator to Cylinder Block. . . . . 2.2 Nm (20 lb in.)
Air Cleaner Base to Carburetor. . . . . 7 N•m (65 lb-in.)
Connecting Rod Cap Screws . . . . . 13 N•m (115 lb-in.)
Crankcase Cover. . . . . 17 N•m (150 lb-in.)
Cylinder Head Cap Screws. . . . . 19 N•m (165 lb-in.)
Cylinder Shield . . . . . 7 N•m (65 lb-in.)
Exhaust Manifold. . . . . 17 N•m (150 lb-in.)
Flywheel Nut . . . . . 175 N•m (129 lb-ft)
Fuel Shutoff Solenoid . . . . . 5 N•m (45 lb-in.)
Oil Breather Mounting Bolt . . . . . 3 N•m (30 lb-in.)
Oil Filter Adaptor Mounting Bolts . . . . . 7 N•m (65 lb-in.)
Oil Pump Mounting Screws. . . . . 7 N•m (65 lb-in.)
Rocker Arm Adjustment Lock Nut. . . . . 7 N•m (65 lb-in.)
Rocker Arm Studs. . . . . 16 N•m (140 lb-in.)
Spark Plug. . . . . 20 N•m (180 lb-in.)
Valve Cover Nuts. . . . . 3 N•m (25 lb-in.)

# TROUBLESHOOTING

| Problem or Symptom / Check or Solution | Engine will not crank | Engine cranks but will not start | Engine starts hard | Engine won't shutoff | Loss of power | Low compression | Excessive engine noise/vibration | Low oil pressure | Engine running on one cylinder | Engine overheats | Fuel mixture too rich |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Battery has low or no charge/ cables loose or dirty | ● | ● | ● | | | | | | | | |
| Fusible link (F1) open | ● | | | | | | | | | | |
| Starter motor/solenoid defective | ● | | | | | | | | | | |
| Improper switch position (See Electrical Section) | ● | ● | | | | | | | | | |
| Engine seized | ● | | | | | | | | | | |
| Fuel shutoff solenoid defective | | ● | | ● | | | | | | | |
| Fuel filter/lines clogged | | ● | ● | | ● | | | | | | |
| Fuel pump defective | | ● | ● | | ● | | | | | | |
| Ignition coil air gap not adjusted properly | | ● | ● | | ● | | | | ● | | |
| Carburetor not adjusted properly, dirty | | ● | ● | ● | ● | | | | | ● | ● |
| Air cleaner dirty | | ● | ● | | ● | | | | | | ● |
| Old/contaminated fuel | | ● | ● | | ● | | | | | | |
| Spark plugs loose/dirty | | ● | ● | | ● | ● | | | ● | | |
| Magneto kill circuit grounded/ shorted (See Electrical Section) | | ● | | | | | | | ● | | |
| Valve tappets need adjustment | | ● | ● | | ● | ● | | | ● | | |
| Lack of compression, check valves, pistons and rings | | ● | ● | | ● | | | | ● | | |
| Magneto kill circuit open (See Electrical Section) | | | | ● | | | | | | | |
| Mower deck binding or dragging | | | | | ● | | ● | | | ● | |
| Grass build-up under deck | | | | | ● | | ● | | | ● | |

| Problem or Symptom / Check or Solution | Engine will not crank | Engine cranks but will not start | Engine starts hard | Engine won't shutoff | Loss of power | Low compression | Excessive engine noise/vibration | Low oil pressure | Engine running on one cylinder | Engine overheats | Fuel mixture too rich |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No lubrication in gear box or hydro/transaxle | | | | | ● | | ● | | | ● | |
| Excessive drive belt tension | | | | | | | | | | ● | |
| Deck spindles seized | | | | | ● | | ● | | | ● | |
| Loose cylinder head bolts | | | | | | ● | | | ● | | |
| Defective head gasket | | | | | | ● | | | ● | | |
| Burned valves, valve seats, and/or loose valve seats | | ● | ● | | ● | ● | | | ● | | |
| Warped cylinder head | | | ● | | ● | ● | | | ● | | |
| Worn bore and/or rings | | | ● | | ● | ● | ● | | ● | | |
| Broken connecting rod | | | ● | | ● | ● | ● | | ● | | |
| Cutter blade or other rotating part bent or out of balance | | | | | | | ● | | | | |
| Mounting bolts loose | | | | | | | ● | | | | |
| Camshaft worn | | ● | ● | | ● | ● | | | ● | | |
| Internal bearings worn or excessive tolerance | | | | | | | | ● | | | |
| Oil galleries/filter clogged | | | | | | | | ● | | | |
| Oil pump defective | | | | | | | | ● | | | |
| Low oil level or wrong viscosity | | | | | | | | ● | | ● | |
| Exhaust system restricted | | | ● | | ● | | | | | ● | |
| Air/fuel mixture excessively lean | | | | | | | | | | ● | |
| Cylinder cooling fins/blower housing filled with grass clippings | | | | | | | | | | ● | |
| Overchoking | | | | | | | | | | | ● |
| Float needle stuck open | | | | | | | | | | | ● |

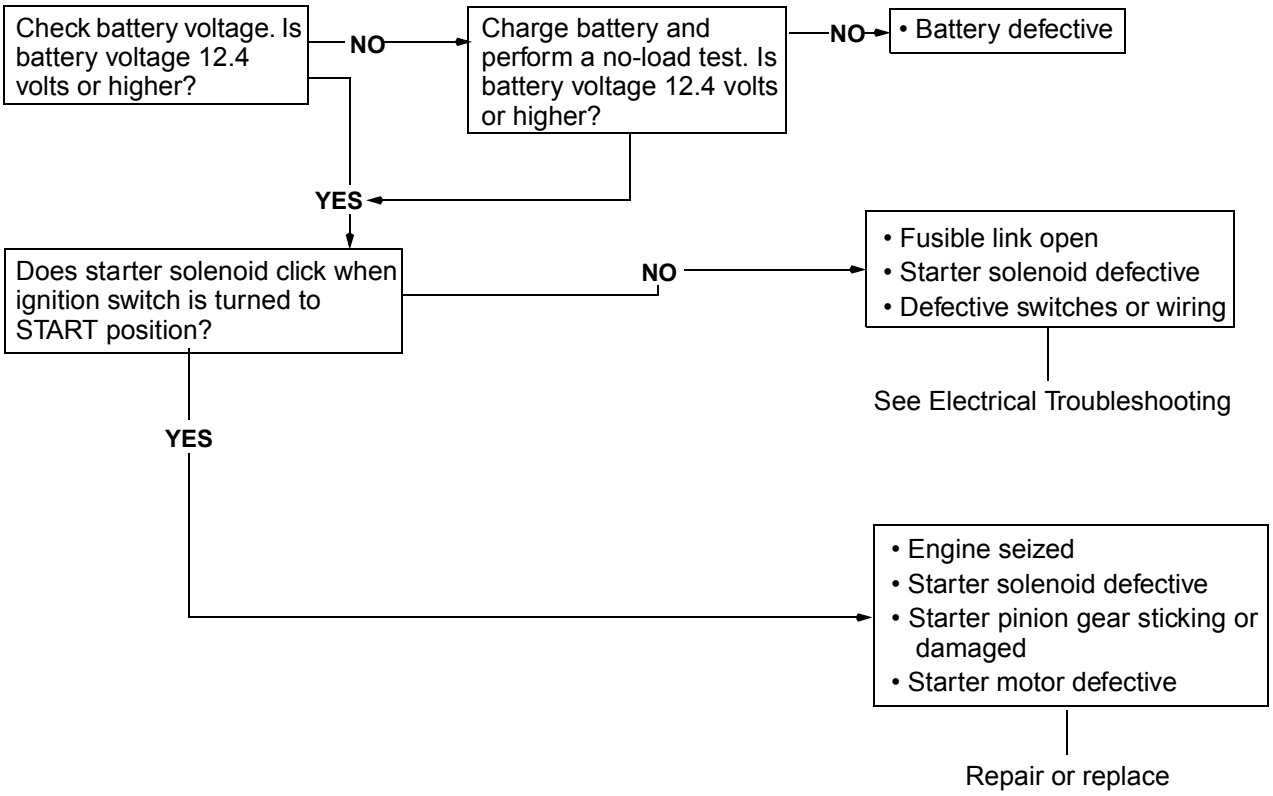
# ENGINE TROUBLESHOOTING

## Engine Will Not Crank

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

**⚠ CAUTION**

**BE AWARE! The engine may start to rotate at any time. Keep hands away from all moving parts when testing.**



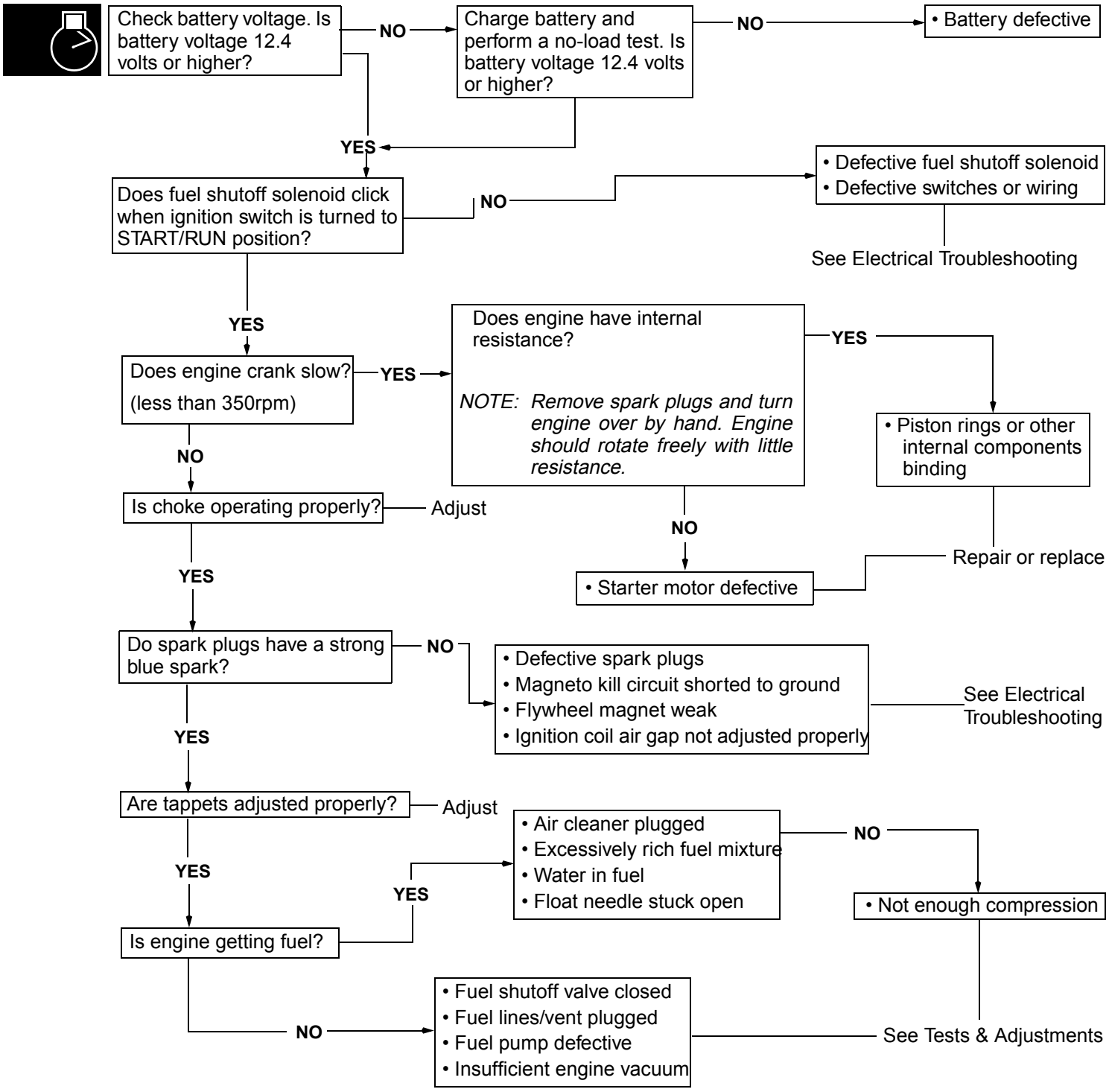
## Engine Cranks But Will Not Start

**⚠ CAUTION**

**DO NOT rotate engine with starter if the spark plugs are removed. Gasoline spray from the open cylinders may be ignited by ignition spark and cause an explosion or fire.**

**IMPORTANT: Perform a visual inspection first to determine if battery cables are tight and not corroded and if the battery is of sufficient size to turn the engine over at minimum cranking speed of 350 rpm.**

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

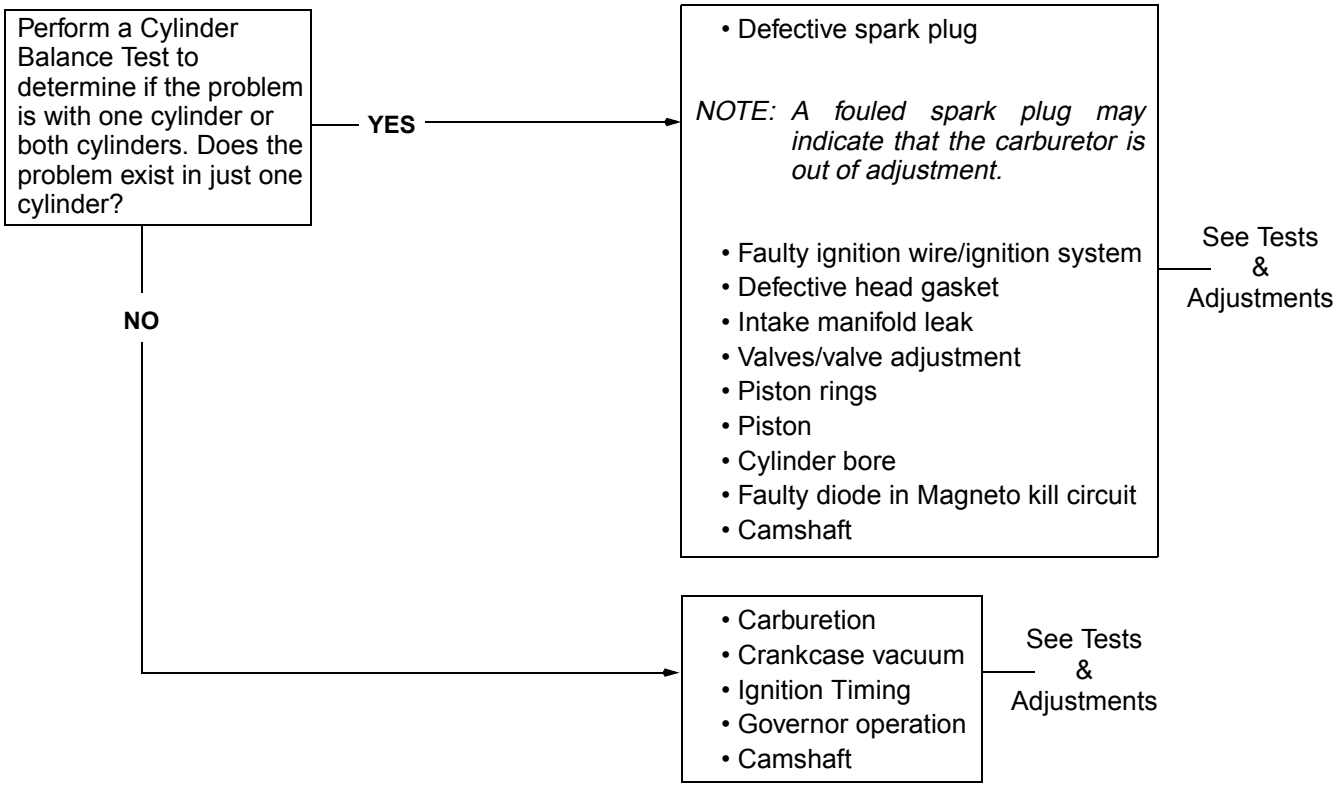


## Engine Runs Erratically/Loss Of Power

**IMPORTANT: Before proceeding, inspect the mower deck and belts for binding in the spindle assemblies or belts that are too tight/loose. A loose belt like a loose blade can cause a backlash effect that will counteract engine cranking effort. Excessive drive belt tension may cause premature bearing wear or result in bearing seizure. Grass clippings that build up near the cutting blades can cause excessive resistance and heat build-up that causes problems with the engine's ability to turn the blades at a constant speed. Low lubricant levels in the spindles will build-up heat causing excessive resistance for the engine to deal with.**

**There is a diode in-line in the magneto kill wire coming from each ignition module. This diode prevents feedback from one module to the other. Without these diodes, one magneto could fire the coil for the other magneto. If a diode fails in one of the magneto kill wires, that coil, could be fired by the other module. The result may be similar to that of an erratic running engine.**
**A twin cylinder engine may run adequately on one cylinder as long as the power required for the application does not exceed the power produced by the one cylinder.**

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



# TESTS & ADJUSTMENTS

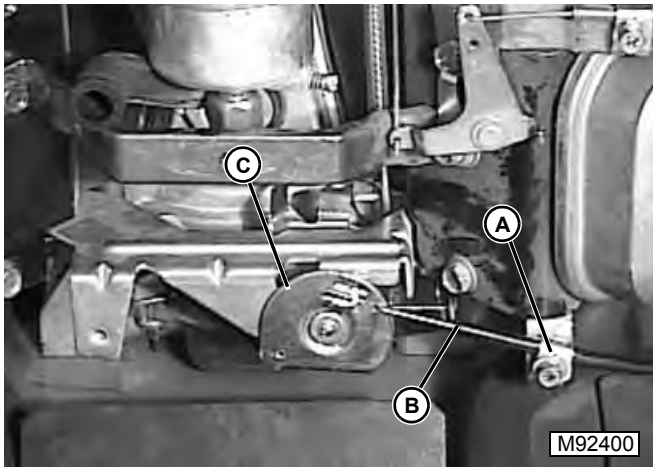
## THROTTLE CABLE ADJUSTMENT

**Reason:**

To make sure the throttle cable moves the throttle through its full range of movement.

**Procedure:**

1. Remove air cleaner assembly, and base.
2. Install nuts on carburetor studs.
3. Move throttle lever to FAST idle position.




4. Loosen throttle cable clamp (A).
5. Move throttle cable (B) until governor control swivel (C) is at end of travel.
6. Tighten throttle cable clamp.

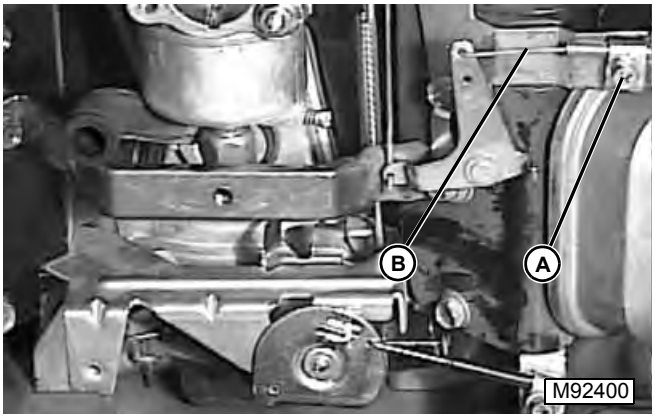
## CHOKE CABLE ADJUSTMENT

**Reason:**

To make sure the choke cable moves the choke through its full range of movement.

**Procedure:**

1. Move choke lever to full choke position.




2. Loosen choke cable clamp (A).
3. Move choke cable (B) until choke is completely closed.
4. Tighten choke cable clamp.

## FUEL SHUTOFF SOLENOID TEST

**Reason:**

To test proper operation of fuel shutoff solenoid.

**Required Tools:**

- Jumper wire

**Procedure:**

1. Remove air cleaner assembly, and base.
2. Install nuts on carburetor studs.
3. Listen for an audible click when ignition switch is turned from OFF to ON.
4. If solenoid does not click, problem could be in equipment wiring.
5. Disconnect wire from solenoid.
6. Momentarily place a jumper wire from solenoid wire to battery positive terminal.
7. If solenoid now clicks, the solenoid is working properly.

*NOTE: If battery voltage drops below 9 volts when cranking engine or while engine is running, the solenoid will not function.*

**Results:**

- Solenoid is operating properly if a click is heard when ignition switched from off to on

# COMPRESSION TEST

**Reason:**

To determine the performance difference between cylinders.

**Required Tools:**

- JDM59 Compression Gauge

*NOTE: Briggs & Stratton does not publish any compression pressures, as it is extremely difficult to obtain an accurate reading without special equipment. Briggs & Stratton recommends to calculate the difference in compression readings between the two cylinders. Two methods are given in the following; one without a cylinder leak tester and one with a cylinder leak tester.*

## WITHOUT CYLINDER LEAK TESTER

**IMPORTANT: The battery must be fully charged for this test.**
**Check and adjust the valves to ensure the valves have not been adjusted too tight. If either valve is off its seat the leak test will be invalid.**

1. The engine should be run for at least five minutes to bring the engine to operating temperature.
2. Remove spark plugs and ground the magnetos by attaching a jumper wire from the magneto kill circuit connector to the engine to prevent a spark that could ignite anything combustible.

3. Insert a compression gauge (A) into either cylinder.
4. Turn engine over with the starter until the highest pressure reading is obtained and record reading.
5. Repeat steps 3 & 4 with the next cylinder and record reading.
6. Use the following example and insert the recorded readings to determine the percent of leakage between cylinders.

**Example:**

cyl #1cyl #2

75 psi55 psi

*Formula:*

55 ÷ 75 = 0.7333 x 100 = 73.333, 100 - 73.333 = 26.7%

**Highest Reading**

**Lowest Reading**

**Results:**

- A difference of more than 25% indicates a loss of compression in the cylinder with the lowest reading.

## WITH CYLINDER LEAK TESTER

**Required Tools:**

- JTO3502 Cylinder Leak Tester
- Breaker Bar & 30 mm Socket

*NOTE: If the directions that come with the tester being used are different than the following, use the directions that came with the tester.*

**IMPORTANT: Check and adjust the valves to ensure the valves have not been adjusted too tight. If either valve is off its seat the leak test will be invalid.**

1. The engine should be run for at least five minutes to bring the engine to operating temperature.

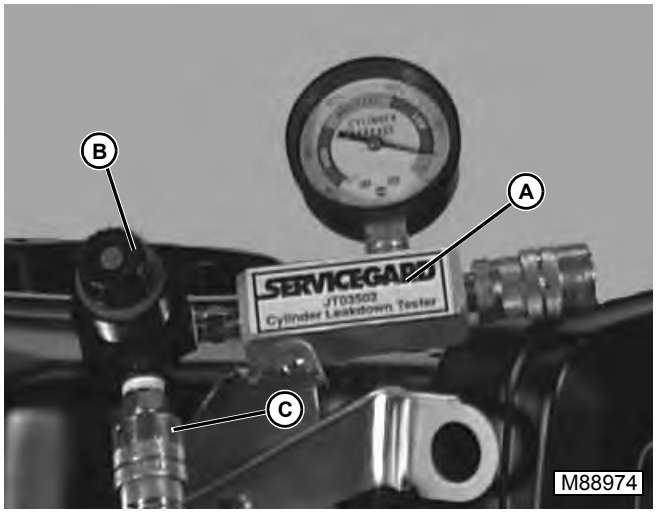
**⚠ CAUTION**

**With spark plugs removed, the magnetos must be grounded to the engine to prevent a spark that could ignite anything combustible.**

2. Remove spark plugs and ground the magnetos by attaching a jumper wire from the magneto kill circuit connector to the engine to prevent a spark that could ignite anything combustible.

**IMPORTANT: The piston must be positioned at Top Dead Center (TDC) to ensure that the intake valves are away from the compression relief balls. If not, the intake valve will be open and the leak test will be invalid.**

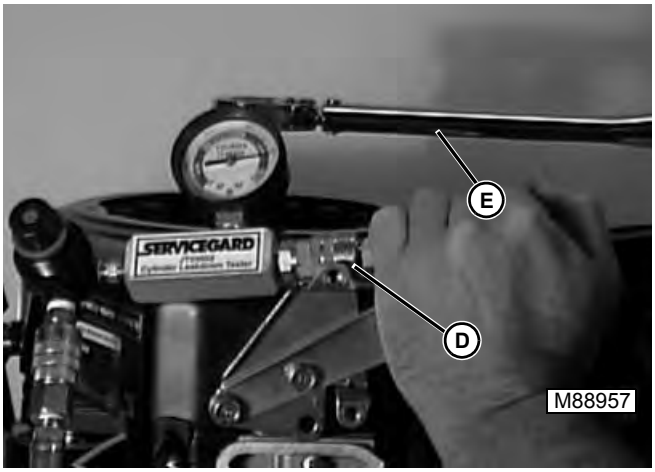
3. Remove valve covers.
4. Remove the rotating screen.
5. Turn crankshaft until piston is at Top Dead Center (TDC), on the compression stroke (Both Valves Closed).
6. Screw the adaptor into the spark plug hole but do not attach it to the tester (A) at this time.




7. Pull back the locking ring and rotate the regulator (B) knob fully counterclockwise. Connect an air line (C) to the tester.

**IMPORTANT: The air supply must have enough supply pressure to calibrate the tester (Usually 85—95 psi).**

8. Pull back the locking ring and rotate the regulator knob clockwise until the gauge needle rests in the SET range of the gauge. Push the locking ring towards the tester to lock it.




9. Connect the adaptor hose (D) to the tester and record the needle position while holding the flywheel in position with a breaker bar (E).

*NOTE: A small amount of air escaping from the crankcase breather is normal.*

**Results:**

- Excessive air escaping from the crankcase breather indicates worn piston rings or cylinder wall
- Air escaping from the carburetor indicates a worn intake valve or seat
- Air escaping from the exhaust pipe indicates a worn exhaust valve or seat
- Gauge reading in the Green (low) area indicates good compression. (Less Than 25% Is Considered Normal)
- Gauge reading in the Yellow (Moderate) area indicates borderline compression. The engine is still usable but an overhaul or replacement should be considered
- Gauge reading in the Red (High) area indicates excessive compression loss and engine reconditioning or replacement is necessary

# GOVERNOR ADJUSTMENT

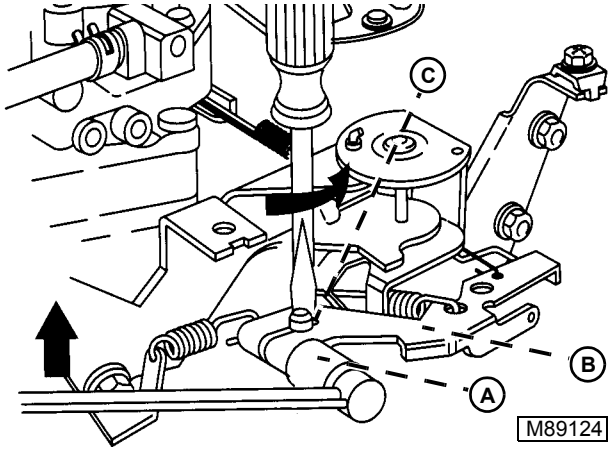
**CAUTION**

**Before starting or running engine, static adjustment of the governor must be made. Failure to make static adjustments first, could result in engine overspeeding, and may result in engine or equipment damage causing personal injury and/or property damage.**

**STATIC ADJUSTMENT (Engine OFF)**

*NOTE: All linkage must be installed to make adjustment.*

**Procedure:**




1. Remove:
   - Hood
   - Top muffler shield
   - Air cleaner assembly
2. Loosen governor lever bolt (A) and nut.
3. Push on governor lever (B) until throttle is wide open.

**IMPORTANT: Do not bend governor link or distort governor lever.**

4. Hold lever in this position and rotate governor shaft (C) counterclockwise as far as it will go. Hold lever and shaft in position and tighten governor lever bolt and nut to **8 N•m (70 lb-in.)**.

**Specification:**

**Lock nut . . . . . 8 N•m (70 lb-in.)**

# SLOW IDLE CARBURETOR ADJUSTMENT

**Reason:**

To set the carburetor mixture screws for proper operation of the carburetor for slow idle.

**Equipment:**

- JT07270 Pulse Tachometer

**IMPORTANT: In order to obtain correct operation of the carburetor, the adjustment procedure must be performed in the sequence shown.**

**INITIAL ADJUSTMENT**

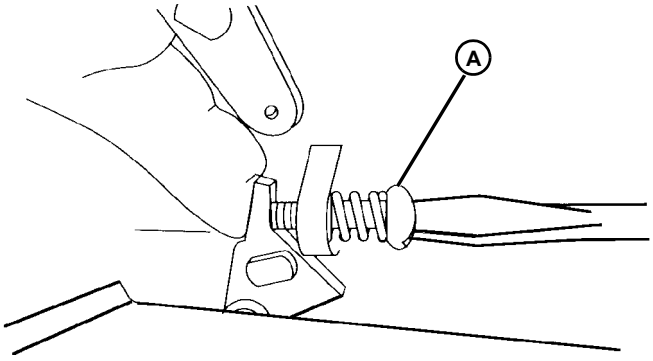
**Procedure:**

1. Remove air cleaner assembly, and base.
2. Install nuts on carburetor studs.
3. Remove limiter cap.
4. Turn idle mixture screw clockwise until it just seats. DO NOT FORCE.
5. Turn screw 1 ¼ turns counter-clockwise. This setting will allow the engine to start.

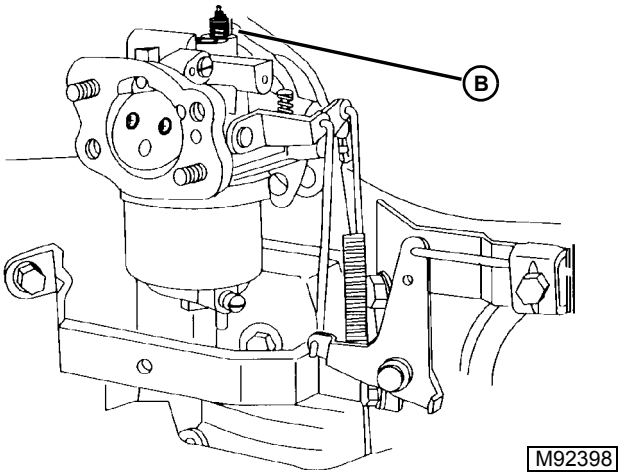
**FINAL ADJUSTMENT**

*NOTE: All carburetor adjustments with engine running must be made with the air cleaner installed.*

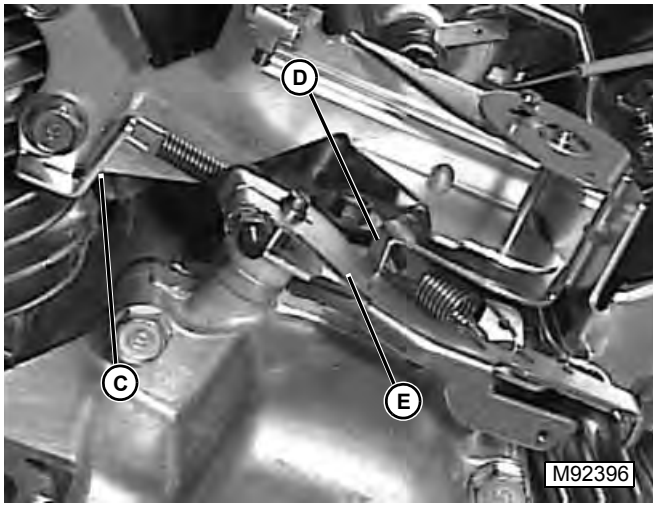
6. Install air cleaner base and air cleaner.
7. Start and run engine for five minutes to allow engine to reach operating temperature.
8. Move throttle lever to SLOW idle position.




9. Install pulse tachometer
10. Hold throttle lever against idle speed screw (A) and temporarily adjust idle speed to 1400 rpm.




11. Turn idle mixture screw slowly clockwise until engine speed just starts to slow (Lean Mixture).
12. Turn idle mixture screw (B) slowly counter-clockwise until engine speed just starts to slow (Rich Mixture).
13. Turn screw to the midpoint between rich and lean settings.
14. Hold throttle lever against idle speed adjustment screw and readjust idle speed to **1200 rpm**.
15. Release throttle lever and note rpm.




16. If necessary bend idle tang (C) to obtain **1750 rpm**.
17. Position limiter cap so that stops on limiter cap are at midpoint between stops on carburetor.
18. With throttle lever in the SLOW position and engine running at governed idle rpm, bend throttle restrictor tang (D) so that it just contacts governor lever (E).
19. Move throttle lever to FAST position.
20. Engine should accelerate smoothly. If necessary, readjust idle mixture screw 1/8 turn counter-clockwise (Richer Mixture).

# FAST IDLE ADJUSTMENT

**Reason:**

To set the carburetor mixture screws for proper operation of the carburetor for fast idle.

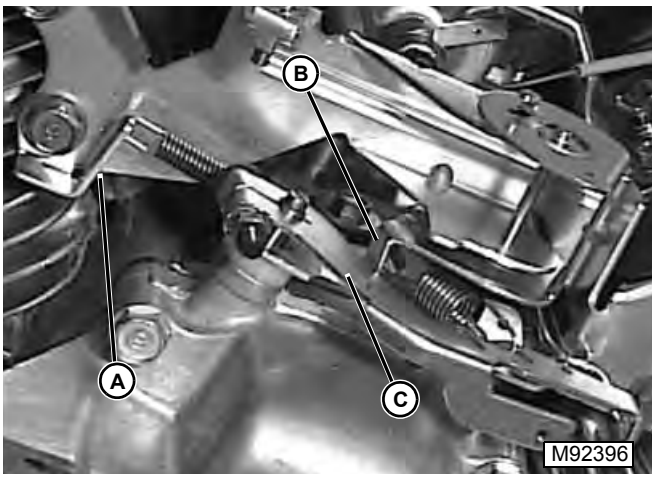
**Equipment:**

- JT07270 Pulse Tachometer

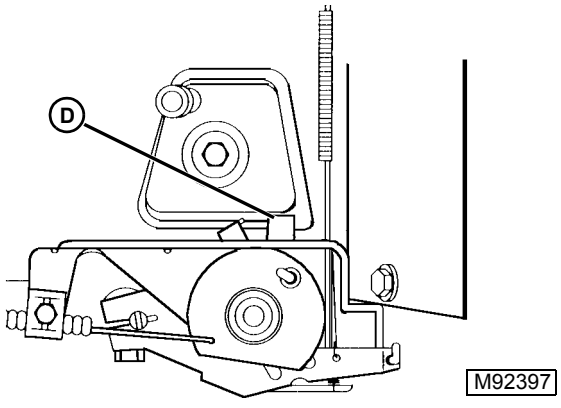
*NOTE: Carburetor mixture adjustments must be made before adjusting governed idle, throttle restrictor and top no load rpm adjustments.*

**Procedure:**

1. Move throttle lever to SLOW idle position.




2. Bend governor idle tang (A) to obtain a slow idle of **1750 rpm**.
3. With throttle lever in SLOW idle position and engine running at governed idle, bend throttle restrictor tang (B) so that it just contacts the governor lever (C).

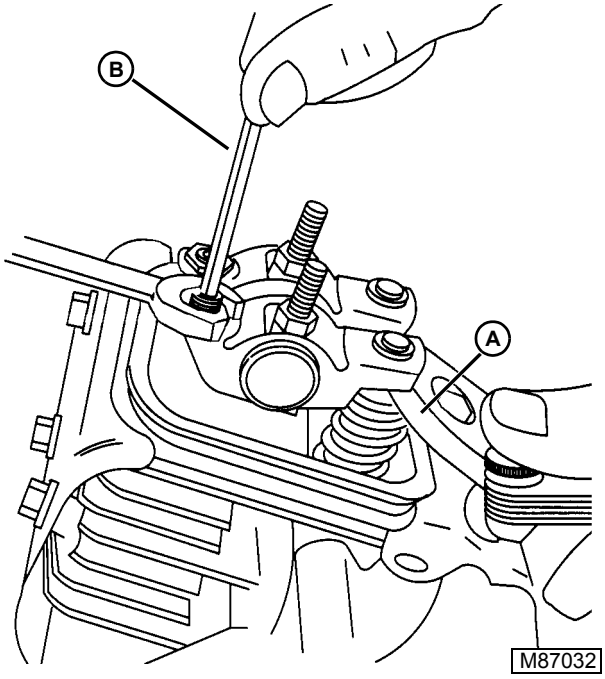



4. Move throttle lever to FAST idle position and bend fast idle tang (D) to obtain top no load engine speed of **3350 rpm**.

## VALVE CLEARANCE ADJUSTMENT

*NOTE: Correct position of crankshaft is necessary to eliminate interference by the compression release mechanism on the cam gear when adjusting valve clearance.*

1. Remove valve cover.
2. Turn crankshaft until piston is at Top Dead Center, (TDC) on the compression stroke (Both Valves Closed).
3. Insert a screwdriver through the spark plug opening until it touches the top of the piston.
4. Continue to turn the crankshaft clockwise until the piston has moved down **6.35 mm (0.25 in.)**.




5. Check valve clearance with a feeler gauge (A) between valve stem and rocker arm. Valve clearance should be **0.10—0.16 mm (0.004—0.006 in.)**.
6. If not, adjust as necessary using a 13 mm open end wrench and a 5 mm hex wrench (B). Tighten lock nut to **7 N•m (60 lb-in.)**.
7. Recheck clearance and make adjustments if necessary.
8. Install valve cover.

**Specifications:**

**Lock nut . . . . . 7 N•m (60 lb-in.)**
**Valve Clearance . . 0.10—0.16 mm (0.004—0.006 in.)**

## CYLINDER BALANCE TEST

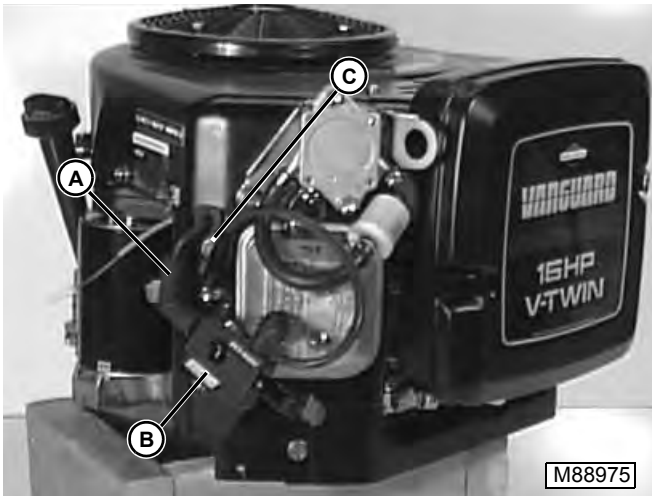
**Reason:**

If engine is hard starting, runs rough, misses or lacks power, perform a cylinder balance test. To determine if both cylinders are operating to their full potential.

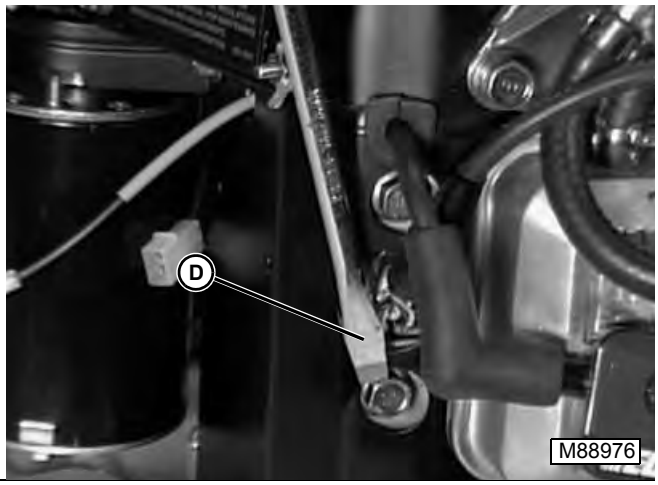
**Equipment:**

- D053515T Spark tester
- JT07270 Engine tachometer
- Screw driver with insulated handle

**Procedure:**




1. Disconnect spark plug high tension lead (A).
2. Connect spark tester (B) to spark plug (C) and high tension lead.
3. Start engine and note spark at tester. Shut engine off.
4. Repeat steps 1—3 for second cylinder.
5. Connect engine tachometer.
6. Start engine and run at top no load speed. Note rpm on tachometer.



7. Ground out one cylinder with screw driver (D). Note rpm on tachometer.
8. Remove screw drive and allow engine to recover.
9. Ground second cylinder with screw driver. Note rpm on tachometer.

**Results:**

- If the difference between the two cylinders is less than 75 rpm, the cylinders should be considered equal
- If the difference between the two cylinders is greater than 75 rpm, this indicates that the cylinder with the least rpm loss is weakest, and should be considered as the possible problem

## ENGINE OIL PRESSURE TEST

**Reason:**

To verify that the engine has enough oil pressure to lubricate the internal engine components.

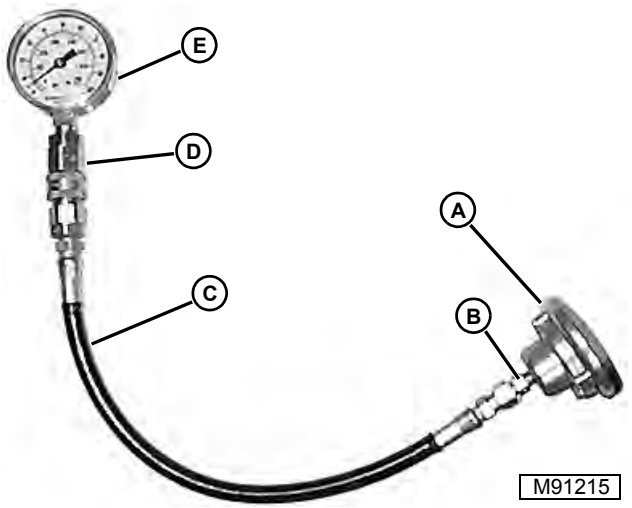
**Equipment:**

- JT07262 Oil Pressure Test Adapter w/ O-ring (required ONLY on engines without test ports)
- JT05847 Connector
- JT03017 Hose Assembly
- JT03262 Coupler
- JT07034 Gauge, 0 – 700 kPa (0 – 100 psi)

*NOTE: The connector, hose assembly, coupler, and gauge are found in other SERVICEGARD™ test kits. The connector pipe thread (NPT) also matches the oil pressure switch port on early Kohler engines.*

**Test Procedure At Oil Filter Base:**

1. Perform test procedure with engine level.
2. Stop engine.
3. Disconnect spark plug wire and allow engine to cool.
4. Drain engine oil from oil filter.
5. Remove oil filter and wipe filter base clean.
6. Install pre-assembled adapter (A), connector (B), hose assembly (C), coupler (D), and gauge (E) on to oil filter base. ONLY hand-tighten adapter to oil filter base.
7. Check crankcase oil level and adjust to full mark.




8. Monitor oil pressure during cranking, if oil pressure is **below 28 kPa (4 psi)—STOP engine immediately** and correct cause before continuing.
9. Connect spark plug wire.
10. Warm-up engine by running at MEDIUM idle for five minutes.

**⚠ CAUTION**

**Engine components are HOT. DO NOT touch with bare skin. Wear protective eye glasses and clothing.**

11. Record oil pressure readings at SLOW and FAST idle.
12. Stop engine and allow to cool.
13. Remove adapter, connector, hose assembly, coupler, and gauge.
14. Install new oil filter.
15. Run engine for 30 seconds and stop engine.
16. Check crankcase oil level and adjust to full mark.

**Results:**

- If oil pressure readings are not within **69 kPa (10.0 psi) – 517 kPa (75.0 psi**) at FAST idle, inspect and/or replace the following:

–Oil pump assembly. See “OIL PUMP DISASSEMBLY AND INSPECTION”.

–Oil suction screen.

–Oil passages

–Bearing wear

–Oil Seals

# FUEL AND AIR REPAIR

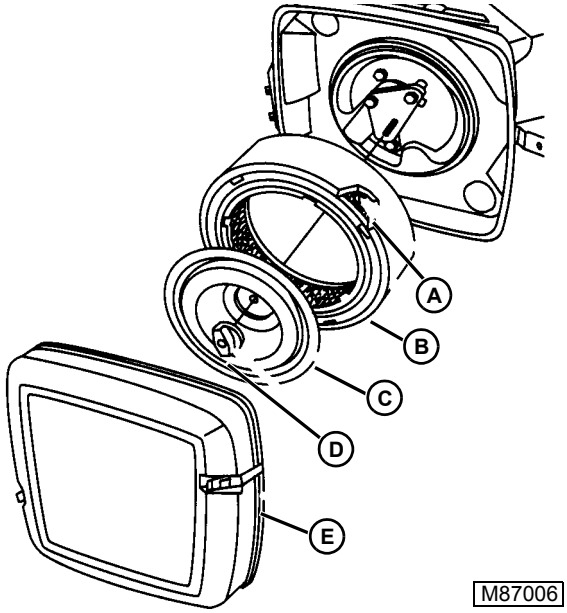
## UPPER BLOWER HOUSING REMOVAL/INSTALLATION

**Procedure:**

1. Remove rotating screen.
2. Remove fuel pump and bracket.
3. Disconnect upper bolt on dipstick tube.
4. Remove top carburetor access plate.
5. Remove upper blower housing (A).
6. Install in reverse order of removal.

## AIR CLEANER SERVICE

**Procedure:**



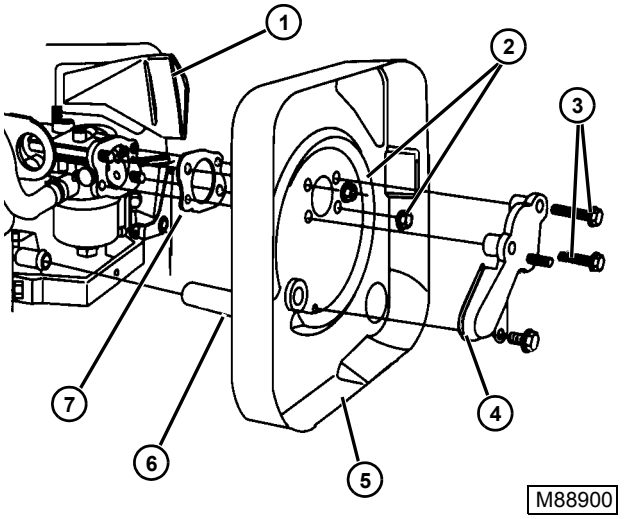

**IMPORTANT: DO NOT use petroleum solvents, such as kerosene, to clean paper cartridge (A). They may cause cartridge to deteriorate. DO NOT oil paper cartridge. DO NOT use pressurized air to clean or dry paper cartridge.**

1. To service pre-cleaner round dual element, remove cover assembly.
2. Slide foam pre-cleaner (B) off cartridge.
3. Wash it in liquid detergent and water.
4. Squeeze it dry in a clean cloth.
5. Saturate it in engine oil. Wrap it in clean absorbent cloth and squeeze to remove excess oil.
6. Remove cartridge (A) and clean by tapping gently on a flat surface. If very dirty, replace.
7. Reinstall cartridge, cover plate (C), knob (D) and pre-cleaner.
8. Reinstall air cleaner cover (E).

# CARBURETOR REMOVAL/ INSTALLATION

**Removal:**

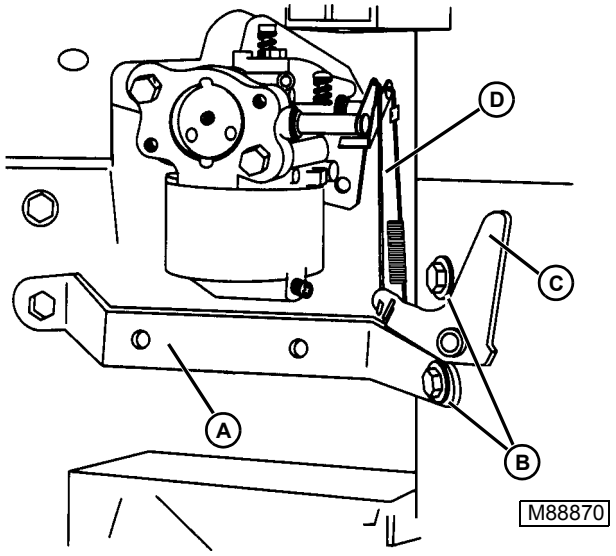
1. Remove carburetor access plate.
2. Remove air cleaner.



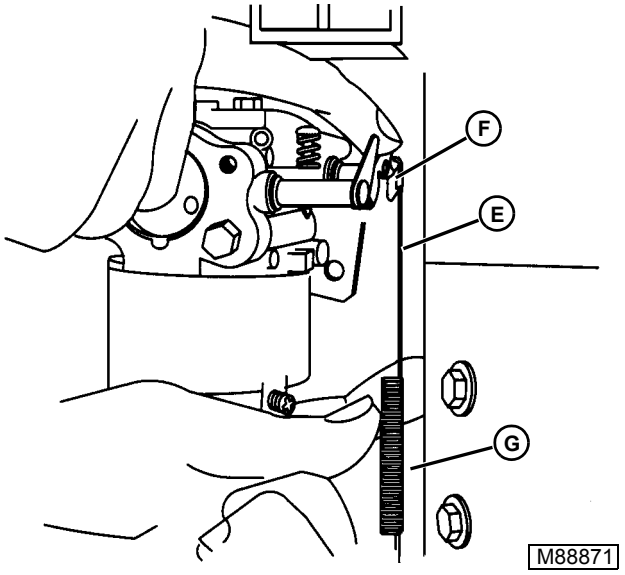

1. Air Inlet Tube
2. Nuts
3. Screws
4. Deflector
5. Air Cleaner Base
6. Breather Tube
7. Gasket

8. Remove air cleaner base, air cleaner inlet tube and breather tube.
9. Remove upper blower housing.

*NOTE: The engine is equipped with fuel shutoff solenoid. The blower housing should be removed so that the solenoid wire can be properly routed during reassembly. Disconnect fuel shutoff solenoid wire from equipment switch wire.*



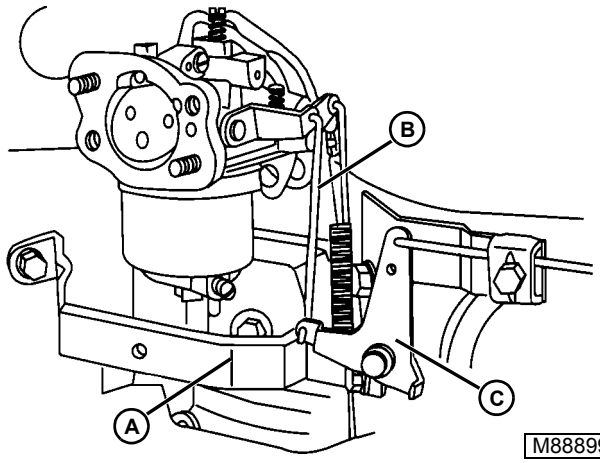

10. Remove air cleaner bracket (A).
11. Remove two screws (B) and choke control bracket (C).
12. Disconnect choke link (D) from carburetor.
13. Remove fuel line clamp and fuel line from carburetor.



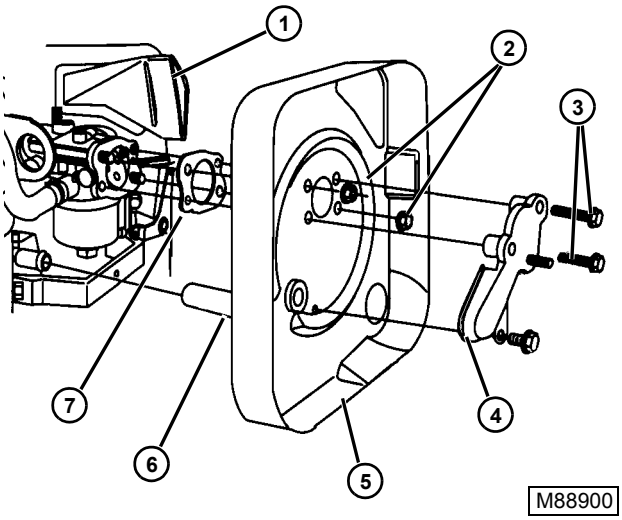

14. Disconnect governor link (E), link retainer (F) and spring (G).
15. Remove carburetor, gaskets and spacer.

**Installation:**

1. Install spacer, gaskets and carburetor. Tighten to **7 N•m (65 lb-in.)**.
2. Connect governor link to throttle lever and snap retainer over link.




3. Install air cleaner bracket (A) and tighten to **7 N•m (65 lb-in.).**
4. Install choke link (B) on choke lever on carburetor. Connect link to choke control lever and install choke control bracket (C).
5. Install fuel line and fuel line clamp.
6. Install blower housing.




1. Air Inlet Tube
2. Nuts
3. Screws
4. Deflector
5. Air Cleaner Base
6. Breather Tube
7. Gasket

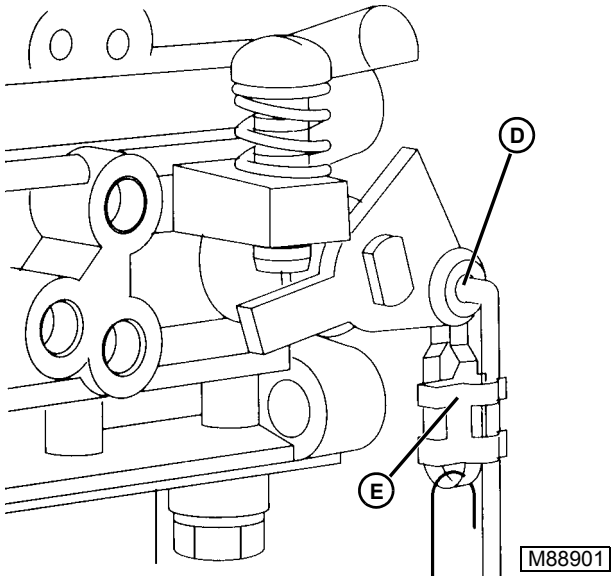
8. Install air cleaner base.

**⚠ CAUTION**

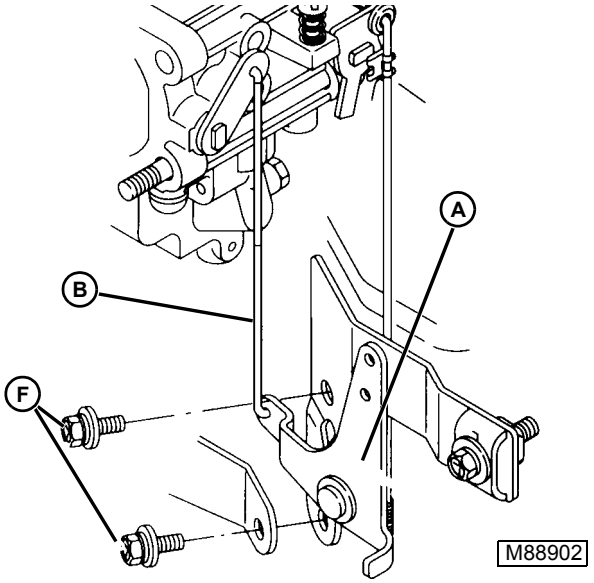
**Static governor adjustment must be made whenever carburetor or manifold has been removed from engine. Failure to make static adjustments first could result in engine overspeeding and may result in engine or equipment damage causing personal injury or property damage.**

**IMPORTANT: Be sure breather tube is not kinked and that it is installed onto nipple as far as possible.**

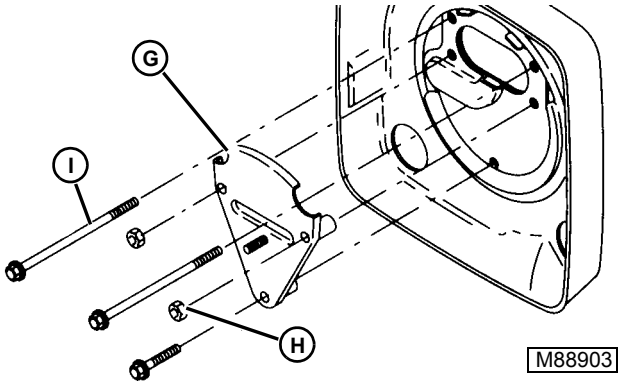
9. Install air cleaner cartridge, pre-cleaner and cover.




10. Connect governor link (D) to throttle lever and snap retainer (E) over link. Then install governor link spring in loop on retainer.




11. Connect choke link (B) to choke lever, install choke control bracket (A), and tighten screws (F) to **7 N•m (65 lb-in.)**.
12. Install blower housing and rotating screen. Install fuel pump and bracket and connect fuel line to carburetor. Rotate fuel line clamp so that it will not interfere with carburetor cover. DO NOT install carburetor cover at this time.




13. Install new air cleaner mounting gasket with adhesive side toward air cleaner base. Guide breather tube onto nipple on breather and install air cleaner base on carburetor mounting studs.
14. Install carburetor shield (G).
15. Install nuts (H) and screws (I) finger tight.

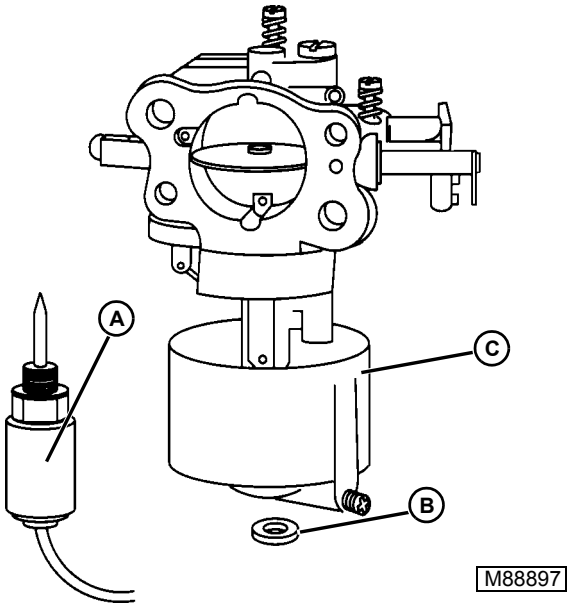
**Specifications:**

**Air cleaner bracket. . . . . 7 N•m (65 lb-in.)**
**Carburetor screws . . . . . 7 N•m (65 lb-in.)**
**Choke control bracket . . . . . 7 N•m (65 lb-in.)**

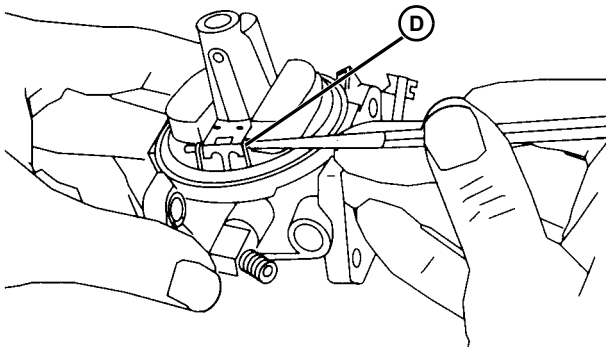
*NOTE: Make sure air inlet tube is installed correctly in air cleaner base.*

## CARBURETOR DISASSEMBLY

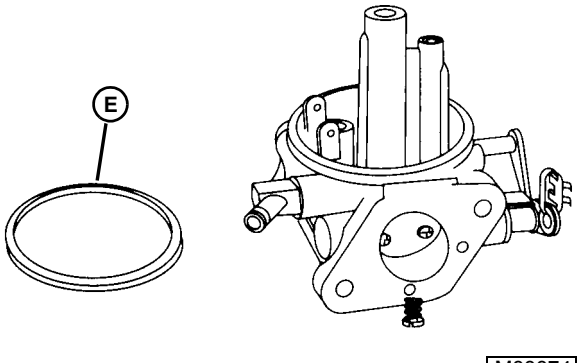
**Procedure:**



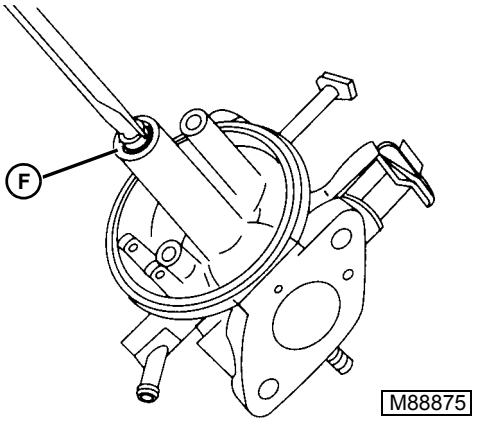

1. Observe position of bowl drain screw to aid in reassembly.
2. Remove fuel shutoff solenoid (A) and washer (B) and bowl (C).



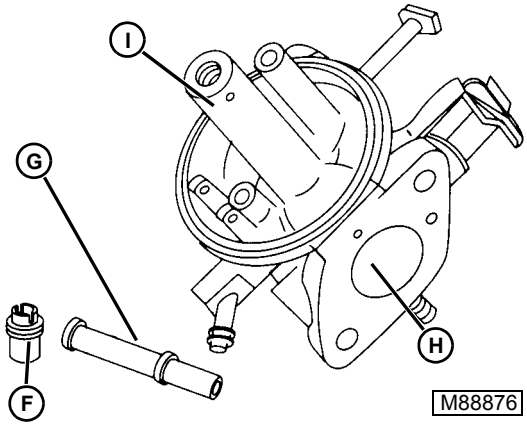

3. With a small punch, drive the float hinge pin (D) out of float hinge. Remove float and fuel inlet valve assembly.



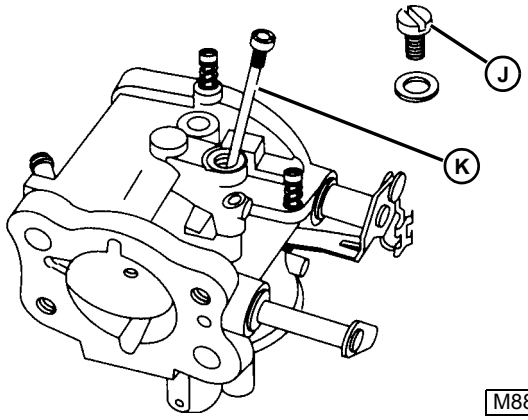

4. Remove carburetor bowl gasket (E).



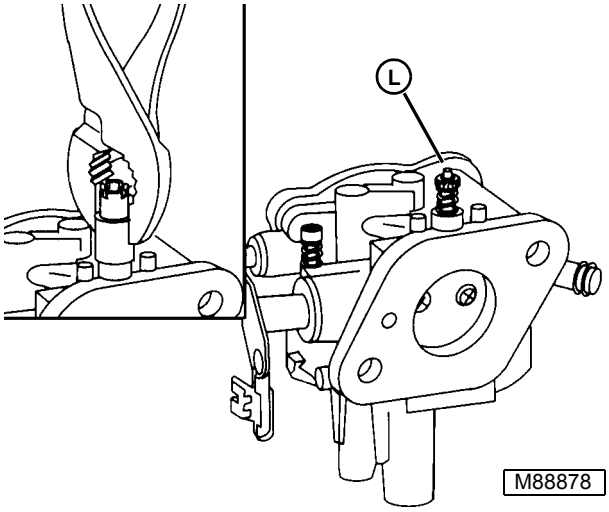

5. Remove fixed main jet (F) using a small bladed screwdriver.



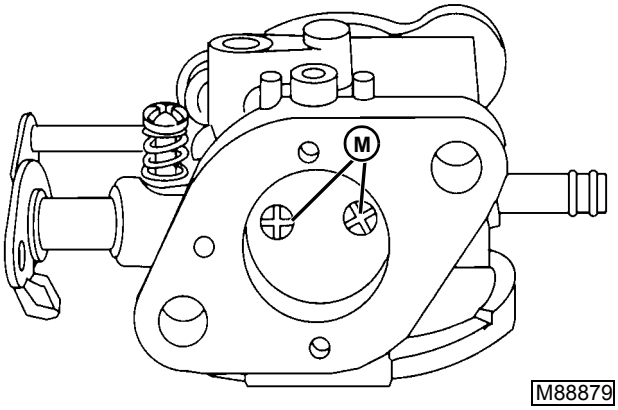

6. When the fixed main jet (F) has been removed, the high speed nozzle (G) can be removed. Reach into carburetor throat (H) with a flat blade screw driver and push the high speed nozzle up through fixed main jet tube (I).



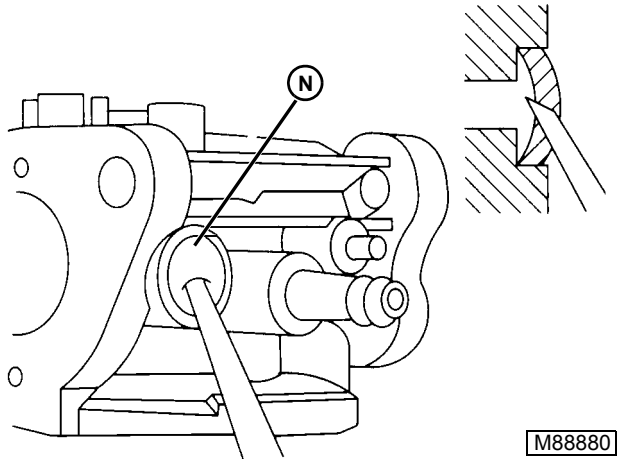

7. Remove idle jet plug (J) and idle jet (K).



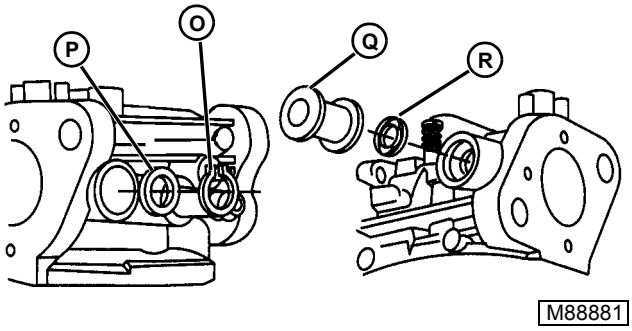

8. The idle mixture valve (L) is equipped with a adjustment limiter cap. Use pliers to remove the cap.
9. Remove the idle mixture valve.



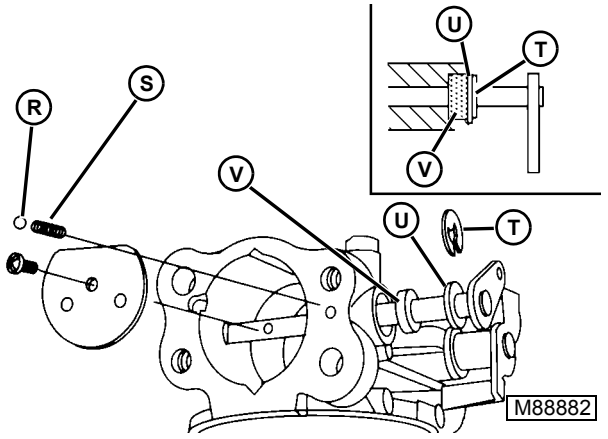

10. Remove two screws (M) holding throttle valve to throttle shaft and remove throttle valve.




11. To remove throttle shaft it is necessary to first remove welch plug (N) from side of carburetor. Use a punch to puncture and remove the plug.

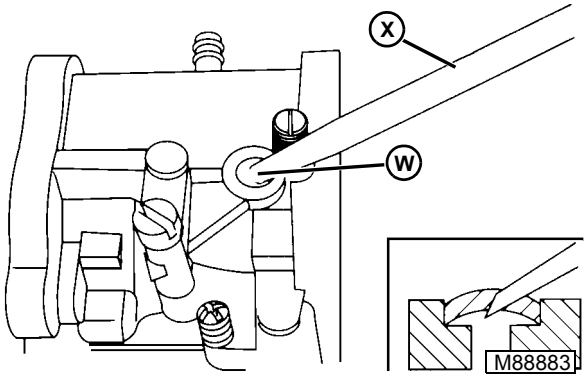



12. Remove external snap ring (O) and throttle shaft washer (P).
13. Remove throttle shaft, throttle shaft collar (Q) and throttle shaft seal (R) (recall lip being outward).




*NOTE: The choke shaft has a ball (R) and spring (S) that keeps tension on the choke shaft. Use care when removing choke shaft.*

14. Remove choke valve screw and choke valve. Remove E- ring (T), then remove choke shaft, washer (U) and felt seal (V).



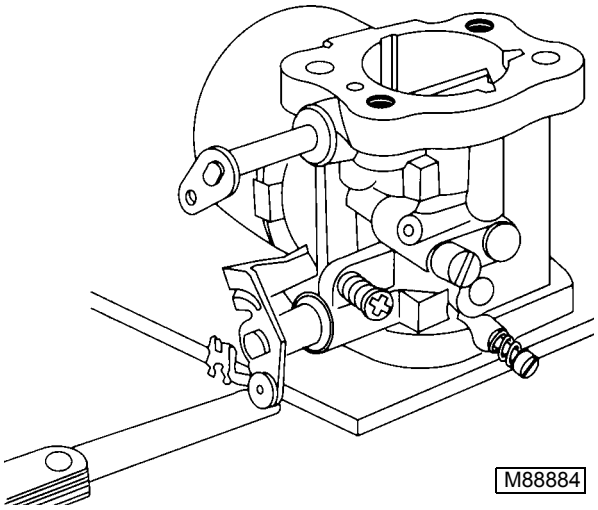

15. Remove small welch plug (W) from top of carburetor body with a small punch (X).

# CARBURETOR INSPECTION

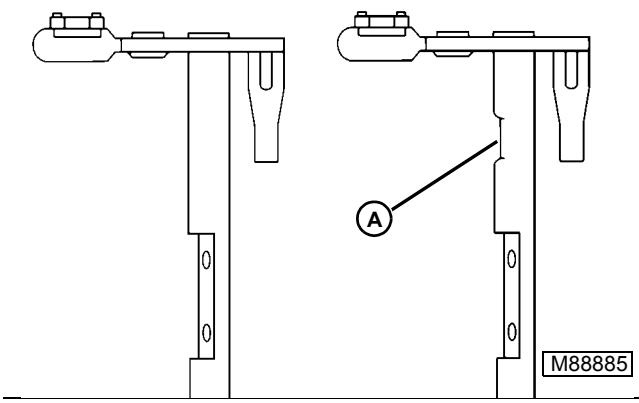
**IMPORTANT: A clean fuel system is necessary in order to maintain proper operation of the engine. Gummy or dirty fuel tanks and carburetors should be cleaned in a carburetor cleaner such as Bendix Carburetor cleaner or equivalent. DO NOT soak rubber, neoprene or plastic parts in cleaner.**

**Procedure:**

1. Check all moving parts for wear, nicks and burrs. Replace, if worn or damaged.
2. Check float for leaks or damage. Replace, if damaged or leaking.
3. Check all mating surfaces for nicks, burrs, foreign material, or cracks. Replace all damaged parts.


M88884

4. Inspect throttle and choke shaft and bushings for wear. Wear between throttle shaft and bushing should not exceed **0.25 mm (0.010 in.)**.
5. Check wear by placing carburetor on a flat surface. Measure the distance between the throttle lever and flat surface with a feeler gauge while pushing shaft down. Measure the distance again while pulling the shaft up.



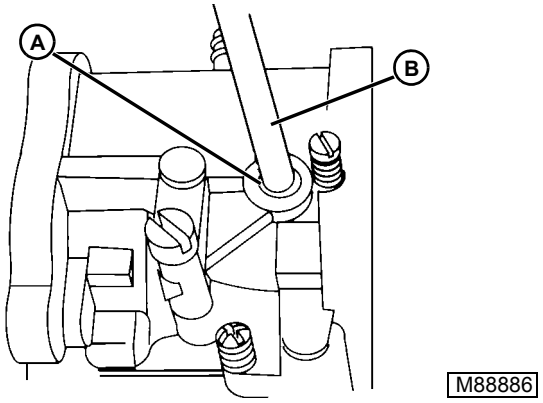
M88885

6. If the difference between the two measurements is greater than **0.25 mm (0.010 in.)**, this indicates that the throttle shaft and/or bushings are worn (A).
7. Wear on the throttle shaft can be checked by comparing the worn and unworn portions of the shaft.
8. Choke shaft and bushings are checked in the same manner.
9. Throttle and choke shaft are replaceable. If throttle or choke shaft bushings are worn, replace carburetor.

# CARBURETOR ASSEMBLY

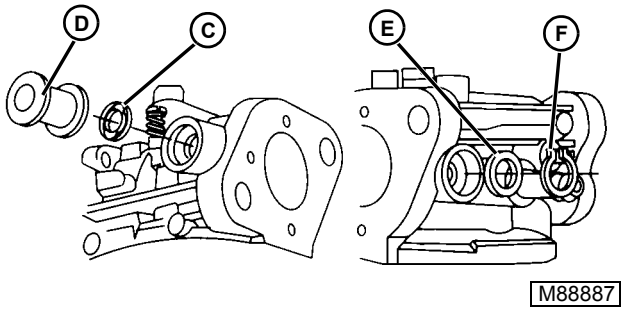
**IMPORTANT: When assembling the carburetor, use new seals and gaskets.**

**Procedure:**



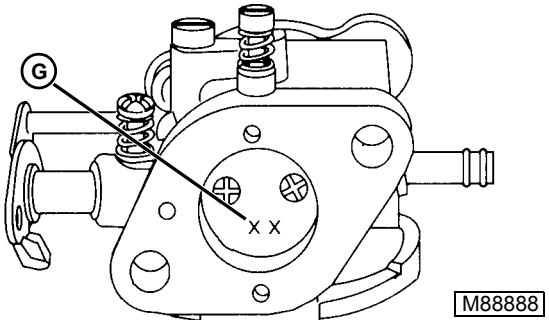
M88886

1. Install new secondary idle port welch plug (A). Use a round punch (B) and tap in plug until it is flat. Use a sealant such as **Permatex® #2** or nail polish on outside diameter of plug to prevent air leaks.

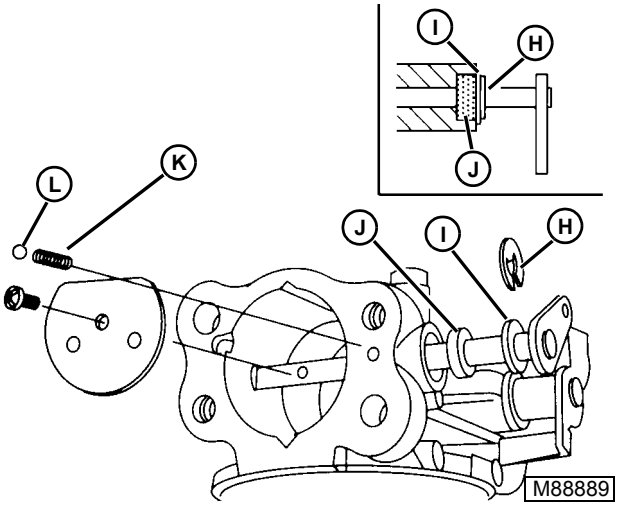


M88887

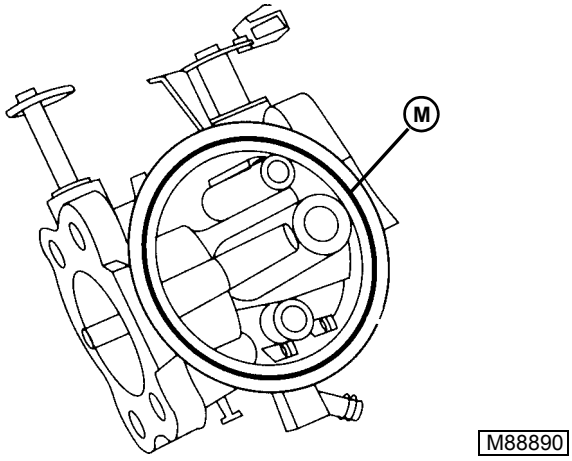
2. Install throttle shaft seal (C) with sealing lip out. Slide collar (D) over throttle shaft and insert throttle shaft through carburetor body. Place washer (E) over end of throttle shaft and install new snap ring (F).



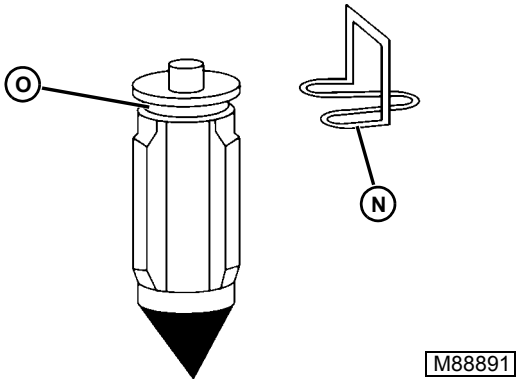

3. Install throttle valve on shaft with numbers down (G). With throttle valve in closed position, tighten screws securely. Then install new welch plug in side of carburetor body. Use a round punch and tap in plug until it is flat. Use a sealant on outside diameter of plug to prevent air leaks.



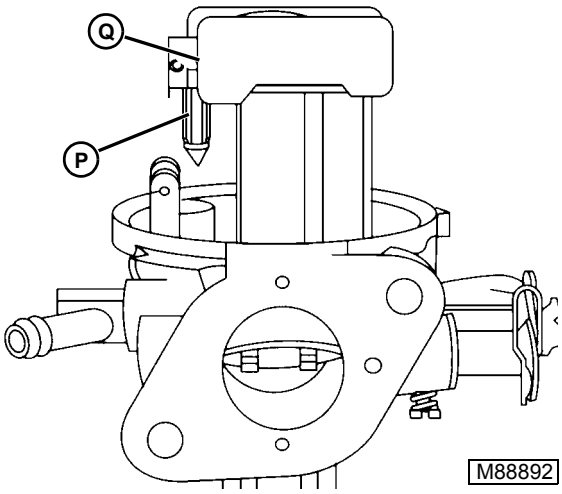

4. Install new E-ring (H), washer (I) and felt seal (J) onto choke shaft.
5. Insert spring (K) and check ball (L) in to spring pocket. Push choke shaft into hole until ball engages groove in choke shaft.
6. Place choke valve onto flat on choke shaft with flat edge of choke valve up and dimples down.
7. With choke valve in closed position, install and tighten screw securely.



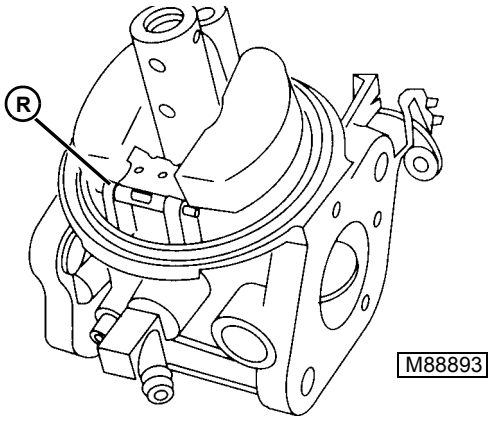

8. Install carburetor bowl gasket (M) in carburetor body groove. Make sure gasket does not twist or kink.



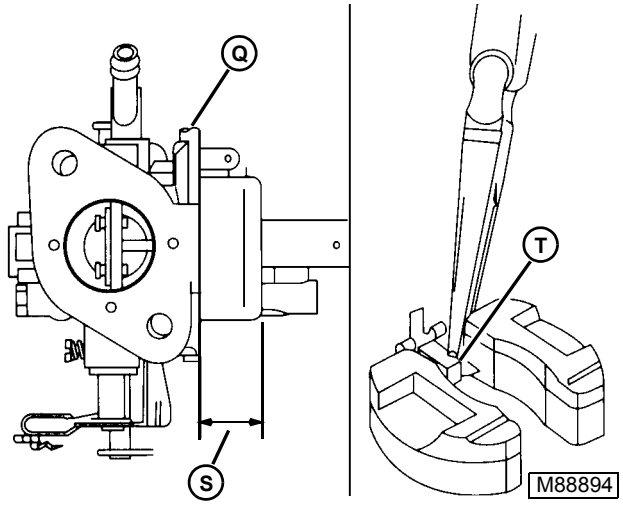

9. Install fuel inlet valve retainer (N) in fuel inlet valve groove (O).



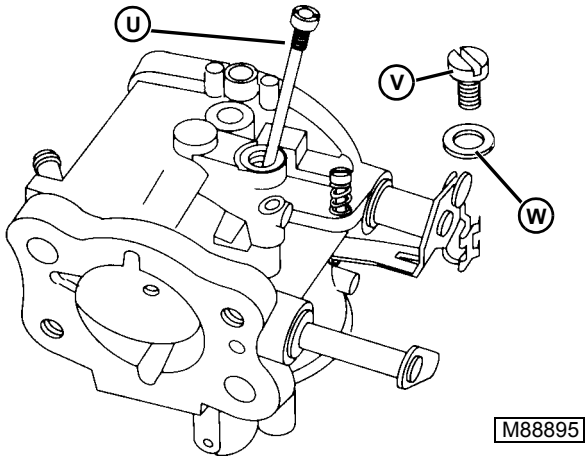

10. Slide fuel inlet valve assembly (P) onto float tang (Q) and place assembly in carburetor.



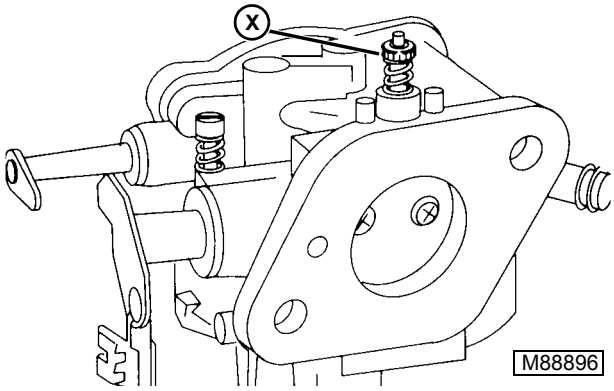

11. Install float hinge pin (R) into place.




12. Hold carburetor in vertical position, with float hinge up. The float should be parallel (S) with carburetor bowl mounting surface. If not, bend tang as shown (T). DO NOT press on float to adjust.

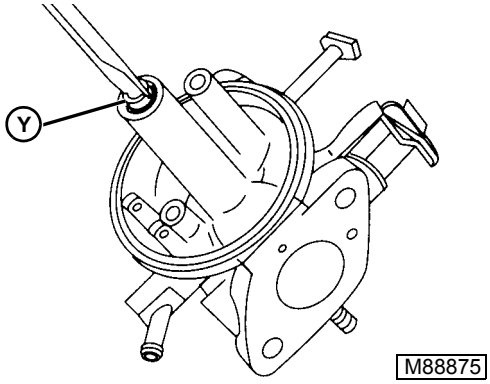



13. Install idle jet (U), plug (V) and gasket (W). Tighten plug securely.

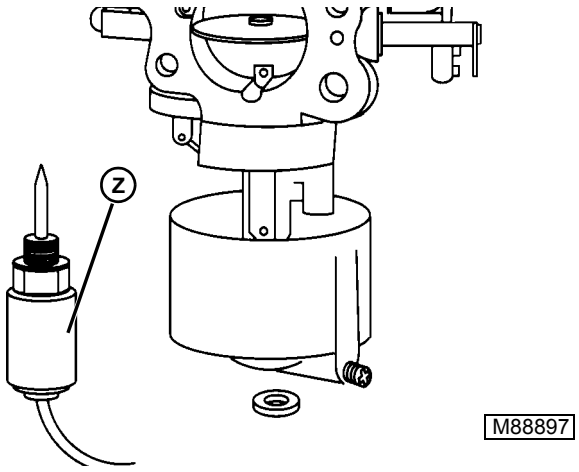



14. Install idle mixture valve and spring (X) and adjustment limiter cap.

*NOTE: Special high altitude jets may be required in certain areas.*




15. Install high speed nozzle and fixed main jet (Y).




16. Install bowl, washer and screw or fuel shutoff solenoid (Z) and washer. Position bowl drain.

**Specification:**

**Solenoid torque . . . . . 5 N•m (45 lb-in.)**

# ENGINE REPAIR

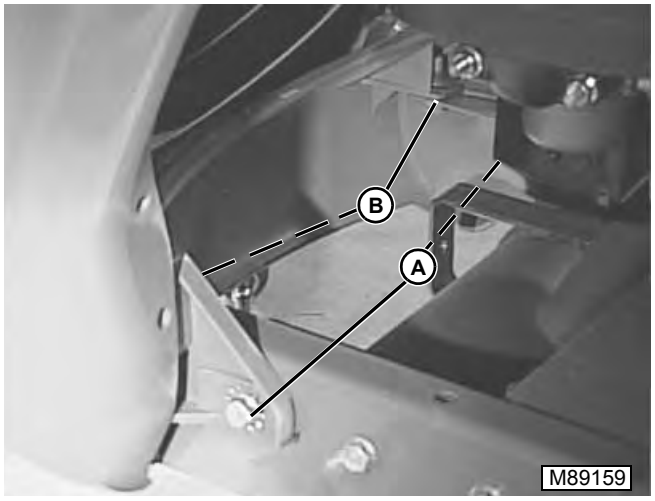
## ENGINE—REMOVAL/INSTALLATION

**Conditions:**

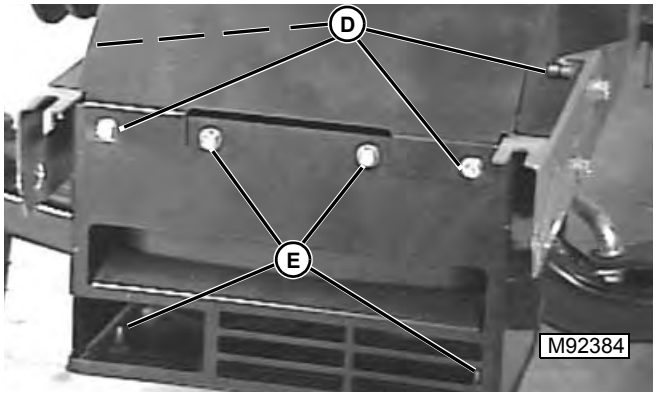
- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Mower deck removed

**Removal:**

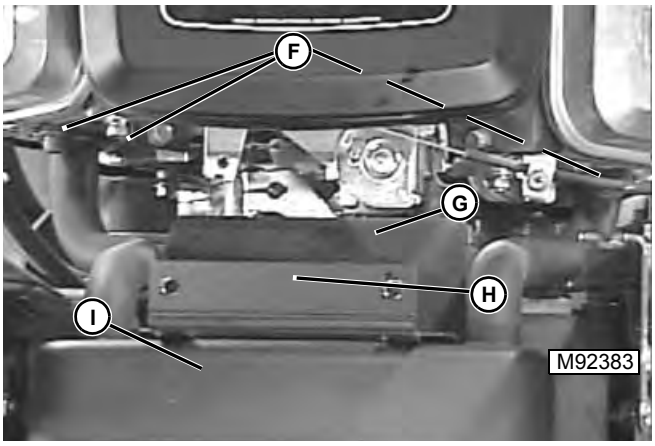
1. Turn all switches OFF, raise hood, disconnect battery, headlight connector, and spark plug lead.




2. Remove two bolts (A) securing the hood to the left and right frame side rails. Loosen the two bolts (B) securing the hood to the upper side of the left and right side rails. Remove hood.



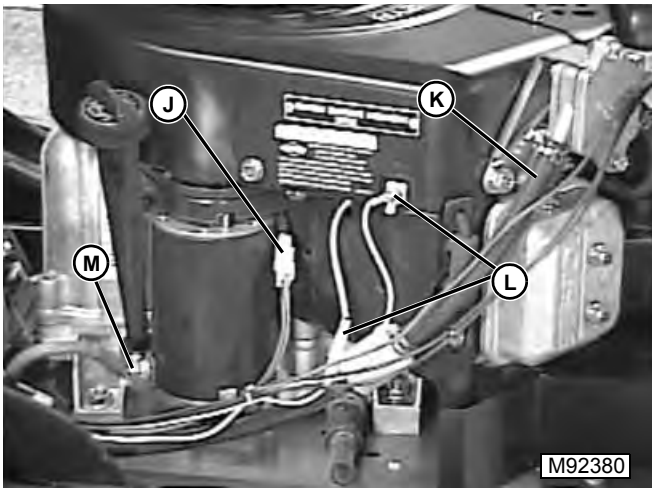

3. Remove four (4) upper shield bolts (D), four (4) lower shield bolts (E) and remove both shields.



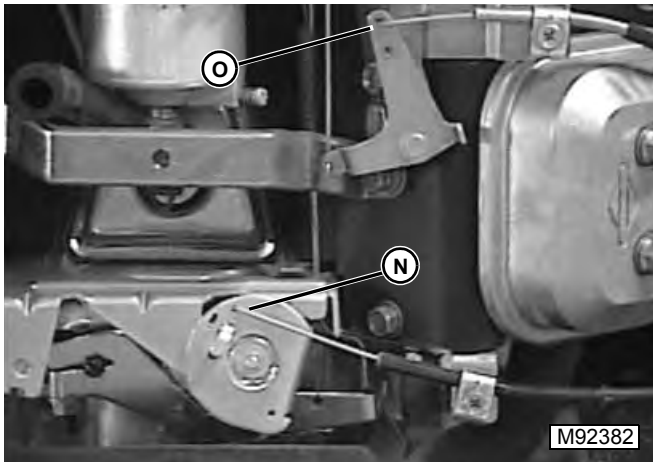

4. Remove inner shield (G), bracket (H) from frame, four (4) muffler bolts (F) and muffler (I).

**⚠ CAUTION**

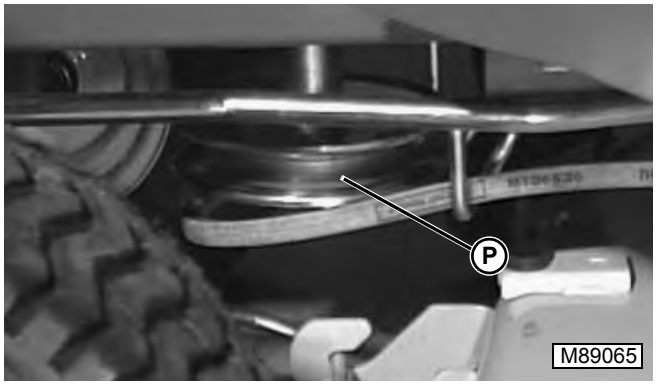
**Gasoline is explosive. Do not expose to flame or spark. Serious injury can result. Store in a properly marked, safe container. Wipe-up any spills IMMEDIATELY.**




5. Disconnect engine connector (J), fuel line (K), engine connections (L) and starter cable (M).



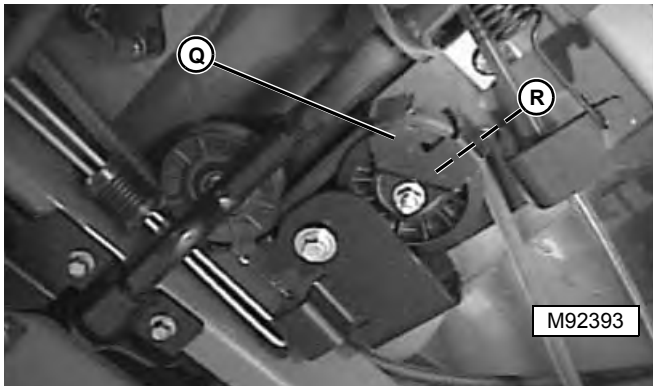

6. Disconnect choke cable (O) and throttle cable (N).



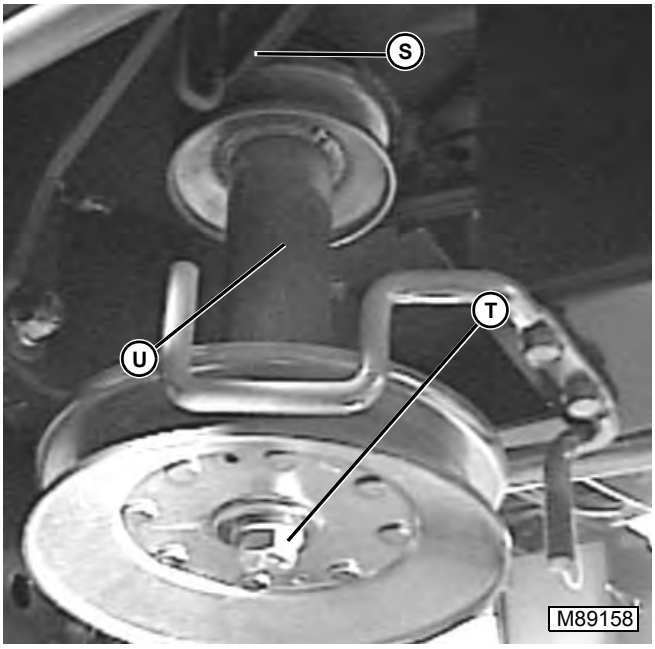

7. Remove mower drive belt (P).

*NOTE: It is not necessary to completely remove drive belt to remove engine.*

.



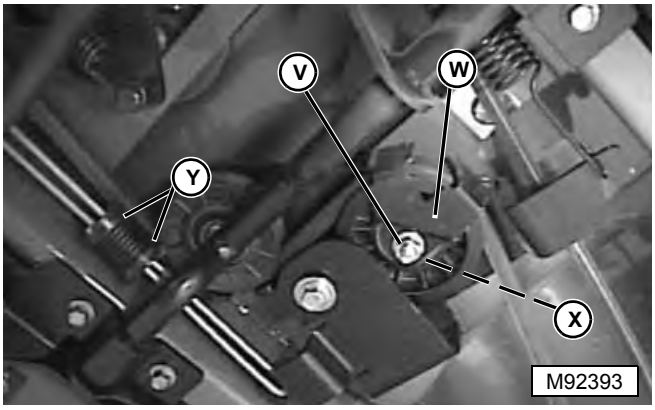

8. Remove belt guide nut and belt guide (Q).
9. Loosen idler nut (R) and slide idler forward until belt can be removed from double sheave.




10. Remove engine drive belt (S) from double sheave.
11. Remove sheave nut (T) and double sheave (U).
12. Remove four (4) engine mounting bolts and remove engine.

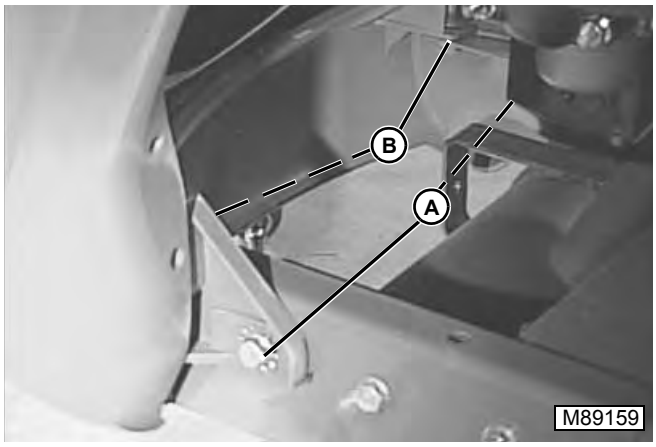
**Installation:**

1. Install engine and tighten four (4) engine mounting bolts to **32 N•m (24 lb-ft)**.
2. Install double sheave and sheave nut. Tighten nut to **75 N•m (55 lb-ft)**.
3. Install drive belt.




4. Slide belt idler (V) rearward until distance between plastic caps of compression spring (Y) is **32.5 mm (1.28 in.)**.
5. Tighten idler nut (X) to **26 N•m (19 lb-ft)**.
6. Install belt guide (W).
7. Inspect muffler flange for flatness. Install muffler, new gasket, and shield. Tighten muffler bolts to **24 N•m (18 lb-ft)**.

8. Connect and adjust throttle cable and choke cable.
9. Connect fuel line and adjust carburetor
10. Make all electrical wiring connections, including spark plug lead and battery (negative cable last).




11. Slide hood into position and install bolts (A). Lightly tighten fasteners so that the hood can be moved forward or backward for alignment.

12. Lower hood into the locked position and align hood as shown (C), tighten bolts (B), then raise hood and tighten bolts (A).

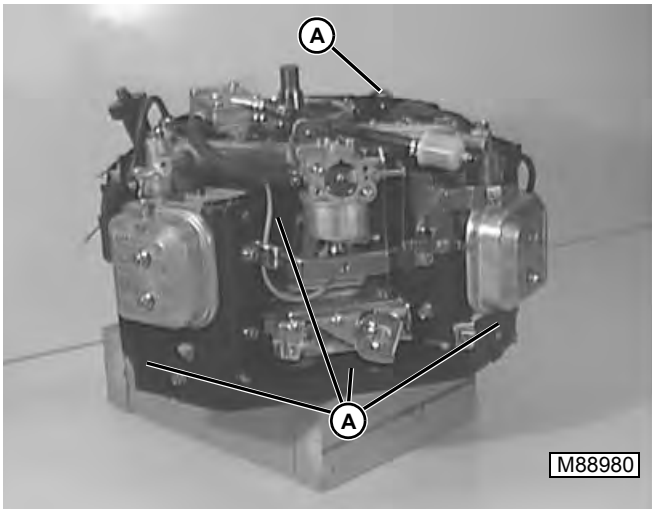
**Specifications:**

**Engine Mounting Bolts . . . . . 32 N•m (24 lb-ft)**
**Muffler Mounting Bolts . . . . . 24 N•m (18 lb-ft)**
**Compression Spring . . . . . 32.5 mm (1.28 in.)**
**Idler Nut . . . . . 26 N•m (19 lb-ft)**
**Double Sheave Bolt . . . . . 75 N•m (55 lb-ft)**

## CYLINDER AIR GUIDES REMOVAL/ INSTALLATION

**Procedure:**

1. Remove upper blower housing.
2. Remove air filter assembly.
3. Disconnect carburetor linkage.
4. Remove carburetor.
5. Remove intake manifold.

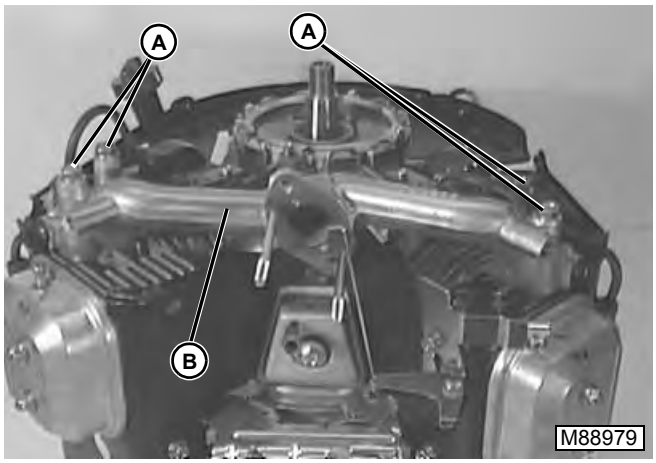



6. Remove front and side cylinder air guides (A).
7. Install right, front and side cylinder air guides.
8. Install carburetor.
9. Install carburetor linkage.
10. Install air filter assembly.
11. Install upper blower housing.

## INTAKE MANIFOLD REMOVAL/ INSTALLATION

**Procedure:**

1. Remove upper blower housing.
2. Remove air filter assembly.
3. Remove cylinder air guides.
4. Disconnect carburetor linkage.
5. Remove carburetor.




6. Remove intake manifold bolts (A) and manifold (B).

*NOTE: Replace used intake manifold and carburetor gaskets with new gaskets.*

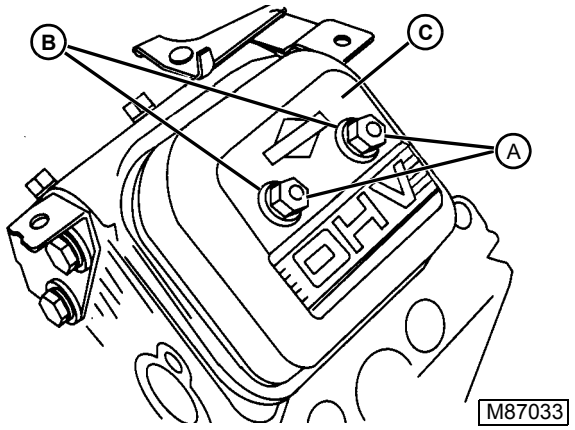
7. Install intake manifold.
8. Install carburetor.
9. Connect carburetor linkage.
10. Install cylinder air guides.
11. Install air filter assembly.
12. Install upper blower housing.

## CYLINDER HEAD REMOVAL/ INSTALLATION

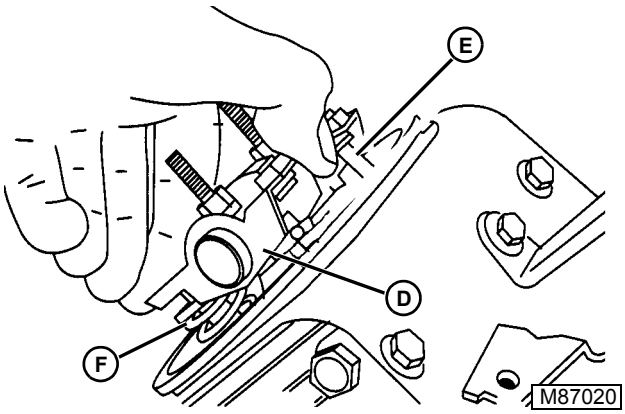
**IMPORTANT: Mark all parts when disassembling cylinder heads to prevent interchanging.**

**Removal:**

1. Disconnect spark plug leads and remove spark plugs.
2. Remove air cleaner assembly, support, choke bracket, carburetor and blower housing.
3. Remove intake manifold, valley cover, exhaust manifold, governor control bracket and linkage.
4. Remove cylinder air guides.



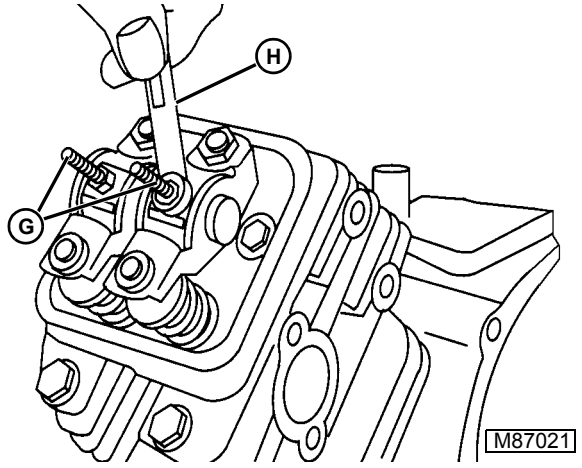

5. Remove nuts (A), seals (B), and valve cover (C).

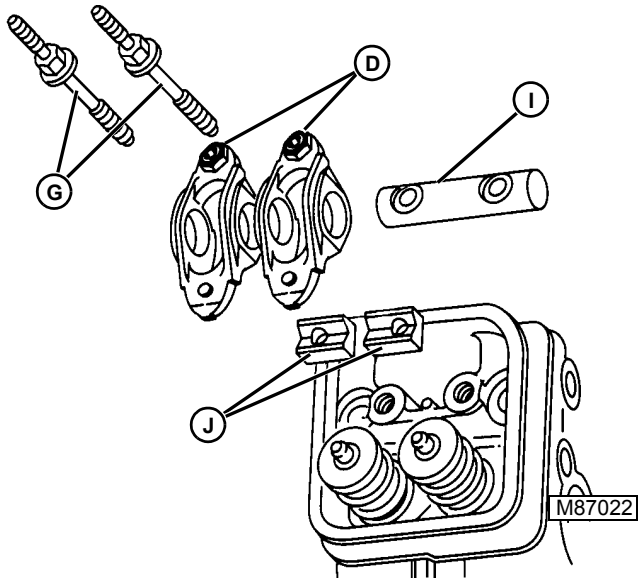



*NOTE: To release spring pressure from rocker arms (D), rock the arm against spring pressure and allow push rod (E) to drop out of the rocker arm socket. Push rod will move out of position, releasing valve spring (F) pressure.*

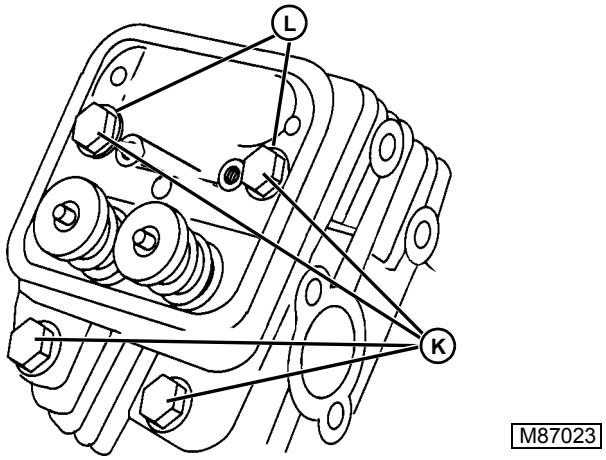
6. Release valve spring pressure.

**IMPORTANT: Exhaust valve push rods are aluminum. Intake valve push rods are steel. Mark push rods for identification with tape or tags to prevent interchange.**




7. Remove rocker studs (G) with a 10 mm wrench (H).
8. Remove shaft (I) and rocker arm shaft supports (J).
9. Lift out push rods.

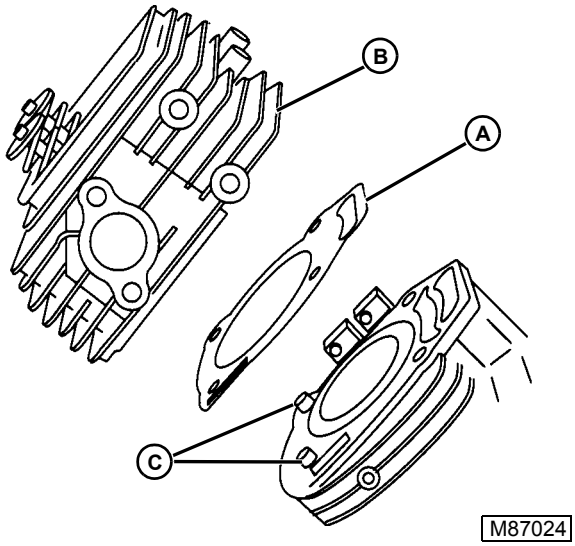



10. Remove cylinder head bolts (K) and sealing washers (L).

11. Remove cylinder head and gasket.

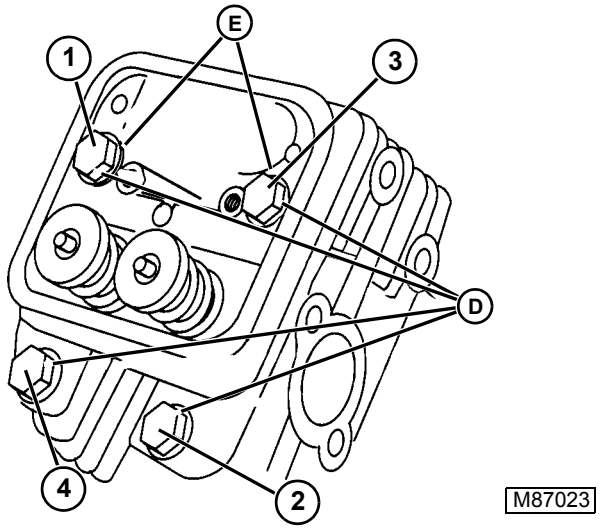
**Installation:**

1. Place new gasket (A) and cylinder head (B) on cylinder. Align head with cylinder head alignment sleeves (C) located in the cylinder.




2. Apply approved lubricant to bolts threads and install four cylinder heads bolts (D) and two sealing washers (E).

**IMPORTANT: Do not use sealer of any kind on gaskets.**

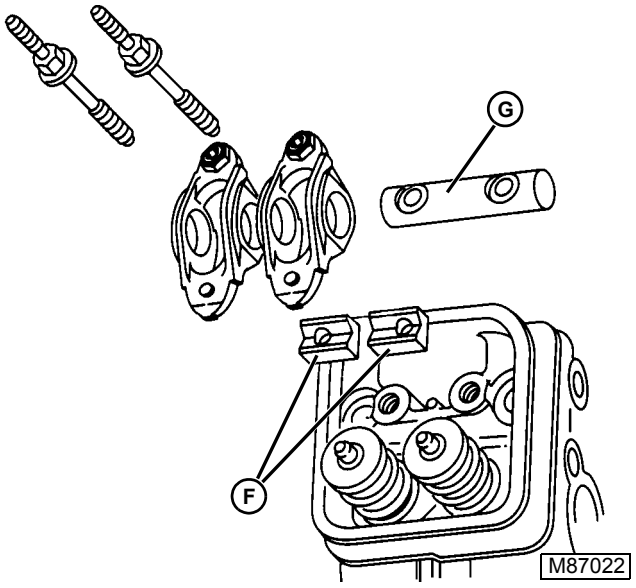



3. Tighten four bolts down evenly by hand. Then, using torque wrench, tighten cylinder head bolts, in sequence shown above.

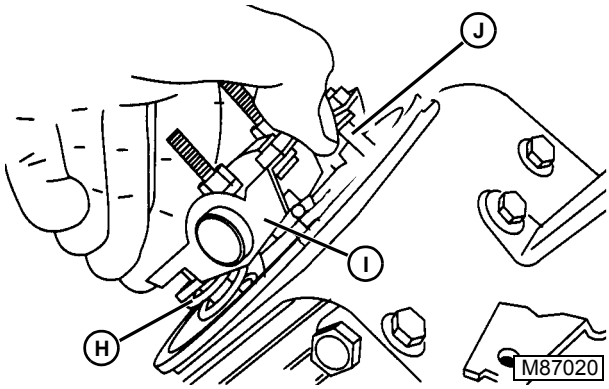
**IMPORTANT: Do not tighten one bolt down completely before the others, as it may cause a warped cylinder head.**

4. Insert push rods into recess in tappets.

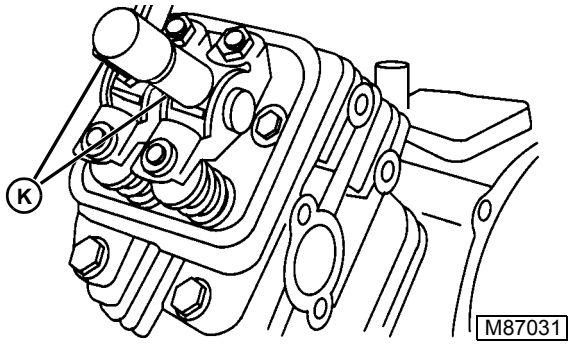
**IMPORTANT: Exhaust valve push rods are aluminum. Intake Valve push rods are steel. Mark push rods for identification with tape or tags to prevent interchange.**




5. The rocker shaft support (F) holes are offset. Install with holes facing outward toward the ends of rocker shaft (G).



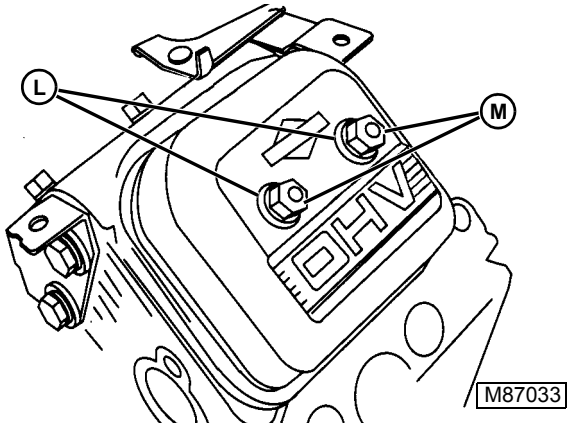

6. Compress valve spring (H) with rocker arm (I) and insert push rod (J) into rocker arm socket. Be sure push rods remain seated in recess in tappets.




7. Assemble rocker arms, shaft, supports and studs (K) and install on cylinder head.
8. Tighten studs to **16 N•m (140 lb-in.)**.
9. Adjust valves. See “VALVE INSTALLATION”.

**Torque Specification:**

**Studs . . . . . 16 N•m (140 lb-in.)**




10. Install gasket and valve cover. Place seal washers (L) and nuts (M) on studs.
11. Install intake and exhaust manifold, governor control bracket, cylinder air guides, valley cover, blower housing and air cleaner assembly.
12. Install and tighten spark plugs to **20 N•m (180 lb-in.)**.
13. Install spark plug leads.

## CYLINDER HEAD INSPECTION AND REPAIR

**Procedure:**

1. Remove combustion chamber deposits from combustion chamber and around valves using a soft, hand wire brush or scraper. With piston at top dead center, remove combustion chamber deposits from top of piston.

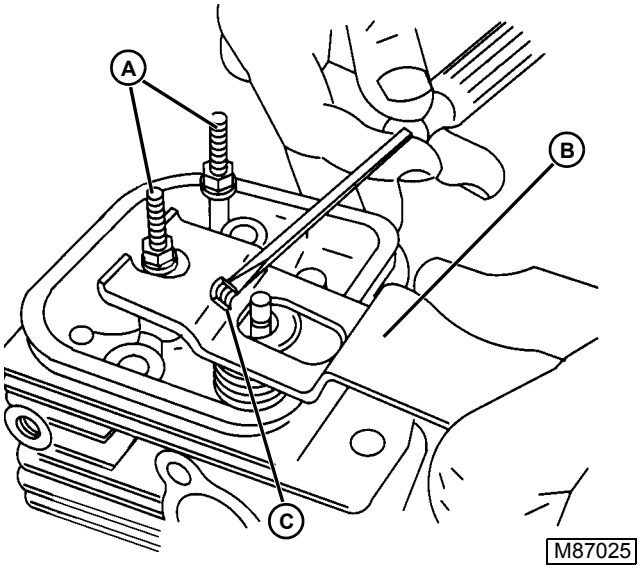
**IMPORTANT: Use care to prevent combustion chamber deposits from entering push rod or oil return cavity in cylinder. Take care not to damage cylinder, top of piston, cylinder head and cylinder head gasket surfaces. Remove only the combustion chamber deposits. It is not necessary to remove the discoloration marks on the piston, valves and cylinder head. These marks are normal and will not affect engine operation.**

2. Inspect cylinder head for broken fins or cracks. Repeat procedure for other cylinder head and cylinder.

## VALVE REMOVAL

**Procedure:**

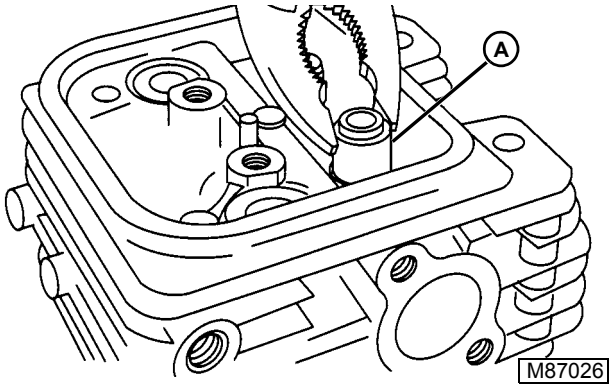
1. Remove the valves, place cylinder on workbench with support to hold valves in place.




2. Reinstall rocker studs (A) into cylinder head. Do not tighten. Slip end of Valve Spring Compressor (B) under stud of valve spring. Press down on tool handle to compress valve spring and remove split retainers (C).
3. Release pressure and remove retaining washer and spring.
4. Remove rocker studs.
5. Repeat procedure on other cylinder head.

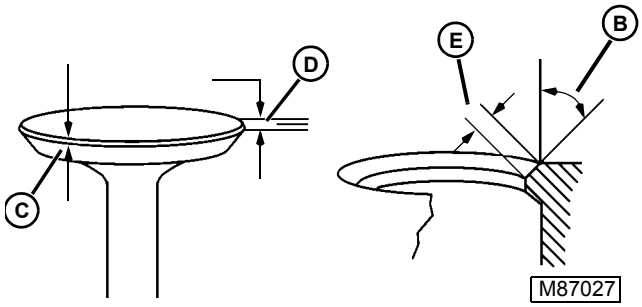
## VALVE INSPECTION AND REPAIR

**Procedure:**




1. To remove valve stem seals, grasp seal with pliers and pull up on seal (A) while turning.

**IMPORTANT: Always replace valve stem seals whenever valves are removed for servicing.**

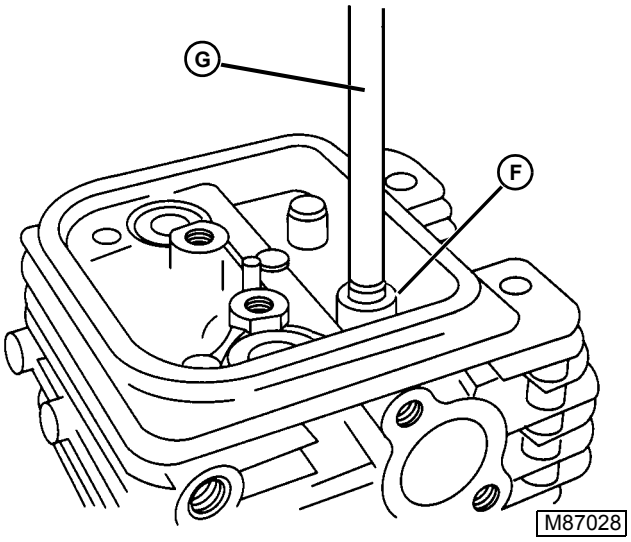



2. Faces on valves may be resurfaced with a valve grinder to 45° (B). Valve seats can be reconditioned using Valve Seat Cutter. Valves and seats should then be lapped with Valve Lapping Tool and Valve Lapping Compound. Remove grinding marks and assure a good seal between valve and seat. Thoroughly clean lapping compound from valve seat and valve face.
3. Valve margin (C) should be **0.8 mm (0.030 in.)** (D). If margin approaches **0.4 mm (0.0156 in.)**, discard and replace valve.
4. Valve seat width should be **1.2—1.6 mm (0.0468—0.0625 in.)** (E).

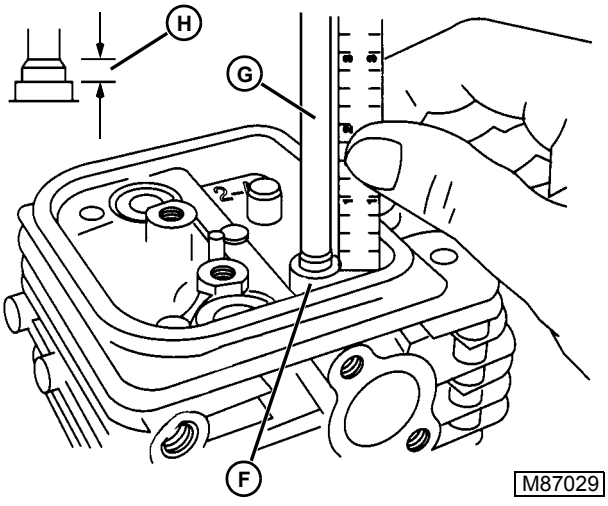
**Specification:**

**Valve seat width . . 1.2—1.6 mm (0.0468—0.0625 in.)**
**Valve margin . . . . . 0.8—0.4 mm (0.030—0.0156 in.)**

5. If seat is wider, it may be narrowed using Valve Seat Cutter. Use 30° side of cutter to narrow the seats. If the valve is badly burned, it should be replaced. Replace valve if margin is badly burned or damaged, replace cylinder head. Valve seats are not replaceable.
6. Inspect valve springs and replace if broken or worn.
7. Inspect valve guides by inserting plug gauge into valve guide. If plug gauge inserts **6.4 mm (0.250 in.)** or more, the guide must be replaced. If plug gauge is not available, the rejection dimension for both intake and exhaust valve guides is **6.05 mm (0.238 in.)**.



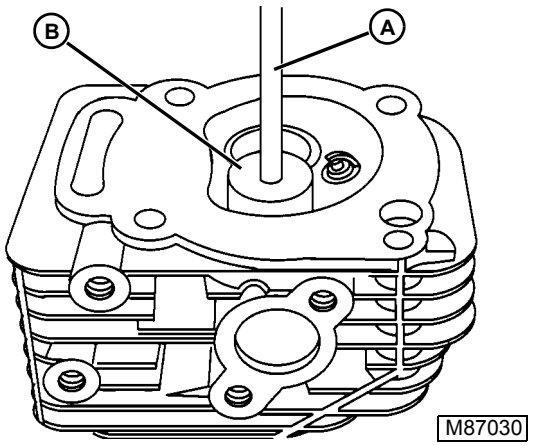

8. To remove valve guides (F), use Bushing Driver (G). Support cylinder head and press out valve guide.




9. To install new valve guides, place new valve guide on Bushing Driver. Valve guide can be installed either way. Press in valve guide to dimension **7.0 mm (0.281 in.)** (H).

## VALVE REAMING

**Procedure:**



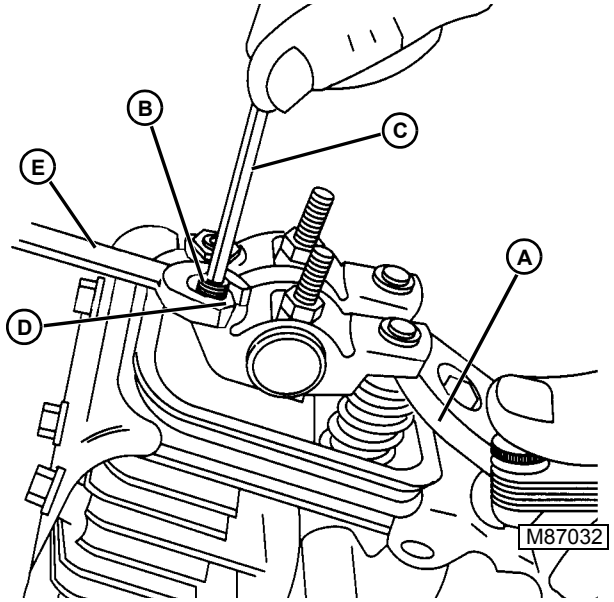

1. To ream valve guides, use Finish Reamer (A) and Reamer Pilot Guide (B) to finish ream valve guide. Use oil, Stanisol or kerosene to lubricate reamer. Ream through entire guide. Keep turning reamer clockwise when removing reamer. Flush out all chips.
2. Install new seals over valve guides. Press down on seal until it bottoms. Valve stems must be free of foreign material and burrs or sticking will occur and valve stem seals will be damaged. Be sure valve guides are free of foreign materials and burrs. Lightly coat valve stems with Valve Guide Lubricant and insert valves into valve guides.

**IMPORTANT: Insure Valve Guide lubricant is not on valve face, seat or end of valve stem.**

## VALVE INSTALLATION

**Procedure:**

1. Install springs and valve spring retainers over valve stems. Temporarily install rocker studs in cylinder head. With Valve Spring Compressor, compress spring and install split retainers. Repeat procedure for other valves. Remove rocker studs.




*NOTE: In order to adjust valve clearance, correct position of the crankshaft is necessary to eliminate interference by the compression release mechanism on the cam gear when adjusting valve clearance.*

2. Turn crankshaft until piston in cylinder you are checking is at top dead center, on the compression stroke (Both Valves Closed). Using a screwdriver or similar object inserted through spark plug hole and touching the top of the piston, continue turning crankshaft clockwise until piston has moved **6.35 mm (0.250 in.)** past top dead center.
3. Check valve clearance with feeler gauge (A) between valve stem and rocker arm. Valve clearance specifications are the same for both the intake and exhausts. Adjust clearance by turning adjusting screw (B) with a 5 mm hex wrench (C).
4. Tighten lock nut (D) with a 13 mm wrench (E) to **7 N•m (60 lb-in.)**.
5. Recheck clearance. Readjust if required.
6. Rotate crankshaft several turns to check for proper operation.

**Specifications:**

**Valve clearance . 0.10—0.16 mm (.004 in.—.006 in.)**
**Lock nut torque . . . . . 7 N•m (60 lb-in.)**

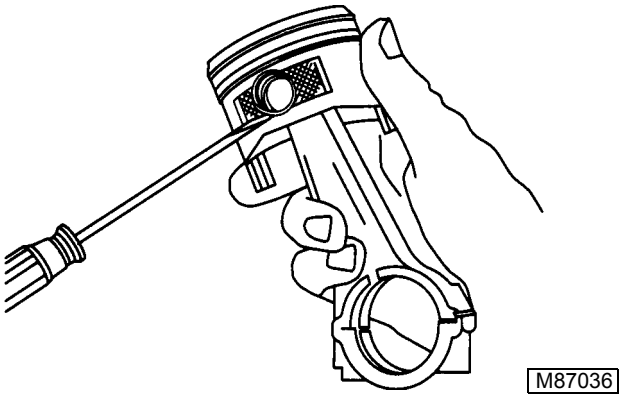
## PISTON, RINGS AND ROD REMOVAL/INSTALLATION

**Procedure:**

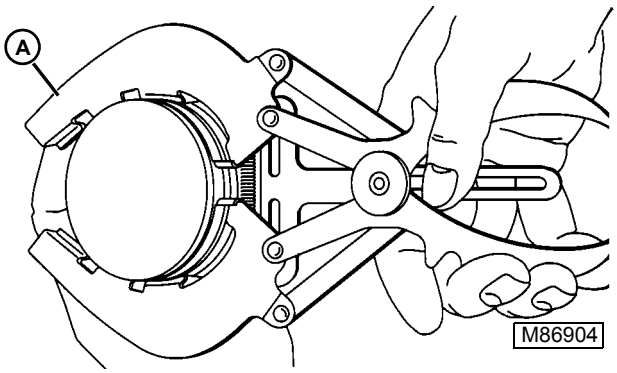
1. Remove air filter and bracket, upper blower housing, flywheel, alternator, carburetor and governor linkage.
2. Remove starter, cylinder heads and crankcase cover.

*NOTE: Remove any carbon or ridge at the top of the cylinder bore. This will prevent breaking the rings when removing the piston and connecting rod from the engine.*

3. Remove the connecting rod cap. Then push the piston and connecting rod out through the top of the cylinder.




4. To remove connecting rod from piston, remove piston pin locks with screwdriver. Piston pin is a push fit in piston and rod. Deposits may build up on piston pin and require the piston pin to be pressed out.

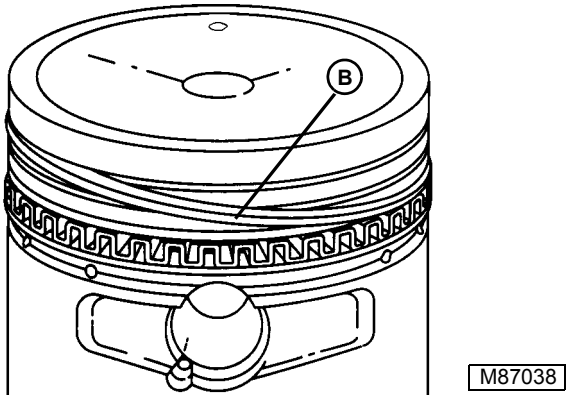


**IMPORTANT: Remove top and center compression rings using ring expander (A). New piston rings must be installed whenever the engine is disassembled for major servicing or overhaul, providing that cylinder bores are within specifications.**

*NOTE: Measure cylinder bores before checking pistons and rings. If cylinder bores require re-sizing it will not be necessary to check pistons and rings since a new oversized piston assembly will be used.*

5. If cylinder bore is more than **0.08 mm (.003 in.)** oversize, or **0.04 mm (.0015 in.)** out of round, it must be resized.

**IMPORTANT: When servicing pistons, rings, piston pins or rods, each rod, piston, piston pin and ring set must be kept as a set for the cylinder that it was removed from. Mark each set before removing from the engine.**

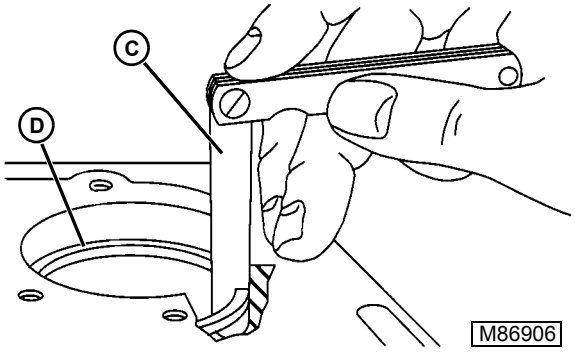



*NOTE: Oil control ring (B) is shown being spiraled into compression ring groove.*

6. Spiral top oil control ring (B) from oil ring groove into center compression ring groove. Repeat into top compression ring groove, and then off piston. Repeat for bottom oil control ring.

*NOTE: If the cylinder is to be resized, there is no reason to check the piston, since a new oversized piston assembly will be used. If however, the cylinder is not to be resized and the piston shows no signs of wear or scoring, the piston rings must be replaced.*

7. Insert old rings one at a time approximately **25.4 mm (1.0 in.)** down into a cylinder bore.




8. Check end gap with feeler gauge (C). If ring gap is greater than **0.76 mm (.030 in.)** for compression and oil ring (D), the ring groove is worn and should be replaced.

A worn ring will usually show scratches caused by abrasives and/or have a shiny appearance. Never reuse worn piston rings.

**⚠ CAUTION**

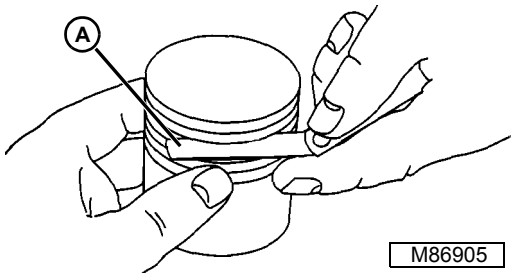
**The top and bottom edges of the ring may be extremely sharp. Never reuse worn piston rings.**

*NOTE: Before installing new piston rings, the cylinder bore should be reconditioned using a rigid hone with finishing stones. This will restore the proper cross hatch angle in the cylinder bores. The correct cylinder cross hatch ensures proper lubrication and piston ring rotation.*

## PISTON INSPECTION

**Procedure:**

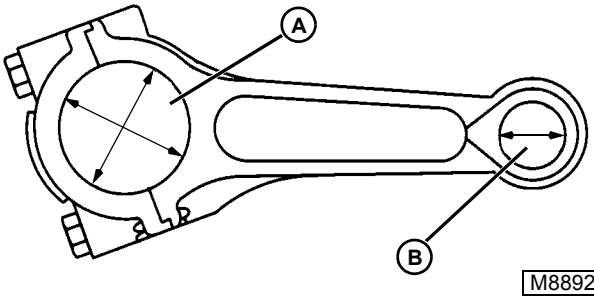
1. Clean carbon from top two ring grooves.
2. Place a new ring in each piston groove.




3. If a **0.10 mm (.004 in.)** or larger feeler gauge (A) can be inserted in the compression ring grooves, or a **0.20 mm (.008 in.)** or larger feeler gauge can be inserted in the oil ring grooves, the compression and ring grooves are worn and the piston should be replaced.
4. To check ring end gap, first clean all carbon from the end of the rings.

## CONNECTING ROD INSPECTION

**Procedure:**

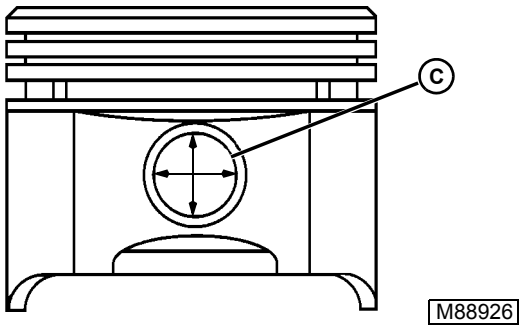



1. If the crankpin bearing (A) in the connecting rod is scored, the rod must be replaced. Reject size of crankpin bearing and piston pin bearing (B) is as follows:

**Specifications:**

**Crankpin bearing . . . . . 37.12 mm (1.4615 in.)**
**Piston pin bearing . . . . . 17.10 mm (0.6735 in.)**

2. Replace connecting rod if either bore is worn.

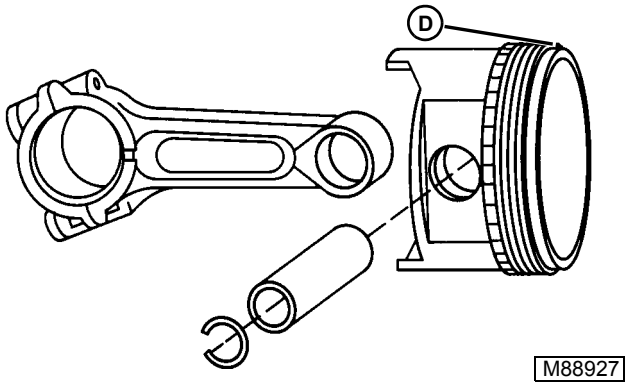



3. Reject sizes for piston pin and piston pin bore (C) are as follows:

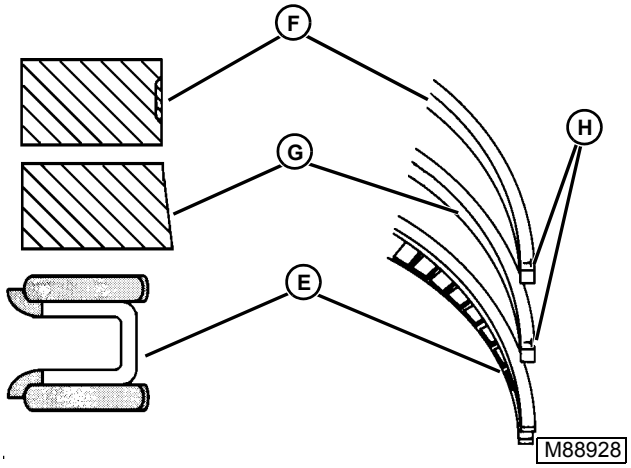
**Specifications:**

**Piston pin . . . . . 17.06 mm (0.6718 in.)**
**Piston pin bore. . . . . 17.10 mm 0.6735 in.)**

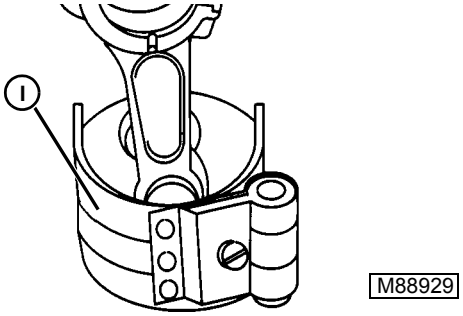
If piston pin is worn **0.01 mm (0.005 in.)** out of round or below reject size, it must be replaced.

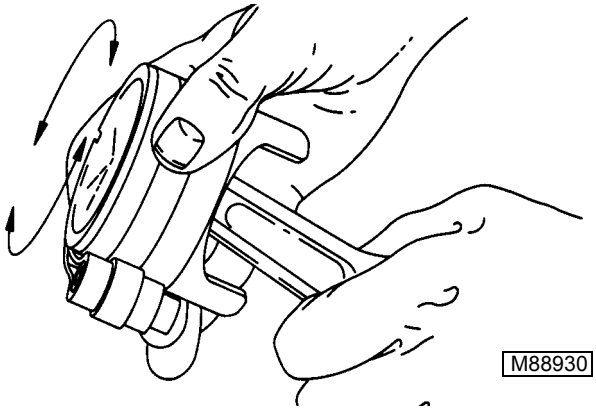



4. The piston pin is a slip fit in both piston and connecting rod. Use a thin nose pliers or screwdriver and install a piston pin lock in groove on one side of piston. Refer to above drawing to determine correct location of rod in relation to notch (D) on piston. Insert piston pin from opposite side of piston until pin stops against piston pin lock. Then install other piston pin lock. Be sure both locks are seated in grooves.

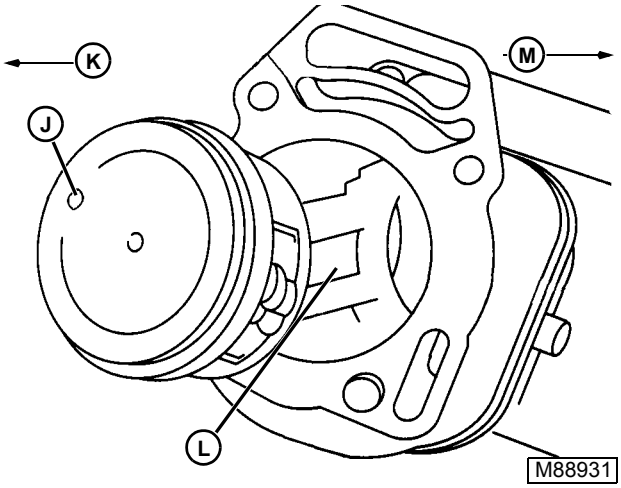



5. The correct piston ring positions are shown above. The oil ring is installed with the expander (E) between the two oil control rings. The top (barrel face) (F) and second compression (taper face) (G) rings are installed with “ID” mark (H) toward top of piston.
6. Install expander first. Spiral bottom oil control ring into top ring groove, then into second ring groove and into position below expander. Repeat procedure for top oil control ring.
7. Using ring expander, install center compression ring then, top compression ring as shown above.

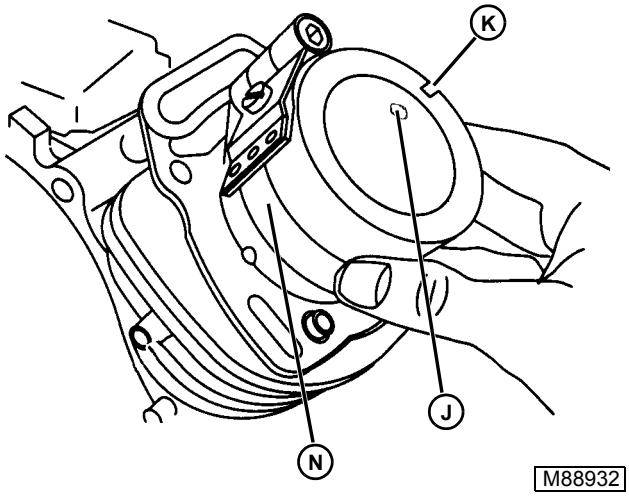


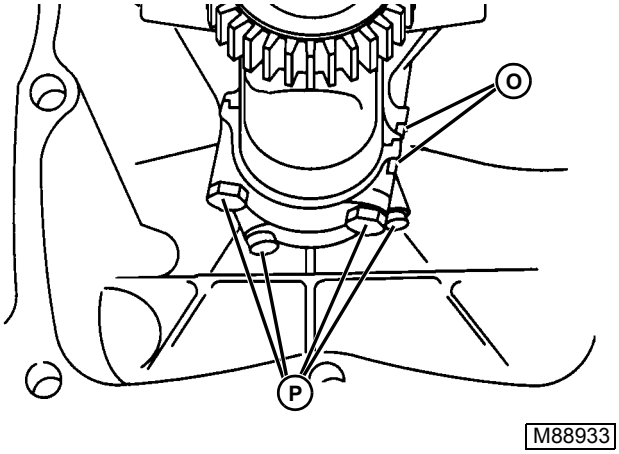

8. Apply oil to piston rings, piston skirt and compress rings with ring compressor tool (I). Place piston and ring compressor upside down on bench and push down until head of piston and edge of ring compressor are even. Tighten ring compressor until rings are fully compressed. Then loosen ring compressor very slightly so that compressor can be rotated on piston skirt while holding connecting rod.




*NOTE: The pistons have offset piston pin bores. When the Circle (J) on piston is facing toward the flywheel side (K) of engine, the words “OUT-1” on the side of the connecting rod for cylinder No. 1 and “OUT-2” on the side of the connecting rod for cylinder No. 2 (L) should face toward the PTO side (M) of the crankcase.*




9. Thoroughly clean and then oil cylinder bore. Rotate crankshaft until crankpin journal is at bottom of stroke. This permits complete entry of compressed rings, piston and rod assembly (N), when pushed into cylinder. If other piston and rod assembly was removed, repeat procedure for that cylinder.




10. Clean and oil crankshaft crankpin.
11. Pull connecting rod against crankpin.
12. Install rod cap with match marks (O) aligned.
13. Install connecting rod screws (P), and tighten to **13 N•m (115 lb-in.)**.

*NOTE: Failure to use a torque wrench can result in loose connecting rods causing breakage, or tight connecting rods causing scoring.*

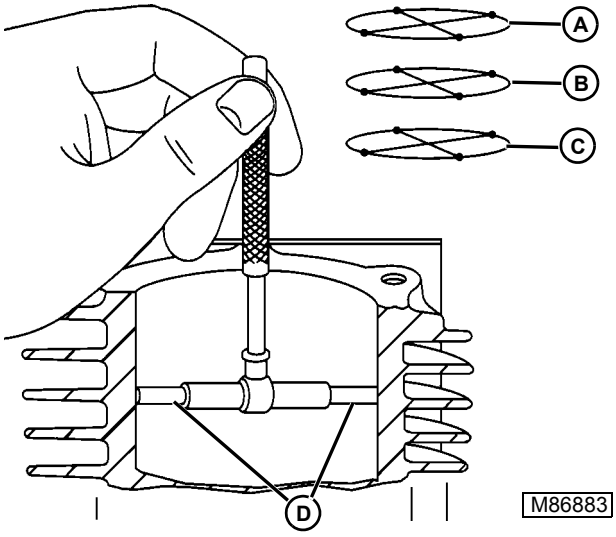
14. Rotate crankshaft two (2) revolutions to check for binding. Rod should also be free to slide sideways on crankpin.

**Specification:**

**Connecting rod screws . . . . . 13 N•m (115 lb-in.)**

# CYLINDER BORE INSPECTION

**Procedure:**




1. Always inspect cylinder after engine has been disassembled. Visual inspection will show if there are any cracks, stripped bolt holes, broken fins or if the cylinder walls are damaged. Use a telescoping gauge, and dial caliper, or an inside micrometer to determine the size of the cylinder bore. Measure at six points from the top (A) to center (B) to the bottom (C) of cylinder at the center of piston ring travel (D).

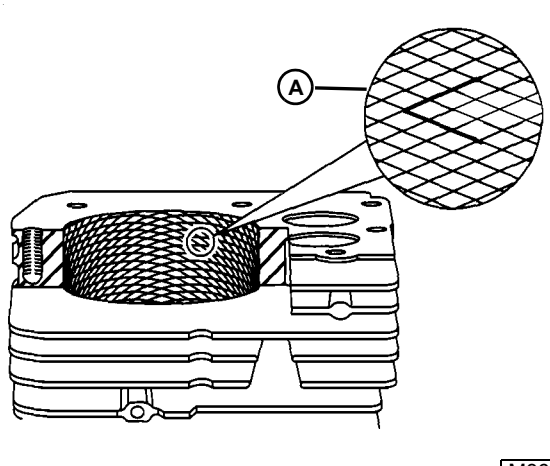
**Specifications:**

**Standard bore size (min.) . . . . . 68.0 mm (2.677 in.)**
**Standard bore size (max.) . . . 68.025 mm (2.678 in.)**

2. If the cylinder bore is more than **0.08 mm (0.003 in.)** oversize, or **0.04 mm (0.0015 in.)** out of round, it must be resized, or replaced. See “RESIZING CYLINDER BORE”.
3. If cylinder bores are within specification and show no signs of scoring or other damage, new pistons rings may be installed providing the cylinder bores are reconditioned using a rigid hone with finishing stones. This will restore the proper cross hatch angle in the cylinder bores. The proper cylinder cross hatch ensures proper lubrication and piston ring rotation.

## CYLINDER BORE HONING

**Procedure:**




1. The cylinder finish, (Cross Hatch) should be applied after cylinder bore has been resized to within **0.04 mm (0.0015 in.)** of the desired size or when reconditioning a cylinder bore. The finishing stones will produce the correct cross hatch necessary for proper lubrication and piston ring rotation. The correct hatch angle is approximately **45°** (A).
2. It is recommended that the cylinder bores be reconditioned to restore the cross hatch when new piston rings are to be installed in a cylinder that is within specification. Be careful not to hone oversize or it will be necessary to resize the cylinder.

*NOTE: To produce the proper cross hatch finish use a drill speed of approximately 200 rpm and 40—60 strokes per minute. Lubricate hone liberally to prevent build up on finishing stones.*

## CYLINDER BORE CLEANING

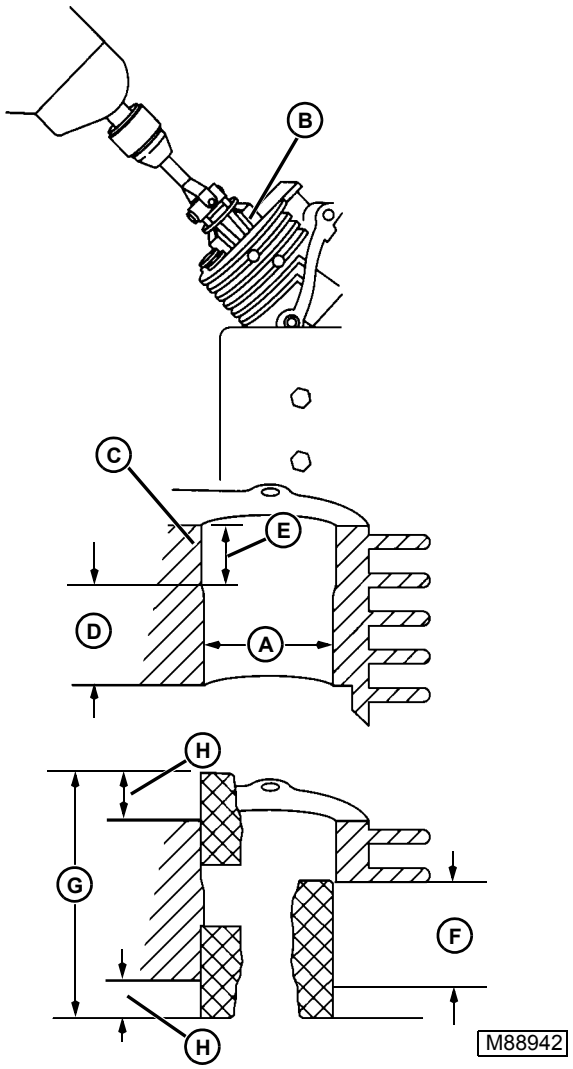
**IMPORTANT: Ensure that the entire cylinder and crankcase are thoroughly cleaned after honing. First wash the cylinder and crankcase carefully in a solvent such as kerosene or commercial solvent. Then thoroughly wash cylinder and crankcase using a stiff brush with soap and hot water, Rinse thoroughly with hot running water. Repeat washing and rinsing until all traces of honing grit are gone. Honing grit is highly abrasive and will cause rapid wear to all of the internal components of the engine unless it is completely removed.**

**Procedure:**

1. When cylinder and crankcase have been thoroughly cleaned, use a clean white rag or napkin and wipe the cylinder bore. If honing grit is present it will appear as a gray residue on rag. If any honing grit is evident, re-wash and rinse entire cylinder and crankcase and check again. When there is no trace of honing grit on rag, the cylinder is properly cleaned. Then oil cylinder bore to prevent rusting.

## RESIZING CYLINDER BORE

**Procedure:**




1. If the cylinder bore (A) is not within specifications, it will have to be resized using a boring bar or hone. Always resize to exactly **0.25 mm (0.010 in.), 0.51 mm (0.020 in.), or 0.76 mm (0.030 in.)** over standard size.

**Specifications:**

**Standard bore size . . . . . Min. 68.0 mm (2.677 in.)**
**Standard bore size . . . . . Max. 68.025 mm (2.678 in.)**

2. If this is done accurately, the service oversize rings and pistons will fit perfectly and proper clearances will be maintained.

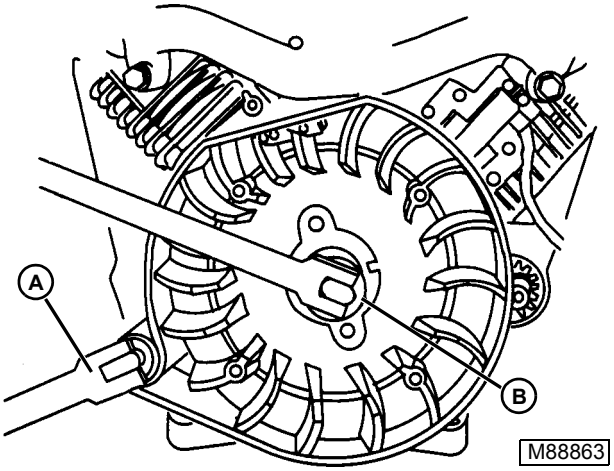
**IMPORTANT: If a boring bar is used, a hone must be used after the boring operation to produce the proper cylinder cross hatch. See "CYLINDER BORE HONING".**

3. If a hone is used to resize the cylinder bore, place hone in middle of cylinder bore. Tighten adjusting knob with finger until stones fit snugly against cylinder wall. DO NOT FORCE.
4. Connect drill drive shaft to hone. Be sure that cylinder and hone are centered and aligned with drive shaft and drill spindle (B). Lubricate hone as recommended by hone manufacturer.
5. The recommended drill speed is **300 to 700 rpm** maximum and **40-60** strokes per minute.
6. Because cylinder bores normally wear (C) only in the area of ring travel, the cylinder bore will be round above and below (D) ring travel (E).
7. Start drill and, as hone spins, move it up and down at the bottom of the cylinder bore (F).
8. Gradually increase the length of the strokes until hone travels full length of cylinder bore (G). Do not travel more than **19.05 mm (0.750 in.) to 25.4 mm (1.0 in.)** (H) above cylinder bore.
9. Lubricate hone frequently to prevent build up on stones.
10. As cutting tension decreases, stop hone and tighten adjusting knob following hone manufacturer's recommendations.
11. Check cylinder bore size frequently.
12. Check cylinder bores at top and bottom for burrs. Remove burrs. Cylinder head and crankcase cover surfaces must be free of burrs and gasket material.
13. After cylinder bore has been brought to proper resizing dimension, a cross hatch must be applied to bore. See "CYLINDER BORE HONING".

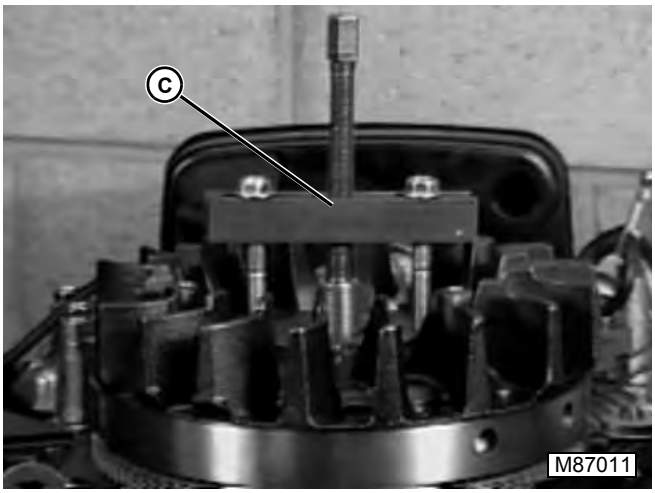
# FLYWHEEL REMOVAL/ INSTALLATION

**Procedure:**

1. Remove rotating screen.
2. Remove blower housing.




3. Place flywheel strap wrench (A) around outer rim of flywheel. Insert 1/2 in. breaker bar into drive end of strap wrench and wind clockwise to remove slack in strap. While holding breaker bar, loosen flywheel nut using 30 mm socket (B) and wrench.

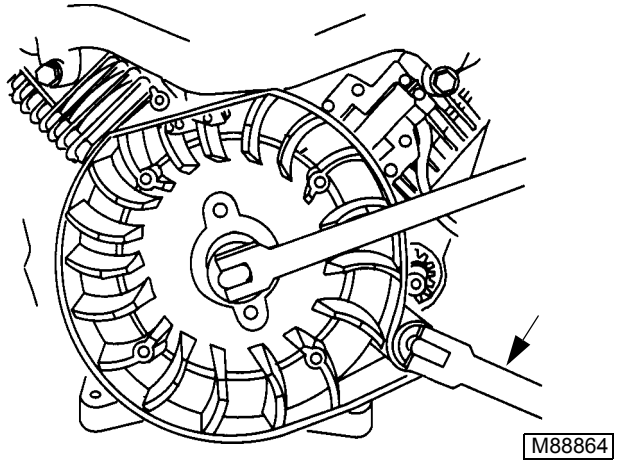



4. Install Flywheel puller (C) turning puller screws into flywheel puller holes evenly. Tighten puller screws equally until flywheel loosens.

**IMPORTANT: Protect crankcase threads during flywheel removal.**

5. Remove flywheel.

6. Flywheel should be inspected for cracks, broken flywheel fins, burrs on taper or keyway and distortion of keyway. Also check taper of crankshaft for burrs, rust or other damage. Replace crankshaft, if damaged.
7. Before installing flywheel, clean taper and crankshaft taper removing all oil, dirt or grease.
8. Install flywheel.
9. Install flywheel nut.


M88864

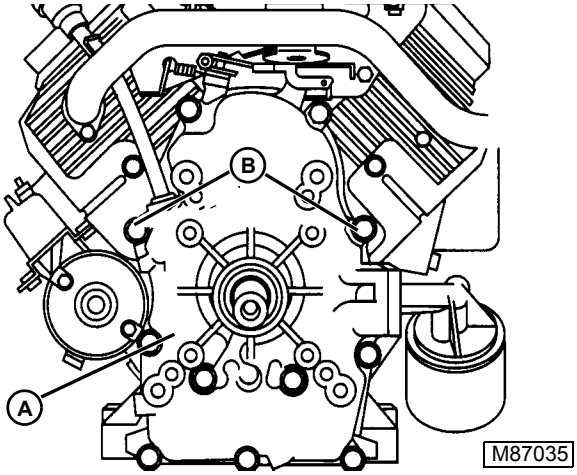
10. Place Flywheel Strap Wrench around outer rim of flywheel. Insert 1/2 in. breaker bar into drive end of strap wrench and wind counterclockwise to remove slack in strap. While holding strap, tighten flywheel nut to **175 N•m (129 lb-in.)**.

**Specification:**

**Flywheel nut . . . . . 175 N•m (129 lb-in.)**

## CRANKSHAFT AND CAM GEAR REMOVAL/INSTALLATION

**Procedure:**

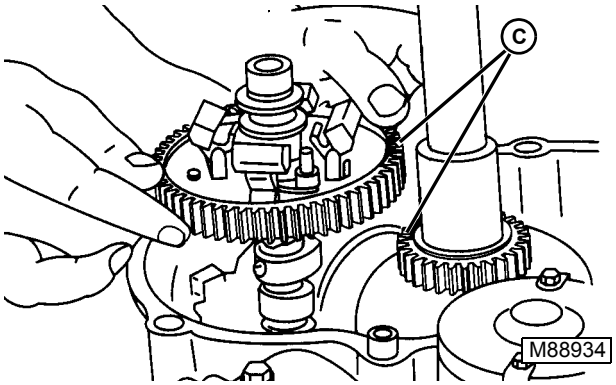


M87035

*NOTE: Before crankcase cover (A) is removed, it is recommended that any rust, paint or burrs be removed from power take off end of crankshaft. This will eliminate or reduce chances of damaging the crankcase cover bearing.*

1. Remove governor lever and disconnect governor link and springs. Remove governor control bracket. Remove oil fill tube and dipstick assembly.
2. Remove exhaust manifold, intake manifold and cylinder heads.
3. Remove crankcase cover (A). If crankcase cover sticks, tap lightly with soft hammer on alternate sides near dowel pins (B).

**IMPORTANT: DO NOT remove dowel pins.**



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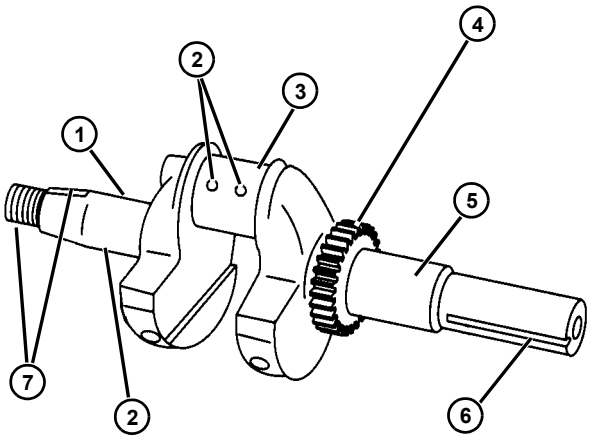
4. Tip engine over onto flywheel side of crankcase.
5. Support engine to prevent end of crankshaft from resting on workbench.
6. Rotate crankshaft until timing marks (C) are aligned. With cam gear in this position, the valve tappets will remain clear of cam lobes.

**IMPORTANT: If engine is rotated from this position, tappets will fall out. Tappets must not be mixed.**

7. Lift out cam gear and governor assembly.




M88935

1. Mag. Journal
2. Oil Galleries
3. Crankpin
4. Timing Gear Teeth
5. P.T.O Journal
6. Keyway
7. Threads and Keyway

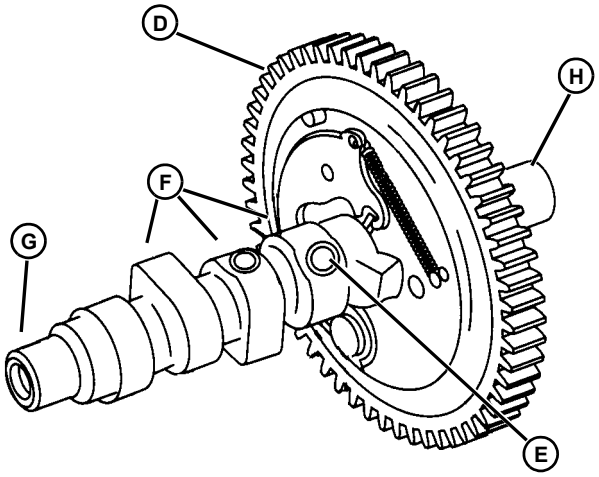
8. Mark the connecting rods and caps to prevent interchanging when reassembling.
9. Remove piston and connecting rod assemblies.
10. Remove crankshaft from crankcase.

**IMPORTANT: The various wear points on the crankshaft must be measured.**

**Specifications:**

**PTO journal . . . . . 34.92 mm (1.375 in.)**
**MAG. journal . . . . . 29.94 mm (1.179 in.)**
**Crankshaft crankpin . . . . . 36.95 mm (1.455 In.)**

11. Replace crankshaft if worn or if journals are scored. Keyways should be checked to be sure they are not worn or spread. Remove burrs from keyway edges to prevent damaging the bearing or oil seal. Check oil galleries for blockage or obstructions.

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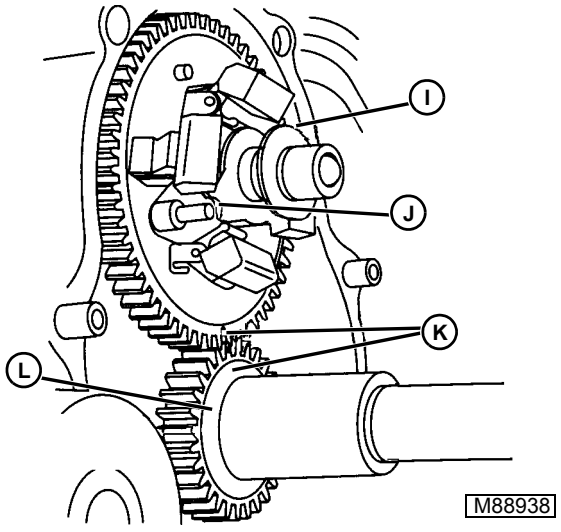
12. Check timing gear teeth (D) for chipped or cracked teeth. Replace if needed.
13. The compression release balls (E) must be clean and free to move when the centrifugal weight is rotated counterclockwise. When the centrifugal weight is released, the balls should move up into the locked position.
14. Inspect cam gear teeth, lobes (F), mag journal (G), and P.T.O journal (H) for wear and nicks. Cam gear journal and lobe reject sizes are as follows:

**Specifications:**

**PTO journal . . . . . 19.92 mm (0.7845 in.)**
**MAG. journal . . . . . 15.93 mm (0.6273 in.)**
**Cam Lobes . . . . . 30.25 mm (1.191 in.)**

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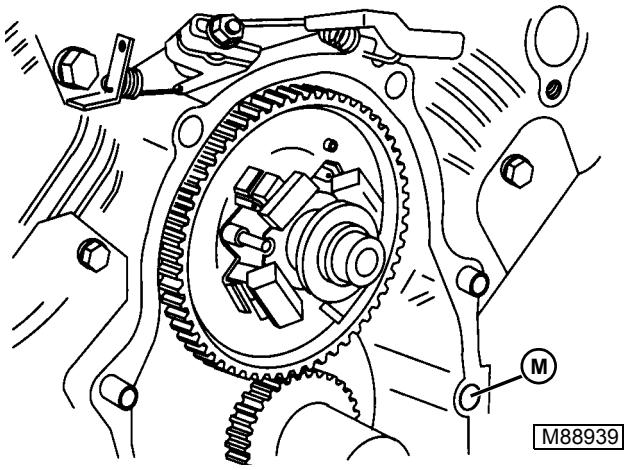
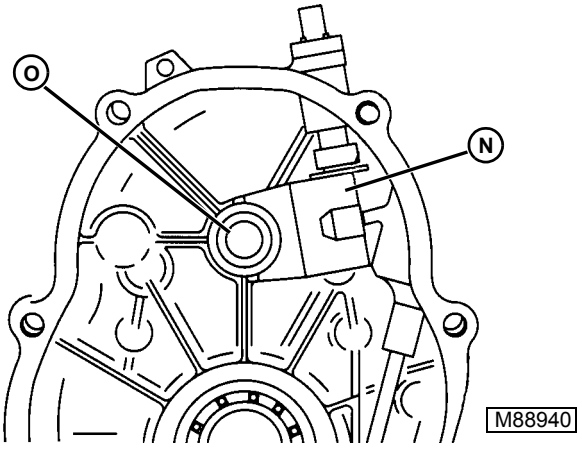
15. Governor slider (I) must move freely on PTO journal of cam gear. Flywheel must pivot freely. Make sure flyweight spring is not stretched. Governor weights must move freely on hinge pins. Make sure hinge pins are not loose.

16. Assemble governor slider onto PTO journal on cam gear making sure that slot on slider fits over locating pin (J) on cam gear. Be sure the weights are in the proper location so that they will be able to move freely without binding.
17. Tip engine to position crankshaft horizontally. Align timing marks (K) and install thrust washer (L), if required.

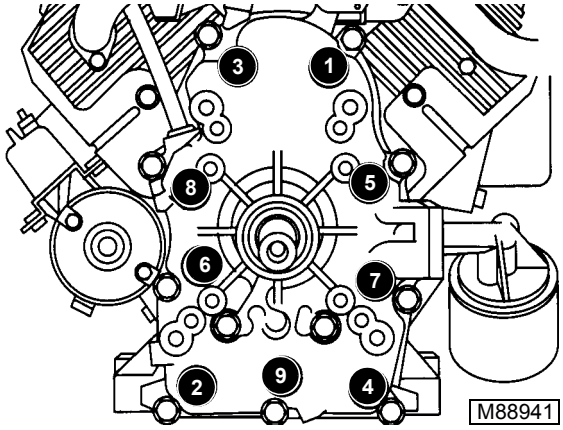



18. Place new crankcase cover gasket on crankcase.

*NOTE: Be sure O-ring (M) is installed in crankcase.*



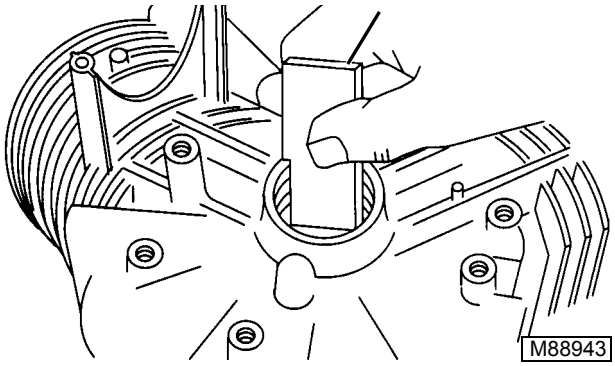

19. Rotate governor shaft (N) against boss (O).
20. Take care to protect the oil seal while assembling crankcase cover. No force should be used.




21. Tighten cover bolts to **17 N•m (150 lb-in.)** in the above sequence.
22. Install cylinder heads.
23. Install flywheel.
24. Install intake manifold and carburetor assembly.
25. Install governor lever and governor springs.
26. Install oil fill tube and dipstick assembly. Perform static governor adjustment.
27. Install engine shrouding.
28. Install air filter assembly.

## MAGNETO BEARING INSPECTION

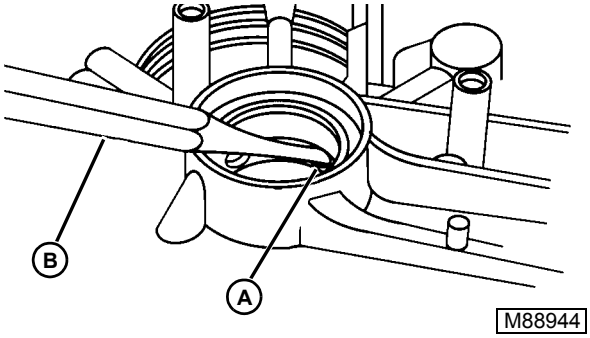
**Procedure:**



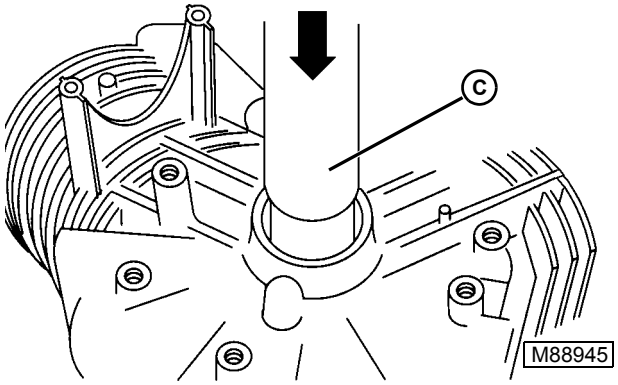

1. When checking the main magneto bearing, it should be replaced if scored or if not within specification.

**Specification:**

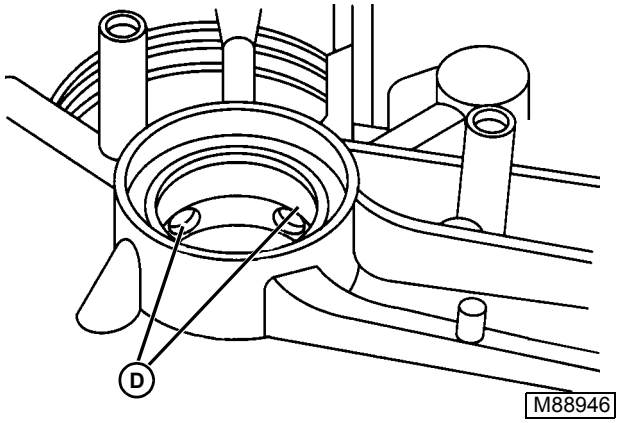
**Magneto bearing reject size . 30.08 mm (1.1845 in.)**



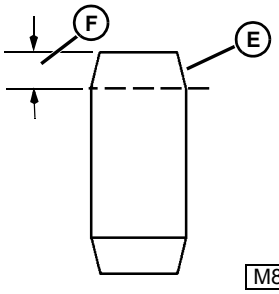

2. To remove the magneto bearing, first remove oil seal. The magneto bearing has a roll pin (A) installed in the oil gallery to prevent the bearing from turning. Use a **4.8 mm (0.1875 in.)** punch (B) to drive roll pin into oil gallery.



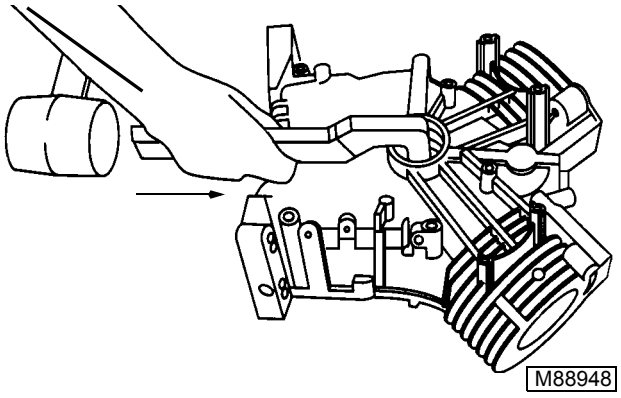

3. To install magneto bearing, place cylinder on a suitable cylinder support. Position new bushing against counterbore bearing in crankcase and carefully align oil holes in bushing with oil gallery holes in bearing. Press in new bushing with a suitable bushing driver tool (C).



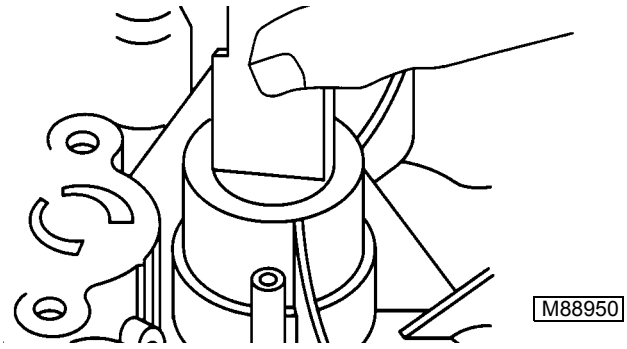

*NOTE: Be sure oil holes in bushing are aligned with oil gallery holes in bearing (D).*




4. Before installing the new roll pin, grind off the taper (E), approximately **3.0 mm (0.125 in.)** (F) from one end of new roll pin. Quench pin in water periodically to prevent loss of temper. Remove all burrs and clean thoroughly.




5. Place tapered end of new roll pin in oil hole in bearing. Use roll pin driver, to install new roll pin. Drive in new roll pin until tool bottoms. Install new oil seal. Use a suitable cylinder support and press in new oil seal until it is flush with cylinder.




**IMPORTANT: The crankcase cover must be replaced if PTO bearing is scored or if dimensions exceed reject size.**

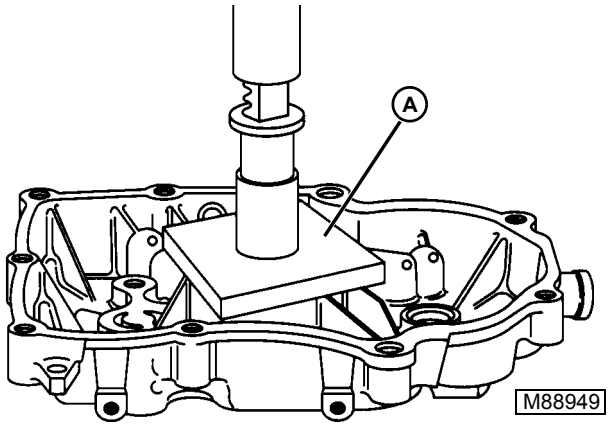
**Specification:**

**PTO main bearing reject size . 35.07 mm (1.381 in.)**

## PTO BEARING REMOVAL/ INSTALLATION

**Procedure:**

1. Remove oil pump.
2. Remove oil seal.
3. Support crankcase cover on arbor press and using bushing driver. Press out bearing toward inside of the cover.




4. Lubricate outside surface of bearing and place on inside of cover. Using an arbor press and flat steel plate (A), press in bearing until flush with surface of cover.
5. Install new oil seal using a cylinder support. Press in seal until it is flush with mounting surface.
6. When installing new PTO oil seal, properly support cylinder. Press in seal until it is **1.5 mm (0.0625 in.)** below mounting surface.
7. The crankcase cover must be replaced if the cam gear bearing dimensions exceed reject size.

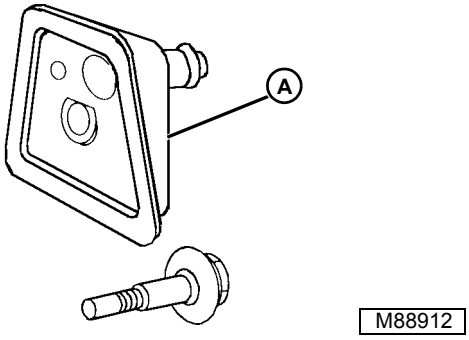
**Specifications:**

**Cam bearing gear bearing reject size**
**Magneto bearing . . . . . 16.08mm (0.633 in.)**
**PTO bearing . . . . . 20.04mm (0.789 in.)**

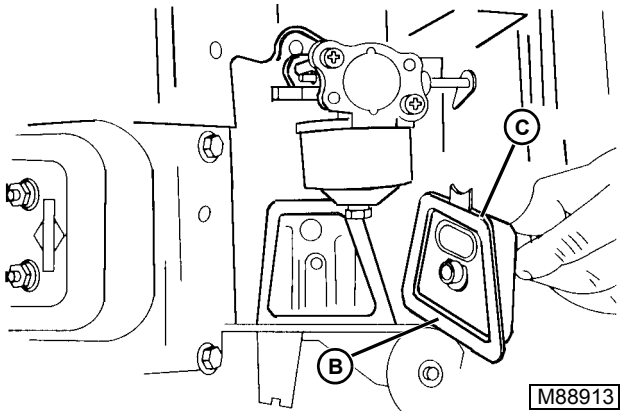
*NOTE: Always install new oil seals whenever engine is disassembled for major servicing or when repairing bearings. Always use the correct seal protector to prevent damaging oil seal.*

## BREATHER VALVE SERVICE

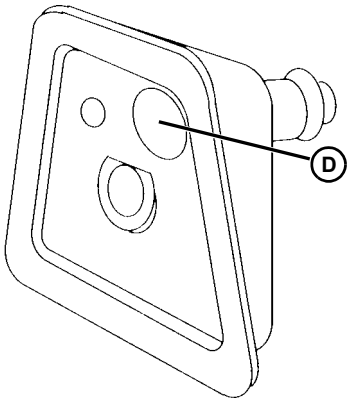
**IMPORTANT: A leak at the seal between the tube and crankcase cover, or at the seal at the upper end of the dipstick, can result in a loss of crankcase vacuum and a discharge of oil or smoke through the muffler.**




*NOTE: The engine utilizes a breather valve (A) to control and maintain a vacuum in the crankcase. The breather valve closes on the up stroke of the piston and opens on the down stroke of the piston to maintain a vacuum in the crankcase. This vacuum prevents oil leakage past piston rings, valve guides, oil seals, governor shaft and gaskets.*

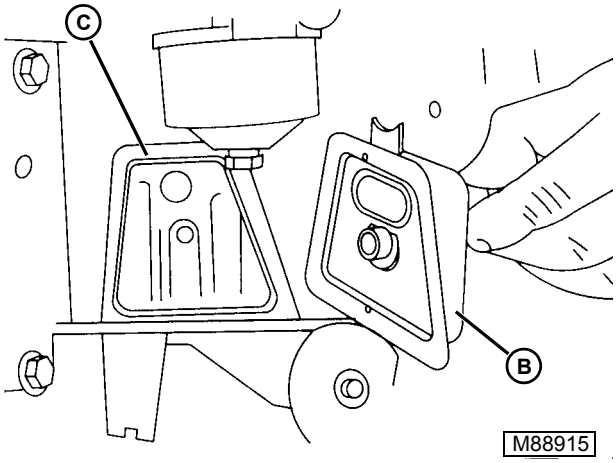



1. Before breather valve assembly (B) and gasket (C) can be removed for inspection, the air cleaner assembly and support bracket must be removed.

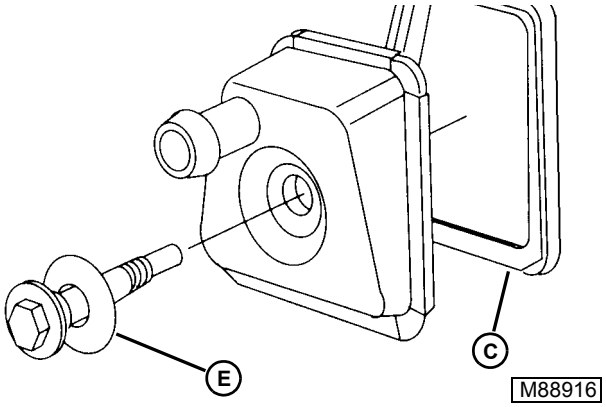



2. Check to see that reed valve (D) is not deformed. The reed valve is spring loaded and must make a complete seal around the vent hole in breather body.

**IMPORTANT: Do not use force on reed valve.**



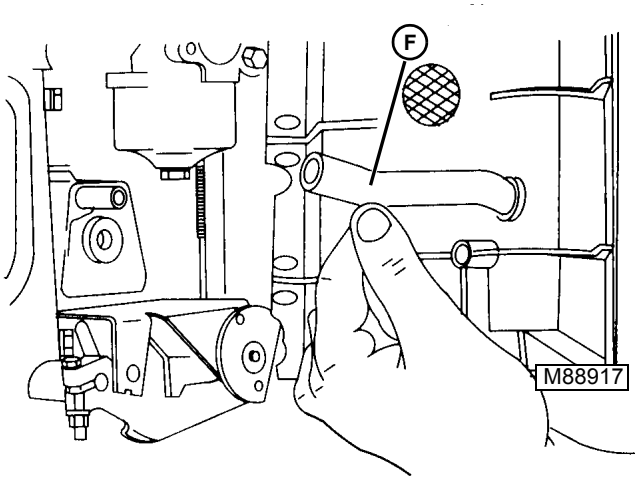

*NOTE: When installing breather (B), make sure breather gasket (C) is located properly.*




3. Place breather on gasket. Slip large O-ring (E) onto mounting screw and install screw and tighten to **3 N•m (30 lb in.)**.

**Specification:**

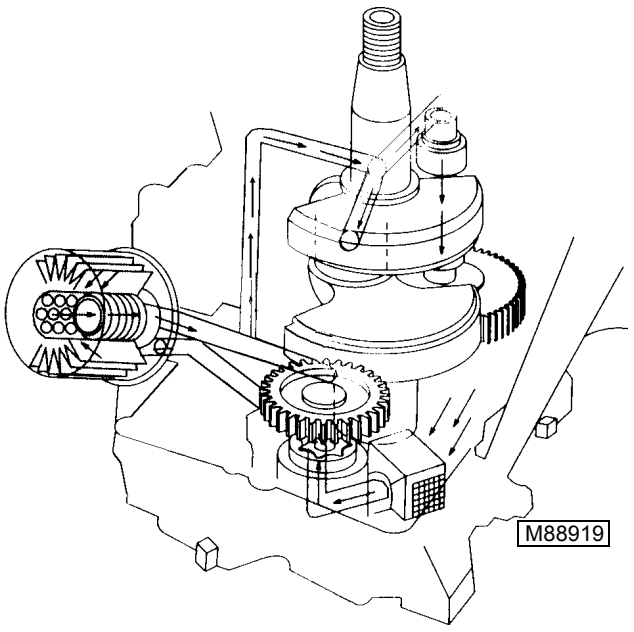
**Breather screw . . . . . 3 N•m (30 lb in.)**



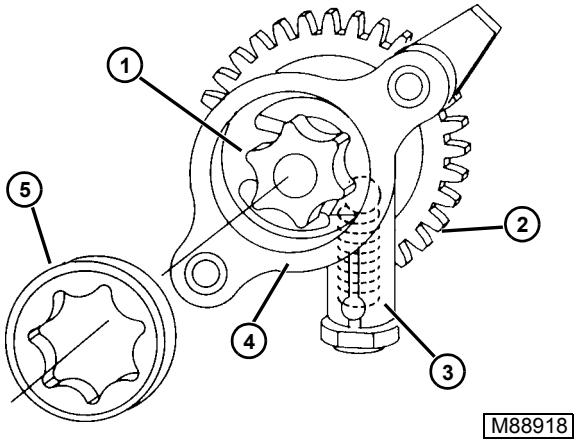

*NOTE: The breather is vented through the air cleaner to prevent dirt from entering the crankcase.*

4. Check breather tube (F) for cracks, holes or hardening. Replace if damaged.

## OIL PUMP REMOVAL / INSTALLATION



This engine is equipped with a full pressure lubrication system with an oil filter.




1. Inner Rotor
2. Drive Gear
3. Pressure Relief Valve
4. Pump Housing
5. Outer Rotor

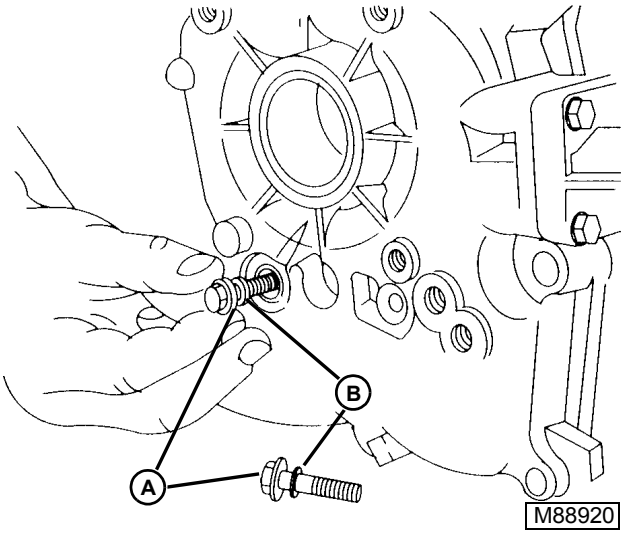
The gear driven oil pump supplies lubrication to all bearing journals.

**Specification:**

**Oil pressure . . . . . .10—50 psi**

*NOTE: Engine oil pressure will vary with oil viscosity, ambient air temperature differences, operating temperatures and engine load.*

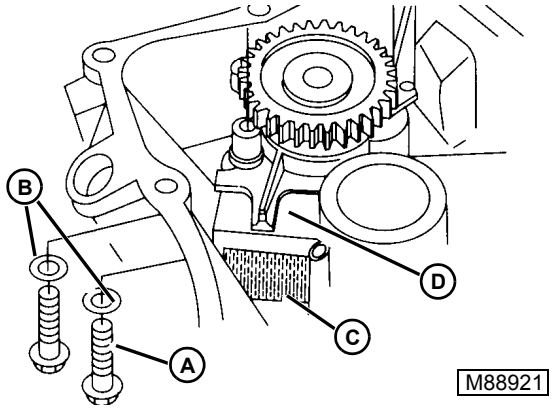
**Procedure:**




*NOTE: The oil pump is attached to the inside of the crankcase cover.*

1. Remove oil fill dipstick assembly.
2. Remove crankcase cover.
3. Remove two screws (A) and O-rings (B) attaching oil pump assembly to crankcase cover.

*NOTE: The outer rotor of pump can be removed for inspection and cleaning. With pump removed, oil pick-up screen (C) may be removed for cleaning.*



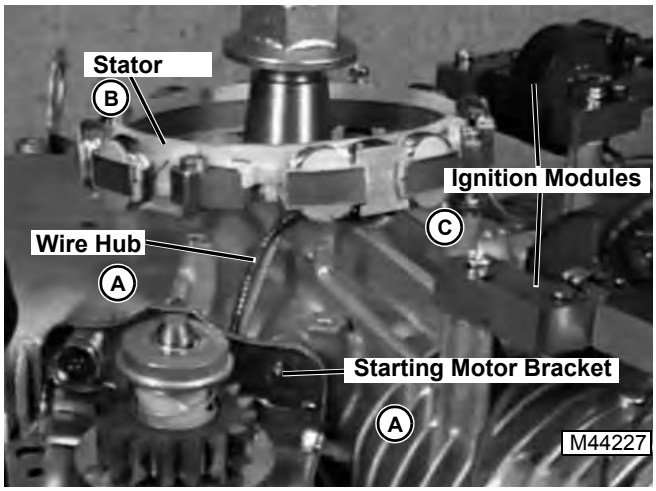

4. Slip oil pick-up screen (C) into slots in crankcase cover.
5. Install oil pump and tighten screws (A) with O-rings (B) to **7 N•m (65 lb-in.)**.

*NOTE: Boss (D) on oil pump body holds pick-up screen in proper position. Be sure in install new "O" rings on pump mounting screws.*

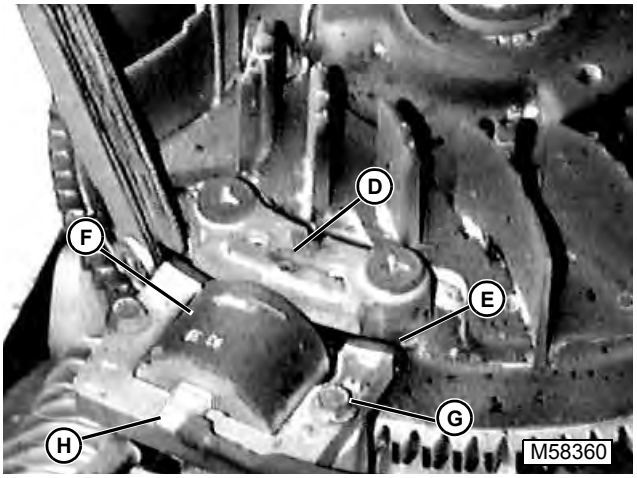
**Torque Specification:**

**Mounting screws . . . . . 7 N•m (65 lb-in.)**

# STATOR AND IGNITION MODULE REMOVE/INSTALL




1. Remove upper blower housing.
2. Turn flywheel magnet away from ignition module.
3. Disconnect wire from ignition module.
4. Remove cap screws and ignition module.
5. Remove flywheel nut and flywheel.
6. Inspect flywheel for damage, broken fins, damaged keyway, and damaged key.
7. Remove starting motor bracket (A).
8. Remove cap screws and stator (B).
9. Inspect for damage.
10. Install stator. Tighten cap screws to specification.
11. Route wires back to original position.
12. Install flywheel and tighten nut to specification.
13. Rotate magnet away from ignition module mount. Install ignition modules (C) by pushing the module away from flywheel as far as possible and tighten one screw. Repeat for second module.




14. Align flywheel magnet (D) with mounting posts for ignition module.
15. Place **0.25 mm (0.01 in.)** feeler gauge blade (E) or shim stock across magnet face.

**IMPORTANT: Ensure flywheel magnet (D) is centered on ignition module (F) so all three poles of the ignition module are properly gapped from the flywheel magnet.**

16. Position ignition module (F) so all three poles mate with the feeler gauge blade and its two mounting holes align with mounting posts.
17. Install and tighten cap screws (G) to **5.1 ± 1.1 N•m (45 ± 10 lb-in.)**.
18. Repeat steps 13 - 16 for second module.
19. Connect ground wire (H) on each module.

**Specifications:**

**Ignition module air gap . . . . . 0.25 mm (0.010 in.)**
**Module cap screws . . . 5.1 ± 1.1 N•m (45 ± 10 lb-in.)**
**Stator cap screws . . . . . 4 N•m (35 lb-in.)**
**Flywheel nut . . . . . 175 N•m (125 lb-ft)**

20. Install stator and tighten to **4 N•m (35 lb-in.)**.

**IMPORTANT: Ensure stator wires are routed behind stator wire hub to prevent interference with flywheel rotation.**

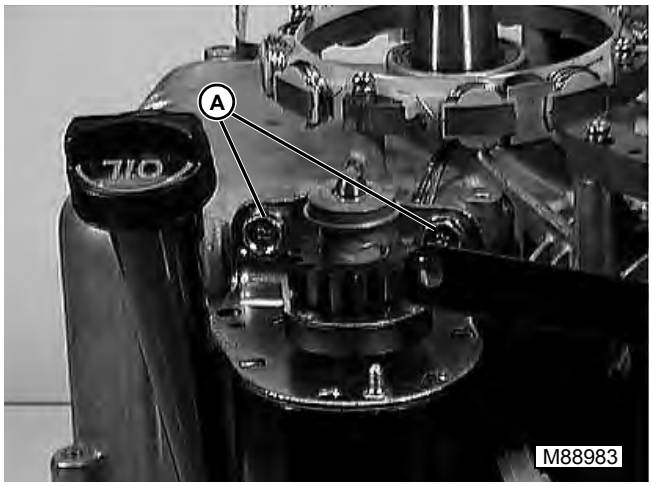
21. Install starting motor and bracket.
22. Install flywheel and tighten flywheel nut to **175 N•m (125 lb-ft)**.
23. Install upper blower housing.

## STARTER REMOVAL /INSTALLATION

**Procedure:**

1. Disconnect negative (–) battery cable.
2. Disconnect wires from the starting motor cable lug.

*NOTE: Upper blower housing, flywheel, plate (below and surrounding stator), and starting motor gear cover plate removed for clarity and/or ease of starting motor removal.*



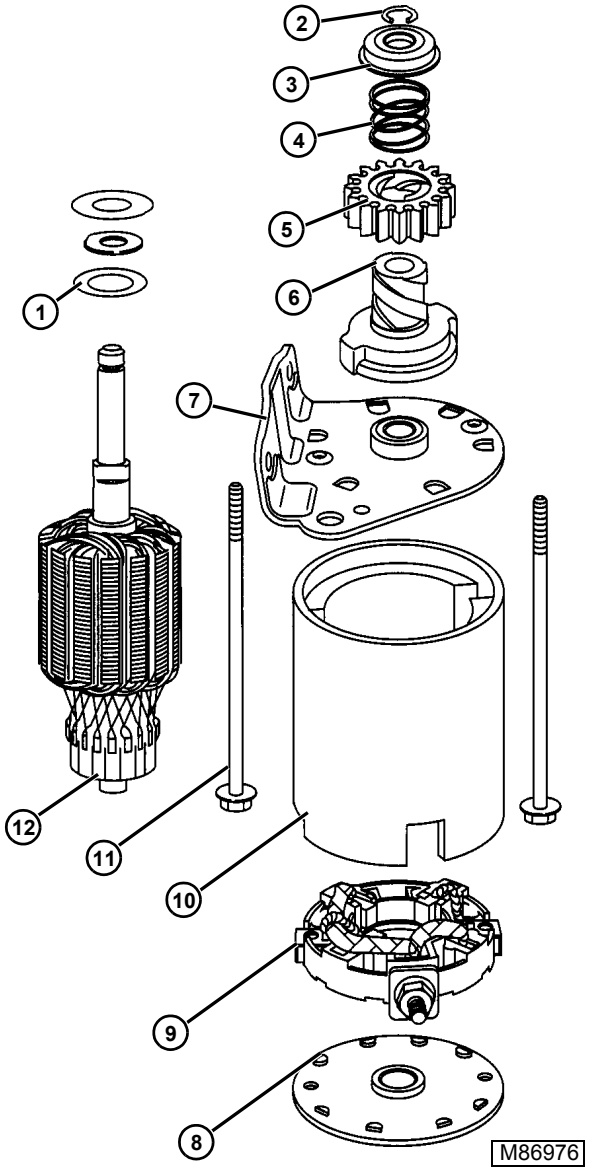

3. Remove starting motor bolts (A).
4. Install starting motor bolts and tighten to specification.

**Torque Specification:**

**Starter Bolts . . . . . 16 N•m (140 lb-in.)**

5. Install starting motor pinion gear cover plate, plate (below and surrounding stator), flywheel and upper blower housing (if removed.).

## STARTER DISASSEMBLY

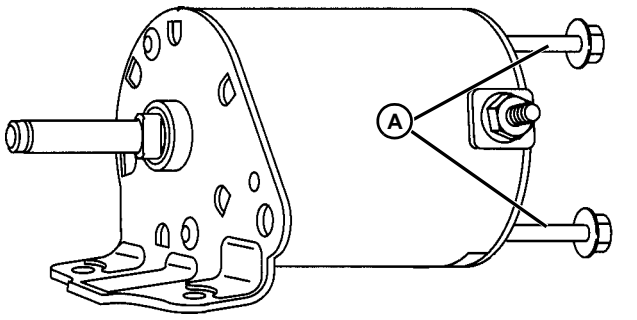



1. Wave Washer
2. C-ring
3. Retainer
4. Spring
5. Drive Gear
6. Helix (Starter Clutch)
7. Drive End Head
8. End Cap
9. Brush Holder
10. Housing
11. Thru Bolt
12. Armature

## ⚠ CAUTION

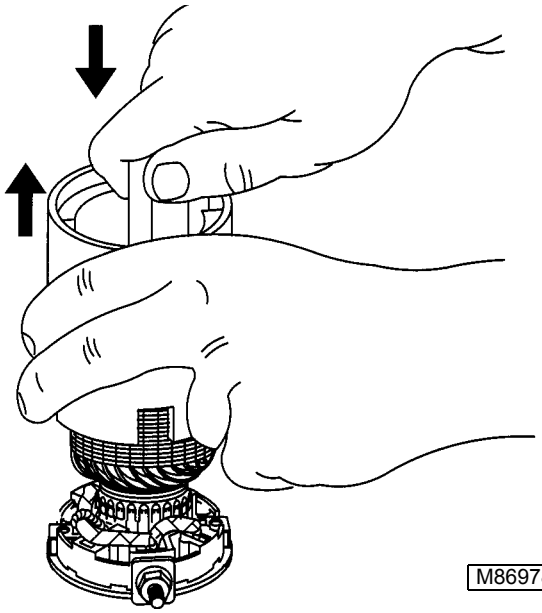
**DO NOT clamp motor housing in a vise or strike with a steel hammer. Starter motors contain two powerful magnets that can be broken or cracked if the motor housing is deformed or damaged.**

1. Refer to Pinion Gear Replacement to remove pinion gear assembly. See “STARTER PINION GEAR REPLACEMENT”.



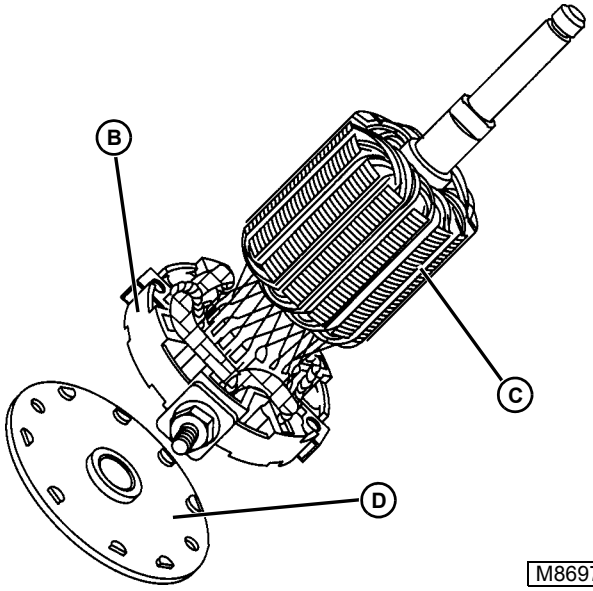

M86977

2. Remove bolts (A) and inspect bushing for wear. If worn, replace drive head end assembly.



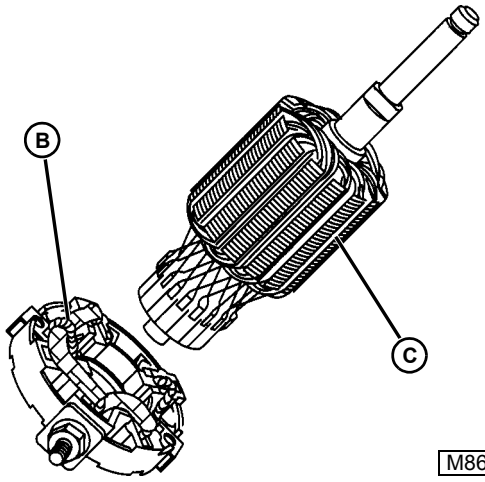
M86978

3. Hold the armature and bearing end cap against a work surface while sliding housing off the armature. (This allows the armature to remain in the bearing end cap and brush holder for inspection of brush contact to armature.)




M86979

4. While holding brush holder (B) and armature commutator (C), remove bearing end cap (D) from armature.

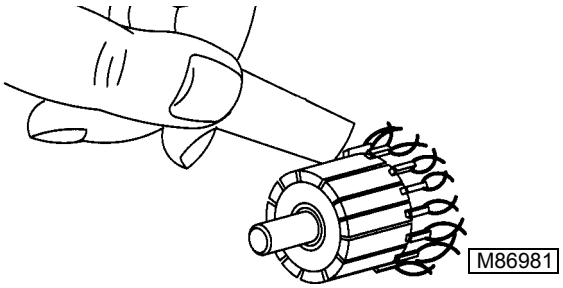



M86980

5. Remove brush holder (B) from armature commutator (C).

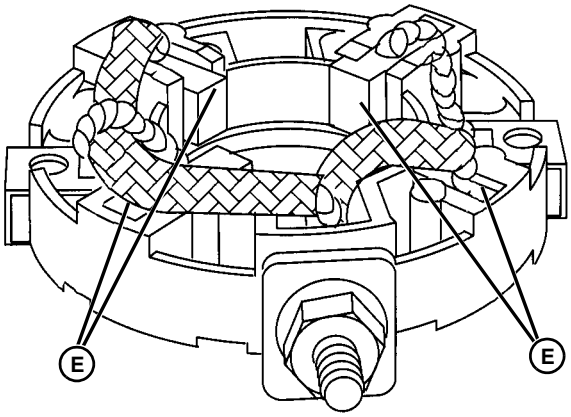
## ⚠ CAUTION

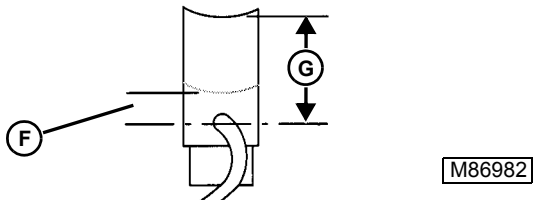
**DO NOT use emery cloth to clean the commutator. The particles from the cloth will become embedded in the commutator and cause rapid brush wear.**


M86981

*NOTE: The bearing housing and armature should not be soaked in a cleaning solution.*
*Fine sandpaper, such as crocus cloth, can be used to clean the armature.*
*The commutator may also be machined with the use of a diamond cutting tool to no less than **31.24 mm (1.23 in.)** outside diameter.*

6. Slots between the commutator bars should be cleaned as shown using a broken piece of hacksaw blade.
7. If it is suspected that the armature field coil, magnets or motor housing is defective, a new part should be tried in the motor. If proper testing equipment is available, check the suspected armature or field coil to determine if it is defective (opens or grounds).



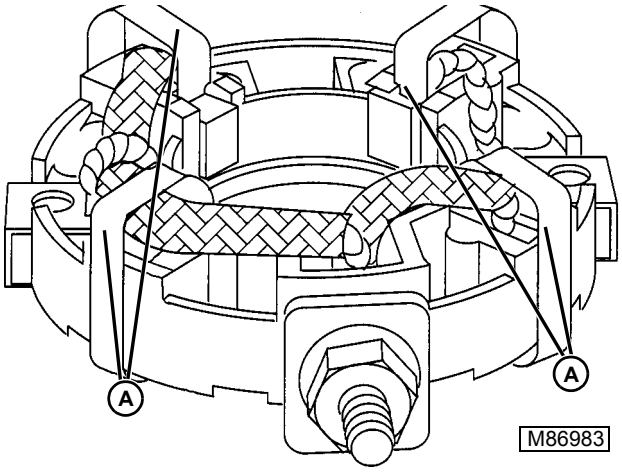



M86982

8. The brushes (E) should be checked for proper seating, weak brush springs, dirt, oil or corrosion.
9. If brushes are worn to **3 mm (0.125 in.)** (F) or less, replace brushes. Normal (new) length (G) is shown for reference.

When all parts have been thoroughly cleaned, lightly lubricate the bearings with #20 oil.

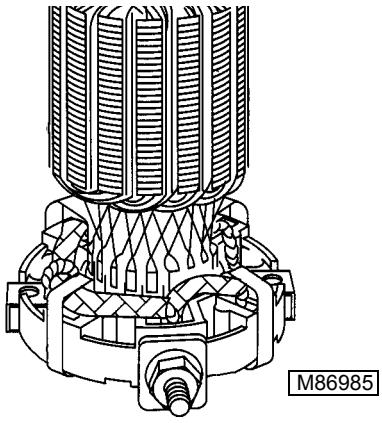
## STARTER ASSEMBLY



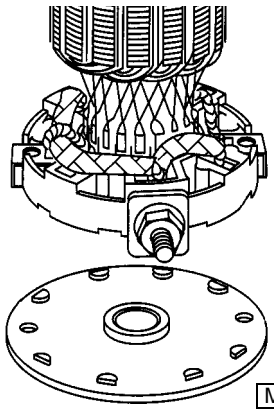
M86983

*NOTE: Brush retainers (A) can be made from standard size paperclips. Straighten and cut to length 63.5 mm (2 1/2 in.). Bend into a U-shape with 25.4 mm (1 in.) sides, and 12.7 mm (0.5 in.) bottom.*

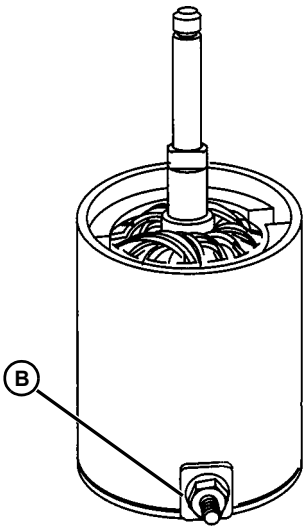
1. Place brushes in their slots, and hold brushes with retainers.


M86985

2. Place armature commutator in brush holder, and remove brush retainers.

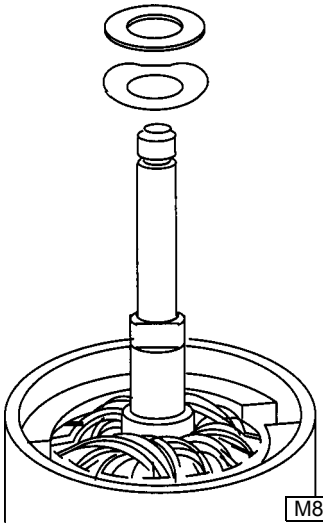

M86986

3. Install bearing end plate on armature commutator journal making sure plate indexes with brush holder.

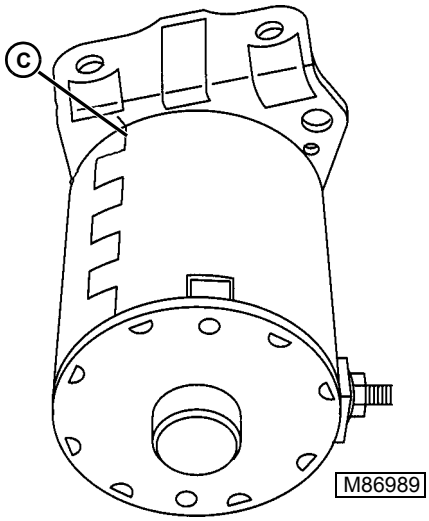


M86987

4. Slide motor housing over armature with the notch (B) toward brush holder.

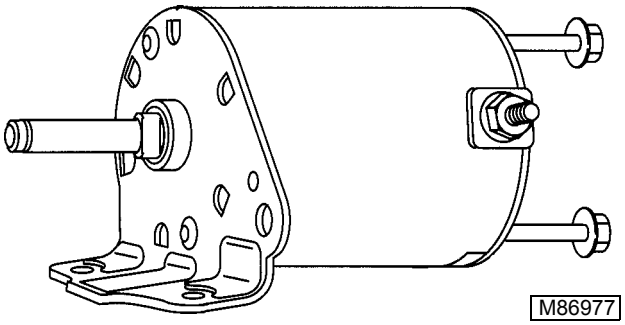

M86988

5. Place wave washer on armature shaft with concave side up. Then place flat washer on armature.



M86989

6. Place drive end cap on starting motor housing making sure that mark (C) on cap lines up with housing seam.


M86977

7. Install thru bolts in starting motor hand tight, use starting motor clutch to check for binding of armature shaft and correct if it binds, Then tighten to **5.7 N•m (50 lb-in.).**
8. Install starting motor drive.
9. Install starting motor and tighten bolts to the following:

**Torque Specifications:**

**Starter Bolts . . . . . 16 N•m (140 lb-in.)**
**Thru Bolts . . . . . 6.0 N•m (50 lb-in.)**

# STARTER PINION GEAR REPLACEMENT

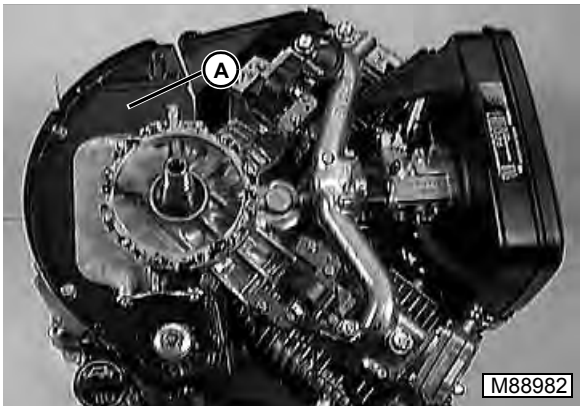
*NOTE: If only the pinion gear is to be replaced, the starting motor does not have to be removed from the engine.*

**Required Tools:**

- JDG1087 C-Ring Remover
- JDG1086 C-Ring Installer

**Procedure:**

1. Disconnect negative (–) battery cable.
2. Remove upper blower housing and flywheel.

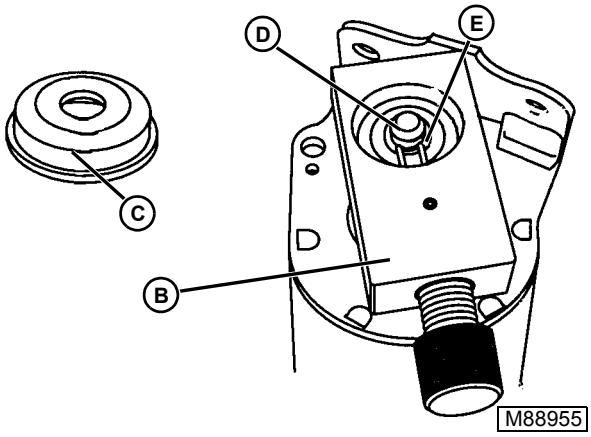


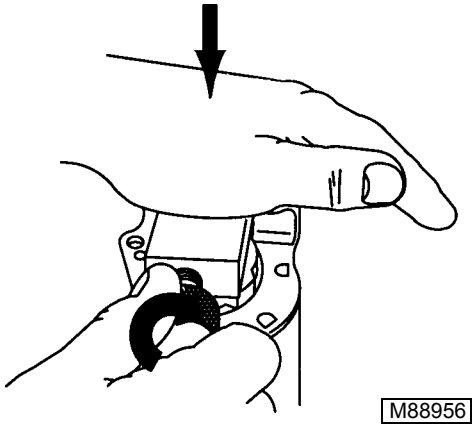

The plate (A) surrounding and below the stator does not have to be removed.

3. Position C-ring using screw driver tip so C-ring removal tool (JDG1087) (B) can be aligned properly.

**⚠ CAUTION**

**To Prevent eye injury, always wear eye protection when removing C-ring.**

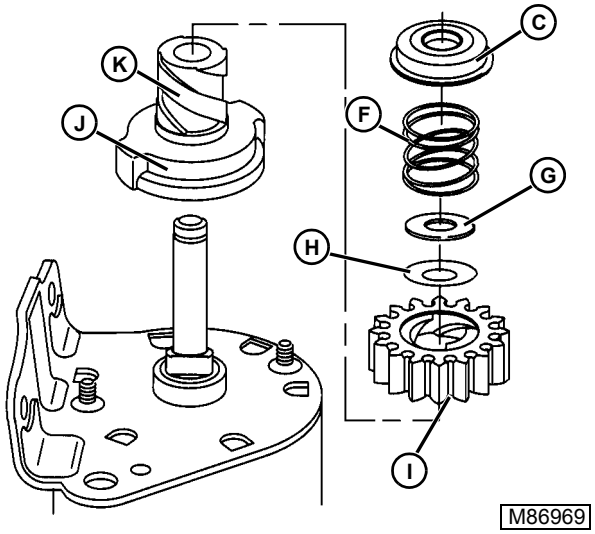



4. Install C-ring removal tool, JDG1087 (B) over retainer (C) and compress spring.

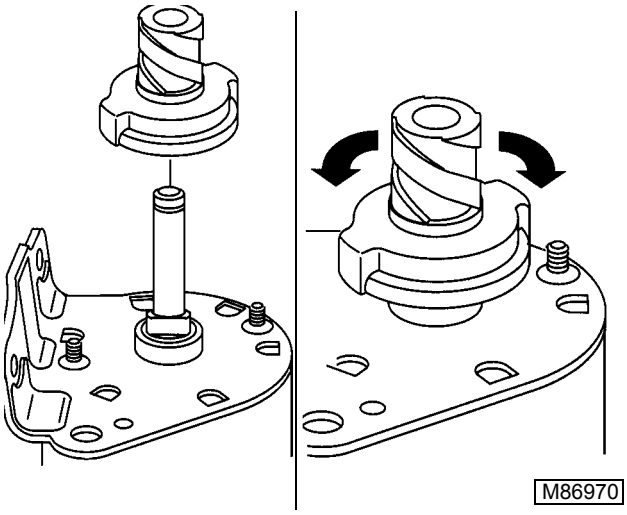
**IMPORTANT: The C-ring (D) is not reusable once removed.**

5. Screw in handle until drive pins (E) on tool forces off the C-ring from starting motor shaft.

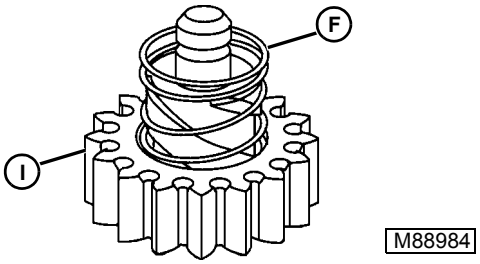



6. Remove retainer (C), spring (F), flat washer (G), wave washer (H), pinion gear (I) and starting motor clutch (J).
7. Before installing starting motor clutch, apply a lithium based lubricant sparingly around base of helix (K).

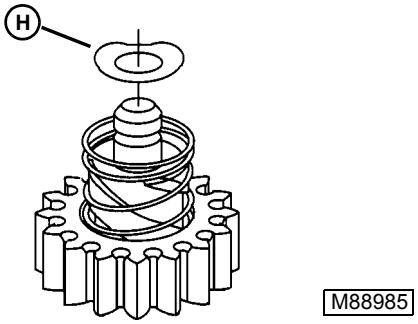
*NOTE: Do not use mineral spirit based lubricants to lubricate helix.*



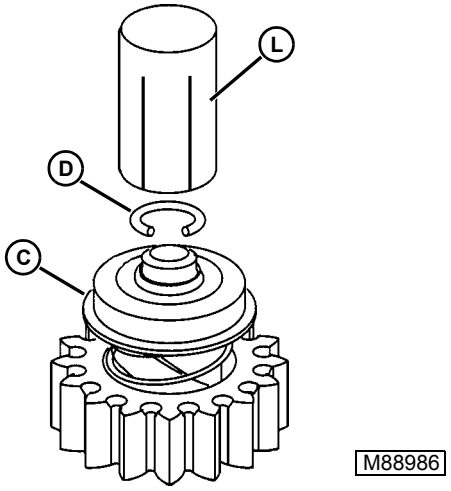

8. Place starting motor clutch on starting motor shaft, rotate clutch until it drops into place.




9. Install pinion gear with beveled side of teeth up, then install return spring making sure spring is in recess of starting motor gear.




10. Place wave washer (H) with concave side up on starting motor clutch spline.




11. Place retainer (C) and new C-ring (D) on starting motor shaft.
12. Align one of the slots on the C-ring installer tool (JDG1086) (L) with open end of C-ring.
13. Use a hammer to drive snap ring down until it engages groove in starting motor shaft. Then make sure retainer is all the way up against the snap ring.
14. Install flywheel, upper blower housing and reconnect negative (–) battery cable.

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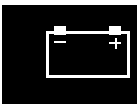


# READING ELECTRICAL SCHEMATICS

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.

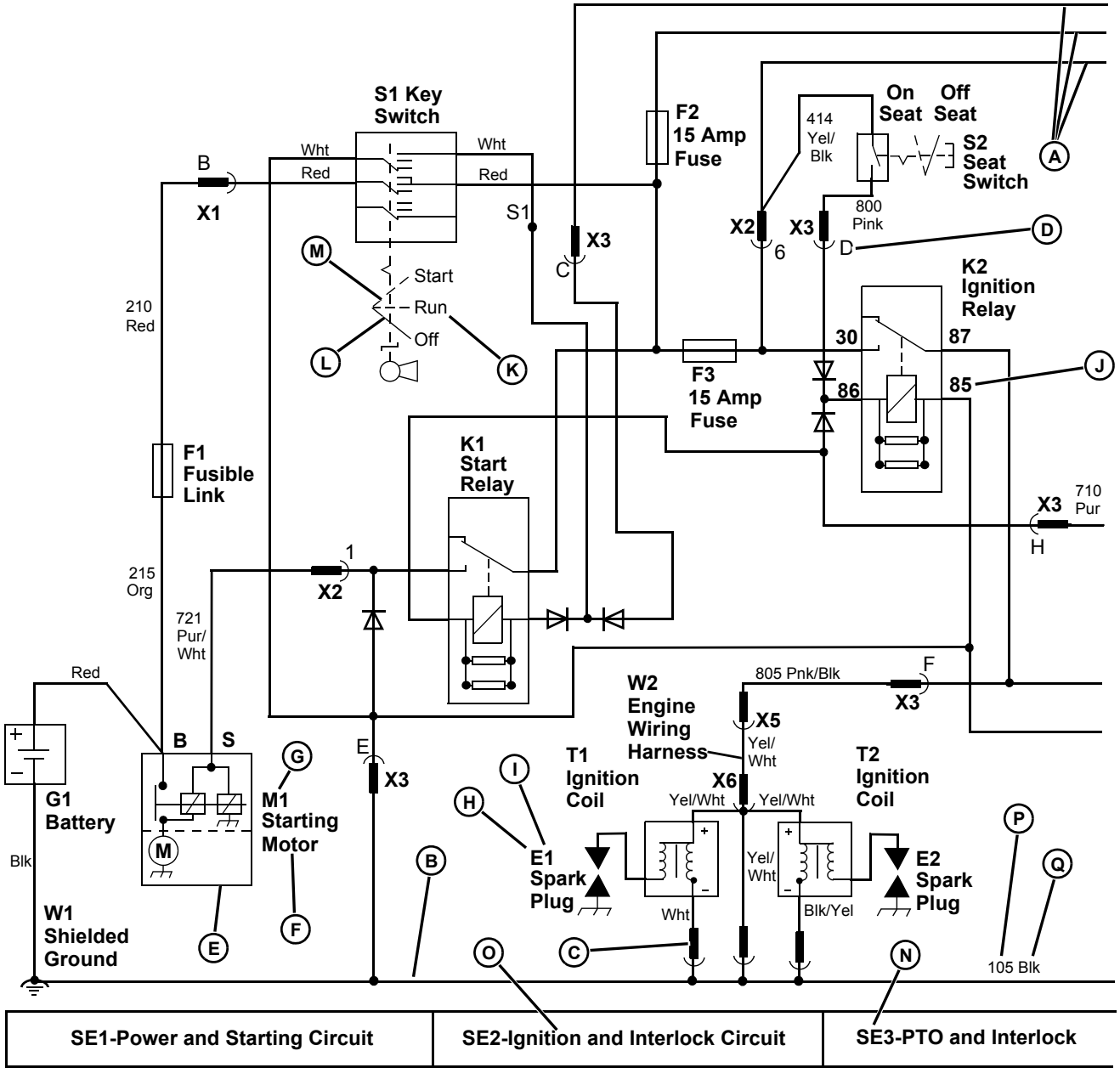
Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

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.

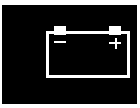
The same component name and identification code are used consistently on all diagrams in this section. Components can be easily cross-referenced.



# THEORY AND DIAGNOSTIC INFORMATION

## THEORY OF OPERATION INFORMATION

The theory of operation 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

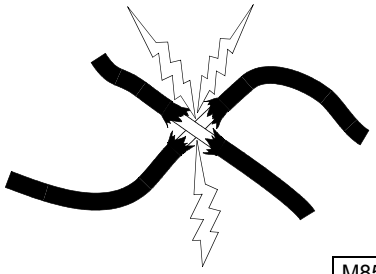
| | |
|---|---|
| Blk | Black |
| Blu | Blue |
| Brn | Brown |
| Grn | Green |
| Gry | Gray |
| Org | Orange |
| Pnk | Pink |
| Pur | Purple |
| Red | Red |
| Tan | Tan |
| Wht | White |
| Yel | Yellow |
| Blk/Wht | Black/White |
| Blu/Wht | Blue/White |
| Brn/Wht | Brown/White |
| Brn/Yel | Brown/Yellow |
| 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 |

# COMMON CIRCUIT TESTS

**Shorted Circuit:**

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

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

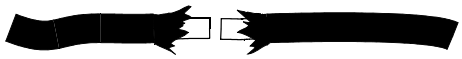


M85600 mif

**High Resistance or Open Circuit:**

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

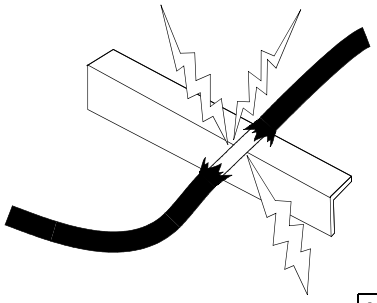
1. Check all terminals and grounds of the circuit for corrosion.
2. If terminals are not corroded or loose, the problem
3. is in the component or wiring.



M85601 mif

**Grounded Circuit:**

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



M85602 mif

# CONDUCTORS FOR 12 VOLT CIRCUITS

| STRANDED CONDUCTORS FOR 12 VOLT CIRCUITS | | | | | | |
|---|---|---|---|---|---|---|
| SAE WIRE SIZE (GAUGE) | 20 | 18 | 16 | 14 | 12 | 10 |
| METRIC WIRE SIZE (MM) | 0.5 | 0.8 | 1.0 | 2.0 | 3.0 | 5.0 |
| TYPICAL STRANDING | 7 X 28 | 16 X 30 | 19 X 29 | 19 X 27 | 19 X 25 | 19 X 23 |
| MINIMUM CONDUCTOR AREA IN CIRCULAR MILS | 1072 | 1537 | 2336 | 3702 | 5833 | 9343 |

# SPECIFICATIONS

**Battery:**

Voltage . . . . . 12 VDC

**Ignition**

**LT133/LT155 (Kohler Engines):**

Air gap . . . . . 0.2 – 0.3 mm (0.008 – 0.012 in.)

**LT166 (Briggs & Stratton Engine):**

Air gap . . . . . 0.2 – 0.3 mm (0.008 – 0.012 in.)

**Spark Plug**

**LT133/LT155 (Kohler Engines):**

Type . . . . . Champion RC12YC

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

Torque . . . . . 24.4 - 29.8 N•m (18 - 22 lb-ft)

**LT166 (Briggs & Stratton Engine):**

Type . . . . . Champion RC12YC

Gap . . . . . 1.02 mm (0.040 in.)

Torque . . . . . 20 N•m (180 lb-in.)

**Starting Motor**

**LT133/LT155 (Kohler Engines):**

Type . . . . . Bendix

Starting motor amp draw (on vehicle) . . . . . 180 amps (max.)

Starting motor no-load amp draw (free running) . . . . . 50 amps (max.)

**LT166 (Briggs & Stratton Engine):**

Type . . . . . Bendix

Starting motor amp draw (on vehicle) . . . . . 90 - 100 amps

Starting motor no-load amp draw (free running) . . . . . 35 amps (max.)

**Stator:**

**LT133/LT155 w/ 3 Amp Charger:**

Size . . . . . .3 amps

Unregulated Amperage (Minimum) at Fast Idle . . . . . 2 - 3 amps

Charging Lead Voltage (Minimum) at Fast Idle . . . . . 28 volts DC

Lighting Lead Voltage (Minimum) at Fast Idle . . . . . 15 volts AC

**LT133/LT155 w/ 15 Amp Charger**

**LT133 . . . . . S/N MOL133A088860–**

**LT155 w/38 in. deck . . . . . S/N MOL155B090931–**

**LT155 w/42 in. deck . . . . . S/N MOL155C086977–**

**LT155 less deck . . . . . .S/N MOL155H085065–:**

Size . . . . . .15 amps

Regulated Amperage (Minimum) at Fast Idle . . . . . 3 - 15 amps

Regulated Voltage (Minimum) at Fast Idle . . . . . 12.2–14.7 volts DC

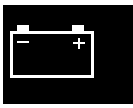
Unregulated Voltage (Minimum) at Fast Idle . . . . . 28 volts AC

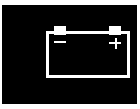
**LT166:**

Size . . . . . .16 amps
Regulated Amperage (Minimum) at Fast Idle . . . . . 3 - 16 amps
Regulated Voltage (Minimum) at Fast Idle . . . . . 12.2–14.7 volts DC
Unregulated Voltage (Minimum) at Fast Idle . . . . . 30 volts AC

**Lighting:**

Headlights . . . . . .GE 1156 or equivalent





# SCHEMATICS AND WIRING HARNESS LEGENDS–LT133/155

## LT133/LT155 w/ 3 AMP SYSTEMS

E1–Spark Plug (SE4, W2)

E2–RH Headlight (SE5, W3)

E3–LH Headlight (SE5, W3)

F1–Fusible Link (SE1, W1)

G1–Battery (SE1, W1)

G2–Stator (SE3, W2)

K1–Starting Motor Solenoid (SE1, W1)

K2–Seat Relay (SE2, W1)

K3–RIO Latch Relay (SE2, W1)

K4–Out of Seat Relay (SE2, W1)

K5–Shunt Relay (SE2, W1)

M1–Starting Motor (SE2, W1)

S1–Key Switch (SE2, W1)

S2–PTO Switch (SE2, W1)

S3–Brake Switch (SE2, W1)

S4–RIS Switch (SE2, W1)

S5–RIO Switch (SE2, W1)

S6–Seat Switch (SE2, W1)

T1–Magneto Ignition (SE4, W2)

V1–Diode (SE2, W1)

V2–Diode (SE4, W2)

W1–Shielded Ground (SE1, W1)

Y1–Fuel Shutoff Solenoid (SE1, W1) (Optional)

**CONNECTORS:**

X1–W1 Main Wiring Harness to Engine (SE3, W1; SE4, W1)

X2–W1 Main Wiring Harness to Headlights (SE5, W1)

X3–W1 Main Wiring Harness to V1 Diode (SE2, W1)

X4–W1 Main Wiring Harness to Y1 Fuel Shutoff Solenoid (SE1, W1)

**WIRING HARNESSES:**

W1–Main Wiring Harness

W2–Kohler Engine Wiring Harness

W3–Headlight Wiring Harness

## LT133/LT155 w/ 15 AMP SYSTEMS and 4 POSITION KEY SWITCH

E1–RH Headlight (SE1, W2)

E2–LH Headlight (SE1, W2)

E3–Spark Plug (SE3, W3)

F1–Fusible Link (SE1, W1)

G1–Battery (SE1, W1)

G2–Stator (SE3, W3)

K1–Starting Motor Solenoid (SE1, W1)

K2–Seat Relay (SE2, W1)

K3–RIO Latch Relay (SE2, W1)

K4–Out of Seat Relay (15 Amp System Only), (SE2, W1)

K4–Shunt Relay (4 Position Key Switch Only) (SE2, W1)

K5–Shunt Relay (15 Amp System Only) (SE2, W1)

M1–Starting Motor (SE1, W1)

S1–Key Switch (SE1, W1)

S2–PTO Switch (SE2, W1)

S3–Brake Switch (SE2, W1)

S4–RIS Switch (SE2, W1)

S5–RIO Switch (SE2, W1)

S6–Seat Switch (SE3, W1)

T1–Magneto Ignition (SE3, W3)

V1–Diode (SE2, W1)

W1–Shielded Ground (SE1, W1)

Y1–Fuel Shutoff Solenoid (SE1, W1) (Optional)

**CONNECTORS:**

X1–W1 Main Wiring Harness to W2 Headlight Wiring Harness (SE1, W1)

X2–W1 Main Wiring Harness to Y1 Fuel Shutoff Solenoid (SE1, W1)

X3–W1 Main Wiring Harness to V1 Diode (SE2, W1)

X4–W1 Main Wiring Harness to W3 Engine Wiring Harness (SE3, W1)

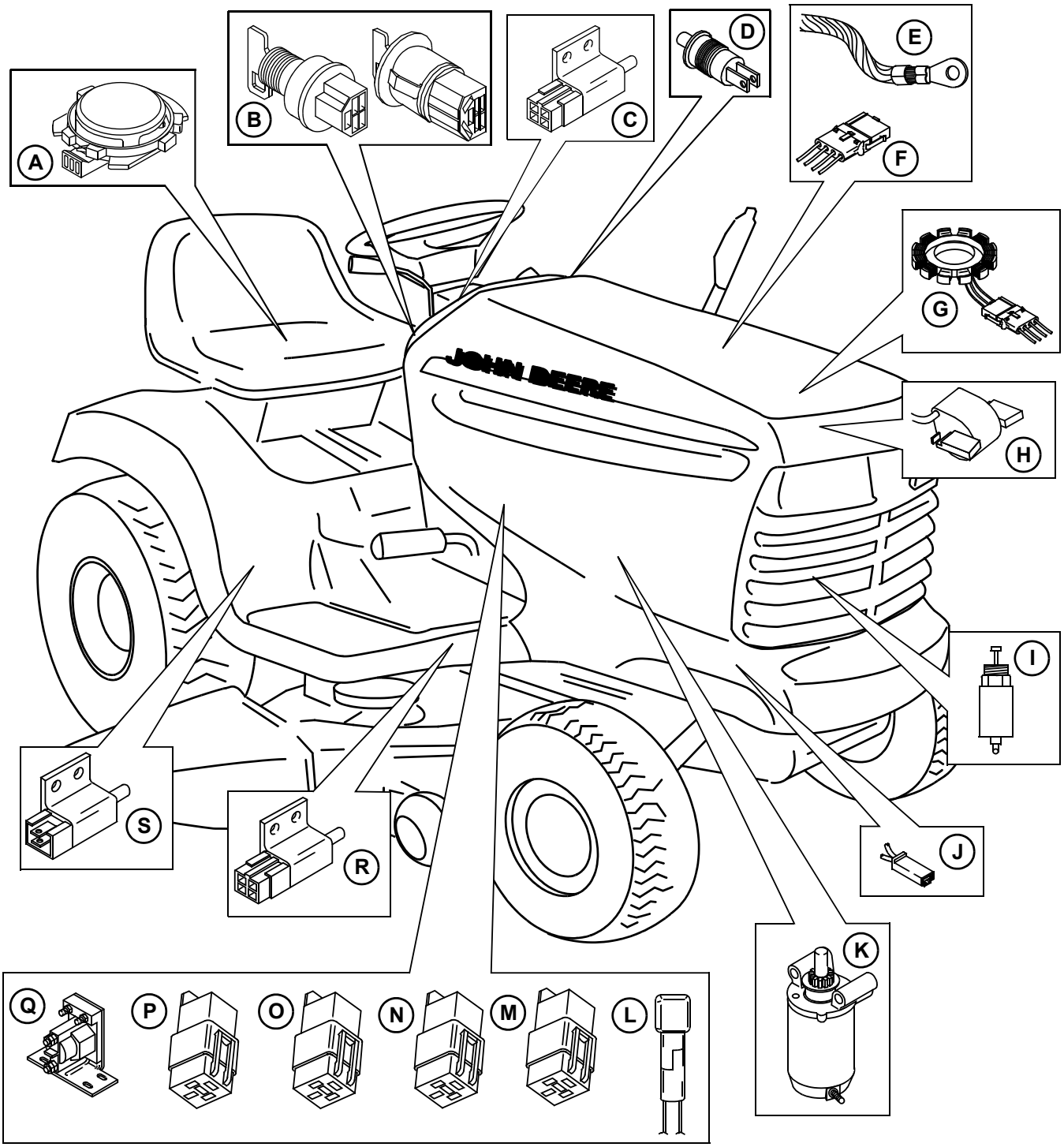
**WIRING HARNESSES:**

W1–Main Wiring Harness

W2–Headlight Wiring Harness

W3–Kohler Engine Wiring Harness

# COMPONENT LOCATION–LT133/LT155




| | | | |
|---|---|---|---|
| A. S6 Seat Switch | F. X1 Engine Connector | K. M1 Starting Motor | P. K3 RIO Latch Relay |
| B. S1 Key Switch | G. G2 Stator | L. V1 Diode | Q. K1 Starting Motor Solenoid |
| C. S2 PTO Switch | H. T1 Magneto Ignition | M. K5 Shunt Relay | R. S3 Brake Switch |
| D. S4 RIS Switch | I. Y1 Fuel Shutoff Solenoid | N. K4 Out of Seat Relay | S. S5 RIO Switch |
| E. W1 Ground | J. X2 Headlight connector | O. K2 Seat Relay | |

# SCHEMATIC AND WIRING HARNESS LEGENDS–LT166

## LT166–w/3 POSITION KEY SWITCH

E1–Spark Plug (SE3, W2)

E2–Spark Plug (SE3, W2)

E3–RH Headlight (SE5, W3)

E4–LH Headlight (SE5, W3)

F1–Fusible Link (SE1, W1)

G1–Battery (SE1, W1)

G2–Stator (SE4, W2)

K1–Starting Motor Solenoid (SE1, W1)

K2–RIO Latch Relay (SE2, W1)

M1–Starting Motor (SE1, W1)

S1–Key Switch (SE2, W1)

S2–RIO Switch (SE2, W1)

S3–PTO Switch (SE2, W1)

S4–Seat Switch (SE2, W1)

S5–RIS Switch (SE2, W1)

S6–Brake Switch (SE2, W1)

T1–Magneto Ignition (SE3, W2)

T2–Magneto Ignition (SE3, W2)

V1–Diode (SE3, W2)

V2–Diode (SE3, W2)

V3–Diode (SE4, W2)

W1–Shielded Ground (SE1, W1)

Y1–Fuel Shutoff Solenoid (SE1, W1)

**CONNECTORS:**

X1–W1 Main Wiring Harness to Engine (SE4, W1)

X2–W1 Main Wiring Harness to Headlights (SE5, W1)

X3–W1 Main Wiring Harness to Y1 Fuel Shutoff Solenoid (SE1, W1)

**WIRING HARNESSES:**

W1–Main Wiring Harness

W2–B&S Engine Wiring Harness

W3–Headlight Wiring Harness

## LT166 w/4 POSITION KEY SWITCH

E1–Spark Plug (SE3, W2)

E2–Spark Plug (SE3, W2)

E3–RH Headlight (SE5, W3)

E4–LH Headlight (SE5, W3)

F1–Fusible Link (SE1, W1)

G1–Battery (SE1, W1)

G2–Stator (SE4, W2)

K1–Starting Motor Solenoid (SE1, W1)

K2–RIO Latch Relay (SE2, W1)

M1–Starting Motor (SE1, W1)

S1–Key Switch (SE2, W1)

S2–RIO Switch (SE2, W1)

S3–PTO Switch (SE2, W1)

S4–Seat Switch (SE2, W1)

S5–Brake Switch (SE2, W1)

S6–RIS Switch (SE2, W1)

T1–Magneto Ignition (SE3, W2)

T2–Magneto Ignition (SE3, W2)

V1–Diode (SE3, W2)

V2–Diode (SE3, W2)

V3–Diode (SE4, W2)

W1–Shielded Ground (SE1, W1)

Y1–Fuel Shutoff Solenoid (SE1, W1)

**CONNECTORS:**

X1–W1 Main Wiring Harness to Y1 Fuel Shutoff Solenoid (SE1, W1)

X2–W1 Main Wiring Harness to T1 and T2 Magneto Ignition (SE3, W1)

X3–W1 Main Wiring Harness to W2 Engine Wiring Harness (SE4, W1)

X4–W1 Main Wiring Harness to W3 Headlight Wiring Harness (SE5, W1)

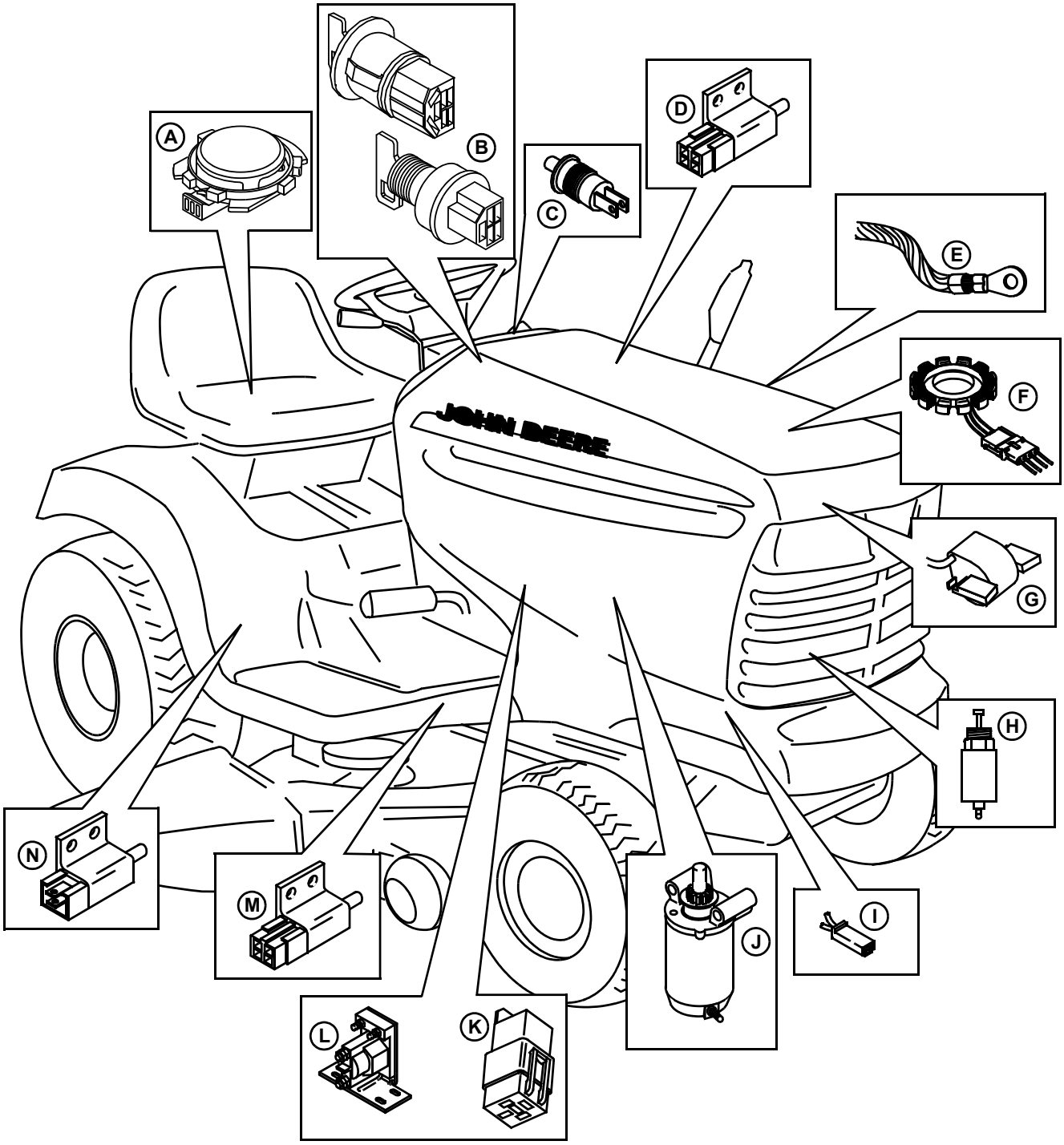
**WIRING HARNESSES:**

W1–Main Wiring Harness

W2–B&S Engine Wiring Harness

W3–Headlight Wiring Harness

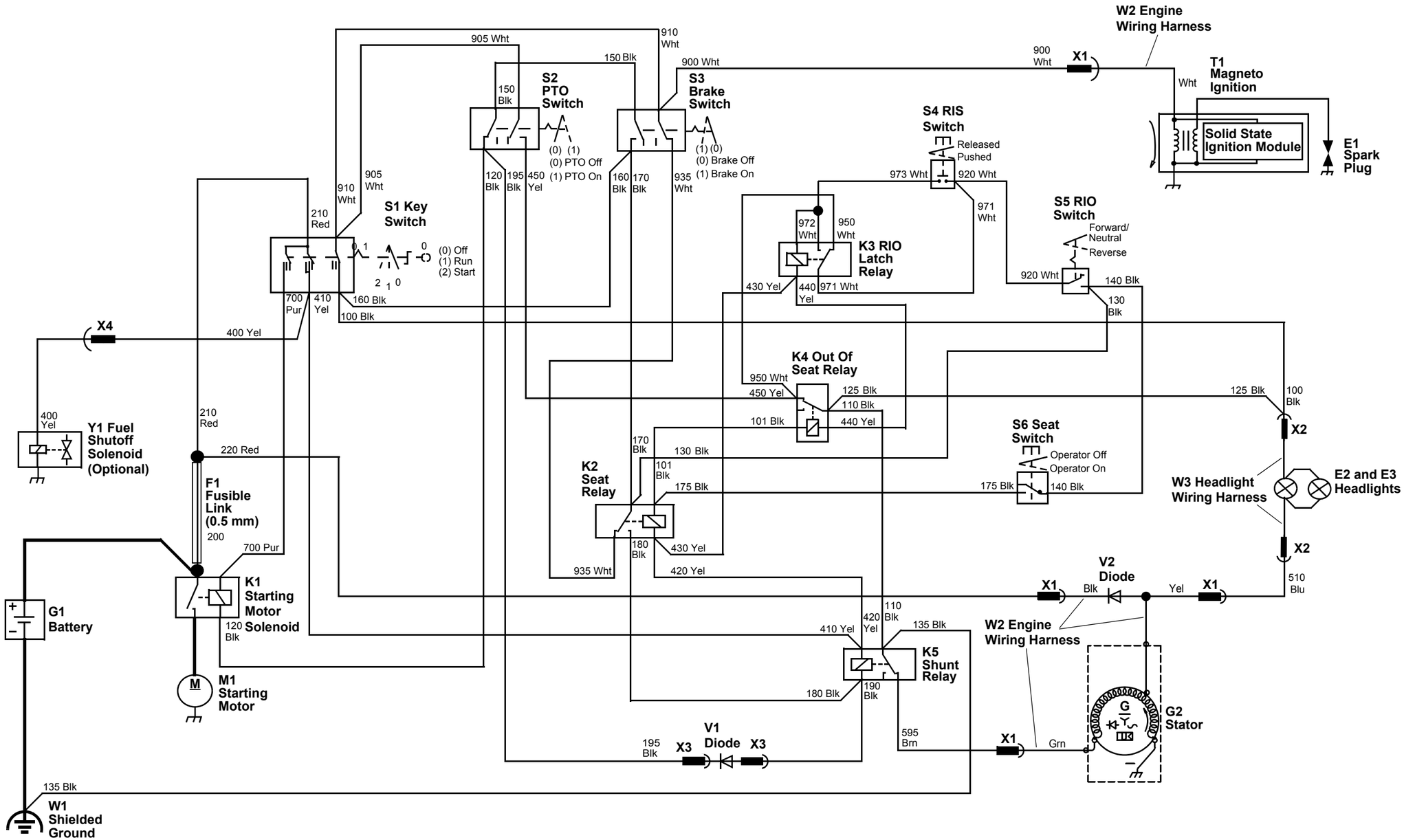
# COMPONENT LOCATION–LT166




| | | | |
|---|---|---|---|
| A. S2 Seat Switch | E. W1 Shielded Ground | I. X4 Headlight Connector | M. S6 Brake Switch |
| B. S1 Key Switch | F. G2 Stator | J. M1 Starting Motor | N. S4 RIO Switch |
| C. S7 RIS Switch | G. T1 & T2 Magneto Ignition | K. K2 RIO Latch Relay | |
| D. S5 PTO Switch | H. Y1 Fuel Shutoff Solenoid | L. K1 Starting Motor Relay | |

# SCHEMATICS AND WIRING HARNESSES

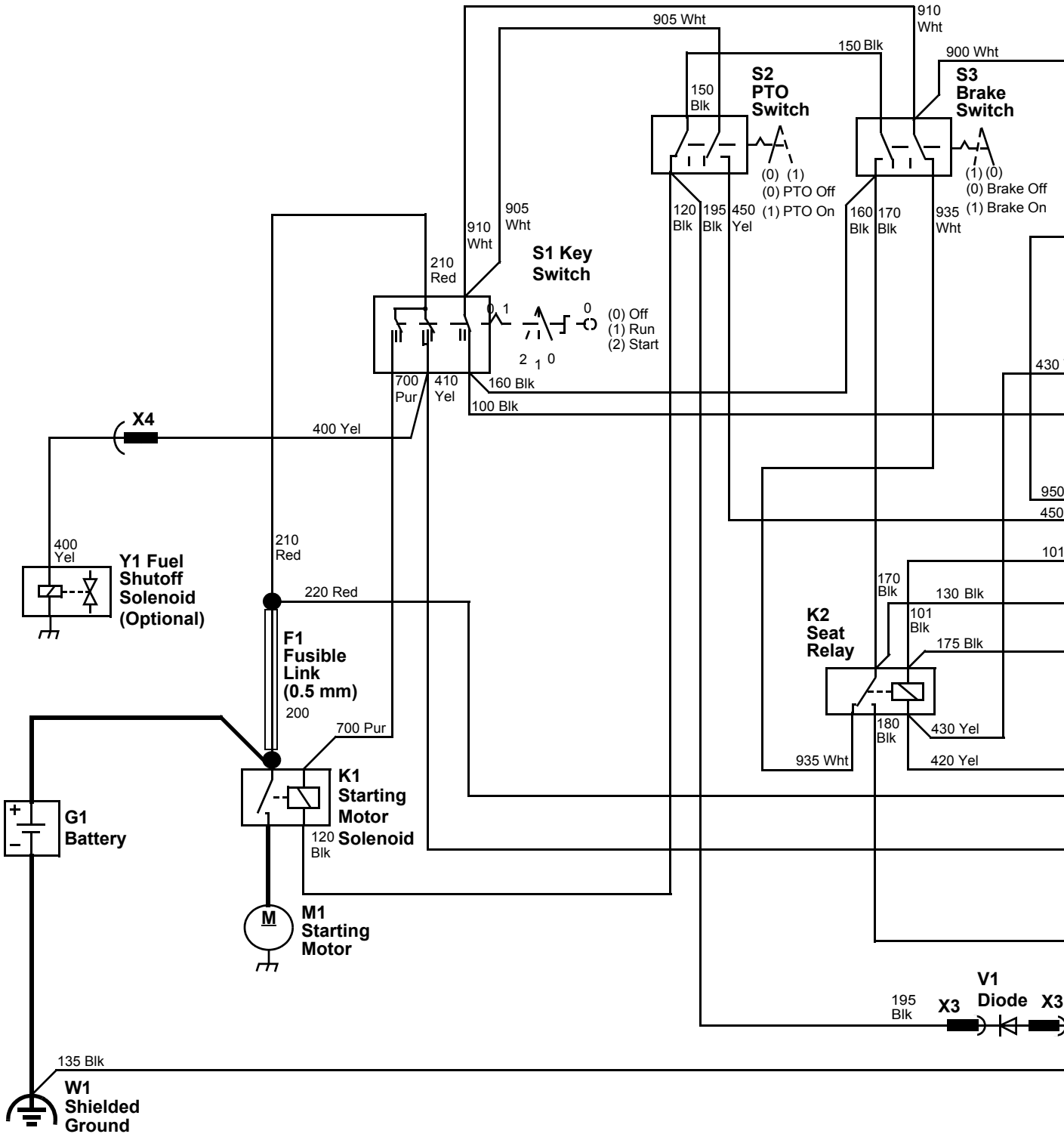
## W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 3 AMP SYSTEM



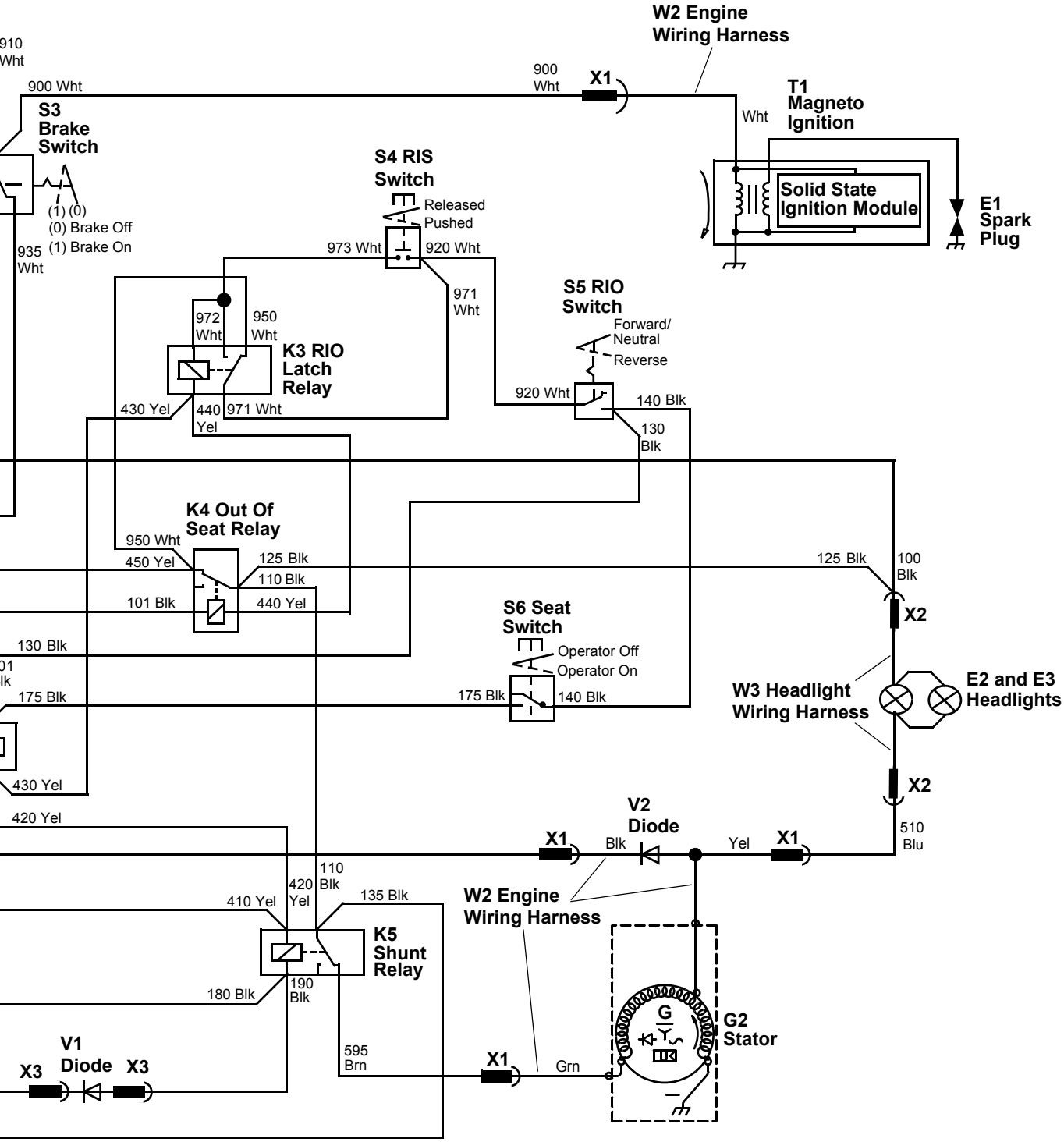

| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK | SE 3 - CHARGING | SE 4 - ENGINE IGNITION | SE 5 - HEADLIGHTS |
|---|---|---|---|---|

# SCHEMATICS AND WIRING HARNESSES

## W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 3 AMP SYSTEM



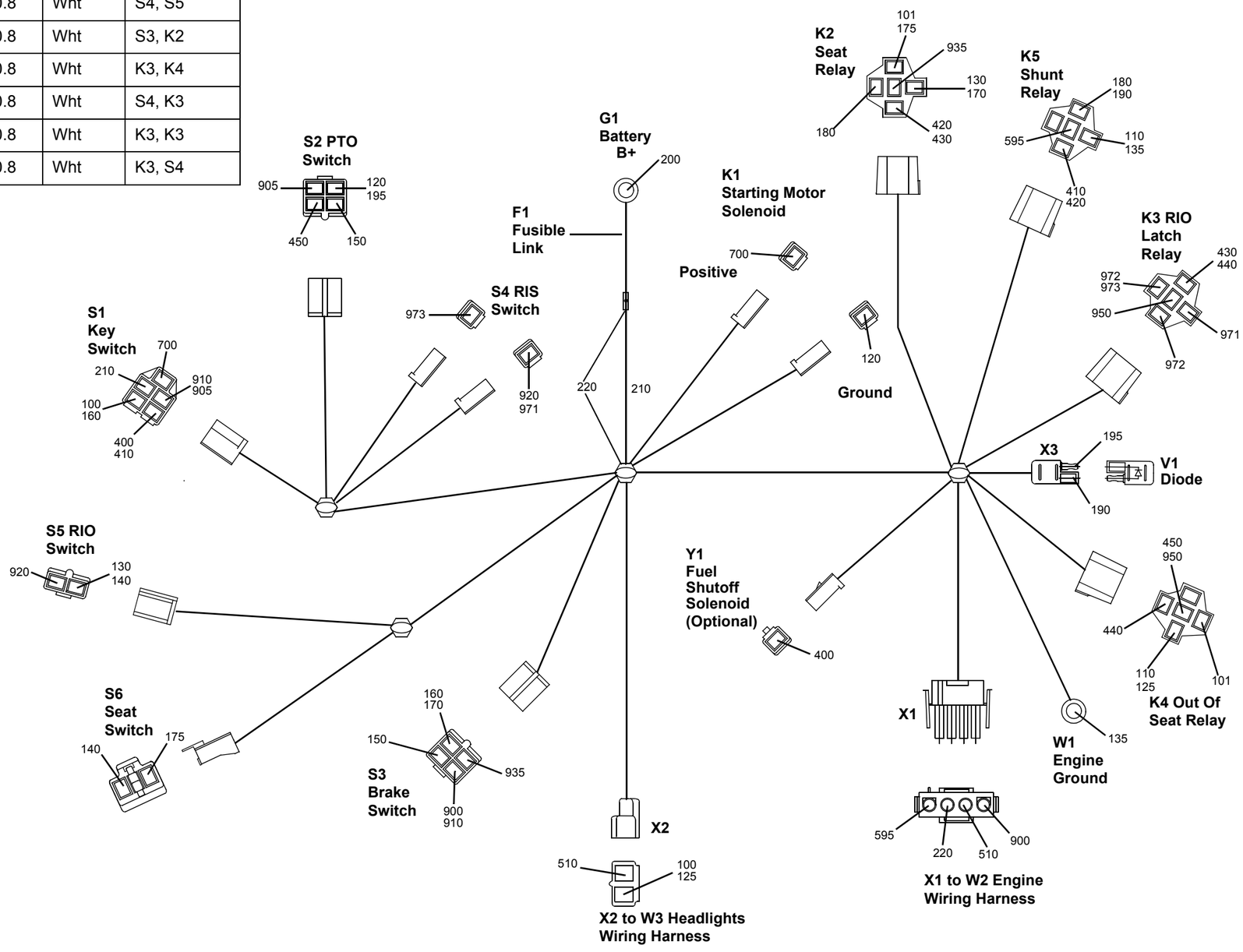

| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK |
|---|---|


W2 Engine
Wiring Harness
910
Wht
900 Wht
900
Wht
X1
T1
Magneto
Ignition
Wht
S3
Brake
Switch
(1) (0)
(0) Brake Off
(1) Brake On
935
Wht
S4 RIS
Switch
Released
Pushed
973 Wht
920 Wht
971
Wht
Solid State
Ignition Module
E1
Spark
Plug
S5 RIO
Switch
Forward/
Neutral
Reverse
972
Wht
950
Wht
K3 RIO
Latch
Relay
920 Wht
140 Blk
130
Blk
430 Yel
440
Yel
971 Wht
K4 Out Of
Seat Relay
950 Wht
450 Yel
125 Blk
110 Blk
101 Blk
440 Yel
125 Blk
100
Blk
X2
S6 Seat
Switch
Operator Off
Operator On
130 Blk
175 Blk
175 Blk
140 Blk
W3 Headlight
Wiring Harness
E2 and E3
Headlights
X2
430 Yel
420 Yel
V2
Diode
X1
Blk
Yel
X1
510
Blu
110
Blk
420
Yel
410 Yel
135 Blk
W2 Engine
Wiring Harness
K5
Shunt
Relay
180 Blk
190
Blk
G
G2
Stator
V1
Diode
X3
X3
595
Brn
X1
Grn

## W1 WIRING HARNESS—LT133/LT155 w/ 3 AMP SYSTEM

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X2 |
| 101 | 0.8 | Blk | K2, K4 |
| 110 | 0.8 | Blk | K4, K5 |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | K4, X2 |
| 130 | 0.8 | Blk | K2, S5 |
| 135 | 2.0 | Blk | K5, W1 |
| 140 | 0.8 | Blk | S5, S6 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, S3 |
| 170 | 0.8 | Blk | S3, K2 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K5 |
| 190 | 0.8 | Blk | K5, V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.5 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X1 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K5 |
| 420 | 0.8 | Yel | K5, K2 |
| 430 | 0.8 | Yel | K2, K3 |
| 440 | 0.8 | Yel | K3, K4 |
| 450 | 0.8 | Yel | K4, S2 |
| 510 | 0.8 | Blu | X1, E2 |
| 595 | 2.0 | Brn | X1, K5 |
| 700 | 0.8 | Pur | K1, S1 |
| 900 | 0.8 | Wht | S3, X1 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |

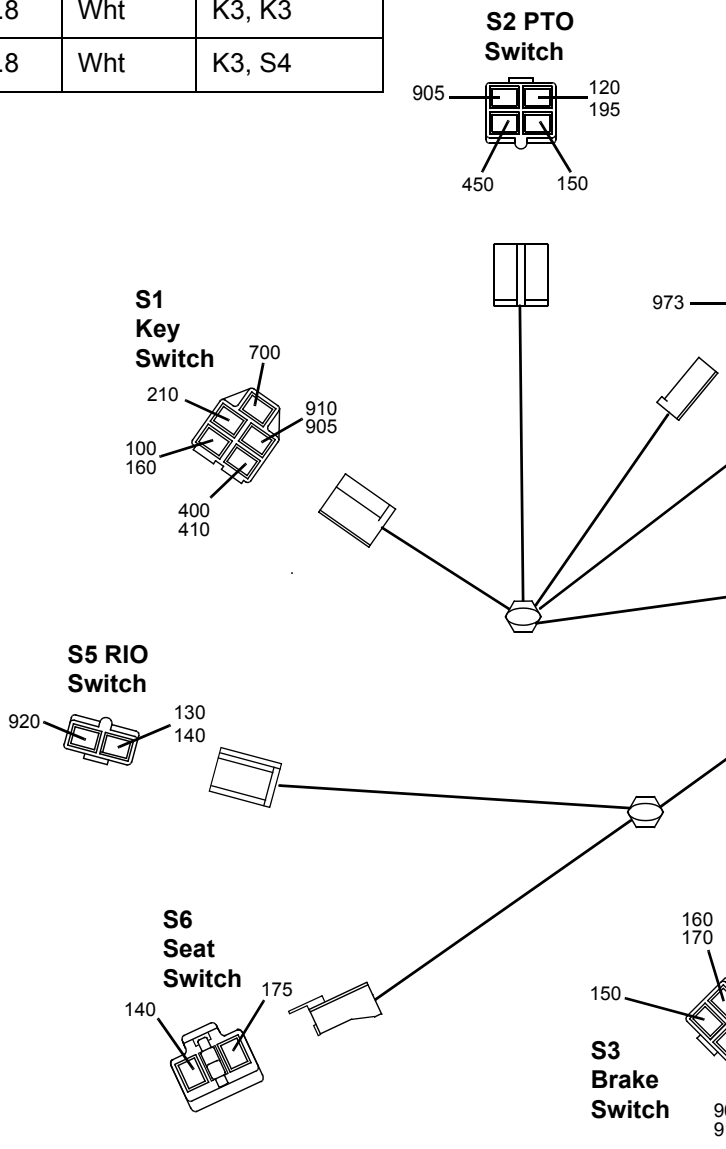
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 920 | 0.8 | Wht | S4, S5 |
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | K3, K4 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |

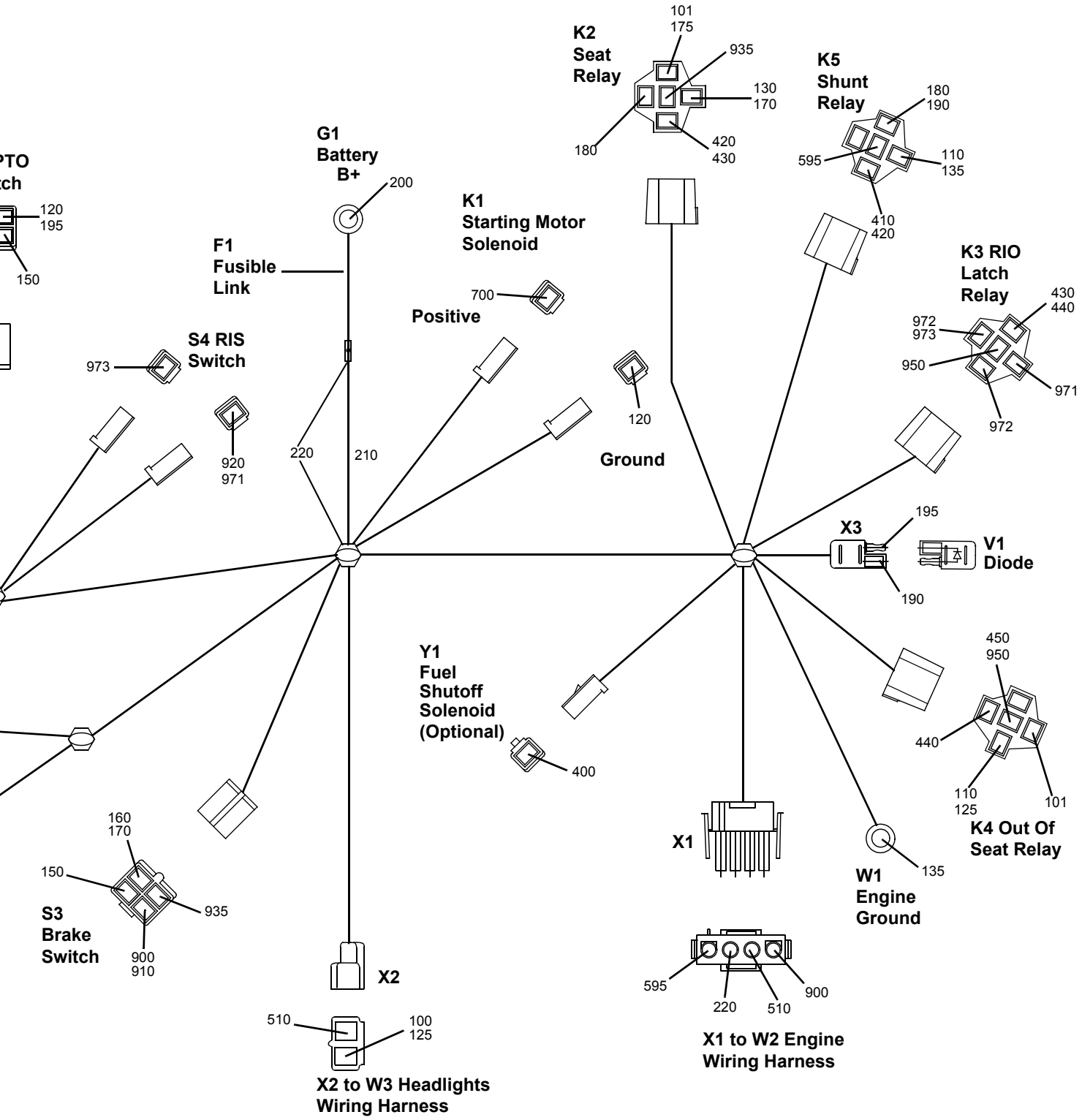


# W1 WIRING HARNESS—LT133/LT155 w/ 3 AMP SYSTEM

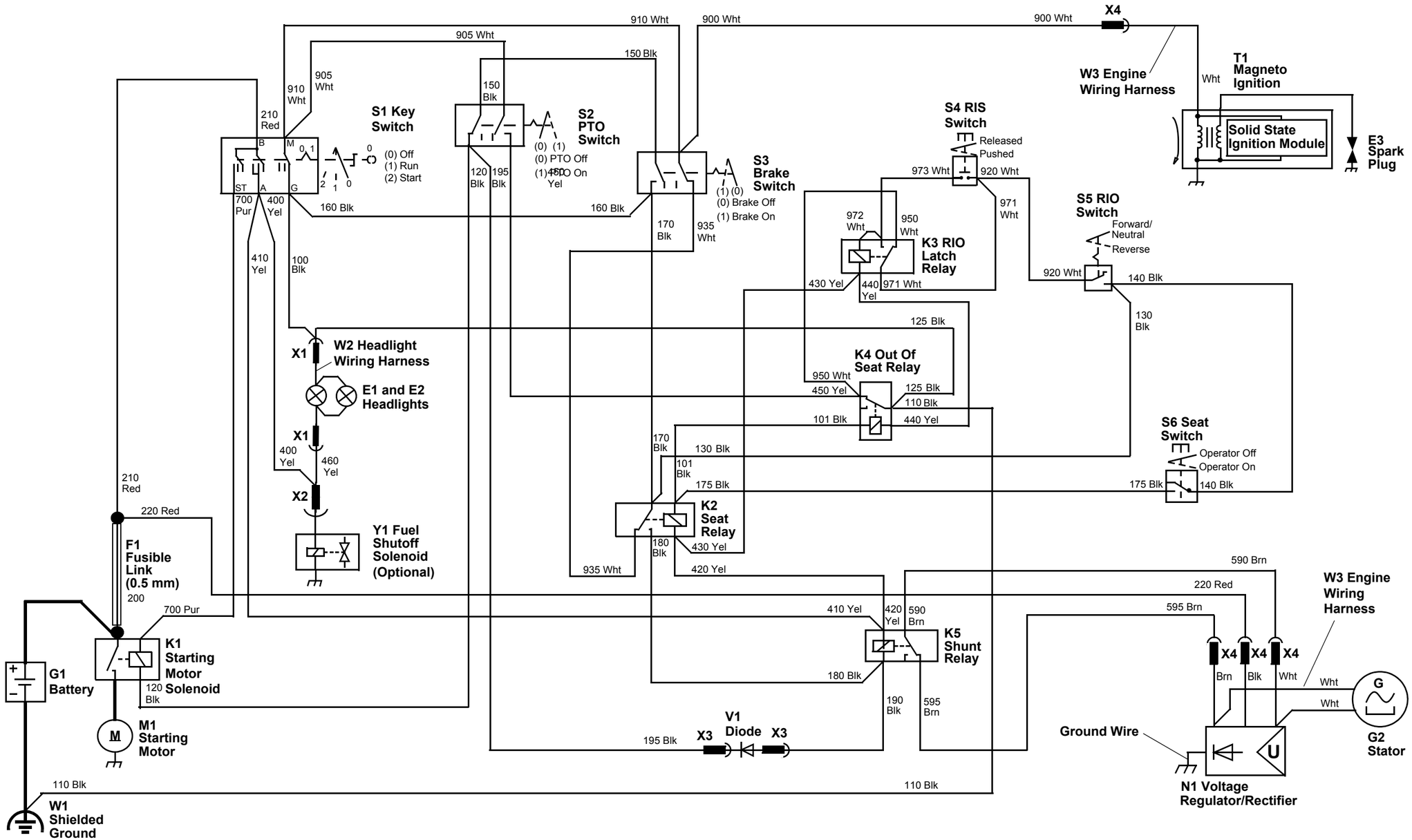
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X2 |
| 101 | 0.8 | Blk | K2, K4 |
| 110 | 0.8 | Blk | K4, K5 |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | K4, X2 |
| 130 | 0.8 | Blk | K2, S5 |
| 135 | 2.0 | Blk | K5, W1 |
| 140 | 0.8 | Blk | S5, S6 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, S3 |
| 170 | 0.8 | Blk | S3, K2 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K5 |
| 190 | 0.8 | Blk | K5, V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.5 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X1 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K5 |
| 420 | 0.8 | Yel | K5, K2 |
| 430 | 0.8 | Yel | K2, K3 |
| 440 | 0.8 | Yel | K3, K4 |
| 450 | 0.8 | Yel | K4, S2 |
| 510 | 0.8 | Blu | X1, E2 |
| 595 | 2.0 | Brn | X1, K5 |
| 700 | 0.8 | Pur | K1, S1 |
| 900 | 0.8 | Wht | S3, X1 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 920 | 0.8 | Wht | S4, S5 |
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | K3, K4 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |



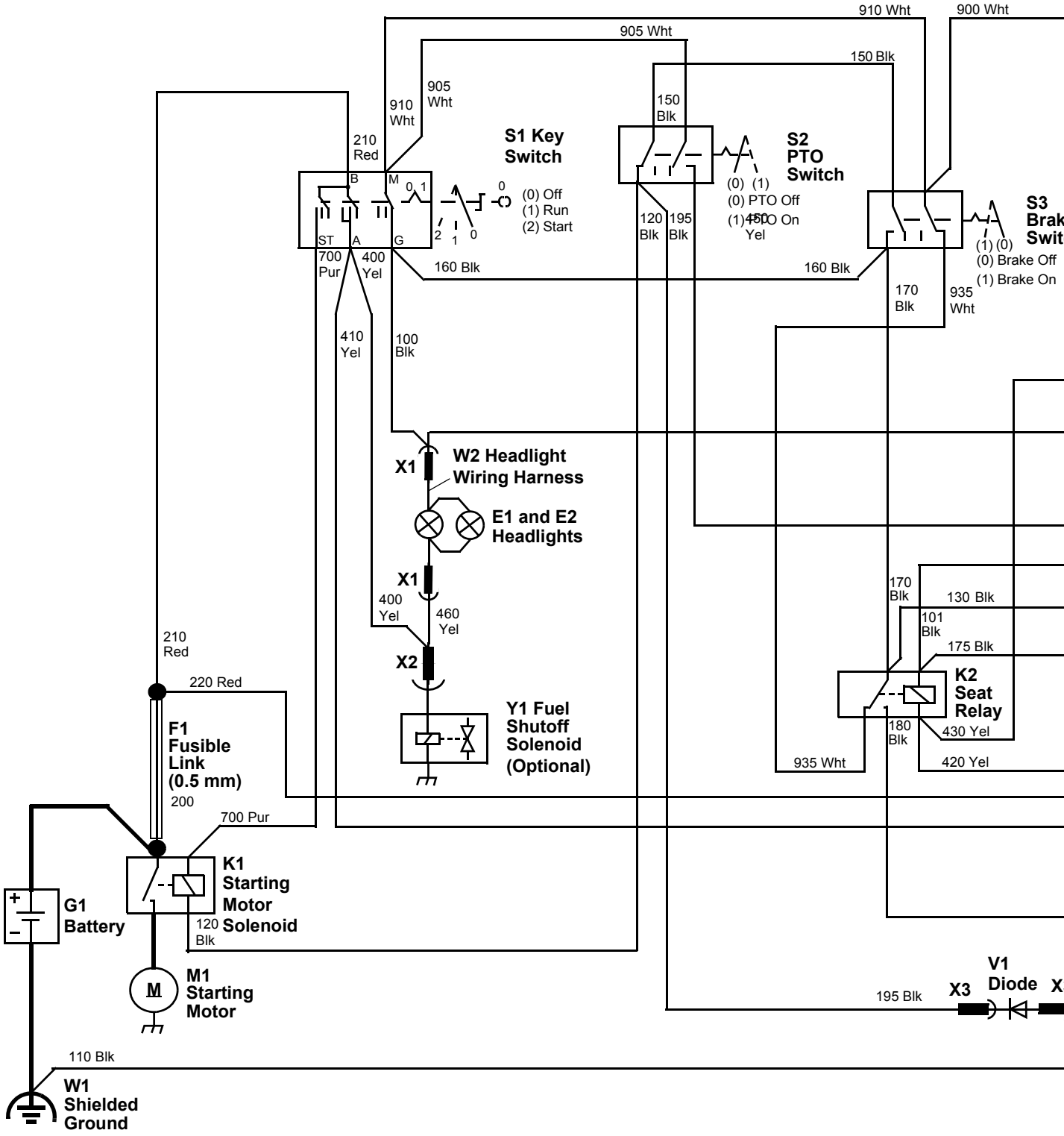

PTO
tch
120
195
150
G1
Battery
B+
200
F1
Fusible
Link
K1
Starting Motor
Solenoid
700
Positive
S4 RIS
Switch
973
920
971
220
210
120
Ground
K2
Seat
Relay
101
175
935
130
170
180
420
430
K5
Shunt
Relay
180
190
595
110
135
410
420
K3 RIO
Latch
Relay
430
440
972
973
950
971
972
X3
195
190
V1
Diode
Y1
Fuel
Shutoff
Solenoid
(Optional)
400
450
950
440
110
125
101
K4 Out Of
Seat Relay
160
170
150
935
S3
Brake
Switch
900
910
X1
W1
Engine
Ground
135
X2
510
100
125
X2 to W3 Headlights
Wiring Harness
595
220
510
900
X1 to W2 Engine
Wiring Harness

# W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 15 AMP SYSTEM

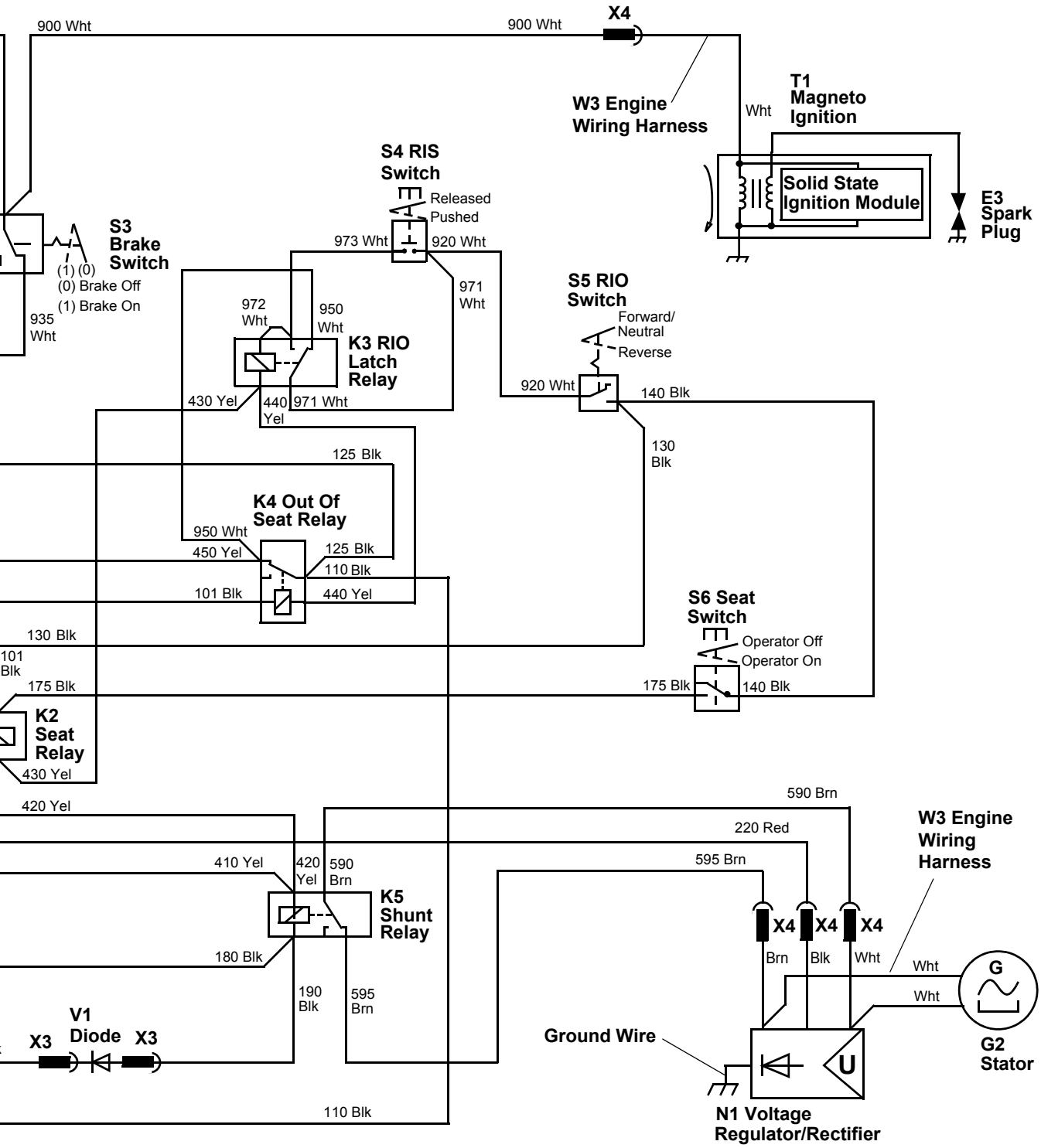



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK | SE 3 - ENGINE IGNITION / CHARGING |
|---|---|---|

# W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 15 AMP SYSTEM



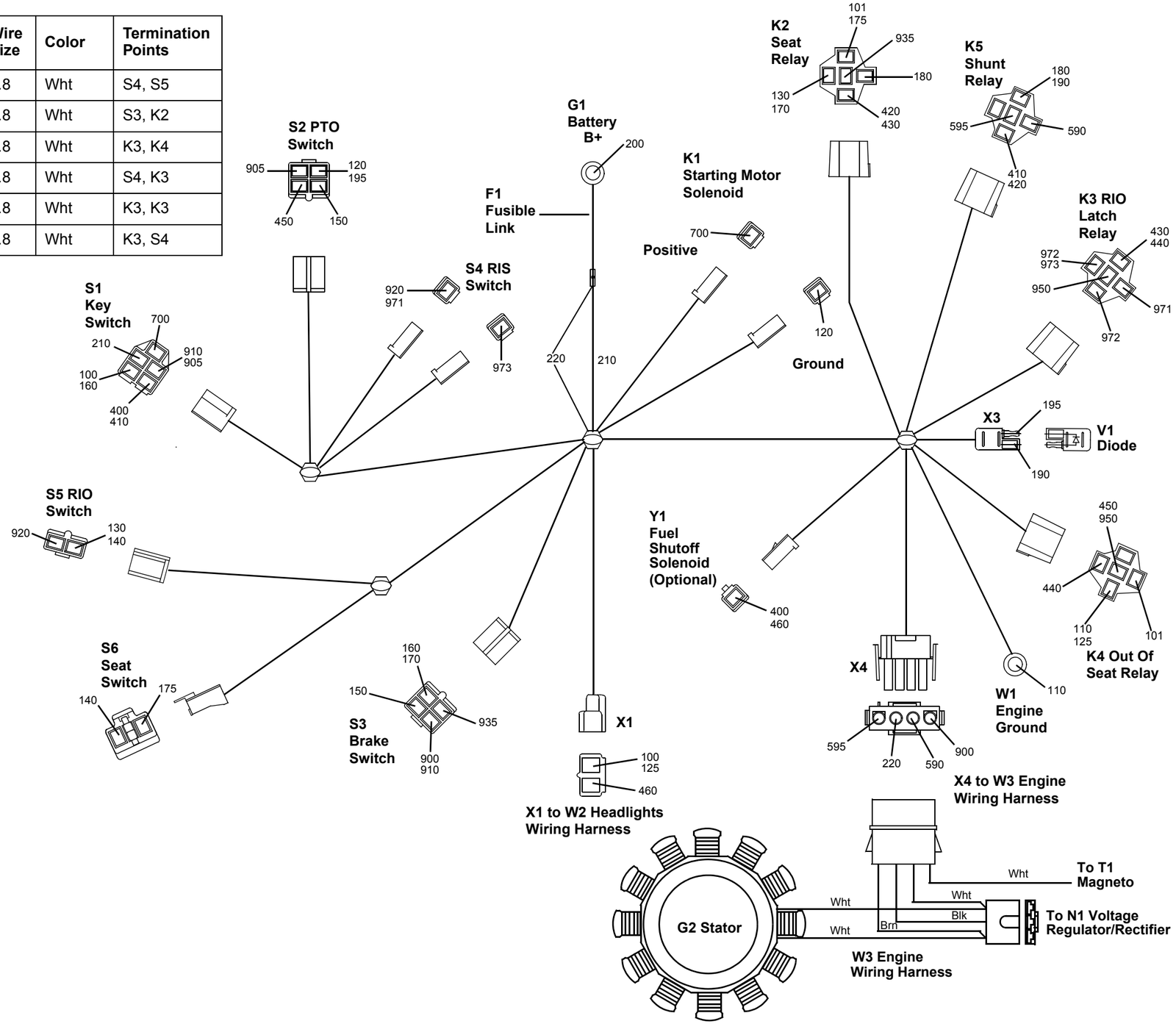

| SE 1 - STARTING | SE 2 - MAGNETO KILL & START |
|---|---|


900 Wht
900 Wht
X4
W3 Engine
Wiring Harness
Wht
T1
Magneto
Ignition
Solid State
Ignition Module
E3
Spark
Plug
S4 RIS
Switch
Released
Pushed
973 Wht
920 Wht
971
Wht
S3
Brake
Switch
(1) (0)
(0) Brake Off
(1) Brake On
935
Wht
972
Wht
950
Wht
K3 RIO
Latch
Relay
S5 RIO
Switch
Forward/
Neutral
Reverse
920 Wht
140 Blk
130
Blk
430 Yel
440
Yel
971 Wht
125 Blk
K4 Out Of
Seat Relay
950 Wht
450 Yel
125 Blk
110 Blk
101 Blk
440 Yel
S6 Seat
Switch
Operator Off
Operator On
130 Blk
101
Blk
175 Blk
175 Blk
140 Blk
K2
Seat
Relay
430 Yel
420 Yel
590 Brn
220 Red
W3 Engine
Wiring
Harness
595 Brn
410 Yel
420
Yel
590
Brn
K5
Shunt
Relay
X4
X4
X4
Brn
Blk
Wht
Wht
Wht
G
180 Blk
190
Blk
595
Brn
V1
Diode
X3
X3
Ground Wire
U
G2
Stator
110 Blk
N1 Voltage
Regulator/Rectifier

# W1 WIRING HARNESS—LT133/LT155 w/ 15 AMP SYSTEM

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X1 |
| 101 | 0.8 | Blk | K2, K4 |
| 110 | 1.0 | Blk | K4, W1 Gnd |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | K4, X1 |
| 130 | 0.8 | Blk | K2, S5 |
| 140 | 0.8 | Blk | S5, S6 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, S3 |
| 170 | 0.8 | Blk | S3, K2 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K5 |
| 190 | 0.8 | Blk | K5, V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.8 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X4 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K5 |
| 420 | 0.8 | Yel | K5, K2 |
| 430 | 0.8 | Yel | K2, K3 |
| 440 | 0.8 | Yel | K3, K4 |
| 450 | 0.8 | Yel | K4, S2 |
| 460 | 0.8 | Yel | X1, Y1 |
| 590 | 0.8 | Blu | X4, K5 |
| 595 | 2.0 | Brn | X4, K5 |
| 700 | 0.8 | Pur | K1, S1 |
| 900 | 0.8 | Wht | S3, X4 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |

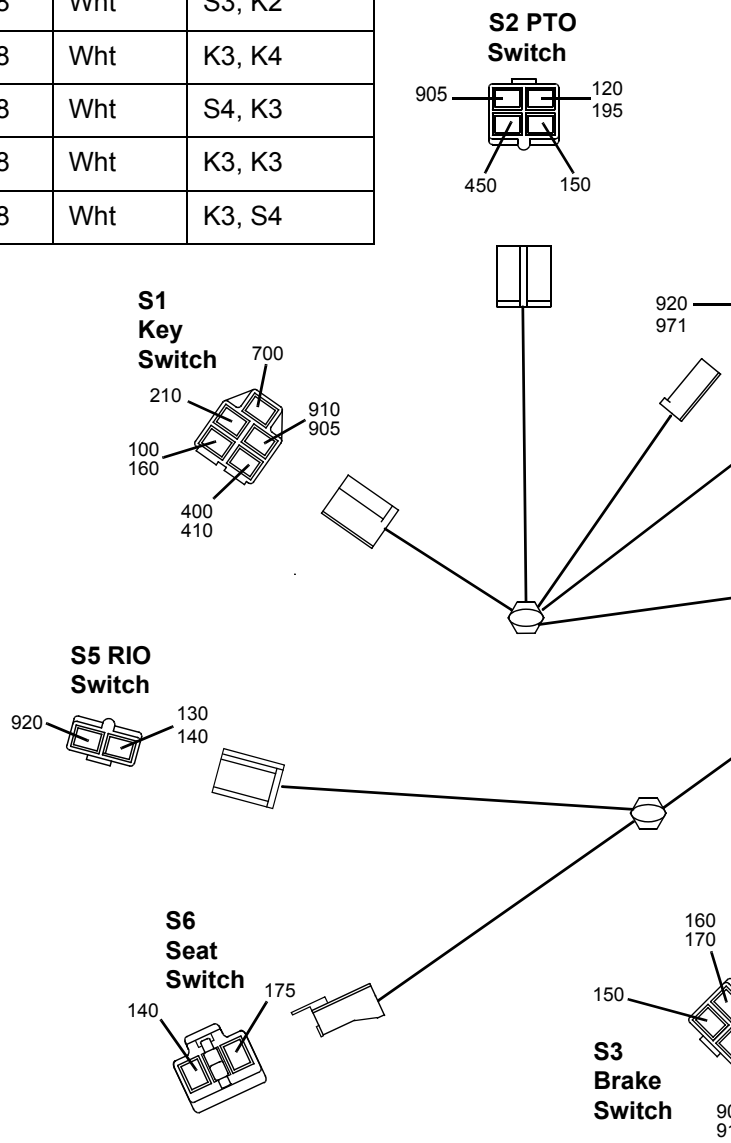
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 920 | 0.8 | Wht | S4, S5 |
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | K3, K4 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |

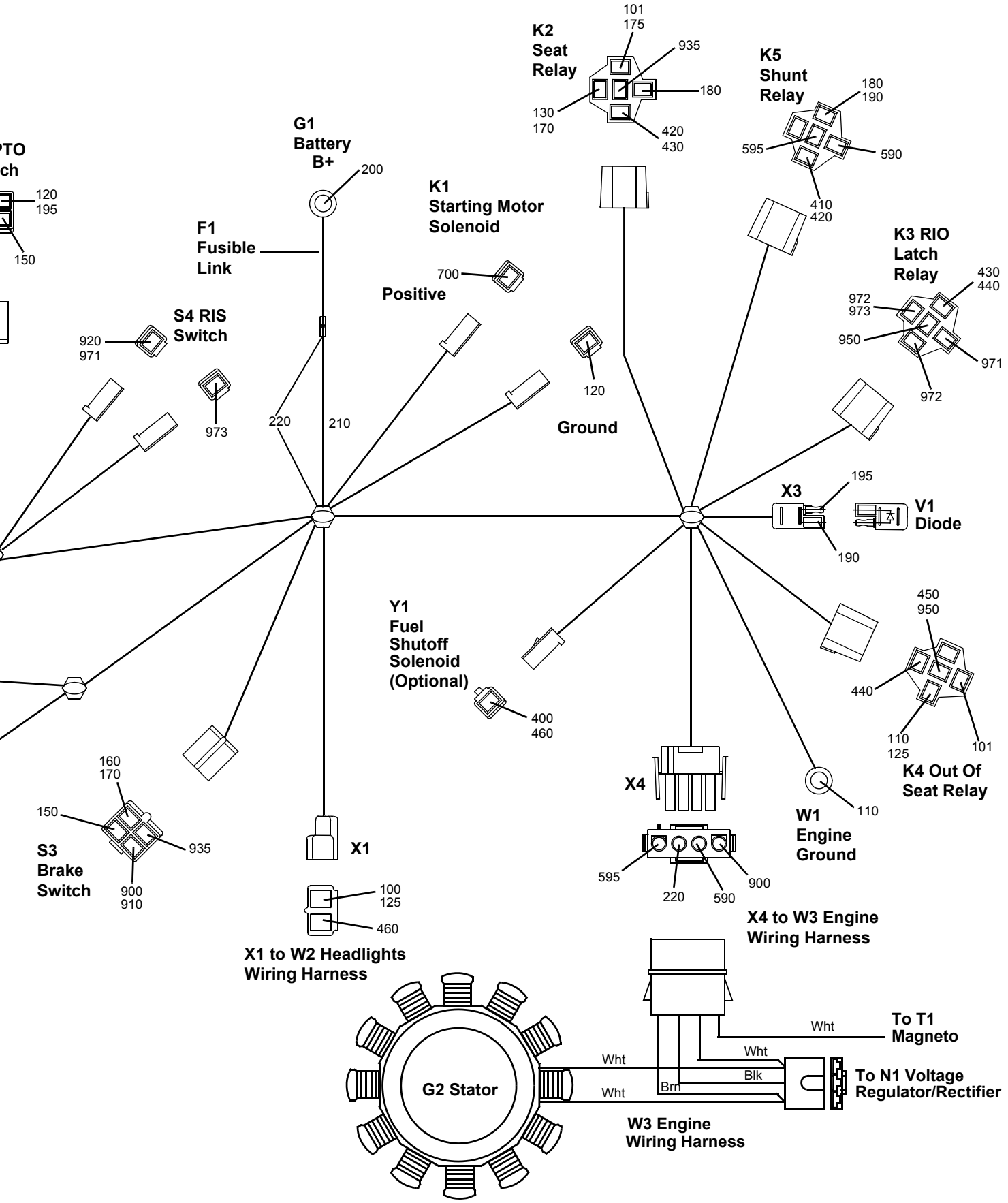


# W1 WIRING HARNESS—LT133/LT155 w/ 15 AMP SYSTEM

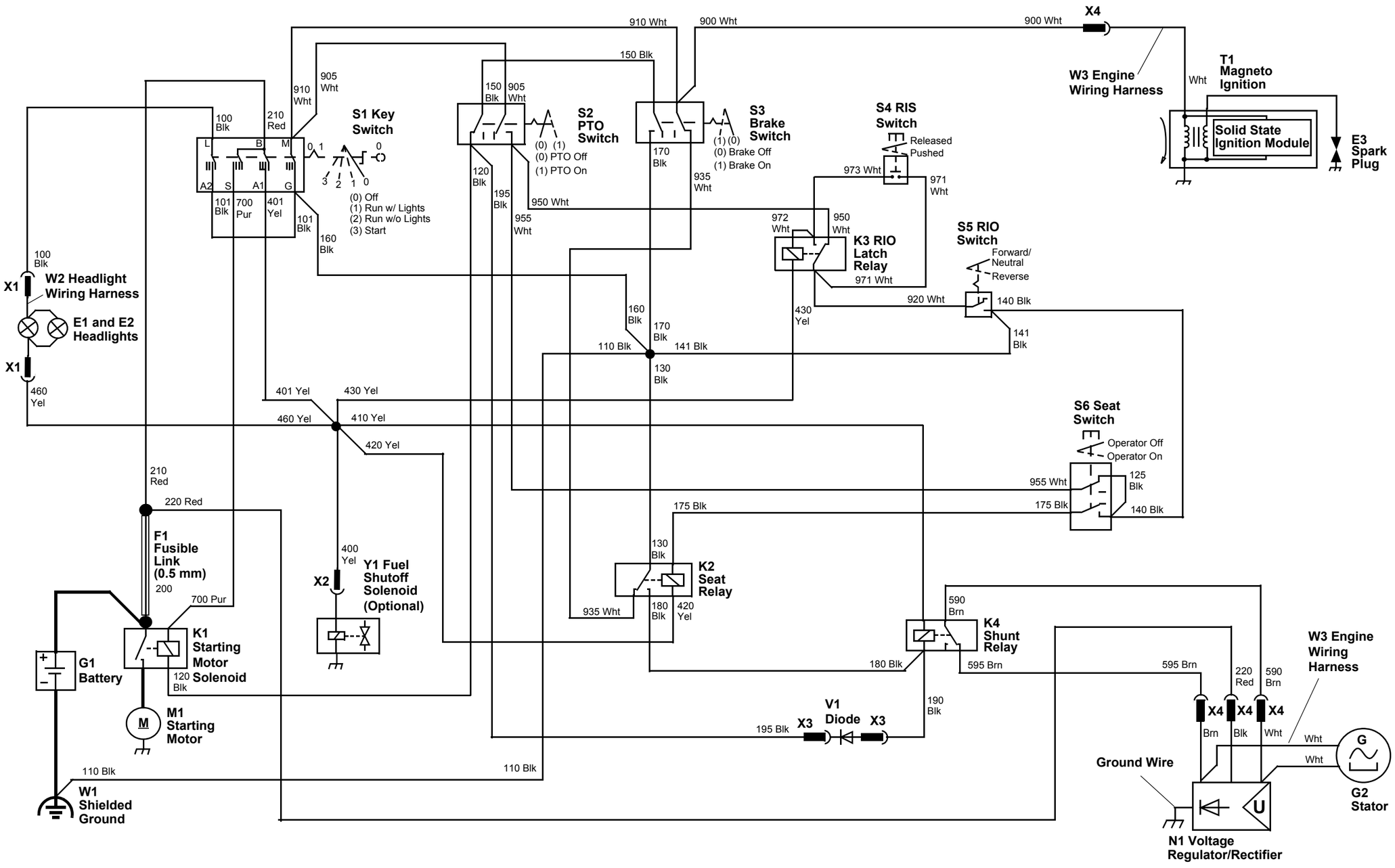
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X1 |
| 101 | 0.8 | Blk | K2, K4 |
| 110 | 1.0 | Blk | K4, W1 Gnd |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | K4, X1 |
| 130 | 0.8 | Blk | K2, S5 |
| 140 | 0.8 | Blk | S5, S6 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, S3 |
| 170 | 0.8 | Blk | S3, K2 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K5 |
| 190 | 0.8 | Blk | K5, V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.8 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X4 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K5 |
| 420 | 0.8 | Yel | K5, K2 |
| 430 | 0.8 | Yel | K2, K3 |
| 440 | 0.8 | Yel | K3, K4 |
| 450 | 0.8 | Yel | K4, S2 |
| 460 | 0.8 | Yel | X1, Y1 |
| 590 | 0.8 | Blu | X4, K5 |
| 595 | 2.0 | Brn | X4, K5 |
| 700 | 0.8 | Pur | K1, S1 |
| 900 | 0.8 | Wht | S3, X4 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 920 | 0.8 | Wht | S4, S5 |
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | K3, K4 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |



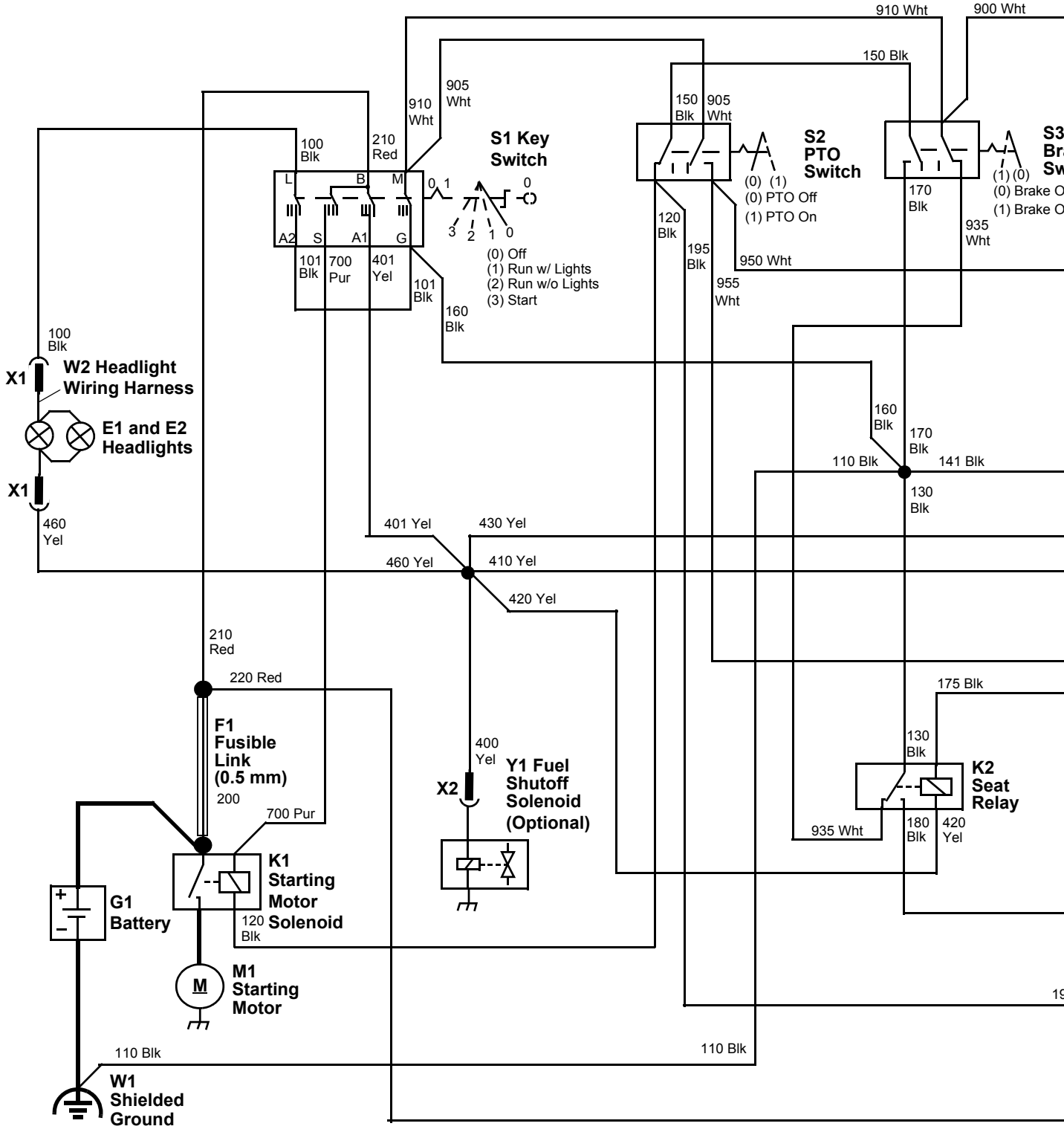

K2
Seat
Relay
101
175
935
180
130
170
420
430
K5
Shunt
Relay
180
190
595
590
410
420
G1
Battery
B+
200
K1
Starting Motor
Solenoid
F1
Fusible
Link
700
Positive
K3 RIO
Latch
Relay
430
440
972
973
950
971
972
S4 RIS
Switch
920
971
973
220
210
120
Ground
X3
195
V1
Diode
190
Y1
Fuel
Shutoff
Solenoid
(Optional)
400
460
450
950
440
110
125
101
K4 Out Of
Seat Relay
160
170
150
935
S3
Brake
Switch
900
910
X4
W1
Engine
Ground
110
595
220
590
900
X1
100
125
460
X1 to W2 Headlights
Wiring Harness
X4 to W3 Engine
Wiring Harness
To T1
Magneto
Wht
Wht
Blk
Brn
Wht
To N1 Voltage
Regulator/Rectifier
G2 Stator
W3 Engine
Wiring Harness

# W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 4 POSITION KEY SWITCH

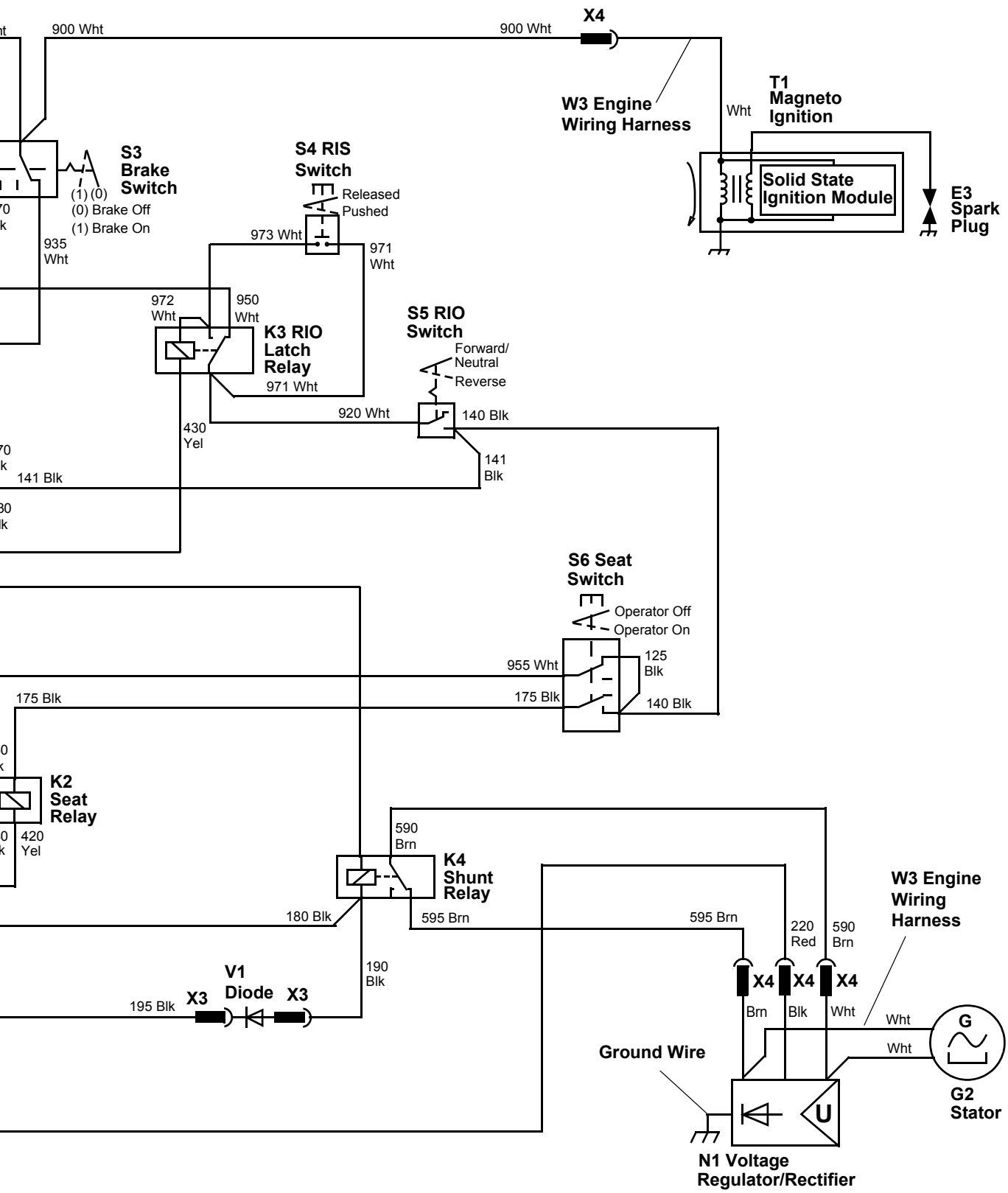



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK | SE 3 - ENGINE IGNITION / CHARGING |
|---|---|---|

# W1 ELECTRICAL SCHEMATIC—LT133/LT155 w/ 4 POSITION KEY SWITCH



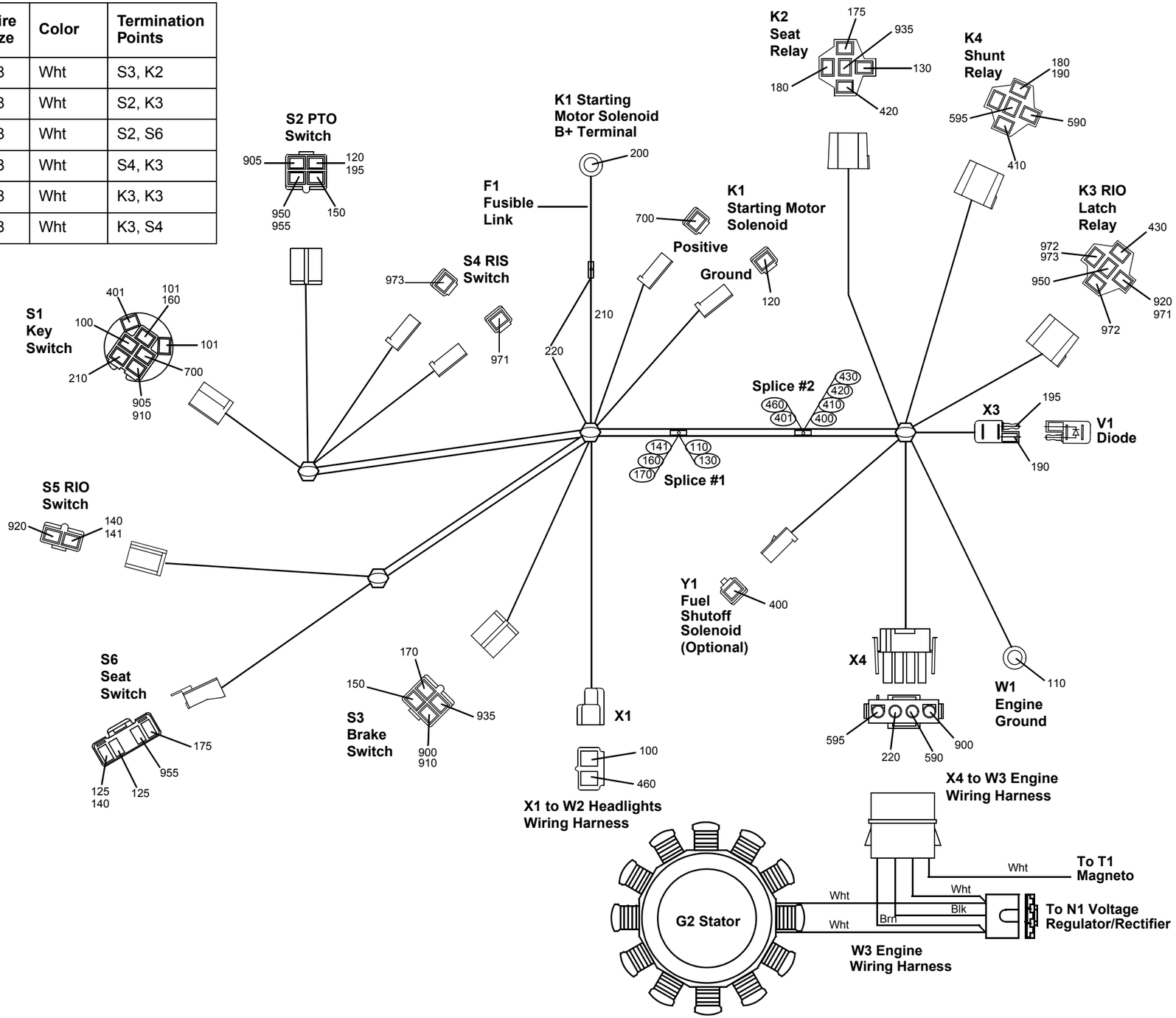

| SE 1 - STARTING | SE 2 - MAGNETO KILL & START I |
|---|---|


900 Wht
900 Wht
X4
W3 Engine
Wiring Harness
T1
Magneto
Ignition
Wht
Solid State
Ignition Module
E3
Spark
Plug
S3
Brake
Switch
(1) (0)
(0) Brake Off
(1) Brake On
935
Wht
S4 RIS
Switch
Released
Pushed
973 Wht
971
Wht
972
Wht
950
Wht
K3 RIO
Latch
Relay
971 Wht
S5 RIO
Switch
Forward/
Neutral
Reverse
920 Wht
140 Blk
430
Yel
141
Blk
141 Blk
S6 Seat
Switch
Operator Off
Operator On
955 Wht
125
Blk
175 Blk
175 Blk
140 Blk
K2
Seat
Relay
420
Yel
590
Brn
K4
Shunt
Relay
180 Blk
595 Brn
595 Brn
220
Red
590
Brn
W3 Engine
Wiring
Harness
X4
X4
X4
Brn
Blk
Wht
Wht
Wht
G
G2
Stator
190
Blk
V1
Diode
195 Blk
X3
X3
Ground Wire
U
N1 Voltage
Regulator/Rectifier

# W1 WIRING HARNESS—LT133/LT155 w/ 4 POSITION KEY SWITCH

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X1 |
| 101 | 0.8 | Blk | S1, S1 |
| 110 | 1.0 | Blk | W1, Splice 1 |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | S6, S6 |
| 130 | 0.8 | Blk | Splice 1, K2 |
| 140 | 0.8 | Blk | S5, S6 |
| 141 | 0.8 | Blk | S5, Splice 1 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, Splice 1 |
| 170 | 0.8 | Blk | S3, Splice 1 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K4 |
| 190 | 0.8 | Blk | K4 V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.8 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X4 |
| 400 | 0.8 | Yel | Splice 2, Y1 |
| 401 | 0.8 | Yel | Splice 2, S1 |
| 410 | 0.8 | Yel | Splice 2, K4 |
| 420 | 0.8 | Yel | Splice 2, K2 |
| 430 | 0.8 | Yel | Splice 2, K3 |
| 460 | 0.8 | Yel | Splice 2, X1 |
| 590 | 2.0 | Brn | X4, K4 |
| 595 | 2.0 | Brn | X4, K4 |
| 700 | 0.8 | Pur | K4 S1 |
| 900 | 0.8 | Wht | S3, X4 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |
| 920 | 0.8 | Wht | S5, K3 |

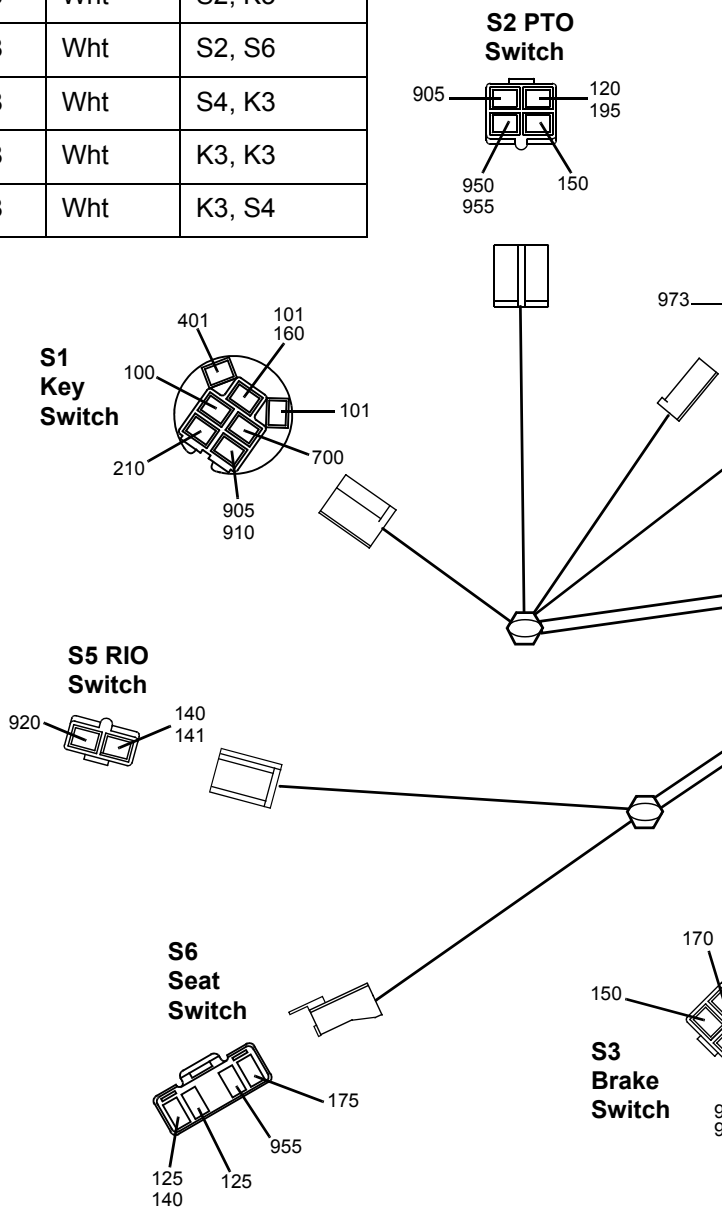
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | S2, K3 |
| 955 | 0.8 | Wht | S2, S6 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |

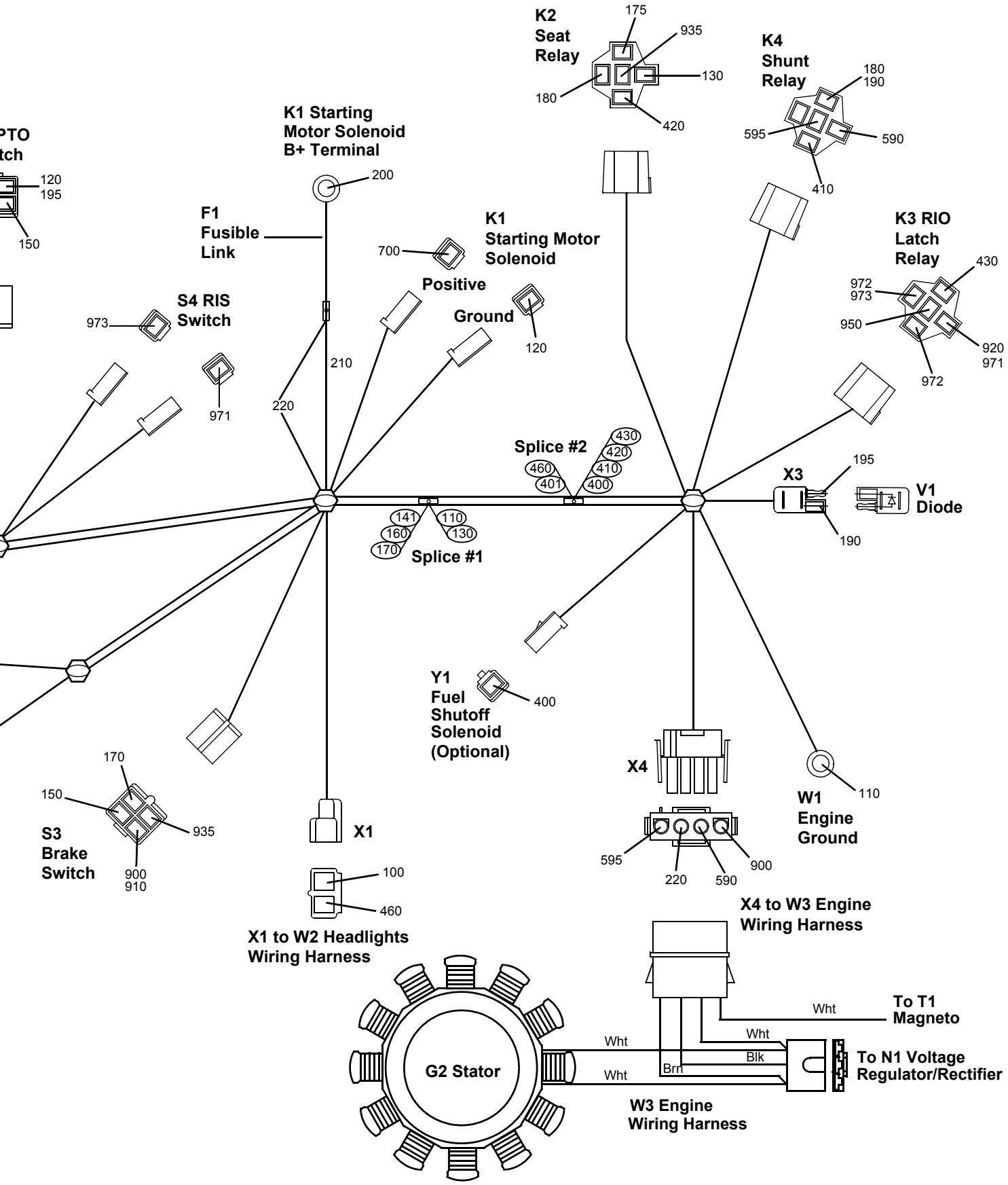


# W1 WIRING HARNESS—LT133/LT155 w/ 4 POSITION KEY SWITCH

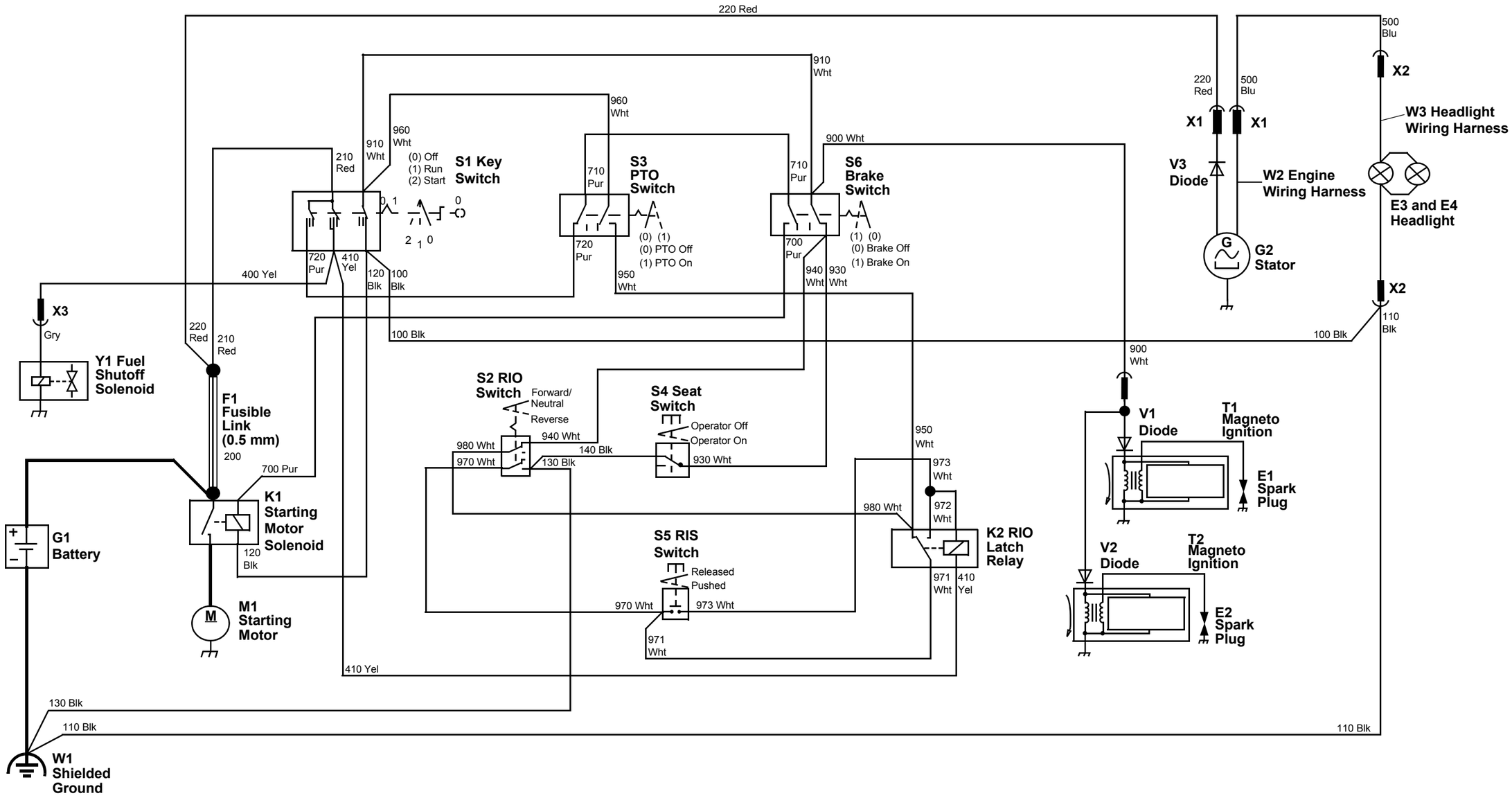
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X1 |
| 101 | 0.8 | Blk | S1, S1 |
| 110 | 1.0 | Blk | W1, Splice 1 |
| 120 | 0.8 | Blk | K1, S2 |
| 125 | 0.8 | Blk | S6, S6 |
| 130 | 0.8 | Blk | Splice 1, K2 |
| 140 | 0.8 | Blk | S5, S6 |
| 141 | 0.8 | Blk | S5, Splice 1 |
| 150 | 0.8 | Blk | S2, S3 |
| 160 | 0.8 | Blk | S1, Splice 1 |
| 170 | 0.8 | Blk | S3, Splice 1 |
| 175 | 0.8 | Blk | K2, S6 |
| 180 | 0.8 | Blk | K2, K4 |
| 190 | 0.8 | Blk | K4 V1 |
| 195 | 0.8 | Blk | S2, V1 |
| 200 | 0.8 | Fus/Lnk | F1, K1 |
| 210 | 1.0 | Red | F1, S1 |
| 220 | 2.0 | Red | F1, X4 |
| 400 | 0.8 | Yel | Splice 2, Y1 |
| 401 | 0.8 | Yel | Splice 2, S1 |
| 410 | 0.8 | Yel | Splice 2, K4 |
| 420 | 0.8 | Yel | Splice 2, K2 |
| 430 | 0.8 | Yel | Splice 2, K3 |
| 460 | 0.8 | Yel | Splice 2, X1 |
| 590 | 2.0 | Brn | X4, K4 |
| 595 | 2.0 | Brn | X4, K4 |
| 700 | 0.8 | Pur | K4 S1 |
| 900 | 0.8 | Wht | S3, X4 |
| 905 | 0.8 | Wht | S1, S2 |
| 910 | 0.8 | Wht | S1, S3 |
| 920 | 0.8 | Wht | S5, K3 |

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 935 | 0.8 | Wht | S3, K2 |
| 950 | 0.8 | Wht | S2, K3 |
| 955 | 0.8 | Wht | S2, S6 |
| 971 | 0.8 | Wht | S4, K3 |
| 972 | 0.8 | Wht | K3, K3 |
| 973 | 0.8 | Wht | K3, S4 |



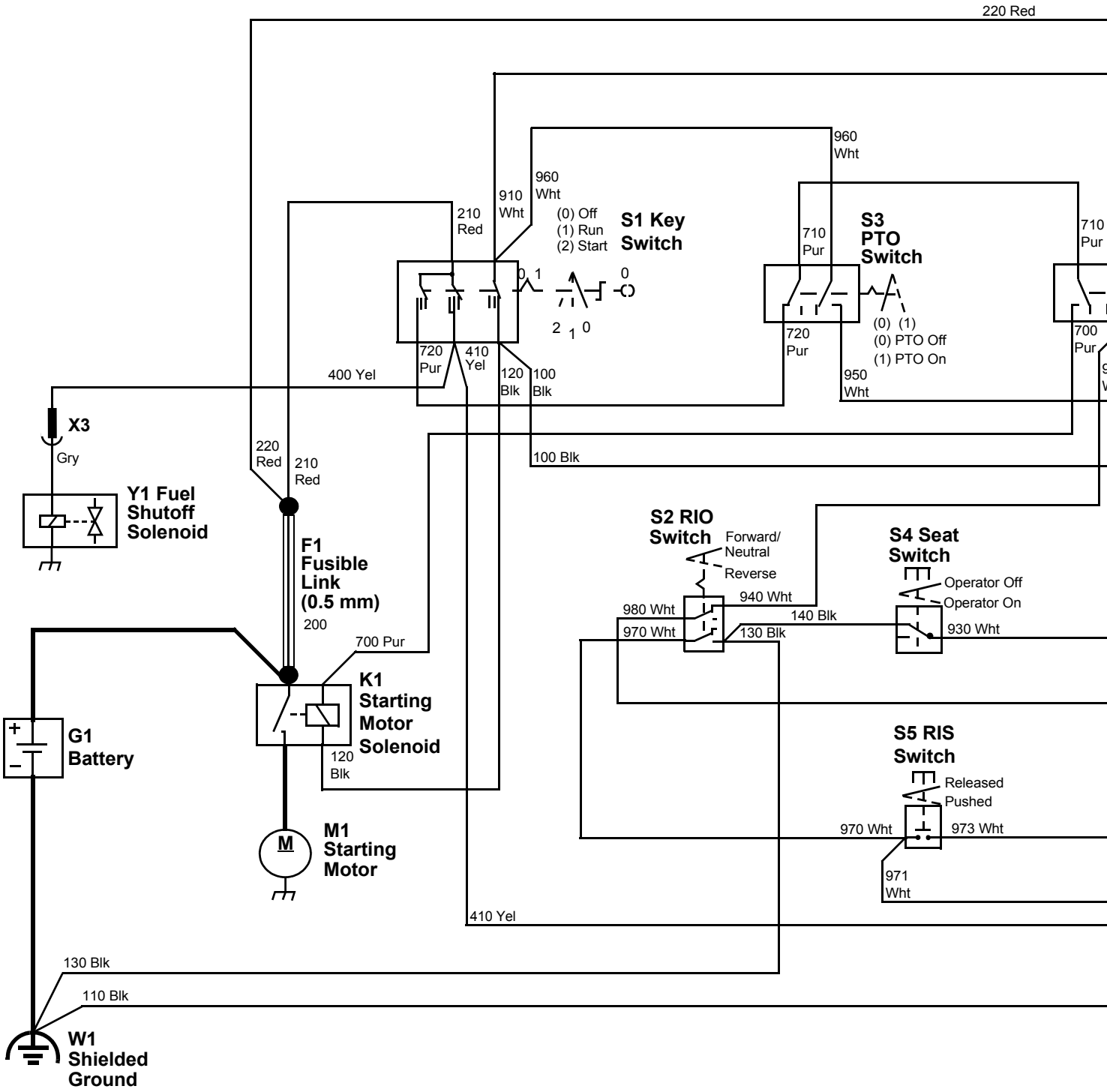

K2
Seat
Relay
175
935
130
180
420
K4
Shunt
Relay
180
190
595
590
410
K1 Starting
Motor Solenoid
B+ Terminal
200
F1
Fusible
Link
700
K1
Starting Motor
Solenoid
Positive
Ground
120
973
S4 RIS
Switch
971
210
220
K3 RIO
Latch
Relay
430
972
973
950
920
971
972
Splice #2
430
420
460
410
401
400
X3
195
V1
Diode
190
141
110
160
130
170
Splice #1
Y1
Fuel
Shutoff
Solenoid
(Optional)
400
X4
W1
Engine
Ground
110
170
150
935
S3
Brake
Switch
900
910
X1
100
460
595
220
590
900
X1 to W2 Headlights
Wiring Harness
X4 to W3 Engine
Wiring Harness
To T1
Magneto
Wht
Wht
Blk
Brn
Wht
To N1 Voltage
Regulator/Rectifier
G2 Stator
W3 Engine
Wiring Harness

# W1 ELECTRICAL SCHEMATIC—LT166 w/ 3 POSITION KEY SWITCH

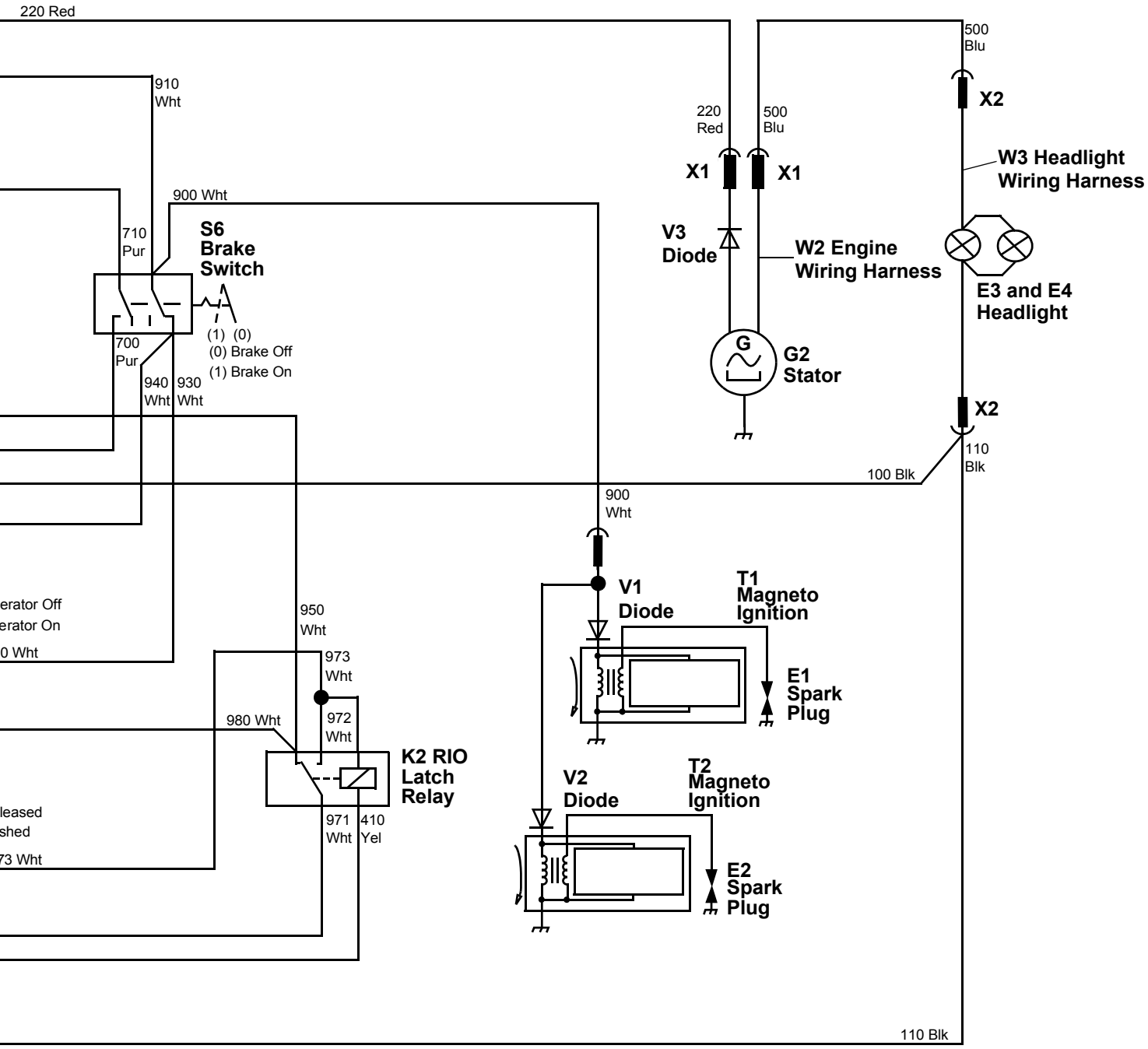



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK | SE 3 - ENGINE IGNITION | SE 4 - CHARGING | SE 5 - HEADLIGHTS |
|---|---|---|---|---|

# W1 ELECTRICAL SCHEMATIC—LT166 w/ 3 POSITION KEY SWITCH

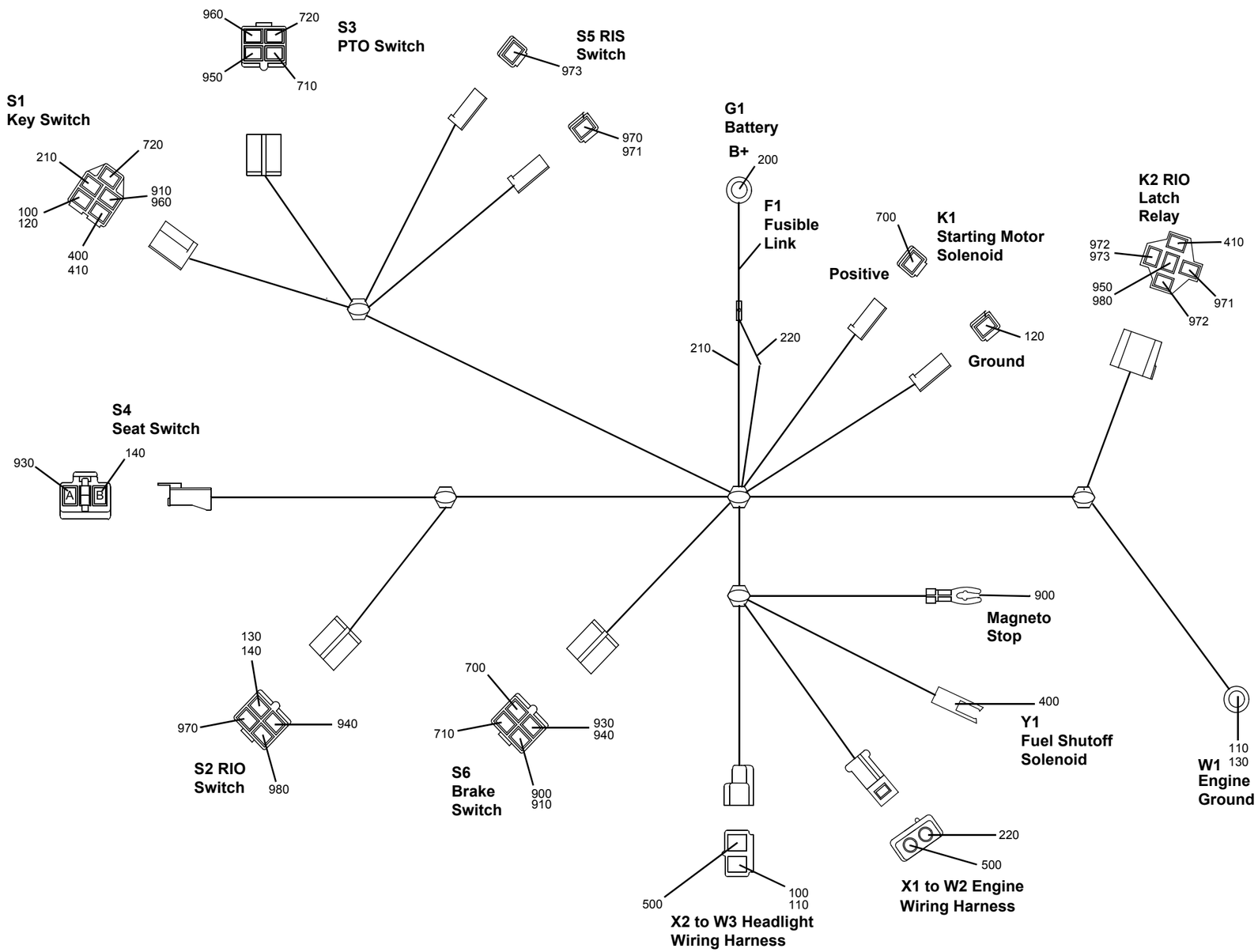



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK |
|---|---|


220 Red
910
Wht
710
Pur
S6
Brake
Switch
(1) (0)
(0) Brake Off
(1) Brake On
700
Pur
940
Wht
930
Wht
900 Wht
220
Red
500
Blu
X1
X1
V3
Diode
W2 Engine
Wiring Harness
G
G2
Stator
500
Blu
X2
W3 Headlight
Wiring Harness
E3 and E4
Headlight
X2
110
Blk
100 Blk
900
Wht
V1
Diode
T1
Magneto
Ignition
E1
Spark
Plug
950
Wht
973
Wht
980 Wht
972
Wht
K2 RIO
Latch
Relay
971
Wht
410
Yel
V2
Diode
T2
Magneto
Ignition
E2
Spark
Plug
110 Blk

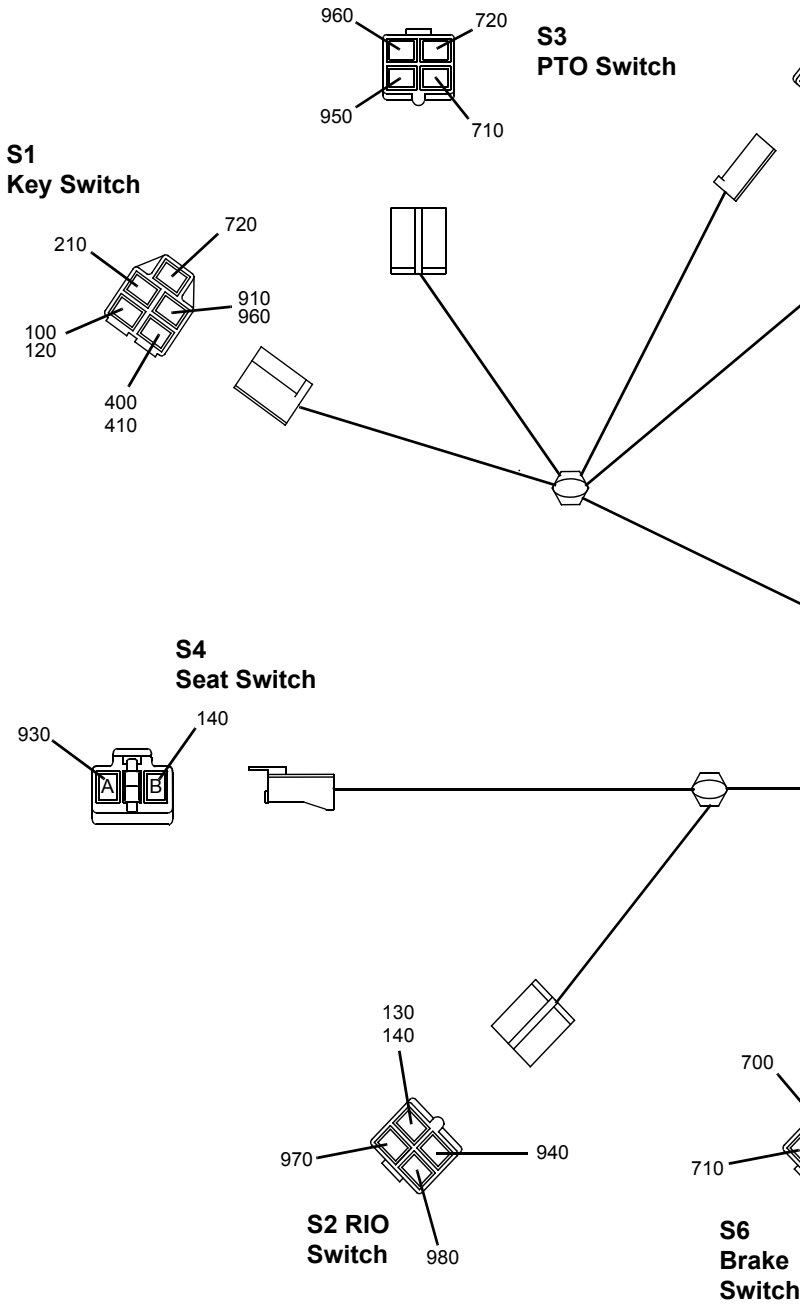
# W1 WIRING HARNESS—LT166 w/ 3 POSITION KEY SWITCH

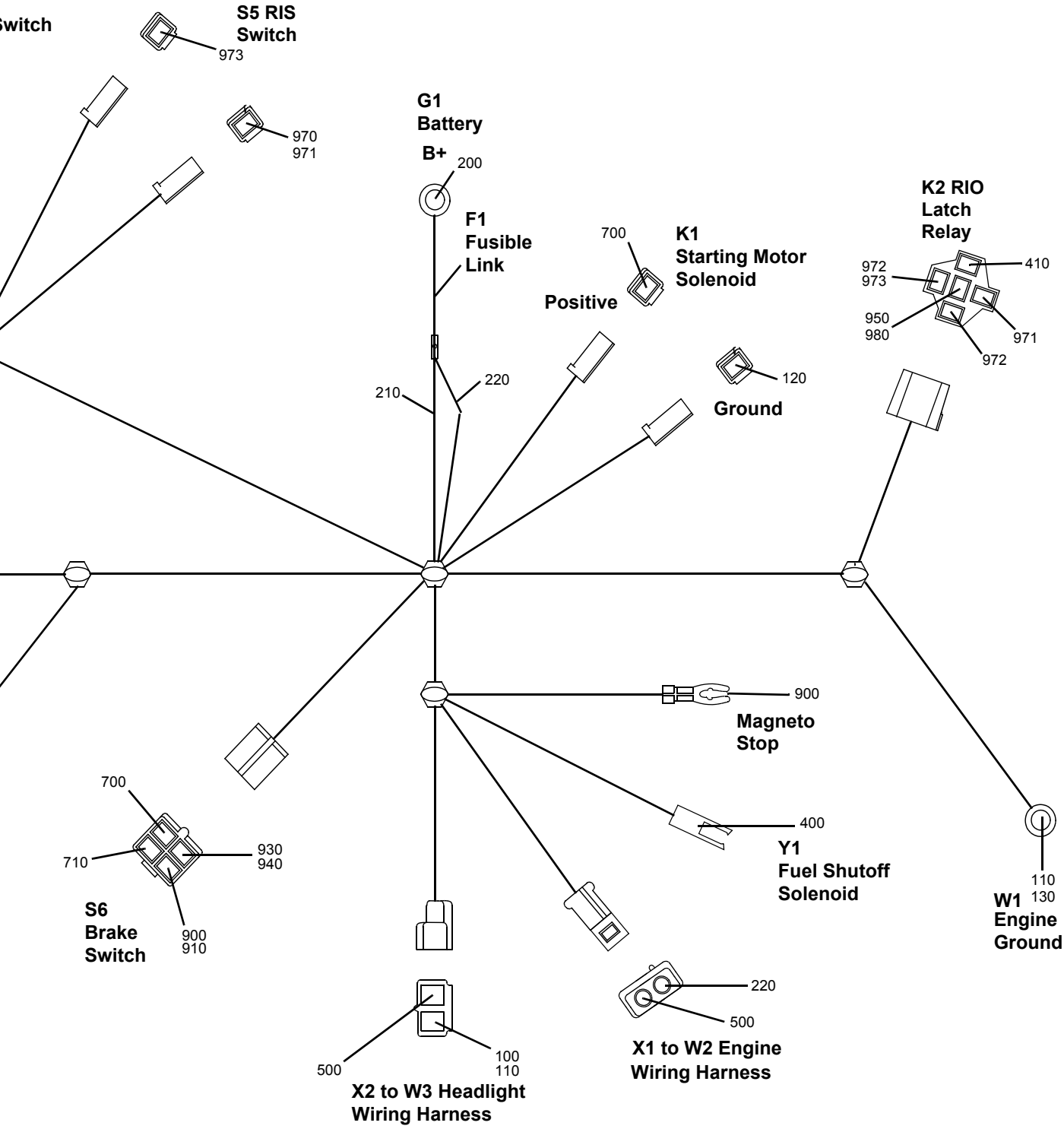
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X2 |
| 110 | 0.8 | Blk | X2, W1 |
| 120 | 0.8 | Blk | S1, K1 |
| 130 | 0.8 | Blk | S2, W1 |
| 140 | 0.8 | Blk | S2, S4 |
| 200 | 0.5 | Fus/ Lnk | K1, F1 |
| 210 | 0.8 | Red | F1, S1 |
| 220 | 1.0 | Red | F1, X1 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K2 |
| 500 | 0.8 | Blu | X1, X2 |
| 700 | 0.8 | Pur | S6, K1 |
| 710 | 0.8 | Pur | S3, S6 |
| 720 | 0.8 | Pur | S1, S3 |
| 900 | 0.8 | Wht | S6, Magneto Stop |
| 910 | 0.8 | Wht | S1, S6 |
| 930 | 0.8 | Wht | S6, S4 |
| 940 | 0.8 | Wht | S6, S2 |
| 950 | 0.8 | Wht | S3, K2 |
| 960 | 0.8 | Wht | S1, S3 |
| 970 | 0.8 | Wht | S2, S5 |
| 971 | 0.8 | Wht | S5, K2 |
| 972 | 0.8 | Wht | K2, K2 |
| 973 | 0.8 | Wht | S5, K2 |
| 980 | 0.8 | Wht | S2, K2 |



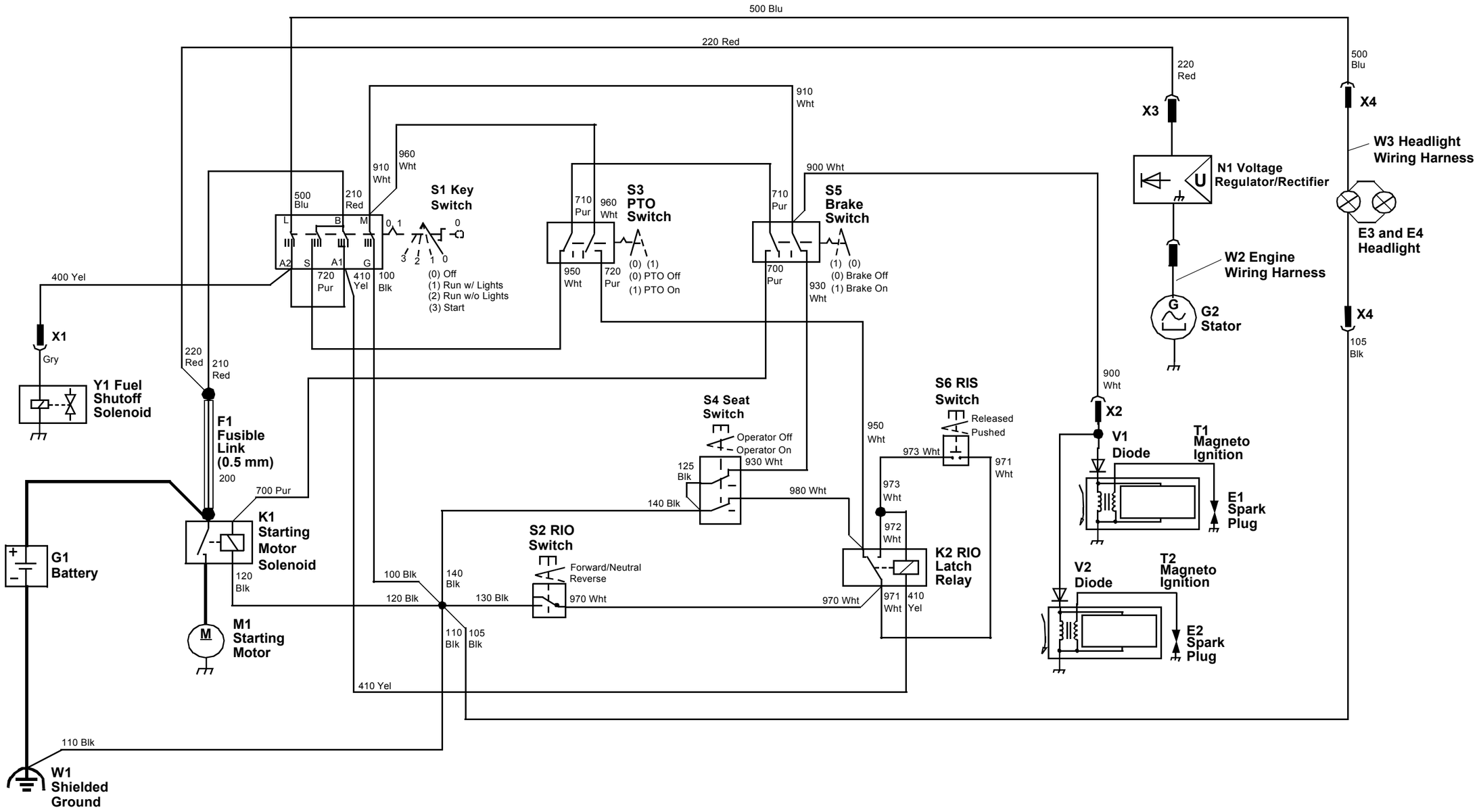
# W1 WIRING HARNESS—LT166 w/ 3 POSITION KEY SWITCH

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, X2 |
| 110 | 0.8 | Blk | X2, W1 |
| 120 | 0.8 | Blk | S1, K1 |
| 130 | 0.8 | Blk | S2, W1 |
| 140 | 0.8 | Blk | S2, S4 |
| 200 | 0.5 | Fus/ Lnk | K1, F1 |
| 210 | 0.8 | Red | F1, S1 |
| 220 | 1.0 | Red | F1, X1 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K2 |
| 500 | 0.8 | Blu | X1, X2 |
| 700 | 0.8 | Pur | S6, K1 |
| 710 | 0.8 | Pur | S3, S6 |
| 720 | 0.8 | Pur | S1, S3 |
| 900 | 0.8 | Wht | S6, Magneto Stop |
| 910 | 0.8 | Wht | S1, S6 |
| 930 | 0.8 | Wht | S6, S4 |
| 940 | 0.8 | Wht | S6, S2 |
| 950 | 0.8 | Wht | S3, K2 |
| 960 | 0.8 | Wht | S1, S3 |
| 970 | 0.8 | Wht | S2, S5 |
| 971 | 0.8 | Wht | S5, K2 |
| 972 | 0.8 | Wht | K2, K2 |
| 973 | 0.8 | Wht | S5, K2 |
| 980 | 0.8 | Wht | S2, K2 |



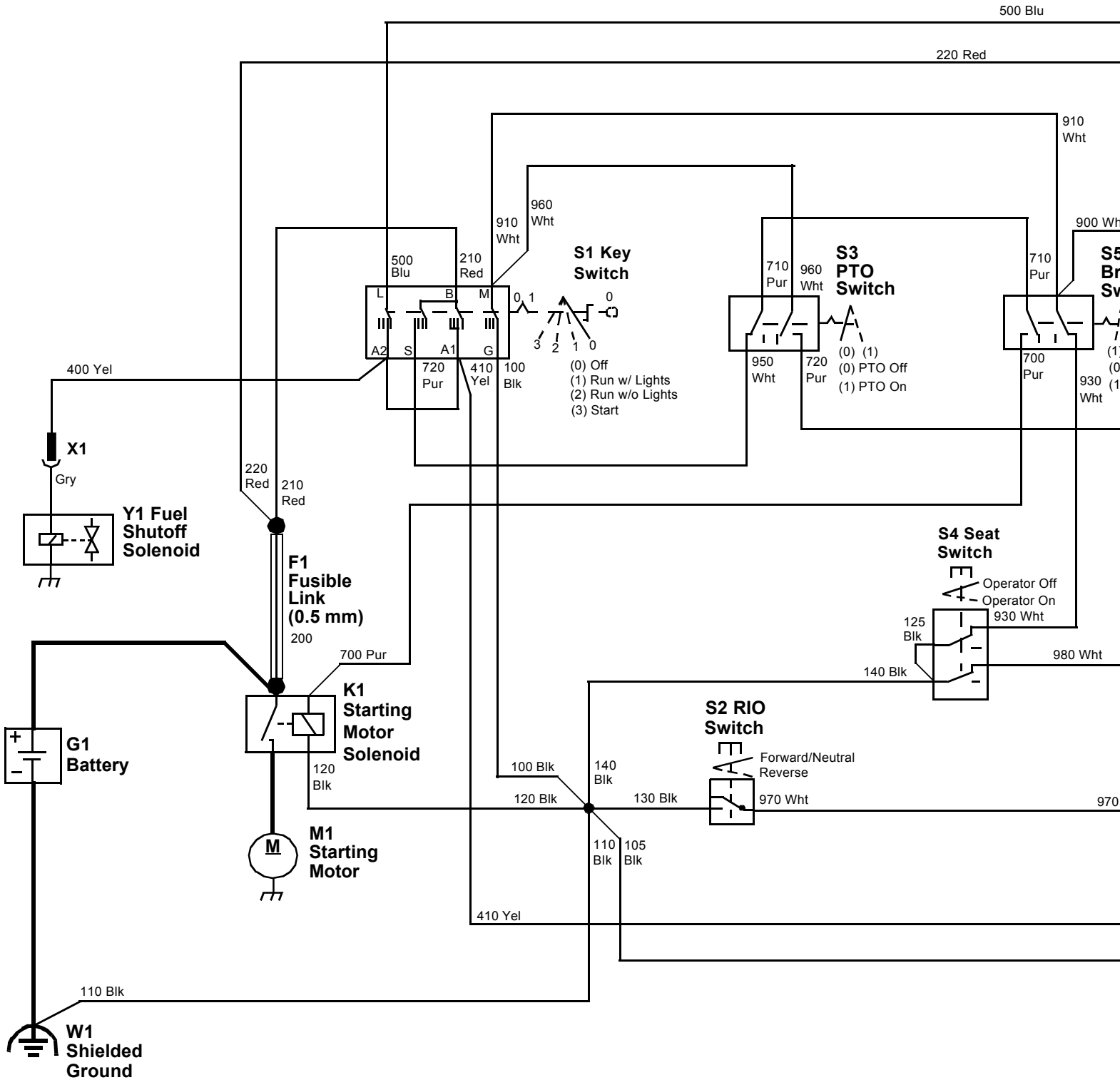

Switch
S5 RIS Switch
973
970
971
G1 Battery
B+
200
F1 Fusible Link
700
K1 Starting Motor Solenoid
Positive
K2 RIO Latch Relay
972
973
410
950
980
971
972
210
220
120
Ground
900
Magneto Stop
700
710
930
940
900
910
S6 Brake Switch
400
Y1 Fuel Shutoff Solenoid
110
130
W1 Engine Ground
500
100
110
X2 to W3 Headlight Wiring Harness
220
500
X1 to W2 Engine Wiring Harness

# W1 ELECTRICAL SCHEMATIC—LT166 w/ 4 POSITION KEY SWITCH

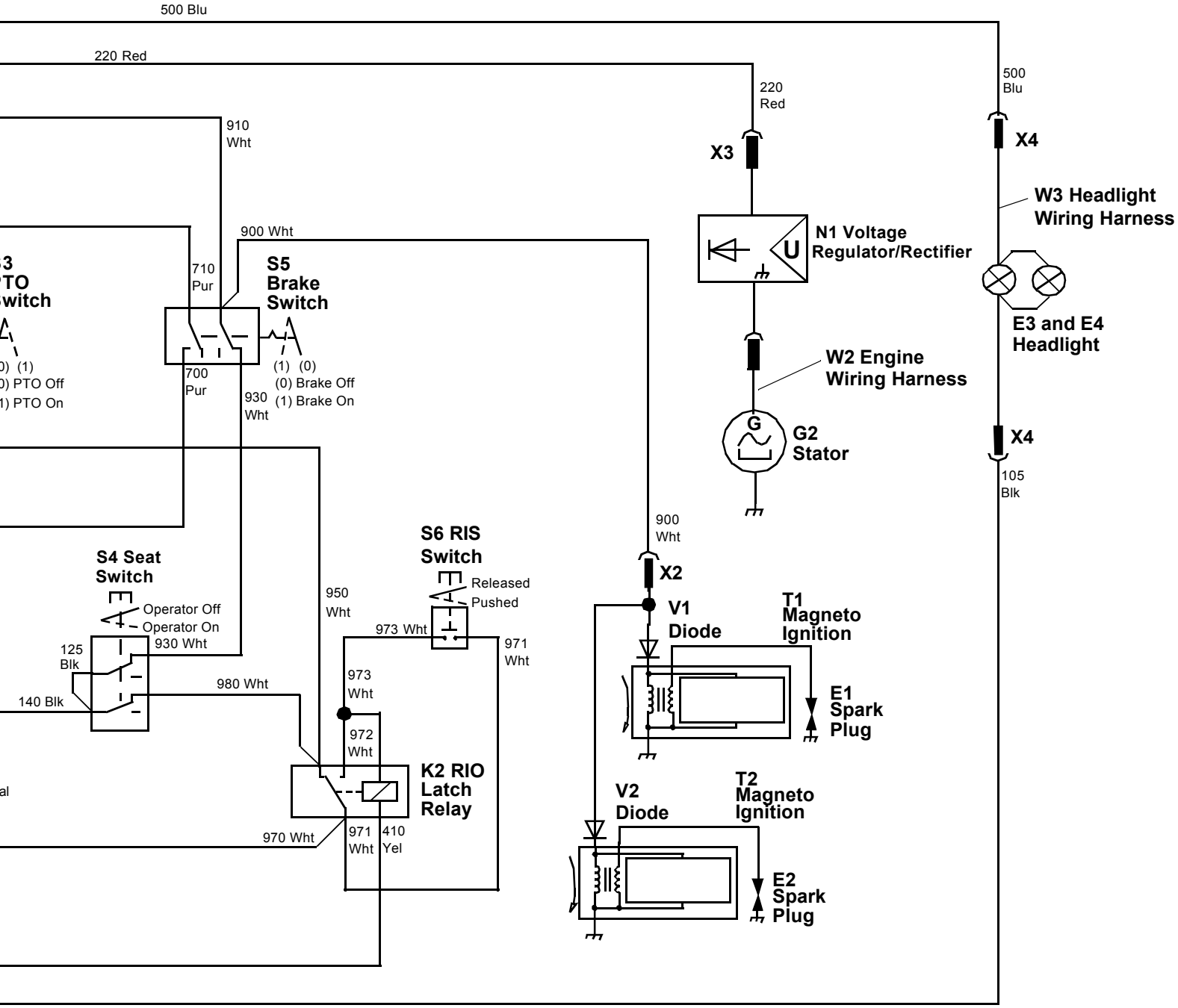



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK | SE 3 - ENGINE IGNITION | SE 4 - CHARGING | SE 5 - HEADLIGHTS |
|---|---|---|---|---|

# W1 ELECTRICAL SCHEMATIC—LT166 w/ 4 POSITION KEY SWITCH

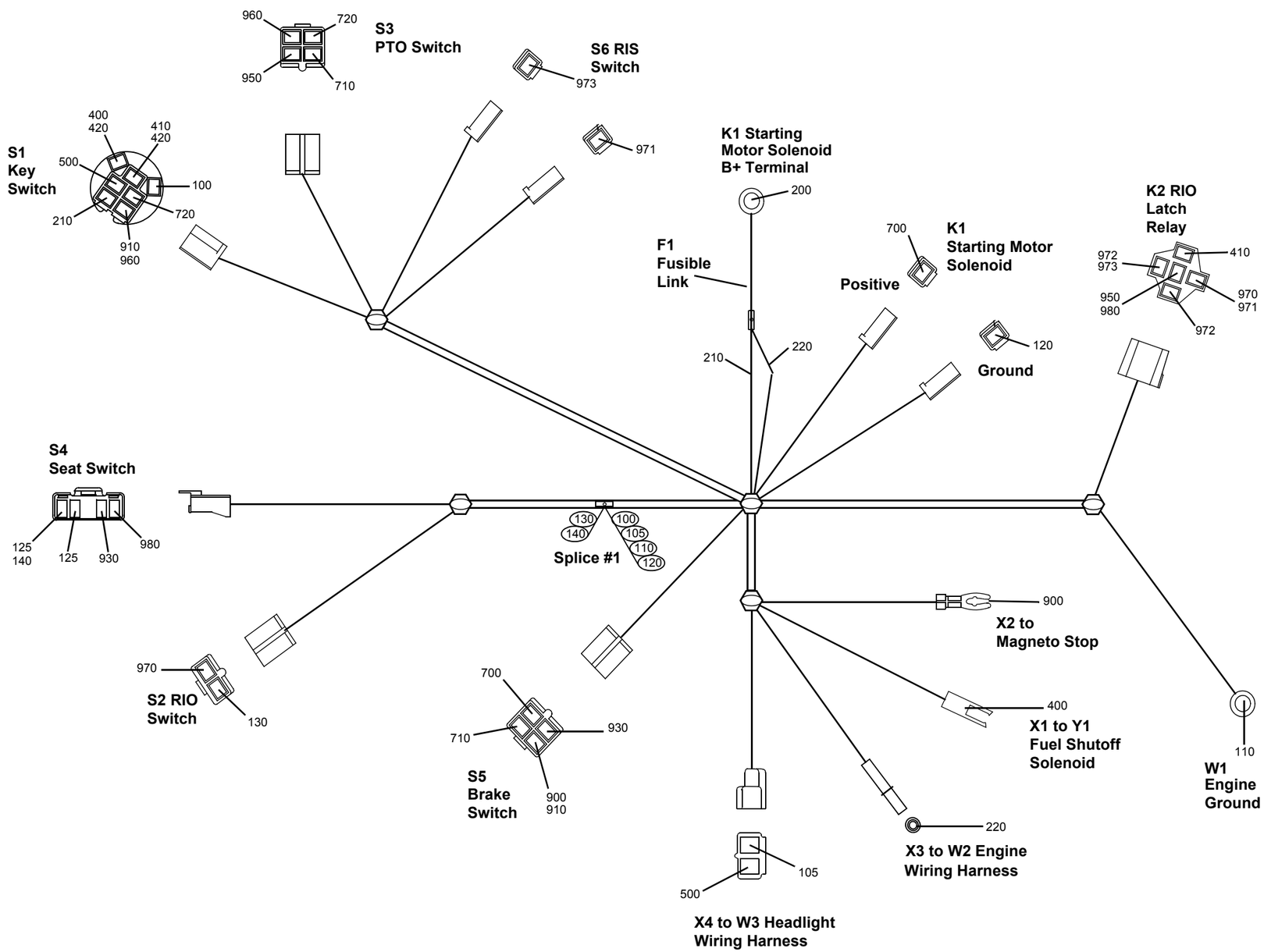



| SE 1 - STARTING | SE 2 - MAGNETO KILL & START INTERLOCK |
|---|---|


500 Blu
220 Red
910 Wht
900 Wht
710 Pur
S5 Brake Switch
700 Pur
930 Wht
(1) (0)
(0) Brake Off
(1) Brake On
220 Red
X3
U
N1 Voltage Regulator/Rectifier
500 Blu
X4
W3 Headlight Wiring Harness
E3 and E4 Headlight
W2 Engine Wiring Harness
G
G2 Stator
X4
105 Blk
900 Wht
X2
V1 Diode
T1 Magneto Ignition
E1 Spark Plug
V2 Diode
T2 Magneto Ignition
E2 Spark Plug
S6 RIS Switch
Released
Pushed
950 Wht
973 Wht
971 Wht
973 Wht
972 Wht
980 Wht
K2 RIO Latch Relay
971 Wht
410 Yel
970 Wht
S4 Seat Switch
Operator Off
Operator On
930 Wht
125 Blk
140 Blk
(0) (1)
(0) PTO Off
(1) PTO On

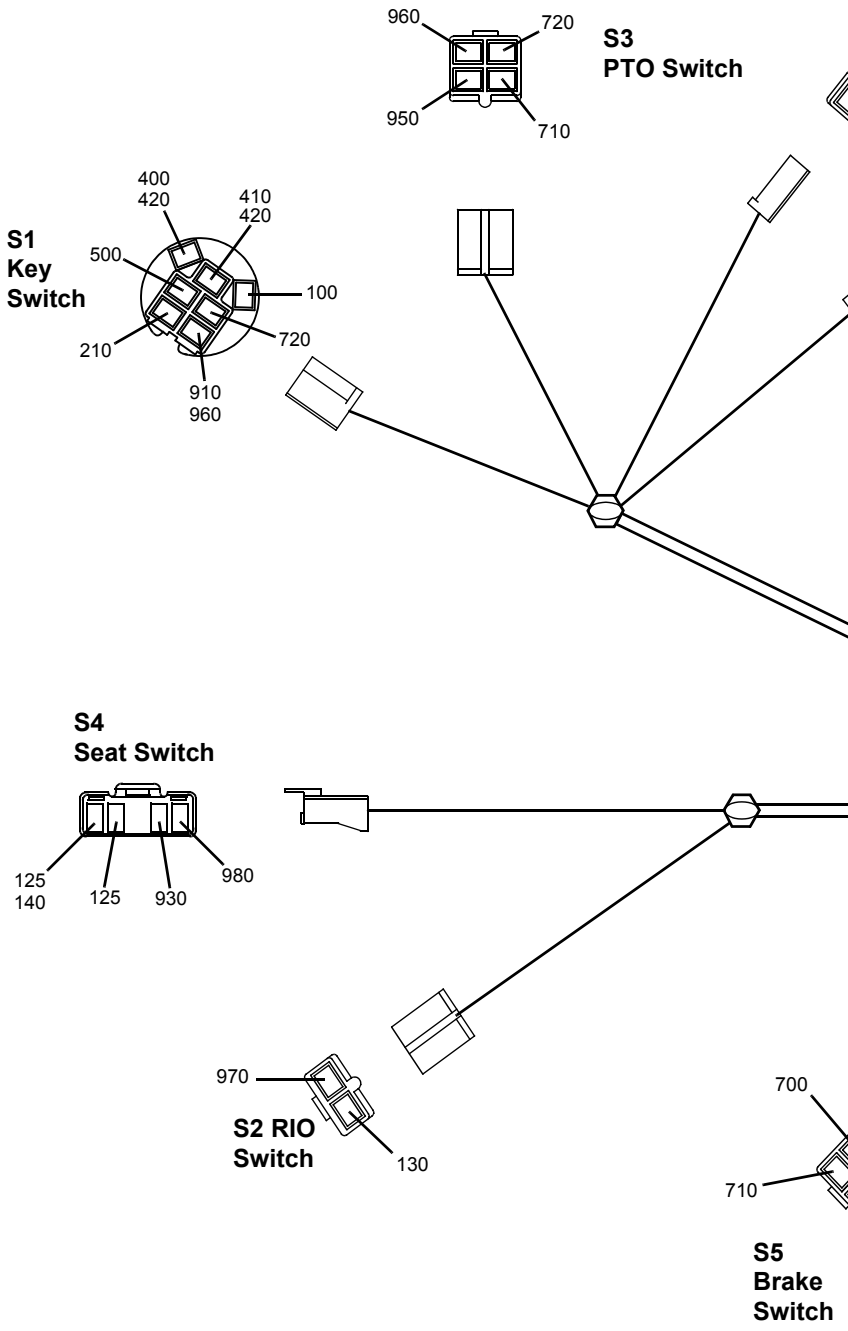
# W1 WIRING HARNESS—LT166 w/ 4 POSITION KEY SWITCH

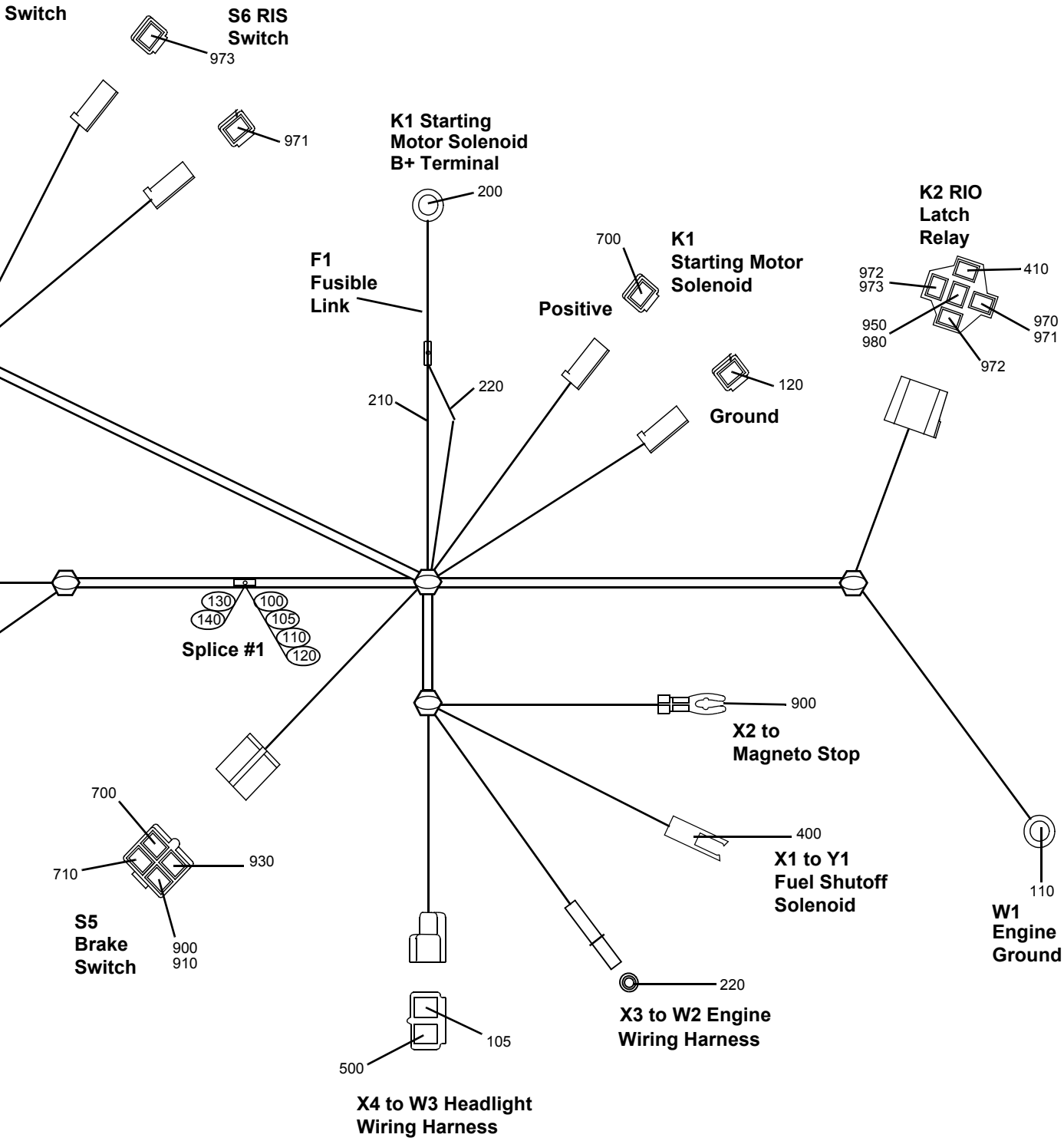
| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, Splice 1 |
| 105 | 0.8 | Blk | Splice 1, X4 |
| 110 | 0.8 | Blk | Splice 1, W1 |
| 120 | 0.8 | Blk | Splice 1, K1 |
| 125 | 0.8 | Blk | S4, S4 |
| 130 | 0.8 | Blk | Splice 1, S2 |
| 140 | 0.8 | Blk | Splice 1, S4 |
| 200 | 0.5 | Fus/ Lnk | K1, F1 |
| 210 | 0.8 | Red | F1, S1 |
| 220 | 1.0 | Red | F1, X3 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K2 |
| 420 | 0.8 | Yel | S1, S1 |
| 500 | 0.8 | Blu | S1, X4 |
| 700 | 0.8 | Pur | S5, K1 |
| 710 | 0.8 | Pur | S3, S5 |
| 720 | 0.8 | Pur | S1, S3 |
| 900 | 0.8 | Wht | S5, X2 |
| 910 | 0.8 | Wht | S1, S5 |
| 930 | 0.8 | Wht | S5, S4 |
| 950 | 0.8 | Wht | S3, K2 |
| 960 | 0.8 | Wht | S1, S3 |
| 970 | 0.8 | Wht | S2, K2 |
| 971 | 0.8 | Wht | S6, K2 |
| 972 | 0.8 | Wht | K2, K2 |
| 973 | 0.8 | Wht | S6, K2 |
| 980 | 0.8 | Wht | S4, K2 |



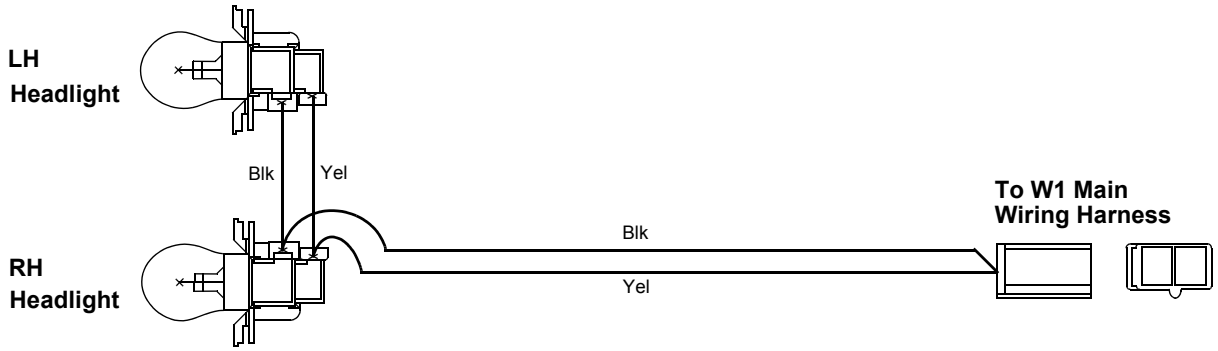
# W1 WIRING HARNESS—LT166 w/ 4 POSITION KEY SWITCH

| Circuit Number | Wire Size | Color | Termination Points |
|---|---|---|---|
| 100 | 0.8 | Blk | S1, Splice 1 |
| 105 | 0.8 | Blk | Splice 1, X4 |
| 110 | 0.8 | Blk | Splice 1, W1 |
| 120 | 0.8 | Blk | Splice 1, K1 |
| 125 | 0.8 | Blk | S4, S4 |
| 130 | 0.8 | Blk | Splice 1, S2 |
| 140 | 0.8 | Blk | Splice 1, S4 |
| 200 | 0.5 | Fus/ Lnk | K1, F1 |
| 210 | 0.8 | Red | F1, S1 |
| 220 | 1.0 | Red | F1, X3 |
| 400 | 0.8 | Yel | S1, Y1 |
| 410 | 0.8 | Yel | S1, K2 |
| 420 | 0.8 | Yel | S1, S1 |
| 500 | 0.8 | Blu | S1, X4 |
| 700 | 0.8 | Pur | S5, K1 |
| 710 | 0.8 | Pur | S3, S5 |
| 720 | 0.8 | Pur | S1, S3 |
| 900 | 0.8 | Wht | S5, X2 |
| 910 | 0.8 | Wht | S1, S5 |
| 930 | 0.8 | Wht | S5, S4 |
| 950 | 0.8 | Wht | S3, K2 |
| 960 | 0.8 | Wht | S1, S3 |
| 970 | 0.8 | Wht | S2, K2 |
| 971 | 0.8 | Wht | S6, K2 |
| 972 | 0.8 | Wht | K2, K2 |
| 973 | 0.8 | Wht | S6, K2 |
| 980 | 0.8 | Wht | S4, K2 |



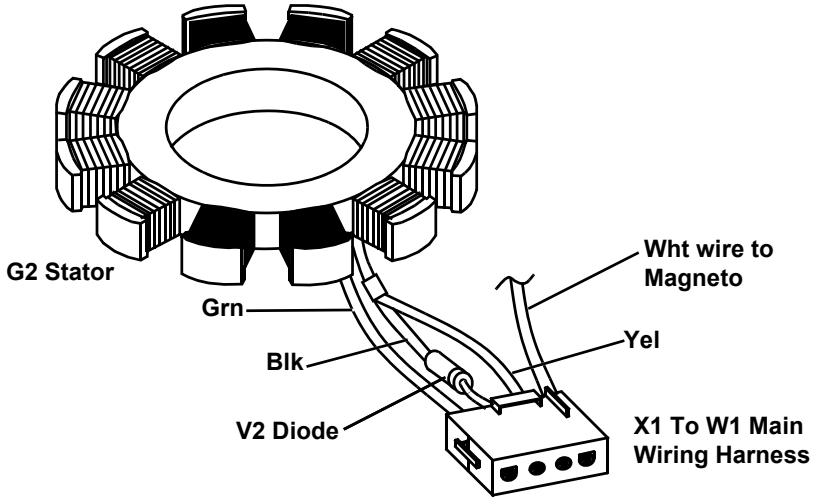

Switch
S6 RIS Switch
973
971
K1 Starting Motor Solenoid B+ Terminal
200
F1 Fusible Link
700
K1 Starting Motor Solenoid
Positive
K2 RIO Latch Relay
972
973
410
950
980
970
971
972
210
220
120
Ground
130
140
100
105
110
120
Splice #1
900
X2 to Magneto Stop
700
710
930
900
910
S5 Brake Switch
400
X1 to Y1 Fuel Shutoff Solenoid
110
W1 Engine Ground
220
X3 to W2 Engine Wiring Harness
105
500
X4 to W3 Headlight Wiring Harness

## HEADLIGHT WIRING HARNESS–LT133/LT155

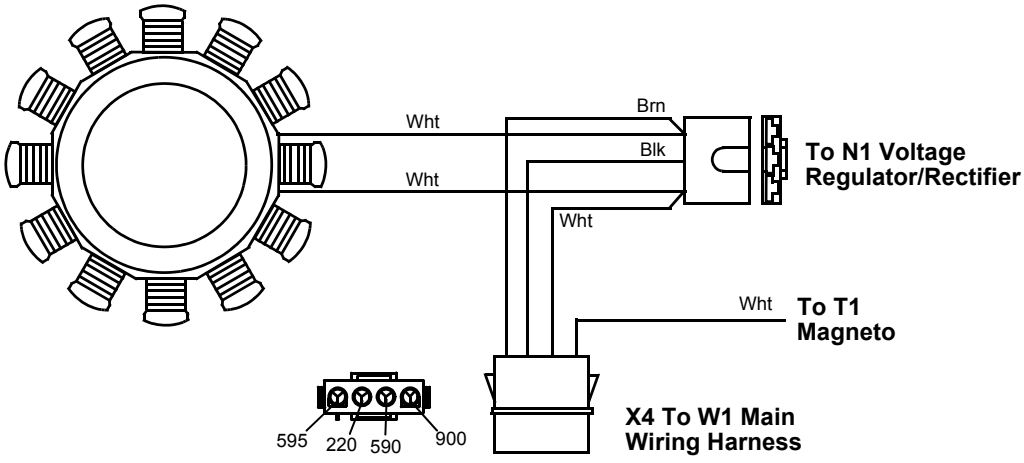



## Y1 FUEL SHUTOFF SOLENOID–LT133/LT155 (OPTIONAL)

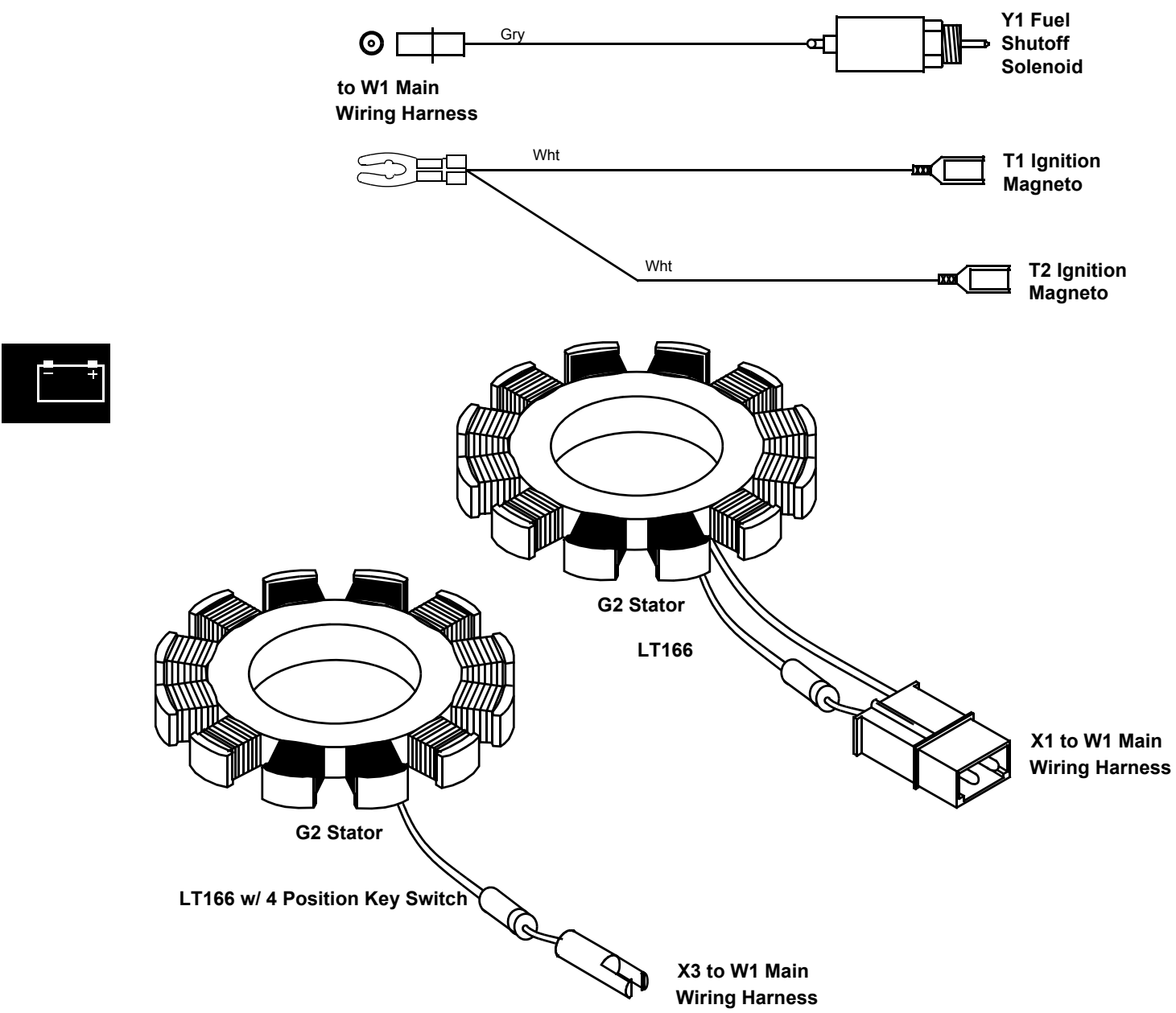
## W2 ENGINE WIRING HARNESS–LT133/LT155 w/ 3 AMP CHARGER



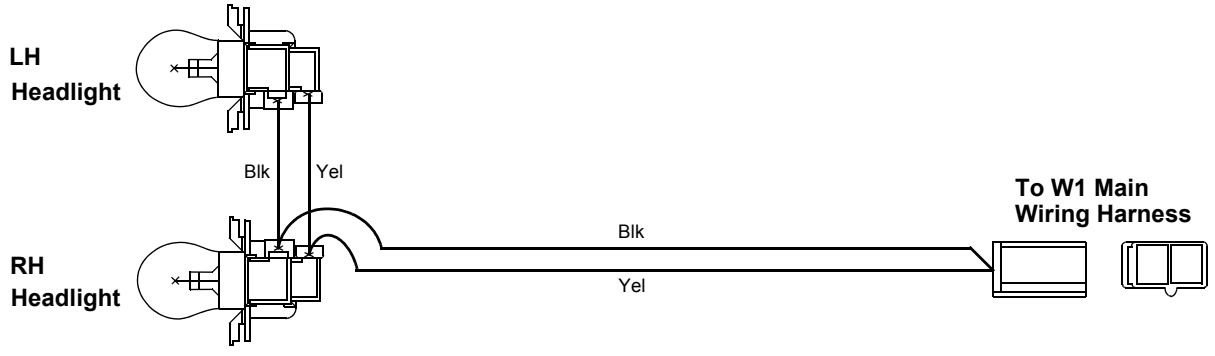

## W3 ENGINE WIRING HARNESS–LT133/LT155 w/ 15 AMP CHARGER



# W2 ENGINE WIRING HARNESS–LT166




# W3 HEADLIGHT WIRING HARNESS–LT166



# TROUBLESHOOTING

This chart will give possible solutions to a problem or refer you to the probable circuit diagnostic sequence.

| Problem or Symptom / Check or Solution | Battery will not maintain charge | Slow cranking speed | Engine will not crank | Engine cranks but will not start | Headlights not working | Engine will not shut off | Backfire or Afterbang when engine is shutdown |
|---|---|---|---|---|---|---|---|
| Test battery | ● | ● | ● | ● | | | |
| Test charging system | ● | | | | | | |
| Loose/corroded/shorted connection | ● | ● | ● | ● | ● | ● | |
| Test starting motor solenoid | | | ● | | | | |
| Test starting motor | | ● | ● | ● | | | |
| Test shunt relay (LT133/LT155) | ● | ● | ● | | ● | | |
| Test PTO switch/adjustment | | | ● | | | | |
| Test brake switch/adjustment | | | ● | | | | |
| Test F1 fuselink | | | ● | | | | |
| Test seat switch/adjustment | | | | ● | | | |
| Test seat relay K3 (LT133/LT155) | | | | ● | | | |
| See Engine Troubleshooting | | ● | ● | ● | | | |
| Magneto kill circuit grounded | | | | ● | | | |
| Ignition module defective | | | | ● | | | |
| Spark plug or ignition wire defective | | | | ● | | | |
| Key switch defective | | | ● | ● | ● | ● | |
| Lighting coil circuit defective | | | | | ● | | |
| Bulbs burned out | | | | | ● | | |
| Magneto kill circuit open | | | | | | ● | |
| Install optional fuel shutoff solenoid (Kit available) | | | | | | | ● |

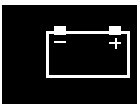
# THEORY OF OPERATION AND DIAGNOSIS

## POWER CIRCUIT OPERATION– LT133/LT155

**Function:**

Provides unswitched power to the primary components and switched power to secondary 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
- Start Relay Positive Contact Stud
- Key Switch
- Red Wire at Engine Wiring Harness Connector

The positive battery cable connects the battery to the starting motor relay bolt.

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.

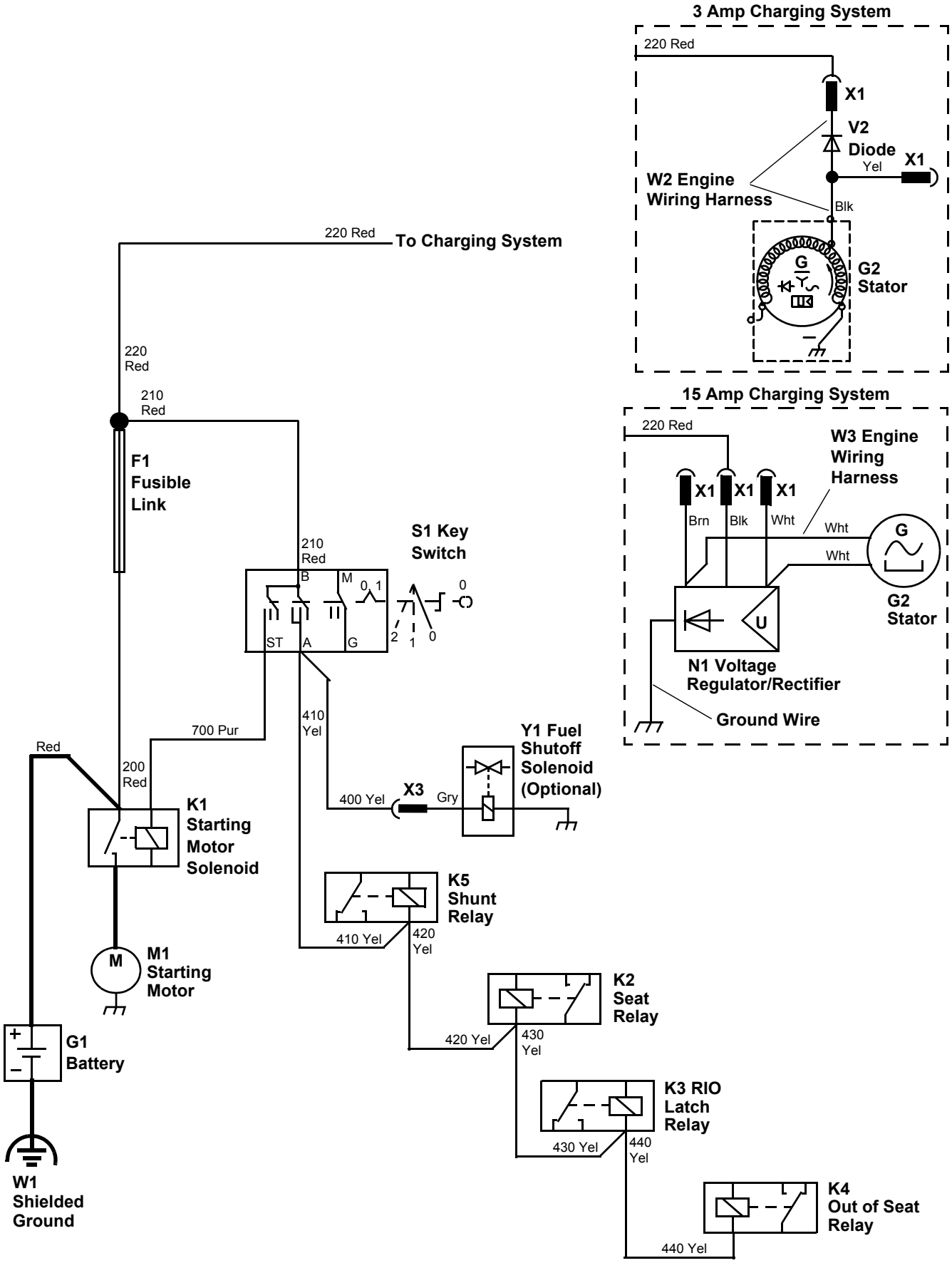
The fusible link and 210 Red wire provide unswitched voltage to the key switch.

The fusible link and 220 Red wire provide unswitched voltage to the engine wiring harness connector.

**Operating Conditions, Switched Circuits:**

Placing the key switch in the RUN position provides voltage from 210 Red wire through the key switch to the 410, 420, 430, and 440 Yel wires. Each of these wires supplies input signal voltage to the four system interlock relays and the fuel shutoff solenoid (if equipped). These relays will not energize until another switch(es) is actuated.

# POWER CIRCUIT SCHEMATIC–LT133/LT155



# POWER CIRCUIT DIAGNOSIS–LT133/LT155

**Test Conditions:**

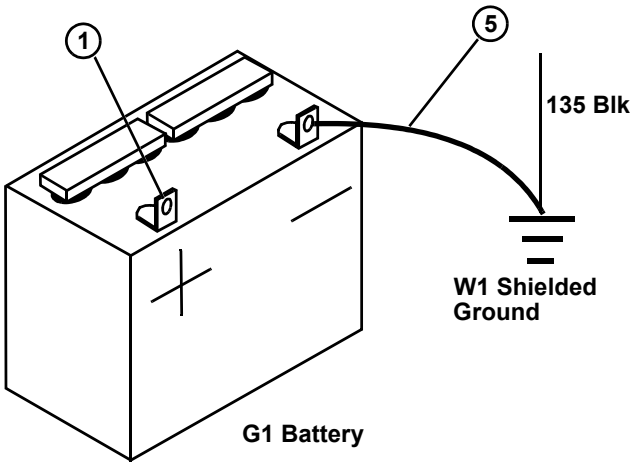
- Key switch in OFF position

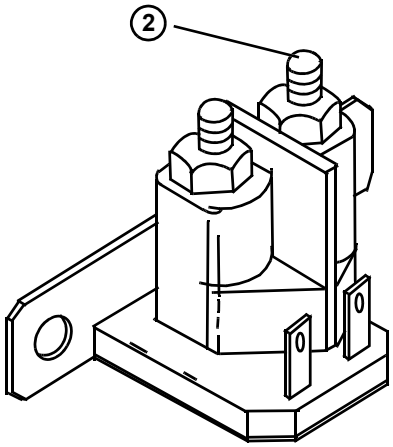
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Positive and negative battery post | 12.4 volts or above | Clean battery terminals and test battery. |
| 2. Start relay stud terminal | Battery voltage | Clean and check battery cable and tighten connections. |
| 3. Key switch | Battery voltage | Check F1 fusible link, 210 Red wire connections. Replace fuseible link. |
| 4. Engine connector | Battery voltage | Check wire 220 Red wire and connections. |
| 5. Ground cable frame connection to negative battery terminal | Less than 0.1 ohm resistance | Check harness wires and negative cable connections to frame, removing any paint, rust or corrosion. Clean negative battery connection to battery post. |

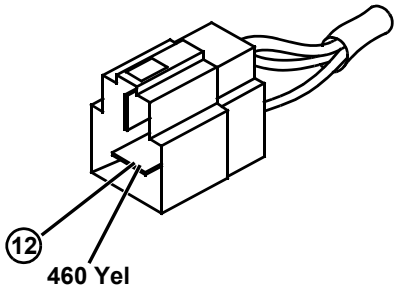
**Test Conditions:**

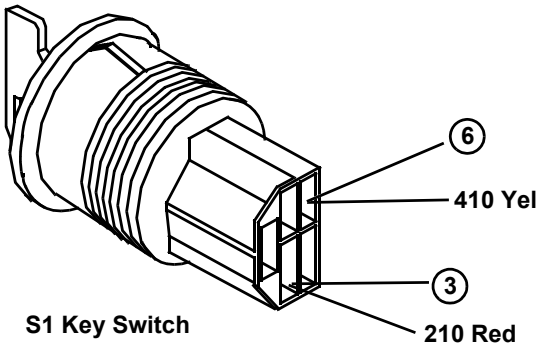
- Key switch in RUN position
- Engine OFF

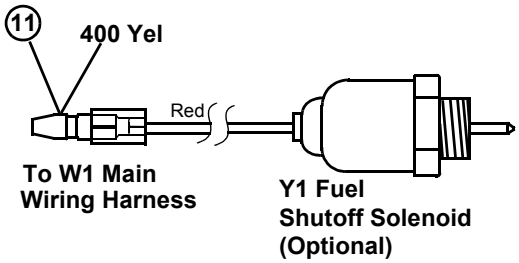
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 6. Key switch | Battery voltage | Replace key switch. |
| 7. Shunt Relay | Battery voltage | Check 410 Yel wire and connections. |
| 8. Seat Relay | Battery voltage | Check 420 Yel wire and connections. |
| 9. RIO Latch Relay | Battery voltage | Check 430 Yel wire and connections. |
| 10. Out Of Seat Relay | Battery voltage | Check 440 Yel wire and connections. |
| 11. Fuel shutoff solenoid wire harness connector | Battery Voltage | Check 400 Yel wire and connections. |
| 12. Headlight Wire Harness Connector (15 amp systems only) | Battery Voltage | Check 460 Yel wire and connections. |

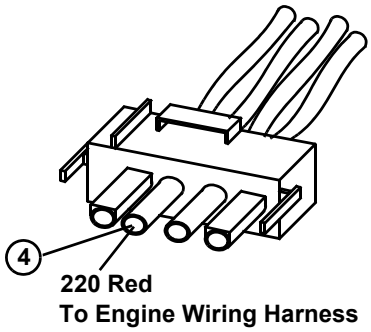

1
5
135 Blk
W1 Shielded Ground
G1 Battery

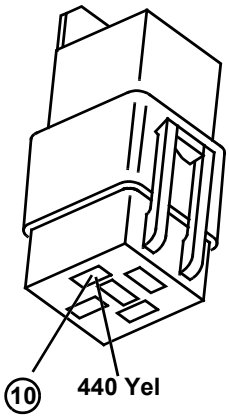

2
K1 Start Relay

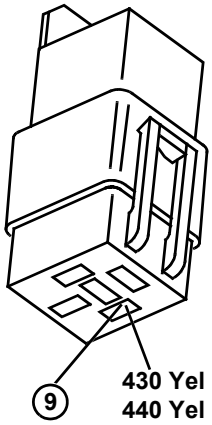

12
460 Yel
Headlight Connector

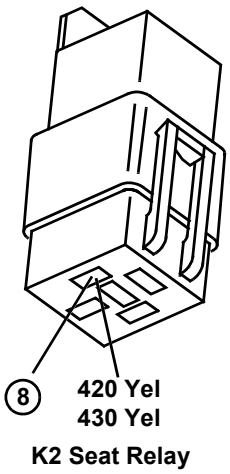

6
410 Yel
3
210 Red
S1 Key Switch

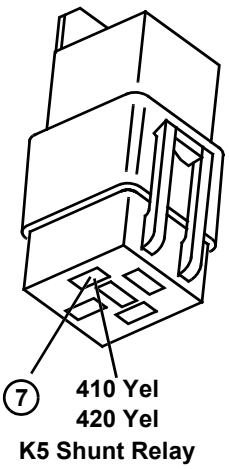

11
400 Yel
Red
To W1 Main Wiring Harness
Y1 Fuel Shutoff Solenoid (Optional)


4
220 Red
To Engine Wiring Harness


10
440 Yel
K4 Out of Seat Relay


9
430 Yel
440 Yel
K3 RIO Latch Relay


8
420 Yel
430 Yel
K2 Seat Relay


7
410 Yel
420 Yel
K5 Shunt Relay

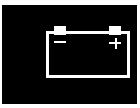
# POWER CIRCUIT OPERATION–LT133/LT155 w/4 POSITION KEY SWITCH

**Function:**

Provides unswitched power to the primary components and switched power to secondary 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
- Starting Motor Solenoid Positive Contact Stud
- Key Switch
- Red Wire at Engine Wiring Harness Connector

The positive battery cable connects the battery to the starting motor solenoid bolt.

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 fusible link and 210 Red wire provide unswitched voltage to the key switch.

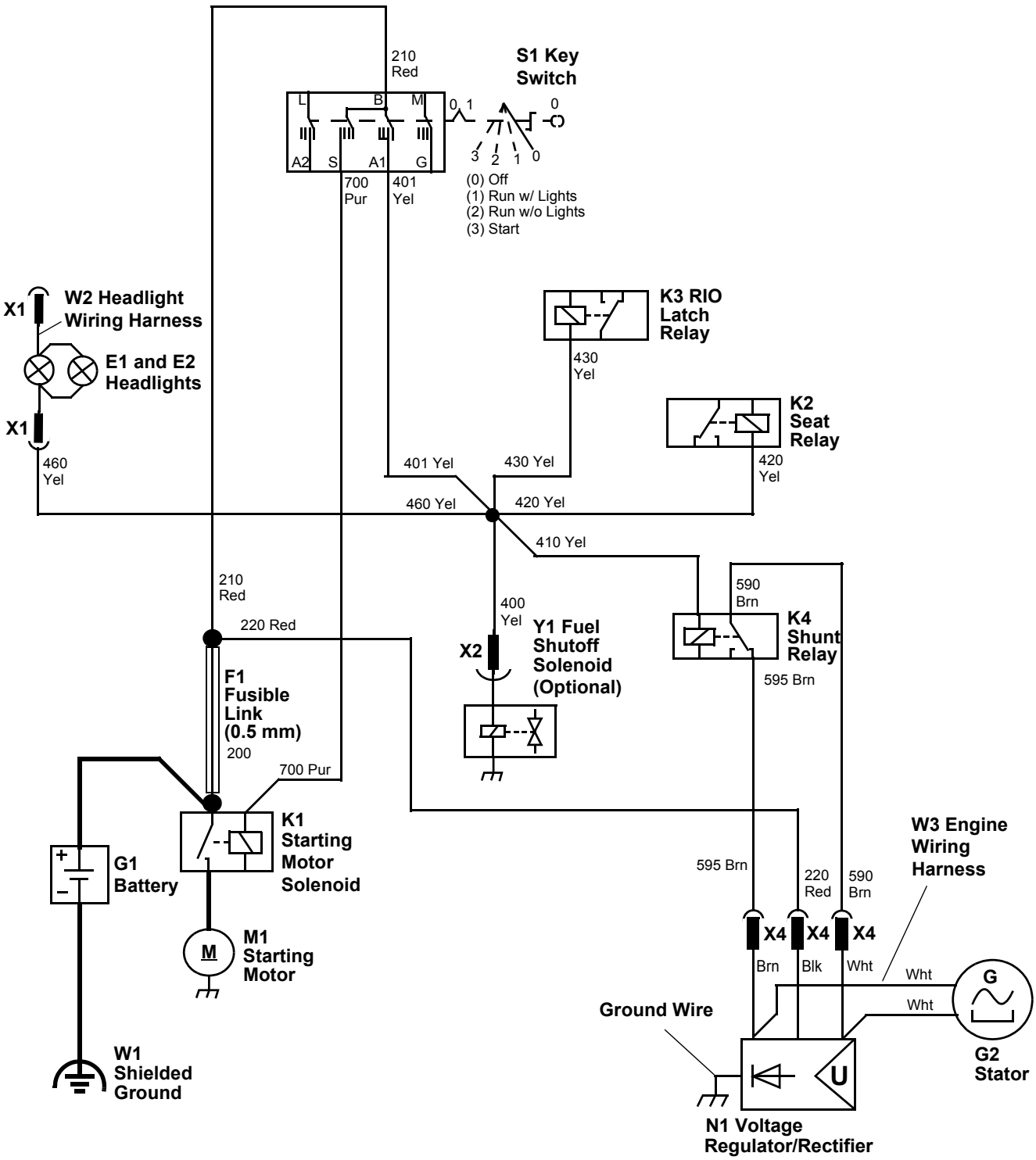
The fusible link and 220 Red wire provide unswitched voltage to the engine wiring harness connector.

**Operating Conditions, Switched Circuits:**

Placing the key switch in the RUN position provides voltage from 210 Red wire through the key switch to the 400, 401, 410, 420, 430 and 460 Yel wires. These wires supply input signal voltage to the three system interlock relays, the headlights and the fuel shutoff solenoid (if equipped). The relays will not energize until another switch(es) is actuated.

Placing the key switch in the START position (See “CRANKING CIRCUIT OPERATION–LT133/LT155 w/ 15 AMP CHARGER”.) provides voltage to the starting motor solenoid coil through the key switch contacts to the 700 Pur wire. The ground for this circuit is provided for the starting motor solenoid by the 120 Blk wire, GCS enable switch contacts (normally closed), 150 Blk wire, brake switch contacts (normally open), 170 and 110 Blk wires.

# POWER CIRCUIT SCHEMATIC–LT133/LT155 w/4 POSITION KEY SWITCH



# POWER CIRCUIT DIAGNOSIS–LT133/LT155 w/4 POS. KEY SWITCH

**Test Conditions:**

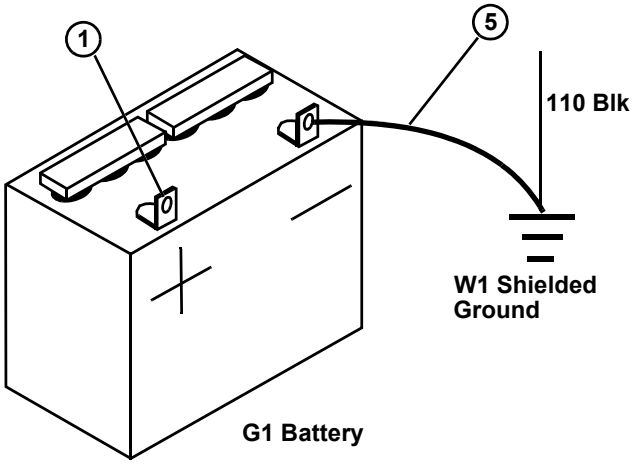
- Key switch in OFF position

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Positive and negative battery post | 12.4 volts or above | Clean battery terminals and test battery. |
| 2. Starting motor solenoid stud terminal | Battery voltage | Clean and check battery cable and tighten connections. |
| 3. Key switch | Battery voltage | Check F1 fusible link, 210 Red wire connections. Replace fuseible link. |
| 4. Engine connector | Battery voltage | Check wire 220 Red wire and connections. |
| 5. Ground cable frame connection to negative battery terminal | Less than 0.1 ohm resistance | Check harness wires and negative cable connections to frame, removing any paint, rust or corrosion. Clean negative battery connection to battery post. |

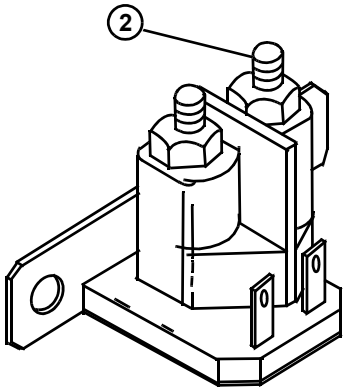
**Test Conditions:**

- Key switch in RUN position
- Engine OFF

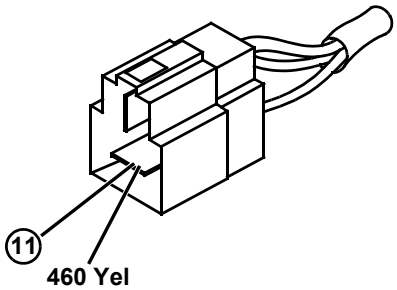
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 6. Key switch | Battery voltage | Replace key switch. |
| 7. Seat Relay | Battery voltage | Check 420 Yel wire and connections. |
| 8. RIO Latch Relay | Battery voltage | Check 430 Yel wire and connections. |
| 9. Shunt Relay | Battery voltage | Check 410 Yel wire and connections. |
| 10. Fuel Shutoff Solenoid | Battery Voltage | Check 400 Yel wire and connections. |
| 11. X1 Headlight Wire Harness Connector | Battery Voltage | Check 460 Yel wire and connections. |



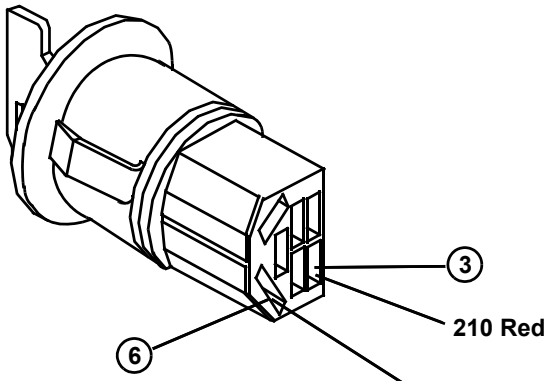

G1 Battery



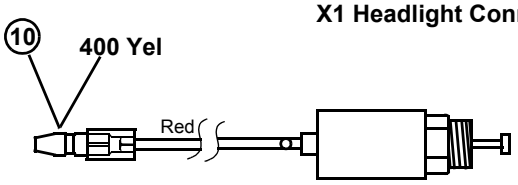

K1 Starting Motor Solenoid




X1 Headlight Connector

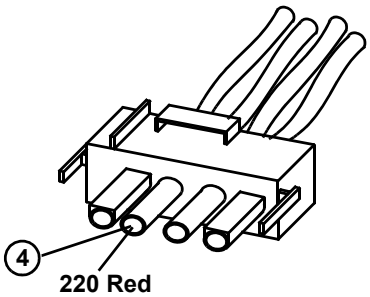



S1 Key Switch

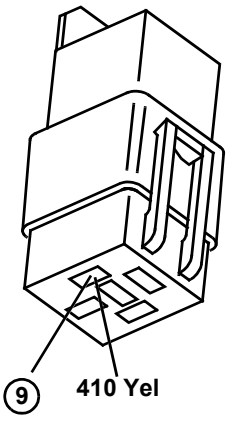



X3 To W1 Main Wiring Harness

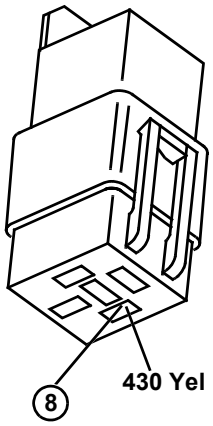
Y1 Fuel Shutoff Solenoid (Optional)



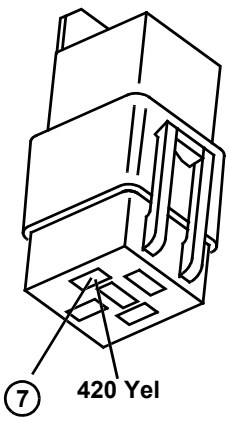

X1 To Engine Wiring Harness




K4 Shunt Relay




K3 RIO Latch Relay




K2 Seat Relay

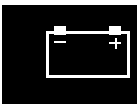
# POWER CIRCUIT OPERATION–LT166–w/ 3 or 4 POSITION KEY SWITCH

**Function:**

Provides unswitched power to the primary components and switched power to secondary 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
- Start Relay Positive Contact Stud
- Key Switch
- Red Wire at Engine Wiring Harness Connector

The positive battery cable connects the battery to the starting motor relay bolt.

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 fusible link and 210 Red wire provide unswitched voltage to the key switch.

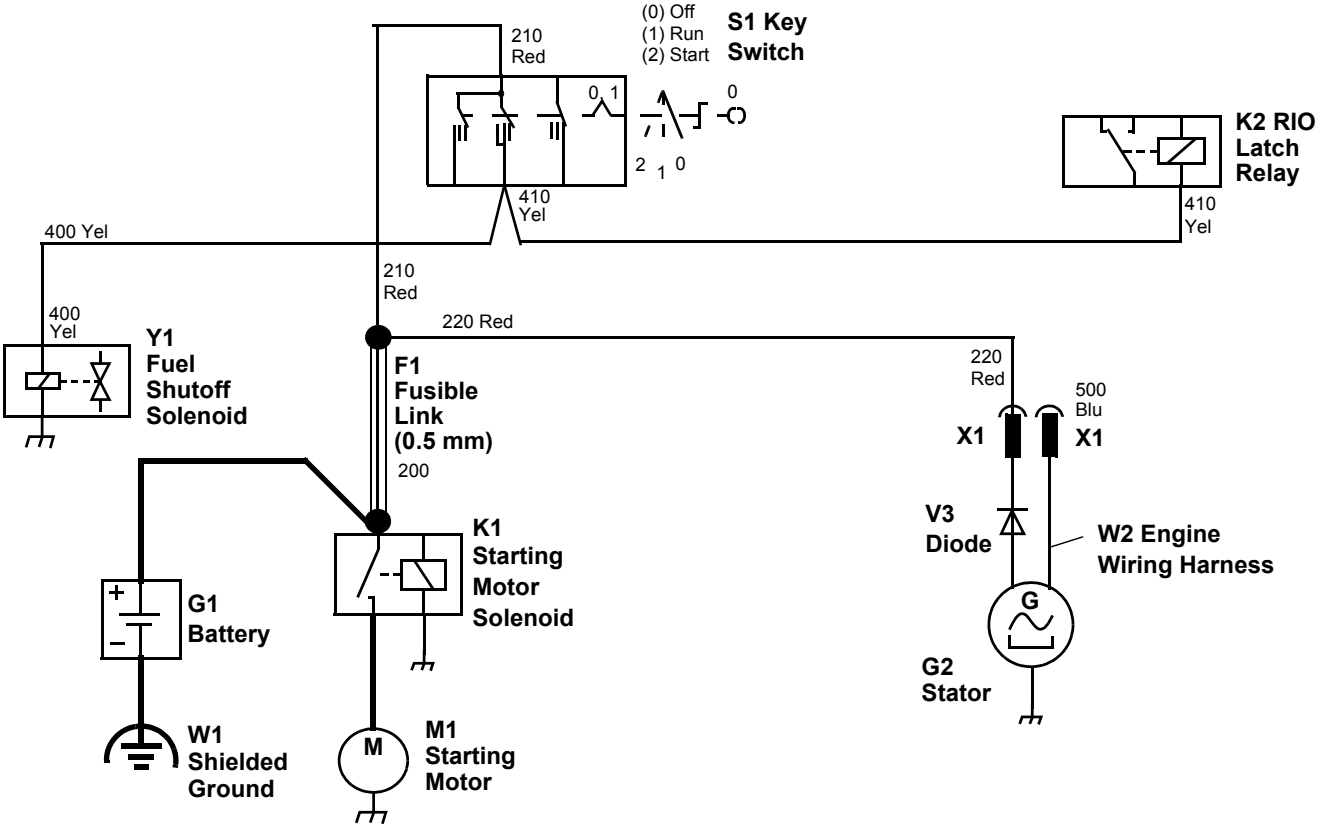
The fusible link and 220 Red wire provide unswitched voltage to the engine wiring harness connector.

**Operating Conditions, Switched Circuits:**

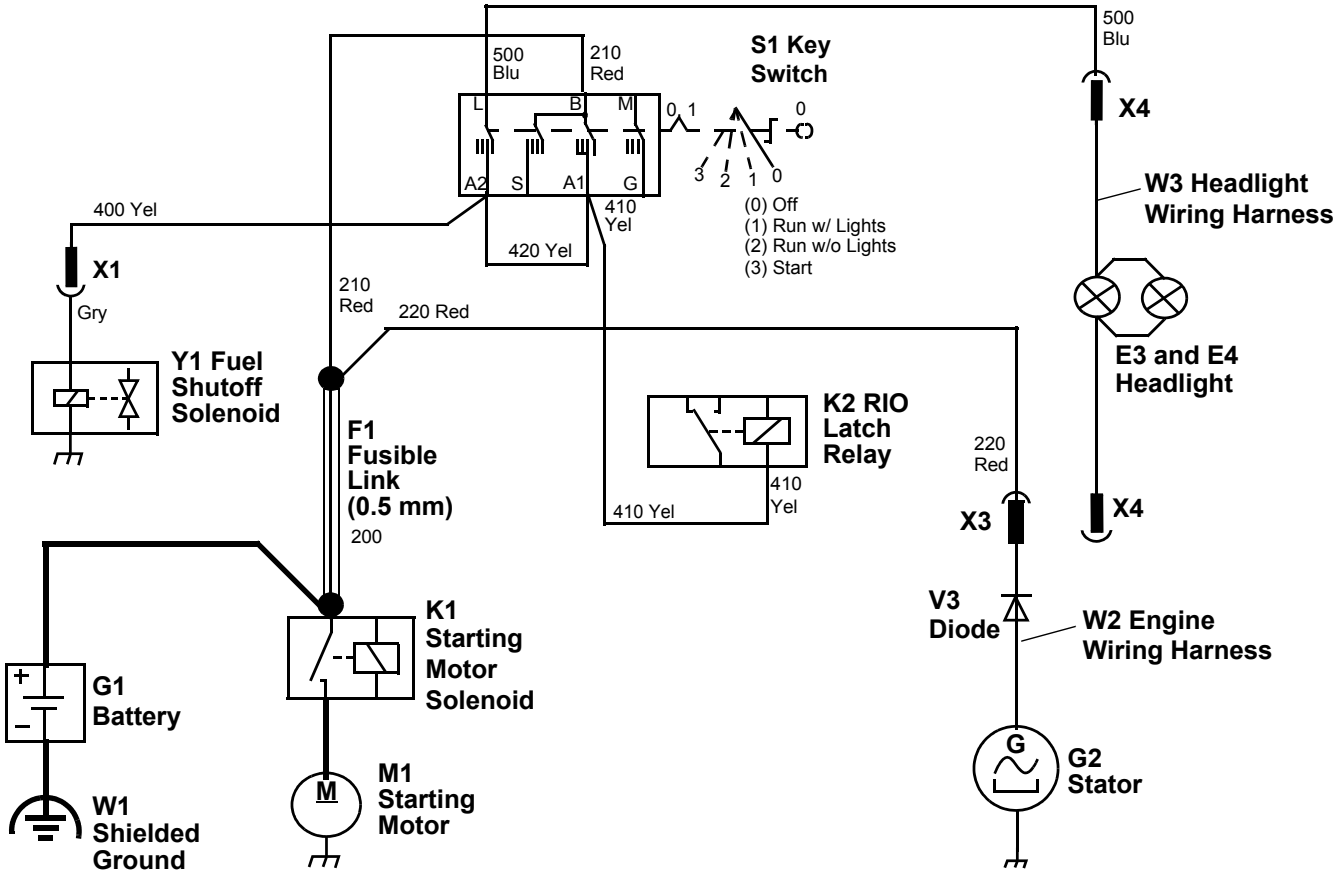
Placing the key switch in the RUN position provides voltage from 210 Red wire through the key switch to the 410 Yel wire. This circuit supplies input signal voltage to the RIO latch relay. This relay will not energize until another switch(s) are actuated.

Placing the key switch in the START position provides voltage to the start relay solenoid coil through the key switch contacts, 720 Pur wire, PTO switch contacts (normally closed), 710 Pur wire, brake switch contacts (normally open), and 700 Pur wire.

## POWER CIRCUIT SCHEMATIC–LT166–w/3 POSITION KEY SWITCH




## POWER CIRCUIT SCHEMATIC–LT166–w/4 POSITION KEY SWITCH



# POWER CIRCUIT DIAGNOSIS–LT166

**Test Conditions:**

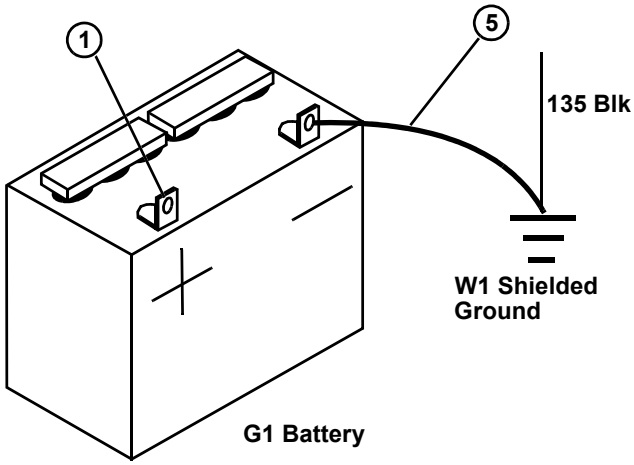
- Key switch in OFF position

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Positive and negative battery post | 12.4 volts or above | Clean battery terminals and test battery. |
| 2. Start relay stud terminal | Battery voltage | Clean and check battery cable and tighten connections. |
| 3. Key switch | Battery voltage | Check F1 fusible link, 210 Red wire connections. Replace fuseible link. |
| 4. Engine connector | Battery voltage | Check wire 220 Red wire and connections. |
| 5. Ground cable frame connection to negative battery terminal | Less than 0.1 ohm resistance | Check harness wires and negative cable connections to frame, removing any paint, rust or corrosion. Clean negative battery connection to battery post. |

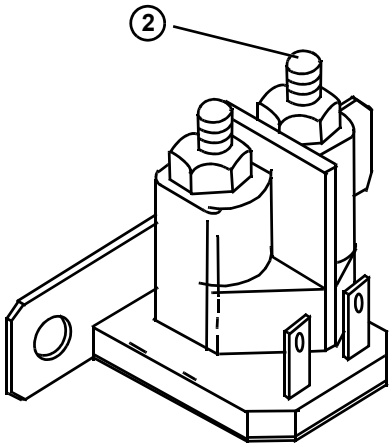
**Test Conditions:**

- Key switch in RUN position
- Engine OFF

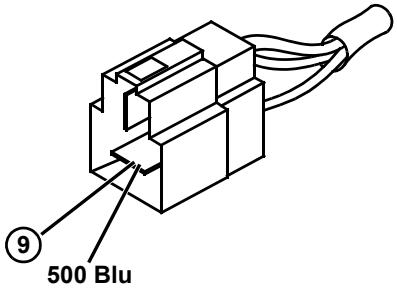
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 6. Key switch | Battery voltage | Replace key switch. |
| 7. RIO latch relay | Battery voltage | Check 410 Yel wire and connections. |
| 8. Fuel Shutoff Solenoid | Battery Voltage | Check 400 Yel wire and connections. |
| 9. X4 Headlight Wire Harness Connector (4 position Key Switch only) | Battery Voltage | Check 500 Blu wire and connections. If OK, replace key switch. |



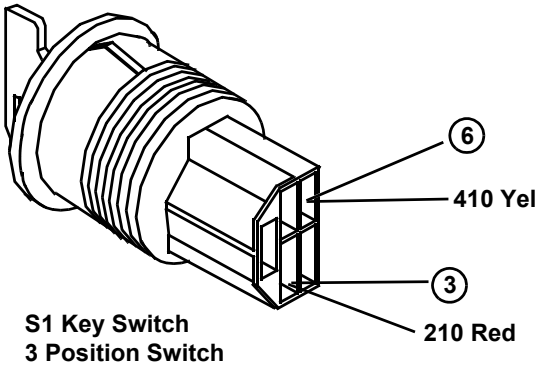

G1 Battery



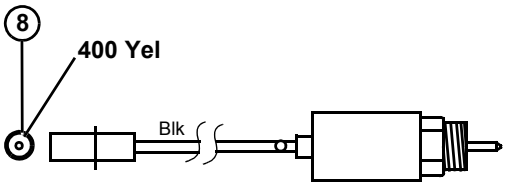

K1 Start Relay




X4 Headlight Connector
4 Position Key Switch

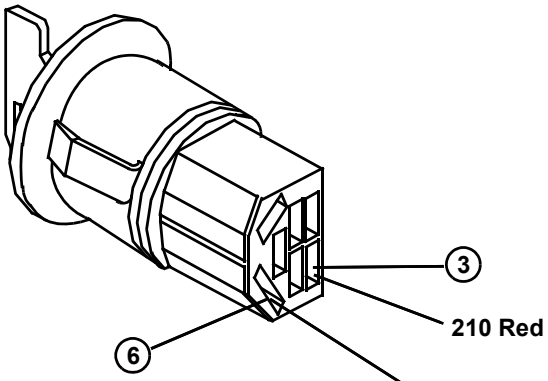



S1 Key Switch
3 Position Switch

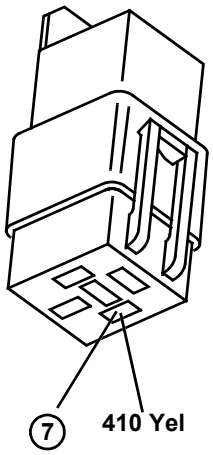



X3 To W2 Engine Wiring Harness

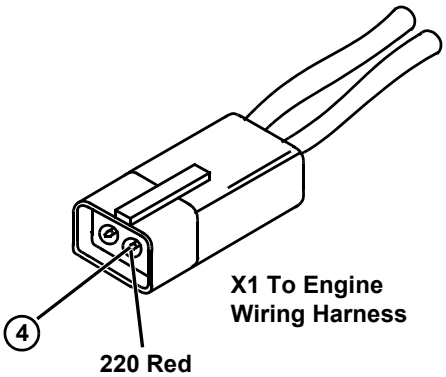
Y2 Fuel Solenoid




S1 Key Switch
4 Position Switch




K2 RIO Latch Relay




X1 To Engine Wiring Harness

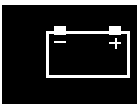
# CRANKING CIRCUIT OPERATION– LT133/LT155 w/ 3 AMP CHARGER

**Function:**

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

**Operating Conditions:**

To crank the engine, the key switch must be in the START position, the brake must be ON and the PTO must be OFF (disengaged). The operator DOES NOT have to be on the seat to crank the engine.



**Theory of Operation:**

Current flows from the battery through F1 fusible link to the key switch. With key switch in the START position current flows through the key switch, through 700 Pur wire to the starting motor solenoid.

The PTO switch and brake switch are used in the starting motor solenoid ground circuit to prevent the engine from cranking if the PTO is engaged or the brake is not engaged.

A ground circuit for the starting motor solenoid is provided through the 120 Blk wire, PTO switch contacts (normally closed), 150 Blk wire, brake switch contacts (normally open), 160 and 135 Blk wires.

With the starting motor solenoid energized, high battery current flows across the starting motor solenoid contacts to the starting motor, causing it to crank the engine.

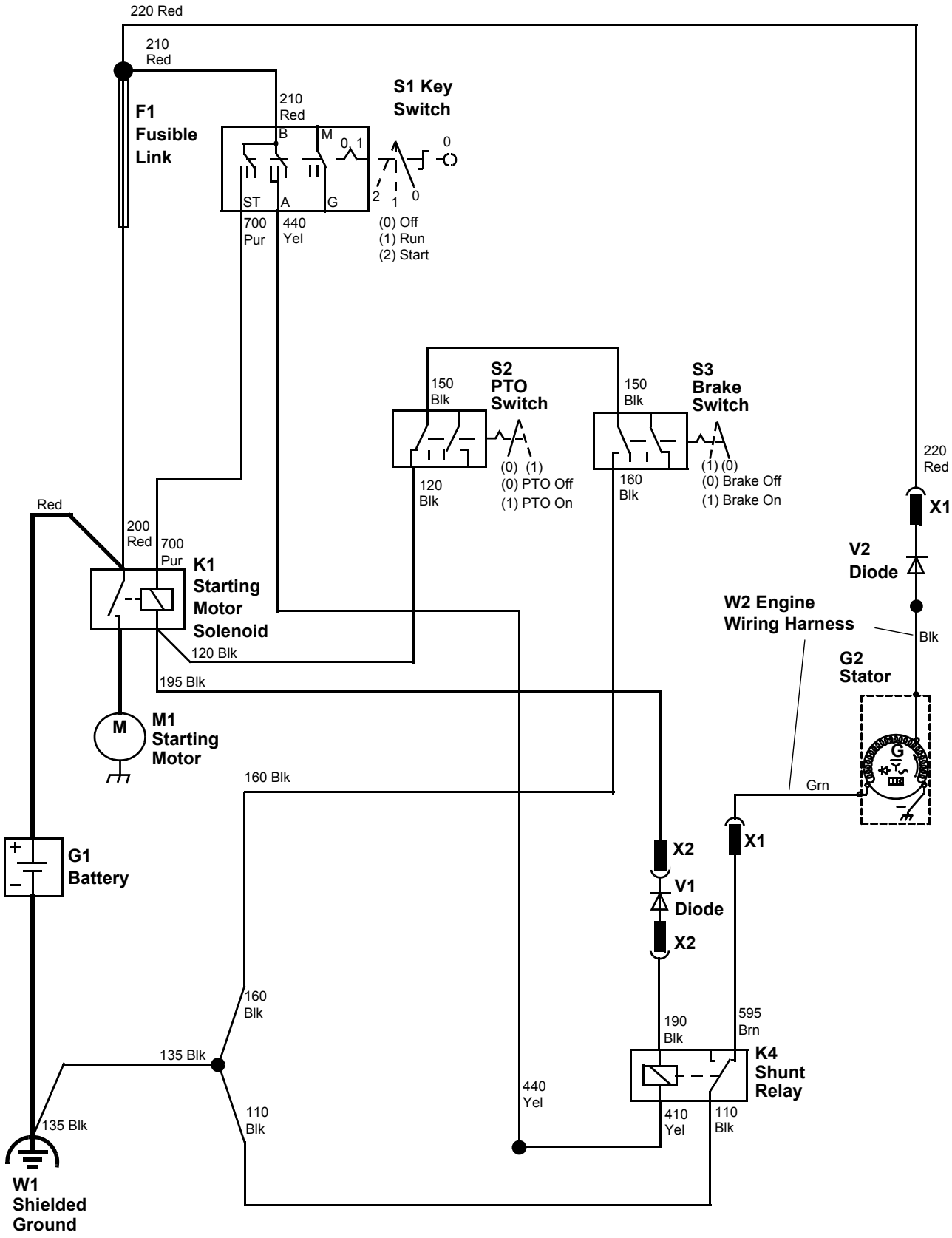
During the cranking operation the shunt relay is energized to remove the electrical load on the stator used to stop the engine from rotating when shutting the engine off. See “CHARGING & SHUNT CIRCUIT OPERATION–LT133/LT155–3 AMP”.

With the key switch in the RUN or START position the current flows across the key switch from the 210 Red wire to the 440 and 410 Yel wires and the shunt relay.

The ground circuit for the shunt relay is provided through the 190 Blk wire, V1 diode, 195 and 120 Blk wire, PTO switch contacts (normally closed), 150 Blk wire, brake switch contacts (normally open), 160 and 135 Blk wires.

This circuit then opens the shunt relay contacts breaking the current path from the stator to ground, removing the electrical load on the stator.

# CRANKING CIRCUIT SCHEMATIC–LT133/LT155 w/ 3 AMP CHARGER



# CRANKING CIRCUIT DIAGNOSIS–LT133/LT155 w/ 3 AMP CHARGER

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF
- Spark plug disconnected

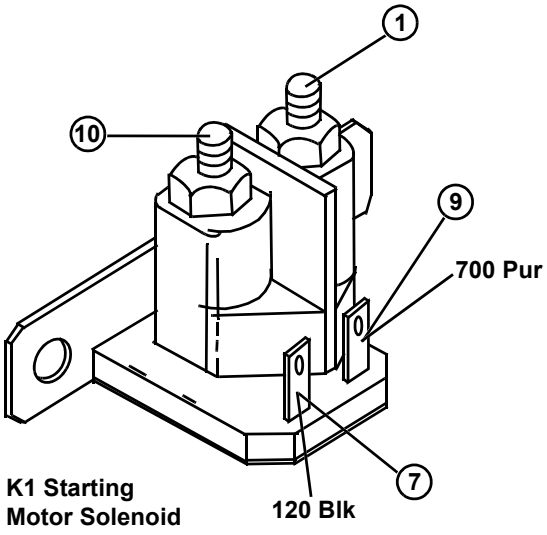
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Starting motor solenoid | Battery voltage | See “POWER CIRCUIT OPERATION–LT133/LT155”. |
| 2. Key switch | Battery voltage | See “POWER CIRCUIT OPERATION–LT133/LT155”. |
| 3. Brake switch | Continuity to ground | Check 135 and 160 Blk wire and connections. |
| 4. Brake switch | Continuity to ground | Replace brake switch. |
| 5. PTO switch | Continuity to ground | Check 150 Blk wire and connections. |
| 6. PTO switch | Continuity to ground | Replace PTO switch. |
| 7. Starting motor solenoid | Continuity to ground | Check 120 Blk wire and connections. |

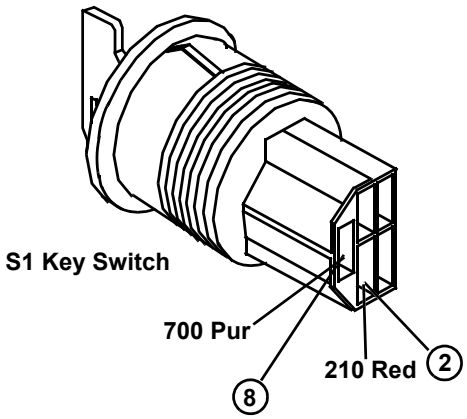
**Test Conditions:**

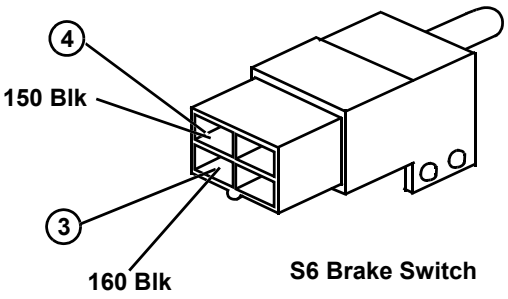
- Key switch in START position while preforming each test step
- Park brake ON
- PTO OFF
- Spark Plug disconnected

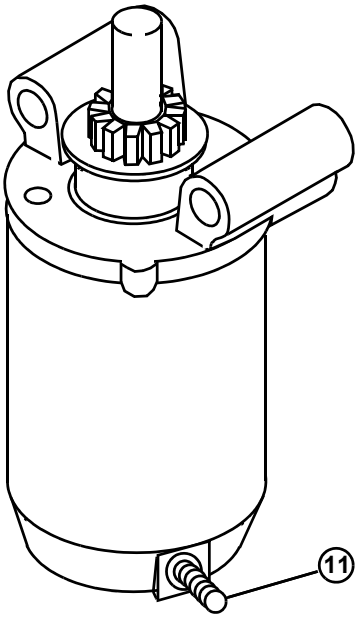
*NOTE: Engine will turn over during this test.*

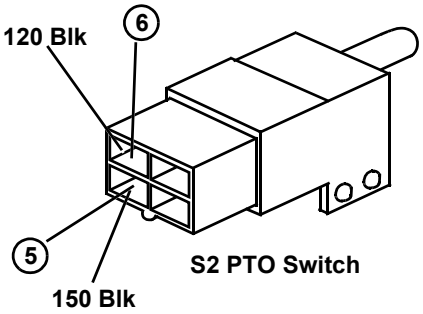
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 8. Key switch | Battery voltage | Replace key switch. |
| 9. Starting motor solenoid | Battery voltage | Check 700 Pur wire and connections. |
| 10. Starting motor solenoid | Battery voltage | Replace starting motor solenoid. |
| 11. Starting motor | Battery voltage | Check Red starting motor cable.See “STARTING MOTOR AMPERAGE DRAW”. |


1
10
9
700 Pur
7
120 Blk
K1 Starting
Motor Solenoid


S1 Key Switch
700 Pur
210 Red
2
8


4
150 Blk
3
160 Blk
S6 Brake Switch


11
M1 Starting Motor


120 Blk
6
5
150 Blk
S2 PTO Switch

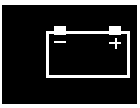
# CRANKING CIRCUIT OPERATION– LT133/LT155 w/ 15 AMP CHARGER

**Function:**

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

**Operating Conditions:**

To crank the engine the key switch must be in the START position, the brake must be ON and the PTO must be OFF (disengaged). The operator DOES NOT have to be on the seat to crank the engine.



**Theory of Operation:**

Current flows from the battery through F1 fusible link to the key switch S1. With key switch in the START position current flows through the key switch, through 700 Pur wire to the starting motor solenoid K1.

The PTO switch S2 and brake switch S3 are used in the starting motor solenoid ground circuit to prevent the engine from cranking if the PTO is engaged or the brake is not engaged.

A ground circuit for the starting motor solenoid is provided through the 120 Blk wire, PTO switch contacts (normally closed), 150 Blk wire, brake switch contacts (normally open), 170 and 110 Blk wires.

With the starting motor solenoid energized, high battery current flows across the starting motor solenoid contacts to the starting motor, causing it to crank the engine.

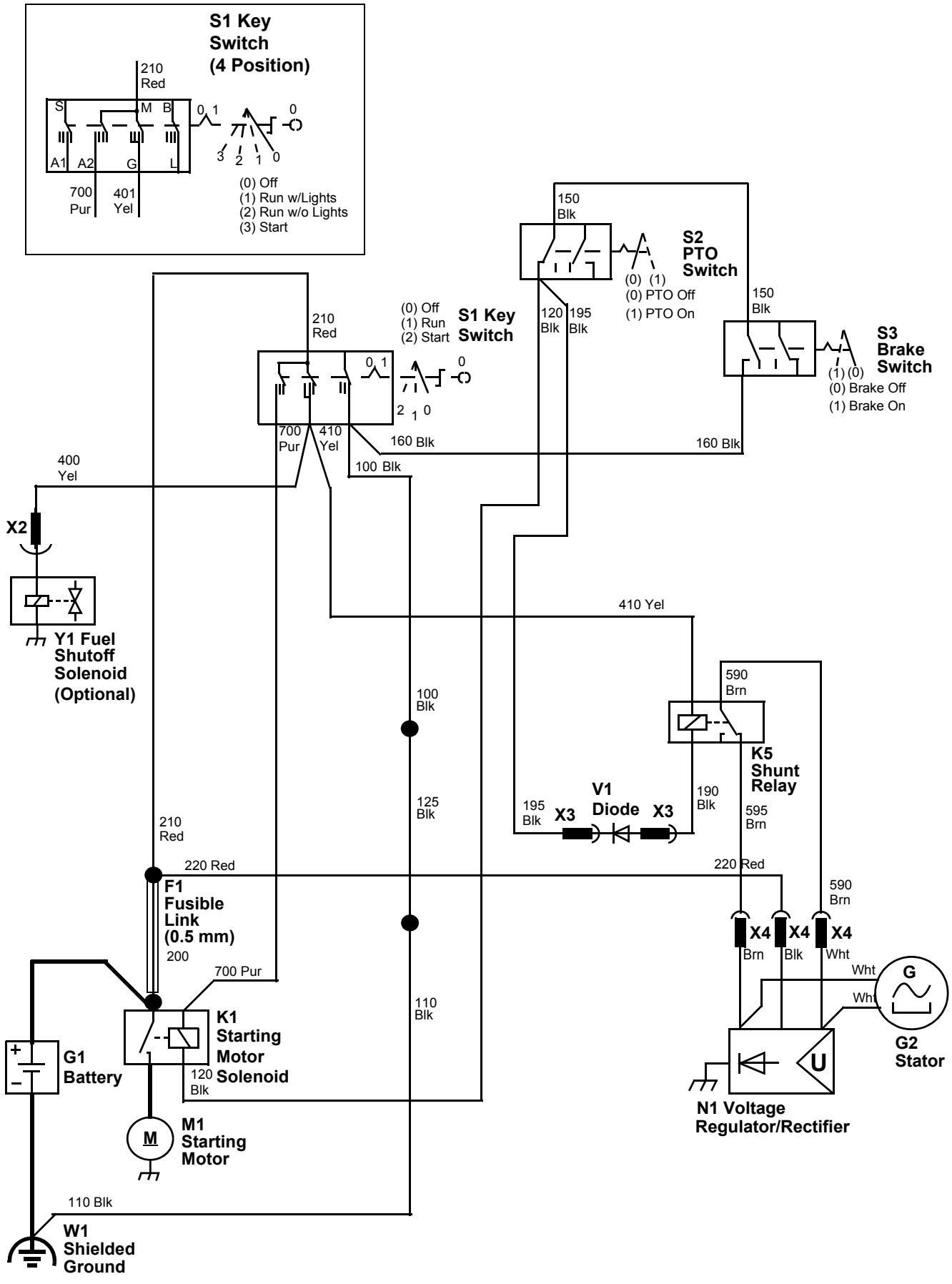
During the cranking operation the shunt relay is energized to remove the electrical load on the stator used to stop the engine from rotating when shutting off the engine. See “CHARGING & SHUNT CIRCUIT OPERATION–LT133/LT155–15 AMP”.

With the key switch in the RUN or START position the current flows across the key switch from the 210 Red wire to the 401 and 410 Yel wires and the shunt relay.

The ground circuit for the shunt relay is provided through the 190 Blk wire, V1 diode, 195 and 120 Blk wire, PTO switch contacts (normally closed), 150 Blk wire, brake switch contacts (normally open), 170 and 110 Blk wires.

This circuit then opens the shunt relay contacts breaking the current path from the stator to ground, removing the electrical load on the stator.

# CRANKING CIRCUIT SCHEMATIC–LT133/LT155 w/ 15 AMP CHARGER



# CRANKING CIRCUIT DIAGNOSIS–LT133/LT155 w/ 15 AMP CHARGER

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF
- Spark plug disconnected

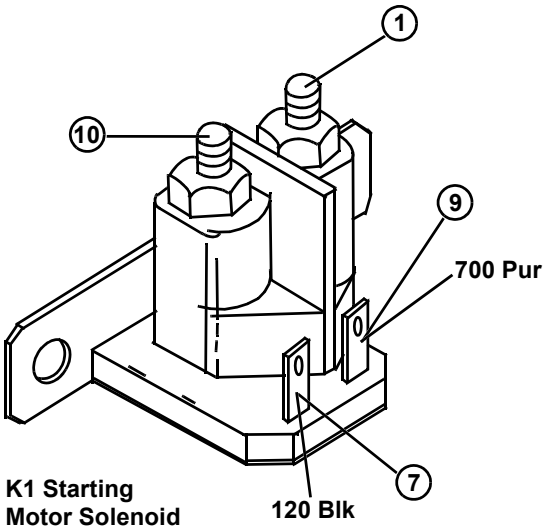
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Starting motor solenoid | Battery voltage | See “POWER CIRCUIT DIAGNOSIS–LT133/LT155 w/4 POS. KEY SWITCH”. |
| 2. Key switch | Battery voltage | See “POWER CIRCUIT OPERATION–LT133/LT155 w/4 POSITION KEY SWITCH”. |
| 3. Brake switch | Continuity to ground | Check 110 and 170 Blk wire and connections. |
| 4. Brake switch | Continuity to ground | Replace brake switch. |
| 5. PTO switch | Continuity to ground | Check 150 Blk wire and connections. |
| 6. PTO switch | Continuity to ground | Replace PTO switch. |
| 7. Starting motor solenoid | Continuity to ground | Check 120 Blk wire and connections. |

**Test Conditions:**

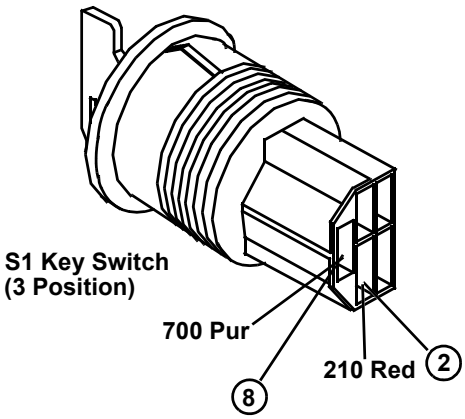
- Key switch in START position while preforming each test step
- Park brake ON
- PTO OFF
- Spark Plug disconnected

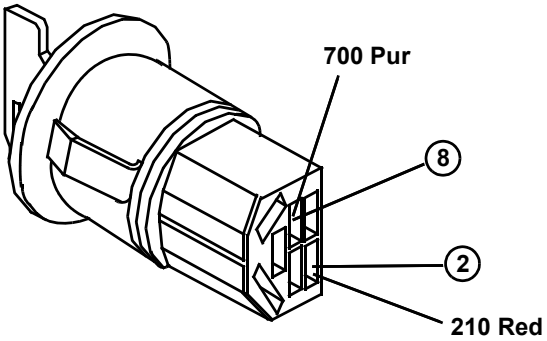
*NOTE: Engine will turn over during this test.*

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 8. Key switch | Battery voltage | Replace key switch. |
| 9. Starting motor solenoid | Battery voltage | Check 700 Pur wire and connections. |
| 10. Starting motor solenoid | Battery voltage | Replace starting motor solenoid. |
| 11. Starting motor | Battery voltage | Check Red starting motor cable.See “STARTING MOTOR AMPERAGE DRAW”. |

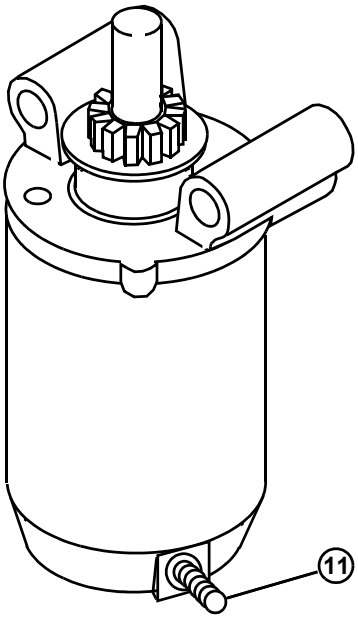



K1 Starting Motor Solenoid

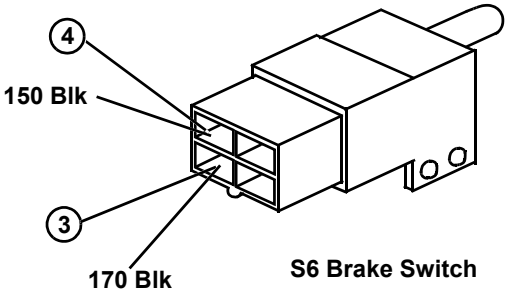


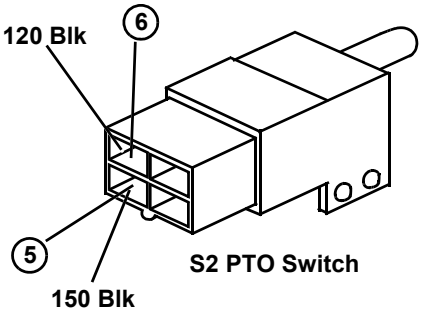

S1 Key Switch
(4 Position)




M1 Starting Motor




S6 Brake Switch




S2 PTO Switch

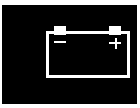
# CRANKING CIRCUIT OPERATION–LT166

**Function:**

To energize the start relay and engage the starting motor which cranks the engine.

**Operating Conditions:**

To crank the engine the key switch must be in the START position, the brake must be ON and the PTO must be in the OFF (disengaged) position. The operator DOES NOT have to be on the seat to crank the engine.



**Theory of Operation:**

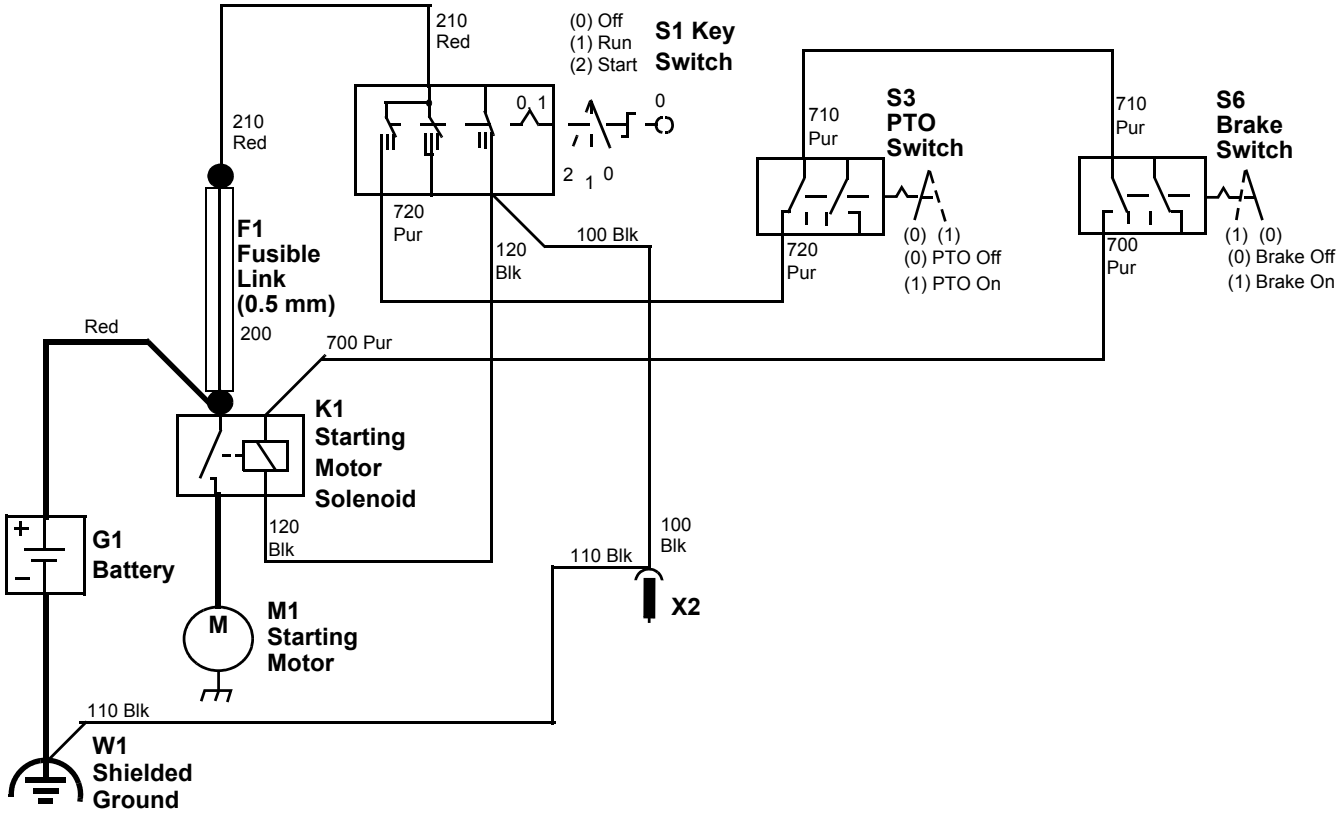
Current flows from the battery through F1 fusible link to the key switch. With key switch in the START position current flows through the key switch, through 720 Pur wire, PTO contacts (normally closed), 710 Pur wire, brake switch contacts (normally open), and 700 Pur wire to the start relay.

The PTO switch and brake switch are used in the start relay power circuit to prevent the engine from cranking if the PTO is engaged or the brake is not engaged.

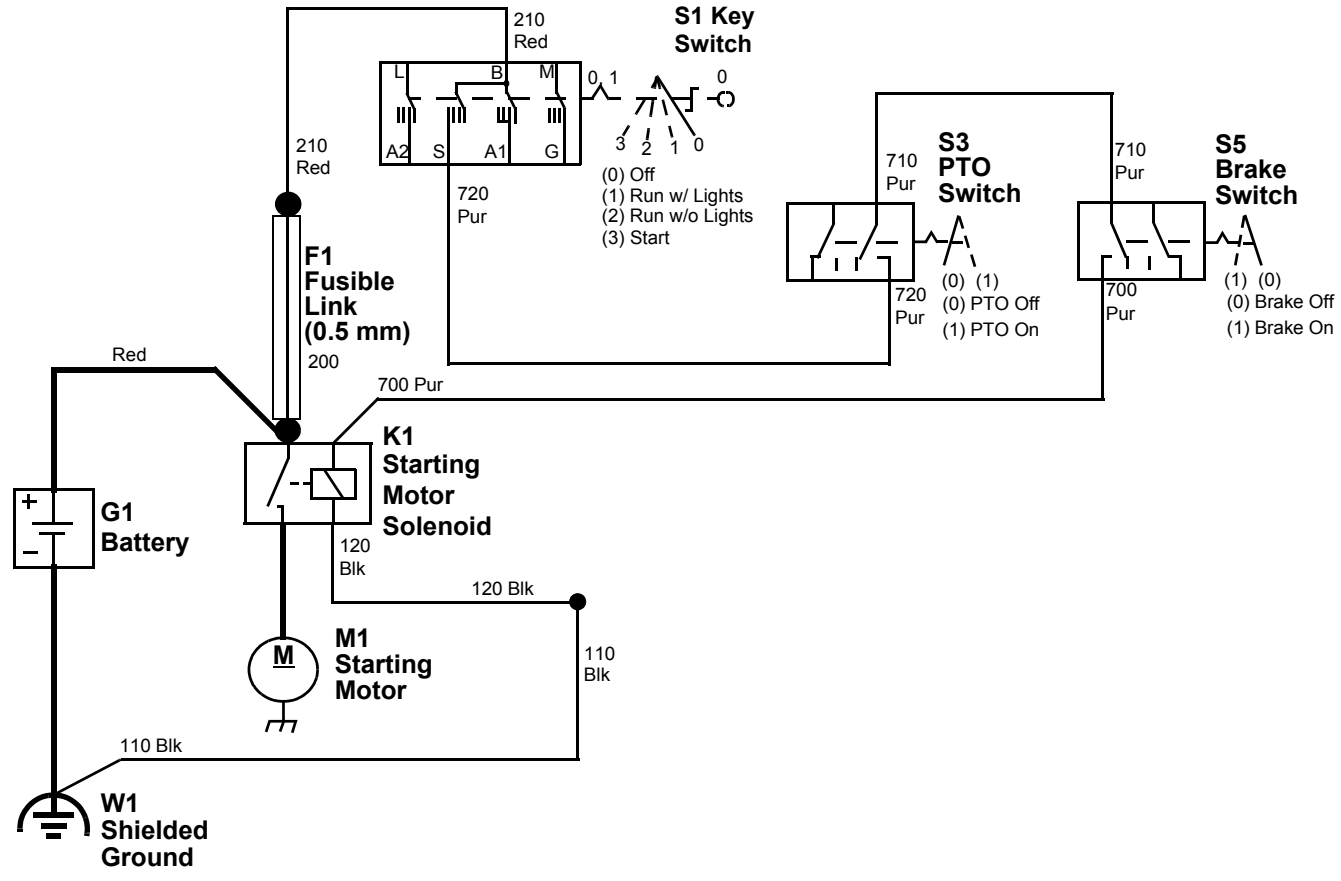
A ground circuit for the start relay is provided through the 120, 100, and 110 Blk wires.

With the start relay energized, high battery current flows across the relay contacts to the starting motor, causing it to crank the engine.

## CRANKING CIRCUIT SCHEMATIC–LT166–w/3 POS. KEY SWITCH




## CRANKING CIRCUIT SCHEMATIC–LT166–w/4 POS. KEY SWITCH



# CRANKING CIRCUIT DIAGNOSIS–LT166

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF
- Spark plug disconnected

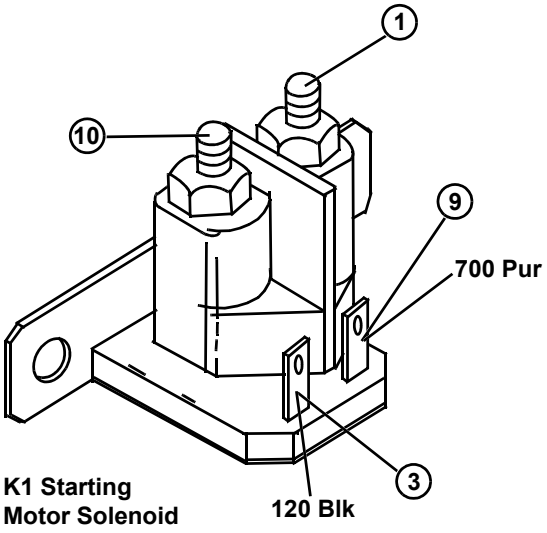
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Starting motor solenoid | Battery voltage | Check Red battery cable and battery. |
| 2. Key switch | Battery voltage | Check F1 fusible link and 210 Red wire and connections. |
| 3. Starting motor solenoid | Continuity to ground | Check 120 (3 Position key switch), or 121 (4 Position key switch) and 110 Blk wires and connections. |

**Test Conditions:**

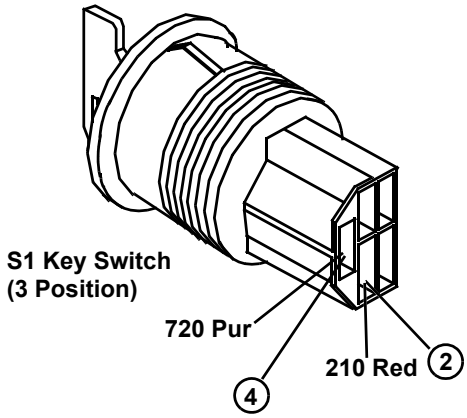
- Key switch in START position while preforming each test step
- Park brake ON
- PTO OFF
- Spark Plug disconnected

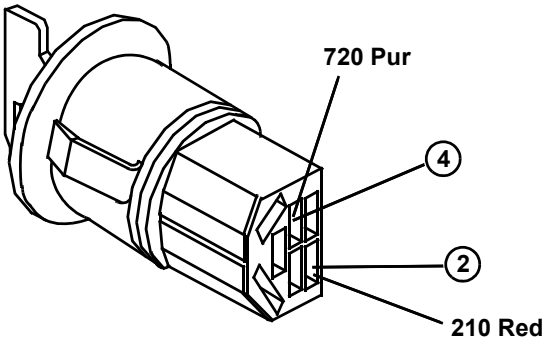
*NOTE: Engine will turn over during this test.*

| | | |
|---|---|---|
| 4. Key switch | Battery voltage | Replace key switch. |
| 5. PTO switch | Battery voltage | Check 720 Pur wire and connections. |
| 6. PTO switch | Battery voltage | Replace PTO switch. |
| 7. Brake switch | Battery voltage | Check 710 Pur wire and connections. |
| 8. Brake switch | Battery voltage | Replace brake switch. |
| 9. Starting motor solenoid | Battery voltage | Check 700 Pur wire and connections. |
| 10. Starting motor solenoid | Battery voltage | Replace starting motor solenoid. |
| 11. Starting motor | Battery voltage | Check Red starting motor cable.See “STARTING MOTOR AMPERAGE DRAW”. |

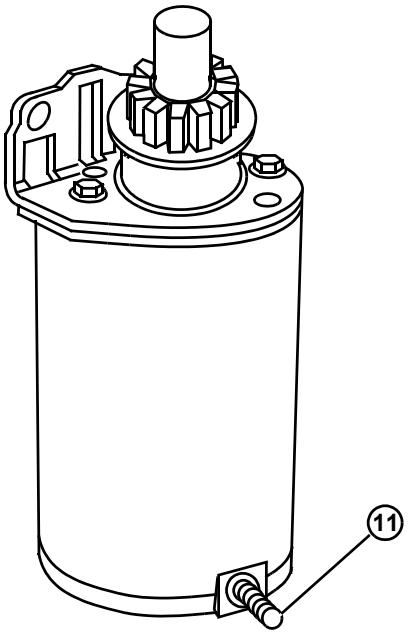



K1 Starting Motor Solenoid

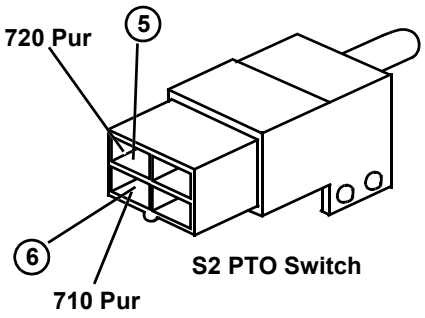


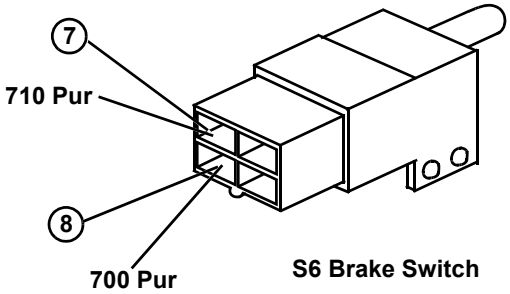




S1 Key Switch (4 Position)




M1 Starting Motor



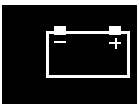
# IGNITION & SHUTOFF CIRCUIT OPERATION–LT133/LT155

**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 START or RUN position. The operator can be ON or OFF the seat; however, the PTO must be disengaged and the brake switch must be engaged (brake pedal depressed or park brake on) to start the engine.



Once the engine is running, the operator must be ON the seat to disengage the brake and/or engage the PTO.

The engine will shutoff under any of the following conditions:

- When the key switch is turned to the OFF position
- If the operator leaves the seat without locking the parking brake
- If the operator leaves the seat with the PTO on (engaged)
- If the operator places the tractor in reverse with the PTO engaged without pressing the reverse implement switch (RIS)

**System Operation**

**Ignition:**

When the engine turning over, (See “CRANKING CIRCUIT OPERATION–LT133/LT155 w/ 3 AMP CHARGER”, or “CRANKING CIRCUIT OPERATION–LT133/LT155 w/ 15 AMP CHARGER”.) the flywheel magnet induces current into the magneto ignition coil, which in turn produces current high enough to jump the spark plug gap, creating spark to ignite the engine fuel/air mixture.

**System Operation**

**Shutoff:**

The engine is shut off by grounding both sides of the ignition primary coil. With the ignition primary coil grounded, a spark cannot be produced.

Placing the key switch in the OFF position creates one path to ground for the Wht wire from the engine magneto, 900, 910 Wht wires, key switch contacts (normally closed), 130 and 135 Blk wires (3 amp charger) or 160 and 110 Blk wires (15 amp charger).

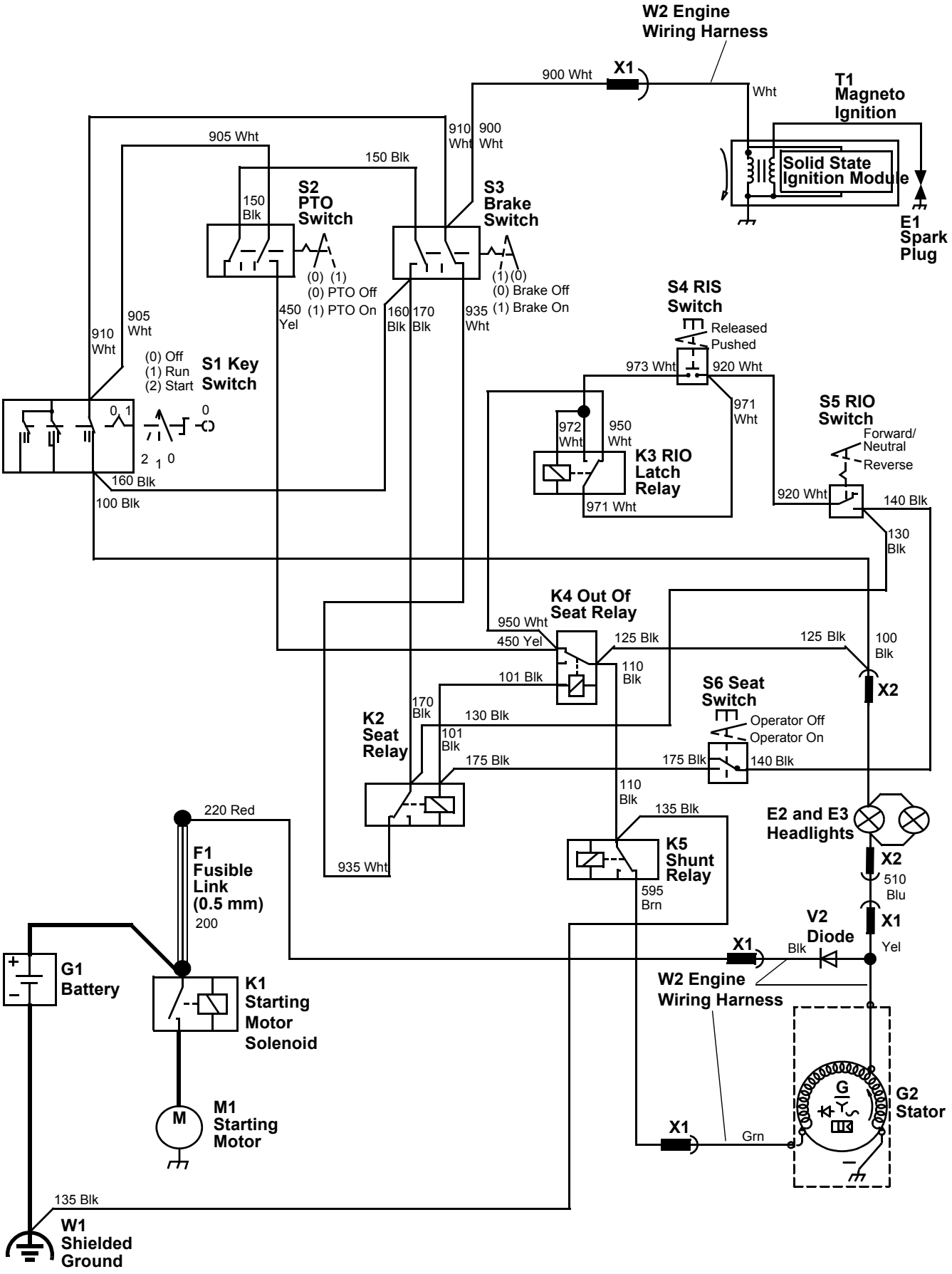
Another path to ground is created with the key switch in the ON position, any time the operator is OFF the seat (seat switch OPEN). The seat switch creates a ground path for the seat relay when the operator is on the seat. With the seat relay energized, the contacts are shifted from the normally closed set of contacts to the normally open set. This breaks the path to ground for the magneto ignition and creates a path to ground for the shunt relay. The shunt relay is then energized and breaks the path to ground for the stator which places a load on the engine to cause it to stop spinning faster on shut down.

If the brake were off when the operator leaves the seat the ground path would be created from the magneto Wht wire, 900 Wht wire, brake switch contacts (normally closed), 935 Wht wire, Seat relay contacts (normally closed), 170 and 135 Blk wires (3 amp charger) or 130 and 110 Blk wires (15 amp charger).

If the PTO were engaged when the operator leaves the seat the ground path would be created from the magneto Wht wire, 900, 910, and 905 Wht wires, PTO contacts (normally closed), 950 and 960 Wht wires, RIO switch contacts (normally closed), 965 Wht wire (3 amp charger) or 980 Wht wire (15 amp charger), seat relay contacts (normally closed), 170 and 135 Blk wires (3 amp charger) or 130 and 110 Blk wires (15 amp charger).

A fourth path to ground will be created with engine running, if the operator places the tractor in reverse while the PTO is engaged and the Reverse Implement Switch is not pressed.

# IGNITION & SHUTOFF CIRCUIT SCHEMATIC–LT133/LT155–3 AMP



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT133/LT155–3 AMP

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine cool to avoid burns

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Spark plug | Spark plug not fouled. Correct air gap. | Adjust air gap. Replace spark plug. |

**Test Conditions:**

- Key switch in START position
- Park brake ON
- PTO OFF (DISENGAGED)

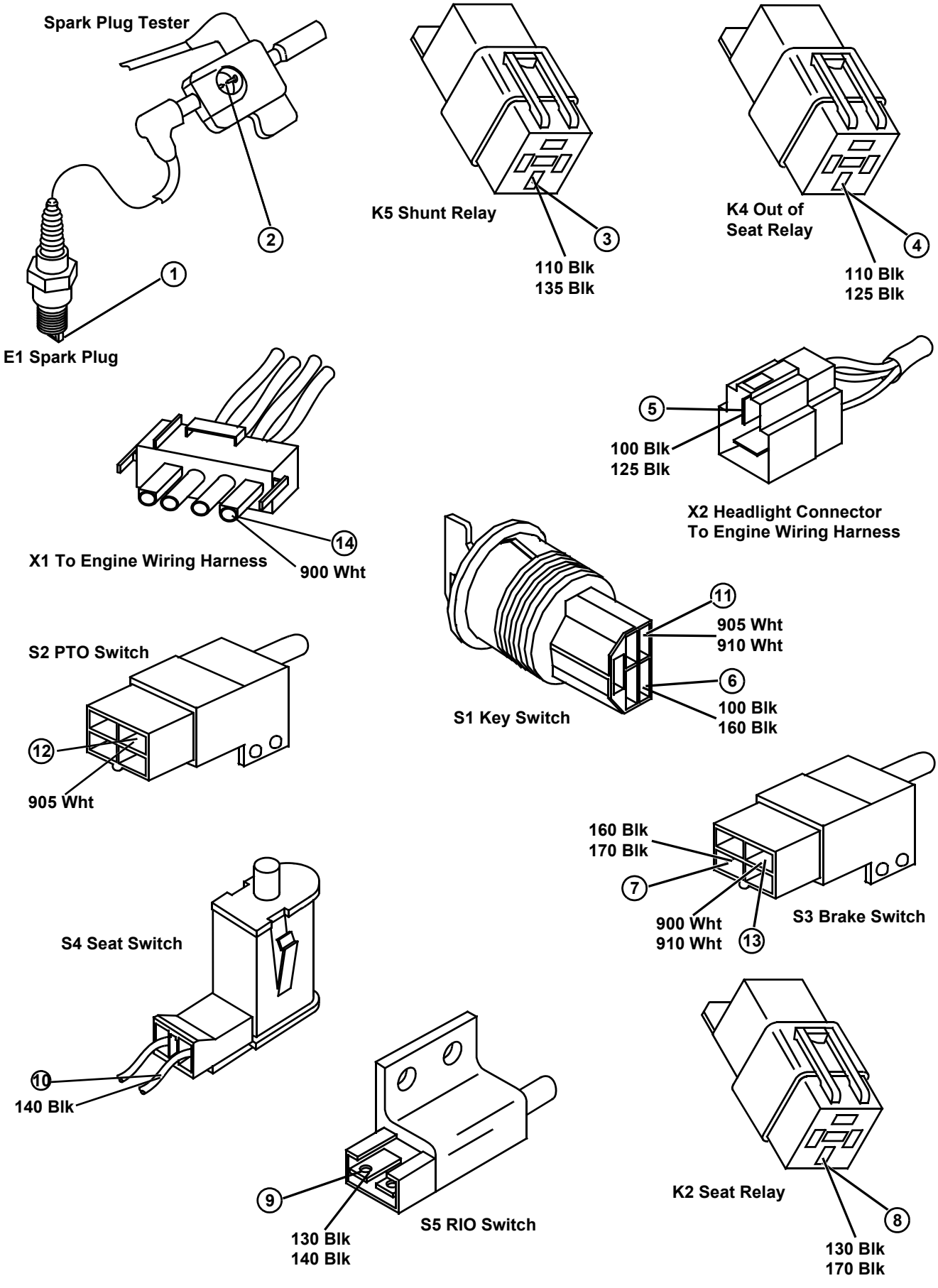
*NOTE: Engine will turn over and can start during this test*

| | | |
|---|---|---|
| 2. Spark plug tester installed. See "SPARK TEST". | Spark present at tester. | No spark: Check armature air gap. Check for grounded primary lead. Check for continuity between engine kill wire and ground (should be infinite). Check ignition coil. Weak Spark: Check spark plug(s). |

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| | | |
|---|---|---|
| 3. Shunt relay | Continuity to ground. | Check 135 Blk wire and connections. |
| 4. Out of Seat relay | Continuity to ground | Check 110 Blk wire and connections. |
| 5. Headlight connector | Continuity to ground | Check 125 Blk wire and connections. |
| 6. Key switch | Continuity to ground | Check 100 Blk wire and connections. |
| 7. Brake switch | Continuity to ground | Check 160 Blk wire and connections. |
| 8. Seat relay | Continuity to ground | Check 170 Blk wire and connections. |
| 9. RIO switch | Continuity to ground | Check 130 Blk wire and connections. |
| 10. Seat switch | Continuity to ground | Check 140 Blk wire and connections. |
| 11. Key switch | Continuity to ground | Replace key switch. |
| 12. PTO switch | Continuity to ground | Check 905 Wht wire and connections. |
| 13. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 14. Engine harness connector | Continuity to ground | Check 900 Wht wire and connections. |


Spark Plug Tester
2
1
E1 Spark Plug
K5 Shunt Relay
3
110 Blk
135 Blk
K4 Out of
Seat Relay
4
110 Blk
125 Blk
5
100 Blk
125 Blk
X2 Headlight Connector
To Engine Wiring Harness
14
X1 To Engine Wiring Harness
900 Wht
11
905 Wht
910 Wht
6
100 Blk
160 Blk
S1 Key Switch
S2 PTO Switch
12
905 Wht
160 Blk
170 Blk
7
900 Wht
910 Wht
13
S3 Brake Switch
S4 Seat Switch
10
140 Blk
9
130 Blk
140 Blk
S5 RIO Switch
K2 Seat Relay
8
130 Blk
170 Blk

# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT133/LT155–3 AMP (cont.)

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 15. Out of Seat relay | Continuity to ground | Replace Out of Seat relay. |
| 16. PTO switch | Continuity to ground | Check 450 Yel wire and connections. |
| 17. RIO latch relay | Continuity to ground | Check 950 Wht wire and connections. |
| 18. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 19. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |
| 20. RIO switch | Continuity to ground | Check 920 Wht wire and connections. |
| 21. Seat relay | Continuity to ground | Replace relay. |
| 22. Brake switch | Continuity to ground | Check 935 Wht wire and connections. |

**Test Conditions:**

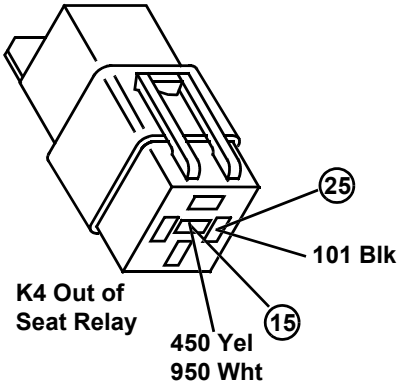
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Seat switch ON (Operator On Seat)
- Engine wiring harness disconnected from main wiring harness

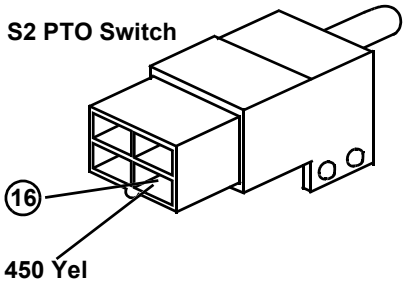
| | | |
|---|---|---|
| 23. Seat switch | Continuity to ground | Replace seat switch. |
| 24. Seat relay | Continuity to ground | Check 175 Blk wire and connections. |
| 25. Out of Seat relay | Continuity to ground | Check 101 Blk wire and connections. |

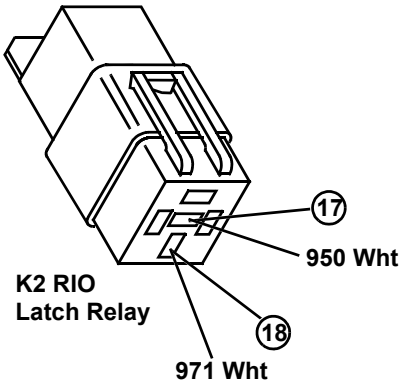
**Test Conditions:**

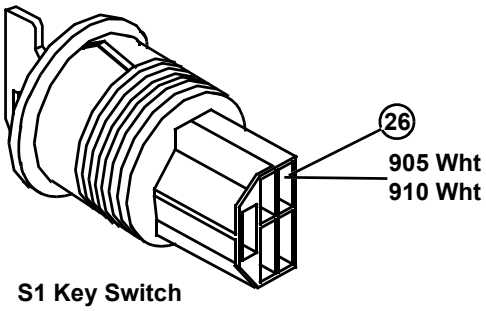
- Key switch in RUN position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

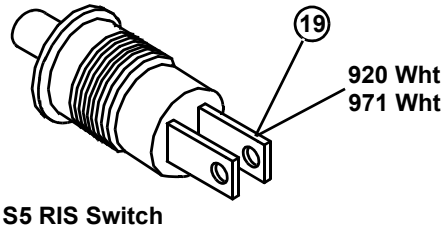
| | | |
|---|---|---|
| 26. Key switch | No continuity to ground. | Replace key switch. |

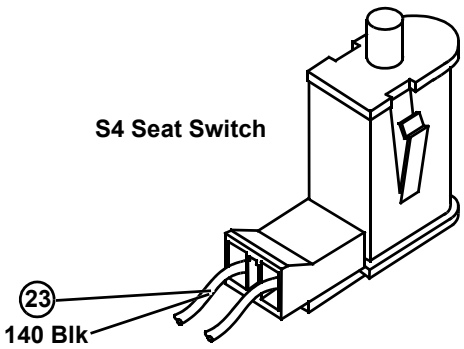

25
101 Blk
K4 Out of
Seat Relay
15
450 Yel
950 Wht

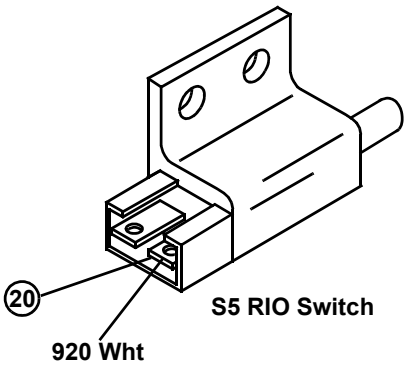

S2 PTO Switch
16
450 Yel

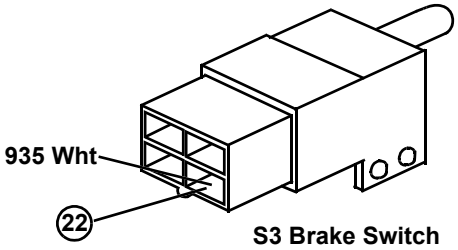

17
950 Wht
K2 RIO
Latch Relay
18
971 Wht

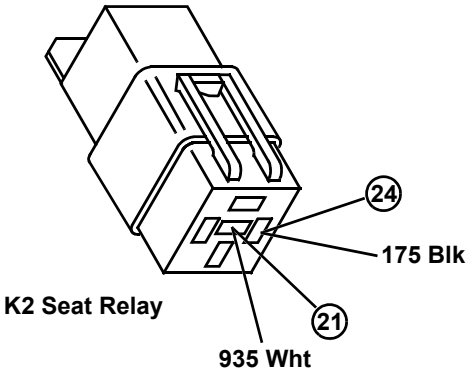

26
905 Wht
910 Wht
S1 Key Switch


19
920 Wht
971 Wht
S5 RIS Switch

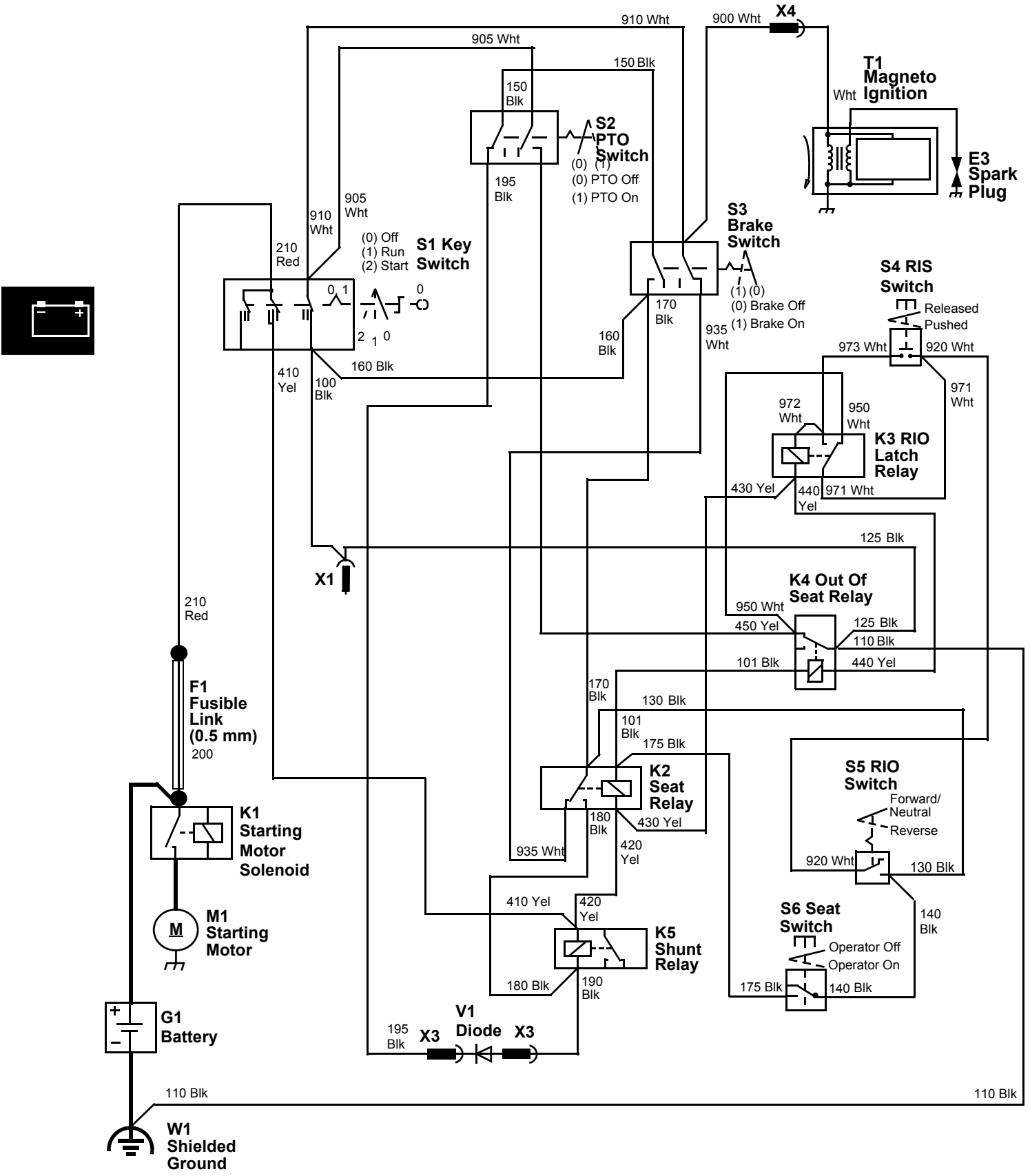

S4 Seat Switch
23
140 Blk


20
S5 RIO Switch
920 Wht


935 Wht
22
S3 Brake Switch


24
175 Blk
K2 Seat Relay
21
935 Wht

# IGNITION & SHUTOFF CIRCUIT SCHEMATIC–LT133/LT155–15 AMP



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT133/LT155–15 AMP

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine cool to avoid burns

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Spark plug | Spark plug not fouled.<br>Correct air gap. | Replace spark plug.<br>Adjust air gap. |

**Test Conditions:**

- Key switch in START position
- Park brake ON
- PTO OFF (DISENGAGED)

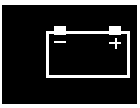
*NOTE: Engine will turn over and can start during this test*

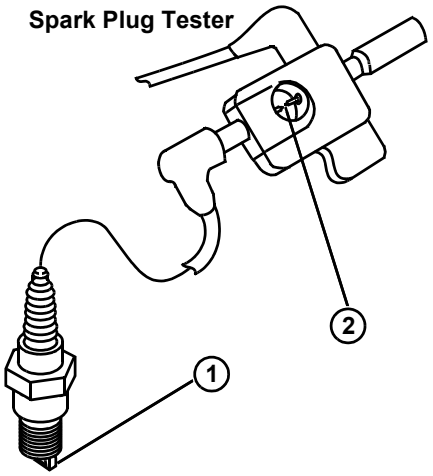
| | | |
|---|---|---|
| 2. Spark plug tester installed. See "SPARK TEST". | Spark present at tester. | No spark: Check armature air gap.<br>Check for grounded primary lead.<br>Check for continuity between engine kill wire and ground (should be infinite).<br>Check ignition coil.<br>Weak Spark: Check spark plug(s). |

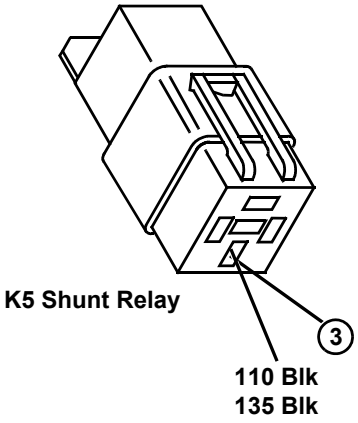
**Test Conditions:**

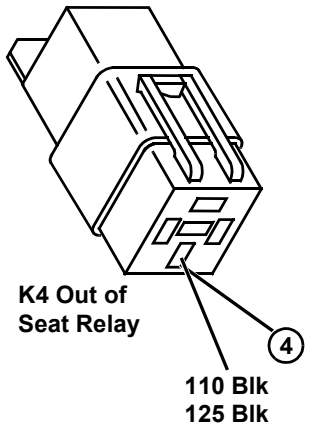
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

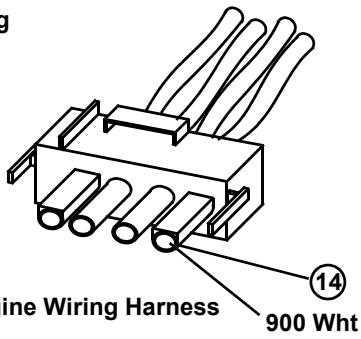
| | | |
|---|---|---|
| 3. Shunt relay | Continuity to ground. | Check 135 Blk wire and connections. |
| 4. Out of Seat relay | Continuity to ground | Check 110 Blk wire and connections. |
| 5. Headlight connector | Continuity to ground | Check 125 Blk wire and connections. |
| 6. Key switch | Continuity to ground | Check 100 Blk wire and connections. |
| 7. Brake switch | Continuity to ground | Check 160 Blk wire and connections. |
| 8. Seat relay | Continuity to ground | Check 170 Blk wire and connections. |
| 9. RIO switch | Continuity to ground | Check 130 Blk wire and connections. |
| 10. Seat switch | Continuity to ground | Check 140 Blk wire and connections. |
| 11. Key switch | Continuity to ground | Replace key switch. |
| 12. PTO switch | Continuity to ground | Check 905 Wht wire and connections. |
| 13. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 14. Engine harness connector | Continuity to ground | Check 900 Wht wire and connections. |

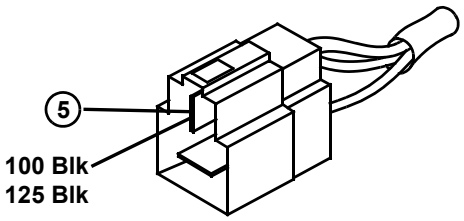




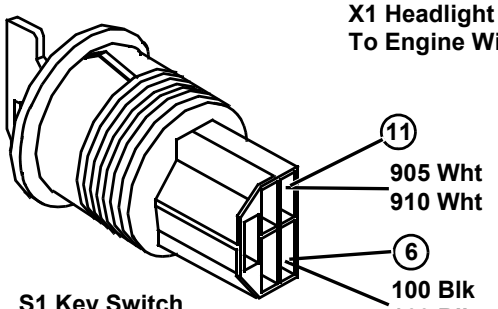



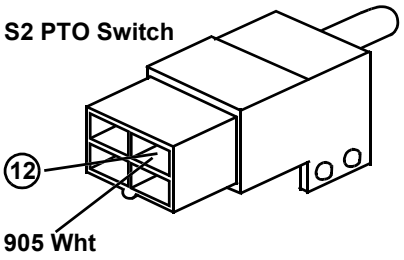



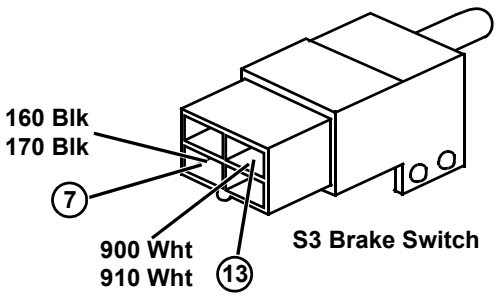



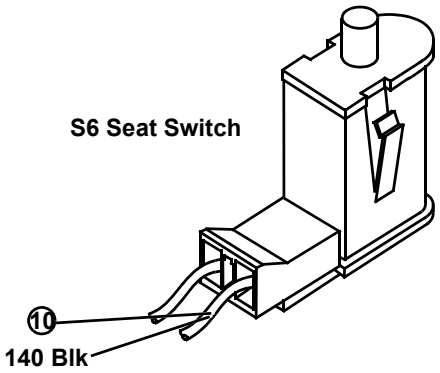



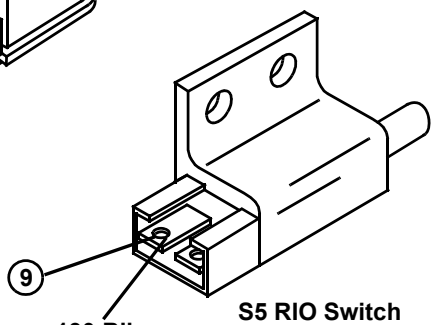

X1 Headlight Connector
To Engine Wiring Harness

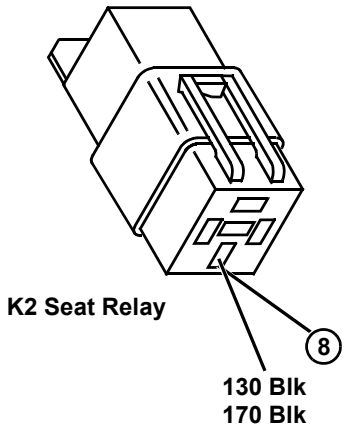


# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT133/LT155–15 AMP (cont.)

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 15. Out of Seat relay | Continuity to ground | Replace Out of Seat relay. |
| 16. PTO switch | Continuity to ground | Check 450 Yel wire and connections. |
| 17. RIO latch relay | Continuity to ground | Check 950 Wht wire and connections. |
| 18. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 19. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |
| 20. RIO switch | Continuity to ground | Check 920 Wht wire and connections. |
| 21. Seat relay | Continuity to ground | Replace relay. |
| 22. Brake switch | Continuity to ground | Check 935 Wht wire and connections. |

**Test Conditions:**

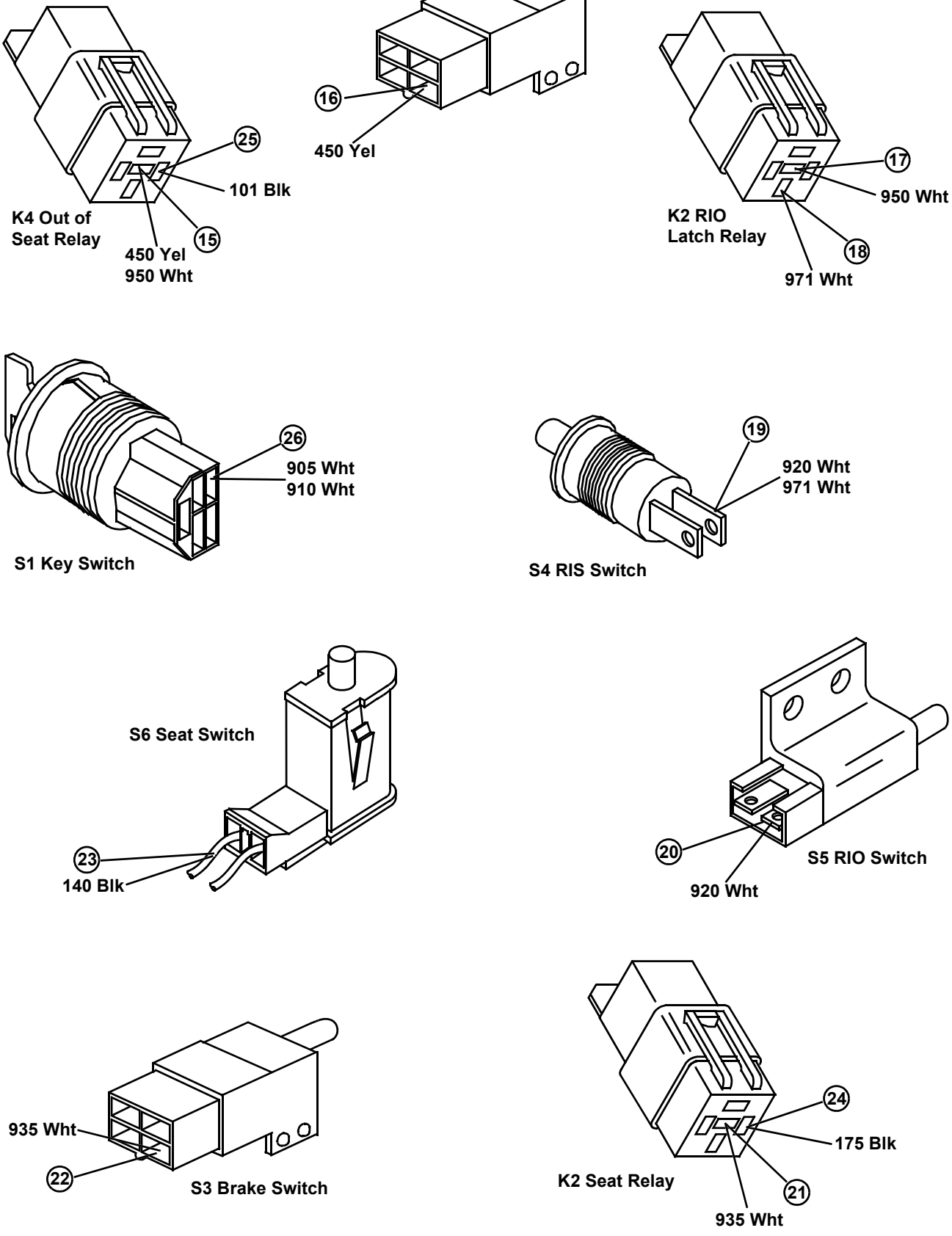
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Seat switch ON (Operator On Seat)
- Engine wiring harness disconnected from main wiring harness

| | | |
|---|---|---|
| 23. Seat switch | Continuity to ground | Replace seat switch |
| 24. Seat relay | Continuity to ground | Check 175 Blk wire and connections. |
| 25. Out of Seat relay | Continuity to ground | Check 101 Blk wire and connections. |

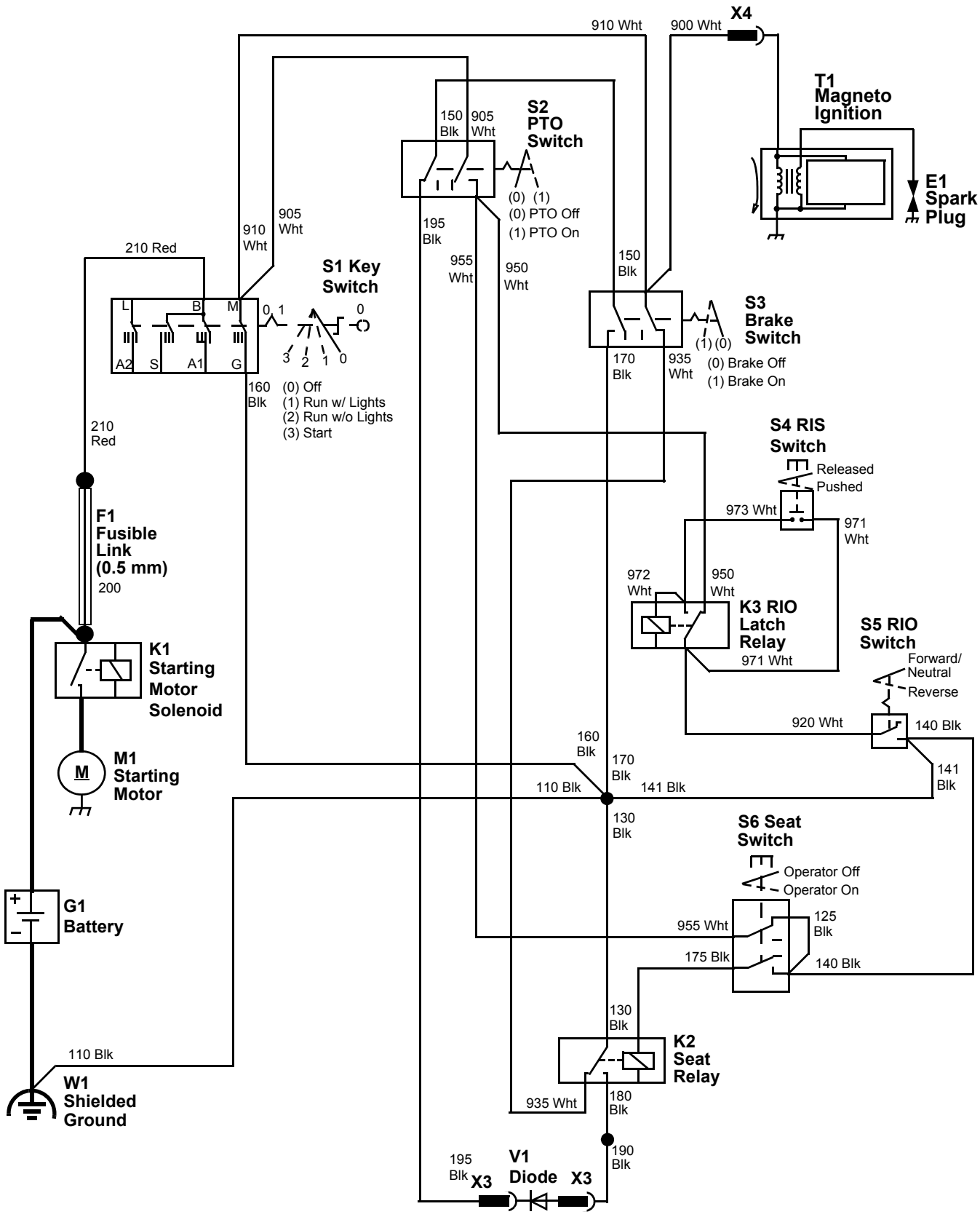
**Test Conditions:**

- Key switch in RUN position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| | | |
|---|---|---|
| 26. Key switch | No continuity to ground. | Replace key switch. |


S2 PTO Switch
16
450 Yel
25
101 Blk
K4 Out of
Seat Relay
15
450 Yel
950 Wht
17
950 Wht
K2 RIO
Latch Relay
18
971 Wht
26
905 Wht
910 Wht
S1 Key Switch
19
920 Wht
971 Wht
S4 RIS Switch
S6 Seat Switch
23
140 Blk
20
S5 RIO Switch
920 Wht
935 Wht
22
S3 Brake Switch
24
175 Blk
K2 Seat Relay
21
935 Wht

# IGNITION & SHUTOFF SCHEMATIC–LT133/LT155–w/4 POS. KEY SWITCH



# IGNITION & SHUTOFF DIAGNOSIS–LT133/LT155–w/4 POS. KEY SWITCH

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine cool to avoid burns

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Spark plug | Spark plug not fouled.<br>Correct air gap. | Replace spark plug.<br>Adjust air gap. |

**Test Conditions:**

- Key switch in START position
- Park brake ON
- PTO OFF (DISENGAGED)

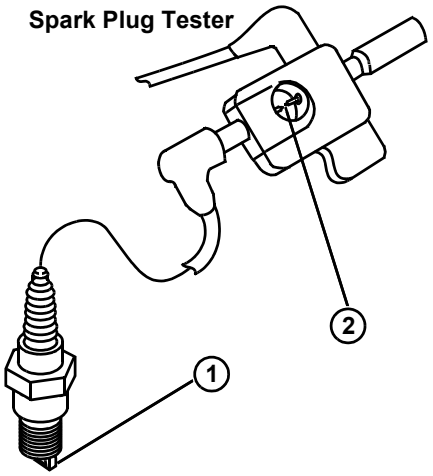
*NOTE: Engine will turn over and can start during this test*

| | | |
|---|---|---|
| 2. Spark plug tester installed. See "SPARK TEST". | Spark present at tester | No spark: Check armature air gap.<br>Check for grounded primary lead.<br>Check for continuity between engine kill wire and ground (should be infinite).<br>Check ignition coil.<br>Weak Spark: Check spark plug(s). |

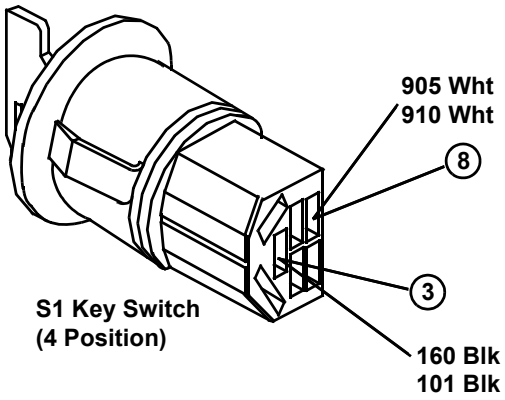
**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

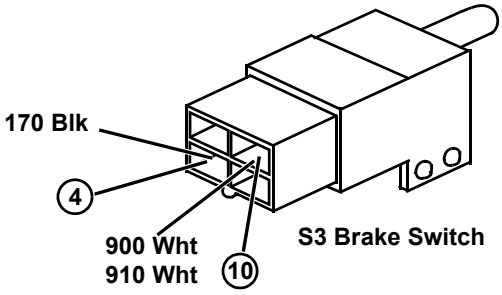
| | | |
|---|---|---|
| 3. Key switch | Continuity to ground | Check 160 Blk wire and connections. |
| 4. Brake switch | Continuity to ground | Check 170 Blk wire and connections. |
| 5. Seat relay | Continuity to ground | Check 130 Blk wire and connections. |
| 6. RIO switch | Continuity to ground | Check 141 Blk wire and connections. |
| 7. Seat switch | Continuity to ground | Check 140 Blk wire and connections. |
| 8. Key switch | Continuity to ground | Replace key switch. |
| 9. PTO switch | Continuity to ground | Check 905 Wht wire and connections. |
| 10. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 11. Engine harness connector | Continuity to ground | Check 900 Wht wire and connections. |



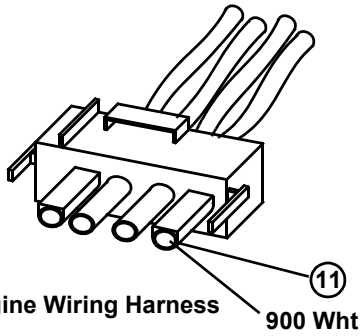

E3 Spark Plug



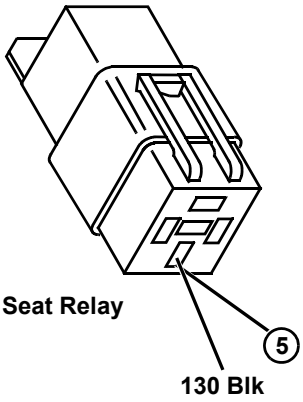

S1 Key Switch
(4 Position)



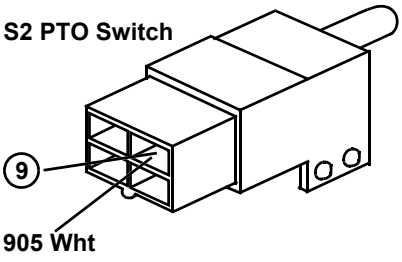

S3 Brake Switch

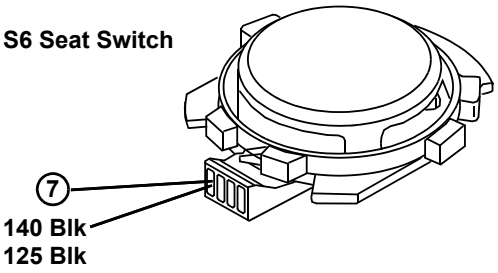


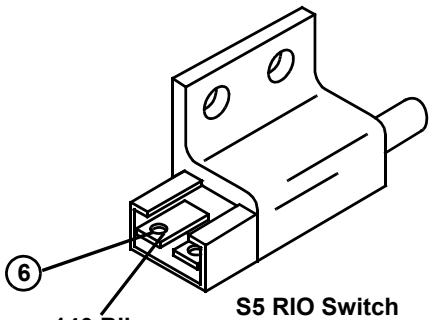

X4 To Engine Wiring Harness




K2 Seat Relay




S5 RIO Switch

# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT133/LT155–15 AMP (cont.)

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 12. PTO switch | Continuity to ground | Check 450 Yel wire and connections. |
| 13. RIO latch relay | Continuity to ground | Check 950 Wht wire and connections. |
| 14. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 15. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |
| 16. RIO switch | Continuity to ground | Check 920 Wht wire and connections. |
| 17. Seat relay | Continuity to ground | Replace relay. |
| 18. Brake switch | Continuity to ground | Check 935 Wht wire and connections. |

**Test Conditions:**

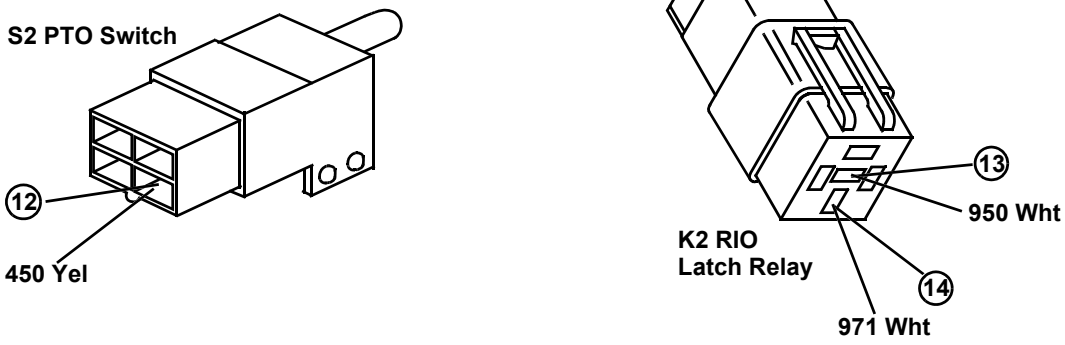
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Seat switch ON (Operator On Seat)
- Engine wiring harness disconnected from main wiring harness

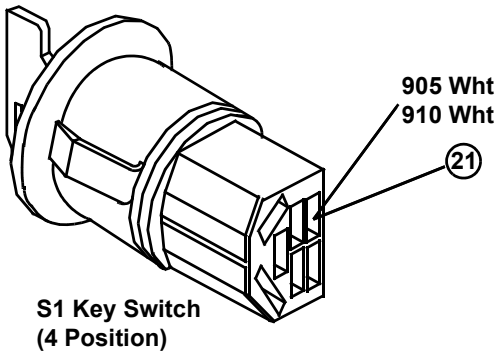
| | | |
|---|---|---|
| 19. Seat switch | Continuity to ground | Replace seat switch. |
| 20. Seat relay | Continuity to ground | Check 175 Blk wire and connections. |

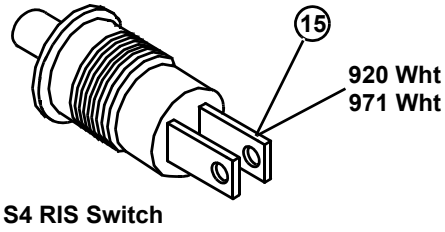
**Test Conditions:**

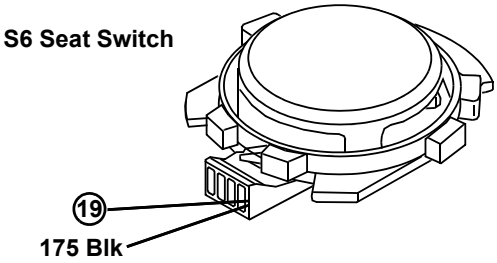
- Key switch in RUN position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

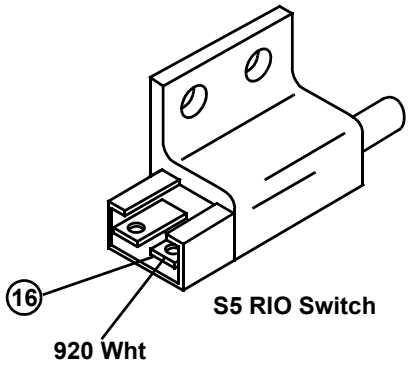
| | | |
|---|---|---|
| 21. Key switch | No continuity to ground | Replace key switch. |

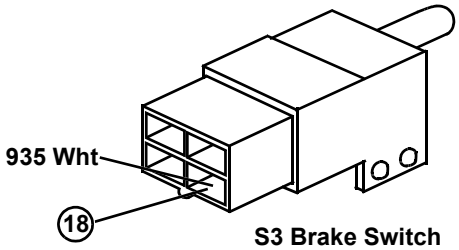

S2 PTO Switch
12
450 Yel
13
950 Wht
K2 RIO
Latch Relay
14
971 Wht

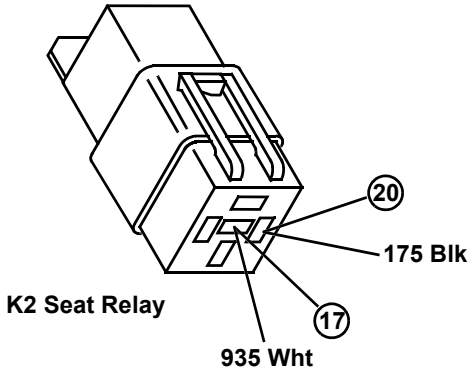

905 Wht
910 Wht
21
S1 Key Switch
(4 Position)


15
920 Wht
971 Wht
S4 RIS Switch


S6 Seat Switch
19
175 Blk


16
S5 RIO Switch
920 Wht


935 Wht
18
S3 Brake Switch


20
175 Blk
K2 Seat Relay
17
935 Wht

# IGNITION & SHUTOFF CIRCUIT OPERATION–LT166–w/3 POS. KEY SWITCH

**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 START or RUN position. The operator can be ON or OFF the seat; however, the PTO must be disengaged and the brake switch must be ENGAGED (brake pedal depressed or park brake on) to start the engine.

Once the engine is running, the operator must be ON the seat to disengage the brake or engage the PTO.

The engine will shutoff when the key switch is turned to the OFF position, the operator leaves the seat without locking the parking brake, and disengaging the PTO, or the operator places the tractor in reverse with the PTO engaged without pressing the reverse implement switch (RIS).

**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 both sides of the ignition primary coil. With the ignition primary coil grounded, a spark cannot be produced.

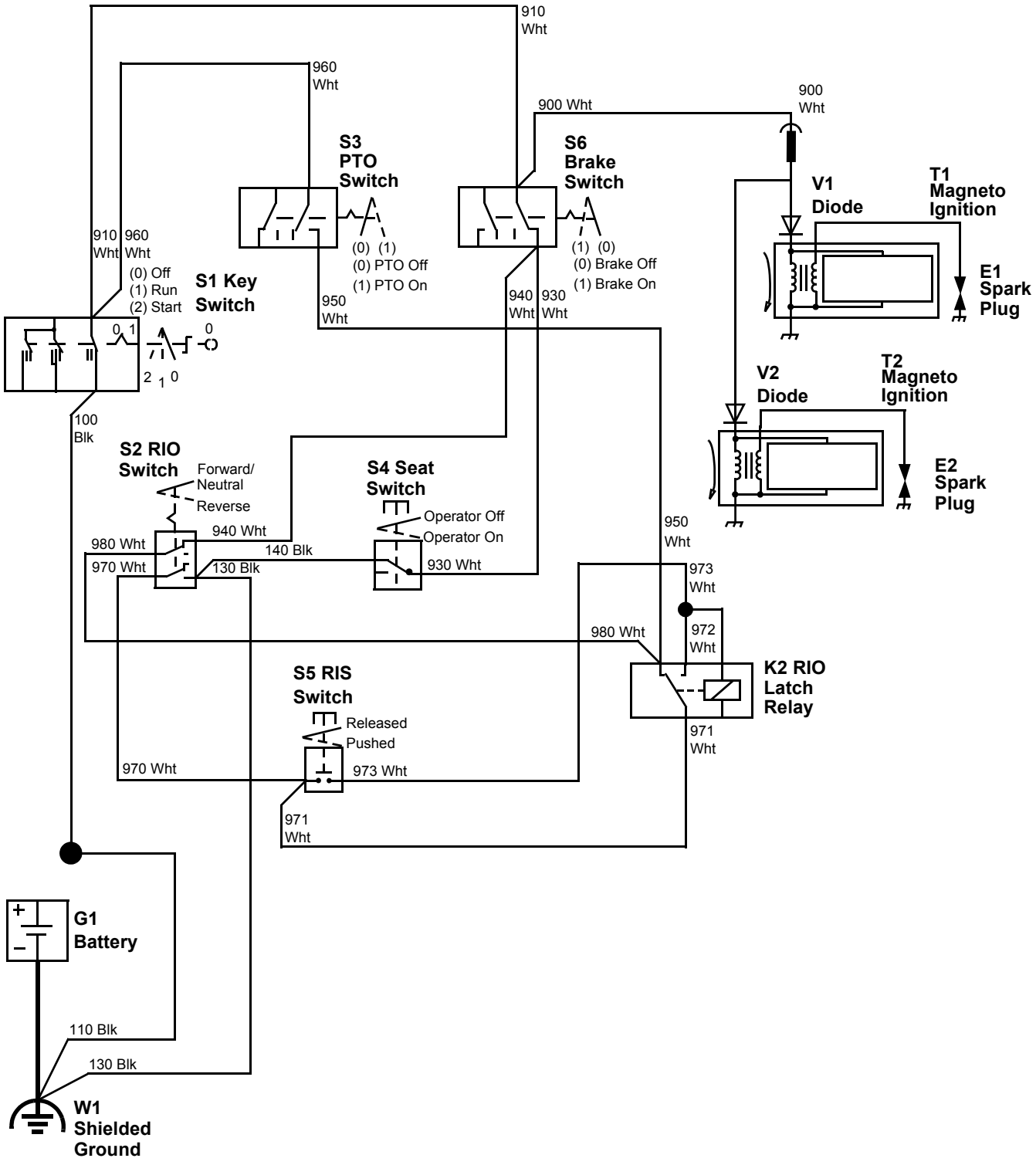
When the engine is turning over, the flywheel magnet induces current into the magneto ignition coil, which in turn produces current high enough to jump the spark plug gap, creating spark to ignite the engine fuel/air mixture.

Placing the key switch in the START or RUN position eliminates the path to ground for the Wht wire from the engine magneto, 900, 910 Wht wires, key switch contacts (normally closed), 100, and 110 Blk wires.

The second path to ground is eliminated if the operator is ON the seat (seat switch open), or the operator is OFF the seat (seat switch closed), and the brake switch is engaged and the PTO is disengaged.

A third path to ground will be created with engine running, if the operator places the tractor in reverse while the PTO is engaged and the Reverse Implement Switch is not pressed. See “PTO with RIO CIRCUIT OPERATION LT166–w/3 POS. KEY SWITCH”.

# IGNITION & SHUTOFF CIRCUIT SCHEMATIC–LT166–w/3 POS. KEY SWITCH



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT166–w/3 POS. KEY SWITCH

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine cool to avoid burns

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Spark plug | Spark plug not fouled.<br>Correct air gap. | Replace spark plug.<br>Adjust air gap. |

**Test Conditions:**

- Key switch in START position
- Park brake ON
- PTO OFF (DISENGAGED)

*NOTE: Engine will turn over and can start during this test*

| | | |
|---|---|---|
| 2. Spark plug tester installed. See "SPARK TEST". | Spark present at tester. | No spark: Check armature air gap.<br>Check for grounded primary lead.<br>Check for continuity between engine kill wire and ground (should be infinite).<br>Check ignition coil.<br>Weak Spark: Check spark plug(s). |

**Test Conditions:**

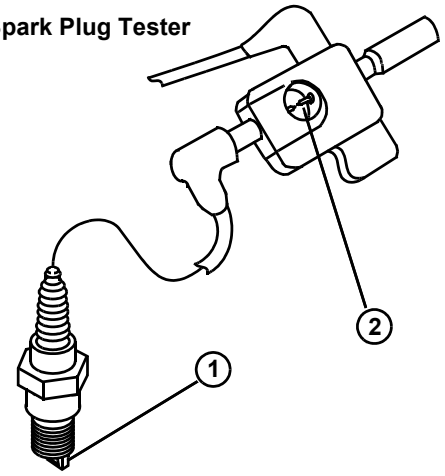
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| | | |
|---|---|---|
| 3. Headlight connector | Continuity to ground. | Check 110 Blk wire and connections. |
| 4. Key switch | Continuity to ground | Check 100 Blk wire and connections. |
| 5. Key switch | Continuity to ground | Replace key switch. |
| 6. PTO switch | Continuity to ground | Check 960 Wht wire and connections. |
| 7. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 8. Engine Wht wire | Continuity to ground | Check 900 Wht wire and connections. |

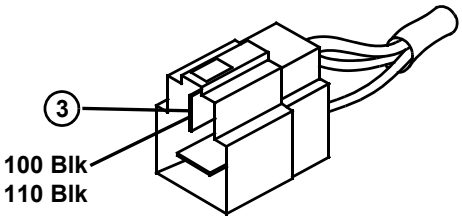
**Test Conditions: (Briggs & Stratton Engines ONLY – Test performed if engine will NOT shut off when operator leaves seat with EITHER PTO ENGAGED or brake switch OFF.)**

- Key switch in OFF position (Closes fuel valve to stop engine)
- Allow engine to cool, and remove engine cover to access ignition coils
- Disconnect diode(s) from ignition coil(s)
- Operator OFF seat
- PTO ON (ENGAGED); or, Park brake OFF

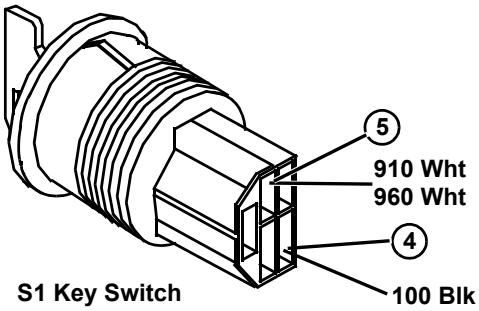
| | | |
|---|---|---|
| 9. Ignition coil diode(s) | Continuity to ground with diode disconnected from ignition coil. | Replace faulty diode(s). |



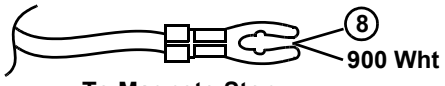

E1 or E2 Spark Plug



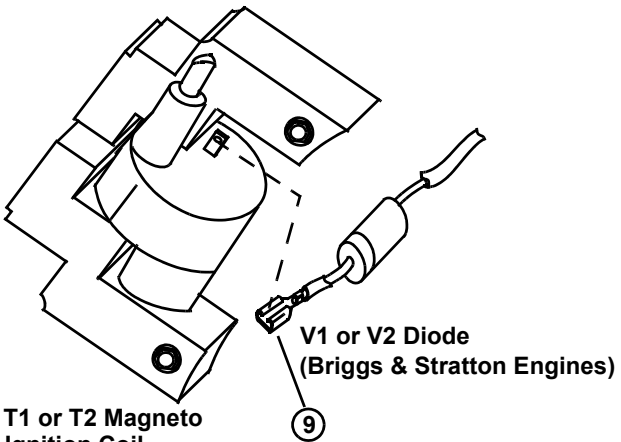

X2 Headlight Connector
To Engine Wiring Harness



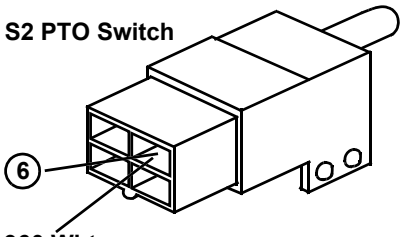

S1 Key Switch

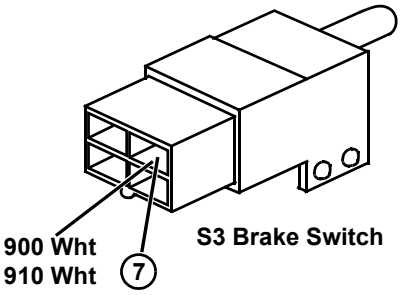



To Magneto Stop




T1 or T2 Magneto
Ignition Coil
(Briggs & Stratton Engines)



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT166–w/3 POS. KEY SWITCH

**Test Conditions:**

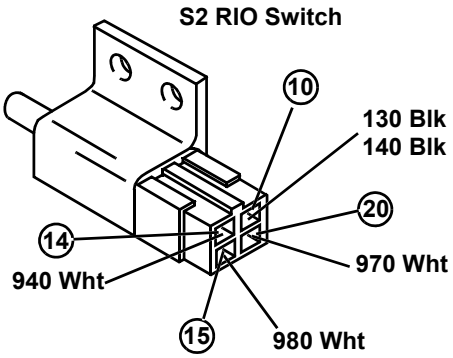
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

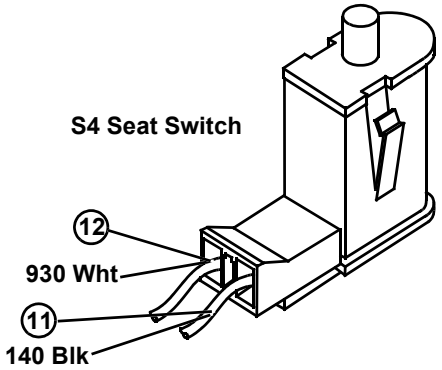
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 10. RIO switch | Continuity to ground. | Check 130 Blk wire and connections. |
| 11. Seat switch | Continuity to ground. | Check 140 Blk wire and connections. |
| 12. Seat switch | Continuity to ground | Replace seat switch. |
| 13. Brake switch | Continuity to ground | Check 930 Wht wire and connections. |
| 14. RIO switch | Continuity to ground | Check 940 Wht wire and connections. |
| 15. RIO switch | Continuity to ground | Replace RIO switch. |
| 16. RIO latch relay | Continuity to ground | Check 980 Wht wire and connections. |
| 17. PTO switch | Continuity to ground | Check 950 Wht wire and connections. |
| 18. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 19. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |
| 20. RIO switch | Continuity to ground | Check 970 Wht wire and connections. |

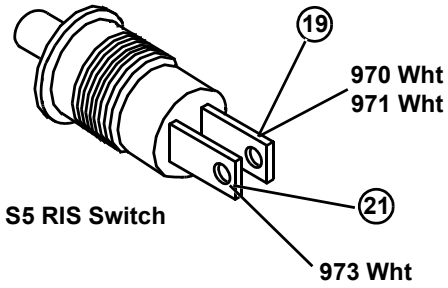
**Test Conditions:**

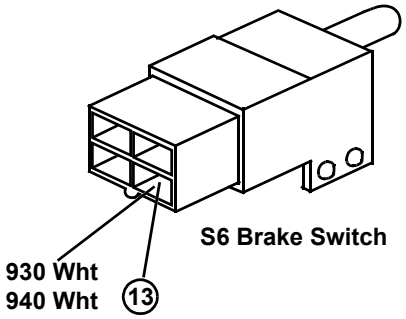
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- RIS switch PRESSED
- Engine wiring harness disconnected from main wiring harness

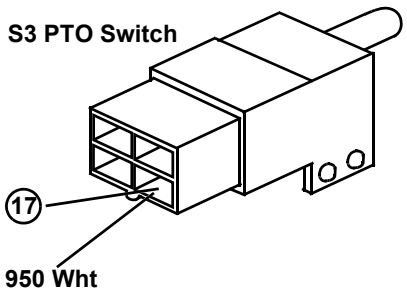
| | | |
|---|---|---|
| 21. RIS switch | Continuity to ground. | Replace RIS switch. |
| 22. RIO latch relay | Continuity to ground. | Check 973 Wht wire and connections. |
| 23. RIO latch relay | Continuity to ground | Check 972 Wht wire and connections. |

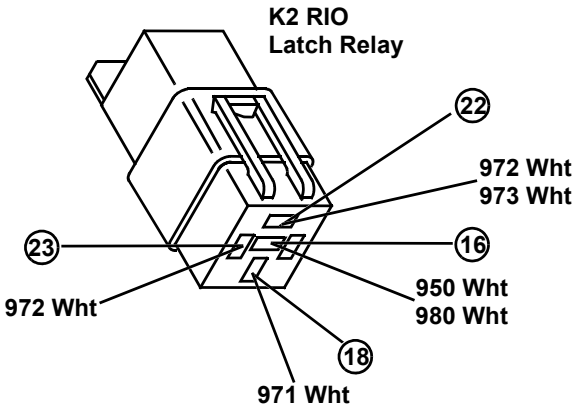

S2 RIO Switch
10
130 Blk
140 Blk
20
14
970 Wht
940 Wht
15
980 Wht


S4 Seat Switch
12
930 Wht
11
140 Blk


19
970 Wht
971 Wht
S5 RIS Switch
21
973 Wht


S6 Brake Switch
930 Wht
940 Wht
13


S3 PTO Switch
17
950 Wht


K2 RIO
Latch Relay
22
972 Wht
973 Wht
23
16
950 Wht
980 Wht
972 Wht
18
971 Wht

# IGNITION & SHUTOFF CIRCUIT OPERATION–LT166–w/4 POS. KEY SWITCH

**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 START or RUN position. The operator can be ON or OFF the seat; however, the PTO must be disengaged and the brake switch must be ENGAGED (brake pedal depressed or park brake on) to start the engine.

Once the engine is running, the operator must be ON the seat to disengage the brake and/or engage the PTO.

The engine will shutoff under any of the following conditions:

- When the key switch is turned to the OFF position
- If the operator leaves the seat without locking the parking brake
- If the operator leaves the seat with the PTO on (engaged)
- If the operator places the tractor in reverse with the PTO engaged without pressing the reverse implement switch (RIS)

**System Operation**

**Ignition:**

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 both sides of the ignition primary coil. With the ignition primary coil grounded, a spark cannot be produced.

When the engine is turning over, (See “CRANKING CIRCUIT OPERATION–LT166”.) the flywheel magnets induces current into the magneto ignition coil, which in turn produces current high enough to jump the spark plug gap, creating spark to ignite the engine fuel/air mixture.

**System Operation**

**Shutoff:**

The engine is shut off by grounding both sides of the ignition primary coil. With the ignition primary coil grounded, a spark cannot be produced.

Placing the key switch in the OFF position creates one path to ground for the Wht wire from the engine magneto, 900, 910 Wht wires, key switch contacts (normally closed), 120 and 110 Blk wires.

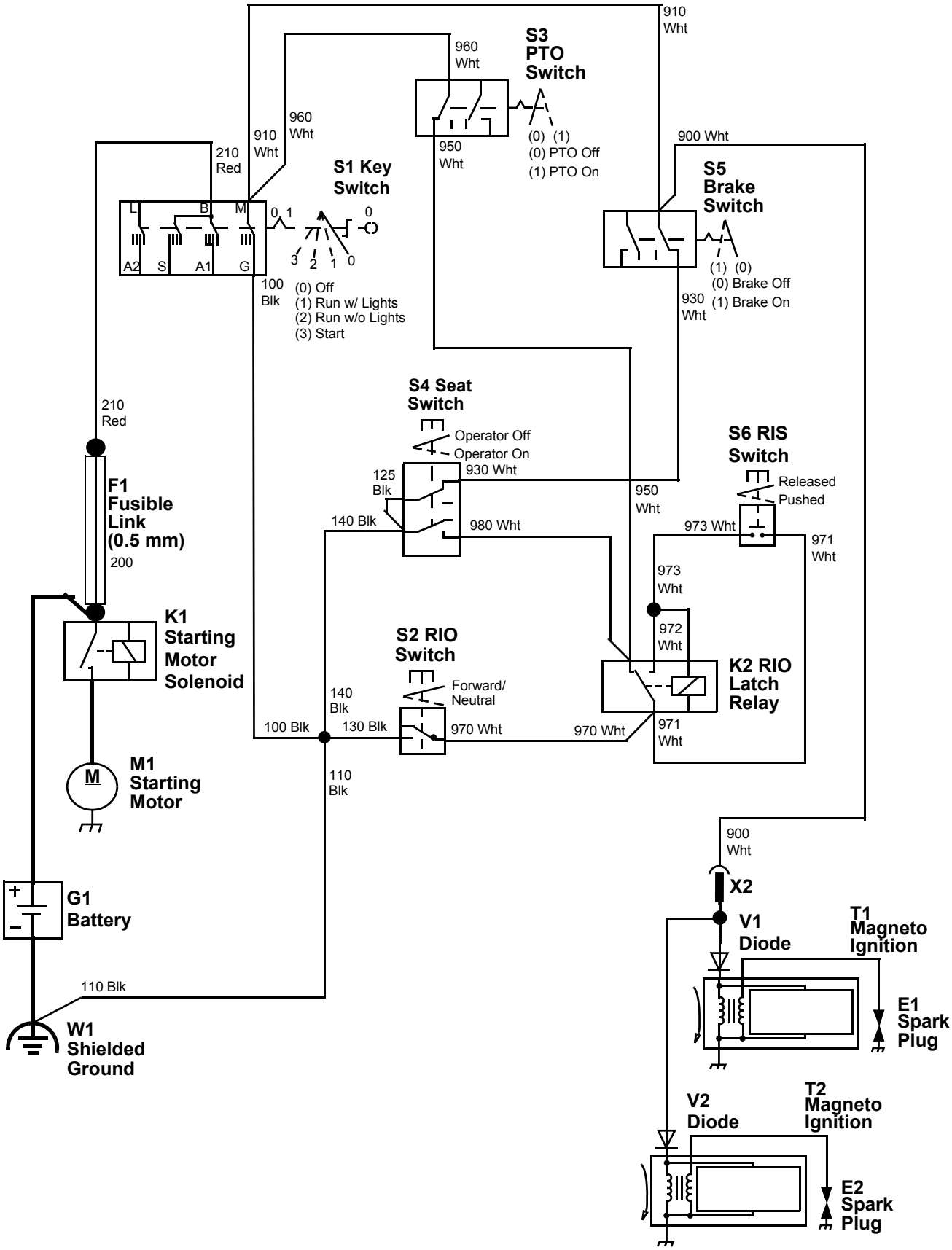
Another path to ground is created with the key switch in the ON position, any time the operator is OFF the seat (seat switch CLOSED) without having the brakes locked on or by having the PTO engaged. The seat switch creates a ground path for the magneto ignition through either the brake switch or the PTO switch.

If the brake were off when the operator leaves the seat the ground path would be created from the magneto Wht wire, 900 Wht wire, brake switch contacts (normally closed), 930 Wht wire, Seat switch contacts (normally closed), 140 and 110 Blk wires.

If the PTO were engaged when the operator leaves the seat the ground path would be created from the magneto Wht wire, 900, 910, and 960 Wht wires, PTO contacts (normally closed), 950 and 980 Wht wires, RIO switch contacts (normally closed), 940 and 930 Wht wire, seat switch contacts (normally closed), 140 and 110 Blk wires.

A fourth path to ground will be created with engine running, if the operator places the tractor in reverse while the PTO is engaged and the Reverse Implement Switch is not pressed. See “PTO with RIO CIRCUIT OPERATION LT166–w/3 POS. KEY SWITCH”.

# IGNITION & SHUTOFF CIRCUIT SCHEMATIC–LT166–w/4 POS. KEY SWITCH



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT166–w/4 POS. KEY SWITCH

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine cool to avoid burns

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Spark plug | Spark plug not fouled.<br>Correct air gap. | Replace spark plug.<br>Adjust air gap. |

**Test Conditions:**

- Key switch in START position
- Park brake ON
- PTO OFF (DISENGAGED)

*NOTE: Engine will turn over and can start during this test*

| | | |
|---|---|---|
| 2. Spark plug tester installed. See "SPARK TEST". | Spark present at tester. | No spark: Check armature air gap.<br>Check for grounded primary lead.<br>Check for continuity between engine kill wire and ground (should be infinite).<br>Check ignition coil.<br>Weak Spark: Check spark plug(s). |

**Test Conditions:**

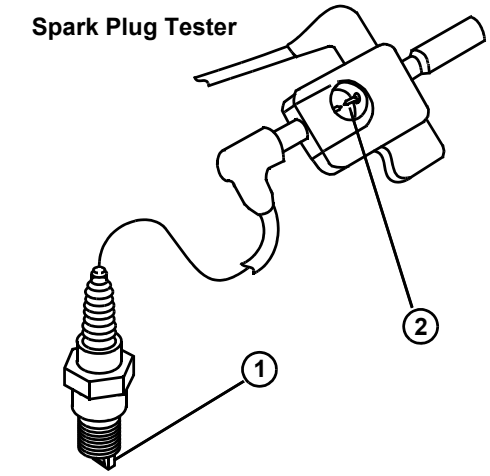
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

| | | |
|---|---|---|
| 3. Key switch | Continuity to ground | Check 100 Blk wire and connections. |
| 4. Key switch | Continuity to ground | Replace key switch. |
| 5. PTO switch | Continuity to ground | Check 960 Wht wire and connections. |
| 6. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 7. Engine Wht wire | Continuity to ground | Check 900 Wht wire and connections. |

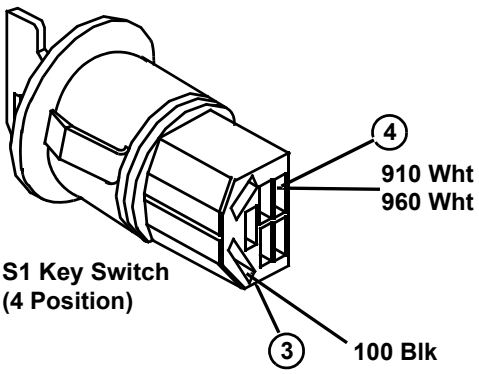
**Test Conditions: (Briggs & Stratton Engines ONLY – Test performed if engine will NOT shut off when operator leaves seat with EITHER PTO ENGAGED or brake switch OFF.)**

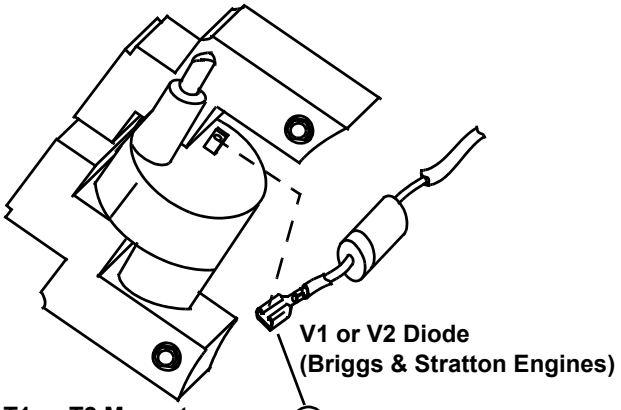
- Key switch in OFF position (Closes fuel valve to stop engine)
- Allow engine to cool, and remove engine cover to access ignition coils
- Disconnect diode(s) from ignition coil(s)
- Operator OFF seat
- PTO ON (ENGAGED); or, Park brake OFF

| | | |
|---|---|---|
| 8. Ignition coil diode(s) | Continuity to ground with diode disconnected from ignition coil. | Replace faulty diode(s). |

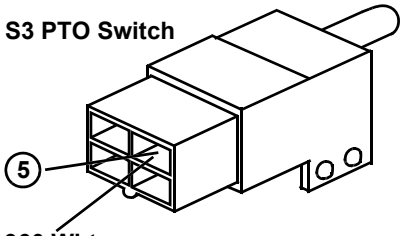


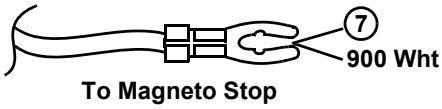

E1 or E2 Spark Plug



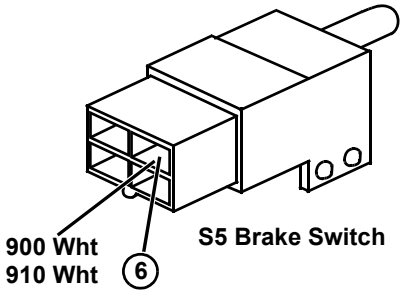




T1 or T2 Magneto
Ignition Coil
(Briggs & Stratton Engines)




To Magneto Stop



# IGNITION & SHUTOFF CIRCUIT DIAGNOSIS–LT166–w/4 POS. KEY SWITCH

**Test Conditions:**

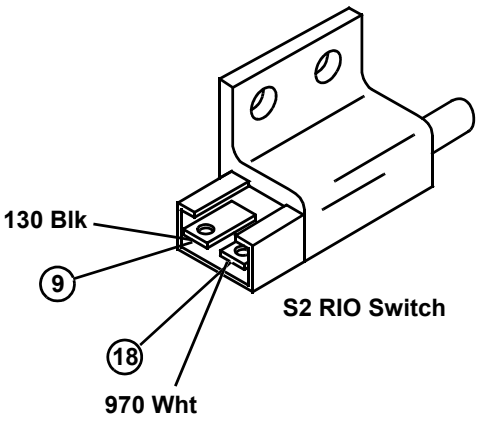
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- Engine wiring harness disconnected from main wiring harness

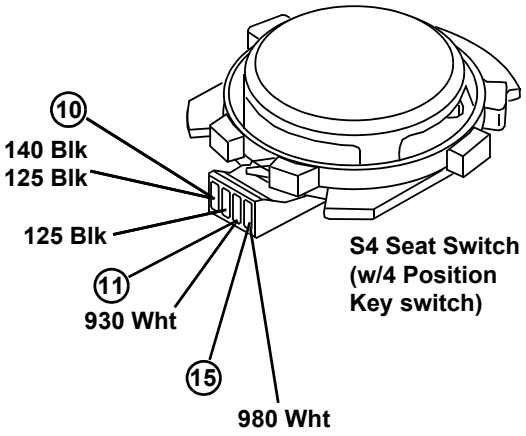
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 9. RIO switch | Continuity to ground. | Check 130 Blk wire and connections. |
| 10. Seat switch | Continuity to ground. | Check 125 and 140 Blk wires and connections. |
| 11. Seat switch | Continuity to ground | Replace seat switch. |
| 12. Brake switch | Continuity to ground | Check 930 Wht wire and connections. |
| 13. Brake switch | Continuity to ground | Replace brake switch. |
| 14. PTO switch | Continuity to ground | Repeat steps 3-5.<br>Test PTO switch. |
| 15. Seat switch | Continuity to ground | Check 980 and 930 Wht wires and connections. |
| 16. RIO latch relay | Continuity to ground | Check 950 Wht wire and connections. |
| 17. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 18. RIO switch | Continuity to ground | Check 970 Wht wire and connections. |
| 19. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |

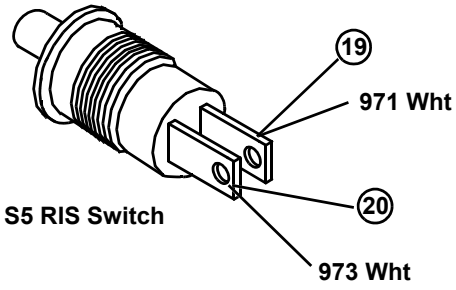
**Test Conditions:**

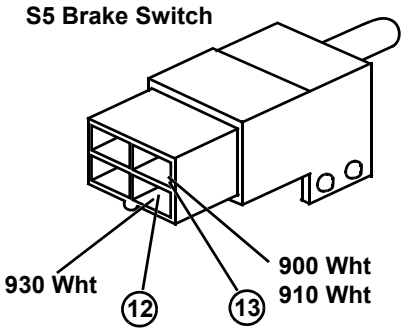
- Key switch in OFF position
- Park brake ON
- PTO OFF (DISENGAGED)
- RIS switch PRESSED
- Engine wiring harness disconnected from main wiring harness

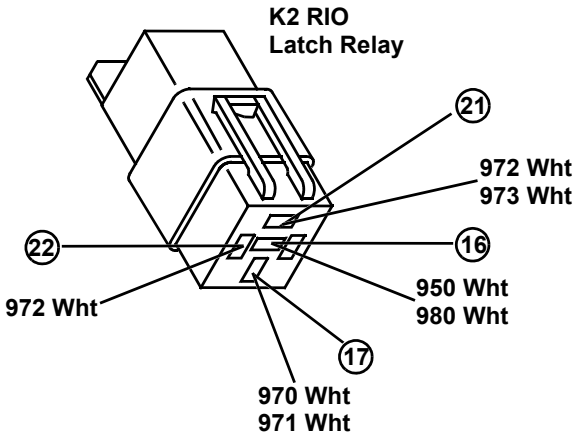
| | | |
|---|---|---|
| 20. RIS switch | Continuity to ground. | Replace RIS switch. |
| 21. RIO latch relay | Continuity to ground. | Check 973 Wht wire and connections. |
| 22. RIO latch relay | Continuity to ground | Check 972 Wht wire and connections. |

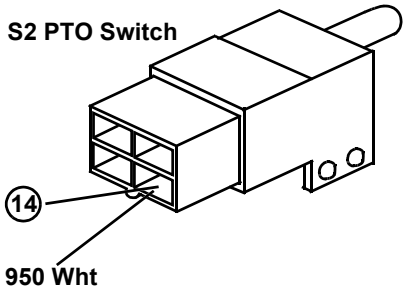

130 Blk
9
S2 RIO Switch
18
970 Wht


10
140 Blk
125 Blk
125 Blk
11
930 Wht
15
980 Wht
S4 Seat Switch
(w/4 Position
Key switch)


19
971 Wht
20
S5 RIS Switch
973 Wht


S5 Brake Switch
930 Wht
12
13
900 Wht
910 Wht


K2 RIO
Latch Relay
21
972 Wht
973 Wht
22
16
950 Wht
980 Wht
972 Wht
17
970 Wht
971 Wht


S2 PTO Switch
14
950 Wht

# CHARGING & SHUNT CIRCUIT OPERATION–LT133/LT155–3 AMP

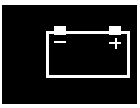
**Function:**

To maintain battery voltage at 12.4 volts or higher, to provide electrical power to light the headlights, and to reduce the time it takes for the engine to shut down.

**Operating Conditions:**

The engine must be running for both the charging system to operate, and the headlights to be on.

The shunt circuit is functional when the engine is turned off.



**System Operation:**

The stator provides DC current for charging the battery, an independent AC circuit for headlights, and an additional independent AC circuit that is used to place a load on the alternator when the engine is shut off.

The battery is not used for lights, so lights are available even if the battery is disconnected or removed. However, the lights will draw current from the battery when the engine is running and below 2600 rpm.

Current for lights is available as long as the engine is running. The output depends upon engine speed, so brightness of the lights changes with engine speed.

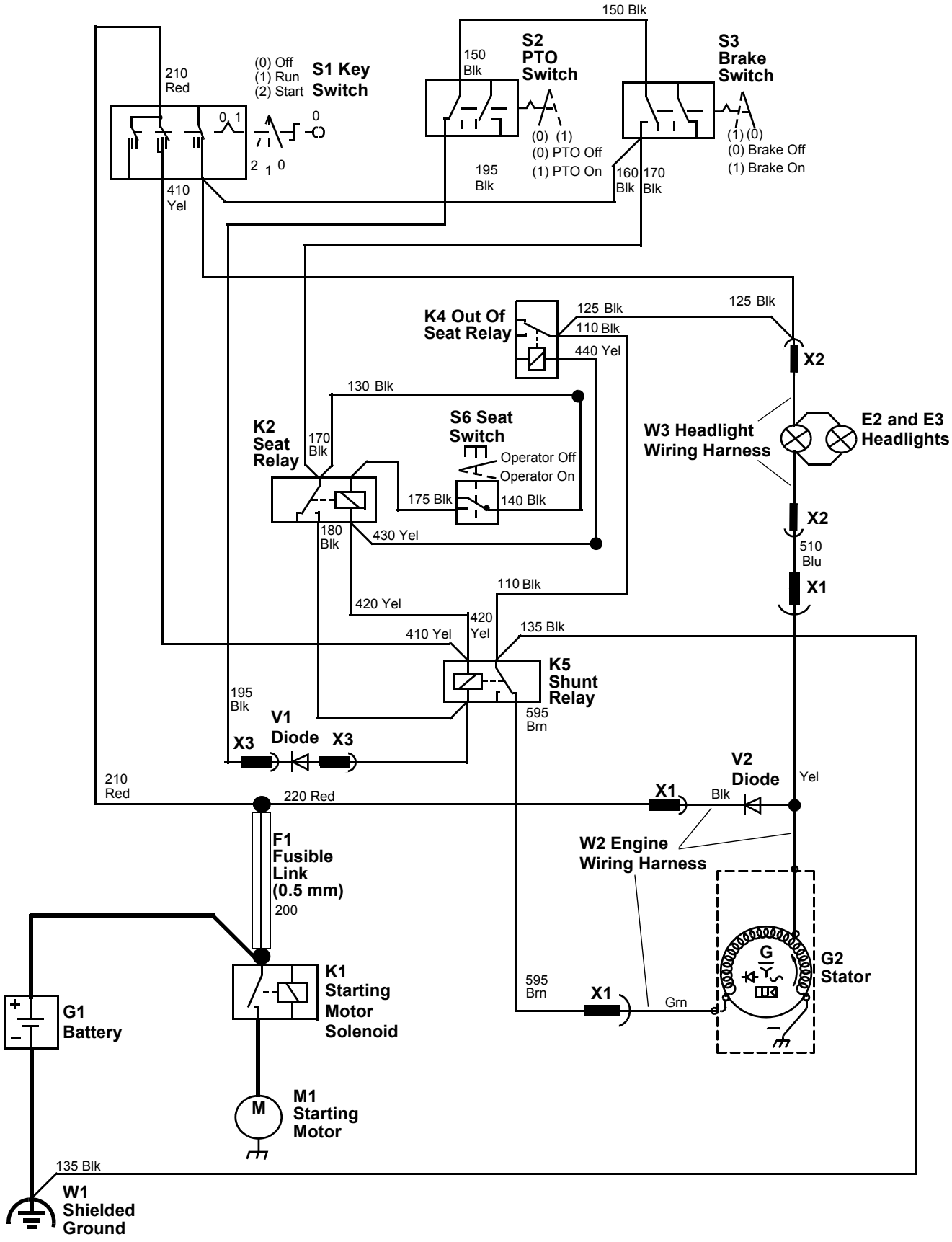
Magnets mounted to the flywheel rotate around two coils of wire, (the stator), mounted underneath the flywheel. As the magnets rotate, current is generated in the coiled wire and converted, with a diode, to DC current to charge the battery.

The current from the DC side of the stator is unregulated and is rated at 3 amps. The output rises from 2 amps at idle to 3 amps at full throttle.

The shunt circuit is used to cause the engine to stop faster when the engine is shut off. When the key switch is in the RUN position and the PTO is off and the brake is on, or the operator is on the seat, the shunt relay is energized and opens the contacts that connect one phase of the alternator to ground. This reduces the load on the alternator to 2-3amps for recharging the battery and 3-5 amps for illuminating the headlights.

When the ignition is grounded to shut the engine off, (See “IGNITION & SHUTOFF CIRCUIT OPERATION–LT133/LT155”.) the shunt relay is deenergized. This allows contact across the normally closed set of contacts, grounding the alternator. This places a load on the alternator, which in turn places a load on the engine. Since the engine ignition system has been turned off, the engine has no power to turn the extra load. The result is that the engine stops spinning faster.

# CHARGING & SHUNT CIRCUIT SCHEMATIC–LT133/LT155–3 AMP



# CHARGING & SHUNT CIRCUIT DIAGNOSIS–LT133/LT155–3 AMP

**Test Conditions:**

- Key switch RUN position, engine RUNNING at full throttle
- Engine connector unplugged
- Park brake ON
- PTO OFF

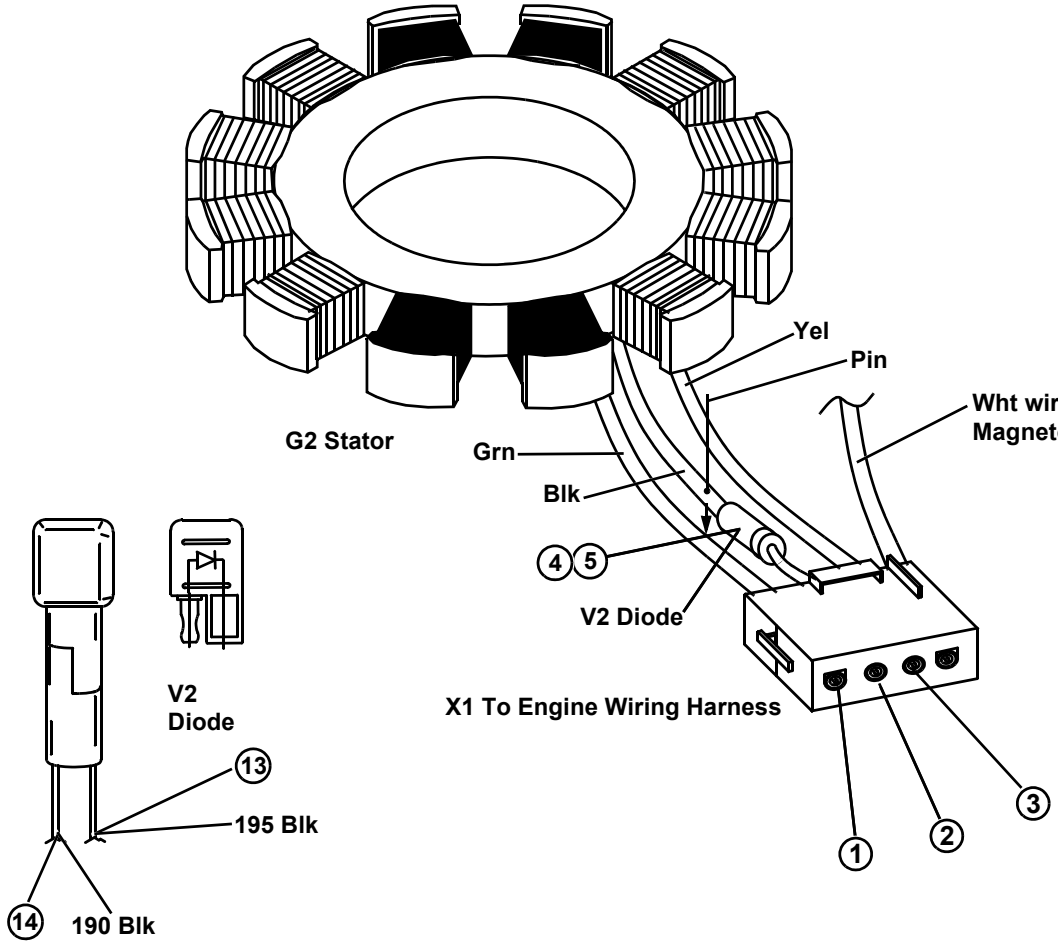
*NOTE: Engine connector must be plugged back together to shut engine off*

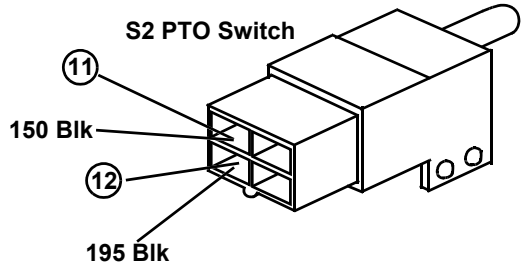
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Engine connector, Grn wire | 45 volts AC or higher | Replace stator. |
| 2. Engine connector, Blk wire | 6.5 volts DC or higher | Check diode, if diode is OK, replace stator. |
| 3. Engine connector, Yel wire | 14.5 volts AC or higher | Replace stator. |

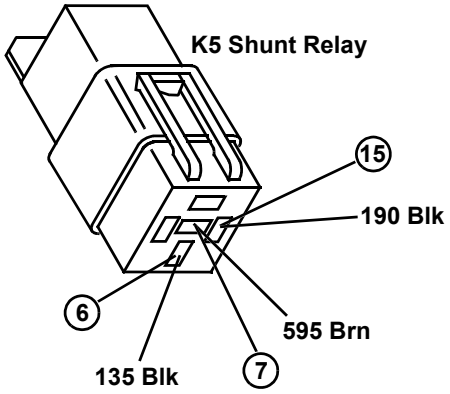
**Test Conditions:**

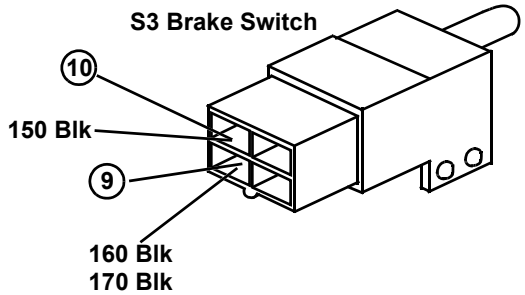
- Key switch OFF
- PTO OFF
- Park Brake ON

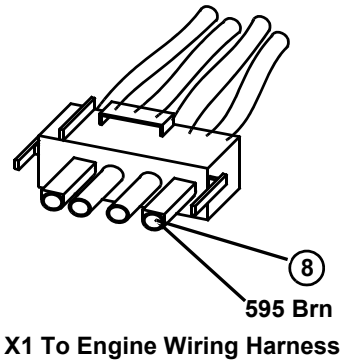
| | | |
|---|---|---|
| 4. Stator wire harness, diode | Continuity with black test lead clipped to connector pin, and red test lead clipped to pin piercing wire behind diode. | Replace diode. |
| 5. Stator wire harness, diode | No continuity with black test lead clipped to pin piercing wire behind diode, and red test lead clipped to connector pin. | Replace diode. |
| 6. Shunt relay | Continuity to ground | Check 135 Blk wire and connections. |
| 7. Shunt relay | Continuity to ground | Replace shunt relay. |
| 8. Engine connector | Continuity to ground | Check 595 Brn wire and connections. |
| 9. Brake switch | Continuity to ground | Check 160, 100, 125, 110, and 135 Blk wires and connections. |
| 10. Brake switch | Continuity to ground | Replace brake switch. |
| 11. PTO switch | Continuity to ground | Check 150 Blk wire and connections. |
| 12. PTO switch | Continuity to ground | Replace PTO switch. |
| 13. Diode connector | Continuity to ground | Check 195 Blk wire and connections. |
| 14. Diode connector | Continuity to ground | Replace diode. |
| 15. Shunt relay | Continuity to ground | Check 190 Blk wire and connections. |


G2 Stator
Yel
Pin
Wht wire to Magneto
Grn
Blk
4
5
V2 Diode
X1 To Engine Wiring Harness
1
2
3
V2 Diode
13
195 Blk
14
190 Blk


S2 PTO Switch
11
150 Blk
12
195 Blk


K5 Shunt Relay
15
190 Blk
6
595 Brn
135 Blk
7


S3 Brake Switch
10
150 Blk
9
160 Blk
170 Blk


8
595 Brn
X1 To Engine Wiring Harness

# CHARGING & SHUNT CIRCUIT OPERATION–LT133/LT155–15 AMP

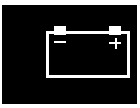
**Function:**

To maintain battery voltage at 12.4 volts or higher and to reduce the time it takes for the engine to shut down.

**Operating Conditions:**

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

The charging system is a permanent magnet and stator design. Charging output is controlled by the (N1) voltage regulator/rectifier.



With the engine running, current flows from the voltage regulator/rectifier to the battery positive (+) terminal through the 220 Red wire, F1 fusible link, 200 Red wire and battery cable. The circuit allows the voltage regulator/rectifier to charge the battery.

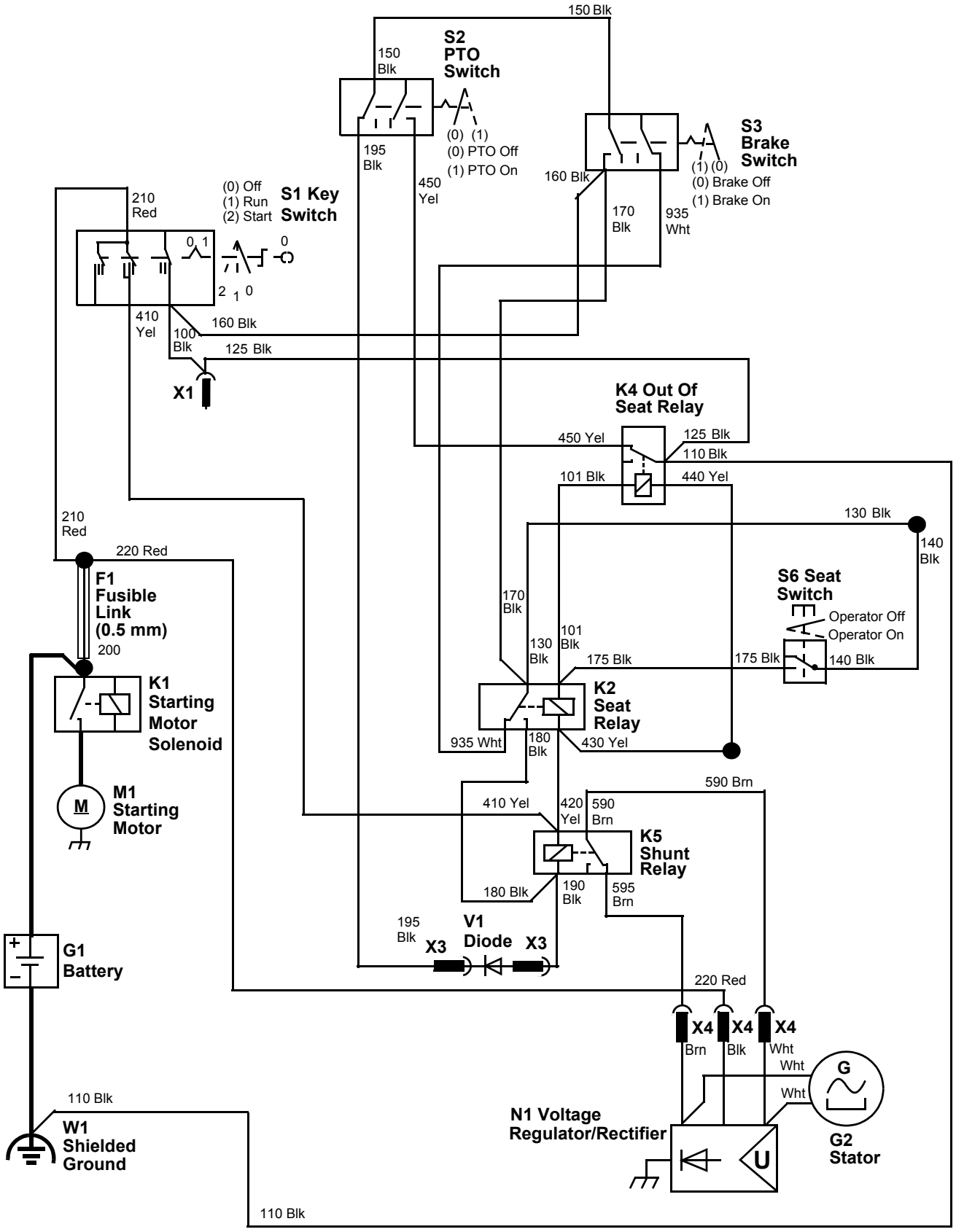
As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator (G2) windings. The AC current flows to the regulator/rectifier. The regulator/rectifier converts the AC current to DC current needed to charge the battery.

When voltage drops below 14.7 VDC, the voltage regulator/rectifier allows DC current to flow to the battery to charge it. As the battery becomes fully charged, the regulator reduces current flow to the battery.

The shunt circuit is used to cause the engine to stop faster when the engine is shut off. When the key switch is in the RUN position and the brake is off; or the operator is on the seat, the K5 shunt relay is energized and opens the contacts that connect the two stator leads, 590 and 595 Brn, together.

When the ignition is grounded to shut the engine off, (See “IGNITION & SHUTOFF CIRCUIT OPERATION–LT133/LT155”.) the operator gets off the seat; or, the brake is applied, the shunt relay is deenergized. This allows contact across the normally closed set of contacts of the shunt relay, shorting the two stator leads together. This places a full output load on the stator, which in turn places a load on the engine. The result is that the engine stops spinning faster.

# CHARGING & SHUNT CIRCUIT SCHEMATIC–LT133/LT155–15 AMP



# CHARGING & SHUNT CIRCUIT DIAGNOSIS–LT133/LT155–15 AMP

**Test Conditions:**

- Key switch OFF
- PTO OFF
- Park Brake ON

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Voltage regulator/rectifier | Battery voltage, 12.4 volts or higher. | Check 220 Red wire, fusible link and connections. If OK, test battery. |
| 2. Voltage regulator/rectifier | Continuity to ground | Check battery negative cable and shielded ground. |
| 3. Seat switch | Continuity to ground | Check 140, 130, 170, 160, 100, 125 and 110 Blk wires and connections. |
| 4. PTO switch | Continuity to ground | Check 150 Blk wire and connections. If OK, test brake switch. |
| 5. Seat relay | Continuity to ground | Check 180, 190 and 195 Blk wires and connections. Test V1 diode. See “DIODE TEST” . |
| 6. X4 Engine connector | Continuity between terminals | Check 590 and 595 Brn wires and connections. If OK, replace shunt relay. |

**Test Conditions:**

- Key switch in RUN position
- PTO OFF
- Seat switch ON (operator ON seat)
- Park brake OFF

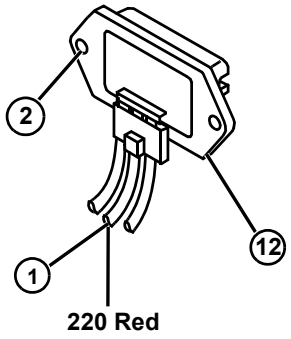
| | | |
|---|---|---|
| 7. Shunt relay | Battery voltage | Check 410 Yel wire and connections. If OK, replace key switch. |
| 8. Seat relay | Battery voltage | Check 420 Yel wire and connections. |
| 9. Seat relay | Continuity to ground | Check 175 Blk wire and connections. If OK, replace the seat switch. |

**Test Conditions:**

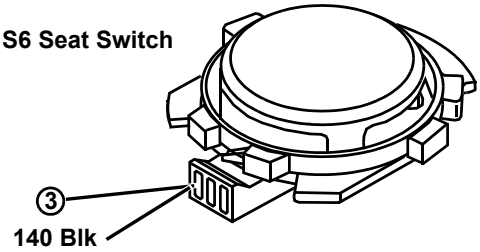
- As defined in test section

| | | |
|---|---|---|
| 10. Seat relay | Passes test | Replace seat relay. |
| 11. Shunt relay | Passes test | Replace shunt relay. |
| 12. Voltage regulator/rectifier. See “VOLTAGE REGULATOR/ RECTIFIER TEST–LT133/LT155 w/ 15 AMP CHARGER”. | Passes test | Replace regulator/rectifier. |
| 13. Stator. See “VOLTAGE OUTPUT TEST–LT133/LT155 w/ 15 AMP CHARGER”. | Passes test | Replace stator. |

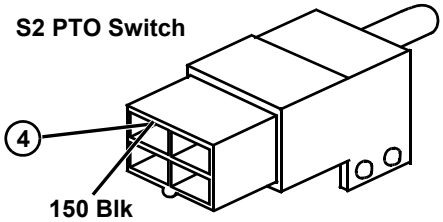
N1 Voltage Regulator/Rectifier

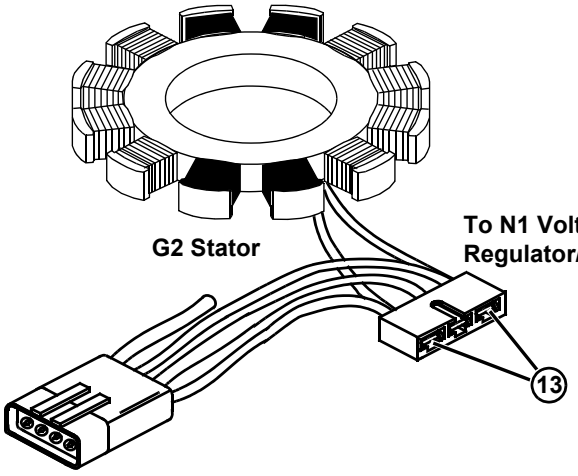



S6 Seat Switch



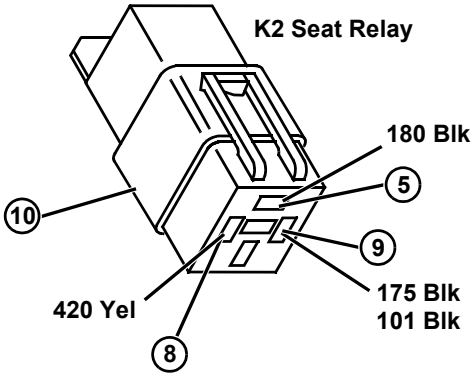

S2 PTO Switch



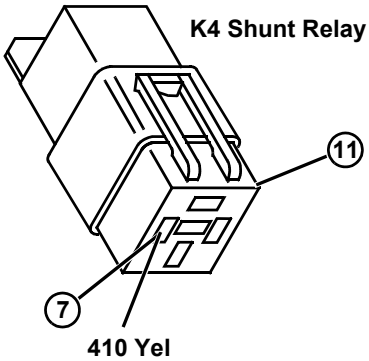



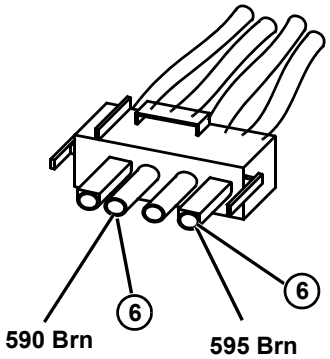

X4 To W1 Main Wiring Harness

K2 Seat Relay




K4 Shunt Relay




X4 To Engine Wiring Harness

# CHARGING & SHUNT OPERATION– LT133/LT155–w/4 POS. KEY SWITCH

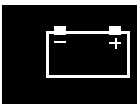
**Function:**

To maintain battery voltage at 12.4 volts or higher and to reduce the time it takes for the engine to shut down.

**Operating Conditions:**

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

The charging system is a permanent magnet and stator design. Charging output is controlled by the (N1) voltage regulator/rectifier.



With the engine running, current flows from the voltage regulator/rectifier to the battery positive (+) terminal through the 220 Red wire, F1 fusible link, 200 Red wire and battery cable. The circuit allows the voltage regulator/rectifier to charge the battery.

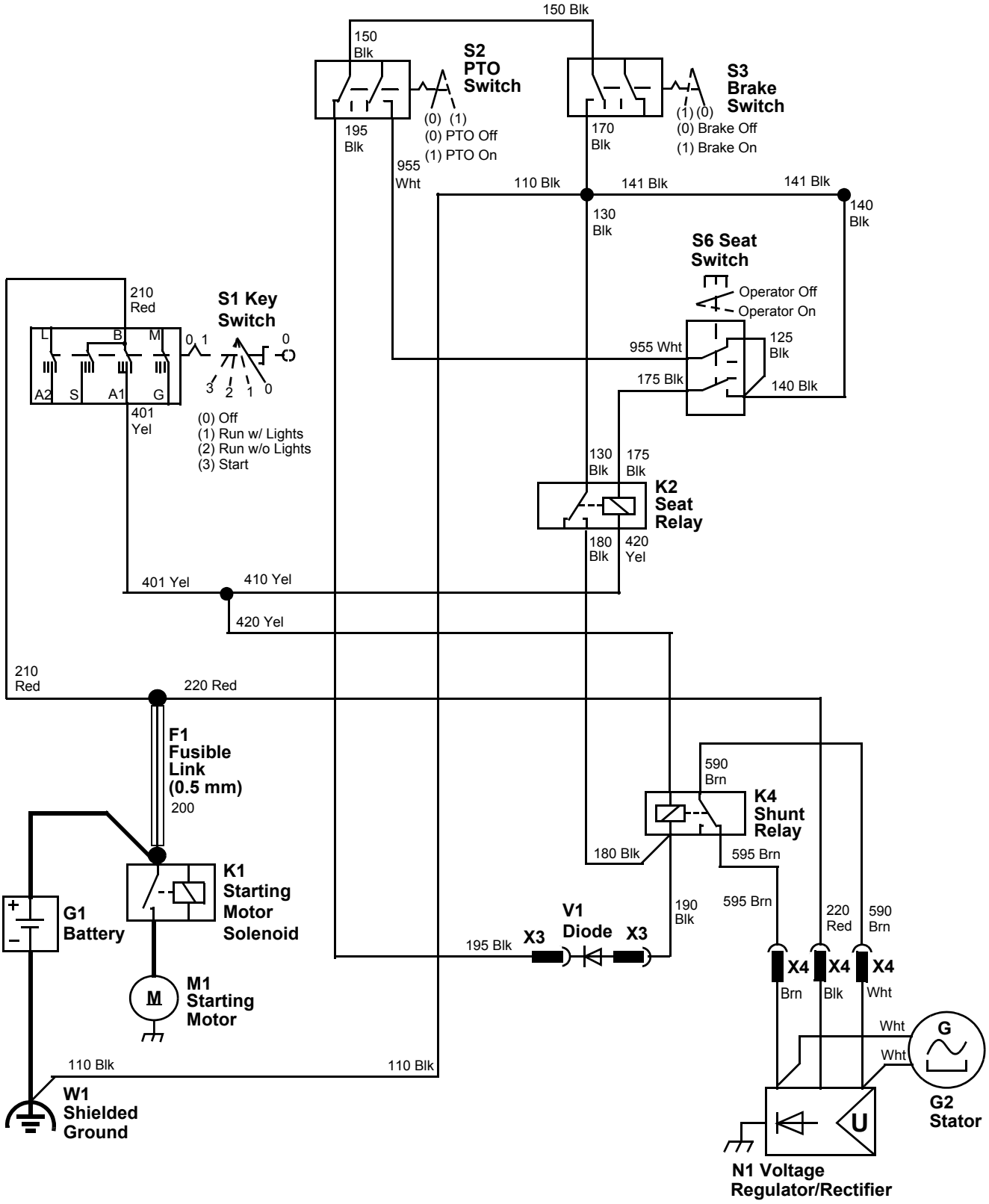
As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator (G2) windings. The AC current flows to the regulator/rectifier. The regulator/rectifier converts the AC current to DC current needed to charge the battery.

When voltage drops below 14.7 VDC, the voltage regulator/rectifier allows DC current to flow to the battery to charge it. As the battery becomes fully charged, the regulator reduces current flow to the battery.

The shunt circuit is used to cause the engine to stop faster when the engine is shut off. When the key switch is in the RUN position and the PTO is off and the brake is on, or the operator is on the seat, the shunt relay is energized and opens the contacts that connect the two stator leads, 590 and 595 Brn, together.

When the ignition is grounded to shut the engine off, (See “IGNITION & SHUTOFF CIRCUIT OPERATION–LT133/LT155”.) the shunt relay is deenergized. This allows contact across the normally closed set of contacts of the shunt relay, shorting the two stator leads together. This places a full output load on the stator, which in turn places a load on the engine. Since the engine ignition system has been turned off, the engine has no power to turn the extra load. The result is that the engine stops spinning faster.

# CHARGING & SHUNT SCHEMATIC–LT133/LT155–w/4 POS. KEY SWITCH



# CHARGING & SHUNT DIAGNOSIS–LT133/LT155–w/4 POS. KEY SWITCH

**Test Conditions:**

- Key switch OFF
- PTO OFF
- Park Brake ON

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Voltage regulator/rectifier | Battery voltage, 12.4 volts or higher. | Check 220 Red wire, fusible link and connections. If OK, test battery. |
| 2. Voltage regulator/rectifier | Continuity to ground | Check battery negative cable and shielded ground. |
| 3. Seat switch | Continuity to ground | Check 140, 141 and 110 Blk wires and connections. |
| 4. Brake switch | Continuity to ground | Check 170 Blk wire and connections. |
| 5. PTO switch | Continuity to ground | Check 150 Blk wire and connections. If OK, replace brake switch. |
| 6. Seat relay | Continuity to ground | Check 180, 190 and 195 Blk wires and connections. Test V1 diode. See “DIODE TEST”. If OK, replace PTO switch. |
| 7. X4 Engine connector | Continuity between terminals | Check 590 and 595 Brn wires and connections. If OK, replace shunt relay. |

**Test Conditions:**

- Key switch in RUN position
- PTO OFF
- Seat switch ON (operator ON seat)
- Park brake OFF

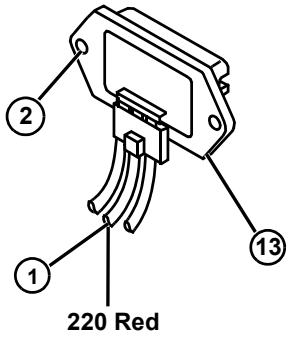
| | | |
|---|---|---|
| 8. Shunt relay | Battery voltage | Check 410 Yel wire and connections. If OK, replace key switch. |
| 9. Seat relay | Battery voltage | Check 420 Yel wire and connections. |
| 10. Seat relay | Continuity to ground | Check 175 Blk wire and connections. If OK, replace the seat switch. |

**Test Conditions:**

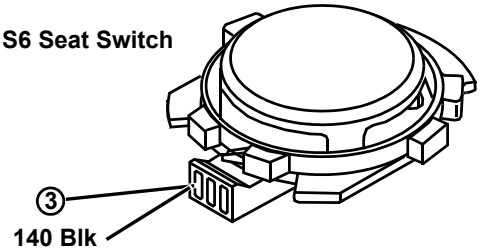
- As defined in test section

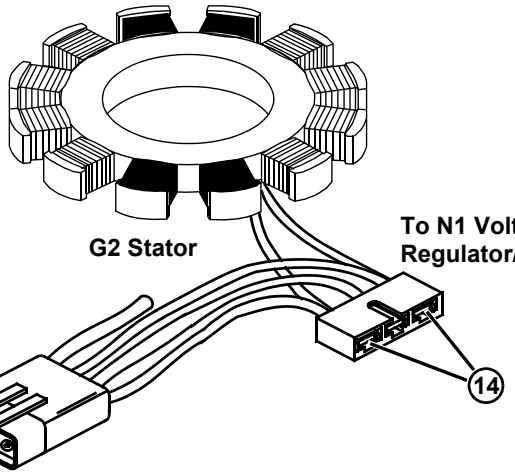
| | | |
|---|---|---|
| 11. Seat relay | Passes test | Replace seat relay. |
| 12. Shunt relay | Passes test | Replace shunt relay. |
| 13. Voltage regulator/rectifier. See “VOLTAGE REGULATOR/ RECTIFIER TEST–LT133/LT155 w/ 15 AMP CHARGER”. | Passes test | Replace regulator/rectifier. |
| 14. Stator. See “VOLTAGE OUTPUT TEST–LT133/LT155 w/ 15 AMP CHARGER”. | Passes test | Replace stator. |

N1 Voltage Regulator/Rectifier



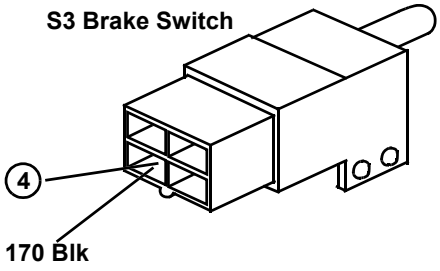

S6 Seat Switch



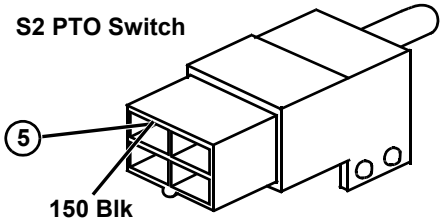




X4 To W1 Main Wiring Harness

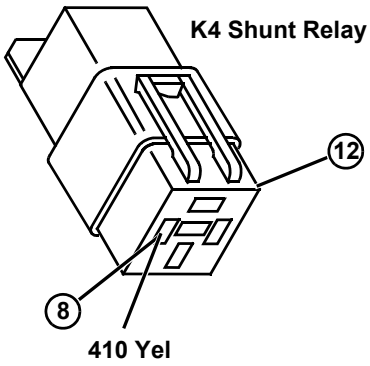
S3 Brake Switch

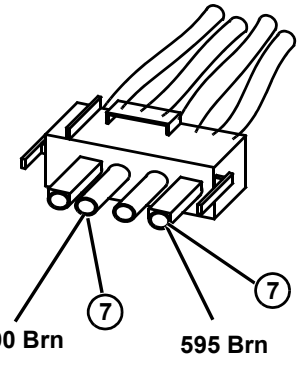



S2 PTO Switch



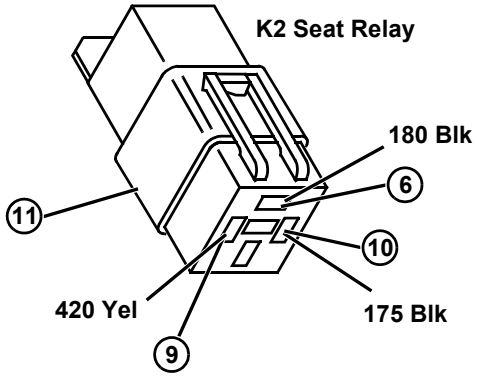

K4 Shunt Relay




X4 To Engine Wiring Harness

K2 Seat Relay



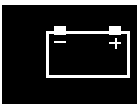
# CHARGING CIRCUIT OPERATION–LT166–w/ 3 or 4 POSITION KEY SWITCH

**Function:**

To maintain battery voltage at 12.4 volts or higher, and provide electrical power to light the headlights.

**Operating Conditions:**

The engine must be running for both the charging system to operate, and the headlights to be on.



**System Operation:**

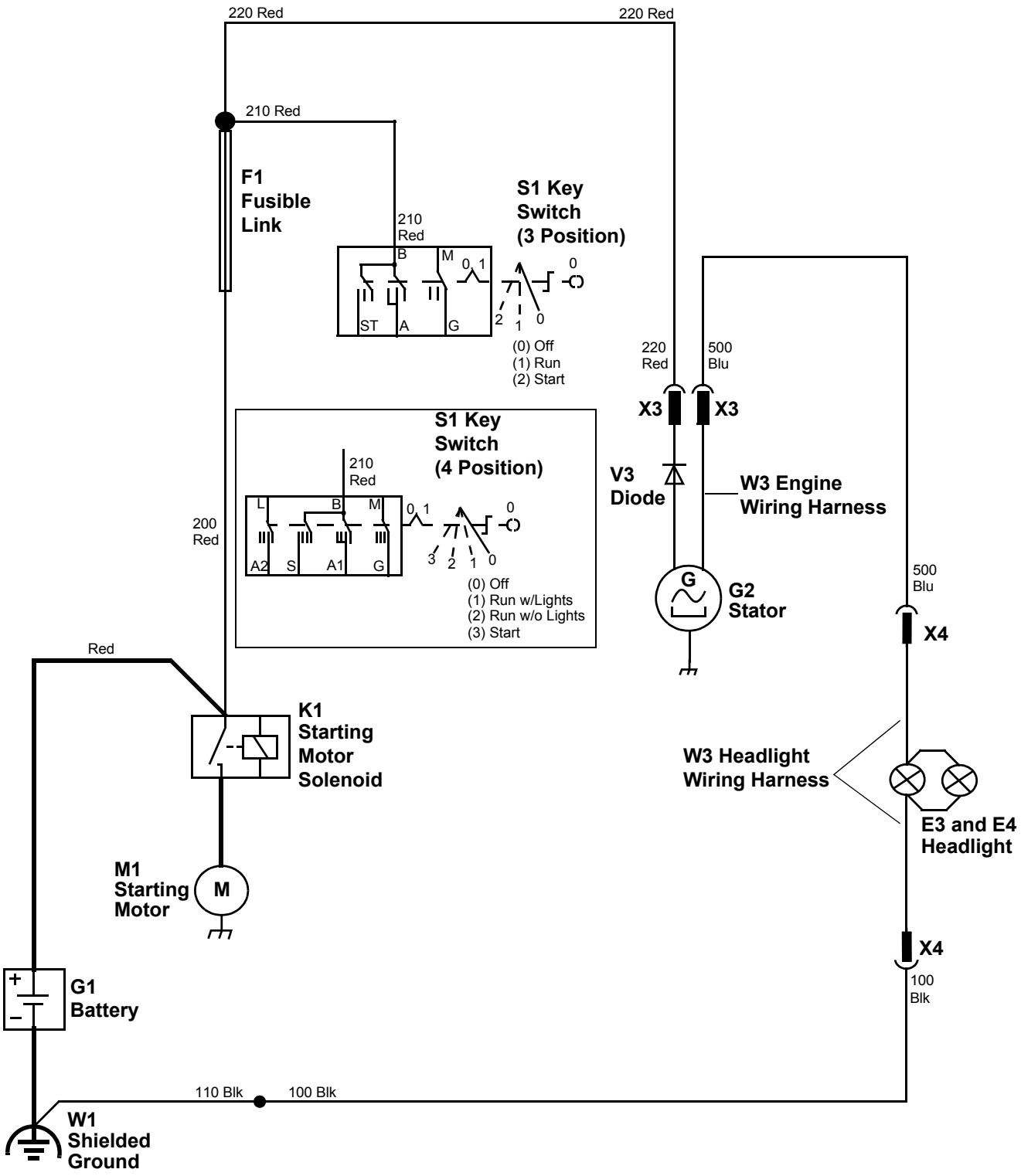
The dual circuit stator provides DC current for charging the battery and an independent AC circuit for headlights. The battery is not used for lights, so lights are available even if the battery is disconnected or removed.

Current for lights is available as long as the engine is running. The output depends upon engine speed, so brightness of the lights changes with engine speed.

Magnets mounted to the flywheel rotate around two coils of wire, (the stator), mounted underneath the flywheel. As the magnets rotate, current is generated in the coiled wire and converted, with a diode, to DC current to charge the battery.

The current from the DC side of the stator is unregulated and is rated at 3 amps. The output rises from 2 amps at 2400 RPM to 3amps at 3600 RPM.

# CHARGING CIRCUIT SCHEMATIC–LT166

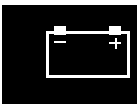


# CHARGING CIRCUIT DIAGNOSIS–LT166

**Test Conditions:**

- Key switch RUN position, engine RUNNING at full throttle
- Stator connector unplugged
- Park brake ON
- PTO OFF

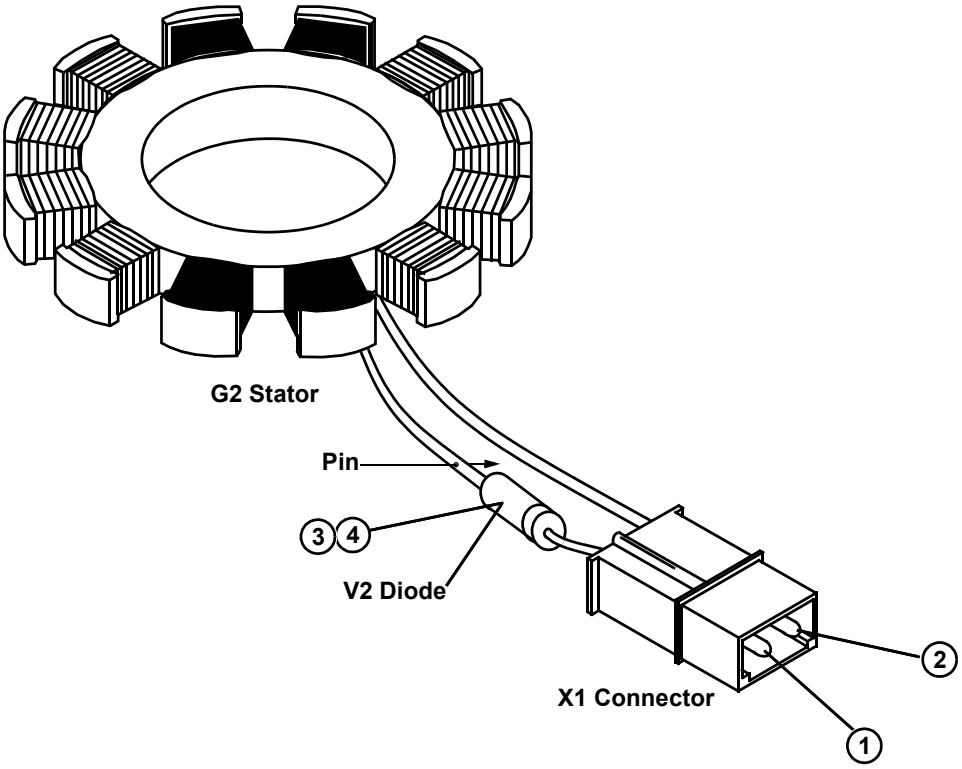
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Stator connector, DC lead | 2 - 4 amps | Check diode in DC wire. |
| 2. Stator connector, AC lead | 14 volts AC or higher | Replace stator. |



**Test Conditions:**

- Key switch OFF
- PTO OFF
- Park Brake ON

| | | |
|---|---|---|
| 3. Stator connector, Diode | Continuity with black test lead clipped to connector pin, and red test lead clipped to pin piercing wire behind diode. | Replace diode. |
| 4. Stator connector, Diode | No continuity with black test lead clipped to pin piercing wire behind diode, and red test lead clipped to connector pin. | Replace diode. |


G2 Stator
Pin
3
4
V2 Diode
2
X1 Connector
1

# PTO with RIO CIRCUIT OPERATION–LT133/LT155

**Function:**

To provide a safety interlock when the tractor is being operated in reverse while the PTO is engaged. This is accomplished by providing a ground path for either the ignition coil (to shut off the engine); or, the Reverse Implement Option (RIO) latch relay (to open its contacts) to provide an ignition ground path and a ground path to latch itself in the energized state and keep the engine running.

An operator choosing to keep the PTO engaged while backing up, must take deliberate action to actuate the Reverse Implement Switch (RIS), by pushing the button momentarily and then pressing the reverse pedal.

**RIO Operating Conditions:**

The key switch must be in the RUN position with the engine running, the operator must be ON the seat, the PTO ENGAGED, and the RIS switch must be pushed (momentary) while starting operation in reverse.

**Theory of Operation:**

The Reverse Implement Option (RIO) is controlled by a relay and two switches wired in a circuit with the ignition coil. These components provide control of three different functional situations:

- PTO OFF with any drive function
- PTO ON and operating in reverse without activating the RIO circuit
- PTO ON and operating in reverse while activating the RIO circuit

**PTO OFF**

When the PTO is disengaged, the tractor will operate in both forward and reverse without activating any other switch(s). The PTO switch is pressed in and breaks (opens) the ground path interlock with the RIO circuit switches for the ignition coil and the engine will continue to run normally.

**PTO ON and operating in reverse without activating the RIO circuit**

*NOTE: Wires listed below are for the 3 amp charging system. For other models, please see appropriate wiring diagrams in the next few pages.*

When the PTO is engaged and the tractor is operated in reverse, there is a ground path created for the ignition coil through wires 135, 110, 125, 100, 160, 170, 130 Blk, RIO switch contacts (normally open), 920, 971 Wht wires, RIO latch relay contacts (normally closed), 950 Wht wire, 450 Yel wire, PTO switch contacts (normally open), 905, 910, 900 Wht wires, and the ignition coil. This will ground the ignition coil and cause the engine to shut off.

**PTO ON and operating in reverse while activating the RIO circuit**

When the PTO is engaged and the tractor is operated in reverse, a ground path is created for the RIO latch relay, both momentary and continuous.

The momentary ground path engages the RIO latch relay, closing the contacts between the common and normally-open contacts of the relay. With the relay normally-open contacts closed, the continuous ground path is created through the RIO switch to hold the RIO latch relay in the ON position while the reverse pedal is activated.

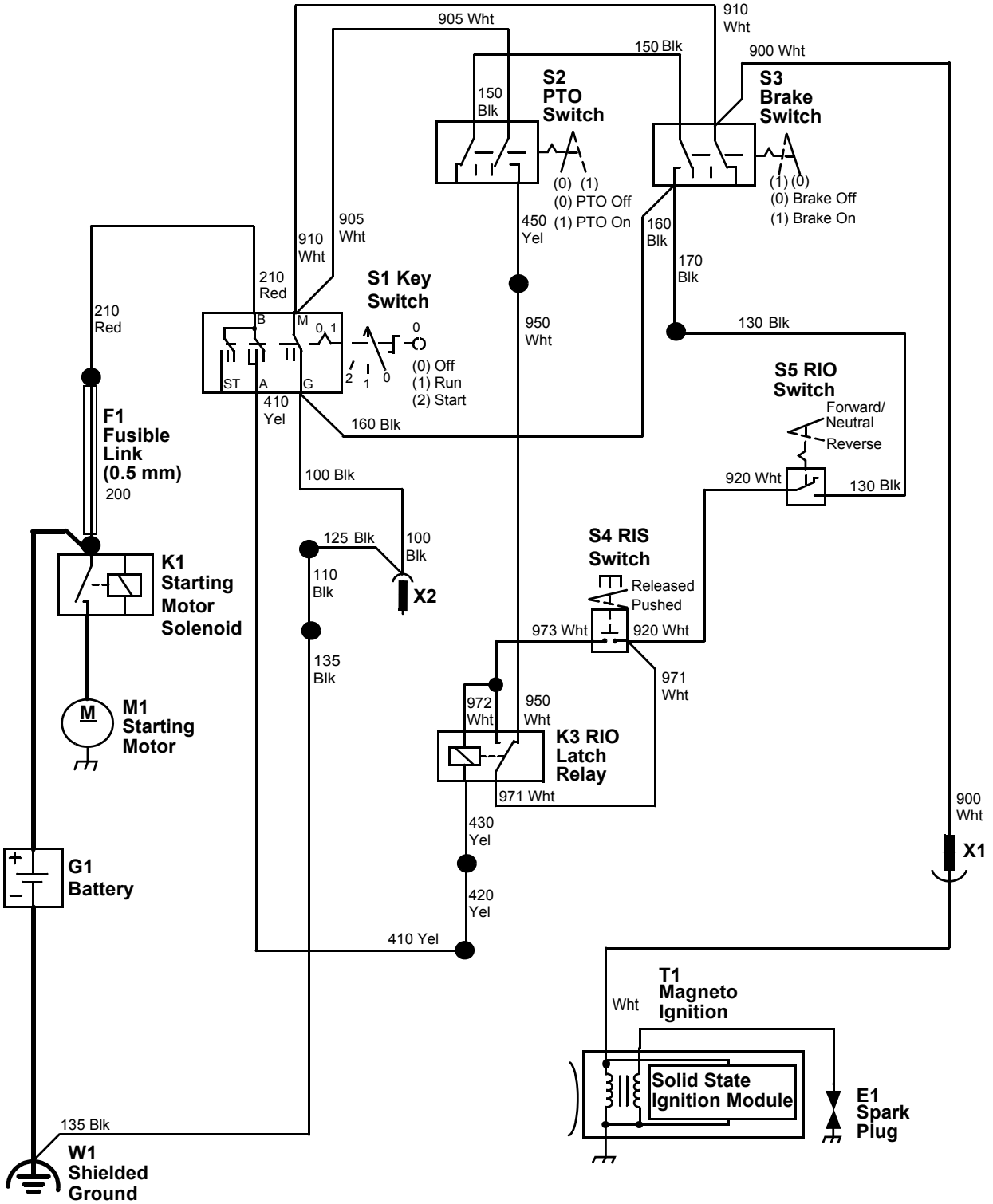
Pushing the RIS switch button provides a ground across the relay from wires 972, 973 Wht, RIS switch contacts (normally open), 920 Wht, RIO switch contacts (normally open), and 135, 110, 125, 100, 160, 170, 130 Blk wire to ground, while the tractor is in reverse.

The momentary path is connected into the continuous path when the RIS switch is pushed and closes its contacts to connect wires 972, 973 Wht to 920 Wht wires.

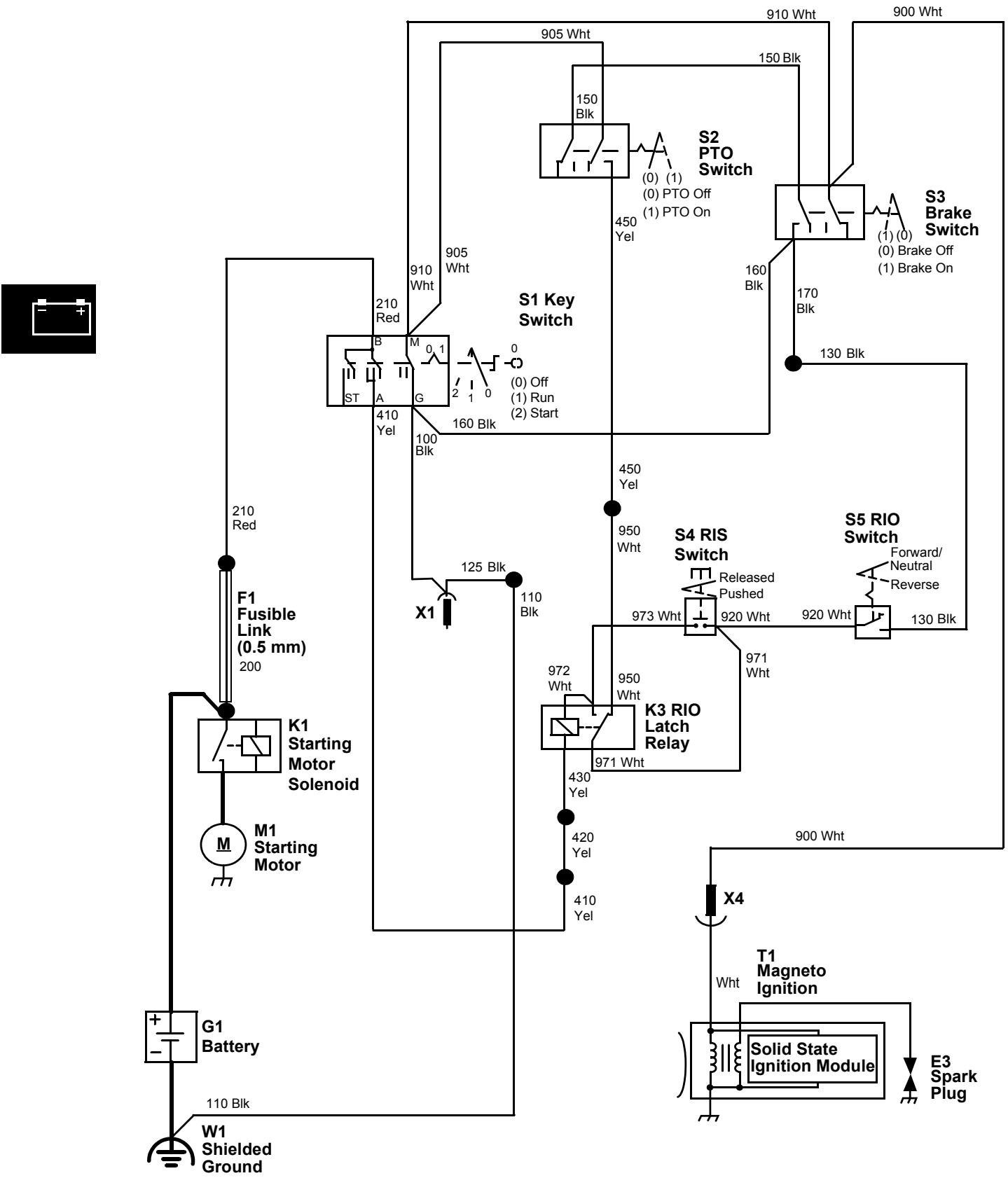
The continuous path is through wire 135, 110, 125, 100, 160, 170, 130 Blk, RIO switch contacts (normally open), 920, 971 Wht wires, RIO latch relay contacts (normally open), and 972 Wht wire.

When the operator returns the foot pedal(s) back to neutral or forward, the RIO switch returns to its normal (static) condition, breaking the ground path holding the latch relay in the ON condition. This allows the circuit to reset and be ready for the next reverse operation with PTO engaged.

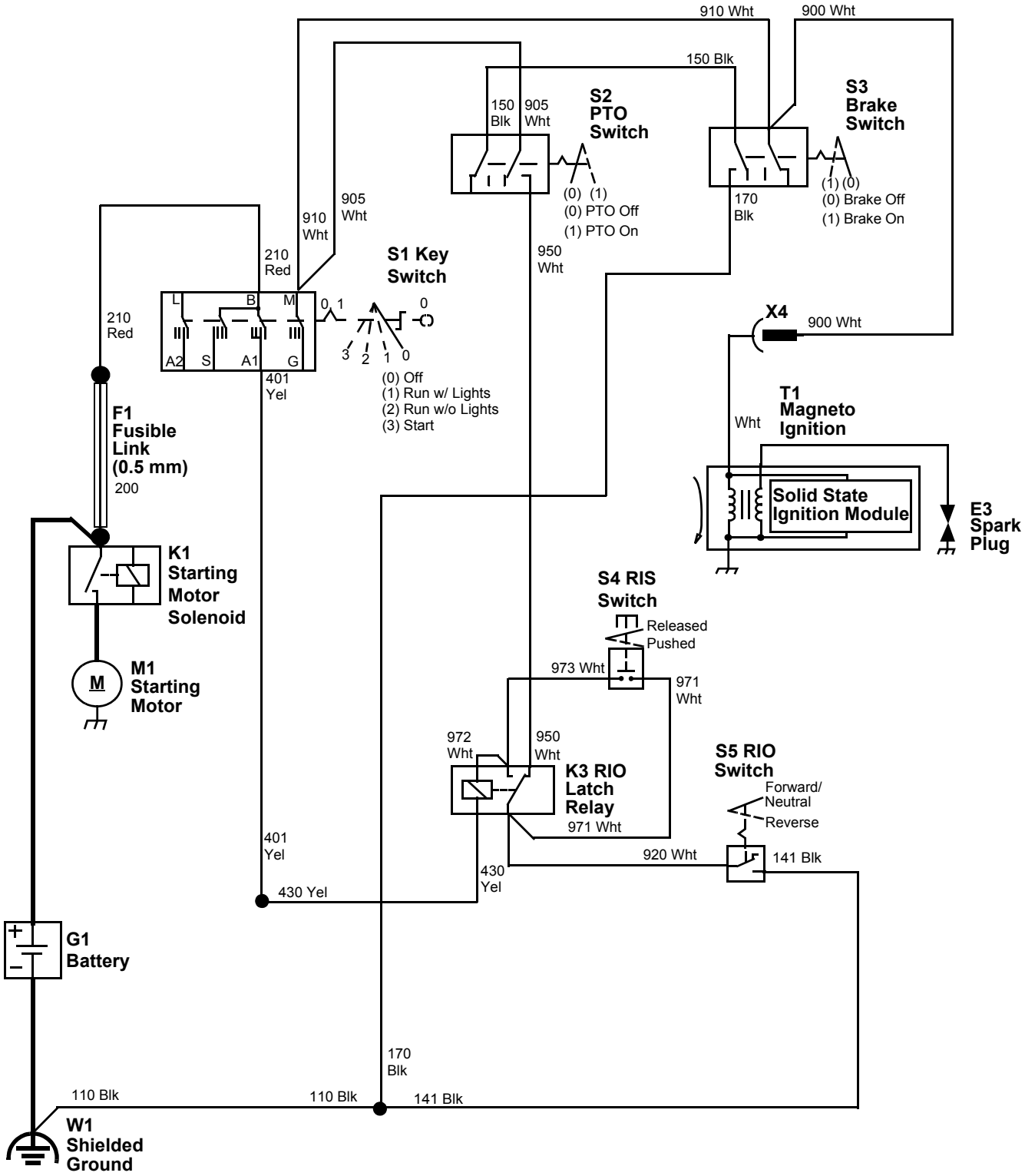
# PTO with RIO CIRCUIT SCHEMATIC–LT133/LT155–3 AMP



# PTO with RIO CIRCUIT SCHEMATIC–LT133/LT155–15 AMP



# PTO with RIO CIRCUIT SCHEMATIC–LT133/LT155–w/4 POS. KEY SWITCH



# PTO with RIO CIRCUIT DIAGNOSIS LT133/LT155

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. RIO switch | Continuity to ground | Check 135, 110, 125, 100, 160, 170, 130 and 141 Blk wires and connections. |

**Test Conditions:**

- Key switch OFF
- Park brake ON
- PTO ON
- Reverse pedal pressed (Switch button pressed in)

| | | |
|---|---|---|
| 2. RIO switch | Continuity to ground | Replace RIO switch. |
| 3. Reverse Implement Option (RIO) Latch Relay | Continuity to ground | Check 971 and 920 Wht wires and connections. |
| 4. PTO switch | Continuity to ground | Check 450 Yel and 950 Wht wires and connections. If OK, replace RIO latch relay. |
| 5. Engine Wire Harness Connector | Continuity to ground | Check 900, 910 and 905 Wht wires and connections. If OK, replace PTO switch. |

**Test Conditions:**

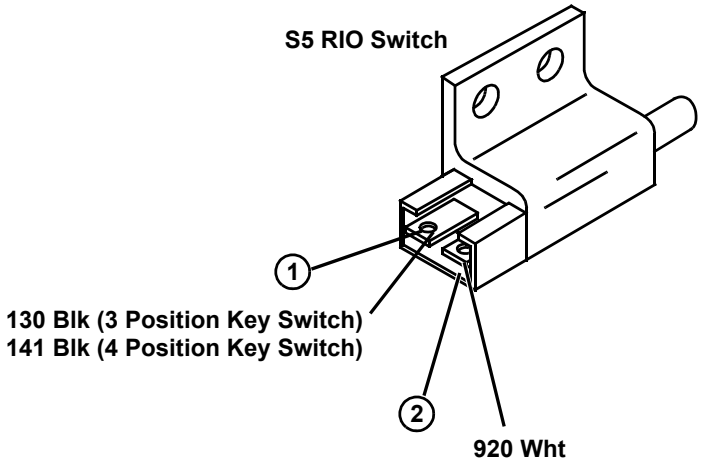
- Key switch ON
- Park brake ON
- PTO ON
- Reverse pedal pressed (Switch button pressed in)

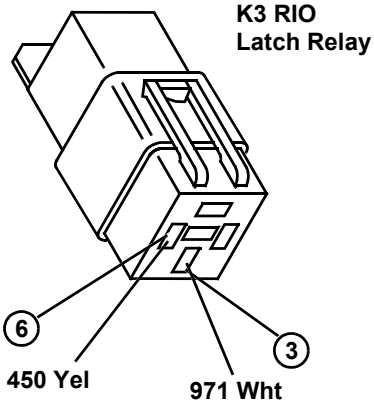
| | | |
|---|---|---|
| 6. Reverse Implement Option (RIO) Latch Relay | Battery voltage | Check 430, 420, 410 and 401 Yel wires and connection. Check key switch and 210 Red wire and F1 fusible link. |

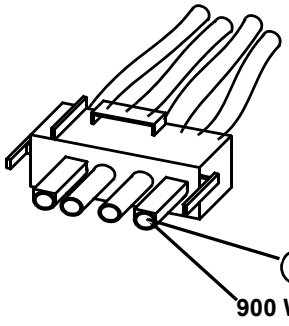
**Test Conditions:**

- See “TESTS & ADJUSTMENTS”.

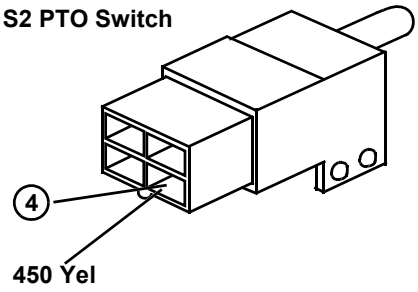
| | | |
|---|---|---|
| 7. Reverse Implement Option (RIO) Latch Relay. See “RELAY TEST”. | Passes test | Replace RIO latch relay. |
| 8. Reverse Implement Switch (RIS). See “RIS SWITCH TEST”. | Battery voltage | Replace RIS switch. |




Connector Engine Wiring Harness



# PTO with RIO CIRCUIT OPERATION LT166–w/3 POS. KEY SWITCH

**Function:**

To provide a safety interlock when the tractor is being operated in reverse while the PTO is engaged. This is accomplished by providing a ground path for either the ignition coil (to shut off the engine); or, the Reverse Implement Option (RIO) latch relay (to open its contacts) to provide an ignition ground path and a ground path to latch itself in the energized state and keep the engine running.

An operator choosing to keep the PTO engaged while backing up, must take deliberate action to actuate the Reverse Implement Switch (RIS), by pushing the button momentarily and then pressing the reverse pedal.

**RIO Operating Conditions:**

The key switch must be in the RUN position with the engine running, the operator must be ON the seat, the PTO ENGAGED, and the RIS switch must be pushed (momentary) while starting operation in reverse.

**Theory of Operation:**

The Reverse Implement Option (RIO) is controlled by a relay and two switches wired in a circuit with the ignition coil. This combination of components provide for control of three different functional situations:

- PTO OFF with any drive function
- PTO ON and operating in reverse without activating the RIO circuit
- PTO ON and operating in reverse while activating the RIO circuit

**PTO OFF**

When the PTO is disengaged, the tractor will operate in both forward and reverse without activating any other switch(s). The PTO switch is pressed in and breaks (opens) the ground path interlock with the RIO circuit switches for the ignition coil and the engine will continue to run normally.

**PTO ON and operating in reverse without activating the RIO circuit**

When the PTO is engaged and the tractor is operated in reverse, there is a ground path created for the ignition coil through wire 130 Blk, RIO switch contacts (normally open), 970, 971 Wht wires, RIO latch relay contacts (normally closed), 950 Wht wire, PTO switch contacts (normally open), 960, 910, 900 Wht wires, and the ignition coil. This will ground the ignition coil and cause the engine to shut off. See “IGNITION & SHUTOFF CIRCUIT OPERATION–LT166–w/3 POS. KEY SWITCH”.

**PTO ON and operating in reverse while activating the RIO circuit**

When the PTO is engaged and the tractor is operated in reverse, there is a ground path created for the RIO latch relay, both momentary and continuous. The momentary ground path allows the RIO latch relay to pull in, closing the contacts between the common and normally open contacts of the relay.

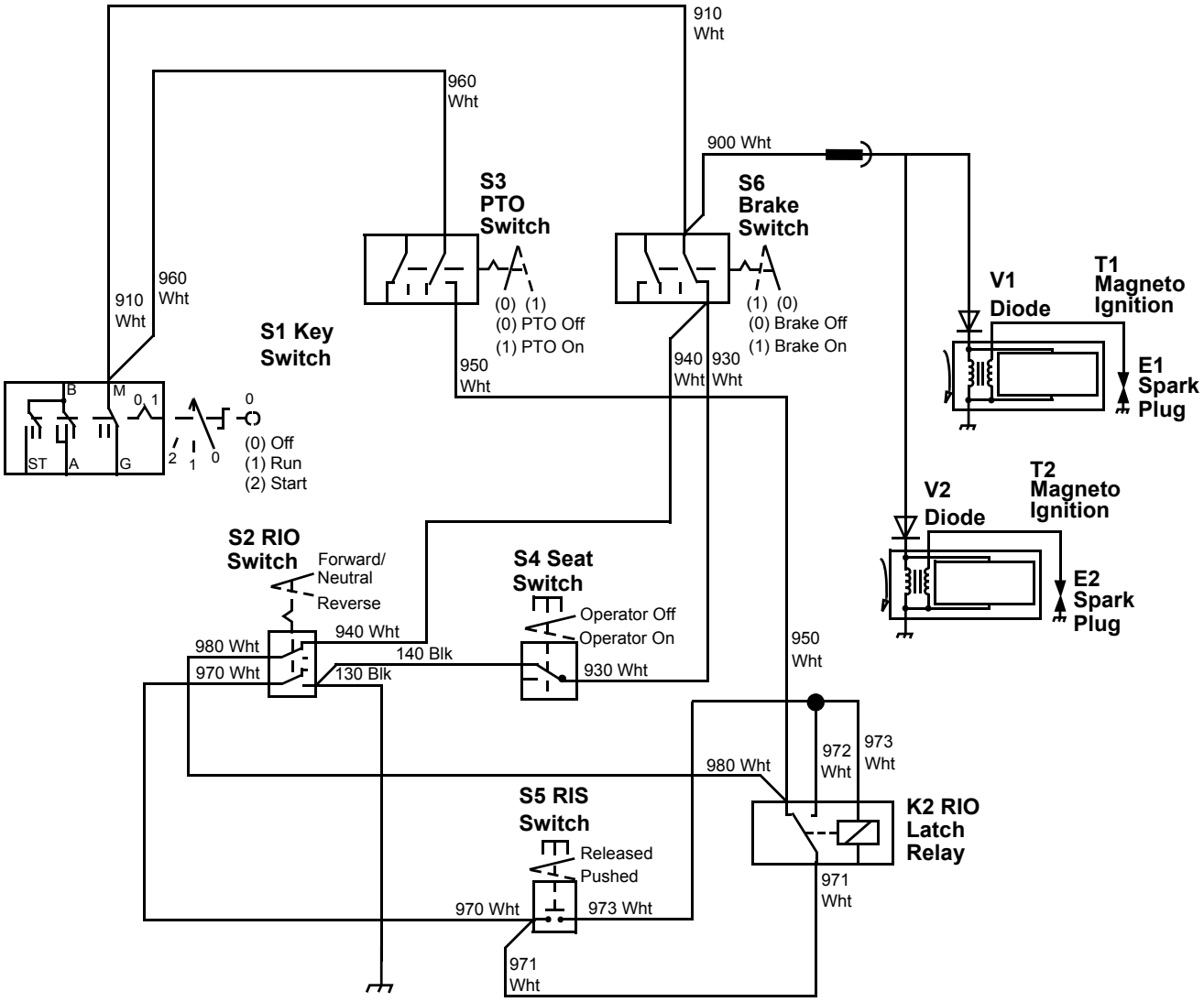
Pushing the RIS switch button provides a ground across the relay from wires 972, 973 Wht, RIS switch contacts (normally open), 970 Wht, RIO switch contacts (normally open), and 130 Blk wire to ground, while the tractor is in reverse.

The momentary path is connected into the continuous path when the RIS switch is pushed and closes its contacts to connect wires 972, 973 Wht to 970 Wht wire.

The continuous path is through wire 130 Blk, RIO switch contacts (normally open), 970, 971 Wht wires, RIO latch relay contacts (normally open), and 972 Wht wire.

When the operator returns the foot pedal(s) back to neutral or forward, the RIO switch returns to its normal (static) condition, breaking the ground path holding the latch relay in the ON condition. This allows the circuit to reset and be ready for the next reverse operation with PTO engaged.

# PTO with RIO CIRCUIT OPERATION LT166–w/3 POS. KEY SWITCH



# PTO with RIO CIRCUIT DIAGNOSIS LT166–w/3 POS. KEY SWITCH

**Test Conditions:**

- Key switch in OFF position
- Park brake ON
- PTO OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. RIO switch | Continuity to ground | Check 130 Blk wire and connections. |
| 2. Seat switch | Continuity to ground | Check 140 Blk wire and connections. |
| 3. Seat switch | Continuity to ground | Replace seat switch. |
| 4. Brake switch | Continuity to ground | Check 930 Wht wire and connections. |
| 5. RIO switch | Continuity to ground | Check 940 Wht wire and connections. |
| 6. RIO switch | Continuity to ground | Replace RIO switch. |
| 7. RIO latch relay | Continuity to ground | Check 980 Wht wire and connections. |
| 8. RIO latch relay | Continuity to ground | Replace RIO latch relay. |
| 9. RIS switch | Continuity to ground | Check 971 Wht wire and connections. |
| 10. RIO switch | Continuity to ground | Check 970 Wht wire and connections. |
| 11. PTO switch | Continuity to ground | Check 950 Wht wire and connections. |

**Test Conditions:**

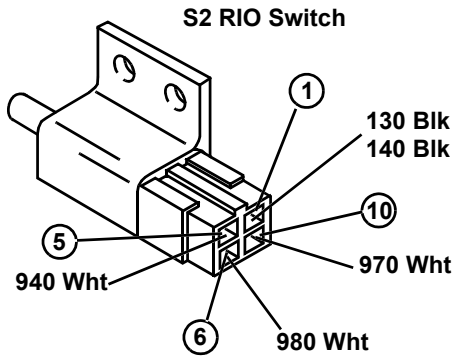
- Key switch in RUN position (Engine not running)
- Park brake ON
- PTO ON

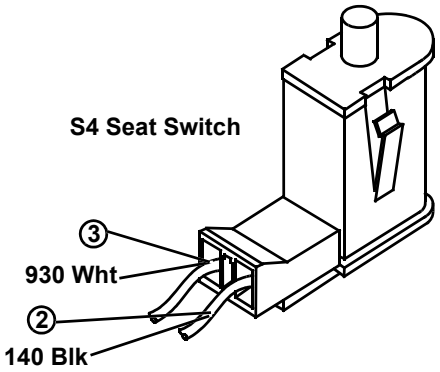
| | | |
|---|---|---|
| 12. PTO switch | Continuity to ground | Replace PTO switch. |
| 13. Key switch | Continuity to ground | Check 960 Wht wire and connections. |
| 14. Brake switch | Continuity to ground | Check 910 Wht wire and connections. |
| 15. Engine connector Wht | Continuity to ground | Check 900 Wht wire and connections. |

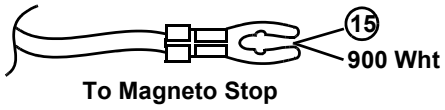
**Test Conditions: (Briggs & Stratton Engines ONLY – Test performed if engine will NOT shut off when operator leaves seat with EITHER PTO ENGAGED or brake switch OFF.)**

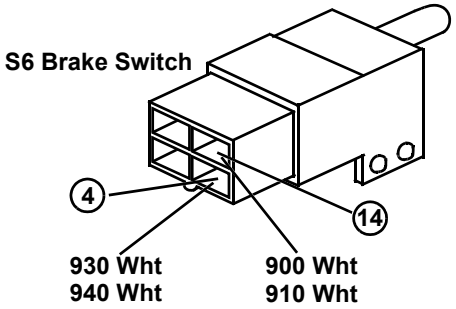
- Key switch in OFF position (Closes fuel valve to stop engine)
- Allow engine to cool, and remove engine cover to access ignition coils
- Disconnect diode(s) from ignition coil(s)
- Operator OFF seat
- PTO ON (ENGAGED); or, Park brake OFF

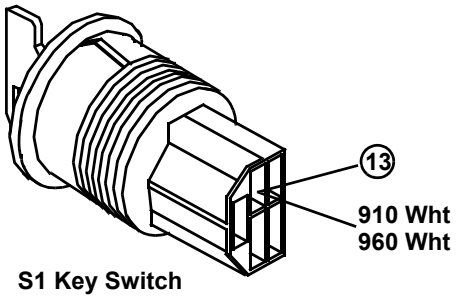
| | | |
|---|---|---|
| 16. Ignition coil diode(s) | Continuity to ground with diode disconnected from ignition coil. | Faulty diode(s). Replace diode(s). |

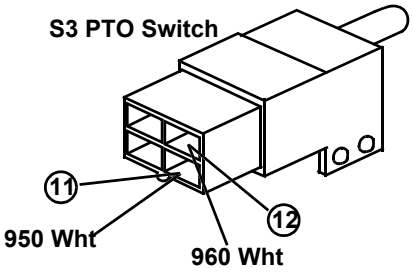

S2 RIO Switch
1
130 Blk
140 Blk
10
5
970 Wht
940 Wht
6
980 Wht

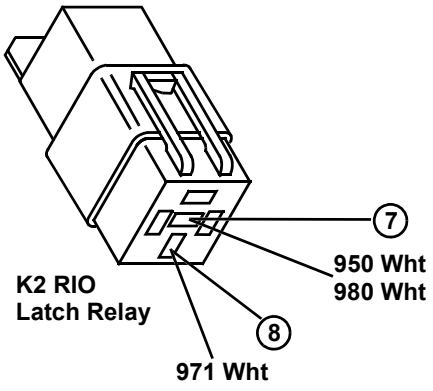

S4 Seat Switch
3
930 Wht
2
140 Blk

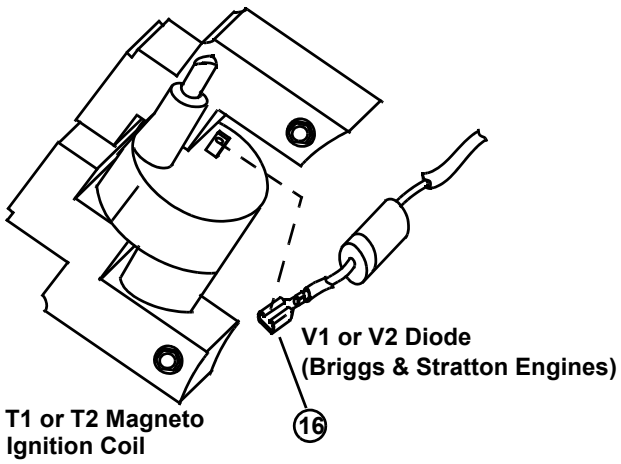

15
900 Wht
To Magneto Stop

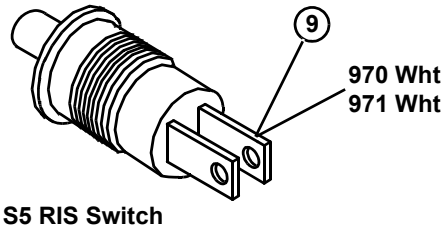

S6 Brake Switch
4
14
930 Wht
940 Wht
900 Wht
910 Wht


13
910 Wht
960 Wht
S1 Key Switch


S3 PTO Switch
11
12
950 Wht
960 Wht


7
950 Wht
980 Wht
K2 RIO
Latch Relay
8
971 Wht


V1 or V2 Diode
(Briggs & Stratton Engines)
16
T1 or T2 Magneto
Ignition Coil
(Briggs & Stratton Engines)


9
970 Wht
971 Wht
S5 RIS Switch

# PTO with RIO CIRCUIT OPERATION–LT166 w/4 POS. KEY SWITCH

**Function:**

To provide a safety interlock when the tractor is being operated in reverse while the PTO is engaged. This is accomplished by providing a ground path for either the ignition coil (to shut off the engine); or, the Reverse Implement Option (RIO) latch relay (to open its contacts) to provide an ignition ground path and a ground path to latch itself in the energized state and keep the engine running.

An operator choosing to keep the PTO engaged while backing up, must take deliberate action to actuate the Reverse Implement Switch (RIS), by pushing the button momentarily and then pressing the reverse pedal.

**RIO Operating Conditions:**

The key switch must be in the RUN position with the engine running, the operator must be ON the seat, the PTO ENGAGED, and the RIS switch must be pushed (momentary) while starting operation in reverse.

**Theory of Operation:**

The Reverse Implement Option (RIO) is controlled by a relay and two switches wired in a circuit with the ignition coil. This combination of components provide for control of three different functional situations:

- PTO OFF with any drive function
- PTO ON and operating in reverse without activating the RIO circuit
- PTO ON and operating in reverse while activating the RIO circuit

**PTO OFF**

When the PTO is disengaged, the tractor will operate in both forward and reverse without activating any other switch(s). The PTO switch is pressed in and breaks (opens) the ground path interlock with the RIO circuit switches for the ignition coil and the engine will continue to run normally.

**PTO ON and operating in reverse without activating the RIO circuit**

When the PTO is engaged and the tractor is operated in reverse, there is a ground path created for the ignition coil through wires 110 and 130 Blk, RIO switch contacts (normally open), 920 and 971 Wht wires, RIO latch relay contacts (normally closed), 950 Wht wire, PTO switch contacts (normally open), 960, 910, 900 Wht wires, and the ignition coil. This will ground the ignition coil and cause the engine to shut off. See “IGNITION & SHUTOFF CIRCUIT OPERATION–LT166–w/3 POS. KEY SWITCH”.

**PTO ON and operating in reverse while activating the RIO circuit**

When the PTO is engaged and the tractor is operated in reverse, there is a ground path created for the RIO latch relay, both momentary and continuous. The momentary ground path allows the RIO latch relay to pull in, closing the contacts between the common and normally open contacts of the relay. With the relay normally open contacts now closed, the continuous ground path is created through the RIO switch to hold the RIO latch relay in the ON position while the reverse pedal is activated.

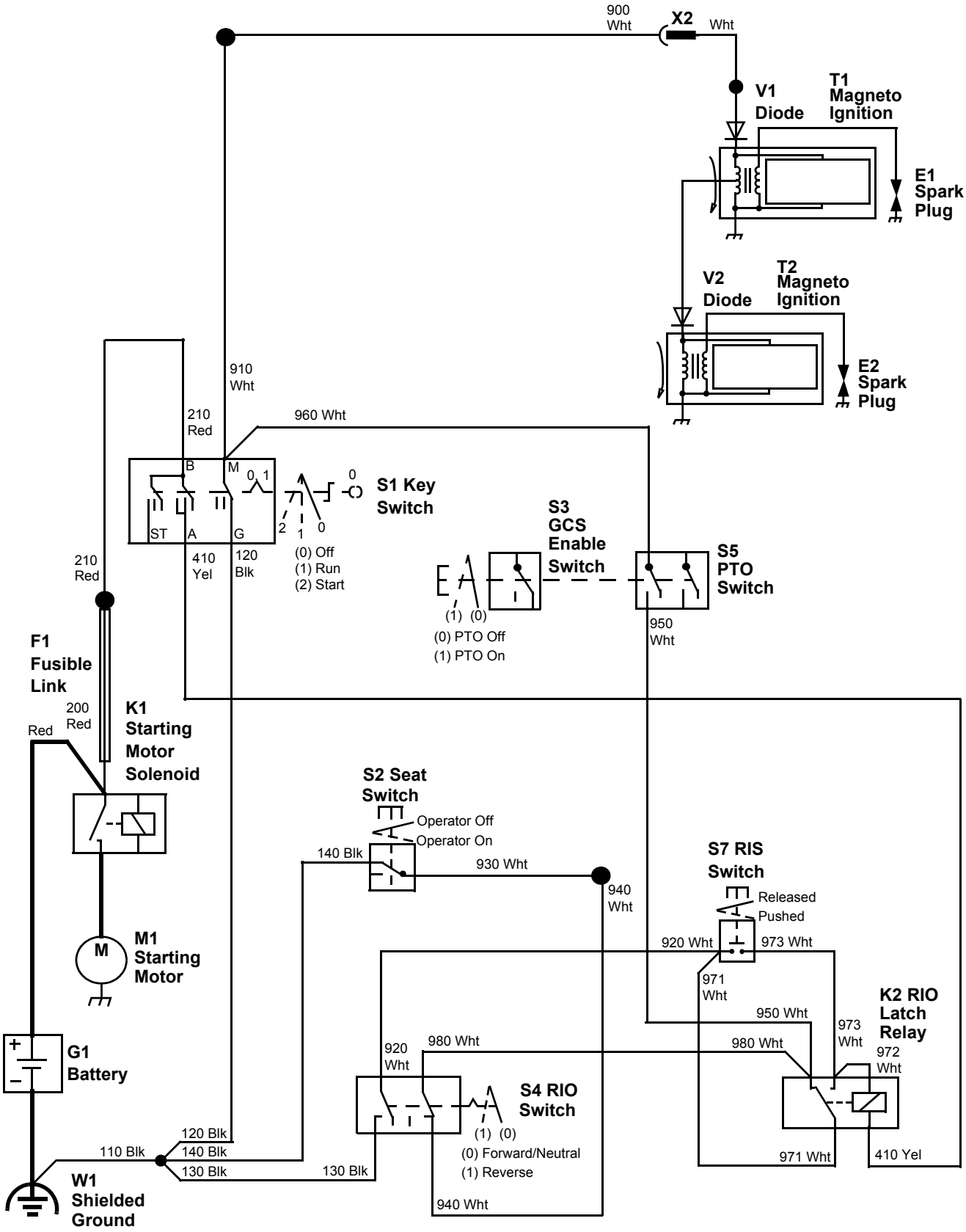
Pushing the RIS switch button provides a ground across the relay from wires 972, 973 Wht, RIS switch contacts (normally open), 920 Wht wire, RIO switch contacts (normally open), 130 and 110 Blk wires to ground, while the tractor is in reverse.

The momentary path is connected into the continuous path when the RIS switch is pushed and closes its contacts to connect wires 972, 973 Wht to the 920 Wht wire.

The continuous path is through wires 110 and 130 Blk, RIO switch contacts (normally open), 920 and 971 Wht wires, RIO latch relay contacts (normally open), and 972 Wht wire.

When the operator places the foot pedal(s) back to neutral or forward, the RIO switch is allowed to return to its normal (static) condition, breaking the ground path holding the latch relay in the ON condition. This allows the circuit to reset and ready for the next reverse operation with PTO engaged.

# PTO with RIO CIRCUIT OPERATION–LT166 w/4 POS. KEY SWITCH



# PTO with RIO CIRCUIT DIAGNOSIS–LT166 w/4 POS. KEY SWITCH

**Test Conditions:**

- Key switch in RUN position (engine not running)
- Park brake ON
- PTO ON
- Reverse pedal pressed down

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. RIO switch | Continuity to ground | Check 130 and 110 Blk wires and connections. |
| 2. RIO latch relay | Continuity to ground | Check 971 and 920 Wht wires and connections. If OK, replace RIO switch. |
| 3. PTO switch | Continuity to ground | Check 950 Wht wire and connections. If OK, replace RIO latch relay. |
| 4. X1 Engine connector | Continuity to ground | Check 900, 910 and 960 Wht wires and connections. If OK, replace PTO switch. |

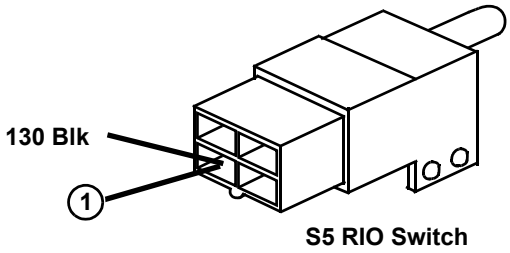
**Test Conditions:**

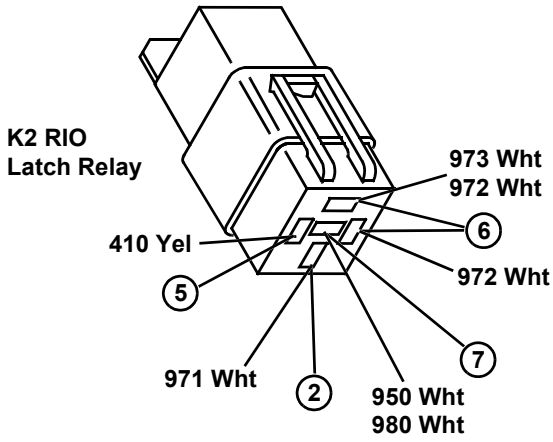
- Key switch in RUN position (engine not running)
- Park brake ON
- PTO ON
- Press and hold RIS switch while pressing down on the reverse pedal

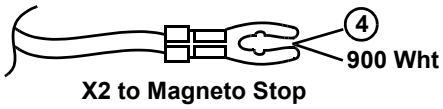
| | | |
|---|---|---|
| 5. RIO latch relay | Battery voltage | Check 410 Yel wire and connections. |
| 6. RIO latch relay | Continuity to ground | Check 972 and 973 Wht wires and connections. Test RIS switch. See “RIS SWITCH TEST”. |

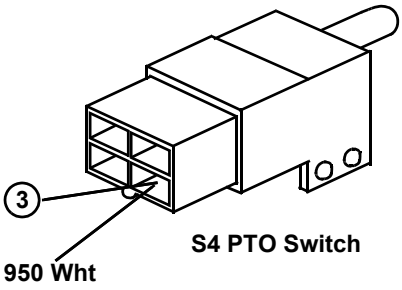
**Test Conditions:**
**(Briggs & Stratton Engines ONLY – Test performed if engine will NOT shut off when operator leaves seat with EITHER PTO ENGAGED or brake switch OFF.)**

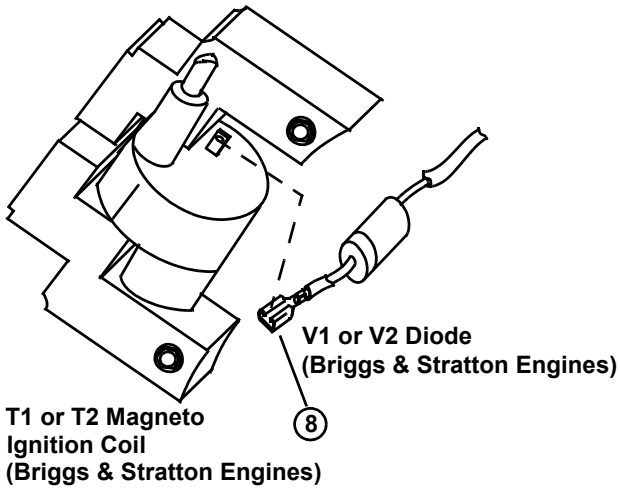
| | | |
|---|---|---|
| 7. Ignition coil diode(s) | Continuity to ground with diode disconnected from ignition coil | Replace faulty diode(s). |


130 Blk
1
S5 RIO Switch


K2 RIO
Latch Relay
973 Wht
972 Wht
6
410 Yel
5
972 Wht
7
971 Wht
2
950 Wht
980 Wht


4
900 Wht
X2 to Magneto Stop


3
S4 PTO Switch
950 Wht


V1 or V2 Diode
(Briggs & Stratton Engines)
8
T1 or T2 Magneto
Ignition Coil
(Briggs & Stratton Engines)

# HEADLIGHT CIRCUIT OPERATION LT133/LT155 - 3 AMP SYSTEM & LT166

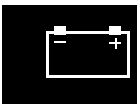
**Function:**

Provides power to the headlights.

**Operating Conditions:**

The engine must be running.

**Theory of Operation:**

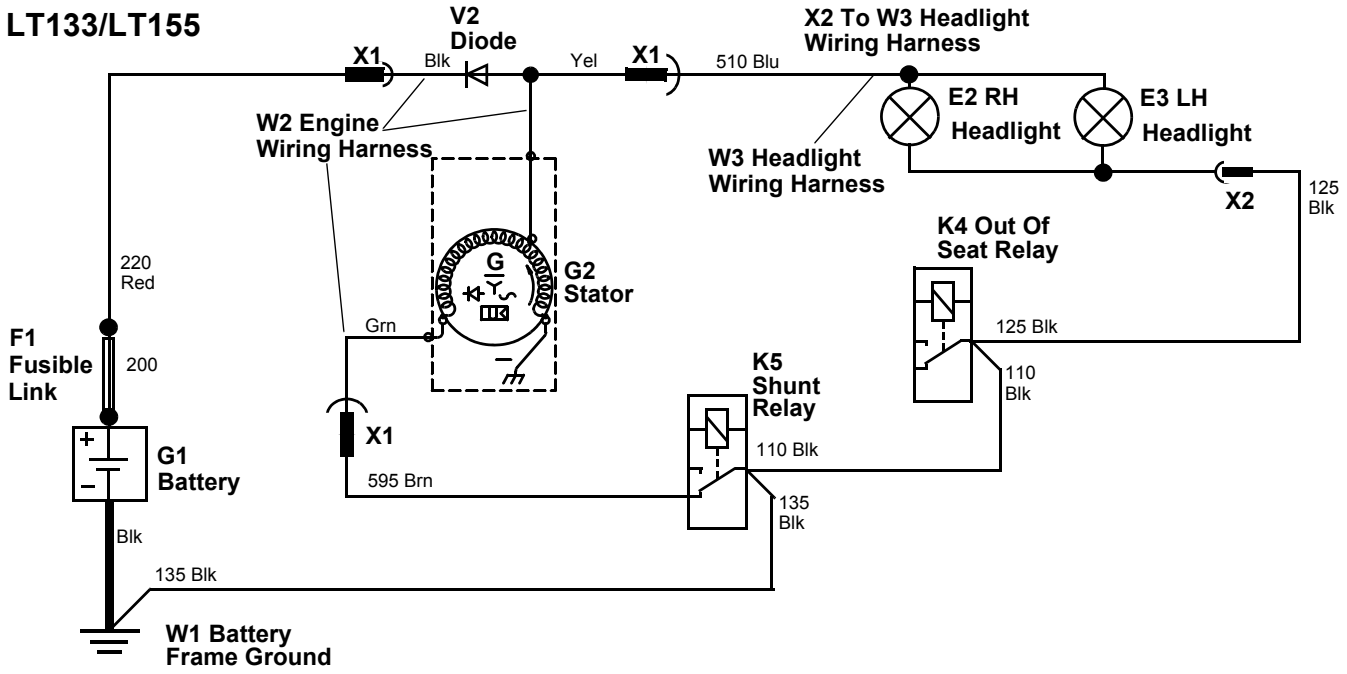


The dual circuit stator provides DC current for charging the battery and an independent AC circuit for headlights. The battery is not used for lights, so lights are available even if the battery is disconnected or removed.

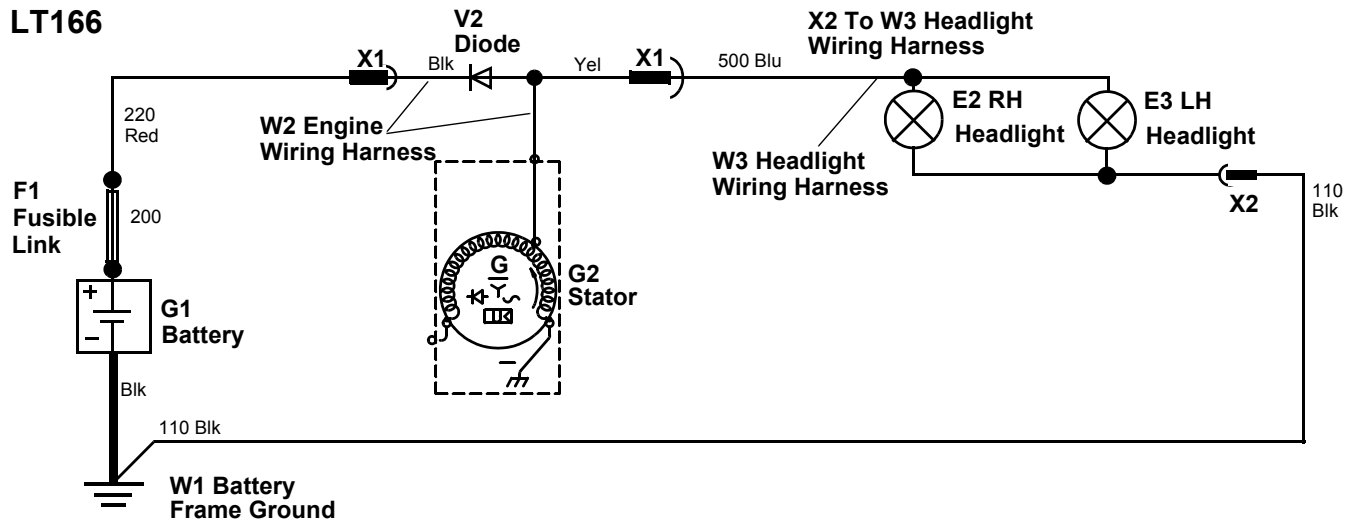
Current for lights is available as long as the engine is running. The output depends upon engine speed, so brightness of the lights changes with engine speed.

The W3 headlight wiring harness is attached to the W1 main wiring harness. Power from the G2 Stator flows through the 510 Blu wire to the headlight harness connector (X2). Current flows from the connector to the headlights. Ground circuit is obtained through the headlight harness connector (X2) and 125, 110, and 135 Blk wire to ground.

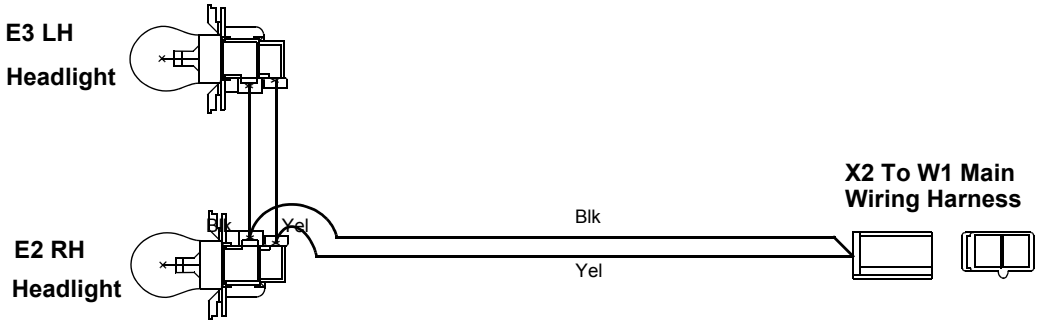
# HEADLIGHT CIRCUIT SCHEMATIC LT133/LT155/LT166 - 3 AMP SYSTEM




# HEADLIGHT CIRCUIT SCHEMATIC LT166 - 3 POSITION KEY SWITCH




# HEADLIGHT WIRING HARNESS

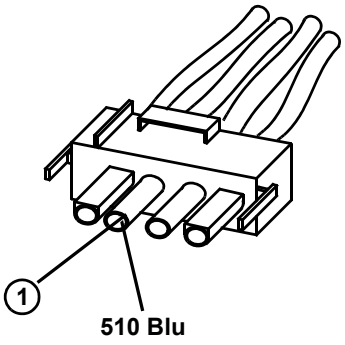


# HEADLIGHT CIRCUIT DIAGNOSIS LT133/LT155/LT166

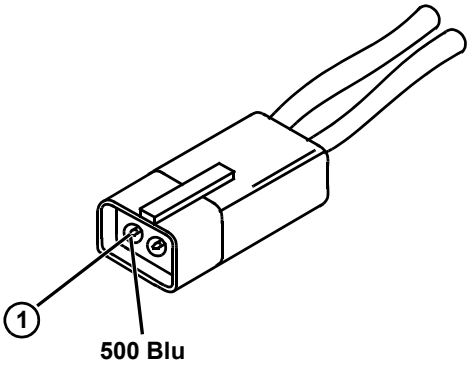
**Test Conditions:**

- Engine must be RUNNING
- Park brake ENGAGED (ON)

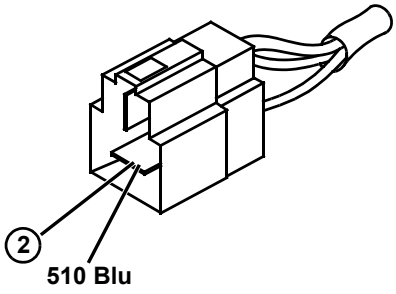
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. X1 Engine wire harness | Battery voltage | See Charging Circuit. |
| 2. X2 headlight wiring harness connector | Battery voltage | Check 510 Blu wire and connections LT133/LT155 or,<br>Check 500 Blu wire and connections LT166. |
| 3. RH headlight | Battery voltage | Check headlight wiring harness and connector. |
| 4. RH headlight | Greater than 0 volts - less than 0.2 volts. | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check harness connector (X2) and 125, 110, 135 Blk wires and connections. |
| 5. LH headlight | Battery voltage | Check Blk jumper wire and connections between headlights. |
| 6. LH headlight | Greater than 0 volts - less than 0.2 volts. | 0 volts: Replace headlight.<br>Greater than 0.2 volts: Check Yel jumper wire and connections between headlights. |



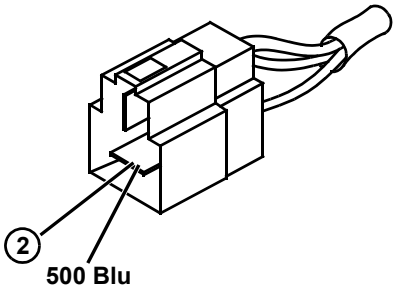

X1 To Engine Wiring Harness LT133/LT155



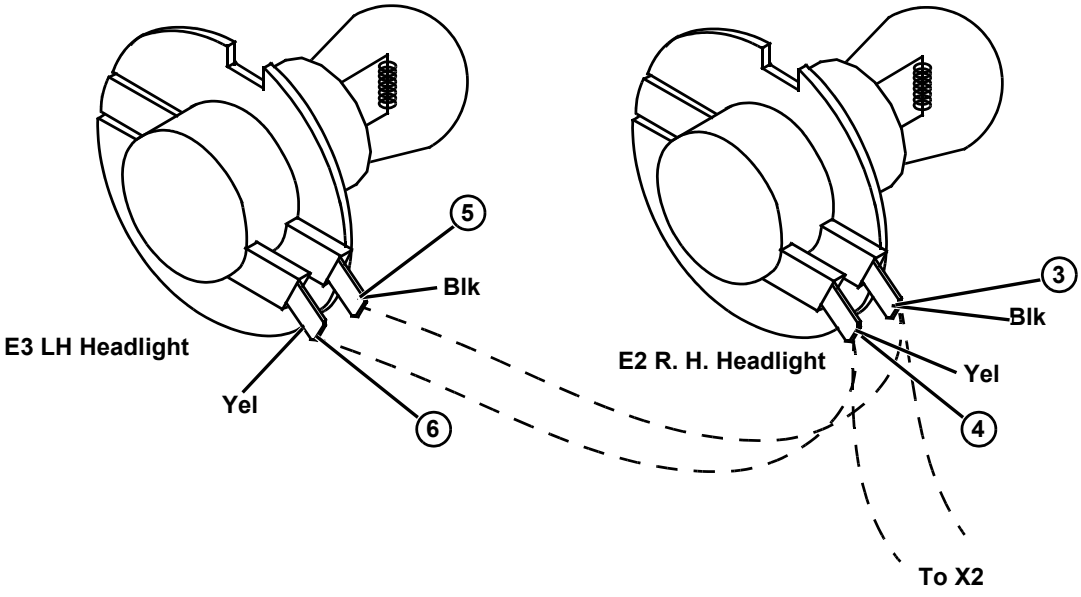

X1 To Engine Wiring Harness LT166




X2 Headlight Connector LT133/LT155




X2 Headlight Connector LT166



# HEADLIGHT CIRCUIT OPERATION – w/ 15 AMP SYSTEM LT133/LT155

**Function:**

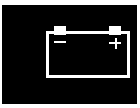
Provides power to the headlights.

**Operating Conditions:**

The key switch must be in the Run or Start position.

**Theory of Operation:**

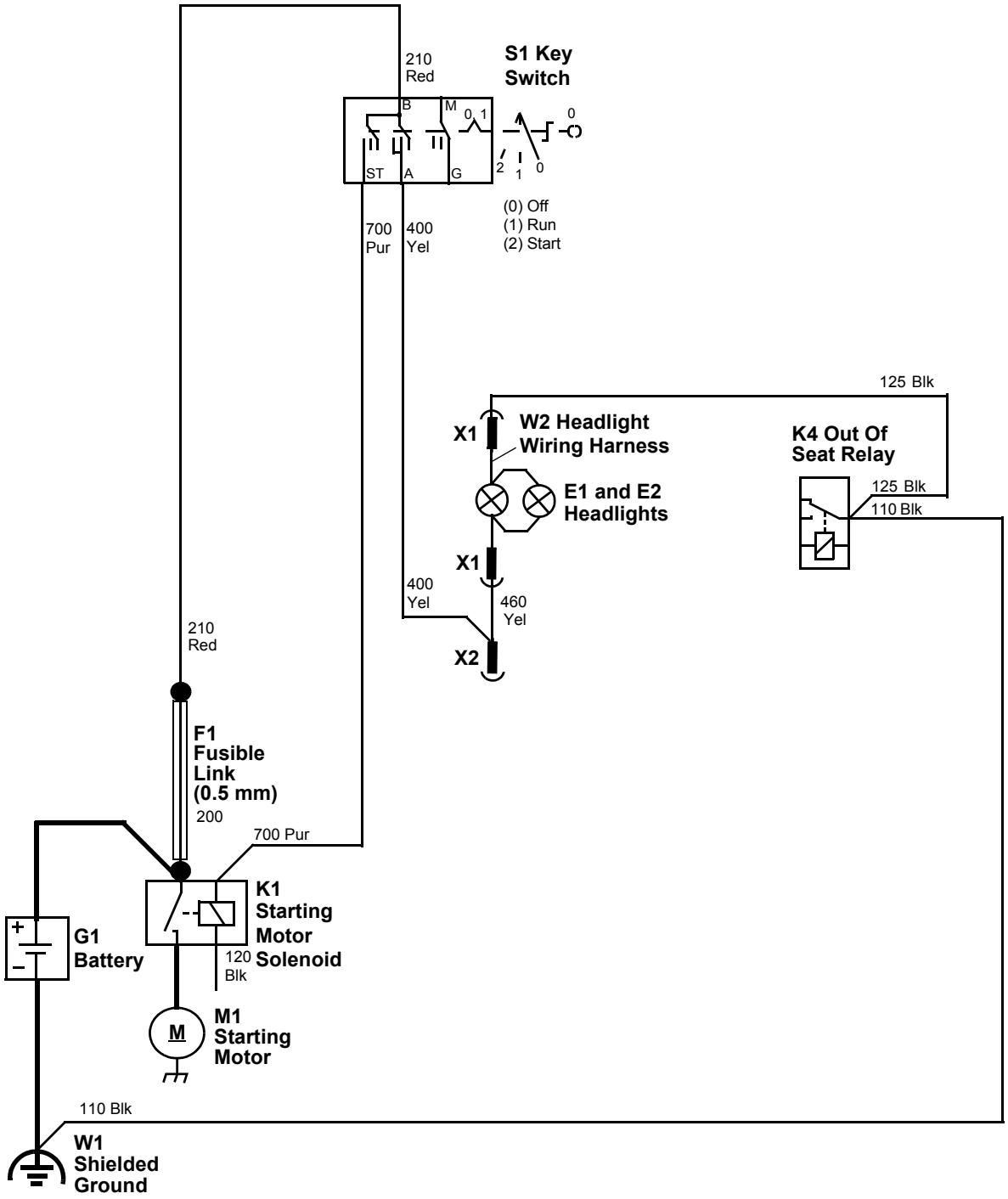
The headlight will be illuminated when ever the key switch is in either the RUN or START positions.



Power for the headlights is provided from the battery positive terminal through the F1 fusible link, 210 Red wire, S1 key switch, 400 and 460 Yel wires, to the headlight harness connector (X1), Yel wire, and headlights.

The ground for the headlights is provided from the headlights wiring harness Blk wire, (X1) connector, to the W1 main wiring harness 125 and 110 Blk wires to ground.

# HEADLIGHT CIRCUIT SCHEMATIC–LT133/LT155 w/ 15 AMP CHARGER



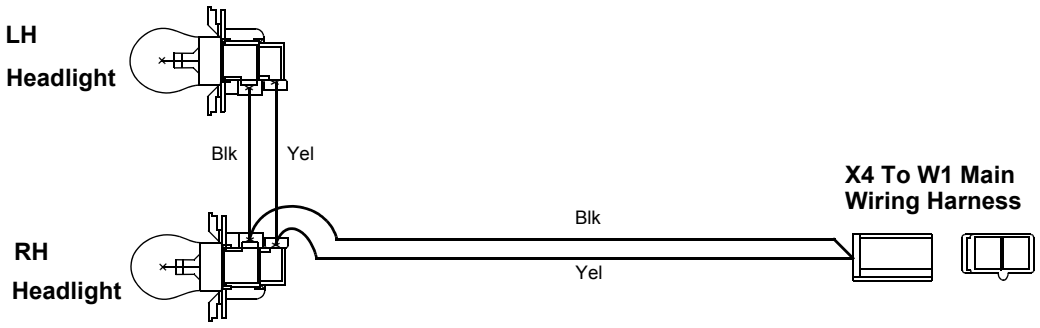
# HEADLIGHT CIRCUIT DIAGNOSIS–LT133/LT155

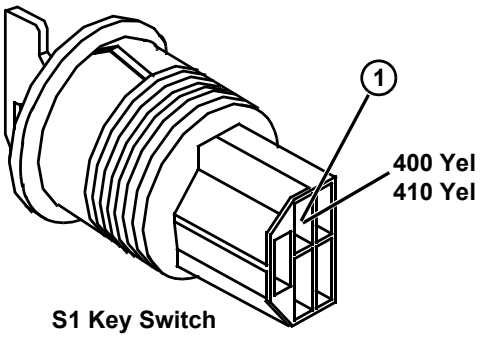
**Test Conditions:**

- Key switch in the ON position
- Park brake ENGAGED (ON)

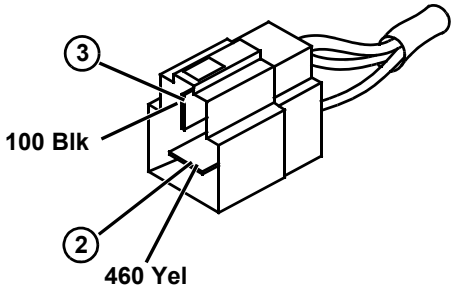
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. S1 key switch | Battery voltage | See Power Circuit. Test key switch. See “KEY SWITCH TEST”. |
| 2. X4 headlight wiring harness connector | Battery voltage | Check 400 and 460 Yel wires and connections. |
| 3. X4 headlight wiring harness connector | Continuity to ground | Check 125 and 110 Blk wires and connections. |
| 4. RH headlight | Battery voltage | Check headlight wiring harness and connector |
| 5. RH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check harness connector (X4) and 100, 110, 135 Blk wires and connections |
| 6. LH headlight | Battery voltage | Check Blk jumper wire and connections between headlights. |
| 7. LH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check Yel jumper wire and connections between headlights |

# HEADLIGHT WIRING HARNESS

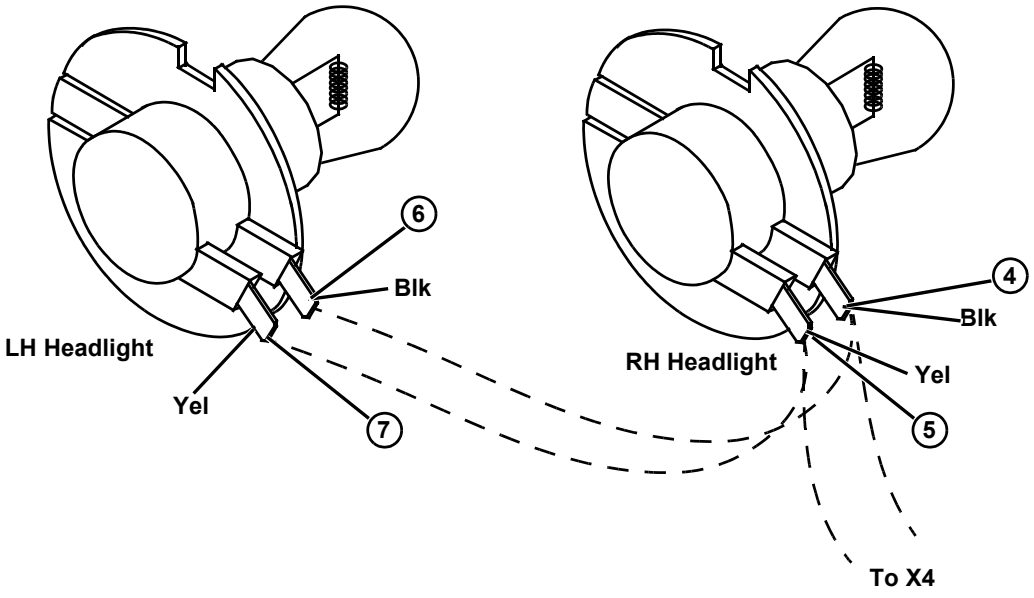





S1 Key Switch




X4 Headlight Connector
LT155 w/ 15 Amp Charger



# HEADLIGHT OPERATION W/ 4 POSITION KEY SWITCH - LT133/ LT155

**Function:**

Provides power to the headlights.

**Operating Conditions:**

The key switch must be in the (≣D) Run w/ Lights position.

**Theory of Operation:**

Headlight operation is controlled by the grounding portion of the headlight circuit.

Power for the headlights is provided from the battery positive terminal through the F1 fusible link, 210 Red wire, S1 key switch, 401 and 460 Yel wires, to the headlight harness connector (X1), Yel wire, and headlights.

Power is provided through the S1 key switch any time the key switch is in the start, run or run w/ headlights positions.

The ground for the headlights is provided from the headlights wiring harness Blk wire, (X1) connector, to the W1 main wiring harness 100 Blk wire to the S1 key switch. When the key switch is in the Run w/lights position, the ground circuit is completed through the key switch to the 101, 160 and 110 Blk wires.

# HEADLIGHT OPERATION W/ 4 POSITION KEY SWITCH - LT166

**Function:**

Provides power to the headlights.

**Operating Conditions:**

The key switch must be in the (≣D) Run w/ Lights position.

**Theory of Operation:**

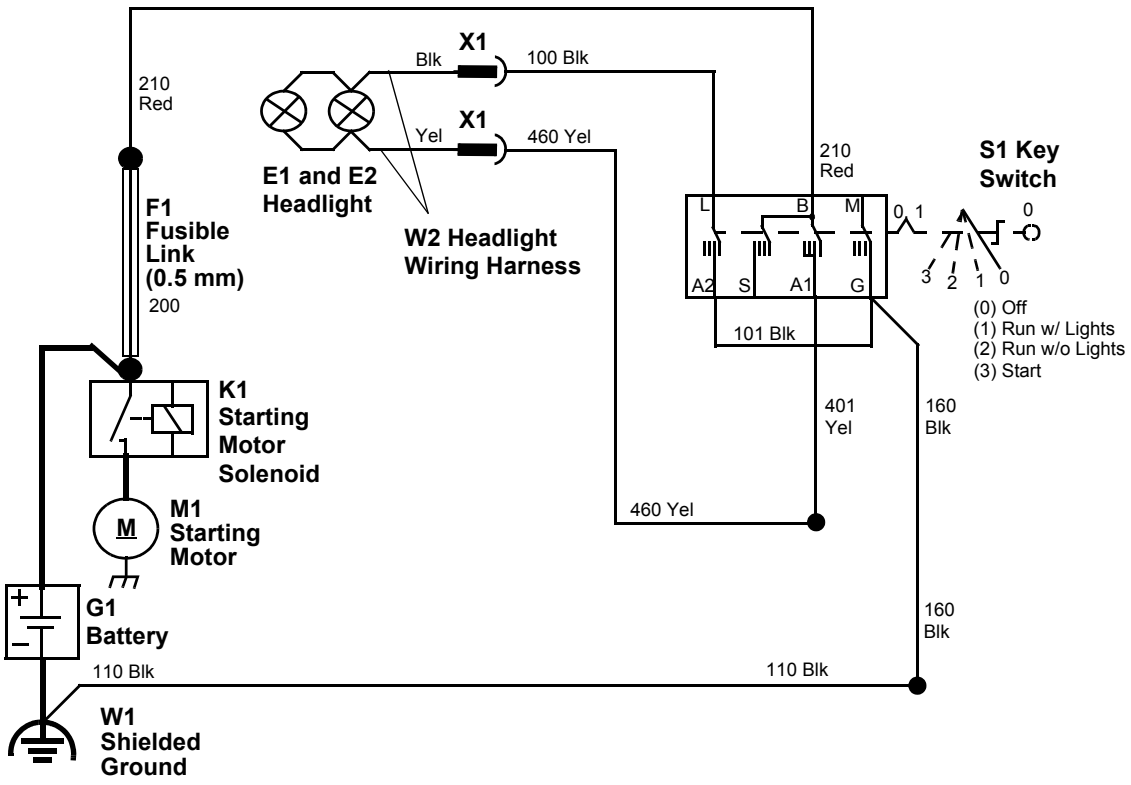
Headlight operation is controlled by the power portion of the headlight circuit.

Power for the headlights is provided from the battery positive terminal through the F1 fusible link, 210 Red wire, S1 key switch, 420 Yel wire, S1 key switch, and 500 Blu wire to the headlight harness connector (X4), Yel wire, and headlights.

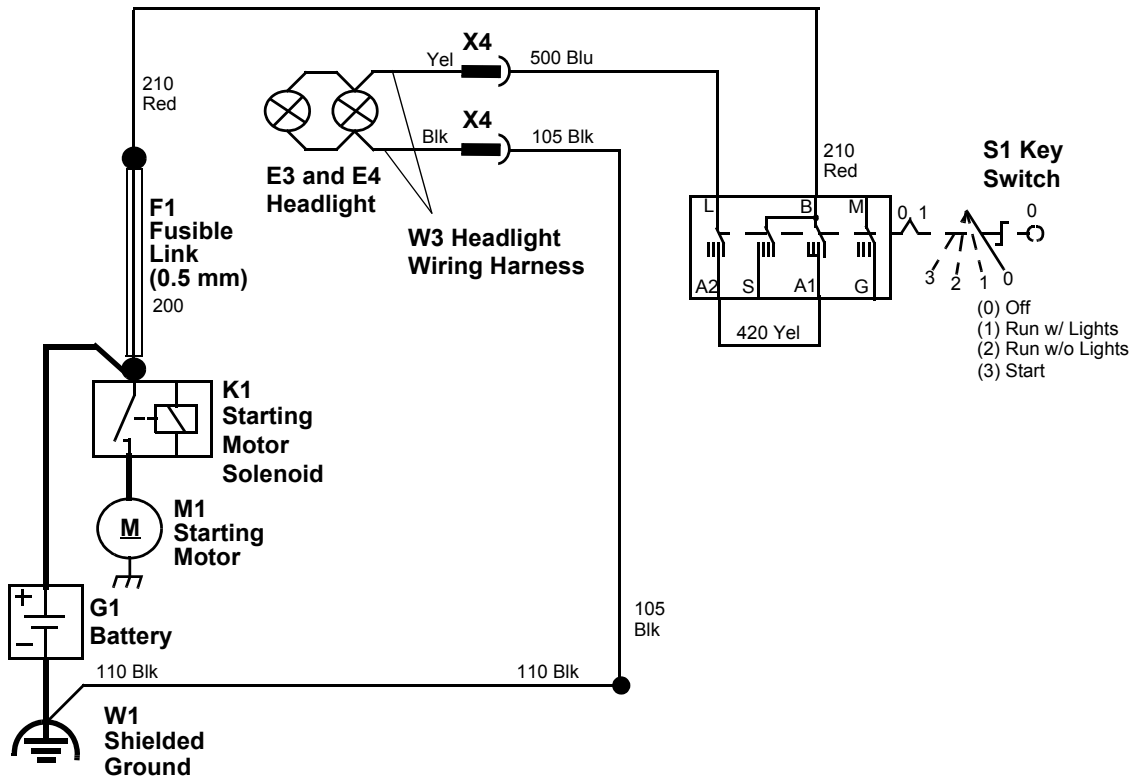
Power is provided to the 420 Yel wire any time the key switch is in the start, run or run w/ headlights position. Power is passed through the key switch to the 500 Blu wire only when the key switch is in the run w/ headlights position.

The ground for the headlights is provided from the headlights wiring harness Blk wire, (X4) connector, to the W1 main wiring harness 105 and 110 Blk wires to ground.

## LT133/LT155 w/ 4 POSITION KEY SWITCH




## LT166 w/ 4 POSITION KEY SWITCH

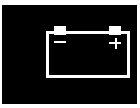


# HEADLIGHT CIRCUIT DIAGNOSIS–LT133/LT155

**Test Conditions:**

- Key Switch in OFF position

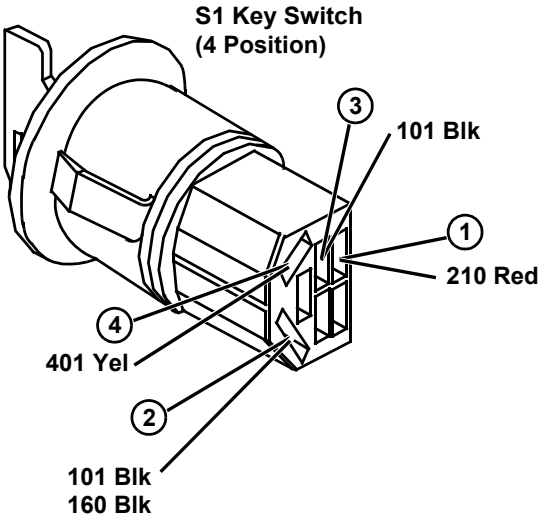
| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. S1 key switch | Battery voltage | See “POWER CIRCUIT DIAGNOSIS–LT133/LT155 w/4 POS. KEY SWITCH”. |
| 2. S1 key switch | Continuity to ground | Check 160 and 110 Blk wires and connections. |
| 3. S1 key switch | Continuity to ground | Check 101 Blk jumper wire. |

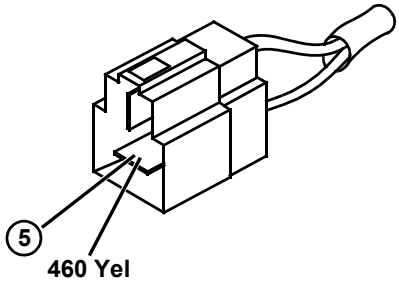


**Test Conditions:**

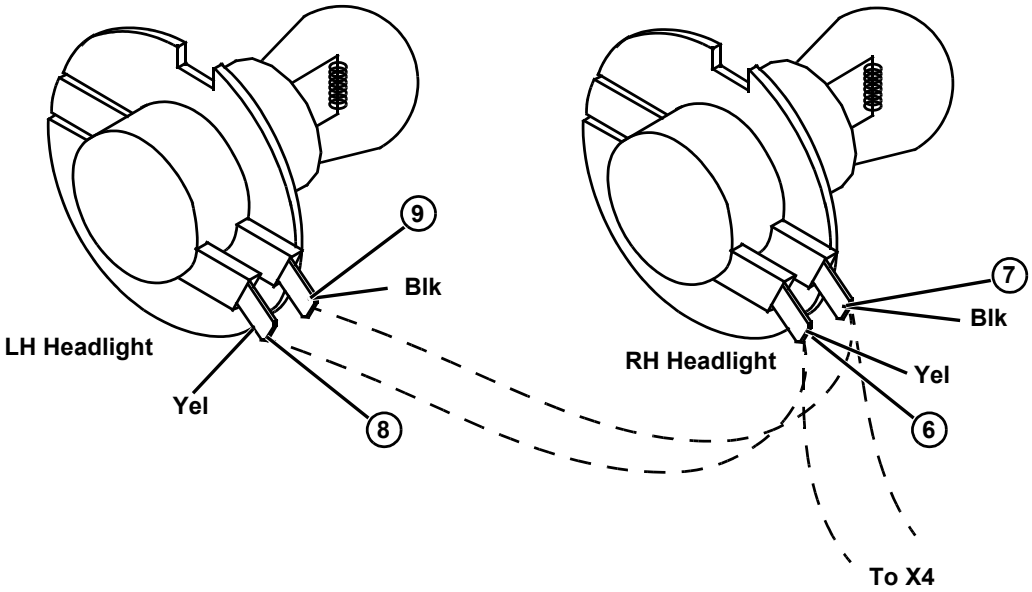
- Key Switch in RUN w/ Lights position
- Engine OFF

| | | |
|---|---|---|
| 4. S1 key switch | Battery voltage | Test switch. See “4 POSITION KEY SWITCH TEST”. |
| 5. X1 connector | Battery voltage | Check 460 Yel wire and connections. |
| 6. Right-hand headlight | Battery voltage | Check Yel wire and connections between headlight and X4. |
| 7. RH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check harness connector (X4) and 100 Blk wire and connections. |
| 8. LH headlight | Battery voltage | Check Yel wire and connections between headlights. |
| 9. LH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check Blk wire and connections between headlights |




X1 Headlight Connector
LT133 and LT155



# HEADLIGHT CIRCUIT DIAGNOSIS–LT166

**Test Conditions:**

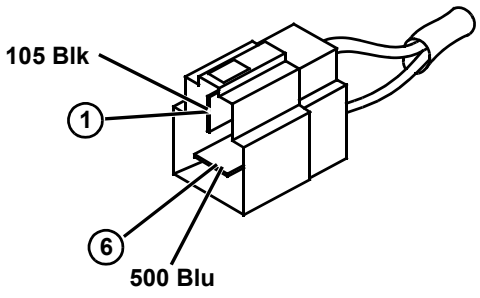
- Key Switch in OFF position

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. X4 connector | Continuity to ground | Check 105 and 110 Blk wires and connections. |
| 2. S1 key switch | Battery voltage | Check 210 Red wire and connections. See “POWER CIRCUIT OPERATION–LT166–w4 POSITION KEY SWITCH” . |

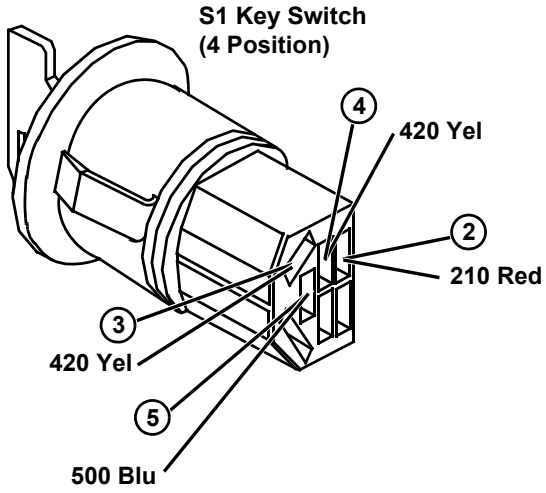
**Test Conditions:**

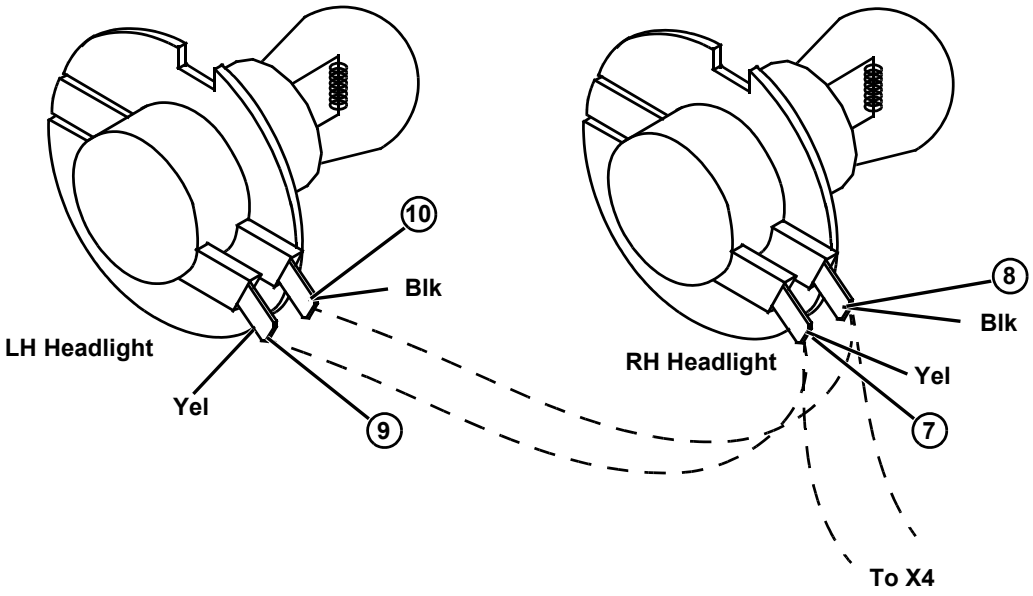
- Key Switch in RUN w/ Lights position
- Engine OFF

| | | |
|---|---|---|
| 3. S1 key switch | Battery voltage | Test switch. See “4 POSITION KEY SWITCH TEST”. |
| 4. S1 key switch | Battery voltage | Check 420 Yel jumper wire. |
| 5. S1 key switch | Battery voltage | Test switch. See “4 POSITION KEY SWITCH TEST”. |
| 6. X4 connector | Battery voltage | Check 500 Blu wire and connections. |
| 7. Right-hand headlight | Battery voltage | Check Yel wire and connections between headlight and X4. |
| 8. RH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check harness connector (X4) and 100 Blk wire and connections. |
| 9. LH headlight | Battery voltage | Check Yel wire and connections between headlights. |
| 10. LH headlight | Greater than 0 volts - less than 0.2 volts | 0 volts: Replace headlight<br>Greater than 0.2 volts: Check Blk wire and connections between headlights |




X4 Headlight Connector
LT166



# TESTS & ADJUSTMENTS

## GROUND CIRCUIT TESTS

**Reason:**

To check for opens, loose terminal wire crimps, poor connections, or corrosion in the ground circuit. The voltmeter method checks ground connections under load.

**Equipment:**

- Ohmmeter or Voltmeter

**Ohmmeter Procedure:**

1. Turn key switch to OFF position. Engage park brake.
2. Connect ohmmeter negative (BLACK) lead to negative (-) terminal of battery. Put meter positive (RED) lead on negative terminal of battery and record reading. Reading should be **0.1 ohm** or less.
3. 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.

**Voltmeter Procedure:**

1. Put transmission in NEUTRAL. Engage park brake. Put PTO switch in OFF position. Turn key switch to ON position.
2. Connect voltmeter negative (BLACK) lead to negative (-) terminal of battery.
3. Put meter positive (RED) lead on ground terminal of component to be tested. Be sure the component circuit is activated (key switch 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 resistance is above 0.1 ohms, check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit
- 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

## BATTERY VOLTAGE & SPECIFIC GRAVITY TESTS

**Reason:**

To check voltage and determine condition of battery.

**Equipment:**

- Voltmeter or JTO5685 Battery Tester
- Hydrometer Procedure
- Clean battery terminals and top of battery

**Procedure:**

**⚠ CAUTION**

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

**Avoid the hazard by:**

- **Filling batteries in a well-ventilated area**
- **Wearing eye protection and rubber gloves**
- **Avoiding breathing fumes when electrolyte is added**
- **Avoid spilling or dripping electrolyte**
- **Use proper jumpstart procedure**

**If you spill acid on yourself:**

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

**If acid is swallowed:**

- **Drink large amounts of water or milk**
- **Then drink milk of magnesia, beaten eggs, or vegetable oil**
- **Get medical attention immediately**

1. Inspect battery terminals and case for breakage or cracks.

2. Check electrolyte level in each battery cell. Add clean, soft water as needed. If water added, charge battery for 20 minutes at 10 amps.
3. Remove surface charge by placing a small load on the battery for 15 seconds.
4. Check battery voltage with voltmeter or JTO5685 Battery Tester.
5. Check specific gravity of each cell with a hydrometer.

**Specifications:**

**Minimum battery voltage . . . . . 12.4 volts**
**Minimum specific gravity**
**. . . . . 1.225 with less than 50 point variation**

**Results:**

- Battery voltage less than 12.4 VDC, charge battery
- Battery voltage more than 12.4 VDC, test specific gravity
- All cells less than 1.175, charge battery at 10 amp rate
- All cells less than 1.225 with less than 50 point variation, charge battery at 10 amp rate
- All cells more than 1.225 with less than 50 point variation, load test battery
- More than 50 point variation: replace battery

## BATTERY–CHARGE

**Reason:**

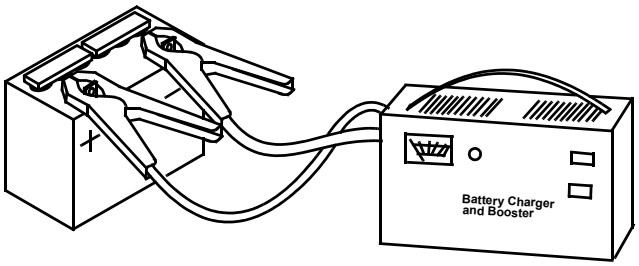
To increase battery charge after battery has been discharged.

**Equipment:**

- Battery charger (variable rate)

**Procedure:**

*NOTE: See "BATTERY VOLTAGE & SPECIFIC GRAVITY TESTS" before charging battery.*




1. Connect variable rate charger to battery.

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

2. Start charger at slow rate. Increase charge rate one setting at a time. Check charger ammeter after 1 minute at each setting. Maintain 10 amp charge rate. Use boost setting as necessary.
3. Check if battery is accepting a 10 amp charge after 10 minutes at boost setting.

**Results:**

- Battery will not accept 10 amp charge after 10 minutes at boost setting: replace battery
- Battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did not need water: go to steps 6 and 7
- 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 4 and 5

4. Set charger at 15–25 amps.

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

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

**Results:**

- More than 50 point variation between cells: replace battery
- Less than 50 point variation between cells: go to steps 6 and 7

*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).*

6. Continue charging battery until specific gravity is 1.230–1.265 points.
7. Load test battery. See "BATTERY–LOAD TEST".

## BATTERY–LOAD TEST

**Reason:**

To check condition of battery under load.

*NOTE: See "BATTERY–CHARGE" before applying a load to battery.*

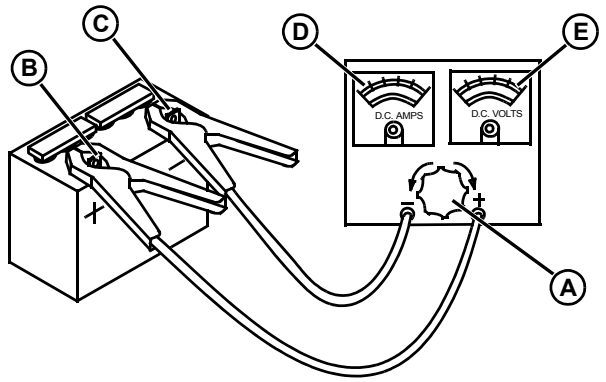
**Equipment:**

- JTO5685 Battery Tester or equivalent

*NOTE: Use the procedures given with the tester.*

**Procedure:**

1. Remove battery.




2. Turn load knob (A) counterclockwise to OFF position.
3. Connect tester positive (red) cable to battery positive (+) terminal (B).
4. Connect tester negative (black) cable to battery negative (–) terminal (C).
5. 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).
6. Hold for 15 seconds and turn load knob (A) of tester counterclockwise (out) into OFF position.
7. Repeat Steps 8 and 9 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.
- If battery DOES NOT pass test and HAS BEEN charged, replace battery.

## STARTING SOLENOID TEST

**Reason:**

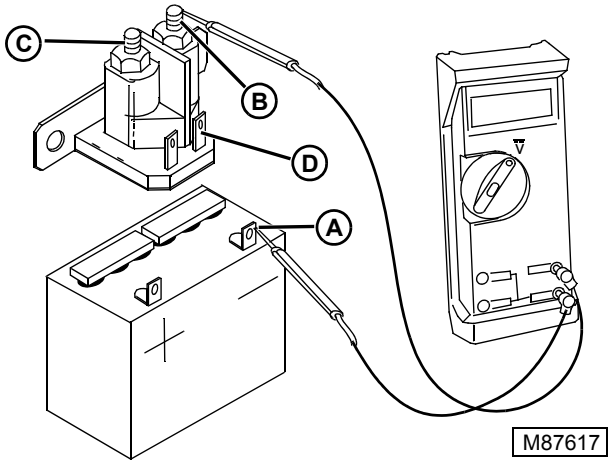
To determine if starting solenoid is defective.

**Equipment:**

- Volt Ohm Meter

**Procedure:**

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage park brake.
5. Raise hood.
6. Disconnect and ground spark plug lead.




7. Connect VOM to negative (–) battery terminal (A) and terminal (B) of starting motor solenoid. Check for battery voltage.

**Results:**

- No battery voltage – Check battery positive (+) terminal and starting motor solenoid terminal (B) for loose connections. Clean any corrosion.
- Battery voltage – go to next step.

8. Connect VOM to negative (–) battery terminal (A) and terminal (C) of starting motor solenoid.
9. Momentarily turn ignition key to START position and check for battery voltage.

**Results**

- No battery voltage – starting motor solenoid is not defective.
- Battery voltage – go to next step.

10. Connect VOM to negative (–) battery terminal (A)

and terminal (D) (Pur wire) of starting motor solenoid.

11. Momentarily turn ignition key to START position and check for battery voltage.

**Results:**

- No battery voltage – Check Pur wire and connections.
- Battery voltage – Check Blk wire and connections between starting motor solenoid and frame ground. If OK, starting motor solenoid is OK.

# STARTING MOTOR AMPERAGE DRAW

## Loaded

**Reason:**

To determine amperage needed to crank the engine.

**Required Tools:**

- JT05791 Multimeter
- JT02153 Current Clamp

**Procedure:**

1. Ensure transmission is in neutral and park brake is set.
2. Remove spark plug lead and ground to engine.

LT 133 Shown

3. Connect current clamp (B) RED lead to the VOLTS jack of the multimeter and the BLACK lead of the current clamp to the COM jack on the multi meter.
4. Clamp jaws of current clamp around the positive battery cable.
5. Set the current clamp to 2000A and the multimeter to 300mV.
6. Adjust the DCA ZERO ADJUST dial on the current clamp for a zero reading on the multimeter.

*NOTE: The core of the jaws may hold some magnetic force after the current clamp has been used for measurement. If you cannot zero adjust the display, open the jaws and snap them closed several times.*

7. Crank the engine and read the starting motor amperage draw.

*NOTE: If using a multimeter other than JT05791, use a meter that will read millivolts. Millivolts = current in amps; 1mV= 1 amp.*

**Specifications:**

**LT133/LT155**

**Maximum starting motor amp draw . . . . 180 amps**

**LT166**

**Maximum starting motor amp draw . . . . 100 amps**

**Result:**

- If amperage is above specification check starting motor for binding or damaged wires or windings.
- If starting motor is good, check internal engine, traction or PTO drive for binding or damage.

## No-Load

**Reason:**

To determine starting motor condition under no-load conditions.

**Required Tools:**

- JT05791 Multimeter
- JT02153 Current Clamp
- 12 Volt Battery
- Jumper Cables

**Procedure:**

> **⚠ CAUTION**
>
> **Do not clamp starting motor housing in vise or strike with a hammer. Clamp only on the mounting bracket. Starting motors contain two ceramic magnets that can be broken or cracked if the motor housing is hit, deformed or dented.**

1. Clamp the starting motor mounting bracket in a vise.
2. Connect the NEG jumper cable to the battery NEG post and the frame of the starting motor.
3. Connect the POS jumper cable to the POS post of the battery.
4. Connect current clamp RED lead to the VOLTS jack of the multimeter and the BLACK lead of the current clamp to the COM jack on the multimeter.
5. Clamp jaws of current clamp around the positive jumper cable.
6. Set the current clamp to 2000A and the multimeter to 300mV.
7. Adjust the DCA ZERO ADJUST dial on the current clamp for a zero reading on the multimeter.

*NOTE: The core of the jaws may hold some magnetic force after the current clamp has been used for measurement. If you cannot zero adjust the display, open the jaws and snap them closed several times.*

8. Momentarily touch the POS jumper cable lead to the starting motor POS post and read the starting motor amperage draw.

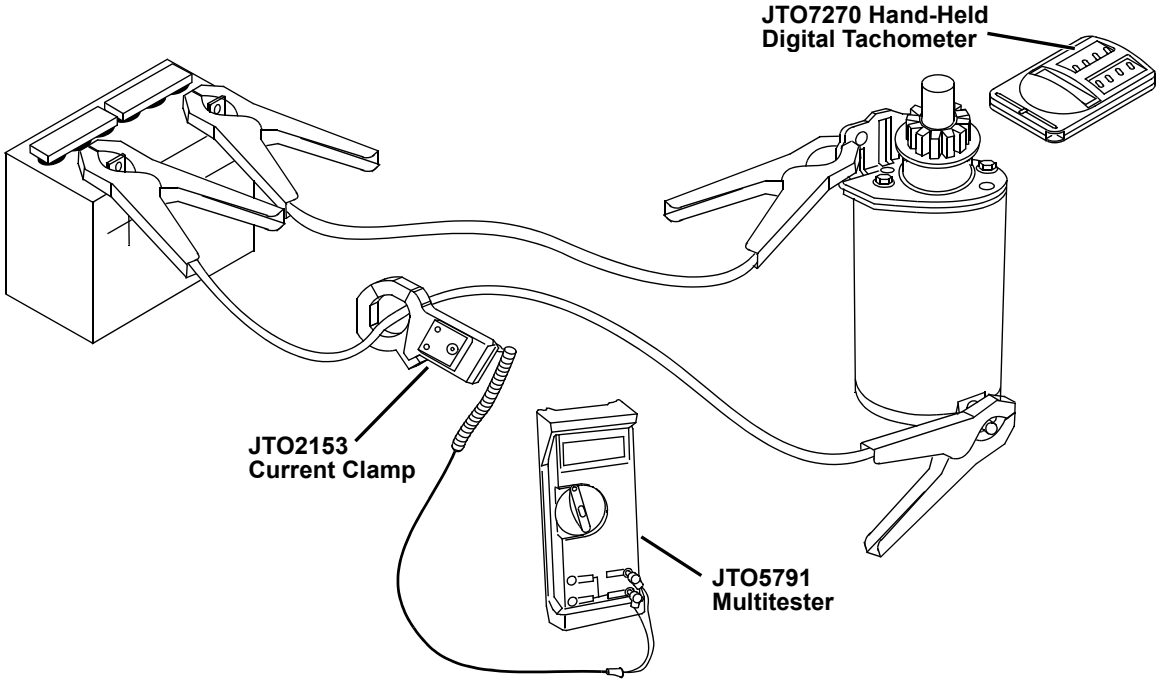
*NOTE: If using a multimeter other than JT05791, use a meter that will read millivolts. Millivolts = current in amps; 1mV= 1 amp.*

**Specifications:**

**LT133/LT155**
**Maximum starting motor amp draw . . . . 50 amps**
**LT166**
**Maximum starting motor amp draw . . . . 35 amps**

**Result:**

- If amperage is above specification, check starting motor for binding or damaged



## STATOR AMPS OUTPUT TEST–LT133/LT155 w/ 3 AMP CHARGER

**Reason:**

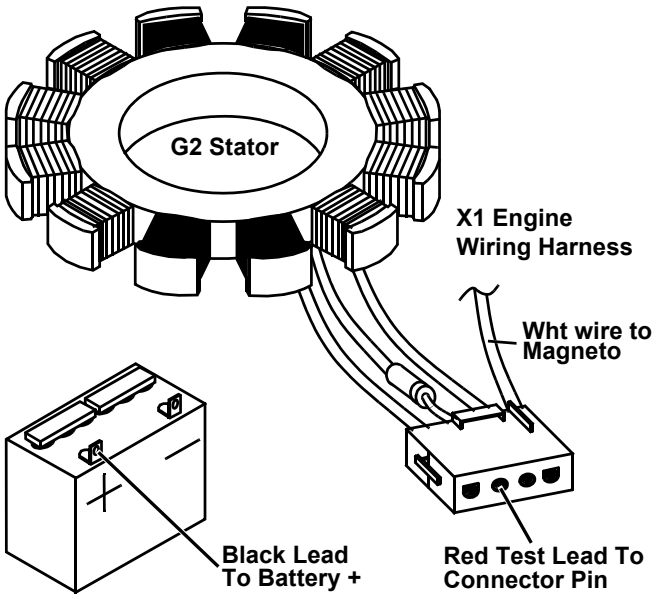
To determine proper output of stator.

**Equipment:**

- Multimeter

**Procedure:**

1. Disconnect connector from stator.
2. Set multi meter for DC amps.




3. Insert RED test lead into 10 A receptacle in meter.
4. Insert BLACK test lead into COM receptacle in meter.
5. Attach RED test clip to DC output pin in connector
6. Attach BLACK test lead clip to positive (+) battery terminal.
7. Start engine and run at full throttle.
8. Check output.

**Specifications:**

**DC amps output at full throttle . . . . . 2–4 amps**

**Results:**

- Output will vary with battery voltage. If battery voltage is at its maximum, output will be approximately 2 amps.
- If no or low output is found, test diode.

## ALTERNATOR DIODE TEST–LT133/LT155 w/ 3 AMP CHARGER

**Reason:**

To determine alternator diode is functioning correctly.

**Equipment:**

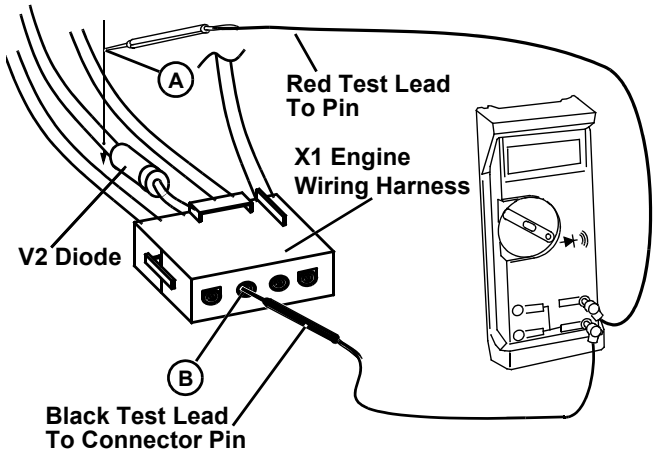
- Multimeter with diode test function.

**Test Connections:**

- Set multi meter for Diode Test position.

**Procedure:**

1. Disconnect connector from stator.




2. Insert RED test lead into VOLTS receptacle in meter.
3. Insert BLACK test lead into COM receptacle in meter.
4. Attach RED test lead clip to point (A). (It may be necessary to pierce wire with a pin as shown)
5. Attach BLACK test lead clip to point (B). (DC output pin)
   - If meter beeps once, diode is OK
   - If meter makes a continuous tone, diode is defective (shorted). Replace diode
   - If meter displays “OL”, proceed to step 6
6. Reverse test leads.
   - If meter beeps once, diode is installed backwards. Replace diode
   - If meter still displays OL, diode is defective (open). Replace diode.

# REGULATED VOLTAGE TEST

**Reason:**

To determine regulated voltage output of the regulator/ rectifier.

**Test Equipment:**

- Voltmeter

**Procedure:**

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise hood.
6. Remove surface charge from battery by placing a small load on the battery for 15 seconds.
7. Set voltmeter to 50 DC volt scale.
8. Connect voltmeter positive (red) lead to battery positive (+) terminal.
9. Connect voltmeter negative (black) lead to battery negative (–) terminal.
10. Start and run engine at **fast idle**.
11. Read voltmeter several times during 5 minutes of running time. Voltage should remain between **12.2–14.7 volts DC**.

**Results:**

- If the DC voltage remains below the minimum specification, test stator voltage output. See "VOLTAGE OUTPUT TEST-LT133/LT155 w/ 15 AMP CHARGER".
- If the DC voltage goes above the maximum specification, replace the regulator/rectifier.

# VOLTAGE OUTPUT TEST–LT133/ LT155 w/ 15 AMP CHARGER

**Reason:**

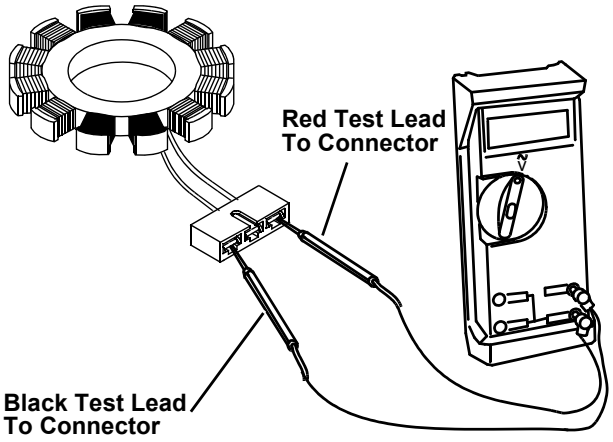
To measure AC voltage output of stator and verify correct resistance of stator.

**Equipment:**

- Fluke Multi-Meter (Set to AC volt scale)

**Procedure:**

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage park brake.
5. Raise hood.
6. Set meter to 50 VAC or Auto range scale.
7. Disconnect regulator/rectifier connector.




8. Start and run at **fast idle (3350 ± 75 RPM)**.
9. Measure stator voltage. Voltage should read a **minimum of 28 volts AC**.

**Results:**

- If voltage is less than specification, test stator with an ohmmeter.

10. Stop engine.
11. Change meter to ohms scale.
12. Measure resistance across stator leads. Resistance should read **0.1 to 0.2 ohms**.

**Results:**

- If resistance is infinite ohms, stator is open. Replace stator.

13. Measure resistance from each stator lead to ground. Resistance should read **infinite ohms**.

**Results:**

- If resistance (or continuity) is measured, stator leads are shorted to ground. Replace stator.

# VOLTAGE REGULATOR/RECTIFIER TEST–LT133/LT155 w/ 15 AMP CHARGER

**Reason:**

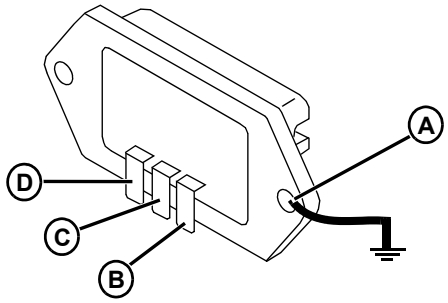
To verify proper operation capability of the voltage regulator/rectifier.

**Equipment:**

- Fluke Multi-Meter (Set to Ohms scale)

**Procedure:**

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage park brake.
5. Raise hood.




6. Disconnect stator connector from the voltage regulator/rectifier.
7. Set the multi-meter to the Ohms scale.
8. Measure resistance between each point as shown in the chart. If resistance is not within specification, replace voltage regulator/rectifier.

| | A | B | C | D |
|---|---|---|---|---|
| **A** | | 8 - 9 M | 8 - 9 M | 31.2 M |
| **B** | OL | | 0.2 | OL |
| **C** | OL | 0.2 | | OL |
| **D** | 31.2 M | 8 - 9 M | 8 - 9 M | |

# REGULATED AMPERAGE TEST

**Reason:**

To determine charging output of rectifier/regulator.

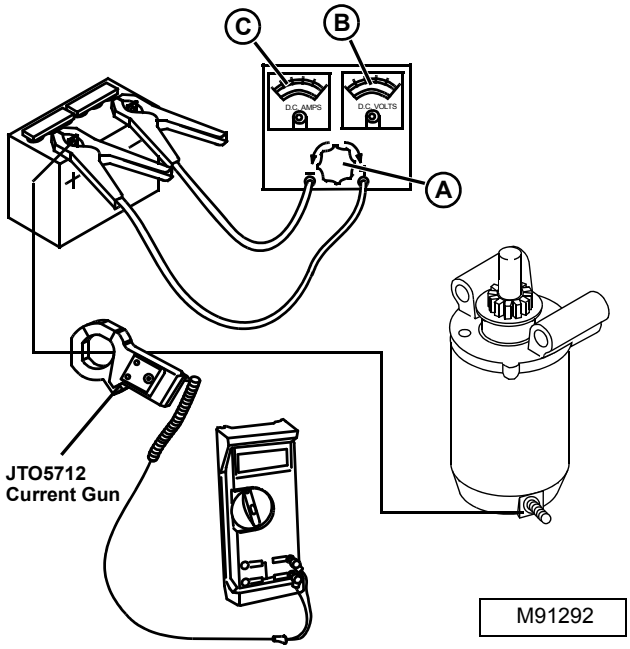
**Test Equipment:**

- Voltmeter
- JT05712 Current Gun
- JT05685 Battery Tester

**Procedure:**

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise hood.

*NOTE: Battery must be in a good state of charge at 12 to 15 VDC.*




6. Connect JTO5712 Current Gun to voltmeter and put around positive (red) battery cable going to starting motor. Set current gun for DC current.

**IMPORTANT: Turn load knob (A) fully counterclockwise (out) into OFF position BEFORE making any test connections.**

7. Connect battery tester to battery.

**IMPORTANT: Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than 5 - 10 seconds.**

8. Turn load knob clockwise (in) until voltage on voltage tester scale reads **11 volts for 5 seconds only** to partially drain battery.
9. Quickly turn load knob completely counter-clockwise (out) to OFF position.
10. Start and run engine at **fast idle**. Battery voltage should read **between 12.2 - 15.0 VDC**.
11. Turn load knob clockwise (in) until voltage on tester voltage scale (B) reads 11 volts and look at current gun for a minimum reading of **13.5 amps**.
12. Quickly turn load knob completely counter-clockwise (out) to OFF position.
13. After load test, voltage scale (B) should return to voltage level prior to test.

**Results:**

- If reading does not meet specifications, test stator voltage output. See "STATOR OUTPUT TEST" procedure.
- If stator voltage output meets specifications and voltage and ground to the regulator/rectifier is verified, replace the regulator/rectifier.

# ALTERNATOR DC OUTPUT TEST–LT166

**Reason:**

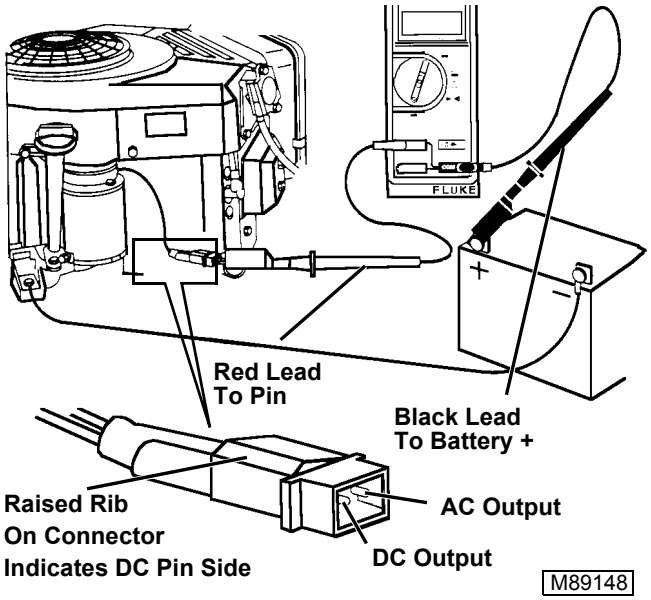
To determine proper output of stator.

**Equipment:**

- Multimeter

**Procedure:**

1. Disconnect connector from stator.
2. Set multi meter for DC amps.




3. Insert RED test lead into 10 A receptacle in meter.
4. Insert BLACK test lead into COM receptacle in meter.
5. Attach RED test clip to DC output pin in connector
6. Attach BLACK test lead clip to positive (+) battery terminal.
7. Start engine and run at full throttle.
8. Check output.

**Specifications:**

**DC output at full throttle . . . . . 2–4 amps**

**Results:**

- Output will vary with battery voltage. If battery voltage is at its maximum, output will be approximately 2 amps
- If no or low output is found, test diode.

# ALTERNATOR DIODE TEST–LT166

**Reason:**

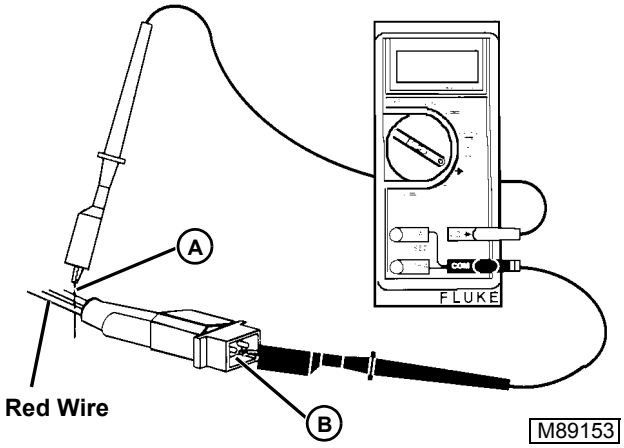
To determine alternator diode is functioning correctly.

**Equipment:**

- Multimeter with diode test function.

**Procedure:**

1. Disconnect connector from stator.
2. Set multi meter for Diode Test position.




3. Insert RED test lead into VOLTS receptacle in meter.
4. Insert BLACK test lead into COM receptacle in meter.
5. Attach RED test lead clip to point (A). (It may be necessary to pierce wire with a pin as shown)
6. Attach BLACK test lead clip to point (B). (DC output pin)

- If meter beeps once, diode is OK.
- If meter makes a continuous tone, diode is defective (shorted). Replace diode.
- If meter displays “OL”, proceed to step 7.

7. Reverse test leads.

- If meter beeps once, diode is installed backwards. Replace diode.
- If meter still displays OL, diode is defective (open). Replace diode.

# DIODE TEST

**Reason:**

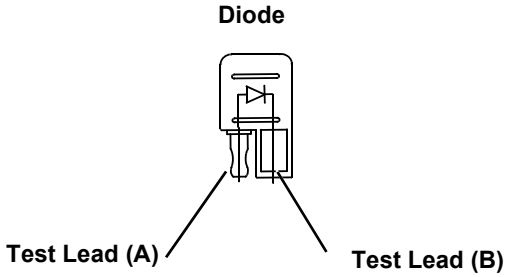
To verify that diode has proper continuity.

**Equipment:**

- Ohmmeter or continuity tester

**Procedure:**

1. Remove diode from connector.




2. Connect ohmmeter red (+) lead to pin (A) of diode. Connect ohmmeter black (-) lead to pin (B) of diode. Check for continuity.
3. Reverse test leads. Check for continuity.

**Results:**

- Diode must have continuity in one direction only Replace defective diode

## RELAY TEST

**Reason:**

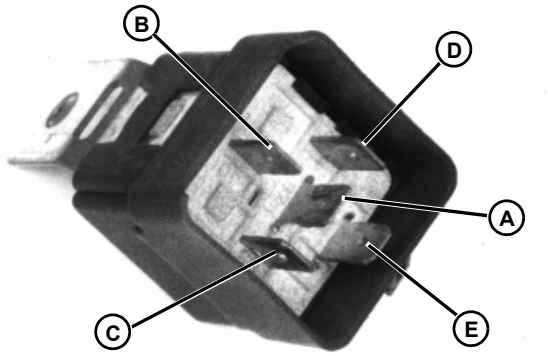
To check relay terminal continuity in the energized and de-energized condition.

**Equipment:**

- Ohmmeter or continuity tester

**Procedure:**

1. Park machine on level surface.
2. Engage park brake.
3. Turn key switch OFF.
4. Disconnect relay connector.
5. Check terminal continuity using an ohmmeter or continuity tester

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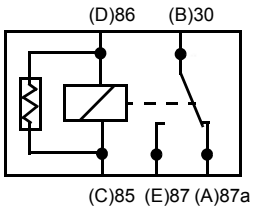



**Results:**

- There should be continuity between terminals (A) and (B), and between terminals (C) and (D)
- There should NOT be continuity between terminals (E) and (B)

6. Connect a jumper wire from battery positive (+) terminal to relay terminal (C). Connect a jumper wire from relay terminal (D) and ground (-).

**Results:**

- There should be continuity between terminals (E) and (B).
- If continuity is NOT correct, replace relay.

## KEY SWITCH TEST

**Reason:**

To determine proper operation of key switch.

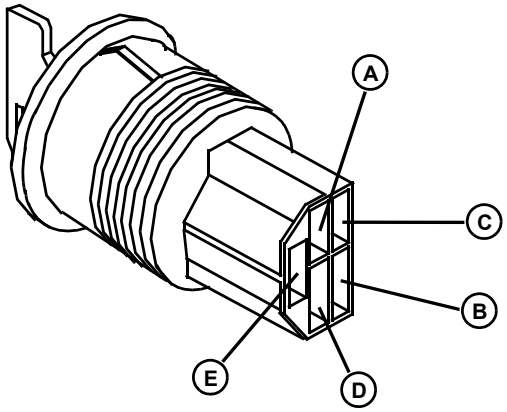
**Equipment:**

- Ohmmeter

**Test Conditions:**

- Set ohmmeter for 1X ohms scale
- Remove connector from back of key switch

**Procedure:**




1. Connect meter leads to pairs of switch posts and compare to specifications.
2. For ignition circuit, turn key switch from OFF to RUN position.
3. For starting circuit, turn key switch from RUN to START position.

**Specifications:**

**Switch in OFF**
**. . . . . no continuity between A and B**
**. . . . . continuity between C and D**
**Switch in RUN**
**. . . . . no continuity between C and D**
**. . . . . continuity between A and B**
**Switch in START. . . . . continuity between D and E**

**Results:**

- If key switch does not pass all tests, replace switch.

# 4 POSITION KEY SWITCH TEST

**Reason:**

To determine proper operation of key switch.

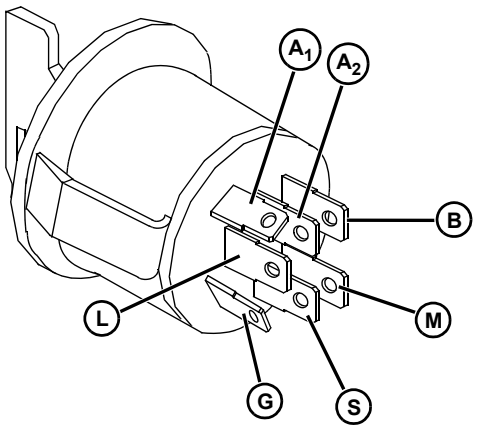
**Equipment:**

- Ohmmeter

**Test Conditions:**

- Set ohmmeter for 1X ohms scale
- Remove connector from back of key switch

**Procedure:**




1. Connect meter leads to pairs of switch posts and compare to specifications.
2. For ignition circuit, turn key switch from OFF to RUN position.
3. For starting circuit, turn key switch from RUN to START position.

**Specifications:**

**Switch in OFF (Stop)**
**. . . . . continuity between M, G and $A_1$**
**Switch in RUN 1 (With Lights)**
**. . . . . continuity between B and $A_1$**
**. . . . . continuity between L and $A_2$**
**Switch in RUN 2 (Without Lights)**
**. . . . . continuity between B and $A_1$**
**Switch in START**
**. . . . . continuity between B, S and $A_1$**

**Results:**

- If key switch does not pass all tests, replace switch.

# PTO/BRAKE (RIO SWITCH LT166) SWITCH TEST

**Reason:**

To determine proper operation of PTO or Brake or RIO switch.

**Equipment:**

- Ohmmeter

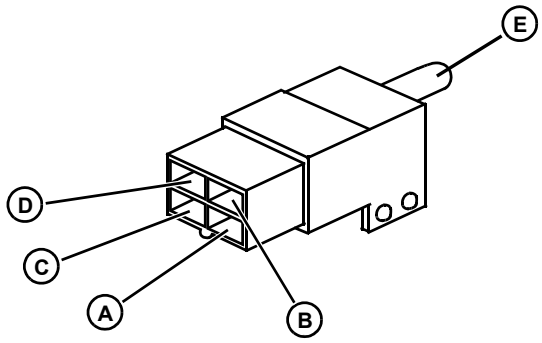
**Test Connections:**

- Set ohmmeter for 1X scale

*NOTE: On analog (swing needle) Ohmmeters, set zero point before each test.*

**Procedure:**

1. Remove connector from PTO or Brake or RIO switch.
2. If testing PTO switch, remove switch from machine.




3. Connect meter leads to pairs of switch posts and compare to specifications.
4. Press and release plunger (E) of switch.

**Specifications:**

**Switch plunger not pressed**
**. . . . . .continuity between posts A and B**
**Switch plunger not pressed**
**. . . . . .no continuity between posts C and D**
**Switch plunger pressed**
**. . . . . .no continuity between posts A and B**
**Switch plunger pressed**
**. . . . . .continuity between posts C and D**

**Results:**

- If PTO or Brake or RIO switch does not pass all tests, replace switch.

## RIS SWITCH TEST

**Reason:**

To determine proper operation of RIS switch.

**Equipment:**

- Ohmmeter

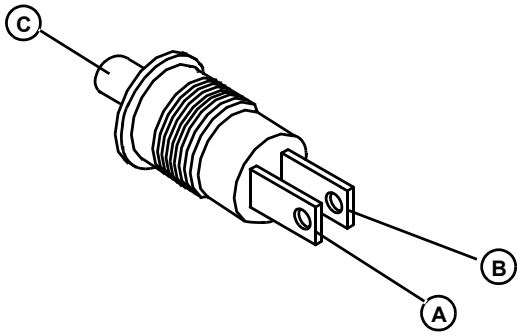
**Test Connections:**

- Set ohmmeter for 1X scale

*NOTE: On analog (swing needle) Ohmmeters, set zero point before each test.*

**Procedure:**

1. Remove connector from RIS switch.




2. Connect meter leads to pairs of switch posts and compare to specifications.
3. Press and release plunger (C) of switch.

**Specifications:**

**Switch plunger not pressed**
**. . . . . no continuity between posts A and B**
**Switch plunger pressed**
**. . . . . .continuity between posts A and B**

**Results:**

- If RIS switch does not pass both tests, replace switch.

## RIO SWITCH TEST LT133/LT155

**Reason:**

To determine proper operation of RIO switch.

**Equipment:**

- Ohmmeter

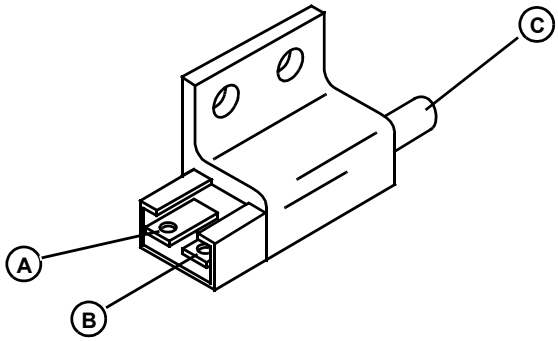
**Test Connections:**

- Set ohmmeter for 1X scale

*NOTE: On analog (swing needle) Ohmmeters, set zero point before each test.*

**Procedure:**

1. Remove connector from RIO switch.




2. Connect meter leads to pairs of switch posts and compare to specifications.
3. Press and release plunger (C) of switch.

**Specifications:**

**Switch plunger not pressed**
**. . . . . no continuity between posts A and B**
**Switch plunger pressed**
**. . . . . .continuity between posts A and B**

**Results:**

- If RIO switch does not pass both tests, replace switch.

## SEAT SWITCH TEST

**Reason:**

To determine proper operation of seat switch.

**Equipment:**

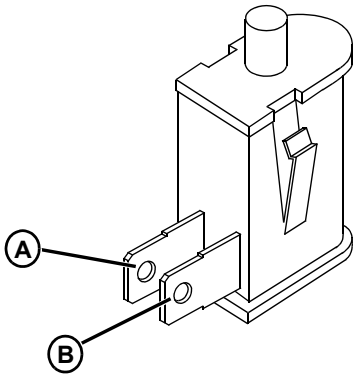
- Ohmmeter

**Test Connections:**

- Set ohmmeter for 1X ohms scale

**Procedure:**

1. Remove connector from seat switch.




2. Connect one lead of meter to post (A) of switch.
3. Connect other lead of meter to post (B) of switch.
4. Press and release seat switch plunger.

**Specifications:**

**LT133/LT155/LT166**

**Seat switch plunger not pressed**
**. . . . . no continuity between post A and B**
**Seat switch plunger pressed**
**. . . . . .continuity between post A and B**

**LT166**

**Seat switch plunger not pressed**
**. . . . . .continuity between post A and B**
**Seat switch plunger pressed**
**. . . . . no continuity between post A and B**

**Results:**

- If the seat switch does not pass both tests, replace switch.

## SPARK TEST

**Reason:**

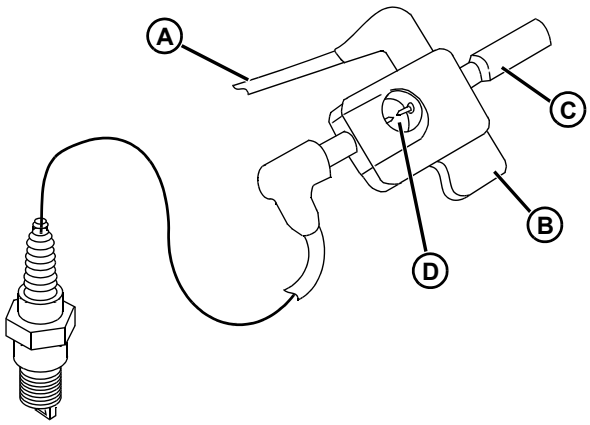
To check overall condition of ignition system.

**Equipment:**

- D-05351ST Spark Tester

**Procedure:**

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Raise hood.
5. Wheels blocked and park brake ON.
6. Remove high tension lead (A) from spark plug and connect to spark tester (B).




7. Connect spark tester lead to spark plug.
8. Adjust spark tester gap to **4.2 mm (0.166 in.)** with screw (C).

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

9. Turn key switch to RUN position and start engine.
10. Watch spark (D) at spark tester.

**Results:**

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

# DIODE TEST (LT166)

**Reason:**

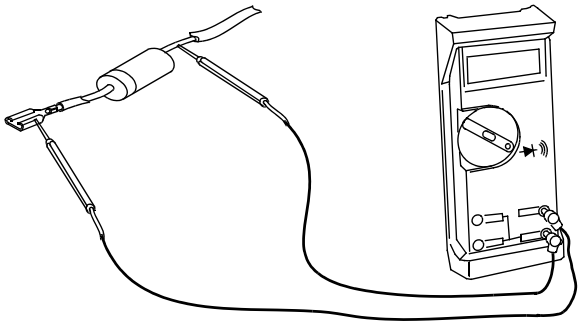
To verify correct function of diodes in engine stop circuit. If a diode fails "open", the cylinder with the open diode will continue to run when the engine is shut off. If a diode fails "short", the cylinder with the shorted diode will not run (no spark).

**Equipment:**

- Ohmmeter

**Procedure:**

1. Park machine on level surface.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage park brake.
5. Place PTO switch in OFF position.
6. Remove engine blower housing.
7. Disconnect diode grounding wire from ignition coil.



8. Set meter to diode test range.

*NOTE: The meter will measure and display voltage drop across diode when set to diode test range.*

9. Place one meter lead on connector and second meter lead on opposite side of diode.
10. Reverse position of meter leads and retest.

*NOTE: If using ohmmeter for test, resistance in one direction will be approximately 80,000 ohms, and reading will "fall" during testing. Ohmmeter reading in opposite direction will be between 4 and 5 mega-ohms and "rise" during testing.*

**Results:**

- Meter should "beep" once in one meter lead position only.
- Meter has continuous tone in either position, diode is shorted, replace diode.
- Meter displays "OL" in both positions, diode is "open", replace diode.

# 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.
2. Turn key switch to OFF position.
3. Move Forward/Reverse pedals to NEUTRAL position.
4. Engage park brake.
5. Raise hood.
6. Remove flywheel blower housing from engine.
7. 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.

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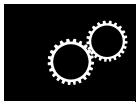


# SPECIFICATIONS

## GENERAL SPECIFICATIONS

**Dimensions:**

Overall Axle Width (End-to-end) . . . . . 735.432 mm (28.954 in.)
Overall Case Width . . . . . 432.562 mm (17.030 in.)
Overall Case Length (Front-to-rear) . . . . . 272.034 mm (10.710 in.)
Overall Height (Top Of Input Shaft-to-bottom Case) . . . . . 183.400 mm (7.220 in.)
Overall Case Height (Top Case-to-bottom Case) . . . . . 154.178 mm (6.070 in.)

**Gear Teeth**

Bevel Pinion Gear (Input Shaft) . . . . . 12
Drive Shaft:
- Bevel Drive Gear . . . . . 36
- Drive Sprocket Gear . . . . . 9
- 1st Gear . . . . . 12
- 2nd Gear . . . . . 15
- 3rd Gear . . . . . 20
- 4th Gear . . . . . 23
- 5th Gear . . . . . 26

Intermediate Shaft:
- Spur Gear . . . . . 12
- Drive Sprocket Gear . . . . . 18
- 1st Gear . . . . . 37
- 2nd Gear . . . . . 35
- 3rd Gear . . . . . 30
- 4th Gear . . . . . 27
- 5th Gear . . . . . 24
- Combination Gear (Idler Shaft) . . . . . 12 and 30

Differential Spur Gear . . . . . 32
Differential Miter Bevel Gears (Axle Shafts) . . . . . 12
Differential Miter Bevel Gears (Cross Shaft) . . . . . 12

**Lubrication:**

Capacity (Multipurpose Grease) . . . . . 638 g (1.396 lbs)
Input Shaft Needle Bearings
Capacity (Multipurpose Grease) . . . . . 2.268 g (0.005 lbs)
Overall Weight (With Grease) . . . . . 14.2 kg (31.2 lbs)

**Rear Axle Loading:**

Maximum . . . . . 204 kg (450 lbs)

# REPAIR SPECIFICATIONS

**Wear Tolerances:**

**Input Shaft (See Exploded View)**

Shim:
Standard. . . . . .16 x 25.4 x 0.254—2.03 mm (0.63 x 1.0 x 0.01—0.082 in.)
Washers:
Standard. . . . . 16 x 35.6 x 1.17 mm (0.63 x 1.4 x 0.046 in.)
. . . . . 16 x 25.4 x 1.17 mm (0.63 x 1.00 x 0.046 in.)

**Intermediate Shaft (See Exploded View)**

Shim:
Standard. . . . . .16 x 25.4 x 0.25—2.03 mm (0.63 x 1.0 x 0.01—0.08 in.)
Spacer:
Standard. . . . . 28.7 x 36.8 x12.5 mm (1.13 x 1.45 x 0.49 in.)
Spacer:
Standard. . . . . .28.7 x 38.1 x 9.5 mm (1.13 x 1.5 x 0.375 in.)
Washer:
Standard. . . . . .16.3 x 35.6 x 1.5 mm (0.64 x 0.14 x 0.06 in.)

**Idler Shaft (See Exploded View)**

Washers:
Standard. . . . . 16 x 25.4 x 1.17 mm (0.63 x 1.0 x 0.046 in.)
Shim:
Standard. . . . . 16 x 25.4 x 2.5 mm (0.63 x 1.0 x 0.01—0.08 in.)

**Drive Shaft (See Exploded View)**

Spacer:
Standard. . . . . .16.3 x 22.9 x 19.3 mm (0.64 x 0.90 x 0.76 in.)
Shim:
Standard. . 19.3 x 28.5—31.8 x 0.254—1.5 mm (0.76 x 1.12—1.25 x 0.01—0.06 in.)
Spacer:
Standard. . . . . .19.8 x 25.4 x 9.7 mm (0.78 x 1.0 x 0.38 in.)
Washers:
Standard. . . . . 16 x 25.4 x 1.5 mm (0.63 x 1.0 x 0.06 in.)

**Left Axle Shaft (See Exploded View)**

Washers:
Standard. . . . . .19.3 x 31.8 x 0.76 mm (0.76 x 1.25 x 0.03 in.)
Shims:
Standard. . . . .19.3 x 28.5—31.8 x 2.5—1.5 mm (0.76 x 1.12—1.25 x 0.01—0.06 in.)

**Right Axle Shaft (See Exploded View)**

Shims:
Standard. . .19.3 x 28.5—31.8 x 0.254—1.5 mm (0.76 x 1.12—1.25 x 0.01—0.06 in.)

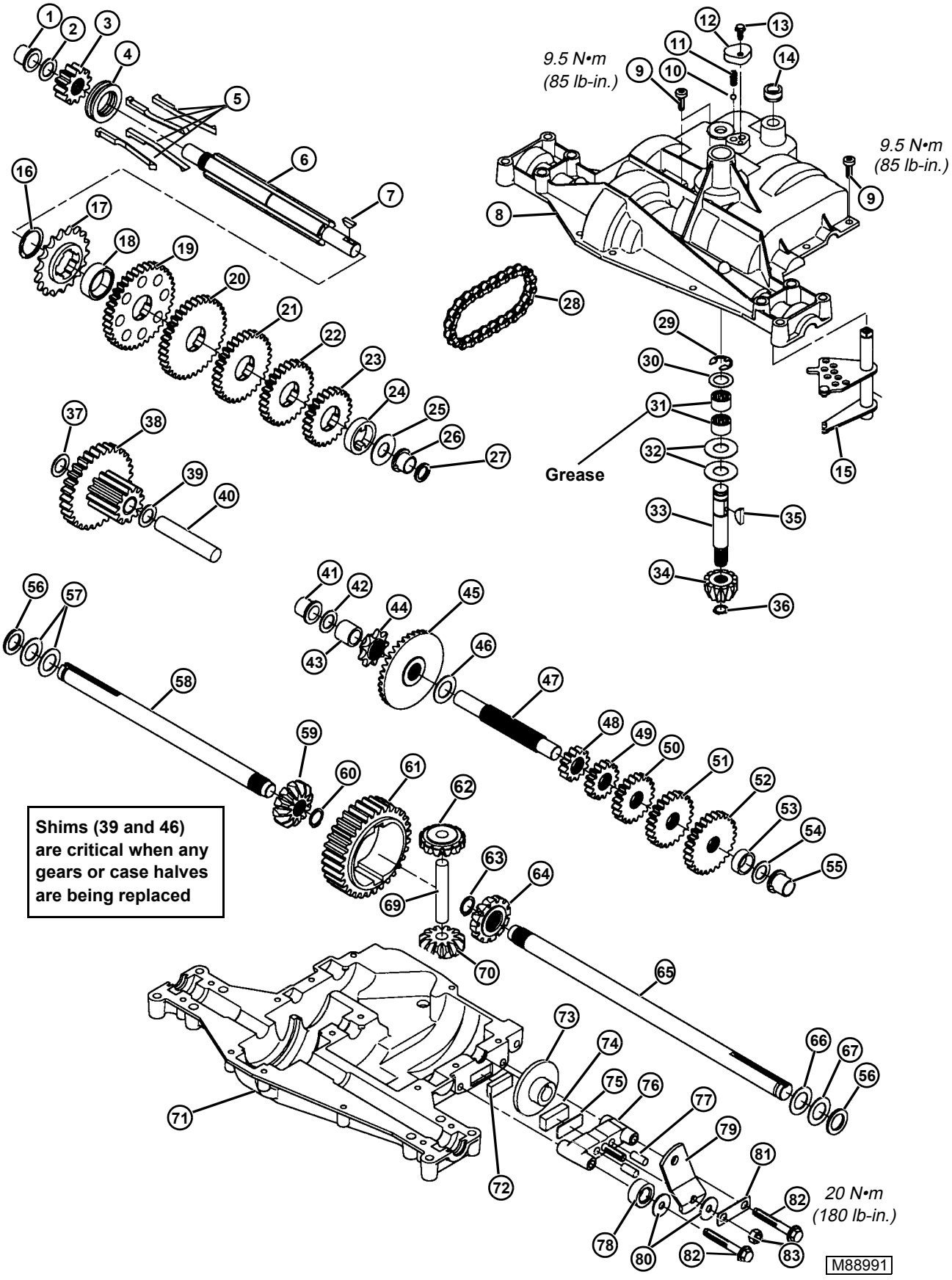
## TORQUE SPECIFICATIONS

| | |
|---|---|
| Gear Shift Arm/Trans | 16 N•m (140 lb-in.) |
| Shift Link To Shift Lever | 13 N•m (120 lb-in.) |
| Gear Shift Arm/Trans | 16 N•m (140 lb-in.) |
| Gear Trans Hitch | 34 N•m (25 lb-ft) |
| Jacksheave/Crank | 75 N•m (55 lb-ft) |
| Transaxle Mounting Cap Screws to Hanger Bracket (Front) | 34 N•m (25 lb-ft) |
| Transaxle Mounting Cap Screws to Frame (Rear) | 34 N•m (25 lb-ft) |
| Brake Assembly Screws (2) | 20 N•m (180 lb-in.) |
| Case Housing Screws (16) | 10 N•m (88 lb-in.) |

# COMPONENT LOCATION

1. Flange bearing
2. Shim
3. Spur gear (12Teeth)
4. Shift collar
5. Shift key (4 Used)
6. Intermediate shifter/brake shaft
7. Woodruff key
8. Upper case housing
9. Screw (16 Used)
10. Detent ball (2 Used)
11. Detent spring (2 Used)
12. Detent cover
13. Detent cover screw
14. V-ring
15. Shifter fork
16. Retaining ring
17. Drive chain large sprocket/reverse gear (18 Teeth)
18. Spacer
19. Intermediate shaft 1st gear (37 Teeth)
20. Intermediate shaft 2nd gear (35 Teeth)
21. Intermediate shaft 3rd gear (30 Teeth)
22. Intermediate shaft 4th gear (27 Teeth)
23. Intermediate shaft 5th gear (24 Teeth)
24. Spacer w/internal keys
25. Washer
26. Flange bearing
27. Lip seal (Open LipTo Inside)
28. Drive chain (24 Pitches)
29. Retaining ring
30. Shim
31. Needle bearing (2 Used)
32. Washer (2 Used)
33. Input shaft
34. Bevel pinion gear (12 Teeth)
35. Woodruff key
36. Retaining ring
37. Washer
38. Idler gear (12 & 30 Teeth)
39. Shim
40. Idler shaft
41. Flange bearing
42. Washer
43. Spacer
44. Drive chain drive sprocket (9Teeth)
45. Drive shaft bevel gear (36 Teeth)
46. Shim
47. Drive shaft
48. Drive shaft 1st gear (12 Teeth)
49. Drive shaft 2nd gear (15 Teeth)
50. Drive shaft 3rd gear (20Teeth)
51. Drive shaft 4th gear (23Teeth)
52. Drive shaft 5th gear (26Teeth)
53. Spacer
54. Washer
55. Flange bearing
56. Square-cut rubber ring
57. Washer (2 Used)
58. Left axle shaft
59. Differential bevel gear (12 Teeth)
60. Retaining ring
61. Differential ring gear (32Teeth)
62. Differential bevel gear (12 Teeth)
63. Retaining ring
64. Differential bevel gear (12 Teeth)
65. Right axle shaft
66. Shim
67. Shim
68. Square-cut rubber ring
69. Differential cross shaft
70. Differential bevel gear (12 Teeth)
71. Lower case housing
72. Thin friction puck
73. Brake disc
74. Thick friction puck
75. Friction puck striker plate
76. Brake jaw
77. Actuator dowel pin (2 Used)
78. Spacer
79. Actuating lever
80. Washer (2 Used)
81. Lever stop bracket
82. Tapping screw (2 Used)
83. Lock nut

# TRANSAXLE COMPONENTS



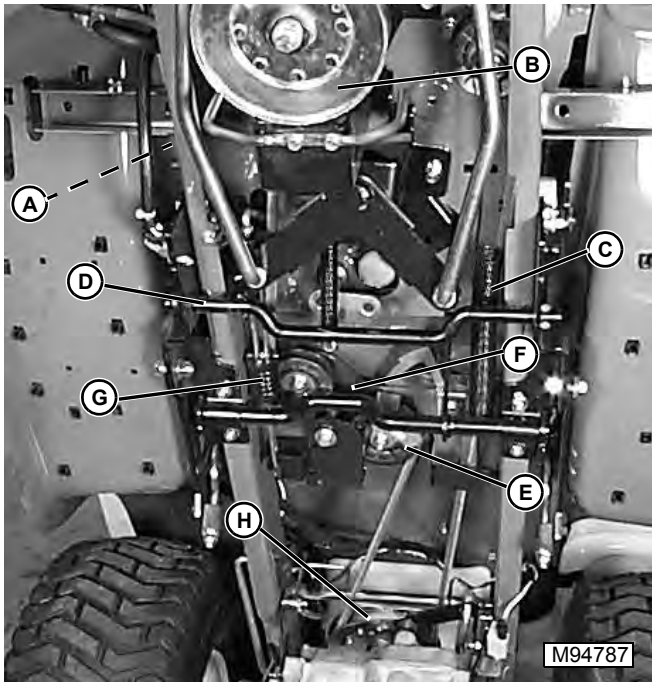
# THEORY OF OPERATION

## CLUTCH PEDAL AND BELT TRACTION DRIVE OPERATION

**Function:**

To transfer power from the engine to the 5-speed transaxle. This system also allows the power transfer to be interrupted in order to stop in gear, change to a different gear or direction, engage power again, or shift to neutral and push the unit with the engine on or off.

**Theory of Operation:**




With engine running and clutch engaged (clutch/brake pedal (A) released), the engine drive sheave (B) pulls the drive belt and transmits power to the transaxle drive sheave (H). As clutch/brake pedal (A) is depressed by the operator, clutch shaft (D) pulls the clutch actuating spring assembly (G) forward. Initial movement of the pedal compresses the spring in the actuating spring assembly (G) and, once compressed, pivots the bellcrank assembly (F). As the bellcrank assembly pivots, the tensioning sheave (E) moves rearward, releasing drive belt tension. This allows the engine drive sheave to rotate without transferring any power through the slackened drive belt.

As the bellcrank pivots rearward, belt tensioning spring (C) is stretched, building additional tension in the spring. As the operator begins to ease-up on the clutch/brake pedal (A), tensioning spring (C) pulls the bellcrank tensioning sheave (E) into the drive belt, causing the belt to tighten and seat in the grooves of the transaxle drive sheave (H) and the engine drive sheave (B). This interaction of components results in turning the transaxle drive sheave rapidly in a clockwise direction, transferring power from the engine to the 5-speed transaxle.

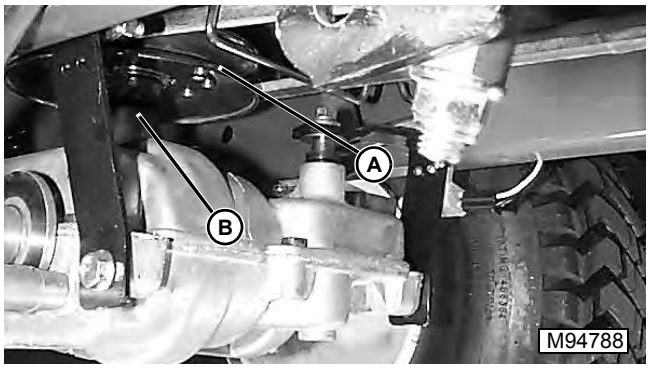
## TRANSAXLE OPERATION

**Function:**

The transaxle transmits power from the engine, through the belt traction drive system, into the transaxle gear matrix, and out the drive axles to the rear wheels. The transaxle provides a gear selection of five forward speeds and one reverse speed.

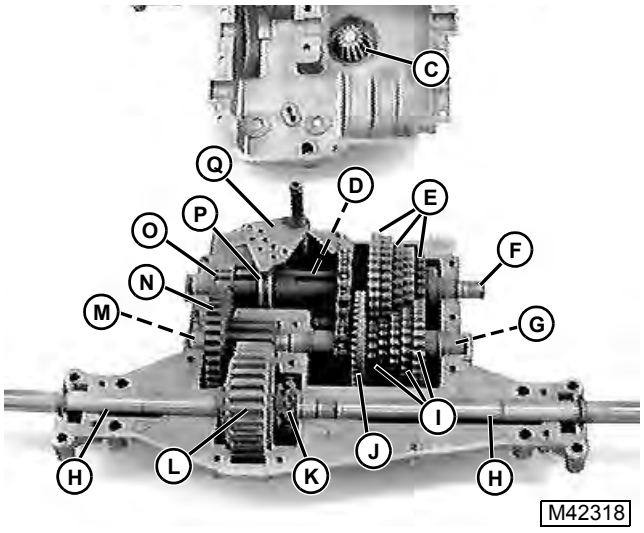
It also provides the means to interrupt the flow of power when shifted into neutral.

**Theory of Operation:**




**Forward:**

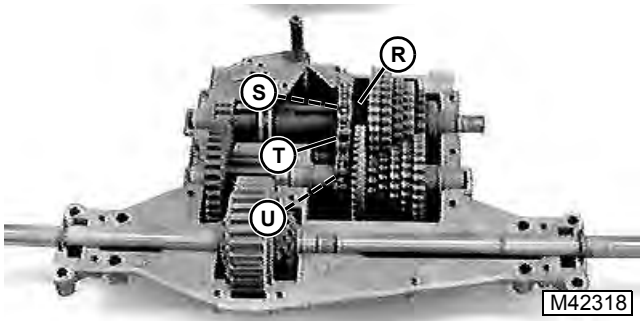
With engine running and clutch engaged, the transaxle input sheave (A) turns rapidly in a clockwise direction. The sheave is retained by a snap-ring and keyed to the input shaft (B).



The input pinion gear (C), that is splined to the input shaft and retained by a snap ring, drives the beveled drive gear (J). The beveled drive gear is splined to the drive shaft (G), as are the five forward drive gears (I).

A forward gear is selected when the operator moves the shift lever. The shift linkage moves the shifter fork (Q), shift collar (P), and shift keys (D) into one of the selected five transfer gears (E). The selected gear is now keyed to the intermediate shifter/brake shaft (F). Power is transferred by the selected gear (E) on the right side of the shaft to the left-side, splined spur gear (O).

The spur gear (O) drives the combination gear (N), on the idler shaft (M), and transfers power into the differential ring gear (L). Power is transferred by the cross shaft and bevel gears (K) to both drive axles (H) out to the wheels and tires. The keyed drive wheels are retained by a E-ring.




**Reverse:**

As in forward—likewise in reverse, with engine running and clutch engaged, the transaxle input sheave turns rapidly in a clockwise direction.

Power is transferred through the belt drive sheave into the input shaft pinion gear (C). The bevel drive gear (J) of the splined drive shaft (G) then carries the power through the splined small drive chain sprocket (U), the drive chain (T), and into the large drive chain sprocket (S) of the intermediate shifter/brake shaft (F).

When the operator shifts the shift lever into reverse, the shifter fork (Q), shift collar (P), and shift keys (D) become keyed to the large drive chain sprocket (S), and turns in the opposite direction as the free-wheeling transfer gears (E). Because the large drive chain sprocket (S) has been engaged by the shift keys (D), the shaft (F) turns in the reverse direction and transfers power through the left side spur gear (O) into the idler shaft combination gear (N), and also turn in the opposite direction as they did in forward.

Power is then transferred into the differential and out the drive axles to the drive wheels and tires, also in this reverse direction.

**Neutral:**

When the operator moves the shift lever into NEUTRAL position, the shifter fork (Q) places the shift keys (D) under the free-floating spacer (R), allowing no power to be transmitted into the intermediate shifter/brake shaft (F), and also allows neutral to be maintained with clutch pedal released and engine running.

## BRAKE SYSTEM OPERATION

**Function:**

The brake system allows the operator to slow down, stop, or lock the tractor into park position.

**Theory of Operation:**

*NOTE: Clutch/brake pedal has approximately **127 mm (5 in.)** of travel.*

The first segment of clutch/brake pedal travel is taking-up freeplay in the linkage and start of compression of clutch bellcrank actuating spring assembly.

The next segment of travel is fully compressing the clutch bellcrank actuating spring assembly and pulling the traction drive clutch bellcrank and idler assembly fully rearward, overcoming the belt tensioning spring and fully disengaging the traction drive system. As the pedal is released, the belt tensioning spring pulls the clutch bellcrank and idler assembly forward into the belt, tensioning the belt and fully engaging the traction drive system.

There is a small segment of pedal travel that briefly allows the tractor to free-wheel so the operator can shift-on-the-go before any brake engagement starts to occur. However, this segment can be adjusted to be more aggressive, causing more friction (Overlapping) between clutch and brake functions if desired, especially in the higher gears.

The last segment of travel is engaging the brake system and manually locking of the park brake linkage. The brake lever with the bottom cam surface contour, pushes the two dowel pins against the striker plate. The striker plate forces the thicker, outer friction puck against the brake disc. The two friction pucks become compressed against both sides of the brake disc. The brake disc is keyed to the end of the intermediate shifter/brake shaft. When the compression force of the friction pucks is great enough to stop the brake disc rotation, the transaxle and wheels stop turning. This works in conjunction with the clutching system.

With the clutch/brake pedal fully depressed and the traction drive system disengaged (Fully Clutched), the park brake lever assembly can be engaged, locking the clutch/brake pedal linkage and the brake disc in park position.

When the clutch/brake pedal is released and the traction drive system is engaged, there must be ample clearance between the friction pucks and the brake disc to prevent the disc brake from dragging.

If a dragging condition exists, the disc brake will over heat and will also experience premature wear.

# TROUBLESHOOTING

| Problem or Symptom / Check or Solution | Belt jumping off or slapping | Lack of drive in one or both directions | Loses power under load, belt slips, or erratic drive | Jerky or aggressive engagement | Cannot get all forward gears | Cannot get reverse gear | Jumps out of gear or must hold into gear | Shifts hard | Noisy operation | Leaking grease | Brakes will not stop tractor | Park brake will not hold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belt sheaves, idlers, and guides loose, out of adjustment, worn, or damaged—tighten, replace, or adjust properly | ● | ● | ● | ● | | | | | ● | | | |
| Belt worn, frayed, glazed, or stretched—replace belt | ● | ● | ● | ● | | | | | ● | | | |
| Clutch/brake pedal linkage out of adjustment—adjust properly | ● | ● | ● | ● | | | ● | ● | | | ● | ● |
| Clutch/brake components worn, bent, or broken—replace and adjust properly | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| Shift lever and linkage bent, worn, out of adjustment, or broken—replace or adjust properly | | | | | ● | ● | ● | ● | | | | |
| Input sheave, input shaft, and axle keys or keyways worn or damaged—replace | | ● | ● | ● | | | | | ● | | ● | ● |
| Internal components worn, stripped, or broken—replace necessary components | ● | ● | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| Transaxle case halves worn or broken—replace halves | ● | ● | ● | ● | ● | ● | | ● | ● | ● | | |
| Incorrect type or volume of lubricant used—replace with correct type and volume | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | |
| Intermediate shifter/brake shaft or axle seals worn or damaged—replace seals | | ● | ● | | ● | ● | ● | ● | ● | ● | | |
| Transaxle cap screws loose or case holes stripped—tighten or replace case half | | ● | ● | | ● | ● | ● | ● | ● | ● | | |
| Poor application of transaxle case halves sealant—replace sealant properly | | | | | | | | | | ● | | |
| Incorrect type sealant—replace with proper sealant | | | | | | | | | | ● | | |

# DIAGNOSTICS

**Test Conditions:**

- Park on level surface
- Park brake ENGAGED
- Engine OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Drive belt | Belt in good condition, not glazed, split, unraveled, or stretched | Replace drive belt |
| 2. Sheaves, idlers, and belt guides | Sheaves, idlers and guides in good condition<br>Guides installed, properly adjusted and tight | Replace any loose, worn, or damaged components<br>Adjust and tighten |
| 3. Clutch/brake pedal linkage | Clutch/brake pedal linkage adjusted properly<br><br>Clutch spring measurement adjusted properly | Adjust clutch/brake pedal linkage<br>Repair or replace clutch/brake pedal components<br>Adjust rear belt idler for correct clutch spring measurement |
| 4. Shift linkage | Shift linkage adjusted properly, shifts smoothly, and obtains all gears | Adjust linkage<br>Repair or replace as needed |
| 5. Brake assembly | Disc and pads not worn or binding | Repair or replace as needed |
| 6. Internal transaxle components | Shifts smoothly, and obtains all gears | Repair or replace components as needed |
| 7. Exterior of transaxle housing | No cracks, leaks, or loose hardware | Tighten hardware<br>Repair or replace as needed |
| 8. Tires, wheels and axles | Tire pressure equal<br>Driving tires have same radii<br>Wheels not bent or out of round<br>Keys, keyways and E-rings in good shape and seated correctly | Adjust air pressure<br>Match tires for same circumference<br>Replace wheels<br>Repair or replace as needed |

## DIAGNOSTICS (continued)

**Test Conditions:**

- Tractor operating in test area
- Engine at operating temperature
- Tests run at engine slow idle and fast idle
- Transaxle run through all speeds in both directions

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Running in test area | Engine running smoothly throughout throttle range | Adjust or tune engine |
| | Belt not squealing or vibrating | Check belt condition<br>Check adjustment and condition of idlers and guides<br>Replace components as needed |
| | Shifting is smooth and all gears obtained | Check clutch/brake linkage adjustment and condition<br>Adjust, repair or replace as needed<br>Check transaxle internal components<br>Repair or replace as needed<br>Check brake components<br>Repair or replace as needed |
| | Constant speed is maintained | Check belt condition<br>Check adjustment and condition of idlers and guides<br>Check clutch/brake linkage adjustment and condition<br>Check transaxle internal components<br>Check brake components<br>Check axles, wheels and tires<br>Replace components as needed |
| | Brakes stop tractor and hold on 17° slope | Check brake linkage and components<br>Repair or replace as needed |

# TESTS & ADJUSTMENTS

## PARK BRAKE TEST

**Reason:**

To ensure park brake functions properly.

**⚠ CAUTION**

**OPERATE on ramp only in first or second gear. Shift to neutral.**

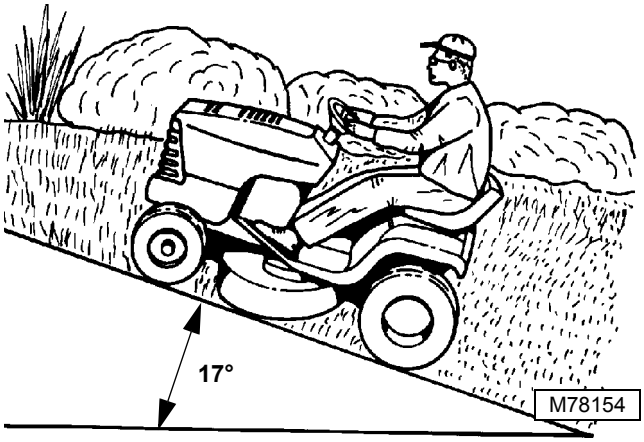
**Procedure:**

- Climb **17°** ramp during running start in 1st or 2nd gear
- Check park brake holds tractor stationary

**Test Drive:**

**⚠ CAUTION**

**DO NOT engage clutch/brake pedal too aggressively or tractor may tip over backwards while performing the test drive on a 17° slope.**




1. Drive tractor onto a **17°** slope and lock clutch/brake pedal inPARK position. Check that park brake holds tractor stationary on slope and that tractor does not creep downward once park brake is set.
2. If park brake test fails, inspect brake assembly components, replace as necessary, and repeat all adjustment procedures and drive tests.

**IMPORTANT: Park brake must hold tractor stationary on slope and tractor must not creep downward once park brake is set.**

3. If any test fails, the clutch and brake linkages must be adjusted or components replaced.

*NOTE: For gear transaxle units, when the clutch/brake pedal is released and the traction drive system is engaged, there must be ample clearance between the friction pucks and the brake disc to prevent the disc brake from dragging.*
*If a dragging condition exists, the disc brake will over heat and will also experience premature wear.*

## TEST DRIVE

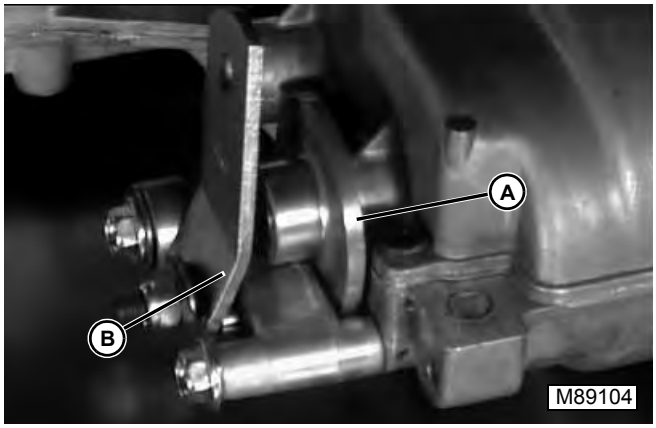
**⚠ CAUTION**

**DO NOT engage clutch/brake pedal too aggressively when going in reverse or tractor may tip over backwards. It is recommended that you install the mower deck before performing the test drive on a 17° slope.**

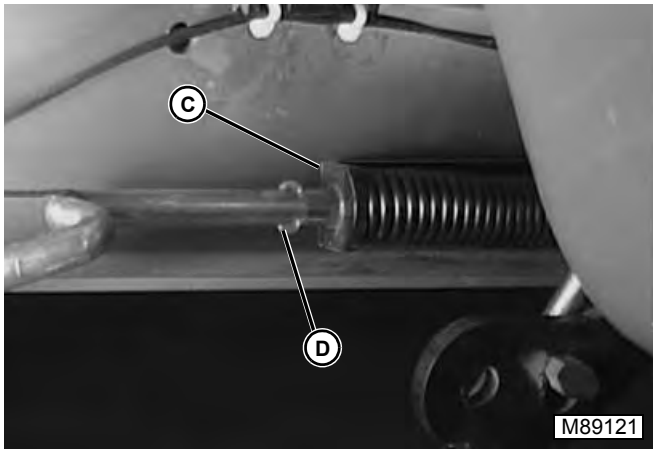
1. Attach mower deck to tractor, this will help stabilize the tractor.
2. Drive tractor on dry pavement in a safe, open and level area at fast idle in high gear. Apply a “panic stop” force (no more than 50 pounds of force) to brake pedal—tractor must stop within **5 feet** at full speed forward.
3. Repeat Steps 2—3 for reverse. Tractor must stop within **2.5 feet** at full speed reverse.
   - If belt is excessively worn, stretched, glazed, or unraveling, replace it
   - If belt is not excessively worn, make finite adjustments above or below specification to gain proper response in traction drive system. **Remember**, to **lengthen** clutch spring causes **increased** traction and aggressiveness; to **shorten** clutch spring causes **decreased** traction and aggressiveness
4. If tractor fails test, inspect brake assembly components, replace as necessary, and repeat all adjustment procedures and drive tests.

## BRAKE ADJUSTMENT—LT133

**Procedure:**




1. First check for brake disc (A) contacting the case and brake lever (B) contacting its mounting bracket, top or bottom.




2. Depress clutch/brake pedal and lock lever into PARK position from the operator's station.
3. Measure distance between end of compression spring bracket (C) and front edge of brake rod stop tabs (D).

**Specifications:**

**Distance between Compression Spring Bracket & Brake Rod Stop Tabs . . 7 – 9 mm (0.28 – 0.35 in.)**

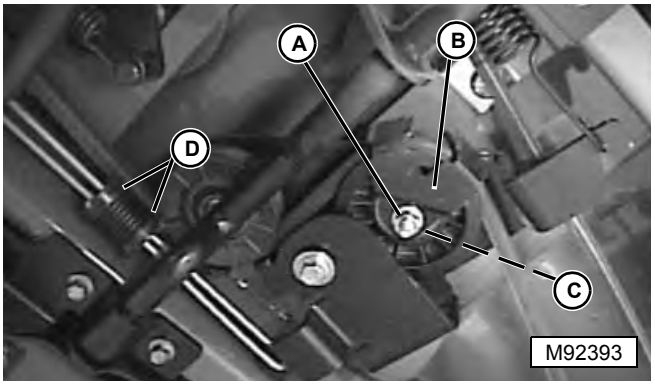
4. If not to specifications, release brake and adjust brake lever tension nut.
5. Repeat steps 3 and 4 until specified measurement is obtained when brake is applied.
6. Check to be sure the brake does not drag when released. If brake drags, replace friction pucks and disc and readjust.

*NOTE: These adjustment procedures can be performed with tractor on the floor; however, you may want to safely raise the tractor for easier access. If you do, remove the battery to avoid spilling any electrolyte solution.*

## DRIVE BELT ADJUSTMENT

**Procedure:**

1. Lock park brake.




2. Remove belt guide nut (A) and belt guide (B).
3. Loosen idler nut (C) and slide idler rearward to decrease distance between plastic caps of compression spring (D) or forward to increase distance.
4. Tighten idler nut.
5. Release park brake and measure distance between plastic caps of compression spring (D).
6. Repeat steps 2 thru 5 until distance between plastic caps of compression spring (D) is **32.5 mm (1.28 in.)**.
7. Tighten idler nut (C) to **26 N•m (19 lb-ft)**.
8. Install belt guide (B).

**Specifications:**

**Compression Spring Spacing . . . 32.5 mm (1.28 in.)**
**Idler Nut. . . . . .26 N•m (19 lb-ft)**

## SHIFT LINKAGE ADJUSTMENT

**Procedure:**

1. Jack and support machine to remove left rear wheel.
2. Place shifter in NEUTRAL position.

3. Loosen nut (A) on shaft mount.

4. Slide shaft mount forward or backward to center shifter in the NEUTRAL slot.
5. Tighten nut on shaft mount.

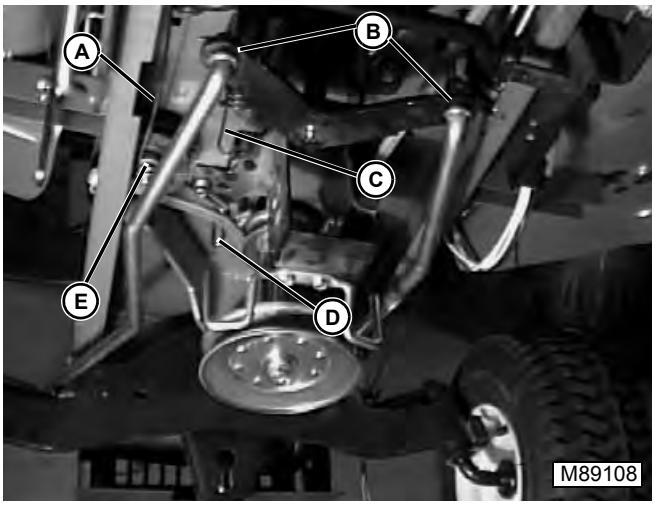
## REPAIR

## TRACTION DRIVE BELT REMOVAL/ INSPECTION/INSTALLATION

*NOTE: If drive belt is in good condition, it does not have to be completely removed to take out the transaxle.*

**Removal:**

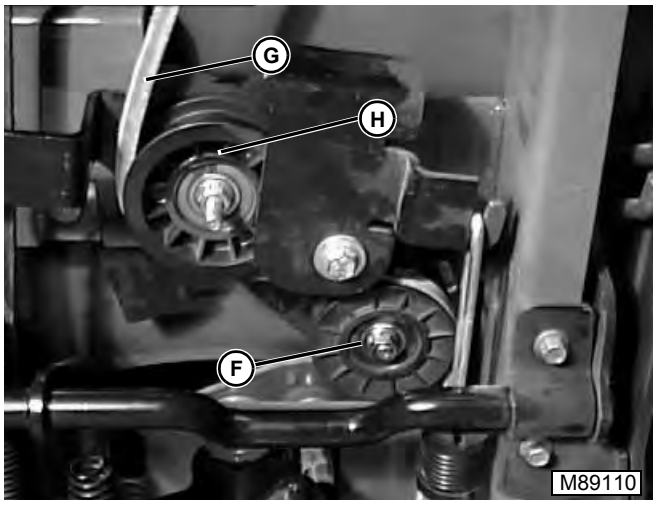
1. Disconnect battery.
2. Park tractor on level surface.
3. Remove mower deck.
4. Safely raise and block tractor to gain easy access to underside of frame.
5. Release clutch/brake pedal to off position.



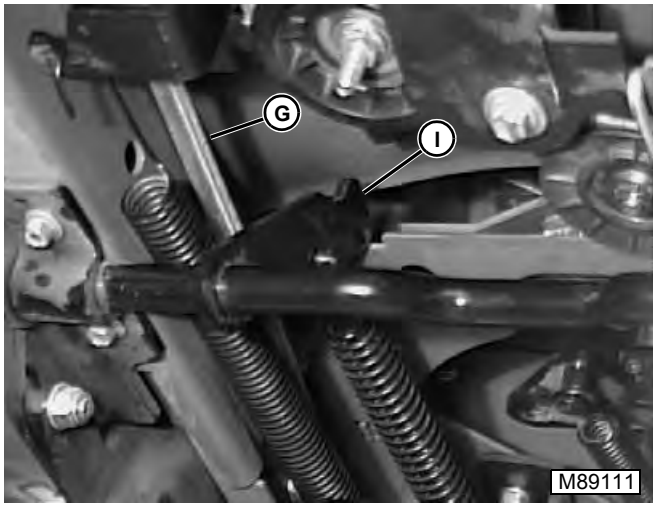

**⚠ CAUTION**

**PTO and Lift Lower springs are under high tension. Use locking pliers or spring puller tool and wear safety glasses when removing and installing springs.**

6. Remove PTO spring (C) from front idler.
7. Remove mower deck lift/lower spring (A) from PTO clutch assembly.
8. Remove front idler guide (D).
9. Remove front idler (E).
10. Remove steering arm tie rods (B).




11. Remove clutch idler (F).
12. Remove belt (G) from transaxle belt drive sheave (H).



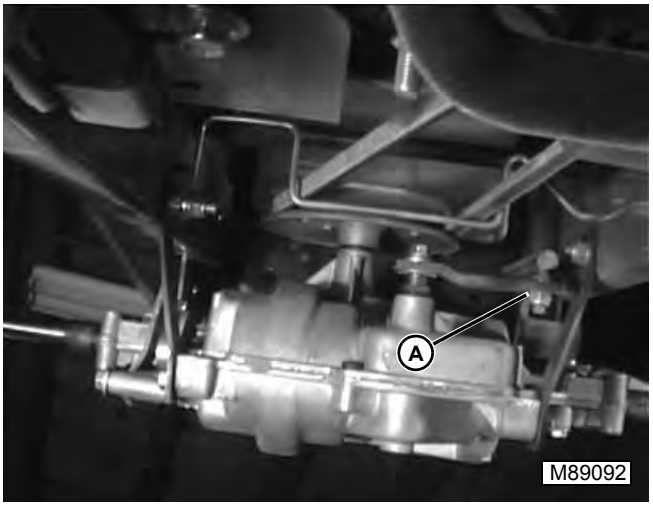

13. Have assistant move mower deck lift/lower arm (I) slightly to allow drive belt (G) to be removed.

**Inspection:**

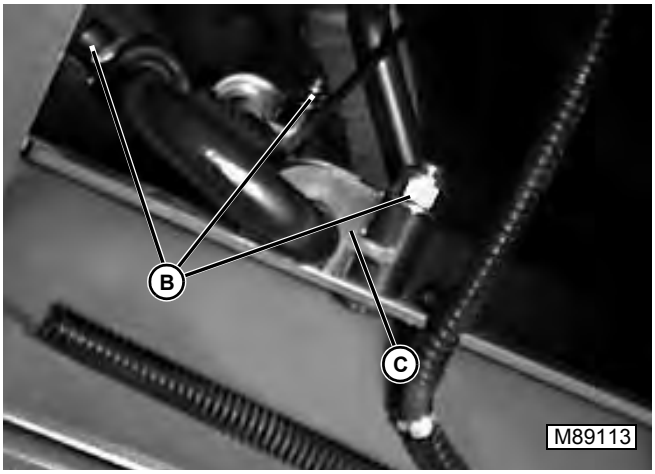
14. Examine belt to determine if it is worn, stretched, cracked, frayed, or damaged beyond the point of continued use.
15. Install belt in reverse order of removal.
16. Adjust drive belt. See “DRIVE BELT ADJUSTMENT”.

## SHIFT LINKAGE REMOVAL/ INSTALLATION

1. Remove battery.
2. Block rear of tractor off surface so you can remove left drive wheel.
3. Remove shift knob and nut.



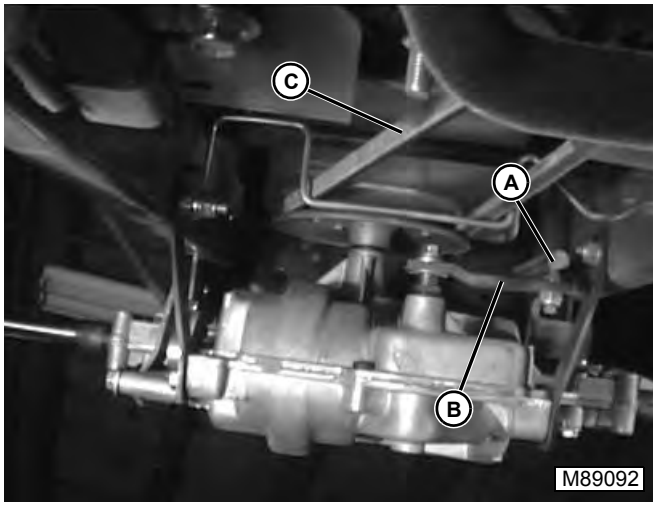

4. Remove locknut (A) from transaxle shift arm.



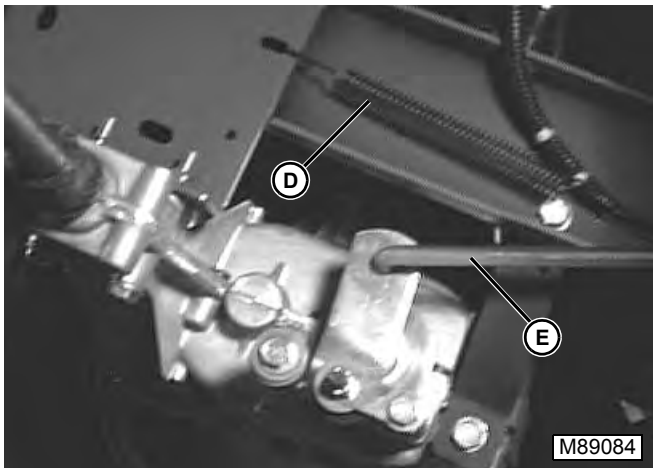

5. Remove shift bracket nuts, bolts (B) and shift shaft arm holders (C).
6. Remove shift linkage from the left side of the frame. You will have to “snake” the shift rod from the tractor.
7. Replace necessary components.
8. Install shift linkage in reverse order of removal.
9. Adjust shift linkage. See “SHIFT LINKAGE ADJUSTMENT”.

## TRANSAXLE REMOVAL/ INSTALLATION

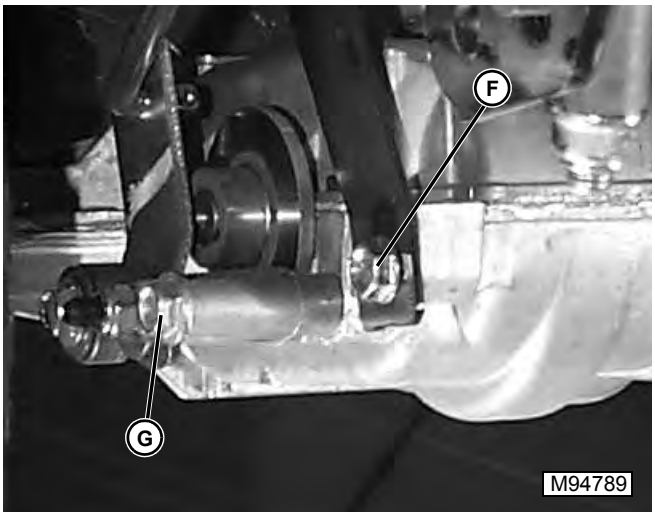
1. Disconnect battery.
2. Remove mower deck.
3. Raise and block tractor off surface.
4. Remove rear wheels.




5. Disconnect shift linkage (A) from shift arm (B).
6. Remove traction drive belt tension spring and belt (C).




7. Disconnect brake rod return spring (D).
8. Disconnect brake rod (E).




9. Support transaxle with jack stands or have a helper hold transaxle in place while you remove hardware.
10. Remove front cap screws (F) and transaxle cap screws (G).
11. Carefully remove transaxle to work bench.
12. Install transaxle in reverse order of removal.
13. Tighten mounting hardware to the following:

**Specifications:**

**Front hanger cap screws to frame . . . . . 34 N•m (25 lb-ft)**
**Front transaxle cap screws to hangers . . . . . 27 N•m (20 lb-ft)**
**Rear axle cap screws and nuts to frame. . . . . 34 N•m (25 lb-ft)**
**Shift linkage lock nut . . . . . 16 N•m (140 lb-in.)**

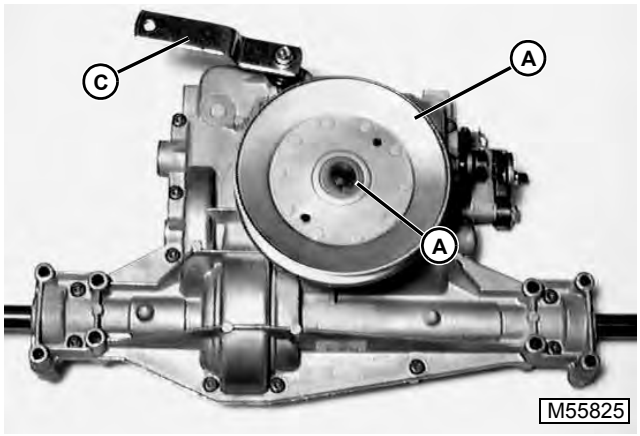
*NOTE: Replacement transaxle will not have tapped holes for front hanger brackets. Reuse original self tapping cap screws and torque to 32.5 N•m (24 lb-ft).*

14. Install traction drive belt.
15. Install mower deck.
16. Lower tractor to surface.
17. Check and adjust shift linkage, See “SHIFT LINKAGE ADJUSTMENT”. For brake linkage and clutch linkage adjustment see BRAKE section.

## TRANSAXLE DISASSEMBLY

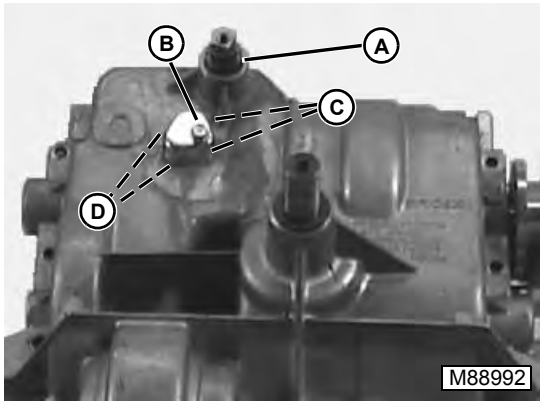
**IMPORTANT: Pay close attention to the order and orientation of all components to their neighbor components. Mark them, if necessary. This will aid assembly.**

**Remove Drive Sheave/Shift Arm:**




1. Remove drive sheave snap ring (A).
2. Remove drive sheave (B).
3. Remove shift arm (C). Be sure when installing that special square hole washer and shift arm are seated properly over square end of shifter shaft.

**Remove Shifter Detent And Repair Gear Assembly**

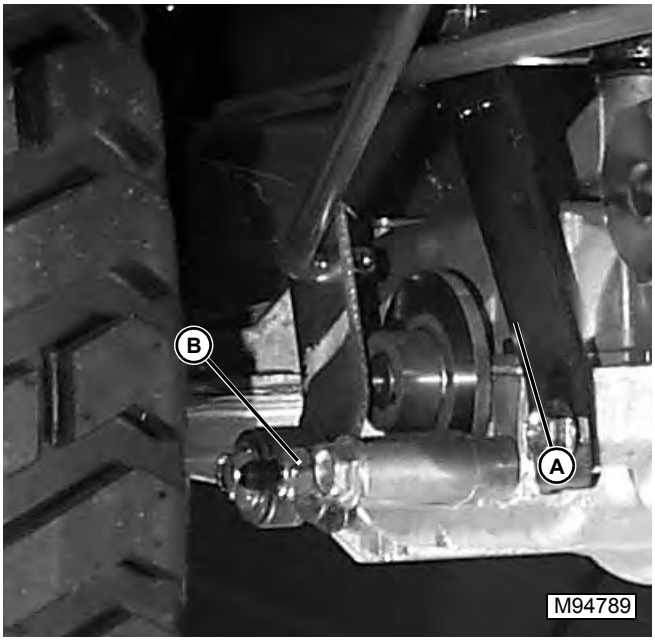



1. Remove shifter shaft rubber boot (A).
2. Remove detent cover (B) and detent springs (C).

**IMPORTANT: DO NOT drop or lose detent balls (D).**

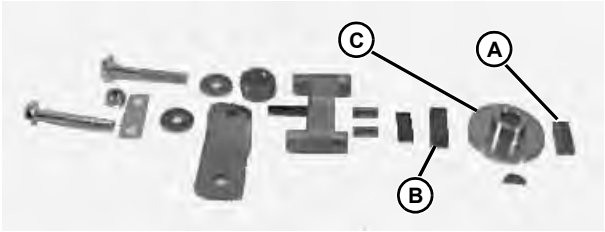
3. Use a magnet or place a shop cloth over holes and turn transaxle upside-down to catch both detent balls in cloth.
4. Inspect detent balls and springs for wear or damage. Replace components as necessary, but do not install until assembly, much later in this section.

**Remove Brake And Repair Gear Assembly:**



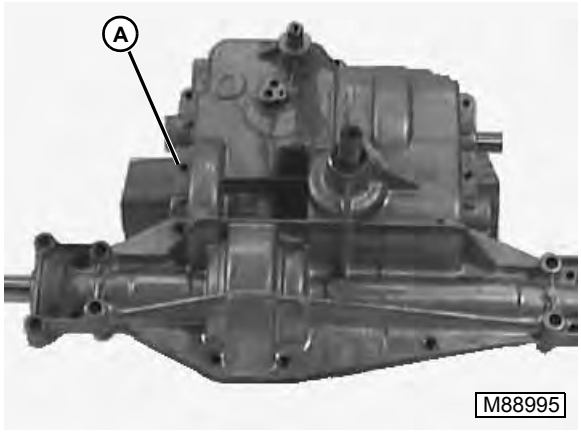

**IMPORTANT: First check brake components for wear. Check for brake disc (A) contacting the case and/or brake lever contacting its mounting bracket (B), top or bottom. If so, all three components must be replaced.**

1. Remove brake assembly.

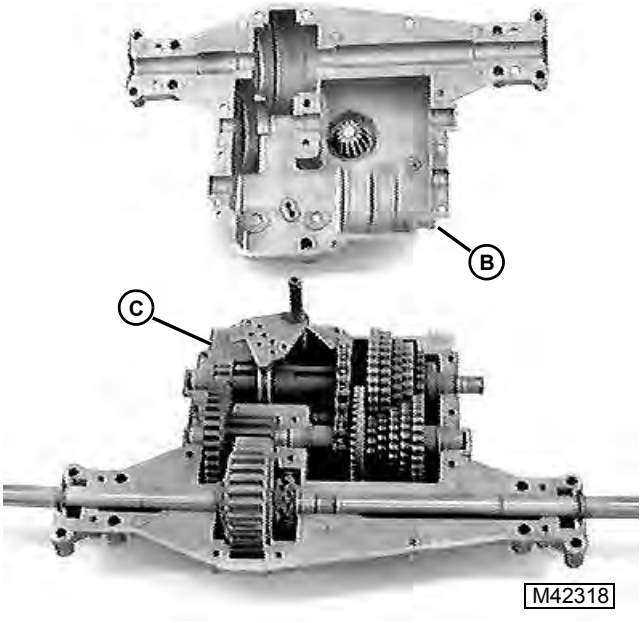



2. It is recommended that thinner (A), inside, and thicker (B), outside friction pucks and brake disc (C) be replaced (Pucks Ordered As Set Only) anytime transaxle is disassembled.
3. Inspect remaining components for wear or damage. Replace components as necessary, but do not install this assembly until transaxle has been completely assembled.

**Separate Transaxle Housing Case Halves:**

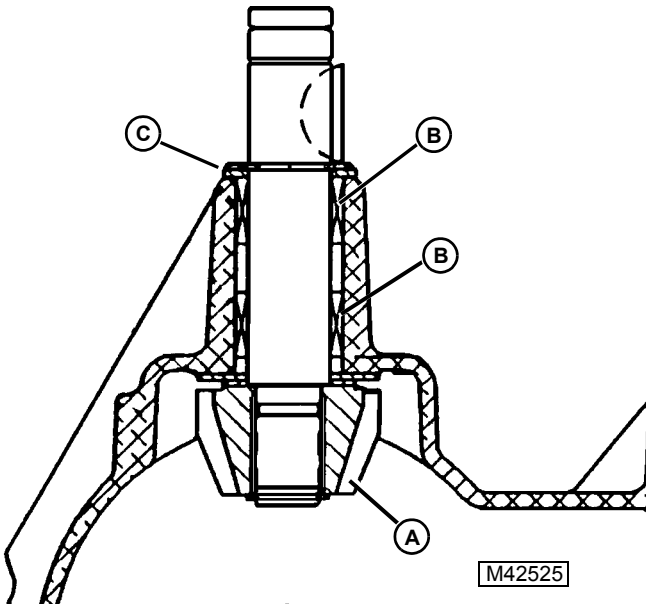



1. Remove all sixteen transaxle housing socket head screws (A). Brake assembly should be removed already.



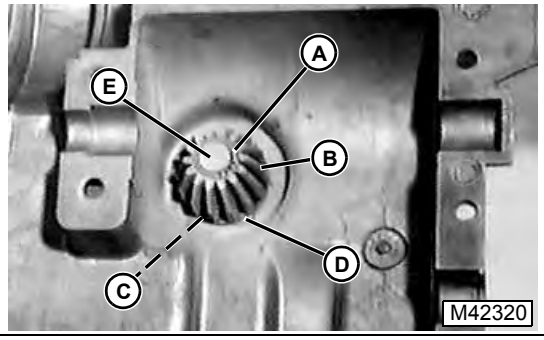

2. Carefully separate transaxle housing into upper (B) and lower (C) case halves.
3. Inspect overall condition of components without removing any of them. Visually target worn or damaged parts for replacement.
4. Remove most of the grease without removing any components.

**Inspect Input Shaft/Pinion Gear Assembly:**

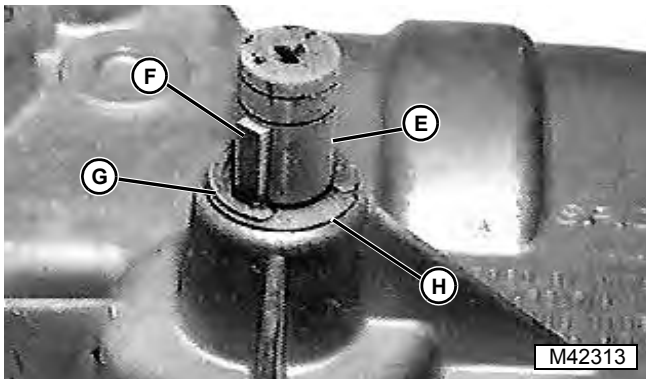



1. Visually check overall condition of assembly, including the key, keyway, and drive sheave hub keyway.
2. Check condition of pinion gear (A), look for wear, pitting, broken teeth, etc.
3. Grasp the input shaft and try to rock it left or right inside case housing. If movement is noticeable, needle bearings (B) inside diameters will need to be measured once shaft is removed.
4. To measure input shaft air gap, push on the end of the input shaft to seat **Pinion Gear** against housing.
5. Use a feeler gauge to measure go-no-go air gap between shim (C) and the top surface of the Input Boss:
   - Go air gap should be **0.25 mm (0.010 in.) or less**
   - No-go measurement is **anything greater than 0.25 mm (0.010 in.)**
6. If measurement results in a no-go reading, shim thickness needs to be changed or worn components must be replaced.

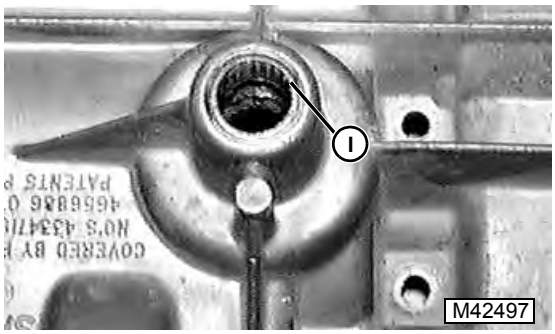
**Disassemble Input Shaft/Pinion Gear Assembly:**

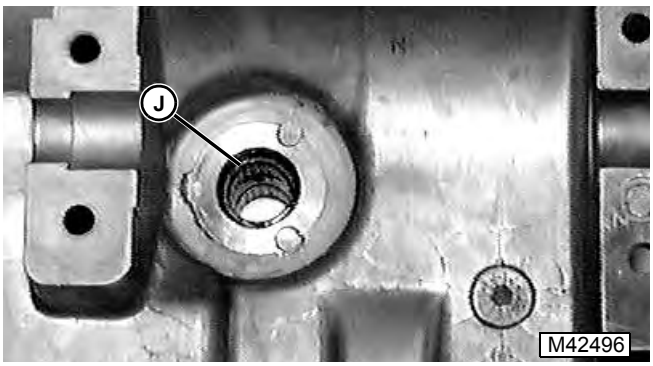


1. Remove snap ring (A), bevel pinion gear (B), small washer (C), and large washer (D) from input shaft (E), inside upper case half.
2. Turn upper case half over.




3. Remove woodruff key (F), E-ring (G), shim washer (H), and input shaft (E).

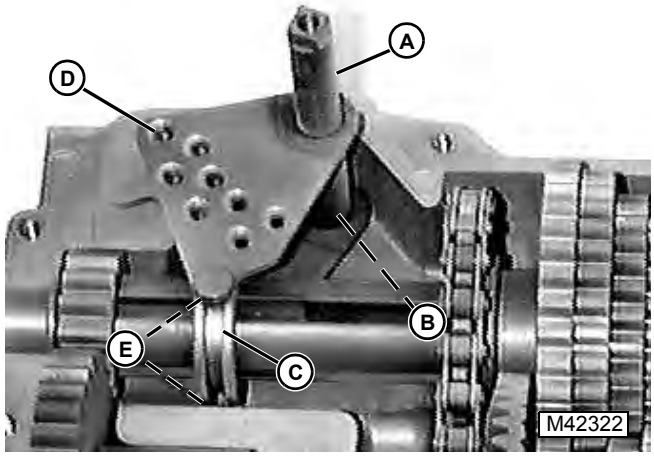


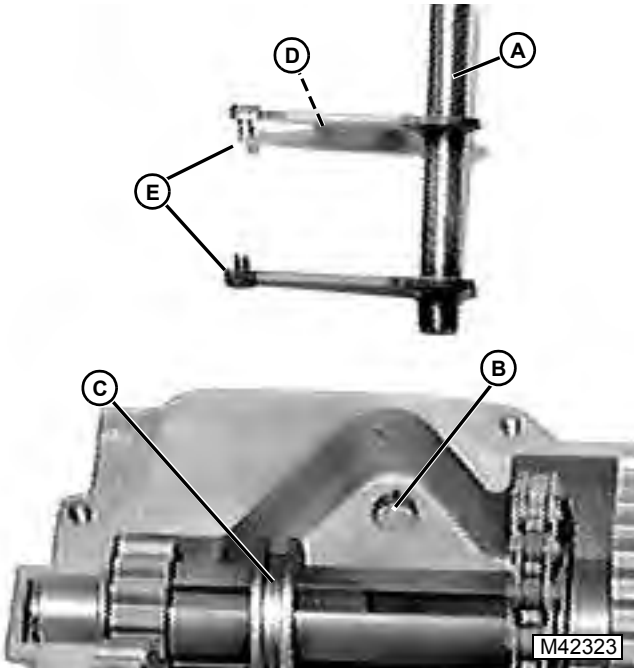

**IMPORTANT: DO NOT scratch or deform upper case half bore when removing needle bearings.**

4. Visually inspect condition of upper case half input shaft needle bearings, upper bearing (I) and lower bearing (J).
5. Measure inside diameters of each bearing:
   - Go measurement should be **15.89—15.92 mm (0.6255—0.6269 in.)**
   - No-go measurement is **anything greater than 15.89—15.92 mm (0.6255—0.6269 in.)**
6. If measurement results in a no-go reading for either bearing, replace both bearings (Ordered As Set With Special Grease) by carefully pressing them from case half bore without damaging bore.
7. Clean and inspect bore. If scratched or deformed, replace upper case half.

**Disassemble Shifter Shaft Assembly:**



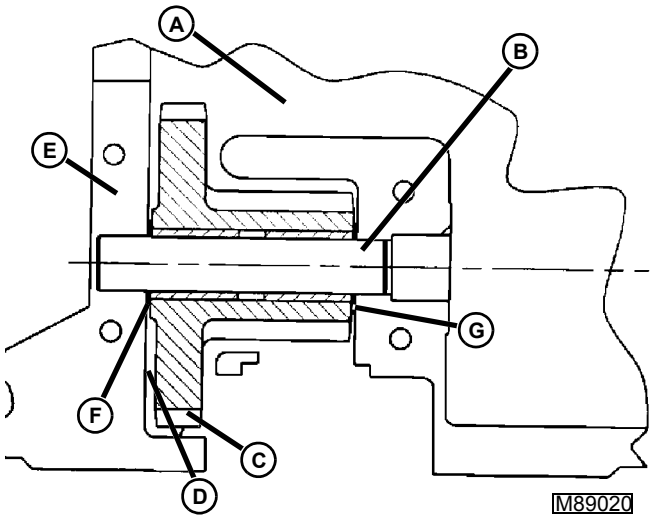

1. Lift shifter shaft assembly (A) from lower case half mounting hole (B) and groove of shift collar (C).




2. Clean shifter shaft assembly once removed.
3. Inspect condition of detent holes (D), shift pins (E), overall shifter shaft assembly, lower case half mounting hole, and shift collar.

4. If any part of shifter shaft assembly is worn or damaged, replace it; also, the rubber boot, and the detent balls and detent springs.
5. If lower case half mounting hole is worn or damaged, replace the case half.
6. If shift collar is worn or damaged, replace it when intermediate shaft assembly is disassembled.

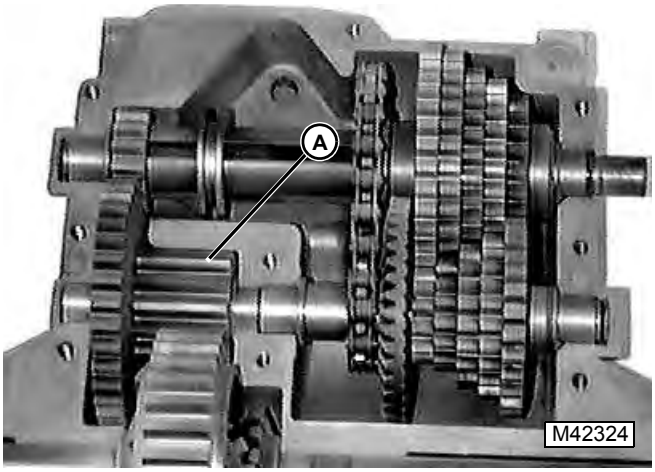
**Inspect Idler Combination Gear Assembly:**



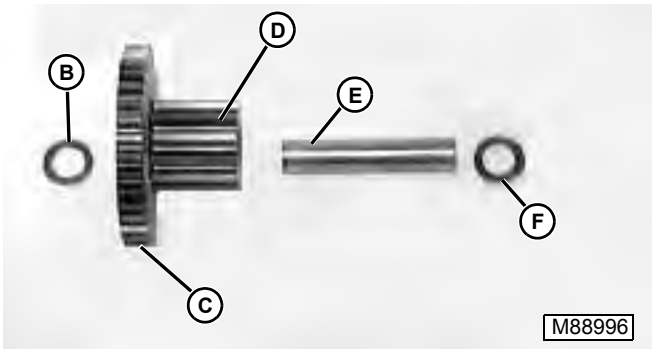

1. Visually check overall condition of lower housing assembly (A), including shaft (B) and bushings, combination gear (C) for wear, pitting, broken teeth, etc.
2. Use a feeler gauge to measure go-no-go air gap (D) between end surface of combination gear and side surface of case half (E):
   - Go air gap should be **0.33—0.63 mm (0.013—0.025 in.)**
   - No-go air gap is **anything greater than 0.33—0.63 mm (0.013—0.025 in.)**
3. If measurement results in a no-go reading, worn and damaged components need to be replaced.

*NOTE: Make note of washer (F), and shim washer (G) if removal of components is necessary.*

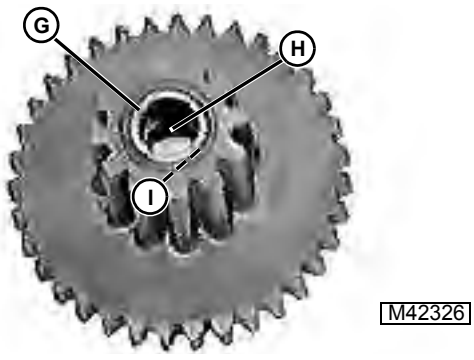
**Disassemble Idler Combination Gear Assembly:**



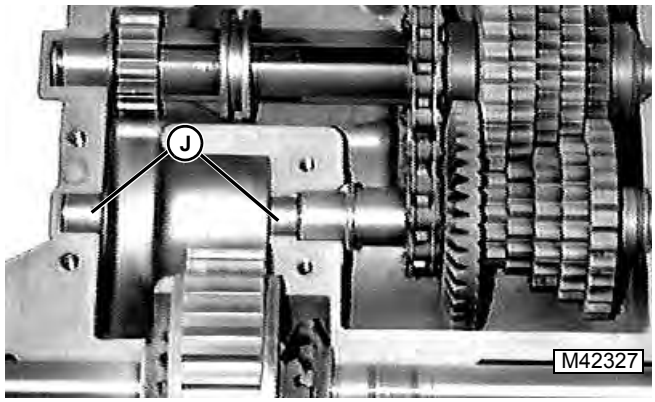

1. Lift idler combination gear assembly (A) from lower case half.
2. Clean components individually once disassembled.




3. Separate and inspect assembly components:
   - Washer (B) should be **0.632 x 1.00 x 0.046 in.**, not scored nor discolored (Burned)
   - Narrow combination gear (C) should have **30** good teeth and wide combination gear (D) should have **12** good teeth, not scored nor discolored (Burned)
   - Idler shaft (E) should be smooth and not scored, pitted, nor discolored (Burned)
   - Shim washer (F) is found in shim kit

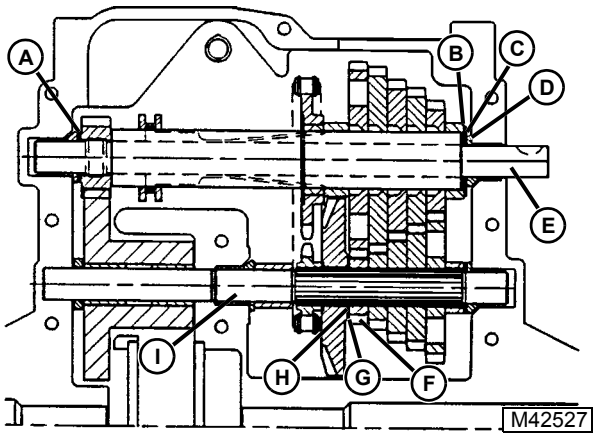


- Inside (G) and outside (H) bearings are press fit and should not be scored nor discolored (Burned)
- Gear bore (I) should not be scored or discolored (Burned). Replacement gear has bronze sleeve bearings (2), a new shaft is also recommended whenever new gear is ordered




4. Inspect lower and upper case halves and idler shaft surfaces (J) for excessive scoring or wear. Replace case halves or idler shaft as necessary.
- The housings to idler shaft is an interference fit that grips the idler shaft to prevent it from rotating

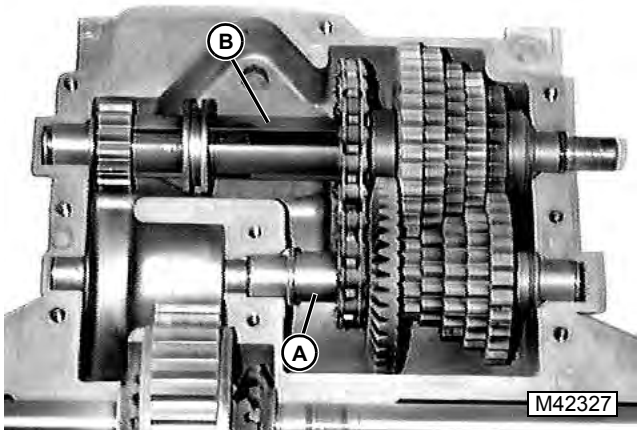
**Inspect Drive/Intermediate Shaft Assemblies:**




1. Visually check overall condition of assemblies, including gears for wear, pitting, broken teeth, etc.
2. For the drive shaft assembly (I), use a feeler gauge to measure go-no-go air gap (G) between side surface of small gear (F) and side surface of shim washer (H):
   - Go air gap should be **0—0.20 mm (0—0.008 in.)**
   - No-go air gap is **anything greater**
3. For the intermediate shaft assembly (E), use a feeler gauge to measure go-no-go air gap (C) between end surface of flange bearing (D) and washer (B):
   - Go air gap should be **0—0.25 mm (0—0.010 in.)**
   - No-go air gap is **anything greater**
4. If either or both measurements result in a no-go reading, shim washers (A and H) need to be added or worn components need to be replaced.

*NOTE: You may prefer to use a calliper to measure the drive shaft gear stack. Remove bevel drive gear only and reinstall rest of drive shaft assembly. Put calliper over shim washer (B) and lip of right-side flange bearing. Calliper should read **61.8617—62.0395 mm (2.4355—2.4425 in.)**.*

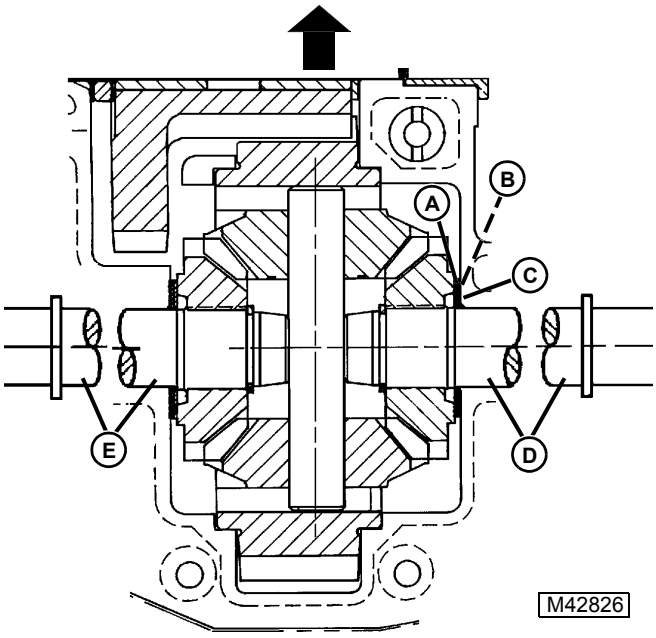
**Disassemble Drive/Intermediate Shaft Assemblies:**




1. Lift both drive (A) and intermediate shaft (B) assemblies out together.
2. Carefully remove drive shaft assembly components (Bottom Row) from drive shaft. Be sure to remember each components orientation to its neighbor and to the drive shaft. You may want to mark the same side of each component to help keep the orientation straight.
3. Clean components individually once disassembled.
4. Inspect each component closely for wear, scoring, cracks, chips, and broken teeth or splines.
5. Do the same for the intermediate shaft and its components (Top Row).
6. Replace components as necessary.

**IMPORTANT: Remember gear sets are a matched set and both must be replaced, even if only one gear in the set is damaged.**

**Inspect Differential/Axle Shafts Assembly**

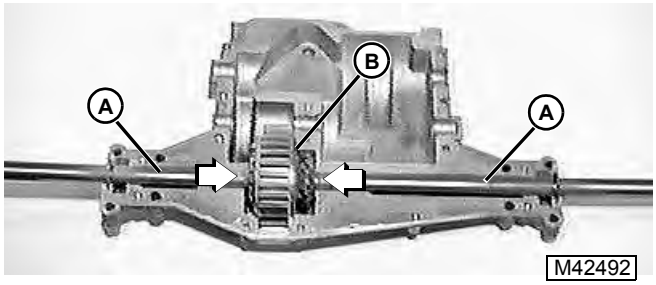



1. Visually check overall condition of assembly.
2. Use a feeler gauge to measure go-no go air gap (B) between side surface of shim washer (A) and side surface of lower case (C):
   - Go: Air gap should be **0.18—0.30 mm (0.007—0.012 in.)**
   - No-go: Air gap is **0.33 mm (0.013 in.) or greater**

*NOTE: Right hand long (D) and left hand short (E) axles shown for reference purposes.*

3. If measurement results in a no-go reading, worn or damaged components must be replaced.

**Disassemble Differential/Axle Shafts Assembly:**



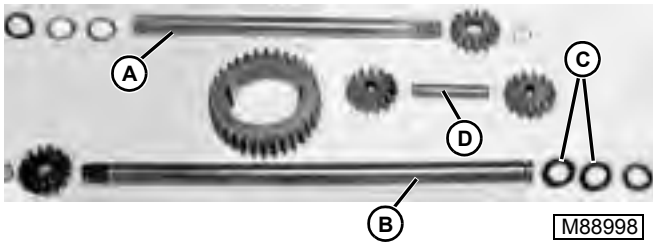

1. Put inward pressure on both axles (A) as you lift differential assembly (B) from lower case.

2. Carefully remove axle shaft assembly components from ring gear (C). Be sure to remember each components orientation to its neighbor and to the ring gear. You may want to mark the same side of each component to help keep the orientation straight.
3. Clean components individually once disassembled, be sure to remove all sealant material from upper and lower case halves.
4. Inspect each component (Especially Both Upper And Lower Case Halves) closely for wear, scoring, cracks, chips, or discoloration (Burnt). Replace components as necessary.
5. Replace seals (D) **every time** transaxle housing has been separated.

## TRANSAXLE ASSEMBLY

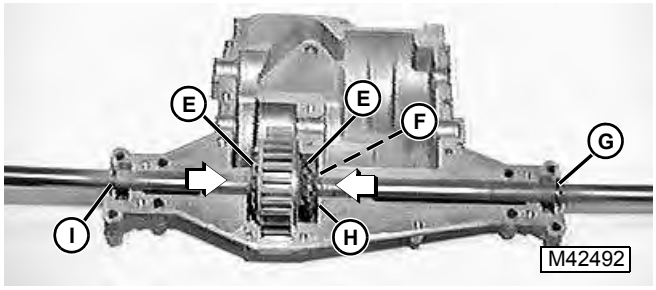
**IMPORTANT: Coat lightly all mating surfaces, except seal surfaces, with SAE 30 weight oil before assembly. Pay close attention to proper order and orientation of all components. Also, it is recommended that you use a calliper to ensure the correct shim, spacer, or washers are installed correctly.**

**Assemble Differential/Axle Shafts Assembly:**



M88998

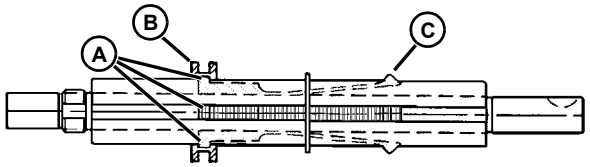
1. Assemble left-hand, short axle (A) as shown with splined, beveled gear facing the ring gear.
2. Assemble right-hand, long axle (B) as shown with splined, beveled gear facing the ring gear and shim washers (C) assembled in combination of thicknesses to obtain specified air gap.
3. Assemble internal shaft (D) as shown with beveled gears facing each other.
4. Install internal shaft assembly in slots of ring gear and push beveled gears away from each other so they are ready to mesh with both axle beveled gears.



M42492

5. Install axle shafts so beveled gears (E) mesh with differential internal shaft beveled gears.
6. Keep inward pressure on both axles as you install differential assembly in lower case housing.
7. Measure air gap between shim washers (F) and side of housing (H). If air gap meets specification, go to next step. If air gap does not meet specification, remove right axle shaft and add other shim washer combinations until air gap in within specification.
8. Carefully install new axle shaft seals (G and I) and seat them in their lower case housing grooves.

**Assemble Drive/Intermediate Shaft Assemblies:**

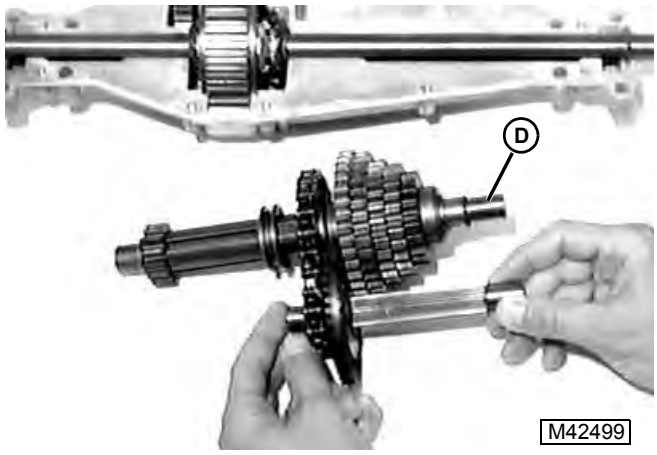


M42526

1. Install four keys in grooves of intermediate shaft and hold them so internal shift collar anchors (A) will seat in internal groove of collar (B) as it is installed on the shaft.
2. Slide shift collar and keys against retaining ring and compress locking ramps/lugs (C) to clear retaining ring.

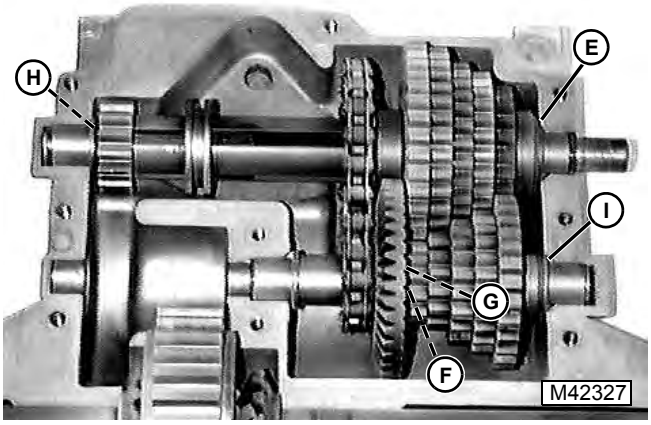
M42498

3. Install remaining intermediate shaft (D) components in their proper order and orientation.



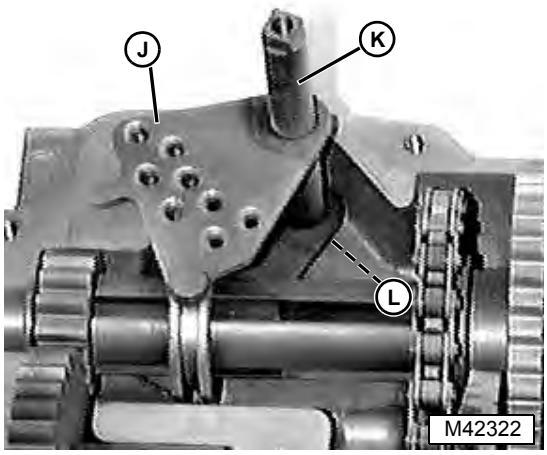
M42499

4. Install drive shaft components one at a time from left-to-right. Long flange of small sprocket faces bevel drive gear.
5. Shim washers for intermediate shaft are found in shim kit.
6. Shim washers for drive shaft are found in shim kit.
7. Install new intermediate shaft seal with open lip facing inside.



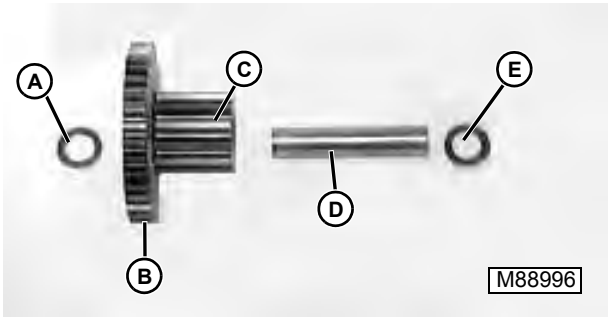

8. Measure air gaps (E and F). Make any changes in shim washer (G) thicknesses from shim kit and shim washer (H) thicknesses from shim kit to obtain proper air gaps.
9. When proper air gap is obtained, gears should drag slightly against feeler gauge.

*NOTE: You may prefer to use a calliper to measure the drive shaft gear stack. Remove bevel drive gear only and reinstall rest of drive shaft assembly. Put calliper over shim washer (G) and lip of right-side flange bearing (I). Calliper should read* ***61.8617—62.0395 mm (2.4355—2.4425 in.)****.*

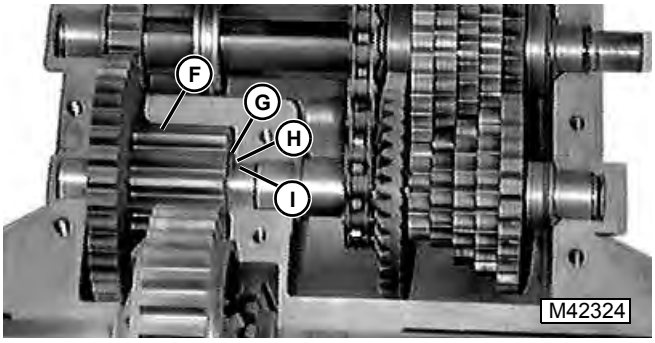



10. John Deere Never-Seez® MUST be applied to top surface (J) of shifter plate and contact portions of shifter shaft (K) and (L) with upper and lower case halves.
11. Install shifter fork assembly.

**Assemble Idler Combination Gear Assembly:**

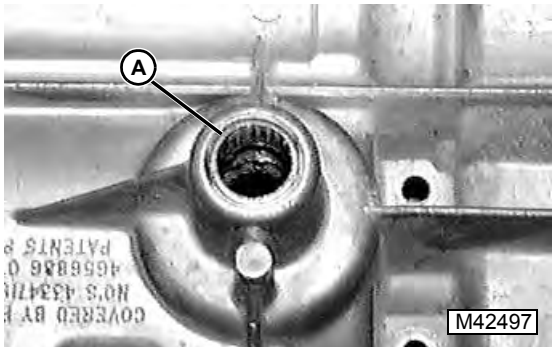


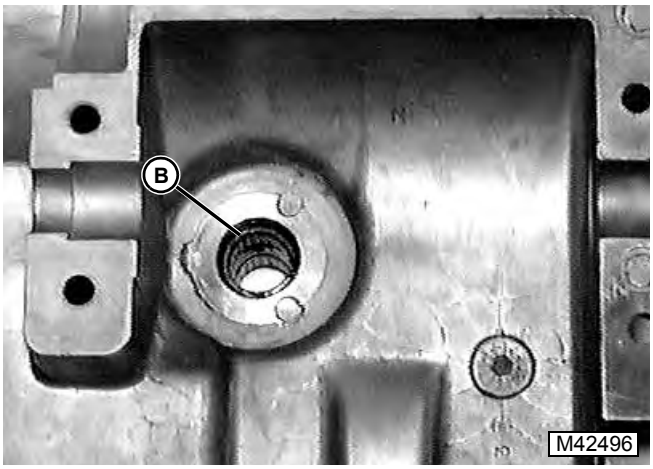

1. Install components on idler shaft in order shown:
   - Washer (A) should be **0.632 x 1.00 x 0.046 in.**
   - Narrow combination gear (B) should have 30 good teeth and wide combination gear (C) should have 12 good teeth
   - Idler shaft (D) should be smooth, not scored, worn, or pitted
   - Shim washer (E) is found in shim kit

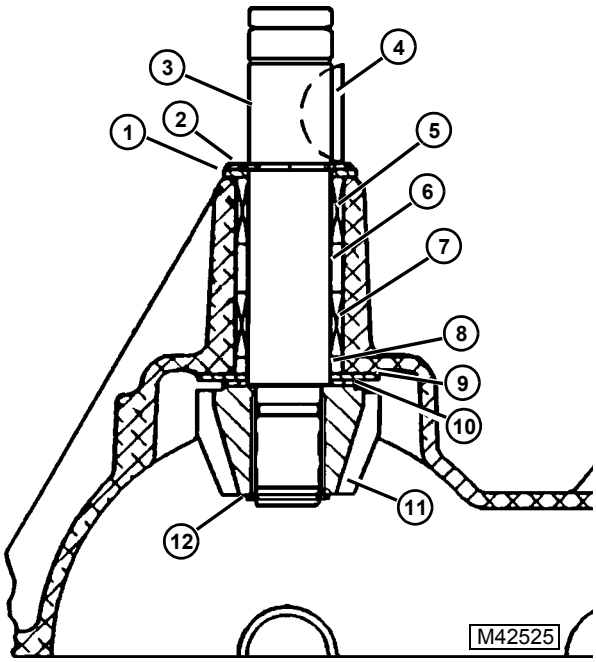



2. Install idler combination gear assembly (F) into lower case half.
3. Measure air gap (G) between shim washer (H) and face of case (I).
4. When proper air gap is obtained, assembly should drag slightly against feeler gauge.

**Assemble Input Shaft/Pinion Gear Assembly:**



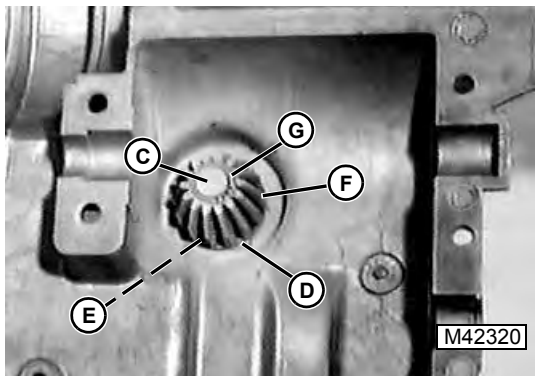


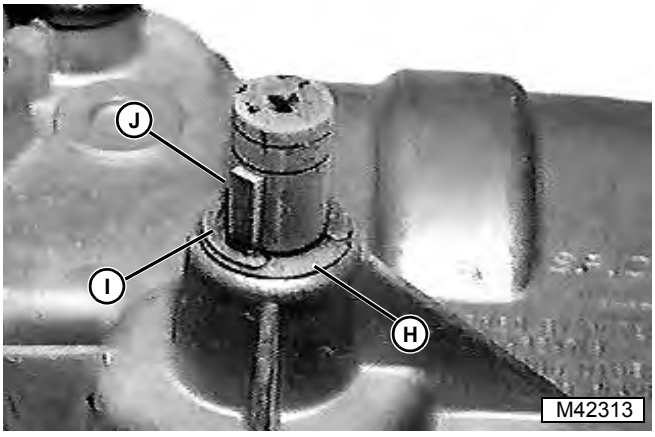

1. Shim Washer
2. E-Ring
3. Input Shaft
4. Woodruff Key
5. Upper Needle Bearing
6. Cavity
7. Lower Needle Bearing
8. Cavity
9. Large Washer
10. Small Washer
11. Bevel Pinion Gear
12. Snap Ring

**IMPORTANT: DO NOT scratch or deform upper case half bore when installing needle bearings.**

1. Needle bearings MUST be packed with grease before installing.
2. Install lower needle bearing (B) with flat side of bearing (With Lettering) toward inside of case. Press lower needle bearing in case bore until it is recessed **3.3 mm (0.13 in.)** from inside bore opening.
3. Install upper needle bearing (A) with flat side of bearing (With Lettering) toward outside of case. Press upper bearing in case bore until it is **flush—0.76 mm recessed (flush—0.03 in. recessed)** with outside bore opening.
4. Pack cavities with grease before installing input shaft.

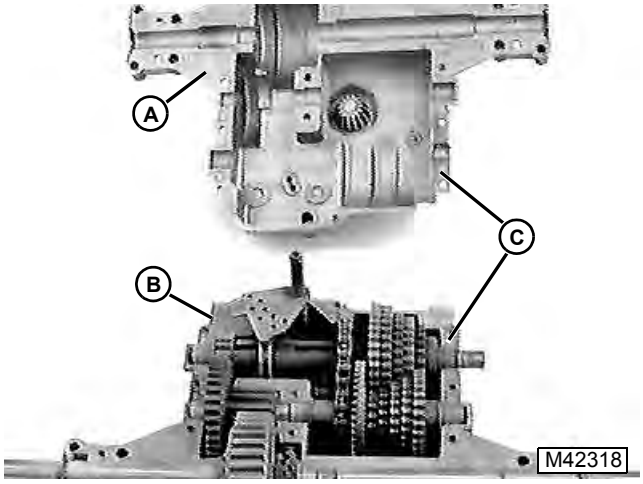



5. Install input shaft (C) (With Keyway On Outside Of Case), large washer (D), small washer (E), bevel pinion gear (F), and snap ring (G).



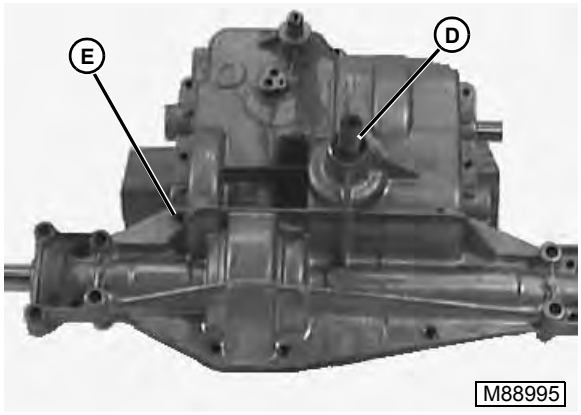

6. Turn upper case half over.
7. Install a shim washer (H) (From Shim Kit) of the proper thickness that allows enough clearance for E-ring (I) to be installed. Go air gap should be **0.25 mm (0.010 in.)** or less.
8. Turn upper case half over and measure air gap between snap ring and bevel pinion gear.
9. If measurement results in a no-go reading, shim thickness needs to be changed.
10. Install woodruff key (J) in shaft keyway.

**Assemble Transaxle Housing Case Halves:**




1. Pack upper case (A) beveled pinion gear and lower case housing assembly (B) with **638 g (1.406 lbs)** of grease.
2. Apply John Deere Form-In-Place Gasket Silicone Sealant to lower case mating surfaces.
3. Apply silicone all around case cutouts where intermediate shaft flange bearing sets into upper and lower case halves (C).

*NOTE: Be sure sealant does not contact any gear, shaft, or bearing surfaces.*

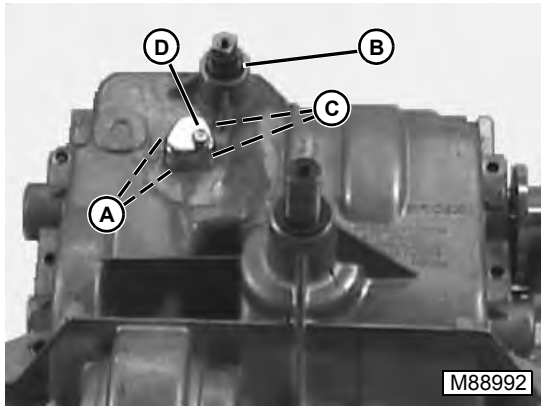



4. Align lower and upper case halves together, be sure shaft seals are seated correctly and you may have to turn input shaft (D) slightly to insure beveled pinon gear meshes with beveled drive gear.
5. Install 16 socket head screws (E).
6. Tighten screws to specification.

**Specification:**

**Transaxle Cap Screw Torque**
**. . . . . 9.50 N•m (85 lb-in.)**

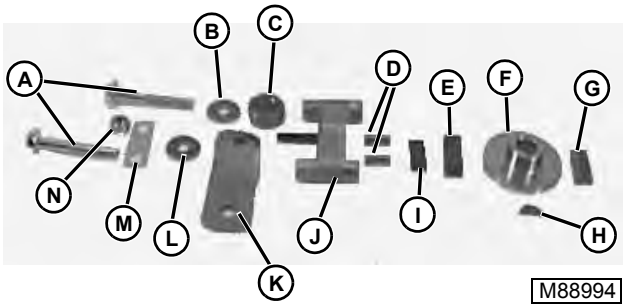
**Install Shifter Detent Assembly:**




**IMPORTANT: DO NOT drop or lose detent balls (A).**

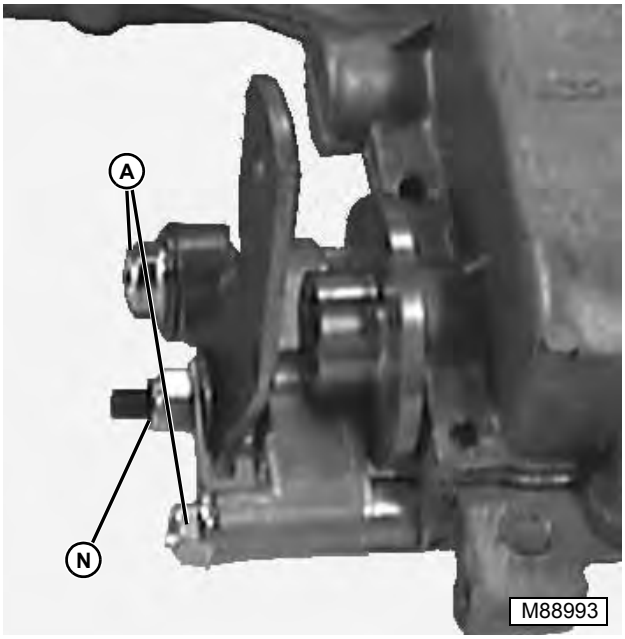
1. Install shifter shaft rubber boot (B).
2. Coat detent balls and springs (C) with John Deere Never-Seez and install in case bores.
3. Apply sealant to inside of detent cover (D).
4. Install and tighten detent cover and screw until flush with top of mounting hole surface.

**Install Brake Assembly:**




1. Install woodruff key (H) into shaft keyway.
2. Install thinner friction puck (G) in lower case puck recess.
3. Install brake disc (F) with hub outward.
4. Install spacer (C) over left lip of mounting bracket (J).
5. Install cap screw (A) and washer (B) in left mounting bracket hole.
6. Install brake lever (K), washer (L), bracket (M), and lock nut (N) on mounting bracket center stud.
7. Install cap screw (A) in right hole of mounting bracket (J).
8. Install dowel pins (D) inside two center holes of mounting bracket (J). Coat dowel pins with John Deere Never-Seez®.

9. Install striker plate (I) and thick friction puck (E) in backside recess of mounting bracket.

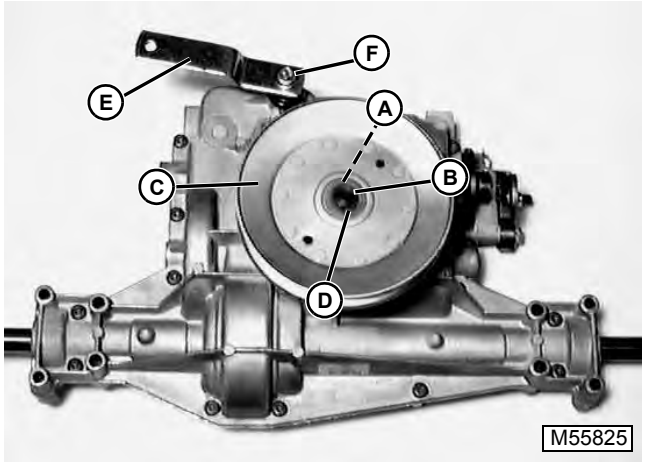



1. Install complete brake assembly to transaxle.
2. Tighten cap screws (A) to **20 N•m (180 lb-in.)**.
3. Tighten lock nut (N) until there is a **.254 mm (0.010 in.)** air gap between thick friction puck and brake disc.
4. Check that brake is not dragging. See Brake Section for adjustment procedure.

**Specifications:**

**Brake Assembly Cap Screws . . . 20 N•m (180 lb-in.)**
**Brake Assembly Lock Nut**
**. . . . . until there is a .254 mm (0.010 in.) air gap between thick friction puck and brake disc**

**Install Drive Sheave and Shift Arm:**




1. Install woodruff key (A) in input shaft (B).
2. Install drive sheave (C) and fasten with snap ring (D).
3. Install shift arm (E). Tighten cap screw (F) to **16 N•m (140 lb-in.)**.

**Specification:**

**Shift Arm Cap Screw . . . . . 16 N•m (140 lb-in.)**

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# SPECIFICATIONS

**Transaxle:**

| | |
|---|---|
| Type | Tuff Torq® K51 Transaxle |
| Axle Torque Output: | |
| Rated | 231 N•m (170 lb-ft) |
| Peak | 1078 N•m (795 lb-ft) |
| Input Speed (Max) | 3050 rpm |
| Weight (Dry) | 13.7 kg (30 lb) |
| Lubrication | 10w-30 CD class oil |
| Capacity | 2.4 L (0.63 gal) |
| Tire Diameter (Max) | 508 mm (20 in.) |
| Static Weight On Axle (Max) | 306 kg (675 lb) |

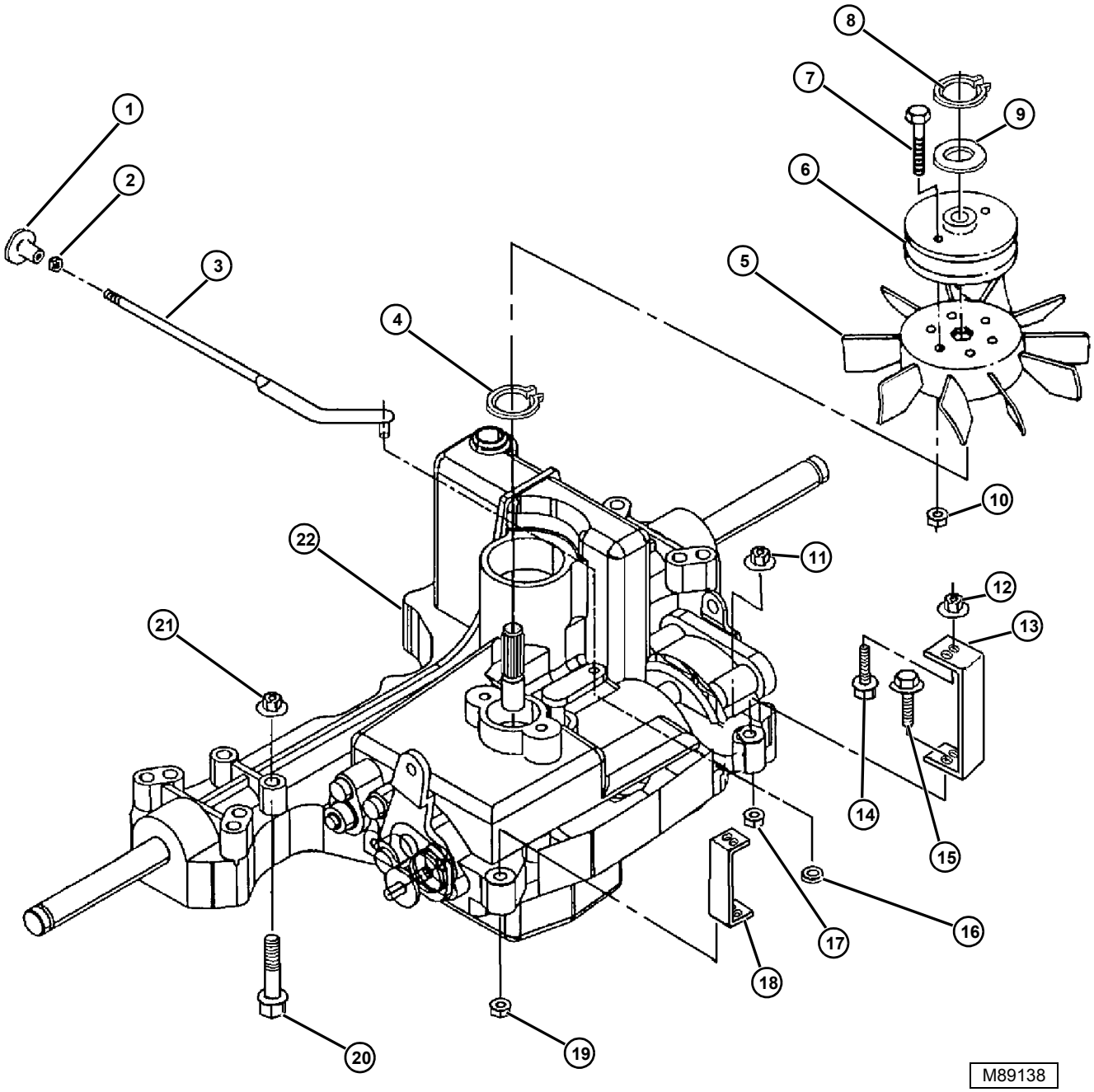
**Brake:**

| | |
|---|---|
| Brake Type | Wet Disk |
| Brake Capacity | 363 N•m (268 lb-ft) with 23 N•m (17 lb-ft) on brake arm |
| Brake LeverTravel (Maximum) | 30° |

# TORQUE SPECIFICATIONS (ALPHABETICAL ORDER)

| | |
|---|---|
| Brake Lever Bracket Cap Screws | 52 N•m (38 lb-ft) |
| Case Cap Screws: | |
| New Case | 30 N•m (22 lb-ft) |
| Used Case | 24 N•m (18 lb-ft) |
| Center Block Cap Screws | 52 N•m (38 lb-ft) |
| Drain Plug | 16 N•m (12 lb-ft) |
| Hydro Pedal Pivot | 45 N•m (33 lb-ft) |
| Reservoir Cover Cap Screws | 47 N•m (35 lb-ft) |
| Transaxle to Frame | 34 N•m (25 lb-ft) |
| Transaxle to Hanger Bracket | 27 N•m (20 lb-ft) |

# COMPONENT LOCATION




| | | | | |
|---|---|---|---|---|
| 1. Knob | 6. Sheave | 11. Lock Nut | 16. Push Nut | 21. Lock Nut |
| 2. 1/4-20 Hex Jam Nut | 7. M6 x 30 Bolt | 12. Lock Nut | 17. Lock Nut | 22. Transaxle Assembly |
| 3. Rod | 8. Snap Ring | 13. Strap | 18. Strap | |
| 4. E-Ring | 9. Spacer | 14. Screw | 19. Lock Nut | |
| 5. Fan | 10. Lock Nut | 15. Screw | 20. Screw | |

# THEORY OF OPERATION

The hydrostatic power train is separated into the following systems:

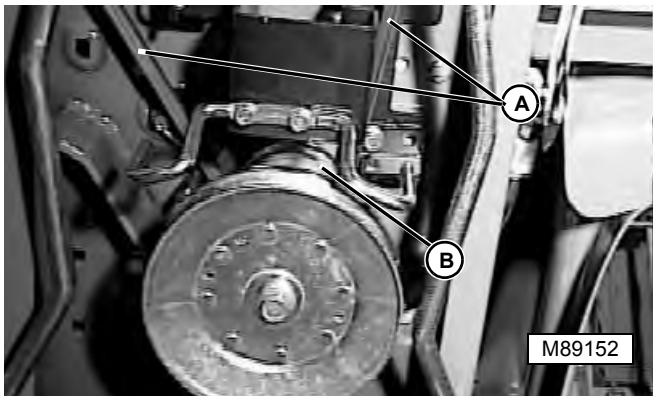
- Traction Drive Belt System
- Transaxle and Shift Pedal Linkage System
- Transport (Free-Wheeling System)

## TRACTION DRIVE BELT SYSTEM

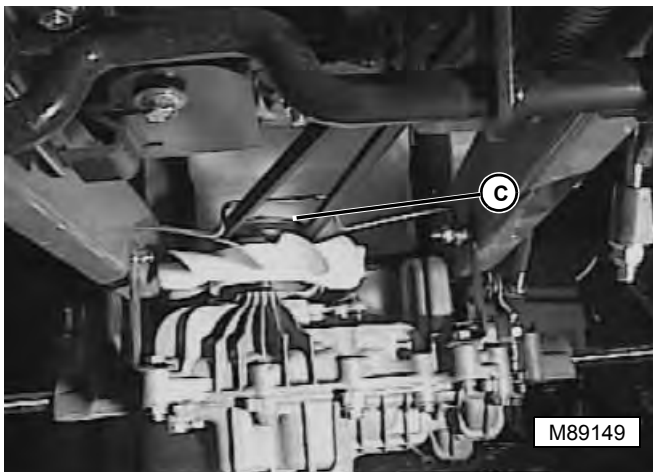
**Function:**

The traction drive belt transfers power from the engine to the input pulley of the hydrostatic transaxle.

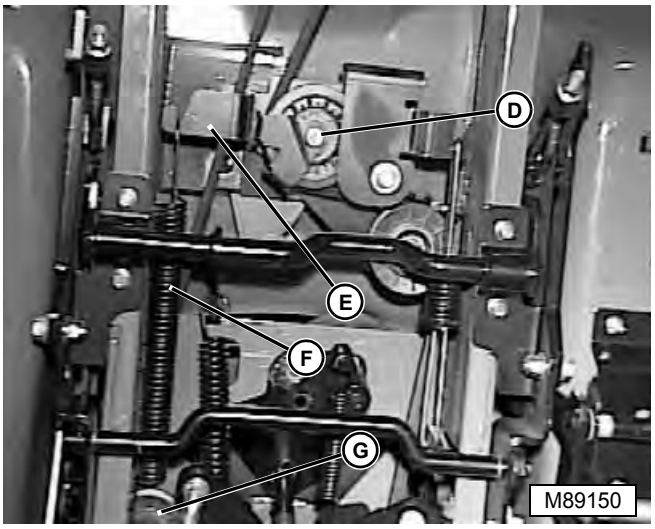
**Theory of Operation:**




The traction drive belt (A) is driven by the upper pulley of the engine drive sheave (B).




The traction belt then transmits engine power to the input pulley (C) of the hydrostatic transaxle.




The traction drive belt is tensioned by the pivot idler (D), which is mounted on a spring loaded bracket (E). The tension spring (F) runs forward and hooks to the forward idler pulley (G) mounting stud.

# TRANSAXLE AND SHIFT PEDAL LINKAGE SYSTEM

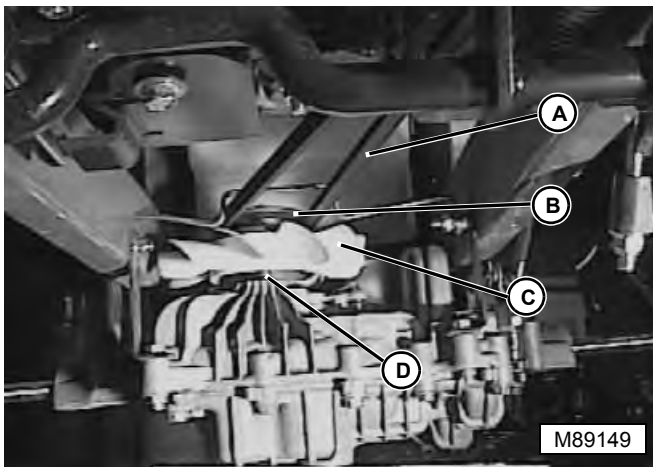
**Function:**

The function of the transaxle is to transfer power from the traction drive belt system (driven by the engine), to the rear wheels, and allow the operator to select ground speed and direction.

The drive belt turns the transaxle input pulley, and drives the transaxle's hydrostatic pump. When the hydrostatic drive is in neutral, no pressure is built up in the pump. When the operator engages the forward or reverse pedals, the drive linkage tilts the swash plate, inside the transaxle, off center, and the pump pistons build pressure which drives the hydrostatic motor. The motor drives the rear axle and wheels through the differential assembly.

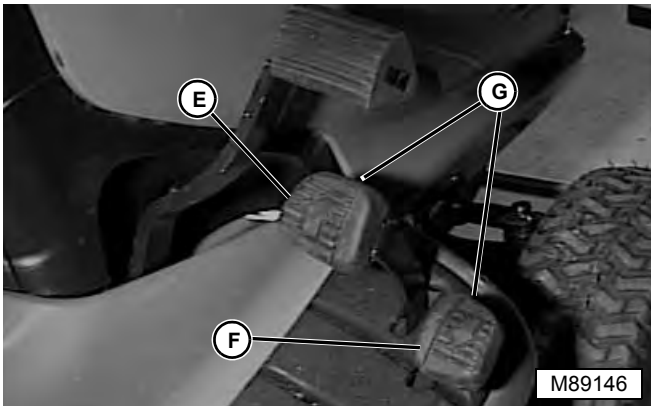
The transaxle provides infinite ground speed selections up to 5 mph in forward and up to 2.6 mph in reverse.

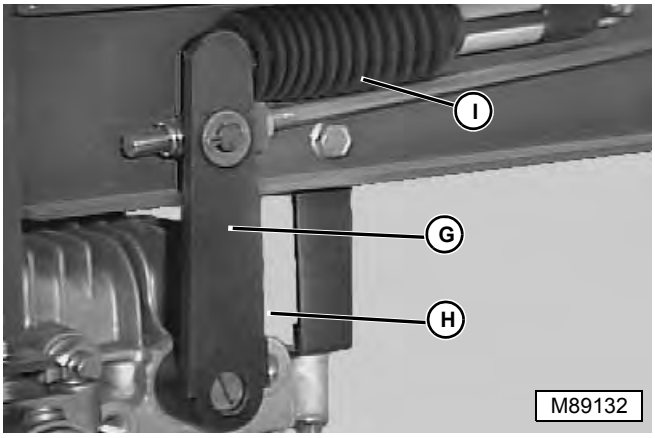
**Theory of Operation:**




**Neutral:**

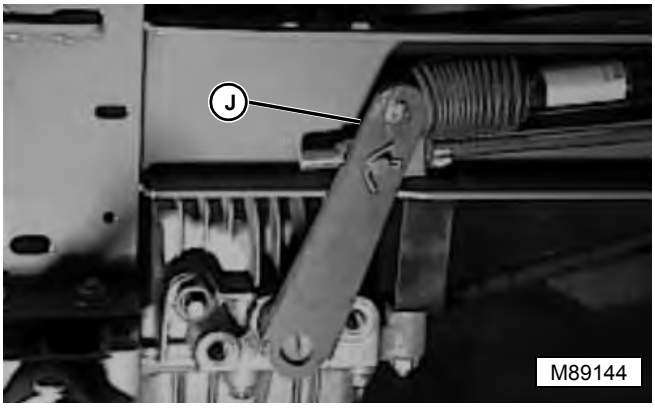
When the engine is running, the traction drive belt (A) turns the transaxle input pulley (B), cooling fan (C), and input shaft (D). The input shaft turns the hydrostatic pump input shaft and pump body, inside the transaxle.



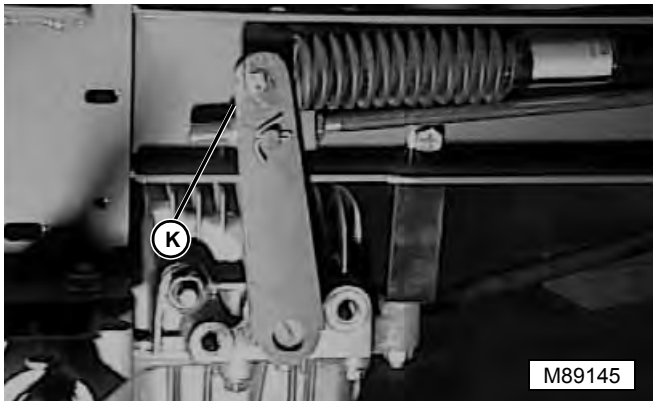

When the forward (E) and reverse (F) pedals are in the neutral position (G), the shift lever (H) and gas shock (I) are centered. When in NEUTRAL, the shift linkage holds the shifter shaft in the NEUTRAL position and the drive axles do not turn.

**Forward:**




When the forward pedal is depressed, the shift linkage moves the transaxle arm forward turning the shifter shaft and causing the drive axles to turn in the FORWARD direction (J).

**Reverse:**




When the reverse pedal is depressed, the shift linkage moves the transaxle arm rearward turning the shifter shaft and causing the drive axles to turn in the REVERSE direction (K).

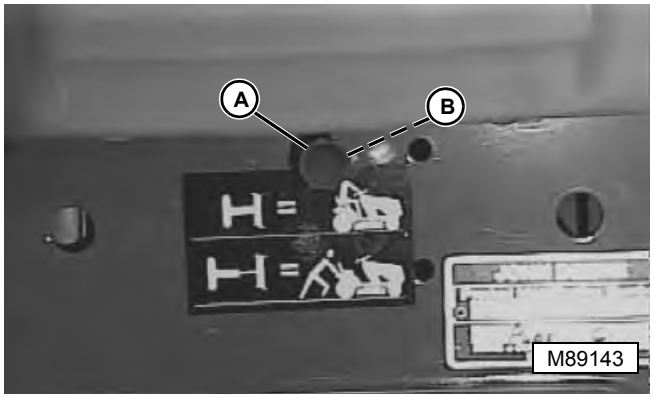
## TRANSPORT (FREE-WHEEL) SYSTEM

**Function:**

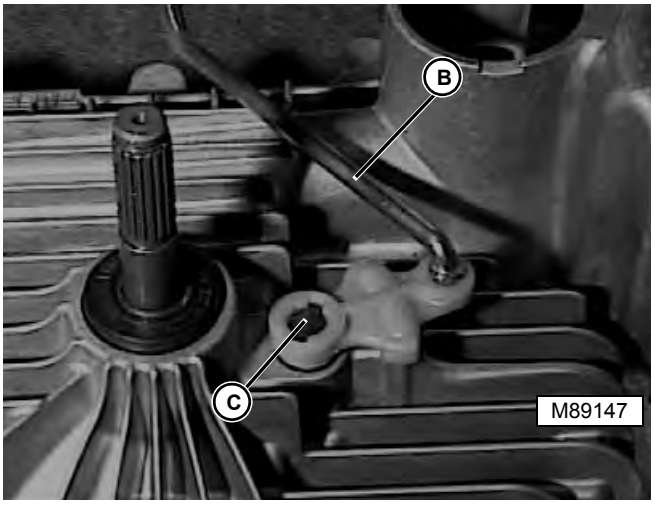
The transport (Free-wheel) system allows the operator to push the tractor forward or reverse with the engine off and the brake released.

> **⚠ CAUTION**
>
> **DO NOT operate freewheel valve with engine running or damage to hydrostatic transmission can occur.**

**Theory of Operation:**




When the free wheel handle (A) is pulled out to its locked position, the free wheel rod (B) rotates the actuating shaft 35°.




When the actuating shaft (C) rotates 35° the operator is allowed to push the tractor in forward or reverse with the engine off and the brake released.

# TROUBLESHOOTING

| Problem or Symptom / Check or Solution | Belt jumping off or slapping | Lack of drive in one wheel or both | Loses power under load, belt slips, or erratic drive | Jerky or aggressive engagement | Cannot get full forward or reverse speed | Input shaft /pulley will not turn | Returns to neutral during operation or under load | Noisy operation | Leaking lubricant | Brakes will not stop tractor | Park brake will not hold | Transaxle overheats | Freewheel valve pushes hard | Creeps in neutral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belt sheaves and idlers loose, out of adjustment, worn, or damaged—tighten, replace, or adjust properly | ● | ● | ● | ● | ● | ● | | ● | | | | | | |
| Belt worn, frayed, glazed, or stretched—replace belt | ● | ● | ● | ● | | | | ● | | | | | | |
| Tensioning spring weak or broken—replace as necessary | ● | ● | ● | | | | | ● | | | | | | |
| Accumulation of grass and other debris in cooling fins or around moving parts of transmission | | ● | ● | | | ● | | ● | | ● | ● | ● | ● | ● |
| Brake pedal linkage out of adjustment—adjust properly | | ● | ● | ● | | ● | ● | | | ● | ● | ● | ● | |
| Brake components out of adjustment— adjust properly or replace transaxle | | ● | | ● | | ● | ● | | | ● | ● | ● | ● | |
| Foot pedal linkage bent, worn, out of adjustment, or broken—replace or adjust properly | | ● | ● | ● | ● | ● | ● | | | | | ● | | ● |
| Neutral return linkage worn, bent, or broken—replace as necessary | | ● | | | | ● | | | | | | | ● | ● |
| Internal transaxle components worn, stripped, or broken—replace as necessary | | ● | ● | ● | | ● | ● | ● | | | | ● | | ● |
| Transaxle case mountings loose, worn, or broken—replace mountings or transaxle | ● | ● | | ● | | | | ● | | | | | ● | ● |

| Problem or Symptom / Check or Solution | Belt jumping off or slapping | Lack of drive in one wheel or both | Loses power under load, belt slips, or erratic drive | Jerky or aggressive engagement | Cannot get full forward or reverse speed | Input shaft /pulley will not turn | Returns to neutral during operation or under load | Noisy operation | Leaking lubricant | Brakes will not stop tractor | Park brake will not hold | Transaxle overheats | Freewheel valve pushes hard | Creeps in neutral |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fan and/or pulley loose or damaged—tighten or replace | ● | | | | | ● | | ● | | | | ● | | |
| Hydrostatic oil filter plugged | | ● | ● | | ● | | | ● | | | | ● | | |
| Incorrect type or volume of lubricant used—replace with correct type and volume | | ● | ● | ● | | | ● | ● | ● | | | ● | | ● |
| Wheels and axle keys, key ways, or snap rings worn—replace as necessary | | ● | ● | | ● | | | ● | | | | | | |
| Transaxle case halves cap screws loose or stripped—tighten to 27 N•m (20 lb-ft) or replace screws | | | | | | | | ● | ● | | | | | |
| Poor application or incorrect sealant on transaxle case halves—replace transaxle | | | | | | | | | ● | | | | | |
| Transport (free-wheeling) valves and linkage damaged—replace transaxle | | ● | ● | | ● | | | ● | | | | ● | ● | |
| Engine performance problems—see Engine Section | | ● | ● | | | | | | | | | | | |

# DIAGNOSTICS

**Test Conditions:**

- Tractor on level surface
- Engine OFF
- Front wheels blocked
- Rear wheels raised off surface with axle housings on jack stands

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Fan | Fan in good condition and tight | Tighten fan<br>Repair or replace |
| 2. Drive belt | Belt in good condition, not glazed, split, unraveled, or stretched | Replace drive belt |
| 3. Tensioning spring | Tensioning spring installed and not damaged | Install spring<br>Repair or replace |
| 4. Sheaves and idlers, belt traction drive system | Drive sheaves and idlers in good condition and adjusted properly<br><br>Belt not slipping, squealing, or vibrating excessively | Adjust idler assembly<br>Repair or replace<br><br>Check belt condition, check adjustment and condition of idlers and guides. Adjust, repair or replace components as needed |
| 5. Hydro housing exterior | No cracks, leaks, or loose hardware | Tighten hardware<br>Replace transaxle<br>Replace any damaged components |
| 6. Axles | Axles straight | Replace as needed |
| 7. Wheels and tires | Air pressure equal in driving tires | Adjust air pressure |
| | Driving tires have same circumference | Match tires for same circumference |
| | Wheels not bent or out of round | Repair or replace wheels as necessary |
| 8. Axles, wheels, and tires | Axles, wheels, and tires in good shape and functioning properly | Check axles and wheel for straitness, check condition of keys and keyways, washers, and snap rings. Check tires for tread wear and proper inflation. Repair or replace components as needed |
| 9. Engine performance | Engine running smoothly throughout throttle range | Adjust, tune, or repair engine |
| 10. Stroking Control Arm: (lack of forward or reverse speed) | Linkage should stroke control until it reaches the stop inside the transaxle (Forward) and should stroke about 2/3 stroke in reverse | Adjust or repair as needed |

# TESTS AND ADJUSTMENTS

## TRACTION DRIVE SYSTEM

**Reason:**

To ensure forward drive, neutral return, brake linkages and belt drive system maintain traction up a 17° slope.

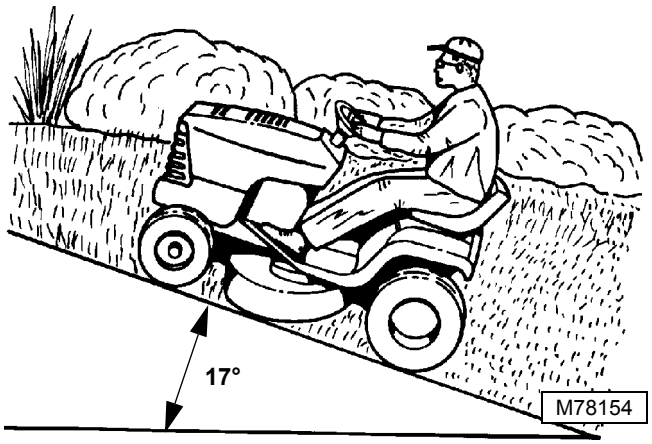
To ensure that transport (free-wheeling) valve assembly and linkage allow tractor to be pushed when engaged and to drive tractor when disengaged. Also to ensure tractor returns to neutral, engages the brake, stops tractor within specification, and holds tractor stationary in PARK position on a 17° slope or less.

**Test Drive:**

**⚠ CAUTION**

**DO NOT engage FORWARD foot pedal too aggressively during the 17° slope test drive. Tractor may tip over backwards. It is recommended that the mower deck be installed before performing the 17° slope test.**

1. Attach mower deck to tractor.
2. Carefully test drive tractor to see if traction drive system pulls tractor steadily up a 17° slope.
3. If tractor fails traction test, the drive belt may be excessively worn, stretched, glazed or unraveling. Replace if above conditions exist.

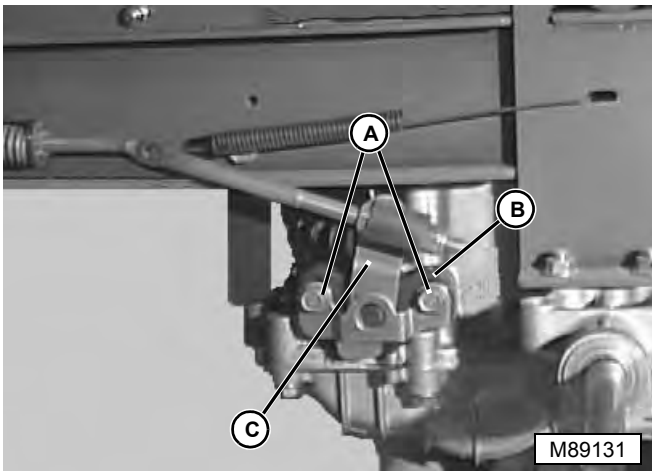



4. Drive or push tractor onto a 17° slope, depress the brake pedal and lock it in the PARK position.
5. FORWARD and REVERSE pedals must return to NEUTRAL position, PARK brake must hold tractor in a stationary position on slope and tractor must not creep downward once park brake is locked into position.
6. Drive tractor on dry pavement in a safe, open and level area at fast idle in the forward direction. Apply a “panic stop” force (no more than 50 pounds of force)—tractor **must stop** within **1.5 M (5 ft)** and both wheels should **“lock-up”**, leaving skid marks on pavement.
7. Repeat steps 4—6 for reverse. Tractor must stop within **0.9 M (3 ft)**.
8. If any test fails, the brake linkage must be adjusted or components replaced.

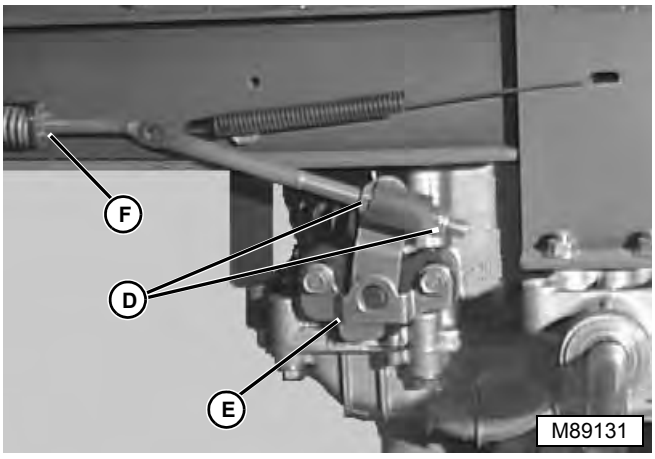
## PARKING BRAKE – LT155/LT166 ADJUSTMENT

**Procedure:**

1. Release park brake.
2. Raise and support tractor and remove left rear wheel.



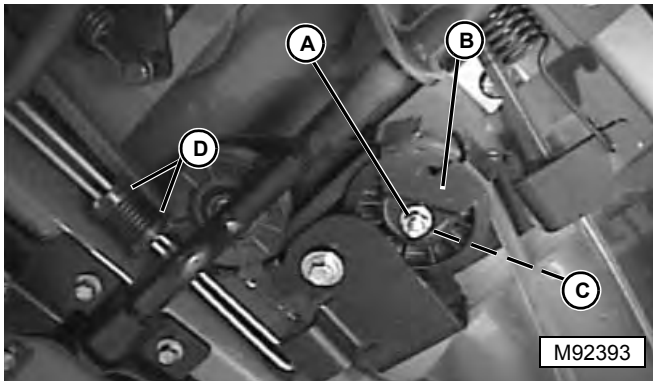

3. Set park brake. Brake should engage when the brake lever reaches the vertical position.
4. If the brake does not engage at the vertical position, loosen cap screws (A) and rotate slotted block (B) until brakes just start to apply when lever arm (C) is vertical.
5. Tighten brake lever cap screws to **52 N•m (38 lb-ft)**.



6. Release park brake.
7. Loosen adjust nuts (D) until brake lever rests against the lever stop (E) then retighten adjustment nuts.
8. Set park brake.
9. A **7—9 mm (0.28—0.35 in.)** gap (F), between the compression spring bracket and the brake rod stop tab, should be noted when the brake is applied and the drive belt should be loose.
10. If not, use the adjustment to obtain the proper gap.
11. Release parking brake and check for a dragging brake, adjust as necessary.

## DRIVE BELT ADJUSTMENT

1. Lock park brake.




2. Remove belt guide nut (A) and belt guide (B).
3. Loosen idler nut (C) and slide idler rearward to increase distance between plastic caps of compression spring (D).
4. Tighten idler nut.
5. Release park brake and measure distance between plastic caps of compression spring (D).
6. Repeat steps 2 thru 5 until distance between plastic caps of compression spring (D) is **32.5 mm (1.28 in.)**.
7. Tighten idler nut (C) to specification.
8. Install belt guide (B).

**Specifications:**

**Compression Spring . . . . . 32.5 mm (1.28 in.)**
**Idler Nut . . . . . .26 N•m (19 lb-ft)**

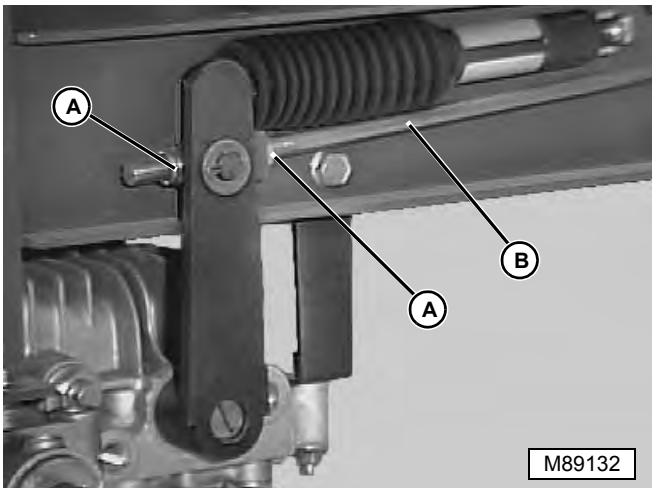
## TRANSAXLE NEUTRAL ADJUSTMENT

*NOTE: Travel pedal adjustment must be checked anytime a neutral adjustment is made.*

1. Loosen locknut on adjuster (A) and rotate adjuster to eliminate neutral creep.
2. Hold adjuster in position and tighten locknut.
3. Check travel pedal adjustment.

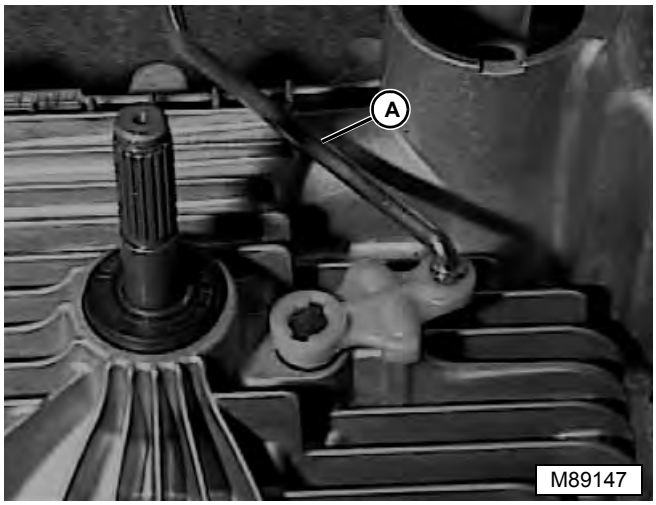
## TRAVEL PEDAL ADJUSTMENT

1. Push each travel pedal forward by hand while watching for pedal contact with the foot rest.
2. If one pedal makes contact and the other pedal does not, and adjustment is needed.




3. Loosen both nuts (A) and move the rod (B) in the appropriate direction and tighten nuts. Repeat this procedure until both pedals make contact with the foot rest.

## TRANSPORT (FREE-WHEEL) TEST




**Test Transport Valve Operation:**

**CAUTION**

**DO NOT operate freewheel valve with engine running or damage to hydrostatic transmission can occur.**

1. Release PARK brake.
2. With engine off and Forward/Reverse pedals disengaged, pull free wheel rod (A) to the free wheel position (Away From Back Of Tractor).
3. Push tractor forward at least 3.05 M (10 ft). Tractor should push easily the entire distance.
4. Push tractor backwards the same distance—tractor should push easily the entire distance.
5. If tractor pushes hard in forward or reverse direction, internal components should be suspect. Adjust linkage or replace transaxle.

**IMPORTANT: After using Transport (Free Wheel), be sure to push engagement rod completely back into rear of tractor. If not completely engaged the transaxle will not operate properly, will operate noisily or internal damage may occur.**

## TRANSAXLE FLUID LEVEL

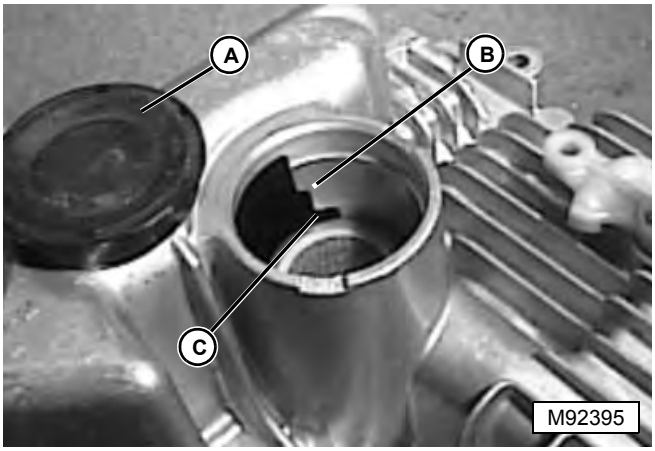
**Procedure:**

1. Disconnect battery **negative** (–) cable.
2. Lift and support tractor.
3. Remove left rear wheel.
4. Raise or lower tractor to level transaxle.

**CAUTION**

**Gasoline is explosive. Do not expose to open flame or spark. Serious injury can result. Store in a proper container. Wipe up any spills immediately.**

5. Drain fuel tank.
6. Remove fuel tank. See “FUEL TANK REMOVAL/ INSTALLATION” in Miscellaneous Section.




7. Remove oil sealing cap (A).
8. Check oil level using an inspection mirror. Fluid level must be between high (B) and low mark (C).
9. Install oil sealing cap.
10. Install fuel tank.
11. Install left rear wheel.
12. Lower tractor and connect battery cable.

**Specifications:**

**Lubrication . . . . . .TURF-GARD® 10W-30**
**. . . . . PLUS4® 10W-30**
**Capacity . . . . . 2.4 L (0.63 gal)**

# REPAIR

## TRACTION DRIVE BELT REMOVAL/ INSPECTION/INSTALLATION

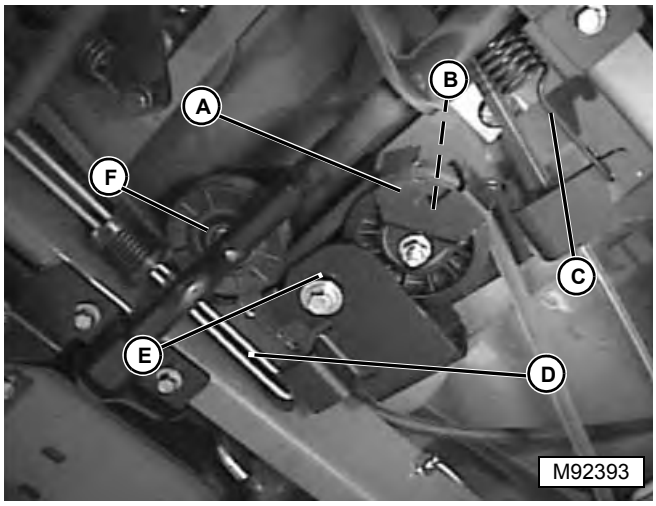
**Conditions:**

- Park tractor on level surface
- Disconnect negative battery cable
- Mower deck removed
- Safely raise and block tractor to gain easy access to underside of frame

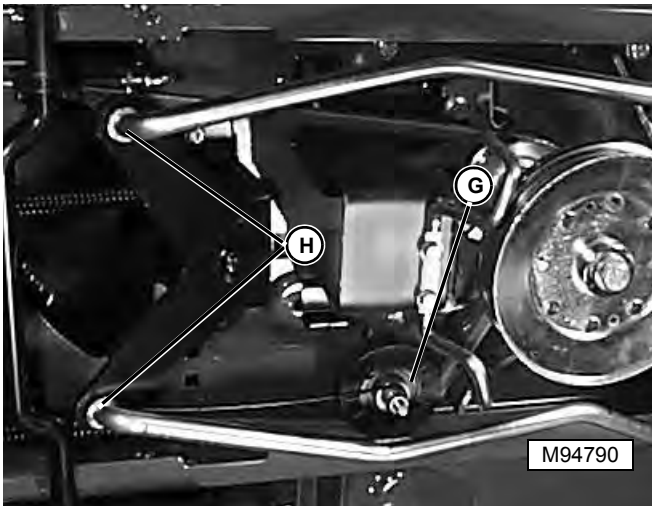
**Procedure:**

**⚠ CAUTION**

**Tensioning spring is under high tension. Wear gloves and use a firm grip when stretching spring.**




1. Remove belt guide nut and belt guide (A).
2. Loosen idler nut (B) and slide idler forward until belt can be removed from drive sheave and transaxle.
3. Remove tensioning spring (C) and pivot idler spring (D).
4. Move lift/lower lever to lower position and remove belt tensioning assembly (E).
5. Loosen idler (F) and remove belt from guide.




6. Loosen idler (G).
7. Remove tie rods (H) from steering gear.
8. Move lift/lower lever to raised position and remove tensioning spring.
9. Remove belt.

**Inspection:**

10. Examine belt to determine if it is worn, stretched, cracked, frayed, or damaged beyond the point of continued use.
11. Install belt in reverse order of removal.

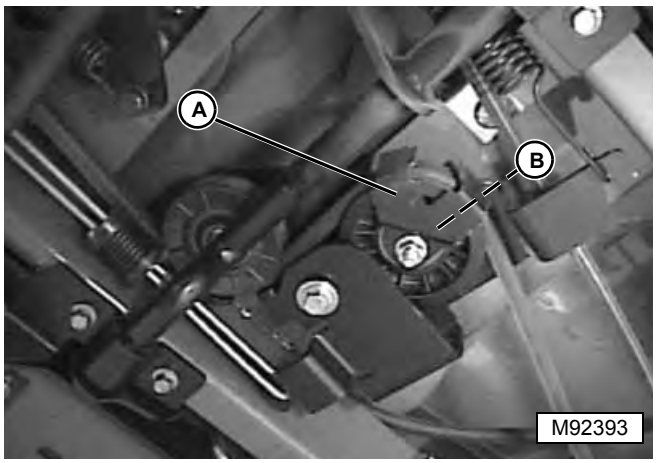
## TRANSAXLE – REMOVAL/ INSTALLATION

**Conditions:**

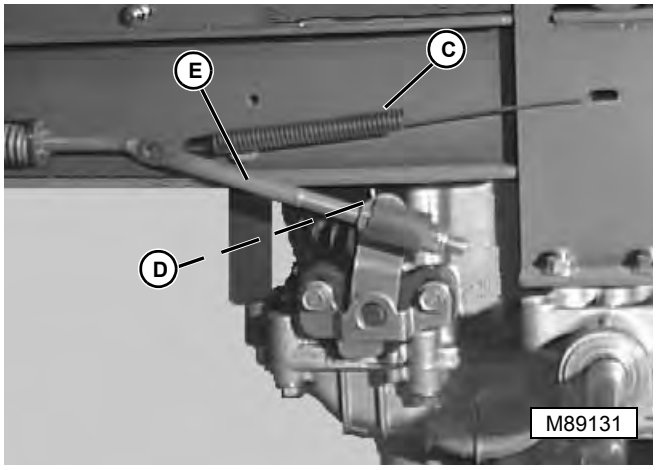
- Park tractor on level surface
- Disconnect negative battery cable
- Mower deck removed
- Safely raise and block tractor to gain easy access to underside of frame

**Procedure:**

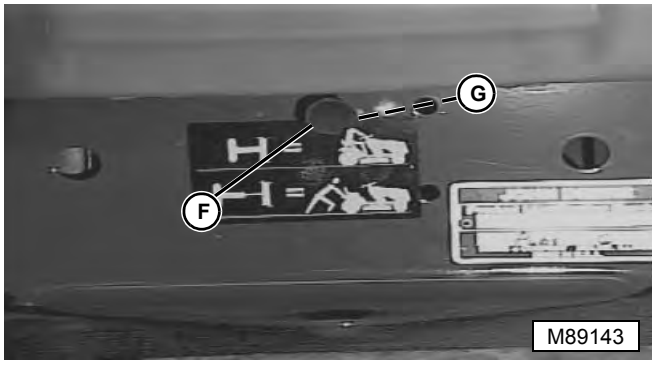
1. Remove rear wheels, inspect keys, keyways, washers, and snap rings. Replace as needed.



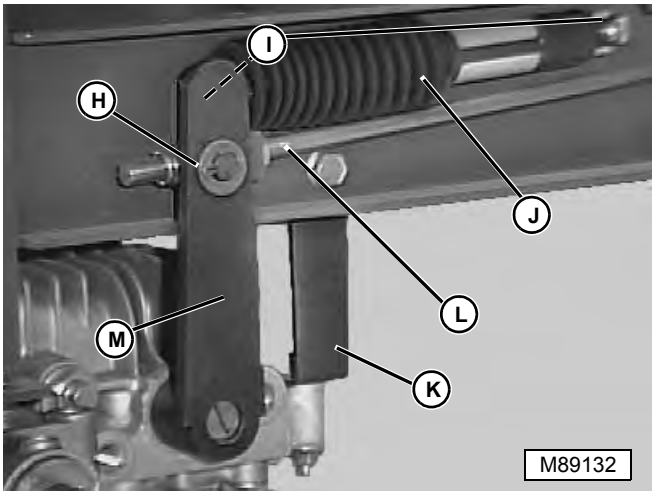

1. Remove belt guide nut and belt guide (A).
2. Loosen idler nut (B) and slide idler forward until belt can be removed from transaxle.




3. Remove return spring (C), cotter pin and washer (D) from brake linkage and disconnect linkage (E) from transaxle.




4. Unscrew and remove free wheel knob (F) and nut (G).
5. Push free wheeling rod in.




6. Remove cotter pin and washer (H) from shift lever.
7. Unfasten retaining clips (I) and remove gas shock (J).
8. Remove bolts from support brackets (K).
9. Support transaxle and remove bolts from frame, move transaxle slightly toward right side of machine to disconnect linkage (L) from lever (M).
10. Ensure free wheel rod is removed through frame.
11. Carefully remove transaxle to workbench.

*NOTE: Transaxle linkage must be in hole of transaxle lever before bolting transaxle in place.*

**Installation:**

12. Being careful to insert free wheeling rod into frame hole, set transaxle into frame.
13. Insert cap screws through transaxle and frame holes. Tighten cap screws to **34 N•m (25 lb-ft)**. Insert cap screws through brackets and tighten to **27 N•m (20 lb-ft)**.
14. Install in reverse order of removal.

**Specifications:**

**Transaxle-to-frame . . . . . 34 N•m (25 lb-ft)**
**Transaxle-to-bracket . . . . . 27 N•m (20 lb-ft)**

## NOTES:

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FRONT AXLE REMOVAL/INSTALLATION . . . . . 5

# SPECIFICATIONS

**Steering**

Type . . . . . Sector and Pinion

# TORQUE SPECIFICATIONS

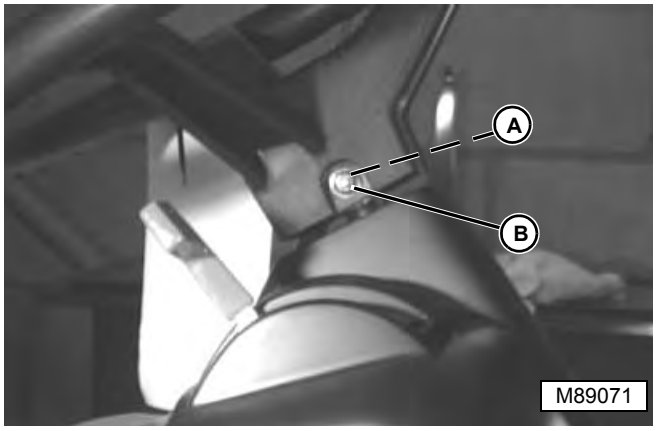
Front Axle Pivot . . . . . 68 N•m (50 lb-ft)
Muffler Bracket to Front Frame . . . . . 16 N•m (12 lb-ft)
Torque Muffler to Engine Nuts . . . . . 24 N•m (18 lb-ft)

# REPAIR

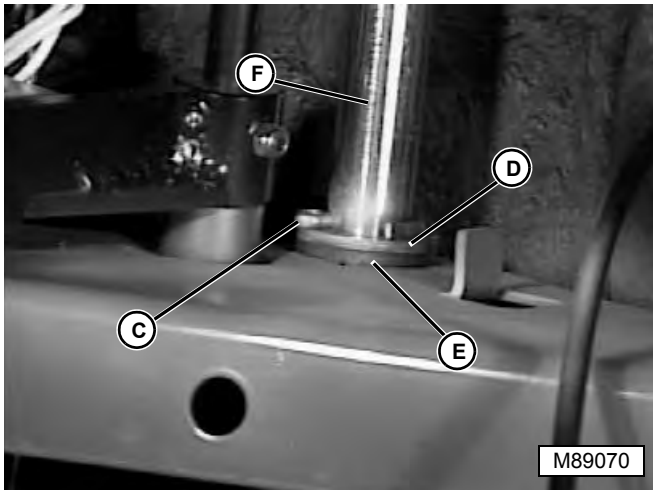
## STEERING GEAR ASSEMBLY REMOVAL/INSTALLATION

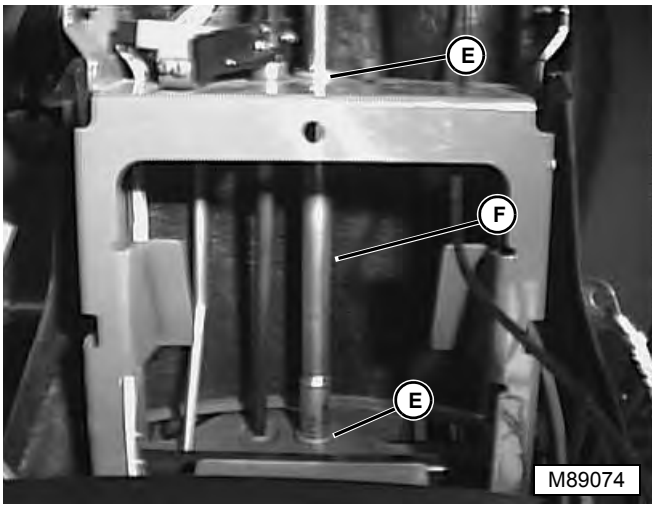
**Procedure:**

1. Disconnect battery and remove.
2. Remove mower deck.
3. Safely raise front and back wheels to a working height.



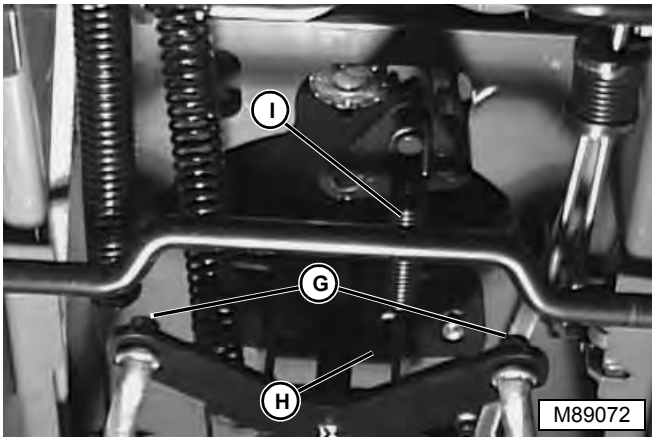

4. Remove steering wheel bolt (A) and nut (B).



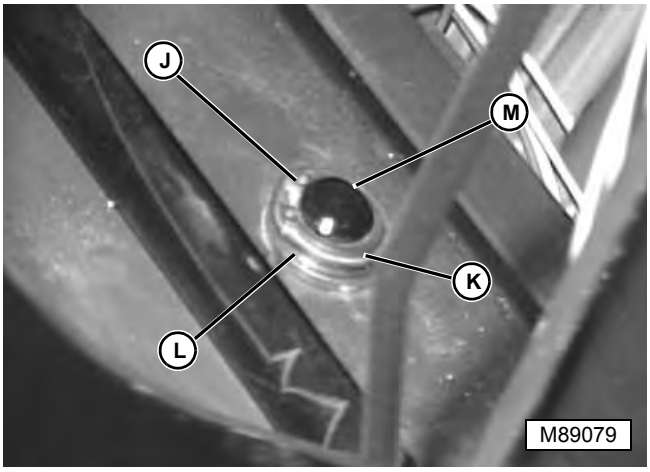




5. Remove cotter pin (C), spacers (D) and bushings (E) from top and center of steering wheel shaft (F).

*NOTE: PTO lever must be ENGAGED and BRAKE must be RELEASED to allow shaft removal from bottom.*



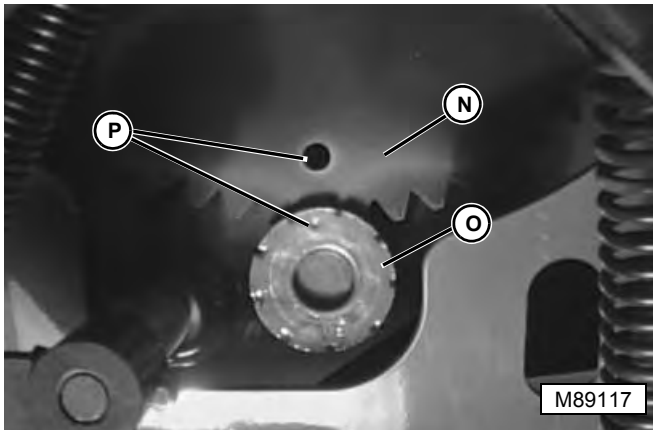

6. Remove cotter pins and washer from tie rods (G) and remove tie rods from steering yoke (H).
7. Remove PTO pivot spring (I) from pivot shaft arm.




8. Remove snap ring (J), washers (K) and bushing (L) from top of sector gear shaft (M).

*NOTE: Write down location and number of washers on pinion and sector gear shafts. If a new shaft is installed, number and placement of washers may need adjustment.*

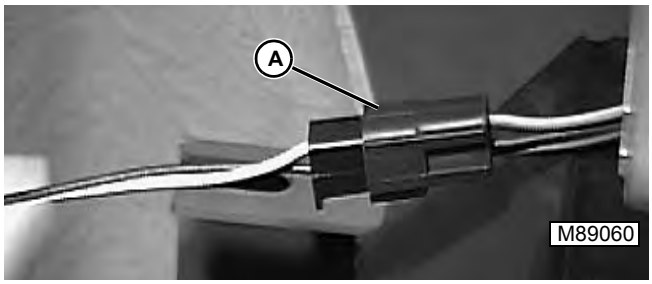
9. Remove pinion gear assembly (N) from bottom of tractor.
10. Inspect shaft and pinion gear assembly, replace as necessary.



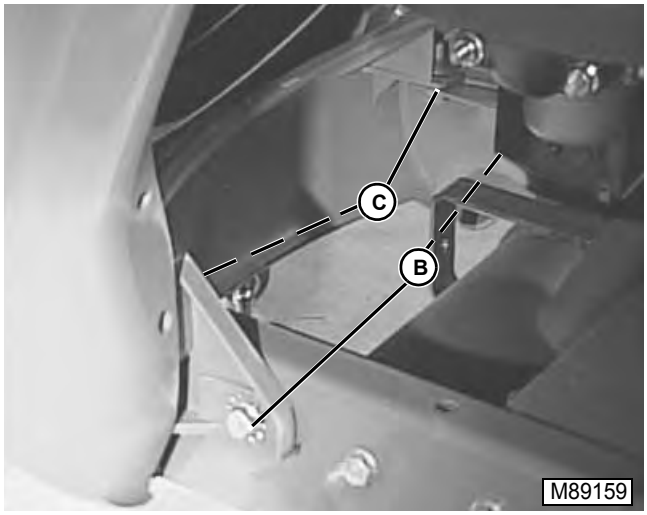

11. Install pinion gear assembly (N) and sector gear (O) making sure pinion gear and sector gear alignment marks (P) are aligned as steering pinion shaft is installed.
12. Install PTO pivot spring on pivot shaft.
13. Install tie rods.
14. Install steering wheel.

# FRONT AXLE REMOVAL/ INSTALLATION

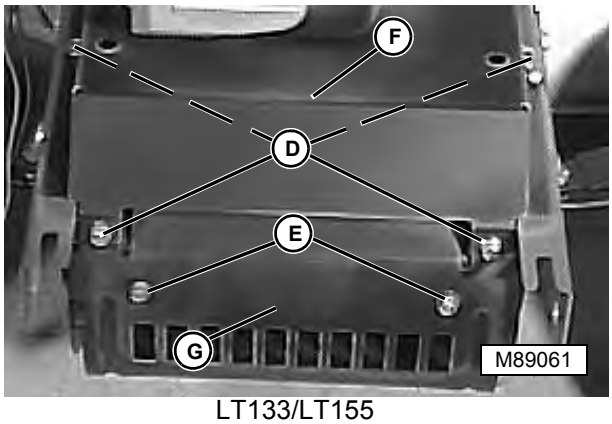
1. Remove mower deck.
2. Safely support front of tractor.
3. Remove front wheels.




4. Raise hood, disconnect battery negative lead, and headlight connector (A).

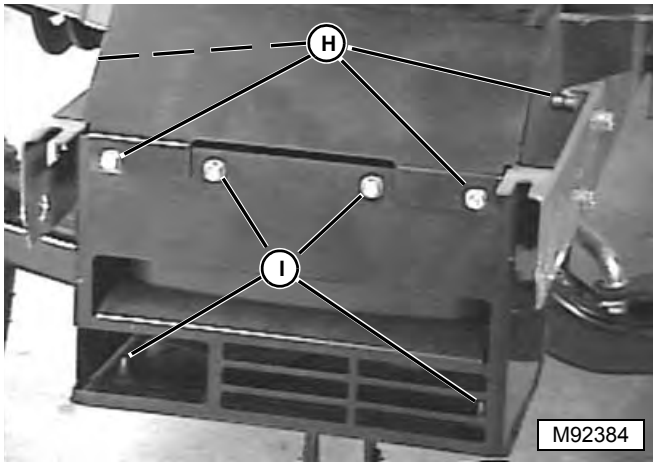



5. Remove two bolts (B) securing the hood to the left and right frame side rails. Loosen the two bolts (C) securing the hood to the upper side of the left and right side rails. Remove hood.



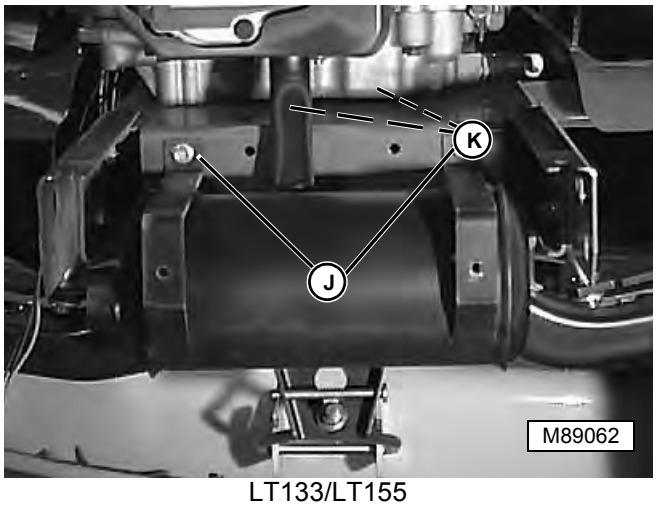

LT133/LT155

6. Remove cap screws (D and E), top shroud (F) and bottom shroud (G).

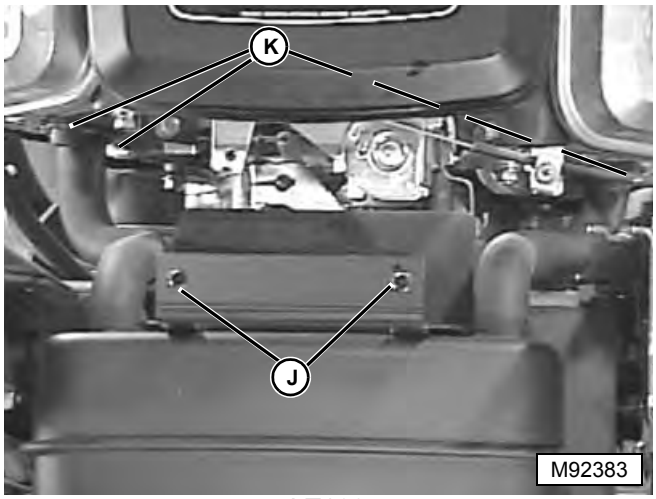



LT166

7. Remove cap screws (H and I) securing muffler shrouds, remove muffler shrouds.

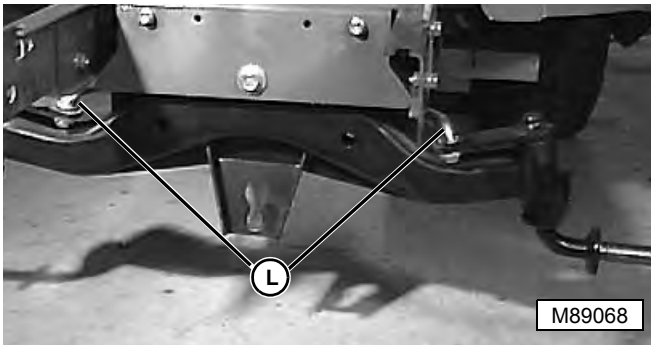



LT133/LT155

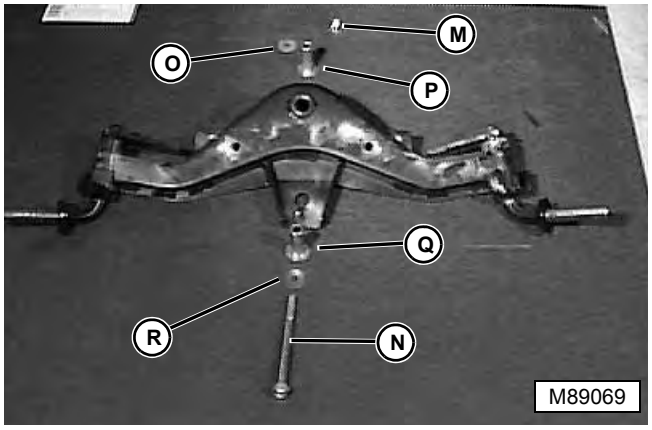



LT166

8. Remove muffler bracket bolts (J), and muffler to engine bolts (K).
9. Remove muffler.



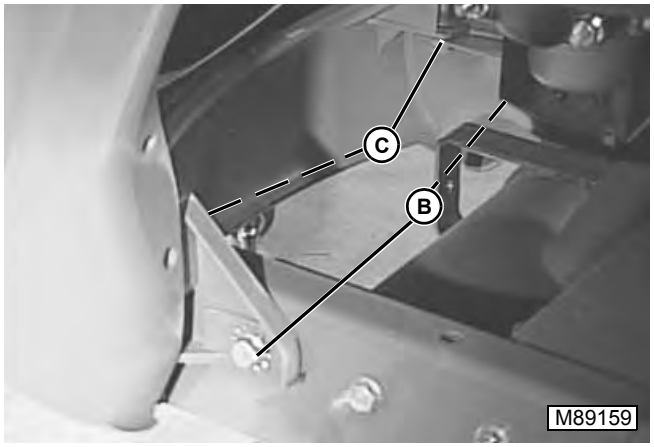

10. Remove steering rod (L) cotter pins, washers and remove arms from axle.



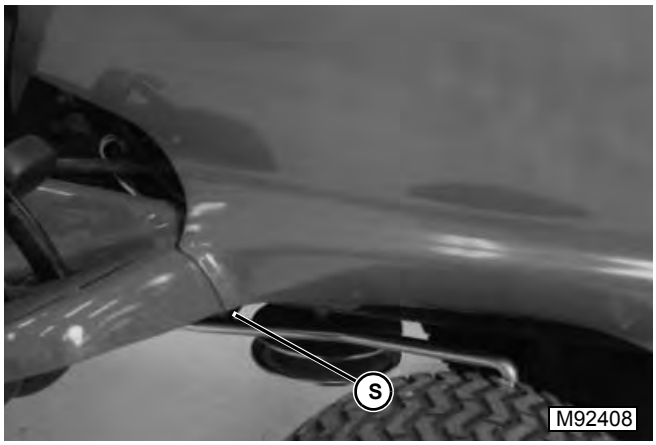

11. Remove axle nut (M), bolt (N), washer (O), bushing (P), rear bushing (Q) and washer (R).

*NOTE: If nylon nut can be tightened by hand, replace.*

12. Remove axle and replace parts as necessary.
13. Grease and install axle and tighten axle pivot to **68 N•m (50 lb-ft)**.
14. Install tie rods.
15. Install muffler and tighten muffler to engine nuts **24 N•m (18 lb-ft)**.
16. Tighten muffler bracket to frame **16 N•m (12 lb-ft).**
17. Install muffler shrouds.




18. Slide hood into position and install bolts (B). Lightly tighten fasteners so that the hood can be moved forward or backward for alignment.




19. Lower hood into the locked position and align hood as shown (S), tighten bolts (C), then raise hood and tighten bolts (B).
20. Reconnect all electrical connections.

**Torque Specifications:**

**Muffler to Engine Nuts. . . . . .24 N•m (18 lb-ft)**
**Muffler Bracket to Front Frame. . . .16 N•m (12 lb-ft)**
**Front Axle Pivot . . . . . .68 N•m (50 lb-ft)**

## NOTES:

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# SPECIFICATIONS

**LT133**

Type . . . . . Disk
Parking . . . . . Pedal
Brake pad minimum thickness . . . . . 6 mm (0.250 in.)
Compression Spring Bracket to Brake Rod Stop Tabs. . . . . 7 – 9 mm (0.27 – 0.35 in.)

**LT155/166**

Type . . . . . Disk
Parking . . . . . Pedal
Brake lever travel (Maximum). . . . . 30°
Compression Spring Bracket to Brake Rod Stop Tabs. . . . . 7 – 9 mm (0.27 – 0.35 in.)

# TORQUE SPECIFICATIONS

**LT133**

Brake assembly cap screws. . . . . 20 N•m (180 lb-in.)

**LT155/166**

Brake lever bracket cap screws . . . . . 52 N•m (38 ft-lb)

# TESTS AND ADJUSTMENTS

## PARK BRAKE TEST

**Reason:**

To ensure park brake functions properly.

**⚠ CAUTION**

**OPERATE on ramp only in first or second gear. Shift to neutral.**

**Procedure:**

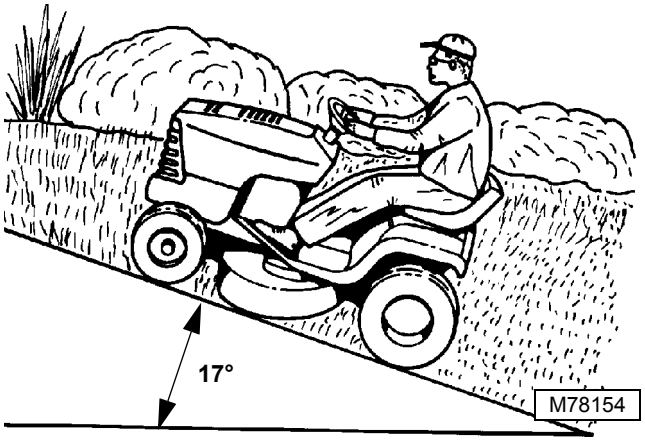
- Climb **17°** ramp during running start in 1st or 2nd gear
- Check park brake holds tractor stationary

**Test Drive:**

**⚠ CAUTION**

**DO NOT engage clutch/brake pedal too aggressively or tractor may tip over backwards while performing the test drive on a 17° slope.**

1. Drive tractor onto a **17°** slope and lock clutch/brake pedal inPARK position. Check that park brake holds tractor stationary on slope and that tractor does not creep downward once park brake is set.
2. If park brake test fails, inspect brake assembly components, replace as necessary, and repeat all adjustment procedures and drive tests.




**IMPORTANT: Park brake must hold tractor stationary on slope and tractor must not creep downward once park brake is set.**

3. If any test fails, the clutch and brake linkages must be adjusted or components replaced.

*NOTE: For gear transaxle units, when the clutch/brake pedal is released and the traction drive system is engaged, there must be ample clearance between the friction pucks and the brake disc to prevent the disc brake from dragging.*
*If a dragging condition exists, the disc brake will over heat and will also experience premature wear.*

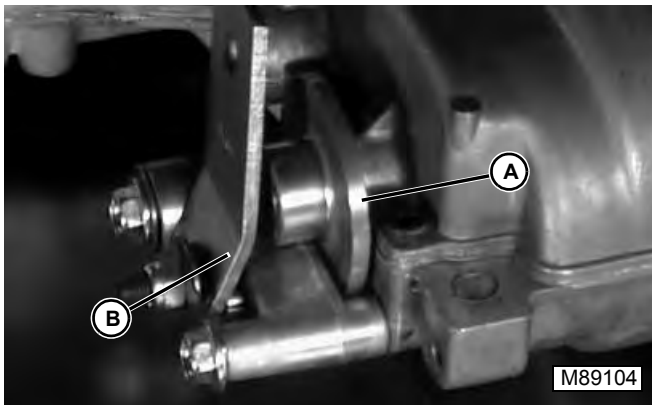
## TEST DRIVE

**⚠ CAUTION**

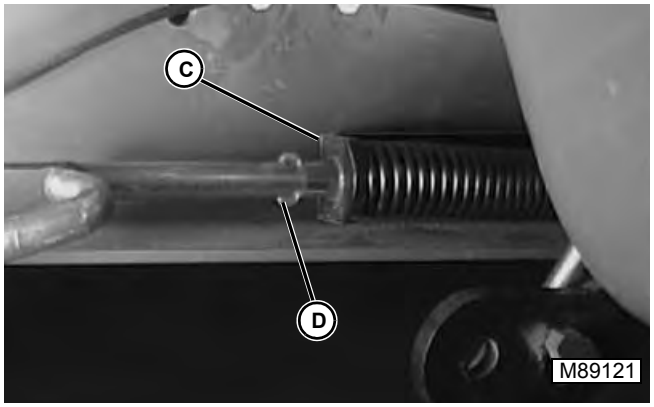
**DO NOT engage clutch/brake pedal too aggressively when going in reverse or tractor may tip over backwards. It is recommended that you install the mower deck before performing the test drive on a 17° slope.**

1. Attach mower deck to tractor, this will help stabilize the tractor.
2. Drive tractor on dry pavement in a safe, open and level area at fast idle in high gear. Apply a “panic stop” force (no more than 50 pounds of force) to brake pedal—tractor must stop within **1.52 M (5 ft)** at full speed forward.
3. Repeat Steps 2—3 for reverse. Tractor must stop within **0.76 M (2.5 ft)** at full speed reverse.
   - If belt is excessively worn, stretched, glazed, or unraveling, replace it
   - If belt is not excessively worn, make finite adjustments above or below specification to gain proper response in traction drive system. **Remember**, to **lengthen** clutch spring causes **increased** traction and aggressiveness; to **shorten** clutch spring causes **decreased** traction and aggressiveness
4. If tractor fails test, inspect brake assembly components, replace as necessary, and repeat all adjustment procedures and drive tests.

## BRAKE ADJUSTMENT – LT133




1. First check for brake disc (A) contacting the case and brake lever (B) contacting its mounting bracket, top or bottom.




2. Depress clutch/brake pedal and lock lever into PARK position from the operator's station.
3. Measure distance between end of compression spring bracket (C) and front edge of brake rod stop tabs (D).

**Specification:**

**Compression Spring Bracket to Brake Rod Stop Tabs . . . . . 7 – 9 mm (0.27 – 0.35 in.)**

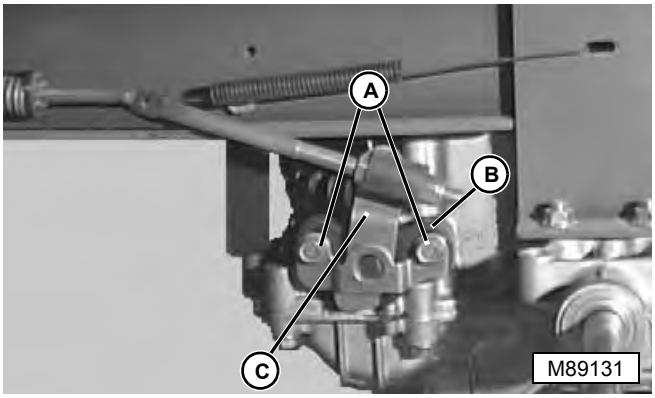
4. If not to specifications, release brake and adjust brake lever tension nut.
5. Repeat steps 3 and 4 until specified measurement is obtained when brake is applied.
6. Check to be sure the brake does not drag when released. If brake drags, replace friction pucks and disc and readjust.

*NOTE: These adjustment procedures can be performed with tractor on the floor; however, you may want to safely raise the tractor for easier access. If you do, remove the battery to avoid spilling any electrolyte solution.*

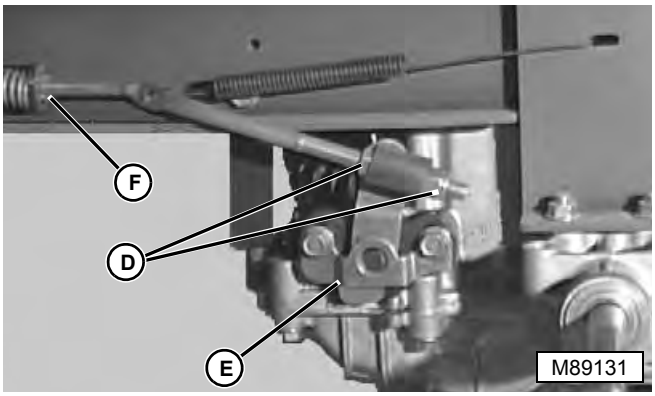
## PARKING BRAKE – LT155/LT166 ADJUSTMENT

**Procedure:**

1. Release park brake.
2. Raise and support tractor and remove left rear wheel.




3. Set park brake. Brake should engage when the brake lever reaches the vertical position.
4. If the brake does not engage at the vertical position, loosen cap screws (A) and rotate slotted block (B) until brakes just start to apply when lever arm (C) is vertical.
5. Tighten brake lever bracket cap screws to **52 N•m (38 ft-lb)**.



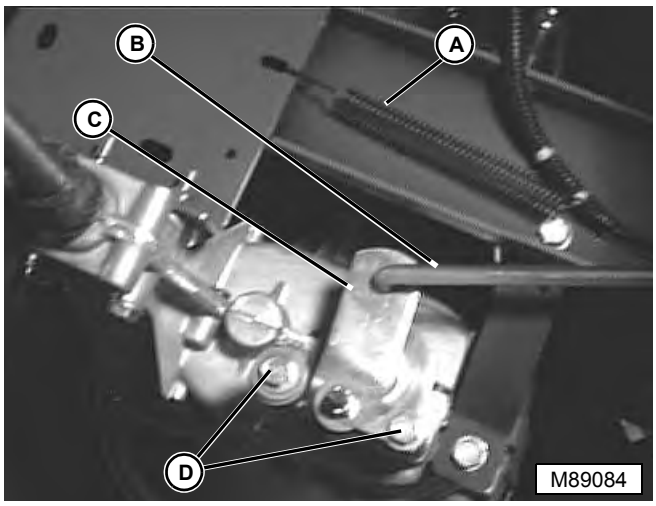

6. Release park brake.
7. Loosen adjust nuts (D) until brake lever rests against the lever stop (E) then retighten adjustment nuts.
8. Set park brake.
9. A **7 – 9 mm (0.27 – 0.35 in.)** gap (F), between the compression spring bracket and the brake rod stop tab, should be noted when the brake is applied and the drive belt should be loose.
10. If not, use the adjustment to obtain the proper gap.
11. Release parking brake and check for a dragging brake, adjust as necessary.

# REPAIR

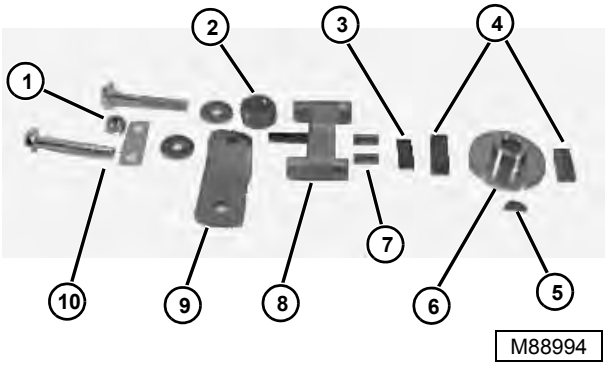
## BRAKE ASSEMBLY – LT133 REMOVAL/INSPECTION/ INSTALLATION

**Procedure:**

1. Lift and support rear of tractor.
2. Remove right rear wheel.




3. Remove brake return spring (A).
4. Remove cotter pin and washer and disconnect brake rod (B) from brake lever (C).
5. Remove cap screws (D) and brake assembly.




1. Holder Nut
2. Bearing
3. Plate
4. Brake Pads
5. Key
6. Brake Disk
7. Dowel Pins
8. Holder
9. Lever
10. Bracket

11. Disassemble brake.
12. Inspect all parts for wear or damage. Replace parts as necessary.
13. Installation is done in the reverse order of removal.

**Specifications:**

**Brake pad minimum thickness . . . . 6 mm (0.250 in.)**

14. Apply a light coat of John Deere LUBRICATE® lubricant or equivalent to brake shaft dowel pins and washer.

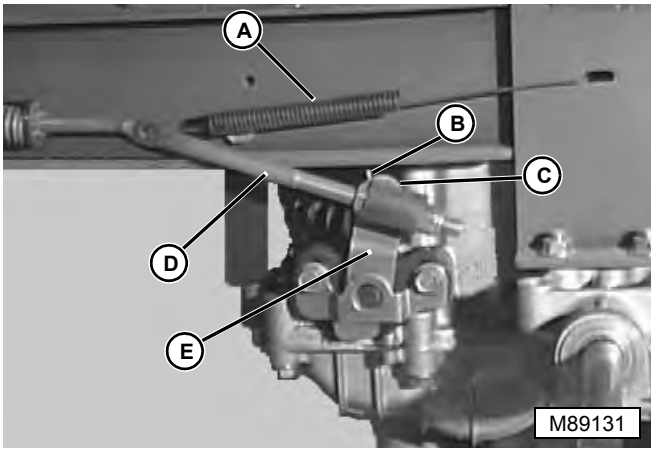
**IMPORTANT: Be very careful not to get grease on brake disk or pads as this will severely decrease brake effectiveness.**

15. Tighten cap screws to **20 N•m (180 lb-in.)**.
16. Adjust brakes. See “PARK BRAKE TEST”.

## BRAKE ASSEMBLY – LT155/LT166 REMOVAL/INSPECTION/ INSTALLATION

**Procedure:**

1. Lift and support rear wheels.
2. Remove left rear wheel.




3. Remove brake return spring (A).
4. Remove cotter pin (B) and washer (C) and remove brake rod (D) from brake lever (E).

**IMPORTANT: When removing brake assembly from transaxle, fluid will leak out. Transaxle must be filled before operating.**

5. Remove bolts, brake plate, brake arm, seal, brake cam, packing and brake shaft.

6. Inspect all parts for wear or damage. Replace parts as necessary.
7. Installation is done in the reverse order of removal.
8. Tighten brake lever bracket cap screws to **52 N•m (38 ft-lb)**.
9. Check transaxle fluid level. See “TRANSAXLE FLUID LEVEL” in Hydro Power Train Section.
10. Adjust brake. See “PARKING BRAKE —LT155/ LT166 ADJUSTMENT”.

## BRAKE LINKAGE – LT133 REMOVAL/INSPECTION/ INSTALLATION

**Procedure:**

1. Lift and support rear wheels.
2. Remove right rear wheel.

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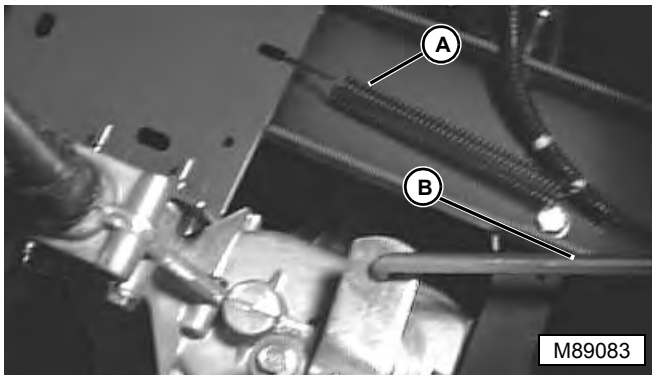
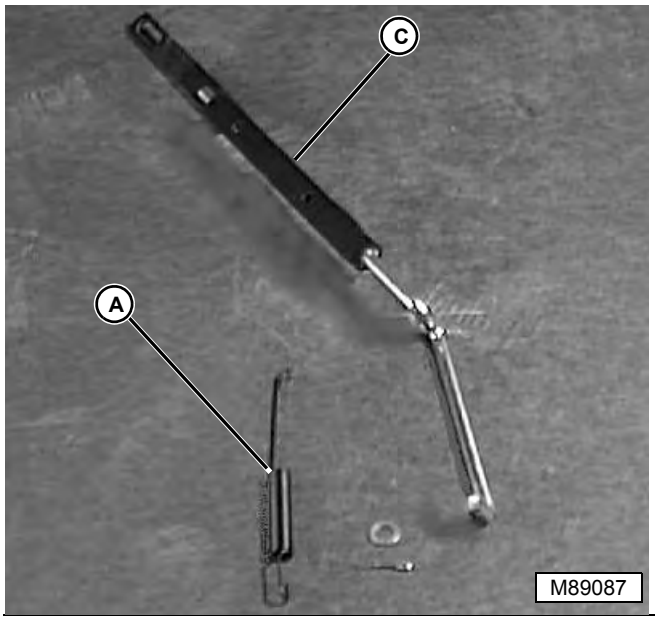



3. Remove return spring (A).
4. Remove rear brake rod cotter pin and washer, and remove brake rod (B).
5. Remove front brake rod cotter pin and washer.

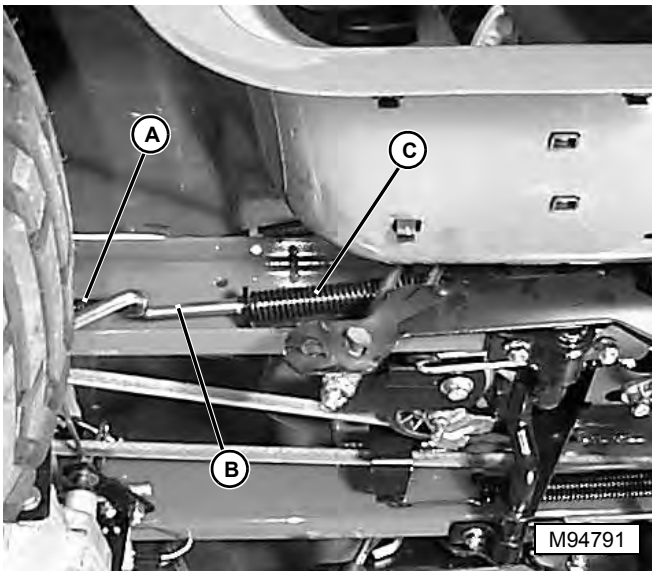



6. Remove brake linkage (C).
7. Inspect all parts for wear or damage. Replace parts as necessary.
8. Installation is done in the reverse order of removal.
9. Adjust brakes. See “PARK BRAKE TEST”.

## BRAKE PEDAL ASSEMBLY – LT133 REMOVAL/INSTALLATION

**Procedure:**

1. Lift and support rear wheels.
2. Remove right rear wheel.




3. Remove return spring (A), brake rod (B), and compression spring (C).

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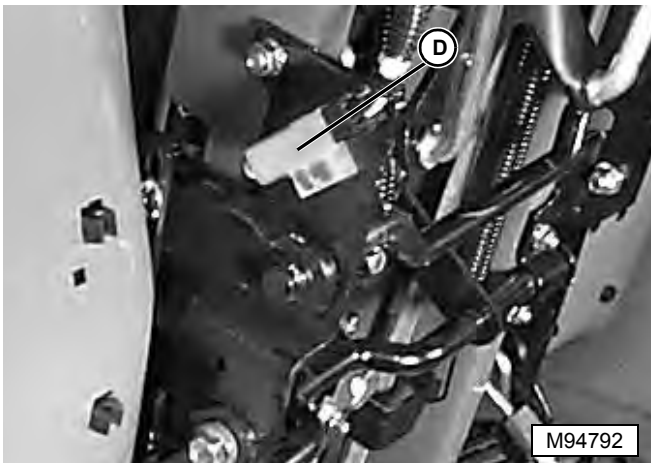
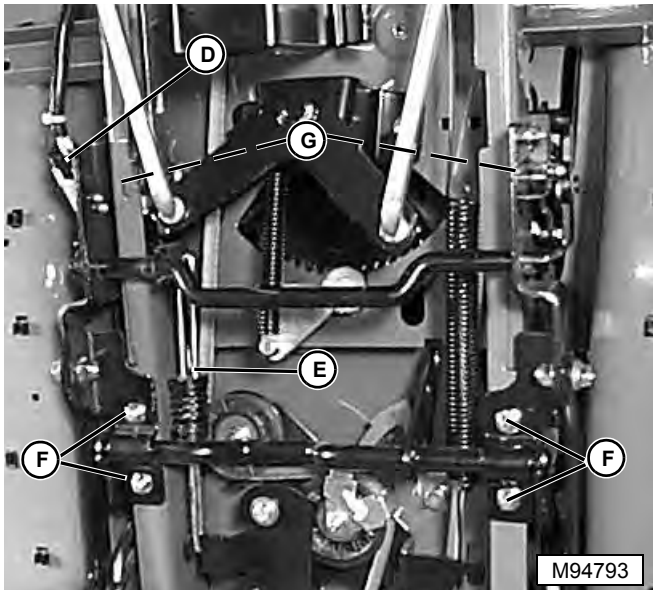
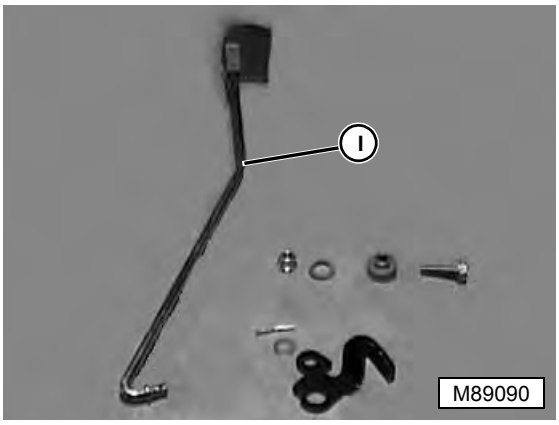



4. Disconnect brake switch connector (D).
5. Move mower deck lift handle to raised position.




6. Remove clutch spring (E).
7. Remove left side deck arm clip.
8. Remove front cap screws (F) from both sides of lift linkage.
9. Remove front assembly cap screws (G).

10. Remove brake pedal rubber (H) and shim.

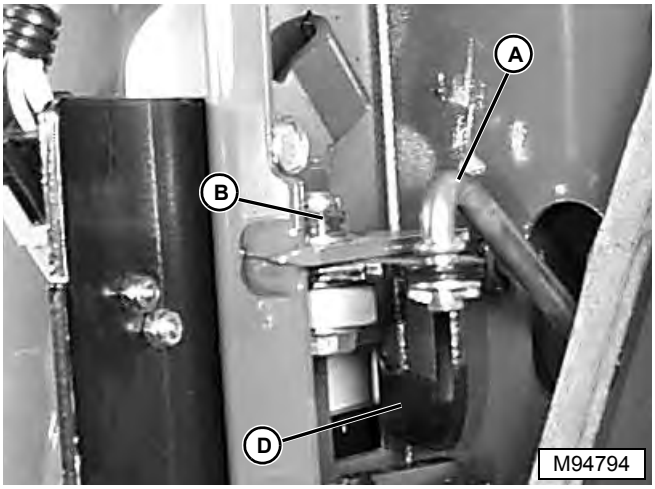



11. Remove lower cotter pin and washer from park brake lever rod (I).
12. Remove brake pedal assembly.
13. Installation is done in the reverse order of removal.
14. Adjust brakes. See “PARK BRAKE TEST”.

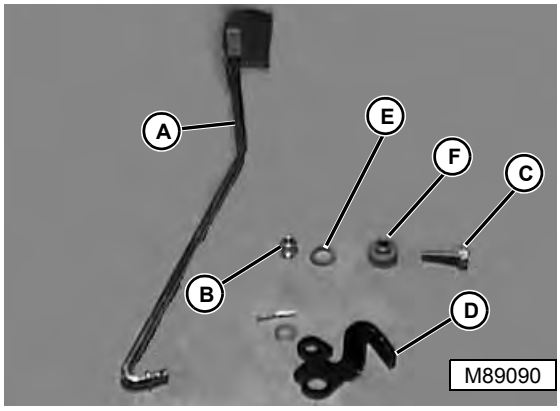
## PARK BRAKE LEVER –LT133 REMOVAL/INSTALLATION

**Procedure:**

1. Remove right rear wheel.
2. Disconnect brake linkage.
3. Remove brake pedal assembly.




4. Remove lower cotter pin from park brake lever rod (A).




5. Remove park brake handle cotter pins (2).
6. Remove park brake lever rod (A) from underside.
7. Remove locking arm nut (B) and bolt (C) to remove locking arm (D).
8. Inspect curved shim (E), bushing (F), and all parts for wear or damage. Replace parts as necessary.
9. Installation is done in the reverse order of removal.

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# SPECIFICATIONS

## REPAIR SPECIFICATIONS

**38 Inch Mower Deck:**

| | |
|---|---|
| Type | Rotary-Two Spindle W/Brake |
| Blade cap screw | 53 N•m (39 lb-ft) |
| Sheave brake wear limit (Includes Backing Plate) | 2.0 mm (0.079 in.) |
| Gage wheels-to-deck | 39 N•m (29 lb-ft) |
| Spindle mounting nuts | 27 N•m (20 lb-ft) |
| Spindle Lubrication | None required |

**42 Inch Mower Deck:**

| | |
|---|---|
| Type | Mulching |
| Blade indexing | 90° ± 10° |
| Blade cap screw | 57 N•m (42 lb-ft) |
| Timing belt tension | (page 15 or pag e16) |
| Drive belt tension | (page 17) |
| Spindle mounting nuts | 27 N•m (20 lb-ft) |
| Tensioning idler nut (Deck SN -095000 only) | 20 N•m (15 lb-ft) |
| Tensioner assembly nut (Deck SN 095001- only) | 87 N•m (64 lb-ft) |
| Timing sprocket mounting nut | 145 N•m (107 lb-ft) |
| Sheave brake wear limit (Includes Backing Plate) | 5.5 mm (0.217 in.) |
| Gauge wheels to deck | 24 N•m (18 lb-ft) |
| Spindle lubrication | EP grease |

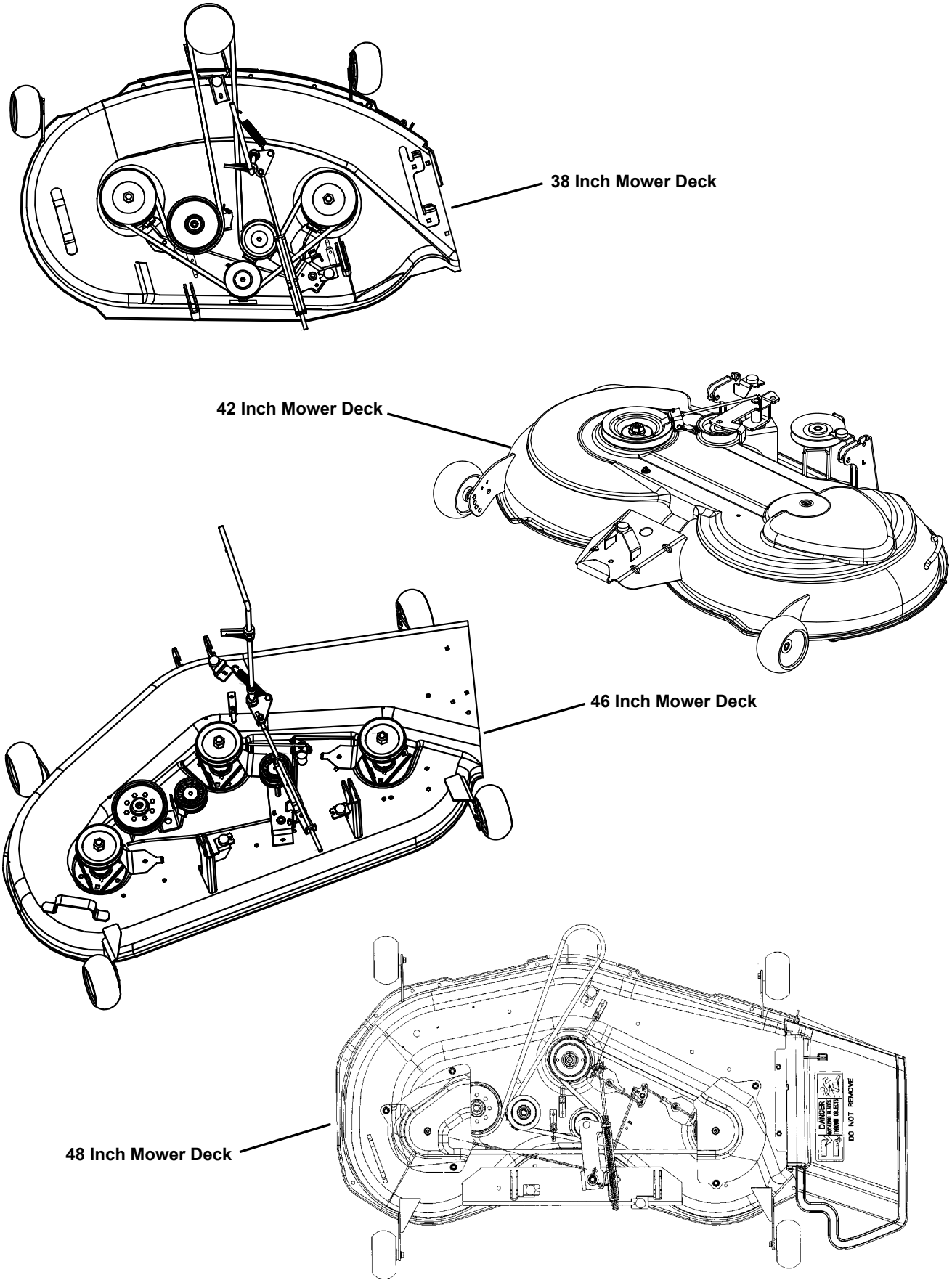
**46 Inch Mower Deck:**

| | |
|---|---|
| Type | Rotary—Triple Spindle W/Brake |
| Blade cap screw | 53 N•m (39 lb-ft) |
| Gage wheels to deck | 48 N•m (35 lb-ft) |
| Spindle mounting nuts | 27 N•m (20 lb-ft) |
| Tensioning rod jam nut | 27 N•m (20 lb-ft) |
| Brake pad to spindle (air gap) | 2 – 3 mm (0.08 – 0.12 in.) |
| Sheave brake wear limit (includes backing plate) | 2.0 mm (0.079 in.) |
| Spindle lubrication | None required |

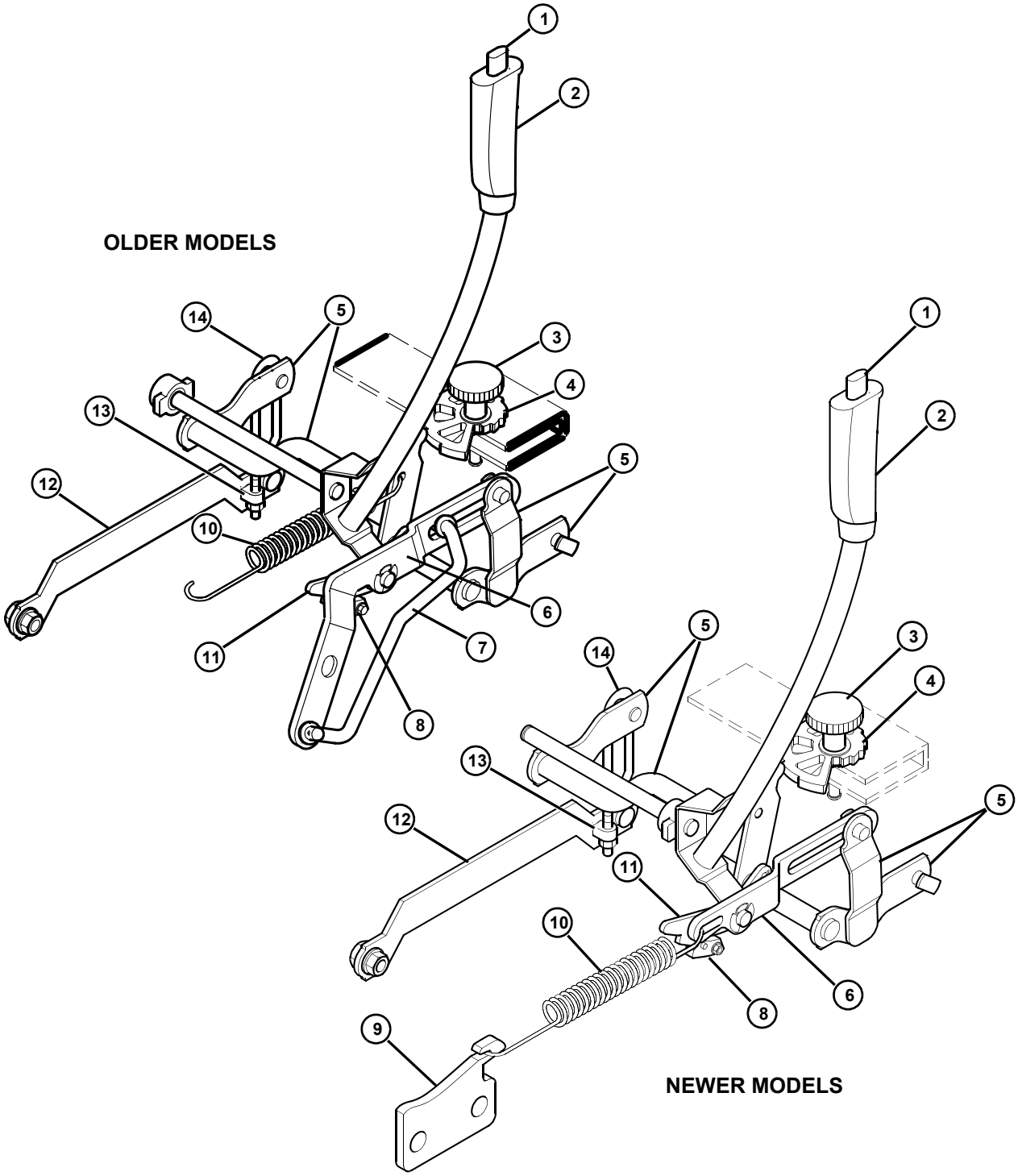
**48 Inch Mower Deck:**

| | |
|---|---|
| Type | Rotary—Triple Spindle W/Brake |
| Blade cap screw | 68 N•m (50 lb-ft) |
| Gage wheels to deck | 25 N•m (221 lb-in.) |
| Spindle mounting nuts | 27 N•m (20 lb-ft) |
| Tensioning rod jam nut | 27 N•m (20 lb-ft) |
| Brake pad to spindle (air gap) | 2 – 3 mm (0.08 – 0.12 in.) |
| Sheave brake wear limit (includes backing plate) | 2.0 mm (0.079 in.) |
| Spindle lubrication | EP grease |

# 38/42/46/48 INCH MOWER DECKS—IDENTIFICATION



# MOWER DECK LIFT LINKAGE




1. Latch release button
2. Lift handle
3. Depth stop knob
4. Depth stop cam
5. Lift shaft assembly
6. Lift strap
7. Mechanical lock rod
8. Striker
9. Spring anchor
10. Lift assist spring
11. Latch
12. Draft arm (RH and LH)
13. Lift link
14. Lift rod

# TROUBLESHOOTING

| Problem or Symptom / Check or Solution | Blades will not drive | Belt slips | Belt jumps off | Vibration | Blades will not stop | Cutting uneven or striping | One blade turns (RH), (LH) does not |
|---|---|---|---|---|---|---|---|
| Engine pulley | ● | ● | ● | ● | ● | | |
| Mower drive belt | ● | ● | ● | ● | ● | ● | |
| Pivot idler | ● | ● | ● | ● | ● | | |
| Idlers | ● | ● | ● | ● | ● | | |
| Brake linkage | ● | ● | | ● | ● | | |
| PTO linkage/spring | ● | ● | ● | ● | ● | | |
| Spindle sheaves | ● | ● | ● | ● | ● | ● | |
| Spindles | ● | ● | ● | ● | ● | ● | |
| Blades | | | | ● | | ● | |
| Mower deck | | | | ● | | ● | |
| Engine | | | | ● | | ● | |
| 42 Inch Mulcher: Damaged timing belt | | | | | | | ● |

# DIAGNOSTICS

## BLADES WILL NOT ROTATE

**Test Conditions:**

- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Ignition switch OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 15. Engine pulley | Tight on crankshaft, key not damaged or missing<br>Belt guides in place, properly adjusted<br>Belt on sheave<br>Sheave angle matching belt angle | Tighten cap screw<br>Replace engine pulley<br>Repair/adjust as needed<br><br>Install<br>Replace engine pulley |
| 16. Mower drive belt | Not damaged, worn or broken<br>Not turned over<br>Routed correctly | Replace belt<br><br>Reroute correctly |
| 17. Pivot idler | Not damaged or binding<br>Belt in place | Repair or replace and adjust as needed |
| 18. Idlers | Not damaged or binding<br>Belt in place | Repair or replace and adjust as needed |
| 19. Brake linkage | Not damaged, bent or binding<br>Properly adjusted | Replace<br>Adjust |
| 20. PTO linkage/spring | Not damaged, bent or binding<br>Properly adjusted | Replace<br>Adjust |
| 21. Spindle sheaves | Not damaged or binding<br>Belt in place | Replace<br>Adjust |
| 22. Spindles<br>42 Inch Mulcher:<br>Spindles | Not damaged or binding<br><br>Both blades turn | Replace<br><br>Damaged timing belt |

# DRIVE BELT SLIPS

**Test Conditions:**

- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Ignition switch OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Engine pulley | Belt guides in place, properly adjusted<br>Sheave angle matching belt angle | Repair/adjust as needed<br><br>Replace engine pulley |
| 2. Mower drive belt | Not damaged, worn or broken<br>Not turned over<br>Routed correctly | Replace belt<br><br>Reroute |
| 3. Pivot idler | Not damaged or binding<br>Brakes release when PTO is engaged | Repair or replace as needed<br>Replace/adjust as needed<br>Adjust PTO linkage |
| 4. Idlers | Not damaged or binding<br>Belt in place | Repair or replace and adjust as needed |
| 5. Brake linkage | Not damaged, bent or binding<br>Properly adjusted | Replace<br>Adjust |
| 6. PTO linkage/spring | Not damaged, bent or binding<br>Properly adjusted<br>PTO spring not weak | Replace<br>Adjust<br>Replace spring |
| 7. Spindle sheaves | Not damaged or binding<br>Belt in place | Replace<br>Adjust |
| 8. Spindles | Not damaged or binding | Replace |
| 9. Mower blade | Turns freely | Remove obstruction (wire, lodged stick etc.) |

# DRIVE BELT WILL NOT STAY ON PULLEYS

**Test Conditions:**

- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Ignition switch OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Engine pulley | Belt guides in place, properly adjusted<br>Sheave angle matching belt angle | Repair/adjust as needed<br><br>Replace engine pulley |
| 2. Mower drive belt | Not damaged, worn or broken<br>Not turned over<br>Routed correctly | Replace belt<br><br>Reroute |
| 3. Pivot idler | Not damaged or binding<br>Brakes release when PTO is engaged | Repair or replace as needed<br>Replace/adjust as needed<br>Adjust PTO linkage |
| 4. Idlers | Not damaged or binding<br>Belt in place | Repair or replace and adjust as needed |
| 5. PTO linkage/spring | Not damaged, bent or binding<br>Properly adjusted<br>PTO spring not weak | Replace<br>Adjust<br>Replace spring |
| 6. Spindle sheaves | Not damaged or binding<br>Belt in place | Replace<br>Adjust |
| 7. Spindles | Not damaged or binding | Replace |
| 8. Deck height | 2.54—10.16 cm (1—4 in.) cut height | Adjust height to match depth stop on tractor |

# VIBRATION

**Test Conditions:**

- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Ignition switch OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Engine pulley | Belt guides in place, properly adjusted<br>Sheave angle matching belt angle | Repair/adjust as needed<br><br>Replace engine pulley |
| 2. Mower drive belt | Not damaged, worn or broken<br>Not turned over<br>Routed correctly | Replace belt<br><br>Re-route |
| 3. Pivot idler | Not damaged or binding<br>Brakes release when PTO is engaged | Repair or replace as needed<br>Replace/adjust as needed<br>Adjust PTO linkage |
| 4. Idlers | Not damaged or binding<br>Belt in place | Repair or replace and adjust as needed |
| 5. Brake linkage | Not damaged, bent or binding<br>Properly adjusted | Replace<br>Adjust |
| 6. PTO linkage/spring | Not damaged, bent or binding<br>Properly adjusted<br>PTO spring not weak | Replace<br>Adjust<br>Replace spring |
| 7. Spindle sheaves | Not damaged or binding<br>Belt in place | Replace<br>Adjust |
| 8. Spindles | Not damaged or binding | Replace |
| 9. Blades | Not damaged or bent<br>Correctly sharpened<br>42” indexed properly | Replace blades<br>Sharpen and balance<br>42”-Re-index |
| 10. Mower deck | Not damaged or bent<br>Properly adjusted | Repair or replace and adjust as needed |
| 11. Engine | Engine running at correct rpm | Check engine adjustments and condition<br>Inform operator that engine should be run at full throttle when mowing |
| 12. 42 inch mulch deck timing belt | Belt intact (no missing teeth) | Replace |

# UNEVEN CUTTING OR STRIPING

**Test Conditions:**

- Machine parked on level surface
- Park brake engaged
- PTO disengaged
- Ignition switch OFF

| Test/Check Point | Normal | If Not Normal |
|---|---|---|
| 1. Mower drive belt | Not slipping | Check for correct belt<br>Check for correct installation<br>Adjust PTO linkage<br>Check for worn, damaged, or binding PTO linkage<br>Check for weak PTO spring<br>Check for worn, damaged, or loose spindle sheave<br>Check for worn, damaged, or loose engine pulley<br>Check that brakes are releasing |
| 2. Spindle sheaves | Not damaged or binding<br>Belt in place | Replace<br>Adjust |
| 3. Spindles | Not damaged or binding | Replace |
| 4. Blades | Not damaged or bent<br>Correctly sharpened | Replace blades<br>Sharpen and balance |
| 5. Mower deck | Mounting hardware not loose, damaged or bent<br>Properly adjusted | Repair or replace and adjust as needed |
| 6. Engine | Engine running at correct rpm | Check engine adjustments and condition<br>Inform operator that engine should be run at full throttle when mowing |
| 7. Travel speed | 1/2—2/3 transport speed | Slow mowing speed |
| 8. Lawn conditions | 15.24 cm (6 in.) tall grass or less | Mow more frequently |

# TESTS & ADJUSTMENTS

*NOTE: For all tests, adjustments, and repairs, see caution below.*

## 38 INCH DECK—LEVELING

**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

**IMPORTANT: Always perform Primary Belt Tensioning Rod Adjustment after leveling deck.**

**Conditions:**

- PTO disengaged
- Cutting height set to **6.35 cm (2.5 in.)**
- Tires inflated to correct pressure

**Specifications:**

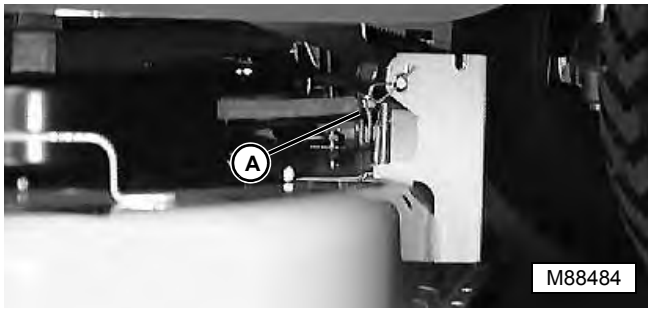
**Side-to-side height. . . . . ± 3 mm (± 0.118 in.)**

**Procedure:**

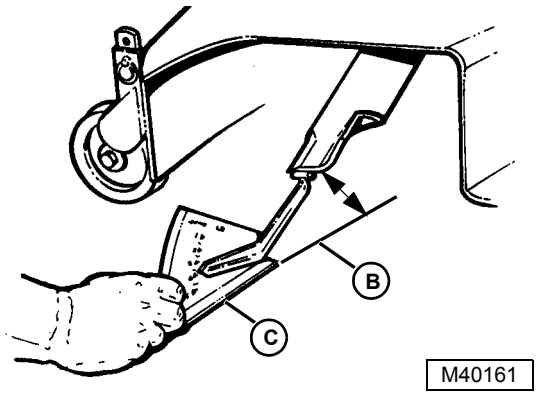
1. Position machine on level surface. Check and set tire pressures to **83 kPa (12 psi)** front tires and **55 kPa (8 psi)** rear tires.
2. Shake deck slightly to ensure deck has settled out on hangers.

*NOTE: Mowing performance is acceptable when operating deck at extreme limits of tolerance. However, for optimum performance, operate deck at ideal setting specified.*
*Whenever possible, use the same blade tip when verifying measurements and checking front-to-rear deck height.*

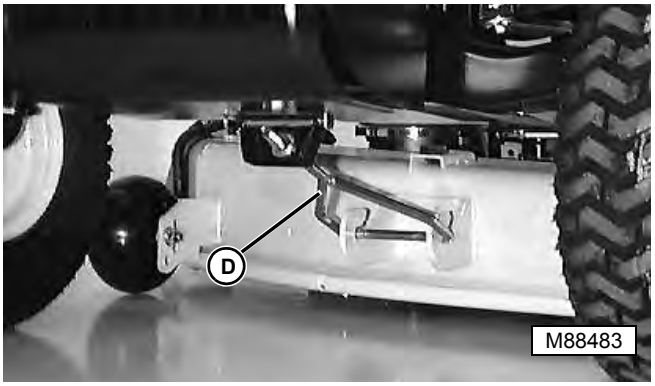
3. Adjust gauge wheels so that the bottom of the wheels is approximately **3 – 13 mm (1/8 – 1/2 in.)** from the ground.
4. Using gloves, rotate one blade to face outboard, and measure blade tip height.




5. Lower or raise deck by turning adjusting nut on rear hanger.




6. With mower deck on a level surface (B), rotate opposite blade to face outboard, and check and adjust blade height with a height gage (C).




**Front To Rear:**

7. Rotate the last blade to face the front of the machine, and measure height of front and rear blade tips to floor surface.

**Specification:**

**Difference between front and rear blade tips . . . . . 6 – 9 mm (0.24 – 0.35 in.)**

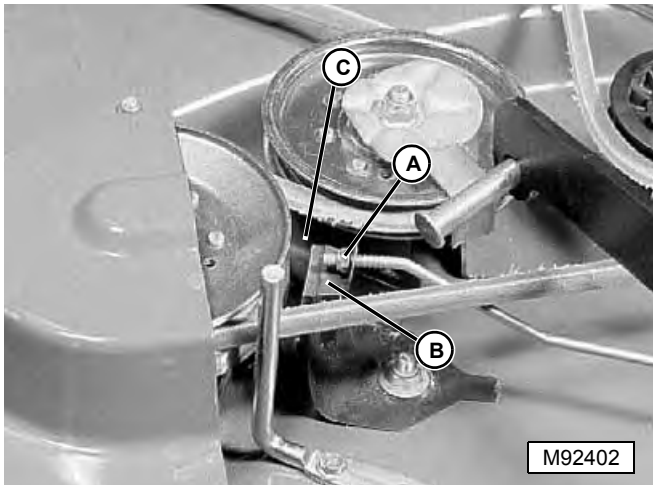
8. Adjust the height by tightening or loosening the front draft rod (D). See “38 INCH DECK—BELT TENSIONING ADJUSTMENT” on pag e13.

## 38 INCH DECK—SHEAVE BRAKE ADJUSTMENT

**IMPORTANT: Spindle brake engagement must be checked and corrected every time the belt tension is adjusted.**
**Belt tension should be adjusted, if required, before brakes are adjusted.**

1. Park mower on a hard, smooth surface. Stop engine, remove key, wait for moving parts to stop.
2. Remove wire from spark plug to prevent accidental starting.
3. Place cutting unit in lowest setting.
4. Engage PTO lever.
5. Remove belt shield.

**IMPORTANT: There are two (2) spindle brakes on the 38 inch deck. Both brakes must be adjusted.**




6. Measure distance from brake surface to pulley braking surface.
7. If not to specification adjust nut (A) on end of brake rod to set brake (B) at the proper distance from pulley (C).

**Specifications:**

**Brake pad to spindle . . . . 2 – 3 mm (0.08 – 0.12 in.)**

8. Reinstall belt covers if removed.
9. Connect spark plug.

## 38 INCH DECK—BELT TENSIONING ADJUSTMENT

**⚠ CAUTION**

**STOP engine, remove ignition key and wait for all moving parts to stop rotating.**

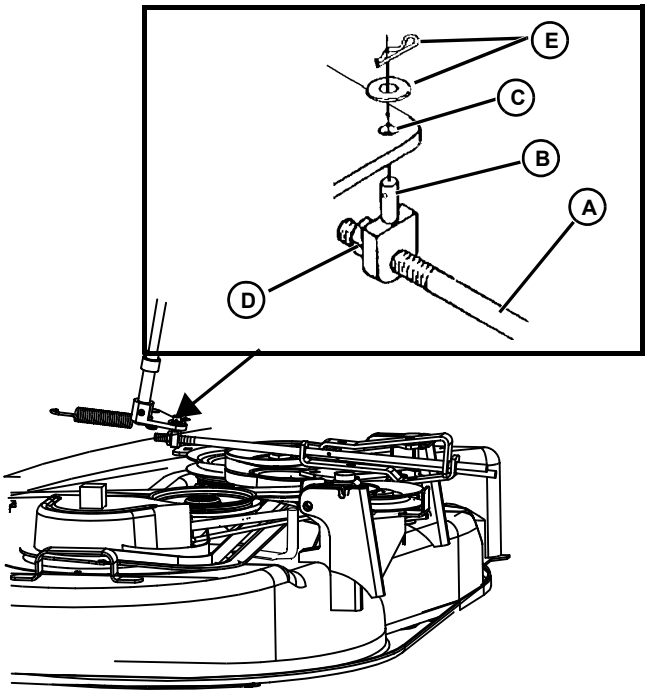
**IMPORTANT: Spindle brake adjustment must be checked every time the belt tension is adjusted. Perform brake adjustment after belt tension adjustment.**

**Conditions:**

- PTO disengaged
- Cutting height set to **1 in.**
- Deck lowered to mow position

**Procedure:**

1. Pull PTO lever in OFF, (DISENGAGED) position.
2. Put mower cutting height in lowest position.




**IMPORTANT: Do not attempt to loosen jam nut on tension rod without using a suitable wrench to support fitting.**

3. Pull mower engagement rod (A) forward to align pin (B) with hole (C).

4. If pin (B) does not line up with hole (C), loosen lock nut (D) and turn pin clockwise to shorten linkage and counter-clockwise to lengthen linkage until pin slips freely into hole.
5. Remove pin from hole. While holding pin straight up, tighten lock nut (D).

**IMPORTANT: DO NOT tighten jam nut with tensioning rod attached to tractor or damage to machine may occur.**

6. Install pin in mower engagement arm hole, and install washer and spring locking pin (E). See “38 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e13.

**Specifications:**

**Tensioning rod jam nut torque . . . 27 N•m (20 lb–ft)**

## 42 INCH DECK—LEVELING

**⚠ CAUTION**

**STOP engine, remove ignition key and wait for all moving parts to stop rotating.**

**IMPORTANT: Always perform Primary Belt Tensioning Rod Adjustment after leveling deck.**

**Conditions:**

- PTO disengaged
- Cutting height set to **2.5 in.**
- Tire pressures checked and set

**Specifications:**

**Side-to-side height. . . . . ± 3 mm (0.118 in.)**

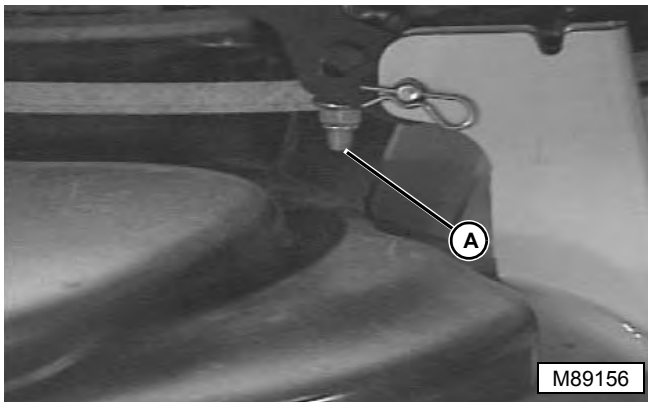
**Procedure:**

**SIDE TO SIDE:**

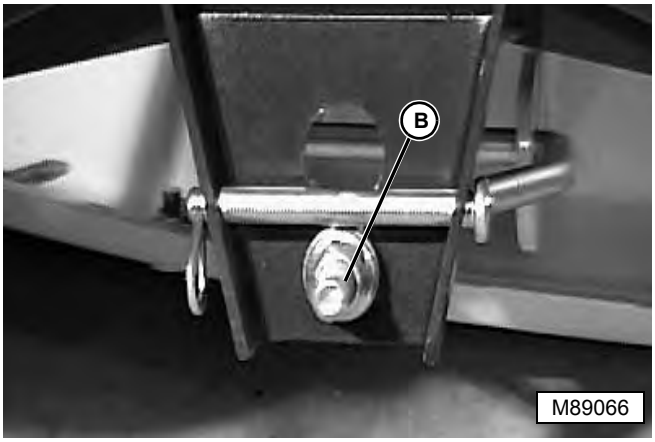
1. Position machine on level surface. Check and set tire pressures to **83 kPa (12 psi)** front tires and **55 kPa (8 psi)** rear tires.
2. Shake deck slightly to ensure deck has settled out on hangers.

*NOTE: Mowing performance is acceptable when operating deck at extreme limits of tolerance. However, for optimum performance, operate deck at ideal setting specified. Whenever possible, use same blade tip when verifying measurements and checking front-to-rear deck height.*

3. Adjust gauge wheels so that the bottom of the wheels is approximately **3 – 13 mm (1/8 – 1/2 in.)** from the ground.
4. Using gloves, rotate one blade to face outboard, and measure blade tip height.




5. Rotate opposite blade **90° ± 10°,** and check and adjust the opposite blade height.
6. Lower or raise deck by turning adjusting nut (A) at rear hanger.



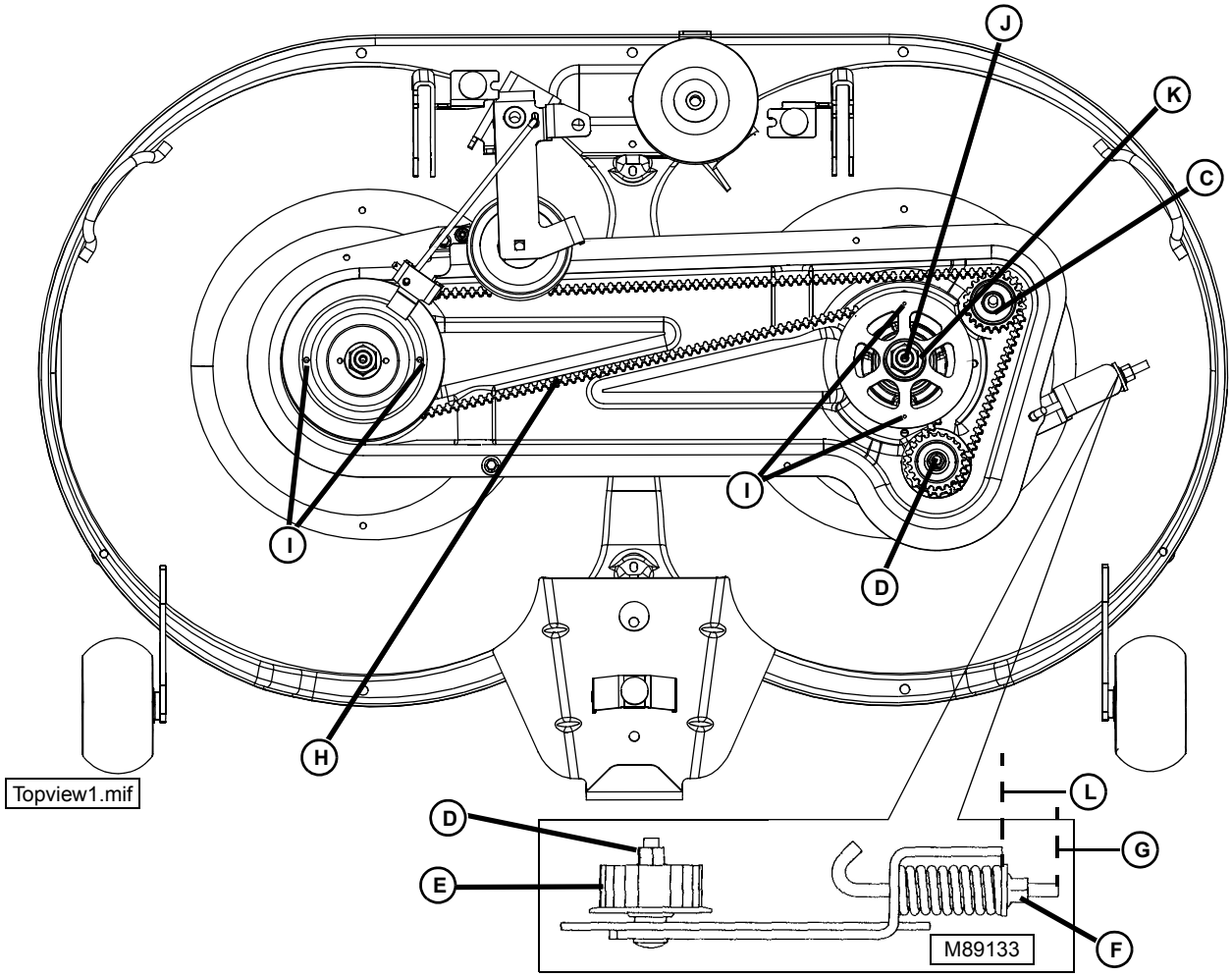

**FRONT TO REAR:**

7. Rotate blade to face the front of the machine, and measure difference between front and rear of blade tip.
8. Adjust the height by tightening or loosening the front draft rod (B).
9. See “42 INCH DECK—DRIVE BELT TENSIONING ADJUSTMENT” on pag e17.

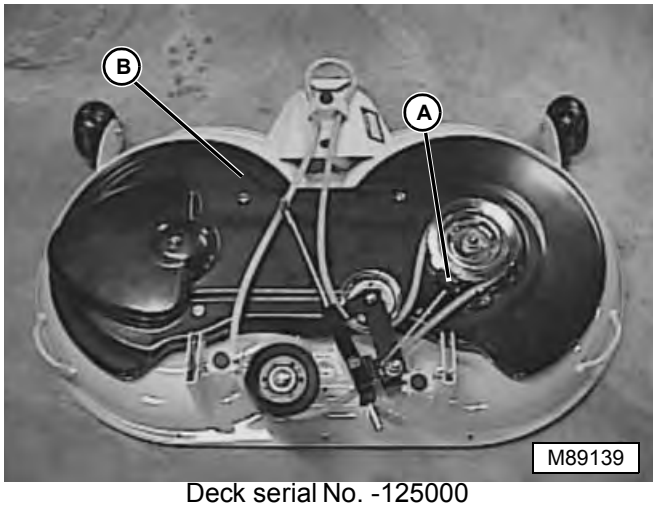
**Specification:**

**Front-to-rear height . . . . . ± 3 mm (0.118 in.)**

# 42 INCH DECK-BLADE TIMING & TIMING BELT TENSIONING-OLD MODEL




**Procedure:**




Deck serial No. -125000

1. Remove mower deck.
2. Remove brake (A) and top cover (B).

*NOTE: DO NOT loosen fixed idler (C) during adjustment.*

3. Loosen nut (D) on tensioning idler (E) one full turn only.
4. Check timing belt condition, and adjust blade timing if necessary.
5. Turn adjust nut (F) counterclockwise to remove tension from timing belt, loosen to end (G) of tension rod.
6. Replace the timing belt (H) at this time if necessary.
7. Index blades **90° ± 10°** apart. **(Look for the timing marks (I) on top of the sheave or sprocket to reference the blade position.)**
   - Loosen timing sprocket mounting nut (J), and adjust with timing marks. Tighten nut to **145 ± 13.6 N•m (107 ± 10 lb-ft).** Note: a **4 mm washer** is used on the right side (K).
8. Rotate adjust nut until washer is aligned with end of idler arm (L).
9. Tighten nut on tensioning idler to **20 N•m (15 lb-ft)**.
10. Install top cover and brake assembly. Ensure belt guide is installed in position shown.

**IMPORTANT: Make sure brake pad contacts sheave face evenly.**

# 42 INCH DECK-BLADE TIMING & TIMING BELT TENSIONING-NEW MODEL

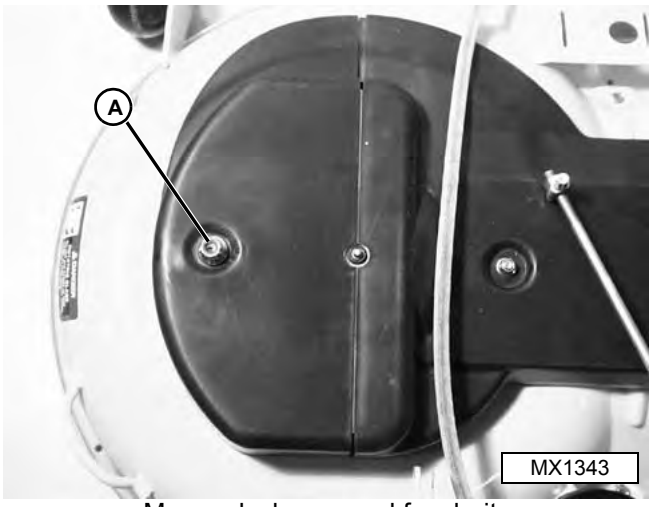
**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

**Procedure:**

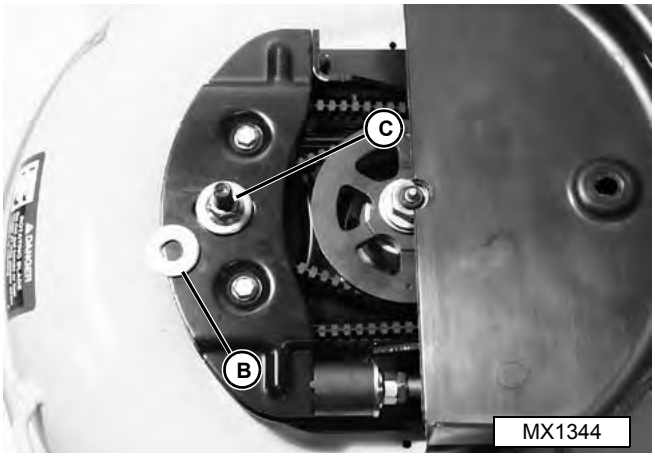
1. Park machine safely.
2. Move lift lever to mowing position, and move to left side of mower.

*NOTE: Mower timing belt cover can be unfastened and flipped open on the left side, exposing the tension adjustment mechanism, without having to remove the mower or the timing belt cover.*

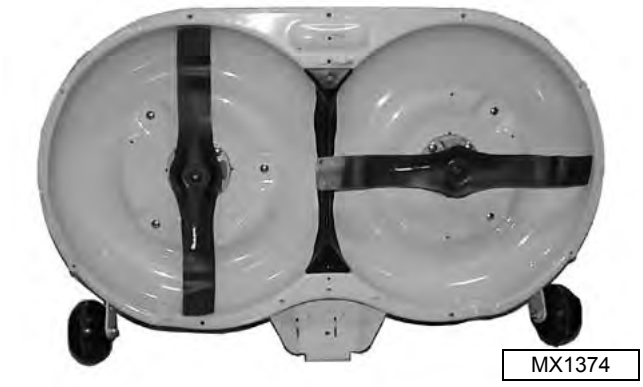



Mower deck removed for clarity

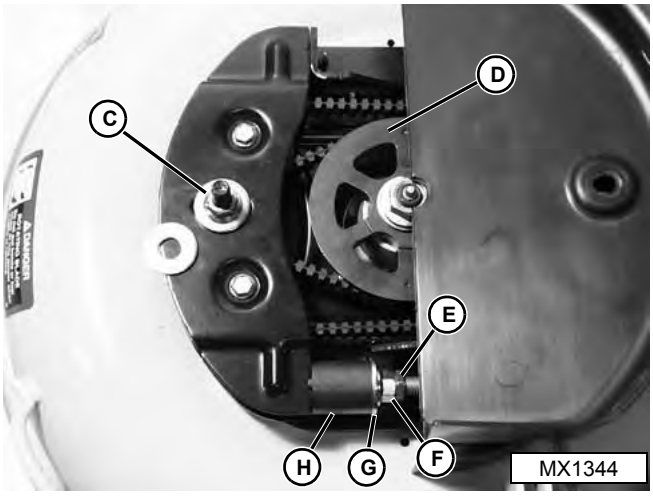
3. Remove flange lock nut (A) to flip open left spindle cover.




4. Checking timing belt for damage. If the belt is damaged, replace the timing belt. See “42 INCH DECK—TIMING BELT REPLACEMENT”.
5. Remove top washer (B) first, then loosen idler assembly center nut (C) ONE FULL TURN ONLY.



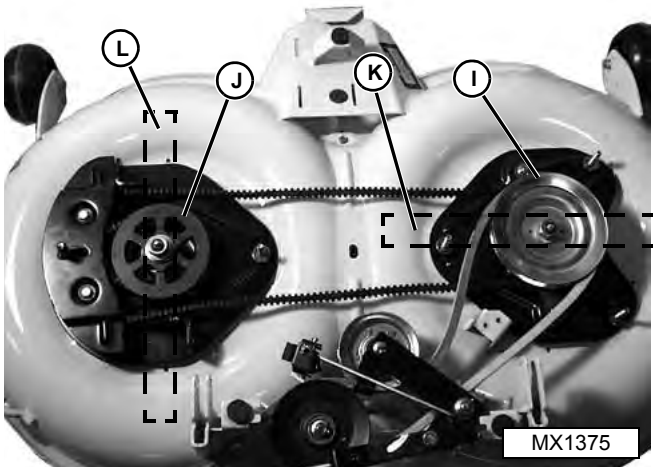

6. Check that blades are timed properly (**90°** from each other). If blades are out of time, set blades to proper timing.




7. Turn left spindle sprocket (D) to be sure belt is seated properly in the sprockets and idlers.

**IMPORTANT: Avoid damage! Incorrect belt tensioning can cause belt damage. Do not over tighten belt tensioning spring assembly.**

8. Loosen jam nut (E) and adjusting nut (F) so that there is a small air gap between washer (G) and mating surface of spring bushing (H).
9. Rotate adjusting nut (F) clockwise until washer (G) makes solid contact with the mating surface of spring bushing (H).
10. Tighten idler assembly center nut (C) to **87 N•m (64 lb-ft).**
11. Tighten jam nut (E) against adjusting nut (F) to **27 N•m (20 lb-ft).**
12. Turn left spindle sprocket (D) to be sure belt is seated properly in the sprockets and idlers.




*NOTE: The position of the drain holes in the spindle sheave (I) and the indentations in the timing sprocket (J) are in alignment with the mower blades (K) and (L).*

13. Check that blades are timed properly (**90°** from each other). If blades are out of time, set blades to proper timing.
14. Install top washer (B) on top of center nut (C) and close left spindle cover.
15. Fasten cover with flange lock nut and tighten to **14 N•m (10 lb-ft).**

## 42 INCH DECK—DRIVE BELT TENSIONING ADJUSTMENT

**⚠ CAUTION**

**STOP engine, remove ignition key and wait for all moving parts to stop rotating.**

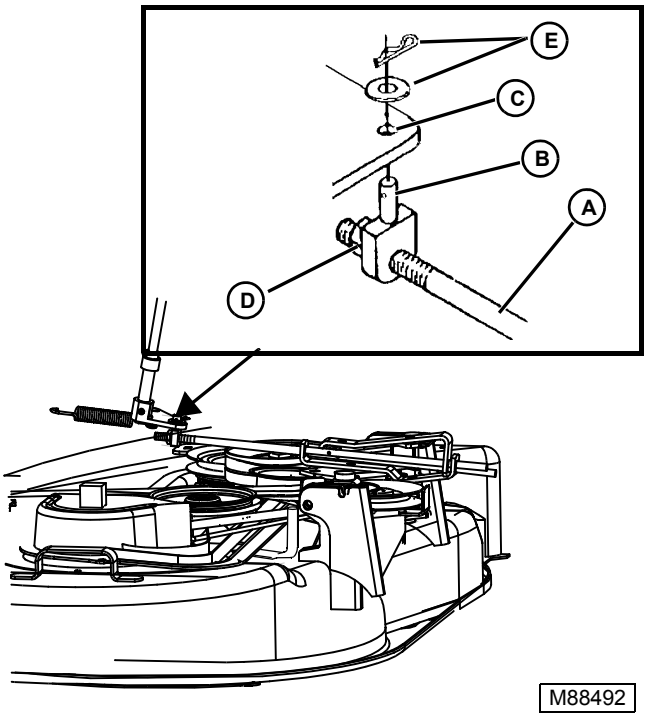
**IMPORTANT: Spindle brake adjustment must be checked every time the belt tension is adjusted. Perform brake adjustment after belt tension adjustment.**

**Conditions:**

- PTO disengaged
- Cutting height set to **1 in.**
- Deck lowered to mow position

**Procedure:**

1. Pull PTO lever in OFF, (DISENGAGED) position.
2. Put mower cutting height in lowest position.




**IMPORTANT: Do not attempt to loosen jam nut on tension rod without using a suitable wrench to support fitting.**

3. Pull mower engagement rod (A) forward to align pin (B) with hole (C).

4. If pin (B) does not line up with hole (C), loosen lock nut (D) and turn pin clockwise to shorten linkage and counter-clockwise to lengthen linkage until pin slips freely into hole.
5. Remove pin from hole. While holding pin straight up, tighten lock nut (D).

**IMPORTANT: DO NOT tighten jam nut with tensioning rod attached to tractor or damage to machine may occur.**

6. Install pin in mower engagement arm hole and install washer and spring locking pin (E).

**Specifications:**

**Tensioning rod jam nut torque . . . 27 N•m (20 lb–ft)**

## 46 INCH DECK—LEVELING

**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

**IMPORTANT: Always perform Primary Belt Tensioning Rod Adjustment after leveling deck.**

**Conditions:**

- PTO disengaged
- Cutting height set to **6.35 cm (2.5 in.)**
- Tires inflated to correct pressure

**SIDE TO SIDE**

**Specifications:**

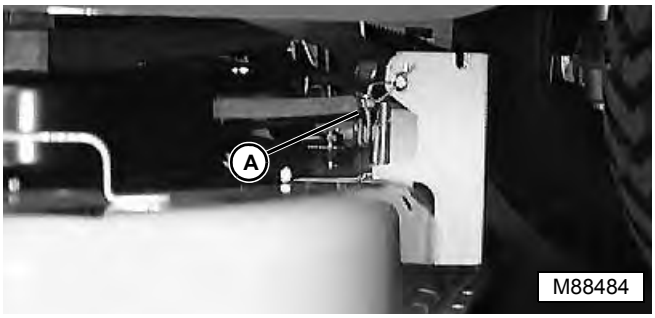
**Side-to-side height. . . . . ± 3 mm (0.118 in.)**

**Procedure:**

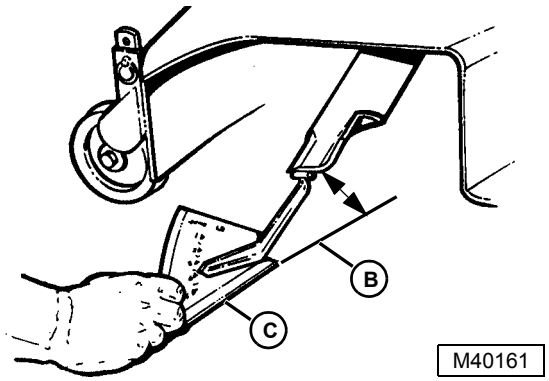
1. Position machine on level surface. Check and set tire pressures to **83 kPa (12 psi)** front tires and **55 kPa (8 psi)** rear.
2. Shake deck slightly to ensure deck has settled out on hangers.

*NOTE: Mowing performance is acceptable when operating deck at extreme limits of tolerance. However, for optimum performance, operate deck at ideal setting specified. Whenever possible, use the same blade tip when verifying measurements and checking front-to-rear deck height.*

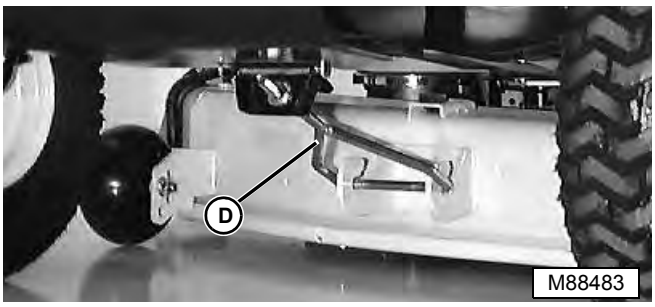
3. Adjust gauge wheels so that the bottom of the wheels is approximately **3 – 13 mm (1/8 – 1/2 in.)** from the ground.
4. Using gloves, rotate one blade to face outboard and measure blade tip height.




5. Lower or raise deck by turning adjusting nut (A) on rear hanger.




6. With mower deck on a level surface (B), rotate opposite blade to face outboard and check and adjust blade height with a height gage (C).



**FRONT TO REAR:**

7. Rotate the last blade to face the front of the machine and measure height difference between front and rear of blade tip.
8. Adjust the height by tightening or loosening the front draft rod (D).

**Specification:**

**Difference between front and rear blade tips . . . . . 6 – 9 mm (0.24 – 0.35 in.)**

## 46 INCH DECK—SHEAVE BRAKE ADJUSTMENT

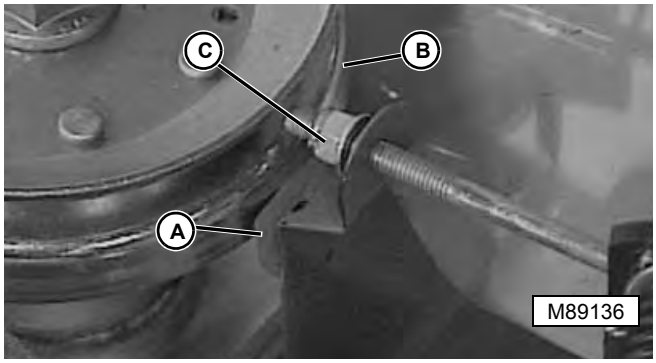
**Reason:**

To ensure that brake pads engage and stop spindles when PTO is disengaged, and brake pads do not contact spindles with PTO engaged.

**IMPORTANT: Sheave brake engagement must be checked and corrected every time the belt tension is adjusted.**
**Belt tension should be adjusted before brakes are adjusted.**

1. Park mower on a hard smooth surface. Stop engine, remove key, wait for moving parts to stop.
2. Remove spark plug wire to prevent accidental starting.
3. Place cutting unit in lowest setting.
4. Engage PTO lever.
5. Remove belt shields.

**IMPORTANT: There are (3) three sheave brakes on the 46 inch deck. All brakes must be adjusted.**




6. Measure distance from brake pad (A) to spindle (B). Set gap to specification.
   - Turn adjusting nut (C) clockwise to pull brake pad away from spindle.
   - Turn adjusting nut counterclockwise to allow brake pad to move toward spindle.

**Specification:**

**Brake pad to spindle . . . . 2 – 3 mm (0.08 – 0.12 in.)**

## 46 INCH DECK—BELT TENSIONING ADJUSTMENT

**⚠ CAUTION**

**STOP engine, remove ignition key and wait for all moving parts to stop rotating.**

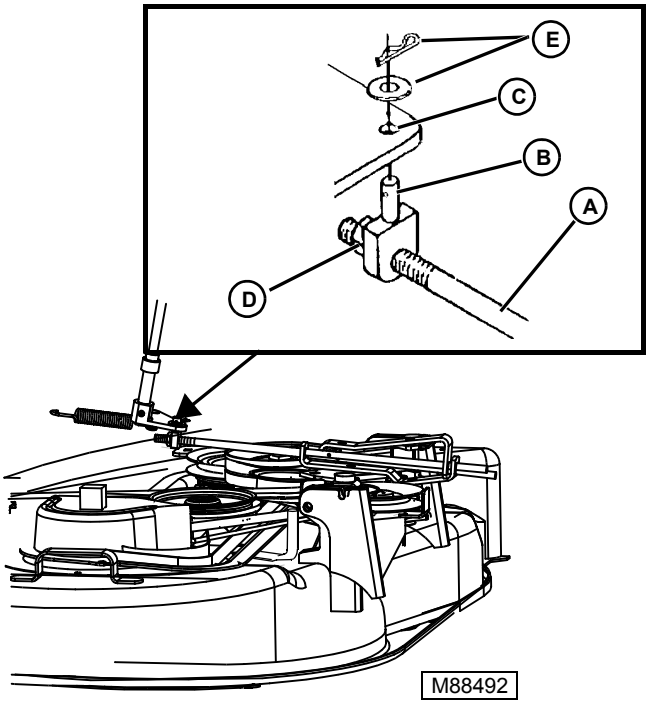
**IMPORTANT: Spindle brake adjustment must be checked every time the belt tension is adjusted. Perform brake adjustment after belt tension adjustment.**

**Conditions:**

- PTO disengaged
- Cutting height set to **1 in.**
- Deck lowered to mow position

**Procedure:**

1. Pull PTO lever in OFF, (DISENGAGED) position.
2. Put mower cutting height in lowest position.



**IMPORTANT: Do not attempt to loosen jam nut on tension rod without using a suitable wrench to support fitting.**

3. Pull mower engagement rod (A) forward to align pin (B) with hole (C).
4. If pin (B) does not line up with hole (C), loosen lock nut (D), and turn pin clockwise to shorten linkage and counter-clockwise to lengthen linkage until pin slips freely into hole.
5. Remove pin from hole. While holding pin straight up, tighten lock nut (D).

**IMPORTANT: DO NOT tighten jam nut with tensioning rod attached to tractor or damage to machine may occur.**

6. Install pin in mower engagement arm hole, and install washer and spring locking pin (E).
7. Adjust brake. See “46 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e19.

**Specifications:**

**Tensioning rod jam nut torque . . . . 27 N•m (20 lb-ft)**

## 48 INCH DECK—LEVELING

**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

**IMPORTANT: Always perform Primary Belt Tensioning Rod Adjustment after leveling deck.**

**Conditions:**

- PTO disengaged
- Cutting height set to **6.35 cm (2.5 in.)**
- Tires inflated to correct pressure

**SIDE TO SIDE**

**Specifications:**

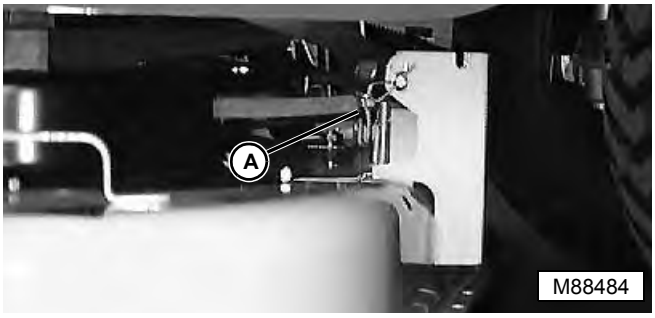
**Side-to-side height. . . . . ± 3 mm (0.118 in.)**

**Procedure:**

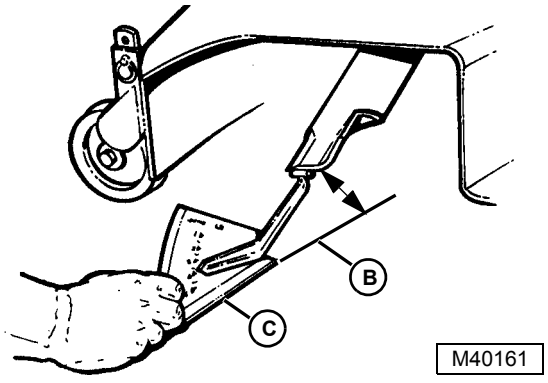
1. Position machine on level surface. Check and set tire pressures to **83 kPa (12 psi)** front tires and **55 kPa (8 psi)** rear.
2. Shake deck slightly to ensure deck has settled out on hangers.

*NOTE: Mowing performance is acceptable when operating deck at extreme limits of tolerance. However, for optimum performance, operate deck at ideal setting specified.*
*Whenever possible, use the same blade tip when verifying measurements and checking front-to-rear deck height.*

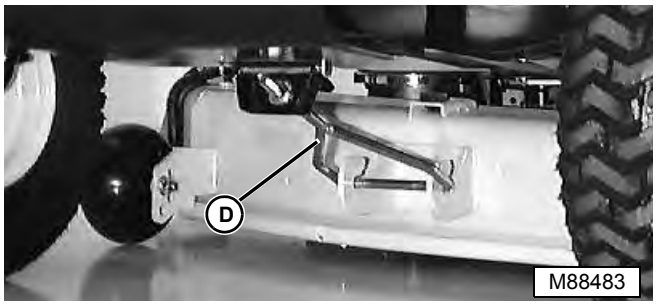
3. Adjust gauge wheels so that the bottom of the wheels is approximately **3 – 13 mm (1/8 – 1/2 in.)** from the ground.
4. Using gloves, rotate one blade to face outboard, and measure blade tip height.




5. Lower or raise deck by turning adjusting nut (A) on rear hanger.




6. With mower deck on a level surface (B), rotate opposite blade to face outboard and check, and adjust blade height with a height gage (C).




**FRONT TO REAR:**

7. Rotate the last blade to face the front of the machine and measure height difference between front and rear of blade tip.
8. Adjust the height by tightening or loosening the front draft rod (D).

**Specification:**

**Difference between front and rear blade tips . . . . . 6 – 9 mm (0.24 – 0.35 in.)**

## 48 INCH DECK—SHEAVE BRAKE ADJUSTMENT

**Reason:**

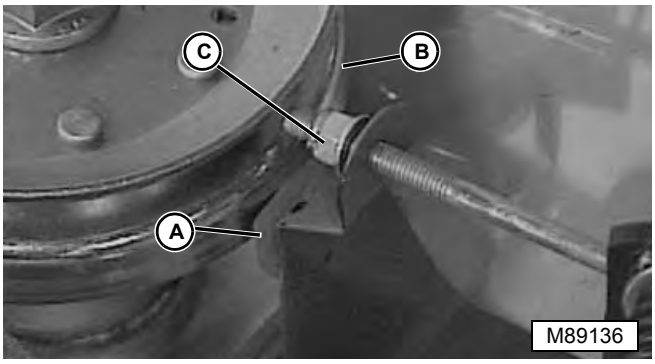
To ensure that brake pads engage and stop spindles when PTO is disengaged, and brake pads do not contact spindles with PTO engaged.

**⚠ CAUTION**

**Sheave brake engagement must be checked and corrected every time the belt tension is adjusted. Belt tension should be adjusted before brakes are adjusted.**

1. Park mower on a hard smooth surface. Stop engine, remove key, wait for moving parts to stop.
2. Remove spark plug wire to prevent accidental starting.
3. Place cutting unit in lowest setting.
4. Engage PTO lever.
5. Remove belt shields.

**IMPORTANT: There are (3) three sheave brakes on the 48 inch deck. All brakes must be adjusted.**




6. Measure distance from brake pad (A) to spindle (B). Set gap to specification.
   - Turn adjusting nut (C) clockwise to pull brake pad away from spindle.
   - Turn adjusting nut counterclockwise to allow brake pad to move toward spindle.

**Specification:**

**Brake pad to spindle . . . . 2 – 3 mm (0.08 – 0.12 in.)**

# 48 INCH DECK—BELT TENSIONING ADJUSTMENT

**⚠ CAUTION**

**STOP engine, remove ignition key and wait for all moving parts to stop rotating.**

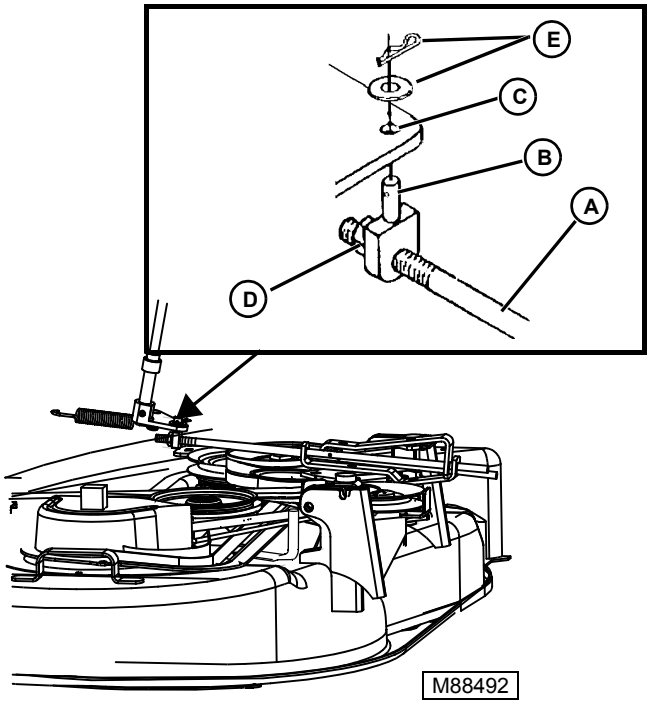
**IMPORTANT: Spindle brake adjustment must be checked every time the belt tension is adjusted. Perform brake adjustment after belt tension adjustment.**

**Conditions:**

- PTO disengaged
- Cutting height set to **1 in.**
- Deck lowered to mow position

**Procedure:**

1. Pull PTO lever in OFF, (DISENGAGED) position.
2. Put mower cutting height in lowest position.




**IMPORTANT: Do not attempt to loosen jam nut on tension rod without using a suitable wrench to support fitting.**

3. Pull mower engagement rod (A) forward to align pin (B) with hole (C).
4. If pin (B) does not line up with hole (C), loosen lock nut (D) and turn pin clockwise to shorten linkage and counter-clockwise to lengthen linkage until pin slips freely into hole.
5. Remove pin from hole. While holding pin straight up, tighten lock nut (D).

**IMPORTANT: DO NOT tighten jam nut with tensioning rod attached to tractor or damage to machine may occur.**

6. Install pin in mower engagement arm hole and install washer and spring locking pin (E).
7. Adjust brake. See “48 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e21.

**Specifications:**

**Tensioning rod jam nut torque . . . . 27 N•m (20 lb-ft)**

# REPAIR

## 38 INCH DECK—REMOVAL/ INSTALLATION

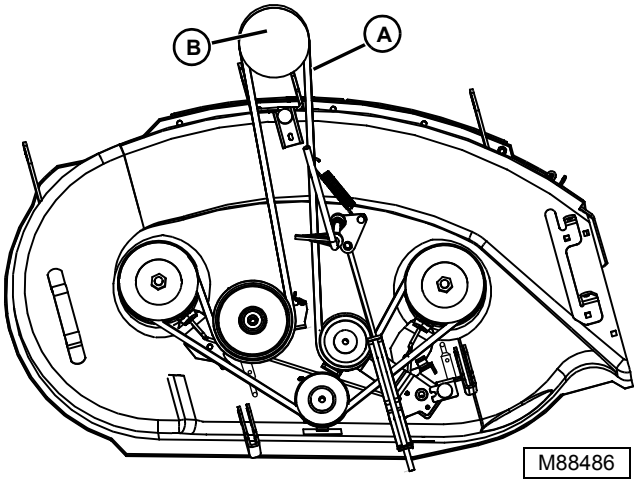
*NOTE: 38 Inch deck used for photos.*

**⚠ CAUTION**

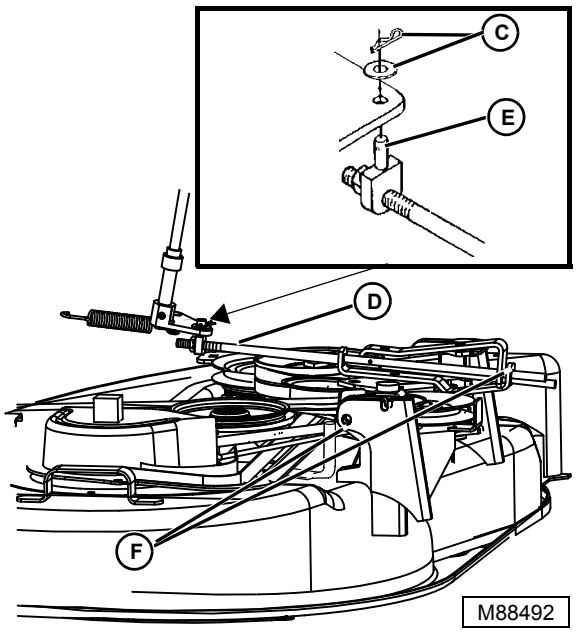
**STOP engine. Remove ignition key. Wait for all moving parts to STOP.**
**Avoid injury from loaded spring and LOCK lift lever before removing mower.**

**Procedure:**

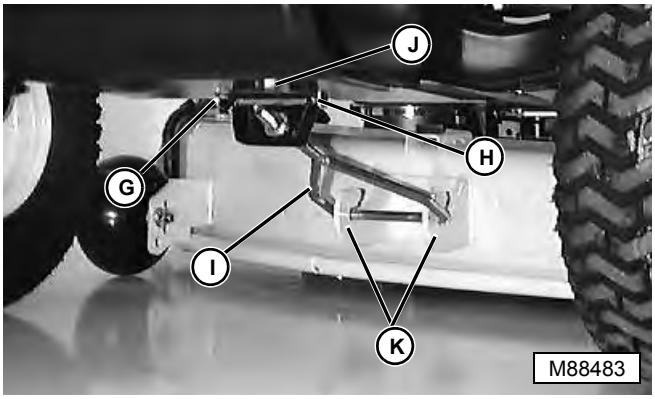
1. Pull mower blade engagement lever (PTO) rearward to DISENGAGE.
2. Raise mower to TRANSPORT (Upper) position.
3. Set cutting height knob to **25 mm (1 in.)**.
4. Put wood blocks under each side of mower.
5. Push mower lift lever down to lower mower deck, and LOCK in MOWING (lower) position, bringing deck down onto blocks.



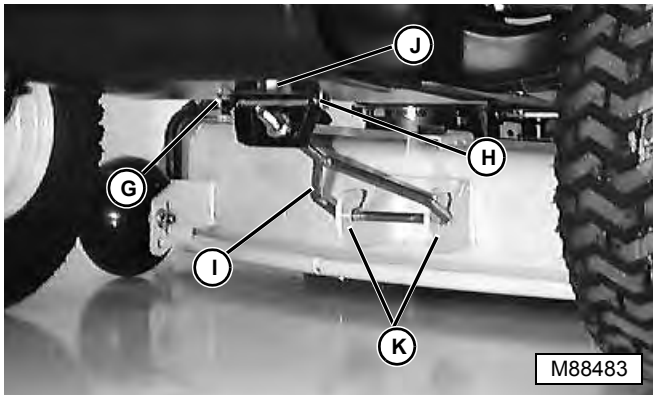

6. Remove belt (A) from engine drive sheave (B) and belt guide.




7. Remove spring locking pin and washer (C) from tensioning rod (D) adjustment pin (E) and remove from PTO link.
8. Disconnect mower deck rear pins (F), right rear side first then left side.



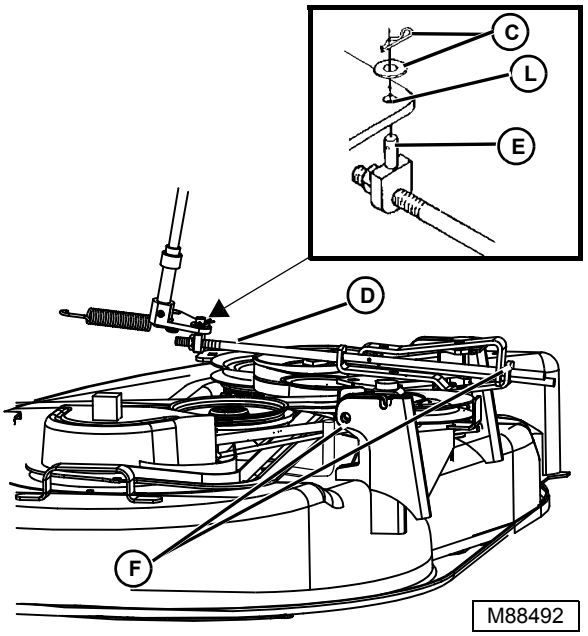

9. Remove spring locking pin (G) and drilled rod (H).
10. Move deck slightly forward and slide front draft rod (I) out of hole (J), and unhook from deck bracket (K).
11. Pull mower lift lever back and LOCK in the transport position.
12. Remove blocks from under deck, and slide mower out from under the tractor.
13. Reinstall in reverse order of removal.
14. Slide mower deck under tractor and place on blocks.
15. Push mower lift lever forward and LOCK in the MOWING position.




16. Move deck slightly forward, hook front draft rod (I) onto deck bracket (K), and slide front draft rod (I) ball into hole (J).

*NOTE: Make sure the ball of the front draft rod is located in formed pocket.*

17. Install drilled rod (H) and spring lock pin (G).

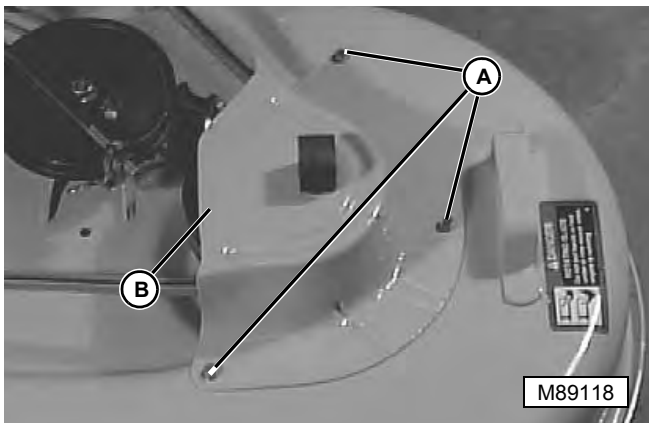



18. Install mower deck rear pins (F), right side first then the left side.
19. Install belt on engine drive sheave and belt guide.
20. Check to be sure that the belt is clear of all belt guides.
21. Remove blocks from under deck.
22. Check to see if pin (E) lines up with hole in PTO link (L). See “38 INCH DECK—BELT TENSIONING ADJUSTMENT”.
23. Install tensioning rod (D) adjustment pin (E) into hole in PTO link (L), and secure with spring locking pin and washer (C).

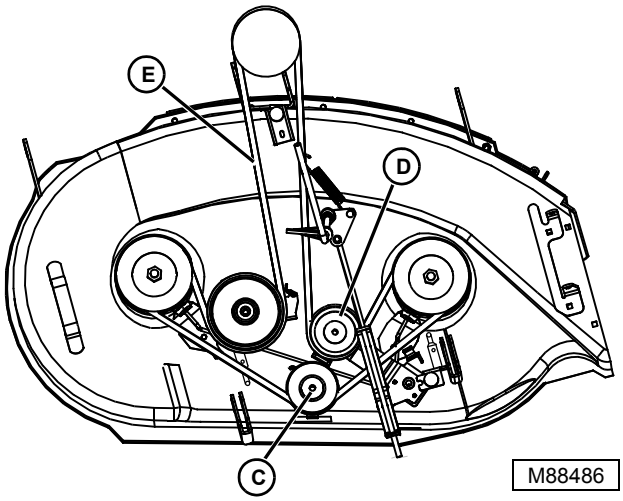
# 38 INCH DECK—DRIVE BELT REMOVAL/INSTALLATION

**Procedure:**

1. Remove mower deck.




2. Remove cap screws (A) and belt shield (B).

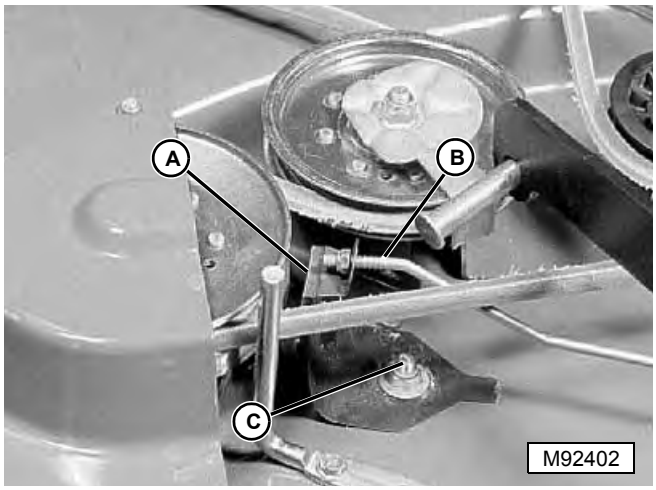



3. Loosen rear idler (C) and tensioning sheave (D).
4. Remove belt (E).
5. Clean upper mower deck and sheaves.
6. Inspect belt for wear or damage; replace as necessary.
7. Reinstall in reverse order of removal; follow diagram above for belt routing.
8. Tighten rear idler (C) and tensioning sheave (D).
9. Install belt shields.
10. Install mower deck.
11. Adjust mower engagement rod if necessary.

## 38 INCH DECK—SHEAVE BRAKE REPLACEMENT

**Procedure:**

1. Remove mower deck.

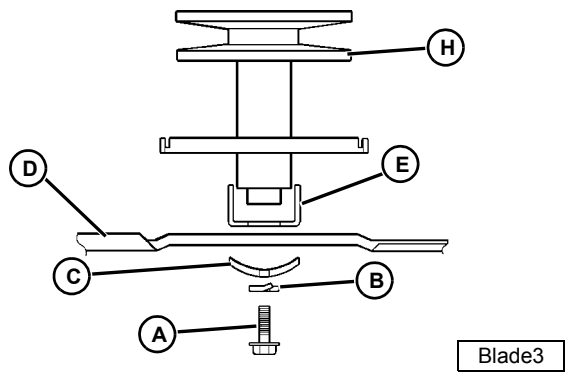



2. Inspect spindle brake pads (A) for wear. Minimum thickness of each brake pad is **2 mm (0.079 in.) including backing plate.**
3. If brake(s) must be replaced, remove brake arm (B).
4. Remove nut and bolt (C) securing brake to deck and remove sheave brake.
5. Replace sheave brake.
6. Install sheave brake on mower deck.
7. Adjust brake. See “38 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e13.

## 38 INCH DECK—SPINDLES REMOVAL/INSTALLATION

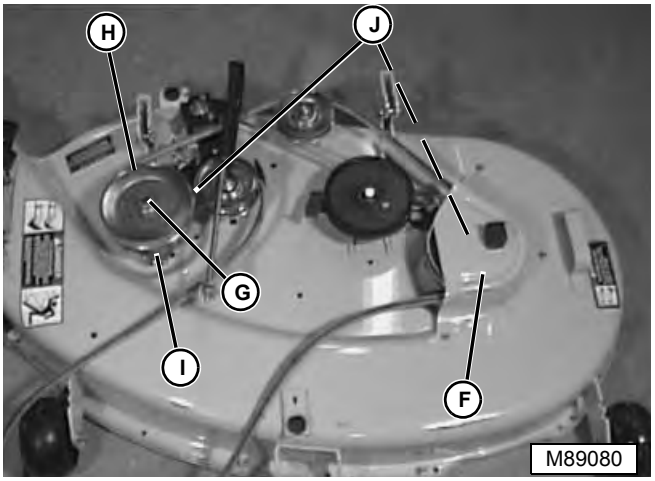
**Procedure:**

1. Remove:
- Mower deck
- Mower blades
- Mower drive belt




*NOTE: Spindles are not serviceable; they must be replaced as a complete assembly if any parts are damaged or worn.*

2. Remove blade cap screw (A), lock washer (B), cup washer (C), blade (D), and deflector cup (E).




3. Remove belt shield (F), sheave nut (G), sheave (H), spindle bolts (I) and spindle assembly (J).
4. Reinstall in reverse order of removal.

*NOTE: Mount spindles such that grease fittings face away from discharge chute.*

5. Tighten spindle nuts to specification.

**Specifications:**

**Spindle mounting nuts . . . . . 27 N•m (20 lb–ft)**

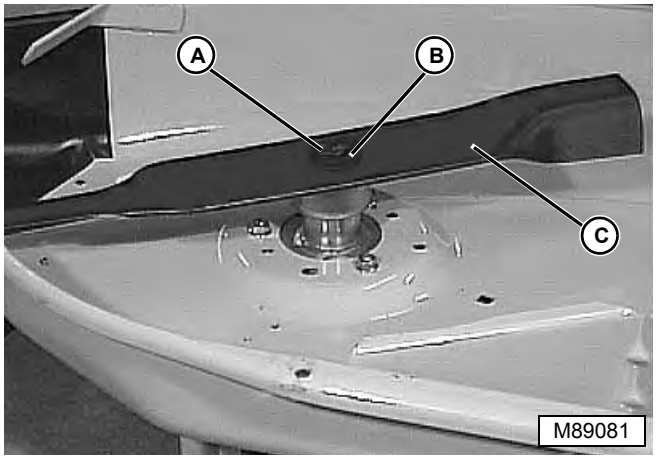
## 38 INCH DECK—BLADES REMOVAL/INSTALLATION

**Procedure:**

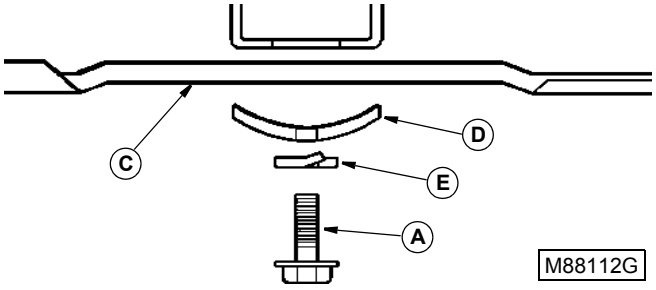
1. Remove mower deck.

**⚠ CAUTION**

**Blades are sharp and could cause personal injury. Wear gloves or wrap blade with rag to remove or install blades. DO NOT hold blades with bare hand. Use a block of wood wedged between deck and blade to keep spindle from turning.**




2. Using a wooden block, wedged between the deck and the blade, remove cap screw (A), washers (B) and blade (C).
3. Inspect blades; sharpen/balance or replace as necessary.
4. Lightly lubricate capscrew threads with general purpose grease or oil. This lubrication is to prevent rusting and seizing.




5. Position mower blade (C) with the cutting edge towards the ground onto the mower spindle.
6. Install blade washer (D) with cup side toward the blade.
7. Install hardened washer (E).
8. Install and tighten capscrew (A) by hand until mower blade is in full contact (fully seated) with spindle.
9. With mower blade blocked to prevent spinning, tighten capscrew to specification.
10. Install mower deck.

**Specification:**

**Blade cap screw . . . . . 53 N•m (39 lb-ft)**

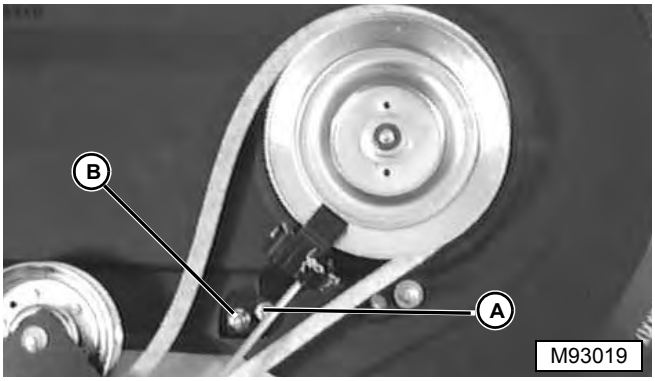
## 42 INCH DECK—DRIVE BELT REMOVAL/INSTALLATION

**⚠ CAUTION**

**STOP engine, remove ignition key, and wait for all moving parts to stop rotating.**

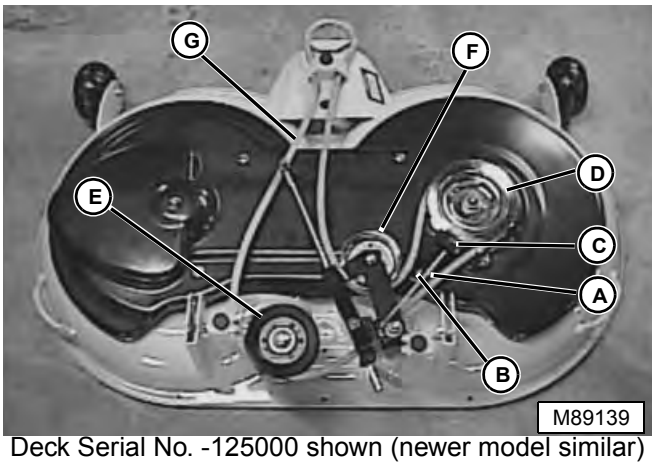
**Procedure:**

1. Remove mower deck.




2. Remove capscrew (A) and nut (B).

*NOTE: On newer models decks (SN 125001- ), there are two self-tapping capscrews (A) holding brake assembly on deck bracket.*




Deck Serial No. -125000 shown (newer model similar)

3. Move brake assembly (C) away from sheave (D).
4. Loosen idler sheave (E) and tensioner sheave (F).
5. Remove belt (G), inspect for wear or damage, and replace as necessary.
6. Install belt in reverse order. Use picture above for belt routing.
7. Tighten idler sheave (E) and tensioner sheave (F).

8. Align brake assembly (C) with sheave (D) and tighten with capscrew (A) and lock nut (B). Brake pad must seat against sheave face.
9. Install mower deck. See “42 INCH DECK—DRIVE BELT TENSIONING ADJUSTMENT” on page 17.

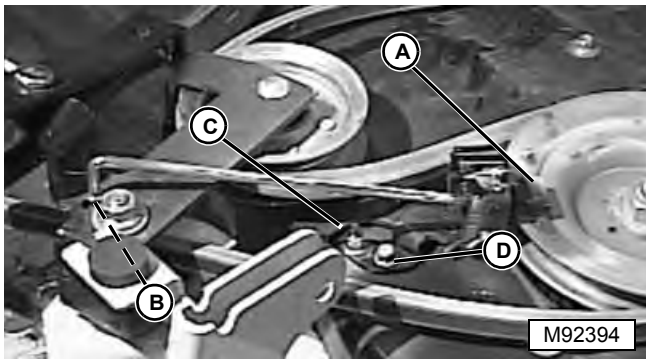
## 42 INCH DECK—SHEAVE BRAKE REPLACEMENT

**CAUTION**

**STOP engine, remove ignition key, and wait for all moving parts to stop rotating.**

**Procedure:**

1. Remove mower deck from tractor.




2. Measure the thickness of the pad (A) (including the backing plate). If thickness is **5.5 mm (0.217 in.)** or less, replace brake.
3. If brake must be replaced, remove cotter pin (B) and washer from sheave brake arm.
4. Remove nut (C) and bolt (D) securing brake to deck, and remove sheave brake assembly.

*NOTE: On newer models decks (SN 125001- ), there are two self-tapping capscrews (D) holding brake assembly on deck bracket.*

5. Disassemble sheave brake assembly. Replace sheave brake and reassemble sheave brake assembly.

*NOTE: Clean sheave with brake cleaner to ensure surface is free of dirt or grease.*

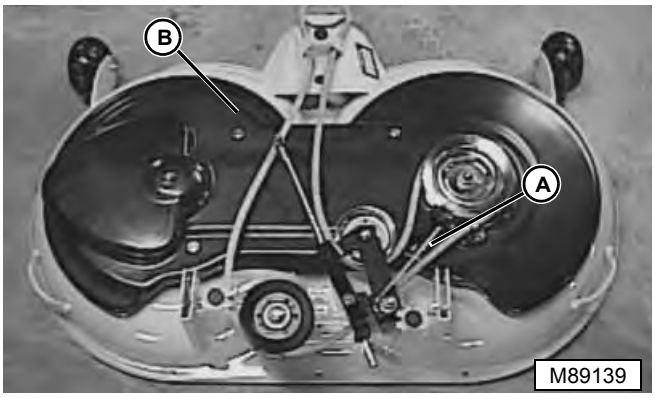
6. Install sheave brake assembly on mower deck.

*NOTE: 42-inch decks have a self-adjusting spindle brake assembly. No adjustment is necessary.*

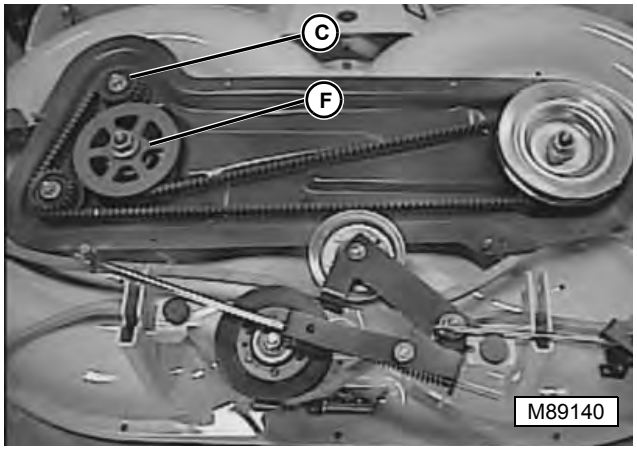
## 42 INCH DECK-SPINDLES REMOVE/ INSTALL & BEARING REPLACEMENT

**Procedure:**

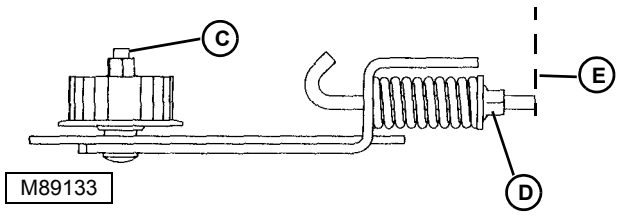
**OLD MODEL (SERIAL NO. -125000):**




1. Remove mower deck.
2. Support blade for spindle being repaired.
3. Remove brake (A) and top cover (B).

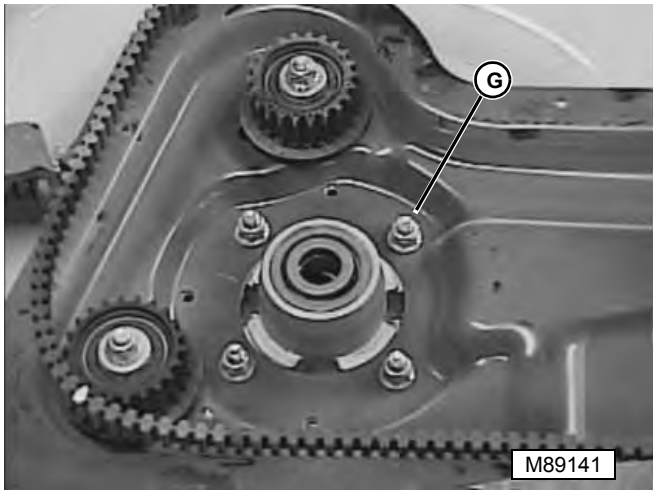



4. Loosen nut (C) on tensioning idler one turn.

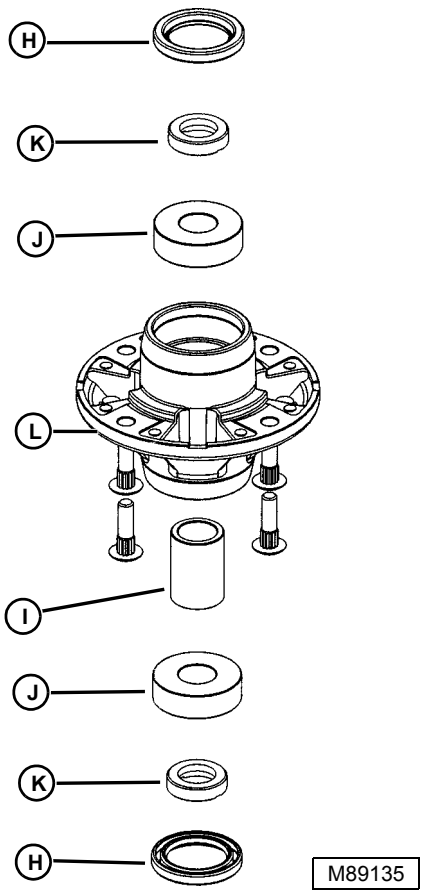



5. Turn adjust nut (D) counterclockwise to remove tension from timing belt; loosen to end of tension rod (E).
6. Remove **timing** sprocket (F), and if necessary pry timing sprocket off evenly using two pry bars.

*NOTE: Spindle shaft may fall out when sprocket is removed.*




7. Remove four spindle mounting nuts (G), and remove spindle.
8. Remove both seal bushings (H).
9. Use a screwdriver to push the spacer (I) to one side, and use a drift punch and a hammer to tap out the bearings (J) and seals (K) evenly.




10. Clean spindle housing (L) with a suitable solvent, and inspect housing for damage.
11. Fill spindle cavity, and pack new bearings with GREASE–GARD® or equivalent.
12. Press upper bearing in against shoulder first.
13. Install spacer, and press in bottom bearing.
14. Lubricate seal lips with grease. Install seals with seal lips facing bearings.
15. Install seal bushings ensuring **notch is down**.
16. Align inside diameter of all components to allow spindle shaft installation.

**IMPORTANT: If the threads on a mounting stud have been damaged, it can be replaced with a nut and bolt. Ensure that the area around the stud to be pressed out is supported from underneath to prevent the spindle mounting flange from being damaged.**

17. Position spindle into deck from the bottom and attach with four nuts; tighten to **27 N•m (20 lb-ft)**.
18. Replace timing sprocket (F) and secure with nut. Tighten nut to **145 N•m (107 ft-lb)**. Align timing marks to blade.
19. See “42 INCH DECK-BLADE TIMING & TIMING BELT TENSIONING-OLD MODEL” on pag e15.

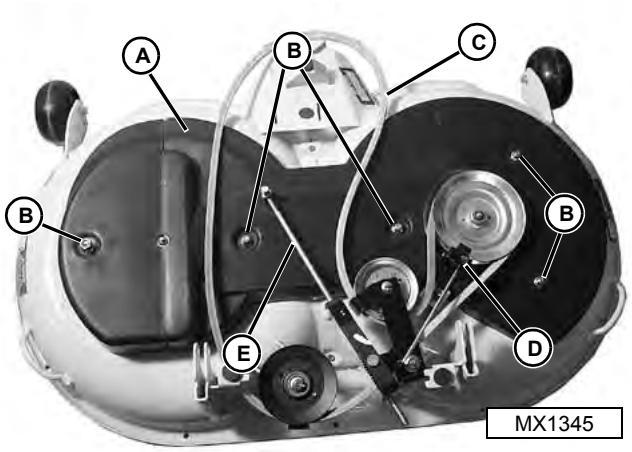
**NEW MODEL (SERIAL NO. 125001- ):**

1. Remove mower deck.

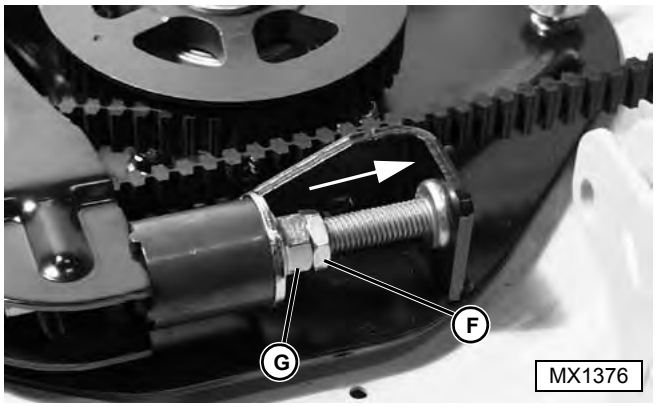
**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

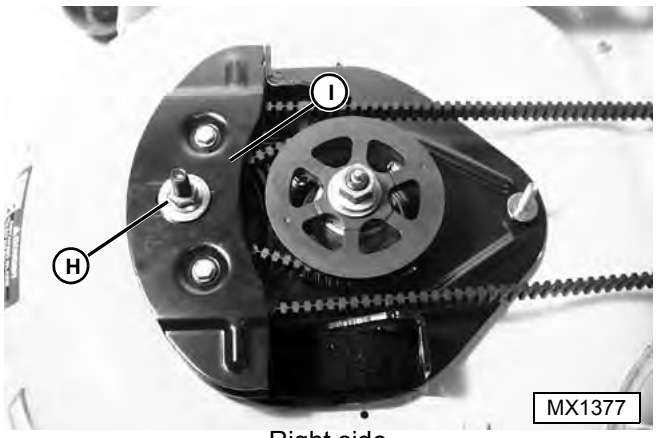
2. Check blade torque anytime mower is removed. Carefully hold blade with glove, use a hand torque wrench, and tighten bolt to **57 N•m (42 lb-ft).**




3. Remove mower drive belt (C).
4. Move spindle brake assembly (D) and mower engagement rod assembly (E) back to clear timing belt cover.
5. Remove five flange lock nuts (B) and cover (A).

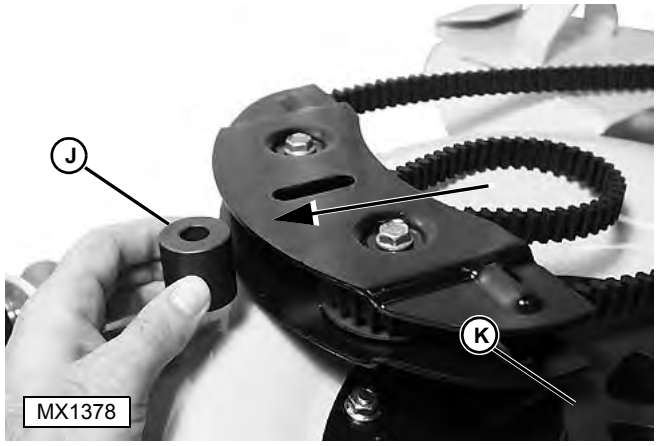



6. Turn jam nut (F) and adjusting nut (G) counterclockwise to end of threaded rod, and remove tensioning spring assembly.

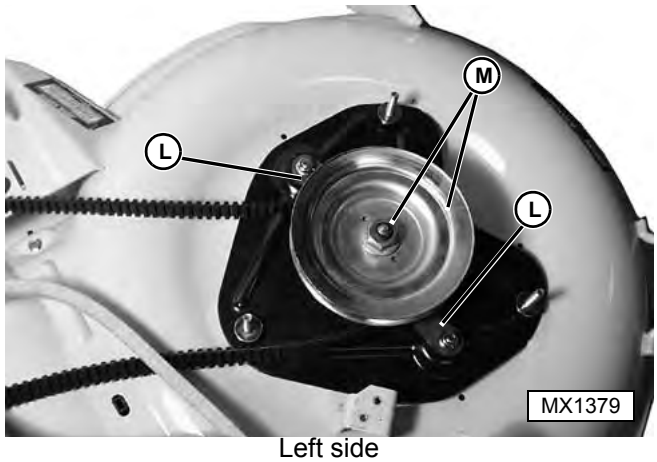



Right side

7. For the right side of deck, remove center nut and washer (H) and move fixed idler assembly (I) close to the spindle sprocket. DO NOT loosen other idle assembly hardware.
8. Raise idler assembly upward as you carefully remove timing belt from the left spindle sprocket.

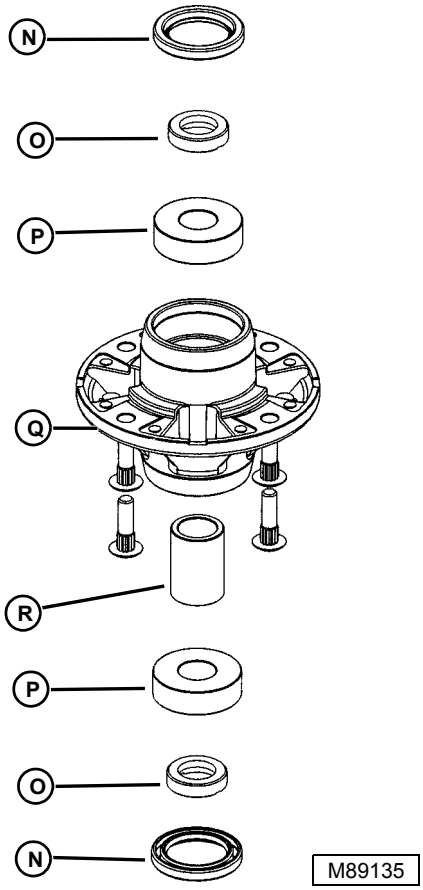



9. Remove spacer (J) located between fixed idler assembly plates and carefully pull belt from assembly.
10. Support blade for right hand spindle.
11. Remove nut and washer, and timing sprocket (K).
12. Remove four nuts securing spindle assembly to deck.




Left side

13. For the left side of the deck, loosen two belt guides (L) and rotate away from left sprocket.
14. Remove timing belt.
15. Support blade for left hand spindle.
16. Remove nut and sheave (M).
17. Remove four nuts securing spindle assembly to deck.




18. Remove both seal bushings (N).
19. Use a screwdriver to push the spacer (R) to one side, and use a drift punch and a hammer to tap out the bearings (P) and seals (O) evenly.
20. Clean spindle housing (Q) with a suitable solvent, and inspect housing for damage.
21. Fill spindle cavity, and pack new bearings with GREASE–GARD® or equivalent.
22. Press upper bearing in against shoulder first.
23. Install spacer, and press in bottom bearing.
24. Lubricate seal lips with grease. Install seals with seal lips facing bearings.
25. Install seal bushings ensuring **notch is down**.
26. Align inside diameter of all components to allow spindle shaft installation.

**IMPORTANT: If the threads on a mounting stud have been damaged, it can be replaced with a nut and bolt. Ensure that the area around the stud to be pressed out is supported from underneath to prevent the spindle mounting flange from being damaged.**

27. Position spindle into deck from the bottom and attach with four nuts; tighten to **27 N•m (20 lb-ft)**.
28. Replace timing sprocket (K) and secure with washer and nut. Tighten nut to **145 N•m (107 ft-lb)**. Align timing marks to blade.
29. See “42 INCH DECK-BLADE TIMING & TIMING BELT TENSIONING-NEW MODEL” on page 16.

## 42 INCH DECK—TIMING BELT REPLACEMENT

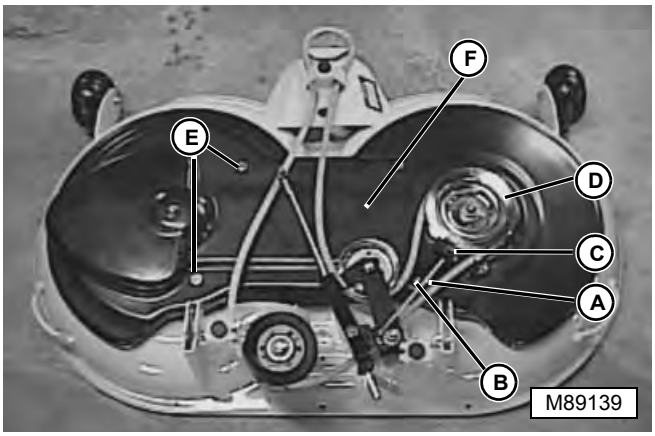
**Procedure:**

**OLD MODEL (SERIAL NO. -125000):**

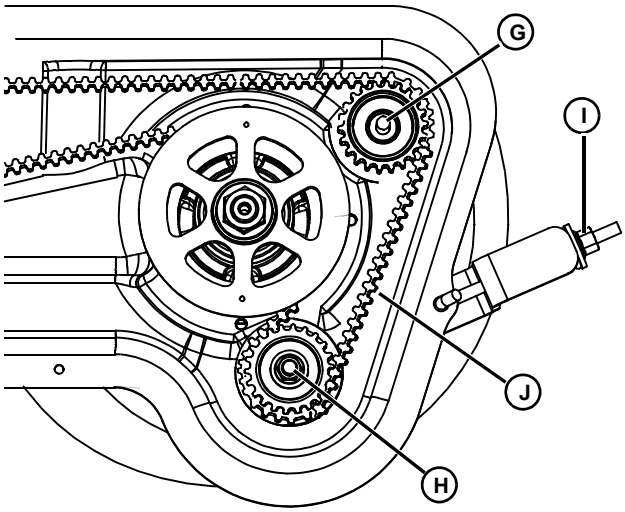
1. Remove mower deck and drive belt.

**⚠ CAUTION**

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**



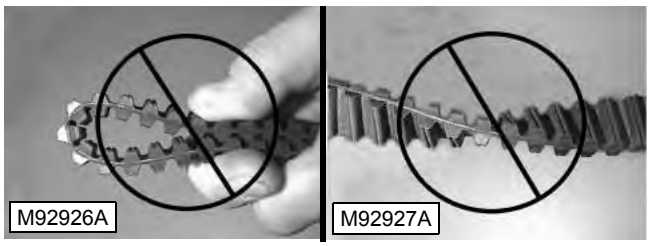

2. Remove capscrew (A) and nut (B).
3. Move brake assembly (C) away from sheave (D).
4. Remove five capscrews (E) and washers, and remove cover (F).

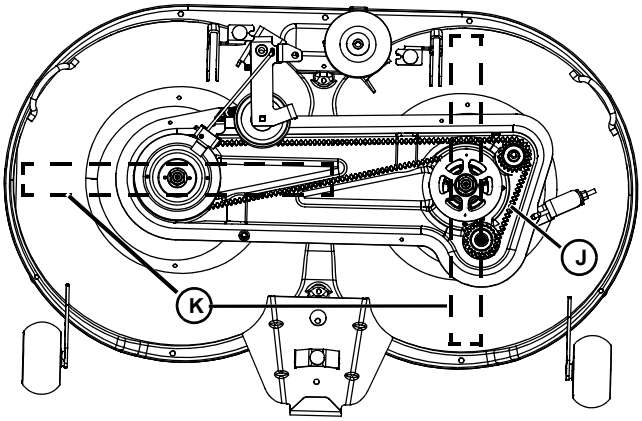



**IMPORTANT: DO NOT loosen fixed idler (G). Loosening tensioning idler nut (H) less than one full turn or more than one full turn will effect final belt tension.**

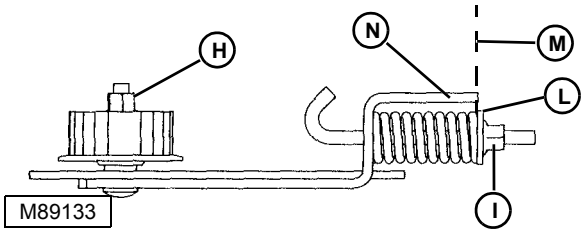
5. Turn adjusting nut (I) counterclockwise to end of threads to remove tension from timing belt.
6. Turn nut (H) on idler ONE FULL TURN counterclockwise to loosen.
7. Remove timing belt (J), inspect for wear or damage, and replace as necessary.

**IMPORTANT: HANDLE TIMING BELT WITH CARE. To avoid belt damage, DO NOT crimp, fold, or twist.**

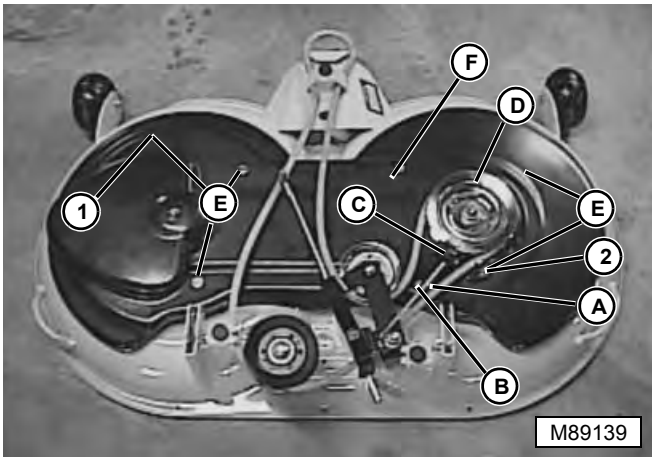



8. Position blades (K) **90° ± 10°** apart. Look for the timing marks on top of the sheave or sprocket to reference the blade position.
9. Install mower deck timing belt. Use diagram above for belt routing.
10. Check that blades are still timed at **90° ± 10°** apart from each other.




11. Rotate adjusting nut (I) clockwise until washer (L) is aligned (M) with end of pretensioner assembly (N).
12. Tighten nut (H) to **20 N•m (15 lb-ft).**
13. Turn blades several rotations, and observe that belt is riding properly in sprockets and idlers.




14. Install cover (F) using five capscrews and washers (E). Tighten capscrews (1) and (2) FIRST.

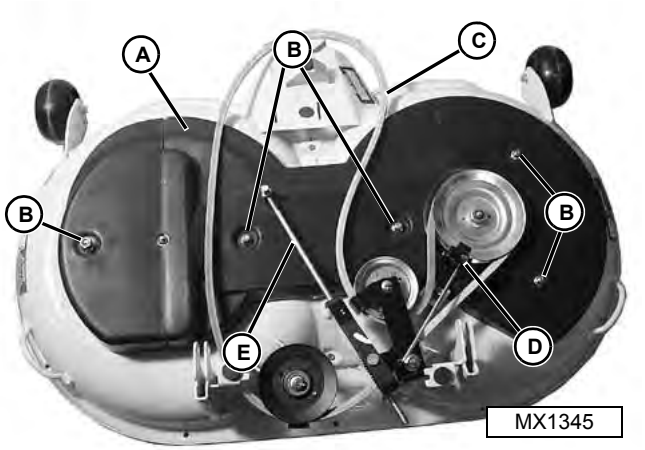
15. Align brake assembly (C) with sheave (D), and tighten with capscrew (A) and lock nut (B). Brake pad must seat against sheave face.
16. Install mower deck.

**NEW MODEL (SERIAL NO. 125001- ):**

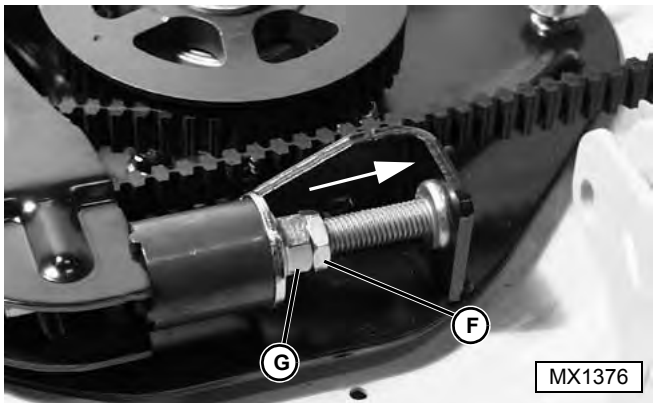
## ⚠ CAUTION

**To avoid injury, before you adjust mower: STOP engine, remove key, wait for blades to STOP. Be careful, sharp edges on mower blades. Always wear gloves when handling mower blades.**

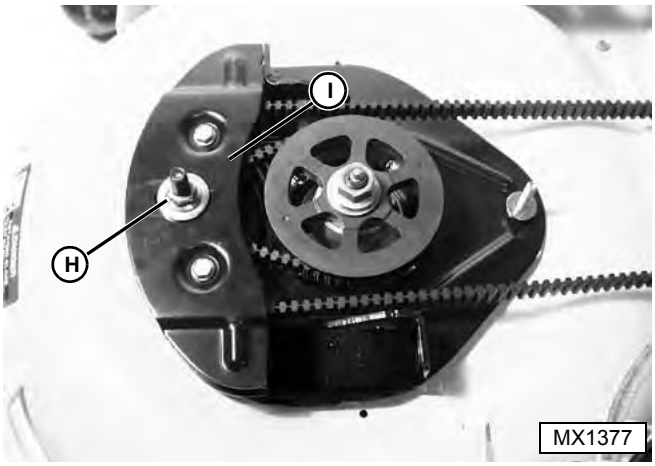
1. Remove mower deck.
2. Check blade torque anytime mower is removed. Carefully hold blade with glove, use a hand torque wrench, and tighten bolt to **57 N•m (42 lb-ft).**



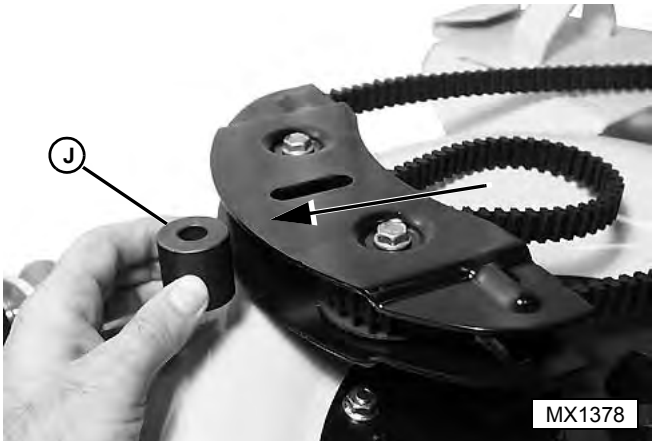

3. Remove mower drive belt (C).
4. Move spindle brake assembly (D) and mower engagement rod assembly (E) back to clear timing belt cover.
5. Remove five flange lock nuts (B) and cover (A).



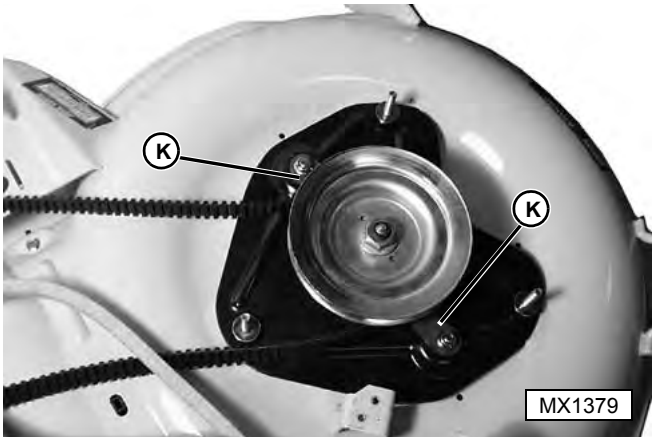

6. Turn jam nut (F) and adjusting nut (G) counterclockwise to end of threaded rod, and remove tensioning spring assembly.



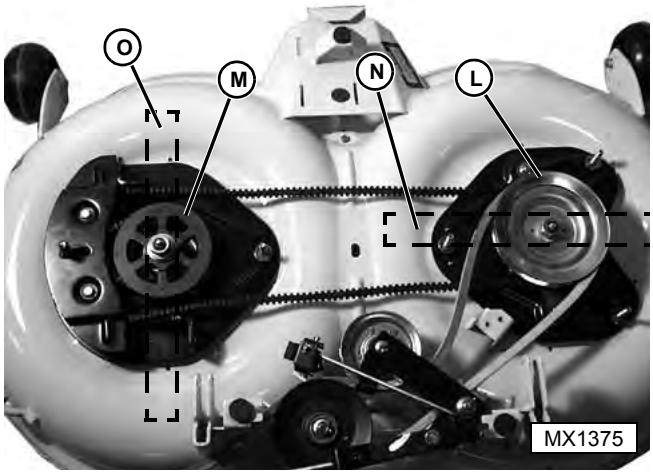

7. Remove center nut and washer (H) and move fixed idler assembly (I) close to the spindle sprocket. DO NOT loosen other idle assembly hardware.
8. Raise idler assembly upward as you carefully remove timing belt from the left spindle sprocket.




9. Remove spacer (J) located between fixed idler assembly plates and carefully pull belt from assembly.



10. Loosen two belts guides (K) and rotate away from left sprocket.
11. Remove timing belt. Replace if necessary.

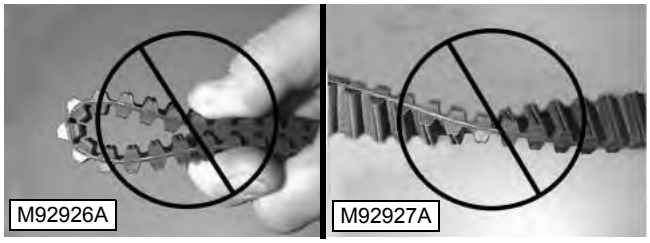


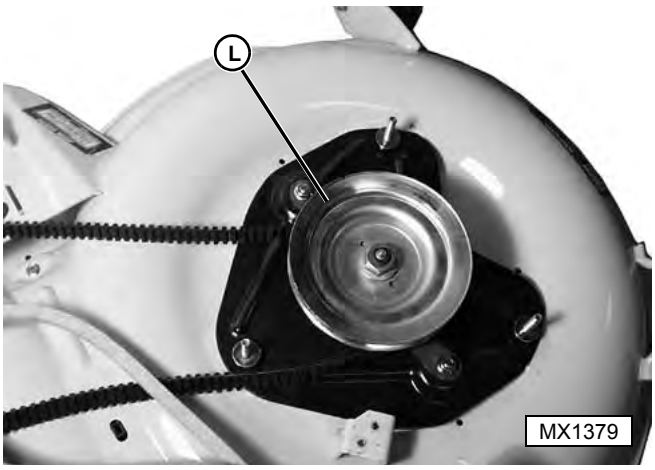

*NOTE: The position of the drain holes in the spindle sheave (L) and the indentations in the timing sprocket (M) are in alignment with the mower blades (N) and (O).*

12. Position mower blades (N) and (O) **90°** from each other.

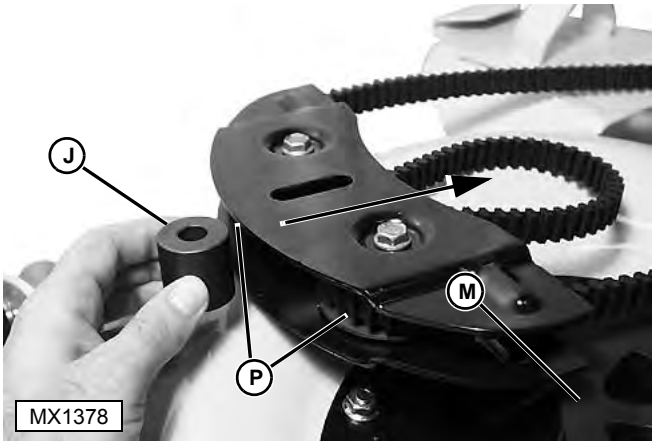
**IMPORTANT: Avoid damage! Handle timing belts with care.**

- DO NOT crimp.
- DO NOT fold.
- DO NOT twist.

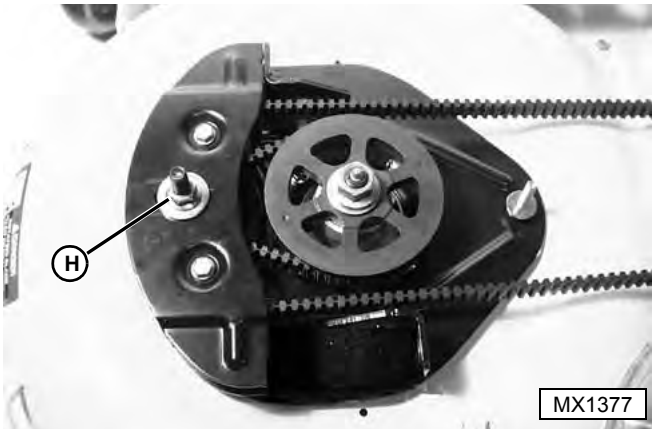


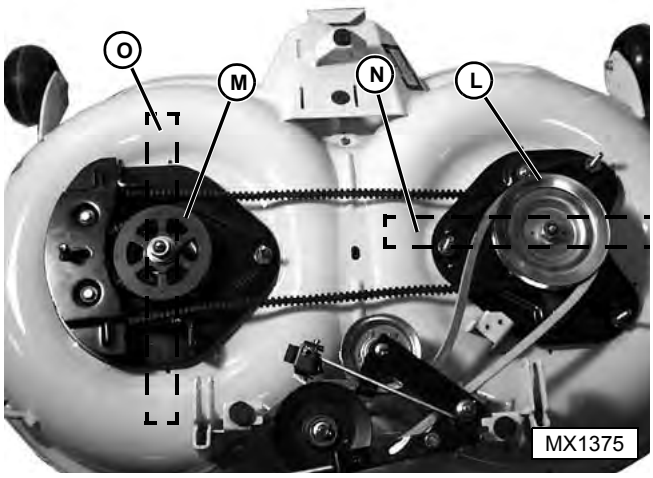

13. Install new mower deck timing belt:
    a. Route belt around right spindle sprocket (L) located under the mower drive belt sheave.




    b. Route belt around outside of idlers and then in between the fixed idlers (P), pulling a belt loop through the idler assembly.
    c. Insert spacer (J) between fixed idler plates and idlers.
    d. Install fixed idler assembly on the stud of the left support plate as you wrap belt loop around left spindle sprocket (M).

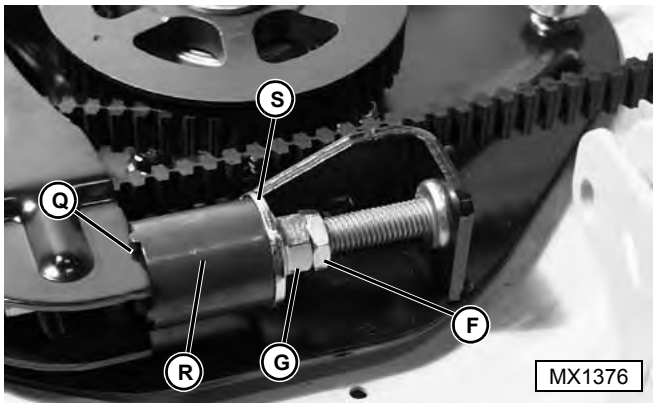


14. Install washer and center nut (H) on fixed idler assembly. Leave nut loose at this time.

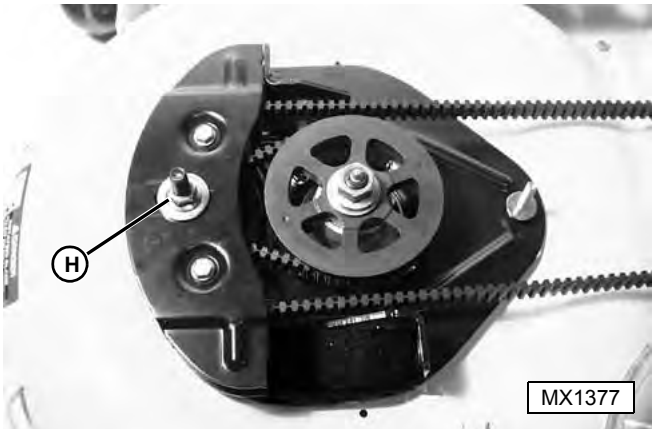



15. Check that blades (N) and (O) are **90°** from each other.

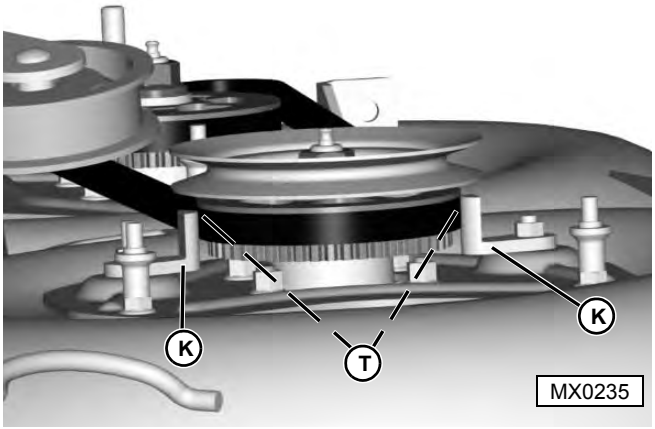
**IMPORTANT: Avoid damage! Incorrect belt tensioning can cause belt damage. DO NOT over tighten belt tensioning spring assembly.**




16. Install tensioning spring assembly and adjust timing belt tension:
    a. Align notch (Q) in idler assembly with tab on spring bushing (R).
    b. Rotate adjusting nut (G) clockwise until the washer (S) makes solid contact with the surface of the spring bushing (R).
    c. Turn adjusting nut an additional 1/2 turn to allow for new belt stretch. DO NOT over tighten.
    d. Rotate right spindle sheave clockwise and observe that belt is riding properly in sprockets and idlers.
    e. Tighten jam nut (F) against adjusting nut.



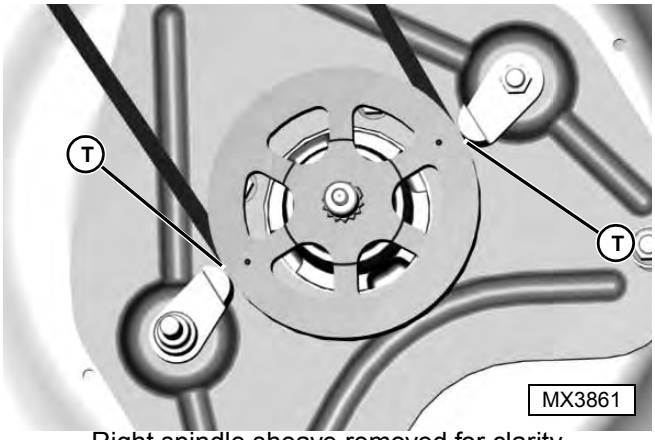

17. Tighten center nut (H) to **73 N•m (54 lb-ft).**
18. Install top washer on top of center nut.




19. Adjust belt guides.

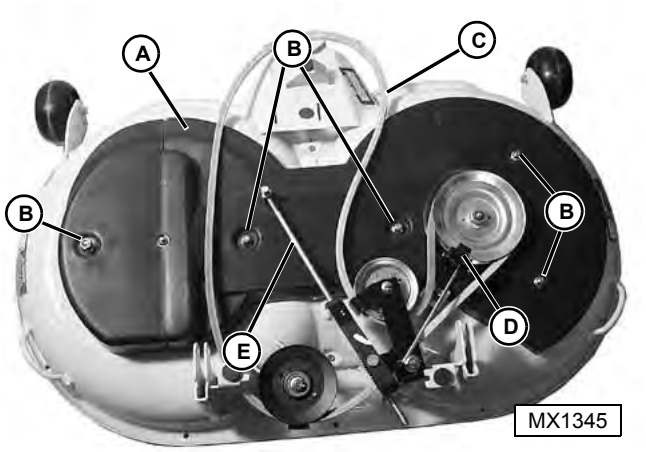
**IMPORTANT: Avoid damage! Check belt guide-to-sprocket rim clearance. Measuring clearance incorrectly can cause belt or blade damage.**

    a. Hold a **1 mm (0.039 in.)** shim/gage between belt guides and sprocket rim, location (T), and rotate belt guides (K) clockwise against gage.
    b. Tighten belt guide nuts to **24 N•m (18 lb-ft)**.




Right spindle sheave removed for clarity

c. Remove gage. Clearance (T), one on each side, should be **1 ± 0.5 mm (0.039 ± 0.020 in.)**. Belt should not contact belt guide.




20. Install timing belt cover (A) and fasten with five nuts (B). Tighten nuts to **14 N•m (10 lb-ft).**
21. Install mower drive belt (C) and brake assembly (D).
22. Install mower and adjust mower engagement rod (E), if necessary.

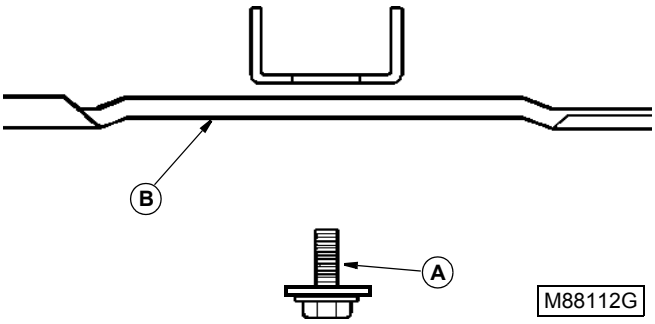
## 42 INCH DECK—BLADES REMOVAL/INSTALLATION

**⚠ CAUTION**

**Blades are sharp and could cause personal injury. Wear gloves or wrap blade with rag to remove or install blades. DO NOT hold blades with bare hands.**

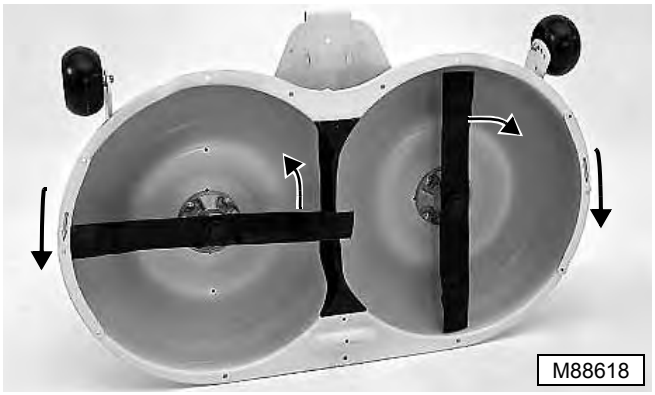
**Procedure:**

1. Remove mower deck.




2. Hold mower blade with glove to prevent spindle from spinning,
3. Remove cap screw with washer (A) and blade (B).
4. Inspect blades; sharpen/balance or replace as necessary.

*NOTE: The RIGHT and LEFT sides are marked on the rear draft brackets of the tractor. There are direction marks on the outside edge of the mower. The blades are also marked for identification.*




5. Using gloves, position mower blade (B) with the cutting edge toward the ground onto the mower spindle, and align key on bottom of spindle with slot in blade.
6. Install and tighten capscrew (A) by hand until mower blade is in full contact (fully seated) with spindle.
7. Hold mower blade with glove to prevent spinning, and tighten capscrew to specification.
8. Ensure blade timing is correct. Blades should be indexed **90° ± 10°** apart; if not, see “42 INCH DECK—BLADE TIMING & TIMING BELT TENSIONING-OLD MODEL”, or see “42 INCH DECK—BLADE TIMING & TIMING BELT TENSIONING-NEW MODEL” .
9. Install mower deck.

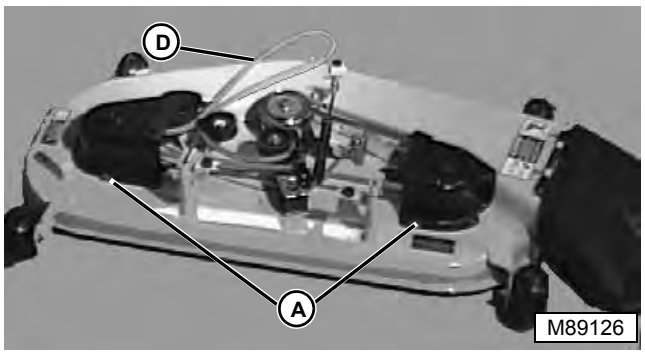
**Specification:**

**Blade cap screw . . . . . 57 N•m (42 lb-ft)**

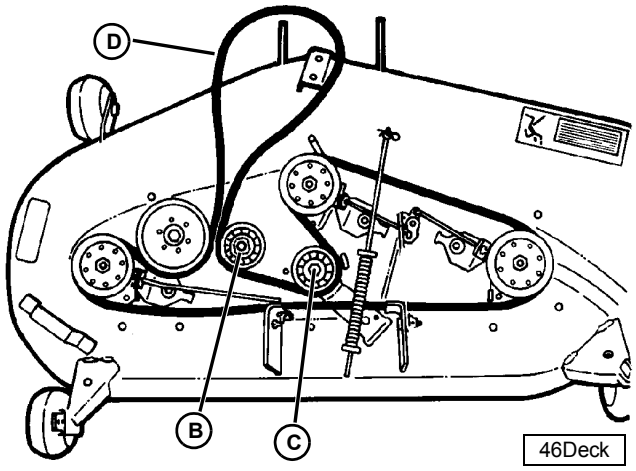
## 46 INCH DECK—DRIVE BELT REMOVAL/INSTALLATION

**Procedure:**

1. Remove mower deck.




2. Remove cap screws (A) and belt covers.




**IMPORTANT: DO NOT remove nuts or idlers from spindles.**

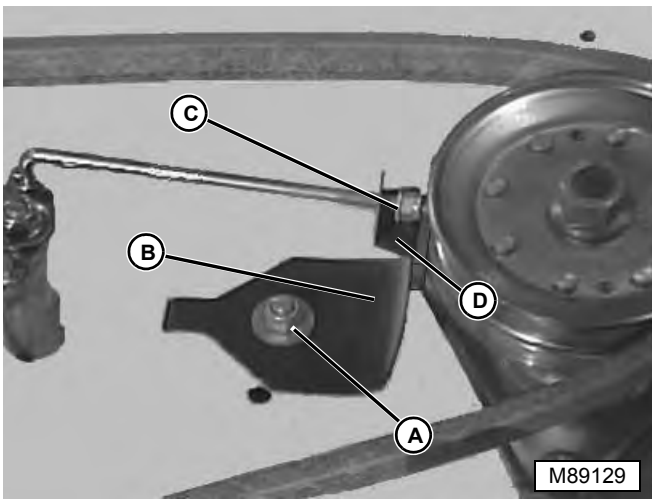
3. Loosen sheaves (B) and (C).
4. Remove belt (D), inspect for wear or damage, and replace as necessary.
5. Clean upper mower deck and sheaves.
6. Install mower deck belt. Use diagram above for belt routing.
7. Tighten sheaves (B) and (C).
8. Install belt shields and fasten with six cap screws.
9. Install mower deck.

## 46 INCH DECK—SHEAVE BRAKE REPLACEMENT

**Procedure:**

1. Remove mower deck from tractor.

.




2. Remove nut (A) securing sheave brake (B) to deck.
3. Remove adjusting nut (C), and discard brake assembly (D).

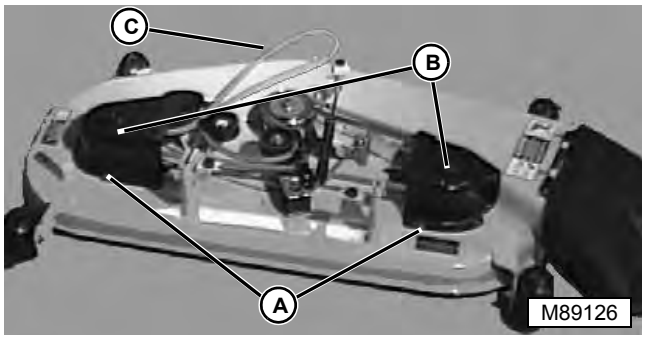
*NOTE: Brake pad minimum thickness is* **2.0 mm (0.079 in.)**.

4. Place new brake into position, and install adjusting nut.
5. Place brake assembly into position, and secure with nut.
6. See “46 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e19.

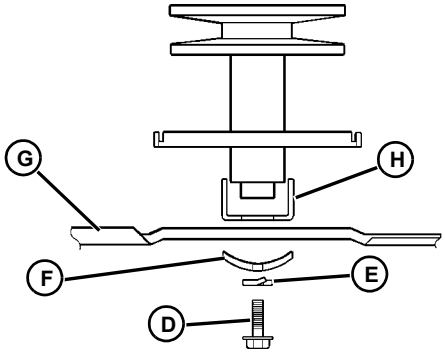
## 46 INCH DECK—SPINDLES REMOVAL/INSTALLATION

*NOTE: Spindles are not serviceable; they must be replaced as a complete assembly if any parts are damaged or worn.*

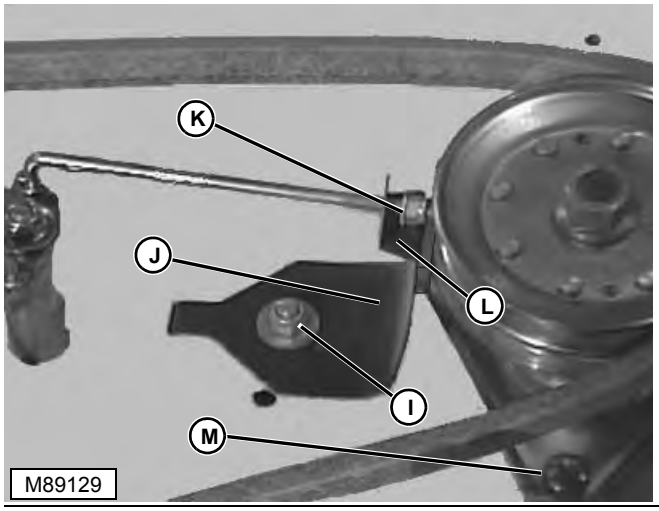
**Procedure:**




1. Remove mower deck, cap screws (A), belt covers (B), and mower drive belt (C).




2. Remove blade cap screw (D), lock washer (E), cupped washer (F), blade (G), and deflector cup (H).




3. Remove nut (I) securing sheave brake (J) to deck.
4. Remove adjusting nut (K), and discard brake assembly (L).
5. Remove nuts (3) and bolts (3) (M) from spindle assembly.
6. Inspect brakes for damage or wear. Replace if necessary.
7. Reinstall in reverse order of removal.
8. See “46 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e19.

**Specifications:**

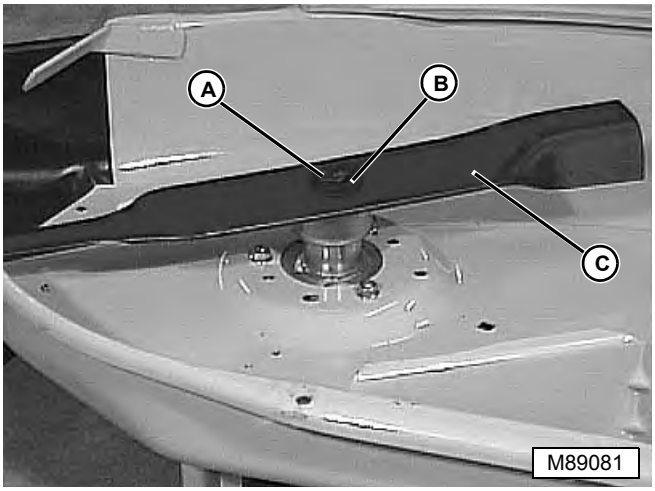
**Spindle mounting nuts . . . . . 27 N•m (20 lb-ft)**
**Blade cap screw . . . . . 53 N•m (39 lb-ft)**

## 46 INCH DECK—BLADES REMOVAL/INSTALLATION

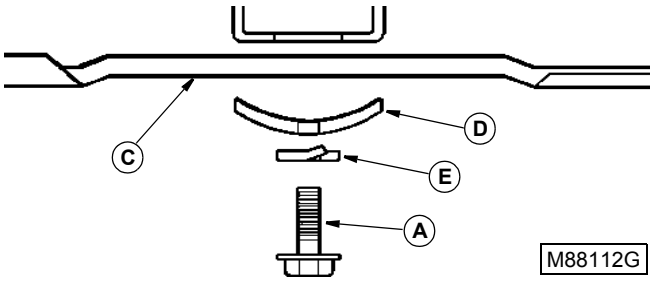
1. Remove mower deck.

**⚠ CAUTION**

**Blades are sharp and could cause personal injury. Wear gloves or wrap blade with rag to remove or install blades. DO NOT hold blades with bare hand. Use a block of wood wedged between deck and blade to keep spindle from turning.**




2. Using a wooden block, wedged between the deck and the blade, remove cap screw (A), washers (B), and blade (C).
3. Inspect blades; sharpen/balance or replace as necessary.
4. Lightly lubricate capscrew threads with general purpose grease or oil. This lubrication is to prevent rusting and seizing.




5. Position mower blade (C) with the cutting edge towards the ground onto the mower spindle.
6. Install blade washer (D) with cup side toward the blade.
7. Install hardened washer (E).
8. Install and tighten capscrew (A) by hand until mower blade is in full contact (fully seated) with spindle.
9. With mower blade blocked, to prevent spinning, tighten capscrew to specification.
10. Install mower deck.

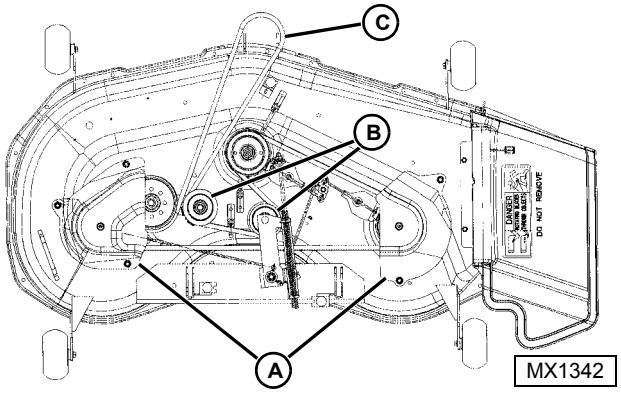
**Specifications:**

**Blade cap screw . . . . . 53 N•m (39 lb-ft)**

## 48 INCH DECK—DRIVE BELT REMOVAL/INSTALLATION

**Procedure:**

1. Remove mower deck.




2. Remove six cap screws and belt covers (A).

**IMPORTANT: DO NOT remove nuts or idlers from spindles.**

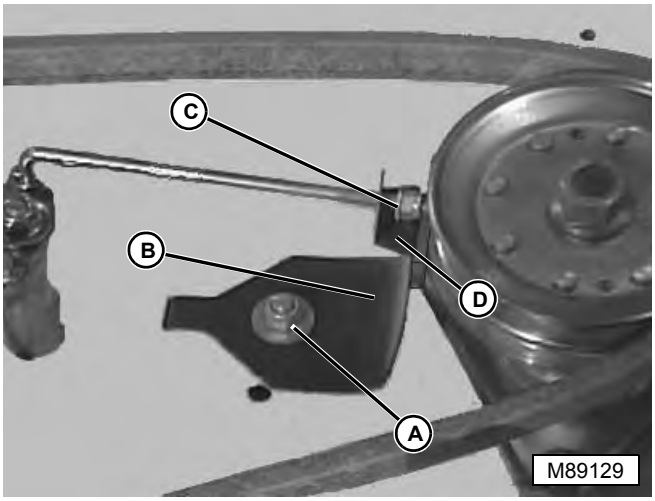
3. Loosen sheaves (B).
4. Remove belt (C).
5. Clean top of mower deck and sheaves.
6. Inspect belt for wear or damage, and replace as necessary.
7. Install mower deck belt. Use diagram above for belt routing.
8. Tighten sheaves (B).
9. Install belt shields, and fasten with six cap screws.
10. Install mower deck and adjust mower engagement rod, if necessary.

## 48 INCH DECK—SHEAVE BRAKE REPLACEMENT

**Procedure:**

1. Remove mower deck from tractor.

.




2. Remove nut (A) securing sheave brake (B) to deck.
3. Remove adjusting nut (C), and discard brake assembly (D).

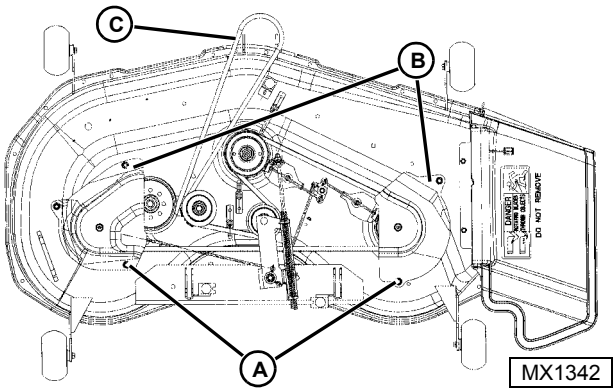
*NOTE: Brake pad minimum thickness is* **2.0 mm (0.079 in.)**.

4. Place new brake into position, and install adjusting nut.
5. Place brake assembly into position, and secure with nut.
6. See “48 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e21.

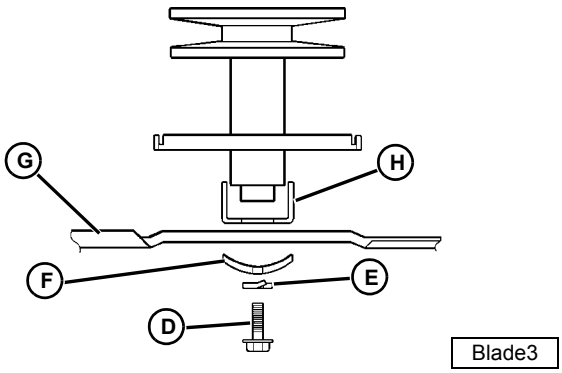
# 48 INCH DECK—SPINDLES REMOVAL/INSTALLATION

*NOTE: Spindles are not serviceable, they must be replaced as a complete assembly if any parts are damaged or worn.*

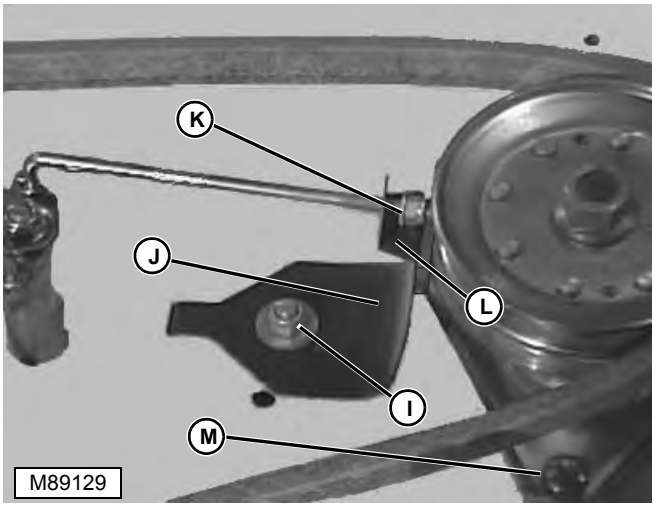
**Procedure:**




1. Remove mower deck, cap screws (A), belt covers (B), and mower drive belt (C).




2. Remove blade cap screw (D), lock washer (E), cupped washer (F), blade (G), and deflector cup (H).




3. Remove nut (I) securing sheave brake (J) to deck.
4. Remove adjusting nut (K), and discard brake assembly (L).
5. Remove nuts (3) and bolts (3) (M) from spindle assembly.
6. Inspect brakes for damage or wear. Replace if necessary.
7. Reinstall in reverse order of removal.
8. See “48 INCH DECK—SHEAVE BRAKE ADJUSTMENT” on pag e21.

**Specifications:**

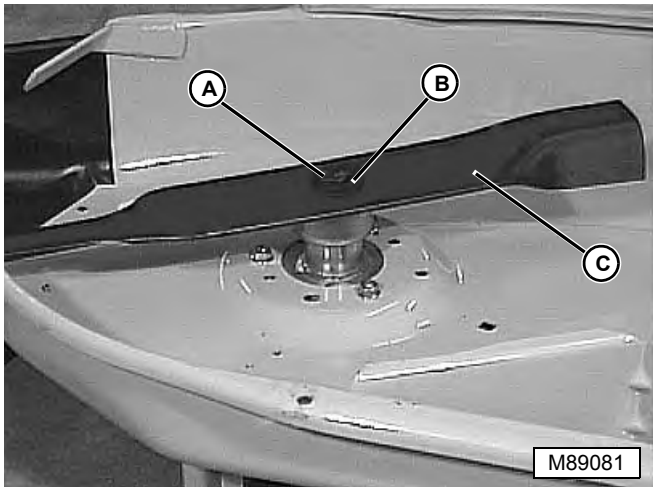
**Spindle mounting nuts . . . . . 27 N•m (20 lb-ft)**
**Blade cap screw . . . . . 53 N•m (39 lb-ft)**

# 48 INCH DECK—BLADES REMOVAL/INSTALLATION

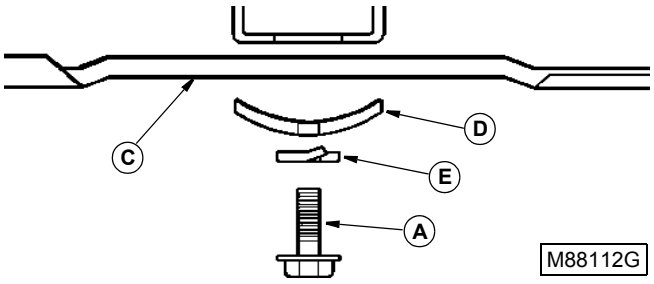
1. Remove mower deck.

**⚠ CAUTION**

**Blades are sharp and could cause personal injury. Wear gloves or wrap blade with rag to remove or install blades. DO NOT hold blades with bare hand. Use a block of wood wedged between deck and blade to keep spindle from turning.**




2. Using a wooden block, wedged between the deck and the blade, remove cap screw (A), washers (B), and blade (C).
3. Inspect blades; sharpen/balance or replace as necessary.
4. Lightly lubricate capscrew threads with general purpose grease or oil. This lubrication is to prevent rusting and seizing.




5. Position mower blade (C) with the cutting edge towards the ground onto the mower spindle.
6. Install blade washer (D) with cup side toward the blade.
7. Install hardened washer (E).
8. Install and tighten capscrew (A) by hand until mower blade is in full contact (fully seated) with spindle.
9. With mower blade blocked, to prevent spinning, tighten capscrew to specification.
10. Install mower deck.

**Specifications:**

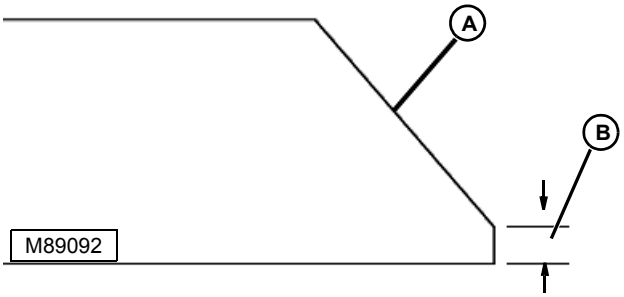
**Blade cap screw . . . . . 68 N•m (50 lb-ft)**

## SHARPENING BLADES

**⚠ CAUTION**

**Wear goggles and gloves when sharpening blades.**

1. Sharpen blade using grinder, file or power sharpener.




2. Do not alter original bevel (A). Blade should have **0.40 mm (0.016 in.)** (B) cutting edge rather than a razor—type edge.
3. See “BALANCING BLADES” on pag e40.

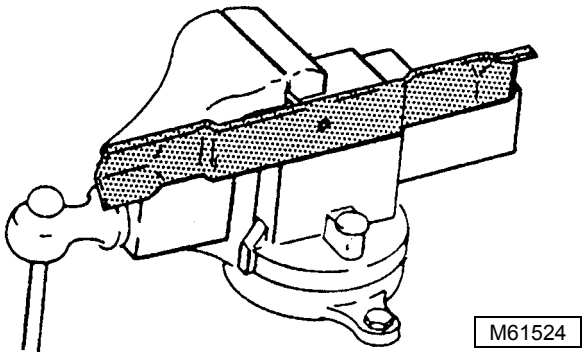
## BALANCING BLADES

**Procedure:**

1. Clean blade.

**⚠ CAUTION**

**Wear gloves when handling blade.**




2. Put blade on nail in a vise or vertical wall stud.
3. Turn blade to HORIZONTAL position. If the blade is not balanced, the heavy end will drop.
4. Grind bevel of heavy end. Do not change blade bevel angle.

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# SPECIFICATIONS

## REPAIR SPECIFICATIONS:

**LT133/155/166**

| | |
|---|---|
| Front tire size | 15 x 6.00 - 6 |
| Front tire pressure | 83 kPa (12 psi) |
| Rear Tire size | 20 x 10.00 - 8 |
| Rear tire pressure | 55 kPa (8 psi) |

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# TESTS AND ADJUSTMENTS

## TIRE PRESSURE ADJUSTMENT

**⚠ CAUTION**

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

- Do not attempt to mount a tire without 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
- Check tires for low pressure, cuts or missing lug bolts and nuts

*NOTE: Front tires are installed with stems to the inside.*
*Rear tires are installed with stems to the outside.*

**Procedure:**

1. Check tire and rim for damage.
2. Using a air pressure gauge, check air pressure.
3. Add or remove air as needed.

**Specifications:**

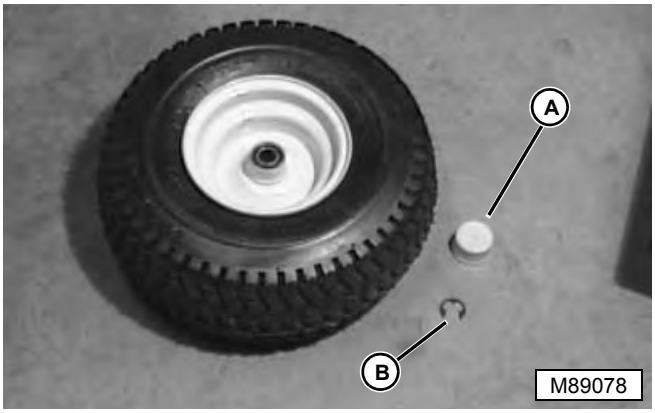
**Front tire size . . . . . 15 x 6.00 - 6**
**Front tire pressure . . . . . 83 kPa (12 psi)**
**Rear Tire size . . . . . 20 x 10.00 - 8**
**Rear tire pressure . . . . . 55 kPa (8 psi)**

# REPAIR

## FRONT WHEEL REMOVAL/ INSTALLATION

**Procedure:**

1. Safely lift and support tractor.




2. Remove plastic cap (A), E-ring (B) and tire.

*NOTE: Front wheels are installed with valves to the inside.*

3. Grease spindles with specified grease.
4. Install wheel on axle.
5. Install snap ring.
6. Install plastic cap.

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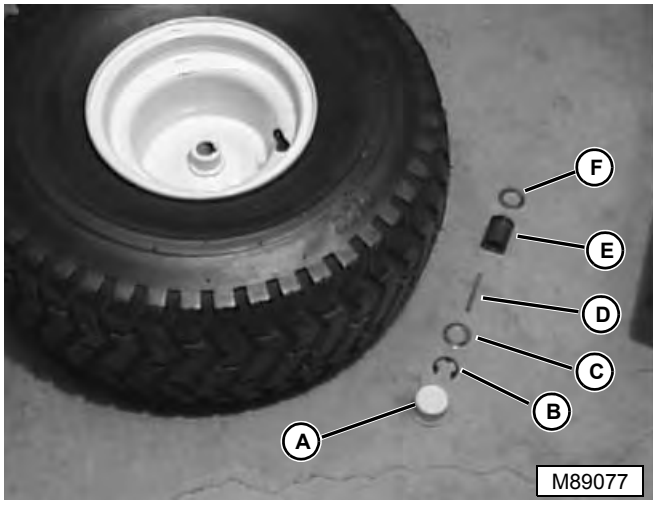
## REAR WHEEL REMOVAL/ INSTALLATION

**Procedure:**

1. Safely lift and support tractor.



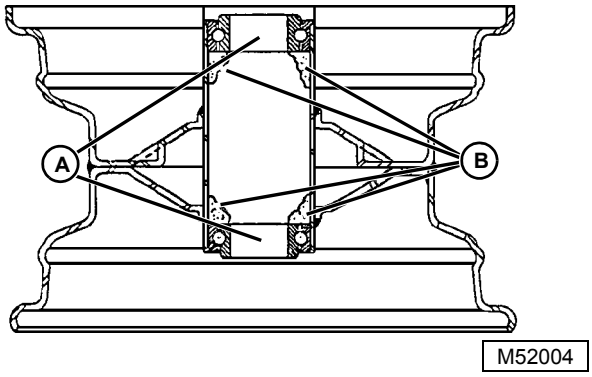

2. Remove plastic cap (A), E-ring (B), and washer (C).
3. Remove wheel.
4. Remove key (D), spacer (E) **(LT–133 Only)** and back washer (F).

*NOTE: Rear wheels are installed with valves to the outside.*

5. Install back washer (F), spacer (E) **(LT133 Only**), and key (D).
6. Install rear wheel, washer (C), E-ring (B) and plastic cap (A).

## FRONT WHEEL BEARING REPAIR

**Procedure:**




1. Remove bearings (A) using slide hammer puller.
2. Install new bearings using suitable driver on outside race of bearing.
3. Pack area behind bearing with specified grease (B).
4. Install wheel.

## FUEL TANK REMOVAL/ INSTALLATION

**Procedure:**

**⚠ CAUTION**

**Gasoline is explosive. Do not expose to open flame or spark. Serious injury can result. Store in a proper container. Wipe up any spills immediately.**

1. Disconnect (–) **negative** battery cable.
2. Remove fuel line at engine and drain fuel from tank into a safe and approved fuel container.
3. Lift and support rear of tractor.
4. Remove left rear wheel.

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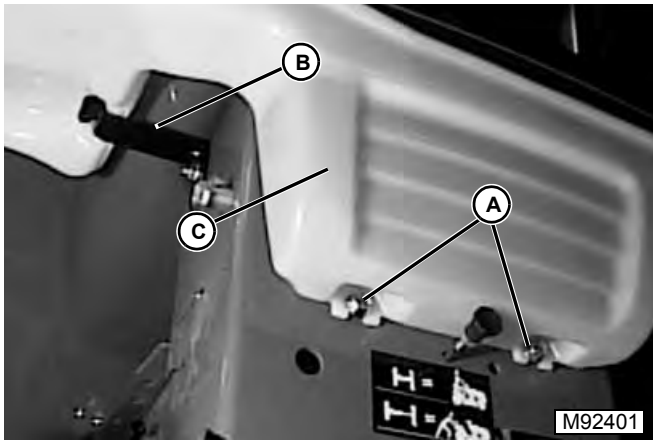


5. Remove screws (A) and bracket (B) from fuel tank (C).
6. Remove fuel fill cap from tank and slide tank out of fender and rear of tractor.
7. Install fuel fill cap back onto fuel tank.
8. Remove fuel line from tank.
9. Install fuel line on tank.

**IMPORTANT: Insure that fuel line is free and clear of all moving parts from fuel tank to engine.**

10. Remove fuel fill cap from tank and insert tank onto tractor.
11. Install fuel fill cap on tank.
12. Install screws and bracket on tank.
13. Install fuel line on engine.
14. Install left rear wheel.
15. Lower tractor to surface.
16. Connect (–) **negative** battery cable.

M

# INDEX


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