JOHN DEERE
WORLDWIDE COMMERCIAL & CONSUMER EQUIPMENT DIVISION

Professional Greens Mower
2500, 2500A, and 2500E

TM1757 DEC05

TECHNICAL MANUAL

JOHN DEERE

North American Version
Litho in U.S.A.

INTRODUCTION

Manual Description

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

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

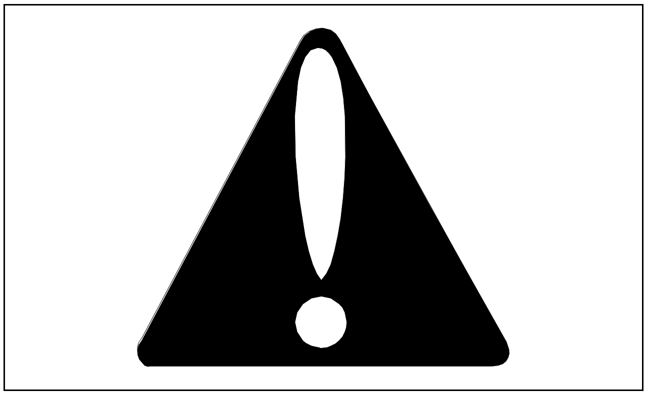
- Table of Contents
- Specifications and Information
- Identification Numbers
- Tools and Materials
- Component Location
- Schematics and Harnesses
- Theory of Operation
- Operation and Diagnostics
- Diagnostics
- Tests and Adjustments
- Repair
- Other

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

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

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

Recognize Safety Information



MIF

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

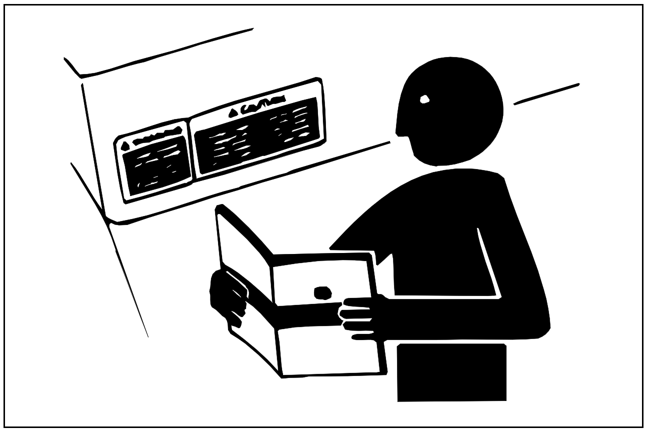
Follow recommended precautions and safe servicing practices.

Understand Signal Words

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

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

Replace Safety Signs

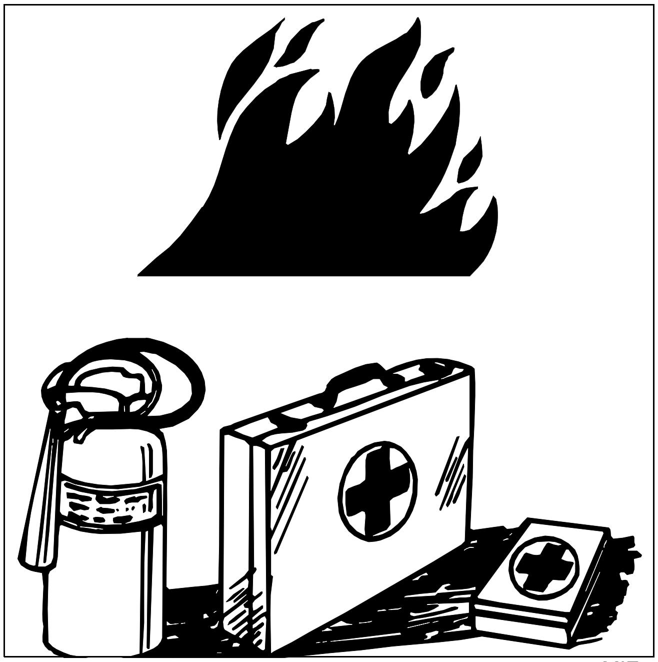


MIF

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

Handle Fluids Safely - Avoid Fires

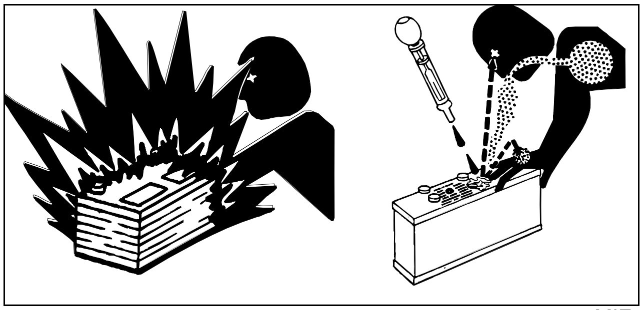
Be Prepared For Emergencies



MIF

- When you work around fuel, do not smoke or work near heaters or other fire hazards.
- Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.
- Make sure machine is clean of trash, grease, and debris.
- Do not store oily rags; they can ignite and burn spontaneously.
- Be prepared if a fire starts.
- Keep a first aid kit and fire extinguisher handy.
- Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

Use Care In Handling and Servicing Batteries



MIF

Prevent Battery Explosions

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

Prevent Acid Burns

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

Avoid acid burns by:

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

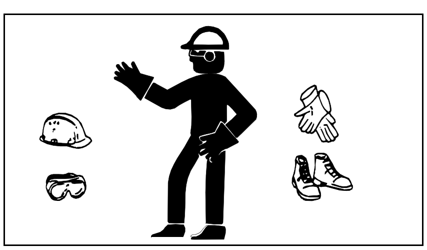
If you spill acid on yourself:

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

If acid is swallowed:

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

Wear Protective Clothing



MIF

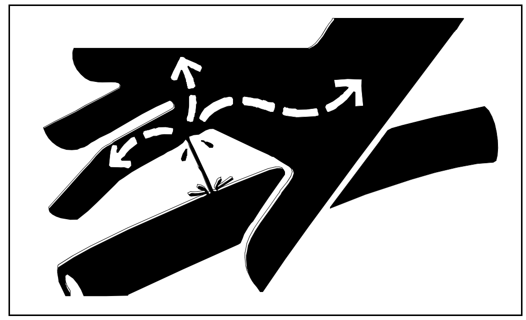
Wear close fitting clothing and safety equipment appropriate to the job.

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

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

Use Care Around High-Pressure Fluid Lines

Avoid High-Pressure Fluids



MIF

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

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

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

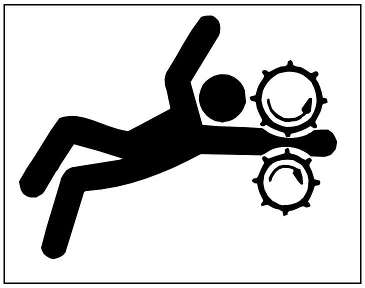
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical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

Avoid Heating Near Pressurized Fluid Lines

MIF

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

Service Machines Safely



MIF

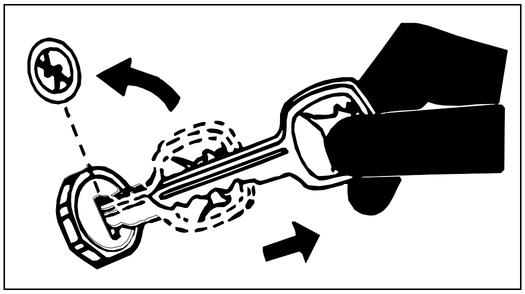
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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

Use Proper Tools

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

Park Machine Safely

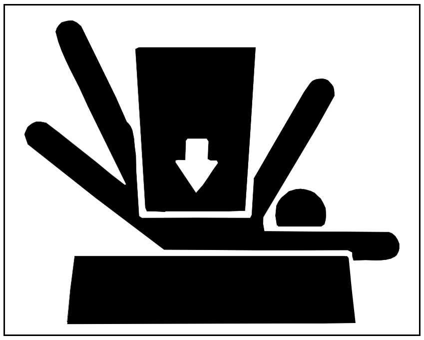


MIF

Before working on the machine:

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

Support Machine Properly and Use Proper Lifting Equipment



MIF

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

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

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

Work In Clean Area

Before starting a job:

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

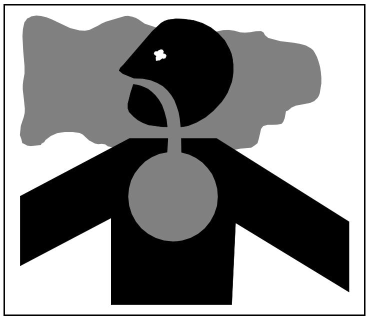
Using High Pressure Washers

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

Illuminate Work Area Safely

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

Work In Ventilated Area



MIF

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

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

Warning: California Proposition 65 Warning

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

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

Remove Paint Before Welding or Heating

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

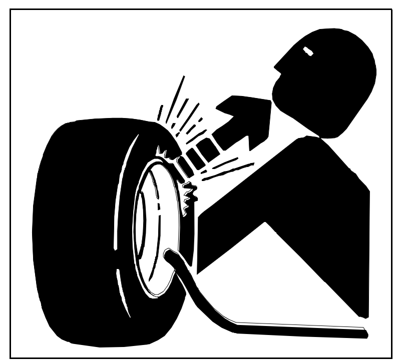
Avoid Harmful Asbestos Dust

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

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

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

Service Tires Safely



MIF

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

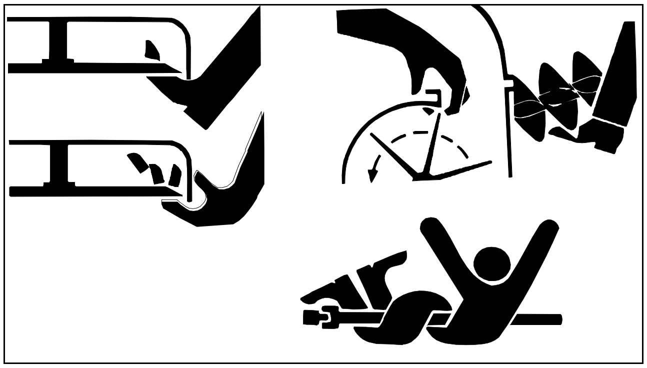
Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job.

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

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

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

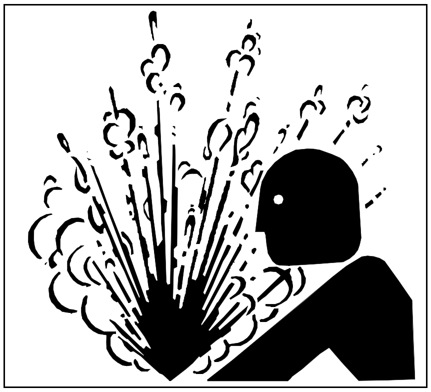
Avoid Injury From Rotating Blades, Augers and PTO Shafts



MIF

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

Service Cooling System Safely

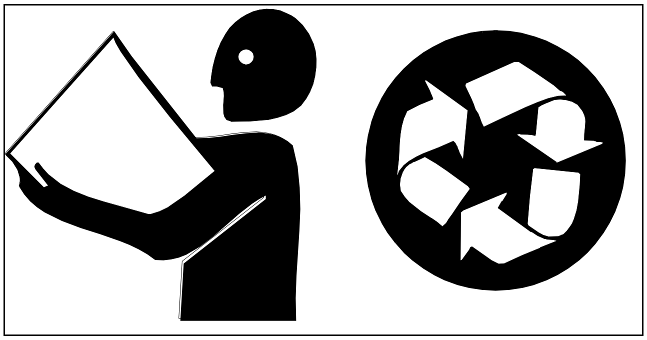


MIF

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

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

Handle Chemical Products Safely



MIF

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

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

Dispose Of Waste Properly

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

Live With Safety

MIF

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

Table of Contents

Specifications

General Vehicle Specifications

NOTE: Specifications and design subject to change without notice.

Gasoline Engine

Make	**Kawasaki**
Type	**4 Cycle, V-Twin**
Model	**FD620D**
Displacement	**617 mL (37.7 cu in.)**
Aspiration	**Natural**
Cooling System	**Liquid cooled**
Cooling System Capacity	**3.5 L (3.7 qt)**
Lubrication	**Full pressure**
Engine Oil Capacity (With Filter)	**1.9 L (2.0 qt)**
Oil Filter	**Replaceable, full flow**
Valving	**Overhead valves**
Air Cleaner	**Paper element with foam pre-cleaner**
Bore	**79 mm (3.11 in.)**
Stroke	**68 mm (2.68 in.)**
Compression Ratio	**9.0:1**
Slow Idle	**1550 ± 100 rpm**
Fast Idle	**3400 ± 50 rpm**

Fuel System - Gasoline Engine

Fuel Tank Location	**Behind operator seat**
Fuel Tank Capacity	**32.2 L (8.5 gal)**
Fuel (Minimum Octane)	**Unleaded gasoline, 87 octane**
Fuel Delivery	**Electric fuel pump**
Carburetor	**Float-type, down draft**
Fuel Filter	**Replaceable element**
Gasoline/Alcohol Blends	**Up to 10% Ethyl Alcohol/90% Unleaded (by volume)**
Gasoline/Ether Blends	**Up to 15% MTBE/85% Unleaded (by volume)**
Fuel Shutoff Solenoid	**Below carburetor float bowl**

Diesel Engine

Make	Yanmar
Type	4 Cycle, 3 cylinder, in-line
Model	3TNE68
Displacement	784 mL (47.8 cu in.)
Aspiration	Natural
Cooling System	Liquid cooled
Cooling System Capacity	3.5 L (3.7 qt)
Lubrication	Full pressure
Engine Oil Capacity (With Filter)	2.2 L (2.3 qt)
Oil Filter	Replaceable, full flow
Valving	Overhead valves
Air Cleaner	Semi-cyclone, dry type duel stage
Bore	68 mm (2.68 in.)
Stroke	72 mm (2.83 in.)
Compression Ratio	23:1
Slow Idle	1450 ± 100 rpm
Fast Idle	3225 ± 50 rpm

Fuel System - Diesel Engine

Fuel Tank Location	Behind operator seat
Fuel Tank Capacity	32.2 L (8.5 gal)
Fuel (Above 4°C [40°F])	Grade No. 2-D
Fuel (Below 4°C [40°F])	Grade No. 1-D
Fuel (All Temperatures - Above 1500 M [5000 ft])	Grade No. 1-D
Fuel Centane (Minimum)	45
Fuel Delivery	Mechanical fuel pump

Drive Train

Type	Hydrostatic
Drive Wheels	Front
Pump Drive	Flex coupler on engine flywheel-to-driven coupler on pump shaft
Travel Speed (Forward)	0-12.9 km/h (0-8.0 mph)
Travel Speed (Forward - Mowing)	0-6.4 km/h (0-4.0 mph)
Travel Speed (Reverse)	0-7.1 km/h (0-4.4 mph)

Hydraulics

Hydraulic Reservoir Oil Capacity	20.4 L (5.4 gal)
Hydraulic System Oil Capacity	28.8 L (7.6 gal)
Pump Type - 2500, 2500A	Triple gear
Pump Type - 2500E	Double gear
Pump Drive	Driven coupler from hydrostatic pump shaft
Systems	Mow (reel drive), lift, and steering
Cutting Unit Lift	Front and rear cylinder
Oil Cooler	Standard - all except “E” model
Mow/Backlap Valve - 2500 and 2500A	Electro-hydraulic
Mow/Backlap Function - 2500E	Electrically controlled
Lift Control Valve	Electro-hydraulic

Steering

Type	Power, hydraulic, rear wheel

Brakes

Main Braking	Hydrostatic (dynamic)
Park Brake	Dual disc
Park Brake Actuation	Pedal

Cutting Units

Number of Cutting Units	3
Cutting Unit Drive - 2500 and 2500A	Direct hydraulic motors
Cutting Unit Drive - 2500E	48V Electric with controllers
Reel Diameter	12.7 cm (5 in.)
Number of Blades (Standard)	11
Number of Blades (Optional)	7
Clip Frequency @ 6.4 km/h (4.0 mph)	4.44 mm (0.175 in.)
Front Rollers	Optional - smooth or grooved
Bed Knife Adjustment	Bed knife-to-reel
Height-of-Cut[1]	2.4-22 mm (3/32-7/8 in.)

Tires

Smooth - Front and Rear	18 x 10.50-10, 2 Ply
Smooth - Front and Rear	20 x 10.00-10, 2 Ply
Soft Trac - Front and Rear	20 x 10.00-10, 4-Ply

Weights and Dimensions

Weight

Machine (Gasoline Powered)	576 kg (1270 lb)
Machine (Diesel Powered)	626 kg (1380 lb)

Overall Width

Without Cutting Reels	1294.9 mm (51 in.)
With Cutting Reels	1694.8 mm (66.7 in.)
With Optional Grass Catchers	1847.9 mm (72.75 in.)

Overall Length

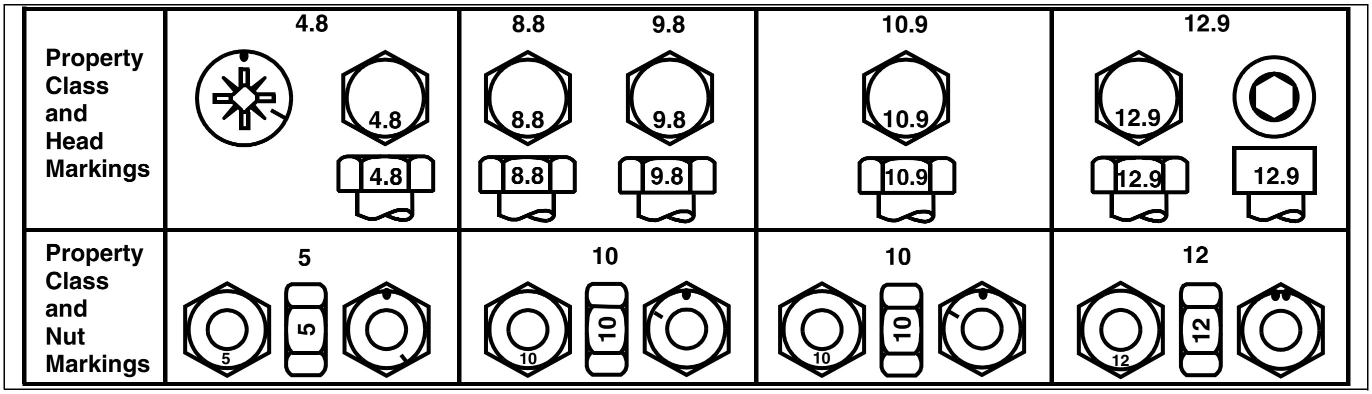
Without Cutting Reels	2272 mm (89.5 in.)
With Cutting Reels	2272 mm (89.5 in.)
With Optional Grass Catchers	2630 mm (103.5 in.)

Overall Height	1940.3 mm (76.5 in.)

1. *Minimum 2 mm (0.080 in.) with ultra low cut tournament bedknife.*

Repair Information

Metric Fastener Torque Values



MIF (TS1163)

	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated[1]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]		Lubricated[a]		Dry[a]	
SIZE	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	109
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

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

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

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

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

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

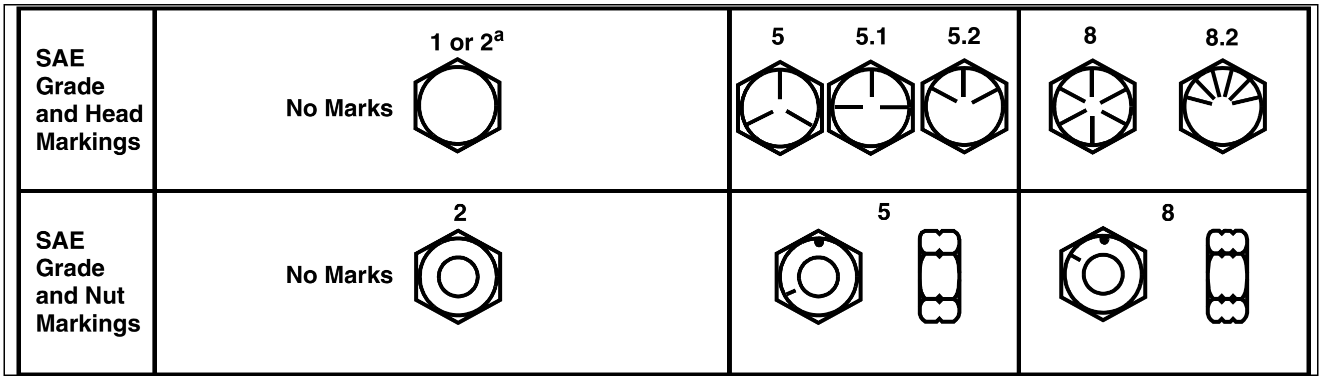
Tighten toothed or serrated-type lock nuts to the full torque value.

Reference: JDS-G200.

Metric Fastener Torque Values - Grade 7

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

Inch Fastener Torque Values



MIF (TS1162)

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

1. *"Grade 2" applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. "Grade 1" applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*
2. *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.*

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

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

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

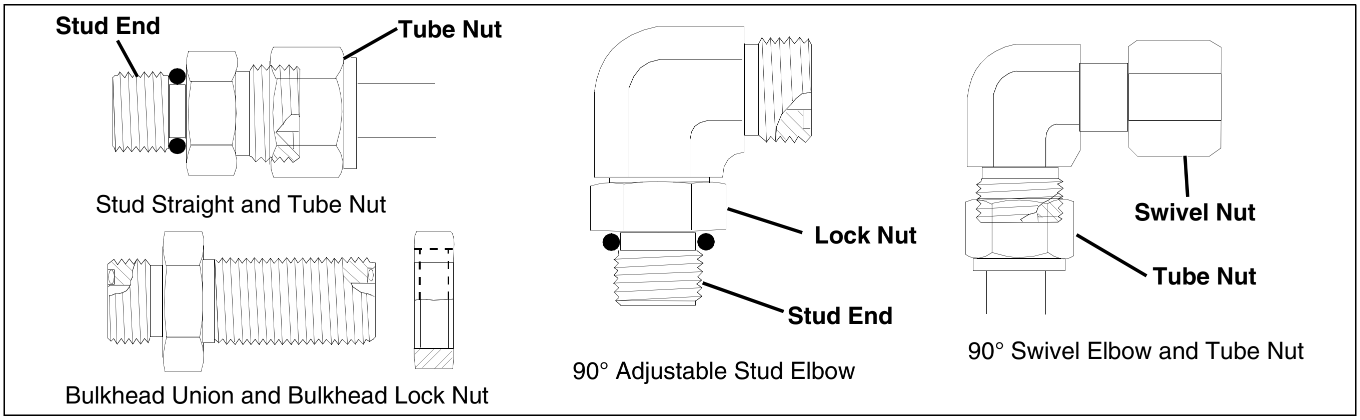
When bolt and nut combination fasteners are used, torque values should be applied to the NUT instead of the bolt head.

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

Reference: JDS-G200.

O-Ring Seal Service Recommendations

Face Seal Fittings with Inch Stud End Torques



Stud Straight and Tube Nut

Bulkhead Union and Bulkhead Lock Nut

90° Adjustable Stud Elbow

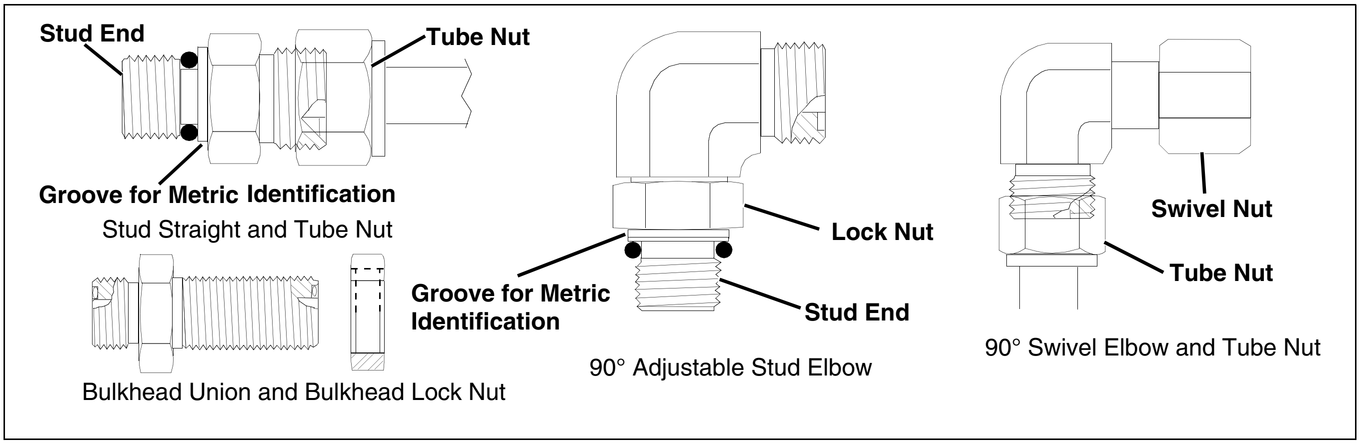
90° Swivel Elbow and Tube Nut

MIF

NOTE: Torque tolerance is +15/-20%

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

Face Seal Fittings with Metric Stud End Torques



Stud Straight and Tube Nut

Bulkhead Union and Bulkhead Lock Nut

90° Adjustable Stud Elbow

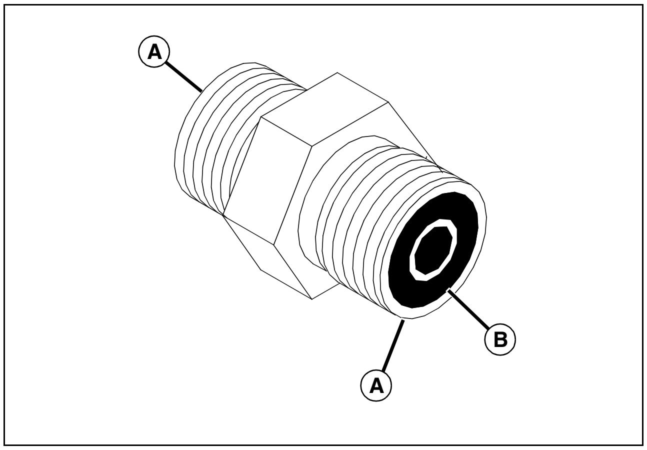
90° Swivel Elbow and Tube Nut

MIF

NOTE: Torque tolerance is +15/-20%

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

O-Ring Face Seal Fittings



MIF

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

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

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

4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.

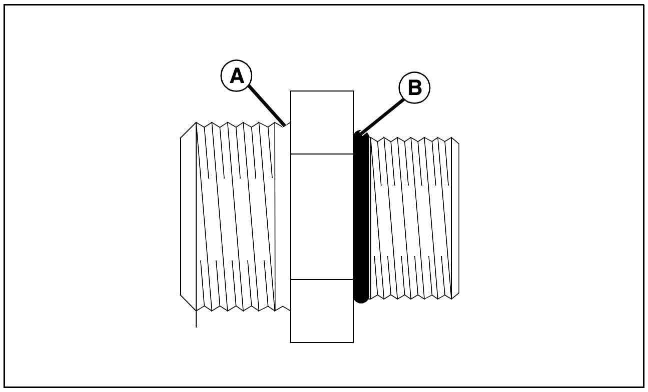
5. Index angle fittings and tighten by hand-pressing joint together to ensure O-ring remains in place.

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

6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.

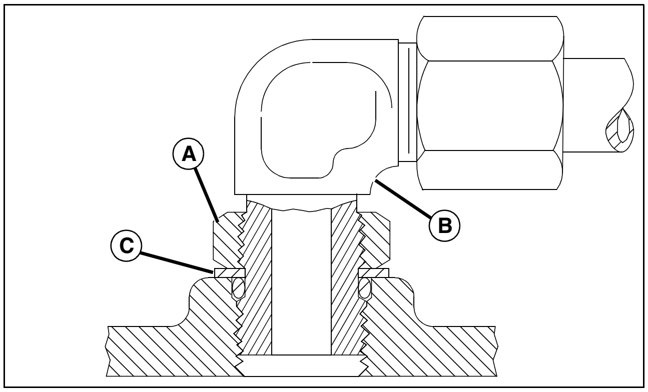
O-Ring Boss Fittings

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



MIF

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



MIF

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

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

5. To position angle fittings, turn the fitting counterclockwise a maximum of one turn.

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

Straight Fitting or Special Nut Torque

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

1. Torque tolerance is ± 10 percent.

2. To be used if a torque wrench cannot be used. After tightening fitting by hand, put a mark on nut or boss; then tighten special nut or straight fitting the number of flats shown.

Fuel

Using Proper Fuel

Using Proper Fuel (Diesel)

Use the proper diesel fuel to help prevent decreased engine performance and increased exhaust emissions. Failure to follow the fuel requirements listed below can void your engine warranty.

Contact your local fuel distributor for properties of the diesel fuel in your area.

In general, diesel fuels are blended to satisfy the low temperature requirements of the geographical area in which they are marketed.

Diesel fuels specified to EN 590 or ASTM D975 are recommended.

Required Fuel Properties

In all cases, the fuel shall meet the following properties:

Cetane number of 45 minimum. Cetane number greater than 50 is preferred, especially when temperatures are below -20°C (-4°F) or elevations above 1500 m (5000 ft).

Cold Filter Plugging Point (CFPP) below the expected low temperature OR **Cloud Point** at least 5°C (9°F) below the expected low temperature.

Fuel lubricity should pass a minimum load level of 3100 grams as measured by ASTM D6078 or maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156-1.

If a fuel of low or unknown lubricity is used, addition of John Deere PREMIUM DIESEL FUEL CONDITIONER at the specified concentration is recommended.

Sulfur Content

- Diesel fuel quality and fuel sulfur content must comply with all existing emissions regulations for the area in which the engine operates.
- Sulfur content less that 0.05% (500 ppm) is recommended for best performance.
- Diesel fuel sulfur content greater than 0.5% (5000 ppm) should not be used.

IMPORTANT: Avoid damage! Do not mix diesel engine oil or any other type of lubricating oil with diesel fuel.

Handling and Storing Diesel Fuel

CAUTION: Avoid injury! Handle fuel carefully. Do not fill the fuel tank when engine is running.

Do not smoke while you fill the fuel tank or service the fuel system.

IMPORTANT: Avoid damage! Do not use galvanized containers—diesel fuel stored in galvanized containers reacts with zinc coating in the container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and flakes will quickly plug fuel filters and damage fuel injectors and fuel pumps.

- Fill the fuel tank at the end of each day's operation to prevent water condensation and freezing during cold weather.

IMPORTANT: Avoid damage! The fuel tank is vented through the filler cap. If a new cap is required, always replace it with an original vented cap.

- When fuel is stored for an extended period or if there is a slow turnover of fuel, add a fuel conditioner to stabilize the fuel and to prevent water condensation. Contact your fuel supplier for recommendations.

Using Proper Fuel (Gas)

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

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

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

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

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

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

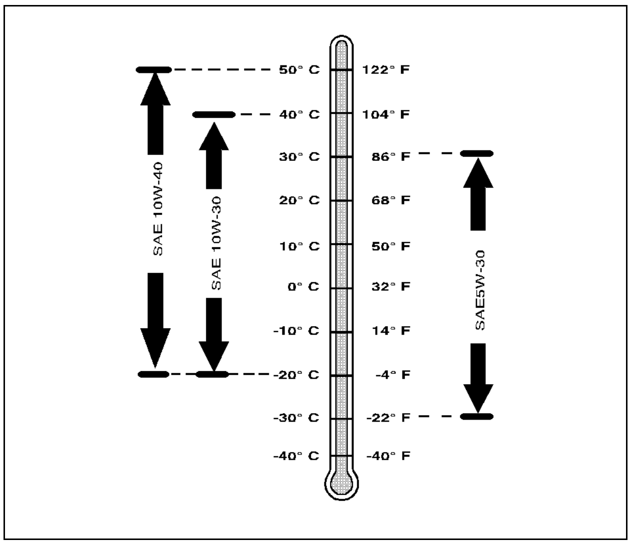
For best year-round performance and fuel-handling, add stabilizer to fuel immediately after fuel purchase. Such practice helps prevent engine performance problems and allows fuel storage in the machine all year without draining.

Oils & Lubricants

Engine Oil

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

The following John Deere oils are preferred:



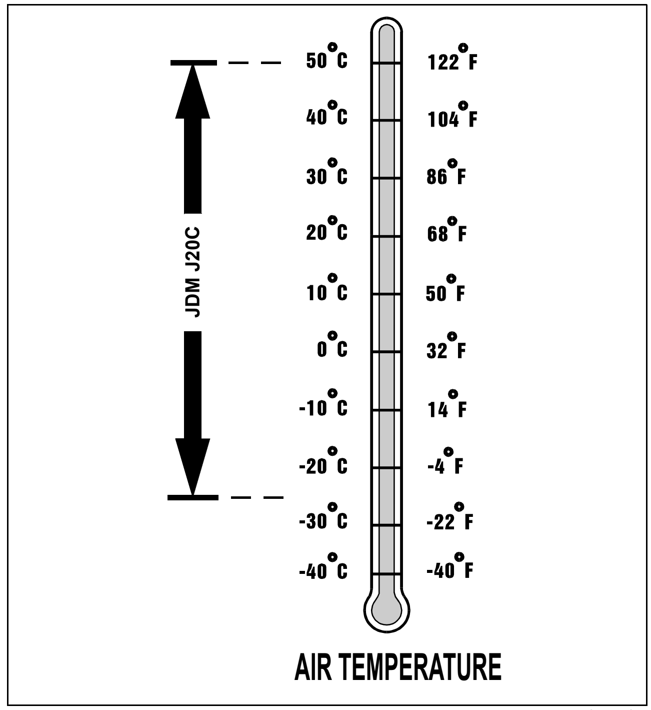
MX4888

- **TURF-GARD™**
- **PLUS-4™**

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

- API Service Classification SG or higher

Hydrostatic Transmission and Hydraulic Oil



M58275 (MIF)

Use the following oil viscosity based on the air temperature range. Operating outside of the recommended oil air temperature range may cause premature hydrostatic transmission failure.

IMPORTANT: Avoid damage! Only use a quality oil in this transmission. DO NOT use engine oil in this transmission. Do not mix any other oils in this transmission. Do not use "Type F" (Red) Automatic Transmission Fluid in this transmission.

The following oil is preferred:

- **JD HY-GARD™**

The following oil is allowed:

- **Oils meeting John Deere Standard JDM J20C**
- **Bio HY-GARD**[1]

The following oil is not recommended:

- Biodegradable oils other than Bio HY-GARD

1. Bio HY-GARD may be used under normal cutting conditions. Do not use on machines used for vertical cutting in temperatures above 32°C (90°F) or scalping operations. Bio HY-GARD should be changed every 400 hours or annually. Biodegradable oils other than Bio HY-GARD are not recommended. See DTAC Solution 01-12-00-2 for more information.

Grease

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

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

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

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

- **John Deere Multi-Purpose SD Polyurea Grease**
- **John Deere Multi-Purpose HD Lithium Complex Grease**

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

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

Chassis And Roller Water Resistant Grease

This grease is specially formulated to prevent corrosion and water washout when used in a wet environment.

The following water resistant greases are **PREFERRED**:

- **Special Purpose HD Water Resistant Grease - TY24425.**
- **Multi-Purpose HD Lithium Complex Grease - TY24416.**

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

- John Deere Standard JDM J13A2, NLGI Grade 2.

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

Alternative Lubricants

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

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

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

Synthetic Lubricants

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

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

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

Lubricant Storage

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

Mixing of Lubricants

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

Oil Filters

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

The following John Deere oil filters are PREFERRED:

- AUTOMOTIVE AND LIGHT TRUCK ENGINE OIL FILTERS.

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

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

- ASTB Tested In Accordance with SAE J806.

Coolant Specifications

Engine Coolant

The engine cooling system when filled with a proper dilution mixture of anti-freeze and deionized or distilled water provides year-round protection against corrosion, cylinder or liner pitting, and winter freeze protection down to -37°C (-34°F).

The following John Deere coolant is PREFERRED:

- **COOL-GARD™ PRE-DILUTED SUMMER COOLANT (TY16036)**.

This coolant satisfies specifications for “Automobile and Light Duty Engine Service” and is safe for use in John Deere Lawn and Grounds Care/Golf and Turf Division equipment, including aluminum block gasoline engines and cooling systems.

The above preferred pre-diluted anti-freeze provides:

- Adequate heat transfer
- Corrosion-resistant chemicals for the cooling system
- Compatibility with cooling system hose and seal material
- Protection during extreme cold and extreme hot weather operations
- Chemically pure water for better service life
- Compliance with ASTM D4656 (JDM H24C2) specifications

If above preferred pre-diluted coolant is not available, the following John Deere concentrate is recommended:

- **COOL-GARD™ CONCENTRATED SUMMER COOLANT CONCENTRATE™ (TY16034).**

If either of above recommended engine coolants are not available use any Automobile and Light Duty Engine Service ethylene glycol base coolant, meeting the following specification:

- ASTM D4985 (JDM H24A2).

Read container label completely before using and follow instructions as stated.

IMPORTANT: Avoid damage! To prevent engine damage, DO NOT use pure anti-freeze or less than a 50% anti-freeze mixture in the cooling system. DO NOT mix or add any additives/ conditioners to the cooling system in Lawn and Grounds Care/Golf and Turf Division equipment. Water used to dilute engine coolant concentrate must be of high quality - clean, clear, potable water (low in chloride and hardness - see table below) is generally acceptable. DO NOT use salt water. Deionized or distilled water is ideal to use. Coolant that is not mixed to these specified levels and water purity can cause excessive scale, sludge deposits, and increased corrosion potential.

Property	Requirements
Total Solids, Maximum	340 ppm (20 grns/gal)
Total Hardness, Maximum	170 ppm (10 grns/gal)
Chloride (as Cl), Maximum	40 ppm (2.5 grns/gal)
Sulfate (as SO_4), Maximum	100 ppm (5.8 grns/gal)

Mix 50 percent anti-freeze concentrate with 50 percent distilled or deionized water. This mixture and the pre-diluted mixture (TY16036) will protect the cooling system down to -37°C (-34°F) and up to 108°C (226°F).

Certain geographical areas may require lower air temperature protection. See the label on your anti-freeze container or consult your John Deere dealer to obtain the latest information and recommendations.

Engine Coolant Drain Interval

When using John Deere Pre-Diluted (TY16036) Automobile and Light Duty Engine Service coolants, drain and flush the cooling system and refill with fresh coolant mixture every 36 months or 3,000 hours of operation, whichever comes first.

When using John Deere Concentrate (TY16034) Automobile and Light Duty Engine Service coolants, drain and flush the cooling system and refill with fresh coolant mixture every 24 months or 2,000 hours of operation, whichever comes first.

If above John Deere Automobile and Light Duty Engine Service coolants are not being used; drain, flush, and refill the cooling system according to instructions found on product container or in equipment operator’s manual or technical manual.

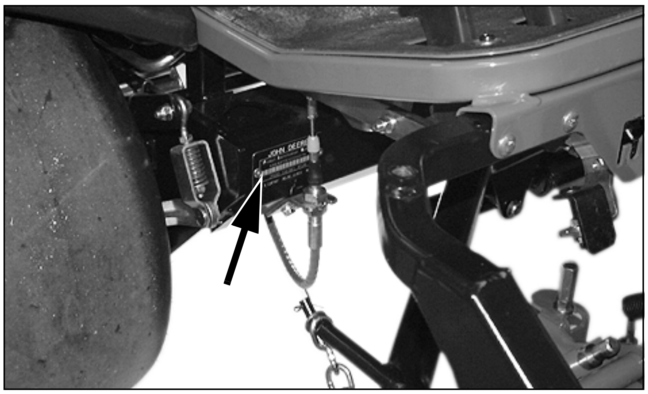
Identification Numbers

Machine Identification Number Locations

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

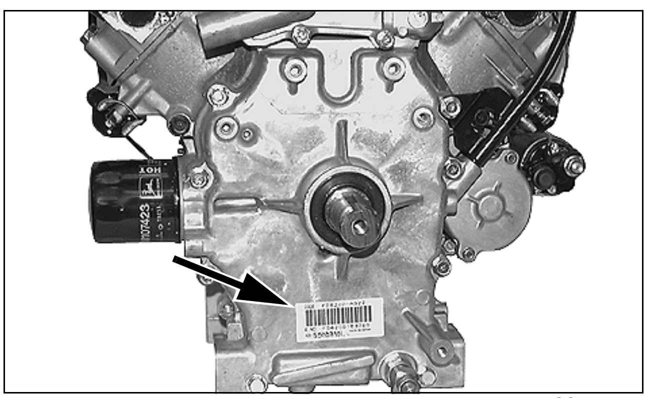
The location of the machine identification number and component serial numbers are shown.

Machine Identification Number



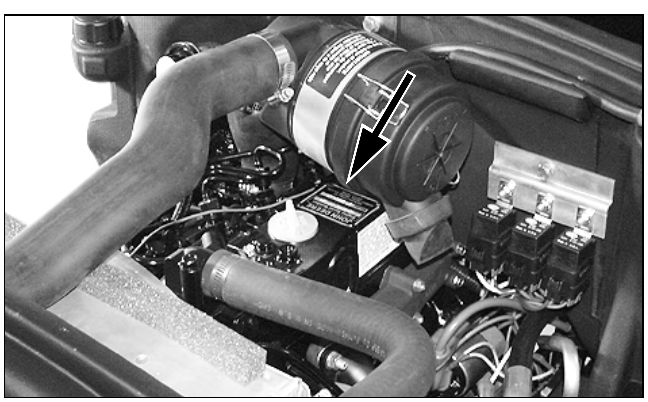
M84560

Gasoline Engine Serial Number



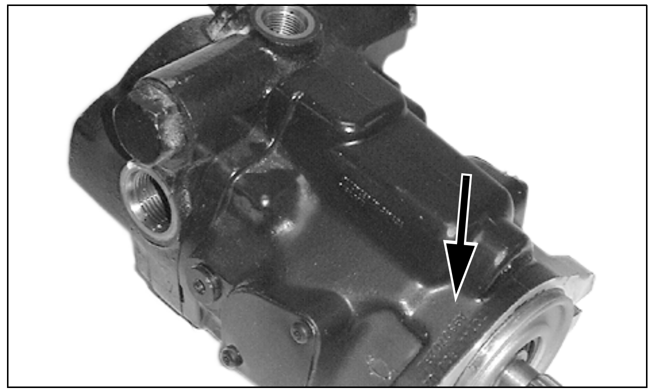
M84561

Diesel Engine Serial Number



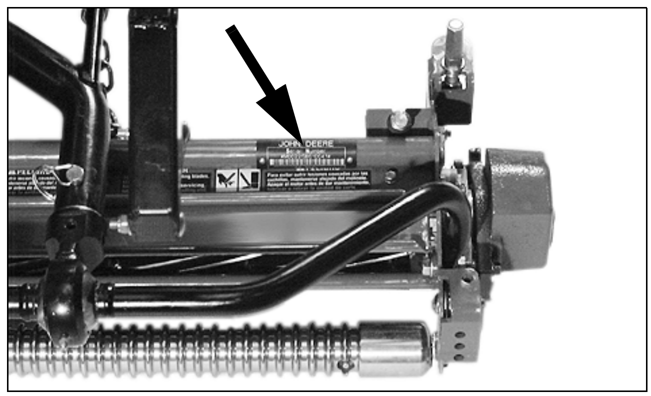
M84562

Hydrostatic Pump Serial Number



M84786

Cutting Unit Serial Number

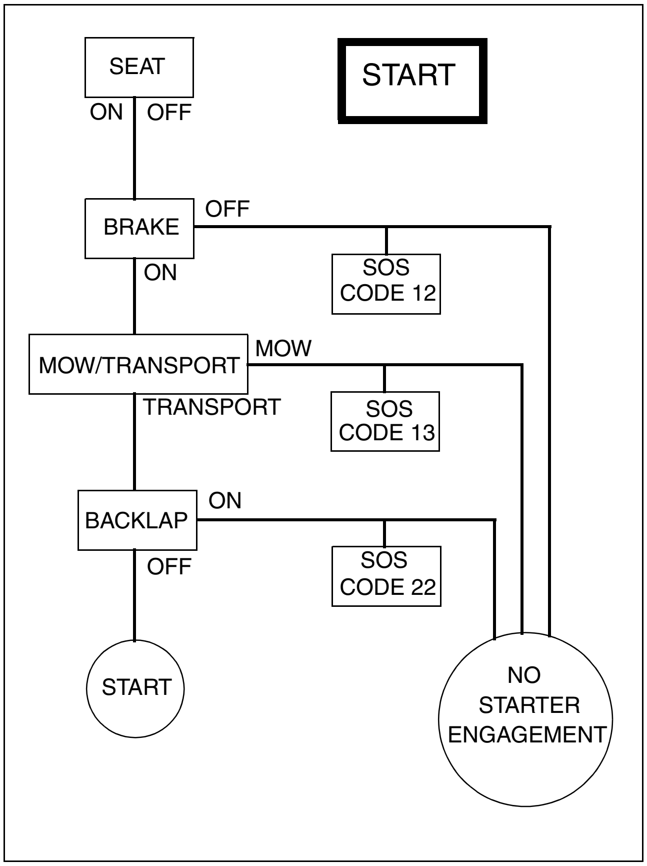


M84563

Operational Checkout

Interlock System Operation

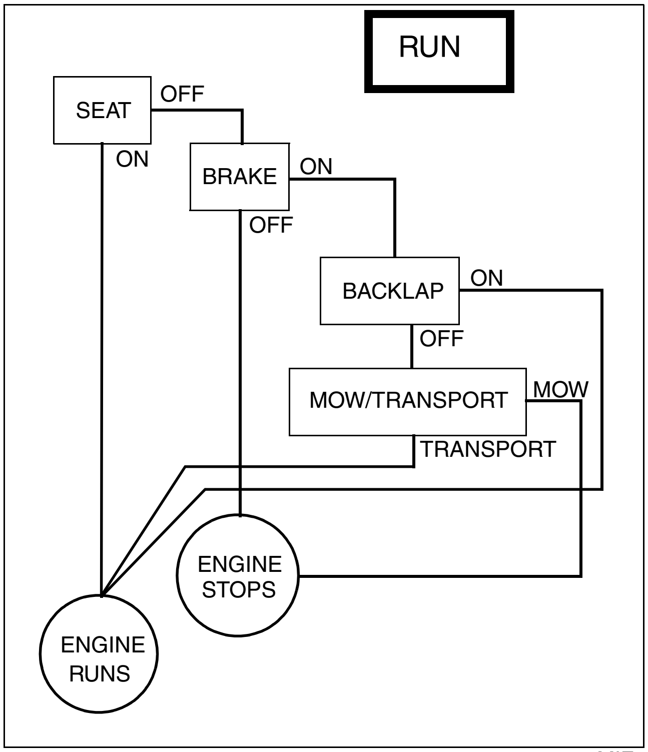
It is important to understand the interlock system and how it works. Before performing the checkout procedures, become familiar with the interlock system so that an interlock function will not be mistaken for a machine problem.



MIF

For the starting motor to engage and the engine to run, the following conditions must be met simultaneously:

- Operator on seat and/or park brake engaged.
- Mow/transport lever/pedals in the TRANSPORT position.
- Mow/backlap valve in MOW position.



MIF

For the engine to run, the following condition must be met:

- Operator must be on the seat or the park brake must be engaged.

If the mow/transport lever is in the TRANSPORT position with the park brake not engaged and the operator rises off the seat, the engine will stop.

If the mow/transport lever is in the MOW position with the park brake engaged and the operator rises off the seat, the engine will stop.

If the operator is mowing and rises off the seat, the cutting reels and engine will stop.

In order to mow, the following conditions must be met:

- Operator in the operator seat.
- Throttle lever moved to the FAST position.
- Mow/transport lever in the MOW position.
- Cutting units lowered to the ground.
- Parking brake not engaged.
- Backlap valve not engaged.

If the operator is mowing and the park brake is depressed, the cutting reels will stop rotating.

If the operator is mowing and engages the backlapping valve while on the operator seat, the cutting reels will stop rotating.

If the operator attempts to backlap the cutting units with the operator seat occupied, the cutting reels will not rotate.

If the operator is backlapping the cutting units with the operator seat not occupied and the park brake is disengaged, the engine will stop.

General Information

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

Checkout List

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

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

Diesel Engine Air Filter Restriction Indicator Check

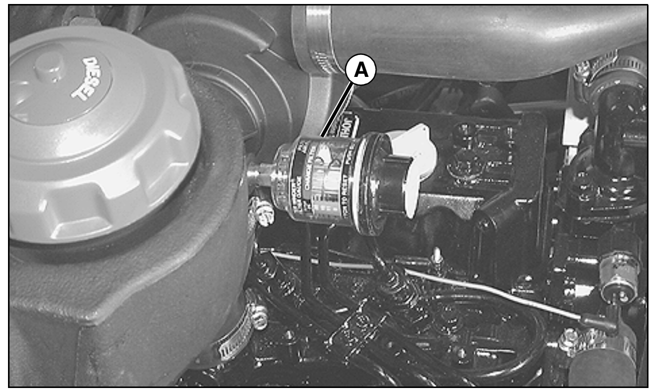
Conditions

- Engine stopped.
- Machine parked on a level surface.
- Cutting units lowered to the ground.
- Mow/transport lever in "TRANSPORT" position.
- Key switch in "STOP" position.
- Park brake engaged.

Procedure

1. Raise cowling.
2. Inspect the housing for cracks or other damage.

NOTE: Indicator will not provide an accurate indication if the housing is cracked or broken.



M84632

3. Check the position of the plunger in the air filter restriction indicator (A).

Normal

- The housing should be free of cracks or other damage.
- The plunger should be in the green area of the indicator.

If Not Normal

- If the housing is cracked or damaged, replace the indicator. (See "Remove and Install Air Filter Restriction Indicator" on page 175.)
- If plunger is in the red area of the indicator, service the air cleaner filter elements. (See "Remove and Install Air Cleaner Assembly" on page 176.)

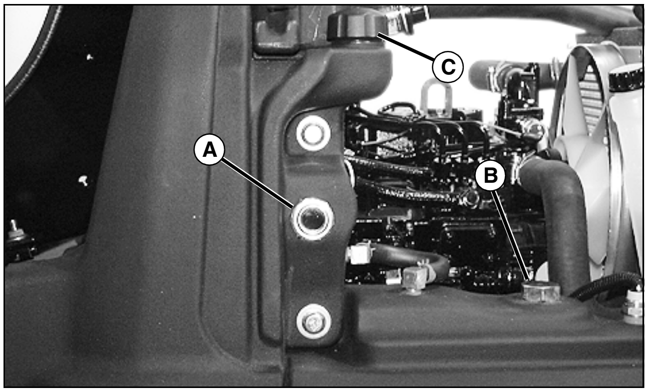
Hydraulic Reservoir Oil Level Check

Condition

- Engine stopped.
- Machine parked on a level surface.
- Cutting units lowered to the ground.
- Mow/transport lever in the "TRANSPORT" position.
- Key switch in the "STOP" position.
- Hydraulic oil cold.
- Park brake engaged.

Procedure

1. Raise cowling.



M84568

2. Check oil level at sight glass (A).
3. Inspect oil for signs of contamination or foaming.

Normal

- Oil level should be at the center of the sight glass.

IMPORTANT: Avoid damage! Oil should be clear, not white, yellow, or cloudy.

- Oil should show no signs of foaming or contamination.

If Not Normal

NOTE: If the main hydraulic reservoir oil level is low, fill reservoir at the reservoir filler cap. Oil added at the expansion tank will not transfer to the reservoir quickly, resulting in an inaccurate reading.

- If oil level is below the sight glass, remove the main hydraulic reservoir filler cap (B), and if needed add hydraulic oil until main reservoir is full, then replace filler cap. Remove expansion tank filler cap (C) and add oil to expansion tank until oil level is at center of the sight glass. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- If the oil level is low, check hydraulic hoses and connections for leaks. Repair as needed.
- If oil shows signs of foaming or contamination, drain hydraulic reservoir, replace oil filter and refill reservoir with clean hydraulic oil.

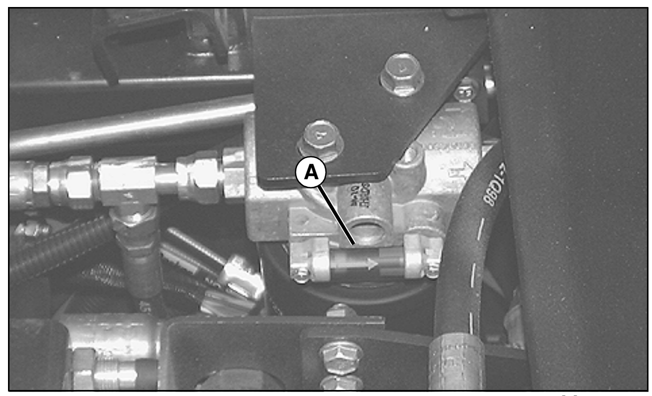
Hydraulic Oil Filter Restriction Indicator Check

Condition

- Machine parked on a level surface.
- Cutting units lowered to the ground.
- Park brake engaged.
- Key switch in “STOP” position.
- Mow/transport lever in “TRANSPORT” position.
- Operator off of seat.

Procedure

1. Raise and lock seat platform.
2. Start engine and run at Fast Idle.



M84631

3. Check the position of the plunger in the hydraulic oil filter restriction indicator (A).

Normal

- The plunger should not be within the red area of the indicator.

If Not Normal

- Replace the oil filter.

Start Circuit Check

Conditions

- Operator on seat.
- Mow/transport lever in TRANSPORT position.
- Park brake engaged.
- Mow/backlap valve in MOW position.

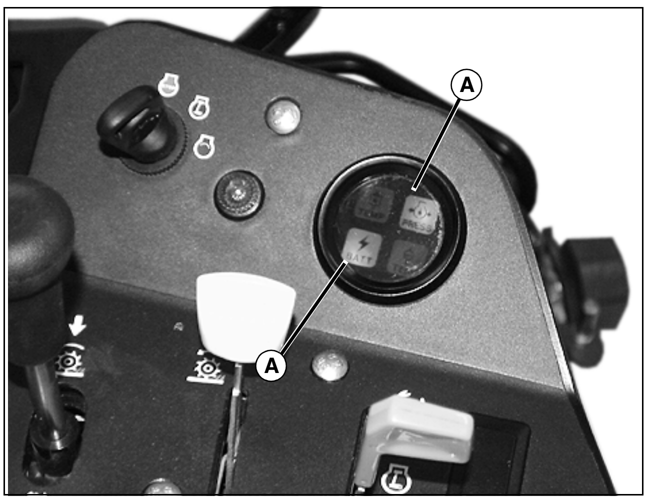
Procedure

1. Turn key switch to START position.

Normal

- The engine should crank and start.

If Not Normal



M84737

If the engine does not crank, the oil pressure light (A) should remain lit and the battery discharge light (B) will begin to flash, indicating one of the following codes:

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed.

- One pulse followed by a short pause, followed by two pulses (Code 1-2); Indicates that the park brake switch is not activated. Engage park brake and repeat check procedure.
- One pulse followed by a short pause, followed by three pulses (Code 1-3); Indicates that the mow switch is activated. Move mow/transport lever to TRANSPORT position and repeat check procedure.
- Two pulses followed by a short pause, followed by two pulses (Code 2-2); Indicates that the mow/backlap valve is in BACKLAP position. Move mow/backlap valve to MOW position and repeat check procedure.
- If there is no response to the key switch and no codes indicated as described above, proceed to the ELECTRONIC CONTROL MODULE CHECK.

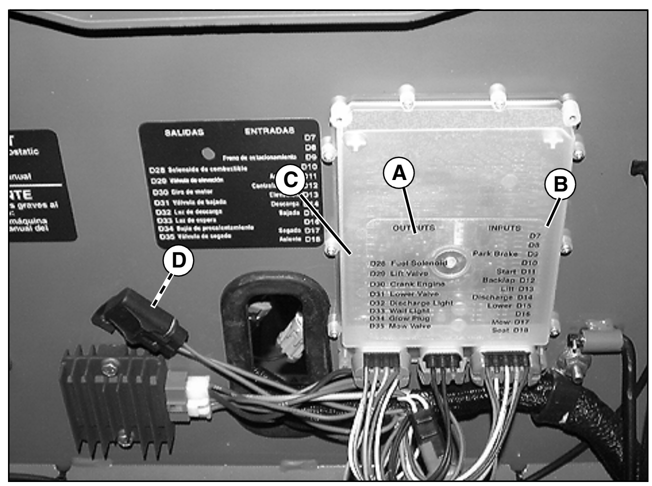
Electronic Control Module Check

Reason

To determine the operating condition of the electronic control module. The electronic control module includes several self-protection features and is designed to last the life of the machine. Most electrical problems are caused by harness or component failures, and are rarely a result of a control module failure.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Move key switch to RUN position.



M84736

7. Check “Heartbeat” light (A) and input/output indicator lights (B and C).

Results

Normal

- “Heartbeat” light flashing in a regular, even rate.
- Input indicator light(s) corresponding to activated switch(es) lit.
- Output indicator light(s) corresponding to active component(s) lit.

If Not Normal

• If the “Heartbeat” light and input/output indicator lights are not lit, check F2 main fuse (D). If fuse is good, check current supply to the control module. For gasoline engine models; (See “Power Circuit Diagnosis - Switched” on page 315.)

For diesel engine models; (See “Power Circuit Diagnosis - Switched” on page 431.)

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed.

• The “Heartbeat” light may flash one of the following codes:

• Three pulses followed by a short pause, followed by another pulse (Code 3-1); Indicates an over-voltage condition (voltage input to control box over 18 volts). For gasoline engine models; (See “Charging Circuit Diagnosis” on page 347.) For diesel engine models; (See “Charging Circuit Diagnosis” on page 463.)

NOTE: When the following codes are displayed, no output indicator lights will be lit.

Circuits connected to the “Output” connector of the control module, operate by switching the ground side of the circuit.

• Three pulses followed by a short pause, followed by two pulses (Code 3-2); Indicates a wiring harness failure. Proceed to Test Control Module procedure.

• Three pulses followed by a short pause, followed by three pulses (Code 3-3); Indicates an output short to positive 12 volt condition on the components of one (or more) of the following circuits:

NOTE: See individual circuit diagnosis in Electrical section for diagnostic procedures.

- Lift/Lower Valve Circuit
- Crank Engine Circuit
- Discharge Light Circuit
- Glow Plug Circuit (Diesel)
- Mow Valve Circuit

• Three pulses followed by a short pause, followed by four pulses (Code 3-4); Indicates a fuel solenoid circuit failure. For gasoline engine models; (See “Run Circuit Diagnosis” on page 339.) For diesel engine models; (See “Run Circuit Diagnosis” on page 454.)

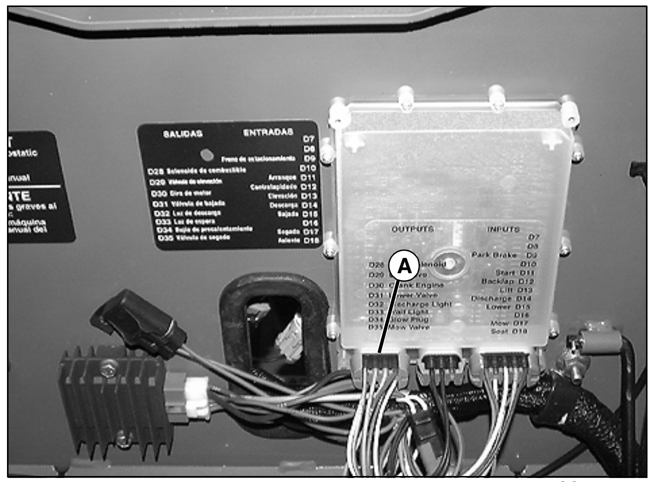
• Three pulses followed by a short pause, followed by five pulses (Code 3-5); Indicates fuel hold internal checking failure on circuit board, or output miswired to +12 volts.

• Three pulses followed by a short pause, followed by six pulses (Code 3-6); Indicates a faulty power or ground connection to the control board.

• Three pulses followed by a short pause, followed by seven pulses (Code 3-7); Indicates a faulty power or ground connection to the control board.

• Three pulses followed by a short pause, followed by eight pulses (Code 3-8); Indicates a faulty power or ground connection to the control board.

Test Control Module



M84736

1. Move key switch to STOP position.
2. Disconnect “Output” connector (A) from control box.
3. Move key switch to RUN position.

Normal

• “Heartbeat” light flashing in a regular, even rate. This indicates the control module is operating properly and the problem is in the wiring harness.

If Not Normal

• If the “Heartbeat” light continues to flash the 3-2 code, replace the control module.

Table of Contents

Specifications

General Specifications

Make	Kawasaki
Engine Model Number	FD620D
Displacement	617 cm^3 (37.7 cu-in.)
Cylinders	2
Stroke/Cycle	4
Valves	Overhead Valves
Bore	76 mm (2.99 in.)
Stroke	68 mm (2.66 in.)
Compression Ratio	8.5:1
Compression Release	Automatic
Crankshaft Type	Horizontal (counterbalanced)
Lubrication	Pressurized by positive displacement pump
Oil Pressure	276 kPa (40 psi) minimum
Oil Filter	Cartridge type, full flow, spin-on filter
Crankcase Capacity (With Filter)	1.9 L (2.0 qt)
Cooling System	Liquid cooled
Cooling System Capacity	2.7 L (2.9 qt)
Air Cleaner	Paper element with foam precleaner

Maximum Angle of Operation (With Full Crankcase):

Continuous (All Directions)	20°
Intermittent (All Directions)	35°

Fuel Filter	Replaceable (in-line type)
Fuel Pump	Electromagnetic pump (in-line type)
Fuel Shut-Off Solenoid	Replaceable (below carburetor float bowl)
Carburetor	Float type, fixed main jet, two barrel
Digital Fuel Injection	Simultaneous port fuel injection
Ignition System	Transistor Controlled Battery
Spark Plug	(M138938) NGK BPR2ES
Charging System	12V - 20 amps with regulator
Type	Solenoid shift
Dry Weight	41.5 kg (91.5 lb)

Tests and Adjustments Specifications

Gasoline Engine

Spark Plug Gap	0.6-0.7 mm (0.024-0.028 in.)
Pulser Coil Gap	0.3-1.2 mm (0.012-0.05 in.)
Intake Valve Clearance	0.25 mm (0.010 in.)
Exhaust Valve Clearance	0.25 mm (0.010 in.)
Oil Pressure (Minimum at 1250 rpm)	276 kPa (40 psi)
Cylinder Compression (Minimum Compression Pressure)	1171 kPa (170 psi)
Cylinder Compression (Maximum Compression Pressure)	1379 kPa (200 psi)
Cylinder Compression (Maximum Difference Between Cylinders)	97 kPa (14 psi)

Crankcase Vacuum (Max Water Movement) . . . . . 18 cm (7 in.)
Radiator Cap Opening Pressure . . . . . 73-103 kPa (10.5-15 psi)
Cooling System Leak Test Pressure . . . . . 90 kPa (13 psi)

Coolant Temperature Switch

Rising Temperature (OFF to ON) . . . . . 108-114°C (226-237°F)
Falling Temperature (ON to OFF) . . . . . 101-107°C (214-225°F)

Thermostat

Begin Opening Temperature . . . . . 82°C (180°F)
Full Open Temperature . . . . . 95°C (203°F)
Minimum Lift Height Above 96°C (203°F) . . . . . 7 mm (0.28 in.)

Fan Belt Tension

Nominal . . . . . 25-55 kg (55-88 lb)
Wear Limit . . . . . 18 kg (40 lb)

Fan Belt Deflection

Nominal . . . . . 9-12 mm (0.35-0.47 in.)
Wear Limit . . . . . 17 mm (0.67 in.)
48V Alternator Drive Belt Deflection
at 50 N (11 lb-force) . . . . . 30 mm (1.188 in.)
48V Alternator Drive Belt Tension Spring
Length . . . . . 66-72 mm (2.6-2.8 in.)

Fuel/Air System

Slow Idle Speed . . . . . 1550 ± 100 rpm
Fast Idle Speed . . . . . 3600 rpm

Fuel Flow (Min in 30 Seconds)

2500 . . . . . 180 mL (6.0 oz)
2500A and 2500E . . . . . 300 mL (10.0 oz)

Fuel Pressure (Min)

2500 . . . . . 19 kPa (2.76 psi)
2500A and 2500E . . . . . 10 kPa (1.50 psi)

Repair Specifications

Cylinder Head

Cylinder Head Distortion (Maximum) . . . . . 0.060 mm (0.002 in.)
Valve Seat Angle (Intake and Exhaust) . . . . . 45°
Spark Plug Torque . . . . . 25 N•m (221 lb-in.)

Valve Seat Width

Standard (Intake and Exhaust) . . . . . 0.50-1.10 mm (0.020-0.043 in.)
Wear Limit (Intake and Exhaust) . . . . . 2.00 mm (0.08 in.)

Crankcase Cover

Crankshaft Bore ID Crankcase Cover (Maximum) . . . . . 34.066 mm (1.341 in.)

Camshaft Bore ID Crankcase Cover (Maximum) . . . . 16.07 mm (0.633 in.)

Crankcase

Breather Air Gap . . . . 0.2 mm (0.008 in.)
Distance Between Governor Shaft and Governor Arm . . . . 7 mm (0.3 in.)
Minimum Cross Shaft OD . . . . 5.962 mm (0.235 in.)

Valves and Valve Lifters

Valve Clearance (Intake/Exhaust Cold) . . . . 0.25 mm (0.01 in.)
Valve Stem Bend (Maximum) . . . . 0.050 mm (0.002 in.)
Intake Valve Stem OD (Minimum) . . . . 5.95 mm (0.234 in.)
Exhaust Valve Stem OD (Minimum) . . . . 5.92 mm (0.233 in.)
Intake Valve Guide ID (Maximum) . . . . 6.05 mm (0.238 in.)
Exhaust Valve Guide ID (Maximum) . . . . 6.06 mm (0.239 in.)
Valve Spring Free Length (Minimum) . . . . 29.7 mm (1.17 in.)
Valve Face Angle (Intake and Exhaust) . . . . 45°
Valve Margin (Min) . . . . 0.60 mm (0.024 in.)
Push Rod Bend (Maximum) . . . . 0.8 mm (0.03 in.)
Rocker Arm Shaft OD (Minimum) . . . . 11.95 mm (0.470 in.)
Rocker Arm Bearing ID (Maximum) . . . . 12.07 mm (0.475 in.)

Crankshaft

Crankshaft Journal Bearing ID: Crankcase Cover . . . . 34.066 mm (1.3412 in.)
Crankshaft Journal Bearing ID: Crankcase . . . . 34.114 mm (1.3431 in.)
Crankshaft Journal OD PTO Side (Minimum) . . . . 33.909 mm (1.3350 in.)
Crankshaft Journal OD Flywheel Side (Minimum) . . . . 33.909 mm (1.3350 in.)
Crankshaft Runout (TIR) (Maximum) . . . . 0.05 mm (0.002 in.)
Crankpin OD (Minimum) . . . . 33.927 mm (1.3357 in.)
Crankpin Width (Maximum) . . . . 44.5 mm (1.75 in.)

Crankshaft Resizing Specifications (Finished)

Connecting Rod Journal Diameter . . . . 33.467—33.480 mm (1.3176—1.318 in.)
Journal Radius . . . . 2.30—2.70 mm (0.06—0.11 in.)
Crankpin Width) (Maximum) . . . . 44.40 mm (1.748 in.)
Bearing Journal-to-Connecting Rod Journal Centerline-to-Centerline . . . . 33.95—34.00 mm (1.337—1.339 in.)

Connecting Rod

Twist (Maximum) . . . . 0.15 mm over 100 mm (0.006 over 3.94 in.)
Bend (Maximum) . . . . 0.15 mm over 100 mm (0.006 over 3.94 in.)
Connecting Rod Large End Width (Maximum) . . . . 21.20 mm (0.83 in.)
Connecting Rod Large End ID (Maximum) . . . . 34.055 mm (1.3407 in.)
Connecting Rod Small End ID (Maximum) . . . . 17.051 mm (0.6713 in.)

ENGINE - GAS SPECIFICATIONS

Camshaft

Bearing ID Maximum (Crankcase)	16.068 mm (0.6326 in.)
Bearing ID Maximum (Crankcase Cover)	16.068 mm (0.6326 in.)
Camshaft Journal PTO Side Diameter (Minimum)	15.907 mm (0.626 in.)
Camshaft Journal Flywheel Side Diameter (Minimum)	15.917 mm (0.627 in.)
Cam Lobe Height (Minimum)	
Intake	25.21 mm (0.993 in.)
Exhaust	25.46 mm (1.002 in.)

Oil Pump

Inner and Outer Rotor Clearance (Maximum)	0.3 mm (0.012 In.)
Outer Rotor OD (Minimum)	40.47 mm (1.593 In.)
Outer Rotor Thickness (Minimum)	9.830 mm (0.387 In.)
Pump Housing ID (Maximum)	40.801 mm (1.606 In.)
Pump Housing Depth (Maximum)	10.230 mm (0.4028 In.)
Rotor Shaft OD (Minimum)	10.923 mm (0.4300 In.)
Rotor Shaft Bearing ID (Maximum)	11.072 mm (0.436 In.)
Relief Valve Spring Length (Minimum)	19.50 mm (0.77 In.)

Cylinder Bore, Pistons and Rings

Cylinder Bore ID New - Standard	75.980—76.000 mm (2.9913—2.9921 in.)
Cylinder Bore - Standard (Maximum)	76.067 mm (2.9948 in.)
Cylinder Bore ID New - 0.50 mm OS	76.480—76.500 mm (3.0110—3.0118 in.)
Cylinder Bore - 0.50 OS Bore (Maximum)	76.567 mm (3.0144 in.)
Cylinder Bore Out of Round (Maximum)	0.056 mm (0.0022 in.)
Piston Pin Bore ID (Maximum)	17.04 mm (0.671 in.)
Piston Pin OD (Minimum)	16.975 mm (0.688 in.)
First Compression Ring-to-Groove Side Clearance	0.15 mm (0.006 in.)
Second Compression Ring-to-Groove Side Clearance	0.12 mm (0.005 in.)
Piston Ring Thickness (Top, Second) (Minimum)	1.12 mm (0.044 in.)
End Gap Compression Ring (Maximum)	1.2 mm (0.05 in.)
Oil Ring End Gap (Maximum)	1.5 mm (0.06 in.)
Piston OD - Standard Size (Minimum)	75.875 mm (2.987 in.)
Piston OD - Oversize (Minimum)	76.375 mm (3.007 in.)

Coolant Pump

Pump Shaft OD (Minimum)	9.94 mm (0.391 in.)
Housing Shaft Bore (Maximum)	10.088 mm (0.397 in.)

Starting Motor

Brush Length (Minimum)	6 mm (0.24 in.)
Commutator Groove Depth (Nominal)	0.5—0.8 mm (0.020—0.031 in.)
Commutator Groove Depth (Minimum)	0.2 mm (0.008 in.)
Commutator OD (Minimum)	27 mm (1.06 in.)
Starting Motor Brush Length (Minimum)	6 mm (0.24 in.)
Commutator Runout (Maximum)	0.4 mm (0.016 in.)

Torque Specifications (Alphabetical)

48V Alternator Belt Tensioner Locknut Torque[1]	**74.5 N•m (55 lb-ft)**
Air Cleaner Mounting Cap Screw	**9.8 N•m (87 lb-in.)**
Air Cleaner Mounting Flanged Nut	**17 N•m (144 lb-in.)**
Breather Cover Cap Screw	**20 N•m (177 lb-in.)**
Carburetor or Throttle Body-to-Manifold Mounting Cap Screw and Nut	**17 N•m (144 lb-in.)**
Choke Valve Screw	**0.88 N•m (7.8 lb-in.)**
Connecting Rod Cap Screw	**21 N•m (186 lb-in.)**
Control Panel Mounting Cap Screw	**5.9 N•m (52 lb-in.)**
Coolant Pump Mounting M6 Cap Screw	**10 N•m (86 lb-in.)**
Coolant Pump Mounting M8 Cap Screw	**24 N•m (216 lb-in.)**
Cooling Fan Bearing Shaft Retaining Nut	**20 N•m (180 lb-in.)**
Coolant Temperature Switch	**27 N•m (240 lb-in.)**
Crankcase Breather Cover Cap Screw	**20 N•m (177 lb-in.)**
Crankcase Cover Cap Screw Final Torque[2]	**24 N•m (216 lb-in.)**

Cylinder Head Cap Screw Torque[1]:

Initial Torque	**15 N•m (132 lb-in.)**
Stepped Increase	**3 N•m (27 lb-in.)**
Final Torque	**21 N•m (186 lb-in.)**

Engine Flywheel Cover Cap Screw (M8)	**6.9 N•m (61 lb-in.)**
Engine Mounting Cap Screw	**41 N•m (30 lb-ft)**
Fan Belt Drive Sheave Cap Screw	**20 N•m (177 lb-in.)**
Flywheel Mounting Nut	**110 N•m (80 lb-ft)**
Fuel Pump Mounting Cap Screw	**7.8 N•m (69 lb-in.)**
Fuel Shutoff Solenoid Valve	**9 N•m (87 lb-in.)**
Clamp Nut	**8 N•m (69 lb-in.)**
Intake Manifold Mounting Cap Screw (Initial Torque)	**3 N•m (26 lb-in.)**
Intake Manifold Mounting Cap Screw (Final Torque)	**7.8 N•m (69 lb-in.)**
Main Jet (Carburetor)	**1.0 N•m (8.9 lb-in.)**
Muffler Mounting Nut	**20 N•m (177 lb-in.)**
Oil Drain Plug	**23 N•m (203 lb-in.)**
Oil Pump Cover Plate Mounting Cap Screw	**6 N•m (52 lb-in.)**
Oil Pressure Switch	**15 N•m (132 lb-in.)**
Oil Screen Mounting Cap Screw	**6 N•m (52 lb-in.)**
Pump Coupler Socket Head Cap Screw	**62 N•m (46 lb-ft)**
Rocker Arm (Valve Clearance) Adjusting Lock Nut	**11 N•m (96 lb-in.)**
Rocker Arm Bracket Mounting Cap Screw	**22 N•m (195 lb-in.)**
Spark Plug Torque	**25 N•m (221 lb-in.)**
Starting Motor Mounting Cap Screw	**20 N•m (177 lb-in.)**
Stator Mounting Cap Screw	**3.4 N•m (30 lb-in.)**
Thermostat Housing Cap Screw	**6 N•m (53 lb-in.)**
Throttle Plate Mounting Cap Screw	**8 N•m (71 lb-in.)**
Voltage Regulator Screw	**3.4 N•m (30 lb-in.)**

1. *Back off 1/8 turn after tightening to specification.*
2. *Tightening sequence required. See procedure for details.*

Tools and Materials

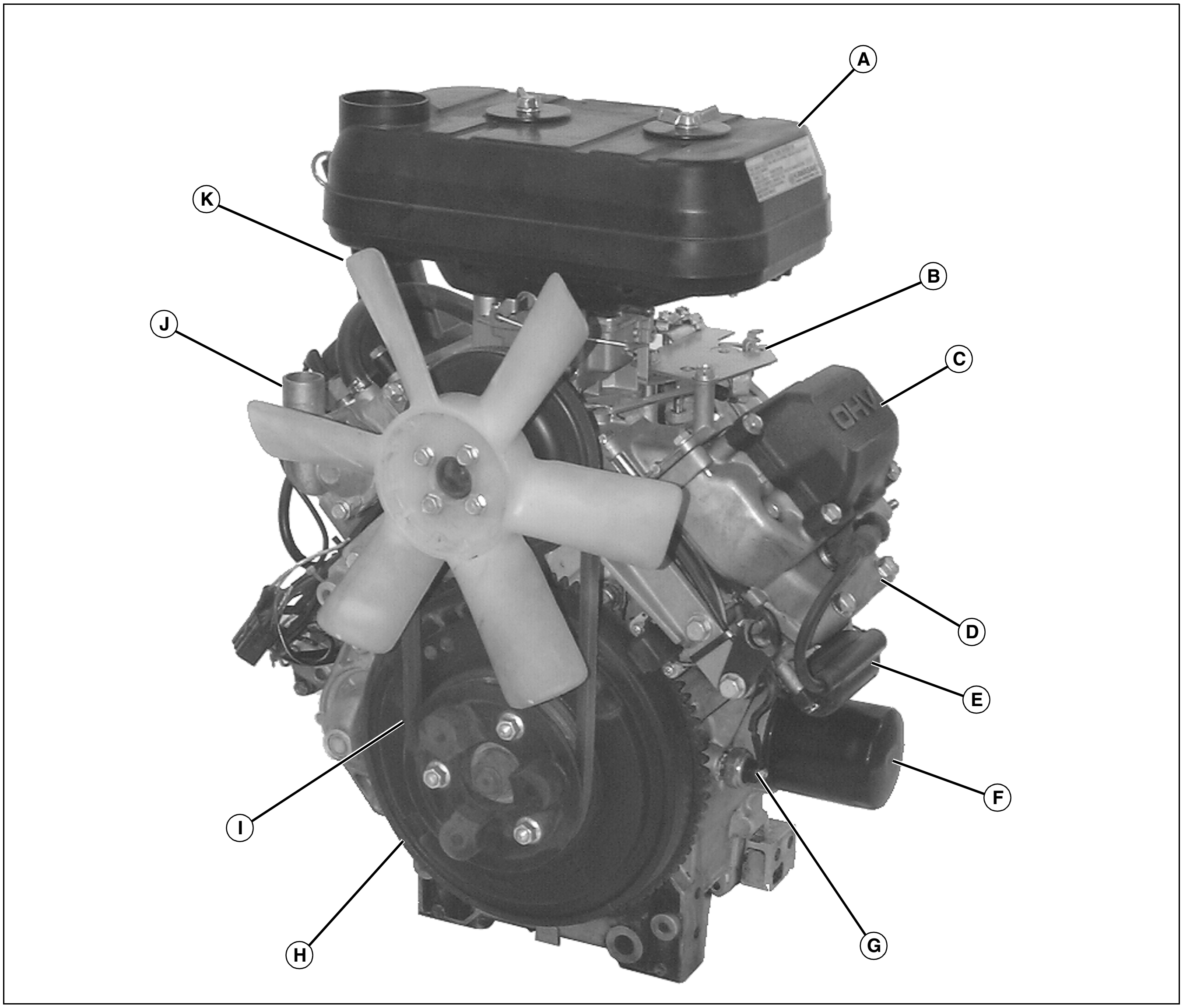
Gas Engine

Special or Required Tools

Tool Name	Tool No.	Tool Use
Spark Tester	D-05351ST	Used to check overall condition of ignition system.
Feeler Gauge	NA	Used to measure spark plug gap.
Belt Tension Gauge	JDG529 or JDST28	Used to measure drive belt deflection.
Straightedge		Used to measure drive belt deflection.
Belt Tension Gauge	JDG529 or JDST28	Used to measure drive belt deflection.

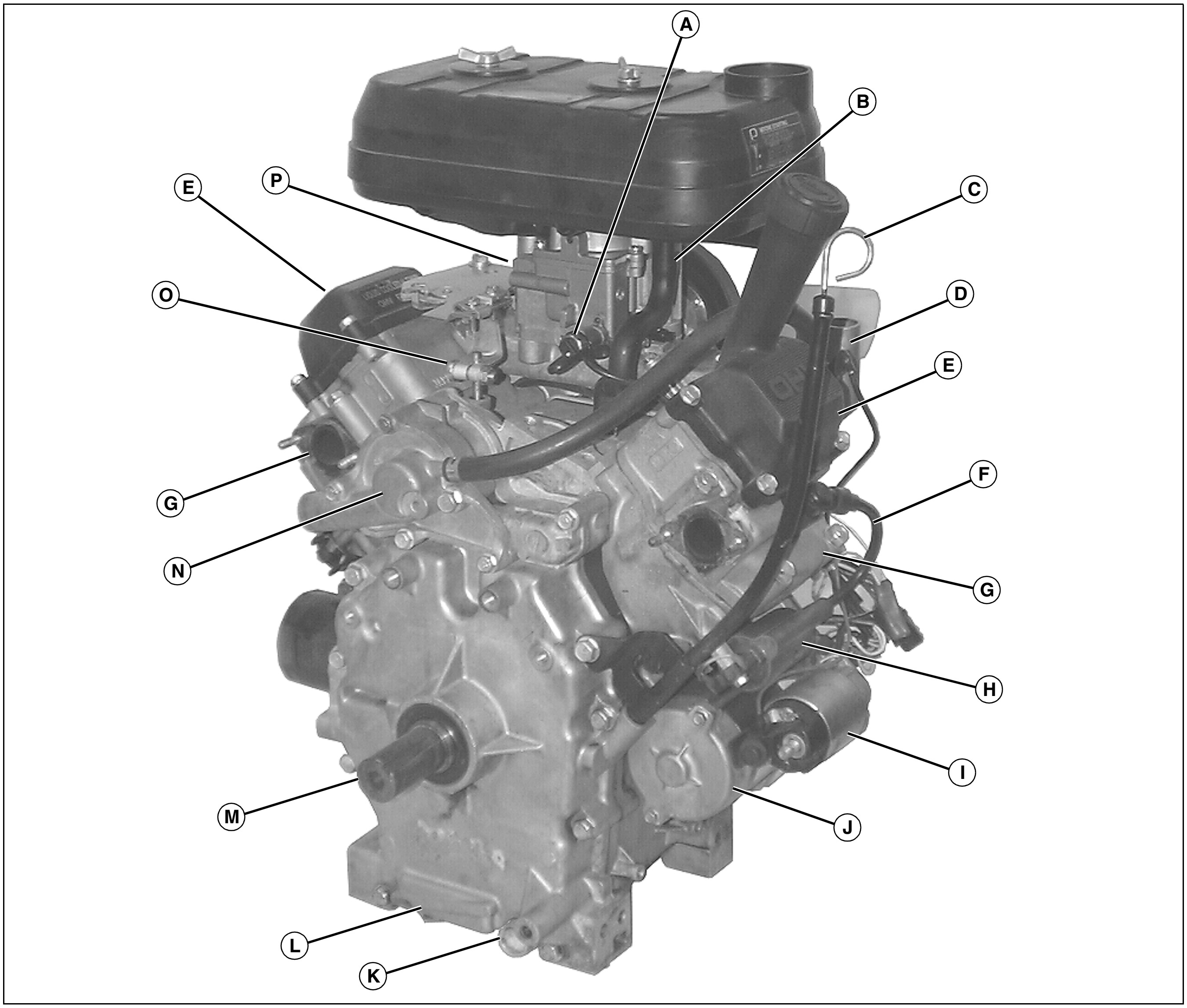
Component Location

Exterior Engine Component Location



M84660

A - Air Cleaner Assembly
B - Throttle Plate
C - Rocker Arm Cover
D - Cylinder Head
E - Ignition Coil
F - Oil Filter
G - Oil Pressure Switch
H - Flywheel
I - Fan Drive Belt
J - Thermostat Housing
K - Cooling Fan

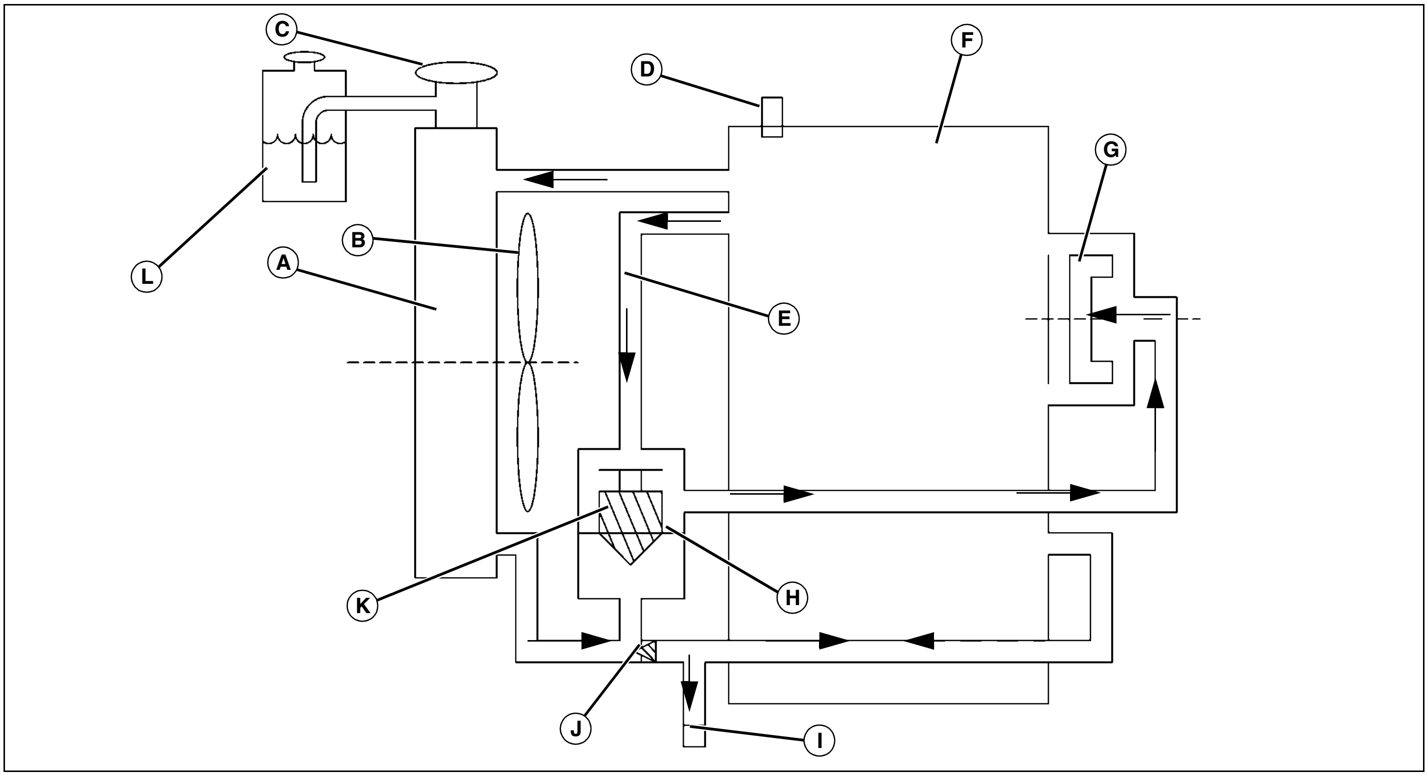


M84659

A - Fuel Shutoff Solenoid
B - Breather Hose
C - Dipstick Tube
D - Coolant Temperature Switch
E - Rocker Arm Cover
F - Spark Plug Lead
G - Cylinder Head
H - Ignition Coil
I - Starter Solenoid
J - Starting Motor
K - Oil Drain
L - Crankcase Cover
M - Crankshaft
N - Coolant Pump
O - Governor Arm

Theory of Operation

Cooling System Operation



MX14217

A - Radiator
B - Cooling Fan
C - Radiator Cap
D - Coolant Temperature Switch
E - Bypass Tube
F - Engine Block
G - Coolant Pump
H - Jiggle Valve
I - Drain Plug
J - Valve, One Way
K - Thermostat
L - Coolant Recovery Tank

Function

The coolant pump (G) circulates coolant through the cooling system, drawing hot coolant from the engine block (F), and circulating it through the radiator (A) for cooling.

System Operation

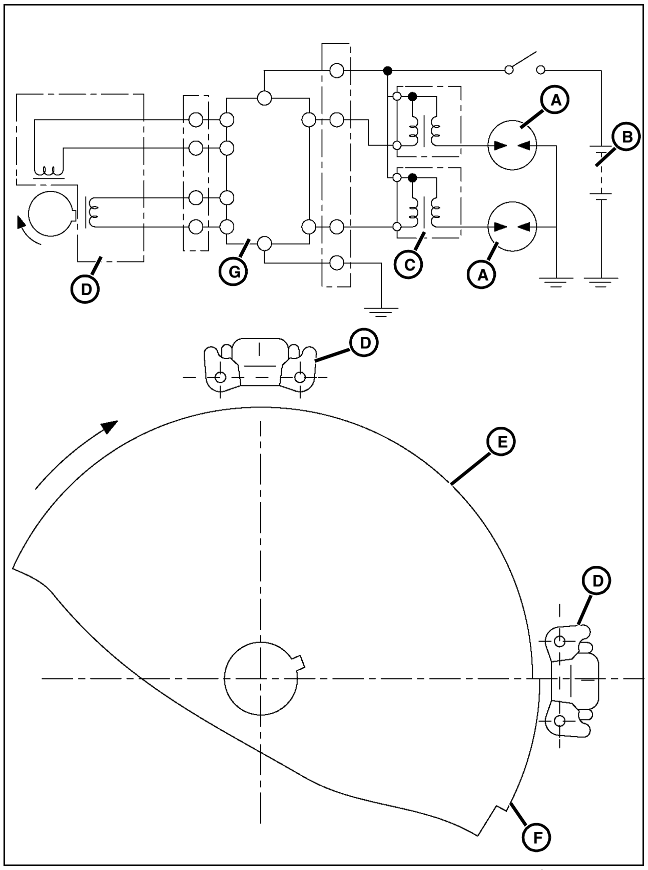
The impeller-type coolant pump draws coolant from the bottom of the radiator when the thermostat (K) is open, or from the bypass tube (E) when the thermostat is closed. Coolant from the coolant pump flows to the water jackets in the block, up through cylinder heads, intake manifold, past the coolant temperature switch (D).

When the engine temperature is below approximately 82°C (180°F), the thermostat is closed and coolant is directed back to the coolant pump through the bypass tube to be recirculated. This allows the engine to warm up to operating temperature quickly.

When the engine temperature is approximately 82°C (180°F), the thermostat begins to open and is fully open at 95°C (203°F). Coolant from the water jackets and cylinder heads now flow through the radiator, which is cooled by the cooling fan (B). The fan is driven by a belt off the crankshaft pulley. If the engine coolant temperature rises to 111°C (232°F), the coolant temperature switch (D) closes and turns on a warning light on the instrument panel, warning you of a potentially dangerous overheating situation.

The radiator cap (C) maintains a pressure of 78-98 kPa (11.3-14.2 psi) in the cooling system, which actually raises the boiling point of the coolant. The radiator cap contains a pressure valve and a vacuum valve. When the coolant is hot and pressure is above 98 kPa (14.2 psi), the pressure valve opens, allowing some coolant to flow to the recovery tank. After the engine is stopped, the coolant cools and the pressure inside the radiator decreases. The pressure difference between the radiator and recovery tank forces the vacuum valve open and some coolant from the recovery tank flows back to the radiator.

Ignition System Operation



MX21452/MX21453

A - Spark Plugs
B - 12V Battery
C - Ignition coil units
D - Pulser coils (pick up coils)
E - Flywheel
F - Reluctor
G - Igniter (Ignition Control Unit)

Transistor controlled battery ignition system is used in this engine. This ignition system is essentially a battery-ignition coil system where the battery (B) supplies the current to the primary circuit in the system. This ignition system is transistorized and controls the current for the primary circuit in the system by use of a electronic switching unit integrated into the igniter (G). The switching unit is triggered by the pulser coils (D) (pick up coils) on each cylinder and contains no mechanical parts.

As the starter turns the flywheel, the reluctor (F) in the flywheel runs past the pulser coils (D), this creates a magnetic field in the pulser coils and close the switching unit in the igniter and allow the current flow through the primary circuit in the ignition coils.

As the flywheel (E) turns, the trailing reluctor passes under pulser coils, opening the switching unit in the igniter and causing the primary coil current to stop suddenly. This creates an induced high voltage in a secondary coil windings, which fire the spark plugs (F).

Each spark plug fires every time the piston rises. When a spark does jump across the electrodes during the exhaust stroke, it will not affect on engine operation, since there is no compression and no combustible fuel/air mixture. The transistor controlled ignition system contains no mechanical parts, no wear occurs and no periodic maintenance is required except for the spark plug.

Fuel Supply and Air Intake System Operation

Function

The fuel system supplies fuel to the engine for combustion. The air intake system filters air needed for combustion.

The fuel pump/pick-up is mounted inside the fuel tank. The fuel pump draws fuel from the fuel tank and supplies it through a fuel filter to the carburetor.

The carbureted engine uses a low-pressure fuel pump.

Air for combustion enters through the air filter assembly. The engine crankcase breather hose connects to the air filter housing. Crankcase fumes are vented into the incoming air stream and are burned to decrease emissions.

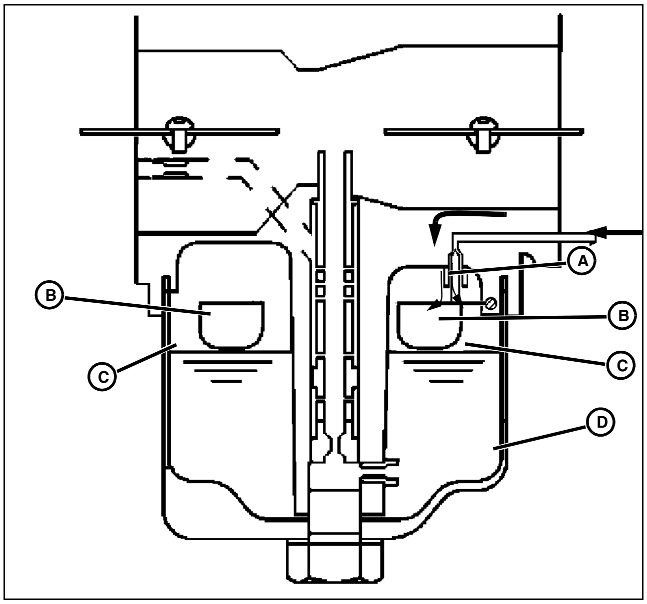
Carburetor Operation

Function

To control engine speed and to mix fuel and air in correct proportions for efficient engine operation at all speeds.

Theory of Operation

The carburetor consists of three fuel circuits: Supply Fuel, Pilot Fuel, and Main Fuel.

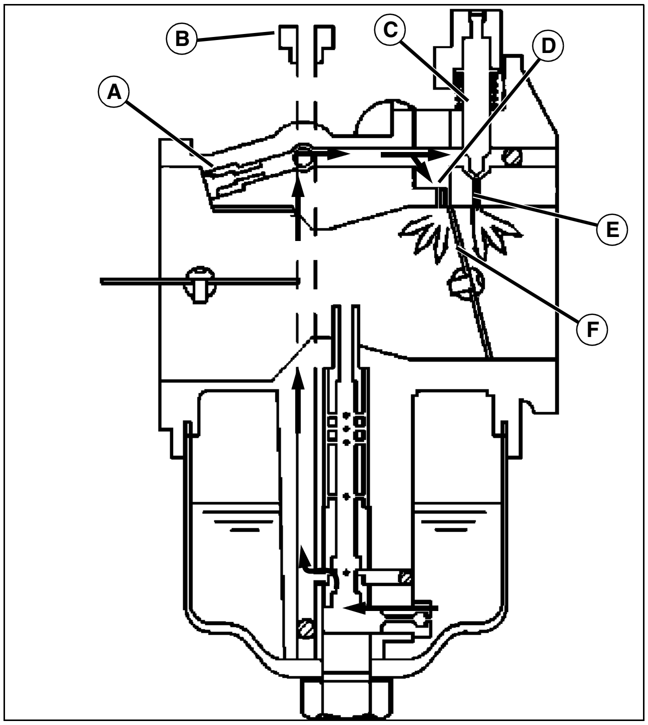


MX6263

Fuel Supply Circuit

The main components of the fuel supply circuit are float chamber (D), float valve (A), and float (B). The fuel supply circuit controls the fuel level (C) in the float chamber.

Fuel under light pressure from the fuel pump enters the carburetor and passes through the float valve (A). As fuel enters the float chamber (D), the float (B) begins to rise. The float valve (A) is located near the float pivot, and as the float rises, the float valve closes. When a predetermined position is reached (referred to as float level), the float completely stops the flow of fuel. Misadjustment of the float level can cause poor engine operation and even premature engine wear or damage. If the float level is high, the fuel/air mixture entering the engine will be rich (excessive fuel) and may cause black exhaust. If the float level is low, the fuel/air mixture will be lean (lack of fuel) and result in low engine power or stalling.

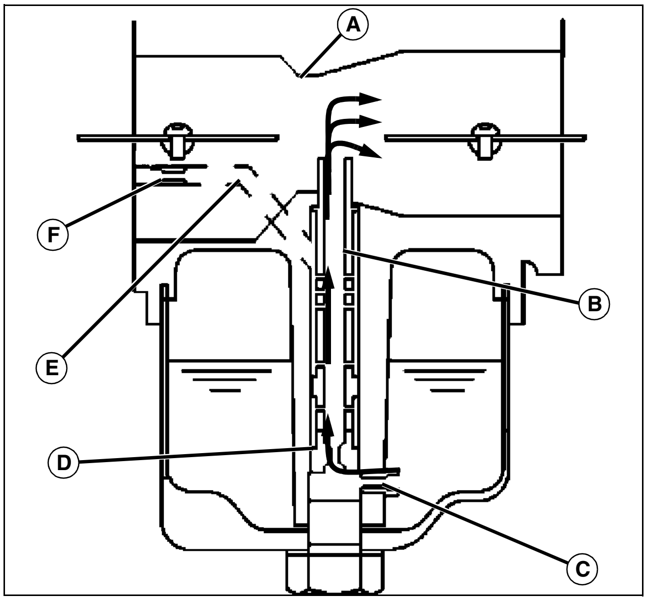


MX6257

Pilot Fuel Circuit

The pilot circuit includes a pilot air jet (A), pilot fuel jet (B), pilot mixture screw (idle mixture screw) (C), bypass holes (D), and pilot outlet (E). The pilot system meters the fuel/air mixture while the engine is idling and running under a light load. Under these conditions there is very little air flow through the carburetor bore, so little that it is not enough to draw fuel through the main system of the carburetor. Instead, the fuel is drawn from the main fuel circuit and through the pilot system. The nearly closed throttle valve (F) causes high speed air flow past the pilot outlet (E) and bypass holes (D), and creates a low pressure area that “pulls” fuel through the pilot circuit.

Fuel flow in the pilot system is metered by the pilot fuel jet (B). Air is admitted into the pilot fuel via the pilot air jet (A) located in the throat of the carburetor, creating an emulsion that results in better atomization of the fuel passing into the engine. The fuel/air emulsion passes into the bore of the carburetor, near the throttle valve, through the bypass holes (D) and pilot outlet (E). At slow idle, the bypass holes (D) are covered by the throttle valve (F) and all fuel/air emulsion is delivered through the pilot outlet (E). As the throttle valve begins to open, it uncovers the bypass holes (D), allowing more fuel/air emulsion to flow. The extra flow is needed due to the increased air passing through the carburetor as the throttle is opened. The pilot mixture screw (C) controls the amount of fuel/air emulsion allowed through the pilot outlet (E), but does not meter the bypass holes (D). A moderate amount of air comes in around the throttle valve at idle, so adjusting the pilot mixture screw (C) changes the fuel/air ratio. Turning the pilot mixture screw (idle mixture screw) out (counterclockwise) enrichens the mixture; turning it in (clockwise) leans the mixture.



MX6258

Main Fuel Circuit

The main fuel circuit consists of the main jet (C), fuel shut-off valve seat (D), main nozzle (B), main air passage (E), and main air orifice (F). The main system meters fuel to the engine during moderate to heavy load conditions.

The throat of the carburetor incorporates an area having a reduced diameter called a venturi (A). As air passes through the venturi, it increases in speed resulting in a low pressure area. The main nozzle (B) is located in the venturi area. The pressure differential between the fuel in the float chamber and the venturi (A) causes the fuel to be “lifted” through the main nozzle (B).

The main jet (C) controls the amount of fuel that passes into the main nozzle (B). Fuel flows through the main jet (C) and into the main nozzle (B), where it is joined by air from the main air passage (E) to create an air/fuel emulsion that is easier to “lift”. The main air orifice (F) controls air flow through the main air passage (E). The resulting emulsion flows out the end of the main nozzle (B) into the carburetor bore, where it is atomized by the high speed air flow, and carried into the engine.

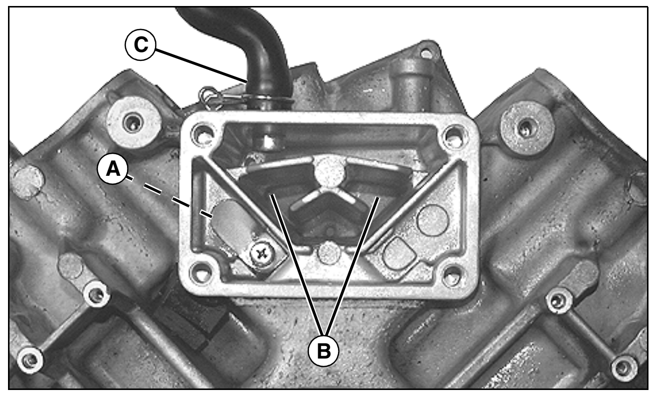
The fuel shutoff solenoid is mounted to the carburetor and shuts off fuel to the main jets, preventing gas fumes from escaping into the air for emission control. An ignition delay module is used with the fuel shutoff solenoid to prevent backfire. The ignition delay module allows the spark plugs to fire for one additional second after the key switch is turned off to burn any remaining fuel in the cylinders.

The throttle control lever, which is connected to the throttle lever and the governor lever, controls engine rpm. The governor lever is connected to the throttle valve inside the carburetor. Slow idle is adjusted by turning the slow idle stop screw and fast idle is adjusted by moving the throttle control plate.

Crankcase Breather Operation

Function

The function of the breather is to create a vacuum in the crankcase which prevents oil from being forced out of the engine through the piston rings, oil seals or gaskets.



M84746

The breather has a reed valve (A), which limits the direction of air flow caused by the piston moving up and down. Air can flow out of the crankcase, but the one way reed valve blocks return flow. It thus maintains a vacuum in the crankcase.

Oil laden air in the crankcase passes through the reed valves and expands into the breather chamber. Here most oil separates from the air and drains back to the crankcase. The air passes through a maze (B) and vents to the air cleaner (C).

Governor Operation

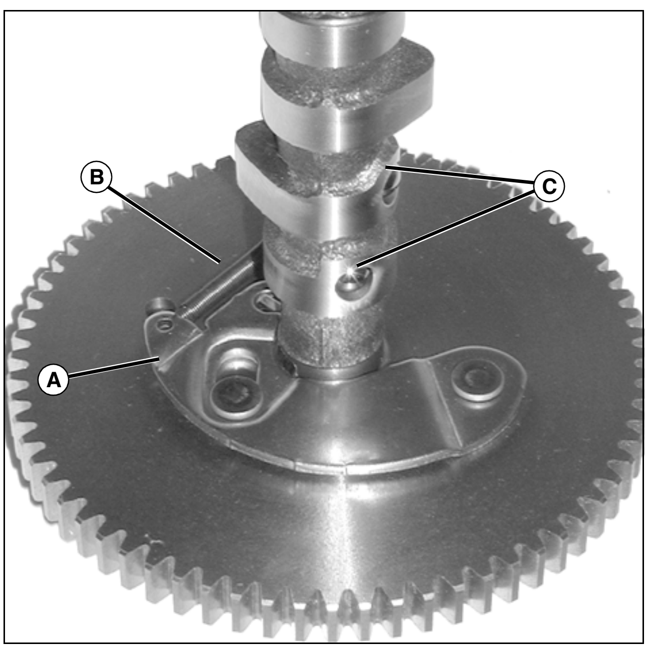
Function

Controls the engine speed.

System Operation

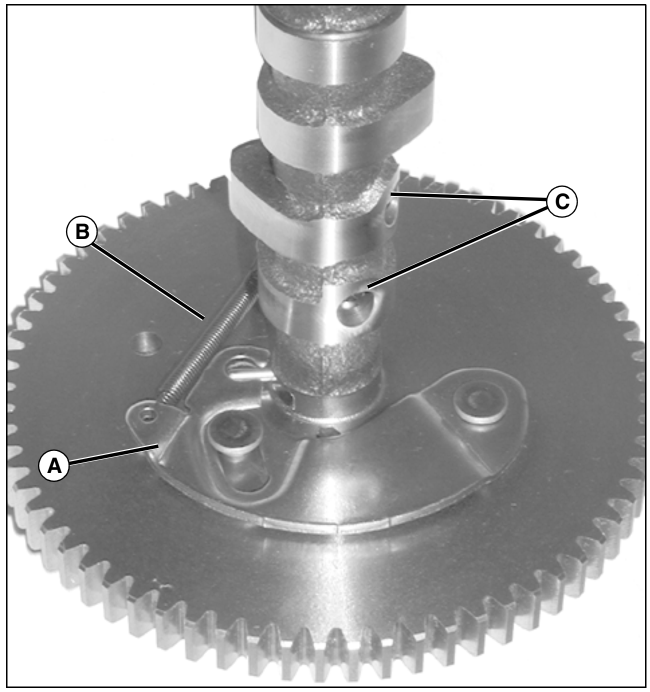
Governed engine speed is a balance between governor spring tension, set by the throttle control, and centrifugal force of the governor flyweights. As tension is applied to governor spring, governor linkage opens the throttle, increasing engine rpm. As the engine speed increases, the flyweight assembly (driven by the crankshaft gear) pushes against the arm of the governor shaft and causes it to rotate. When the governor shaft rotates, the lever attached to it causes the throttle linkage to move, closing the throttle slightly and reducing rpm to the desired governed operating speed. If a heavy load is encountered, engine speed drops, as does the governor assembly speed. Flyweights retract and allow shaft arm to move governor shaft and lever in the opposite direction to open throttle until engine operating speed is recovered. Springs provide a smooth yet responsive transitional control.

Automatic Compression Release (ACR) Operation



MX6172a

Picture Note: Cranking



MX6172b

Picture Note: Running

Function

The automatic compression release (ACR) relieves some of the compression created during starting of the engine. This is done by slightly raising the exhaust valve as the engine rotates through the compression stroke.

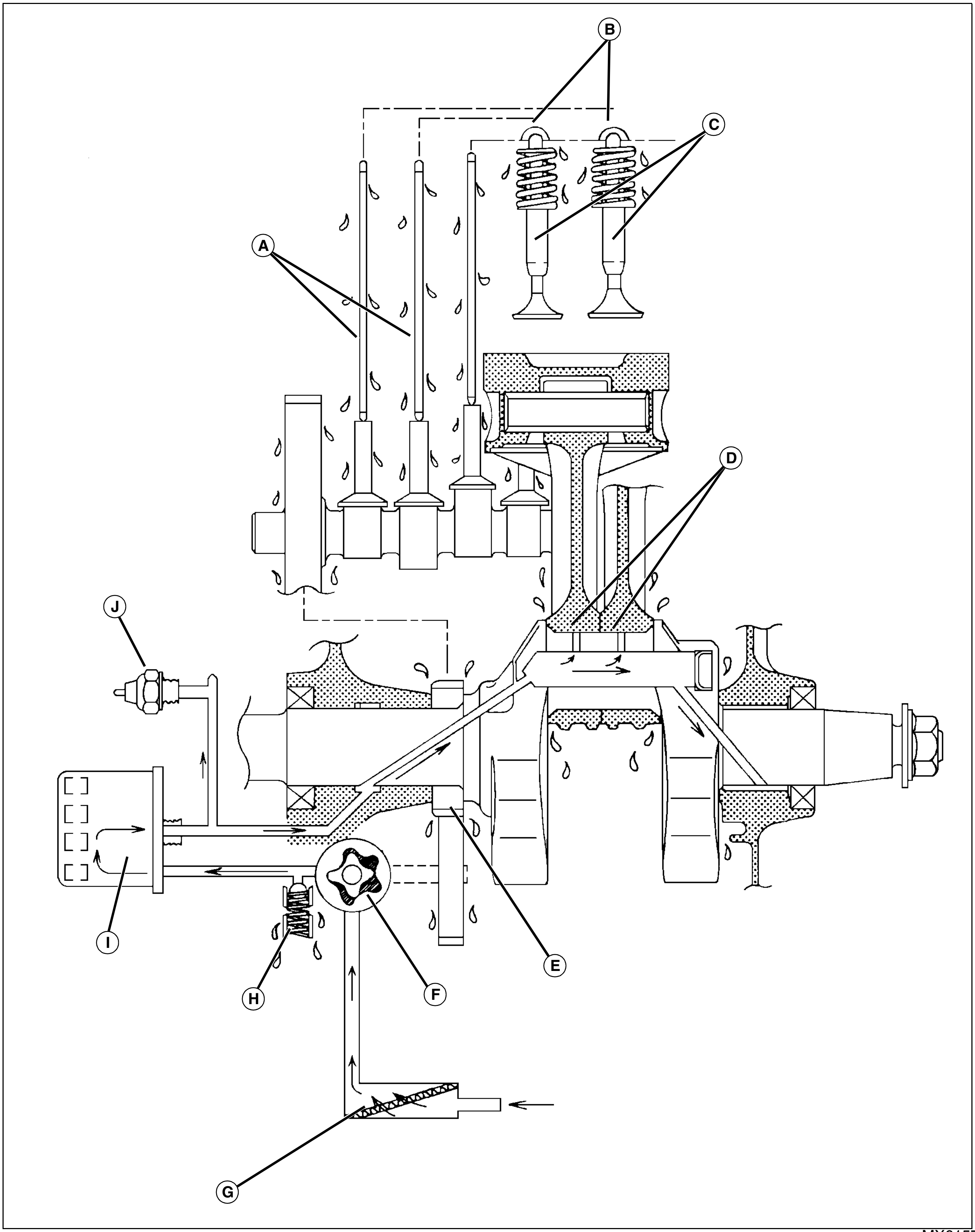
Theory of Operation

The ACR consists of a flyweight (A) that is attached to the cam gear, balls (C), and a return spring (B). The ACR is attached to the camshaft and has limited serviceability.

When the engine is cranked, the pins are held above the surface of the exhaust cam lobes, causing the exhaust valves to open slightly during the compression stroke. The result is a lowered cylinder pressure, allowing the engine to turn over more easily.

When the engine starts, the centrifugal force overcomes the force of the return spring and the flyweight moves away from its at-rest position. As the flyweight rotates, the compression release pins withdraw below the surface of the cam lobe, allowing normal valve timing and engine operation.

Lubrication System Operation



MX6157

Function

To provide oil to lubricate internal engine components.

Theory of Operation

A positive displacement Gerotor pump (F) is used to pressurize the lubrication system. The oil pump is driven directly off the crankshaft gear (E). The lubrication system is protected by an oil pressure relief valve (H), low oil pressure switch (J), and an oil filter (I) with bypass.

The oil pump (F) draws oil from the sump through a pickup screen (G). Pressurized oil flows from the pump to a pressure relief valve (H) that limits the oil pressure to approximately 241-310 kPa (35-45 psi). Relief oil is vented back to the sump.

The pressurized, non-relieved oil flows through a full flow spin-on oil filter (I). Filtered oil is then routed to the crankshaft and camshaft bearings. Drilled passages (D) in the connecting rods allow for lubrication of the piston pin and pistons.

The rocker arms (B), valves (C) and push rods (A) are lubricated by an oil/air mixture carried to the head through the breather tube.

Diagnostics

Engine Diagnosis

Under certain operating conditions, oil volume in the crankcase might actually increase. This increase can be due to fuel or moisture accumulation. Poor maintenance, poor fuel, humidity, continuous days of rain, or a light duty cycle can cause or worsen this situation.

In testing and field visits the factory has found many causes for this issue. A large contributor is poor quality fuel. Also poor engine maintenance has been a major contributor.

Conversely, this issue is not always fuel related. The increase of the oil level is sometimes due to water contamination. We have seen growth due to humidity or units being run in the rain.

Using the unit in a light duty cycle is also a contributor. Running the machine at full throttle under light load may cause this condition.

Symptoms of this issue may include:

- Low power (due to fouled plugs, misadjusted cables or a misadjusted governor)
- Low compression (due to valve maladjustment or damaged rings)
- Rough running (due to choke maladjustment or poor quality fuel)

If a unit is exhibiting these symptoms it may be experiencing oil growth as well. These symptoms are not caused by the oil growth, but instead are symptoms to an underlying problem.

Check the following:

- Test the fuel.

From tests performed by the factory, fuel quality has been found to be a major contributing factor to this issue. Poor quality fuel can cause this issue, or make it substantially worse. Due to current and future EPA regulations fuel quality is VERY important to proper operation of this and other engines. As emissions regulations change, fuel quality will be more and more crucial to engine performance.

  - Remove a fuel sample from the fuel tank. Have the lab provide you with a testing report for reference. Fuel should meet either the EN 228 or ASTM D4814 standards.

- Check and adjust throttle cable. (See “Adjust Throttle Cable” on page 54.)
- Check and adjust choke cable. (See “Adjust Choke Cable” on page 55.)
- Check and adjust governor. (See “Adjust Slow Idle Speed” on page 55.)
- Adjust slow idle speed. (See “Adjust Slow Idle Speed” on page 55.)
- Adjust fast idle speed. (See “Adjust Fast Idle Speed” on page 56.).
- Check pulser coil. (See “Test Pulser Coil - Gasoline Engine” on page 561.)
- Test Ignition coil. (See “Test Ignition Coil - Gasoline Engine” on page 562.)
- Check and adjust valve clearance. (See “Check and Adjust Valve Clearance” on page 58.)
- Check cylinder compression. (See “Check Compression” on page 57.)
- Check carburetor float operation and adjustment. (See “Carburetor - Float Level Adjustment” on page 92.)
- Check cylinder head for flatness. Clean the combustion chamber. (See “Remove and Install Cylinder Head” on page 94.)

Diagnosis

Symptom: Engine Cranks but Will Not Start.

(1) Is battery voltage within 11.8-13.2 volts?

Yes - Go to step (2).

No - Charge and test battery. (See “Charge Battery” on page 542.) (See “Load Test Battery” on page 543.)

(2) Is choke adjusted properly?

Yes - Go to step (4).

No - Adjust choke. (See “Adjust Choke Cable” on page 55.)

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

Yes - Go to step (4).

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

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

Yes - Go to step (5).

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

No - Check for plugged air cleaner.

No - Check float level for proper adjustment. (See “Remove and Install Carburetor” on page 89.)

(5) The ignition system should produce a steady, strong blue spark. (See “Test Spark” on page 54.) Is the spark weak or no spark at all?

Yes - Go to step (6).

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

(6) Disconnect white wire at terminal of each ignition coil. Test wires for infinite resistance with key switch in RUN and START positions. Does meter show infinite resistance?

Yes - Go to step (7).

No - Repair short circuit as required.

(7) Do ignition coils test OK? (See “Test Ignition Coil - Gasoline Engine” on page 548.)

Yes - Go to step (8).

No - Replace ignition coil(s).

Symptom: Engine Cranks but Will Not Start.

(8) Is air gap between pulser coils and flywheel within specifications? (See “Remove and Install Pulser Coil” on page 125.)

Yes - Go to step (9).

No - Adjust air gap.

(9) Check flywheel for damage. Inspect magnetic pole plate which is mounted on outer surface of flywheel. Is flywheel with magnetic pole plate in good condition?

Yes - Go to step (10).

No - Replace flywheel. (See “Remove and Install Flywheel” on page 103.)

(10) Is cylinder compression within specification? (See “Check Compression” on page 57.)

Yes - Go to step (11).

No - Repair or replace engine as necessary. (See “Remove and Install Engine” on page 100.) (See “Disassemble and Assemble Cylinder Head and Valves” on page 95.) (See “Inspect Cylinder Head and Valves” on page 96.) (See “Inspect Piston and Connecting Rod” on page 110.)

(11) Is battery voltage present at fuel pump with key switch in RUN and START positions? (See “Power Circuit Operation - Switched” on page 309.)

Yes - Go to step (12).

No - Repair open or short circuit. (See “Run Circuit Operation - Operator On Seat” on page 327.)

(12) Is fuel flow within specifications? (See “Test Fuel Flow - 2500A and 2500E” on page 62.)

Yes - Go to step (13).

No - Follow “Results” of the fuel pressure test procedure.

(13) Is fuel pressure within specifications? (See “Test Fuel Pressure - 2500A and 2500E” on page 62.)

Yes - Go to step (14).

No - Follow “Results” of the fuel pressure test procedure.

(14) Is fuel shutoff solenoid functioning properly? (See “Test Fuel Shutoff Solenoid - Gasoline Engine” on page 557.)

Yes - Go to step (15).

No - Replace fuel shutoff solenoid.

Symptom: Engine Cranks but Will Not Start.

(15) Is carburetor clean and free of any build-up in fuel and air passages? (See "Remove and Install Carburetor" on page 89.)

No - Clean carburetor as necessary.

Symptom: Engine Malfunctions at Low RPM

(1) Is governor linkage adjusted properly? (See "Installation" on page 107.)

Yes - Go to step (2).

No - Adjust governor linkage.

(2) Is choke adjusted properly? (See "Adjust Choke Cable" on page 55.)

Yes - Go to step (3).

No - Adjust choke.

(3) Is slow idle speed adjusted properly? (See "Adjust Slow Idle Speed" on page 55.)

Yes - Go to step (4).

No - Adjust slow idle speed.

(4) Does the ignition system produce a steady, strong blue spark. (See "Test Spark" on page 54.)

Yes - Go to step (5).

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

(5) Is engine coolant temperature within normal operating range - engine not overheating?

Yes - Go to step (6).

No - Check for properly tensioned fan belt.

No - Find and repair cause of cooling system malfunction.

(6) Is cylinder compression within specification? (See "Check Compression" on page 57.)

Yes - Go to step (7).

No - Repair or replace engine as necessary. (See "Remove and Install Engine" on page 100.) (See "Disassemble and Assemble Cylinder Head and Valves" on page 95.) (See "Inspect Cylinder Head and Valves" on page 96.) (See "Inspect Piston and Connecting Rod" on page 110.)

(7) Are valves properly adjusted? (See "Check and Adjust Valve Clearance" on page 58.)

Yes - Go to step (8).

No - Adjust valve clearance.

Symptom: Engine Malfunctions at Low RPM

(8) Are carburetor/throttle body and intake manifold flanges properly sealed - no air leaks.?

Yes - Go to step (9).

No - Seal flanged surfaces as required. (See "Remove and Install Carburetor" on page 89.) (See "Remove and Install Intake Manifold" on page 92.)

(9) Is carburetor clean and free of any build-up in fuel and air passages? (See "Remove and Install Carburetor" on page 89.)

Yes - Go to step (10).

No - Clean carburetor as necessary.

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

No - Repair as necessary. (See "Remove Governor Assembly" on page 124.) (See "Install Governor Assembly" on page 124.)

Symptom: Engine Malfunctions at High RPM

(1) Is choke adjusted properly? (See "Adjust Choke Cable" on page 55.)

Yes - Go to step (2).

No - Adjust choke.

(2) Is governor spring in good condition?

Yes - Go to step (3).

No - Replace governor spring.

(3) Is fast idle speed adjusted properly? (See "Adjust Fast Idle Speed" on page 56.)

Yes - Go to step (4).

No - Adjust fast idle speed.

(4) Does the ignition system produce a steady, strong blue spark. (See "Test Spark" on page 54.)

Yes - Go to step (5).

No - Follow "Results" of the test spark procedure. Go to step (5) if problem continues.

(5) Do ignition coils test OK? (See "Test Ignition Coil - Gasoline Engine" on page 548.)

Yes - Go to step (6).

No - Replace ignition coil(s).

Symptom: Engine Malfunctions at High RPM

(6) Is engine coolant temperature within normal operating range - engine not overheating?

Yes - Go to step (7).

No - Check for properly tensioned fan belt.

No - Find and repair cause of cooling system malfunction.

(7) Is cylinder compression within specification? (See “Check Compression” on page 57.)

Yes - Go to step (8).

No - Repair or replace engine as necessary. (See “Remove and Install Engine” on page 100.) (See “Disassemble and Assemble Cylinder Head and Valves” on page 95.) (See “Inspect Cylinder Head and Valves” on page 96.) (See “Inspect Piston and Connecting Rod” on page 110.)

(8) Are valves properly adjusted? (See “Check and Adjust Valve Clearance” on page 58.)

Yes - Go to step (9).

No - Adjust valve clearance.

(9) Is fuel flow within specifications? (See “Test Fuel Flow - 2500A and 2500E” on page 62.)

Yes - Go to step (10).

No - Follow “Results” of the fuel pressure test procedure.

(10) Is fuel pressure within specifications? (See “Test Fuel Pressure - 2500A and 2500E” on page 62.)

Yes - Go to step (11).

No - Follow results of the fuel pressure test procedure.

(11) Is float level in carburetor properly adjusted? (See “Carburetor - Float Level Adjustment” on page 92.)

Yes - Go to step (12).

No - Adjust float level.

(12) Are carburetor/throttle body and intake manifold flanges properly sealed—no air leaks.?

Yes - Go to step (13).

No - Seal flanged surfaces as required. (See “Remove and Install Carburetor” on page 89.) (See “Remove and Install Intake Manifold” on page 92.)

Symptom: Engine Malfunctions at High RPM

(13) Is carburetor clean and free of any build-up in fuel and air passages? (See “Remove and Install Carburetor” on page 89.)

Yes - Go to step (14).

No - Clean carburetor as necessary.

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

No - Repair as necessary. (See “Remove Governor Assembly” on page 124.) (See “Install Governor Assembly” on page 124.)

Symptom: Excessive Oil Consumption

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

Yes - Go to step (2).

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

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

Yes - Go to step (3).

No - Drain excessive engine oil.

(3) Are the breather valves functioning properly?

Yes - Go to step (4).

No - Clean or replace breather valve(s). (See “Crankcase Breather Operation” on page 44.)

(4) Is cylinder compression within specification? (See “Check Compression” on page 57.)

Yes - Go to step (5).

No - Repair or replace engine as necessary. (See “Remove and Install Engine” on page 100.) (See “Disassemble and Assemble Cylinder Head and Valves” on page 95.) (See “Inspect Cylinder Head and Valves” on page 96.) (See “Inspect Piston and Connecting Rod” on page 110.)

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

Yes - Go to step (6).

No - Clear obstructions from drain in breather chamber.

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

No - Clean oil ring grooves. (See “Inspect Piston and Connecting Rod” on page 110.)

Symptom: Engine Overheats

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

Yes - Go to step (2).

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

(2) Are radiator and screens clear of debris?

Yes - Go to step (3).

No - Clean radiator and screens of debris.

(3) Are radiator fins properly positioned and radiator coolant passages free of kinks and bends?

Yes - Go to step (4).

No - Repair or replace radiator as needed. (See "Inspect Radiator" on page 79.) (See "Remove and Install Radiator" on page 77.)

(4) Is coolant filled to proper level?

Yes - Go to step (5).

No - Fill coolant to proper level. Check for leaks. (See "Test Cooling System" on page 66.)

No - Check overflow tube for obstructions.

(5) Are passages inside radiator clean and free of any restrictions?

Yes - Go to step (6).

No - Flush, repair or replace radiator as needed. (See "Remove and Install Radiator" on page 77.)

(6) Is fan shroud installed and in good condition?

Yes - Go to step (7).

No - Install or repair fan shroud as needed.

(7) Is fan belt in good condition and properly tensioned? (See "Check and Adjust Fan Belt Tension" on page 63.)

Yes - Go to step (8).

No - Adjust or replace fan belt.

(8) Are coolant hoses in good condition and not collapsing during engine operation?

Yes - Go to step (9).

No - Replace coolant hose(s).

Symptom: Engine Overheats

(9) Is there any internal or external coolant leakage? Check for presence of coolant in crankcase and intake manifold. Check radiator, hoses, thermostat housing, intake manifold and water pump area for leakage due to worn or damaged seal(s), loose stud bolts and cap screws or cracked housings/castings. (See "Test Cooling System" on page 66.)

Yes - Go to step (10).

No - Repair as necessary.

(10) Is thermostat operating normally? (See "Test Thermostat" on page 65.)

Yes - Go to step (11).

No - Replace thermostat. (See "Remove and Install Thermostat" on page 73.)

(11) Is coolant pump operating properly?

Yes - Go to step (12).

No - Replace coolant pump. (See "Remove and Install Coolant Pump" on page 75.)

(12) Are coolant system component gaskets properly installed and not obstructing any passages?

Yes - Go to step (13).

No - Replace affected gasket with correct gasket.

(13) Is head gasket preventing cylinder compression pressure from entering coolant system? (See "Radiator Bubble Test" on page 64.)

No - Repair as needed. (See "Remove and Install Cylinder Head" on page 94.) (See "Inspect Cylinder Head and Valves" on page 96 to inspect cylinder head for distortion.)

Symptom: Excessive Fuel Consumption

(1) Is choke adjusted properly?

Yes - Go to step (2).

No - Adjust choke. (See "Adjust Choke Cable" on page 55.)

Symptom: Excessive Fuel Consumption

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

Yes - Go to step (3).

No - Check for plugged air cleaner.

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

No - Check float level for proper adjustment. (See “Carburetor - Float Level Adjustment” on page 92.)

(3) The ignition system should produce a steady, strong blue spark. (See “Test Spark” on page 54.) Is the spark weak or no spark at all?

Yes - Go to step (4).

No - The ignition system is operating satisfactorily. Go to step (5).

(4) Do ignition coils test OK? (See “Test Ignition Coil - Gasoline Engine” on page 548.)

Yes - Go to step (5).

No - Replace ignition coil(s).

(5) Is cylinder compression within specification? (See “Check Compression” on page 57.)

Yes - Go to step (6).

No - Repair or replace engine as necessary. (See “Remove and Install Engine” on page 100.) (See “Disassemble and Assemble Cylinder Head and Valves” on page 95.) (See “Inspect Cylinder Head and Valves” on page 96.) (See “Inspect Piston and Connecting Rod” on page 110.)

Symptom: Excessive Fuel Consumption

(6) Is slow idle speed adjusted properly? (See “Adjust Slow Idle Speed” on page 55.)

Yes - Go to step (7).

No - Adjust slow idle speed.

(7) Is fast idle speed adjusted properly? (See “Adjust Fast Idle Speed” on page 56.)

Yes - Go to step (8).

No - Adjust fast idle speed.

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

No - Torque cylinder head cap screws. (See “Remove and Install Cylinder Head” on page 94.)

Tests and Adjustments

Test Spark

Reason

To test the overall condition of the ignition system.

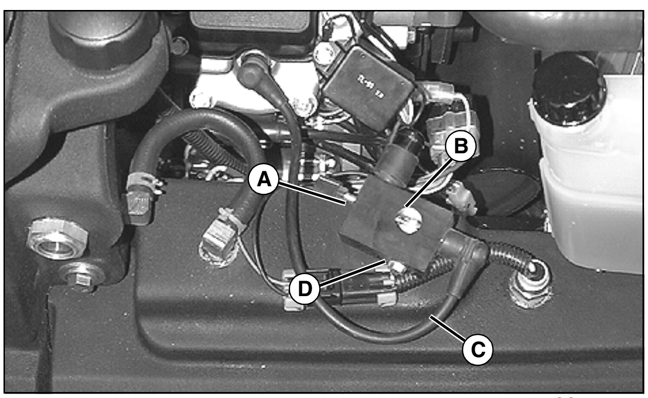
Special or Required Tools

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

Procedure

1. Park machine on a level surface.
2. Move key switch to STOP position.
3. Engage parking brake.
4. Mow/transport lever in TRANSPORT position.
5. Raise cowling.

NOTE: 2500E requires the 48V alternator to be removed to access the right-hand spark plug. (See "Remove and Install 48V Alternator" on page 73.)



M98778

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

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

9. Adjust spark tester gap to 4.2 mm (0.166 in.) (4 turns) with screw (D).
10. Move key switch to START position.
11. Crank engine and watch spark at spark tester. If engine will start, watch spark (B) with engine running. A steady, strong, blue spark should be observed.

Results

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

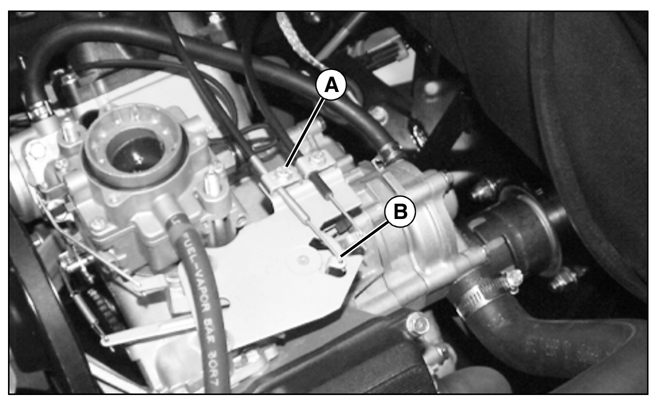
Adjust Throttle Cable

Reason

To ensure that the throttle control arm is adjusted properly to ensure correct engine speed settings.

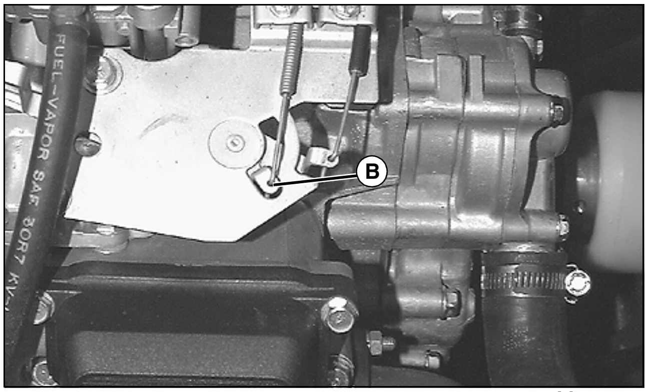
Procedure

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.
5. Remove air cleaner assembly. (See "Remove and Install Air Cleaner" on page 80.)
6. Move throttle lever to SLOW idle position.



M98475

7. Loosen throttle cable clamp (A).



M98618

8. Push throttle arm (B) against the edge of the opening.

9. Tighten the cable clamp.

10. Move throttle control lever through full range to be sure linkage is not binding.

11. Install air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)

Adjust Choke Cable

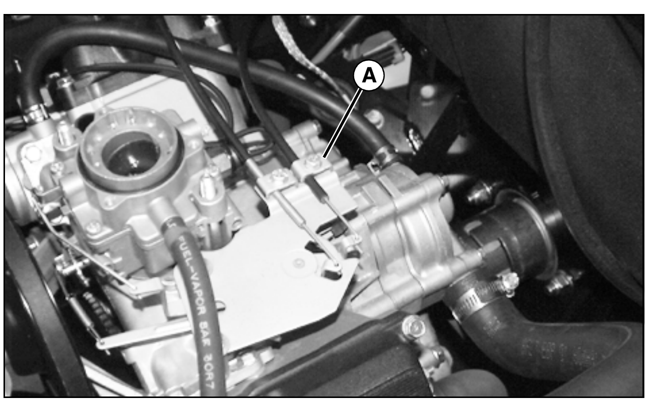
Reason

To make sure the choke plate is fully closed when the throttle control lever is in the full choke position and does not stay partially closed when throttle contact lever is in FAST idle position.

Procedure

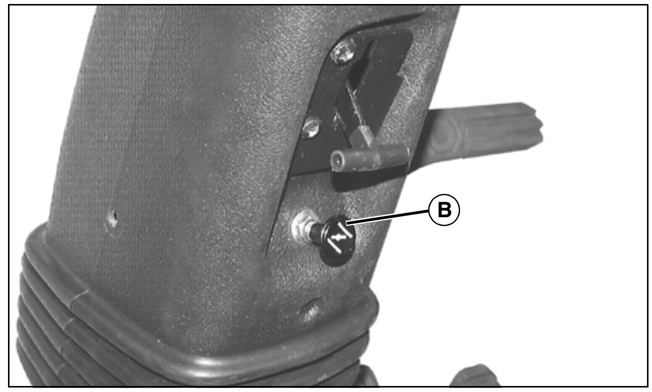
NOTE: Adjust throttle cable before adjusting choke.

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.
5. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



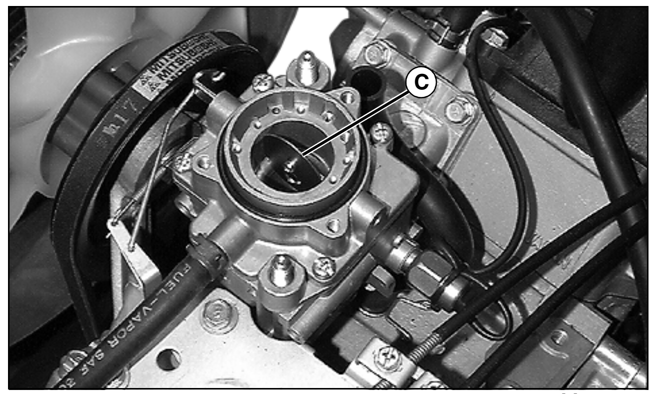
M98475

6. Loosen choke cable clamp (A).



m98619

7. Push choke knob (B) in (choke OFF position).



M98620

8. Check to make sure the choke plate (C) is in the full open position.

9. Tighten choke cable clamp.

10. Cycle choke knob in and out and observe choke plate movement. The choke plate should open and close fully.

11. Install air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)

Adjust Slow Idle Speed

CAUTION: Avoid Injury! DO NOT attempt to adjust the carburetor unless you are a factory trained technician with authorization to service CARB/EPA Certified engines.

Reason

To set engine SLOW idle mixture and rpm. This insures the engine meets the CARB/EPA emissions requirements.

Special or Required Tools

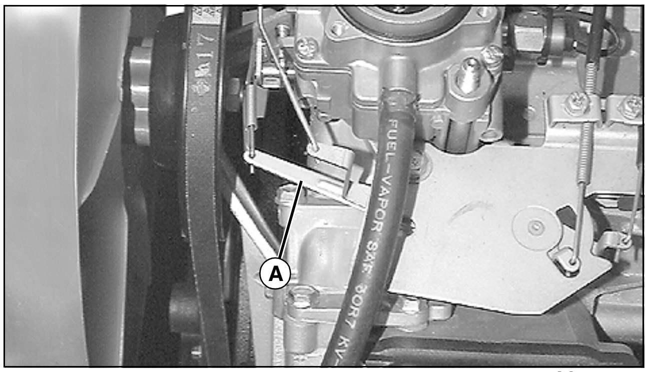
Tool Name	Tool No.	Tool Use
Pulse Tachometer	JT07270	Used to measure engine speed.

Procedure

NOTE: The throttle and choke cables should be adjusted before adjusting the slow idle speed.

DO NOT perform this adjustment with the air cleaner removed. Air cleaner removed for photo clarity only.

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.



M98621

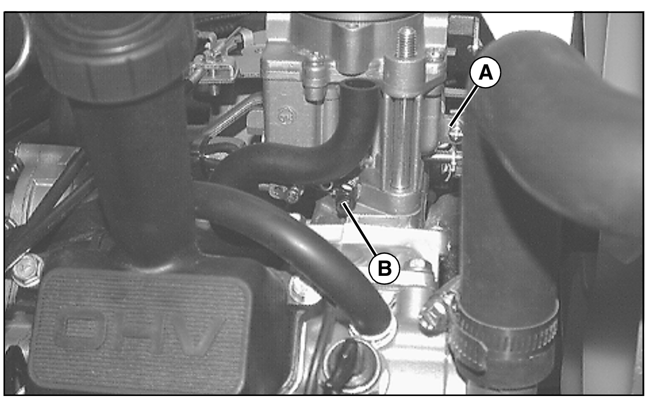
5. Ensure governor arm and shaft are properly adjusted.

   a. Loosen governor arm clamp screw nut.

   b. Rotate governor arm (A) counterclockwise to fully open throttle plate.

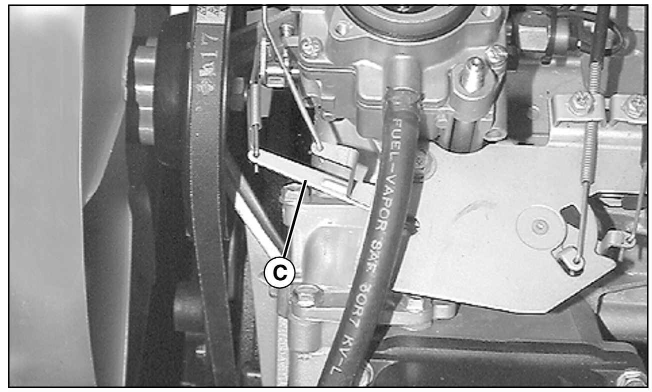
   c. Rotate governor shaft counterclockwise to the end of its travel.

   d. Tighten clamp screw nut to specification.



M98615

6. Turn idle mixture screw (B) in (clockwise) until it seats against the carburetor body.
7. Back the screw out approximately 5/8 of a turn.
8. Start and run engine for five minutes to bring the engine up to operating temperature.
9. Hold a JT07270 Digital Pulse Tachometer at spark plug lead.
10. Move throttle lever to slow idle position.



M98621

11. Hold governor arm (C) closed (push toward carburetor).
12. Turn idle stop screw (A) on carburetor until slow idle speed meets specification.
13. Continue holding the governor arm in the closed position, and adjust the slow idle mixture screw in or out until the engine reaches its highest speed; then turn the idle mixture screw out (counterclockwise) 1/8 of a turn.
14. Repeat steps 10-12 to verify slow idle speed.
15. Perform FAST IDLE SPEED ADJUSTMENT.

Specifications

Slow Idle Speed .1550 ± 100 rpm
Governor Clamp Screw Nut Torque . 7.8 N•m (69 lb-in.)

Adjust Fast Idle Speed

Reason

To set engine FAST idle rpm.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Pulse Tachometer	JT07270	Used to measure engine speed.

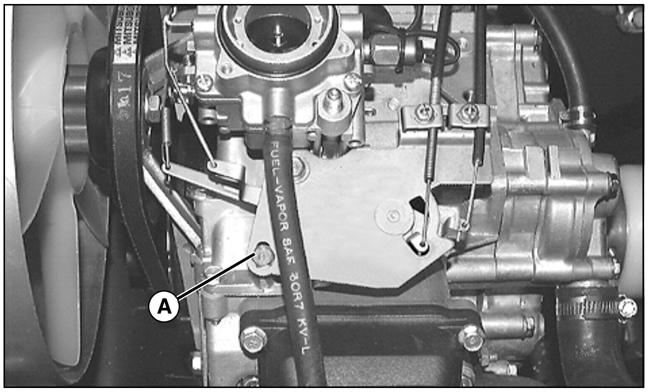
Procedure

NOTE: DO NOT perform this adjustment with the air cleaner removed. Air cleaner removed for photo clarity only.

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.
5. Start and run engine at MEDIUM idle for five minutes to bring the engine up to operating temperature.

6. Move throttle control lever to FAST idle position.

7. Hold a JT07270 Digital Pulse Tachometer at spark plug lead and check fast idle speed. Fast idle should be to specification. If adjustment is needed, proceed to step 8.



M98622

8. Loosen two throttle plate mounting cap screws (A).

9. Move the throttle plate mounting cap screws.

10.Tighten throttle place mounting cap screws to specification.

Specifications

Fast Idle Speed . . . . .3600 rpm
Throttle Plate Mounting Cap Screw . . . 8 N•m (71 lb-in.)

Check Compression

Reason

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Compression Gauge	JDM59	Used to measure engine cylinder pressure.

Procedure

1. Run engine for five minutes to bring engine to operating temperature.

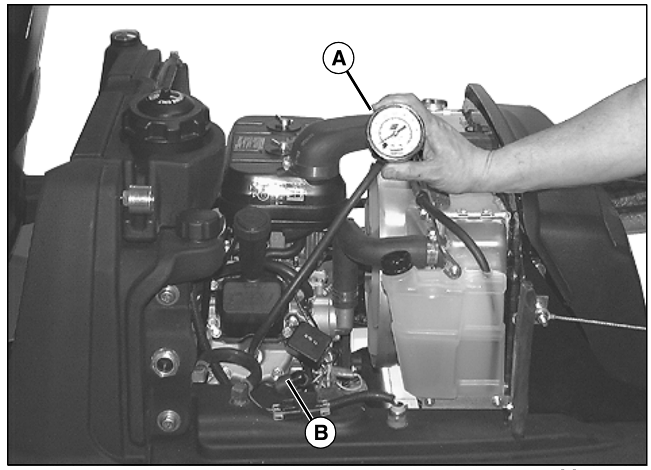
2. Park machine on level surface.

3. Turn key switch to STOP position.

4. Engage parking brake.

5. Raise cowling.

6. Remove both spark plugs.



M98479

7. Install JDM59 Compression Gauge (A) in spark plug hole.

8. Ground high tension leads (B) or disconnect positive lead from ignition coil.

9. Move throttle control lever to FAST idle position.

10.Crank engine for three to five compression strokes.

11.Record pressure reading.

12.Repeat test with other cylinder. Compression should read to specifications.

Specifications

Minimum Compression . . . . 1171 kPa (170 psi)
Maximum Pressure Between Cylinders . 97 kPa (14 psi)

Results

NOTE: Above specification is for an engine that has sufficient time to allow rings to fully seat.

Compression that is lower than specifications on low-hour machines (but relatively equal on both cylinders) probably does not indicate a problem.

- If pressure readings are above specification, adjust valves and check fuel and intake air systems. Check exhaust for restriction.
- If pressure readings are below specification, squirt clean engine oil into cylinders and repeat test.
    - If pressure increases significantly, check piston rings and cylinder walls for wear or damage.
    - If pressure does NOT increase after retest, check for leaking valves, valve seats or cylinder head gaskets.

Check and Adjust Valve Clearance

Reason

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

Special or Required Tools

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

Check Procedure

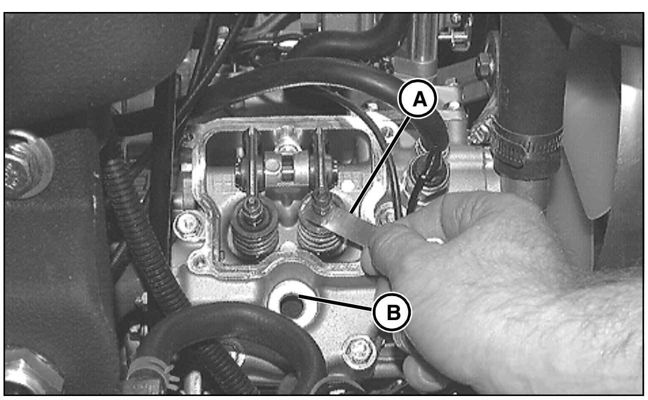
IMPORTANT: Avoid damage! Perform adjustment when engine is cold.

NOTE: Check valve clearance for each cylinder separately.

1. Park machine on a level surface.
2. Move key switch to STOP position. Allow engine to cool.
3. Engage park brake.
4. Raise cowling.

NOTE: 2500E requires the 48V alternator to be removed to access the right-hand spark plug. (See "Remove and Install 48V Alternator" on page 73.)

5. Remove spark plug.
6. Remove rocker arm covers. (See "Remove and Install Rocker Arm Covers" on page 93.)



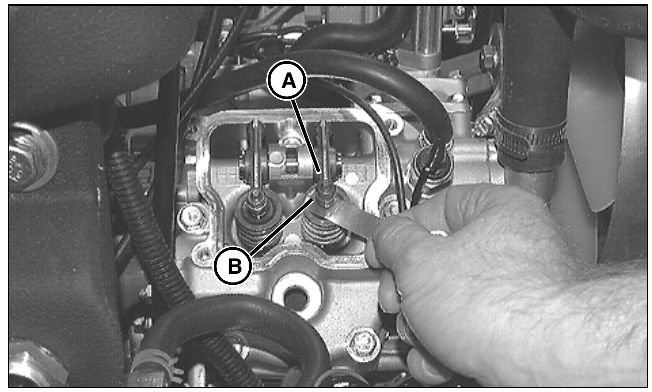
M98623

7. Turn crankshaft until piston, visible in spark plug hole (B), is at Top Dead Center (TDC) of the compression stroke (both intake and exhaust valves will be closed).
8. Use a blade-type feeler gauge (A) to measure valve clearance. Valve clearance should be to specification.
9. Repeat steps 7-8 for remaining rocker arms.

Check Procedure Results

If valve clearance does not meet the specifications, perform "Adjustment Procedure" on page 58.

Adjustment Procedure



M98623

1. Hold rocker arm adjustment screw (A) and loosen jam nut (B).
2. Turn adjustment screw until clearance is to specification.
3. Tighten the jam nut while holding the adjustment screw.
4. Recheck valve clearance after tightening locknut.
5. Repeat steps 1-4 with remaining valves.

Specifications

Intake Valve Clearance . . . . 0.25 mm (0.01 in.)
Exhaust Valve Clearance. . . . . 0.25 mm (0.01 in.)

Test Crankcase Vacuum

Reason

To check operation of the breather and condition of seals, gaskets, rings, pistons, and cylinder walls.

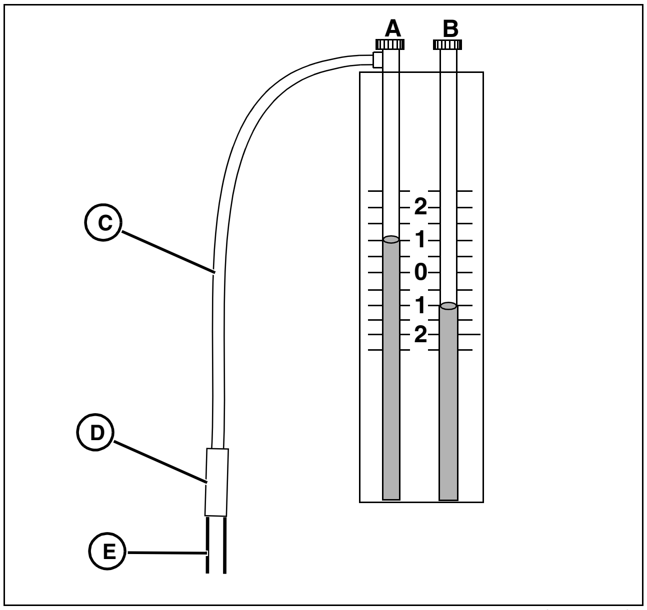
Special or Required Tools

Tool Name	Tool No.	Tool Use
U-Tube Manometer Kit	JT05698	Crankcase vacuum measurement.

Procedure

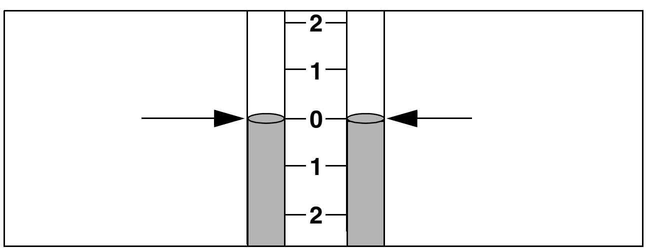
1. Park machine on a level surface.
2. Move key switch to OFF position.
3. Engage park brake.
4. Raise cowling.
5. Remove dipstick and install appropriate plug from U-tube manometer kit.
6. Attach manometer magnets to solid metal surface.

IMPORTANT: Avoid damage! Attaching manometer to engine before starting engine will cause all of the water in the manometer to be drawn into the engine crankcase. DO NOT use more than 914 mm (3 ft) of manometer tubing. If a longer hose is used the manometer readings will be inaccurate. Some units require a rubber hose (adapter) using clamps to fit the dipstick opening.



MIF(M85864)

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



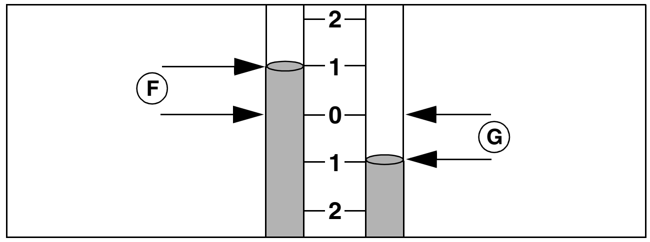
MIF

8. Set the manometer to zero by sliding the ruled scale up or down so “0” mark is located where water level on both sides is even.

9. Start and run engine at FAST idle.

10.Allow engine to reach operating temperature.

11.Quickly remove engine dipstick and attach hose from manometer to dipstick opening.



MIF

12.Record vacuum reading. The reading is obtained by adding (F and G) water movement from “0”. In this case reading would be 2 inches of vacuum (1 inch + 1 inch). Reading from (F) should always be above the “0” mark. If reading from (F) (actual crankcase vacuum) is below the “0” mark, then crankcase is pressurized, causing seals to leak oil.

13.Repeat test at least three times for accuracy.

DO NOT shut off engine. To repeat test, remove the manometer tube from top of manometer valve (A). DO NOT remove manometer tube from engine. Reset manometer at zero (see step 8). Reattach manometer tube (C) to valve (A) and record reading.

14.Remove tube (C) from manometer valve (A), before stopping engine. Then remove plug (E) from oil fill opening and install oil fill cap.

Specifications

Fast Idle. . . . . .3600 rpm

Results

If crankcase vacuum reading is greater than specification, check the following:

- Crankcase breather clogged or inoperative
- Seals and gaskets for leakage, including rocker arm cover gasket (loose or improperly tightened fasteners)
- Valve and valve seats for wear or damage
- Rings, piston, and cylinder bore for wear or damage

Specifications

Crankcase Vacuum (Max,
in Water Movement) . . . . 18 cm (7 in.)

Test Engine Oil Pressure

Reason

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

Special or Required Tools

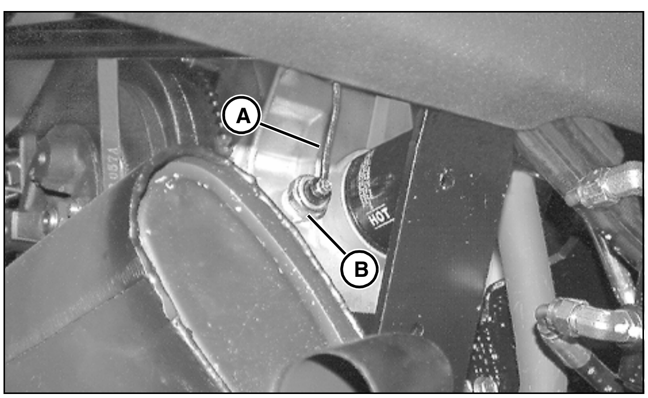
Tool Name	Tool No.	Tool Use
Pressure Gauge Assembly	JT03344	Used to measure engine oil pressure.
Connector	JT03349	Used to attache hose to engine.
Hose Assembly	JT03017	Used to connect gauge to connector.

Procedure - Preliminary Check

1. Park machine on level surface and engage park brake.
2. Turn key switch to STOP. Allow engine to cool.
3. Raise cowling.

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

4. Check engine oil level; bring oil level to full mark.



M98777

5. Disconnect oil pressure switch wiring lead (A) from oil pressure switch (B).
6. Remove oil pressure switch from engine.

IMPORTANT: Avoid damage! The oil pressure switch port in the engine is British Pipe Thread (BPT). Only use JT03349 Connector.

7. Install JT03349 Connector in oil pressure switch port.
8. Connect JT03017 Hose Assembly and JT03344 Pressure Gauge Assembly.

Procedure - Engine Running

IMPORTANT: Avoid damage! If pressure reading is below 69 kPa (10 psi), STOP ENGINE IMMEDIATELY and determine cause.

1. Start and run engine at medium idle for five minutes to heat engine oil to normal operating temperature.
2. Run engine at FAST idle (3600 rpm) and check oil pressure. Gauge should read at least the minimum oil pressure specification.

Results

- If oil pressure reading is BELOW specifications, inspect or replace the following:

- Oil pressure relief valve spring worn or broken.

- Oil pressure relief valve stuck or broken.

- Oil pump worn or damaged.

- Oil pump suction screen or oil passages plugged.

- Connecting rod and main bearing journals excessively worn.

Specifications

Minimum Oil Pressure . . . . 276 kPa (40 psi)

Test Fuel Pump - 2500

Reason:

To check condition of fuel pump.

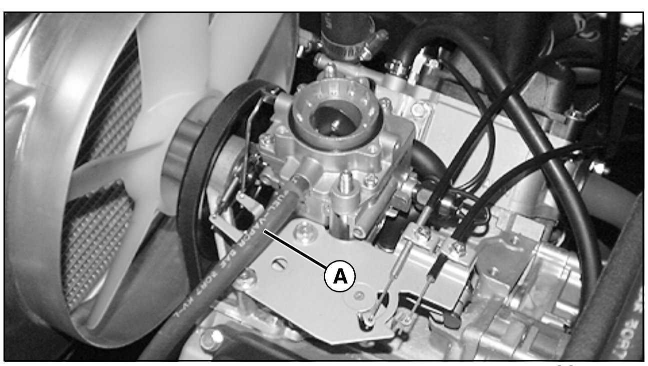
Special or Required Tools

Tool Name	Tool No.	Tool Use
Fuel Pump Pressure Test Kit	JDG356	Used to measure fuel pump outlet pressure.
Graduated Container	NA	Used to catch and measure fuel outlet of fuel pump.

Procedure:

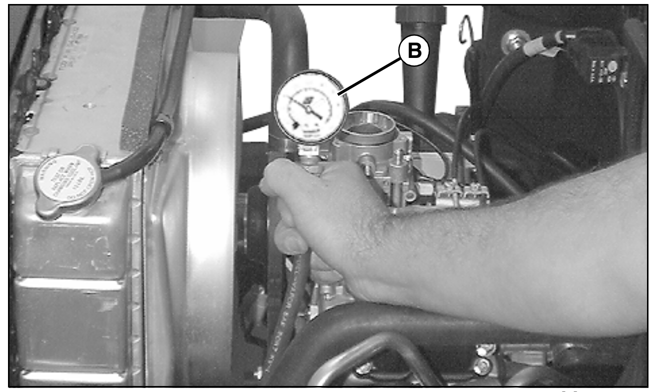
> **CAUTION: Avoid Injury! Gasoline is extremely flammable. Do not smoke. Always work in a ventilated area away from open flame or spark producing equipment: this includes equipment that utilizes pilot lights.**

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.
5. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80).



M98476

6. Disconnect the fuel hose (A) at the carburetor.



M98477

7. Connect pressure gauge (B) to fuel hose.
8. Turn key switch to RUN position. DO NOT start engine.
9. Record pressure reading. Pressure should read to specification.
10. Turn key switch to STOP position.
11. Remove pressure gauge from fuel hose.

M98478

12. Place fuel hose in a graduated container (C).
13. Turn key switch to RUN position. DO NOT start engine.
14. Run fuel pump for 30 seconds.
15. Turn key switch to STOP position.
16. Measure the volume of fuel in the container. The minimum fuel delivery rate should be to specification.

Results:

If fuel pressure and/or flow does not meet specifications, check the following:

- Fuel hoses, filter and fuel tank cap for restrictions.
- Replace fuel filter and/or fuel pump.

Pressure Gauge Reading . . . . 19 kPa (2.76 psi)
Fuel Flow (Min) in 30 Seconds . . . . 180 mL (6.0 oz.)

Test Fuel Flow - 2500A and 2500E

Reason

To check output flow rate of fuel pump.

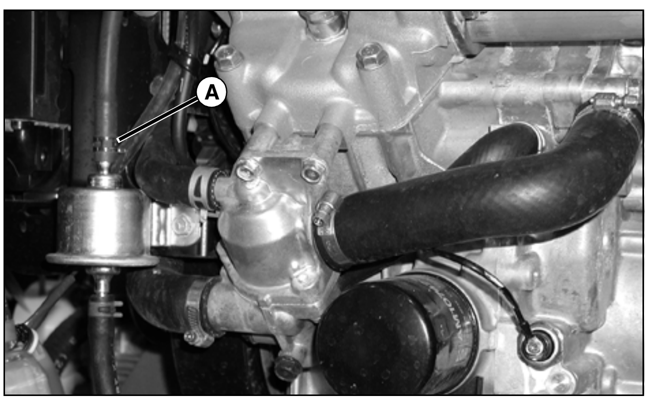
Special or Required Tools

Tool Name	Tool No.	Tool Use
Graduated Container	NA	Used to catch and measure fuel output of fuel pump.

Procedure

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

1. Park machine on a level surface.
2. Move key switch to STOP position.
3. Engage park brake.
4. Raise cowling.
5. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



MX18118

6. Disconnect fuel hose from carburetor.
7. Place fuel hose in a graduated container.
8. Turn key switch to RUN position (do not crank engine) for 30 seconds and catch fuel in container.
9. Run fuel pump for 10 seconds.
10. Turn key switch to STOP position.
11. Measure the volume of fuel in the container. The minimum fuel delivery rate should be to specification.

Results

If fuel flow is below specifications, do the following:

- Check fuel lines, fuel tank pick-up and fuel tank cap for blockage, kinks, or restrictions.
- Replace in-line filter and repeat test. If results are still not satisfactory, replace fuel pump.

Specifications

Fuel Flow (Min) in 30 Seconds . . . . 300 mL (10 oz)

Test Fuel Pressure - 2500A and 2500E

Reason

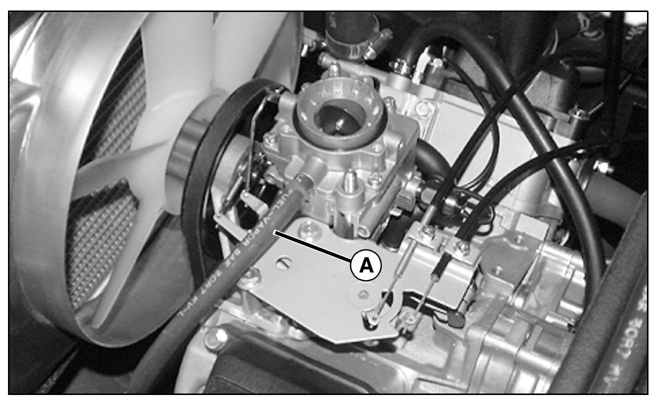
To check output pressure of fuel pump.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Fuel Pump Pressure Test Kit	JDG356	Used to measure fuel pump pressure.

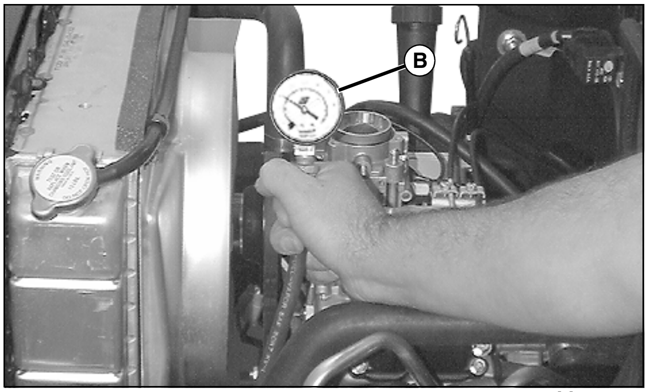
Procedure

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Raise cowling.
5. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



M98476

6. Disconnect fuel hose (A) at the carburetor.



M98477

7. Connect pressure gauge (B) to fuel hose.

8. Turn key switch to RUN position. DO NOT start engine.

9. Record pressure reading. Minimum pressure should be to specification.

10.Turn key switch to STOP position.

Results

- If fuel pressure is below specification, check fuel line screen filter in fuel tank, in-line filter, and hoses for debris or restrictions. Replace filters; then test again.
- If pressure is still below specification, replace fuel pump.

Specifications

Fuel Pressure (Min) . . . . 10 kPa (1.5 psi)

Check and Adjust Fan Belt Tension

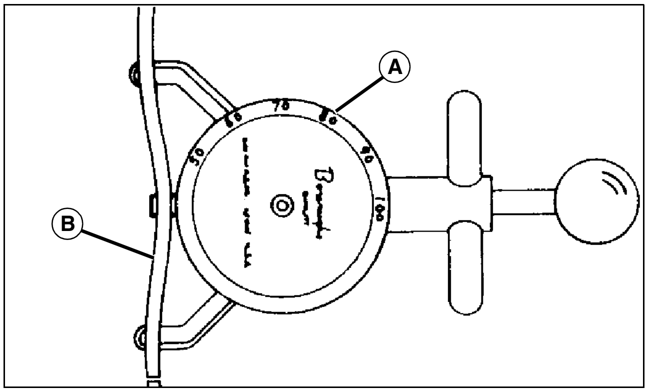
Reason

To keep proper tension on belt to drive cooling fan.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Belt Tension Gauge	JDST28	Used to measure belt tension.

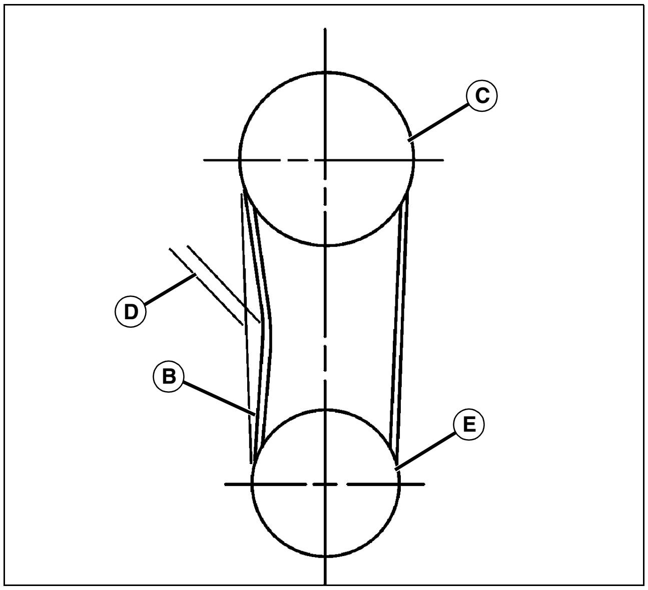
Check Tension



M72914A

1. Measure belt tension with a suitable gauge (A).

2. Follow manufacturer's instructions for use of belt tension gauge. Belt tension is adjusted between specification, which is the manufacturing standard.



M72914B

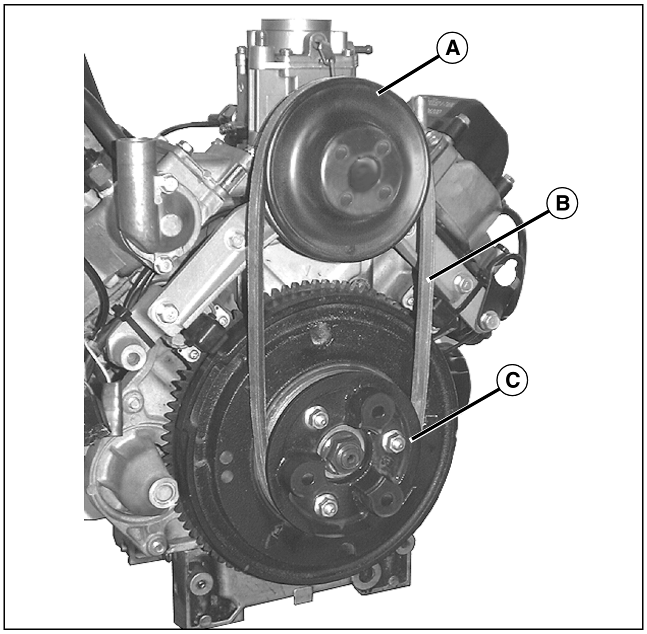
3. If a belt gauge is not available, push belt (B) with your thumb strongly in the middle between top pulley (E) and bottom pulley (C).

4. Measure the slack (D) in belt. Use the following table as a guide.

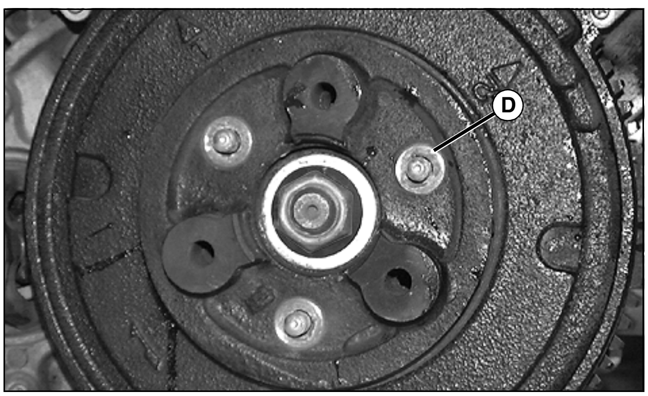
5. If belt tension is less than specified limit, adjust or replace belt.

Adjust Tension

NOTE: Belt tension is adjusted by adding (loosening tension) or removing (tightening tension) shims from between inner and outer halves of bottom pulley.

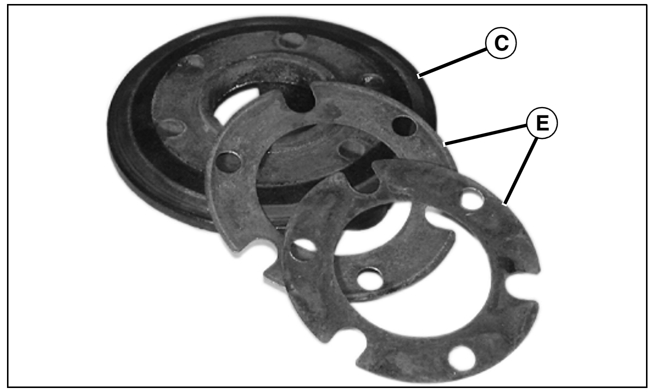


M84678



M84679

1. Remove three nuts and washers (D) from bottom pulley.



M84797

2. Remove outer half of bottom pulley (C) and shims (E) from flywheel.

3. Install or remove shims as required to obtain proper tension.

4. Install shims, belt (B), and outer half of bottom pulley.

NOTE: Slightly rocking fan while tightening pulley nuts will help to prevent belt from being pinched between pulley halves.

5. Tighten pulley nuts.

6. Run engine for a few seconds and recheck tension. Adjust if required.

Specifications

Belt Tension

25 kg (55 lb) . . . . 12 mm (0.47 in.)
40 kg (88 lb) . . . . 9 mm (0.35 in.)

Results

- If deflection is not within specifications, remove outer sheave half of fan drive pulley. Remove shim(s) to increase belt tension or add shim(s) to decrease tension. If proper belt tension cannot obtained, replace belt. (See “Remove and Install Fan Belt - 2500 and 2500A” on page 70 for procedure and component exploded view for adjustment.)

Radiator Bubble Test

Reason

To determine if compression pressure is leaking past head gaskets and into cooling system.

Procedure

1. With coolant at proper level and radiator cap tight, start and run engine to bring it to operating temperature.

2. Remove overflow hose from coolant recovery tank.

3. Put end of hose in a container of water.

4. Check for bubbles coming from hose.

Results

- If bubbles are present, replace head gaskets.

Pressure Test Radiator Cap

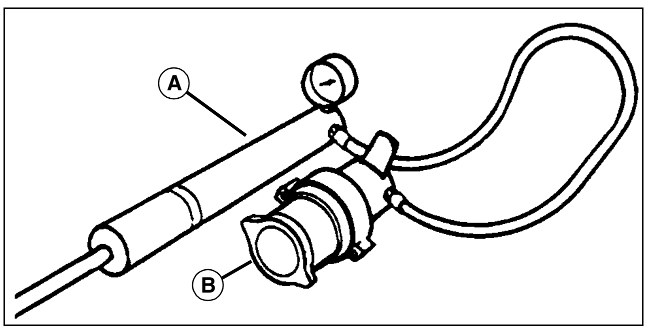
Reason

To test radiator cap for operating in correct pressure range.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to create pressure.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to pressurize radiator cap.

Procedure



T6333AX

1. Wet sealing surfaces of radiator cap (B) and install on D05104ST Cooling System Pressure Pump (A).

2. Apply pressure. Pressure valve in cap should open according to specifications.

Specifications

Relief Valve Opening
Pressure . . . . 73-103 kPa (10.5-15 psi)

Results

- If cap leaks, relieve pressure and retighten cap. Test again. Replace cap if pressure is not within specification.

Test Thermostat

Reason

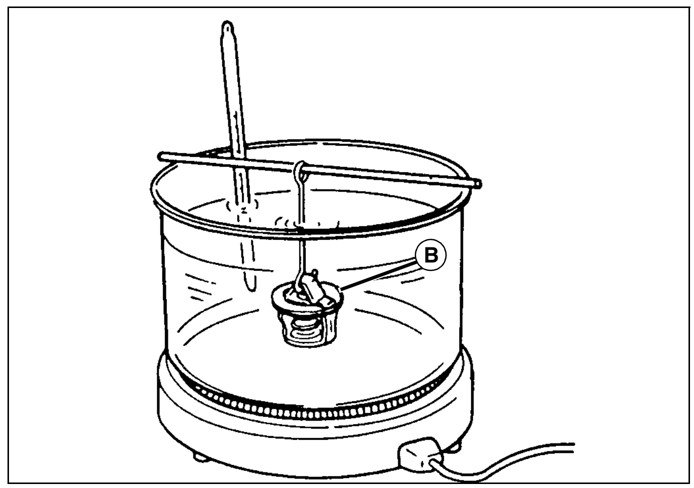
To determine opening temperature of thermostat.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure water temperature.
Glass Container	NA	Used to hold heated water.
Heating Unit	NA	Used to heat water.

CAUTION: Avoid Injury! DO NOT allow thermostat or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if overheated.

Procedure



M82122a

1. Suspend thermostat (B) and a thermometer (A) in a container filled with a water/anti-freeze mixture.

2. Heat and stir the water. Observe opening action of thermostat and compare temperatures with specifications.

3. Remove thermostat and observe its closing action as it cools.

Specifications

Begin Opening . . . . 82°C (180°F)
Fully Open. . . . . 95°C (203°F)

Results

- If thermostat does not open according to specifications, replace.
- If closing action is not smooth and slow, replace thermostat.

Coolant Temperature Switch Test

Reason:

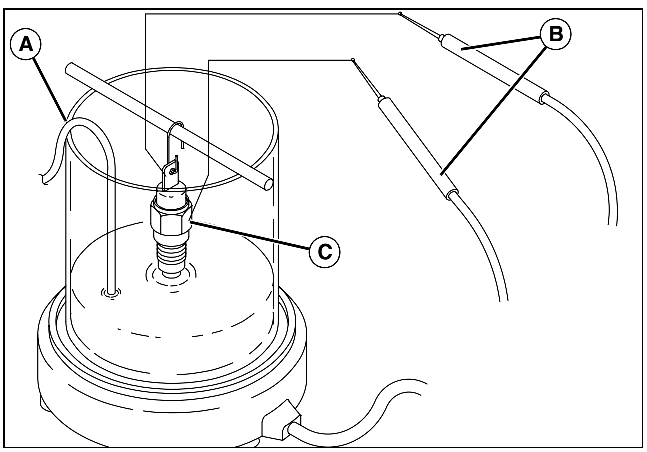
To determine opening temperature of the temperature switch.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Thermometer	JT05800	Used to measure temperature.
Glass Container	NA	Used to hold coolant.
Heating Unit	NA	Used to heat coolant.
Ohmmeter	NA	Used to measure ohms.

Procedure:

CAUTION: Avoid Injury! DO NOT allow thermostat or thermometer to rest against the side or bottom of the glass container when heating water. Either may rupture if overheated.



M83311AE

1. Connect ohmmeter leads (B) to switch (C) terminal and body.

2. Suspend switch in a container filled with a water/ antifreeze (coolant) mixture.

3. Place digital thermometer leads (A) in coolant solution.

4. Heat and stir coolant solution. Observe the temperatures when continuity occurs. Continuity should occur at specification.

5. Remove heat and allow solution to cool. Observe the temperatures when switch opens. The switch should open at specification.

Results:

If switch does perform according to specifications, replace switch.

Test Cooling System

Reason

To inspect cooling system for leaks.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to pressurize cooling system.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to connect pump to radiator.

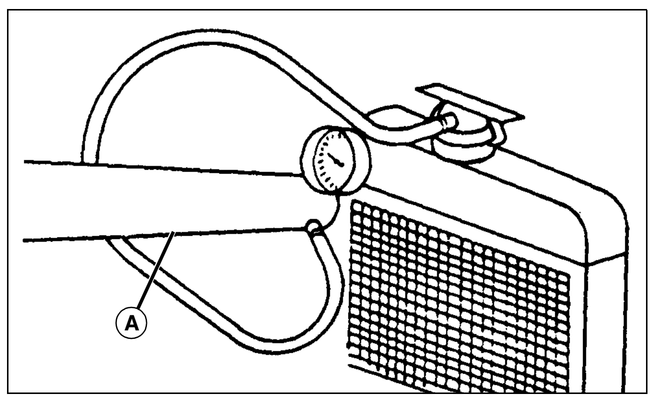
Procedure

1. Park machine on level surface.

2. Turn key switch to STOP position and allow the engine to cool.

3. Engage parking brake.

4. Raise cowling.



T6333AW

5. Remove radiator cap and attach D05104ST Cooling System Pressure Pump (A) to radiator.

6. Apply specified pressure to cooling system. Pressure should hold steady to specification.

Results

- Pressure should hold to specifications. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.

- If leakage continues after all external leaks have been stopped, a defective head gasket, cracked block, or cylinder head may be the cause. (See “Cylinder Leakage Test” on page 67.)

Cylinder Leakage Test

Reason

To determine if compression pressure is leaking from the cylinder.

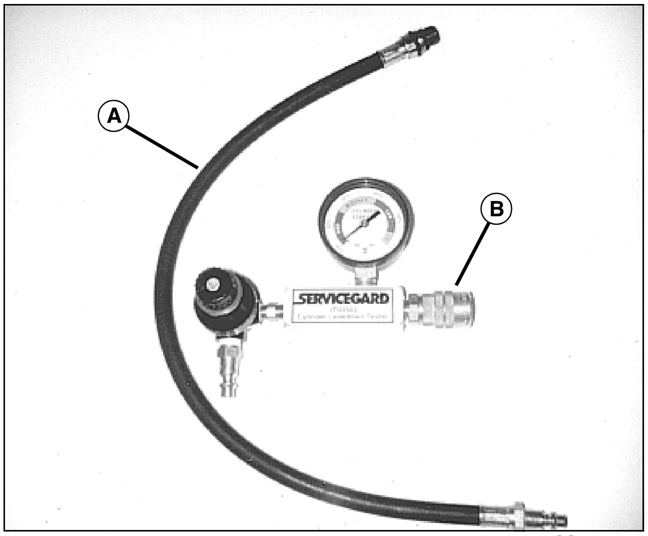
Special or Required Tools

Tool Name	Tool No.	Tool Use
Cylinder Leakdown Test Kit	JT03502	Measure cylinder leakage.

Procedure

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

1. Park machine on level surface.
2. Turn key switch to STOP position.
3. Engage parking brake.
4. Run engine for five minutes to bring to operating temperature.
5. Raise cowling.
6. Remove spark plugs.
7. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)
8. Turn crankshaft until piston, visible in spark plug hole, is at Top Dead Center (TDC) of the compression stroke (both intake and exhaust valves will be closed.) This position must be maintained while testing.



M85931

9. Install hose (A) in spark plug hole of cylinder to be tested.
10. Connect hose to JT03502 Cylinder Leakdown Tester (B).
11. Connect hose from compressed air source to cylinder leakdown tester.
12. Apply maximum air pressure into cylinder.
13. Check for bubbles in recovery tank or air escaping from muffler, air cleaner or oil fill opening.
14. Repeat for other cylinder.

Results

NOTE: All engines will leak air past the piston rings to some extent. Rings are worn if leakage is excessive.

- **If bubbles are present in the coolant overflow bottle,** check for cracks in cylinder head and block. Check for damaged head gasket.
- **If air escapes from muffler,** check for worn exhaust valve.
- **If air escapes from air cleaner,** check for worn intake valve.
- **If air escapes from engine oil dipstick tube,** check for worn piston rings.
- Gauge reading in “low” (green) zone: Piston rings and cylinder in good condition.
- Gauge reading in “moderate” (yellow) zone: Engine is still usable, but there is some wear present. Customer should start planning for overhaul or replacement.
- Gauge reading in “high” (red) zone: Rings and/or cylinder have considerable wear. Engine should be reconditioned or replaced.

Specifications

Air Pressure (Max) . . . . 1379 kPa (200 psi)

Spark Plug Gap Adjustment

Reason

To ensure correct spark plug gap for maximum performance.

Special or Required Tools

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

Procedure

1. Park machine on a level surface.

2. Move key switch to STOP position. Allow engine to cool.
3. Engage park brake.
4. Raise cowling.

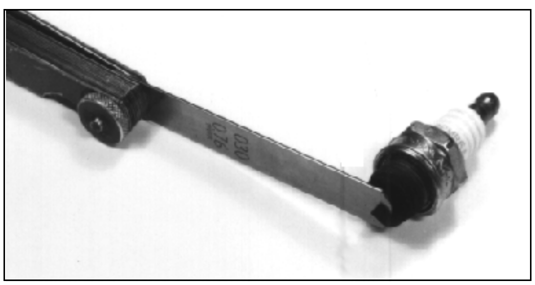
CAUTION: Avoid injury! Engine components are HOT. Be careful not to touch, especially the muffler, while making adjustments. Wear protective eye glasses and clothing.

NOTE: 2500E requires the 48V alternator to be removed to access the right-hand spark plug. (See "Remove and Install 48V Alternator" on page 73.)

5. Remove spark plug.

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

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



M48365

8. Check spark plug gap using a feeler gauge. Set gap to specification.
9. Inspect sealing washer. Replace spark plug if necessary.
10. Install plug and tighten to specification.

Specifications

Spark Plug Gap. . . . . 0.6-0.7 mm (0.024-0.028 in.)
Spark Plug Torque . . . . 25 N•m (221 lb-in.)

Check and Adjust 48V Alternator Drive Belt Tension - 2500E

Reason

To maintain correct alternator drive belt tension.

Special or Required Tools

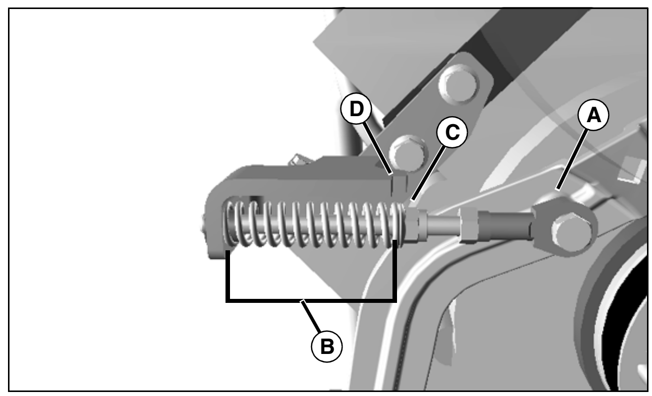
Tool Name	Tool No.	Tool Use
Belt Tension Gauge	JDG529 or JDST28	Used to measure drive belt deflection.
Straightedge	NA	Used to measure drive belt deflection.

Procedure

1. Inspect belt for excessive wear or fraying.

CAUTION: Avoid injury! Idler arm is under load when removing or installing a new belt. Injury can occur if released suddenly. Keep hands and fingers from the surrounding area of the arm.

2. Inspect the grooved side of belt for cracking or abnormal wear. Replace as necessary.



MX20425

3. Inspect ball joint (A) for looseness or abnormal wear.
4. Apply approximately 50 N (11 lb-force) to the belt at the midpoint between the engine pulley and the 48V alternator pulley. Check belt deflection using JDG529 or JDST28 Belt Tension Gauge and a straightedge and compare to specification.
5. Spring length (B) should fall within notch (D). Measure length of spring with belt installed. Compare to specification.
6. If tension adjustment is needed, loosen or tighten nut (C) as required.

Specifications

48V Alternator Drive Belt Deflection at 50 N (11 lb-force) . . . . 30 mm (1.188 in.)
48V Alternator Drive Belt Tension Spring Length . . . . 66-72 mm (2.6-2.8 in.)

Repair

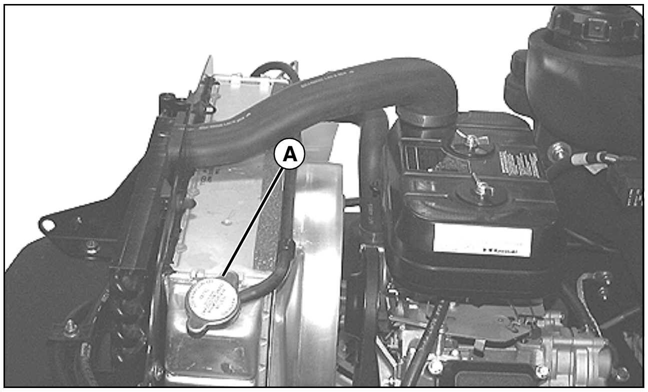
Servicing Cooling System

Draining Cooling System

> **CAUTION: Avoid injury! The radiator will be hot and can burn skin. Built-up pressure may cause explosive release of coolant when the radiator cap is removed:**
>
> - **Shut off the engine and allow to cool.**
> - **Do not remove the cap unless the radiator and the engine are cool enough to touch with bare hands.**
> - **Slowly loosen the cap to the first stop to release all pressure. Then remove the cap.**

1. Park the machine safely. (See “Park Machine Safely” on page 3.)

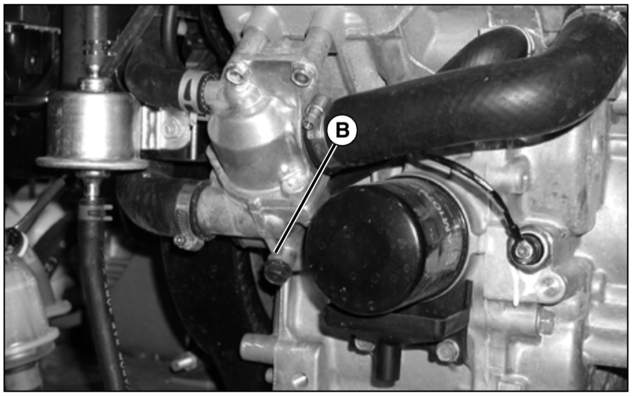
2. Allow engine to cool.



M98521

3. Slowly open radiator cap (A) to the first stop to release all pressure.

4. Close radiator cap tightly.



MX18118

5. Place a drain pan with at least 3 L (3.17 qt) capacity under the engine coolant drain (B). Remove engine coolant drain plug from thermostat housing.

6. When coolant has drained from the recovery tank, remove radiator cap.

7. After all coolant has drained, install engine coolant drain plug.

8. Flush cooling system.

Flushing Cooling System

1. Fill cooling system with clean water and John Deere Cooling System Cleaner, or John Deere Cooling System Quick Flush or an equivalent. Follow directions on the can.

2. Install and tighten radiator cap.

3. Start and run engine until it reaches operating temperature.

4. Stop engine.

> **CAUTION: Avoid injury! The radiator will be hot and can burn skin. Built-up pressure may cause explosive release of coolant when the radiator cap is removed:**
>
> - **Slowly loosen the cap to the first stop to release all pressure. Then remove the drain plug.**

5. Slowly loosen radiator cap to the first stop to release pressure. Remove radiator cap ONLY after all pressure has been released.

6. Remove engine coolant drain plug.

7. Drain cooling system immediately before rust and dirt settle.

8. Install drain plug. Fill system with clean water and repeat steps 3-7.

9. Install engine coolant drain plug and fill cooling system with correct coolant.

Filling Cooling System

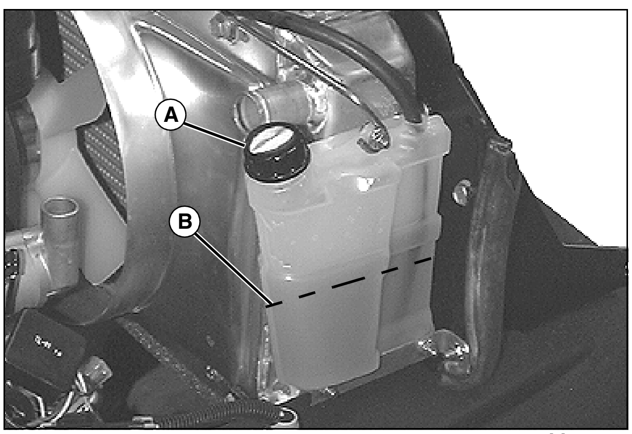
NOTE: John Deere COOL-GARD coolant is recommended when adding new coolant to the cooling system.

Follow the directions on the container for correct mixture ratio.

IMPORTANT: Avoid damage! Using incorrect coolant mixture can damage the radiator:

- **Do not operate engine with plain water.**
- **Use antifreeze approved for use in aluminum engines.**
- **Do not exceed a 50% antifreeze mixture for the coolant.**
- **Do not pour coolant or water into the radiator when the engine is hot.**

1. Allow radiator to cool.
2. Fill cooling system. Cooling system capacity is 2.7 L (2.9 qt).
3. Install and tighten radiator cap.
4. Run engine until it reaches operating temperature.
5. Stop engine.



M98524

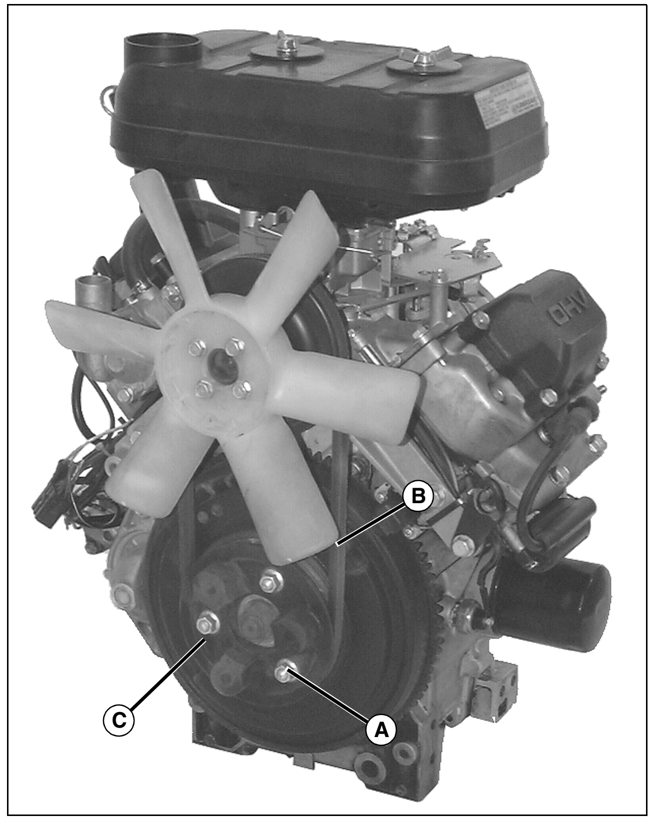
6. Check recovery tank coolant level:
   - Coolant level should be at the lower line (B) on the recovery tank when the engine is cold.
7. Remove cap (A) from recovery tank to add coolant if necessary.

Remove and Install Fan Belt - 2500 and 2500A

Removal

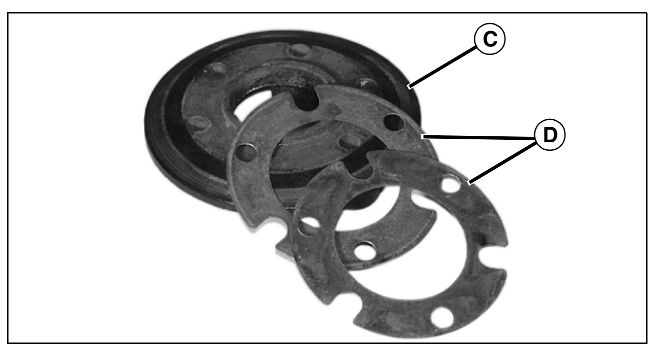
NOTE: Disconnect and remove spark plugs to allow for easy flywheel rotation during outer sheave half installation.

1. Remove spark plugs.



M84660

2. Remove three (3) nuts (A) from bottom pulley.



M84797

3. Remove outer half of bottom pulley (C) and shims (D) from flywheel.
4. Work belt (B) between tips of fan and fan shroud to remove belt.

Installation

1. Install shims, belt, and outer half of bottom pulley.

NOTE: Slightly rocking fan while tightening pulley nuts will help to prevent belt from being pinched between pulley halves.

2. Tighten pulley nuts.
3. Install spark plugs.
4. Run engine for a few seconds. Stop engine and check tension. Adjust if required. (See "Check and Adjust Fan Belt Tension" on page 63)

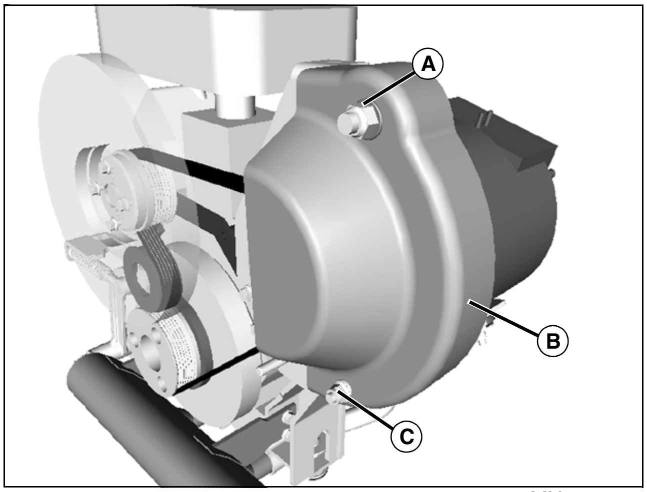
Specifications

Spark Plug Torque . . . . 25 N•m (221 lb-in.)

Remove and Install 48V Alternator Belt - 2500E

Removal

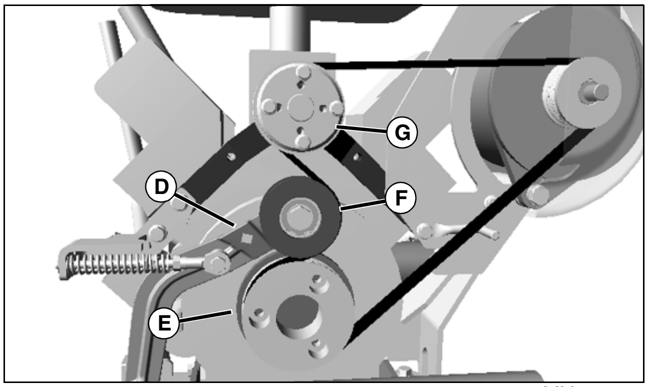
1. Remove key from key switch to prevent engine from being mistakenly started.



MX20331a

2. Remove nut (A), washer, grommet and cap screw.
3. Remove nut (C), washer, grommet and cap screw.
4. Remove belt guard (B).

CAUTION: Avoid injury! Idler arm is under load when removing or installing a new belt. Injury can occur if released suddenly. Keep hands and fingers from the surrounding area of the arm.



MX20420

5. Insert the square drive of a 3/8 in. breaker bar in the square hole (D) of the tensioner arm.
6. Pull on breaker bar to rotate belt tensioner and hold in that position.
7. While holding breaker bar, remove belt from alternator pulley first, then the remaining pulleys. Allow tensioner to rotate to a relaxed position.
8. Work belt between tips of fan and fan shroud to remove belt.
9. Inspect belt for wear, cracking, or other damage. Replace as necessary.

Installation

1. Work belt between tips of fan and fan shroud to install.

IMPORTANT: Avoid damage! Ensure belt is correctly seated in grooves of pulleys. Failure to do so will result in belt damage immediately after engine is started.

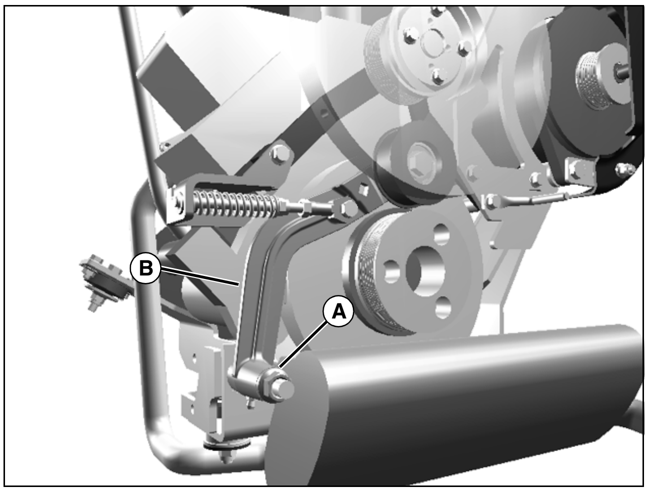
2. Route belt around engine pulley (E), idler pulley (F), and fan pulley (G) as shown.
3. Use a breaker bar to rotate tensioner and hold in place.
4. Install belt over alternator pulley.
5. Install belt guard (B). Install cap screw, grommet, washer, and nut (A) and tighten securely.
6. Install cap screw, grommet, washer, and nut (C) and tighten securely.
7. Run engine for a few seconds. Stop engine and check tension. Adjust if required. See "Check and Adjust 48V Alternator Drive Belt Tension - 2500E" on page 68 in this section.

Remove and Install 48V Alternator Belt Tensioner

Removal

1. Remove alternator belt. (See “Remove and Install 48V Alternator Belt - 2500E” on page 71.)

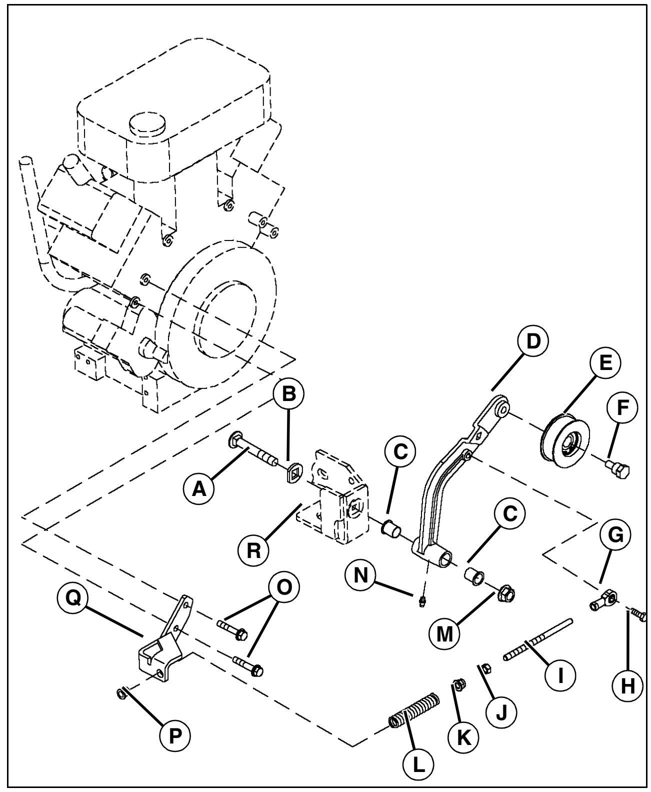
CAUTION: Avoid injury! Engine components are HOT. Be careful not to touch, especially the muffler, while making adjustments. Wear protective eye glasses and clothing.



MX20769

2. Remove locknut (A).
3. Remove tensioner assembly (B).

Inspection



MX20770

A - Carriage Bolt
B - Washer
C - Bushing
D - Bracket
E - Pulley
F - Cap Screw
G - Link End
H - Cap Screw
I - Rod
J - Nut
K - Locknut
L - Spring
M - Locknut
N - Lubrication Fitting
O - Cap Screw
P - Bushing
Q - Bracket

Inspect all parts for wear or damage. Replace as needed.

Inspect fan belt for wear, cracking or glazing. Replace belt as needed.

Installation

Installation is done in reverse order of removal.

- Tighten locknut (M) to specification and back off 1/8 turn. Verify that tensioner pivots freely.
- Adjust belt tension. (See "Check and Adjust 48V Alternator Drive Belt Tension - 2500E" on page 68.)

Specifications

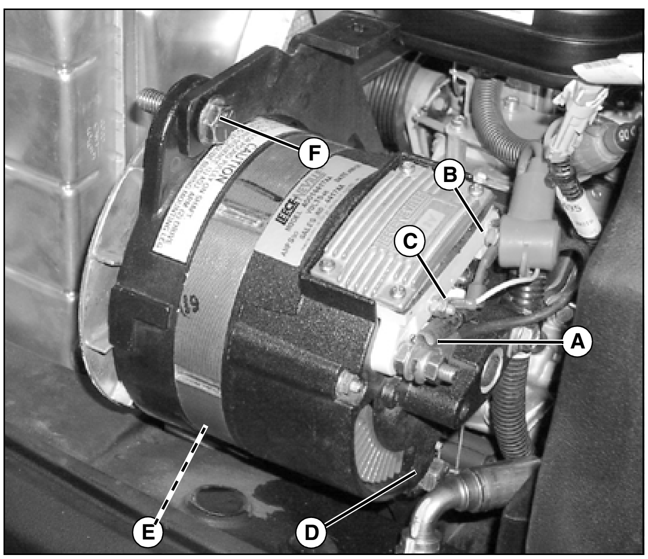
48V Alternator Belt Tensioner Locknut Torque[1] . . . . 74.5 N•m (55 lb-ft)

Remove and Install 48V Alternator

Removal

IMPORTANT: Avoid damage! Always disconnect the negative (-) cable from the battery before working on any electrical components.

1. Disconnect the negative (-) cable from the battery.
2. Remove alternator belt. (See "Remove and Install 48V Alternator Belt - 2500E" on page 71.)



MX20493

3. Remove cap screw (F).
4. Disconnect ground lead (A).
5. Raise the plastic protective cover from the positive (RED) lead (B). Remove the nut and washer, and disconnect the lead from the alternator stud.
6. Disconnect the wire lead (C).
7. Remove mounting cap screws (D and E). Remove alternator.
8. Installation is done in reverse order of removal.

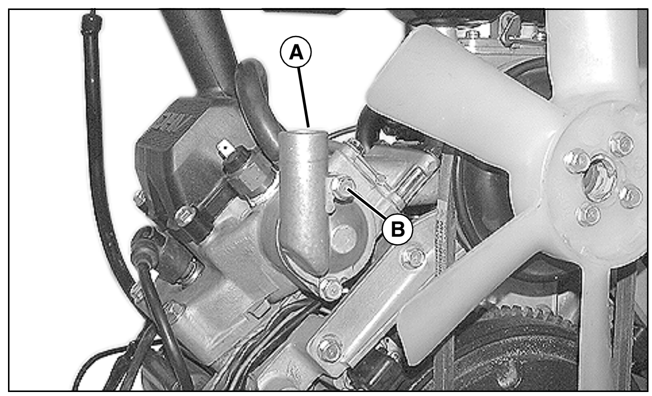
Remove and Install Thermostat

1. Park machine on flat level surface and set park brake.

CAUTION: Avoid Injury! Coolant may be above boiling temperature and under pressure in cooling system. DO NOT remove pressure cap when system is hot. Escaping steam will burn unprotected skin. Always wear protective clothing and goggles when servicing cooling system

2. Allow engine to cool before servicing cooling system. Squeeze top radiator hose to verify the system pressure has dropped before opening radiator cap.
3. Drain engine coolant. (See "Servicing Cooling System" on page 69.)

NOTE: Cooling system capacity is approximately 2.7 L (2.9 qt).



M98547

4. Remove two cap screws (B).
5. Remove housing (A), gasket, and thermostat.
6. Test thermostat. (See "Test Thermostat" on page 65.)

Installation

Installation is done in the reverse order of removal.

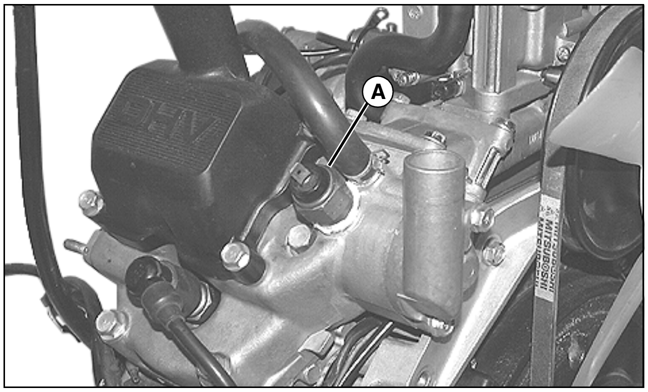
- Clean mating surfaces of thermostat housing and engine block of gasket residue.
- Use new gasket for installation
- Tighten housing cap screws to specification.

Specifications

Thermostat Housing Cap Screw. . . . . 6 N•m (53 lb-in.)

1. *Back off 1/8 turn after tightening to specification.*

Remove and Install Coolant Temperature Switch



M98546

1. Remove switch (A).

2. Test switch. (See “Coolant Temperature Switch Test” on page 66.)

Installation

Installation is done in the reverse order of removal.

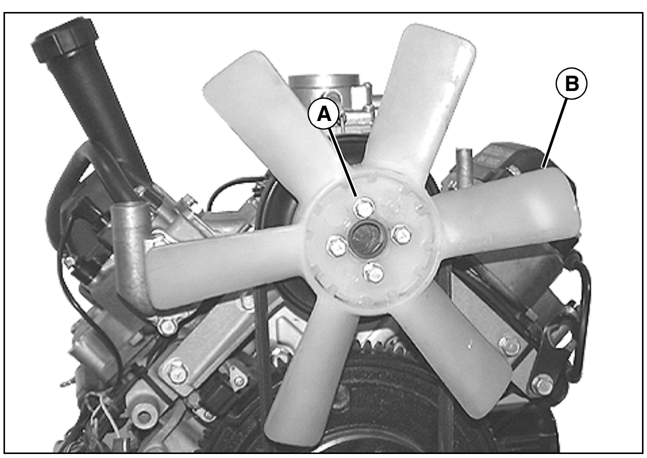
- Apply thread sealant to switch threads before installation.
- Tighten switch to specification.

Specifications

Coolant Temperature Switch . . . . . . 27 N•m (240 lb-in.)

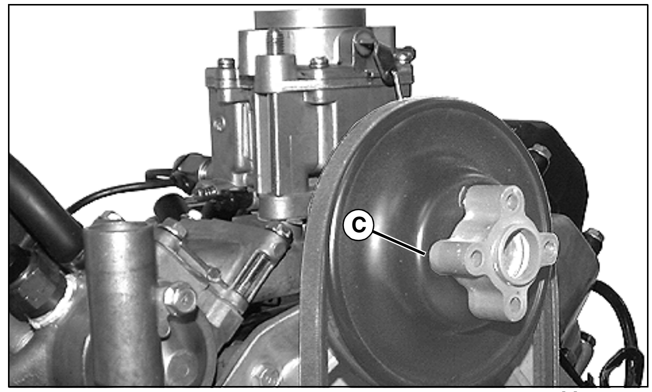
Remove and Install Cooling Fan

1. Remove are cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



M84675

2. Remove fan shroud.
3. Remove four cap screws (A).
4. Remove cooling fan (B).



M84677

5. Inspect cooling fan blades for wear or damage. Replace as needed.
6. Remove cooling fan spacer (C).
7. Inspect fan belt for wear, cracking or glazing. Replace belt as needed.

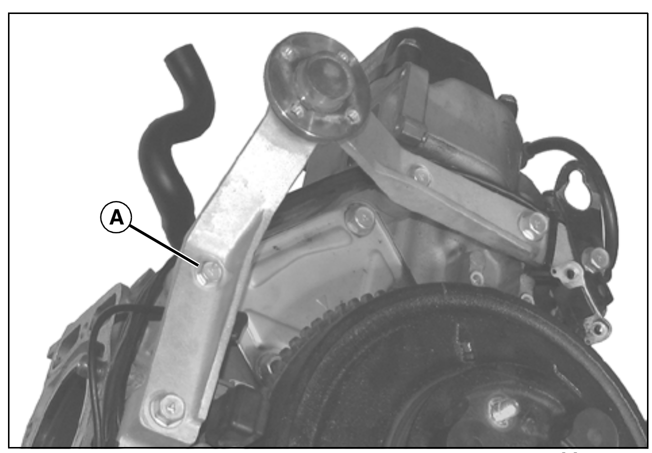
Installation

Installation is done in the reverse order of removal.

- Adjust belt tension. (See “Check and Adjust Fan Belt Tension” on page 63.)
- Tighten cooling fan cap screws securely.

Remove and Install Fan Mounting Bracket

1. Remove cooling fan, fan belt and pulley. (See “Remove and Install Cooling Fan” on page 74.)
2. Cut wire ties from wiring harness.
3. Remove pulser coils. (See “Remove and Install Pulser Coil” on page 125.)



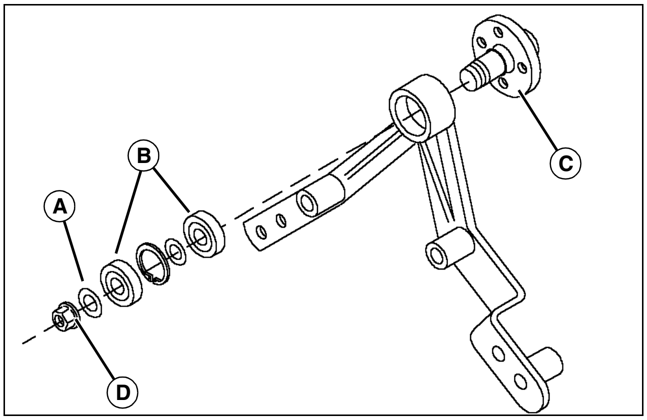
M84739

4. Remove five cap screws (A) and fan mounting bracket.
5. Installation is done in the reverse order of removal.

Remove and Install Bearing - Fan Mounting Bracket

IMPORTANT: Avoid damage! DO NOT remove bearing unless defective. When it is removed, it must be replaced.

1. Remove fan mounting bracket. (See “Remove and Install Fan Mounting Bracket” on page 74.)



M84814

2. Remove fan mounting bracket nut (D), washer (A), and shaft (C).

3. Rotate bearing (B) slowly with a finger. If any roughness or free-play is noted, replace bearing.

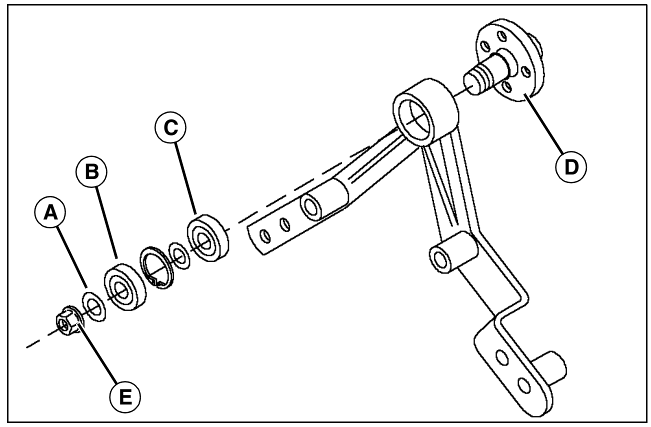
CAUTION: Avoid Injury! DO NOT allow a flame or heating element to come in direct contact with the oil. Heat oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

4. To remove bearing, heat in hot oil, 150° C (302° F).

NOTE: Use heat shield gloves to prevent burns.

5. Place bearing housing on a bench (bearing side up). Remove bearing with correct tool.

Installation



M84814

1. Coat bearing surfaces with a light film of clean engine oil.

2. Using a bearing driver, press in fan side of bearing (C) (flush with housing).

3. Install opposite side of bearing (B) with a bearing driver until it stops at spacer in hole.

4. Install shaft (D), washer (A) and nut (E). Tighten nut to specification.

Specifications

Fan Bearing Shaft Retaining Nut Torque . . . . 20 N•m (180 lb-in.)

Remove and Install Coolant Pump

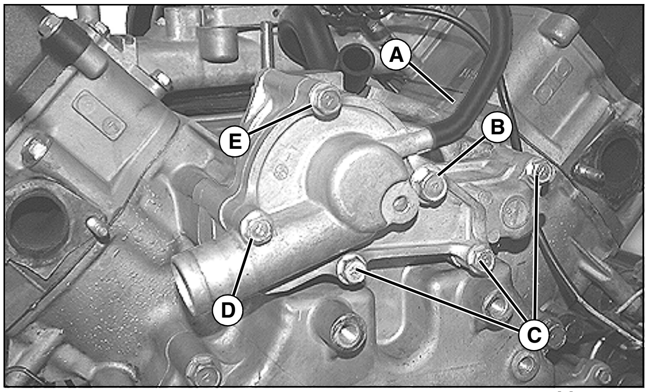
1. Remove muffler. (See “Remove and Install Muffler” on page 79.)

CAUTION: Avoid Injury! Coolant may be above boiling temperature and under pressure in cooling system. DO NOT remove pressure cap when system is hot. Escaping steam will burn unprotected skin. Always wear protective clothing and goggles when servicing cooling system

2. Allow engine to cool before servicing cooling system. Squeeze top radiator hose to verify the system pressure has dropped before opening radiator cap.

NOTE: Cooling system capacity is approximately 2.7 L (2.9 qt).

3. Drain engine coolant.



M84684

A - Coolant Bypass Hose
B - M8 Cap Screw
C - M6 Cap Screw (45 mm (1.77 in.))
D - M6 Cap Screw (75 mm (2.95 in.))
E - M6 Cap Screw (65 mm (2.56 in.))

4. Loosen tube clamp and disconnect coolant bypass hose (A).

NOTE: Cap screws are different lengths; note location for correct installation.

5. Remove mounting cap screws (B—E), coolant pump, and gasket.

6. Inspect all parts for wear or damage.

Installation

Installation is done in the reverse order of removal.

- Use new gaskets for installation.

NOTE: Be sure coolant pump gear fits together with cam gear when installing pump assembly. DO NOT force pump into position.

Cap screw attaches crankcase cover to crankcase.

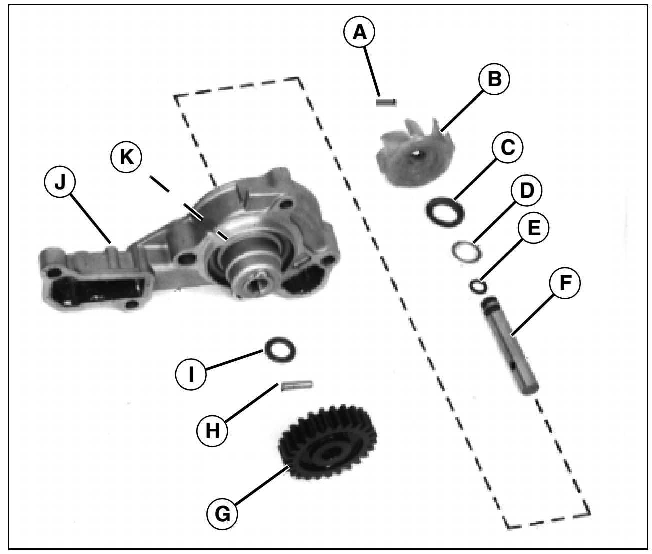
- Tighten cap screws to specification.

Specifications

Coolant Pump Mounting
M6 Cap Screw Torque . . . . 10 N•m (86 lb-in.)
Coolant Pump Mounting
M8 Cap Screw Torque . . . . 24 N•m (216 lb-in.)

Disassembly, Inspection and Assembly Coolant Pump

IMPORTANT: Avoid damage! Leakage from coolant pump will drain into the engine block and could cause engine damage. If there is any doubt of the condition of the coolant pump, replace it as a complete assembly.



M51706

A - Dowel Pin
B - Impeller
C - Oil Seal
D - Mating Ring
E - O-Ring
F - Shaft
G - Spur Gear
H - Dowel Pin
I - Washer
J - Housing
K - Mechanical Seal

1. Remove spur gear (G) with puller.

2. Remove impeller assembly from housing (J). Disassemble impeller assembly.

NOTE: Mechanical seal is sealed in place and will be difficult to remove.

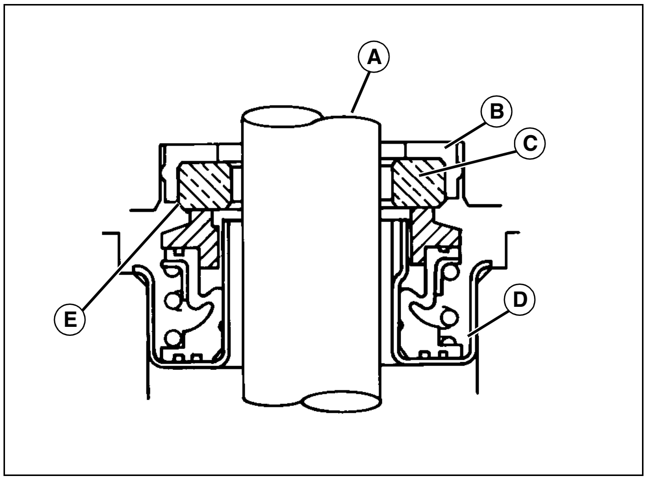
3. Drive old mechanical seal from housing.

M51716

4. Measure outside diameter of impeller shaft. If shaft diameter is less than specification, or shows any signs of corrosion, replace shaft.

5. Measure inside diameter of pump shaft bore in housing. Replace housing if shaft bore is greater than specification.

Assembly is done in the reverse order of disassembly.



M51707

A - Shaft
B - Oil Seal
C - Mating Ring
D - Mechanical Seal
E - Mating Surface

- Install mechanical seal using special driver included in seal kit.
- When installing impeller assembly to housing, coat mating surfaces with clean coolant.

Specifications

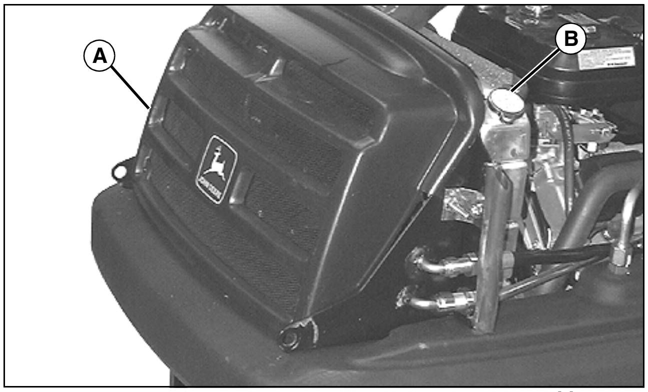
Minimum Diameter of Impeller Shaft. . . . . 9.94 mm (0.391 in.)
Maximum Diameter of Shaft Bore . . . . 10.09 mm (0.397 in.)

Remove and Install Radiator

CAUTION: Avoid Injury! Coolant may be above boiling temperature and under pressure in cooling system. DO NOT remove pressure cap when system is hot. Escaping steam will burn unprotected skin. Always wear protective clothing and goggles when servicing cooling system

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position and allow the engine to cool.
4. Engage park brake.
5. Remove cowling. (See “Remove and Install Cowling” on page 798.)

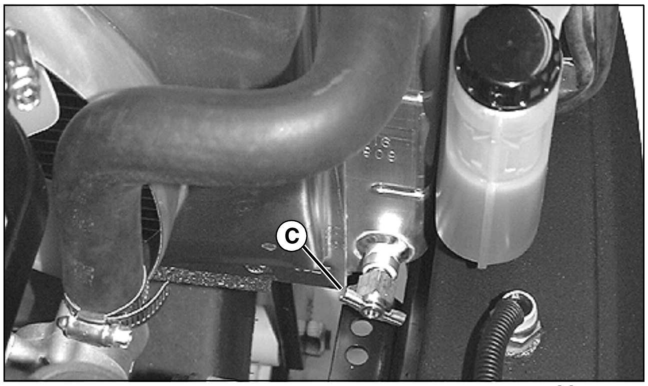
NOTE: Early style radiator shown in photos.



M98519

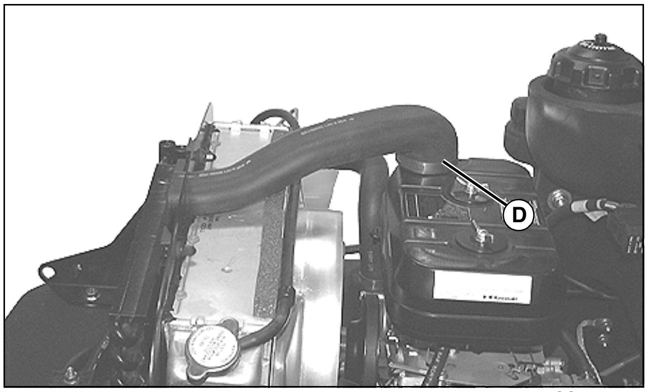
6. Remove grille (A).
7. Loosen radiator cap (B) to first stop to relieve pressure.

NOTE: 2500E may require the 48V alternator to be removed to drain coolant.



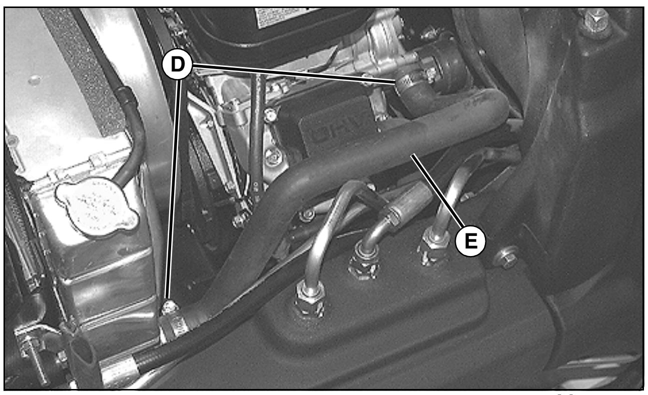
M98520

8. Drain coolant from radiator/engine. Drain valve (C) is located on the lower left side of the radiator.



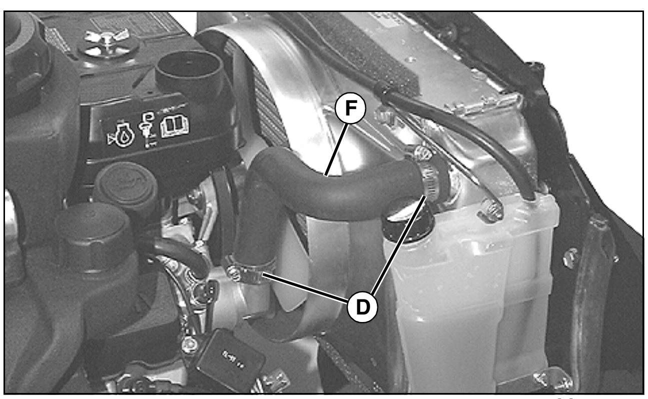
M98521

9. Loosen hose clamp (D) and remove air cleaner intake hose.



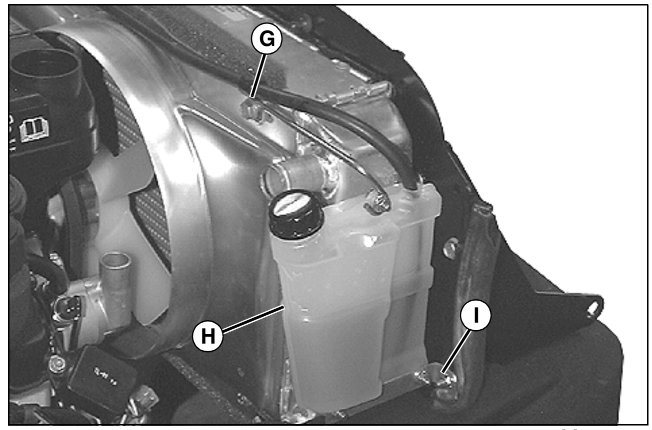
M98522

10.Loosen hose clamps (D) and remove lower radiator hose (E).



M98523

11.Loosen hose clamps (D) and remove upper radiator hose (F).



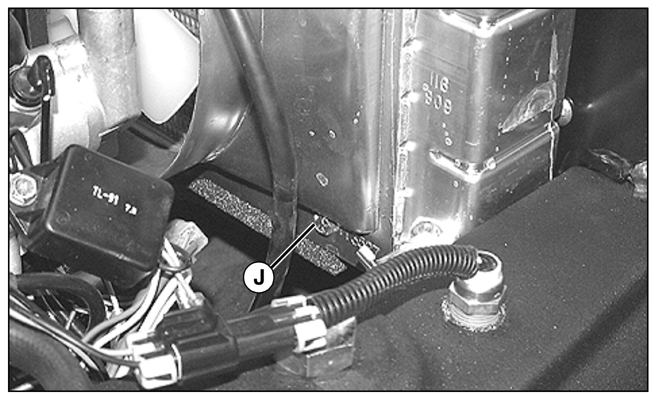
M98524

12.Remove upper overflow tank bracket cap screw (G).

13.Remove cap screw and nut (I) from lower bracket.

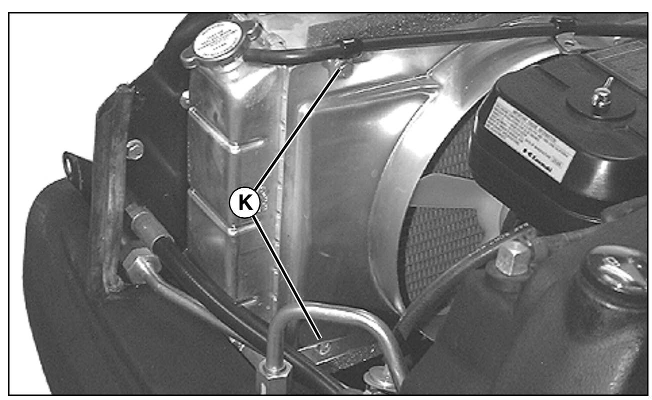
14.Remove overflow tank (H).

NOTE: 2500 model shown. 2500A is similar.



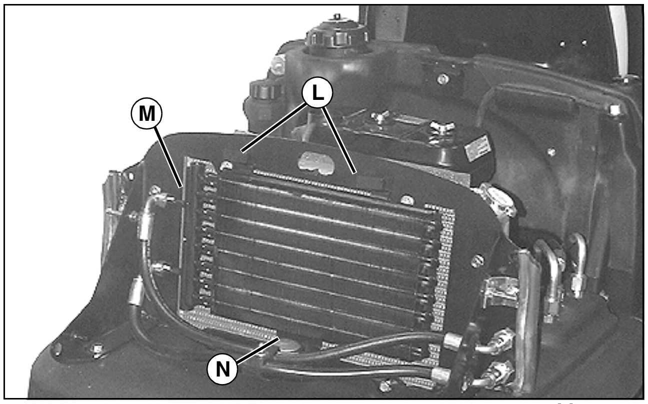
M98525

15.Remove lower right fan shroud cap screw (J).



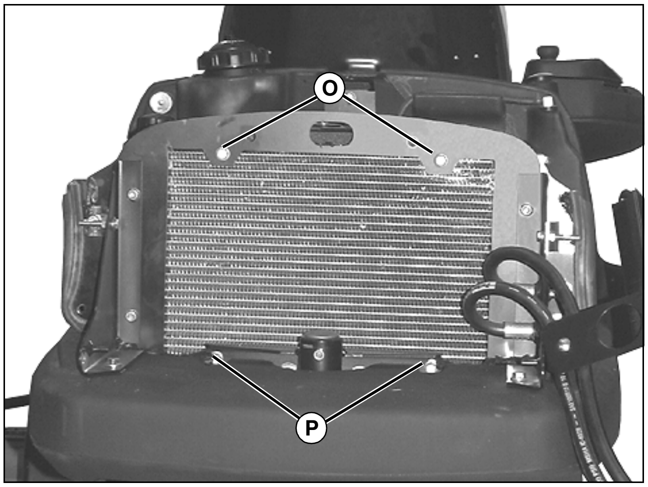
M98526

16.Remove fan shroud cap screws (K).



M98527

17.Release latches (L) and lift the hydraulic oil cooler assembly (M) clear of the steering clevis post (N). Swing cooler aside.



M98528

18.Remove upper (O) and lower cap screws (P).

19.Inspect radiator. (See “Inspect Radiator” on page 79.)

20.Check radiator for debris lodged in fins. Clean radiator using compressed air or water.

NOTE: Hoses may be deteriorated on the inside while appearing good on the outside.

21.Inspect hoses for signs of cracks or deterioration. Squeeze the hoses; the hoses should not be brittle or swollen or soft. Replace hoses as needed.

Installation

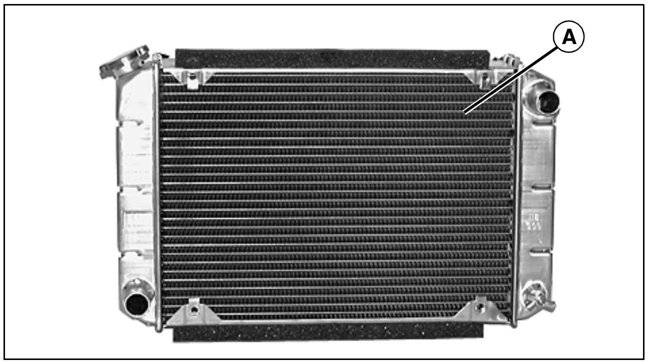
Installation is done in the reverse order of removal.

- Seal the gap between the radiator and bulkhead using ribbon sealant.
- Fill engine cooling system to proper level with coolant of correct specifications. (See “Coolant Specifications” on page 22 in specifications and Information section.)

Inspect Radiator

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

IMPORTANT: Avoid damage! DO NOT apply high-pressure spray directly at fins when cleaning the radiator, as this could result in damage. Direct the spray parallel to the fins.

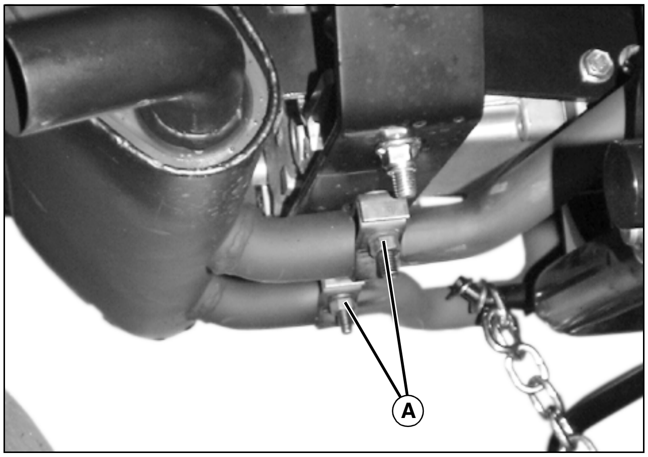


M98529

- Check radiator for debris lodged in fins (A). Clean radiator using compressed air or pressure washer.
- Inspect radiator for bent fins, cracks and damaged seams. Repair or replace radiator if necessary.

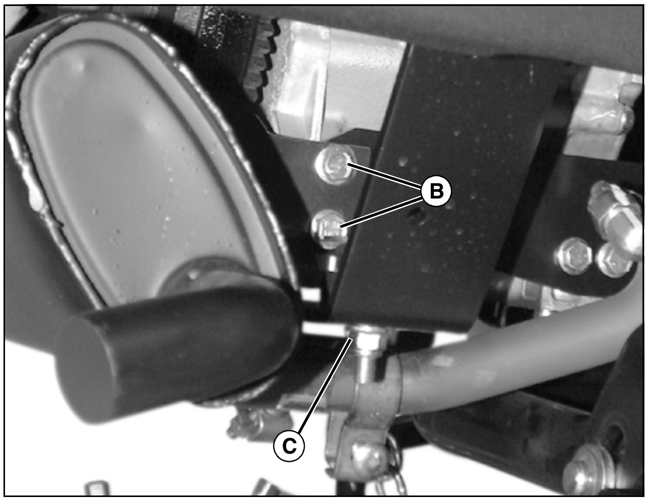
Remove and Install Muffler

1. Park vehicle on a level surface.
2. Turn key switch to STOP position and allow the engine to cool.
3. Lower cutting units to the ground.
4. Engage park brake.



M98480

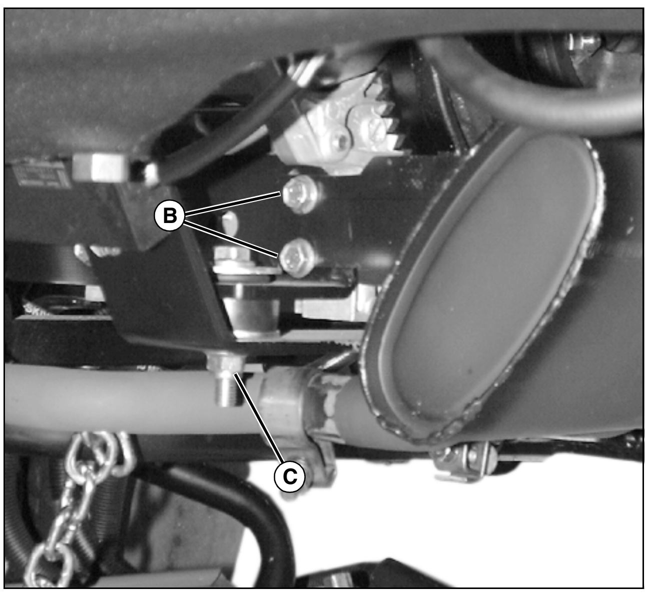
5. Loosen nuts (A) from both clamps and slide clamps away from muffler.



M98483

6. Remove engine mount cap screw, washer and nut (C) to gain access to lower muffler mounting cap screw.

7. Remove muffler bracket cap screws (B).



M98484

8. Remove engine mount cap screw and nut (C).

9. Remove muffler bracket cap screws (B).

10.Remove muffler and gaskets.

Installation

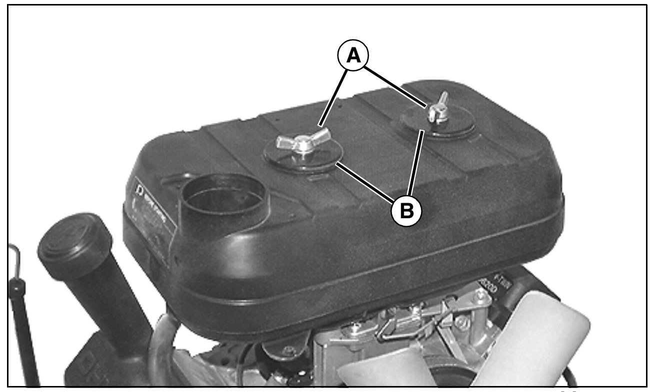
Installation is done in the reverse order of removal.

- Use new gaskets for installation.

Specifications

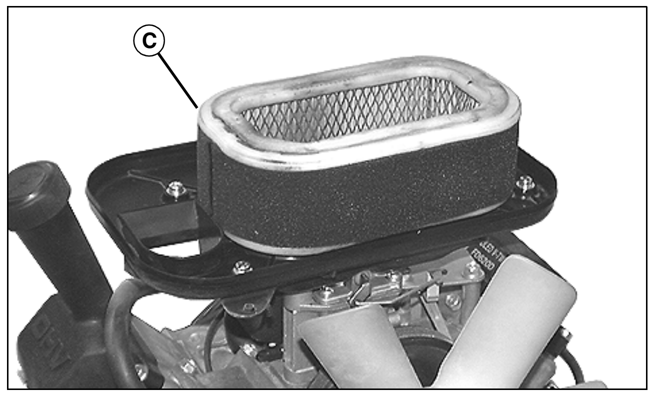
Muffler Mounting Nut Torque. . . . . . 20 N•m (177 lb-in.)

Remove and Install Air Cleaner



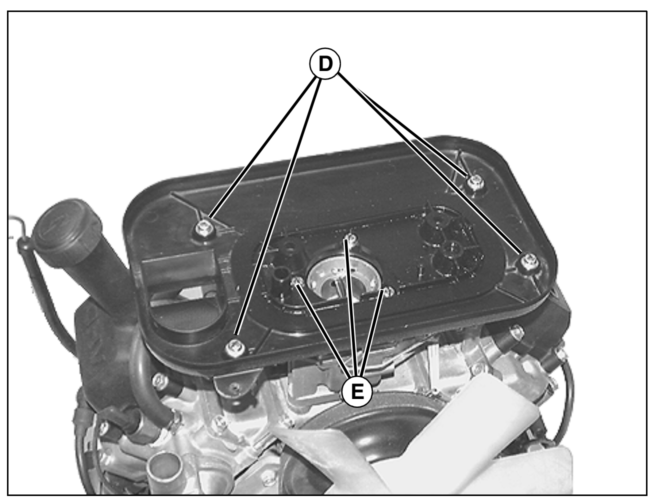
M84661

1. Remove special screws (A) and flat washers (B).
2. Remove cover.



M84662

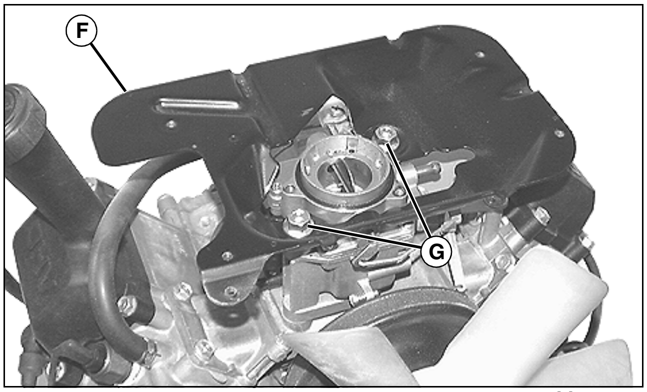
3. Remove filter elements (C).



M84663

4. Remove four base plate-to-adapter plate screw (D) and washers.

5. Remove three base plate-to-carburetor screws (E) and washers.



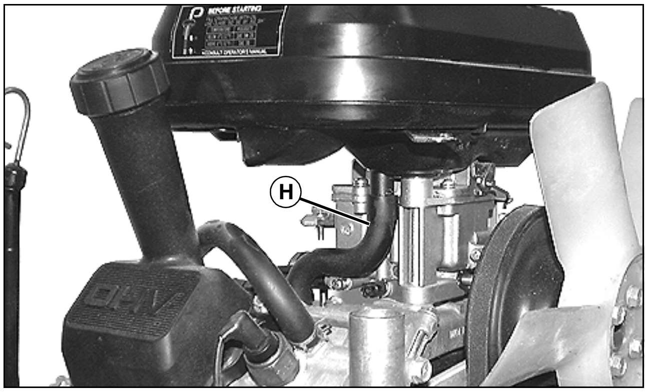
M84664

6. Remove flanged nuts (G).
7. Remove adapter plate (F).

Installation

Installation is done in the reverse order of removal.

- Tighten carburetor/air cleaner base plate mounting flanged nuts to specification.



M84665

- Install breather hose (H) before installing air cleaner assembly.

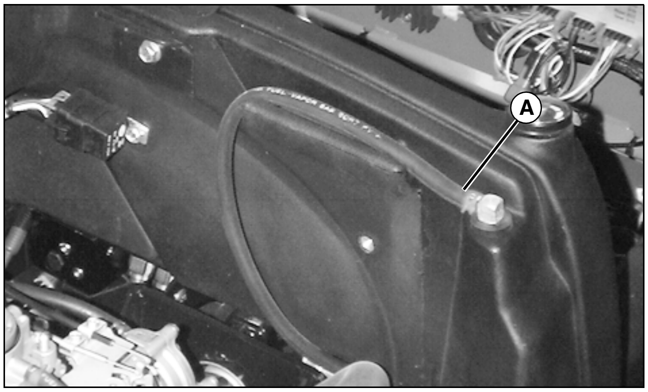
Specifications

Air Cleaner Mounting Flanged Nut . 17 N•m (144 lb-in.)

Remove and Install Fuel Pump - Model 2500

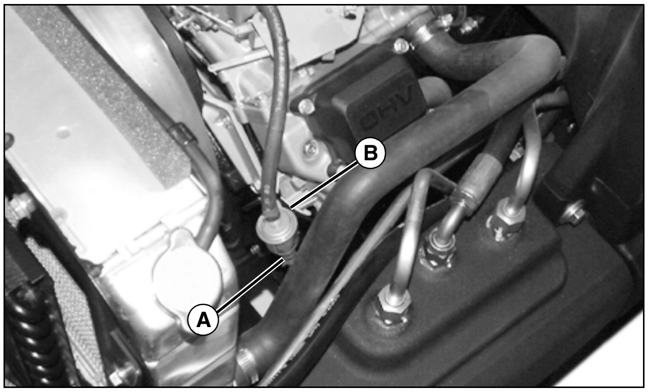
> **CAUTION: Avoid injury! Gasoline vapor is explosive. DO NOT expose to spark or flame. Serious personal injury can result.**

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Raise and latch seat platform.
7. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



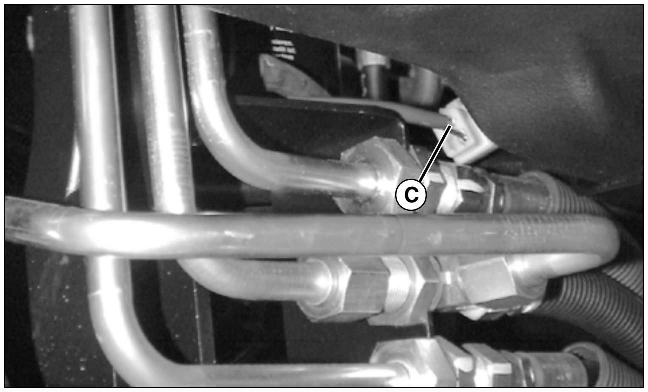
M98497

8. Disconnect fuel hose (A) at fuel tank.



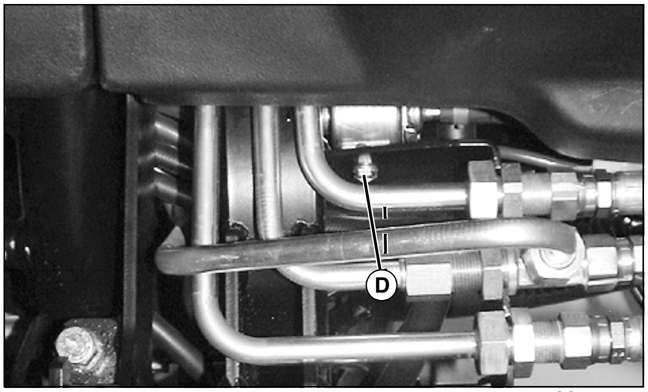
M98498

9. Disconnect fuel hose (A) at intake side of fuel filter (B).



M98481

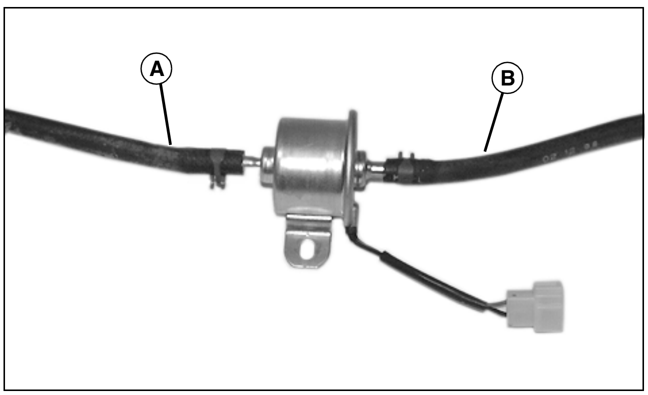
10. Disconnect wiring connector (C).



M98499

11.Remove two cap screws (D) and nuts.

NOTE: Ensure fuel hoses are connected to correct ends of pump.



M98500

A - Fuel hose to fuel filter
B - Fuel hose from fuel tank

12.Remove hoses (A) and (B).

Installation

Installation is done in the reverse order of removal.

- Tighten fuel pump mounting cap screws to specification.

Specifications

Fuel Pump Mounting Cap Screw Torque . . . . . 5.9 N•m (52 lb-in.)

Remove and Install Fuel Pump - Model 2500A and 2500E

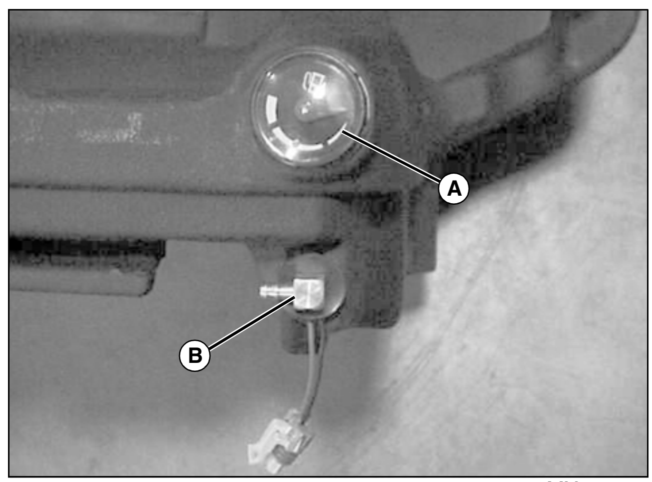
Removal

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

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Disconnect negative (—) cable from battery.

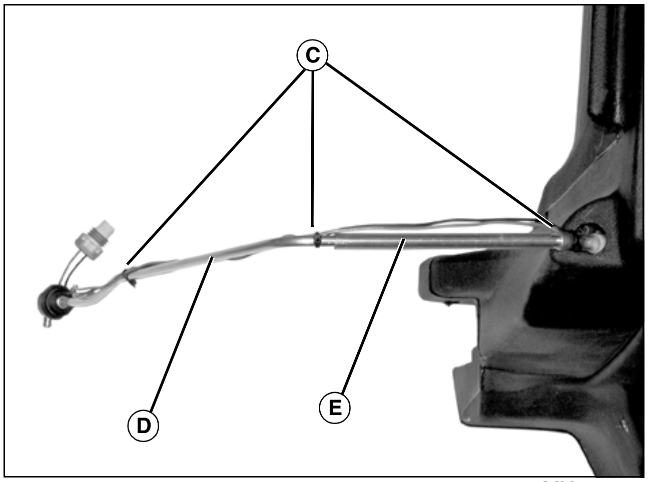
NOTE: Fuel tank shown off machine. Fuel pump can be removed and installed with tank mounted on machine.

6. Disconnect fuel supply hose an fuel pump wire connector at fuel tank.



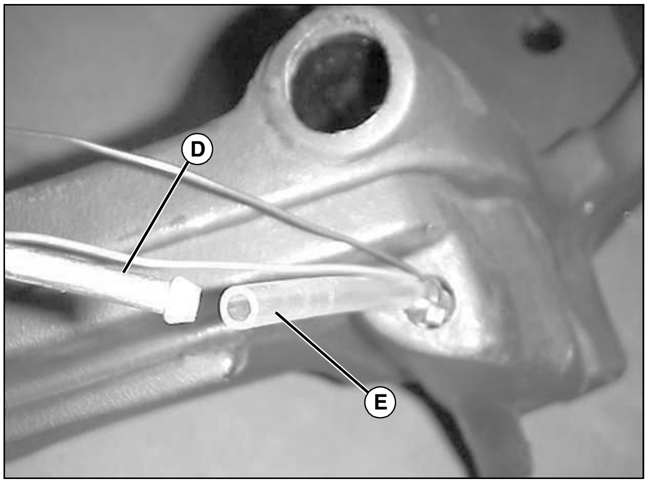
MX18358

7. Carefully pry fuel gauge (A) out of rubber bushing in tank. Remove gauge and bushing.
8. Pry fuel pickup tube (B) out of rubber bushing, taking care not to damage wires.
9. Pull pickup tube and bushing partially out of tank.



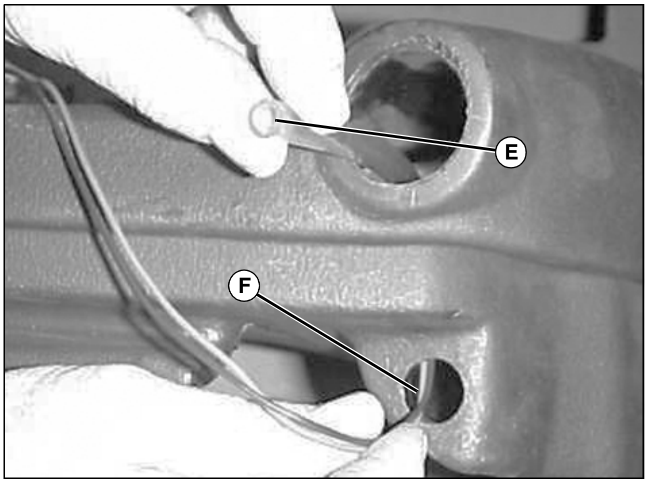
MX18183

10.Cut tie wraps (C) holding wires to pickup tube (D).



MX18183

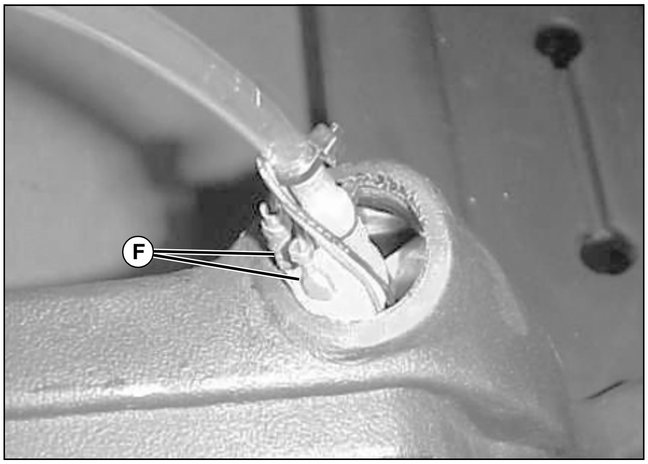
11.Slide pickup tube (D) out of flexible hose (E) completely and push hose back in tank, keeping hold of the wires.



MX18354

12.Pull up gently on wires (F) to position tube within reach of fuel gauge hole.

13.Grasp rubber hose through fuel gauge hole and lift pump into position to remove wires.



MX18353

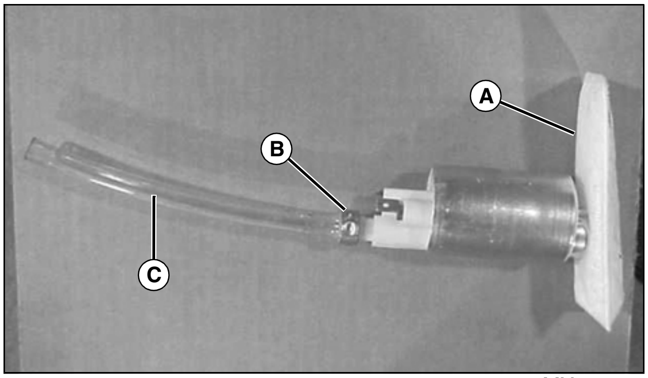
14.Cut tie wrap (C) and disconnect wires (F) from pump.

15.Pull pump up and out of fuel gauge hole.

16.Repair or replace as required.

Installation

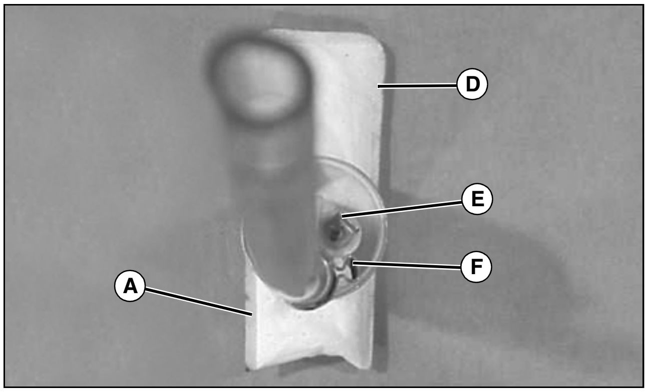
CAUTION: Avoid Injury! Gasoline is extremely flammable. DO NOT smoke. Always work in a ventilated area away from open flame or spark producing equipment; this includes equipment that utilizes pilot lights.



MX18355

1. Install flexible hose (C) onto fuel pump with any arch upward as shown.

NOTE: Clamp ear (F) must be inside pump profile and on the right as shown or pump will not fit into tank and damage to tank will occur. Long end of strainer must be facing away from pump outlet fitting.



MX18356

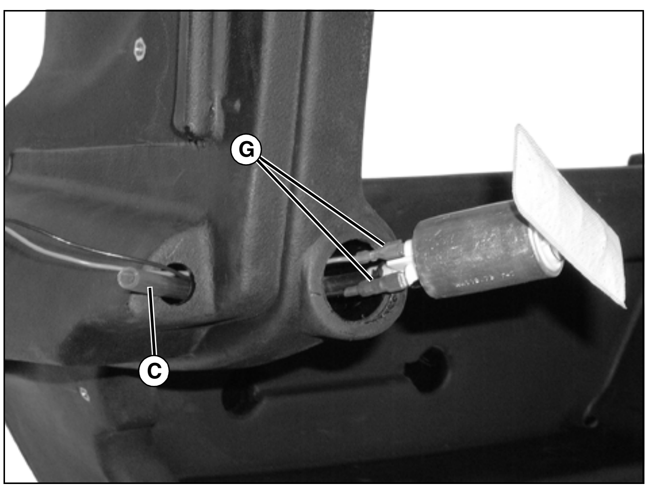
2. Position strainer (A) on pump so long (D) end of strainer is facing away from pump outlet fitting.

3. Slide clamp over hose and onto pump fitting.

4. Clamp ear must be positioned inside pump profile and toward the right as shown or pump will not fit into tank.

IMPORTANT: Avoid damage! Special crimping pliers must be used to ensure proper installation of clamp.

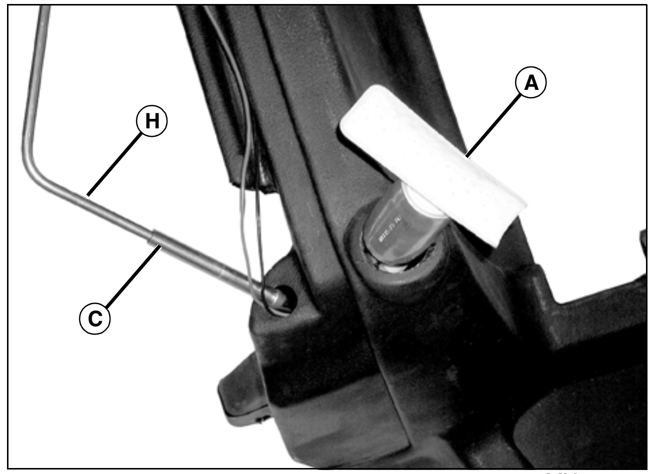
5. Using a model of 1098 straight ear clamp pincher or a model 1099 side ear clamp pincher made by Oetiker, pinch clamp to secure hose to pump fitting.



MX18186

6. Slide fuel pump wires through pickup tube hole in tank. Connect wires (G) to pump.

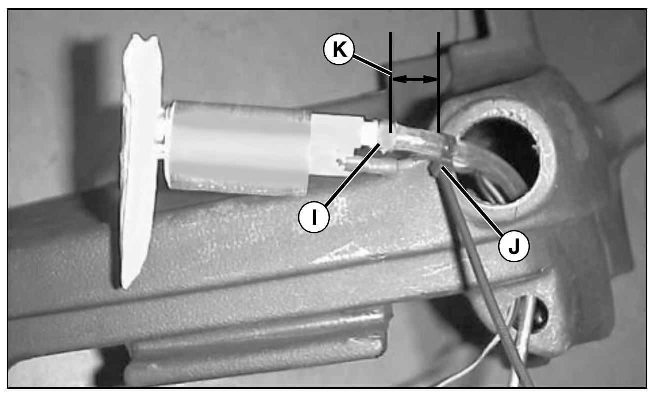
7. Slide flexible hose (C) out through same hole.



MX18184

8. Lubricate flexible hose (C) and slide onto pickup hose (H) approximately 25-50 mm (1-2 in.)

IMPORTANT: Avoid damage! There must be 25 mm (1 in.) ± 6 mm (1/4 in.) of flexible hose between top of fuel pump fitting and end of pick up tube. If there is more than 25 mm (1 in.) ± 6 mm (1/4 in.) or less than 25 mm (1 in.) ± 6 mm (1/4 in.) pump will not assemble into the correct location of the tank.



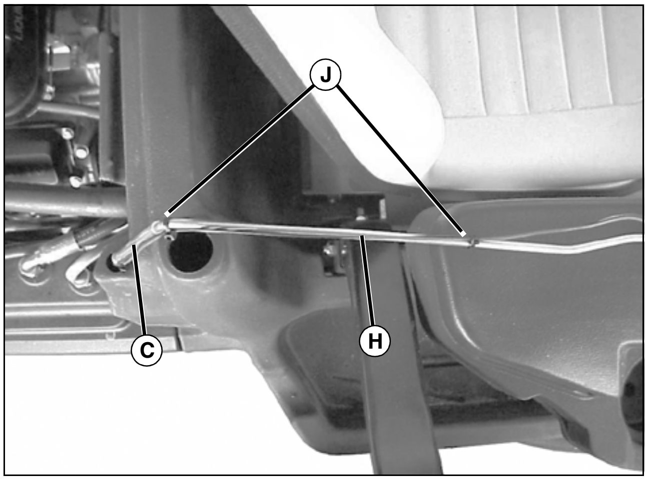
MX18357

9. Measure 25 mm (1 in.) (K) from top of fuel pump fitting (I) and using a tie wrap (J), attach pump wires to pickup tube.

MX18360

10.With pick up tube pointing forward, strainer should also point forward. Push pump into tank.

11.Slide the flexible hose all the way up the pickup tube. The end of the pickup tube should be at the tie wrap installed in step 9. There must be 25 mm (1 in.) of flexible hose between the top of fuel pump fitting and end of pickup tube or pump will not install into tank correctly.

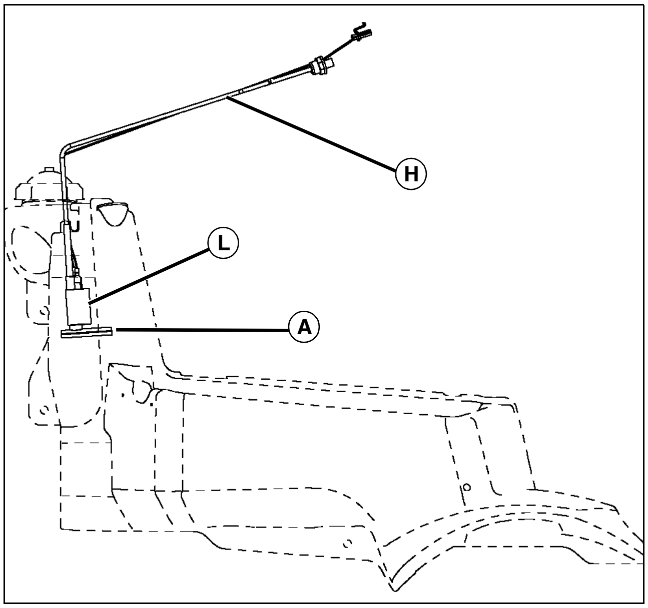


MX18361

12.Secure pump wires using tie wraps (J). Install a tie wrap near bend in pickup tube (H) and halfway up tube from bend.

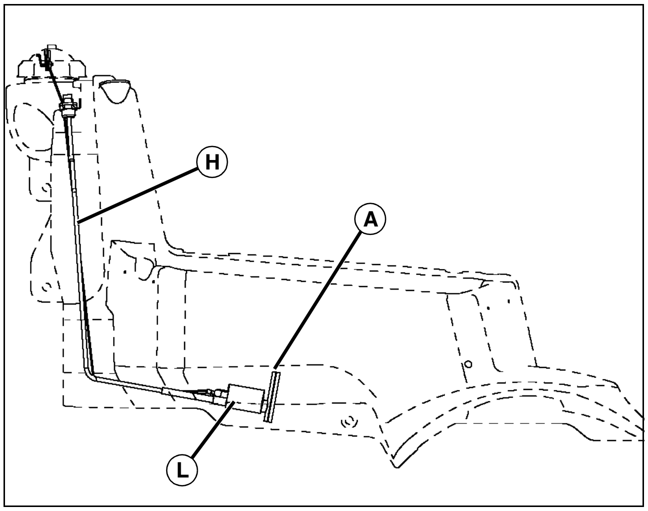
13.Pull wires tight and trim tie wraps.

IMPORTANT: Avoid damage! Orientation is critical for the correct installation of the pump and the strainer.



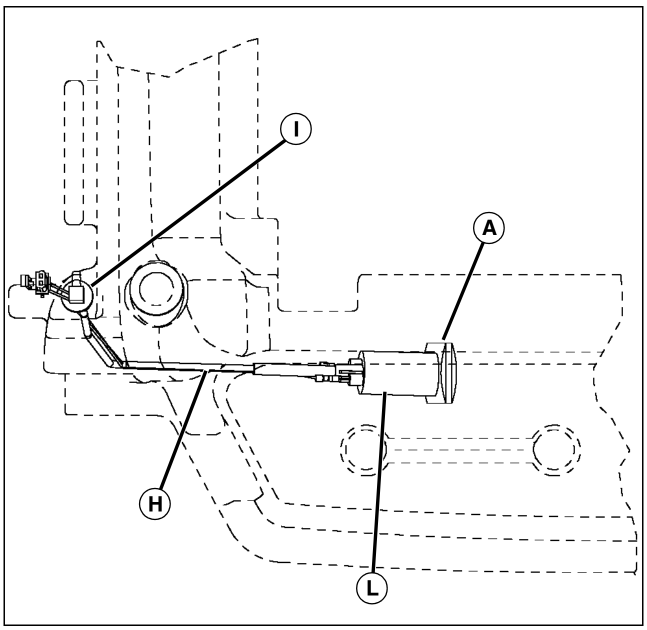
MX18370

14.With pickup tube (H) pointing forward, long end of strainer (A) should also be pointing forward. Insert pickup tube and shake fuel pump (L) down into tank.



MX18369

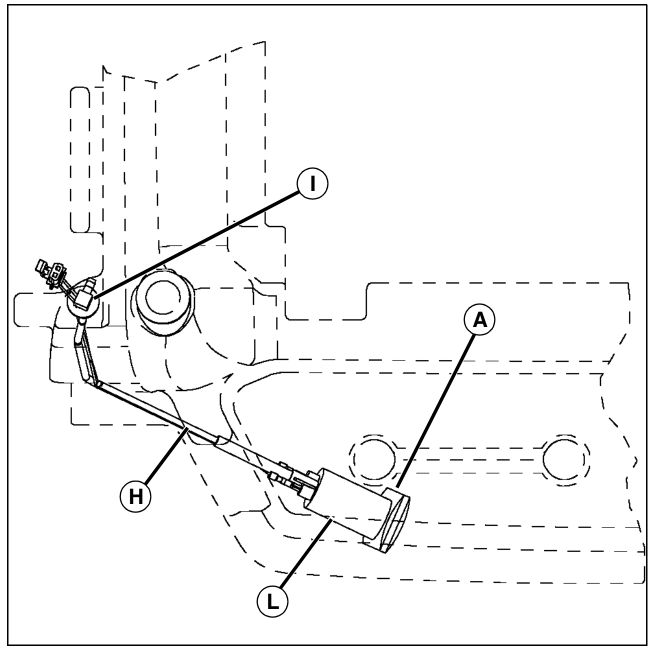
Picture Note: Correct: Side View



MX18368

Picture Note: Correct: Top View

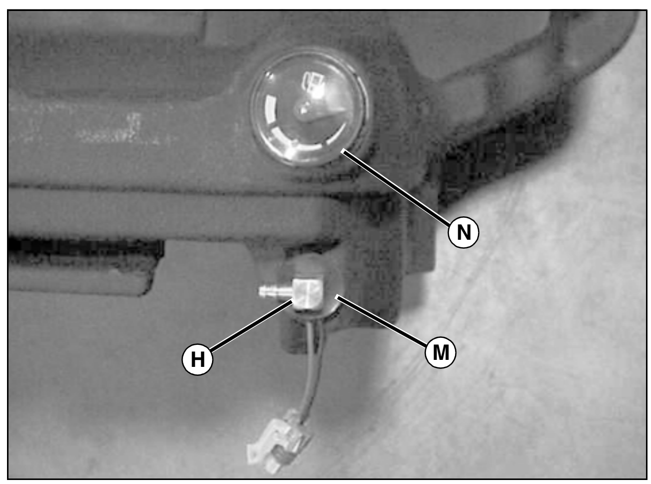
15.When pump (L) is installed correctly, the fitting (I) on top of the tank, the pump and the strainer (A) will be oriented as shown.



MX18367

Picture Note: Wrong: Top View

16.When pump (L) is installed wrong, the fitting (I) on the top of the tank, the pump and the strainer (A) will be oriented as shown.



MX18358

17.Lubricate grommet and install pickup tube (H) and washer (M) into grommet.

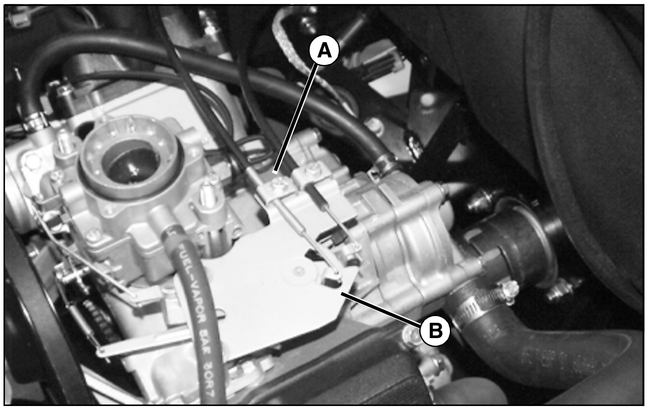
18.Fitting on end of tube must be positioned as shown or pump is not in correct location in tank.

19.Lubricate rubber grommet in tank and install gauge.

20.Connect fuel supply line and fuel pump wire connector.

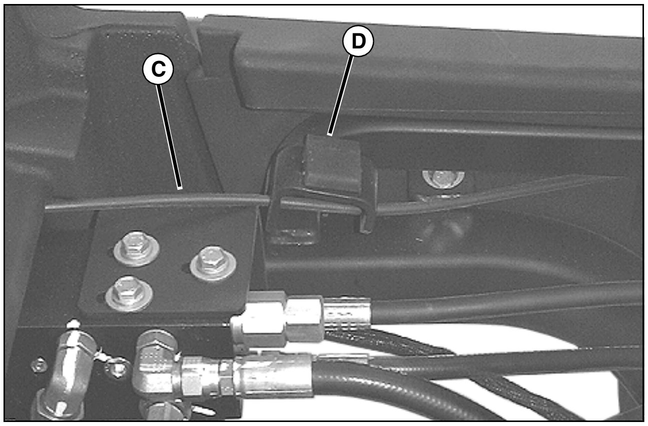
Remove and Install Throttle Lever and Cable

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Raise and latch seat platform.
7. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



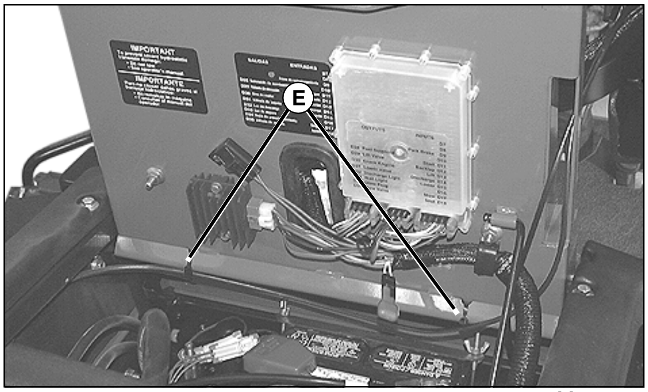
M98475

8. Remove throttle cable clamp (A).
9. Disconnect throttle cable at throttle plate (B).



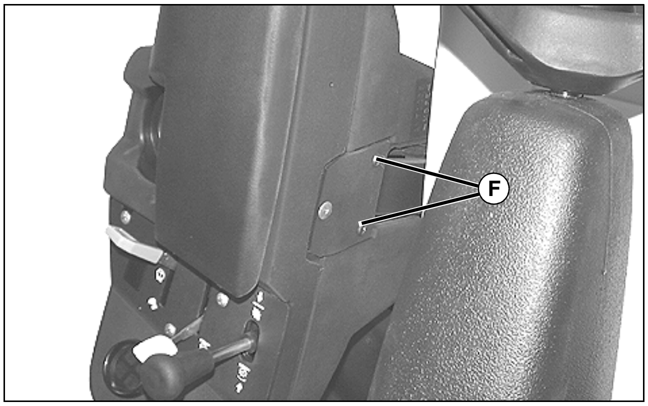
M84634

10. Pull throttle cable (C) through seat platform stop (D).



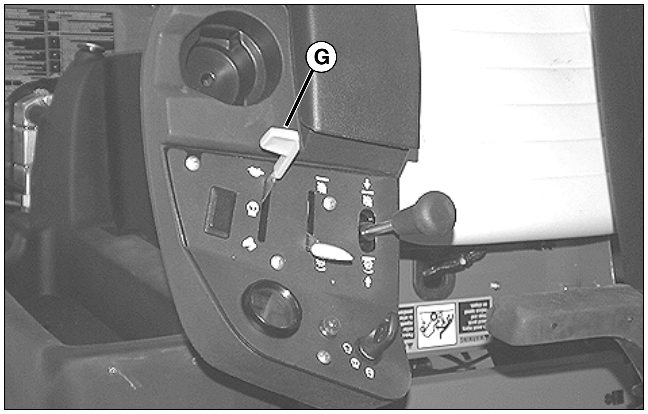
M84635

11. Cut tie wraps (E) securing the cable to seat platform.



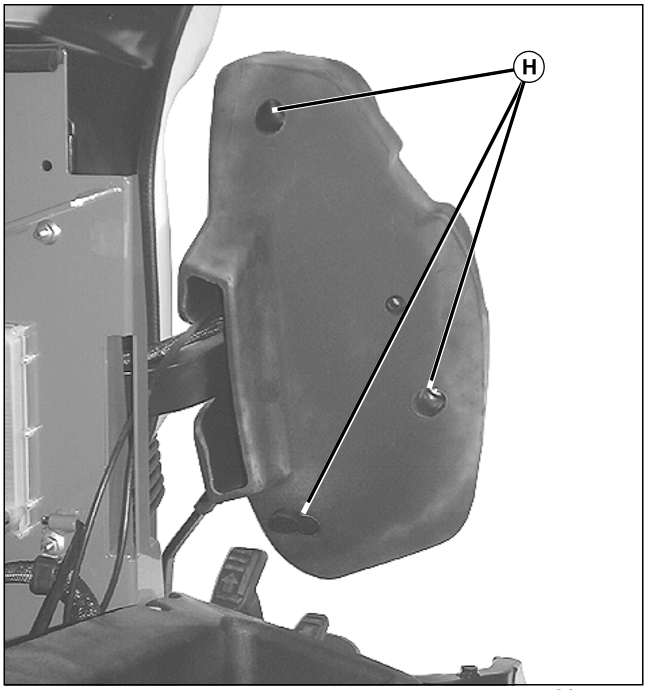
M84636

12. Remove screws (F).



M84637

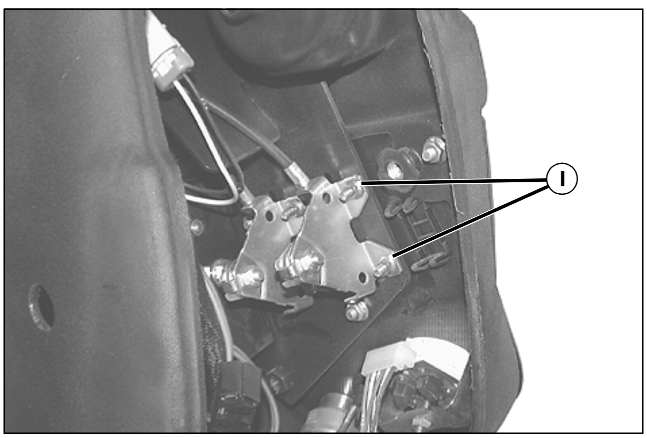
13. Remove throttle lever knob (G).



M84638

14.Remove cap screws and washers (H).

15.Pull lower console cover away from console top.



M84639

16.Remove bracket nuts (I).

17.Remove throttle cable/lever assembly.

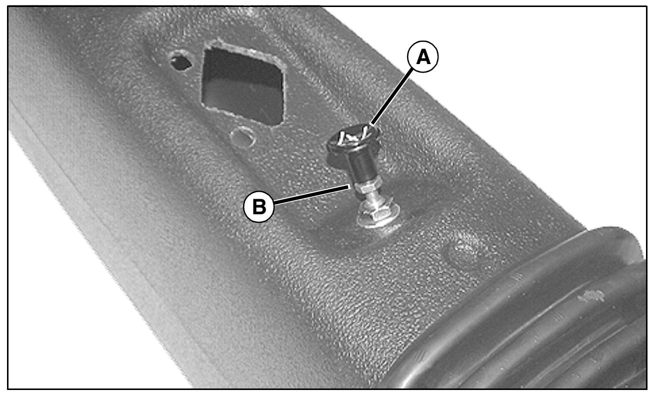
Installation

Installation is done in the reverse order of removal.

- Adjust throttle cable. (See “Adjust Throttle Cable” on page 54.)

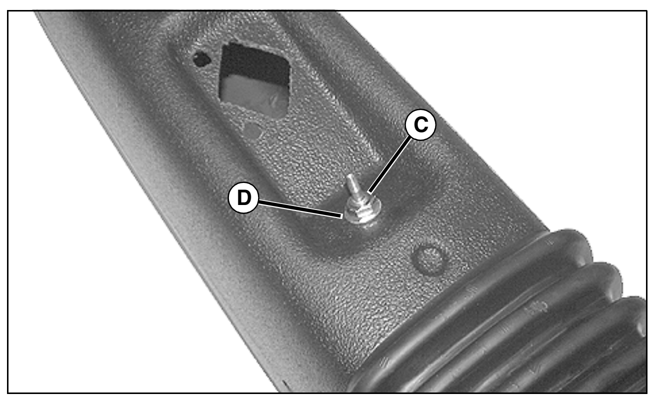
Remove and Install Choke Cable

1. Park vehicle on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)
7. Remove steering column cover. (See “Remove and Install Steering Column Cover (S.N. -030000)” on page 712 or See “Remove and Install Steering Column Cover (S.N. 030001-)” on page 713 in Steering section.)



M98603

8. Remove knob (A) and jam nut (C).



M98604

9. Remove lock nut (C) and washer (D).

10.Remove choke cable from steering column cover.

Installation

Installation is done in the reverse order of removal.

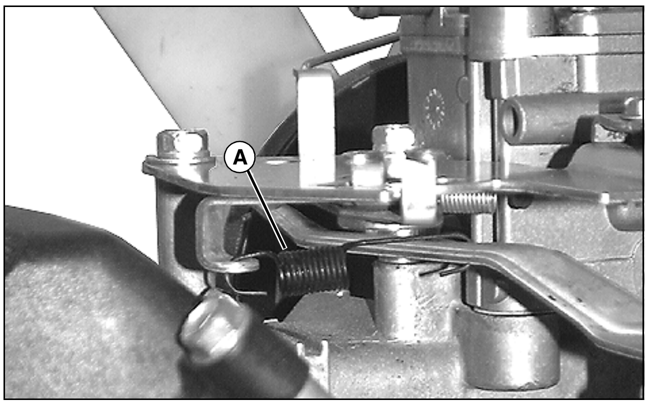
- Adjust choke cable. (See “Adjust Choke Cable” on page 55.)

Remove and Install Carburetor

CAUTION: Avoid Injury! Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. DO NOT smoke, and make sure the area is well ventilated and free from any source of flame or sparks.

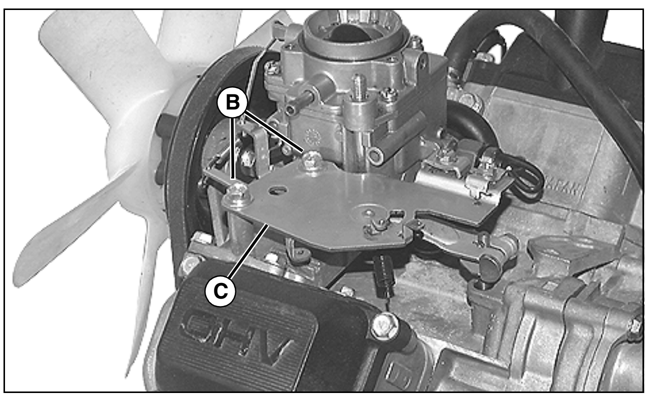
Removal

1. Remove air cleaner and related parts. (See "Remove and Install Air Cleaner" on page 80.)
2. Drain carburetor. Wipe up spilled fuel IMMEDIATELY



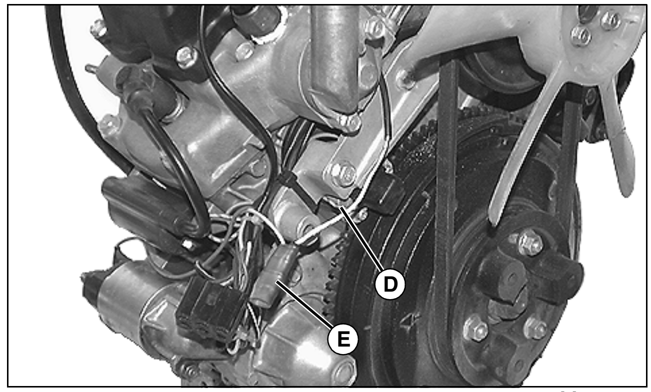
M84667

3. Disconnect governor spring (A).



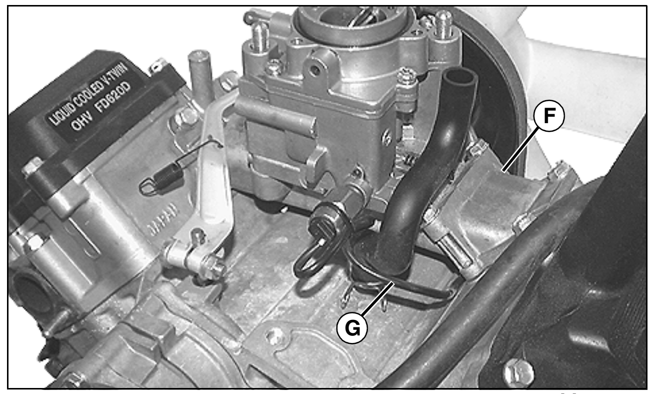
M84668

4. Remove throttle plate cap screws (B) and throttle plate (C).



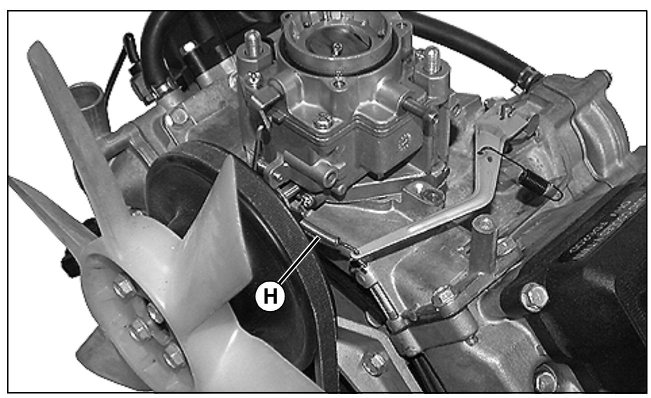
M84669

5. Disconnect fuel shutoff lead (D) at connector (E).

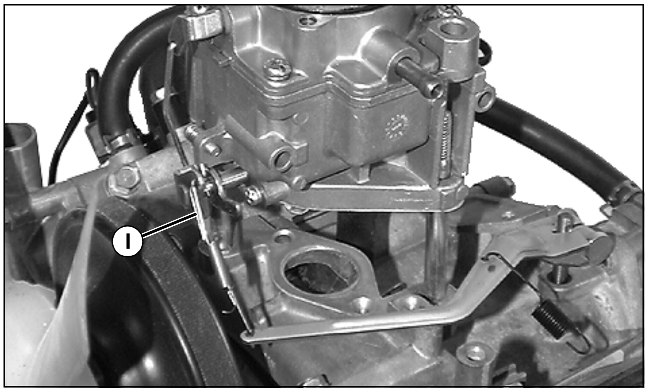


M84670

6. Pull fuel shutoff solenoid lead (G) from under intake manifold (F).



7. Disconnect link spring (H).



8. Lift carburetor and disconnect throttle link arm (I).

Installation

Installation is done in the reverse order of removal.

- Use a new gasket for installation.
- Tighten carburetor/air cleaner base plate mounting flanged nuts to specification.

Specifications

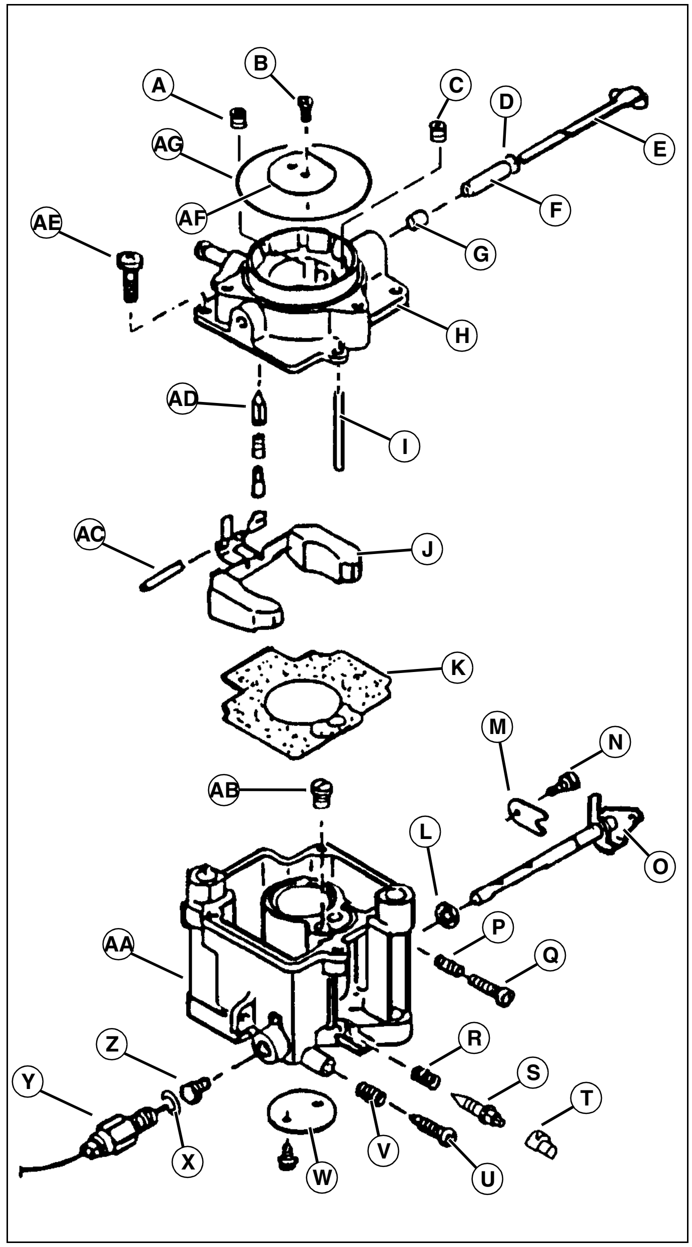
Carburetor/Air Cleaner Base Plate
Mounting Nuts . . . . 17 N•m (144 lb-ft)

Disassemble and Assemble Carburetor

CAUTION: Avoid Injury! Gasoline is extremely flammable and can be explosive under certain conditions. Turn the ignition switch OFF. DO NOT smoke, and make sure the area is well ventilated and free from any source of flame or sparks.

IMPORTANT: Avoid damage! There are a number of boil plugs on/in the carburetor that should not be removed.

IMPORTANT: Avoid damage! To remove float, use a long-nosed pliers on the deformed end of the pin. DO NOT strike opposite end of pin. Damage to pin holder may result.



M84795

A - Pilot Air Jet
B - Screw
C - Main Air Jet
D - Seal
E - Choke Shaft
F - Gasket
G - Gasket
H - Air Horn
I - Emulsion Tube
J - Float
K - Gasket
L - Seal
M - Stopper Plate
N - Stopper Screw
O - Throttle Shaft
P - Spring
Q - Screw
R - Spring
S - Pilot Air Screw
T - Restrictor
U - Drain Screw
V - Spring
W - Throttle Plate
X - Gasket
Y - Fuel Shutoff Solenoid
Z - Main Jet
AA- Carburetor Body
AB- Pilot Jet
AC- Float Pin
AD- Inlet Needle
AE- Screw
AF- Choke Plate
AG- Gasket

Carburetor - Clean, Inspect and Rebuild

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

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

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

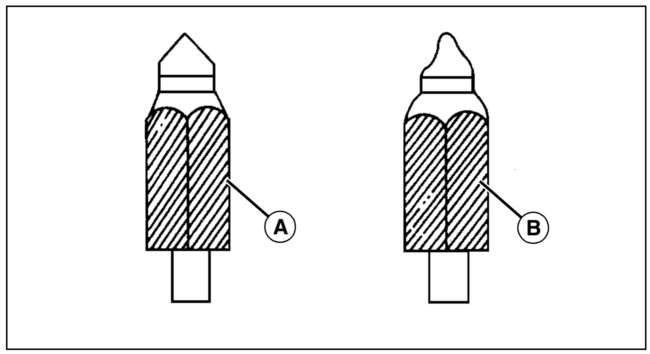
CAUTION: Avoid Injury! Reduce compressed air to less than 210 kPa (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

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

2. Rinse carburetor parts in warm water and dry with compressed air. Do not use rags or paper to dry parts; lint can plug holes and passages in carburetor.

3. Inspect all parts for wear or damage.

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



M98559

A - Good
B - Worn (Replace)

- Inspect inlet needle for wear or damage. The tip should be smooth, without any grooves, scratches or tears. If worn or damaged, replace float assembly and carburetor body as a set.
- Inspect idle mixture screw for wear or damage. Replace if necessary.

4. Turn idle mixture screw in until it lightly seats, then back it out 1-3/8 turns.

5. Install choke plate with metering hole toward fuel inlet joint of carburetor.

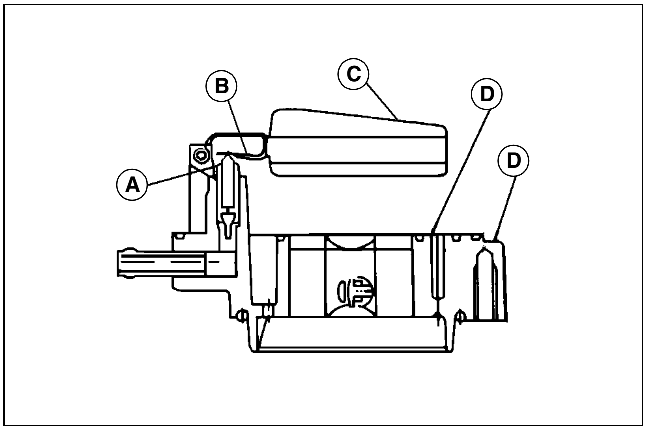
6. Apply thread lock and sealer (medium strength) to threads of throttle and choke plate screws.

7. Verify that float pin extends the same distance on both sides of float hinge bracket when reassembling carburetor.

8. Verify that throttle and choke shafts move freely and that shaft bosses are not elongated or worn. If shaft bosses have any of these conditions, replace carburetor.

Carburetor - Float Level Adjustment

NOTE: Plastic floats are non-adjustable.



M57333

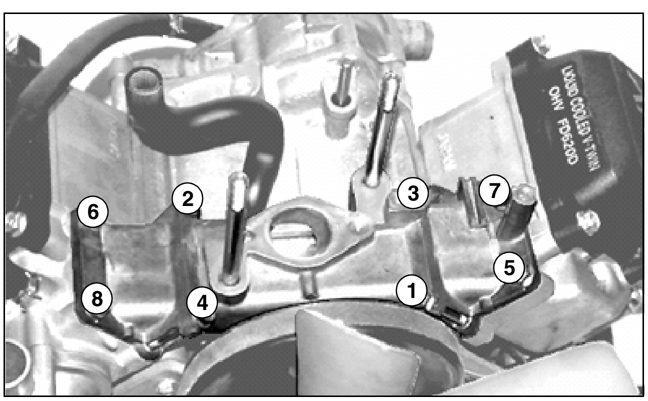
1. Adjust float level. Hold carburetor upside down at eye level with float assembly installed.
2. Gently support float (C) with a finger and lower it slowly until float arm tab (B) just touches inlet needle (A). The float lower surface should be parallel with body mating surface (D).
3. If necessary, bend float arm tab to adjust float level.

Remove and Install Intake Manifold

Removal

1. Remove air cleaner assembly. (See "Remove and Install Air Cleaner" on page 80.)
2. Remove air filter base.

IMPORTANT: Avoid damage! To prevent warpage, loosen cap screws 1/4 turn at a time, in sequence shown, until all cap screws are loose.



M84824

3. Remove two cap screws (C) securing control panel.
4. Remove the control panel assembly (B), while unhooking the governor spring (D) end loop at the panel bracket.
5. Disconnect the choke link rod end (A) from the choke lever.

Installation

Installation is done in the reverse order of removal.

- Use new gaskets for installation.
- Tighten cap screws in sequence shown to initial torque specification, then to final torque specification.

Specifications

Intake Manifold Mounting Cap Screw Initial Torque . . . . 3 N•m (26 lb-in.)

Intake Manifold Mounting Cap Screw Final Torque. . . . . 6 N•m (53 lb-in.)

Intake Manifold - Inspection

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

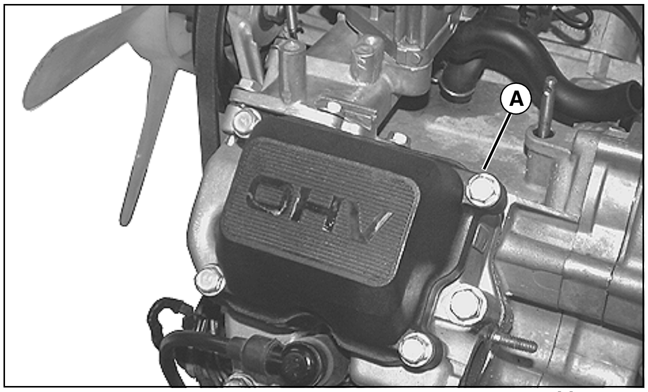
Visually inspect manifold passages for corrosion, cracks, porous castings, or deposits. Clean or replace as necessary.

Remove and Install Rocker Arm Covers

Removal

NOTE: The following procedures are done separately on both cylinder head assemblies.

2500E may require the 48V alternator to be removed to access the right-hand rocker arm cover. (See "Remove and Install 48V Alternator" on page 73.)

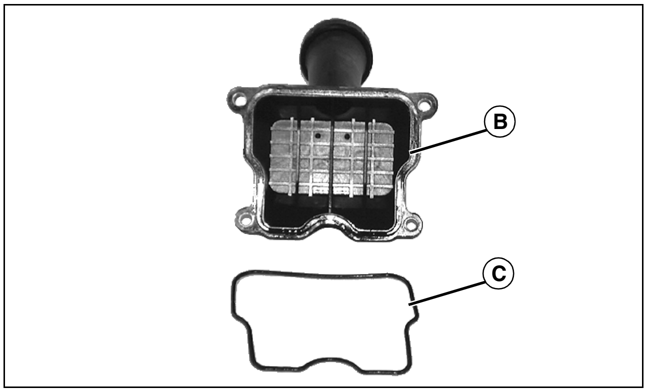


M84674

1. Remove four cap screws (A).
2. Remove rocker arm cover and O-ring.

Installation

Installation is done in the reverse order of removal.



M84680

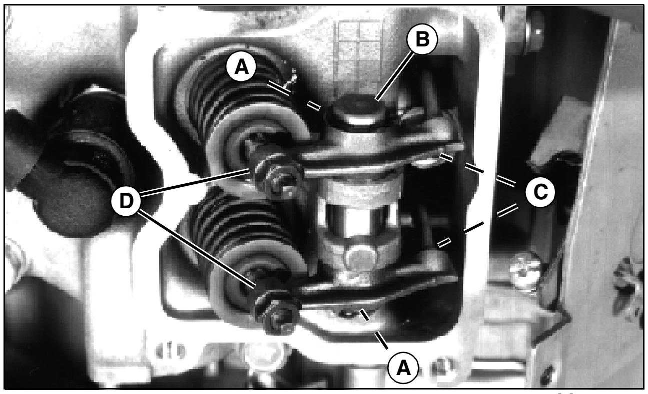
- Clean mating surfaces of rocker arm cover (B) and head before installation.
- Install new O-rings (C) for installation.

Remove and Install Rocker Arm Assembly

NOTE: The following procedures are done separately on both cylinder head assemblies.

1. Remove rocker arm cover. (See "Remove and Install Rocker Arm Covers" on page 93.)
2. Turn crankshaft until piston is at highest position on compression stroke.

IMPORTANT: Avoid damage! Note location of components when disassembling. Components should be installed in the same location where they were removed from.



M51708

3. Remove snap rings (A).
4. Remove rocker arm pivot bolts and rocker arms (D).
5. Remove rocker arm shaft (B).
6. Remove push rods (C). Push rods must go in exact location as removed. Mark cylinder head and push rods to aid assembly.
7. Inspect all parts for wear or damage. (See "Inspect Rocker Arm Assembly" on page 94.)

Installation

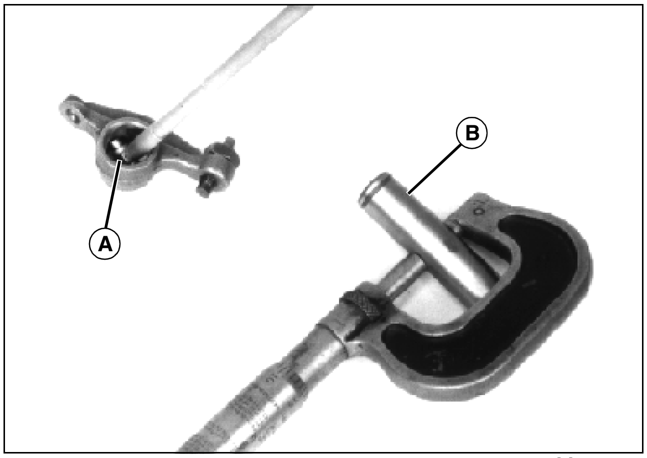
Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! DO NOT interchange parts from one cylinder head with parts from the other cylinder head.

If engine is started with valve spring completely compressed (no gap between coils), engine valve train will be damaged.

- Rotate engine to check for free operation of the valve train. Check the clearance between valve spring coils at full camshaft lift. If valve spring is compressed to the point of binding (no free space between spring coils), lifter is overextended. Allow 10-15 minutes for lifter to bleed down, and recheck clearance. If there still is no clearance between spring coils, repair or replace overextended lifter.
- Adjust valve clearance. (See "Check and Adjust Valve Clearance" on page 58.)

Inspect Rocker Arm Assembly



M51709

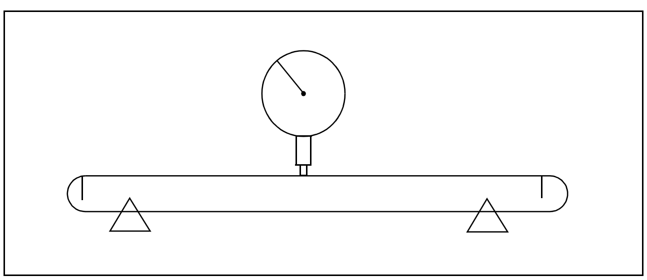
- Measure outer diameter of rocker arm shaft (B). Replace if shaft diameter measures less than specification.
- Measure inner diameter of rocker arm bearing (A). Replace bearing if inside diameter is greater than specification.

Specifications

Minimum Rocker Arm Shaft OD . . . . 11.95 mm (0.470 in.)

Maximum Rocker Arm Bearing ID . . . . 12.07 mm (0.475 in.)

Inspect Push Rod



M50044

Inspect push rods for bend using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace rod if variation is greater than specification.

Specifications

Maximum Push Rod Bend . . . . 0.80 mm (0.030 in.)

Remove and Install Cylinder Head

Removal

1. 2500E Models: Remove 48V alternator. (See “Remove and Install 48V Alternator” on page 73.)

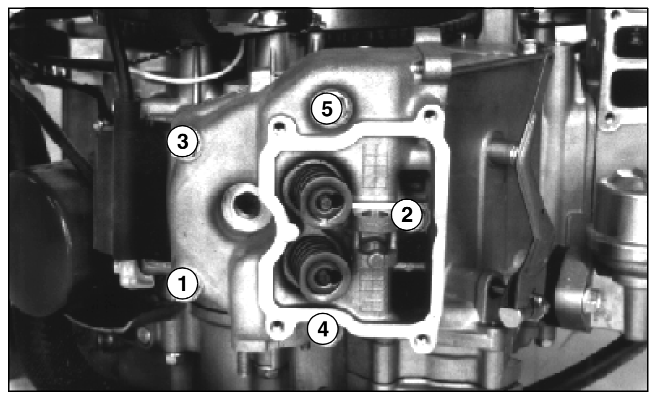
NOTE: No. 1 cylinder head is shown. No. 2 cylinder head is the same, except it has a thermostat housing, a coolant bypass port, and a thermoswitch port.

2. Remove intake manifold. (See “Remove and Install Intake Manifold” on page 92.)

3. Remove rocker arm assembly and push rods. (See “Remove and Install Rocker Arm Assembly” on page 93.)

4. Remove spark plug.

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



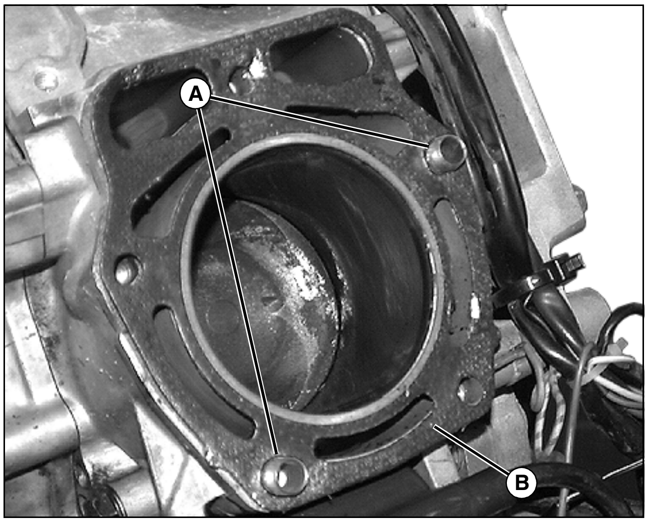
M51710

5. Remove head bolts, cylinder head and gasket. Discard gasket.

6. Disassemble and inspect cylinder head and valves. (See “Inspect Cylinder Head and Valves” on page 96.

7. Clean cylinder head and engine block mating surfaces. Check to make sure there are no nicks or burrs on the sealing surfaces of the cylinder head and engine block.

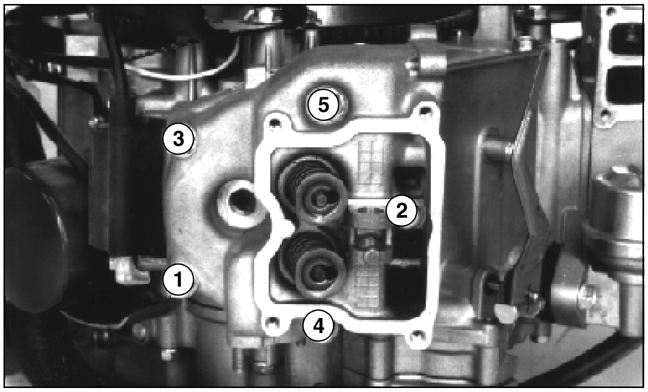
Installation



M84682

1. Install locator pins (A) (if removed).
2. Install new gasket (B).

NOTE: DO NOT tighten head mounting cap screws at this time.



M51710

3. Install both heads.
4. Install cap screws, finger-tight.
5. Install intake manifold. (See "Remove and Install Intake Manifold" on page 92.)

> **IMPORTANT: Avoid damage! Tighten cylinder head cap screws in the sequence shown to prevent warpage.**

6. Tighten cylinder head cap screws in specified step increments in the sequence shown to the initial torque specification.
7. Complete tightening the cylinder head cap screws to the final torque specification.
8. Install spark plug. Tighten to specification.
9. Install rocker arm assemblies. (See "Remove and Install Rocker Arm Assembly" on page 93.)
10. Install carburetor. (See "Remove and Install Carburetor" on page 89.)
11. Adjust valve clearance. (See "Check and Adjust Valve Clearance" on page 58.)
12. Install 48V alternator. (See "Remove and Install 48V Alternator" on page 73.)

Specifications

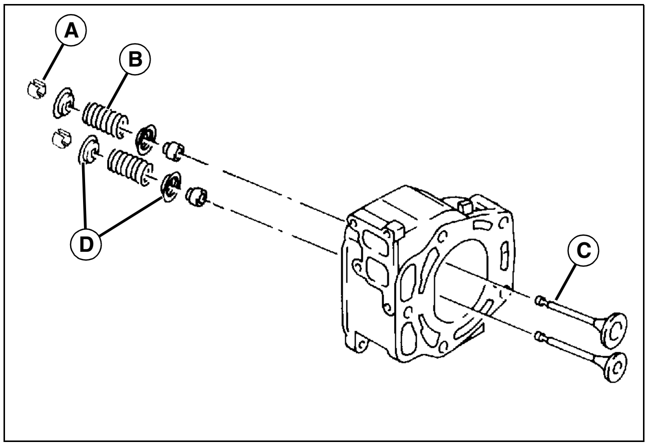
Cylinder Head Cap Screw Torque:

Initial Torque. 13 N•m (120 lb-in.)
Stepped Increase . . . . 3 N•m (27 lb-in.)
Final Torque . . . . 21 N•m (180 lb-in.)

Spark Plug Torque . . . . 25 N•m (221 lb-in.)

Disassemble and Assemble Cylinder Head and Valves

1. Compress valve springs using a suitable valve spring compressor.

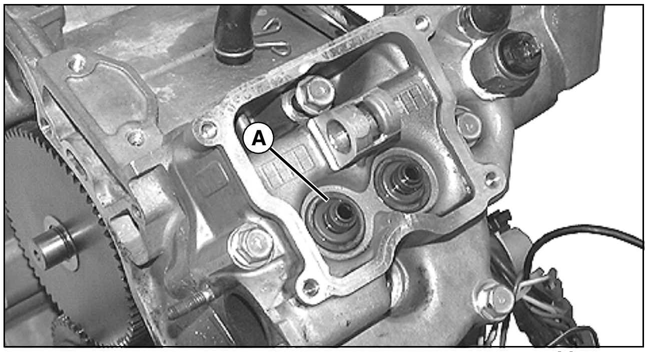


M82905AE

2. Remove keepers (A), retainers (D), springs (B), and valves (C).
3. Inspect all parts for wear or damage. (See "Inspect Cylinder Head and Valves" on page 96.)

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! Always use a new seal when valves are installed in the cylinder head. Also, replace the seals if they are deteriorated or damaged in any way. Never reuse an old seal.



M84728

- Replace valve stem seals (A).
- Apply clean engine oil on intake and exhaust valve stems during assembly.

Inspect Cylinder Head and Valves

Other Material

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

Cylinder Head

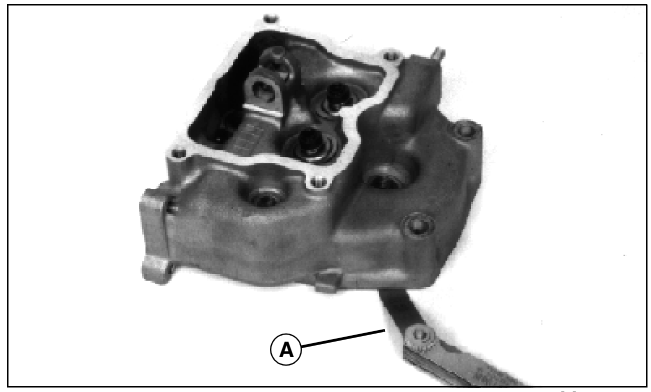
1. Remove carbon deposits from combustion chamber using SCOTCH-BRITE™ abrasive pads or an equivalent.

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

2. Clean head with a suitable solvent and dry with compressed air.

3. Inspect head for cracks or broken cooling fins.

4. Inspect gasket surface for burrs and nicks.

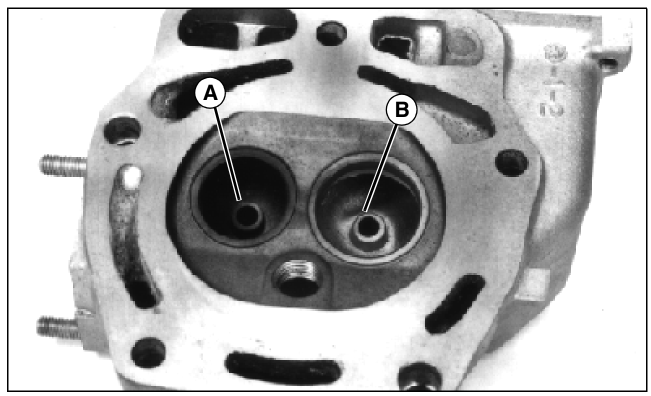


M51712

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

Valve Guides

NOTE: Intake and exhaust valve guides cannot be replaced. Replace cylinder head if worn.



M51713

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

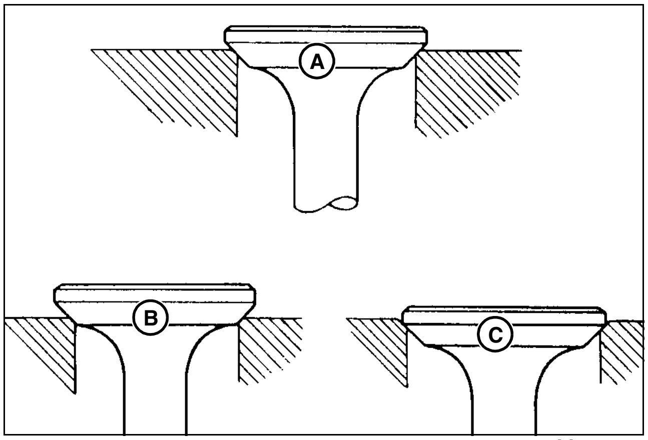
2. Measure inside diameter of the intake valve guide (B) in three locations along length of guide. Replace cylinder head if inside diameter is greater than wear limit.

3. Measure inside diameter of the exhaust valve guides (A) in three locations along length of guide. Replace cylinder head if inside diameter is greater than wear limit.

Valve Seats

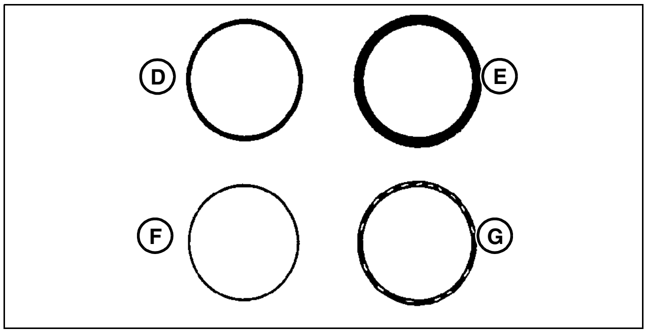
1. Remove carbon and deposits from valve seat and port areas.

NOTE: If valve seats are loose, warped, or distorted beyond reconditioning, replace the cylinder head. Pitted or worn seats can be reconditioned using a suitable valve seat cutter.



M18615

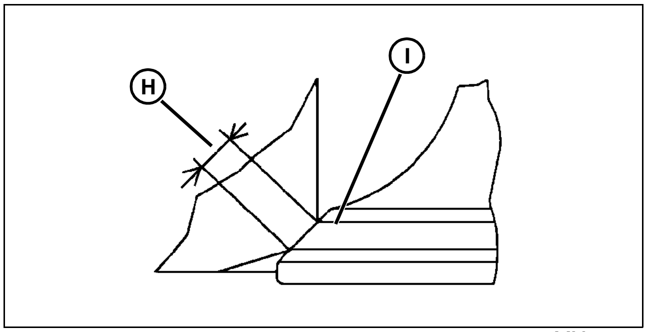
A - Correct Seat Position
B - Valve Too High
C - Valve Too Deep



MX6288

Picture Note: Valve Seat Patterns

D - Correct
E - Too Wide
F - Too Narrow
G - Uneven Wear



MX6287

2. Check valve face (I) for correct valve seat contact width (H), correct seat position, width, and even contact all around. If not within specification, recondition seats and reface or replace valves. (See “Recondition Valve Seats” on page 99.)

a. Coat the valve seat with machinist’s dye.

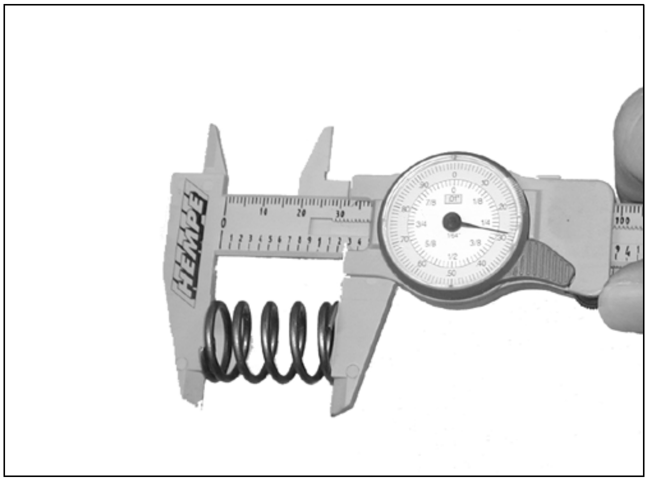
b. Install valve and rotate against the seat using a lapping tool.

c. Remove valve. Inspect the seat and valve face contact areas and measure width.

3. Lap valves prior to installation and recheck seat width and contact pattern. (See “Lap Valves” on page 100.)

Valve Springs

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



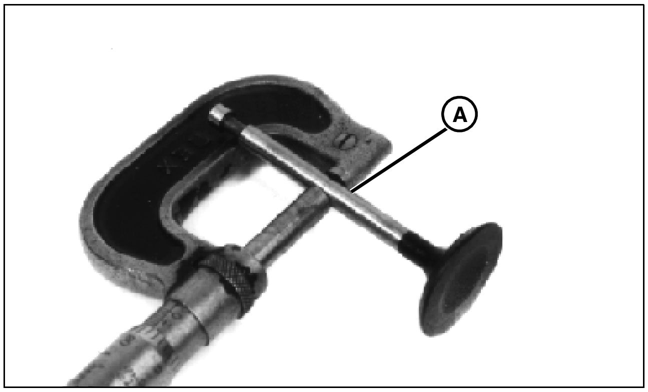
MX6291

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

Intake and Exhaust Valves

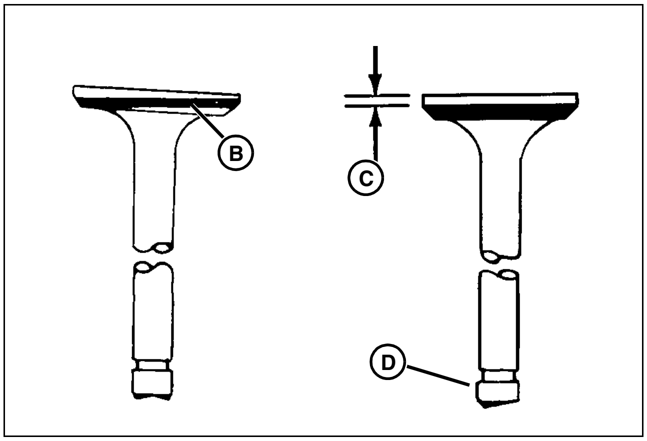
1. Remove carbon from valve head, face and stem with a power-operated wire brush. Be sure carbon is removed, not merely burnished.

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



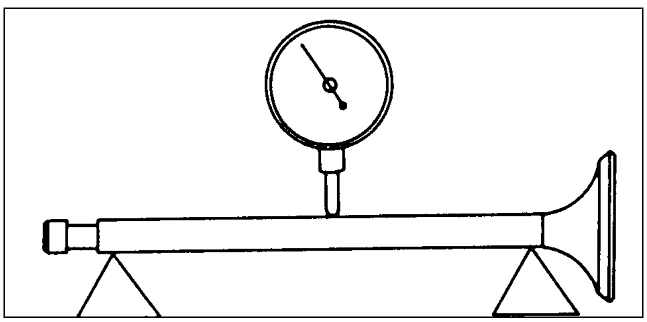
M53961

3. Measure the diameter of the valve stem (A) in two directions at right angles, at four different positions on the stem. Replace if diameter is less than specification.



M38087

4. Replace warped valves (B) or valves with a margin less than specification (C). Valve stem ends (D) should be ground square before checking valve-to-rocker arm clearance.



M51753

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

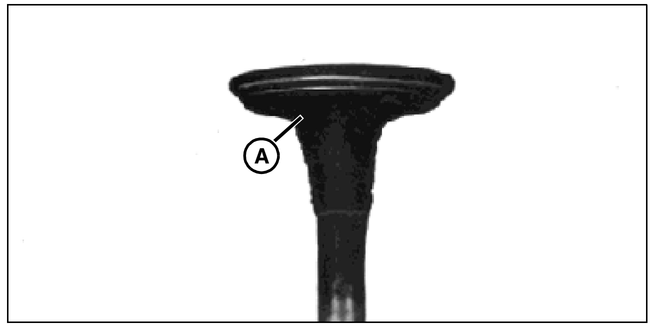
Specifications

Cylinder Head Distortion (Max)	**0.06 mm (0.002 in.)**
Valve Spring Free Length (Min)	**29.70 mm (1.17 in.)**
Intake Valve Guide ID (Max)	**6.05 mm (0.238 in.)**
Exhaust Valve Guide ID (Max)	**6.06 mm (0.239 in.)**
Intake Valve Stem OD (Min)	**5.95 mm (0.234 in.)**
Exhaust Valve Stem OD (Min)	**5.92 mm (0.233 in.)**
Valve Stem Bend (Max)	**0.05 mm (0.002 in.)**
Valve Margin (Min)	**0.60 mm (0.024 in.)**
Valve Seat Angle (Intake and Exhaust)	**45°**
Valve Face Angle (Intake and Exhaust)	**45°**

Valve Seat Width

Intake and Exhaust (Nominal)	**0.50-1.10 mm (0.020-0.043 in.)**
Wear Limit (Intake and Exhaust)	**2.00 mm (0.08 in.)**

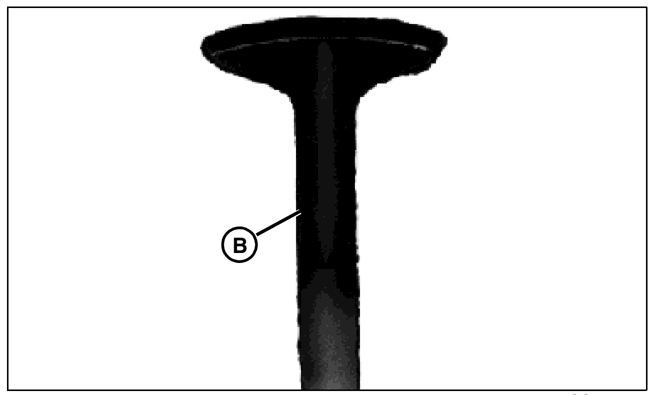
Analyze Valves



M29934

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

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

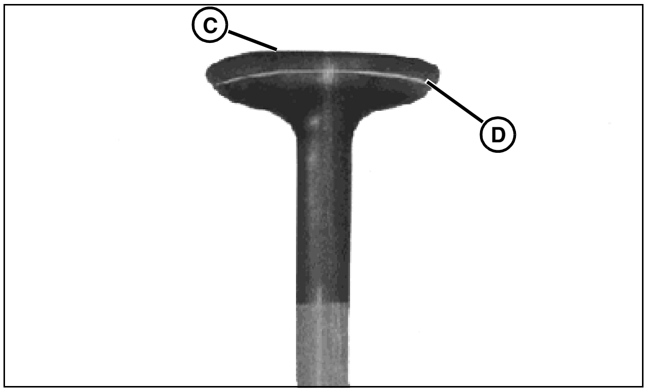


M5563

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

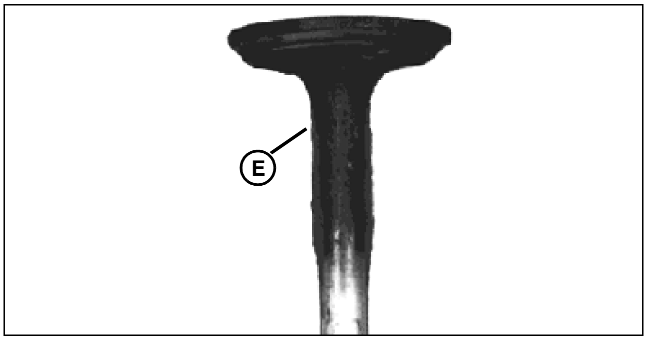
Valve corrosion can also occur during storage. Fogging or pouring oil in the combustion chamber before storing helps prevent valve corrosion.

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



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

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



M29936

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

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

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

Reconditon Valve Seats

Other Material

Part No.	Part Name	Part Use
NA	Prussian Blue Compound	Check valve seat contact.
NA	Valve Lapping Compound	Lap valves to seats after reconditioning.

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

NOTE: Hardened steel alloy intake and exhaust valve seat inserts are press fitted into the cylinder head. The inserts are not replaceable on the engine but can be reconditioned if not too badly pitted or distorted. If cracked or badly warped, the cylinder head must be replaced.

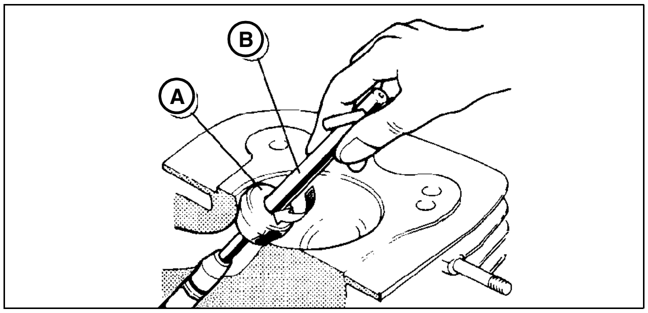
2. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.

3. Inspect the valve seat contact pattern. (See “Inspect Cylinder Head and Valves” on page 96)

4. Apply a light coat of machinist’s dye to the seat area to improve inspection as the seat is resurfaced.

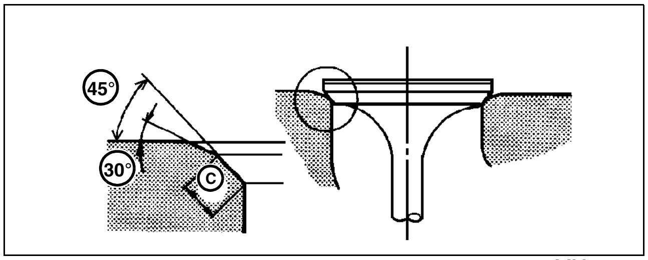
IMPORTANT: Avoid damage! ONLY turn cutter clockwise, DO NOT turn counterclockwise. Continue to turn cutter as you lift it off the valve seat.

NOTE: The valve guide must be in good condition to recondition seat properly.



MX6290

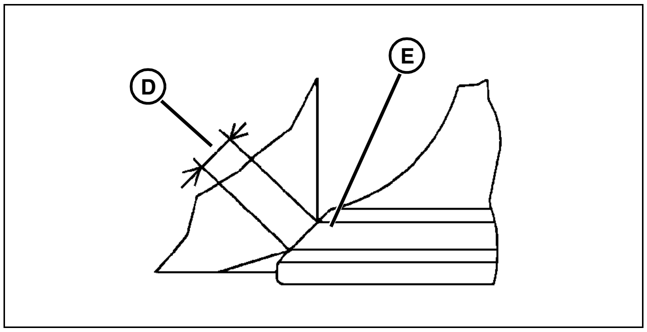
5. Resurface the seat using a 45° cutter (A) and driver (B). Remove only enough material to produce a fresh contact area all around the seat.



MX6294

6. Measure seat width (C).

- Use a 30° cutter to narrow a wide seat to specification.
- Continue to cut with a 45° cutter if the seat is still too narrow.



MX6287

7. Apply a light coating of machinist's dye to the seat. Install the valve and rotate against the seat using a valve lapping tool. Remove the valve and inspect the contact area (D) on the valve face (E).

8. If necessary, use a 30° cutter to "top dress" and narrow the valve seat, so that seat makes contact near the middle of the valve face.

9. Recheck valve seat width and adjust if necessary.

10.Lap valves. (See "Lap Valves" on page 100.)

Specifications

Valve Seat Angle (Intake and Exhaust). . . . . 45°
Valve Face Angle (Intake and Exhaust) . . . . 45°

Valve Seat Width

Intake and Exhaust
(Nominal). . . . . 0.50-1.10 mm (0.020-0.043 in.)
Wear Limit (Intake and Exhaust). . . . 2.00 mm (0.08 in.)

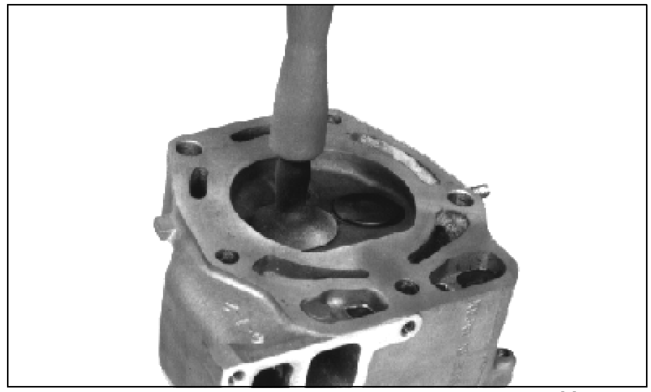
Lap Valves

Other Material

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

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

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

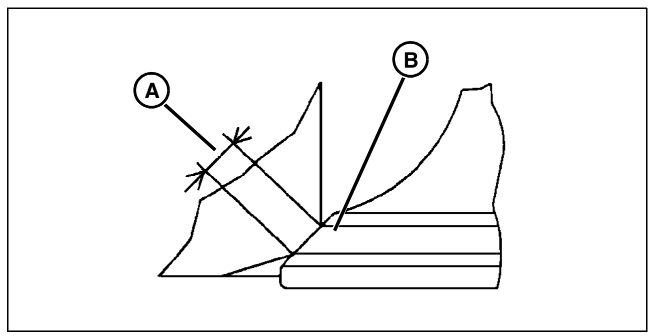


M51714

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

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

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



MX6287

A - Valve Seat Contact Area Width
B - Valve Face

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

Remove and Install Engine

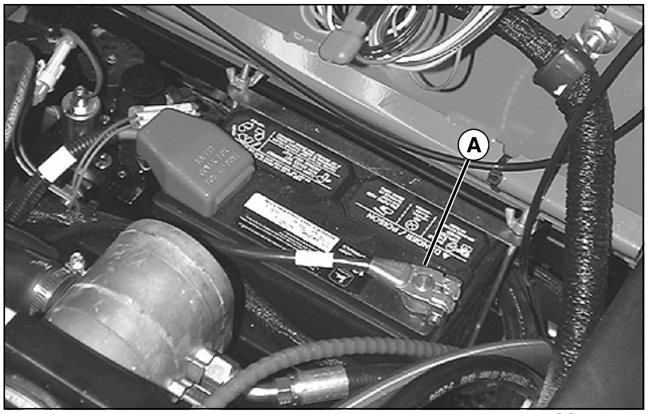
Removal

1. Remove Cowling. (See "Remove and Install Cowling" on page 798 in Miscellaneous section.)

2. Remove operator protective device (OPD). (See "Remove and Install Operator Protective Device (OPD)" on page 798 in Miscellaneous section.)

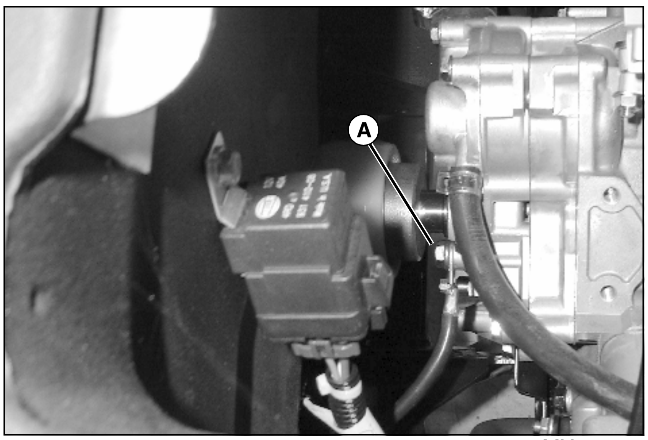
NOTE: 2500E may require the 48V alternator to be removed to remove muffler.

3. Remove muffler. (See "Remove and Install Muffler" on page 79.)



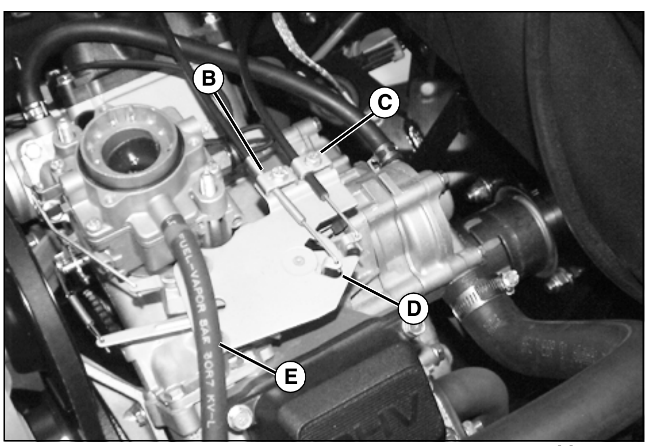
M98530

4. Disconnect negative (—) battery cable (A) at battery.



MX18021

5. Disconnect battery negative (—) cable (A) from engine block.



M98475

Picture Note: 2500 model shown. 2500A is similar.

6. Remove throttle cable clamp (B).

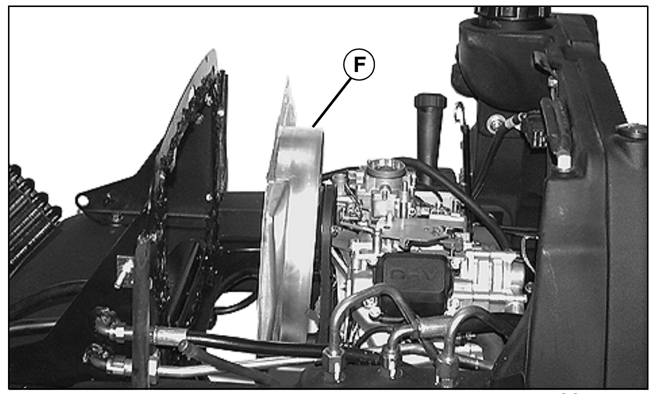
7. Remove choke cable clamp (C).

8. Disconnect throttle and choke cables at throttle plate (D).

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

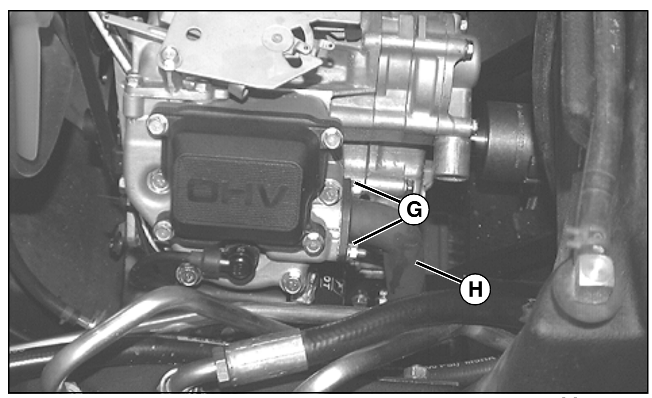
9. Note hose routing to aid in assembly. Disconnect fuel hose (E) at carburetor. Plug fuel hose and wipe up spilled fuel IMMEDIATELY.

10.Remove radiator. (See “Remove and Install Radiator” on page 77.)



M98556

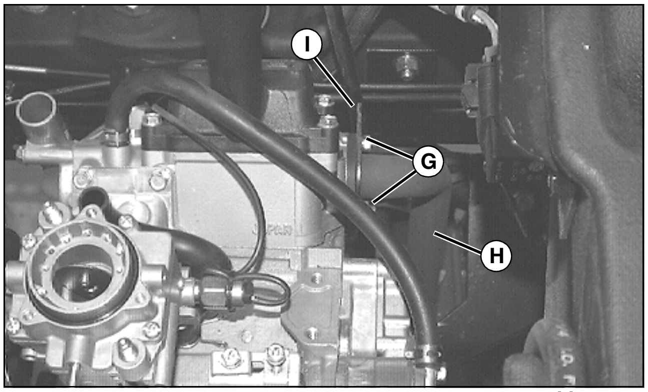
11.Remove fan shroud (F).



M98533

12.Remove nuts and washers (G).

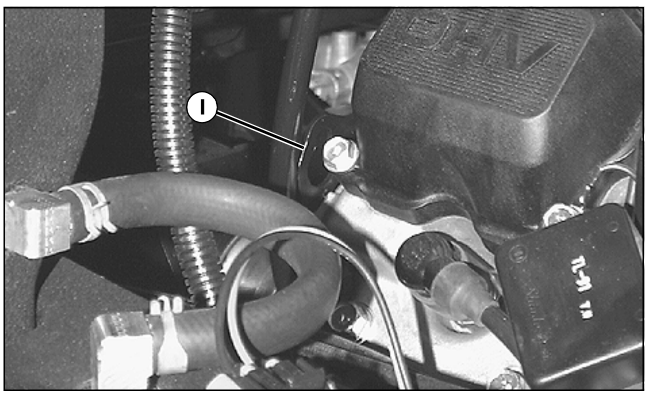
13.Remove right exhaust pipe (H) and gasket.



M98534

14.Remove nuts and washers (G).

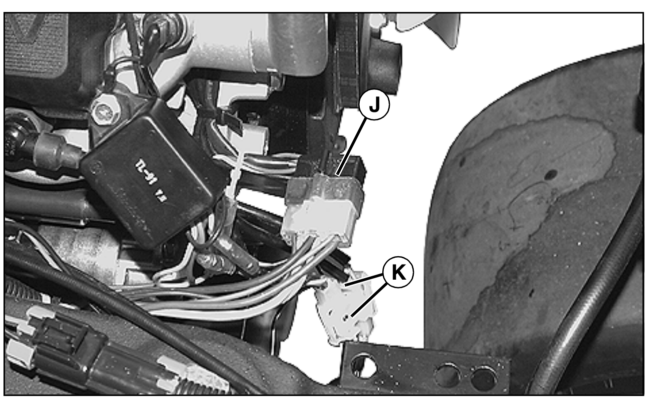
15.Remove left exhaust pipe (H), gasket and lifting eye bracket (I).



M98535

Picture Note: 2500 model shown. 2500A is similar.

16.Install lifting eye bracket (I) on studs using washers and nuts.

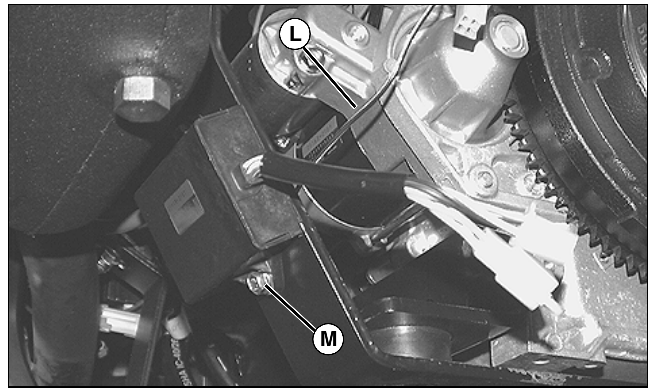


M98536

Picture Note: 2500 model shown. 2500A is similar.

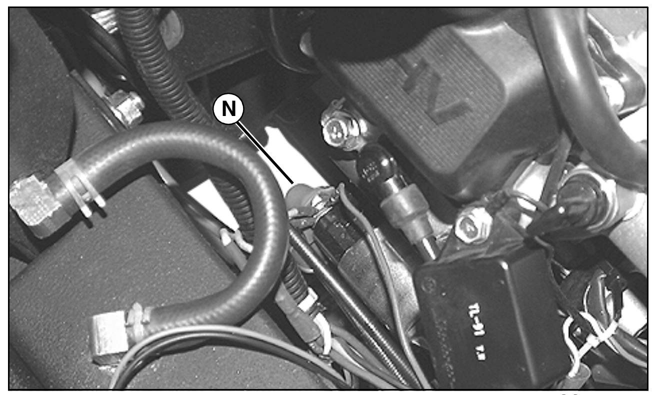
17.Disconnect engine/main harness wiring connector (J).

18.Disconnect ignition module harness connectors (K).



M98538

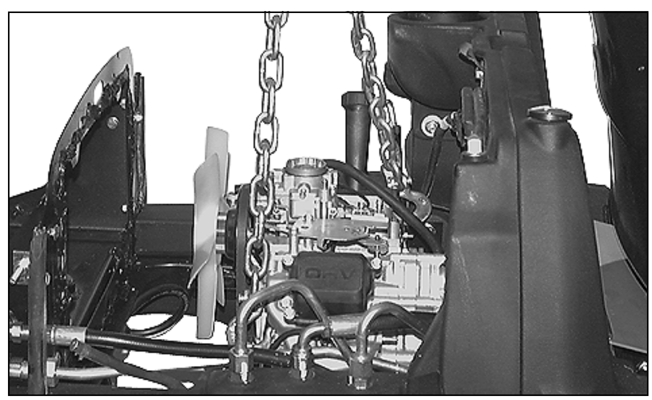
19.**2500 Models Only:** Remove ignition module mounting screw and nut (M) and disconnect ground wire (L).



M98539

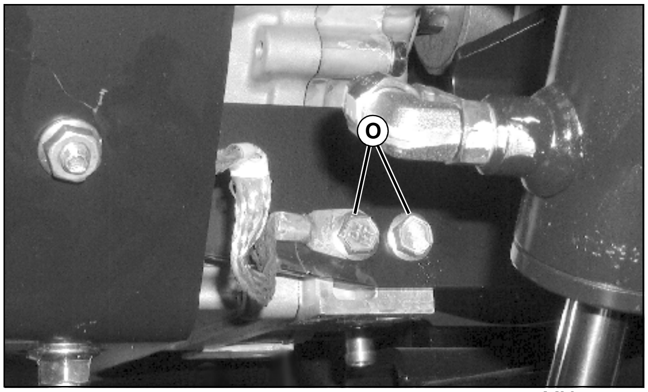
Picture Note: 2500 model shown. 2500A is similar.

20.Disconnect wires (N) from starting motor solenoid.



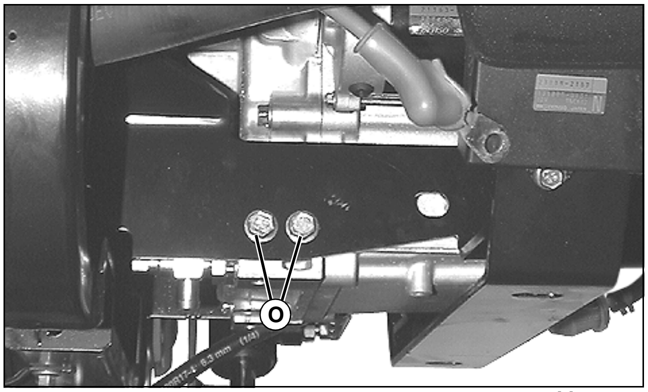
M98545

21.Attach a hoist to the lifting eye brackets.



MX18020

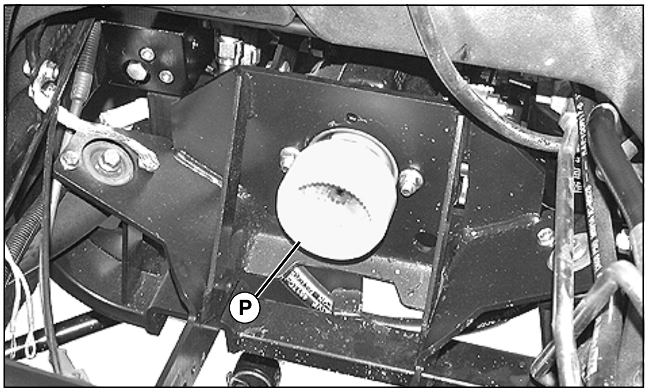
22.Remove right front engine mounting cap screws (O). Note that the engine-to-chassis ground strap is also retained by one of the cap screws on 2500A models.



M98543

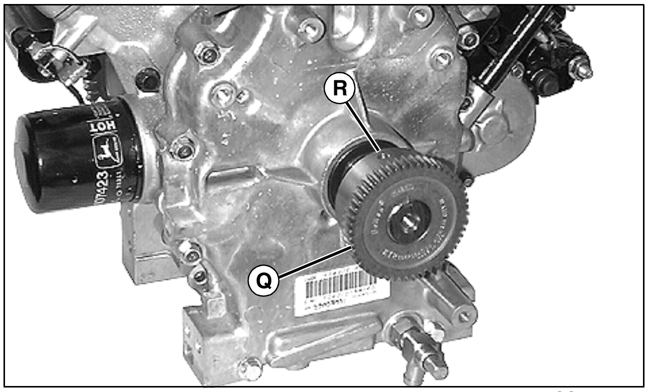
23.Remove left front engine mounting cap screws (O).

24.Lift engine from machine.



M98555

25.Inspect flex coupler (P) for wear or damage. Replace as needed.



M98554

26.If the engine is to be repaired:

- Drain engine oil.
- Remove coupler gear (Q) and key.

Installation

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

Installation is done in the reverse order of removal.

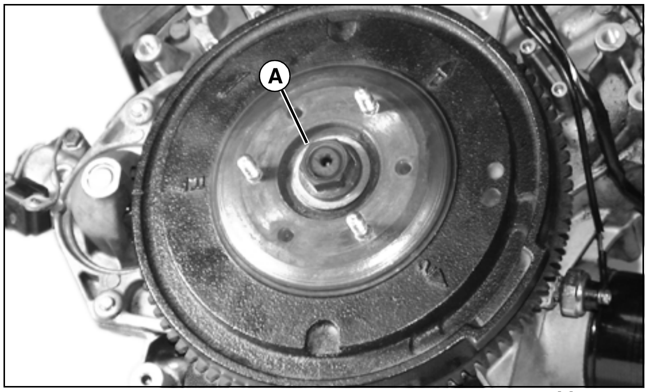
- Apply MPG-2 Multipurpose Polymer Grease to engine crankshaft.
- Tighten coupler socket head cap screws to specification.
- Tighten engine mounting cap screws to specification.
- Fill engine to proper level with oil of the correct specifications. (See “Engine Oil” on page 20.)
- Fill engine cooling system to proper level with coolant of correct specifications. (See “Coolant Specifications” on page 22.)
- Adjust throttle and choke cables. (See “Adjust Throttle Cable” on page 54 and “Adjust Choke Cable” on page 55.)
- Connect battery cable negative cable LAST.

Specifications

Crankcase Capacity . . . . 1.9 L (2.0 qt)
Engine Mounting Cap Screw. . . . . 41 N•m (30 lb-ft)
Coupler Socket Head Cap Screw . . . . . 62 N•m (46 lb-ft)

Remove and Install Flywheel

1. Park machine safely.
2. Remove engine from machine. (See “Remove and Install Engine” on page 100.)
3. Remove cooling fan, fan belt, and two pulleys. (See “Remove and Install Cooling Fan” on page 74.)
4. Remove pulser coils. (See “Remove and Install Pulser Coil” on page 125.)



M84813

5. Remove mounting nut (A).

6. Remove flywheel using a flywheel puller.

7. Inspect flywheel for cracks, chips and broken teeth. Replace as necessary.

Installation

Installation is done in the reverse order of removal.

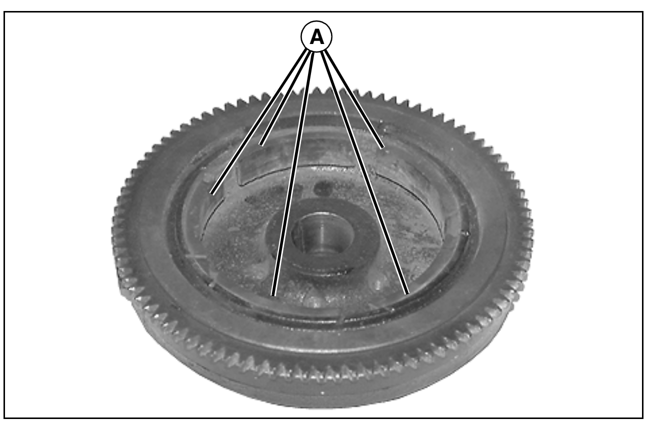
IMPORTANT: Avoid damage! Improperly installed flywheel can cause machine damage and serious personal injury.

- Tighten mounting nuts to specification, then loosen nut and retighten to specification to ensure complete seating of the flywheel.

Specifications

Flywheel Mounting Nut Torque . . . . . 110 N•m (80 lb-ft)

Inspect Flywheel



M98786

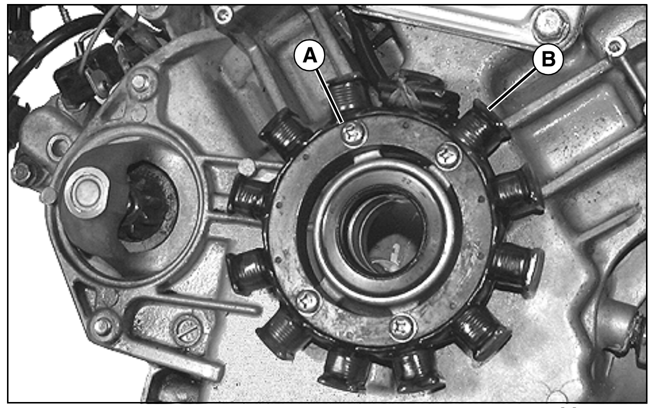
Hold a steel tool about 25 mm (1.0 in.) from the stator magnets (A). The tool should be attracted to the magnets. Replace the flywheel if the tool is not attracted to the magnets.

Remove and Install Stator

1. Remove engine from machine. (See “Remove and Install Engine” on page 100.)

2. Remove flywheel. (See “Remove and Install Flywheel” on page 103.)

3. Remove fan mounting bracket. (See “Remove and Install Fan Mounting Bracket” on page 74.)



M84744

4. Remove four cap screws (A) and stator (B).

Installation

Installation is done in the reverse order of removal.

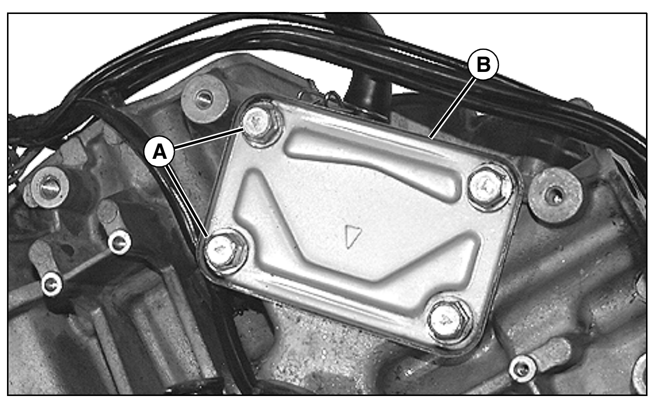
- Tighten all cap screws to specification.

Specifications

Stator Screw Torque . . . . 3.4 N•m (30 lb-in.)

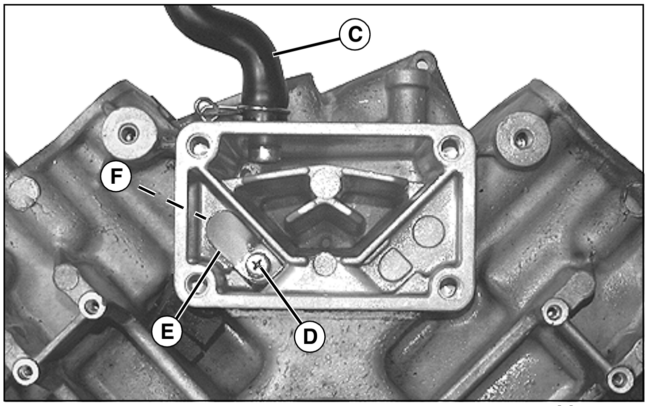
Remove and Install Breather

1. Remove fan mounting bracket. (See “Remove and Install Fan Mounting Bracket” on page 74.)



M84745

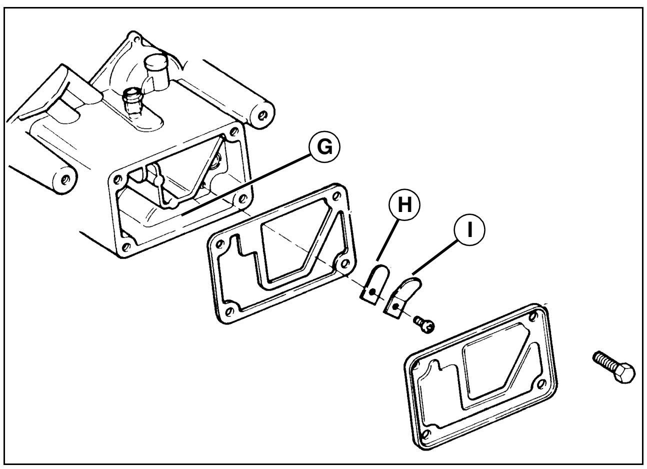
2. Remove four cap screws (A) and breather cover (B).



M84746

3. Remove screw (D), reed valve (F) and reed retainer/ back plate (E).

4. Remove breather vent tube (C). Inspect tube for tears or other damage. Replace if necessary.

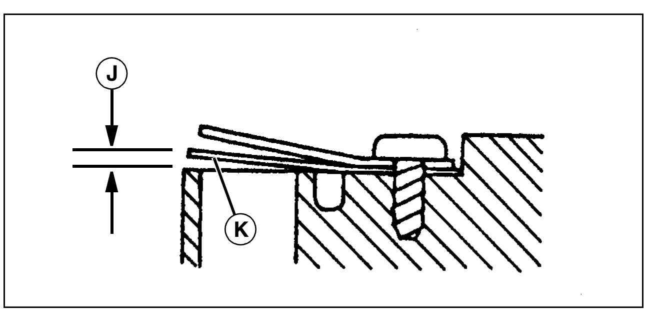


M54277

5. Check that drain hole (G) in bottom of breather chamber is open.

6. Inspect reed valve (H) for breakage, hairline cracks or distortion. Replace if necessary.

7. Inspect reed retainer/back plate (I) for damage or rough contact surface.



M51757

8. Check reed valve (K) tip air gap (J). Gap should be to specification.

Installation

Installation is done in the reverse order of removal.

- Tighten all cap screws to specification.

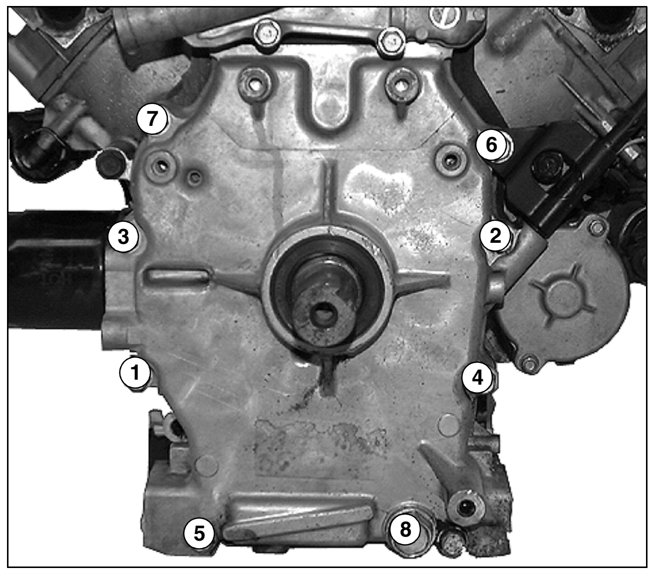
Specifications

Breather Air Gap . . . . 0.2 mm (0.008 in.)
Breather Cover Cap Screw Torque . . 20 N•m (177 lb-in.)

Remove Crankcase Cover

1. Drain oil from crankcase. Capacity is approximately 1.8 L (1.9 qt.)

2. Remove coolant pump. (See “Remove and Install Coolant Pump” on page 75.)



M84676

3. Remove eight cap screws in sequence shown.

4. Pry crankcase cover from crankcase using a flat blade screwdriver.

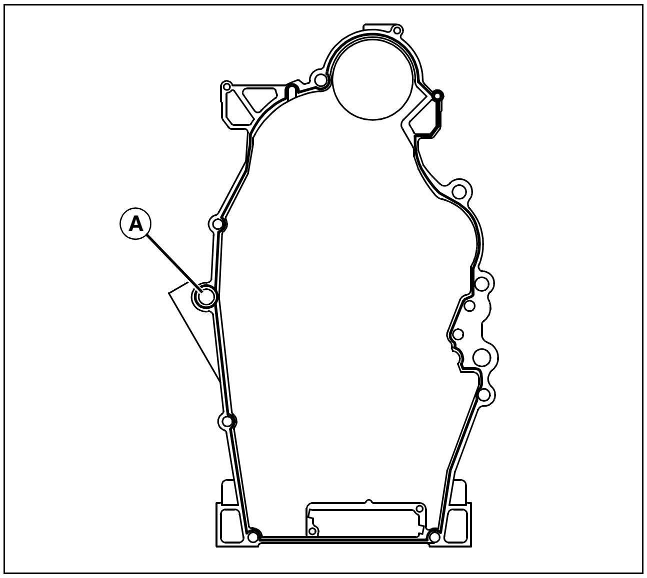
5. Clean mating surfaces of crankcase and crankcase cover.

6. Inspect crankcase cover. (See “Inspect Crankcase Cover” on page 106.)

7. Replace crankcase cover seal. (See “Crankcase Cover - Oil Seal Replacement” on page 107.)

Install Crankcase Cover

IMPORTANT: Avoid damage! DO NOT get sealant in oil passage. Apply just enough to seal both sides of oil passage when case halves are fastened together.



M84749

1. Install new O-ring in oil passage (A).

2. Apply 1.6 mm (1/16 in.) bead of RTV silicone sealant to crankcase cover flange. DO NOT block oil passage.

3. Apply grease to inside lip of crankcase cover seal.

IMPORTANT: Avoid damage! Be sure to align flats of governor cross shaft before installing crankcase cover.

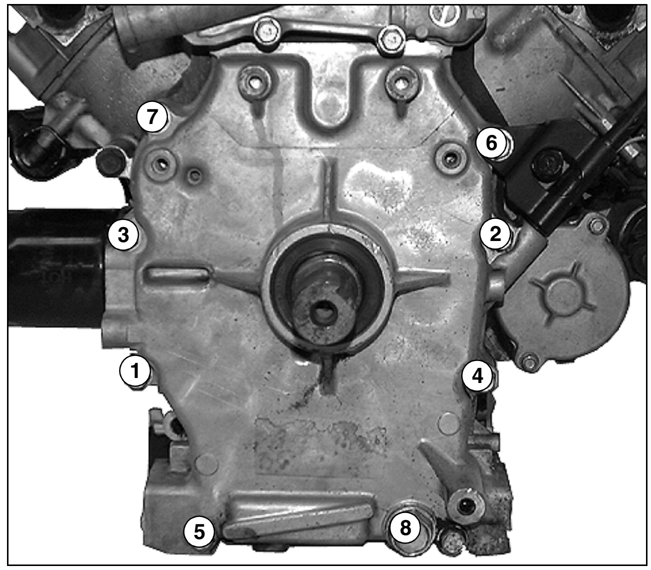
NOTE: Install crankcase cover crankshaft carefully to avoid damaging crankcase cover seal.

4. Install cover onto crankcase.

IMPORTANT: Avoid damage! DO NOT force cover. Gears must mesh for proper positioning.

Use new gasket for installation. DO NOT get sealant in oil passage. Apply just enough to seal both sides of oil passage when case halves are fastened together.

Do not completely tighten one screw before tightening the others. Tighten crankcase screws evenly in stages to final torque. If one screw is tightened completely before the others, it may cause the crankcase to warp.



M84676

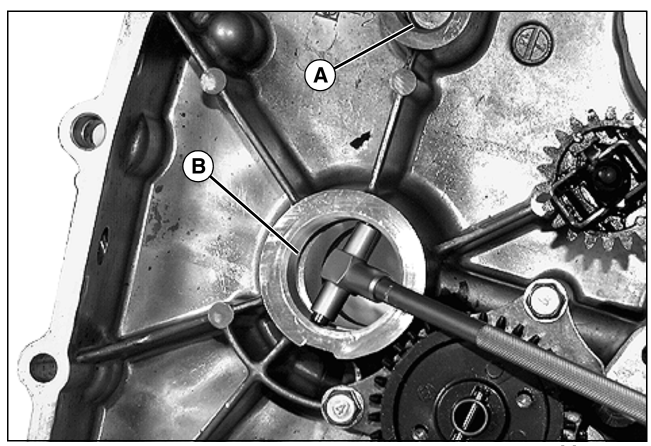
5. Tighten crankcase cover cap screws evenly in stages. Tighten in sequence shown to specification.

Specifications

Crankcase Cover Cap Screw . . . . . . 24 N•m (216 lb-in.)

Inspect Crankcase Cover

Procedure



M84748

1. Measure crankshaft bore (B) inside diameter in crankcase cover. Replace crankcase cover if bore exceeds specification.

2. Check bore for nicks or cracks. Replace crankcase cover if bore is damaged.

3. Measure camshaft bore (A) in crankcase cover. Replace cover if inside diameter is greater than specification.

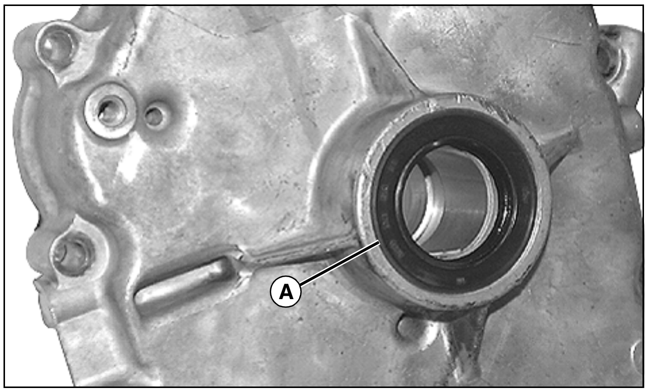
4. Inspect crankcase cover for nicks or damage. Replace crankcase cover as needed.

Specifications

Maximum Crankshaft Bore ID
Crankcase Cover . . . . 34.066 mm (1.341 in.)
Maximum Camshaft Bore ID
Crankcase Cover . . . . 16.07 mm (0.633 in.)

Crankcase Cover - Oil Seal Replacement

IMPORTANT: Avoid damage! DO NOT damage seal bore when removing seal.



M84689

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

2. Apply a light coat of clean engine oil to outside diameter of oil seal.

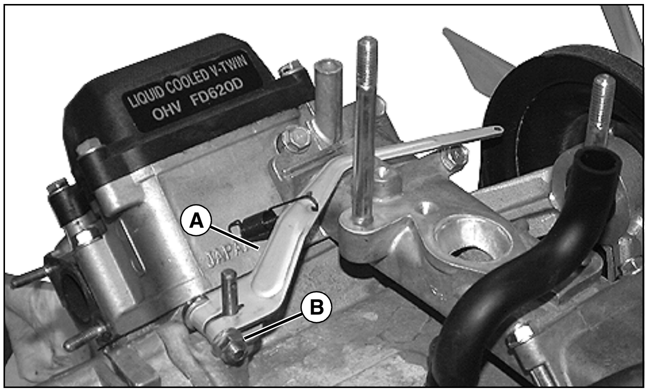
3. Drive oil seal into crankcase cover using appropriate driver until the seal is flush with the flange surface.

4. Apply multipurpose grease to the lips of the seal.

Remove and Install Governor Arm

Removal

1. Remove carburetor and throttle plate assembly. (See "Remove and Install Carburetor" on page 89.)

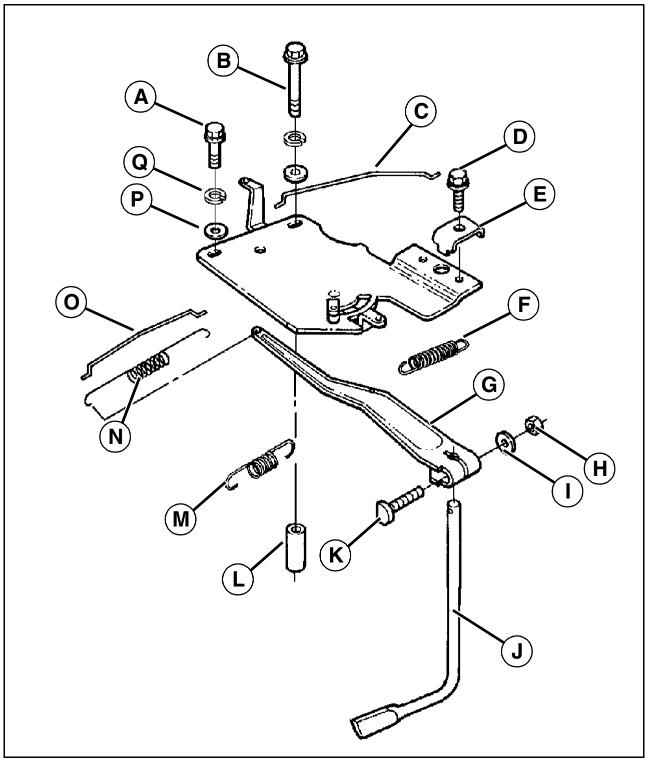


M84673

2. Loosen clamp nut (B).

3. Remove governor arm (A).

Installation



M84796

A - Cap Screw
B - Cap Screw
C - Link
D - Cap Screw
E - Clamp
F - Spring
G - Governor Arm
H - Nut
I - Washer
J - Governor Cross Shaft
K - Bolt
L - Bushing
M - Governor Spring
N - Throttle Link Spring
O - Throttle Link Rod
P - Washer
Q - Lock Washer

1. Install governor arm (G) onto governor cross shaft (J) temporarily.

2. Install throttle plate assembly. (See "Remove and Install Carburetor" on page 89.)

3. Connect governor arm (G) with governor spring (M).

4. Install carburetor except for air cleaner base plate. (See “Remove and Install Carburetor” on page 89.)

NOTE: Be sure link spring around throttle link rod is in place and that it pulls governor arm and throttle lever to each other.

5. Loosen clamp nut on governor arm enough to move governor shaft.

6. Turn top end of governor arm counterclockwise to fully open carburetor throttle valve and hold it there.

NOTE: Be sure governor shaft extends from governor arm to specification.

7. Turn governor shaft counterclockwise by inserting a needle into hole in shaft end hole. Fully turn shaft to end of its travel and tighten clamp nut to specification.

Specifications

Governor Arm Clamp Nut Torque . . . . 8 N•m (69 lb-in.)
Distance Between Governor Shaft and Governor Arm . . . . 7 mm (0.3 in.)

Remove Piston and Connecting Rod

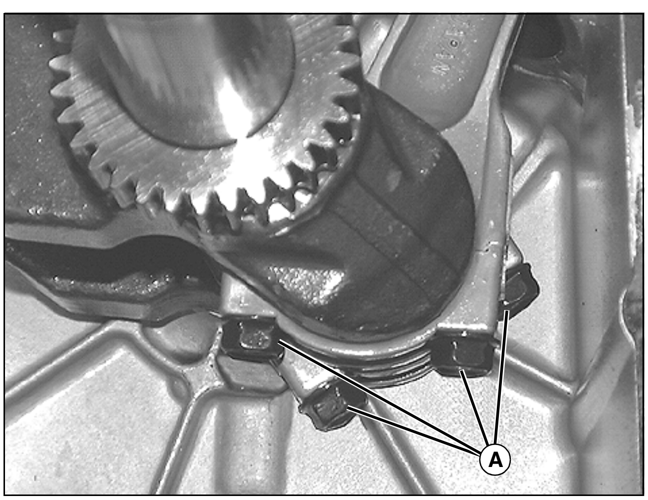
NOTE: The thermostat is located on the No. 2 cylinder head.

1. Remove cylinder head (See “Remove and Install Cylinder Head” on page 94).

2. Remove camshaft. (See “Remove and Install Camshaft and Tappet” on page 116.)

3. Check cylinder bore for carbon and varnish ridges. These ridges can cause piston damage if not removed. If necessary, remove ridges from top of cylinder bore with ridge reamer.

4. Rotate crankshaft to expose connecting rod end caps.



M84683

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

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

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

Install Piston and Connecting Rod

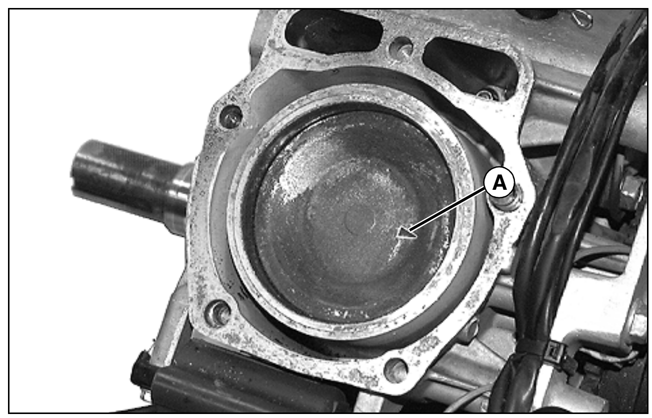
1. Hone cylinder bore. (See “Cylinder Bore Honing” on page 115.)

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

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

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

NOTE: Gently tap piston with wood dowel - DO NOT force.

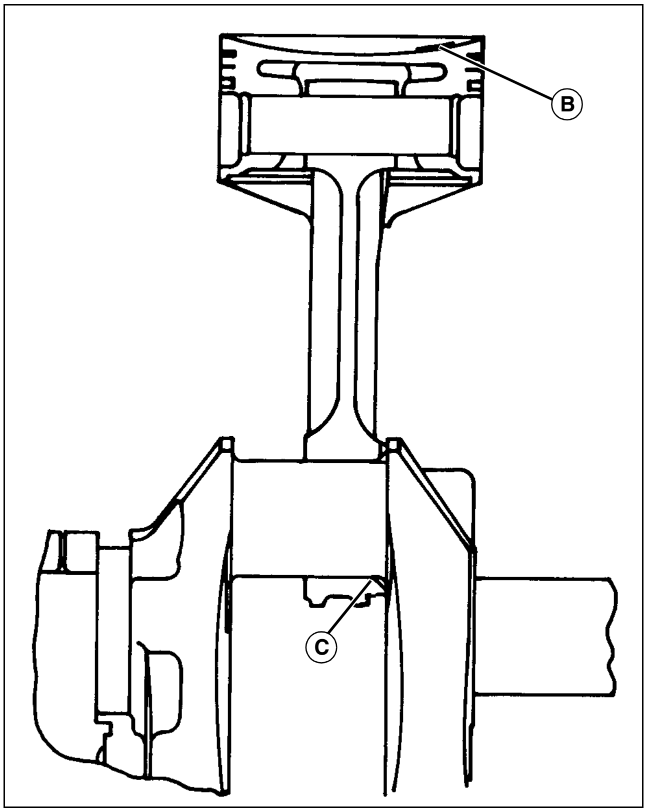


M84691

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

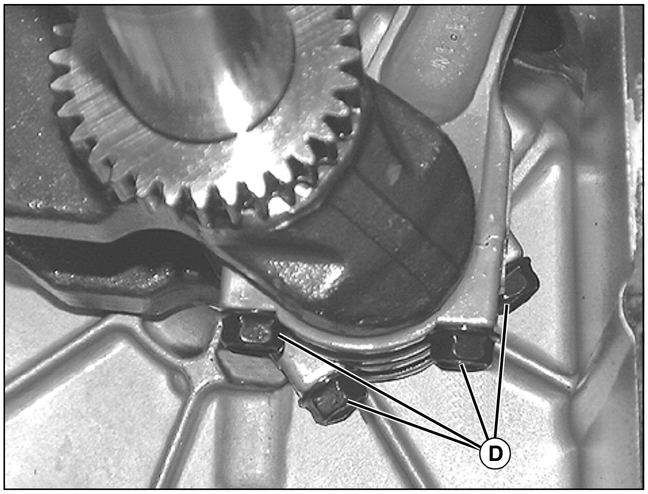
IMPORTANT: Avoid damage! Match mark (B) on pistons must face flywheel. Large chamfer (C) of connecting rods must be against crankshaft web. (Opposite each other.)

NOTE: No. 1 cylinder shown.



M51727

6. Install piston and connecting rod assembly in cylinder bore with arrow match mark (B) on piston head facing flywheel side of engine.



M84683

7. Apply a light film of clean engine oil to cap bearing surface and cap screws (D).

8. Install connecting rod cap with chamfer facing crank web. Tighten cap screws to specification.

9. Install camshaft. (See “Remove and Install Camshaft and Tappet” on page 116).

10.Install cylinder heads. (See “Remove and Install Cylinder Head” on page 94).

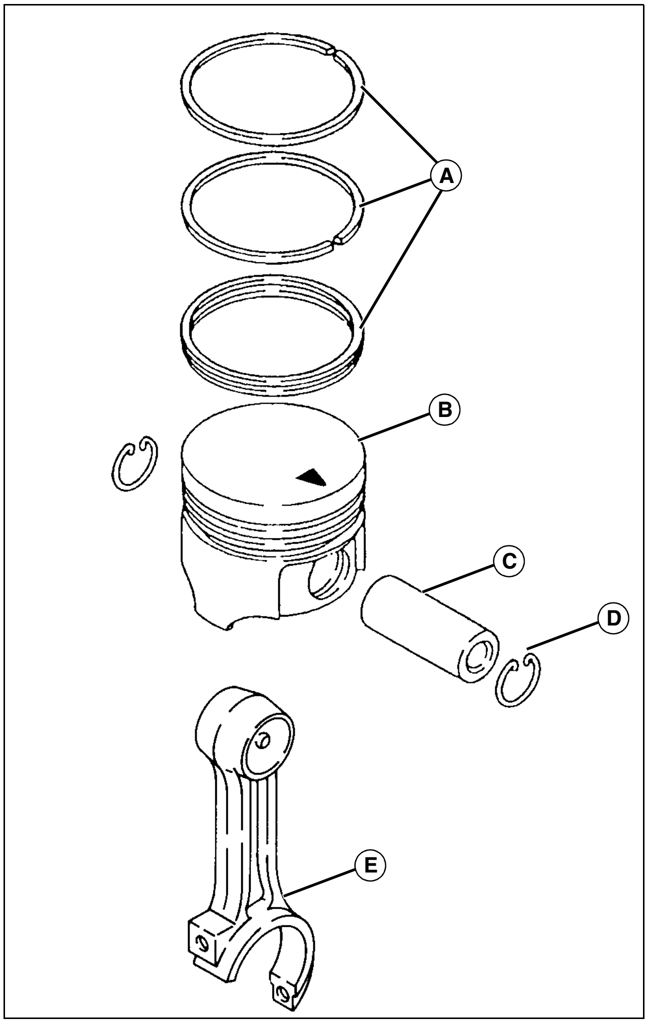
11.Install crankcase cover. (See “Install Crankcase Cover” on page 106.)

Specifications

Connecting Rod Cap Screw . . . . 21 N•m (186 lb-in.)

Disassemble Piston and Connecting Rod

IMPORTANT: Avoid damage! Note location of arrow match mark on piston head in relation to MADE IN JAPAN on connecting rod. No. 1 piston is opposite No. 2 piston. Keep parts together as a set.



M82902A

- Analyze piston (B) and piston ring (A) wear. (See “Analyze Piston Ring Wear” on page 113.)

- Mark each piston and connecting rod (E) to aid in assembly.
- Remove piston rings (C) with a piston ring expander.
- Inspect all parts for wear or damage. Replace as necessary. (See "Install Piston and Connecting Rod" on page 108).

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

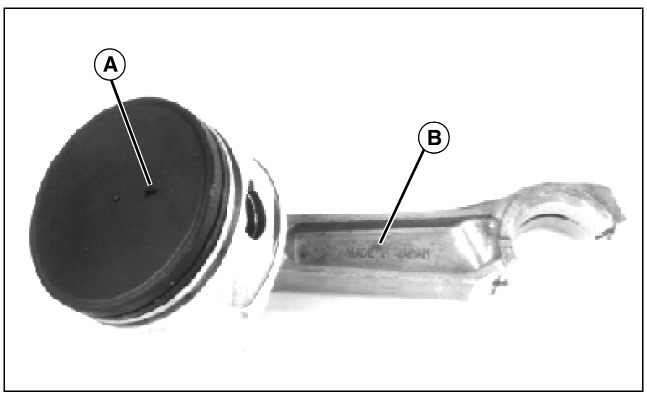
Assemble Piston and Connecting Rod

Apply a thin film of clean engine oil to piston pin and connecting rod bearing during assembly.

NOTE: With pistons installed, No. 1 piston is designated by the large chamfer on connecting rod facing toward flywheel.

No. 2 piston is designated by the large chamfer on the connecting rod facing away from flywheel.

The arrow match mark on both piston heads should point toward the flywheel.

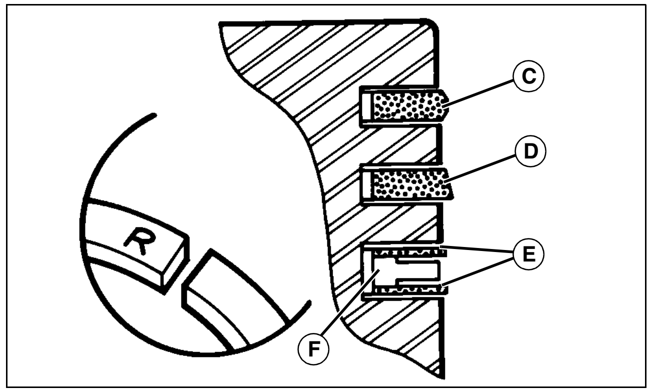


M38111

1. Assemble pistons to connecting rods:
   - No. 1 piston: Align arrow match mark (A) on piston head with "MADE IN JAPAN" (B) on connecting rod.
   - No. 2 piston: Align arrow match mark on piston head opposite "MADE IN JAPAN" on connecting rod.

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

2. Install piston pin with new retaining rings.
3. Before installing rings on piston, check ring end gap in cylinder bore. (See "Inspect Piston Rings" on page 112).



M38074

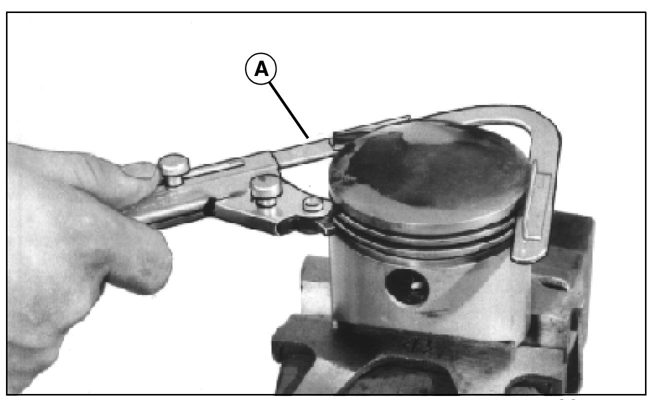
4. Install oil control and compression rings:
   - Oil ring: Install spacer (F), then side rails (E). Position lower side rail end gap approximately 45° away from arrow match mark on top of piston. Align upper side rail end gap 180° to lower side rail end gap.
   - Install second compression ring (D) in middle groove with "R" or "NPR" mark facing up. Ring should turn freely in groove. Turn ring until gap is aligned with lower oil ring side rail end gap.
   - Install first compression ring (C) in top groove. Ring should turn freely in groove. Turn ring until gap is aligned with upper oil ring side rail end gap.

Inspect Piston and Connecting Rod

Inspect Piston

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

1. Remove all deposits from the piston.



M29946

2. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it to carefully clean groove.
3. Check that all oil return passages in grooves are open.

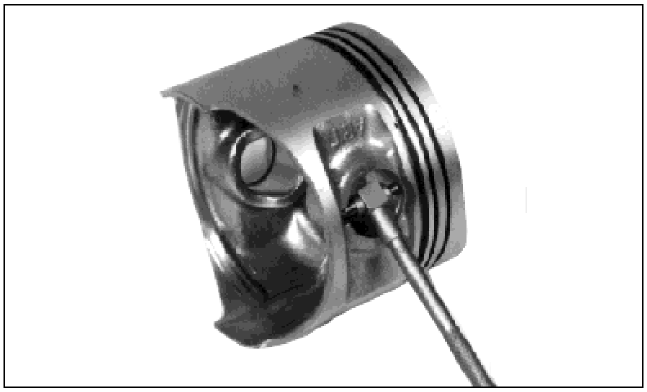
4. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

MX11833

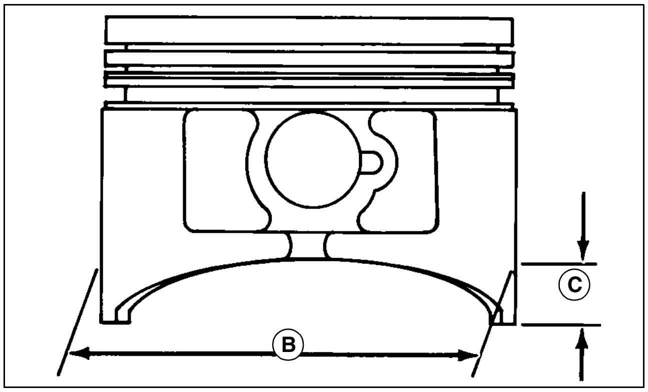
5. Using a new ring, check top compression ring-to-groove clearance at several points around piston. Replace piston if clearance is greater than specification.

6. Using a new ring, check second compression ring-to-groove clearance at several points around piston. Replace piston if clearance is greater than specification.



M80427

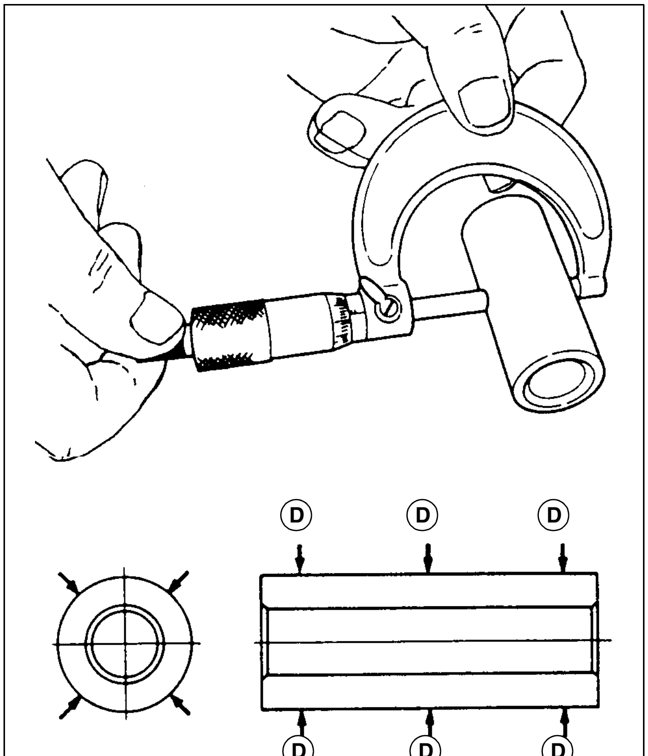
7. Measure piston pin bore diameter in piston. Replace piston if measurement is greater than specification.



8. Measure piston outside diameter (B) at a point 11 mm (0.433 in.) from the bottom of the skirt (C) and perpendicular to piston pin. If piston diameter is less than specification, install a new piston.

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

9. Measure cylinder bore diameter. (See “Inspect Cylinder Block” on page 120).

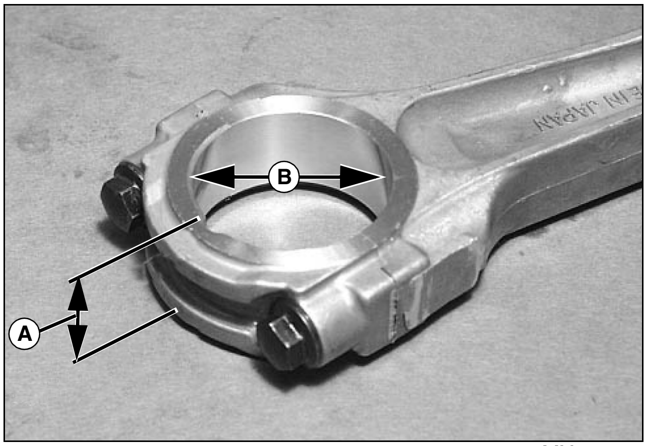


M82050A

10.Measure piston pin diameter at six places (D). Replace pin if measurement is less than specification.

Inspect Connecting Rod

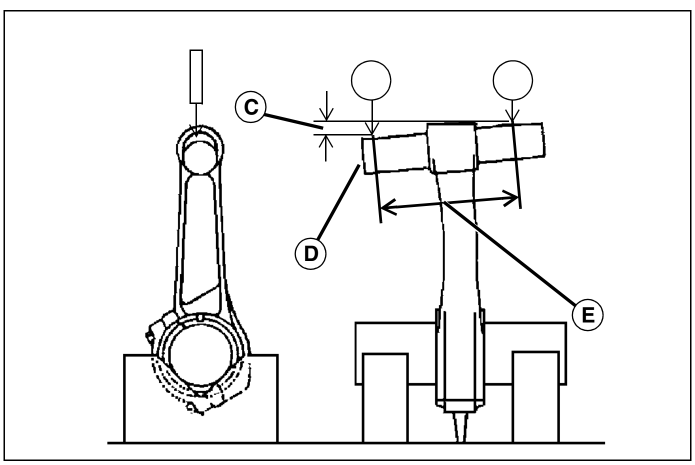
1. Remove pistons and connecting rods. (See "Remove Piston and Connecting Rod" on page 108.)



MX16152

2. Apply a light film of oil to the threads of the cap screws. Install the rod cap and the cap screws and tighten the cap screws to 21 N•m (186 lb-in.). Measure the inside diameter (B) of the large end at several points with a telescoping gauge or inside micrometer. If the inside diameter is greater than the service limit, the rod and cap must be replaced.

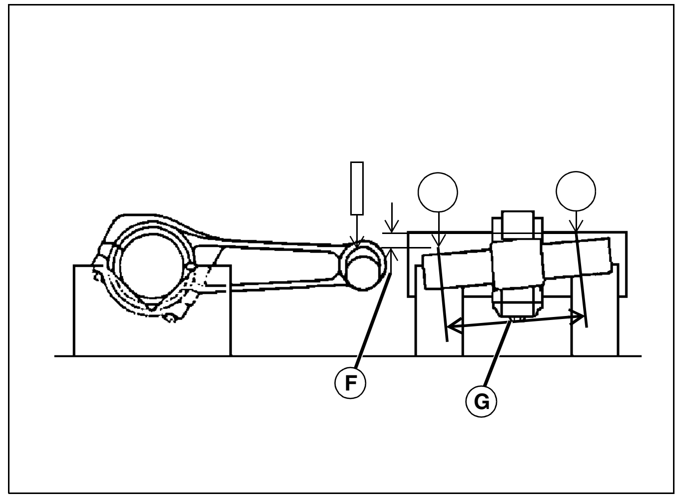
3. Measure the connecting rod large end width (A) with a micrometer or dial caliper. If the measurement is less than the service limit, the rod must be replaced.



MX11898

4. Measure connecting rod bend. Insert an arbor the same size as the large end through the connecting rod large end. Insert an arbor (D) the same diameter as the small end and at least 100 mm (3.397 in.) long through the connecting rod small end. Place V-blocks on a surface plate, and support the large end arbor in the V-blocks.

5. Hold the small end of the rod straight up vertically and measure from the surface plate to the small end arbor on both sides of the connecting rod. Measurements must be taken at a point that is exactly 100 mm (3.397 in.) apart (E). The difference between the two measurements determines the rod bend (C). If the connecting rod bend exceeds the service limit the rod and rod cap must be replaced.

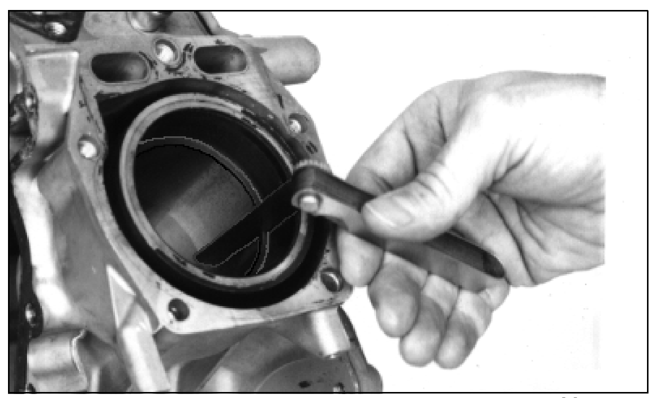


MX11901

6. Measure connecting rod twist. With the large end mounted in V-blocks, hold the connecting rod horizontally and measure the amount that the small end arbor varies (F) from being parallel with the surface plate over a 100 mm (3.94 in.) length (G). If twist exceeds the service limit the rod and cap must be replaced.

7. Install the connecting rods and pistons. (See "Remove Piston and Connecting Rod" on page 108.)

Inspect Piston Rings



M53962

Check piston ring end gap.

- Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
- Check end gap. Replace ring if end gap is greater than specifications.

Specifications

Maximum First Compression Ring-to-Groove Side Clearance . . . . 0.15 mm (0.006 in.)

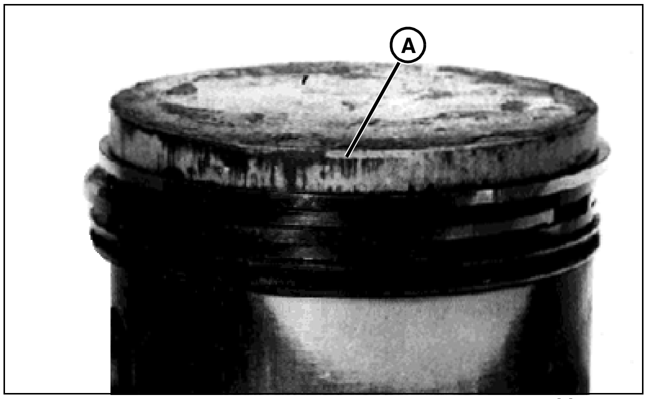
Maximum Second Compression Ring-to-Groove Side Clearance . . . . 0.12 mm (0.005 in.)

Minimum Piston Pin OD. . . . . 16.975 mm (0.668 in.)
Maximum Piston Pin Bore ID. . . . . 17.04 mm (0.671 in.)
Minimum Piston OD (Standard) . . . . 75.875 mm (2.987 in.)
Minimum Piston OD (Oversize) . . . . 76.375 mm (3.007 in.)
Maximum End Gap Compression Rings . . . . 1.20 mm (0.05 in.)
Maximum End Gap Oil Control Ring (Side Rails) . . . . 1.50 mm (0.06 in.)
Connecting Rod Large End Width Service Limit . . . . 21.20 mm (0.83 in.)
Connecting Rod Large End Inside Diameter Service Limit . . 34.055 mm (1.3407 in.)
Connecting Rod Bend Service Limit. . . . . . 0.15. mm (0.006 in.) over 100 mm (3.94 in.)
Connecting Rod Twist Service Limit. . . . . . . 0.15 mm (0.006 in.) over 100 mm (3.94 in.)

Analyze Piston Ring Wear

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

Ring end gaps should be staggered on the piston during installation. (See “Assemble Piston and Connecting Rod” on page 110.) End gaps in alignment can also cause oil consumption and blow-by.

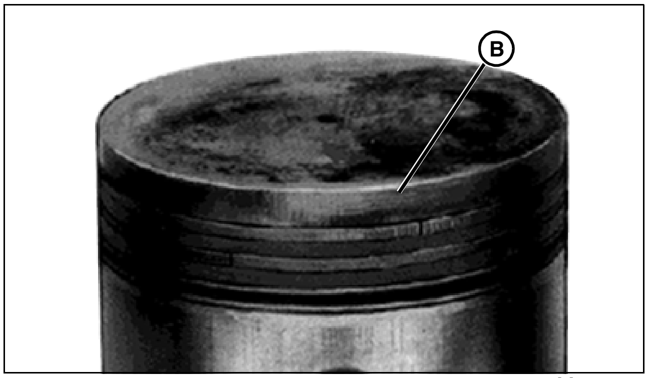


M29943

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

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

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

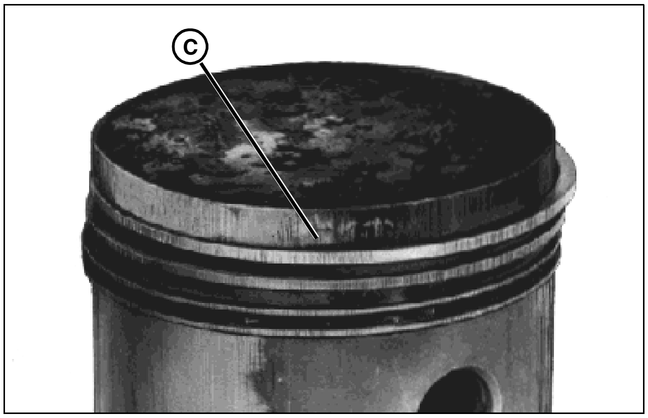


M29944

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

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

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



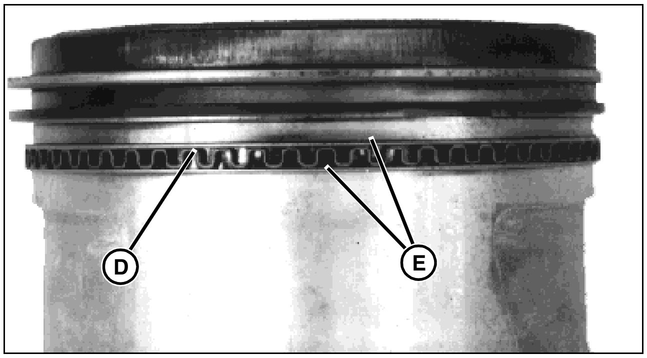
M29945

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

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

- Damaged, collapsed, or improperly installed air filter.
- Loose connection or damaged basket between air cleaner and carburetor.

- Air leak around carburetor-to-cylinder head gasket.
- Air leak around throttle shaft.
- Failure to properly clean cylinder bore after reconditioning engine.



M38101

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

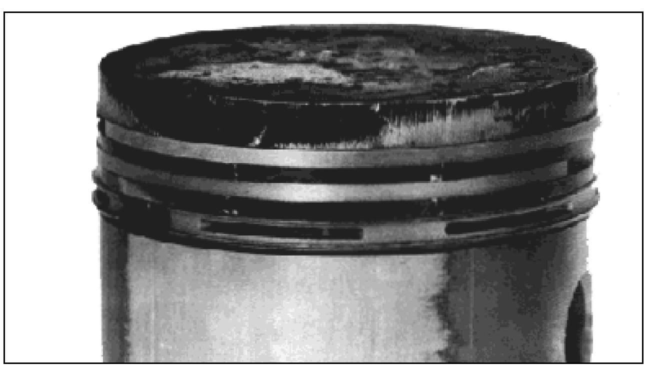
- High oil consumption.
- Increased deposits in combustion chamber.
- Sticking compression rings.

Increased oil consumption may be caused by:

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

Analyze Piston Wear

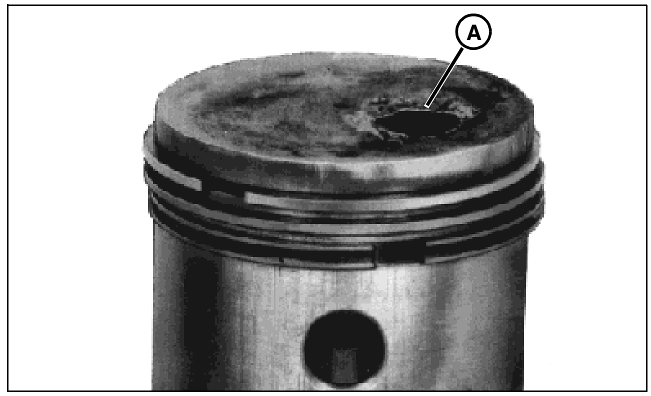
Detonation is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called knock, spark knock or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.



M29947

The following is a list of possible causes for detonation.

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

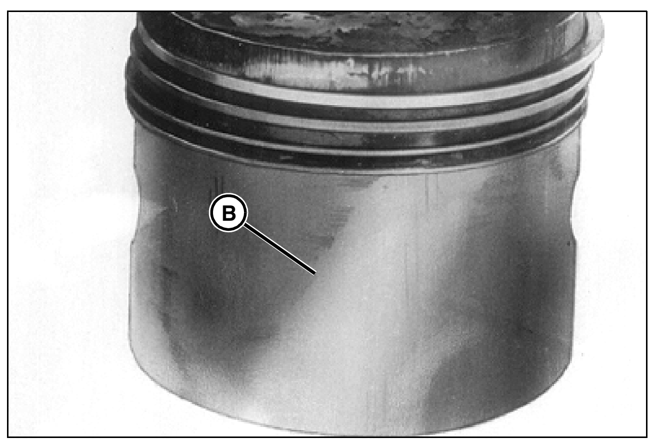


M30039

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

Check the following for causes of pre-ignition:

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



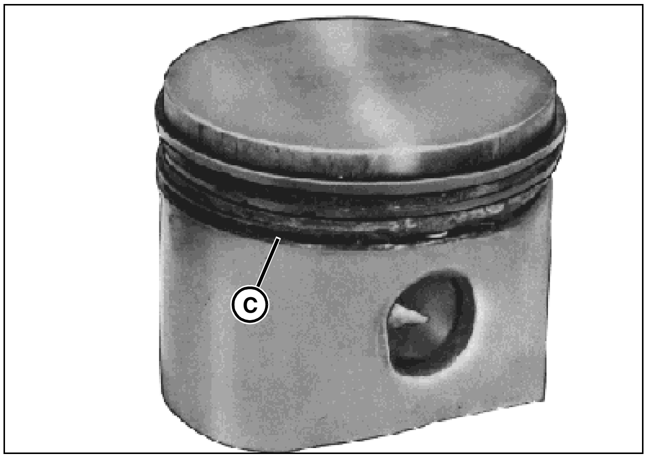
M29948

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

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

This condition causes:

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



M29949

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

Retaining rings loosen or break due to:

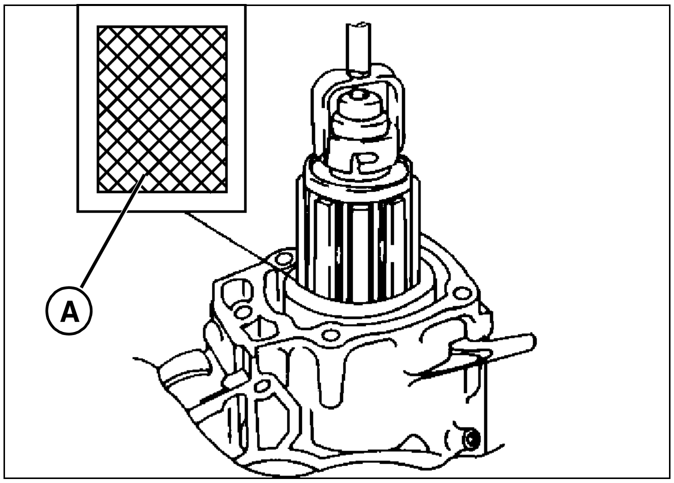
- Rod misalignment.
- Excessive crankshaft end play.
- Crankshaft journal taper.
- Weak retaining rings.
- Incorrectly installed retaining rings.

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

Cylinder Bore Honing

Procedure

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.



MX18271

1. The cylinder finish (cross hatch) should be applied after cylinder bore has been resized to within 0.007-0.009 mm (0.0003-0.0004 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).

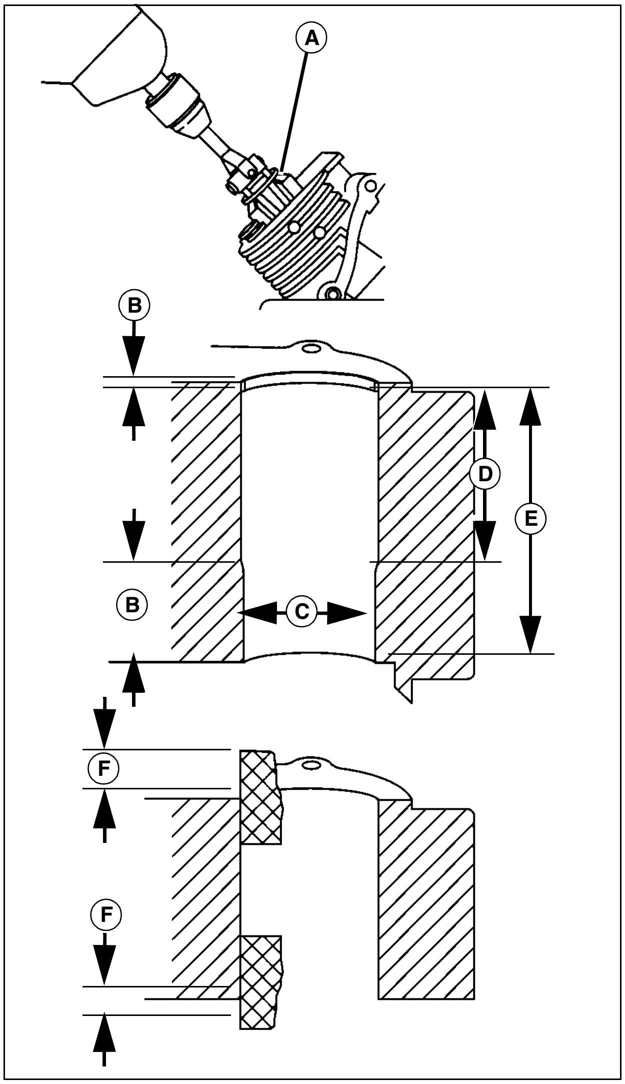
2. It is recommended that the cylinder bores be reconditioned to restore the cross hatch when new piston rings are to be installed in a cylinder that is within specification. Be careful not to hone oversize or it will be necessary to resize the cylinder.

IMPORTANT: Avoid damage! 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.

3. When cylinder and crankcase have been thoroughly cleaned, use a white rag or napkin and wipe the cylinder bore. If honing grit is present, it will appear as a grey residue on rag. If any honing grit is evident, re-wash and rinse entire cylinder and crankcase and check again. When cleaning is complete, oil cylinder bore to prevent rusting.

Cylinder Bore Resizing

Procedure



MX18276

1. If the cylinder bore is not within specifications, it will have to be resized using a boring bar or hone. Always resize to exactly 0.50 mm (0.020 in.) over standard size.

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

3. Because cylinder bores normally wear only in the area of ring travel (D), the cylinder bore will be round above and below ring travel (B).

IMPORTANT: Avoid damage! If a boring bar is used, a hone must be used after the boring operation to produce the proper cylinder cross hatch.

4. Place hone (A) at smallest diameter of cylinder bore (C). Tighten adjusting knob with finger until stones fit snugly against cylinder wall. DO NOT FORCE.

5. Connect drive shaft to hone. Be sure that cylinder and hone are centered and aligned with drive shaft and drill spindle. Lubricate hone as recommended by hone manufacturer.

6. The recommended drill speed is 300 to 700 rpm maximum and 40-60 strokes per minute.

7. Start drill and, as hone spins, move it up and down in the cylinder bore to create a proper crosshatch (See “Cylinder Bore Honing” on page 115.) until hone travels full length of cylinder bore (E). Do not travel more than 19.05 mm (0.750 in.) to 25.4 mm (1.0 in.) above or below cylinder bore (F).

8. Lubricate hone frequently to prevent build-up on stones.

9. As cutting tension decreases, stop hone and tighten adjusting knob following hone manufacturer’s recommendations.

10.Check cylinder bore size frequently.

11.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.

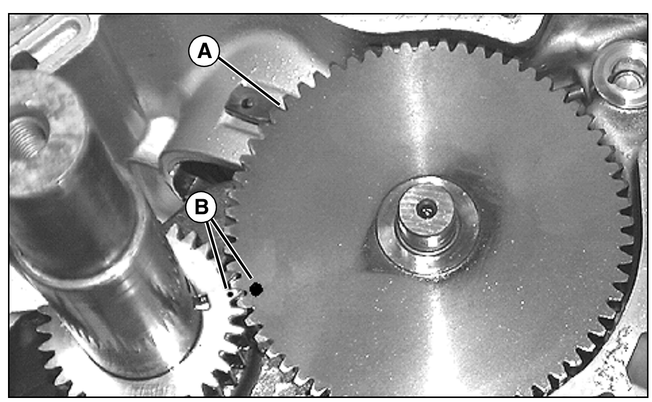
12.After cylinder bore has been brought to within 0.007-0.009 mm (0.0003-0.0004 in) of proper resizing dimension, a cross hatch must be applied to bore. (See “Cylinder Bore Honing” on page 115.)

Remove and Install Camshaft and Tappet

1. Remove rocker arm assemblies. (See “Remove and Install Rocker Arm Assembly” on page 93.)

2. Remove crankcase cover. (See “Remove Crankcase Cover” on page 105.)

IMPORTANT: Avoid damage! Align timing marks to prevent damage to tappets when removing camshaft.

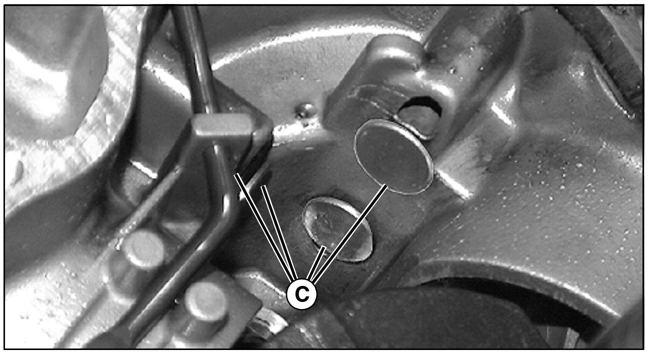


M84681

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

4. Remove and inspect camshaft (A). (See “Remove and Install Camshaft and Tappet” on page 116 and See “Inspect Camshaft” on page 117.)

NOTE: Mark tappets so they can be installed in their original guides during assembly.



M84685

5. Remove and inspect tappets (C) for wear or damage. Replace if necessary.

Installation

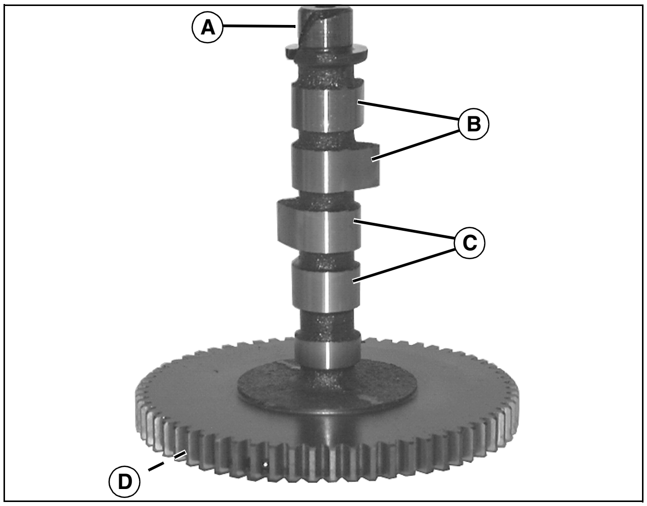
Installation is done in the reverse order of removal.

- Apply a light coat of clean engine oil to all parts before installing.
- Align timing marks when installing camshaft.

Inspect Camshaft

1. Inspect camshaft gear for pitting, fatigue cracks, burrs or uneven wear due to improper tooth contact. Replace camshaft if necessary.

2. Check for loose rivets holding gear to camshaft. Replace camshaft if loose.



M84687

3. Measure flywheel side journal (A) diameter. Replace camshaft if journal diameter is less than specification.

4. Measure PTO side journal (D) diameter. Replace camshaft if journal diameter is less than specification.

5. Measure intake cam lobe (B) height. Replace camshaft if love height is less than specification.

6. Measure exhaust cam lobe (C) height. Replace camshaft if love height is less than specification.

7. Measure camshaft bearing in cylinder block. (See “Inspect Cylinder Block” on page 120.)

8. Measure camshaft bearings in crankcase cover. (See “Inspect Crankcase Cover” on page 106.)

Specifications

Minimum Flywheel Side Journal Diameter . . . . 15.917 mm (0.627 in.)

Minimum PTO Side Journal Diameter . . . . 15.907 mm (0.626 in.)

Intake Cam Lobe Height . . . . 25.21 mm (0.993 in.)

Exhaust Cam Lobe Height. . . . . . . 25.46 mm (1.002 in.)

Remove and Replace Crankshaft

Procedure

1. Remove engine and drain oil. (See “Remove and Install Engine” on page 100.)

2. Remove flywheel. (See “Remove and Install Flywheel” on page 103.)

CAUTION: Avoid Injury! Used tappets are mated to their camshaft lobes. Mark them for installation in the same bore they were removed from.

3. Remove camshaft and tappets. (See “Remove and Install Camshaft and Tappet” on page 116.)

4. Remove connecting rod and piston assemblies. (See “Remove Piston and Connecting Rod” on page 108.)

5. Pull the crankshaft out of the crankcase. It may be necessary to tap on the crankshaft with a wood or plastic mallet to loosen the crankshaft.

6. Before installing the crankshaft, clean the crankshaft journals and the crankcase bearing surfaces thoroughly.

7. Pack high temperature grease into the crankcase oil seal.

8. Apply engine oil to the crank journals and bearing surfaces and carefully insert crankshaft into the main bearing and oil seal in the crankcase.

9. Install pistons and rods on crankshaft (See “Install Piston and Connecting Rod” on page 108).

10.Install camshaft and tappets. (See “Remove and Install Camshaft and Tappet” on page 116.)

11.Install a new crank oil seal if necessary in the crankcase cover. Install the crankcase cover. (See “Install Crankcase Cover” on page 106 and See “Crankcase Cover - Oil Seal Replacement” on page 107.)

Inspect Crankshaft

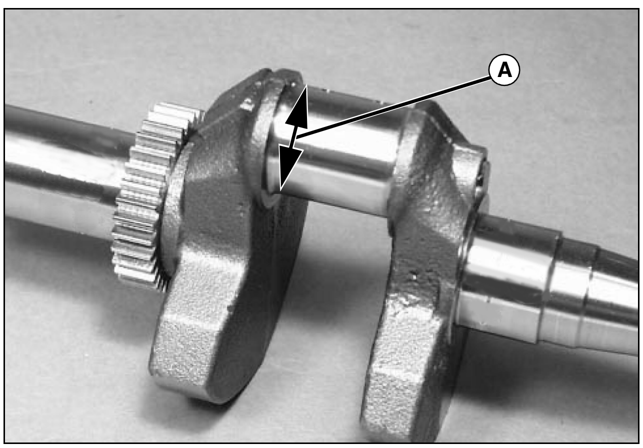
Procedure

1. Remove crankshaft. (See “Remove and Replace Crankshaft” on page 117.)

2. Clean the crankshaft and connecting rods with a high flash point solvent and dry with compressed air.

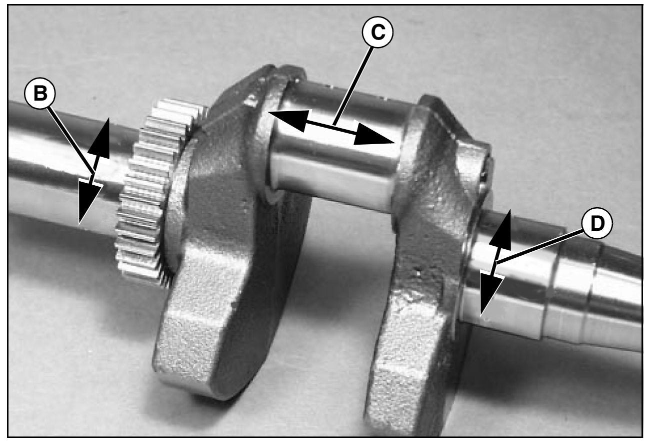
3. Inspect the teeth of the crankshaft gear for fatigue cracks, pitting or signs of uneven tooth contact. Replace crank gear if necessary.

4. Inspect the crankshaft and connecting rod bearing surfaces for excessive wear, uneven contact or gouging and scratching. Components should be replaced if any of these conditions exist.



MX16148

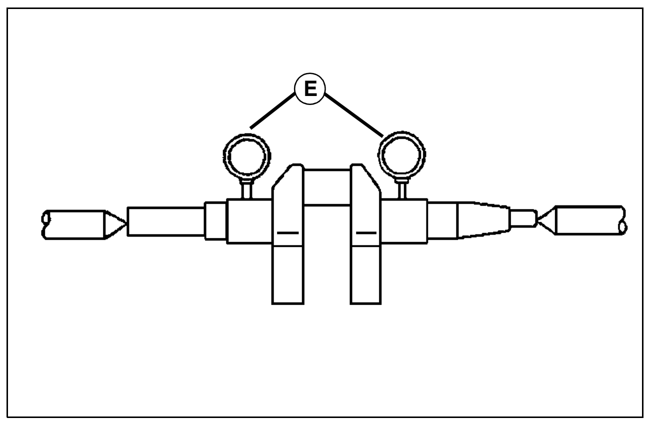
5. Measure the crankpin outside diameter (A) at several points around the circumference. If the crankpin diameter is less than the service limit at any point, replace the crankshaft.



MX16148

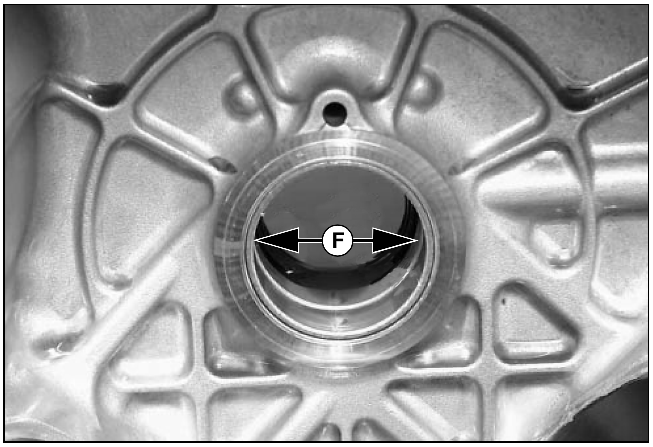
6. Measure the crankpin width (C) at several points with a dial caliper. If crankpin width exceeds the service limit at any point, replace the crankshaft.

7. Measure the flywheel side (D) and PTO side (B) main journals at several points. If either journal is less than the service limit, the crankshaft must be replaced.



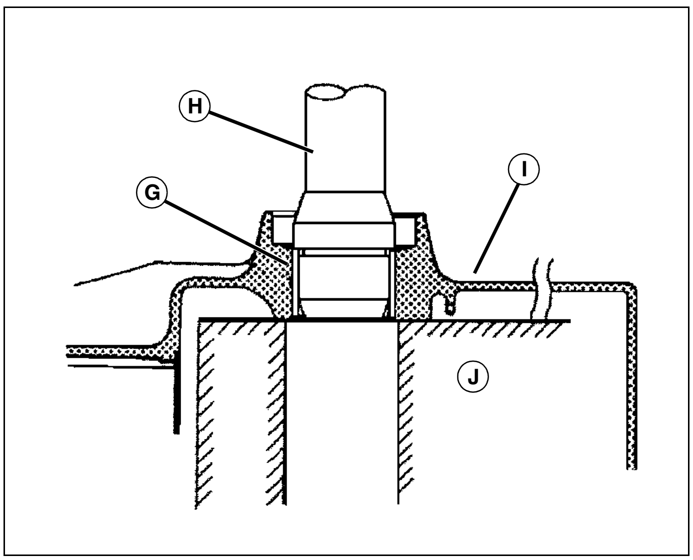
MX11892

8. Measure the crankshaft runout. Set the crankshaft in a flywheel alignment jig or on V-blocks. Set up dial gauges (E) at both bearing journals. Turn the crankshaft slowly by hand and measure the runout. The difference between the highest and lowest dial gauge readings is the amount of runout. If the measurement at either journal exceeds the service limit, the crankshaft must be replaced.



MX16150

9. Measure the inside diameter (F) of the crankshaft journal bearing on the crankcase at several points. Replace the journal bearing if the inside diameter is more than the service limit.



MX16151

10.The journal bearing (G) is press fit into the crankcase (I).

- Remove the oil seal on the crankcase. (Note: The oil seal should be replaced once removed.)
- Place the crankcase on a support block (J), with the oil seal side up.
- Using a bushing tool (H), drive out the bearing as shown.

Specifications

Crankpin Outside Diameter (Service Limit). . . . . 33.927 mm (1.3357 in.)

Crankpin Width (Service Limit) . . . . 44.50 mm (1.75 in.)

Crankshaft Main Journal PTO Side (Service Limit). . . . . 33.909 mm (1.3357 in.)

Crankshaft Main Journal Flywheel Side (Service Limit) . . . . 33.909 mm (1.3357 in.)

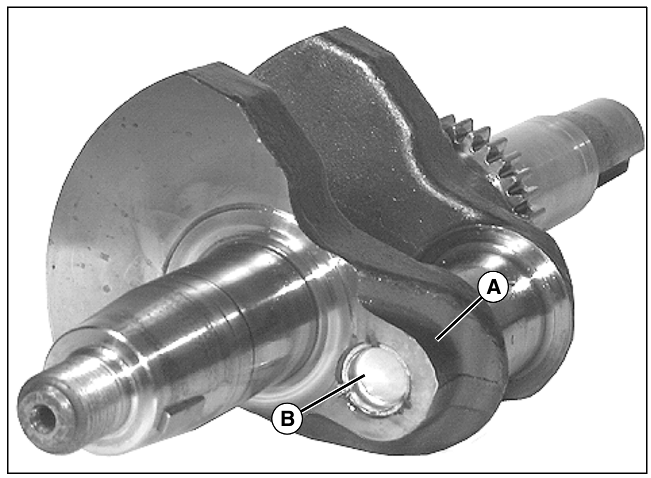
Crankshaft Runout (Service Limit) . . . . 0.05 mm (0.002 in.)

Crankcase Journal Bearing Inside Diameter (Service Limit) . . . . 34.114 mm (1.3431 in.)

Regrind Crankshaft

IMPORTANT: Avoid damage! Grinding stone deposits can get caught in oil passages which could cause severe engine damage. Removing the plug each time crankshaft is ground provides easy access for cleaning any grinding deposits that collect in oil passages.

NOTE: Have grinding done by a reliable repair shop.

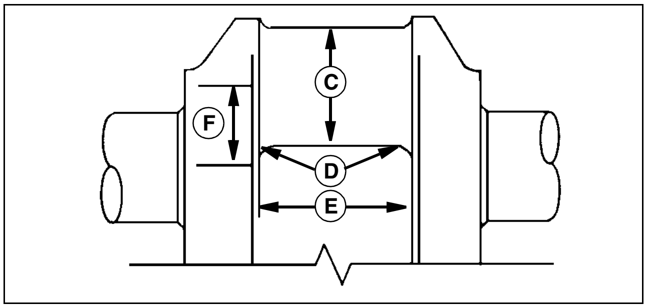


M84743

1. Drill a 3/16-inch hole through plug (B) in crankshaft.
2. Thread a 3/4- or 1-inch long self tapping screw with a flat washer into drilled hole. Flat washer must be large enough to seat against shoulder (A) of plug bore.
3. Tighten self-tapping screw until it draws plug out of crankshaft.
4. Install new plug. Gently tap plug into place using suitable driver. Plug must seat evenly at bottom of bore.

IMPORTANT: Avoid damage! A bent crankshaft must be replaced; it cannot be straightened. Replace crankshaft if any cracks are found.

5. Clean and inspect crankshaft. Replace if scratched, cracked or damaged.



M57348

6. Grind connecting rod journal to specifications.

NOTE: The main bearing journals and connecting rod journals should be concentric and parallel to each other within specification.

7. Finish the connection rod journal surface with a super finishing stone.

Specifications

Connecting Rod Journal
Diameter (C) . . . . . 33.467-33.480 mm (1.3176-1.318 in.)
Journal Radius (D) . . . . 2.30-2.70 mm (0.06-0.11 in.)
Crankpin Width (E) (Maximum) . . . 44.40 mm (1.748 in.)
Bearing Journal-to-Connecting Rod Journal Centerline-to-Centerline (F) . . . . 33.95-34.00 mm (1.337-1.339 in.)

Replace Crankshaft Oil Seals

Flywheel End: Remove crankshaft. (See “Remove and Replace Crankshaft” on page 117.)

PTO End: Remove crankcase cover. (See “Remove Crankcase Cover” on page 105.)

- Remove worn or damaged seals using a screwdriver.
- Install seals with lip toward inside of engine using a driver set. Press in seals until flush with flange surface.
- Pack lithium-based grease inside lips of seals.

Analyze Crankshaft and Connecting Rod Wear

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

Lack of lubrication or improper lubrication can cause the connecting rod and cap to seize the crankshaft.

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

Crankshaft and connecting rod damage can result from:

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

Inspect Cylinder Block

Other Material

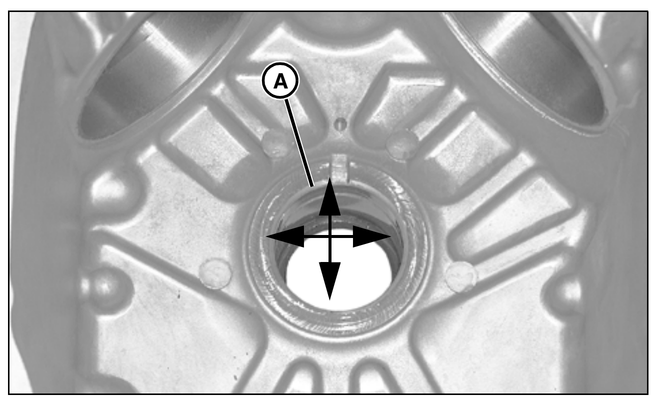
Part No.	Part Name	Part Use
NA	Zinc Oxide/Wood Alcohol	Check block for cracks.

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

A bare block is available for service.

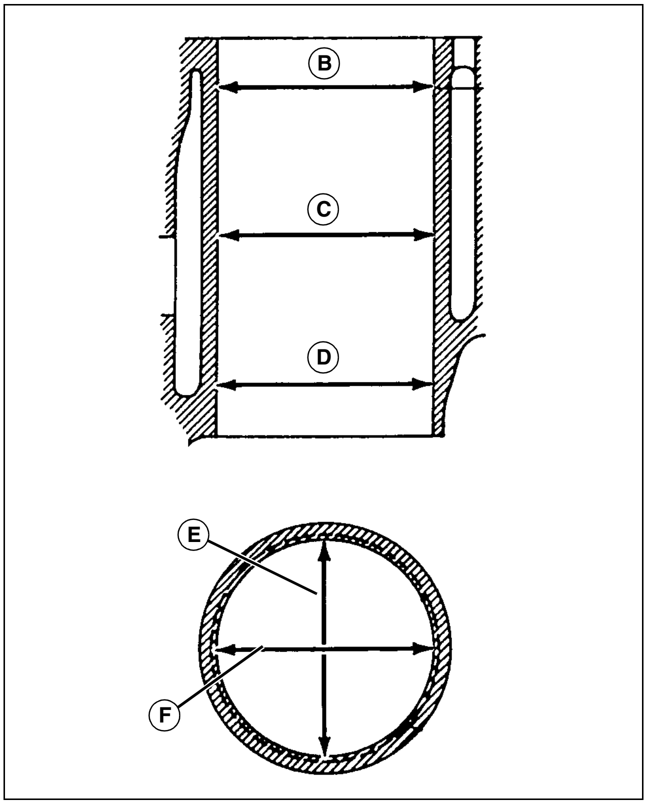
1. Clean block and check for cracks.

NOTE: Measurements should be made at several points and at 90° to one another.



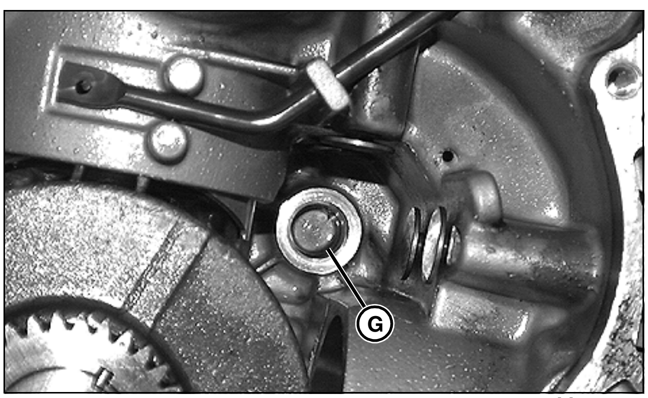
MX6355

2. Measure crankshaft bore (A). Check bore for wear or scoring.



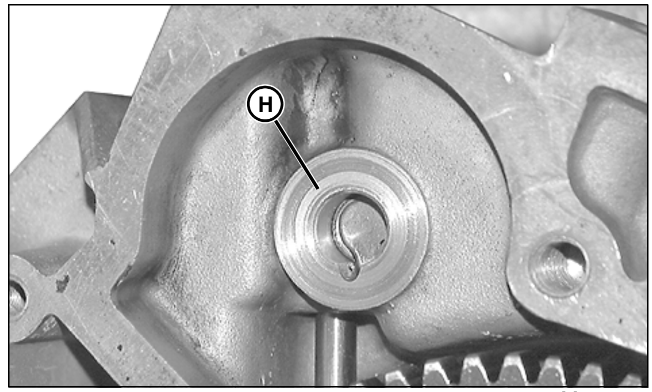
M82053A

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



M84686

4. Measure camshaft bearing (G) in cylinder block. Replace block if inside diameter is greater than specification.



M98808

5. Measure coolant pump shaft bore (H) inside diameter in crankcase cover. Replace block if bore exceeds specification.

6. Check bore for nicks or cracks. Replace block if bore is damaged.

Specifications

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

Cylinder Bore ID New (Standard) . . 75.980-76.000 mm (2.9913-2.9921 in.)

Cylinder Bore ID Wear Limit (Standard). . . . 76.067 mm (2.9948 in.)

Cylinder Bore ID Maximum Out-of-Round (Standard). . . . . . . 0.056 mm (0.0022 in.)

Cylinder Bore ID New (0.5 mm Oversize) . . . . 76.480-76.500 mm (3.0110-3.0118 in.)

Cylinder Bore ID Wear Limit (0.5 mm Oversize) . . . . 76.567 mm (3.0144 in.)

Cylinder Bore ID Maximum Out-of-Round (0.5 mm Oversize) . . . . 0.056 mm (0.0022 in.)

Crankshaft Bore ID Wear Limit . . . 40.15 mm (1.581 in.)

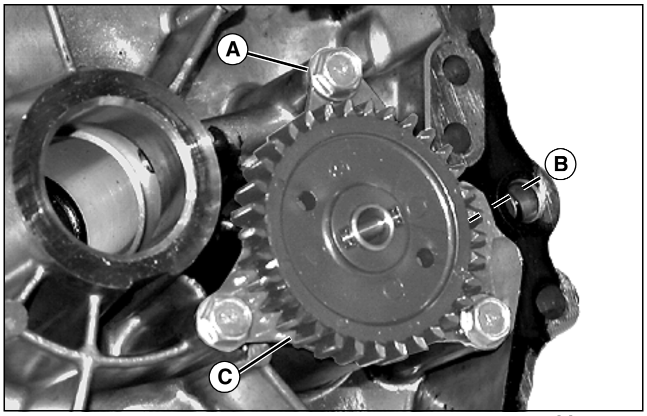
Maximum Camshaft Bearing ID 16.068 mm (0.6326 in.)

Maximum Coolant Pump Shaft Bore ID . . . . 10.088 mm (0.397 in.)

Remove and Install Oil Pump and Oil Pickup

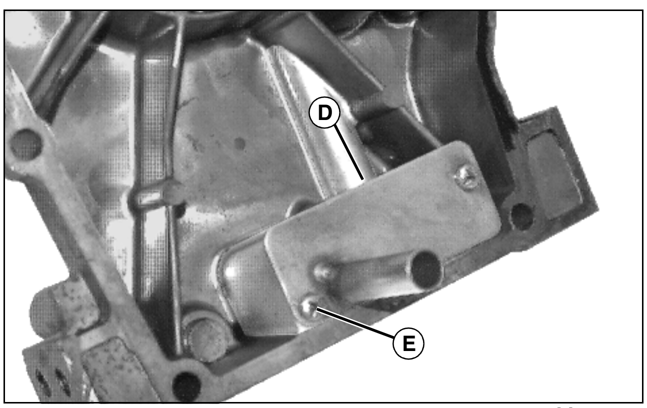
1. Remove crankcase cover. (See “Remove Crankcase Cover” on page 105.)

IMPORTANT: Avoid damage! Oil pressure relief valve spring will be loose when oil pump assembly is removed.



M84690

2. Remove three cap screws (A).
3. Remove oil pump assembly (C) from crankcase cover.
4. Remove oil pump rotors.
5. Remove relief spring and ball (B).



M84730

6. Remove two screws (E) and oil pickup cover (D).
7. Remove oil pickup screen.
8. Inspect all parts for wear. (See “Inspect Oil Pump and Oil Pickup” on page 123.)

Installation

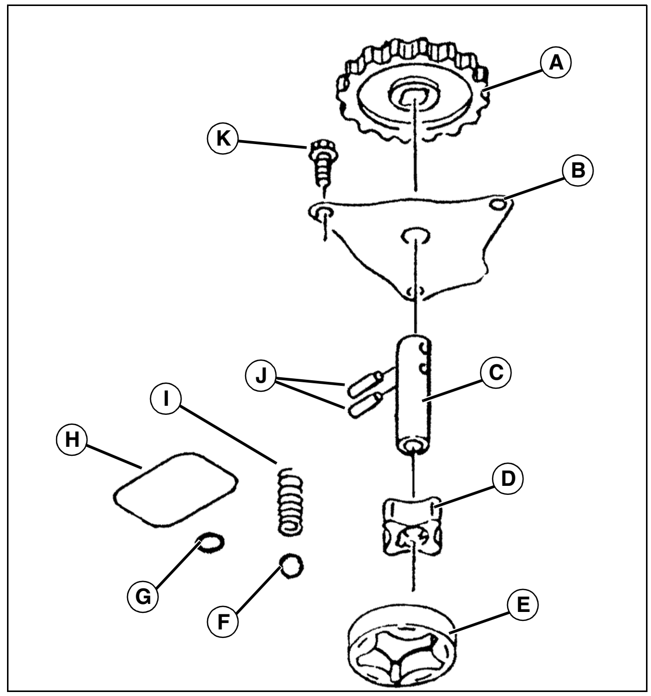
Installation is done in the reverse order of removal.

- Fill rotor housing with engine oil for initial lubrication.
- Install oil pump assembly so that hole in the plate is centered over relief valve.
- Rotate oil pump gear. Make sure there is no binding of pump. If binding occurs, loosen cap screws, reposition pump, retighten, and check movement.

Specifications

Oil Pump Cover Plate
Mounting Cap Screw Torque. . . . . 6 N•m (52 lb-in.)

Disassemble and Assemble Oil Pump and Oil Pickup



M84729

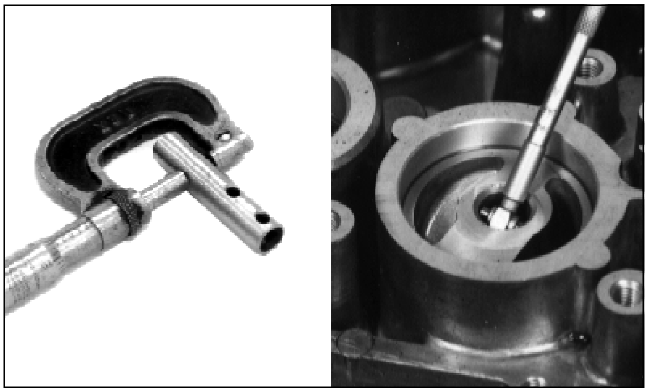
A - Gear
B - Cover
C - Rotor Shaft
D - Inner Rotor
E - Outer Rotor
F - Relief Valve Ball
G - O-Ring
H - O-Ring
I - Relief Valve Spring
J - Pin
K - Cap Screw

Inspect all parts for wear or damage. (See “Inspect Oil Pump and Oil Pickup” on page 123.)

Inspect Oil Pump and Oil Pickup

1. Inspect oil pressure relief valve piston. It should be free of nicks or burrs.

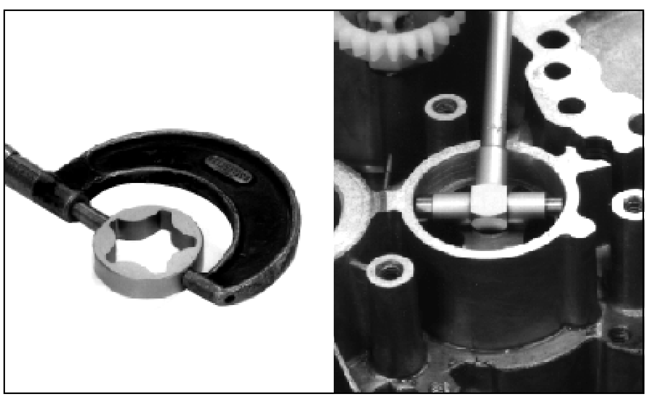
NOTE: Rotors and rotor shaft are replaced as a kit. If any of the parts show signs of wear or are scored, replace.



M53968 M53969

2. Measure rotor shaft outer diameter. If shaft OD is less than specification, replace both shaft and outer rotor.

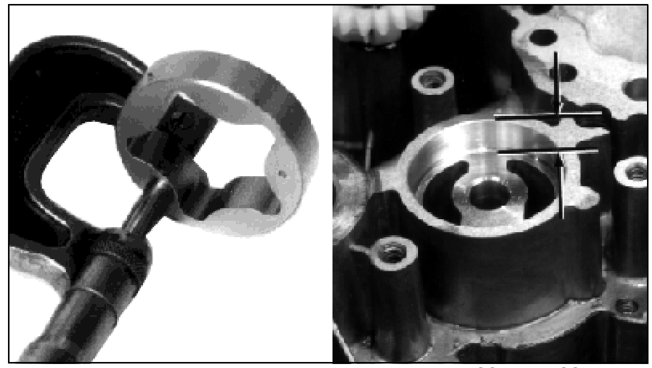
3. Measure rotor shaft bearing inside diameter. If bearing ID is greater than specification, replace both shaft and outer rotor.



M53970 M53971

4. Measure the outside diameter of the outside rotor at several points with a micrometer. If the rotor diameter is less than specification, replace both outer rotor and shaft.

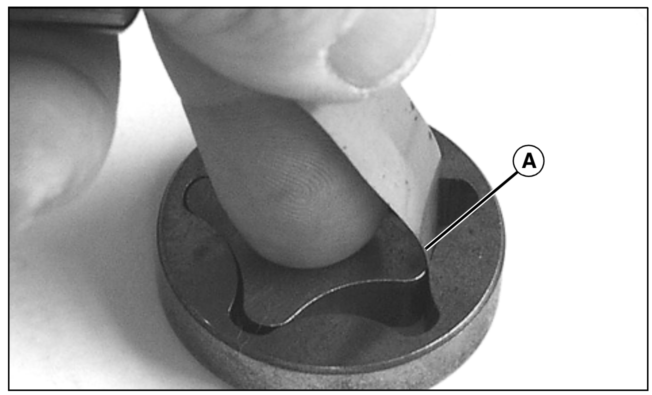
5. Measure the inside diameter of the pump housing. If ID is greater than specification, replace crankcase cover.



M80015 M82908

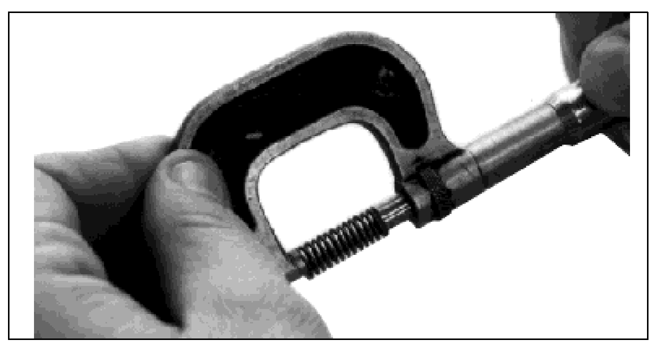
6. Measure thickness of outer rotor. If thickness is less than specification, replace motor.

7. Measure pump housing depth. If depth is greater than specification, replace crankcase cover.



MX9543

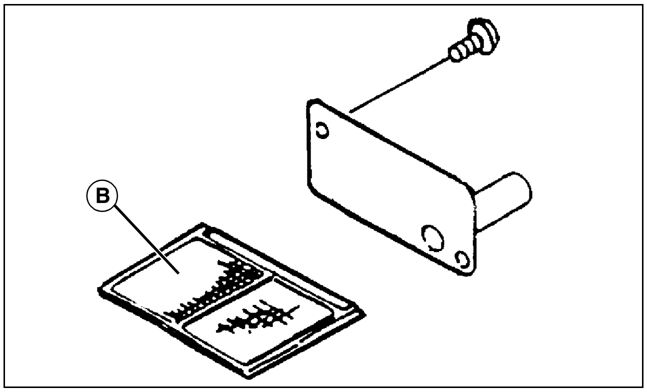
8. Measure inner to outer rotor clearance (A) with a feeler gauge. Replace both rotors if greater than specification.



M50083

9. Inspect relief valve spring for wear or distortion. Replace spring if it is distorted or worn.

10.Measure relief valve spring. If free length is less than specification, replace spring.



M84738

11.Inspect oil pickup screen (B) for holes, broken wire or other damage. Replace if necessary.

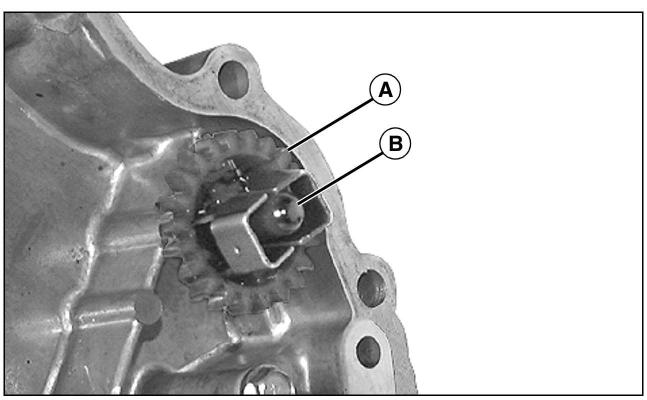
Specifications

Minimum Outer Rotor OD . . . . . . 40.47 mm (1.593 in.)
Maximum Pump Housing ID . . . . 40.80 mm (1.606 in.)
Minimum Outer Rotor Thickness . . . . 9.830 mm (0.387 in.)
Maximum Pump Housing Depth . . . . 10.23 mm (0.403 in.)
Minimum Rotor Shaft OD. . . . . 10.923 mm (0.4300 in.)
Maximum Rotor Shaft Bearing ID . . . . 11.072 mm (0.4359 in.)
Maximum Inner to Outer Rotor Clearance . . . . 0.3 mm (0.012 in.)
Minimum Spring Free Length . . . . . 19.50 mm (0.77 in.)

Remove Governor Assembly

1. Remove throttle plate assembly. (See “Remove and Install Carburetor” on page 89.)

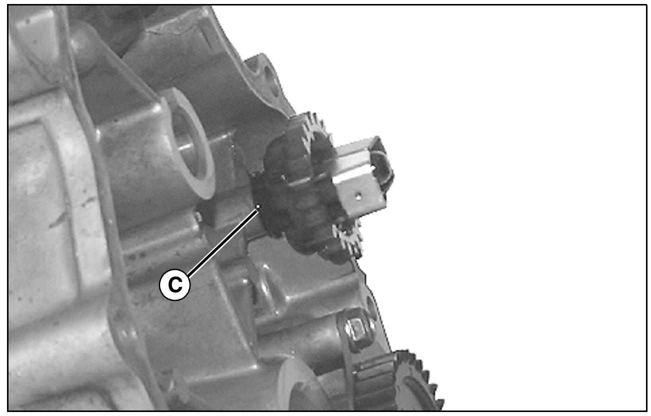
2. Remove crankcase cover. (See “Remove Crankcase Cover” on page 105.)



M84731

3. Remove governor assembly (A) with sleeve (B) by prying gear with two screwdrivers.

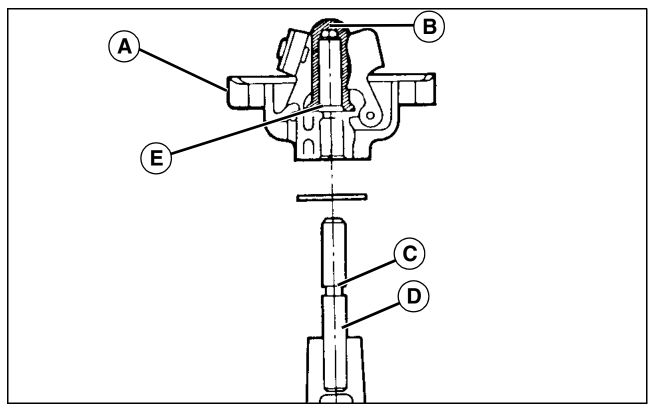
IMPORTANT: Avoid damage! DO NOT remove governor assembly unless it is absolutely necessary. When assembly is removed, it must be replaced.



M84732

4. Remove thrust washer (C) located under governor assembly.

Install Governor Assembly



M51762

1. Fit sleeve (B) into governor assembly (A) and install them as a set.

NOTE: Sleeve and governor assembly cannot be installed separately. Push the set onto shaft (D) until inner flange (E) snaps into groove (C) securely.

2. Spin governor assembly by hand and check that flyweights operate freely and sleeve moves outward.

3. Check individual parts and assembly for wear and damage. If any part is worn or damaged, replace entire assembly.

4. Install crankcase cover. (See “Install Crankcase Cover” on page 106.)

Remove and Install Governor Cross Shaft

1. Remove governor arm. (See “Remove and Install Governor Arm” on page 107.)
2. Remove camshaft. (See “Remove and Install Camshaft and Tappet” on page 116.)
3. Remove governor cross shaft.(See “Remove and Install Governor Cross Shaft” on page 125.)
4. Measure outside diameter of cross shaft. Replace cross shaft if outside diameter is less than specification.
5. Inspect cross shaft for damage. Replace if necessary.
6. Inspect shaft seal for leakage or damage. Replace if necessary.

Installation

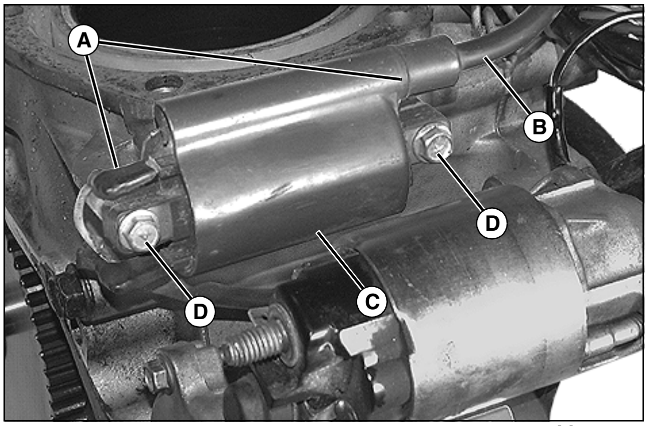
Installation is done in the reverse order of removal.

Install oil seal with seal lip towards inside of engine. Press oil seal in until the top of the seal is 1.0 mm (0.04 in.) below crankcase surface.

Specifications

Minimum Cross Shaft OD . . . . 5.962 mm (0.235 in.)

Remove and Install Ignition Coil



M84740

1. Disconnect wiring leads (A) and spark plug lead (B).
2. Remove two cap screws (D) and coil (C).

Installation

Installation is done in the reverse order of removal.

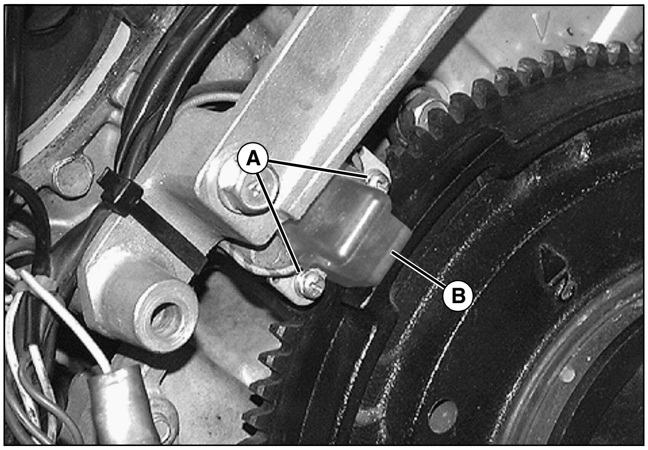
- Tighten cap screws to specification.

Specifications

Ignition Coil Cap Screws . . . . 9.8 N•m (87 lb-in.)

Remove and Install Pulser Coil

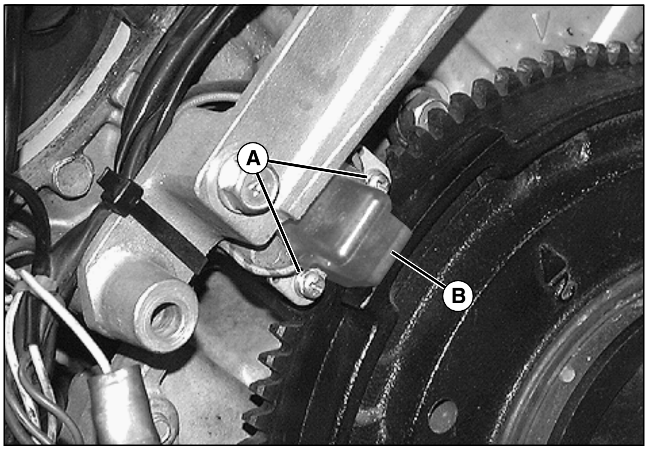
1. Remove cooling fan, fan belt and pulley. (See “Remove and Install Cooling Fan” on page 74.)



M84735

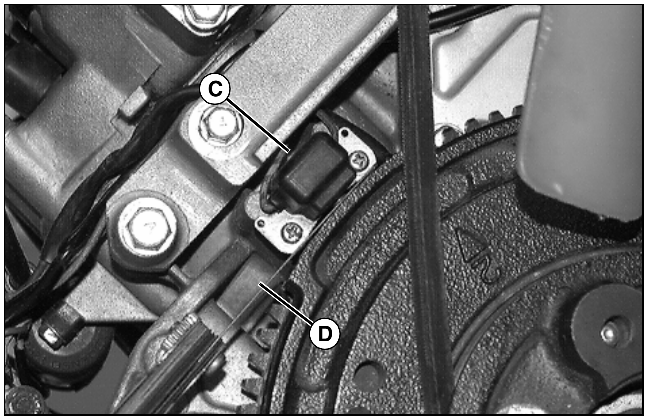
2. Remove two screws (A).
3. Remove pulser coils (B).

Installation



M84735

1. Install pulser coils loosely. Rotate the raised area of the flywheel away from pulser coils.



2. Rotate the flywheel to position the raised area of the flywheel directly under the pulser coil (C).

3. Insert a 0.762 mm (0.030 in.) feeler gauge or shim stock between the pulser coil and raised area (D).

4. Loosen the mounting screws and allow the pulser coil to rest against the feeler gauge.

5. Tighten the mounting screws.

6. Repeat steps 2-5 for the other pulser coil.

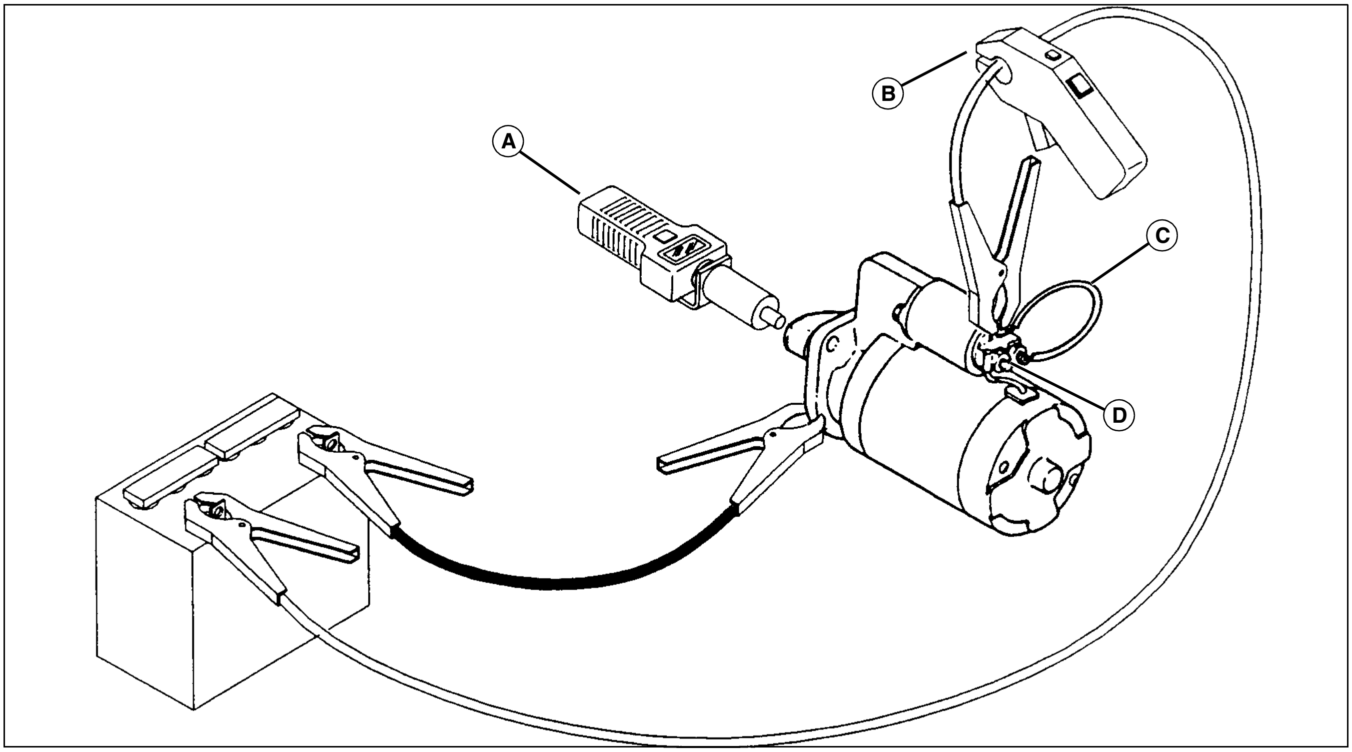
7. Rotate the flywheel back and forth to check clearance between the pulser coils and raised area of the flywheel.

8. Recheck the gap. The final gap should be to specification.

Specifications

Pulser Coil Gap. . . . . 0.3-1.2 mm (0.012-0.05 in.)

Starting Motor - No-Load Amperage Draw and RPM Test



M82149A

A - JT05719 Hand-Held Digital Tachometer

B - JT05712 Current Gun

C - Jumper Wire

D - Solenoid Switch Terminal

Reason

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

Equipment

- JT05712 Current Gun
- JT05719 Hand-Held Digital Tachometer
- Jumper Cables
- Jumper Wire

Procedure

IMPORTANT: Avoid damage! Compete this test in 20 seconds or less to prevent starter damage.

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

1. Connect jumper cables to a 12-volt battery.

2. Connect positive (+) cable to solenoid battery terminal on starter.

3. Connect negative (-) cable to starter body.

4. Attach current gun to positive (+) cable.

5. Use a jumper wire to briefly connect positive (+) starter terminal to solenoid switch terminal. Starter should engage and run.

6. Read and record starter amperage and rpm.

Results

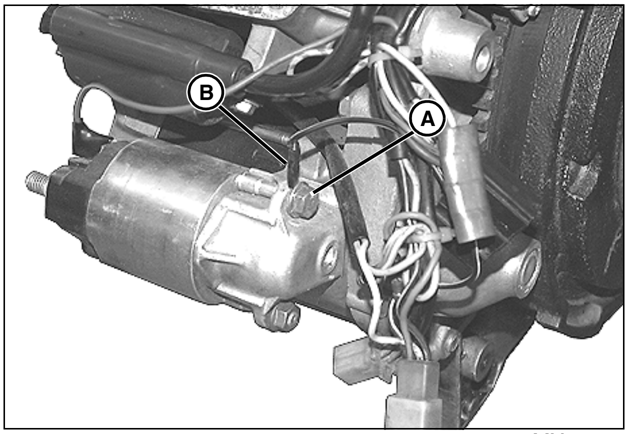
- If solenoid “clicks” or chatters and motor does not turn, replace solenoid.
- If pinion gear engages and motor doesn’t turn, repair or replace starter motor.
- If starter engages and runs, but amperage is more than **50 amps at 6000 rpm**, repair or replace starter.
- If free-running rpm is **less than 6000 rpm**, repair or replace starter.

Remove and Install Starting Motor

NOTE: Disconnect negative (-) battery cable first.

1. Disconnect negative (-) battery cable at battery.

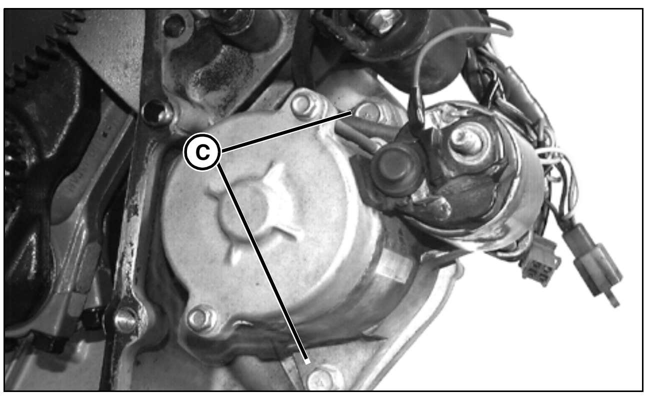
2. Disconnect positive (+) battery cable from starting motor.



MX14279

3. Remove nut (A).

4. Disconnect black/white wire (B) from starting motor.



M84727

5. Remove the two (2) mounting cap screws (C) and pull the starter motor from the engine.

6. Clean the starter motor and engine mounting flanges to ensure good electrical contact when installing starter. If corrosion is evident on either machined mounting surface, clean the area with emery cloth or sandpaper.

Installation

Installation is done in the reverse order of removal.

NOTE: Connect negative (-) battery cable last.

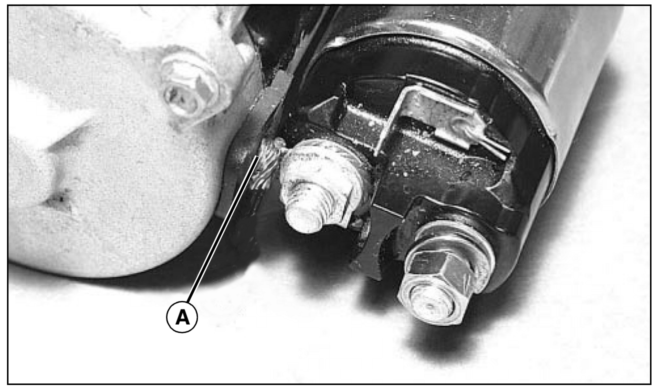
- Tighten mounting cap screws to specification.

Specifications

Starting Motor Mounting
Cap Screw Torque . . . . 20 N•m (177 lb-in.)

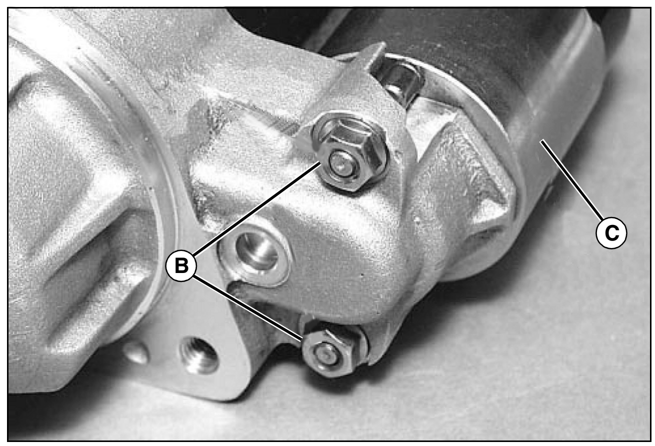
Disassemble and Assemble Starting Motor

1. Remove the starter motor from the engine. (See “Remove and Install Starting Motor” on page 128.)



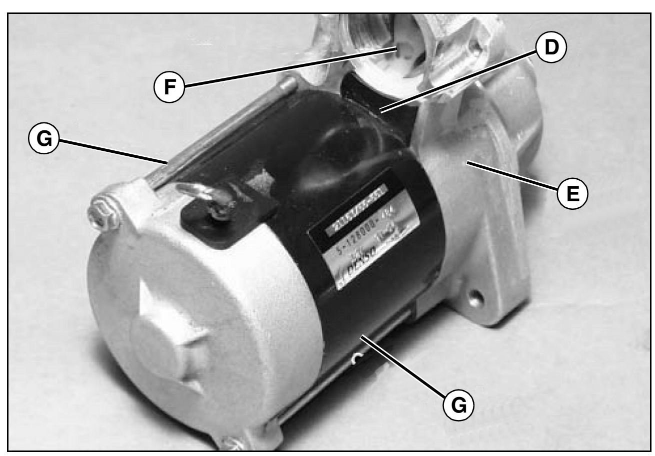
MX11970

2. Pull back the rubber boot and remove the lead (A) from the starter motor to the solenoid.



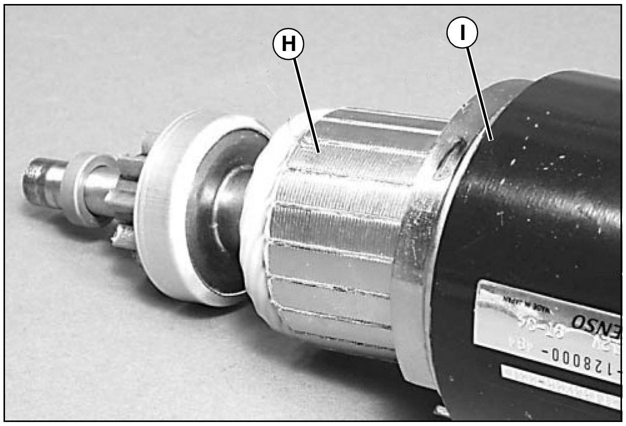
MX11971

3. Remove the mounting nuts (B) and remove the solenoid assembly (C).



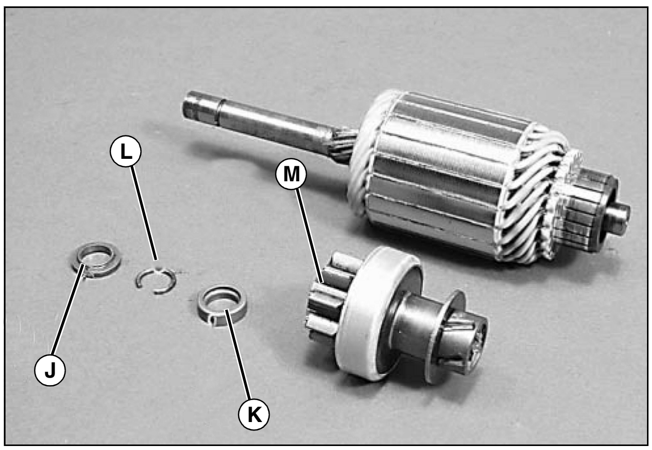
MX11972

4. Pull the rubber insert (D) from the starter motor and remove the pinion gear cover (E). Slip the actuating arm (F) from the pinion gear. Remove the motor through bolts (G).



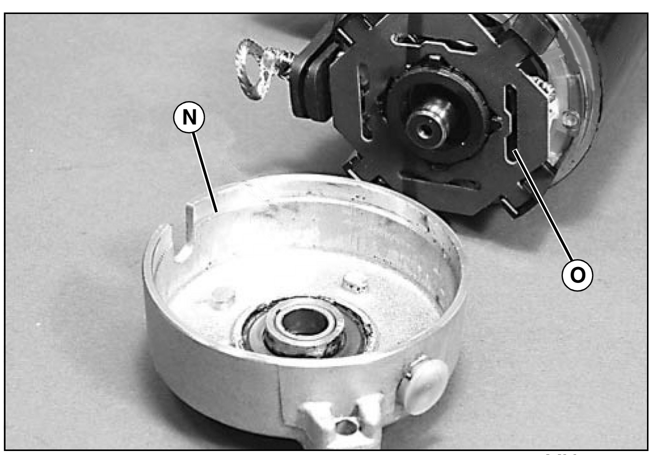
MX11973

5. Pull the armature (H) from the yoke (I).



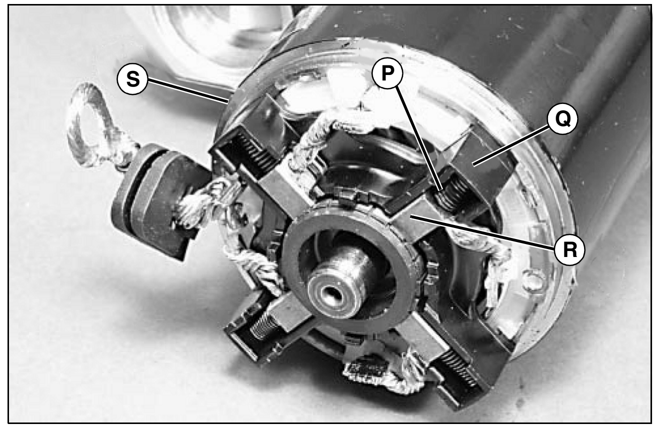
MX11974

6. Separate the front stopper (J) from the rear stopper (K) and remove the front stopper from the armature shaft. Push the rear stopper down the shaft and remove the snap ring (L). Pull the rear stopper and pinion gear (M) from the armature shaft.



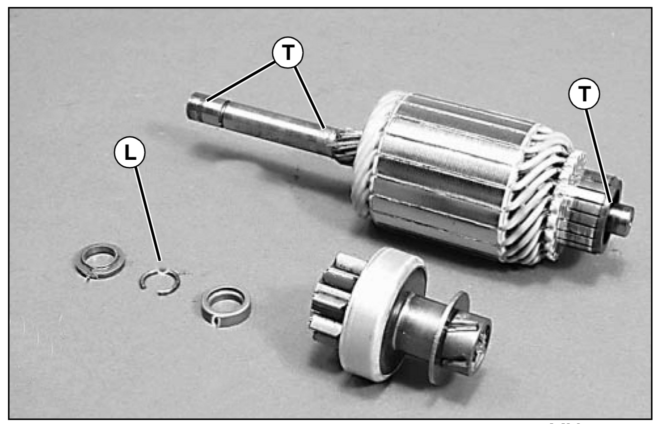
MX11975

7. Pull the end cover (N) from the yoke and remove the insulator (O).



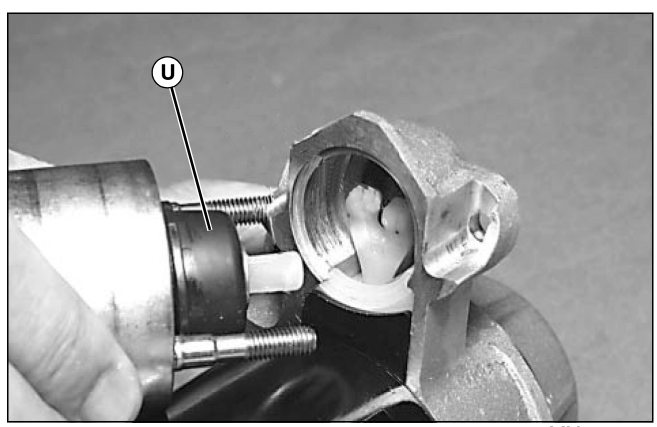
MX11976

8. Remove the brush springs (P) from the brush holder (Q). Separate the brushes (R) from the holder and remove the holder from the yoke (S).



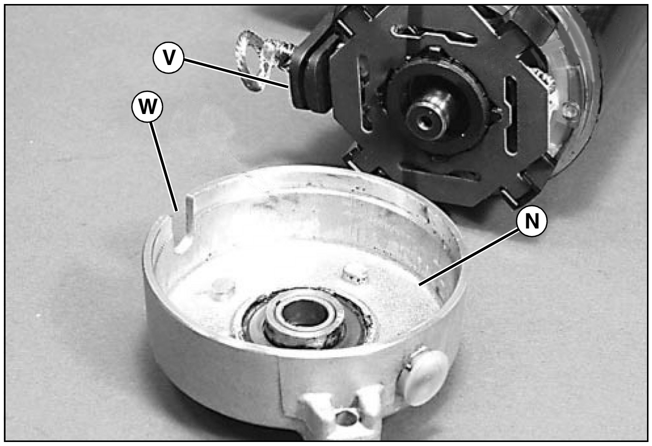
MX11974

9. Before beginning assembly apply a small amount of electric grease to the indicated areas (T) of the armature shaft. Obtain a new snap ring (L). Assemble the pinion gear on the armature shaft with the new snap ring and install the pinion assembly and actuating arm. Slide the yoke over the armature.



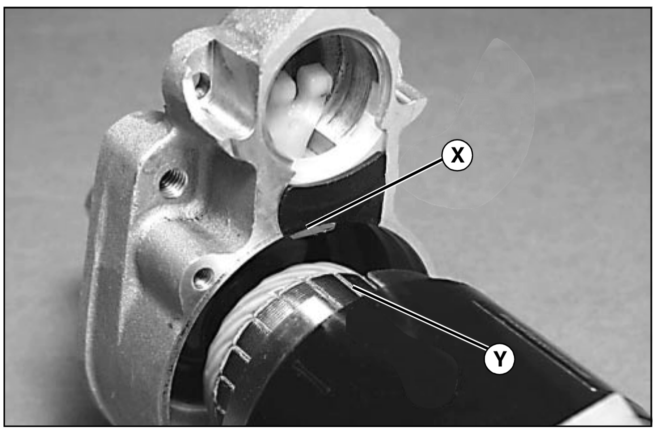
MX11979

10. Inspect the solenoid rubber boot (U) for visible damage (hole, rips, dry rot, etc.); replace if necessary.



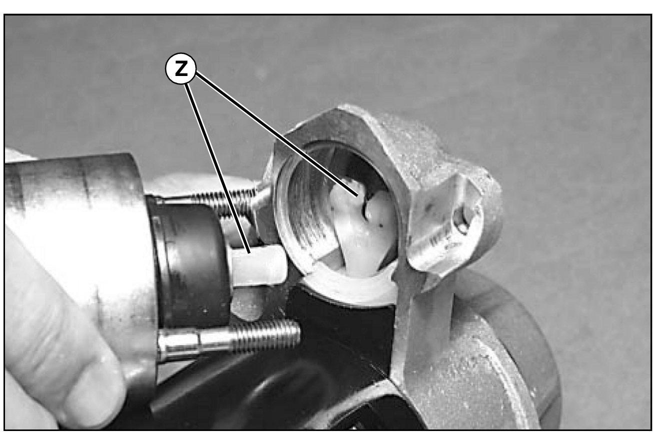
MX11975

11. Install the brush assembly and insulator on the yoke. Fit the notch (V) in the (-) lead grommet onto the projection (W) on the end cover (N). Install the end cover.



MX11981

12. Grease the pinion gear fork fingers, and set the pinion gear fork so that the fingers fit into the groove in the gear. Fit the notch (Y) in the yoke onto the projection (X) on the pinion gear fork. Install the through bolts through the rear cover and thread into the pinion gear cover.



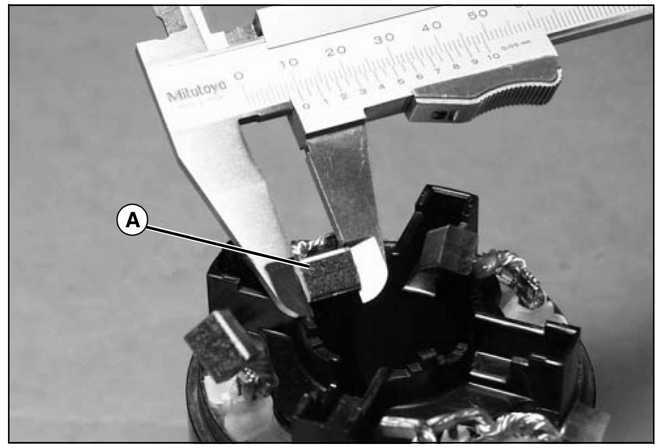
MX11979

13. Engage the hook (Z) on the starter solenoid with the pinion gear fork. Install the solenoid mounting nuts.

14. Install the solenoid to starter motor lead. Install the starter assembly onto the engine. (See “Remove and Install Starting Motor” on page 128.)

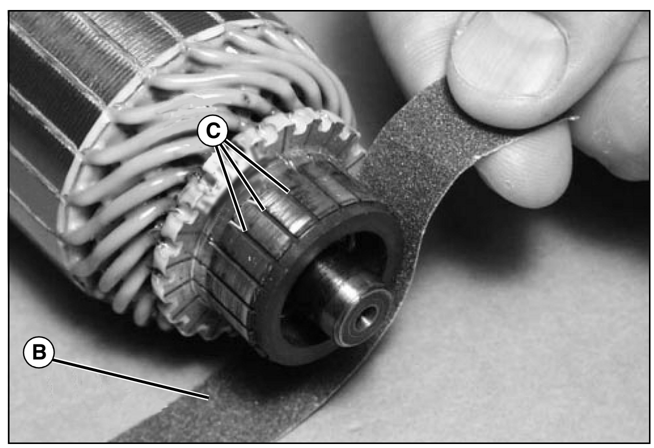
Inspect Starting Motor

1. Disassemble starter. (See “Disassemble and Assemble Starting Motor” on page 128.)



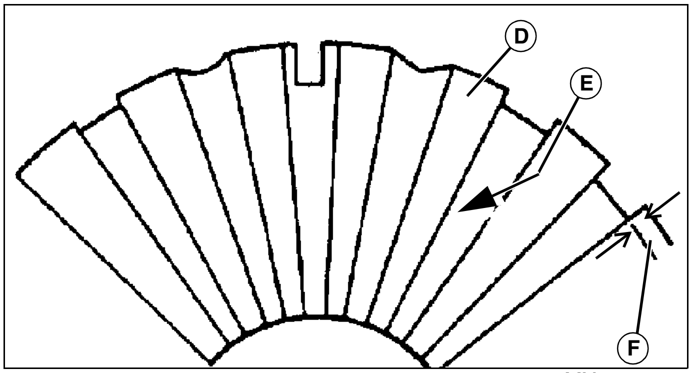
MX11984

2. Measure length of brush (A). If any brush is shorter than specification, replace all brushes. Inspect the brush springs for any distortion or damage. Replace if necessary.



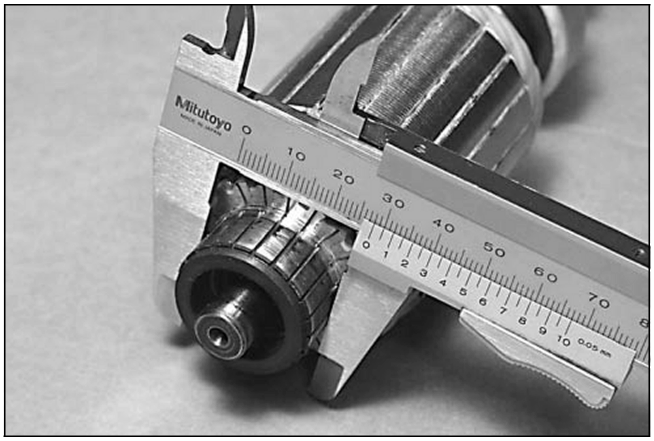
MX11980

3. Inspect the surface of the commutator. If the surface is scratched or dirty, polish it with very fine emery cloth (B) and then clean out the grooves (C).



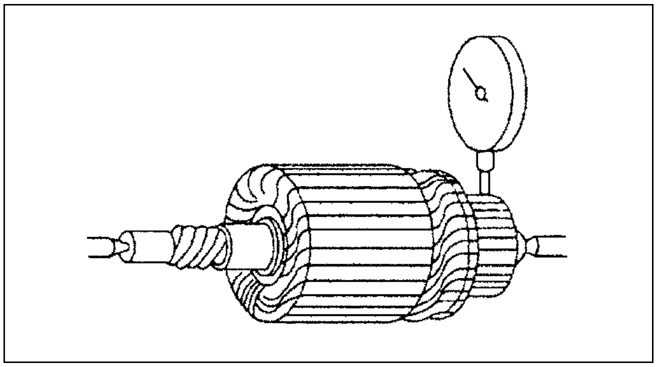
MX11987

4. Measure the depth of the grooves between the commutator segments (D). If groove depth is less than specification, undercut the insulating mica (E) to the standard specified depth (F) using a thin file. If grooves are only dirty, clean them carefully and measure depth before cutting the mica.



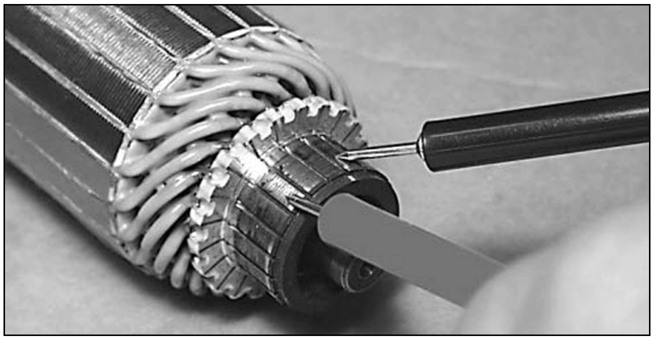
MX11988

5. Measure the commutator outside diameter at several points. If the diameter is less than specification replace the armature with a new one.



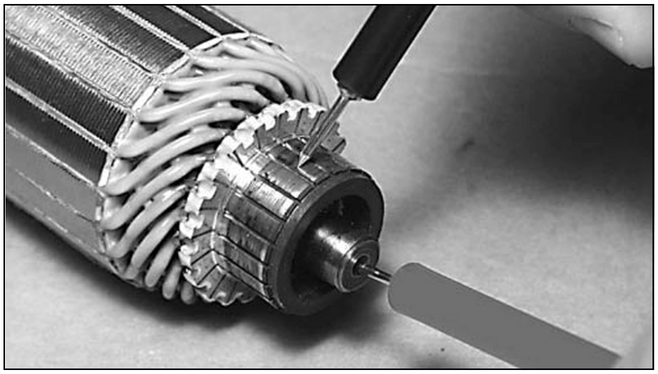
MX11989

6. Support the armature in an alignment jig at each end of the shaft as shown. Position a dial indicator perpendicular to the commutator. Rotate the armature slowly and read the commutator runout. If runout is more than specification replace the armature.



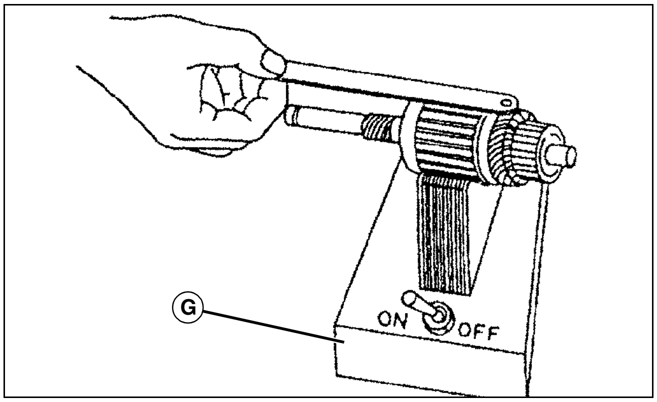
MX11990

7. Set a multimeter to the R x 1 ohm position and check the resistance between each segment and all others. If the armature winding resistance registers either infinite or much greater than 0 ohms the starter motor should be replaced.



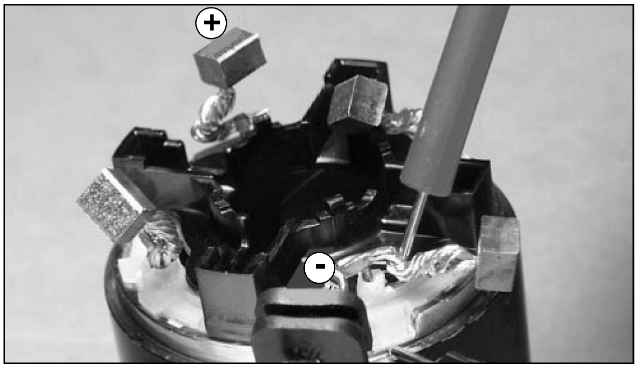
MX11991

8. With the multimeter in the R x 1 ohm position, measure the resistance between the armature shaft and the commutator. If the resistance is less than infinite, the armature is shorted and must be replaced.



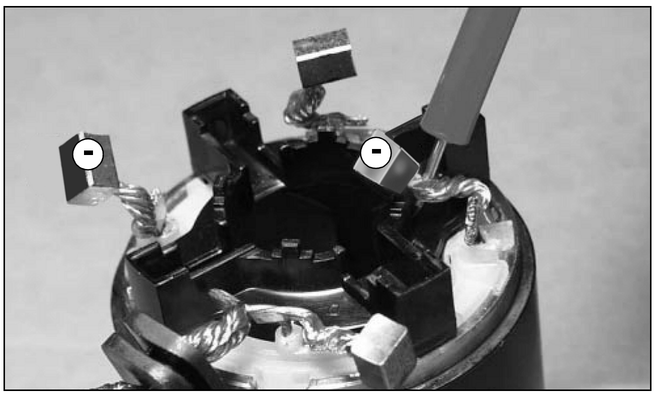
MX11992

9. Place the armature on a growler (G) and hold a thin metal strip (e.g., a hack saw blade) on top of the armature. Turn on the growler and rotate the armature one complete turn. If the metal strip vibrates, the windings are internally shorted to each other and the starter must be replaced.



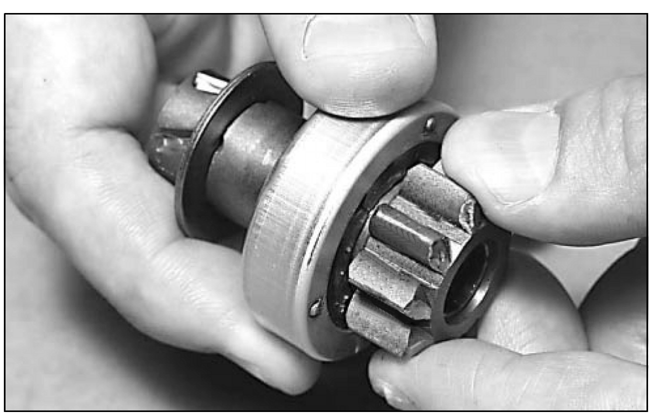
MX11998

10.With the multimeter in the R x 1 k-ohm position, measure the resistance between the positive brushes and starter motor yoke. If resistance is less than infinite on any brush, the brush is shorted and the complete yoke assembly must be replaced.



MX12000

11.With the multimeter in the R x 1 ohm position, measure the resistance between the negative brushes and starter motor yoke. If resistance is less than infinite on any brush, the brush is shorted and the complete yoke assembly must be replaced.



MX14440

12.Remove the pinion clutch and turn it by hand. The clutch should turn freely counterclockwise, and lock up and not turn in a clockwise direction. If the clutch does not operate correctly or is noisy when freewheeling, replace it.

Specifications

Brush Length (Minimum). . . . . 6 mm (0.24 in.)

Commutator Groove Depth (Nominal) . . . . . . 0.5—0.8 mm (0.020—0.031 in.)

Commutator Groove Depth (Minimum) . . . . 0.2 mm (0.008 in.)

Commutator OD (Minimum) . . . . 27 mm (1.06 in.)

Starting Motor Brush Length (Minimum) . . . . 6 mm (0.24 in.)

Commutator Runout (Maximum) . . . 0.4 mm (0.016 in.)

Table of Contents

Specifications

General Specifications

Make	**Yanmar**
Model	**3TNE68**
Type	**4-cycle diesel**
Bore	**68 mm (2.68 in.)**
Stroke	**72 mm (2.83 in.)**
Cylinders	**3**
Valves	**Overhead**
Displacement	**0.784 L (47.8 cu in.)**
Maximum Torque at 2400 RPM	**61.7 N•m (45.5 lb-ft)**
Firing Order	**1-3-2**
Direction of Rotation	**Counterclockwise (viewed from flywheel)**
Combustion System	**Indirect injection type**
Compression Ratio	**23:1**
Oil Capacity with Filter (Approximately)	**2.4 L (2.5 qt)**
Cooling	**Liquid with pump and radiator**
Governor	**Centrifugal**
Slow Idle (No Load)	**1450 ± 100 rpm**
Fast Idle (No Load)	**3225 ± 50 rpm**
Fuel Filter/Water Separator	**Replaceable element fuel water separator**
Air Filter	**Dry replaceable primary and secondary elements**
Weight (Approximately)	**81 kg (179 lb)**

Test and Adjustment Specifications

12V Alternator Drive Belt Deflection (2500 and 2500A) at 98 N (22 lb-force)	**10-15 mm (0.40-0.60 in.)**
48V Alternator Drive Belt Deflection (2500E) at 50 N (11 lb-force)	**30 mm (1.188 in.)**
48V Alternator Drive Belt Tension Spring Length (2500E)	**66-72 mm (2.6-2.8 in.)**
48V Tensioner Locknut Torque[2]	**74.5 N•m (55 lb-ft)**
Valve Clearance	**0.2 mm (0.008 in.)**
Cylinder Compression Pressure (Minimum)	**2549 kPa (369 psi)**
Pressure Difference Between Cylinders (Maximum)	**241 kPa (35 psi)**
Engine Oil Pressure at Rated Speed	**297-393 kPa (43-57 psi)**
Fuel Pump Pressure (Minimum)	**29 kPa (4.3 psi)**
Slow Idle Speed	**1450 ± 100 rpm**
Fast Idle Speed	**3225 ± 50 rpm**

2. Back off 1/8 turn after tightening to specification.

Fuel Injection Nozzles

Opening Pressure. . . . . 11 722 ± 480 kPa (1700 ± 70 psi)
Leakage at 11 032 kPa (1600 psi) . . . . No leakage for 10 seconds (Minimum)

Chatter and Spray Pattern
At 11 722 ± 480 kPa (1700 ± 70 psi)

Slow Hand Lever Movement . . . . Chatter sound
Slow Hand Lever Movement . . . . Fine stream, 5-10° spray pattern
Fast Hand Lever Movement. . . . . Fine atomized spray, 5-10° spray pattern

Fuel Injector Torque . . . . 51 N•m (38 lb-ft)
Cooling System Pressure (Maximum Applied) . . . . 177 kPa (17 psi)
Cooling System Pressure (Minimum after 15 Sec) . . . . 88 ± 15 kPa (12.8 ± 2.2 psi)
Radiator Cap Valve Opening Pressure. . . . . 90 kPa (13 psi)
Thermostat Begin Opening Temperature. . . . . 69.5-72.5°C (157-163°F)
Thermostat Fully Open Temperature . . . . 85°C (185°F)
Lift Height Above 85°C (185°F) (Minimum). . . . . 4.5 mm (0.177 in.)
Cylinder Pressure (Maximum Applied). . . . . 2448 kPa (355 psi)

Repair Specifications

Cooling System Capacity (Approximately) . . . . 3.5 L (3.7 qt)
Engine Oil Capacity with Filter (Approximately) . . . . 2.4 L (2.5 qt)

Rocker Arm

Rocker Arm Shaft OD Wear Limit . . . . 9.95 mm (0.391 in.)
Rocker Arm and Shaft Support ID Wear Limit. . . . . 10.09 mm (0.397 in.)
Rocker Arm and Shaft Support Oil Clearance Wear Limit . . . . 0.14 mm (0.006 in.)
Push Rod Bend. . . . . 0.00-0.03 mm (0.000-0.001 in.)

Cylinder Head Distortion

Standard (Maximum) . . . . 0.05 mm (0.002 in.)
Wear Limit . . . . 0.15 mm (0.006 in.)
Allowable Removed Material (Maximum) . . . . 0.20 mm (0.008 in.)

Valve Seat Width

Intake Standard. . . . . 1.15 mm (0.045 in.)
Intake Wear Limit . . . . 1.65 mm (0.065 in.)
Exhaust Standard. . . . . 1.41 mm (0.56 in.)
Exhaust Wear Limit . . . . 1.91 mm (0.075 in.)

Valve Grinding

Intake Valve Face Margin . . . . 0.99-1.29 mm (0.039-0.051 in.)
Exhaust Valve Face Margin . . . . 0.95-1.25 mm (0.037-0.049 in.)
Valve Face Margin Wear Limit . . . . 0.50 mm (0.020 in.)
Intake Valve Face Angle. . . . . .30°
Exhaust Valve Face Angle . . . . .45°

Valve Stem

Measuring Point (3) Distance . . . . 20 mm (0.787 in.)
Measuring Point (4) Distance . . . . 40 mm (1.575 in.)
Intake Valve Stem Standard OD . . . . 5.46-5.48 mm (0.215-0.216 in.)
Intake Valve Stem OD Wear Limit . . . . 5.40 mm (0.213 in.)
Exhaust Valve Stem Standard OD. . . . . 5.45-5.46 mm (0.214-0.215 in.)
Exhaust Valve Stem OD Wear Limit . . . . 5.40 mm (0.213 in.)

Valve Recession

Intake Valve Standard Recession . . . . 0.30-0.50 mm (0.012-0.020 in.)
Intake Valve Recession Wear Limit. . . . . 1.0 mm (0.039 in.)
Exhaust Valve Standard Recession . . . . 0.75-0.95 mm (0.030-0.037 in.)
Exhaust Valve Recession Wear Limit . . . . 1.0 mm (0.039 in.)

Valve Guides

Valve Guide Standard ID . . . . 5.50-5.52 mm (0.216-0.217 in.)
Valve Guide ID Wear Limit . . . . 5.58 mm (0.22 in.)
Intake Valve Guide-to-Valve Stem Standard Oil Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)
Exhaust Valve Guide-to-Valve Stem Standard Oil Clearance. . . . . 0.040-0.070 mm (0.002-0.003 in.)
Valve Guide-to-Valve Stem Oil Clearance Wear Limit (Both) . . . . 0.18 mm (0.007 in.)
Valve Guide Knurling Clearance (Maximum) . . . . 0.127-0.178 mm (0.005-0.007 in.)
Valve Guide Replacement Clearance . . . . 0.20 mm (0.008 in.)
Valve Guide Height. . . . . 7 mm (0.276 in.)

Valve Springs

Spring Free Length. . . . . 28 mm (1.102 in.)
Spring Inclination (Maximum) . . . . 0.8 mm (0.03 in.)

Piston-to-Cylinder Head Clearance . . . . 0.61-0.73 mm (0.024-0.028 in.)

Connecting Rod Bearings

Connecting Rod Bearing ID Wear Limit . . . . 39.02 mm (1.536 in.)
Connecting Rod Bearing Standard Oil Clearance. . . . . 0.033-0.059 mm (0.001-0.002 in.)
Connecting Rod Bearing Oil Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

Piston Rings

Top Piston Ring Groove Side Clearance . . . . 0.06-0.10 mm (0.002-0.004 in.)
Middle Piston Ring Groove Side Clearance. . . . . 0.090-0.125 mm (0.004-0.005 in.)
Oil Control Ring Groove Side Clearance . . . . 0.020-0.055 mm (0.0008-0.0022 in.)
Piston Ring Standard End Gap (All Except Oil Control Ring) . . . . 0.20-0.40 mm (0.008-0.016 in.)
Oil Control Ring Standard End Gap . . . . 0.15-0.35 mm (0.006-0.014 in.)
Piston Ring End Gap Wear Limit. . . . . 1.50 mm (0.059 in.)

Piston Pins

Piston Pin Standard OD. . . . . 19.99-20.00 mm (0.787-0.787 in.)
Piston Pin OD Wear Limit . . . . 19.90 mm (0.783 in.)

Piston Pin Bores

Bore Standard ID . . . . 20.00-20.01 mm (0.787-0.778 in.)
Bore ID Wear Limit . . . . 20.02 mm (0.789 in.)

Piston Pin Bushings

Bushing Standard ID . . . . 20.025-20.038 mm (0.788-0.789 in.)
Bushing ID Wear Limit . . . . 20.10 mm (0.791 in.)
Piston Pin-to-Rod Bore Standard Oil Clearance . . . . 0.025-0.047 mm (0.001-0.002 in.)
Piston Pin-to-Rod Bore Oil Clearance Wear Limit . . . . 0.20 mm (0.008 in.)
Pin-to-Bushing Clearance Wear Limit . . . . 0.20 mm (0.008 in.)

Pistons

Diameter Measuring Point (1) Distance . . . . 24 mm (0.945 in.)
Standard Size Piston Standard OD . . . . 67.94-67.97 mm (2.675-2.676 in.)
Standard Size Piston OD Wear Limit . . . . 67.90 mm (2.673 in.)
Oversize Piston Standard OD . . . . 68.19-68.23 mm (2.685-2.686 in.)
Oversize Piston OD Wear Limit . . . . 68.19 mm (2.685 in.)

Connecting Rods

Side Play . . . . 0.40 mm (0.016 in.)
Connecting Rod Bearing ID . . . . 39.02 mm (1.536 in.)
Bearing Standard Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)
Bearing Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

Cylinder Bore

Piston-to-Cylinder Bore Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)
Cylinder Standard Roundness . . . . 0.00-0.01 mm (0.0000-0.0004 in.)
Cylinder Roundness Wear Limit . . . . 0.03 mm (0.001 in.)
Cylinder Standard Taper . . . . 0.00-0.01 mm (0.0000-0.0004 in.)
Cylinder Taper Wear Limit . . . . 0.03 mm (0.001 in.)
Standard Size Cylinder Bore Standard ID . . . . 68.00-68.03 mm (2.677-2.678 in.)
Standard Size Cylinder Bore ID Wear Limit . . . . 68.20 mm (2.685 in.)
Oversize Cylinder Bore Standard ID . . . . 68.25-68.28 mm (2.687-2.688 in.)
Oversize Cylinder Bore ID Wear Limit . . . . 68.45 mm (2.695 in.)

Flywheel

Out-of-Flat (Maximum) . . . . 0.02 mm (0.001 in.)

Crankshaft and Main Bearings

Crankshaft Bend (Maximum) . . . . 0.02 mm (0.001 in.)
Crankshaft Connecting Rod Journal Standard OD . . . . 35.97-35.98 mm (1.416-1.417 in.)
Crankshaft Connecting Rod Journal OD Wear Limit . . . . 35.91 mm (1.414 in.)
Crankshaft Main Bearing Journal Standard OD . . . . 39.97-39.98 mm (1.573-1.574 in.)
Crankshaft Main Bearing Journal OD Wear Limit . . . . 39.90 mm (1.571 in.)
Main Bearing Standard Oil Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)
Main Bearing Oil Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

Camshaft

Standard Bend . . . . 0.02 mm (0.0008 in.)
Bend Wear Limit . . . . 0.05 mm (0.002 in.)
Standard Lobe Height . . . . 29.97-30.03 mm (1.180-1.182 in.)
Lobe Height Wear Limit . . . . 29.75 mm (1.171 in.)
Gear Housing and Flywheel End Journal Standard OD . . . . 35.94-35.96 mm (1.415-1.416 in.)

Gear Housing and Flywheel End Journal OD Wear Limit . . . . 35.85 mm (1.411 in.)
Intermediate Journal Standard OD . . . . 35.91-35.94 mm (1.414-1.415 in.)
Intermediate Journal OD Wear Limit . . . . 35.85 mm (1.411 in.)
Camshaft Bushing Standard ID . . . . 35.98-36.05 mm (1.417-1.419 in.)
Camshaft Bushing ID Wear Limit . . . . 36.05 mm (1.419 in.)
Camshaft Intermediate Bore Standard ID . . . . 35.98-36.05 mm (1.417-1.419 in.)
Camshaft Intermediate Bore ID Wear Limit . . . . 36.05 mm (1.419 in.)
Camshaft Flywheel-End Bore Standard ID . . . . 35.98-36.05 mm (1.417-1.419 in.)
Camshaft Flywheel-End Bore ID Wear Limit . . . . 36.05 mm (1.419 in.)
Bore Oil Clearance (Maximum) . . . . 0.20 mm (0.008 in.)

Bearing-to-Camshaft Gear Housing End Journal Clearance (Wear Limit) . . . . 0.85 mm (0.003 in.)
Bearing-to-Camshaft Intermediate Journals Clearance (Wear Limit) . . . . 0.115 mm (0.005 in.)
Bearing-to-Camshaft Flywheel End Journal Clearance (Wear Limit) . . . . 0.125 mm (0.005 in.)

Camshaft Followers

Standard OD . . . . 17.95-17.97 mm (0.706-0.707 in.)
OD Wear Limit . . . . 17.93 mm (0.706 in.)
Bore Standard ID . . . . 18.00-18.02 mm (0.708-0.709 in.)
Bore ID Wear Limit . . . . 18.05 mm (0.711 in.)
Tappet-to-Bore Standard Oil Clearance . . . . 0.03-0.07 mm (0.001-0.003 in.)
Tappet-to-Bore Oil Clearance Wear Limit . . . . 0.12 mm (0.005 in.)

Idler Gear

Shaft Standard OD . . . . 19.96-19.98 mm (0.786-0.787 in.)
Shaft OD Wear Limit . . . . 19.93 mm (0.785 in.)
Idler Gear Bushing Standard ID . . . . 20.00-20.02 mm (0.787-0.788 in.)
Bushing ID Wear Limit . . . . 20.02 mm (0.789 in.)
Oil Clearance . . . . 0.020-0.062 mm (0.0008-0.002 in.)
Oil Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

Oil Pump

Gear Backlash . . . . 0.11-0.19 mm (0.004-0.007 in.)
Standard Rotor Shaft OD-to-Housing ID Clearance . . . . 0.013-0.043 mm (0.0005-0.002 in.)
Rotor Shaft OD-to-Housing Clearance Wear Limit . . . . 0.2 mm (0.008 in.)
Standard Rotor-to-Pump Housing Side Clearance . . . . 0.03-0.9 mm (0.001-0.004 in.)
Rotor-to-Pump Housing Side Clearance Wear Limit . . . . 0.13 mm (0.005 in.)
Standard Outer Rotor-to-Pump Body Clearance . . . . 0.10-0.16 mm (0.004-0.006 in.)
Outer Rotor-to-Pump Body Clearance Wear Limit . . . . 0.25 mm (0.006 in.)
Inner Rotor-to-Outer Rotor Clearance (Maximum) . . . . 0.15 mm (0.006 in.)

Fuel Injection Nozzles

Separator Plate Contact Surface . . . . 0.10 mm (0.004 in.)

Alternator

Rotor Slip Ring Outside Diameter (Wear Limit) . . . . 14 mm (0.55 in.)
Brush Length (Min) . . . . 4.5 mm (0.17 in.)

Torque Specifications

Cylinder Head Mounting Cap Screw Torque

First . . . . . . 13 N•m (115 lb-in.)
Second. . . . . . 26 N•m (20 lb-ft)
Final . . . . . . 39 N•m (29 lb-ft)

12V Alternator Pulley Retaining Nut Torque . . . . . . 69 N•m (51 lb-ft)
48V Tensioner Locknut Torque[3] . . . . . . 74.5 N•m (55 lb-ft)

Exhaust Manifold Mounting Cap Screw Torque . . . . . . 28 N•m (240 lb-in.)
Intake Manifold Mounting Cap Screw Torque . . . . . . 11 N•m (97 lb-in.)
Glow Plug Torque . . . . . . 19 N•m (168 lb-in)
Rocker Arm Cover Special Nut Torque. . . . . . 18 N•m (160 lb-in.)
Rocker Arm Assembly Mounting Nut Torque . . . . . . 26 N•m (226 lb-in.)
Connecting Rod Cap Screw Torque . . . . . . 24 N•m (18 lb-ft)
Flywheel Mounting Cap Screw Torque. . . . . . 83 N•m (61 lb-ft)
Flywheel Adapter Plate Cap Screw Torque . . . . . . 68 N•m (50 lb-ft)
Crankshaft Pulley Cap Screw Torque. . . . . . 88 N•m (65 lb-ft)
Main Bearing Cap Screw Torque. . . . . . 54 N•m (40 lb-ft)
Camshaft Thrust Plate Cap Screw Torque . . . . . . 11 N•m (96 lb-in.)
Timing Gear Cover Mounting Cap Screw Torque . . . . . . 9 N•m (78 lb-in.)
Timing Gear Housing Mounting Cap Screw Torque . . . . . . 11 N•m (96 lb-in.)
Oil Pan Cap Screw Torque . . . . . . 4.8 N•m (42 lb-in.)
Fuel Pump Cap Screw Torque. . . . . . 11 N•m (96 lb-in.)
Oil Pressure Regulating Valve Retaining Nut Torque . . . . . . 30 N•m (22 lb-ft)

Fuel Injection Nozzles

Injection Nozzle Body Torque . . . . . . 51 N•m (37 lb-ft)
Leak-Off Fitting Nut Torque . . . . . . 32 N•m (24 lb-ft)

3. Back off 1/8 turn after tightening to specification.

Special or Required Tools

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
0-700 kPa (0-100 psi) Pressure Gauge	JT05577	Used for engine oil pressure test.
Adapter	JDG472	Used for cylinder compression check and radiator bubble test.
Adapter Set	D01110AA	Used for fuel injection nozzle test.
Belt Tension Gauge	JDG529 or JDST28	Used to adjust the coolant pump/alternator drive belt tension.
Bushing, Bearing, and Seal Driver Set	NA	Used for removing and installing bushings, bearings, and seals.
Compression Gauge Assembly	JT01682	Used for cylinder compression check.
Connector	JT03349	Used for engine oil pressure test.
Cooling System Pressure Pump	D05104ST	Used for cooling system pressure test.
Cylinder Leakdown Tester	JT03502	Used to test cylinders for compression pressure leakdown.
Dial Indicator with Magnetic Base	NA	Used to measure valve lift, end play, and backlash.
Diesel Fuel Injection Nozzle Tester	D01109AA	Used for fuel injection nozzle test.
Fuel Injection Timing Tool	DFMZ1A	Used to set injection pump timing.
Digital Pulse Tachometer	JT07270	Used to set slow idle speed and check fast idle speed.
Flex Hone (with 180-Grit Stone)	NA	Used to deglaze cylinder bores.
Fuel Pump Pressure Test Kit	JDG356	Used for fuel pump pressure test.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hose Assembly	JT03017	Used for engine oil pressure test.
Lifting Bracket (2 used)	JT01748	Used with hoist for removing and installing cylinder head and flywheel.
Magnetic Follower Holder Kit	D15001NU	Used to hold cam followers when removing and installing camshaft.
Nozzle Cleaning Kit	JDF13	Used to clean fuel injection nozzles.
PLASTIGAGE ® Bearing Clearance Measurement Tool	NA	Used to measure clearances.
Radiator Pressure Test Kit Adapters	JDG692	Used for cooling system pressure test.
Ridge Reamer	NA	Used to remove ridges from cylinder bore.
Rigid Hone (with 300-Grit Stone)	NA	Used with drill press to rebore cylinder to use oversize pistons and rings.
Straightedge		Used to measure drive belt deflection.
Straight Adapter	23622	Used for fuel injection nozzle test.
Valve Guide Driver	JDE504	Used to install valve guides in cylinder head.
Valve Guide Knurler	D-20019WI	Used to knurl inside diameter of valve guides.
Valve Guide Reamer	D-20021WI	Used to ream out valve guides.
Valve Spring Compressor	JDE138	Used to remove valves.

Other Material

Other Material

Part No.	Part Name	Part Use
TY16021 (U.S.)/ TY9484 (Canada)	John Deere High-Flex Form-in-Place Gasket	Used to seal crankcase extension housing, rear oil seal case, and flywheel housing to engine block. Used to seal oil pan to timing gear housing and engine block.
T43512 (U.S.)/ TY9473 (Canada)	Thread Lock and Sealer (Medium Strength)	Applied to threads of crankshaft sheave cap screws before installation.
TY9375 (U.S.)/ TY9480 (Canada)	Pipe Sealant	Applied to threads of dual temperature coolant switch before installation.

Diagnostics

Diesel Engine Troubleshooting

> **CAUTION: Avoid Injury! The engine may start to rotate at any time. Keep hands away from all moving parts when testing.**
>
> **Coolant in the radiator is extremely hot during operation.**

Symptom: Engine Will Not Start

(1) Proper starting procedure being used is correct for conditions?

Yes - Go to step (2).

No - Use correct procedure for conditions. See the Operator's Manual.

(2) Battery 12.7 VDC or higher?

Yes - Go to step (3).

No - Charge and check battery.

(3) No open circuits in wiring?

Yes - Go to step (4).

No - Repair or replace as needed.

(4) Starting motor functioning properly?

Yes - Go to step (5).

No - Repair or replace starting motor.

(5) Correct type of fuel being used?

Yes - Go to step (6).

No - Drain and replace fuel.

(6) Engine oil of correct viscosity and type?

Yes - Go to step (7).

No - Replace engine oil with oil of proper viscosity and type. Replace oil filter.

(7) No water in fuel?

Yes - Go to step (8).

No - Drain and replace fuel.

(8) fuel filter not clogged?

Yes - Go to step (9).

No - Replace fuel filter.

Symptom: Engine Will Not Start

(9) No air leak in fuel system?

Yes - Go to step (10).

No - Repair fuel system.

(10) Fuel lines not plugged, pinched or cracked?

Yes - Go to step (11).

No - Repair or replace fuel lines as needed.

(11) Correct volume of fuel supplied to injection pump?

Yes - Go to step (12).

No - Replace fuel transfer pump.

(12) Intake and/or exhaust valve clearance correct?

Yes - Go to step (13).

No - Adjust valve clearance. See "Adjust Valve Clearance" on page 154.

(13) Intake and/or exhaust valve not seized?

Yes - Go to step (14).

No - Replace valve and check valve guide. (See "Recondition Cylinder Head" on page 189.)

(14) Piston rings not broken or seized?

Yes - Go to step (15).

No - Replace rings. Check piston and cylinder. (See "Remove and Install Piston and Connecting Rod" on page 194. See "Cylinder Bore" on page 201.)

(15) Piston rings, piston or cylinder not worn?

Yes - Go to step (16).

No - Replace piston and/or rings, bore or hone cylinder. (See "Remove and Install Piston and Connecting Rod" on page 194. See "Cylinder Bore" on page 201.)

(16) Crankshaft pin or bearing not seized?

Yes - Go to step (17).

No - Regrind crankshaft and replace bearings. (See "Crankshaft and Main Bearings" on page 205.)

(17) Is injection pump timing correct?

No - See "Injection Pump Static Timing" on page 164.

Symptom: Engine Starts But Does Not Continue Running - No Exhaust Smoke

(1) Correct type of fuel being used?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) Engine oil of proper viscosity and type?

Yes - Go to step (3).

No - Replace engine oil filter and oil of proper viscosity and type.

(3) Fuel filter not clogged?

Yes - Go to step (4).

No - Replace fuel filter.

(4) No air leak in fuel system?

Yes - Go to step (5).

No - Repair fuel system.

(5) Fuel lines not plugged, pinched or cracked?

Yes - Go to step (6).

No - Repair or replace fuel lines as needed.

(6) Correct volume of fuel supplied to injection pump?

Yes - Go to step (7).

No - Replace fuel transfer pump.

(7) Valve clearance correct?

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

Symptom: Engine Starts But Does Not Continue Running - Excess Exhaust Smoke

(1) Correct type of fuel being used?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) No water in fuel?

Yes - Go to step (3).

No - Drain and replace fuel.

(3) Fuel filter not clogged?

Yes - Go to step (4).

No - Replace fuel filter.

Symptom: Engine Starts But Does Not Continue Running - Excess Exhaust Smoke

(4) Intake and/or exhaust valve not seized?

Yes - Go to step (5).

No - Repair as necessary. (See “Recondition Cylinder Head” on page 189.)

(5) Piston rings not broken or seized?

Yes - Go to step (6).

No - Replace rings. Check piston and cylinder. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(6) Piston rings, piston or cylinder not worn?

No - Replace piston and/or rings, bore or hone cylinder. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Low Engine Output - Exhaust Color NORMAL

(1) Correct type of fuel being used?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) Fuel filter not clogged?

Yes - Go to step (3).

No - Replace fuel filter.

(3) Fuel lines not clogged, cracked or pinched?

Yes - Go to step (4).

No - Clean or replace fuel lines.

(4) No air leakage into fuel system?

Yes - Go to step (5).

No - Repair fuel supply system.

(5) Proper volume of fuel to injection pump?

Yes - Go to step (6).

No - Check or replace fuel transfer pump.

(6) Intake and exhaust valve clearance correct?

Yes - Go to step (7).

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

Symptom: Low Engine Output - Exhaust Color NORMAL

(7) Intake or exhaust valves not leaking compression?

Yes - Go to step (8).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(8) Intake or exhaust valves not seized?

Yes - Go to step (9).

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

(9) Cylinder head gasket not leaking compression?

No - Replace head gasket. (See “Remove and Install Cylinder Head” on page 187.) Resurface head and block if necessary. (See “Cylinder Head Distortion” on page 192.)

Symptom: Low Engine Output - Exhaust Color WHITE

(1) Correct type of fuel?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) No water in fuel?

Yes - Go to step (3).

No - Drain and replace fuel.

(3) Even volume of fuel being injected?

Yes - Go to step (4).

No - Repair or replace fuel injector pump or fuel injectors.

(4) Proper spray pattern from injectors?

Yes - Go to step (5).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(5) Intake or exhaust valve stems not worn?

Yes - Go to step (6).

No - Replace valve guides and valves. (See “Recondition Cylinder Head” on page 189.)

Symptom: Low Engine Output - Exhaust Color WHITE

(6) Is injection pump timing correct?

Yes - Go to step (7).

No - See “Injection Pump Static Timing” on page 164.

(7) Piston rings installed correctly?

Yes - Go to step (8).

No - Install piston rings correctly. (See “Remove and Install Piston and Connecting Rod” on page 194.)

(8) Piston ring ends staggered?

Yes - Go to step (9).

No - Stagger piston ring ends. (See “Remove and Install Piston and Connecting Rod” on page 194.)

(9) Piston, rings, or cylinder not worn?

Yes - Go to step (10).

No - Replace pistons and rings, bore or hone cylinders. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(10) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Low Engine Output - Exhaust Color BLACK

(1) Is engine NOT being run under high altitude or high temperature conditions?

Yes - Go to step (2).

No - Reduce load.

(2) Correct type of fuel?

Yes - Go to step (3).

No - Drain and replace fuel.

(3) Air filter elements not clogged?

Yes - Go to step (4).

No - Clean or replace air filter elements.

Symptom: Low Engine Output - Exhaust Color BLACK

(4) Exhaust pipe not clogged?

Yes - Go to step (5).

No - Clean exhaust pipe.

(5) Engine running cool enough?

Yes - Go to step (6).

No - Check thermostat. (See “Test Thermostat” on page 168.) Replace if faulty. Adjust fan belt tension. (See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153.)

(6) Cooling system filled to correct level?

Yes - Go to step (7).

No - Check for leaks and fill system to correct level.

(7) Correct volume of fuel being injected?

Yes - Go to step (8).

No - Replace faulty fuel injector pump or fuel injectors.

(8) Correct pattern from fuel injectors?

Yes - Go to step (9).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(9) Is injector pump timing correct?

Yes - Go to step (10).

No - See “Injection Pump Static Timing” on page 164

(10) Intake or exhaust valves not leaking compression?

Yes - Go to step (11).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(11) Intake or exhaust valve not seized?

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

Symptom: Exhaust Color WHITE Under Load

(1) Correct type of fuel?

Yes - Go to step (2).

No - Drain and replace fuel.

Symptom: Exhaust Color WHITE Under Load

(2) No water in fuel?

Yes - Go to step (3).

No - Drain and replace fuel.

(3) Engine not running too cool?

Yes - Go to step (4).

No - Check thermostat. (See “Test Thermostat” on page 168.) Replace if faulty.

(4) Correct volume of fuel being injected?

Yes - Go to step (5).

No - Replace faulty fuel injector pump.

(5) Correct pattern from fuel injectors?

Yes - Go to step (6).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(6) Is injector pump timing correct?

Yes - Go to step (7).

No - See “Injection Pump Static Timing” on page 164.

(7) Piston rings installed correctly?

Yes - Go to step (8).

No - Install piston rings correctly. (See “Remove and Install Piston and Connecting Rod” on page 194.)

(8) Pistons, rings or cylinders not worn?

Yes - Go to step (9).

No - Replace pistons and rings, bore or hone cylinders. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(9) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Exhaust Color BLACK Under Load

(1) Is engine NOT being run under high altitude or high temperature conditions?

Yes - Go to step (2).

No - Reduce load.

Symptom: Exhaust Color BLACK Under Load

(2) Correct type of fuel?

Yes - Go to step (3).

No - Drain and replace fuel.

(3) Air filter elements not clogged?

Yes - Go to step (4).

No - Clean or replace air filter elements.

(4) Exhaust pipe not clogged?

Yes - Go to step (5).

No - Clean exhaust pipe.

(5) Even volume of fuel being injected?

Yes - Go to step (6).

No - Replace faulty fuel injector pump or fuel injectors.

(6) Correct volume of fuel being injected?

Yes - Go to step (7).

No - Replace faulty fuel injector pump or fuel injectors.

(7) Proper spray pattern from injectors?

Yes - Go to step (8).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(8) Is injector pump timing correct?

Yes - Go to step (9).

No - See “Injection Pump Static Timing” on page 164.

(9) Intake or exhaust valves not leaking compression?

Yes - Go to step (10).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(10) Intake or exhaust valves not seized?

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

Symptom: Exhaust Temperature Too High

(1) Cooling system filled to correct level?

Yes - Go to step (2).

No - Check for leaks and fill system to correct level.

Symptom: Exhaust Temperature Too High

(2) Engine running cool enough?

Yes - Go to step (3).

No - Check thermostat. (See “Test Thermostat” on page 168.) Replace if faulty. Adjust fan belt tension. (See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153.)

(3) Exhaust pipe not clogged?

Yes - Go to step (4).

No - Clean exhaust pipe.

(4) Correct volume of fuel being injected?

Yes - Go to step (5).

No - Replace faulty fuel injector pump or fuel injectors.

(5) Intake or exhaust valve clearance correct?

Yes - Go to step (6).

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

(6) Intake or exhaust valves not leaking compression?

Yes - Go to step (7).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(7) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Engine Runs Rough - Misfiring

(1) No water in fuel?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) Intake or exhaust valve clearance correct?

Yes - Go to step (3).

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

(3) Correct volume of fuel being injected?

Yes - Go to step (4).

No - Replace faulty fuel injector pump or fuel injectors.

Symptom: Engine Runs Rough - Misfiring

(4) Is injector pump timing correct?

Yes - Go to step (5).

No - See “Injection Pump Static Timing” on page 164.
No - .

(5) Backlash of timing gear not excessive?

Yes - Go to step (6).

No - Repair gears as needed. (See “Timing Gear Backlash Check” on page 213.)

(6) Combustion chambers clean of foreign matter?

Yes - Go to step (7).

No - Clean combustion chambers. (See “Remove and Install Cylinder Head” on page 187.)

(7) Intake or exhaust valves not leaking compression?

Yes - Go to step (8).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(8) Intake or exhaust valves not seized?

Yes - Go to step (9).

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

(9) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Engine Runs Rough - Uneven Combustion Sound

(1) Correct type of fuel being used?

Yes - Go to step (2).

No - Drain and replace fuel.

(2) No water in fuel?

Yes - Go to step (3).

No - Drain and replace fuel. Check fuel filter.

(3) Intake and exhaust valve clearance correct?

Yes - Go to step (4).

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

Symptom: Engine Runs Rough - Uneven Combustion Sound

(4) Even volume of fuel being injected?

Yes - Go to step (5).

No - Replace faulty fuel injector pump or fuel injectors.

(5) Proper spray pattern from injectors?

Yes - Go to step (6).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(6) Air filter elements not clogged?

Yes - Go to step (7).

No - Clean or replace air filter elements.

(7) Exhaust pipe not clogged?

No - Clean exhaust pipe.

Symptom: Engine Runs Rough - Engine Surges DURING IDLING

(1) No water in fuel?

Yes - Go to step (2).

No - Drain and replace fuel. Check fuel filter.

(2) Even volume of fuel injected?

Yes - Go to step (3).

No - Replace faulty fuel injector pump or fuel injectors.

(3) Intake and exhaust valve clearance correct?

Yes - Go to step (4).

No - Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

(4) Proper spray pattern from injectors?

Yes - Go to step (5).

No - Clean or replace fuel injector nozzles. See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.

(5) Intake or exhaust valves not seized?

Yes - Go to step (6).

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

Symptom: Engine Runs Rough - Engine Surges DURING IDLING

(6) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Engine Runs Rough - Engine Surges UNDER LOAD

(1) No water in fuel?

Yes - Go to step (2).

No - Drain and replace fuel. Check fuel filters.

(2) Even volume of fuel injected?

Yes - Go to step (3).

No - Replace faulty fuel injector pump or fuel injectors.

(3) Proper spray pattern from injectors?

Yes - Go to step (4).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(4) Piston rings not broken or seized?

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Engine Runs Rough - Excessive Engine Vibration

(1) Even volume of fuel injected?

Yes - Go to step (2).

No - Replace faulty fuel injector pump or fuel injectors.

(2) Proper spray pattern from injectors?

Yes - Go to step (3).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

Symptom: Engine Runs Rough - Excessive Engine Vibration

(3) Piston rings not broken or seized?

Yes - Go to step (4).

No - Replace rings. Replace pistons if damaged. Bore cylinder if damaged. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(4) Crankshaft pin or bearing not worn or seized?

Yes - Go to step (5).

No - Regrind crankshaft and replace bearings. (See “Crankshaft and Main Bearings” on page 205.)

(5) Connecting rod bolts torqued properly?

No - Replace damaged components. (See “Remove and Install Piston and Connecting Rod” on page 194.)

Symptom: Excessive Fuel Consumption

(1) Engine not running too cool?

Yes - Go to step (2).

No - Check thermostat. (See “Test Thermostat” on page 168.) Replace if faulty.

(2) Correct volume of fuel being injected?

Yes - Go to step (3).

No - Replace faulty fuel injector pump or fuel injectors.

(3) Correct pattern from fuel injectors?

Yes - Go to step (4).

No - Clean or replace fuel injector nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)

(4) Intake or exhaust valves not leaking compression?

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

Symptom: Excessive Oil Consumption

(1) Engine oil of correct viscosity and type?

Yes - Go to step (2).

No - Replace engine oil with oil of proper viscosity and type. Replace oil filter.

Symptom: Excessive Oil Consumption

(2) No external or internal oil leak?

Yes - Go to step (3).

No - Repair as needed.

(3) Intake or exhaust valve stems not worn?

Yes - Go to step (4).

No - Replace valve guides and valves. (See “Recondition Cylinder Head” on page 189.)

(4) Piston rings installed correctly and properly staggered?

Yes - Go to step (5).

No - Install piston rings correctly. (See “Remove and Install Piston and Connecting Rod” on page 194.)

(5) Pistons, rings or cylinders not worn?

Yes - Go to step (6).

No - Replace pistons and rings, bore or hone cylinders. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(6) Piston rings not broken or seized?

No - Replace rings. Check piston and cylinder. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Fuel Oil in Crankcase

(1) Correct volume of fuel being injected”

Yes - Go to step (2).

No - Replace faulty fuel injector pump or fuel injectors.

(2) Intake or exhaust valve not seized or broken?

Yes - Go to step (3).

No - Replace valve and check valve guide. (See “Recondition Cylinder Head” on page 189.)

(3) Piston rings not broken or seized?

Yes - Go to step (4).

No - Replace rings. Check piston and cylinder. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(4) Pistons rings, piston or cylinders not worn?

No - Replace pistons and rings, bore or hone cylinders. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

Symptom: Coolant in Crankcase

(1) Cylinder head gasket not leaking?

Yes - Go to step (2).

No - Replace head gasket. Resurface head and block if necessary. (See “Remove and Install Cylinder Head” on page 187.)

(2) Is cylinder block not cracked?

No - Replace cylinder block.

Symptom: Low Oil Pressure

(1) Oil at correct level?

Yes - Go to step (2).

No - Add oil.

(2) Engine oil of correct viscosity and type?

Yes - Go to step (3).

No - Replace engine oil with oil of proper viscosity and type. Replace oil filter.

(3) No external or internal oil leak?

Yes - Go to step (4).

No - Repair as needed.

(4) Oil pressure relief valve not worn or damaged?

Yes - Go to step (5).

No - Clean or replace relief valve. (. See “Remove and Install Oil Pressure Regulating Valve” on page 219.)

(5) Crankshaft pin or bearing not worn?

Yes - Go to step (6).

No - Regrind crankshaft and replace bearings. (See “Crankshaft and Main Bearings” on page 205.)

(6) Connecting rod bolts torqued properly?

Yes - Go to step (7).

No - Replace damaged components. Tighten to correct specification.

(7) Is engine not worn excessively?

No - Replace oil pump. (See “Oil Pump” on page 218.)

Symptom: Engine Is Overheating

(1) Is engine NOT being run under high altitude or high temperature conditions?

Yes - Go to step (2).

No - Reduce load on engine.

(2) Cooling system filled to correct level?

Yes - Go to step (3).

No - Check for leaks and fill system to correct level.

(3) Is radiator clear of debris?

Yes - Go to step (4).

No - Clean radiator fins.

(4) Is radiator core free from blockage?

Yes - Go to step (5).

No - Clean or replace radiator.

(5) Is thermostat operating correctly?

Yes - Go to step (6).

No - Check thermostat. See “Test Thermostat” on page 168. Replace if faulty. Adjust fan belt tension. See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153.

(6) Is lower radiator hose not collapsed?

Yes - Go to step (7).

No - Replace lower radiator hose.

(7) Is cylinder head gasket not leaking?

Yes - Go to step (8).

No - Replace head gasket. Resurface head and block if necessary. (See “Remove and Install Cylinder Head” on page 187. See “Recondition Cylinder Head” on page 189.)

(8) Is cylinder block not cracked?

No - Replace cylinder block.

Symptom: Low Engine Coolant Temperature

(1) Is thermostat operating correctly?

No - Check thermostat. (See “Test Thermostat” on page 168. Replace if faulty.)

Symptom: Low Compression

(1) Intake or exhaust valves not leaking compression?

Yes - Go to step (2).

No - Grind valves and seats. (See “Recondition Cylinder Head” on page 189.)

(2) Intake or exhaust valve not seized?

Yes - Go to step (3).

No - Replace valve guides and valves. (See “Recondition Cylinder Head” on page 189.)

(3) Pistons, rings or cylinders not worn or seized?

Yes - Go to step (4).

No - Replace pistons and rings, bore or hone cylinders. (See “Remove and Install Piston and Connecting Rod” on page 194. See “Cylinder Bore” on page 201.)

(4) Piston rings installed correctly and properly staggered?

No - Install piston rings correctly. (See “Remove and Install Piston and Connecting Rod” on page 194.)

Starting Motor Troubleshooting Guide

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

IMPORTANT: Avoid damage! If starting motor continues to run after turning ignition switch to OFF position, disconnect negative (-) lead from battery as soon as possible.

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

Symptom: Starter Does Not Rotate

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

Yes - Go to step (2).

No - Check that all starting conditions are met.

(2) Are battery cables clean and tight?

Yes - Go to step (3).

No - Tighten or clean as necessary.

(3) Is battery fully charged? (See “Test Battery” on page 541.)

Yes - Go to step (4).

No - Charge battery. (See “Charge Battery” on page 542.)

(4) Does crankshaft rotate freely?

Yes - Go to step (5).

No - See “Crankshaft and Main Bearings” on page 205.

(5) Are starting circuit and key switch working correctly?

No - Repair as necessary. (See “Cranking Circuit” on page 319.)

Symptom: Starter Rotates Slowly

(1) Are battery cables clean and tight?

Yes - Go to step (2).

Tighten or clean as necessary.

Symptom: Starter Rotates Slowly

(2) Is battery fully charged? (See “Test Battery” on page 541.)

Yes - Go to step (3).

Charge battery. (See “Charge Battery” on page 542.)

(3) Does crankshaft rotate freely?

Yes - Go to step (4).

No - See “Crankshaft and Main Bearings” on page 205.

(4) Are starting motor and solenoid functioning correctly?

Repair or replace. (See “Test Starting Motor Solenoid - Diesel Engine” on page 546.)

Symptom: Starter Rotates But Does Not Crank

(1) Does the pinion mesh with ring gear?

Faulty starter drive. Replace.

Check for worn pinion or ring gear, and incorrect starting motor alignment.

Tests and Adjustments

Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)

Reason

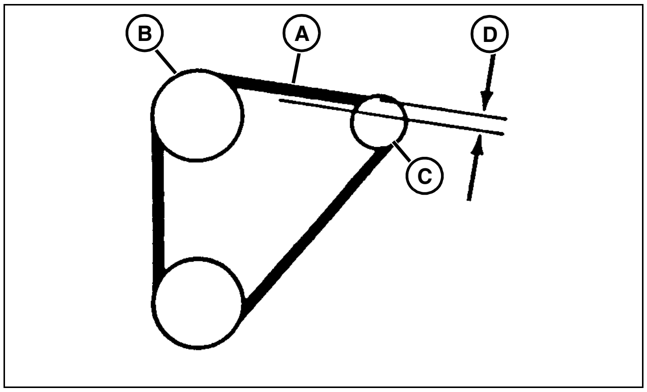
To maintain correct alternator drive belt tension.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Belt Tension Gauge	JDG529 or JDST28	Used to measure drive belt deflection.
Straightedge		Used to measure drive belt deflection.

Check Procedure

1. Park machine safely.
2. Remove engine cover.
3. Disconnect battery negative (-) battery cable.



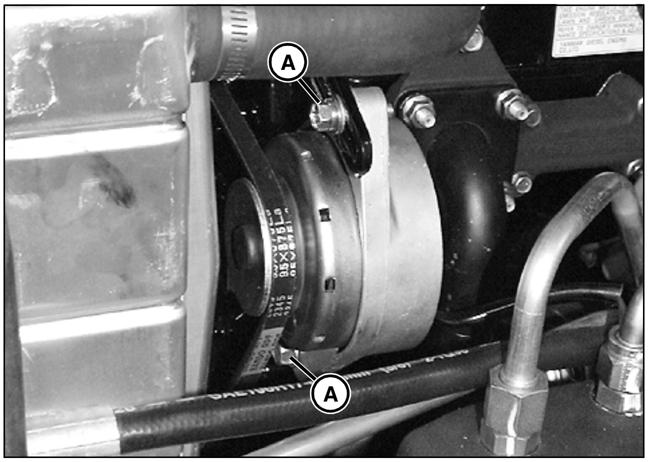
M54014

4. Apply approximately 98 N (22 lb-force) (A) to the belt at the midpoint between the fan/coolant pump pulley (B) and the alternator pulley (C). Check belt deflection (D) using JDG529 or JDST28 Belt Tension Gauge and a straightedge and compare to specification.

Check Results

If deflection is not within specification, perform Adjustment Procedure.

Adjustment Procedure



M84600

1. Loosen cap screws and nuts (A).
2. Apply force to the alternator housing until tension is correct.
3. Tighten cap screws and nut.

Specifications

12V Alternator Drive Belt Deflection
at 98 N (22 lb-force) . . . . 10-15 mm (0.40-0.60 in.)

Check and Adjust 48V Alternator Drive Belt Tension (Model 2500E)

Reason

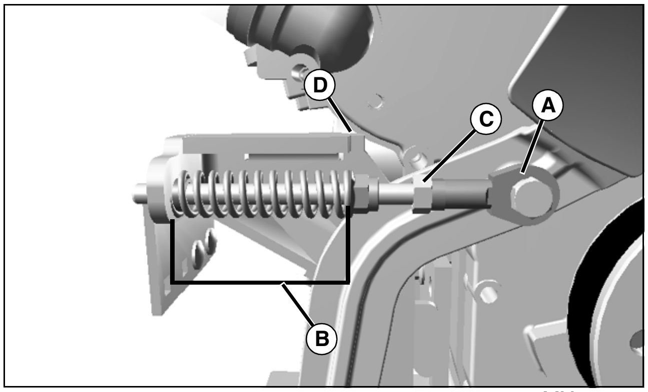
To maintain correct alternator drive belt tension

Special or Required Tools

Tool Name	Tool No.	Tool Use
Belt Tension Gauge	JDG529 or JDST28	Used to measure drive belt deflection.
Straightedge		Used to measure drive belt deflection.

Procedure

1. Inspect belt for excessive wear or fraying.
2. Inspect the grooved side of belt for cracking or abnormal wear. Replace as necessary.



MX20426

3. Inspect ball joint (A) for looseness or abnormal wear.

4. Apply approximately 50 N (11 lb-force) to the belt at the midpoint between the engine pulley and the 48V alternator pulley. Check belt deflection using JDG529 or JDST28 Belt Tension Gauge and a straightedge and compare to specification.

5. Spring length (B) should fall within notch (D). Measure length of spring with belt installed. Compare to specification.

6. If tension adjustment is needed, loosen or tighten nut (C) as required.

Specifications

48V Alternator Drive Belt Deflection at 50 N (11 lb-force) . . . . 30 mm (1.188 in.)

48V Alternator Drive Belt Tension Spring Length . . . . 66-72 mm (2.6-2.8 in.)

Adjust Valve Clearance

Reason

To be sure valves are fully opening at the correct time, but not remaining open too long or wearing valve train unnecessarily.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Feeler Gauge	NA	Used to check valve clearance.
10 mm End Wrench	NA	Used to loosen and tighten lock nut.
Flat Blade Screwdriver	NA	Used to hold and turn adjusting screw.
17 mm Wrench	NA	Used to turn crankshaft pulley.

Procedure

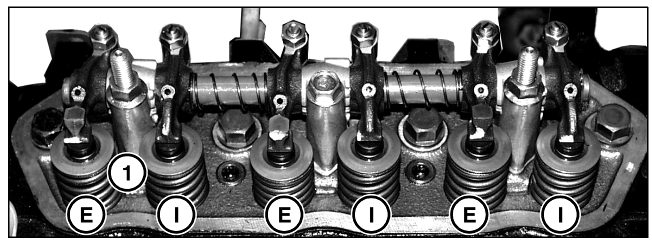
1. Engine must be cool (room temperature) before valve clearance is checked.

2. Be sure ignition is off and key is removed before attempting to turn engine by hand.

3. Remove rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)

NOTE: Top Dead Center (TDC) is where the piston is at its highest point of travel during the compression stroke. The valves (E and I) must be checked with piston at or near TDC.

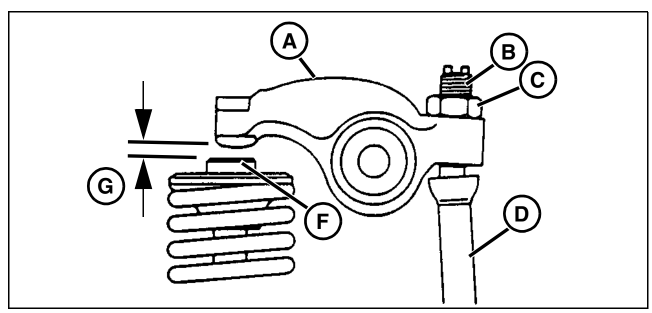
Cylinder number one is located toward the front of machine (flywheel side).



MX0738

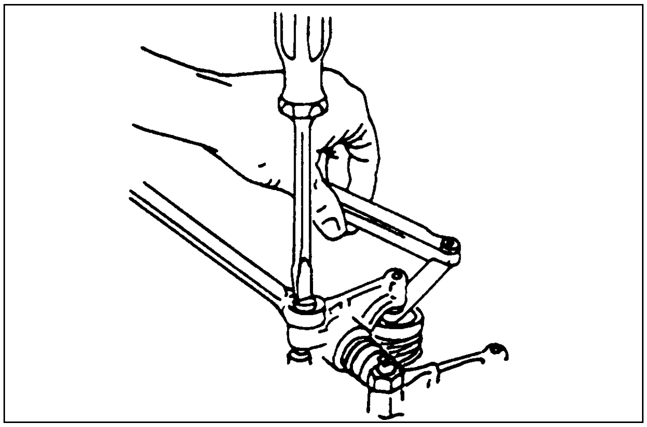
Picture Note: E Identifies the Exhaust Valves, I Identifies the Intake Valves

4. Using a 17 mm wrench, turn the crankshaft pulley in the direction of engine rotation while watching the rocker arms of the number one cylinder. When the intake valve has completely closed (raised up), turn the crankshaft an additional half turn.



MX0737

5. Try to move rocker arms (A) and push rods (D) for the cylinder to be adjusted. If both rocker arms and push rods are loose, the piston is near TDC on the compression stroke and you may proceed to step 8.

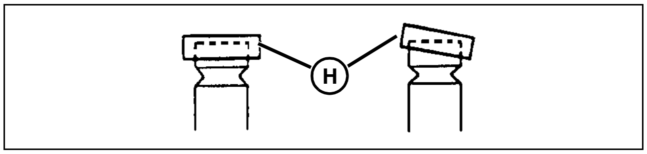


T6105BF

6. Slide feeler gauge of appropriate size between valve cap (F) and rocker arm. There should be a slight drag on the feeler gauge when the clearance (G) is to specification.

7. To adjust a valve, loosen lock nut (C) and turn adjusting screw (B) until blade of feeler gauge has a slight drag when inserted between rocker arm and valve cap. Hold adjusting screw while tightening lock nut.

8. Recheck valve clearance after tightening lock nut.



MX5696

Picture Note: Left Valve Cap Shows Normal Position

9. Check that valve cap (H) on end of valve stem remained seated on valve and inside valve spring retainer.

10.Repeat steps 4 through 9 for cylinders two and three.

11.Install rocker arm cover.

Specifications

Valve Clearance . . . . 0.2 mm (0.008 in.)

Check Valve Lift

Reason

To test for excessive wear on camshaft lobes, cam followers, rocker arms, valve stems, and valve caps, and for worn or bent push rods.

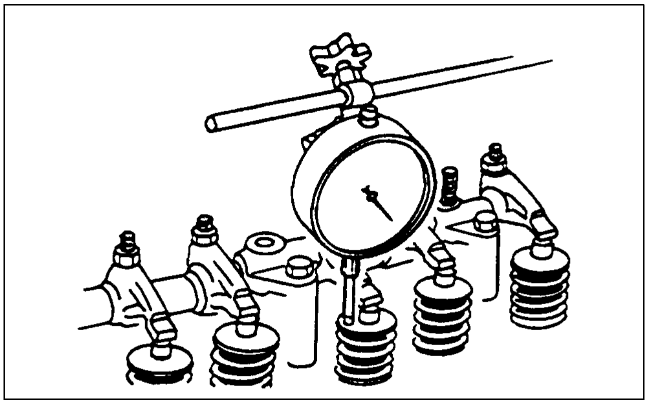
Special or Required Tools

Tool Name	Tool No.	Tool Use
Dial Indicator with Magnetic Base	NA	Used to measure valve lift.

Procedure

1. Remove rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)

2. Check that valve clearance is within specification. Adjust if necessary. (See “Adjust Valve Clearance” on page 154.)



T6333DT

3. Fasten dial indicator to engine and position indicator tip on valve retainer. Valve must be fully closed and rocker arm must move freely.

4. Set the dial indicator to zero.

5. Rotate crankshaft while observing dial indicator as valve is moved to full open (down) position.

6. Repeat for each valve.

Results

The valve lift should be the same for all valves. If one or more valves have less travel than the others, remove and inspect the camshaft, followers, and push rods. (See “Camshaft” on page 209.) If camshaft, followers, and push rods are within specification, remove and inspect the cylinder head. (See “Remove and Install Cylinder Head” on page 187.)

Test Cylinder Compression

Reason

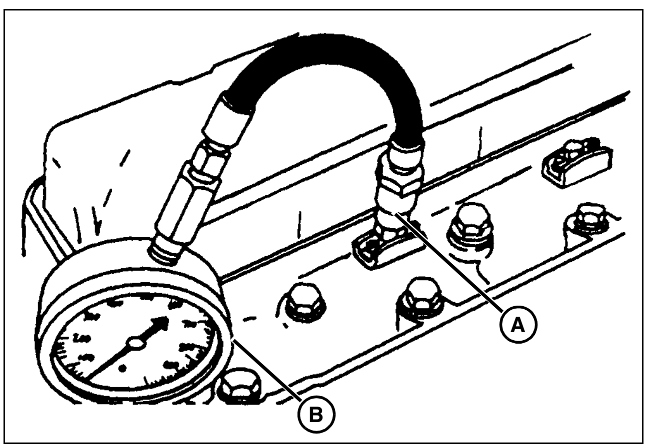
To determine the condition of the pistons, rings, cylinder walls, and valves.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Compression Gauge Assembly	JT01682	Used to measure cylinder compression.
Adapter	JDG472	Used to install gauge assembly.

Procedure

1. Run engine for five minutes to bring to operating temperature. Shut off engine.
2. Move fuel shutoff valve on fuel filter to OFF position.
3. Remove injection nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224)



T6333EU

4. Install JDG472 or JDG560 Adapter (A).
5. Install JT01682 Compression Gauge Assembly (B).
6. Disconnect the fuel control solenoid connector.

IMPORTANT: Avoid damage! Do not overheat the starting motor during this test.

7. Crank the engine for five seconds with the starting motor. Minimum cranking speed is 250 rpm.
8. Record the pressure reading for each cylinder. Compare the pressure readings with specifications.

Results

- If the pressure reading is below specification, squirt clean engine oil into the cylinders through the injector ports and repeat the test.
- If the pressure increases significantly, check piston, rings, and cylinder walls for wear or damage.
- If the pressure does not increase significantly, check for leaking valves, valve seats, or cylinder head gasket.

Specifications

Cylinder Compression Pressure
(Minimum) . . . . 2549 kPa (369 psi)
Pressure Difference Between Cylinders
(Maximum) . . . . 241 kPa (35 psi)

Test Engine Oil Pressure

Reason

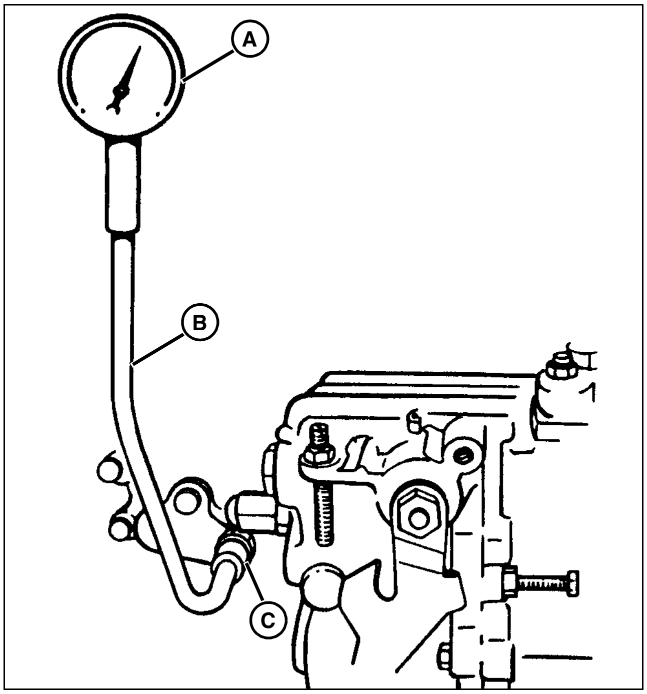
To determine if the engine bearings or the lubrication system components are worn.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Connector	JT03349	Used to connect gauge to oil pressure switch port.
Hose Assembly	JT03017	Used to connect gauge to oil pressure switch port.
0-700 kPa (0-100 psi) Gauge	JT07034	Used to measure engine oil pressure.

NOTE: The connector, hose assembly, and gauge are found in other SERVICEGARD™ test kits.

Procedure



T6471FB

1. Remove the oil pressure switch.
2. Install JT03349 Connector (C).
3. Connect JT03017 Hose Assembly (B) and JT07034 Gauge (A).

IMPORTANT: Avoid damage! Do not run the engine if there is insufficient oil pressure!

4. Start the engine. If the pressure reading is below 60 kPa (8.7 psi) at slow idle rpm, stop the engine.
5. If the oil pressure is at least 60 kPa (8.7 psi), run the engine approximately five minutes to heat the oil. Check the oil pressure at engine rated speed.

Results

- If oil pressure is not within specification, inspect the oil pump and oil pressure regulating valve for wear or damage. Replace parts as needed. (See “Removal” on page 218 and/or See “Remove and Install Oil Pressure Regulating Valve” on page 219)
- If oil pump is within specifications, the engine may have parts worn beyond specification. (See “Diagnostics” on page 143 in this section for more information.)

Specifications

Engine Oil Pressure
at Rated Speed . . . . 297-393 kPa (43-57 psi)

Leak Test Air Intake System

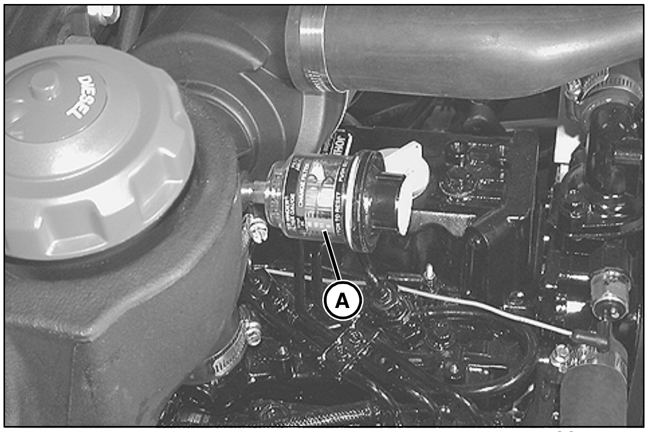
Reason

Check for leaks in the air intake system.

Special or Required Tools

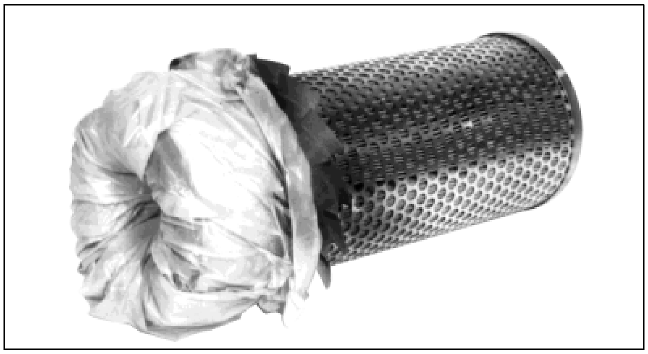
Tool Name	Tool No.	Tool Use
Air Pressure Regulator	NA	Used to pressurize the air intake system to check for leaks.
Test Fitting	NA	Used to connect air pressure regulator.

Procedure



M84632

1. Remove the air filter restriction indicator (A) and install the test fitting.
2. Connect the air pressure regulator to manifold using the hose and fitting from air cleaner.
3. Remove the air cleaner cover and the main filter element.



M82124

4. Put a large plastic bag into and over end of main filter element. Install the main filter element and cover.

5. Pressurize the air intake system between **34-69 kPa (5-10 psi)**. If the air intake system cannot be pressurized, turn the engine slightly to close valves.

6. Spray a soap solution over all the connections from the air cleaner to the intake manifold and check for leaks.

Results

Find leaks and repair or replace parts as necessary.

Test Fuel Pump Pressure

Reason

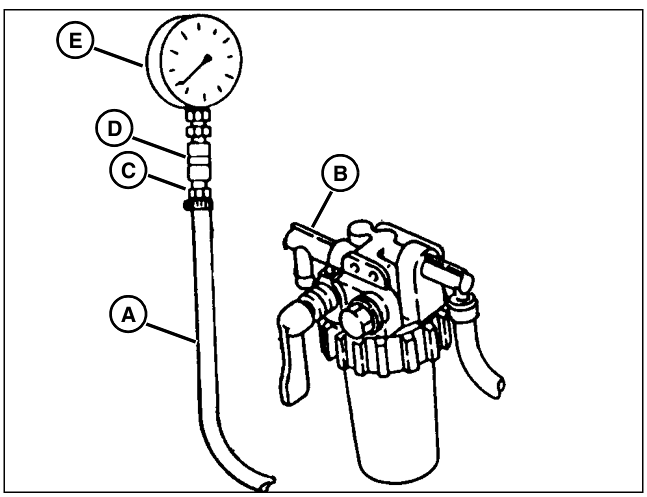
To determine supply pump operating pressure.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Fuel Pump Pressure Test Kit	JDG356	Used to measure pump operating pressure.

Procedure

1. Park machine safely.
2. Remove engine cover.



M82145A

3. Disconnect supply pump-to-filter hose (A) at fuel filter (B).

4. Assemble hose coupling (C), coupling reducer (D), and gauge (E).

5. Connect gauge/fitting assembly to supply pump-to-filter hose.

6. Disconnect wire connector to fuel shutoff solenoid.

IMPORTANT: Avoid damage! Do not run starting motor for more than ten seconds at a time.

7. Crank engine using the starting motor. Compare reading on gauge to specification.

Results

If pressure is below specification, replace fuel pump.

Specifications

Fuel Pump Pressure (Minimum) . . . . . . 29 kPa (4.3 psi)

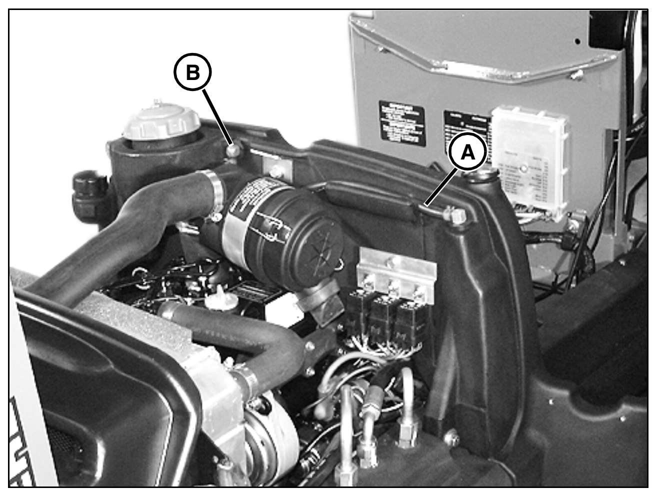
Leak Test Fuel System

Reason

Tests the fuel system plumbing for external leakage. This test also determines if air is entering the fuel system at connections, allowing fuel to siphon back to tank.

Procedure

1. Park machine safely.
2. Remove engine cover.



M84586

3. Disconnect the fuel supply line (A) and return line (B) at the fuel tank.

4. Place the fuel return line into a suitable container to catch drained fuel.

CAUTION: Avoid injury! Do not apply more than 103 kPa (15 psi) air pressure to the fuel system. Damage to the injection pump or personal injury may result.

5. Apply 34-69 kPa (5-10 psi) air pressure to fuel supply hose until all fuel is drained from the system.

6. Plug the end of the fuel return hose.

7. Apply air pressure within specification to the fuel system at the fuel supply line. Do not exceed a maximum pressure of **103 kPa (15 psi)**.

8. Apply liquid soap and water solution to all joints and connections in the fuel system, and inspect for leaks.

Results

Find leaks and repair or replace parts as necessary.

Procedure for Bleeding Fuel System

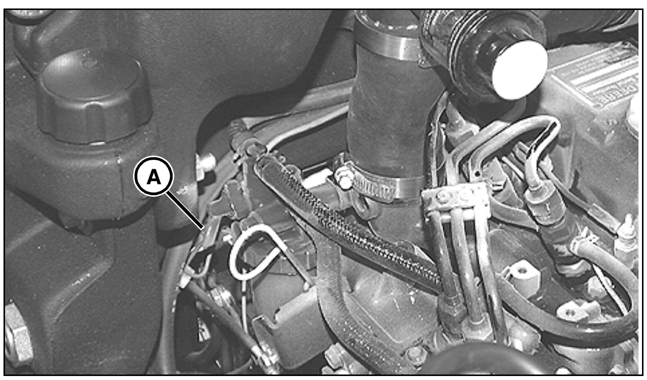
Reason

Any time the fuel system has been opened up for service (lines disconnected or filter removed), it is necessary to bleed air from the system.

Procedure

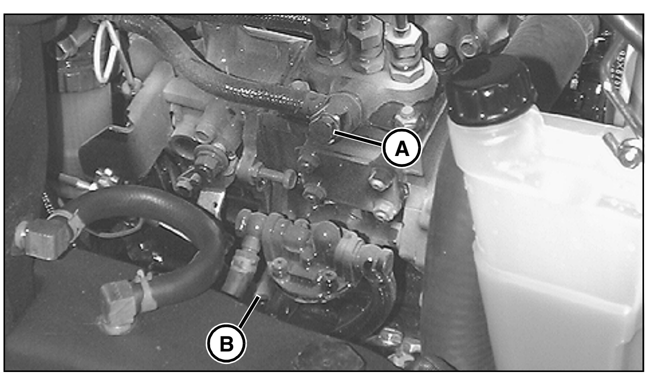
NOTE: The engine is equipped with an automatic air venting system, which makes the fuel system self-bleeding.

1. Park machine safely.
2. Remove engine cover.
3. Verify that all fuel line connections are tight.



M84628

4. Turn fuel filter shutoff valve (A) to OPEN position.
5. Turn key switch to RUN position.



M84629

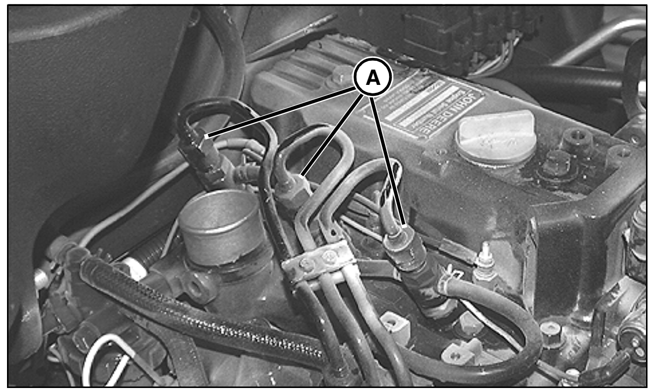
6. Loosen air bleeder screw (A) on fuel injection pump.

7. Operate hand primer lever (B) on the fuel supply pump for approximately one minute to bleed most of the air back to the tank through the fuel return lines.

8. Tighten bleed screw.

9. Start engine. If engine does not start after several attempts, proceed to step 10.

10. Remove air cleaner assembly. (See “Remove and Install Air Cleaner Assembly” on page 176.)



M84630

11. Loosen all three injector line nuts (A). Be sure not to loosen bottom nut of injector.

12. Crank engine over with starting motor.

13. When fuel appears at nozzles, tighten line nuts.

Adjust Slow Idle Speed

IMPORTANT: Avoid damage! The slow idle adjustment is the only adjustment that can be made on this engine.

The fast idle and torque capsule adjustments are pre-set by the engine manufacturer to comply with strict EPA/CARB emissions requirements, and are adjustable only by authorized diesel service facilities.

Reason

To achieve proper slow idle speed setting. Provides adequate rpm to keep engine running smoothly without stalling.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Pulse Tachometer	JT07270	Used to set slow idle speed.

Procedure

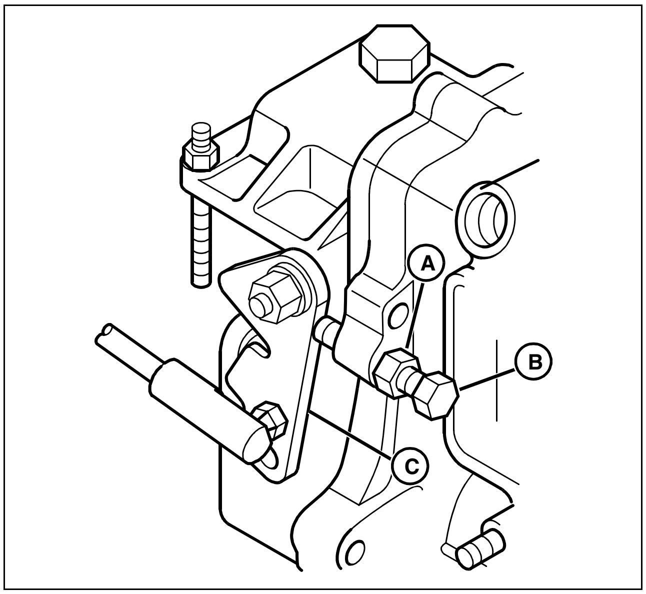
1. Park machine safely.

2. Start engine and run for five minutes to bring machine to operating temperature.

3. Remove engine cover.

4. Move throttle lever to slow idle position.

5. Use JT07270 Digital Pulse Tachometer to check engine speed at crankshaft pulley.



MIF M91893

6. Visually check that the injection pump throttle lever (C) is against the slow idle stop screw. Check slow idle speed and compare to specification.

7. If slow idle speed does not meet specification, loosen jam nut (A) and turn screw (B). After adjustment, tighten jam nut.

8. After slow idle speed adjustment, adjust throttle cable. (See “Adjust Throttle Cable” on page 160.)

Specifications

Slow Idle Speed . . . . 1450 ± 100 rpm

Adjust Throttle Cable

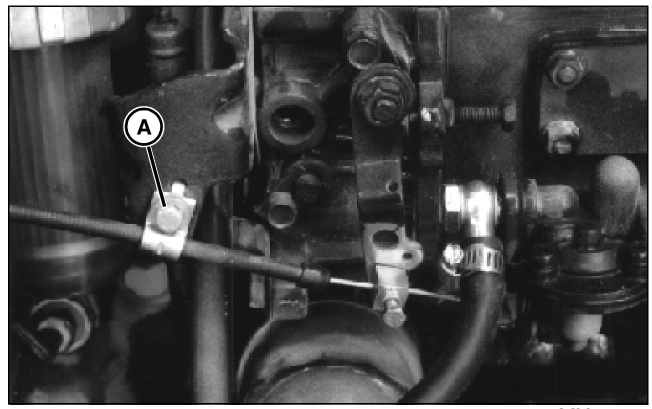
Reason

To ensure that throttle linkage is adjusted correctly, and allow full fast idle and slow idle positions of governor throttle lever.

Procedure

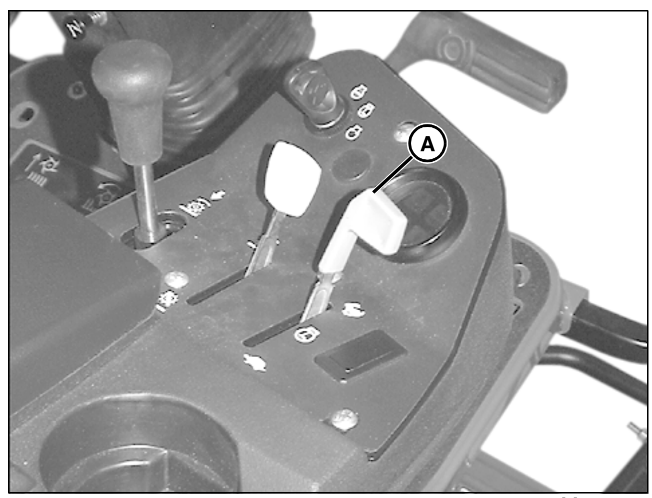
1. Park machine on level surface with key switch off, transmission in neutral, and park brake on.

2. Remove engine cover.



MX5415

3. Loosen throttle clamp screw (A).



M98196

4. Move throttle lever (A) toward FAST idle position until throttle lever is **2-3 mm (0.080-0.120 in.)** away from frame slot.

5. Hold throttle control lever against fast idle stop. Pull throttle cable tight. Tighten clamp screw.

6. Move throttle lever through full range. Check to be sure governor control lever moves through complete range and linkage is not binding.

Fast Idle Speed Check

Reason

To achieve the proper fast idle setting.

CAUTION: Avoid injury! DO NOT attempt to adjust fuel control assembly unless you are a factory trained technician with authorization to service CARB/EPA Certified Engines.

Equipment

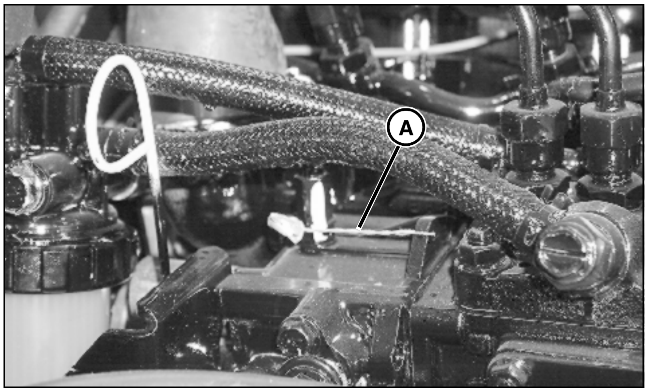
- JT05719 Hand-Held Digital Tachometer
- JDG991 Fast Idle Adjustment Tool

Procedure

1. Park machine on level surface.
2. Engage park brake.
3. Raise engine cover.
4. Place a small piece of reflective tape on crankshaft pulley.

NOTE: Make sure air cleaner is clean and not restricted. Replace air cleaner element as necessary.

5. Start engine and run for five minutes to obtain normal operating temperature.
6. Move throttle lever to FAST idle position.
7. Use JT05719 Hand-Held Digital Tachometer to check engine speed at crankshaft pulley. Check fast idle speed and compare to specification.
8. Turn key switch to STOP position.



MX18025

NOTE: The governor is sealed with a crimped wire seal to prevent adjustment by unauthorized personnel.

Results

- If engine DOES NOT meet fast idle speed specification, have injection pump inspected by a CARB/EPA Certified Authorized Diesel Service (ADS) center.

Specifications

Fast Idle Speed. . . . . 3225 ± 50 rpm

Test Fuel Injection System

CAUTION: Avoid injury! Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high-pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. Information may be obtained in the United States and Canada only by calling 1-800-822-8262.

Reason

To stop fuel flow to the cylinders (one at a time), while engine is running, to determine what effect that cylinder has on overall engine performance.

Special or Required Tools

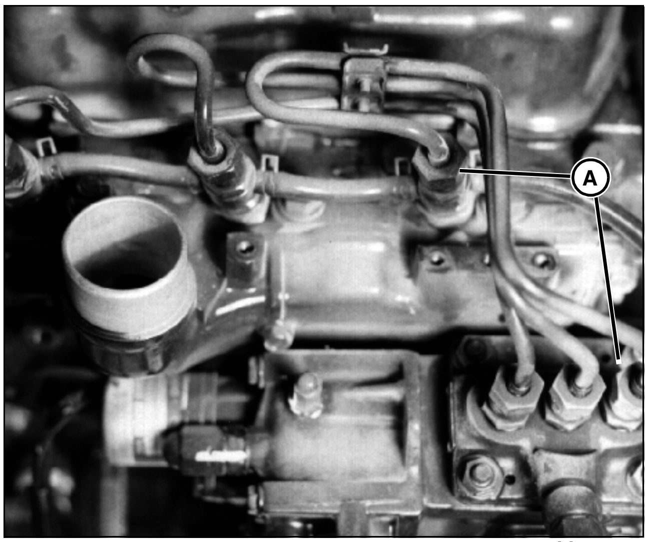
Tool Name	Tool No.	Tool Use
17 mm Open End Wrench (2 used)	NA	Used to loosen nut on high-pressure fuel injector line.

Procedure

1. Park machine on level surface with park brake on and transmission in neutral.

CAUTION: Avoid injury! This test will cause diesel fuel to be released from fuel system. Injection pump is capable of producing extremely high pressure. Eye protection must be worn. Do not open fuel injector connectors more than 1/8 of a turn. Do not place hands near injectors during test. Do not allow any debris to enter intake manifold during test. Do not smoke.

2. Start engine and run at slow idle.



M76984

3. Using two 17 mm open end wrenches, loosen nut (A) on one high-pressure fuel injector line, either at the injector nozzle or at injection pump, while holding lower nut stationary with second wrench. Loosen nut only 1/8 of a turn (45°).

4. Listen for engine speed to drop and exhaust noise to change.

5. Tighten nut and allow engine to return to original speed before loosening next cylinder's fuel line nut.

6. Compare sound and speed of each cylinder as it is disabled.

7. Tighten fuel line nuts and stop engine.

Results

When fuel flow is stopped to a cylinder, engine rpm should drop, engine should begin to vibrate and run roughly, and exhaust noise will be uneven until fuel flow is restored.

If test produces the results described above but engine performance remains poor, test the following

- Clogged air cleaner elements, leaking air filter outlet hoses, or clamps.
- Restriction in exhaust system.
- Presence of coolant or diesel fuel in crankcase oil.

If defeating a single cylinder has no effect on overall engine performance, test the following

- Fuel injector nozzle opening pressure, spray pattern, and leakage for that cylinder. (See "Test Fuel Injection Nozzle" on page 162,)
- Cylinder compression or cylinder leakage. (See "Test Cylinder Compression" on page 156.)
- Fuel supply pump pressure.
- Fuel shutoff solenoid opening fully.
- Fuel control and governor linkage flyweights allowing full fuel flow to injector pump.
- Injection pump timing correct.

If the above test results are within specifications, remove injection pump and have tested at an Authorized Diesel Service (ADS) Center.

Test Fuel Injection Nozzle

Reason

To determine opening pressure, leakage, and chatter and spray patterns of fuel injection nozzle.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Diesel Fuel Injection Nozzle Tester	D01109AA	Used to test fuel injection nozzle.
Adapter Set	D01110AA	Used to install diesel fuel injection nozzle tester.
Straight Adapter	23622	Used to install diesel fuel injection nozzle tester.
Container	NA	Used to hold diesel fuel released during test.

Connections

IMPORTANT: Avoid damage! Use clean, filtered diesel fuel when testing injection nozzles for best results.

M35913

Connect fuel injection nozzle to D01109AA Diesel Injection Nozzle Tester using parts from D01110AA Adapter Set and 23622 Straight Adapter.

Pressure Test Procedure

Test fuel injection nozzle opening pressure following the nozzle tester manufacturer's instructions. Compare to specification.

Pressure Test Results

If pressure reading does not meet specification, disassemble injection nozzle and inspect nozzle assembly for contamination or stuck valve. (See "Remove, Inspect, and Install Fuel Injection Nozzle" on page 224.) If necessary, add or remove shims to change opening pressure.

Leakage Test Procedure

Test fuel injection nozzle leakage following the nozzle tester manufacturer's instructions.

1. Dry nozzle completely using a lint-free cloth.
2. Pressurize nozzle to 11032 kPa (1600 psi).
3. Watch for leakage from nozzle spray orifice. Keep track of time elapsed before leakage begins. Compare to specification.

Leakage Test Results

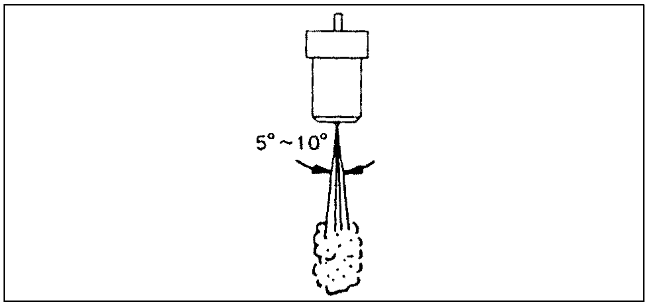
If leakage time does not meet specification, disassemble injection nozzle and inspect nozzle assembly for contamination. Replace nozzle assembly if necessary. (See "Remove, Inspect, and Install Fuel Injection Nozzle" on page 224.)

Chatter and Spray Pattern Test Procedure

Test fuel injection nozzle chatter and spray pattern following the nozzle tester manufacturer's instructions.

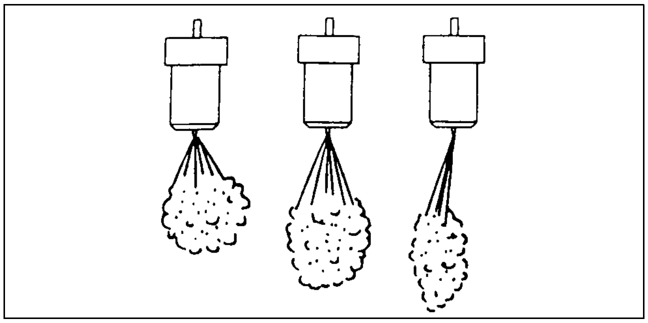
1. Pressurize nozzle until nozzle opening pressure is reached.
2. Listen for "chatter" sound and watch spray pattern.

Chatter and Spray Pattern Test Results



M76981

Picture Note: Correct Spray Pattern



M76985

Picture Note: Incorrect Spray Patterns

- If nozzle chatter or spray pattern does not meet specifications, disassemble injection nozzle and inspect nozzle assembly for contamination. Inspect valve seating surface. Replace nozzle assembly if necessary. (See "Remove, Inspect, and Install Fuel Injection Nozzle" on page 224.)
- If there is excessive difference in spray angle or injection angle, incomplete atomizing, or sluggish starting/stopping of injection, disassemble injection nozzle and inspect nozzle assembly for contamination. Replace nozzle assembly if necessary. (See "Remove, Inspect, and Install Fuel Injection Nozzle" on page 224.)

Specifications

Fuel Injection Nozzle

Nozzle Opening
Pressure . . . . 11 722 ± 480 kPa (1700 ±70 psi)

Leakage at 11 032 kPa
(1600 psi). . . . . No leakage for 10 sec (Minimum)

Chatter and Spray Pattern
at 11 722 ± 480 kPa (1700 ± 70 psi)

Slow Hand Lever Movement . . . . Chatter sound

Slow Hand Lever Movement . . Fine stream, 5-10° spray pattern

Fast Hand Lever Movement. . . . Fine atomized spray, 5-10° spray pattern

Injection Pump Static Timing

Reason

To insure that the injection pump timing is set to the correct specifications.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Fuel Injection Timing Tool	DFMZ1A	Used to set injection pump timing.

Check Procedure

1. Park machine on a level surface.

2. Turn key switch to STOP position, and allow engine to cool.

3. Engage park brake.

4. Raise engine cover.

5. Remove fuel tank. (See “Remove and Install Fuel Tank - Diesel” on page 804.)

6. Remove hydraulic reservoir expansion tank. (See “Remove and Install Hydraulic Reservoir Expansion Tank” on page 658.)

IMPORTANT: Avoid damage! Injection pump timing should be correct. Once timing is set, it will not normally change during the life of the engine, unless it was altered.

Check and adjust timing only as the last option. Check fuel, fuel supply system, nozzles, air intake system and cylinder compression before continuing.

NOTE: Never steam clean or pour cold water on injection pump while the pump is running or warm. Doing so can damage the pump.

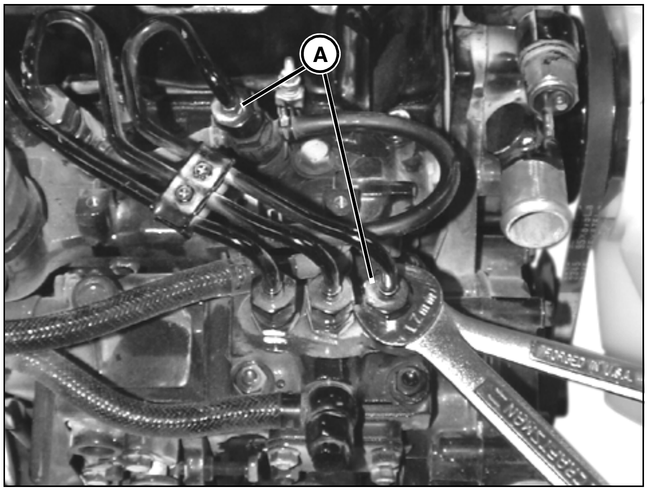
7. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner.

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

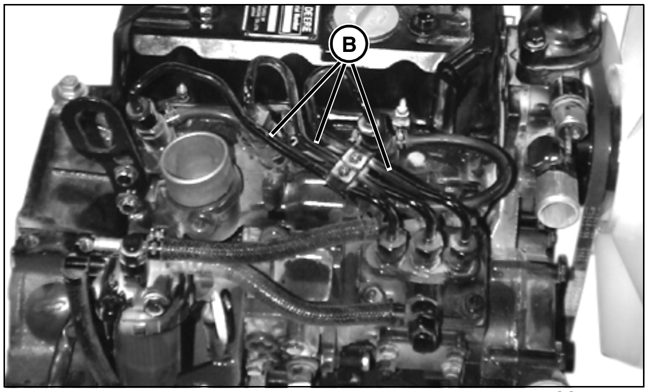
IMPORTANT: Avoid damage! When removing injection lines, DO NOT turn pump delivery valve fittings. Turning fittings may damage pump internally.

NOTE: Nozzles are matched to the cylinders. If removing more than on nozzle, tag nozzles, according to the cylinder from which it was removed.



M84896

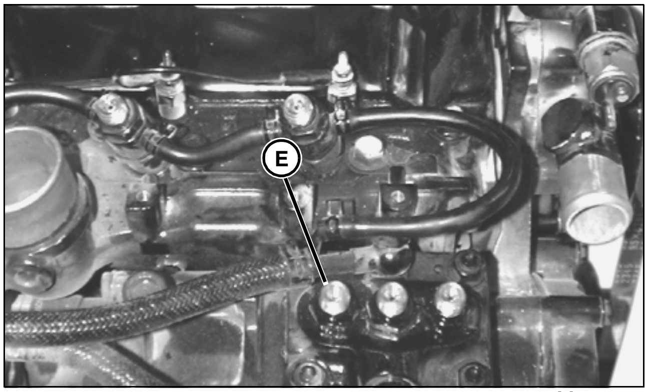
8. Loosen fuel injector line connectors (A) (on fuel injection pump and fuel injectors) slightly to release pressure in the fuel system. When loosening connectors, use another wrench to keep delivery valves from loosening.



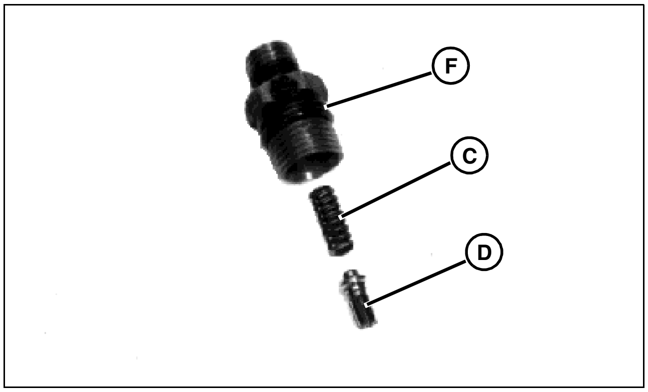
M84898

9. Remove fuel injection lines (B).

NOTE: The engine rotates counterclockwise (as viewed from the flywheel end). The cylinders are numbered from the flywheel end (No. 1 cylinder located nearest to the flywheel).



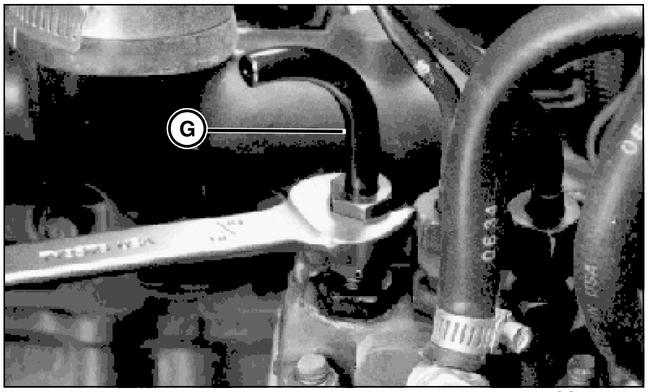
M84898



T6333HP

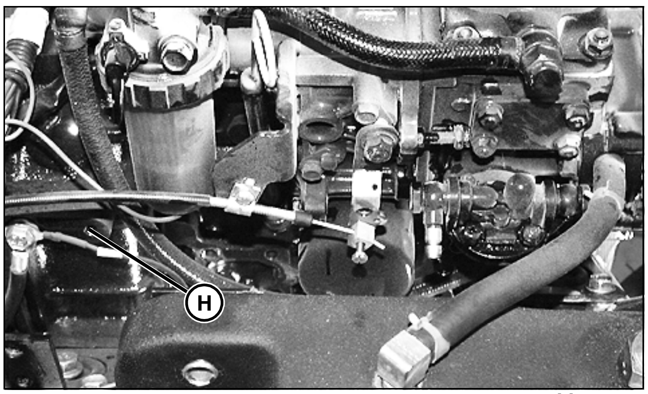
10. Remove the spring (C) and delivery valve (D) from the No. 1 fuel injection nozzle assembly (E). DO NOT remove the delivery valve seat.

11. Install the delivery valve fitting (F) and tighten to specification.



M35865

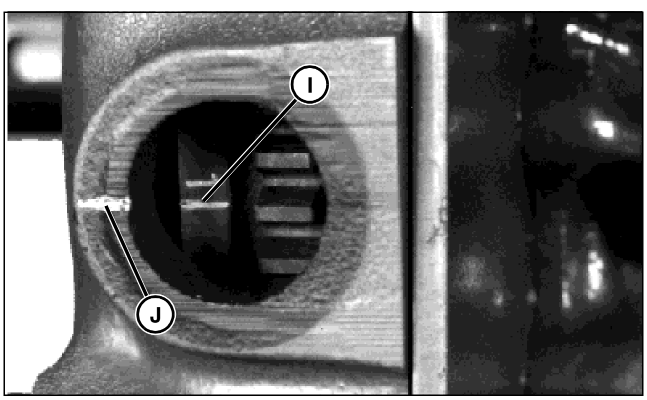
12.Install DFMX1A Fuel Injector Timing Tool (G).



M84899

13.Remove plug (H) from flywheel housing.

14.Remove glow plugs to aid turning crankshaft pulley. (See “Remove and Install Glow Plug” on page 183.)



M37500

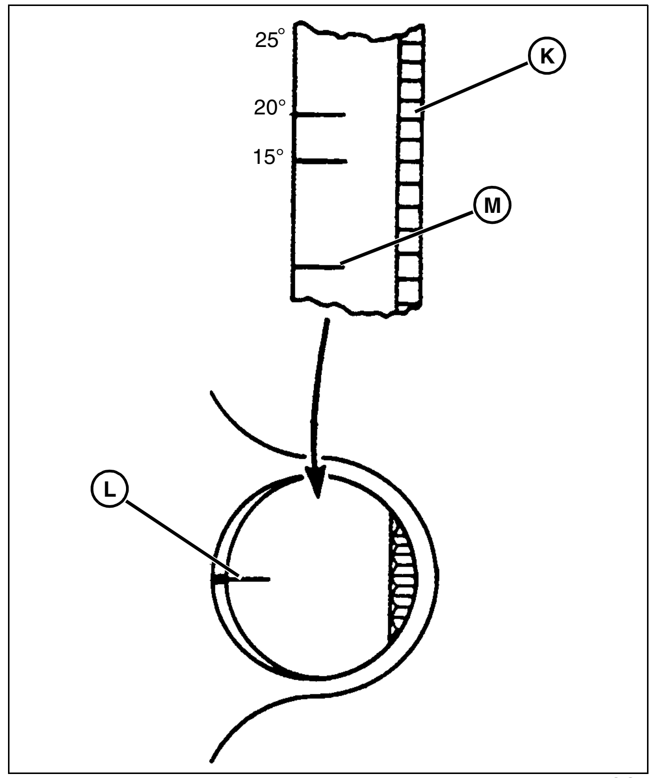
15.Rotate the engine clockwise, by rotating the crankshaft pulley, until the No. 1 cylinder mark (I) aligns with the index mark (J) on the flywheel housing.

16.Place a container under the timing tool to collect any fuel.

17.Rotate the flywheel clockwise (as viewed from the flywheel end) until fuel flows in a stream.

NOTE: If the fuel flow does not stop, the No. 1 cylinder is on the exhaust stroke instead of the compression stroke. Rotate the flywheel one complete revolution and repeat steps 13-16.

18.Slowly rotate the flywheel counterclockwise until fuel flow changes from a stream and then stops completely. This is the point of injection timing at which the pump is set.



T6471CS

19.Check the timing on the flywheel (K). The index mark (L) must align with the 14° mark before top dead center (M) on the flywheel.

If timing is correct

1. Install rubber plug in flywheel housing.
2. Remove timing tool.
3. Remove delivery valve fitting.
4. Install delivery valve and spring.
5. Install new O-ring and delivery valve fitting. Tighten to specification.
6. Install fuel injection lines.

Results

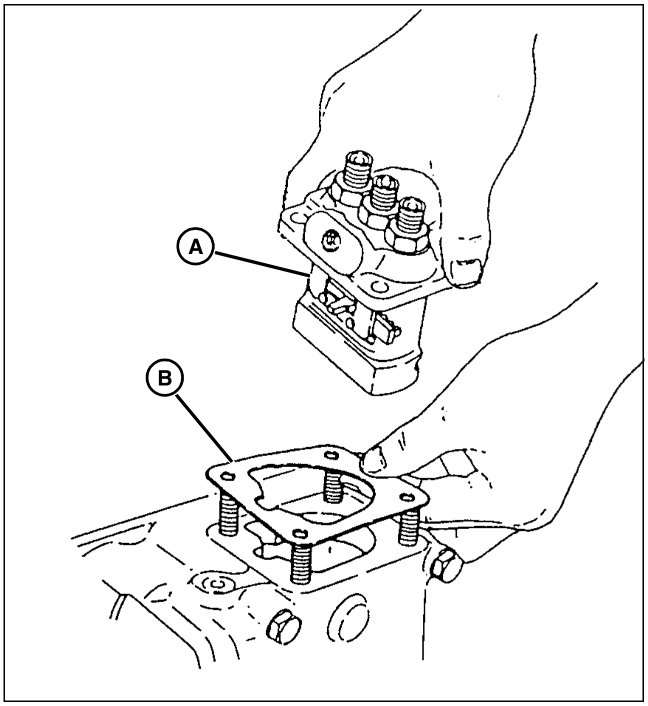
- If the injection timing does not meet specifications, perform adjustment procedure.

• If engine performance is poor, check air cleaners, fuel filter, fuel supply, nozzles and cylinder compression before removing pump for service. Check all timing gears for wear. Retest performance.

• If performance did not change, have pump tested by a diesel injection service.

Adjustment Procedure

NOTE: Injection pump timing is set by a shim pack between pump body and housing.



M99032

1. Remove fuel injection pump (A).
2. Adjust the fuel injection timing by adding or removing the number of shims (B):
   - **To delay the injection pump**: increase the number of shims.
   - **To advance the injection timing:** remove shims.
3. Install fuel injection pump.
4. Recheck injection pump timing. (See “Check Procedure” on page 164.)

Specifications

Fuel Injector Torque . . . . 51 N•m (37 lb-ft)

Pressure Test Cooling System

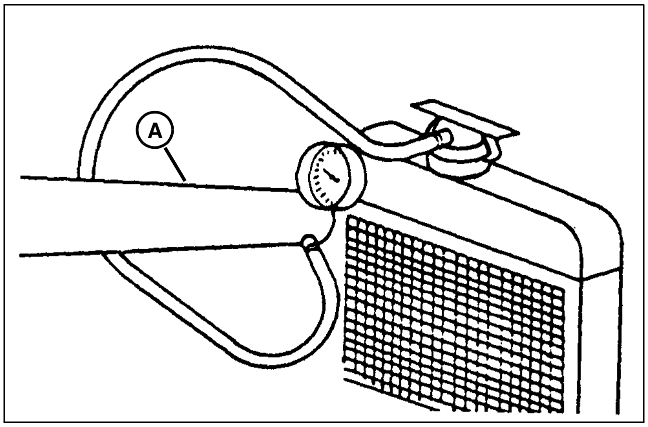
Reason

Inspect the cooling system for leaks.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to pressurize cooling system to check for leaks.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to connect pressure pump to radiator.

Procedure



T6333AW

1. Remove the cap and attach the pressure pump (A) to radiator.
2. Apply pressure according to minimum specification, but not in excess of maximum specification.
3. Check for leaks throughout the cooling system. After 15 seconds, the pressure should be at or above minimum specification.

Results

• Pressure should hold to minimum specification. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.

• If the pressure test still indicates leakage after all external leaks have been stopped, a defective head gasket, cracked block, or cylinder head may be the cause. (See “Test Cylinder Leakage” on page 169.)

Specifications

Cooling System Pressure
(Maximum Applied) . . . . 117 kPa (17 psi)

Pressure Test Radiator Cap

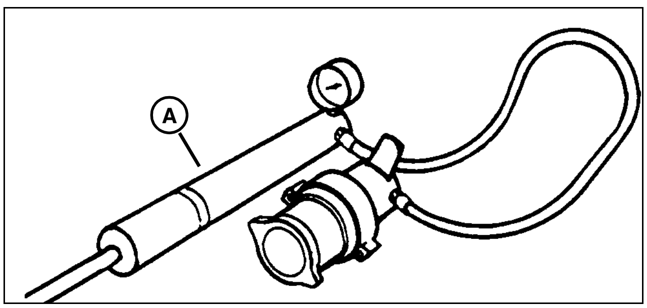
Reason

Test the radiator cap for operating in the correct pressure range.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cooling System Pressure Pump	D05104ST	Used to apply pressure to radiator cap to check for valve opening.
Radiator Pressure Test Kit (Adapters)	JDG692	Used to connect the pressure pump to the radiator cap.

Procedure



T6333AX

1. Install the radiator cap on the pressure pump (A).

2. Apply pressure. Pressure valve in the cap should open at specification.

Results

If the cap leaks, retighten and test again. Replace the cap if pressure is not within specification.

Specifications

Radiator Cap Valve
Opening Pressure. . . . . 90 kPa (13 psi)

Test Thermostat

Reason

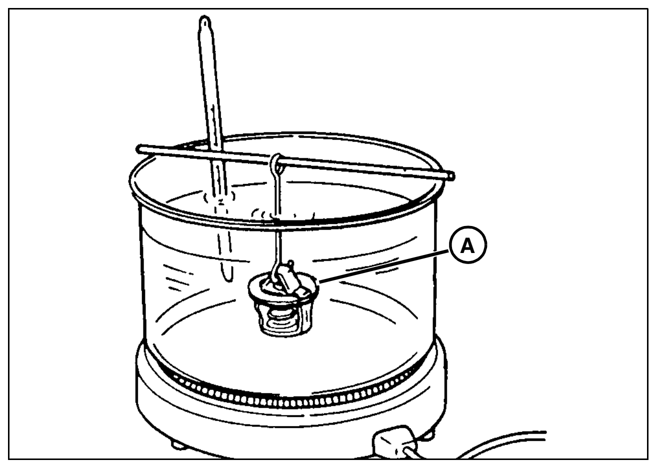
To determine opening temperature of thermostat.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure temperature at which thermostat opens.
Glass Container	NA	Used to hold heated water for test.
Heating Unit	NA	Used to heat water for test.

Procedure

CAUTION: Avoid injury! Do not allow thermostat or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if overheated.



M82122A

1. Suspend thermostat (A) and thermometer in a container of water.

2. Heat and stir the water. Observe opening action of thermostat and compare temperatures with specifications.

3. Remove thermostat and observe its closing action as it cools.

Results

- If thermostat does not open according to specifications, replace thermostat.
- If closing action is not smooth and slow, replace thermostat.

Specifications

Thermostat Begin-Opening Temperature . . . . 69.5-72.5°C (157-163°F)

Thermostat Fully-Open Temperature . . . . 85°C (185°F)

Test Cylinder Leakage

Reason

To determine if compression pressure is leaking from the cylinder.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Cylinder Leakdown Tester	JT03502	Used to test cylinder for compression pressure leakage.
Adapter	JDG472	Used to install gauge assembly.

Procedure

1. Park machine safely.
2. Remove engine cover.
3. With coolant at proper level and radiator cap tight, run engine for five minutes to bring to operating temperature.
4. Remove cap from recovery tank.
5. Check for bubbles coming from overflow hose at bottom of tank. If bubbles are present, isolate source of compression leak.
   a. Remove fuel injection nozzles. (See “Remove, Inspect, and Install Fuel Injection Nozzle” on page 224.)
   b. Install JDG472 adapter in injection port of cylinder to be tested.
   c. Move piston to bottom of stroke with intake and exhaust valves closed.
   d. Connect hose from JT03502 Cylinder Leakdown Tester to adapter.
   e. Apply 2448 kPa (355 psi) maximum air pressure into cylinder.
   f. Check for bubbles in recovery tank or air escaping from muffler, air cleaner, or oil dipstick tube.
6. Repeat for each cylinder.

Results

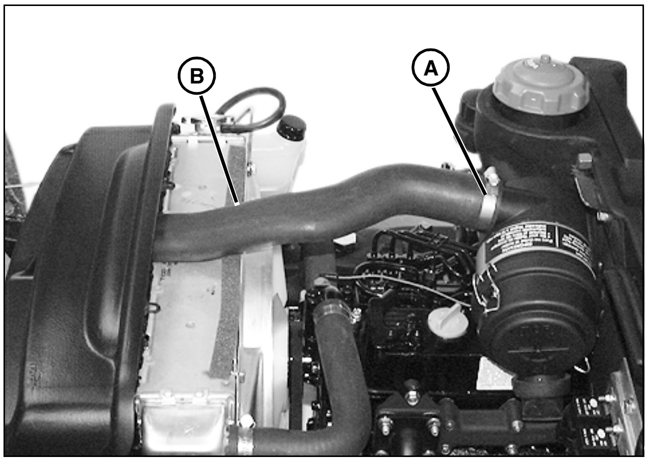
- If bubbles are present in the recovery tank, check for cracks in cylinder head and block. Check for damaged head gasket.
- If air escapes from muffler, check for worn exhaust valve.
- If air escapes from air cleaner, check for worn intake valve.
- If air escapes from engine oil dipstick tube, check for worn piston rings.

Repair

Remove and Install 12V Alternator Drive Belt (Model 2500 and 2500A)

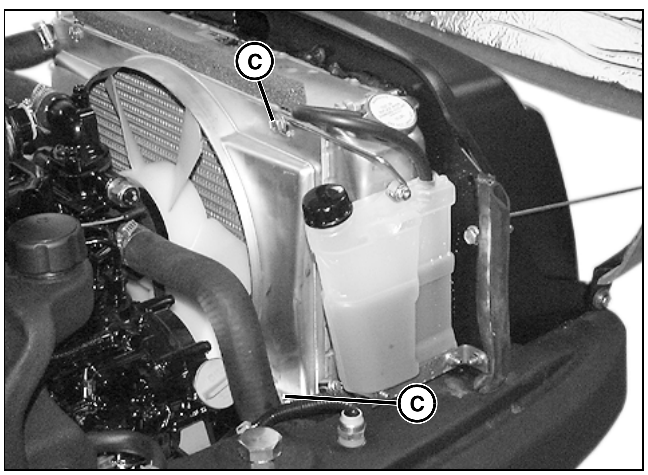
Removal

1. Park machine safely.
2. Engage park brake.
3. Remove engine cover.
4. Disconnect battery negative (-) cable.



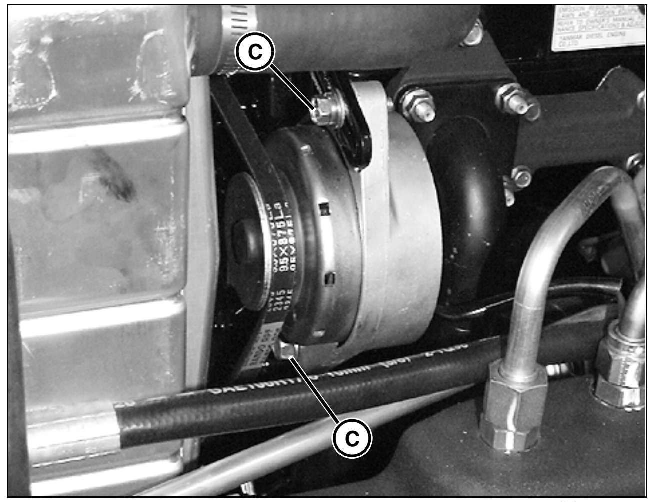
M84598

5. Loosen hose clamp (A) and remove air cleaner intake hose (B).



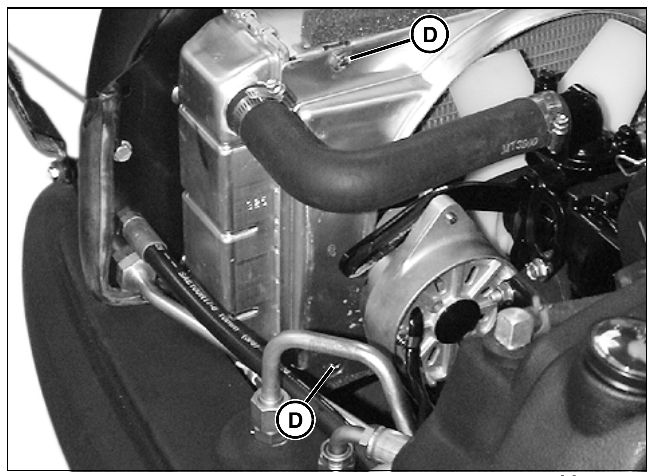
M84599

6. Remove right side fan shroud mounting cap screws (C).



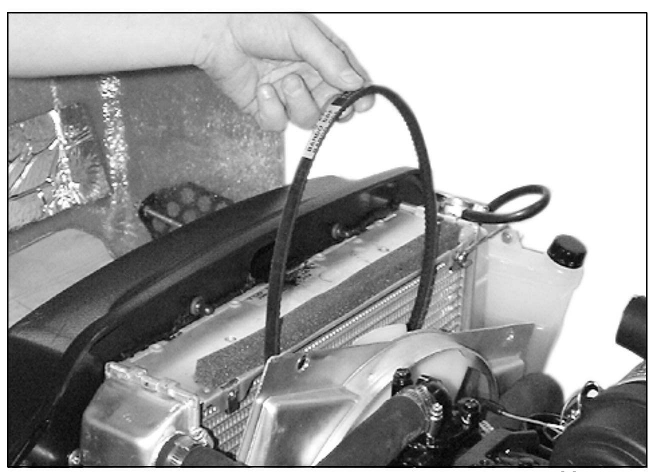
M84600

7. Loosen alternator mounting cap screws (C) and push alternator toward engine to loosen belt.



M84601

8. Remove left side fan shroud mounting cap screws (D).
9. Move fan shroud toward engine.



M84602

10.Carefully work the belt between the fan and fan shroud remove belt.

11.Inspect belt for cracking, damage or signs of wear. Replace as needed.

Installation

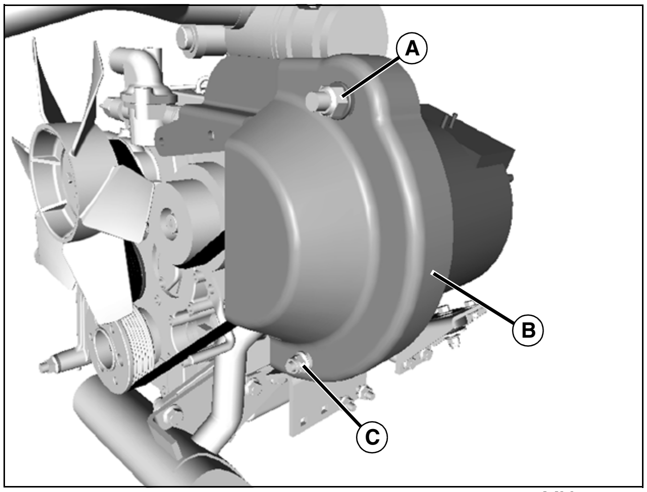
1. Install alternator drive belt. Installation is done in the reverse order of removal.

2. Adjust belt tension. (See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153.)

Remove and Install 48V Alternator Belt - 2500E

Removal

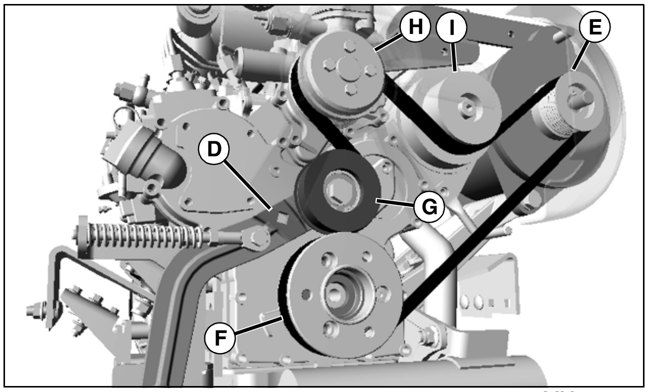
1. Remove key from key switch to prevent engine from starting.



MX20428

2. Remove nut (A), washer, grommet and cap screw.
3. Remove nut (C), washer, grommet and cap screw.
4. Remove belt guard (B).

CAUTION: Avoid injury! Idler arm is under load when removing or installing a new belt. Injury can occur if released suddenly. Keep hands and fingers from the surrounding area of the arm.



MX20427

5. Insert the square drive of a 3/8 in. breaker bar in the square hole (D) of the tensioner arm.

6. Pull on breaker bar to rotate belt tensioner and hold in that position.

7. While holding breaker bar, remove belt from 48V alternator pulley (E) first, then the remaining pulleys. Allow tensioner to rotate to a relaxed position.

8. Work belt between tips of fan and fan shroud to remove belt.

9. Inspect belt for wear, cracking, or other damage. Replace as necessary.

Installation

1. Work belt between tips of fan and fan shroud to install.

IMPORTANT: Avoid damage! Ensure belt is correctly seated in grooves of pulleys. Failure to do so will result in belt damage immediately after engine is started.

2. Route belt around engine pulley (F), idler pulley (G), fan pulley (H), and 12V alternator pulley (I) as shown.

3. Use a breaker bar to rotate tensioner and hold in place.

4. Install belt over 48V alternator pulley (E).

5. Install belt guard (B). Install cap screw, grommet, washer and nut (A) and tighten securely.

6. Install cap screw, grommet, washer and nut (C) and tighten securely.

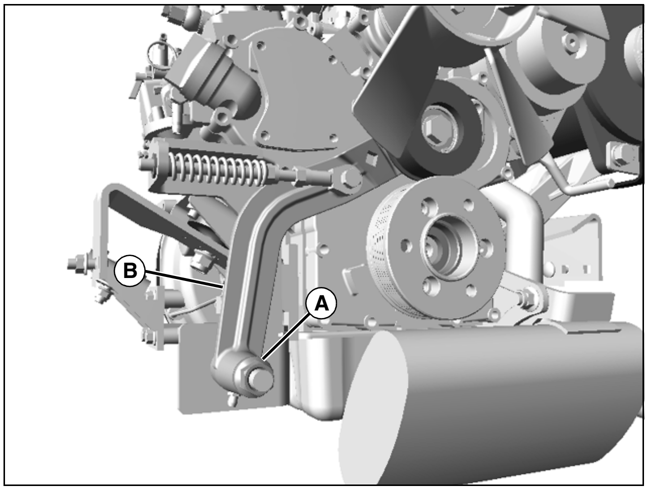
7. Run engine for a few seconds. Stop engine and check tension. Adjust if required. (See “Check and Adjust 48V Alternator Drive Belt Tension (Model 2500E)” on page 153.)

Remove and Install 48V Alternator Belt Tensioner - 2500E

Removal

1. Remove alternator belt. (See “Remove and Install 48V Alternator Belt - 2500E” on page 171.)

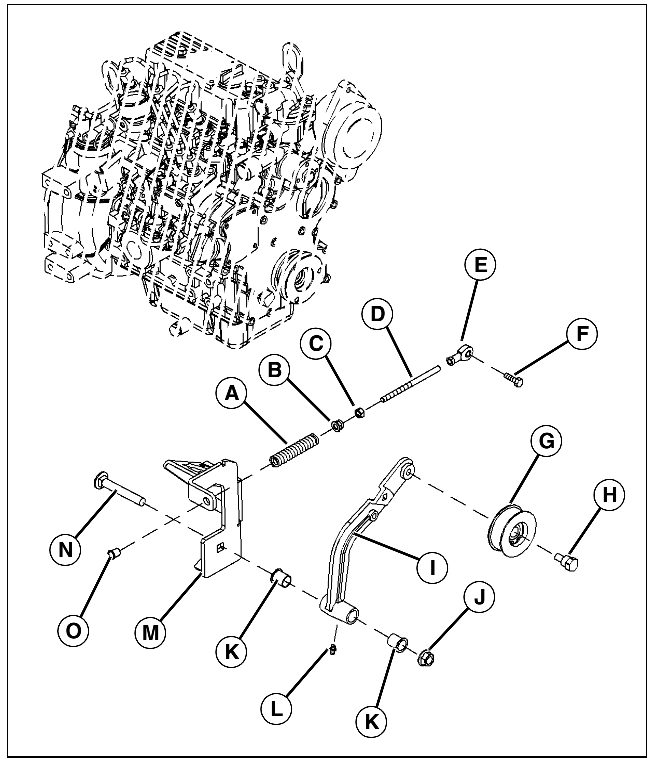
CAUTION: Avoid injury! Engine components are HOT. Be careful not to touch, especially the muffler, while making adjustments. Wear protective eye glasses and clothing.



MX20771

2. Remove locknut (A).
3. Remove tensioner assembly (B).

Inspection



MX20772

A - Spring
B - Locknut
C - Nut
D - Rod
E - Link End
F - Cap Screw
G - Pulley
H - Cap Screw
I - Bracket
J - Locknut
K - Bushing
L - Lubrication Fitting
M - Bracket
N - Cap Screw
O - Bushing

Inspect all parts for wear or damage. Replace as needed.

Inspect fan belt for wear, cracking or glazing. Replace belt as needed.

Installation is done in the reverse order of removal.

- Tighten locknut (J) to specification and back off 1/8 turn. Verify that tensioner pivots freely.
- Adjust belt tension. (See “Check and Adjust 48V Alternator Drive Belt Tension (Model 2500E)” on page 153.)

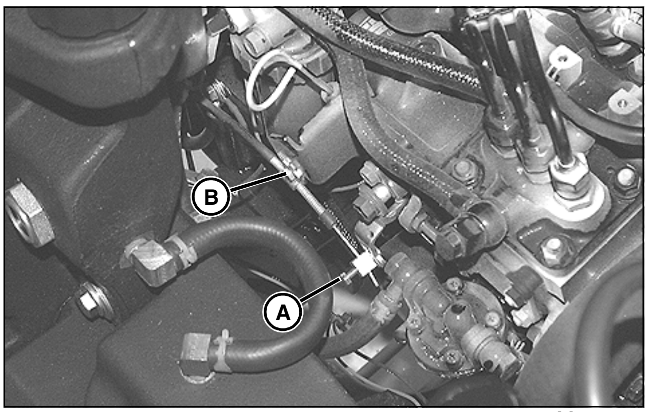
Specifications

48V Tensioner Locknut Torque[4] . . . 74.5 N•m (55 lb-ft)

Remove and Install Throttle Cable Assembly

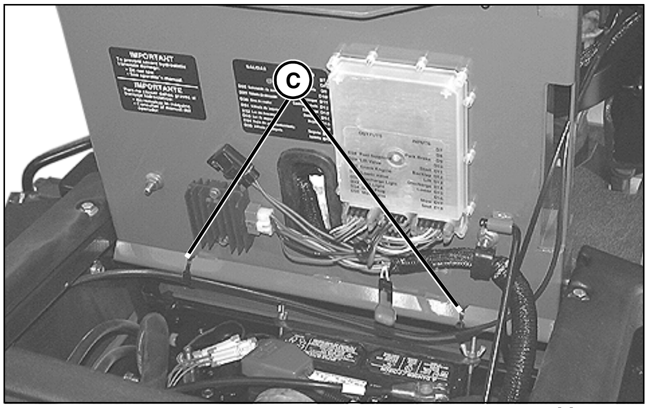
Removal

1. Park machine safely.
2. Remove engine cover.
3. Raise and latch seat platform.
4. Move throttle lever to SLOW idle position.



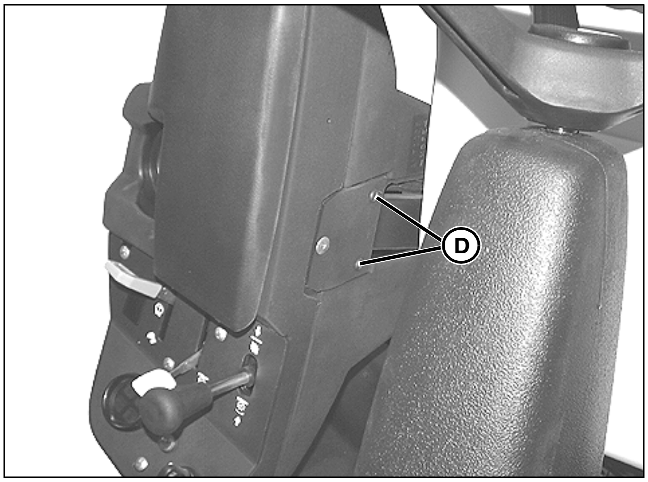
M84636

5. Loosen throttle stop screw (A).
6. Loosen clamp screw (B).
7. Remove throttle cable.
8. Pull throttle cable from between lift valve and frame.



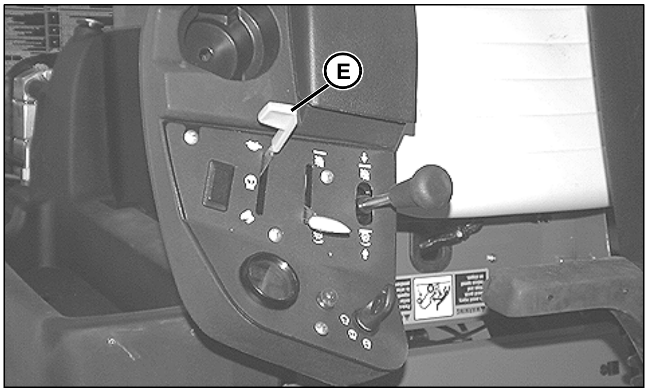
M84635

9. Cut tie wraps (C) securing the cable to seat platform.



M84636

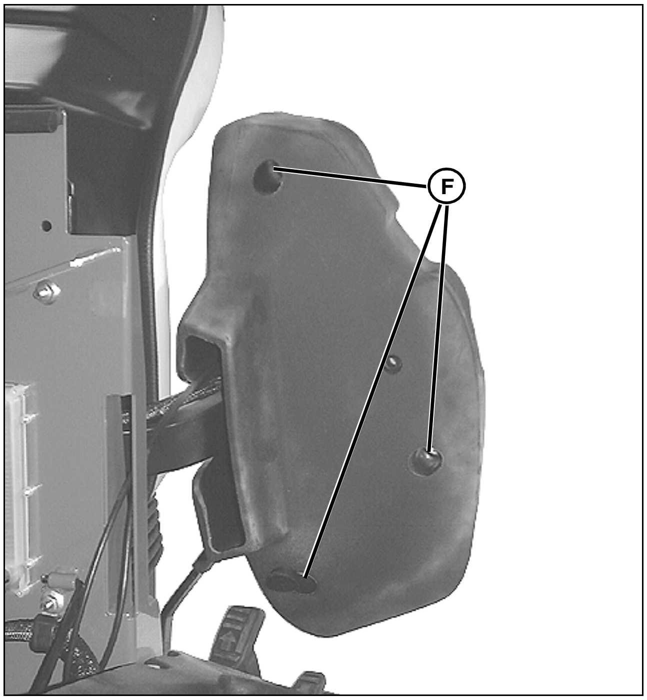
10. Remove two screws (D).



M84637

11. Remove throttle lever knob (E).

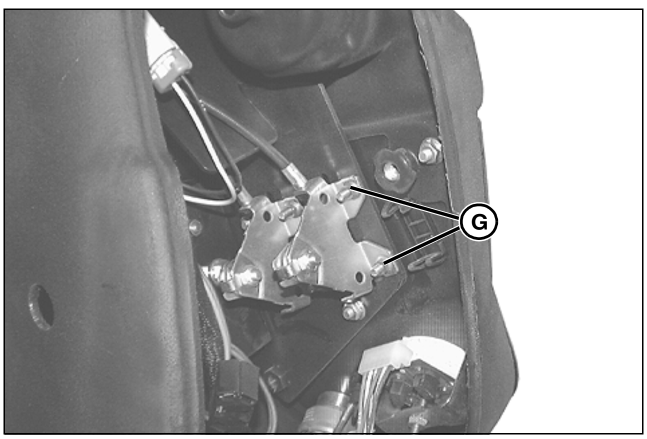
4. *Back off 1/8 turn after tightening to specification.*



M84638

12.Remove cap screws (F) and washers.

13.Pull lower console cover away from console top.



M84639

14.Remove bracket nuts (G).

15.Remove throttle cable/lever assembly.

Installation

1. Install throttle cable assembly. Installation is done in the reverse order or removal.

2. Adjust throttle cable. (See "Adjust Throttle Cable" on page 160.)

Remove, Install and Inspect Radiator

Remove

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

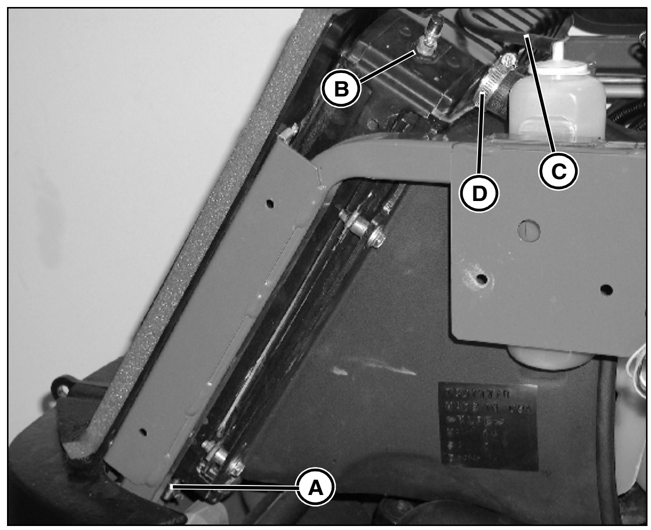
1. Park machine safely.

2. Turn key switch to stop position and allow the engine to cool.

3. Remove engine cover.

4. Loosen radiator cap to first stop to relieve pressure.

5. Remove radiator cap.



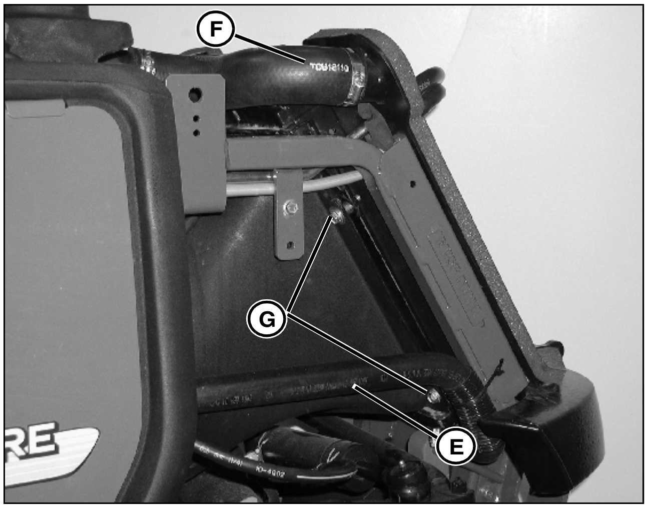
MX20008

6. Attach a 12-inch hose to drain valve (A) located on lower right side of radiator.

7. Open radiator vent (B) and drain valve (A). Allow coolant to drain. Once coolant has stopped draining, close drain valve and vent.

8. Disconnect overflow hose (C) from radiator.

9. Remove hose (D) from radiator.

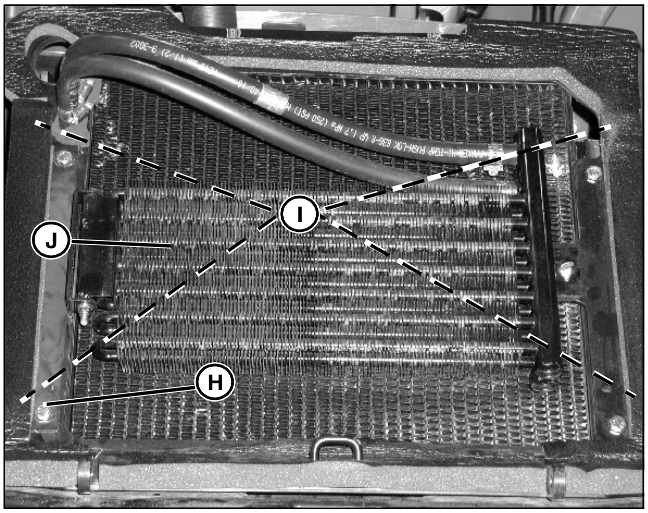


MX20080

10.Remove hose (E) from radiator.

11.Remove hose (F).

12.Remove shroud cap screws (G) and move shroud from radiator.



MX20010

13.Remove cap screws (H).

IMPORTANT: Avoid damage! Use caution when moving oil cooler aside to prevent damaging fins.

14.Peel back foam and remove four bolts (I) securing radiator and oil cooler to frame. Carefully move the oil cooler (J) and associated brackets away from radiator.

15.Remove radiator as an assembly.

Install

Installation is done in the reverse order of removal.

• Start engine and watch coolant level in radiator. Add coolant if necessary to bring coolant level up to filler neck.

Inspect

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

IMPORTANT: Avoid damage! Do not apply high-pressure spray directly at fins when cleaning the radiator, as this could result in damage. Direct the spray parallel to the fins.

1. Check radiator for debris lodged in fins. Clean radiator using compressed air or pressure washer.

2. Inspect radiator for bent fins, cracks, and damaged seams. Repair or replace radiator if necessary.

Specifications:

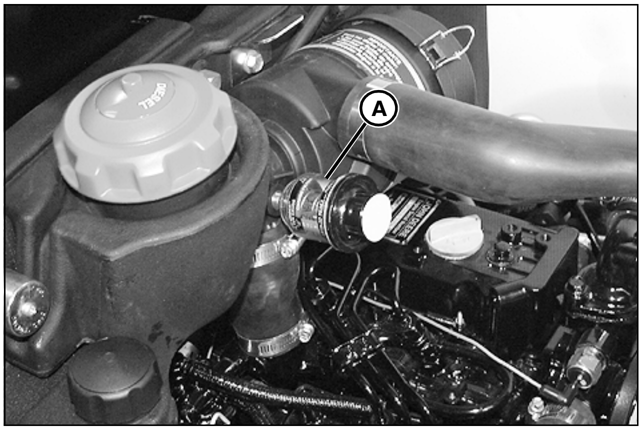
Cooling System Capacity
(Approximately) . . . . 3.5 L (3.7 qt)

Remove and Install Air Filter Restriction Indicator

Removal

1. Park machine safely.

2. Remove engine cover.



M84571

3. Remove air restriction indicator (A).

4. Inspect housing for cracks or other damage. Replace as needed.

Installation

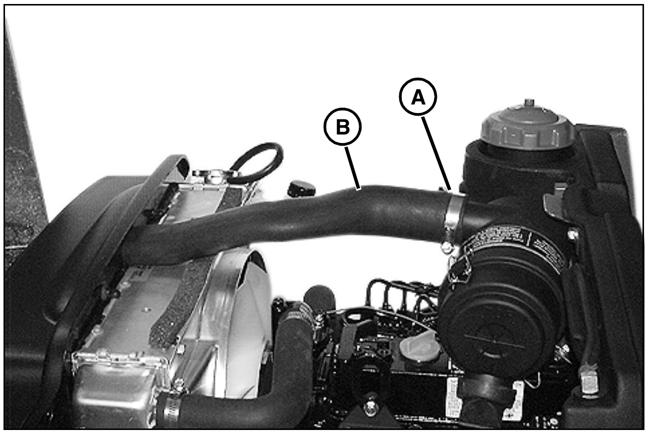
Installation is done in reverse order of removal.

• Install air restriction indicator (A) onto adapter until snug.

Remove and Install Air Cleaner Assembly

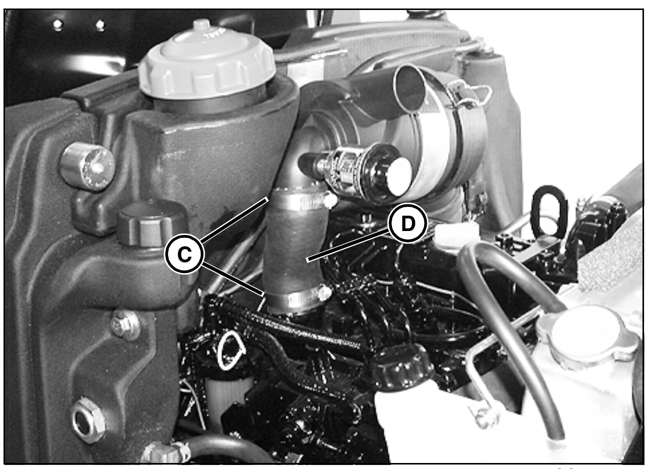
Removal

1. Park machine safely.
2. Remove engine cover.



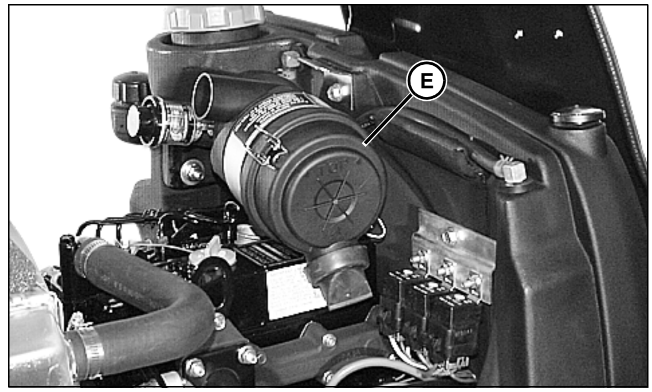
M84570

3. Loosen hose clamp (A).
4. Remove intake hose (B).

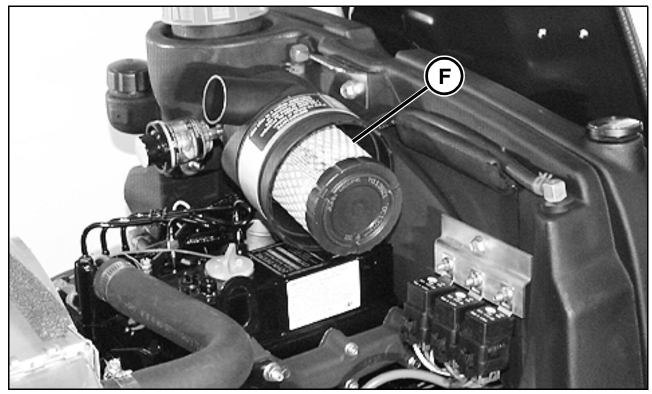


M84572

5. Loosen hose clamps (C).
6. Remove air cleaner-to-intake manifold hose (D).

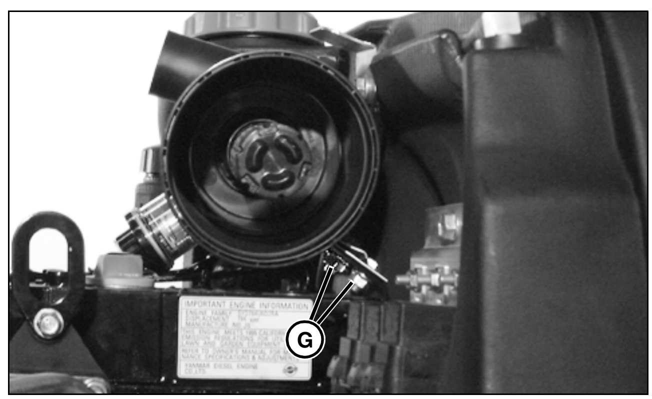


7. Remove air cleaner cover (E).



M84574

8. Remove primary filter element (F).



M84575

9. Remove flanged-head cap screws and nuts (G).

10.Remove air cleaner housing.

11.Inspect all parts for wear or damage. Replace as needed.

12.Inspect hoses for cracking or damage. Replace as needed.

Installation

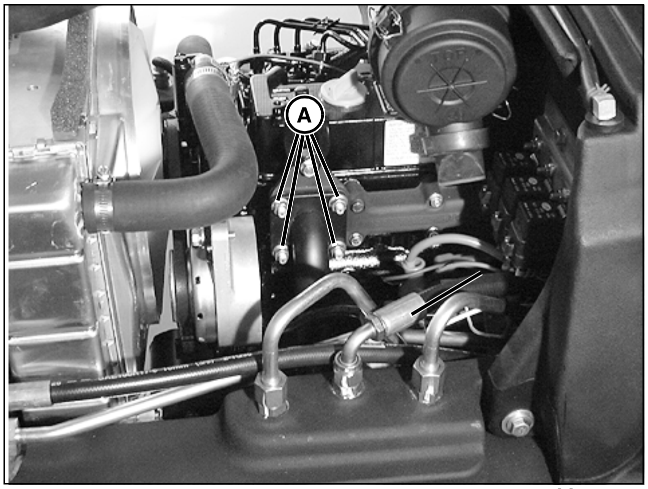
Installation is done in reverse order of removal.

Remove and Install Muffler

Removal

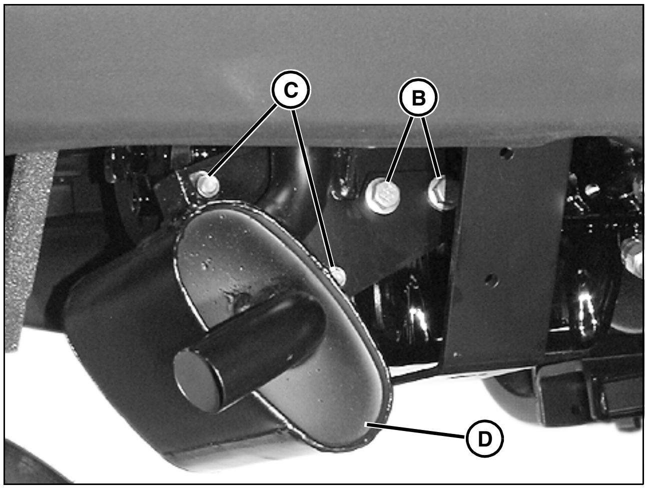
CAUTION: Avoid injury! To prevent possible burns, allow engine to cool before removing muffler.

1. Park machine safely.
2. Remove engine cover.



M84577

3. Remove nuts from manifold (A).



M84578

4. Remove flanged-head cap screws and nuts (B).
5. Remove flanged-head cap screws (C).
6. Remove muffler (D) and gasket.

Installation

Installation is done in reverse order of removal.

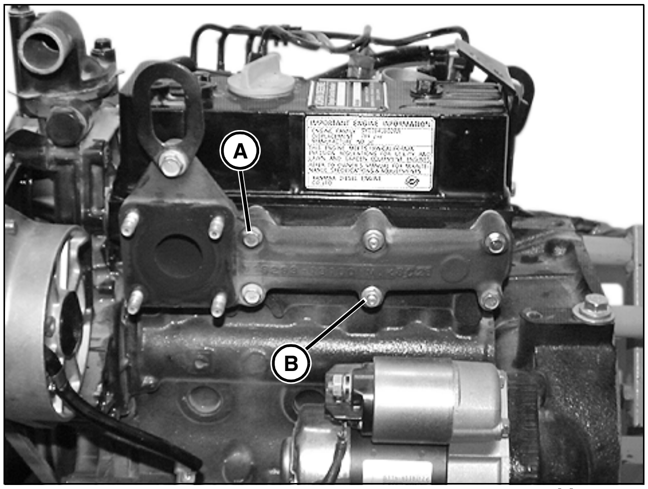
- Install new gasket on exhaust manifold with metal side of gasket facing out.
- Tighten manifold nuts to specification.

Specifications

Manifold Nut Torque. . . . . 28 N•m (240 lb-in.).

Remove and Install Exhaust Manifold

Removal



M84821

1. Remove four cap screws (A).
2. Remove two nuts (B).
3. Remove manifold and gasket.
4. Clean all mating surfaces thoroughly.

Installation

Installation is done in the reverse order of removal.

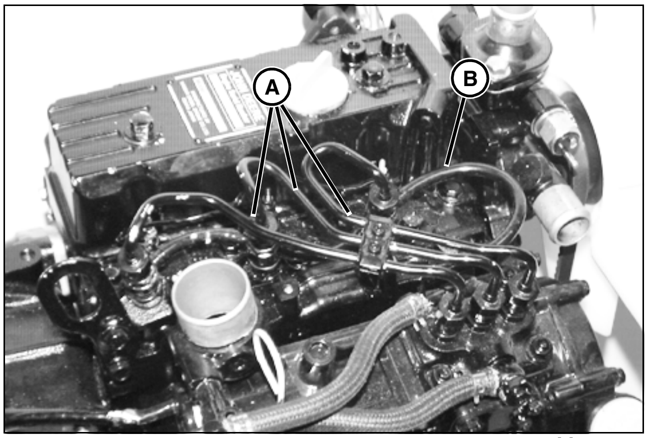
- Install new gasket between exhaust manifold and cylinder head.
- Tighten mounting cap screws to specification.

Remove and Install Intake Manifold

Removal

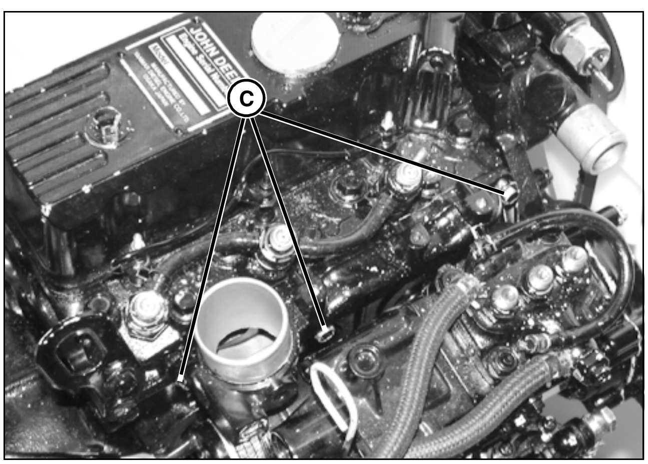
1. Remove fuel filter/water separator. (See “Assemble Fuel Filter and Water Separator” on page 221.)

IMPORTANT: Avoid damage! When removing injection lines, DO NOT turn pump delivery valve fittings. Turning fittings may damage pump internally.



M98819

2. Loosen fuel injection line connectors (on fuel injection pump and fuel injectors) slightly to release pressure in the fuel system. When loosening connectors, use another wrench to keep delivery valves from loosening.
3. Remove fuel injection lines (A).
4. Disconnect leak-off hose (B) at fuel injector.



M98814

5. Remove three cap screws (C).
6. Remove intake manifold.

Installation

Installation done in reverse order of removal.

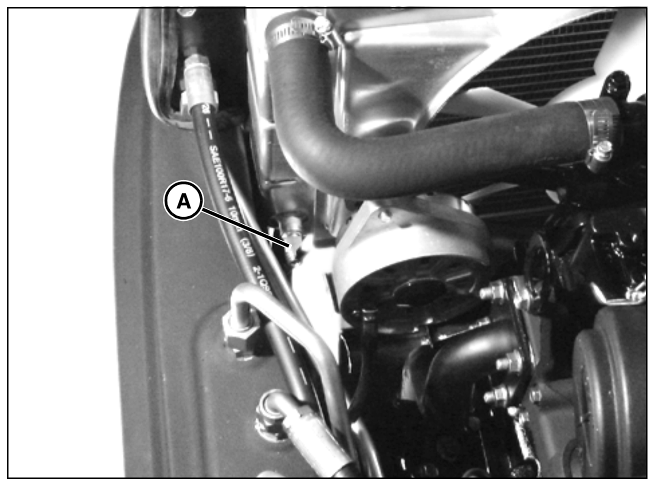
- Install a new gasket for installation.

Remove and Install Thermostat

Removal

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

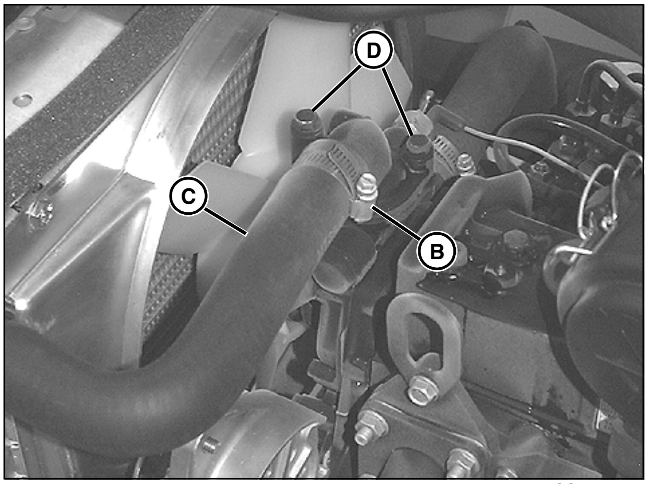
1. Park machine safely.
2. Turn key switch to stop position and allow the engine to cool.
3. Remove engine cover.
4. Loosen radiator cap to first stop to relieve pressure.
5. Remove radiator cap.



M84591

Picture Note: Model 2500/2500A Shown

6. Attach a 12-inch hose to drain valve (A) located on lower left side of radiator.
7. Drain coolant from radiator/engine into container large enough to hold full capacity of cooling system.



M84604

8. Loosen hose clamp (B).

9. Remove radiator hose (C) from thermostat cover.

10.Remove two cap screws (D) from cover and remove cover and gasket.

11.Remove thermostat from housing.

12.If thermostat is to be reinstalled, test thermostat. (See “Test Thermostat” on page 168.)

Installation

Installation is done in reverse order of removal.

- Install thermostat in housing with spring end inside coolant pump.
- Place gasket over thermostat and place cover over thermostat on coolant pump.
- Fill cooling system to specifications.
- Start engine and watch coolant level in radiator. Add coolant if necessary to bring coolant level up to filler neck.

Specifications

Cooling System Capacity
(Approximately) . . . . 3.5 L (3.7 qt)

Remove and Install Coolant Temperature Switch

Other Material

Part No.	Part Name	Part Use
TY9375 (U.S.)/ TY9480 (Canada)	Pipe Sealant	Applied to threads of dual temperature coolant switch before installation.

Removal

CAUTION: Avoid injury! Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Remove filler cap only when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

1. Park machine safely.

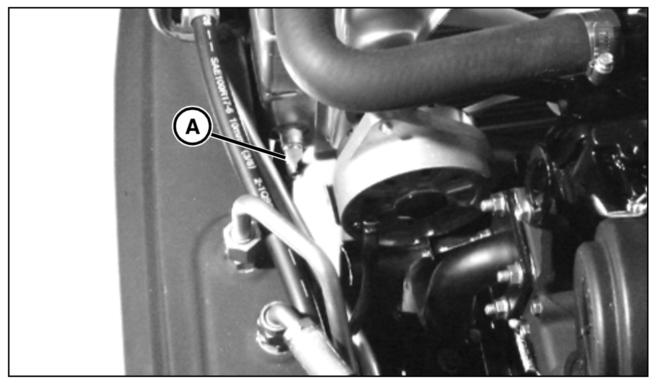
2. Turn key switch to stop position and allow the engine to cool.

3. Remove engine cover.

4. Loosen radiator cap to first stop to relieve pressure.

5. Remove radiator cap.

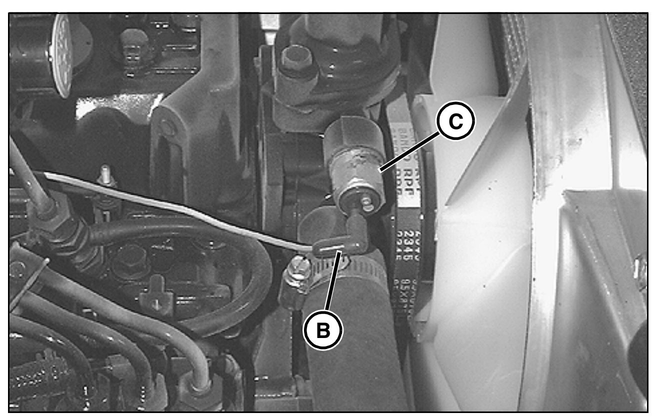
6. Remove air cleaner assembly.



M84591

7. Attach a 12-inch hose to drain valve (A) located on lower left side of radiator.

8. Drain coolant from radiator/engine into container large enough to hold full capacity of cooling system.



M84603

9. Disconnect electrical connector (B).

10.Remove switch (C) and copper washer.

11.Test switch. (See “Test Engine Coolant Temperature Switch” on page 575.)

Installation

Installation is done in reverse order of removal.

- Apply TY9375 Pipe Sealant to temperature coolant switch threads.
- Fill cooling system to specifications.
- Start engine and watch coolant level in radiator. Add coolant if necessary to bring coolant level up to filler neck.

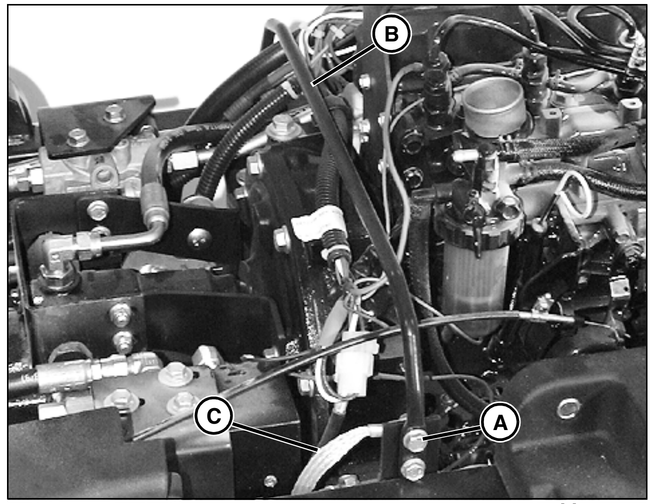
Specifications

Cooling System Capacity (Approximately) . . . . 3.5 L (3.7 qt)

Remove and Install Engine

Removal

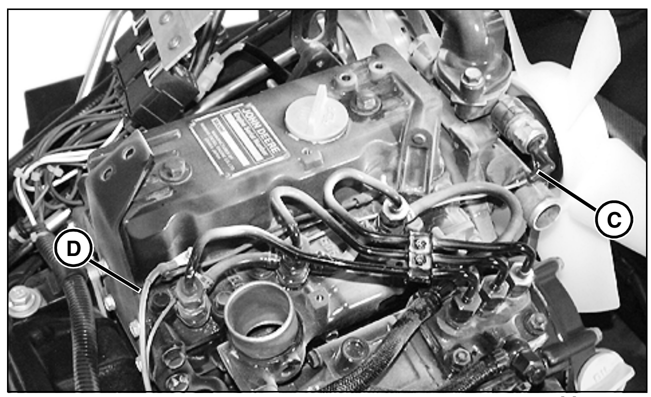
1. Park machine on a hard, level surface. Lock park brake.
2. Tilt operator’s seat forward.
3. Disconnect battery negative (-) cable from the battery.
4. Remove engine cover.
5. Remove operator protective device (OPD). (See “Remove and Install Operator Protective Device (OPD)” on page 798.)
6. Remove muffler (See “Remove and Install Muffler” on page 177.)
7. Remove air cleaner assembly. (See “Remove and Install Air Cleaner Assembly” on page 176.)
8. Remove radiator. (See “Remove, Install and Inspect Radiator” on page 174.)
9. Remove fuel tank. (See “Remove and Install Fuel Tank - Diesel” on page 804.)
10. Remove hydraulic reservoir expansion tank.(See “Remove and Install Hydraulic Reservoir Expansion Tank” on page 658)
11. **2500E Models only:** Remove 48V alternator.



M84644

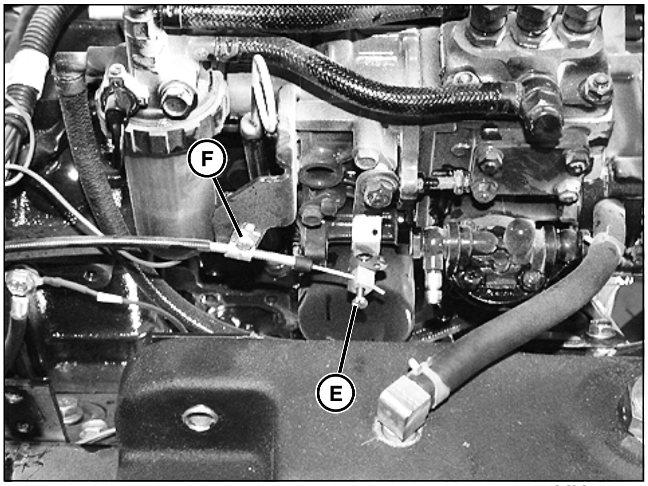
Picture Note: 2500 model shown. 2500A is similar.

12. **2500 Models only**: Remove four (two on each side) flange head cap screws (A) and nuts.
13. **2500 Models only:** Remove cross bar (B).
14. **2500A Models only:** Remove flange head cap screw and nut. Remove ground strap and two ground leads.



M84645

15. Disconnect green wire (C) from coolant temperature switch.
16. Disconnect red wire (D) from glow plug.

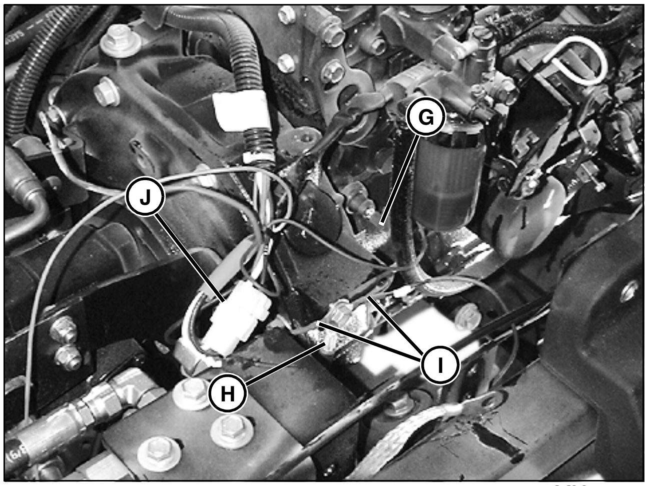


MX5445

17.Loosen throttle stop screw (E).

18.Loosen cable screw (F).

19.Remove throttle cable.

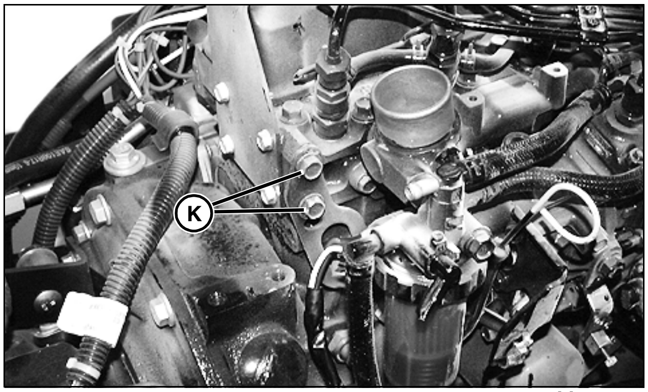


MX5441

20.Disconnect brown wire (G) from oil pressure switch.

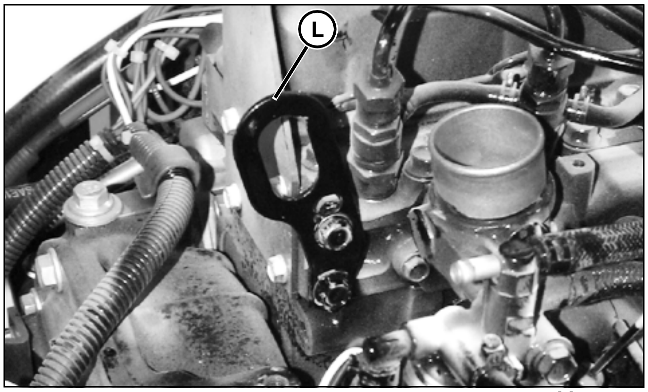
21.**2500 Models only:** Remove negative (-) battery cable (H) and ground leads (I) from engine block.

22.Disconnect fuel shutoff solenoid wire connector (J) at harness.



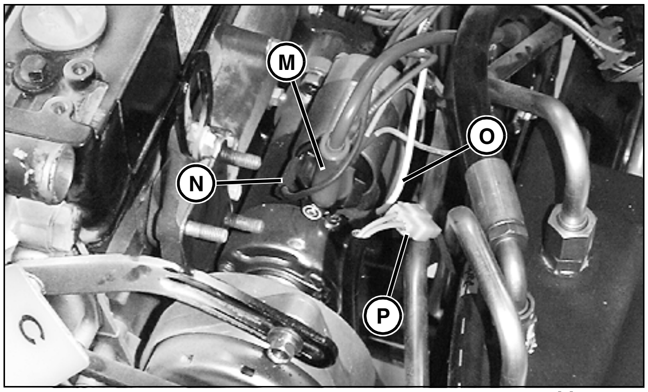
M84648

23.Remove cap screws (K) securing the lifting eye to the cylinder head.



M84649

24.Install the lifting eye (L) to the cylinder head and tighten the cap screws.



M84650

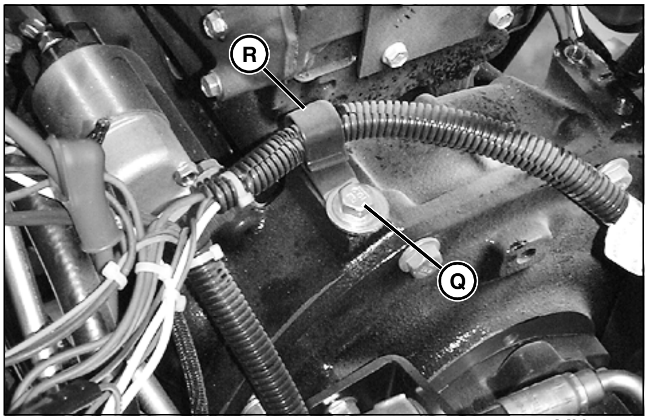
25.Disconnect fuse links #012 and #013, positive (+) battery cable, and red wire #002 from starting motor solenoid (battery terminal) (M).

26.Disconnect fuse link #112 from starting motor solenoid (battery terminal). (Vehicles equipped with optional headlight circuit only.)

27.Disconnect brown wire #301 (N) from starter solenoid.

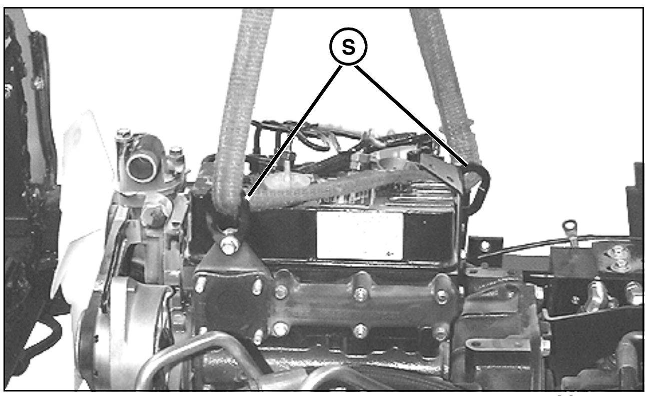
28.Disconnect white wire #419 (O) from starting motor solenoid output terminal.

29.Disconnect alternator wire connector (P) at harness.



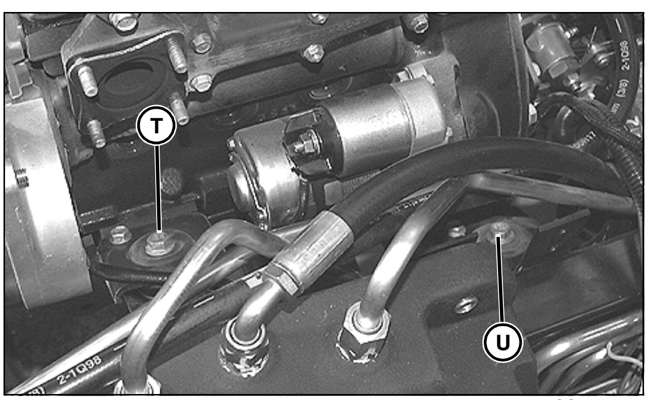
MX5412

30.Remove cap screw (Q), washer, and wiring clamp (R).



M84652

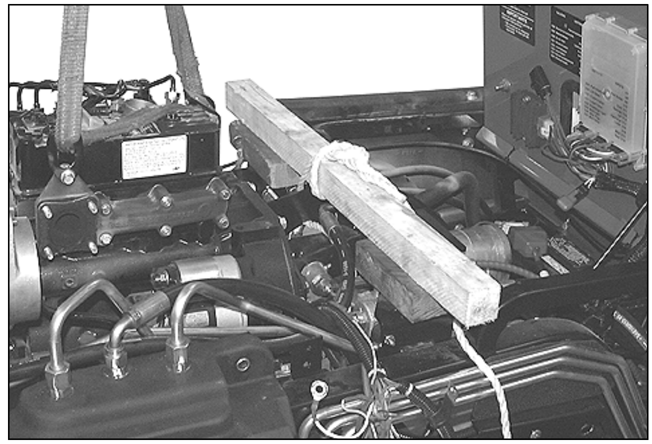
31.Attach a hoist to the engine lifting eyes (S).



M84654

32.Remove nuts from front (T) and rear (U) engine mounts (both sides of engine).

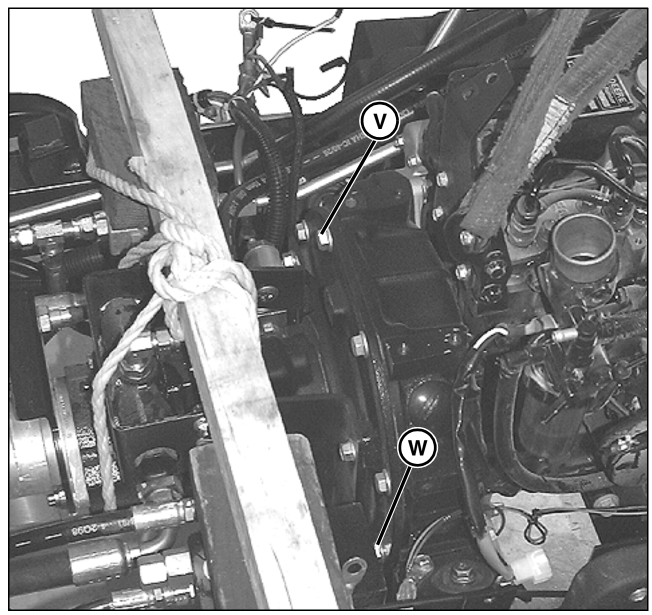
33.Lift engine/pump assembly slightly 76-100 mm (3-4 in.).



M84653

Picture Note: Hydrostatic pump assembly can be supported using a floor jack from below or from above as shown.

34.Support hydrostatic/hydraulic pump assembly.

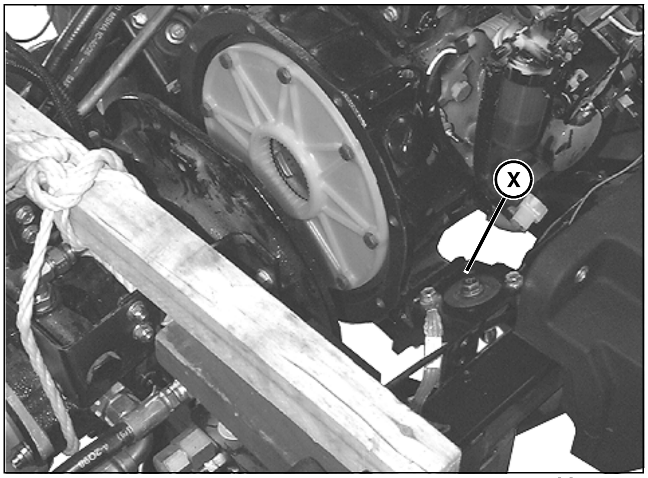


M84655

Picture Note: 2500 Model shown. 2500A is similar.

35.Remove eight flanged-head cap screws (V) from flywheel housing adapter plate.

2500A Models: Note location of ground strap attaching point (W) under on of the flywheel housing cap screws to aid in assembly.



M84656

36.Remove right rear engine (X) mount to gain clearance.

37.Pull engine forward slightly.

38.Remove engine from machine.

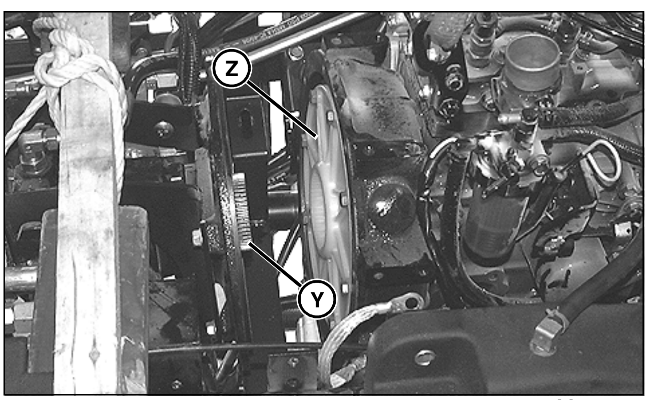
39.If the engine is to be repaired, remove oil drain plug and drain crankcase into a container large enough to hold full capacity.

40.Inspect engine mount pads for wear or damage. Replace as necessary.

Installation

IMPORTANT: Avoid damage! Alignment of engine and transaxle must be checked with alignment tool.

Install engine in reverse order of removal.



M84657

- Align teeth on coupler (Y) with teeth on flex-drive coupler plate (Z).
- Tighten engine mount cap screws securely. DO NOT compress rubber isolators on mounts.
- Tighten flywheel adapter plate cap screws to specification.

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

IMPORTANT: Avoid damage! When filling engine with oil use care not to fill too fast. Excess oil will flow out crankcase breather and run into intake manifold and into engine cylinder. Attempting to start engine with oil in cylinder will severely damage engine!

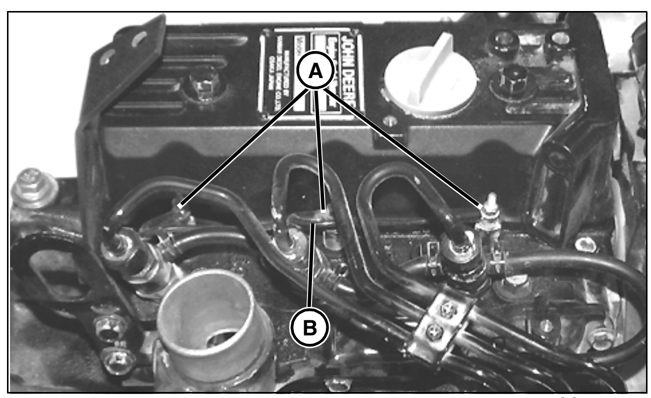
- Fill engine to proper level with oil of correct specification.
- Fill cooling system to correct level with coolant of correct specification.
- Adjust throttle cable. (See “Adjust Throttle Cable” on page 160.)
- Bleed air from fuel system. (See “Procedure for Bleeding Fuel System” on page 159.)

Specifications

Engine Oil Capacity with Filter (Approximately) . . . . 2.4 L (2.5 qt)
Flywheel Adapter Plate Cap Screw Torque . . . . 68 N•m (50 lb-ft)

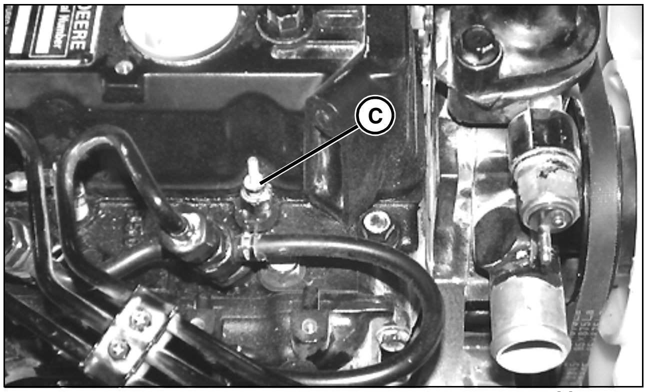
Remove and Install Glow Plug

Removal



M98188

1. Remove nut (A), lock washer, and flat washer from each glow plug.
2. Remove wiring harness (B).



M98189

3. Remove glow plugs (C).

4. Test glow plugs. (See “Test Glow Plug - Diesel” on page 549.)

Installation

Installation is done in reverse order of removal.

- Tighten glow plugs to specifications.

Specifications

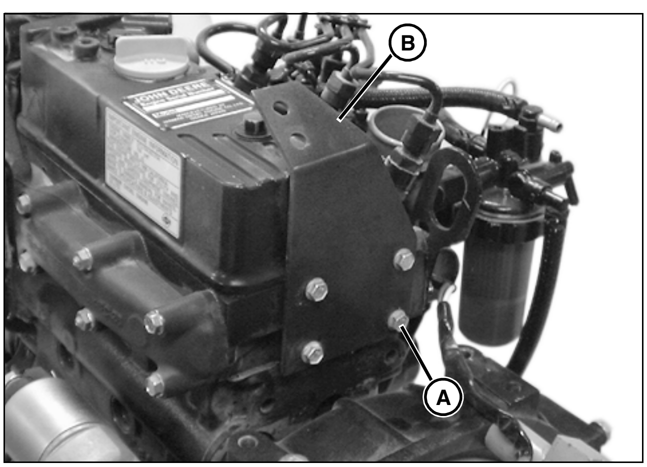
Glow Plug Torque . . . . 19 N•m (168 lb-in.)

Remove and Install Rocker Arm Cover

Removal

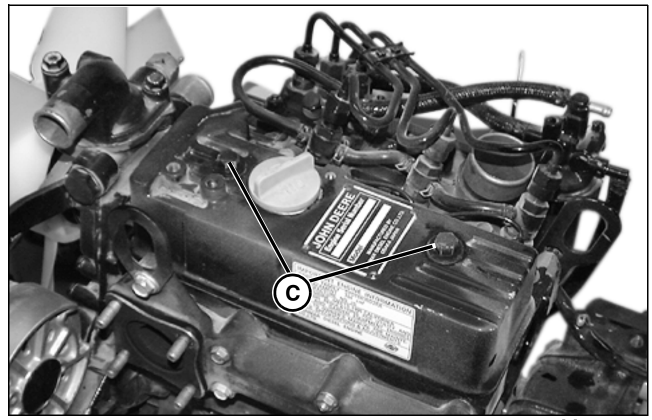
NOTE: If the rocker arm cover is to be removed with the engine installed in the machine to perform valve clearance check and adjustment procedure, remove the air cleaner assembly and fuel tank. (See “Remove and Install Air Cleaner Assembly” on page 176 and See “Remove and Install Fuel Tank - Diesel” on page 804.)

1. Park machine safely.
2. Remove engine cover.



M84806

3. Remove four cap screws (A).
4. Remove air cleaner mounting bracket (B).



M84807

5. Remove two special nuts (C) securing cover to cylinder head.
6. Remove the rocker arm cover.

Installation

IMPORTANT: Avoid damage! Do not overtighten the special nuts securing rocker arm cover to engine.

Installation done in reverse order of removal.

- Clean the cylinder head surface and install the rocker arm cover to the cylinder head.
- Inspect the rocker arm cover O-ring before reinstalling the rocker arm cover. Replace if damaged.
- Tighten the special nuts to specification.

Specifications

Rocker Arm Cover
Special Nut Torque. . . . . 18 N•m (160 lb-in.)

Remove and Install Rocker Arm Assembly

Removal

1. Remove rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)
2. Remove three M8 rocker arm mounting nuts.
3. Pull rocker arm assembly straight up off mounting studs on cylinder head.

IMPORTANT: Avoid damage! Be sure valve caps are in place on end of valve stems before installing rocker arms.

4. Align rocker arm supports with studs on cylinder head. Align rockers with valve stems.
5. Install push rods in block and align into rocker arms.

6. Install mounting nuts on rocker arm supports and evenly tighten nuts to pull rocker assembly to head. Tighten nuts to specification.

7. Adjust valve clearance. (See “Adjust Valve Clearance” on page 154.)

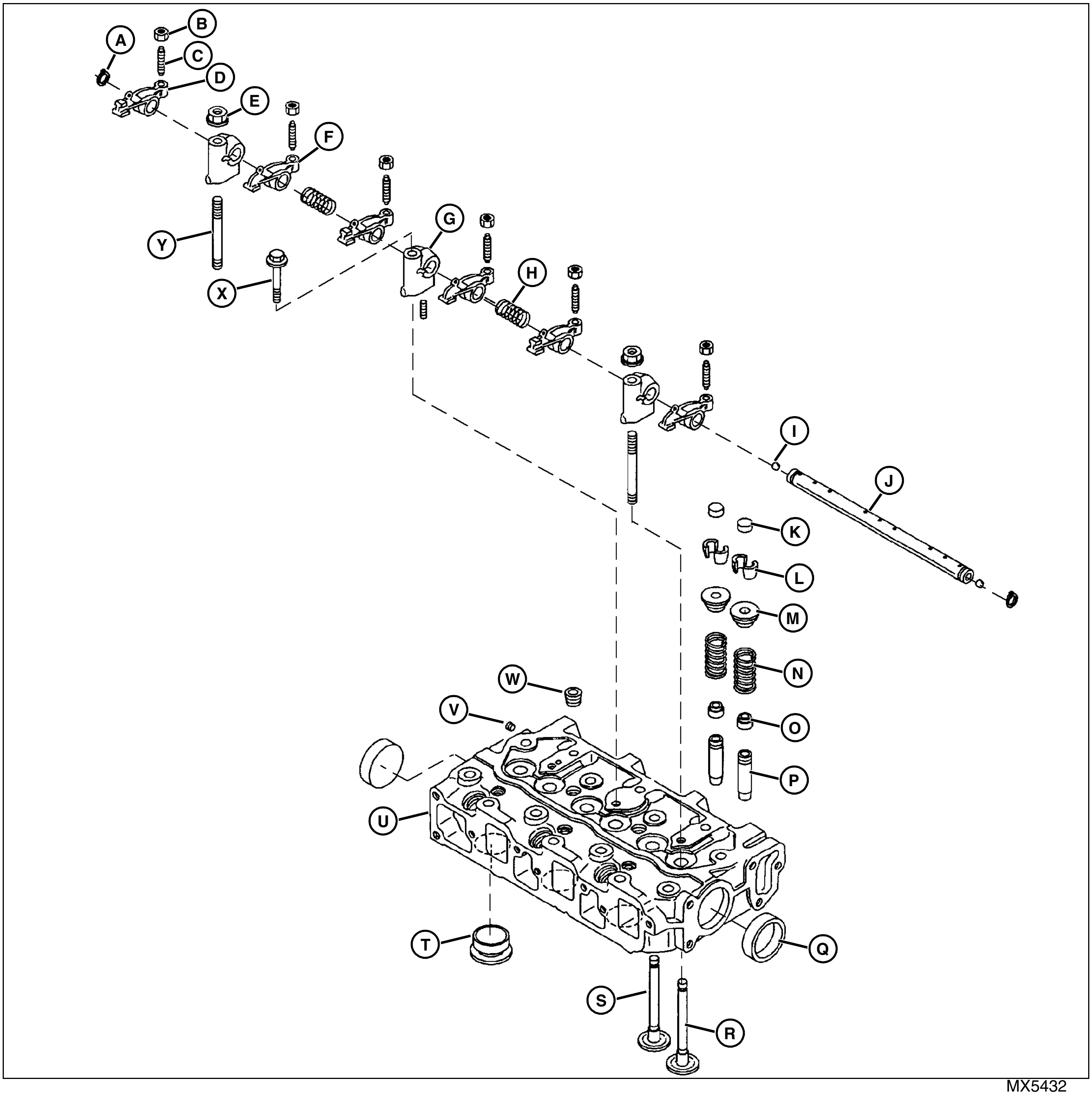
8. Install rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)

Specifications

Rocker Arm Assembly Mounting Nut Torque . . 26 N•m (226 lb-in.)

Disassemble and Assemble Rocker Arm

Disassembly



- A - Snap Ring (2 used)
- B - Nut (6 used)
- C - Stud (6 used)
- D - Rocker Arm (3 used)
- E - Nut (2 used)
- F - Rocker Arm (3 used)
- G - Rocker Arm Support (3 used)
- H - Spring (2 used)
- I - Ball (2 used)
- J - Shaft
- K - Cap (6 used)
- L - Collet (6 used)
- M - Retainer (6 used)
- N - Spring (6 used)
- O - Seal (6 used)
- P - Valve Guide (6 used)
- Q - Plug (2 used)
- R - Intake Valve (3 used)
- S - Exhaust Valve (3 used)
- T - Plug (3 used)
- U - Cylinder Head
- V - Plug
- W - Plug (2 used)
- X - Cap Screw
- Y - Stud (2 used)

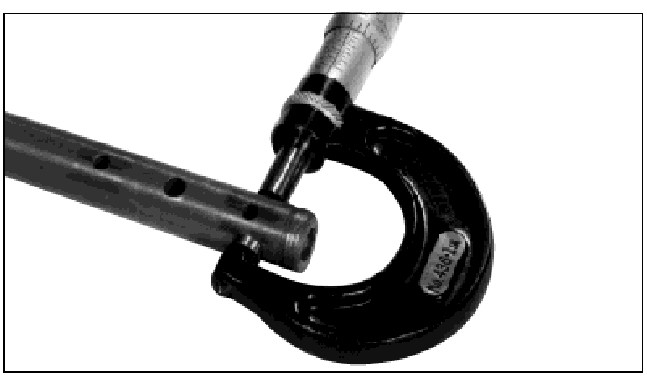
1. Mark all parts for location before disassembly to aid assembly.

2. Remove end retaining rings and slide components off rocker shaft.

3. Remove set screw from center support. Remove rocker shaft from center support.

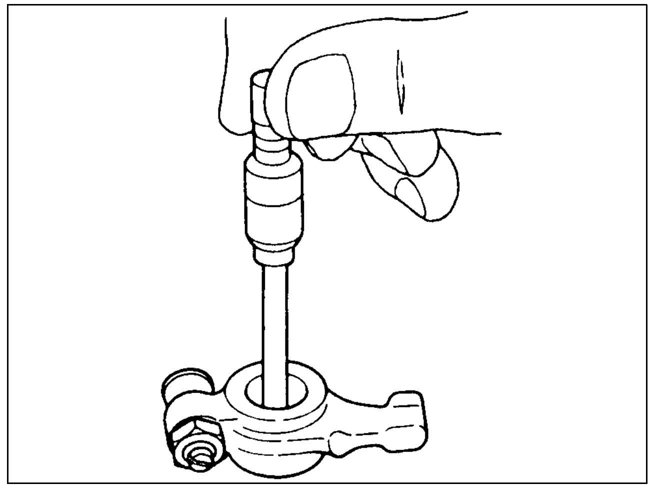
4. Clean all parts of varnish and oil.

Rocker Arm Inspection



M35262

1. Measure outer diameter of rocker arm shaft. Replace rocker arm shaft if measurement is less than wear limit.

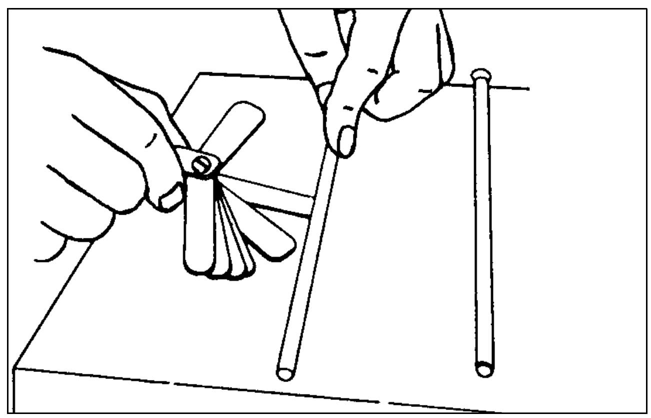


M82022A

2. Measure inside diameter of rocker arms and rocker shaft supports. Replace rocker arms or supports if inner diameter is more than wear limit.

3. If shaft and support/arm clearance (support/arm ID minus shaft OD) exceeds wear limit, replace all parts.

Push Rod Inspection



M98811

1. Lay push rod on flat surface and roll while checking for a gap under center of rod. Use feeler gauge to check dimension.

2. Check the surface of the adjusting screw that contacts the push rod for wear. Replace push rod or adjusting screw if worn.

3. Check the rocker arm-to-valve stem cap contact surface for wear. Replace rocker arm if worn.

Assembly

1. Assemble rocker arm shaft into center support, aligning set screw hole in support with hole in rocker arm shaft.

2. Be sure rocker arms are installed in same order as removed.

Specifications

Rocker Arm Shaft OD Wear Limit . . 9.95 mm (0.391 in.)

Rocker Arm and Shaft Support ID Wear Limit. . . . . 10.09 mm (0.397 in.)

Rocker Arm and Shaft Support Oil Clearance Wear Limit. . . . . 0.14 mm (0.006 in.)

Push Rod Bend. . . . . 0.00-0.03 mm (0.000-0.001 in.)

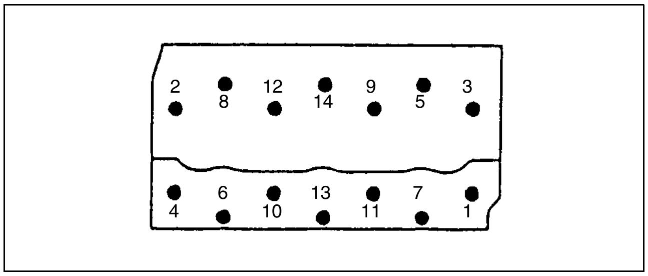
Remove and Install Cylinder Head

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hoist	NA	Used to remove cylinder head from block.
Lifting Bracket (2 used)	JT01748	Used to remove cylinder head from block.

Removal

1. Park machine on level surface with park brake locked and engine off.
2. Disconnect negative (-) battery cable from battery.
3. Shut off fuel valve on fuel filter/water separator.
4. Allow engine to cool, and cooling system pressure to return to zero. Drain coolant from engine and radiator.
5. Remove pipe from exhaust manifold. (See “Remove and Install Muffler” on page 177.)
6. Remove upper and lower radiator hoses from coolant pump.
7. Disconnect wiring from coolant temperature sensor.
8. Remove upper alternator bracket and belt from coolant pump.
9. Remove coolant pump. (See “Remove and Install Coolant Pump (Thermostat Included)” on page 220,)
10. Remove high-pressure fuel lines and fuel leak-off line running from fuel injection pump to nozzles.
11. Disconnect glow plug wiring harness from engine harness.
12. Remove rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)
13. Remove rocker arm assembly, push rods, and valve caps from cylinder head. (See “Remove and Install Rocker Arm Assembly” on page 184,)



M82260A

Picture Note: Top of Drawing Is Exhaust Manifold Side, Bottom Is Intake Manifold Side

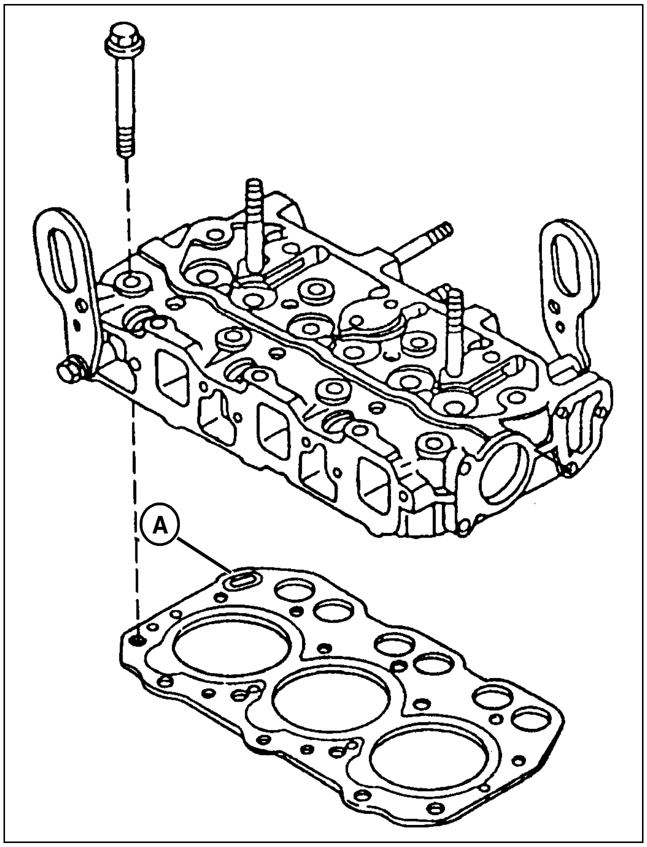
14. Remove cylinder head cap screws in the order shown.
15. Using lift brackets and hoist, pull head straight up from block.
16. Remove exhaust and intake manifolds. (See “Remove and Install Exhaust Manifold” on page 177, and “Remove and Install Intake Manifold” on page 178)
17. Disassemble and inspect cylinder head and valves. (See “Recondition Cylinder Head” on page 189.)

Installation

1. Clean all threads in top of cylinder block with a flat bottom tap, and blow debris from hole.
2. Clean top of cylinder block and check for flatness.

IMPORTANT: Avoid damage! Oil passage in gasket must be located over oil passage (A) in cylinder block.

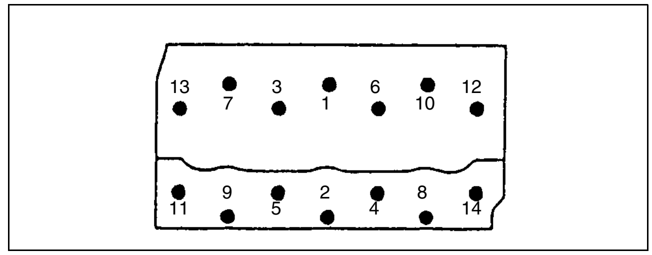
If cylinder head was resurfaced, check piston-to-cylinder head clearance.



M82259A

3. Place a new cylinder head gasket on cylinder block with locating pins on front and rear of block inside holes in gasket. Line up oil passage (A) on left rear of block with oil passage in gasket. If cylinder head was resurfaced, check piston-to-cylinder head clearance. (See “Remove and Install Piston and Connecting Rod” on page 194.)

4. Clean threads of cylinder head cap screws and dip in clean oil before installing. Install all cap screws finger tight before tightening with wrench.



M82260A

Picture Note: Top of Drawing Is Exhaust Manifold Side, Bottom Is Intake Manifold Side

5. Tighten cylinder head cap screws to specification in sequence shown above in three steps of torque from table below.

6. Install rocker arm assembly, push rods, and valve caps. (See “Remove and Install Rocker Arm Assembly” on page 184)

7. Install rocker arm cover. (See “Remove and Install Rocker Arm Cover” on page 184.)

8. Connect fuel lines, radiator hoses, and wires.

9. Install coolant pump. (See “Remove and Install Coolant Pump (Thermostat Included)” on page 220,)

10. Install exhaust pipe to manifold. (See “Remove and Install Muffler” on page 177.)

11. Install upper alternator bracket and belt.

Specifications

First . . . . 13 N•m (115 lb-in.)

Second . . . . 26 N•m (20 lb-ft)

Final. . . . . 39 N•m (29 lb-ft)

IMPORTANT: Avoid damage! Cylinder head mounting cap screws must be checked for proper torque after 50 hours of engine operation.

Recondition Cylinder Head

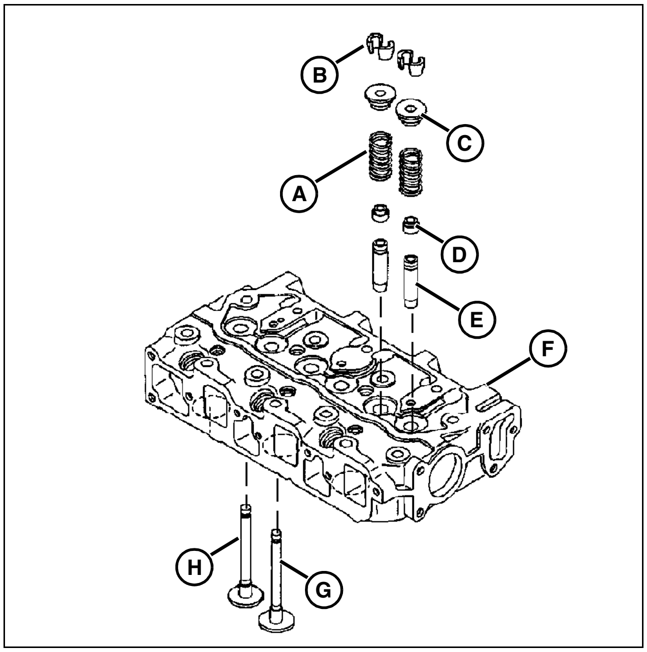
Special or Required Tools

Tool Name	Tool No.	Tool Use
Valve Spring Compressor	JDE138	Used to remove valves.
Valve Guide Driver	JDE504	Used to install valve guides in cylinder head.

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

Disassembly/Assembly

1. Check valve recession before disassembly. (See “Valve Recession Measurement” on page 190.)



MX5433

2. Compress valve springs (A) using JDE138 Valve Spring Compressor.

NOTE: It may be necessary to tap on valve spring retainer (C) while initially operating compressor to break retainer free from valve stem.

3. Remove collet halves (B) from retainer.
4. Slowly release compressor and valve spring.

IMPORTANT: Avoid damage! Do not reuse stem seals (D) if removed. Used seals will leak.

5. Remove valve spring, stem seal (D), and valve (G or H) from head (F).

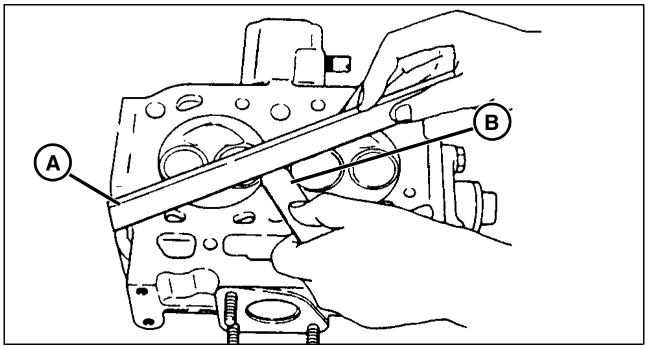
NOTE: Valve seats are not replaceable.

6. Intake and exhaust valve guides (E) are press fit. Remove guides only if replacement is necessary.
7. Inspect all parts for wear or damage. Clean all carbon deposits and measure all parts for proper clearances.
8. Apply clean engine oil on intake and exhaust valve stems during assembly.
9. Install springs with smaller pitch end or paint mark toward cylinder head.
10. Use valve spring compressor to compress spring and retainer, and install collet as removed.
11. After valve has been assembled, tap on top of valve stem with a plastic hammer to seat retainer.
12. Repeat for remaining valves.
13. Measure valve recession if new valves were installed. (See “Valve Recession Measurement” on page 190.)

Inspection/Replacement

Before inspection, thoroughly clean all components of carbon or dirt.

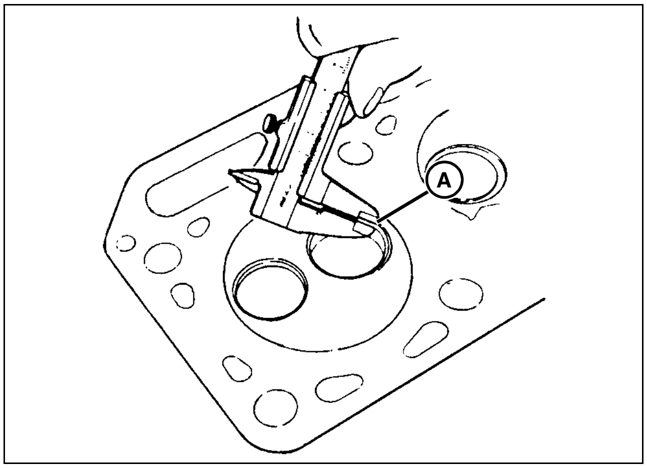
Cylinder Head



M82028A

1. Measure cylinder head flatness. Place a straightedge (A) along each of the four sides and each diagonal. Measure clearance between straightedge and gasket surface with a feeler gauge (B).
2. If distortion exceeds the wear limit, resurface or replace cylinder head. Remove only enough metal to make cylinder head flat, but do not remove more than maximum amount specified.
3. Inspect for cracks or other damage.
4. Inspect condition of valve seats and measure valve seat width. (See “Valve Seat Width” on page 190.)
5. If cylinder head was resurfaced, measure valve recession. (See “Valve Recession Measurement” on page 190.)

Valve Seat Width

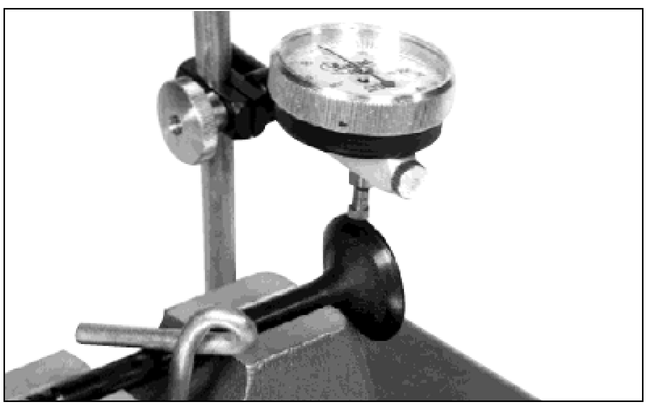


M82029A

1. Measure valve seat width (A) for intake and exhaust valves and compare to specification.

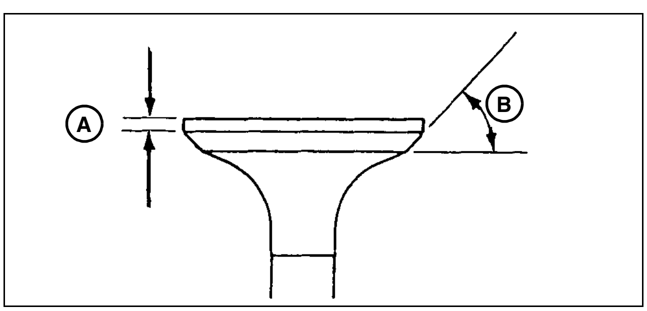
2. If necessary, grind valve seats to meet specification. (See "Valve Seat Grinding" on page 191.)

Intake and Exhaust Valves



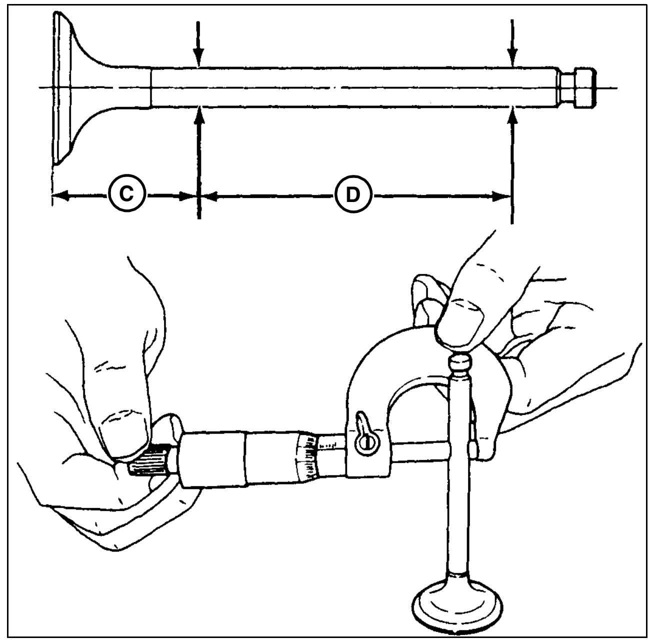
M35307

1. Check valve for out-of-round, bent, or warped condition using a valve inspection center and dial indicator. Replace valve if necessary.



M82030A

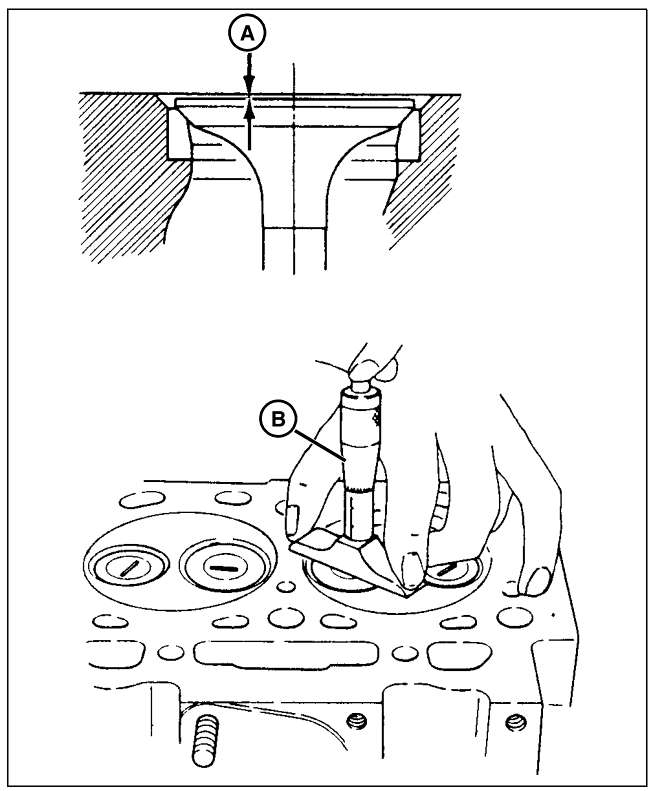
2. If valve faces are worn, burned, or pitted, grind valves to proper face angle (B). If valve face margin (A) is less than specification after grinding, replace valve.



M82031A

3. Measure valve stem diameter at the two locations (C and D) shown above. Replace valve if measurement exceeds wear limit.

Valve Recession Measurement



M82032A

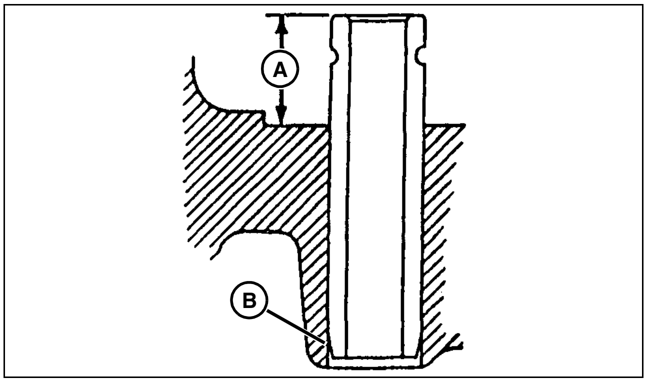
Measure valve recession (A) using a depth gauge (B). Replace valve or cylinder head if measurement exceeds wear limit.

Valve Guide Measurement

1. Clean valve guides using a valve guide brush.

2. Measure valve guide inside diameter using a ball or telescoping snap gauge.

- If valve guide inside diameter exceeds wear limit, knurl or replace guide.
- If valve guide inside diameter is less than wear limit, determine guide-to-stem clearance (valve guide diameter minus valve stem diameter).
- If clearance exceeds knurl specification, knurl valve guides using a 7 mm or 12 mm valve guide knurling tool.
- If clearance exceeds replacement specification, replace valve guides.

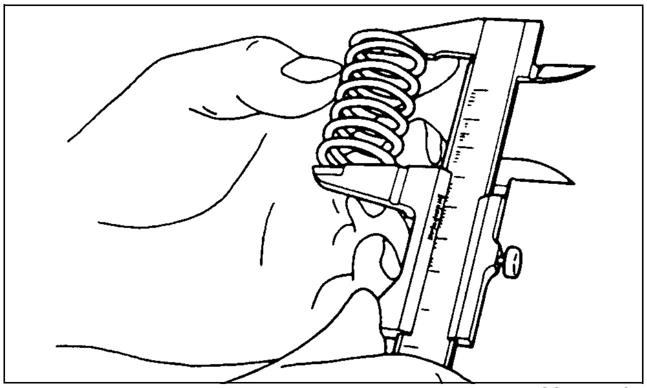


M82193A

3. Install valve guides with tapered end (B) down using JDE504 Valve Guide Driver. Push valve guides down until tops of valve guides are projecting the specified height (A) from the valve spring seat in the cylinder head.

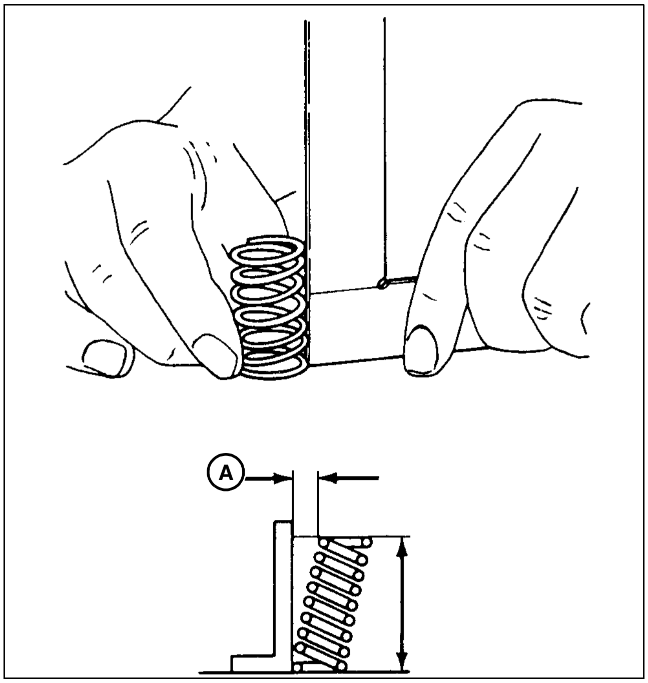
4. Ream inside diameter of valve guides using a 7 mm valve guide reamer.

Valve Springs



M82034A

1. Measure spring free length. Replace spring if measurement exceeds specification.

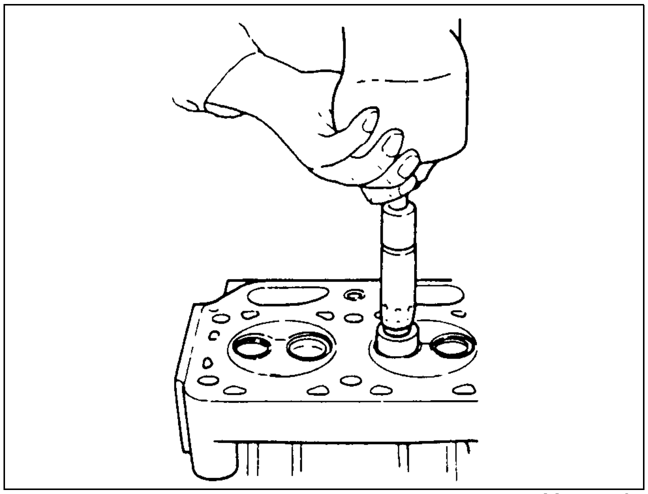


M82035A

2. Measure spring inclination. Replace spring if measurement exceeds specification.

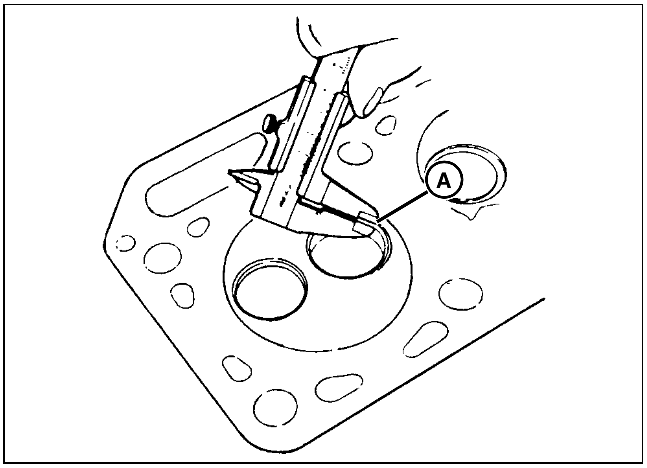
Valve Seat Grinding

NOTE: Lightly grind valve seats for only a few seconds to avoid excessive valve seat width. If valve guide is to be replaced, always replace guide before grinding valve seat, as seat grinder pilot is centered by guide.



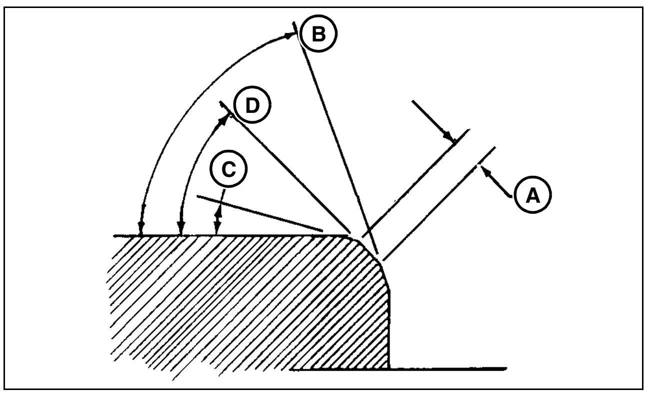
M82039A

1. Grind intake valve seat using a 30° seat grinder, and exhaust valve seat using a 45° seat grinder. Follow tool manufacturer's instructions.



M82029A

2. Measure valve seat width (A) after grinding.



M82040A

3. If seat (A) is too wide after grinding, grind lower seat surface (B) using a 70° seat grinder until seat width is close to specifications.

4. Grind upper seat surface (C) using a 15° seat grinder until seat width is narrowed to specification.

5. Dimension (D) is 30° for intake and 45° for exhaust seat.

NOTE: If valve recession exceeds maximum specification, replace cylinder head.

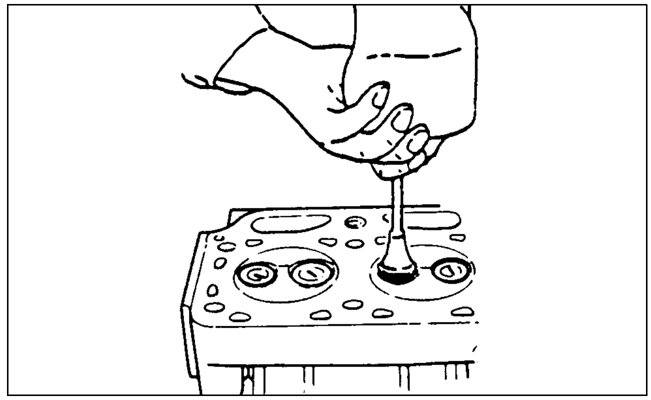
6. If valve seats are ground, measure valve recession and check contact pattern between the seat and valve with bluing dye.

7. Lap valves. (See “Valve Lapping” on page 192.)

Valve Lapping

NOTE: Use a rubber-type lapping tool for valves without a lapping tool groove slit.

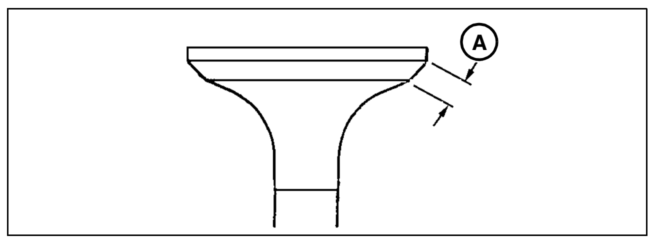
If seat does not make proper contact, lap the valve into the seat.



M82041A

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

2. Turn valve to lap valve to seat.



M82030B

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

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

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

Specifications

Cylinder Head Distortion

Wear Limit. . . . . 0.15 mm (0.006 in.)
Allowable Removed Material (Maximum) . . . . 0.20 mm (0.008 in.)

Valve Seat Width

Intake Standard . . . . 1.15 mm (0.045 in.)
Intake Wear Limit . . . . 1.65 mm (0.065 in.)
Exhaust Standard. . . . . 1.41 mm (0.056 in.)
Exhaust Wear Limit . . . . 1.91 mm (0.075 in.)

Valve Grinding

Intake Valve
Face Margin. . . . . 0.99-1.29 mm (0.039-0.051 in.)

Exhaust Valve
Face Margin. . . . . 0.95-1.25 mm (0.037-0.049 in.)

Valve Face Margin Wear Limit . . . . . 0.50 mm (0.020 in.)

Intake Valve Face Angle. . . . . .30°

Exhaust Valve Face Angle . . . . .45°

Valve Stem

Measuring Point (3) Distance . . . . . . 20 mm (0.787 in.)

Measuring Point (4) Distance . . . . . . 40 mm (1.575 in.)

Intake Valve Stem OD Wear Limit . . 5.40 mm (0.213 in.)

Exhaust Valve Stem
OD Wear Limit. . . . . 5.40 mm (0.213 in.)

Valve Recession

Intake Valve Recession Wear Limit. . 1.0 mm (0.039 in.)

Exhaust Valve Recession
Wear Limit . . . . 1.0 mm (0.039 in.)

Valve Guides

Valve Guide
Standard ID . . . . 5.50-5.52 mm (0.275-0.276 in.)

Valve Guide ID Wear Limit . . . . 5.58 mm (0.22 in.)

Intake Valve Guide-to-Valve Stem Standard Oil
Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)

Exhaust Valve Guide-to-Valve Stem Standard Oil
Clearance . . . . 0.040-0.070 mm (0.002-0.003 in.)

Valve Guide-to-Valve Stem Oil Clearance Wear Limit
(Both). . . . . 0.18 mm (0.007 in.)

Valve Guide Knurling Clearance
(Maximum). . . . . 0.127-0.178 mm (0.005-0.007 in.)

Valve Guide Replacement
Clearance . . . . 0.20 mm (0.008 in.)

Valve Guide Height. . . . . 7 mm (0.276 in.)

Valve Springs

Spring Free Length. . . . . 28 mm (1.102 in.)

Spring Inclination (Maximum) . . . . 0.8 mm (0.03 in.)

Measure Piston-to-Cylinder Head Clearance

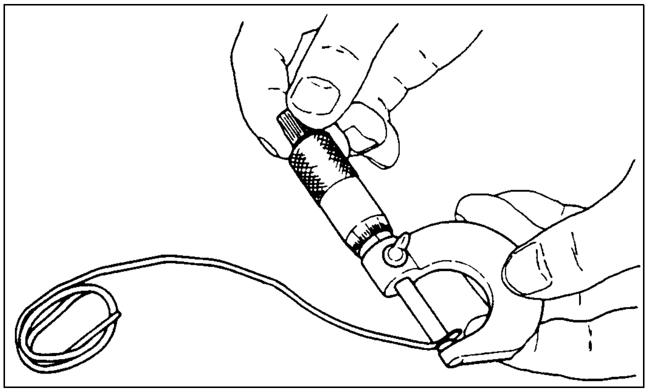
Procedure

1. Place three 10 mm (0.4 in.) long pieces of 1.5 mm (0.06 in.) diameter soft wire in three positions on the flat part of the piston head.

2. Install the cylinder head and old gasket. Install cylinder head cap screws and tighten in proper sequence. (See “Remove and Install Cylinder Head” on page 187.)

3. Slowly turn the crankshaft one complete revolution.

4. Remove the cylinder head and gasket.



M82042A

5. Measure the thickness of the flattened section of each piece of wire. Calculate the average thickness of the wires to obtain the piston-to-cylinder head clearance specification.

6. If clearance is less than specification, replace cylinder head. (See “Remove and Install Cylinder Head” on page 187.)

Specifications

Piston-to-Cylinder Head
Clearance . . . . 0.61-0.73 mm (0.024-0.028 in.)

Remove and Install Piston and Connecting Rod

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ridge Reamer	NA	Used to remove ridges from cylinder bore.
Bushing, Bearing, and Seal Driver Set	NA	Used to remove piston pin bushing.

Removal

NOTE: The engine must be removed from the machine to perform this procedure.

1. Remove the oil pan and oil pickup tube. (See “Oil Pan and Strainer” on page 218.)

2. Remove the cylinder head. (See “Remove and Install Cylinder Head” on page 187.)

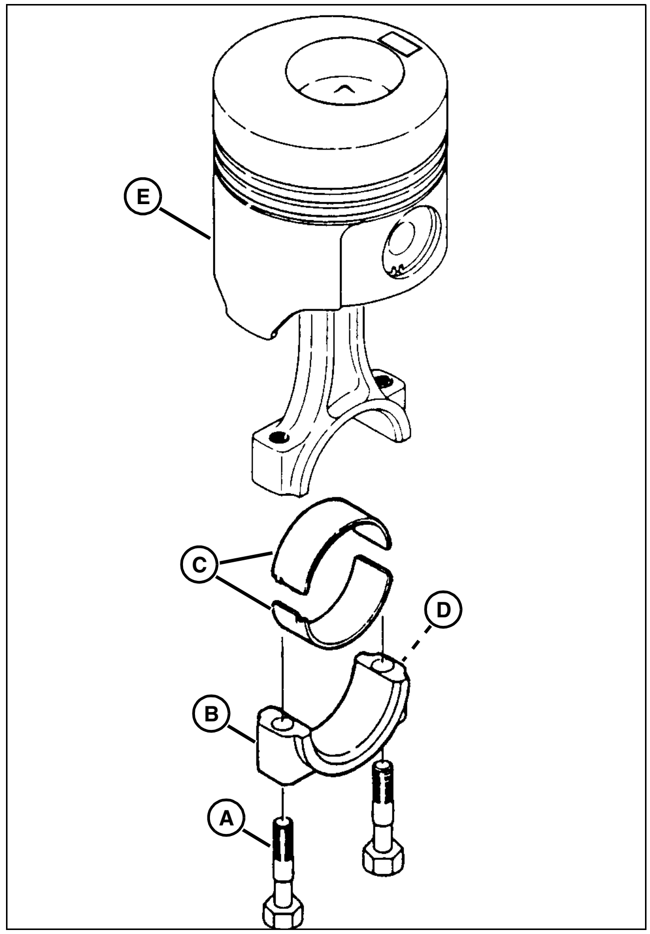
3. Check the cylinder bore for ridges. These ridges can cause damage to piston if ridge is not removed. If necessary, remove any ridge from top of cylinder bore using a ridge reamer.

4. Measure the connecting rod side play. (See “Connecting Rod Side Play Check” on page 200.)

5. Measure the crankshaft end play.

6. Measure the connecting rod bearing clearance. (See “Check Connecting Rod Bearing Clearance” on page 200.)

IMPORTANT: Avoid damage! Keep the connecting rods and rod caps together. Rods and caps are a matched set. Note the stamped numbers on each part.



M82196AB

7. Remove the rod cap screws (A), connecting rod cap (B), and bearing inserts (C).

IMPORTANT: Avoid damage! The pistons and cylinders are matched. Pistons must be installed in the cylinders from which they are removed.

8. Note the connecting rod stamped number (D) in relation to the cylinders. Start at the flywheel end with cylinder number one, then two, etc.

9. Push the piston and connecting rod (E) out of the cylinder bore using a wooden dowel.

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

11.Inspect cylinder bore. (See “Cylinder Bore” on page 201.)

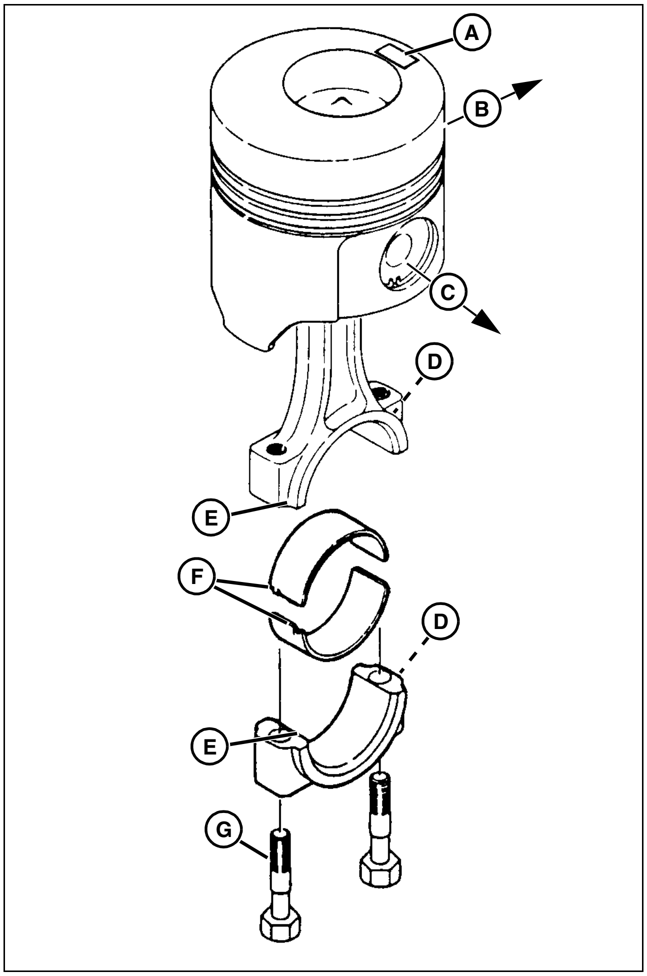
Installation

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

2. Always replace the connecting rod cap screws. Do not reuse the bolts.

3. Assemble the piston and connecting rod. (See “Assembly” on page 196.)

IMPORTANT: Avoid damage! Pistons must be installed in the cylinders from which they were removed and in the same direction. Be careful not to damage the crankshaft rod journals while installing pistons.



M82196AB

A - Piston Recess
B - Fuel Injection Pump Side
C - Flywheel Side
D - Stamped Number
E - Groove
F - Tang
G - Cap Screw

4. Install the piston and connecting rod into the cylinder from which it was removed. The stamped number (D) on the connecting rod or the piston recess (A) on top of piston should point toward the fuel injection pump.

IMPORTANT: Avoid damage! Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surface.

5. Install the bearing inserts to the connecting rod and rod cap, aligning tangs (F) with grooves (E).

IMPORTANT: Avoid damage! Connecting rod caps must be installed on the same connecting rods they were removed from.

6. Match the connecting rods to caps using stamped numbers (D). Install the rod caps.

7. Dip the entire connecting rod cap screws (G) in clean engine oil. Install new cap screws and tighten to specification.

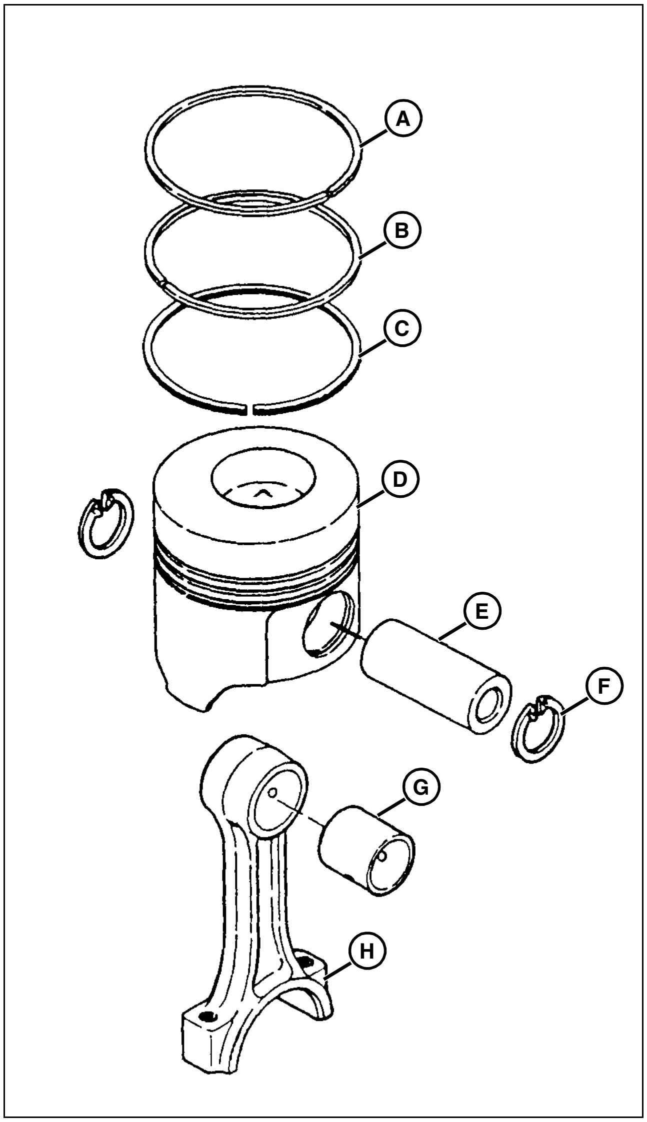
8. If a new piston and connecting rod were installed, stamp a number corresponding to the cylinder number on the connecting rod and rod cap.

9. Install the cylinder head. (See “Remove and Install Cylinder Head” on page 187.)

10.Install the oil pan and oil pickup tube. (See “Oil Pan and Strainer” on page 218.)

Disassembly

IMPORTANT: Avoid damage! Pistons must be installed on the same connecting rod they were removed from.



A - Top Piston Ring
B - Middle Piston Ring
C - Oil Control Ring with Expander
D - Piston
E - Piston Pin
F - Snap Ring
G - Piston Pin Bushing
H - Connecting Rod

1. Put a mark on each piston and connecting rod to aid in assembly.

2. Remove piston rings (A-C), starting with the first compression ring, by gently spreading them open just enough to clear the outside diameter of the piston. This can be done by hand or with a ring expander.

3. Remove piston pin retaining rings (F).

4. Remove piston pin (E). Excessive pressure should not be necessary to remove piston pin.

NOTE: The piston pin bushing (G) is a press fit in the connecting rod. Remove the bushing only if replacement is necessary. (See "Piston Pin Bushing" on page 199.)

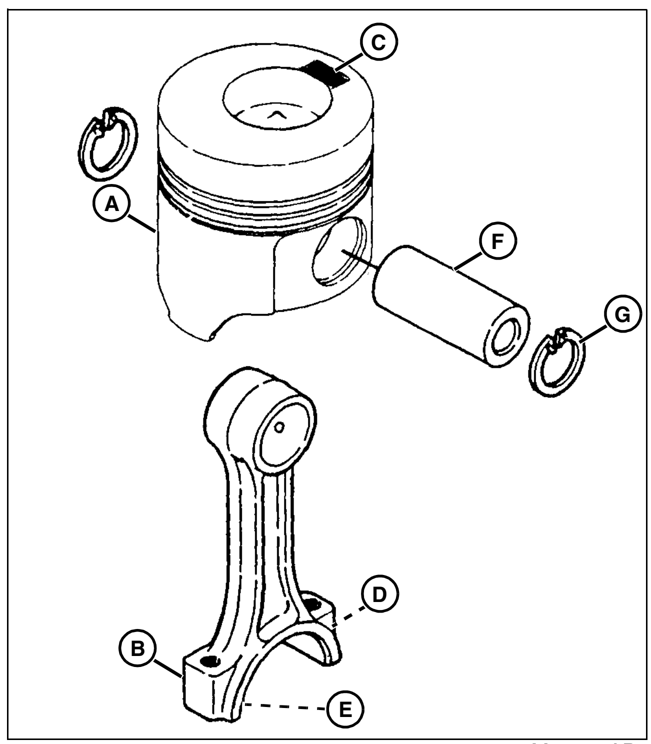
5. Inspect all parts for wear or damage. Replace as necessary.

Assembly

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

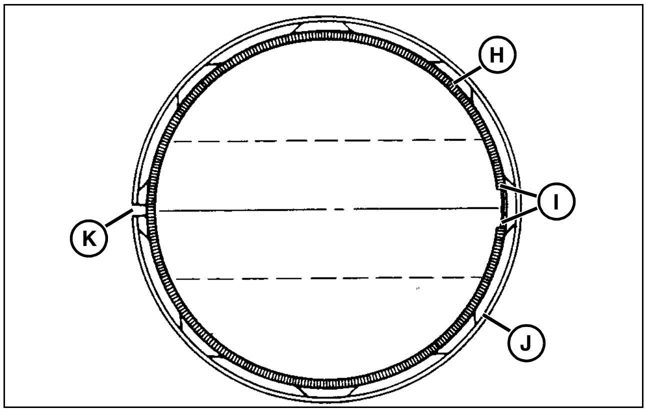
IMPORTANT: Avoid damage! The pistons must be installed on the same connecting rod they were removed from.

2. Install piston pin bushing in connecting rod with oil holes aligned.



3. Assemble the piston (A) to the connecting rod (B) with piston recess (C) on the same side as the connecting rod stamped number (D). If a new connecting rod is used, assemble the piston to the connecting rod with piston recess opposite the connecting rod bearing insert groove (E).

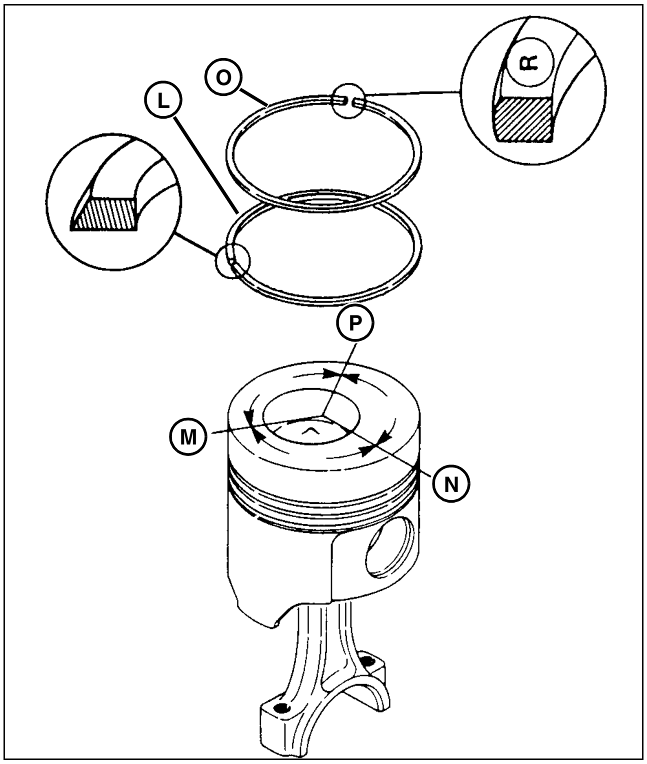
4. Install piston pin (F) and snap rings (G).



M82046A

5. Install an oil ring expander (H) in the bottom ring groove of the piston, with the ends (I) above either end of the piston pin.

6. Install oil ring (J) over the expander with the ring gap (K) opposite (180°) the expander ends.



M82199A

7. Install the middle piston ring (L), with the small diameter of taper toward top of piston, in the middle groove. Turn the ring until the middle piston ring gap (M) is 120° away from the oil ring gap (N).

8. Install the top piston ring (chrome plated) (O), with the manufacturer's mark "R," "T," or "RN" (near the ring gap) toward the top of the piston, in the top groove. Turn the ring until the top piston ring gap (P) is 120° away from the middle ring gap (M).

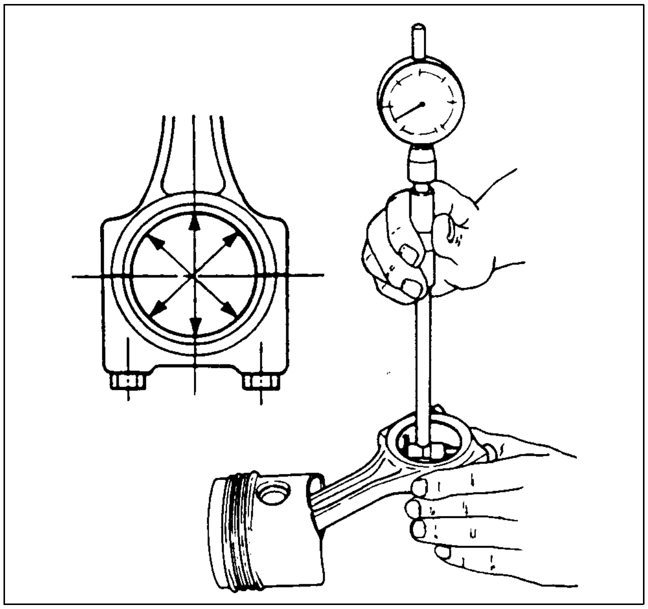
Inspection/Replacement

1. Inspect all parts for wear or damage. Replace as necessary. (See Connecting Rod Bearing, Piston Ring Groove, Piston Ring End Gap, Piston Pin Bore, Piston Pin Bushing, and Piston Diameter procedures below.)

2. Measure the crankshaft connecting rod journal diameter. (See "Crankshaft and Main Bearings" on page 205.)

Connecting Rod Bearing

1. Install the connecting rod cap and bearing inserts on the connecting rod. Install the old connecting rod cap screws and tighten to specification.



M82048A

2. Measure the connecting rod bearing diameter. Replace the bearing inserts if bearing diameter is not within specification.

3. Measure the oil clearance between the bearing inserts and the crankshaft, and verify that the clearance is within specification. If the bearing oil clearance exceeds the wear limit, grind the crankshaft connecting rod journals and install undersized bearing inserts, or replace the bearing inserts and the crankshaft.

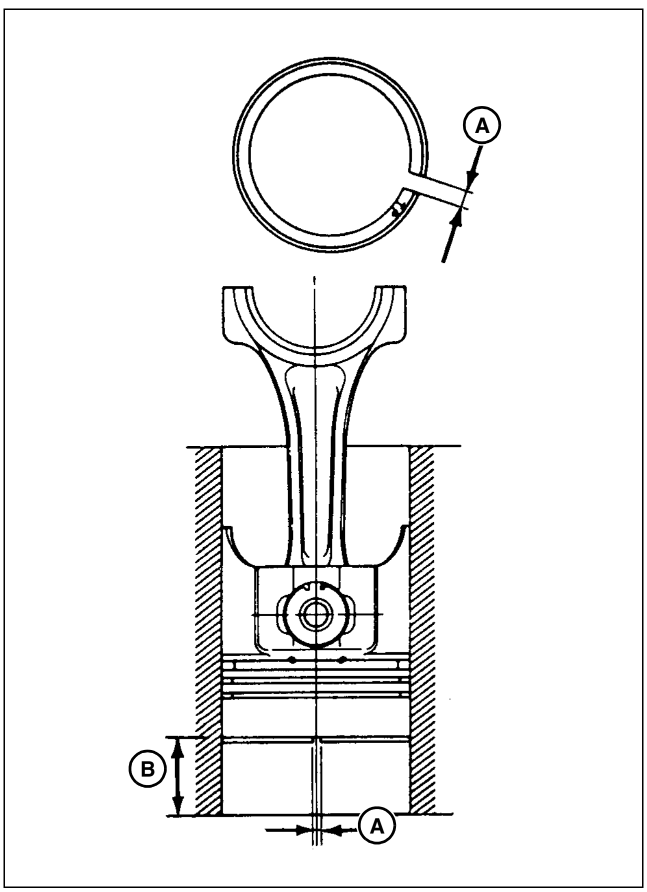
Piston Ring Groove

M35360

1. With the rings installed on the piston, measure the piston ring groove side clearance. Measure at several places around each piston.

2. Replace the rings or the piston if the clearances exceed specification.

Piston Ring End Gap

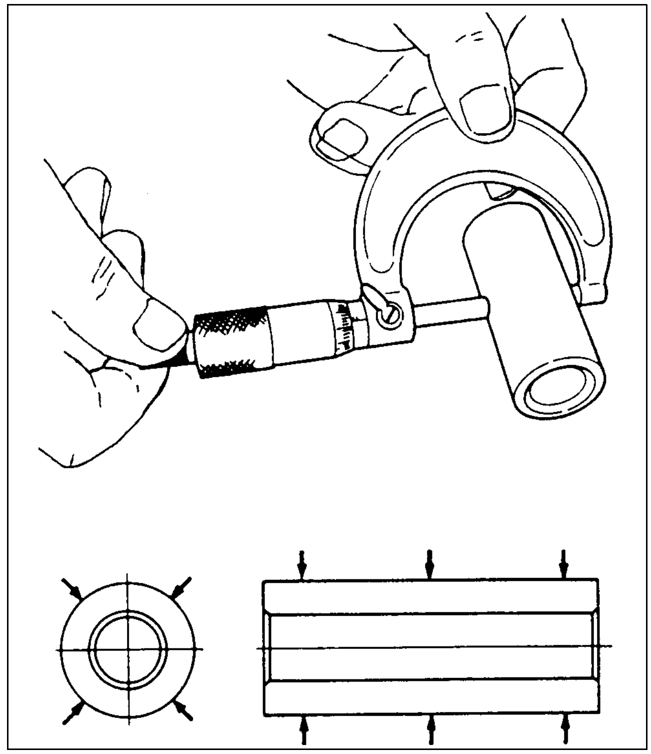


M82049A

1. Push ring into cylinder bore, using a piston, until ring installed depth (B) is approximately 30 mm (1.18 in.) from bottom of cylinder bore.

2. Measure piston ring end gap (A). If ring end gap exceeds wear limit, replace ring.

Piston Pin



M82050A

Measure the piston pin diameter at six places. Replace any pin that is not within specification.

Piston Pin Bore

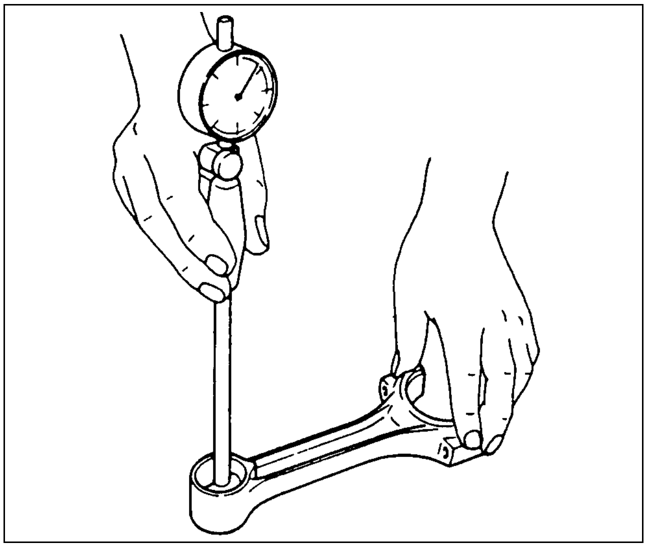
M37683

1. Measure the pin bore diameter in the piston. If the piston pin bore exceeds the wear limit, replace the piston.

2. If the piston pin-to-piston oil clearance (bore ID minus pin OD) exceeds the wear limit, replace the piston, piston pin, or both.

Piston Pin Bushing

NOTE: The piston pin bushing is a press fit. Replace the bushing using a driver set. When installing the bushing, make sure to align the oil hole in the bushing with the hole in the connecting rod.



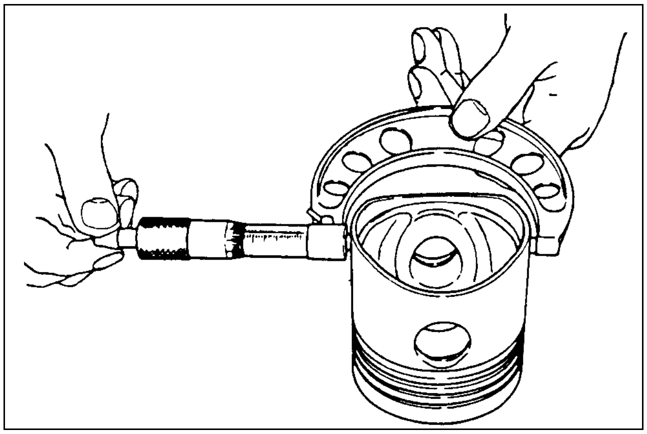
M82051A

1. Measure the piston pin bushing diameter in the connecting rod. If the bushing diameter exceeds the wear limit, replace bushing.

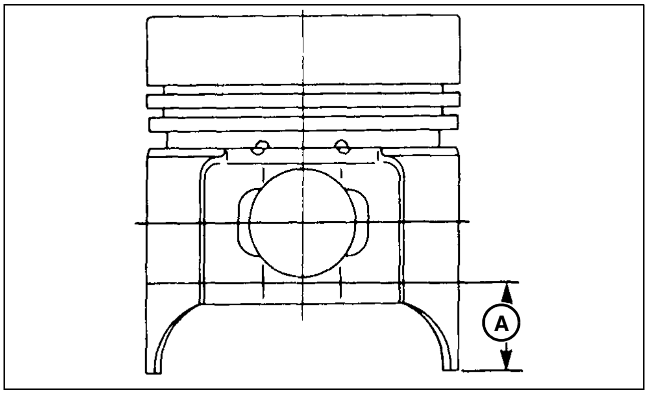
2. If piston pin-to-rod bore oil clearance (bushing ID minus pin OD) exceeds specification, replace the bushing or the piston pin.

Piston Diameter

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



M82052A



M82200A

Measure the piston diameter perpendicular to the piston pin bore at distance (A). If the piston diameter is less than the wear limit, install a new piston.

Specifications

Connecting Rods

Connecting Rod
Cap Screw Torque . . . . 24 N•m (18 lb-ft)

Connecting Rod Bearings

Connecting Rod
Bearing ID . . . . 39.02 mm (1.536 in.)

Connecting Rod Bearing Oil Clearance
Wear Limit . . . . 0.15 mm (0.006 in.)

Piston Rings

Top Piston Ring Groove
Side Clearance . . . . 0.06-0.10 mm (0.002-0.004 in.)

Middle Piston Ring Groove
Side Clearance . . . . . . 0.090-0.125 mm (0.004-0.005 in.)

Oil Control Ring Groove
Side Clearance . . . . 0.020-0.055 mm (0.0008-0.0022 in.)

Piston Ring Standard End Gap (All Except Oil Control Ring) . . . . 0.20-0.40 mm (0.008-0.016 in.)

Oil Control Ring
Standard End Gap . . . . . 0.15-0.35 mm (0.006-0.014 in.)

Piston Ring End Gap Wear Limit . . 1.50 mm (0.059 in.)

Piston Pins

Piston Pin OD Wear Limit . . . . 19.90 mm (0.783 in.)

Piston Pin Bores

Bore ID Wear Limit . . . . 20.02 mm (0.789 in.)

Piston Pin Bushings

Bushing ID Wear Limit . . . . 20.10 mm (0.79 in.)

Piston Pin-to-Rod Bore Oil Clearance
Wear Limit . . . . 0.20 mm (0.007 in.)

Pin-to-Bushing Clearance Wear Limit . . . . 0.20 mm (0.008 in.)

Pistons

Diameter Measuring Point Distance (1) . . . . 24 mm (0.945 in.)

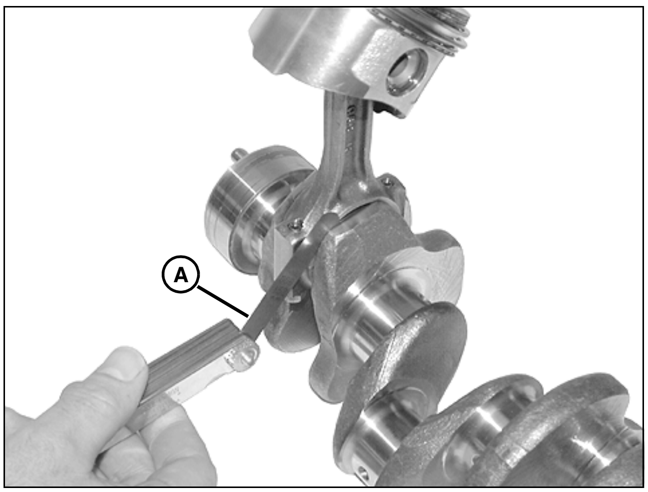
Standard Size Piston OD Wear Limit. . . . . 67.90 mm (2.673 in.)

Oversize Piston OD Wear Limit. . . 68.19 mm (2.685 in.)

Connecting Rod Side Play Check

1. Remove crankshaft from cylinder block. (See “Crankshaft and Main Bearings” on page 205.)

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



M98862

3. Measure connecting rod side play using a feeler gauge (A). Replace connecting rod and crankshaft, as necessary, if side play exceeds specification.

Specifications

Connecting Rod Side Play . . . . 0.40 mm (0.016 in.)

Connecting Rod Cap Screw Torque . . . . 24 N•m (18 lb-ft)

Check Connecting Rod Bearing Clearance

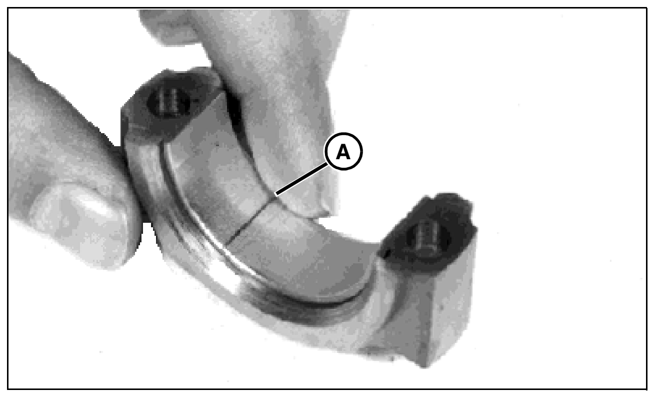
Special or Required Tools

Tool Name	Tool No.	Tool Use
PLASTIGAGE® Bearing Clearance Measurement Tool (or equivalent)	NA	Used between bearing insert and crankshaft journal to measure clearance.

IMPORTANT: Avoid damage! Connecting rod caps must be installed on the same connecting rod and in the same direction to prevent crankshaft and connecting rod damage.

1. Remove connecting rod cap.

2. Wipe oil from bearing insert and crankshaft journal.



M35351

3. Put a piece of PLASTIGAGE (A), or an equivalent, along the full length of the bearing insert approximately 6 mm (0.250 in.) off center.

4. Turn crankshaft approximately 30° from bottom dead center.

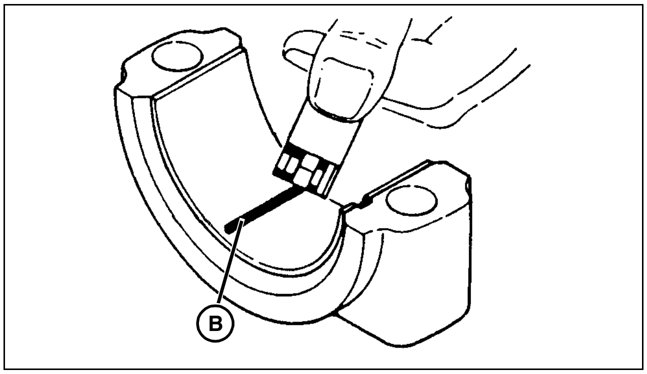
IMPORTANT: Avoid damage! Rotating the crankshaft will cause PLASTIGAGE to smear, resulting in a false reading. Do not allow crankshaft to rotate after installing bearing cap.

NOTE: Lightly lubricate bolts with engine oil before installing.

5. Install connecting rod end cap and original cap screws. Tighten cap screws to specification.

6. Remove cap screws and connecting rod cap.

NOTE: The flattened PLASTIGAGE will be found on either the bearing insert or the crankshaft journal.



M82117A

7. Use the graduation marks on the envelope to compare the width of the flattened PLASTIGAGE (B) at its widest point.

8. Determine bearing clearance. The number within the graduation marks indicates the bearing clearance in inches or millimeters, depending on which side of the envelope is used.

9. If clearance exceeds specification, replace bearing inserts.

10.Remove PLASTIGAGE.

Specifications

Connecting Rod End Cap
Cap Screw Torque . . . . 24 N•m (18 lb-ft.)
Connecting Rod Bearing
Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

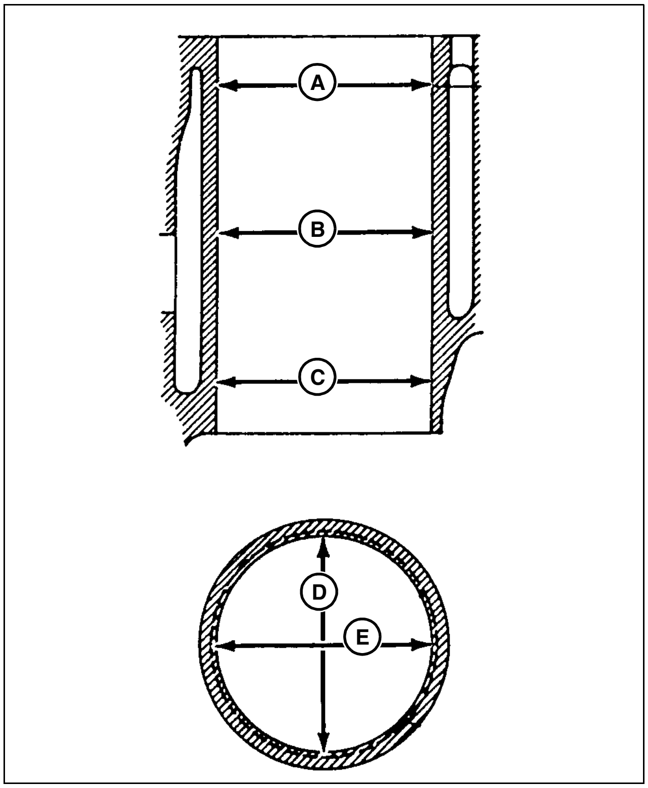
Cylinder Bore

Special or Required Tools

Tool Name	Tool No.	Tool Use
Flex Hone (with 180-Grit Stone)	NA	Used to deglaze cylinder bores.
Rigid Hone (with 300-Grit Stone)	NA	Used with drill press to rebore cylinder to use oversize pistons and rings.
Drill Press	NA	Used with rigid hone to rebore cylinder to use oversize pistons and rings.

Inspection

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



M82053A

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

2. If cylinder bore inner diameter exceeds wear limit, have cylinder rebored. (See “Reboring” on page 202.)

3. If cylinder is rebored, oversize pistons and rings must be installed.

4. If cylinder bore exceeds oversize bore inner diameter, replace the cylinder block.

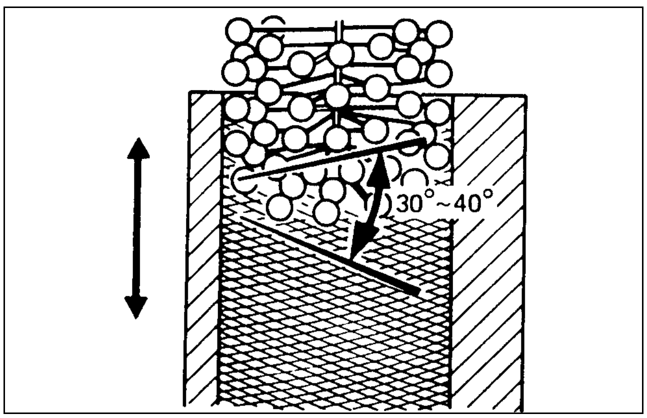
5. If clearance (cylinder bore ID minus piston OD) exceeds specification, replace cylinder block, piston, or both; or rebore cylinder and install oversize pistons and rings.

6. Slightly uneven wear, flaws, or minor damage may be corrected by deglazing. (See “Deglazing” on page 202.)

Deglazing

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

1. Deglaze cylinder bores using a flex hone with 180-grit stone.



M82054A

2. Use flex hone as instructed by manufacturer to obtain a 30-40° crosshatch pattern as shown.

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

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

Reboring

NOTE: The cylinder block can be rebored to use oversize pistons and rings. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.

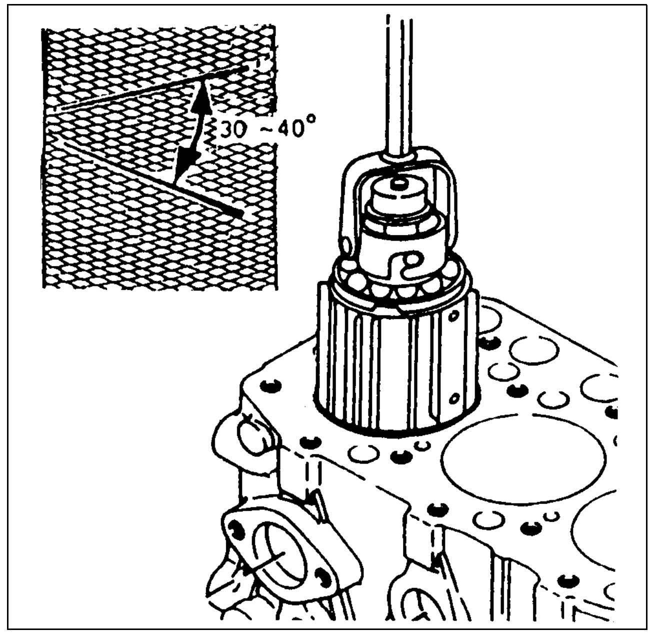
1. Align center of bore to drill press center.

IMPORTANT: Avoid damage! Check stone for wear or damage. Use a rigid hone with 300-grit stone.

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

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

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



M52959

5. Run drill press at about 250 rpm. Move rigid hone up and down in order to obtain a 30-40° crosshatch pattern.

NOTE: Measure bore when cylinder is cool.

6. Stop press and check cylinder diameter.

NOTE: Finish should not be smooth. It should have a 30-40° crosshatch pattern.

7. Remove rigid hone when cylinder is within 0.03 mm (0.001 in.) of desired size.

8. Use a flex hone with 180-grit stone for honing to final size.

9. Check bore for size, taper, and out-of-round. (See “Inspection” on page 201.)

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

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

Specifications

Piston-to-Cylinder Bore Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)

Cylinder Standard Roundness . . . . 0.00-0.01 mm (0.0000-0.0004 in.)

Cylinder Roundness Wear Limit . . . 0.03 mm (0.001 in.)

Cylinder Standard Taper . . . . . . 0.00-0.01 mm (0.0000-0.0004 in.)

Cylinder Taper Wear Limit . . . . 0.03 mm (0.001 in.)

Standard Size Cylinder Bore Standard ID . . . . 68.00-68.03 mm (2.677-2.678 in.)

Standard Size Cylinder Bore ID Wear Limit. . . . . 68.20 mm (2.685 in.)

Oversize Cylinder Bore Standard ID . . . . 68.25-68.28 mm (2.687-2.688 in.)

Oversize Cylinder Bore ID Wear Limit. . . . . 68.45 mm (2.695 in.)

Crankshaft Rear Oil Seal

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hoist	NA	Used with lifting brackets to remove flywheel from crankshaft.
Lifting Bracket (2 used)	JT01748	Used with hoist to remove flywheel from crankshaft.
Bushing, Bearing, and Seal Driver Set	NA	Used to install crankshaft rear oil seal.

Other Material

Part No.	Part Name	Part Use
TY16021 (U.S.) /TY9484 (Canada)	John Deere High-Flex Form-in-Place Gasket	Applied to seal case-to-engine block mating surfaces before installing seal case.

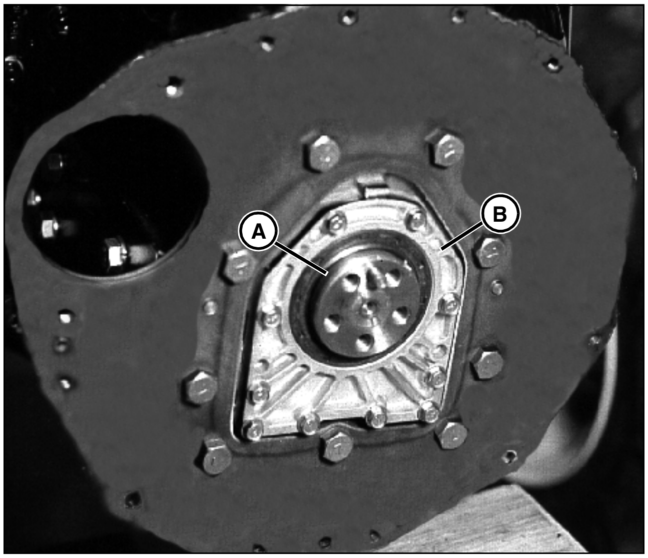
Rear Oil Seal Removal/Installation

IMPORTANT: Avoid damage! Flywheel is heavy! Do not remove flywheel mounting cap screws unless flywheel is secure. Use a hoist and lifting brackets to lift flywheel from crankshaft.

NOTE: Engine removal is not necessary to replace rear oil seal.

1. Remove flywheel. (See “Remove and Install Flywheel” on page 208.)

NOTE: It is not necessary to remove oil seal case (B) to remove oil seal (A).



M76968

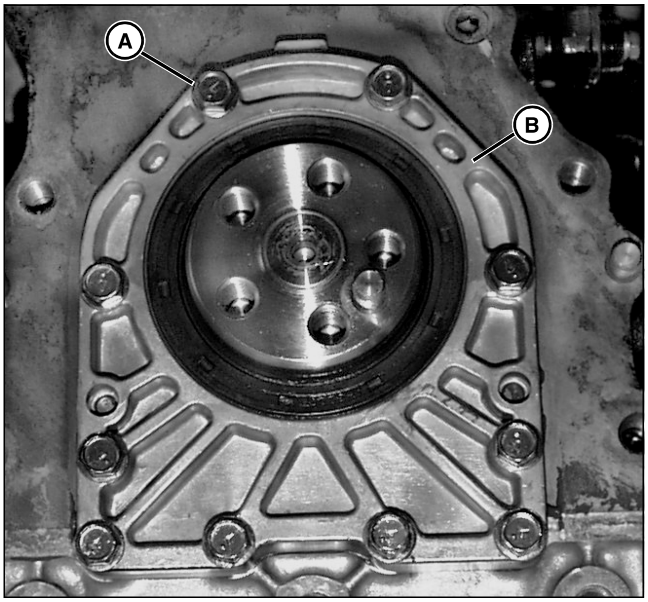
2. Carefully pry oil seal (A) from oil seal case (B).

NOTE: Oil seal is normally installed flush with surface of oil seal case. If oil seal has worn a groove in crankshaft at oil seal contact point, seal can be installed 3 mm (0.120 in.) deeper into oil seal case.

3. Replace oil seal using a driver set. Install seal with lip toward cylinder block. Install seal flush with surface of oil seal case.

Rear Oil Seal Case Removal/Installation

NOTE: It is not necessary to remove oil seal case to remove oil seal. It is not necessary to remove oil seal to remove oil seal case.



MX0749

1. Remove oil seal case-to-cylinder block cap screws (A).
2. Pry oil seal case (B) from engine block.
3. Clean all old gasket material from oil seal case and engine block.
4. Apply TY16021 John Deere High-Flex Form-in-Place Gasket to seal case-to-engine block mating surfaces. Install seal case.
5. Install new oil seal after oil seal case is installed.
6. Install flywheel onto crankshaft, aligning crankshaft pin into flywheel mounting flange. Tighten mounting cap screws to specification.
7. Install flex plate with longer center hub facing out.
8. Install drive shaft.

Specifications

Flywheel Mounting Cap Screw
Torque . . . . 83 N•m (61 lb-ft)

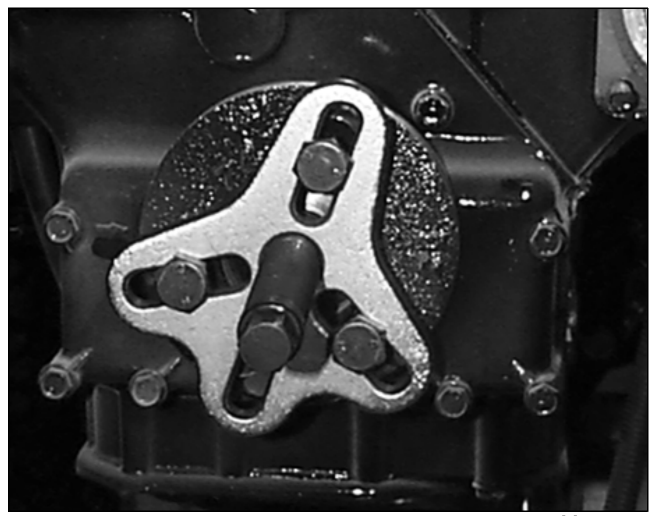
Crankshaft Front Oil Seal

Special or Required Tools

Tool Name	Tool No.	Tool Use
Pulley Puller	NA	Used to remove crankshaft sheave.
Bushing, Bearing, and Seal Driver Set	NA	Used to install crankshaft front oil seal.

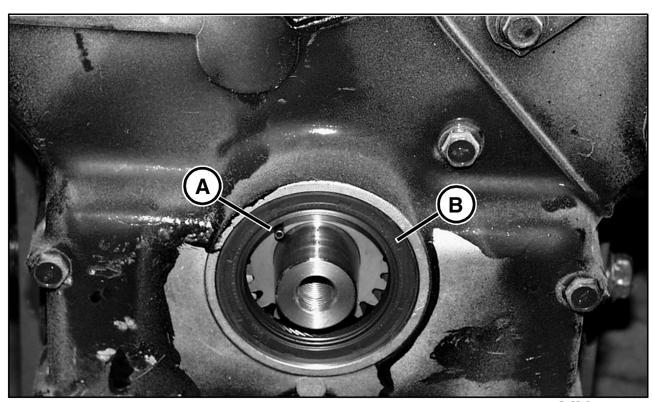
Procedure

1. Park machine with engine off and park brake on.
2. Remove alternator belt. (See “Remove and Install 12V Alternator Drive Belt (Model 2500 and 2500A)” on page 170.)



M89691

3. Remove crankshaft sheave cap screw. Install puller to crankshaft sheave and remove sheave.



MX0750

4. Carefully pry oil seal (B) from timing gear cover.
5. Install new oil seal using a bushing, bearing, and seal driver set. Install seal with lip toward engine. Install seal flush with surface of cover.

6. Coat lip of seal with clean engine oil.

7. Install crankshaft sheave on crankshaft, lining up pin (A) on crankshaft timing gear with hole in crankshaft sheave.

8. Install flat washer and cap screw. Tighten cap screw to specification.

9. Install alternator belt and adjust belt.

2500, 2500A: (See “Remove and Install 12V Alternator Drive Belt (Model 2500 and 2500A)” on page 170 and “Check and Adjust 48V Alternator Drive Belt Tension (Model 2500E)” on page 153.)

2500E: (See “Remove and Install 48V Alternator Belt - 2500E” on page 171, and “Check and Adjust 12V Alternator Drive Belt Tension (2500 & 2500A Models)” on page 145.)

Specifications

Crankshaft Pulley
Cap Screw Torque . . . . 88 N•m (65 lb-ft)

Crankshaft and Main Bearings

Special or Required Tools

Tool Name	Tool No.	Tool Use
Knife-Edge Puller	NA	Used with press to remove gear from crankshaft.
Press	NA	Used with knife-edge puller to remove gear from crankshaft.
Dial Indicator	NA	Used with V-blocks to inspect crankshaft for bend.
V-Block (2 used)	NA	Used with dial indicator to inspect crankshaft for bend.

Removal

1. Check crankshaft end play.

2. Remove oil pan and strainer.(See “Oil Pan and Strainer” on page 218.)

3. Remove flywheel. (See “Remove and Install Flywheel” on page 208.)

4. Remove rear oil seal case. (See “Crankshaft Rear Oil Seal” on page 203.)

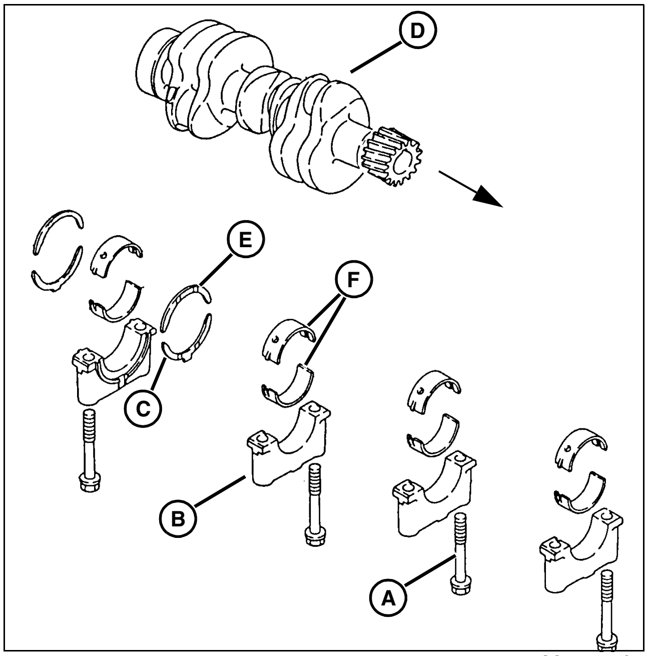
5. Remove timing gear cover, timing gears, timing gear housing, and flywheel of engine.

6. Check crankshaft bearing clearance. (See “Inspection/ Replacement” on page 206.)

IMPORTANT: Avoid damage! Connecting rod end caps must be installed on the same connecting rods from which they were removed. Note stamped numbers on caps and rods.

7. Remove connecting rod cap screws and end caps. Push pistons and connecting rods away from crankshaft.

IMPORTANT: Avoid damage! Main bearing caps must be installed on the same main bearings from which they were removed.



Picture Note: Arrow Points to Front of Engine

8. Remove main bearing cap screws (A), caps (B), and cap thrust bearings (C).

9. Remove crankshaft (D).

10.Remove block thrust bearings (E) and main bearing inserts (F).

11.Inspect all parts for wear or damage. (See “Inspection/ Replacement” on page 206.)

Installation

1. Apply clean engine oil on all parts during installation.

IMPORTANT: Avoid damage! Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surfaces.

2. Install bearing inserts drilled with oil passage in cylinder block bearing bores, aligning tangs with slots in bores.

3. Install block thrust bearings with oil grooves facing away from engine block.

NOTE: Main bearing caps have raised arrows that are stamped with numbers. Both correspond to their location on the engine block. The number "1" main bearing bore is at flywheel end. Install bearing caps beginning with number 1, then 2, etc. The main bearing cap at gear train end does not have a number. Also install bearing caps with the arrow toward the flywheel end.

4. Install crankshaft.

5. Install smooth bearing inserts in main bearing caps, aligning tangs with slots in caps.

6. Install cap thrust bearings with oil grooves facing away from cap, in the number "1" main bearing cap.

7. Install main bearing caps in their original locations with arrows pointing toward flywheel side of engine.

IMPORTANT: Avoid damage! Do not use high speed power tools or air wrenches to tighten main bearing cap screws.

8. Dip entire main bearing cap screws in clean engine oil. Install cap screws and tighten. Do not tighten to specification at this time.

9. Using a soft-faced hammer, tap the front end of the crankshaft and then the rear end of the crankshaft to align the thrust bearings.

10. Tighten main bearing cap screws to specification. When tightening, start at center main bearing cap and work your way out, alternating to the ends. Turn crankshaft by hand. If it does not turn easily, disassemble the parts and find the cause.

IMPORTANT: Avoid damage! The connecting rod caps must be installed on the same connecting rods from which they were removed. Never reuse connecting rod cap screws. Replace with new.

11. Match the connecting rod caps to the rods using stamped numbers. Install the caps to the rods.

12. Dip entire connecting rod cap screws in clean engine oil. Install new cap screws to the rods, and tighten to specification.

13. Install the rear oil seal. (See "Crankshaft Rear Oil Seal" on page 203.)

14. Install the flywheel. (See "Remove and Install Flywheel" on page 208.)

15. Install the timing gear cover. (See "Remove and Install Timing Gear Cover" on page 214.)

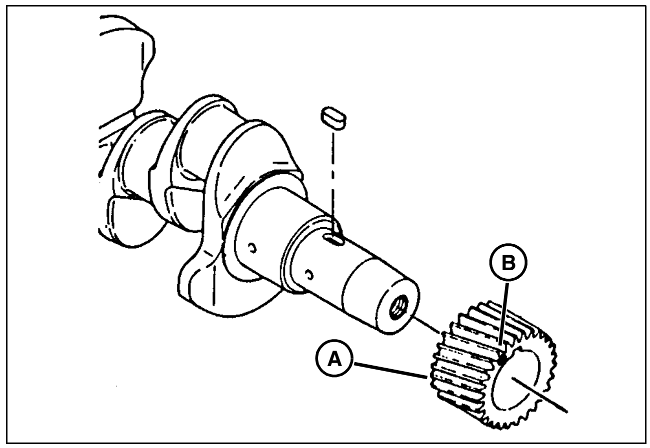
16. Install the front oil seal. (See "Crankshaft Front Oil Seal" on page 204.)

17. Install the oil pan. (See "Oil Pan and Strainer" on page 218.)

Inspection/Replacement

1. Inspect crankshaft gear for chipped or broken teeth. If replacement is necessary, remove gear from crankshaft using a knife-edge puller and a press.

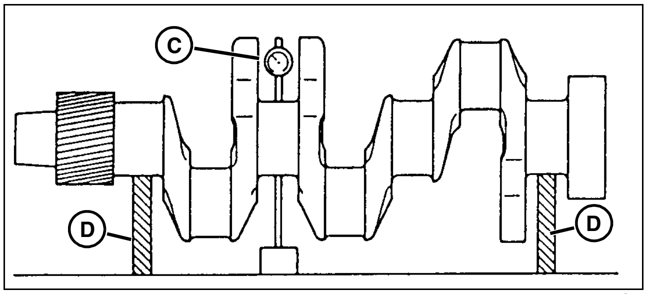
CAUTION: Avoid injury! Do not heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.



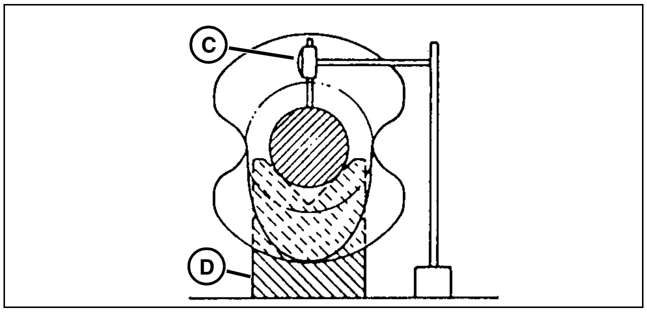
M82060A

2. Heat gear to approximately 150°C (300°F). Install gear (A) with timing mark (B) toward press table.

3. Align slot in gear with key in shaft. Press crankshaft into gear until gear is tight against crankshaft shoulder.



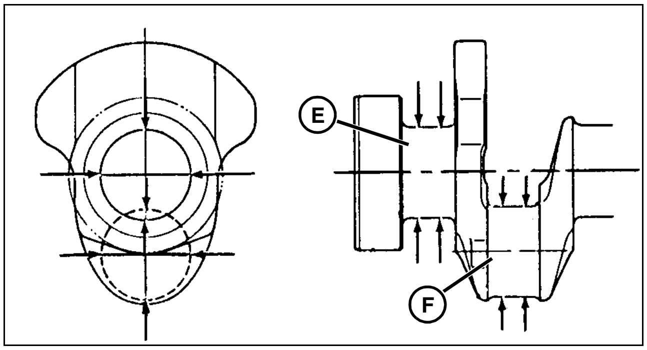
M82284C



M82284B

4. Inspect crankshaft for bend using V-blocks (D) and a dial indicator (C). Turn crankshaft slowly and read variation on indicator. If variation is greater than specification, replace crankshaft.

NOTE: If engine has had a previous major overhaul, journals may have been ground and undersize bearing inserts installed.



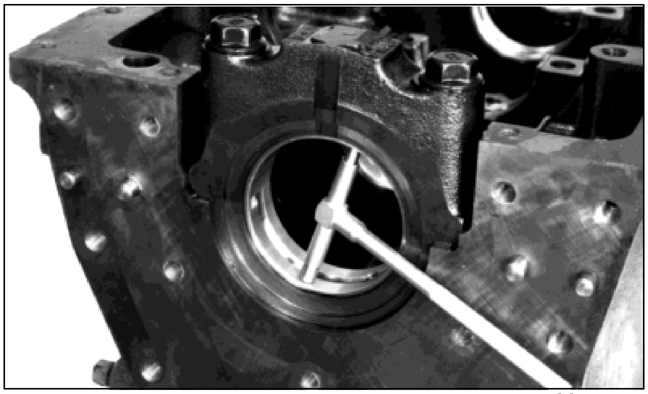
M82062A

5. Measure crankshaft connecting rod journals (F) and main bearing journal (E) diameters. Measure several places around each journal.

6. If journal diameter is less than wear limit, replace crankshaft or have journals ground undersize by a qualified machine shop.

7. If journals are ground, undersize bearing inserts must be installed. Bearing inserts are available in 0.25 mm (0.010 in.) undersize.

8. Install bearing inserts and main bearing cap on main bearing. Tighten main bearing cap screws to specification.



M82063

9. Measure main bearing diameter.

10.Subtract the crankshaft main bearing journal outer diameter from the main bearing inner diameter to obtain the main bearing oil clearance.

- If crankshaft is within specification but main bearing oil clearance exceeds the wear limit, replace the bearing inserts.
- If crankshaft is not within specification, have crankshaft journals ground undersize by a qualified machine shop and install undersize bearing inserts.
- If crankshaft is worn past the wear limit, replace the crankshaft.

11.Clean and inspect oil passages in main bearing journals, connecting rod journals, and main bearing bores in cylinder block.

12.Inspect crankshaft for cracks or damage. Replace if necessary.

Specifications

Connecting Rod
Cap Screw Torque . . . . 24 N•m (18 lb-ft)
Main Bearing
Cap Screw Torque . . . . 54 N•m (40 lb-ft)
Crankshaft Bend (Maximum) . . . . . 0.02 mm (0.001 in.)
Crankshaft Connecting Rod Journal
Standard OD . . . . 35.97-35.98 mm (1.416-1.417 in.)
Crankshaft Connecting Rod Journal
OD Wear Limit . . . . 35.91 mm (1.414 in.)
Crankshaft Main Bearing Journal
Standard OD . . . . 39.97-39.98 mm (1.573-1.574 in.)
Crankshaft Main Bearing Journal
OD Wear Limit . . . . 39.90 mm (1.571 in.)
Main Bearing Standard Oil
Clearance . . . . 0.03-0.06 mm (0.001-0.002 in.)
Main Bearing Oil Clearance
Wear Limit. 0.15 mm (0.006 in.)

Crankshaft Main Bearing Clearance Check

Special or Required Tools:

Tool Name	Tool No.	Tool Use
PLASTIGAGE®	NA	Used to measure main bearing clearance.

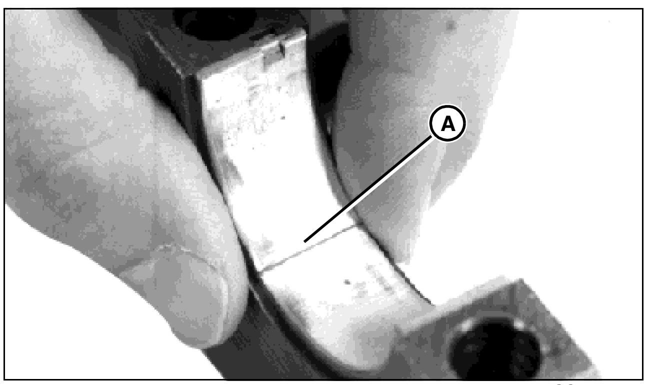
NOTE: The engine must be removed from the tractor to perform this test.

1. Remove the oil pan, oil pick-up, crankcase extension, and balancer assembly.

IMPORTANT: Avoid damage! Main bearing caps must be installed to the same location and in the same direction to prevent crankshaft and main bearing damage.

2. Remove the main bearing cap.

3. Wipe oil from the bearing insert and the crankshaft journal.



M35382

4. Put a piece of PLASTIGAGE (A), or equivalent, along the full width of the bearing insert approximately 6 mm (0.25 in.) off center.

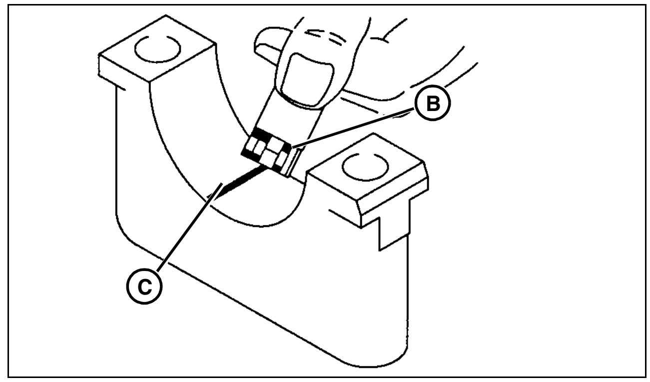
IMPORTANT: Avoid damage! Rotating the crankshaft will cause PLASTIGAGE to smear, resulting in a false reading. Do not allow crankshaft to rotate after installing bearing cap.

NOTE: Lightly lubricate bolts with engine oil before installing.

5. Install main bearing cap and bolts. Tighten bolts to specification.

6. Remove bolts and main bearing cap.

NOTE: The flattened PLASTIGAGE will be found on either the bearing insert or crankshaft journal.



M82119A

7. Use the graduation marks on the envelope (B) to compare the width of the flattened PLASTIGAGE (C) at its widest point. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used.

8. If clearance exceeds specification, replace main bearing.

9. Remove PLASTIGAGE.

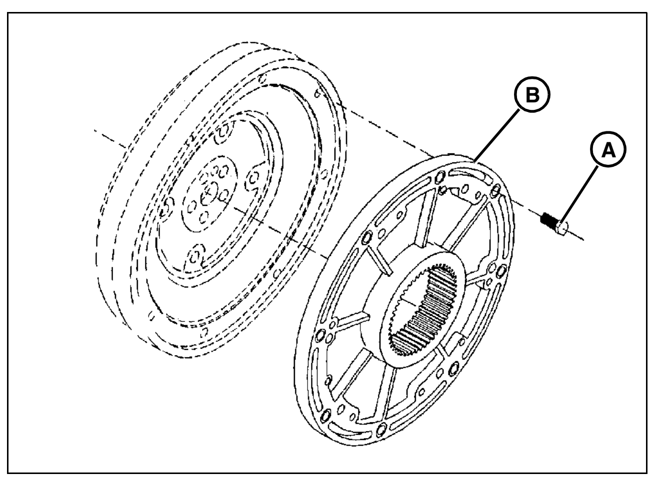
Specifications:

Main Bearing
Cap Screw Torque . . . . 54 N•m (40 lb-ft)
Main Bearing Oil Clearance
Wear Limit. . . . . 0.15 mm (0.006 in.)

Remove and Install Flywheel

Removal

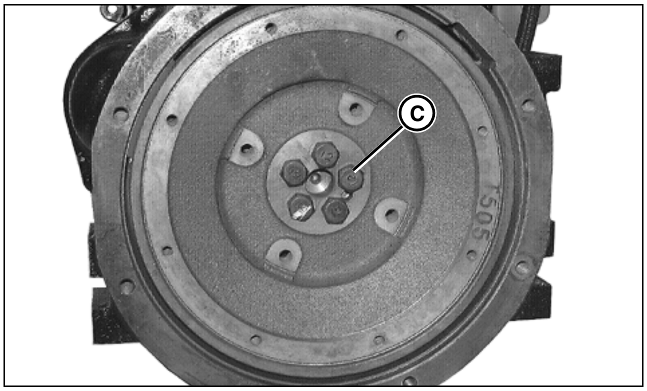
1. Remove starting motor. (See “Remove and Install Starting Motor” on page 229.)



M98883

2. Remove eight cap screws (A) and flex plate (B).

IMPORTANT: Avoid damage! Always install new flywheel mounting cap screws.



M98836

3. Remove the flywheel mounting cap screws (C).
4. Remove flywheel.
5. Inspect flywheel for damage. Replace as needed.

Installation

Installation done in reverse order of removal.

IMPORTANT: Avoid damage! Always install new flywheel mounting cap screws.

- Install the flywheel. Apply lubrication oil to the mounting cap screws and tighten to specification.
- Install flex plate with raised hub facing away from flywheel.

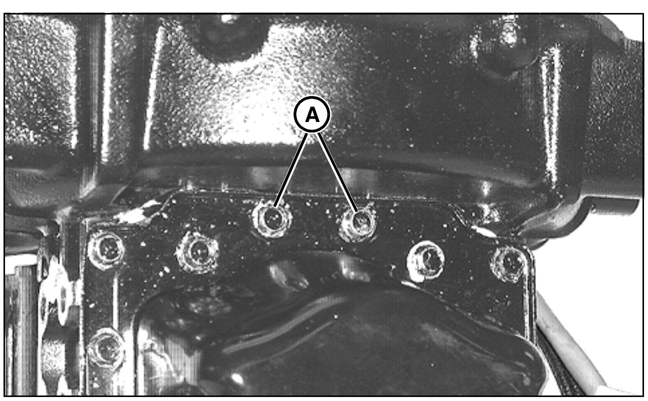
Specifications

Flywheel Mounting
Cap Screw Torque . . . . 83 N•m (61 lb-ft)
Flywheel Out-of-Flat (Maximum) . . . 0.02 mm (0.001 in.)

Remove and Install Flywheel Housing

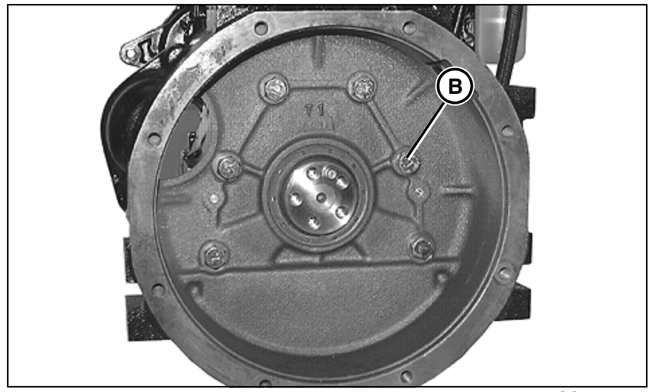
Removal

1. Remove flywheel. (See “Remove and Install Flywheel” on page 208.)



M98838

2. Remove two rear cap screws from oil pan.



M98837

3. Remove six cap screws (B).
4. Remove flywheel housing.

Installation

Installation is done in reverse order of removal.

Camshaft

IMPORTANT: Avoid damage! Always replace camshaft followers when installing a new camshaft. Always replace camshaft when replacing camshaft followers. The components wear as a set and replacing only one will accelerate the wear of the other.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Magnetic Follower Holder Kit	D15001NU	Used to hold cam followers away from camshaft.
Knife-Edge Puller	NA	Used with arbor press for removing gear from camshaft.
Arbor Press	NA	Used with knife-edge puller for removing gear from camshaft.
V-Block (2 used)	NA	Used to hold camshaft during inspection.
Dial Indicator	NA	Used to measure camshaft bend.
Micrometer	NA	Used to measure camshaft lobe height.
Bushing Driver Set	NA	Used to replace worn camshaft bushing.

Other Material

Part No.	Part Name	Part Use
TY16021 (U.S.)/ LOCTITE® 17430/TY9484 (Canada)	John Deere High-Flex Form-in-Place Gasket	Applied to camshaft bore plug before reinstallation.

Camshaft Removal

1. Remove engine. (See “Remove and Install Engine” on page 180.)

2. Remove rocker arm assembly and push rods. (See “Remove and Install Rocker Arm Assembly” on page 184.)

3. Remove timing gear cover. (See “Remove and Install Timing Gear Cover” on page 214.)

4. Check camshaft end play. (See “Camshaft End Play Check” on page 212.)

5. Check backlash of timing gears. (See “Timing Gear Backlash Check” on page 213.)

NOTE: If camshaft is being removed with cylinder head installed, use a magnetic follower holder tool, or turn engine until oil pan is upward, to hold cam followers away from camshaft.

6. Hold cam followers away from camshaft using a magnetic follower holder kit such as D15001NU.

NOTE: Due to the odd number of teeth on the idler gear, timing marks will align only periodically.

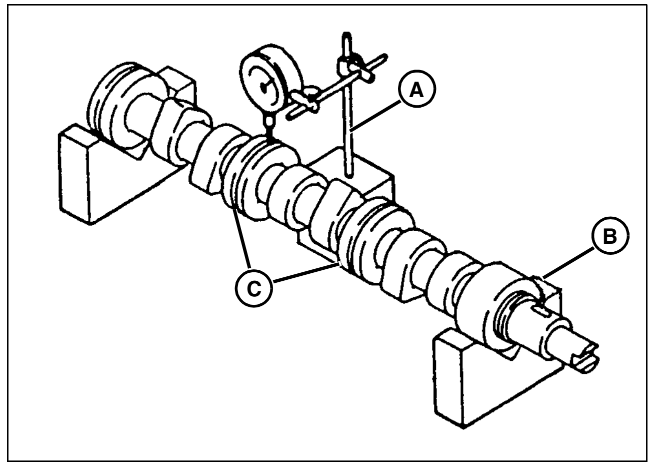
7. Rotate the crankshaft and align the timing marks.

IMPORTANT: Avoid damage! Do not allow camshaft lobes to hit bearing surfaces while removing camshaft. Machined surfaces can be damaged.

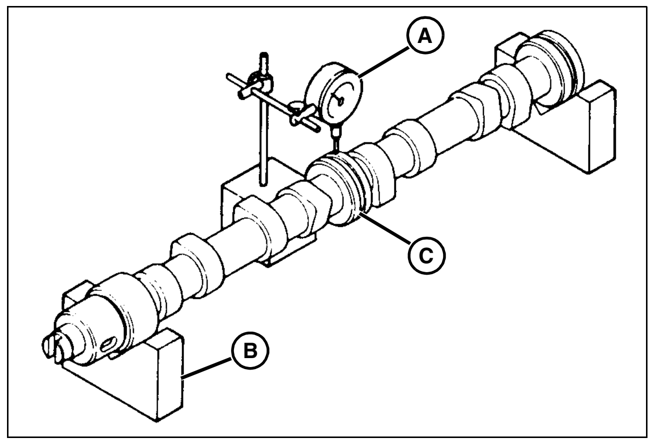
8. Remove two thrust plate mounting cap screws, the thrust plate, and the camshaft.

9. Inspect all parts for wear or damage. (See “Camshaft Inspection” on page 210.)

Camshaft Inspection

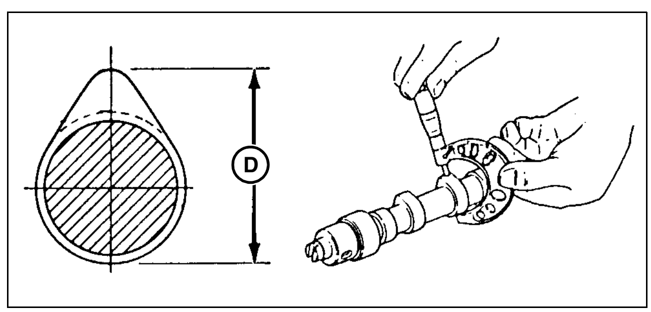


M82291A



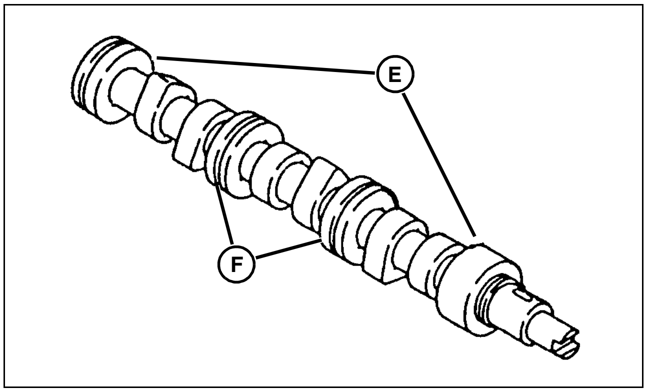
M82069A

1. Inspect camshaft for bend by using a pair of V-blocks (B) and a dial indicator (A). Turn camshaft slowly and read variation of camshaft bearing journals (C) on indicator. If variation is greater than wear limit, replace camshaft.



M82070A

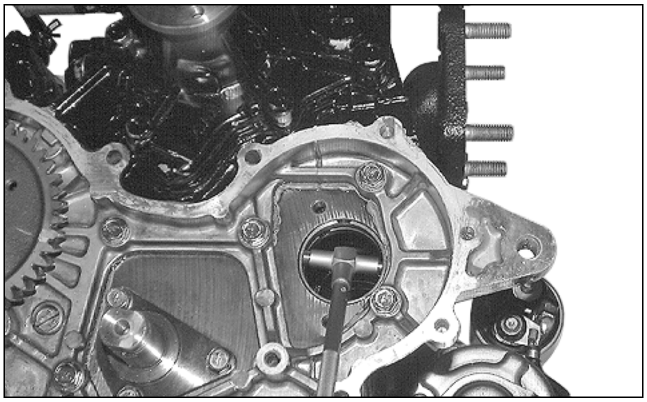
2. Measure camshaft lobe height (D) using a micrometer. If lobe height is less than wear limit, or if there are chips or scratches in lobes or bearing journals, replace camshaft.



M82292A

3. Measure camshaft end journal (E) and intermediate journal (F) outside diameters. If journal diameters are less than wear limit, replace camshaft.

IMPORTANT: Avoid damage! Camshaft bearing journals must be measured and found to be within specifications before camshaft bushings can be determined serviceable or unserviceable.



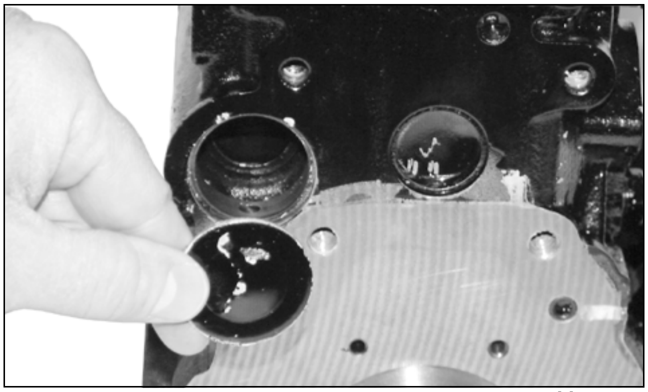
M98827

4. Measure camshaft bushing diameter at gear housing end. If bushing diameter exceeds wear limit, replace bushing using a driver set.

5. Subtract camshaft journal outside diameter from gear housing end bushing inside diameter to determine clearance. If clearance exceeds specifications replace bushings.

6. Measure intermediate and flywheel end camshaft bushing diameter using the following procedures:

7. Remove flywheel. (See “Remove and Install Flywheel” on page 208.)



M98853

8. Remove plug using a long wooden dowel. Insert wooden dowel through gear housing side.

9. Measure flywheel end and intermediate bearing inside diameters with telescoping gauge and micrometer.

10.Subtract camshaft journal outside diameter from intermediate clearance. If clearance exceeds specification, replace bushings.

11.Subtract camshaft journal outside diameter from flywheel end bushing inside diameter to determine clearance. If clearance exceeds specification, replace bushings.

12.Apply TY16021 John Deere High-Flex Form-in-Place Gasket, or equivalent, on outer edge of plug. Install plug until it bottoms in bore.

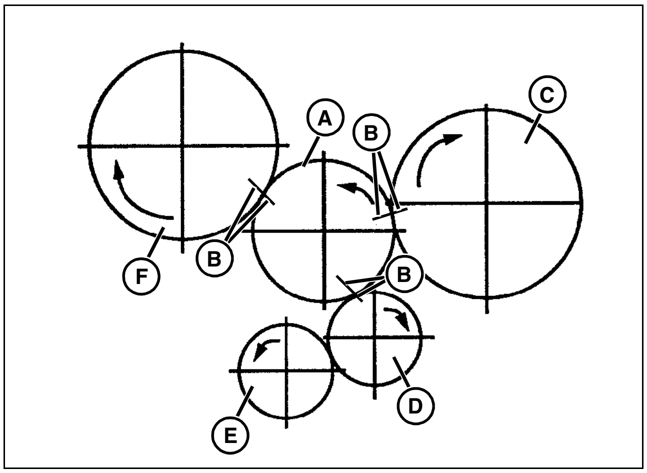
13.Install engine back plate.

Camshaft Installation

IMPORTANT: Avoid damage! Do not allow camshaft lobes to hit bearing surfaces while installing camshaft. Machined surfaces can be damaged.

NOTE: Apply clean engine oil on all parts during installation.

The fuel injection drive gear, camshaft gear, and crankshaft gear all must be correctly timed to the idler gear. It is not necessary to time the oil pump gear. Due to the odd number of teeth on the idler gear, timing marks will only align periodically. (See "Timing Gear Backlash Check" on page 213.)



MX5627

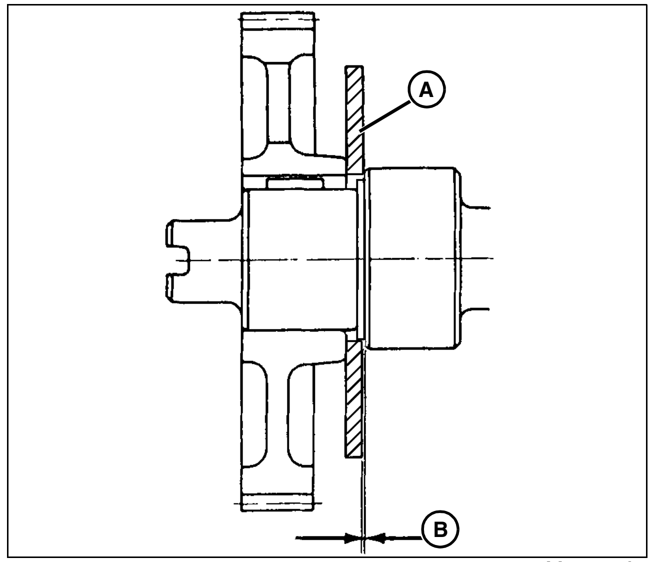
Picture Note: Arrows Indicate Direction of Rotation (Viewed from Gear Case)

A - Idler Gear
B - Timing Marks
C - Camshaft Gear
D - Crankshaft Gear
E - Oil Pump Gear
F - Fuel Injection Drive Gear

1. Rotate the crankshaft to align the timing marks.
2. Install the camshaft.
3. Install the thrust plate and cap screws. Tighten to specification.
4. Install timing gear cover. (See "Remove and Install Timing Gear Cover" on page 214.)
5. If cam followers were removed, replace into same holes as removed.
6. Install push rods and rocker arm assembly. (See "Remove and Install Rocker Arm Assembly" on page 184.)

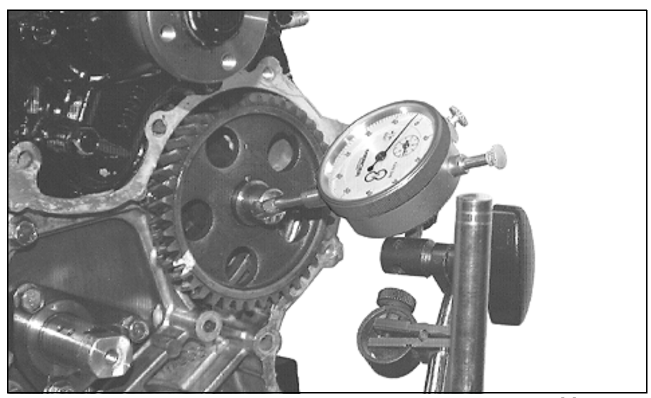
Camshaft End Play Check

NOTE: Follow this procedure if camshaft is installed in cylinder block. If camshaft is removed from cylinder block, check end play (B) using a feeler gauge between camshaft thrust plate (A) and front side of first camshaft bearing journal.



M82067A

1. Remove timing gear cover. (See "Remove and Install Timing Gear Cover" on page 214.)
2. Remove idler gear. (See "Remove and Install Idler Gear" on page 216.)

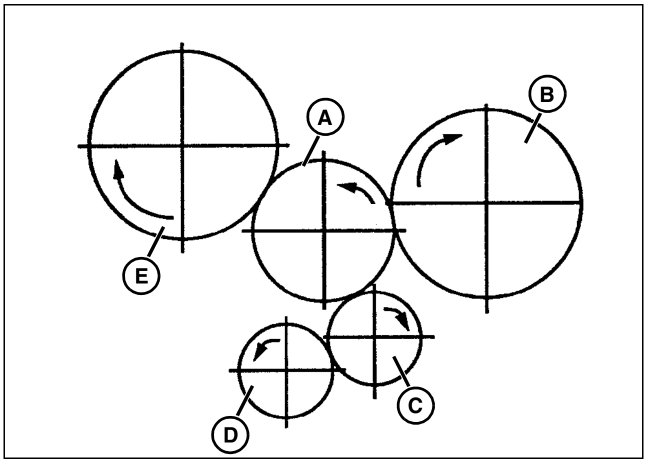


M98825

3. Fasten dial indicator base to cylinder block and position indicator tip on end of camshaft.
4. Push camshaft toward the rear as far as possible.
5. Set the dial indicator to zero.
6. Pull camshaft forward as far as possible.
7. If camshaft end play exceeds specification, remove camshaft and inspect thrust plate, camshaft, and camshaft gear for wear. Replace parts as needed.

Timing Gear Backlash Check

1. Remove timing gear cover. (See "Remove and Install Timing Gear Cover" on page 214.)



Picture Note: Arrows Indicate Direction of Rotation (Viewed from Gear Case)

A - Idler Gear
B - Camshaft Gear
C - Crankshaft Gear
D - Oil Pump Gear
E - Fuel Injection Drive Gear

2. Place dial indicator magnetic base on cylinder block with tip of indicator on tooth of gear being measured.

3. Holding opposite gear stationary, move measured gear back and forth while measuring backlash between meshing gears.

4. If backlash exceeds specifications, replace worn gears as a complete set: Idler Gear, Camshaft Gear, Crankshaft Gear, Oil Pump Gear, and Fuel Injection Drive Gear.

Camshaft Gear Removal

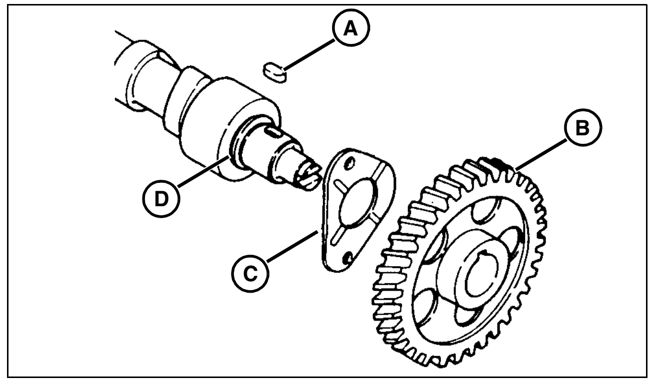
1. Remove gear from camshaft using a knife-edge puller and an arbor press. Place fat side of puller against camshaft gear.

2. Inspect gear for chipped or broken teeth. Replace if necessary.

Camshaft Gear Installation

CAUTION: Avoid injury! Do not heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

1. Heat gear to approximately 150°C (300°F).



2. Install key (A) into slot of camshaft.

3. Install thrust plate (C) onto camshaft, centering onto stepped shoulder (D). (Thrust plate has no "front" or "rear" side.)

IMPORTANT: Avoid damage! Be sure thrust plate is not trapped between camshaft gear and stepped shoulder while gear is being pressed on.

4. Install heated camshaft gear (B) with longer hub of camshaft gear facing camshaft. Align slot in gear with key in shaft. Press camshaft into gear until hub of gear is tight against camshaft shoulder. Thrust plate must spin freely on camshaft.

Specifications

Camshaft Thrust Plate Cap Screw Torque . . . . 11 N•m (96 lb-in.)
Camshaft Bend Wear Limit . . . . 0.02 mm (0.001 in.)
Camshaft Lobe Height Wear Limit. 29.75 mm (1.171 in.)
Gear Housing and Flywheel End Journal OD Wear Limit . . . . 35.85 mm (1.411 in.)
Intermediate Journal OD Wear Limit . . . . 35.85 mm (1.411 in.)
Bearing-to-Camshaft Gear Housing End Journal Clearance (Wear Limit) . . . . 0.85 mm (0.003 in.)
Bearing-to-Camshaft Intermediate Journals Clearance (Wear Limit) . . . . 0.115 mm (0.005 in.)
Bearing-to-Camshaft Flywheel End Journal Clearance (Wear Limit) . . . . 0.125 mm (0.005 in.)

Remove, Inspect, and Install Camshaft Follower

Special or Required Tools

Tool Name	Tool No.	Tool Use
Magnetic Pick-Up Tool	NA	Used to remove cam followers from cylinder block.

Removal

1. Remove cylinder head. (See “Remove and Install Cylinder Head” on page 187.)

IMPORTANT: Avoid damage! Cam followers must be installed in the same bores from which they were removed. Put a mark on each cam follower and cylinder block bore to aid in installation.

Always replace camshaft when replacing cam followers. Always replace cam followers when installing new camshaft. The components wear as a set and replacing only one will accelerate the wear of the other.

2. Remove cam followers from cylinder block with magnetic pick-up tool.

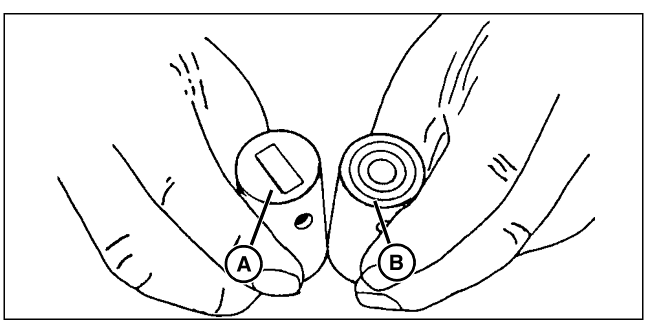
3. Inspect all parts for wear or damage. (See Inspection procedure below.)

Installation

Installation is done in the reverse order of removal.

- Apply clean engine oil on all parts during installation.
- Install cam followers after camshaft is installed. Install followers with the flat contact surface toward the camshaft.

Inspection



M82293A

1. Inspect cam follower contact surface for abnormal wear (A). Normal wear (B) has light circular lines and flat surface.

M35268

2. Measure cam follower diameter. If outside diameter is less than wear limit, replace cam follower.

3. Use a straightedge and place it on the contact surface perpendicular to the wear mark across cam follower. Replace if surface appears to “valley” on wear mark.

4. Measure cam follower bore diameter in cylinder block. If cam follower bore diameter exceeds wear limit, replace cylinder block.

5. If tappet-to-bore oil clearance (bore ID minus follower OD) exceeds specification, replace cam follower, cylinder block, or both.

Specifications

Cam Follower OD Wear Limit . . . . 17.93 mm (0.706 in.)
Cam Follower Bore ID Wear Limit. 18.05 mm (0.711 in.)
Tappet-to-Bore Oil Clearance
Wear Limit. . . . . 0.12 mm (0.005 in.)

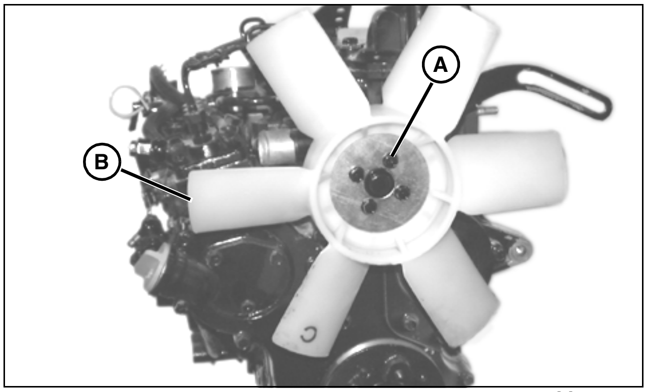
Remove and Install Timing Gear Cover

Other Material

Part No.	Part Name	Part Use
TY16021 (U.S.)/ LOCTITE ® 17430/ TY9484 (Canada)	John Deere High-Flex Form-in-Place Gasket	Applied to timing cover before installation.

Removal

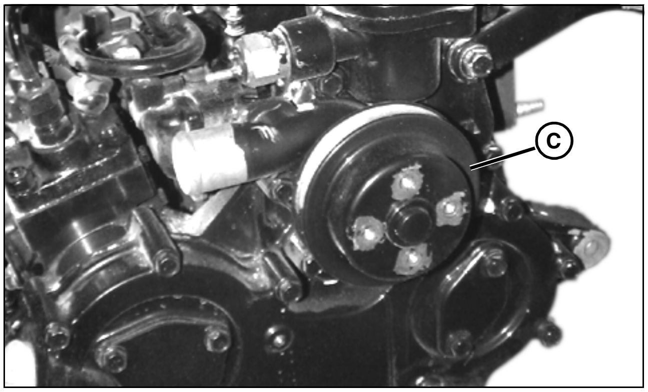
1. Remove alternator. (See “Remove and Install 12V Alternator” on page 235 or See “Remove and Install 48V Alternator - 2500E” on page 234.)



M84889

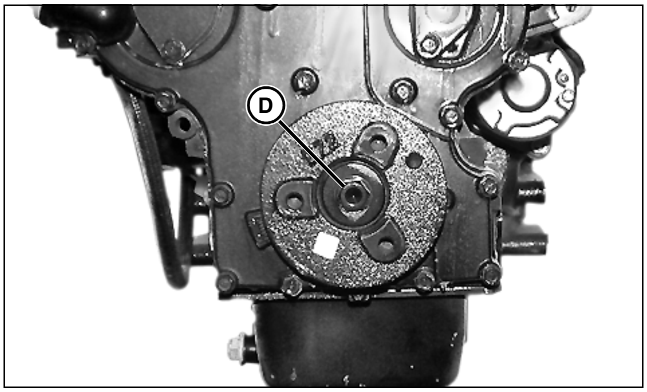
2. Remove four cap screws (A).

3. Remove fan (B).



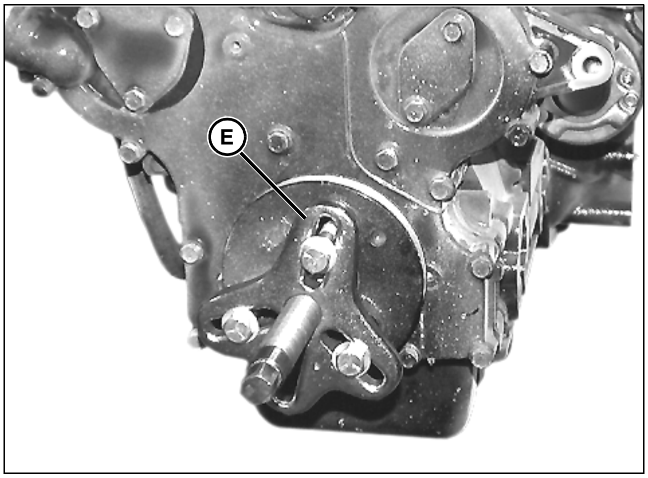
M84890

4. Remove pulley (C).



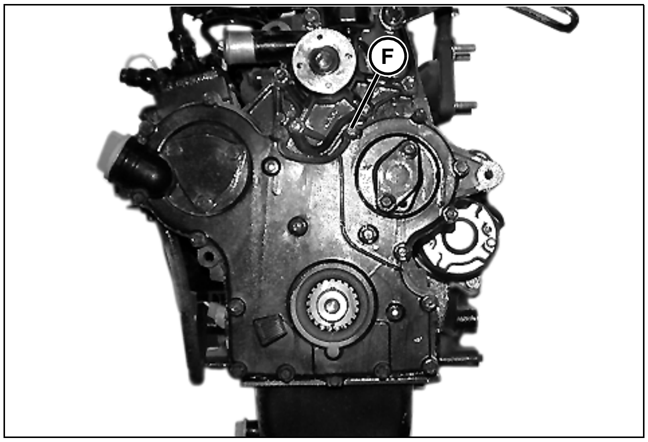
M98197

5. Remove crankshaft sheave mounting cap screw and washer (D).



M89691

6. Install puller (E) to crankshaft pulley and remove pulley.



M98199

7. Remove timing gear cover mounting cap screws (F).

IMPORTANT: Avoid damage! Use extreme care in removal of cover. Cover is aluminum and easily damaged, broken or bent by prying. DO NOT hammer on cover at any time.

8. Remove timing gear cover.

9. Clean all old gasket material from timing gear cover and timing gear cover housing on block.

Installation

Installation done in reverse order as removal.

• Apply a thin bead of TY16021 John Deere High-Flex Form-in-Place Gasket to timing gear cover prior to installation.

• Tighten all timing gear cover mounting cap screws to specification.

• Adjust belt tension. (See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153 or “Check and Adjust 48V Alternator Drive Belt

Tension (Model 2500E)” on page 153.)

Specifications

Timing Gear Cover Mounting
Cap Screw Torque . . . . 9 N•m (78 lb-in.)
Crankshaft Pulley
Cap Screw Torque . . . . 88 N•m (65 lb-ft)

Remove and Install Idler Gear

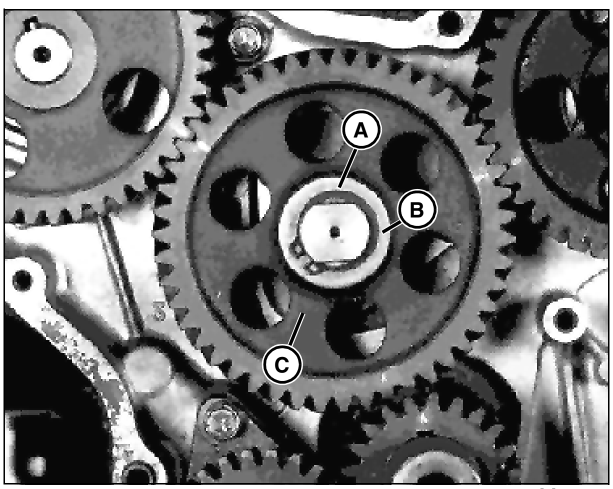
Special or Required Tools

Tool Name	Tool No.	Tool Use
Bushing Driver Set	NA	Used to replace worn idler gear bushing.

Removal

1. Remove timing gear cover. (See “Remove and Install Timing Gear Cover” on page 214.)

2. Check backlash of timing gears. (See “Timing Gear Backlash Check” on page 213.)



M37516

3. Rotate crankshaft and align timing marks.

NOTE: Timing mark on crankshaft gear is on front of tooth used for timing, but since gear is spiral cut it will appear to not be aligned with mark on idler gear.

4. Remove snap ring (A), washer (B), and gear (C).

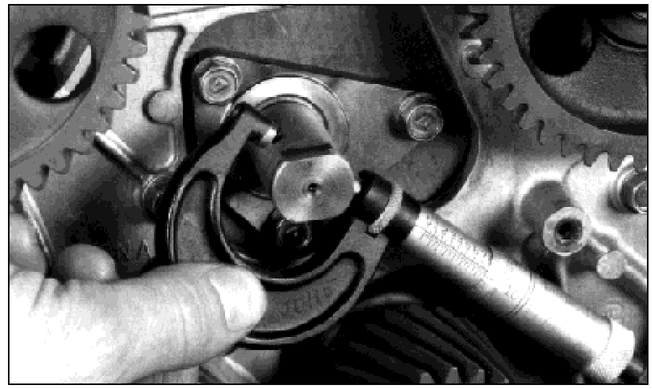
5. Inspect all parts for wear or damage. (See “Inspection/ Replacement” on page 216.)

Installation

Installation is done in the reverse order of removal. It is not necessary to time oil pump gear.

Inspection/Replacement

1. Inspect gear for chipped or broken teeth. Replace if necessary.


M37834

2. Measure idler gear shaft diameter. If shaft diameter is less than wear limit, replace idler gear shaft.


M35492

3. Measure idler gear bushing diameter. If bushing diameter exceeds wear limit, replace bushing using a driver set.

  a. Align oil holes in bushing and idler gear.

  b. Install bushing flush with surface of idler gear.

4. If bushing oil clearance (bushing ID minus shaft OD) exceeds specification, replace bushing, shaft, or both.

Specifications

Idler Gear Shaft
Standard OD . . . . 19.96-19.98 mm (0.786-0.787 in.)
Idler Gear Shaft OD Wear Limit. . . 19.93 mm (0.785 in.)
Idler Gear Bushing
Standard ID . . . . 20.00-20.02 mm (0.787-0.788 in.)
Oil Clearance . . . . . . 0.020-0.062 mm (0.0008-0.002 in.)
Oil Clearance Wear Limit . . . . 0.15 mm (0.006 in.)

Remove and Install Timing Gear Housing

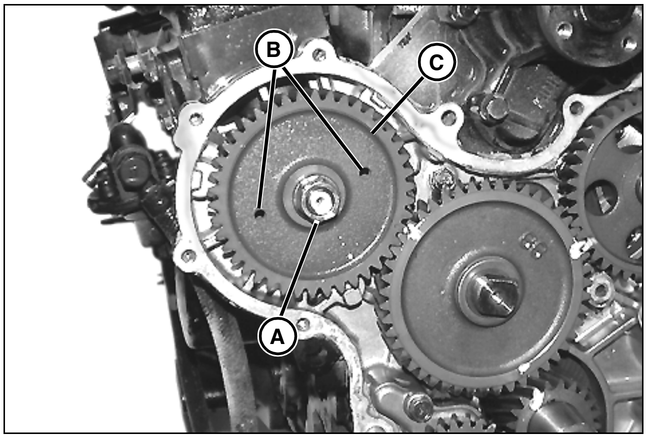
Other Material

Part No.	Part Name	Part Use
TY16021 (U.S.)/ TY9484 (Canada)	John Deere High-Flex Form-in-Place Gasket	Applied to timing gear housing before installation.

Removal

1. Remove engine. (See “Remove and Install Engine” on page 180.)

2. Remove timing gear cover. (See “Remove and Install Timing Gear Cover” on page 214.)



M98252

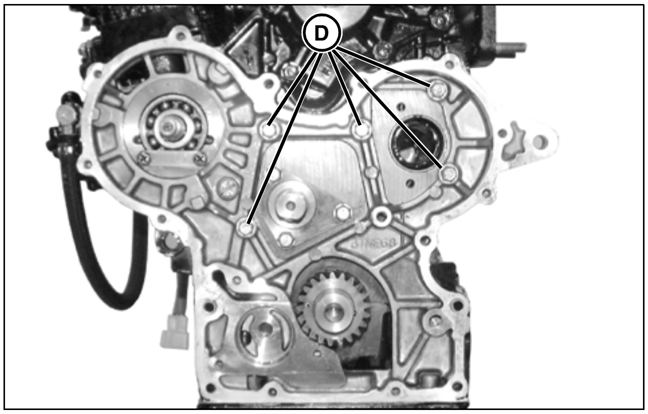
3. Remove nut and washer (A).

4. If gear has threaded holes (B) remove the gear using a H-bar puller. If gear (C) is spoked, remove using a suitable puller.

5. Remove engine camshaft. (See “Camshaft” on page 209.)

6. Remove coolant pump. (See “Remove and Install Coolant Pump (Thermostat Included)” on page 220.)

7. Remove oil pan. (See “Oil Pan and Strainer” on page 218.)



M98854

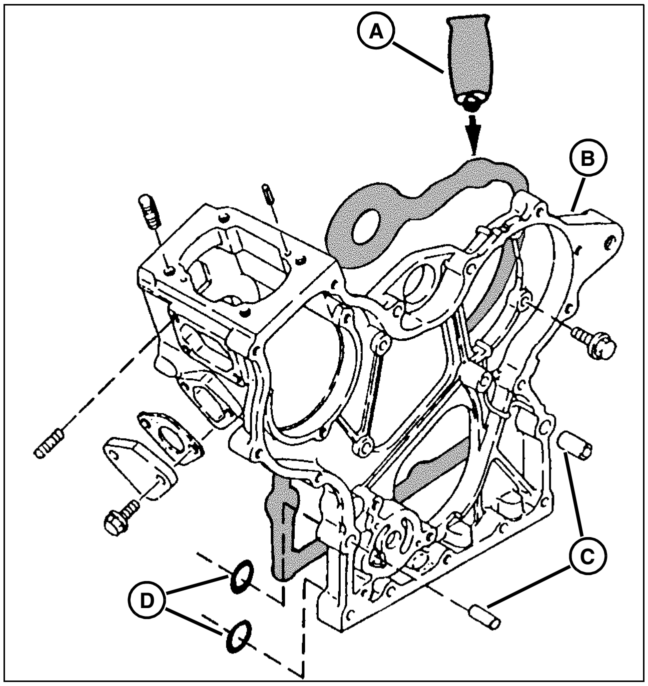
8. Remove timing gear housing mounting cap screws (D) and remove housing from cylinder block.

9. If replacing timing housing, remove fuel injection pump and governor.

Installation

Installation is done in the reverse order of removal.

- Clean all parts of old gasket sealer, gasket material, oil, and dirt before attempting installation.



M82299A

- Install alignment dowels (C) in timing gear housing (B).
- Replace O-rings (D) behind oil pump.
- Apply TY16021 John Deere High-Flex Form-in-Place Gasket (A) to timing gear housing when installing to cylinder block.
- Tighten mounting cap screws to specification.

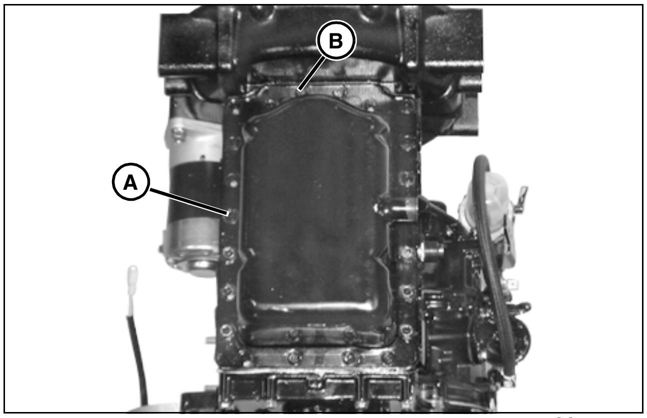
Specifications

Timing Gear Housing Mounting Cap Screw Torque . . . . 11 N•m (96 lb-in.)

Oil Pan and Strainer

Removal

1. Drain engine oil into a suitable container.

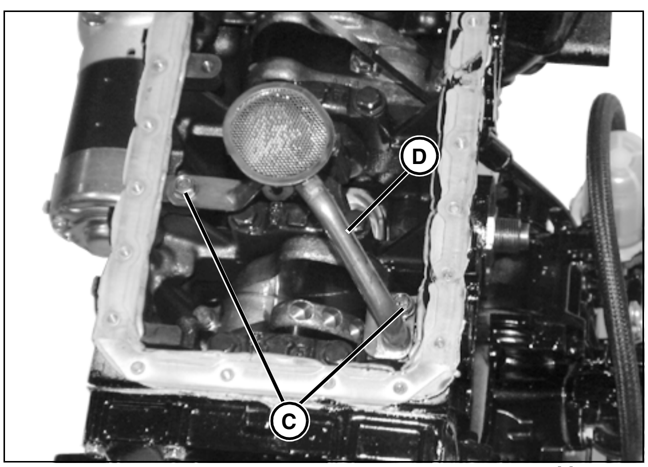


M98813

2. Remove 16 cap screws (A) and six cap screws (B).

IMPORTANT: Avoid damage! DO NOT a screwdriver to pry oil pan from engine block. Oil pan or engine block may be damaged.

3. Carefully tap on oil pan with a soft-faced mallet to loosen oil pan from engine block.



M98821

4. Remove cap screws (C) from strainer.
5. Remove oil strainer (D) and discard O-ring. Replace O-ring before installation.
6. Remove sealant residue from oil pan engine block mating surfaces.

Installation

Installation is done in reverse order of removal.

- Apply RTV silicone sealant to oil pan sealing surface.
- Tighten oil pan cap screws to specification.
- Fill engine to proper level with oil of correct specifications. (See “Engine Oil” on page 20.)

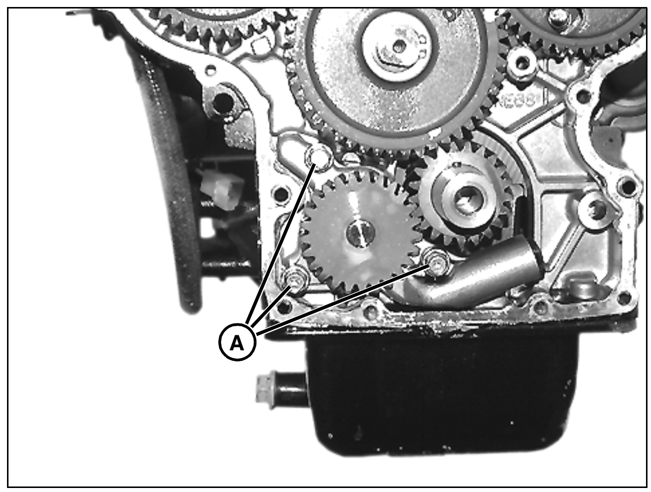
Specifications

Oil Pan Cap Screw Torque. . . . . 4.8 N•m (42 lb-in.)

Oil Pump

Removal

1. Remove timing gear cover. (See “Remove and Install Timing Gear Cover” on page 214.)
2. Check oil pump gear backlash. Replace entire oil pump assembly if backlash exceeds specification.



M98253

3. Remove three mounting cap screws (A).
4. Remove oil pump, and gasket.
5. Inspect all parts for wear or damage. (See Inspection procedure below.)

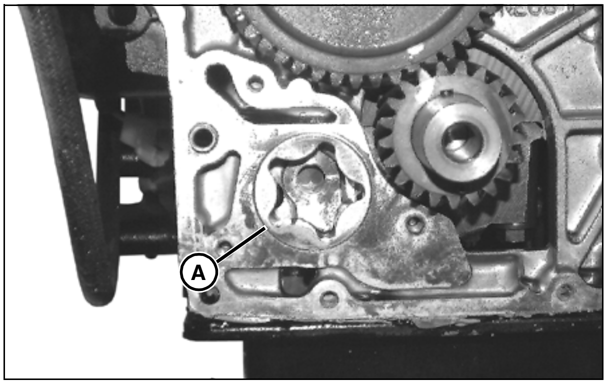
Installation

Installation is done in reverse order of removal.

Disassembly/Assembly

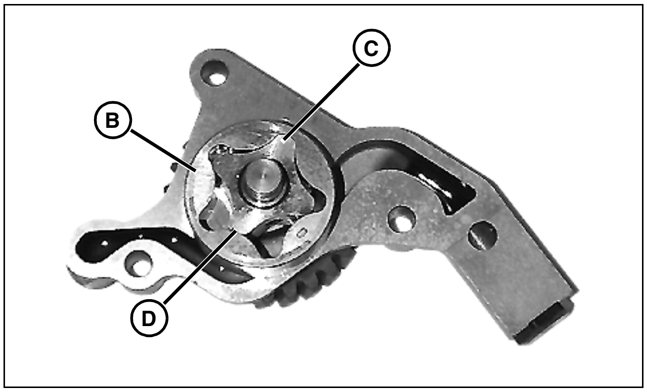
1. Inspect parts for wear or damage. (See Inspection procedure below.)
2. Coat all parts with clean engine oil.
3. Install outer rotor with identification mark facing toward inside of housing assembly.

Inspection



M98254

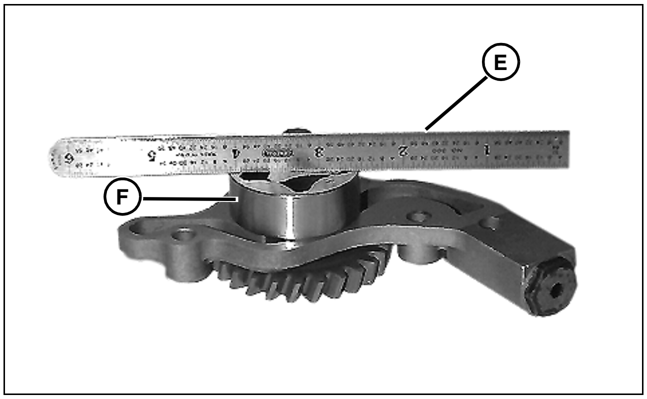
1. Measure outer rotor-to-housing clearance (A) using a feeler gauge. If the clearance is more than the wear limit, replace entire assembly.



M98255

2. Remove outer rotor (B) from housing and install the outer rotor over the inner rotor (C).

3. Check clearance (D) between the tip of the inner rotor and the outer rotor. If clearance exceeds specification, replace both inner and outer rotor.



M98256

4. Lay a straightedge (E) across inner and outer rotors. Using a feeler gauge, check side clearance of inner and outer rotors (F). If rotor side clearance is beyond wear limit, replace rotor assembly.

Specifications

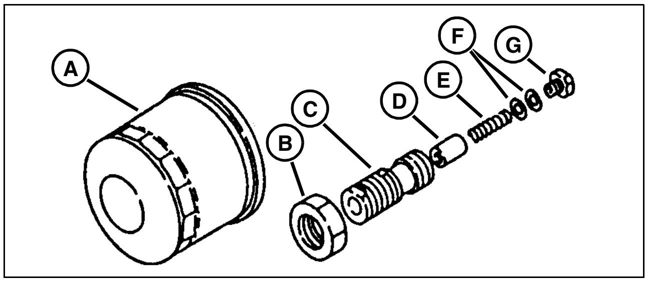
Outer Rotor-to-Pump Housing Clearance Wear Limit. . . . . 0.25 mm (0.006 in.)

Inner Rotor-to-Outer Rotor Clearance (Maximum) . . . . 0.15 mm (0.006 in.)

Rotor-to-Pump Housing Side Clearance Wear Limit . . . . 0.13 mm (0.005 in.)

Remove and Install Oil Pressure Regulating Valve

Removal



M82311B

1. Remove oil filter (A).

2. Remove retaining nut (B) and valve assembly (C).

NOTE: Valve components (D-G) are not serviced individually. Replace complete regulating valve if any components are defective.

3. Inspect all parts for wear or damage. Replace complete valve if any parts are bad.

Installation

1. Install oil pressure regulating valve. Installation is done in the reverse order of removal.

2. Tighten retaining nut to specification.

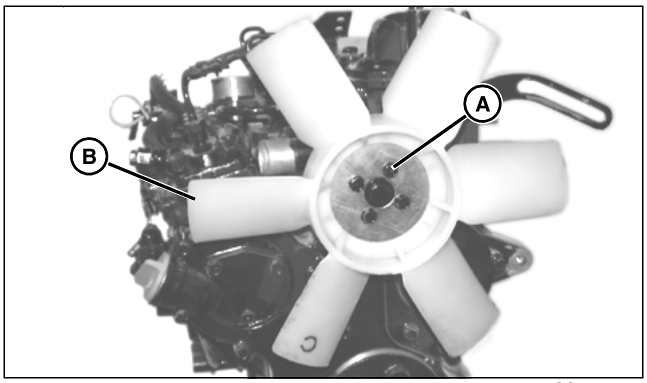
Specifications

Oil Pressure Regulating Valve Retaining Nut Torque. . . . . 30 N•m (22 lb-ft)

Remove and Install Coolant Pump (Thermostat Included)

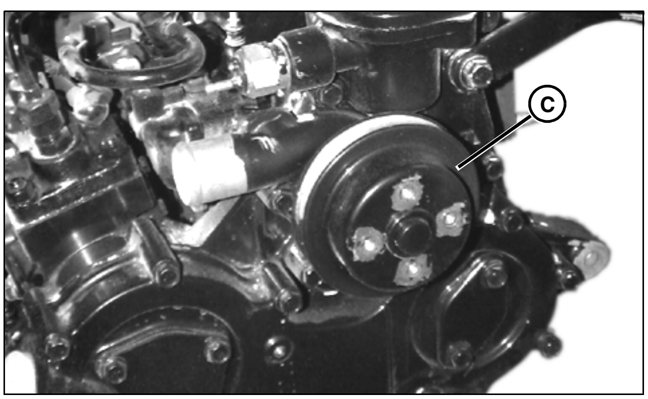
Removal

1. Park machine on level surface with park brake locked.
2. Allow engine to cool and pressure in cooling system to drop before working on coolant pump.
3. Disconnect battery negative (-) cable from battery.
4. Remove alternator. (See “Remove and Install 12V Alternator” on page 235 or “Remove and Install 48V Alternator - 2500E” on page 234.)



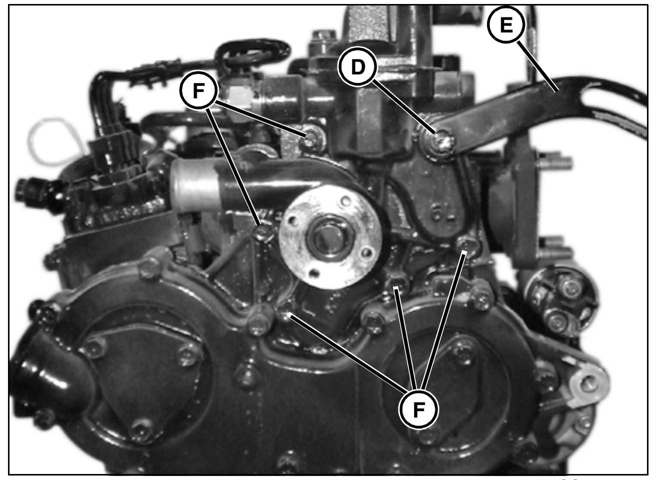
M84889

5. Remove four cap screws (A).
6. Remove fan (B).
7. Loosen alternator mounting cap screws and remove coolant pump/alternator drive belt.



M84890

8. Remove pulley (C).



M84891

9. Remove cap screw (D) and alternator bracket (E).
10. Remove coolant pump cap screws (F).
11. Remove coolant pump.
12. If the coolant pump is to be replaced, remove the coolant temperature switch and thermostat. (See “Remove and Install Coolant Temperature Switch” on page 179 and See “Remove and Install Thermostat” on page 178.)

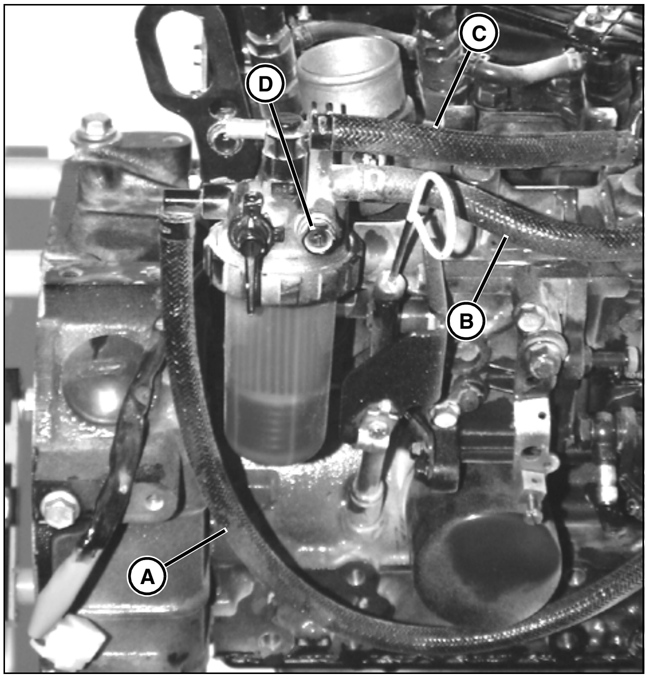
Installation

Installation is done in the reverse order of removal.

- Remove gasket residue from mating surfaces of coolant pump and timing gear cover. Use a new gasket for installation.
- Adjust coolant pump/alternator drive belt tension. (See “Check and Adjust 12V Alternator Drive Belt Tension (2500 and 2500A Models)” on page 153 or “Check and Adjust 48V Alternator Drive Belt Tension (Model 2500E)” on page 153.)

Remove and Install Fuel Filter and Water Separator Assembly

Removal



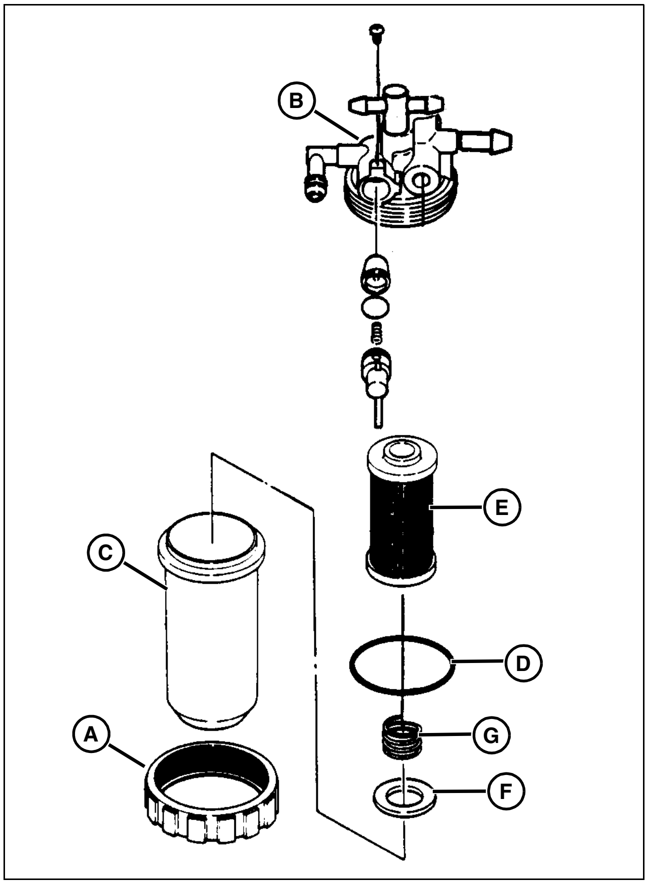
M84895

1. Disconnect fuel filter-to-fuel pump hose (A).
2. Disconnect leak-off hose (B).
3. Disconnect fuel filter-to-injection pump hose (C).
4. Remove mounting cap screw (D).
5. Remove fuel filter/water separator assembly.

Installation

Installation is done in reverse order of removal.

Assemble Fuel Filter and Water Separator



M76799

1. Remove the retaining ring (A) from the mounting base (B) while holding on to the filter cover (C).
2. Remove the filter cover from the mounting base.
3. Remove and replace O-ring (D) and filter element (E).
4. Be sure the ring (F) and spring (G) are in the filter cover.

IMPORTANT: Avoid damage! Tighten retaining nut only enough to keep the filter assembly from leaking. Overtightening the nut may damage the filter cover or retaining ring.

5. Place the filter element on mounting base.
6. Install the filter cover and retaining ring.

Remove and Install Fuel Injection Pump

Removal

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

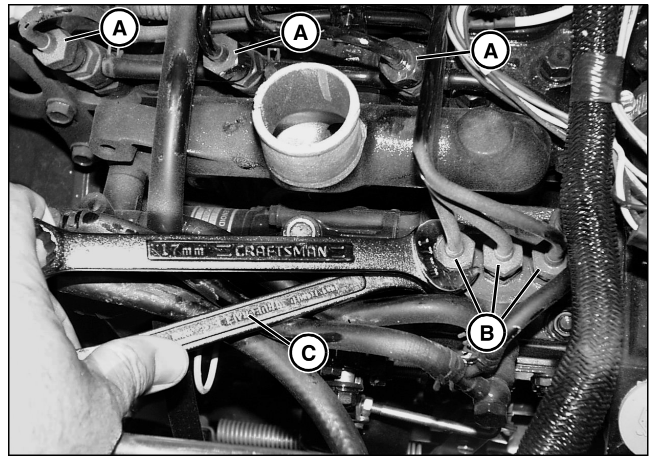
- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

CAUTION: Avoid injury! Do not attempt to remove the CARB/EPA Certified Emissions fuel injection pump unless you are a factory trained technician with authorization to service CARB/EPA Certified Emissions engines.

IMPORTANT: Avoid damage! Never steam clean or pour cold water on injection pump while pump is running or warm. Doing so can damage the pump.

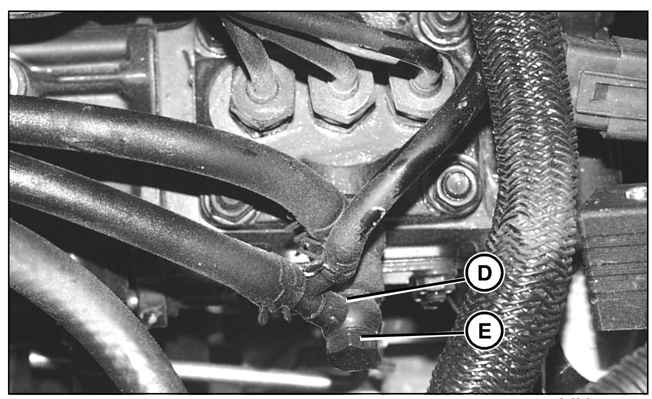
1. Park machine on level surface with park brake locked and key switch off.
2. Turn the fuel shut-off valve on the fuel filter/water separator to the closed position.
3. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner (cold engine).
4. Remove air cleaner hose.

IMPORTANT: Avoid damage! When removing injection lines, Do not turn pump delivery valve fittings. Turning fittings may damage pump internally. Always use a backup wrench when removing lines.



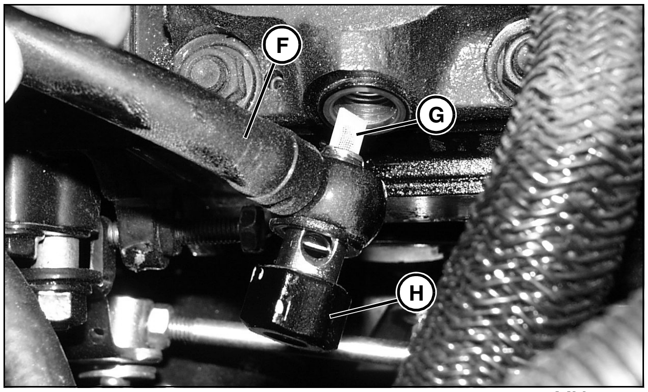
MX0770

5. Loosen fuel line nuts at fuel injection pump (B) and on the injector nozzles (A). When loosening connectors on the injector pump, use a backup wrench (C) to keep delivery valves from loosening.
6. Remove injector lines.



MX0772

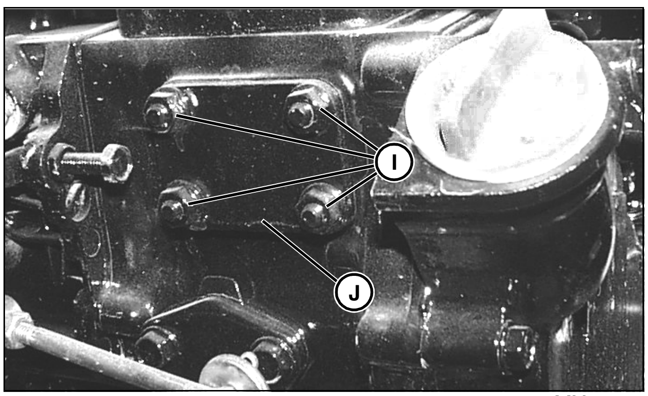
7. Remove cap screw (E) and return line fitting (D) from injection pump.



MX0773

8. Remove special cap screw (H) and fuel supply line (F). Be careful not to damage screen (G).

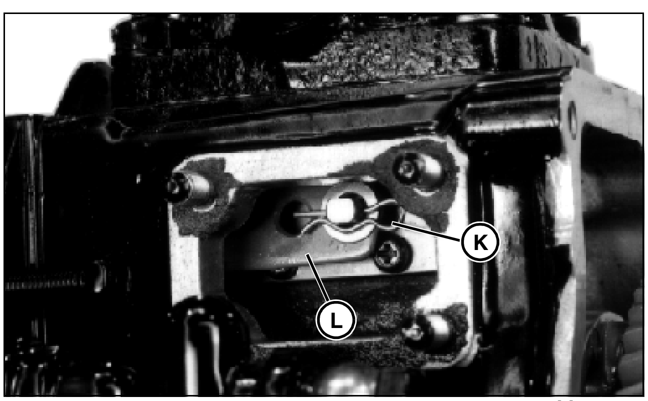
NOTE: Note location of copper washers on each side of both fittings.



MX0777

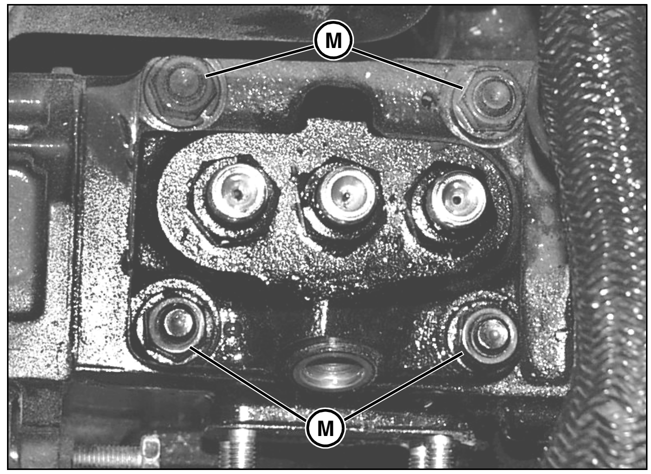
9. Remove four cap screws (I) and cover (J).

NOTE: Washer may or may not be fixed to linkage. Do not drop pin or washer during removal.



M82685

10.Remove spring pin (K) and washer, if removable. Disconnect governor linkage (L) from injection pump.

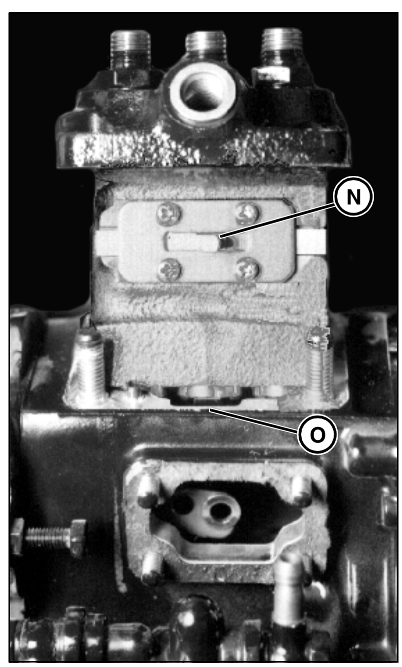


MX0774

11.Remove four cap screws (M) and washers from injector pump mounting flange.

CAUTION: Avoid injury! Do not attempt to adjust the CARB/EPA Certified Emissions fuel injection pump unless you are a factory trained technician with authorization to service CARB/ EPA Certified Emissions engines.

IMPORTANT: Avoid damage! Do not pry fuel injection pump from governor housing with sharp edge tool. Timing shims and/or housing may be damaged. Make sure rack pin is lined up with notch in center of housing, or it may catch and break pin.



M76983

12.Carefully pull injector pump straight up from governor housing. Ensure pin (N) is in line with notch in housing (O).

Installation

CAUTION: Avoid injury! Do not attempt to adjust the CARB/EPA Certified Emissions fuel injection pump unless you are a factory trained technician with authorization to service CARB/ EPA Certified Emissions engines.

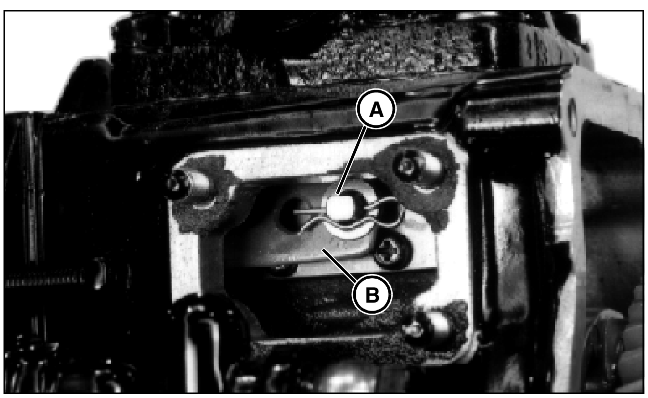
IMPORTANT: Avoid damage! If serviced or replacement fuel injection pump is installed, measure old shim thickness and install new shims of the same thickness.

NOTE: Governor linkage has two holes. Connect governor linkage to injection pump rack at hole in end of linkage.

Do not drop pin or washer into housing during installation. Place a small amount of engine assembly grease on washer to help it stick in place while assembling.

1. Install fuel injection pump. Installation is done in the reverse order of removal.

2. Install shims on top of governor housing to match thickness of original shims.



M82685

3. When connecting governor linkage (B) to injection pump rack (A), attach link to rack at hole in end of linkage.

4. If new injection pump is being installed, check and adjust injection pump timing. (See “Injection Pump Static Timing” on page 164.)

Remove, Inspect, and Install Fuel Injection Nozzle

Special or Required Tools

Tool Name	Tool No.	Tool Use
Nozzle Cleaning Kit	JDF13	Used to clean fuel injection nozzles.

Removal

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

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

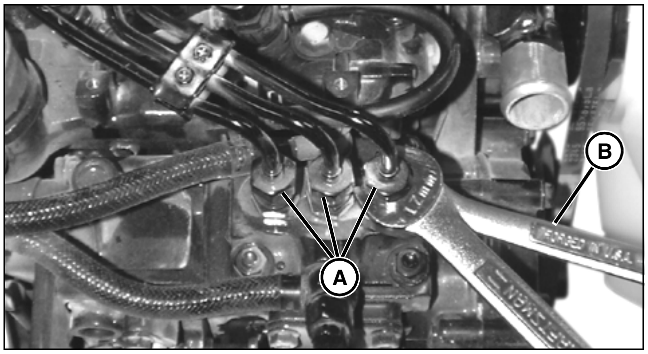
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

IMPORTANT: Avoid damage! Never steam clean or pour cold water on injection pump while the pump is running, or engine is warm. Doing so can damage the pump.

When removing injection lines, Do not turn pump delivery valve fittings. Turning fittings may damage pump internally. Always use a backup wrench when removing lines.

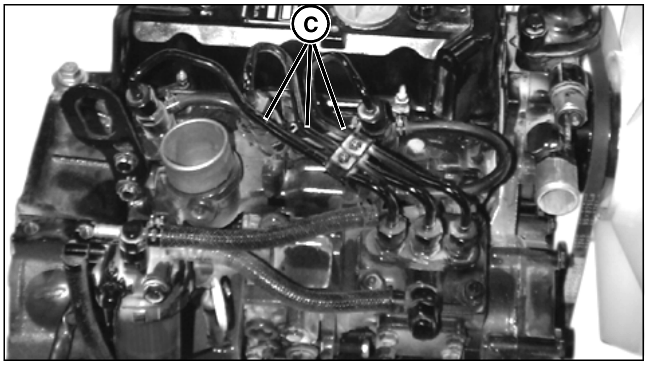
1. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner (cold engine).

NOTE: Nozzles are matched to the cylinders. If removing more than one nozzle, tag each nozzle, according to the cylinder from which it was removed.



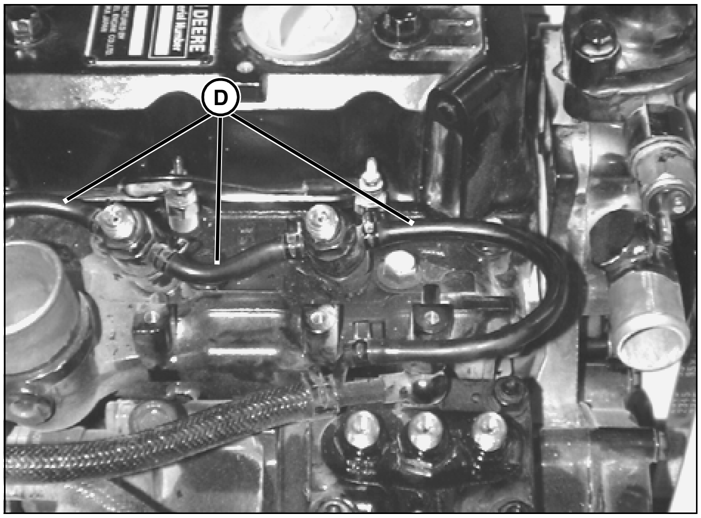
M84896

2. Loosen fuel line connectors (A) at injection pump to release pressure in the fuel system. When loosening connectors, use a backup wrench (B) to prevent delivery valves from turning.



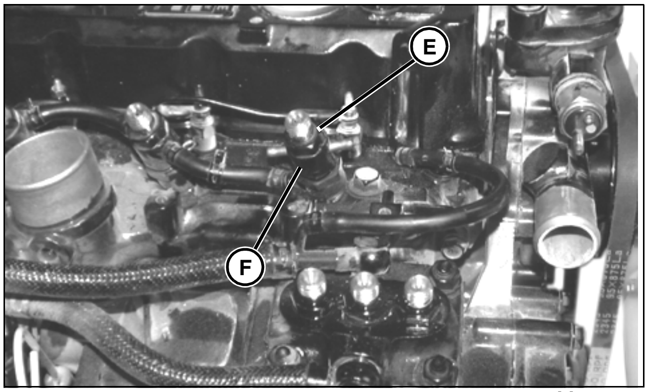
M84897

3. Remove fuel line nuts at injector nozzles and remove injector lines (C).



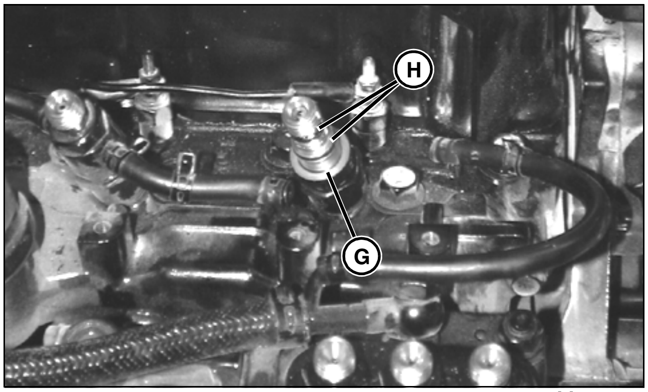
M84898

4. Remove leak-off hoses (D).



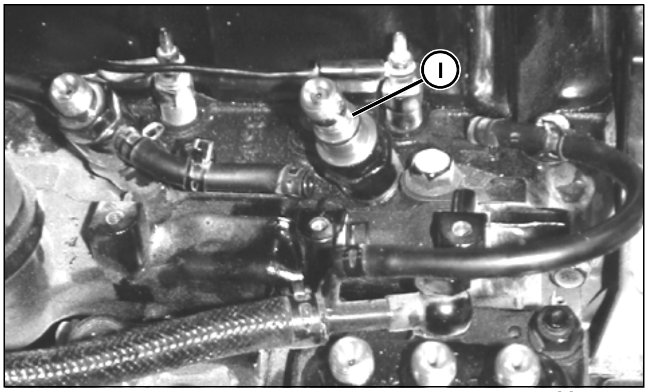
M84899

5. Remove three nuts (E) and fittings (F).



M98180

6. Remove bronze washers (G) and O-rings (H).



M98181

7. Remove injection nozzle (I), washers, and heat protector.

8. Test injection nozzles. (See “Test Fuel Injection Nozzle” on page 162.)

Installation

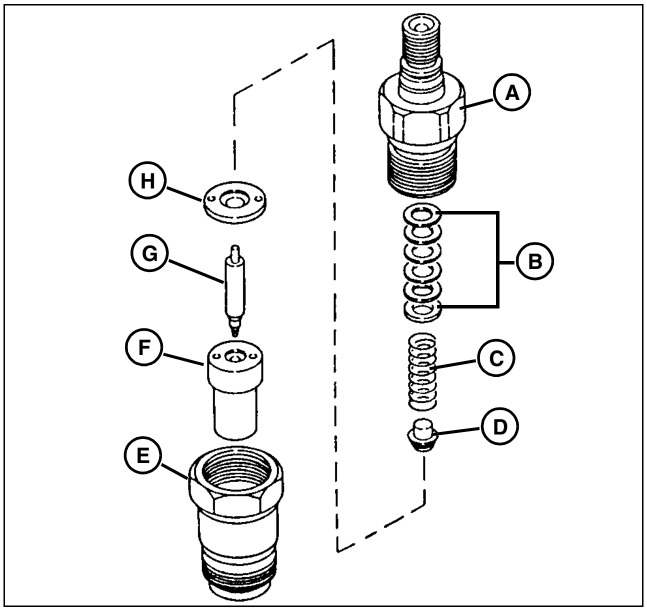
Installation is done in the reverse order of removal.

- Replace heat protectors, washers, and O-rings.
- Tighten injector nozzle body to specification.
- Tighten leak-off fitting nut to specification.

Repair

IMPORTANT: Avoid damage! If injection nozzles are disassembled to be cleaned, the same number and thickness of shims must be installed.

NOTE: If servicing more than one nozzle, keep parts for each nozzle separate from one another.

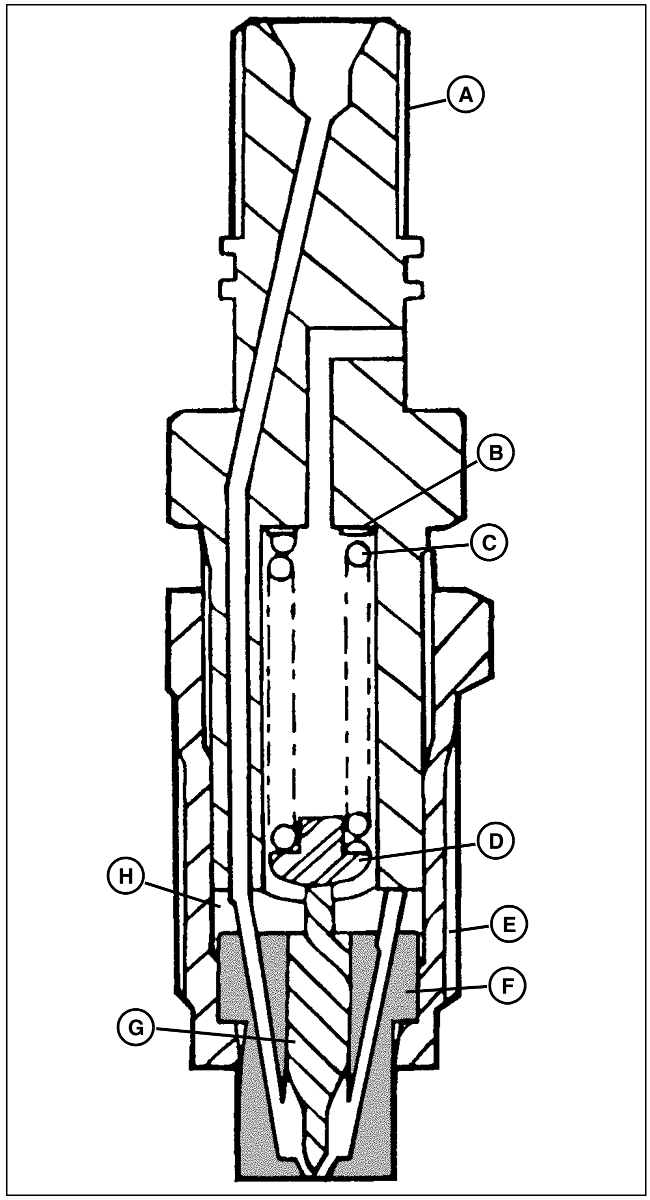


M82324A

A - Injector Body
B - Shims (as required)
C - Spring
D - Spring Seat
E - Nozzle Fitting
F - Nozzle Body
G - Nozzle Valve
H - Separator Plate

- Clean and inspect nozzle assembly. (See "Cleaning and Inspection" on page 227.)
- After assembly is complete, test injection nozzle. (See "Test Fuel Injection Nozzle" on page 162.)

Injection Nozzle Cross Section



M82325A

A - Injector Body
B - Shims (as required)
C - Spring
D - Spring Seat
E - Nozzle Fitting
F - Nozzle Body
G - Nozzle Valve
H - Separator Plate

Cleaning and Inspection

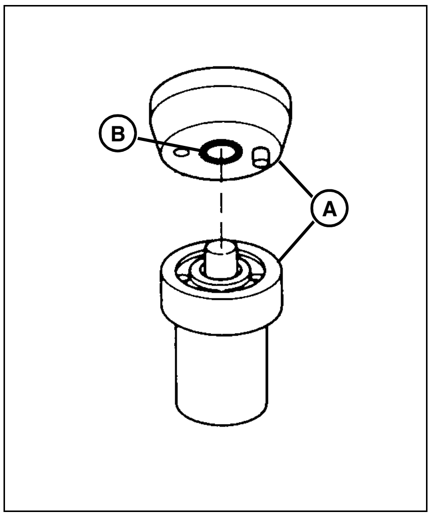
NOTE: To clean nozzles properly, JDF13 Nozzle Cleaning Kit is recommended. The Cleaning Kit is available through the John Deere SERVICEGARD™ Catalog.

1. Remove anti-corrosive grease from new or reconditioned nozzles by washing them thoroughly in diesel fuel.

IMPORTANT: Avoid damage! Never use a steel brush to clean nozzles as this will distort the spray hole.

2. Remove carbon from used nozzles, and clean by washing in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush (supplied in JDF13 Nozzle Cleaning Kit).

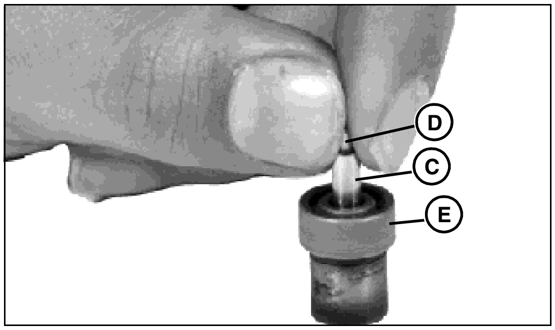
3. After removing carbon or lacquer from the exterior of nozzle, inspect sealing surfaces between separator plate and nozzle body for nicks or scratches.



M82326A

4. Inspect condition of separator plate and nozzle body. Contact area of separator plate (A) (both parts) must not be scored or pitted. Use an inspection magnifier (No. 16487 or equivalent) to aid in making the inspection.

5. Check nozzle contact surface (B) on separator plate for wear. If contact surface is more than the specified measurement, replace nozzle assembly.



M35919

6. Inspect the piston (C) (large) part of nozzle valve to see that it is not scratched or scored and that lower (tip) end of valve is not broken. If any of these conditions are present, replace the nozzle assembly.

7. Further inspect the nozzle assembly by performing a slide test.

- Dip the nozzle valve (D) in clean diesel fuel. Insert valve in nozzle body (E).
- Hold nozzle vertical, and pull valve out about 1/3 of its engaged length.
- Release valve. Valve should slide down to its seat by its own weight.

Replace nozzle assembly if the valve does not slide freely to its seat.

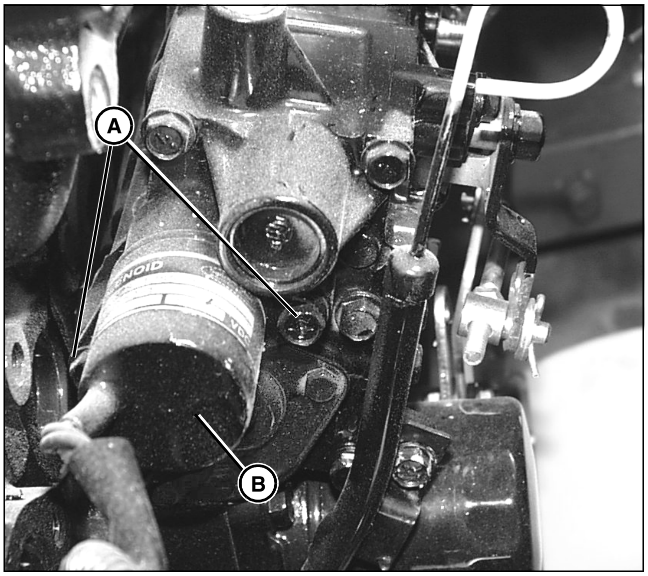
Specifications

Injection Nozzle Body Torque . . . . 51 N•m (37 lb-ft)
Leak-Off Fitting Nut Torque. . . . . 32 N•m (24 lb-ft)
Separator Plate Contact Surface . . 0.10 mm (0.004 in.)

Remove and Install Fuel Shutoff Solenoid

Removal

1. Park machine on level surface, park brake locked, key switch in off position.
2. Clean around the fuel shutoff solenoid using a parts cleaning solvent or steam cleaner.
3. Disconnect the electrical lead to the fuel shutoff solenoid.



MX0775

4. Disconnect electrical lead and remove fuel shutoff solenoid.
5. Remove the two solenoid mounting cap screws (A) and remove solenoid (B) from governor housing.
6. Test fuel solenoid. (See “Fuel Shutoff Solenoid Test - Diesel Engine” on page 558 in the Electrical section.)

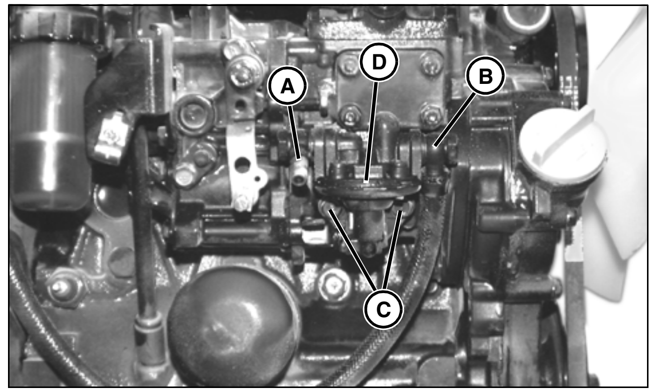
Installation

NOTE: Check condition of O-ring on solenoid before installing.

Install fuel shutoff solenoid. Installation is done in the reverse order of removal.

Remove and Install Fuel Pump

Removal



M84894

1. Disconnect fuel supply line (A).
2. Disconnect fuel hose from fuel filter (B).
3. Remove two cap screws (C).
4. Remove fuel pump (D).

Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! Replace all copper washers. Damaged or used washers may leak.

- Remove gasket residue from fuel pump and fuel injection pump mating surfaces.
- Use a new gasket for installation.
- Tighten cap screws to specification.
- Bleed air from fuel system. (See “Procedure for Bleeding Fuel System” on page 159.)

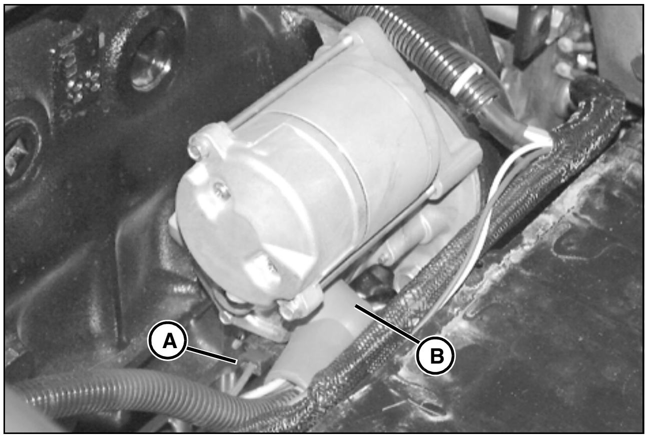
Specifications

Fuel Pump Cap Screw Torque. . . . . . . 11 N•m (96 lb-in.)

Remove and Install Starting Motor

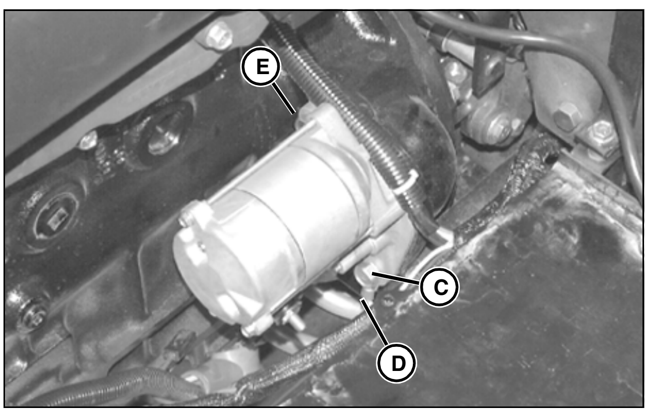
Removal

1. Park machine safely. (See “Park Machine Safely” on page 3.)
2. Raise engine cover.
3. Disconnect battery negative (-) cable.
4. Disconnect white wire from starter solenoid.



MX2339

5. Disconnect violet wire (A) from solenoid.
6. Disconnect wires (B) from solenoid battery terminal.



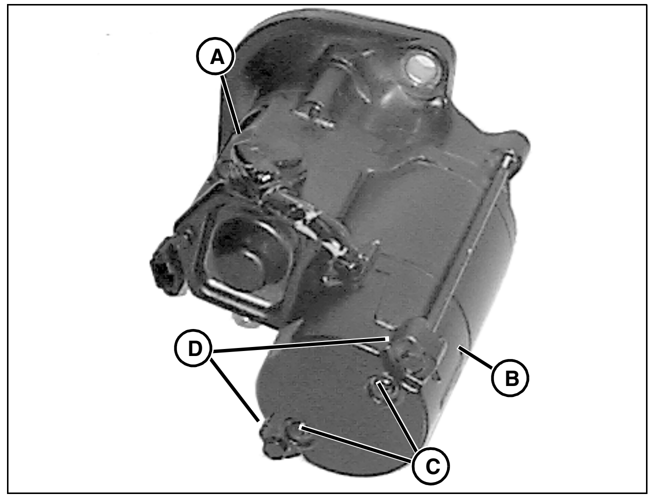
MX2340

7. Remove lower cap screw (C) and ground strap (D).
8. Remove upper cap screw (E).
9. Remove starting motor.

Installation

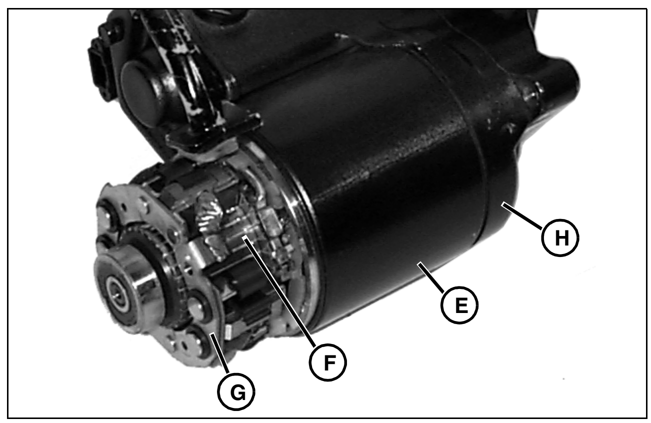
Installation is done in the reverse order of removal.

Starting Motor Disassembly and Assembly



M82233A

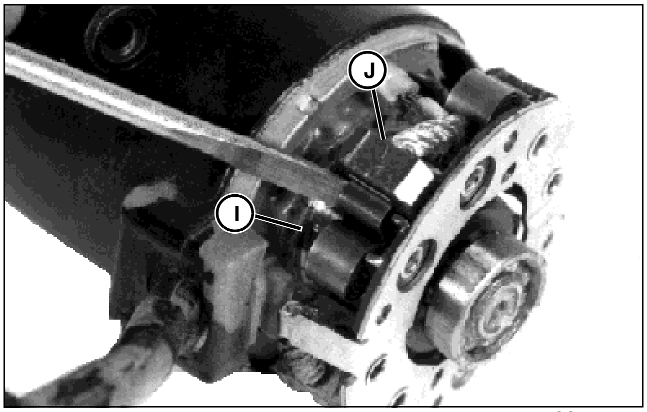
1. Disconnect field lead (A).
2. Remove two cover cap screws (C).
3. Remove two clutch housing-to-motor cap screws (D).
4. Remove rear cover (B).



M91667

5. Remove field coil housing (E), armature (F), and brush holder (G) as a unit from the clutch housing (H).

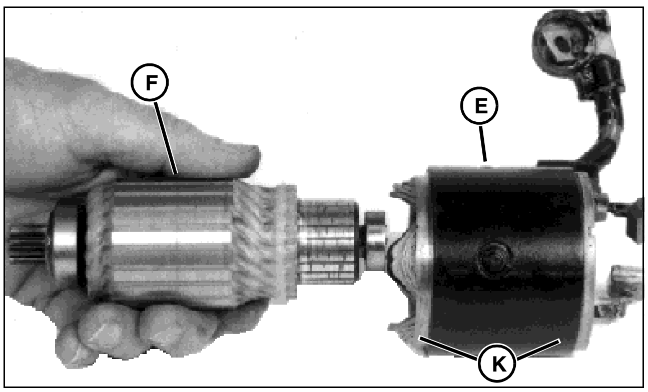
NOTE: Brushes are not serviced separately. If brushes require replacement, the entire brush holder with brushes attached must be replaced.



M36754

6. Pry the brush springs (I) away, and pull negative brushes (J) up enough to hold the brush in place.

7. Remove brush holder.



M36759

8. Remove armature from field coil housing.

9. Inspect O-rings (K) on field coil housing. Replace as needed.

10.Inspect all parts for wear or damage. Replace parts as needed.

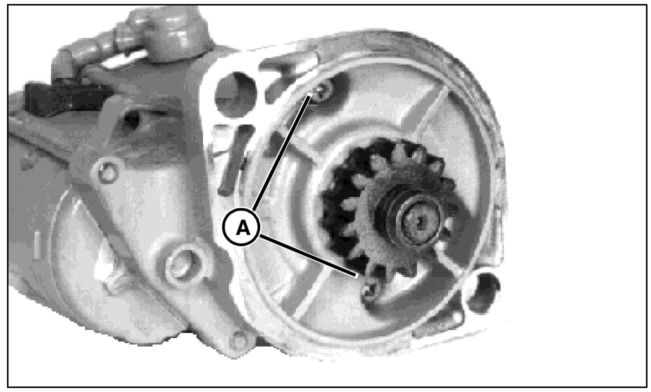
Assembly

Assembly is done in the reverse order of disassembly.

IMPORTANT: Avoid damage! When installing the rear cover, do not let field brush wires touch cover. Turn the brush holder slightly to take up slack in brush wires. Press wires inward to clear rear cover.

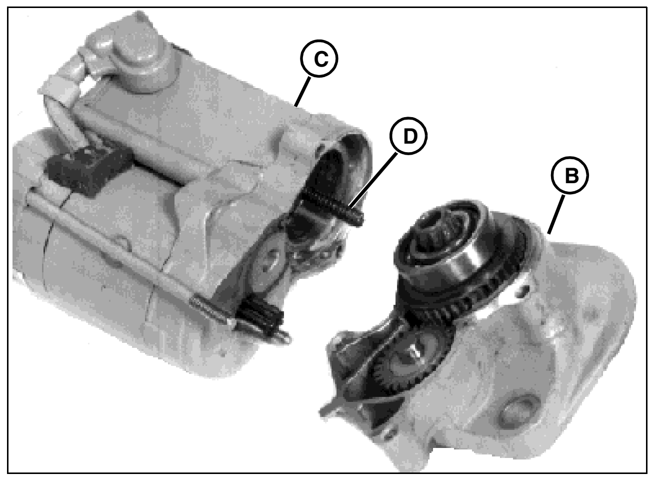
Apply multi-purpose grease to bearing cup inside rear cover.

Clutch Housing Assembly Disassembly and Assembly



M82238

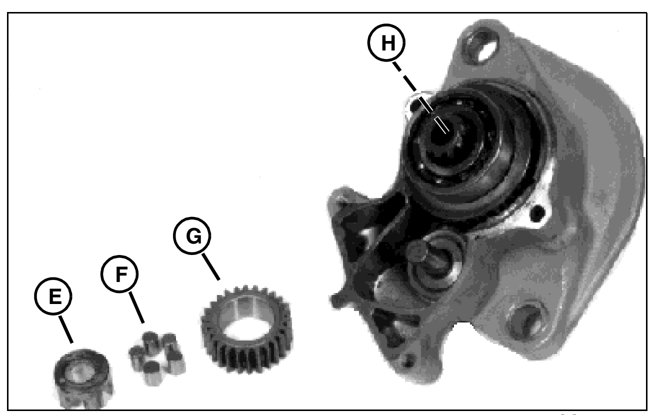
1. Remove two cap screws (A).



M82239

2. Separate the clutch housing (B) from the solenoid/motor assembly (C).

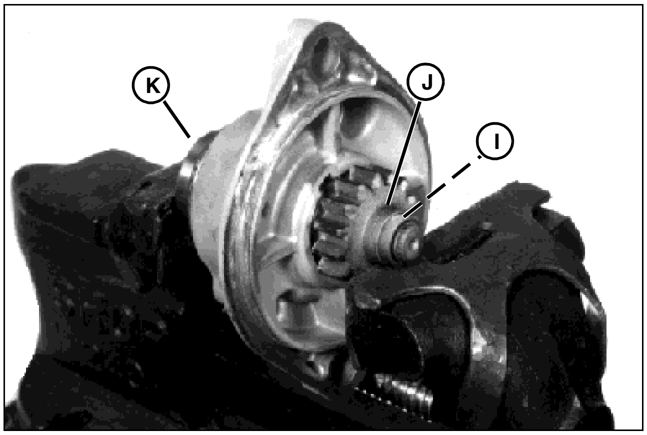
3. Remove plunger spring (D).



M82240

4. Remove retainer (E), five rollers (F), and pinion gear (G).

5. Remove steel ball (H).



M82241

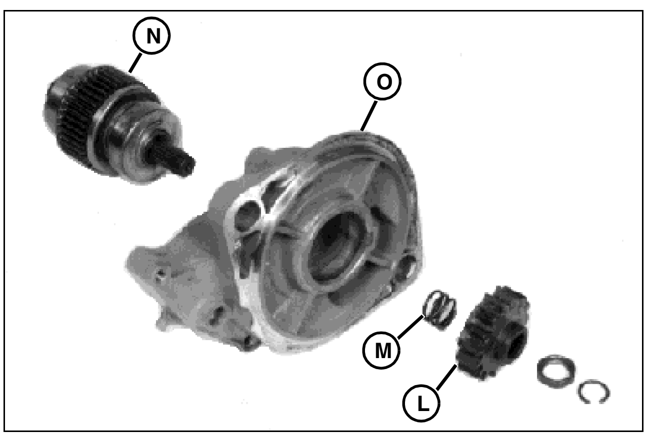
6. Place clutch housing assembly (K) in a soft-jawed vise as shown.

7. Tighten vise slowly, until the drive gear spring is fully compressed.

8. Remove circlip (I) and retainer (J).

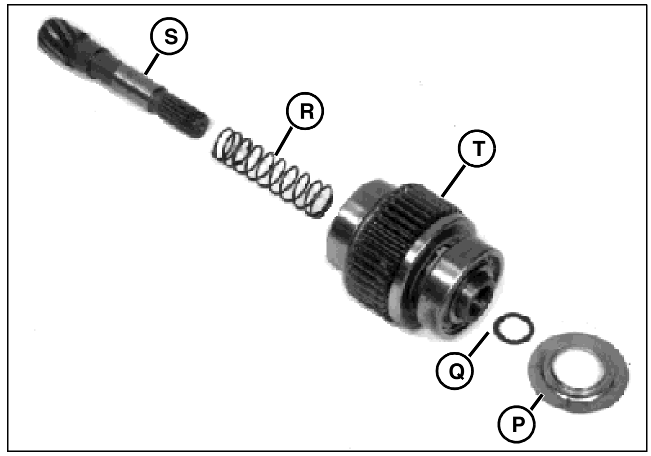
> **CAUTION: Avoid injury! RELEASE TENSION SLOWLY. Shaft could be propelled from clutch with considerable force, if the spring is not allowed to extend fully while in the vise.**

9. While holding the clutch assembly (K), slowly open the vise until the spring is fully extended.



M82242

10.Remove drive gear (L), spring (M), and clutch assembly (N) from clutch housing (O).



M82243

11.Remove large washer (P), toothed washer (Q), spring (R), and clutch shaft (S) from housing (T).

12.Inspect all parts for wear or damage. Replace parts as needed.

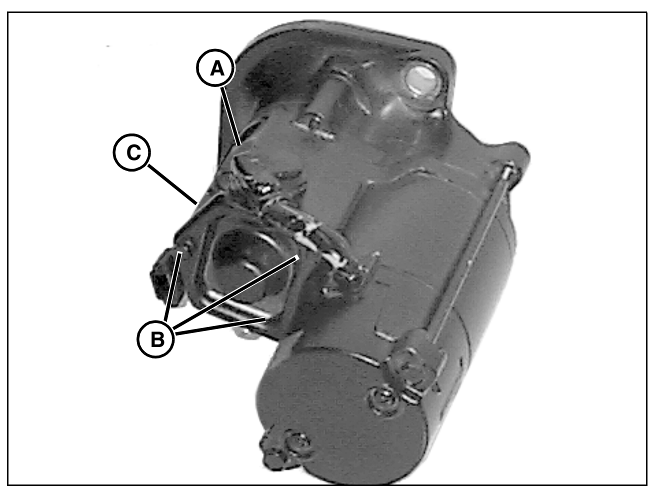
Assembly

Assembly is done in the reverse order of disassembly.

- Apply multi-purpose grease to clutch shaft (S), springs (M and R), pinion gear (G), retainer (E), rollers (F) and steel ball (H).
- Install large washer (P) with flat side toward clutch assembly.
- Install retainer (E) with cupped side away from clutch assembly.

Solenoid Disassembly and Assembly

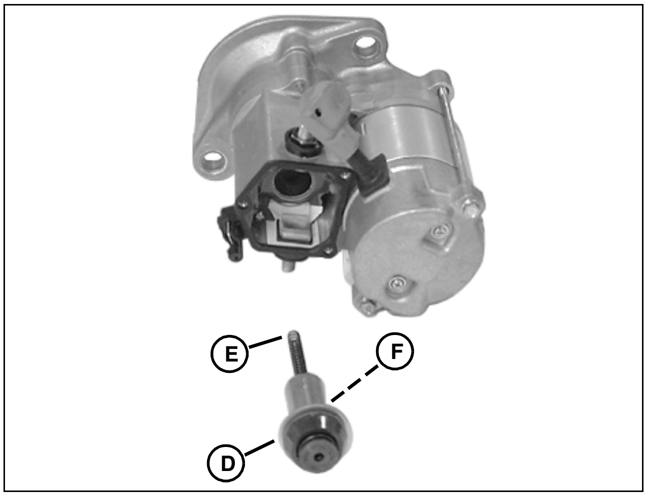
NOTE: The solenoid can be serviced without disassembling the motor/clutch housing assembly.



M82233A

1. Disconnect field lead (A).
2. Remove three cover cap screws (B).

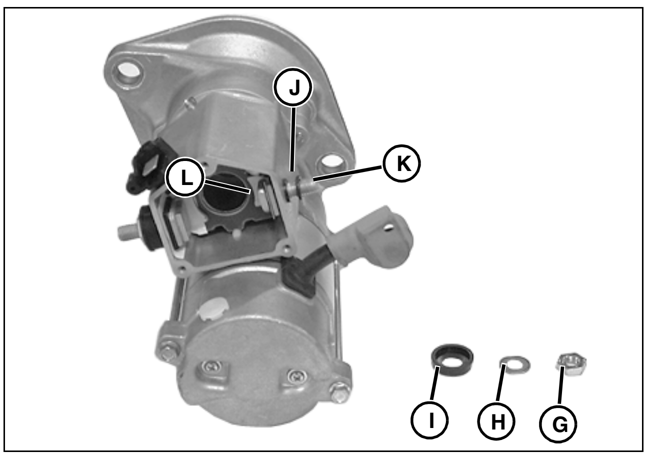
3. Remove cover (C) and gasket.



MX2371

4. Remove plunger (D) and spring (E).

5. Inspect copper washer (F) for signs of excessive burning or pitting. Clean burned areas to improve contact. Replace the entire solenoid if burnt or pitted areas cannot be cleaned.



MX2372

6. Remove nut (G), washer (H), insulator (I), and O-ring (J) (both sides).

7. Remove terminal bolt (K) and contact plate (L) (both sides).

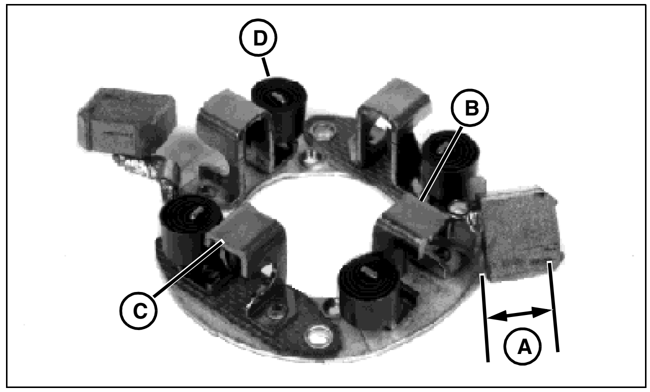
8. Inspect contact plates (L) for signs of excessive burning or pitting. Clean burnt areas to improve contact. Replace the entire solenoid if burnt or pitted areas cannot be cleaned.

Assembly

Assembly is done in the reverse order of disassembly.

Starting Motor Component Inspection

Brush Holder



M82234

1. Measure brush lengths (A). Minimum brush length is 8.5 mm (0.335 in.). Replace brush if length is below minimum.

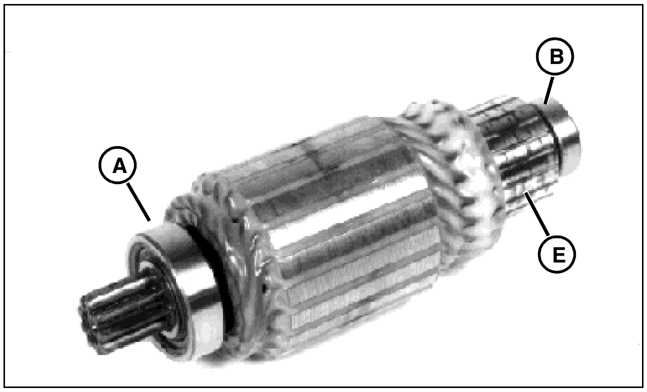
NOTE: Test brush holder using an ohmmeter or test light.

2. Test brush holder: Touch one probe of tester to negative brush holder (B) and other probe to field brush holder (C). If there is continuity, replace the brush holder.

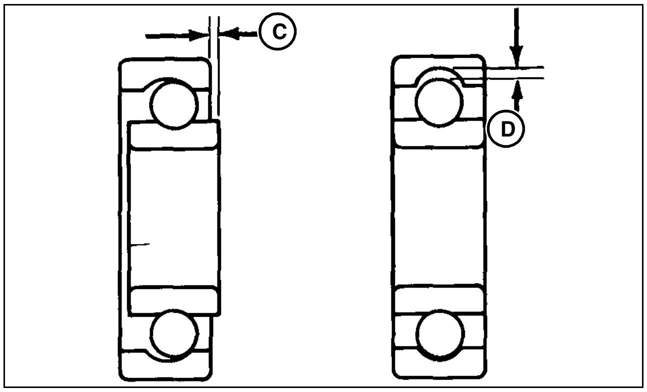
3. Inspect springs (D) for wear or damage. Replace if necessary.

Armature Assembly

IMPORTANT: Avoid damage! DO NOT clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.



M82237



M38073

1. Inspect armature. Look for signs of dragging against pole shoes.

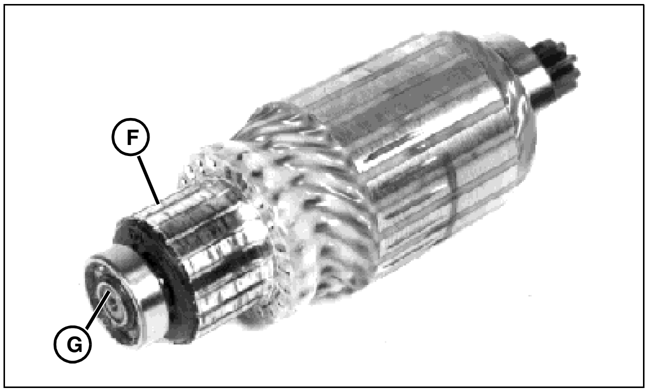
2. Inspect bearings (A and B) for axial (C) and/or radial (D) free play or rough movement. Replace bearings as needed.

IMPORTANT: Avoid damage! NEVER use emery cloth to clean commutator.

3. Inspect commutator (E). Look for roughness, burned bars, or any material which might cause short circuits between bars. If necessary, clean and touch up with 400 sandpaper. Clean all dust from armature when finished.

NOTE: Test armature windings using an ohmmeter or test light.

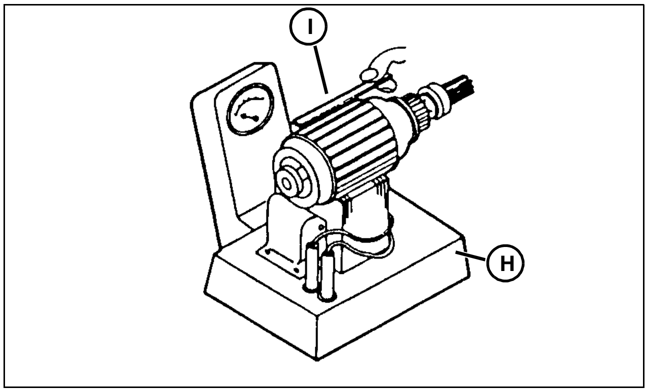
Armature windings are connected in series, so only one commutator bar needs to be checked. If the test shows continuity, a winding is grounded and the armature must be replaced.



M82236

4. Test for grounded windings. Touch one meter probe to a commutator bar (F) and the other to the armature shaft (G). If continuity is present, replace the armature.

5. Test for open circuits in the windings. Touch the meter probes to two commutator bars. If the test shows no continuity, the armature has an open circuit and the armature must be replaced.



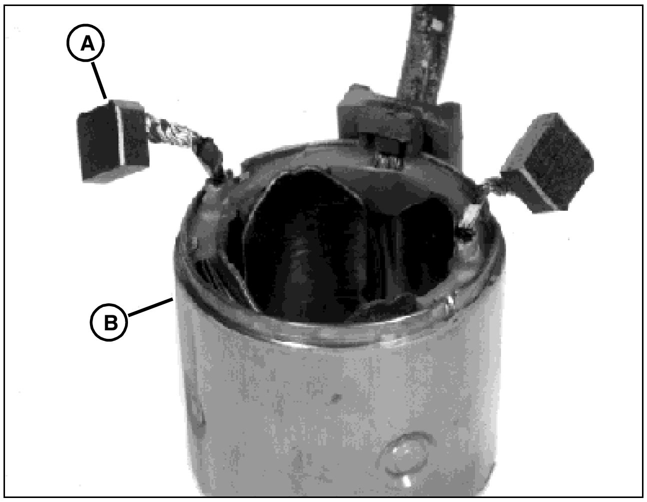
M82125A

6. Test for short circuited windings using a growler (H). Put armature in growler and hold a hacksaw blade (I) above each slot while slowly rotating armature. If coil is shorted, the blade will vibrate on the slot.

NOTE: A short circuit most often occurs because of copper dust or filings between two commutator segments.

7. If test indicates short circuited windings, clean the commutator of dust and filings. Check the armature again. If the test still indicates a short circuit, replace the armature.

Field Coil and Housing



M82235

NOTE: Test field coil using an ohmmeter or test light.

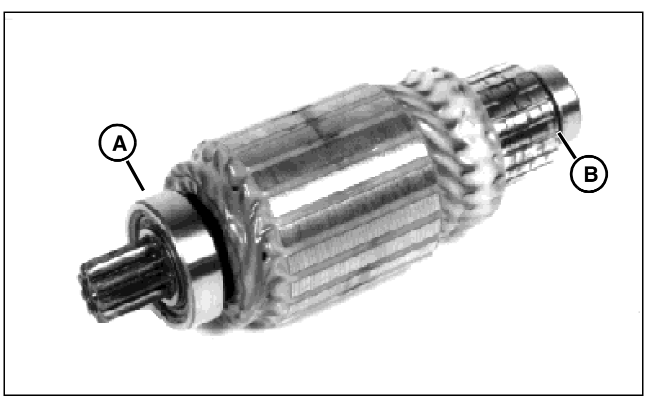
Be sure the field coil brush is not touching the housing.

1. Test for grounded field winding. Touch one meter probe to the field coil brush (A) and the other meter probe to the field coil housing (B). If continuity is present, replace the field coil.

2. Test for open field coil. Touch one meter probe to one field coil brush (A). Touch the other meter probe to the remaining field coil brushes.

3. If continuity is not read between any two brushes, the field coil is open and the entire field coil housing must be replaced.

Armature Bearing Replacement



M82237

1. Remove bearings (A and B) using a knife-edge puller.

IMPORTANT: Avoid damage! Press on bearing race only. Applying pressure to bearing outer diameter will damage bearing.

NOTE: Install both bearings with seal side toward armature.

2. Install new bearings using a press until the bearings are tight against the shoulder of the shaft.

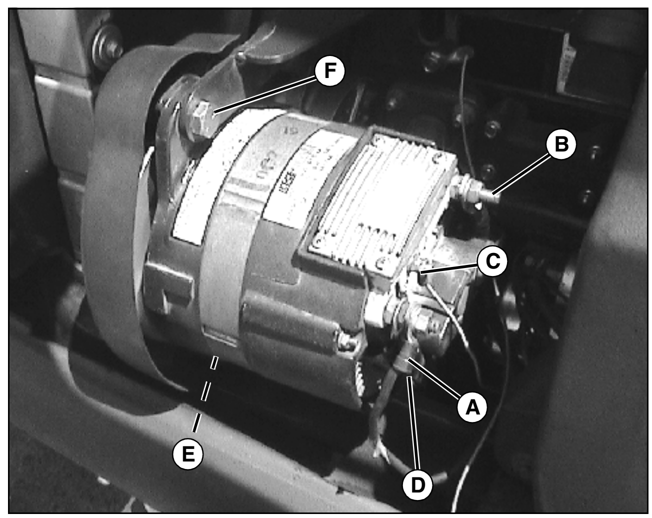
Remove and Install 48V Alternator - 2500E

Removal

IMPORTANT: Avoid damage! Always disconnect the negative (-) cable from the battery before working on any electrical components.

1. Disconnect the negative (-) cable from the battery.

2. Remove alternator belt. (See “Remove and Install 48V Alternator Belt - 2500E” on page 171.)



MX20773

3. Remove cap screw (F).

4. Disconnect ground lead (A).

5. Raise the plastic protective cover from the positive (RED) lead (B). Remove the nut and washer, and disconnect the lead from the alternator stud.

6. Disconnect the wire lead (C).

7. Remove mounting cap screws (D and E). Remove alternator.

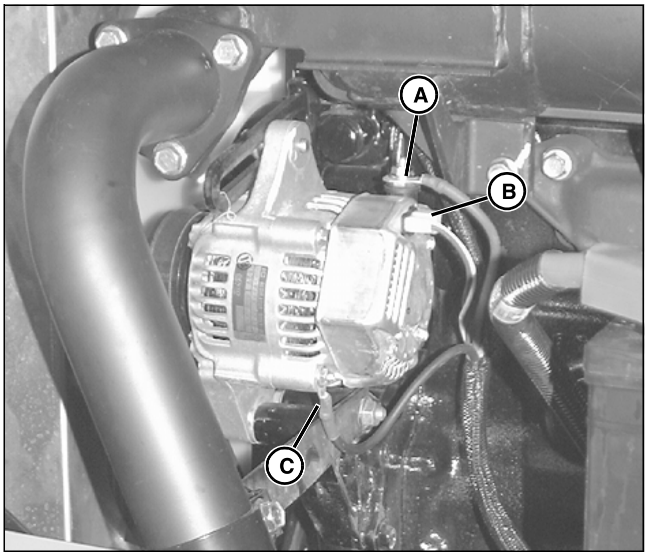
Installation

Installation is done in the reverse order of removal.

Remove and Install 12V Alternator

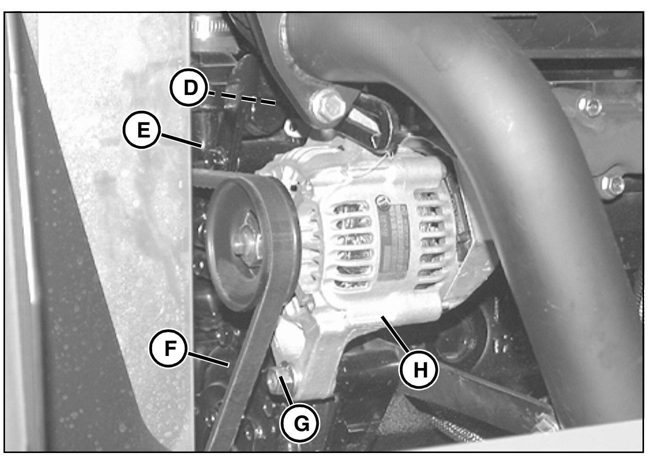
Removal

1. Park machine safely. (See "Park Machine Safely" on page 3.)
2. Raise hood.
3. Disconnect negative (-) battery cable.



MX2261

4. Disconnect red wire (A) from alternator.
5. Disconnect wiring connector (B).
6. Disconnect black wire (C).



MX2262

7. Loosen top cap screw (D) and mounting bracket cap screw (E) and push alternator toward engine to loosen belt.
8. Remove drive belt (F) from alternator pulley.
9. Remove lower cap screw (G).
10. Remove top cap screw (D).
11. Remove alternator (H).

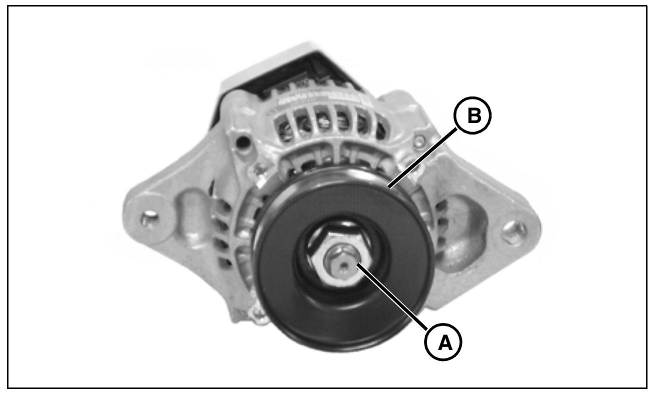
Installation

Installation is done in the reverse order of removal.

- Adjust belt tension.

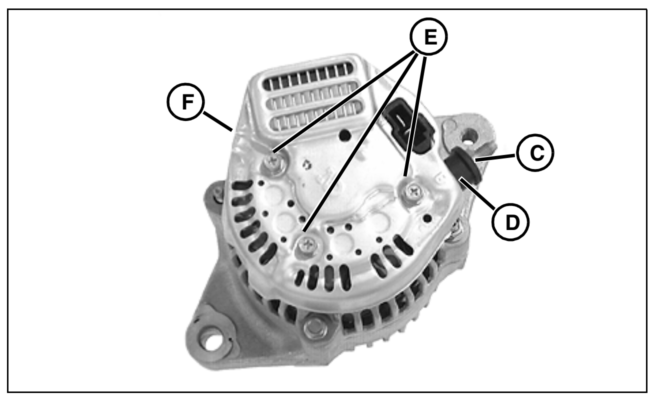
12v Alternator Disassembly and Assembly

NOTE: Clamp pulley in a soft-jawed vise and use an air impact wrench to remove pulley nut.



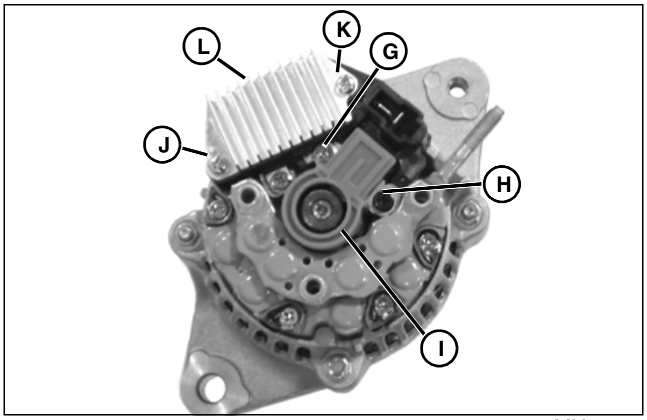
MX2364

1. Remove nut (A).
2. Remove pulley (B) using a puller.



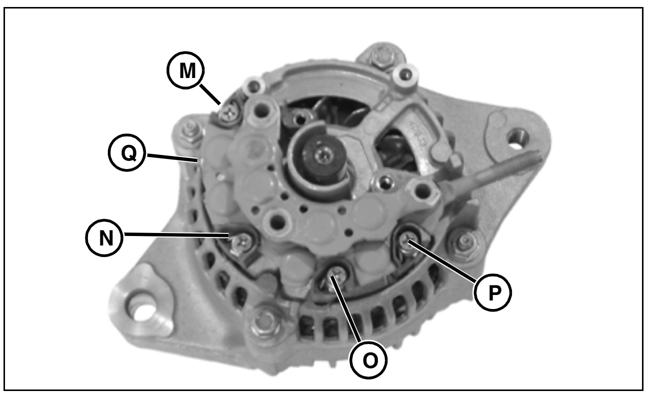
MX2365

3. Remove nut (C) and insulator (D) from battery terminal post.
4. Remove three screws (E) securing the cover to the body.
5. Remove cover (F).



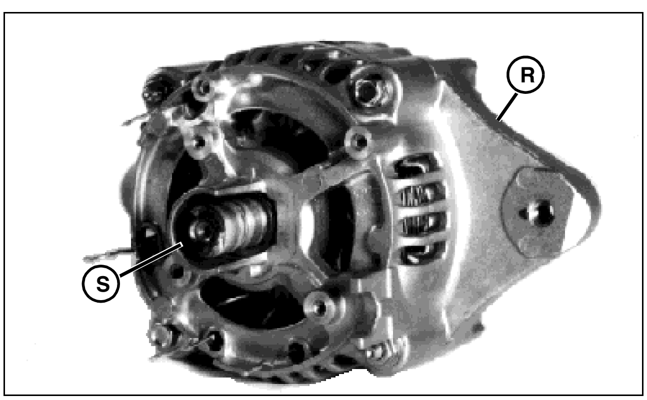
MX2366

6. Remove two screws (G, short, and H, long).
7. Remove brush holder and cover (I).
8. Remove two screws (J and K).
9. Remove regulator (L).



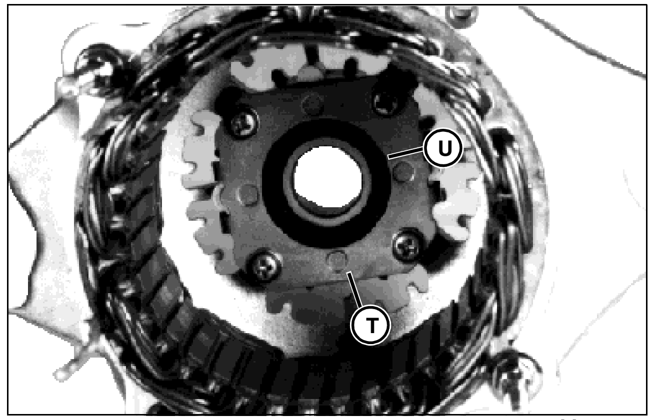
MX2367

10. Remove screws (M-P).
11. Straighten wires below each screw.
12. Remove rectifier (Q).



M52473

13. Remove rear frame (R).
14. Press rotor shaft (S) from rear frame.

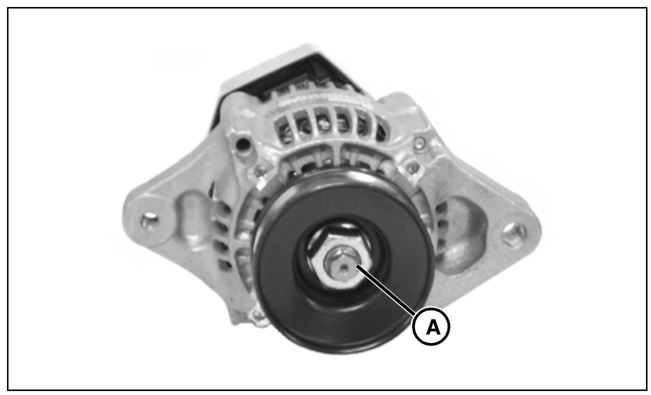


M52475

15. Remove retainer plate (T).
16. Press bearing (U) from case.

Assembly

Assembly is done in the reverse order of disassembly.



MX2364

Tighten pulley retaining nut (A) to specification.

Specifications

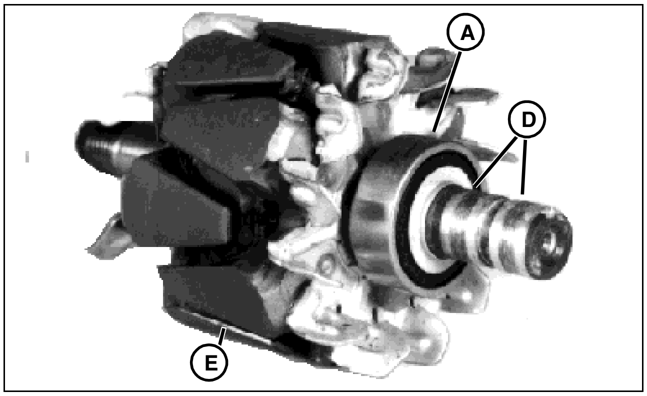
12V Alternator Pulley Retaining Nut Torque . . . . 69 N•m (51 lb-ft)

12V Alternator Component Inspection

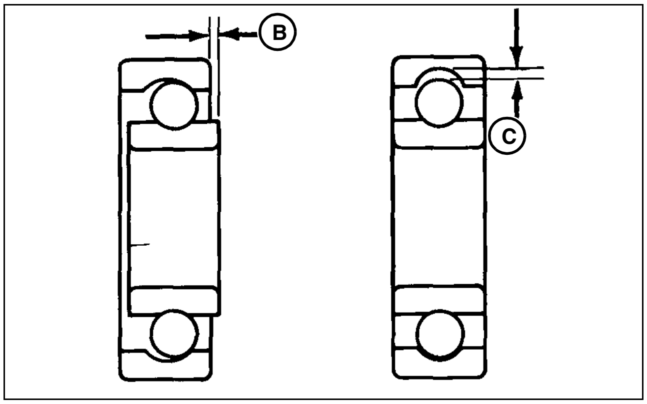
Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter or Continuity Tester	NA	Used to check for continuity during component inspection.

Rotor



M52474



M38073

1. Inspect bearing (A) for axial (B) and/or radial (C) free play or rough movement. Replace bearings as needed.

2. Inspect slip rings (D) for dirt or rough spots. If necessary, use No. 00 sandpaper or 400-grit silicone carbide paper to polish rings.

3. Measure the outer diameter of the slip rings. Replace the rotor if the diameter measures less than specification.

4. Check continuity between slip rings using an ohmmeter or continuity tester. Replace rotor if there is no continuity.

5. Check continuity between slip rings and rotor core (E). Replace rotor if there is no continuity.

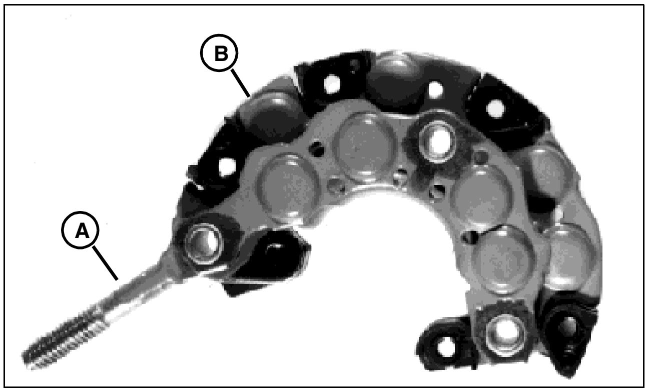
Stator

1. Inspect stator for defective insulation, discoloration or a burned odor. Replace the stator as needed.

NOTE: Use an ohmmeter that is sensitive to 0-1 ohm.

2. Check for continuity between each stator lead and body. Replace the stator if there is no continuity.

Diodes

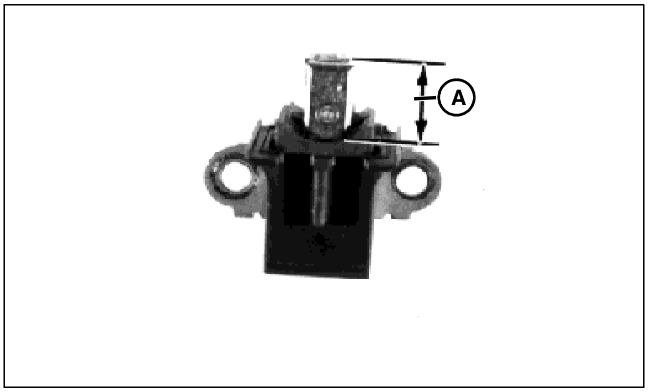


M52477

NOTE: Set ohmmeter to K ohm range.

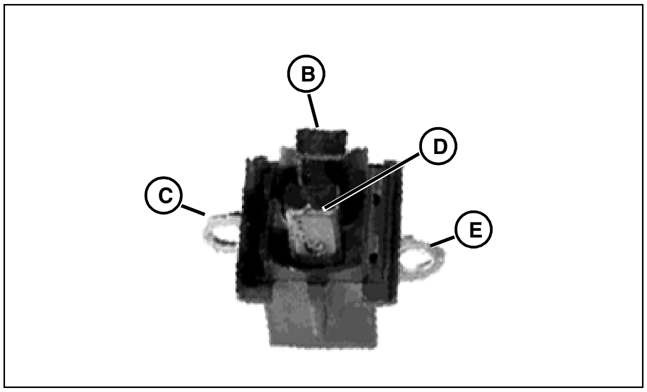
Check continuity between main lead (A) and each diode lead (B). Reverse ohmmeter leads and recheck. There should be continuity in one direction, but there should not be continuity when the leads are reversed. Replace the entire holder assembly if continuity is not correct.

Brushes



M52478

1. Measure the length of brush protruding from holder (A). The maximum length of brush protruding from the holder is 10.5 mm (0.41 in.). Replace brushes if worn to less than specification.



M52479

2. Check continuity between the brush (B) and terminal (C). Check continuity between the brush (D) and terminal (E). There should be no continuity between any other points. Replace brush if continuity is not correct.

Specifications

Rotor Slip Ring Outside Diameter
(Wear Limit) . . . . 14 mm (0.55 in.)

Brush Length (Min). . . . . 4.5 mm (0.17 in.)

Table of Contents

ELECTRICAL TABLE OF CONTENTS

Specifications

Test Specifications

Battery Specific Gravity . . . . 1.230-1.265 points
Regulated Voltage . . . . 12.2-14.7 Volts
Unregulated Voltage - Gas Engine (minimum). . . . . 28 Volts AC
Unregulated Voltage - Diesel Engine (minimum). . . . . 28 Volts AC
Starting Motor Cranking Amperage Draw (maximum) at 225 engine RPM . . . . 180 Amps
Glow Plug Resistance - Diesel Engine . . . . 1.35-1.65 ohms
Reel Motor Speed Control - Model 2500E . . . . See procedure

Pulser Coil Resistance - Gas Engine

Yellow-to-Green/White . . . . 85-270 ohms
Pink-to-White/Blue . . . . 85-270 ohms

Ignition Coil Resistance - Gas Engine

Primary Windings . . . . 3.4-4.6 ohms
Secondary Windings . . . . 10.4-15.6 k-ohms

Engine Coolant Temperature Switch

Operating Temperature . . . . 108-114°C (226-237°F)

Tools

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydrometer	NA	Used to test battery.
Battery Tester	JT05685	Used to test battery. Used to test alternator amperage and voltage.
Battery Charger (variable rate) (use according to manufacturer’s instructions)	NA	Used to charge battery. Used to test starter loaded amperage draw.
Digital Multimeter	JT05791	Used to test alternator amperage and voltage. Used to test diodes. Used to test various switches. Used to test relays. Used to test solenoids. Used to test fuse continuity.
Ammeter Shunt Assembly	JT05792	Used to test alternator amperage and voltage.
Two (2) Jumper Wires	NA	Used to test starter solenoid. Used to test relays. Used to test fuel pump.
Two (2) Jumper Cables	NA	Used to test starter solenoid.
12-V Battery	NA	Used to test starter solenoid. Used to test relays.

General 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 are used to test the complete circuit regardless of the problem or complaint. Select a circuit or symptom from Circuit Operation and Diagnosis and follow the test procedures under that heading.

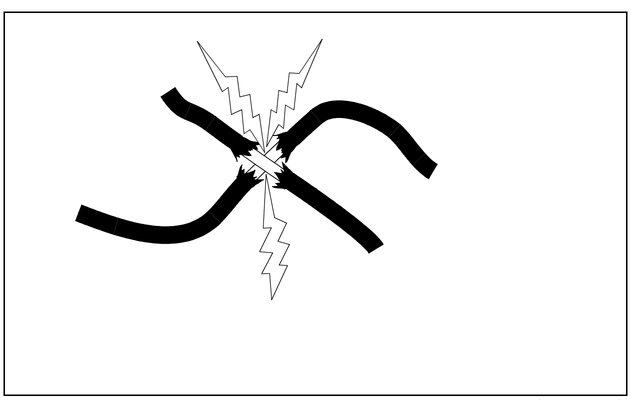
The diagnostic procedure provides:

- Test conditions
- Test location
- A question regarding the normal reading
- A yes or no answer based on the test results

When performing the test or check, be sure to set your machine up to the test conditions listed and follow the sequence carefully.

Common Circuit Tests

Shorted Circuit



MIF (M85600)

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

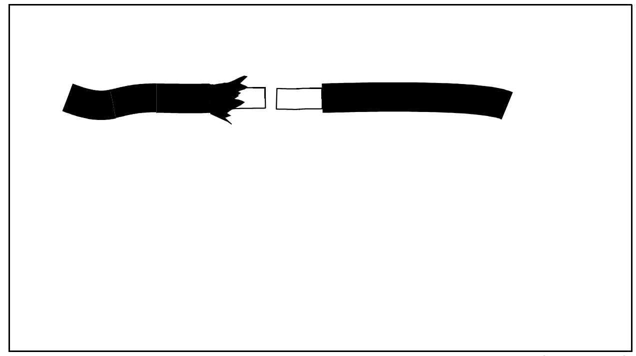
1. Turn component switch ON.

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

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

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

High Resistance or Open Circuit



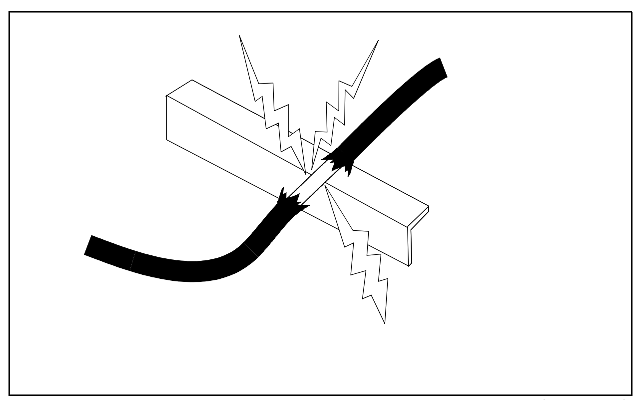
MIF (M85601)

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

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

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

Grounded Circuit



MIF (M85602)

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

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.

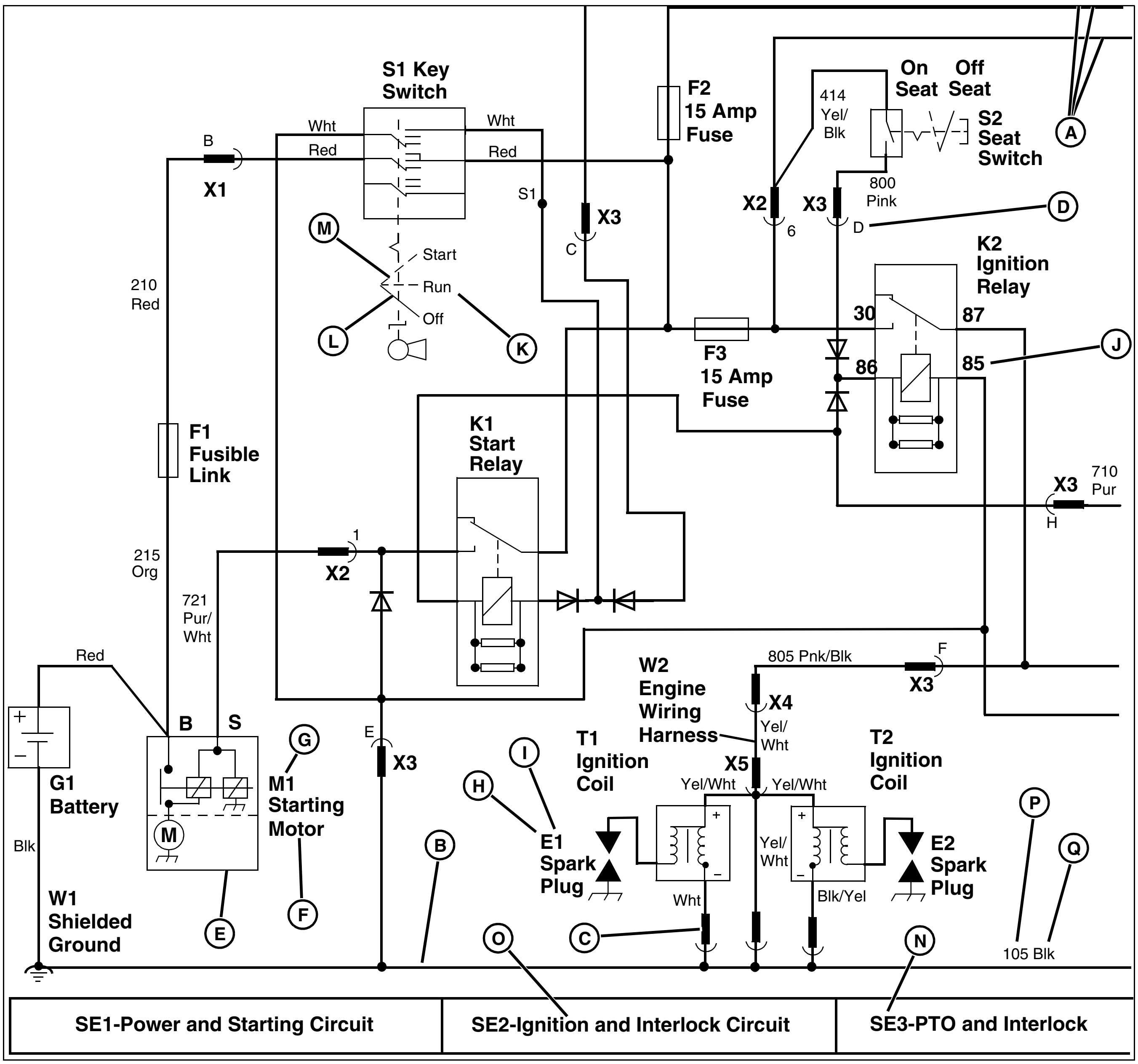
Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

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.



MIF

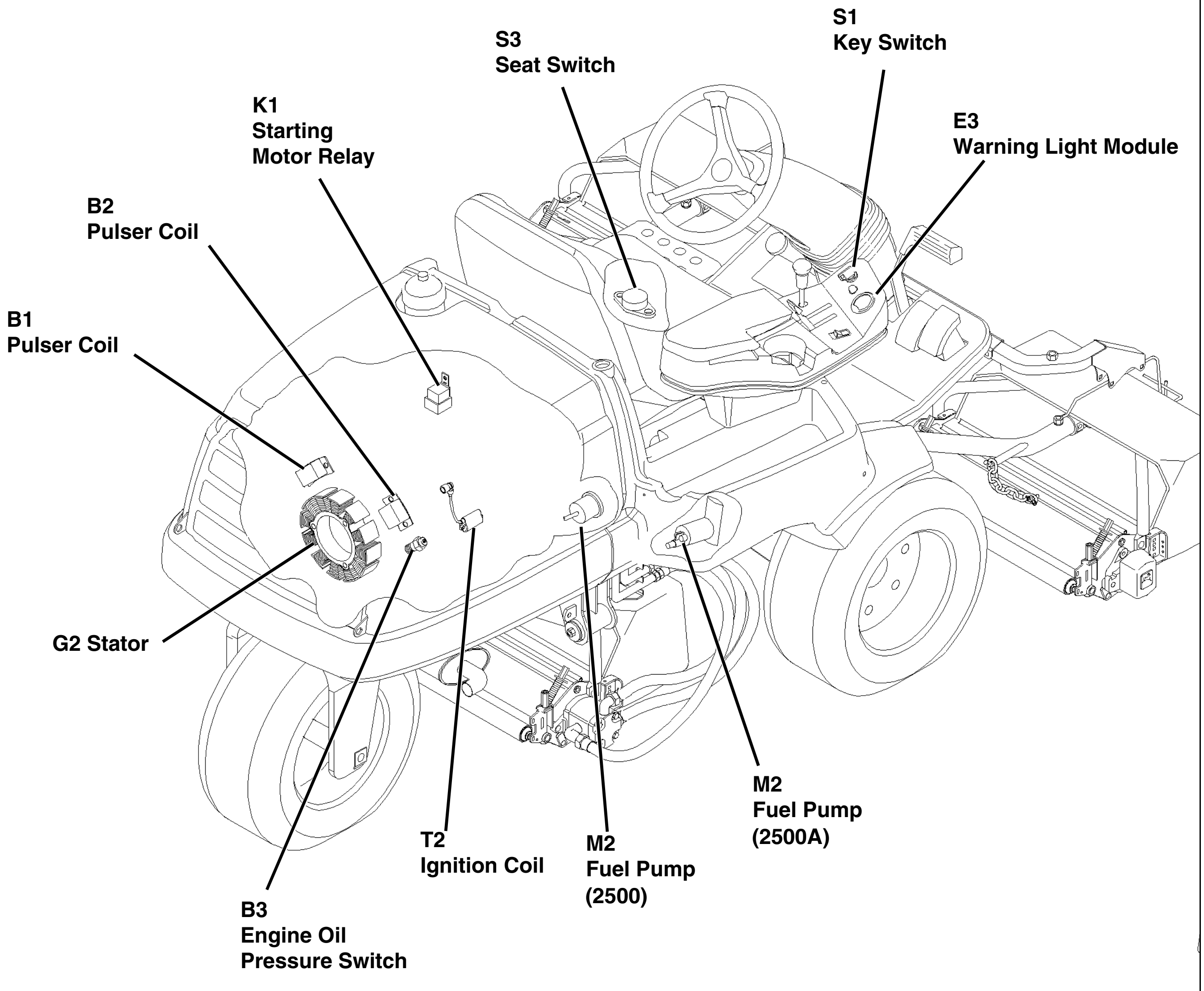
Wire Color Abbreviation Chart

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

Component Location

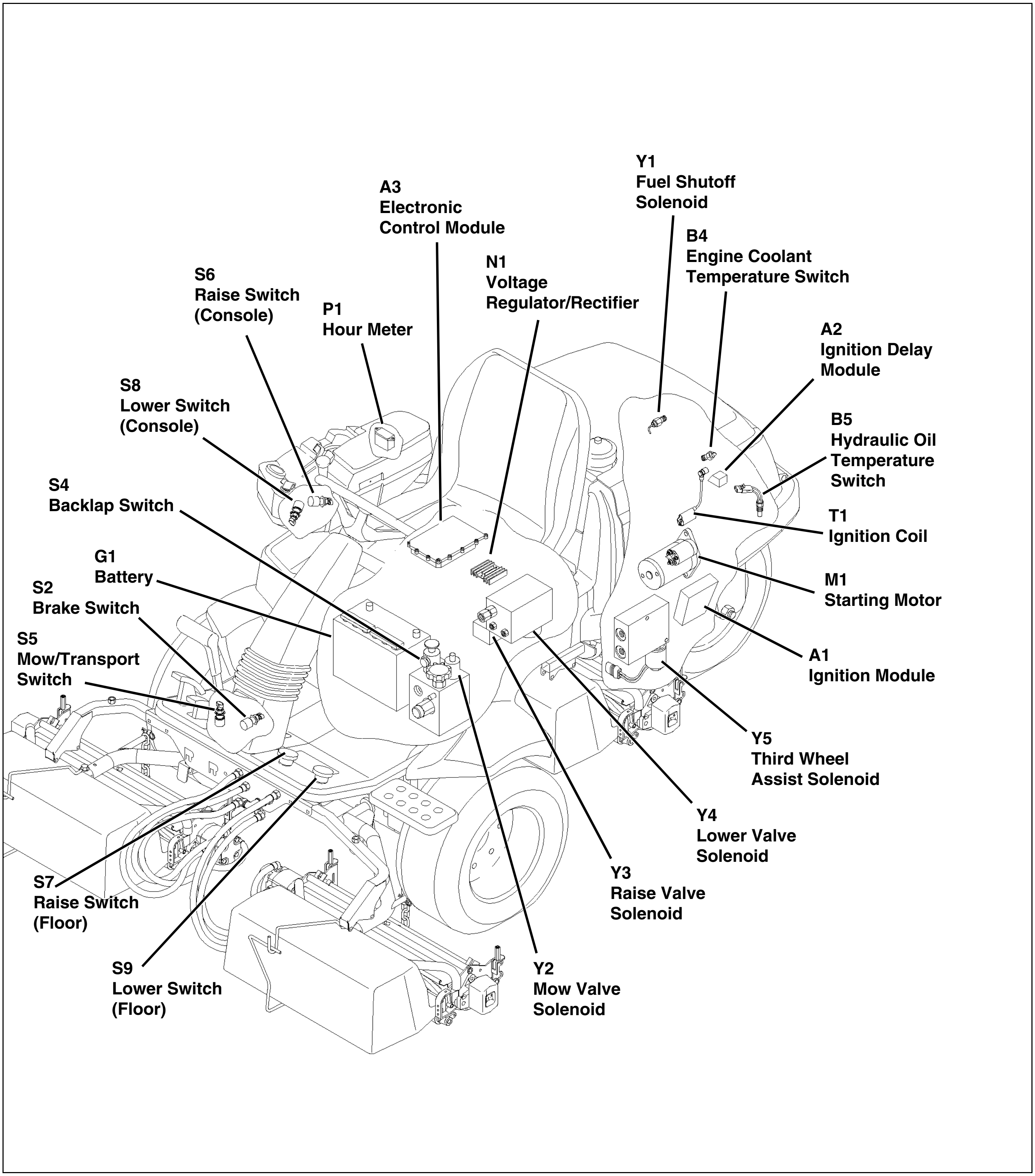
Electrical Components - Gasoline Engine Models 2500 and 2500A

(Page 1 of 2)



MX18192A

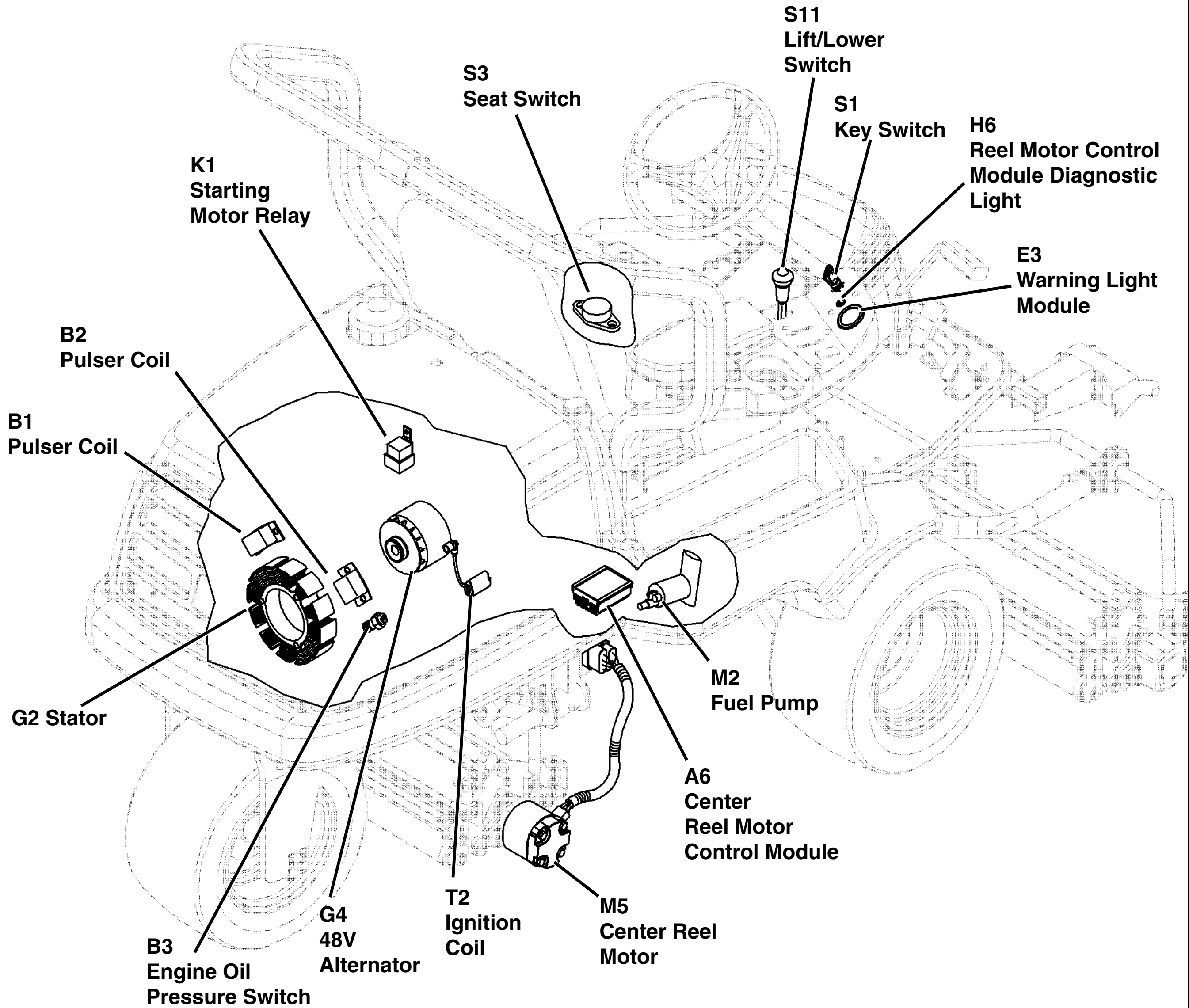
(Page 2 of 2)



MX18192B

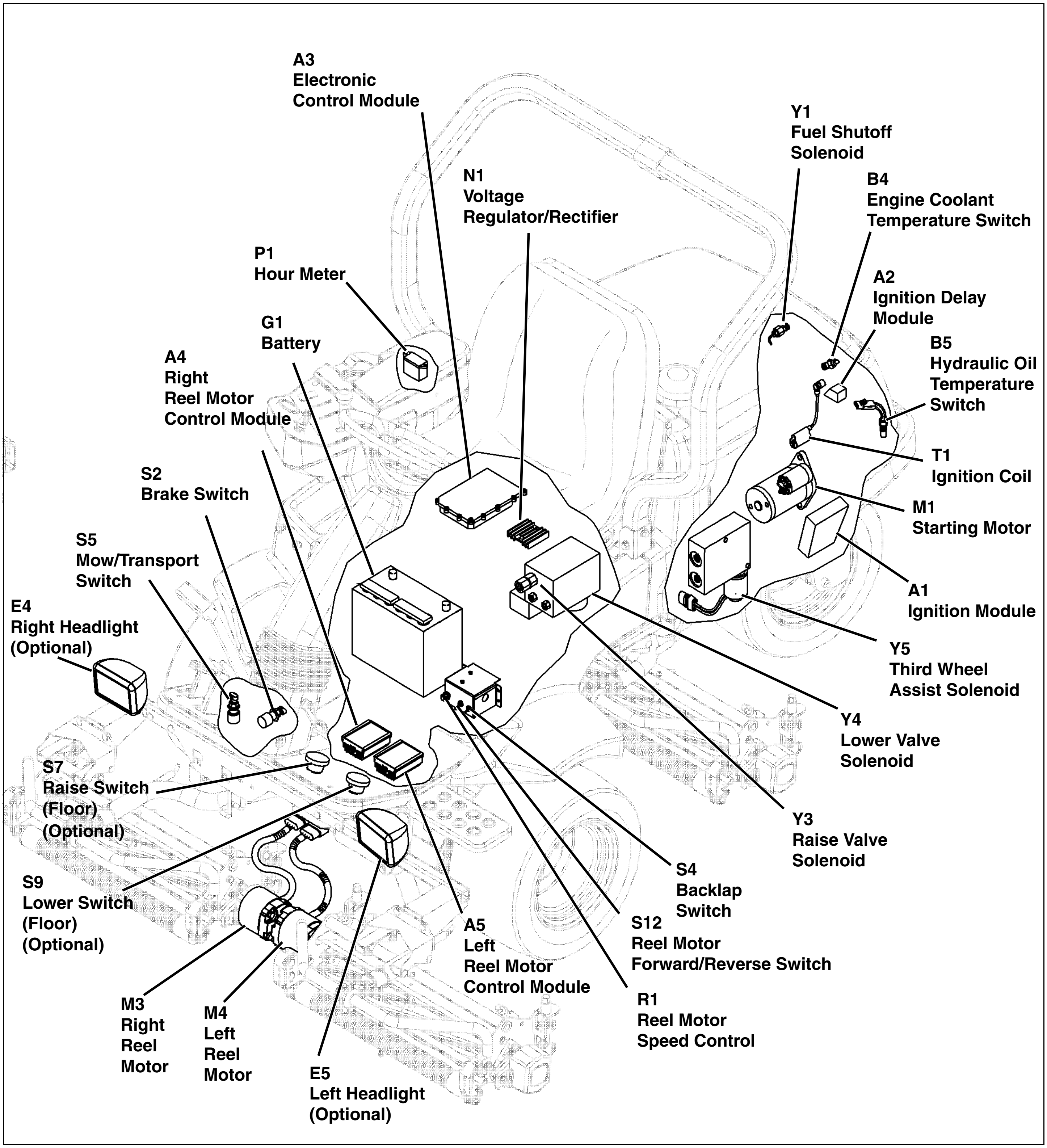
Electrical Components - Gasoline Engine Model 2500E

(Page 1 of 2)



MX20434A (MIF)

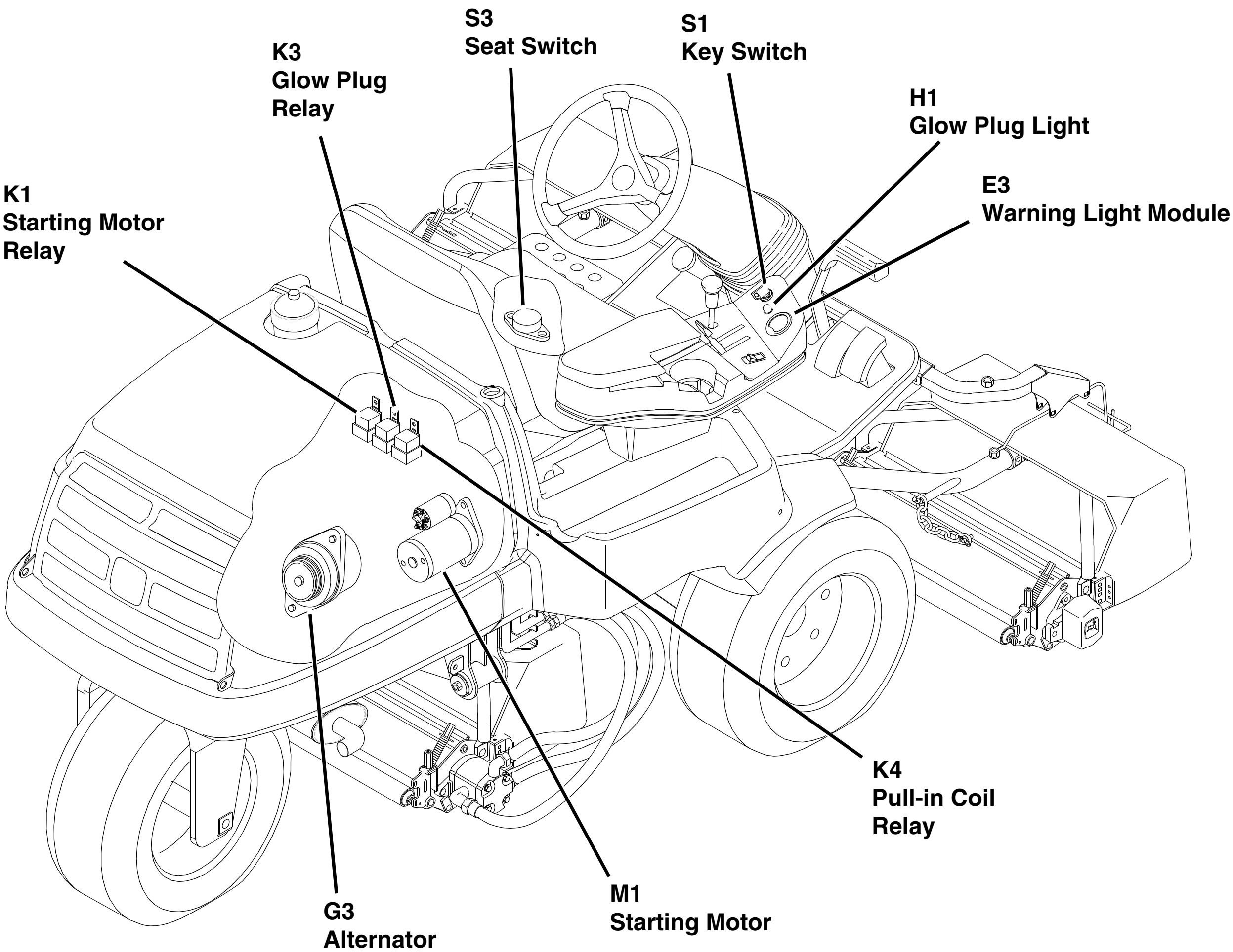
(Page 2 of 2)



MX20434B (MIF)

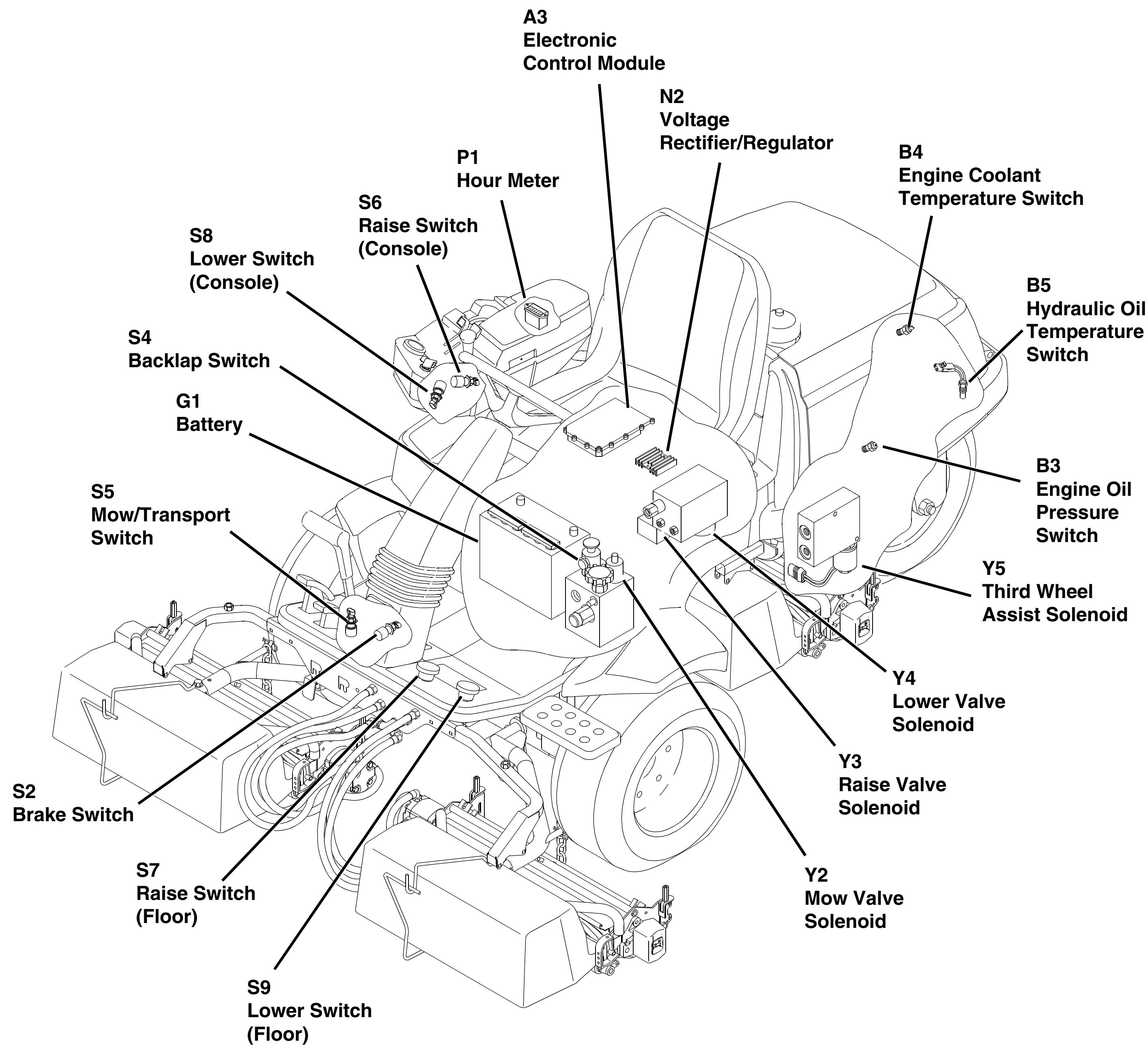
Electrical Components - Diesel Engine Models 2500, 2500A

(Page 1 of 2)



M98644A (MIF)

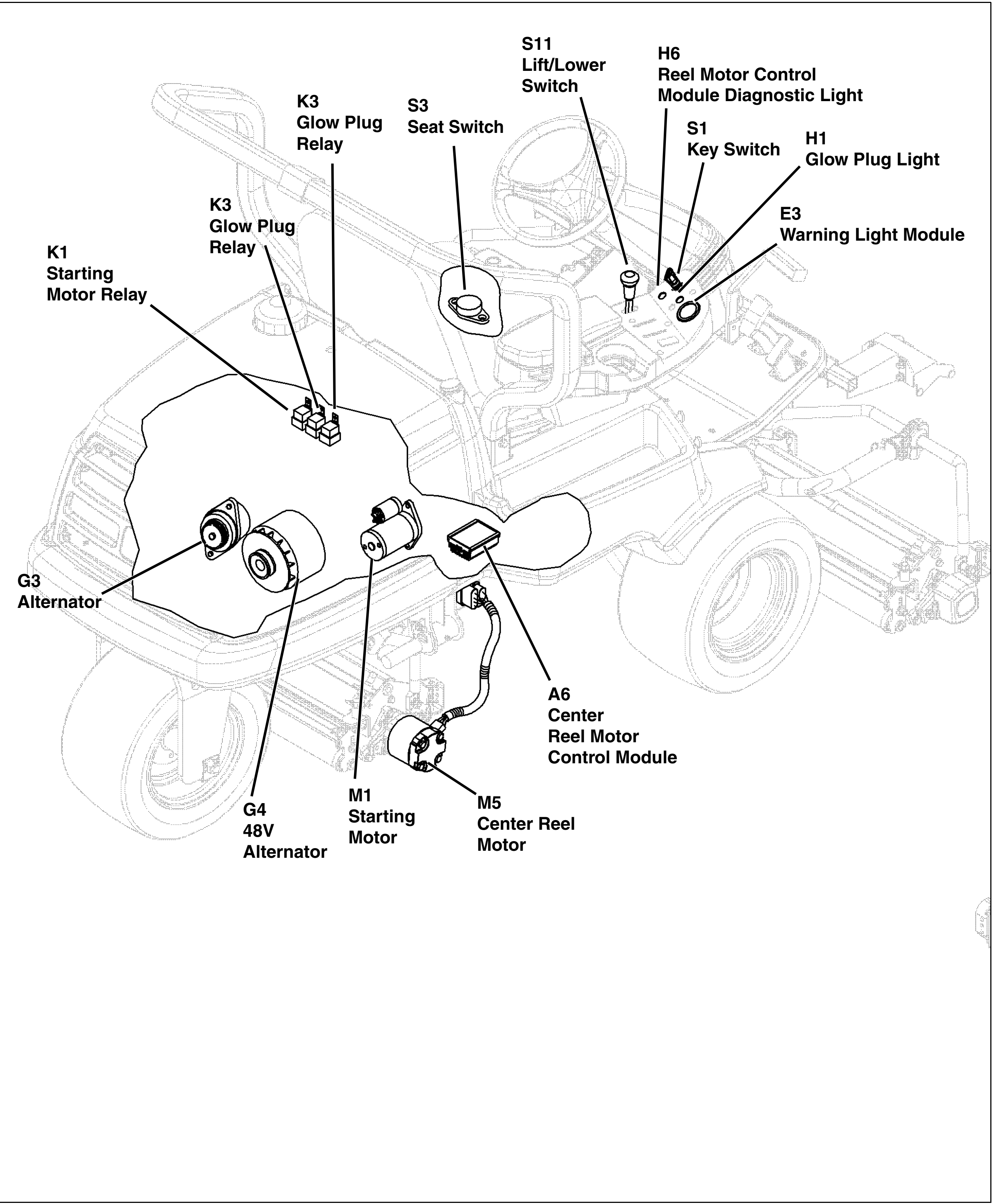
(Page 2 of 2)



M98644B (MIF)

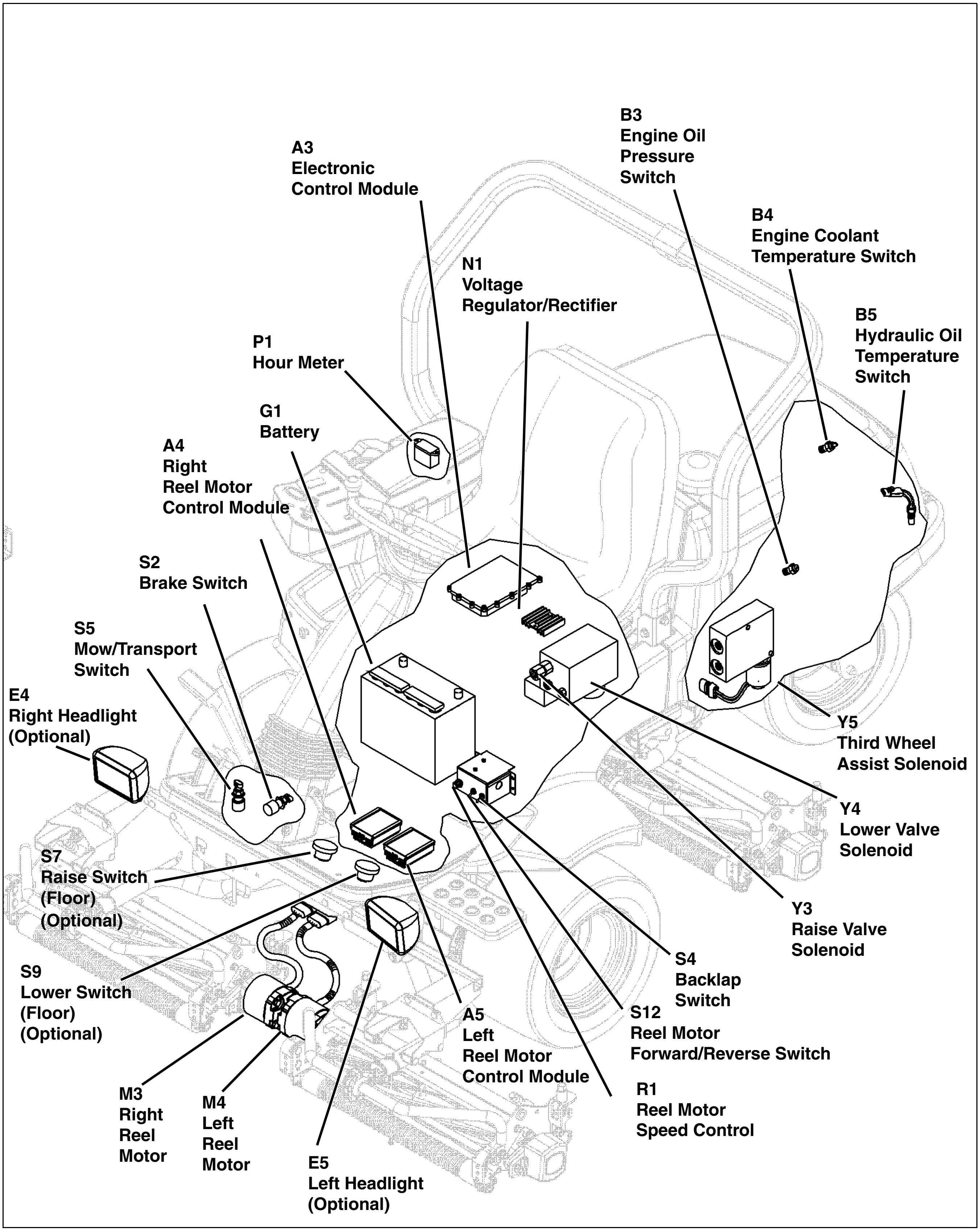
Electrical Components - Diesel Engine Model 2500E

(Page 1 of 2)



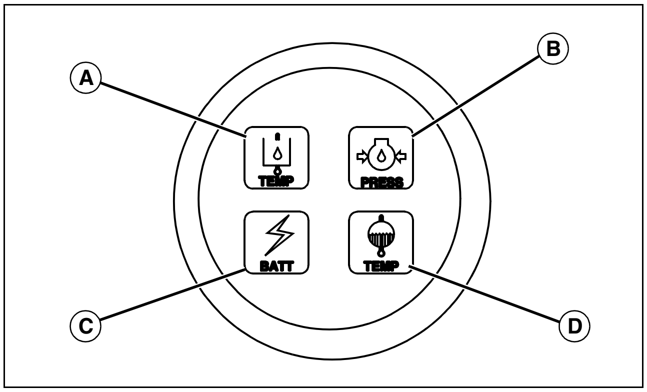
MX20481A (MIF)

(Page 2 of 2)



MX20481B (MIF)

Warning Light Module



MIF

- **A - Hydraulic Oil Temperature Light**
- **B - Engine Oil Pressure Light**
- **C - Discharge Light**
- **D - Engine Coolant Temperature Light**

Schematics and Harnesses

Schematic and Wiring Harness Legend - Gasoline Engine

Component

A1 - Ignition Module (SE3, W7)

A2 - Delay Module (SE3, W9)

A3 - Electronic Control Module (SE4, W1)

A4 - Right Reel Motor Control Module (SE16) Model 2500E

A5 - Left Reel Motor Control Module (SE16) Model 2500E

A6 - Center Reel Motor Control Module (SE16) Model 2500E

B1 - Pulser Coil (SE3, W8)

B2 - Pulser Coil (SE3, W8)

B3 - Engine Oil Pressure Switch (SE12, W5)

B4 - Engine Coolant Temperature Switch (SE12, W5)

B5 - Hydraulic Oil Temperature Switch (SE12, W1)

B6 - Not Used

B7 - Not Used

B8 - Not Used

E1 - Spark Plug (SE3)

E2 - Spark Plug (SE3)

E3 - Warning Light Module (SE12, W3[1], W17[2])

E4 - Right Headlight (SE13, W12)

E5 - Left Headlight (SE13, W12)

E6 - Rear Grass Catcher Light (SE13, W12)

F1 - Fusible Link (SE1, W1)

F2 - 15-amp Fuse (SE1, W1)

F3 - 15-amp Fuse (SE1, W1)

F4 - Fusible Link (SE13, W12)

G1 - Battery (SE1)

G2 - Stator (SE2, W6)

G3 - Not Used

G4 - 48 Volt Alternator (SE16) Model 2500E

H1 - Not Used

H2 - Discharge Light (SE12, W3[1], W17[2])

H3 - Engine Oil Pressure Light (SE12, W3[1], W17[2])

H4 - Engine Coolant Temperature Light (SE12, W3[1], W17[2])

H5 - Hydraulic Oil Temperature Light (SE12, W3[1], W17[2])

H6 - Reel Motor Control Module Diagnostic Light (SE16) Model 2500E

K1 - Starting Motor Relay (SE1, W1)

K2 - Headlight Relay (SE13, W12)

K3 - Not Used

K4 - Not Used

M1 - Starting Motor (SE1, W1)

M2 - Fuel Pump (SE3, W1)

M3 - Right Reel Motor (SE16) Model 2500E

M4 - Left Reel Motor (SE16) Model 2500E

M5 - Center Reel Motor (SE16) Model 2500E

N1 - Voltage Regulator/Rectifier (SE2, W1)

N2 - Not Used

P1 - Hour Meter (SE11, W3[1], W17[2])

R1 - Reel Motor Speed Control (SE16, W15)

S1 - Key Switch (SE1, W3[1], W17[2])

S2 - Brake Switch (SE4, W1)

S3 - Seat Switch (SE4, W1)

S4 - Backlap Switch (SE5, W1) Models 2500, 2500A

S5 - Mow/Transport Switch (SE6, W1)

S6 - Raise Switch (Console) (SE8, W3) Models 2500, 2500A (S.N. -020000)

S7 - Raise Switch (Floor) (SE9, W1)

S8 - Lower Switch (Console) (SE8, W3) Models 2500, 2500A (S.N. -020000)

S9 - Lower Switch (Floor) (SE9, W1)

S10 - Headlight Switch (SE13, W3[1], W17[2])

S11 - Lift/Lower Switch (SE10, W17) Models 2500A (S.N. 020001-), 2500E

T1 - Ignition Coil (SE3, W4)

T2 - Ignition Coil (SE3, W4)

V1 - Starting Motor Relay Diode (SE1, W1)

V2 - Third Wheel Assist Diode (SE15, W11)

V3 - Not Used

Y1 - Fuel Shutoff Solenoid (SE3, W4)

Y2 - Mow Valve Solenoid (SE6, W1) Models 2500, 2500A

Y3 - Raise Solenoid (SE7, W1)

Y4 - Lower Solenoid (SE7, W1)

Y5 - Third Wheel Assist Solenoid (SE15, W11)

Y6 - Not Used

1. Models 2500, 2500A (S.N. -020000)

2. Models 2500A (S.N. 020001-), 2500E

Connectors

X1 - Main Wiring Harness-to-Console Wiring Harness Connector (SE1, SE4, W1, W3[1], W17[2])

X2 - Main Wiring Harness-to-Console Wiring Harness Connector (SE1, SE4, W1, W3[1], W17[2])

X3 - Main Wiring Harness-to-Console Wiring Harness Connector (SE1, SE4, SE8, SE10, SE12, W1, W3[1], W17[2])

X4 - Main Wiring Harness-to-Console Wiring Harness Connector (SE13, W1, W3[1], W17[2])

X5 - Seat Switch (S3) Connector (W1)

X6 - Seat Switch (S3) Connector (W1)

X7 - Electronic Control Module (A3) Connector (SE4, W1)

X8 - Electronic Control Module (A3) Connector (SE4, W1)

X9 - Electronic Control Module (A3) Connector (SE4, W1)

X10 - Main Wiring Harness-to-Ground Ring Terminal Terminal (SE1, W1)

X11 - Lower Valve Solenoid (Y4) Connector (SE7, W1)

X12 - Raise Valve Solenoid (Y3) Connector (SE7, W1)

X13 - Main Wiring Harness-to-Leak Detection (SE14, W1)

X14 - Mow Valve Solenoid (Y2) Connector (SE6, W1) Models 2500, 2500A

X14 - Mow Valve Solenoid (Y2) Connector (SE16, W1) Model 2500E

X15 - Backlap Switch(S4) Connector (W1)

X16 - Starting Motor Relay (K1) Connector (W1)

X17 - Main Wiring Harness-to-Engine Harness (SE1, SE2, SE3, SE12, W1, W5)

X18 - Brake Switch (S2) Connector (W1)

X19 - Hydraulic Oil Temperature Switch (B5) Connector (SE12, W1)

X20 - Main Wiring Harness-to-Starting Motor Battery Terminal Connector (SE1, W1)

X21 - Main Wiring Harness-to-Starting Motor Battery Terminal Connector (SE1, W1)

X22 - Mow/Transport Switch (S5) Connector (SE6, W1) Models 2500, 2500A

X22 - Mow/Transport Switch (S5) Connector (SE16, W1) Models 2500E

X23 - Raise Switch (Floor) (S7) Connector (W1)

X24 - Lower Switch (Floor) (S9) Connector (W1)

X25 - Main Wiring Harness-to-Lighting Kit Harness (SE13, W1, W12)

X26 - Fuel Pump (M2) Connector (W1)

X27 - Starting Motor Relay Diode (V1) Connector (W1)

X28 - Voltage Rectifier/Regulator (N1) Connector (W1)

X29 - 15-amp Fuse (F3) Connector (W1)

X30 - Not Used

X31 - Key Switch (S1) Connector (SE1, W3[1], W17[2])

X32 - Glow Plug Light Terminal (Not Used) (W3[1], W17[2])

X33 - Glow Plug Light Terminal Connector (Not Used) (SE4, W3[1], W17[2])

X34 - Lower Switch (S8) Connector (W3[1], W17[2])

X35 - Raise Switch (S6) Connector (W3[1], W17[2])

X36 - Hour Meter (P1) Connector (SE11, W3[1], W17[2])

X37 - Headlight Switch (S10) Connector (W3[1], W17[2])

X38 - Warning Light Module (E3) Connector (SE12, W3[1], W17[2])

X39 - Ignition Wiring Harness-to-Ground Ring Terminal Connector (W4)

X40 - Ignition Coil Terminal Connector (W4)

X41 - Ignition Coil Terminal Connector (W4)

X42 - Ignition Coil Terminal Connector (W4)

X43 - Ignition Coil Terminal Connector (W4)

X44 - Ignition Wiring Harness-to-Ignition Delay Module Harness Connector (SE3, W4, W9)

X45 - Ignition Wiring Harness-to-Ignition Delay Module Harness Connector (SE3, W4, W9)

X46 - Ignition Wiring Harness-to-Ignition Module Harness Connector (SE3, W4, W7)

X47 - Engine Wiring Harness-to-Ignition Delay Wiring Harness Connector (SE3, W4, SE12, W9)

X48 - Engine Wiring Harness-to-Oil Pressure Switch (B3) Terminal Connector (W5)

X49 - Engine Wiring Harness-to-Engine Coolant Temperature Switch (B4) Terminal Connector (W5)

X50 - Engine Wiring Harness-to-Starting Motor (M1) Solenoid Terminal Connector (W5)

X51 - Ignition Module Harness-to-Pulser Coil Harness Connector (SE3, W7, W8)

X52 - Not Used

X53 - Ignition Delay Module (A2) Ground Terminal Connector (SE3, W9)

X54 - Ignition Delay Module (A2) Wiring Harness-to-Starting Motor (M1) Battery Terminal Connector (SE3, W9)

X55 - Not Used

X56 - Not Used

X57 - Not Used

X58 - Not Used

X59 - Not Used

X60 - Not Used

X61 - Not Used

X62 - Not Used

X63 - Not Used

X64 - Not Used

X65 - Not Used

X66 - Not Used

X67 - Not Used

X68 - Not Used

X69 - Third Wheel Assist Wiring Harness-to-Mow/Transport Switch Connector (SE6, SE16, W11)

X70 - Third Wheel Assist Wiring Harness-to-Main Harness Mow/Transport Switch Connector (SE6, SE11, W11)

X71 - Third Wheel Assist Solenoid (Y5) Connector (SE15, W11)

X72 - Third Wheel Assist Wiring Harness Ground Terminal Connector (SE15, W11)

X73 - Third Wheel Assist Diode (V2) Connector (SE15, W11)

X74 - Headlight Relay (K2) Connector (W12)

X75 - Lighting Harness-to-Starting Motor (M1) Battery Terminal Connector (SE13, W12)

X76 - Lighting Harness Ground Terminal Connector (W12)

X77 - Right Headlight (E4) Connector (SE13, W12)

X78 - Left Headlight (E5) Connector (SE13, W12)

X79 - Grass Catcher Light (E6) Connector (SE13, W12)

X80 - Fuel Pump Harness Connector (W13, W14)

X81 - Fuel Pump Terminal (W14)

X82 - Fuel Pump Terminal (W14)

X83 - Center Reel Motor Control Module Connector (SE16, W15)

X84 - Reel Motor Forward/Reverse Switch Connector (SE16, W15)

X85 - Reel Motor Control Module Diagnostic Light Harness Connector (SE16, W15)

X86 - Reel Motor Speed Control Connector (SE16, W15)

X87 - Reel Motor Control Module Signal Harness -to-Mow Solenoid Connector (X14) (SE16, W15)

X88 - Right Reel Motor Control Module Connector (SE16, W15)

X89 - Left Reel Motor Control Module Connector (SE16, W15)

X90 - Reel Motor Control Module Diagnostic Light Terminal Connector

X91 - Reel Motor Control Module Diagnostic Light Terminal Connector

X92 - Reel Motor Power Harness-to-Mow/Transport Switch (SE6, W16)

X93 - Reel Motor Power Harness-to-Main Harness-to-Mow/Transport Switch Connector (SE6, W16)

X94 - Reel Motor Power Harness Jumper Wire Terminal Connector (SE16, W16)

X95 - Reel Motor Power Harness Jumper Wire Terminal Connector (SE16, W16)

X96 - Reel Motor Power Harness 48V Alternator-to-Junction Block Terminal Connector (SE16, W16)

X97 - Reel Motor Power Harness 48V Alternator Ground Terminal Connector (SE16, W16)

X98 - Reel Motor Power Harness 48V Alternator Positive (+) Terminal Connector (SE16, W16)

X99 - Reel Motor Power Harness 48V Alternator Field Terminal Connector (SE16, W16)

X100 - Reel Motor Power Harness Frame Ground Terminal Connector (SE16, W16)

X101 - Lift/Lower Switch Connector (SE10, W17)[2]

1. Models 2500, 2500A (S.N. -020000)

2. Models 2500A (S.N. 020001-), 2500E

Harness

W1 - Main Wiring Harness

W2 - Not Used

W3 - Console Wiring Harness Models 2500, 2500A (S.N. -020000)

W4 - Ignition Wiring Harness

W5 - Engine Wiring Harness

W6 - Stator Wiring Harness

W7 - Igniting Module Wiring Harness

W8 - Pulser Coil Wiring Harness

W9 - Ignition Delay Module Wiring Harness

W10 - Not Used

W11 - Third Wheel Assist Harness

W12 - Lighting Kit Wiring Harness

W13 - Fuel Pump Jumper Wiring Harness

W14 - Fuel Pump Wiring Harness

W15 - Reel Motor Control Module Signal Wiring Harness Model 2500E

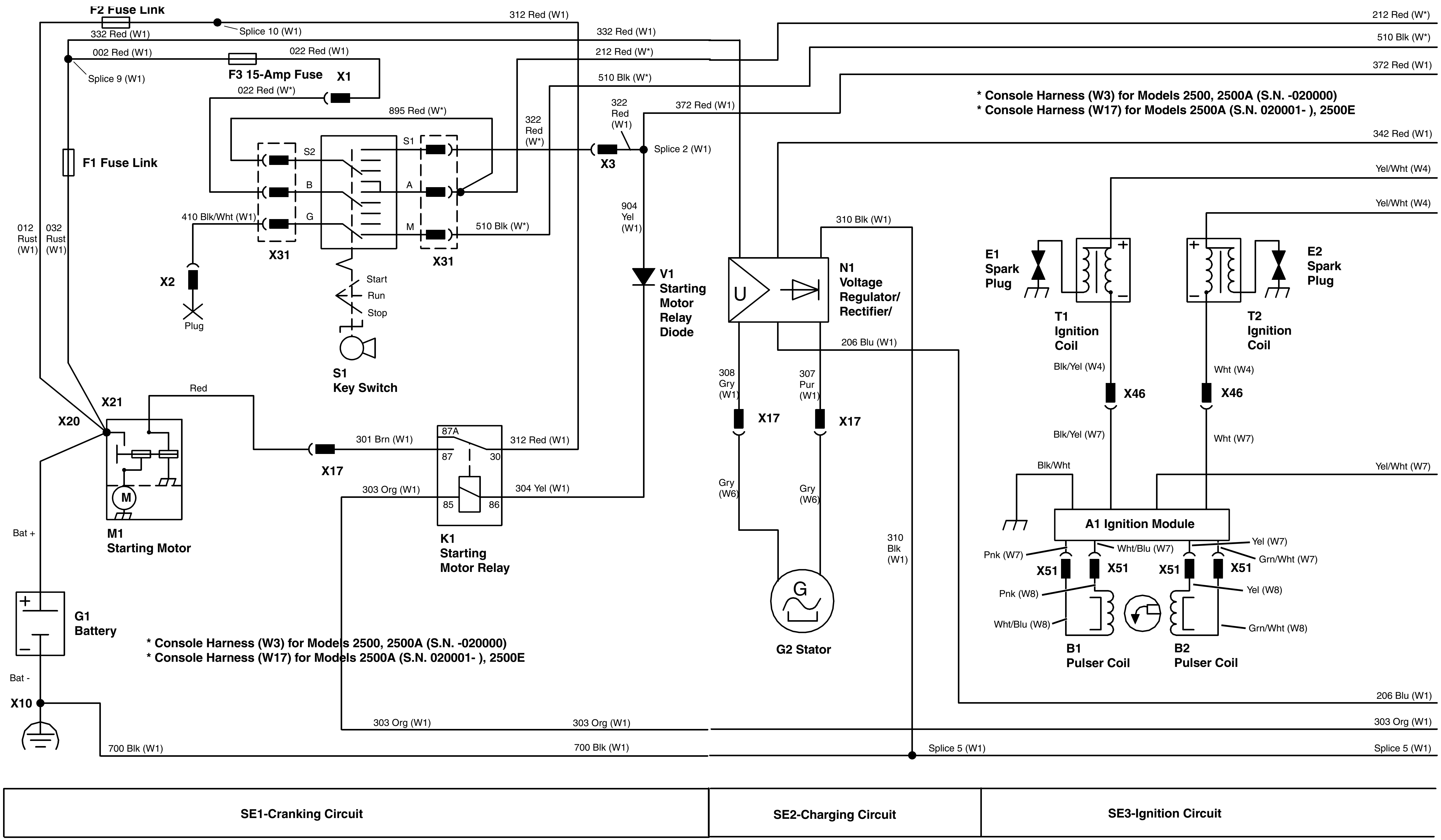
W16 - Reel Motor Control Module Power Wiring Harness Model 2500E

W17 - Console Wiring Harness Models 2500A (S.N. 020001-), 2500E

W18 Reel Motor Diagnostic Light Wiring Harness Model 2500E

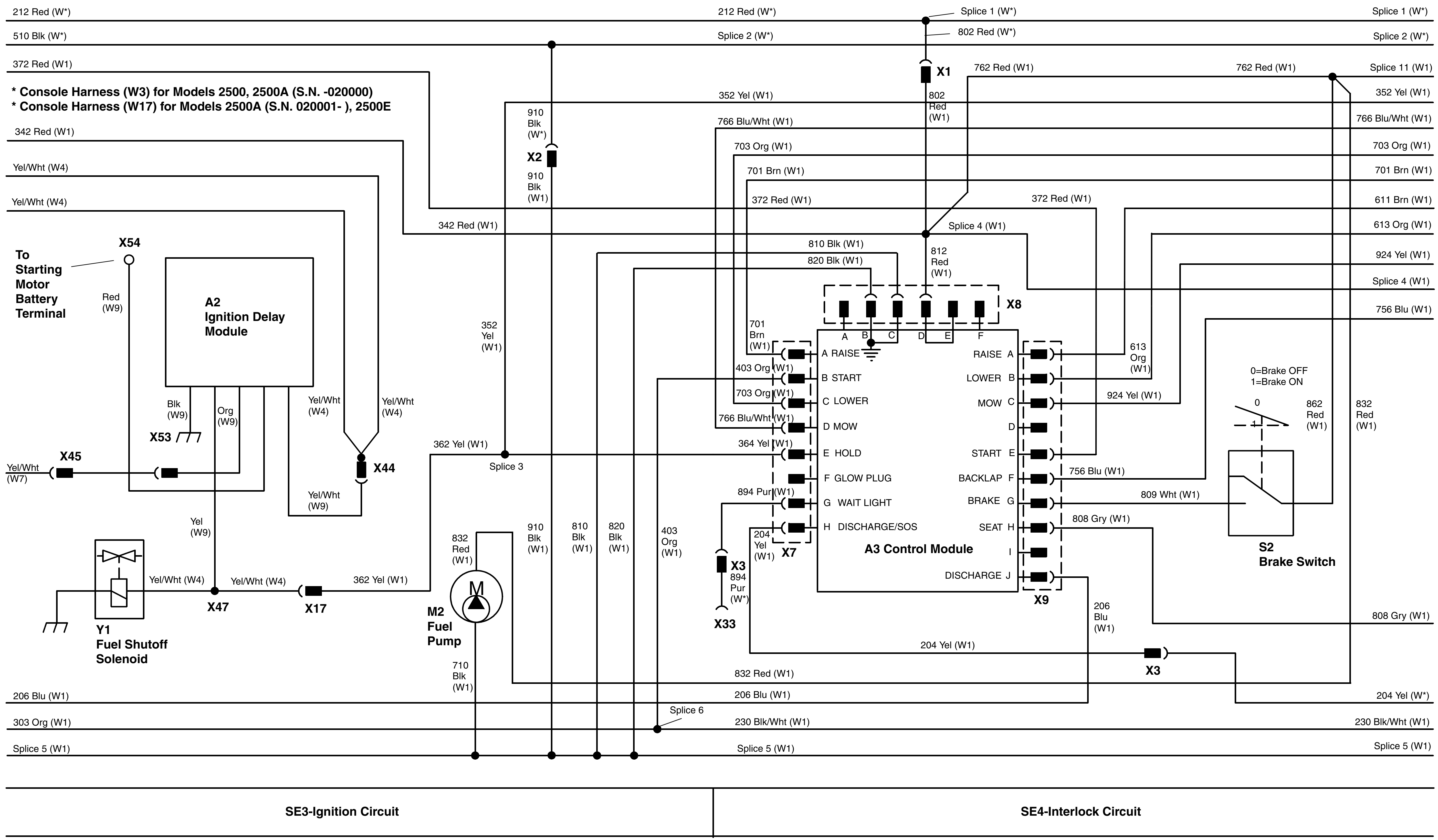
Main Electrical Schematic - Gasoline Engine

Gasoline Engine (1 of 6)



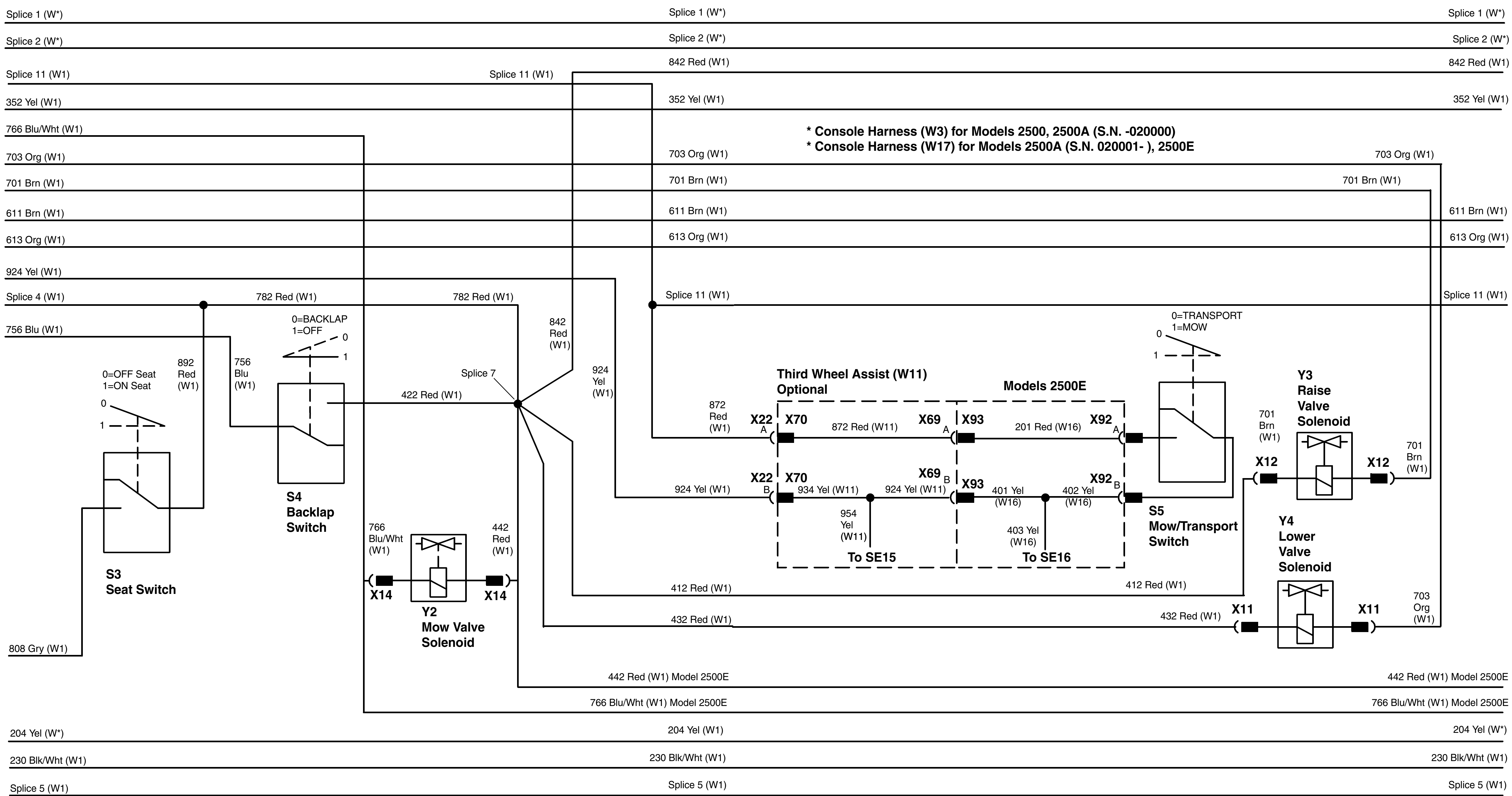
MX20409 (MIF)

Gasoline Engine (2 of 6)



MX20410 (MIF)

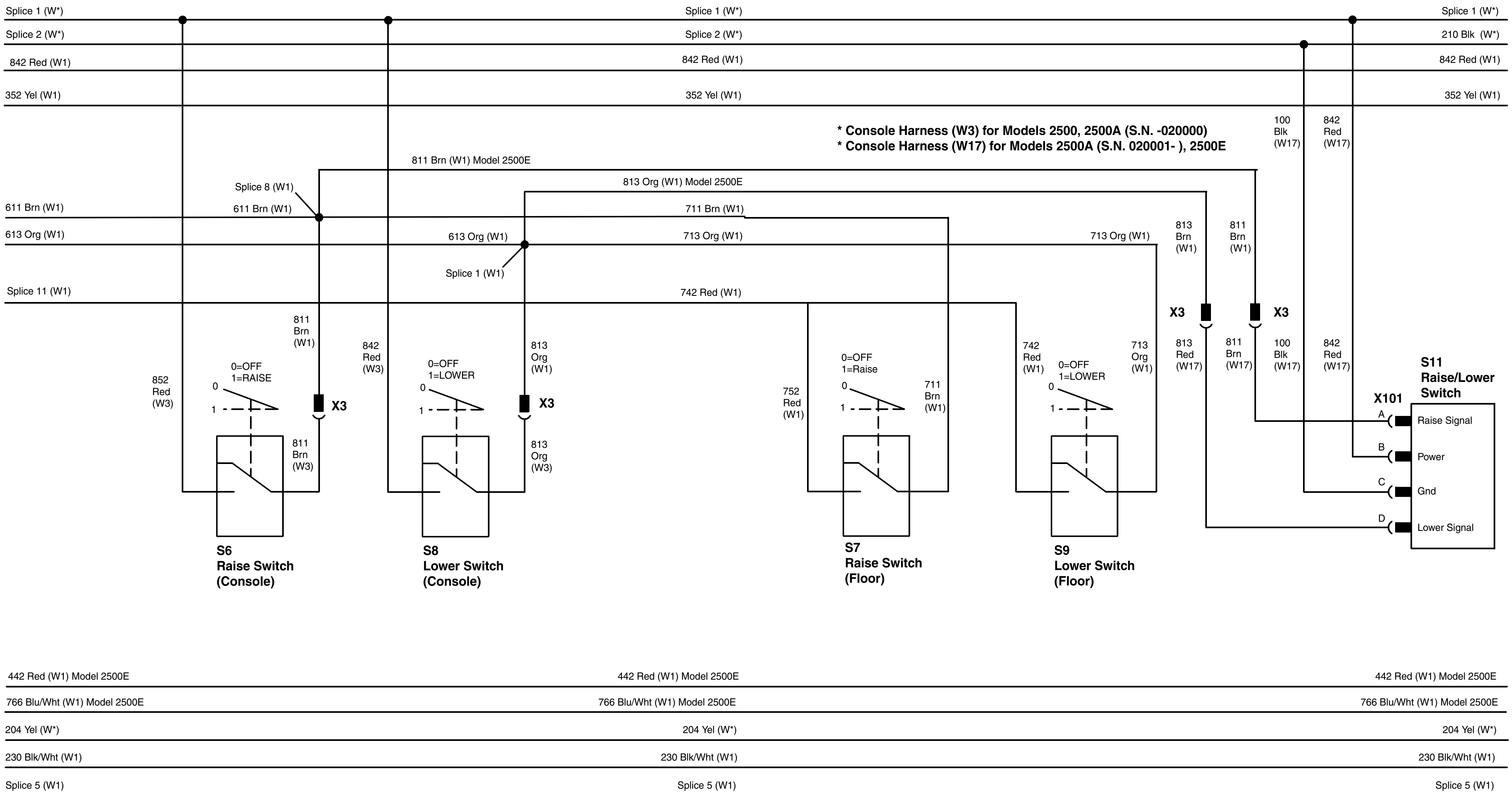
Gasoline Engine (3 of 6)



SE4-Interlock Circuit	SE5-Backlap Circuit	SE6-Mow Circuit Models 2500, 2500A	SE7-Raise/Lower Circuit

MX20411 gas (MIF)

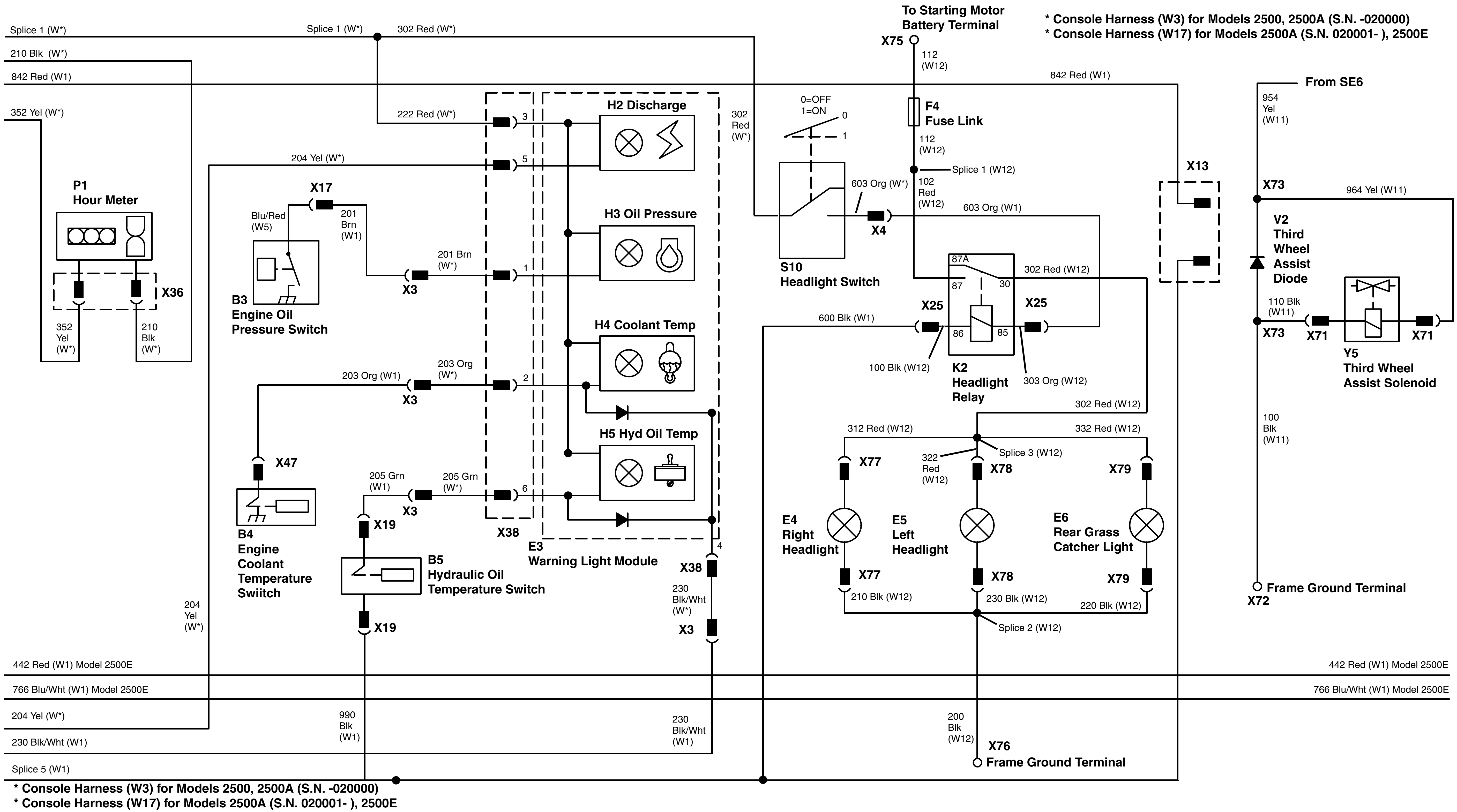
Gasoline Engine (4 of 6)



SE8-Raise/Lower Console Switches Models 2500, 2500A (S.N. -020000)	SE9-Raise/Lower Floor Switches (Optional)	SE10-Raise/Lower Console Switch Models 2500A (S.N. 020001-), 2500E

MX20412 gas (MIF)

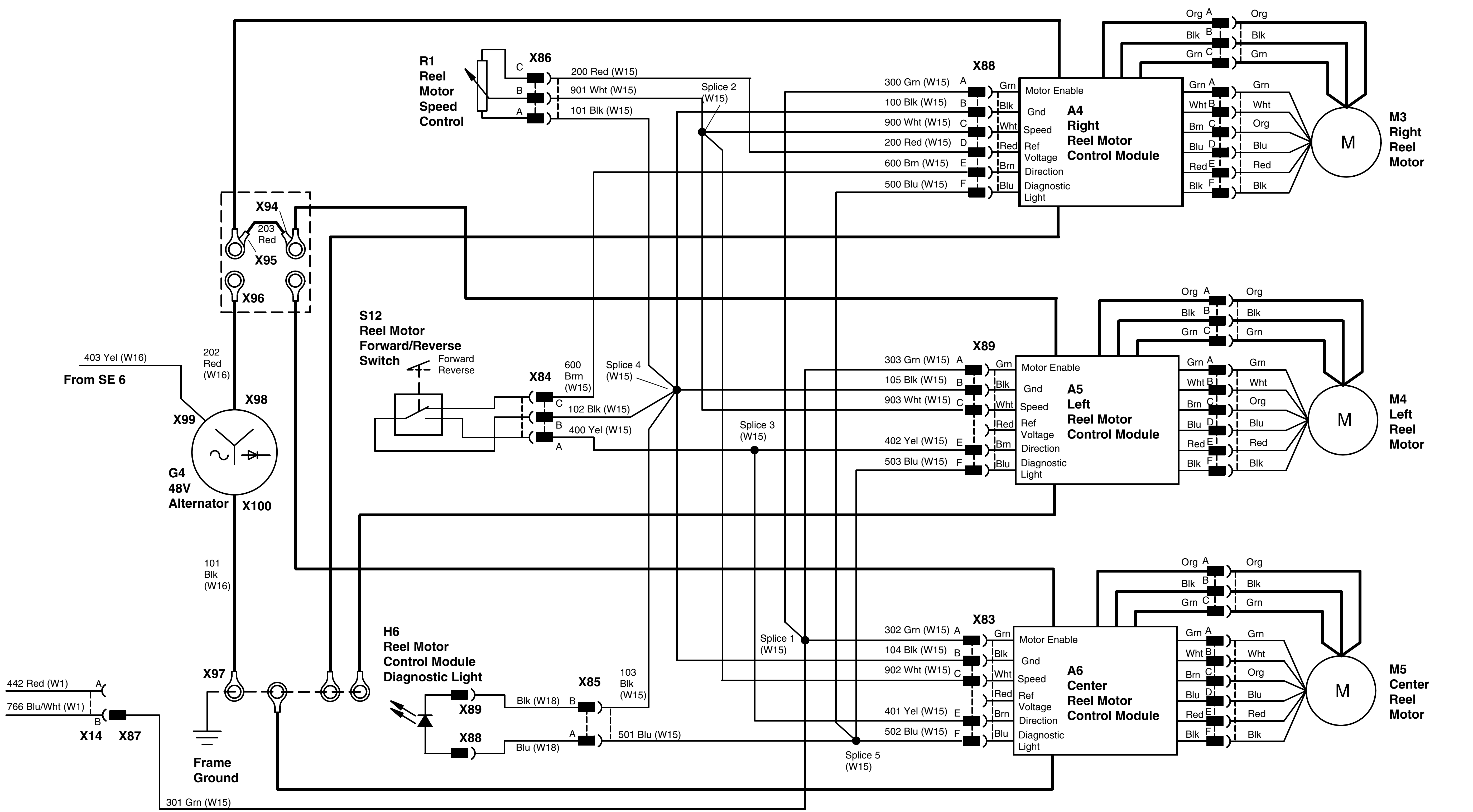
Gasoline Engine (5 of 6)



SE11-Hour Meter Circuit	SE12-Warning Light Circuit	SE13-Lighting Circuit	SE-14 Leak Detection	SE15-Third Wheel Assist Circuit

MX20413 (MIF)

Gasoline Engine (6 of 6)



SE16-Mow Circuit Model 2500E	SE16-Mow Circuit Model 2500E

MX20414 gas (MIF)

Schematic and Wiring Harness Legend - Diesel Engine

Component

A1 - Not Used

A2 - Not Used

A3 - Electronic Control Module (SE5, W2)

A4 - Right Reel Motor Control Module (SE17, W15) Model 2500E

A5 - Left Reel Motor Control Module (SE17, W15) Model 2500E

A6 - Center Reel Motor Control Module (SE17, W15) Model 2500E

B1 - Not Used

B2 - Not Used

B3 - Engine Oil Pressure Switch (SE3, W10)

B4 - Engine Coolant Temperature Switch (SE13, W10)

B5 - Hydraulic Oil Temperature Switch (SE13, W2)

B6 - Glow Plug (SE2, W2)

B7 - Glow Plug (SE2, W2)

B8 - Glow Plug (SE2, W2)

E1 - Not Used

E2 - Not Used

E3 - Warning Light Module (SE13, W3[1], W17[2])

E4 - Right Headlight (SE14, W12)

E5 - Left Headlight (SE14, W12)

E6 - Rear Grass Catcher Light (SE14, W12)

F1 - Fusible Link (SE1, W2)

F2 - Not Used

F3 - 15-amp Fuse (SE1, W2)

F4 - Fusible Link (SE14, W12)

G1 - Battery (SE1)

G2 - Not Used

G3 - 12 Volt Alternator (SE4, W10)

G4 - 48 Volt Alternator (SE17) Model 2500E

H1 - Glow Plug Light (SE2, W3[1], W17[2])

H2 - Discharge Light (SE13, W3[1], W17[2])

H3 - Engine Oil Pressure Light (SE13, W3[1], W17[2])

H4 - Engine Coolant Temperature Light (SE13, W3[1], W17[2])

H5 - Hydraulic Oil Temperature Light (SE13, W3[1], W17[2])

H6 - Reel Motor Control Module Diagnostic Light (SE17) Model 2500E

K1 - Starting Motor Relay (SE1, W10)

K2 - Headlight Relay (SE14, W12)

K3 - Glow Plug Relay (SE2, W10)

K4 - Pull-in Coil Relay (SE3, W10)

M1 - Starting Motor (SE1, W2)

M2 - Not Used

M3 - Right Reel Motor (SE17) Model 2500E

M4 - Left Reel Motor (SE17) Model 2500E

M5 - Center Reel Motor (SE17) Model 2500E

N1 - Not Used

N2 - Voltage Regulator/Rectifier (SE4, W2)

P1 - Hour Meter (SE12, W3[1], W17[2])

S1 - Key Switch (SE1, W3[1], W17[2])

S2 - Brake Switch (SE5, W2)

S3 - Seat Switch (SE5, W2)

S4 - Backlap Switch (SE5, W2)

S5 - Mow/Transport Switch (SE7, W2)

S6 - Raise Switch (Console) (SE9, W3) Models 2500, 2500A (S.N. -020000)

S7 - Lift Switch (Floor) (SE10, W2)

S8 - Lower Switch (Console) (SE9, W3) Models 2500, 2500A (S.N. -020000)

S9 - Lower Switch (Floor) (SE10, W2)

S10 - Headlight Switch (SE14, W3[1], W17[2])

S11 - Lift/Lower Switch (SE11, W17) Models 2500A (S.N. 020001-), 2500E

T1 - Not Used

T2 - Not Used

V1 - Starting Motor Relay Diode (SE1, W2)

V2 - Third Wheel Assist Diode (SE16, W11)

V3 - Pull-in Coil Diode (SE3, W10)

Y1 - Not Used

Y2 - Mow Valve Solenoid (SE7, W2) Models 2500, 2500A

Y3 - Raise Solenoid (SE8, W2)

Y4 - Lower Solenoid (SE8, W2)

Y5 - Third Wheel Assist Solenoid (SE16, W11)

Y6 - Fuel Shutoff Solenoid (SE3, W10)

1. Models 2500, 2500A (S.N. -020000)

2. Models 2500A (S.N. 020001-), 2500E

Connectors

X1 - Main Wiring Harness-to-Console Wiring Harness Connector (SE1, SE5, W2, W3[1], W17[2])

X2 - Main Wiring Harness-to-Console Wiring Harness Connector (SE1, SE5, W2, W3[1], W17[2])

X3 - Main Wiring Harness-to-Console Wiring Harness Connector (SE2, SE5, SE9[1], SE11[2], SE12, SE13, W2, W3[1], W17[2])

X4 - Main Wiring Harness-to-Console Wiring Harness Connector (SE4, SE14, W2, W3[1], W17[2])

X5 - Seat Switch Connector (W2)

X6 - Seat Switch Connector (W2)

X7 - Electronic Control Module Connector (SE5, W2)

X8 - Electronic Control Module Connector (SE5, W2)

X9 - Electronic Control Module Connector (SE5, W2)

X10 - Main Wiring Harness-to-Ground Terminal (W2)

X11 - Lower Valve Solenoid Connector (SE8, W2)

X12 - Raise Valve Solenoid Connector (SE8, W2)

X13 - Main Wiring Harness-to-Leak Detection (SE15, W2)

X14 - Mow Valve Solenoid Connector (SE7, W2) Models 2500, 2500A

X14 - Mow Valve Solenoid Connector (SE17, W2, W16) Model 2500E

X15 - Backlap Switch Connector (W2)

X16 - Not Used

X17 - Main Wiring Harness-to-Engine Harness (SE2, SE3, SE4, SE13, W2, W10)

X18 - Brake Switch Connector (W2)

X19 - Hydraulic Oil Temperature Switch Connector (SE13, W2)

X20 - Not Used

X21 - Main Wiring Harness-to-Starting Motor Battery Terminal Connector (X 21, W2)

X22 - Mow/Transport Switch (S5) Connector (SE7, W2)

X23 - Floor Raise Switch Connector (W2)

X24 - Floor Lower Switch Connector (W2)

X25 - Main Wiring Harness-to-Lighting Kit Harness (SE14, W2, W12)

X26 - Not Used

X27 - Starting Motor Relay Diode Connector (W2)

X28 - Voltage Rectifier/Regulator Connector (W2)

X29 - 15-amp Fuse (F3) Connector (W2)

X30 - Main Wiring Harness-to- Engine Harness (SE1, W2, W10)

X31 - Key Switch (S1) Connector (SE1, W3[1], W17[2])

X32 - Glow Plug Light (H1) Connector (W3[1], W17[2])

X33 - Glow Plug Light (H1) Connector (SE3, W3[1], W17[2])

X34 - Lower Switch (S8) Connector (W3[1], W17[2])

X35 - Raise Switch (S6) Connector (W3[1], W17[2])

X36 - Hour Meter (P1) Connector (SE12, W3[1], W17[2])

X37 - Headlight Switch (S10) Connector (W3[1], W17[2])

X38 - Warning Light Module (E3) Connector (SE13, W3[1], W17[2])

X39 - Not Used

X40 - Not Used

X41 - Not Used

X42 - Not Used

X43 - Not Used

X44 - Not Used

X45 - Not Used

X46 - Not Used

X47 - Not Used

X48 - Not Used

X49 - Not Used

X50 - Not Used

X51 - Not Used

X52 - Not Used

X53 - Not Used

X54 - Not Used

X55 - Engine Wiring Harness to Alternator Connector (SE2, W10)

X56 - Engine Wiring Harness to Starting Motor (M1) Battery Terminal Connector (SE1, W10)

X57 - Engine Wiring Harness to Starting Motor (M1) Solenoid Connector (W10)

X58 - Engine Wiring Harness to Starting Motor (M1) Battery Terminal Connector (SE1, W10)

X59 - Engine Wiring Harness to Starting Motor (M1) Solenoid Terminal Connector (SE1, W10)

X60 - Glow Plug (B6) Terminal Connector (W10)

X61 - Fuel Shutoff Solenoid (Y6) Connector (SE1, W10)

X62 - Glow Plug Relay (K3) Connector (W10)

X63 - Engine Wiring Harness Ground Terminal Connector (SE3, W10)

X64 - Fuel Pull-in Coil Relay (K4) Connector (W10)

X65 - Fuel Pull-in Coil Diode (V3) Connector (W10)

X66 - Starting Motor Relay (K1) Connector (W10)

X67 - Engine Coolant Temperature Switch (B4) Connector (SE13, W10)

X68 - Engine Oil Pressure Switch (B3) Connector (W10)

X69 - Third Wheel Assist Wiring Harness-to-Mow/ Transport Switch Connector (SE7, W2, W11)

X70 - Third Wheel Assist Wiring Harness-to-Main Harness Mow/Transport Switch Connector (SE7, W11)

X71 - Third Wheel Assist Solenoid (Y5) Connector (SE16, W11)

X72 - Third Wheel Assist Wiring Harness Ground Terminal Connector (SE16, W11)

X73 - Third Wheel Assist Diode (V2) Connector (SE16, W11)

X74 - Headlight Relay (K2) Connector (W12)

X75 - Lighting Harness-to-Starting Motor (M1) Battery Terminal Connector (W12)

X76 - Lighting Harness Ground Terminal Connector (SE14, W12)

X77 - Right Headlight (E4) Connector (SE14, W12)

X78 - Left Headlight (E5) Connector (SE14, W12)

X79 - Grass Catcher Light (E6) Connector (SE14, W12)

X80 - Fuel Pump Harness Connector (W13, W14)

X81 - Fuel Pump Terminal (W14)

X82 - Fuel Pump Terminal (W14)

X83 - Center Reel Motor Control Module Connector (SE17, W15)

X84 - Reel Motor Forward/Reverse Switch Connector (SE17, W15)

X85 - Reel Motor Control Module Diagnostic Light Harness Connector (SE17, W15)

X86 - Reel Motor Speed Control Connector (SE17, W15)

X87 - Reel Motor Control Module Signal Harness -to-Mow Solenoid Connector (X14) (SE17, W15)

X88 - Right Reel Motor Control Module Connector (SE17, W15)

X89 - Left Reel Motor Control Module Connector (SE17, W15)

X90 - Reel Motor Control Module Diagnostic Light Terminal Connector

X91 - Reel Motor Control Module Diagnostic Light Terminal Connector

X92 - Reel Motor Power Harness-to-Mow/Transport Switch (SE17, W16)

X93 - Reel Motor Power Harness-to-Main Harness-to-Mow/Transport Switch Connector (SE17, W16)

X94 - Reel Motor Power Harness Jumper Wire Terminal Connector (SE17, W16)

X95 - Reel Motor Power Harness Jumper Wire Terminal Connector (SE17, W16)

X96 - Reel Motor Power Harness 48V Alternator-to-Junction Block Terminal Connector (SE17, W16)

X97 - Reel Motor Power Harness 48V Alternator Ground Terminal Connector (SE17, W16)

X98 - Reel Motor Power Harness 48V Alternator Positive (+) Terminal Connector (SE17, W16)

X99 - Reel Motor Power Harness 48V Alternator Field Terminal Connector (SE17, W16)

X100 - Reel Motor Power Harness Frame Ground Terminal Connector (SE17, W16)

X101 - Lift/Lower Switch Connector (SE11, W17)[2]

1. Models 2500, 2500A (S.N. -020000)

2. Models 2500A (S.N. 020001-), 2500E

Harness

W1 - Not Used

W2 - Main Wiring Harness

W3 - Console Wiring Harness Models 2500, 2500A (S.N. -020000)

W4 - Not Used

W5 - Not Used

W6 - Not Used

W7 - Not Used

W8 - Not Used

W9 - Not Used

W10 - Engine Wiring Harness

W11 - Third Wheel Assist Harness

W12 - Lighting Kit Wiring Harness

W13 - Not Used

W14 - Not Used

W15 - Reel Motor Control Module Signal Wiring Harness Model 2500E

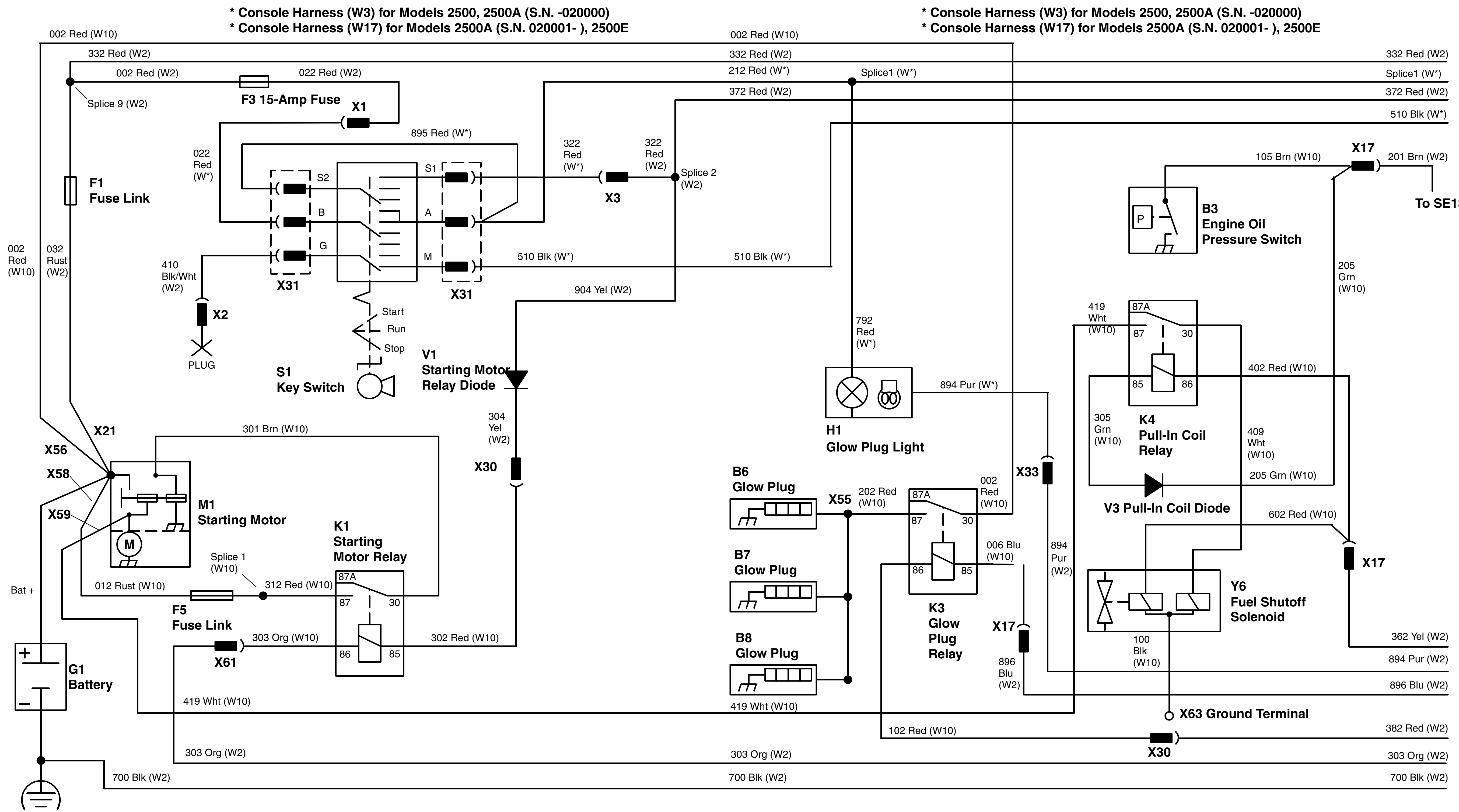
W16 - Reel Motor Control Module Power Wiring Harness Model 2500E

W17 - Console Wiring Harness Models 2500A (S.N. 020001-), 2500E

W18 Reel Motor Diagnostic Light Wiring Harness Model 2500E

Main Electrical Schematic - Diesel Engine

Diesel Engine (1 of 6)

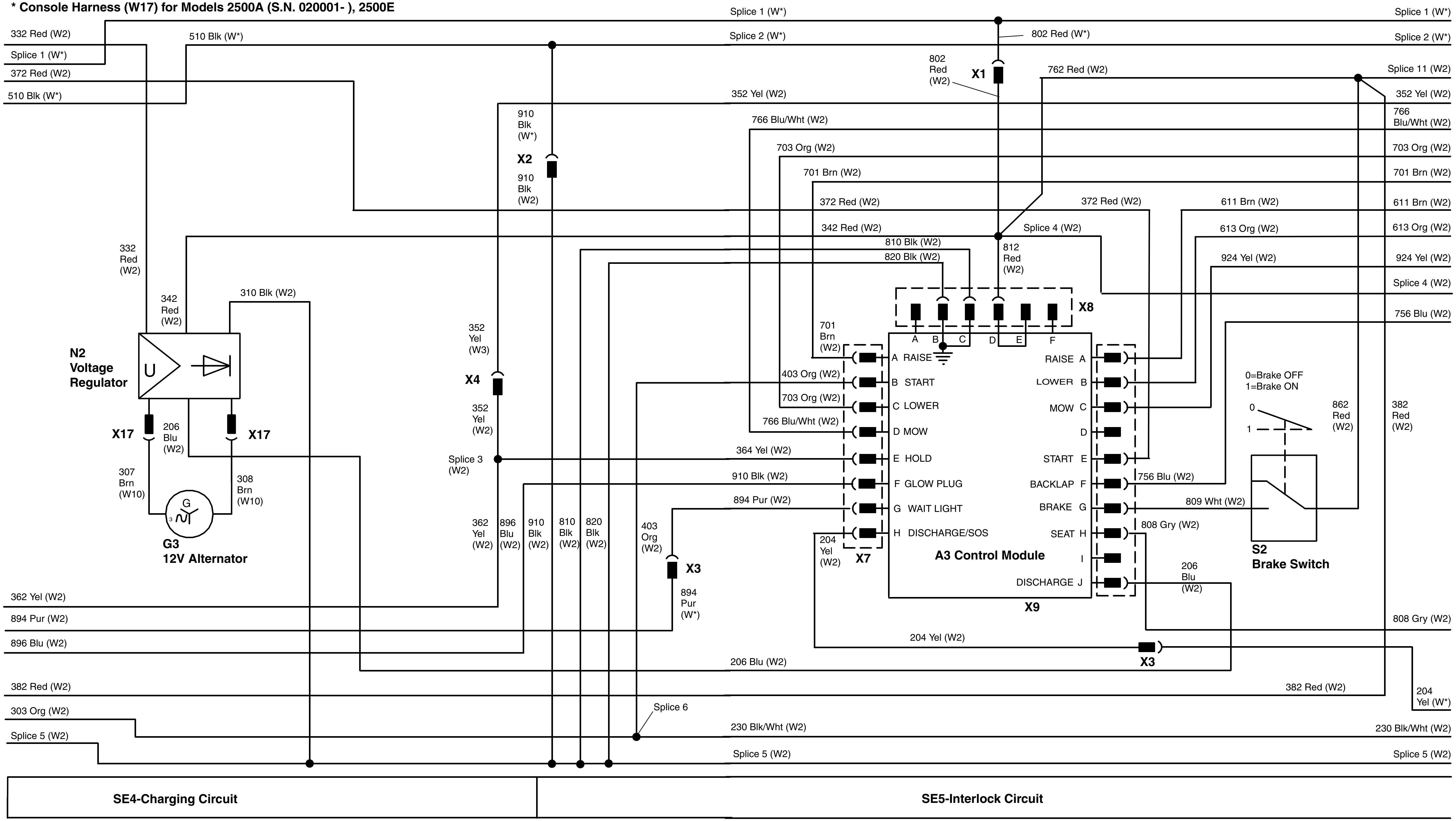


SE1-Cranking Circuit	SE2-Glow Plug Circuit	SE3-Fuel Shutoff Solenoid Circuit

MX20456 (MIF)

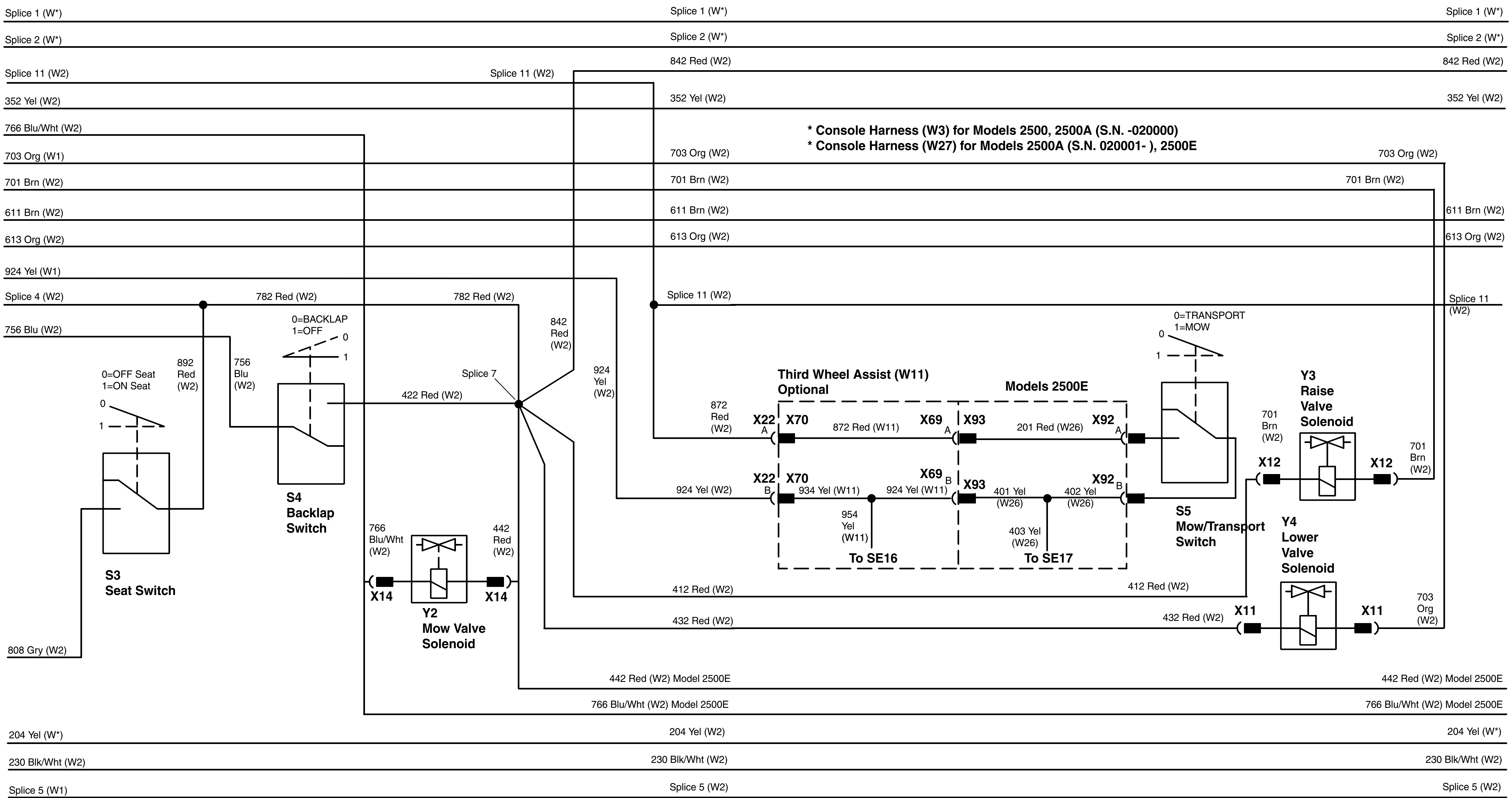
Diesel Engine (2 of 6)

*** Console Harness (W3) for Models 2500, 2500A (S.N. -020000)**
*** Console Harness (W17) for Models 2500A (S.N. 020001-), 2500E**



MX20457 (MIF)

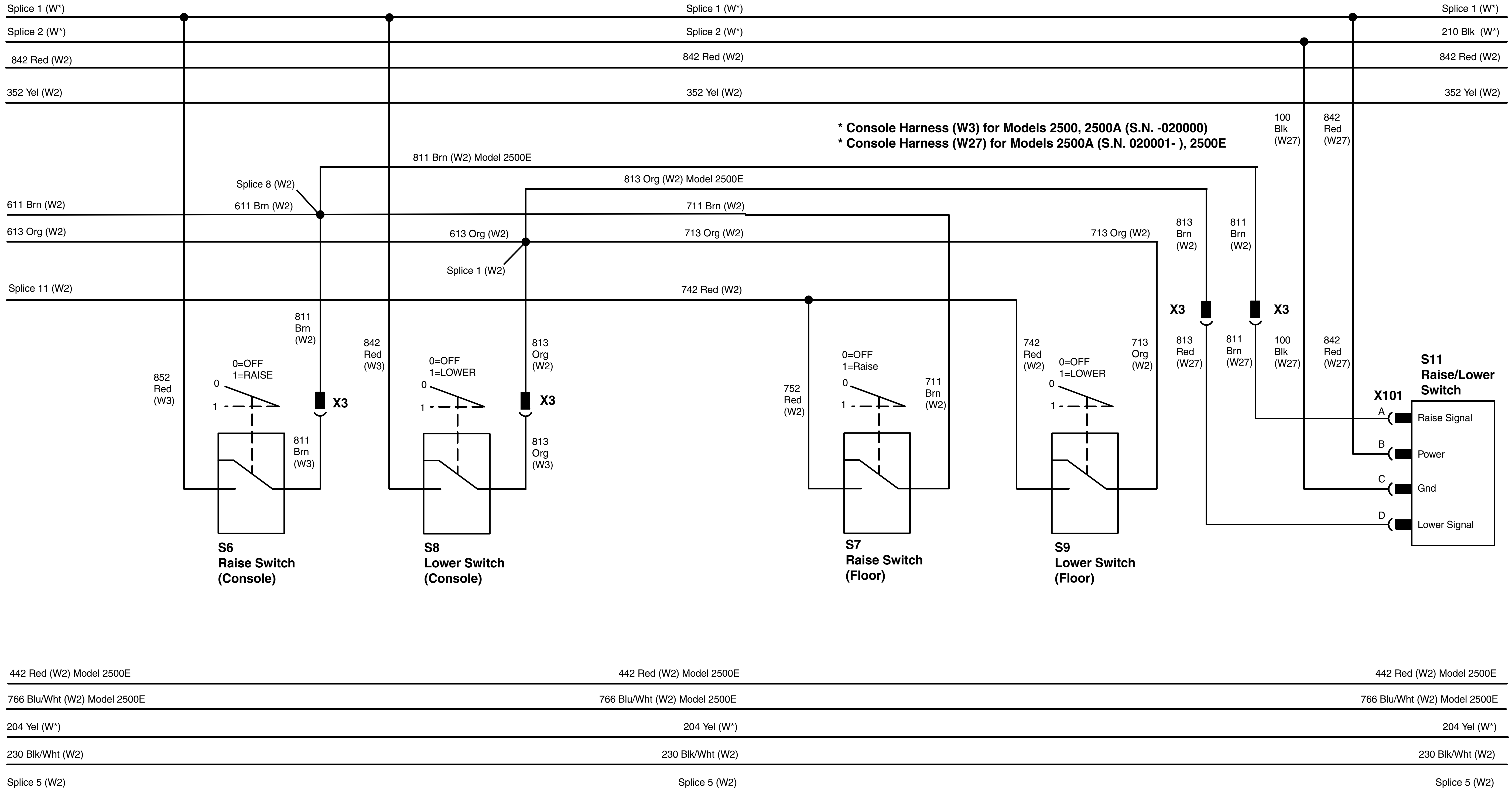
Diesel Engine (3 of 6)



SE5-Interlock Circuit	SE6-Backlap Circuit	SE7-Mow Circuit Models 2500, 2500A	SE8-Raise/Lower Circuit

MX20411 diesel (MIF)

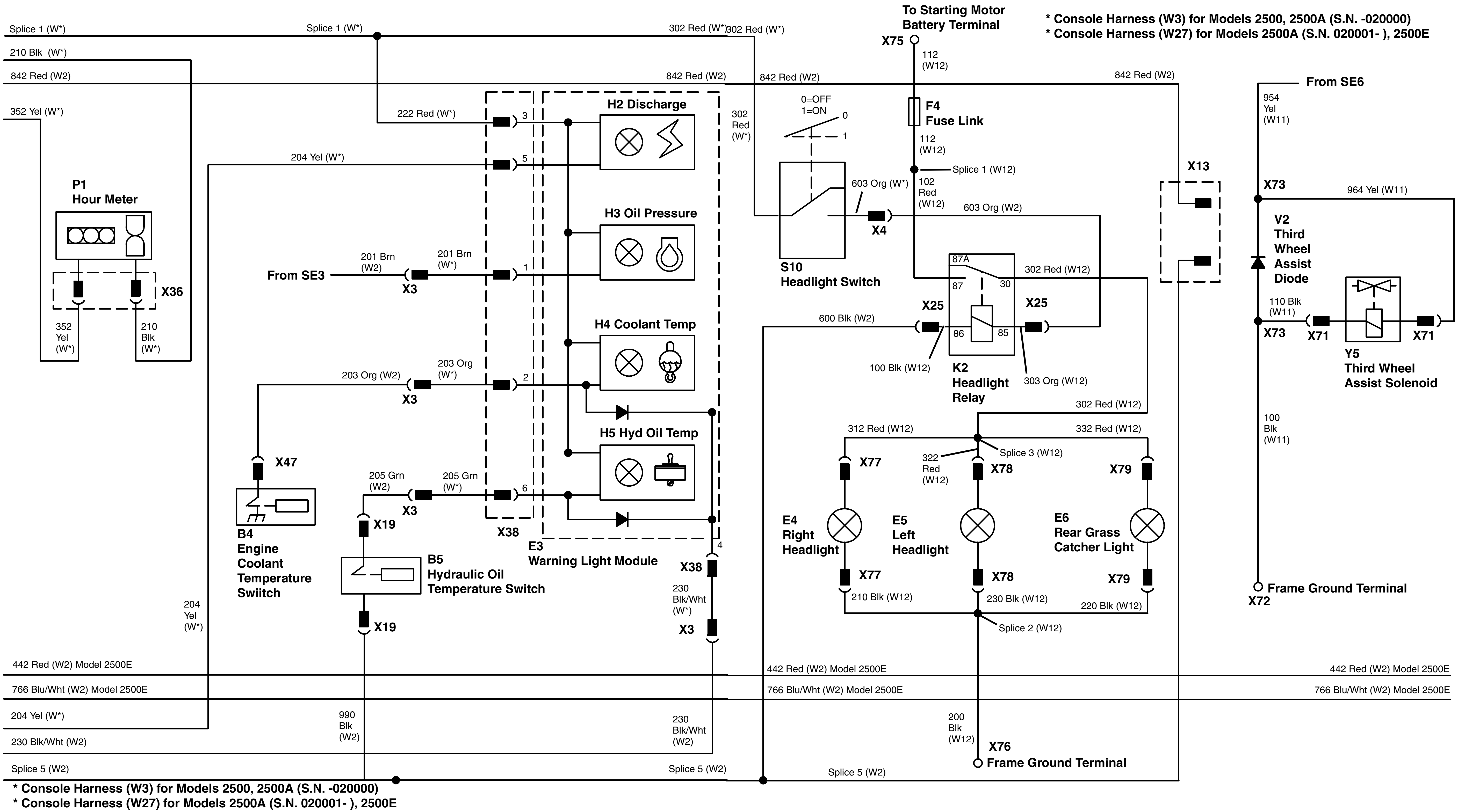
Diesel Engine (4 of 6)



SE9-Raise/Lower Console Switches Models 2500, 2500A (S.N. -020000)	SE10-Raise/Lower Floor Switches (Optional)	SE11-Raise/Lower Console Switch Models 2500A (S.N. 020001-), 2500E

MX20412 diesel (MIF)

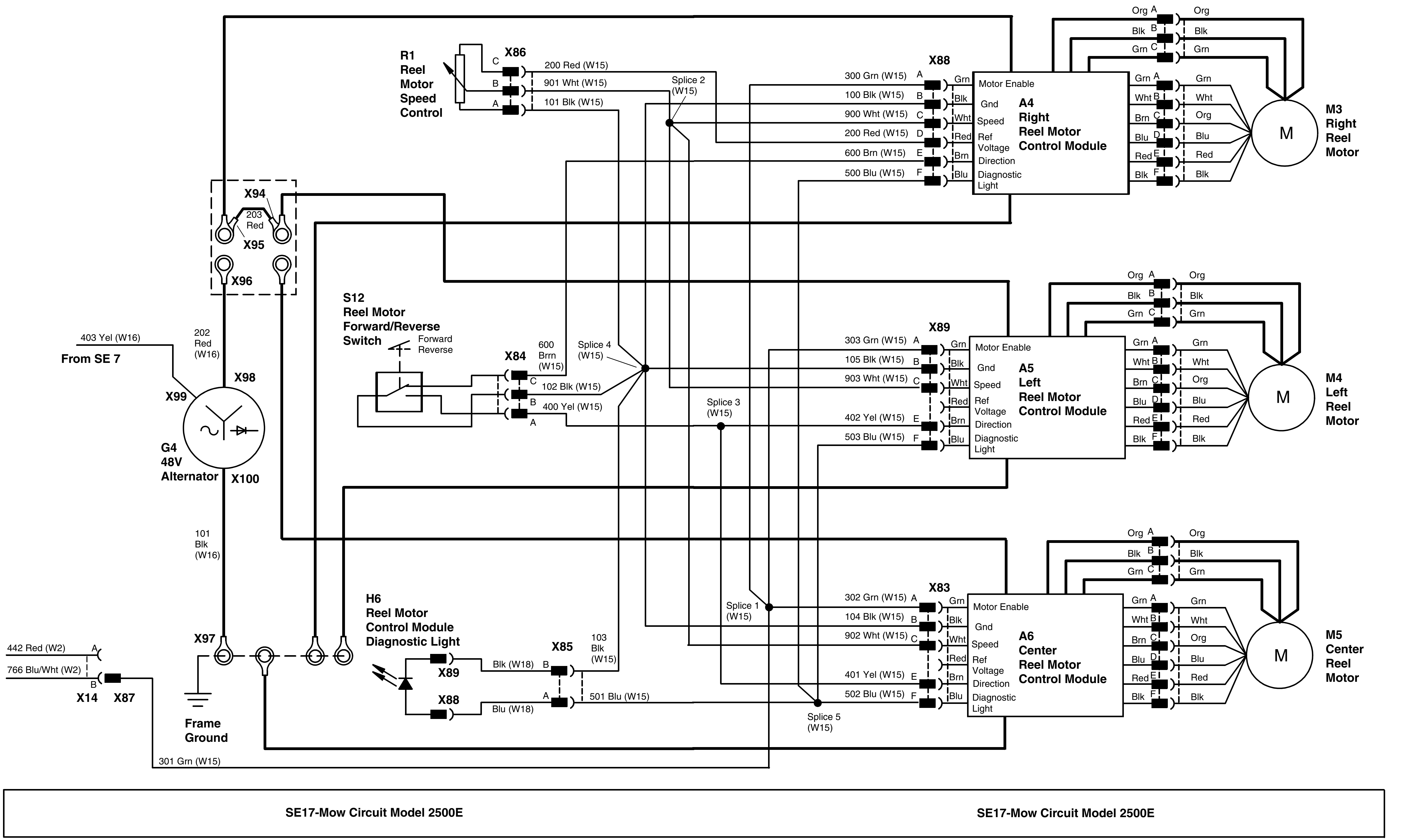
Diesel Engine (5 of 6)



SE12-Hour Meter Circuit	SE13-Warning Light Circuit	SE14-Lighting Circuit	SE-15 Leak Detection	SE16-Third Wheel Assist Circuit

MX20458 (MIF)

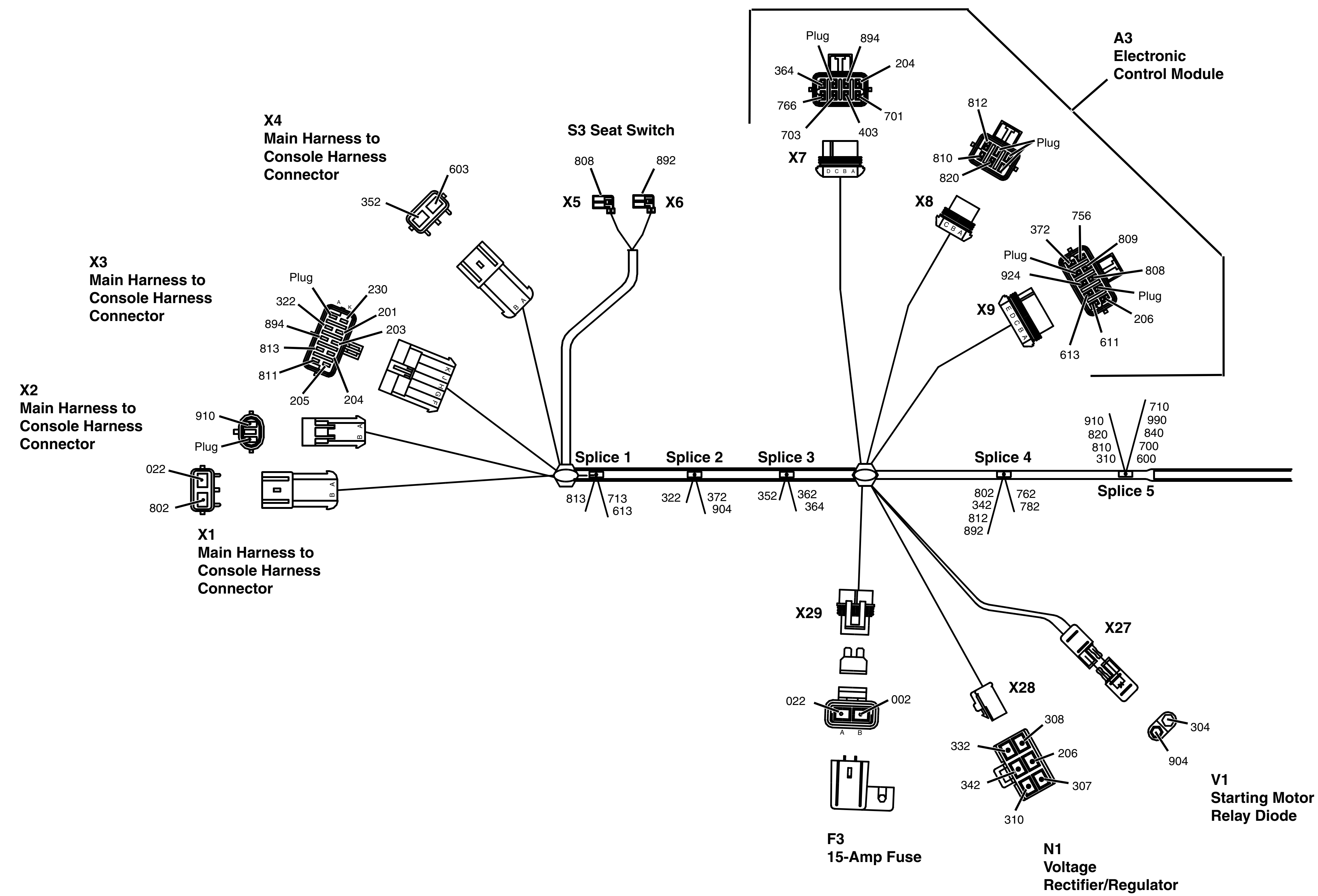
Diesel Engine (6 of 6)



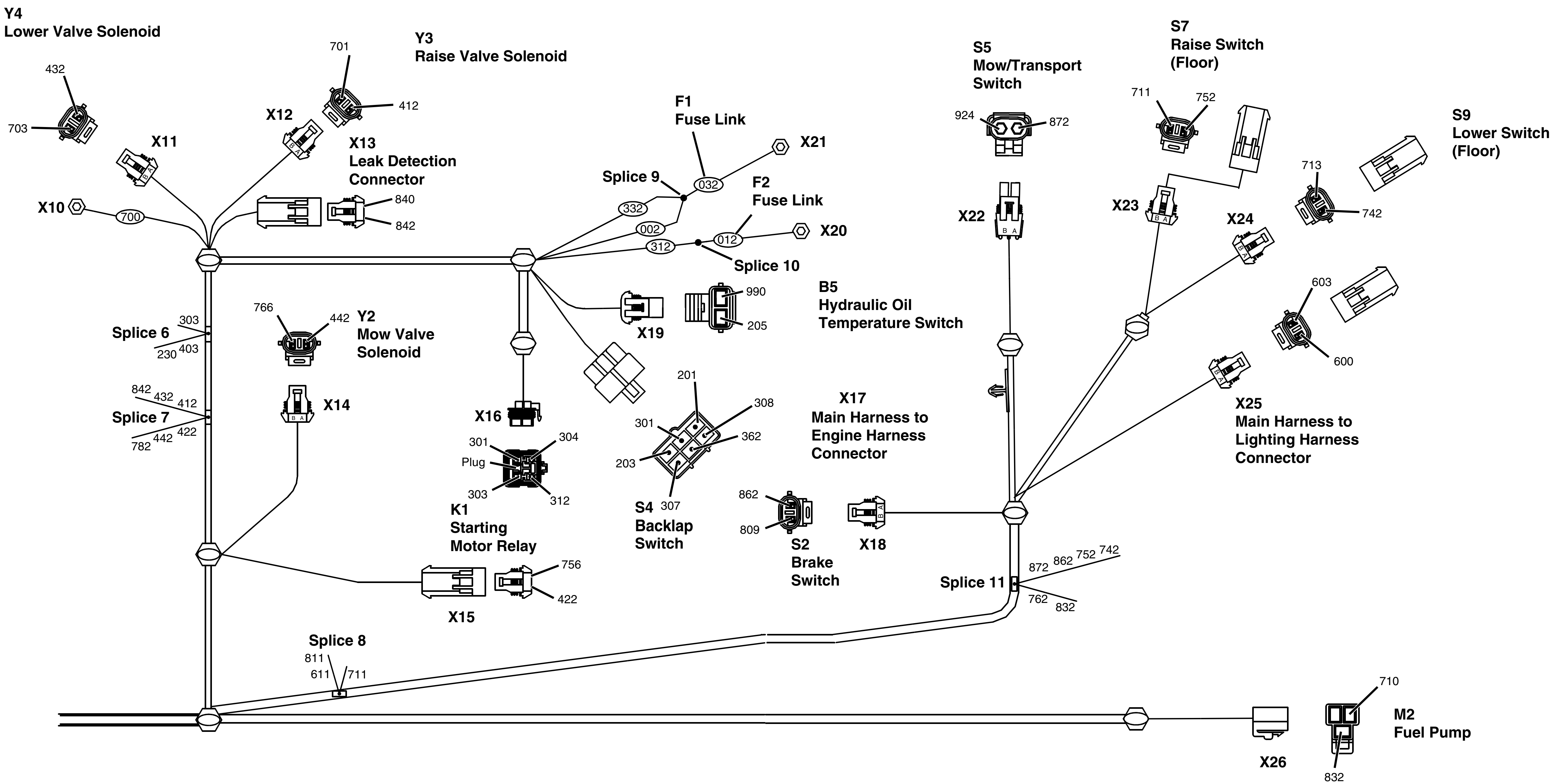
MX20414 diesel (MIF)

Main Wiring Harness (W1) - Gasoline Engine

Main Harness - Gasoline Engine (1 of 2)



Main Harness - Gasoline Engine (2 of 2)



M84557B (MIF)

Main Wiring Harness (W1) - Gasoline Engine Wire Code Table

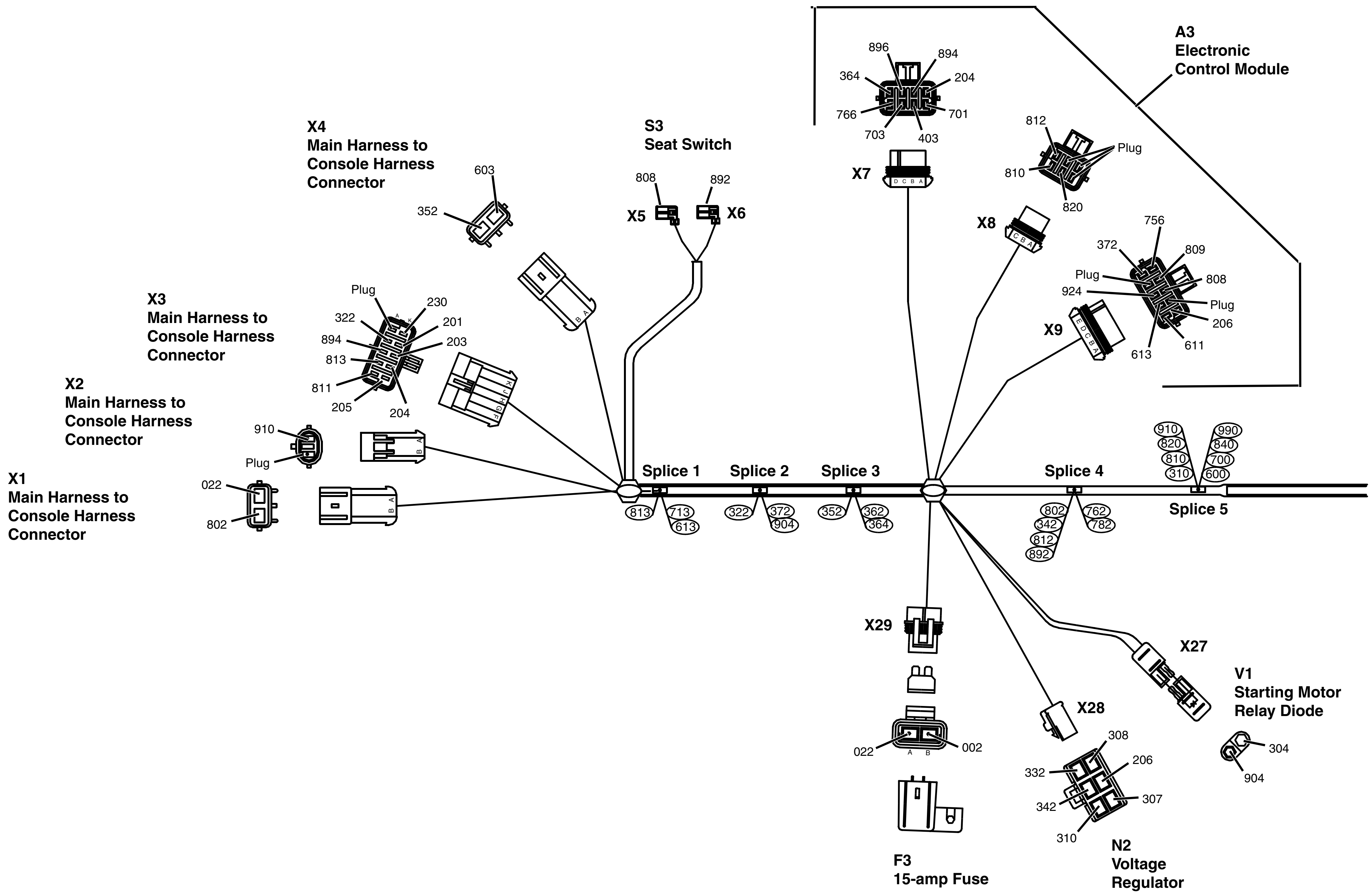
Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
002	2.0	Red	X29 (B), Splice 9
012	0.8	Rust	X20, Splice 10
022	2.0	Red	X1 (A), X29 (A)
032	0.8	Rust	X21, Splice 9
201	0.5	Brn	X3, X17
203	0.5	Org	X3, X17
204	0.5	Yel	X3, X7
205	0.5	Grn	X3, X19
206	0.8	Blu	X9, X28
230	0.5	Blk/Wht	X3, Splice 6
301	2.0	Brn	X16 (87), X17
303	0.8	Org	X16 (85), Splice 6
304	0.8	Yel	X16 (86), X27
307	3.0	Pur	X28, X17
308	3.0	Gry	X28, X17
310	3.0	Blk	X28, Splice 5
312	2.0	Red	X16 (30), Splice 10
322	1.0	Red	X3, Splice 2
332	3.0	Red	X28, Splice 9
342	1.0	Red	X28, Splice 4
352	0.8	Yel	X4, Splice 3
362	0.8	Yel	X17, Splice 3
364	0.8	Yel	X7, Splice 3
372	0.8	Red	X9, Splice 2
403	0.8	Org	X7, Splice 6
412	0.8	Red	X12, Splice 7
422	0.8	Red	X15, Splice 7
432	0.8	Red	X11, Splice 7
442	0.8	Red	X14, Splice 7
600	1.0	Blk	X25, Splice 5

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
603	1.0	Org	X25, X4
611	1.0	Brn	X9, Splice 8
613	1.0	Org	X9, Splice 1
700	2.0	Blk	X10, Splice 5
701	0.8	Brn	X12, X7
703	0.8	Org	X11, X7
710	0.8	Blk	X26, Splice 5
711	0.8	Brn	X23, Splice 8
713	0.8	Org	X24, Splice 1
742	1.0	Red	X24, Splice 11
752	0.8	Red	X23, Splice 11
756	0.8	Blu	X15, X9
762	1.0	Red	Splice 4, Splice 11
766	0.8	Blu/Wht	X14, X7
782	1.0	Red	Splice 4, Splice 7
802	2.0	Red	X1, Splice 4
808	0.8	Gry	X5, X9
809	0.8	Wht	X9, X18
810	1.0	Blk	X8, Splice 5
811	0.8	Brn	X3, Splice 8
812	1.0	Red	X8, Splice 4
813	0.8	Org	X3, Splice 1
820	1.0	Blk	X8, Splice 5
832	0.8	Red	X26, Splice 11
840	1.0	Blk	X13, Splice 5
842	1.0	Red	X13, Splice 7
862	1.0	Red	X18, Splice 11
872	0.8	Red	X22, Splice 11
892	0.8	Red	X6, Splice 4
894	0.8	Pur	X3, X7

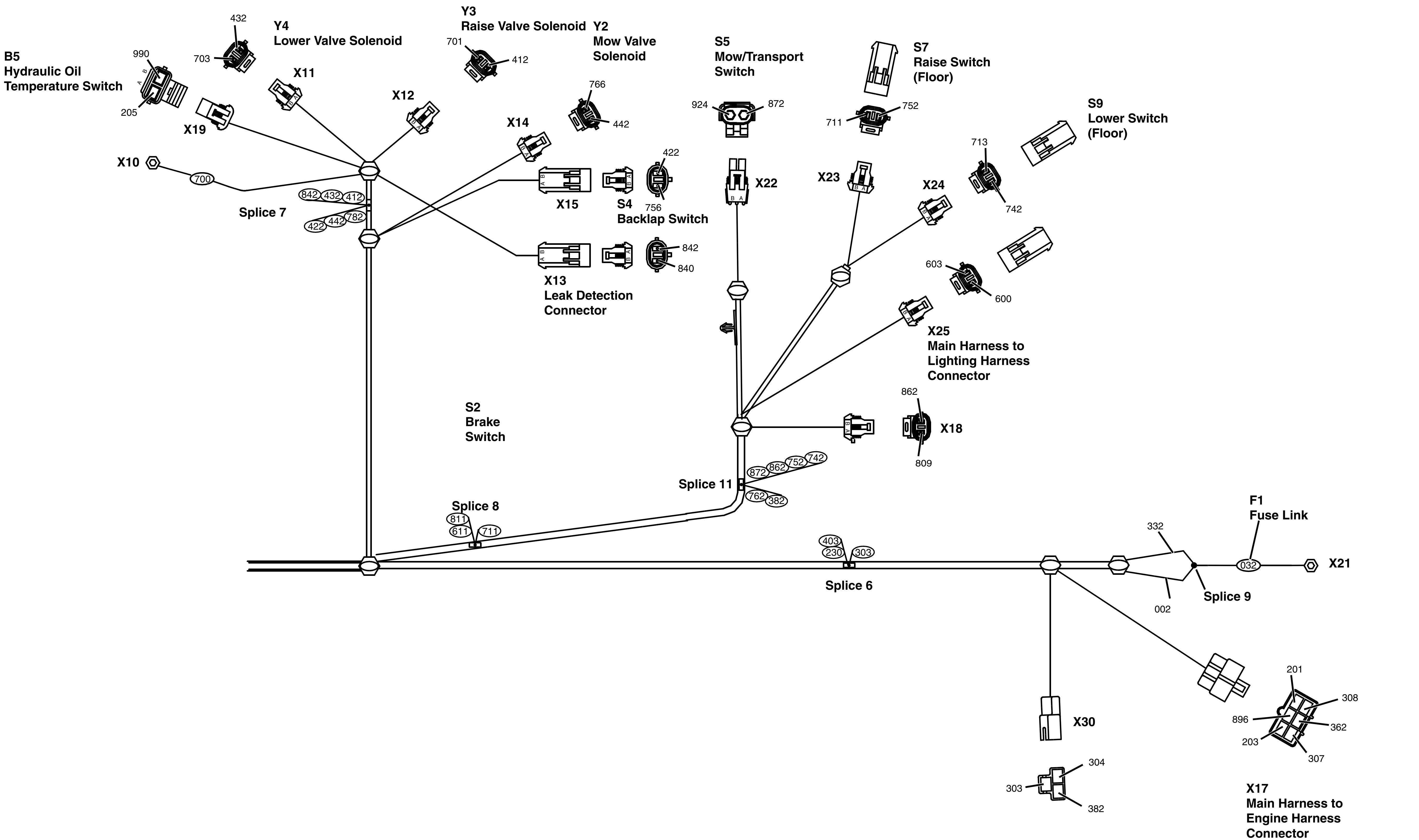
Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
904	0.8	Yel	X27, Splice2
910	0.8	Blk	X2, Splice 5
924	0.8	Yel	X9, X22
990	0.8	Blk	X19, Splice 5

Main Wiring Harness (W2) - Diesel Engine

Main Harness (W2) - Diesel Engine (1 of 2)



Main Harness (W2) - Diesel Engine (2 of 2)



M84558B (MIF)

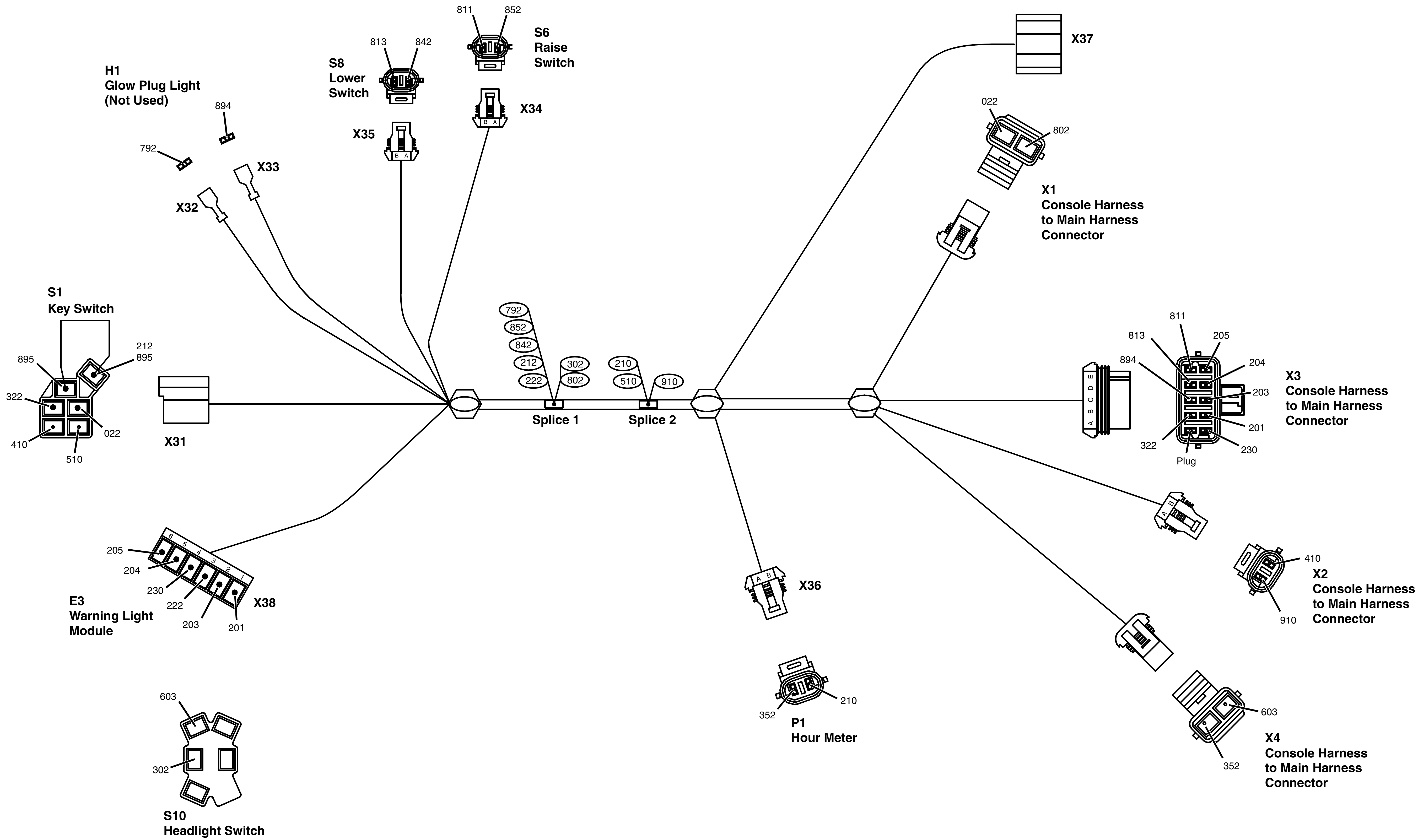
Main Wiring Harness (W2) - Diesel Engine Wire Code Table

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
002	2.0	Red	X29 (B), Splice 9
022	2.0	Red	X1 (A), X29 (A)
032	0.8	Rust	X21, Splice 9
201	0.5	Brn	X3, X17
203	0.5	Org	X3, X17
204	0.5	Yel	X3, X7
205	0.5	Grn	X3, X19
206	0.8	Blu	X9, X28
230	0.5	Blk/Wht	X3, Splice 6
303	0.8	Org	X30, Splice 6
304	0.8	Yel	X30, X27
307	3.0	Pur	X28, X17
308	3.0	Gry	X28, X17
310	3.0	Blk	X28, Splice 5
322	1.0	Red	X3, Splice 2
332	3.0	Red	X28, Splice 9
342	1.0	Red	X28, Splice 4
352	0.8	Yel	X4, Splice 3
362	0.8	Yel	X17, Splice 3
364	0.8	Yel	X7, Splice 3
372	0.8	Red	X9, Splice 2
382	0.8	Red	X30, Splice 11
403	0.8	Org	X7, Splice 6
412	0.8	Red	X12, Splice 7
422	0.8	Red	X15, Splice 7
432	0.8	Red	X11, Splice 7
442	0.8	Red	X14, Splice 7
600	1.0	Blk	X25, Splice 5
603	1.0	Org	X25, X4
611	1.0	Brn	X9, Splice 8

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
613	1.0	Org	X9, Splice 1
700	2.0	Blk	X10, Splice 5
701	0.8	Brn	X12, X7
703	0.8	Org	X11, X7
711	0.8	Brn	X23, Splice 8
713	0.8	Org	X24, Splice 1
742	1.0	Red	X24, Splice 11
752	0.8	Red	X23, Splice 11
756	0.8	Blu	X15, X9
762	1.0	Red	Splice 4, Splice 11
766	0.8	Blu/Wht	X14, X7
782	1.0	Red	Splice 4, Splice 7
802	2.0	Red	X1, Splice 4
808	0.8	Gry	X5, X9
809	0.8	Wht	X9, X18
810	1.0	Blk	X8, Splice 5
811	0.8	Brn	X3, Splice 8
812	1.0	Red	X8, Splice 4
813	0.8	Org	X3, Splice 1
820	1.0	Blk	X8, Splice 5
840	1.0	Blk	X13, Splice 5
842	1.0	Red	X13, Splice 7
862	1.0	Red	X18, Splice 11
872	0.8	Red	X22, Splice 11
892	0.8	Red	X6, Splice 4
894	0.8	Pur	X3, X7
896	0.8	Blu	X7, X17
904	0.8	Yel	X27, Splice2
910	0.8	Blk	X2, Splice 5
924	0.8	Yel	X9, X22

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
990	0.8	Blk	X19, Splice 5

Console Wiring Harness (W3) - Models 2500, 2500A (S.N. -020000)



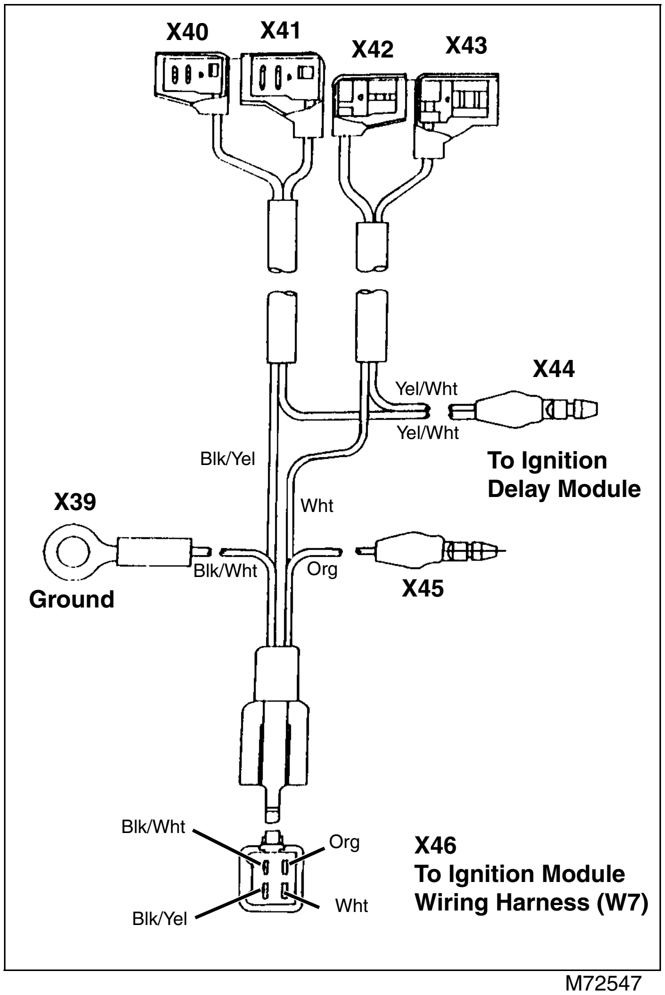
M84556 (MIF)

Console Wiring Harness (W3) Wire Code Table - Models 2500 and 2500A (S.N. -020000)

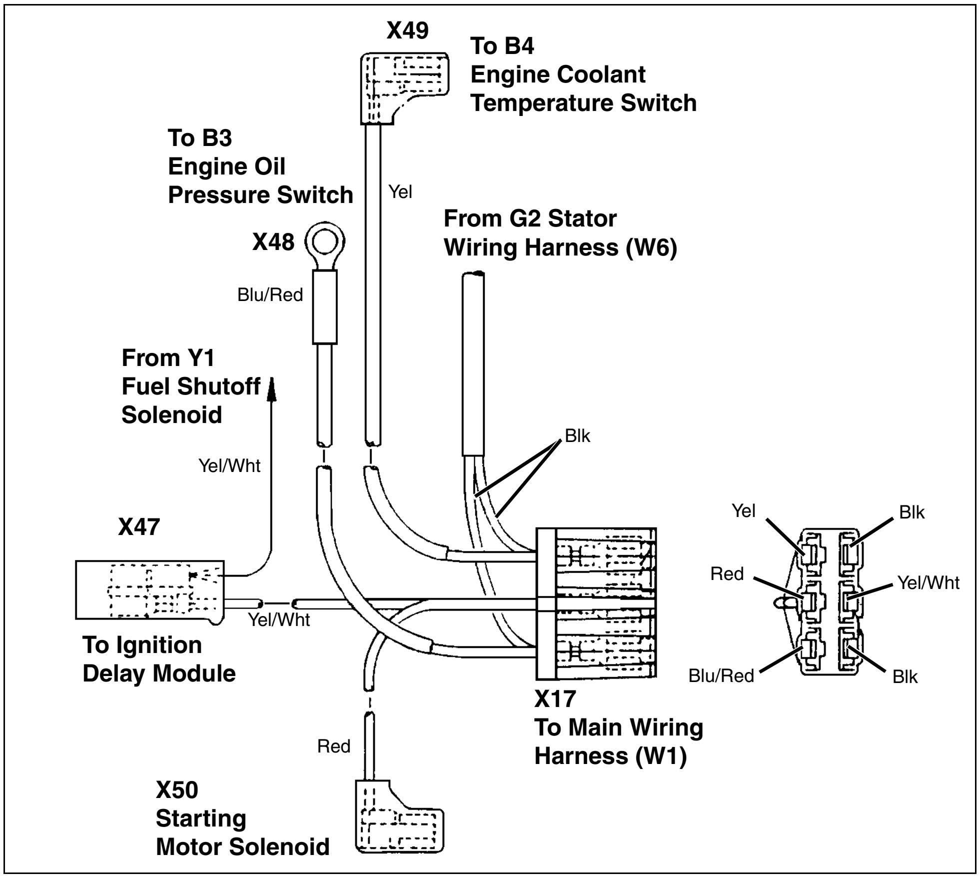
Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
022	2.0	Red	X31 (B), X1 (A)
201	0.5	Brn	X3 (I), X38 (1)
203	0.5	Org	X3 (H), X38 (2)
204	0.5	Yel	X3 (G), X38 (5)
205	0.5	Grn	X3 (F), X38 (6)
210	0.8	Blk	X36 (B), Splice 2
212	2.0	Red	X31 (A), Splice 1
222	0.5	Red	X38 (3), Splice 1
230	0.5	Blk/Wht	X3 (J), X38 (4)
302	1.0	Red	X37, Splice 1
322	1.0	Red	X31 (S1), X3 (B)
352	0.8	Yel	X36 (A), X4 (B)
410	0.8	Blk/Wht	X31 (G), X2 (B)
510	0.8	Blk	X31 (M), Splice 2
603	1.0	Org	X37, X4 (A)
792	0.8	Red	X32, Splice 1
802	2.0	Red	X1 (B), Splice 1
811	0.8	Brn	X35 (B), X3 (E)
813	0.8	Org	X34 (B), X3 (D)
842	0.8	Red	X34 (A), Splice 1
852	0.8	Red	X35 (A), Splice 1
894	0.8	Pur	X33, X3 (C)
895	2.0	Red	X31 (A), X31 (S2)
910	0.8	Blk	X2 (A), Splice 2

Gasoline Engine Wiring Harnesses

Ignition Wiring Harness (W4)

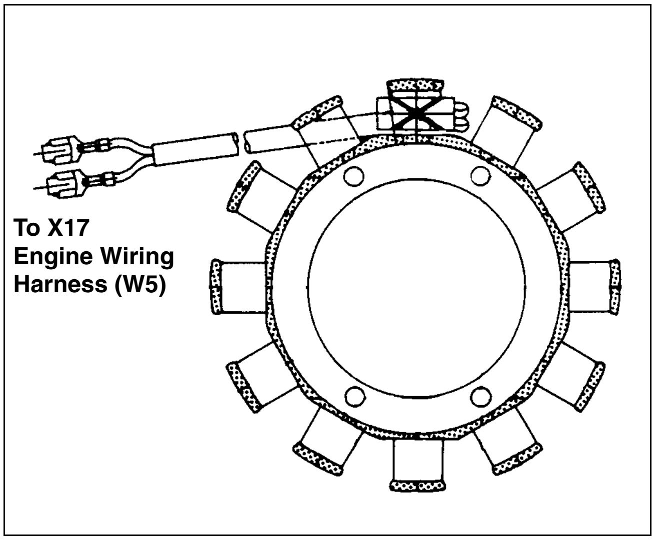


Engine Wiring Harness (W5)



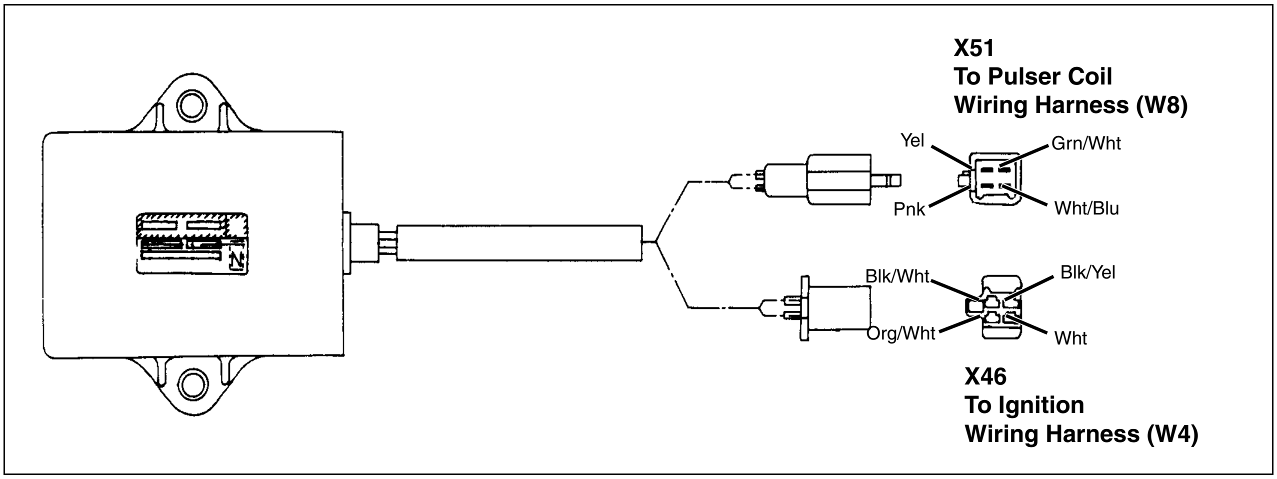
M98617

Stator Wiring Harness (W6)



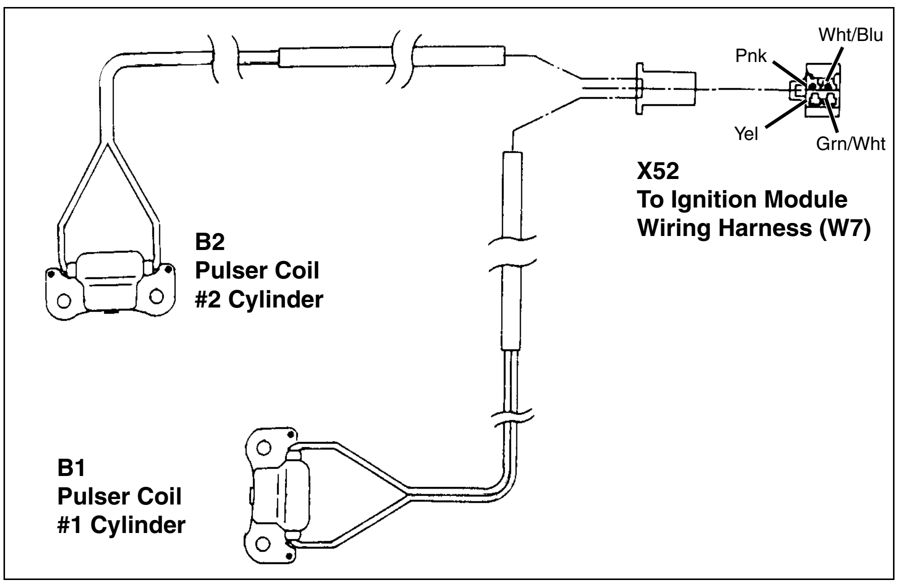
M72550

Ignition Module Wiring Harness (W7)



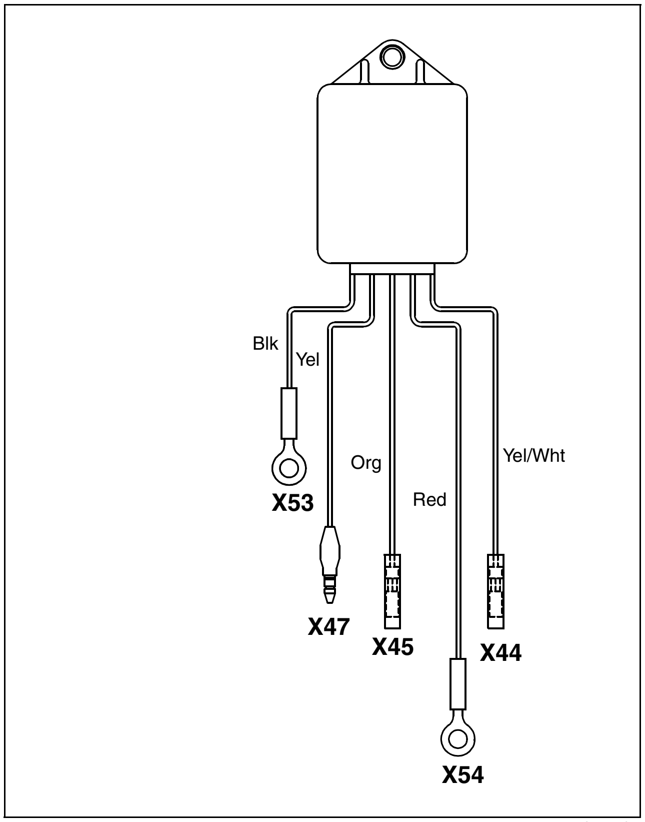
M72548

Pulser Coil Module Wiring Harness (W8)



M72549

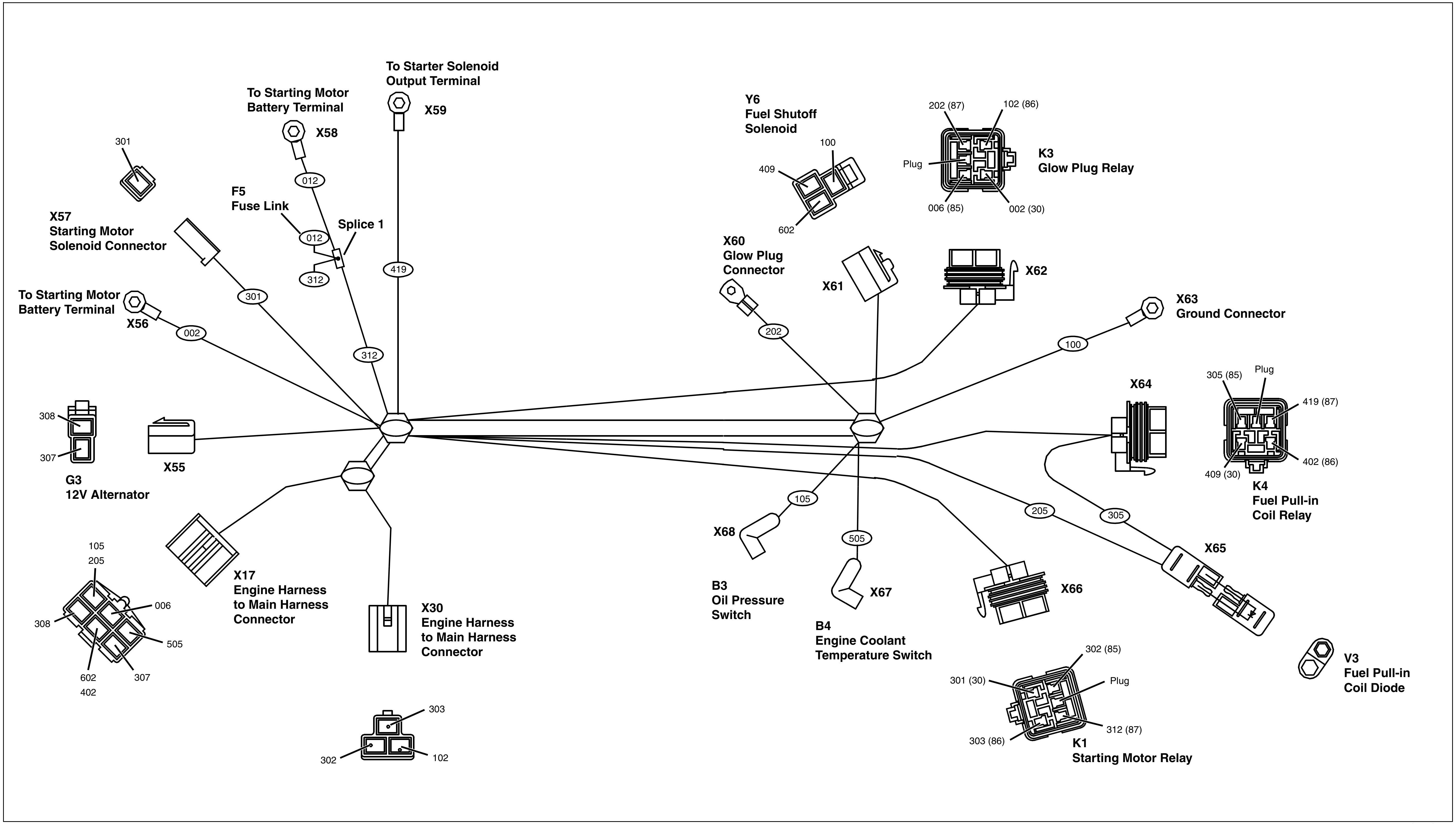
Ignition Delay Module Wiring Harness (W9)



M98868 (MIF)

Engine Wiring Harnesses

Diesel Engine Wiring Harness (W10)

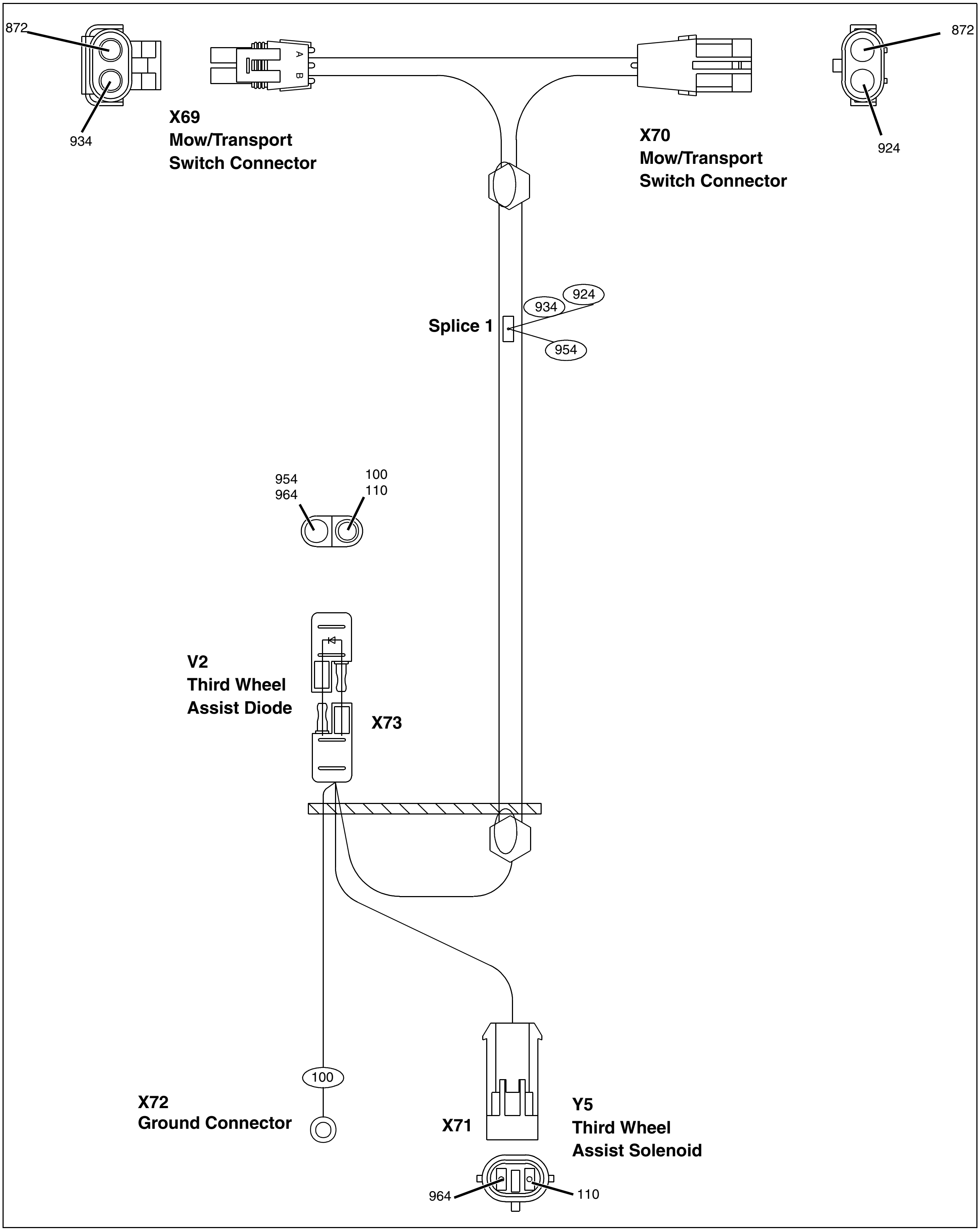


MX84559 (MIF)

Diesel Engine Wiring Harness (W10) - Wire Code Table

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
002	3.0	Red	X56, X62 (30)
006	0.8	Blu	X17, X62 (85)
012	0.8	Fusible Link	X58, Splice 1
100	2.0	Blk	X63, X61
102	0.8	Red	X30, X62 (86)
105	0.8	Brn	X68, X17
202	3.0	Red	X60, X62 (87)
205	1.0	Grn	X65, X17
301	2.0	Brn	X66 (30), X57
302	1.0	Red	X66 (85), X30
303	0.8	Org	X66 (86), X30
305	1.0	Grn	X65, X64 (85)
307	3.0	Brn	X17, X55
308	3.0	Brn	X17, X55
312	2.0	Red	X66 (87), Splice 1
402	0.8	Red	X17, X64 (86)
409	3.0	Wht	X64 (30), X61
419	3.0	Wht	X59, X64 (87)
505	0.8	Grn	X17, X67
602	1.0	Red	X17, 61

Optional Third Wheel Assist Wiring Harness (W11)

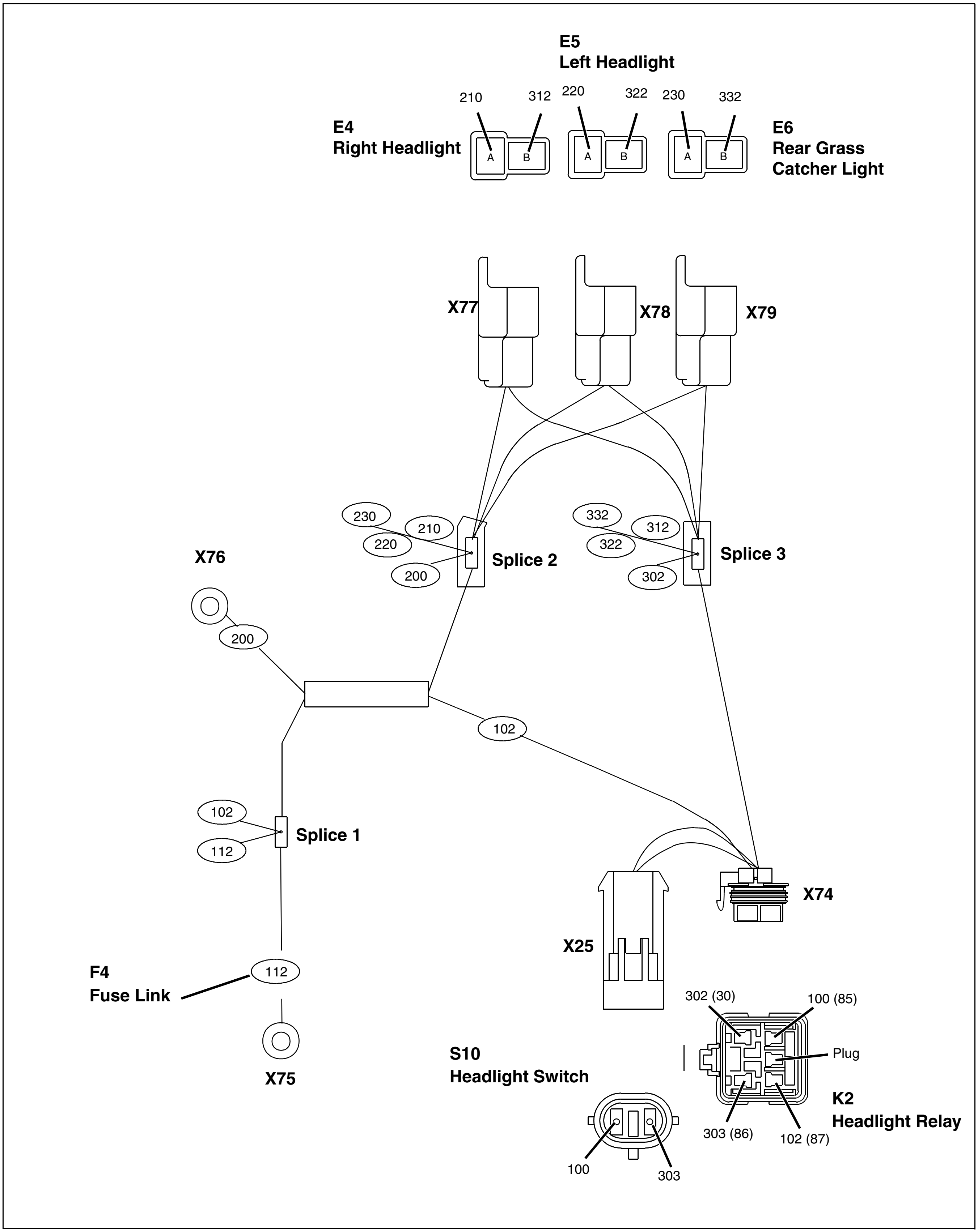


M98616 (MIF)

Optional Third Wheel Assist Wiring Harness (W11) - Wire Code Table

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
100	0.8	Blk	X72, X73
110	0.8	Blk	X73, X71
872	0.8	Red	X69, X70
924	0.8	Yel	X70, Splice 1
934	0.8	Yel	X69, Splice 1
954	0.8	Yel	X73, Splice 1
964	0.8	Yel	X71, X73

Lighting Wiring Harness (W12)

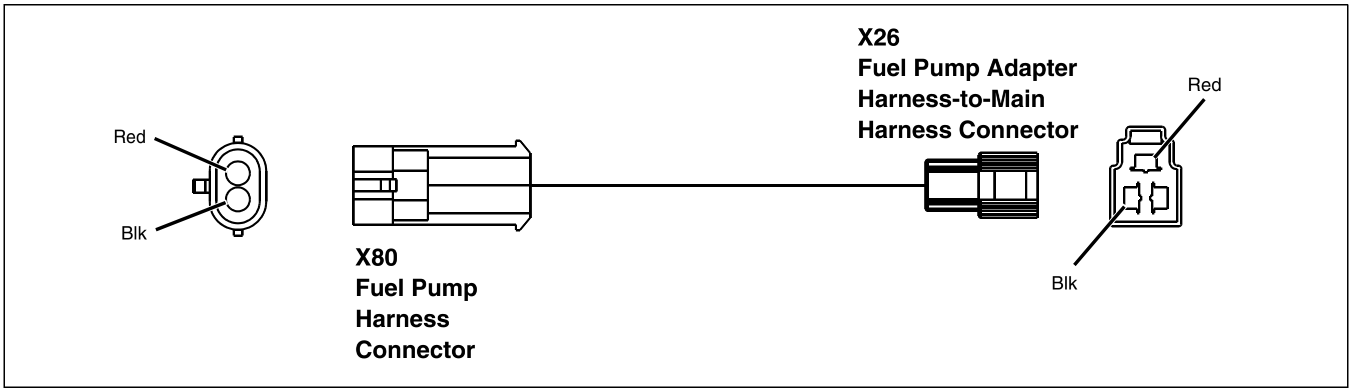


M98626 (MIF)

Lighting Wiring Harness (W12) - Wire Code Table

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
100	0.8	Blk	X25, X74 (85)
102	1.0	Red	X74 (87), Splice 1
112	0.5	Fusible Link	X75, Splice 1
200	0.8	Blk	X76, Splice 2
210	0.8	Blk	X77, Splice 2
220	0.8	Blk	X78, Splice 2
230	0.8	Blk	X79, Splice 2
302	1.0	Red	X74 (30), Splice 3
303	0.8	Org	X74 (86), X24
312	0.8	Red	X77, Splice 3
322	0.8	Red	X78, Splice 3
332	0.8	Red	X79, Splice 3

Fuel Pump Adapter Harness (W13) (Gas Engine Only)

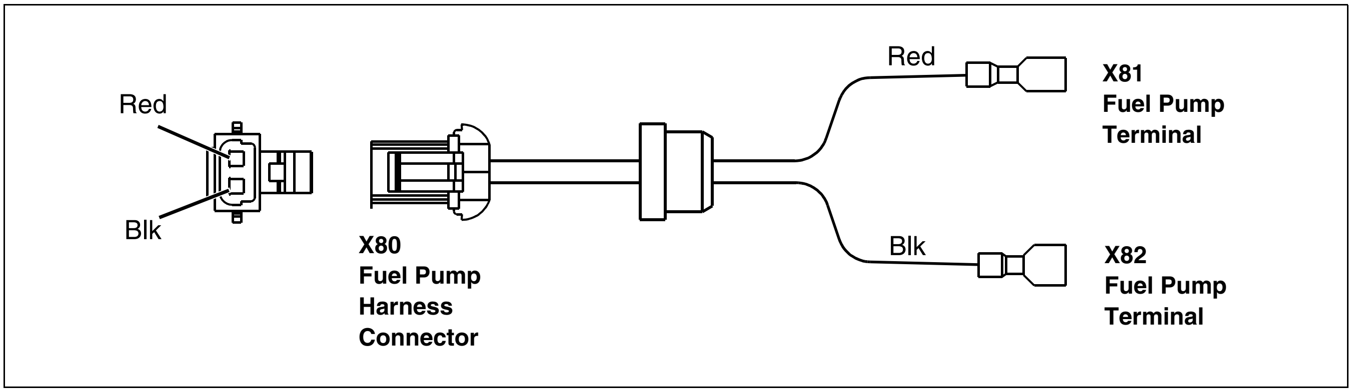


MIF

Fuel Pump Adapter Harness (W13) - Wire Code Table

Wire Size (mm^2)	Wire Color	Termination Points
1.0	Blk	X80, X26
1.0	Red	X80, X26

Fuel Pump Harness (W14) (Gas Engine Only)

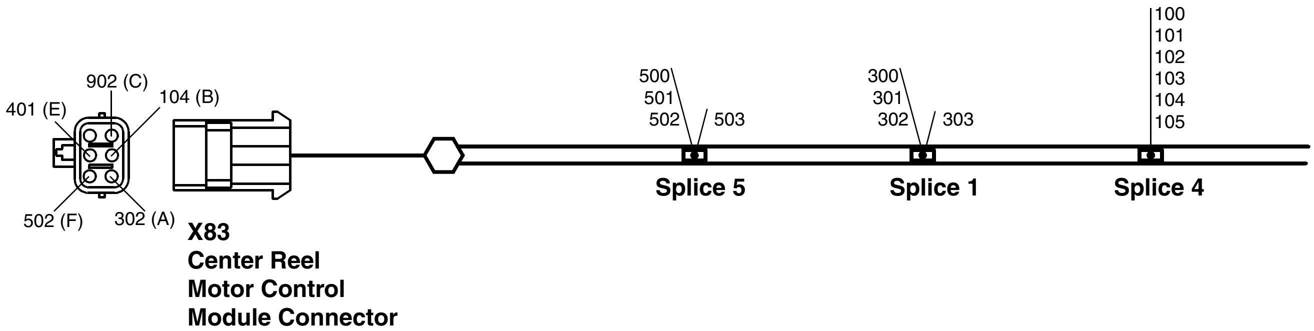


MIF

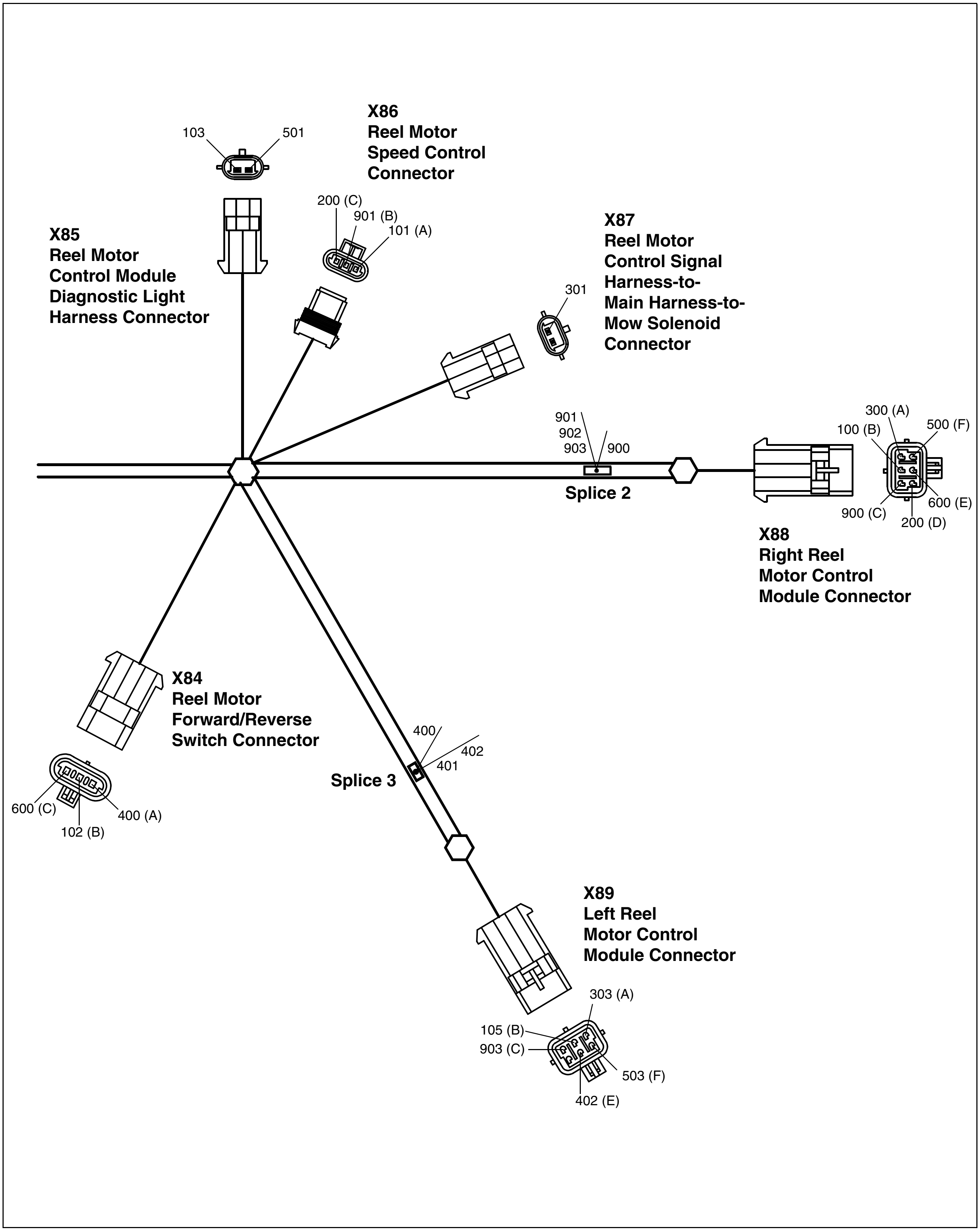
Fuel Pump Harness (W14) - Wire Code Table

Wire Size (mm^2)	Wire Color	Termination Points
1.0	Blk	X80, X82
1.0	Red	X80, X81

Reel Motor Control Module Signal Harness (W15)



MIF



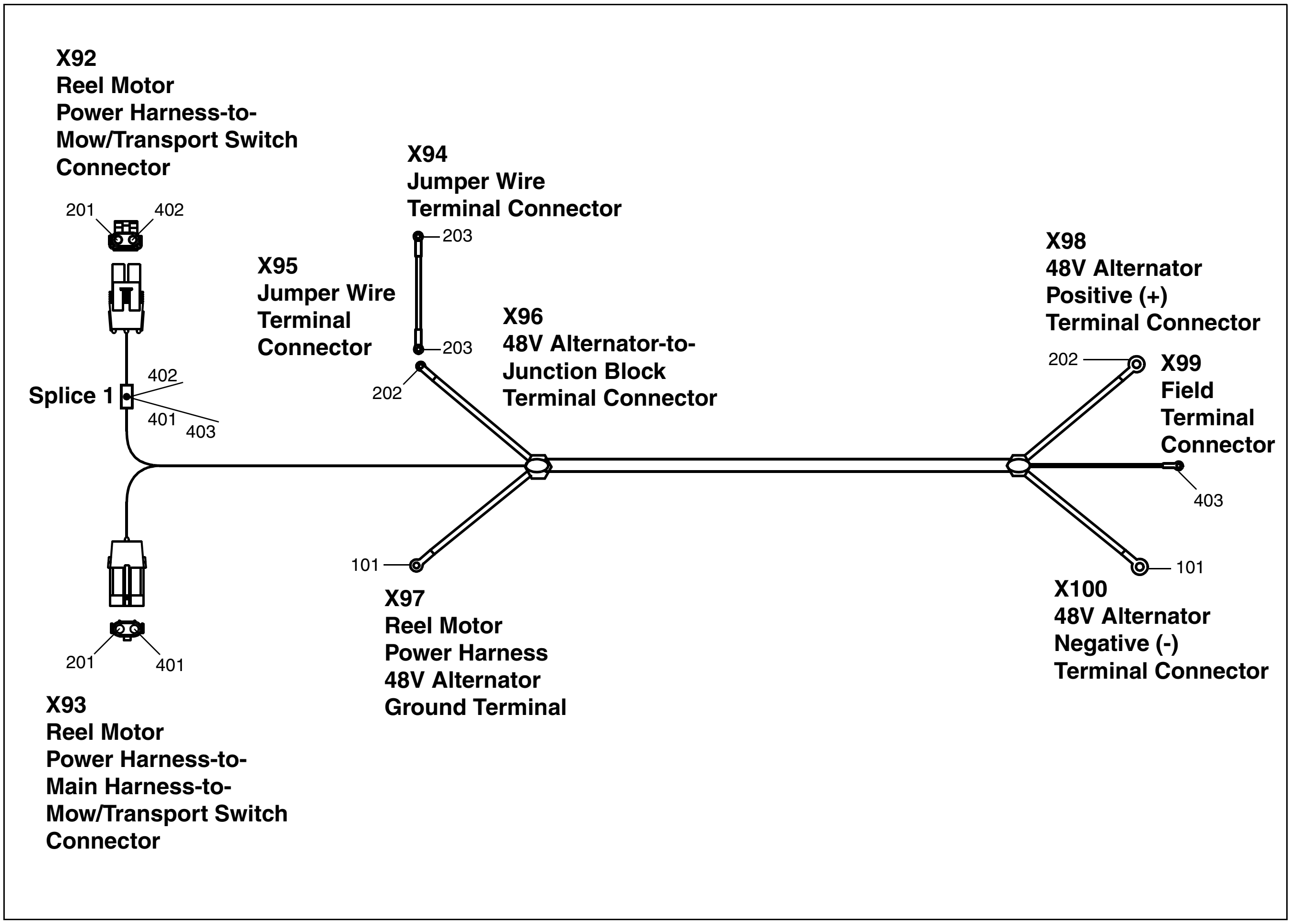
103
501
X86
Reel Motor
Speed Control
Connector
200 (C)
901 (B)
101 (A)
X85
Reel Motor
Control Module
Diagnostic Light
Harness Connector
X87
Reel Motor
Control Signal
Harness-to-
Main Harness-to-
Mow Solenoid
Connector
301
901
902
903
900
Splice 2
300 (A)
100 (B)
500 (F)
600 (E)
900 (C)
200 (D)
X88
Right Reel
Motor Control
Module Connector
X84
Reel Motor
Forward/Reverse
Switch Connector
600 (C)
102 (B)
400 (A)
400
402
401
Splice 3
X89
Left Reel
Motor Control
Module Connector
303 (A)
105 (B)
903 (C)
503 (F)
402 (E)

MIF

Reel Motor Control Module Signal Wiring Harness (W15) Wire Code Table - Model 2500E

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
100	0.8	Blk	X88 (B), Splice 4
101	0.8	Blk	X86 (A), Splice 4
102	0.8	Blk	X84 (B), Splice 4
103	0.8	Blk	X85 (B), Splice 4
104	0.8	Blk	X83 (B), Splice 4
105	0.8	Blk	X89 (B), Splice 4
200	0.8	Red	X86 (C), X88 (D)
300	0.8	Grn	X88 (A), Splice 1
301	0.8	Grn	X87 (B), Splice 1
302	0.8	Grn	X83 (A), Splice 1
303	0.8	Grn	X89 (A), Splice 1
400	0.8	Yel	X84 (A), Splice 3
401	0.8	Yel	X83 (E), Splice 3
402	0.8	Yel	X89 (E), Splice 3
500	0.8	Blu	X88 (F), Splice 5
501	0.8	Blu	X85 (A), Splice 5
502	0.8	Blu	X83 (F), Splice 5
503	0.8	Blu	X89 (F), Splice 5
600	0.8	Brn	X88 (E), X84 (C)
900	0.8	Wht	X88 (C), Splice 2
901	0.8	Wht	X86 (B), Splice 2
902	0.8	Wht	X83 (C), Splice 2
903	0.8	Wht	X89 (C), Splice 2

Reel Motor Power Harness (W16)

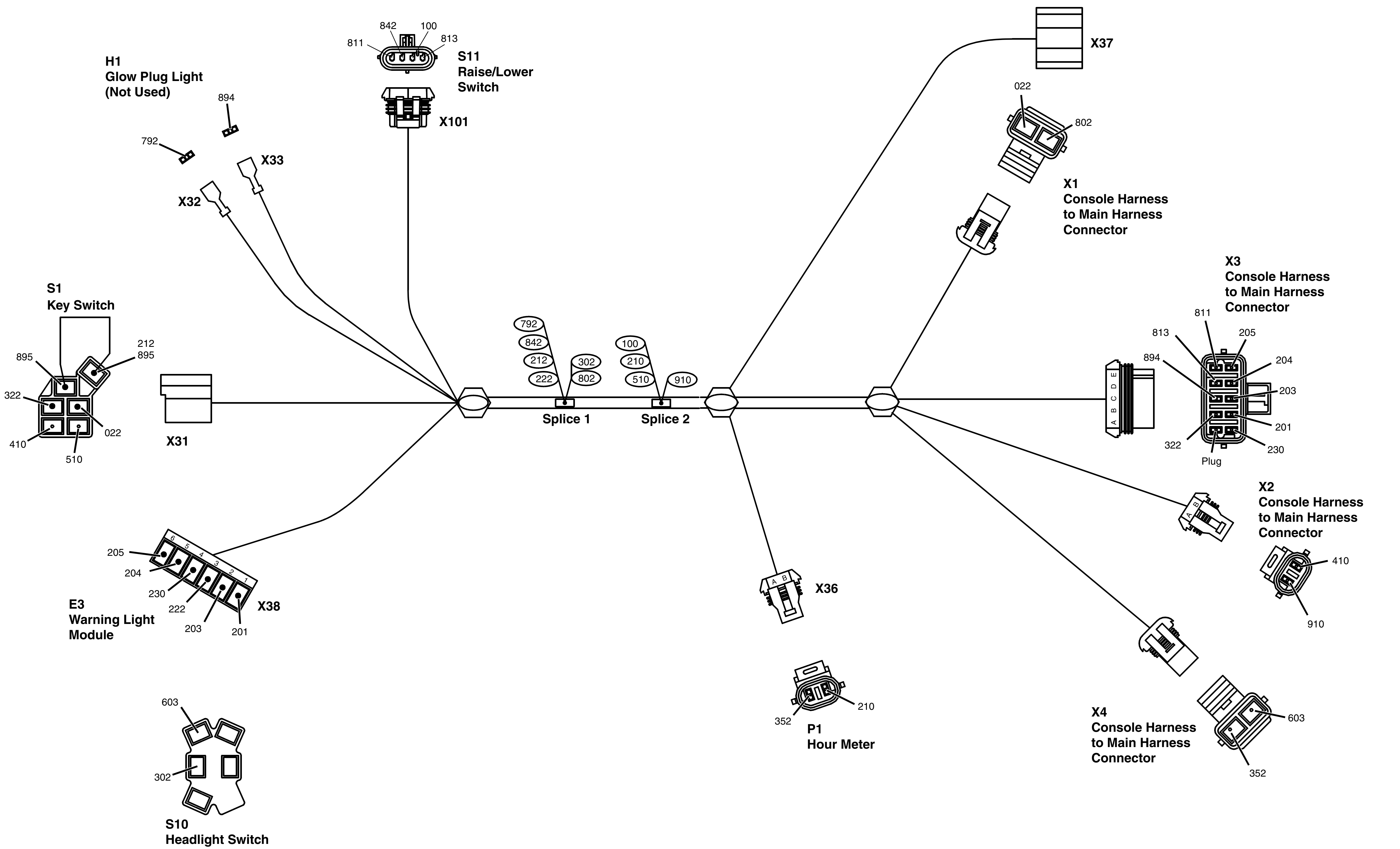


MIF

Reel Motor Power Wiring Harness (W16) Wire Code Table - Model 2500E

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
101	8.0	Blk	X97, X100
201	0.8	Red	X92 (A), X93 (A)
202	8.0	Red	X96, X98
203	8.0	Red	X94, X95
401	0.8	Yel	X93 (B), Splice 1
402	0.8	Yel	X92 (B), Splice 1
403	0.8	Yel	X99, Splice 1

Console Wiring Harness (W17) Models 2500A (S.N. 020001-), 2500E

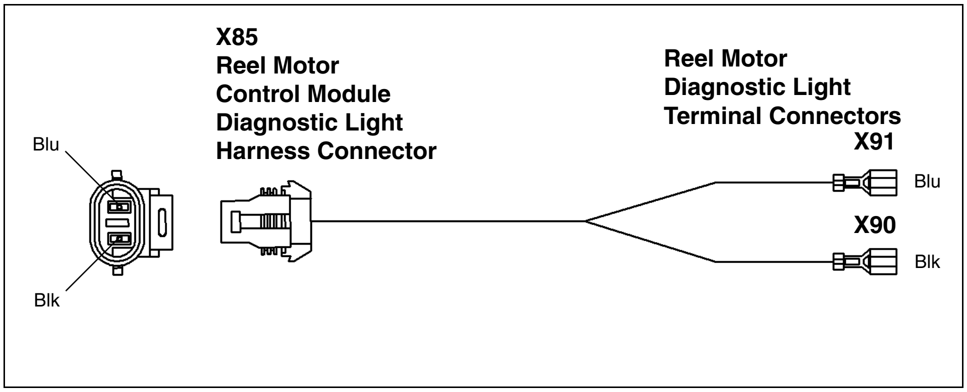


MX20415 (MIF)

Console Wiring Harness (W17) Wire Code Table - Models 2500A (S.N. 020001-) and 2500E

Circuit Number	Wire Size (mm^2)	Wire Color	Termination Points
022	2.0	Red	X31 (B), X1 (A)
100	0.8	Blk	X83 (C), Splice 2
201	0.5	Brn	X3 (I), X38 (1)
203	0.5	Org	X3 (H), X38 (2)
204	0.5	Yel	X3 (G), X38 (5)
205	0.5	Grn	X3 (F), X38 (6)
210	0.8	Blk	X36 (B), Splice 2
212	2.0	Red	X31 (A), Splice 1
222	0.5	Red	X38 (3), Splice 1
230	0.5	Blk/Wht	X3 (J), X38 (4)
302	1.0	Red	X37, Splice 1
322	1.0	Red	X31 (S1), X3 (B)
352	0.8	Yel	X36 (A), X4 (B)
410	0.8	Blk/Wht	X31 (G), X2 (B)
510	0.8	Blk	X31 (M), Splice 2
603	1.0	Org	X37, X4 (A)
792	0.8	Red	X32, Splice 1
802	2.0	Red	X1 (B), Splice 1
811	0.8	Brn	X83 (A), X3 (E)
813	0.8	Org	X83 (D), X3 (D)
842	0.8	Red	X83 (B), Splice 1
894	0.8	Pur	X33, X3 (C)
895	2.0	Red	X31 (A), X31 (S2)
910	0.8	Blk	X2 (A), Splice 2

Reel Motor Diagnostic Light Wiring Harness (W18)



MX20471

Operation and Diagnostics - Gasoline Engine

Diagnostic Codes

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed for additional codes.

Code 1-2

One pulse followed by a short pause, followed by two pulses; Indicates that the park brake switch is not activated. Engage park brake and repeat check procedure.

If the code continues to flash after the brake has been set; Perform INPUT CIRCUIT LIGHT CHECK - Brake Switch Input.

Code 1-3

One pulse followed by a short pause, followed by three pulses; Indicates that the mow switch is activated. Move mow/transport lever to TRANSPORT position and repeat check procedure.

If the code continues to flash after the mow/transport lever has been moved to the TRANSPORT position; Perform INPUT CIRCUIT LIGHT CHECK - Mow/Transport Switch Input.

Code 2-2

Two pulses followed by a short pause, followed by two pulses; Indicates that the mow/backlap valve is in BACKLAP position. Move mow/backlap valve to MOW position and repeat check procedure.

If the code continues to flash after the mow/backlap valve has been moved to the MOW position; Perform INPUT CIRCUIT LIGHT CHECK - Backlap Switch Input.

Code 3-1

Three pulses followed by a short pause, followed by another pulse; Indicates an over-voltage condition (voltage input to control box over 18 volts). (See “Charging Circuit Diagnosis” on page 347.)

NOTE: *When the following codes are displayed, no output indicator lights will be lit.*

Circuits connected to the “Output” connector of the electronic control module operate by switching the ground side of the circuit.

Code 3-2

Three pulses followed by a short pause, followed by two pulses; Indicates a wiring harness failure. Proceed to Control Module Check procedure.

Code 3-3

Three pulses followed by a short pause, followed by three pulses; Indicates an output short to positive 12 volt condition on the components of one (or more) of the following circuits:

- Lift and Lower Valve Circuit
- Cranking Circuit
- Discharge Light Circuit
- Glow Plug Circuit (Diesel only)
- Mow Circuit

See individual circuit diagnosis for diagnostic procedures.

Code 3-4

Three pulses followed by a short pause, followed by four pulses; Indicates a fuel solenoid circuit failure.

Code 3-5

Three pulses followed by a short pause, followed by five pulses; Indicates fuel hold internal checking failure on circuit board, or fuel hold output miswired to +12 volts.

Code 3-6

Three pulses followed by a short pause, followed by six pulses; Indicates a faulty power or ground connection to the control board.

Code 3-7

Three pulses followed by a short pause, followed by seven pulses; Indicates a faulty power or ground connection to the control board.

Code 3-8

Three pulses followed by a short pause, followed by eight pulses; Indicates a faulty power or ground connection to the control board.

- If there is no response to the key switch and no codes indicated as described above, proceed to the ELECTRONIC CONTROL MODULE CHECK.

Power Circuit Operation - Unswitched

Function

Provides power to the primary circuit whenever the battery is connected.

Operating Conditions

- Key switch in STOP position.

Theory of Operation

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

- Battery (G1) positive (+) terminal
- Battery terminal of starting motor (M1) solenoid
- Battery terminal of alternator (G2)
- Battery terminal of key switch (S1)
- Terminal 30 of starting motor relay (K1)
- Battery terminal of voltage regulator/rectifier (N1).
- Ignition delay module (A2).
- Terminal 30 of optional headlight relay (K2)

The positive (+) battery cable connects the battery to the starting motor solenoid. The starting motor solenoid connection is used as a tie point for the rest of the electrical system.

The battery cables and the starting motor solenoid connections must be in good condition for the electrical system to function properly.

The ground cable connections are equally as important as the positive (+) cable. Starting motor operation depends on these cables and connections to carry the high current necessary for its operation.

The connection between the starting motor (M1) and key switch (S1) and starting motor relay (K1) and battery (G1) are protected by the fusible links (F1) and (F2). These links are short lengths of wire which are designed to protect the main wiring harness and will fail if current load becomes excessive or if a short circuit occurs.

Power Circuit Operation - Switched

Function

Provides power to components by means of a key switch.

Operating Conditions

- Key switch in RUN position.

Theory of Operation

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

- All unswitched locations.
- Terminal A of key switch (S1).
- Terminal S2 of key switch (S1).
- Voltage regulator/rectifier (N1).
- Terminal D of connector X8 on electronic control module (A3).
- Brake switch (S2).
- Seat switch (S3).
- Mow valve solenoid (Y2).
- Backlap switch (S4).
- Mow/transport switch (S5).
- Lift switch (console) (S6).
- Lift switch (floor) (S7).
- Lift valve solenoid (Y3).
- Lower switch (console) (S8).
- Lower switch (floor) (S9).
- Lower valve solenoid (Y4).
- Leak detection system connector (X13).
- Fuel pump (M2).
- Terminal 3 of connector X38 on warning indicator module (E3).

These circuits are controlled by the key switch and are protected by the fusible link (F1) and 20-amp main power fuse (F3).

Operating Conditions

- Key switch in START position.

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

- Terminal 86 of the starting motor relay (K1).
- Terminal E of connector X9 on electronic control module (A3).

Power Circuit Operation - Switched - Optional Equipment

Function

Provides power to components by means of a key switch.

Operating Conditions

- Key switch in RUN position.

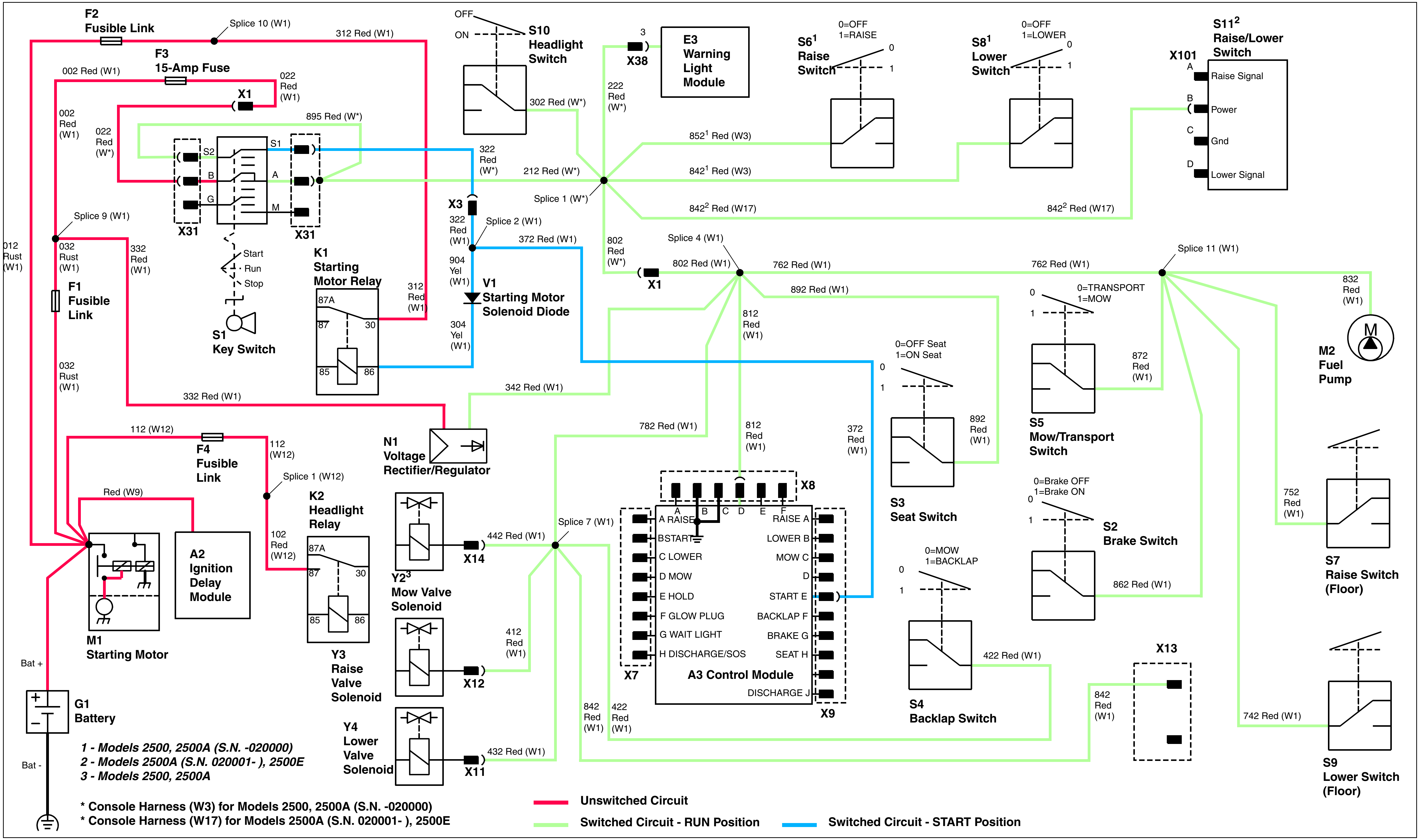
Theory of Operation

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

- All unswitched locations.
- All standard equipment switched locations.
- Common terminal of headlight switch (S10).

This circuit is controlled by the key switch and is protected by the fusible link (F4).

Power Circuit



1 - Models 2500, 2500A (S.N. -020000)
2 - Models 2500A (S.N. 020001-), 2500E
3 - Models 2500, 2500A

* Console Harness (W3) for Models 2500, 2500A (S.N. -020000)
* Console Harness (W17) for Models 2500A (S.N. 020001-), 2500E

MX20860

Power Circuit Diagnosis - Unswitched

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

NOTE: Although current is supplied to many components, the power circuit diagnosis will be limited to components not directly controlled by the electronic control module. Diagnosis for these components will be covered in the individual circuits where they apply.

A test light is preferred method for testing circuits.

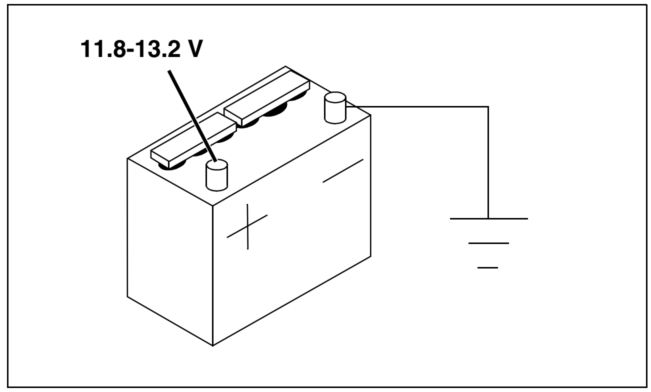
Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Unswitched Power Circuit

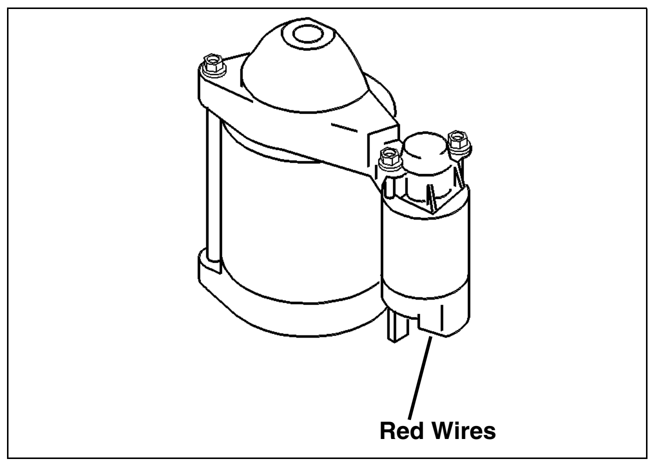


MIF

(1) Measure voltage at battery positive (+) post. Is voltage in the range 11.8-13.2 V?

Yes - Go to step (2).

No - Check battery condition. (See “Test Battery” on page 541.)



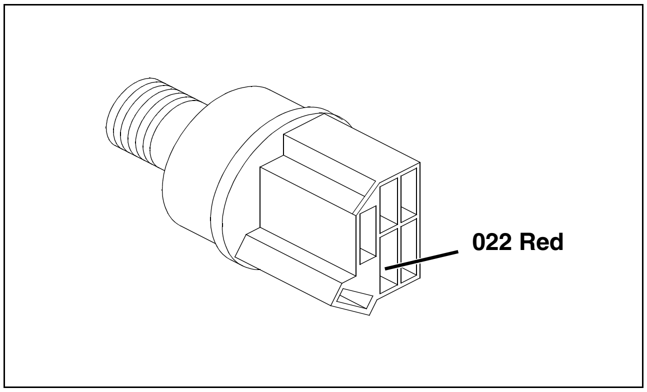
MIF

(2) Measure voltage at starting motor solenoid - red wires. Is battery voltage present?[1]

Yes - Go to step (3).

No - Check battery positive (+) cable and clamps. Clean and tighten connections.

System: Unswitched Power Circuit

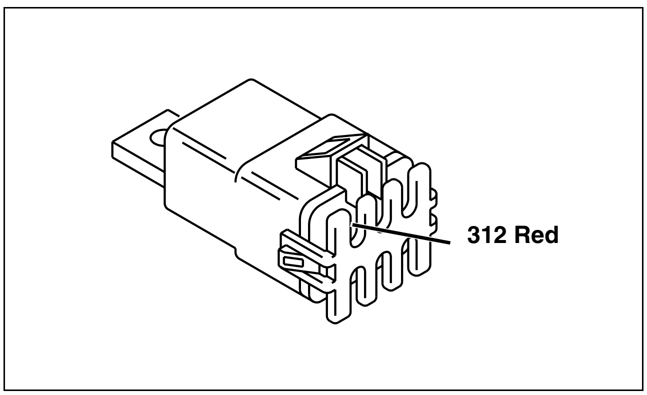


MIF

(3) Measure voltage at key switch (S1) - terminal B, wire 022 red. Is battery voltage present?

Yes - Go to step (4).

No - Test wires 022 red (W3) and 022 red (W1) and key switch fuse (F3). Test wire 002 red (W1) and fusible link (F1) - wire 032 rust (W1) and connections.



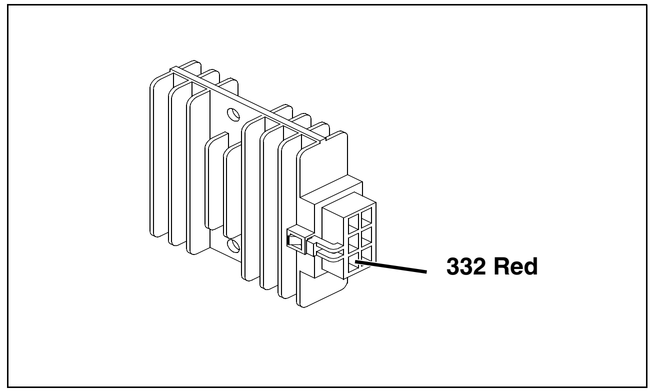
MIF

(4) [2]Measure voltage at starting motor relay (K1) - terminal 30, wire 312 red. Is battery voltage present?

Yes - Go to step (5).

No - Test wires 012 rust (W1) and 312 red (W1) and connections. Test fusible link (F2).

System: Unswitched Power Circuit

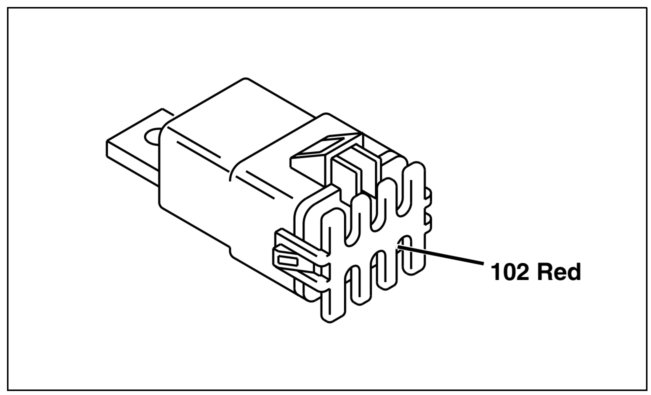


MIF

(5) Measure voltage at voltage regulator/rectifier (N1) connector (X28), terminal 1, wire 332 red. Is battery voltage present?

Yes - Go to step (6).

No - Test fusible link (F1) - 032 rust (W1) and wire 332 red (W1) and connections



MIF

(6) [2]Measure voltage at optional headlight relay (K2) connector (X74), terminal 87, wire 102 red. Is battery voltage present?

No - Test wire 102 red (W12) and fusible link (F4) - wire 112 rust (W12) and connections.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

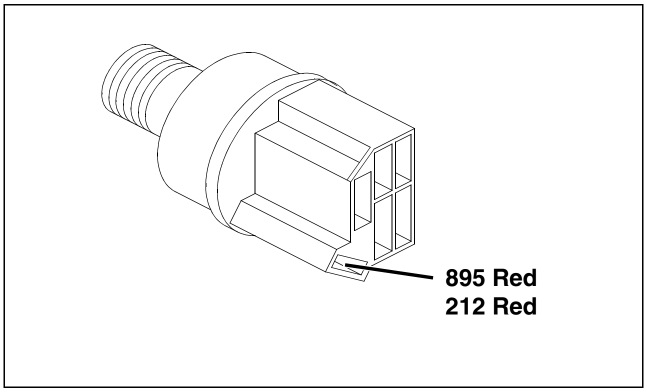
2. When checking voltages and/or resistance at relay terminals, it may be necessary to disconnect the relay connector and perform the test at the open terminal. Reconnect the relay connector after performing the check.

Power Circuit Diagnosis - Switched

Test Conditions:

- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Switched Power Circuit

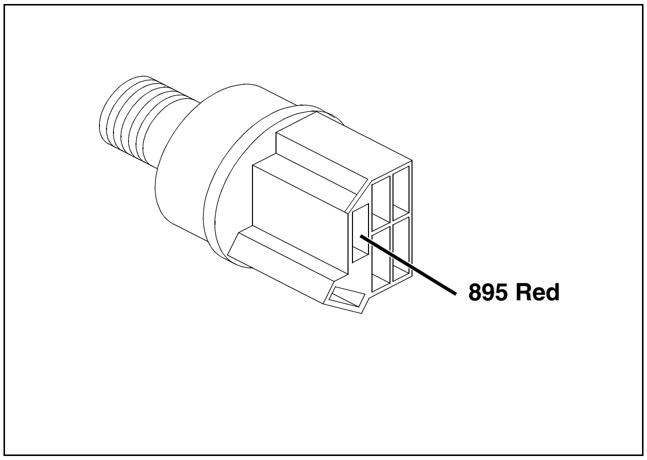


MIF

(1) Measure voltage at key switch (S1) - terminal A, wires 895 and 212 red. Is voltage in the range 11.8-13.2 V?

Yes - Go to step (2).

No - Test key switch. (See “Test Key Switch” on page 551.)



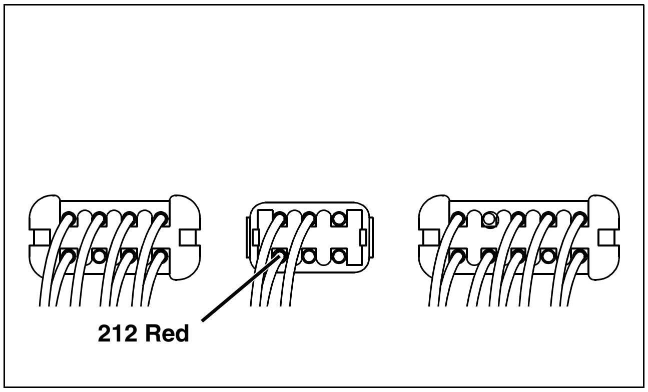
MIF

(2) Measure voltage at key switch (S1) - terminal S2, wire 895 red. Is battery voltage present?

Yes - Go to step (3).

No - Test wire 895 red (W3) and connections.

System: Switched Power Circuit

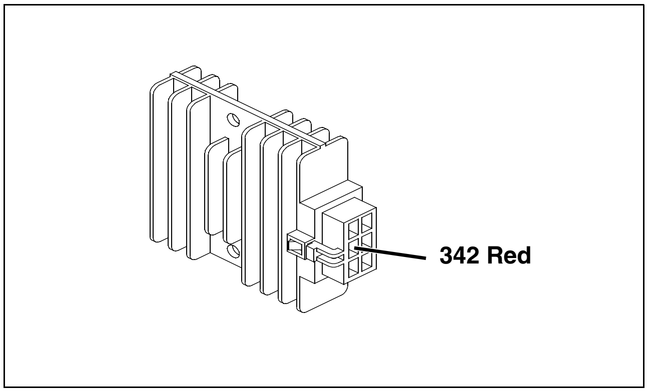


MIF

(3) Measure voltage at electronic control module connector (X8) - terminal D, write 212 red. Is battery voltage present?

Yes - Go to step (4).

No - Test wires 812 and 802 red (W1) and wires 802 and 212 red (W3) and connections.



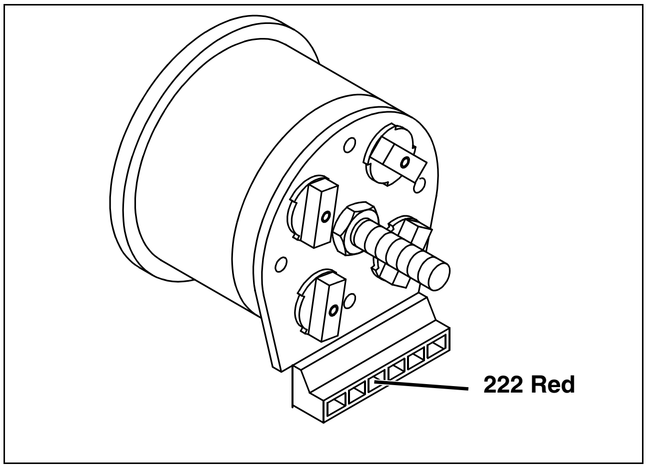
MIF

(4) Measure voltage at voltage regulator/rectifier (N1) - wire 342 red. Is battery voltage present?

Yes - Go to step (5).

No - Test wire 342 red (W1) and connections.

System: Switched Power Circuit

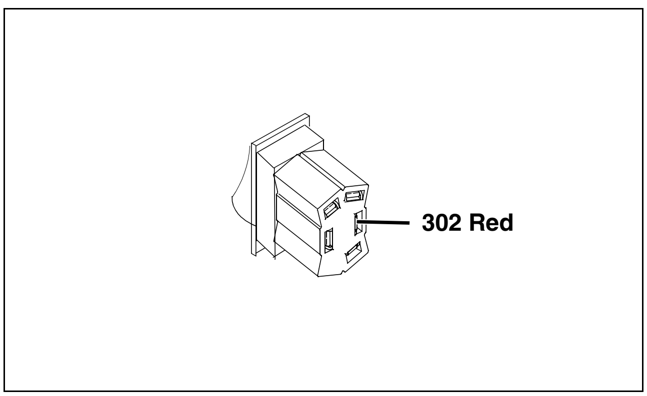


MIF

(5) Measure voltage at warning light module (E3) connector (X38), wire 222 red. Is battery voltage present?

Yes - Go to step (6).

No - Test wires 222 and 212 red (W3) and connections.



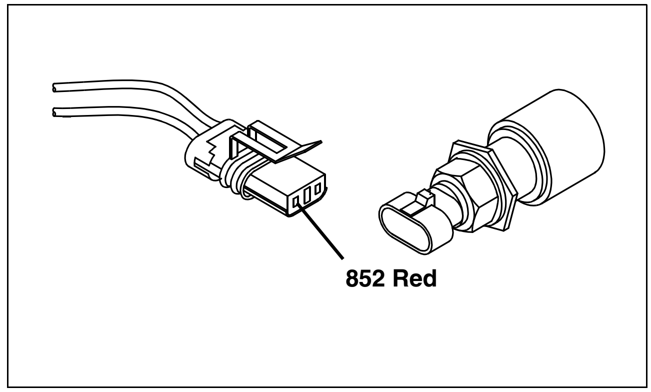
MIF

(6) Measure voltage at optional headlight switch (S10) connector (X37), wire 302 red. Is battery voltage present?

Yes - Go to step (7).

No - Test wires 302 and 212 red (W3) and connections.

System: Switched Power Circuit

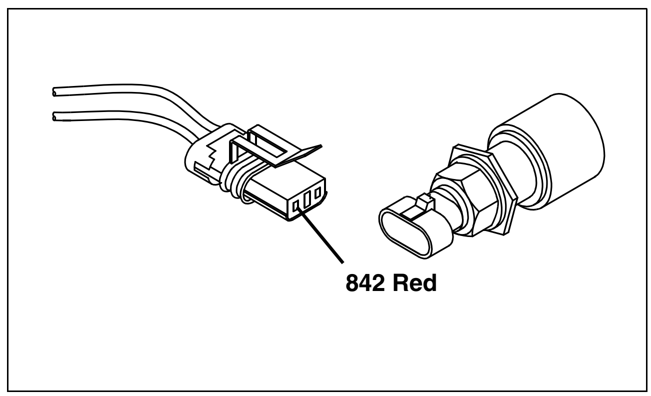


MIF

(7) Models 2500, 2500A (S.N. -020000). Measure voltage at raise switch (S61) - wire 852 red. Is battery voltage present?

Yes - Go to step (8).

No - Test wires 852 and 212 red (W3) and connections.



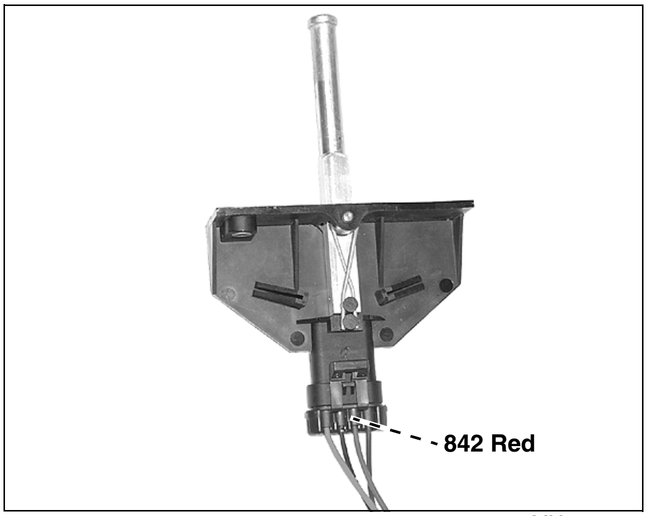
MIF

(8) Models 2500, 2500A (S.N. -020000). Measure voltage at lower switch (S8) - wire 842 red. Is battery voltage present?

Yes - Go to step (9).

No - Test wires 842 and 212 red (W3) and connections.

System: Switched Power Circuit



MX20489

(9) Models 2500A (S.N. 020001-) and 2500E. With a small diameter probe measure voltage at lift and lower switch (S11) - wire 842 red. Is battery voltage present?

No - Test wires 842 and 212 red (W17) and connections.

Cranking Circuit Operation

Function

To energize the starting motor solenoid and engage the starting motor.

Operating Conditions

To crank the engine, the following conditions must be met:

- Operator ON seat.
- Park brake ENGAGED.
- Mow/transport lever in TRANSPORT position.
- Backlap switch in MOW (OFF) position.
- Key switch in START position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cranking circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

Current is also supplied to the starting motor relay (K1) directly from the battery and is protected by a 15-amp fuse (F2). Current flows from the battery positive terminal to the fuse to terminal 30 of the starting motor relay (red wire No. 312 [W1]).

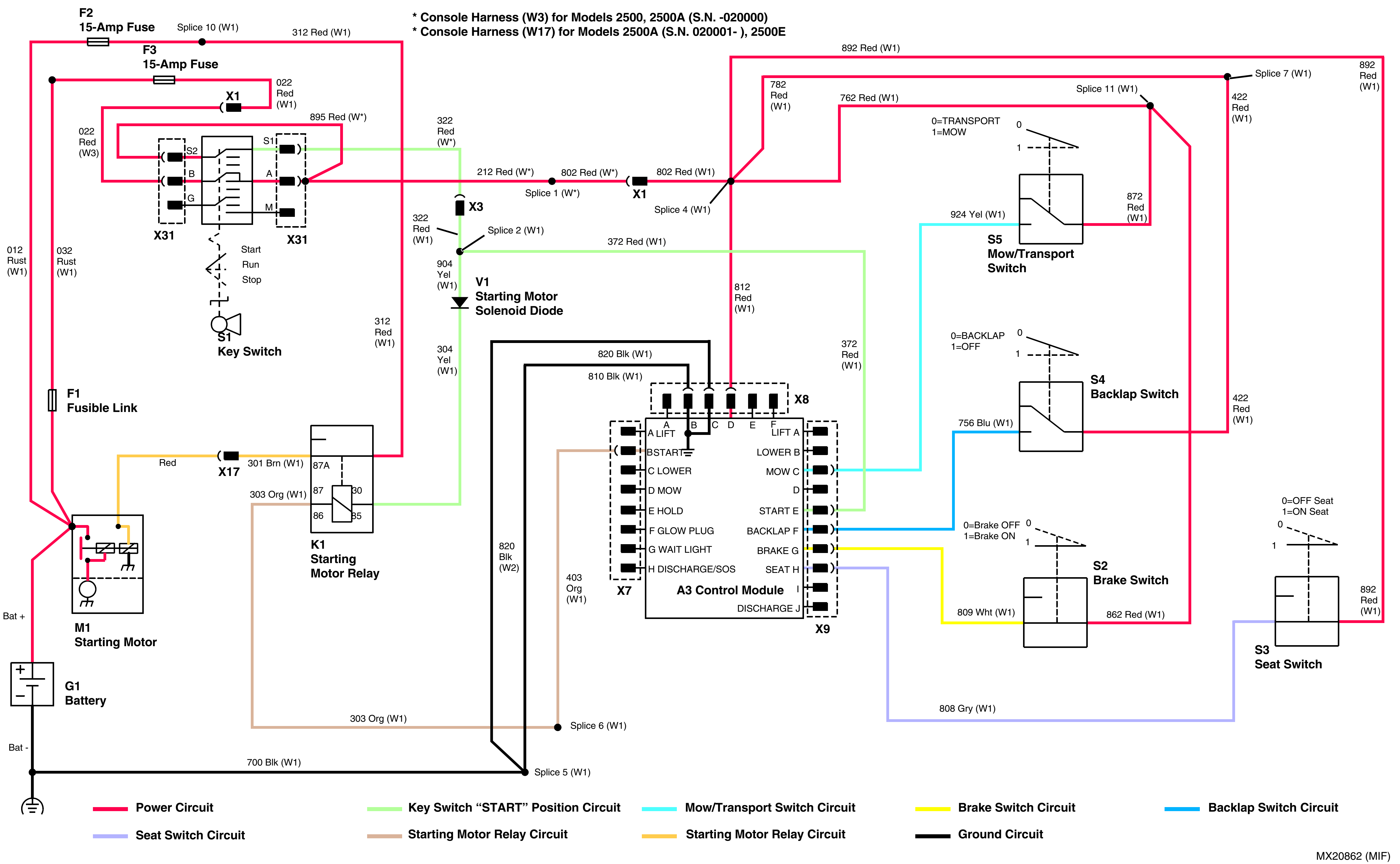
With the key switch in the START position, current flows to terminal D of connector X8 on the electronic control module (A3) (red wires No. 212 [W3], 802 [W3], 802 [W1] and 812 [W1]. Current is also supplied to the backlap switch (S4) (red wires 762 [W1], 782 [W1] and 422 [W1]), mow/ transport switch (S5) (red wires 762 [W1] and 872 [W1]), brake switch (S2) (red wires 762 [W1] and 862 [W1]) and seat switch (S3) (red wires 762 [W1] and 892 [W1]).

Current also flows to key switch terminal S2 (red wire No. 895 [W3]), through the switch to terminal S1, to terminal E of connector X9 on the electronic control module (red wires No. 322 [W3], 322 [W1] and 372 [W1]).

Current also flows from key switch terminal S1 to the starting motor relay diode (V1) to terminal 86 of the starting motor relay.

The ground side of the starting motor relay is connected through the electronic control module (orange wires No. 303 (W1) and 403 (W1). With the brake, mow/transport, seat and backlap switches in the correct positions to allow engine cranking (as listed in Operating Conditions), the electronic control module completes the path to ground circuit (black wires 810 [W1], 820 [W1] and 700 [W1]) energizing the relay.

Cranking Circuit Schematic



Cranking Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

Diagnostic Codes

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed for additional codes.

Code 1-2

One pulse followed by a short pause, followed by two pulses (Code 1-2); Indicates that the park brake switch is not activated. Engage park brake and repeat check procedure.

If the code continues to flash after the brake has been set, perform INPUT CIRCUIT LIGHT CHECK - “Brake Switch Input” on page 322.

Code 1-3

One pulse followed by a short pause, followed by three pulses (Code 1-3); Indicates that the mow switch is activated. Move mow/transport lever to TRANSPORT position and repeat check procedure.

If the code continues to flash after the mow/transport lever has been moved to the TRANSPORT position, perform INPUT CIRCUIT LIGHT CHECK - “Mow/Transport Switch Input” on page 322.

Code 2-2

Two pulses followed by a short pause, followed by two pulses (Code 2-2); Indicates that the mow/backlap valve is in BACKLAP position. Move mow/backlap valve to MOW position and repeat check procedure.

If the code continues to flash after the mow/backlap valve has been moved to the MOW position, perform INPUT CIRCUIT LIGHT CHECK - “Backlap Switch Input” on page 322.

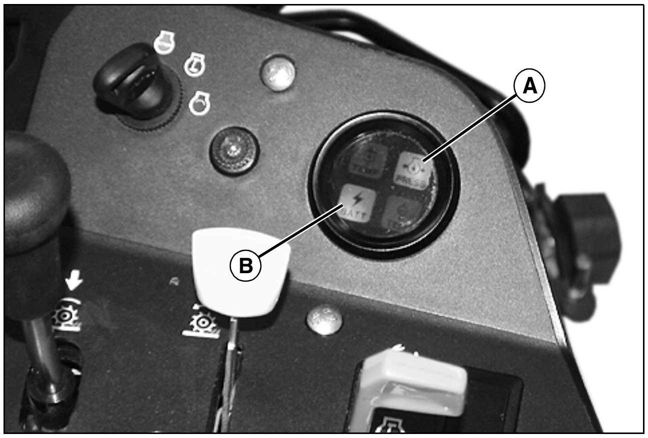
- If there is no response to the key switch and no codes indicated as described above, test electronic control module. (See “Electronic Control Module Check” on page 539.)

STEP 1: START CIRCUIT CHECK

Test Conditions:

- Mow/transport lever in TRANSPORT position.
- Park brake engaged.
- Mow/backlap valve in MOW position.

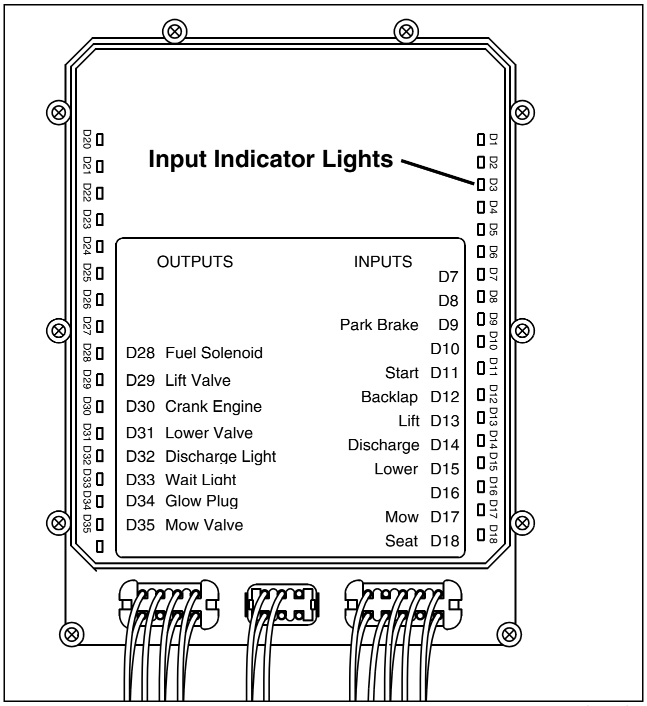
1. Turn key switch to START position.
    - The engine should crank and start.



- If the engine does not crank, the oil pressure light (A) should remain lit and the battery discharge light (B) will begin to flash, indicating a code. (See “Diagnostic Codes” on page 308.)
- If the engine does not crank, and the battery discharge light does not come on, but the oil pressure light does, check control module. (See “Electronic Control Module Check” on page 539.)
- If the engine does not crank, and the battery discharge and oil pressure light does come on, but does not flash a code, check key switch input test. (See INPUT CIRCUIT LIGHT CHECK - “Key Switch Input” on page 322.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire, wire 301 brown.

3. Move key switch to the START position and back to the RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

Seat Switch Input

1. Press down on the lower cushion of the seat to engage the seat switch.

2. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).

3. Release the seat switch.

4. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 323.)

Brake Switch Input

1. Depress the park brake pedal.

2. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).

3. Release the park brake pedal.

4. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON; First check brake switch adjustment (See “Adjust Park Brake Switch” on page 729.) If brake light does not come ON after adjustment, test brake switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 323.)

Mow/Transport Switch Input

1. Move mow/transport lever to MOW position.

2. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 323.)

Backlap Switch Input

1. Move the backlap valve to the MOW position.

2. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described, test the backlap switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 323.)

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

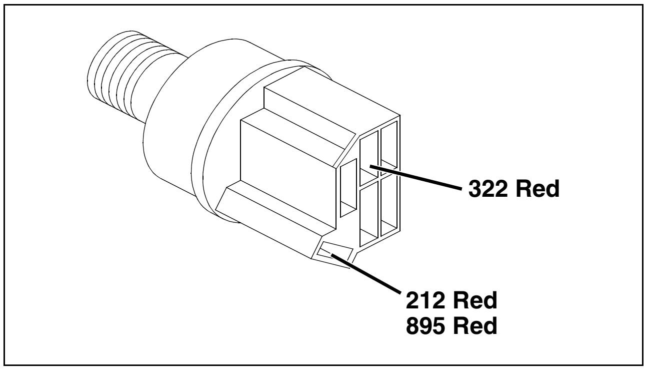
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in START position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X9) disconnected.

System: Key Switch Circuit Test



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 322 red. Is battery voltage/ test light on?

Yes - Go to step (2).

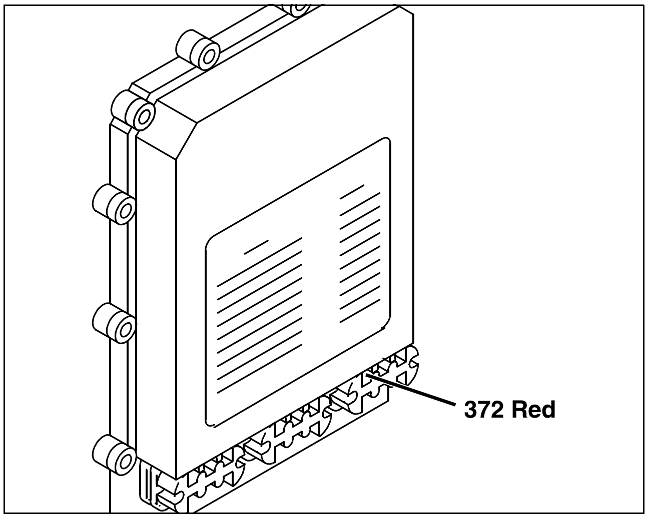
No - Test red wire No. 895 (W3) and connections.

(2) Check voltage at key switch (S1) connector (X31), terminal S1, wire 212 red. Is battery voltage/ test light on?

Yes - Go to step (3).

No - Test key switch. (See “Test Key Switch” on page 551.)

System: Key Switch Circuit Test



MIF

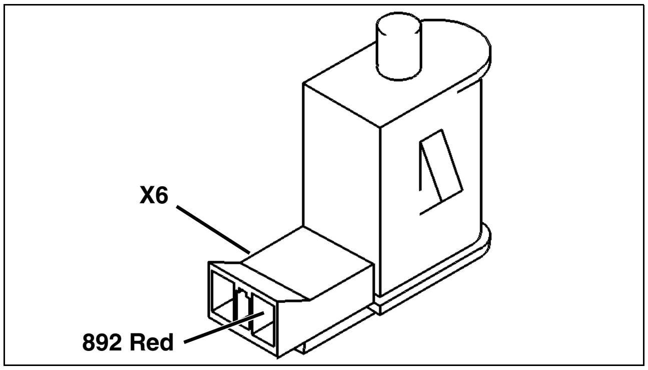
(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

No - Test red wires No. 372 (W1), 322 (W1) and 322 (W3) and connections.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Seat switch connector (X6) disconnected.

System: Seat Switch Circuit Test



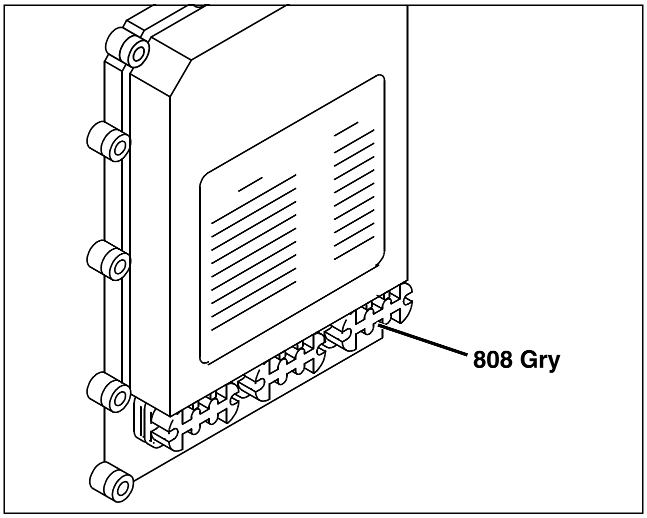
MIF

(1) Check voltage at seat switch connector (X6), wire 892 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 892 red (W2) and connections.

System: Seat Switch Circuit Test



MIF

(2) Seat switch connector (X6) connected.
Seat switch engaged.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal H, wire 808 grey. Is battery voltage/test light on?

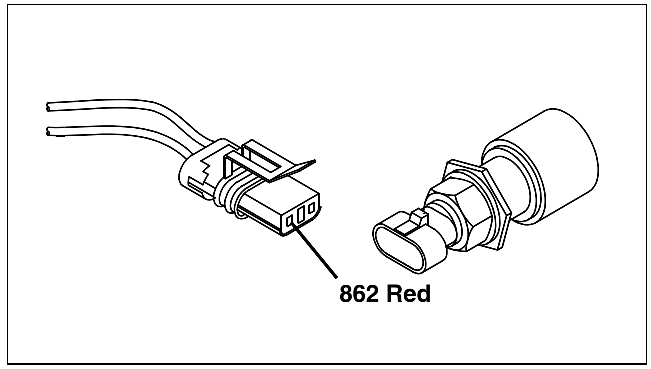
No - Test wire 808 gray (W1) and connections.

No - Test seat switch. (See "Test Seat Switch" on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Brake switch connector (X18) disconnected.

System: Park Brake Switch Circuit Test

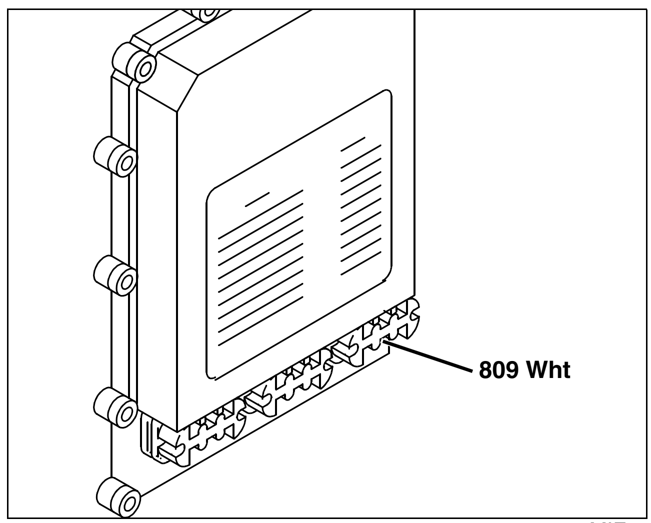


MIF

(1) Check voltage at brake switch connector (X18), wire 862 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 862 red (W1) and connections.



MIF

(2) Park brake switch connector (X18) connected.
Park brake engaged.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal G, wire 809 white. Is battery voltage/test light on?

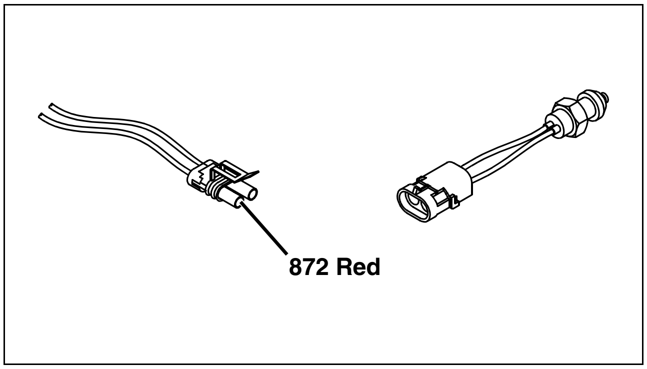
No - Test wire 809 white (W1) and connections.

No - Test park brake switch. (See "Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)" on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Mow/transport switch connector (X22) disconnected.

System: Mow/Transport Switch Circuit Test



MIF

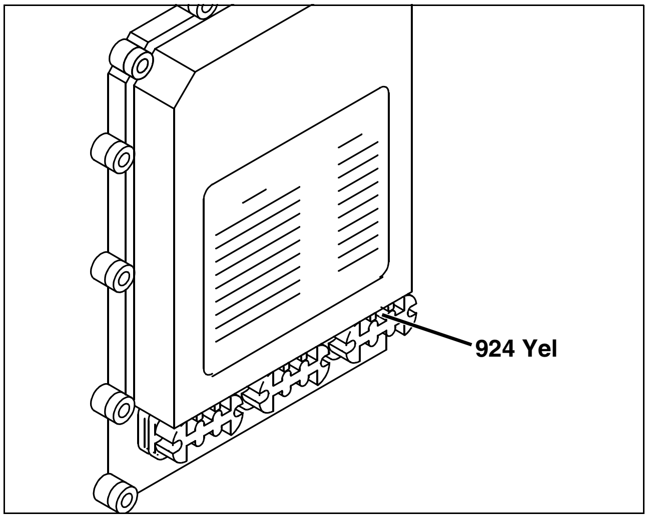
(1) Check voltage at mow/transport switch (S5) connector (X22), wire 872 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test wire 872 red (W1) and connections.

No - Third wheel assist units: Test wire 872 red (W11) and connections.

System: Mow/Transport Switch Circuit Test



MIF

(2) Mow/transport switch connector (X22) connected.
Mow/transport lever in MOW position.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal C, wire 924 yellow. Is battery voltage/test light on?

No - Test wire 924 yellow (W1) and connections.

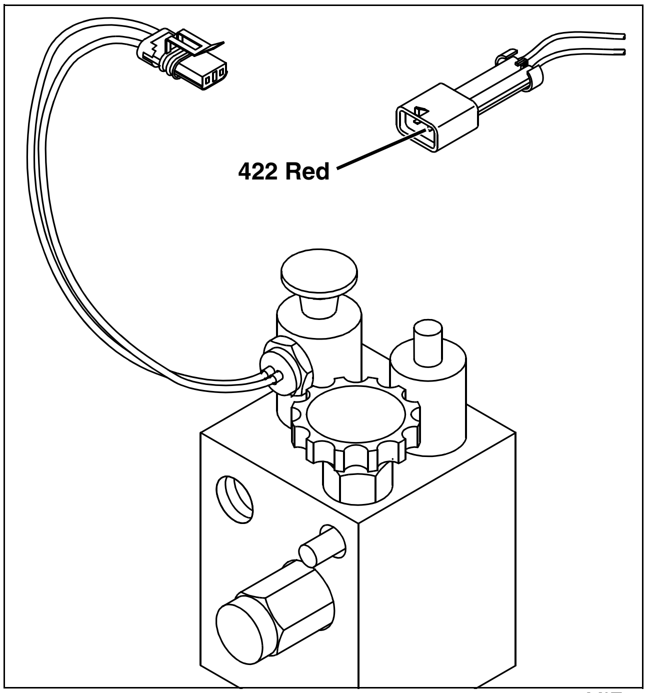
No - Third wheel assist units: Test yellow wires No. 924 (W11) and 934 (W11) and connections.

No - Test mow/transport switch. (See “Test Mow/ Transport Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Backlap switch connector (X15) disconnected.

System: Backlap Switch Circuit Test



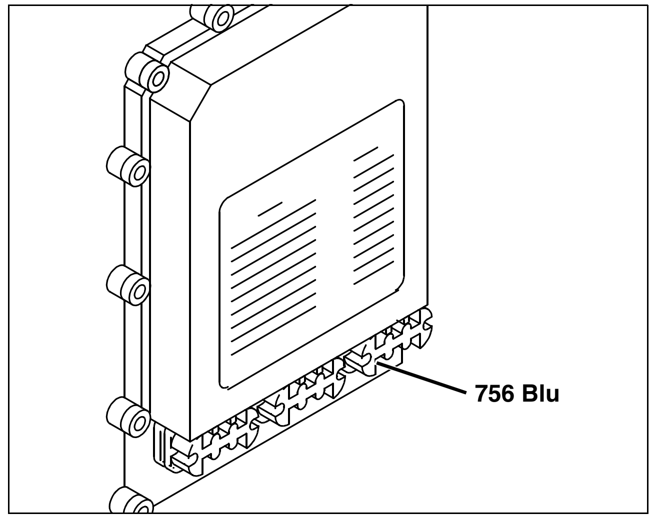
MIF

(1) Check voltage at backlap switch (S4) connector (X15), wire 422 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test red wire No. 422 (W1) and connections.

System: Backlap Switch Circuit Test



MIF

(2) Backlap switch in BACKLAP position. Backlap switch connector (X15) connected. Electronic control module - connector (X9) disconnected. Check voltage at electronic control module (A3) connector (X9), terminal F, wire 756 blue. Is battery voltage/test light on?

No - Test blue wire No. 756 (W1) and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.) (See “Test Backlap Switch - Model 2500E” on page 560.)

Run Circuit Operation - Operator On Seat

Function

To allow the engine to run with the operator on the seat.

Operating Conditions

- Key switch in RUN position - engine running.
- Operator on seat.
- Park brake RELEASED.
- Backlap valve in OFF position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the run circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal. Current is also supplied to the ignition delay module (A2) (red wire [W9]).

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current is also supplied to the backlap switch (S4) (red wires 762 [W1], 782 [W1] and 422 [W1]), mow/transport switch (S5) (red wires 762 [W1] and 872 [W1]), brake switch (S2) (red wires 762 [W1] and 862 [W1]) and seat switch (S3) (red wires 762 [W1] and 892 [W1]).

Current is also supplied to the fuel pump (M2) (red wires No. 832 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3], engaging the fuel pump.

With the operator on the seat, the seat switch is closed, allowing current to flow to connector X9, terminal G of the control module (gray wire No. 808 [W1]). The control module then energizes the fuel shutoff solenoid (Y1) (yellow/white wire [W5], and yellow wires No. 362 [W1] and 364 [W1]), allowing fuel to flow to the carburetor.

Current is also supplied to the ignition delay module (yellow wire [W9], yellow/white wire [W5] and yellow wires No. 362 [W1] and 364 [W1]).

The ignition delay module then provides current to the ignition coils (T1 and T2) (yellow/white wires [W4] and the ignition module (A1) (yellow/white wire [W7] and orange wire [W9]).

The ignition coils consist of iron coils with two sets of wires wound around them. The primary windings are connected to the ignition to the ignition module (A1). The secondary windings are connected to the spark plugs (E1 and E2) through the high tension leads. There are many more windings in the secondary coils of the coils than the primary windings.

As the flywheel rotates prior to the spark plugs firing, the ignition module allows current from the battery to the primary windings of the ignition coils.

When the raised area of the flywheel aligns with the pulser coils (B1 and B2) a triggering signal is generated. These triggering signals are routed to the ignition module. The ignition module acts as an electronic switch, controlling the timing of the flow of current to the primary coils of the ignition coils (T1 and T2).

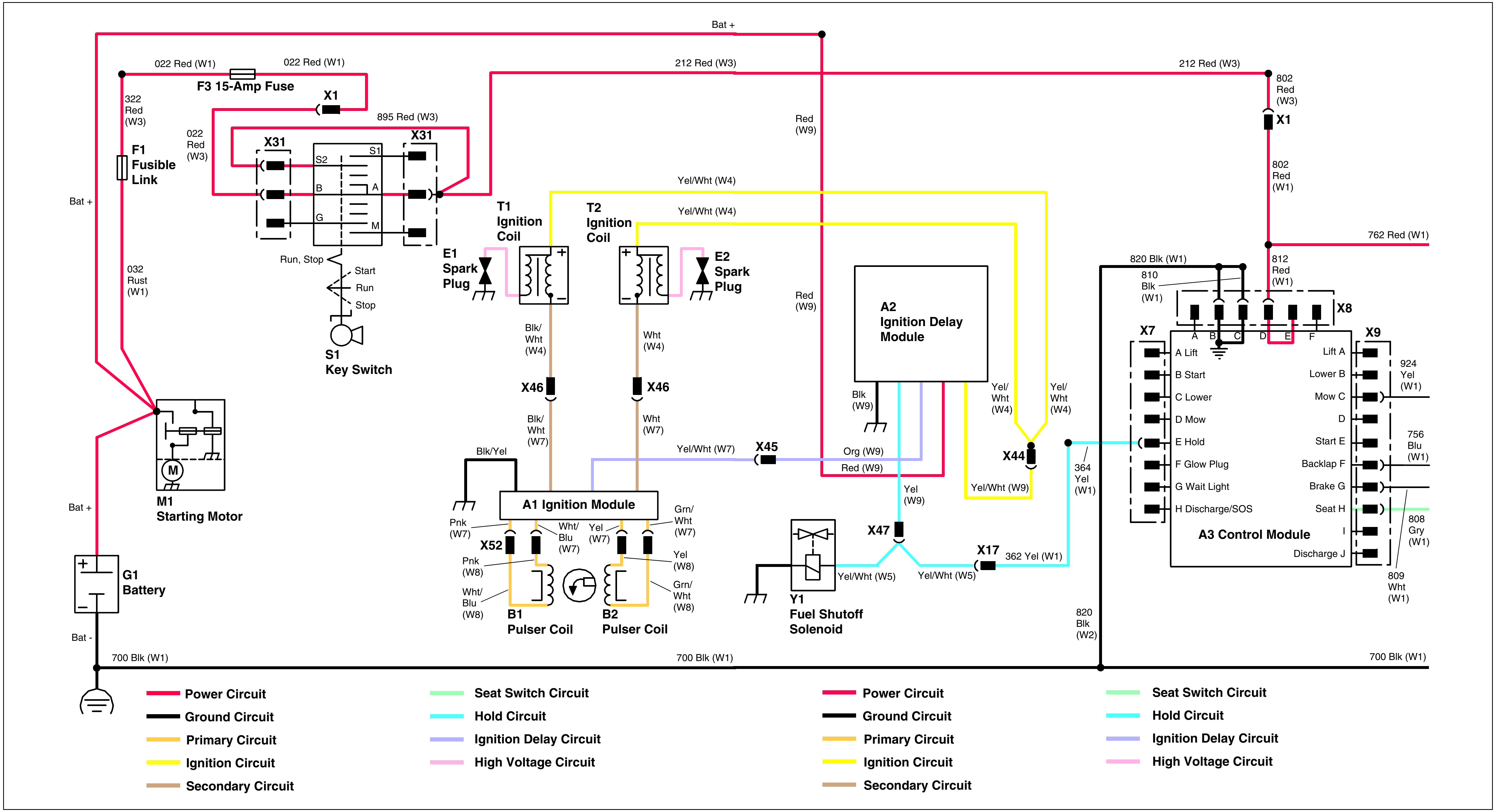
When the signal from the pulser coil is received at the ignition module, current flow to the primary windings is stopped. As the voltage in the primary windings drops from battery voltage to 0, a strong magnetic field is created around the primary and secondary windings. The strong magnetic field generates a voltage in the secondary windings of the coil. The voltage generated in the secondary windings is much higher than the battery voltage that was applied due to the greater number of windings.

The high voltage flows to the spark plugs (E1 and E2), igniting the fuel/air mixture in the cylinders.

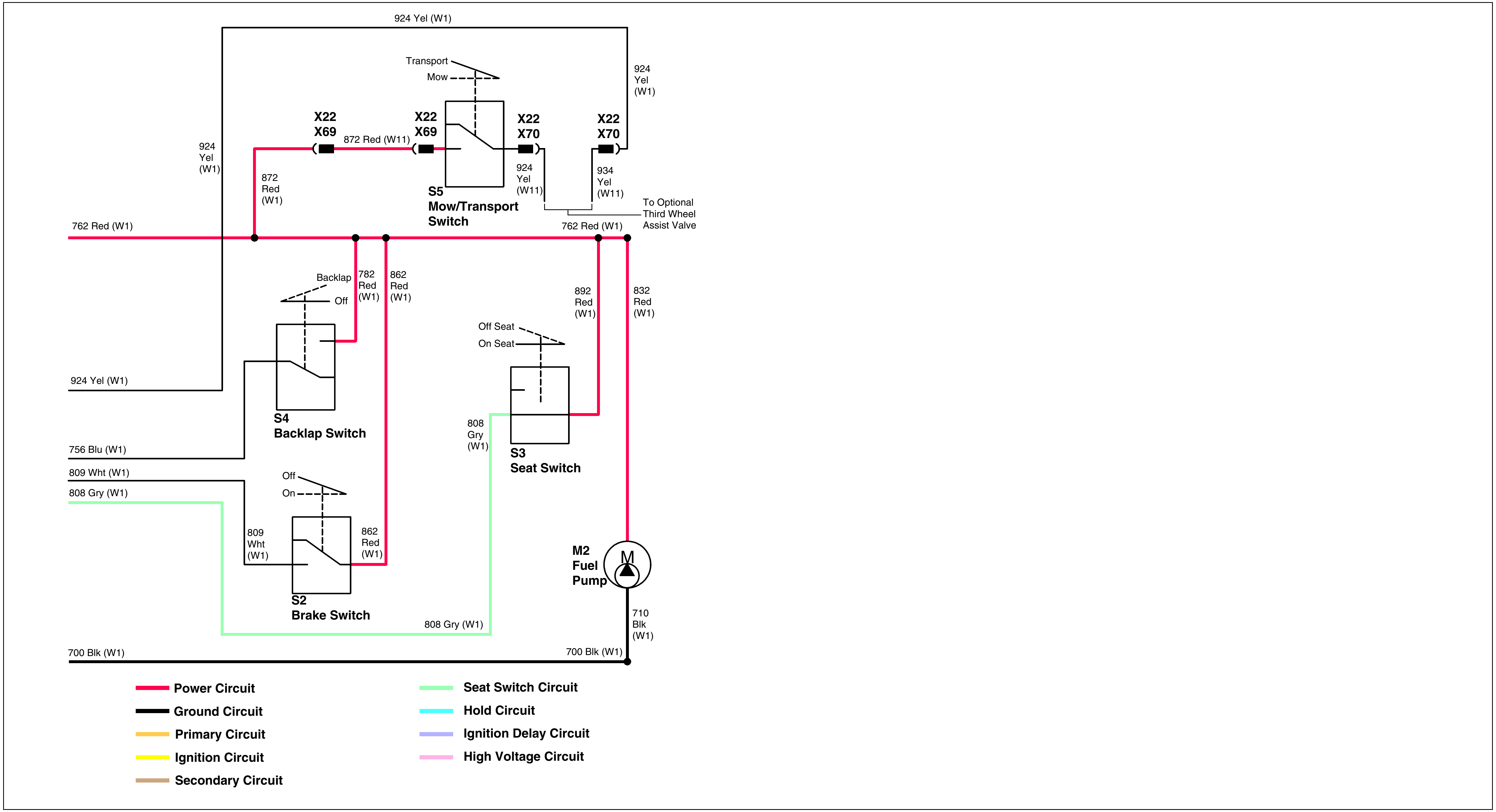
A ground circuit provides a path to ground for the control module (black wires No. 810 [W1], 820 [W1] and 700 [W1]) and fuel pump (black wires No. 710 [W1] and 700 [W1]).

Gasoline Engine

Run Circuit - Operator On Seat



MIF


924 Yel (W1)
Transport
Mow
924 Yel (W1)
X22 X69
872 Red (W11)
X22 X69
X22 X70
X22 X70
924 Yel (W1)
872 Red (W1)
924 Yel (W11)
934 Yel (W11)
S5 Mow/Transport Switch
To Optional Third Wheel Assist Valve
762 Red (W1)
762 Red (W1)
Backlap
Off
782 Red (W1)
862 Red (W1)
892 Red (W1)
832 Red (W1)
Off Seat
On Seat
924 Yel (W1)
S4 Backlap Switch
808 Gry (W1)
S3 Seat Switch
756 Blu (W1)
809 Wht (W1)
808 Gry (W1)
Off
On
809 Wht (W1)
862 Red (W1)
M2 Fuel Pump
M
S2 Brake Switch
808 Gry (W1)
710 Blk (W1)
700 Blk (W1)
700 Blk (W1)
Power Circuit
Ground Circuit
Primary Circuit
Ignition Circuit
Secondary Circuit
Seat Switch Circuit
Hold Circuit
Ignition Delay Circuit
High Voltage Circuit

MIF

Run Circuit Operation - Operator Off Seat

Function

To allow the engine to run when the operator is off the seat. This is necessary when performing the backlapping procedure.

Operating Conditions

- Key switch in RUN position - engine running.
- Operator off seat.
- Park brake engaged.
- Backlap valve in OFF position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the run circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal. Current is also supplied to the ignition delay module (A2) (red wire [W9]).

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current is also supplied to the backlap switch (S4) (red wires 762 [W1], 782 [W1] and 422 [W1]), mow/transport switch (S5) (red wires 762 [W1] and 872 [W1]), brake switch (S2) (red wires 762 [W1] and 862 [W1]) and seat switch (S3) (red wires 762 [W1] and 892 [W1]).

Current is also supplied to the fuel pump (M2) (red wires No. 832 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3], engaging the fuel pump.

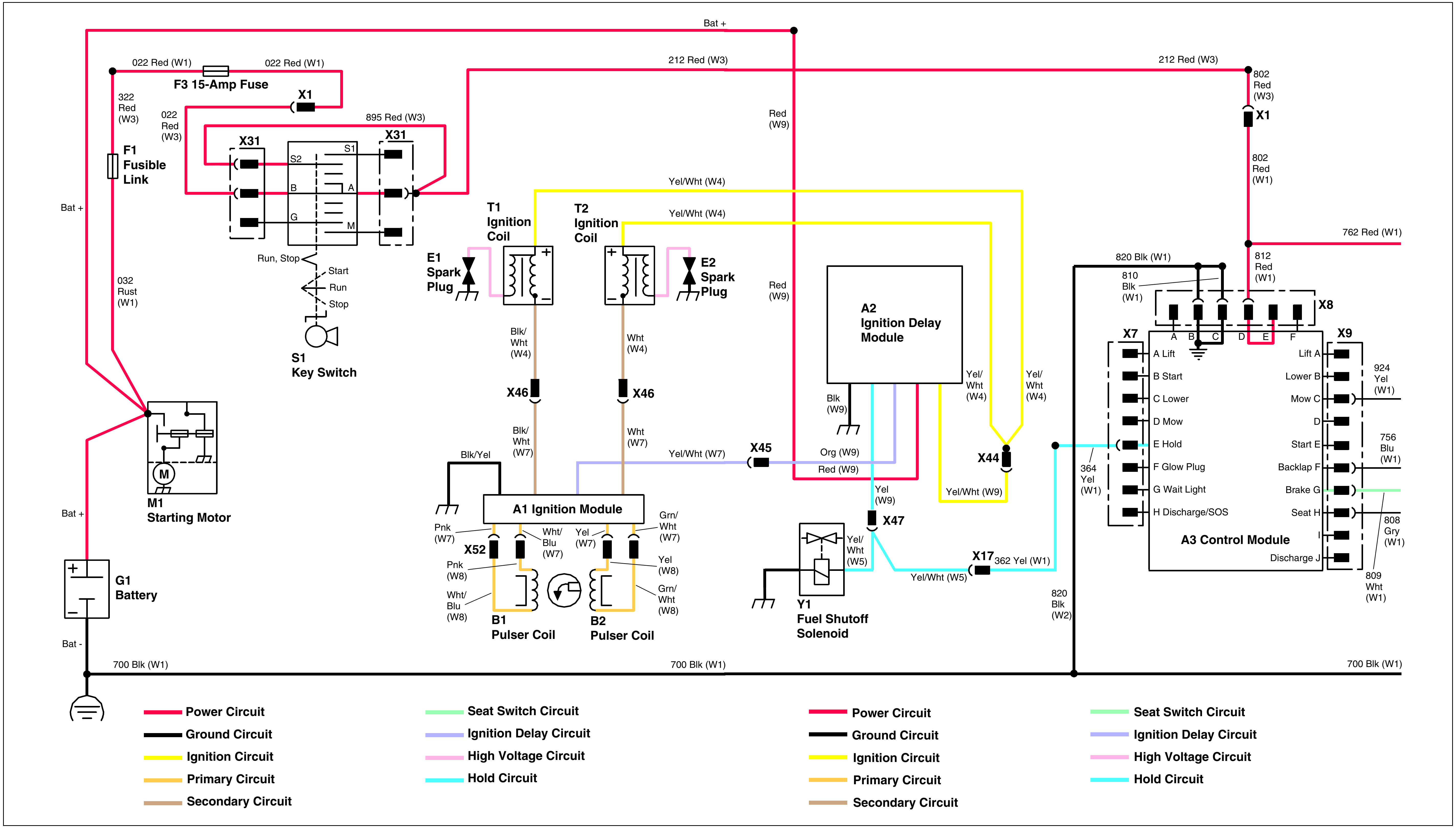
With the operator off the seat, and the park brake engaged, the brake switch is closed, allowing current to flow to connector X9, terminal H of the control module (gray wire No. 808 [W1]). The control module then energizes the fuel shutoff solenoid (Y1) (yellow/white wire [W5], and yellow wires No. 362 [W1] and 364 [W1]), allowing fuel to flow to the carburetor.

Current is also supplied to the ignition delay module (yellow wire [W9], yellow/white wire [W5] and yellow wires No. 362 [W1] and 364 [W1]).

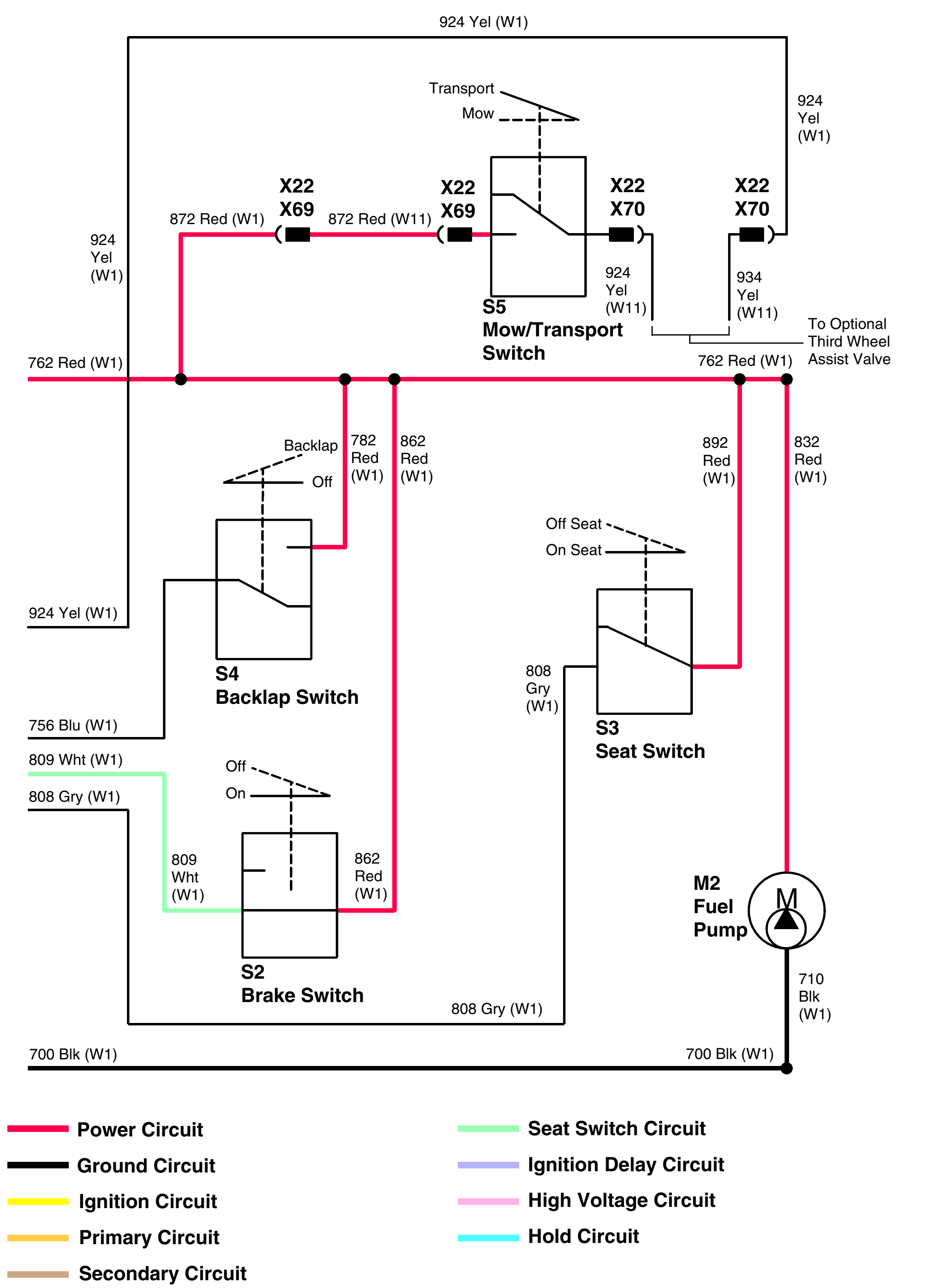
The ignition delay module then provides current to the ignition coils (T1 and T2) (yellow/white wires [W4] and the ignition module (A1) (yellow/white wire [W7] and orange wire [W9]).

Gasoline Engine

Run Circuit - Operator Off Seat



MIF



924 Yel (W1)
Transport
Mow
924 Yel (W1)
X22 X69
X22 X69
X22 X70
X22 X70
872 Red (W1)
872 Red (W11)
924 Yel (W1)
924 Yel (W11)
934 Yel (W11)
S5 Mow/Transport Switch
To Optional Third Wheel Assist Valve
762 Red (W1)
762 Red (W1)
Backlap
Off
782 Red (W1)
862 Red (W1)
892 Red (W1)
832 Red (W1)
Off Seat
On Seat
924 Yel (W1)
S4 Backlap Switch
808 Gry (W1)
S3 Seat Switch
756 Blu (W1)
809 Wht (W1)
808 Gry (W1)
Off
On
809 Wht (W1)
862 Red (W1)
M2 Fuel Pump
M
710 Blk (W1)
S2 Brake Switch
808 Gry (W1)
700 Blk (W1)
700 Blk (W1)
Power Circuit
Ground Circuit
Ignition Circuit
Primary Circuit
Secondary Circuit
Seat Switch Circuit
Ignition Delay Circuit
High Voltage Circuit
Hold Circuit

MIF

Run Circuit Operation - Engine Shutdown

Function

To keep the ignition system active for a short time after the key switch has been moved to the STOP position. This allows the engine to burn the remaining fuel/air mixture before the engine is shut-down.

Operating Conditions

- Key switch in STOP position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the run circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal. Current is also supplied to the ignition delay module (A2) (red wire [W9]).

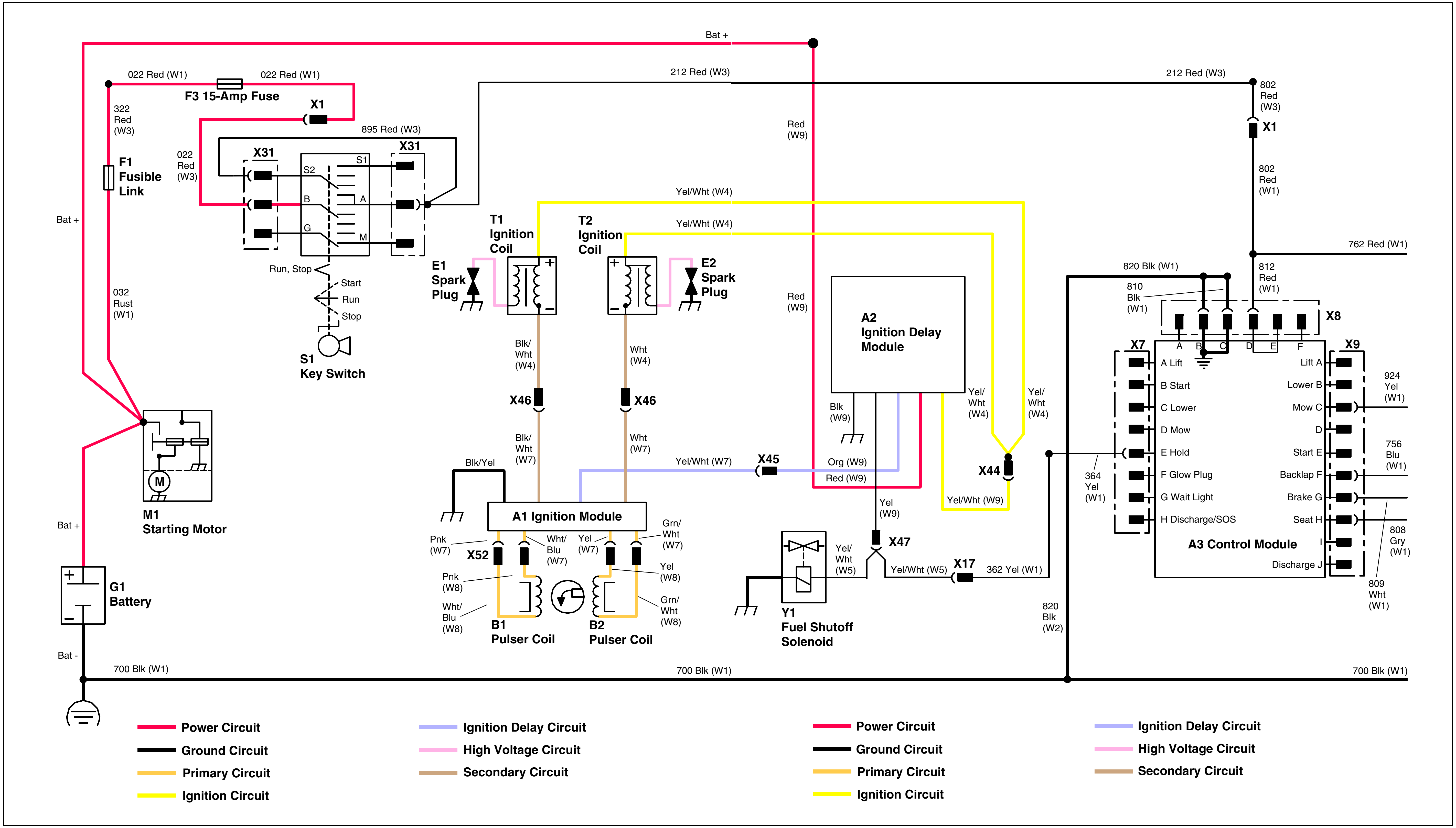
With the key switch in the STOP position, current flow to the control module, mow/transport, brake, backlap and seat switches. With current flow to the control module stopped, control signal to the ignition delay module and fuel shutoff solenoid (Y1) is interrupted, de-energizing the fuel shutoff solenoid, stopping the flow of fuel to the carburetor.

Current flow to the fuel pump is also stopped, shutting off the fuel pump.

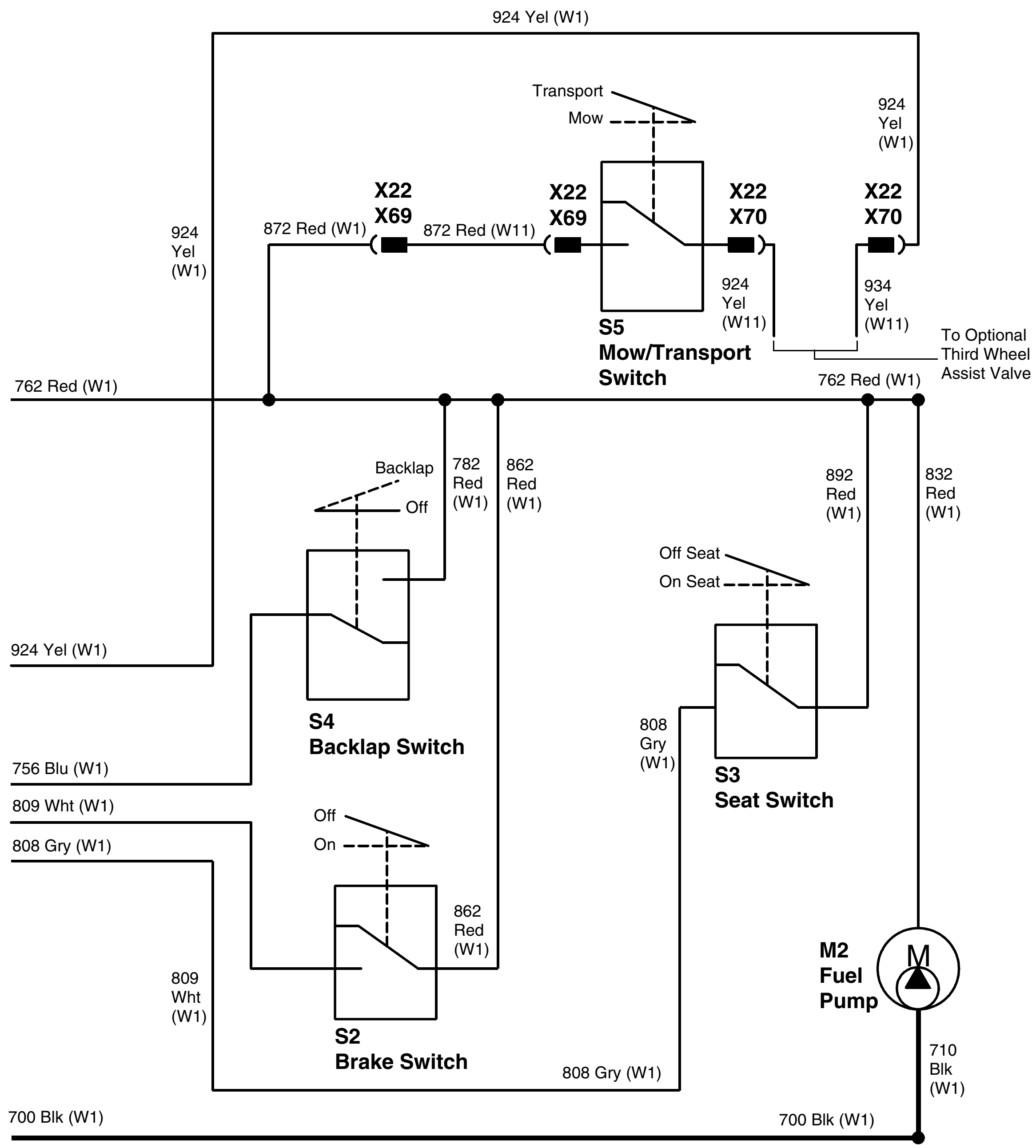
The ignition delay module receives current from the unswitched power circuit (red wire [W9]). This allows the ignition system to continue to operate until the remaining air/fuel mixture is burned, before timing out and shutting off the ignition system.

Gasoline Engine

Run Circuit - Engine Shutdown



MIF



924 Yel (W1)
Transport
Mow
924
Yel
(W1)
X22
X69
X22
X69
X22
X70
X22
X70
924
Yel
(W1)
872 Red (W1)
872 Red (W11)
924
Yel
(W11)
934
Yel
(W11)
S5
Mow/Transport
Switch
To Optional
Third Wheel
Assist Valve
762 Red (W1)
762 Red (W1)
Backlap
Off
782
Red
(W1)
862
Red
(W1)
892
Red
(W1)
832
Red
(W1)
Off Seat
On Seat
924 Yel (W1)
S4
Backlap Switch
808
Gry
(W1)
S3
Seat Switch
756 Blu (W1)
809 Wht (W1)
808 Gry (W1)
Off
On
862
Red
(W1)
M2
Fuel
Pump
M
809
Wht
(W1)
S2
Brake Switch
808 Gry (W1)
710
Blk
(W1)
700 Blk (W1)
700 Blk (W1)

MIF

Run Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

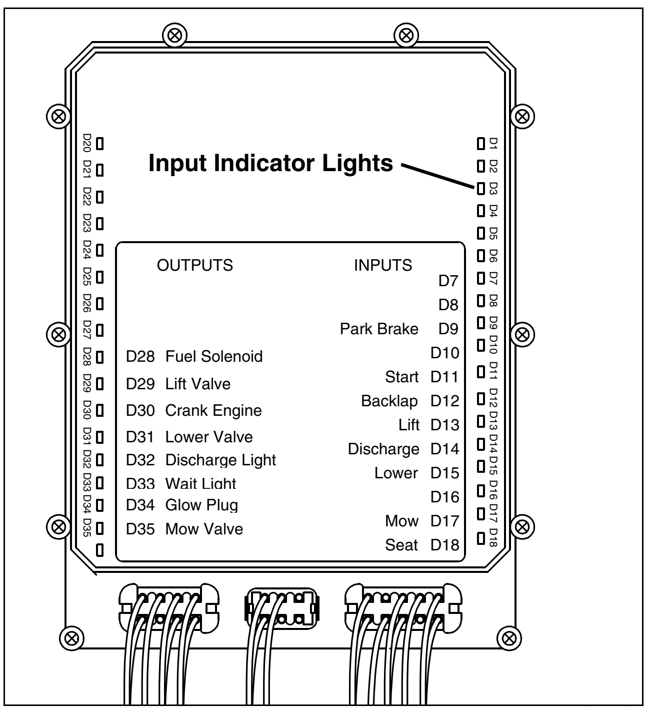
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Seat Switch Input

1. Raise and lock seat platform.

2. Press down on the lower cushion of the seat to engage the seat switch.

3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).

4. Release the seat switch.

5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

Brake Switch Input

1. Depress the park brake pedal.

2. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).

3. Release the park brake pedal.

4. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON, first check brake switch adjustment (See “Adjust Park Brake Switch” on page 729). If brake light does not come ON after adjustment, test brake switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

Mow/Transport Switch Input

1. Move mow/transport lever to MOW position.

2. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

Backlap Switch Input

1. Move the backlap valve to the MOW position.

2. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described, test the backlap switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

Fuel Solenoid Output

1. Release park brake.

2. Press down on the lower cushion of the seat to engage the seat switch.

3. Observe the FUEL SOLENOID output light (D28). The light should be ON when the seat switch is engaged (operator on seat).

4. Release the seat switch.

5. Observe the FUEL SOLENOID output light (D28). The light should be OFF when the seat switch is released (operator off seat).

- If the light does not come ON, test seat switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

6. Depress the park brake pedal.

7. Observe the FUEL SOLENOID output light (D28). The light should be ON when the park brake pedal is depressed (brake switch engaged).

8. Release the park brake pedal.

9. Observe the FUEL SOLENOID output light (D28). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON, first check brake switch adjustment. (See “Adjust Park Brake Switch” on page 729). If FUEL SOLENOID light does not come ON after adjustment, test brake switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

If the FUEL SOLENOID output light functions as described, but the fuel shutoff solenoid does not engage (engine does not run), test fuel shutoff solenoid circuit. (See “STEP 3: CIRCUIT TESTS” on page 455.)

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

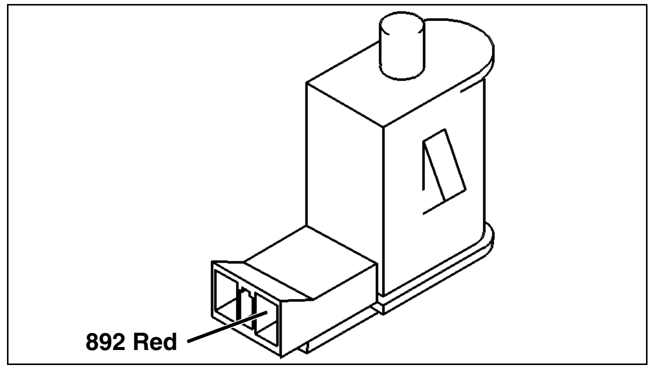
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Seat switch connector (X6) disconnected.

System: Seat Switch Circuit Test

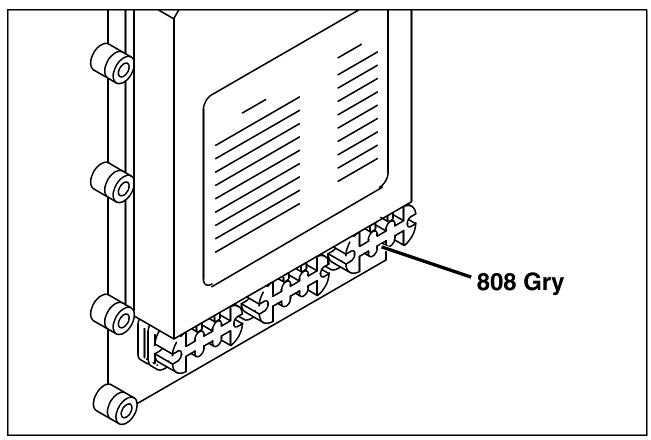


MIF

(1) Check voltage at electronic control module (A3) - connector X9, terminal H, wire 892 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 892 red (W1) and connections.



MIF

(2) Seat switch connector (X6) connected.
Seat switch engaged.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal H, wire 808 grey. Is battery voltage/test light on?

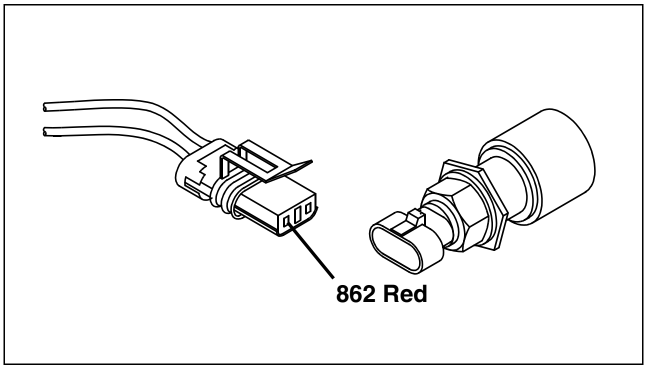
No - Test wire 808 gray (W1) and connections.

No - Test seat switch. (See “Test Seat Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Brake switch connector (X18) disconnected.

System: Park Brake Switch Circuit Test

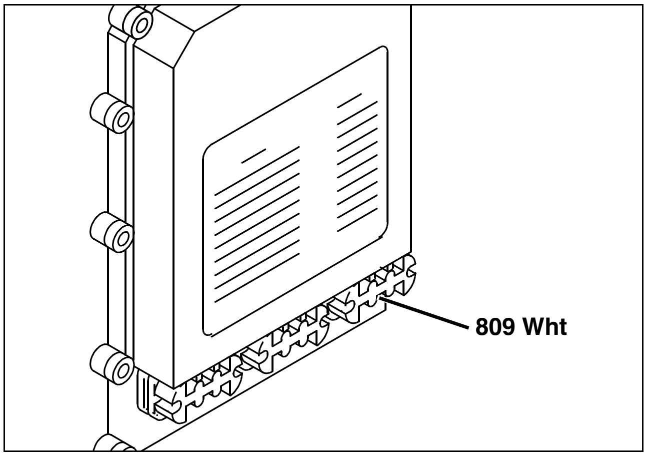


MIF

(1) Check voltage at brake switch connector (X18), wire 862 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 862 red (W1) and connections.



MIF

(2) Mow/transport switch (S5) connector (X22) connected.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal G, wire 809 white. Is battery voltage/test light on?

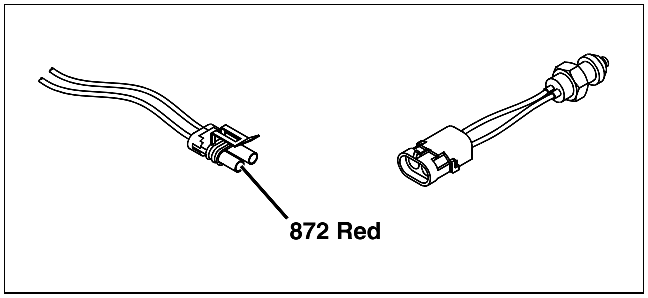
No - Test wire 809 white (W1) and connections.

No - Test park brake switch. (See "Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)" on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Mow/transport switch connector (X22) disconnected.

System: Mow/Transport Switch Circuit Test



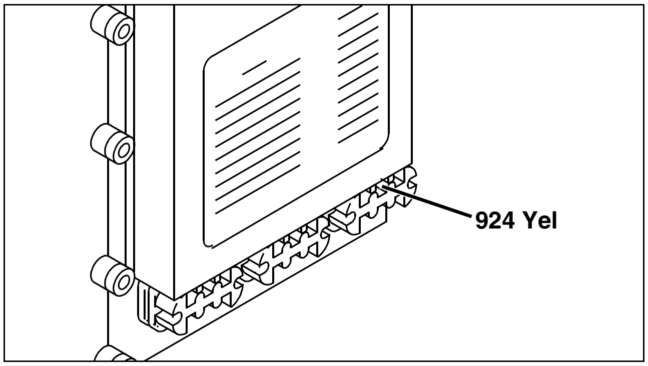
MIF

(1) Check voltage at mow/transport switch (S5) connector (X22), wire 872 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 872 red (W1) and connections.

No - Third wheel assist units: Test wire 872 red (W11) and connections.



MIF

(2) Mow/transport switch (S5) connector (X22) connected.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal C, wire 924 yellow. Is battery voltage/test light on?

No - Test wire 924 yellow (W1) and connections.

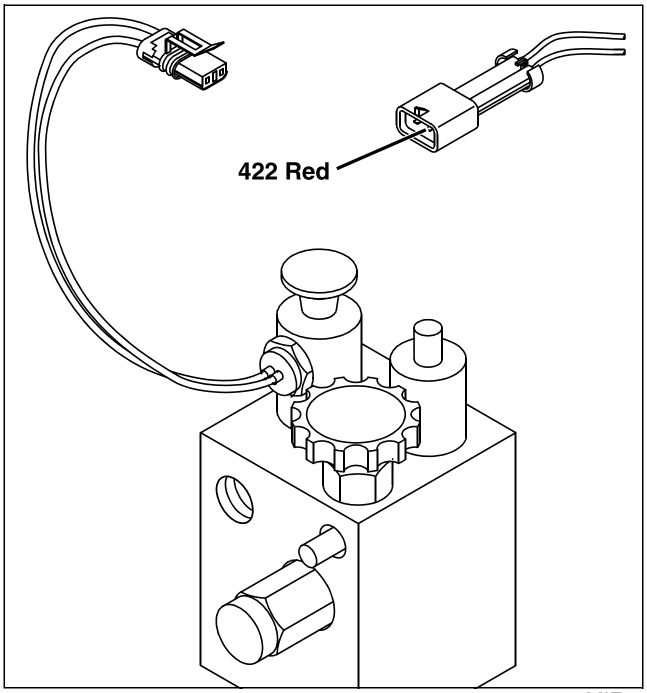
No - Third wheel assist units: Test yellow wires No. 924 (W11) and 934 (W11) and connections.

No - Test mow/transport switch. (See "Test Mow/Transport Switch" on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Backlap switch connector (X15) disconnected.

System: Backlap Switch Circuit Test



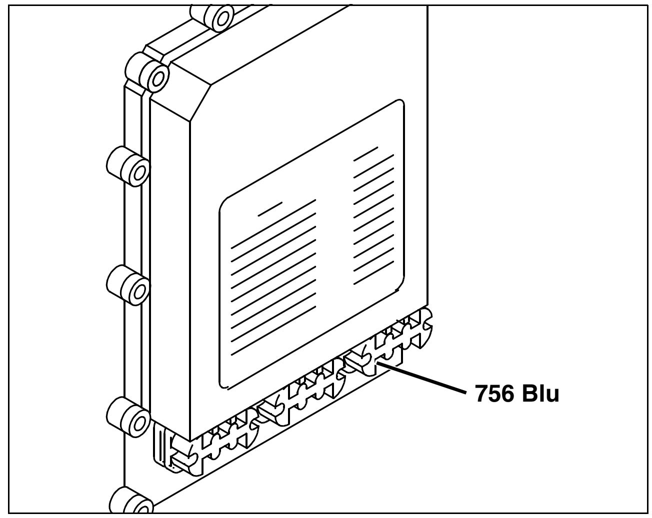
MIF

(1) Check voltage at backlap switch (S4) connector (X15), wire 422 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test red wire No. 422 (W1) and connections.

System: Backlap Switch Circuit Test



MIF

(2) Backlap switch in BACKLAP position. Backlap switch connector (X15) connected. Electronic control module - connector (X9) disconnected. Check voltage at electronic control module (A3) - connector (X9), terminal F, wire 756 blue. Is battery voltage/test light on?

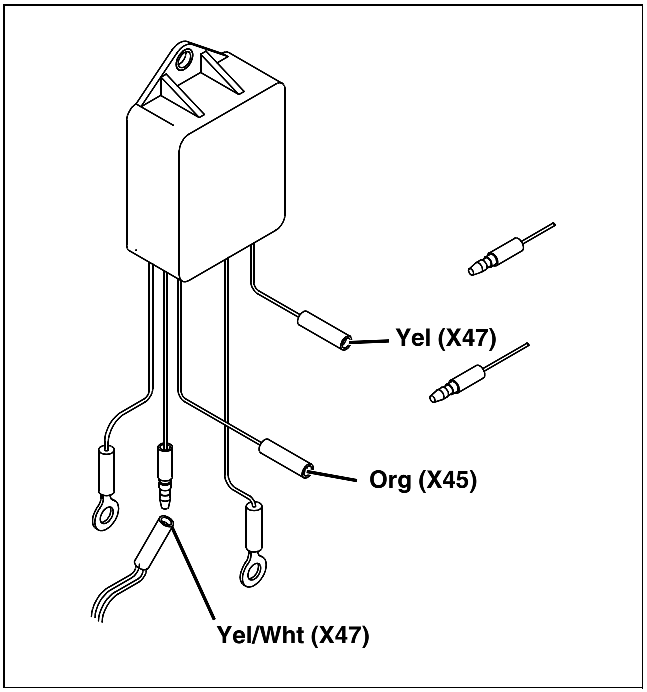
No - Test blue wire No. 756 (W1) and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.) (See “Test Backlap Switch - Model 2500E” on page 560.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Ignition delay module connector (X47) disconnected.

System: Ignition Delay Module Circuit Test



MIF

(1) Check voltage at ignition delay module (A2) connector (X47), yellow/white wire. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test yellow/white wire (W4), yellow wires No. 362 (W1) and 364 (W1) and connections.

(2) Ignition delay module connectors (X44, X45, X47) connected.
Check voltage at ignition delay module (A2) connector (X45), orange wire. Is battery voltage/ test light on?

Yes - Go to step (3).

No - Replace ignition delay module.

(3) Check voltage at ignition delay module (A2) connector (X44), yellow wire. Is battery voltage/test light on?

No - Replace ignition delay module.

Charging Circuit Operation

Function

To maintain battery voltage between 11.8 and 13.2 VDC.

Operating Conditions

- Key switch in the RUN position
- Engine running

Theory of Operation

The charging circuit is a permanent magnet and stator design. Charging output is controlled by a voltage regulator/rectifier (N1).

The power circuit provides current to the key switch (S1) and protects the charging circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch "B" terminal.

The power circuit also provides current and a direct connection from the battery and voltage regulator/rectifier (N1) red wire No. 332 (W1).

With the key switch in the RUN position, current flows to the electronic control module (A3) (red wires No. 212 [W1], 802 [W1], 802 [W3] and 212 [W3]) Current is also supplied to the voltage regulator/rectifier (red wires No. 342 [W1], 802 [W1], 802 [W3] and 212 [W1]) and to the warning light module (E3) (red wires No. 222 [W3], 212 [W3]). The ground side of the discharge light is connected to connector X7, pin H of the control module.

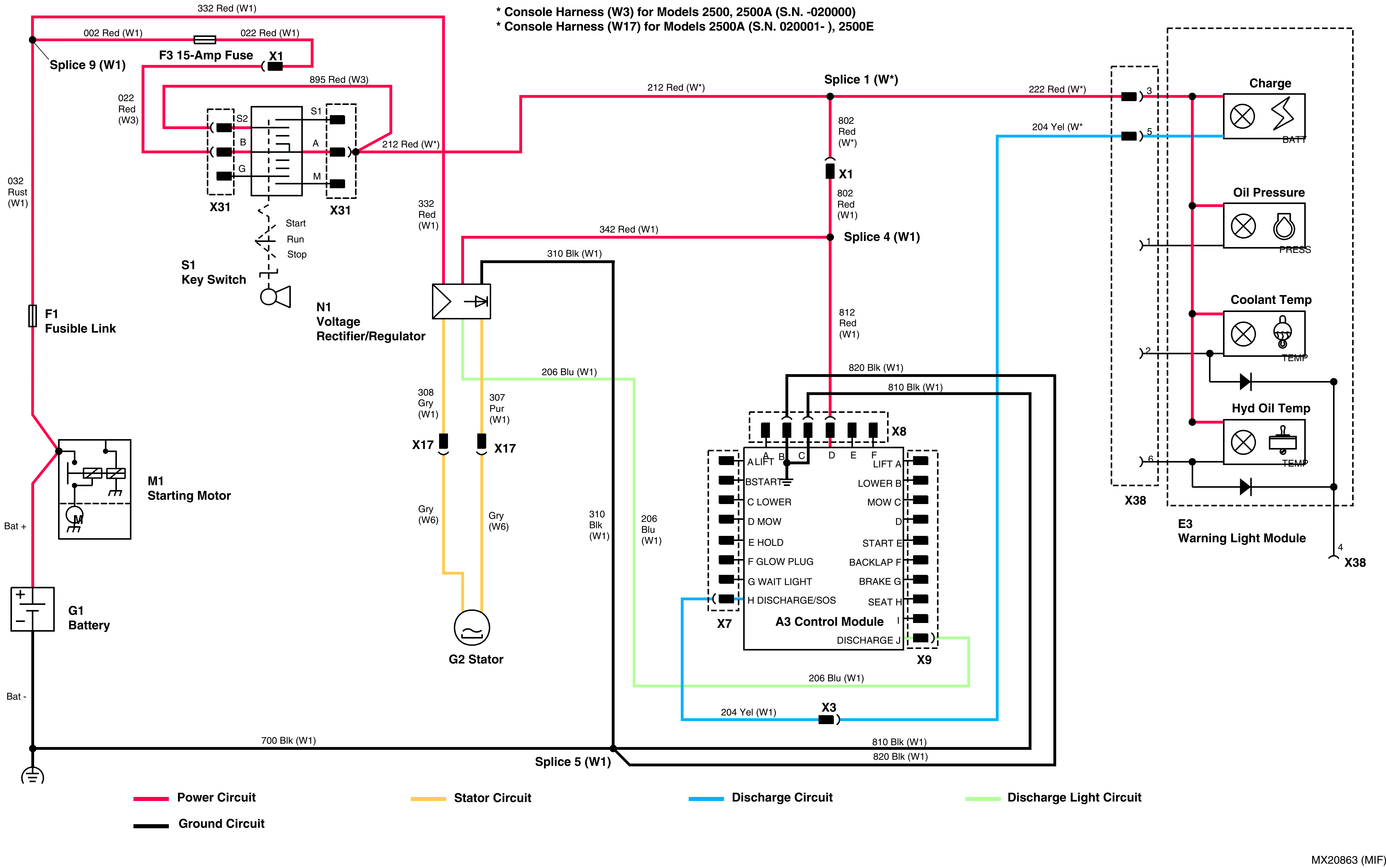
As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator (G2). The AC current flows to the regulator/rectifier. The regulator/rectifier converts the AC current to DC current needed to charge the battery.

If the battery voltage is low, the regulator/rectifier allows DC current to flow to the battery to charge it through the power/battery charging circuit. When the battery is fully charged, the regulator stops current flow to the battery.

If the stator current output to the regulator/rectifier stops, the voltage regulator/rectifier allows current to flow to connector X9, pin J of the control module (blue wire No. 206 [W1]). The control module will than complete the path to ground for the discharge warning light, illuminating the warning light.

A ground circuit provides a path to ground for the voltage regulator/rectifier (blue wire No. 310 [W1] and black wire No. 700 [W1]).

Charging Circuit



Charging Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

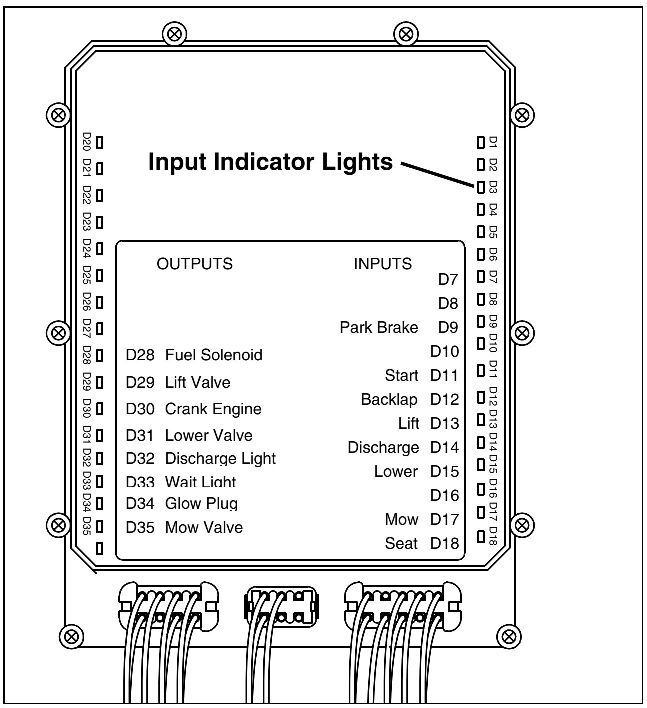
> **IMPORTANT: Avoid damage! Steps must be performed in sequence.**

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Voltage Regulator/Rectifier Input Circuit

1. Raise and lock seat platform.

2. Observe the DISCHARGE input light (D14). The light should be ON when the key switch is in the RUN position with the engine not running. The light should be OFF when the engine is running.

If the light does not come ON when the engine is not running, test the discharge light circuit. (See “STEP 3: CIRCUIT TESTS” on page 347.)

Discharge Light Output Circuit

1. Observe the DISCHARGE LIGHT output light (D32) and DISCHARGE light on the warning light module (E3). The both lights should be ON when the key switch is in the RUN position with the engine not running. The lights should be OFF when the engine is running.

If the DISCHARGE output light (D28) does come ON, but the DISCHARGE warning light in the warning light module does not come ON when the engine is not running, test the discharge warning light circuit. (See “STEP 3: CIRCUIT TESTS” on page 347.)

STEP 3: CIRCUIT TESTS

> **IMPORTANT: Avoid damage! DO NOT force test light/meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.**

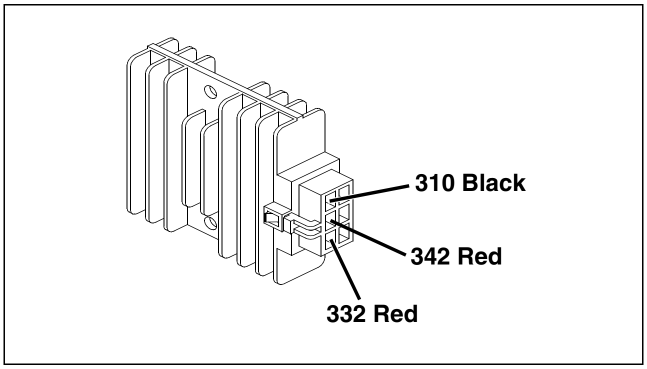
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Voltage regulator/rectifier connector (X28) disconnected.

System: Voltage Regulator/Rectifier Circuit Test



MIF

(1) Check voltage at voltage regulator/rectifier (N1) connector (X28), wire 332 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test wire 332 red (W1) and connections.

(2) Check resistance at voltage regulator/rectifier (N1) connector (X28), wire 310 black. Is resistance less than 0.1 ohm[1]?

Yes - Go to step (3).

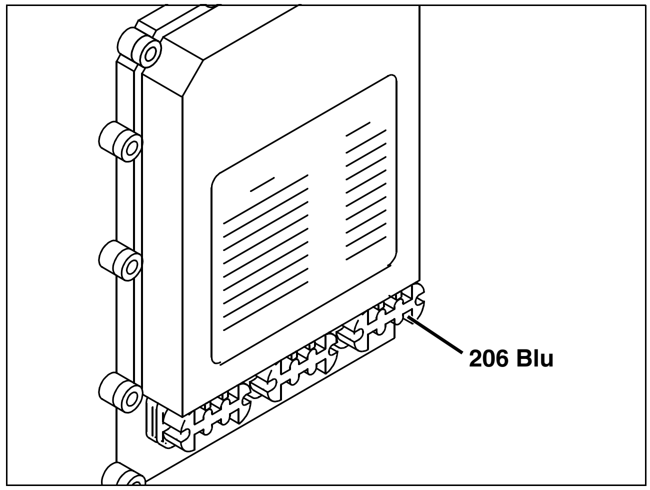
No - Test black wire No. 310 (W1) and connections.

(3) Key switch in RUN position - engine not running.
Check voltage at voltage regulator/rectifier (N1) connector (X28), wire 342 red. Is battery voltage/ test light on?

Yes - Go to step (4).

No - Test wire 342 red (W1) and connections.

System: Voltage Regulator/Rectifier Circuit Test



MIF

(4) Voltage regulator/rectifier connector (X28) connected.
Electronic control module - Connector X9 disconnected.
Check voltage at electronic control module (A3) connector X9, Terminal J, wire 206 blue. Is battery voltage/test light on?

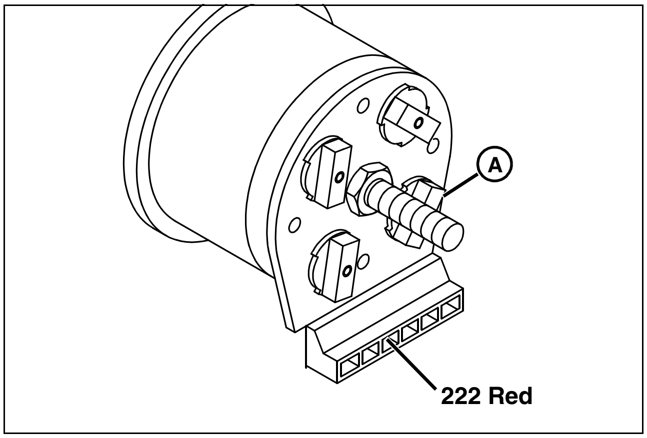
No - Test blue wire No. 206 (W1) and connections.

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Warning light module connector (X38) disconnected.

System: Discharge Warning Light Circuit Test



MIF

(1) Check voltage at warning light module (E3)connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

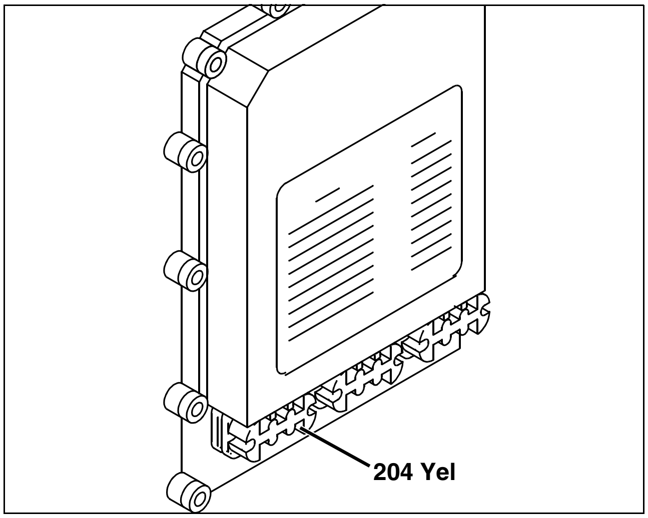
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Warning light module (E3) discharge light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Discharge Warning Light Circuit Test



MIF

(3) Warning light module connector (X38) connected.
Check voltage at electronic control module (A3) - Connector X7, terminal H, wire 204 yellow. Is battery voltage/test light on?

No - Test yellow wires No. 204 (W3) and 204 (W1) and connections.

Engine Oil Pressure Warning Light Circuit Operation

Function

To warn the operator if the engine oil pressure drops below the safe operating level.

Operating Conditions

- Key switch in the RUN position
- Engine running

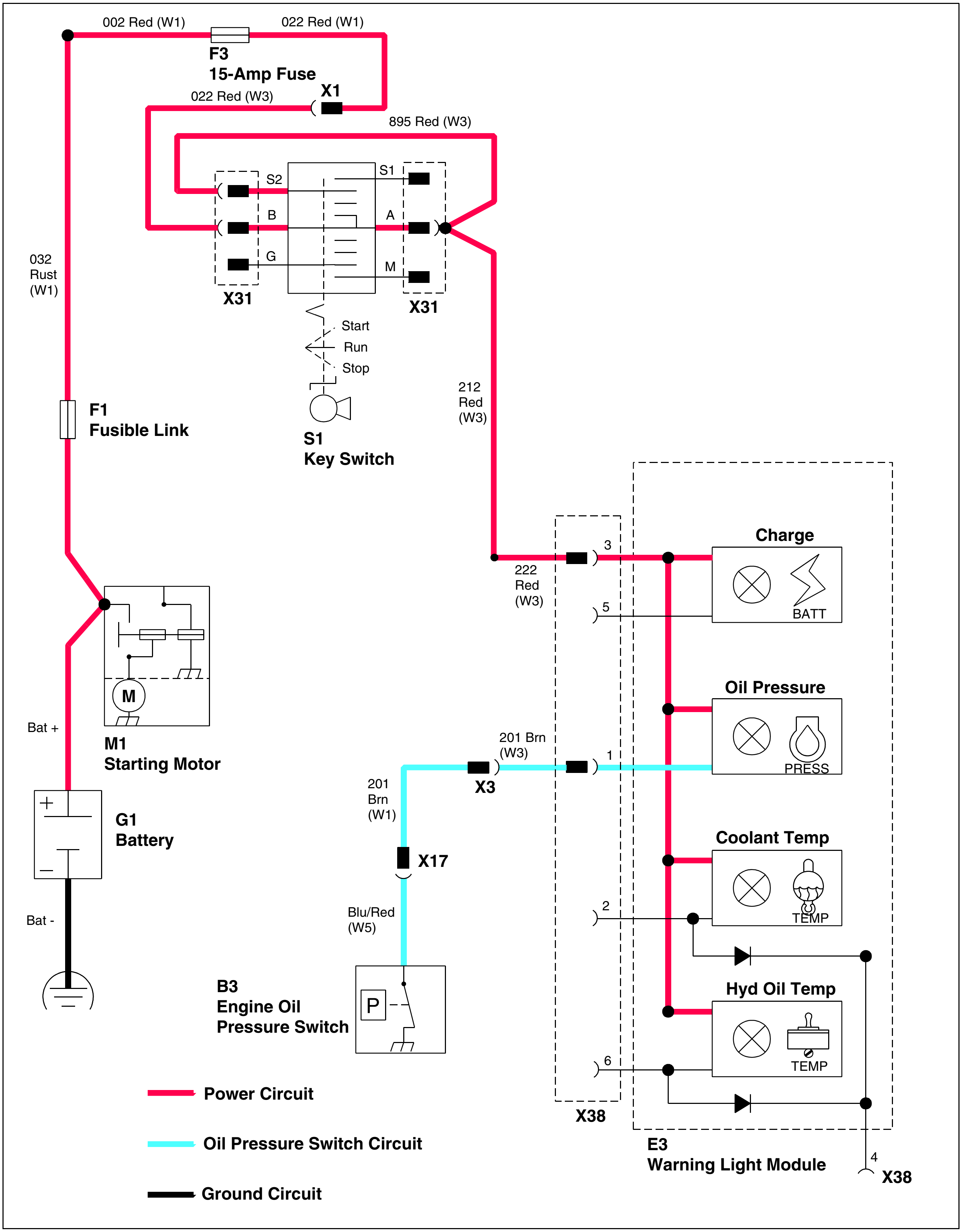
Theory of Operation

The power circuit provides current to the key switch (S1) and protects the oil pressure warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032), 15-amp fuse and key switch (red wires No. 002 [W1], 022 [W1] and 022 [W3]).

With the key switch in the RUN position, current flows to the warning light module (E3) (red wires No. 212 [W3] and 222 [W3] and oil pressure light.

When the engine oil pressure drops below the safe operating level, the oil pressure switch (B3) closes and completes the circuit to ground (brown wires No. 201 [W3], 201 [W1] and blue/red [W5]) lighting the oil pressure light.

Engine Oil Pressure Warning Light Circuit



M98632 (MIF)

Engine Oil Pressure Warning Light Diagnosis

Circuit Diagnosis

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

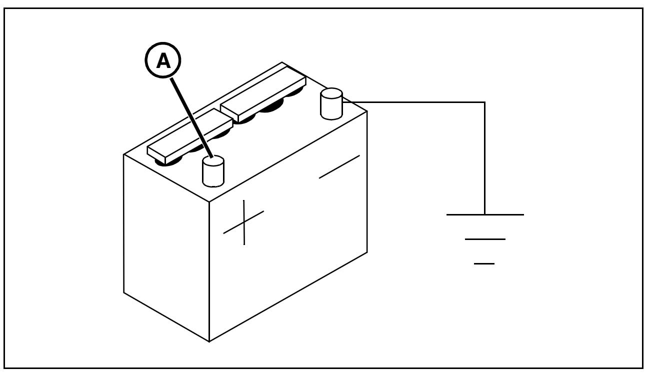
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Engine oil pressure switch - Connector (X48) disconnected.

System: Engine Oil Pressure Warning Light Circuit Test



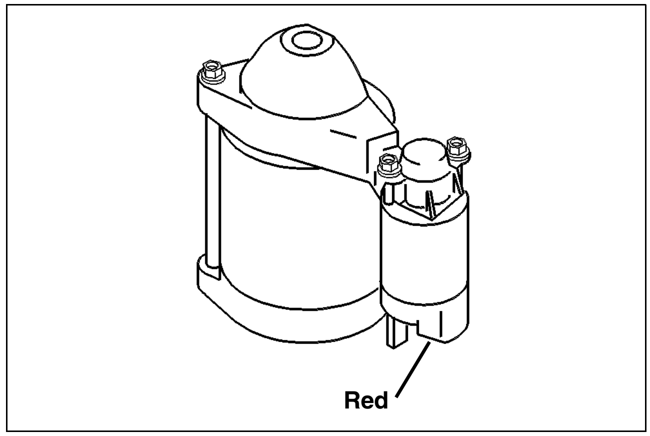
MIF

(1) Check voltage at battery positive (+) post (A). Is battery voltage between 11.8 - 13.2 volts?

Yes - Go to step (2).

No - Check battery condition. (See "Test Battery" on page 541.)

System: Engine Oil Pressure Warning Light Circuit Test

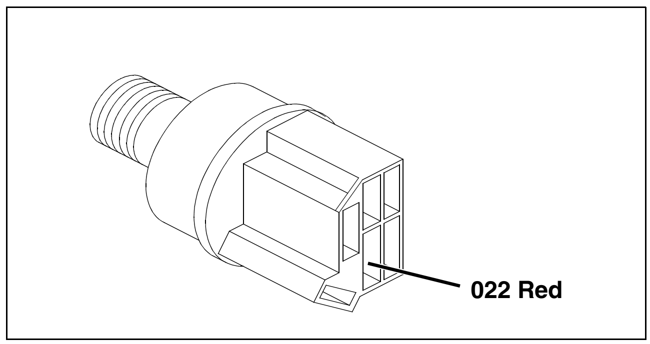


MIF

(2) Check voltage at starting motor solenoid - Battery terminal. Is battery voltage/test light on?[1]

Yes - Go to step (3).

No - Check battery cables and clamps. Clean and tighten connections.



MIF

(3) Check voltage at key switch (S1) connector (X31), terminal B, wire 022 red. Is battery voltage/ test light on?

Yes - Go to step (4).

No - Test red wires No. 022 (W3), 022 (W1), 002 (W1) and connections.

No - Test fuse (F3). (See "Test Fuse" on page 549.)

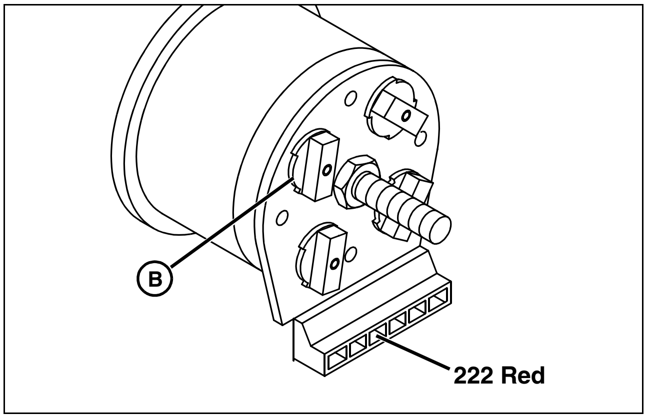
No - Test fuse link (F1) (rust wire No. 032).

System: Engine Oil Pressure Warning Light Circuit Test

(4) Key switch in RUN position - engine not running.
Warning light module connector (X38) disconnected.
Oil pressure switch connector (X48) disconnected.
Check voltage at key switch (S1) connector (X31), terminal A, wire 212 red. Is battery voltage/test light on?

Yes - Go to step (5).

No - Test key switch. (See “Test Key Switch” on page 551.)



MIF

(5) Check voltage at warning light module (E3) connector (X38), terminal 3. Is battery voltage/test light on?

Yes - Go to step (6).

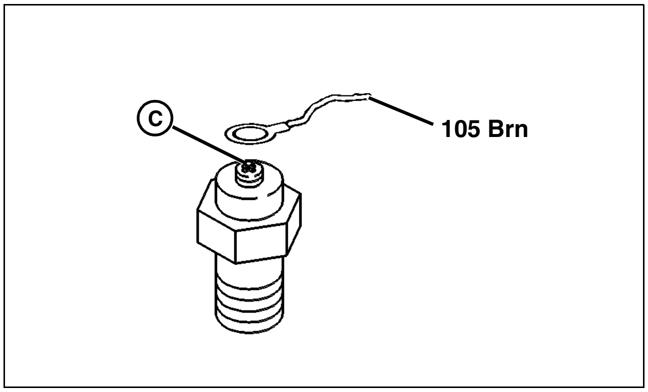
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(6) Check voltage at warning light module (E3) oil pressure light bulb (B). Is bulb in good condition?

Yes - Go to step (7).

No - Replace bulb as needed.

System: Engine Oil Pressure Warning Light Circuit Test



MIF

(7) Check voltage at oil pressure switch (B3) connector (X48), wire 105 brown. Is battery voltage/test light on?.

Yes - Go to step (8).

No - Test brown wires No. 201 (W3), 201 (W1) and 105 (W1) and connections.

(8) Key switch in RUN position - engine running. Warning light module connector (X38) connected. Check resistance at oil pressure switch (B3) terminal (C). No continuity to ground (maximum resistance)?

No - Check engine oil pressure. (See “Test Engine Oil Pressure” on page 60.) If engine oil pressure is OK, replace oil pressure switch.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

Engine Coolant Warning Light Circuit Operation

Function

To warn the operator if the engine coolant temperature exceeds the safe operating limit.

Operating Conditions

- Key switch in the RUN position
- Engine running

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the coolant temperature warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032), 15-amp fuse and key switch (red wires No. 002 [W1], 222 [W1] and 022 [W3]).

With the key switch in the RUN position, current flows to the warning light module (E3) (red wires No. 222 [W3] and 212 [W3] and coolant temperature light. Current is also supplied to the connector X8, pin D of the electronic control module (A3) (red wires 812 [W1], 802 [W1], 802 [W3] and 212 [W3]).

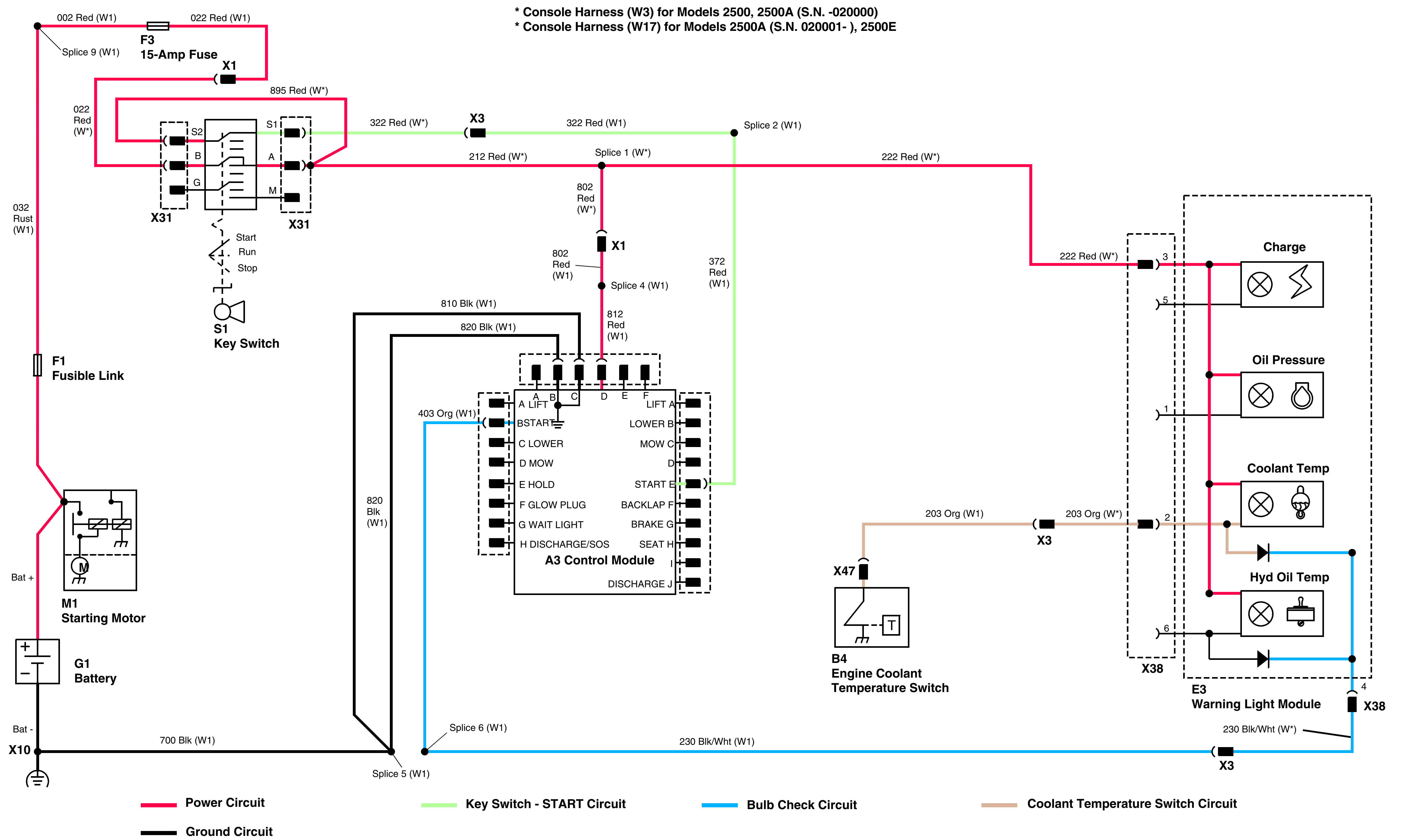
With the key switch in the START position, current flows Current also flows to key switch terminal S2 (red wire No. 895 [W3]), through the switch to terminal S1, to terminal E of connector X9 on the control module (red wires No. 322 [W3], 322 [W1] and 372 [W1]).

When the key switch is moved to the START position, the control module completes a path to ground for the warning light (black wires No. 230 [W3] and 230 [W1] and orange wires No. 303 [W1] and 403 [W1]) to perform a bulb check.

When the engine coolant temperature rises above the safe operating level, the coolant temperature switch (B4) closes and completes the circuit to ground (orange wires No. 203 [W3] and 203 [W1]) lighting the coolant temperature warning light.

A ground circuit provides a path to ground for the control module (black wires No. 810 [W1], 820 [W1] and 700 [W1]).

Engine Coolant Warning Light Circuit



MX20864 (MIF)

Engine Coolant Warning Light Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

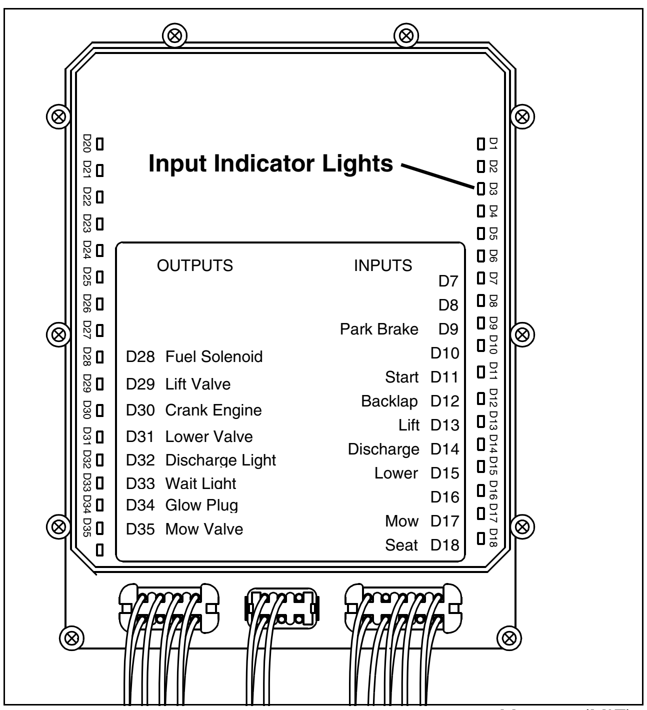
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See "Electronic Control Module Check" on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

3. Move key switch to START position and back to RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does not come ON when the key switch is in the START position, test key switch circuit. (See "STEP 4: CIRCUIT TESTS" on page 358.)

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See "STEP 4: CIRCUIT TESTS" on page 358.)

STEP 3: BULB CHECK CIRCUIT TEST

1. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

2. Move key switch to START position and back to RUN position.

M84737

3. Observe the engine coolant warning light (A). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See "STEP 4: CIRCUIT TESTS" on page 358.)

STEP 4: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

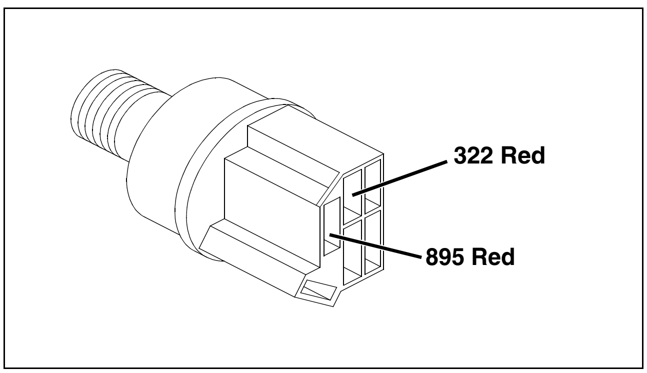
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in START position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X8) disconnected.

System: Key Switch Circuit Test



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 895 red. Is battery voltage/ test light on?

Yes - Go to step (2).

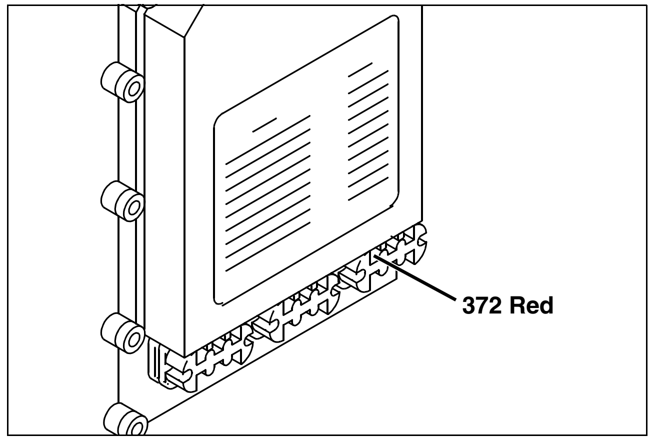
No - Test red wire No. 895 (W3) and connections.

(2) Check voltage at key switch (S1) connector (X31), terminal S1, wire 322 red. Is battery voltage/ test light on?

Yes - Go to step (3).

No - Test key switch. (See “Test Key Switch” on page 551.)

System: Key Switch Circuit Test



MIF

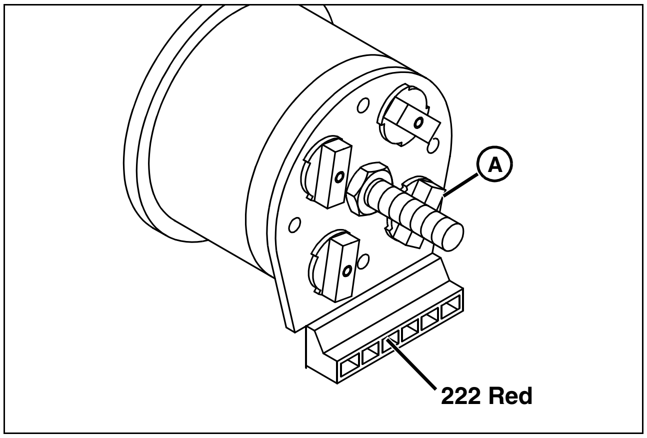
(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

No - Test red wires No. 372 (W1), 322 (W1) and 322 (W3) and connections.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Engine coolant temperature switch connector (X48) disconnected.

System: Engine Coolant Warning Light Circuit Test



MIF

(1) Check voltage at warning light module (E3)connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

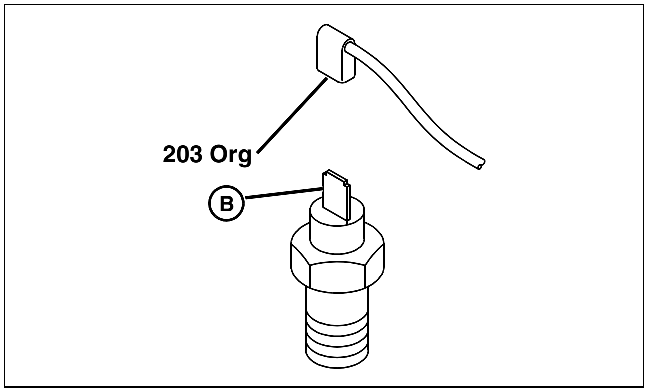
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Warning indicator module (E3) - Coolant temperature light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Engine Coolant Warning Light Circuit Test



MIF

(3) Check voltage at engine coolant temperature switch (B4) connector, wire 203 orange. Is battery voltage/test light on?

Yes - Go to step (4).

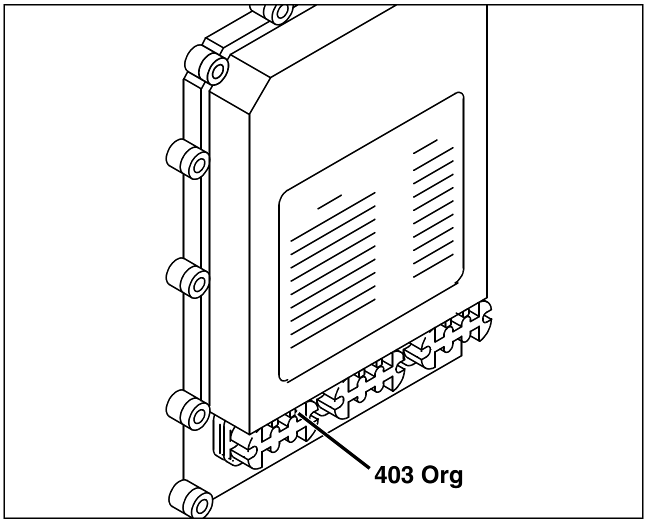
No - Test orange wires No. 203 (W3), 203 (W1) and connections.

(4) Check resistance at engine coolant temperature switch (B4) terminal (B). No continuity to ground (maximum resistance)?

Yes - Go to step (5).

No - Test coolant temperature switch. (See "Test Engine Coolant Temperature Switch" on page 561.)

System: Engine Coolant Warning Light Circuit Test



MIF

(5) Key switch in START position.
Warning light module connector (X7) disconnected.
Check voltage at electronic control module (A3) - Connector X7, terminal B, wire 403 orange. Is battery voltage/test light on?

No - Test orange wires No. 403 (W1) and 303 (W1) and black/white wires No. 230 (W3) and 230 (W1) and connections.

Hydraulic Oil Temperature Warning Light Circuit Operation

Function

To warn the operator if the hydraulic oil temperature exceeds the safe operating limit.

Operating Conditions

- Key switch in the RUN position
- Engine running

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the hydraulic oil temperature warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current is also supplied to the warning light module (E3) (red wire No. 212 [W3]) and hydraulic oil temperature light.

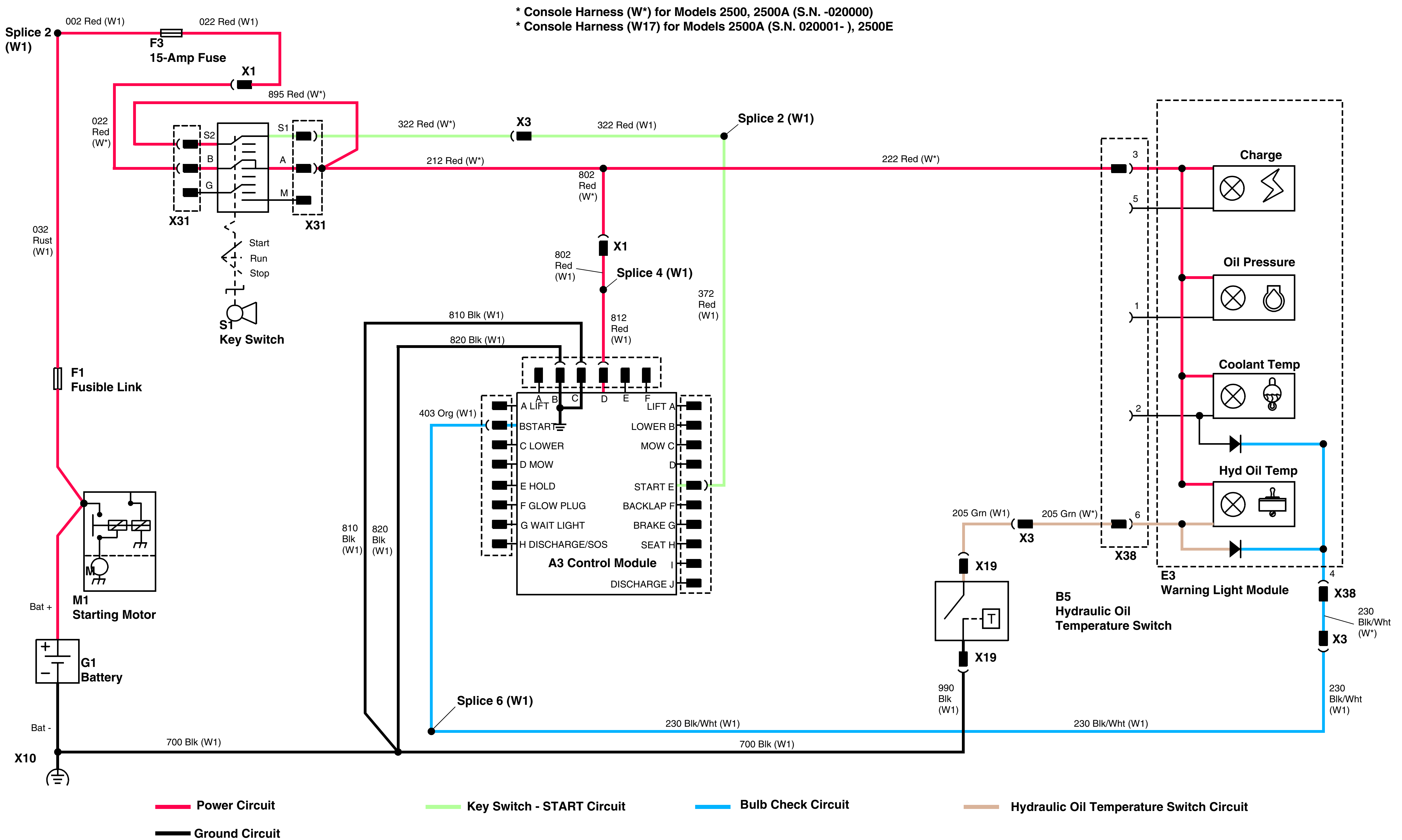
The hydraulic oil temperature warning light, is connected to the hydraulic oil temperature switch (B4).

At room temperature, the switch is open (infinite resistance). If the hydraulic oil temperature rises above the safe operating level (96° C [200° F]), the switch closes, completing the circuit to ground (black wires No. 990 [W1], and 700 [W1] lighting the warning light.

With the key switch in the START position, current flows to key switch terminal S2 (red wire No. 895 [W3]), through the switch to terminal S1, to terminal E of connector X9 on the control module (red wires No. 322 [W3], 322 [W1] and 372 [W1]).

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W1], 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for both the hour meter and control module.

Hydraulic Oil Temperature Warning Light Circuit



MX20865 (MIF)

Hydraulic Oil Temperature Warning Light Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

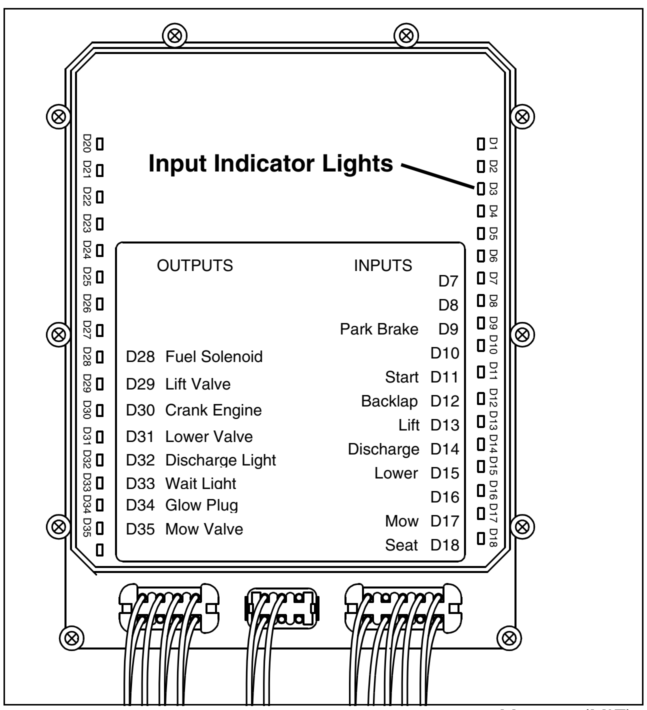
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

3. Move key switch to START position and back to RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does not come ON when the key switch is in the START position, test key switch circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

STEP 3: BULB CHECK CIRCUIT TEST

1. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

2. Move key switch to START position and back to RUN position.

M84737

3. Observe the hydraulic oil temperature warning light (A). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

STEP 4: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

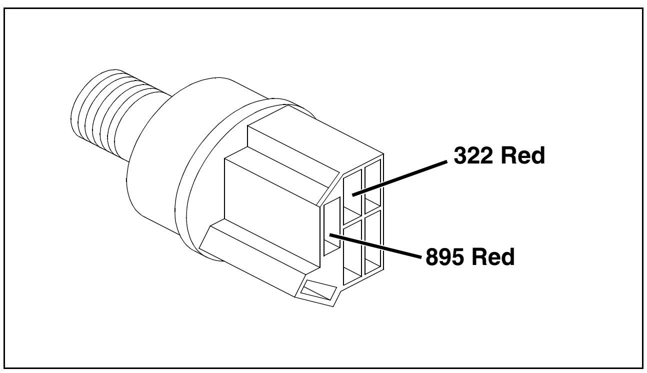
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X8) disconnected.

System: Key Switch Circuit Test



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 895 red. Is battery voltage/test light on?

Yes - Go to step (2).

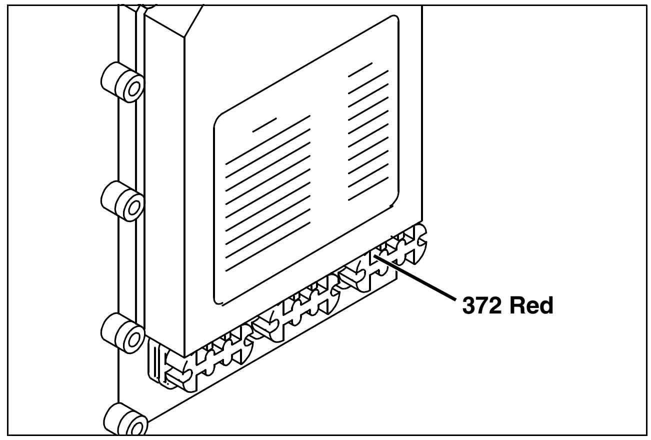
No - Test red wire No. 895 (W3) and connections.

(2) Check voltage at key switch (S1) connector (X31), terminal S1, wire 322 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test key switch. (See “Test Key Switch” on page 551.)

System: Key Switch Circuit Test



MIF

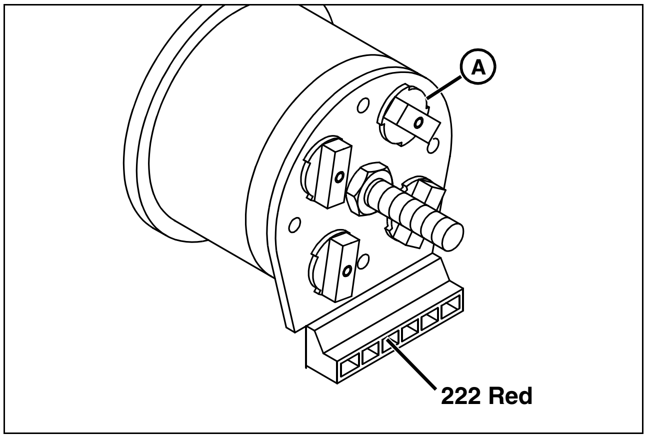
(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

No - Test red wires No. 372 (W1), 322 (W1) and 322 (W3) and connections.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Hydraulic oil temperature switch connector (X19) disconnected.

System: Hydraulic Oil Temperature Warning Light Circuit Test



MIF

(1) Check voltage at warning light module (E3)connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

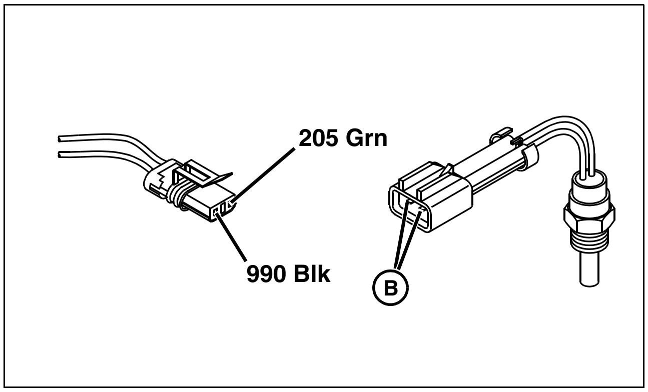
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Check voltage at warning indicator module (E3) - Hydraulic oil temperature light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Hydraulic Oil Temperature Warning Light Circuit Test



MIF

(3) Check voltage at hydraulic oil temperature switch (B5) connector (X19), wire 205 green. Is battery voltage/test light on?

Yes - Go to step (4).

No - Test green wires No. 205 (W1) and 205 (W3) and connections.

(4) Check resistance at hydraulic oil temperature switch (B5) terminals (B). No continuity to ground (maximum resistance)?

Yes - Go to step (5).

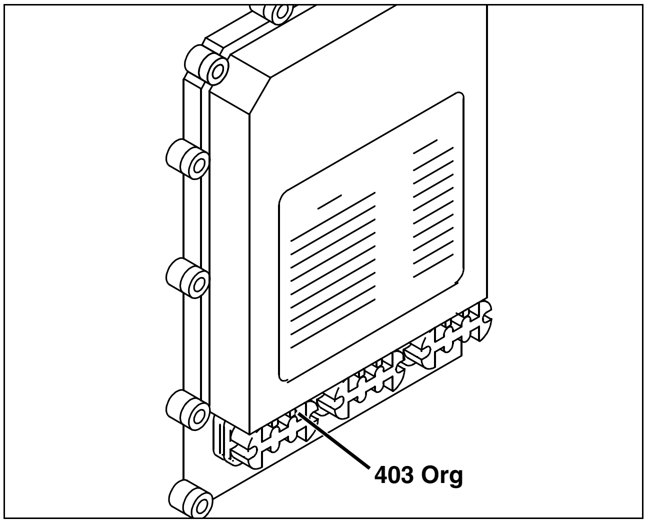
No - Replace hydraulic oil temperature switch.

(5) Check resistance at hydraulic oil temperature switch (B5) connector (X19), wire 990 black. Is resistance less than 0.1 ohm?[1]

Yes - Go to step (6).

No - Test black wires No. 990 (W1) and 700 (W1) and connections.

System: Hydraulic Oil Temperature Warning Light Circuit Test



MIF

(6) Key switch in START position.
Electronic control module connector (X7) disconnected.
Check voltage at electronic control module (A3) connector (X7), terminal B, wire 403 orange. Is battery voltage/test light on?

No - Test orange wires No. 403 (W1) and 303 (W1) and black/white wires No. 230 (W3) and 230 (W1) and connections.

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Hour Meter Circuit Operation

Function

To record the number of hours the key switch is in the RUN position.

Operating Conditions

- Key switch in the RUN position
- Park brake ENGAGED or operator ON seat.

NOTE: If the mow/transport lever is in the MOW position, the operator MUST be on the seat.

Theory of Operation

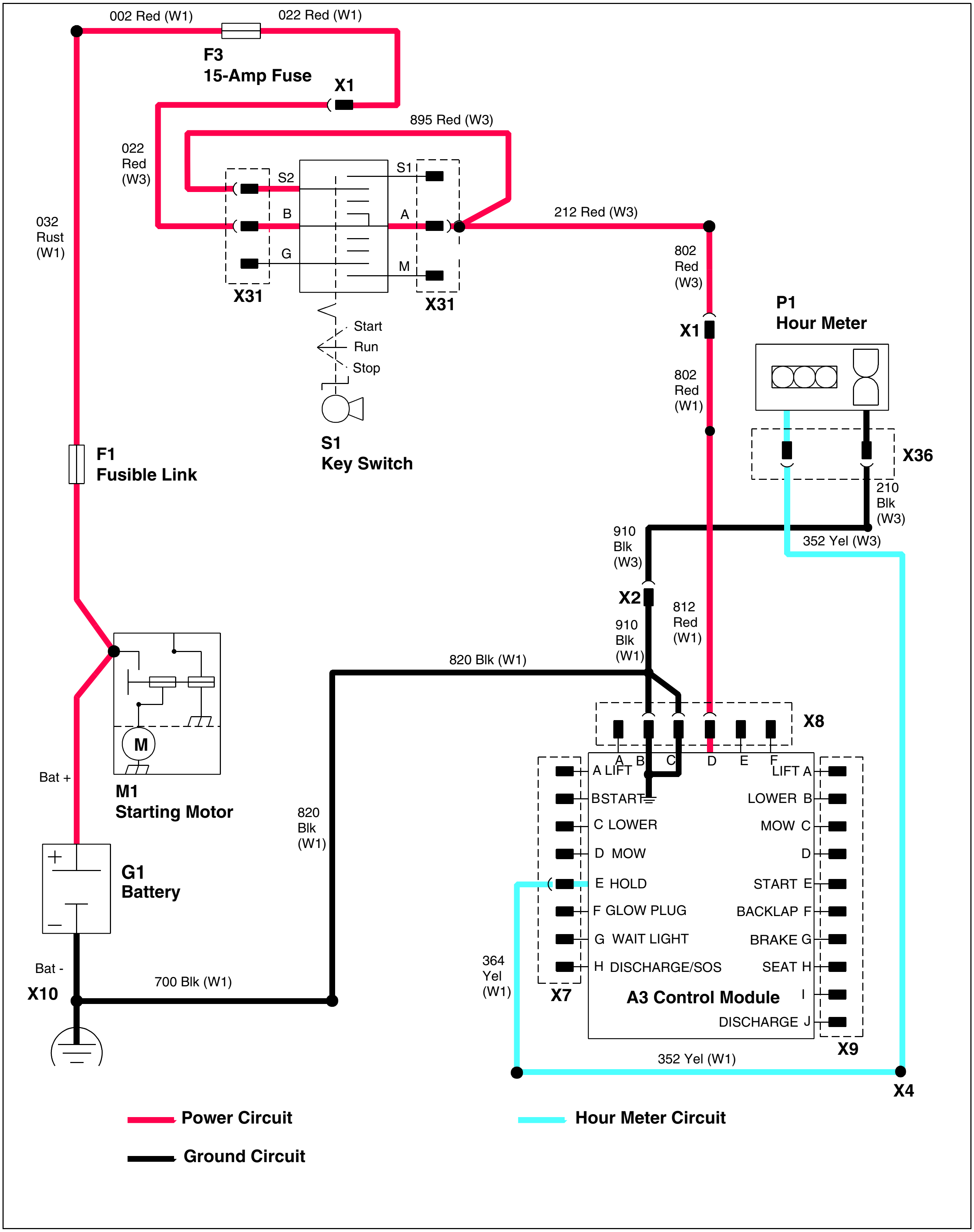
The power circuit provides current to the key switch (S1) and protects the oil pressure warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032), 15-amp fuse and key switch (red wires No. 002 [W1], 222 [W1] and 022 [W3]).

With the key switch in the RUN position, current flows to the connector X8, pin D of the electric control module (A3) (red wires No. 802 [W1], 802 [W3] and 212 [W3].

With the control module ON, current flows to the hour meter (P1) (yellow wires No. 352 [W3], 352 [W2] and 364 [W2]). The hour meter will record the number of hours the key switch is in the RUN position in 1/10 hour increments.

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W2], 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for both the hour meter and control module.

Hour Meter Circuit



M98633 (MIF)

Hour Meter Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

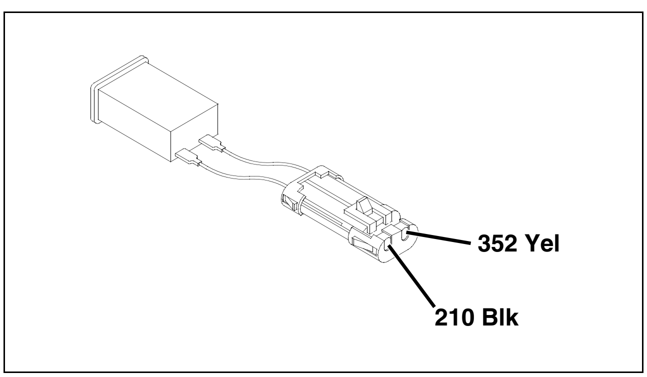
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.
- Mow/transport lever in TRANSPORT position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Key Switch Circuit Test



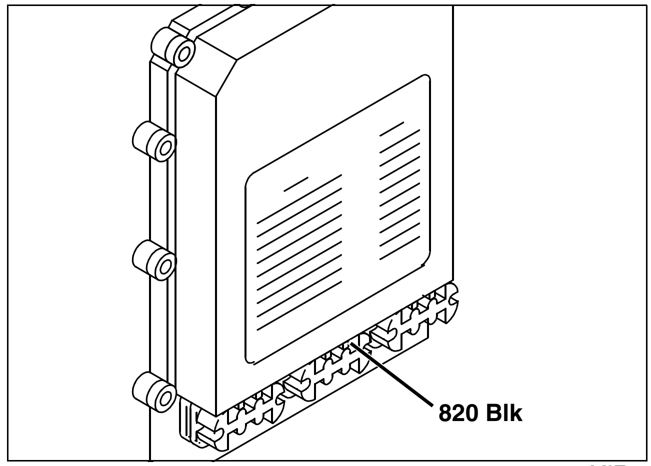
MIF

(1) Check voltage at hour meter (P1) connector (X36), positive (+) terminal, wire 252 yellow. Is battery voltage/test light on?

System: Key Switch Circuit Test

Yes - Go to step (2).

No - Test red wire No. 895 (W3) and connections.



MIF

(2) Key switch in STOP position.
Electric control module connector (X8) disconnected.
Hour meter connector (X36) disconnected.
Check resistance at hour meter (P1) connector (X36), wire 210 black and electronic control module (A3) connector (X8), terminal B, wire 820 black. Is resistance less than 0.1 ohm?[1]

No - Test black wires No. 210 (W3), 910 (W3), 910 (W1) and 820 (W1) and connections.

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Cutting Unit - Raise Circuit Operation Models 2500, 2500A (S.N. -020000)

Function

To engage the cutting unit raise system.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cutting unit raise circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current also flows to the raise switch (S6) located on the lift and lower lever assembly in the console (red wires No. 852 [W3] and 212 [W3]), and if equipped to the optional floor-mounted raise switch (S7) (red wires No. 752 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3]).

Current is also supplied to the raise valve solenoid (Y3) located on the raise valve assembly (red wires 412 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3]). The ground side of the raise valve solenoid is connected to the control module - connector X7, terminal A (green wire No. 701 [W1]).

As either raise switch is activated, current is supplied to the control module - connector X9, terminal A. The control module complete the path to ground for the raise valve solenoid, energizing the solenoid.

A time delay feature in the electric control module will keep the raise valve solenoid engaged for approximately four seconds, to ensure that the cutting units have been fully raised.

The ground circuit (black wires No. 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

Cutting Unit - Lower Circuit Operation Models 2500, 2500A (S.N. -020000)

Function

To lower the cutting units.

Operating Conditions

- Key switch in the RUN position

Theory of Operation

NOTE: The cutting unit lower system is gravity assisted, and does not require hydraulic oil pressure to function.

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current also flows to the lower switch (S8) located on the lift and lower lever assembly in the console (red wires No. 842 [W3] and 212 [W3]), and if equipped to the optional floor-mounted lower switch (S9) (red wires No. 742 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3]).

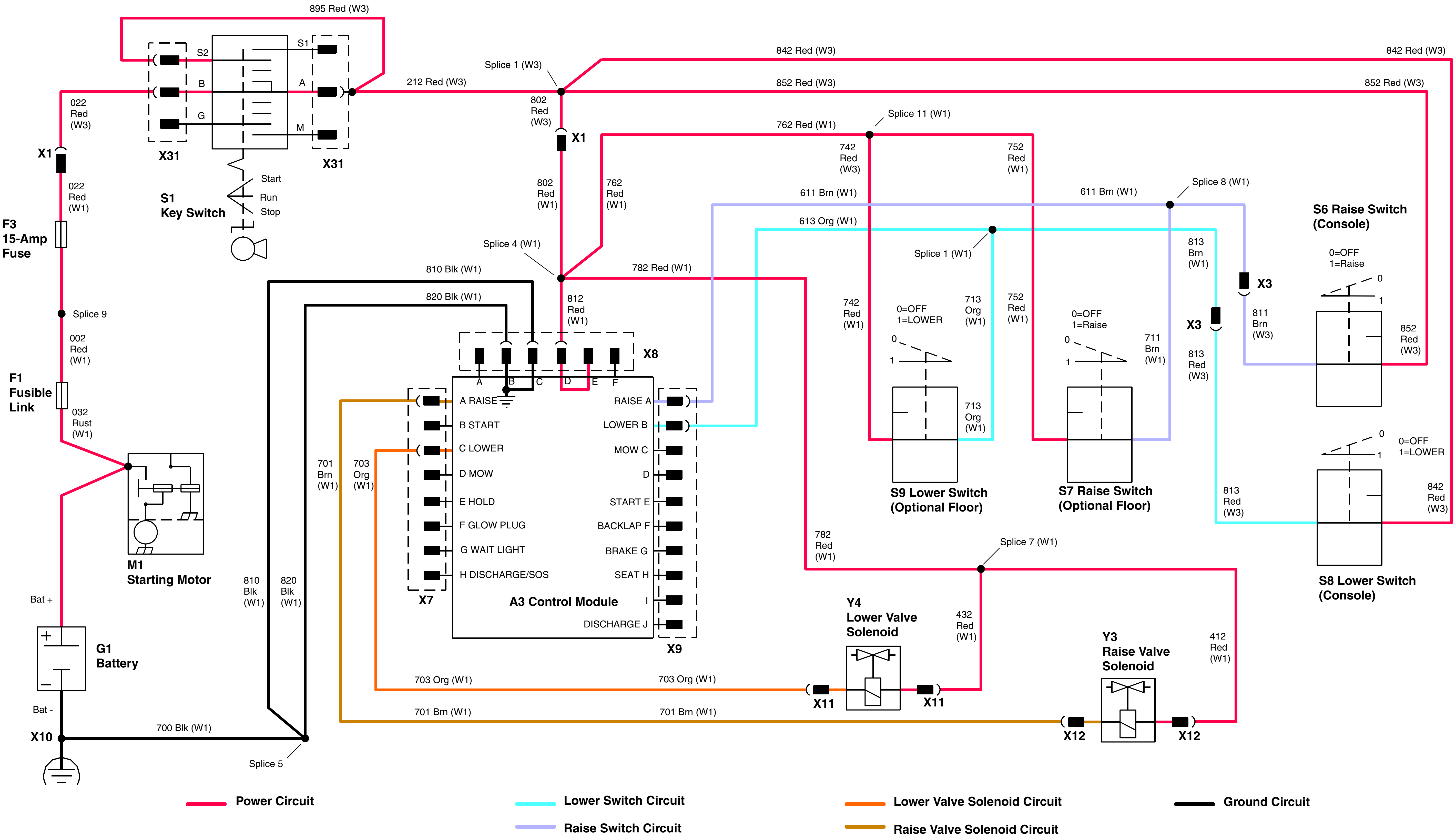
Current is also supplied to the lower valve solenoid (Y4) located on the raise valve assembly (red wires 432 [W1], 762 [W1], 802 [W1], 802 [W3] and 212 [W3]). The ground side of the lower valve solenoid is connected to the control module - connector X7, terminal C (orange wire No. 703 [W1]).

As either lower switch is activated, current is supplied to the control module - connector X9, terminal B. The control module completes the path to ground for the lower valve solenoid, energizing the solenoid.

A time delay feature in the control module will keep the lower valve solenoid engaged for approximately four seconds, to ensure that the cutting units have been fully lowered.

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W1], 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

Cutting Unit - Raise/Lower Circuit - Models 2500, 2500A (S.N. -020000)



MX20492 gas (MIF)

Lift and Lower Circuit Diagnosis - Models 2500,2500A (S.N. -020000)

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

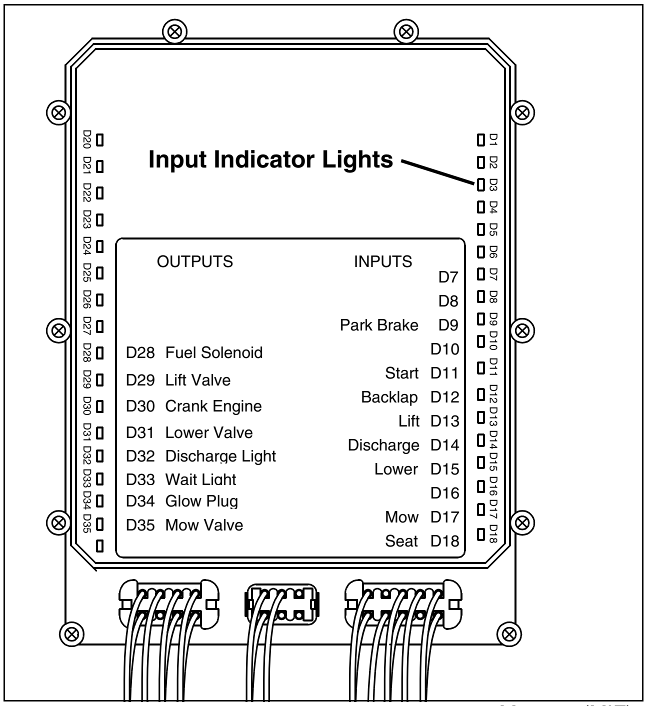
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Lower Switch Input/Lower Valve Output

1. Raise and lock seat platform.

2. Move lift/lower lever to LOWER position, or depress optional floor-mounted LOWER switch.

3. Observe the LOWER input light (D15). The light should be ON when either lower switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lower switches are activated, test lower switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 374.)

4. Observe the LOWER VALVE output light (D31). The light should be ON when either lower switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lower switches are activated, replace electronic control module.

Lift Switch Input/Lift Valve Output

1. Move lift/lower lever to LIFT position, or depress optional floor-mounted LIFT switch.

2. Observe the LIFT input light (D13). The light should be ON when either lift switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lower switches are activated, test lift switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 374.)

3. Observe the LIFT VALVE output light (D29). The light should be ON when either lift switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lift switches are activated, replace electronic control module.

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

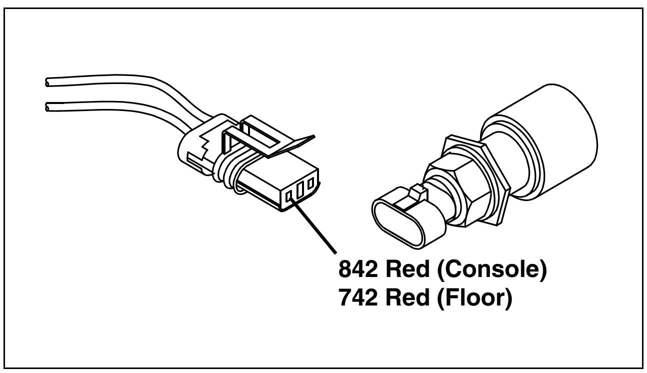
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower switch connectors (X34) (console) or (X11) (floor) disconnected.

System: Lower Switch Circuit Test



MIF

(1) Check voltage at console lower switch (S8) connector (X34), wire 842 red. Is battery voltage/ test light on?

Yes - Go to step (2).

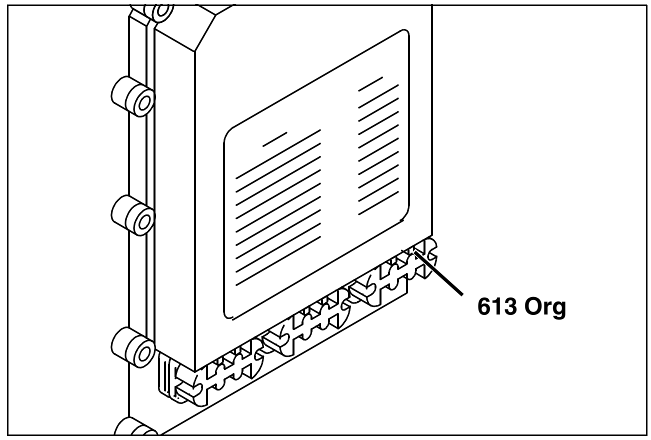
No - Test red wires No. 842 (W3) and 212 (W3) and connections.

(2) Check voltage at optional floor-mounted lower switch (S9) connector (X24), wire 742 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test red wires No. 742 (W1), 762 (W1), 802 (W1), 802 (W3) and 212 (W3) and connections.

System: Lower Switch Circuit Test



MIF

(3) Lower switches engaged.
Lower switch connectors (X34) (console) or (X11) (floor) connected.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal B, wire 613 orange. Is battery voltage/test light on?

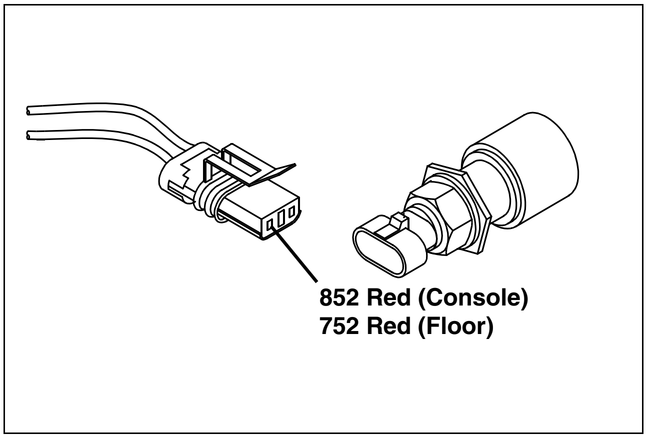
No - Test orange wire No. 613 (W1) and red wires No. 813 (W1) and 813 (W3) - Console switch or orange wire No. 713 (W1) - Optional floor-mounted switch and connections.

No - Test lower switch(es). (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lift switch connectors (X35) (console) or (X23) (floor) disconnected.

System: Lift Switch Circuit Test



(1) Check voltage at console lift switch (S6) connector (X35), wire 852 red. Is battery voltage/ test light on?

Yes - Go to step (2).

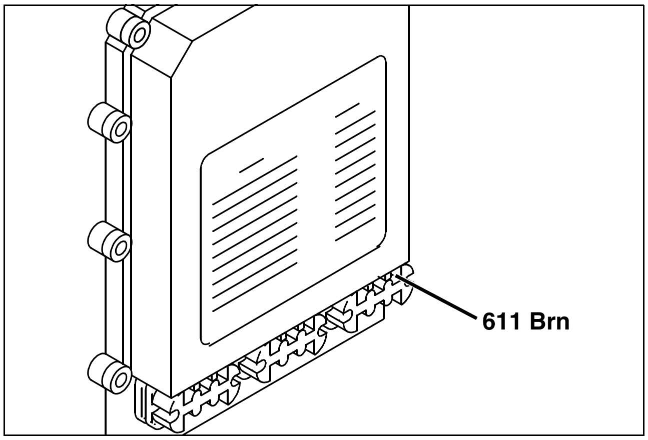
No - Test red wires No. 852 (W3) and 212 (W3) and connections.

(2) Check voltage at optional floor-mounted lift switch (S7) connector (X23), wire 752 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test red wires No. 752 (W1), 762 (W1), 802 (W1), 802 (W3) and 212 (W3) and connections.

System: Lift Switch Circuit Test



(3) Lift switches engaged.
Lift switch connectors (X35) (console) or (X23) (floor) connected.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal A, wire 311 brown. Is battery voltage/test light on?

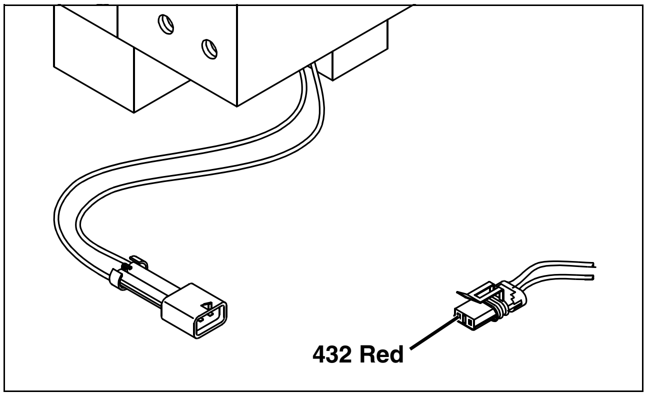
No - Test brown wires No. 611 (W1), 811 (W1) and 811 (W3) - Console switch or brown wires No. 611 (W1), 711 (W1) - Optional floor-mounted switch and connections.

No - Test lift switch(es). (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower valve solenoid connector (X11) disconnected.

System: Lower Valve Solenoid Circuit Test

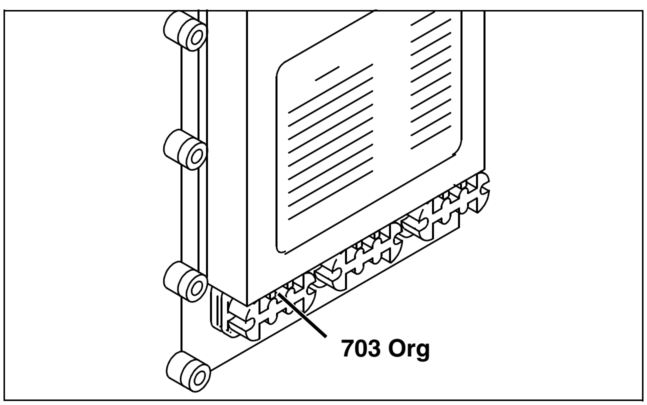


MIF

(1) Check voltage at lower valve solenoid (Y4) connector (X11), wire 432 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test red wires No. 432 (W1) 782 (W1), 802 (W1) and 802 (W3) and connections.



MIF

(2) Electronic control module connector (X7) disconnected.
Check resistance at lower valve solenoid (Y4) connector (X11) to electronic control module (A3) connector (X7), terminal C. Is resistance less than 0.1 ohm?[1]

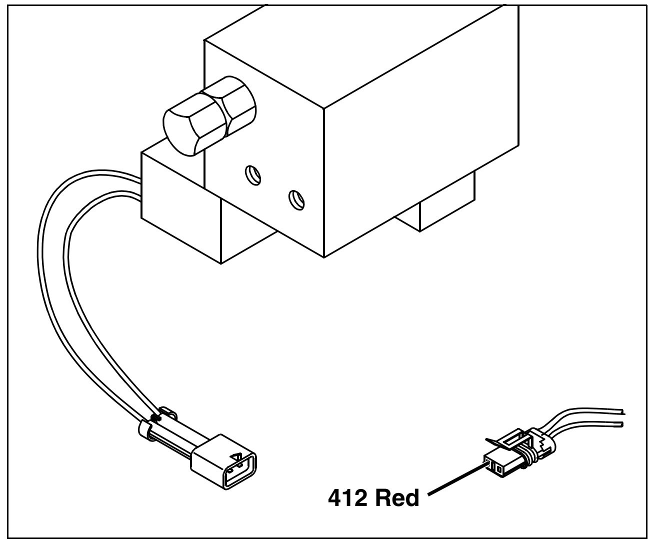
No - Test orange wire No. 703 (W1).

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower valve solenoid connector (X11) disconnected.

System: Lift Valve Solenoid Circuit Test



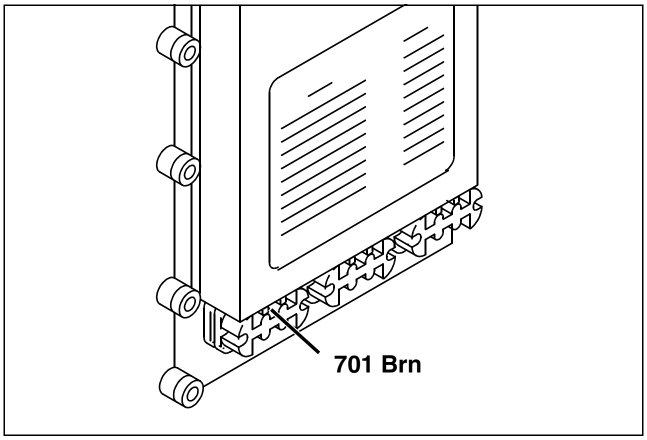
MIF

(1) Check voltage at lift valve solenoid (Y3) connector (X12), wire 412 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test red wires No. 412 (W1) 782 (W1), 802 (W1) and 802 (W3) and connections.

System: Lift Valve Solenoid Circuit Test



MIF

(2) Electronic control module connector (X7) disconnected.
Lift valve solenoid (Y4) connector (X11) to Check voltage at electronic control module (A3) connector (X7), terminal A. Is resistance less than 0.1 ohm?[1]

No - Test brown wire No. 701 (W1).

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Cutting Unit - Mow Circuit Operation - Models 2500, 2500A

Function

To engage the reel motors when the cutting units are lowered.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Mow/transport switch in MOW position.
- Backlap switch in MOW (OFF) position.
- Operator on seat (seat switch engaged).
- Cutting units lowered to the ground.

Theory of Operation

NOTE: If the mow circuit is engaged while the cutting units are in the raised position, the cutting units will not start until the cutting units are lowered.

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3]).

Current is also supplied to the seat switch (S3) (red wires No. 892 [W1], 762 [W1], 802 [W3] and 212 [W3], backlap switch (S4) (red wires No. 422 [W1], 762 [W1], 802 [W3] and 212 [W3]), mow valve solenoid (Y2) (red wires No. 412 [W1], 422 [W1], 762 [W1], 802 [W3] and 212 [W3]) and mow/transport switch (S5) (red wires No. 872 [W11 - optional third wheel assist], 872 [W1], 762 [W1], 802 [W3] and 212 [W3]).

With the operator on the seat, current flows to connector X9, pin K of the control module (gray wire No. 808 [W1]), enabling the mow circuit.

As the mow/transport switch is moved the to MOW position, current flows to connector X9, pin C of the control module (yellow wires No. 924 and 934 [W11 - optional third wheel assist], and 924 [W1]). The control module will then complete the path to ground for the mow valve solenoid (blue/white wire No. 766 [W1]), activating the mow valve and engaging the reel drive motors.

The ground circuit (black wires No. 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

Cutting Unit - Backlap Circuit Operation - Models 2500, 2500A

Function

To engage the reel motors when the cutting units are lower and the backlap switch is in the BACKLAP position.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Backlap switch in BACKLAP position.
- Cutting units lowered to the ground.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current is also supplied to the seat switch (S3) (red wires No. 892 [W1], 762 [W1], 802 [W3] and 212 [W3]), backlap switch (S4) (red wires No. 422 [W1], 762 [W1], 802 [W3] and 212 [W3]), mow valve solenoid (Y2) (red wires No. 412 [W1], 422 [W1], 762 [W1], 802 [W3] and 212 [W3]) and mow/transport switch (S5) (red wires No. 872 [W11 - optional third wheel assist], 872 [W1], 762 [W1], 802 [W3] and 212 [W3]).

As the backlap switch is moved the to BACKLAP position, current flows to connector X9, pin F of the control module (blue wire No. 756 [W1]). The control module will then complete the path to ground for the mow valve solenoid (blue/white wire No. 766 [W1]), activating the mow valve and engaging the reel drive motors.

The ground circuit (black wires No. 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

Mow/Backlap Circuit Diagnosis - Models 2500, 2500A

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See “Electronic Control Module Check” on page 539.)

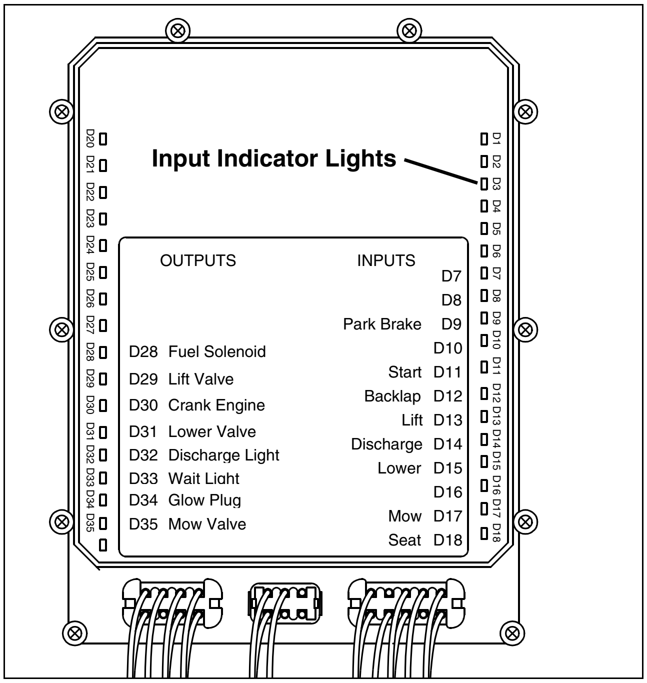
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Seat Switch Input

1. Move key switch to RUN position.
2. Press down on the lower cushion of the seat to engage the seat switch.
3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).
4. Release the seat switch.
5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See “Seat Switch Circuit Test” on page 382.)

Brake Switch Input

1. Move key switch to RUN position.
2. Depress the park brake pedal.
3. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).
4. Release the park brake pedal.
5. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON or OFF, first check brake switch adjustment (See “Adjust Park Brake Switch” on page 729). If brake light does not come ON after adjustment, test brake switch circuit. (See “Brake Switch Circuit Test” on page 383.)

Mow/Transport Switch Input

1. Move key switch to RUN position.
2. Move mow/transport lever to MOW position.
3. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See “Mow/Transport Switch Circuit Test” on page 384.)

Backlap Switch Input

1. Move key switch to RUN position.
2. Move the backlap valve to the MOW position.
3. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described; Test the Backlap Switch Circuit. (See “Backlap Switch Circuit Test” on page 386.)

Step 3: Circuit Tests

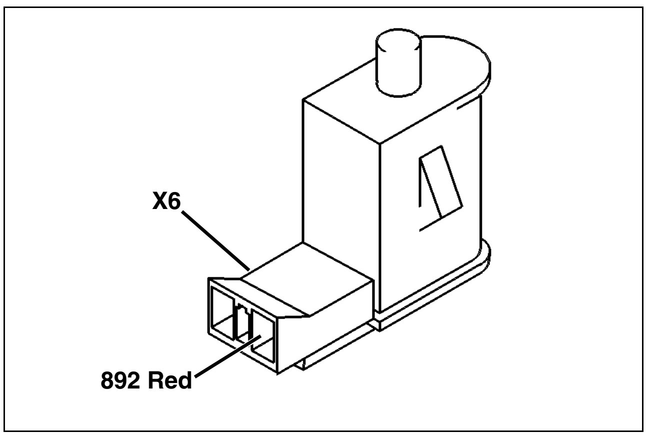
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

Seat Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Seat Switch Circuit



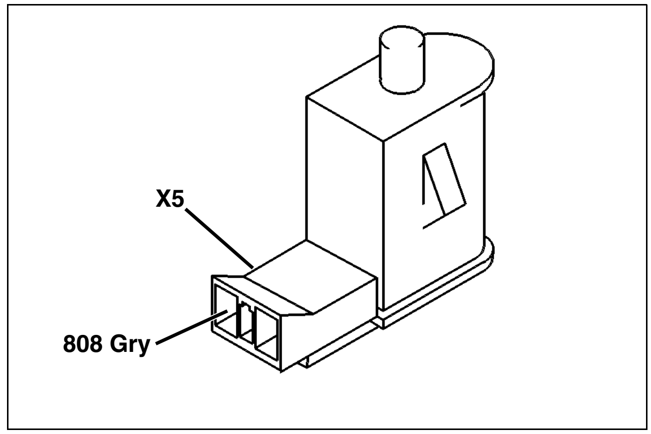
MIF

(1) Measure voltage at seat switch connector (X6), wire 892 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 892 red (W1) and connections.

System: Seat Switch Circuit

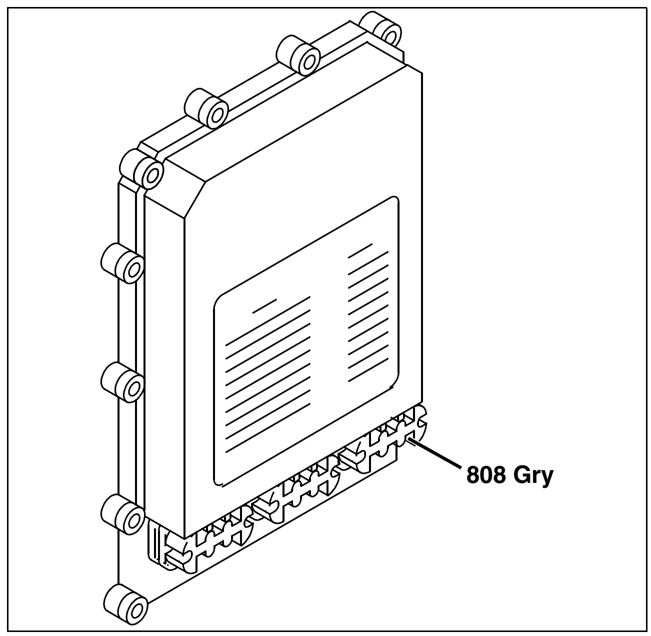


MIF

(2) Measure voltage at seat switch connector (X5), wire 808 gry. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. See “Test Seat Switch” on page 553.



MIF

(3) Check voltage at electronic control module connector (X9) - terminal H, wire 808 gry. Is battery voltage present?

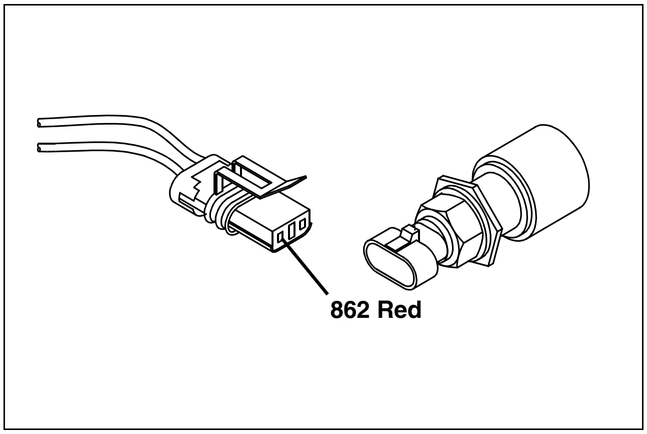
No - Test wire 808 gry and connections.

Brake Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake engaged.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Brake Switch Circuit



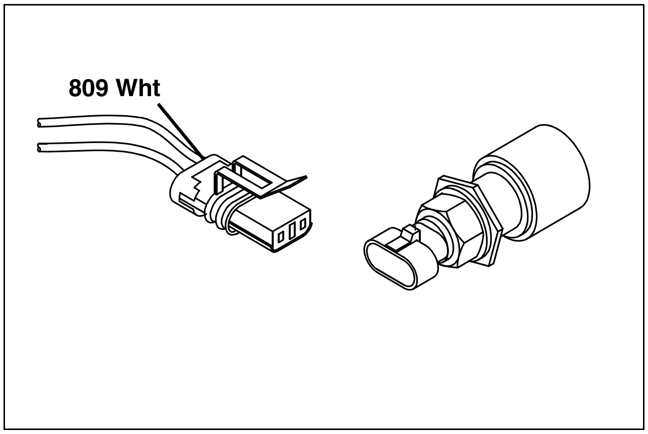
MIF

(1) Brake switch disconnected.
Measure voltage at brake switch connector (X18) - wire 862 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 862 red (W1) and connections.

System: Brake Switch Circuit

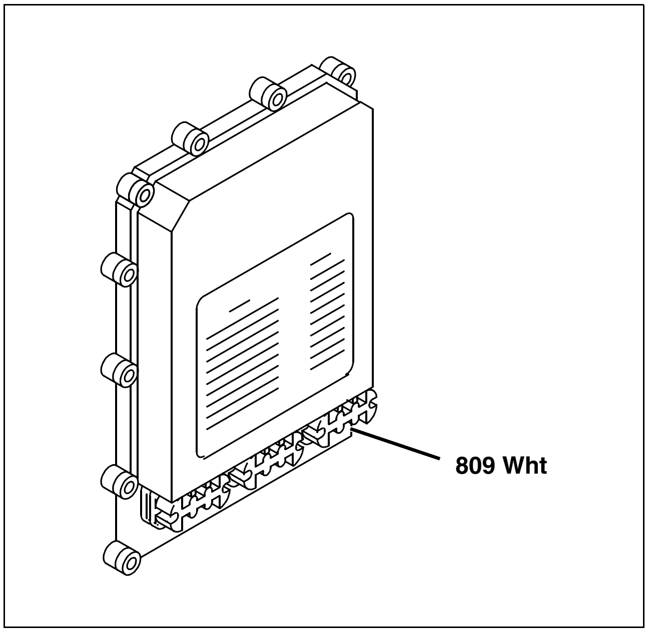


MIF

(2) Brake switch connected.
Measure voltage at brake switch connector (X18) - wire 809 wht. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)



MIF

(3) Check voltage at electronic control module connector (X9) - terminal G, wire 809 wht. Is battery voltage present?

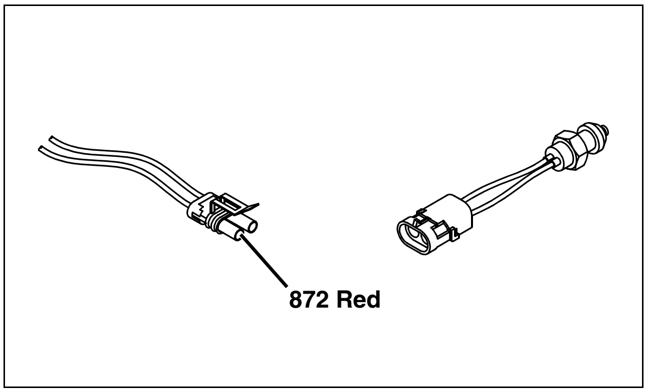
No - Test wire 809 wht and connections.

Mow/Transport Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow/Transport Switch Circuit

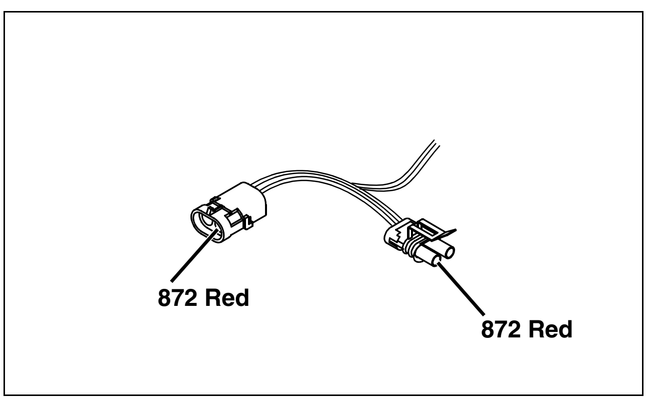


MIF

(1) Mow/transport switch connector disconnected. Measure voltage at mow/transport switch connector (X22) - wire 872 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 872 red (W1) and connections.



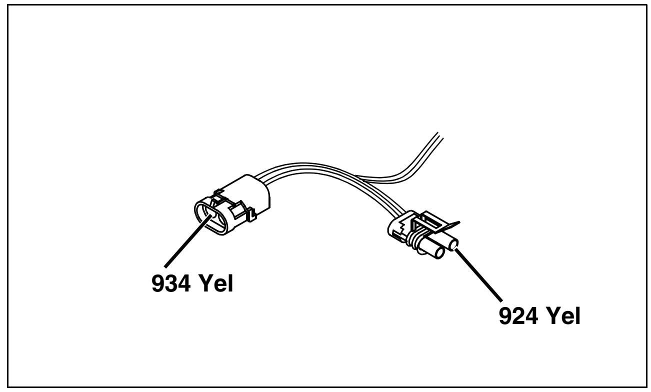
MIF

(2) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wire 872 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wire 872 red (W11) and connections.

System: Mow/Transport Switch Circuit

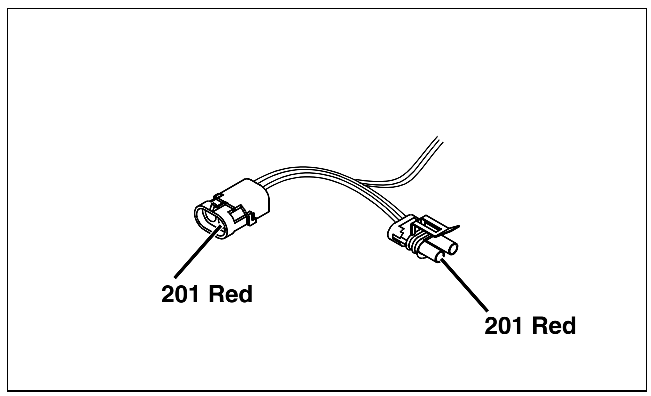


MIF

(3) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wires 924 and 934 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (4).

No - Test wires 924 and 934 yel (W11) and connections.



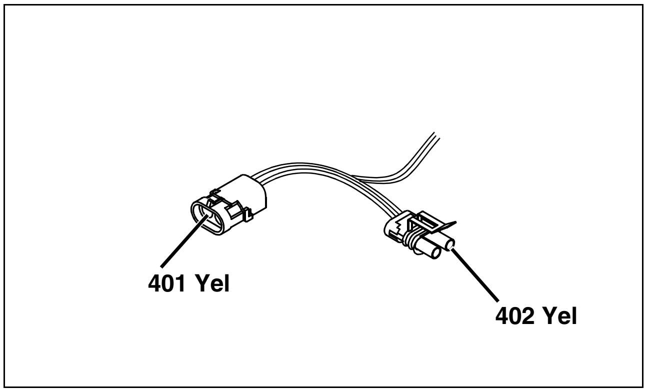
MIF

(4) Measure continuity between reel motor power harness (W16) connectors (X92 and X93) - wire 201 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (5).

No - Test wire 201 red (W16) and connections.

System: Mow/Transport Switch Circuit

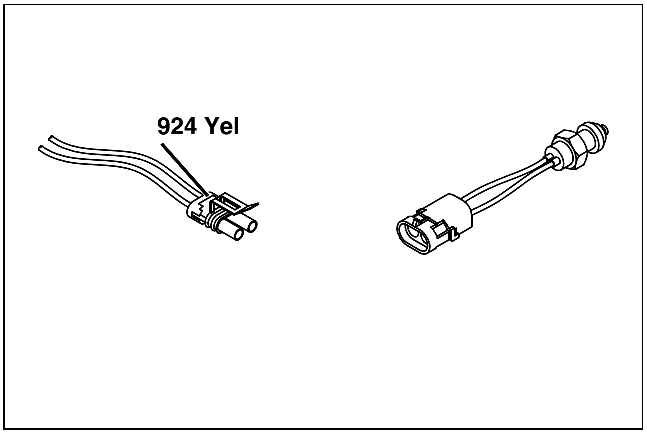


MIF

(5) Measure continuity between reel motor power harness (W16) connectors (X92 and X93) - wires 401 and 402 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (6).

No - Test wires 401 and 402 yel (W16) and connections.



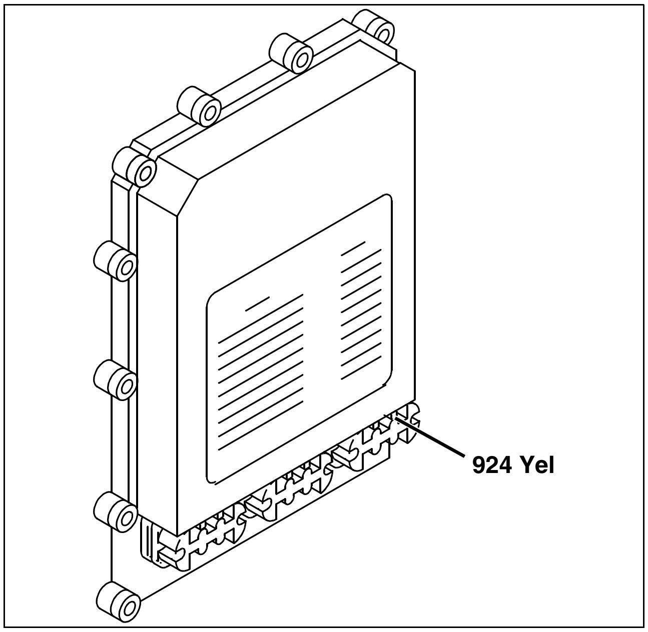
MIF

(6) Mow/transport switch connected to reel power harness connector (X92).
Main harness-to-mow/transport switch connector (X22) connected to reel power harness connector (X93) and if installed third wheel assist connectors. Measure voltage at mow/transport switch connector (X22) - wire 924 yel. Is battery voltage present?

Yes - Go to step (7).

No - Test switch. (See “Test Mow/Transport Switch” on page 553.)

System: Mow/Transport Switch Circuit



MIF

(7) Check voltage at electronic control module connector (X9) - terminal C, wire 924 yel. Is battery voltage present?

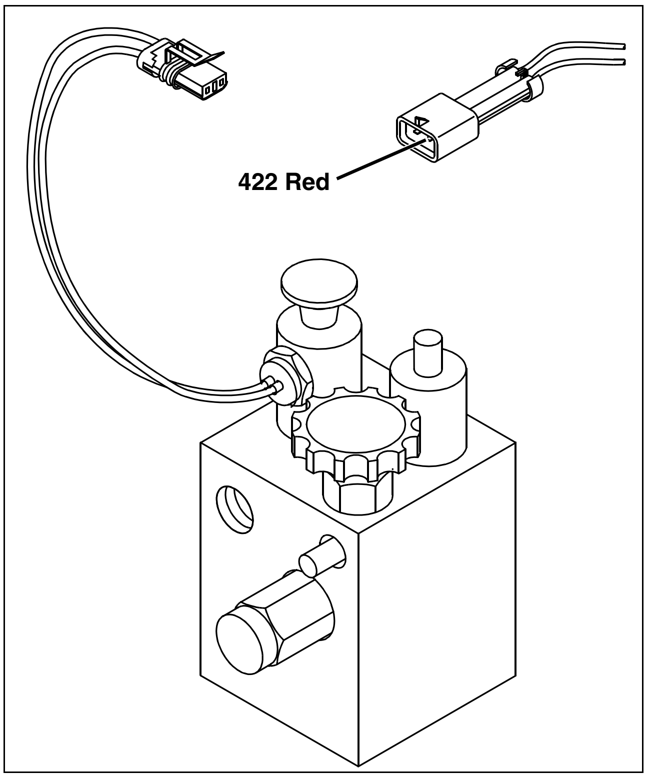
No - Test wire 924 yel and connections.

Backlap Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Backlap Switch Circuit

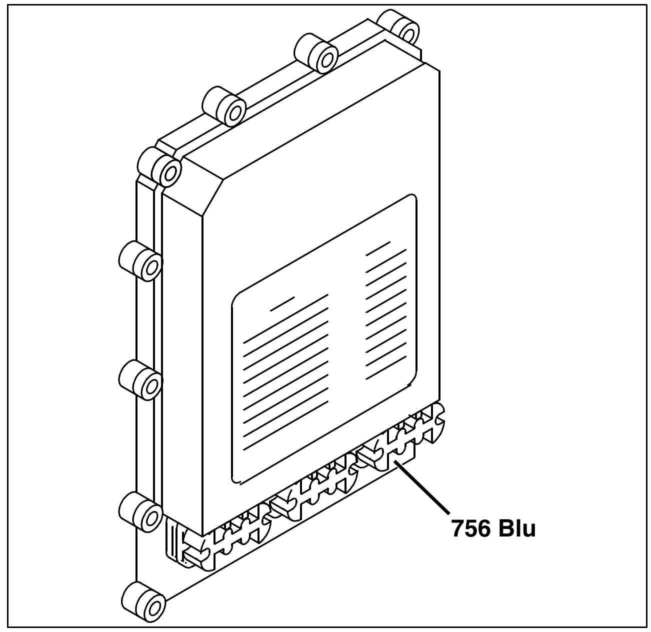


(1) Check voltage at backlap switch connector (X15) - wire 422 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 422 red and connections.

System: Backlap Switch Circuit



(2) Backlap switch connector (X15) connected. Backlap switch in BACKLAP position. Electronic control module connector (X9) disconnected. Check voltage at electronic control module connector (X9) - terminal F, wire 756 blu. Is battery voltage present?

No - Test wire 756 blu and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.)

Cutting Unit - Lift and Lower Circuit Operation - Models 2500A (S.N. 020001-), 2500E

Function

To raise and lower the cutting units.

Operating Conditions

- Key switch in the RUN position
- Engine operating

Theory of Operation

NOTE: The cutting unit lower system is gravity assisted, and does not require hydraulic oil pressure to function.

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch through wires 002 (W1), 322 (W1) and 332 (W17) red, to key switch terminal B.

The ground circuit provides a path to ground for the control module through wires 700 (W1), 810 (W1) and 820 (W1) blk.

When the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) through wires 812 (W1), 802 (W1), 802 (W17) and 212 (W17) red.

With the key switch in the RUN position, voltage is available to the following:

- Optional floor raise switch (S7):
  - Wire 752 red (W1) to splice 11 (W1).
  - Wire 762 red (W1) to splice 4 (W1).
  - Wire 802 red (W1).
  - Wire 802 red (W17) to splice 1 (W17).
  - Wire 212 red (W17).
- Optional floor lower switch (S9):
  - Wire 742 red (W1) to splice 11 (W1).
  - Wire 762 red (W1) to splice 4 (W1).
  - Wire 802 red (W1).
  - Wire 802 red (W17) to splice 1 (W17).
  - Wire 212 red (W17).
- Raise valve solenoid (Y3):
  - Wire 412 red (W1) to splice 7 (W1).
  - Wire 782 red (W1) to splice 4 (W1).
  - Wire 802 red (W1).
  - Wire 802 red (W17) to splice 1 (W17).
  - Wire 212 red (W17).
- Lower valve solenoid (Y3):
  - Wire 432 red (W1) to splice 7 (W1).
  - Wire 782 red (W1) to splice 4 (W1).
  - Wire 802 red (W1).
  - Wire 802 red (W17) to splice 1 (W17).
  - Wire 212 red (W17).

With the key switch in the RUN position, current also flows to the lift and lower switch (S11) located in the console through wire 842 red (W17).

The lift and lower switch is provided ground through wires 910 (W1), 910 (W17) and 100 (W17) blk and has two outputs. One output goes to the electronic control module connector (X9), terminal A through wires 611 (W1), 811 (W1), 811(W17) brn, to signal the control module when the lift and lower switch is in the RAISE position. The other output goes to terminal B through wires 613 (W1), 813 (W1), 813(W17) org, to signal the control module when the lift and lower switch is in the LOWER position.

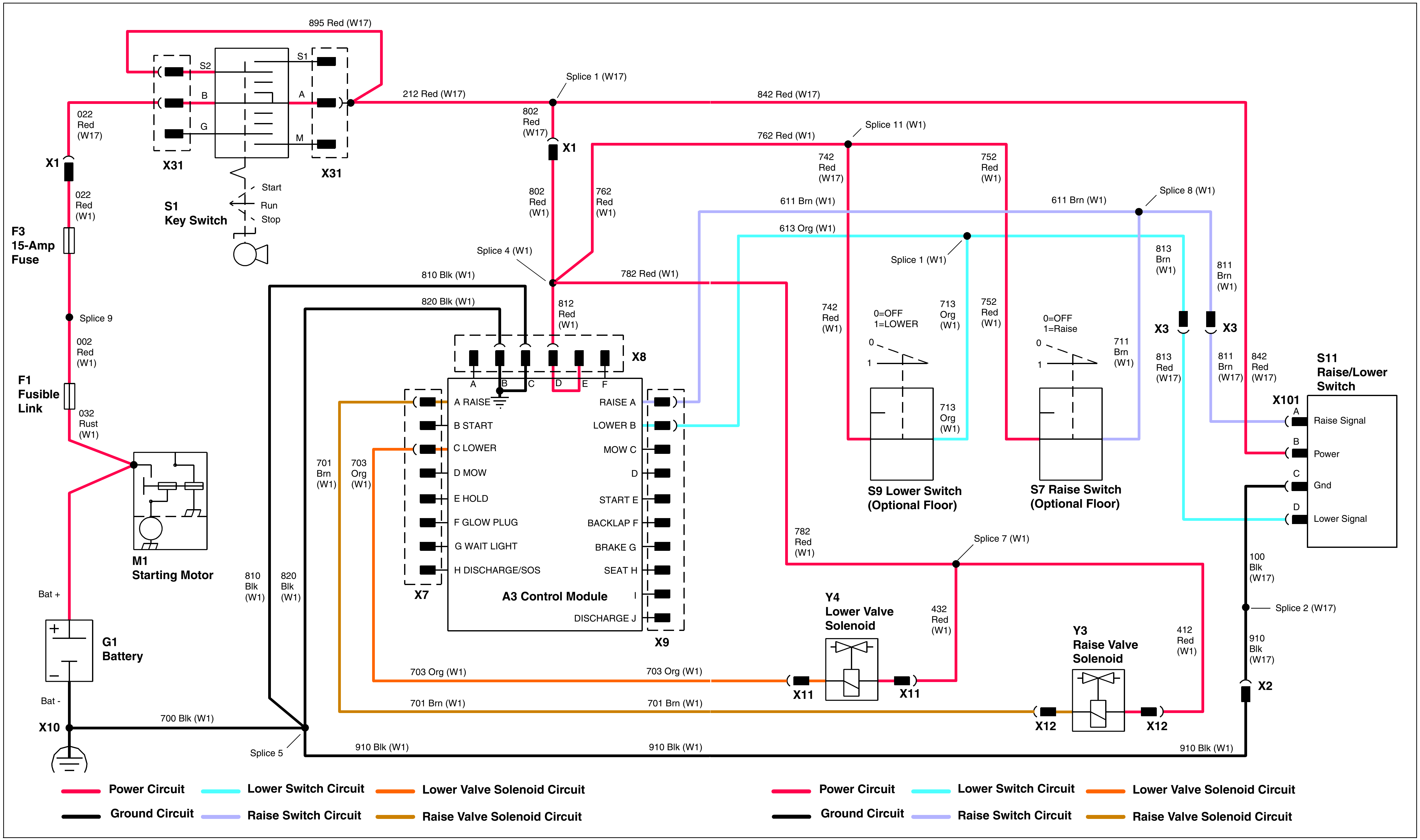
Optional floor raise switch (S7) connects to electronic control module connector (X9), terminal A through wires 611 (W1), 711 (W1) brn, to signal the control module when raise switch is DEPRESSED.

Optional floor lower switch (S9) connects to electronic control module connector (X9), terminal B through wires 613 (W1), 713 (W1) org, to signal the control module when lower switch is DEPRESSED.

When voltage is applied to the electronic control module raise input from either the lift and lower switch or optional floor raise switch, the module provides ground at electronic control module connector (X7), terminal A. When this ground is provided, current flows from the raise solenoid (Y3) to ground through wire 701 brn (W1), energizing the solenoid to raise the cutting units. The electronic control module provides this ground for only about three seconds.

When voltage is applied to the electronic control module lower input from either the lift and lower switch or optional floor lower switch, the module provides ground at electronic control module connector (X7), terminal C. Current flows from the lower solenoid (Y4) to ground through wire 703 org (W1), energizing the solenoid to lower the cutting units. The electronic control module continuously provides this ground once activated.

Cutting Unit - Raise/Lower Circuit Operation - Models 2500A (S.N. 020001-), 2500E



Lift and Lower Circuit Diagnosis - Models 2500A (S.N. 020001-), 2500E

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See "Electronic Control Module Check" on page 539.)

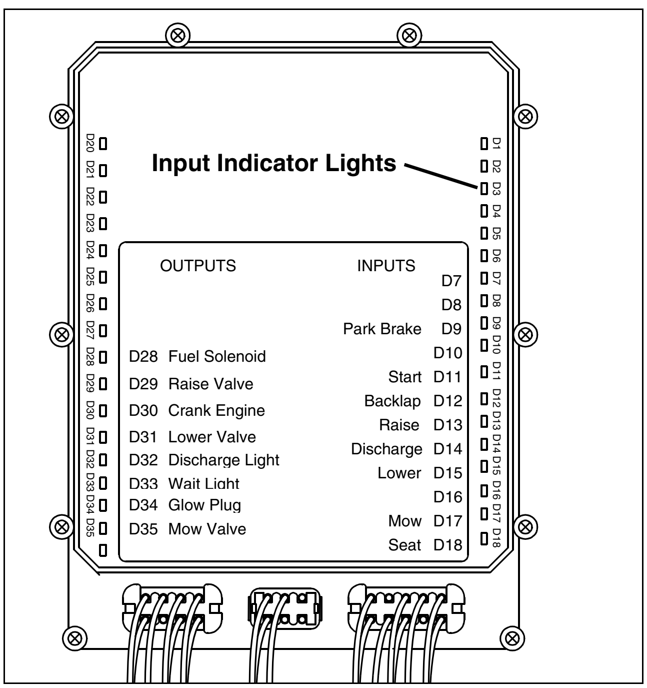
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Lower Switch Input and Lower Valve Output

1. Move key switch to RUN position.

2. Move lift and lower switch to LOWER position, or depress optional floor-mounted lower switch.

3. Observe the LOWER input light (D15). The light should be ON when either switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lift and lower switch is activated; Test lift and lower switch circuit. (See "Lift and Lower Switch Circuit Test" on page 392.)

If the light does not come ON when the optional floor-mounted lower switch is activated; Test lower switch circuit. (See "Optional Floor Mounted Lower Switch Circuit Test" on page 395.)

4. Observe the LOWER VALVE output light (D31). The light should be ON when either lower switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lower switches are activated; Replace electronic control module.

If the light operates correctly, but lower solenoid does not energize; Test lower solenoid circuit. (See "Lower Solenoid Circuit Test" on page 397.)

Raise Switch Input and Raise Valve Output

1. Move key switch to RUN position.

2. Move lift and lower switch to RAISE position, or DEPRESS optional floor-mounted raise switch.

3. Observe the RAISE input light (D13). The light should be ON when either raise switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lift and lower switch is activated; Test lift and lower switch circuit. (See "Lift and Lower Switch Circuit Test" on page 392.)

If the light does not come ON when the optional floor-mounted raise switch is activated; Test raise switch circuit. (See "Optional Floor Mounted Raise Switch Circuit Test" on page 394.)

4. Observe the RAISE VALVE output light (D29). The light should be ON when the switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the switches are activated; Replace electronic control module.

If the light operates correctly, but raise solenoid does not energize; Test raise solenoid circuit. (See "Raise Solenoid Circuit Test" on page 396.)

Step 3: Circuit Tests

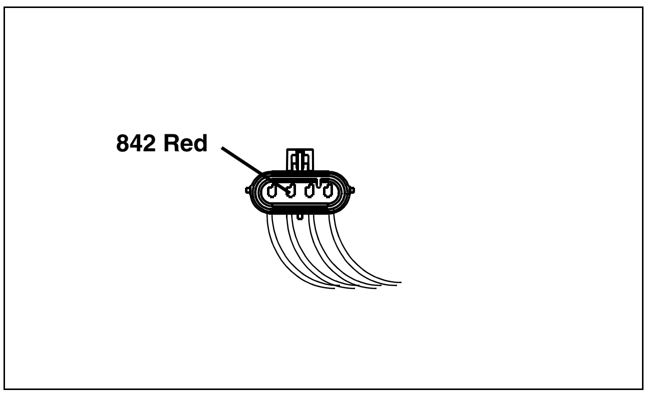
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

Lift and Lower Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lift and Lower Switch Circuit



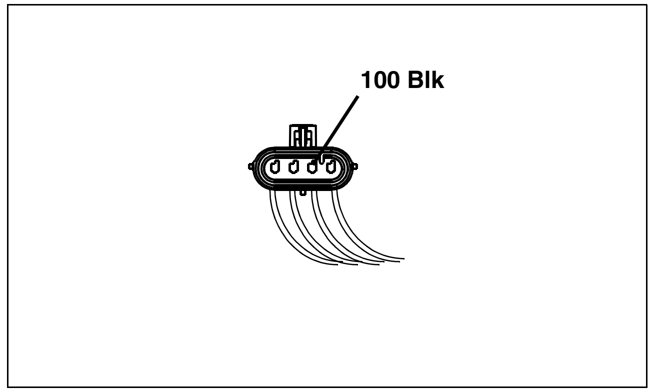
MIF

(1) Disconnect lift and lower switch connector (X83). Measure voltage at lift and lower switch connector (X83) - wire 842 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 842 and 212 red (W17) and connections between lift and lower switch connector and key switch connector.

System: Lift and Lower Switch Circuit

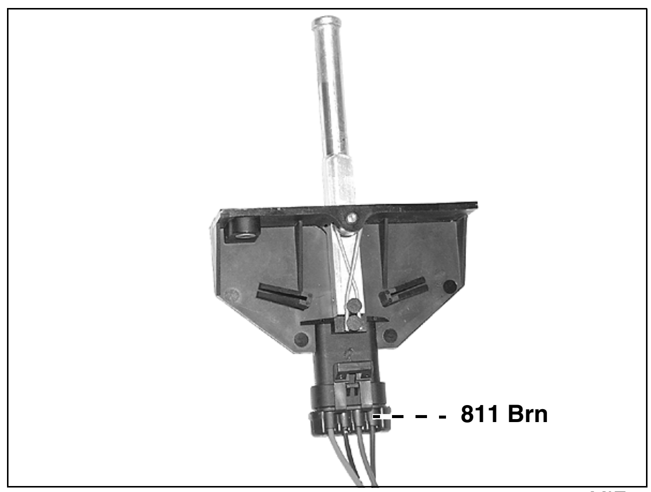


MIF

(2) Measure ground circuit resistance at lift and lower switch connector (X83) - wire 100 blk. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wires 100, 910 blk (W17) and wire 910 blk (W1) and connections.



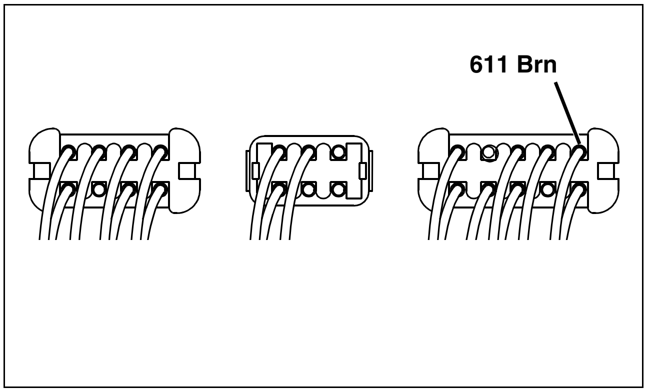
MIF

(3) Lift and Lower switch connected. Lift and lower switch in the RAISED position.
With a small diameter probe, measure voltage at lift and lower switch connector (X83) - wire 811 brn. Is there battery voltage when the switch is in the RAISED position and NO battery voltage in the RELEASED Position?

Yes - Go to step (4).

No - Replace lift and lower switch.

System: Lift and Lower Switch Circuit

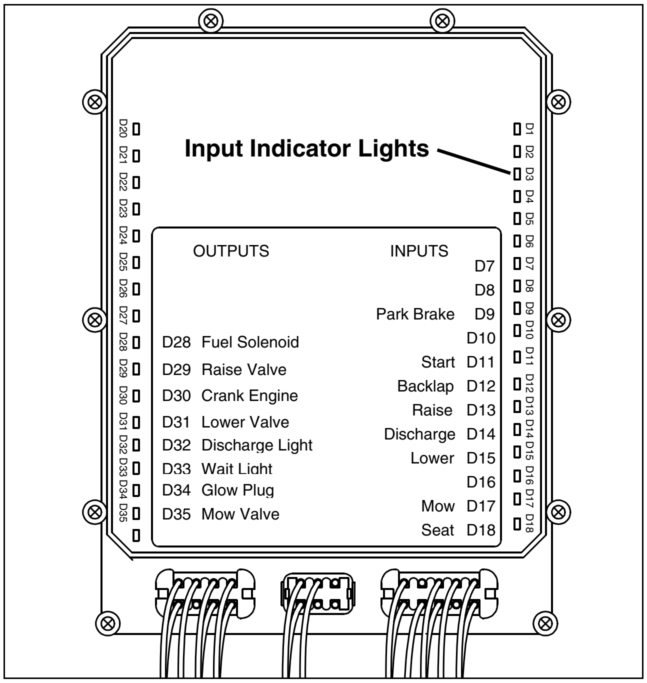


MIF

(4) With lift and lower switch in the RAISE position, measure voltage at electronic control module connector (X9) - wire 611 brn. Is battery voltage present?

Yes - Go to step (5).

No - Test wires 611, 811 brn (W1) and 811 brn (W17) and connections between lift and lower switch and electronic control module.



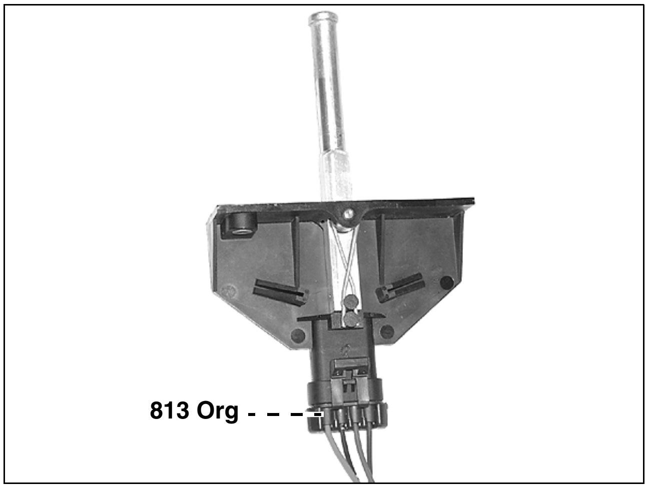
MIF

(5) Lift and lower switch (S11) in the RAISE position. Electronic control module (A3) input LED check. Is raise LED ON?

Yes - Go to step (6).

No - Replace control module.

System: Lift and Lower Switch Circuit

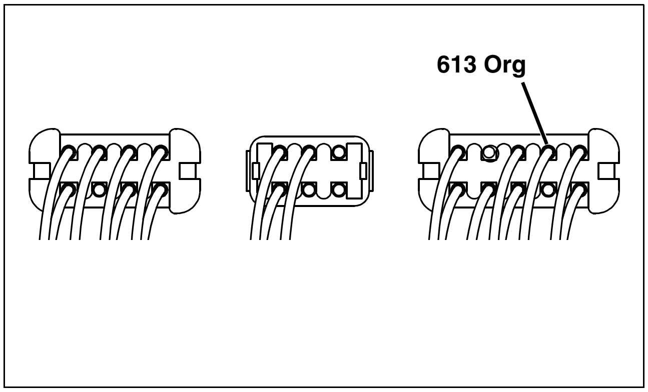


MIF

(6) Lift and lower switch in the LOWER position. With a small diameter probe, measure voltage at lift and lower switch connector (X83) - wire 813 org. Is there battery voltage when the switch is in the LOWER position and NO battery voltage in the RELEASED Position?

Yes - Go to step (7).

No - Replace lift and lower switch.



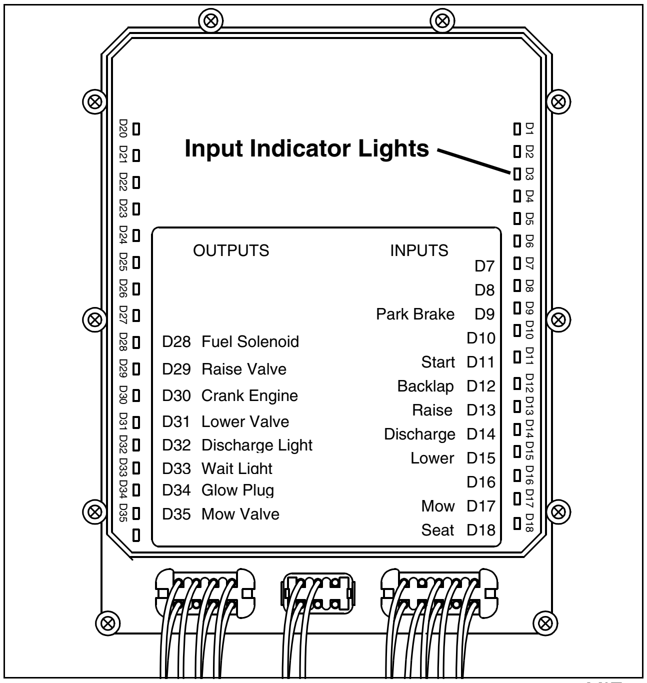
MIF

(7) With lift and lower switch in the LOWER position, measure voltage at electronic control module connector (X9) - wire 613 org. Is battery voltage present?

Yes - Go to step (8).

No - Test wires 613, 813 org (W1) and 813 org (W17) and connections between lift and lower switch and electronic control module.

System: Lift and Lower Switch Circuit



MIF

(8) Lift and lower switch (S11) in the LOWER position. Electronic control module (A3) input LED check. Is lower LED ON?

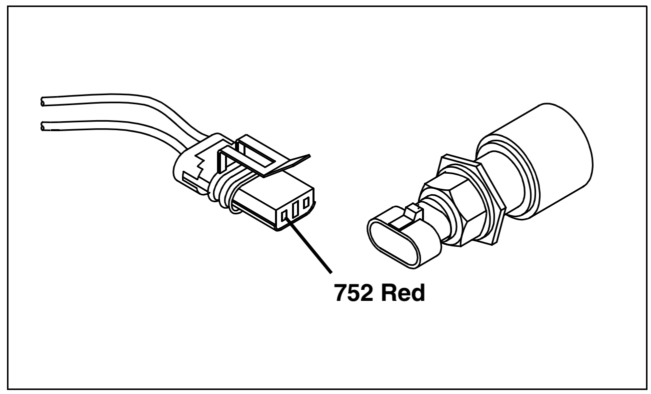
No - Replace control module.

Optional Floor Mounted Raise Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Raise Switch Circuit



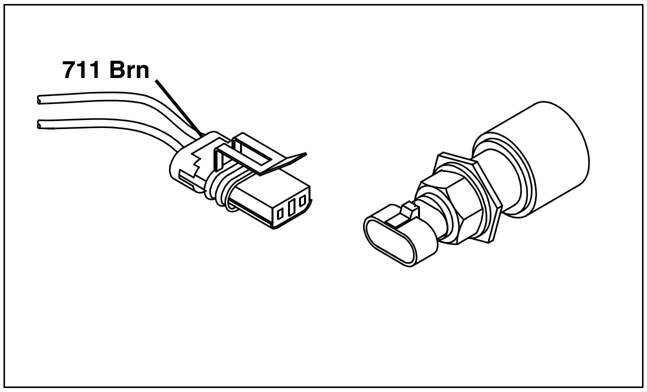
MIF

(1) Disconnect raise switch (floor) connector (X23). Measure voltage at raise switch (floor) connector (X23) - wire 752 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 752, 762, 802 red (W1) and wires 802 and 212 red (W17) and connections between raise switch connector and key switch connector.

System: Raise Switch Circuit

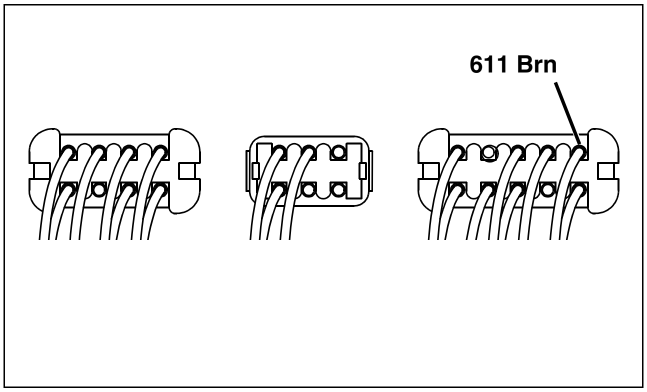


MIF

(2) Raise switch connector (X23) connected. Raise switch (floor) in the DEPRESSED position. Measure voltage at raise switch connector (X23) - wire 711 brn. Is there battery voltage when the switch is in the DEPRESSED position and NO battery voltage in the RELEASED Position?

Yes - Go to step (3).

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552)



MIF

(3) With raise switch (floor) in the DEPRESSED position, measure voltage at electronic control module connector (X9) - wire 611 brn. Is battery voltage present?

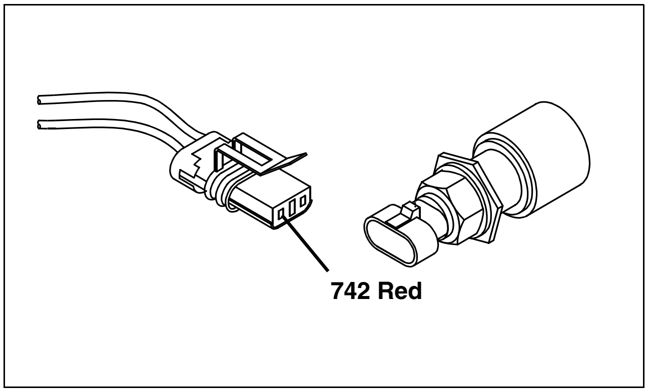
No - Test wires 611, 711 brn (W1) and connections between raise switch and electronic control module.

Optional Floor Mounted Lower Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lower Switch Circuit



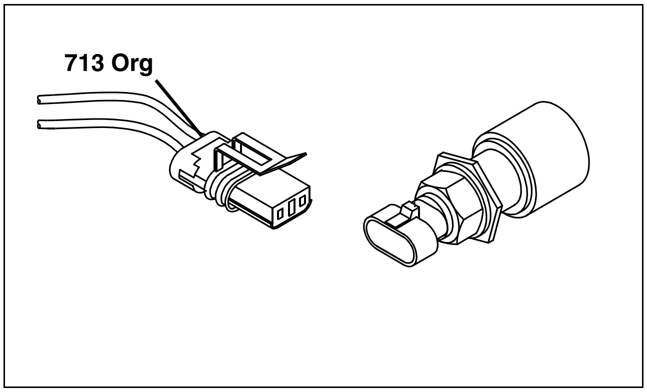
MIF

(1) Disconnect lower switch (floor) connector (X24). Measure voltage at lower switch (floor) connector (X24) - wire 742 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 742, 762, 802 red (W1) and wires 802 and 212 red (W17) and connections between raise switch connector and key switch connector.

System: Lower Switch Circuit

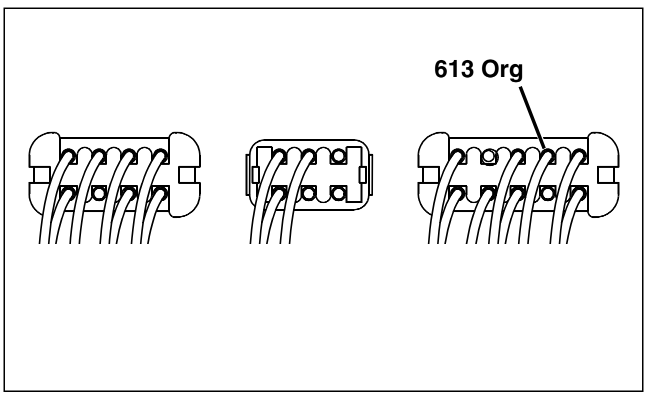


MIF

(2) Lower switch connector (X24) connected. Lower switch (floor) in the DEPRESSED position. Measure voltage at lower switch connector (X24) - wire 713 org. Is there battery voltage when the switch is in the DEPRESSED position and NO battery voltage in the RELEASED Position?

Yes - Go to step (3).

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)



MIF

(3) With lower switch (floor) in the DEPRESSED position, measure voltage at electronic control module connector (X9) - wire 613 org. Is battery voltage present?

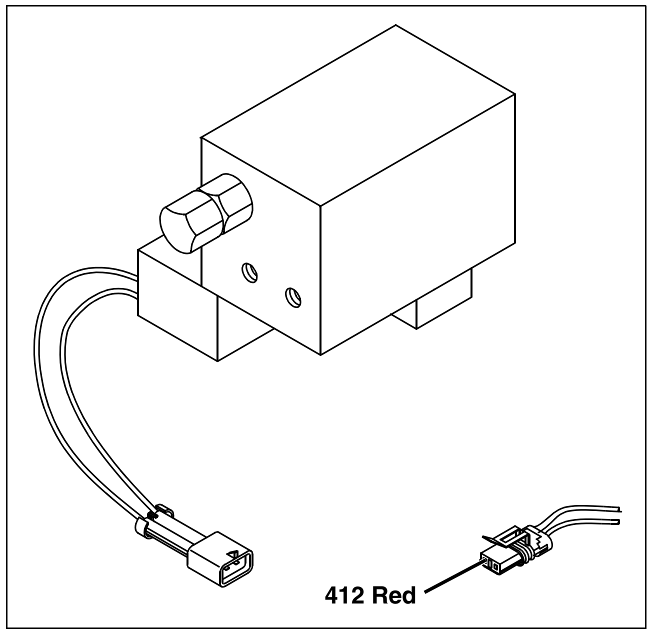
No - Test wires 613, 713 org (W1) and connections between raise switch and electronic control module.

Raise Solenoid Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Raise solenoid connector (X12) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Raise Solenoid Circuit



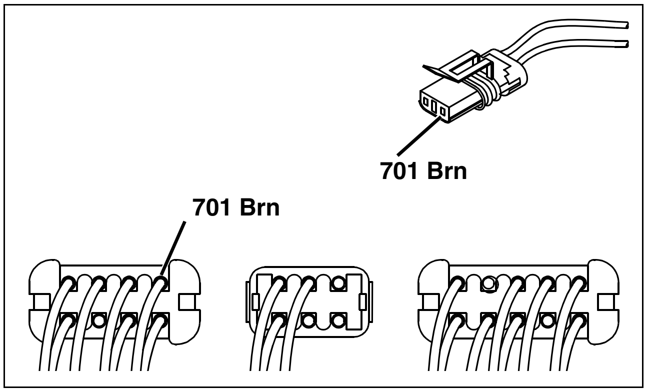
MIF

(1) Measure voltage at raise solenoid connector (X12) - wire 412 red. Is battery voltage present?

Yes - Go to step (2).

No - Check wires 412, 782, 802 red (W1) and wires 802 and 212 red (W17) and connections between raise solenoid connector (X12) and key switch connector (X31).

System: Raise Solenoid Circuit



MIF

(2) Measure resistance between electronic control module connector (X7) - wire 701 brn and raise solenoid connector (X12) - wire 701 brn. Is resistance less than 0.1 ohm?

Yes - Test raise solenoid. (See “Test lift and lower Valve Solenoid” on page 555.)

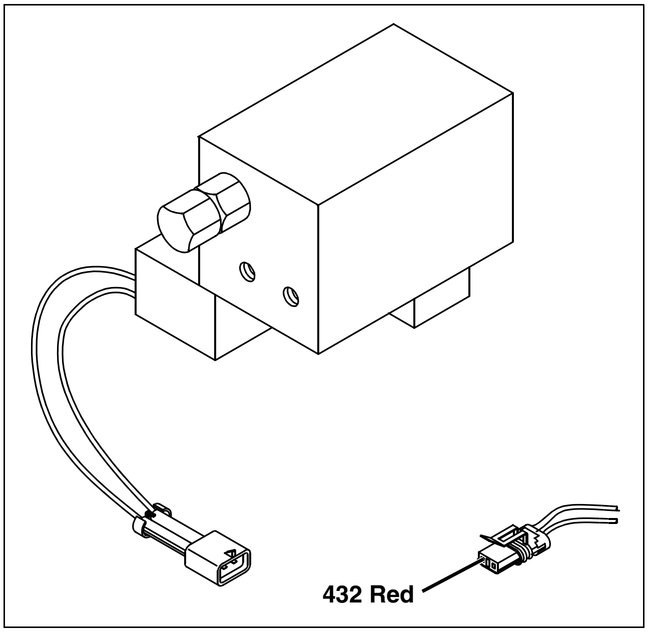
No - Check wire 701 brn (W1) and connections.

Lower Solenoid Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Lower solenoid connector (X11) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lower Solenoid Circuit



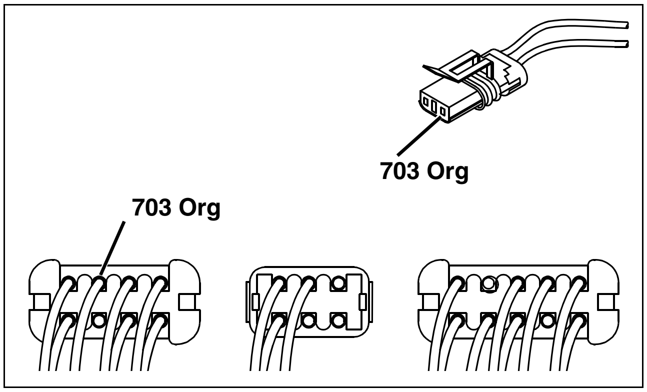
MIF

(1) Measure voltage at Lower solenoid connector (X11) - wire 432 red. Is battery voltage present?

Yes - Go to step (2).

No - Check wires 432, 782, 802 red (W1) and wires 802 and 212 red (W17) and connections between lower solenoid connector (X11) and key switch connector (X31).

System: Lower Solenoid Circuit



MIF

(2) Measure resistance between electronic control module connector (X7) - wire 703 org and lower solenoid connector (X11) - wire 703 org. Is resistance less than 0.1 ohm?

Yes - Test lower solenoid. (See “Test lift and lower Valve Solenoid” on page 555.)

No - Check wire 703 org (W1) and connections.

Cutting Unit - Mow Circuit Operation - Model 2500E

Function

To engage the reel motors when the cutting units are lowered.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Mow/transport switch in MOW position.
- Backlap switch in MOW (OFF) position.
- Operator on seat (seat switch engaged).
- Cutting units lowered to the ground.

Theory of Operation

NOTE: If the mow/transport lever is in the MOW position while the cutting units are in the raised position, the cutting units will not start until the lift and lower switch is placed in the LOWER position. If the cutting units are in the lower position and then the mow/transport lever is placed in the MOW position, the lift and lower switch must be placed in the LOWER position before the cutting units will start.

Main wiring harness W1 for gasoline models and W2 for diesel models are not indicated with wire numbers. Only sub-harness are indicated with wire numbers.

Power Circuit

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fuse link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fuse link, 15-amp fuse and key switch (red wires No. 002, 322 and 332 [W17]), to key switch "B" terminal.

When the key switch (S1) is in the RUN position, voltage is made available to splice 4 through the following:

- Wire 802 red.
- Main harness-to-console harness connector (X1).
- Wire 802 red (W17).
- Splice 1 (W17).
- Wire 212 red (W17)
- Key switch (S1) - terminal A

With the key switch in the RUN position, current also flows from splice 4 to the connector X8, pin D of the electronic control module (A3) through wire 812 red, causing the electronic control module to power up. The ground circuit (black wires No. 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

With the key switch in the RUN position, voltage is also available from splice 4 to the following components:

- Seat switch (S3) - wire 892 red.
- Backlap switch (S4):
    - Wire 422 red.
    - Splice 7.
    - Wire 762 red.
- Mow valve solenoid (Y2) connector (X14):
    - Wire 442 red.
    - Splice 7.
    - Wire 782 red.
- Mow/transport switch (S5):
    - Power harness (W16) - wire 201 red.
    - Optional third wheel assist harness (W11) - wire 872 red.
    - Wire 872 red.
    - Splice 11.
    - Wire 762 red.

Seat Switch

With the operator on the seat, current flows to connector X9, pin K of the electronic control module (gray wire No. 808 [W1]), enabling the run circuit.

Mow/Transport Switch

The mow/transport switch provides several machine functions:

- Provides power to optional third wheel assist circuit, when installed.
- Provides field voltage to reel motor system 48 volt alternator.
- Signals the electronic control module that the mow/transport lever is in the MOW position.

When the mow/transport lever is moved to the MOW position, current flows between mow/transport switch (S5) contacts to the following:

- Current flows to 48 volt alternator (G4) through wires 402 and 403 yellow, causing the 48 volt alternator to output voltage. This provides the power to operate the reel motor system.

- Optional third wheel assist harness (W11) - wires 924 and 934 yel.
- Current continues to flow to electronic control module connector (X9) - terminal C through the following:
  - Wires 402 and 401 yel (W16).
  - Wires 924 and 934 yel (W11).
  - Wire 924 yel.

This signals the electronic control module (A3) that the mow/transport lever is in the MOW position.

Mow Control Circuit

With the mow/transport switch in the MOW position, electronic control module (A3) provides a ground signal to left, right and center reel motor control module motor enable inputs, causing each reel motor control module to operate its respective motor. The electronic control module (A3) provides the ground signal on the mow output terminal C of electronic control module connector X9 to mow solenoid connector (X14) through wire 766 blu/wht. The ground signal continues through reel motor control module signal harness-to-main harness-to-mow solenoid connector (X87) - wire 301 grn (W15) and splice 1 to the following:

- Right reel motor control module connector (X88) - terminal A, wire 300 grn.
- Left reel motor control module connector (X89) - terminal A, wire 303 grn.
- Center reel motor control module connector (X83) - terminal A, wire 302 grn.

Reel Motor Forward/Reverse Switch

When reel motor forward/reverse switch (S12) is in the FORWARD position, right reel motor control module (A4) direction input is provided a ground. This causes the right reel motor control module (A4) to operate the right reel motor (M3) in the clockwise direction (viewed from the motor shaft end). While at the same time, left and center reel motor control modules (A5 and A6) have no ground applied to their direction inputs, causing reel motor control modules (A5 and A6) to operate their respective motors (M4 and M5) in the counterclockwise direction. The reason for the right reel motor (M3) to rotate in the clockwise direction while the left and center reel motors (M4 and M5) rotate in the opposite direction is because right reel motor (M3) is mounted on the side opposite of the cutting unit that the left and center reel motors (M4 and M5) are mounted on their cutting units.

With the reel motor forward/reverse switch (S12) in the FORWARD position, ground is provided to right reel control module connector (X88) - terminal E from the following:

- Wire 600 brn (W15).
- Forward/reverse switch connector (X84) - terminals B and C.
- Wire 102 blk (W15).
- Splice 4 (W15).

When reel motor forward/reverse switch (S12) is in the REVERSE position, the opposite occurs; right reel motor control module (A4) direction input is NOT provided a ground. This causes the right reel motor control module (A4) to operate the right reel motor (M3) in the counterclockwise direction. While at the same time, left and center reel motor control modules (A5 and A6) are provided a ground to their direction inputs, causing reel motor control modules (A5 and A6) to operate their respective motors (M4 and M5) in the clockwise direction.

With the reel motor forward/ reverse switch (S12) in the REVERSE position, ground is provided to left reel control module connector (X89) - terminal E from the following:

- Wire 402 yel (W15).
- Forward/reverse switch (S12) - terminals B and A.
- Wire 102 blk (W15).
- Splice 4 (W15).

With the reel motor forward/ reverse switch (S12) in the REVERSE position, ground is also provided to center reel control module connector (X83) - terminal E from the following:

- Wire 401 yel (W15).
- Forward/reverse switch (S12) - terminals B and A.
- Wire 102 blk (W15).
- Splice 4 (W15).

Reel Motor Speed Control

Reel motor speed is controlled by motor speed control (R1) a 5 k-ohm potentiometer. Right reel motor control module (A4) provides a 5-volt reference voltage to reel motor speed control (R1). Reel motor speed control (R1) is provided ground through wire 101 blk from splice 4. The variable voltage output from reel motor speed control (R1) is applied to left, right and center reel motor control modules (A4, A5 and A6) speed inputs. With the same speed voltage applied to the three reel motor control modules, the three reel motor control modules operate their respective motors at the same speed.

The variable speed output voltage is provided to splice 2 from reel motor speed control connector (X86) - terminal B through wire 901 wht (W15) to the following:

- Right reel motor control module connector (X88) - terminal C, wire 900 wht (W15).
- Left reel motor control module connector (X89) - terminal C, wire 903 wht (W15).

- Center reel motor control module connector (X83) - terminal C, wire 902 wht (W15).

Reel Motor Control Module Diagnostic Light Circuit

Reel motor control module diagnostic light (H6) is shared between left, right and center reel motor control modules. When the 48 volt alternator power is available, all reel motor control modules power up and output 5 volts to reel motor control module diagnostic light (H6) for approximately 5 seconds, causing the diagnostic light to come ON for approximately 5 seconds. Ground is provided to reel control diagnostic light (H6) from splice 4 through wire 103 blk.

All reel motor control module diagnostic light outputs connect to reel motor control module diagnostic light connector (X85) - terminal A from splice 5 through wire 501 blu. Diagnostic light outputs connect to splice 5 from the following:

- Right reel motor control module connector (X88) - terminal F, wire 500 blu (W15).
- Left reel motor control module connector (X89) - terminal F, wire 503 blu (W15).
- Center reel motor control module connector (X83) - terminal F, wire 502 blu (W15).

If more than one motor stops operating, erroneous codes can occur when more than one control module outputs its diagnostic codes.

Reel Control Diagnostic Light Codes

The number of times reel control diagnostic light (H6) flashes is determined by the malfunction. The code will repeat after a short pause. Codes will clear when mow/ transport lever is placed in the TRANSPORT position.

NOTE: If erratic codes appear while mowing, check for proper mow/transport lever activation of mow/ transport switch. Erroneous codes can occur when more than one motor has stopped operating.

Flashes	Malfunction	Cause
1	No Start	Motor failed to start. Large motor connector disconnected. Motor failed. Reel motor control module failed.
2	Stalled	Motor stopped during normal operation. Cutting reel jammed by debris while operating.
3	Hall at Start	Bad connection between reel motor control module and 6 terminal motor signal connector. Motor failed. Reel motor control module failed.
4	DCV High	48 volt alternator voltage greater than 68 volts.
5	DCV Low	48 volt alternator voltage less than 28 volts.
6	Pot V Low	Potentiometer 5 volt supply is less than 4 volts. Harness short. Right reel motor control module - 5 volt internal power supply failed.
7	Pot V High	Potentiometer 5 volt supply is greater than 5 volts. Harness short. Right reel motor control module - 5 volt internal power supply failed.
8	No Motor I	Motor failed Reel motor control module failed.
9	Motor I-Motor Off	Motor failed Reel motor control module failed.
10	Motor Over Temp	Reel motor overheated.
11	Hall Signal	Bad connection between reel motor control module and 6 terminal motor signal connector. Motor failed. Reel motor control module failed.
12	Phase Short	Motor failed.
13	Ground Short	Motor failed.

Cutting Unit - Backlap Circuit Operation - Model 2500E

Function

To engage the reel motors when the cutting units are lower and the backlap switch is in the BACKLAP position.

Operating Conditions

- Key switch in the RUN position.
- Engine running.
- Park brake LOCKED.
- Backlap switch in BACKLAP position.
- Forward/reverse switch in the REVERSE position.
- Mow/transport switch in the MOW position.
- Cutting units lowered to the ground.

Theory of Operation

NOTE: Main wiring harness W1 for gasoline models and W2 for diesel models are not indicated with wire numbers. Only sub-harness are indicated with wire numbers.

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fuse link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fuse link, 15-amp fuse and key switch through wires 002, 322 and 332 (W17) red, to key switch terminal B.

The ground circuit provides a path to ground for the control module through wires 700, 810 and 820 blk.

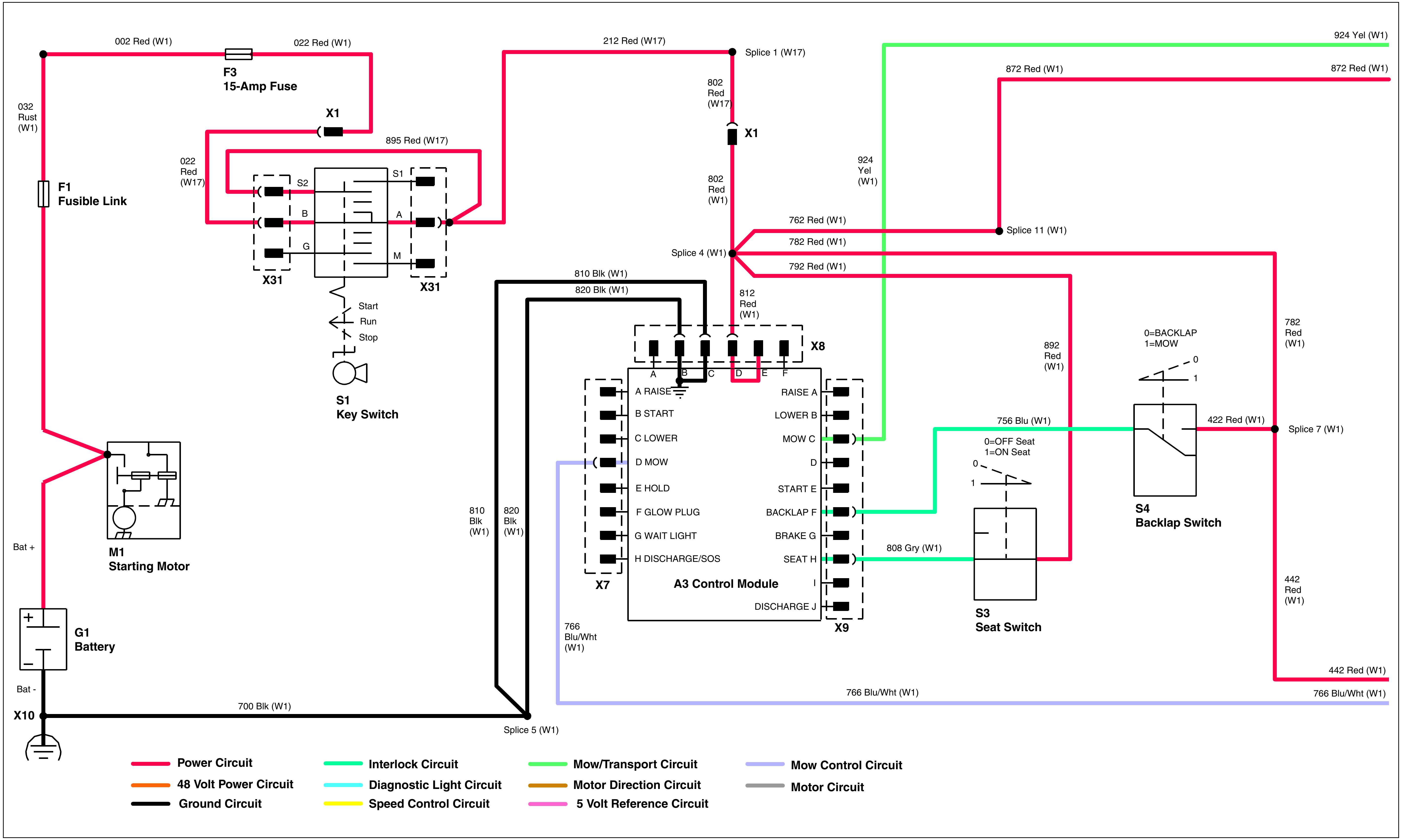
With the key switch in the RUN position, current flows to connector (X8), pin D, of the electronic control module (A3), through wires 812, 802, 802 (W17) and 212 (W17) red.

With the key switch in the RUN position, voltage is available to backlap switch (S4) through the following:

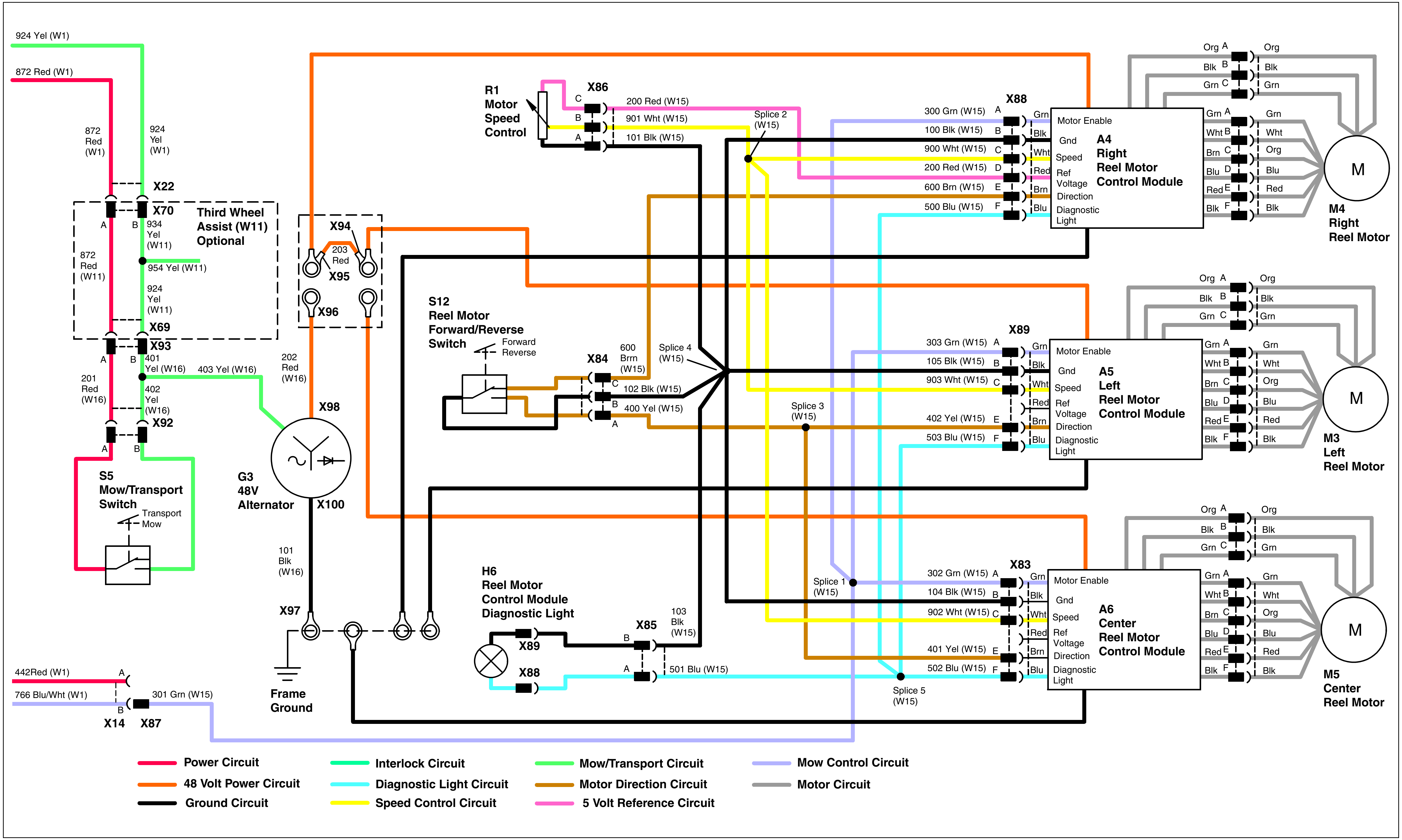
- Wire 442 red to splice 7.
- Wire 782 red to splice 4.
- Wire 802 red.
- Wire 802 red (W17) to splice 1 (W17).
- Wire 212 red (W17).

When backlap switch (S4) is in the BACKLAP position, voltage is applied to electronic control module connector (X9) terminal F through wire 756 blu. With voltage applied to electronic control module (A3) backlap input, the control module allows the mow circuit to operate with the park brake LOCKED and the operator OFF the seat. (See “Cutting Unit - Mow Circuit Operation - Model 2500E” on page 399 for theory of operation.(

Cutting Unit - Mow and Backlap Circuit Operation - Model 2500E



MX20467 gas (MIF)



MX20468 gas (MIF)

Cutting Unit - Mow/Backlap Circuit Diagnosis - Model 2500E

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See “Electronic Control Module Check” on page 539.)

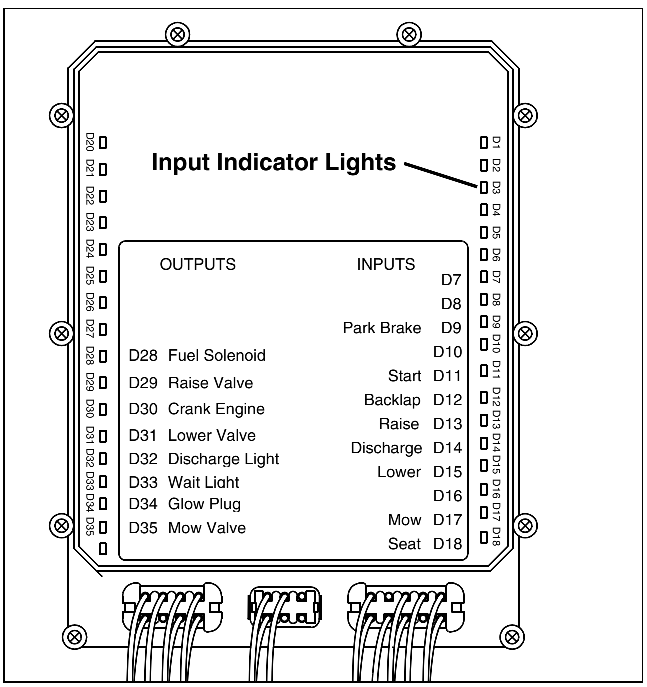
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Seat Switch Input

1. Move key switch to RUN position.
2. Press down on the lower cushion of the seat to engage the seat switch.
3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).
4. Release the seat switch.
5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON: Test seat switch circuit. (See “Seat Switch Circuit Test” on page 408.)

Brake Switch Input

1. Move key switch to RUN position.
2. Depress the park brake pedal.
3. Observe the PARK BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).
4. Release the park brake pedal.
5. Observe the PARK BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON or OFF: test brake switch circuit. (See “Brake Switch Circuit Test” on page 409.)

Mow/Transport Switch Input

1. Move key switch to RUN position.
2. Move mow/transport lever to MOW position.
3. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON: Test the mow transport switch circuit. (See “Mow/Transport Switch Circuit Test” on page 410.)

Backlap Switch Input

1. Move key switch to RUN position.
2. Move the backlap switch to the MOW position.
3. Observe the BACKLAP input light (D12). The light should be ON when the backlap switch is in the BACKLAP position and OFF when the switch is in the MOW position.

If the light does not function as described: Test the backlap switch circuit. (See “Backlap Switch Circuit Test” on page 411.)

Mow Valve Output

1. Move key switch to RUN position.

2. Depress the seat switch plunger.
3. Move the backlap switch to the MOW position.
4. Move the mow/transport lever to the MOW position.
5. Move the lift and lower lever to the LOWER position.
6. Observe the MOW VALVE output light (D35). The light should be ON when the lift and lower switch is in the LOWER position and OFF when the switch is in the RAISE position.

If the light does not function as described: Test the electronic control module. (See “Electronic Control Module Check” on page 539.)

If the light does function as described and one or more reel motors do not operate: Test the Mow Circuit. (See “Mow Circuit Test” on page 412.)

Step 3: Circuit Tests

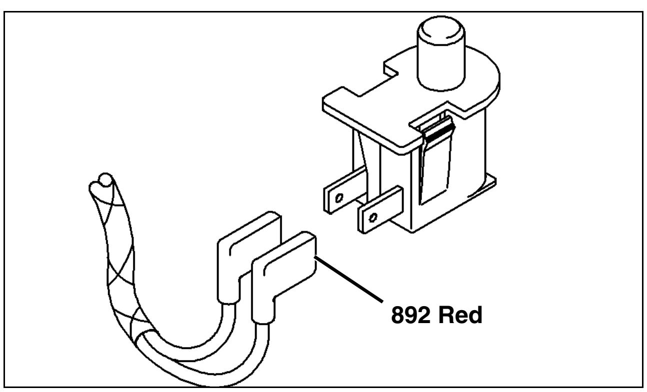
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors; excess force can damage terminals. Touch the probes lightly to terminals when testing.

Seat Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Seat Switch Circuit



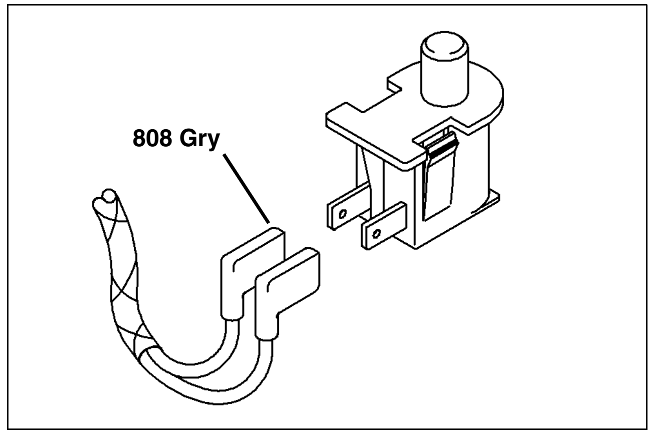
MX20470

(1) Measure voltage at seat switch connector (X6) - wire 892 red. Is battery voltage present?

Yes - Go to step (2).

System: Seat Switch Circuit

No - Test wire 892 red and connections.

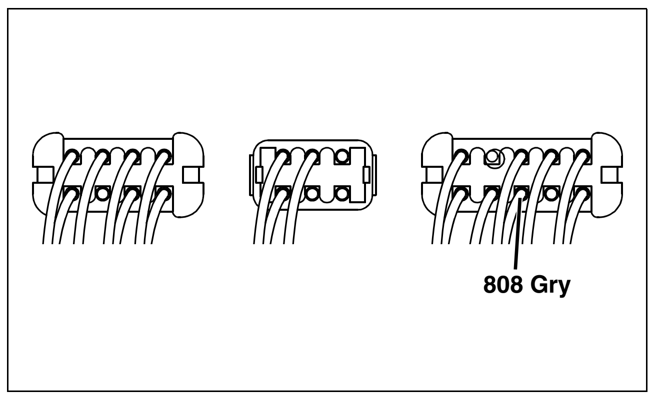


MIF

(2) Seat switch plugger depressed. With seat switch connectors (X5 and X6) connected, measure voltage at seat switch connector (X5) - wire 808 gry. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. (See “Test Seat Switch” on page 553.)



MIF

(3) Measure battery voltage at electronic control module connector (X9) - terminal H, wire 808 gry. Is battery voltage present?

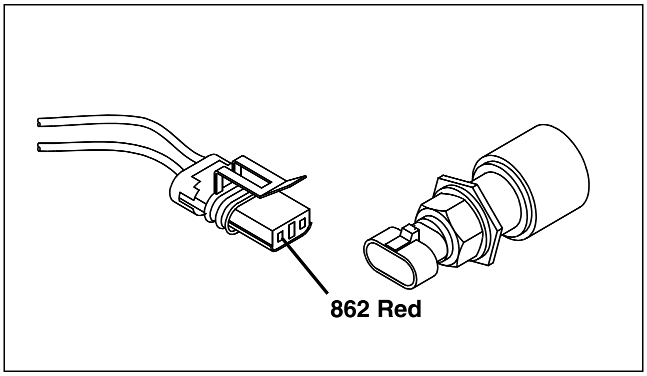
No - Test wire 808 gry and connections.

Brake Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake engaged.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Brake Switch Circuit

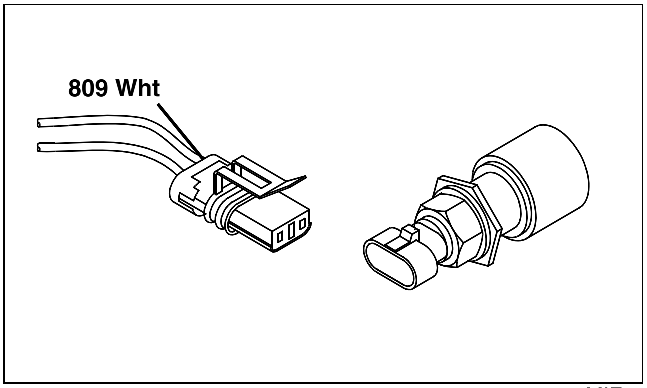


MIF

(1) Brake switch disconnected. Measure voltage at brake switch connector (X18) - wire 862 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 862 red and connections.



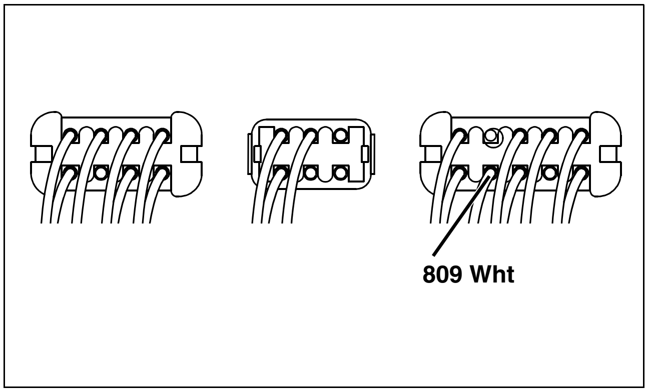
MIF

(2) Brake switch connected. Measure voltage at brake switch connector (X18) - wire 809 wht. Is battery voltage present?

Yes - Go to step (3).

System: Brake Switch Circuit

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. - 020000)” on page 552.)



MIF

(3) Measure battery voltage at electronic control module connector (X9) - terminal G, wire 809 wht. Is battery voltage present?

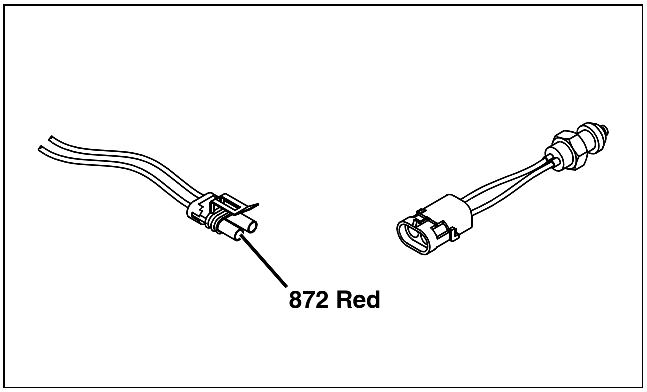
No - Test wire 809 wht and connections.

Mow/Transport Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow/Transport Switch Circuit

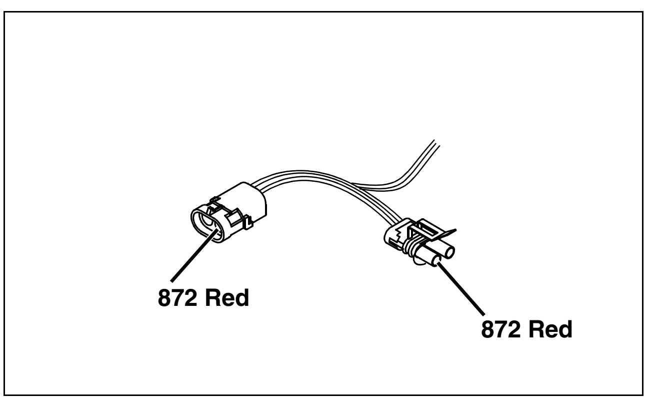


MIF

(1) Mow/transport switch connector disconnected. Measure voltage at mow/transport switch connector (X22) - wire 872 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 872 red and connections.



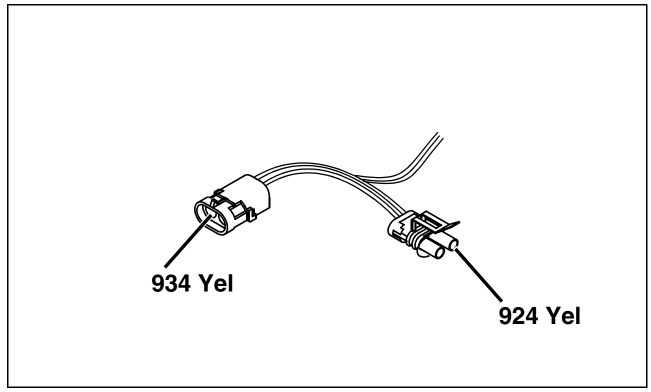
MIF

(2) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wire 872 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wire 872 red (W11) and connections.

System: Mow/Transport Switch Circuit

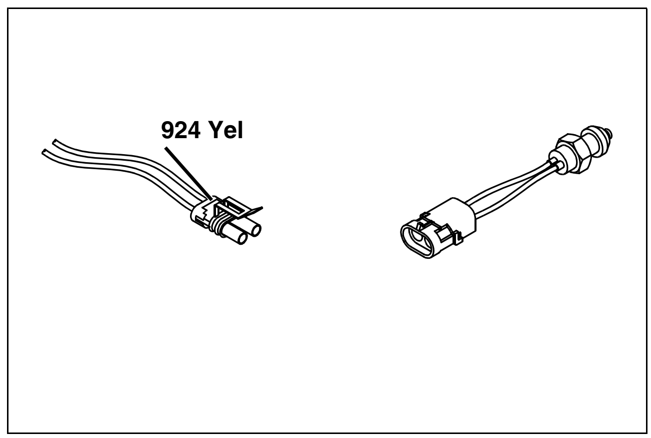


MIF

(3) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wires 924 and 934 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (4).

No - Test wires 924 and 934 yel (W11) and connections.



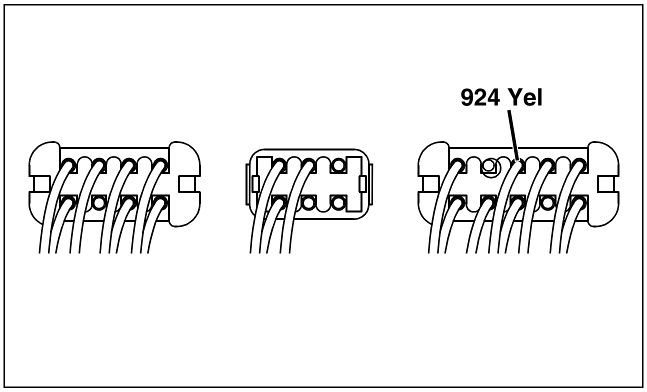
MIF

(4) Mow/transport switch connected and if installed third wheel assist connectors. Measure voltage at mow/transport switch connector (X22) - wire 924 yel. Is battery voltage present?

Yes - Go to step (5).

No - Test switch. (See “Test Mow/Transport Switch” on page 553.)

System: Mow/Transport Switch Circuit



MIF

(5) Measure battery voltage at electronic control module connector (X9) - terminal C, wire 924 yel. Is battery voltage present?

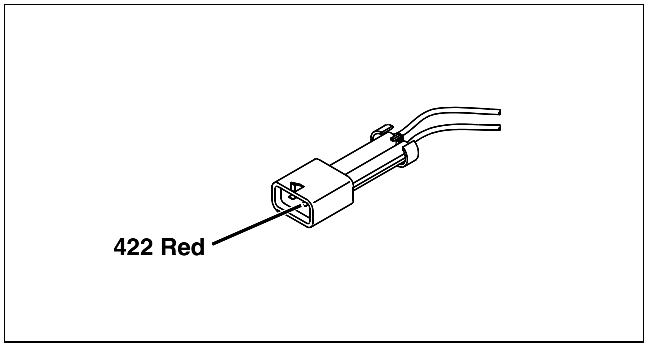
No - Test wire 924 yel and connections.

Backlap Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Backlap Switch Circuit

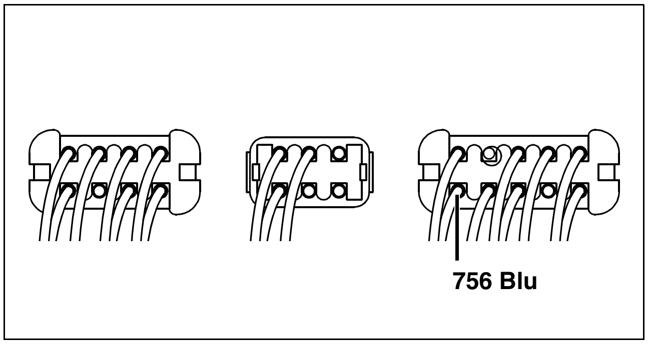


MIF

(1) Measure battery voltage at backlap switch connector (X15) - wire 422 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 422 red and connections.



MIF

(2) Backlap switch connector (X15) connected.
Backlap switch in BACKLAP position.
Electronic control module connector (X9) disconnected.
Electronic control module connector (X9) - terminal F, wire 756 blu. Is battery voltage present?

No - Test wire 756 blu and connections.

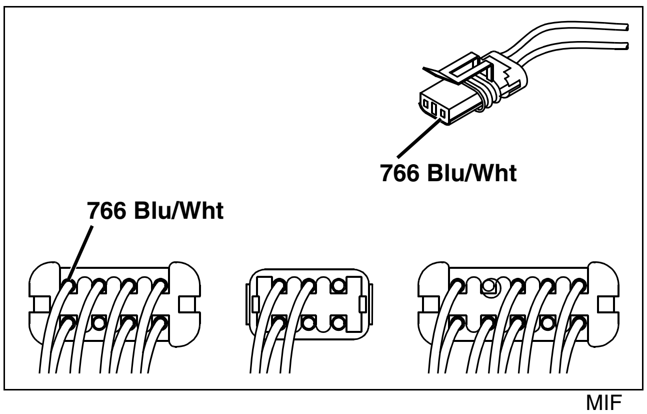
No - Test backlap switch. (See “Test Backlap Switch - Model 2500E” on page 560.)

Mow Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow Circuit

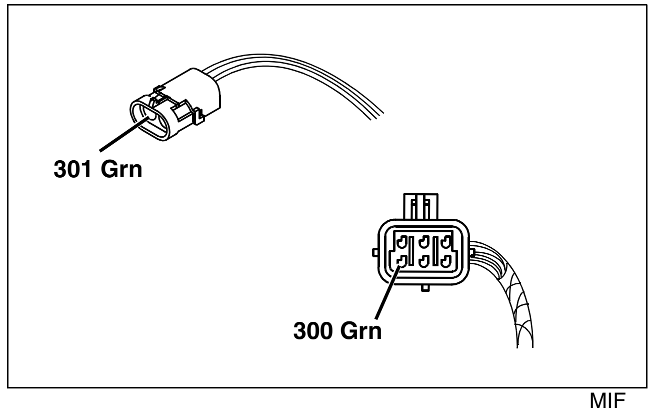


(1) Measure resistance between electronic control module connector (X7) - wire 766 blu/wht and mow valve connector (X14) - wire 766 blu/wht. Is resistance less than 0.1 ohm?

Yes - Go to step (2).

No - Check wire 766 blu/wht and connections.

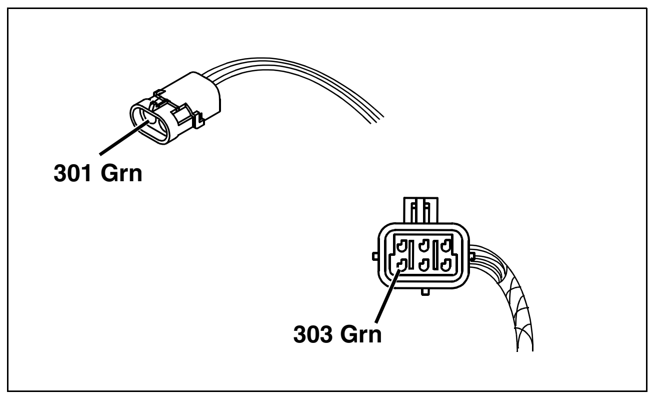
System: Mow Circuit



(2) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and right reel motor control module connector (X88) - wire 300 grn. Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Check wires 301 and 300 grn and connections.

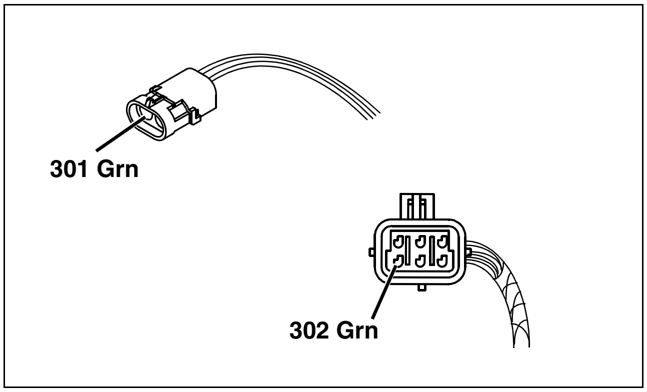


(3) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and left reel motor control module connector (X89) - wire 303 grn. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check wires 301 and 303 grn and connections.

System: Mow Circuit



(4) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and center reel motor control module connector (X83) - wire 302 grn. Is resistance less than 0.1 ohm?

No - Check wires 301 and 302 grn and connections.

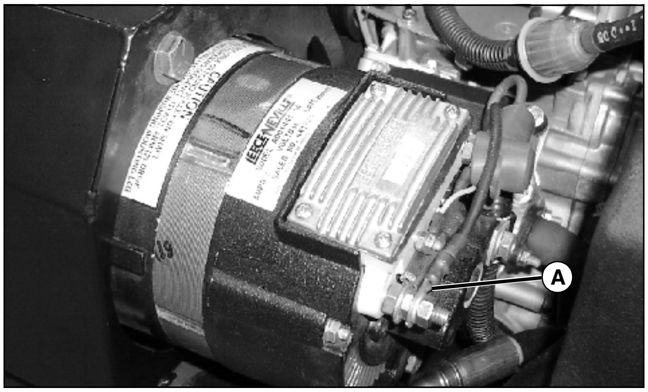
Reel Motor Circuit Diagnosis - Model 2500E

48 Volt Alternator Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position (engine operating at medium idle).
- Mow/transport lever in the MOW position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: 48 Volt Alternator Circuit



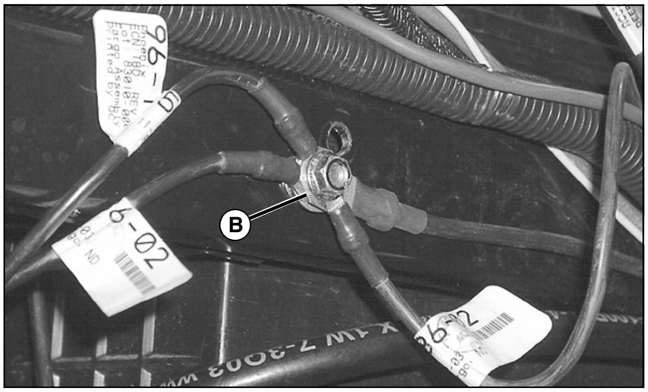
MX20831

(1) Measure resistance at 48 volt alternator ground terminal (X97) - wire 101 blk (A). Is resistance less than 0.1 ohm?

Yes - Go to step (2).

No - Check wire 101 blk and connections between frame ground and 48 volt alternator terminal.

System: 48 Volt Alternator Circuit

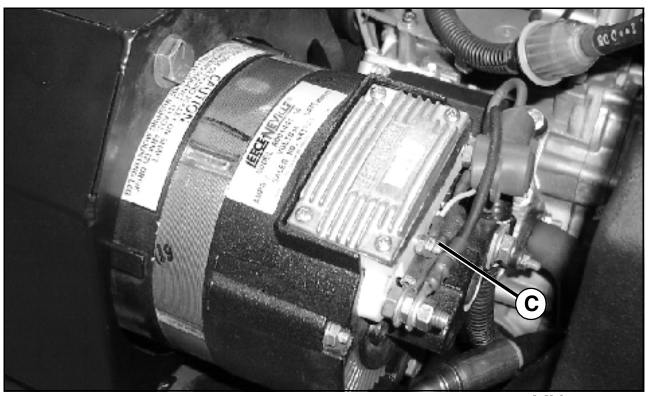


MX20490

(2) Measure resistance at frame ground (B). Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Clean and tighten terminals.



MX20831

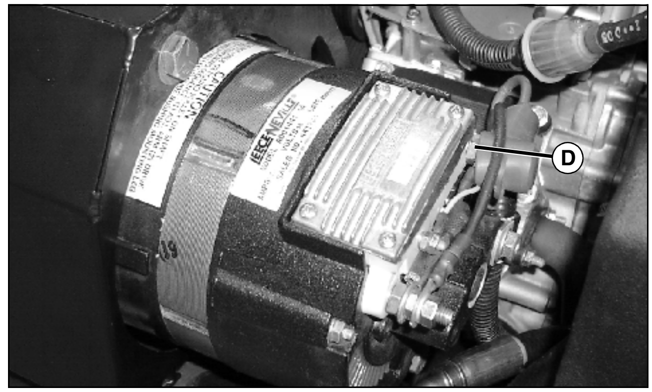
(3) Measure voltage at 48 volt alternator field terminal (X99) - wire 403 yel (C). Is battery voltage present?

Yes - Go to step (4).

No - Check wire 403 yel and connections between mow/transport switch and 48 volt alternator terminal.

No - Check mow/transport switch circuit. (See “Mow/ Transport Switch Circuit Test” on page 410.)

System: 48 Volt Alternator Circuit

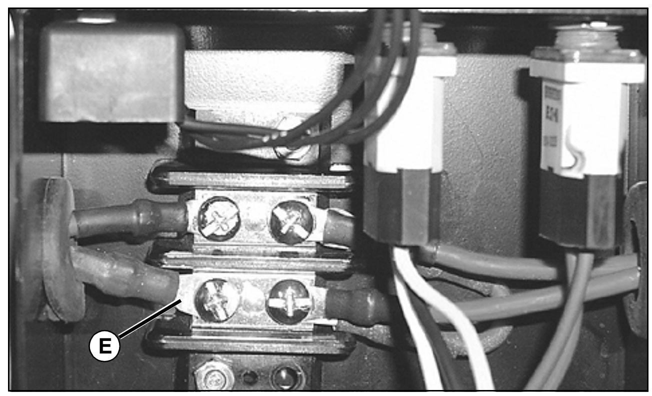


MX20831

(4) Measure voltage at 48 volt alternator positive (+) output terminal (X98) - wire 202 red (D). Is voltage in the range of 46-50 volts?

Yes - Go to step (5).

No - Replace 48 volt alternator.



(5) Measure voltage at 48 volt terminal block - wire 202 red (E). Is voltage in the range of 46-50 volts?

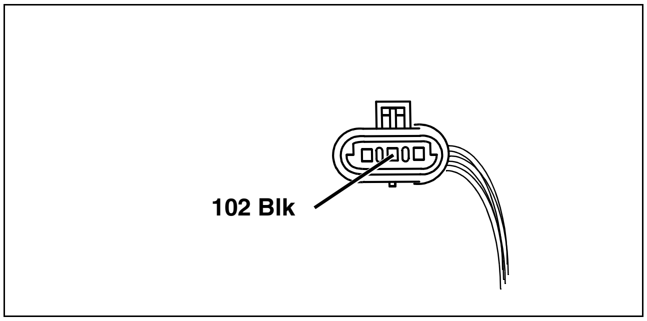
No - Check wire 202 red between terminal block and 48 volt alternator. Clean and tighten terminals.

Reel Motor Forward/Reverse Switch Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in STOP position.
- Forward/reverse switch in the FORWARD position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Reel Motor Forward/Reverse Switch Circuit



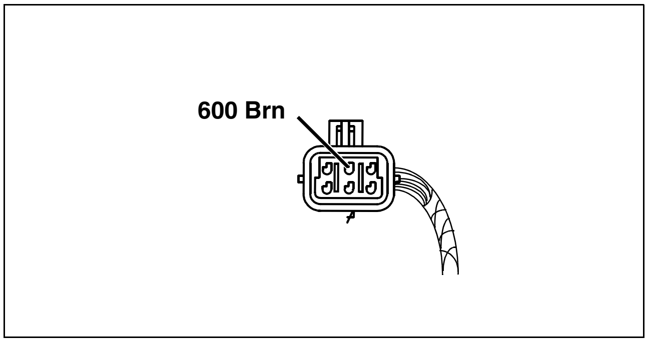
MIF

(1) Forward/reverse switch disconnected. Measure ground circuit for resistance at reel motor forward/reverse switch connector (X84) - wire 102 blk. Is there less than 0.1 ohm of resistance?

Yes - Go to step (2).

No - Check wire 102 blk and connections.

System: Reel Motor Forward/Reverse Switch Circuit

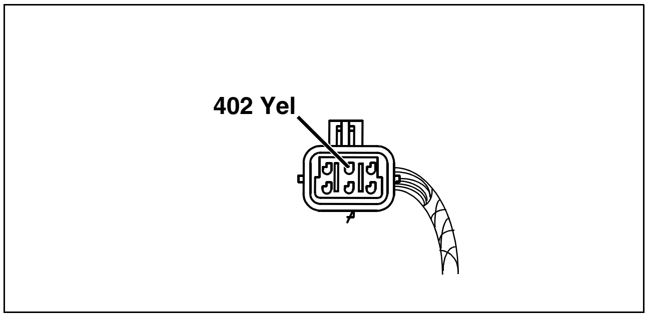


(2) Forward/reverse switch connected. Right reel motor control module connector (X88) disconnected. Measure resistance between ground and right reel motor control module connector (X88) - wire 600 brn. Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Check forward/reverse switch. (See “Test Reel Motor Forward/Reverse Switch - Model 2500E” on page 560.)

No - Check wire 600 brn between forward/reverse switch connector and right reel motor control module connector.



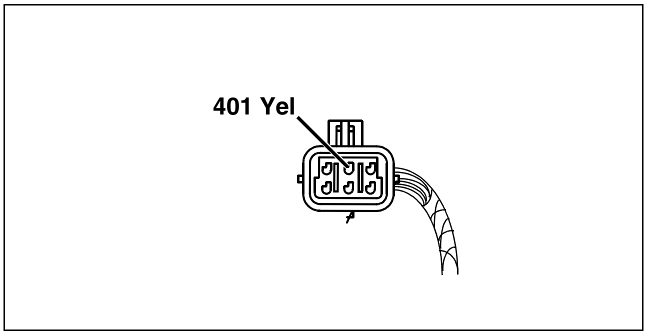
(3) Forward/reverse switch in the REVERSE position. Left reel motor control module connector (X89) disconnected. Measure resistance between ground and left reel motor control module connector (X89) - wire 402 yel. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check forward/reverse switch. (See “Test Reel Motor Forward/Reverse Switch - Model 2500E” on page 560.)

No - Check wire 402 yel between forward/reverse switch connector and left reel motor control module connector.

System: Reel Motor Forward/Reverse Switch Circuit



(4) Center reel motor control module connector (X83) disconnected. Measure resistance between ground and center reel motor control module connector (X83) - wire 401 yel. Is resistance less than 0.1 ohm?

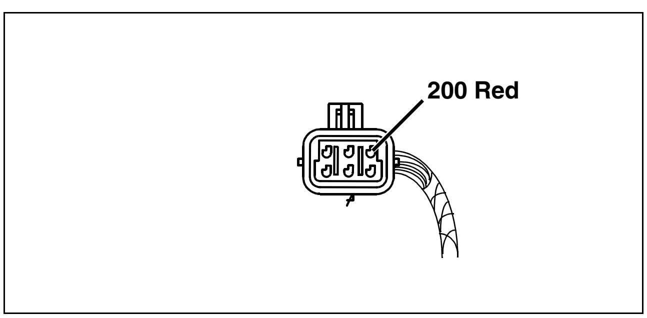
No - Check wire 401 yel between forward/reverse switch connector and center reel motor control module connector.

Reel Motor Speed Control Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position (engine operating at medium idle).
- Mow/transport lever in MOW position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Reel Motor Speed Control Circuit



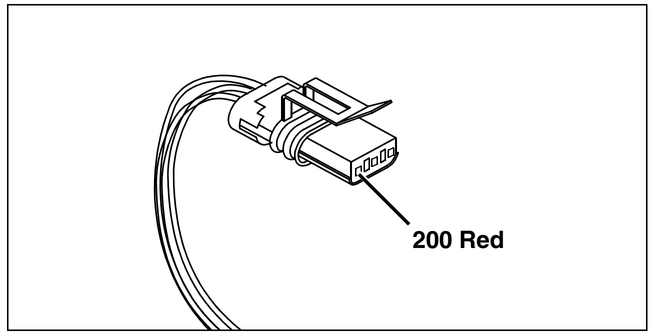
MIF

(1) Right reel motor control module connector (X88) disconnected. Measure voltage at right reel motor control module connector (X88) - wire 200 red. Is voltage in the range of 4.75-5.25 volts?

System: Reel Motor Speed Control Circuit

Yes - Go to step (2).

No - Replace right reel motor control module.

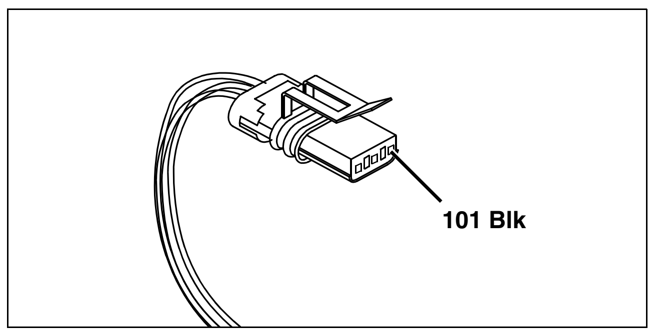


MIF

(2) Right reel motor control module connector (X88) connected. Measure voltage at reel motor speed control connector (X86) - wire 200 red. Is voltage in the range of 4.75-5.25 volts?

Yes - Go to step (3).

No - Check wire 200 red and connections between reel motor speed control connector and right reel motor control module connector.



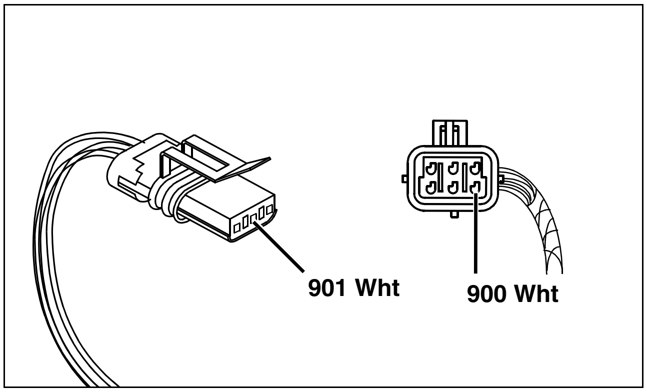
MIF

(3) Key switch in STOP position. Measure resistance between ground and reel motor speed control connector (X86) - wire 101 blk. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check wire 101 blk and connections.

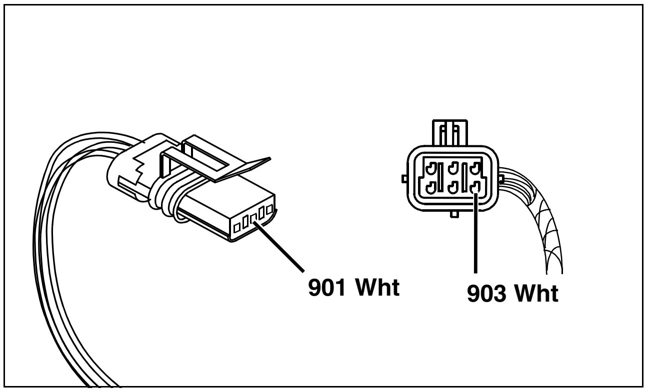
System: Reel Motor Speed Control Circuit



(4) Right reel motor control module connector (X88) disconnected. Reel motor speed control connector (X86) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and right reel motor control module connector (X88) - 900 wht. Is resistance less than 0.1 ohm?

Yes - Go to step (5).

No - Check wires 901 and 900 wht and connections.

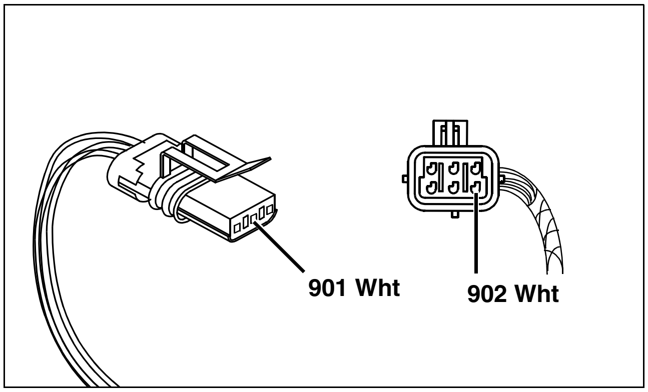


(5) Left reel motor control module connector (X89) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and left reel motor control module connector (X89) - 903 wht. Is resistance less than 0.1 ohm?

Yes - Go to step (6).

No - Check wires 901 and 903 wht and connections.

System: Reel Motor Speed Control Circuit



(6) Center reel motor control module connector (X83) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and center reel motor control module connector (X83) - 902 wht. Is resistance less than 0.1 ohm?

Yes - Test reel motor speed control. (See “Test Reel Motor Speed Control - Model 2500E” on page 561.)

No - Check wires 901 and 902 wht and connections.

Reel Motor Control Module Diagnosis

The following circuits must be tested before replacing a reel motor control module:

- Mow input circuits. (See “Cutting Unit - Mow/Backlap Circuit Diagnosis - Model 2500E” on page 407.)
- Mow output circuit. (See “Mow Circuit Test” on page 412.)
- 48 volt alternator. (See “48 Volt Alternator Circuit Diagnosis” on page 413.)

Reel motors can be tested by connecting the suspected failed motor to a known operating reel motor control module. This also will indicate a failed motor control module; if a suspected failed motor is moved to known operating reel motor control module and begins to operate, then the reel motor control module that was connected to the motor is the failed component. If the reel motor continues to fail, then the motor is the failed component. (See “Test Reel Motor - Model 2500E” on page 562.)

Lighting Circuit Operation

Function

To provide power to the headlights and rear grass catcher to illuminate the work area.

Operating Conditions

- Key switch in the RUN position
- Headlight switch in the ON position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the headlight circuit with a fusible link (F1). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (rust wire No. 032 [fusible link] and red wires No. 002, 022 [W1] and 022 [W3]).

Current is also supplied to the headlight relay (K2) directly from the battery and is protected by a fusible link (F4). Current flows from the battery positive terminal to the fusible link to terminal 87 of the headlight relay (rust wire No. 122 [fusible link] and red wire No. 102).

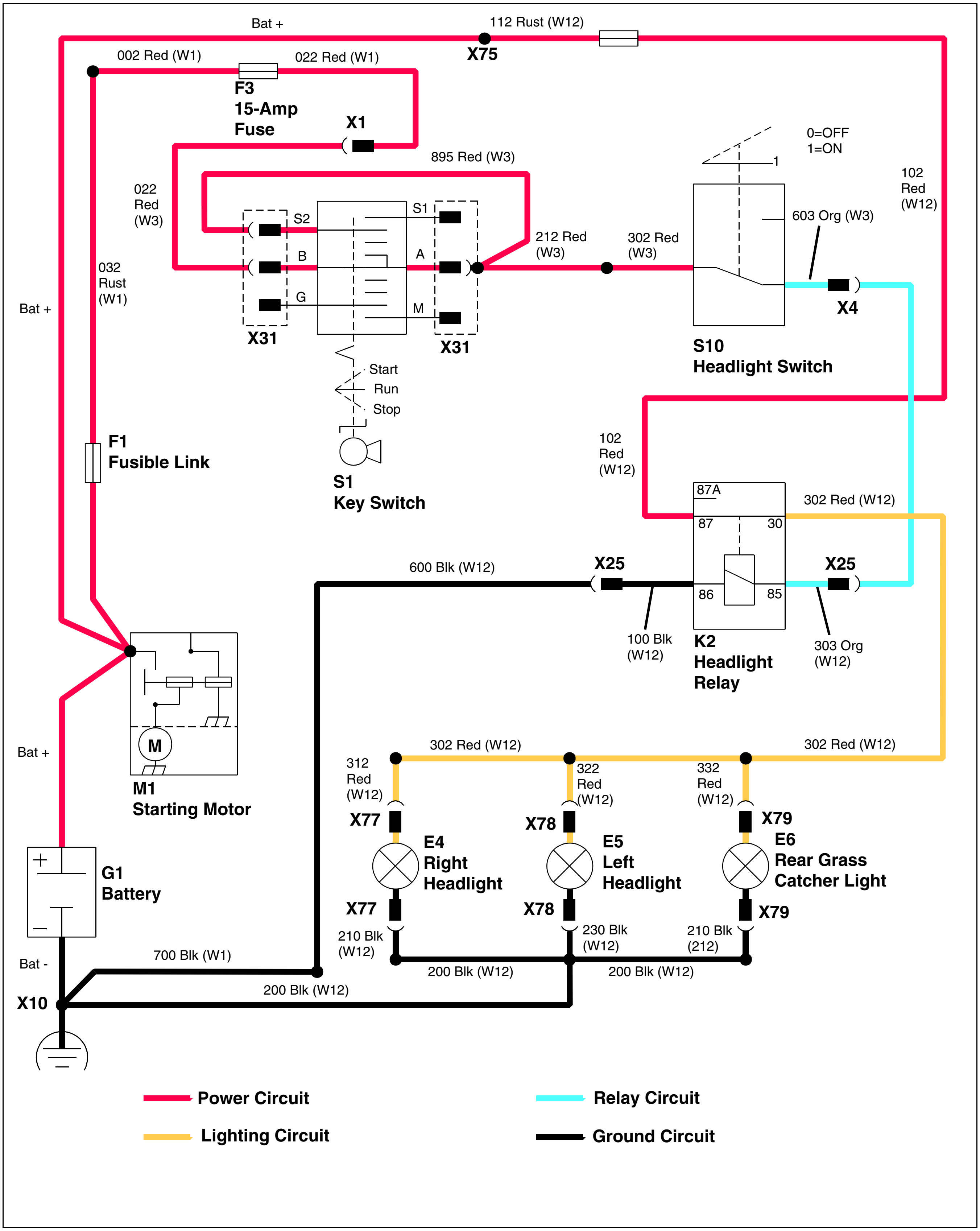
With the key switch in the RUN position, current flows to the headlight switch (S10) (red wires No. 212 [W1] and 302 [W3]).

With the headlight switch in the ON position, current flows to terminal 85 of the headlight relay (orange wires No. 603 [W3], 603 [W1] and 603 [W12]). A path to ground (black wires 100 [W12] 600 [W1] and 700 [W1]) completes the circuit, energizing the relay.

With the relay energized, current flows from relay terminal 87 to 30 and to the right headlight (E4) (red wires No. 302 and 312 [W12]), left headlight (E5) (red wires No. 302 and 322 [W12]) and rear grass catcher light (E6) (red wires No. 302 and 332 [W12]) to illuminate the lamps.

The ground circuit (black wires No. 210 [right headlight], 230 [left headlight], 220 [rear grass catcher light], 200 and 700) provides a path to ground for the headlights.

Lighting Circuit



M98631 (MIF)

Lighting Circuit Diagnosis

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

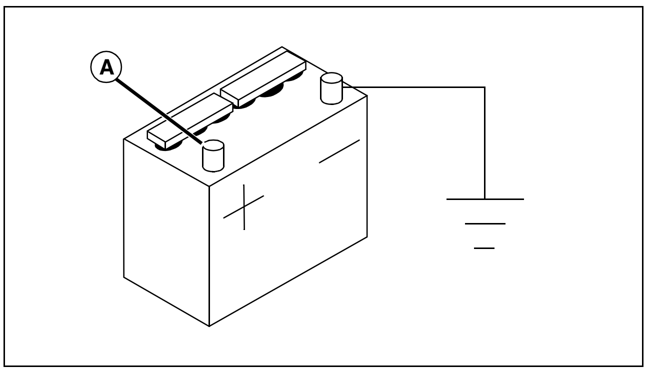
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Lighting Circuit



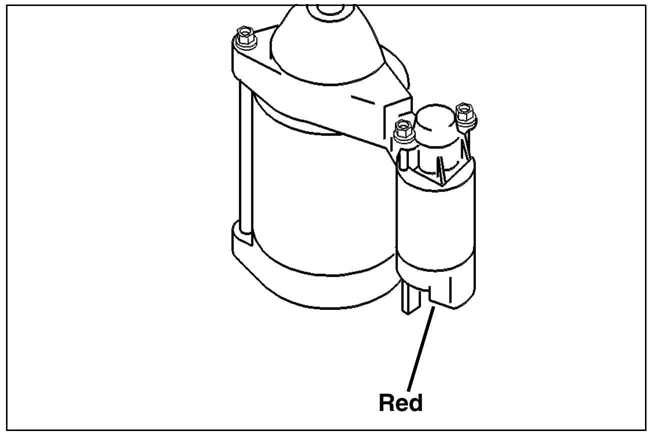
MIF

(1) Check battery voltage at positive (+) post (A). Does volt meter read 11.8-13.2 volts?

Yes - Go to step (2).

No - Check battery condition. (See “Test Battery” on page 541.)

System: Lighting Circuit

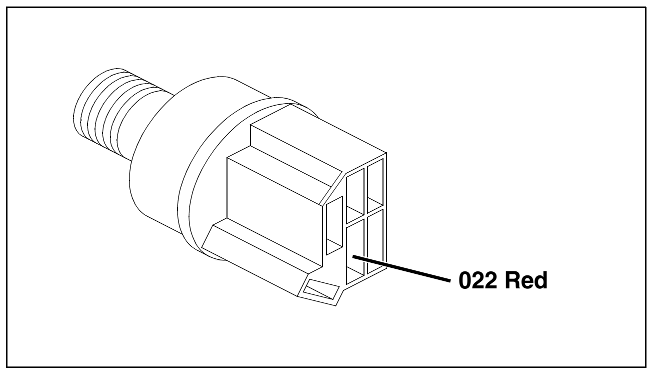


MIF

(2) Check voltage at starting motor solenoid battery terminal, red wire. Does volt meter indicate battery voltage?[1]

Yes - Go to step (3).

No - Check battery cables and clamps. Clean and tighten connections.



MIF

(3) Check voltage at key switch (S1) connector (X31), terminal B, wire 022 red. Is battery voltage/ test light on?

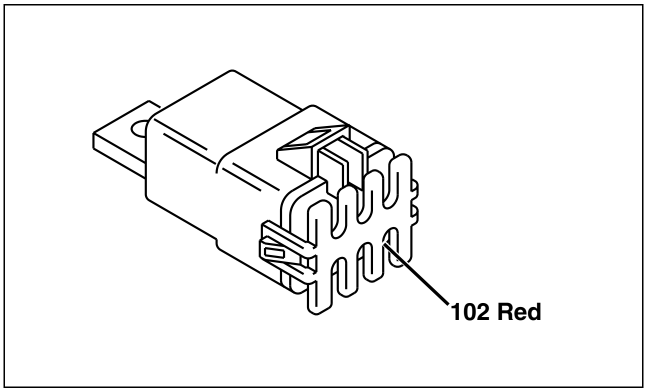
Yes - Go to step (4).

No - Test red wires No. 022 (W3) and 022 (W1) and connections.

No - Test fuse (F3). (See “Test Fuse” on page 549.)

No - Test fuse link (F1) (rust wire No. 032).

System: Lighting Circuit



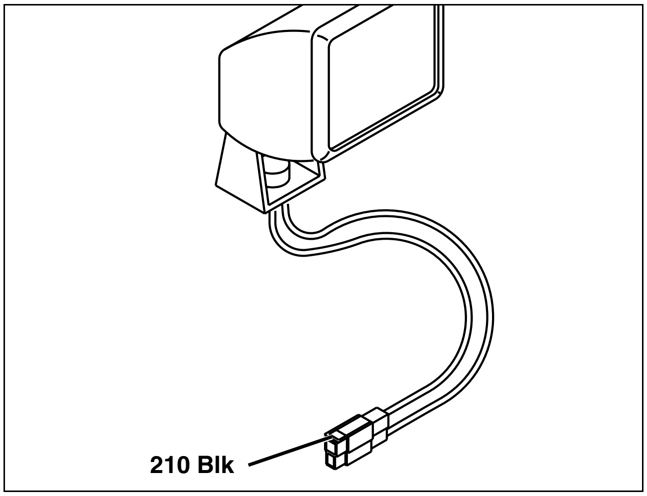
MIF

(4) Check voltage at headlight relay (K2) connector (X69), terminal 87, wire 102 red. Is battery voltage/ test light on?

Yes - Go to step (5).

No - Test red wire No. 102 (W12) and connections.

No - Test fusible link (F4) (rust wire No. 112).



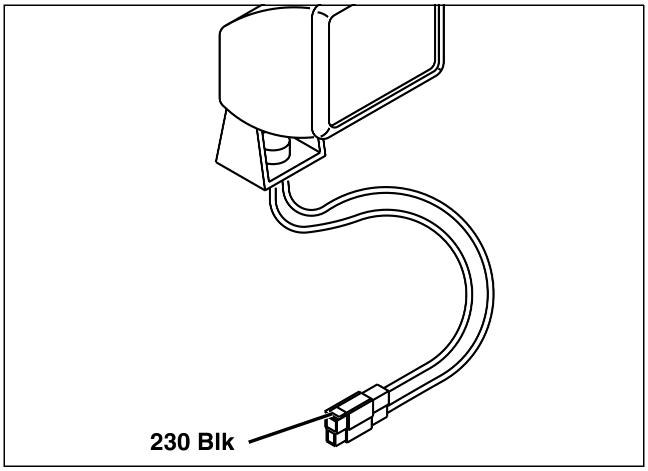
MIF

(5) Check resistance at right headlight (E4)connector (X77), wire 210 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (6).

No - Test black wires No. 210 (W12) and 200 (W12) and connections.

System: Lighting Circuit

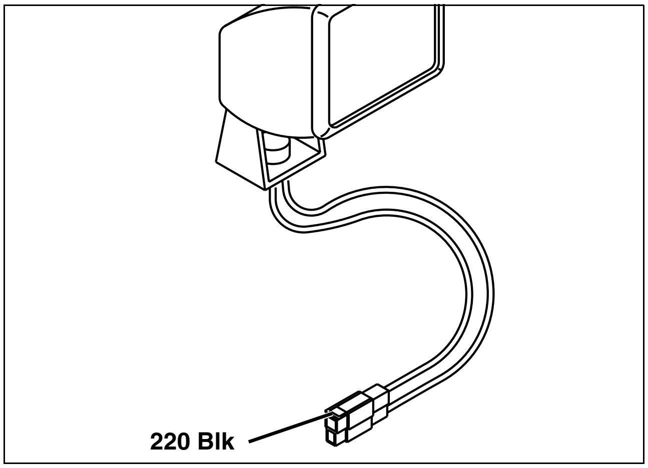


MIF

(6) Check resistance at left headlight (E5) connector (X78), wire 230 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (7).

No - Test black wires No. 220 (W12) and 200 (W12) and connections.



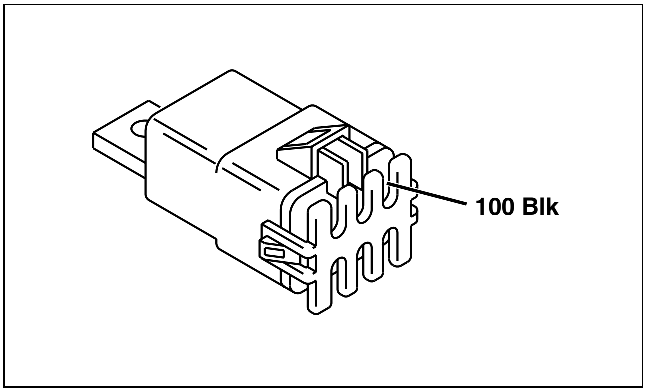
MIF

(7) Check resistance at rear grass catcher light (E6) connector (X79), wire 220 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (8).

No - Test black wires No. 230 (W12) and 200 (W12) and connections.

System: Lighting Circuit

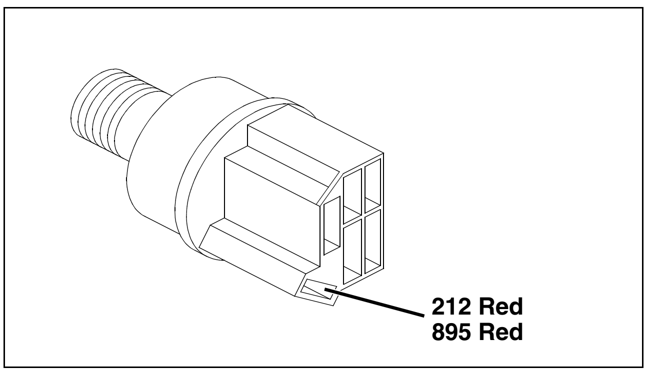


MIF

(8) Check resistance at headlight relay (K2) connector (X74), terminal 86, wire 100 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (9).

No - Test black wires No. 100 (W12), 600 (W1) and 700 (W1) and connections.



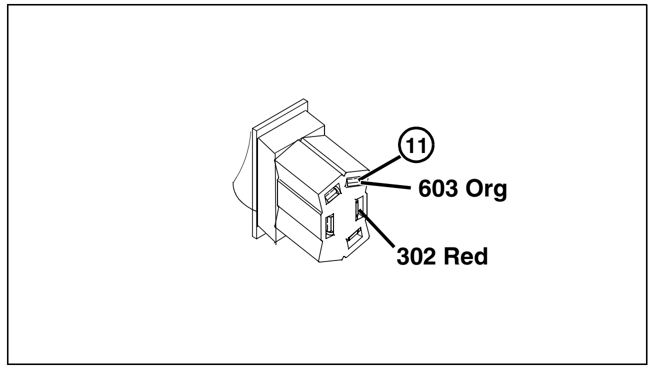
MIF

(9) Key switch in RUN position.
Check voltage at key switch (S1) connector (X31), terminal A. Is battery voltage/test light on?

Yes - Go to step (10).

No - Test key switch. (See "Test Key Switch" on page 551.)

System: Lighting Circuit



MIF

(10) Check voltage at headlight switch (S10) connector (X37), wire 302 red. Is battery voltage/ test light on?

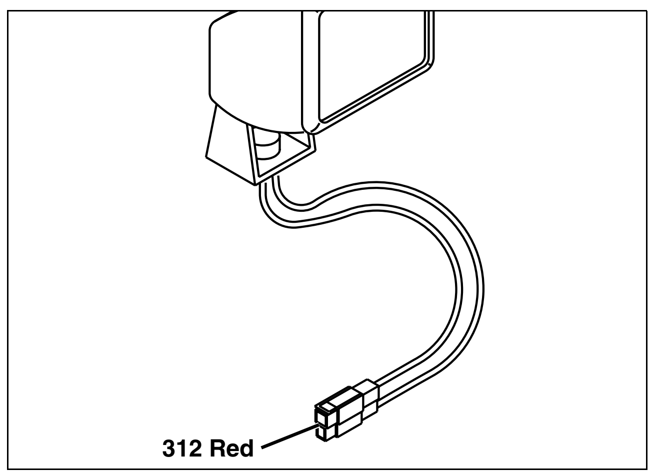
Yes - Go to step (11).

No - Test red wires No. 212 (W3) and 302 (W3) and connections.

(11) Headlight switch in ON position.
Check voltage at headlight switch (S10) connector (X37), wire 603 orange. Is battery voltage/test light on?

Yes - Go to step (12).

No - Test headlight switch. (See "Test Headlight Switch (Optional)" on page 559.)



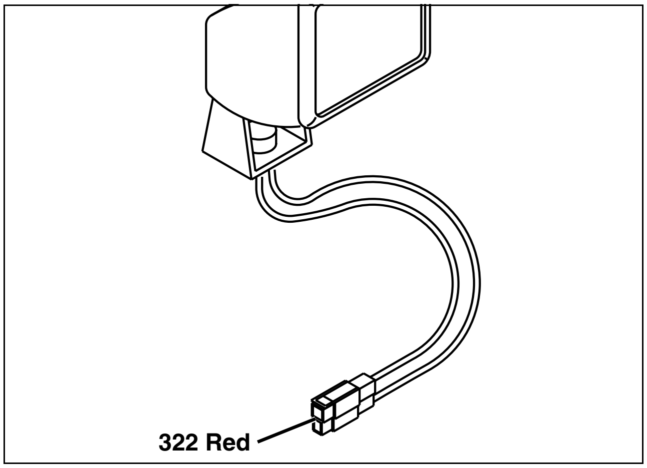
MIF

(12) Check voltage at right headlight (E4) connector (X77), wire 312 red. Is battery voltage/ test light on?

Yes - Go to step (13).

No - Test red wires No. 312 (W12) and 302 (W12) and connections.

System: Lighting Circuit

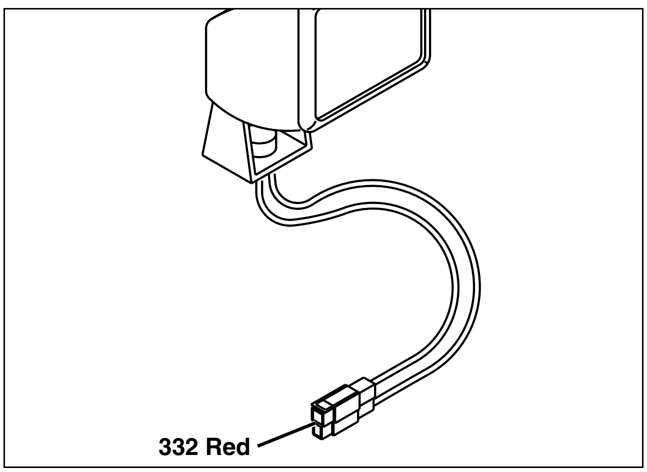


MIF

(13) Check voltage at left headlight (E5) connector (X78), wire 322 red. Is battery voltage/test light on?

Yes - Go to step (14).

No - Test red wires No. 322 (W12) and 302 (W12) and connections.



MIF

(14) Check voltage at rear grass catcher light (E6) - Connector X79, wire 332 red. Is battery voltage/test light on?

No - Test red wire No. 332 (W12) and 302 (W12) and connections.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

2. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Operation and Diagnostics - Diesel Engine

Diagnostic Codes

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed for additional codes.

Code 1-2

One pulse followed by a short pause, followed by two pulses; Indicates that the park brake switch is not activated. Engage park brake and repeat check procedure.

If the code continues to flash after the brake has been set; Perform INPUT CIRCUIT LIGHT CHECK - Brake Switch Input.

Code 1-3

One pulse followed by a short pause, followed by three pulses; Indicates that the mow switch is activated. Move mow/transport lever to TRANSPORT position and repeat check procedure.

If the code continues to flash after the mow/transport lever has been moved to the TRANSPORT position; Perform INPUT CIRCUIT LIGHT CHECK - Mow/Transport Switch Input.

Code 2-2

Two pulses followed by a short pause, followed by two pulses; Indicates that the mow/backlap valve is in BACKLAP position. Move mow/backlap valve to MOW position and repeat check procedure.

If the code continues to flash after the mow/backlap valve has been moved to the MOW position; Perform INPUT CIRCUIT LIGHT CHECK - Backlap Switch Input.

Code 3-1

Three pulses followed by a short pause, followed by another pulse; Indicates an over-voltage condition (voltage input to control box over 18 volts). (See “Charging Circuit Diagnosis” on page 463.)

NOTE: *When the following codes are displayed, no output indicator lights will be lit.*

Circuits connected to the “Output” connector of the electronic control module operate by switching the ground side of the circuit.

Code 3-2

Three pulses followed by a short pause, followed by two pulses; Indicates a wiring harness failure. Proceed to Control Module Check procedure.

Code 3-3

Three pulses followed by a short pause, followed by three pulses; Indicates an output short to positive 12 volt condition on the components of one (or more) of the following circuits:

- Lift and Lower Valve Circuit
- Cranking Circuit
- Discharge Light Circuit
- Glow Plug Circuit (Diesel)
- Mow Circuit

See individual circuit diagnosis for diagnostic procedures.

Code 3-4

Three pulses followed by a short pause, followed by four pulses; Indicates a fuel solenoid circuit failure.

Code 3-5

Three pulses followed by a short pause, followed by five pulses; Indicates fuel hold internal checking failure on circuit board, or fuel hold output miswired to +12 volts.

Code 3-6

Three pulses followed by a short pause, followed by six pulses; Indicates a faulty power or ground connection to the control board.

Code 3-7

Three pulses followed by a short pause, followed by seven pulses; Indicates a faulty power or ground connection to the control board.

Code 3-8

Three pulses followed by a short pause, followed by eight pulses; Indicates a faulty power or ground connection to the control board.

- If there is no response to the key switch and no codes indicated as described above, proceed to the ELECTRONIC CONTROL MODULE CHECK.

Power Circuit Operation - Unswitched

Function

Provides power to the primary circuit whenever the battery is connected.

Operating Conditions

- Key switch in STOP position.

Theory of Operation

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

- Battery (G1) positive (+) terminal.
- Battery terminal of starting motor solenoid.
- Battery terminal of key switch (S1).
- Terminal 30 of starting motor relay (K1).
- Terminal 30 of glow plug relay (K3).
- Terminal 87 of headlight relay (K2).
- Battery terminal of voltage regulator/rectifier (N1).

The positive (+) battery cable connects the battery to the starting motor solenoid. The starting motor solenoid connection is used as a tie point for the rest of the electrical system.

The battery cables and the starting motor solenoid connections must be in good condition for the electrical system to function properly.

The ground cable connections are equally as important as the positive (+) cable. Starting motor operation depends on these cables and connections to carry the high current necessary for its operation.

The connection between the starting motor (M1) and key switch (S1) and starting motor relay (K1) and battery (G1) are protected by the fusible links (F1) and (F5). These links are short lengths of wire which are designed to protect the main wiring harness and will fail if current load becomes excessive or if a short circuit occurs.

Power Circuit Operation - Switched

Function

Provides power to components by means of a key switch.

Operating Conditions

- Key switch in RUN position.

Theory of Operation

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

- All unswitched locations.
- Terminal A of key switch (S1).
- Terminal S2 of key switch (S1).
- Voltage regulator/rectifier (N1).
- Glow plug light (H1).
- Terminal D of connector X8 of electronic control module (A3).
- Brake switch (S2).
- Seat switch (S3).
- Mow valve solenoid (Y2).
- Backlap switch (S4).
- Mow/transport switch (S5).
- Raise switch (console) (S6).
- Raise switch (floor) (S7).
- Raise valve solenoid (Y3).
- Lower switch (console) (S8).
- Lower switch (floor) (S9).
- Lower valve solenoid (Y4).
- Leak detection system connector (X13).
- Terminal 3 of warning indicator module (E3).

These circuits are controlled by the key switch and are protected by the fusible link (F1) and 15-amp main power fuse (F3).

Operating Conditions

- Key switch in START position.

Theory of Operation

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

- Terminal 85 of starting motor relay (K1).
- Terminal E of connector X9 of electronic control module (A3).
- Terminal 87 of pull-in coil relay (K4).

Power Circuit Operation - Switched - Optional Equipment

Function

Provides power to optional components by means of a key switch.

Operating Conditions

- Key switch in RUN position.

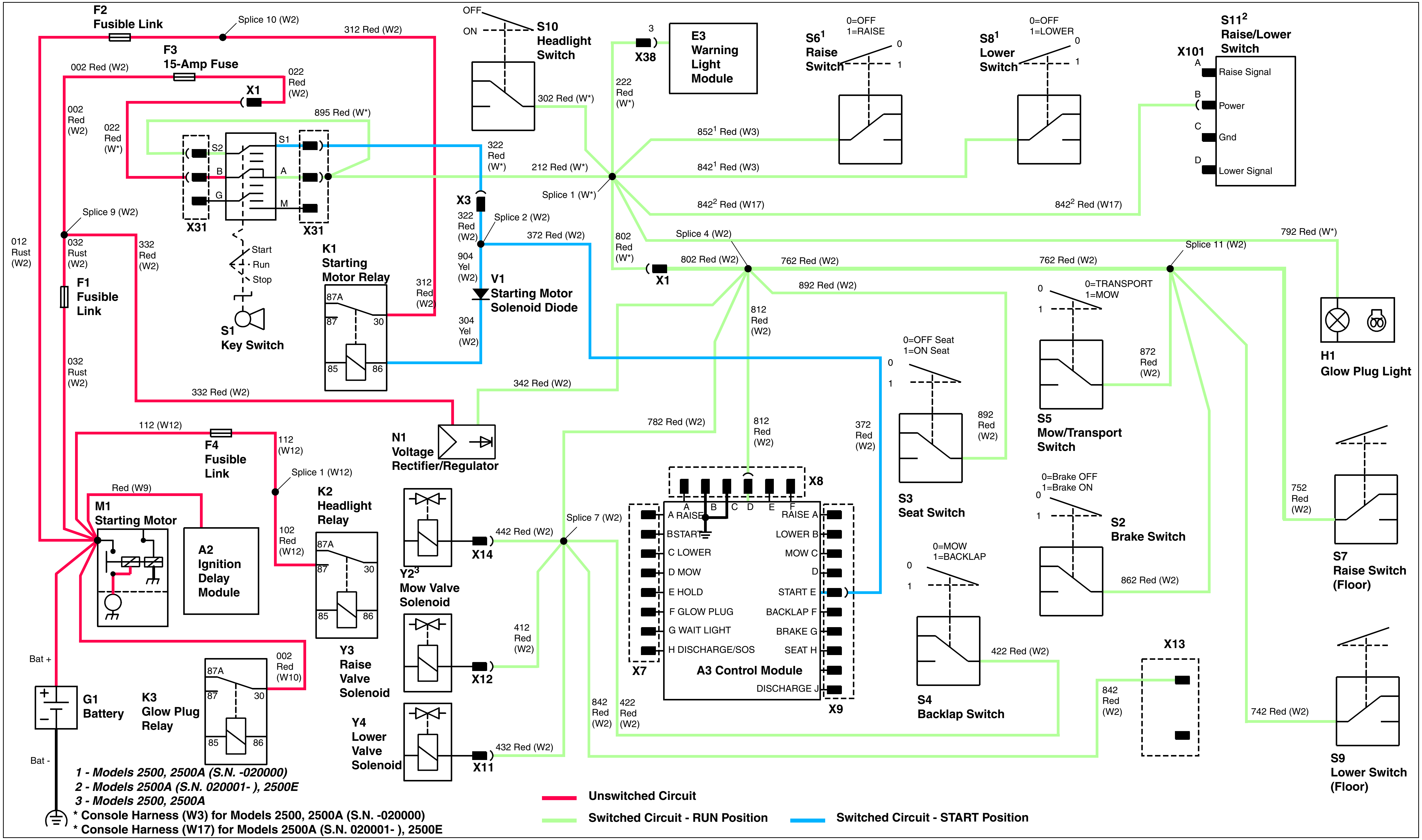
Theory of Operation

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

- All standard equipment unswitched and switched locations.
- Common terminal of headlight switch (S10).

These circuits are controlled by the key switch and are protected by the fusible link (F1) and 20-amp main power fuse (F2).

Power Circuit



1 - Models 2500, 2500A (S.N. -020000)
2 - Models 2500A (S.N. 020001-), 2500E
3 - Models 2500, 2500A
*** Console Harness (W3) for Models 2500, 2500A (S.N. -020000)**
*** Console Harness (W17) for Models 2500A (S.N. 020001-), 2500E**

MX20861

Power Circuit Diagnosis - Unswitched

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

NOTE: Although current is supplied to many components, the power circuit diagnosis will be limited to components not directly controlled by the electronic control module. Diagnosis for these components will be covered in the individual circuits where they apply.

A test light is preferred method for testing circuits.

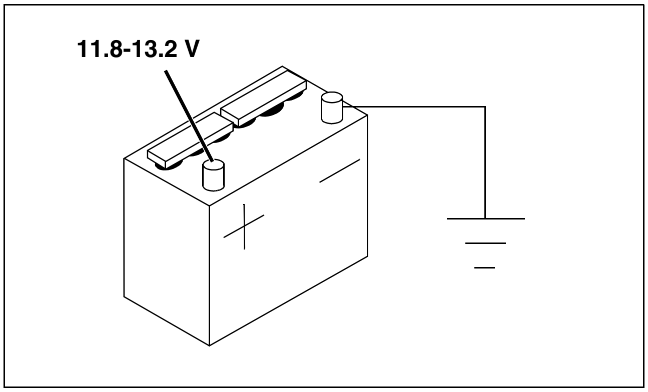
Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Unswitched Power Circuit

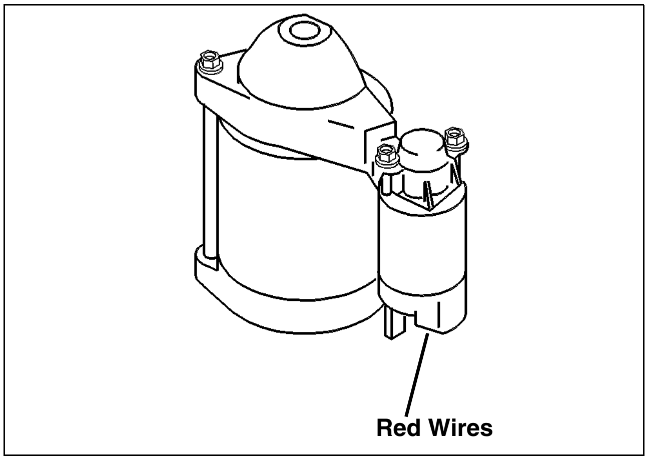


MIF

(1) Measure voltage at battery positive (+) post. Is voltage in the range 11.8-13.2 V?

Yes - Go to step (2).

No - Check battery condition. (See “Test Battery” on page 541.)



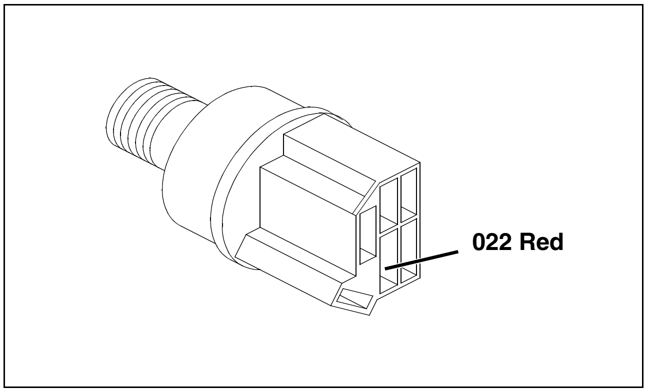
MIF

(2) Measure voltage at starting motor solenoid - red wires. Is battery voltage present?[1]

Yes - Go to step (3).

No - Check battery positive (+) cable and clamps. Clean and tighten connections.

System: Unswitched Power Circuit

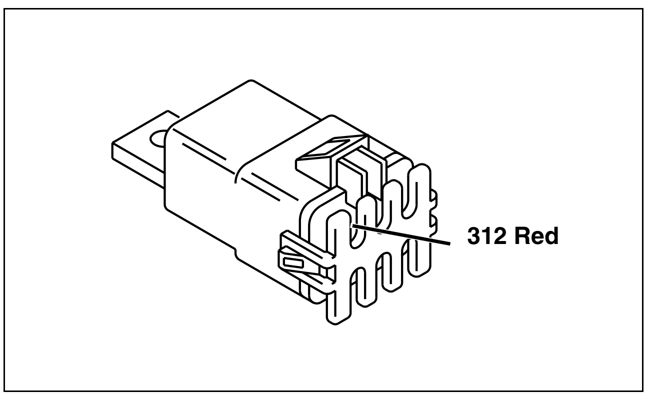


MIF

(3) Measure voltage at key switch (S1) - terminal B, wire 022 red. Is battery voltage present?

Yes - Go to step (4).

No - Test wires 002, 022 red (W3) and 022 red (W2). Test key switch fuse (F3). Test fusible link (F1) wire 032 rust (W2) and connections.



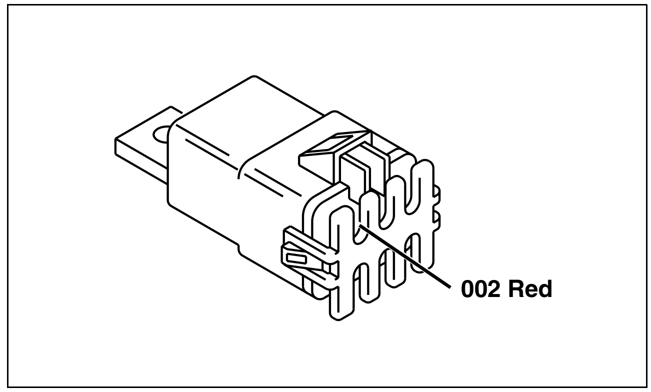
MIF

(4) [2]Measure voltage at starting motor relay (K1) - terminal 30, wire 312 red. Is battery voltage present?

Yes - Go to step (5).

No - Test wires 012 rust (W10) and 312 red (W10) and connections. Test fusible link (F2).

System: Unswitched Power Circuit

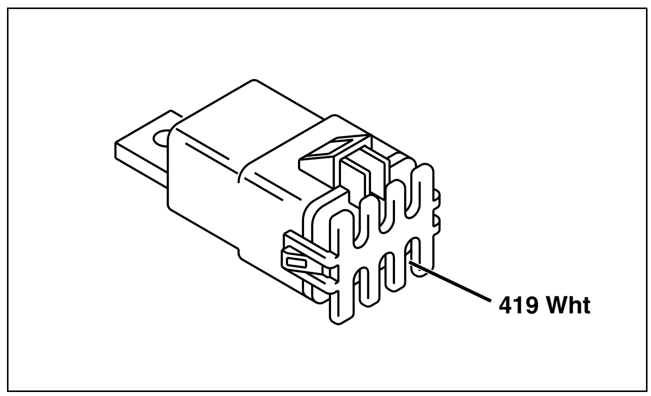


MIF

(5) [2]Measure voltage at glow plug relay (K3) connector (X62), terminal 30, wire 002 red. Is battery voltage present?

Yes - Go to step (6).

No - Test red wire No. 002 (W10) and connections.



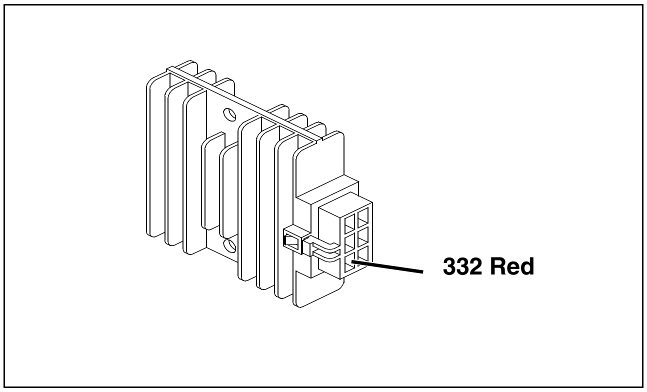
MIF

(6) [2]Measure voltage at pull-in coil relay (K4) connector (X64), terminal 87, wire 419 white. Is battery voltage present?

Yes - Go to step (7).

No - Test white wire No. 419 (W10) and connections.

System: Unswitched Power Circuit

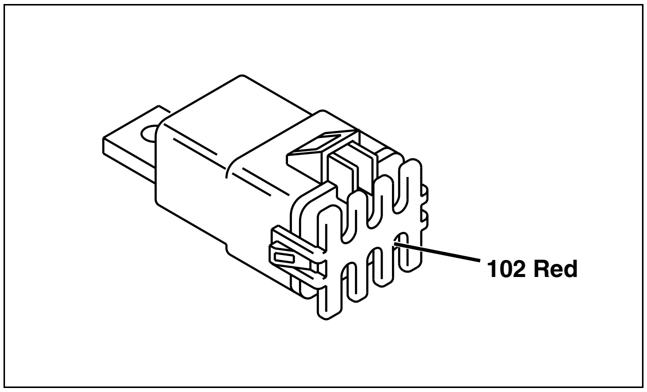


MIF

(7) Measure voltage at voltage regulator/rectifier (N1) connector (X28), terminal 1, wire 332 red. Is battery voltage present?

Yes - Go to step (8).

No - Test fusible link (F1) wire 032 rust (W2) and wire 332 red (W1) and connections



MIF

(8) [2]Measure voltage at optional headlight relay (K2) connector (X74), terminal 87, wire 102 red. Is battery voltage present?

No - Test wire 102 red (W12) and fusible link (F4) - wire 112 rust (W12) and connections.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

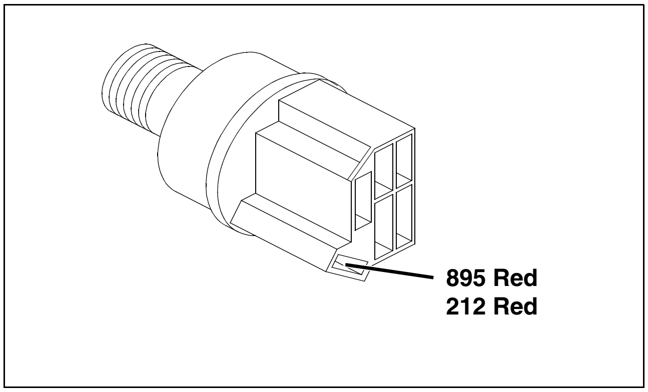
2. When checking voltages and/or resistance at relay terminals, it may be necessary to disconnect the relay connector and perform the test at the open terminal. Reconnect the relay connector after performing the check.

Power Circuit Diagnosis - Switched

Test Conditions:

- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X8) disconnected.

System: Switched Power Circuit

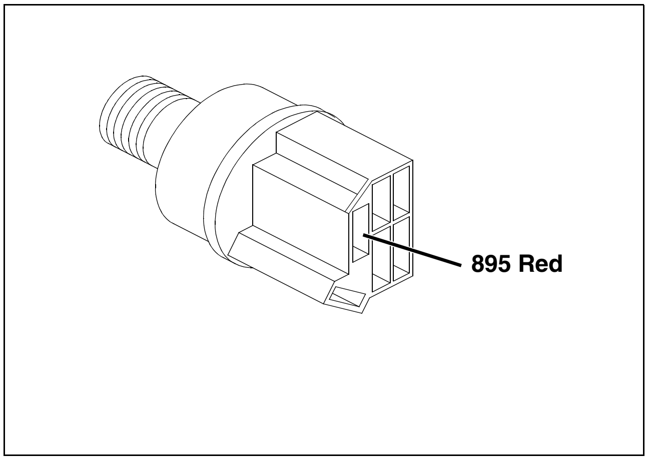


MIF

(1) Measure voltage at key switch (S1) - terminal A, wires 895 and 212 red. Is voltage in the range 11.8-13.2 V?

Yes - Go to step (2).

No - Test key switch. (See “Test Key Switch” on page 551.)



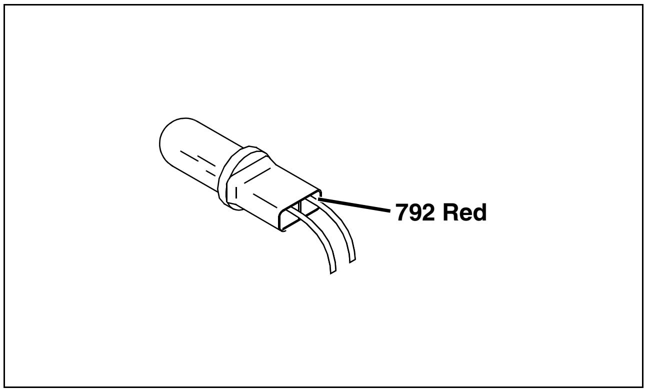
MIF

(2) Measure voltage at key switch (S1) - terminal S2, wire 895 red. Is battery voltage present?

Yes - Go to step (3).

No - Test wire 895 red (W3) and connections.

System: Switched Power Circuit

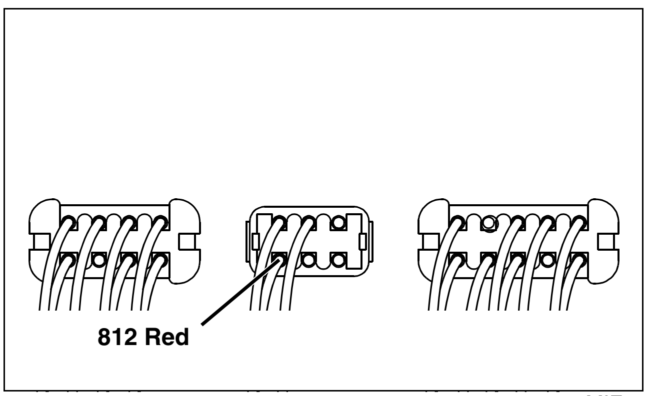


MIF

(3) Measure voltage at glow plug lamp (H1) connector (X32), wire 792 red. Is battery voltage present?

Yes - Go to step (4).

No - Test red wires No. 792 (W3) and 212 (W3) and connections.



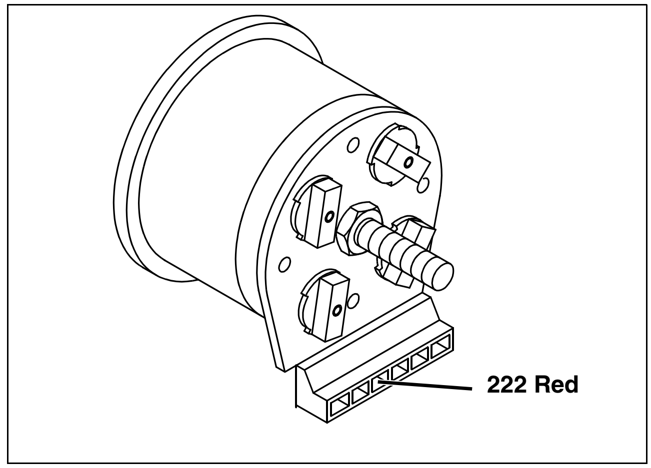
MIF

(4) Measure voltage at electronic control module connector (X8) - terminal D, wire 812 red. Is battery voltage present?

Yes - Go to step (5).

No - Test wires 812 and 802 red (W2) and wires 802 and 212 red (W3) and connections.

System: Switched Power Circuit

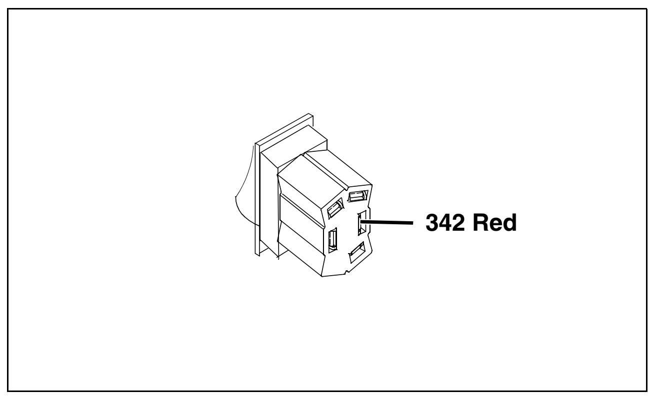


MIF

(5) Measure voltage at warning light module (E3) connector (X38), wire 222 red. Is battery voltage present?

Yes - Go to step (6).

No - Test wires 222 and 212 red (W3) and connections.



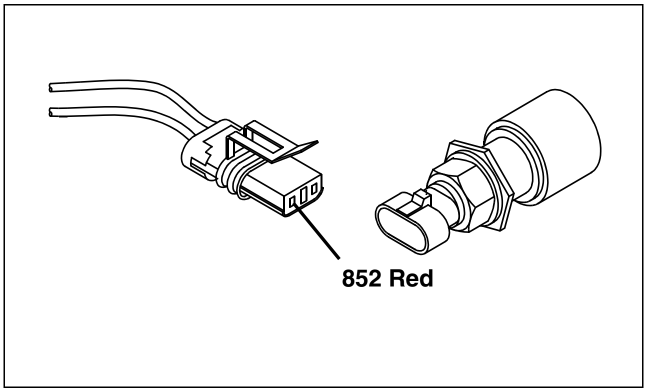
MIF

(6) Measure voltage at optional headlight switch (S10) connector (X37), wire 302 red. Is battery voltage present?

Yes - Go to step (7).

No - Test wires 302 and 212 red (W3) and connections.

System: Switched Power Circuit

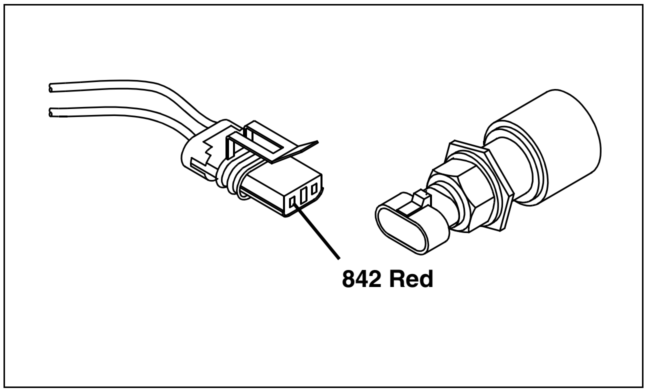


MIF

(7) Models 2500, 2500A (S.N. -020000). Measure voltage at raise switch (S61) - wire 852 red. Is battery voltage present?

Yes - Go to step (8).

No - Test wires 852 and 212 red (W3) and connections.



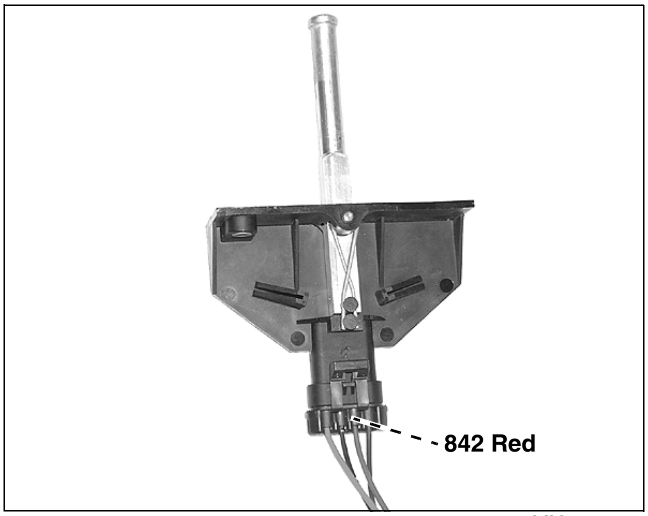
MIF

(8) Models 2500, 2500A (S.N. -020000). Measure voltage at lower switch (S8) - wire 842 red. Is battery voltage present?

Yes - Go to step (9).

No - Test wires 842 and 212 red (W3) and connections.

System: Switched Power Circuit



MX20489

(9) Models 2500A (S.N. 020001-) and 2500E. With a small diameter probe measure voltage at lift and lower switch (S11) - wire 842 red. Is battery voltage present?

No - Test wires 842 and 212 red (W17) and connections.

Cranking Circuit Operation

Function

To energize the starting motor solenoid and engage the starting motor.

Operating Conditions

To crank the engine, the following conditions must be met:

- Operator ON seat.
- Park brake ENGAGED.
- Mow/transport lever in TRANSPORT position.
- Backlap switch in MOW (OFF) position.
- Key switch in START position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cranking circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 022 [W2] and 022 [W3]), to key switch “B” terminal.

Current is also supplied to the starting motor relay (K1) directly from the battery and is protected by a fusible link (F5). Current flows from the battery positive terminal to the fuse to terminal 87 of the starting motor relay (K1) (rust wire No. 012 [W10] and red wire No. 312 [W10]).

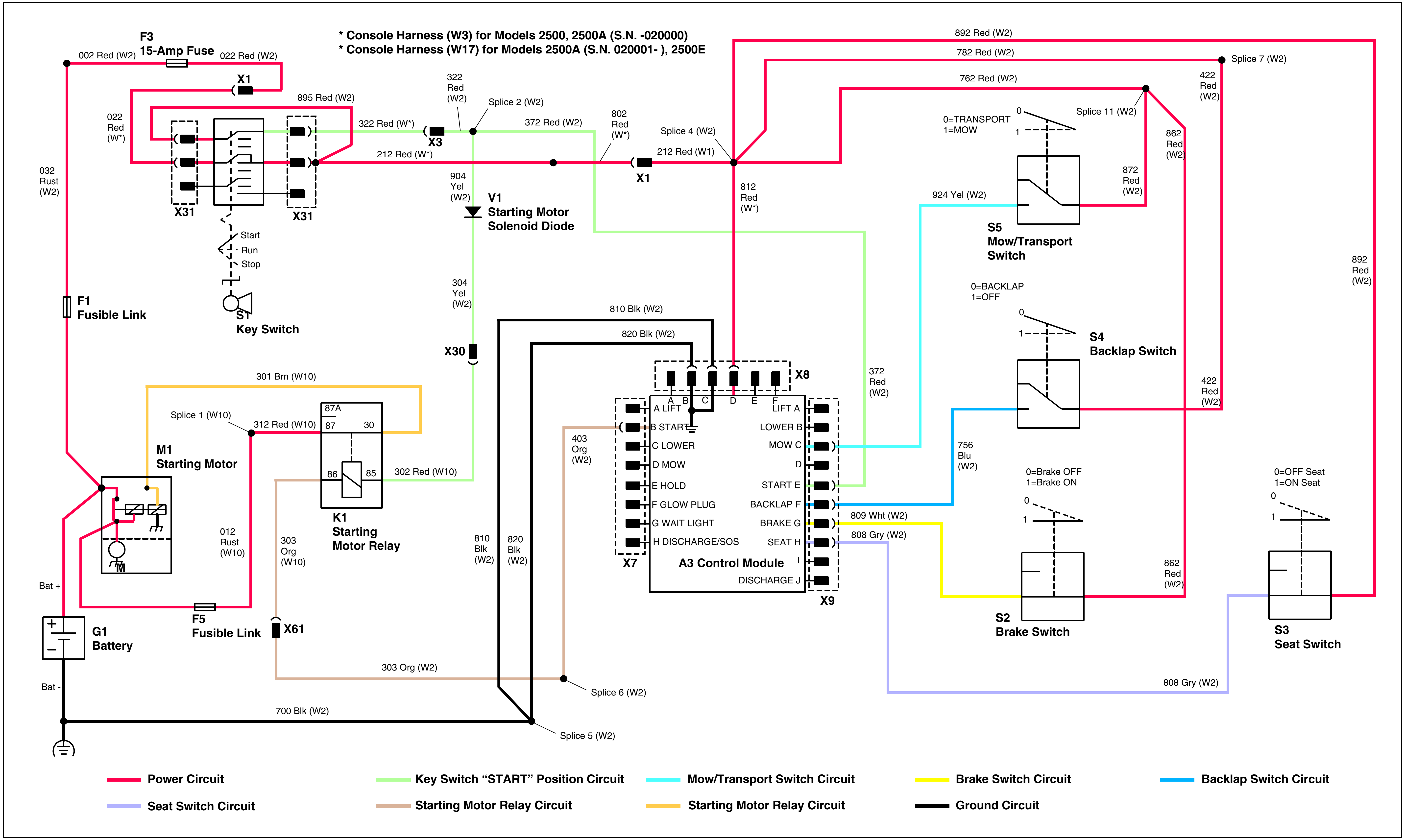
With the key switch in the START position, current flows to the glow plug light (H1) (red wires No. 792 [W3] and 212 [W3]), terminal D of connector X8 on the electronic control module (A3) (red wires No. 212 [W3], 802 [W3], 802 [W2] and 812 [W2]. Current is also supplied to the backlap switch (S4) (red wires 422 [W1], 802 [W2], 802 [W3], 212 [W3]), mow/transport switch (S5) (red wires 872 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3], brake switch (S2) (red wires 862 [W2], 762 [W2] 802 [W2] 802 [W3] and 212 [W3]) and seat switch (S3) (red wires 862 [W2] 802 [W2], 802 [W3] and 212 [W3]).

Current also flows to key switch terminal S2 (red wire No. 895 [W3]), through the switch to terminal S1, to terminal E of connector X9 on the electronic control module. Current also flows from key switch terminal S1 to the starting motor relay diode (V1) to terminal 85 of the starting motor relay.

The ground side of the starting motor relay is connected through the control module (orange wires No. 303 (W2) and 403 (W2). With the brake, mow/transport, seat and backlap switches in the correct positions to allow engine cranking (as listed in Operating Conditions), the control module completes the path to ground circuit (black wires 810 [W2], 820 [W2] and 700 [W2]) energizing the relay.

With the relay energized, current flows across terminals 30 and 87 of the relay to the starting motor solenoid, engaging the starting motor (brown wire No. 301 [W1]).

Cranking Circuit



MX20870 (MIF)

Cranking Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

Diagnostic Codes

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed for additional codes.

Code 1-2

One pulse followed by a short pause, followed by two pulses (Code 1-2); Indicates that the park brake switch is not activated. Engage park brake and repeat check procedure.

If the code continues to flash after the brake has been set; Perform INPUT CIRCUIT LIGHT CHECK - Brake Switch Input. (See “STEP 2: INPUT CIRCUIT LIGHT CHECK” on page 438.)

Code 1-3

One pulse followed by a short pause, followed by three pulses (Code 1-3); Indicates that the mow switch is activated. Move mow/transport lever to TRANSPORT position and repeat check procedure.

If the code continues to flash after the mow/transport lever has been moved to the TRANSPORT position, perform INPUT CIRCUIT LIGHT CHECK - Mow/Transport Switch Input. (See “STEP 2: INPUT CIRCUIT LIGHT CHECK” on page 438.)

Code 2-2

Two pulses followed by a short pause, followed by two pulses (Code 2-2); Indicates that the mow/backlap valve is in BACKLAP position. Move mow/backlap valve to MOW position and repeat check procedure.

If the code continues to flash after the mow/backlap valve has been moved to the MOW position, perform INPUT CIRCUIT LIGHT CHECK - Backlap Switch Input. (See “STEP 2: INPUT CIRCUIT LIGHT CHECK” on page 438.)

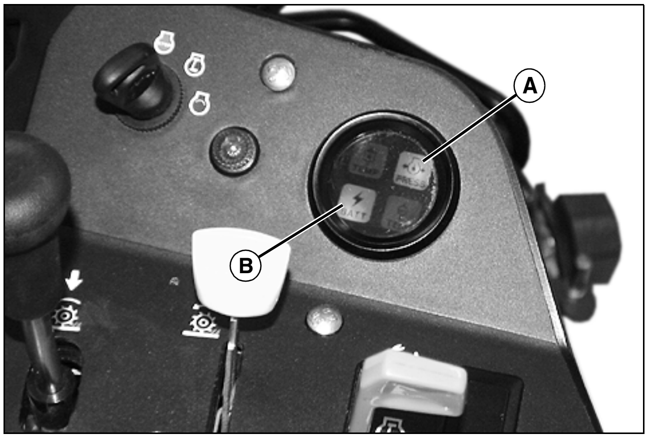
- If there is no response to the key switch and no codes indicated as described above, test electronic control module. (See “Electronic Control Module Check” on page 539.)

STEP 1: START CIRCUIT CHECK

Test Conditions:

- Mow/transport lever in TRANSPORT position.
- Park brake engaged.
- Mow/backlap valve in MOW position.

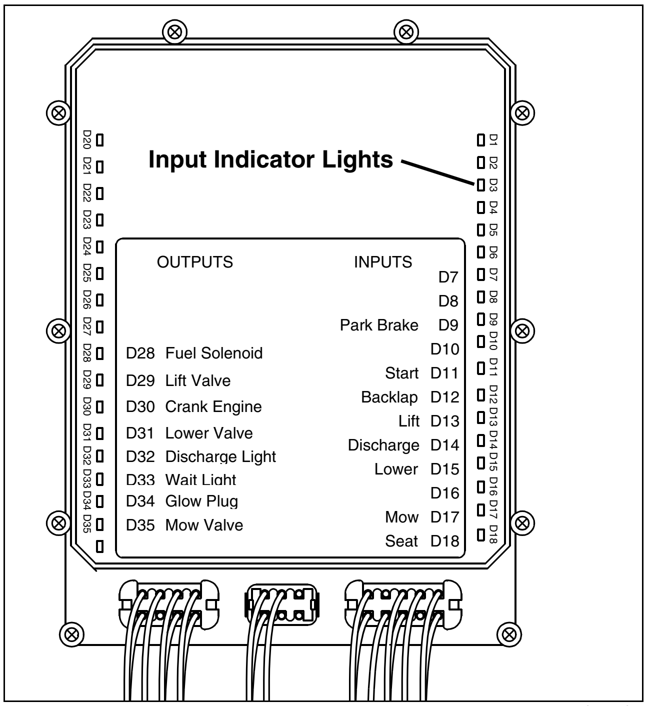
1. Turn key switch to START position.
    - The engine should crank and start.



- If the engine does not crank, the oil pressure light (A) should remain lit and the battery discharge light (B) will begin to flash, indicating a code. (See Codes.)
- If the engine does not crank, and the battery discharge light does not come on, but the oil pressure light does, check control module. (See “Electronic Control Module Check” on page 539.)
- If the engine does not crank, and the battery discharge and oil pressure light does come on, but does not flash a code, check key switch input test. (See “STEP 2: INPUT CIRCUIT LIGHT CHECK” on page 438.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire, wire 301 brown.

3. Move key switch to the START position and back to the RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

Seat Switch Input

1. Press down on the lower cushion of the seat to engage the seat switch.

2. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).

3. Release the seat switch.

4. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 439.)

Brake Switch Input

1. Depress the park brake pedal.

2. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).

3. Release the park brake pedal.

4. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON, first check brake switch adjustment. (See "Adjust Park Brake Switch" on page 729.) If brake light does not come ON after adjustment, test brake switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 439.)

Mow/Transport Switch Input

1. Move mow/transport lever to MOW position.

2. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 439.)

Backlap Switch Input

1. Move the backlap valve to the MOW position.

2. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described, test the Backlap Switch Circuit. (See "STEP 3: CIRCUIT TESTS" on page 439.)

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

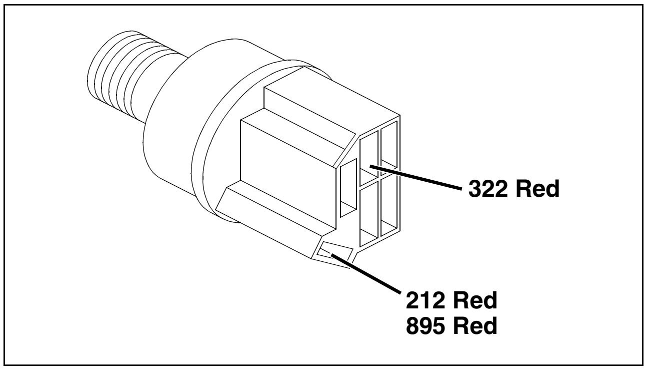
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in START position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X9) disconnected.

System: Key Switch Circuit Test



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 322 red. Is battery voltage/ test light on?

Yes - Go to step (2).

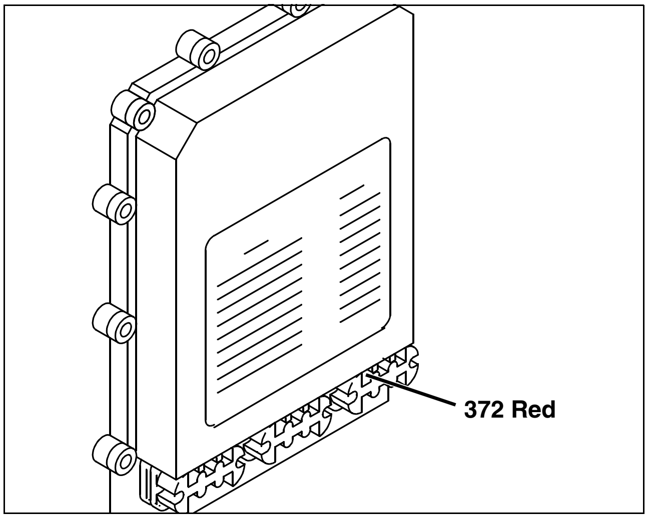
No - Test red wire No. 895 (W3) and connections.

(2) Check voltage at key switch (S1) connector (X31), terminal S1, wire 212 red. Is battery voltage/ test light on?

Yes - Go to step (3).

No - Test key switch. (See “Test Key Switch” on page 551.)

System: Key Switch Circuit Test

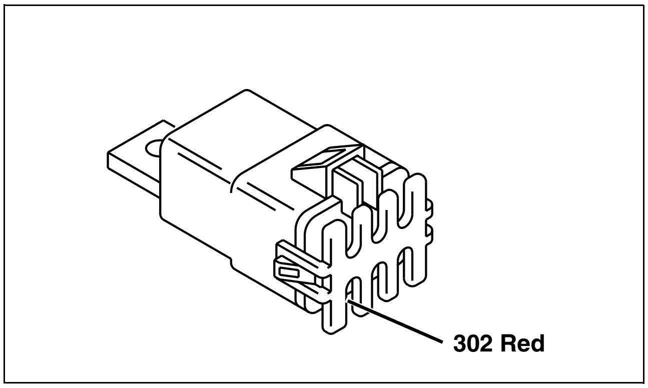


MIF

(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

Yes - Go to step (4).

No - Test red wires No. 372 (W1), 322 (W2) and 322 (W3) and connections.



MIF

(4) Check voltage at starting motor relay (K1) connector (X66), terminal 85, wire 302 red. Is battery voltage/test light on?

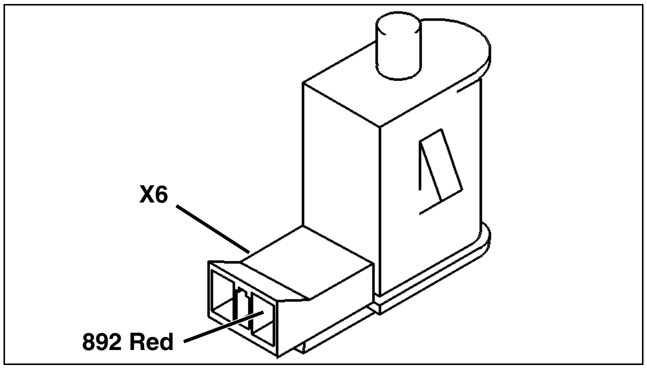
No - Test red wires No. 302 (W10), 322 (W2) and 322 (W3), yellow wires No. 304 (W2) and 904 (W2) and connections.

No - Test starting motor relay diode (V1). (See “Test Diode” on page 550.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Seat switch connector (X6) disconnected.

System: Seat Switch Circuit Test

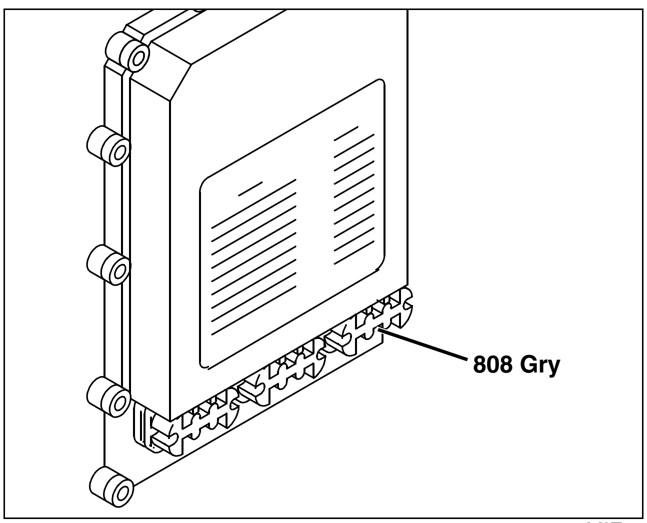


MIF

(1) Check voltage at seat switch connector (X6), wire 892 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 892 red (W2) and connections.



MIF

(2) Seat switch connector (X6) connected.
Seat switch engaged.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal H, wire 808 grey. Is battery voltage/test light on?

No - Test wire 808 gray (W2) and connections.

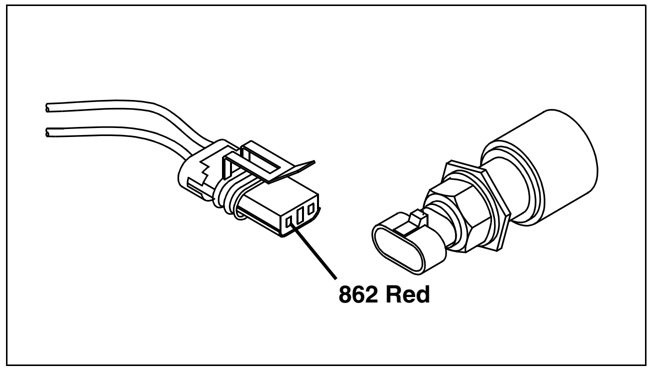
System: Seat Switch Circuit Test

No - Test seat switch. (See “Test Seat Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Brake switch connector (X18) disconnected.

System: Park Brake Switch Circuit Test



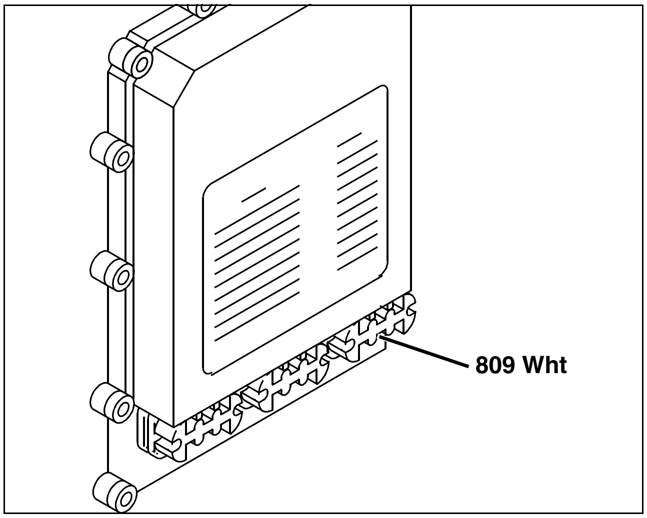
MIF

(1) Check voltage at brake switch connector (X18), wire 862 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 862 red (W2) and connections.

System: Park Brake Switch Circuit Test



MIF

(2) Park brake switch connector (X18) connected. Park brake engaged.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal G, wire 809 white. Is battery voltage/test light on?

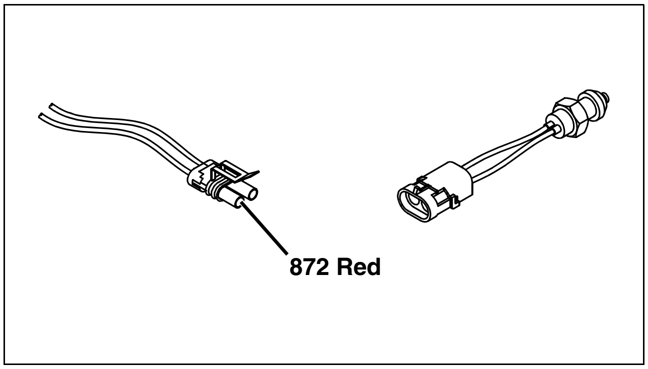
No - Test wire 809 white (W2) and connections.

No - Test park brake switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Mow/transport switch connector (X22) disconnected.

System: Mow/Transport Switch Circuit Test



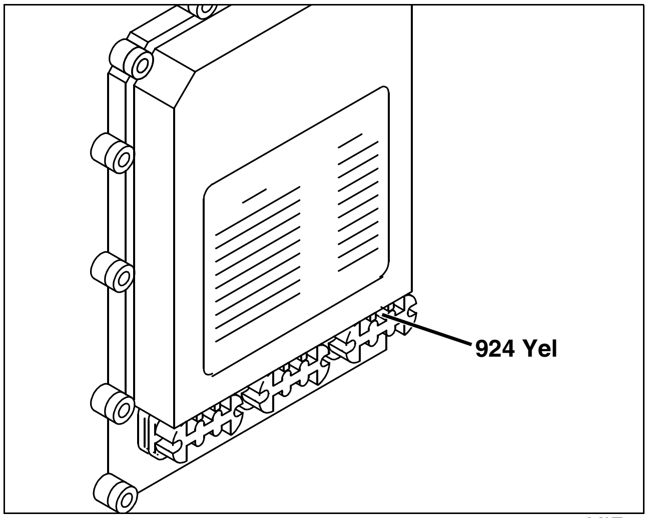
MIF

(1) Check voltage at mow/transport switch (S5) connector (X22), wire 872 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test wire 872 red (W2) and connections.

No - Third wheel assist units: Test wire 872 red (W11) and connections.



MIF

(2) Mow/transport switch connector (X22) connected.
Mow/transport lever in MOW position.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal C, wire 924 yellow. Is battery voltage/test light on?

No - Test wire 924 yellow (W1) and connections.

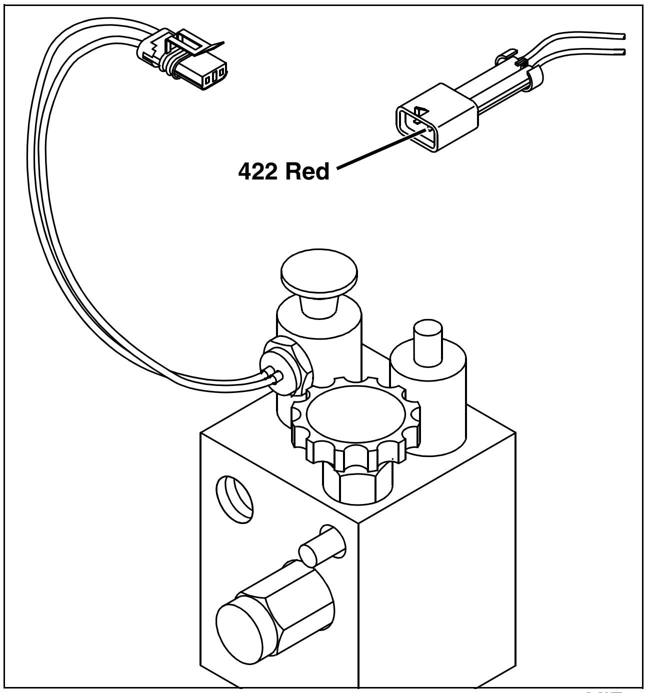
No - Third wheel assist units: Test yellow wires No. 924 (W11) and 934 (W11) and connections.

No - Test mow/transport switch. (See “Test Mow/ Transport Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Backlap switch connector (X15) disconnected.

System: Backlap Switch Circuit Test



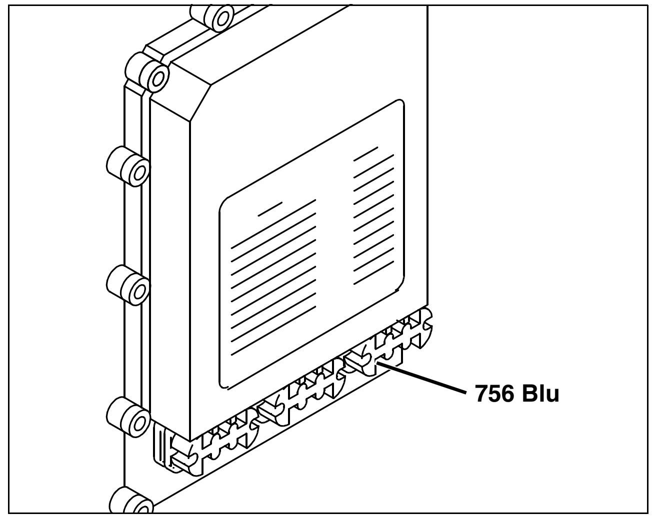
MIF

(1) Check voltage at backlap switch (S4) connector (X15), wire 422 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test red wire No. 422 (W1) and connections.

System: Backlap Switch Circuit Test



MIF

(2) Backlap switch in BACKLAP position. Backlap switch connector (X15) connected. Electronic control module - connector (X9) disconnected. Check voltage at electronic control module (A3) connector (X9), terminal F, wire 756 blue. Is battery voltage/test light on?

No - Test blue wire No. 756 (W1) and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.) (See “Test Backlap Switch - Model 2500E” on page 560.)

Glow Plug Circuit Operation

Function

To provide current to the glows plugs to preheat the engine for better starting performance.

Operating Conditions

- Key switch in the RUN position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the glow plug circuit with a fusible link (F1). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (rust wire No. 032 [fusible link] and red wires No. 002, 022 [W1] and 022 [W3]). Current is also supplied to the terminal 30 of the glow plug relay (K3).

With the key switch in the RUN position, current flows to the glow plug light (H1) (red wires No. 792 [W3] and 212 [W3]), terminal D of connector X8 on the electronic control module (A3) (red wires No. 212 [W3], 802 [W3], 802 [W2] and 812 [W2]. The ground side of the glow plug light is connected to the electronic control module (blue wires No. 006 [W10] and 896 [W2]).

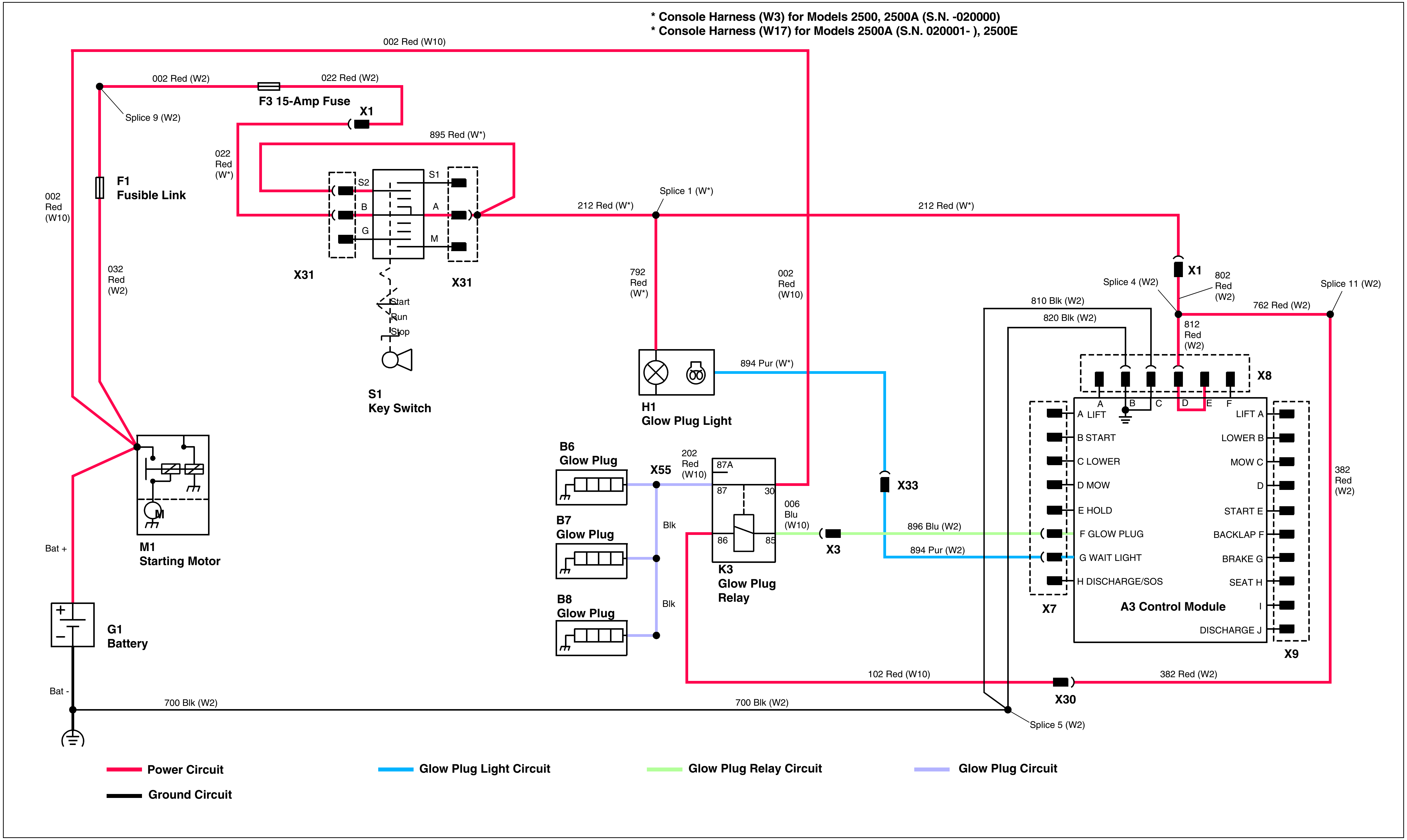
Current is also supplied to terminal 86 of the glow plug relay (red wires No. 102 [W10], 382 [W2], 762 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3]. The ground side of the glow plug relay is connected to the electronic control module (blue wires No. 006 [W10] and 896 [W2]).

The electronic control module completes the circuit for the glow plug light and glow plug relay, energizing the relay allowing current to flow to the glow plugs, warming the cylinders.

The electronic control module will hold the glow plug light on for approximately four seconds. The glow plug relay will be held on for approximately ten seconds.

A ground circuit provides a path to ground for the electronic control module (black wires No. 810 [W2], 820 [W2] and 700 [W2])

Glow Plug Circuit



MX20871 (MIF)

Glow Plug Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

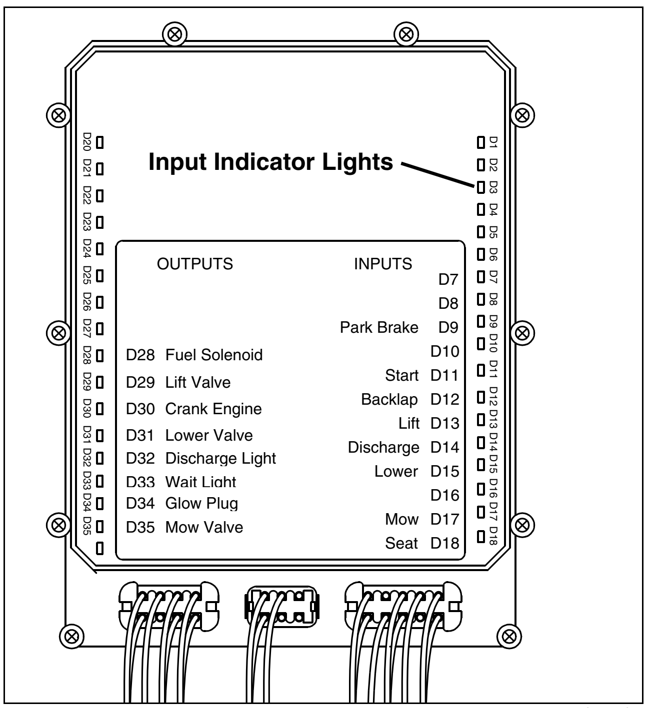
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See "Electronic Control Module Check" on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Glow Plug/Wait Light Output

1. Raise and lock seat platform.
2. Move key switch to RUN position.
3. Observe the WAIT output (D33) and GLOW PLUG output (D34) lights. The WAIT output and glow plug indicator light on the console should be ON for approximately four seconds. The GLOW PLUG output light should remain on for approximately ten seconds.

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

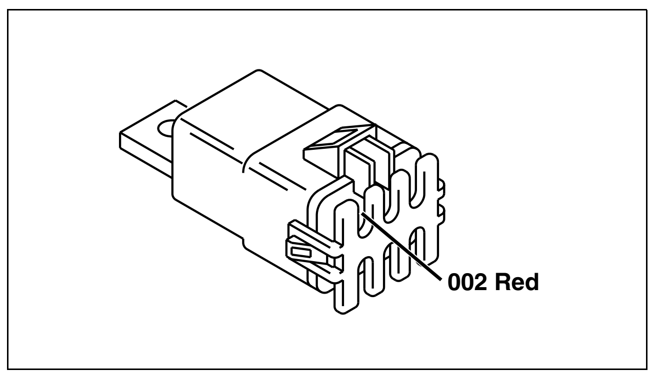
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Seat switch connector (X6) disconnected.

System: Glow Plug Circuit



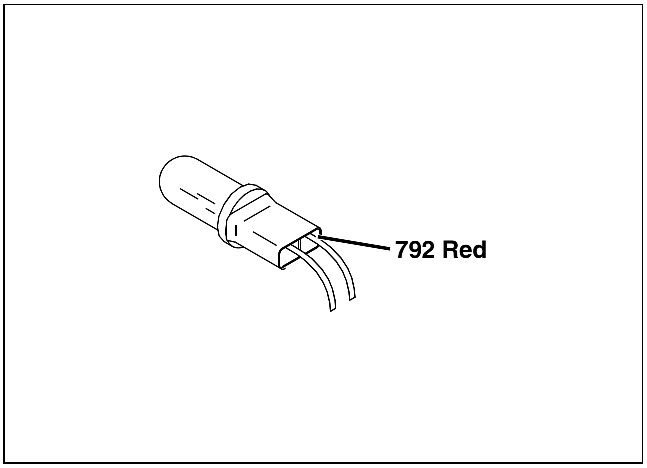
MIF

(1) Check voltage at glow plug relay (K3) connector (X62), terminal 30, wire 002 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test red wire No. 002 (W10) and connections.

System: Glow Plug Circuit

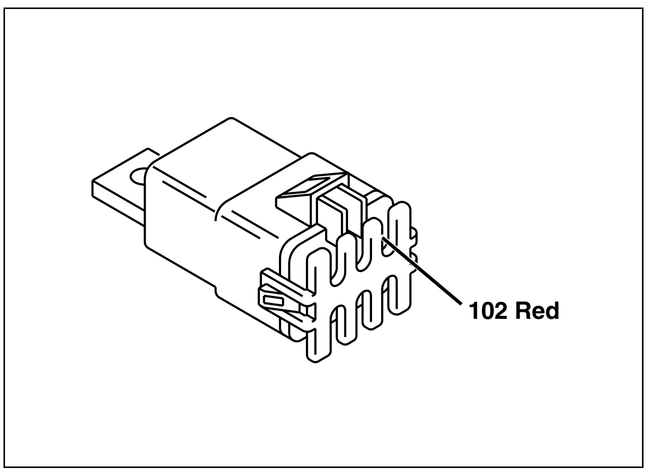


MIF

(2) Key switch in RUN position
Check voltage at glow plug light (H1) connector (X32), wire 792 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test red wires No. 792 (W3) and 212 (W3) and connections.



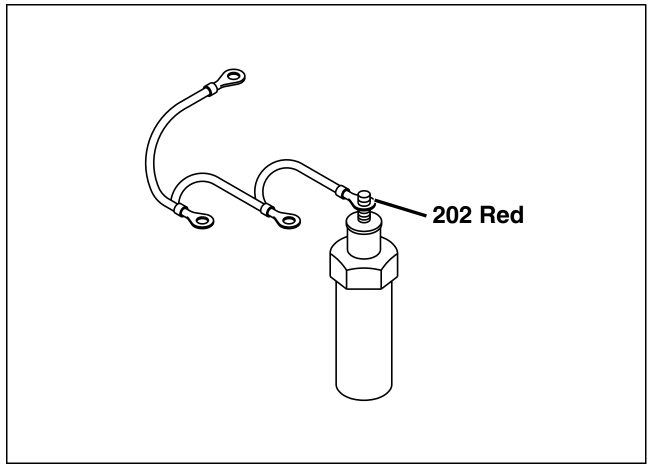
MIF

(3) [1]Check voltage at glow plug relay (K3) - Connector X64, Terminal 86, wire 102 red. Is battery voltage/test light on?

Yes - Go to step (4).

No - Test red wire No. 102 (W10), 382 (W2), 762 (W2), 802 (W2), 802 (W3) and 212 (W3) and connections.

System: Glow Plug Circuit



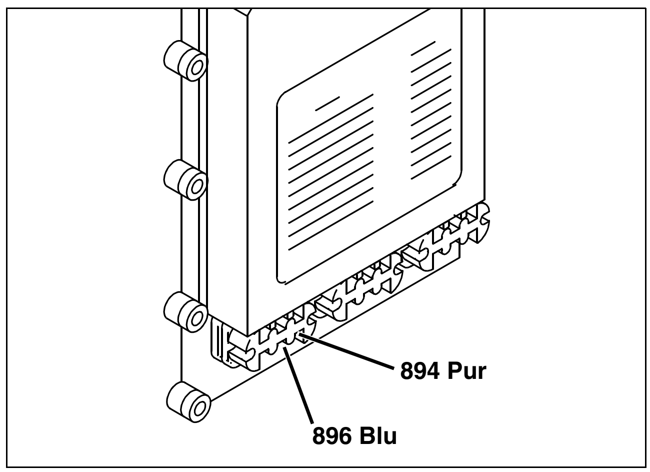
MIF

(4) Turn key switch OFF then ON and check voltage at glow plug(s) terminal, wire 202 red. Is battery voltage/test light on?[2]

Yes - Go to step (5).

No - Test red wire No. 202 (W10) and connections.

No - Test glow plug relay. (See “Test Electrical Relays” on page 550.)



MIF

(5) Glow plug light connector (X33) disconnected. Electronic control module connector (X7) disconnected.
Check resistance between glow plug light (H1) connector (X33) and Electronic control module (A3) connector (X7), terminal G, wire 494 purple. Is resistance less than 0.1 ohm?[3]

Yes - Go to step (6).

No - Test purple wires No. 894 (W3) and 894 (W2) and connections.

System: Glow Plug Circuit

(6) Check resistance between glow plug relay (K3) connector (X62) and electronic control module (A3) connector (X7), terminal F, wire 896 blue. Is resistance less than 0.1 ohm?

No - Test red wires No. 792 (W3) and 212 (W3) and connections.

1. When checking voltages and/or resistance at relay terminals, it may be necessary to disconnect the relay connector and perform the test at the open terminal. Reconnect the relay connector after performing the check.

2. Voltage will only be present for approximately ten seconds after the key switch has been moved to the RUN position.

3. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Run Circuit Operation - Operator On Seat

Function

To allow the engine to run with the operator on the seat.

Operating Conditions

- Key switch in RUN position - engine running.
- Operator on seat.
- Backlap valve in OFF position.
- Mow/transport switch in either MOW or TRANSPORT position.
- Park brake released.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the run circuit with a fusible link (F1). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032 [W2]), 15-amp fuse (F3) and key switch (red wires No. 002 [W2], 022 [W2] and 022 [W3]).

With the key switch in the RUN position, current flows to terminal D of connector X8 on the electronic control module (A3) (red wires No. 802 [W2], 802 [W3], and 212 [W3]. Current is also supplied to the brake switch (S2) (red wires 862 [W2], 762 [W2] 802 [W2] 802 [W3] and 212 [W3]), seat switch (S3) (red wires 892 [W2] 802 [W2], 802 [W3] and 212 [W3]), backlap switch (S4) (red wires 422 [W2], 802 [W2], 802 [W3], 212 [W3]), and mow/transport switch (S5) (red wires 872 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3].

With the operator on the seat, the seat switch allows current to flow to connector X9, pin H of the electronic control module. The control module will activate the HOLD circuit, sending current to the hold-in coil of the fuel shutoff solenoid (Y6) (red wires No. 602 [W10] and 364 [W2] and yellow wire No. W2]) and the pull-in coil relay (K4) (red wires No. 402 [W10] and 364 [W2] and yellow wire No. 362 [W2]).

NOTE: Current is present at terminal 87 of the pull-in coil relay only while the starting motor is running (key switch in the START position).

When the key switch is moved to the START position, current flows to terminal 87 of the pull-in coil relay (white wire No. 419 [W10]).

During initial engine start-up (before the oil pressure has reached normal operating level), the engine oil pressure switch closes, energizing the pull-in coil relay (green wires No. 305 [W10] and 205 [W10] and brown wire No. 105 [W10]). The current then flows through the relay, energizing the pull-in coil of the fuel shutoff solenoid (white wire No. 409 [W10]).

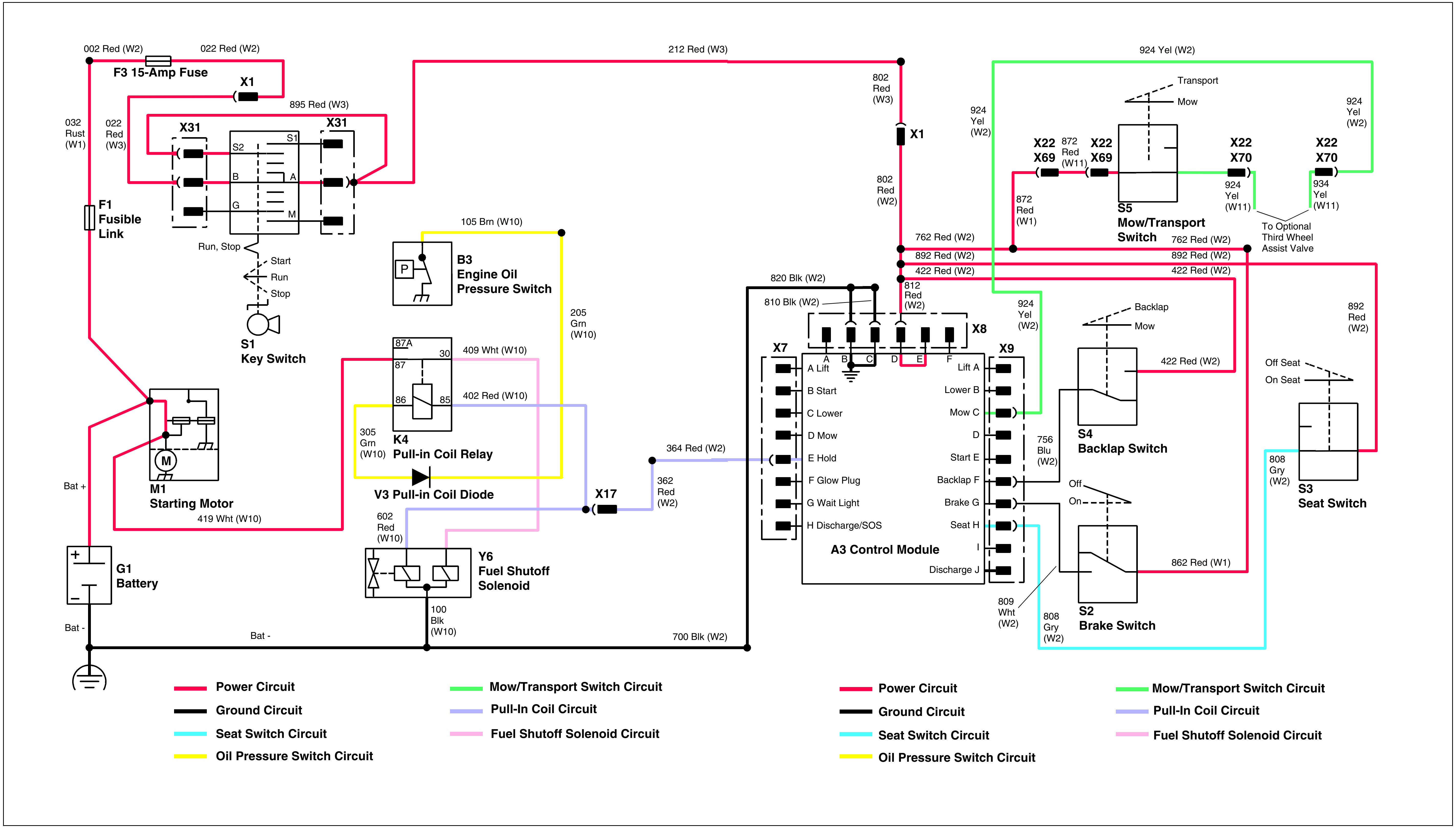
As the engine oil pressure rises to the normal operating level, the oil pressure switch opens, breaking the path to ground, de-energizing the relay stopping current flow to the fuel solenoid pull-in coil.

The hold-in coil will keep the fuel shutoff solenoid energized, allowing fuel to be supplied to the engine to keep the engine running.

A ground circuit provides a path to ground for the control module (black wires No. 810 [W2], 820 [W2] and 700 [W2]) and fuel shutoff solenoid (black wire No. 100 [W10]).

Diesel Engine

Run Circuit - Operator On Seat



MIF

Run Circuit Operation - Operator Off Seat

Function

To allow the engine to run when the operator is off the seat in order to perform the backlapping procedure.

Operating Conditions

- Key switch in RUN position - engine running.
- Operator off seat.
- Backlap valve in BACKLAP position.
- Mow/transport switch in either MOW position.
- Park brake engaged.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the run circuit with a fusible link (F1). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032 [W2]), 15-amp fuse (F3) and key switch (red wires No. 002 [W2], 022 [W2] and 022 [W3]).

With the key switch in the RUN position, current flows to terminal D of connector X8 on the electronic control module (A3) (red wires No. 802 [W2], 802 [W3], and 212 [W3]. Current is also supplied to the brake switch (S2) (red wires 862 [W2], 762 [W2] 802 [W2] 802 [W3] and 212 [W3]), seat switch (S3) (red wires 892 [W2] 802 [W2], 802 [W3] and 212 [W3]), backlap switch (S4) (red wires 422 [W2], 802 [W2], 802 [W3], 212 [W3]), and mow/transport switch (S5) (red wires 872 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3].

NOTE: If the machine is equipped with the third wheel assist option, the third wheel assist harness (W11) will be connected between the mow/transport switch and the main wiring harness (W2), to allow activation of the third wheel assist valve solenoid.

With the mow/transport switch in the MOW position, current flows to connector X9, pin C of the control module (yellow wires No. 924 [W2]).

With the backlap switch in the BACKLAP position, current flows to connector X9, pin F of the control module (blue wire No. 756 [W2]).

With the mow/transport, brake, seat and backlap switches in the correct position, the control module will activate the HOLD circuit, sending current to the hold-in coil of the fuel shutoff solenoid (Y6) (red wires No. 602 [W10] and 364 [W2] and yellow wire No. W2]) and the pull-in coil relay (K4) (red wires No. 402 [W10] and 364 [W2] and yellow wire No. 362 [W2]).

NOTE: Current is present at terminal 87 of the pull-in coil relay only while the starting motor is running (key switch in the START position).

When the key switch is moved to the START position, current flows to terminal 87 of the pull-in coil relay (white wire No. 419 [W9]).

During initial engine start-up (before the oil pressure has reached normal operating level), the engine oil pressure switch closes, energizing the pull-in coil relay (green wires No. 305 [W10] and 205 [W10] and brown wire No. 105 [W10]). The current then flows through the relay, energizing the pull-in coil of the fuel shutoff solenoid (white wire No. 409 [W10]).

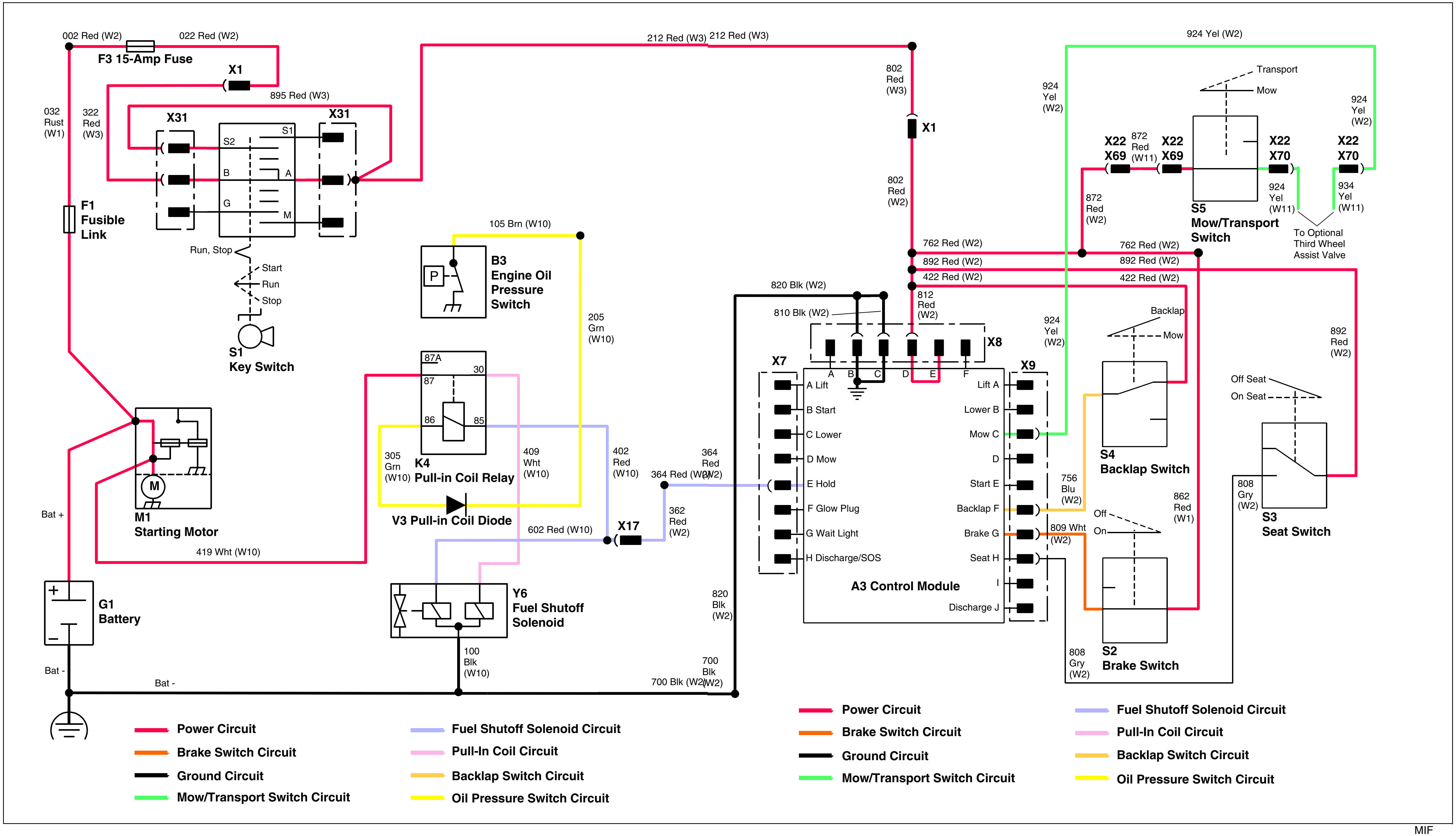
As the engine oil pressure rises to the normal operating level, the oil pressure switch opens, breaking the path to ground, de-energizing the relay stopping current flow to the fuel solenoid pull-in coil.

The hold-in coil will keep the fuel shutoff solenoid energized, allowing fuel to be supplied to the engine to keep the engine running.

A ground circuit provides a path to ground for the control module (black wires No. 810 [W2], 820 [W2] and 700 [W2]) and fuel shutoff solenoid (black wire No. 100 [W10]).

Diesel Engine

Run Circuit - Operator Off Seat



Run Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

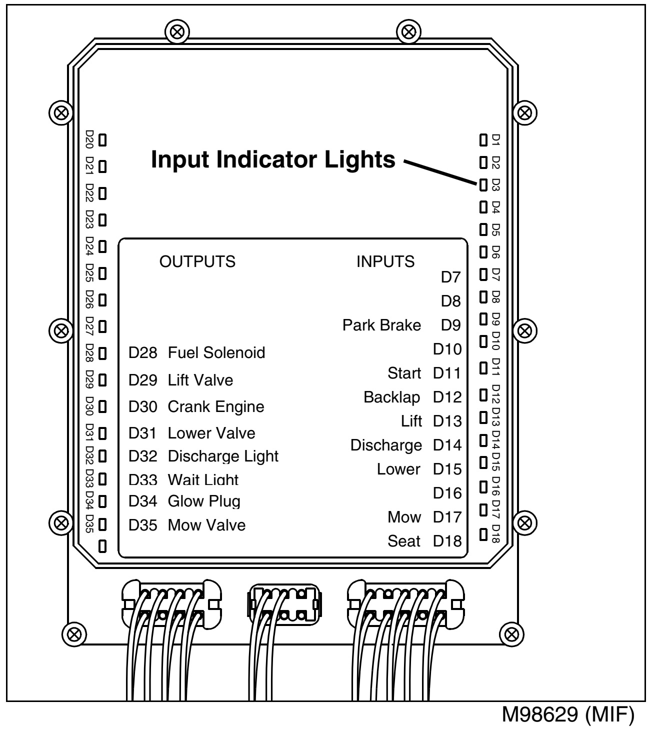
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See "Electronic Control Module Check" on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Seat Switch Input

1. Raise and lock seat platform.

2. Press down on the lower cushion of the seat to engage the seat switch.

3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).

4. Release the seat switch.

5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See "Test Seat Switch" on page 553.)

Brake Switch Input

1. Depress the park brake pedal.

2. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).

3. Release the park brake pedal.

4. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON, first check brake switch adjustment. (See "Adjust Park Brake Switch" on page 751.) If brake light does not come ON after adjustment, test brake switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

Mow/Transport Switch Input

1. Move mow/transport lever to MOW position.

2. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

Backlap Switch Input

1. Move the backlap valve to the MOW position.

2. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described, test the backlap switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

Fuel Solenoid Output

1. Release park brake.
2. Press down on the lower cushion of the seat to engage the seat switch.
3. Observe the FUEL SOLENOID output light (D28). The light should be ON when the seat switch is engaged (operator on seat).
4. Release the seat switch.
5. Observe the FUEL SOLENOID output light (D28). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

6. Depress the park brake pedal.
7. Observe the FUEL SOLENOID output light (D28). The light should be ON when the park brake pedal is depressed (brake switch engaged).
8. Release the park brake pedal.
9. Observe the FUEL SOLENOID output light (D28). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON, first check brake switch adjustment. (See "Adjust Park Brake Switch" on page 729.) If FUEL SOLENOID light does not come ON after adjustment, test brake switch circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

If the FUEL SOLENOID output light functions as described, but the fuel shutoff solenoid does not engage (engine does not run), test fuel shutoff solenoid circuit. (See "STEP 3: CIRCUIT TESTS" on page 455.)

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

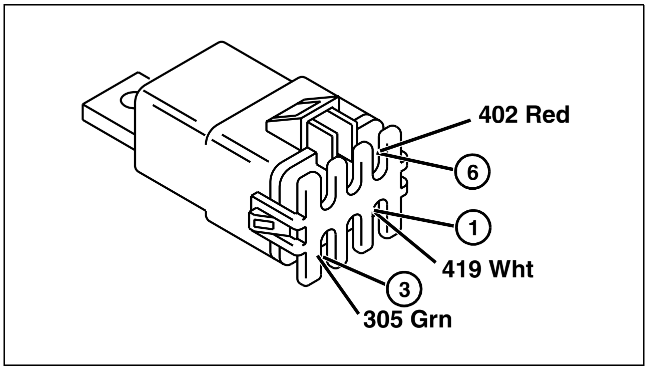
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Fuel shutoff solenoid connector (X61) disconnected.
- Engine oil pressure switch connector (X68) disconnected.

System: Fuel Shutoff Solenoid Circuit

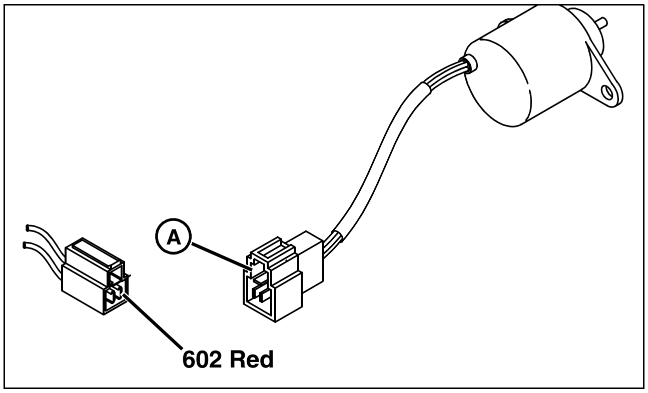


MIF

(1) Check voltage at pull-in coil relay (K4) connector (X64), terminal 87, wire 419 white. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test white wire No. 419 (W10) and connections.



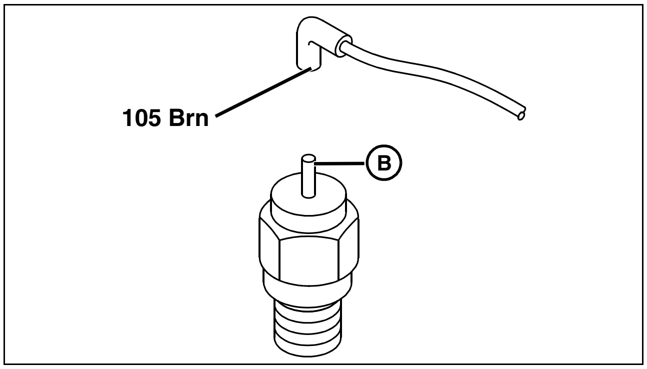
MIF

(2) Check continuity from fuel shutoff solenoid (Y1) connector position (A) to ground. Is resistance less than 0.1 ohm[1]?

Yes - Go to step (3).

No - Test fuel shutoff solenoid. (See "Test Fuel Shutoff Solenoid - Gasoline Engine" on page 557.)

System: Fuel Shutoff Solenoid Circuit



MIF

(3) Check continuity from engine oil pressure switch (B3) connector (X5), wire 105 brown and pull-in coil relay (K4) connector (X64), terminal 85[2], wire 305 green. Is resistance less than 0.1 ohm?[1]

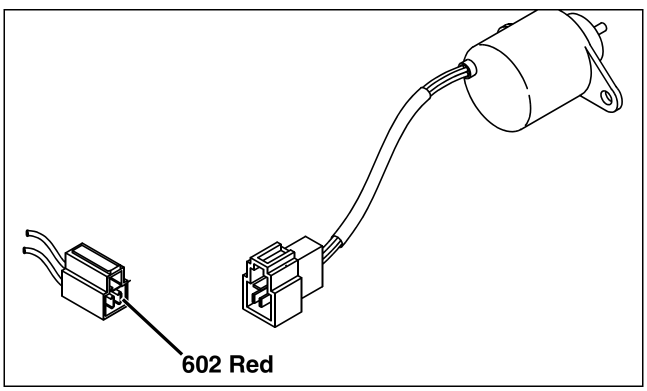
Yes - Go to step (4).

No - Test green wires No. 305 (W10) and 205 (W10), brown wire No. 105 (W10) and connections.

(4) Check continuity from engine oil pressure switch (B3) terminal (B) to engine. Is there no continuity to ground (maximum resistance)?[1]

Yes - Go to step (5).

No - Test engine oil pressure switch. (See “Engine Oil Pressure Switch Test - Diesel Engine” on page 559.)



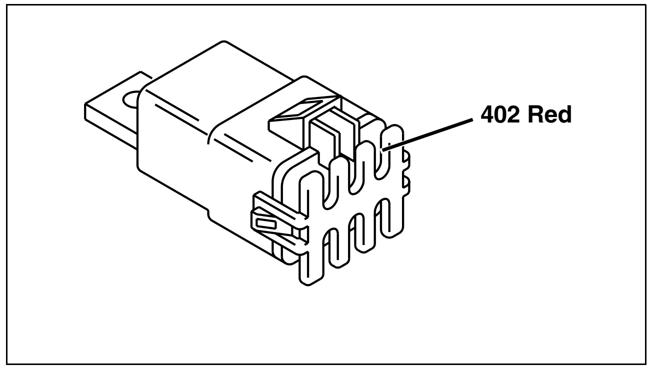
MIF

(5) Key switch in RUN position; engine not running. Check voltage at fuel shutoff solenoid connector (X61), wire 602 red. Is battery voltage/test light on?

Yes - Go to step (6).

No - Test red wire No. 602 (W10) and yellow wire No. 362 (W2) and connections.

System: Fuel Shutoff Solenoid Circuit



MIF

(6) Check voltage at pull-in coil relay (K4) connector (X64)[2], terminal 86, wire 402 red. Is battery voltage/test light on?

No - Test red wire No. 402 (W10) and yellow wire No. 362 (W2) and connections.

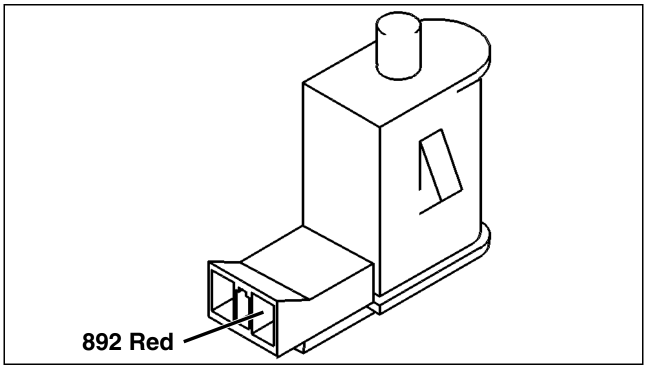
1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

2. When checking voltages and/or resistance at relay terminals, it may be necessary to disconnect the relay connector and perform the test at the open terminal. Reconnect the relay connector after performing the check.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Seat switch connector (X6) disconnected.

System: Seat Switch Circuit

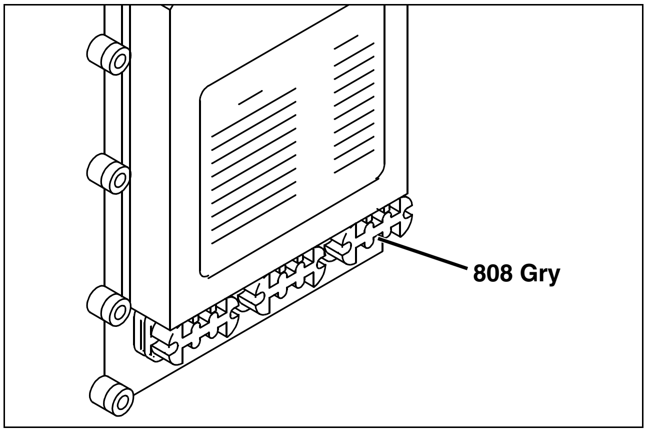


MIF

(1) Check voltage at electronic control module (A3) - connector X9, terminal H, wire 892 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 892 red (W2) and connections.



MIF

(2) Seat switch connector (X6) connected.
Seat switch engaged.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal H, wire 808 grey. Is battery voltage/test light on?

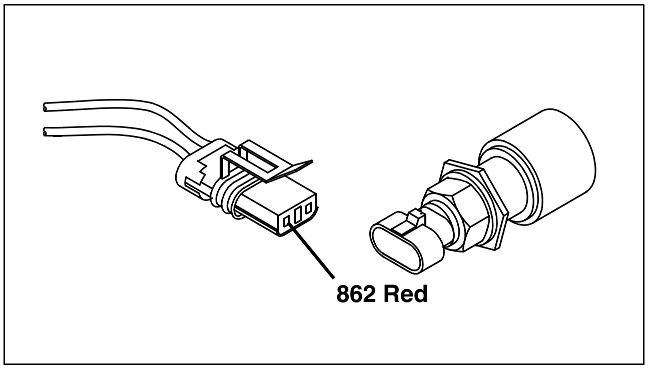
No - Test wire 808 gray (W2) and connections.

No - Test seat switch. (See “Test Seat Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Brake switch connector (X18) disconnected.

System: Park Brake Switch Circuit

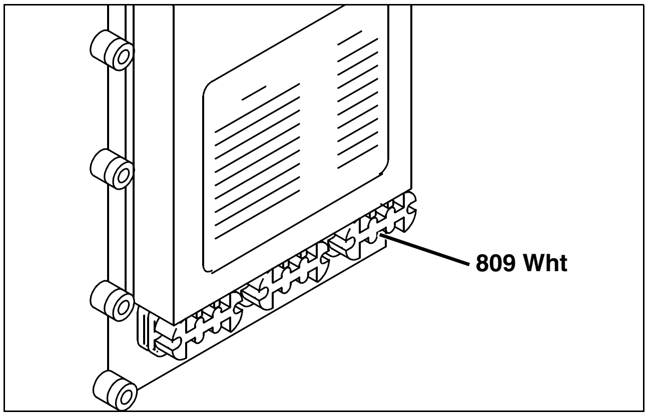


MIF

(1) Check voltage at brake switch connector (X18), wire 862 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test wire 862 red (W2) and connections.



MIF

(2) Mow/transport switch (S5) connector (X22) connected.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal G, wire 809 white. Is battery voltage/test light on?

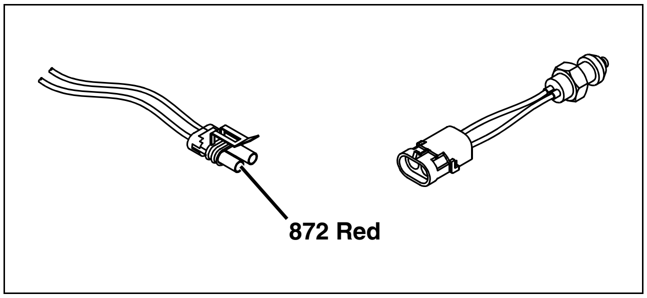
No - Test wire 809 white (W2) and connections.

No - Test park brake switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Mow/transport switch connector (X22) disconnected.

System: Mow/Transport Switch Circuit



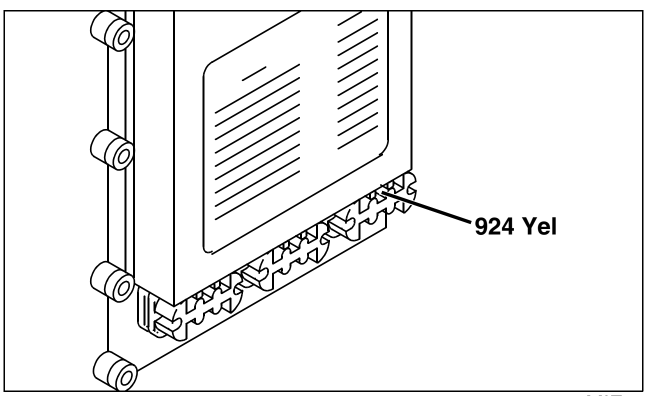
MIF

(1) Check voltage at mow/transport switch (S5) connector (X22), wire 872 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test wire 872 red (W2) and connections.

No - Third wheel assist units: Test wire 872 red (W11) and connections.



MIF

(2) Mow/transport switch (S5) connector (X22) connected.
Electronic control module - connector (X9) disconnected.
Check voltage at electronic control module (A3) - connector (X9), terminal C, wire 924 yellow. Is battery voltage/test light on?

No - Test wire 924 yellow (W2) and connections.

No - Third wheel assist units: Test yellow wires No. 924 (W11) and 934 (W11) and connections.

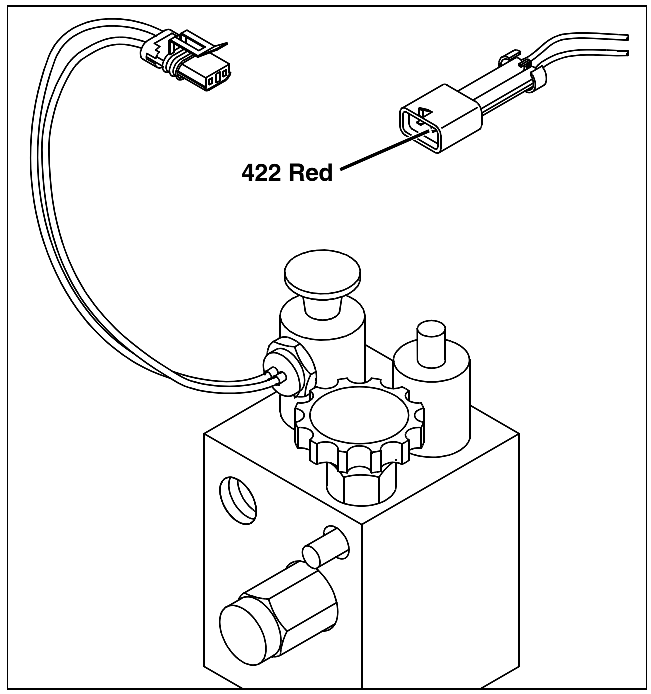
System: Mow/Transport Switch Circuit

No - Test mow/transport switch. (See “Test Mow/ Transport Switch” on page 553.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Backlap switch connector (X15) disconnected.

System: Backlap Switch Circuit



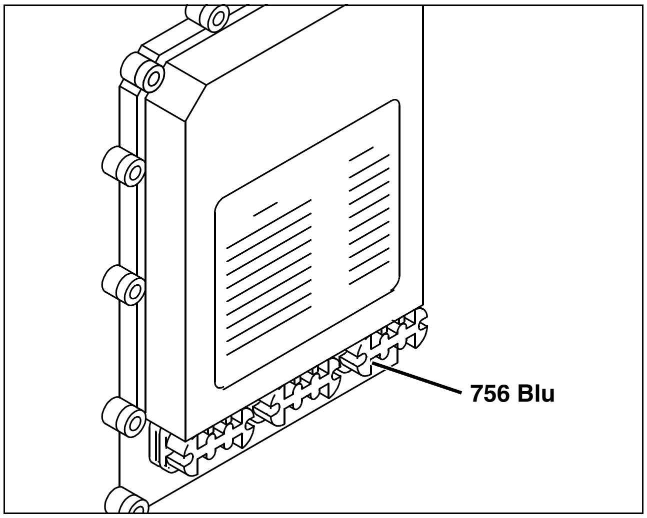
MIF

(1) Check voltage at backlap switch (S4) connector (X15), wire 422 red. Is battery voltage/test light on?

Yes - Go to step (2).

No - Test red wire No. 422 (W2) and connections.

System: Backlap Switch Circuit



MIF

(2) Backlap switch in BACKLAP position. Backlap switch connector (X15) connected. Electronic control module - connector (X9) disconnected. Check voltage at electronic control module (A3) - connector (X9), terminal F, wire 756 blue. Is battery voltage/test light on?

No - Test blue wire No. 756 (W1) and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.) (See “Test Backlap Switch - Model 2500E” on page 560.)

Charging Circuit Operation

Function

To maintain battery voltage between 11.8 and 13.2 volts DC.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the charging circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (red wires No. 002 [W2], 322 [W2] and 332 [W3]), to key switch “B” terminal.

The power circuit also provides current and a direct connection from the battery and voltage regulator/rectifier (N1) red wire No. 332 (W2).

With the key switch in the RUN position, current flows to the electronic control module (A3) (red wires No. 212 [W2], 802 [W2], 802 [W3] and 212 [W3]) Current is also supplied to the voltage regulator/rectifier (red wires No. 342 [W2], 802 [W2], 802 [W3] and 212 [W2]) and to the warning light module (E3) (red wires No. 222 [W3], 212 [W3]). The ground side of the discharge light is connected to connector X7, pin H of the control module.

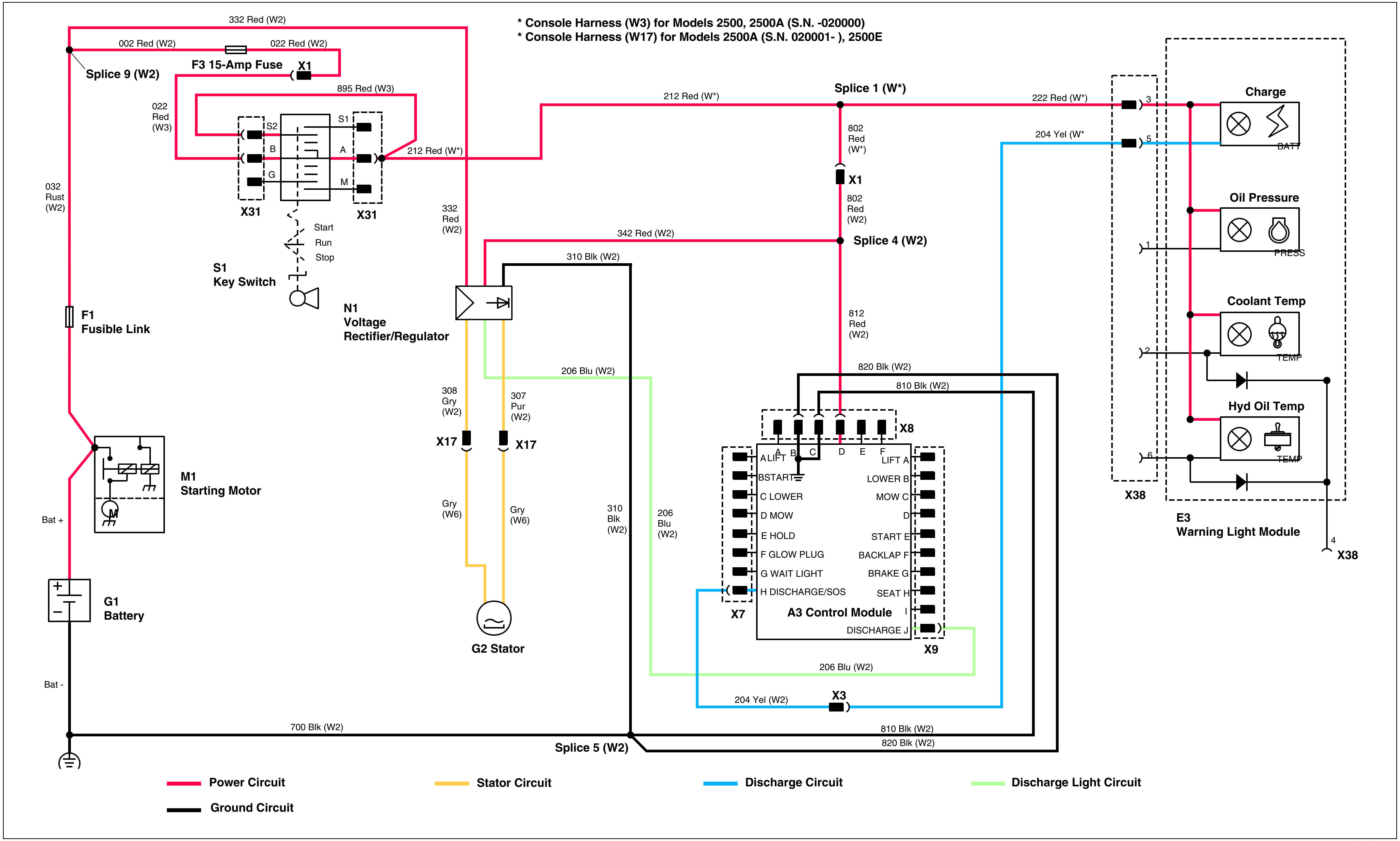
As the engine turns alternator (G3), AC current produced. The AC current flows to the regulator/rectifier from alternator connector X55 (brn wires 307 and 308 [W10]). The regulator/rectifier converts the AC current to DC current needed to charge the battery.

If the battery voltage is low, the regulator/rectifier allows DC current to flow to the battery to charge it through the power/battery charging circuit. When the battery is fully charged, the regulator stops current flow to the battery.

If the alternator current output to the regulator/rectifier stops, the voltage regulator/rectifier allows current to flow to connector X9, pin J of the control module (blue wire No. 206 [W2]). The control module will than complete the path to ground for the discharge warning light, illuminating the warning light.

A ground circuit provides a path to ground for the voltage regulator/rectifier (blue wire No. 310 [W2] and black wire No. 700 [W2]).

Charging Circuit



MX20863 (MIF)

Charging Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

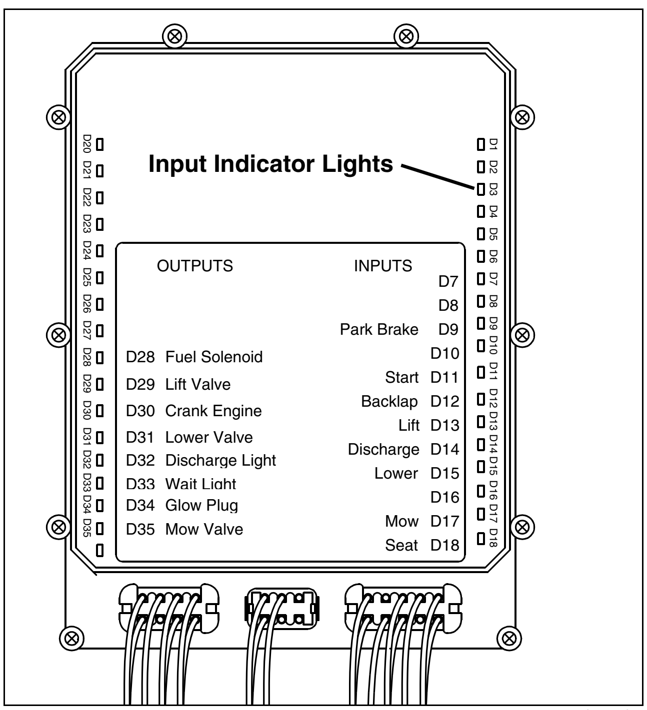
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Voltage Regulator/Rectifier Input Circuit

1. Raise and lock seat platform.

2. Observe the DISCHARGE input light (D14). The light should be ON when the key switch is in the RUN position with the engine not running. The light should be OFF when the engine is running.

If the light does not come ON when the engine is not running, test the discharge light circuit. (See “STEP 3: CIRCUIT TESTS” on page 463.)

Discharge Light Output Circuit

1. Observe the DISCHARGE LIGHT output light (D32) and DISCHARGE light on the warning light module (E3). The both lights should be ON when the key switch is in the RUN position with the engine not running. The lights should be OFF when the engine is running.

If the DISCHARGE output light (D28) does come ON, but the DISCHARGE warning light in the warning light module does not come ON when the engine is not running, test the discharge warning light circuit. (See “STEP 3: CIRCUIT TESTS” on page 463.)

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

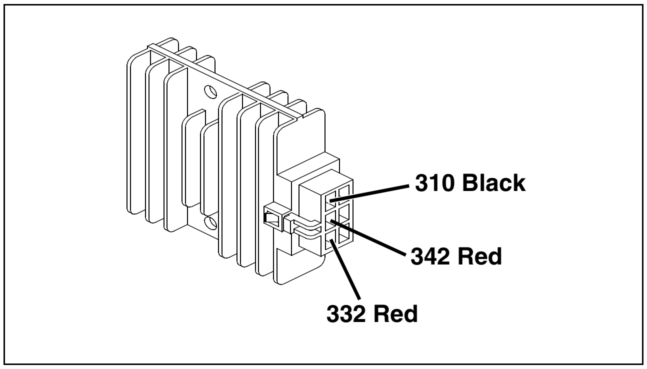
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Voltage regulator/rectifier connector (X28) disconnected.

System: Voltage Regulator/Rectifier Circuit



MIF

(1) Check voltage at voltage regulator/rectifier (N2) connector (X28), wire 332 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test wire 332 red (W2) and connections.

(2) Check resistance at voltage regulator/rectifier (N2) connector (X28), wire 310 black. Is resistance less than 0.1 ohm[1]?

Yes - Go to step (3).

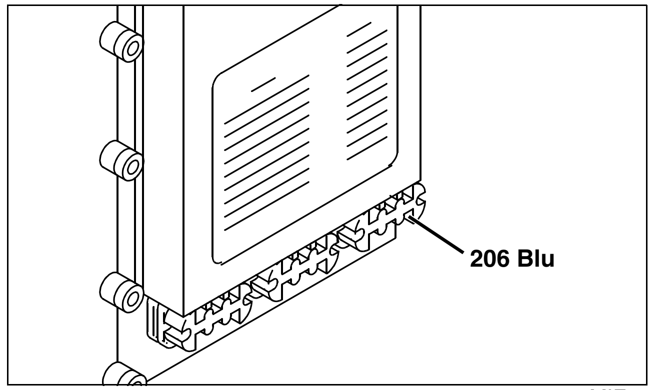
No - Test black wire No. 310 (W2) and connections.

(3) Key switch in RUN position - engine not running.
Check voltage at voltage regulator/rectifier (N1) connector (X28), wire 342 red. Is battery voltage/ test light on?

Yes - Go to step (4).

No - Test wire 342 red (W2) and connections.

System: Voltage Regulator/Rectifier Circuit

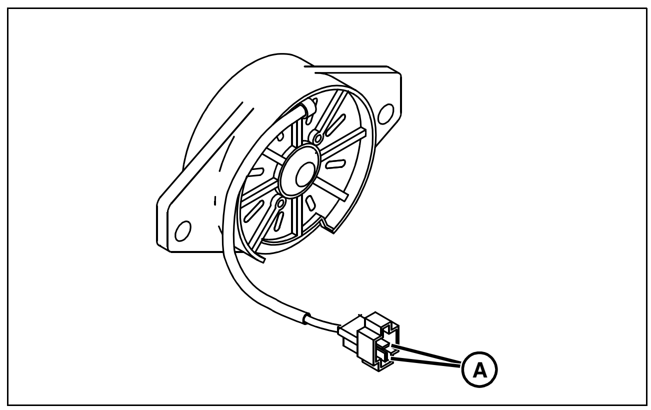


MIF

(4) Voltage regulator/rectifier connector (X28) connected.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal J, wire 206 blue. Is battery voltage/test light on?

Yes - Go to step (5).

No - Test blue wire No. 206 (W2) and connections.



MIF

(5) Key switch in run position and engine running at fast idle.
Electronic control module connector (X9) connected.
Alternator connector (X50) disconnected.
Measure voltage across alternator connector (X55) (A) (reading alternator output.) Is output to specification?

No - Repair alternator. (See “12V Alternator Disassembly and Assembly” on page 235.)

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

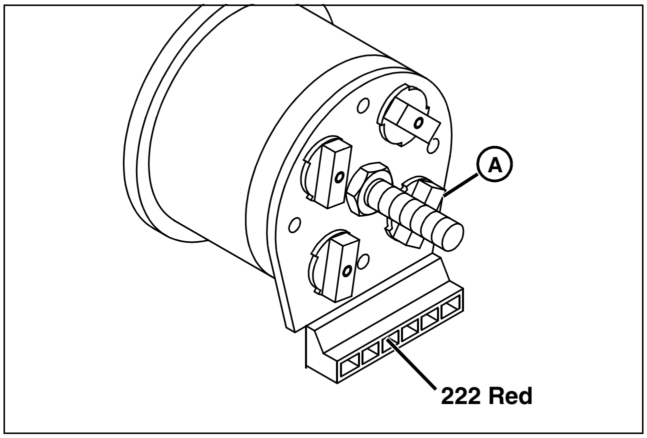
Specification

Unregulated Voltage - Diesel Engine (minimum) . . . . 28 Volts AC

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Warning light module connector (X38) disconnected.

System: Discharge Warning Light Circuit



MIF

(1) Check voltage at warning light module (E3) connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

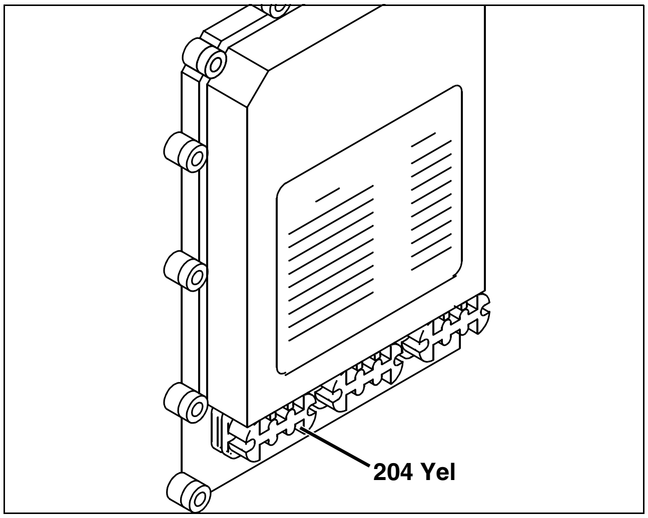
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Warning light module (E3) discharge light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Discharge Warning Light Circuit



MIF

(3) Warning light module connector (X38) connected.
Check voltage at electronic control module (A3) - Connector X7, terminal H, wire 204 yellow. Is battery voltage/test light on?

No - Test yellow wires No. 204 (W3) and 204 (W2) and connections.

Engine Oil Pressure Warning Light Circuit Operation

Function

To warn the operator if the engine oil pressure drops below the safe operating level.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

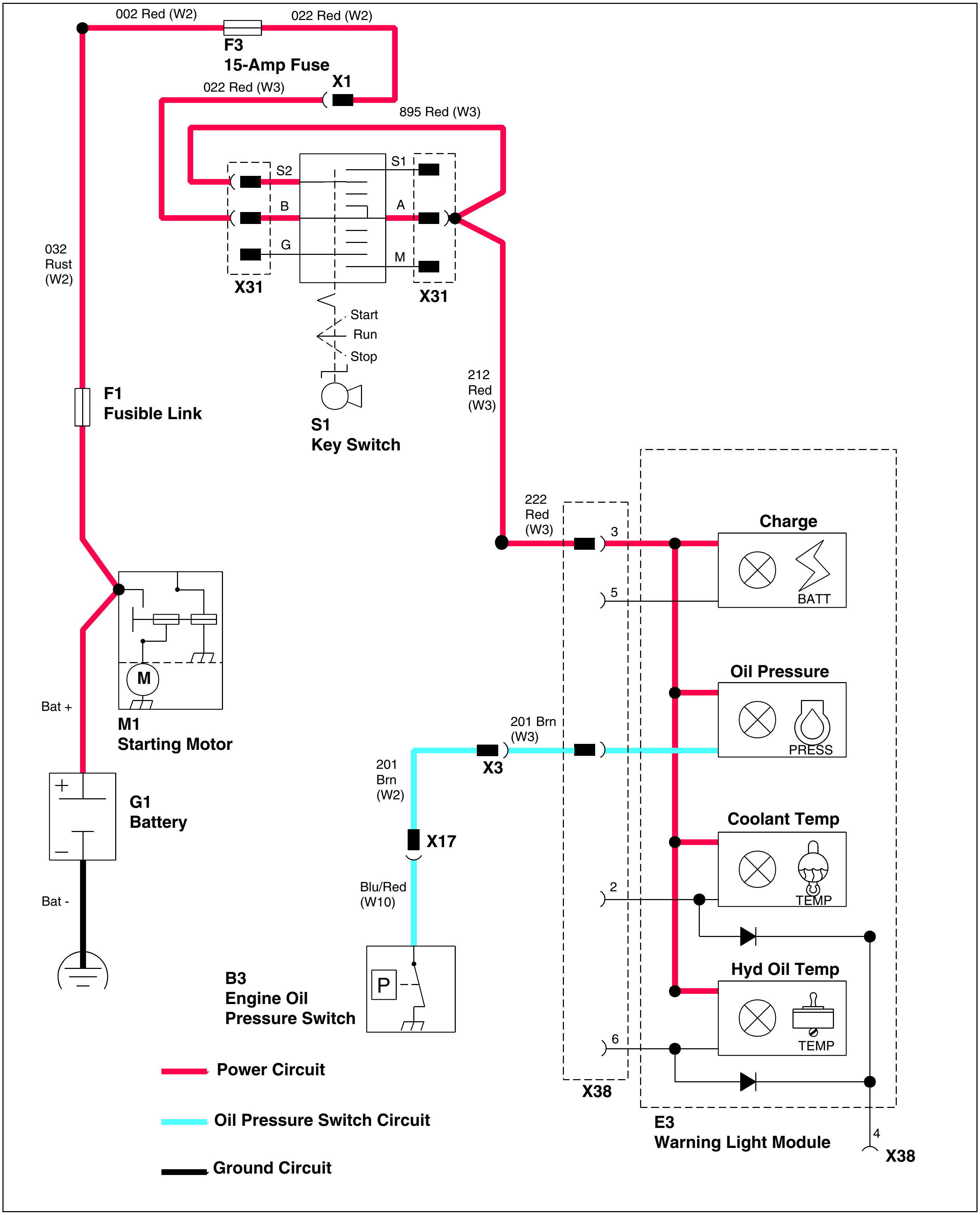
Theory of Operation

The power circuit provides current to the key switch (S1) and protects the oil pressure warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032) and key switch (red wires No. 002 [W2], 222 [W2] and 022 [W3]).

With the key switch in the RUN position, current flows to the warning light module (E3) (red wires No. 212 [W2] and 222 [W3] and oil pressure light.

When the engine oil pressure drops below the safe operating level, the oil pressure switch (B3) closes and completes the circuit to ground (brown wires No. 201 [W3], 201 [W2] and 105 [W10]) lighting the oil pressure light.

Engine Oil Pressure Warning Light Circuit



M98632 (MIF)

Engine Oil Pressure Warning Light Circuit Diagnosis

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

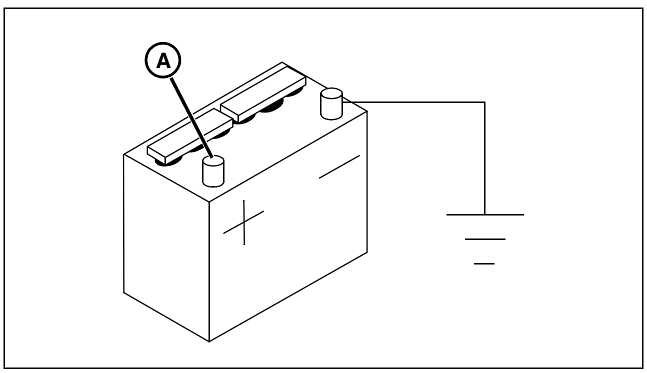
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Engine oil pressure switch - Connector (X48) disconnected.

System: Engine Oil Pressure Warning Light Circuit



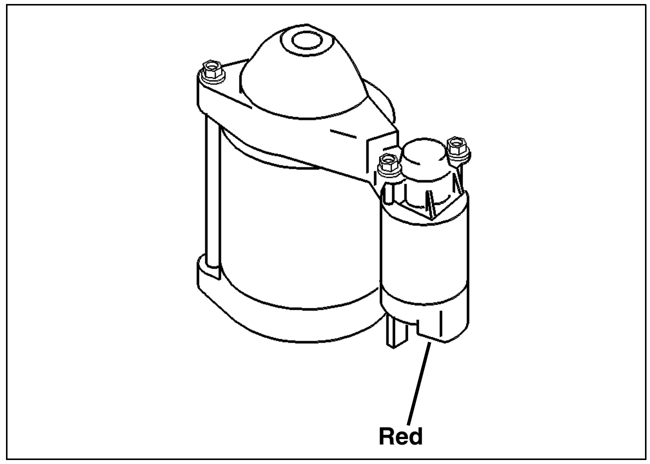
MIF

(1) Check voltage at battery positive (+) post (A). Is battery voltage between 11.8 - 13.2 volts?

Yes - Go to step (2).

No - Check battery condition. (See “Test Battery” on page 541.)

System: Engine Oil Pressure Warning Light Circuit

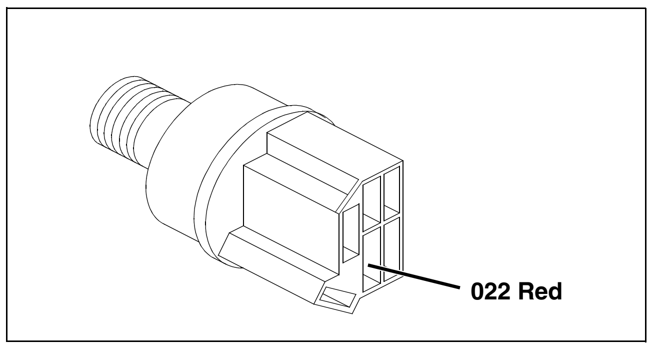


MIF

(2) Check voltage at starting motor solenoid - Battery terminal. Is battery voltage/test light on?[1]

Yes - Go to step (3).

No - Check battery cables and clamps. Clean and tighten connections.



MIF

(3) Check voltage at key switch (S1) connector (X31), terminal B, wire 022 red. Is battery voltage/ test light on?

Yes - Go to step (4).

No - Test red wires No. 022 (W3), 022 (W2), 002 (W2) and connections.

No - Test fuse (F3). (See “Test Fuse” on page 549.)

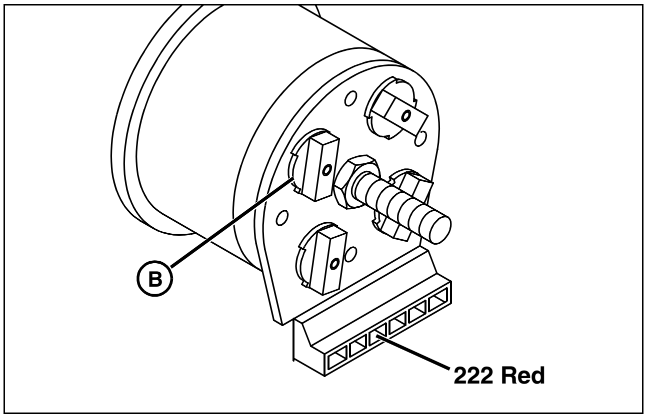
No - Test fuse link (F1) (rust wire No. 032).

System: Engine Oil Pressure Warning Light Circuit

(4) Key switch in RUN position - engine not running.
Warning light module connector (X38) disconnected.
Oil pressure switch connector (X68) disconnected.
Check voltage at key switch (S1) connector (X31), terminal A, wire 212 red. Is battery voltage/test light on?

Yes - Go to step (5).

No - Test key switch. (See “Test Key Switch” on page 551.)



MIF

(5) Check voltage at warning light module (E3) connector (X38), terminal 3. Is battery voltage/test light on?

Yes - Go to step (6).

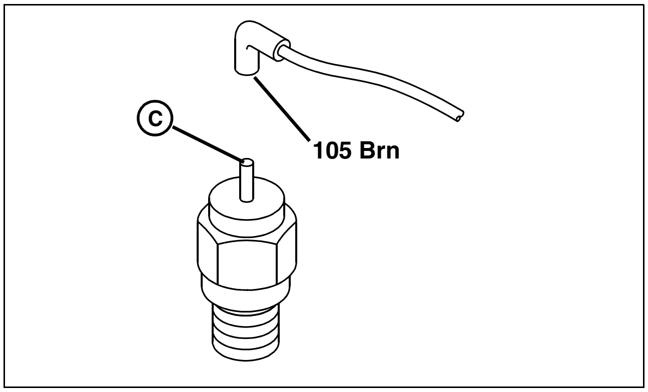
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(6) Warning light module (E3) oil pressure light bulb (B). Is bulb in good condition?

Yes - Go to step (7).

No - Replace bulb as needed.

System: Engine Oil Pressure Warning Light Circuit



MIF

(7) Check voltage at oil pressure switch (B3) connector (X68), wire 105 brown. Is battery voltage/test light on?.

Yes - Go to step (8).

No - Test brown wires No. 201 (W3), 201 (W2) and 105 (W2) and connections.

System: Engine Oil Pressure Warning Light Circuit

(8) Key switch in RUN position - engine running. Warning light module connector (X38) connected. Check resistance at oil pressure switch (B3) terminal (C). No continuity to ground (maximum resistance)?

No - Check engine oil pressure. (See “Test Engine Oil Pressure” on page 60.) If engine oil pressure is OK, replace oil pressure switch.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

Engine Coolant Warning Light Circuit Operation

Function

To warn the operator if the engine coolant temperature exceeds the safe operating limit.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the coolant temperature warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032), 15-amp fuse and key switch (red wires No. 002 [W2], 222 [W2] and 022 [W3]).

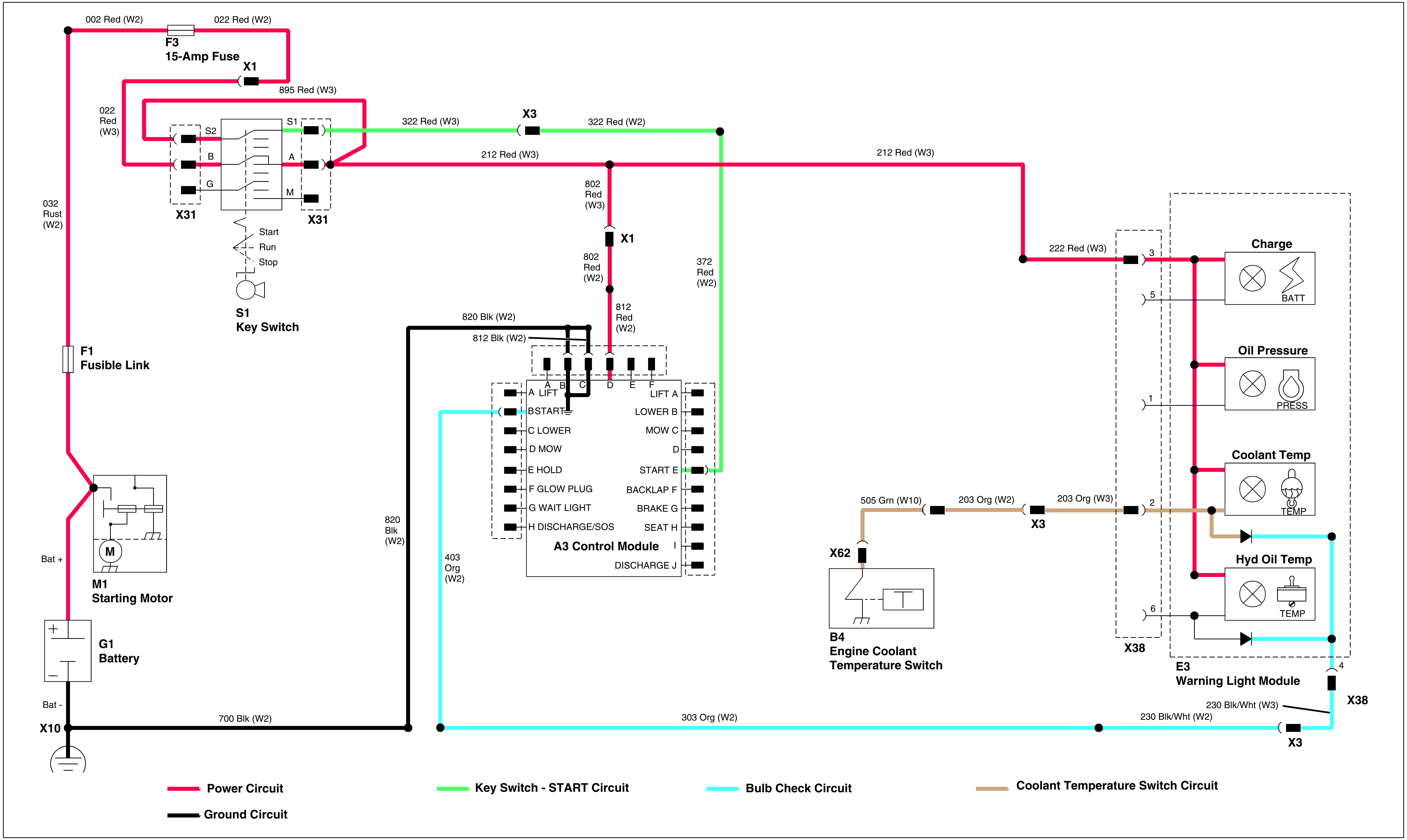
With the key switch in the RUN position, current flows to the warning light module (E3) (red wires No. 222 [W3] and 212 [W3] and coolant temperature light. Current is also supplied to the connector X8, pin D of the electronic control module (A3) (red wires 812 [W2], 802 [W2], 802 [W3] and 212 [W3]).

When the engine coolant temperature rises above the safe operating level, the coolant temperature switch (B4) closes and completes the circuit to ground (orange wires No. 203 [W3] and 203 [W2] and green wire No. 505) lighting the coolant temperature warning light.

When the key switch is moved to the START position, the control module completes a path to ground for the warning light (black wires No. 230 [W3] and 230 [W2] and orange wires No. 303 [W2] and 403 [W2]) to perform a bulb check.

A ground circuit provides a path to ground for the control module (black wires No. 810 [W2], 820 [W2] and 700 [W2]).

Engine Coolant Warning Circuit



M98896 (MIF)

Engine Coolant Warning Light Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

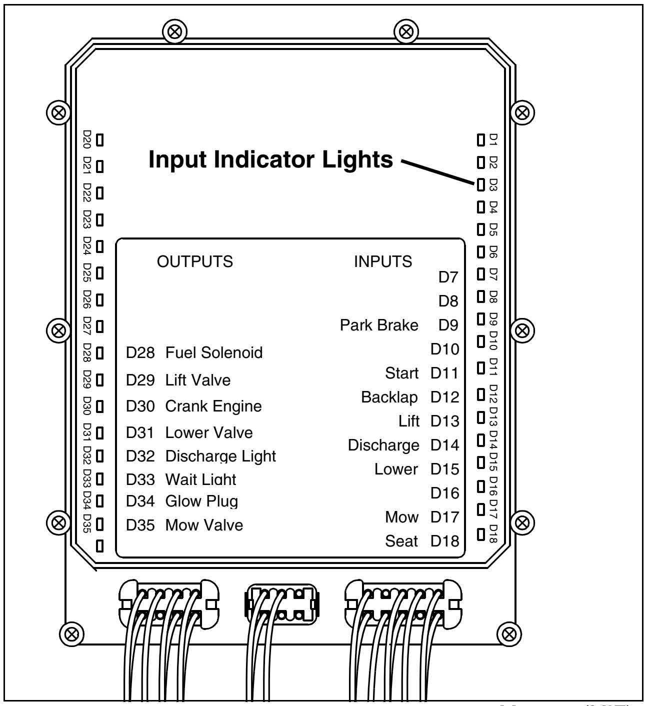
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

3. Move key switch to START position and back to RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

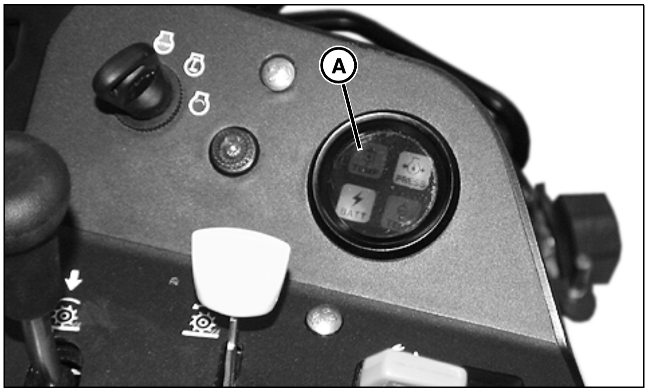
If the light does not come ON when the key switch is in the START position, test key switch circuit. (See “STEP 4: CIRCUIT TESTS” on page 474.)

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 474.)

STEP 3: BULB CHECK CIRCUIT TEST

1. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

2. Move key switch to START position and back to RUN position.



M84737

3. Observe the engine coolant warning light (A). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 474.)

STEP 4: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

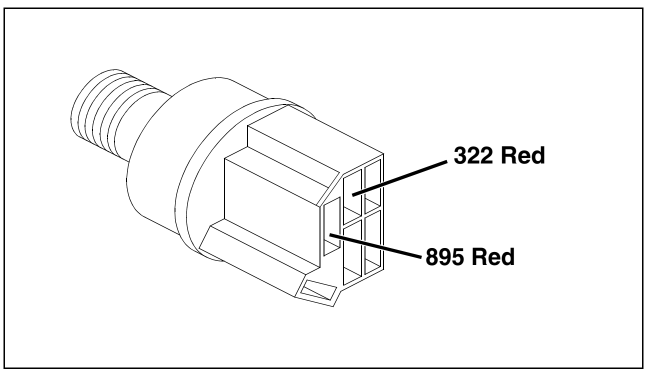
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X8) disconnected.

System: Key Switch Circuit



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 895 red. Is battery voltage/ test light on?

Yes - Go to step (2).

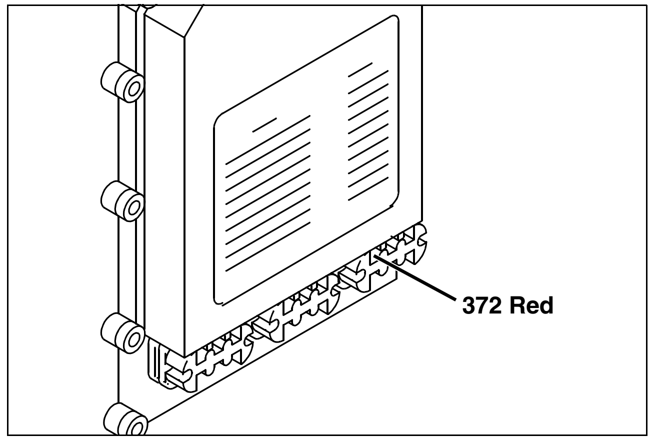
No - Test red wire No. 895 (W3) and connections.

(2) Key switch in START position.
Check voltage at key switch connector (X31), terminal S1, wire 322 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test key switch. (See "Test Key Switch" on page 551.)

System: Key Switch Circuit



MIF

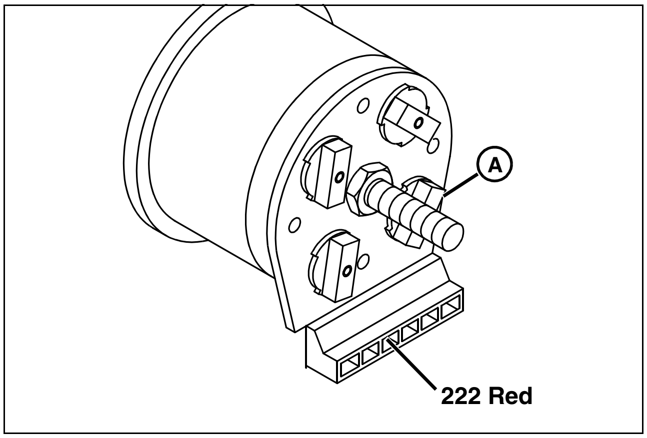
(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

No - Test red wires No. 372 (W2), 322 (W2) and 322 (W3) and connections.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Engine coolant temperature switch connector (X49) disconnected.

System: Engine Coolant Warning Light Circuit



MIF

(1) Check voltage at warning light module (E3)connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

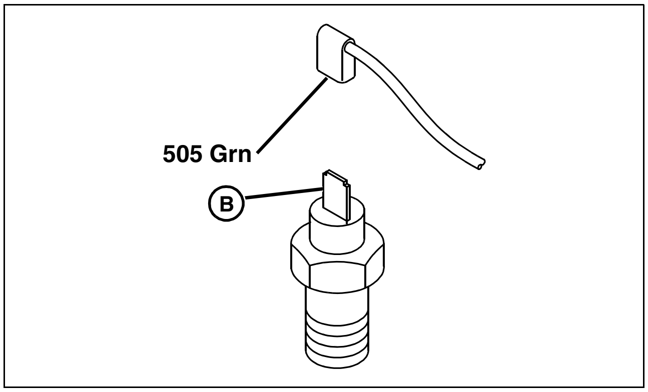
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Warning indicator module (E3) coolant temperature light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Engine Coolant Warning Light Circuit



MIF

(3) Check voltage at engine coolant temperature switch (B4) connector (X49), wire 505 green. Is battery voltage/test light on?

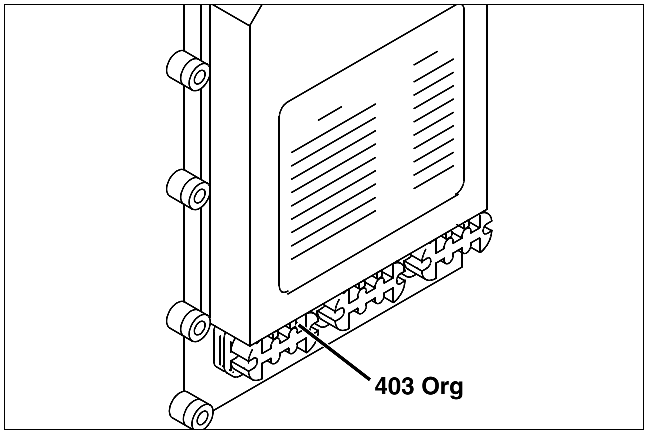
Yes - Go to step (4).

No - Test orange wires No. 203 (W3), 203 (W2) and green wire No. 505 (W10) and connections.

(4) Check resistance at engine coolant temperature switch (B4) terminal (B). No continuity to ground (maximum resistance)?

Yes - Go to step (5).

No - Test coolant temperature switch. (See "Test Engine Coolant Temperature Switch" on page 561.)



MIF

(5) Key switch in START position.
Warning light module connector (X7) disconnected.
Check voltage at electronic control module (A3) - Connector X7, terminal B, wire 403 orange. Is battery voltage/test light on?

No - Test orange wires No. 403 (W2) and 303 (W3) and black/white wires No. 203 (W3) and 203 (W2) and connections.

Hydraulic Oil Temperature Warning Light Circuit Operation

Function

To warn the operator if the hydraulic oil temperature exceeds the safe operating limit.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the hydraulic oil temperature warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 022 [W2] and 002 [W3]), to key switch "B" terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W2], 802 [W2], 802 [W3] and 212 [W3].

Current is also supplied to the warning light module (E3) (red wire No. 212 [W3]) and hydraulic oil temperature light.

The hydraulic oil temperature warning light, is connected to the hydraulic oil temperature switch (B4)

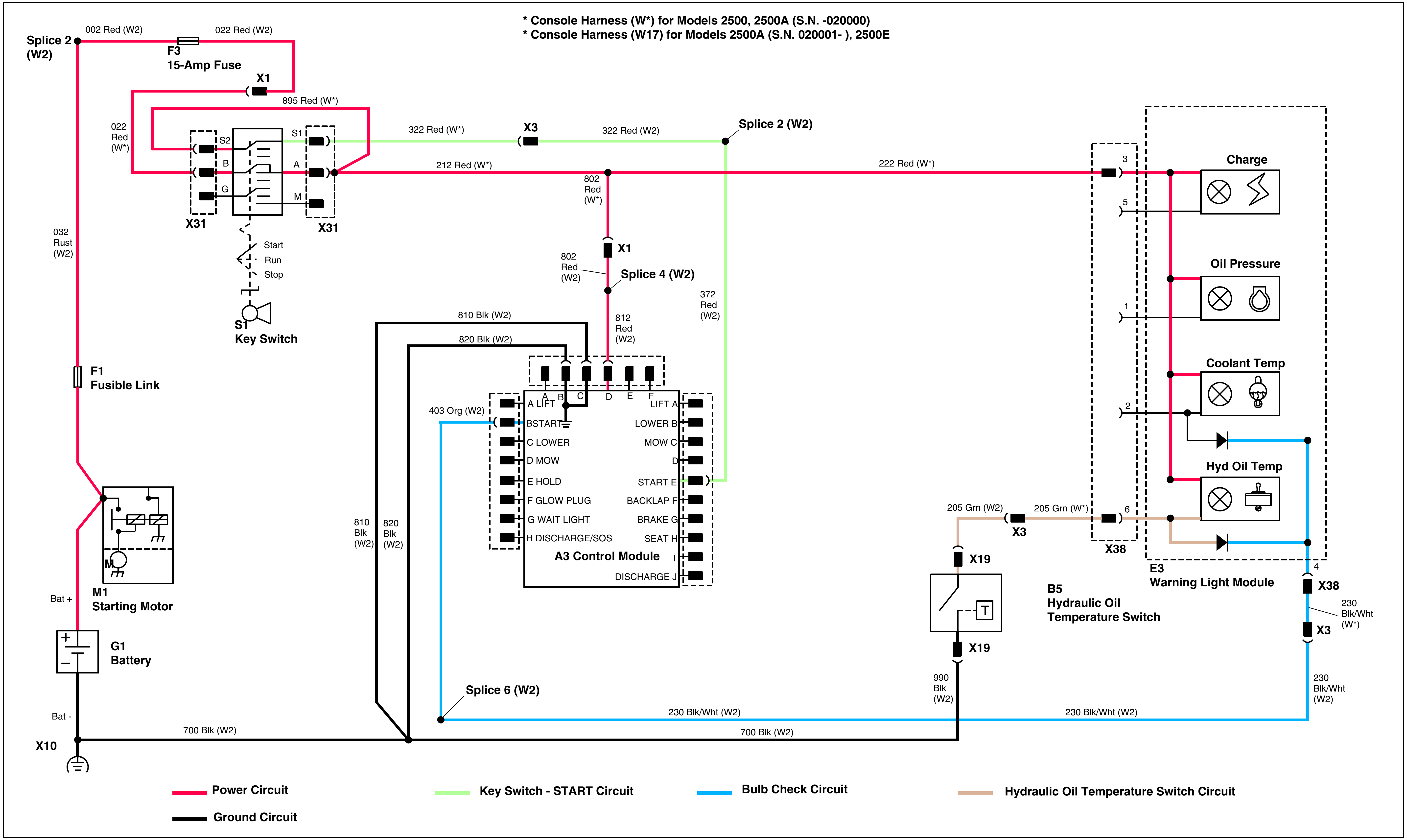
At room temperature, the switch is open (infinite resistance). If the hydraulic oil temperature rises above the safe operating level (96° C [200° F]), the switch closes, completing the circuit to ground (black wires No. 990 [W2], and 700 [W2] lighting the warning light.

With the key switch in the START position, current flows to key switch terminal S2 (red wire No. 895 [W3]), through the switch to terminal S1, to terminal E of connector X9 on the control module (A3).

When the key switch is in the START position, the control module provides an alternate path to ground for the warning light (black/white wires No. 230 [W3], 230 [W2] and orange wires No. 303 [W2] and 403 [W2]) to perform a bulb check.

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W2], 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for both the hour meter and control module.

Hydraulic Oil Temperature Warning Light Circuit



MX20865 (MIF)

Hydraulic Oil Temperature Warning Light Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

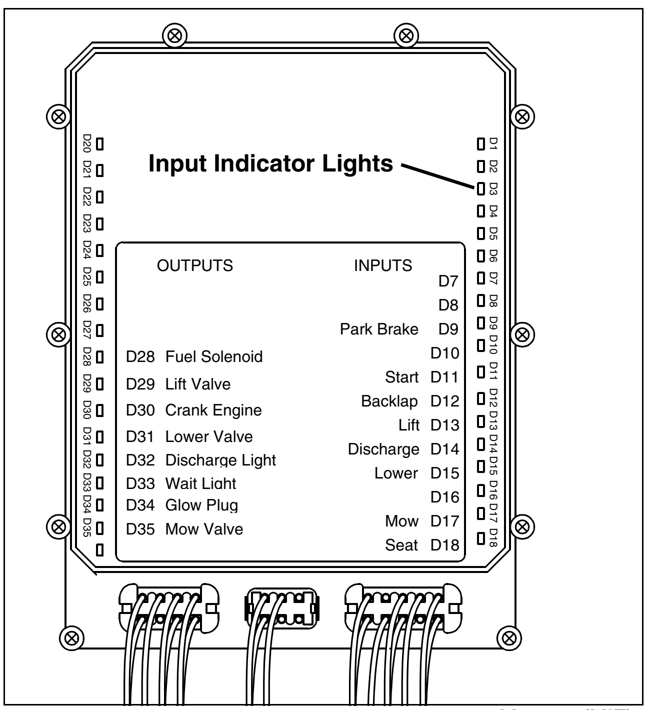
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Key Switch Input

1. Raise and lock seat platform.

2. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

3. Move key switch to START position and back to RUN position.

4. Observe the START input light (D11). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does not come ON when the key switch is in the START position, test key switch circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

STEP 3: BULB CHECK CIRCUIT TEST

1. Disable the starting motor, by disconnecting the starting motor solenoid wire (Red wire).

2. Move key switch to START position and back to RUN position.

M84737

3. Observe the hydraulic oil temperature warning light (A). The light should be on when the key switch is in the START position, and off when the key switch is in the RUN position.

If the light does come ON when the key switch is in the START position, test warning light module circuit. (See “STEP 4: CIRCUIT TESTS” on page 480.)

STEP 4: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

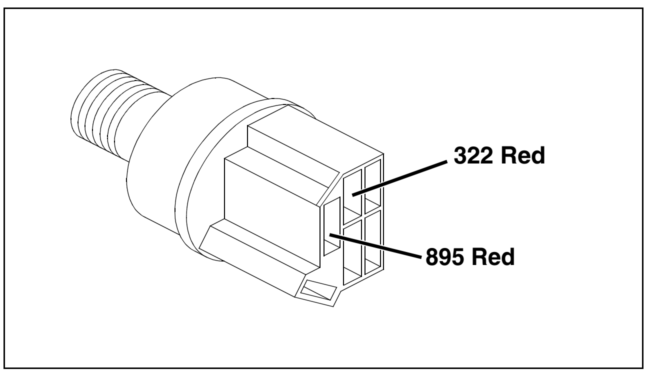
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Electronic control module connector (X8) disconnected.

System: Key Switch Circuit



MIF

(1) Check voltage at key switch (S1) connector (X31), terminal S2, wire 895 red. Is battery voltage/ test light on?

Yes - Go to step (2).

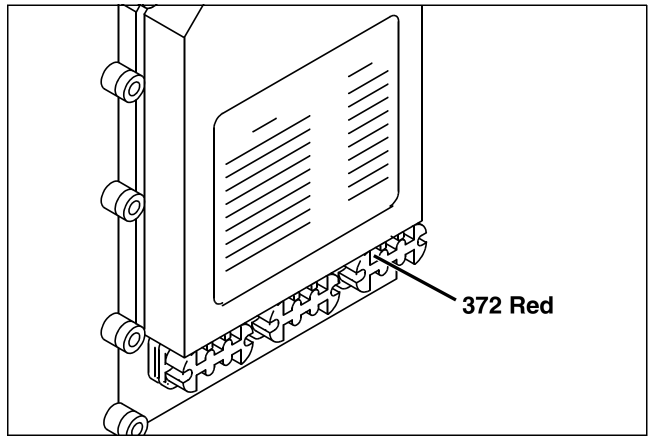
No - Test red wire No. 895 (W3) and connections.

(2) Check voltage at key switch (S1) connector (X31), terminal S1, wire 322 red. Is battery voltage/ test light on?

Yes - Go to step (3).

No - Test key switch. (See "Test Key Switch" on page 551.)

System: Key Switch Circuit



MIF

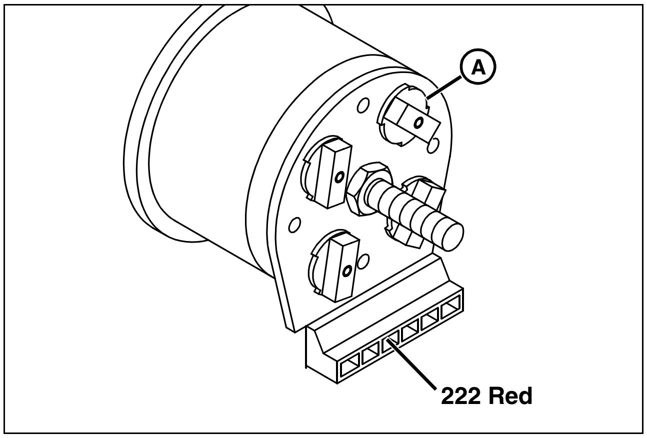
(3) Check voltage at electronic control module (A3) connector (X9), terminal E, wire 372 red. Is battery voltage/test light on?

No - Test red wires No. 372 (W2), 322 (W2) and 322 (W3) and connections.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Hydraulic oil temperature switch connector (X19) disconnected.

System: Hydraulic Oil Temperature Warning Light Circuit



MIF

(1) Check voltage at warning light module (E3)connector (X38), terminal 3, wire 222 red. Is battery voltage/test light on?

Yes - Go to step (2).

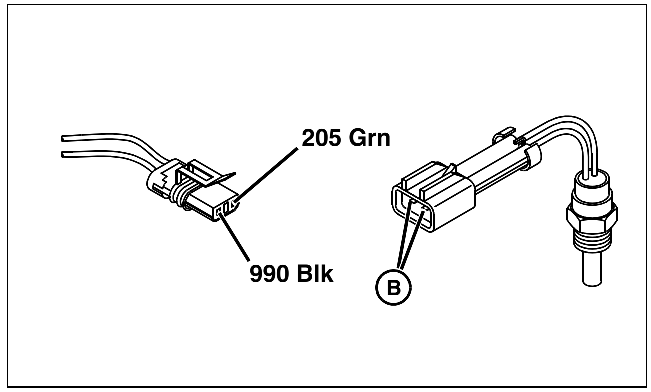
No - Test red wires No. 222 (W3) and 212 (W3) and connections.

(2) Warning indicator module (E3) - Hydraulic oil temperature light bulb (A). Is bulb in good condition, not burned out?

Yes - Go to step (3).

No - Replace bulb as needed.

System: Hydraulic Oil Temperature Warning Light Circuit



MIF

(3) Check voltage at hydraulic oil temperature switch (B5) connector (X19), wire 205 green. Is battery voltage/test light on?

Yes - Go to step (4).

No - Test green wires No. 205 (W2) and 205 (W3) and connections.

(4) Check resistance at hydraulic oil temperature switch (B5) terminals (B). No continuity to ground (maximum resistance)?

Yes - Go to step (5).

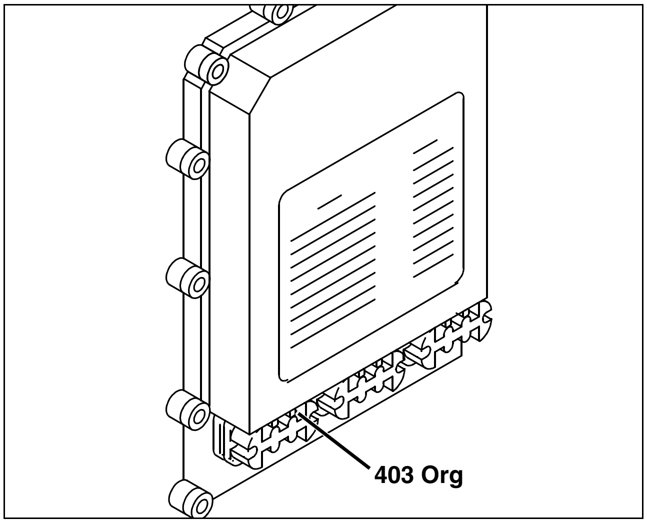
No - Replace hydraulic oil temperature switch.

(5) Check resistance at hydraulic oil temperature switch (B5) connector (X19), wire 990 black. Is resistance less than 0.1 ohm?[1]

Yes - Go to step (6).

No - Test black wires No. 990 (W2) and 700 (W2) and connections.

System: Hydraulic Oil Temperature Warning Light Circuit



MIF

(6) Key switch in START position.
Electronic control module connector (X7) disconnected.
Check voltage at electronic control module (A3) connector (X7), terminal B, wire 403 orange. Is battery voltage/test light on?

No - Test orange wires No. 403 (W2) and 303 (W2) and black/white wires No. 230 (W3) and 230 (W2) and connections.

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Hour Meter Circuit Operation

Function

To record the number of hours the key switch is in the RUN position.

Operating Conditions

- Key switch in the RUN position
- Park brake ENGAGED or operator ON seat.

NOTE: If the mow/transport lever is in the MOW position, the operator MUST be on the seat.

Theory of Operation

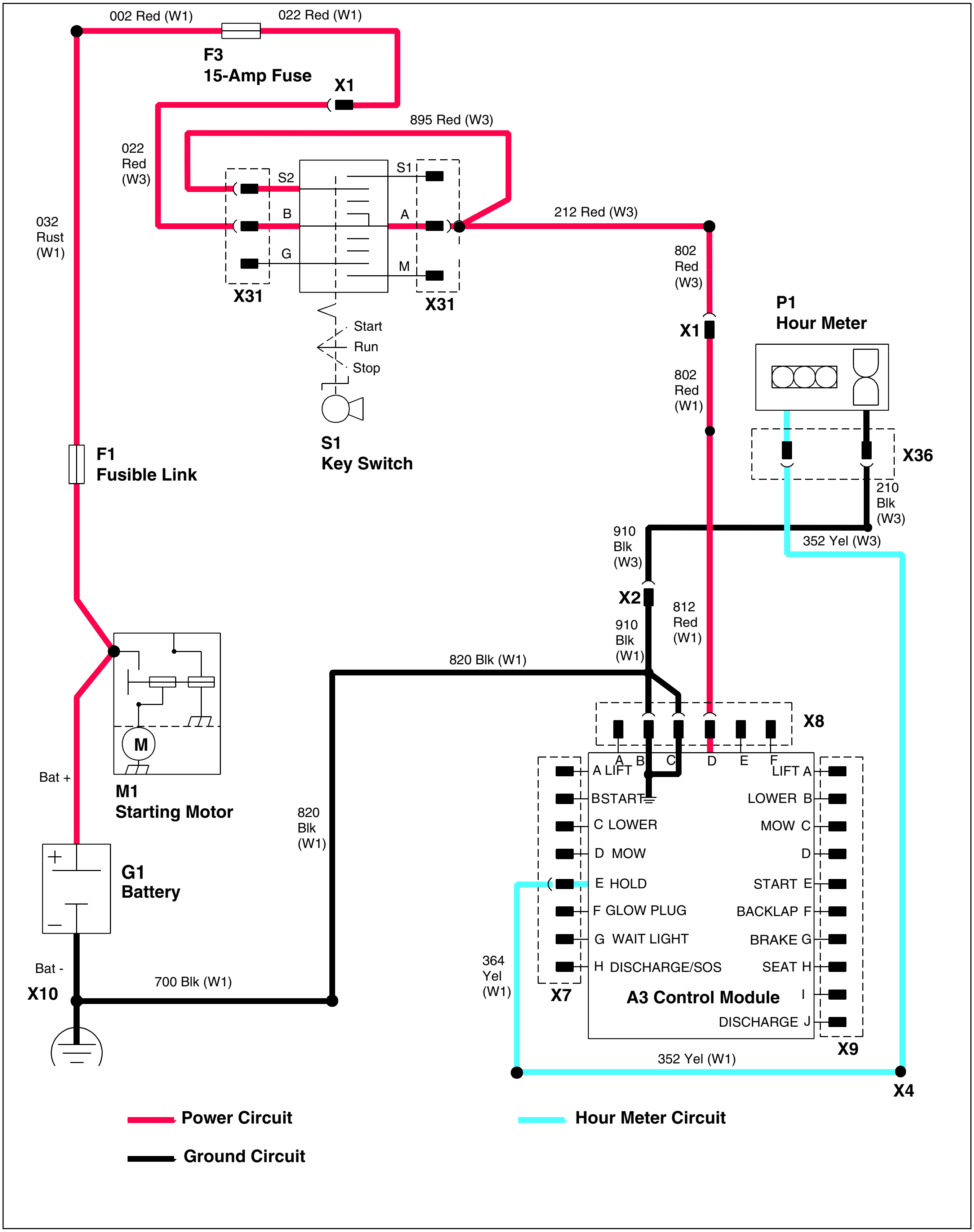
The power circuit provides current to the key switch (S1) and protects the oil pressure warning light circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (rust wire No. 032) and key switch (red wires No. 002 [W2], 222 [W2] and 022 [W3]).

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W2], 802 [W2], 802 [W3] and 212 [W3].

With the control module ON, current flows to the hour meter (P1) (yellow wires No. 352 [W3], 352 [W2] and 364 [W2]). The hour meter will record the number of hours the key switch in the RUN position in 1/10 hour increments.

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W2], 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for both the hour meter and the control module.

Hour Meter Circuit



M98633 (MIF)

Hour Meter Circuit Diagnosis

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See "Electronic Control Module Check" on page 539.)

STEP 2: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

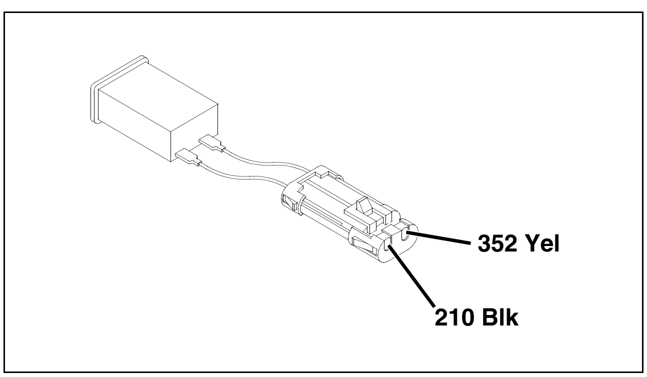
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.
- Mow/transport lever in TRANSPORT position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Key Switch Circuit



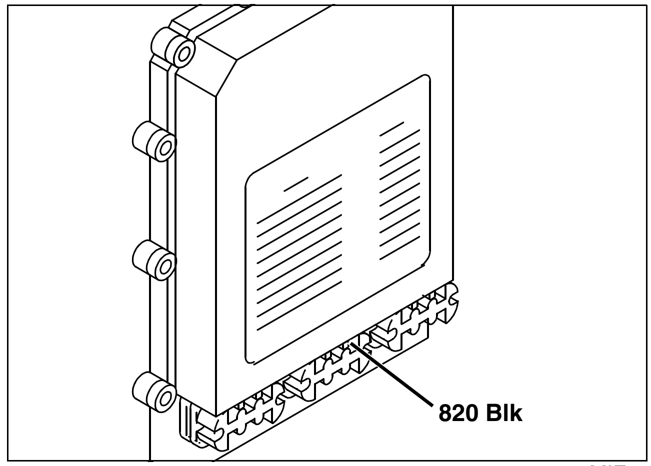
MIF

(1) Check voltage at hour meter (P1) connector (X36), positive (+) terminal, wire 252 yellow. Is battery voltage/test light on?

System: Key Switch Circuit

Yes - Go to step (2).

No - Test red wire No. 895 (W3) and connections.



MIF

(2) Key switch in STOP position.
Electric control module connector (X8) disconnected.
Hour meter connector (X36) disconnected.
Check resistance at hour meter (P1) connector (X36), wire 210 black and electronic control module (A3) connector (X8), terminal B, wire 820 black. Is resistance less than 0.1 ohm?[1]

No - Test black wires No. 210 (W3), 910 (W3), 910 (W2) and 820 (W2) and connections.

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Cutting Unit - Raise Circuit Operation - Models 2500, 2500A (S.N. -020000)

Function

To engage the cutting unit raise system.

Operating Conditions

- Key switch in the RUN position.
- Engine running.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cutting unit raise circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 322 [W2] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W2], 802 [W2], 802 [W3] and 212 [W3].

Current also flows to the raise switch (S6) located on the lift and lower lever assembly in the console (red wires No. 852 [W3] and 212 [W3]), and if equipped to the optional floor-mounted raise switch (S7) (red wires No. 752 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3]).

Current is also supplied to the raise valve solenoid (Y3) located on the raise valve assembly (red wires 412 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3]). The ground side of the raise valve solenoid is connected to the control module - connector X7, terminal A (green wire No. 701 [W2]).

As either raise switch is activated, current is supplied to the control module - connector X9, terminal A. The control module complete the path to ground for the raise valve solenoid, energizing the solenoid.

A time delay feature in the electric control module will keep the raise valve solenoid engaged for approximately four seconds, to ensure that the cutting units have been fully raised.

The ground circuit (black wires No. 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for the control module.

Cutting Unit - Lower Circuit Operation - Models 2500, 2500A (S.N. -020000)

Function

To lower the cutting units.

Operating Conditions

- Key switch in the RUN position

Theory of Operation

NOTE: The cutting unit lower system is gravity assisted, and does not require hydraulic oil pressure to function.

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 322 [W2] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W2], 802 [W2], 802 [W3] and 212 [W3].

Current also flows to the lower switch (S8) located on the lift and lower lever assembly in the console (red wires No. 842 [W3] and 212 [W3]), and if equipped to the optional floor-mounted lower switch (S9) (red wires No. 742 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3]).

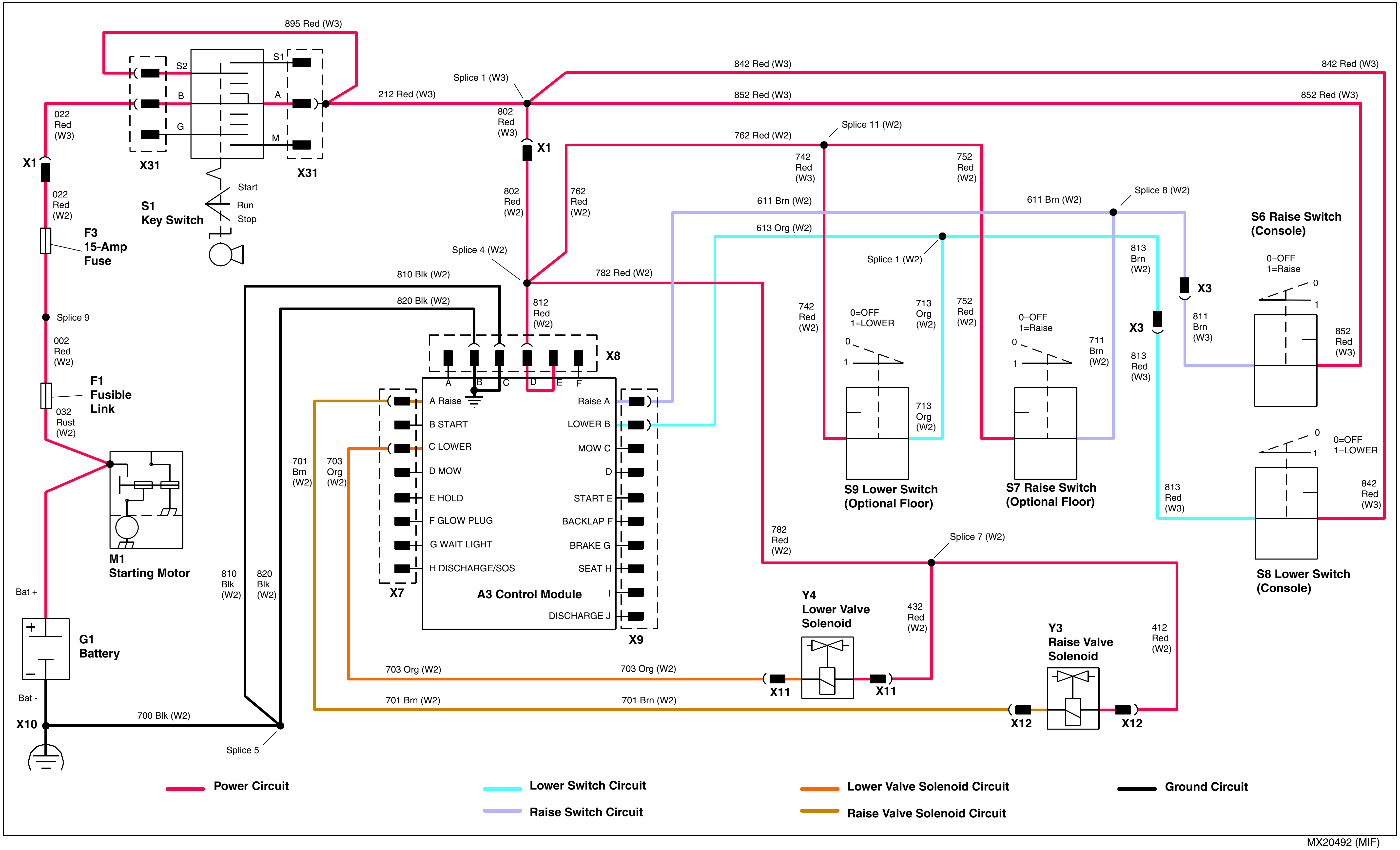
Current is also supplied to the lower valve solenoid (Y4) located on the raise valve assembly (red wires 432 [W2], 762 [W2], 802 [W2], 802 [W3] and 212 [W3]). The ground side of the lower valve solenoid is connected to the control module - connector X7, terminal C (orange wire No. 703 [W2]).

As either lower switch is activated, current is supplied to the control module - connector X9, terminal B. The control module completes the path to ground for the lower valve solenoid, energizing the solenoid.

A time delay feature in the control module will keep the lower valve solenoid engaged for approximately four seconds, to ensure that the cutting units have been fully lowered.

The ground circuit (black wires No. 210 [W3], 910 [W3], 910 [W2], 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for the control module.

Cutting Unit - Raise/Lower Circuit - Models 2500, 2500A (S.N. -020000)



Lift and Lower Circuit Diagnosis - Models 2500, 2500A (S.N. -020000)

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks.

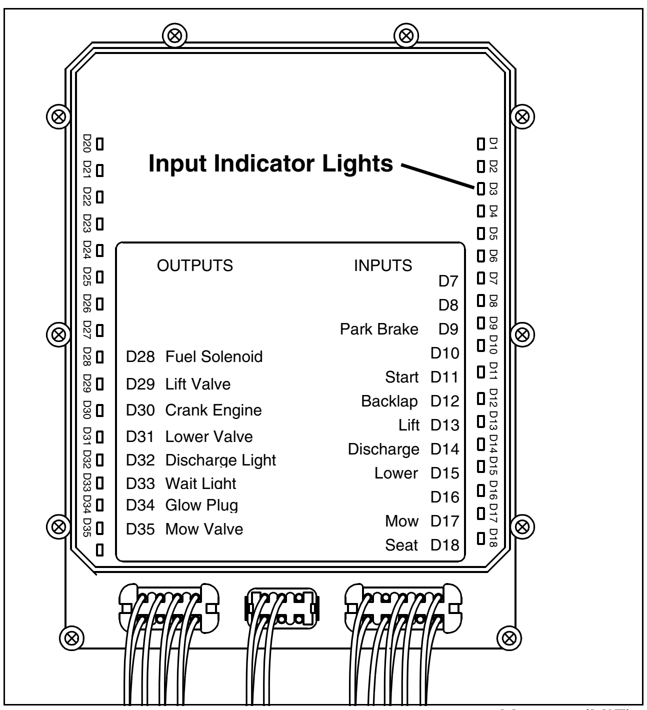
IMPORTANT: Avoid damage! Steps must be performed in sequence.

STEP 1: ELECTRONIC CONTROL MODULE CHECK

Perform electronic control module test. (See “Electronic Control Module Check” on page 539.)

STEP 2: INPUT CIRCUIT LIGHT CHECK

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.



M98629 (MIF)

Test Conditions:

- Key switch in RUN position.

Lower Switch Input/Lower Valve Output

1. Raise and lock seat platform.

2. Move lift/lower lever to LOWER position, or depress optional floor-mounted LOWER switch.

3. Observe the LOWER input light (D15). The light should be ON when either lower switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lower switches are activated, test lower switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 490.)

4. Observe the LOWER VALVE output light (D31). The light should be ON when either lower switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lower switches are activated, replace electronic control module.

Lift Switch Input/Lift Valve Output

1. Move lift/lower lever to LIFT position, or depress optional floor-mounted LIFT switch.

2. Observe the LIFT input light (D13). The light should be ON when either lift switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lower switches are activated, test lift switch circuit. (See “STEP 3: CIRCUIT TESTS” on page 490.)

3. Observe the LIFT VALVE output light (D29). The light should be ON when either lift switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lift switches are activated; Replace electronic control module.

STEP 3: CIRCUIT TESTS

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

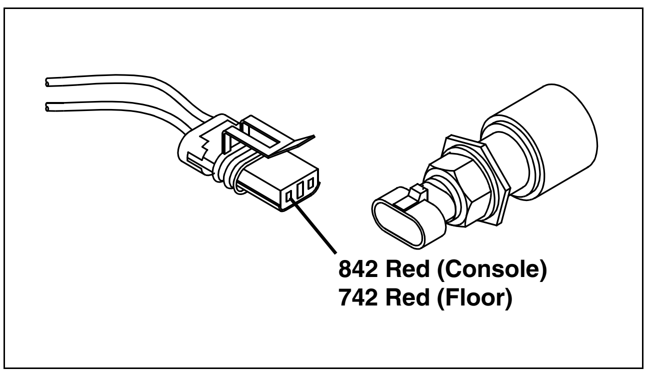
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower switch connectors (X34) (console) or (X11) (floor) disconnected.

System: Lower Switch Circuit



MIF

(1) Check voltage at console lower switch (S8) connector (X34), wire 842 red. Is battery voltage/ test light on?

Yes - Go to step (2).

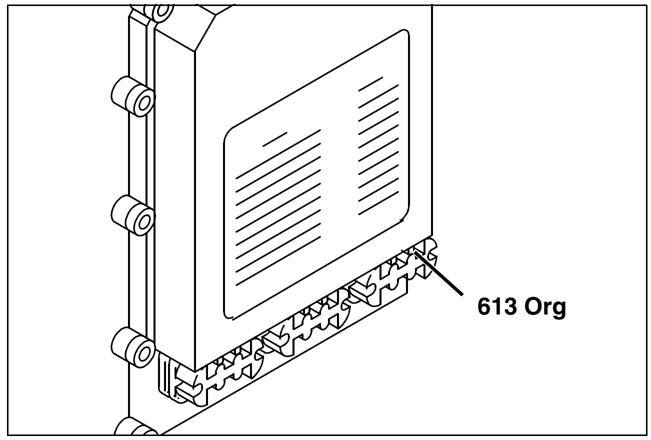
No - Test red wires No. 842 (W3) and 212 (W3) and connections.

(2) Check voltage at optional floor-mounted lower switch (S9) connector (X24), wire 742 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test red wires No. 742 (W2), 762 (W2), 802 (W2), 802 (W3) and 212 (W3) and connections.

System: Lower Switch Circuit



MIF

(3) Lower switches engaged.
Lower switch connectors (X34) (console) or (X11) (floor) connected.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal B, wire 613 orange. Is battery voltage/test light on?

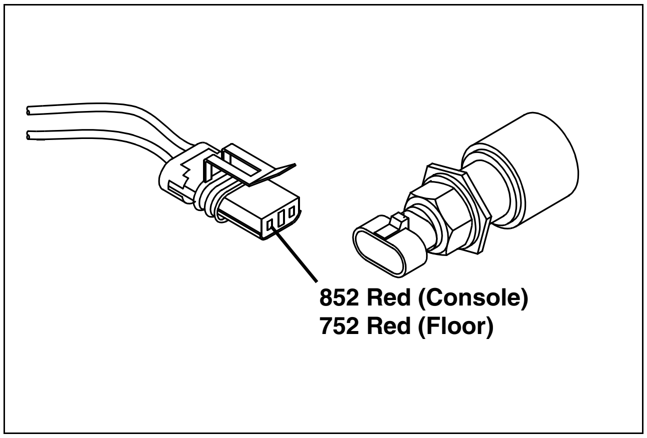
No - Test orange wire No. 613 (W2) and red wires No. 813 (W2) and 813 (W3) - Console switch or orange wire No. 713 (W2) - Optional floor-mounted switch and connections.

No - Test lower switch(es). (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lift switch connectors (X35) (console) or (X23) (floor) disconnected.

System: Lift Switch Circuit



MIF

(1) Check voltage at console lift switch (S6) connector (X35), wire 852 red. Is battery voltage/ test light on?

Yes - Go to step (2).

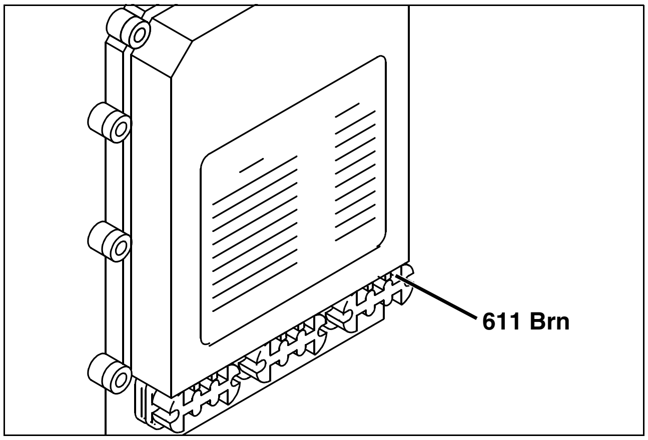
No - Test red wires No. 852 (W3) and 212 (W3) and connections.

(2) Check voltage at optional floor-mounted lift switch (S7) connector (X23), wire 752 red. Is battery voltage/test light on?

Yes - Go to step (3).

No - Test red wires No. 752 (W2), 762 (W2), 802 (W2), 802 (W3) and 212 (W3) and connections.

System: Lift Switch Circuit



MIF

(3) Lift switches engaged.
Lift switch connectors (X35) (console) or (X23) (floor) connected.
Electronic control module connector (X9) disconnected.
Check voltage at electronic control module (A3) connector (X9), terminal A, wire 311 brown. Is battery voltage/test light on?

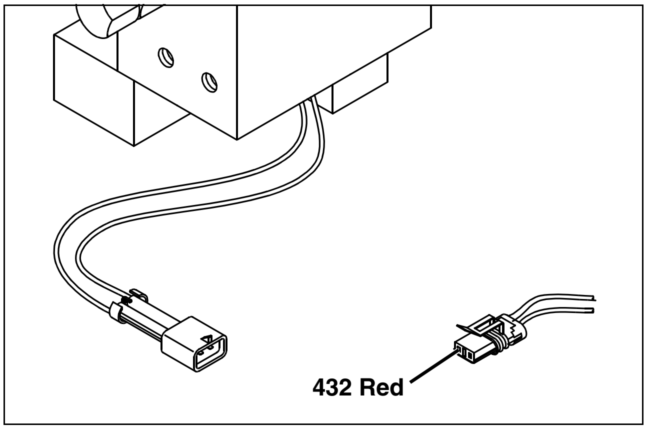
No - Test brown wires No. 611 (W2), 811 (W2) and 811 (W3) - Console switch or brown wires No. 611 (W2), 711 (W2) - Optional floor-mounted switch and connections.

No - Test lift switch(es). (See "Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)" on page 552.)

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower valve solenoid connector (X11) disconnected.

System: Lower Valve Solenoid Circuit

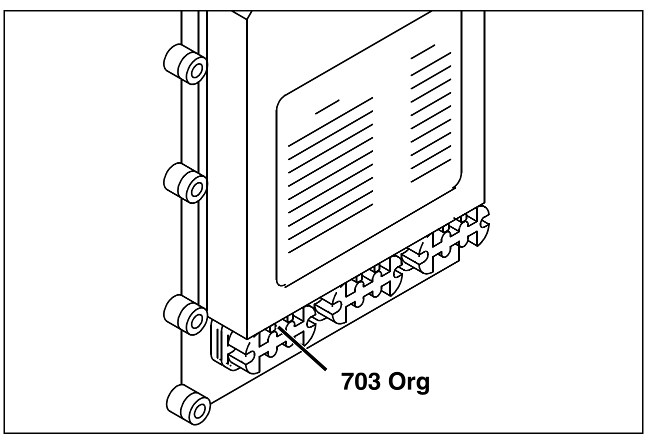


MIF

(1) Check voltage at lower valve solenoid (Y4) connector (X11), wire 432 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test red wires No. 432 (W2) 782 (W2), 802 (W2) and 802 (W3) and connections.



MIF

(2) Electronic control module connector (X7) disconnected.
Check resistance at lower valve solenoid (Y4) connector (X11) to electronic control module (A3) connector (X7), terminal C. Is resistance less than 0.1 ohm?[1]

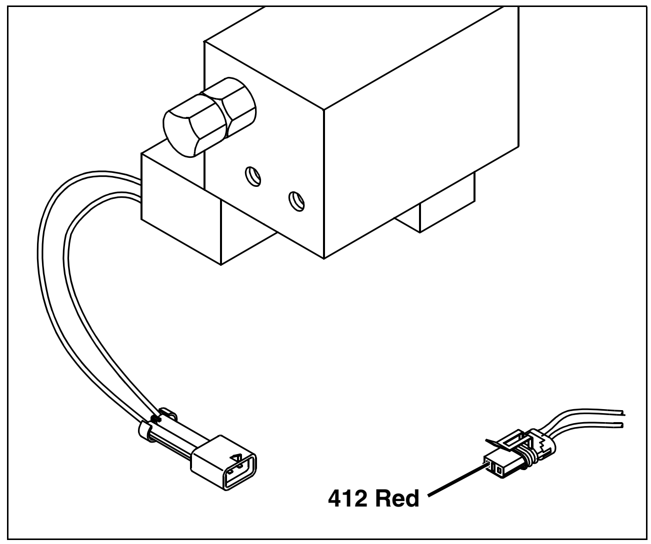
No - Test orange wire No. 703 (W2).

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Test Conditions:

- Key switch in RUN position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Lower valve solenoid connector (X11) disconnected.

System: Lift Valve Solenoid Circuit



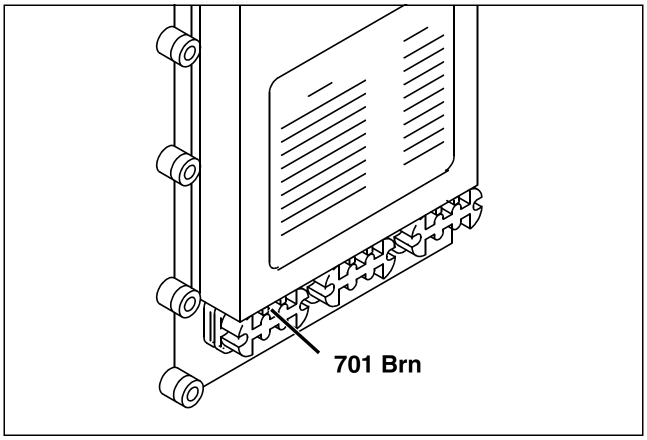
MIF

(1) Check voltage at lift valve solenoid (Y3) connector (X12), wire 412 red. Is battery voltage/ test light on?

Yes - Go to step (2).

No - Test red wires No. 412 (W2) 782 (W2), 802 (W2) and 802 (W3) and connections.

System: Lift Valve Solenoid Circuit



MIF

(2) Electronic control module connector (X7) disconnected.
Lift valve solenoid (Y4) connector (X11) to Check voltage at electronic control module (A3) connector (X7), terminal A. Is resistance less than 0.1 ohm?[1]

No - Test brown wire No. 701 (W2).

1. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Cutting Unit - Mow Circuit Operation Models 2500, 2500A

Function

To engage the reel motors when the cutting units are lowered.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Mow/transport switch in MOW position.
- Backlap switch in MOW (OFF) position.
- Operator on seat (seat switch engaged).
- Cutting units lowered to the ground.

Theory of Operation

NOTE: If the mow circuit is engaged while the cutting units are in the raised position, the cutting units will not start until the cutting units are lowered.

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W1], 322 [W1] and 332 [W3]), to key switch “B” terminal.

With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W1], 802 [W1], 802 [W3] and 212 [W3].

Current is also supplied to the seat switch (S3) (red wires No. 892 [W1], 762 [W1], 802 [W3] and 212 [W3], backlap switch (S4) (red wires No. 422 [W1], 762 [W1], 802 [W3] and 212 [W3], mow valve solenoid (Y2) (red wires No. 412 [W1], 422 [W1], 762 [W1], 802 [W3] and 212 [W3] and mow/transport switch (S5) (red wires No. 872 [W11 - optional third wheel assist], 872 [W1], 762 [W1], 802 [W3] and 212 [W3].

With the operator on the seat, current flows to connector X9, pin K of the control module (gray wire No. 808 [W1]), enabling the mow circuit.

As the mow/transport switch is moved the to MOW position, current flows to connector X9, pin C of the control module (yellow wires No. 924 and 934 [W11 - optional third wheel assist], and 924 [W1]). The control module will then complete the path to ground for the mow valve solenoid (blue/white wire No. 766 [W1]), activating the mow valve and engaging the reel drive motors.

The ground circuit (black wires No. 810 [W1], 820 [W1] and 700 [W1]) provides a path to ground for the control module.

Cutting Unit - Backlap Circuit Operation - Models 2500, 2500A

Function

To engage the reel motors when the cutting units are lower and the backlap switch is in the BACKLAP position.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Backlap switch in BACKLAP position.
- Cutting units lowered to the ground.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 322 [W2] and 332 [W3]), to key switch “B” terminal.

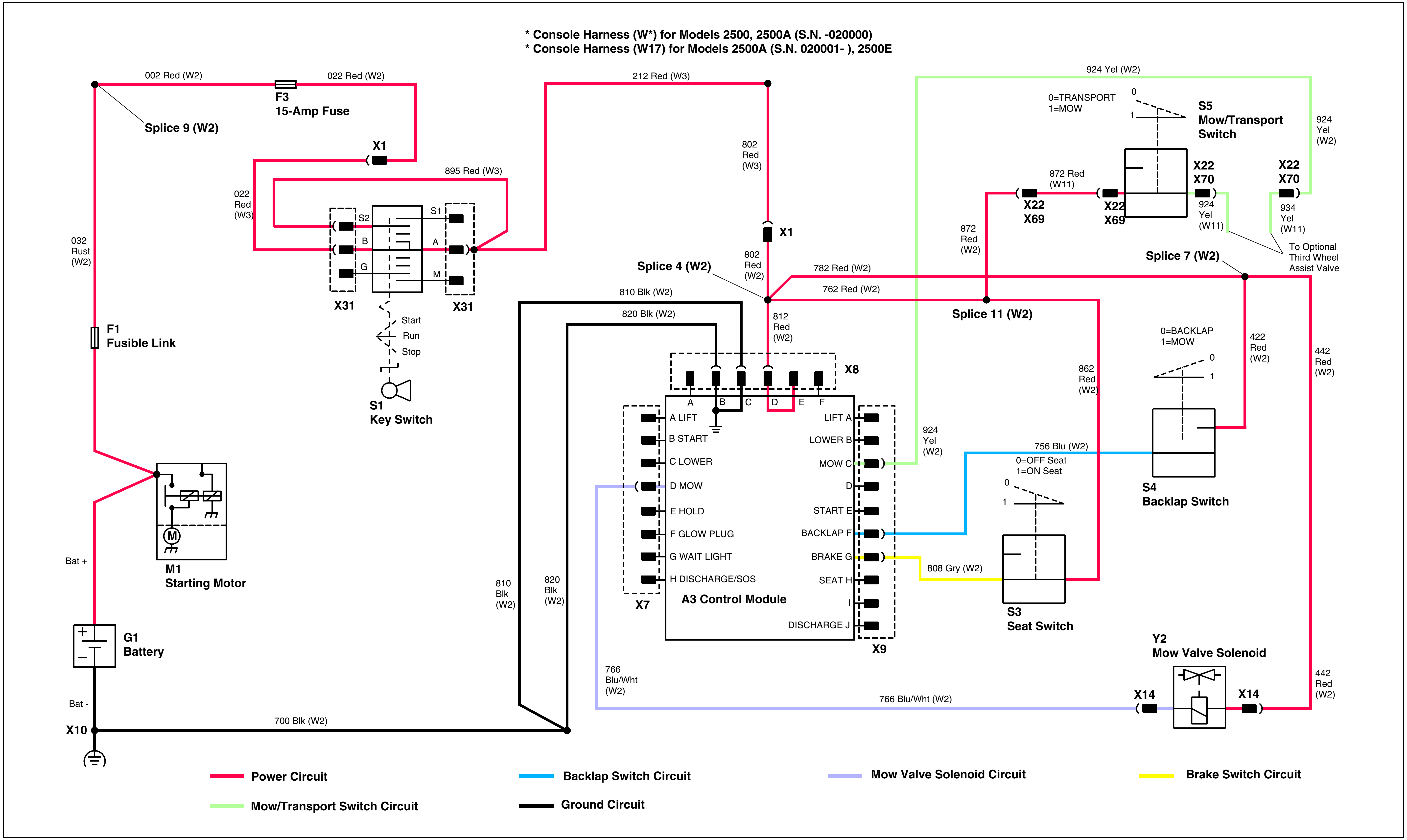
With the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) (red wires No. 812 [W2], 802 [W2], 802 [W3] and 212 [W3].

Current is also supplied to the seat switch (S3) (red wires No. 892 [W2], 762 [W2], 802 [W3] and 212 [W3], backlap switch (S4) (red wires No. 422 [W2], 762 [W2], 802 [W3] and 212 [W3], mow valve solenoid (Y2) (red wires No. 412 [W2], 422 [W2], 762 [W2], 802 [W3] and 212 [W3] and mow/transport switch (S5) (red wires No. 872 [W11 - optional third wheel assist], 872 [W2], 762 [W2], 802 [W3] and 212 [W3].

As the backlap switch is moved the to BACKLAP position, current flows to connector X9, pin F of the control module (blue wire No. 756 [W2]). The control module will then complete the path to ground for the mow valve solenoid (blue/white wire No. 766 [W2]), activating the mow valve and engaging the reel drive motors.

The ground circuit (black wires No. 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for the control module.

Cutting Unit - Mow and Backlap Circuit - Models 2500, 2500A (S.N. -020000)



MX20869 (MIF)

Mow/Backlap Circuit Diagnosis - Models 2500, 2500A

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See “Electronic Control Module Check” on page 539.)

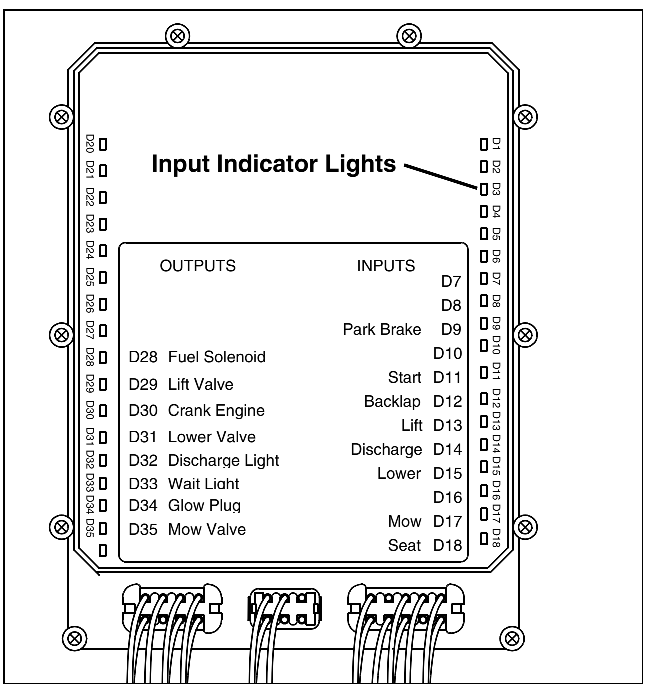
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Seat Switch Input

1. Move key switch to RUN position.
2. Press down on the lower cushion of the seat to engage the seat switch.
3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).
4. Release the seat switch.
5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See “Seat Switch Circuit Test” on page 382.)

Brake Switch Input

1. Move key switch to RUN position.
2. Depress the park brake pedal.
3. Observe the BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).
4. Release the park brake pedal.
5. Observe the BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON or OFF, first check brake switch adjustment (See “Adjust Park Brake Switch” on page 729.) If brake light does not come ON after adjustment, test brake switch circuit. (See “Brake Switch Circuit Test” on page 383.)

Mow/Transport Switch Input

1. Move key switch to RUN position.
2. Move mow/transport lever to MOW position.
3. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See “Mow/Transport Switch Circuit Test” on page 384.)

Backlap Switch Input

1. Move key switch to RUN position.
2. Move the backlap valve to the MOW position.
3. Observe the BACKLAP input light (D12). The light should be ON when the backlap valve is in the BACKLAP position and OFF when the valve is in the MOW position.

If the light does not function as described; Test the Backlap Switch Circuit. (See “Backlap Switch Circuit Test” on page 502.)

Step 3: Circuit Tests

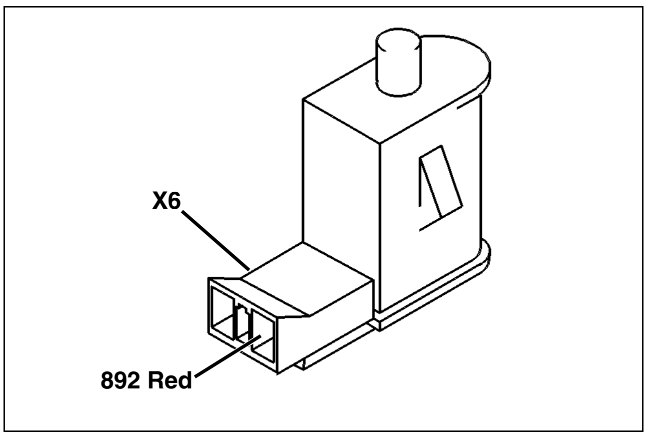
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

Seat Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Seat Switch Circuit



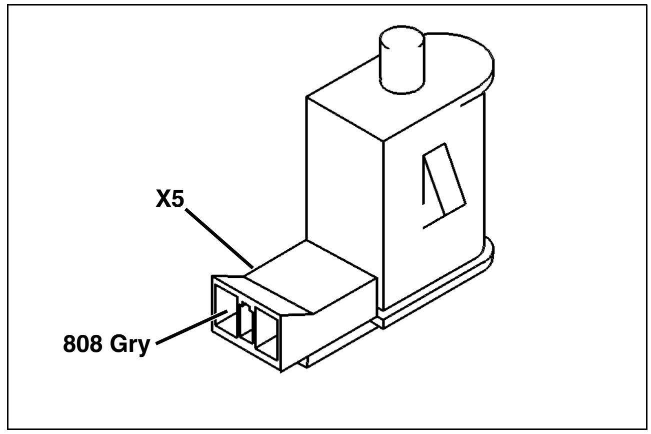
MIF

(1) Check voltage at seat switch connector (X6), wire 892 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 892 red (W2) and connections.

System: Seat Switch Circuit

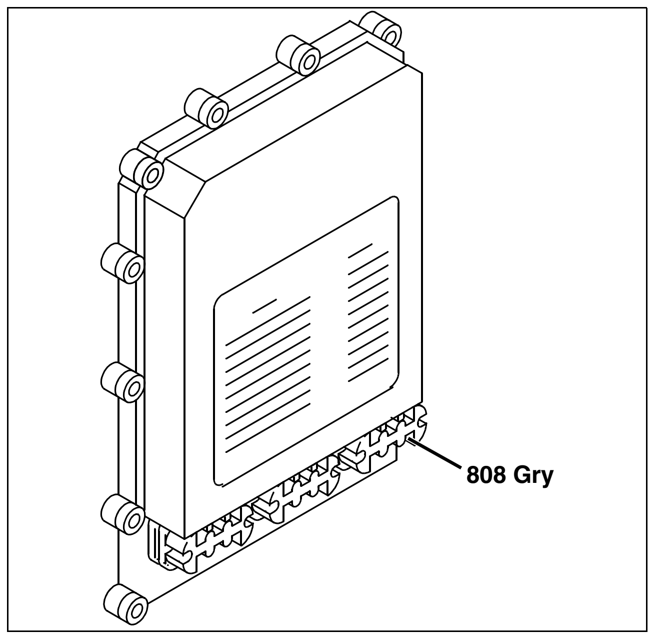


MIF

(2) Check voltage at seat switch connector (X5), wire 808 gry. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. See "Test Seat Switch" on page 553.



MIF

(3) Check voltage at electronic control module connector (X9) - terminal H, wire 808 gry. Is battery voltage present?

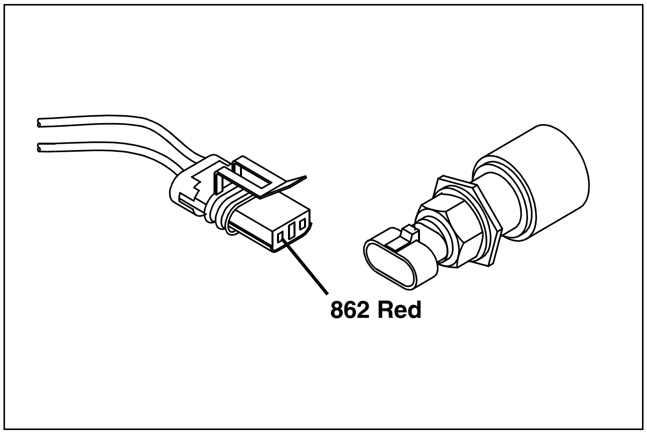
No - Test wire 808 gry and connections.

Brake Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake engaged.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Brake Switch Circuit



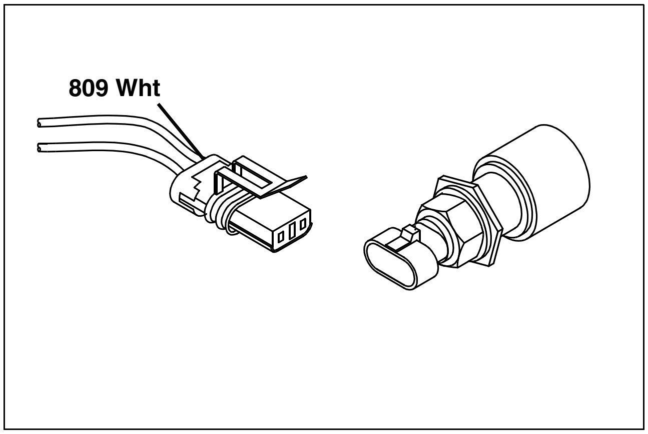
MIF

(1) Brake switch disconnected. Check voltage at brake switch connector (X18) - wire 862 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 862 red (W2) and connections.

System: Brake Switch Circuit

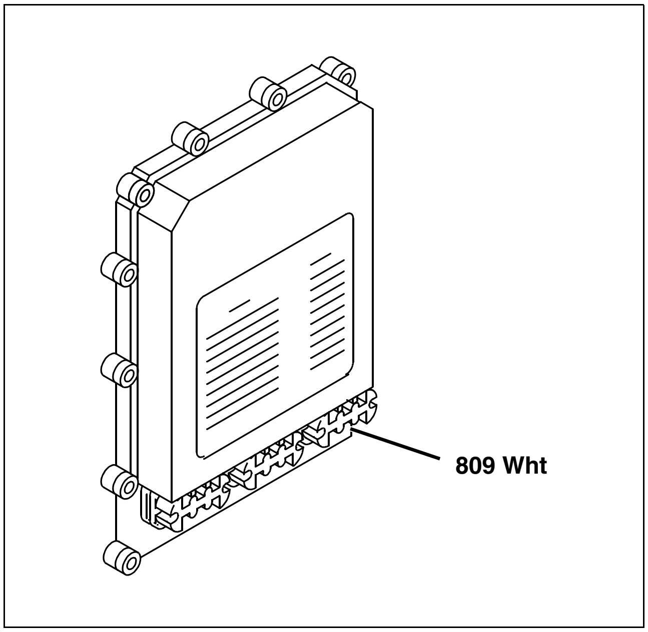


MIF

(2) Brake switch connected. Check voltage at brake switch connector (X18) - wire 809 wht. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)



MIF

(3) Check voltage at electronic control module connector (X9) - terminal G, wire 809 wht. Is battery voltage present?

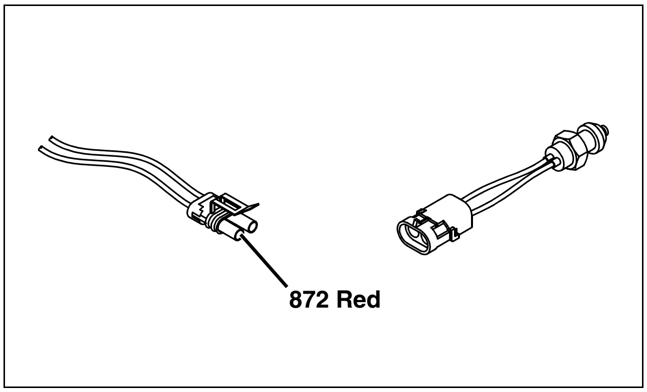
No - Test wire 809 wht and connections.

Mow/Transport Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow/Transport Switch Circuit

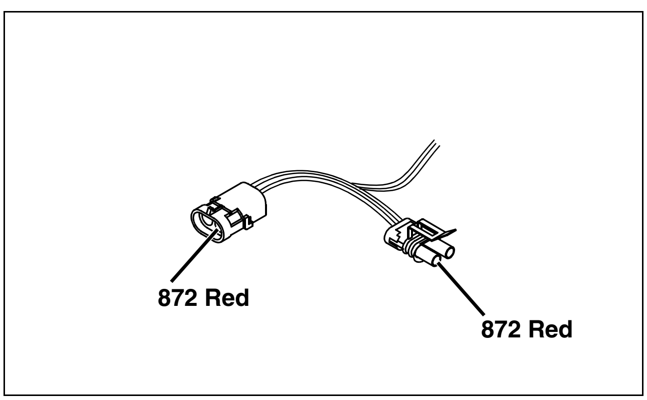


MIF

(1) Mow/transport switch connector disconnected. Measure voltage at mow/transport switch connector (X22) - wire 872 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 872 red (W2) and connections.



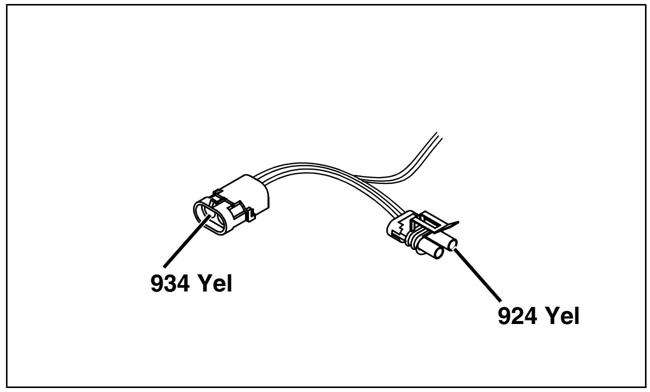
MIF

(2) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wire 872 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wire 872 red (W11) and connections.

System: Mow/Transport Switch Circuit

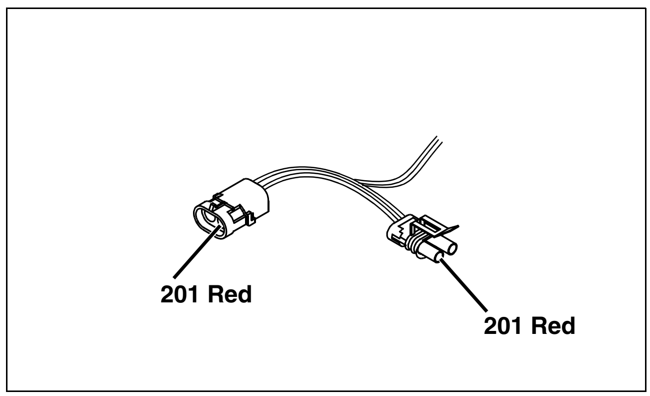


MIF

(3) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wires 924 and 934 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (4).

No - Test wires 924 and 934 yel (W11) and connections.



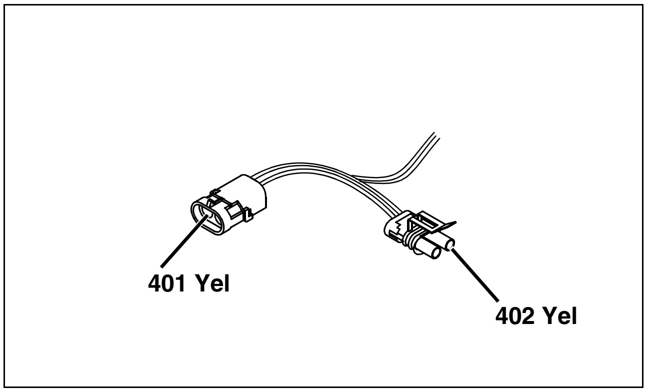
MIF

(4) Measure continuity between reel motor power harness (W16) connectors (X92 and X93) - wire 201 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (5).

No - Test wire 201 red (W16) and connections.

System: Mow/Transport Switch Circuit

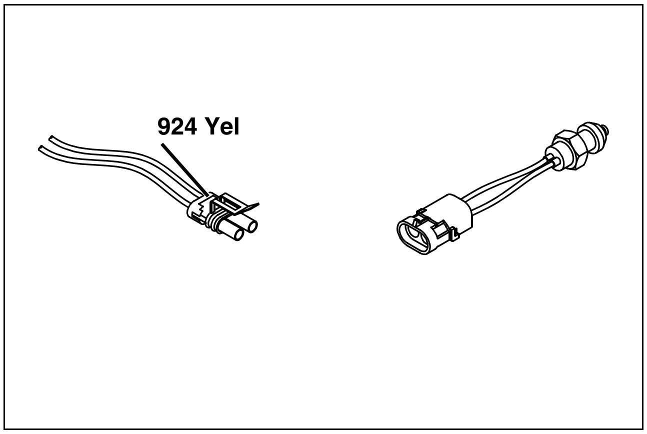


MIF

(5) Measure continuity between reel motor power harness (W16) connectors (X92 and X93) - wires 401 and 402 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (6).

No - Test wires 401 and 402 yel (W16) and connections.



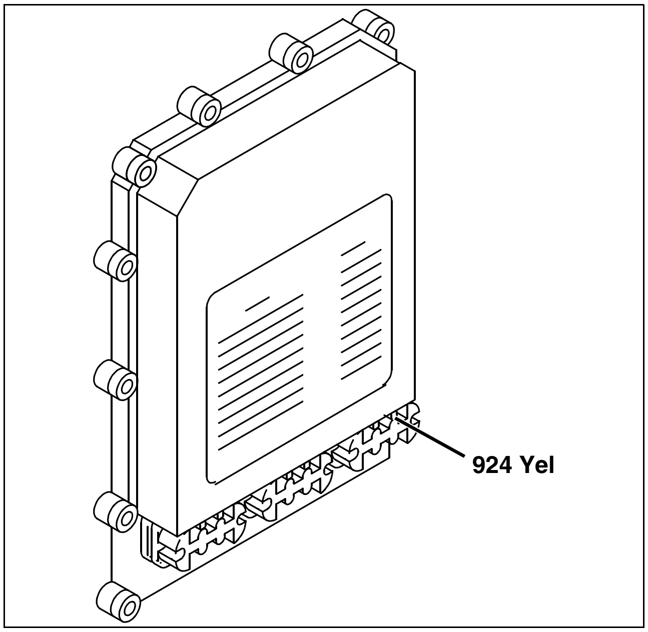
MIF

(6) Mow/transport switch connected to reel power harness connector (X92). Main harness-to-mow/ transport switch connector (X22) connected to reel power harness connector (X93) and if installed third wheel assist connectors. Measure voltage at mow/transport switch connector (X22) - wire 924 yel. Is battery voltage present?

Yes - Go to step (7).

No - Test switch. (See "Test Mow/Transport Switch" on page 553.)

System: Mow/Transport Switch Circuit



MIF

(7) Check voltage at electronic control module connector (X9) - terminal C, wire 924 yel. Is battery voltage present?

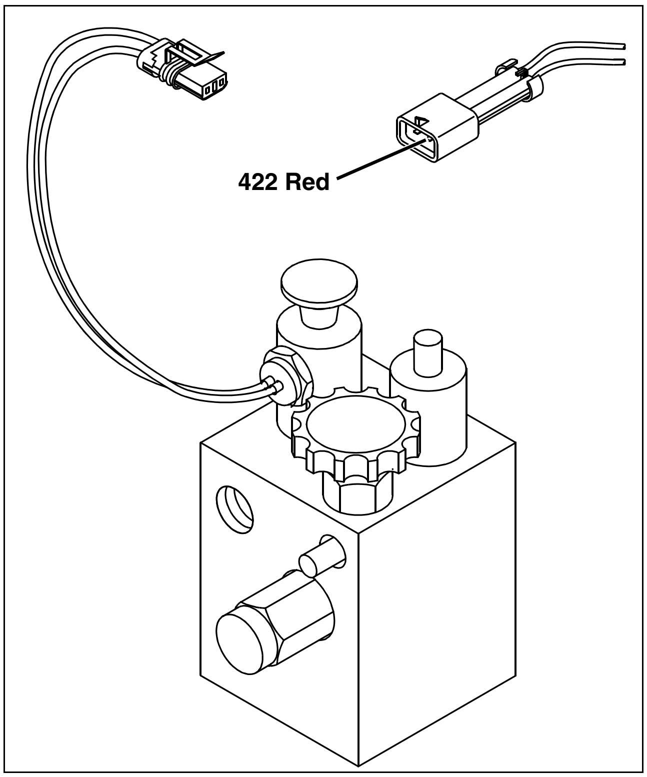
No - Test wire 924 yel and connections.

Backlap Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Backlap Switch Circuit

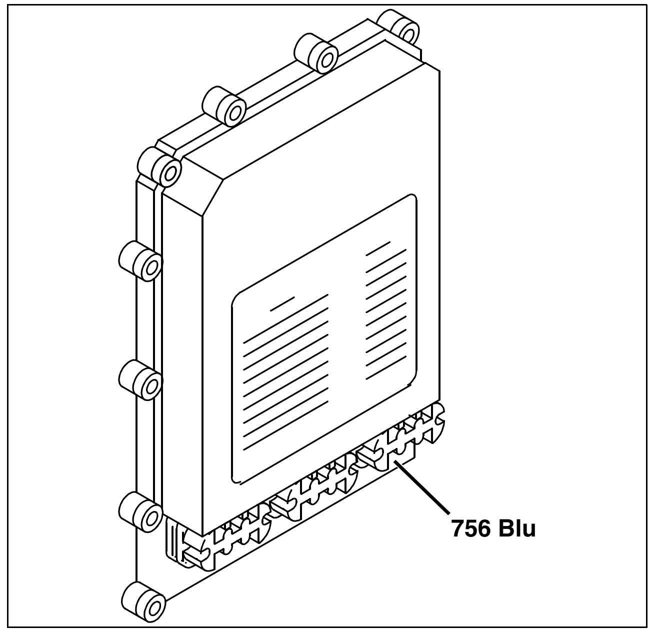


(1) Check voltage at backlap switch connector (X15) - wire 422 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 422 red and connections.

System: Backlap Switch Circuit



(2) Backlap switch connector (X15) connected. Backlap switch in BACKLAP position. Electronic control module connector (X9) disconnected. Check voltage at electronic control module connector (X9) - terminal F, wire 756 blu. Is battery voltage present?

No - Test wire 756 blu and connections.

No - Test backlap switch. (See “Test Backlap Switch - Models 2500, 2500A” on page 556.)

Cutting Unit - Lift and Lower Circuit Operation - Models 2500A (S.N. 020001-), 2500E

Function

To raise and lower the cutting units.

Operating Conditions

- Key switch in the RUN position
- Engine operating

Theory of Operation

NOTE: The cutting unit lower system is gravity assisted, and does not require hydraulic oil pressure to function.

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch through wires 002 (W2), 322 (W2) and 332 (W27) red, to key switch terminal B.

The ground circuit provides a path to ground for the control module through wires 700 (W2), 810 (W2) and 820 (W2) blk.

When the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) through wires 812 (W2), 802 (W2), 802 (W27) and 212 (W27) red.

With the key switch in the RUN position, voltage is available to the following:

- Optional floor raise switch (S7):
    - Wire 752 red (W2) to splice 11 (W2).
    - Wire 762 red (W2) to splice 4 (W2).
    - Wire 802 red (W2).
    - Wire 802 red (W27) to splice 1 (W27).
    - Wire 212 red (W27).
- Optional floor lower switch (S9):
    - Wire 742 red (W2) to splice 11 (W2).
    - Wire 762 red (W2) to splice 4 (W2).
    - Wire 802 red (W2).
    - Wire 802 red (W27) to splice 1 (W27).
    - Wire 212 red (W27).
- Raise valve solenoid (Y3):
    - Wire 412 red (W2) to splice 7 (W2).
    - Wire 782 red (W2) to splice 4 (W2).
    - Wire 802 red (W2).
    - Wire 802 red (W27) to splice 1 (W27).
    - Wire 212 red (W27).
- Lower valve solenoid (Y3):
    - Wire 432 red (W2) to splice 7 (W2).
    - Wire 782 red (W2) to splice 4 (W2).
    - Wire 802 red (W2).
    - Wire 802 red (W27) to splice 1 (W27).
    - Wire 212 red (W27).

With the key switch in the RUN position, current also flows to the lift and lower switch (S11) located in the console through wire 842 red (W27).

The lift and lower switch is provided ground through wires 910 (W2), 910 (W27) and 100 (W27) blk and has two outputs. One output goes to the electronic control module connector (X9), terminal A through wires 611 (W2), 811 (W2), 811(W27) brn, to signal the control module when the lift and lower switch is in the RAISE position. The other output goes to terminal B through wires 613 (W2), 813 (W2), 813(W27) org, to signal the control module when the lift and lower switch is in the LOWER position.

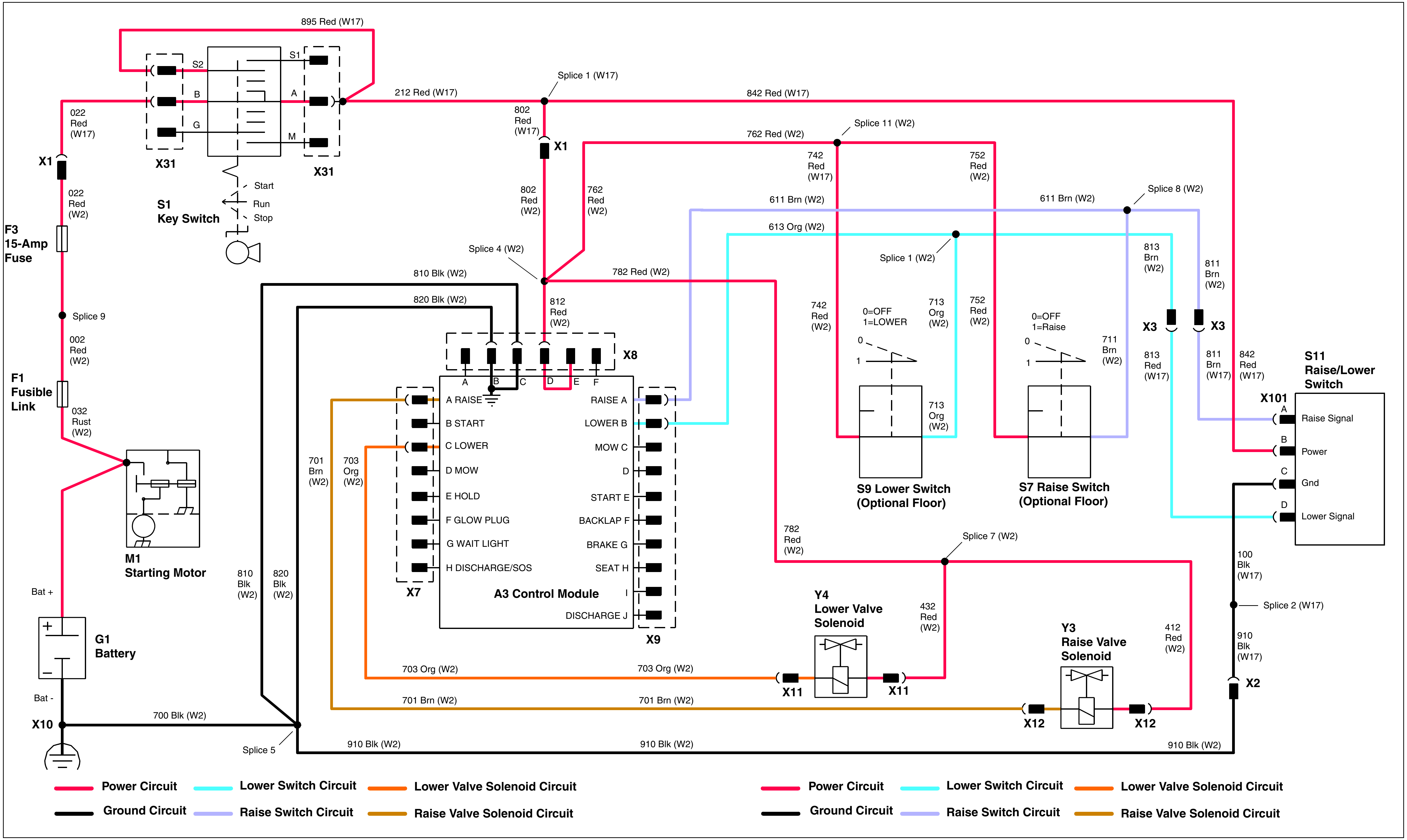
Optional floor raise switch (S7) connects to electronic control module connector (X9), terminal A through wires 611 (W2), 711 (W2) brn, to signal the control module when raise switch is DEPRESSED.

Optional floor lower switch (S9) connects to electronic control module connector (X9), terminal B through wires 613 (W2), 713 (W2) org, to signal the control module when lower switch is DEPRESSED.

When voltage is applied to the electronic control module raise input from either the lift and lower switch or optional floor raise switch, the module provides ground at electronic control module connector (X7), terminal A. When this ground is provided, current flows from the raise solenoid (Y3) to ground through wire 701 brn (W2), energizing the solenoid to raise the cutting units. The electronic control module provides this ground for only about three seconds.

When voltage is applied to the electronic control module lower input from either the lift and lower switch or optional floor lower switch, the module provides ground at electronic control module connector (X7), terminal C. Current flows from the lower solenoid (Y4) to ground through wire 703 org (W2), energizing the solenoid to lower the cutting units. The electronic control module continuously provides this ground once activated.

Cutting Unit - Raise/Lower Circuit Operation - Models 2500A (S.N. 020001-), 2500E



MX20491 diesel (MIF)

Lift and Lower Circuit Diagnosis - Models 2500A (S.N. 020001-), 2500E

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See "Electronic Control Module Check" on page 539.)

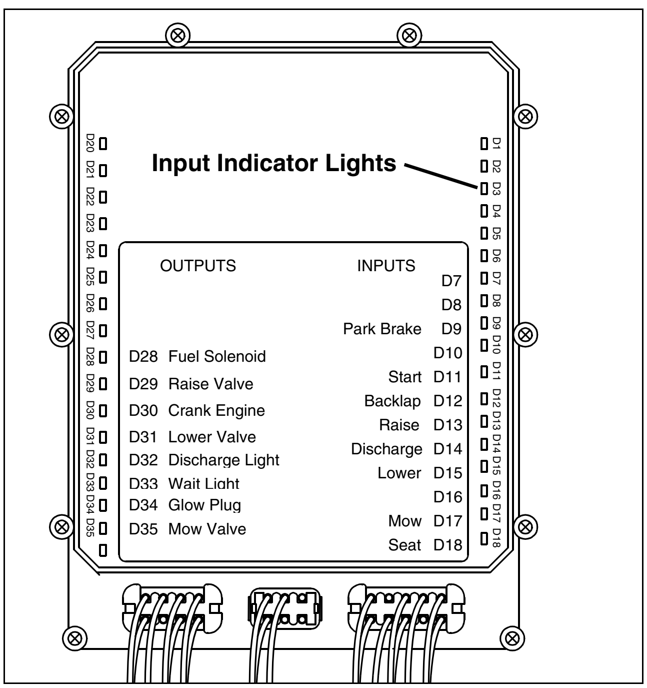
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Lower Switch Input and Lower Valve Output

1. Move key switch to RUN position.

2. Move lift and lower switch to LOWER position, or depress optional floor-mounted lower switch.

3. Observe the LOWER input light (D15). The light should be ON when either switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lift and lower switch is activated, test lift and lower switch circuit. (See "Lift and Lower Switch Circuit Test" on page 392.)

If the light does not come ON when the optional floor-mounted lower switch is activated, test lower switch circuit. (See "Optional Floor Mounted Lower Switch Circuit Test" on page 395.)

4. Observe the LOWER VALVE output light (D31). The light should be ON when either lower switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the lower switches are activated; Replace electronic control module.

If the light operates correctly, but lower solenoid does not energize, test lower solenoid circuit. (See "Lower Solenoid Circuit Test" on page 397.)

Raise Switch Input and Raise Valve Output

1. Move key switch to RUN position.

2. Move lift and lower switch to RAISE position, or DEPRESS optional floor-mounted raise switch.

3. Observe the RAISE input light (D13). The light should be ON when either raise switch is activated, and OFF when the switch(es) are released.

If the light does not come ON when the lift and lower switch is activated, test lift and lower switch circuit. (See "Lift and Lower Switch Circuit Test" on page 392.)

If the light does not come ON when the optional floor-mounted raise switch is activated, test raise switch circuit. (See "Optional Floor Mounted Raise Switch Circuit Test" on page 394.)

4. Observe the RAISE VALVE output light (D29). The light should be ON when the switch is activated and should remain ON for approximately four seconds.

If the light does not come ON when the switches are activated; Replace electronic control module.

If the light operates correctly, but raise solenoid does not energize, test raise solenoid circuit. (See "Raise Solenoid Circuit Test" on page 396.)

Step 3: Circuit Tests

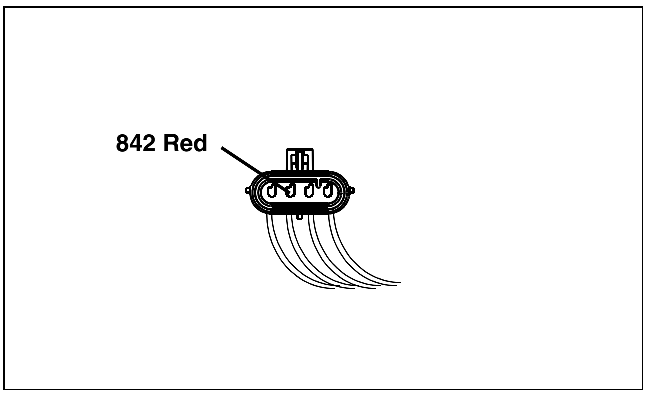
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

Lift and Lower Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lift and Lower Switch Circuit



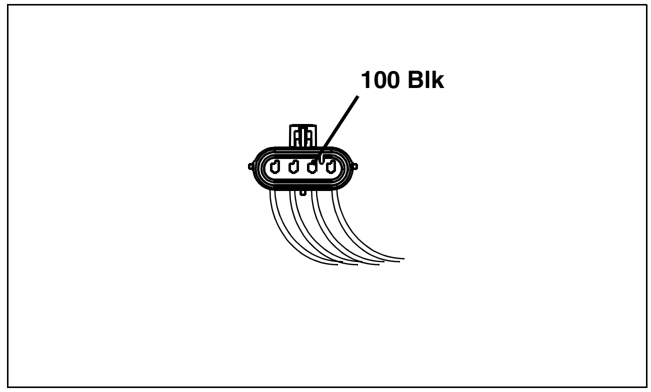
MIF

(1) Disconnect lift and lower switch connector (X83). Measure voltage at lift and lower switch connector (X83) - wire 842 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 842 and 212 red (W27) and connections between lift and lower switch connector and key switch connector.

System: Lift and Lower Switch Circuit

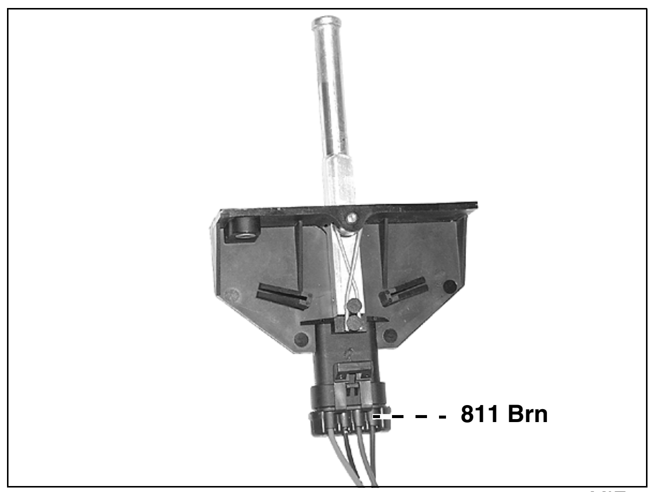


MIF

(2) Measure ground circuit resistance at lift and lower switch connector (X83) - wire 100 blk. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wires 100, 910 blk (W27) and wire 910 blk (W2) and connections.



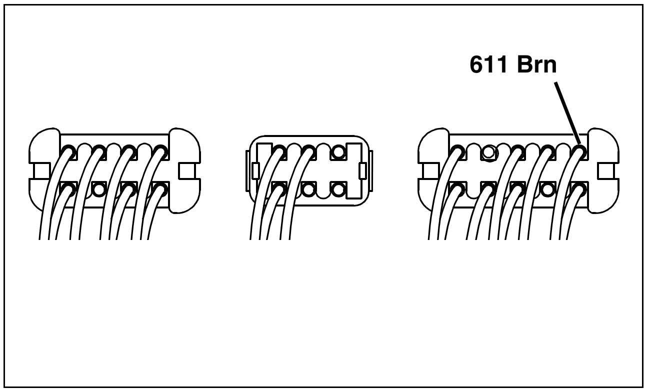
MIF

**(3) Lift and Lower switch connected.Lift and lower switch in the RAISED position.
With a small diameter probe, measure voltage at lift and lower switch connector (X83) - wire 811 brn. Is there battery voltage when the switch is in the RAISED position and NO battery voltage in the RELEASED Position?**

Yes - Go to step (4).

No - Replace lift and lower switch.

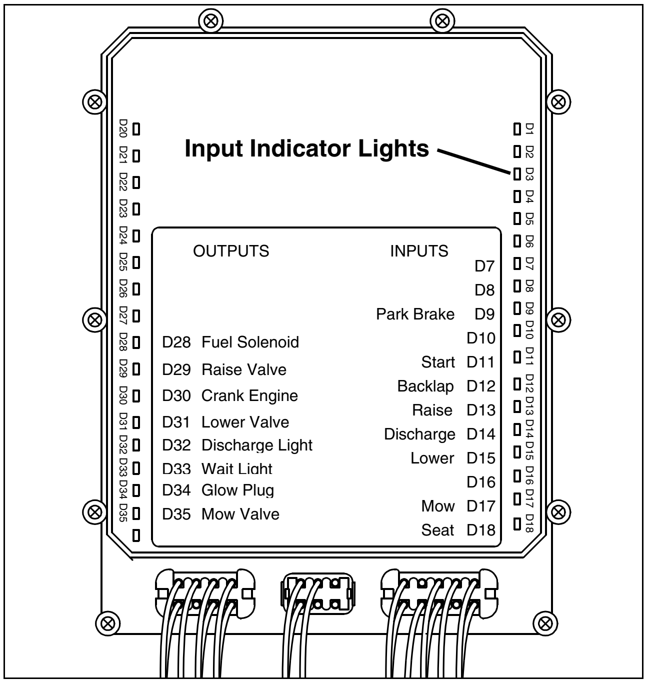
System: Lift and Lower Switch Circuit



(4) With lift and lower switch in the RAISE position, measure voltage at electronic control module connector (X9) - wire 611 brn. Is battery voltage present?

Yes - Go to step (5).

No - Test wires 611, 811 brn (W2) and 811 brn (W27) and connections between lift and lower switch and electronic control module.

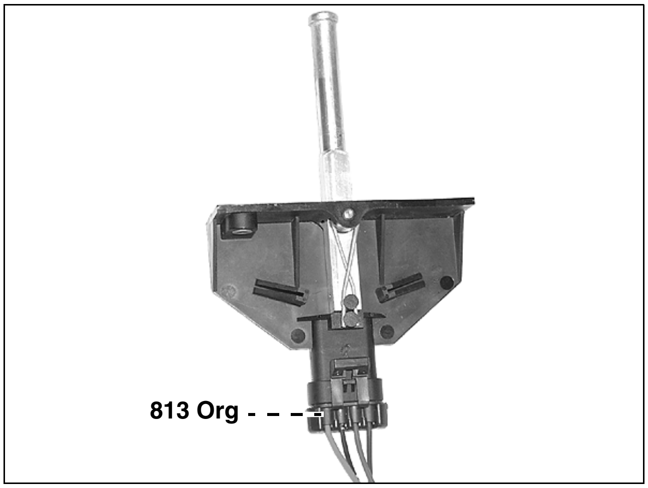


(5) Lift and lower switch (S11) in the RAISE position. Electronic control module (A3) input LED check. Is raise LED ON?

Yes - Go to step (6).

No - Replace control module.

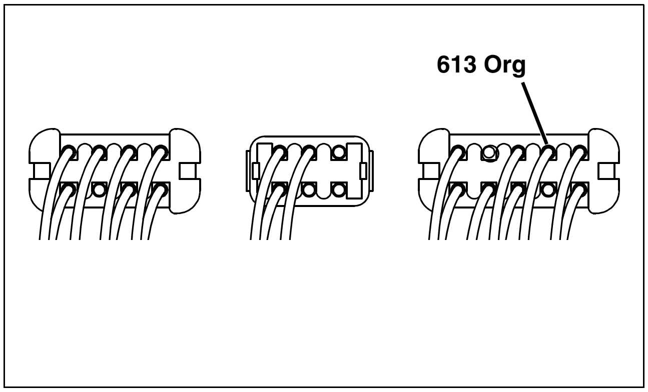
System: Lift and Lower Switch Circuit



(6) Lift and lower switch in the LOWER position. With a small diameter probe, measure voltage at lift and lower switch connector (X83) - wire 813 org. Is there battery voltage when the switch is in the LOWER position and NO battery voltage in the RELEASED Position?

Yes - Go to step (7).

No - Replace lift and lower switch.

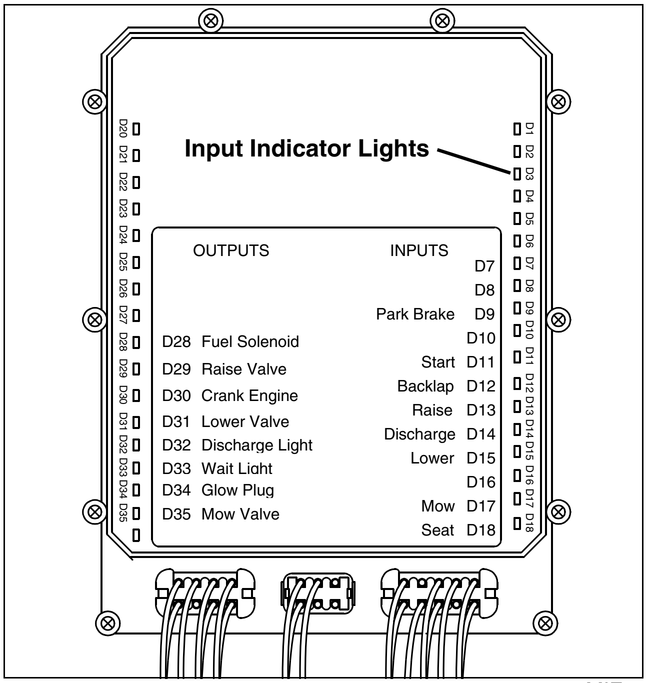


(7) With lift and lower switch in the LOWER position, measure voltage at electronic control module connector (X9) - wire 613 org. Is battery voltage present?

Yes - Go to step (8).

No - Test wires 613, 813 org (W2) and 813 org (W27) and connections between lift and lower switch and electronic control module.

System: Lift and Lower Switch Circuit



MIF

(8) Lift and lower switch (S11) in the LOWER position. Electronic control module (A3) input LED check. Is lower LED ON?

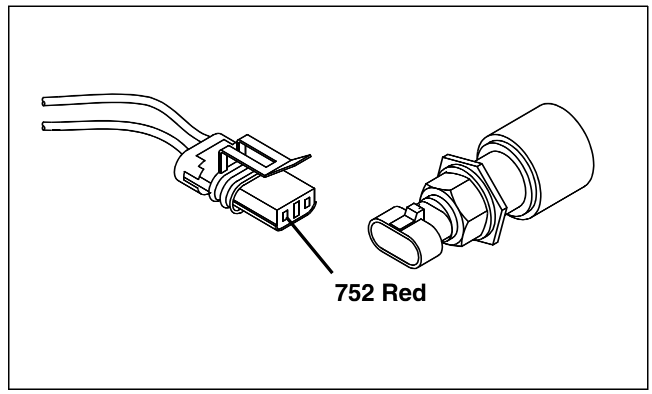
No - Replace control module.

Optional Floor Mounted Raise Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Raise Switch Circuit



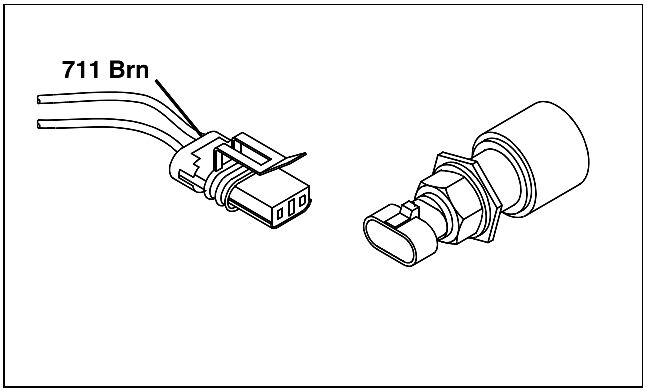
MIF

(1) Disconnect raise switch (floor) connector (X23). Measure voltage at raise switch (floor) connector (X23) - wire 752 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 752, 762, 802 red (W2) and wires 802 and 212 red (W27) and connections between raise switch connector and key switch connector.

System: Raise Switch Circuit

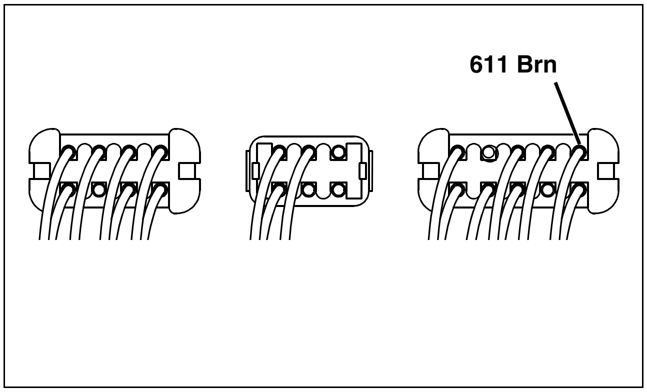


MIF

(2) Raise switch connector (X23) connected. Raise switch (floor) in the DEPRESSED position. Measure voltage at raise switch connector (X23) - wire 711 brn. Is there battery voltage when the switch is in the DEPRESSED position and NO battery voltage in the RELEASED Position?

Yes - Go to step (3).

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)



MIF

(3) With raise switch (floor) in the DEPRESSED position, measure voltage at electronic control module connector (X9) - wire 611 brn. Is battery voltage present?

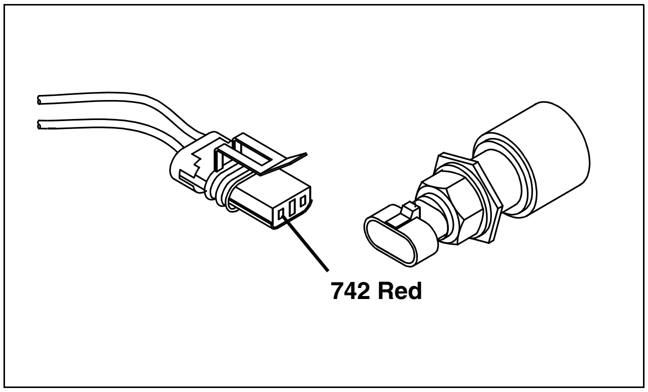
No - Test wires 611, 711 brn (W2) and connections between raise switch and electronic control module.

Optional Floor Mounted Lower Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lower Switch Circuit



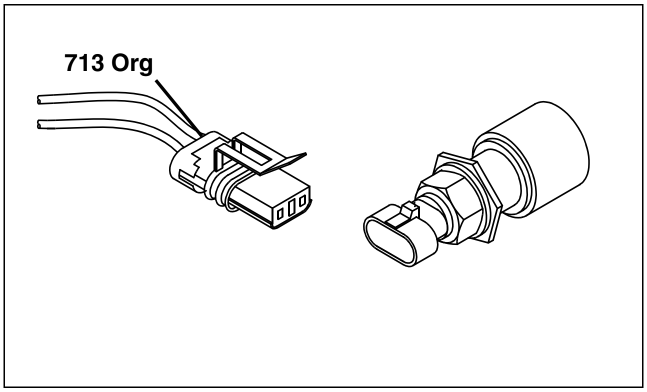
MIF

(1) Disconnect lower switch (floor) connector (X24). Measure voltage at lower switch (floor) connector (X24) - wire 742 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wires 742, 762, 802 red (W2) and wires 802 and 212 red (W27) and connections between raise switch connector and key switch connector.

System: Lower Switch Circuit

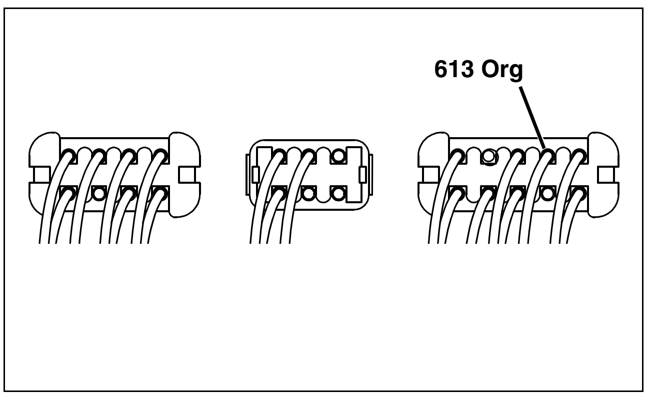


MIF

(2) Lower switch connector (X24) connected. Lower switch (floor) in the DEPRESSED position. Measure voltage at lower switch connector (X24) - wire 713 org. Is there battery voltage when the switch is in the DEPRESSED position and NO battery voltage in the RELEASED Position?

Yes - Go to step (3).

No - Test switch. (See "Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)" on page 552.)



MIF

(3) With lower switch (floor) in the DEPRESSED position, measure voltage at electronic control module connector (X9) - wire 613 org. Is battery voltage present?

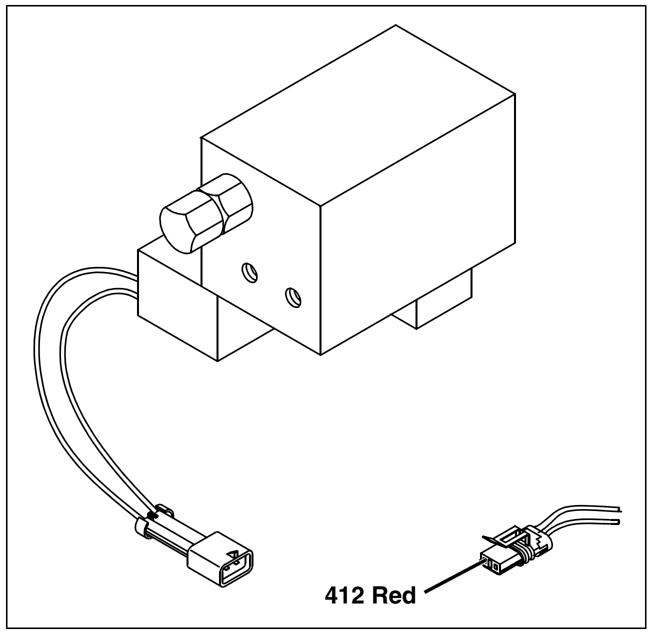
No - Test wires 613, 713 org (W2) and connections between raise switch and electronic control module.

Raise Solenoid Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Raise solenoid connector (X12) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Raise Solenoid Circuit



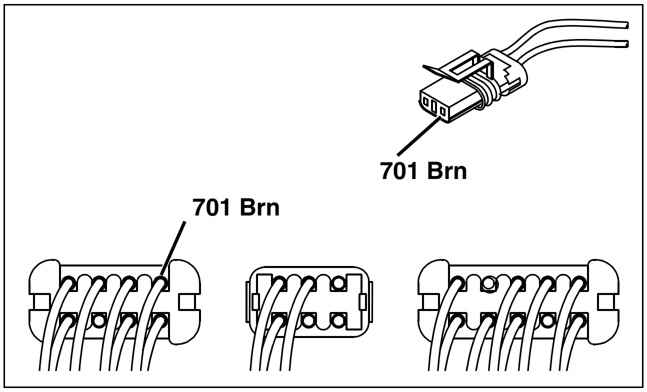
MIF

(1) Measure voltage at raise solenoid connector (X12) - wire 412 red. Is battery voltage present?

Yes - Go to step (2).

No - Check wires 412, 782, 802 red (W2) and wires 802 and 212 red (W27) and connections between raise solenoid connector (X12) and key switch connector (X31).

System: Raise Solenoid Circuit



MIF

(2) Measure resistance between electronic control module connector (X7) - wire 701 brn and raise solenoid connector (X12) - wire 701 brn. Is resistance less than 0.1 ohm?

Yes - Test raise solenoid. (See “Test lift and lower Valve Solenoid” on page 555.)

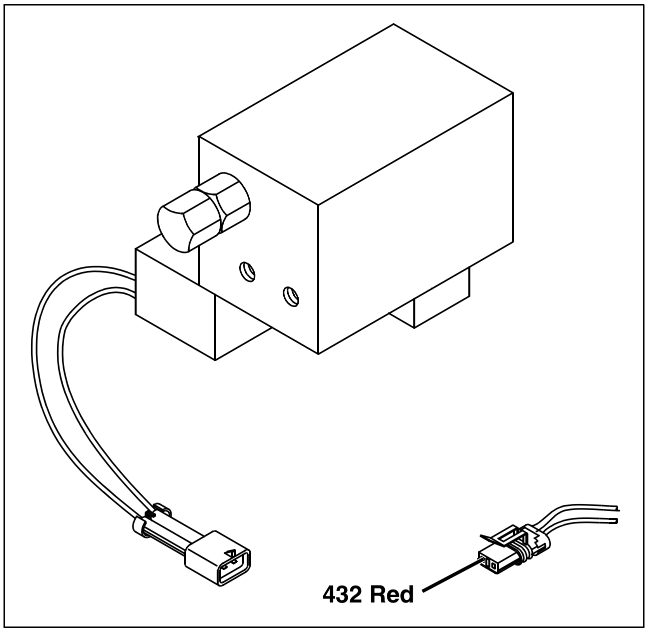
No - Check wire 701 brn (W2) and connections.

Lower Solenoid Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Lower solenoid connector (X11) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Lower Solenoid Circuit

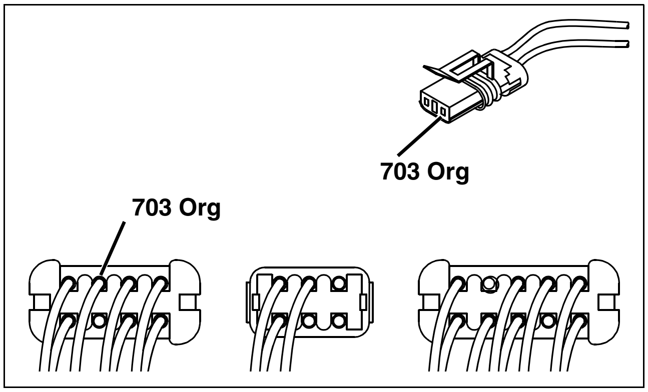


MIF

(1) Measure voltage at Lower solenoid connector (X11) - wire 432 red. Is battery voltage present?

Yes - Go to step (2).

No - Check wires 432, 782, 802 red (W2) and wires 802 and 212 red (W27) and connections between lower solenoid connector (X11) and key switch connector (X31).



MIF

(2) Measure resistance between electronic control module connector (X7) - wire 703 org and lower solenoid connector (X11) - wire 703 org. Is resistance less than 0.1 ohm?

Yes - Test lower solenoid. (See “Test lift and lower Valve Solenoid” on page 555.)

No - Check wire 703 org (W2) and connections.

Cutting Unit - Mow Circuit Operation - Models 2500E

Function

To engage the reel motors when the cutting units are lowered.

Operating Conditions

- Key switch in the RUN position
- Engine running.
- Mow/transport switch in MOW position.
- Backlap switch in MOW (OFF) position.
- Operator on seat (seat switch engaged).
- Cutting units lowered to the ground.

Theory of Operation

NOTE: If the mow/transport lever is in the MOW position while the cutting units are in the raised position, the cutting units will not start until the lift and lower switch is placed in the LOWER position. If the cutting units are in the lower position and then the mow/transport lever is placed in the MOW position, the lift and lower switch must be placed in the LOWER position before the cutting units will start.

Power Circuit

The power circuit provides current to the key switch (S1) and protects the mow circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch (red wires No. 002 [W2], 322 [W2] and 332 [W27]), to key switch “B” terminal.

When the key switch (S1) is in the RUN position, voltage is made available to Splice 4 through the following:

- Wire 802 red (W2).
- Main harness-to-console harness connector (X1) (W2 and W27).
- Wire 802 red (W27).
- Splice 1 (W27).
- Wire 212 red (W27)
- Key switch (S1) - terminal A

With the key switch in the RUN position, current also flows from splice 4 (W2) to the connector X8, pin D of the electronic control module (A3) through wire 812 red (W2), causing the electronic control module to power up. The ground circuit (black wires No. 810 [W2], 820 [W2] and 700 [W2]) provides a path to ground for the control module.

With the key switch in the RUN position, voltage is also available from splice 4 (W2) to the following components:

- Seat switch (S3) - wire 892 red (W2).
- Backlap switch (S4):
    - Wire 422 red (W2).
    - Splice 7 (W2)
    - Wire 762 red (W2)
- Mow valve solenoid (Y2) connector (X14):
    - Wire 442 red (W2).
    - Splice 7.
    - Wire 782 red.
- Mow/transport switch (S5):
    - Power harness (W26) - wire 201 red.
    - Optional third wheel assist harness (W21) - wire 872 red.
    - Wire 872 red (W2).
    - Splice 11 (W2)
    - Wire 762 red (W2).

Seat Switch

With the operator on the seat, current flows to connector X9, pin K of the electronic control module (gray wire No. 808 [W2]), enabling the run circuit.

Mow/Transport Switch

The Mow/transport switch provides several machine functions:

- Provides power to optional third wheel assist circuit, when installed.
- Provides field voltage to reel motor system 48 volt alternator.
- Signals the electronic control module that the mow/transport lever is in the MOW position.

When the mow/transport lever is moved to the MOW position, current flows between mow/transport switch (S5) contacts to the following:

- Current flows to 48 volt alternator (G3) through wires 402 and 403 yellow, causing the 48 volt alternator to output voltage. This provides the power to operate the reel motor system.
- Optional third wheel assist harness (W21) - wires 924 and 934 yel.

- Current continues to flow to electronic control module connector (X9) - terminal C through the following:
  - Wires 402 and 401 yel (W26).
  - Wires 924 and 934 yel (W21).
  - Wire 924 yel (W2).

This signals the electronic control module (A3) that the mow/transport lever is in the MOW position.

Mow Control Circuit

With the mow/transport switch in the MOW position, electronic control module (A3) provides a ground signal to left, right and center reel motor control module motor enable inputs, causing the reel motor control modules to operate their respective motor. The electronic control module (A3) provides the ground signal on the mow output terminal C of electronic control module connector X9 to mow solenoid connector (X14) through wire 766 blu/wht (W2). The ground signal continues through reel motor control module signal harness-to-main harness-to-mow solenoid connector (X87) - wire 301 grn (W83) and splice 1 to the following:

- Right reel motor control module connector (X89) - terminal A, wire 300 grn.
- Left reel motor control module connector (X88) - terminal A, wire 303 grn.
- Center reel motor control module connector (X83) - terminal A, wire 302 grn.

Reel Motor Forward/Reverse Switch

When reel motor forward/reverse switch (S12) is in the FORWARD position, right reel motor control module (A4) direction input is provided a ground. This causes the right reel motor control module (A4) to operate the right reel motor (M3) in the REVERSE direction. While at the same time left and center reel motor control modules (A5 and A6) have no ground applied to their direction inputs, causing reel motor control modules (A5 and A6) to operate their respective motors (M4 and M5) in the FORWARD direction. The reason for the right reel motor (M3) to rotate in the REVERSE direction while the left and center reel motors (M4 and M5) rotate in the FORWARD direction is because right reel motor (M3) is mounted on the side opposite of the cutting unit that the left and center reel motors (M4 and M5) are mounted on their cutting units.

With the reel motor forward/ reverse switch (S12) is in the FORWARD position, ground is provided to right reel control module connector (X88) - terminal E from the following:

- Wire 600 brn (W25).
- Forward/reverse switch connector (X84) - terminals B and C.
- Wire 102 blk (W25).
- Splice 4 (W25).

When reel motor forward/reverse switch (S12) is in the REVERSE position, the opposite occurs; right reel motor control module (A4) direction input is NOT provided a ground. This causes the right reel motor control module (A4) to operate the right reel motor (M3) in the FORWARD direction. While at the same time left and center reel motor control modules (A5 and A6) are provided a ground to their direction inputs, causing reel motor control modules (A5 and A6) to operate their respective motors (M4 and M5) in the REVERSE direction.

With the reel motor forward/ reverse switch (S12) is in the REVERSE position, ground is provided to left reel control module connector (X89) - terminal E from the following:

- Wire 402 yel (W25).
- Forward/reverse switch (S12) - terminals B and A.
- Wire 102 blk (W25).
- Splice 4 (W25).

With the reel motor forward/ reverse switch (S12) is in the REVERSE position, ground is also provided to center reel control module connector (X83) - terminal E from the following:

- Wire 401 yel (W25).
- Forward/reverse switch (S12) - terminals B and A.
- Wire 102 blk (W25).
- Splice 4 (W25).

Reel Motor Speed Control

Reel motor speed is controlled by motor speed control (R1) a 5 k-ohm potentiometer. Right reel motor control module (A4) provides a 5 volt reference voltage to reel motor speed control (R1). Reel motor speed control (R1) is provided ground through wire 101 blk from splice 4. The variable voltage output from reel motor speed control (R1) is applied to left, right and center reel motor control modules (A4, A5 and A6) speed inputs. With the same speed voltage applied to the three reel motor control modules, causes the three reel motor control modules to operate their respective motors at the same speed.

The variable speed output voltage is provided to splice 2 from reel motor speed control connector (X86) - terminal B through wire 901 wht (W25) to the following:

- Right reel motor control module connector (X88) - terminal C, wire 900 wht (W25).
- Left reel motor control module connector (X89) - terminal C, wire 903 wht (W25).
- Center reel motor control module connector (X83) - terminal C, wire 902 wht (W25).

Reel Motor Control Module Diagnostic Light Circuit

Reel motor control Module diagnostic light (H6) is shared between left, right and center reel motor control modules. When the 48 volt alternator power is available, all reel motor control modules power up and output 5 volts to reel motor control module diagnostic light (H6) for approximately 5 seconds, causing the diagnostic light to come ON for approximately 5 seconds. Ground is provided to reel control diagnostic light (H6) from splice 4 through wire 103 blk.

All reel motor control module diagnostic light outputs connect to reel motor control module diagnostic light connector (X85) - terminal A from splice 5 through wire 501 blu. Diagnostic light outputs connect to splice 5 from the following:

- Right reel motor control module connector (X88) - terminal F, wire 500 blu (W25).
- Left reel motor control module connector (X89) - terminal F, wire 503 blu (W25).
- Center reel motor control module connector (X83) - terminal F, wire 502 blu (W25).

If more than one motor stops operating, erroneous codes can occur when more than one control module outputs it’s diagnostic codes.

Reel Control Module Diagnostic Light Codes

The number of times reel control diagnostic light (H6) flashes is determined by the malfunction. The code will repeat after a short pause. Codes will clear when mow/transport lever is placed in the TRANSPORT position.

NOTE: If erratic codes appear while mowing, check for proper mow/transport lever activation of mow/transport switch. Erroneous codes can occur when more than one motor has stopped operating.

Flashes	Malfunction	Cause
1	No Start	Motor failed to start. Large motor connector disconnected. Motor failed. Reel motor control module failed.
2	Stalled	Motor stopped during normal operation. Cutting reel jammed by debris while operating.
3	Hall at Start	Bad connection between reel motor control module and 6 terminal motor signal connector. Motor failed. Reel motor control module failed.
4	DCV High	48 volt alternator voltage greater than 68 volts.
5	DCV Low	48 volt alternator voltage less than 28 volts.
6	Pot V Low	Potentiometer 5 volt supply is less than 4 volts. Harness short. Right reel motor control module - 5 volt internal power supply failed.
7	Pot V High	Potentiometer 5 volt supply is greater than 5 volts. Harness short. Right reel motor control module - 5 volt internal power supply failed.
8	No Motor I	Motor failed Reel motor control module failed.
9	Motor I-Motor Off	Motor failed Reel motor control module failed.
10	Motor Over Temp	Reel motor overheated.
11	Hall Signal	Bad connection between reel motor control module and 6 terminal motor signal connector. Motor failed. Reel motor control module failed.
12	Phase Short	Motor failed.
13	Ground Short	Motor failed.

Cutting Unit - Backlap Circuit Operation - Model 2500E

Function

To engage the reel motors when the cutting units are lower and the backlap switch is in the BACKLAP position.

Operating Conditions

- Key switch in the RUN position.
- Engine running.
- Park brake LOCKED.
- Backlap switch in BACKLAP position.
- Forward/reverse switch in the REVERSE position.
- Mow/transport switch in the MOW position.
- Cutting units lowered to the ground.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, 15-amp fuse and key switch through wires 002 (W2), 322 (W2) and 332 (W27) red, to key switch terminal B.

The ground circuit provides a path to ground for the control module through wires 700 (W2), 810 (W2) and 820 (W2) blk.

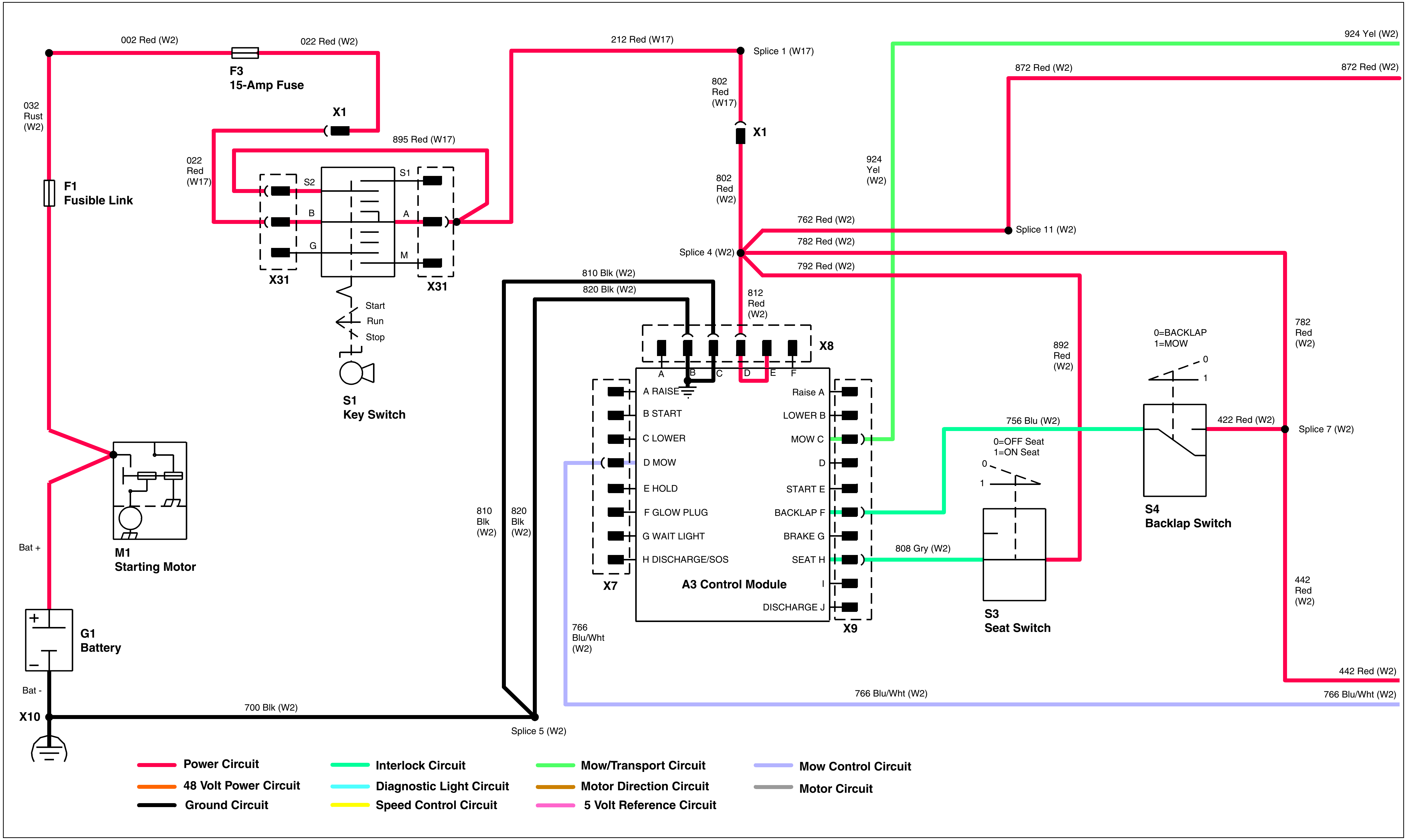
When the key switch in the RUN position, current flows to the connector X8, pin D of the electronic control module (A3) through wires 812 (W2), 802 (W2), 802 (W27) and 212 (W27) red.

With the key switch in the RUN position, voltage is available to backlap switch (S4) through the following:

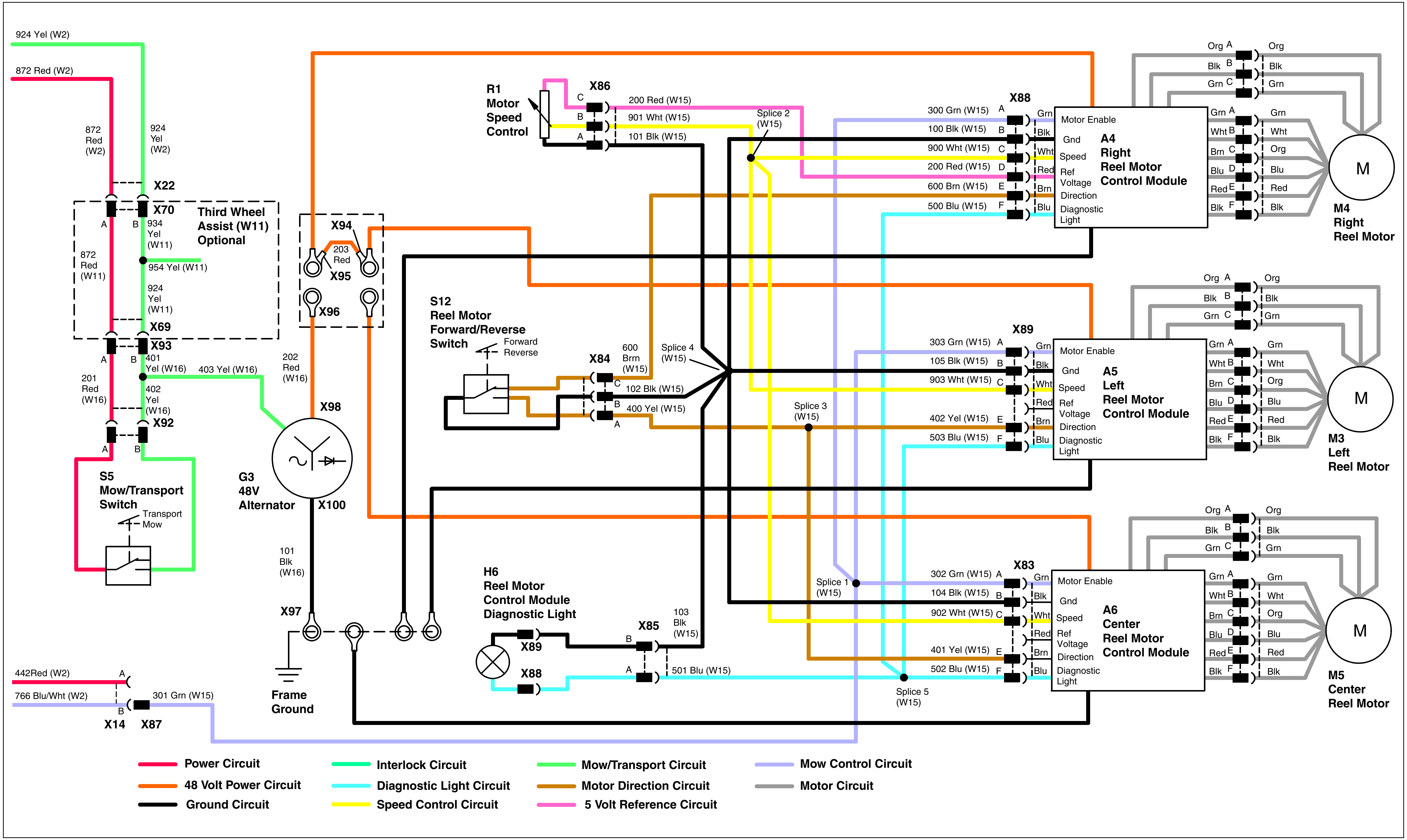
- Wire 442 red (W2) to splice 7 (W2).
- Wire 782 red (W2) to splice 4 (W2).
- Wire 802 red (W2).
- Wire 802 red (W27) to splice 1 (W27).
- Wire 212 red (W27).

When backlap switch (S4) is in the BACKLAP position, voltage is applied to electronic control module connector (X9) terminal F through wire 756 blu (W2). With voltage applied to electronic control module (A3) backlap input, the control module allows the mow circuit to operate with the park brake LOCKED and the operator OFF the seat. (See “Cutting Unit - Mow Circuit Operation - Model 2500E” on page 399 for theory of operation.)

Cutting Unit - Mow and Backlap Circuit Operation - Model 2500E



MX20467 diesel (MIF)



MX20468 diesel (MIF)

Mow/Backlap Circuit Diagnosis - Model 2500E

The electrical diagnosis for circuits that include the electronic control module is a multi-step process. This process is designed to take advantage of the self-diagnostic feature of the control module and to minimize the need to perform voltage and/or continuity checks. It is important that all steps be performed in sequence.

Step 1: Electronic Control Module Check

Perform electronic control module check. (See “Electronic Control Module Check” on page 539.)

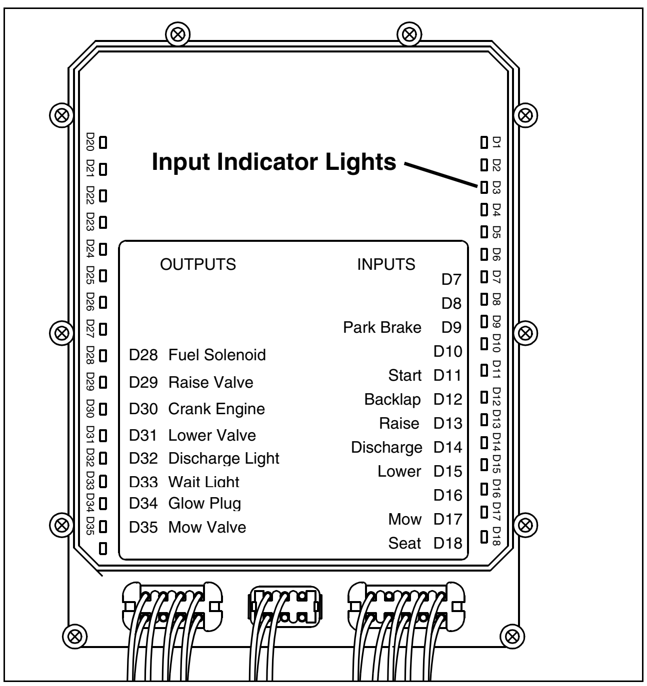
Step 2: Input Circuit Light Check

Test Conditions:

- Key switch in RUN position.
- Backlap valve in MOW position.

Procedure

1. Raise and lock seat platform.



M98629

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers on label to determine location, as they may not necessarily align with the lights.

Seat Switch Input

1. Move key switch to RUN position.
2. Press down on the lower cushion of the seat to engage the seat switch.
3. Observe the SEAT input light (D18). The light should be ON when the seat switch is engaged (operator on seat).
4. Release the seat switch.
5. Observe the SEAT input light (D18). The light should be OFF when the seat switch is released (operator off seat).

If the light does not come ON, test seat switch circuit. (See “Seat Switch Circuit Test” on page 408.)

Brake Switch Input

1. Move key switch to RUN position.
2. Depress the park brake pedal.
3. Observe the PARK BRAKE input light (D9). The light should be ON when the park brake pedal is depressed (brake switch engaged).
4. Release the park brake pedal.
5. Observe the PARK BRAKE input light (D9). The light should be OFF when the park brake pedal is released (brake switch is released).

If the light does not come ON or OFF, test brake switch circuit. (See “Brake Switch Circuit Test” on page 409.)

Mow/Transport Switch Input

1. Move key switch to RUN position.
2. Move mow/transport lever to MOW position.
3. Observe the MOW input light (D17). The light should be ON when the mow/transport lever is in the MOW position (mow/transport switch engaged).

If the light does not come ON, test the mow transport switch circuit. (See “Mow/Transport Switch Circuit Test” on page 410.)

Backlap Switch Input

1. Move key switch to RUN position.
2. Move the backlap switch to the MOW position.
3. Observe the BACKLAP input light (D12). The light should be ON when the backlap switch is in the BACKLAP position and OFF when the switch is in the MOW position.

If the light does not function as described, test the backlap switch circuit. (See “Backlap Switch Circuit Test” on page 411.)

Mow Valve Output

1. Move key switch to RUN position.

2. Depress the seat switch plunger.
3. Move the backlap switch to the MOW position.
4. Move the mow/transport lever to the MOW position.
5. Move the lift and lower lever to the LOWER position.
6. Observe the MOW VALVE output light (D35). The light should be ON when the lift and lower switch is in the LOWER position and OFF when the switch is in the RAISE position.

If the light does not function as described, test the electronic control module. (See “Electronic Control Module Check” on page 539.)

If the light does function as described and one or more reel motors do not operate, test the mow circuit. (See “Mow Circuit Test” on page 412.)

Step 3: Circuit Tests

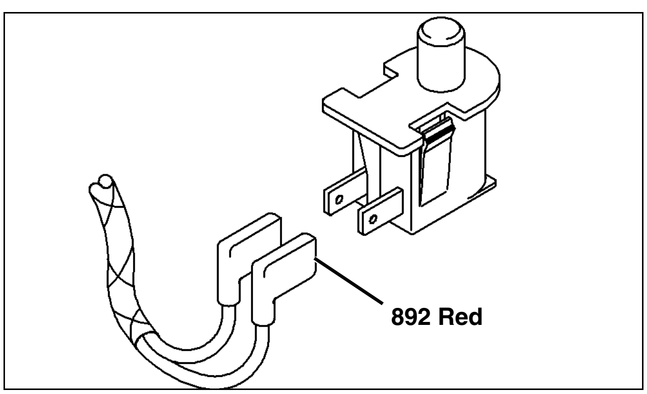
IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors; excess force can damage terminals. Touch the probes lightly to terminals when testing.

Seat Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Seat Switch Circuit



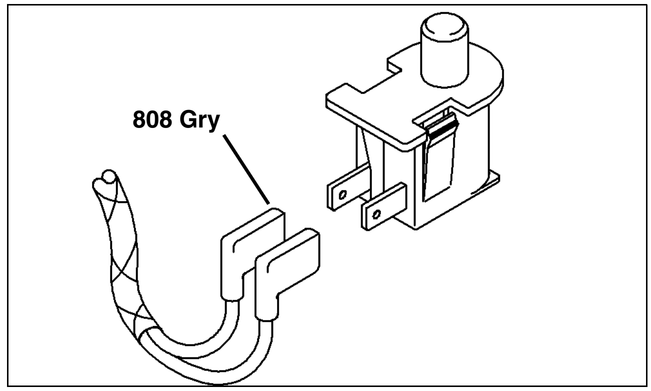
MX20470

(1) Measure voltage at seat switch connector (X6) - wire 892 red. Is battery voltage present?

Yes - Go to step (2).

System: Seat Switch Circuit

No - Test wire 892 red and connections.

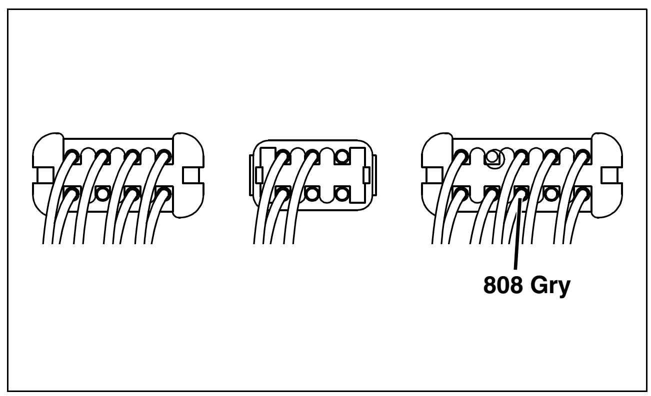


MIF

(2) Seat switch plugger depressed. With seat switch connectors (X5 and X6) connected, measure voltage at seat switch connector (X5) - wire 808 gry. Is battery voltage present?

Yes - Go to step (3).

No - Test switch. (See “Test Seat Switch” on page 553.)



MIF

(3) Measure battery voltage at electronic control module connector (X9) - terminal H, wire 808 gry. Is battery voltage present?

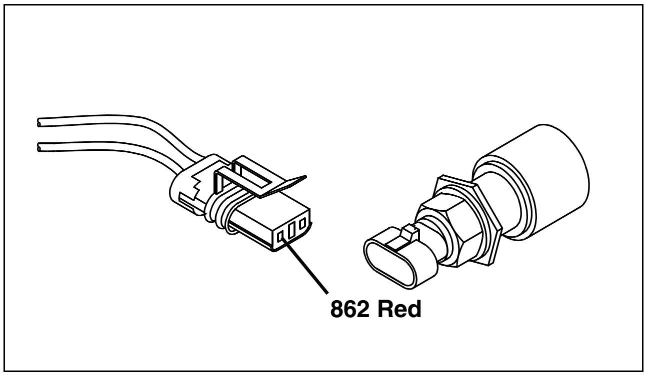
No - Test wire 808 gry and connections.

Brake Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Park brake engaged.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Brake Switch Circuit

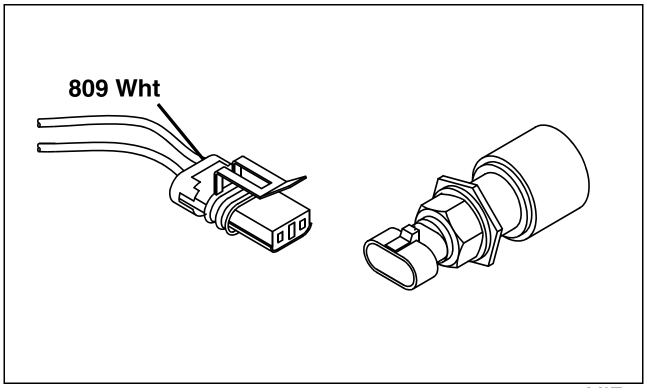


MIF

(1) Brake switch disconnected. Measure voltage at brake switch connector (X18) - wire 862 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 862 red and connections.



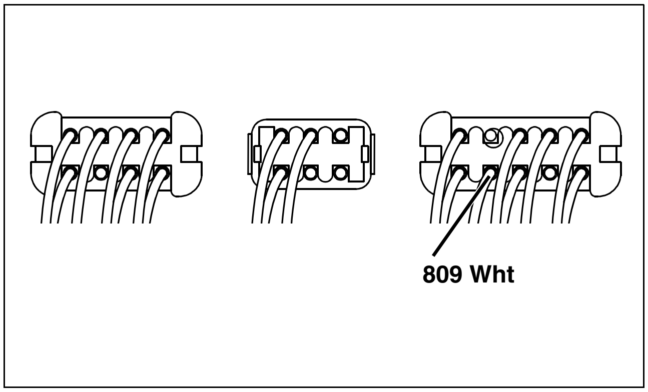
MIF

(2) Brake switch connected. Measure voltage at brake switch connector (X18) - wire 809 wht. Is battery voltage present?

Yes - Go to step (3).

System: Brake Switch Circuit

No - Test switch. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)



MIF

(3) Measure battery voltage at electronic control module connector (X9) - terminal G, wire 809 wht. Is battery voltage present?

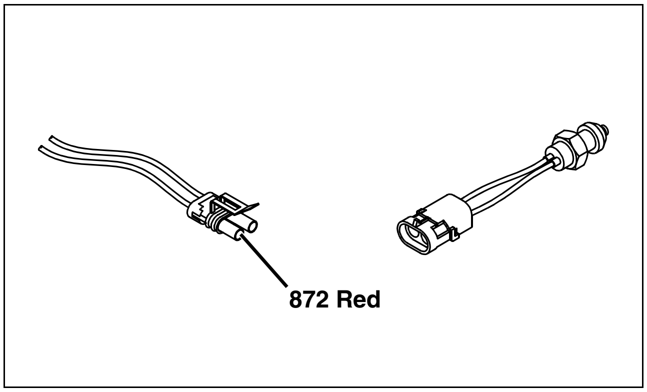
No - Test wire 809 wht and connections.

Mow/Transport Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow/Transport Switch Circuit

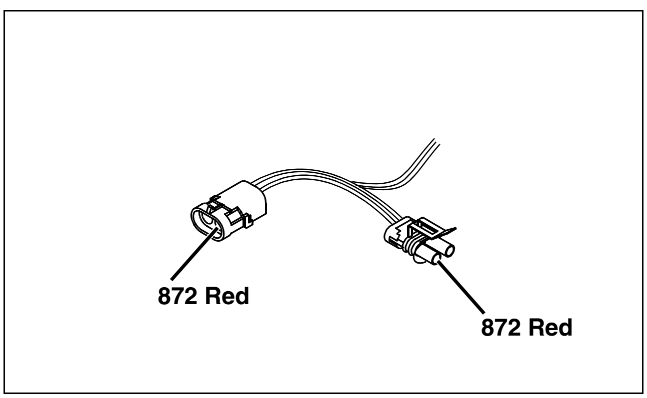


MIF

(1) Mow/transport switch connector disconnected. Measure voltage at mow/transport switch connector (X22) - wire 872 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 872 red and connections.



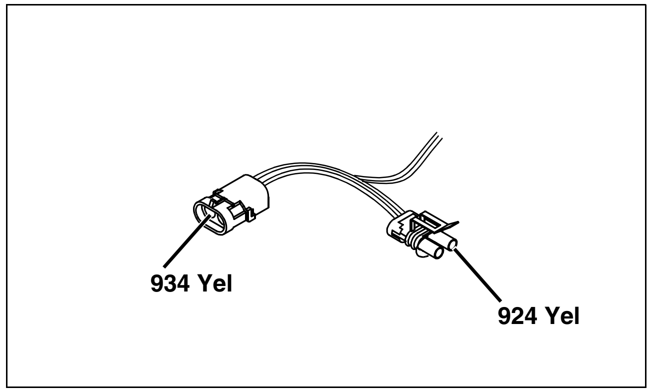
MIF

(2) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wire 872 red. Is there less than 0.1 ohm of resistance?

Yes - Go to step (3).

No - Test wire 872 red (W21) and connections.

System: Mow/Transport Switch Circuit

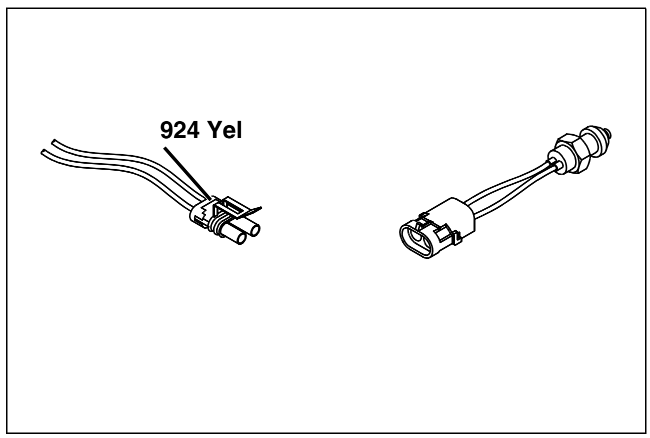


MIF

(3) Models with third wheel assist installed. Measure continuity between third wheel assist harness connectors (X69 and X70) - wires 924 and 934 yel. Is there less than 0.1 ohm of resistance?

Yes - Go to step (4).

No - Test wires 924 and 934 yel (W21) and connections.



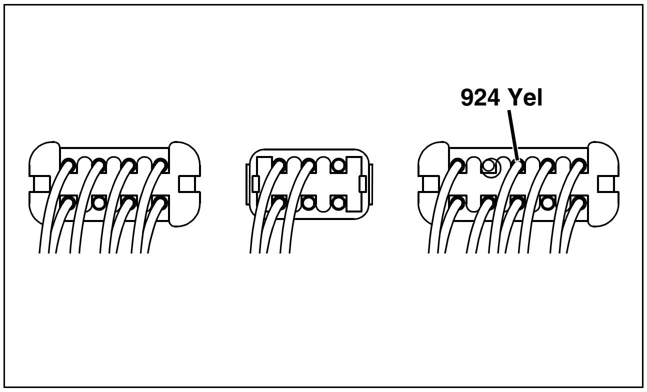
MIF

(4) Mow/transport switch connected and if installed third wheel assist connectors. Measure voltage at mow/transport switch connector (X22) - wire 924 yel. Is battery voltage present?

Yes - Go to step (5).

No - Test switch. (See “Test Mow/Transport Switch” on page 553.)

System: Mow/Transport Switch Circuit



MIF

(5) Measure battery voltage at electronic control module connector (X9) - terminal C, wire 924 yel. Is battery voltage present?

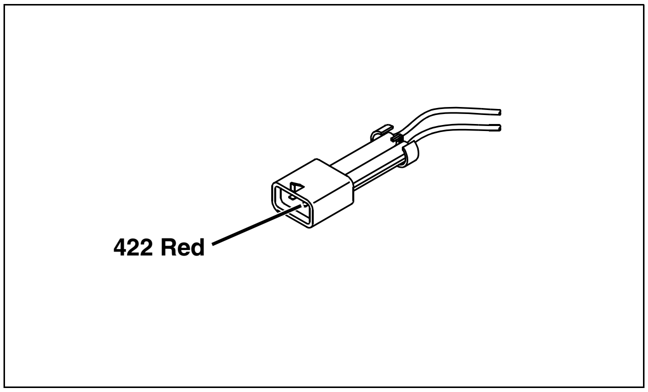
No - Test wire 924 yel and connections.

Backlap Switch Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Backlap Switch Circuit



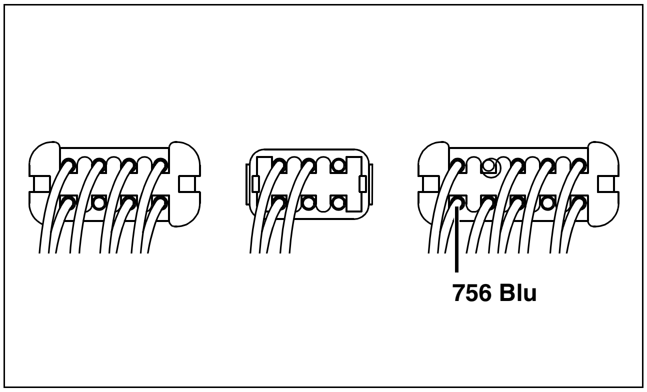
MIF

(1) Measure battery voltage at backlap switch connector (X15) - wire 422 red. Is battery voltage present?

Yes - Go to step (2).

No - Test wire 422 red and connections.

System: Backlap Switch Circuit



(2) Backlap switch connector (X15) connected. Backlap switch in BACKLAP position. Electronic control module connector (X9) disconnected. Electronic control module connector (X9) - terminal F, wire 756 blu. Is battery voltage present?

No - Test wire 756 blu and connections.

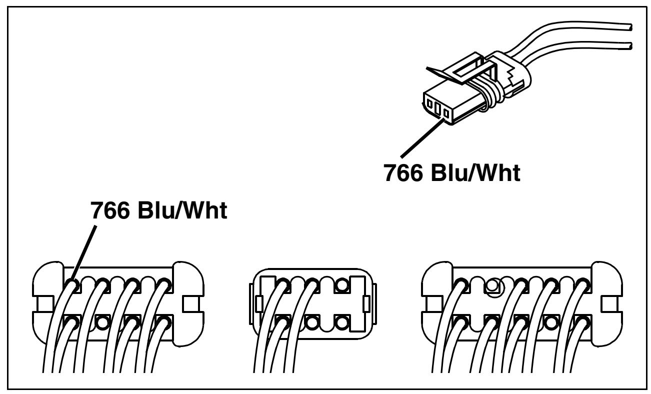
No - Test backlap switch. (See “Test Backlap Switch - Model 2500E” on page 560.)

Mow Circuit Test

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position.
- Backlap switch connector (X15) disconnected.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Mow Circuit

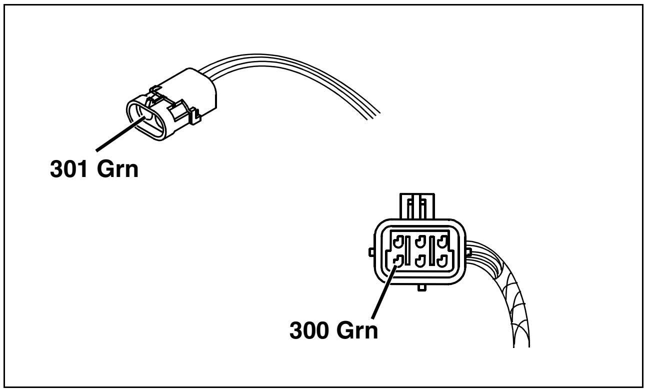


(1) Measure resistance between electronic control module connector (X7) - wire 766 blu/wht and mow valve connector (X14) - wire 766 blu/wht. Is resistance less than 0.1 ohm?

Yes - Go to step (2).

No - Check wire 766 blu/wht and connections.

System: Mow Circuit

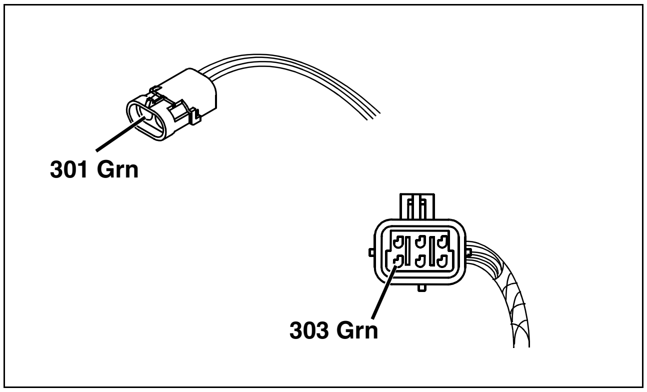


MIF

(2) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and right reel motor control module connector (X88) - wire 300 grn. Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Check wires 301 and 300 grn and connections.

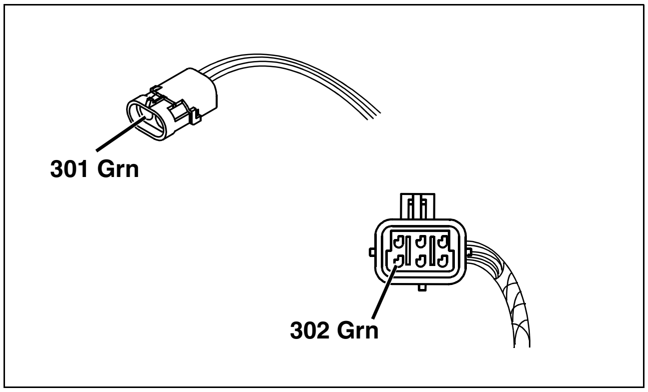


(3) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and left reel motor control module connector (X89) - wire 303 grn. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check wires 301 and 303 grn and connections.

System: Mow Circuit



(4) Measure resistance between reel motor control signal harness-to-main harness-to-mow valve solenoid connector (X87) - wire 301 grn and center reel motor control module connector (X83) - wire 302 grn. Is resistance less than 0.1 ohm?

No - Check wires 301 and 302 grn and connections.

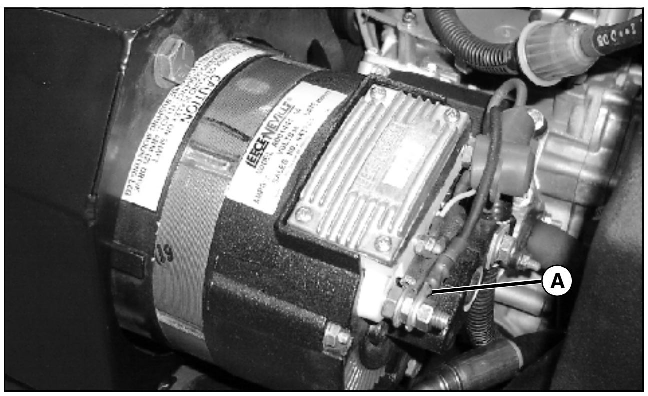
Reel Motor Circuit Diagnosis - Model 2500E

48 Volt Alternator Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position (engine operating at medium idle).
- Mow/transport lever in the MOW position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: 48 Volt Alternator Circuit



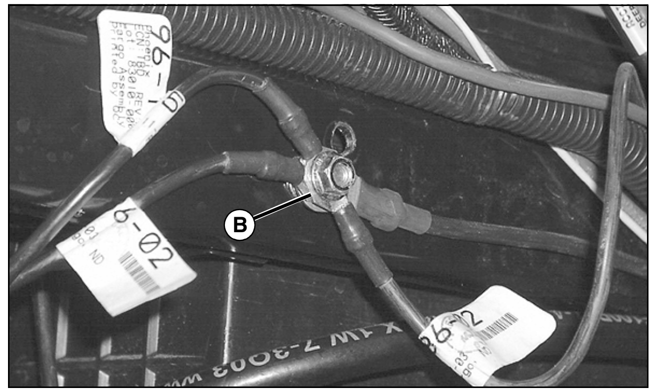
MX20831

(1) Measure resistance at 48 volt alternator ground terminal (X97) - wire 101 blk (A). Is resistance less than 0.1 ohm?

Yes - Go to step (2).

No - Check wire 101 blk and connections between frame ground and 48 volt alternator terminal.

System: 48 Volt Alternator Circuit



MX20490

(2) Measure resistance at frame ground (B). Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Clean and tighten terminals.

MX20831

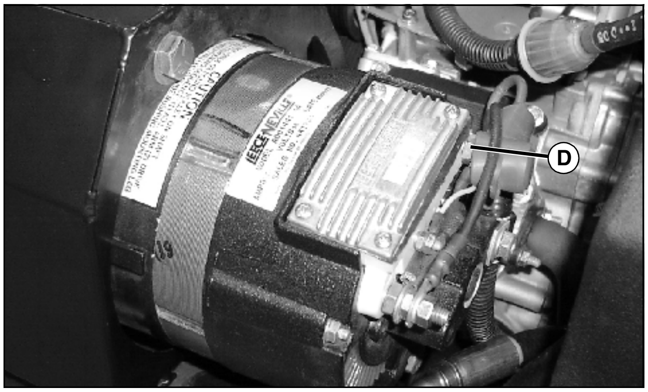
(3) Measure voltage at 48 volt alternator field terminal (X99) - wire 403 yel (C). Is battery voltage present?

Yes - Go to step (4).

No - Check wire 403 yel and connections between mow/transport switch and 48 volt alternator terminal.

No - Check mow/transport switch circuit. (See “Mow/ Transport Switch Circuit Test” on page 410.)

System: 48 Volt Alternator Circuit

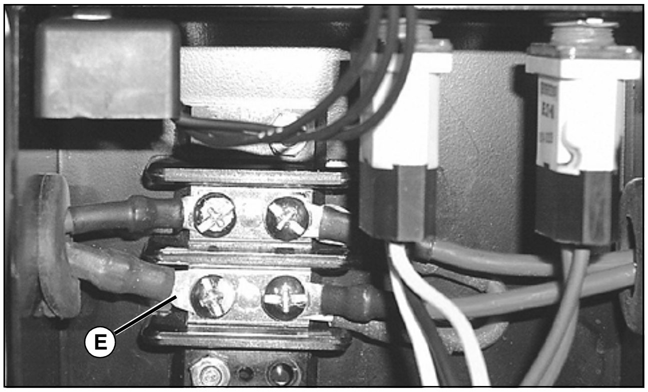


MX20831

(4) Measure voltage at 48 volt alternator positive (+) output terminal (X98) - wire 202 red (D). Is voltage in the range of 46-50 volts?

Yes - Go to step (5).

No - Replace 48 volt alternator.



(5) Measure voltage at 48 volt terminal block - wire 202 red (E). Is voltage in the range of 46-50 volts?

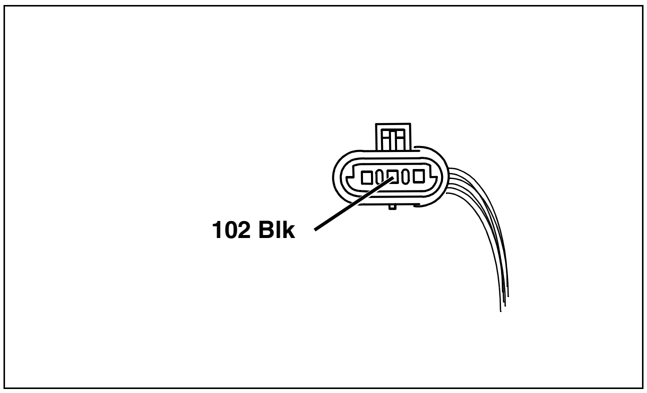
No - Check wire 202 red between terminal block and 48 volt alternator. Clean and tighten terminals.

Reel Motor Forward/Reverse Switch Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in STOP position.
- Forward/reverse switch in the FORWARD position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Reel Motor Forward/Reverse Switch Circuit



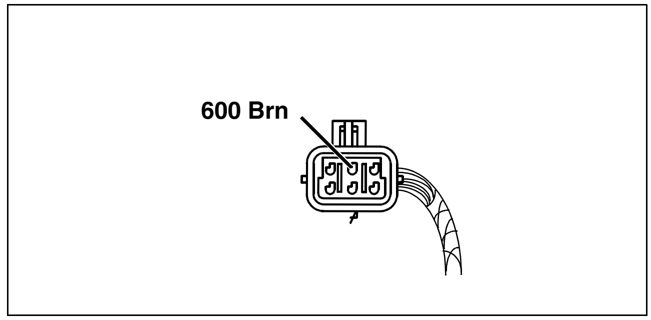
MIF

(1) Forward/reverse switch disconnected. Measure ground circuit for resistance at reel motor forward/ reverse switch connector (X84) - wire 102 blk. Is there less than 0.1 ohm of resistance?

Yes - Go to step (2).

No - Check wire 102 blk and connections.

System: Reel Motor Forward/Reverse Switch Circuit

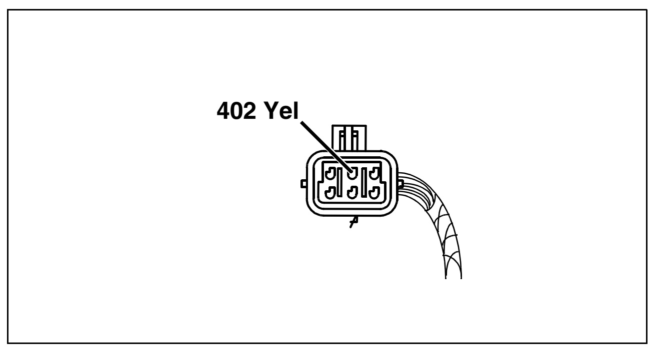


(2) Forward/reverse switch connected. Right reel motor control module connector (X88) disconnected. Measure resistance between ground and right reel motor control module connector (X88) - wire 600 brn. Is resistance less than 0.1 ohm?

Yes - Go to step (3).

No - Check forward/reverse switch. (See “Test Reel Motor Forward/Reverse Switch - Model 2500E” on page 560.)

No - Check wire 600 brn between forward/reverse switch connector and right reel motor control module connector.



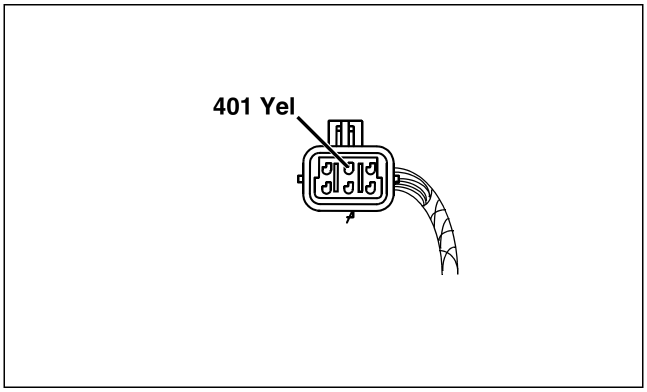
(3) Forward/reverse switch in the REVERSE position. Left reel motor control module connector (X89) disconnected. Measure resistance between ground and left reel motor control module connector (X89) - wire 402 yel. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check forward/reverse switch. (See “Test Reel Motor Forward/Reverse Switch - Model 2500E” on page 560.)

No - Check wire 402 yel between forward/reverse switch connector and left reel motor control module connector.

System: Reel Motor Forward/Reverse Switch Circuit



(4) Center reel motor control module connector (X83) disconnected. Measure resistance between ground and center reel motor control module connector (X83) - wire 401 yel. Is resistance less than 0.1 ohm?

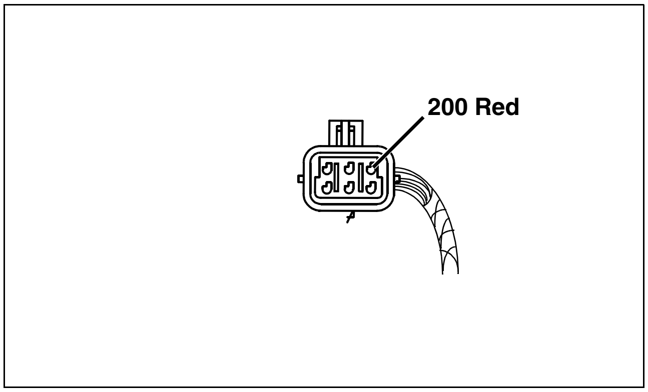
No - Check wire 401 yel between forward/reverse switch connector and center reel motor control module connector.

Reel Motor Speed Control Circuit Diagnosis

Test Conditions:

- Machine parked on a level surface.
- Key switch in RUN position (engine operating at medium idle).
- Mow/transport lever in MOW position.
- Meter negative (-) lead on battery negative (-) terminal or chassis ground.
- Check connections for corrosion and looseness when checking/testing.

System: Reel Motor Speed Control Circuit

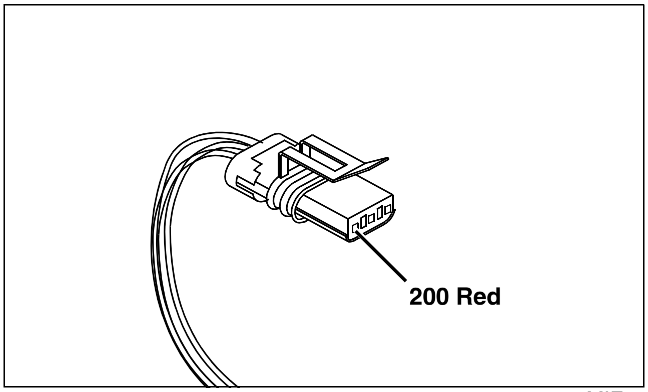


MIF

(1) Right reel motor control module connector (X88) disconnected. Measure voltage at right reel motor control module connector (X88) - wire 200 red. Is voltage in the range of 4.75-5.25 volts?

Yes - Go to step (2).

No - Replace right reel motor control module.



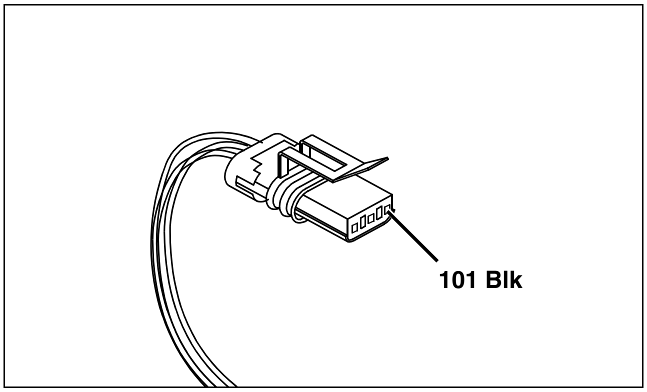
MIF

(2) Right reel motor control module connector (X88) connected. Measure voltage at reel motor speed control connector (X86) - wire 200 red. Is voltage in the range of 4.75-5.25 volts?

Yes - Go to step (3).

No - Check wire 200 red and connections between reel motor speed control connector and right reel motor control module connector.

System: Reel Motor Speed Control Circuit

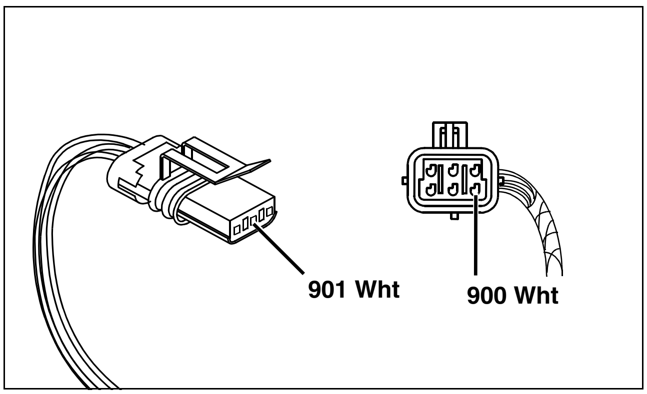


MIF

(3) Key switch in STOP position. Measure resistance between ground and reel motor speed control connector (X86) - wire 101 blk. Is resistance less than 0.1 ohm?

Yes - Go to step (4).

No - Check wire 101 blk and connections.

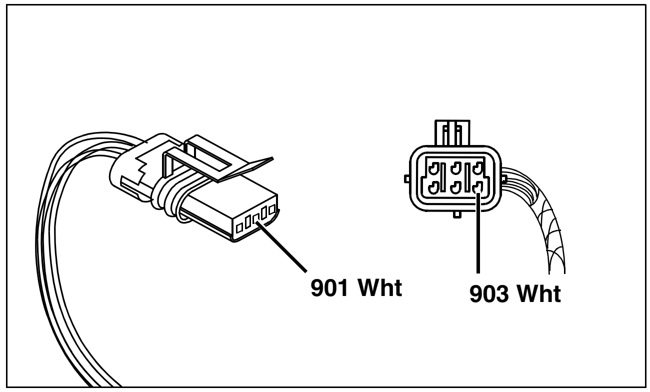


(4) Right reel motor control module connector (X88) disconnected. Reel motor speed control connector (X86) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and right reel motor control module connector (X88) - 900 wht. Is resistance less than 0.1 ohm?

Yes - Go to step (5).

No - Check wires 901 and 900 wht and connections.

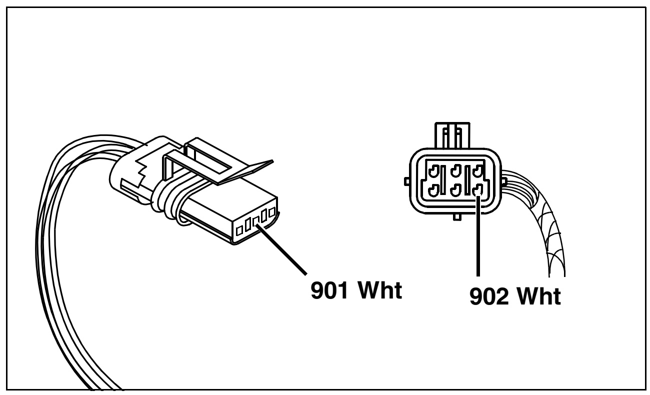
System: Reel Motor Speed Control Circuit



(5) Left reel motor control module connector (X89) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and left reel motor control module connector (X89) - 903 wht. Is resistance less than 0.1 ohm?

Yes - Go to step (6).

No - Check wires 901 and 903 wht and connections.



(6) Center reel motor control module connector (X83) disconnected. Measure resistance between reel motor speed control connector (X86) - wire 901 wht and center reel motor control module connector (X83) - 902 wht. Is resistance less than 0.1 ohm?

Yes - Test reel motor speed control. (See “Test Reel Motor Speed Control - Model 2500E” on page 561.)

No - Check wires 901 and 902 wht and connections.

Reel Motor Control Module Diagnosis

The following circuits must be tested before replacing a reel motor control module:

- Mow input circuits. (See "Cutting Unit - Mow/Backlap Circuit Diagnosis - Model 2500E" on page 407.)
- Mow output circuit. (See "Mow Circuit Test" on page 412.)
- 48 volt alternator. (See "48 Volt Alternator Circuit Diagnosis" on page 413.)

Reel motors can be tested by connecting the suspected failed motor to a known operating reel motor control module. This also will indicate a failed motor control module; if a suspected failed motor is moved to a known operating reel motor control module and begins to operate, then the reel motor control module that was connected to the motor is the failed component. If the reel motor continues to fail, then the motor is the failed component. (See "Test Reel Motor - Model 2500E" on page 562.)

System: Reel Motor Controller

(1) Connect a known good reel motor to suspected controller. Does reel motor operate?

Yes - Controller is good. Replace suspected reel motor.

No - Controller has failed. Replace reel motor controller

(2) Connect suspected reel motor to a known good controller. Does motor operate?

Yes - Replace suspected reel motor controller.

No - Replace reel motor.

Lighting Circuit Operation

Function

To provide power to the headlights and rear grass catcher to illuminate the work area.

Operating Conditions

- Key switch in the RUN position
- Headlight switch in the ON position.

Theory of Operation

The power circuit provides current to the key switch (S1) and protects the lighting circuit with a fusible link (F1). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (rust wire No. 032 [fusible link] and red wires No. 002 [W2], 022 [W2] and 022 [W3]).

Current is also supplied to the headlight relay (K2) directly from the battery and is protected by a fusible link (F4). Current flows from the battery positive terminal to the fusible link to terminal 87 of the headlight relay (rust wire No. 122 [fusible link] and red wire No. 102 (W2]).

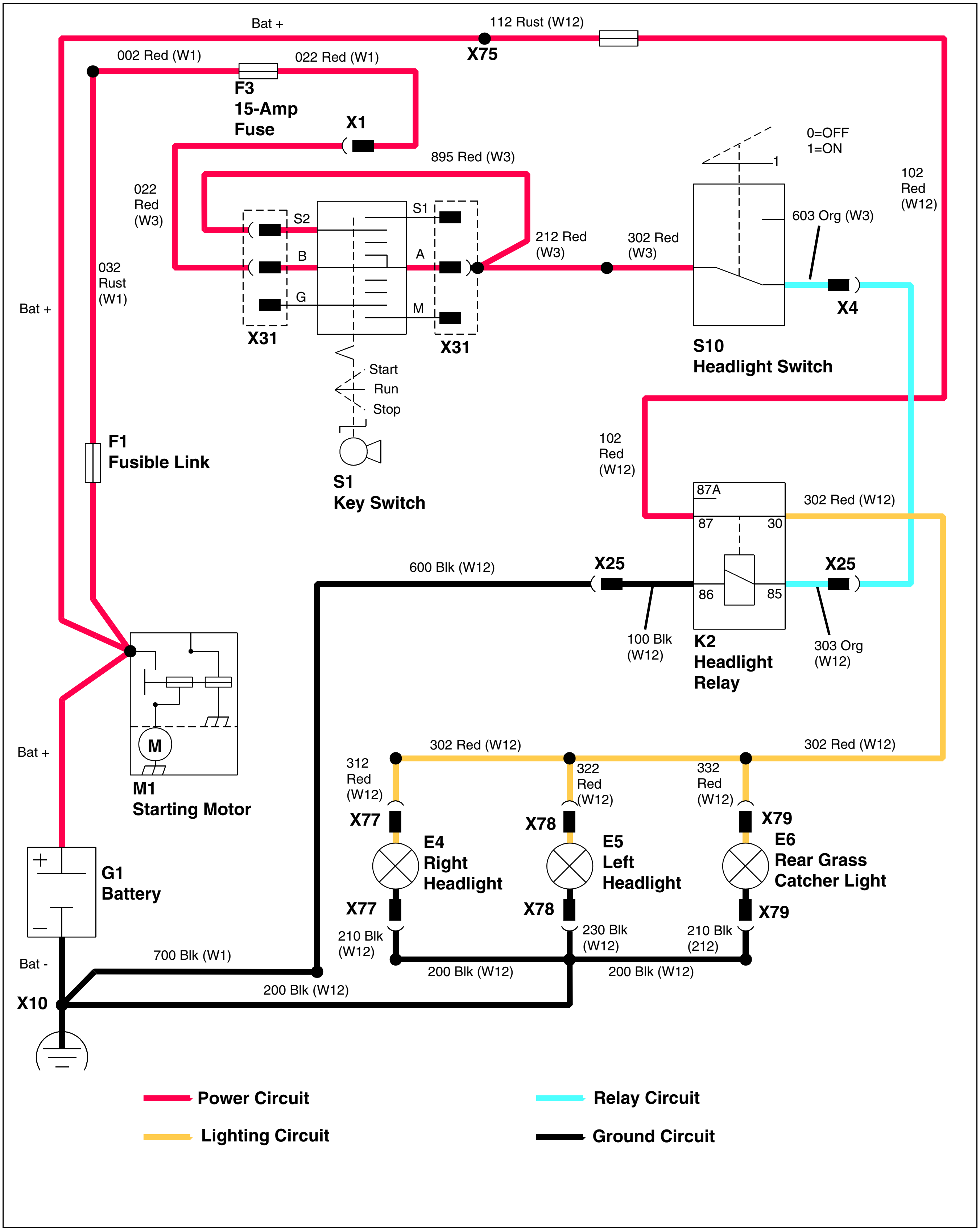
With the key switch in the RUN position, current flows to the headlight switch (S10) (red wires No. 212 [W2] and 302 [W3]).

With the headlight switch in the ON position, current flows to terminal 85 of the headlight relay (orange wires No. 603 [W3], 603 [W2] and 603 [W12]). A path to ground (black wires 100 [W12] 600 [W2] and 700 [W2]) completes the circuit, energizing the relay.

With the relay energized, current flows from relay terminal 87 to 30 and to the right headlight (E4) (red wires No. 302 and 312 [W12]), left headlight (E5) (red wires No. 302 and 322 [W12]) and rear grass catcher light (E6) (red wires No. 302 and 332 [W12]) to illuminate the lamps.

The ground circuit provides a path to ground for the right headlight (E4), left headlight (E5) and rear grass catcher light (E6) (black wires No. 210 [W12], (220 [W12], 200 [W12] and 700 [W2]).

Lighting Circuit



M98631 (MIF)

Lighting Circuit Diagnosis

IMPORTANT: Avoid damage! DO NOT force test light/ meter probes into female terminals of Metri-Pack™ connectors, excess force can damage terminals. Touch the probes lightly to terminals when testing.

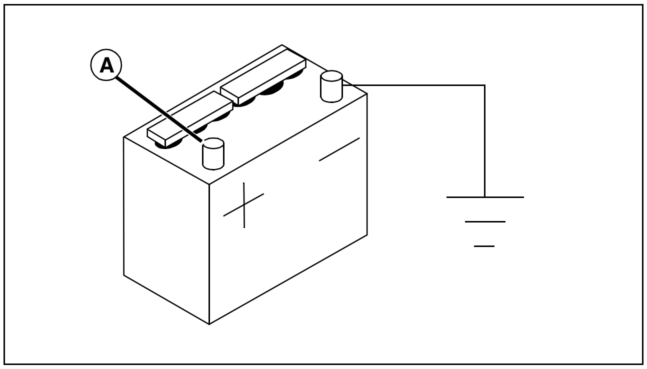
NOTE: A test light is preferred method for testing circuits. Connectors and terminals are available as service parts for harness repairs.

Check connections for corrosion and looseness when checking/testing.

Test Conditions:

- Key switch in STOP position.
- Test light/meter negative (-) lead on battery negative (-) terminal or chassis ground.

System: Lighting Circuit



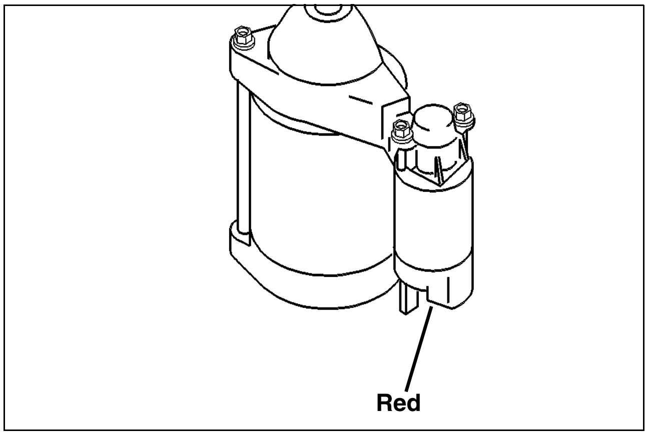
MIF

(1) Check battery voltage at positive (+) post (A). Does volt meter read 11.8-13.2 volts?

Yes - Go to step (2).

No - Check battery condition. (See “Test Battery” on page 541.)

System: Lighting Circuit

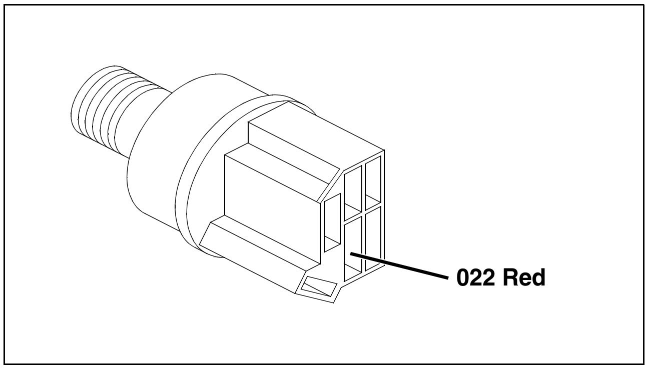


MIF

(2) Check voltage at starting motor solenoid battery terminal, red wire. Does volt meter indicate battery voltage?[1]

Yes - Go to step (3).

No - Check battery cables and clamps. Clean and tighten connections.



MIF

(3) Check voltage at key switch (S1) connector (X31), terminal B, wire 022 red. Is battery voltage/ test light on?

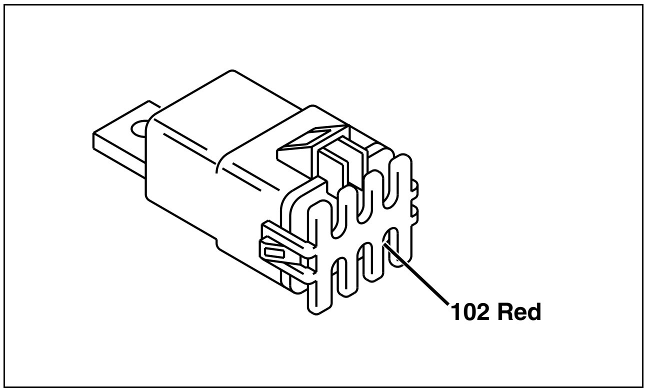
Yes - Go to step (4).

No - Test red wires No. 022 (W3) and 022 (W2) and connections.

No - Test fuse (F3). (See “Test Fuse” on page 549.)

No - Test fuse link (F1) (rust wire No. 032).

System: Lighting Circuit



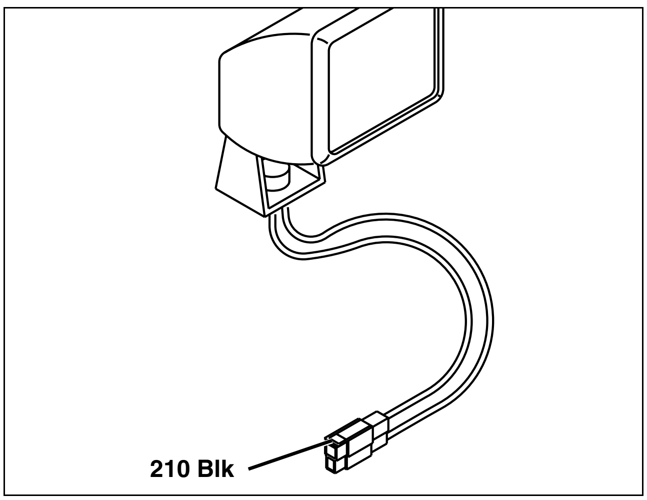
MIF

(4) Check voltage at headlight relay (K2) connector (X69), terminal 87, wire 102 red. Is battery voltage/ test light on?

Yes - Go to step (5).

No - Test red wire No. 102 (W12) and connections.

No - Test fusible link (F4) (rust wire No. 112).



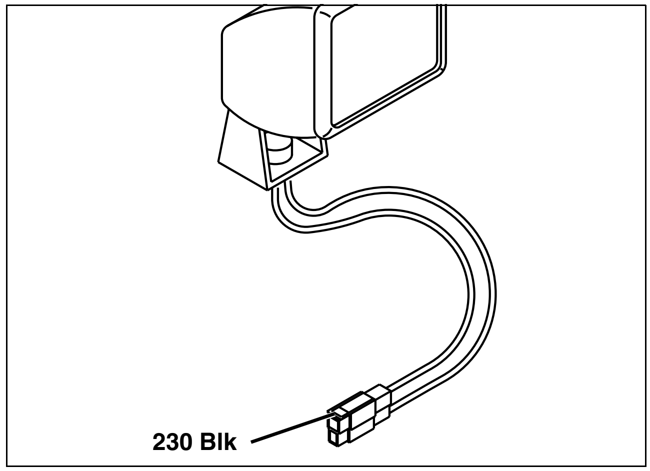
MIF

(5) Check resistance at right headlight (E4)connector (X77), wire 210 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (6).

No - Test black wires No. 210 (W12) and 200 (W12) and connections.

System: Lighting Circuit

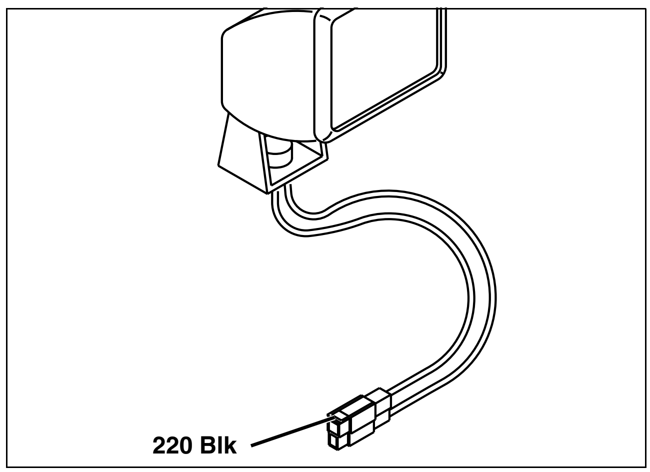


MIF

(6) Check resistance at left headlight (E5) connector (X78), wire 230 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (7).

No - Test black wires No. 220 (W12) and 200 (W12) and connections.



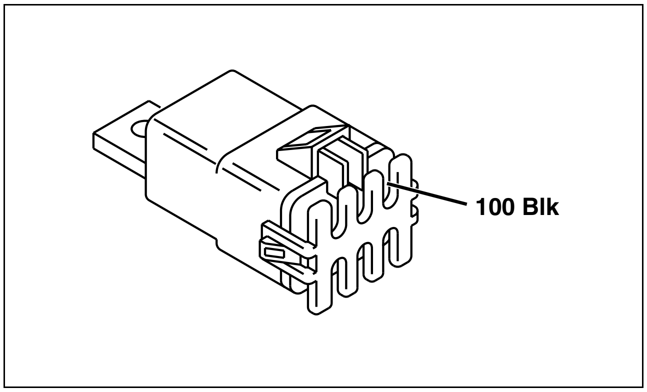
MIF

(7) Check resistance at rear grass catcher light (E6) connector (X79), wire 220 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (8).

No - Test black wires No. 230 (W12) and 200 (W12) and connections.

System: Lighting Circuit

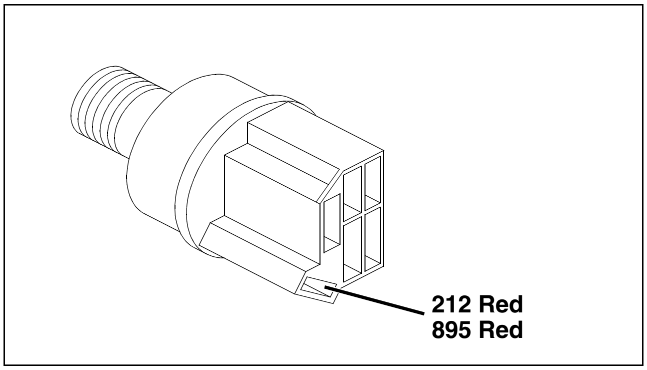


MIF

(8) Check resistance at headlight relay (K2) connector (X74), terminal 86, wire 100 black. Is resistance less than 0.1 ohm?[2]

Yes - Go to step (9).

No - Test black wires No. 100 (W12), 600 (W2) and 700 (W2) and connections.



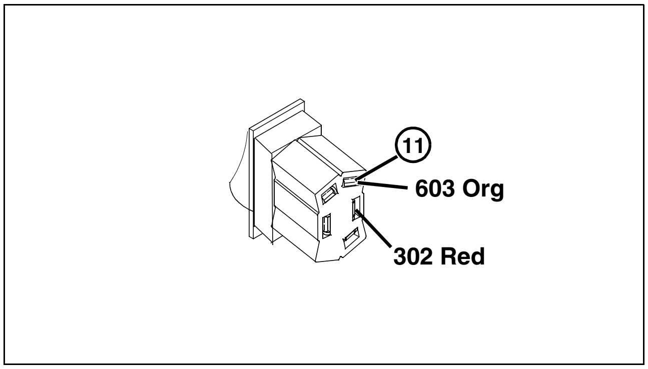
MIF

(9) Key switch in RUN position.
Check voltage at key switch (S1) connector (X31), terminal A. Is battery voltage/test light on?

Yes - Go to step (10).

No - Test key switch. (See “Test Key Switch” on page 551.)

System: Lighting Circuit



MIF

(10) Check voltage at headlight switch (S10) connector (X37), wire 302 red. Is battery voltage/ test light on?

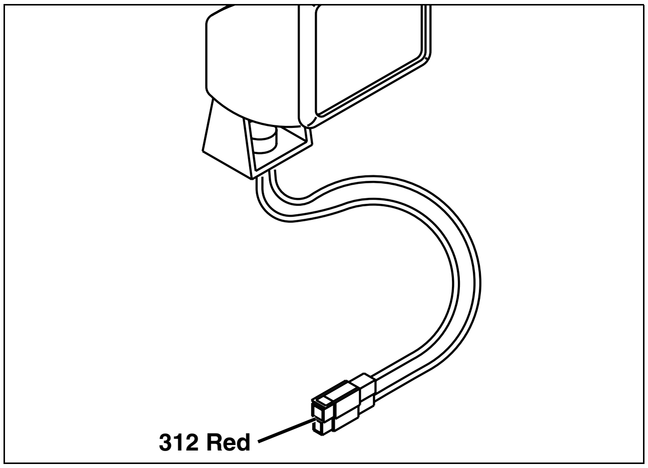
Yes - Go to step (11).

No - Test red wires No. 212 (W3) and 302 (W3) and connections.

(11) Headlight switch in ON position.
Check voltage at headlight switch (S10) connector (X37), wire 603 orange. Is battery voltage/test light on?

Yes - Go to step (12).

No - Test headlight switch. (See “Test Headlight Switch (Optional)” on page 559.)



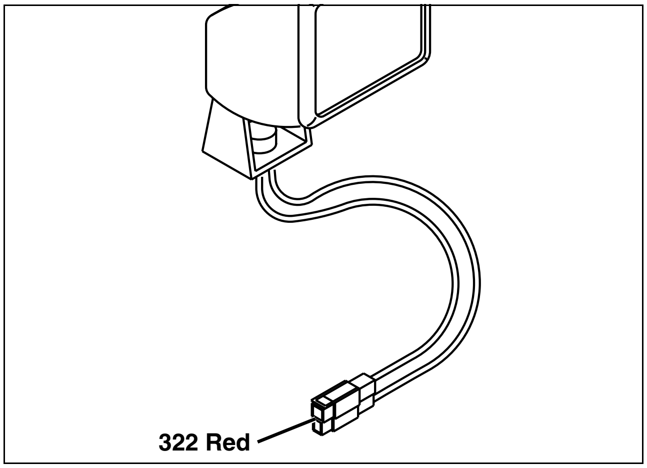
MIF

(12) Check voltage at right headlight (E4) connector (X77), wire 312 red. Is battery voltage/ test light on?

Yes - Go to step (13).

No - Test red wires No. 312 (W12) and 302 (W12) and connections.

System: Lighting Circuit

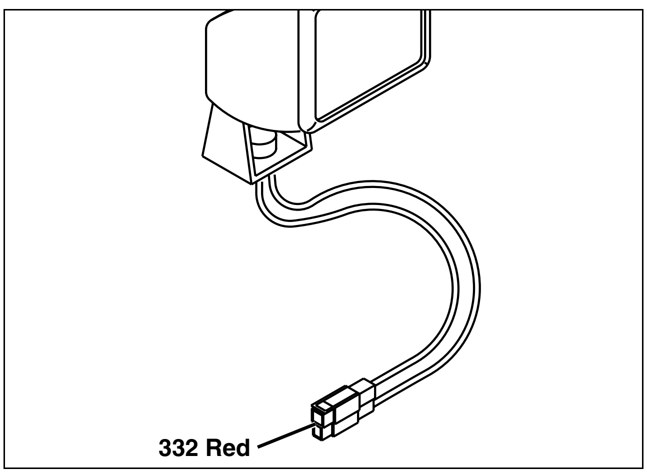


MIF

(13) Check voltage at left headlight (E5) connector (X78), wire 322 red. Is battery voltage/test light on?

Yes - Go to step (14).

No - Test red wires No. 322 (W12) and 302 (W12) and connections.



MIF

(14) Check voltage at rear grass catcher light (E6) - Connector X79, wire 332 red. Is battery voltage/test light on?

No - Test red wire No. 332 (W12) and 302 (W12) and connections.

1. Voltage may read correct when no load is present, but may drop when a load is applied due to corrosion or poor connection. If the engine cranks hard or slowly, inspect the connections and clean as needed.

2. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Tests and Adjustments

Test Ground Circuit

Reason

To check for open circuits, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

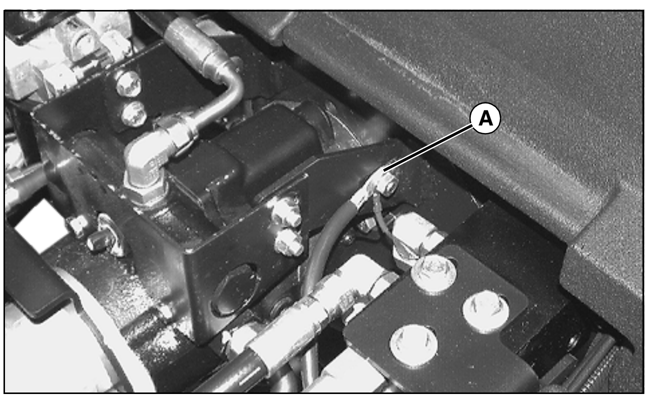
NOTE: The 2500 Greensmower uses a "switched ground" system, not all components grounded directly to the battery. Most circuit/components are grounded through the control module.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure resistance.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Connect ohmmeter negative (black) lead to negative (-) terminal of battery.



M98612

Picture Note: 2500 Gasoline-powered model shown.

7. Connect ohmmeter red lead to ground terminal of circuit (A) or component to be tested that is closest to the battery negative terminal. Resistance reading must be the same or very close to the battery negative terminal reading. Work backward from the battery on the ground side of the problem circuit until the resistance reading increases above 0.1 ohm. 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 ohm[5]. Check both sides of the connectors closely, as disconnecting and connecting may temporarily solve problem.

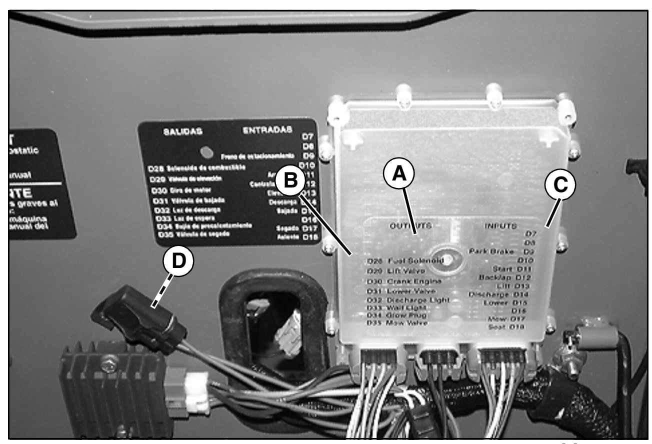
Electronic Control Module Check

Reason

To determine the operating condition of the electronic control module. The electronic control module includes several self-protection features and is designed to last the life of the machine. Most electrical problems are caused by harness or component failures, and are rarely a result of a control module failure.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Move key switch to RUN position.



M84736

7. Check "Heartbeat" light (A) and input/output indicator lights (B and C).

Results

Normal

- "Heartbeat" light flashing in a regular, even rate.
- Input indicator light(s) corresponding to activated switch(es) lit.
- Output indicator light(s) corresponding to active component(s) lit.

5. Some ohmmeters may not provide an accurate reading at a very low resistance. Touch meter probe leads together, and subtract shorted probe reading from the measured resistance reading.

Not Normal

- If the “Heartbeat” light and input/output indicator lights are not lit, check F2 main fuse (D). If fuse is good, check current supply to the control module. For gasoline engine models; (See “Power Circuit Diagnosis - Switched” on page 315.)

For diesel engine models; (See “Power Circuit Diagnosis - Switched” on page 431.)

NOTE: The code will cycle continuously with a two second pause between display cycles.

Only one code can be displayed at a time. Repeat check procedure after repairs have been completed.

- The “Heartbeat” light may flash one of the following codes:
- Three pulses followed by a short pause, followed by another pulse (Code 3-1); Indicates an over-voltage condition (voltage input to control box over 18 volts). For gasoline engine models; (See “Charging Circuit Diagnosis” on page 347.) For diesel engine models; (See “Charging Circuit Diagnosis” on page 463.)

NOTE: When the following codes are displayed, no output indicator lights will be lit.

Circuits connected to the “Output” connector of the control module, operate by switching the ground side of the circuit.

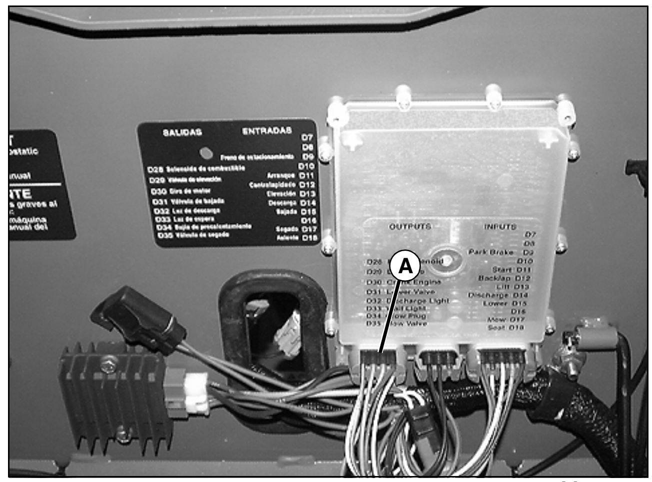
- Three pulses followed by a short pause, followed by two pulses (Code 3-2); Indicates a wiring harness failure. Proceed to Test Control Module procedure.
- Three pulses followed by a short pause, followed by three pulses (Code 3-3); Indicates an output short to positive 12 volt condition on the components of one (or more) of the following circuits:

NOTE: See individual circuit diagnosis in Electrical section for diagnostic procedures.

  - Lift/Lower Valve Circuit
  - Crank Engine Circuit
  - Discharge Light Circuit
  - Glow Plug Circuit (Diesel)
  - Mow Valve Circuit

- Three pulses followed by a short pause, followed by four pulses (Code 3-4); Indicates a fuel solenoid circuit failure. For gasoline engine models; (See “Run Circuit Diagnosis” on page 339.) For diesel engine models; (See “Run Circuit Diagnosis” on page 454.)
- Three pulses followed by a short pause, followed by five pulses (Code 3-5); Indicates fuel hold internal checking failure on circuit board, or output miswired to +12 volts.
- Three pulses followed by a short pause, followed by six pulses (Code 3-6); Indicates a faulty power or ground connection to the control board.
- Three pulses followed by a short pause, followed by seven pulses (Code 3-7); Indicates a faulty power or ground connection to the control board.
- Three pulses followed by a short pause, followed by eight pulses (Code 3-8); Indicates a faulty power or ground connection to the control board.

Test Control Module



M84736

1. Move key switch to STOP position.
2. Disconnect “Output” connector (A) from control box.
3. Move key switch to RUN position.

Normal

- “Heartbeat” light flashing in a regular, even rate. This indicates the control module is operating properly and the problem is in the wiring harness.

If Not Normal

- If the “Heartbeat” light continues to flash the 3-2 code, replace the control module.

Test Battery

CAUTION: Avoid injury! Battery electrolyte contains sulfuric acid. It is poisonous and can cause serious burns:

- **Wear eye protection and gloves.**
- **Keep skin protected.**
- **If electrolyte is swallowed, get medical attention immediately.**
- **If electrolyte is splashed into eyes, flush immediately with water for 15-30 minutes and get medical attention.**
- **If electrolyte is splashed onto skin, flush immediately with water and get medical attention if necessary.**

NOTE: The original battery supplied with this machine is a sealed battery and is not serviceable. This procedure is for a serviceable battery that has replaced the original sealed battery.

Do not attempt to open, add fluid or service a sealed battery.

To test a sealed battery, perform a battery load test. (See "Load Test Battery" on page 543.)

Reason

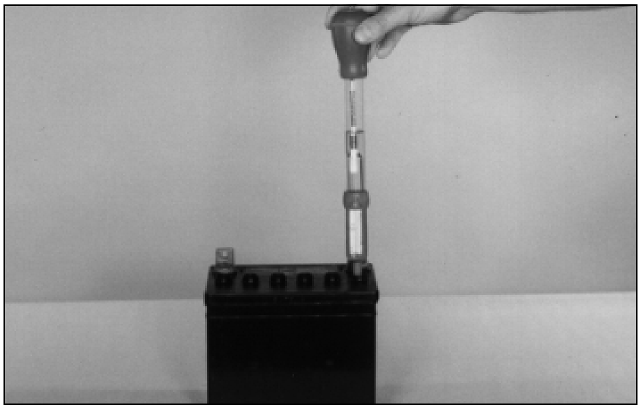
To check condition of battery and determine battery voltage.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydrometer	NA	Used to check specific gravity.
Voltmeter	NA	Used to check battery voltage.
Battery Tester	JT05685	Used to check battery voltage.

Procedure

1. Park machine on level surface.
2. Move control levers to NEUTRAL position.
3. Turn key switch to OFF position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Clean cable ends, battery terminals and top of battery. (See "Clean Battery" on page 563.)
7. Remove battery. (See "Battery Removal/Installation" on page 563.)
8. Inspect battery terminals and case for breakage or cracks.
9. Check electrolyte level in each battery cell. Add clean, distilled water as needed. If water is added, charge battery for 20 minutes at 10 amps.
10. Remove surface charge by placing a small load on the battery for 15 seconds.



M49596

11. Use a hydrometer to check for a minimum specific gravity of 1.225 with less than a 50 point variation in each cell. If specific gravity is not within range perform one of the following:
    - If all cells are less than 1.175, charge battery at 10 amp rate.
    - If all cells are less than 1.225 with less than 50 point variation, charge battery at 10 amps.
    - If all cells are more than 1.225 with less than 50 point variation, load test battery.
    - If more than 50 point variation, replace battery.
12. Use a voltmeter or JT05685 Battery Tester to check for a minimum battery voltage of 12.4 volts. One of the following may result:
    - If battery voltage is less than 12.4 VDC, charge battery.
    - If battery voltage is more than 12.4 VDC, test specific gravity. (See step 11.)
13. Install battery. (See "Battery Removal/Installation" on page 563.)

Charge Battery

CAUTION: Avoid injury! The battery produces a flammable and explosive gas. The battery may explode:

- **Do not smoke near battery.**
- **Wear eye protection and gloves.**
- **Do not allow direct metal contact across battery posts.**
- **Remove negative cable first when disconnecting.**
- **Install negative cable last when connecting.**

Reason

To increase battery charge after the battery has been discharged.

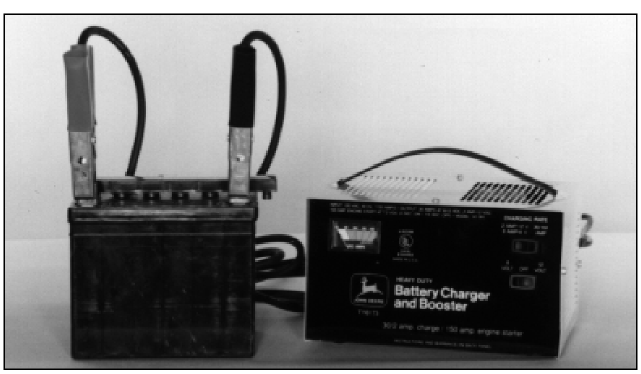
Special or Required Tools

Tool Name	Tool No.	Tool Use
Battery Charger (Variable Rate)	NA	Used to charge battery.

Procedure

NOTE: Before charging serviceable battery, check electrolyte level. (See “Test Battery” on page 541.)

1. Park machine on level surface.
2. Move control levers to NEUTRAL position.
3. Turn key switch to OFF position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Clean cable ends, battery terminals and top of battery.
7. Remove battery. (See “Battery Removal/Installation” on page 563.)



M49598

8. Connect variable rate charger to battery.
9. 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.
10. Check if battery is accepting 10-amp charge rate after 10 minutes at boost setting. One of the following may result:
    - If battery WILL NOT accept 10-amp charge after 10 minutes at boost setting, replace battery.
    - **Serviceable batteries only:** If battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did NOT need water, go to steps 12 and 13.
    - **Serviceable batteries only:** If battery is accepting 10-amp charge after 10 minutes at boost setting, but battery DID need water or all cells were BELOW 1.175, go to steps 11 and 12.
11. Set charger at 15-25 amps.

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

12. **Serviceable batteries only:** Check specific gravity after 30 minutes. One of the following problems may result:
    - If MORE THAN 50 point variation between cells, replace battery.
    - If LESS THAN 50 point variation between cells, go to steps 13 and 14.

NOTE: Serviceable batteries: If battery was discharged at slow or unknown rate, charge battery at 10-15 amps for 6-12 hours.

Maintenance-free batteries: Follow battery charger manufacturer’s recommendations.

13. Load test battery.
14. Install battery. (See “Battery Removal/Installation” on page 563.)

Specifications

Battery Specific Gravity. . . . . 1.230-1.265 points

Load Test Battery

Reason

To check condition of battery under load.

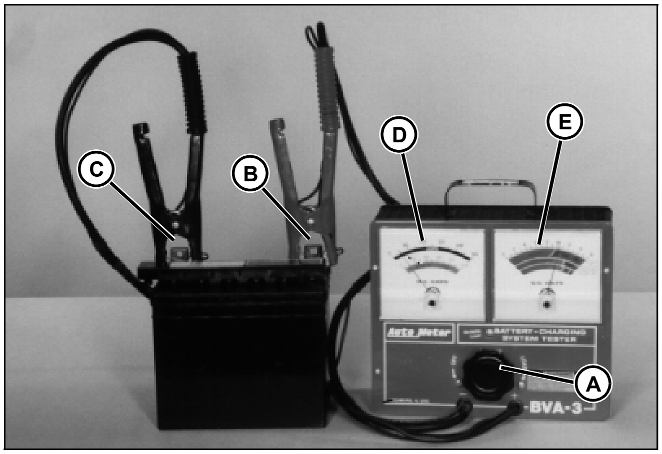
Special or Required Tools

Tool Name	Tool No.	Tool Use
Battery Tester (use according to manufacturer's instructions)	JT05685	Used to test battery.

Procedure

1. Park machine on level surface.
2. Turn key OFF and lock park brake.
3. Open engine cover.
4. Disconnect negative (-) and positive (+) battery cable clamps. Remove battery hold-down clamps.
5. Remove battery from machine.
6. Clean battery terminals and case.

IMPORTANT: Avoid damage! Turn load knob on battery tester fully out (counterclockwise) BEFORE making any test connections.



M49597

7. Connect tester positive cable (red) to battery positive (+) terminal (B).
8. Connect tester negative cable (black) to battery negative (-) terminal (C).

IMPORTANT: Avoid damage! Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than 5-10 seconds.

9. Turn load knob (A) of tester clockwise (in) until amperage reading (D) is equal to:
   - cold cranking amperage rating of battery (use blue scale).
   -or-
   - three times ampere hour rating (use black scale).

10. Hold for 15 seconds and turn load knob (A) of tester counterclockwise (out) into OFF position.
11. Repeat steps 9 and 10 above and read condition of battery at DC volts scale (E).
12. If battery DOES NOT pass test and HAS NOT been charged, charge battery and retest. (See “Charge Battery” on page 542.)
13. If battery DOES NOT pass test and HAS been charged, replace the battery.

Test Regulated Voltage Output

Reason

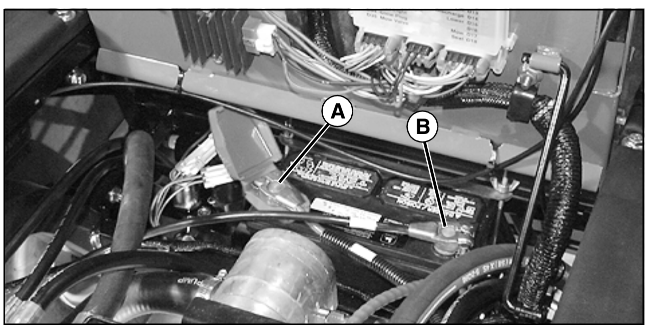
To check the regulated voltage (charging) output of the voltage regulator/rectifier.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure voltage.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Remove surface charge from battery by cranking the engine for 15 seconds.
7. Set multimeter to measure voltage.



M84579

8. Connect meter red lead to battery positive (+) terminal (A).
9. Connect meter black lead to battery negative (-) terminal (B).
10. Start and run engine at FAST idle (Gas - 3400 ± 50 rpm; Diesel - 3225 ± 50 rpm).
11. Read meter several times during 5 minutes of running time. Voltage should remain at specification.

Specifications

Regulated Voltage . . . . 12.2-14.7 Volts

Results

- If the DC voltage remains below the minimum specification, perform unregulated voltage output tests (gas or diesel). (See “Test Unregulated Voltage Output - Gasoline Engine” on page 544.) (See “Test Unregulated Voltage Output - Diesel Engine” on page 545.)
- If the DC voltage goes above the maximum specification, replace the voltage regulator/rectifier.

Test Unregulated Voltage Output - Gasoline Engine

Reason

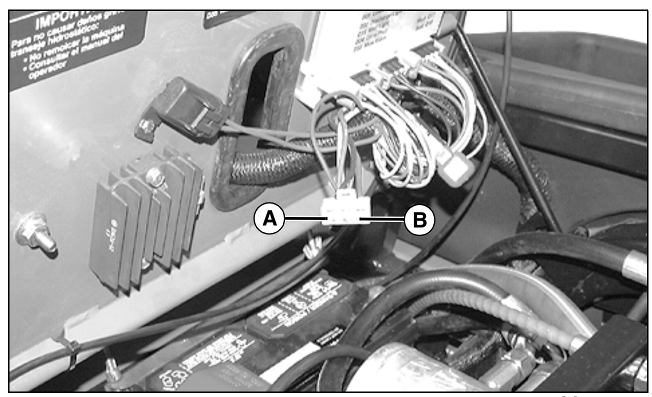
To check the stator output voltage to determine the stator condition.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure voltage.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.



M98896

6. Disconnect the voltage regulator/rectifier connector
7. Set multimeter to measure voltage.
8. Connect multimeter leads across stator leads, purple wire No. 307 (A) and gray wire No. 308 (B).
9. Start and run engine at FAST idle (3400 ± 50 rpm).
10. Read and record stator output voltage.

Specification

Unregulated Voltage - Gas Engine (minimum). . . . . 28 Volts AC

Results

If reading is less than specifications, test flywheel magnet. (See “Inspect Flywheel” on page 104.) If flywheel magnet tests OK, replace stator.

Test Unregulated Voltage Output - Diesel Engine

Reason

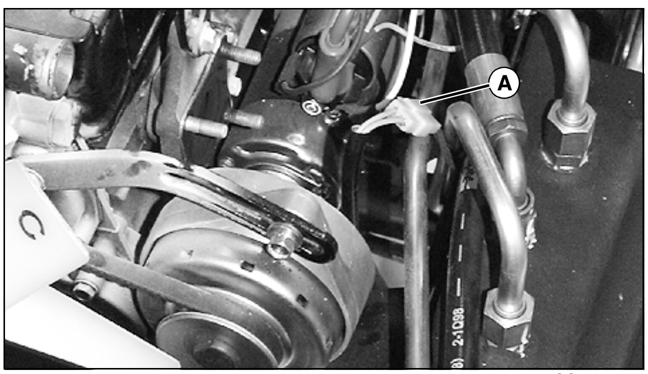
To check the stator output voltage to determine the stator condition.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure voltage.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.



M84650

6. Disconnect the alternator wiring connector (A).
7. Set multimeter to measure voltage.
8. Connect multimeter leads across stator leads.
9. Start and run engine at FAST idle.
10. Read and record stator output voltage.

Specification

Unregulated Voltage - Diesel Engine (minimum) . . . . 28 Volts AC

Results

If reading is less than specifications, repair or replace alternator.

Test Starting Motor Cranking Amperage Draw

Reason

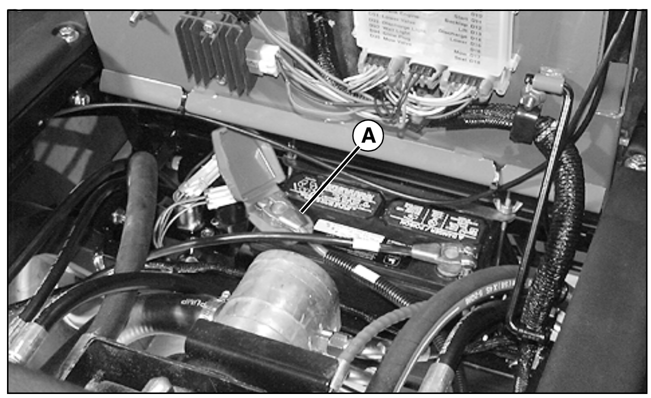
To determine the amperage required to crank the engine and check starter motor operation under load.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Current Clamp	JT02153	Used to measure starting motor current.
Digital Multimeter	JT05791	Used with current clamp.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Test system ground circuit connections. (See “Test Ground Circuit” on page 539.)
7. Test battery. (See “Test Battery” on page 541.)



M84579

8. Connect JT02153 Current Clamp around battery positive (+) cable.
9. Set multimeter to measure DC amperage.
10. Connect multimeter to current clamp.
11. Remove spark plug high-tension leads and ground to engine.

IMPORTANT: Avoid damage! Perform the following procedure within 15 seconds to prevent damage to electrical components.

12. Crank engine and read amperage on DC amp scale of multimeter.

13.Turn key switch to OFF position.

Specification

Starting Motor Cranking Amperage Draw (maximum) at 225 engine RPM . . . . 180 Amps

Results

- If amperage is above specifications, or rpm is low, check starter for binding or damage.
- f starter is good, check engine for internal binding or damage.

Test Starting Motor Solenoid - Gasoline Engine

Reason

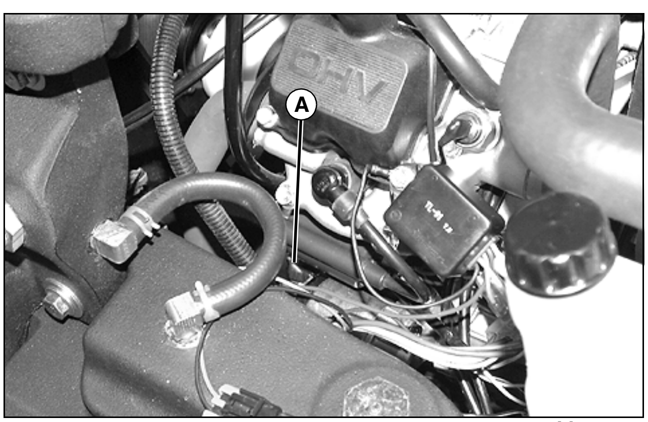
To determine if the starter solenoid or starting motor is defective.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Jumper Wire	NA	Used to test starting motor solenoid.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Remove spark plug high-tension leads and ground to engine.



M99031

7. Disconnect red wire (A) from starter solenoid.

NOTE: All solenoid terminals must be clean and free of corrosion.

8. Connect jumper wire to positive (+) battery terminal and briefly jump to starting motor tang.
   - Starter runs: Solenoid is good, check circuit wiring (See “Cranking Circuit Diagnosis” on page 321.)
   - Starter does not run: Go to step 9.
9. Briefly connect jumper wire between starter solenoid large terminals.
   - Starter runs: Replace solenoid.
   - Starter does not run: Check battery cables, replace starter.

Test Starting Motor Solenoid - Diesel Engine

Reason

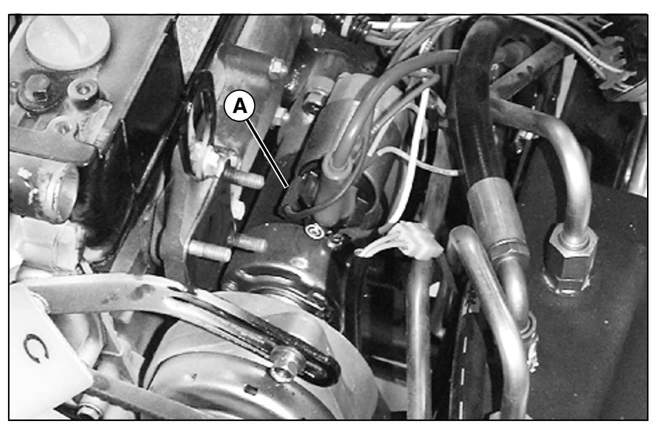
To determine if the starter solenoid or starting motor is defective.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Jumper Wire	NA	Used to test starting motor solenoid.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect fuel shutoff solenoid wiring connector.



M84650

7. Disconnect brown wire No. 301 (A) from starter solenoid.

NOTE: All solenoid terminals must be clean and free of corrosion.

8. Connect jumper wire to positive (+) battery terminal and briefly jump to starting motor tang.

- Starter runs: Solenoid is good, check circuit wiring (See “Cranking Circuit Diagnosis” on page 437.)
- Starter does not run: Go to step 9.

9. Briefly connect jumper wire between starter solenoid large terminals.

- Starter runs: Replace solenoid.
- Starter does not run: Check battery cables, replace starter.

Test Pulser Coil - Gasoline Engine

Reason

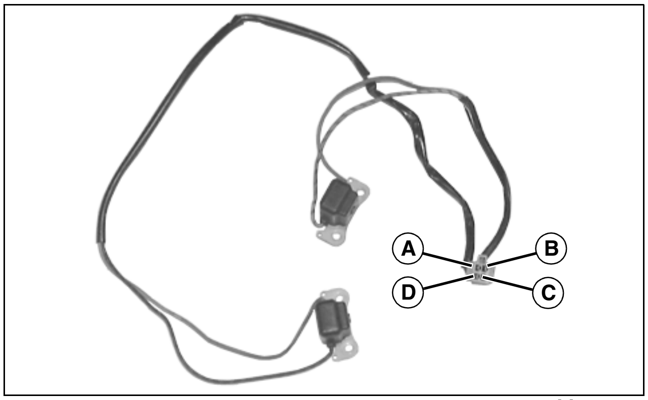
To determine if the pulser coils are operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Multimeter	JT05791	Used to measure pulser coil resistance.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect pulser coil wiring connector.
7. Set multimeter to measure resistance.



M98812

8. Measure resistance between yellow and green/white wires (D and C).
9. Measure resistance between pink and white/blue wires (A and B).

Specifications

Pulser Coil Resistance - Gas Engine

Yellow-to-Green/White . . . . 85-270 ohms
Pink-to-White/Blue . . . . 85-270 ohms

Results

If any resistance reading is not within specifications, replace pulser coils.

Test Ignition Coil - Gasoline Engine

Reason

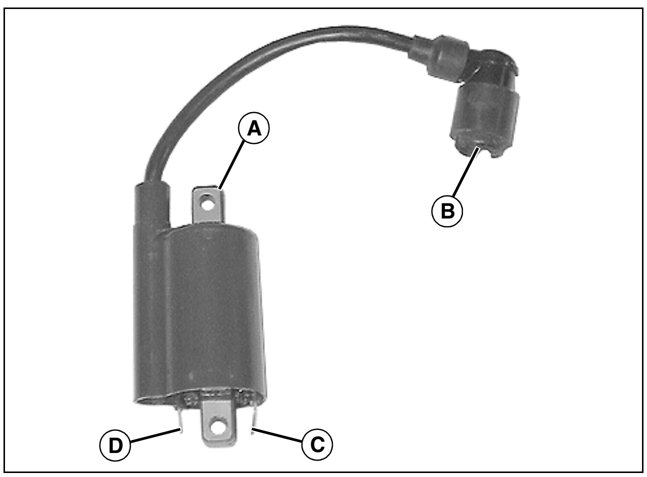
To determine if the engine ignition coil is defective.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Multimeter	JT05791	Used to measure ignition coil resistance.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect wires from ignition coil terminals.
7. Set multimeter to measure resistance.



M98601

8. Measure resistance across primary windings, terminals (C and D).

9. Measure resistance across secondary windings.

10.Measure resistance between primary lead (C) and coil core (A). There should be no continuity (open circuit).

11.Measure resistance between high tension lead (B) and coil core (A). There should be no continuity (open circuit).

Specifications

Ignition Coil Resistance - Gas Engine

Primary Windings. .3.4-4.6 ohms

Secondary Windings . . . . 10.4-15.6 k-ohms

Results

- If any resistance readings are not within specifications, replace the coil.
- f the resistance readings are within specifications, the coil is probably good. If the ignition system still does not perform properly after all checks and tests are performed, replace the coil with a known good coil.

Test Ignition Module - Gasoline Engine

Reason

To determine if the ignition module is working properly.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move key switch to STOP position.
4. Engage park brake.

M98869

5. The ignition module is very sensitive to the type of ohmmeter used to check resistance. Due to variations in ohmmeters, the best way to determine if the ignition module is good, is to replace the questionable module with a known good module.

Results

If the ignition module does not correct the problem, check the other ignition components.

Test Glow Plug - Diesel

Reason

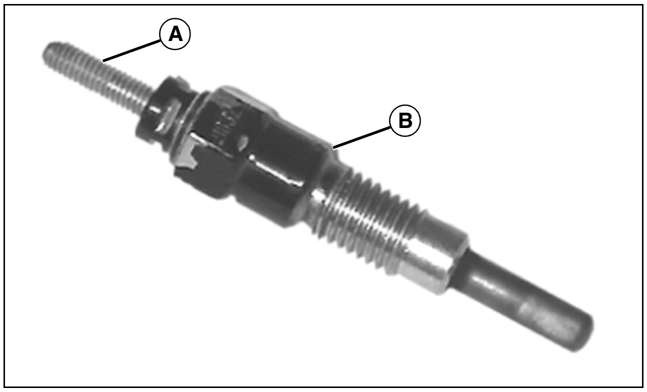
To test the condition of the glow plug.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Multimeter	JT05791	Used to measure glow plug resistance.

Procedure

1. Remove glow plug(s). (See “Remove and Install Glow Plug” on page 183.)



M98190

2. Check resistance across terminal (A) and glow plug body (B).

Specifications

Glow Plug Resistance . . . . .1.35-1.65 ohms

Results

If the glow plug does not have the correct resistance, replace the glow plug.

Test Fuse

Reason

To determine if fuse has failed.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to test fuse continuity.

Procedure

1. Remove fuse to be tested.
2. Set ohmmeter to ohms function.

M48391

3. Connect one meter lead to one post of fuse. Connect other meter lead to other post of fuse.

Results

If there is no continuity between posts, replace fuse.

Test Diode

Reason

To determine if diode has failed.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to test diode.

Procedure

1. Remove diode from connector.
2. Set meter to diode test.

3. Connect meter test lead to each lead of diode. Check for continuity.
4. Reverse test leads. Check for continuity.

Results

Diode must have a low resistance reading in one direction only. Replace defective diode.

Test Electrical Relays

Reason

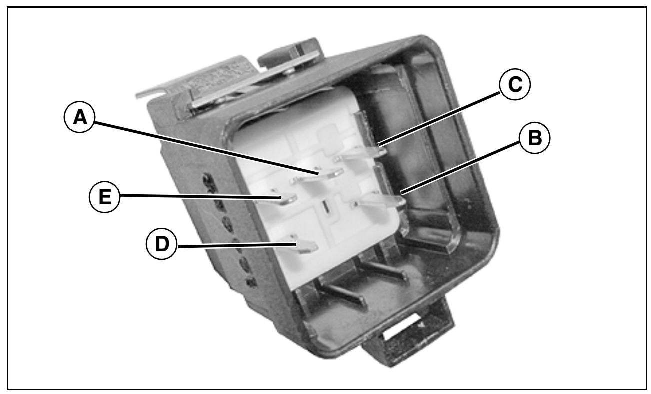
To determine if electrical relay coils are actuating correctly and resistance of relay contact points is correct.

Special or Required Tools

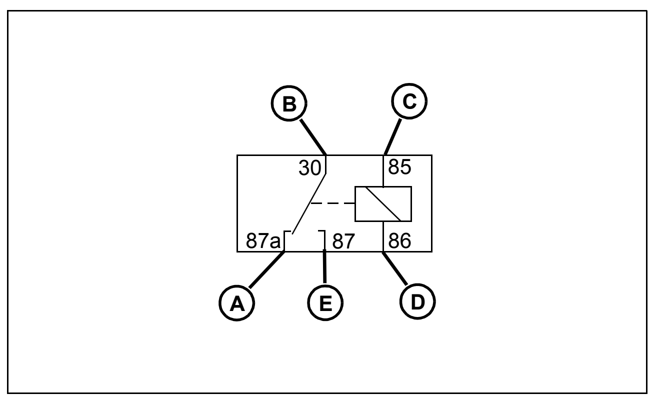
Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to test relays.
Jumper Wires (2)	NA	Used to test relays.
12-V Battery	NA	Used to test relays.

Procedure

NOTE: All relays function the same. The relay schematic below reflects the operation of the relays.



MX14471



MIF

1. Check terminal continuity using an ohmmeter or continuity tester.
   - Continuity should exist between relay terminals 87a and 30 (A and B) and between 85 and 86 (C and D).
   - No continuity between relay terminals 30 and 87 (B and E).

2. Connect jumper wire from battery positive (+) terminal to relay terminal 85 (C). Connect another jumper wire from relay terminal 86 (D) to battery negative (-) terminal.

- Continuity could exist between relay terminals 30 and 87 (B and E).
- No continuity between relay terminals 30 and 87a (B and A).

Results

If continuity is not correct, replace relay.

Test Bulb

Reason

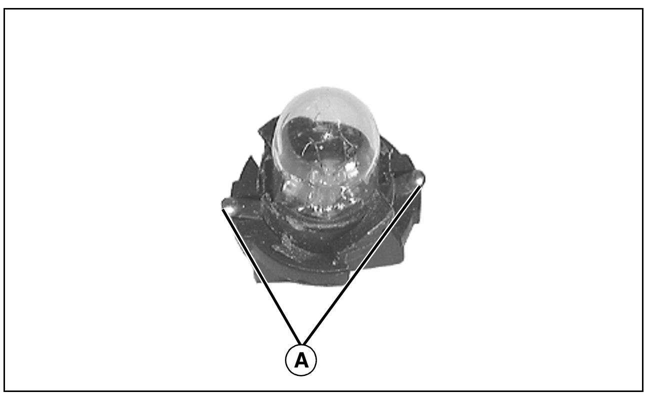
To verify that the warning indicator lights are in working order.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to check bulb continuity.

Procedure

1. Remove indicator light socket from warning light module.



M98864

2. Check for continuity between socket terminals (A).

Results

If continuity is not indicated, replace bulb.

Test Key Switch

Reason

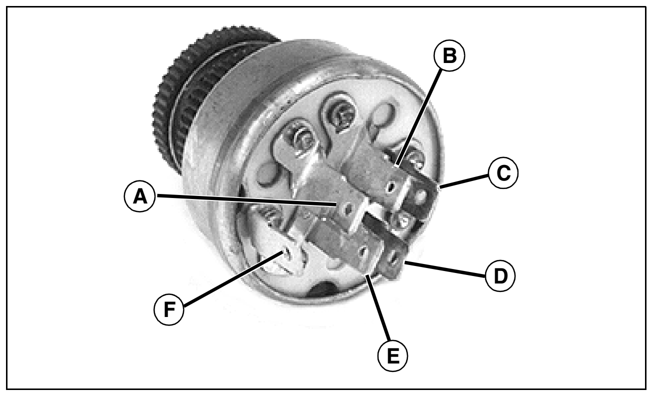
To verify that the key switch is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure key switch continuity.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect key switch connector.



M83171

7. Measure for continuity between switch terminals with switch in OFF, RUN and START positions.

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

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

Results

If any continuity is NOT correct, replace the switch.

Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)

Reason

To verify continuity between the switch terminals when the park brake switch or lift and lower lever/pedals have been activated.

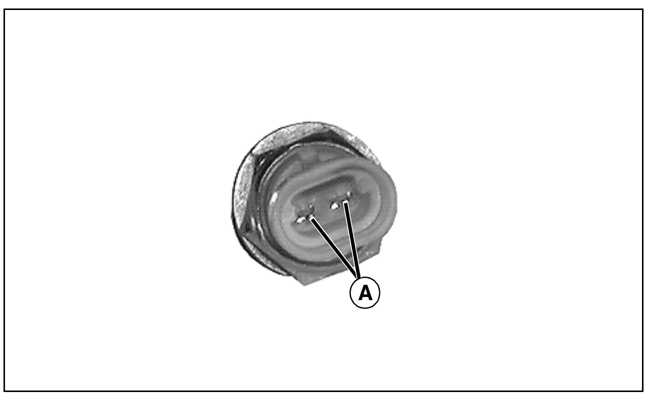
Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

NOTE: This procedure applies to both the lift and lower switches located in the console and floor-mounted lift and lower switches.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Release park brake.
5. Disconnect brake or lift and lower switch connector.



M98551

6. Check continuity across switch terminals (A). There should be NO continuity.
7. Depress plunger.
8. Check continuity across terminals. There should be continuity.

Results

If continuity is not correct in the either position, replace switch.

Test Lift and Lower Switch - Models 2500A (S.N. 020001-), 2500E

Reason

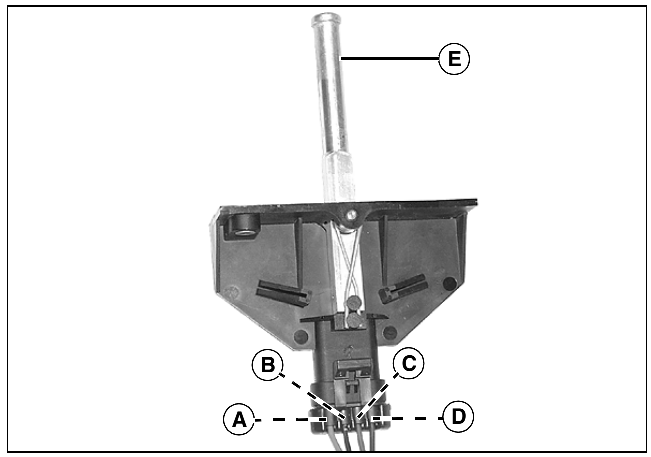
To determine if lift and lower switch is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to test lift and lower switch.

Procedure

1. Turn key switch to RUN position.



MX20489

2. With a small diameter probe connect meter negative (-) lead to lift and lower switch connector terminal (B) (wire 100 blk). With a small diameter probe connect meter positive (+) lead to lift and lower switch connector terminal (C) (wire 842 red). There must be battery voltage. If there is NO battery voltage, test lift and lower circuit.

3. Leave meter negative (-) lead connected to lift and lower switch connector terminal (B) (wire 100 blk) for remainder of procedure.

4. With a small diameter probe connect meter positive (+) lead to lift and lower switch connector terminal (D) (wire 811 brn). Move lift and lower switch lever (E) to RAISE position. There must be battery voltage.

Move lever to the LOWER position. Voltage should go to 0.

5. With a small diameter probe connect meter positive (+) lead to lift and lower switch connector terminal (A) (wire 813 org). Move lift and lower switch lever (E) to RAISE position. There must be battery voltage.

Move lever to the LOWER position. Voltage should go to 0.

Results

- If voltage is not as specified, replace lift and lower switch.

Test Seat Switch

Reason

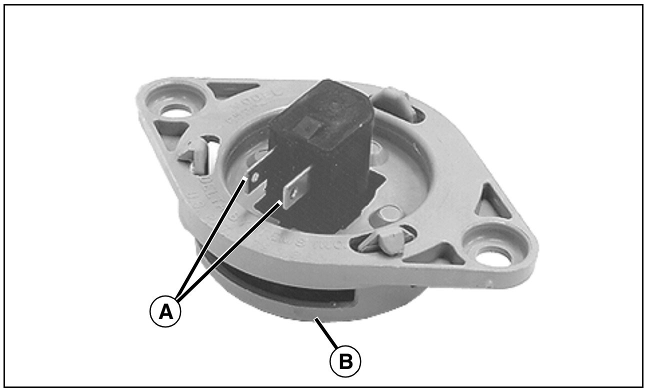
To verify continuity between the seat switch terminals when the operator is on the seat.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and latch seat platform.
6. Disconnect seat switch connector.



M84358

7. Check continuity across switch terminals. There should be no continuity.
8. Depress plunger (B).
9. Check continuity across switch terminals (A). Continuity should exist between terminals.

Results

If continuity is not correct, replace the switch.

Test Mow/Transport Switch

Reason

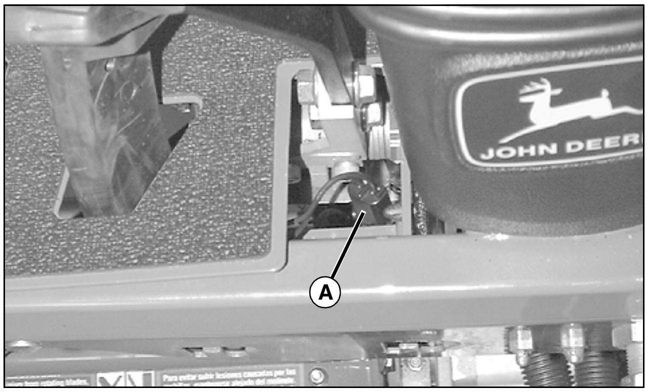
To verify continuity between the switch terminals when the machine is in the MOW and TRANSPORT modes.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

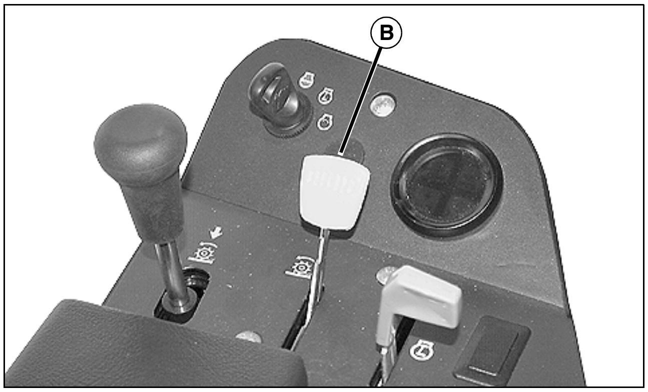
Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.



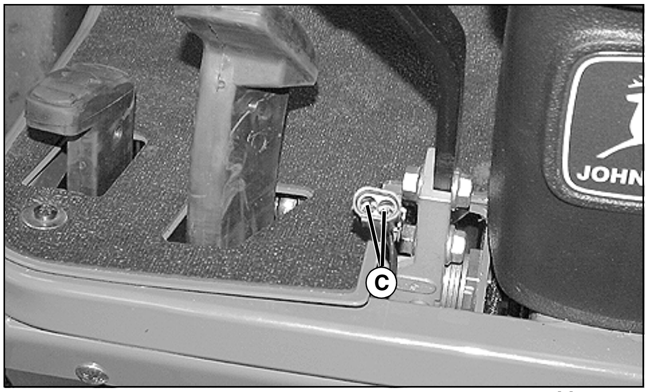
M98553

5. Disconnect switch wiring connector (A).



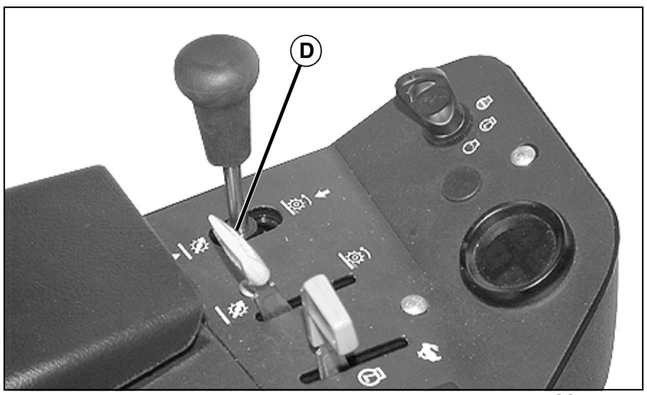
M98549

6. Move mow/transport lever (B) to MOW position.



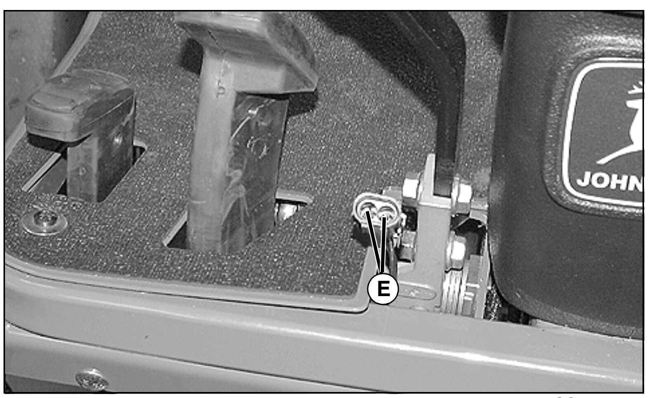
M98548

7. Check continuity across switch terminals (C). There should be continuity.



M98550

8. Move mow/transport lever (D) to TRANSPORT position



M98548

9. Check continuity across switch terminals (E). Continuity should not exist between terminals.

Results

If continuity is not correct, replace the switch.

Test Mow Valve Solenoid - Models 2500, 2500A

Reason

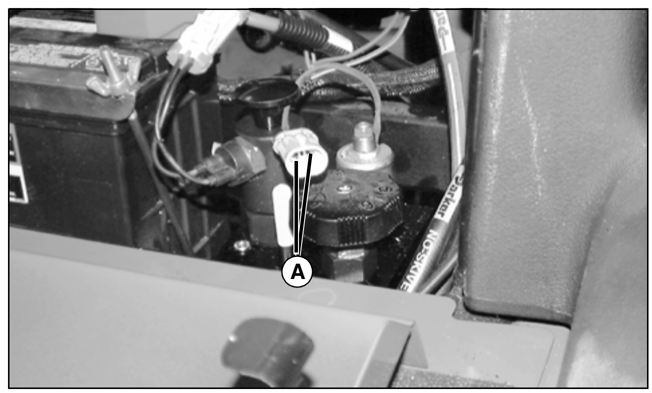
To verify that the mow valve solenoid coil is operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure coil continuity.

Procedure

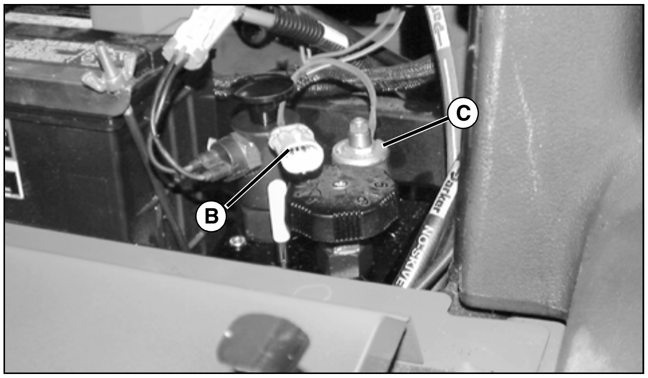
1. Park machine on level surface
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and lock seat platform.
6. Disconnect mow valve solenoid wiring connector.



M98865

Picture Note: Model 2500 shown

7. Connect an ohmmeter/continuity tester leads across solenoid terminals (A). There should be continuity across terminals.



M98865

Picture Note: Model 2500 shown

8. Connect one ohmmeter/continuity tester lead to one coil terminal (B), and the other lead to bare metal on the coil case (C).There should be no continuity between the coil terminal and coil case.

Results

Replace coil if continuity is present between coil terminal and coil case or if NO continuity is present between coil terminals.

Test lift and lower Valve Solenoid

Reason

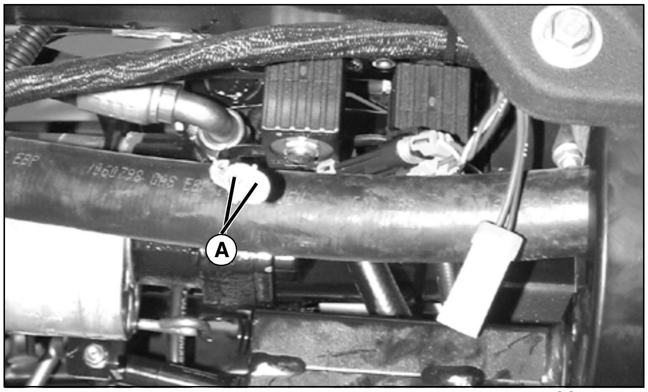
To verify that the lift and lower valve solenoid coils are operating properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure coil continuity.

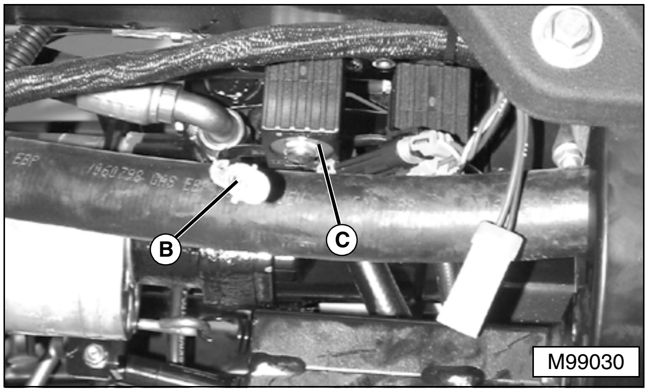
Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Disconnect raise valve solenoid wiring connector.



M99030

6. Connect an ohmmeter/continuity tester leads across solenoid terminals (A). There should be continuity across terminals.



7. Connect one ohmmeter/continuity tester lead to one coil terminal (B), and the other lead to bare metal on the coil case (C).There should be no continuity between the coil terminal and coil case.

Results

Replace coil if continuity is present between coil terminal and coil case or if NO continuity is present between coil terminals.

Test Backlap Switch - Models 2500, 2500A

Reason

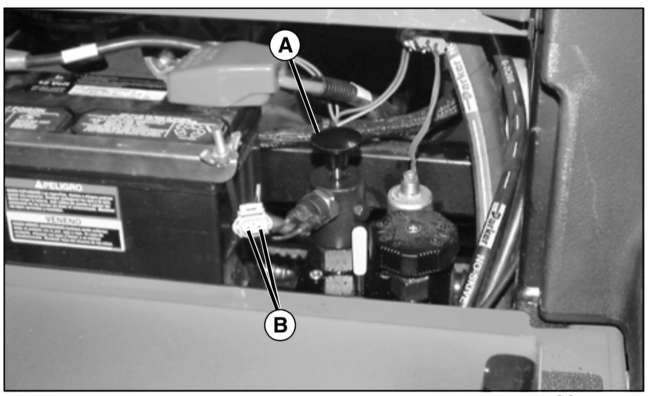
To verify continuity between the switch terminals when the machine is in the MOW and BACKLAP modes.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise and lock seat platform.
6. Disconnect backlap switch wiring connector.



M98866

7. Move backlap valve (A) to MOW (OFF) position (DOWN).
8. Check continuity across connector terminals (B). There should be no continuity.
9. Move backlap valve to BACKLAP (ON) position (UP).
10.Check continuity across connector terminals. There should be continuity.

Results

If continuity is not correct, replace the switch.

Test Hydraulic Temperature Switch

Reason

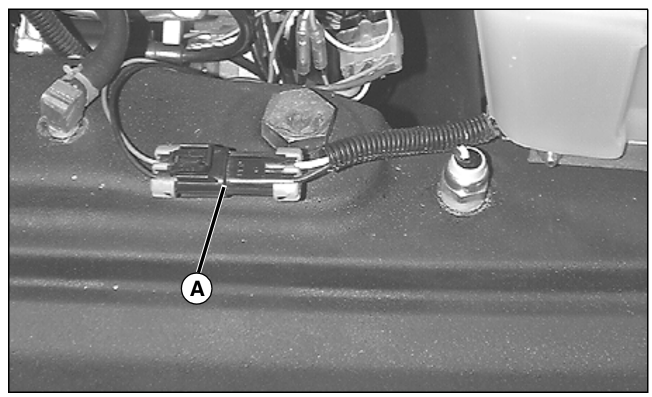
To verify the hydraulic oil temperature switch is functioning properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

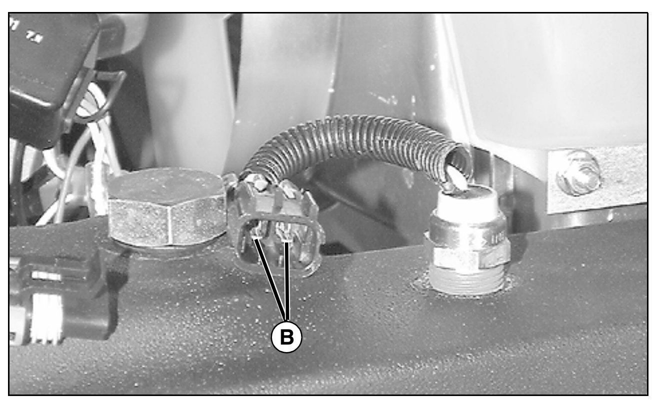
Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position and allow the hydraulic oil to cool to room temperature.
4. Engage park brake.
5. Raise cowling.



M98650

6. Disconnect wiring connector (A).



M98776

7. Measure resistance across switch terminals (B). There should be No continuity across the terminals at room temperature.

Results

Replace the switch, if continuity is read at room temperature.

Test Engine Oil Pressure Switch - Gasoline Engine

Reason

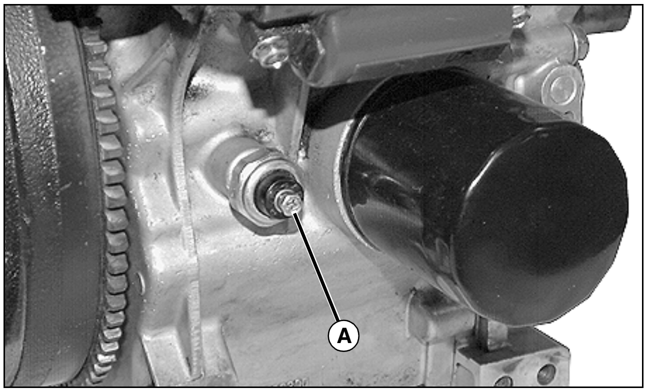
To determine if the engine oil pressure switch is functioning properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect wire from oil pressure switch.



M98552

7. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to switch terminal (A).
8. Measure resistance between switch terminal and engine block. There should be continuity between switch terminal and ground.
9. Start and run engine
10. Measure resistance between switch terminal and engine block. There should be NO continuity between switch terminal and ground.

Results

NOTE: Apply pipe sealant with TEFLON® to threads of switch any time it is installed.

- If there is NO continuity between switch terminal and engine block (ground) with engine NOT running, replace the oil pressure switch.
- If the switch DOES have continuity between switch terminal and engine block (ground) with engine running, check oil pressure. If oil pressure is to specification, replace the oil pressure switch.

Test Fuel Shutoff Solenoid - Gasoline Engine

Reason

To verify the operation of the fuel shutoff solenoid.

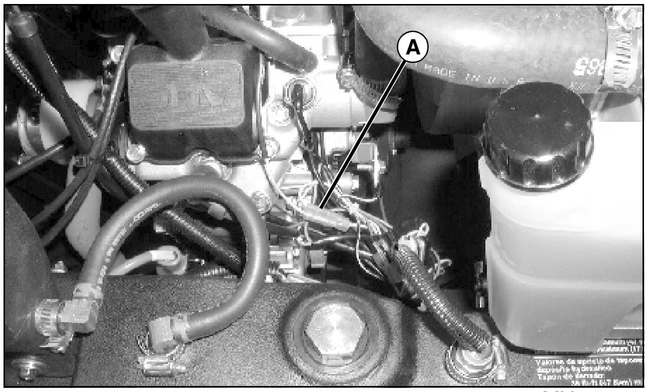
Special or Required Tools

Tool Name	Tool No.	Tool Use
Jumper Wire	NA	Used to test fuel shutoff solenoid.

Procedure

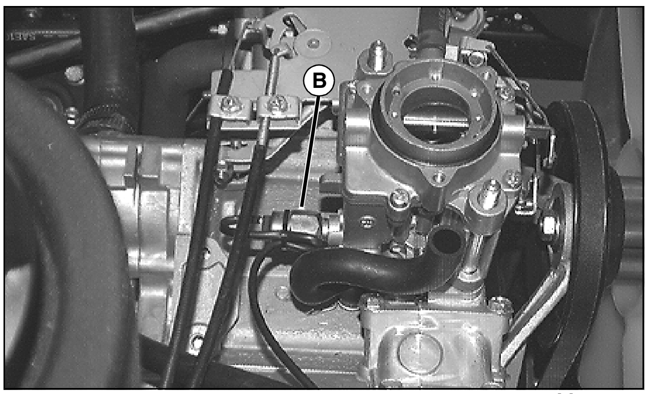
CAUTION: Avoid injury! Gasoline is present in the carburetor and fuel line. Gasoline is extremely flammable and its vapors can explode if ignited. Keep sparks and other sources of ignition away from the engine.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



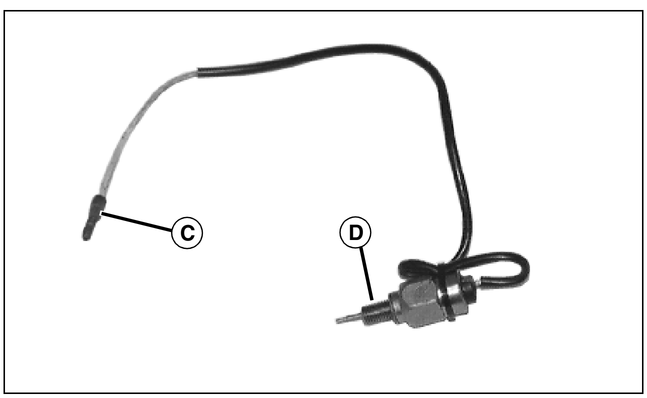
MX18023

7. Disconnect solenoid lead (A).



M98647

8. Remove fuel shutoff solenoid (B).



M98649

9. Connect a wire to the battery negative (-) terminal to solenoid threads (D).

10.Briefly touch male terminal of the solenoid lead (C) to the battery positive (+) terminal.

Results

- If the pin retracts, the solenoid is good.
- If the pin fails to retract, replace the solenoid.

Fuel Shutoff Solenoid Test - Diesel Engine

Reason:

To verify proper fuel shutoff solenoid operation.

Special or Required Tools:

Tool Name	Tool No.	Tool Use
Ohmmeter	NA	Used to measure resistance of fuel shutoff solenoid coils.

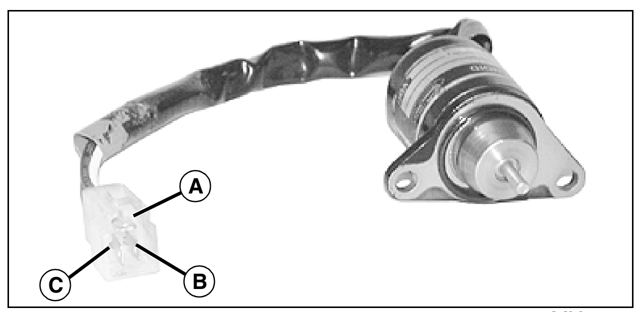
Procedure:

1. Park machine safely on a level surface.
2. Disengage PTO.
3. Turn key switch to STOP position.
4. Move travel pedals to NEUTRAL position.
5. LOCK park brake.
6. Turn key switch to RUN position. A click should be heard as the solenoid engages.

Results:

- If a click is not heard, proceed to next step.

7. Open engine cover.
8. Disconnect the solenoid connector from the harness.



MX2492

9. Using an ohmmeter, check resistance across terminals (A) and (B). Resistance should be within specification for fuel shutoff solenoid pull-in coil.

10.Using an ohmmeter, check resistance across terminals (A) and (C). Resistance should be within specification for fuel shutoff solenoid hold-in coil.

Results:

- If resistance is not to specifications, replace solenoid.

Specifications:

Fuel Shutoff Solenoid Resistance

Pull-In Coil . . . . 0.4 ohms

Hold-In Coil. . . . . 23.6 ohms

Engine Oil Pressure Switch Test - Diesel Engine

Reason

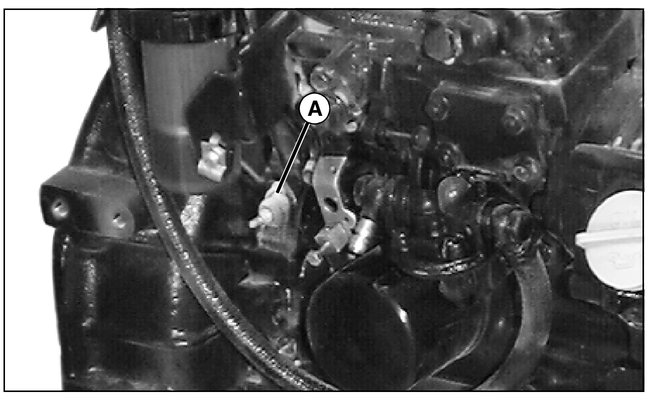
To determine if the engine oil pressure switch is functioning properly.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Raise cowling.
6. Disconnect brown wire No. 105 from oil pressure switch.



M99029

7. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal of switch (A).
8. Measure resistance between the switch terminal and engine block. There should be continuity between switch terminal and ground.
9. Start and run engine at FAST idle.
10. Measure resistance between the switch terminal and engine block. There should be NO continuity between switch terminal and ground.

Results

NOTE: Apply pipe sealant with TEFLON® to threads of switch any time it is installed.

- If there is NO continuity between switch terminal and engine block (ground) with engine NOT running, replace the oil pressure switch.
- If the switch DOES have continuity between switch terminal and engine block (ground) with engine running, check oil pressure. If oil pressure is to specification, replace the oil pressure switch.

Test Headlight Switch (Optional)

Reason

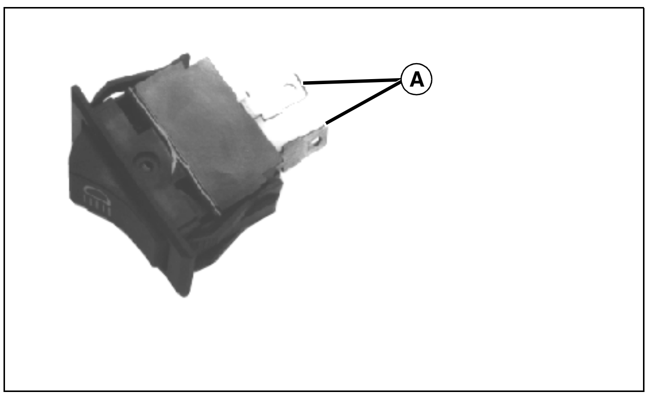
To verify that the headlight switch terminals have continuity when the headlight switch is ON.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to measure switch continuity.

Procedure

1. Park machine on level surface.
2. Engage park brake.
3. Turn key switch to STOP position.
4. Engage park brake.
5. Disconnect headlight switch connector.



M48378

6. Check continuity between switch terminals (A) with the switch in the ON and OFF positions.

Results

- If there is NO continuity with the switch in the ON position, replace the switch.
- If continuity exists with the switch in the OFF position, replace the switch.

Test Reel Motor Forward/Reverse Switch - Model 2500E

Reason

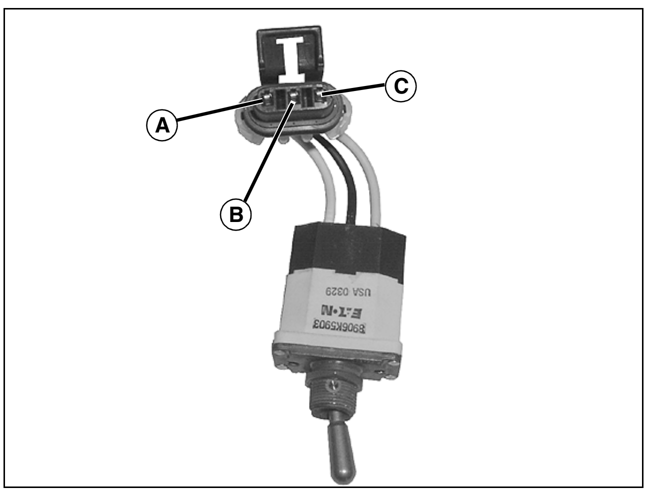
To verify proper reel motor forward/reverse switch operation.

Special or Required Tools:

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to check continuity of reel motor forward/reverse switch.

Procedure

1. Park machine safely on a level surface.
2. Turn key switch to STOP position.
3. Engage park brake.
4. Disconnect reel motor forward/reverse switch connector and remove switch.
5. Use an ohmmeter to test switch continuity.



MX20452

Reel Motor Forward/Reverse Switch Continuity	
Switch Position	**Terminal Continuity**
Forward	B and C
Reverse	B and A

Results

- If continuity is not correct, replace switch.

Test Backlap Switch - Model 2500E

Reason

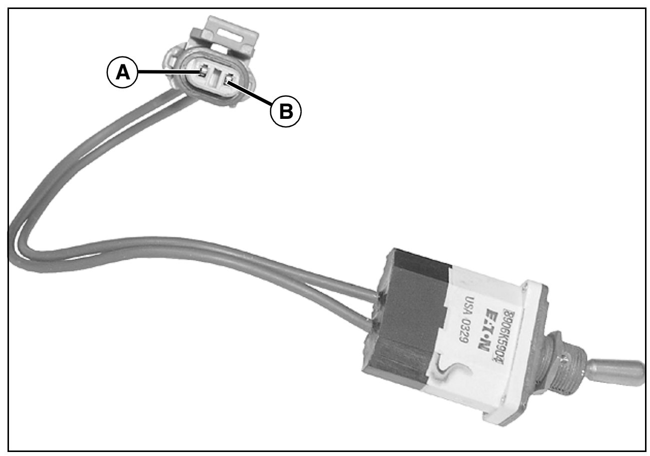
To verify proper backlap switch operation.

Special or Required Tools:

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to check continuity of backlap switch.

Procedure

1. Park machine safely on a level surface.
2. Turn key switch to STOP position.
3. Engage park brake.
4. Disconnect backlap switch connector and remove switch.
5. Use an ohmmeter to test switch continuity.



MX20453

6. Test continuity between switch terminals (A and B) with the switch in the MOW and BACKLAP positions.

Backlap Switch Continuity	
Switch Position	**Terminal Continuity**
Mow	No Continuity
Backlap	Continuity

Results

- If continuity is not correct, replace switch.

Test Reel Motor Speed Control - Model 2500E

Reason

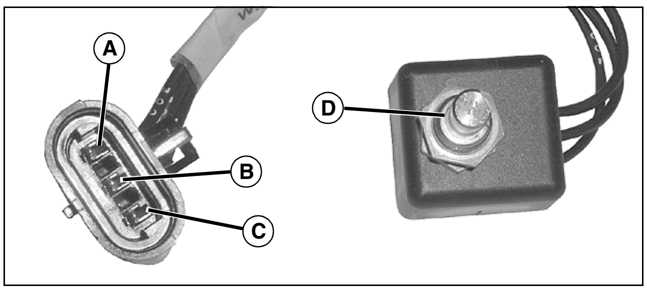
To verify proper reel motor speed control operation.

Special or Required Tools:

Tool Name	Tool No.	Tool Use
Digital Multimeter	JT05791	Used to check resistance of reel motor speed control.

Procedure

1. Park machine safely on a level surface.
2. Turn key switch to STOP position.
3. Engage park brake.
4. Disconnect reel motor speed control connector and remove control.



MX20454

5. Measure resistance between terminals (A and C), resistance must be approximately 5000 ± 1000 ohms.
6. Measure resistance between terminals (A and B) while rotating control stem (D), resistance must vary smoothly between 1000 to 4000 ± 1000 ohms.
7. Measure resistance between terminals (B and C) while rotating control stem (D), resistance must vary smoothly between 1000 to 4000 ± 1000 ohms.

Reel Motor Speed Control Resistance	
Terminals	**Resistance**
A and C	5000 ± 1000 ohms
A and B	1000-4000 ± 1000 ohms
B and C	1000-4000 ± 1000 ohms

Specifications

Reel Motor Speed Control - Model 2500E
. . . . . See procedure

Results

- If resistance is not correct, replace speed control.

Test Engine Coolant Temperature Switch

Reason

To determine the operating temperature of the switch.

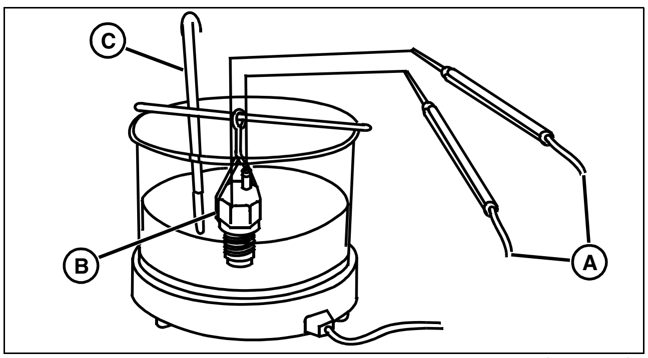
Special or Required Tools

Tool Name	Tool No.	Tool Use
Thermometer	NA	Used to measure water temperature.
Glass Container	NA	Used to contain water in test.
Heating Unit	NA	Used to heat water.
Ohmmeter	NA	Used to measure continuity.

Procedure

1. Park machine on level surface.
2. Remove coolant temperature switch.

CAUTION: Avoid injury! DO NOT allow switch or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if overheated.



MIF (M91295)

3. Connect lead wires from ohmmeter probes (A) to switch terminal and body.
4. Suspend switch (B) and a thermometer (C) in a container of water and coolant mixture.
5. Heat and stir the mixture. Observe temperature, when continuity occurs. Temperature must be to specification.
6. Install temperature switch using pipe sealant with TEFLON in the threads. Tighten to specification.

Results

If continuity does not occur within specification, replace switch.

Specifications

Engine Coolant Temperature Switch

Operating Temperature . . . . 108-114°C (226-237°F)

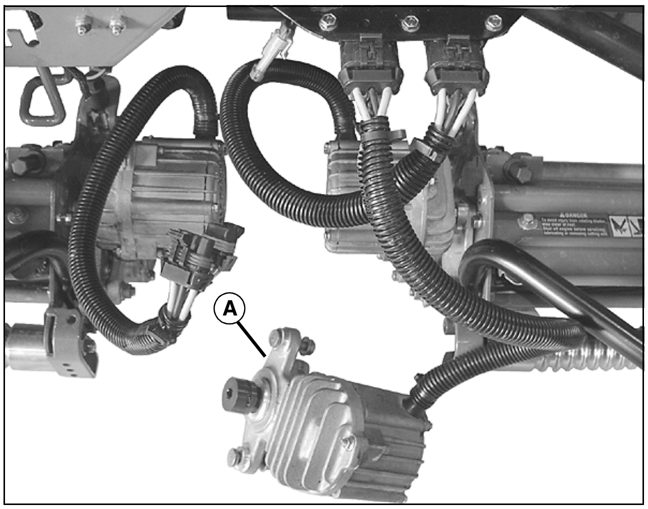
Test Reel Motor - Model 2500E

Reason

To determine if reel motor is operating properly.

Procedure

1. Machine parked on a level surface.
2. Key switch in STOP position.
3. Brake pedal in LOCKED position.



4. Connect suspected failed motor (A) to a known operating reel motor control module.
5. Operator ON seat.
6. Start and operate engine at medium idle.
7. Release brake pedal.
8. Place mow/transport lever in the MOW position.
9. Place lift and lower lever in the LOWER position.

Results

- If suspected failed motor operates, motor tests good.
- If suspected failed motor does not operate, then motor has failed. Replace motor.

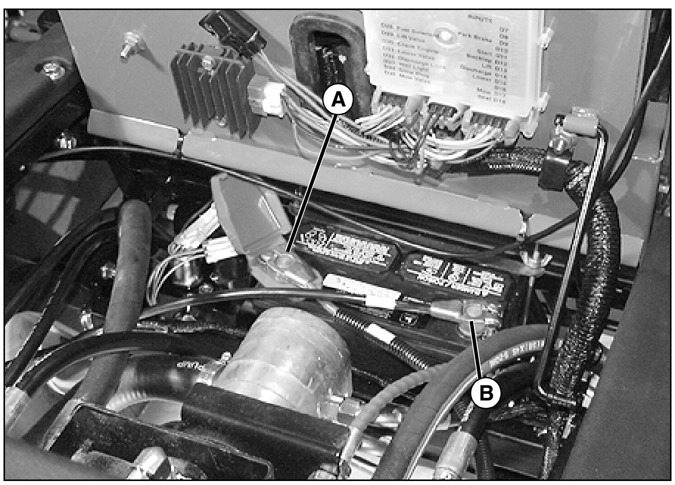
NOTE: Do not rely on visual movement of gear when testing operating condition of motor, a broken belt may falsely indicate a failed motor.

Repair

Battery Removal/Installation

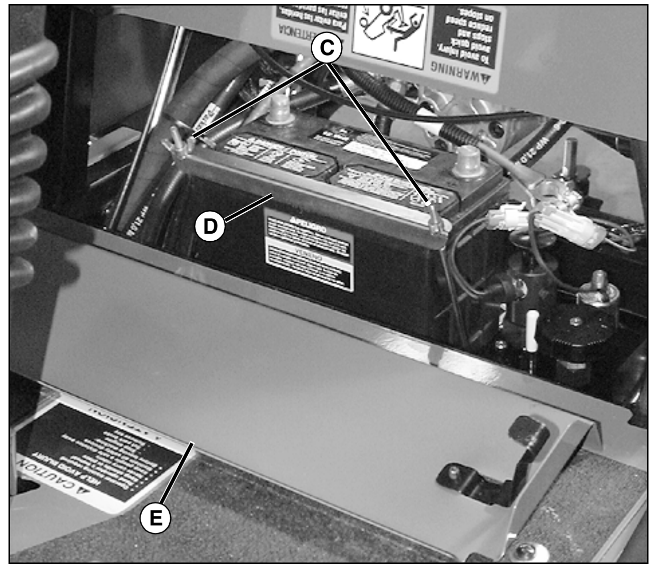
> **CAUTION: Avoid injury! Battery electrolyte contains sulfuric acid. It is poisonous and can cause serious burns:**
>
> - **Wear eye protection and gloves.**
> - **Keep skin protected.**
> - **If electrolyte is swallowed, get medical attention immediately.**
> - **If electrolyte is splashed into eyes, flush immediately with water for 15-30 minutes and get medical attention.**
> - **If electrolyte is splashed onto skin, flush immediately with water and get medical attention if necessary.**

1. Raise and latch seat platform.



M84579

2. Disconnect negative (-) cable (B) first, then positive (+) cable (A).



M84580

3. Open front access panel (E).
4. Remove wing nuts (C) and bracket (D).
5. Remove battery.

Installation

Installation is done in the reverse order of removal.

- Clean battery if dirty. (See “Clean Battery” on page 563.)
- Inspect battery terminals and case for breakage or cracks. Replace if needed.
- Test battery condition. (See “Test Battery” on page 541.)
- Connect negative (-) cable last.

Clean Battery

1. Remove battery from machine. (See “Battery Removal/ Installation” on page 563.)

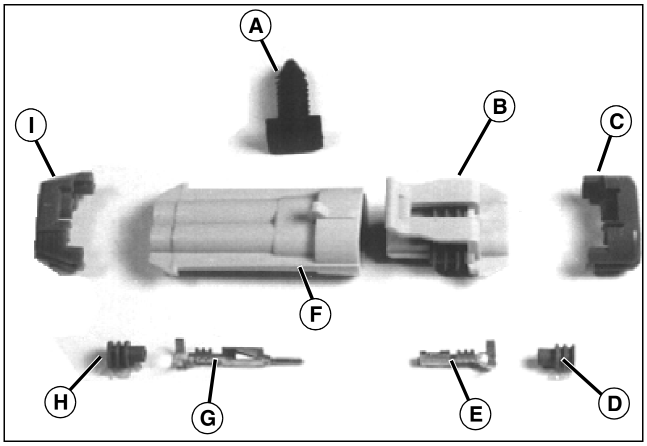
NOTE: Keep cleaning solution out of battery cells.

2. Clean battery, battery terminals, cable ends, bracket and battery box with a solution of one part baking soda and four parts water.
3. Rinse all parts with clean water. Let dry thoroughly.
4. Apply petroleum jelly to battery terminals to prevent corrosion.

METRI-PACK™ Connector Removal

Special or Required Tools

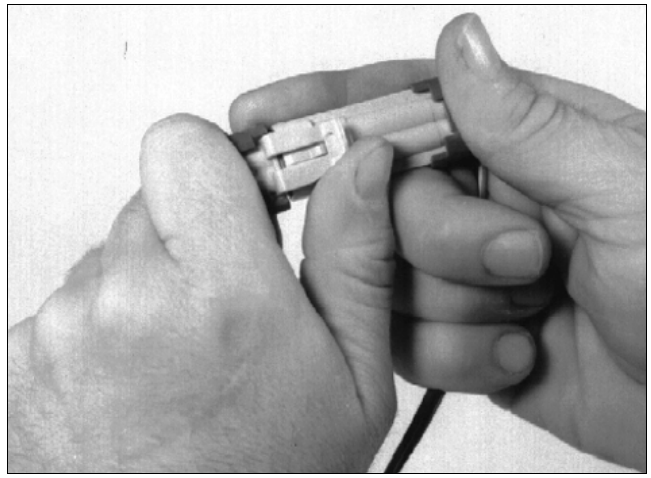
Tool Name	Tool No.	Tool Use
Terminal Removal Tool	JSG777	Used to depress locking tang and remove contact.



M56685

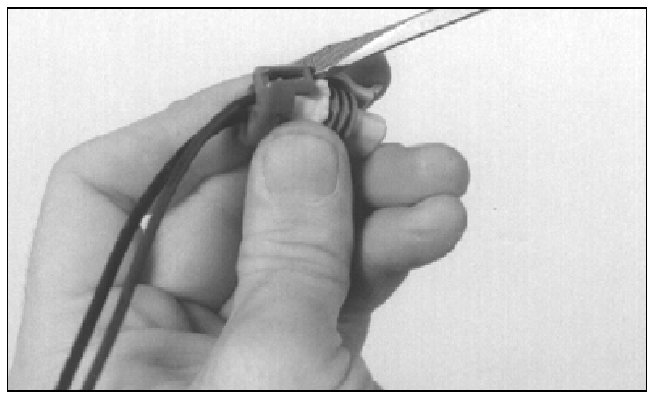
A - Mounting Post (Optional)
B - Sleeve Body
C - Wire Retainer
D - Sure-Seal
E - Sleeve
F - Pin Body
G - Pin
H - Sure-Seal
I - Wire Retainer

IMPORTANT: Avoid damage! Identify wire number/color locations with connector terminal letters.



M56682

1. Open connector body.

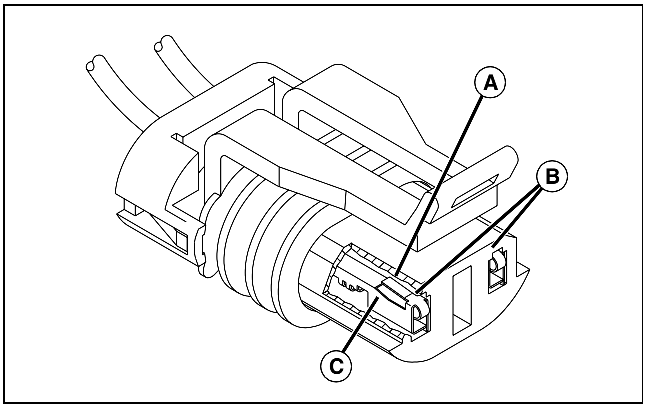


M56684

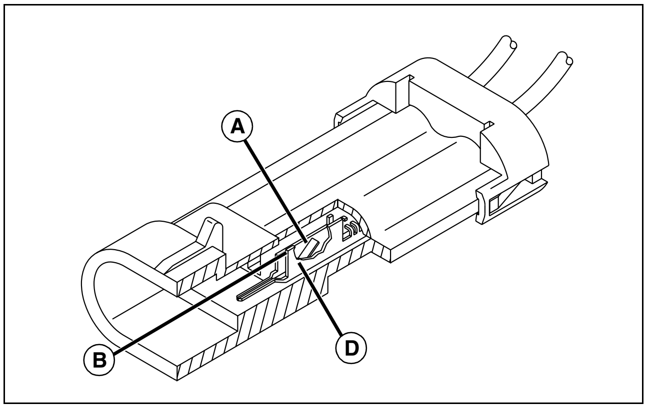
2. Remove retainer on wire end of connector with a screwdriver.

IMPORTANT: Avoid damage! Insertion of the tool in the correct location is critical when removing contact from connector body. Incorrect insertion can damage connector.

NOTE: To remove sleeve contact from sleeve body (short connector half), insert the tool in slot between terminal contact and connector body. To remove pin contact from body (long connector half), insert tool in center of contact.



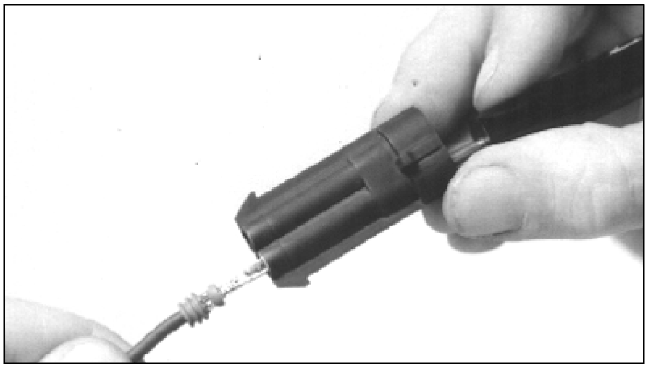
M83501



M83502

A - Locking Tang
B - Tool Insertion Point
C - Sleeve Contact
D - Pin Contact

3. Use JSG777 Terminal Removal Tool to depress locking tang. Remove contact from connector body.



M56689

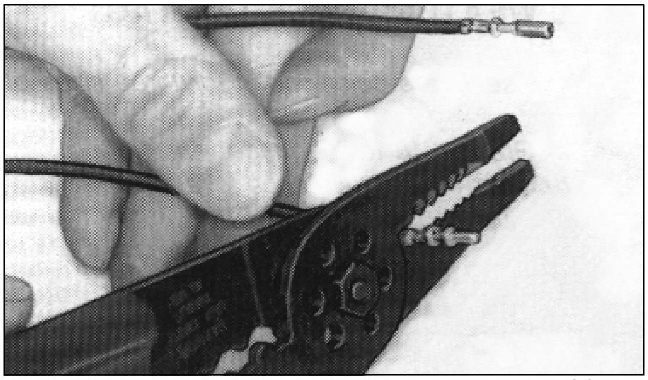
4. Hold the removal tool fully seated and pull wire from connector body.

METRI-PACK™ Connector Replacement

Special or Required Tools

Tool Name	Tool No.	Tool Use
Universal Electrical Pliers	JDG145	Used to cut wire.

1. Remove wire from connector.



TSO132

2. Use JDG145 Universal Electrical Pliers or similar tool to cut wire as close as possible to connector.

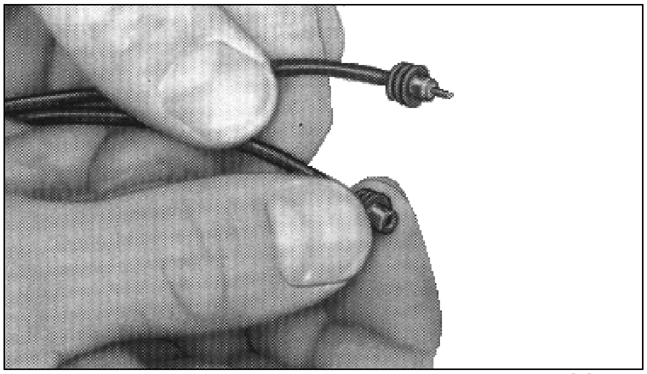
IMPORTANT: Avoid damage! METRI-PACK™ connectors are “keyed” (A, B, C, etc.) for proper contact mating. Be sure contacts and wire color/ numbers match and are in proper alignment.

NOTE: Cable seals are available for three sizes of wire:

Large - 1.0 mm (16 gauge) wire

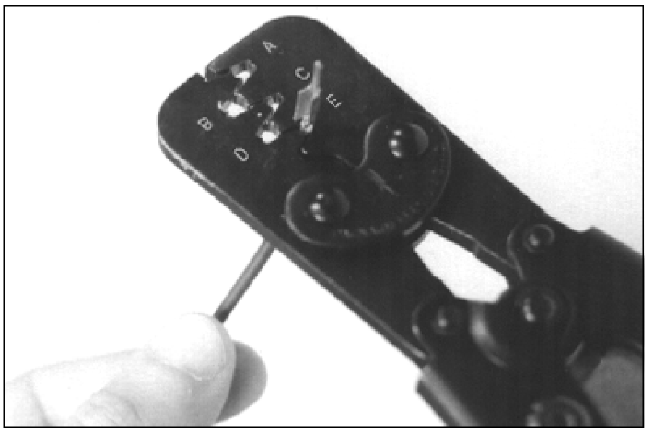
Medium - 0.8 mm (18 gauge) wire

Small - 0.5 mm (20 gauge) wire



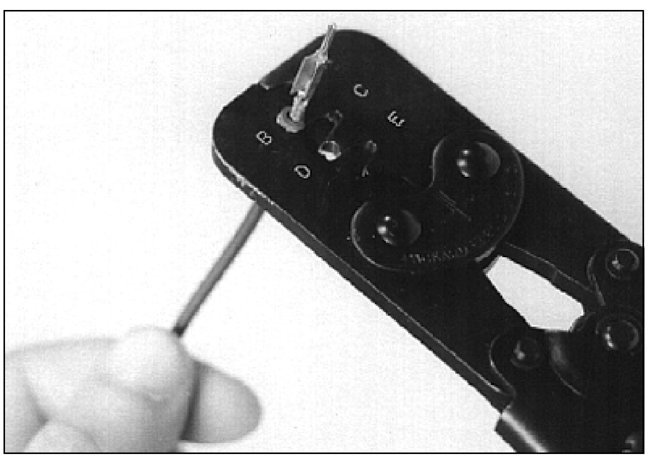
TSO136

3. Remove enough insulation to expose 6 mm (0.25 in.) of wire. Align cable seal with edge of insulation.



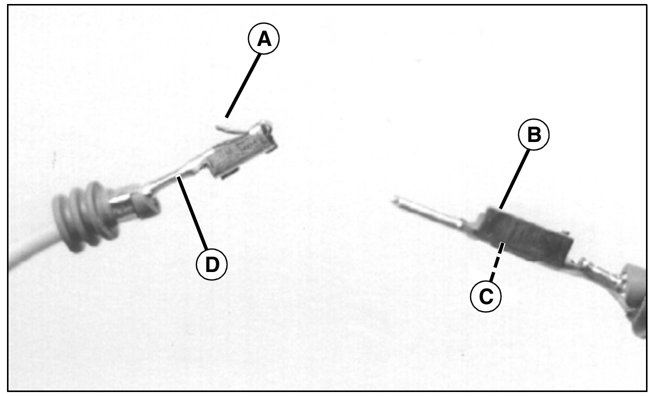
M56686

4. Place proper size contact on wire and use JDG865 Crimper to crimp contact in place with a "W" type crimp.



M56687

5. Use JDG865 Crimper to secure cable seal to contact as shown.

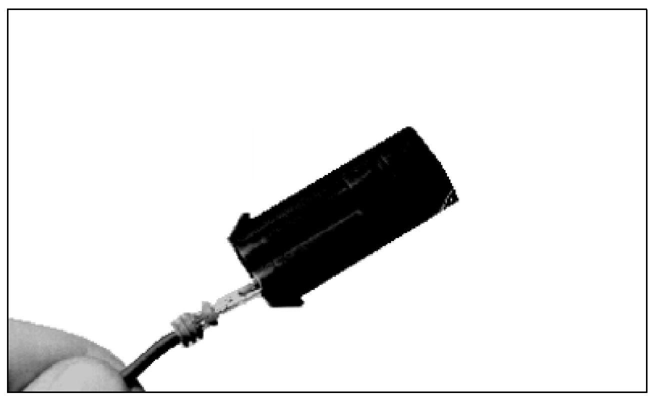


M56688

A - Barb
B - Pin
C - Barb (Inside)
D - Sleeve

IMPORTANT: Avoid damage! Proper barb location and orientation for installation of "sleeve" and "pin" is shown.

NOTE: Connector bodies are "keyed" for proper contact mating. Be sure contacts are in proper alignment.

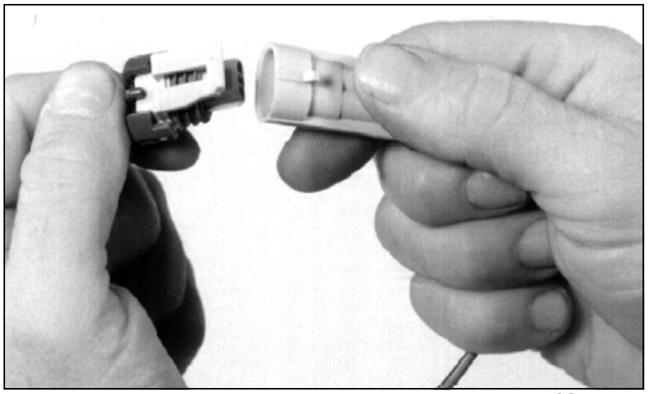


M56689A

6. Push contact into new connector body until fully seated.

7. Pull on wire slightly to be certain terminal is locked in place.

8. Install wire retainer.



M56683

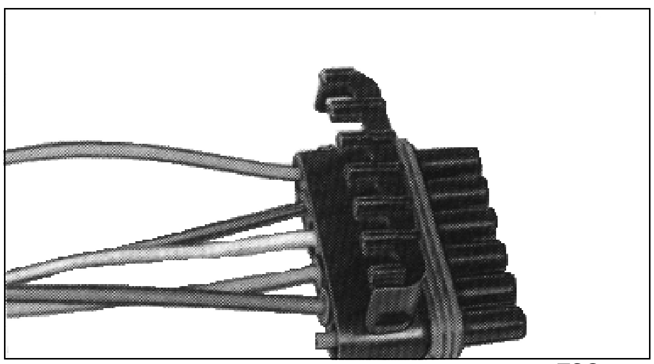
9. Transfer remaining wires to correct terminal in new connector.

10.Place retainer on wire end of connector and strap in place.

11.Close connector body.

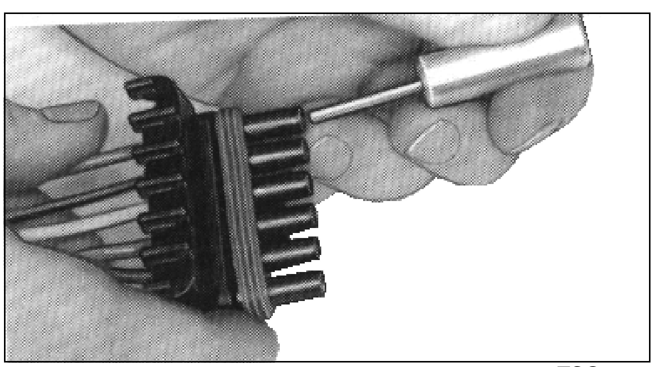
WEATHER PACK™ Connector Removal

IMPORTANT: Avoid damage! Identify wire color locations with connector terminal letters.



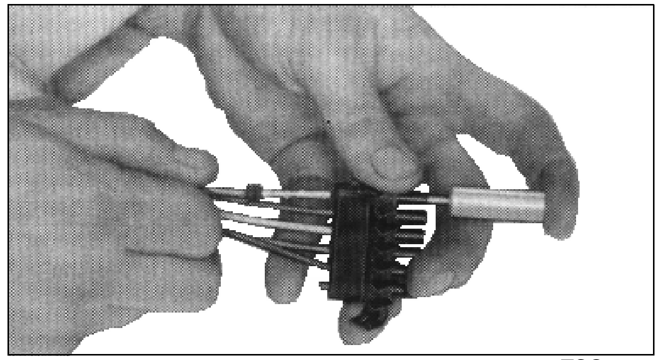
TSO127

1. Open connector body.



TSO128

2. Insert JDG364 Extraction Tool over terminal contact in connector body.



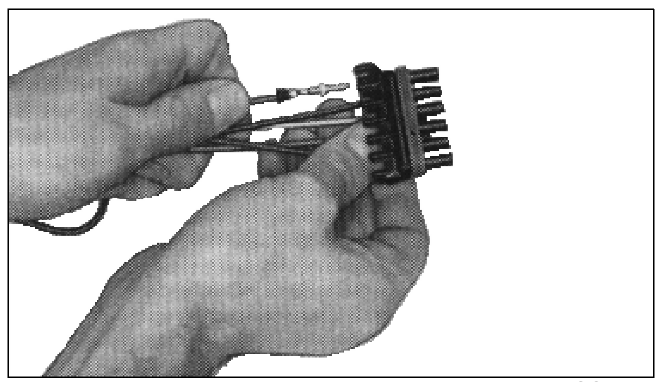
TSO129

3. Hold the extractor tool fully seated and pull wire from connector body.

IMPORTANT: Avoid damage! Carefully spread contact lances to ensure good seating on connector body.

NOTE: If terminal cannot be removed, insert wire or nail through extractor tool handle and push terminal contact from connector.

Connector bodies are "keyed" for proper contact mating. Be sure contacts are in proper alignment.



TSO130

4. Push contact into new connector body until fully seated.

5. Pull on wire slightly to be certain contact is locked in place.

6. Transfer remaining wires to correct terminal in new connector.

7. Close connector body.

Table of Contents

Specifications

Test and Adjustment Specifications

Hydrostatic Pump Control Linkage Return Spring Free Length . . . . . **62 mm (2.44 in.)**
Hydrostatic Pump Charge Oil Pressure . . . . . **620-1240 kPa (90-180 psi)**
Mowing Speed . . . . . **7.1 km/h (4.4 mph)**
Pump Efficiency (Minimum) **80%**

Repair Specifications

Hydraulic System Oil Capacity . . . . . **28.8 L (7.6 gal.)**
Hydraulic Oil Reservoir Capacity . . . . . **20.4 L (5.4 gal.)**

Hydrostatic Pump

Flywheel Adapter Plate Cap Screws (Diesel Engine) . . . . . **68 N•m (50 lb-ft)**
Input Hose Connection Torque . . . . . **47 N•m (35 lb-ft)**
Flex Coupler Socket Head Screw Torque . . . . . **62 N•m (46 lb-ft)**
Displacement Control Arm Cap Screw Torque . . . . . **37 N•m (27 lb-ft)**
Dump Valve Torque . . . . . **33 N•m (28 lb-ft)**
Relief Valve Plug Seat Torque . . . . . **135 N•m (100 lb-ft)**
Charge Relief Valve Torque . . . . . **38 N•m (29 lb-ft)**
Backplate Cap Screw Torque . . . . . **25 N•m (19 lb-ft)**

Wheel Motors

Brake Rotor Retaining Nut Torque . . . . . **407 N•m (300 lb-ft)**
Rotor Lobe-to-Roller Vane Maximum Clearance . . . . . **0.13 mm (0.005 in.)**
Coupling Shaft Installed Depth (below housing wear surface plate) . . . . . **2.54 mm (0.10 in.)**
Third Wheel Assist Motor Hub Retaining Nut Torque . . . . . **475 N•m (350 lb-ft)**
Retaining Cap Screw Torque . . . . . **68 N•m (50 lb-ft)**

Third Wheel Assist Valve

Solenoid Coil Retaining Nut Torque . . . . . **18 N•m (159 lb-in.)**

Tools and Materials

Tools

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydraulic Diagnostic Test Kit	BM19949	Connect pressure gauge for hydrostatic charge pressure test.
Hose	AMT846	Connect pressure gage for hydrostatic charge pressure test.
Pressure Gauge 0-20 000 kPa (3000 psi)	JT03345	Read hydrostatic charge pressure.
Fitting 16-12F5OLO-S	61H1179	Connect flow gage for hydrostatic pump flow test.
Hose -16	TCA15306	Connect flow gage for hydrostatic pump flow test.
Flow Gage	TCB10906	Read hydrostatic pump flow.

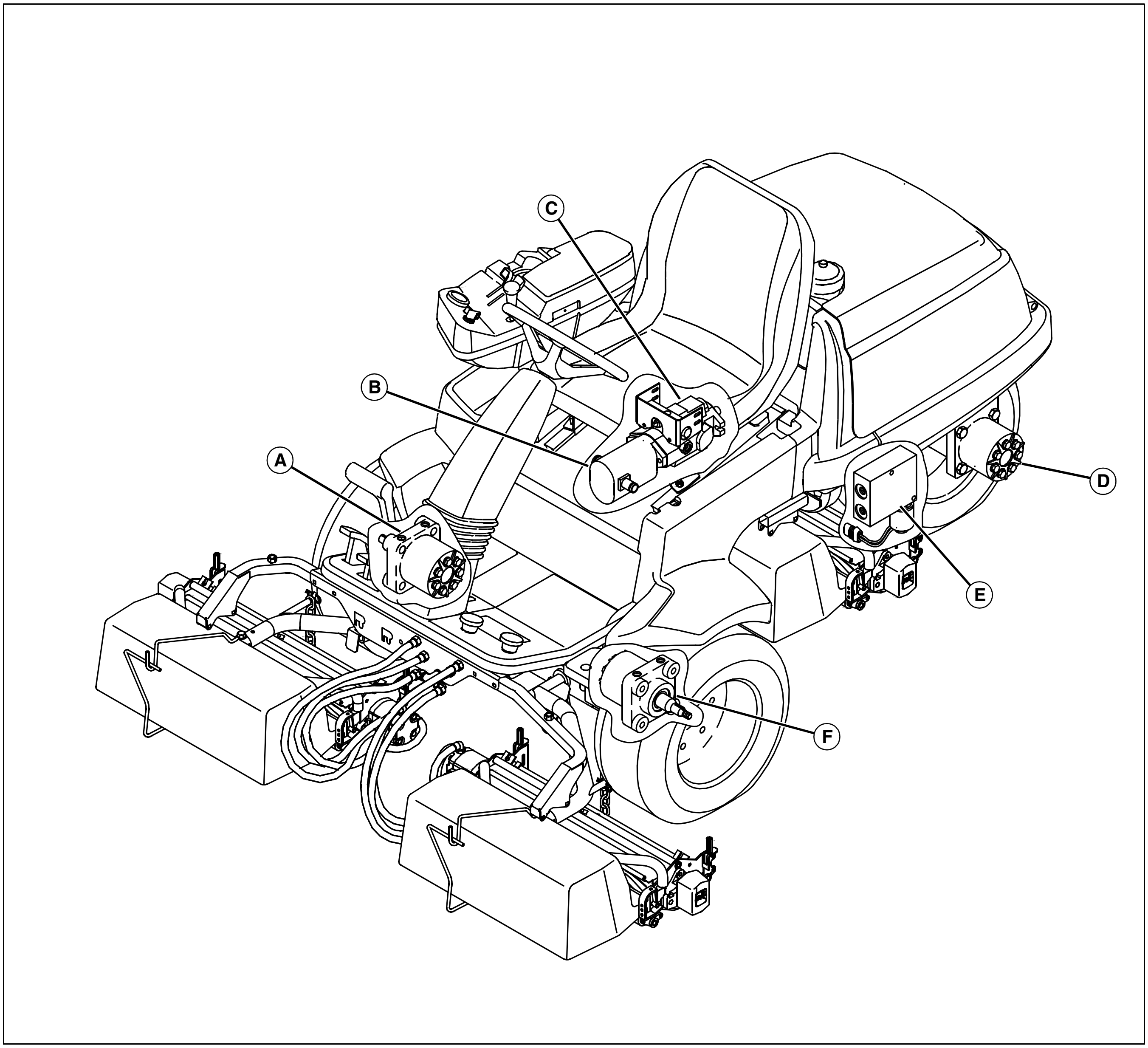
Materials

Other Material

Part No.	Part Name	Part Use
	Mobilith SHC® Grease	Apply to wheel motor seals and seal rings.

Component Location

Hydrostatic Drive Components



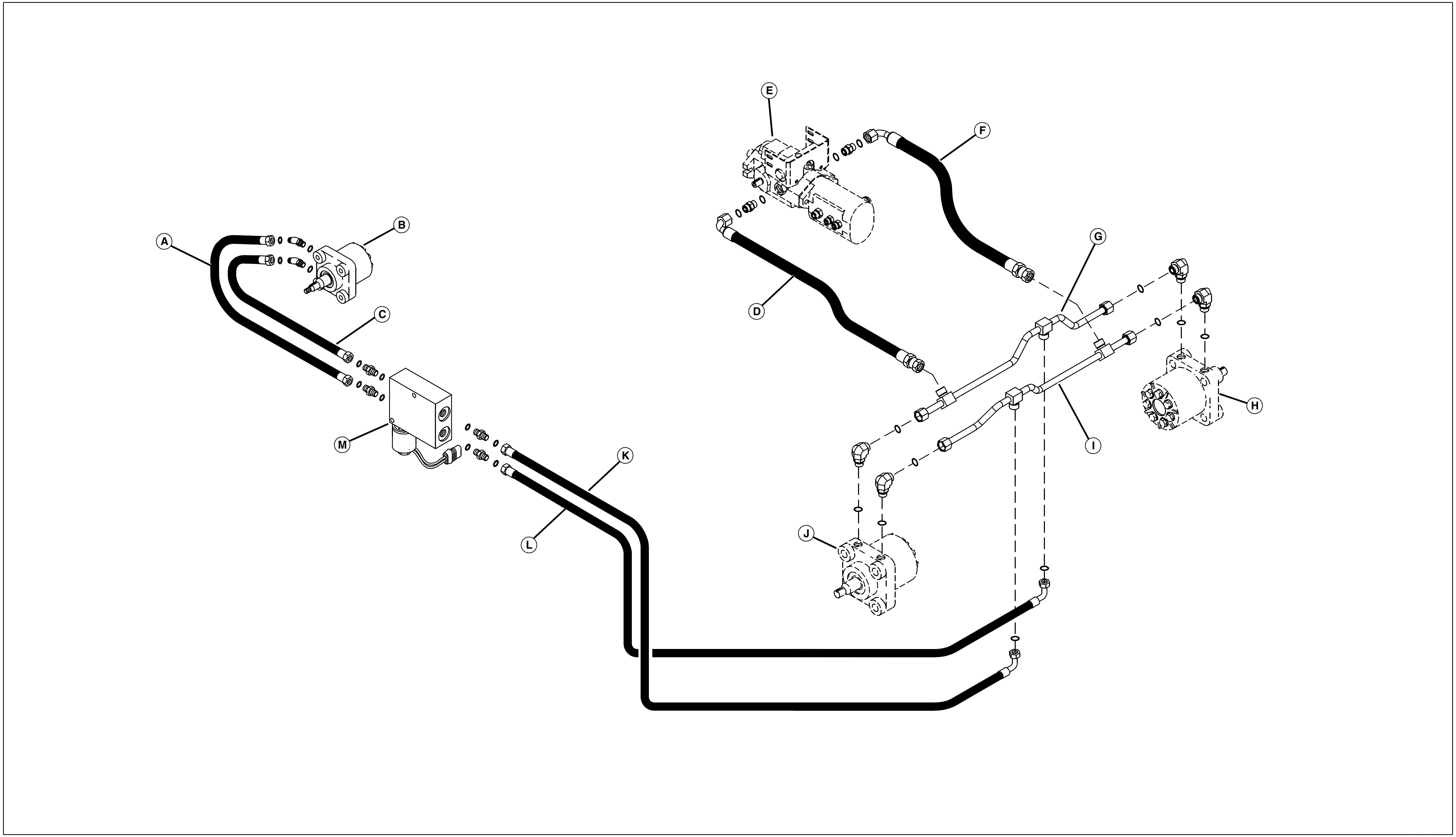
M98557

Picture Note: Models 2500/2500A Shown.

A - Front Right Wheel Motor
B - Hydraulic Pump
C - Hydrostatic Pump
D - Third Wheel Assist Motor
E - Third Wheel Assist Valve
F - Front Left Wheel Motor

Component Location

Hydraulic System Hose Routing - Motor Drive System



M98518 (MIF)

HYDROSTATIC POWER TRAIN COMPONENT LOCATION

A - Return Hose (Forward)
B - Third Wheel Assist Motor (Optional)
C - Pressure Hose (Forward)
D - Return Hose (Forward)
E - Hydrostatic Pump Assembly
F - Pressure Hose (Forward)
G - Return Line (Forward)
H - Left Wheel Motor
I - Pressure Line (Forward)
J - Right Wheel Motor
K - Pressure Hose (Forward)
L - Return Hise (forward)
M - Third Wheel Assist Valve (Optional)

Theory of Operation

Hydrostatic Transmission

Function

The hydrostatic system provides a means to transfer power from the engine to the final drive for the wheels. It also provides infinitely variable speed control.

Theory

The hydrostatic system is a closed loop fluid power system that consists of a variable displacement piston pump and two (two-wheel drive) or three (all-wheel drive) motors. Speed and direction are controlled by two foot pedals.

Engine power is transferred to the hydrostatic pump by a splined coupler. The piston pump, or hydrostatic transmission, is mounted to a bulkhead under the operator's platform.

Hydrostatic fluid is provided to the hydrostatic pump from a pressurized charge pump flow. Fluid from the steering/ charge pump is directed through two dual purpose system relief/check valves located in the pump backplate. An internal charge pump relief valve maintains a minimum charge pressure level. Excess charge fluid is returned to the reservoir.

The hydrostatic pump provides hydraulic fluid in varying amounts to the motors through hydraulic lines and fittings. The hydraulic fluid in the power train circulates in a closed loop. The amount and pressure of the fluid is a result of the displacement of the pump pistons, which are controlled by a variably angled surface called a swash plate or cam plate. Fluid leaves the pump, flows through the motors and is returned to the pump, not the reservoir.

During operation, some fluid intentionally leaves this closed loop circuit, such as case drain, and is replenished by cool filtered fluid from the front gear set (steering/charge pump) of the hydraulic pump assembly. This fresh fluid enters through the check valve part of the relief/check valve assembly. If the pressure going to the wheel motors exceeds a certain pre-set amount, the relief valve for that circuit will move off it's seat and allow some fluid to pass to the low pressure side of the system.

Hydrostatic Pump

The pump is an axial piston, manually variable displacement pump.

Hydrostatic fluid is provided to the hydrostatic pump from a pressurized charge pump flow. An internal charge pump relief valve maintains a minimum charge pressure level of 620-1240 kPa (90-180 PSI). During operation, some fluid is intentionally "leaked" from the hydrostatic circuit and is routed back into the reservoir. This fluid is replaced by charge oil that enters the closed loop through one of the relief/check valves, thereby introducing cool filtered oil into the hydrostatic system.

Directional control, forward or reverse, is controlled by varying the direction of fluid flow through the hydrostatic pump. This is accomplished by varying the direction of rotation of the swash plate in the pump. The direction and the amount of swash plate rotation is controlled by two foot pedals. The left pedal controls forward motion; the right pedal controls reverse motion. The movement of the pump swash plate in either the forward or reverse position controls the direction of the motor rotation. In the reverse position, the pump shaft still rotates in the same direction, but the discharge of oil from the pump is reversed, thus reversing the motor rotation.

Speed is controlled by the displacement of the pistons as controlled by the angle of the swash plate. The greater the angle of the swash plate from the center position (neutral) the greater the volume of fluid the pistons will displace and the faster the vehicle travels. Maximum speed is limited by an adjustable stop. This stop allows pre-setting optimum ground speed for consistent cutting of turf.

System Pressure Relief

The pressure relief valves are combination relief and check valves mounted within the hydrostatic pump assembly. One serves the forward pressure loop and one serves the reverse pressure loop.

The function of the system relief valve is to relieve excess hydrostatic pressure if the vehicle encounters a heavy load or stalls out.

When a preset pressure is reached, the large spring in the relief valve compresses and opens an orifice allowing oil to bypass into the low pressure side of the system. The opposite relief valve, serving as a check valve, opens and allows the oil to flow to the intake side of the pump.

Steering/Charge Pump

The steering/charge pump provides several functions to the hydrostatic circuits:

- Provides flow to keep circuits primed and make up internal leakages.
- Provides flow, under pressure, for maintaining back pressure on pump/motors pistons.
- Provides flow, under pressure, for hydraulic control purposes.
- Provides cooled and cleansed fluid for temperature control and flushing.

Wheel Motors

The wheel motors are fixed displacement type delivering a constant output torque for a given pressure throughout the speed range of the motor.

The drive wheels are mounted on hubs which are keyed onto the output shaft of each motor.

Third Wheel Assist Valve

When the operator places the machine in the MOW mode, current is supplied to the third wheel assist solenoid, moving the valve from the NEUTRAL to DRIVE position.

High-pressure oil from the front wheel motor oil line enters the valve assembly at port “B” and is routed to the solenoid valve. With the valve spool to the DRIVE position, oil is directed to port “C”, routing oil to the third wheel assist motor.

High-pressure oil is also routed to the pilot line of the direction valve, shifting the valve spool to the FORWARD position.

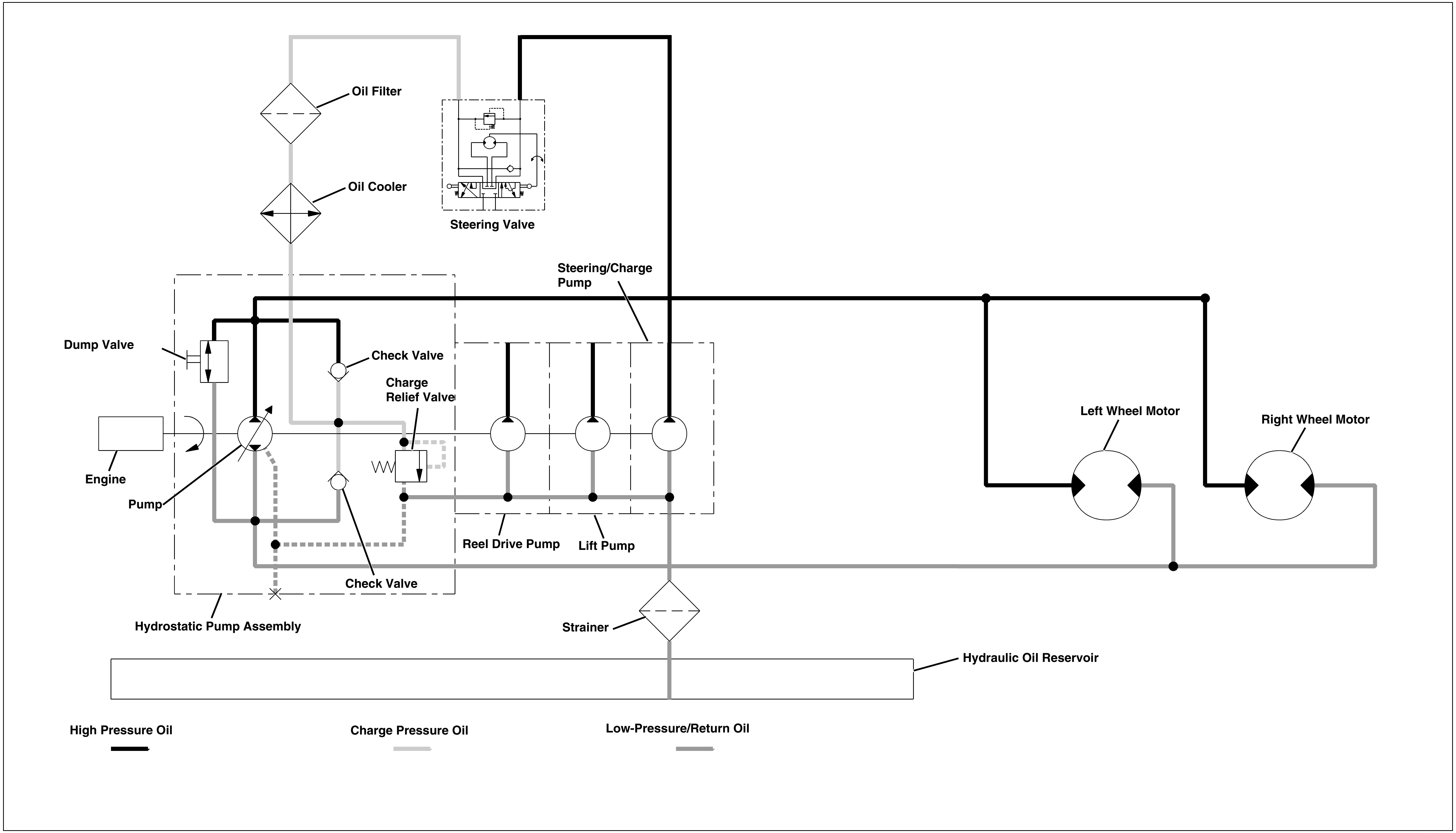
Oil returning from the wheel motor enters the valve assembly at port “D”, passes through the direction valve and exits the valve assembly at port “A”, and returns to the hydrostatic pump by way of the wheel motor return line and hoses.

When the machine is driven in reverse, high-pressure oil from the front wheel motor oil line enters the valve assembly at port “A” and is routed to the pilot line and orifice disk of the direction valve, shifting the valve spool to the REVERSE position.

When the direction valve is in the REVERSE position, high-pressure oil is blocked at the direction valve. In this position, the assist wheel motor freewheels as low-pressure oil is allowed to flow through the direction valve and solenoid valve.

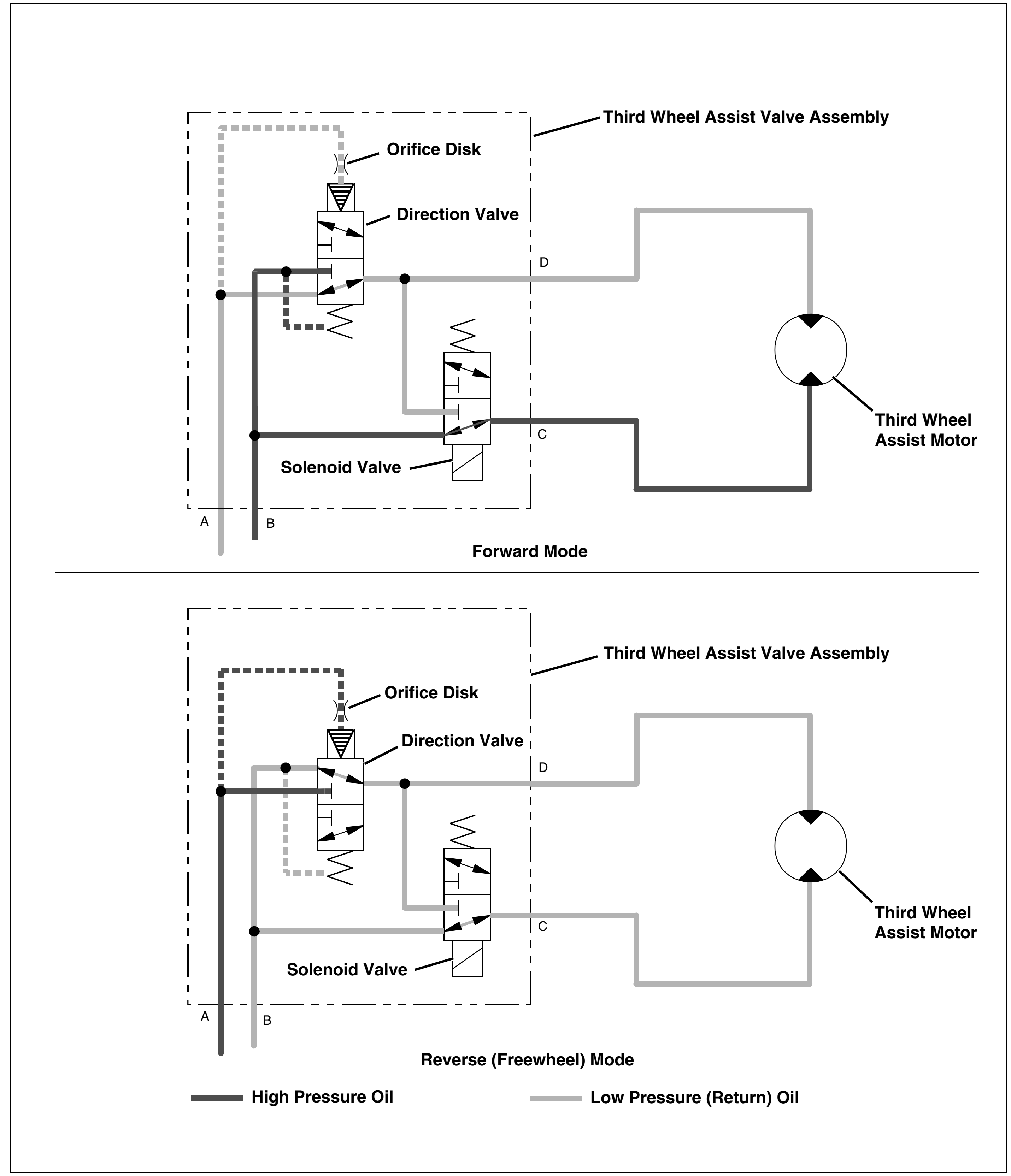
Hydrostatic Schematics

Main Hydrostatic Diagram



MIF (M98606)

Third Wheel Assist Hydrostatic Diagram



MIF

Diagnostics

Troubleshooting Hints

The most noticeable result of a worn pump or motor is reduced travel speed. This results from either the pump's inability to provide the necessary flow at the required pressure, or the pump/motor bypassing fluid to case drain.

Component wear is normally caused by either fluid contamination or pump cavitation. Pump cavitation can be a result of fluid contamination, clogged filter, or insufficient fluid in the system.

Before testing the hydrostatic pump, check the charge pump pressure. Once you are satisfied that charge pressure is sufficient, test the hydrostatic pump efficiency (forward and reverse) with a flow meter. If the hydrostatic pump is delivering the required flow at full output pressure, the problem is probably with a wheel motor.

Hydrostatic Power Train Troubleshooting

Symptom: Mower Will Not Move in Forward or Reverse

(1) Is hydraulic fluid at proper level in reservoir?

Yes - Go to step (2).

No - Fill reservoir to proper level.

(2) Is correct grade hydraulic oil used (hydraulic oil viscosity not too high for operating conditions)?

Yes - Go to step (3).

No - Replace hydraulic oil with correct grade of proper viscosity.

(3) Is dump valve closed?

Yes - Go to step (4).

No - Close dump valve.

(4) Do the pedals move freely down and back? Is the linkage connected properly?

Yes - Go to step (5).

No - Check linkage for bent or broken components. Repair or replace parts as necessary.

(5) Is the suction strainer clear of restrictions?

Yes - Go to step (6).

No - Clean suction strainer.

Symptom: Mower Will Not Move in Forward or Reverse

(6) Check charge pressure. (See "Test Charge Pressure" on page 584.) Is charge pressure within specifications?

Yes - Go to step (7).

No - If pressure does not meet specification, follow results of procedure.

(7) Is the drive shaft secure?

No - Secure, repair or replace drive shaft.

Symptom: Mower Will Not Reach Full Speed

(1) Is hydraulic fluid at proper level in reservoir?

Yes - Go to step (2).

No - Fill reservoir to proper level.

(2) Is correct grade hydraulic oil used (hydraulic oil viscosity not too high for operating conditions)?

Yes - Go to step (3).

No - Replace hydraulic oil with correct grade of proper viscosity.

(3) Is dump valve closed?

Yes - Go to step (4).

No - Close dump valve.

(4) Do the pedals move freely down and back? Is the linkage connected properly?

Yes - Go to step (5).

No - Check linkage for bent or broken components. Repair or replace parts as necessary.

(5) Is the suction strainer clear of restrictions?

Yes - Go to step (6).

No - Clean suction strainer.

(6) Is hydraulic fluid free from air bubbles?

Yes - Go to step (7).

No - Check suction line for air leaks. Repair as necessary.

(7) Check charge pressure. (See "Test Charge Pressure" on page 584.) Is charge pressure within specifications?

Yes - Go to step (8).

No - If pressure does not meet specification, follow results of procedure.

Symptom: Mower Will Not Reach Full Speed

(8) Perform hydrostatic transmission flow test. (See "Test Hydrostatic Transmission Pump Flow" on page 585.) Is hydrostatic transmission flow within specifications?

Yes - Go to step (9).

No - Check and/or replace relief valves. Repair or replace pump as necessary.

(9) Remove drive motors and bench check. (See "Disassemble and Inspect Wheel Motors" on page 608.)

No - Repair or replace as necessary.

Symptom: Sluggish Response to Acceleration or Deceleration

(1) Is hydraulic fluid at proper level in reservoir?

Yes - Go to step (2).

No - Fill reservoir to proper level.

(2) Is correct grade hydraulic oil used (hydraulic oil viscosity not too high for operating conditions)?

Yes - Go to step (3).

No - Replace hydraulic oil with correct grade of proper viscosity.

(3) Is dump valve closed?

Yes - Go to step (4).

No - Close dump valve.

(4) Is the suction strainer clear of restrictions?

Yes - Go to step (5).

No - Clean suction strainer.

(5) Is hydraulic fluid free from air bubbles?

Yes - Go to step (6).

No - Check suction line for air leaks. Repair as necessary.

(6) Check charge pressure. (See "Test Charge Pressure" on page 584.) Is charge pressure within specifications?

Yes - Go to step (7).

No - If pressure does not meet specification, follow results of procedure.

Symptom: Sluggish Response to Acceleration or Deceleration

(7) Perform hydrostatic transmission flow test. (See "Test Hydrostatic Transmission Pump Flow" on page 585.) Is hydrostatic transmission flow within specifications?

No - Replace relief valve(s).

Symptom: Hydrostatic System Operating Hot

(1) Is hydraulic fluid at proper level in reservoir?

Yes - Go to step (2).

No - Fill reservoir to proper level with hydraulic fluid.

(2) Are oil cooler fins free of dirt and debris?

Yes - Go to step (3).

No - Clean oil cooler fins of dirt and debris.

(3) Check charge pressure. (See "Test Charge Pressure" on page 584.) Is charge pressure within specifications?

Yes - Go to step (4).

No - If pressure does not meet specification, follow results of procedure.

(4) Perform hydrostatic transmission flow test. (See "Test Hydrostatic Transmission Pump Flow" on page 585.) Does pump operate correctly?

No - Repair hydrostatic pump.

Symptom: Noisy Pump

(1) Is hydraulic fluid at proper level in reservoir?

Yes - Go to step (2).

No - Fill reservoir to proper level.

(2) Is dump valve closed?

Yes - Go to step (3).

No - Close dump valve.

(3) Is hydraulic fluid free from air bubbles?

Yes - Go to step (4).

No - Check suction line for air leaks. Repair as necessary.

(4) Is oil filter clean (free from restrictions)?

Yes - Go to step (5).

No - Replace filter. Find source of any excess contamination.

Symptom: Noisy Pump

(5) Perform hydrostatic transmission forward and reverse relief valve tests. (See “Test Hydrostatic Transmission Pump Flow” on page 585.) IS flow within specification?

Yes - Go to step (6).

No - Repair hydrostatic pump.

(6) Disassemble and Inspect pump for damage. (See “Disassemble and Inspect Hydrostatic Pump” on page 599.) Was any damage found?

No - Repair or replace as necessary.

Tests And Adjustments

Test Charge Pressure

Reason

To ensure that there is sufficient pressure to keep the hydrostatic pump properly charged.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydraulic Diagnostic Test Kit	BM19949	Connect pressure gauge for hydrostatic charge pressure test.
Hose	AMT846	Connect pressure gage for hydrostatic charge pressure test.
Pressure Gauge 0-20 000 kPa (3000 psi)	JT03345	Read hydrostatic charge pressure.

Procedure

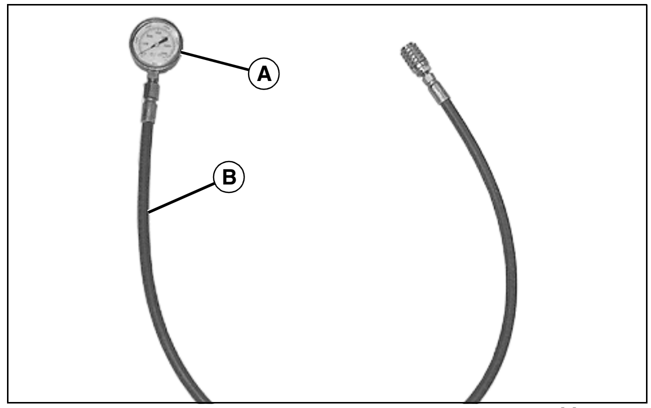
CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

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

- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

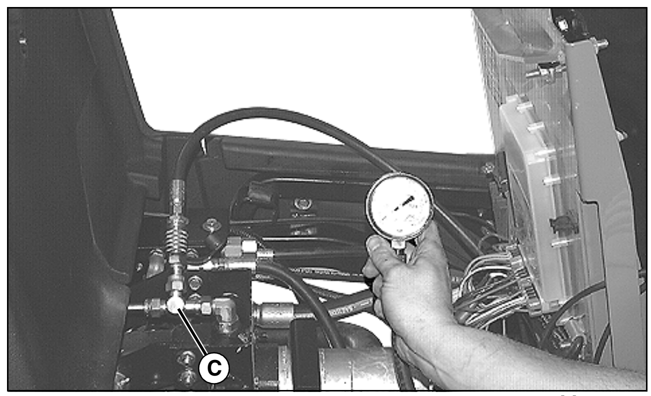
NOTE: The optional diagnostic kit (part number BM19949) must be installed on the machine to perform this test.

1. Park machine on level surface
2. lower cutting units to ground.
3. Move mow/transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Chock wheels to prevent inadvertent movement of machine during test.



M98645

7. Assemble JT03345 Pressure Gauge (A) onto diagnostic hose (B) provided with BM19949 Hydraulic Diagnostic Test Kit.



M98780

8. Connect gauge/hose assembly to hydrostatic pump diagnostic fitting (C).

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**

- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

9. Start engine ad run at slow idle.

10.Observe reading on pressure gauge.

Results

If charge pressure is below specification, check the following:

- Hydraulic hoses and lines for bends or restrictions.
- Check hydraulic filter for restrictions. (.)
- Perform a charge/steering pump flow test. (.)
- If flow test and filter are good, remove and inspect hydrostatic pump. Repair or replace as necessary.

Specifications

Gas Engine Slow Idle . . . . 1550 ± 100 rpm
Diesel Engine Slow Idle . . . . 1450 ± 100 rpm
Hydrostatic Pump Charge Pressure . . . . 620-1240 kPa (90-180 psi)

Test Hydrostatic Transmission Pump Flow

Reason

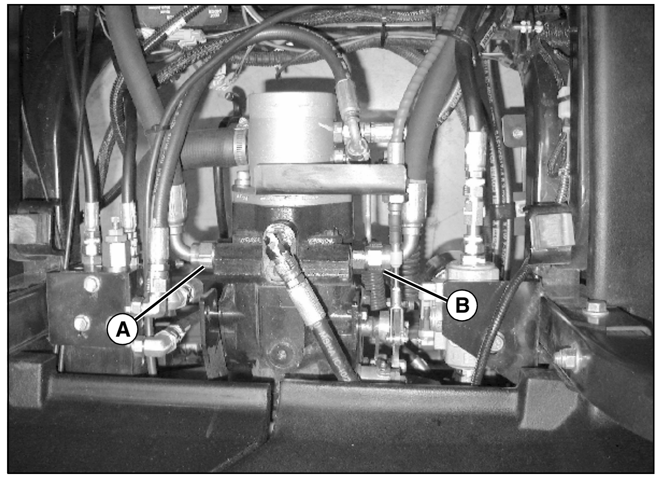
To verify that hydrostatic pump is operating at optimum efficiency.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Fitting 16-12F5OLO-S	61H1179	Connect flow gage for hydrostatic pump flow test.
Hose -16	TCA15306	Connect flow gage for hydrostatic pump flow test.
Flow Gage	TCB10906	Read hydrostatic pump flow.

Procedure

CAUTION: Avoid injury! Raise the machine safely and support it with suitable jackstands.



MX21404

1. Raise machine so wheels are off the ground. Support machine with suitable jack stands.
2. Remove pump-to-wheel motor hydraulic hose at hydrostatic pump. Left line (A) for forward test or right line (B) for reverse test.
3. Connect one 61H1179 Fitting and TCA15306 Hose to the inlet port of TCB10906 Flow Gage. Connect one 61H1179 Fitting to the outlet port.
4. Connect flow gage inlet hose to the pump and the hose from the wheel motor to the flow gage outlet.

IMPORTANT: Avoid damage! Make sure that pressure control valve on tester is screwed out completely (counterclockwise). Be careful not to screw handle completely out of valve.

5. Turn flow control knob completely open (counterclockwise).
6. Start engine and set throttle to fast idle.
7. Depress the forward or reverse pedal, depending on which you are testing.
8. Record free flow reading.
9. With pedal depressed, slowly close flow control knob (clockwise) until pressure reading is 20 684 kPa (3000 psi).
10. Record 20 684 kPa (3000 psi) flow reading.
11. Return load valve to full flow position. Release forward or reverse pedal and turn engine OFF.
12. Divide reading recorded at 20 684 kPa (3000 psi) by the free flow reading to obtain pump efficiency.

Example

Pump Free Flow = 24.6 L/min (6.5 gpm)

Pump Flow at 20 684 kPa (3000 psi) load = 23 L/min (6.0 gpm)

Pump Efficiency = 6.0 ÷ 6.5 = 0.923 or 92%

Results

If pump efficiency is below the minimum specification, verify charge pressure is within specification. (See "Test Charge Pressure" on page 584.)

If charge pressure is to specification, repair or replace hydrostatic pump.

Specifications

Gas Engine Fast Idle . . . . 3400 ± 50 rpm
Diesel Engine Fast Idle . . . . 3225 ± 50 rpm
Pump Efficiency (Minimum) 80%

Adjust Hydrostatic Pump Control Linkage

Reason

To ensure that the machine does not move when pedals are in the NEUTRAL position while the engine is running.

NOTE: The hydrostatic transmission control linkage adjustment consists of two parts: Transmission Neutral Adjustment and Neutral Lock Adjustment.

Transmission Neutral Adjustment Procedure

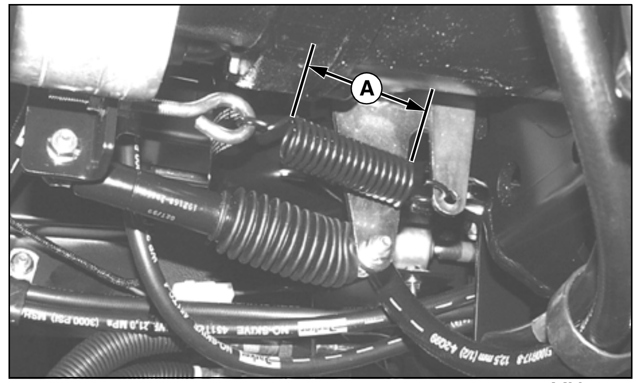
1. Park machine on a level surface
2. Lower cutting units to the ground
3. Move mow/transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Perform a thorough visual inspection of linkages and return springs for damage before making any adjustment. Repair as necessary.

CAUTION: Avoid injury! Avoid possible injury from entanglement. Drive wheels are free to move during this adjustment. Stay clear of drive wheels and keep bystanders away during adjustment.

Never work on machine while supported only on mechanical or hydraulic jack. Use jackstands for support. Ensure all wheels are off the ground (third wheel assist units).

NOTE: Drive wheels must be able to rotate freely.

7. Raise machine high enough to raise the drive wheels off the ground. Support the machine by placing jackstands under the frame.
8. Raise and latch seat platform.



MX2045

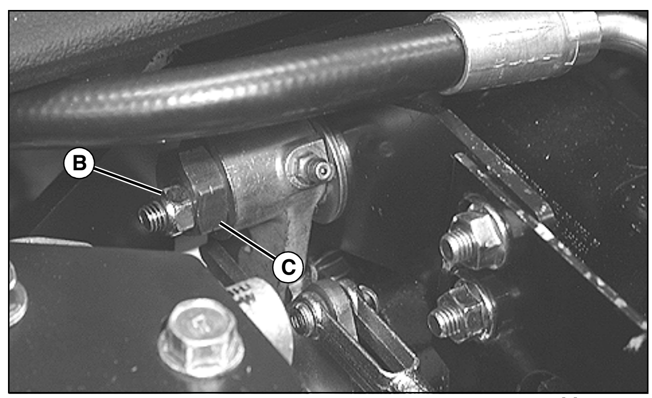
9. Check return spring free length (A) and compare with specification. If the spring requires adjustment, loosen the lock nuts and adjust the eyebolt as needed.

CAUTION: Avoid injury! Engine exhaust fumes can cause sickness or death.

If it is necessary to run engine in an enclosed area, use an exhaust pipe extension to remove the fumes.

Always try to work in a well-ventilated area.

10. Start engine and run at SLOW idle.
11. Release park brake.
12. Observe wheel movement.

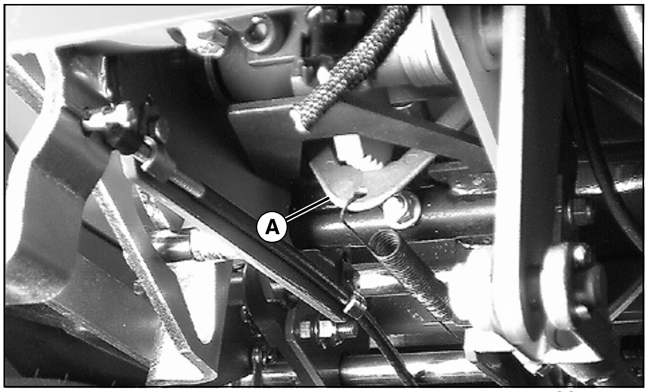


M84816

13. If wheel movement is noted, loosen eccentric jam nut (B).
14. Slowly turn eccentric cam (C) clockwise until wheel movement stops.
15. Tighten eccentric jam nut.
16. Put pedals in neutral. Depress both forward and reverse speed pedals, then release.
17. Observe wheel movement in neutral. If any movement is noted, repeat procedure.
18. Turn key switch to STOP position.

19.Proceed to Neutral Lock Check Procedure.

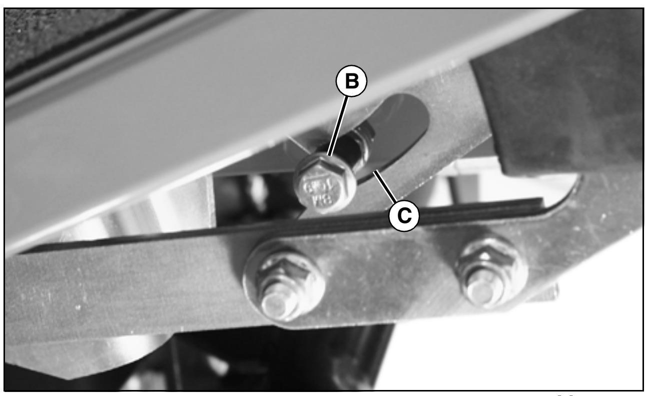
Neutral Lock Check Procedure



M84817

1. Depress the brake pedal and lock the pawl (A) in the first tooth of the brake pedal.

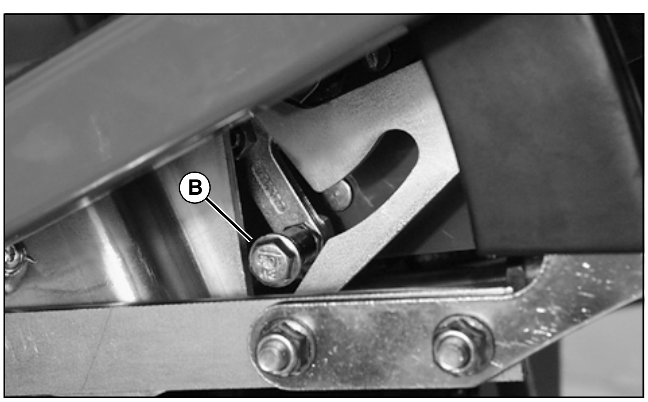
NOTE: The neutral lock linkage is located under the right side of the operator's platform.



M84836

2. Observe the position of the neutral lock pin (B). The pin should be engaged in the narrow opening of the slot (C) in the FORWARD travel pedal linkage.

3. Release the park brake.

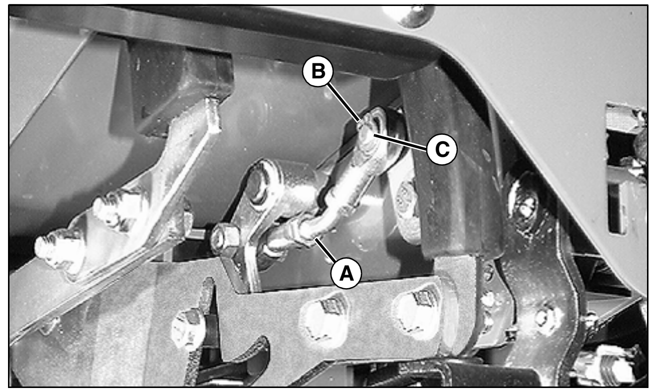


M84835

4. Observe the position of the neutral lock pin. The pin should be in the wide opening of the slot in the FORWARD travel pedal linkage. The travel pedals should have full travel within the pedal linkage opening.

5. If either of the conditions are not as described in steps 2 and 4, proceed to Neutral Lock Adjustment Procedure.

Neutral Lock Adjustment Procedure



M98628

1. Loosen jam nut (A) on neutral lock rod.

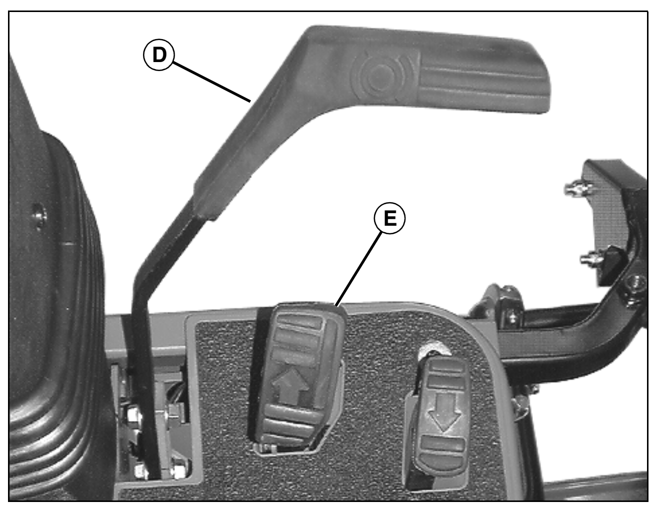
2. Remove cotter pin (B) and flat washer. (C)

3. Remove neutral lock arm from driver arm.

4. Rotate the rod as needed to adjust.

5. Install the neutral lock arm on driver arm. Secure with flat washer and cotter pin.

6. Tighten jam nut.



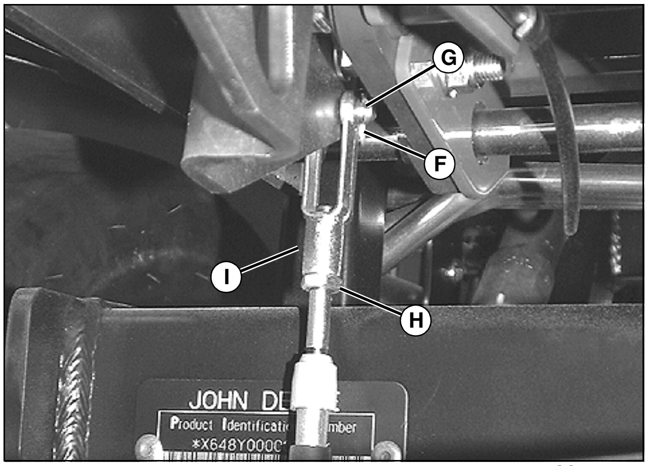
M84818

7. Engage park brake (D) and observe the FORWARD pedal (E). The pedal should not move, or should lift up slightly when the brake is engaged.

8. Start and run engine at SLOW idle.

9. Observe wheel movement. If movement is noted, proceed to step 11.

10.Turn key switch to STOP position.



M84699

11.Remove cotter pin (F) and drilled head pin (G).

12.Loosen jam nut (H).

13.Adjust yoke (I) as needed.

14.Tighten jam nut.

15.Install yoke on pedal arm using drilled-head pin and cotter pin.

16.Start engine and check for wheel movement. Repeat adjustment as needed.

Results

Drive wheels should stop turning when pedals are released. If not, repeat adjustment.

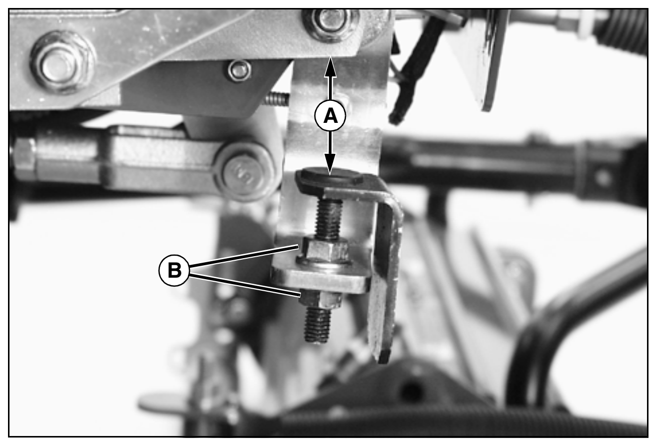
Mowing Speed Adjustment

NOTE: The mowing speed is preset at the factory to operate at approximately 7.1 km/h (4.4 mph).

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to MOW position.
4. Turn key switch to STOP position.
5. Engage park brake.

NOTE: The mow speed adjustment bracket is located on the right side of the machine above the right cutting unit.

The preliminary (factory preset) distance between the top of mow speed adjustment bracket and bottom of the forward travel pedal linkage is 22 mm (0.87 in.) (A). If the adjustment is changed, record the distance for future use.



M84837

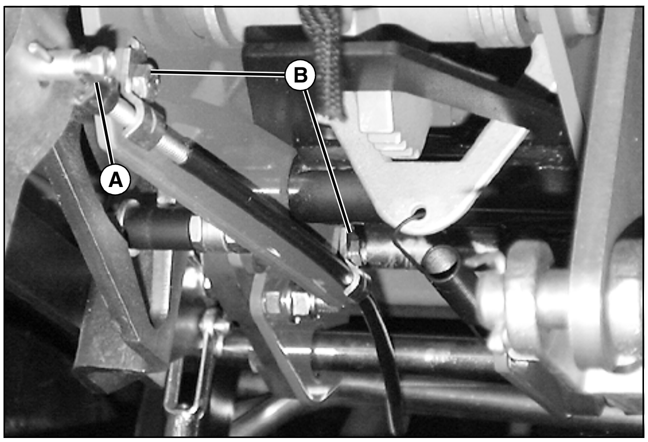
6. Loosen jam nuts (B) and adjust bracket.
   - Lower bracket to increase mowing speed.
   - Raise bracket to decrease mowing speed.
7. Tighten jam nuts.
8. Check speed and frequency of cut.
9. Repeat procedure as needed.

Repair

Remove and Install Mow/Transport Cable and Lever Assembly

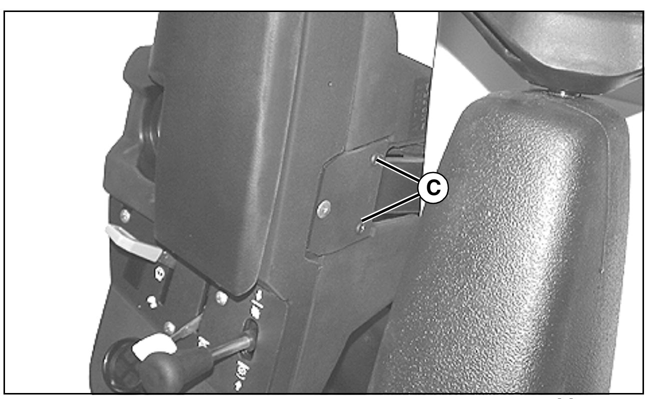
Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Raise and latch seat platform.
7. Move throttle lever to SLOW IDLE position.



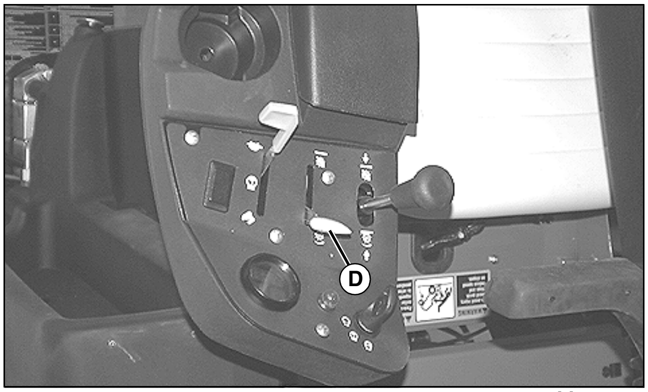
M84641

8. Loosen cable stop screw (A).
9. Loosen cable clamp screws (B).
10. Remove cable.



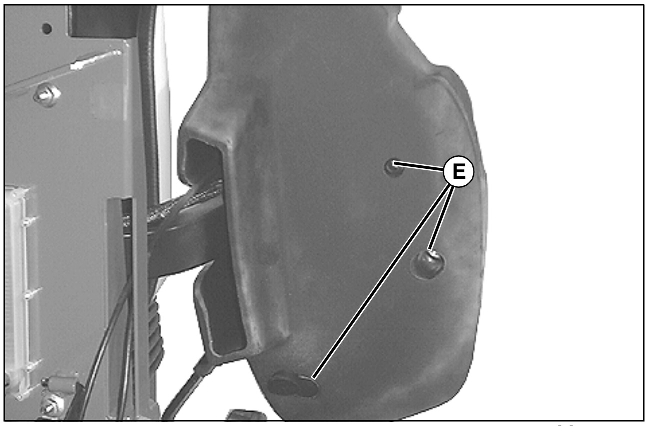
M84636

11. Remove screws (C).



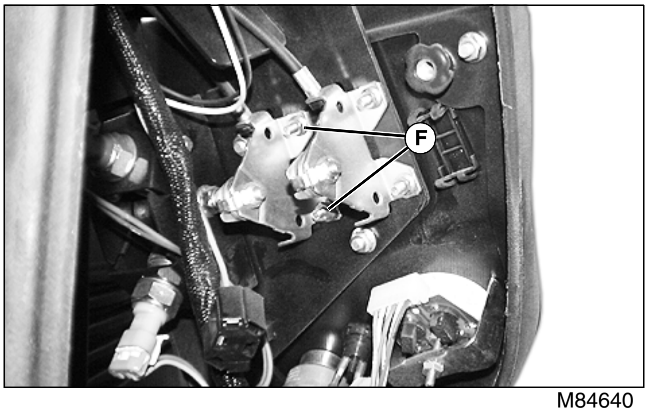
M84637

12. Remove mow/transport lever knob (D).



M84638

13. Remove cap screws and washers (E).
14. Pull lower console cover down.



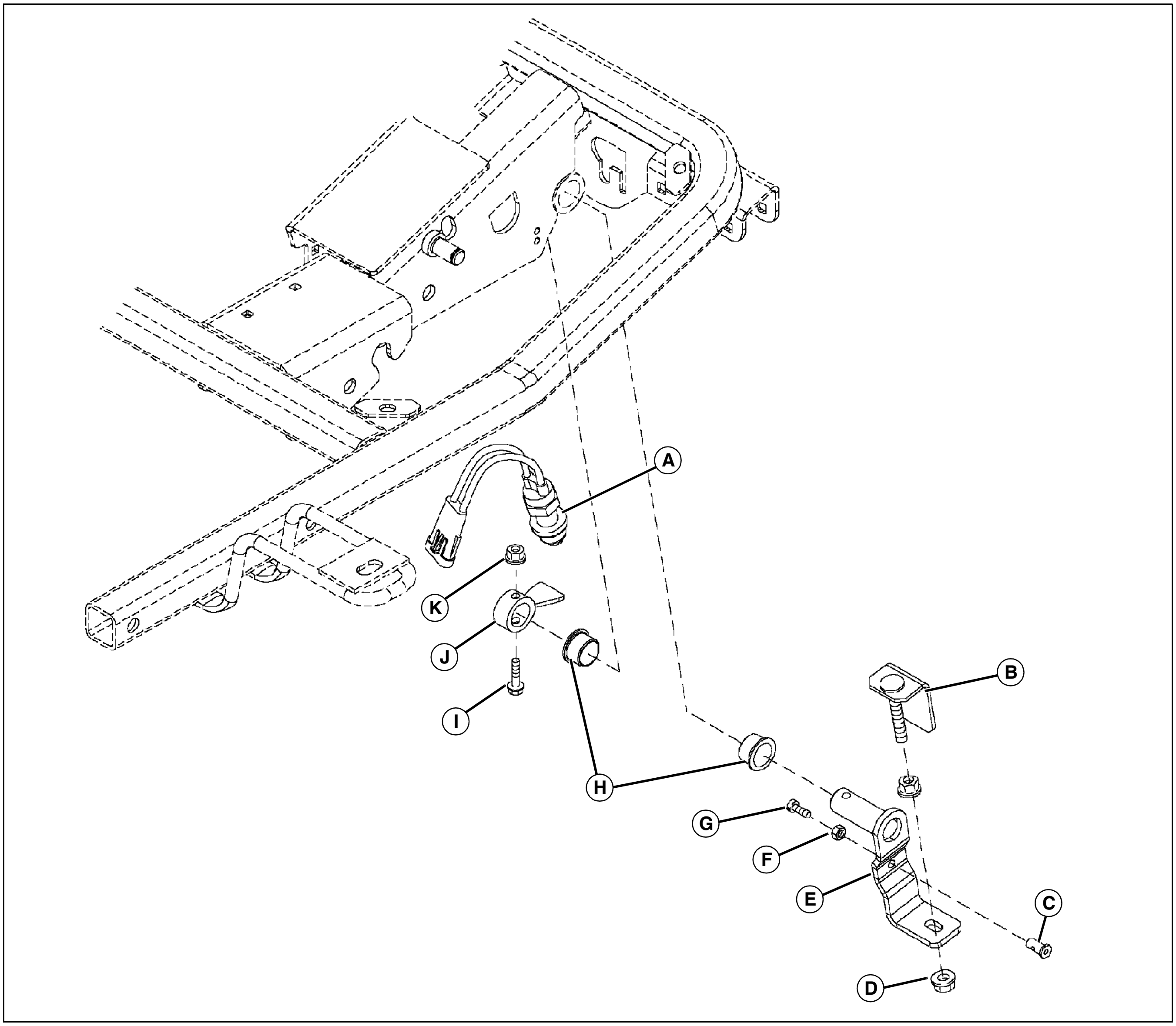
M84640

15. Remove bracket nuts (F).
16. Remove mow/transport cables.

Installation

Installation is performed in reverse order of removal.

Mow/Transport Switch and Lever Repair



M98544

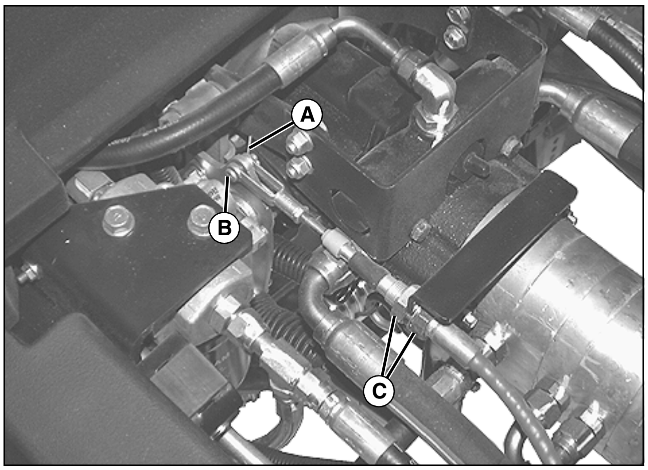
A - Mow/Transport Switch
B - Stop
C - Pin
D - Flanged Nut (2 used)
E - Swivel
F - Nut
G - Screw
H - Bushing (2 used)
I - Screw
J - Actuator
K - Flanged nut

- Inspect all parts for wear or damage. Replace parts as needed.
- Adjust stop position. (See “Mowing Speed Adjustment” on page 588.)

Remove and Install Hydrostatic Pump Control Cable

Removal

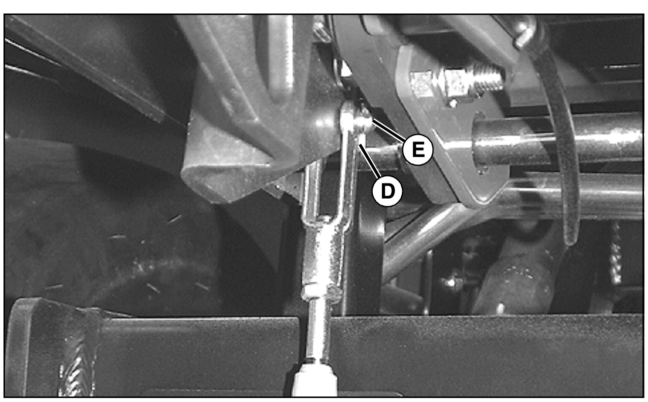
1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move Mow/Transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Raise and latch seat platform.



M84698

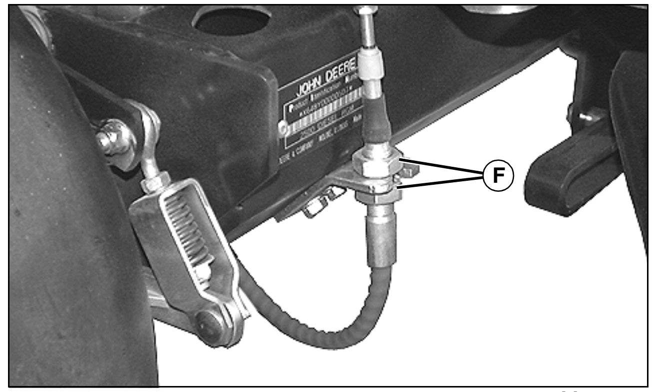
Picture Note: 2500 shown. 2500A and 2500E are similar.

7. Remove cotter pin (A) and retainer pin (B) connecting cable to hydrostatic pump lever.
8. Loosen adjustment nuts (C).
9. Slide cable out of bracket.
10. Cut tie strap securing cable to hoses.



M84699

11. Remove cotter pin (D) and drilled head pin (E).



M84700

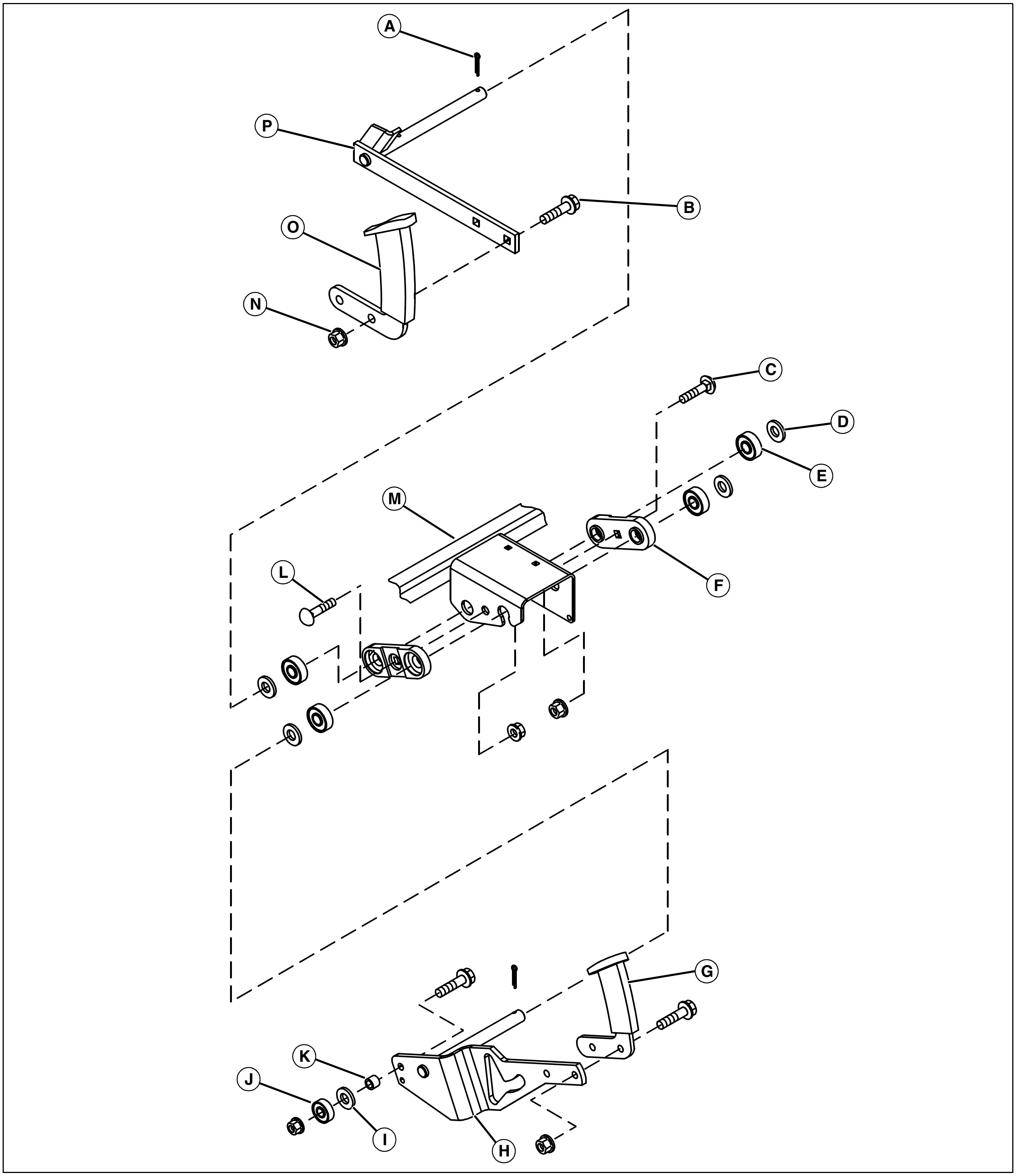
12. Loosen adjustment nuts (F).
13. Slide cable out of bracket.
14. Remove control cable.

Installation

Installation is performed in reverse order of removal.

- Adjust control cable. See “Adjust Hydrostatic Pump Control Linkage” on page 586.

Forward and Reverse Travel Pedal Repair



M84773

A - Cotter Pin (4 used)

B - Cap Screw (4 used)

C - Cap Screw (2 used)

D - Washer (2 used)

E - Bearing (4 used)

F - Retainer (2 used)

G - Pedal

H - Lever
I - Washer
J - Bearing
K - Bushing
L - Cap Screw (2 used)
M - Frame
N - Lock Nut (7 used)
O - Pedal
P - Lever

- Inspect all parts for wear and damage. Replace parts as needed.
- Adjust control cable. (See “Adjust Hydrostatic Pump Control Linkage” on page 586.)

Remove and Install Hydrostatic Pump Assembly - Gasoline Engine

Removal

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

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

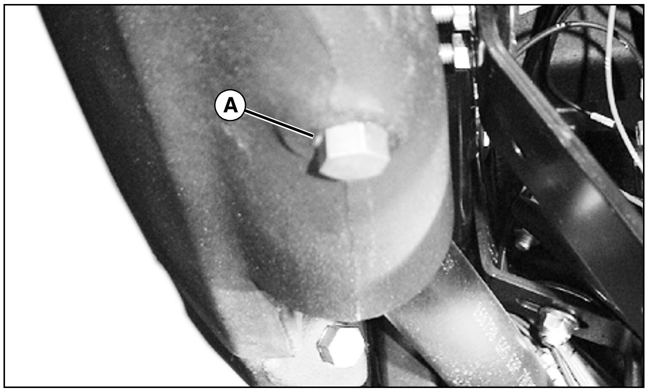
• If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.

NOTE: Model 2500 shown throughout this procedure. 2500A and 2500E are similar.

Variations in hose routing exist between models. Record routing of hydraulic hoses and lines to assist in assembly.

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise and lock seat platform.
7. Remove fuel tank. (See “Remove and Install Fuel Tank - Gasoline” on page 803.)
8. Remove hydraulic reservoir expansion tank. (See “Remove and Install Hydraulic Reservoir Expansion Tank” on page 658.)

NOTE: Hydraulic system capacity is approximately 28.8 L (7.6 gal).

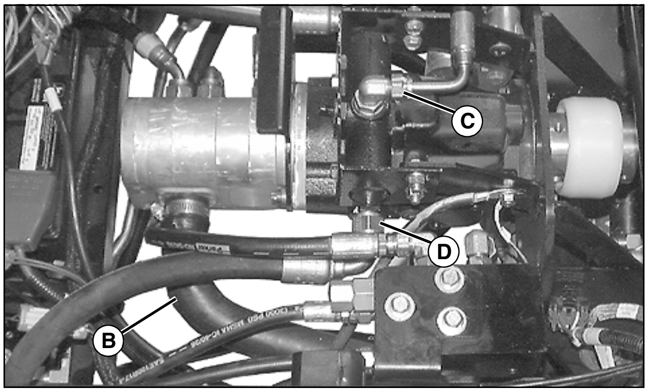


M84605

9. Remove drain plug (A) and drain main hydraulic reservoir/hydraulic system.

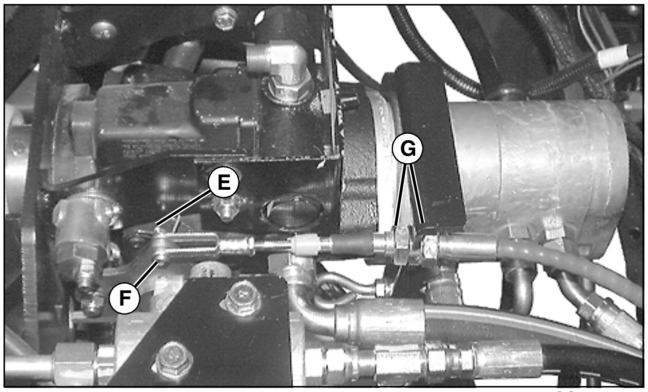
NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M98788

10. Loosen clamp and disconnect hydraulic pump supply hose (B).
11. Disconnect hydrostatic pump supply hose (C).
12. Disconnect hydrostatic pump output hose (D).



M98787

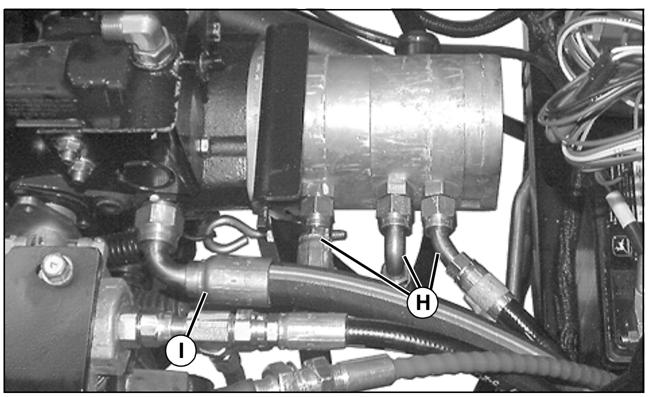
13.Remove cotter pin (E) and retainer pin (F).

14.Loosen cable adjustment nuts (G).

15.Slide cable out of the bracket and swing cable aside.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

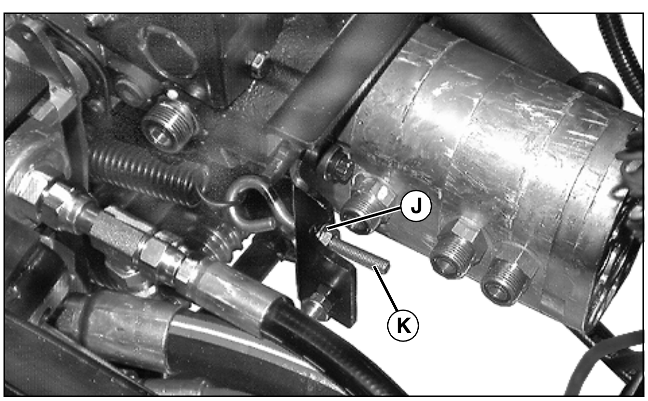
Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M98789

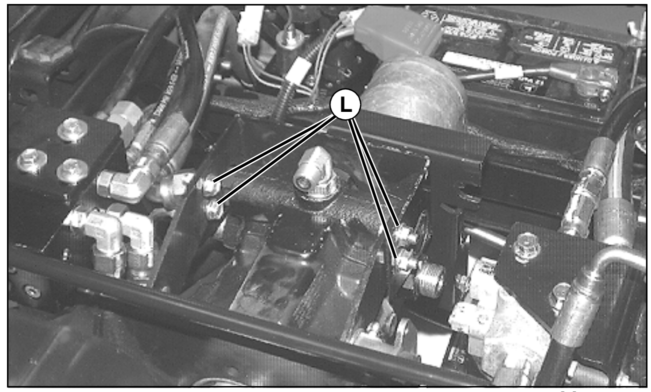
16.Disconnect hydraulic pump output hoses (H).

17.Disconnect hydrostatic pump output hose (I).



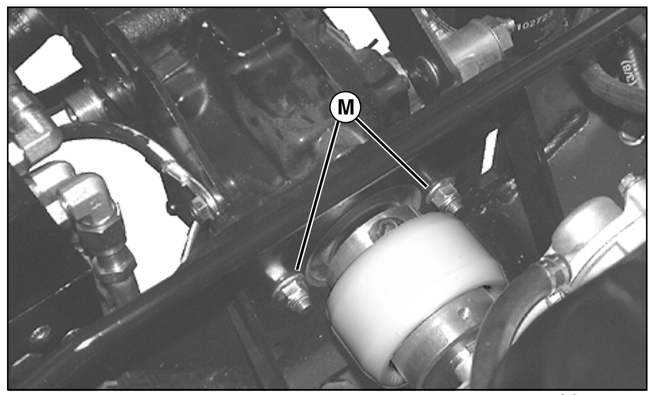
M98790

18.Remove nut (J) and disconnect eyebolt (K).



M98793

19.Remove hydrostatic pump bracket cap screws and nuts (L).



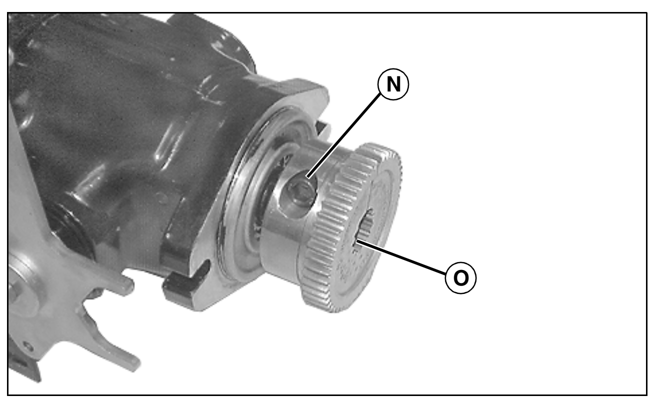
M98794

20.Support the hydrostatic/hydraulic pump assembly.

21.Remove pump mounting cap screws and nuts (M).

22.Carefully pull the hydrostatic/hydraulic pump assembly forward to allow the coupler to clear the engine cradle bracket.

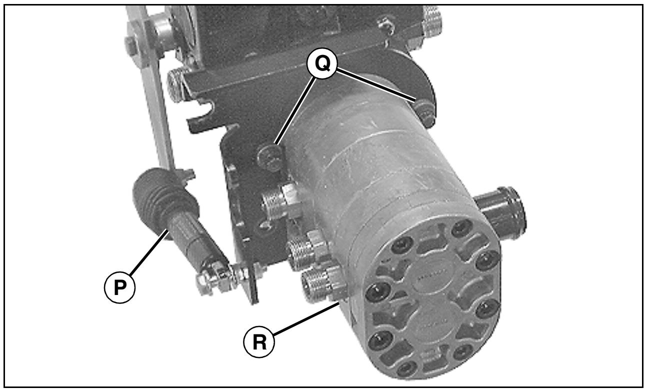
23.Remove pump assembly from machine.



M98792

24.Loosen socket head cap screw (N).

25.Remove coupler (O).

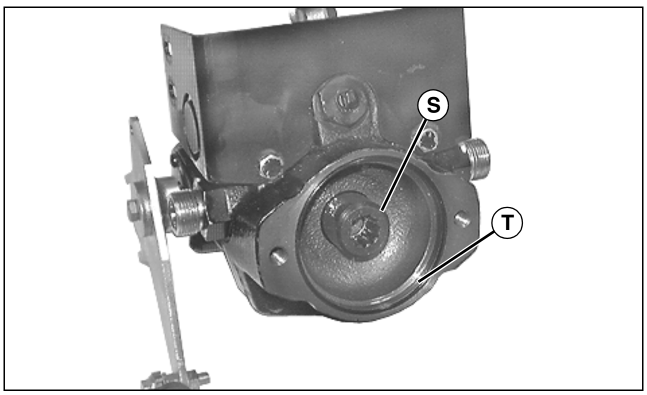


M98795

26.Remove nut and disconnect dampener (P).

27.Remove special cap screws and washers (Q).

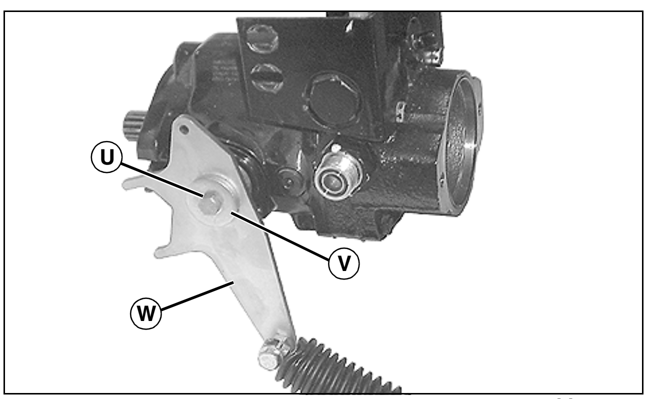
28.Remove hydraulic pump assembly (R).



M98796

29.Remove coupler (S).

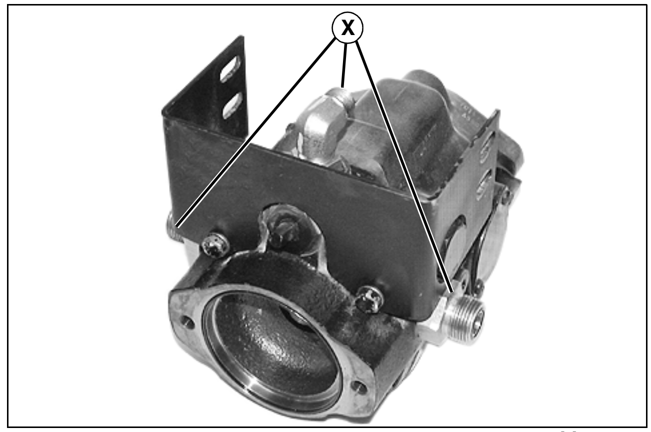
30.Remove O-ring (T).



M98797

31.Remove cap screw (U) and special washer (V).

32.Remove control arm (W).



M84754

33.If hydrostatic pump is to be repaired, remove fittings (X).

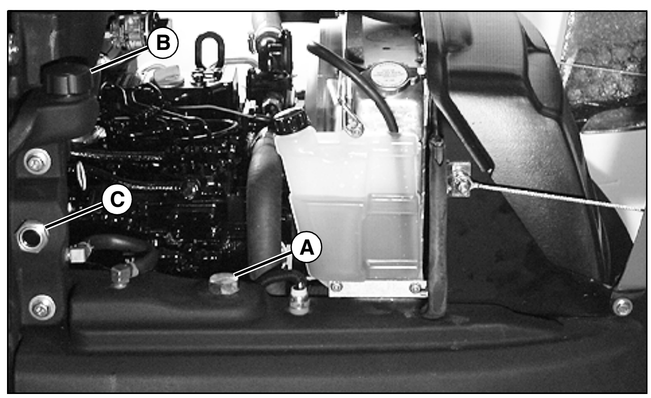
Installation

Installation is performed in reverse order of removal.

- Tighten displacement control arm cap screw to specification.
- Tighten coupler socket head cap screw to specification.
- Tighten input hose connector to specification.

NOTE: Fill main reservoir at the reservoir filler cap. Oil added at the expansion tank will not transfer to the reservoir quickly, resulting in an inaccurate oil level indication.

After main reservoir is filled, add oil to expansion tank until oil level is at the center of the sight glass.



M84567

- Fill hydraulic reservoir at filler cap (A) and at expansion tank (B) using sight glass (C) to correct level with oil meeting correct specifications (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Specifications

Displacement Control Arm
Cap Screw. . . . . 37 N•m (27 lb-ft)

Pump Coupler Socket
Head Cap Screw . . . . 62 N•m (46 lb-ft)
Hydrostatic Pump Supply Hose . . . . . 47 N•m (35 lb-ft)

Remove and Install Hydrostatic Pump Assembly - Diesel Engine

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

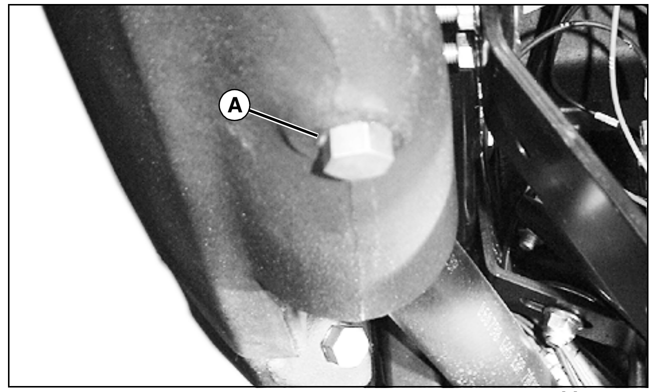
NOTE: Model 2500 shown throughout this procedure. 2500A and 2500E are similar.

Variations in hose routing exist between models. Record routing of hydraulic hoses and lines to assist in assembly.

Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise and lock seat platform.
7. Remove fuel tank. (See “Remove and Install Fuel Tank - Diesel” on page 804.)
8. Remove hydraulic reservoir expansion tank. (See “Remove and Install Hydraulic Reservoir Expansion Tank” on page 658.)

NOTE: Hydraulic system capacity is approximately 28.8 L (7.6 gal).

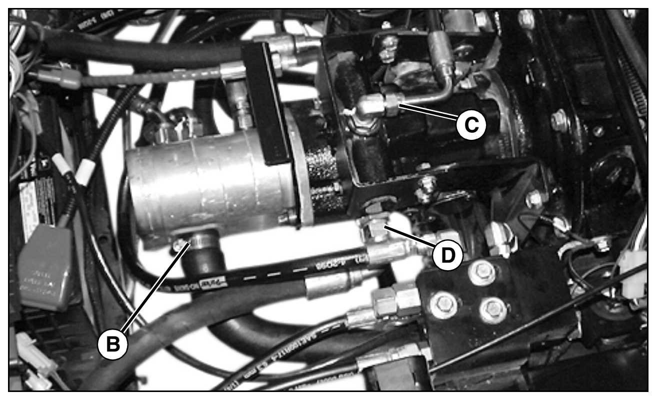


M84605

9. Remove drain plug (A) and drain main hydraulic reservoir/hydraulic system.

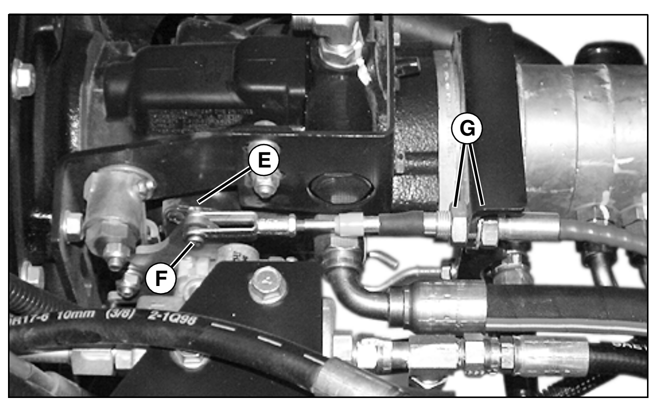
NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M84706

10. Loosen clamp and disconnect hydraulic pump supply hose (B).
11. Disconnect hydrostatic pump charge hose (C).
12. Disconnect hydrostatic pump output hose (D).



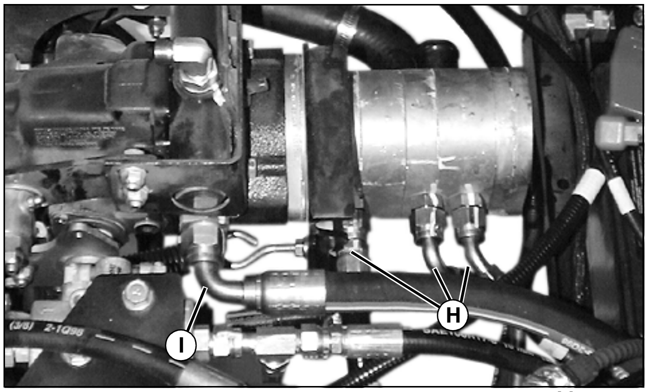
M84707

13. Remove cotter pin (E) and retainer pin (F).
14. Loosen cable adjustment nuts (G).

15.Slide cable out of the bracket and swing cable aside.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

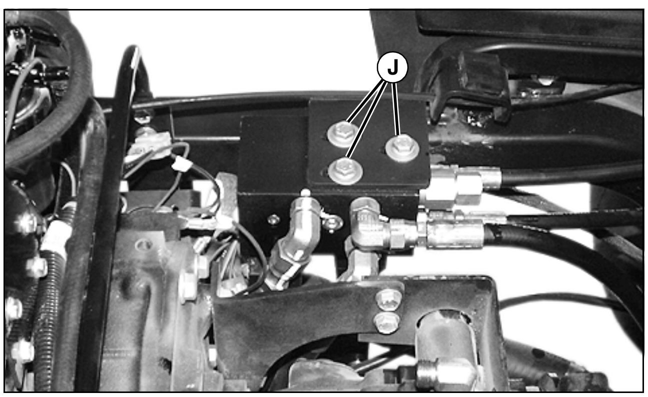
Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M84708

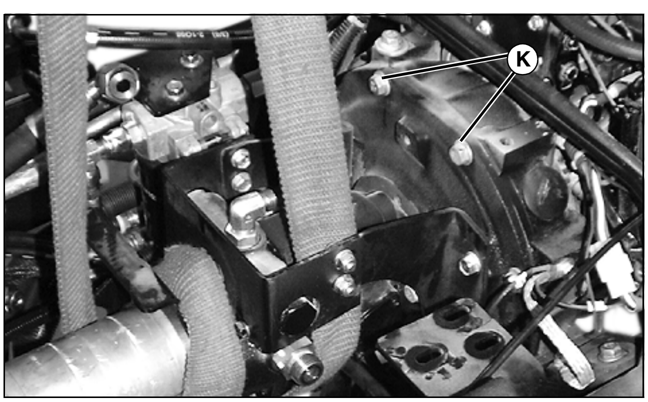
16.Disconnect hydraulic pump output hoses (H).

17.Disconnect hydrostatic pump output hose (I).



M84709

18.Remove lift valve cap screws (J) and carefully push the lift valve forward.

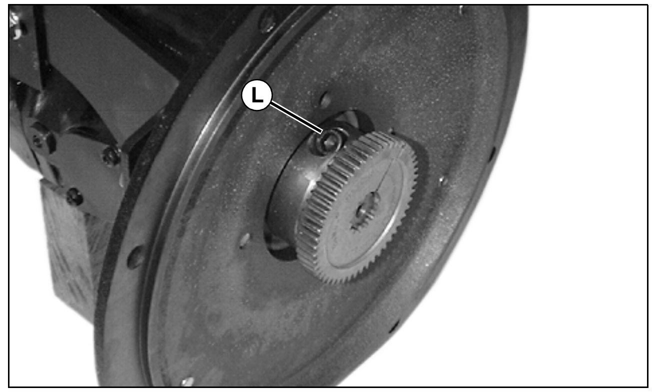


M84711

19.Attach hoist and nylon strap to pump assembly. Remove slack.

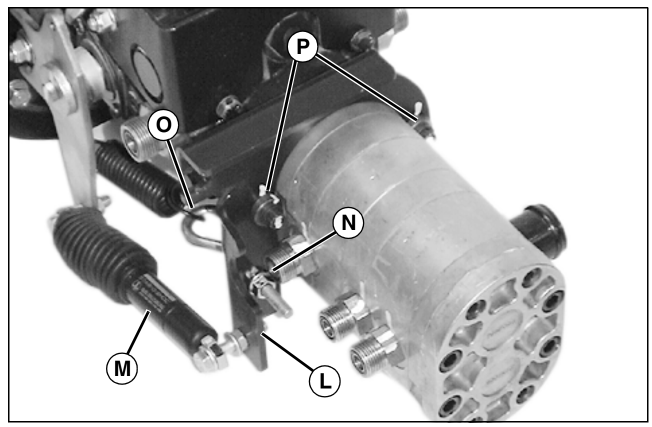
20.Remove eight flanged-head cap screws from flywheel housing adapter plate.

21.Carefully pull the hydrostatic/hydraulic pump assembly forward to allow the coupler to clear the flywheel.



M84715

22.Loosen socket head cap screw (L) and remove coupler.



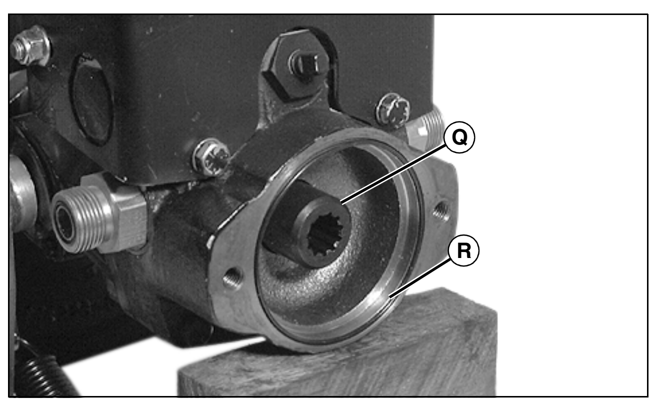
M84712

23.Remove nut (L) and disconnect dampener (M).

24.Remove nut (N) and disconnect spring and eyebolt (O).

25.Remove special cap screws and washers (P).

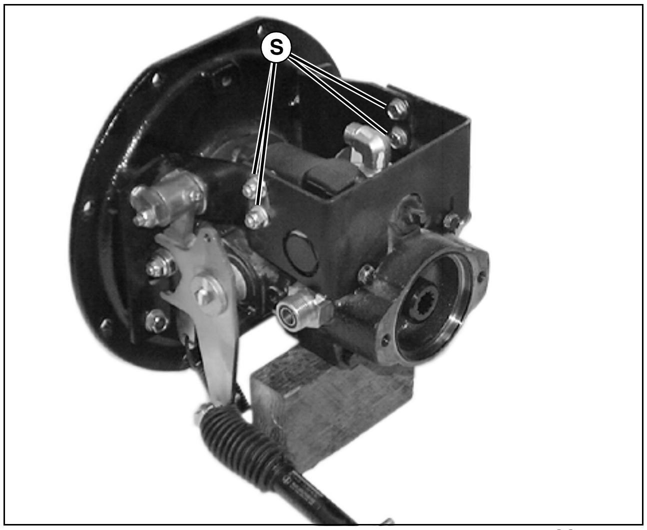
26.Remove hydraulic pump.



M84753

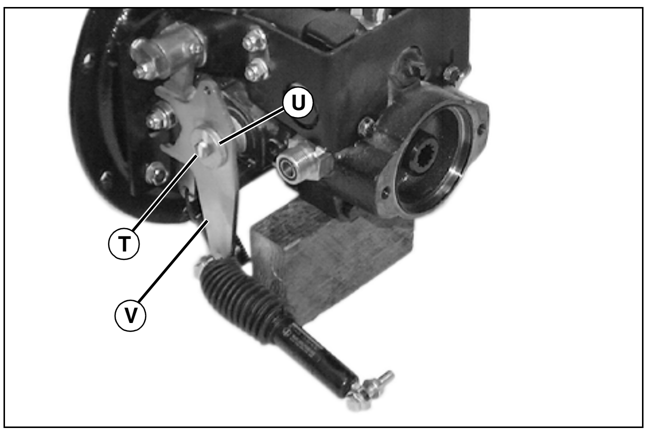
27.Remove coupler (Q).

28.Remove O-ring (R).



M84713

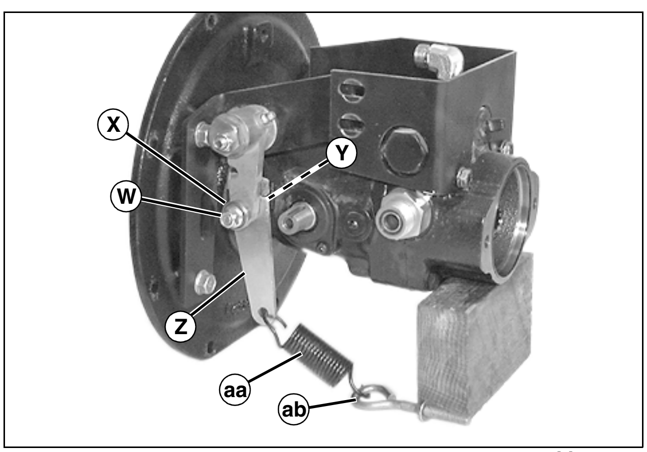
29.Remove bracket cap screws and nuts (S).



M84714

30.Remove cap screw (T) and special washer (U).

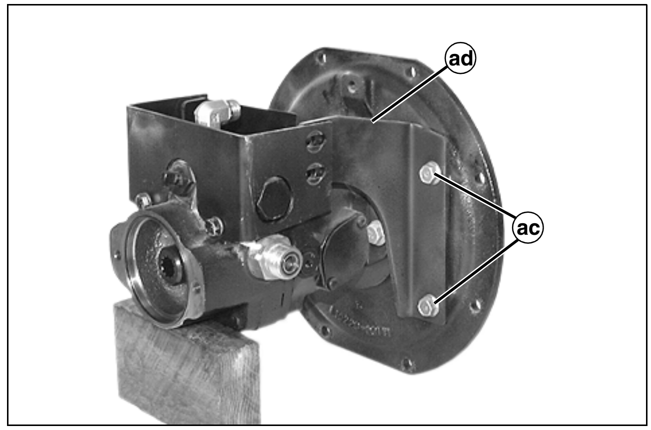
31.Remove control arm (V).



M84718

32.Remove cap screw (W), bearing (X) and nut (Y).

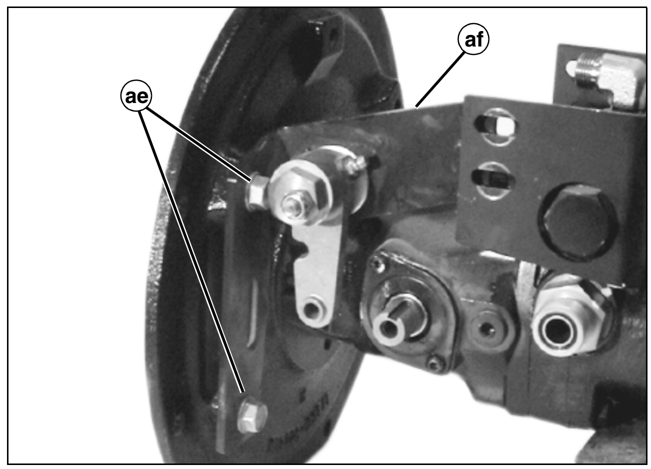
33.Remove linkage arm (Z), spring (AA) and eyebolt (AB).



M84716

34.Remove right side bracket-to-adapter plate cap screws (AC).

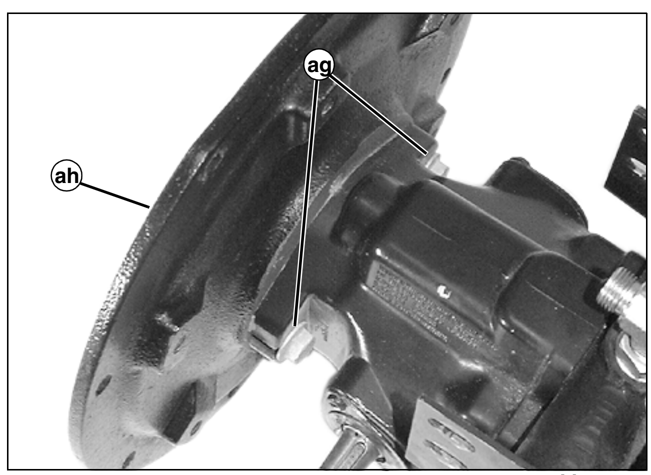
35.Remove bracket (AD).



M84717

36.Remove left side bracket-to-adapter plate cap screws (AE).

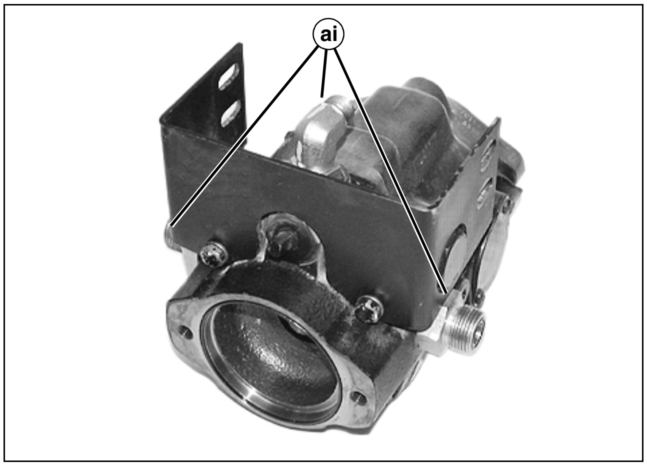
37.Remove bracket (AF).



M84719

38.Remove pump-to-adapter plate cap screws (AG).

39.Remove adapter plate (AH) from pump.



M84754

40.If hydrostatic pump is to be repaired, remove fittings (AI).

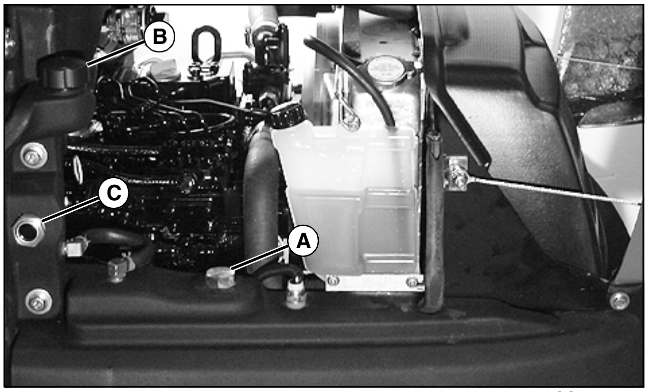
Installation

Installation is performed in reverse order of removal.

- Tighten flywheel adapter plate cap screws to specification.
- Tighten displacement control arm cap screw to specification.
- Tighten coupler socket head cap screw to specification.

NOTE: Fill main reservoir at the reservoir filler cap. Oil added at the expansion tank will not transfer to the reservoir quickly, resulting in an inaccurate oil level indication.

After main reservoir is filled, add oil to expansion tank until oil level is at the center of the sight glass.



M84567

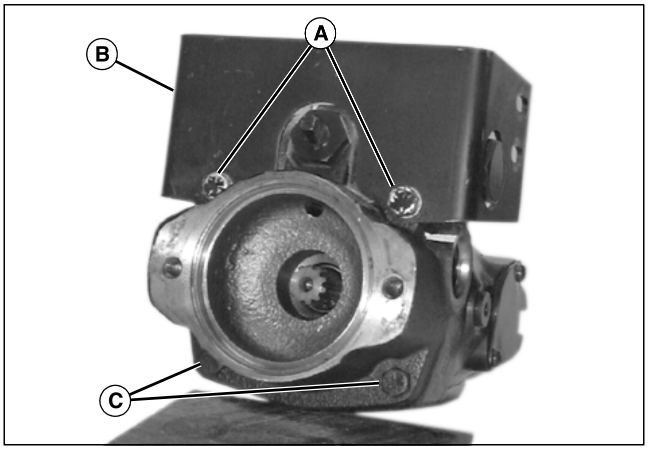
- Fill hydraulic reservoir at filler cap (A) and at expansion tank (B) using sight glass (C) to correct level with oil meeting correct specifications (See "Hydrostatic Transmission and Hydraulic Oil" on page 20.)
- Bleed air from hydraulic system. (See "Bleed Hydraulic System" on page 651.)

Specifications

Flywheel Adapter Plate Cap Screws . . 68 N•m (50 lb-ft)
Displacement Control Arm Cap Screw 37 N•m (27 lb-ft)
Pump Coupler Socket Head
Cap Screw. . . . . 20 N•m (177 lb-in.)

Disassemble and Inspect Hydrostatic Pump

1. Plug all ports and thoroughly clean the outside of the pump. Remove plugs and drain oil.

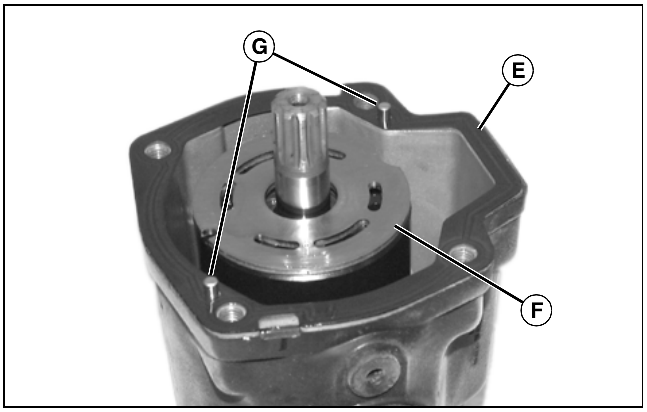


M84784

2. Remove two cap screws (A) from bracket/backplate.
3. Remove bracket (B).
4. Remove two lower cap screws (C) from backplate.

M84785

5. Use screwdriver slots (D) in housing to pry up on the backplate or tap with a plastic mallet to loosen, then pull the backplate straight up to remove.



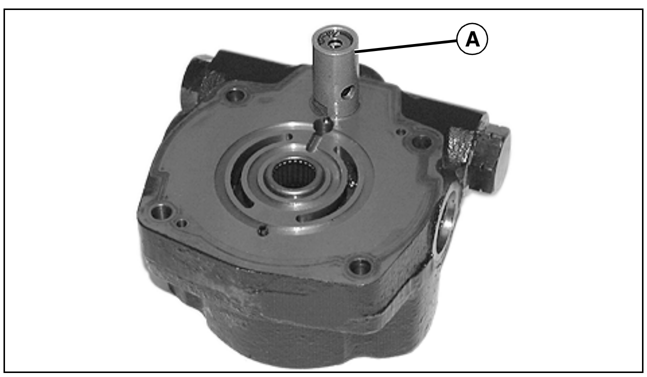
M84787

6. Remove gasket (E) and valve plate (F).

7. Inspect dowel pins (G) for wear or damage. Replace if necessary.

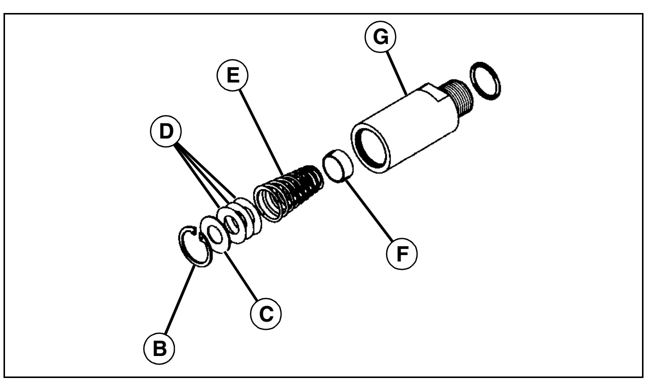
Backplate Assembly:

NOTE: Some standard wrenches may not fit between the surface of the backplate and the top of the flats on the charge relief valve. Use a wrench with a low profile.



M84790

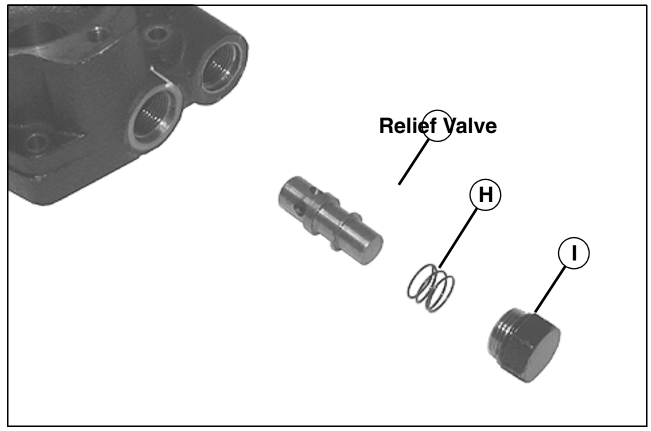
1. Remove charge relief valve (A).



M56535

2. Disassemble charge relief valve by removing retaining ring (B), washer (C), shim(s) (D), conical spring (E) and plunger (F) from body (G). Make note of the number of shims removed for reassembly.

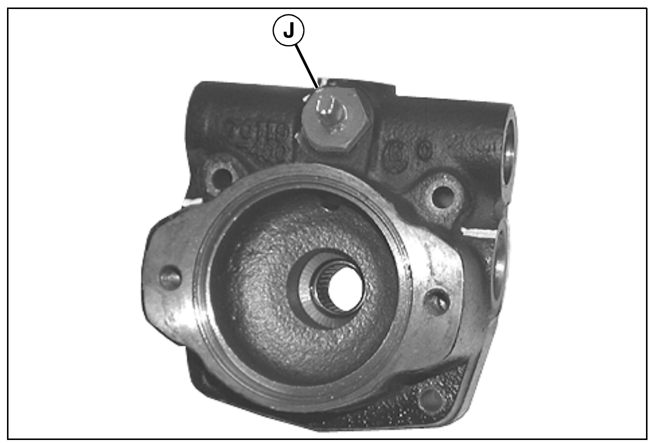
3. Inspect the charge pump relief valve spring, cup and seat for wear, replace the entire relief valve if worn.



M84799

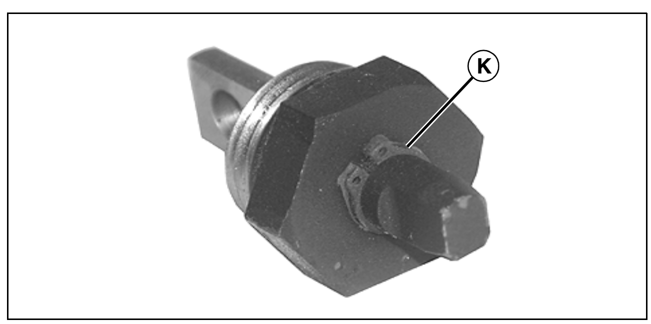
4. Remove plug, spring (H) and plug seats (I) from backplate.

5. Inspect the plug seats and springs for condition and wear; replace if necessary.



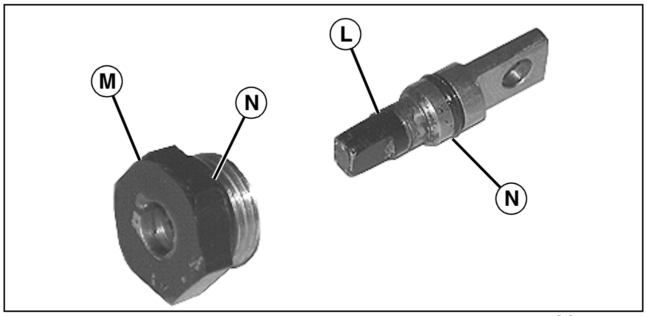
M84800

6. Remove dump valve assembly (J) from backplate.



M84805

7. Remove retaining ring (K).

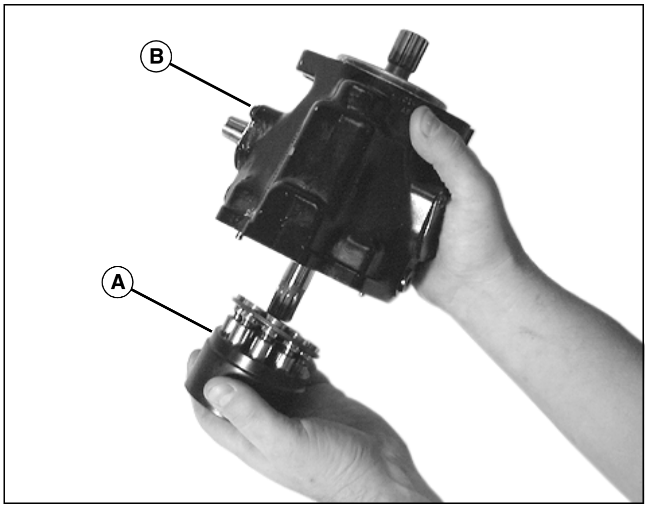


M84801

8. Disassemble dump valve by pulling the valve (L) from the plug (M) taking care not to damage O-rings (N).

Piston Block Assembly

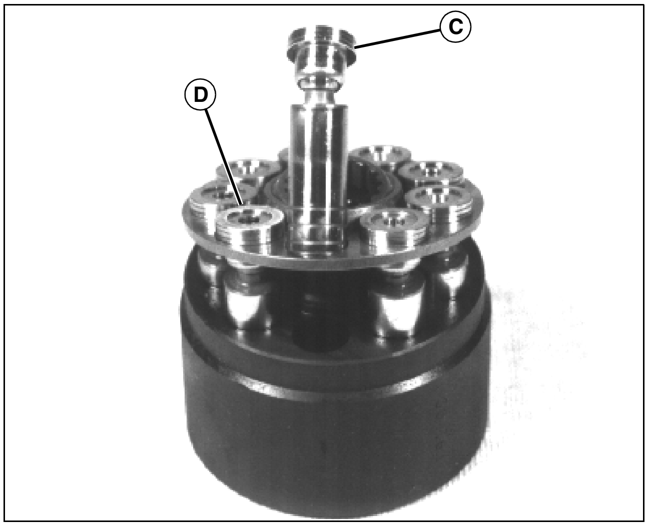
IMPORTANT: Avoid damage! Keep pistons and piston block together as an assembly when removing the rotating assembly.



M84791

1. Hold piston block assembly (A) in place and turn the housing (B) upside down. Remove the piston block assembly.

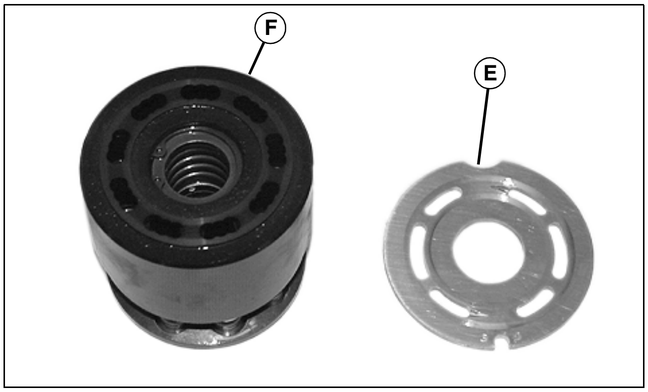
NOTE: Piston block components are not serviceable. Replace the complete assembly if any parts are worn or damaged.



M56554

2. Inspect the outside diameter of pistons for finish condition. The pistons should not show signs of wear or deep scratches.

3. Inspect shoes (C). The shoes should fit snugly on the ball end of the piston and the shoe face (D) (the area that comes in contact with the cam plate) should be free of scratches or wear. DO NOT LAP PISTON SHOES.

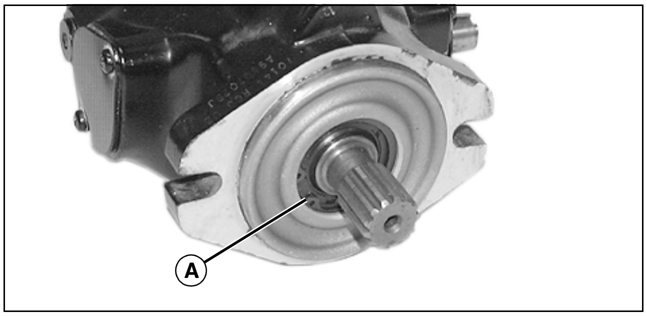


M84798

4. Inspect surface of the valve plate (E) for scoring, galling or fretting; replace as needed.

5. Inspect surface of the piston block (F) and the cam plate for scoring or wear; replace as needed.

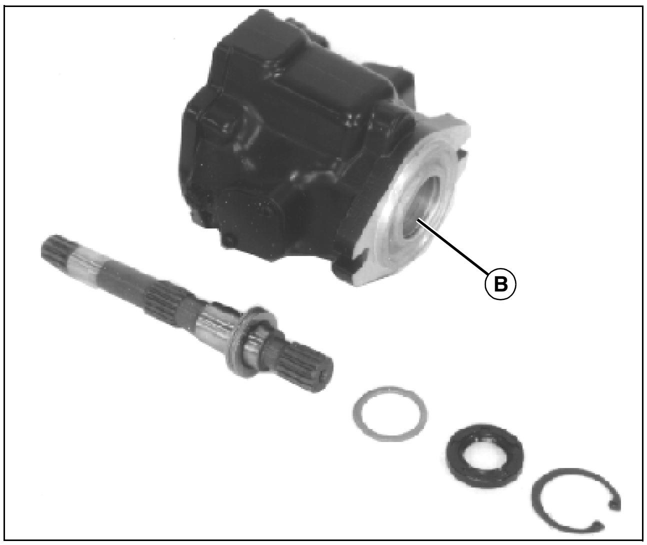
Pump Body



M84792

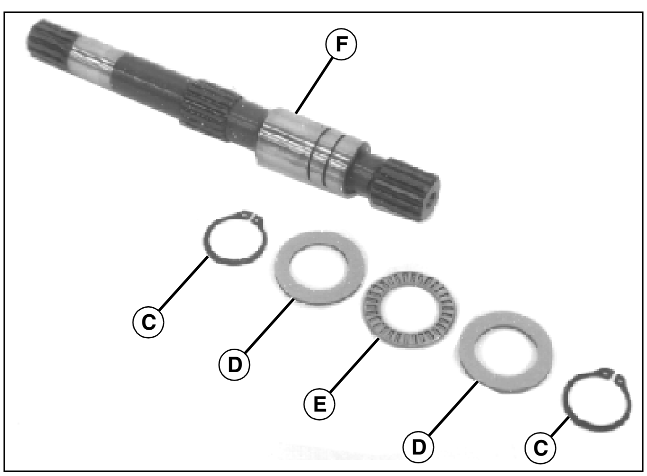
1. Remove retaining ring (A).
2. Press the shaft, with seal and washer, from the housing.

NOTE: Bearing is press fit in housing. Remove bearing only if replacement is necessary.



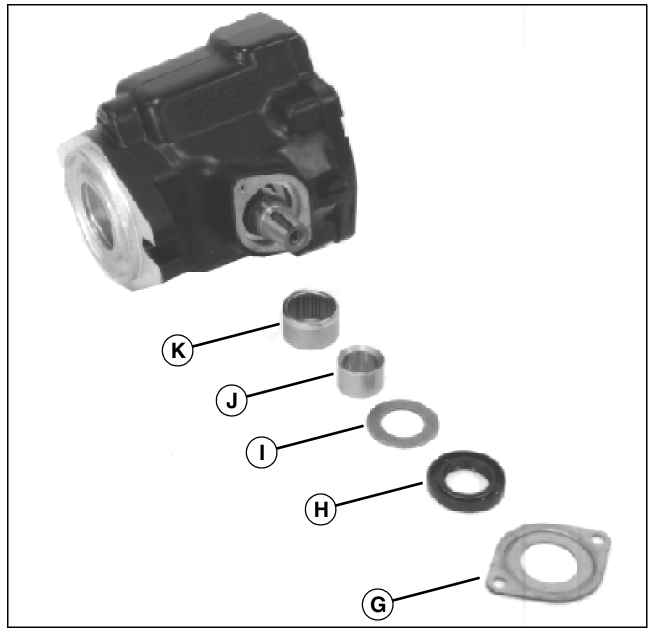
M82700

3. Inspect bearing (B) for signs of wear or damage. If necessary, remove bearing using a blind-hole puller.



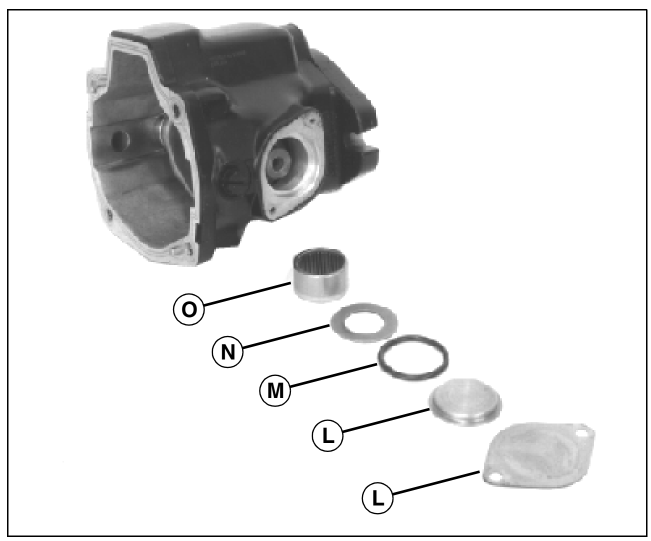
M82701

4. Remove snap ring (C) at the front of shaft.
5. Remove washers (D) and thrust bearing (E).
6. Inspect input shaft (F) for signs of wear or damage. Replace as needed.
7. Inspect thrust bearing for signs of wear or damage. Replace as needed.



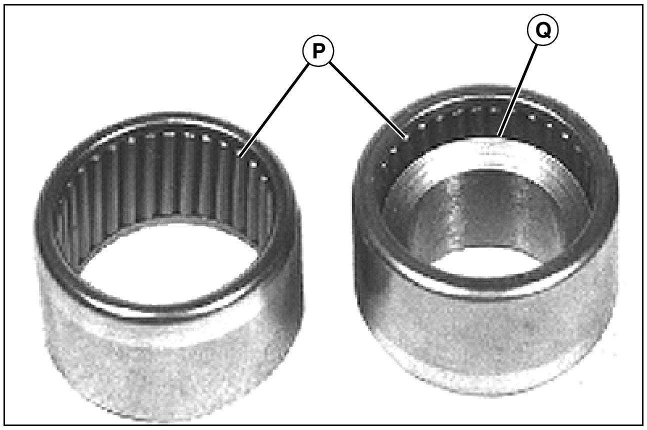
M82702

8. Remove seal cover (G).
9. Remove seal (H), washer (I), inner race (J) and bearing (K).



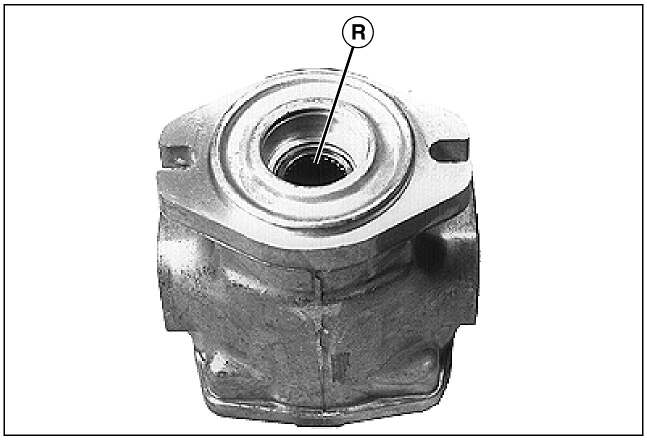
M82703

10.Remove trunnion covers (L).
11.Remove O-ring (M), washer (N), and bearing (O).



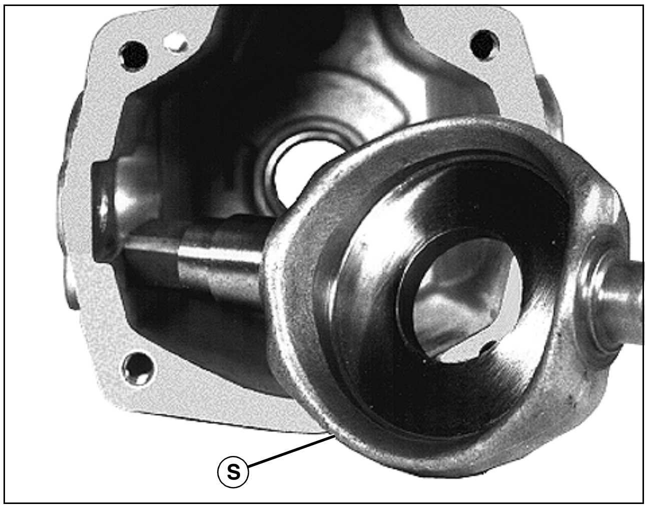
M56556

12.Inspect the needle bearings (P) and inner race (Q) of the cam plate trunnion bearings for wear or galling, keeping the needle bearings in the cage.



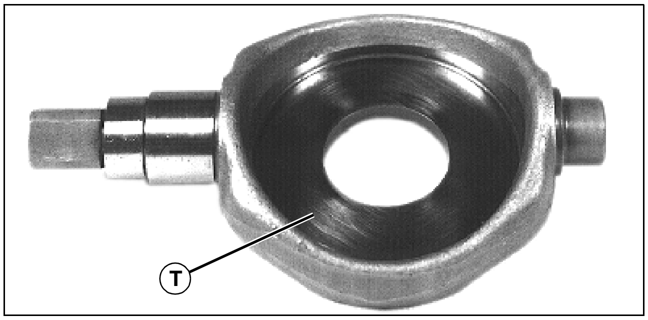
M84804

13.Inspect the needle bearings (R) in the housing assembly, making sure the bearings remain in the bearing cage.



M56561

14.Remove cam plate (S).



M56555

15.Inspect the polished surface (T) of the cam plate for scoring, galling, or fretting; replace as needed.

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

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on hydrostatic pump. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydrostatic/ hydraulic system and cause damage.

16.Clean all metal parts with solvent and blow dry with compressed air.

17.Inspect all parts for damage, nicks or unusual wear. Replace entire wheel motor assembly if any parts other than seal rings, seals or outer bearing are worn or damaged.

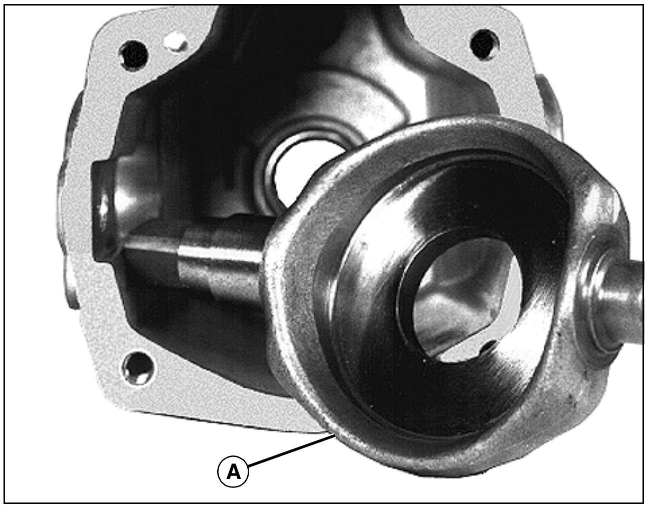
Assemble Hydrostatic Pump

IMPORTANT: Avoid damage! Ensure work area is clean. Ensure all parts are clean and free of lint.

Always use new seals and O-rings. Damage or used parts will leak.

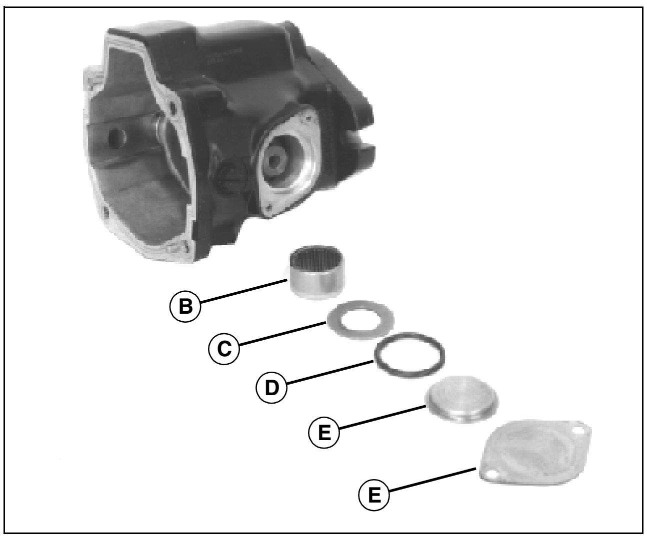
NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply a light coat of clean hydraulic oil to all internal parts when assembling the pump.



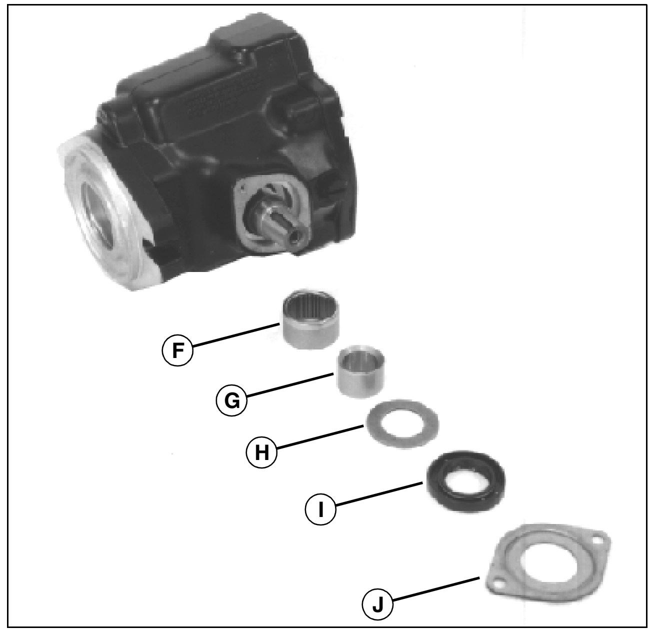
M56561

1. Install cam plate (A) in housing, long end first.



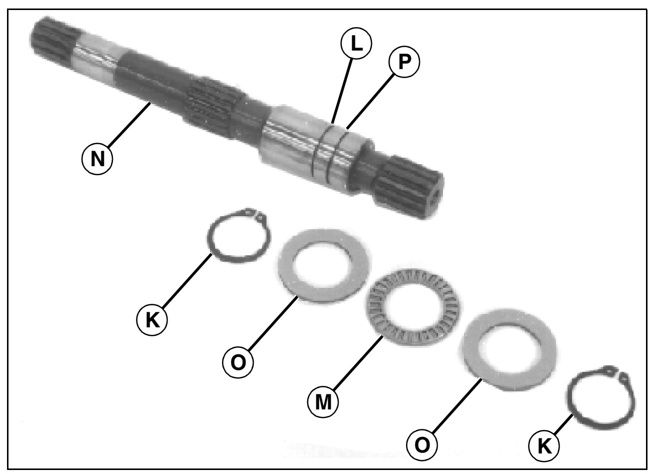
M82703

2. Install bearing (B), washer (C), O-ring (D), and trunnion covers (E); use plenty of hydraulic fluid to lubricate bearings and to aid in seal installation.



M82702

3. Install bearing (F), inner race (G), washer (H), seal (I), and seal cover (J); use plenty of hydraulic fluid to lubricate bearings and O-ring. Verify that the cam plate has full travel and moves freely.

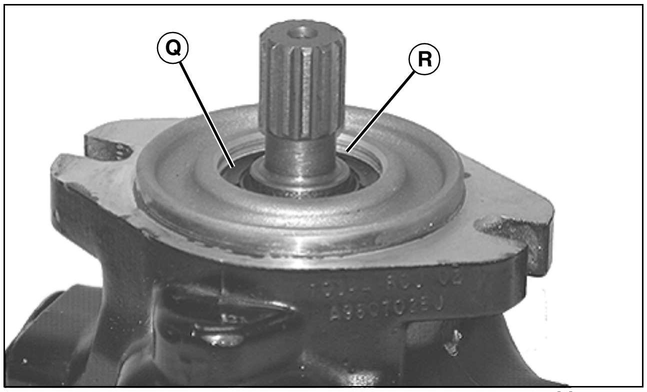


M82701

4. Install a snap ring (K) in the rear groove (L).

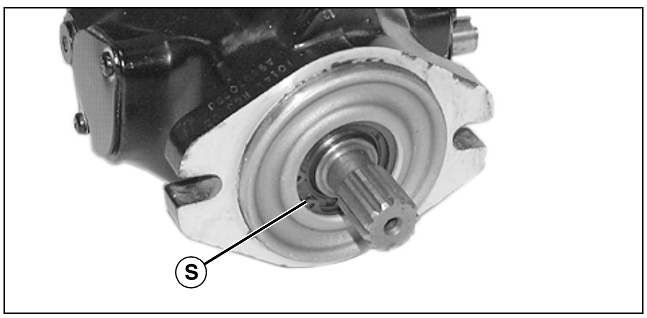
5. Install the thrust bearing (M) on the shaft (N) with a washer (O) on each side.

6. Secure the washers/bearing by installing a snap ring in the front input groove (P).



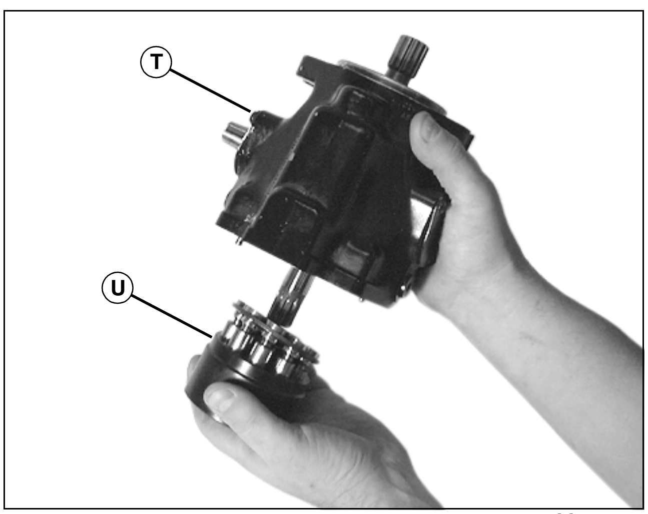
M84803

7. Install shaft and seal (Q); use hydraulic fluid liberally to avoid damaging the seal during installation. Ensure the seal is positioned below retaining ring groove (R).



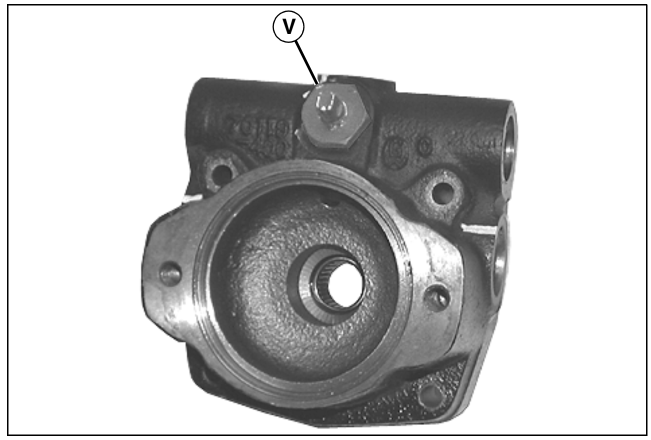
M84792

8. Install retaining ring (S) with sharp edge of ring facing the outside of the case.



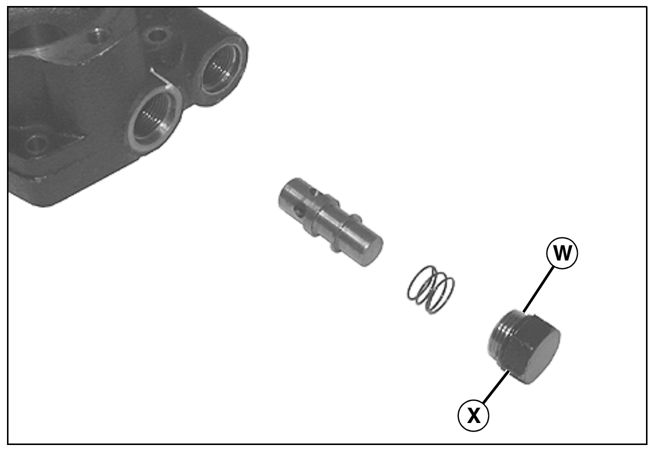
M84791

9. Hold the housing (T) upside down and install the piston block assembly (U). Make sure the assembly is seated against the cam plate.



M84800

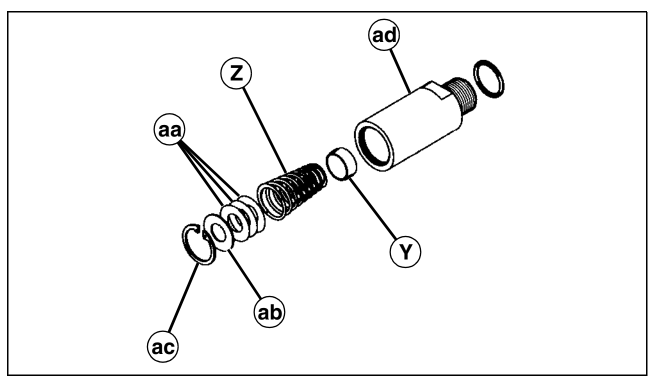
10.Install dump valve (V). Tighten to specification.



M84799

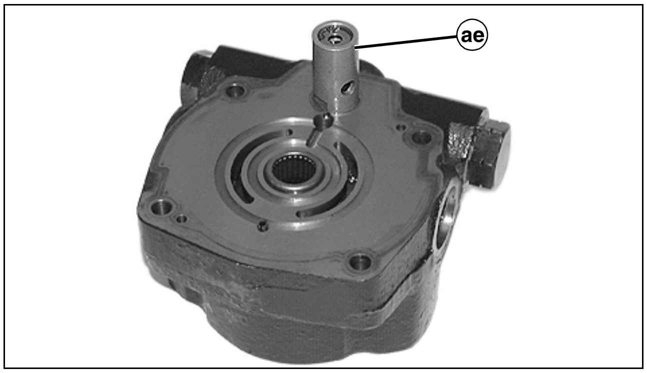
11.Install new O-ring (W) on plug seat (X).

12.Install plug seats. Tighten plugs to specification.



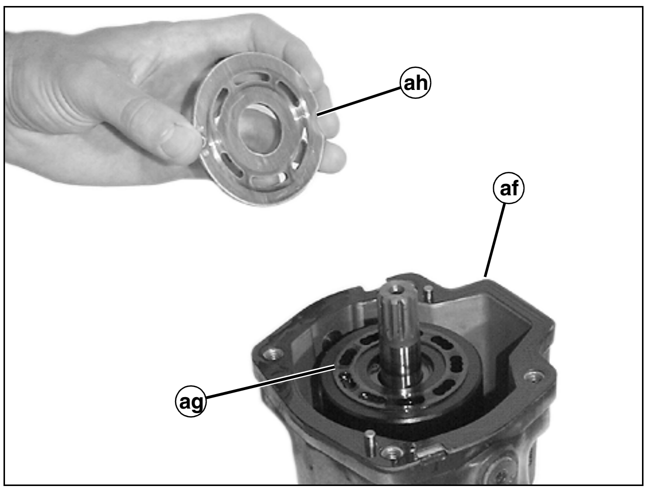
M56535

13.Assemble charge relief valve by installing plunger (Y), conical spring (Z), shims (AA), washer (AB), and retaining ring (AC) to body (AD); use the same number and thickness of shims as removed.



M84790

14.Install charge relief valve (AE) on backplate assembly. Tighten to specification.



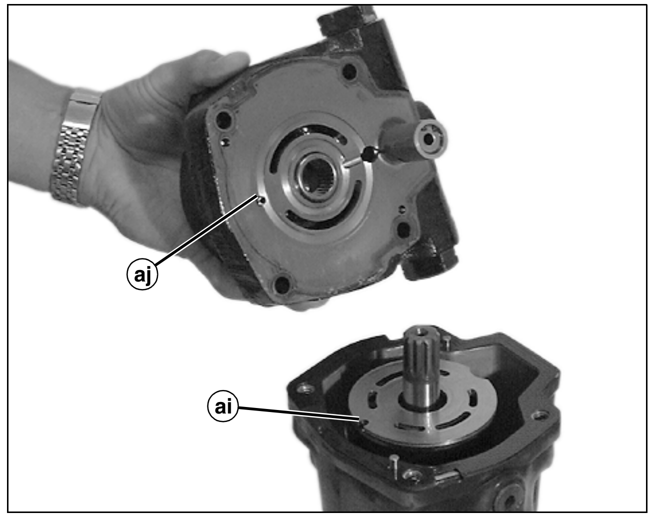
M84788

15.Install gasket (AF).

NOTE: Install valve plate with copper-coated side toward piston block assembly (AG).

16.Install valve plate (AH).

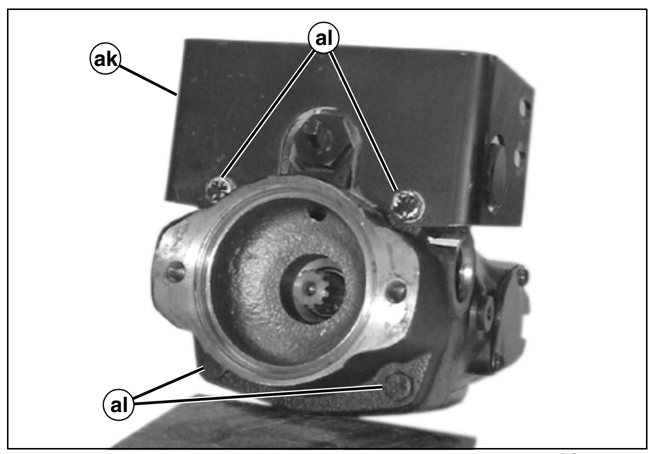
NOTE: Align notch (AI) on valve plate with alignment dowel (AJ) on backplate assembly.



M84789

17.Install backplate.

IMPORTANT: Avoid damage! DO NOT use the bolts to force the parts to mate when assembling backplate to housing. 44-67 newtons (10-15 pounds) of force should be all that is necessary for assembly.



M84784

18.Install bracket (ak) onto the backplate using two cap screws (al). Tighten cap screws to specification.

19.Install two cap screws in lower holes in backplate. Tighten cap screws to specification.

Specifications

Dump Valve Torque . . . . 33 N•m (28 lb-ft)

Relief Valve Plug Seat Torque . . . . . . 135 N•m (100 lb-ft)

Charge Relief Valve Torque . . . . 38 N•m (29 lb-ft)

Backplate Cap Screw Torque . . . . 25 N•m (19 lb-ft)

Remove and Install Front Wheel Motors

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

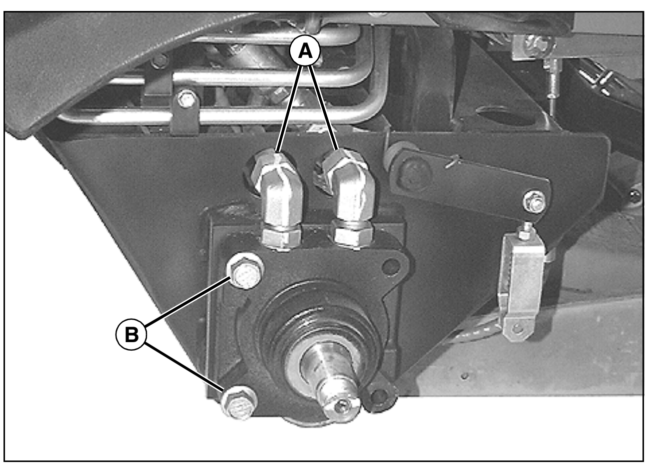
- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

1. Remove park brake assembly and rotor. (See “Remove and Install Park Brake” on page 731.)

NOTE: Cap the hoses to prevent draining the oil reservoir.

Note position of wheel motor hoses to ensure correct installation.



M84267

2. Disconnect hydraulic hoses (A).
3. Remove mounting cap screws (B).
4. Remove the wheel motor.
5. If the motor is to be repaired, remove fittings.

Installation

Installation is performed in reverse order of removal.

- Apply MPG-2 Multi-Purpose Grease to wheel motor shaft and key. (See “Grease” on page 21.)
- Tighten the nut securing the rotor to the wheel to specification.
- Fill hydraulic reservoir to correct level with oil of proper specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Specifications

Brake Rotor Retaining Nut Torque . . 407 N•m (300 lb-ft)

Remove and Install Third Wheel Assist Motor

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

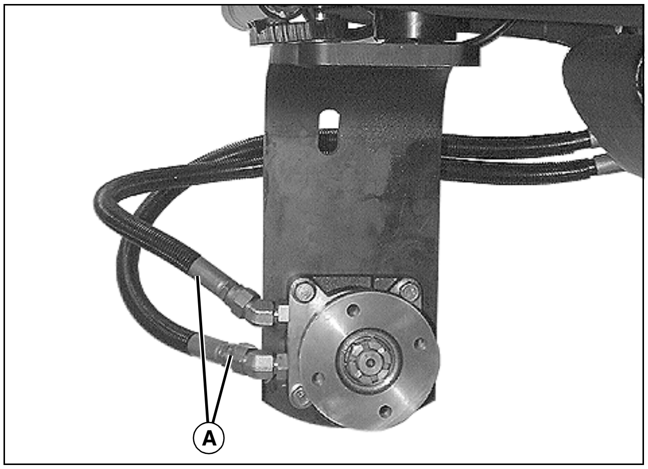
- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

1. Use a safe lifting device to raise the machine high enough to remove weight from wheel. Place blocks or jackstands under machine frame.
2. Remove rear wheel. (See “Remove and Install Rear Wheel (Third Wheel Assist)” on page 799.)

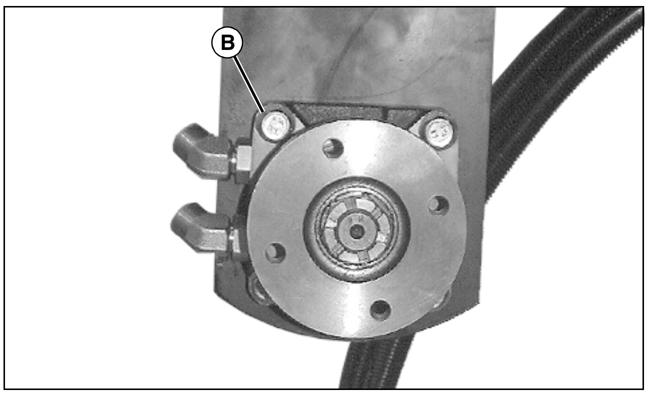
NOTE: Cap hoses to prevent draining the oil reservoir.

Note position of wheel motor hoses to ensure correct installation.



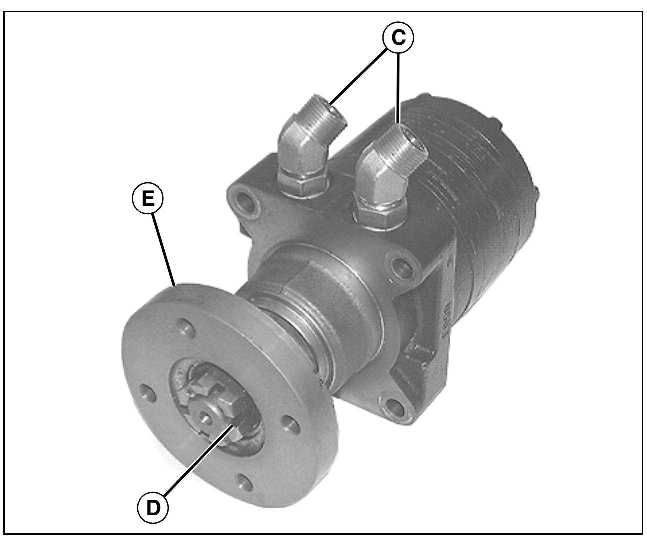
M98609

3. Disconnect hydraulic hoses (A).



M98611

4. Remove cap screws and nuts (B).
5. Remove wheel motor.



M98611

6. If the motor is to be repaired, remove:
   - Fittings (C).
   - Nut (D), wheel hub (E), and key.

Installation

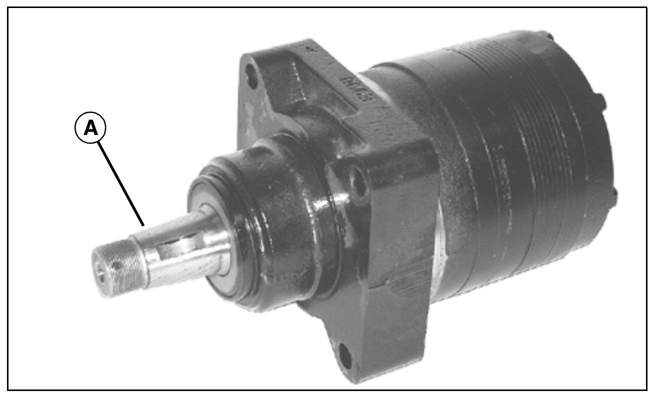
Installation is done in the reverse order of removal.

- Apply MPG-2 Multi-Purpose Grease to wheel motor output shaft and key. (See “Grease” on page 21.)
- Tighten the nut securing the wheel hub to the motor to specification.
- Fill hydraulic reservoir to correct level with oil of proper specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Specifications

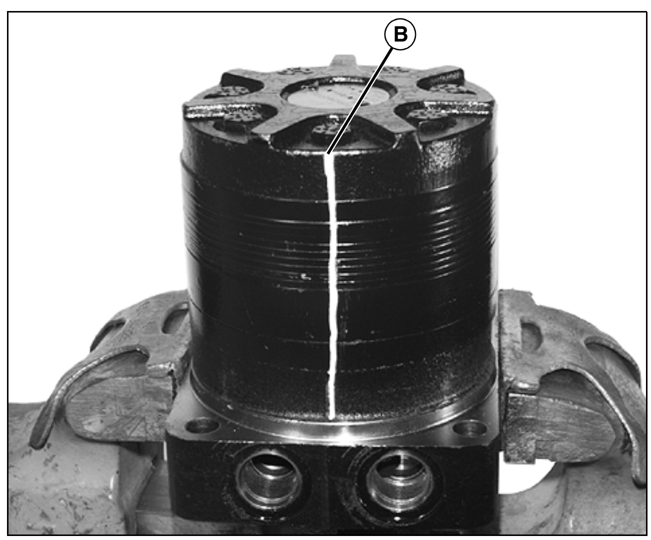
Hub Retaining Nut Torque . . . . 475 N•m (350 lb-ft)

Disassemble and Inspect Wheel Motors



M84266

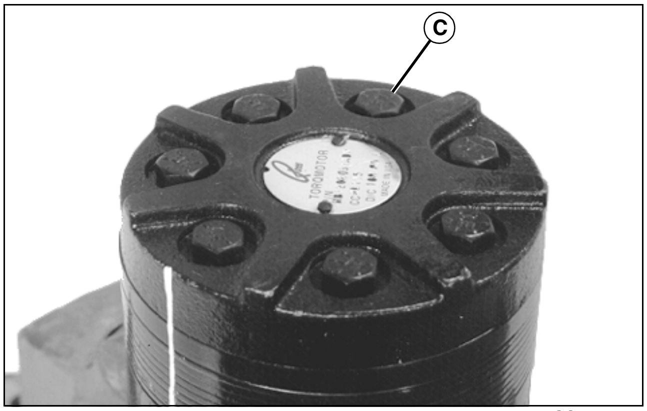
1. Clean rust, dirt and corrosion from coupling shaft (A).



M84267

2. Place wheel motor in a soft-jawed vise with the output shaft down, clamping firmly on sides of the housing, mounting flange or port bosses.

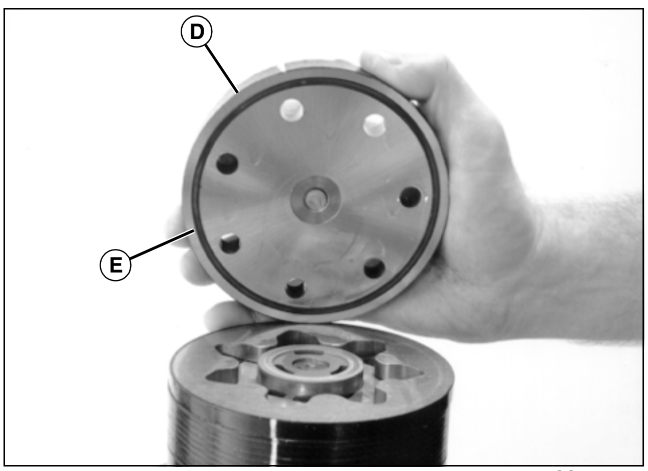
3. Scribe (or paint) an alignment mark (B) across the motor housing.



M84268

4. Remove seven retaining bolts (C).

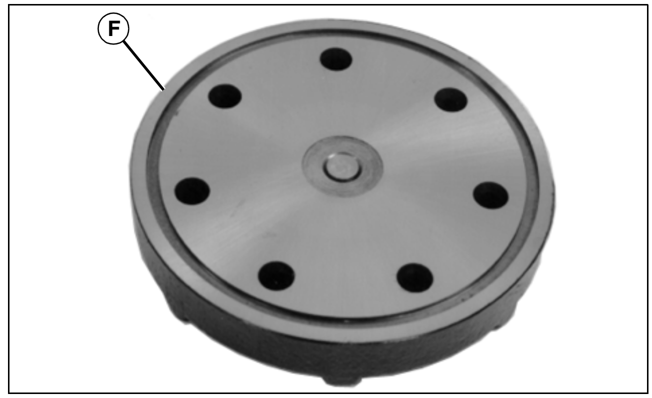
5. Inspect bolts for damaged threads and damage to sealing ring under the bolt head.



M84270

6. Remove end cover assembly (D) and seal ring (E). Discard seal ring.

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

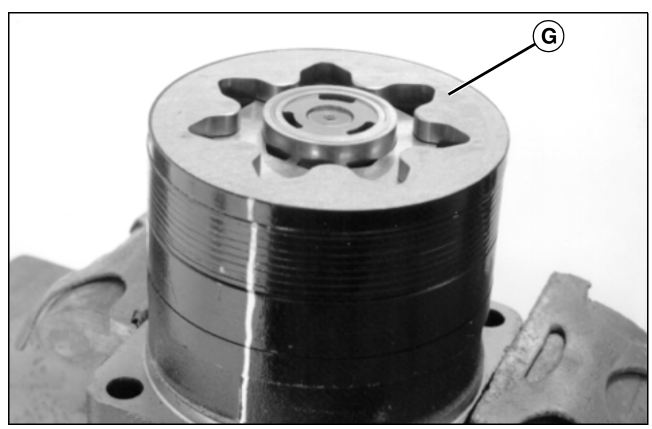


M84271

7. Thoroughly clean end cover (F) with solvent and blow dry with compressed air.

NOTE: A polished pattern on the face of the cover caused by rotation of the commutator is normal; however, the face should be free of scratches. Discoloration of the face surface may be caused by excessive fluid temperature, thermal shock or excessive speed. If discoloration is noted, thoroughly inspect all motor components for further damage. Inspect the entire drive/hydraulic system and correct any problems to prevent any possible further damage.

8. Inspect end cover for cracks, damage, discoloration or unusual wear.

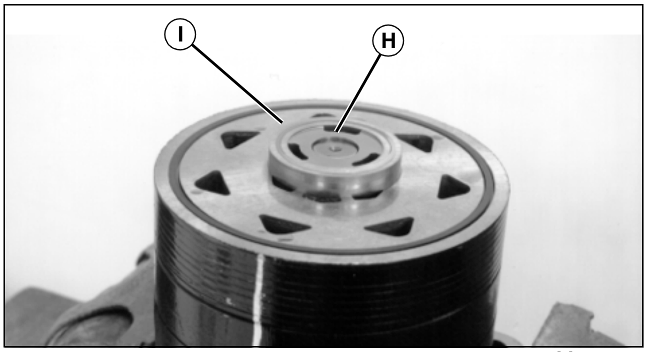


M84272

9. Remove commutator ring (G).

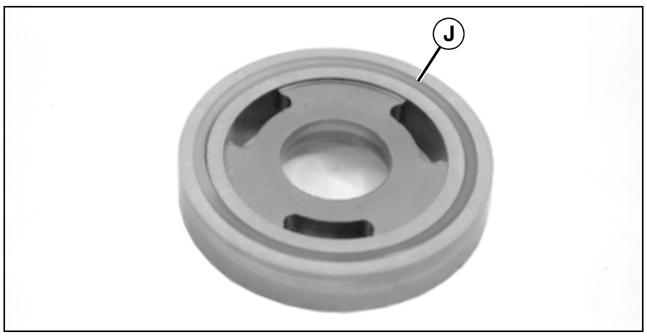
10. Inspect commutator ring for cracks or burrs.

NOTE: Drive link (H) may stick to commutator (I). Hold drive link in place while removing commutator.



M84273

11.Remove commutator.

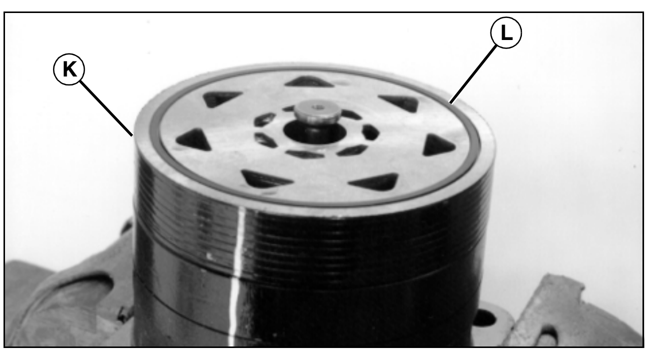


M84274

12.Remove seal ring (J) from commutator by blowing compressed air into the ring grove until the seal ring is lifted out of the groove. Discard seal ring.

13.Inspect commutator for cracks, burrs, scoring, spalling, brinelling or unusual wear.

NOTE: Make note of orientation of manifold to ensure correct installation.



M84275

14.Remove manifold (K).

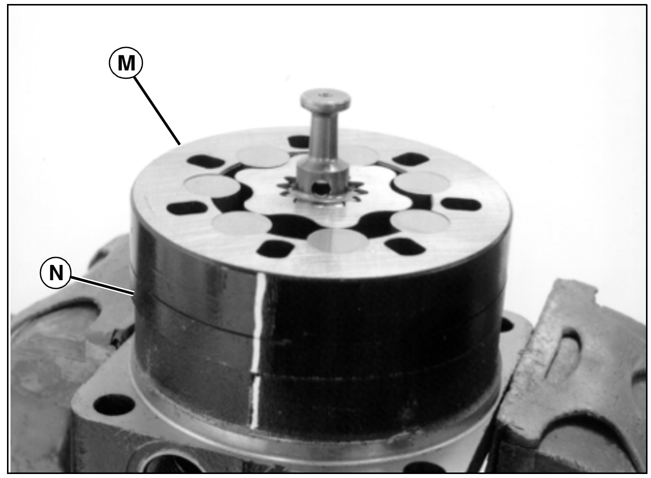
15.Remove seal rings (L) from both sides of the manifold. Discard seals.

NOTE: A polished pattern on the ground surface of the manifold caused by rotation of the commutator is normal.

16.Inspect manifold for cracks, surface scoring, spalling or brinelling.

NOTE: Hold rotor set and wear plate together while removing to maintain rotor vane-to-stator contact surfaces.

The drive link may come out with the rotor set. If it does, hold the drive link while removing the rotor set/ wear plate.



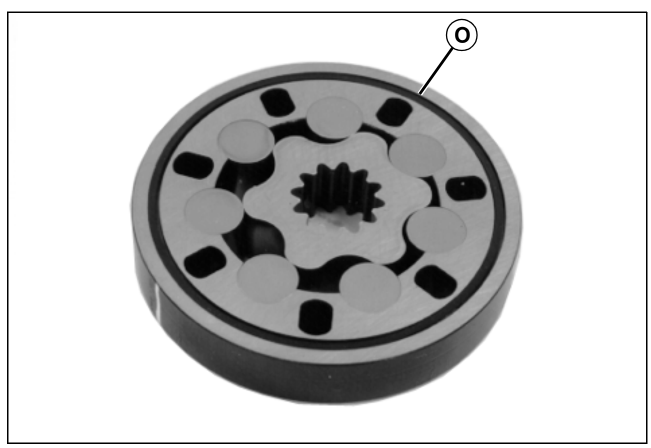
M84276

Picture Note: Bottom of Rotor Set Shown

17.Remove rotor set (M) and wear plate (N) as a set.

NOTE: Maintain rotor set components in their original positions. DO NOT disassemble.

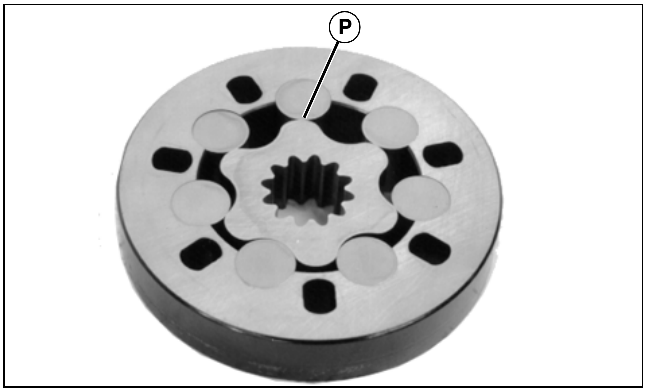
If disassembly is required, mark the upper surface of the rotor and stator, and all rotor components to ensure correct installation during assembly.



M84277

18.Separate the rotor set from the wear plate. Discard seal ring (O).

19.Inspect rotor set for nicks, scoring or spalling on any surface, or for broken or worn splines.



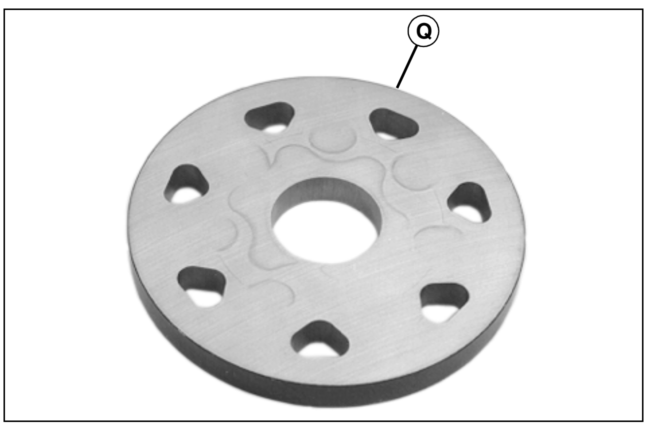
M84278

20.Place rotor set on a surface plate.

21.Position the rotor in the stator so that two rotor lobes (180° apart) and roller vane centerline are on the same stator centerline.

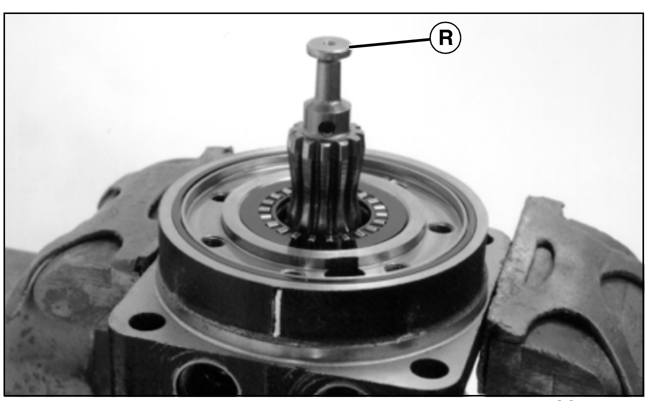
22.Check the rotor lobe-to-roller vane clearance at the common centerline (P) using a feeler gauge. Clearance should not be greater than 0.13 mm (0.005 inches).

NOTE: A polished pattern on the ground surface of the wear plate caused by rotation of the rotor is normal.



M84279

23.Inspect wear plate (Q) for cracks, brinelling or scoring.

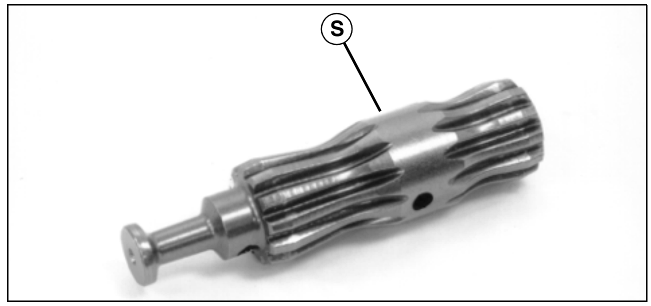


M84280

24.Inspect for play between drive link (R) and coupling shaft. There should be no noticeable play.

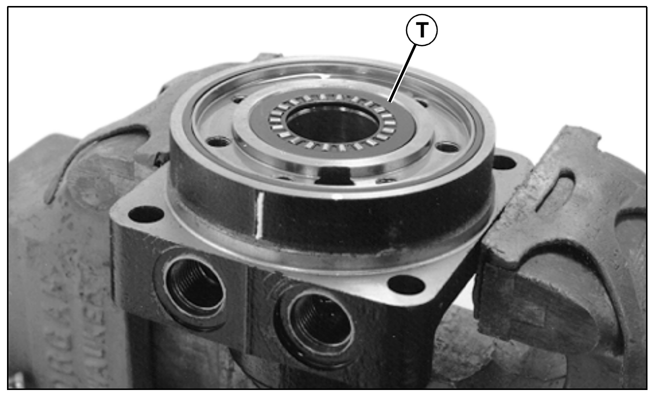
25.Mark drive link and coupling shaft splines to ensure reassembly in the original positions.

26.Remove drive link from the coupling shaft.



M84281

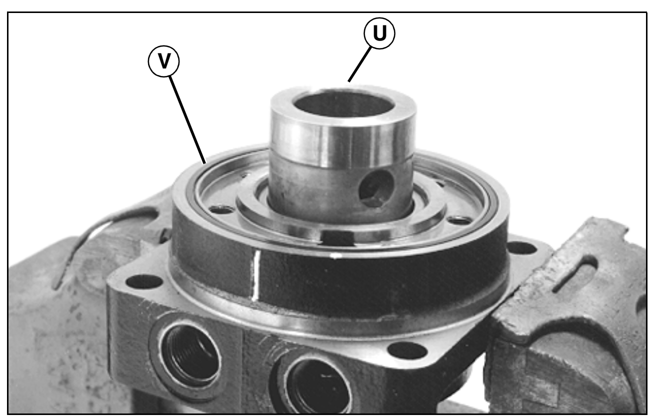
27.Inspect the drive link (S) for cracks and worn or damaged splines.



M84282

28.Remove thrust bearing (T) from coupling shaft.

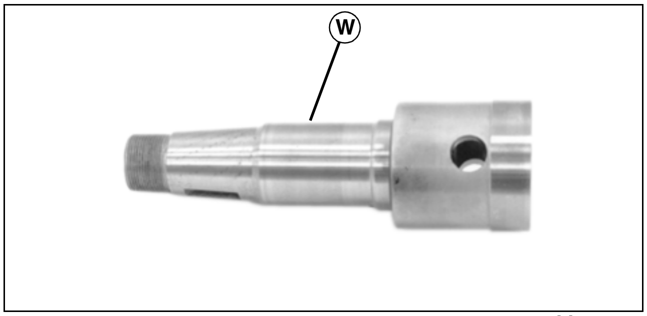
29.Inspect thrust bearing for wear, brinelling, corrosion and missing rollers.



M84283

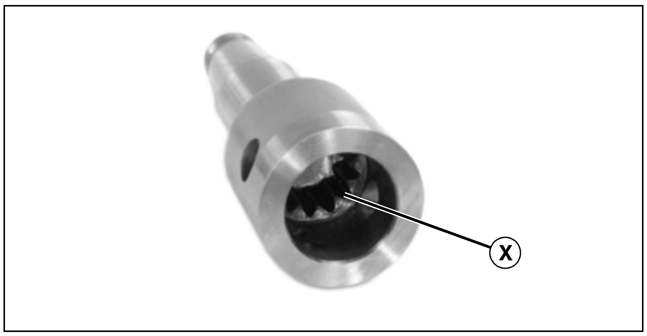
30.Remove coupling shaft (U).

31.Remove seal ring (V) from housing. Discard seal.



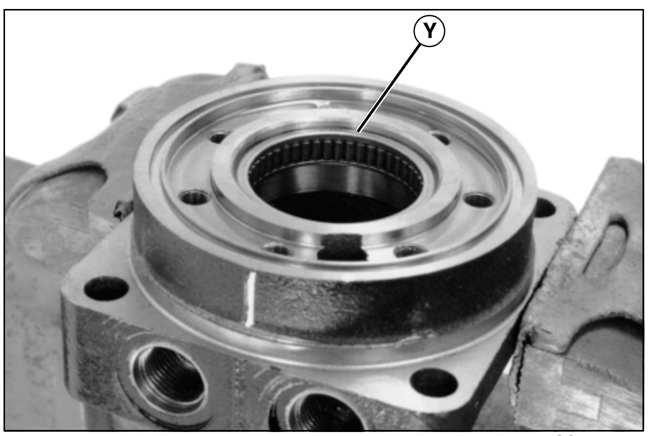
M84284

32.Inspect coupling shaft bearing and seal surface (W) for spalling, nicks, excessive wear or corrosion.



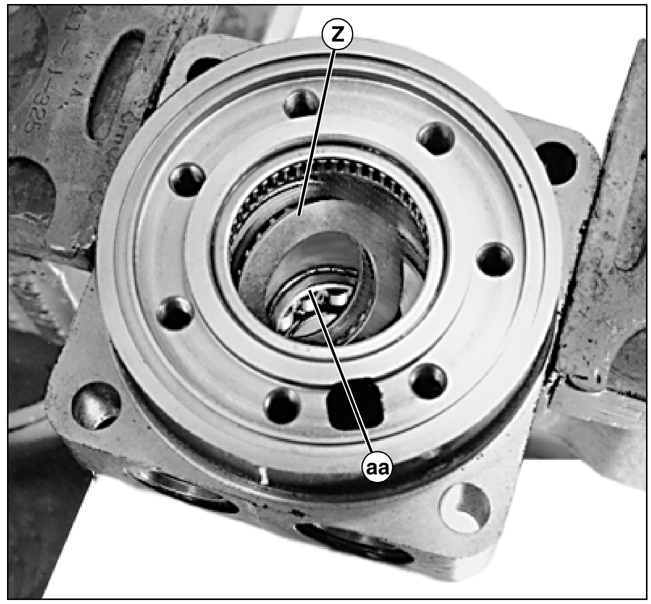
M84285

33.Inspect coupling shaft splines (X) for wear or damage.



M84286

34.Inspect inner bearing (Y) for free rotation and excessive play in bearing cage. Also inspect bearing for brinelling or corrosion.

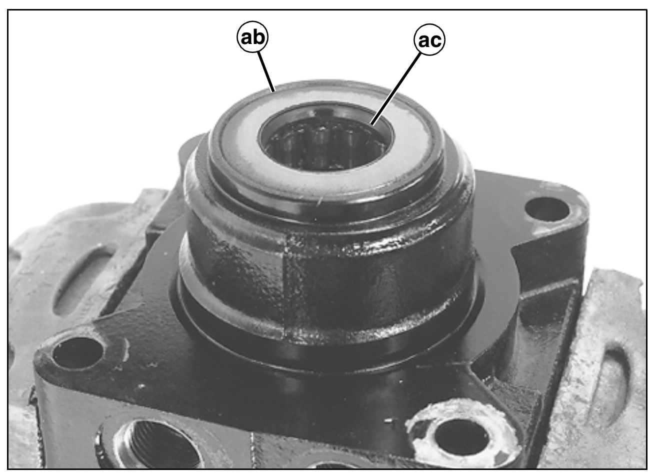


M84339

35.Inspect thrust bearing.

NOTE: A dental pick or similar device can be used to remove the seal.

36.Push thrust bearing and washers (Z) aside and remove seal and backup washers (AA).



M84289

37.Remove wheel motor from vise. Invert it and reinstall it in vise.

38.Remove seal (AB) using a blind-hole bearing or seal puller.

39.Inspect the housing for cracks, excessive wear or damage. Inspect machined surfaces for nicks, burrs, brinelling or corrosion. Inspect tapped holes for thread damage.

40.Inspect bearings (AC) for free rotation and excessive play in bearing cages. Also inspect bearings for brinelling or corrosion.

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

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on wheel motor. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydrostatic/ hydraulic system and cause damage.

41.Clean all metal parts with solvent and blow dry with compressed air.

42.Inspect all parts for damage, nicks or unusual wear. Replace entire wheel motor assembly if any parts other than seal rings, seals or outer bearing are worn or damaged.

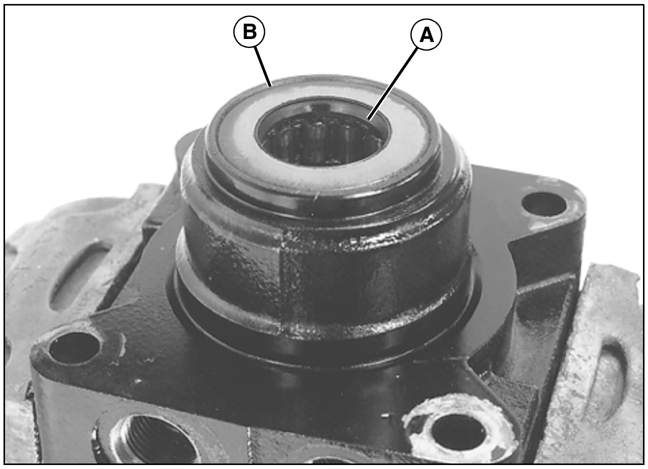
Assemble Wheel Motors

IMPORTANT: Avoid damage! Always use new O-rings. Damaged or used parts will leak.

NOTE: Alignment studs screwed finger tight into the bolt holes 180° apart can be used to assist alignment during assembly. Alignment studs can be made by cutting the heads off 3/8-24 UNF 2A x 5-in. cap screws.

Lubricate all seals and seal rings with Mobilith SHC® 460 grease (supplied with seal kit) during assembly.

IMPORTANT: Avoid damage! The outer bearing is not lubricated by the system's hydraulic oil. Thoroughly pack the bearing with grease before installation.

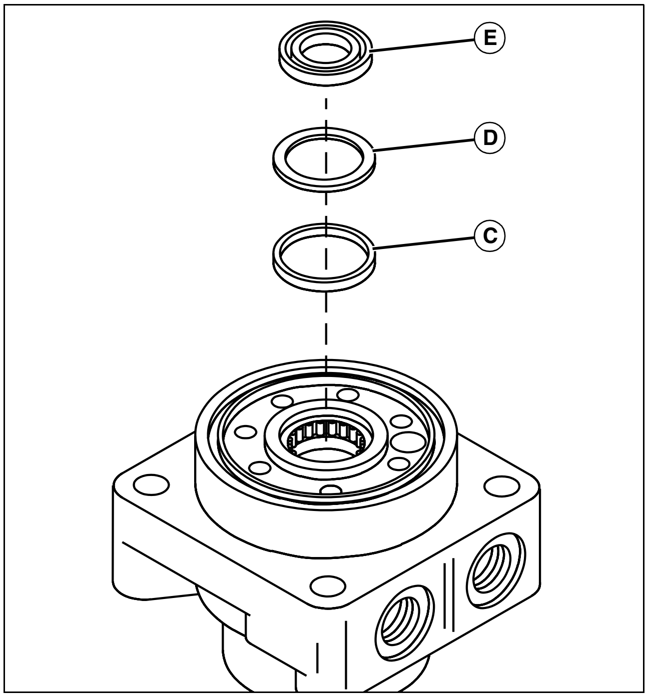


M84289

1. Pack and coat the new outer bearing/bushing (A) with anti-corrosion grease.

2. Install a new outer bearing seal (B) with the lip facing out. Press seal into housing until the seal is flush with the end of the housing.

3. Remove wheel motor from vise. Invert it and reinstall it in vise.

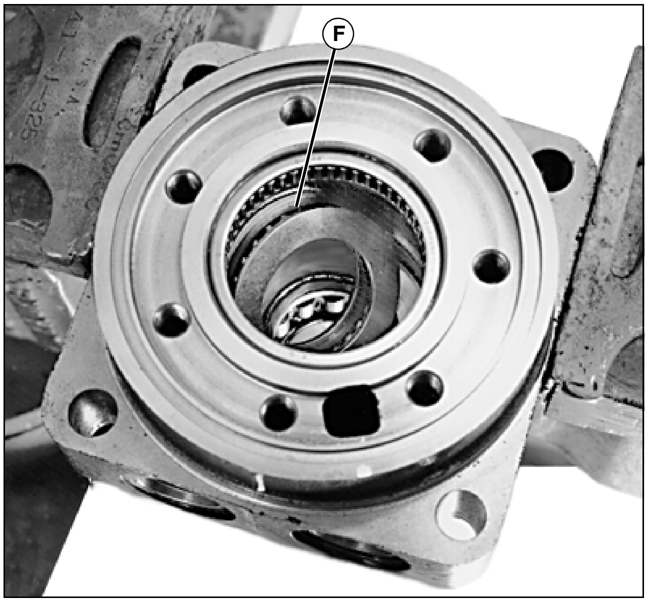


M84288

4. Install backup ring (C) and washer (D).

IMPORTANT: Avoid damage! Make sure the seal is completely seated in bore. Improper seating may result in seal damage when installing coupling shaft, resulting in leakage.

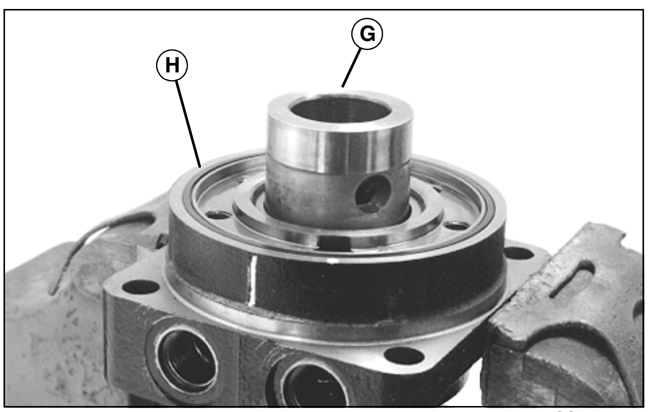
5. Install a new seal (E) with the lip facing toward the inside of the motor.



M84339

6. Seat thrust bearing and thrust washers (F) (one above and one below the thrust bearing).

IMPORTANT: Avoid damage! Apply anti-corrosion grease to the outer bearing/bushing and tape to the threads and keyway of the coupling shaft to prevent damage to the seal during installation.



M84283

7. Apply tape to the threads and keyway of the coupling shaft (G) to prevent damage to the seal during installation.

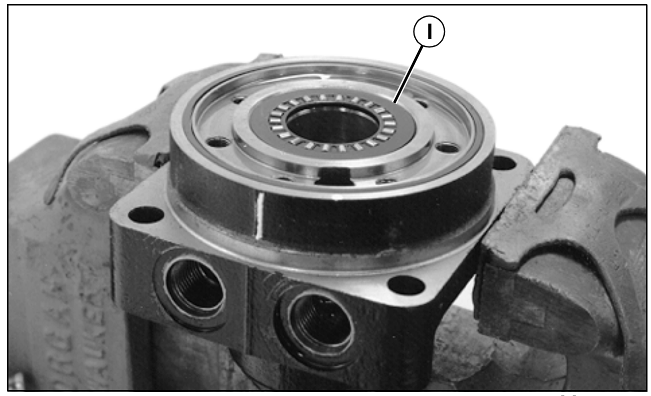
8. Apply grease to the seal.

NOTE: When properly installed, the coupling shaft will be approximately 2.54 mm (0.10 in.) below the housing wear surface plate. The coupling shaft must rotate freely on the thrust bearing assembly.

9. Install the coupling shaft into the housing until it rests against the thrust washer.

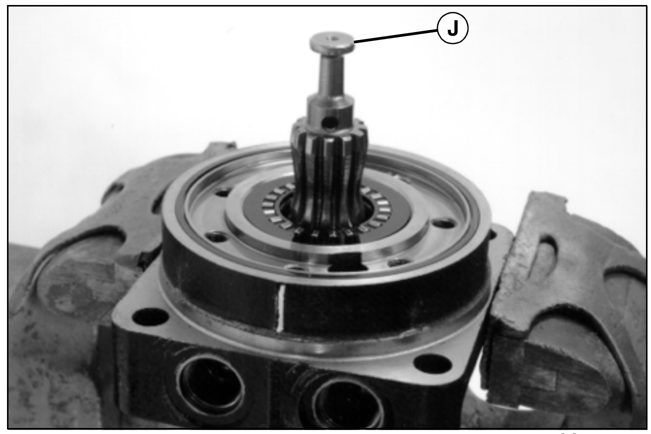
10. Apply a light coat of grease to the seal ring (H).

11. Install seal ring in the groove in the housing.



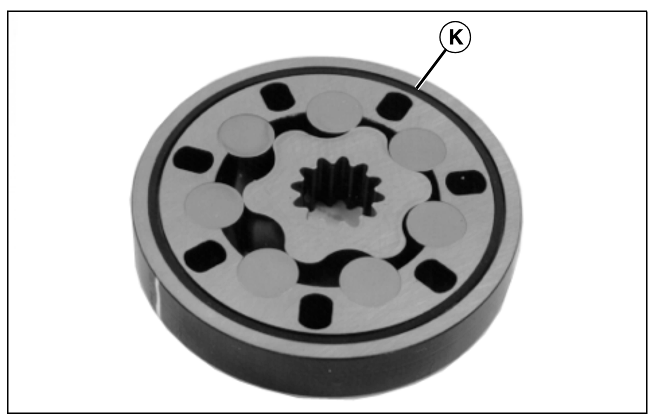
M84282

12. Install thrust bearing (I) on the coupling shaft.



M84280

13. Install drive link (J) with the splined end toward the coupling shaft. Align marked splines on drive link and coupling shaft.



M84277

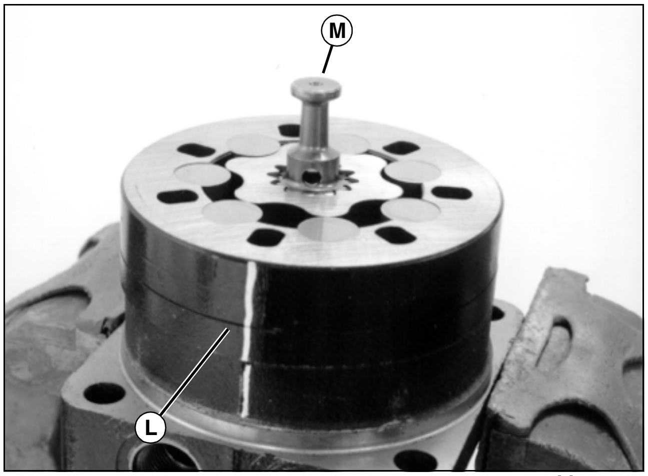
Picture Note: Bottom of Rotor Set Shown

14. Apply a light coat of grease to seal ring (K).

15. Install seal ring in the groove in the rotor set assembly.

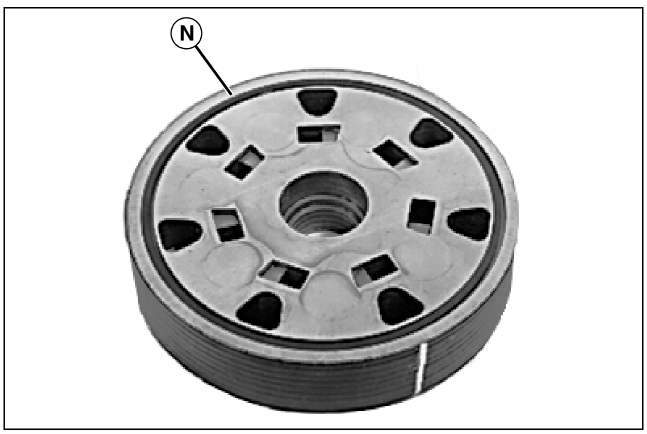
16. Install wear plate on rotor set.

17. Carefully flip rotor set/wear plate assembly over, while holding rotor set components in place.



M84276

18.Install rotor set/wear plate assembly (L) over the drive link (M).



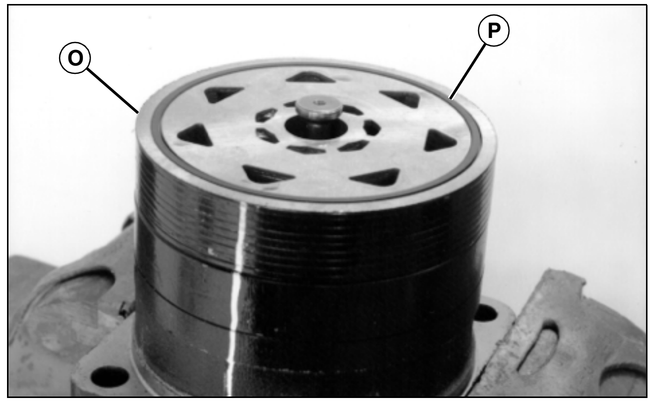
M84340

Picture Note: Bottom of Manifold Shown

19.Apply a light coat of grease to seal ring (N).

20.Install seal ring in the groove in the bottom of manifold.

NOTE: Correct installation of the manifold is important for proper operation. The manifold should be installed with the surface with the irregular shaped cavities on the largest circumference toward the rotor set.

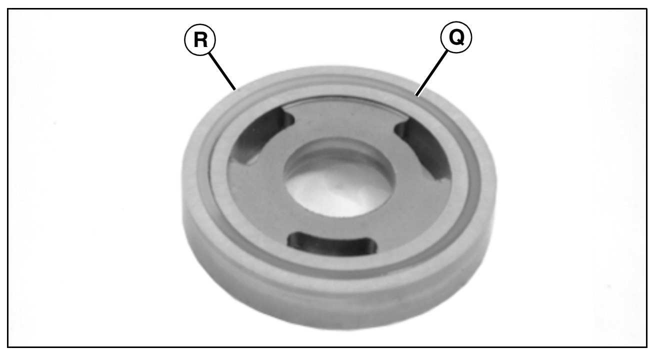


M84275

21.Install manifold (O).

22.Apply a light coat of grease to the seal ring (P).

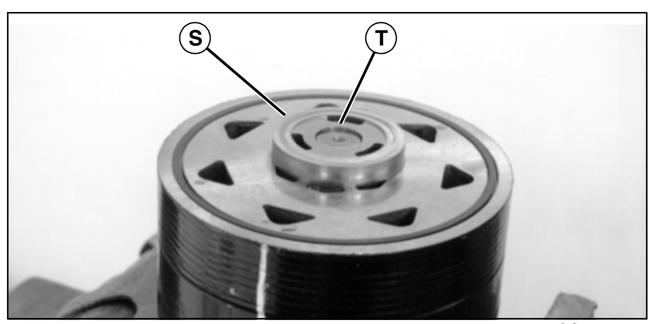
23.Install seal ring in the groove in the manifold.



M84274

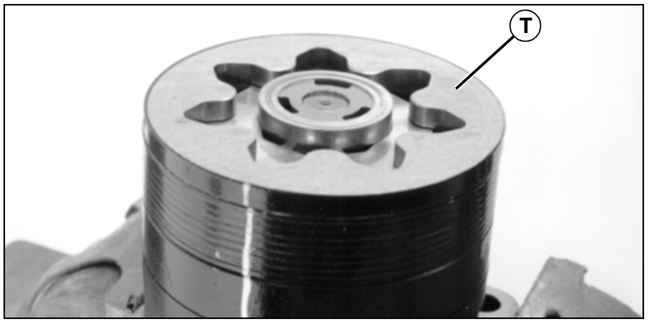
24.Apply a light coat of grease to the seal ring (Q).

25.Install seal ring in the groove in the commutator (R).



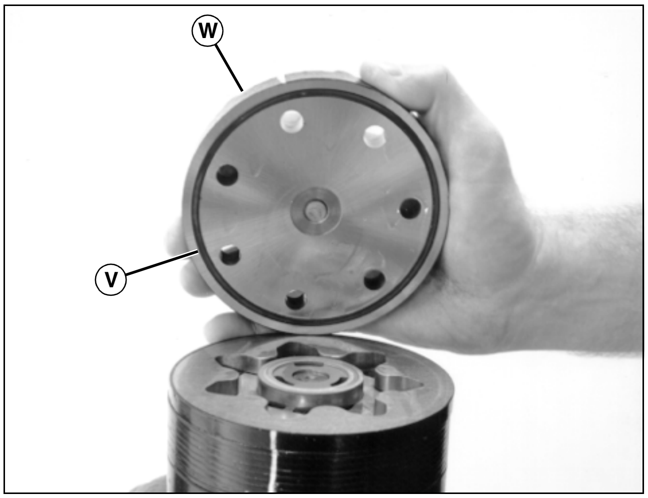
M84273

26.Install commutator (S) on drive link (T).



M84272

27.Install commutator ring (U).

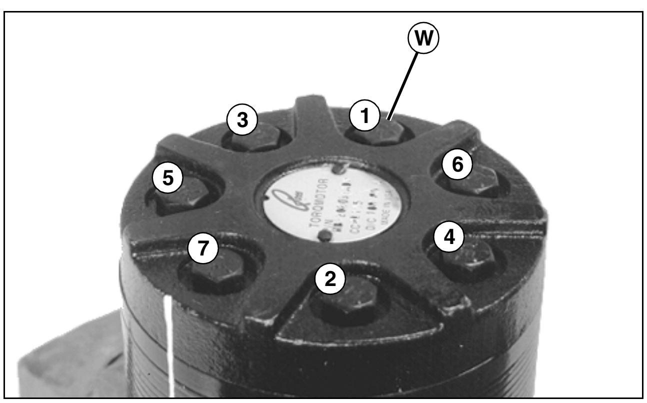


M84270

28.Apply a light coat of grease to seal ring (V).

29.Install seal ring in the groove in the end cover (W).

30.Install end cover.



M84268

31.Install retaining cap screws (W).

32.Tighten cap screws evenly, in the sequence shown, to specification.

Specifications

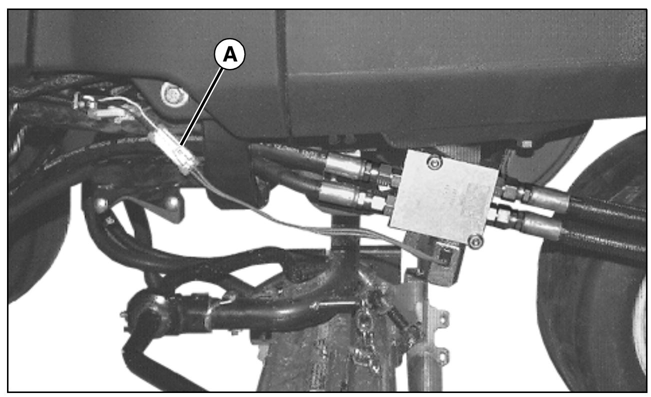
Retaining Cap Screw Torque . . . . 68 N•m (50 lb-ft)

Remove and Install Third Wheel Assist Valve

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

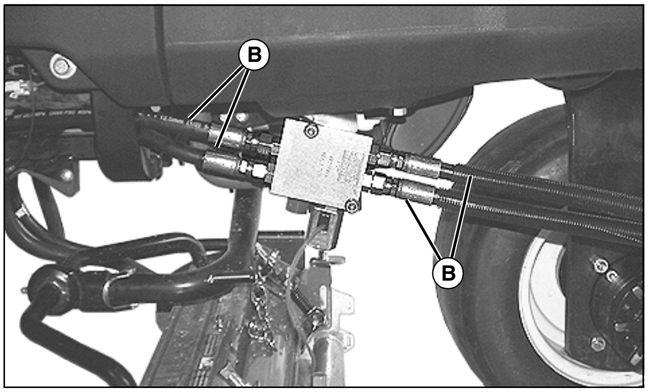


M98638

1. Disconnect wiring connector (A).

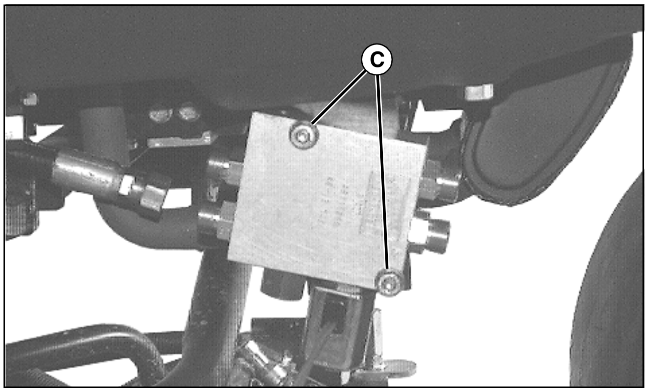
NOTE: Cap the hoses to prevent draining the oil reservoir.

NOTE: Note position of hoses to insure correct installation.



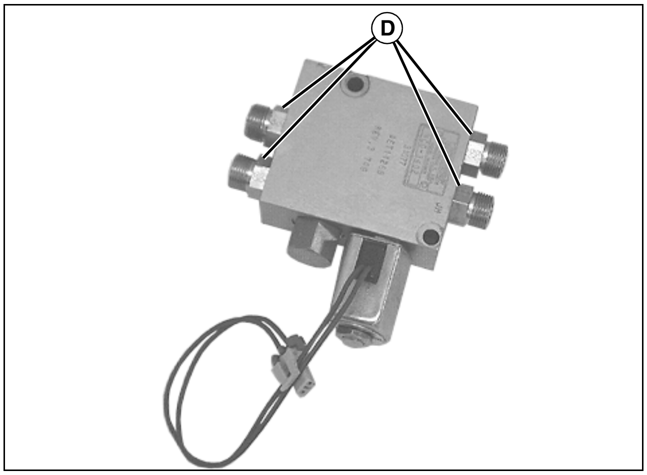
M98639

2. Disconnect hydraulic hoses (B).



M98640

3. Remove cap screws and nuts (C).
4. Remove valve assembly.



M98641

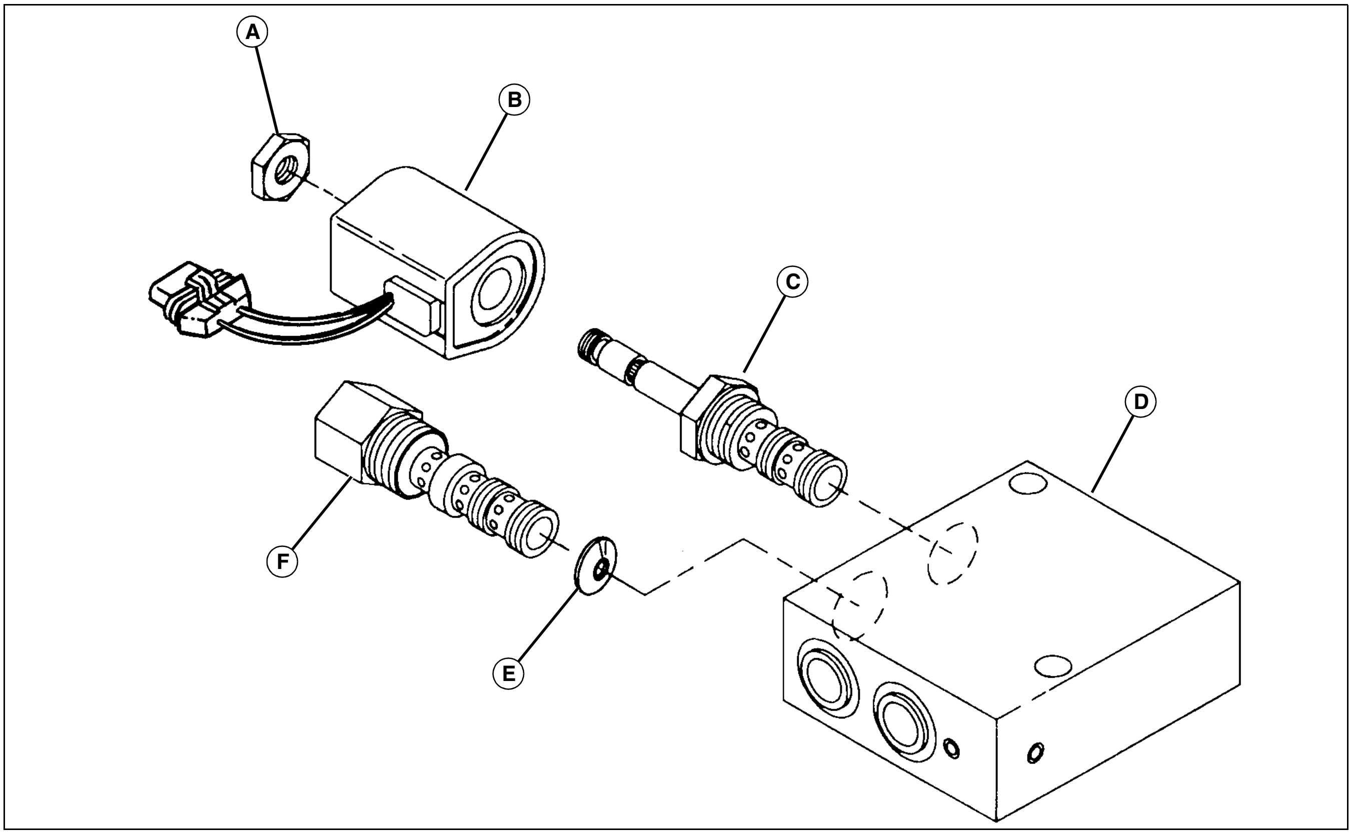
5. If the valve is to be repaired, remove fittings (D).

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir to correct level with oil of proper specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Repair Third Wheel Assist Drive Valve



M98642

A - Nut
B - Coil
C - Solenoid Valve
D - Valve Body
E - Orifice
F - Spool Valve

- Inspect all parts for wear or damage. Replace parts as needed.

IMPORTANT: Avoid damage! Always use new O-rings. Damaged or used O-rings will leak.

NOTE: Lubricate all O-rings with petroleum jelly before installing valves.

- Apply clean hydrostatic/hydraulic oil to all internal parts before assembly.
- Tighten solenoid coil retaining nut to specification.

Specifications

Solenoid Coil Retaining Nut Torque   18 N•m (159 lb-in.)

Table of Contents

Specifications

Test and Adjustment Specifications

Hydraulic Oil Operating Temperature . . . . . 43°C (110°F)
Slow Idle Speed - Gas . . . . . 1550 ± 100 rpm
Slow Idle Speed - Diesel . . . . . 1450 ±100 rpm
Lift Pump Flow @ 1723 kPa (250 psi) . . . . . 15.5 L/min (4.1 gpm)
Lift Pump Flow @ 6895 kPa (1000 psi) . . . . . 13.2 L/min (3.5 gpm)
Reel Drive Pump Output Pressure . . . . . 20 684 ± 1034 kPa (3000 ± 150 psi)
Reel Drive Pump Flow @ 1723 kPa (250 psi) . . . . . 15.5 L/min (4.1 gpm)
Reel Drive Pump Flow @ 6895 kPa (1000 psi) . . . . . 13.2 L/min (3.5 gpm)
Mow Valve Relief Valve Pressure . . . . . 20 684 ± 1034 kPa (3000 ± 150 psi)
Front Lift Arm Distance (Center of Ball Joint-to-Ground). . . . . 225 ± 5 mm (8.85 ± 0.20 in.)
Rear Lift Arm Distance (Center of Ball Joint-to-Ground) . . . . . 225 ± 5 mm (8.85 ± 0.20 in.)

Repair Specifications

Hydraulic and Charge Pump

3/8-inch Socket Head Bolt Torque. . . . . 42 N•m (31 Lb-ft)
5/16-inch Socket Head Bolt Torque. . . . . 23 N•m (17 Lb-ft)

Reel Motor Rear Cover Cap Screw Torque. . . . . 42 N•m (31 Lb-ft)
Mow Valve Torque. . . . . 31 N•m (23 Lb-ft)
Flow Control Valve Torque. . . . . 64 N•m (47 Lb-ft)
Logic Element Torque . . . . . 64 N•m (47 Lb-ft)
Ball Switch Torque . . . . . 17 N•m (150 Lb-in.)
Direction Valve Torque. . . . . 237 N•m (175 Lb-ft)
Solenoid Coil Retaining Nut Torque . . . . . 8 N•m (70 Lb-in.)
Input Hose (Port P) Connection Torque . . . . . 25 N•m (18 Lb-ft)

Tools and Materials

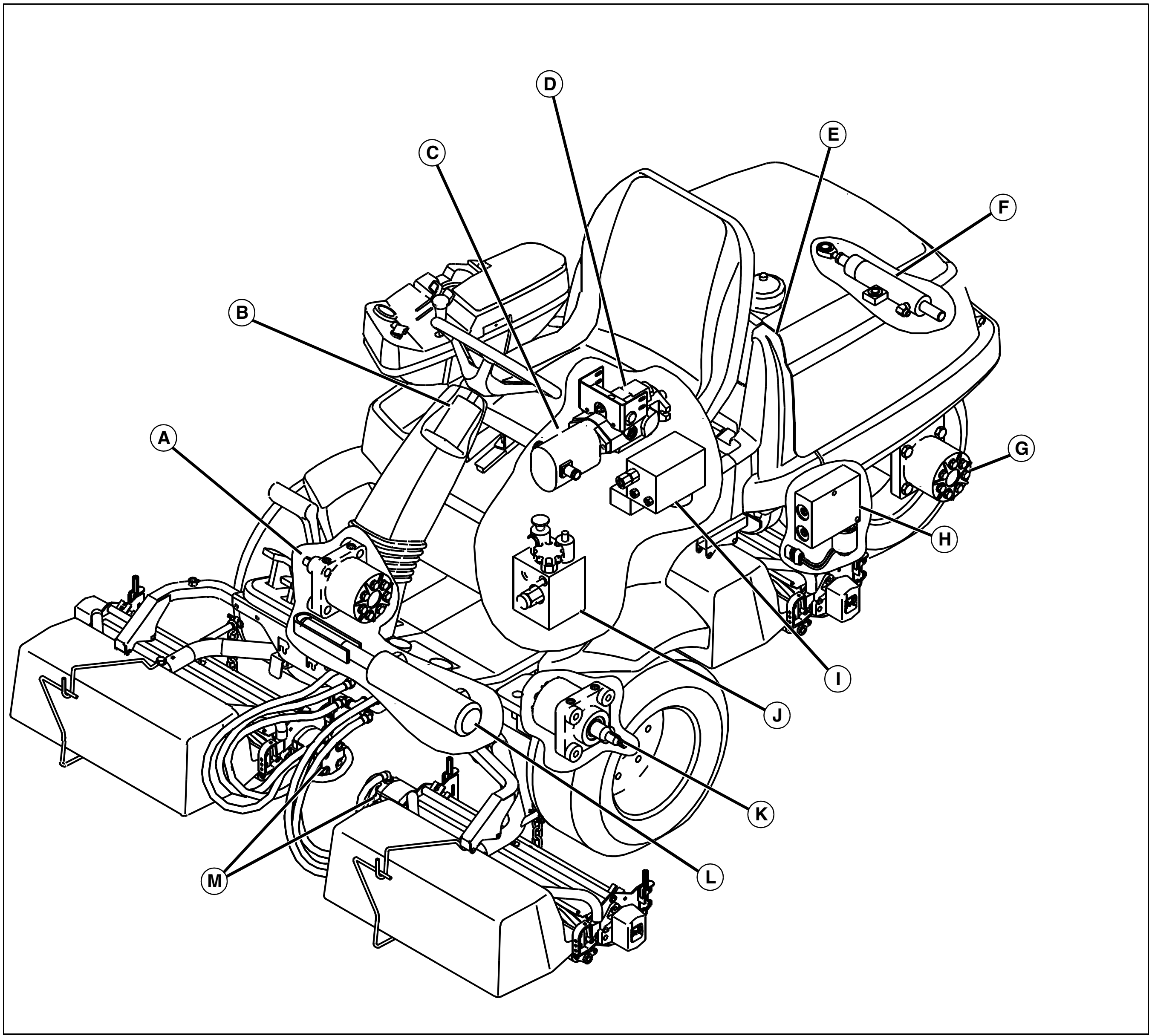
Tools

Special or Required Tools

Tool Name	Tool No.	Tool Use
Temperature Gage	JDG282	Used to measure hydraulic system oil temperature.
Flowmeter Kit	JT05469	Used to measure lift pump oil flow and reel drive pump oil flow.
Connector 13/16-16 M ORFS x 1/2 M NPT	JT03367	Used to install flowmeter.
Connector 13/16-16 F ORFS Sw x 3/4 F NPT 45°	JT03368	Used to install flowmeter.
Connector 1/2 F NPT x 3/4 F NPT	JT03369	Used to install flowmeter.
Hydraulic Diagnostic Kit	BM19949	Used to connect pressure gage to reel drive pump or mow and backlapping valve.
Pressure Gage 0-40 000 kPa (0-6000 psi)	JT07047	Used to measure drive pump output pressure or to measure mow valve relief pressure.

Component Location

Hydraulic System Component Location

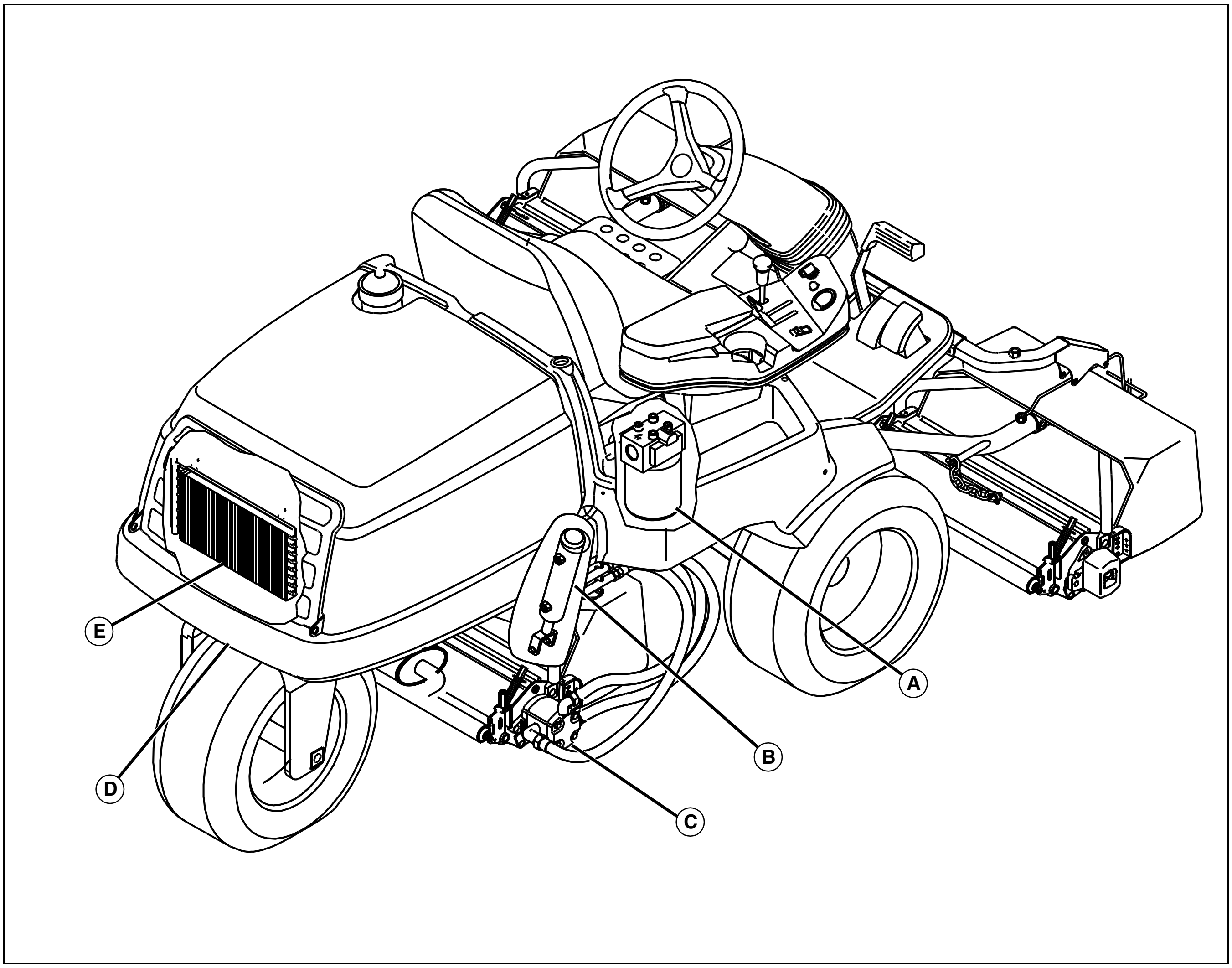


MIF M98624a

A - Right Wheel Motor
B - Steering Valve
C - Hydraulic and Charge Pump[6]
D - Hydrostatic Pump Assembly
E - Hydraulic Oil Expansion Tank
F - Steering Cylinder
G - Rear Wheel Motor (Optional)
H - Third Wheel Assist Valve (Optional)
I - Lift Valve
J - Mow and Backlap Valve (2500/2500A Only)
K - Left Wheel Motor
L - Front Lift Cylinder
M - Reel Drive Motors (2500/2500A Only)

---

6. 2500 and 2500A incorporate a triple (three layer) pump. 2500E incorporates a similar pump but only has two layers, eliminating the reel drive section.

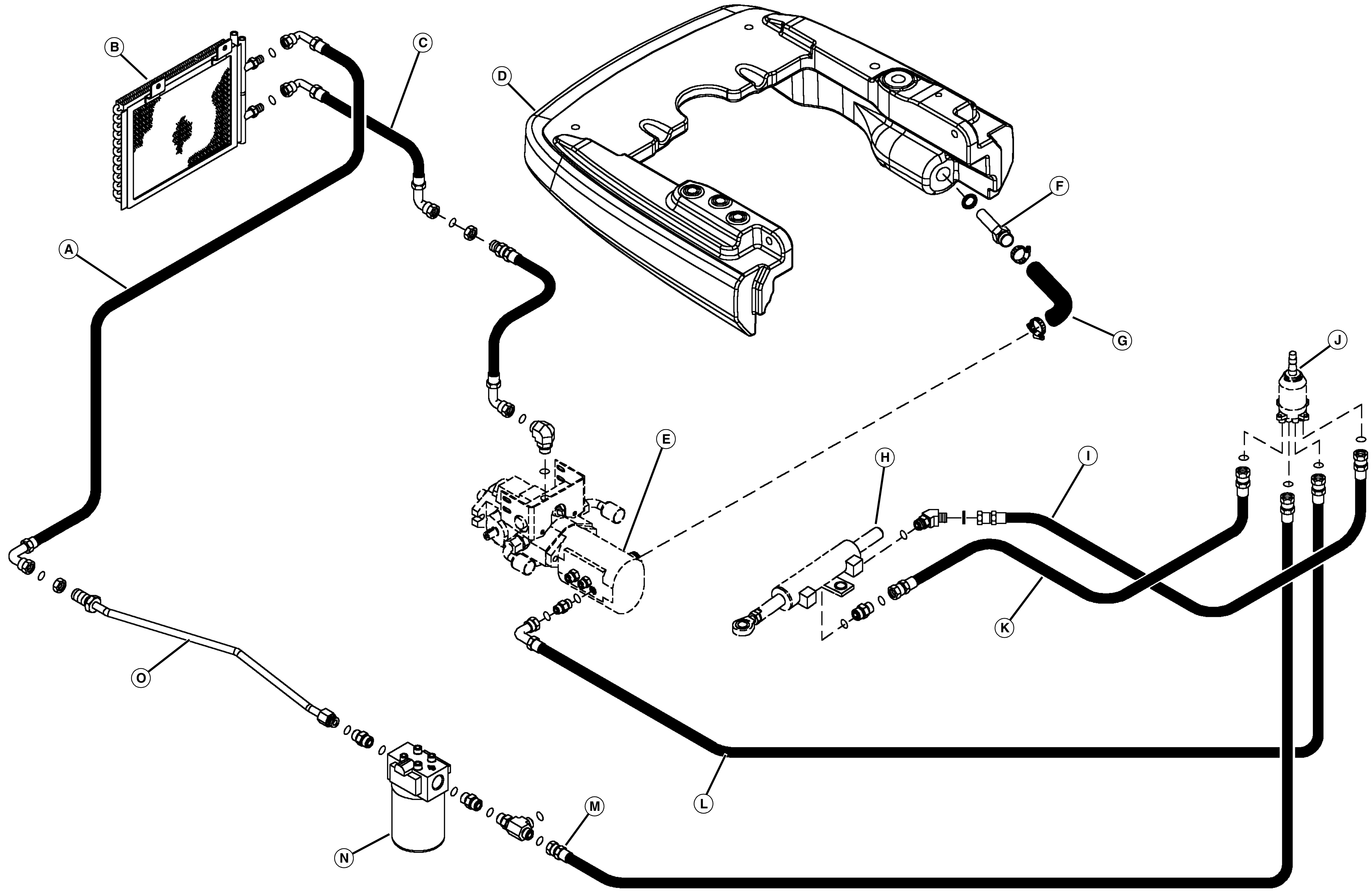


MIF M98624b

A - Hydraulic Oil Filter
B - Rear Lift Cylinder
C - Reel Drive Motor (2500/2500A Only)
D - Hydraulic Oil Reservoir
E - Hydraulic Oil Cooler (2500/2500A Only)

Component Location

Hydraulic System Hose Routing - Steering System

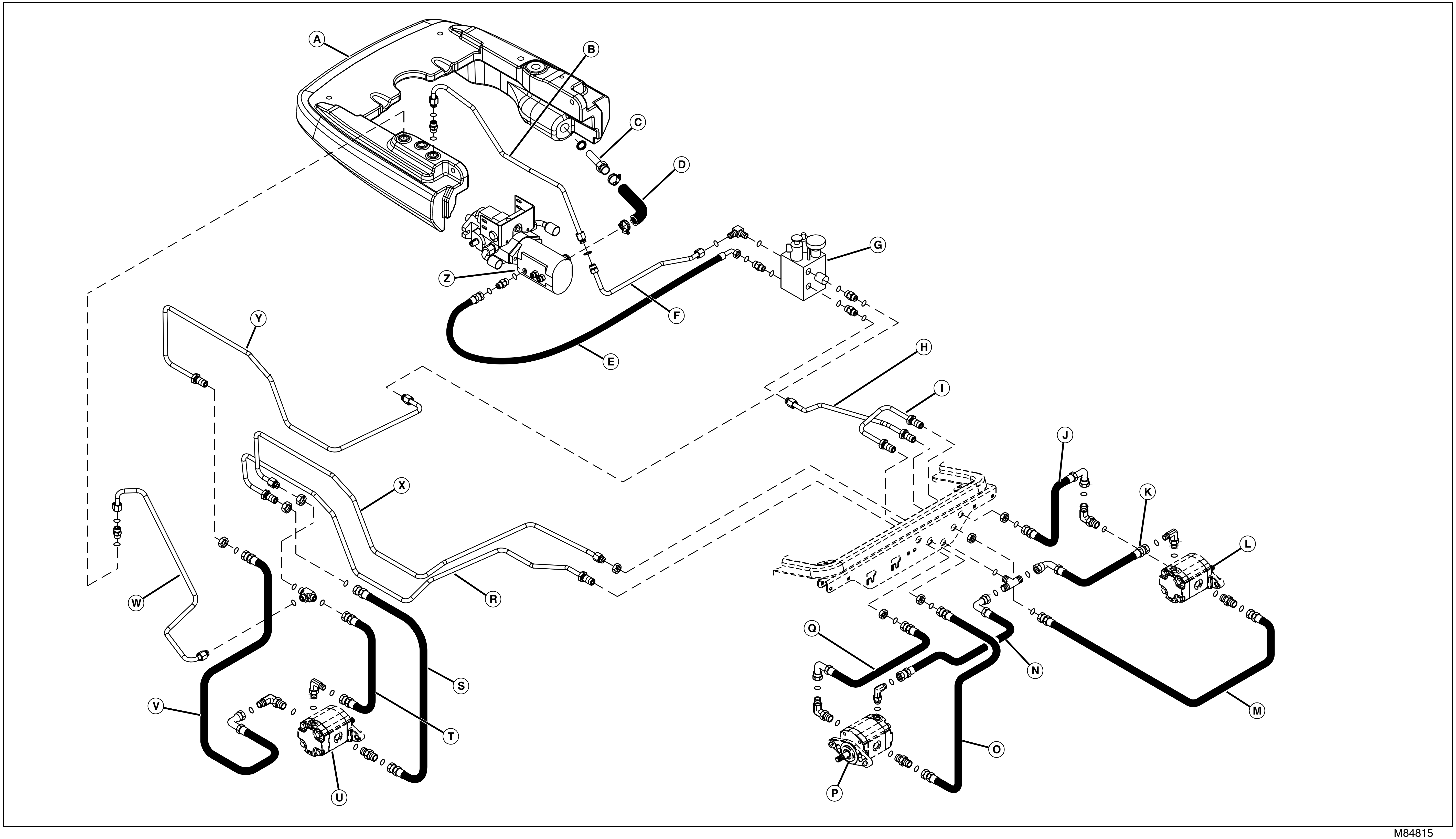


M98517 (MIF)

A - Return Hose
B - Oil Cooler
C - Hydrostatic Pump Inlet Hose
D - Hydraulic Oil Reservoir
E - Hydraulic/Steering/Charge Pump
F - Strainer
G - Supply Hose
H - Steering Cylinder
I - Pressure Hose
J - Steering Valve
K - Pressure Hose
L - Pressure Hose
M - Return Hose
N - Hydraulic Oil Filter
O - Return Line

Component Location

Hydraulic System Hose Routing - Reel Drive System - Models 2500, 2500A

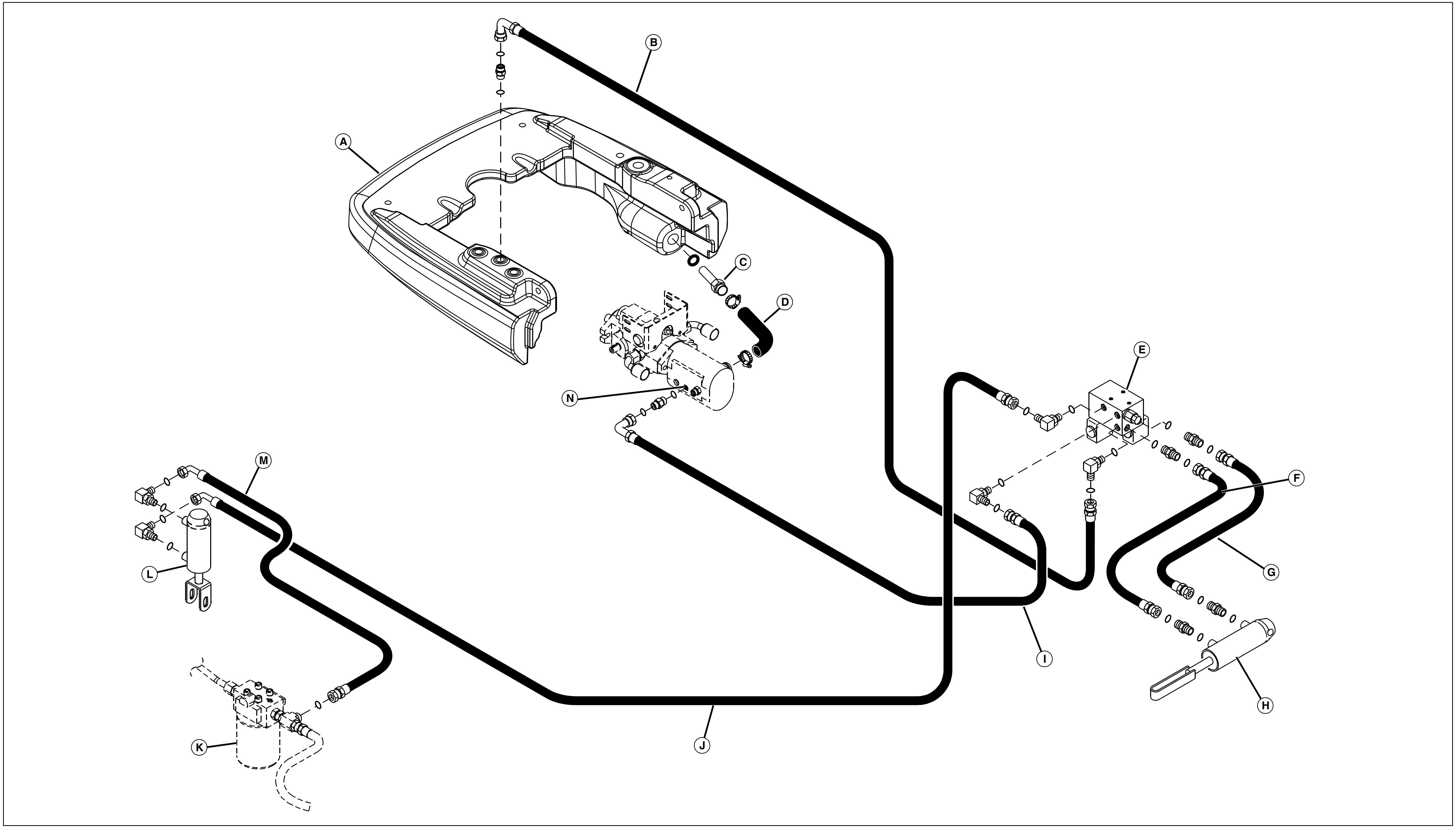


HYDRAULICS COMPONENT LOCATION

A - Hydraulic Oil Reservoir
B - Return Line
C - Strainer
D - Pump Supply Hose
E - Pressure Hose
F - Return Line
G - Mow/Backlap Valve
H - Pressure Line
I - Pressure Line
J - Return Hose
K - Case Drain Hose
L - Left Reel Motor
M - Pressure Hose
N - Case Drain Hose
O - Pressure Hose
P - Right Reel Motor
Q - Return Hose
R - Pressure Line
S - Pressure Hose
T - Case Drain Hose
U - Rear Reel Motor
V - Pressure Hose
W - Return Line
X - Return Line
Y - Pressure Line
Z - Hydraulic/Steering/Charge Pump

Component Location

Hydraulic System Hose Routing - Cutting Unit Lift System



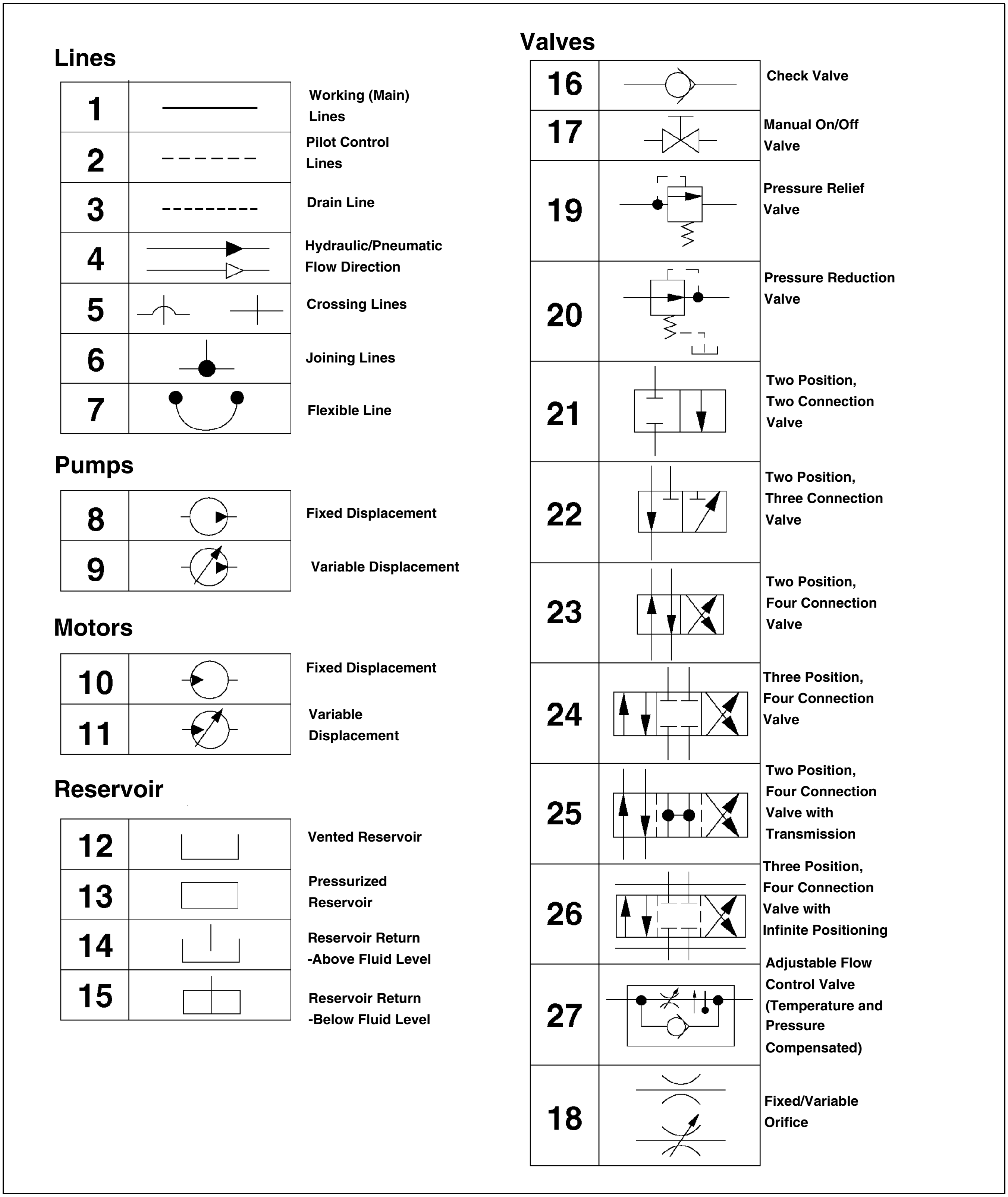
M98516 (MIF)

HYDRAULICS COMPONENT LOCATION

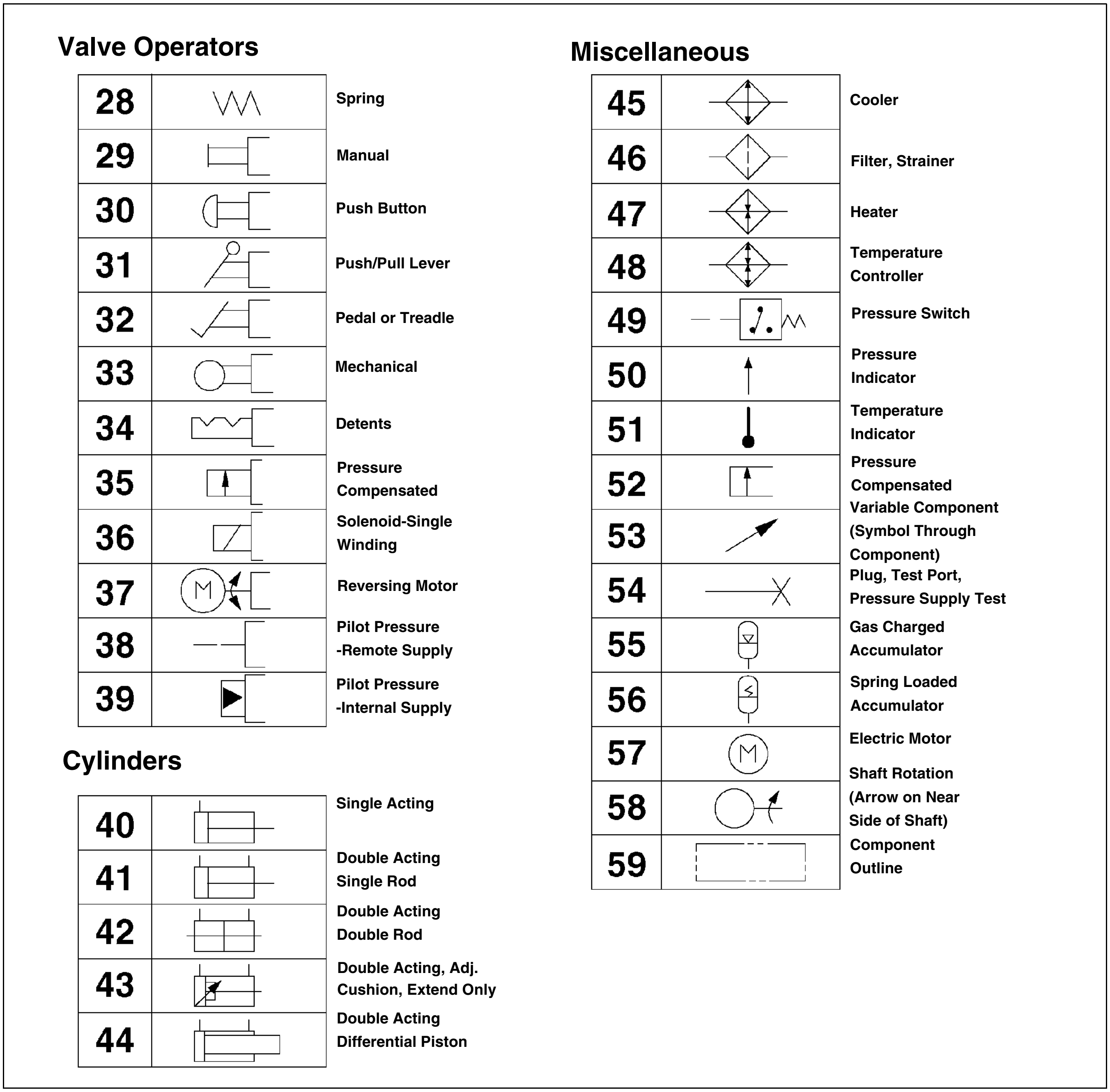
A - Hydraulic Oil Reservoir
B - Return Line
C - Strainer
D - Pump Supply Hose
E - Lift Valve
F - Pressure Hose
G - Return hose
H - Front Lift Cylinder
I - Pressure Hose
J - Pressure Hose
K - Hydraulic Oil Filter
L - Rear Lift Cylinder
M - Return Hose
N - Hydraulic/Steering/Charge Punp

Schematics and Harnesses

JIC Hydraulic Circuit Symbols

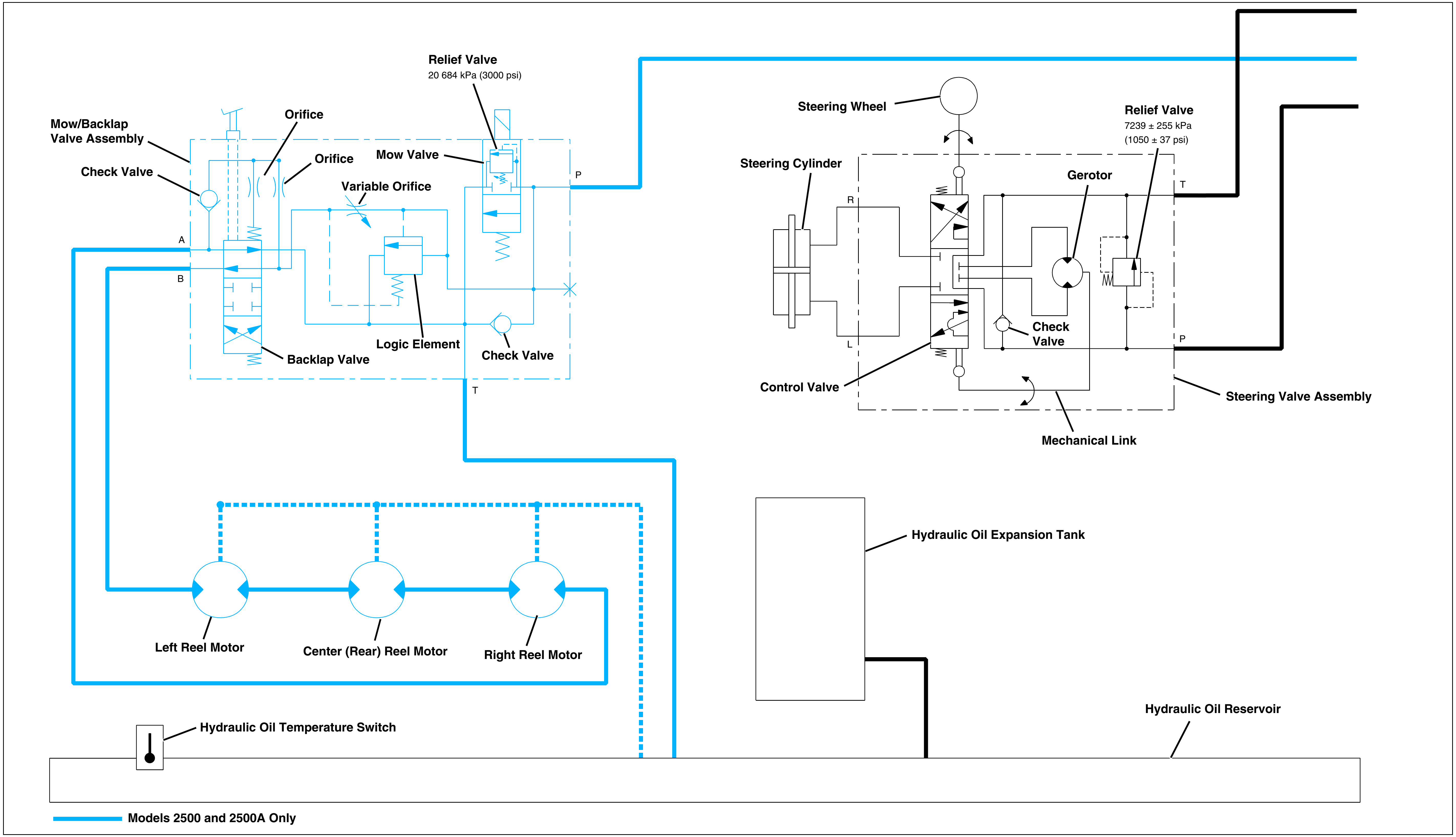


MX30024

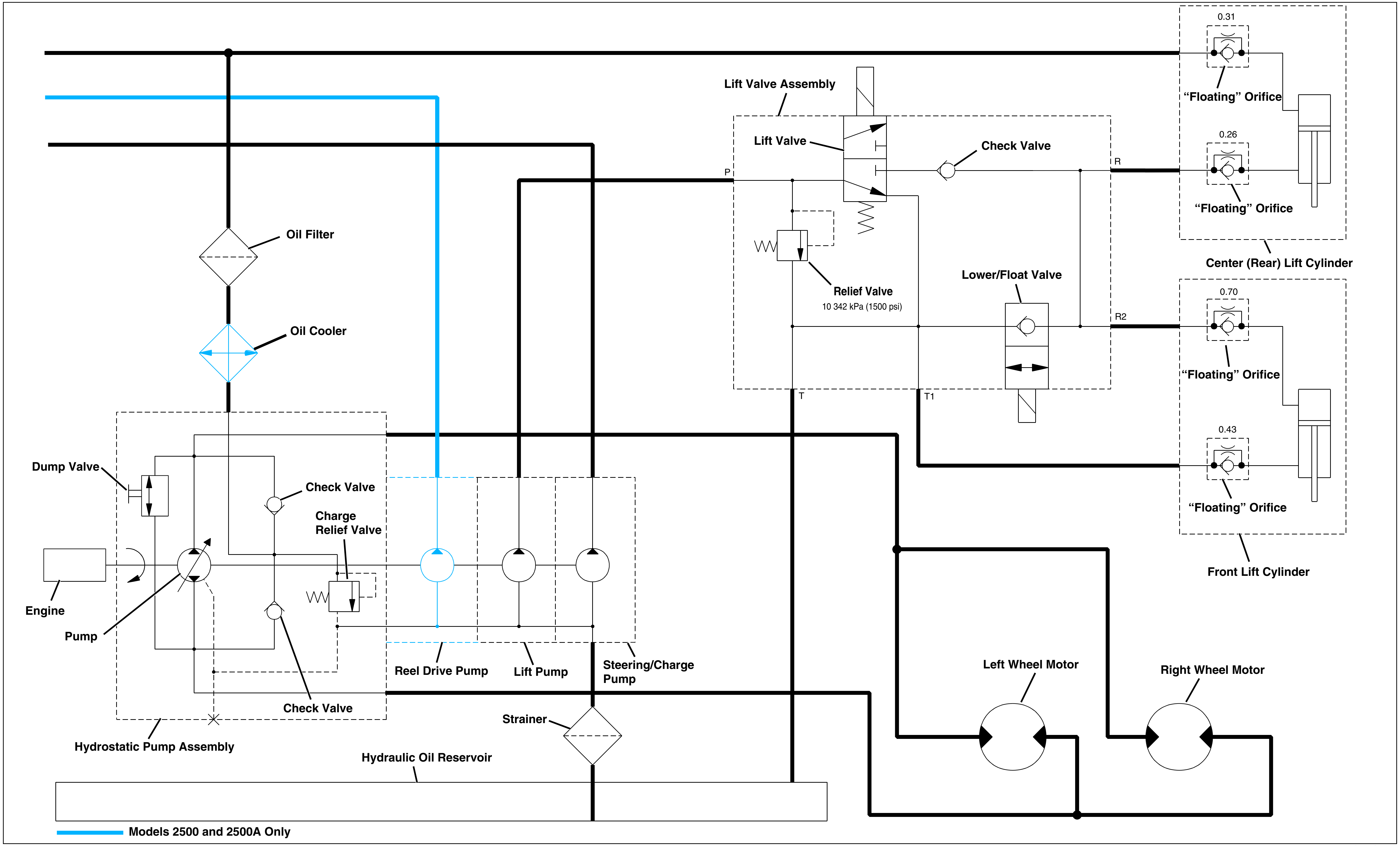

Valve Operators
28 Spring
29 Manual
30 Push Button
31 Push/Pull Lever
32 Pedal or Treadle
33 Mechanical
34 Detents
35 Pressure Compensated
36 Solenoid-Single Winding
37 Reversing Motor
38 Pilot Pressure -Remote Supply
39 Pilot Pressure -Internal Supply
Cylinders
40 Single Acting
41 Double Acting Single Rod
42 Double Acting Double Rod
43 Double Acting, Adj. Cushion, Extend Only
44 Double Acting Differential Piston
Miscellaneous
45 Cooler
46 Filter, Strainer
47 Heater
48 Temperature Controller
49 Pressure Switch
50 Pressure Indicator
51 Temperature Indicator
52 Pressure Compensated
53 Variable Component (Symbol Through Component)
54 Plug, Test Port, Pressure Supply Test
55 Gas Charged Accumulator
56 Spring Loaded Accumulator
57 Electric Motor
58 Shaft Rotation (Arrow on Near Side of Shaft)
59 Component Outline

MX30025

Hydraulic System Schematic



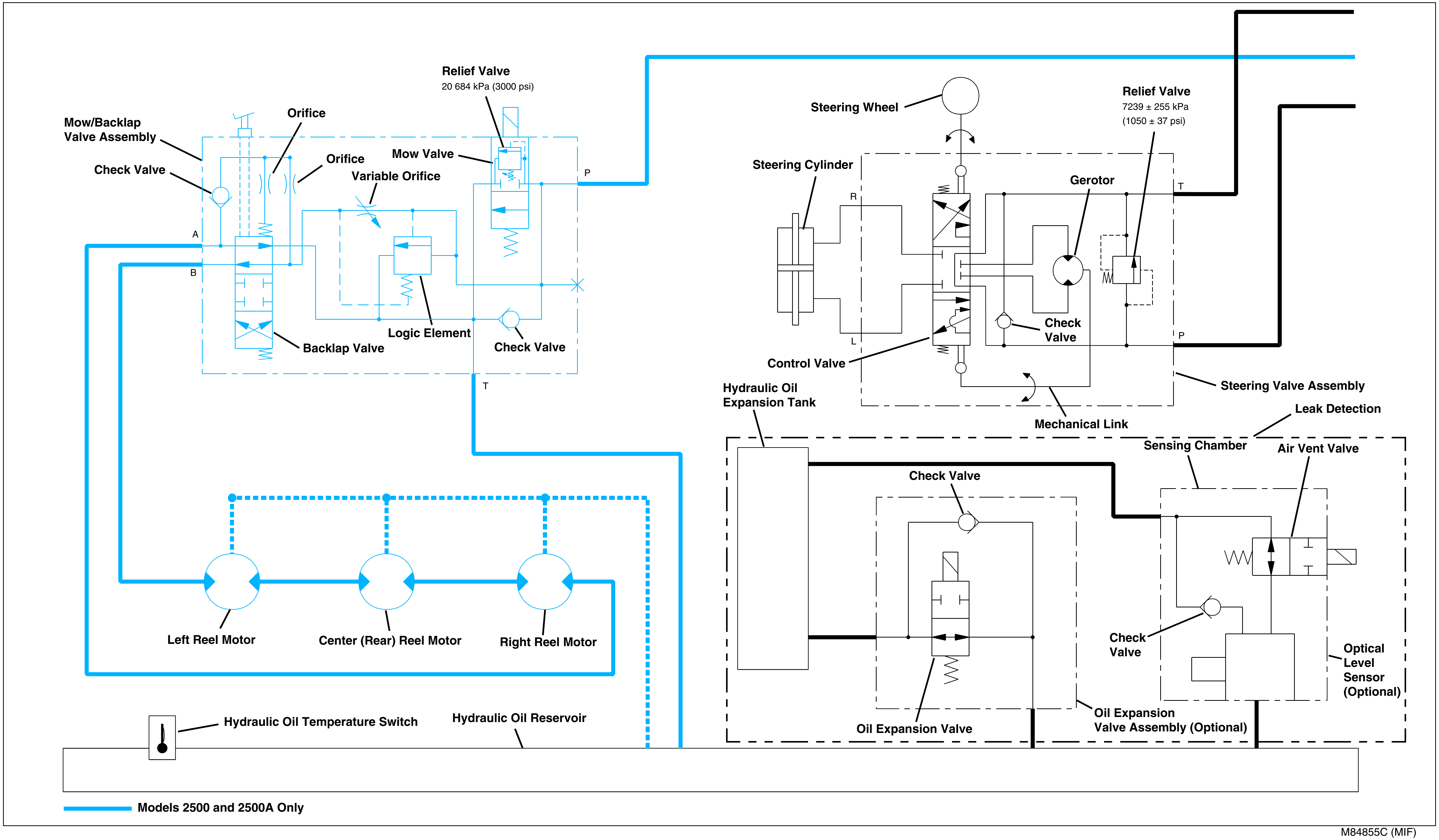
M84855A (MIF)

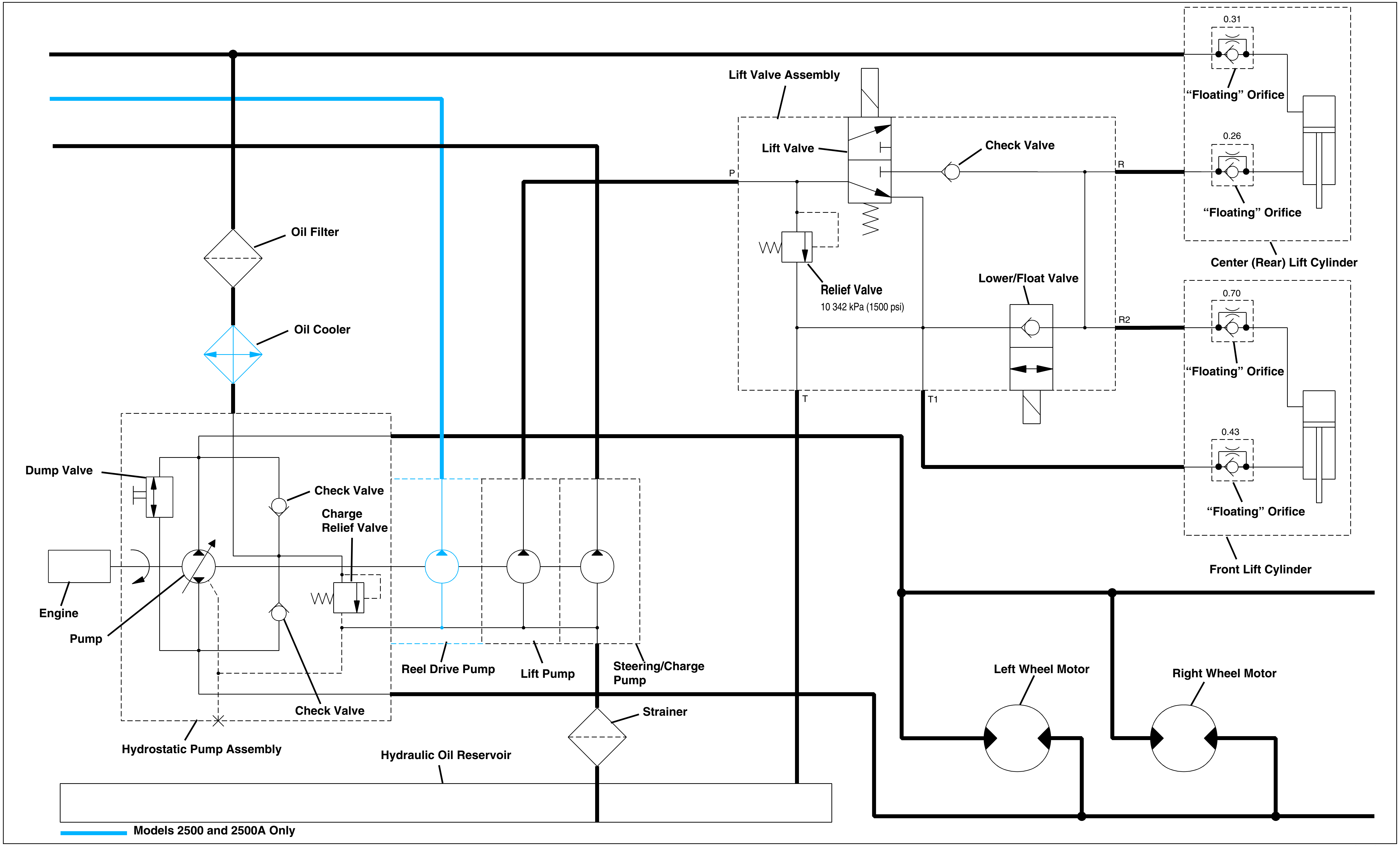

0.31
"Floating" Orifice
Lift Valve Assembly
Lift Valve
Check Valve
R
P
0.26
"Floating" Orifice
Oil Filter
Center (Rear) Lift Cylinder
Relief Valve
10 342 kPa (1500 psi)
Lower/Float Valve
0.70
Oil Cooler
R2
"Floating" Orifice
T
T1
0.43
Dump Valve
Check Valve
Charge
Relief Valve
"Floating" Orifice
Front Lift Cylinder
Engine
Pump
Reel Drive Pump
Lift Pump
Steering/Charge
Pump
Left Wheel Motor
Right Wheel Motor
Check Valve
Strainer
Hydrostatic Pump Assembly
Hydraulic Oil Reservoir
Models 2500 and 2500A Only

M84855B (MIF)

Schematics

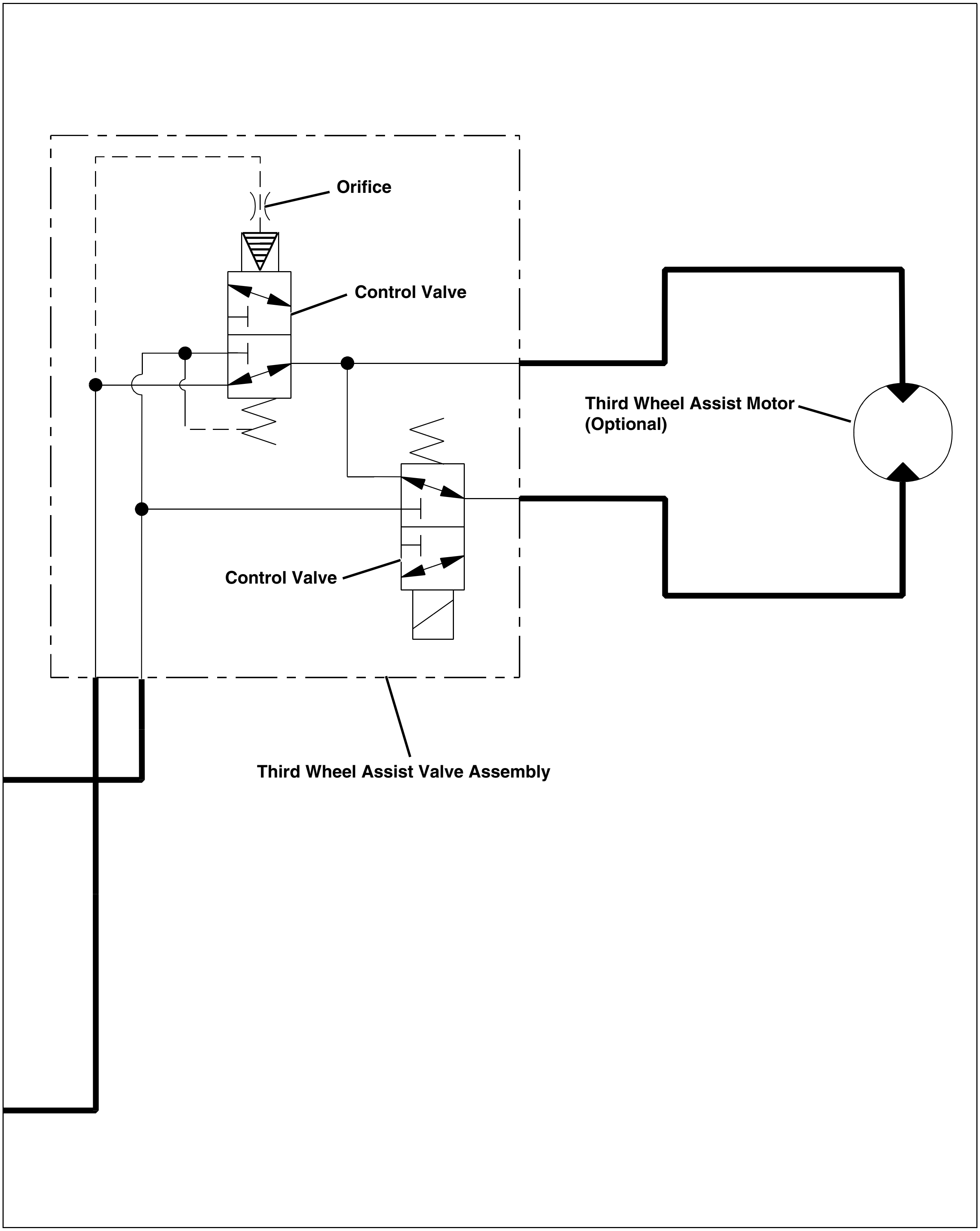
Hydraulic System Schematic - Models with Optional Equipment





0.31
"Floating" Orifice
Lift Valve Assembly
Lift Valve
Check Valve
P
R
0.26
"Floating" Orifice
Center (Rear) Lift Cylinder
Oil Filter
Relief Valve
10 342 kPa (1500 psi)
Lower/Float Valve
R2
0.70
"Floating" Orifice
Oil Cooler
T
T1
0.43
"Floating" Orifice
Dump Valve
Check Valve
Charge
Relief Valve
Front Lift Cylinder
Engine
Pump
Reel Drive Pump
Lift Pump
Steering/Charge
Pump
Left Wheel Motor
Right Wheel Motor
Check Valve
Strainer
Hydrostatic Pump Assembly
Hydraulic Oil Reservoir
Models 2500 and 2500A Only

M84855D (MIF)


Orifice
Control Valve
Third Wheel Assist Motor
(Optional)
Control Valve
Third Wheel Assist Valve Assembly

MIF M84855E

Operation and Diagnostics

Reel Drive System - Mow Operation - Models 2500, 2500A

NOTE: 2500E uses electric reel motors.

Function

To drive the cutting unit reel motors.

Theory of Operation

The reel drive system is an independent hydraulic circuit, consisting of the hydraulic reservoir, hydraulic pump assembly (reel drive pump section), mow and backlap valve assembly and three hydraulic reel motors.

The reel drive pump draws oil from the hydraulic reservoir. The oil is then routed to port “P” of the mow and backlap valve. If the mow valve is in the OFF position, oil freely flows through the mow valve, exiting the valve at port “T” returning to the hydraulic reservoir, bypassing the reel motors.

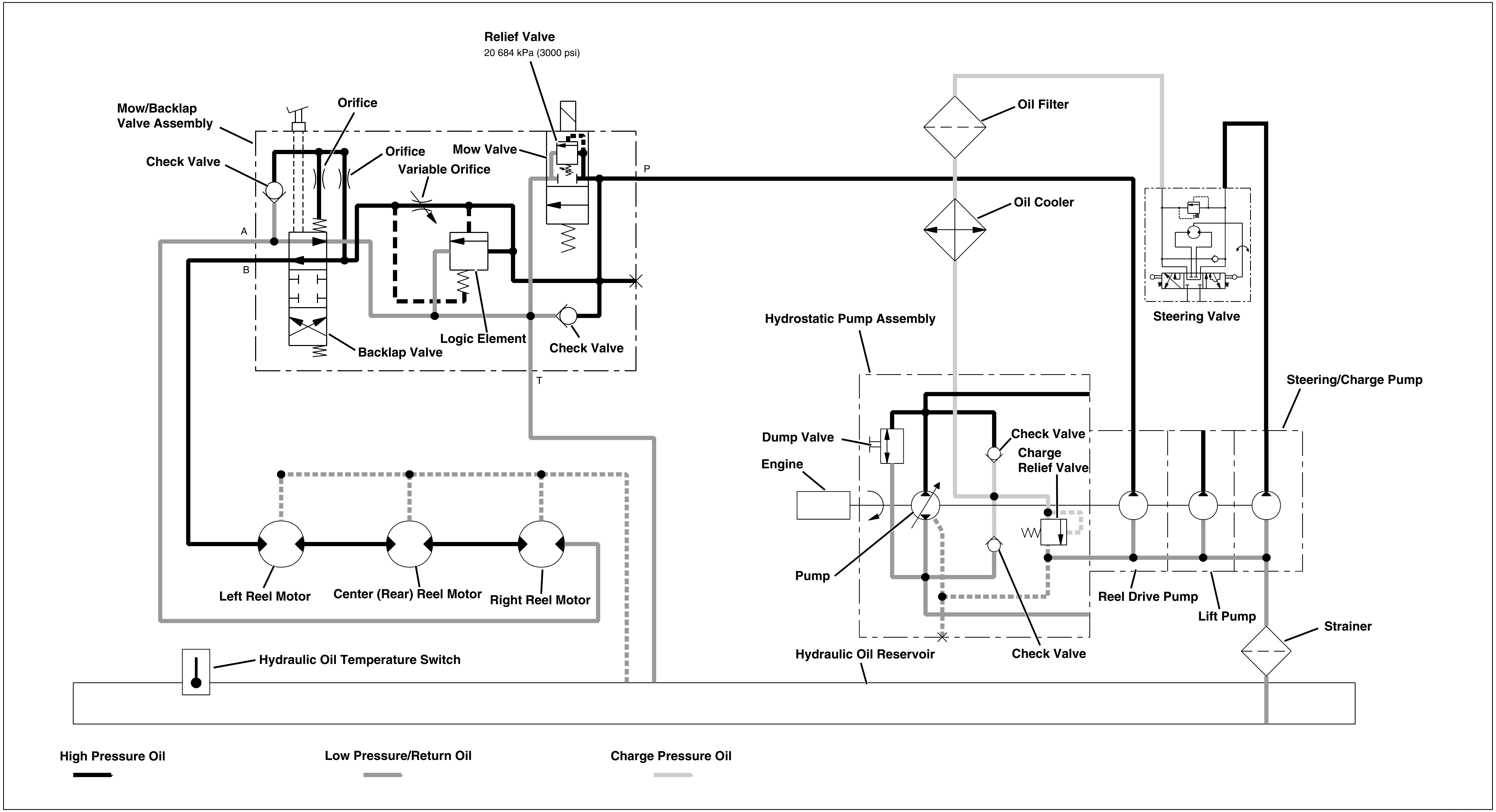
When the mow and transport lever is moved to the MOW position, the mow valve solenoid is engaged, moving the valve spool. In this position, the mow valve directs the flow of oil through the variable orifice and backlap valve and exits the valve at port “B”.

Oil is then routed to the reel motors in series, first to the left reel motor, then to the right reel motor and finally to the center (rear) motor. The oil is then routed back to the mow and backlap valve at port “A” and flows through the backlap valve and out of the valve at port “T” returning to the hydraulic reservoir.

The reel motor circuit is protected by a relief valve located in the mow valve. If the oil pressure reaches 20 684 kPa (3000 psi), the relief valve opens, allowing the oil to return directly to the hydraulic reservoir.

Reel motors are bidirectional. Some of the pressurized oil is allowed to leak past the moving gears in the motors for lubrication and cooling. This leak-off oil is routed back to the reservoir.

Reel Drive System - Mow Operation - Models 2500, 2500A



M98607 (MIF)

Reel Drive System - Backlap Operation - Models 2500, 2500A

Function

To drive the cutting reel motors in reverse to allow backlapping of the cutting reels and bed knives.

Theory of Operation

The backlapping procedure is performed to maintain sharp cutting reel edges between grinding. In order to perform this procedure, the cutting reels must be driven in reverse at low speed. To accomplish this, the backlap valve must be manually set to the BACKLAP position, reversing the flow of oil to the reel motors.

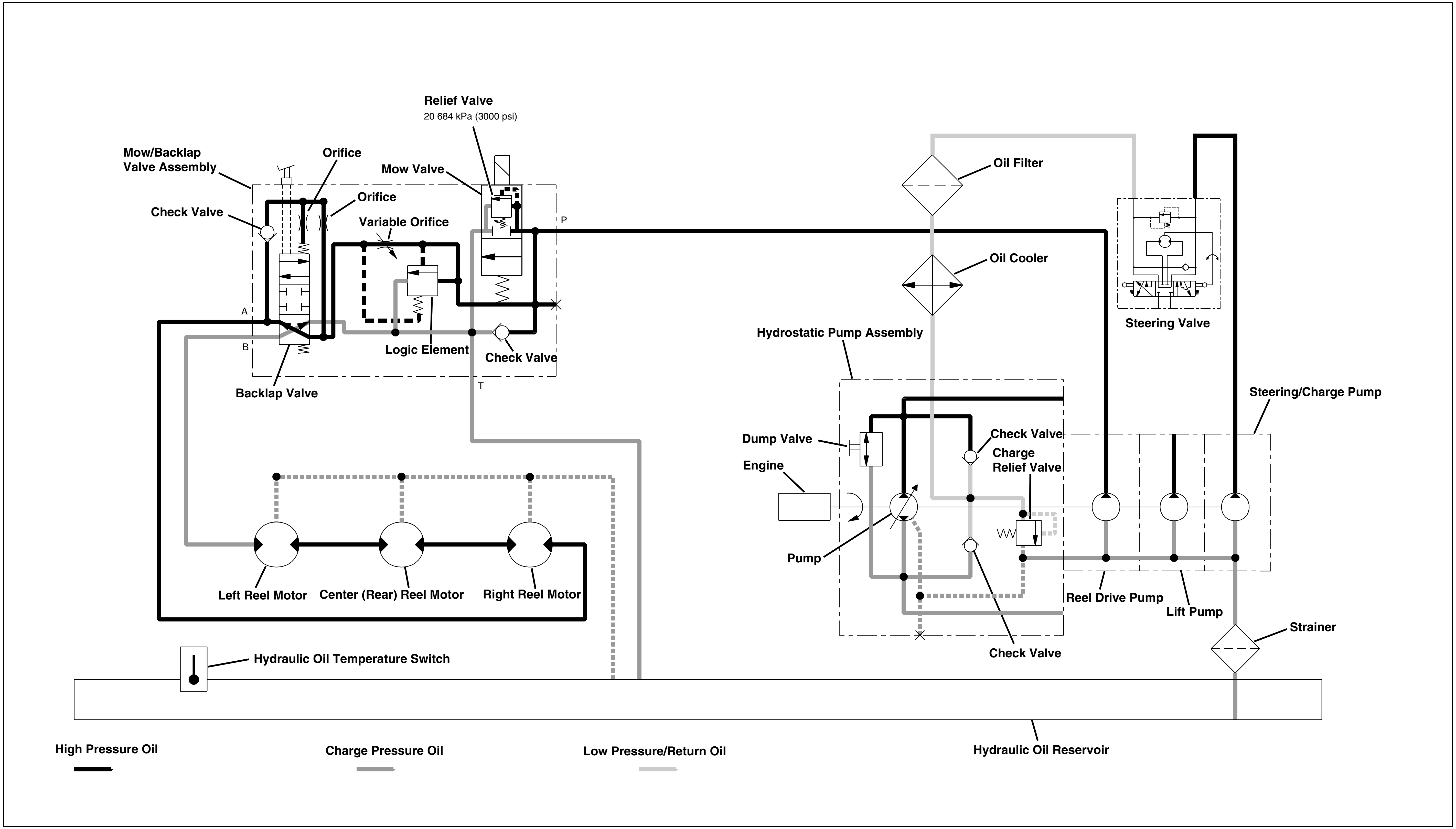
As in the MOW operation, the reel drive pump draws oil from the hydraulic reservoir. The oil is then routed to port “P” of the mow/backlap valve.

When the mow/transport lever is moved to the mow position, the mow valve solenoid is engaged, moving the valve spool. In this position, the mow valve directs the flow of oil to the variable orifice. The variable orifice allows the flow of oil to be metered, varying the speed of the reel motors.

The oil then flows to the backlap valve. With the valve in the BACKLAP position, oil is directed to port “A”. Oil is then routed to the reel motors in series, first to the right reel motor, then to the center (rear) reel motor and finally to the left reel motor. The oil is then routed back to the mow/ backlap valve at port “B” and flows through the backlap valve and out of the valve at port “T” returning to the hydraulic reservoir.

Cutting Unit Lift System Operation - Lift

Reel Drive System - Backlap Operation - Models 2500, 2500A



M98608 (MIF)

Function

To lift the cutting units when the mow system is disengaged.

Theory of Operation

NOTE: The lift system is designed so that the front lift cylinder extends to lift the cutting units, and the center (rear) lift cylinder retracts to lift the cutting units.

The lift system is an independent hydraulic circuit, consisting of the hydraulic reservoir, hydraulic pump assembly (lift pump section), lift valve, front lift cylinder and center (rear) lift cylinder.

The lift pump draws oil from the hydraulic reservoir. This oil is then routed to port “P” of the lift valve assembly.

When the lift switch is engaged, the lift valve solenoid shifts the lift valve spool, allowing pressurized oil to flow through the valve. The pressurized oil overcomes the check valve, forcing the check valve in the lower/float valve closed. The oil then flows to the rod end of the center (rear) cylinder and the piston end of the front lift cylinder.

Oil flowing into the lift cylinders is controlled by “floating” orifices. These orifices meter the flow of oil into the cylinders. In the lift mode, the orifices allow the oil to flow freely into the cylinders without restriction.

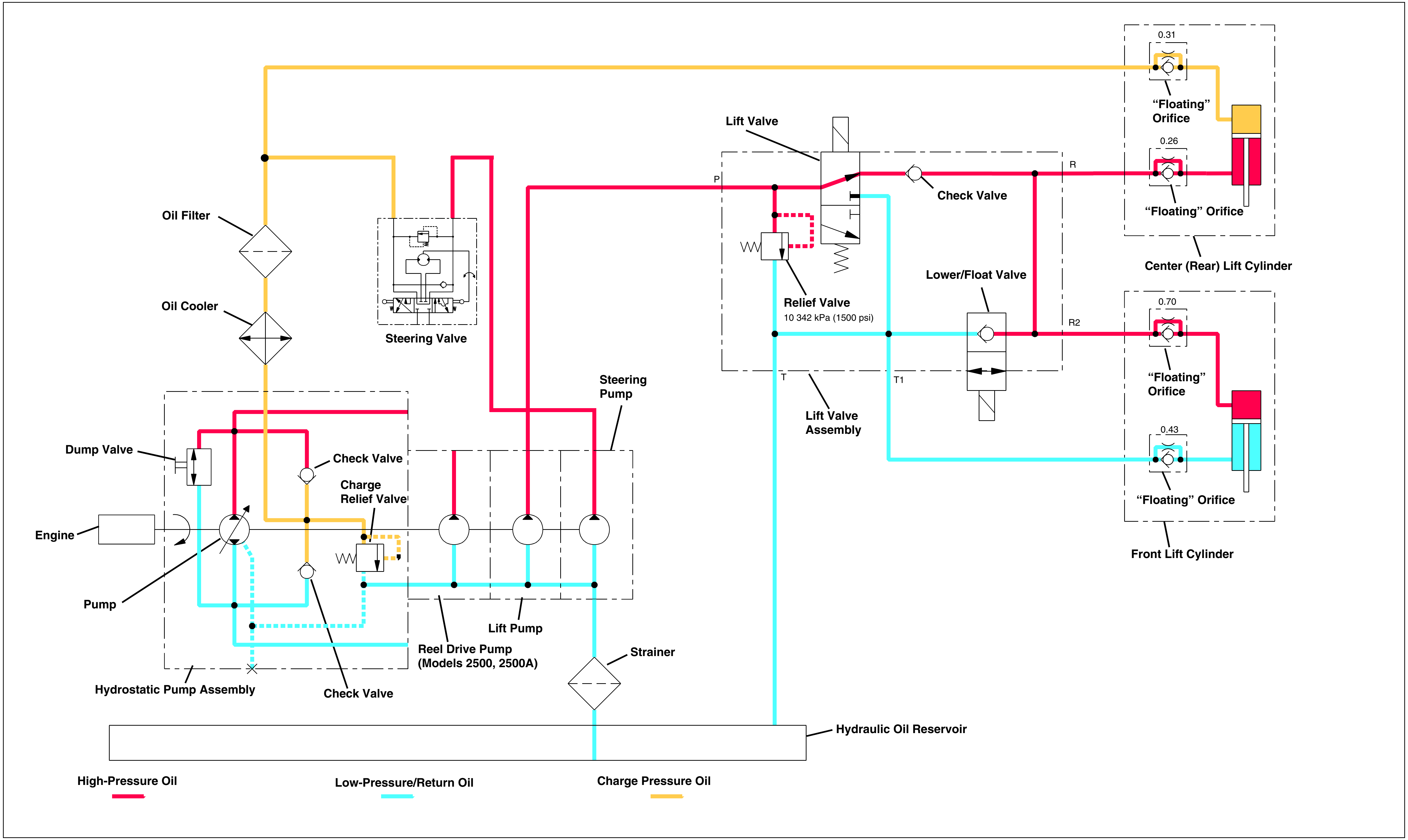
Oil on the low pressure side of the front cylinder returns to the hydraulic reservoir.

Oil on the low pressure side of the center (rear) cylinder is routed through the oil filter and oil cooler, and then to the hydrostatic pump. This oil is “make-up” or “charge” oil if the pressure on the low-pressure side of the hydrostatic pump drops.

The lift circuit is protected by a relief valve in the lift valve. If the oil pressure reaches 10 342 kPa (1500 psi), the relief valve opens allowing the oil to return directly to the hydraulic reservoir.

When the lift switch is released, the lift valve solenoid is energized, allowing the valve spool to return to the NEUTRAL position, trapping the oil in the cylinders, holding the cylinders in the raised position.

Cutting Unit Lift System Operation - Lift



M98784 (MIF)

Cutting Unit Lift System Operation - Lower and Float

Function

To lower the cutting units when the mow system is engaged.

Theory of Operation

NOTE: The lift system is designed so that the front lift cylinder retracts to lower the cutting units, and the center (rear) lift cylinder extends to lower the cutting unit.

When the lift cylinders are in the UP position, the lift valve spool is in the NEUTRAL position. In this position, oil flows through the lift valve, and flows back to the hydraulic reservoir.'

When the lower switch is engaged, the lower valve solenoid shifts the lift valve spool, releasing the oil trapped in the system.

Lowering of the cutting units is assisted by gravity. The weight of the front cutting units pulls on the front cylinder rods, and the rear cutting unit pushes on the rear cylinder rod, forcing oil out of the high-pressure side of the cylinders. This allows the cutting units to be lowered, even when hydraulic pressure is not available.

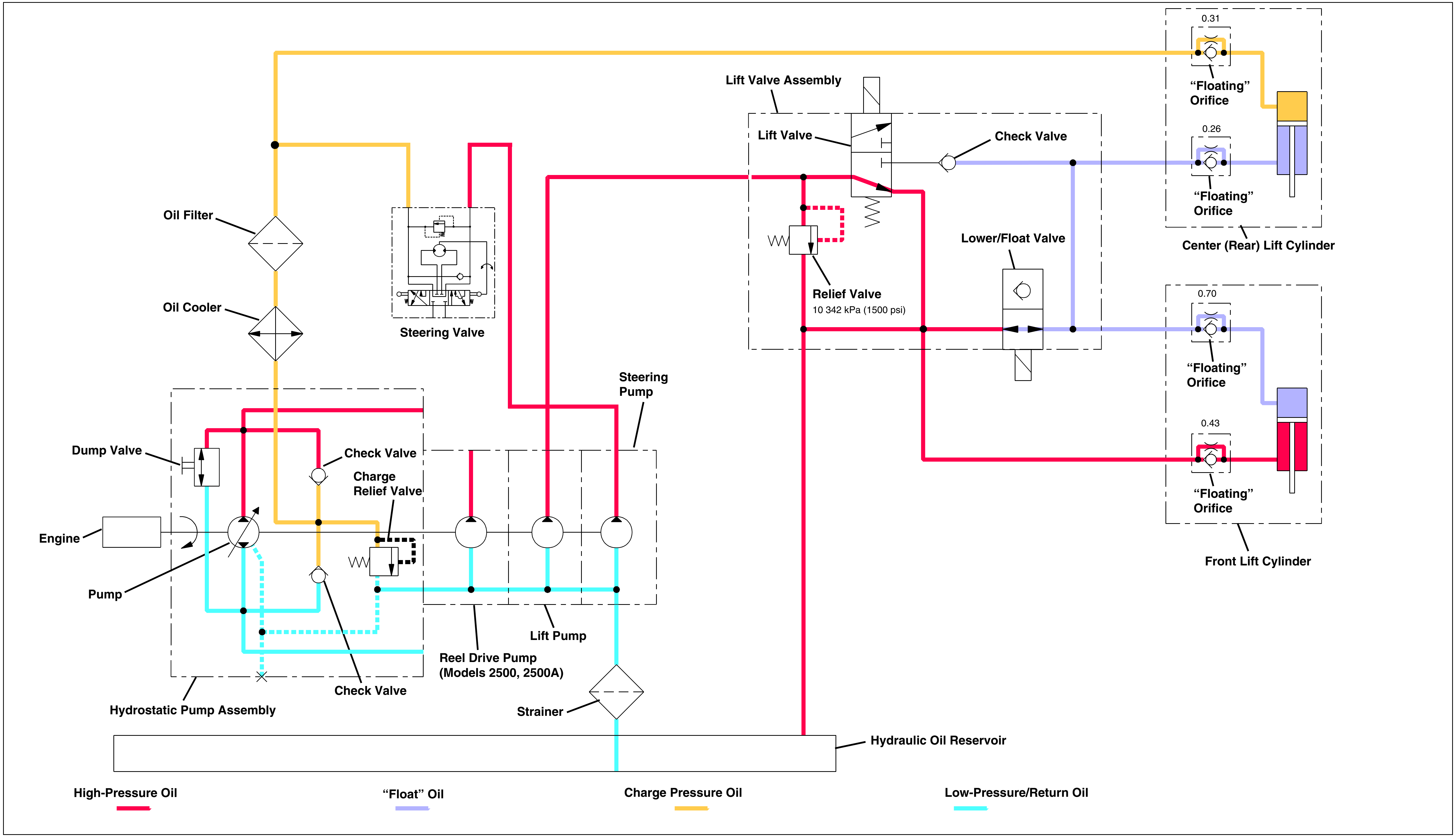
Oil flowing out of the lift cylinders is controlled by “floating” orifices. In the lower mode, the orifices meter the oil flow, allowing the cutting units to lower smoothly.

Slots at the end of each cylinder allow the cutting units to float with the terrain.

Oil on the low-pressure side of the center (rear) lift cylinder is routed through the oil filter and oil cooler, and then to the hydrostatic pump.

Leak Detection System Operation (Optional)

Cutting Unit Lift System Operation - Lower and Float



MIF M98785

Function

The leak detection system monitors the level of the hydraulic oil within the hydraulic reservoir. The system will activate a warning buzzer when the oil level drops to notify the operator.

Theory of Operation

The leak detection system consists of the sealed hydraulic reservoir, oil expansion tank, sensing chamber, and oil expansion valve.

The oil expansion valve is connected in-line between the bottom of the oil expansion tank and the input side of the hydraulic reservoir.

The sensing chamber is connected between the output side of the hydraulic reservoir and the top of the oil expansion tank.

Machine Shutdown - Establishing Sensing Level

When the machine is not running, the oil expansion valve and air vent valve in the sensing chamber are open, allowing the sensing chamber to become filled. This becomes a starting point each time the machine is shut down.

Machine Running - Oil Temperature Rising

When the machine is running, the oil expansion valve and air vent valve are closed. As the oil temperature rises, the check valve in the oil expansion valve opens, allowing a small amount of oil to vent to the oil expansion tank.

Lift System Operation

During normal operation, the same amount of oil returns to the sealed hydraulic reservoir that leaves, except when the lift cylinders are extended or, the system has leaked oil.

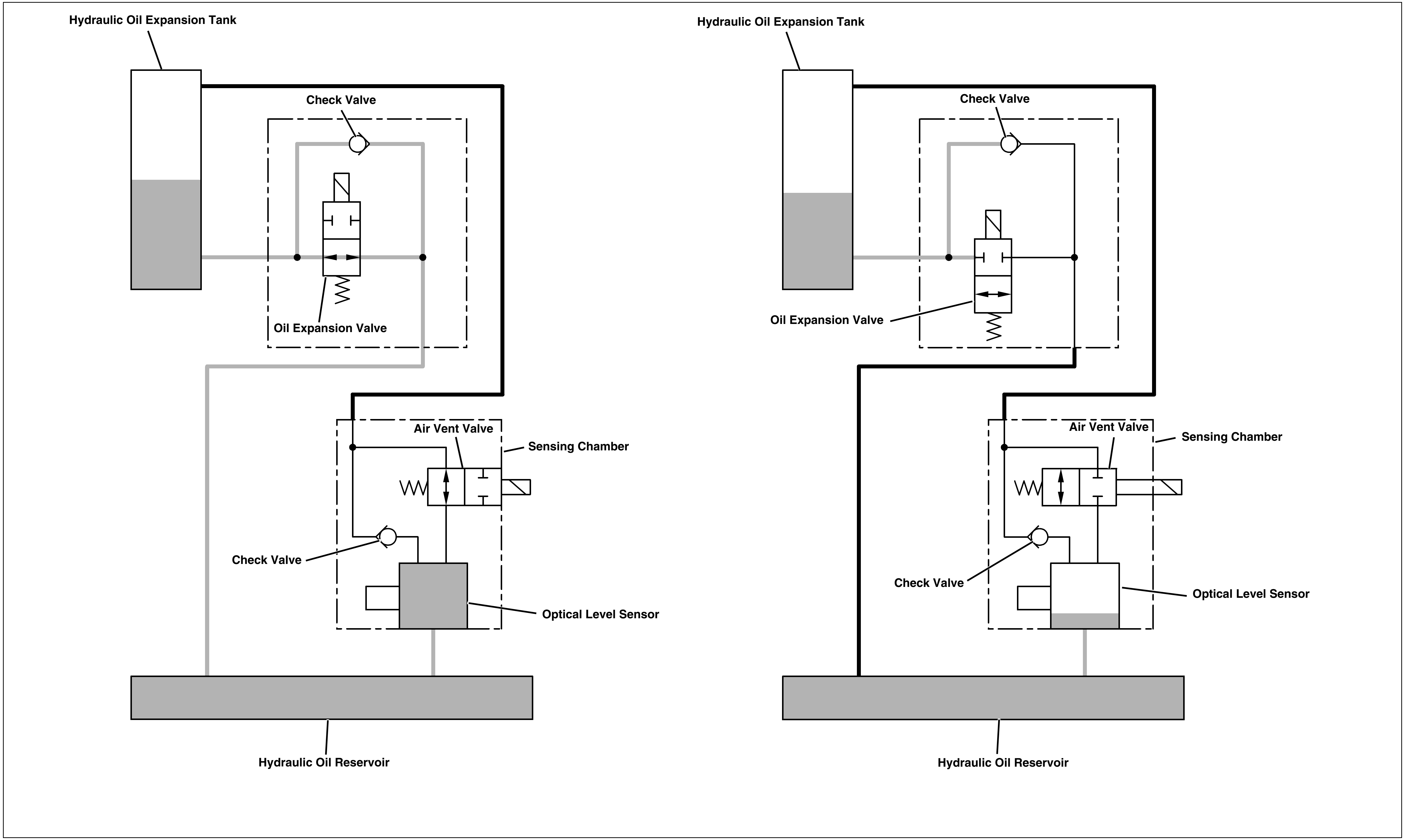
Because of the volume difference between the rod and piston end of the cylinders, slightly more oil leaves the reservoir when cylinders are extended.

The lift system is designed so that the front lift cylinder retracts to lower the cutting units, and the center (rear) lift cylinder extends to lower the cutting unit. This will compensate for the volume difference between the two ends of the cylinders.

Leak Detection

If a leak occurs, and the machine running, the oil expansion valve and air vent valves are closed, preventing oil from leaving the expansion tank to replenish the hydraulic reservoir. If the oil level in the hydraulic reservoir is low, oil from the sensing chamber will drain back to the reservoir. If the oil level in the sensing chamber drops below the level of the optical sensor, the electrical control module will trigger a warning buzzer.

Leak Detection System Operation (Optional)



M98829 (MIF)

Reel Drive Diagnosis - 2500, 2500A

NOTE: The front three cutting units and the rear two cutting units are driven by separate hydraulic systems. Problems that affect both systems are either electrical or lift system related.

Symptom: One Reel Turns Slowly

(1) Is reel-to-bed knife clearance adjusted properly?

Yes - Go to step (2).

No - Adjust reel-to-bed knife clearance to specification. (See “Adjust Reel-to-Bed Knife” on page 751.)

(2) Is reel motor operating properly?

Yes - Go to step (3).

No - See “Test Reel Drive Pump Oil Flow - Models 2500, 2500A” on page 653.

(3) Are cutting unit bearings in good condition?

No - Inspect cutting unit bearings, replace if necessary.

Symptom: All Reels in One System Are Turning Slowly

(1) Is flow control knob in the fully open position?

Yes - Go to step (2).

No - Move flow control knob to position “6”.

(2) Is reel-to-bed knife clearance adjusted properly?

Yes - Go to step (3).

No - Adjust reel-to-bed knife clearance to specification. (See “Adjust Reel-to-Bed Knife” on page 751.)

(3) Is backlap valve inlet screen clean and free of debris?

Yes - Go to step (4).

No - Clean backlap valve inlet screen.

(4) Is reel drive pump operating properly?

No - See “Test Reel Drive Pump Oil Flow - Models 2500, 2500A” on page 653.

Symptom: One Cutting Unit Is Not Turning

(1) Is hydraulic motor spline and coupler in good condition?

Yes - Go to step (2).

Symptom: One Cutting Unit Is Not Turning

No - Repair or replace as necessary.

(2) Are cutting unit bearings in good working condition?

Yes - Go to step (3).

No - Replace cutting unit bearings

(3) Is reel drive motor operating properly?

No - See “Test Reel Drive Pump Oil Flow - Models 2500, 2500A” on page 653.

Symptom: One System Will Not Backlap

(1) Is backlap knob in the up secured position?

Yes - Go to step (2).

No - Place backlap knob in the up secured position.

(2) Is flow control valve fully open?

Yes - Go to step (3).

No - Move control knob to the open position.

(3) Is mow solenoid operating?

Yes - Go to step (4).

No - Check if 12 V is present at solenoid.

(4) Is mow solenoid valve operating properly?

No - Remove solenoid valve and check function.

Symptom: Pump Is Noisy

(1) Is hydraulic oil reservoir at proper level?

Yes - Go to step (2).

No - Fill reservoir to proper level with recommended oil.

(2) Is reel drive pump operating properly?

Yes - Go to step (3).

No - Check pump for wear. (See “Test Reel Drive Pump Oil Flow - Models 2500, 2500A” on page 653.)

(3) Is backlap valve inlet screen clean and free of debris?

No - Clean backlap valve inlet screen.

Lift System Diagnosis - All Machines

Symptom: Front and Rear Lift Arms Will Not Rise

(1) Is 12 V present at lift solenoid (SV1)?

Symptom: Front and Rear Lift Arms Will Not Rise

Yes - Go to step (2).

No - Check control module for proper function. (See “Electronic Control Module Check” on page 539.)

(2) Is lift solenoid (SV1) working properly?

Yes - Go to step (3).

No - Remove and inspect (SV1) cartridge. Replace if necessary.

(3) Is engine speed to specification?

Yes - Go to step (4).

No - Perform fast idle adjustment.

(4) Is steering system leakage within specification?

Yes - Go to step (5).

No - Perform steering system leakage test. (See “Test Steering System Leakage” on page 706.)

(5) Is lift system free of air?

Yes - Go to step (6).

No - Start engine and cycle lift arms to purge air from system.

(6) Are lift system hydraulic fittings tight and free from leaks?

Yes - Go to step (7).

No - Tighten fittings and replace O-rings as needed.

(7) Is lift pump operating properly?

Yes - Go to step (8).

No - Perform lift pump flow test. (See “Test Lift Pump Oil Flow” on page 652.)

(8) Is lift valve operating properly?

No - Repair or replace as needed.

Symptom: Front and Rear Lift Arms Will Not Lower

(1) Is 12 V present at lift solenoid (SV2)?

Yes - Go to step (2).

Symptom: Front and Rear Lift Arms Will Not Lower

No - Check control module for proper function.
Gas models; (See “Lift and Lower Circuit Diagnosis - Models 2500,2500A (S.N. -020000)” on page 373.) or (See “Lift and Lower Circuit Diagnosis - Models 2500A (S.N. 020001-), 2500E” on page 391.)
Diesel models; (See “Lift and Lower Circuit Diagnosis - Models 2500, 2500A (S.N. -020000)” on page 489.) or (See “Lift and Lower Circuit Diagnosis - Models 2500A (S.N. 020001-), 2500E” on page 507.)

(2) Is lift valve operating properly?

No - Repair or replace lift valve as required.

Symptom: Front and Rear Lift Arms Will Not Stay in Raised Position

(1) Are lift system hydraulic fittings tight and free from leaks?

Yes - Go to step (2).

No - Tighten fittings and replace O-rings as needed.

(2) Is lift valve operating properly?

Yes - Replace lift cylinder.

No - Replace lift valve.

Tests and Adjustments

Warm Up Hydraulic Oil

Reason

When performing hydraulic system tests, the oil must be heated to a specified temperature for the tests to be accurate.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Temperature Gage	JDG282	Used to measure hydraulic system oil temperature.

Procedure

1. Park machine on a level surface.
2. Move FORWARD and REVERSE travel pedals to NEUTRAL position.
3. Lower cutting units to the ground.
4. Move mow and transport lever to TRANSPORT position.
5. Turn key switch to STOP position.
6. Engage park brake.
7. Install JDG282 Temperature Gage on hydraulic pump assembly.
8. Start and run engine at fast idle.

NOTE: Periodically cycle all hydraulic functions to distribute heated oil.

9. Run engine until oil temperature reaches operating temperature (reservoir warm to the touch).

Specifications

Hydraulic Oil Operating Temperature. . . . 43°C (110°F)

Bleed Hydraulic System

Reason

To ensure that air is purged from hydraulic system after the hoses or lines have been disconnected.

Procedure

1. Park machine on a level surface.
2. Move FORWARD and REVERSE travel pedals to NEUTRAL position.
3. Lower cutting units to the ground.
4. Move mow and transport lever to TRANSPORT position.
5. Turn key switch to STOP position.
6. Engage park brake.
7. Check level of hydraulic oil. Fill as needed. (See “Hydraulic Reservoir Oil Level Check” on page 26.)

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

8. Start engine and run at SLOW idle.
9. Turn steering wheel full left and hold for five seconds.
10. Turn steering wheel straight forward and hold for ten seconds.
11. Turn steering wheel full right and hold for five seconds.
12. Cycle cutting units up and down ten times.
13. Return steer wheel to straight forward position.
14. Drive machine straight forward for 6 meters (20 feet), then make two hard left turns, then make two hard right turns.
15. Drive machine in reverse approximately 3 meters (10 feet).
16. Turn key switch to STOP position.
17. Check all hoses and connections for leaks. Tighten connections and/or replace hoses as needed.
18. Check oil level at sight glass on the hydraulic expansion tank. Add oil as needed.

Specifications

Slow Idle Speed - Gas . . . . .1550 ± 100 rpm

Slow Idle Speed - Diesel . . . . 1450 ±100 rpm

Test Lift Pump Oil Flow

Reason

To determine if the lift pump is providing the correct oil flow volume.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Flowmeter Kit	JT05469	Used to measure oil flow out of lift pump.
Connector 13/16-16 M ORFS x 1/2 M NPT	JT03367	Used to install flowmeter.
Connector 13/16-16 F ORFS Sw x 3/4 F NPT 45°	JT03368	Used to install flowmeter.
Connector 1/2 F NPT x 3/4 F NPT	JT03369	Used to install flowmeter.

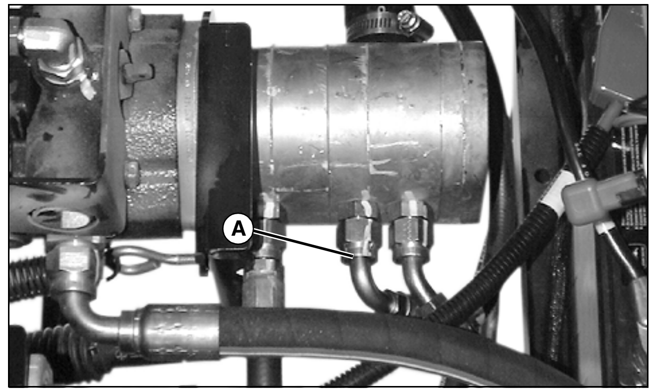
Procedure

CAUTION: Avoid injury! Lower cutting units to the ground prior to removing any hydraulic lines or fittings.

NOTE: 2500/2500A hydraulic pump shown throughout. 2500E has a two section (double) pump. Procedures are the same except where noted.

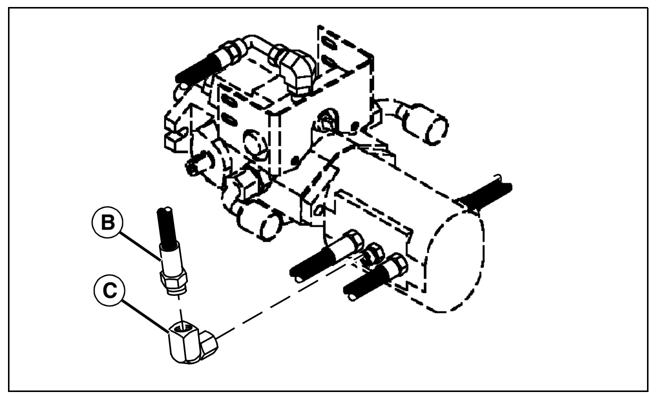
Test is performed by measuring the oil flow between the lift pump and lift valve.

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Check level of hydraulic oil. Fill as needed. (See “Hydraulic Reservoir Oil Level Check” on page 26.)
7. Raise and latch seat platform.



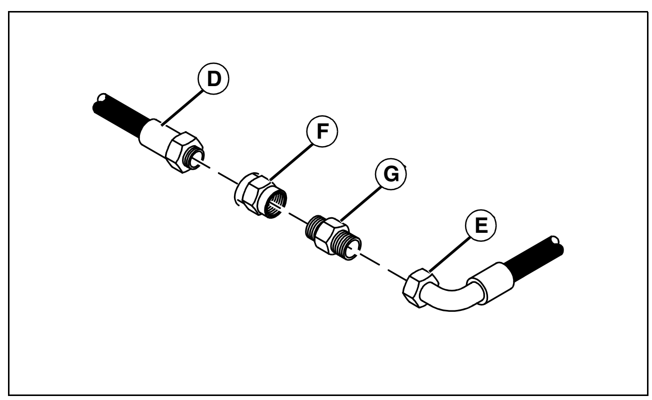
8. Disconnect output hose (A) from lift pump.

NOTE: The flowmeter is directional and must be connected properly to obtain correct flow reading. Direction of flow is marked on flowmeter with an arrow.



MIF M98805

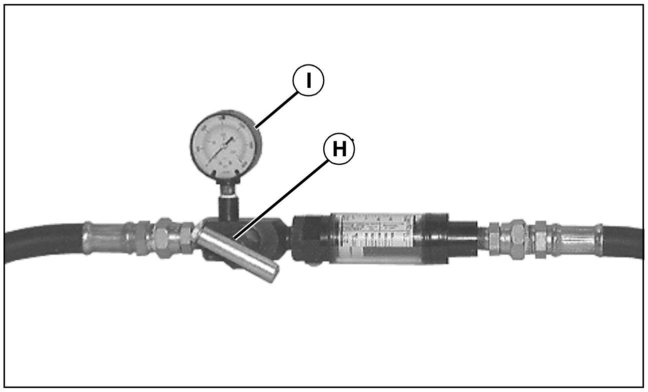
9. Connect JT05469 Flowmeter Kit input hose (B) to lift pump using JT03368 Connector (C).



MIF M98803

10.Connect the flowmeter output hose (D) to lift valve hose (E) using JT03369 (F) and JT03367 (G) Connectors.

IMPORTANT: Avoid damage! Flowmeter valve MUST be open before starting engine, otherwise damage to hydraulic components may result.



M98804

11. Open flowmeter valve (H) fully.

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

12. Start and run engine at FAST idle.

13. Slowly close flowmeter valve until **1723 kPa (250 psi)** is registered on gage (I). Record flow rate. Flow rate should be to specification.

14. Adjust flowmeter valve until **6895 kPa (1000 psi)** is registered on gage. Record flow rate. Flow rate should be to specification.

Results

- If the lift pump does not meet specifications, rebuild or replace pump. (See "Remove and Install Hydraulic Pump Assembly" on page 664.)

Specifications

Lift Pump Flow @ 1723 kPa (250 psi). . . . . 15.5 L/min (4.1 gpm)

Lift Pump Flow @ 6895 kPa (1000 psi). . . . . 13.2 L/min (3.5 gpm)

Test Reel Drive Pump Oil Flow - Models 2500, 2500A

Reason

To determine if the reel drive pump is providing the correct oil flow volume.

Special or Required Tools

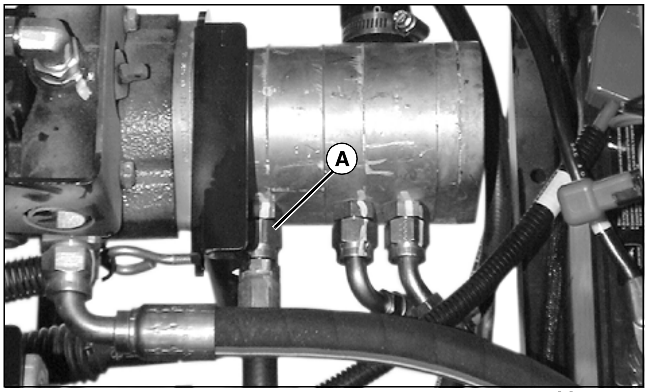
Tool Name	Tool No.	Tool Use
Flowmeter Kit	JT05469	Used to measure oil flow out of reel drive pump.
Connector 13/16-16 M ORFS x 1/2 M NPT	JT03367	Used to install flowmeter.
Connector 13/16-16 F ORFS Sw x 3/4 F NPT 45°	JT03368	Used to install flowmeter.
Connector 1/2 F NPT x 3/4 F NPT	JT03369	Used to install flowmeter.

Procedure

CAUTION: Avoid injury! Lower cutting units to the ground prior to removing any hydraulic lines or fittings.

NOTE: Test is performed by measuring the oil flow between the reel drive pump and mow and backlap valve.

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Check level of hydraulic oil. Fill as needed. (See "Hydraulic Reservoir Oil Level Check" on page 26.)
7. Raise and latch seat platform.

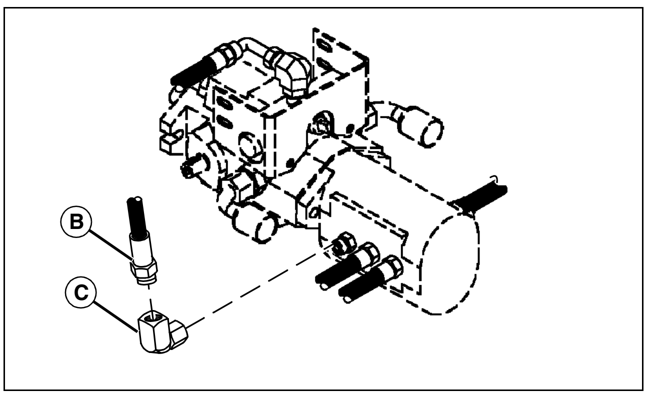


M84694

Picture Note: Control cable removed for photo clarity only.

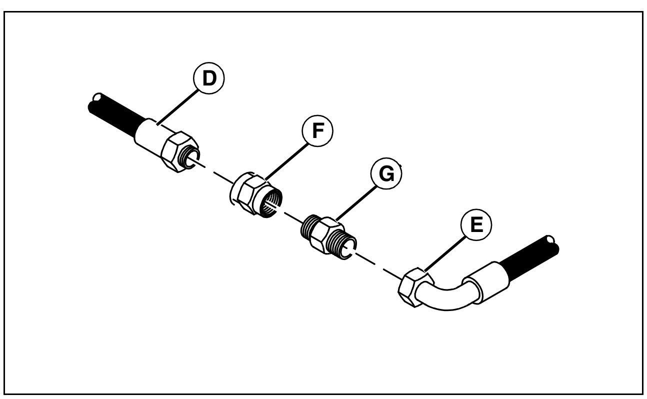
8. Disconnect output hose (A) from reel drive pump.

NOTE: The flowmeter is directional and must be connected properly to obtain correct flow reading. Direction of flow is marked on flowmeter with an arrow.



MIF M98806

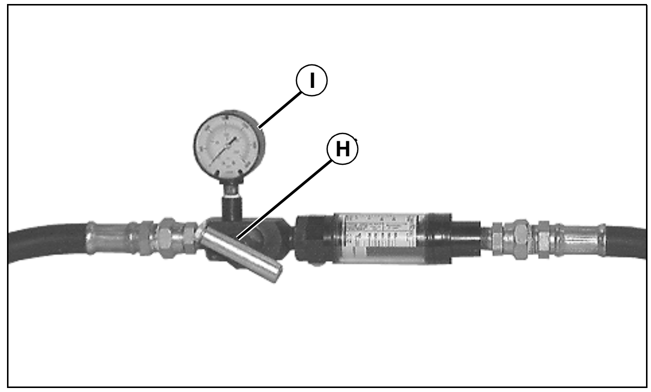
9. Connect JT05469 Flowmeter Kit input hose (B) to reel drive pump using JT03368 Connector (C).



MIF M98803

10. Connect the flowmeter output hose (D) to the mow and backlap valve hose (E) using JT03369 (F) and JT03367 (G) Connectors.

IMPORTANT: Avoid damage! Flowmeter valve MUST be open before starting engine, otherwise damage to hydraulic components may result.



M98804

11. Open flowmeter valve (H) fully.

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

12. Start and run engine at FAST idle.

13. Slowly close flowmeter valve until 1723 kPa (250 psi) is registered on gage (I). Record flow rate. Flow rate should be to specification.

14. Adjust flowmeter valve until 6895 kPa (1000 psi) is registered on gage. Record flow rate. Flow rate should be to specification.

Results

- If the reel drive pump does not meet specifications, rebuild or replace pump. (See “Remove and Install Hydraulic Pump Assembly” on page 664.)

Specifications

Reel Drive Pump Flow @ 1723 kPa (250 psi). . . . . 15.5 L/min (4.1 gpm)

Reel Drive Pump Flow @ 6895 kPa (1000 psi). . . . . 13.2 L/min (3.5 gpm)

Test and Adjust Mow Valve Relief Valve - Models 2500, 2500A

Reason

To ensure that the mow valve relief valve is operating properly.

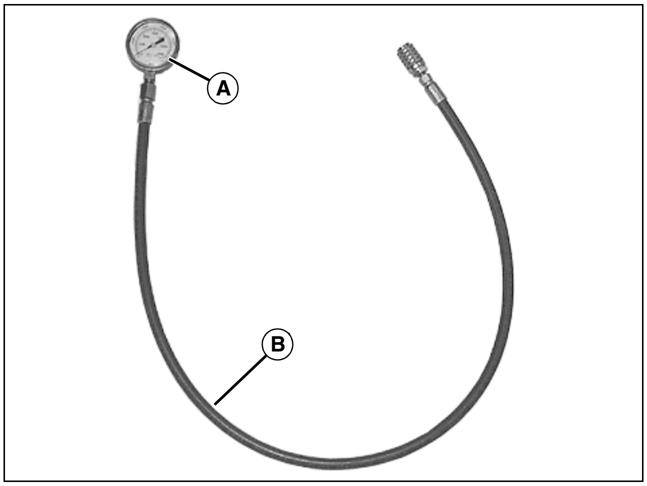
Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydraulic Diagnostic Kit	BM19949	Used to connect pressure gage to mow and backlapping valve.
Pressure Gage 0-40 000 kPa (0-6000 psi)	JT07047	Used to measure mow valve relief pressure.

Procedure

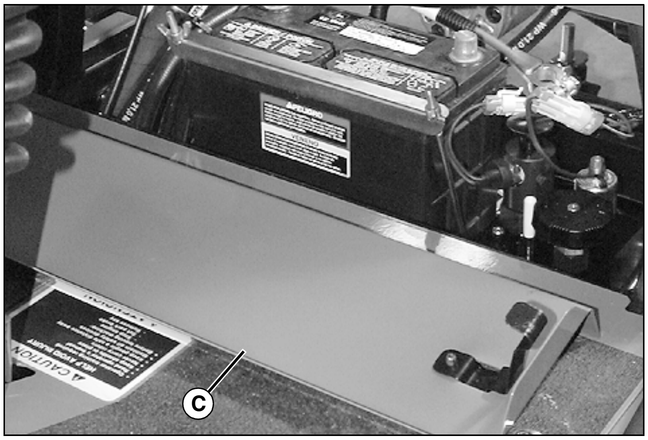
NOTE: Test is performed by measuring system pressure at test fitting provided on mow and backlapping valve.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Engage park brake.
5. Turn key switch to STOP position.
6. Check level of hydraulic oil. Fill as needed. (See “Hydraulic Reservoir Oil Level Check” on page 26.)



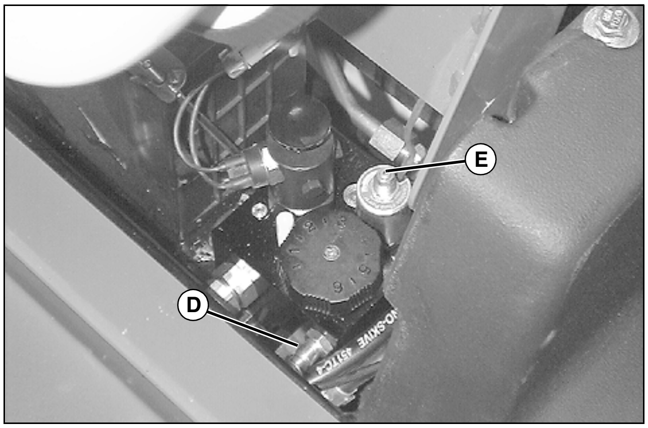
M98645

7. Install JT07047 Gage (A) on hose (B) from BM19949 Hydraulic Diagnostic Kit.
8. Raise and latch seat platform.



M84580

9. Open front access panel (C).



M98801

10. Locate test fitting in the mow and backlapping valve.
11. Connect gage and hose assembly to diagnostic fitting (D) on mow and backlapping valve.
12. Apply park brake.
13. With cutting units lowered to the ground, block all three reels with wooden blocks to prevent reels from rotating.

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

14. Start engine and run at FAST idle.

NOTE: If the engine stalls while performing this test, set the throttle to full speed and repeat test.

15.Move mow and transport lever to MOW position.

16.Note reading on gage.

Results

- Reading on gage should be to specification.
- If reading is not to specification, adjust relief valve by turning socket head screw (E) to the right (clockwise) to increase pressure or to the left (counterclockwise) to decrease pressure.

Specifications

Mow Valve Relief Valve
Pressure . . . . 20 684 ± 1034 kPa (3000 ± 150 psi)

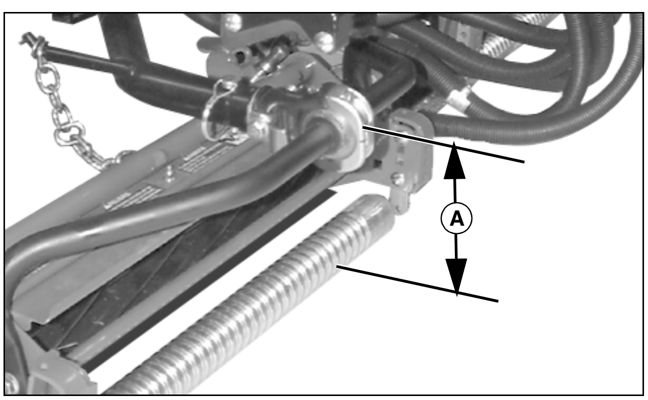
Adjust Front Lift Arm

Reason

To ensure that the front cutting units are at the correct height when lowered.

Procedure

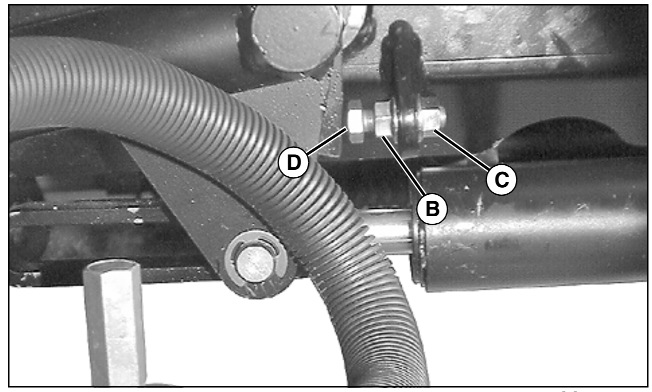
1. Park machine on hard, level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Push down on one of the lift arms.



MX2221

7. Measure the distance (A) between the center of the lift arm ball joint and the ground. The distance should be to specification.

If adjustment is required, proceed to step 8.



M98816

8. Loosen nut (B) and locknut (C).
9. Turn the adjustment bolt (D) in or out until the distance between the center of the arm ball joint and the ground is to specification.

Specifications

Front Lift Arm Distance (Center of Ball Joint-to-Ground) . . . . 225 ± 5 mm (8.85 ± 0.20 in.)

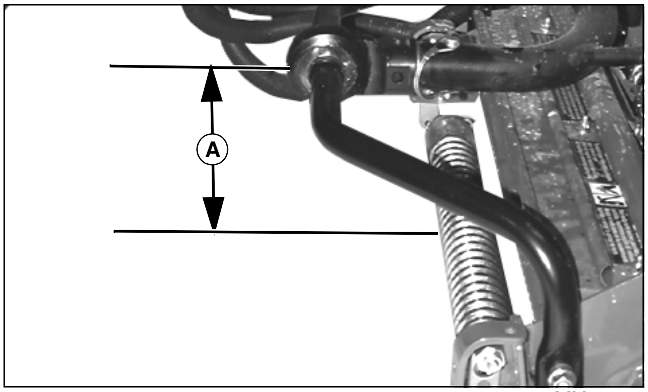
Adjust Rear Lift Arm

Reason

To ensure that the rear cutting units are at the correct height when lowered.

Procedure

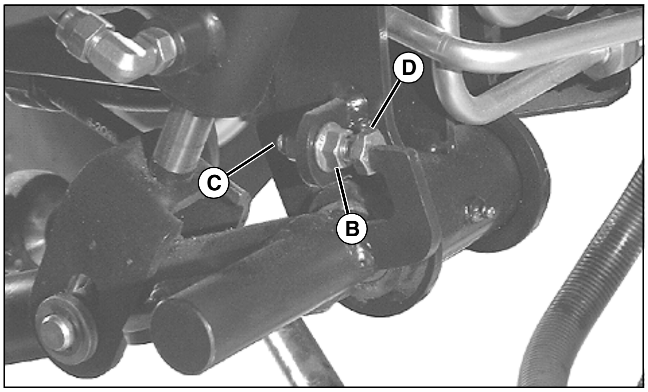
1. Park machine on hard, level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Push down on lift arm.



MX2222

7. Measure the distance (A) between the center of the lift arm ball joint and the ground. The distance should be to specification

If adjustment is required, proceed to step 8.



M98471

8. Loosen nut (B) and locknut (C).

9. Turn the adjustment bolt (D) in or out until the distance between the center of the arm ball joint and the ground is to specification.

Specifications

Rear Lift Arm Distance (Center of Ball Joint-to-Ground). . . . . 225 ± 5 mm (8.85 ± 0.20 in.)

Repair

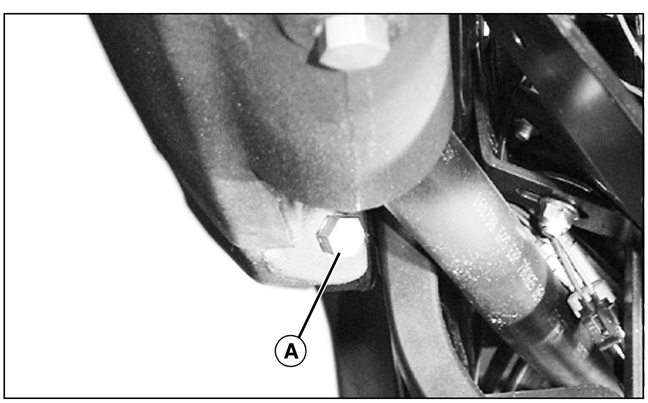
Remove and Install Hydraulic Reservoir Expansion Tank

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

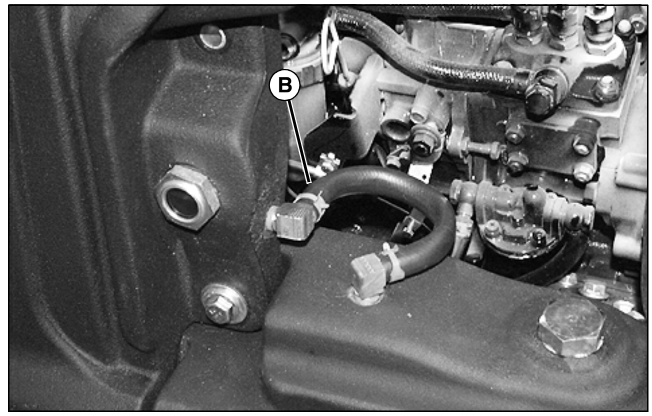
Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise cowling.
7. Remove fuel tank. (See “Remove and Install Fuel Tank - Gasoline” on page 803.)



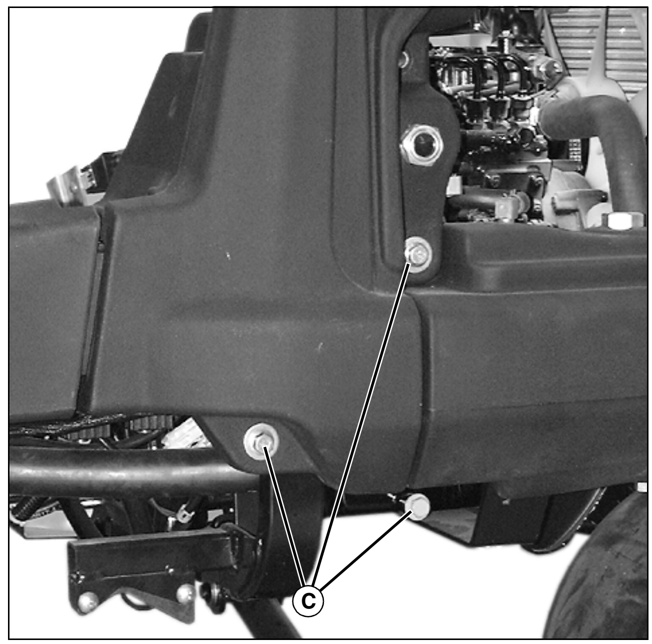
M84605

8. Remove drain plug (A) and drain oil into a clean container.



M84642

9. Disconnect expansion tank-to-main reservoir hose (B) at expansion tank.



M84643

10. Remove cap screws, washers, and nuts (C).
11. Remove expansion tank.

Installation

Installation is done in reverse order of removal.

- Apply pipe sealant with TEFLON to threads of drain plug.
- Fill hydraulic oil reservoir expansion tank until oil level is at the center of the sight glass with oil meeting specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Remove and Install Hydraulic Reservoir

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

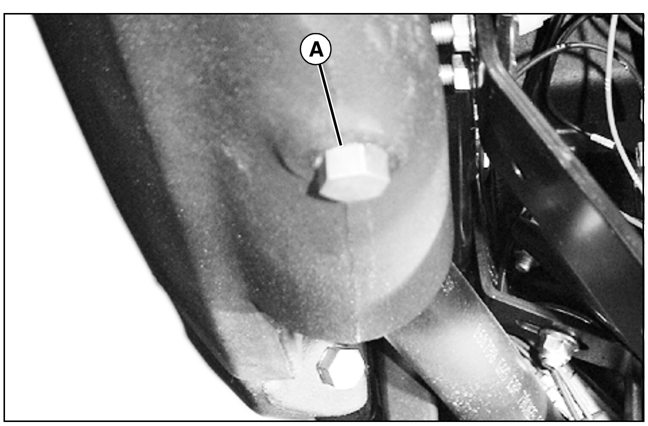
- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**

- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

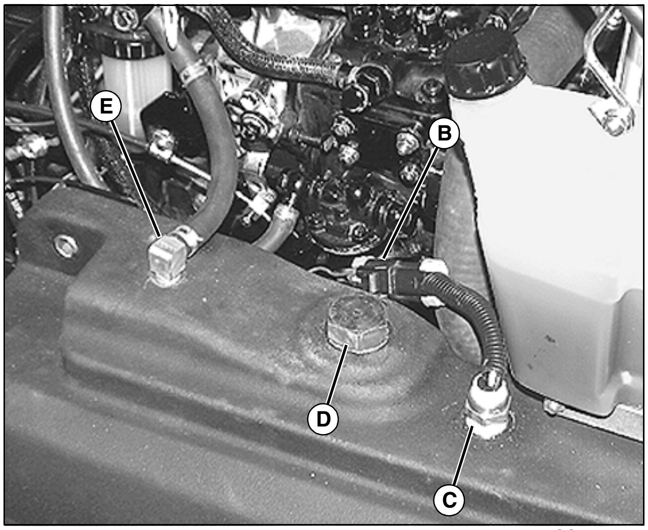
1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Remove radiator. (See “Remove and Install Radiator” on page 77.)

NOTE: Hydraulic reservoir capacity is approximately 28.8 L (7.6 gal).



M84605

7. Remove drain plug (A) and drain oil into a clean container.
8. Remove hydraulic reservoir expansion tank. (See “Remove and Install Hydraulic Reservoir Expansion Tank” on page 658.)

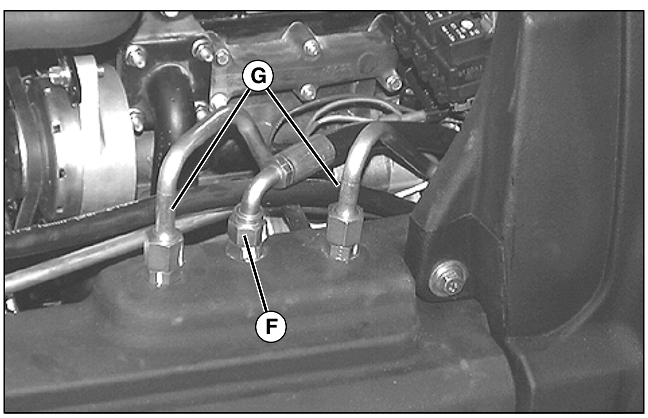


M98269

9. Disconnect hydraulic oil temperature switch wiring connector (B).
10. Remove hydraulic oil temperature switch (C).
11. Remove filler cap (D).
12. Remove expansion tank hose and fitting (E).
13. Remove radiator. (See “Remove and Install Radiator” on page 77.)

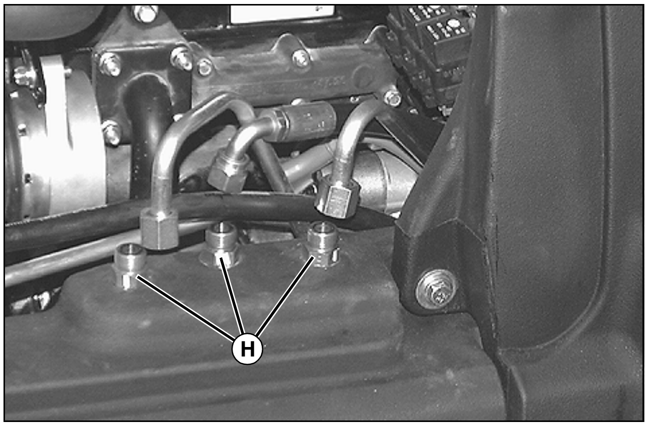
NOTE: Mark all hydraulic hoses/lines before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



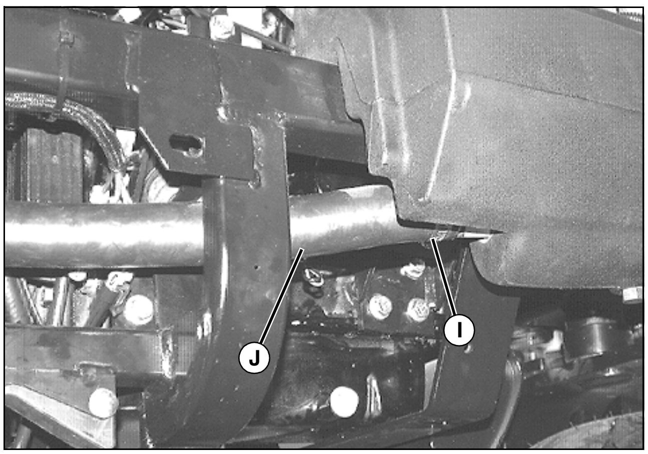
M98264

14. Disconnect hydraulic hose (F) and lines (G).



M98267

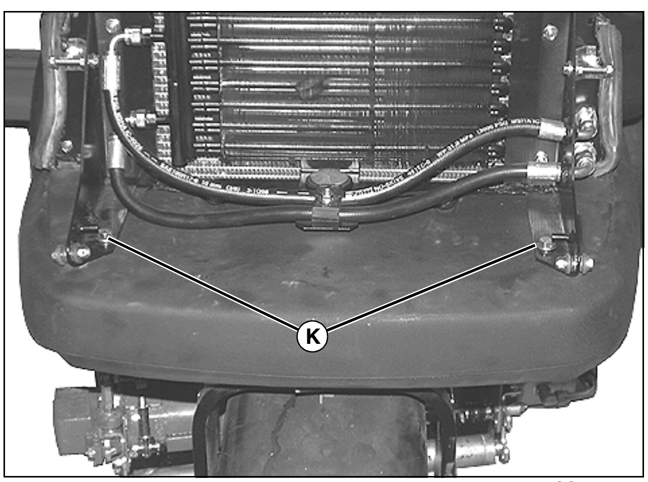
15.Remove fittings (H).



M98268

16.Loosen supply hose clamp (I) at left side of main reservoir.

17.Remove supply hose (J).

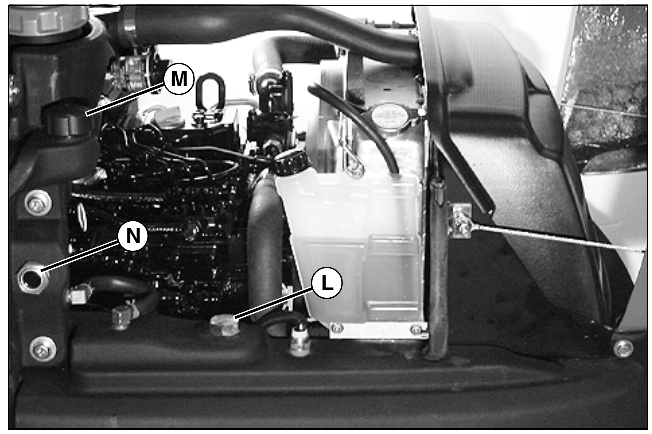


M98270

18.Remove two cap screws (K).

19.Slide reservoir out.

Installation



M84567

Installation is done in the reverse order of removal.

NOTE: Hydraulic oil drained from the system in step 7 can be reused if the oil is clean and free of contaminants. Use a strainer when filling reservoir.

Fill main reservoir at the reservoir filler cap (L). Oil added at the expansion tank (M) will not transfer to the reservoir quickly, resulting in an inaccurate oil level indication.

After main reservoir is 100% filled, run machine slowly to fill all lines. Add oil to main reservoir as needed to maintain level. Add oil to expansion tank until oil level is at the center of the sight glass (N).

- Apply pipe sealant with TEFLON to threads of drain plug.
- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

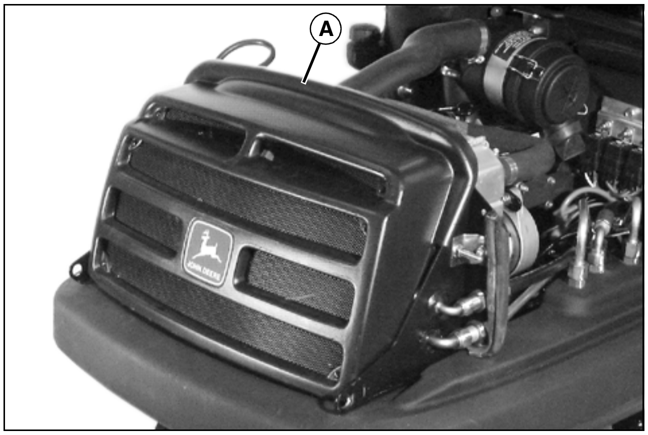
Remove and Install Oil Cooler - Models 2500, 2500A

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

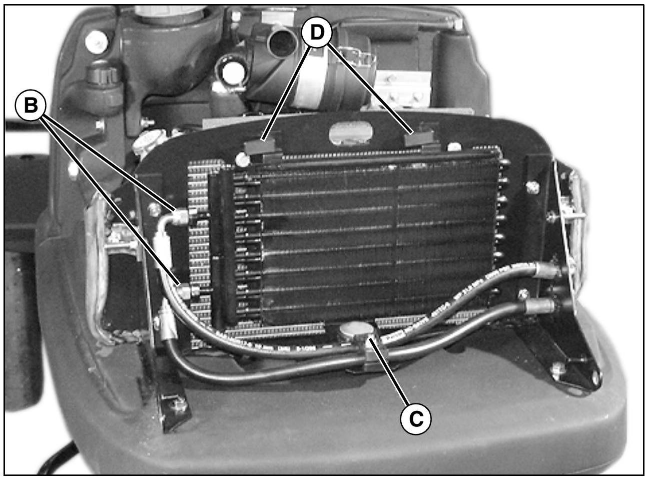
Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Remove cowling. (See “Remove and Install Cowling” on page 798.)



M84590

7. Remove grille (A).

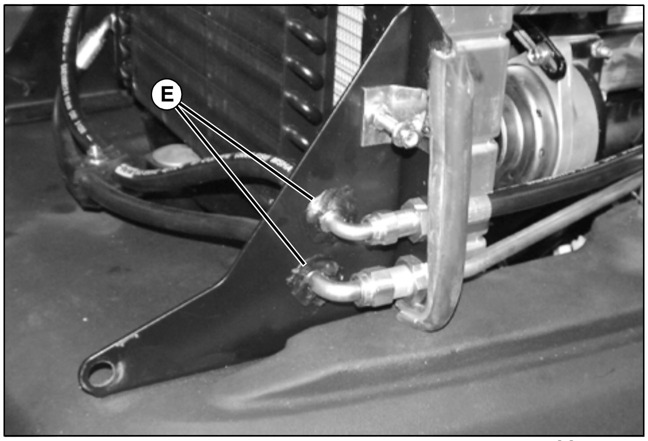


M84596

8. Disconnect hydraulic hoses (B) at oil cooler.
9. Remove hose clamp (C).
10. Release latches (D).
11. Remove oil cooler.

Installation

Installation is done in the reverse order of removal.



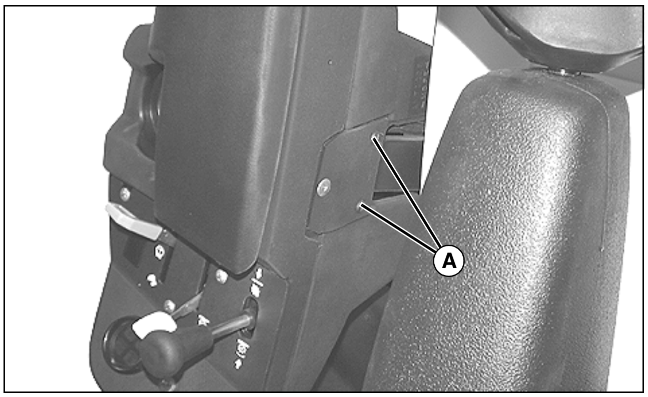
M84605

- If hoses are replaced, seal around where hoses pass through support (E) using ribbon sealant.
- Fill expansion tank until oil level is at the center of the sight glass with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Remove and Install Lift and Lower Lever Assembly

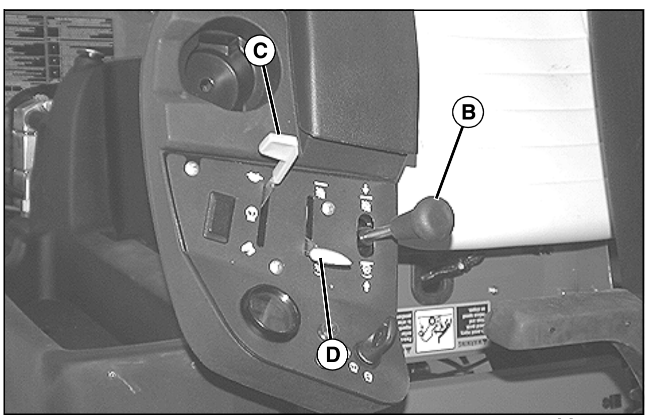
Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position.
5. Engage park brake.
6. Raise and latch seat platform.



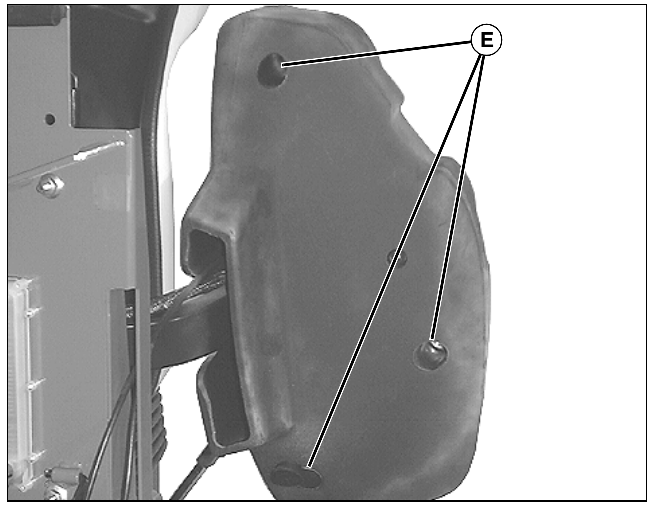
M84636

7. Remove phillips-head screws (A).



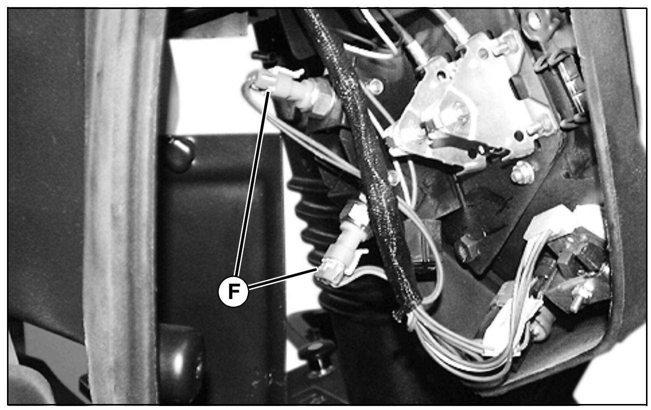
M84637

8. Remove mow lift and lower lever (B).
9. Remove throttle lever knob (C).
10. Remove mow and transport lever knob (D).



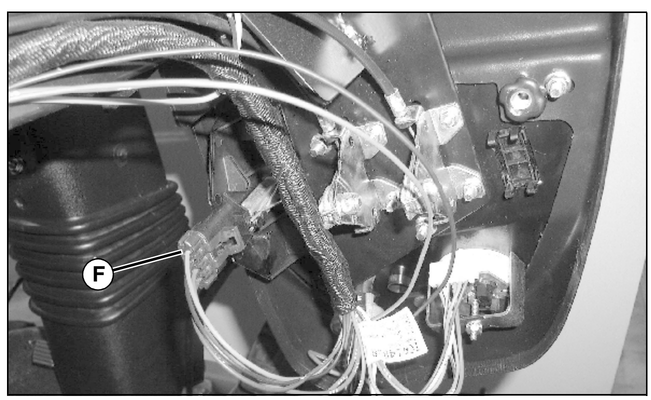
M84638

11. Remove cap screws and washers (E).
12. Pull lower console cover away from console top.



M84702

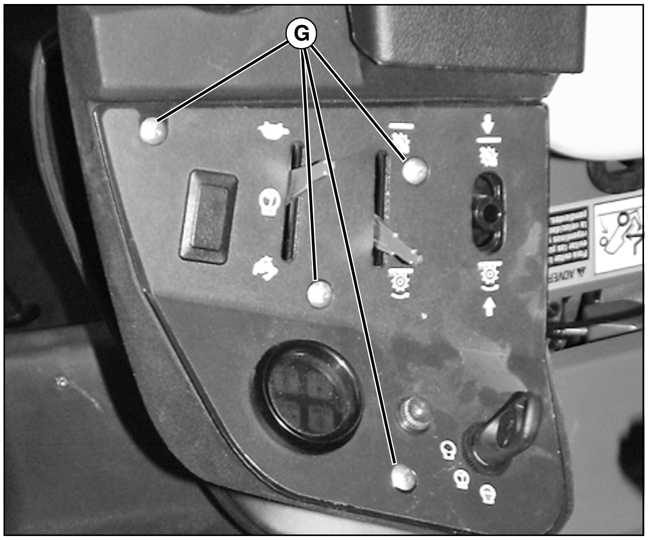
Picture Note: Models 2500, 2500A (S.N. -020000)



MX21539

Picture Note: Model 2500E

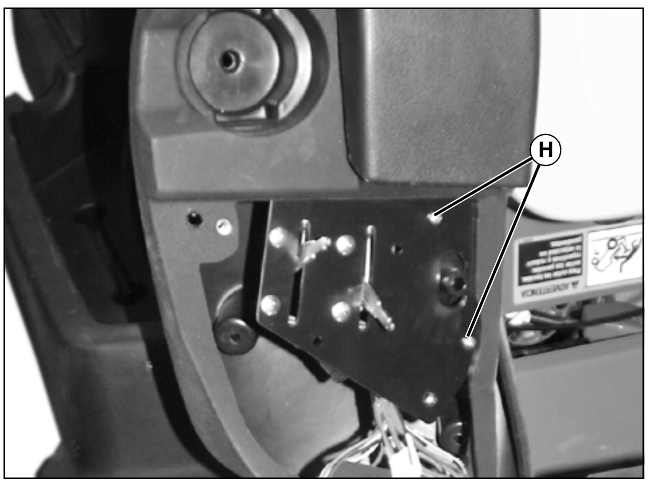
13. Disconnect switch wire connectors (F).



M84703

14.Remove four round head cap screws and nuts (G).

15.Pull dash panel away from console.



M84704

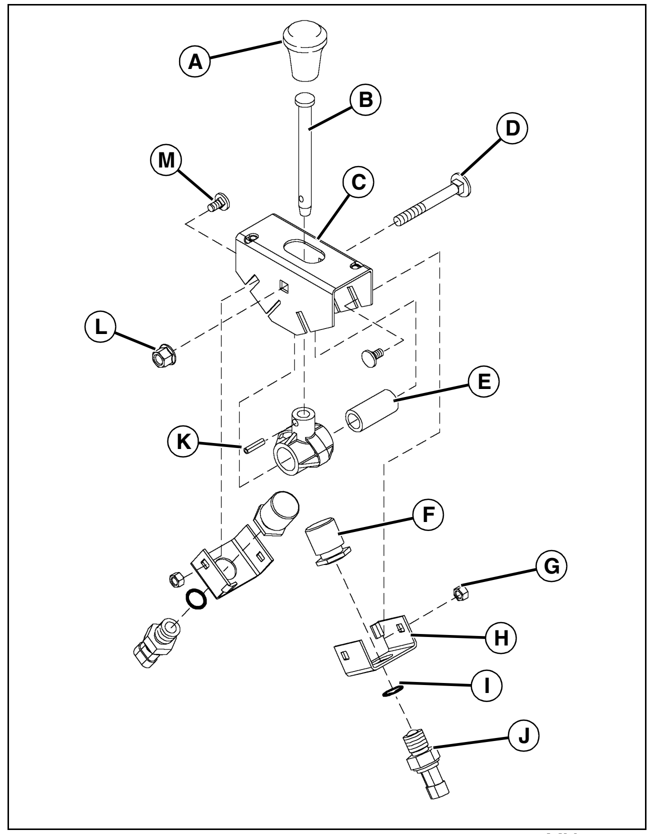
16.Remove mounting screws (H).

17.Remove lever assembly.

Installation

Installation is done in the reverse order of removal.

Repair Lift and Lower Lever Assembly - Models 2500, 2500A (S.N. -020000)



MX84701

A - Lever
B - Pin
C - Bracket
D - Bolt
E - Bushing
F - Push Button (2 Used)
G - Locknut (4 Used)
H - Bracket (2 Used)
I - O-Ring (2 Used)
J - Switch (2 Used)
K - Spring Pin
L - Locknut
M - Bolt (4 Used)

- Inspect all parts for damage. Replace parts as needed.
- Test switches. (See “Test Brake Switch or Test Lift and Lower Switch - Models 2500, 2500A (S.N. -020000)” on page 552.)

Repair Lift and Lower Lever Assembly - Models 2500A (S.N. 020000-), 2500E

The lift and lower switch for the above models cannot be repaired and must be serviced as an assembly.

- Test switches. (See “Test Lift and Lower Switch - Models 2500A (S.N. 020001-), 2500E” on page 552.)
- Replace switch assembly if switch tests defective.

Remove and Install Hydraulic Pump Assembly

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

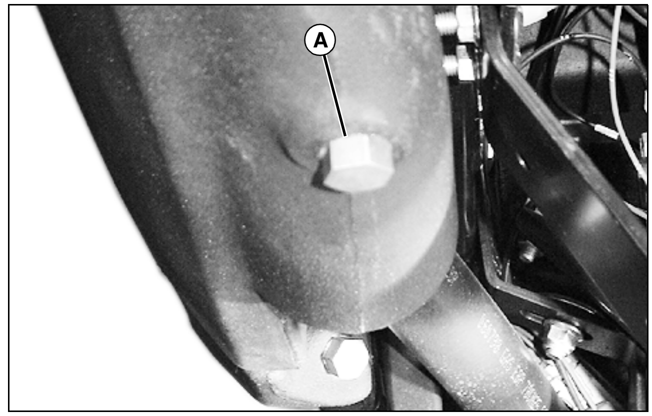
IMPORTANT: Avoid damage! Plug or cap all hydraulic lines and fittings to prevent contamination.

NOTE: Models 2500 and 2500A are shown throughout this procedure. The 2500E uses a two-layer pump instead of a three-layer pump.

Variations in hose routing exist between models. Record routing of hydraulic hoses and lines to assist in assembly.

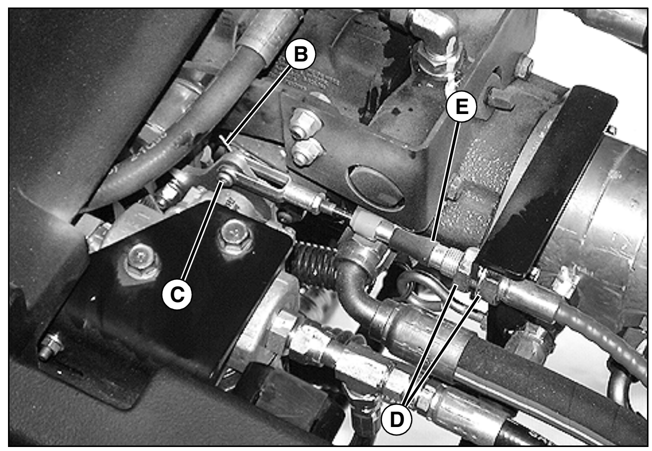
1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise and lock seat platform.

NOTE: Hydraulic system capacity is approximately 28.8 L (7.6 gal).



M84605

7. Remove drain plug (A) and drain oil into a clean container.

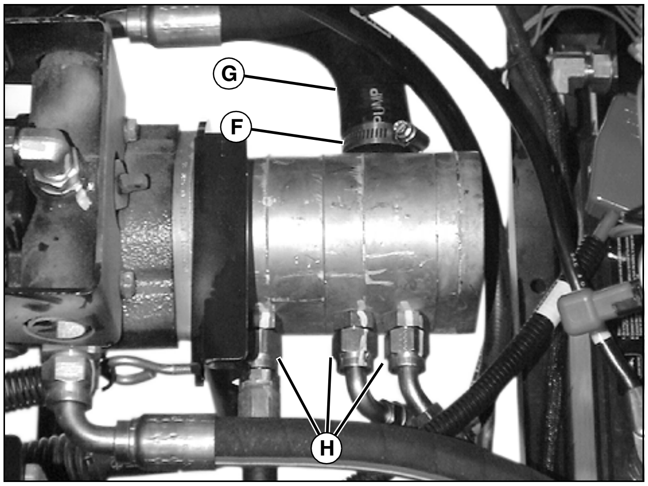


M84696

8. Remove cotter pin (B) and remove retainer pin (C) connecting cable to hydrostatic pump lever.
9. Loosen control cable locking nuts (D).
10. Remove control cable (E) from bracket and swing cable aside.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.

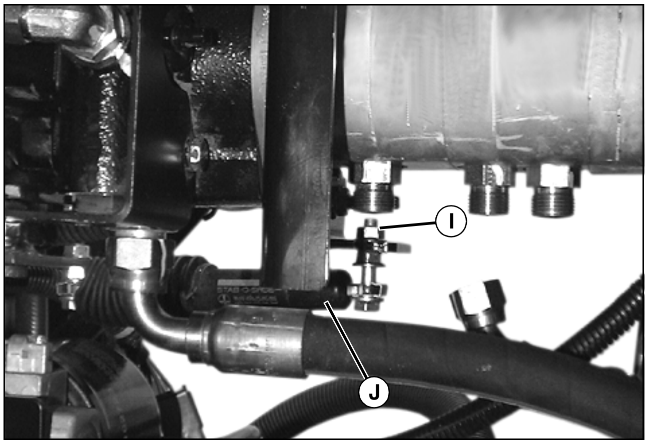


M84694

Picture Note: 2500 shown.

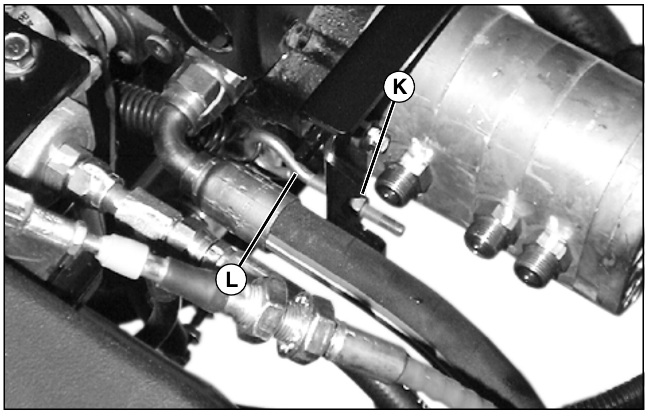
11.Loosen clamp (F) and disconnect pump supply hose (G).

12.Disconnect pump output hoses (H).



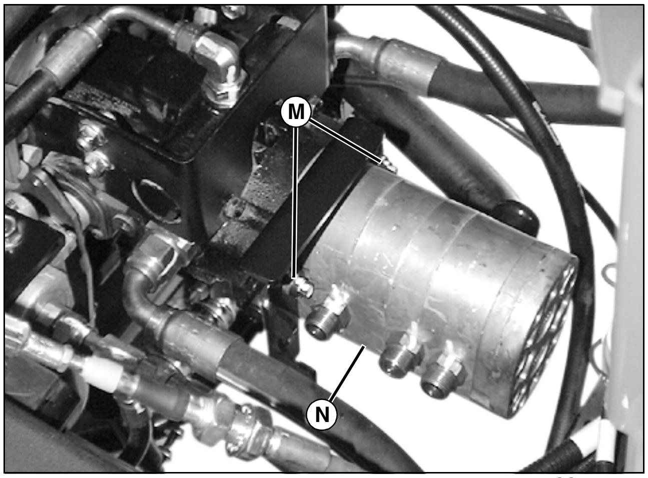
M84695

13.Remove nut (I) and disconnect dampener (J).



M84705

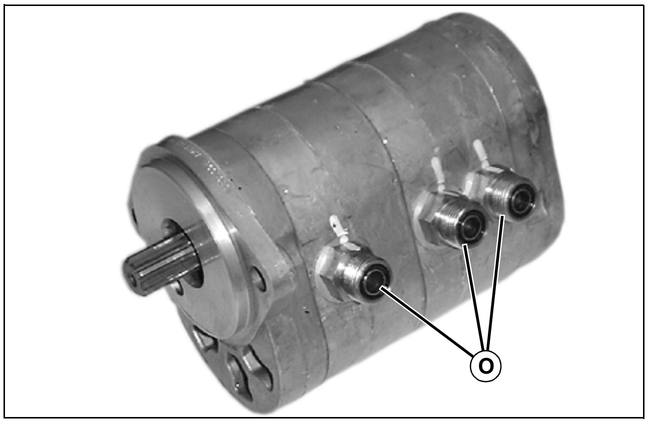
14.Remove nut (K) and remove eyebolt (L) from bracket.



M84697

15.Remove special mounting screws and washers (M).

16.Remove hydraulic pump assembly (N).

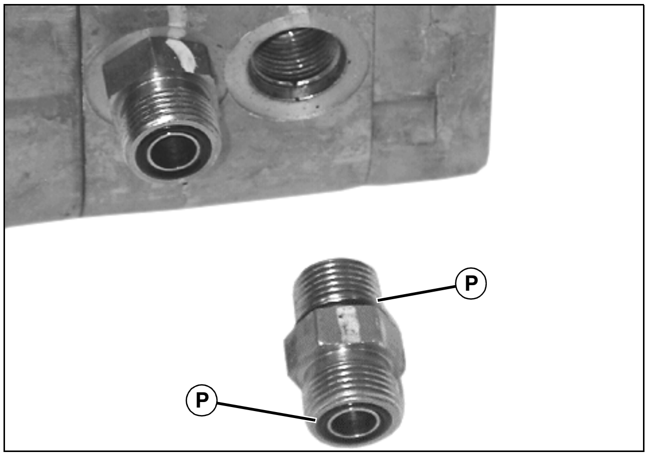


M84710

17.If hydraulic pump assembly is to be repaired, remove fittings (O).

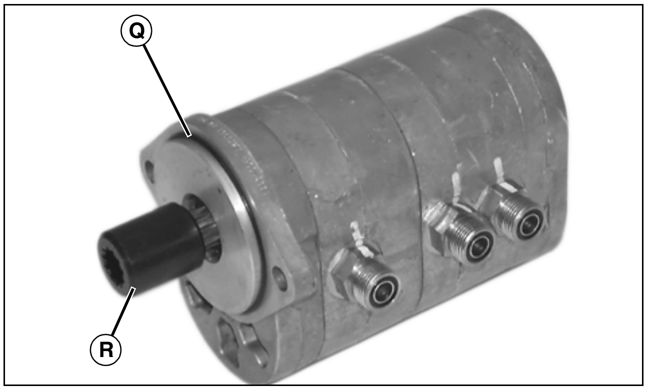
Installation

Installation is done in the reverse order of removal.



M84862

- Install new O-rings (P) on all fittings.



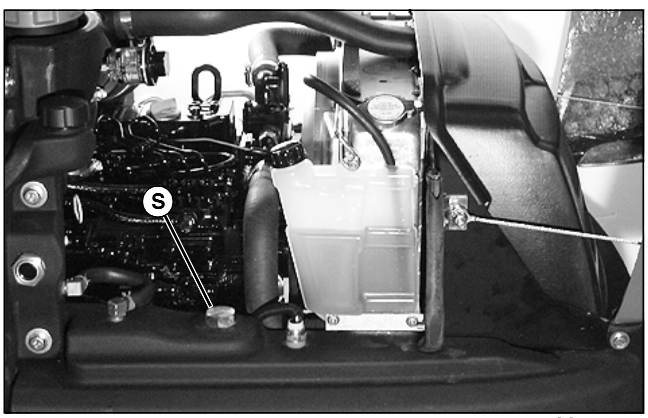
M84887

- Install new O-ring (Q) for installation.
- Install coupler (R).

NOTE: Hydraulic oil drained from the system in step 7 can be reused if the oil is clean and free of contaminants. Use a strainer when filling reservoir.

Fill main reservoir at the reservoir filler cap. Oil added at the expansion tank will not transfer to the reservoir quickly, resulting in an inaccurate oil level indication.

After main reservoir is 100% filled, run machine slowly to fill all lines. Add oil to main reservoir as needed to maintain level. Add oil to expansion tank until oil level is at the center of the sight glass.



M84567

- Apply pipe sealant with TEFLON to threads of drain plug (S).
- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)
- Check all connections for leaks. Repair as needed.
- Adjust control cable. (See “Adjust Hydrostatic Pump Control Linkage” on page 586.)

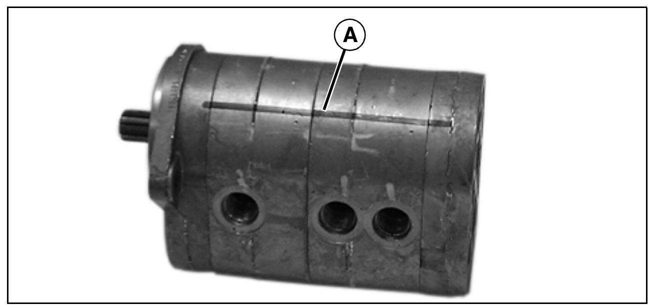
Disassemble and Inspect Hydraulic Pump Assembly

IMPORTANT: Avoid damage! Pump components are aluminum. Use caution when cleaning machined surfaces.

DO NOT pry components apart. If resistance is noticed, tap lightly on the input shaft using a plastic hammer.

NOTE: A three-layer pump is shown throughout this procedure. Model 2500E uses a two-layer pump that does not include the portion that powers the hydraulic reel motors. The repair procedures are similar.

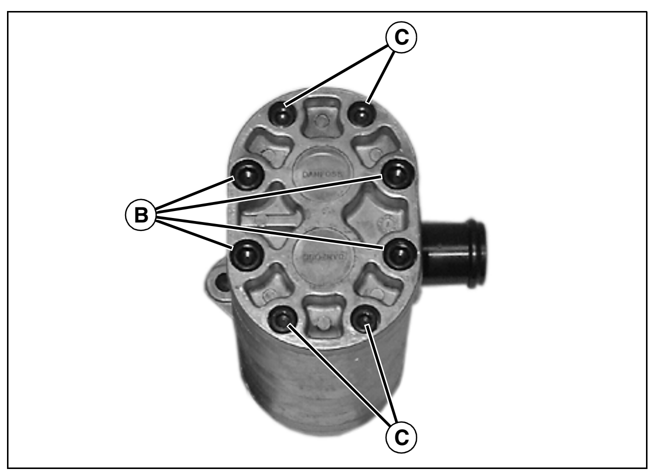
1. Thoroughly clean and dry the outside of the pump assembly.



M84856

2. Mark pump housing (A) with a solvent-resistant marker or paint to ensure correct assembly.

IMPORTANT: Avoid damage! Excessive clamping pressure will distort pump housing.

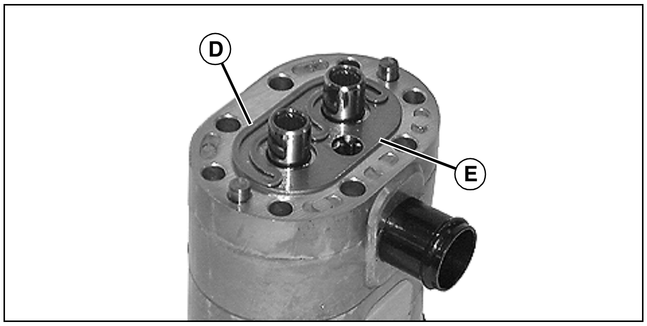


M84857

3. Place pump in a soft-jaw vise using just enough pressure to prevent the pump from turning while removing socket head cap bolts.
4. Remove four 3/8-inch socket head bolts (B) and four 5/16-inch socket head bolts (C) from end cover.

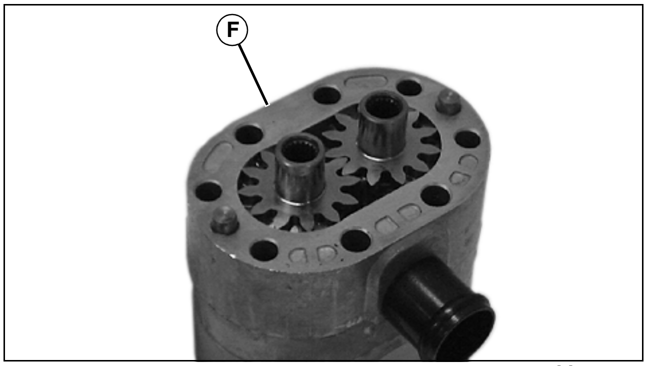
5. Remove end cover.

NOTE: Wear plate and "blue" seal may remain with end cover when the end cover is removed.



M84861

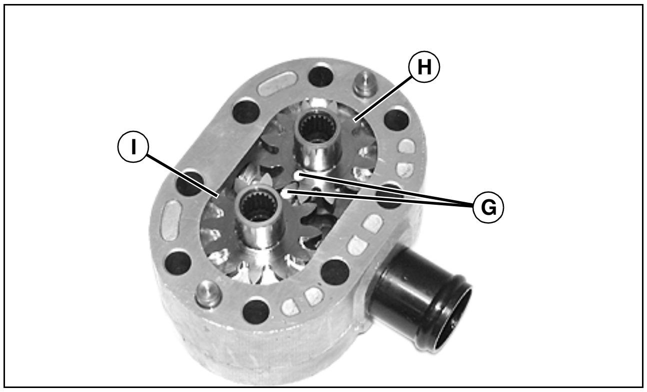
6. Remove "blue" seal (D) and wear plate (E).



M84863

7. Remove steering and charge pump (F).

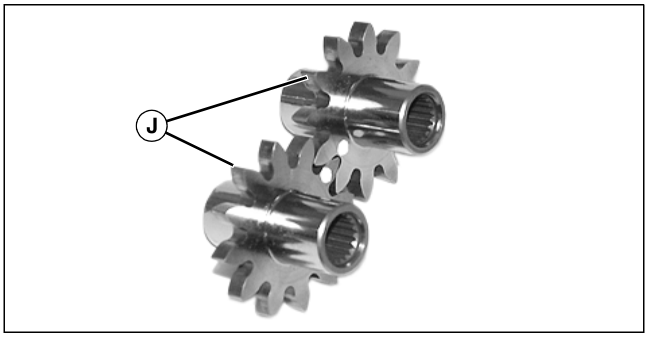
Steering and Charge Pump



M84873

1. Mark mating gear teeth (G) to ensure correct installation.

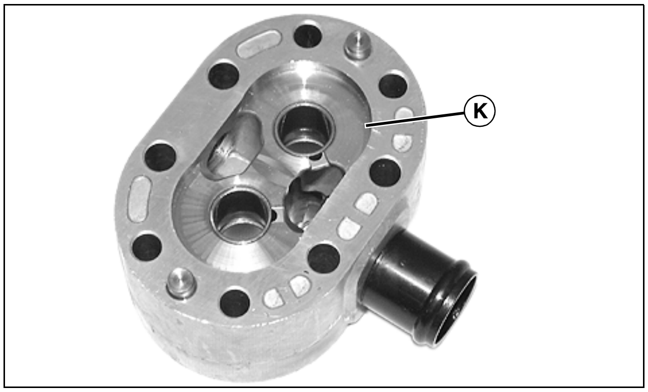
2. Remove drive gear (H) and driven gear (I).



M84874

3. Inspect gear teeth (J) for signs of excessive wear or damage.

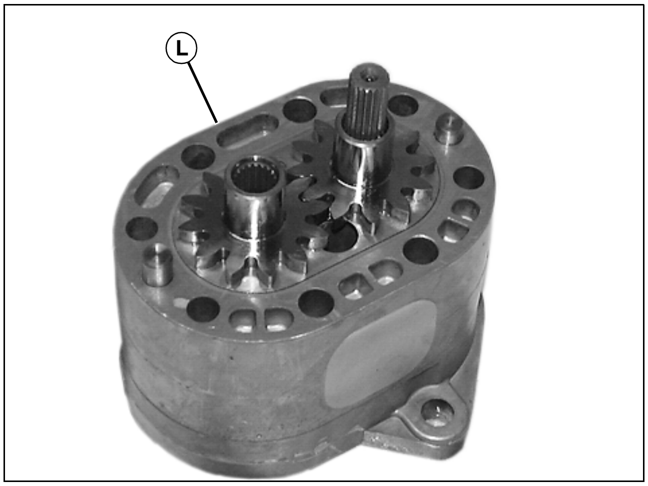
NOTE: Minor nicks and/or scratches are normal.



M84875

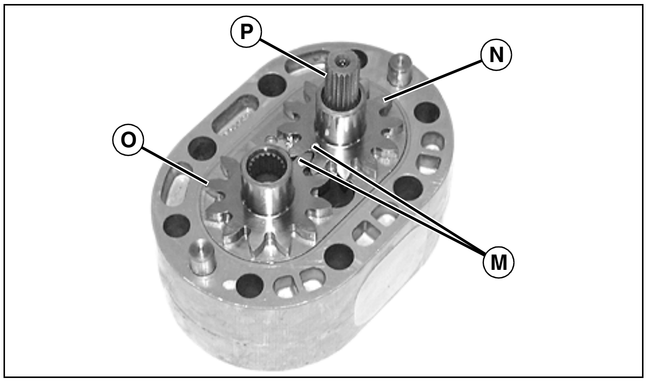
4. Turn housing over and inspect bore (K) for signs of excessive wear or damage, nicks and/or scoring.

Lift System Pump



M84864

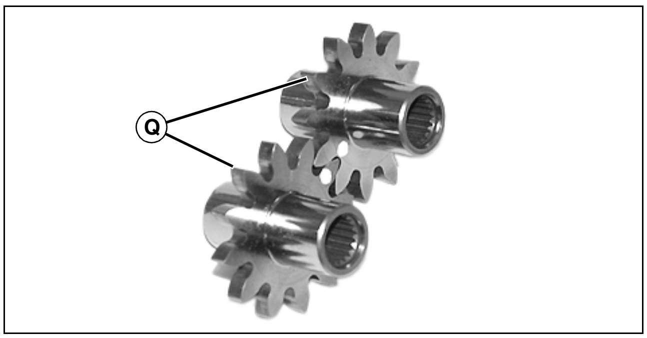
1. Remove lift pump (L).



M84869

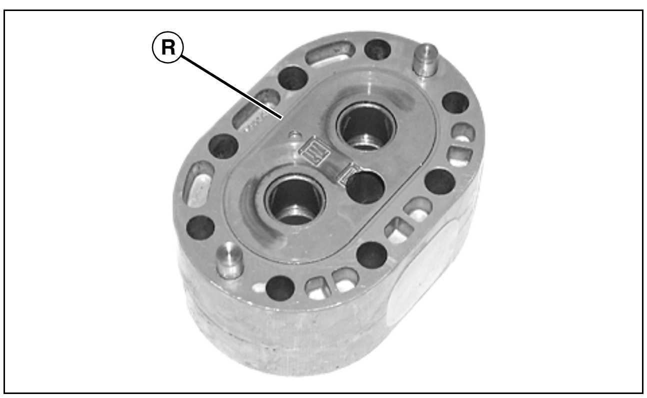
2. Mark mating gear teeth (M) to ensure correct installation.

3. Remove drive gear (N), driven gear (O) and splined coupler (P).



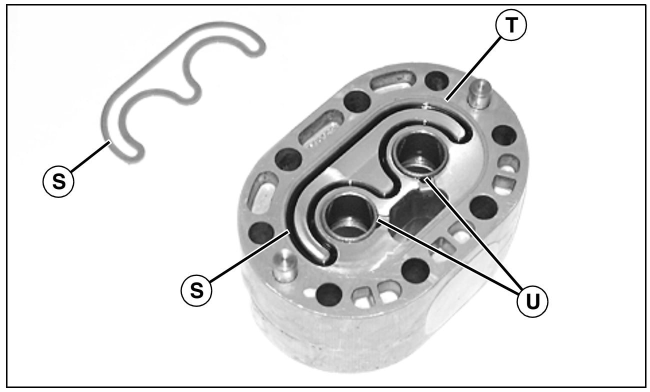
M84874

4. Inspect gear teeth (Q) for signs of excessive wear or damage.



M84870

5. Remove wear plate (R).

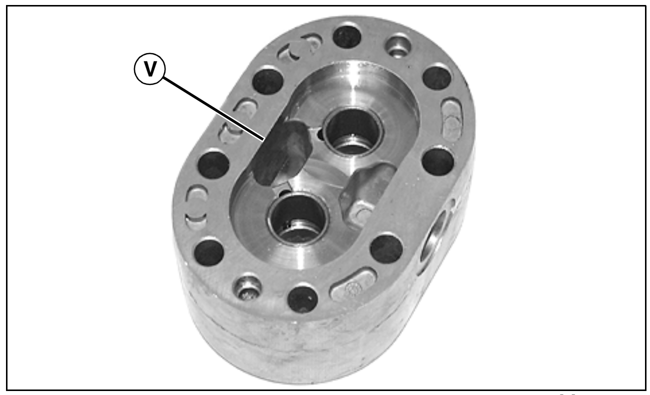


M84871

6. Remove seals (S) and O-ring (T).

7. Inspect oil passages (U) for obstructions.

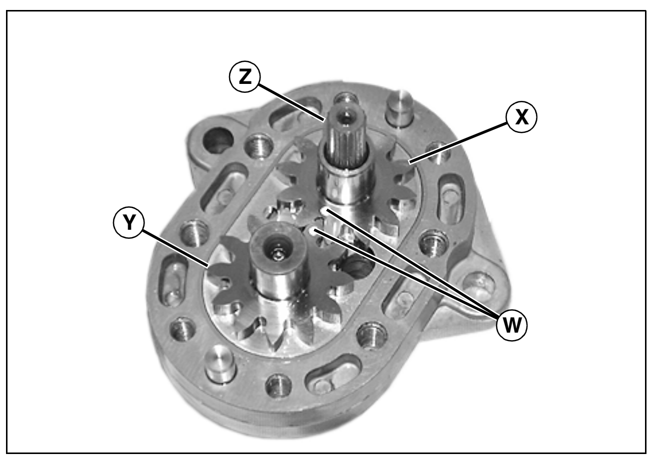
NOTE: Minor nicks and/or scratches are normal.



M84872

8. Turn housing over and inspect bore (V) for signs of excessive wear or damage, nicks and/or scoring.

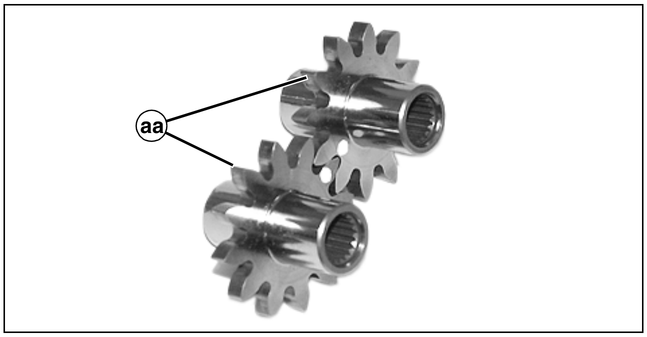
Reel Drive Pump



M84865

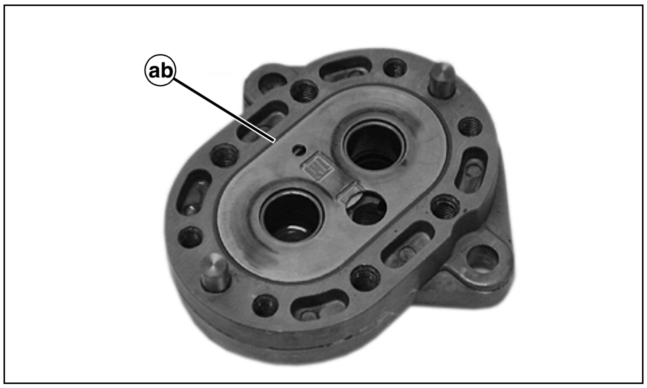
1. Mark mating gear teeth (W) to ensure correct installation.

2. Remove drive gear (X), driven gear (Y), and splined coupler (Z).



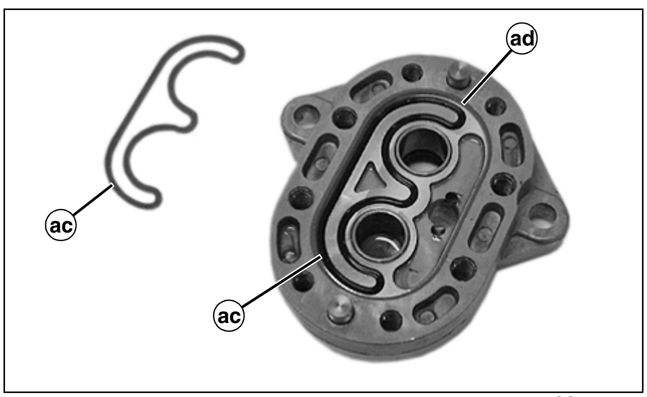
M84874

3. Inspect gear teeth (AA) for signs of excessive wear or damage.



M84866

4. Remove wear plate (AB).



M84867

5. Remove seals (AC) and O-ring (AD).

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

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on reel motor. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydrostatic/ hydraulic system and cause damage.

6. Clean all metal parts with solvent and blow dry with compressed air.

7. Inspect all parts for damage, nicks or unusual wear. Replace entire hydraulic pump assembly if any parts other than seals, wear plates and/or O-rings are worn or damaged.

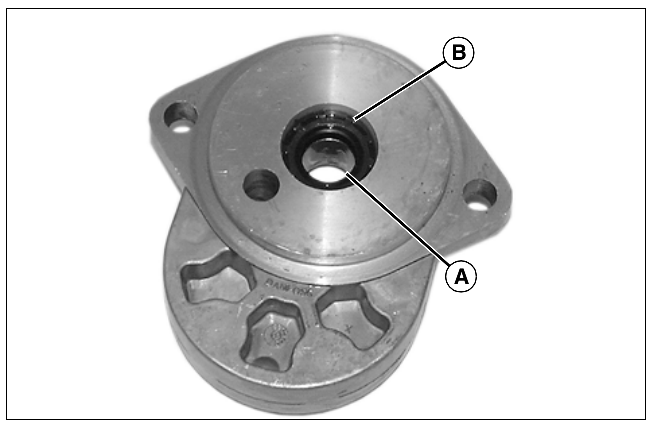
Assemble Hydraulic Pump Assembly

IMPORTANT: Avoid damage! Always use new O-rings, wear plates and seals. Damaged or used parts will leak

NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply a light coat of clean hydraulic oil to all internal parts when assembling hydraulic pump

Reel Drive Pump

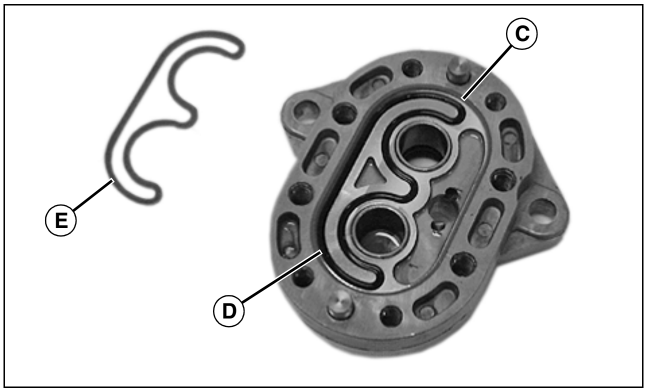


M84868

1. Apply multipurpose grease to lips of seal.

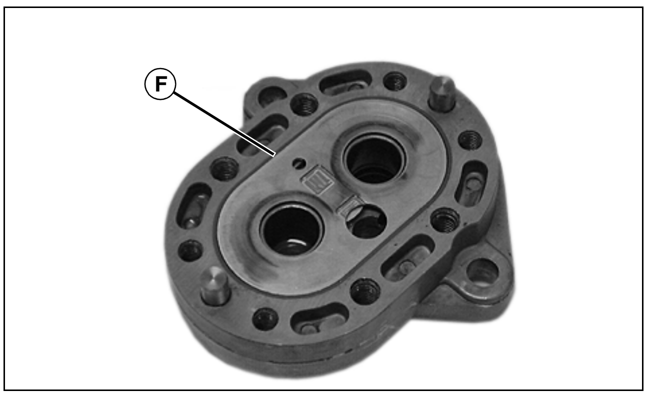
2. Install a new seal (A) parallel to the bore and seat tight against shoulder of bore.

3. Install retaining ring (B).



M84867

4. Install O-ring (C).
5. Install “black” seal (D) in housing.
6. Install “blue” seal (E) on top of black seal.

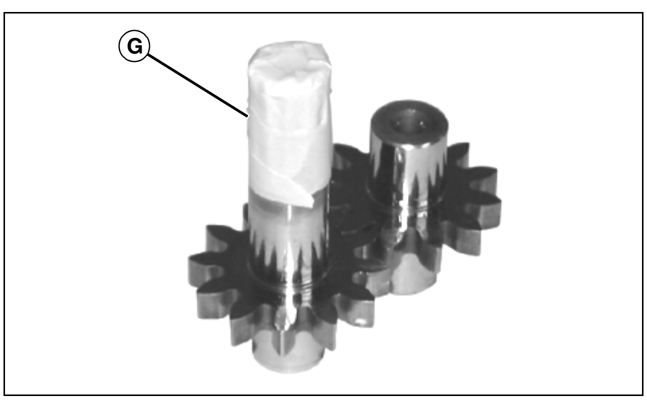


M84866

7. Apply a light coat of multipurpose grease to the back (seal side) of the wear plate (F).

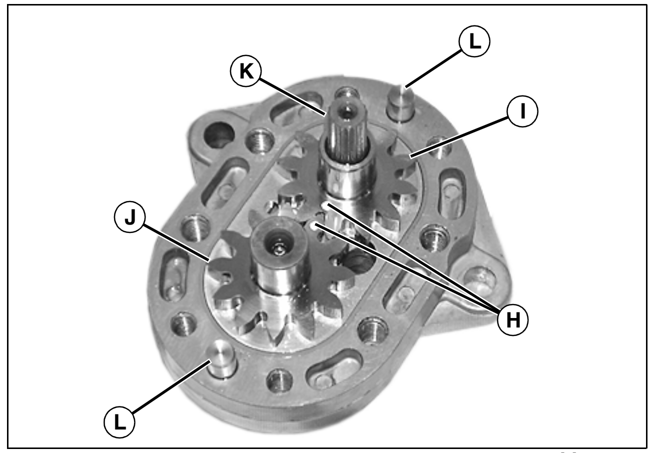
8. Install wear plate with bronze side facing away from seals.

NOTE: The repair kit may include a plastic sleeve.



M98186

9. Cover the splines of the input shaft with tape (or sleeve included with the repair kit) (G), to prevent damaging the seal during installation.



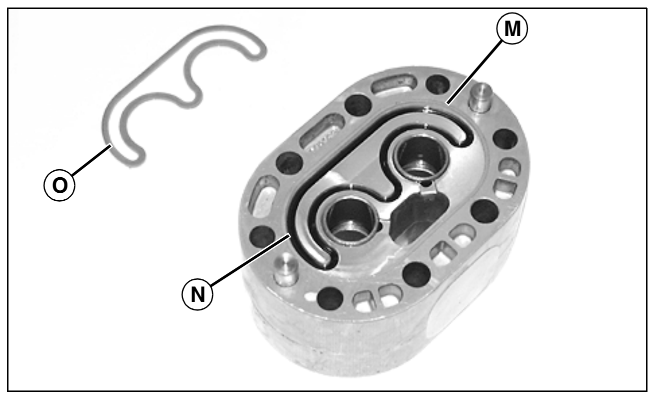
M84865

10. Align marks (H) and install drive gear (I) and driven gear (J).

11. Install splined coupler (K).

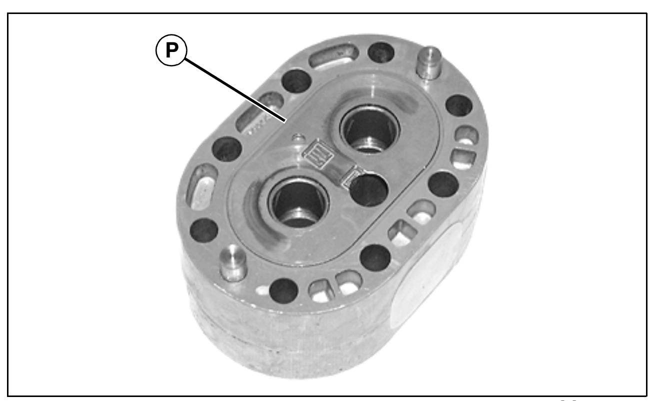
12. Install alignment pins (if removed) (L).

Lift System Pump



M84871

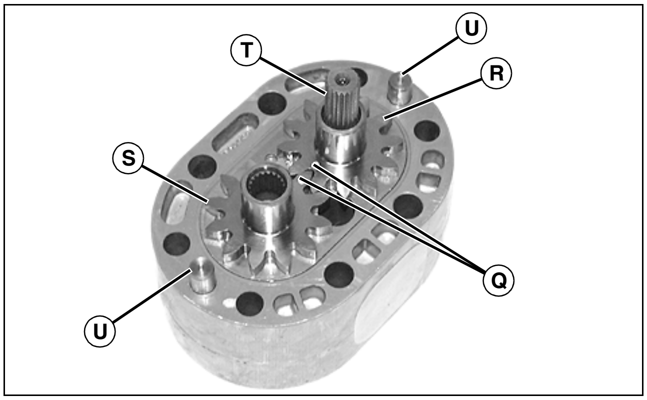
1. Install O-ring in housing (M).
2. Install “black” seal (N) in housing.
3. Install “blue” seal (O) on top of black seal.



M84870

4. Apply a light coat of multipurpose grease to the back (seal side) of the wear plate (P).

5. Install wear plate with bronze side facing away from seals.

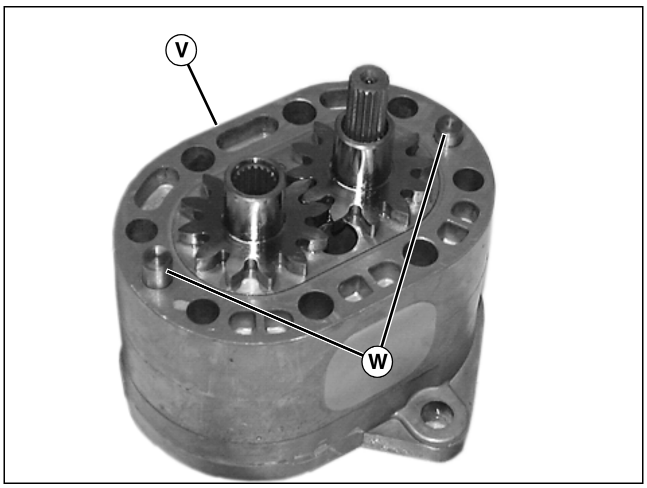


M84869

6. Align marks (Q) and install drive gear (R) and driven gear (S).

7. Install splined coupler (T).

8. Install alignment pins (if removed) (U).

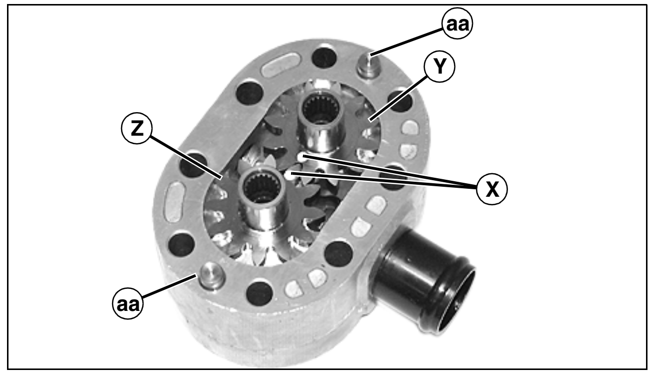


M84864

9. Install lift pump (V) on reel drive pump.

10. Install alignment pins (if removed) (W).

Steering and Charge Pump

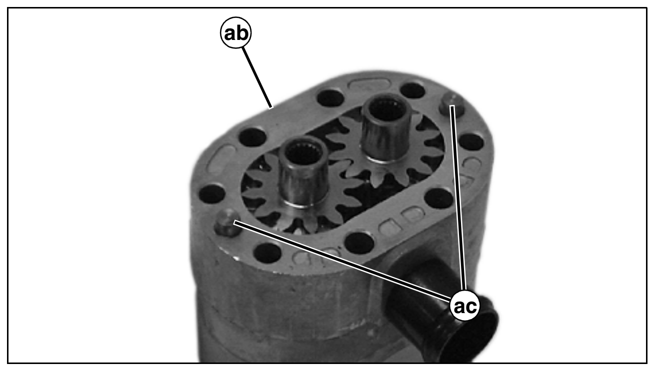


M84873

1. Align marks (X) and install drive gear (Y) and driven gear (Z).

2. Install splined coupler.

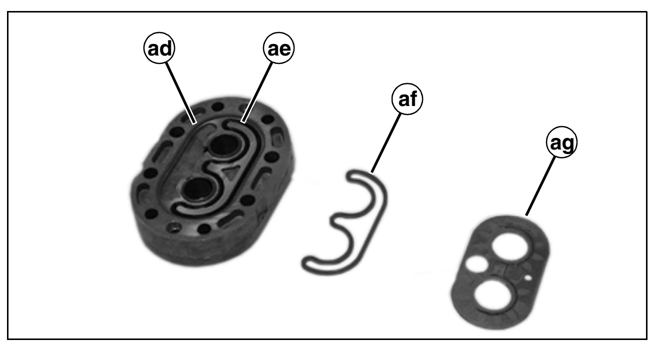
3. Install alignment pins (if removed) (AA).



M84863

4. Install steering and charge pump (AB).

5. Install alignment pins (if removed) (AC).



M84860

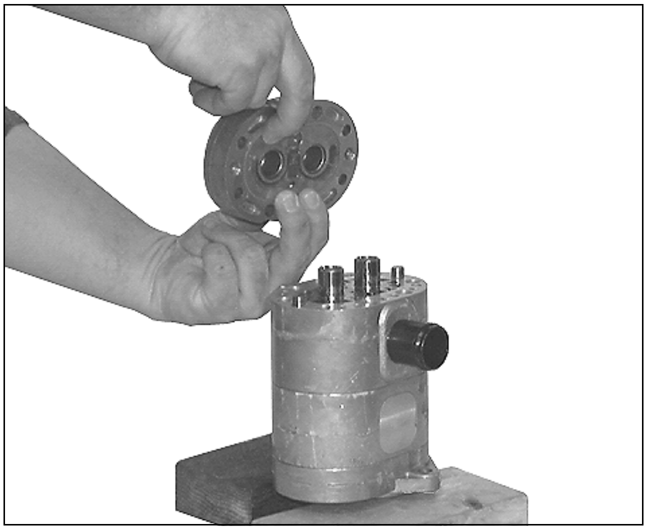
6. Install O-ring (AD) in end cover.

7. Install “black” seal (AE) in end cover.

8. Install “blue” seal (AF) on top of black seal.

9. Apply a light coat of multipurpose grease to the back (seal side) of the wear plate (AG).

10. Install wear plate on end cover with bronze side facing away from seals.

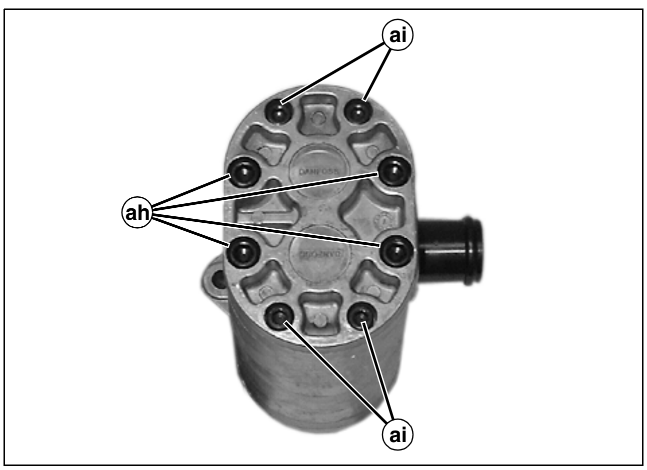


M84859

11.Hold wear plate in place, and install end cover on pump.

IMPORTANT: Avoid damage! Make sure that all parts are properly aligned before tightening end cover screws.

DO NOT force the end cap. Damage to seals and other components may result.



M84857

12.Install four 3/8-inch socket head bolts (hand tight) (AH).

13.Install four 5/16-inch socket head bolts (hand tight) (AI).

14.Rotate input shaft to verify that all parts are mating smoothly.

15.Tighten 3/8-inch socket head bolts in an alternating pattern to specification.

16.Tighten 5/16-inch socket head bolts in an alternating pattern to specification.

Specifications

3/8-Inch Socket Head Bolt Torque. . . . 42 N•m (31 Lb-ft)
5/16-Inch Socket Head Bolt Torque. . . 23 N•m (17 Lb-ft)

Remove and Install Reel Motor - 2500, 2500A

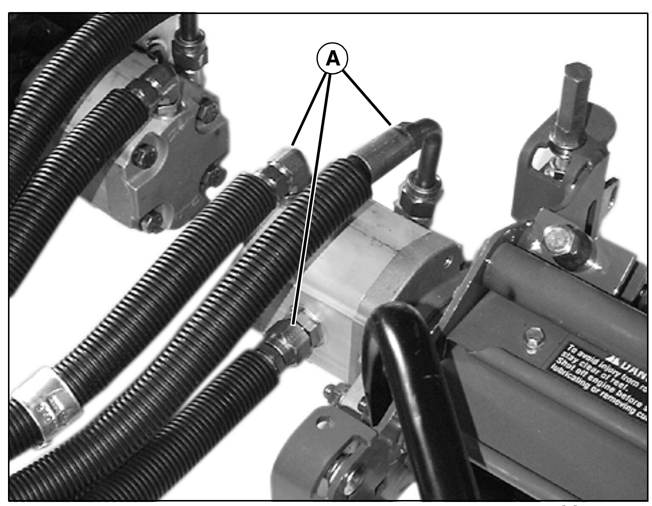
CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

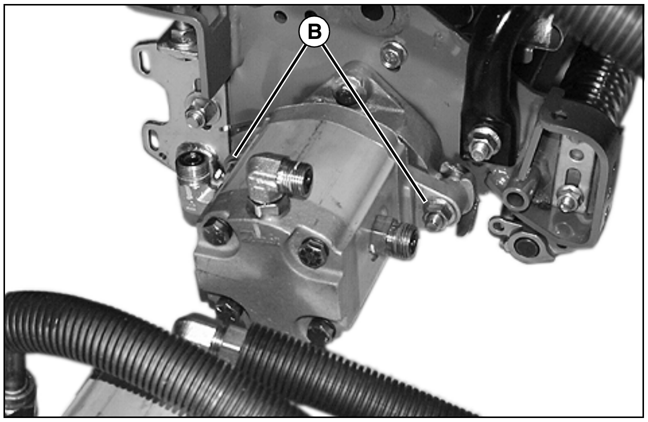
1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.



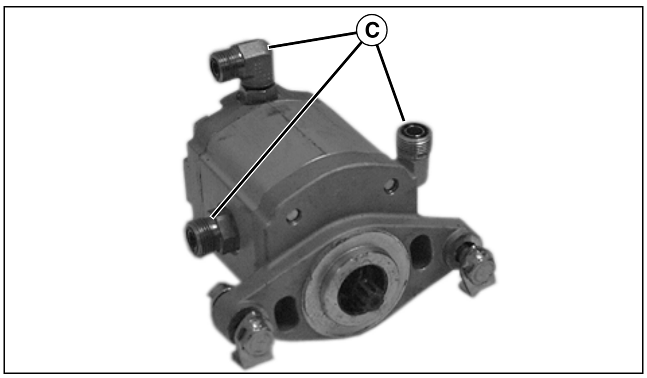
M84724

6. Remove and cap hydraulic hoses (A).



M84725

7. Loosen reel motor mounting cap screws (B).
8. Remove the reel motor.

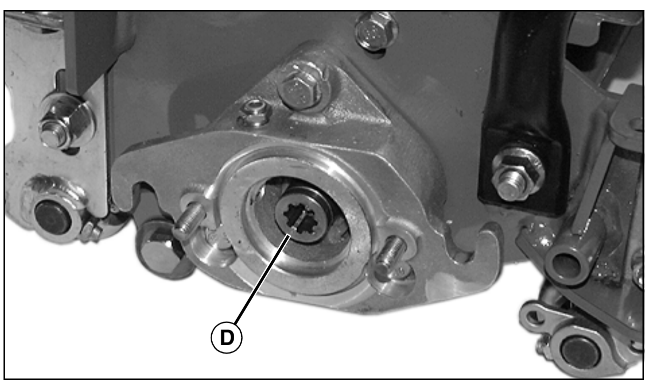


M84752

9. If the motor is to be repaired, remove fittings (C).

Installation

Installation is done in the reverse order of removal.



M84751

- Apply MPG-2 Multi-Purpose Grease to coupler (D). (See “Grease” on page 21.)
- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. See “Bleed Hydraulic System” on page 651.

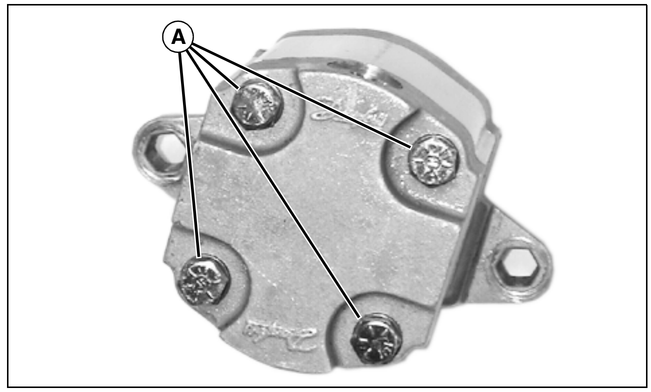
Disassemble and Inspect Reel Motor

1. Thoroughly clean and dry outside of motor.

IMPORTANT: Avoid damage! Never pry components apart. Light tapping with a plastic hammer on input shaft will separate components without burring.

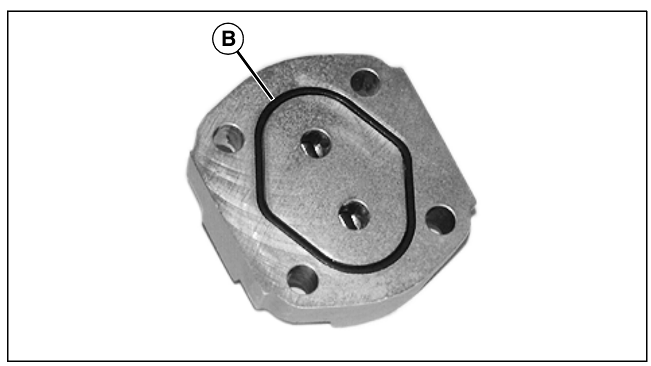
Be careful not to drop any parts or disengage gear mesh when separating assemblies.

Excessive clamping pressure will distort motor housing.



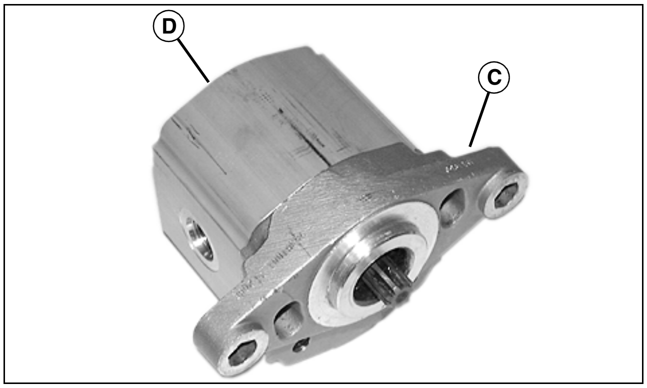
M84877

2. Place motor in a soft-jaw vise using just enough pressure to prevent the motor from turning when removing cap screws.
3. Remove four cap screws (A).
4. Remove end cover.



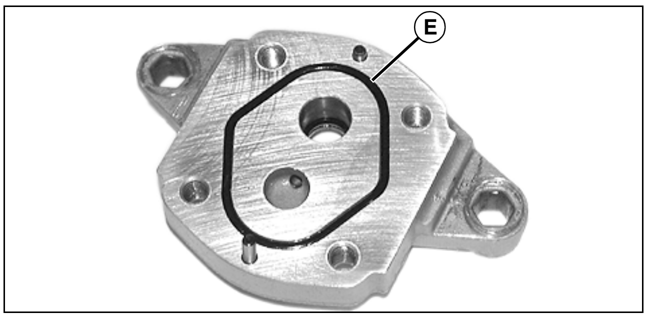
M84878

5. Remove O-ring (B) from end cover.



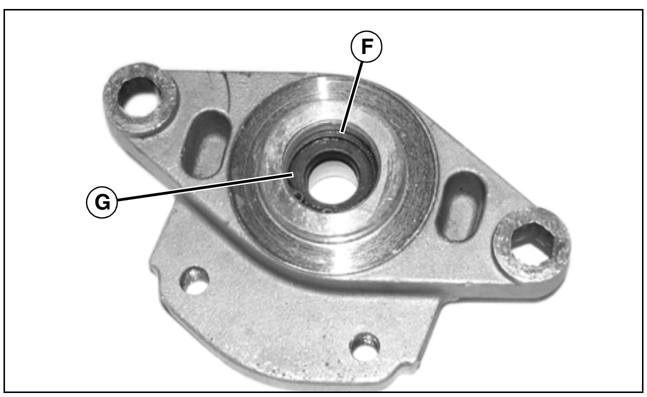
M84879

6. Separate front end cover (C) from main body (D).



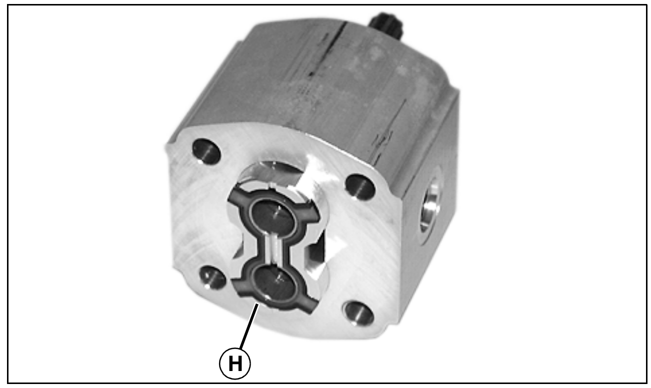
M84880

7. Remove O-ring (E) from front end cover.



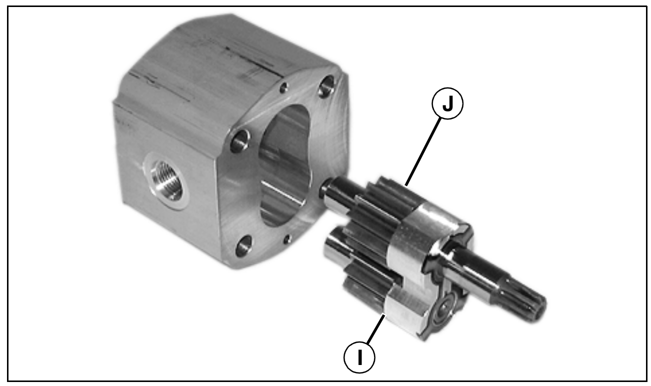
M84881

8. Remove retaining ring (F).
9. Remove seal (G).



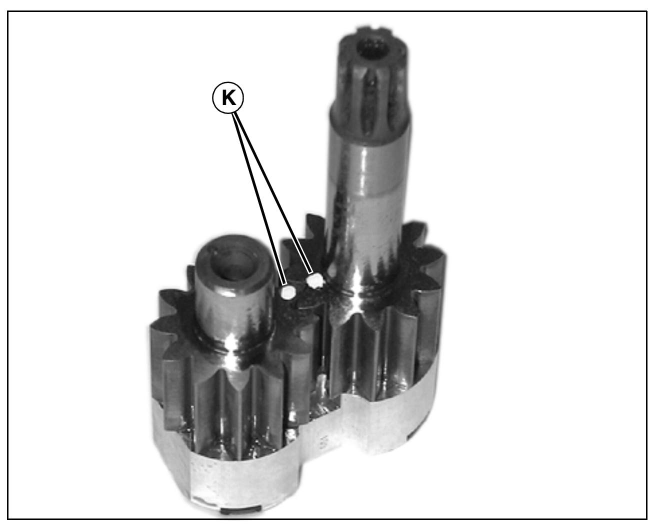
M84882

10.Remove rear wear block assembly (H).



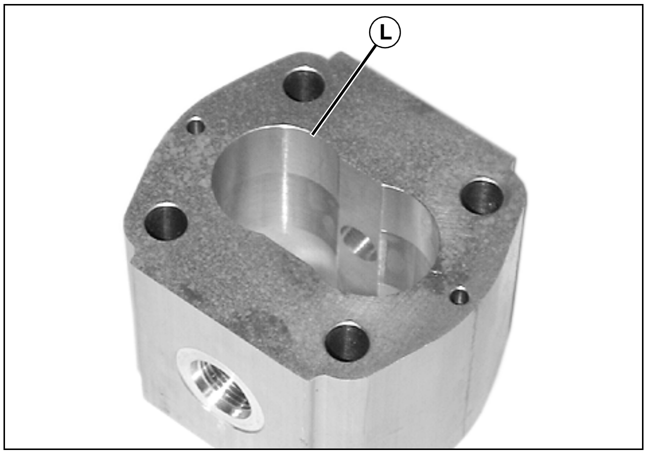
M84883

11.Remove front wear block assembly (I) and gear set (J).



M84885

12.Mark gear mating teeth (K) and remove gears from wear block assembly.



M84886

13.Inspect housing bore (L) for signs of damage.

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

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on reel motor. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydrostatic/ hydraulic system and cause damage.

14.Clean all metal parts with solvent and blow dry with compressed air.

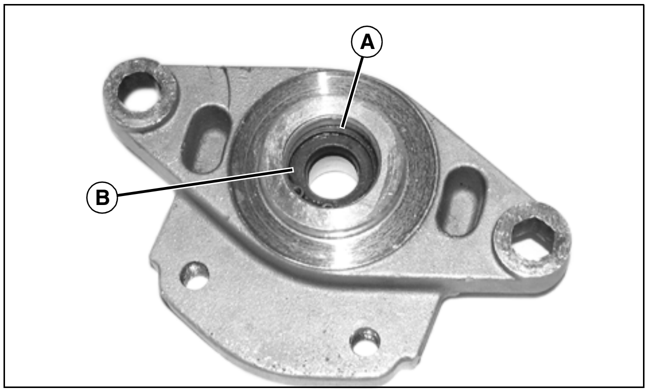
15.Inspect all parts for damage, nicks or unusual wear. Replace entire reel motor assembly if any parts other than seal rings, seals or outer bearing are worn or damaged.

Assemble Reel Motor

IMPORTANT: Avoid damage! Always use new O-rings. Damaged or used parts will leak.

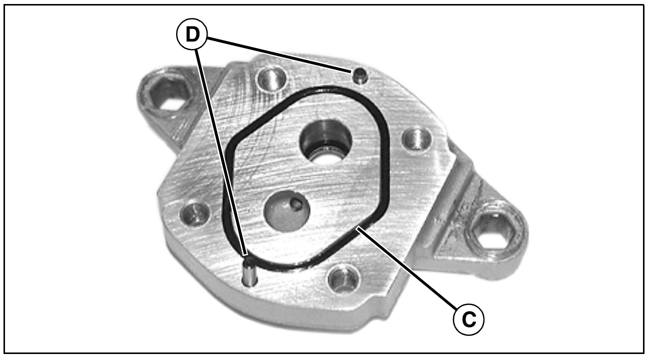
NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply a light coat of clean hydraulic oil to all internal parts when assembling the reel motor



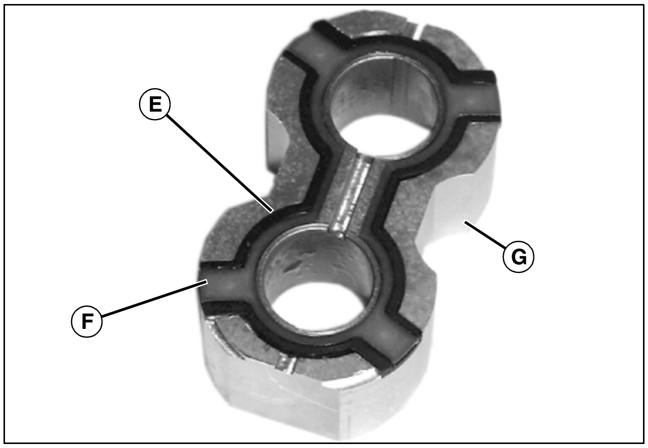
M84881

1. Apply multipurpose grease to lips of seal (A).
2. Install a new seal parallel to the bore and seat tight against shoulder of bore.
3. Install retaining ring (B).



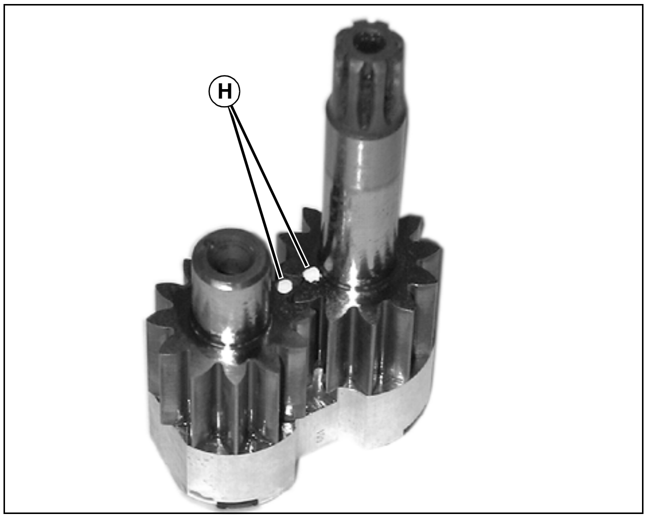
M84880

4. Install new O-ring (C).
5. Install alignment pins (if removed) (D).



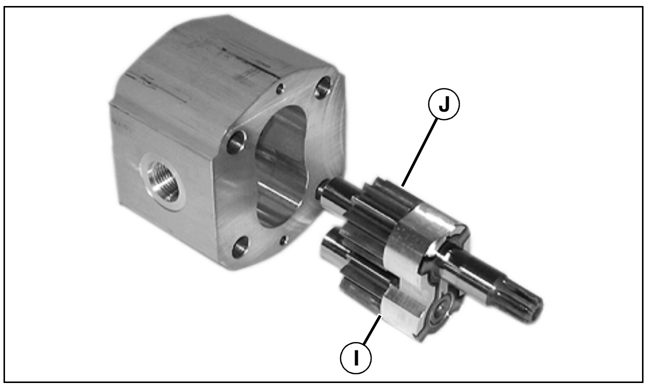
M84884

6. Install new seals (E) and spreaders (F) in wear block (G).



M84885

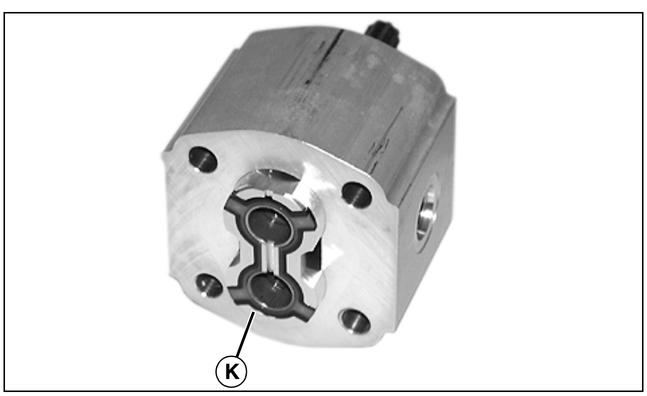
7. Align marks (H) and install gears in wear block.



M84883

8. Apply a light coat of clean hydraulic oil to wear block (I) gear set (J) assembly.

9. Install front wear block and gear set assembly in housing.

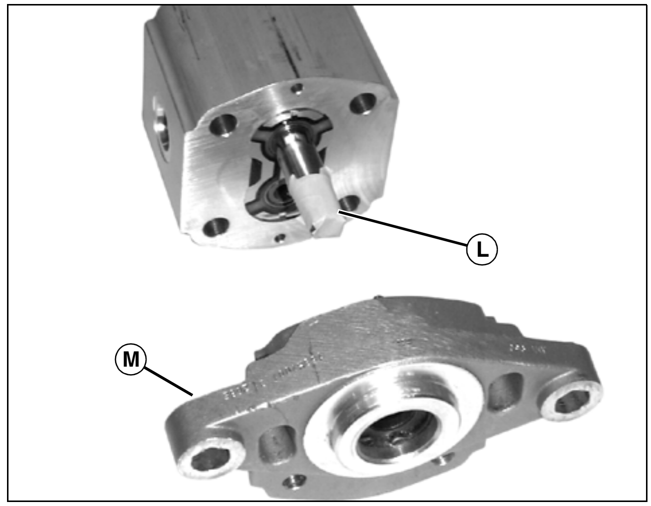


M84882

10.Apply a light coat of clean hydraulic oil to wear block gear set assembly

11.Install rear wear block and gear set assembly (K) in housing.

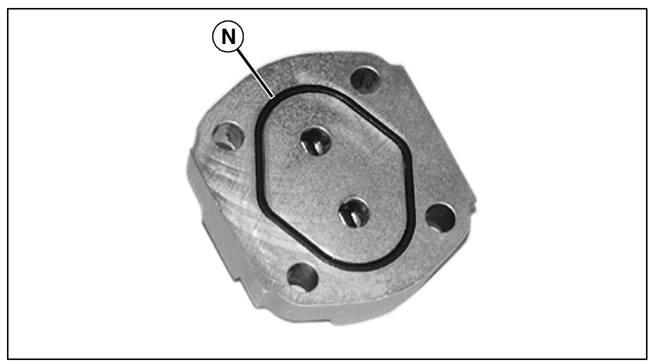
NOTE: The repair kit may include a plastic sleeve.



M98191

12.Cover the splines of the input shaft with tape (or sleeve included with the repair kit) (L), to prevent damaging the seal during installation.

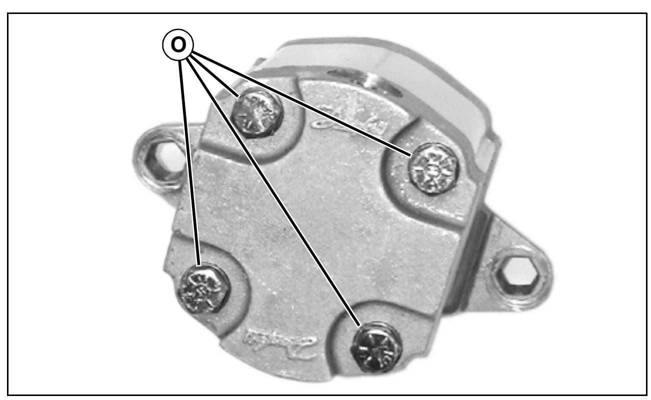
13.Install front cover (M).



M84878

14.Install new O-ring (N) in rear cover.

15.Install rear cover.



M84877

16.Install cap screws (O) hand tight.

17.Rotate input shaft to verify that all parts are mating smoothly.

18.Tighten cap screws in an alternating pattern to specification.

Specifications

Reel Motor Rear Cover Cap Screw
Torque . . . . 42 N•m (31 lb-ft)

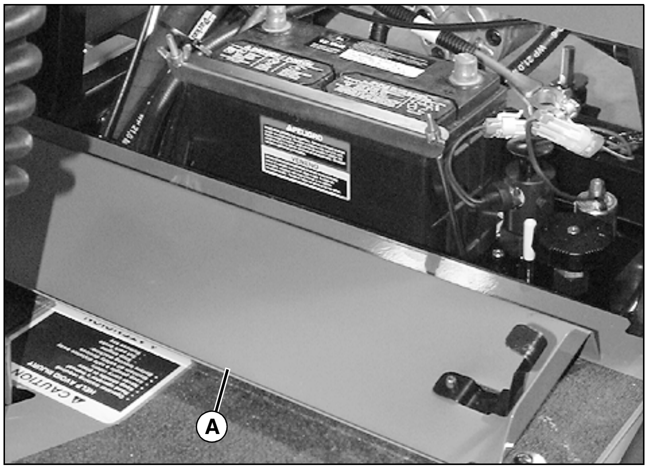
Remove and Install Mow and Backlap Valve

> **CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.**
>
> - **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
> - **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

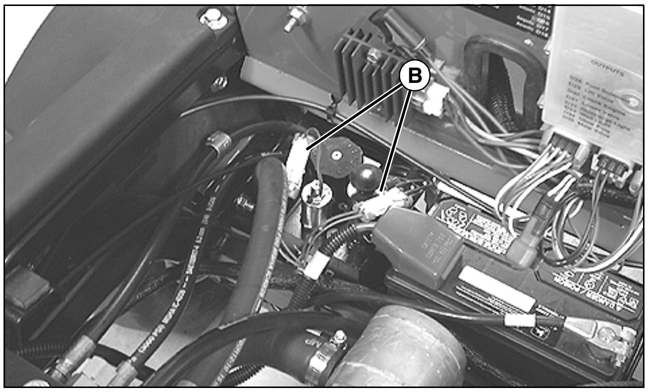
1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise and latch seat platform.

NOTE: 2500 model shown. Procedure is the same for 2500A models.



M84580

7. Open front access panel (A).

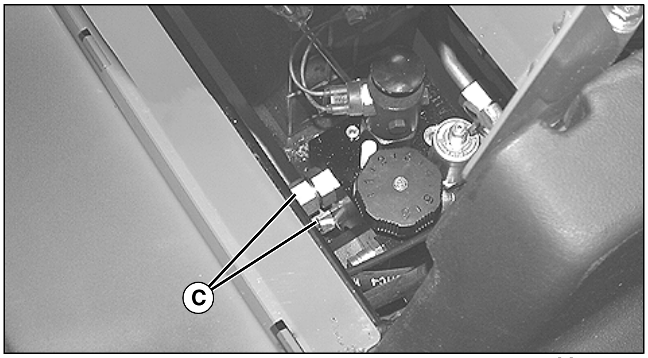


M84720

8. Disconnect wiring connectors (B).

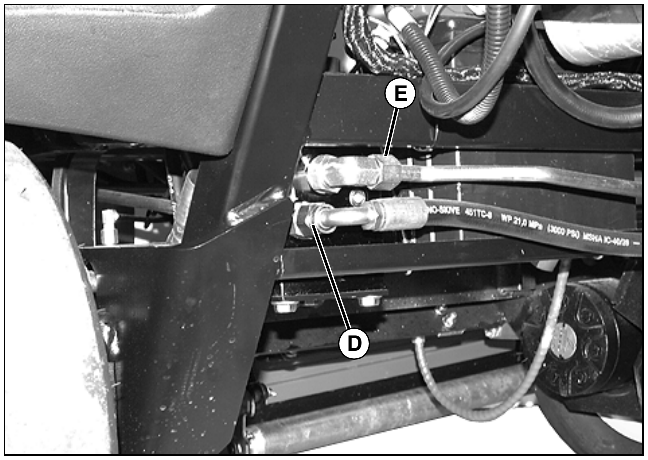
NOTE: Mark all hydraulic lines before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M84721

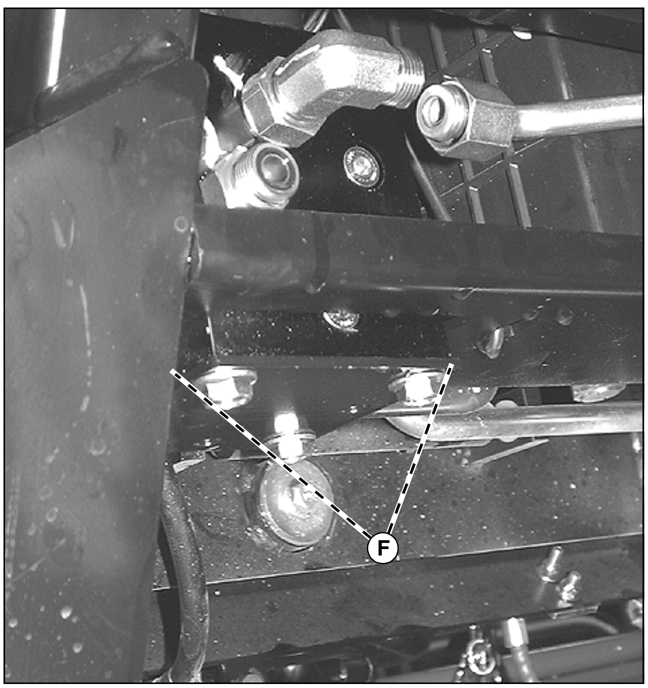
9. Disconnect and cap front hydraulic lines (C).



M84722

10.Disconnect and cap hose (D) from lift pump from port “P”.

11.Disconnect and cap return line (E) from port “T”.



M84723

12.Remove two round head bolts and nuts (F) from the valve bracket.

13.Remove mow and backlap valve and bracket.

Installation

Installation is done in the reverse order of removal.

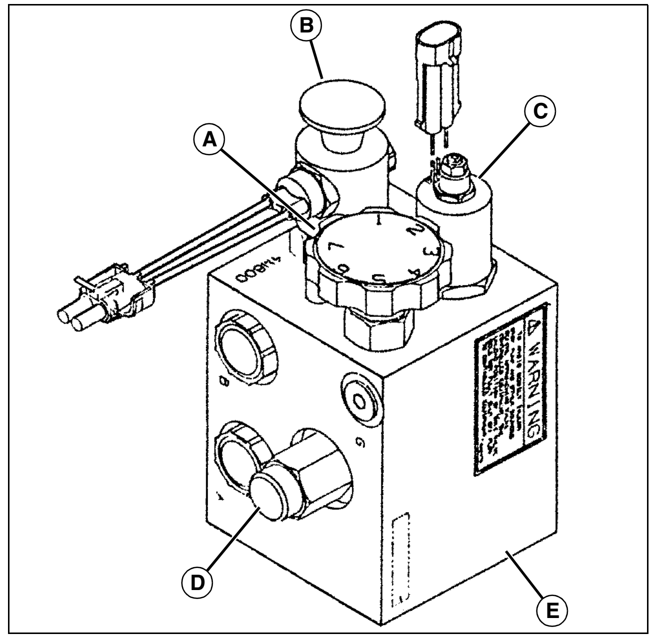
• Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)

• Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Disassemble and Inspect Mow and Backlap Valve

The valve body is a single machined block. The valves may be removed and inspected for wear, and seals replaced.

NOTE: 2500 model valve shown. 2500A models similar.



M56667A

A - Flow Control Valve
B - Backlap Valve
C - Mow Valve
D - Logic Element
E - Valve Body

IMPORTANT: Avoid damage! Absolute cleanliness is essential when working on valve components. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

• Clean all parts with a suitable solvent. Clean bores with a brush hone and solvent.

• Inspect bores in valve housing for scoring.

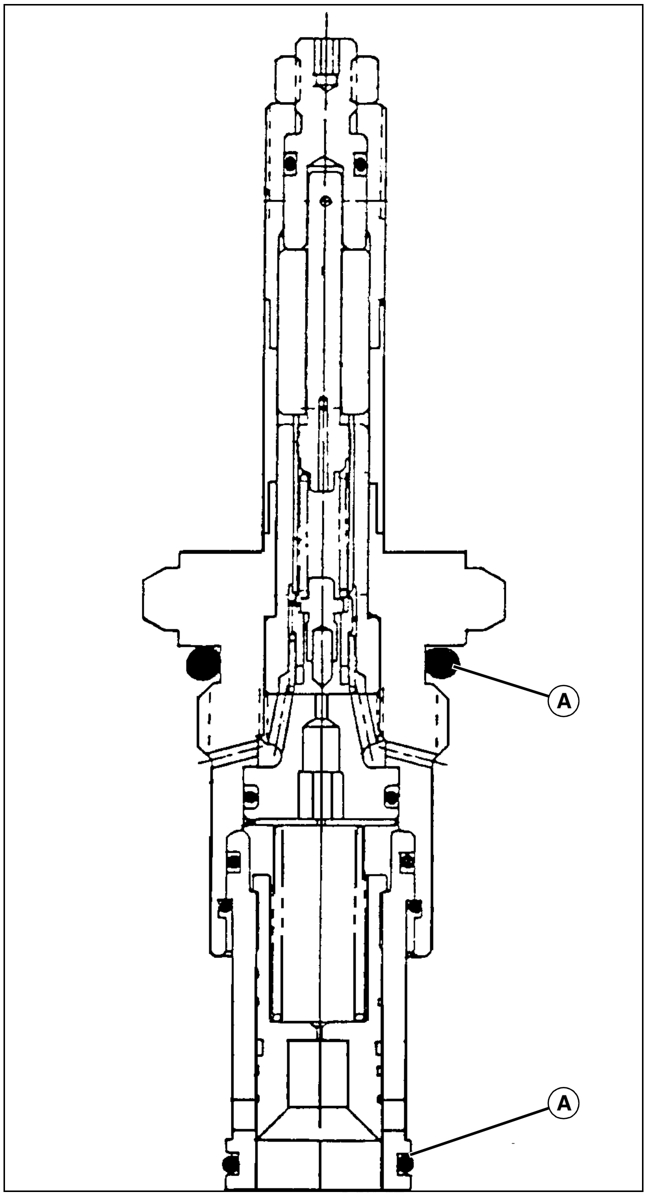
• Inspect spools for scoring, fretting and straightness.

Assemble Mow and Backlap Valve

IMPORTANT: Avoid damage! Always use new O-rings. Damaged or used O-rings will leak.

The following diagrams show seal placement for individual components:

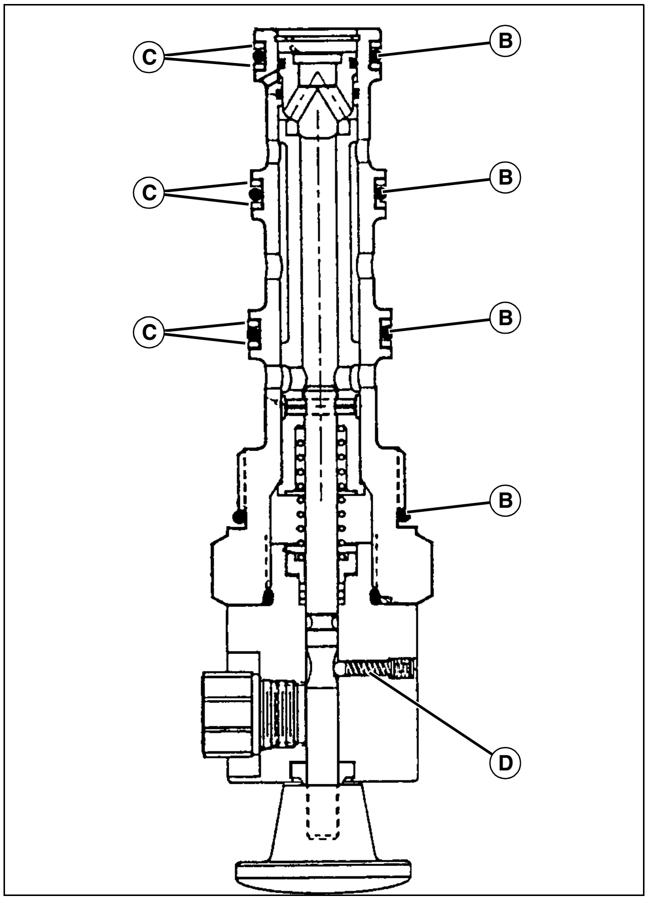
Mow Valve



M56666

Verify that O-rings (A) are installed and lubricated before installing plunger.

Backlap Valve



M56665

1. Verify that O-rings (B) are installed between back-up washers (C).

2. Install base O-ring.

3. Lubricate O-rings and back-up washers before installing valve.

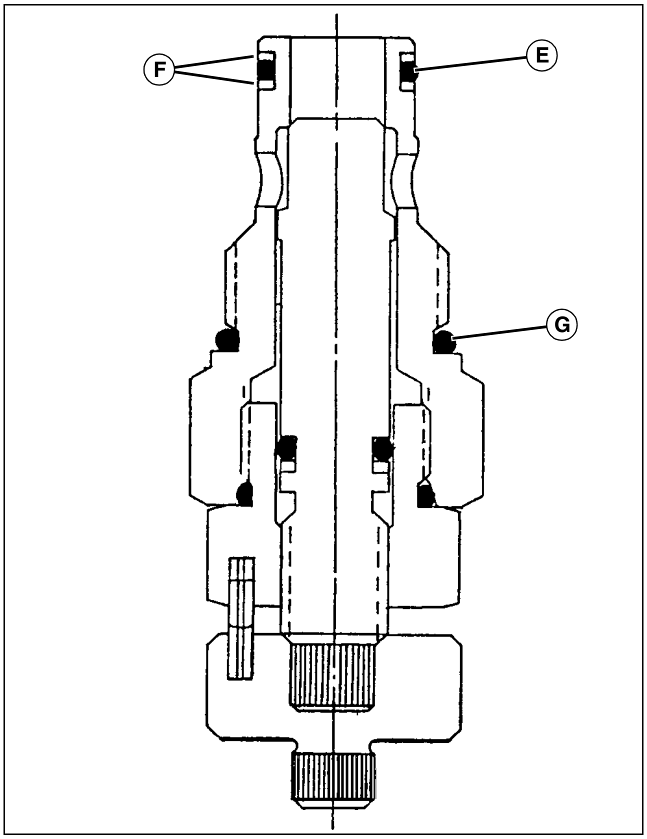
NOTE: Steps 4 and 5 for 2500 only.

4. Install detent ball and spring (D). Secure with allen head retainer.

NOTE: Detent ball and spring must be adjusted with machine running and system under pressure.

5. Adjust detent tension with system under pressure. Proper tension is achieved when the direction control knob stays IN with the system pressurized.

Flow Control Valve



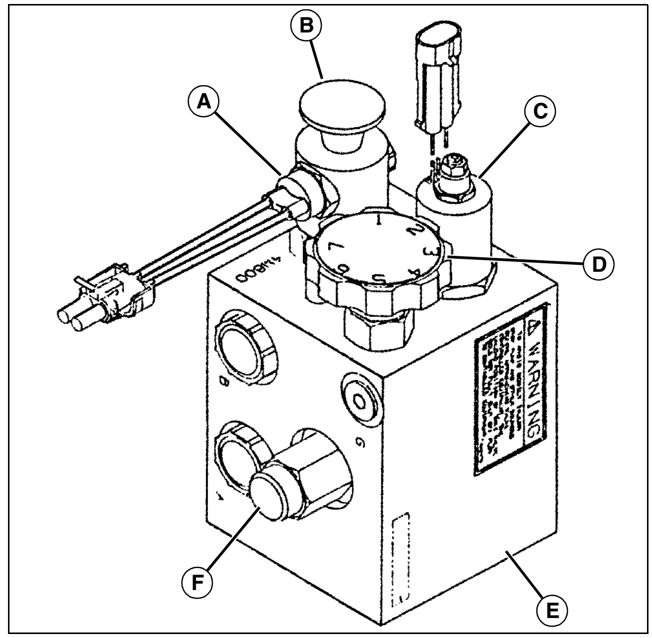
M56664

1. Verify that the small O-ring (E) is installed between back-up washers (F).

2. Install large O-ring (G).

3. Lubricate O-rings and back-up washers before installing flow control valve.

NOTE: Lubricate all O-rings with petroleum jelly before installing valves.



M56667A

A - Ball Switch
B - Backlap Valve
C - Mow Valve
D - Flow Control Valve
E - Valve Body
F - Logic Element

4. Lubricate all O-rings with petroleum jelly before installing valves.

5. Apply clean hydrostatic/hydraulic oil to all internal parts before assembly.

6. Tighten mow valve to specification.

7. Tighten flow control valve to specification.

8. Tighten logic element to specification.

9. Tighten ball switch to specification.

10. Tighten direction valve to specification.

11. Tighten solenoid coil retaining nut to specification.

Specifications

Mow Valve Torque . . . . 31 N•m (23 Lb-ft)
Flow Control Valve Torque . . . . 64 N•m (47 Lb-ft)
Logic Element Torque . . . . 64 N•m (47 Lb-ft)
Ball Switch Torque . . . . 17 N•m (150 Lb-in.)
Direction Valve Torque. . . . . 237 N•m (175 Lb-ft)
Solenoid Coil Retaining Nut Torque . . 8 N•m (70 Lb-in.)

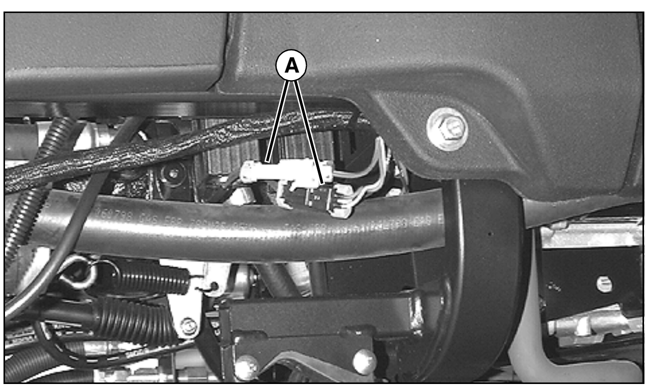
Remove and Install Lift Valve

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.
6. Raise and lock seat platform.

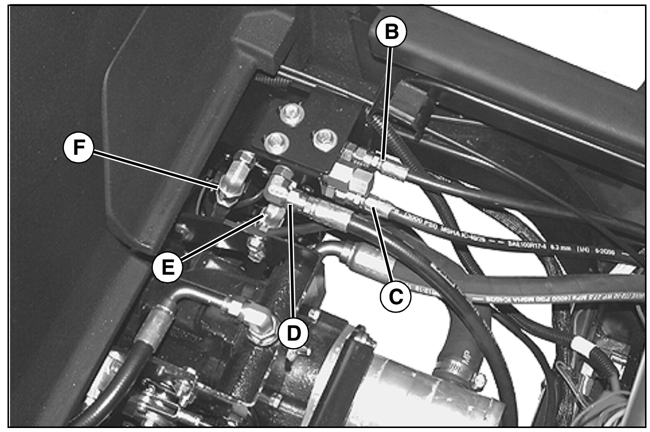


M98507

7. Disconnect wiring connectors (A).

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

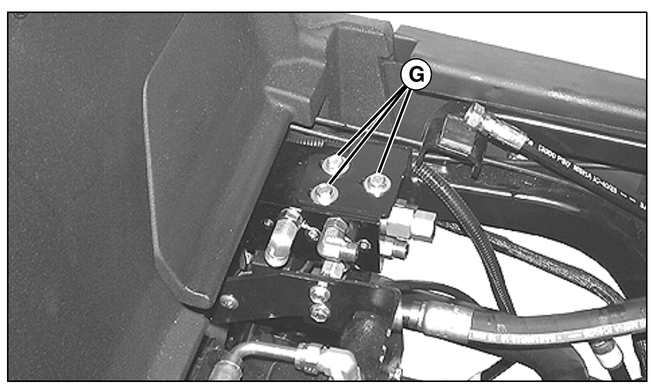
Place drip pan under machine to catch oil that will leak out when hoses are disconnected.



M98513

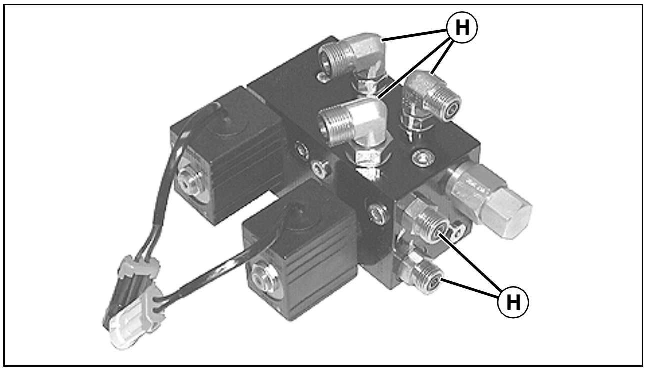
Picture Note: 2500 shown. 2500A is similar.

8. Disconnect and cap hose at port R (B) (to front lift cylinder).
9. Disconnect and cap hose at port T1 (C) (to front lift cylinder - rod end).
10. Disconnect and cap hose at port P (D) (to hydraulic pump assembly - lift pump).
11. Disconnect and cap hose at port T (E) (to hydraulic reservoir - center fitting).
12. Disconnect and cap hose from port R2 (F) (to rear lift cylinder - rod end).



M98514

13. Remove three cap screws and washers (G).
14. Remove lift valve.



M98515

15.If the valve is to be replaced, remove the fittings (H).

Installation

Installation is done in the reverse order of removal.

- Tighten to input hose (port P) connection to specification.
- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Specifications

Input Hose (Port P) Connection Torque . 25 N•m (18 Lb-ft)

Remove and Install Front Lift Cylinder

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

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

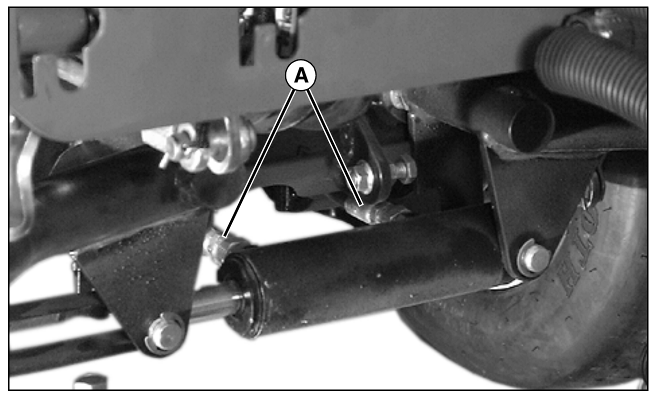
• If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.

Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Move mow and transport lever to TRANSPORT position.
4. Turn key switch to STOP position and allow the machine to cool.
5. Engage park brake.

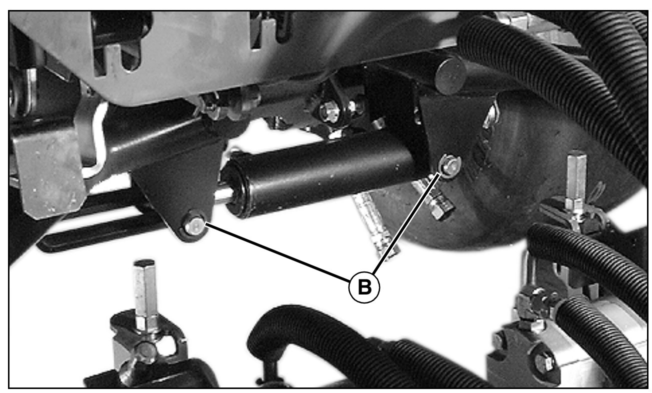
NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



M84778

6. Disconnect and cap hoses (A).



M84779

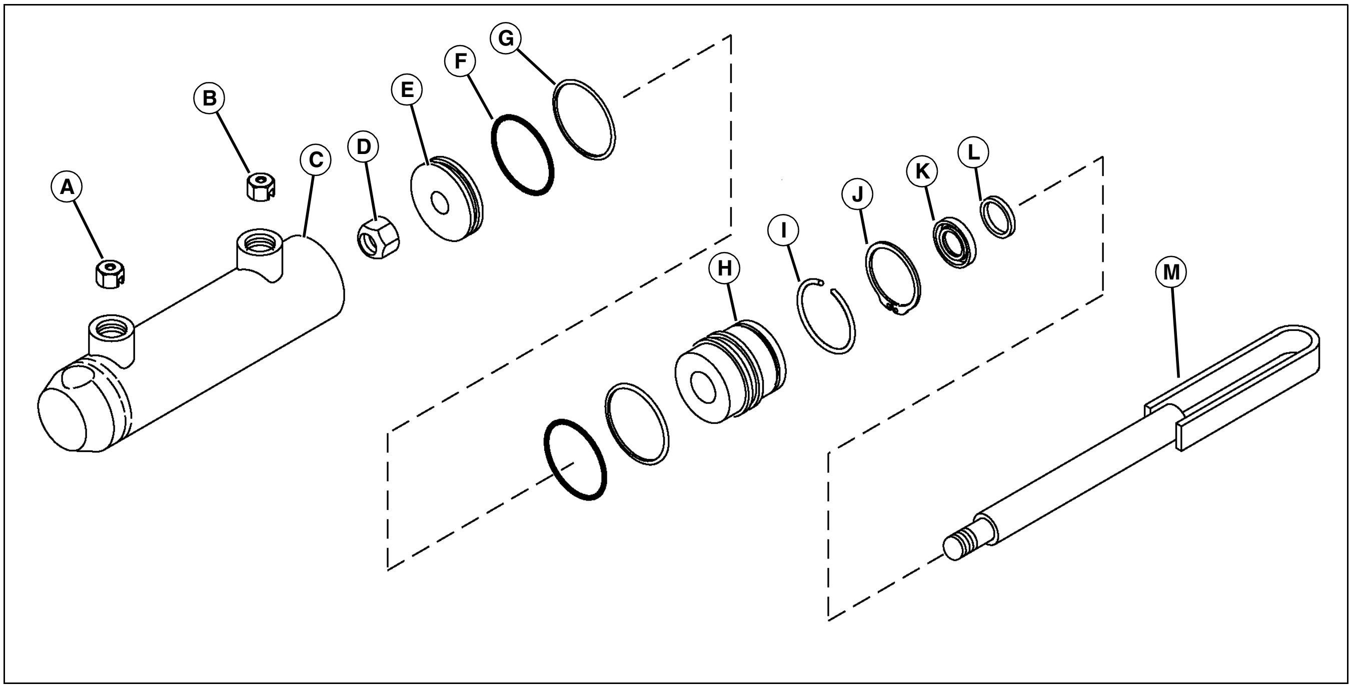
7. Remove retaining rings (B).
8. Remove anchor pins.
9. Remove lift cylinder.

Installation

Installation is done in the reverse order of removal.

- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Disassemble and Assemble Front Lift Cylinder



M98598

A - Orifice (Stamped #43) 1.778 mm (0.07 in.)
B - Orifice (Stamped #34) 1.092 mm (0.092 in.)
C - Body
D - Nut
E - Piston
F - O-Ring (2 Used)
G - Back-Up Ring
H - Rod Guide
I - Snap Ring
J - Retaining Ring
K - Seal
L - Wiper Seal
M - Rod

Disassembly

1. Thoroughly clean the outside of the cylinder before disassembly. Remove any paint or debris on cylinder rod.

2. Remove retaining ring.

3. Remove rod assembly from cylinder body.

4. Remove nut.

5. Remove piston and rod guide.

6. Inspect all parts for wear or damage. Replace parts as needed.

Assembly

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.

Assembly is done in the reverse order of disassembly.

Removal and Installation Center (Rear) Lift Cylinder

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

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

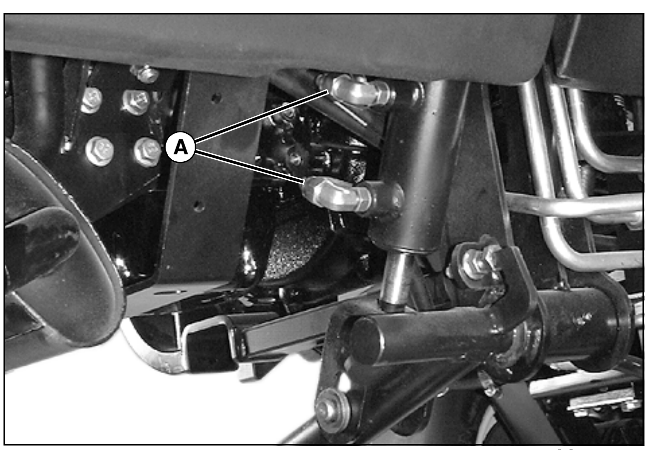
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

Removal

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position and allow the machine to cool.
4. Engage park brake.

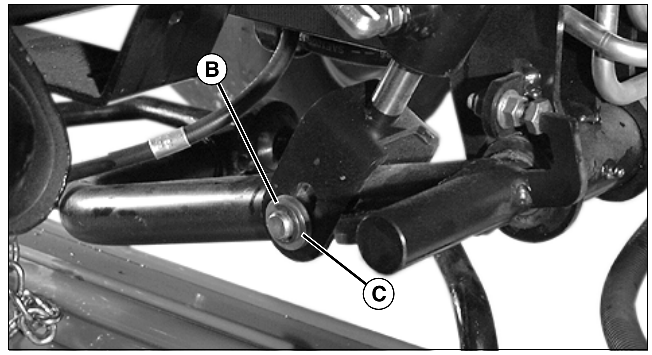
NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil that will leak out when lines are disconnected.



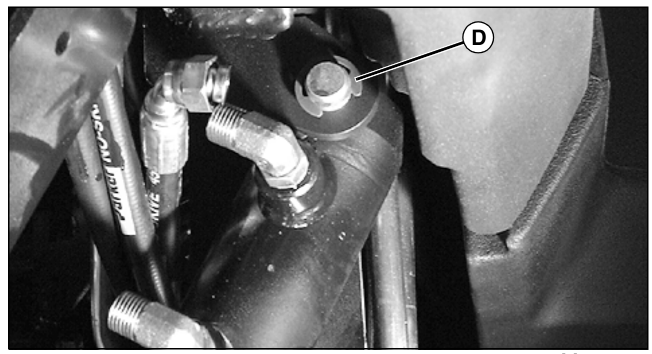
M84780

5. Disconnect and cap hoses (A).



M84781

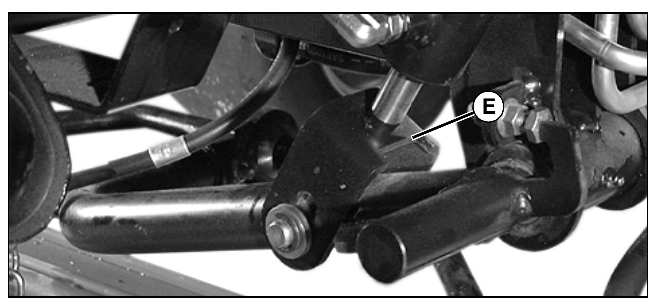
6. Remove retaining ring (B) and flat washer (C) from lower anchor pin.
7. Remove lower anchor pin.



M84782

8. Remove retaining ring (D) from the front side of the upper anchor pin.
9. Remove upper anchor pin.
10. Remove lift cylinder.

Installation



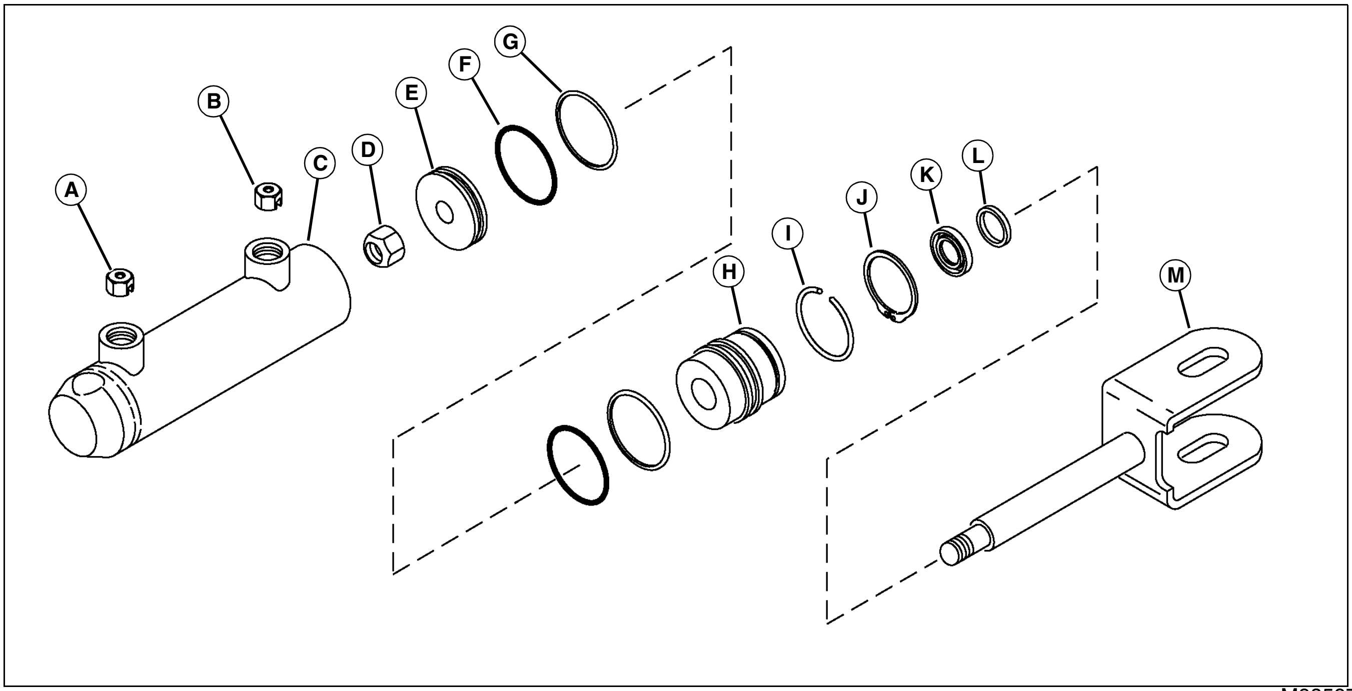
M84781

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! The notch (E) in the cylinder clevis must face toward lift arm.

- Fill hydraulic reservoir and expansion tank to correct level with oil meeting correct specifications. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 651.)

Disassemble and Assemble Center (Rear) Lift Cylinder



M98597

- **A - Orifice (Stamped #23) 0.787 mm (0.031 in.)**
- **B - Orifice (Stamped #20) 0.66 mm (0.026 in.)**
- **C - Body**
- **D - Nut**
- **E - Piston**
- **F - O-Ring (2 Used)**
- **G - Back-Up Ring**
- **H - Rod Guide**
- **I - Snap Ring**
- **J - Retaining Ring**
- **K - Seal**
- **L - Wiper Seal**
- **M - Rod**

Disassembly

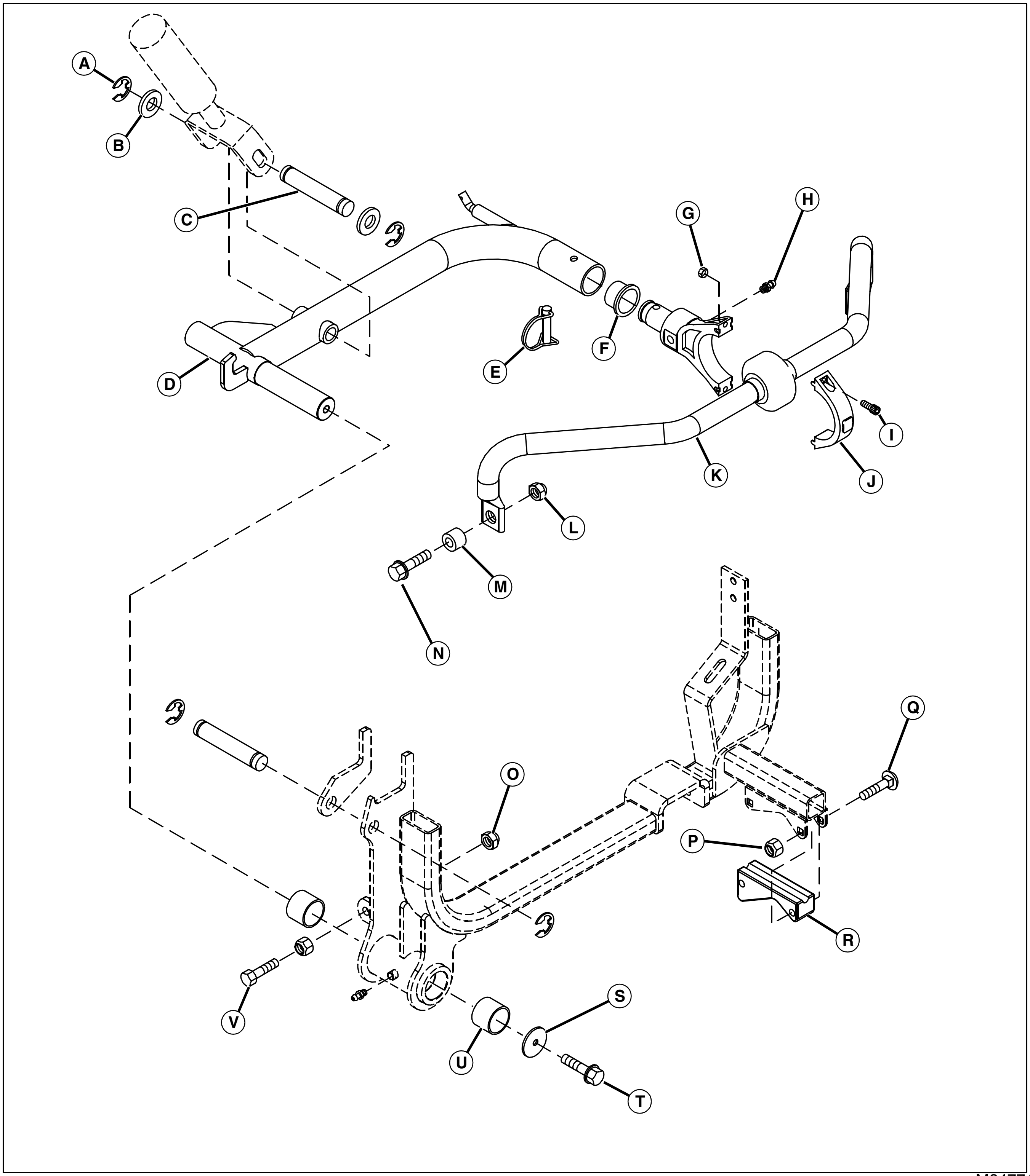
1. Thoroughly clean the outside of the cylinder before disassembly. Remove any paint or debris on cylinder rod.
2. Remove retaining ring.
3. Remove rod assembly from cylinder body.
4. Remove nut.
5. Remove piston and rod guide.
6. Inspect all parts for wear or damage. Replace parts as needed.

Assembly

IMPORTANT: Avoid damage! Always use new O-rings and seals. Damaged or used parts will leak.

Assembly is done in the reverse order of disassembly.

Repair Center (Rear) Lift Arm

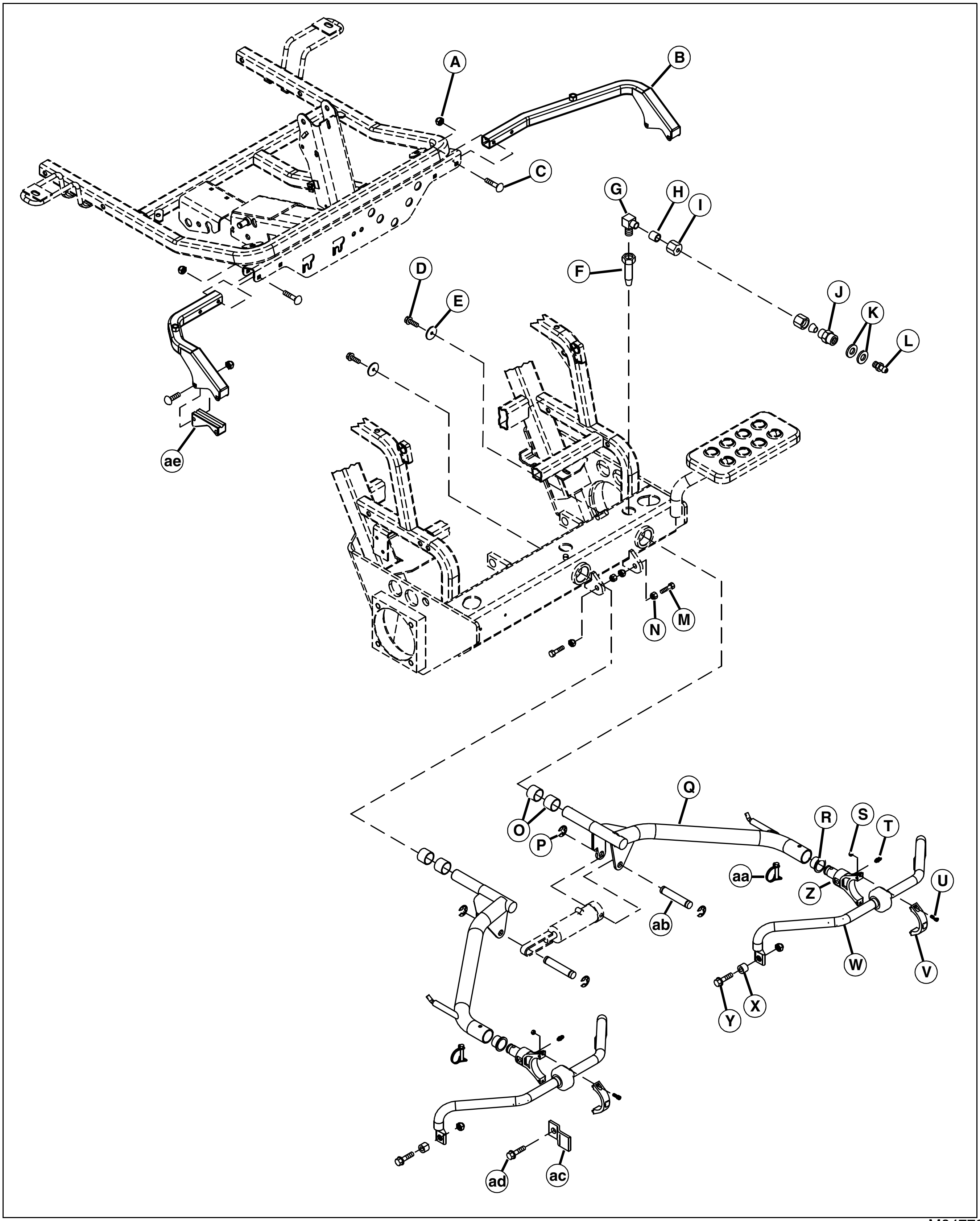


A - Snap Ring (4 Used)
B - Washer (2 Used)
C - Pin (2 Used)
D - Lift Arm
E - Spring Locking Pin
F - Bushing
G - Locknut (2 Used)
H - Lubrication Fitting (2 Used)

I - Screw (2 Used)
J - Bracket
K - Tube
L - Nut (2 Used)
M - Washer (2 Used)
N - Cap Screw
O - Nut
P - Locknut (2 Used)
Q - Bolt (2 Used)
R - Guide
S - Washer
T - Cap Screw
U - Spacer
V - Cap Screw

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.
- Adjust lift arm height. (See “Adjust Rear Lift Arm” on page 656.)

Repair Front Lift Arms



M84772

A - Locknut (8 Used)
B - Arm
C - Bolt (8 Used)
D - Screw (2 Used)
E - Washer (2 Used)
F - Extension (2 Used)
G - Elbow Fitting (2 Used)
H - Sleeve Fitting (2 Used)
I - Nut (2 Used)
J - Union Fitting (2 Used)
K - Washer (4 Used)
L - Lubrication Fitting (2 Used)
M - Cap Screw (2 Used)
N - Nut (8 Used)
O - Bushing (4 Used)
P - Snap Ring (4 Used)
Q - Lift Arm
R - Bushing (2 Used)
S - Locknut (4 Used)
T - Lubrication Fitting (2 Used)
U - Screw (4 Used)
V - Bracket (2 Used)
W - Tube (2 Used)
X - Washer (8 Used)
Y - Screw (4 Used)
Z - Pin (2 Used)
AA- Spring Locking Pin (2 Used)
AB- Pin (2 Used)
AC- Bracket
AD- Screw
AE- Guide (2 Used)

- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.
- Adjust lift arm height. (See “Adjust Front Lift Arm” on page 656.)

Table of Contents

STEERING SPECIFICATIONS

Specifications

Test and Adjustment Specifications

Slow Idle - Gas Engine . . . . 1550 ± 100 rpm
Slow Idle - Diesel Engine . . . . 1450 ± 100 rpm
Constant Applied Torque to Steering Wheel . . . . 6.8 N•m (72 lb-in.)
Steering Wheel RPM @ 6.8 N•m (72 lb-in.) Applied Torque (Maximum) 6
Steering Relief Valve Opening Pressure . . . . 7200 kPa (1044 psi)
Steering/Charge Pump Flow @ 1723 kPa (250 psi) (Minimum) . . . . 15.5 L/min (4.1 gpm)
Steering/Charge Pump Flow @ 6895 kPa (1000 psi) (Minimum) . . . . 13.2 L/min (3.5 gpm)

Repair Specifications

Steering Wheel Retaining Nut Torque . . . . 38 N•m (28 lb-ft)
Wheel Motor Mounting Cap Screws and Nuts Torque . . . . 37 N•m (27 lb-ft)

Tools and Materials

Special or Essential Tools

Special or Required Tools

Tool Name	Tool No.	Tool Use
Torque Wrench	NA	Used to count rotations of steering wheel.
Plugs	NA	Used to close steering cylinder lines.
Hydraulic Diagnostic Kit	BM19949	Used to connect gage to steering/charge pump.
Pressure Gage with Male Quick Coupler 20 000 kPa (3000 psi)	JT03345	Used to measure steering pressure.
Flow Meter Kit	JT05469	Used to measure steering/charge pump flow.
Connector 13/16-16 M ORFS x 1/2 M NPT	JT03367	Used to connect flow meter to steering/ charge pump.
Connector 13/16-16 F ORFS Sw x 3/4 F NPT 45°	JT03368	Used to connect flow meter to steering/ charge pump.
Connector 1/2 F NPT x 3/4 F NPT	JT03369	Used to connect flow meter to steering/ charge pump.

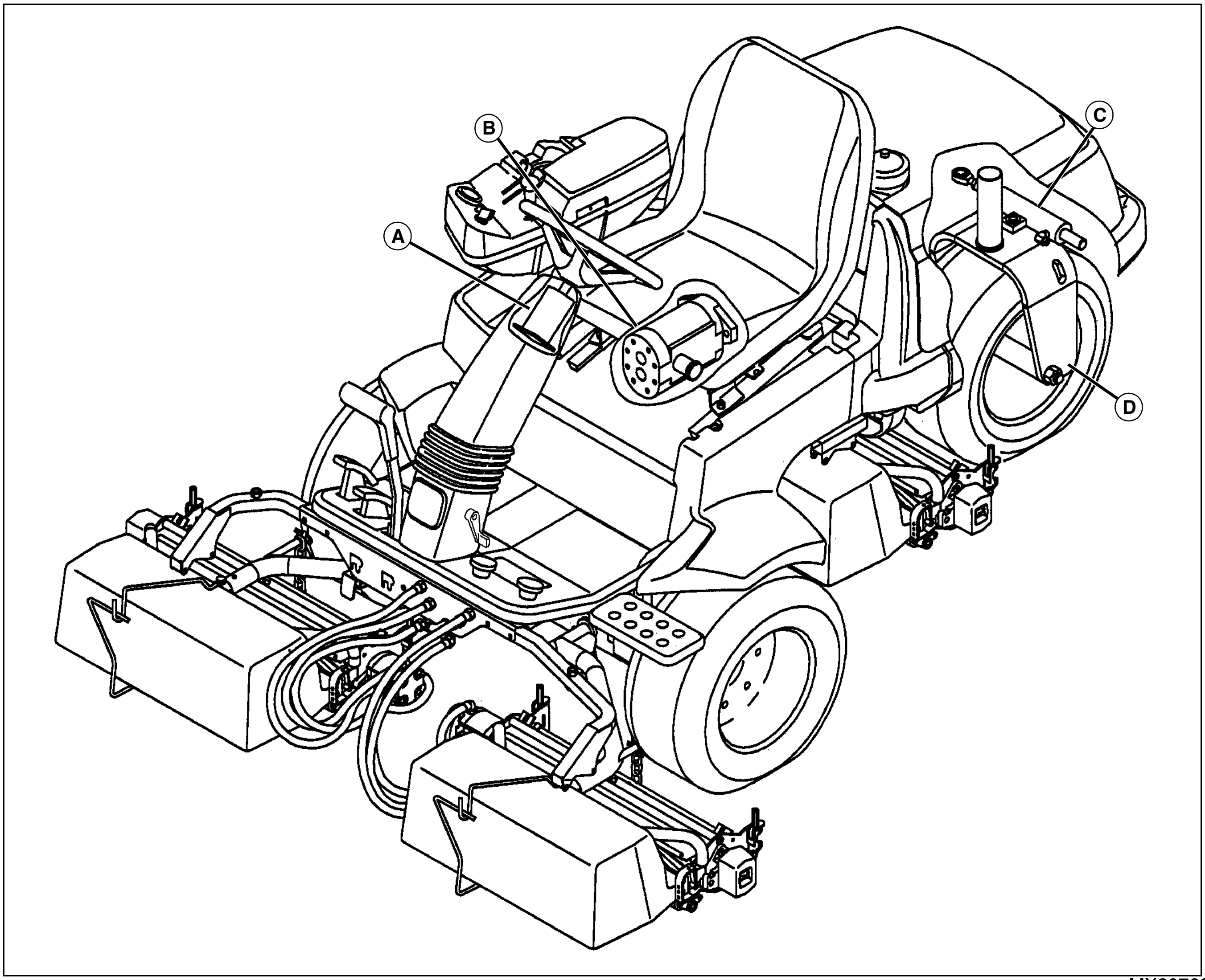
Other Materials

Other Material

Part No.	Part Name	Part Use
TY9370	Thread Lock and Sealer (Medium Strength)	Apply to steering cylinder rod eye threads.

Component Location

Steering System Component Location

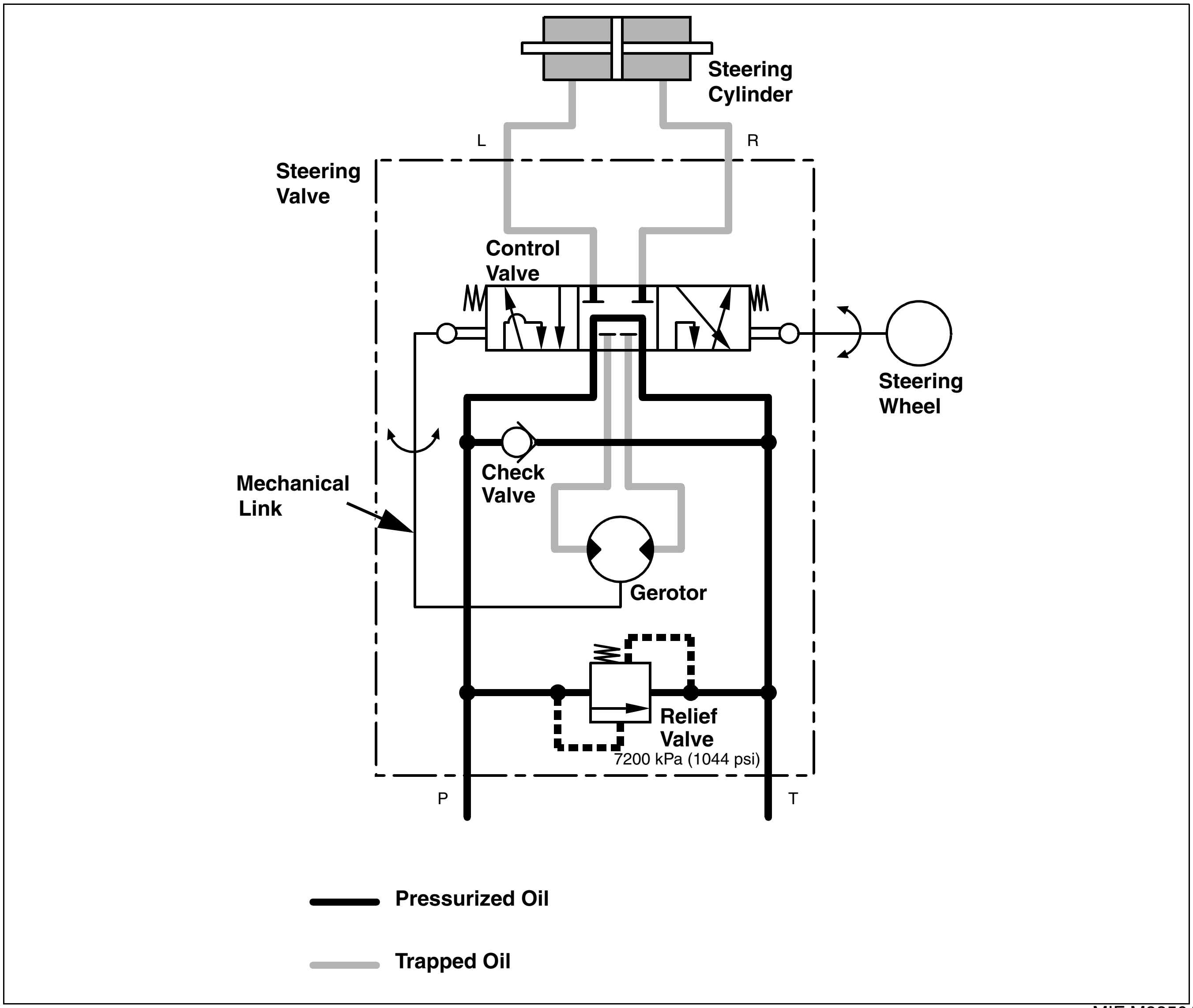


Picture Note: 2500A Shown. 2500E Similar.

A - Steering Valve
B - Steering/Charge Pump
C - Steering Cylinder
D - Steering Clevis

Theory of Operation

Steering System Operation - Neutral



MIF M98501

Function

To block the flow of pressurized oil to the steering cylinder when no turning action is desired.

Theory of Operation

The steering valve consists of a check valve, relief valve and a self-centering fluid control valve which is hydraulically and mechanically interconnected with the gerotor inside the unit.

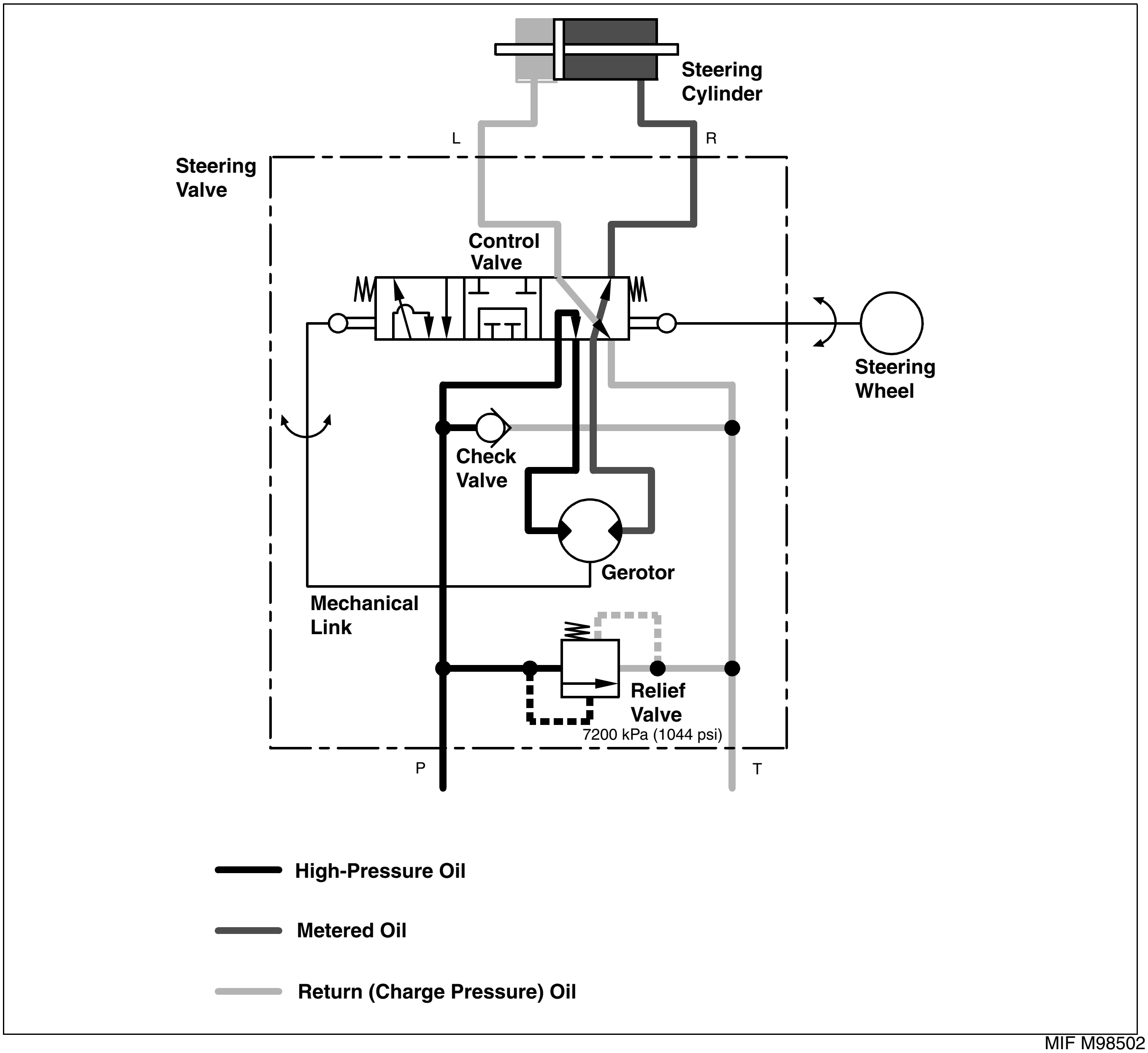
Pressurized oil is supplied to the steering valve IN port by the steering/charge pump section of the hydraulic pump assembly.

Whenever the steering wheel is released, spring pressure moves the steering valve to the neutral position. In this position, pressurized oil from the steering/charge pump enters the steering valve at the IN port. It is then allowed to flow through the control valve section and flows out through the OUT port. In this position, the control valve blocks pressurized oil from reaching the gerotor, and stops the flow of pressurized oil to the steering cylinder.

As the oil exits the OUT port of the steering valve, the oil is used as charge flow for the hydrostatic pump.

While the steering valve is in the neutral position, trapped oil in the steering cylinder is allowed to flow into the control valve section. This slight flow will give the operator a feel of any change in direction of the rear wheel, through the steering system, because of the mechanical link between the gerotor and steering wheel.

Steering System Operation - Power Turn



Picture Note: Right Turn Shown

Function

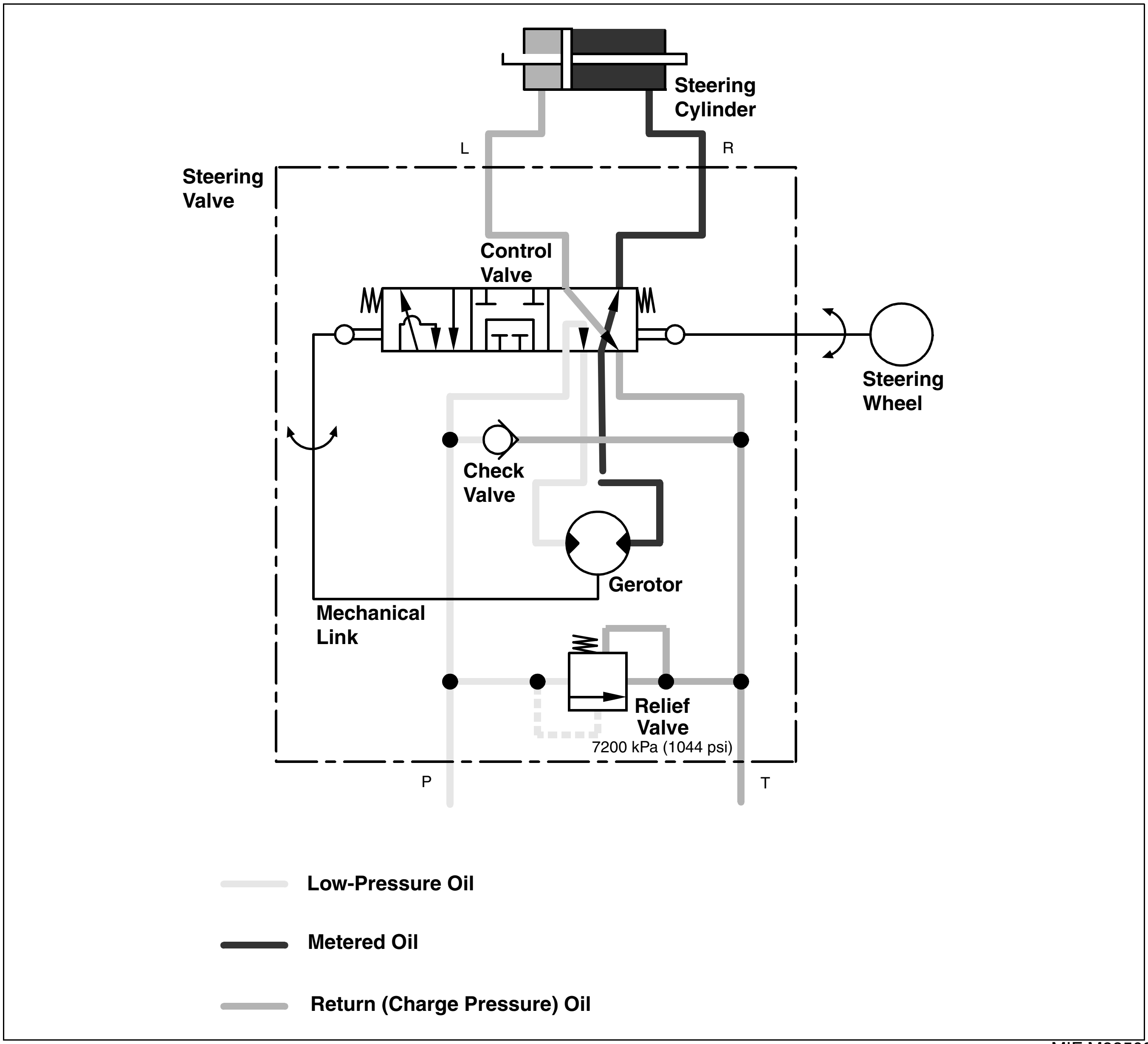
To supply pressurized oil to the proper side of the steering cylinder to turn the rear wheel.

Theory of Operation

When the steering wheel is turned to the right, the control valve is shifted by the mechanical link. This allows pressurized oil to flow through the control valve to the inlet of the gerotor. As the steering wheel continues to turn, system oil is forced through the gerotor and control valve. Metered oil is directed to the right side of the steering cylinder, forcing the piston to the left. Oil is forced out the other side of the cylinder and flows back through the control valve. This return oil then continues to flow out of the steering valve, through the oil cooler, and then as charge flow for the hydrostatic pump.

If the steering wheel is held against the stop, the relief valve will open at 7200 kPa (1044 psi), allowing the excess high-pressure oil to exit the steering valve.

Steering System Operation - Manual Turn



MIF M98503

Picture Note: Left Turn Shown

Function

To allow manual steering if hydraulic pressure is not available.

Theory of Operation

If hydraulic pressure is lost, the machine can still be steered without hydraulic assistance. All components still function the same, with the exception of the gerotor and check valve.

The gerotor now acts as a pump, moving oil from one side of the gerotor to the other as the steering wheel is turned. The check valve opens, allowing oil to be drawn from the return side of the steering cylinder. Hydraulic oil is forced by the gerotor to either end of the steering cylinder, depending on which way the steering wheel is turned.

When the steering wheel is released, the centering springs move the control valve to the center (neutral) position, and will remain there until the steering wheel is turned again.

Diagnostics

Steering Not Driving Straight

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Not Driving Straight

(1) Tires.
Are tires inflated to correct pressure?

Yes - Go to step (2).

No - Inflate rear tires to specification. (See Misc. Section for specification.)

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (3).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 705.)

(3) Rear Wheels.
Are rear wheel bearings worn?

Yes - Replace wheel bearings. (See "Disassemble and Assemble Rear Wheel" on page 800.)

No - Go to step (4) if problem continues.

(4) Steering Clevis.
Are clevis bearings worn?

Yes - Replace clevis bearings. (See "Remove and Install Steering Clevis" on page 718.)

No - Go to step (5) if problem continues.

(5) Steering Cylinder.
Is mounting hardware loose or missing?

Yes - Mounting hardware is loose or missing. Tighten and/or replace missing hardware.

Test Conditions:

- Engine running at fast idle.
- FORWARD/REVERSE travel pedals in NEUTRAL position.
- Park brake ENGAGED.

Symptom: Steering Not Driving Straight

(1) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See "Test Steering System Leakage" on page 706.)

No - Go to step (2) if problem continues.

(2) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See "Test Steering System Leakage" on page 706.)

No - Go to step (3) if problem continues.

(3) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

Steering Wheel Vibration

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Wheel Vibration

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (2).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 705.)

(2) Rear Tire.
Is tire inflated to correct pressure?

Yes - Go to step (3).

No - Inflate rear tires to specification. (See Tire Inflation Specification in Misc. Section.)

(3) Rear Wheels.
Are rear wheel bearings worn?

Yes - Replace wheel bearings. (See “Disassemble and Assemble Rear Wheel” on page 800.)

No - Go to step (4) if problem continues.

(4) Steering Clevis.
Are clevis bearings worn?

Yes - Replace clevis bearings. (See “Remove and Install Steering Clevis” on page 718.)

No - Go to step (5) if problem continues.

(5) Steering Cylinder.
Is mounting hardware loose or missing?

Yes - Mounting hardware is loose or missing. Tighten and/or replace missing hardware.

Sluggish Steering Response

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Sluggish Steering Response

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (2).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 705.)

(2) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

Test Conditions:

- Engine running at fast idle
- FORWARD/REVERSE travel pedals in NEUTRAL position.

Symptom: Sluggish Steering Response

(1) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Test Steering System Leakage” on page 706.)

No - Go to step (2) if problem continues.

(2) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Test Steering System Leakage” on page 706.)

No - Go to step (3) if problem continues.

Symptom: Sluggish Steering Response

(3) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

No - Go to step (4) if problem continues.

(4) Steering/Charge Pump.
Is pump damaged or operating improperly?

Yes - Check steering/charge pump output flow. (See “Test Steering/Charge Pump Flow” on page 709.)

Yes - Check steering relief valve pressure. (See “Test Steering Relief Valve” on page 708.) Repair or replace steering/lift pump as needed.

High Steering Effort in Both Directions

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: High Steering Effort in Both Directions

(1) Rear Tire.
Is rear tire inflated to correct pressure?

Yes - Go to step (2).

No - Inflate rear tires to specification. (See Misc. Section for Rear Tire Pressure.)

(2) Steering Clevis.
Are clevis bearings worn?

Yes - Replace clevis bearings. (See “Remove and Install Steering Clevis” on page 718.)

No - Go to step (3) if problem continues.

Symptom: High Steering Effort in Both Directions

(3) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (4).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 705.)

(4) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

No - Go to step (5) if problem continues.

(5) Steering Cylinder.
Is mounting hardware loose or missing?

Yes - Mounting hardware is loose or missing. Tighten and/or replace missing hardware.

Test Conditions:

- Engine running at fast idle.
- FORWARD/REVERSE travel pedals in NEUTRAL position.

Symptom: High Steering Effort in Both Directions

(1) Steering/Charge Pump.
Is pump damaged or operating improperly?

Yes - Check steering/charge pump output flow. (See “Test Steering/Charge Pump Flow” on page 709.)

Yes - Check steering relief valve pressure. (See “Test Steering Relief Valve” on page 708.) Repair or replace steering/charge pump as needed.

No - Go to step (2) if problem continues.

Symptom: High Steering Effort in Both Directions

(2) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See "Test Steering System Leakage" on page 706.)

No - Go to step (3) if problem continues.

(3) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See "Test Steering System Leakage" on page 706.)

Steering Effort Is Not Smooth

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Effort Is Not Smooth

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (2).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See "Hydraulic Oil Foams" on page 705.)

(2) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Do hoses have any sharp bends or restrictions?

Yes - Replace hoses.

Test Conditions:

- Engine running at fast idle.
- FORWARD/REVERSE travel pedals in NEUTRAL position.

Symptom: Steering Effort Is Not Smooth

(1) Pressure Hoses.
Check pressure hoses from steering valve to steering cylinder. Are hoses or connections leaking?

Yes - Tighten connections and/or replace hoses.

No - Go to step (2) if problem continues.

(2) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See "Test Steering Valve Leakage" on page 706.)

No - Go to step (3) if problem continues.

(3) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See "Test Steering Valve Leakage" on page 706.)

No - Go to step (4) if problem continues.

(4) Steering/Charge Pump.
Is pump damaged or operating improperly?

Yes - Check steering/charge pump output flow. (See "Test Steering/Charge Pump Flow" on page 709.)

Yes - Check steering relief valve pressure. (See "Test Steering Relief Valve" on page 708.) Repair or replace steering/charge pump as needed.

Machine Continues to Turn after Steering Wheel Has Returned to Center Position

Test Conditions:

- Park brake ENGAGED.
- Engine running at FAST idle.
- Forward/reverse pedals in NEUTRAL position.

Symptom: Machine Continues to Turn after Steering Wheel Has Returned to Center Position

(1) Steering Valve.
Does steering valve operate smoothly without sticking?

Yes - Go to step (2).

No - Replace steering valve. (See “Test Steering/ Charge Pump Flow” on page 709.)

(2) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 705.)

Lost Motion at Steering Wheel

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Lost Motion at Steering Wheel

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?
Is hydraulic oil free of foam (air in system)?

Yes - Go to step (2).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

No - Oil is foamy. (See “Hydraulic Oil Foams” on page 705.)

(2) Steering Valve.
Is steering valve securely mounted?

No - Tighten mounting cap screws.

Test Conditions:

- Engine running at FAST idle.
- FORWARD/REVERSE travel pedals in NEUTRAL position.

Symptom:

(1) Steering Cylinder.
Is cylinder damaged or operating incorrectly?

Yes - Test steering cylinder for leakage and repair or replace as needed. (See “Test Steering System Leakage” on page 706.)

No - Go to step (2) if problem continues.

(2) Steering Valve.
Is valve damaged or operating incorrectly?

Yes - Test steering valve for leakage and replace as needed. (See “Test Steering Valve Leakage” on page 706.)

Steering Operation Reversed

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Steering Operation Reversed

(1) Steering Cylinder.
Are pressure hoses properly connected to steering cylinder and not reversed?

No - Connect hoses to proper fittings on cylinder.

Hydraulic Oil Foams

Test Conditions:

- Key switch in STOP position.
- Park brake ENGAGED.

Symptom: Hydraulic Oil Foams

(1) Hydraulic Reservoir.
Is hydraulic reservoir filled to correct level with clean oil of correct specifications?
Is hydraulic oil free of contamination?

Yes - Go to step (2).

No - Reservoir is not properly filled. Fill hydraulic oil reservoir to proper level with oil meeting specifications.

No - Oil is contaminated. Drain system, fill hydraulic oil reservoir to proper level with oil meeting specifications, and replace oil filter.

(2) Check pressure hoses.
Do hoses have sharp bends or restrictions?
Are connections leaking?

Yes - Hoses have sharp bends and/or restrictions. Replace hose(s).

Yes - Connections are leaking. Tighten connections and/or replace hoses.

No - Go to step (3) if problem continues.

Symptom: Hydraulic Oil Foams

(3) Hydraulic Suction Hoses.
Check suction hoses.
Are hoses cracked, cut, or badly scuffed?
Are hose connections loose or leaking?

Yes - Hoses are cracked, cut, or badly scuffed. Replace hoses as needed with hoses of proper size.

Yes - Hose connections loose or leaking. Tighten connections and/or replace O-rings as needed.

Tests and Adjustments

Test Steering System Leakage

Reason

To check the steering system for internal leakage.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Torque Wrench	NA	Used to count rotations of steering wheel.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Bring hydraulic system oil to operating temperature. (See "Warm Up Hydraulic Oil" on page 676.)

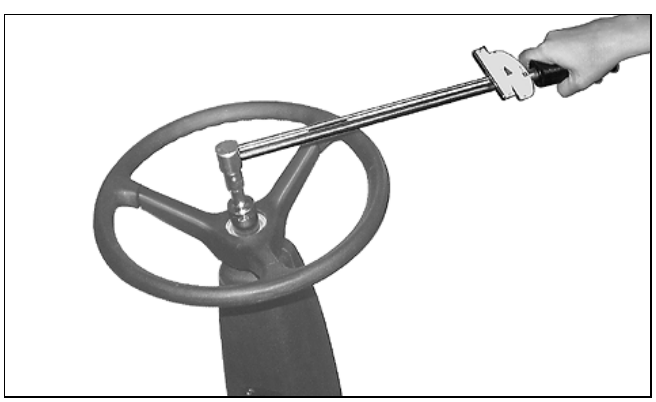
CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

6. Start engine and set throttle to SLOW idle specifications.



M98614

7. With steering wheel at the maximum right turn position, apply a constant torque to specification. Count the number of rotations occurring in one minute.
8. Repeat step 7 with the steering wheel at the maximum left turn position.

Results

If the number of rotations exceeds 6 per minute, perform steering valve leakage test. (See "Test Steering Valve Leakage" on page 706.)

Specifications

Slow Idle - Gas Engine. . . . . .1550 ± 100 rpm
Slow Idle - Diesel Engine. . . . . .1450 ± 100 rpm
Constant Applied Torque to Steering Wheel. . . . . 6.8 N•m (72 lb-in.)
Steering Wheel RPM @ 6.8 N•m (72 lb-in.) Applied Torque (Maximum) 6

Test Steering Valve Leakage

Reason

To determine if leakage is in steering valve or in steering cylinder.

Special or Required Tools

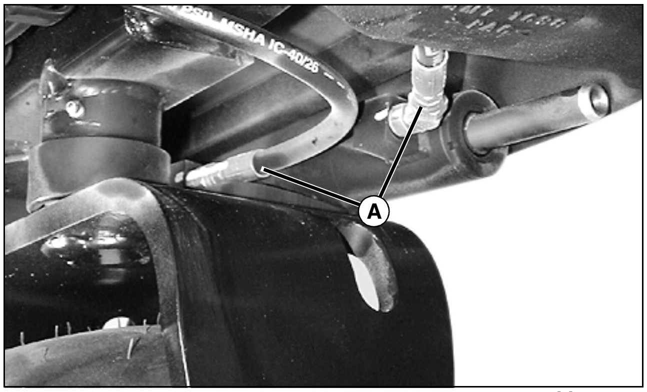
Tool Name	Tool No.	Tool Use
Torque Wrench	NA	Used to count rotations of steering wheel.
Plugs	NA	Used to close steering cylinder lines.

Procedure

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Bring hydraulic system oil to operating temperature. (See "Warm Up Hydraulic Oil" on page 676.)
6. Turn key switch to STOP position.

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**



M84768

7. Disconnect and close hoses (A) using a plug.

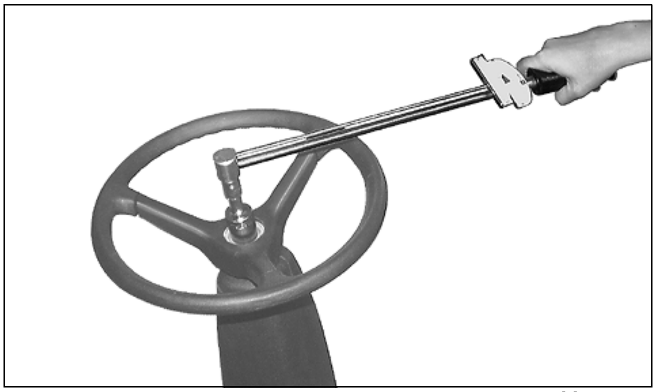
CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

8. Start engine and set throttle to SLOW idle specification.



M98614

9. With steering wheel at the maximum right turn position, continue turning, applying a constant torque to specification, and count the number of rotations occurring in one minute.

10. Repeat step 9, starting with the steering wheel at the maximum left turn position and continuing to turn wheel to the left.

Results

- If the number of rotations exceeds 6 per minute, replace steering valve.
- If the number of rotations is less than 6 per minute, repair or replace steering cylinder.

Specifications

Slow Idle - Gas Engine. . . . . .1550 ± 100 rpm

Slow Idle - Diesel Engine. . . . . .1450 ± 100 rpm

Constant Applied Torque to Steering Wheel. . . . . 6.8 N•m (72 lb-in.)

Steering Wheel RPM @ 6.8 N•m (72 lb-in.) Applied Torque (Maximum) 6

Test Steering Relief Valve

Reason

To determine if the steering relief valve is opening at the correct pressure.

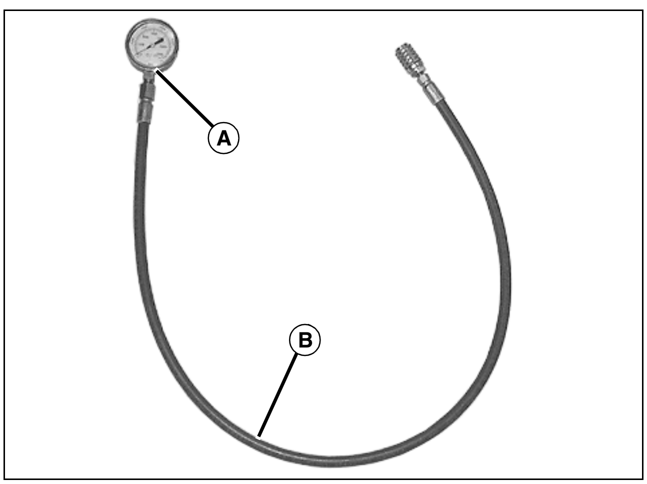
Special or Required Tools

Tool Name	Tool No.	Tool Use
Hydraulic Diagnostic Kit	BM19949	Used to connect gage to steering/ charge pump.
Pressure Gage with Male Quick Coupler 20 000 kPa (3000 psi)	JT03345	Used to measure steering pressure.

Procedure

Test is performed by reading system pressure between the rear section of hydraulic pump assembly (steering/charge pump) and steering valve.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Turn key switch to STOP position.
6. Check hydraulic reservoir oil level. (See “Hydraulic Reservoir Oil Level Check” on page 26.)
7. Raise and latch seat platform.



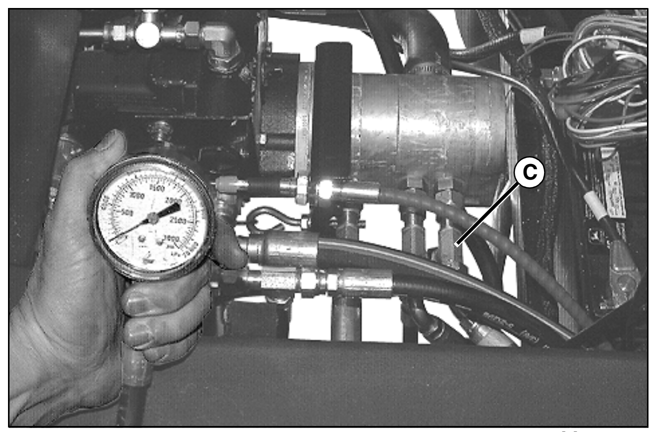
M98645

8. Install JT03345 Gage (A) on diagnostic hose assembly (B) from BM19949 Hydraulic Diagnostic Kit.

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

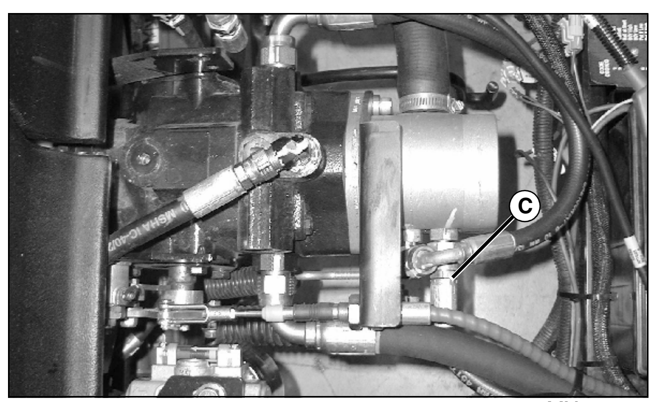
• Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

• If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.



M98646

Picture Note: 2500 shown. 2500A is similar.



MX21634

Picture Note: 2500E shown.

9. Connect gage/hose assembly to diagnostic fitting (C) on steering/charge pump.

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

10.Start engine and run at FAST idle.

11.Bring the hydraulic oil to operating temperature.

12.Turn the steering wheel in one direction fully and hold against the stop.

13.Observe reading on pressure gauge.

Results

- The relief valve opening pressure should be to specification.
- If relief valve does not open at the specified pressure, replace steering valve.

Specifications

Steering Relief Valve Opening Pressure . . . . 7200 kPa (1044 psi)

Test Steering/Charge Pump Flow

Reason

To determine if the steering/charge pump is providing the correct oil flow volume.

Test Equipment

Special or Required Tools

Tool Name	Tool No.	Tool Use
Flow Meter Kit	JT05469	Used to measure steering/charge pump flow.
Connector 13/16-16 M ORFS x 1/2 M NPT	JT03367	Used to connect flow meter to steering/ charge pump.

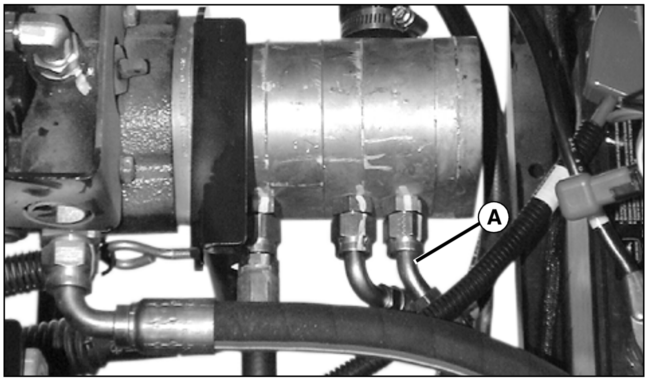
Special or Required Tools

Tool Name	Tool No.	Tool Use
Connector 13/16-16 F ORFS Sw x 3/4 F NPT 45°	JT03368	Used to connect flow meter to steering/ charge pump.
Connector 1/2 F NPT x 3/4 F NPT	JT03369	Used to connect flow meter to steering/ charge pump.

Procedure

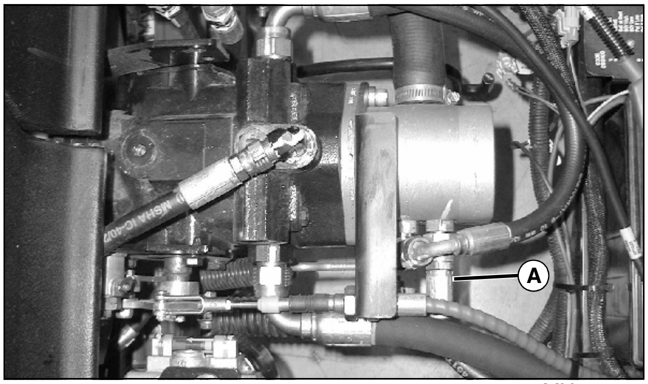
Test is performed by reading the oil flow between the rear section of hydraulic pump assembly (steering/charge pump) and steering valve.

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Engage park brake.
5. Turn key switch to STOP position.
6. Check hydraulic reservoir oil level. (See "Hydraulic Reservoir Oil Level Check" on page 26.)
7. Raise and latch seat platform.



M84694

Picture Note: 2500 shown. 2500A is similar.

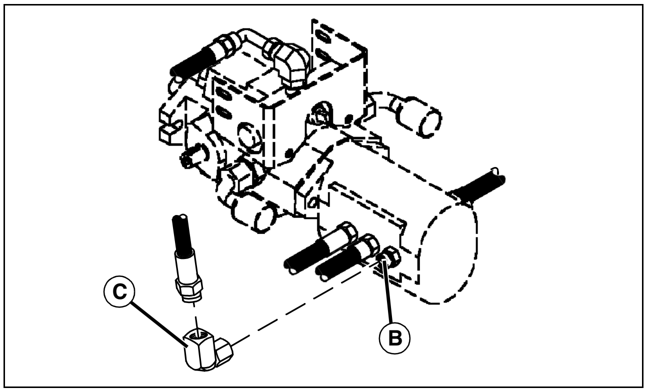


MX21634

Picture Note: 2500E shown.

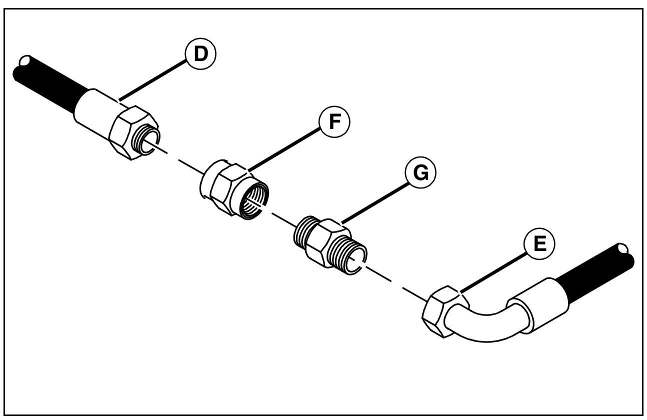
8. Disconnect hose (A) from steering/charge pump.

NOTE: The flow meter is directional and must be connected properly to obtain correct reading.



MIF M98802

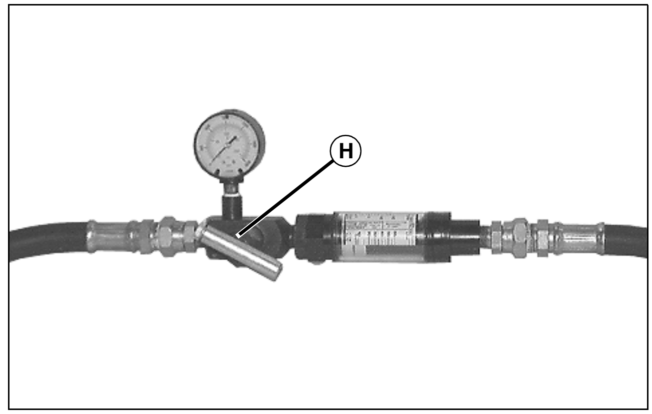
9. Connect input hose of JT05469 Flow Meter to the steering/charge pump fitting (B) using JT03368 Connector (C).



M98803

10.Connect the flow meter output hose (D) to the steering valve hose (E) using JT03369 (F) and JT03367 (G) Connectors.

IMPORTANT: Avoid damage! Flow meter valve MUST be open before starting engine. Damage to hydraulic components may occur.



M98804

11.Open flow meter valve (H) fully.

CAUTION: Avoid injury! Engine exhaust fumes contain carbon monoxide and can cause serious illness or death.

Move the machine to an outside area before running the engine.

Do not run an engine in an enclosed area without adequate ventilation.

- **Connect a pipe extension to the engine exhaust pipe to direct the exhaust fumes out of the area.**
- **Allow fresh outside air into the work area to clear the exhaust fumes out.**

12.Start and run engine at fast idle.

13.Slowly close flow meter valve until pressure gage reads 1723 kPa (250 psi). Flow should be to specification.

14.Slowly close flow meter until pressure gage reads 6895 kPa (1000 psi). Flow should be to specification.

Results

- If steering/charge pump oil flow does not meet specifications, repair or replace hydraulic pump. (See "Disassemble and Inspect Hydraulic Pump Assembly" on page 691.)

Specifications

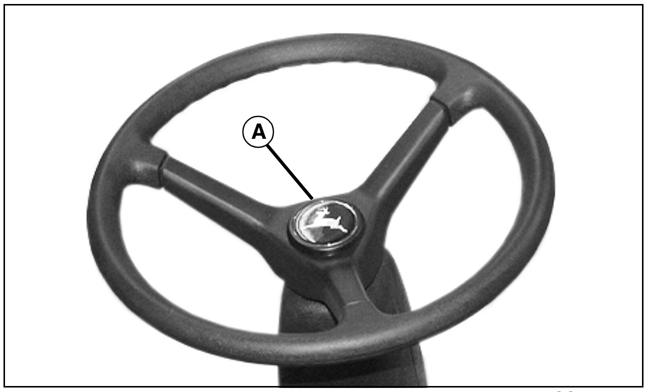
Steering/Charge Pump Flow @ 1723 kPa (250 psi) (Minimum) . . . . 15.5 L/min (4.1 gpm)

Steering/Charge Pump Flow @ 6895 kPa (1000 psi) (Minimum) . . . 13.2 L/min (3.5 gpm)

Repair

Remove and Install Steering Wheel (S.N. -030000)

Removal

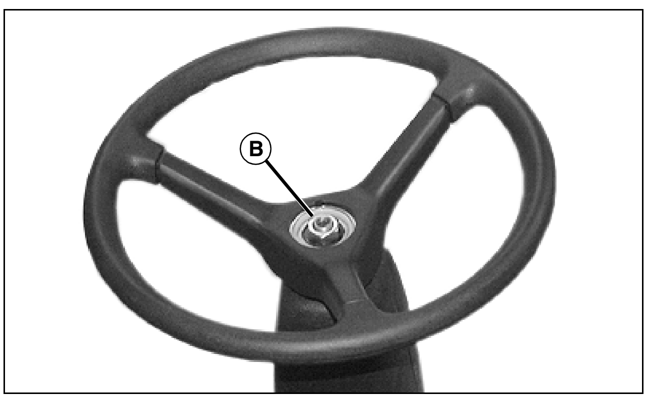


M84614

1. Remove steering wheel cap (A).

IMPORTANT: Avoid damage! DO NOT use a hammer on the end of steering shaft. Damage can occur to steering valve or shaft.

NOTE: If steering wheel cannot be pulled off shaft easily, use a knife-edge puller to remove.



M84615

2. Remove nut (B) and steering wheel.

Installation

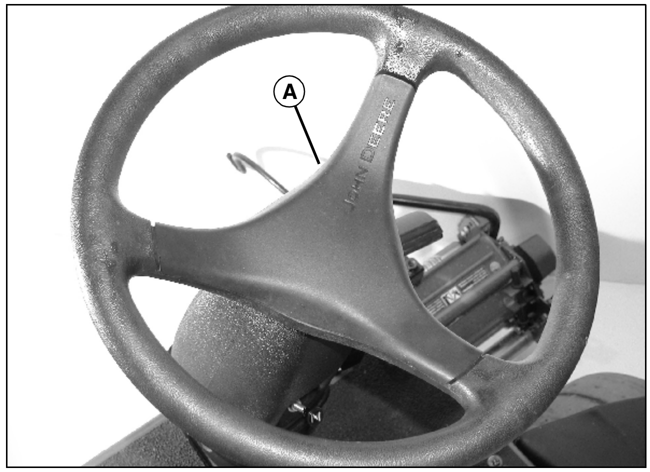
- Installation is done in the reverse order of removal.
- Tighten nut (B) to specification.

Specifications

Steering Wheel Retaining Nut
Torque . . . . 38 N•m (28 lb-ft)

Remove and Install Steering Wheel (S.N. 030001-)

Removal

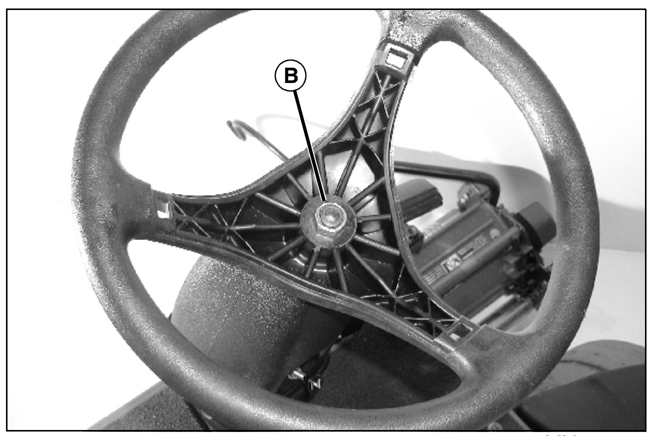


MX20348

1. Remove steering wheel cap (A).

IMPORTANT: Avoid damage! DO NOT use a hammer on the end of steering shaft. Damage can occur to steering valve or shaft.

NOTE: If steering wheel cannot be pulled off shaft easily, use a knife-edge puller to remove.



MX20349

2. Remove nut (B) and steering wheel.

Installation

- Installation is done in the reverse order of removal.
- Tighten nut (B) to specification.

Specifications

Steering Wheel Retaining Nut
Torque . . . . 38 N•m (28 lb-ft)

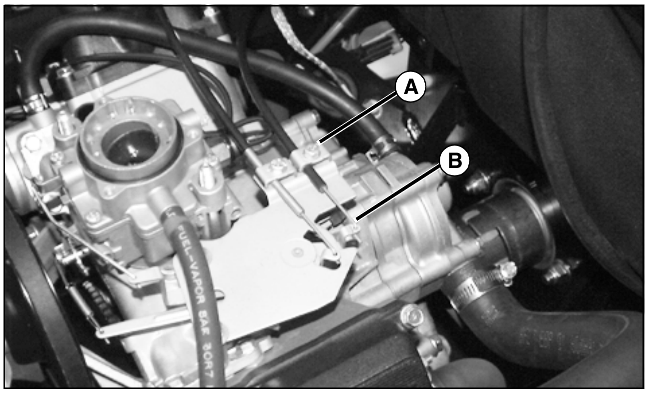
Remove and Install Steering Column Cover (S.N. -030000)

Removal

NOTE: Steps 2 and 3 apply to the gasoline powered machine only.

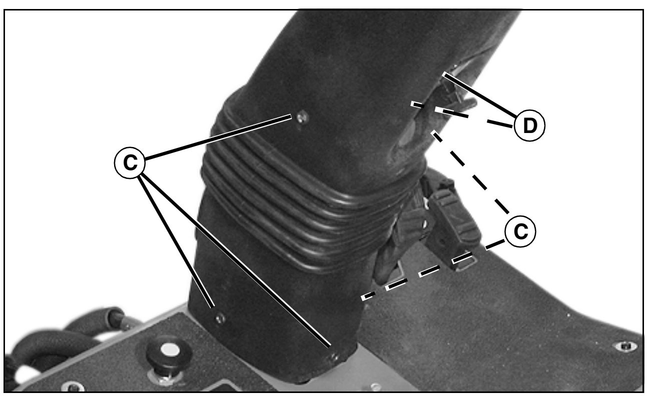
1. Remove steering wheel. (See “Remove and Install Steering Wheel (S.N. -030000)” on page 711.)

2. **Gasoline-Powered Machine Only:** Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



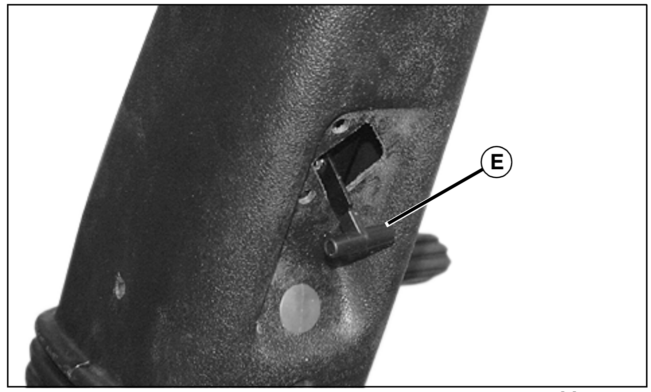
M98475

3. **Gasoline-Powered Machine Only:** Remove choke cable clamp (A) and disconnect cable at throttle plate (B).



M84756

4. Remove cover screws (C) and tilt cover plate screws (D).



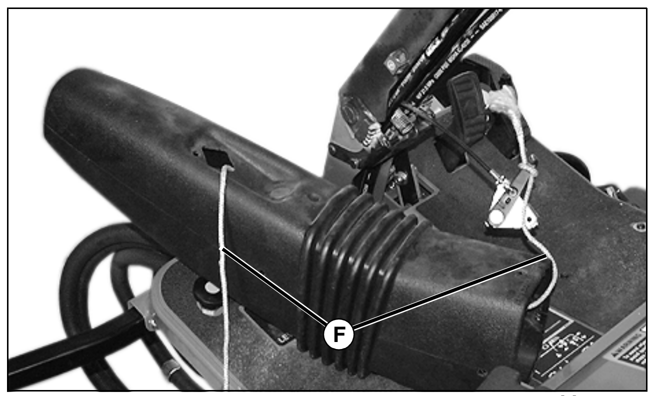
M84766

5. Remove cover plate and push tilt lever (E) through the cover opening.

6. Remove steering column cover.

Installation

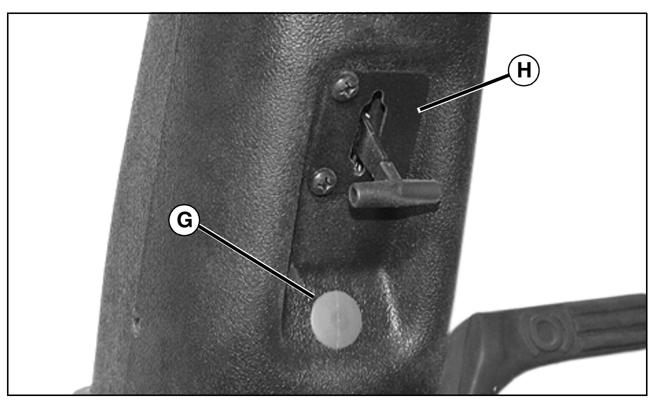
NOTE: Steps 3, 7, 8, and 9 apply to the gasoline powered machine only.



M84767

1. Tie a rope (F) to the tilt lever handle and route the rope through the opening in the cover as shown.

2. Slide cover over steering column.



M84757

3. **Gasoline-Powered Machine Only:** Guide choke cable through tilt bracket and into opening (G) located below tilt lever opening.

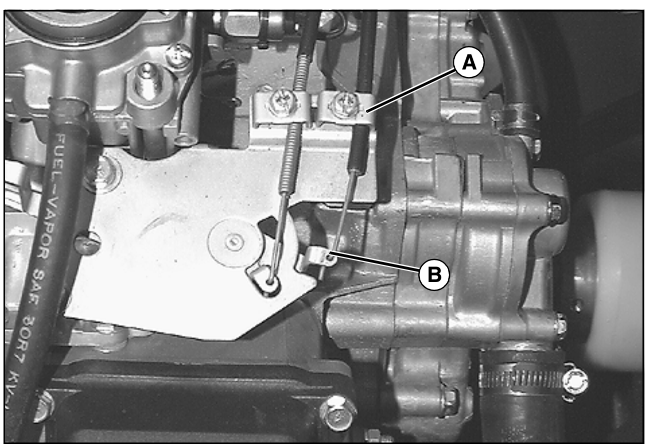
4. Carefully pull rope and tilt lever through opening.
5. Install tilt lever cover plate (H).
6. Install column cover screws.
7. **Gasoline-Powered Machine Only:** Install choke cable to throttle plate and cable clamp.
8. **Gasoline-Powered Machine Only:** Adjust choke cable. (See “Adjust Choke Cable” on page 55.)
9. **Gasoline-Powered Machine Only:** Install air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)
10. Install steering wheel. (See “Remove and Install Steering Wheel (S.N. -030000)” on page 711.)

Remove and Install Steering Column Cover (S.N. 030001-)

Removal

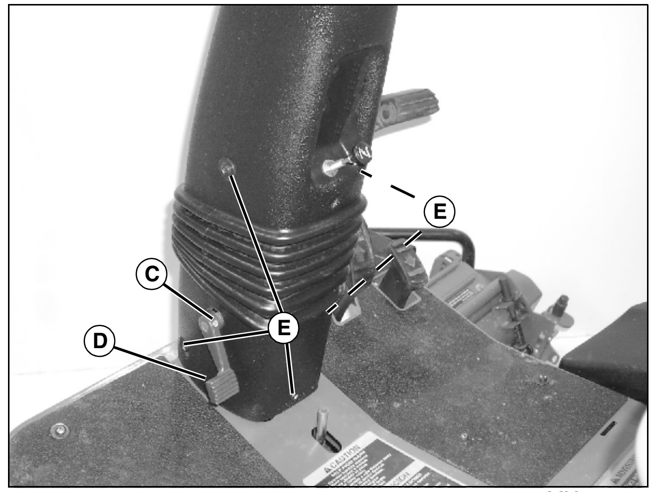
NOTE: Steps 2, 3, and 4 apply to the gasoline-powered machine only.

1. Remove steering wheel. (See “Remove and Install Steering Wheel (S.N. 030001-)” on page 711.)
2. **Gasoline-Powered Machine Only:** Remove air cleaner assembly. (See “Remove and Install Air Cleaner” on page 80.)



MX98618

3. **Gasoline-Powered Machine Only:** Remove choke cable clamp (A).
4. **Gasoline-Powered Machine Only:** Disconnect choke cable at throttle plate (B).

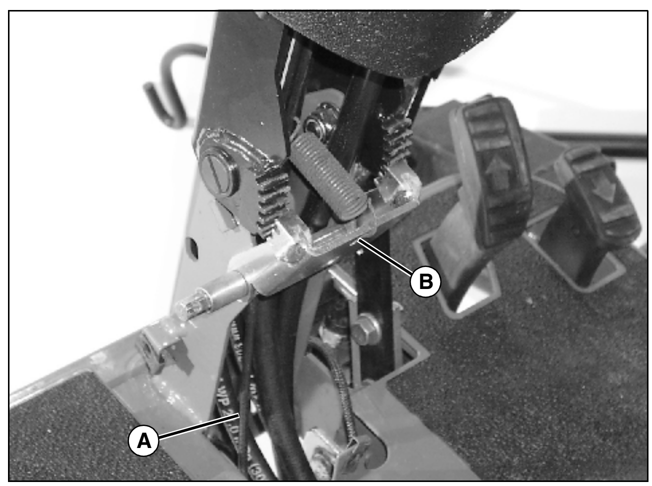


MX20345

5. Remove tilt lever roll pin (C) and remove tilt lever (D).
6. Remove five cover screws (E).
7. Remove cover.

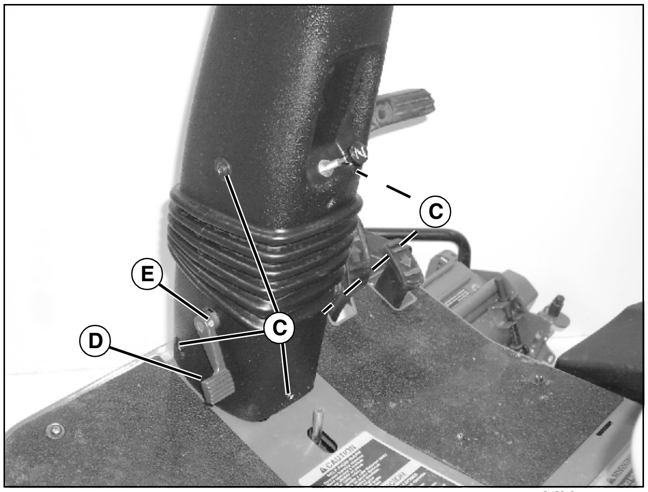
Installation

NOTE: Steps 2, 5, 6, and 7 apply to the gasoline-powered machine only.



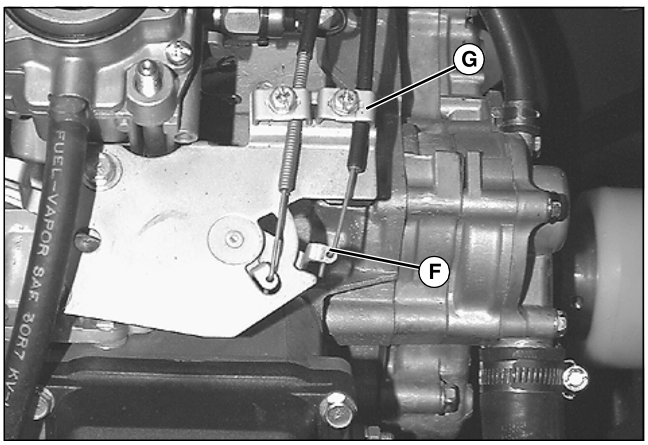
MX20346

1. Slide cover over steering column.
2. **Gasoline-Powered Machine Only:** Guide choke cable (A) through tilt bracket (B) and opening at the bottom of the platform.



MX20345

3. Install cover screws (C).
4. Install tilt lever (D) and roll pin (E).



MX98618

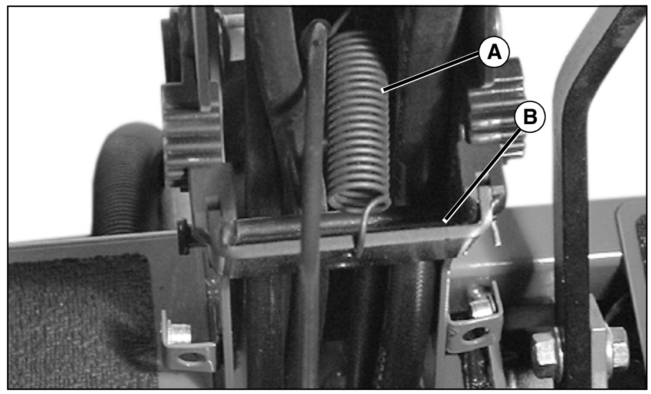
5. **Gasoline-Powered Machine Only:** Install choke cable at throttle plate (F).
6. **Gasoline-Powered Machine Only:** Install choke cable clamp (G).
7. **Gasoline-Powered Machine Only:** Adjust choke cable. (See “Adjust Choke Cable” on page 55.)

Remove and Install Steering Column Tilt Cable (S.N. -030000)

Removal

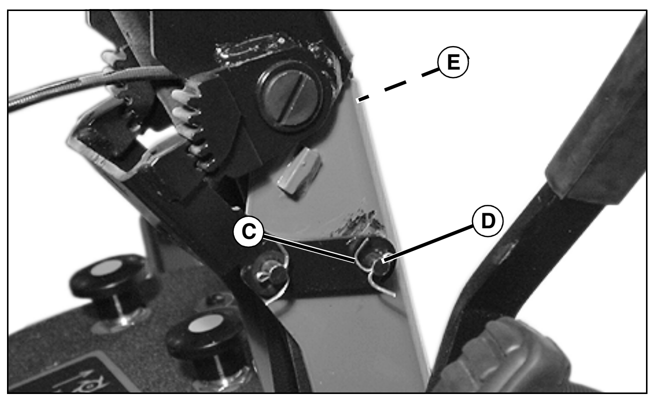
1. Remove steering column cover. (See “Remove and Install Steering Column Cover (S.N. -030000)” on page 712.)

> **CAUTION: Avoid injury! The steering column can move unexpectedly if the latch pawl bracket is bumped when the tension spring is removed.**



M84759

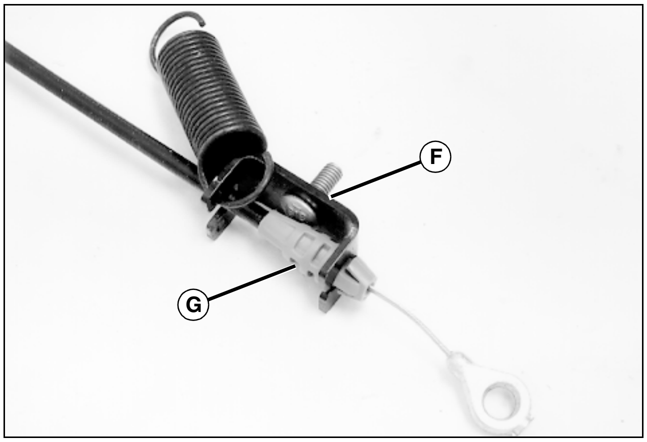
2. Disconnect tension spring (A) from latch pawl bracket (B).



M84760

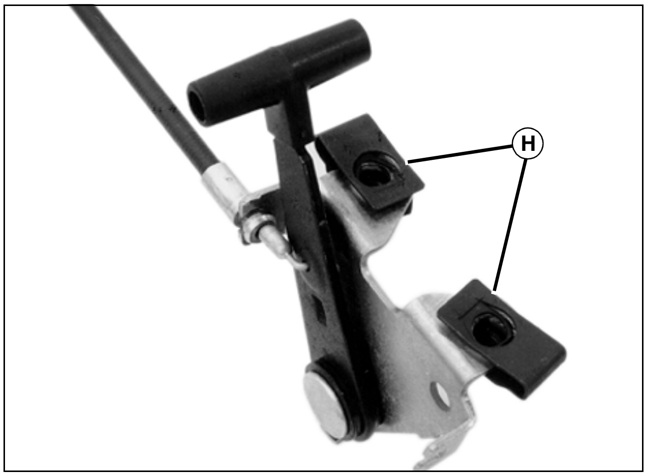
3. Remove spring pin (C), anchor pin (D), and nut (E).
4. Remove cable and bracket.
5. Remove cable from bracket.

Installation



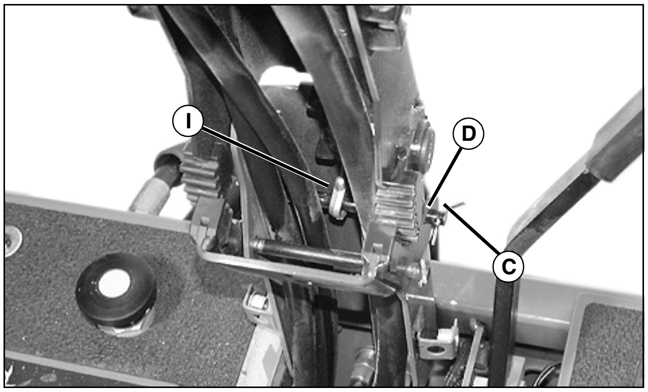
M84764

1. Install bracket (F) on cable (G).



M84758

2. Install nut clips (H) on cable lever bracket (if removed).
3. Install cable assembly and nut (E).



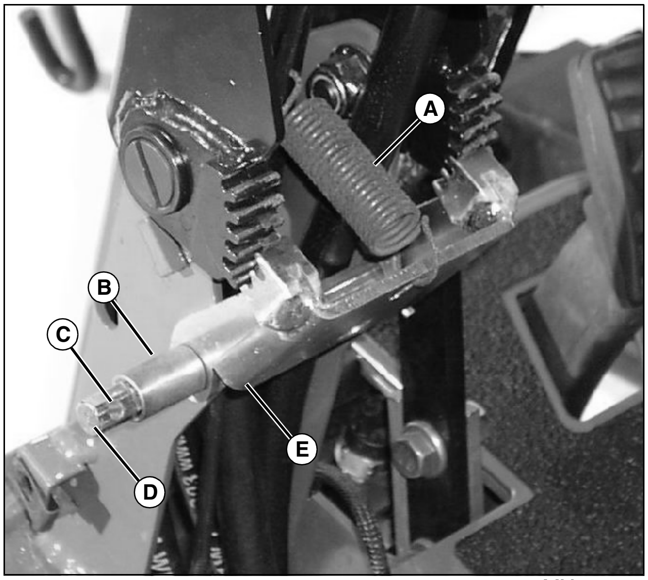
M84777

4. Slide the anchor pin (D) through the ring (I) at bottom of tilt cable.
5. Install spring pin (C).
6. Install tension spring to latch pawl bracket.
7. Install steering column cover. (See "Remove and Install Steering Column Cover (S.N. -030000)" on page 712.)

Remove and Install Steering Column Tilt Pawl (S.N. 030001-)

1. Remove steering column cover. (See "Remove and Install Steering Column Cover (S.N. 030001-)" on page 713.)

CAUTION: Avoid injury! The steering column can move unexpectedly if the latch pawl bracket is bumped when the tension spring is disconnected. Steering column must be supported in upright position to remove tilt pawl.



MX20441

2. Support top half of steering column.
3. Remove tension spring (A).
4. Remove spacer (B).

IMPORTANT: Avoid damage! Note direction of pin hole (C) in shaft for reassembly.

5. Push pivot rod (D) out of tilt pawl (E) and column.
6. Remove tilt pawl.
7. Installation is done in the reverse order of removal.

Remove and Install Steering Valve

Removal

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

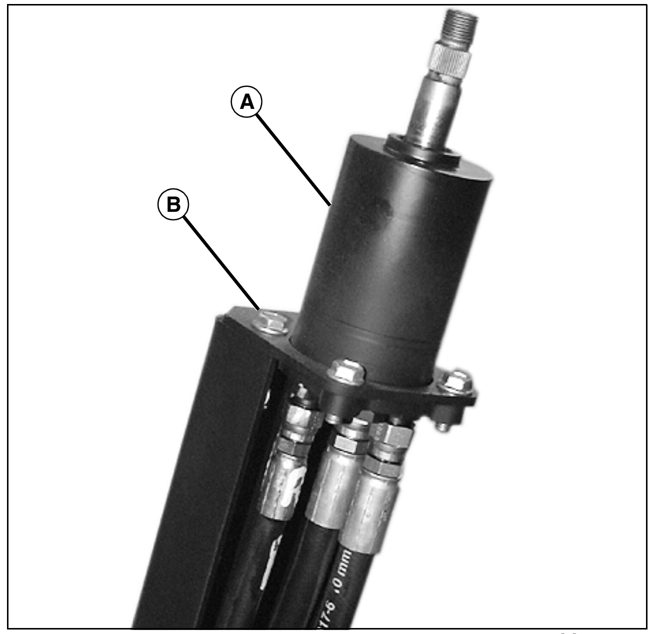
- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.

2. Remove steering column cover. (See “Remove and Install Steering Column Cover (S.N. -030000)” on page 712.)

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.

Place drip pan under machine to catch oil when hoses are disconnected.



M84761

3. Mark and disconnect hoses from steering valve (A).

4. Remove cap screws (B) and valve.

Installation

- Installation is done in the reverse order of removal.
- Fill hydraulic reservoir and expansion tank with specified oil. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 676.)
- Check all connections for leaks. Repair as needed.

Remove and Install Steering Cylinder

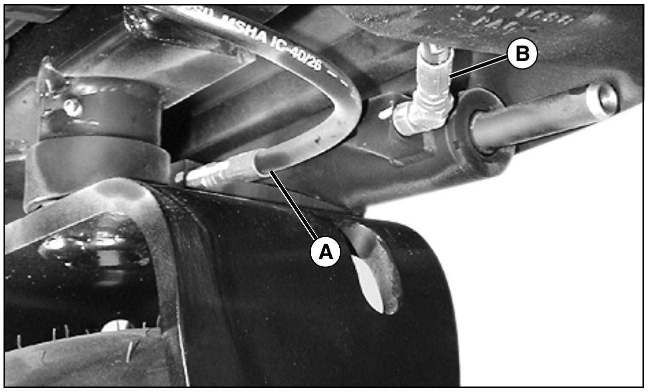
Removal

CAUTION: Avoid injury! Escaping fluid under high pressure can penetrate the skin and cause serious injury. Avoid the hazard by relieving pressure before connecting hydraulic or other lines. Tighten all connections before applying pressure.

- **Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.**
- **If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical Department in Moline, Illinois, U.S.A. In the United States and Canada only, this information may be obtained by calling 1-800-822-8262.**

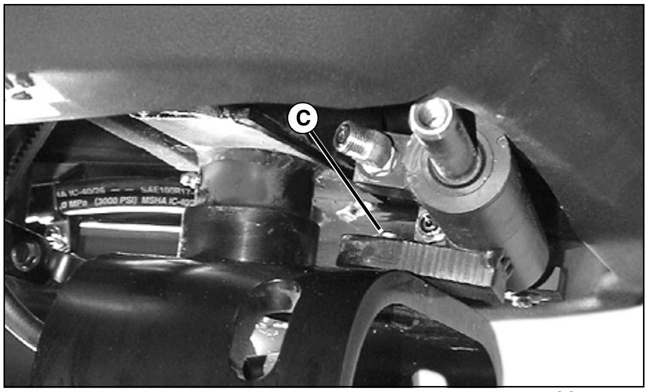
1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.

NOTE: Mark all hydraulic hoses before removing to ensure correct installation.



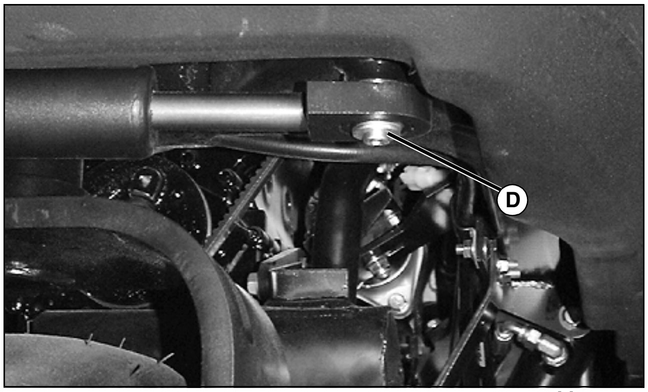
M84768

2. Mark and disconnect hoses (A and B).



M84769

3. Remove special screw and washer (C) attaching steering cylinder to steering clevis.



M84770

4. Remove special screw and washer (D) attaching steering cylinder to frame.

5. Remove steering cylinder.

6. Repair or replace cylinder as needed. (See “Disassemble and Assemble Steering Cylinder” on page 718.)

Installation

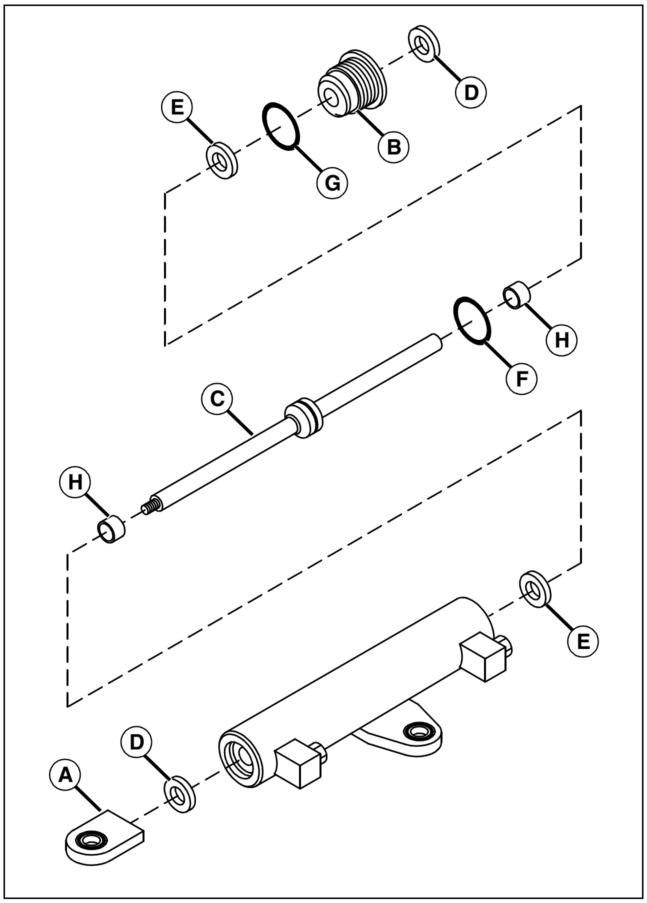
- Installation is done in the reverse order of removal.
- Fill hydraulic reservoir and expansion tank with specified oil. (See “Hydrostatic Transmission and Hydraulic Oil” on page 20.)
- Bleed air from hydraulic system. (See “Bleed Hydraulic System” on page 676.)
- Check all connections for leaks. Repair as needed.

Disassemble and Assemble Steering Cylinder

Other Material

Part No.	Part Name	Part Use
TY9370	Thread Lock and Sealer (Medium Strength)	Apply to steering cylinder rod eye threads.

NOTE: Thoroughly clean outside of cylinder before disassembling to prevent contamination of internal parts.



MIF M98596

1. Clean outside of cylinder and remove any paint or debris from rod.

2. Remove rod eye (A) and gland (B).

3. Remove rod and piston assembly (C).

4. Remove wipers (D), seals (E), piston seal (F), and O-ring (G).

Assembly

- Assembly is done in reverse order of disassembly.
- Inspect bushings (H), remove only if replacement is necessary.

IMPORTANT: Avoid damage! Always use new O-rings, seals, and wipers. Damaged or used parts will leak.

- Install new wipers, seals, piston seal, and O-ring.
- Apply TY9370 Thread Lock and Sealer (Medium Strength) to threads of rod eye.

Remove and Install Steering Clevis

Removal

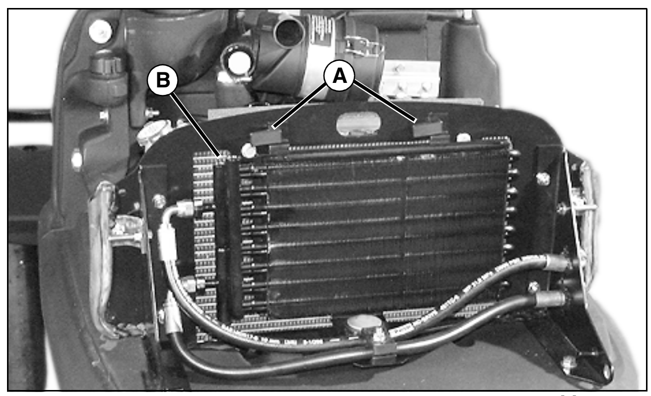
1. Raise rear of machine until wheel is off the ground. Support machine by placing the appropriate jackstands under the frame.

2. Remove rear wheel. (See “Remove and Install Rear Wheel (Third Wheel Assist)” on page 799.)

3. Remove cowling. (See “Remove and Install Cowling” on page 798.)

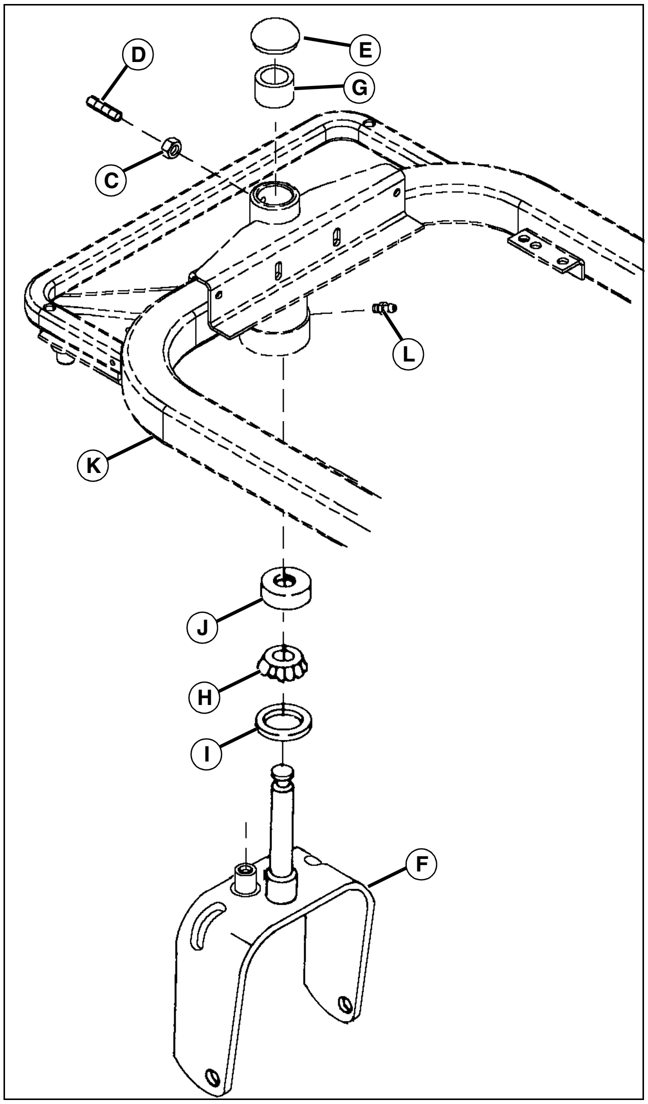
4. Remove steering cylinder. (See “Remove and Install Steering Cylinder” on page 717.)

5. Remove grille.



M84596

6. Release latches (A). Lift oil cooler assembly (B) and move to the side without disconnecting hoses.



7. Loosen locknut (C) and set screw (D).

8. Remove cap (E) and steering clevis (F).

NOTE: Remove bushing only if replacement is necessary.

9. Inspect bushing (G). Replace if necessary.

IMPORTANT: Avoid damage! Bearing cup and cone are matched and MUST be replaced as a set.

10.Remove bearing cone (H) and seal (I).

NOTE: Remove bearing cup only if replacement is necessary.

11.Inspect bearing cup (J). Replace if necessary.

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

Installation

1. Pack bearing cone (H) with multi-purpose grease. (See “Grease” on page 21).

2. Install bearing cup (J) and cone.

3. Install bushing (G).

4. Install seal (I) with smaller outside diameter facing away from frame (K). Install seal flush with bottom of frame.

5. Install steering clevis (F) in frame.

6. Tighten set screw (D), making sure it enters groove in clevis shaft. Tighten set screw fully, then back out 1/2 turn. Tighten locknut (C).

7. Install cap (E) and apply multi-purpose grease to lubrication fitting (L). (See “Grease” on page 21.)

8. Install steering cylinder. (See “Remove and Install Steering Cylinder” on page 717.)

9. Move oil cooler (B) into place and close latches (A).

10.Install grille.

11.Install rear wheel. (See “Remove and Install Rear Wheel” on page 799.)

12.Install cowling. (See “Remove and Install Cowling” on page 798.)

Remove and Install Steering Clevis (Third Wheel Assist)

Removal

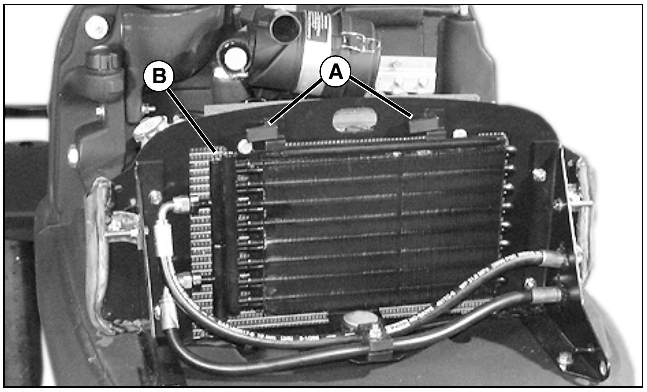
1. Raise rear of machine until wheel is off the ground. Support machine by placing the appropriate jackstands under the frame.

2. Remove rear wheel. (See “Remove and Install Rear Wheel (Third Wheel Assist)” on page 799.)

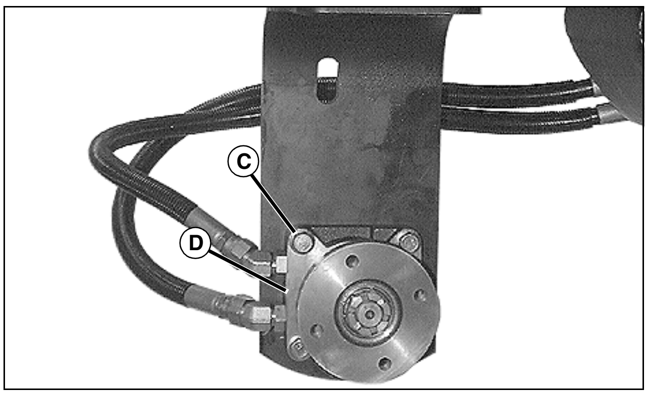
3. Remove cowling. (See “Remove and Install Cowling” on page 798.)

4. Remove steering cylinder. (See “Remove and Install Steering Cylinder” on page 717.)

5. Remove grille.



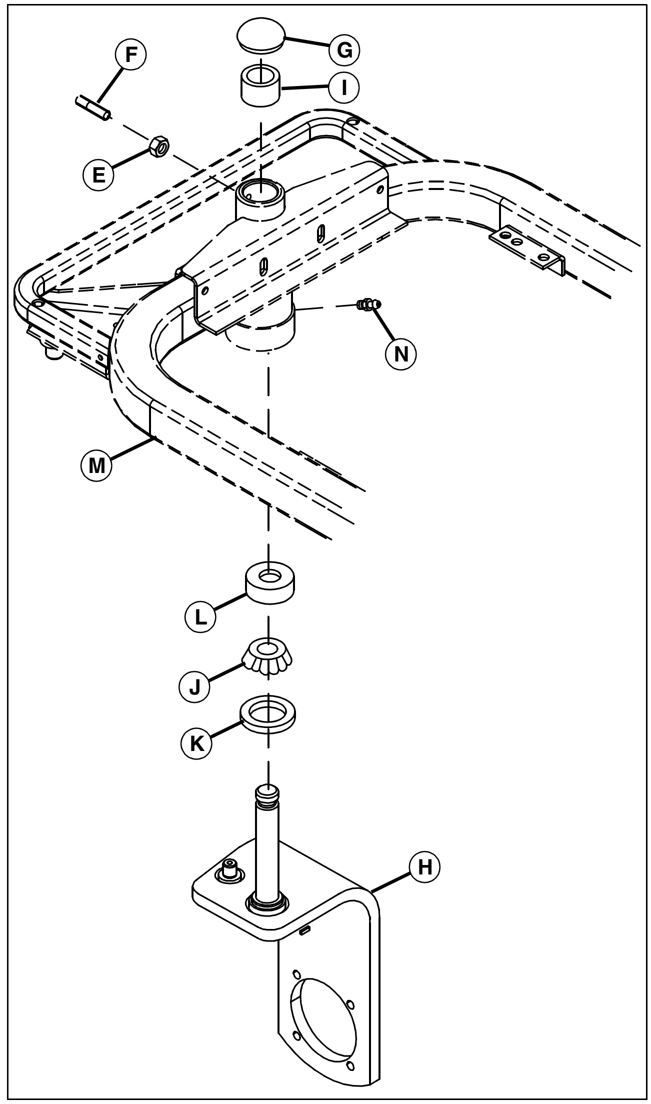
6. Release latches (A). Lift oil cooler assembly (B) and move to the side without disconnecting hoses.



M98609

7. Remove cap screws and nuts (C).

8. Remove wheel motor (D) and move to the side without disconnecting hoses.



M98613

9. Loosen locknut (E) and set screw (F).

10.Remove cap (G) and steering clevis (H).

NOTE: Remove bushing only if replacement is necessary.

11.Inspect bushing (I). Replace if necessary.

IMPORTANT: Avoid damage! Bearing cup and cone are matched and MUST be replaced as a set.

12.Remove bearing cone (J) and seal (K).

NOTE: Remove bearing cup only if replacement is necessary.

13.Inspect bearing cup (L), replace if necessary.

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

Installation

1. Pack bearing cone (J) with multi-purpose grease. (See "Grease" on page 21.)
2. Install bearing cup (L) and cone.
3. Install bushing (I).
4. Install seal (K) with smaller outside diameter facing away from frame (M). Install seal flush with bottom of frame.
5. Install steering clevis (H) in frame.
6. Tighten set screw (F) making sure it enters groove in clevis shaft. Tighten set screw fully, then back out 1/2 turn. Tighten locknut (E).
7. Install cap (G) and apply multi-purpose grease to lubrication fitting (N). (See "Grease" on page 21.)
8. Install steering cylinder. (See "Remove and Install Steering Cylinder" on page 717.)
9. Install wheel motor (D) using cap screws and nuts (C). Tighten cap screws and nuts to specification.
10. Move oil cooler assembly (B) into place and close latches (A).
11. Install grille.
12. Install rear wheel. (See "Remove and Install Rear Wheel" on page 799.)
13. Install cowling. (See "Remove and Install Cowling" on page 798.)

Specifications

Wheel Motor Mounting Cap Screws and Nuts
Torque . . . . 37 N•m (27 lb-ft)

Table of Contents

BRAKES SPECIFICATIONS

Specifications

Adjustment Specifications

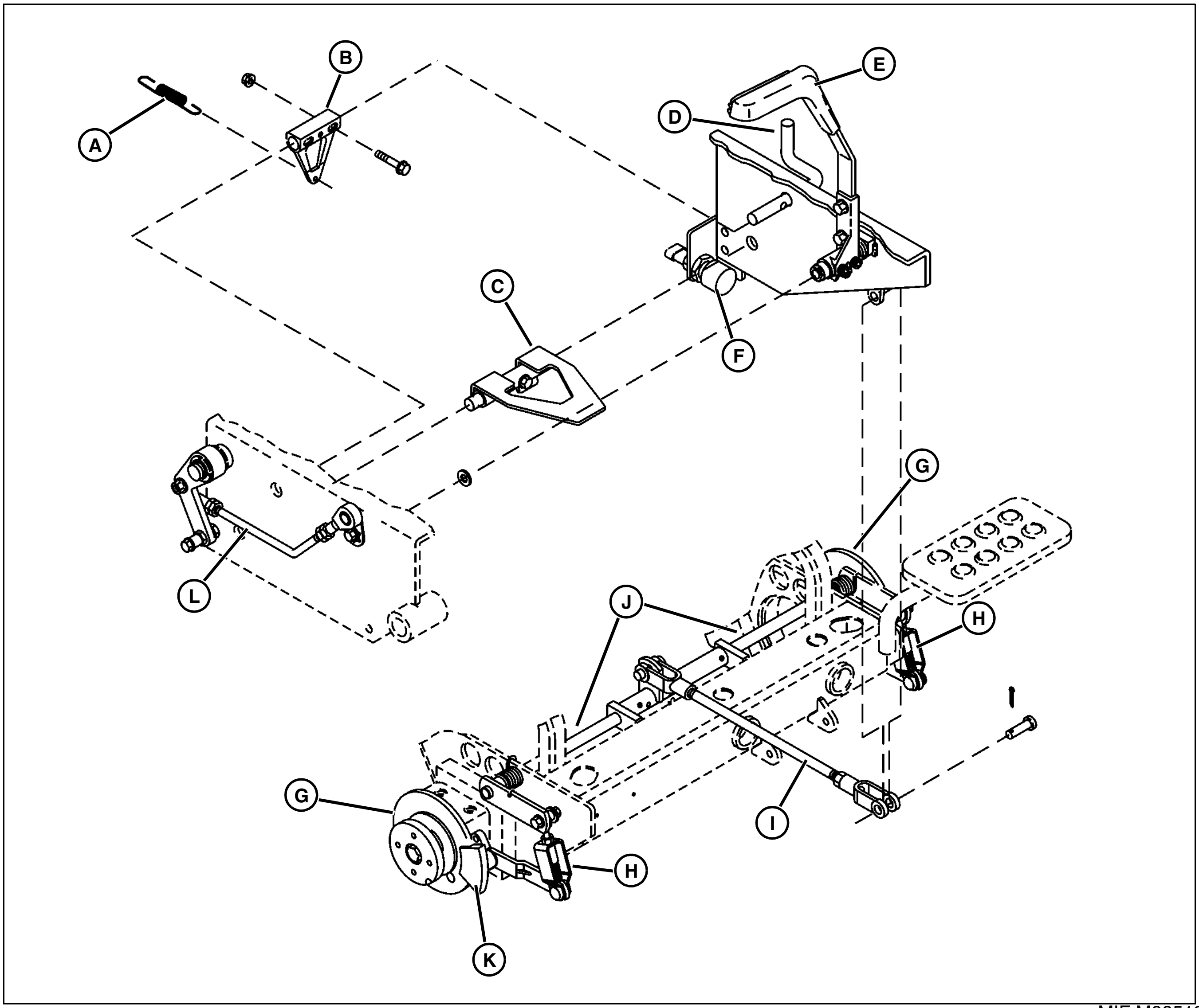
Park Brake Linkage Exposed Rod Threads (Maximum) . . . . 25 mm (1.0 in.)

Repair Specifications

Brake Rotor Retaining Nut. . . . . 203 N•m (150 lb-ft)
Brake Pad Lever-Side Thickness (Minimum) . . . . 0.5 mm (1/64 in.)
Brake Pad Carrier-Side Thickness (Minimum). . . . . 0.5 mm (1/64 in.)

Component Location

Brake System Component Location



MIF M98512

- **A - Return Spring**
- **B - Park Lock Pawl**
- **C - Brake Switch Actuator**
- **D - Lock Lever**
- **E - Park Brake Pedal**
- **F - Brake Interlock Switch**
- **G - Rotor (2 used)**
- **H - Actuator Linkage (2 used)**
- **I - Brake Rod**
- **J - Brake Shafts**
- **K - Caliper Assembly**
- **L - Neutral Linkage**

Theory of Operation

Brake System Operation

Function

To provide a means of preventing the machine from moving when parked.

Theory of Operation - Normal Braking

During normal operation, braking is done by internal (hydraulic) resistance in the wheel motors.

Theory of Operation - Park Brake

The park brake consists of a pedal-operated disk brake mounted on each wheel motor.

When the park brake pedal is depressed, the brake rod is pushed back, causing the brake shafts to rotate. The brake shafts cause the actuator linkages to apply pressure to the lever-side brake pads, forcing them against the brake rotor. The rotors are held between the stationary carrier-side brake pad and the lever-side brake pad. The pedal can be locked by holding the pedal down and pressing the lock lever, engaging the park lock pawl with teeth at the bottom of the park brake pedal assembly.

The park brake pedal is also connected to the neutral linkage and brake switch actuator. The neutral linkage forces the FORWARD/REVERSE travel pedals/hydrostatic pump to the neutral position when the park brake is engaged.

The brake switch activator engages the brake interlock switch when the park brake is engaged. This allows the engine to be started or remain running if the operator leaves the seat.

Diagnostics

Brake System Troubleshooting

Symptom: Machine Will Not Move

(1) Does park brake pedal assembly move freely?

Yes - Go to step (2).

No - Repair worn or damaged parts as necessary.

(2) Is brake linkage adjusted properly? (See "Adjust Park Brake Linkage" on page 729)

Yes - Go to step (3).

No - Adjust park brake.

(3) Are brake actuator arms moving freely?

No - Repair park brake. (See "Disassemble and Assemble Park Brake" on page 731.)

Symptom: Brake Will Not Engage or Hold Machine

(1) Is brake linkage properly adjusted? (See "Adjust Park Brake Linkage" on page 729)

Yes - Go to step (2).

No - Adjust park brake.

(2) Are the brake pads in good condition, not worn or damaged?

Yes - Go to step (3).

No - Replace brake pads. (See "Disassemble and Assemble Park Brake" on page 731.)

(3) Are the brake rotor discs in good condition, not worn or damaged?

No - Replace rotor discs. (See "Remove and Install Park Brake" on page 731.)

Symptom: Excessive Brake Wear

(1) Is brake linkage properly adjusted? (See "Adjust Park Brake Linkage" on page 729)

Yes - Go to step (2).

No - Adjust park brake.

(2) Is park brake actuator arm moving freely, not jammed or binding?

Yes - Go to step (3).

No - Repair or replace damaged parts. (See "Disassemble and Assemble Park Brake" on page 731.)

Symptom: Excessive Brake Wear

(3) Are the brake pad retaining springs in good condition?

Yes - Go to step (4).

No - Replace brake pad retaining springs. (See "Disassemble and Assemble Park Brake" on page 731.)

(4) Are the brake rotor discs in good condition, not warped or damaged?

No - Replace rotor discs. (See "Remove and Install Park Brake" on page 731.)

Tests and Adjustments

Adjust Park Brake Linkage

Reason

To remove pedal free-play when the park brake is disengaged and to compensate for brake pad wear.

Procedure

1. Park machine on level ground.

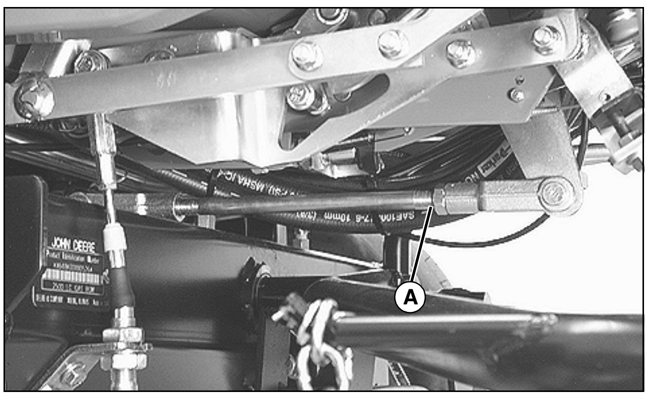
2. Move FORWARD/REVERSE travel pedals to NEUTRAL position.

3. Lower cutting units to the ground.

4. Move MOW/TRANSPORT lever to TRANSPORT position.

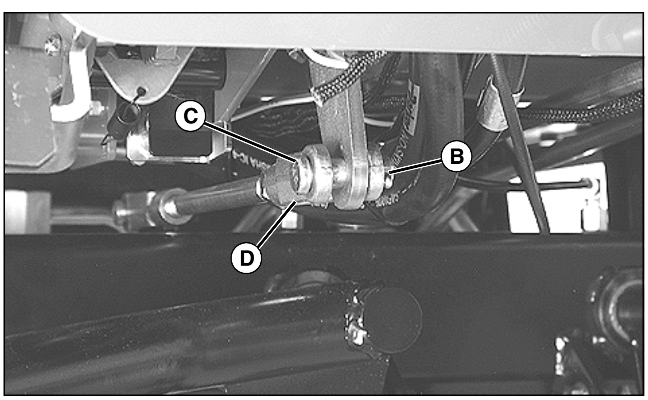
5. Turn key switch to STOP position.

6. Disengage park brake.



M84838

7. Loosen jam nut (A) on brake rod.



M84839

8. Remove spring pin (B) and yoke pin (C).

NOTE: Adjust front yoke as needed to a maximum of 25 mm (1.0 in.) of exposed threads on rod. If additional travel is required, adjust rear yoke.

9. Hold brake rod. Turn front yoke (D) counterclockwise, until the brake rod needs to be depressed slightly in order to align holes in yoke and hole in pedal arm.

10. Install pin and spring pin.

11. If pedal free-play is still noticed, adjust yokes until pedal free-play is removed.

Results

If correct adjustment cannot be obtained with both yokes adjusted to their maximum specification, replace brake pads. (See “Disassemble and Assemble Park Brake” on page 731.)

Specifications

Park Brake Linkage Exposed Rod Threads (Maximum) . . . . 25 mm (1.0 in.)

Adjust Park Brake Switch

Reason

To ensure the park brake switch is being activated when the park brake is engaged.

Procedure

1. Park machine on level ground.

2. Lower cutting units to the ground.

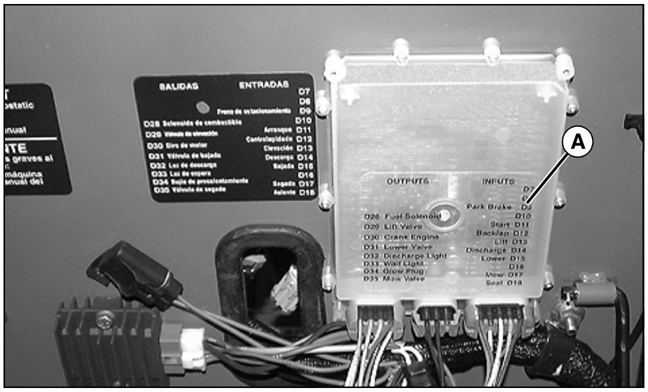
3. Move MOW/TRANSPORT lever to TRANSPORT position.

4. Engage park brake in the first lock position.

5. Move key switch to RUN position.

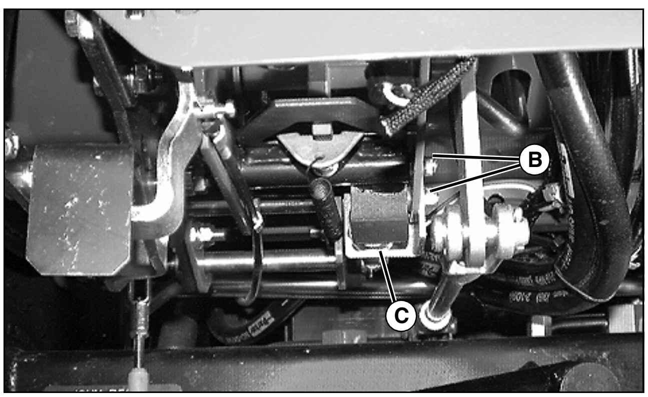
6. Raise and lock seat platform.

NOTE: When checking the input/output lights, identify lights from the numbers printed next to the lights directly on the circuit board. DO NOT read identification numbers to determine location from label, as they may not necessarily align.



M84736

7. Check the park brake input light “D9” (A) on the electronic control module (ECM). The light should be ON when the park brake is engaged. If the light does not come on, proceed to next step.



M98627

8. Loosen nuts (B) and slide bracket (C) forward until the brake input light on the ECM is ON. Tighten nuts.

Results

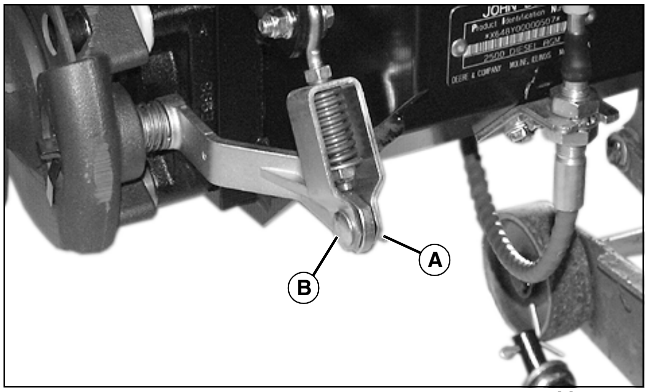
Release the brake, the brake input light “D9” on ECM should be OFF.

Repair

Remove and Install Park Brake

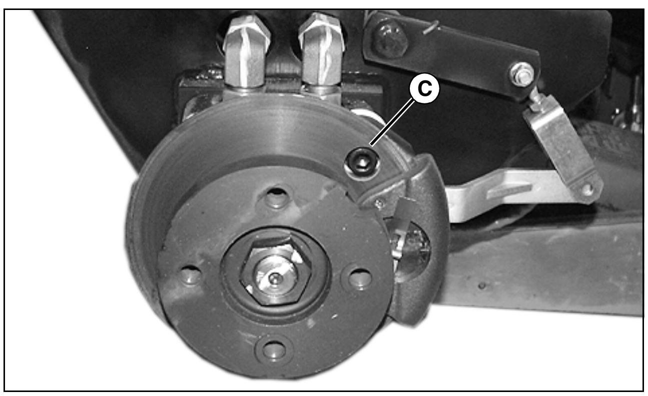
Removal

1. Remove front wheels. (See "Remove and Install Front Wheels" on page 799.)



M84616

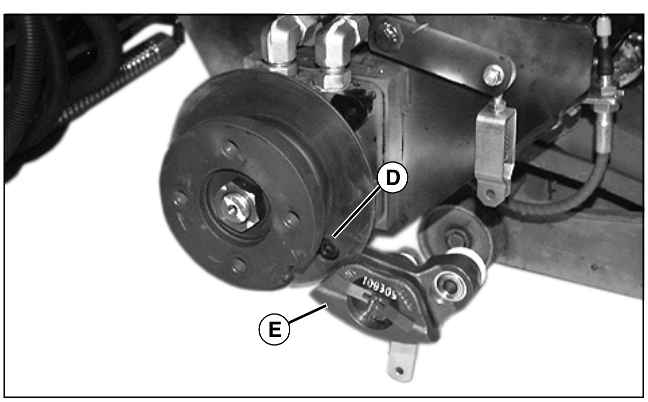
2. Remove spring pin (A) and retainer pin (B).



M84617

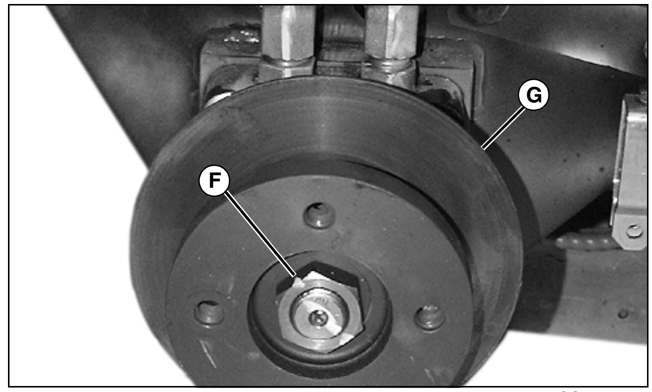
3. Rotate brake rotor to align hole in rotor with top caliper socket-head screw (C).

4. Remove socket-head screw.



M84618

5. Remove bottom caliper socket-head screw (D) and caliper assembly (E).



M84619

6. Inspect brake rotor for wear or damage.

7. If rotor replacement is required, remove nut (F), rotor (G), and key using an appropriate puller.

Installation

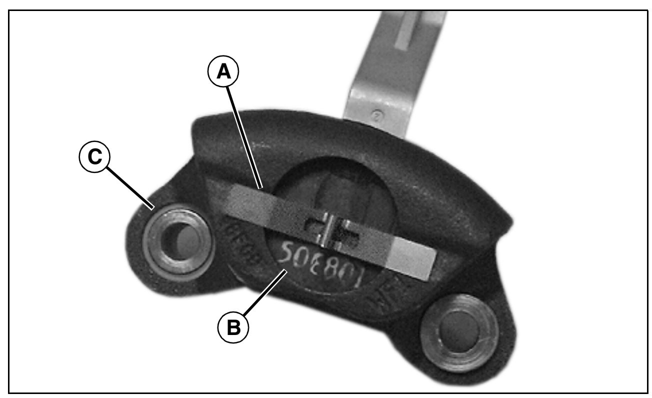
- Installation is done in the reverse order of removal.
- Tighten brake rotor retaining nut to specification.

Specifications

Brake Rotor Retaining Nut . . . . 203 N•m (150 lb-ft)

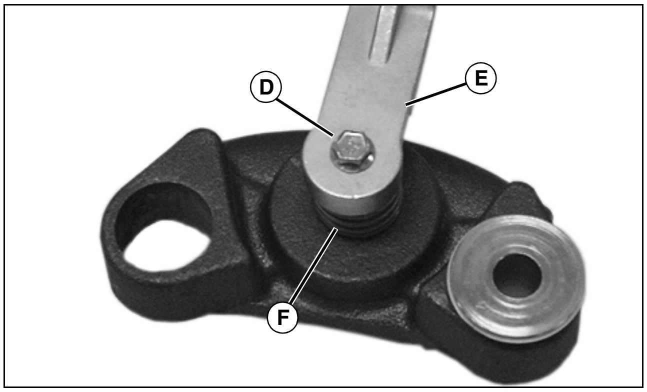
Disassemble and Assemble Park Brake

Disassembly



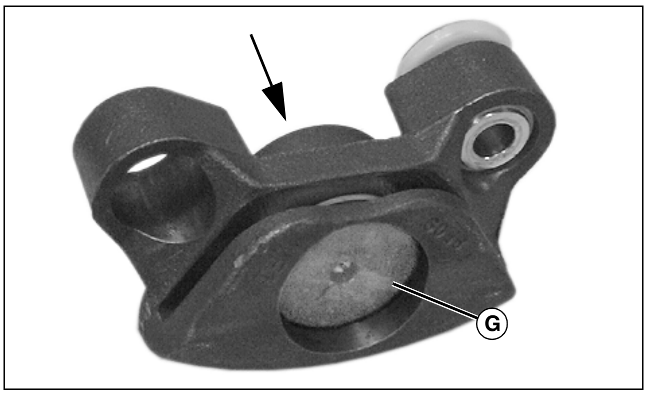
M84620

1. Remove brake pad retaining spring (A), brake pad (B), and pivot spacer (C).



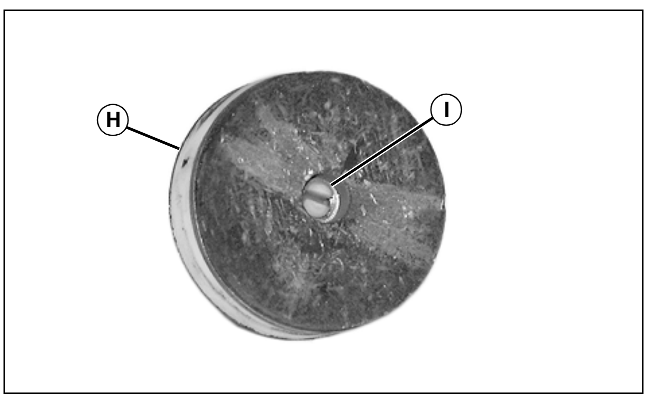
M84621

2. Remove cap screw (D), actuator lever (E), and spring (F).



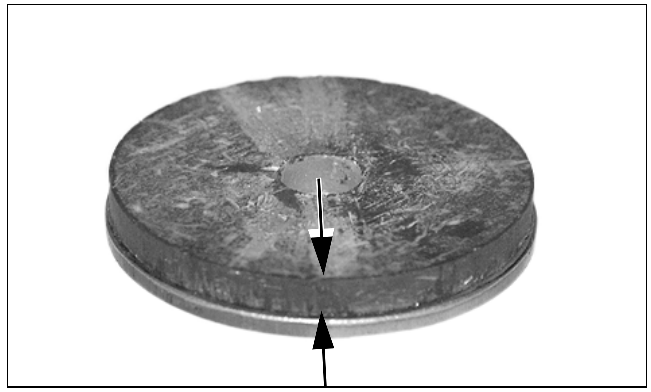
M84622

3. Remove the lever-side brake pad assembly (G) by pushing it out through the opening in the caliper housing.



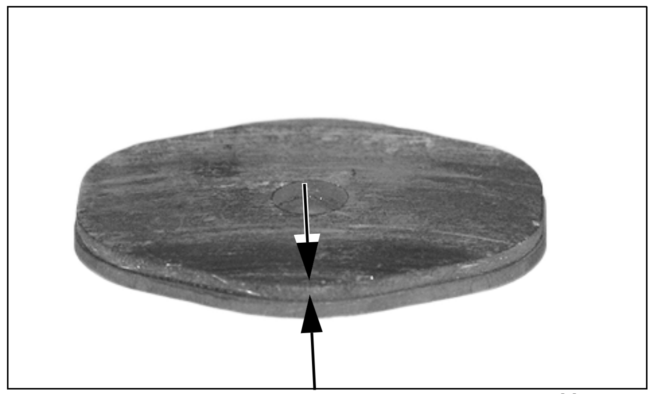
M84623

4. Remove lever-side brake pad (H) from rotor by pressing tabs (I) together.



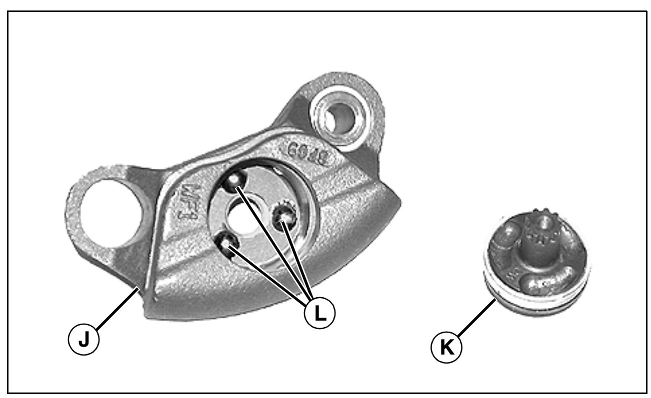
M84624

5. Measure lever-side brake pad thickness and inspect for uneven wear. If thickness of pad is less than specification or worn to backing plate at any point, replace brake pad.



M84625

6. Measure carrier-side brake pad thickness and inspect for uneven wear. If thickness of pad is less than specification or worn to backing plate at any point, replace brake pad.



M84626

7. Inspect housing (J), actuator puck (K), and pivot balls (L) for wear or damage. Replace as necessary.

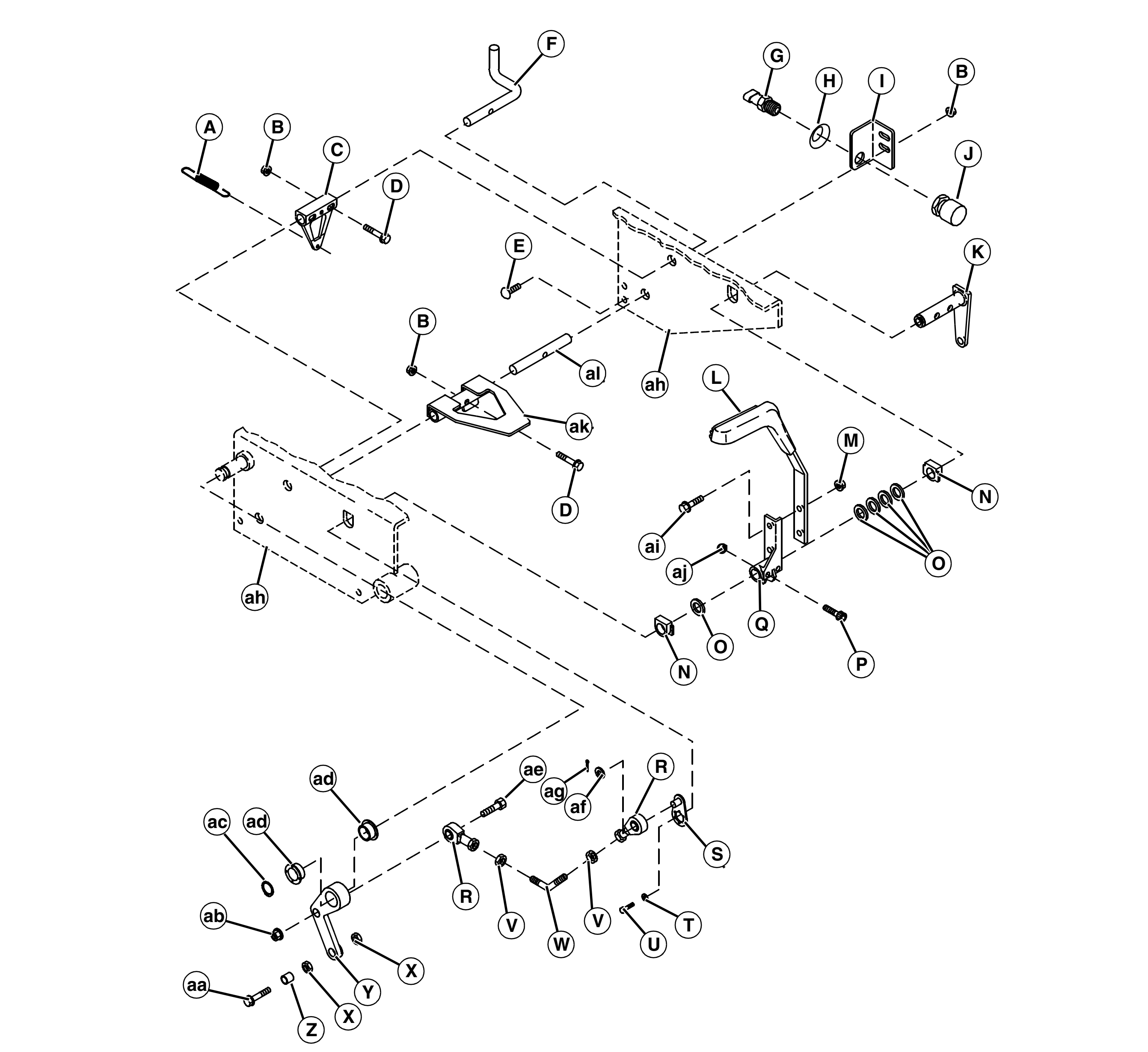
Assembly

- Assembly is done in the reverse order of disassembly.

Specifications

Brake Pad Lever-Side Thickness
(Minimum) . . . . 0.5 mm (1/64 in.)
Brake Pad Carrier-Side Thickness
(Minimum) . . . . 0.5 mm (1/64 in.)

Disassemble and Assemble Park Brake Pedal and Lock Linkage



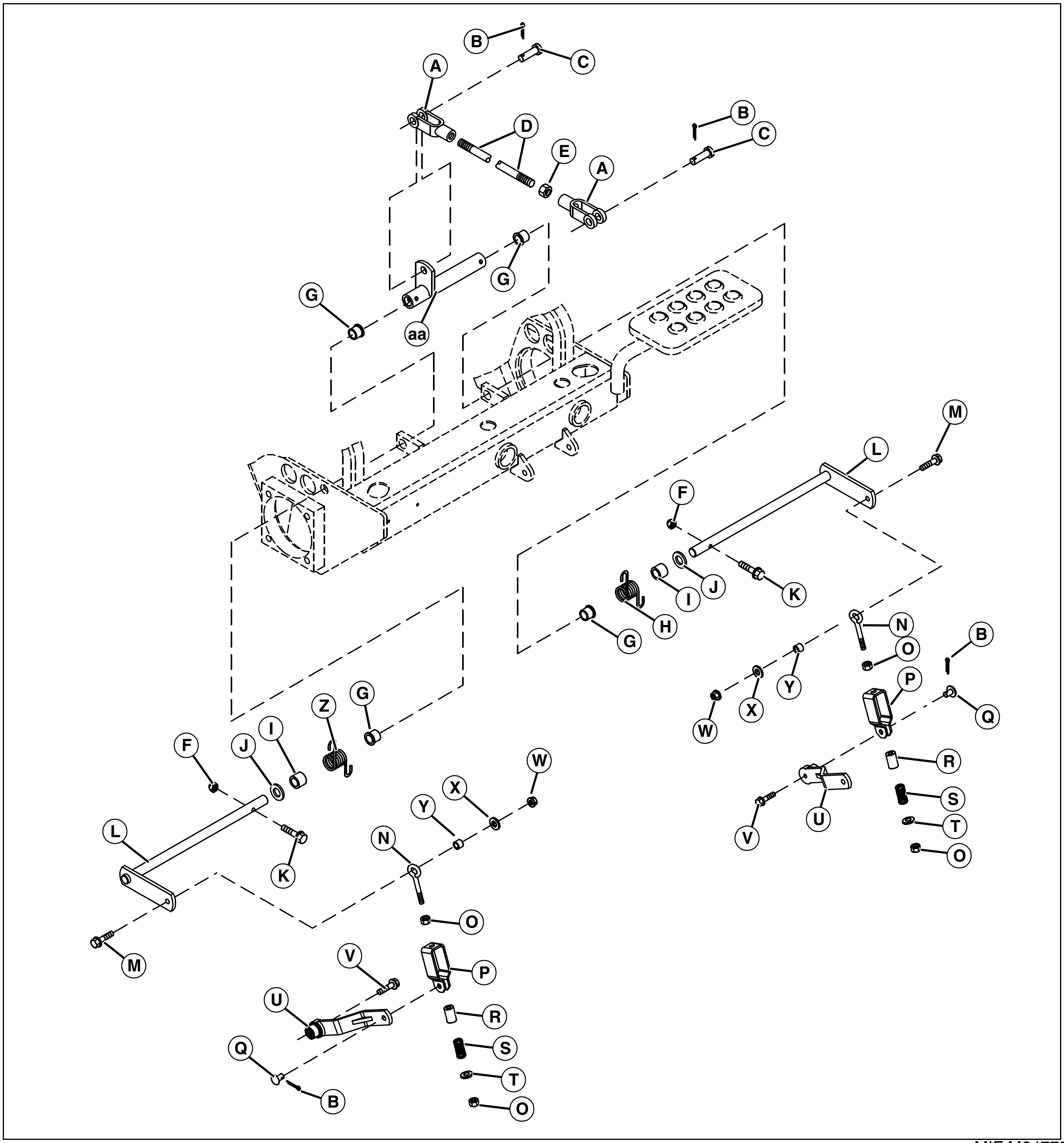
MIF M84774

A - Extension Spring
B - Locknut (4 used)
C - Park Lock
D - Cap Screw (2 used)
E - Bolt (2 used)
F - Arm
G - Switch
H - O-Ring
I - Bracket
J - Push Button

K - Shaft
L - Pedal
M - Nut (2 used)
N - Bearing (2 used)
O - Washer (5 used)
P - Screw (2 used)
Q - Pivot
R - Ball Joint (2 used)
S - Arm
T - Washer
U - Cap Screw
V - Nut (2 used)
W - Rod
X - Nut
Y - Arm
Z - Bushing
AA- Cap Screw
AB- Flange Nut
AC- Snap Ring
AD- Bushing (2 used)
AE- Cap Screw
AF- Washer
AG- Spring Pin
AH- Frame
AI - Cap Screw (2 used)
AJ- Locknut (2 used)
AK- Arm
AL- Pin

- Inspect all parts for wear or damage. Replace parts as necessary.
- Adjust brake linkage. (See “Adjust Park Brake Linkage” on page 729.)

Disassemble and Assemble Park Brake Linkage



MIF M84775

A - Yoke (2 used)
B - Spring Pin (4 used)
C - Pin (2 used)
D - Rod
E - Nut
F - Locknut (2 used)
G - Bushing (4 used)
H - Spring (Left)
I - Bushing (2 used)
J - Washer (2 used)

K - Cap Screw (2 used)
L - Shaft (2 used)
M - Cap Screw (2 used)
N - Eyebolt (2 used)
O - Locknut (6 used)
P - Retainer (2 used)
Q - Pin (2 used)
R - Bushing (2 used)
S - Compression Spring (2 used)
T - Washer (2 used)
U - Brake Lever (2 used)
V - Cap Screw (2 used)
W - Locknut (2 used)
X - Washer (2 used)
Y - Bushing (2 used)
Z - Spring (Right)
AA- Shaft

- Inspect all parts for wear or damage. Replace parts as necessary.
- Adjust brake linkage. (See “Adjust Park Brake Linkage” on page 729.)

Table of Contents

Specifications

General Specifications

Cutting Units

Number of Cutting Units 3
Cutting Unit Drive - 2500 and 2500A . . . . . Direct hydraulic motors
Cutting Unit Drive - 2500E . . . . . 48V Electric with controllers
Reel Diameter . . . . . 12.7 cm (5 in.)
Number of Blades (Standard) 11
Number of Blades (Optional) 7
Clip Frequency @ 6.4 km/h (4.0 mph) . . . . . 4.44 mm (0.175 in.)
Front Rollers . . . . . Optional - smooth or grooved
Bed Knife Adjustment . . . . . Bed knife-to-reel
Height-of-Cut[7] . . . . . 2.4-22 mm (3/32-7/8 in.)

Adjustment Specifications

Bed Knife-to-Cutting Reel Clearance . . . . . 0.025 mm (0.001 in.)
Front Roller Out-of-Parallel (Maximum) . . . . . 0.050 mm (0.005 in.)
Cutting Shield-to-Cutting Reel Clearance (Maximum) . . . . . 1 mm (0.04 in.)

Repair Specifications

Bed Knife Shoulder Bolt Torque . . . . . 55 N•m (40 lb-ft)
Bed Knife Mounting Screw Torque . . . . . 7 N•m (62 lb-in.)
GTC Shaft Retaining Nut Torque . . . . . 47 N•m (35 lb-ft)
Vertical Cutting Unit Shaft Runout (Maximum) . . . . . 0.50 mm (0.020 in.)

7. Minimum 2 mm (0.080 in.) with ultra low cut tournament bedknife.

Tools and Materials

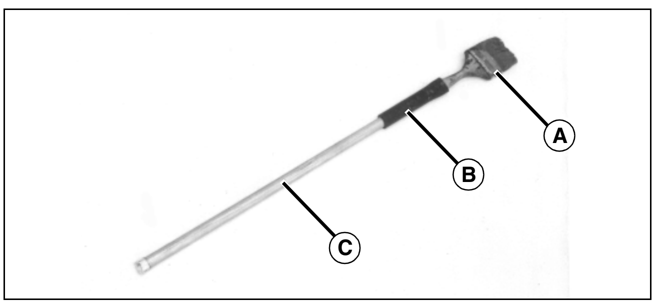
Special or Essential Tools

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

Special or Required Tools

Tool Name	Tool No.	Tool Use
Bearing Installer	JDG243	Used to install bearings.
Bearing Installer	JDG506	Used to install bearings.
Roller Bearing Puller	JDG795	Used to remove bearings from rollers.
Height-of-Cut Gauge Bar	AMT2978	Used to adjust cutting height.
Bench Plate	NA	Used to adjust front roller.

Dealer Fabricated Tools



E32285

Attach a piece of rubber hose (B) and additional handle (C) to a paint brush (A) to extend its length. This is used to apply lapping compound.

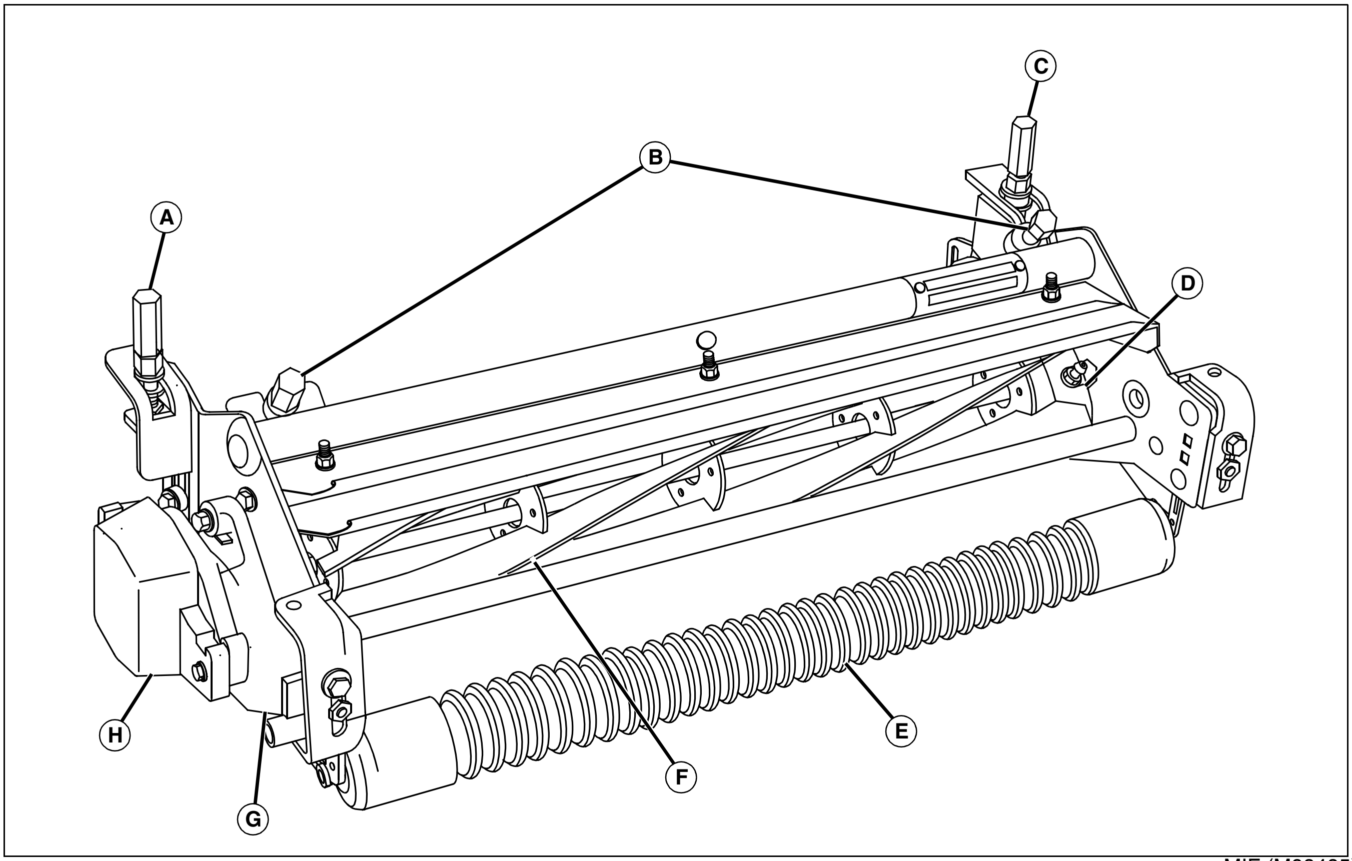
Other Materials

Other Material

Part No.	Part Name	Part Use
NA	Lapping Compound	Used to backlap bed knife/cutting reels.
TY25083	John Deere Golf And Turf Cutting Unit Grease	Used to lubricate mower bearings and seals.
AN102562	John Deere Corn Head Grease	Used to lubricate reel drive gearcase.
TY24425	John Deere Special Purpose HD Water Resistant Grease	Used to lubricate roller shaft bearing.

Component Location

Cutting Unit

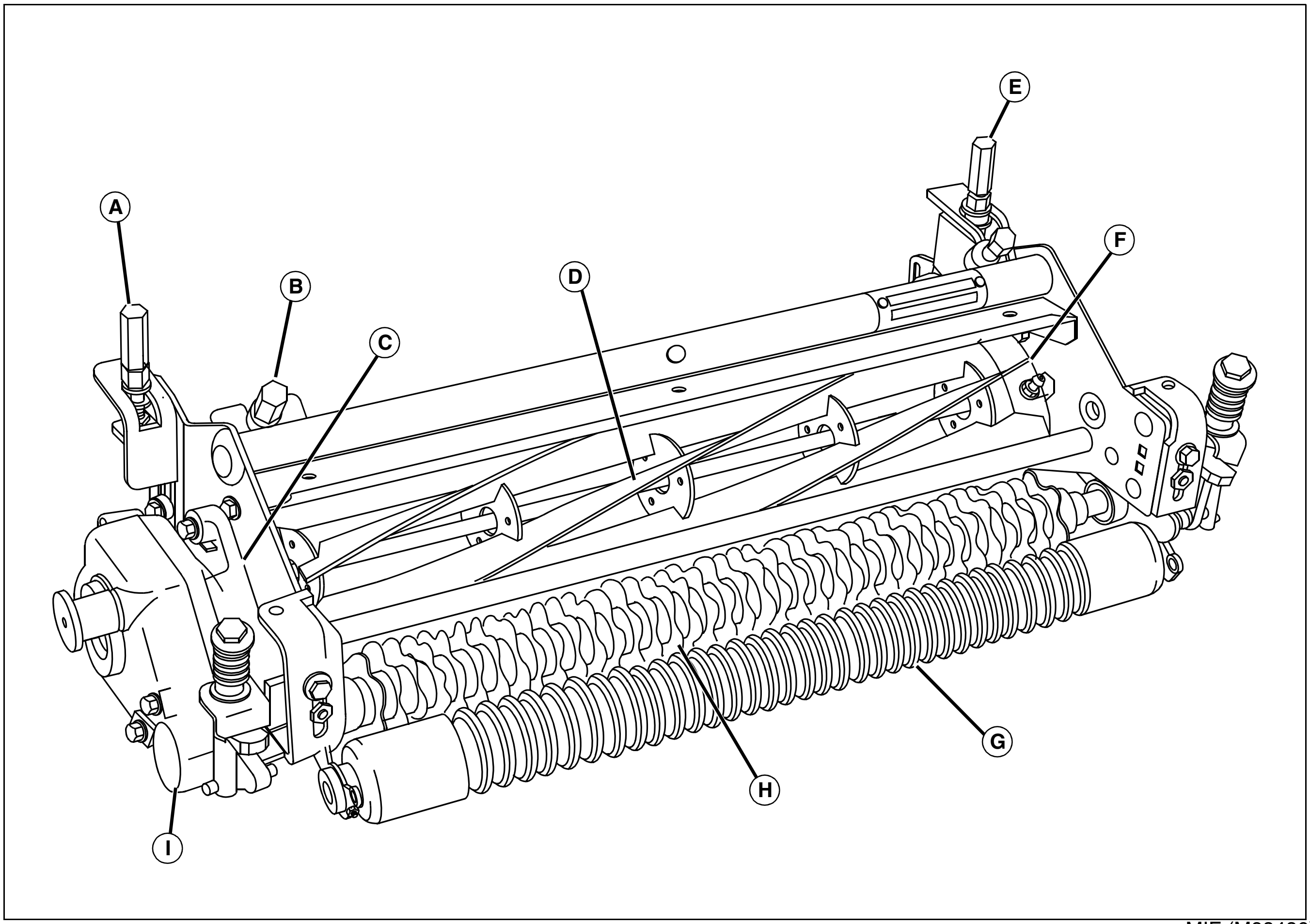


MIF (M98485)

A - Rear Roller Height Adjuster
B - Bed Knife Adjusters
C - Rear Roller Height Adjuster
D - Bearing Housing
E - Front Roller
F - Reel
G - Bearing Housing
H - Counterweight

Two reels are available, a 7-blade reel for tee collars and fairway mowing applications, and an 11-blade reel for greens and tees. A greens and turf conditioner can be mounted on the cutting unit for slicing stolons, providing grain control and a truer playing surface. A power brush attachment is available to keep the roller clear of cut-grass build-up that can affect cutting height.

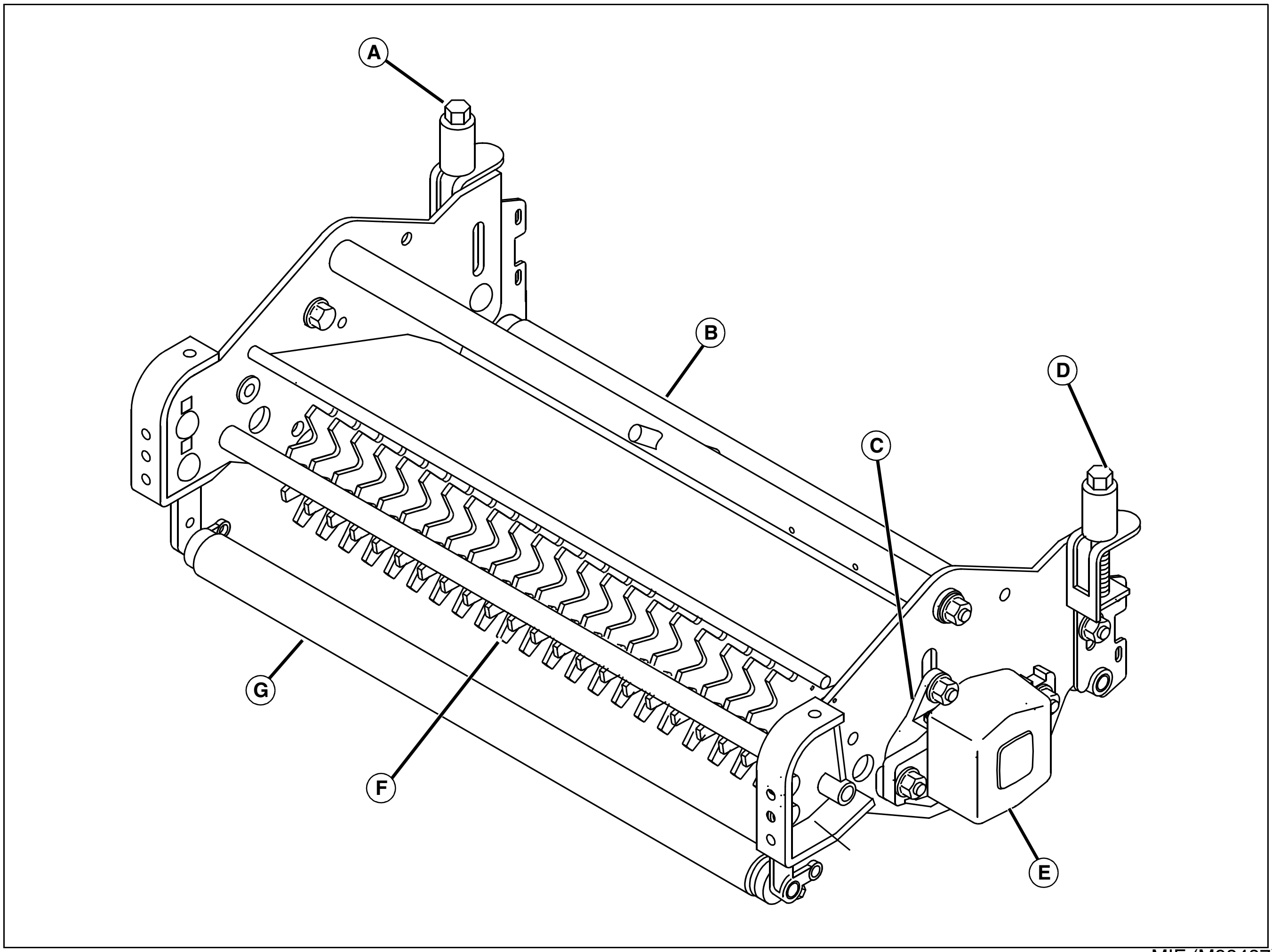
Greens and Turf Conditioner (GTC)



MIF (M98486)

A - Rear Roller Height Adjuster
B - Bed Knife Adjuster
C - Bearing Housing
D - Reel
E - Rear Roller Height Adjuster
F - Bearing Housing
G - Front Roller
H - GTC Shaft Assembly
I - GTC Gear Case

Vertical Cutting Unit



MIF (M98487)

A - Rear Roller Height Adjuster
B - Rear Roller
C - Bearing Housing
D - Rear Roller Height Adjuster
E - Counterweight
F - Vertical Blades
G - Front Roller

The vertical cutting unit is a dedicated cutting unit used to dethatch greens and tees prior to topdressing. This tends to promote vertical growth for better consistency of play on the golf course.

The vertical blades are positioned in a helix pattern and are placed 3/4 inch apart as shipped from the factory. Spacing is accomplished by placing three 1/4-inch spacers together between each blade. If a closer spacing is desired, spacers can be removed and blades added.

Normal rotational direction for the reel is forward; however, for very aggressive cutting, the reel should be operated in the reverse direction. This will prevent the cutting blades from pulling the machine and will provide a more desirable cutting action.

To operate the reel in reverse the hydraulic hoses must be reversed at the reel motors.

Always tighten oil hose connections to the correct specifications and check for leaks after connecting oil hoses.

Theory of Operation

Reel and Bed Knife Grinding

Reel and Bed Knife Relationship

Reel mowers are precision machines requiring daily maintenance to maintain the well-groomed appearance of turfgrass. The scissor-like shearing action, that only a reel mower is capable of achieving, is only possible if the reel and bed knife are sharp and the reel-to-bed knife clearance is maintained.

Close examination of the reel-to-bed knife relationship reveals two square edges passing one another with approximately 0.051 mm (0.002 in.) clearance. There are several reasons why this clearance is necessary.

- When the reel is allowed to contact the bed knife, the square (sharp) edges of the reel and bed knife will roll over, becoming dull.
- Contact between the reel and bed knife generates heat. Heat generated through this contact will distort the shape of the bed knife. Distortion causes the bed knife to draw closer to the reel, resulting in more rollover of the cutting surfaces and more heat generated in the bed knife.
- Drag produced by an improperly adjusted cutting unit may result in an unacceptable clip ratio, undue strain on drive mechanisms and premature wear of the cutting unit.

Reasons for Grinding

- To restore the cylindrical shape of a reel that has become cone-shaped due to improper adjustment of the reel-to-bed knife clearance or worn reel bearings.
- To restore the edge when the grass is not being cut across the entire length of the bed knife, evidenced by streaks of grass left after the mower has passed, usually the result of nicked blades caused by hitting foreign objects in the grass.
- To restore the edge when the lack of frequent backlapping allowed the edge to be rounded beyond the capability of the backlapping procedure to restore the edge.
- To restore the edge when the reel-to-bed knife clearance has been improperly adjusted (reel contacting bed knife).

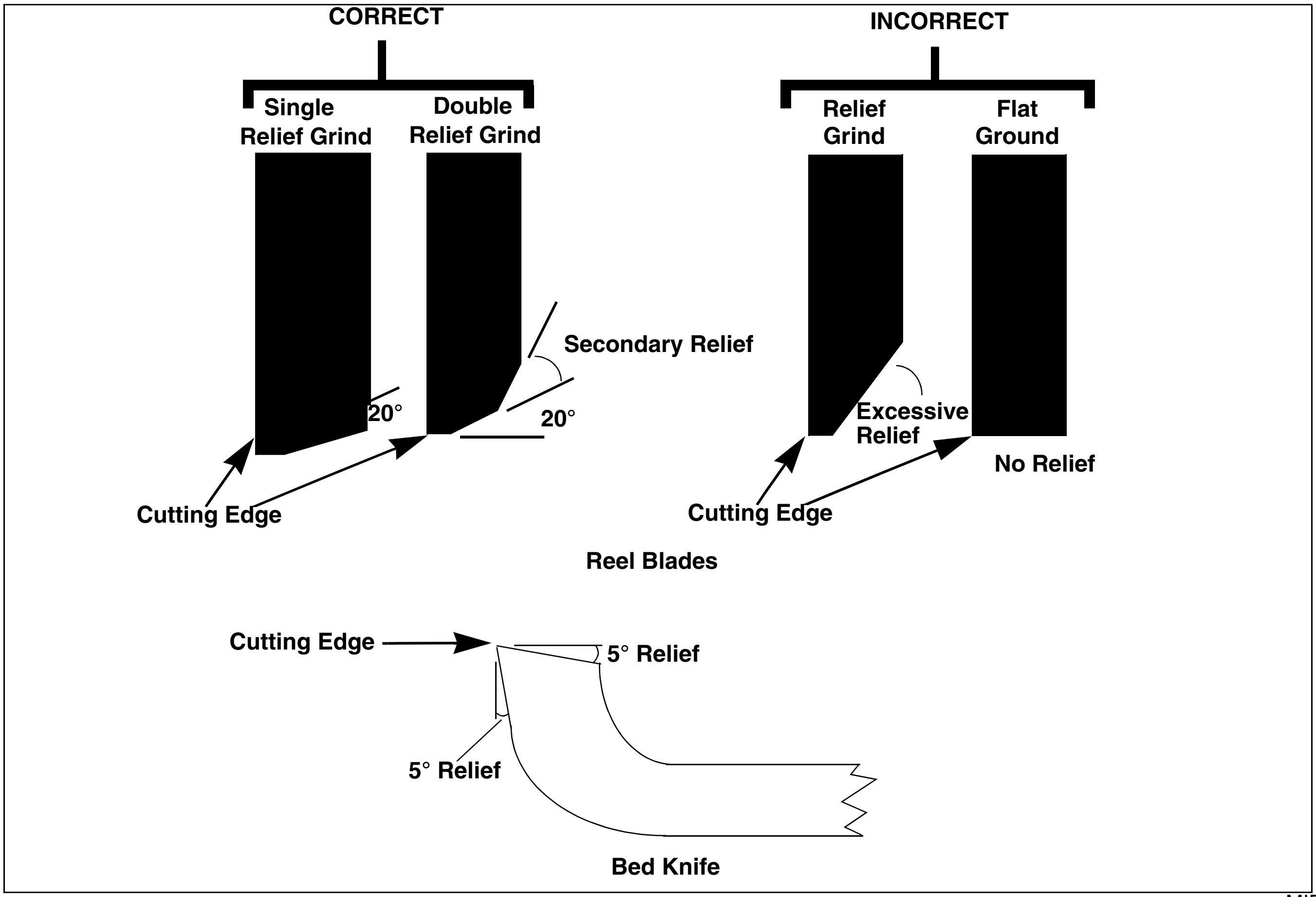
Cutting action begins as the bed knife positions the grass to be cut at the cutting edge. The reel then pulls the grass towards the bed knife where it is sheared by the cutting edges as they pass one another.

In order for the grass to be cut at the proper height, it must contact the bed knife at the cutting edge. This is accomplished by grinding a 5° relief angle on the front face of the bed knife. Without a relief angle, the blade of grass will contact the lower edge of the bed knife and be bent over at too much of an angle prior to being cut. In the case of mowing greens, where very small cuts are being taken, the reel may not capture the grass at all, and no grass will be cut.

Although some spin-grinding machine manufacturers say backlapping is not necessary, John Deere recommends backlapping after spingrinding to remove burrs and rough edges left from the spingrinding procedure. Backlapping produces a honed edge that will cut the grass evenly and leave the tops of the grass with clean, straight edges.

It is important to note that dull cutting edges will tear rather than shear the grass drawn into the bed knife. This will shock the grass plant and retard its growth.

Relief Grinding



MIF

John Deere recommends relief grinding the reels before spin-grinding for the following reasons:

- Reduces blade contact area, results in less friction, requiring less horsepower to drive the reels.
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade forming an angle (relief angle) to reduce the contact area of the cutting edges.
- Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is 0.025-0.052 mm (0.001-0.002 in.) out of round.

Backlapping

Backlapping is used to sharpen the cutting edges when grinding is not necessary. See “Reel and Bed Knife Grinding” on page 744 to determine if grinding is necessary.

When compared to grinding, backlapping removes a very small amount of metal, requires less time and will effect a smooth, clean cut.

The backlapping procedure is accomplished by spinning the reel backwards while applying special abrasive compounds to the reel. Usually, coarse compounds are used initially, followed by a finer abrasive for final honing. Recommended grits for fairways and roughs are 60, 80 and 120-grit. Reel sharpening compounds should not be toxic, oily, or greasy.

The cutting unit should be inspected, backlapped, adjusted and checked daily for a uniform cut along the complete length of the bed knife. It is important that the adjustment allows the reel to turn freely without dragging against the bed knife. Metal-to-metal contact will generate heat, causing the reel to expand and intensifying the dragging that produces more heat. This vicious cycle will quickly "shut down" the mower.

Vertical Cutting Unit

The vertical cutting unit is a dedicated cutting unit used to de-thatch fairways, greens and tees prior to topdressing. This tends to promote vertical growth for better consistency of play on the golf course.

The vertical blades are positioned in a helix pattern and are placed 3/4 in. apart as shipped from the factory. Spacing is accomplished by placing three 1/4 in. spacers together between each blade. If a closer spacing is desired, spacers can be removed and blades added.

The helix pattern in the cutters is formed by indexing the center hexagonal cut one additional flat.

Normal rotational direction for the reel is forward; however, for very aggressive cutting, the reel should be operated in the reverse direction. This will prevent the cutting blades from pulling the machine and will provide a more desirable cutting action.

To operate the reel in reverse, the hydraulic hoses must be reversed at the reel motors.

Rollers

Smooth Roller

The roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward. A smooth roller is generally used on the rear of a cutting unit to establish the cutting height range. (Under certain circumstances, grooved rollers are used on the rear.) A front roller used in conjunction with a rear roller is needed to achieve more exact cutting heights under 25 mm (1 in.).

Grooved Roller

The grooved roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward. The main advantage in using a grooved roller rather than a smooth one comes when cutting long grass that is very wet. Grass that is wet will tend to stay down rather than spring up after the roller passes. Grooved rollers will not bend the grass over, allowing it to be cut rather than passed over.

Along with advantages come disadvantages. Because of the reduced contact area inherent with a grooved roller, the roller may penetrate deeper into the soil (especially in wet conditions), lowering the effective cutting height and possibly scalping the turf. Serious consideration should be given to mowing fairways or greens with a grooved roller attached, especially when the turf is very wet.

Spiral Roller

The 3-in. diameter spiral-grooved front roller with spiral end-caps allows more grass to stand up along the entire width of the cutting unit, providing a better quality of cut. This roller is also self-cleaning, reduces material buildup on the ends, and improves the overall appearance of the finished cut.

Performance Variables

Three performance variables that affect the quality of cut are:

- Number of reel blades
- Reel rpm
- Ground speed of machine

NOTE: When discussing performance variables, we must assume that other factors such as rate of growth, mowing frequency, soil fertility and equipment condition have been considered and are not affecting the quality of cut.

To apply performance variables to a formula we need to understand three terms:

Shear Point - A single point of cutting contact between the cutting unit and the turf. Due to the reel mower design, there is an infinite number of shear points across the bed knife.

Clip Ratio (CR) - The forward distance traveled between successive cutting contacts at any one shear point.

Cutting Height (CH) - The distance above the soil line that grasses are clipped.

The most uniform cut occurs when the Clip Ratio (CR) equals the Cutting Height (CH). If CR is 20% greater than CH, marcelling (a wavy, rib-like appearance) can occur. CR should be within 20% of CH. Therefore, a CH of 13 mm (0.50 in.) requires a CR of 10-15 mm (0.40-0.60 in.). If CH is 20% greater than CR, the rotating blades create a fanning effect that blows the grass down without cutting it.

CR is controlled by the performance variables (the number of blades on the reel, ground speed and reel speed). In most cases, only two of these performance variables (the number of blades on the reel and/or the vehicle ground speed) are changeable for a given cutting height.

Since the number of blades on the reel, the reel speed, the cutting height and the clip ratio (since CR must equal CH) are known, the formula to calculate optimum vehicle ground speed (mph) is:

mph = (reel rpm) x (CR) x (No. of blades) ÷ 1056

Example:

Using:

- 3215/3235 Lightweight Fairway Mower at a tested reel speed of 2100 rpm
- 9-blade reel on a 22-in. cutting unit
- CH = 0.14 (therefore, CR = 0.14)

Optimum vehicle ground speed (mph) is:

(2100) x (0.14) x (9) ÷ 1056 = 2.5 mph

NOTE: To measure vehicle ground speed (mph):

• Measure off an 88-ft distance and record the length of time (in seconds) it takes to travel that distance.

• Vehicle ground speed equals 60 divided by that time.

Diagnostics

Reel Attachments Troubleshooting

Symptom: Marcelling

(1) Is the ground speed correct?

Yes - Go to step (2).

No - Increase or decrease ground speed as necessary. (See “Performance Variables” on page 746.)

(2) Is engine rpm correct (not too low)?

Yes - Go to step (3).

No - Increase engine speed to specification. (See operator's manual.)

(3) Are the reel and bed knife sharp?

Yes - Go to step (4).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Backlapping Procedure” on page 752.)

(4) Is the correct number of reel blades being used for desired clip ratio (CR)?

No - Install reel with correct number of blades. (See “Performance Variables” on page 746.)

Symptom: Streaking

(1) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

Yes - Go to step (2).

No - Perform reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Adjust Reel-to-Bed Knife” on page 751.)

(2) Are the reel and bed knife in good condition (no nicks, uneven wear, or distortions)?

No - Grind reel and bed knife. (See “Reel and Bed Knife Grinding” on page 744.)

Symptom: Height-of-Cut (HOC) Changes

(1) Is the grass dry enough for proper cutting (not too wet)?

Yes - Go to step (2).

No - Allow sufficient time for grass to dry before cutting.

Symptom: Height-of-Cut (HOC) Changes

(2) Is the roller clean (no grass or dirt collecting on the roller)?

Yes - Go to step (3).

No - Install scraper or power brush on roller.

(3) Is the condition of the soil good (not rough or changing)?

Yes - Go to step (4).

No - Use a smooth roller.

(4) Is the cutting unit floating properly?

Yes - Go to step (5).

No - See operator's manual.

(5) Are the roller clamp bolts tight?

Yes - Go to step (6).

No - Perform height-of-cut (HOC) Adjustment. (See “Adjust Height-of-Cut Range” on page 756.)

(6) Are the rollers concentric (not out-of-round)?

Yes - Go to step (7).

No - Replace roller. (See “Remove and Install Front Roller” on page 772 or See “Remove Rear Roller” on page 773.)

(7) Are the roller bearings in good condition (not worn)?

No - Replace roller bearings. (See “Disassemble and Assemble Roller” on page 774.)

Symptom: Poor Quality of Cut

(1) Is the grass at an acceptable height (not too high)?

Yes - Go to step (2).

No - Mow grass more frequently.

(2) Are the reel and bed knife sharp?

Yes - Go to step (3).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Backlapping Procedure” on page 752.)

Symptom: Poor Quality of Cut

(3) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

Yes - Go to step (4).

No - Perform reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Adjust Reel-to-Bed Knife” on page 751)

(4) Are the roller bearings in good condition (not worn or seized)?

No - Replace roller bearings.

Symptom: Reel Does Not Rotate

(1) Is the machine operating properly?

Yes - Go to step (2).

No - See machine operator's manual.

(2) Is the reel and bed knife free of debris?

Yes - Go to step (3).

No - Remove material jammed between reel and bed knife.

(3) Is coupler (or couplers) installed?

Yes - Go to step (4).

No - Install coupler (or couplers). (See “Remove and Install Electric Reel Motor - Model 2500E” on page 764.) (See “Remove and Install Reel Motor - 2500, 2500A” on page 672.)

(4) Are mower electrical control circuits operating correctly?

No - See appropriate diagnostics in Electrical section.

Symptom: Unit Not Cutting

(1) Is the grass dry and height of the grass not too excessive?

Yes - Go to step (2).

No - Allow sufficient time for grass to dry and mow more frequently.

(2) Are the engine and ground speeds correct?

Yes - Go to step (3).

No - Adjust engine speed to specification. (See operator's manual.) Adjust ground speed to conditions. (See “Performance Variables” on page 746.)

Symptom: Unit Not Cutting

(3) Is the correct number of blades used for conditions?

Yes - Go to step (4).

No - Install reel with correct number of blades. (See “Performance Variables” on page 746.)

(4) Is the reel speed correct?

Yes - Go to step (5). May be necessary to change to a more aggressive bed knife.

No - Adjust reel speed. (See “Adjust Reel Speed” on page 750.)

(5) Are the reel and bed knife sharp?

Yes - Go to step (6).

No - Perform backlapping and reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Backlapping Procedure” on page 752.)

(6) Is the reel-to-bed knife clearance within specification and consistent along the bed knife?

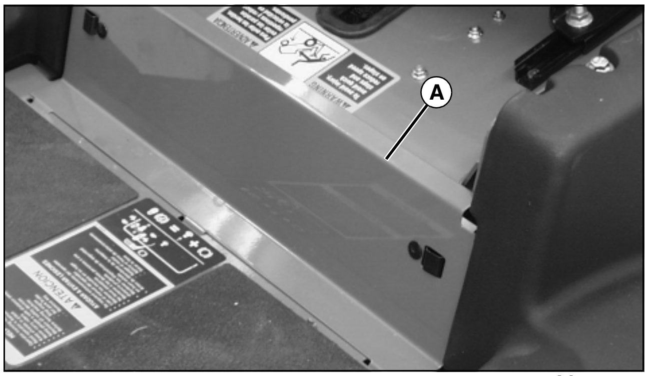
No - Perform reel-to-bed knife adjustment. (See “Backlapping and Bed Knife-to-Reel Adjustment” on page 752 and See “Adjust Reel-to-Bed Knife” on page 751.)

Tests and Adjustments

Adjust Reel Speed

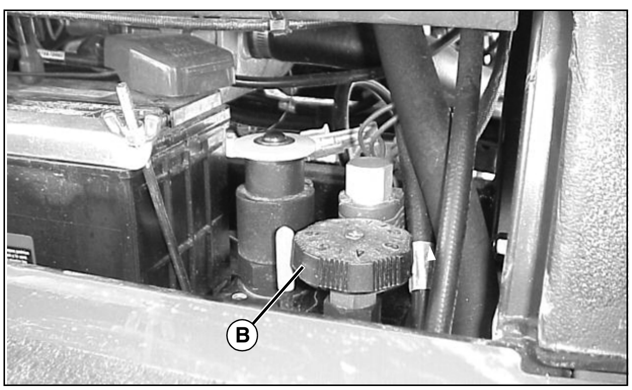
IMPORTANT: Avoid damage! Operating the reels at a high speed can cause excessive bed knife and reel wear. Operate the reels at the appropriate reel speeds.

1. Park the vehicle safely. (See “Park Machine Safely” on page 3.)



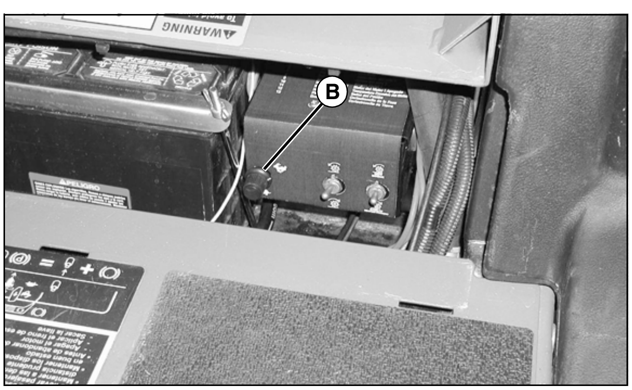
M97408

2. Open service access panel (A) below operator seat platform.



MX20450

Picture Note: 2500A Model Shown. 2500 is similar.



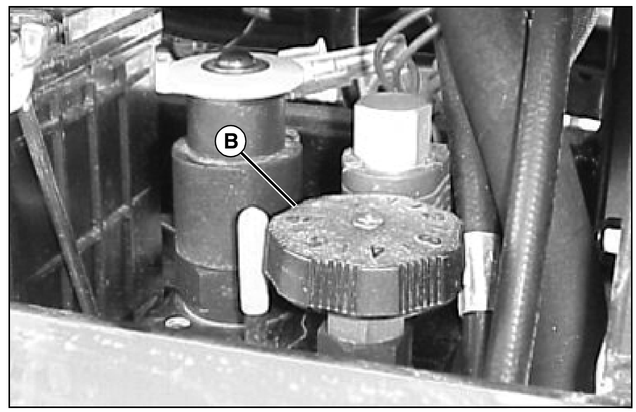
MX20382

Picture Note: 2500E Model Shown

3. Locate reel speed control knob (B) behind service access panel.

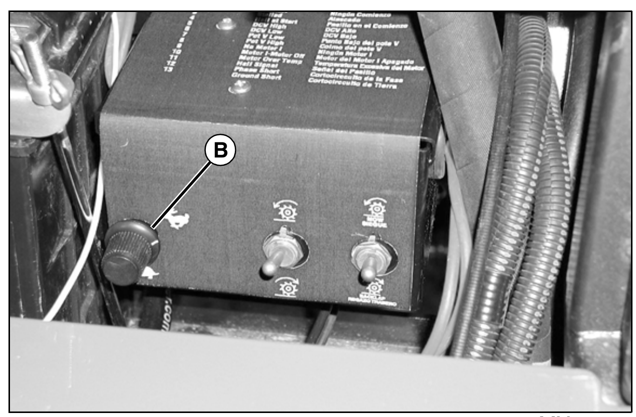
NOTE: Reel speed can be adjusted depending on the type of application for the greensmower, which type of cutting units are used, and grass height and conditions.

It may be appropriate to reduce reel speed when cutting taller grass to prevent grass from being blown over and not being cut. Faster reel speeds with dry grass may cause grass clippings to be thrown over the grass catcher.



MX20450

Picture Note: 2500A Model Shown. 2500 is similar.



MX20429

Picture Note: 2500E Model Shown

4. Adjust reel speed:
   - **For mowing greens,** set the speed control knob (B) to the highest setting (fully clockwise) for best cutting performance in most conditions.
   - **For mowing approaches and fairways,** reel speed may be reduced by turning the speed control knob counterclockwise.
5. Close service access panel.

Adjust Reel-to-Bed Knife

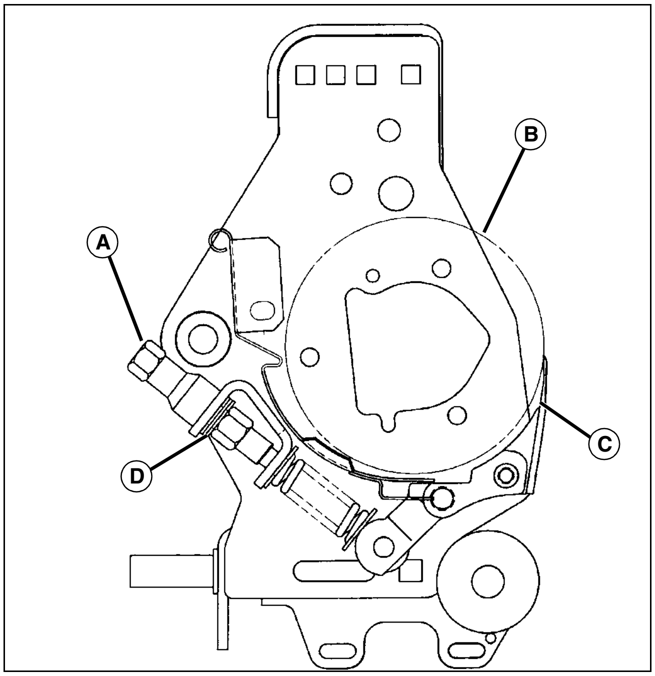
Reason

To maintain reel-to-bed knife clearance for clean, consistent cutting.

Procedure

CAUTION: Avoid injury! Always wear protective gloves when working on or near the cutting reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

1. Remove cutting units from mower.



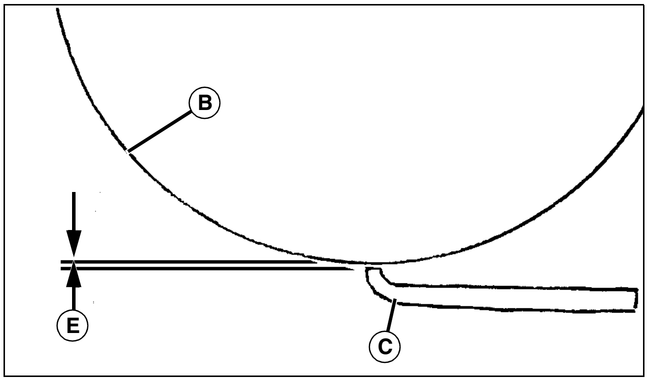
M84842

2. Place cutting unit on a stable working surface with the front roller facing up.
3. Loosen jam nut (D) on both sides of the cutting unit.

IMPORTANT: Avoid damage! Both sides of the bed knife must be adjusted evenly in small increments. DO NOT turn each bed knife adjuster more than one flat at a time.

4. Turn both bed knife adjusters (A) counterclockwise (alternating from one side to the other) until the bed knife (C) is tight against the cutting reel (B).
5. Slowly turn both bed knife adjusters clockwise (alternating from one side to the other) until the bed knife begins to pull away from the cutting reel. At this time the cutting reel should rotate freely.

NOTE: Make sure that when making the final adjustment, the bed knife is moving away from cutting reel.



E35559

6. Using a feeler gauge, turn both bed knife adjusters clockwise (alternating from one side to the other) until bed knife-to-cutting reel clearance (E) is set to specifications.
7. Tighten jam nuts.

IMPORTANT: Avoid damage! Always rotate the cutting wheel backwards to prevent damaging or dulling the cutting edges of the reel and/or bed knife.

8. Slowly rotate the cutting reel backwards and check the gap at several points along the entire length of the bed knife using a 0.050 mm (0.002 in.) feeler gauge. The feeler gauge should not pass between the bed knife and cutting reel at any point.

Results

- **If the gap is 0.050 mm (0.002 in.) or greater at the center of the bed knife:** Grind the reel and/or bed knife to eliminate the “smile” in the bed knife or the out-of-round condition of the reel.
- **If there is contact at the center of the bed knife:** Grind the reel and/or bed knife to eliminate the “frown” in the bed knife or the out-of-round condition of the reel.

Specifications

Reel-to-Bed Knife Clearance . . . . 0.025 mm (0.001 in.)

Backlapping and Bed Knife-to-Reel Adjustment

It is best to think of backlapping and bed knife-to-reel adjustments as one procedure. Although backlapping removes only a small amount of metal, the clearance between the reel and bed knife will be increased and must be readjusted.

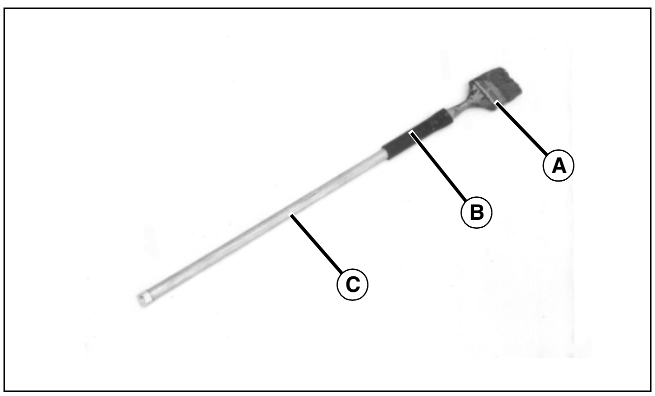
Another very important point to remember is that adjustments can only be successful if the frame integrity (straightness and strength) is maintained. Attaching bolts must be secure and bearings must be well lubricated and not worn.

Backlapping Procedure

Reason

To provide a consistent cutting action and prolong reel life.

Dealer Fabricated Tools



E32285

Attach a piece of rubber hose (B) and additional handle (C) to a paint brush (A) to extend its length. This is used to apply lapping compound.

Other Material

Part No.	Part Name	Part Use
NA	Lapping Compound	Used to backlap bed knife/cutting reel.

Procedure

CAUTION: Avoid injury! Rotating blades are dangerous and can cut fingers and toes. Keep hands and feet away while greensmower is running.

Disengage greens and turf conditioner (GTC) before backlapping.

IMPORTANT: Avoid damage! Backlapping cutting units should be done by trained personnel on a routine basis approximately every 25 hours. Backlap intervals will vary depending on conditions. Backlapping is done to prolong reel life, prevent downtime and provide a consistently sharp cutting action.

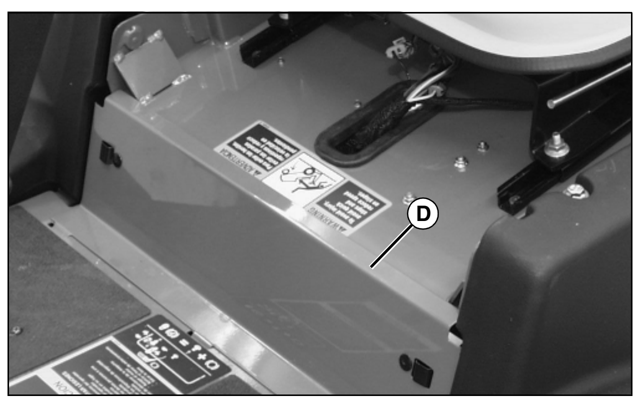
NOTE: To help maintain sharp edges required on cutting reels, bed knife-to-reel clearance should be checked before the backlapping function begins. The bed knife must be adjusted properly to ensure light, even contact over the length of the cutting blades.

Cutting reels are all backlapped at the same time.

1. Check bed knife-to-reel clearance on all three cutting reels. Adjust if necessary.
2. Operator on seat.
3. Move mow-transport lever to the TRANSPORT position.
4. Lock park brake.
5. Lower cutting units to the ground.

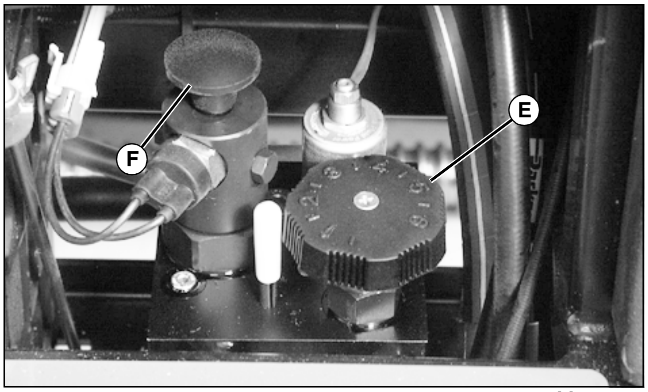
NOTE: Operator must be off the seat for the backlapping valve to function.

6. Operator off seat.



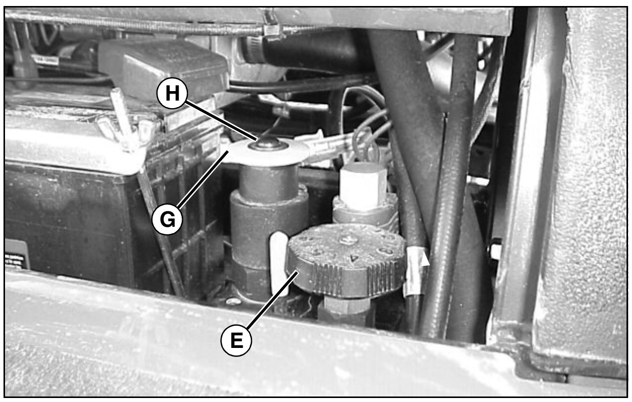
M97408

7. Open service access panel (D) below operator seat platform.



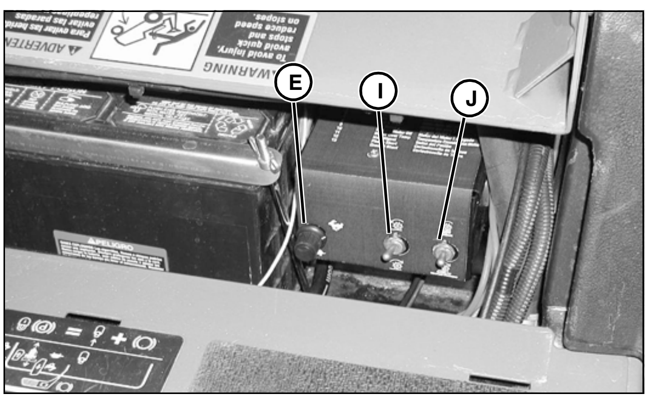
M84846

Picture Note: 2500 Model



MX20450

Picture Note: 2500A Model



MX20382

Picture Note: 2500E Model

8. Locate backlapping control to the left of the battery.
9. Start engine.
10. Position throttle lever between mid-range and SLOW idle.
11. Adjust reel speed control knob (E) fully counterclockwise.
12. Engage backlapping valve:

- **2500:** Pull the forward-reverse knob (F) up until a "click" is heard to engage REVERSE position.

NOTE: 2500A: Forward-reverse control knob must be pulled up completely past first detent for the backlapping valve to function properly.

- **2500A:** Press in on the release button (H) at the center of the forward-reverse knob (G) and pull the knob out until it locks into the REVERSE position.
- **2500E:** Move mow-backlap switch (J) to BACKLAP position. Move forward-reverse switch (I) to REVERSE position.

13. Move the mow-transport lever to MOW position.

CAUTION: Avoid injury! Rotating blades are dangerous. Keep hands and feet away while greensmower is operating.

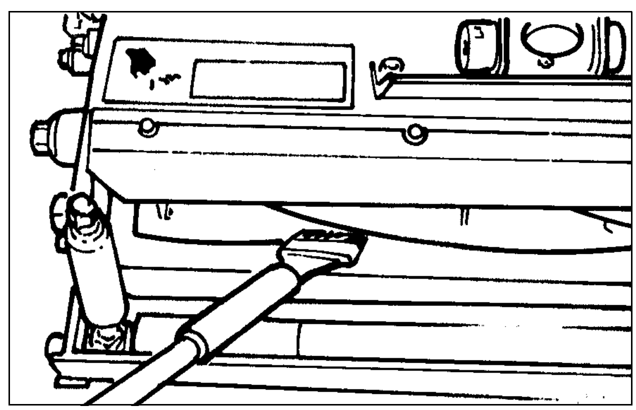
Use a brush with a long handle when performing backlapping procedure to keep fingers and hands from rotating blades.

14. Activate raise-lower lever.

- Move and hold lever forward.
- When cutting reels begin turning in REVERSE, release lever.

NOTE: Adjust reel speed so that reel sharpening compound is not thrown off during the backlapping procedure.

15. Increase reel speed slightly, but not so fast that backlapping compound is thrown off.



M79054

16. Using a long-handled brush, carefully apply reel sharpening compound, uniformly, from one end of the cutting reel to the other. Repeat application in opposite direction. Allow cutting reel to continue running backwards until reel is quiet.

CAUTION: Avoid injury! Rotating blades are danerous and can cut fingers and toes. Keep hands and feet away while greensmower is operating.

Do not attempt to disengage the cutting units using the reel speed control knob. Reels can continue to rotate if engine is running.

17.Periodically disengage cutting units by moving the mow-transport lever to the TRANSPORT position and turn key switch to the STOP position. Visually check blade appearance.

NOTE: 2500A - Forward-reverse control knob must be pushed down to restart engine.

2500E - Mow backlap switch must be moved to MOW to restart engine.

- Check for uniform clearance across entire bed knife. If clearance is not uniform, repeat backlapping procedure until clearance is uniform across entire bed knife.

IMPORTANT: Avoid damage! Do not operate cutting reels in the forward direction until reel sharpening compound is washed from the unit. Unless properly washed, the reels can be dulled by the compound.

18.Use water to thoroughly wash off all reel sharpening compound while cutting reels are turning in reverse.

19.Adjust reel-to-bed knife clearance.

20.Move mow-transport lever to the TRANSPORT position.

21.Return forward-reverse control to FORWARD position.

22.**2500E:** Return mow-backlap switch to MOW position.

23.Adjust cutting reels to desired operating speed.

Results

Reel and bed knife should be sharp and free from minor nicks and scratches.

Grinding Reel and Bed Knife

Reel and Bed Knife Relationship

Reel mowers are precision machines requiring daily maintenance to maintain the well-groomed appearance of turfgrass. The scissor-like shearing action, that only a reel mower is capable of achieving, is only possible if the reel and bed knife are sharp and the reel-to-bed knife clearance is maintained.

Close examination of the reel-to-bed knife relationship reveals two square edges passing one another with approximately 0.051 mm (0.002 in.) clearance. There are several reasons why this clearance is necessary.

- When the reel is allowed to contact the bed knife, the square (sharp) edges of the reel and bed knife will roll over, becoming dull.
- Contact between the reel and bed knife generates heat. Heat generated through this contact will distort the shape of the bed knife. Distortion causes the bed knife to draw closer to the reel, resulting in more rollover of the cutting surfaces and more heat generated in the bed knife.
- Drag produced by an improperly adjusted cutting unit may result in an unacceptable clip ratio, undue strain on drive mechanisms and premature wear of the cutting unit.

Reasons for Grinding

- To restore the cylindrical shape of a reel that has become cone-shaped due to improper adjustment of the reel-to-bed knife clearance or worn reel bearings.
- To restore the edge when the grass is not being cut across the entire length of the bed knife, evidenced by streaks of grass left after the mower has passed. Usually the result of nicked blades caused by hitting foreign objects in the grass.
- To restore the edge when the lack of frequent backlapping allowed the edge to be rounded beyond the capability of the backlapping procedure to restore the edge.
- To restore the edge when the reel-to-bed knife clearance has been improperly adjusted (reel contacting bed knife).

Cutting action begins as the bed knife positions the grass to be cut at the cutting edge. The reel then pulls the grass toward the bed knife where it is sheared by the cutting edges as they pass one another.

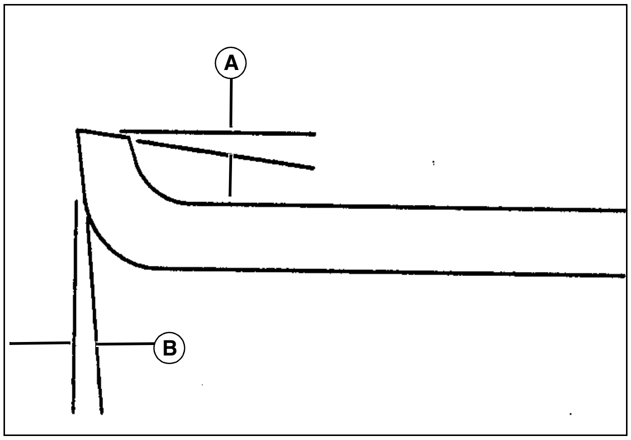
In order for the grass to be cut at the proper height, it must contact the bed knife at the cutting edge. This is accomplished by grinding a 5° relief angle on the front face of the bed knife. Without a relief angle, the blade of grass will contact the lower edge of the bed knife and be bent over at too much of an angle prior to being cut. In the case of mowing greens, where very small cuts are being taken, the reel may not capture the grass at all, and no grass will be cut.

Although some spin grinding machine manufacturers say backlapping is not necessary, John Deere recommends backlapping after spin grinding to remove burrs and rough edges left from the spin grinding procedure. Backlapping produces a honed edge that will cut the grass evenly and leave the tops of the grass with clean, straight edges.

It is important to note, dull cutting edges will tear rather than shear the grass drawn into the bed knife. This will shock the grass plant and retard its growth.

Grinding the Bed Knife

NOTE: Bed knife and support assembly must be ground as a complete unit.

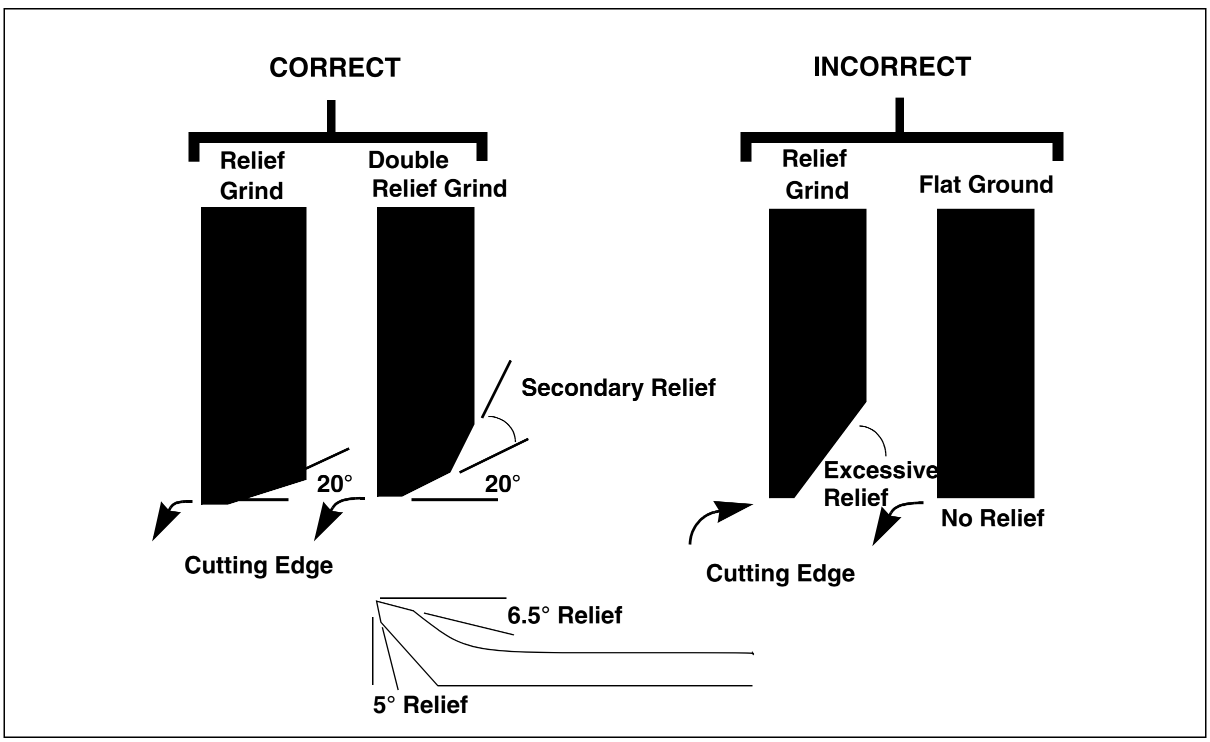


M47199

1. When grinding the bed knife, it is important to have a 6.5° relief angle on the top surface (A) and a 5° relief angle on the front surface (B).

2. Put entire bed knife support and bed knife in a suitable grinder and grind until material is consistently removed from the entire length of the top and front surfaces of the bed knife.

Grinding the Reel



MIF

John Deere recommends relief grinding the reels before spin grinding for these reasons:

- Reduced blade contact area results in less friction, requiring less horsepower to drive the reel and increases fuel efficiency.
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade, forming an angle (relief angle) to reduce the contact area of the cutting edges.
- Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is 0.025-0.051 mm (0.001-0.002 in.) too high.

Adjust Height-of-Cut Range

Reason

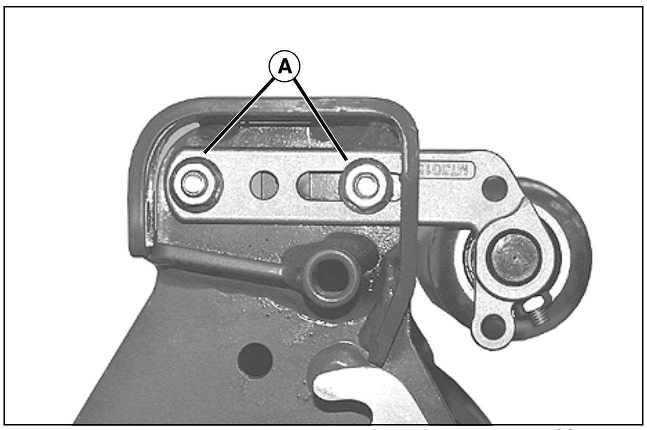
To set front roller range for proper height-of-cut position.

Procedure

1. Remove cutting units from mower. (See "Remove and Install Cutting Unit" on page 765.)

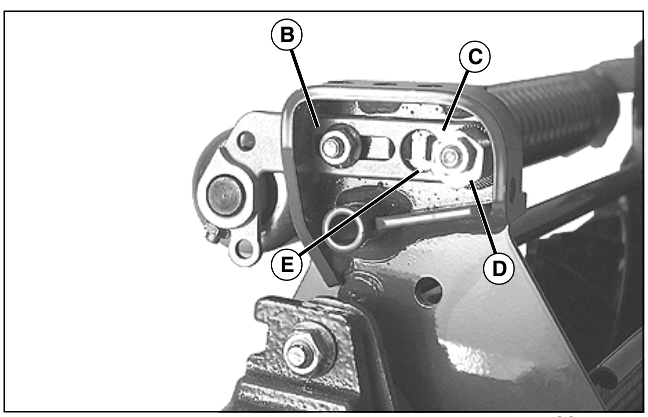
2. Place cutting unit on a stable working surface with the front roller facing up.

NOTE: The effective height-of-cut may differ from the bench setting due to the weight of options used, type of roller (grooved or smooth), soil conditions, grass condition and the use of competitive machines in conjunction with one another.



M84841

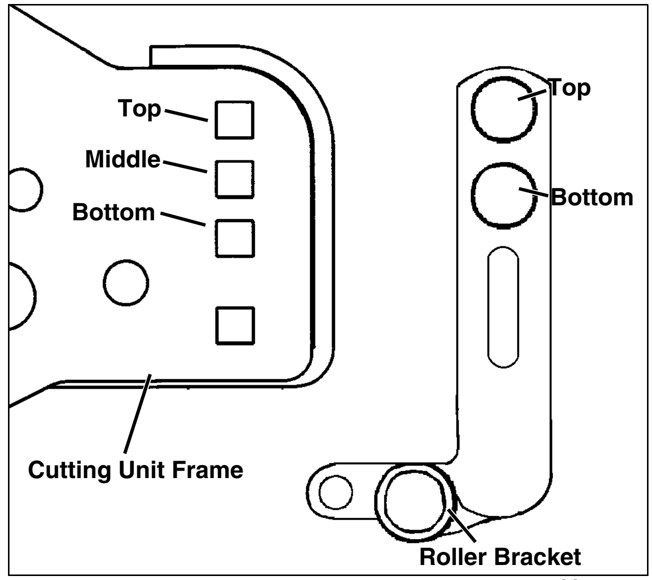
3. Remove two flanged nuts and carriage bolts (A).



M84828

4. Remove lower flanged nut and carriage bolt (B).

5. Remove lock nut (C), eccentric adjuster (E), serrated washer (D) and carriage bolt.

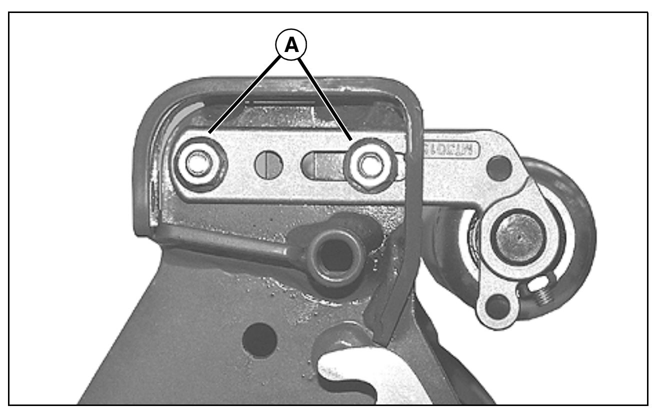


M84845

6. Reposition roller bracket to holes in cutting unit frame to the desire cutting height range (see chart).

Height of Cut	Roller Bracket Hole	Cutting Unit Frame Hole
0-9.53 mm (0-3/8 in.)	Top	Top
6.35-15.88 mm (1/4-5/8 in.)	Bottom	Bottom
12.70-22.23 mm (1/2-7/8 in.)	Top	Middle
0-6.53 mm[1] (0-1/4 in.)	Bottom	Middle

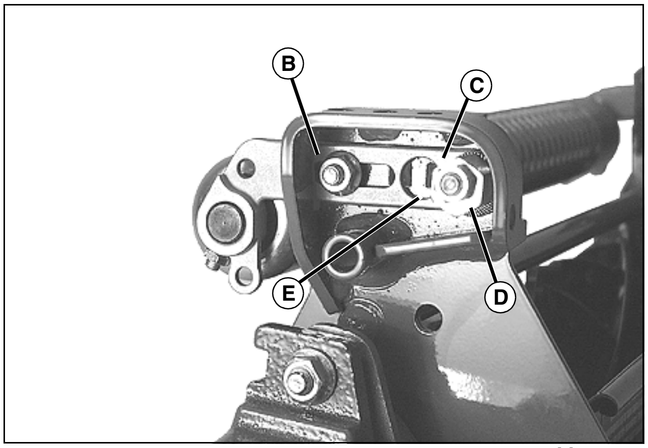
1. This setting is used when the diameter of the cutting reel has worn down to 120 mm (4.7 in.) or less.



M84841

7. Install two flanged nuts and carriage bolts (A).

8. Tighten nuts.



M84828

9. Install lower flanged nut and carriage bolt (B).

10.Install serrated washer (D), eccentric adjuster (E), carriage bolt and lock nut (C).

11.Adjust front roller. (See “Adjust Front Roller” on page 757.

Results

Front roller range positioned for proper height-of-cut adjustment.

Adjust Front Roller

Reason

To ensure that the front roller is parallel with the bed knife.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Bench Plate	NA	Used to adjust front roller.
Height-of-Cut Gauge Bar	AMT2978	Used to adjust front roller.

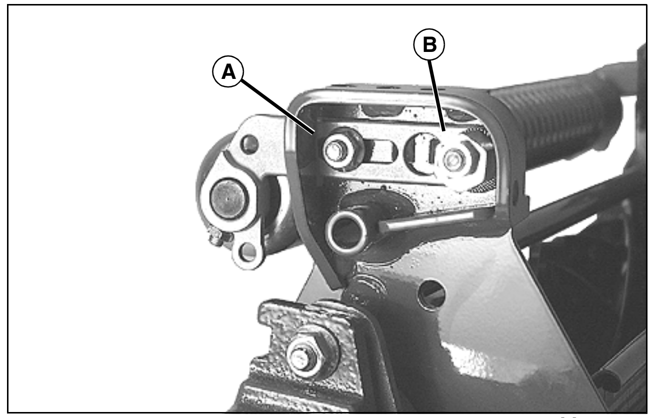
Procedure

CAUTION: Avoid injury! Always wear protective gloves when working on or near the cutting reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

NOTE: The bed knife-to reel clearance should be adjusted before performing the following procedure.

Bench Plate Procedure

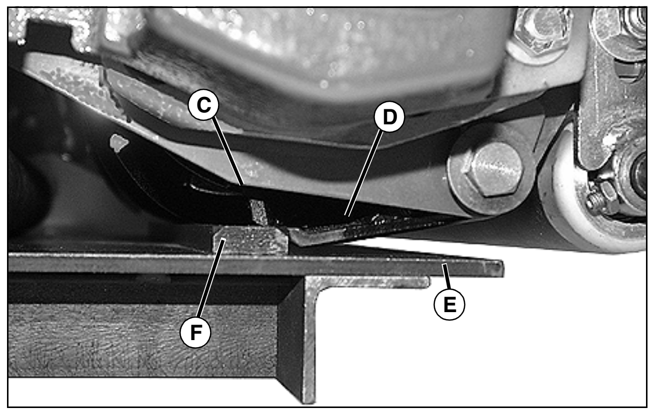
1. Place cutting unit on a stable working surface with the front roller facing up.



M84828

2. Loosen flanged nut (A) on left roller bracket.

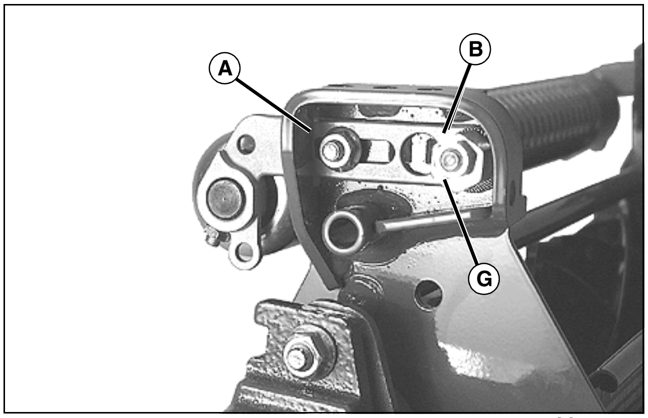
3. Loosen eccentric lock nut (B).



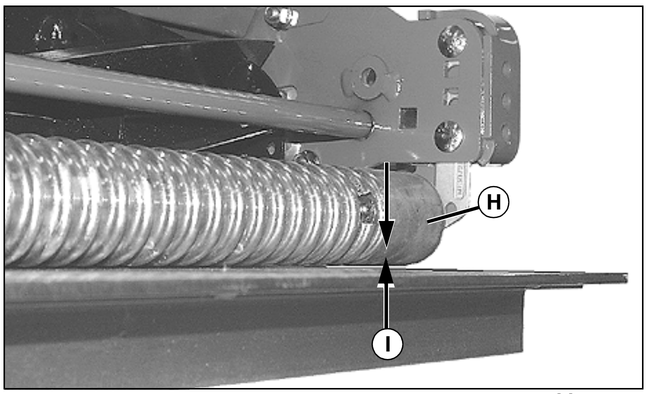
M84829

4. Set bench plate (E) on a level surface.

5. Set cutting unit on top of bench plate. The bed knife (D) must rest firmly against the plate stop (F), with the cutting reel blade (C) on top of plate stop.



M84828



M84830

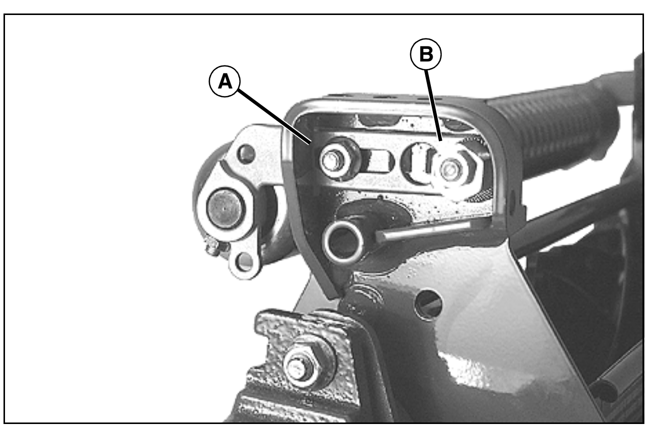
6. Rotate eccentric adjuster (G) until the front roller (H) sits flat and parallel with the bench plate. The gap (I) should not exceed 0.050 mm (0.005 in.).

7. Tighten left roller lower flanged nut (A).

8. Tighten eccentric lock nut (B).

Height-of-Cut Gauge Bar Procedure

1. Place cutting unit on a stable working surface with the front roller facing up.

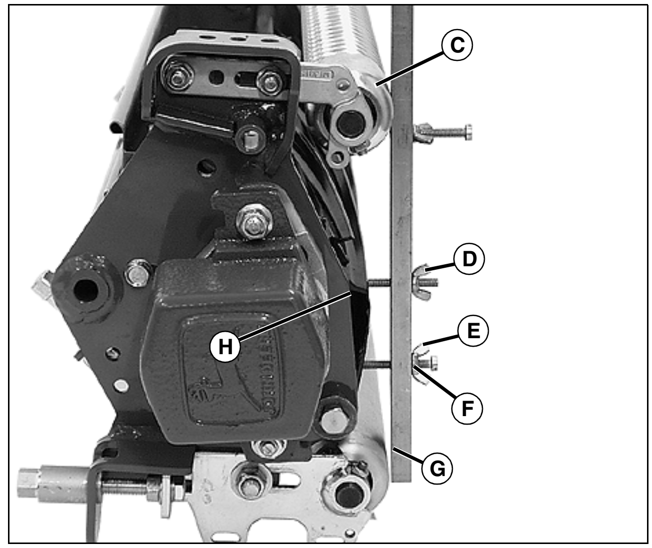


M84828

2. Loosen lower flanged nut (A) on left roller bracket.

3. Loosen eccentric lock nut (B).

NOTE: The height-of-cut gauge bar should not contact the bottom of the rear roller.



M84831

4. Rest the height-of-cut gauge bar (G) approximately 51 mm (2.0 in.) from the right end of bed knife (H).

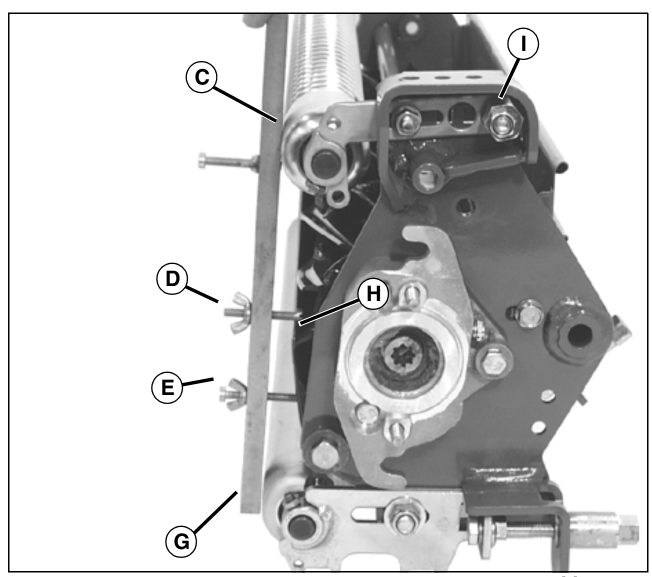
5. Hook the center gauge screw head (D) on the edge of the bed knife. Hold end of gauge bar against the bottom of the front roller (C).

6. Loosen wing nut (F).

7. Turn lower gauge screw (E) clockwise until the top of screw makes contact with the flat edge of bed knife.

8. Tighten wing nut (F).

NOTE: The height-of-cut bar should not contact the bottom of the rear roller.

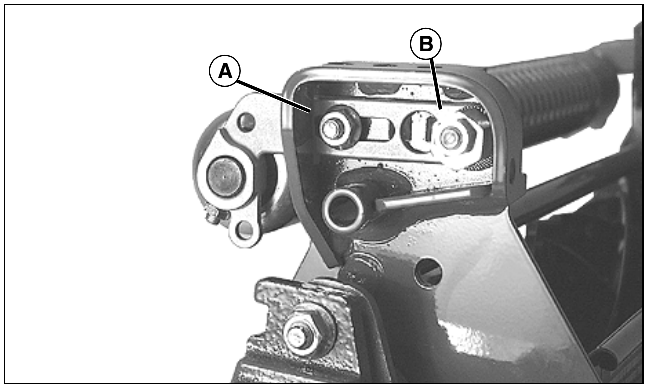


M84832

9. Rest the height-of-cut gauge bar (G) approximately 51 mm (2.0 in.) from the left end of the bed knife (H).

10.Hook the center gauge screw head (D) on the edge of the bed knife. Hold end of gauge bar against the bottom of the front roller (C).

11.Rotate eccentric adjuster (I) until the top of lower gauge screw (E) makes contact with the bed knife.



M84828

12.Tighten left roller lower flanged nut (A).

13.Tighten eccentric lock nut (B).

14.Check adjustment using height-of-cut bar.

15.Adjust cutting height. (See "Adjust Height-of-Cut (HOC)" on page 759.)

Results

Front roller positioned for proper height-of-cut adjustment.

Adjust Height-of-Cut (HOC)

Reason

To set desired cutting height.

Special or Required Tools

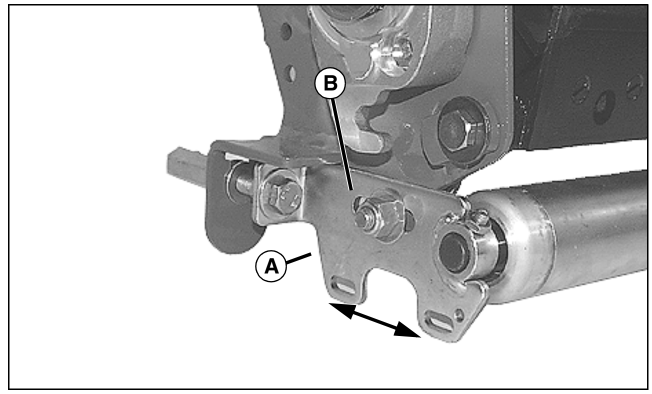
Tool Name	Tool No.	Tool Use
Height-of-Cut Gauge Bar	AMT2978	Used to set desired cutting height.

Procedure

CAUTION: Avoid injury! Always wear protective gloves when working on or near the cutting reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

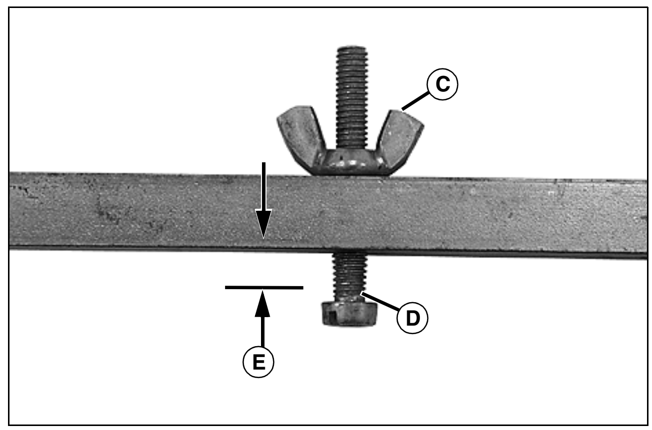
1. Remove cutting units from mower. (See "Remove and Install Cutting Unit" on page 765.)

2. Place cutting unit on a stable working surface with the front roller facing up.



M98489

3. Loosen lock nut (B) on each side of the cutting unit, just enough to allow the height-of-cut bracket (A) to slide.

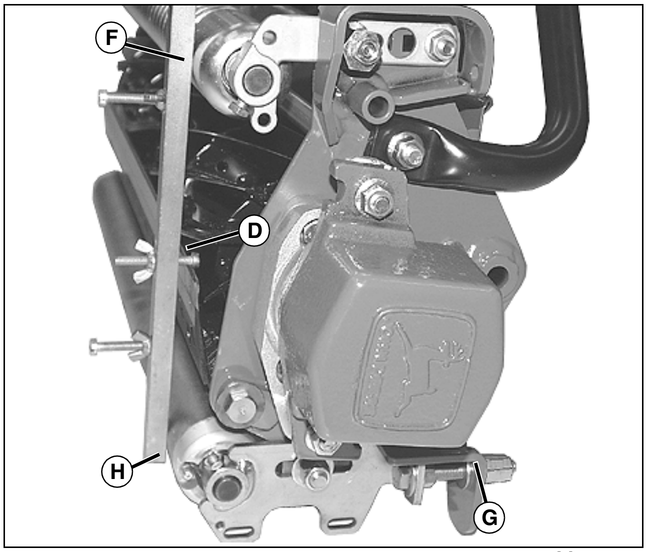


M84833

4. Adjust the center adjustment bolt head (D) on the height-of-cut gauge bar to the desired cutting height (E).

NOTE: DO NOT allow the adjustment bolt to turn while turning the wing nut.

5. Hold the adjustment bolt and turn the wing nut (C) until it sets firmly against the bar.

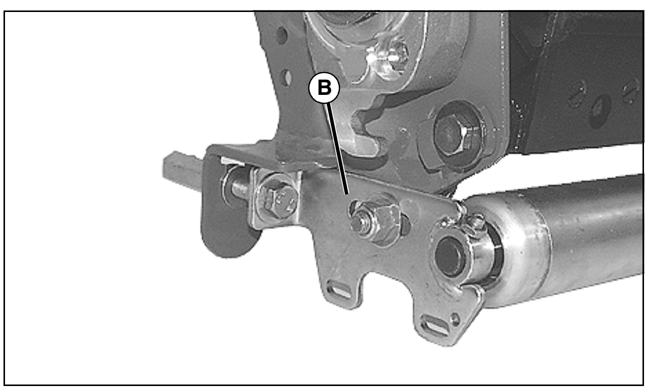


M84834

6. Rest height-of-cut gauge bar against the front roller (F), approximately 51 mm (2.0 in.) from the end of the bed knife. Rest the inside of the bolt head (D) against the edge of the bed knife.

7. Turn tower adjuster (G) until the rear roller (H) makes contact with the height-of-cut gauge bar. Repeat for other side.

8. Check adjustment on both sides of cutting unit using height-of-cut gauge bar. Repeat adjustment as needed.



M98489

9. Tighten lock nut (B) on each side of the cutting unit.

Results

Height-of-cut should be adjusted to desired level, consistently across cutting unit.

Adjust Greens and Turf Conditioner (GTC)

Reason

To set the desired cutting height.

Special or Required Tools

Tool Name	Tool No.	Tool Use
Height-of-Cut Gauge Bar	AMT2978	Used to set desired cutting height.

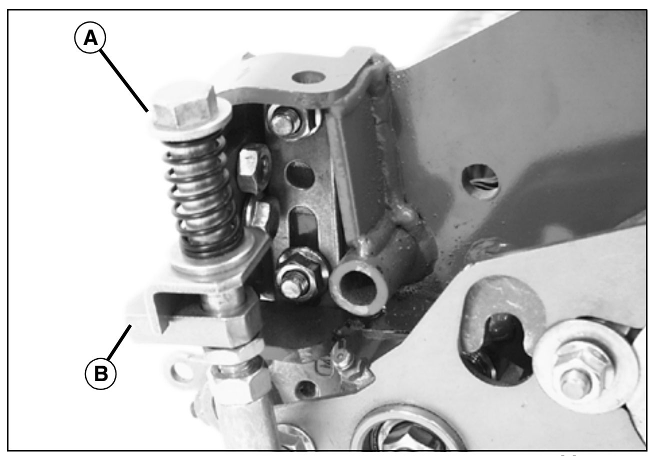
Procedure

NOTE: Height-of-cut must be adjusted before adjusting the greens and turf conditioner.

CAUTION: Avoid injury! Always wear protective gloves when working on or near the cutting reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

2. Place cutting unit on a stable working surface.

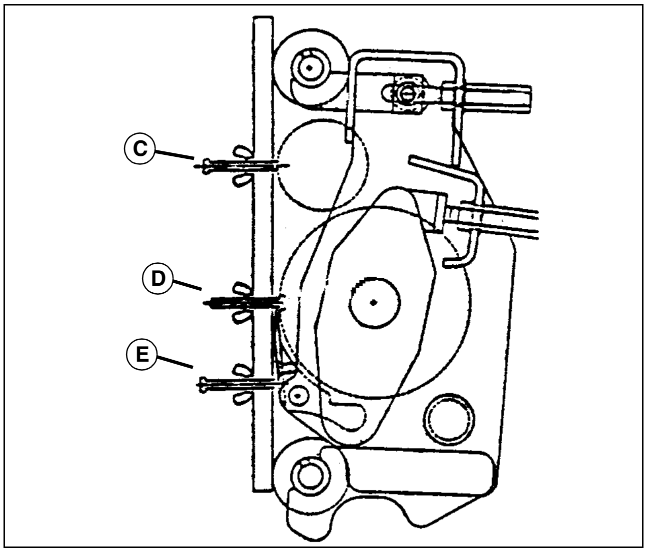


M98505

Picture Note: Operating Position Shown

3. Press down on GTC adjuster bolts (A) and swing adjuster stops (B) toward the front of the cutting unit on both ends of the cutting unit (engaged position).

NOTE: Measure the usable blade length of the cutting blades. If the usable blade length is less than the desired cutting depth, replace the cutting blades before continuing.

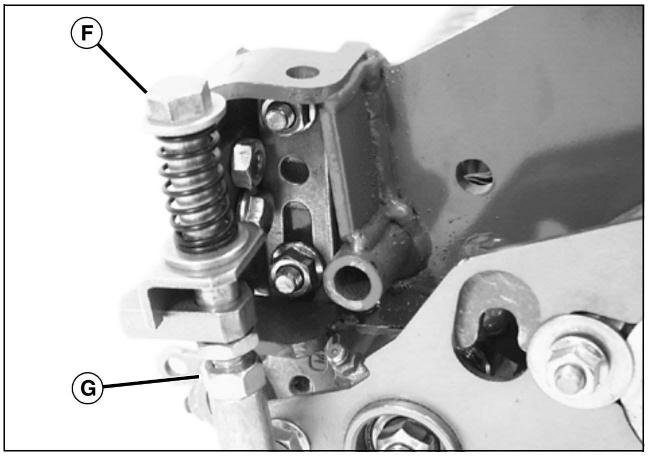


M44324

4. Set GTC adjustment screw (C) on the gauge bar to desired height.

5. Loosen adjustment screw (E), if needed, to allow the gauge bar to rest against the rollers.

6. Place the depth gauge on cutting unit. Hook the underside of height-of-cut screw head (D) on bed knife. The ends should rest firmly on the front and rear rollers.



M98505

Picture Note: Operating Position Shown

7. Loosen adjuster lock nut (G) on both ends of the cutting unit.

8. Turn adjuster bolt (F) to raise or lower GTC roller. Alternate from end to end until the teeth touch the screw on the gauge bar.

9. Tighten adjuster lock nuts.

10.Remove gauge bar.

Results

FTC cutting height should be set to desired level, consistently across cutting unit.

Adjust Cutting Shield

Reason

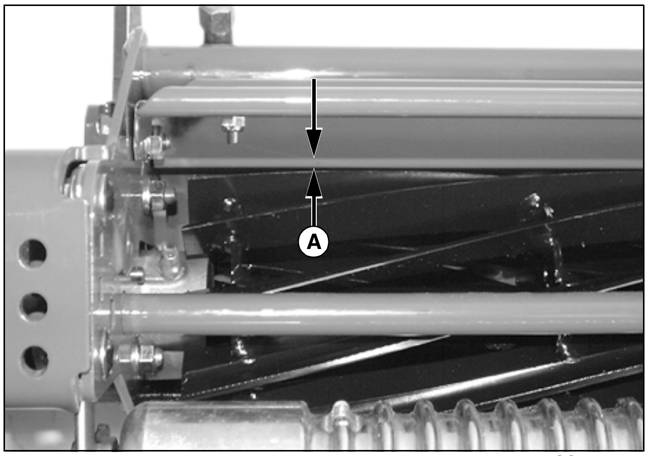
Correct adjustment of the cutting shield improves the performance of the grass catcher.

Procedure

CAUTION: Avoid injury! Always wear protective gloves when working on or near the cutting reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

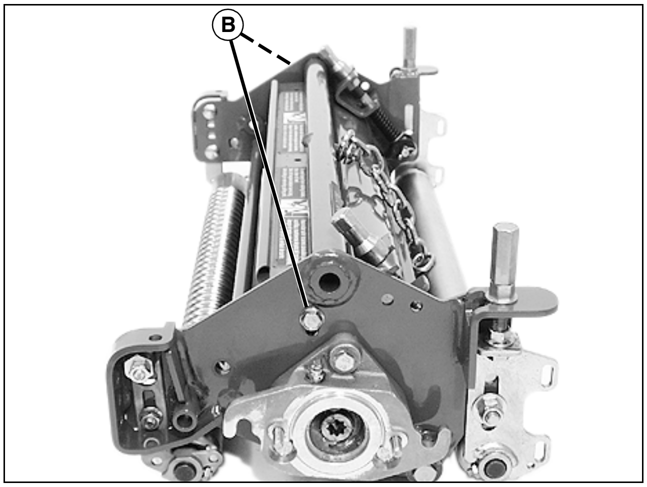
1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

2. Place cutting unit on a stable working surface.



M84844

3. Check the clearance (A) between the bottom of the cutting shield and the cutting blades. Gap should be at specifications. If the clearance is not correct, adjust as follows.



M84848

4. Loosen cap screws and lock nuts (B) on both sides of cutting unit.

5. Raise or lower shield until correct clearance is obtained.

6. Tighten bolts and lock nuts.

Results

Proper clearance between shield and cutting blades will result in greater grass catching performance.

Specifications

Cutting Unit Shield Clearance . . . . 1 mm (0.04 in.)

Adjust Depth-of-Cut - Vertical Cutting Units

Reason

To set the desired cutting depth.

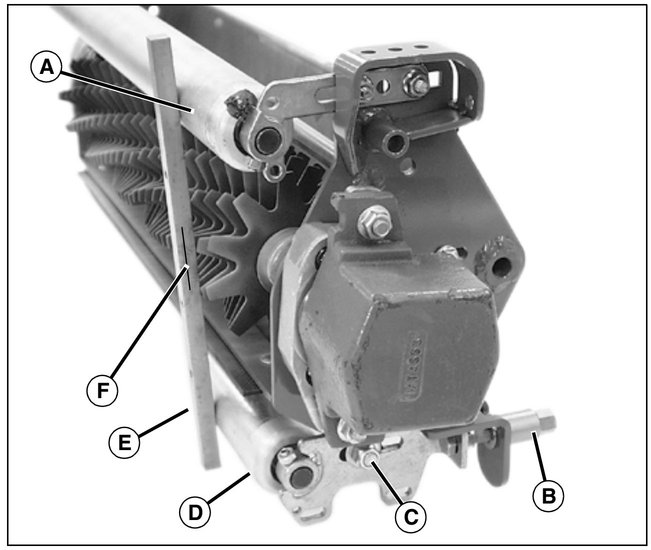
Special or Required Tools

Tool Name	Tool No.	Tool Use
Height-of-Cut Gauge Bar	AMT2978	Used to set desired cutting height.

Procedure

1. Remove cutting units from mower.

2. Place cutting unit on a stable working surface with the front roller facing up.



M98504

3. Mark the desired cutting depth (F) on the gauge bar (E).

4. Place gauge bar across the front and rear rollers (A and D) approximately 50 mm (2 in.) in from the end of the rollers.

5. Loosen the lock nut (C) on each side of the cutting unit.

6. Turn each tower adjuster (B) until the leading edge of the vertical cutting unit blade aligns with the cutting depth on the gauge bar.

7. Rotate the cutting reel back and forth to ensure the tips of the cutting blade do not extend past the mark on the gauge bar.

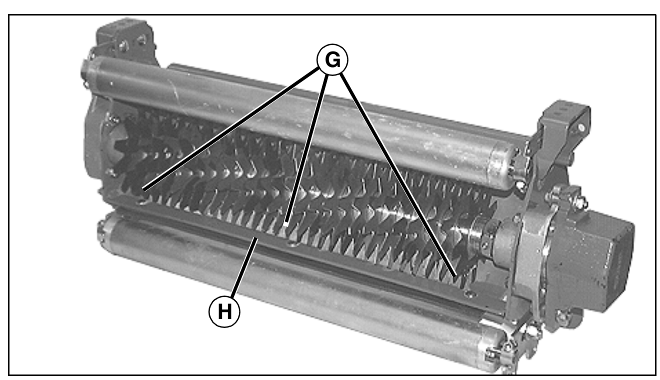
8. Repeat steps 4-7 on the other side of the cutting reel.

9. Tighten lock nuts.

NOTE: Adjustment of flap height will depend on turf conditions.

On short turf, lower flap to prevent material from flying out the rear of the cutting unit.

On turf with a lot of thatch, raise flap to allow the removed thatch to exit out the rear of the cutting unit.



M98561

10.Loosen three carriage bolts and hex nuts (G).

11.Adjust distance of flap (H) from the bottom of the rollers to specifications.

12.Tighten hardware.

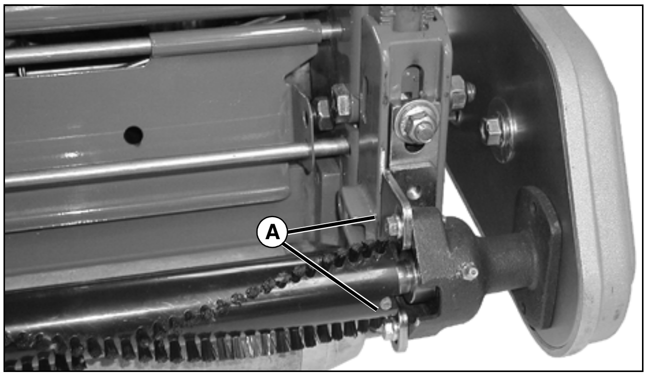
Results

Height-of-cut should be adjusted to desired level, consistently across cutting unit.

Specifications

Vertical Cutting Unit Flap Adjustment . 13 mm (0.5 in.)

Adjust Power Brush



MX18343

Picture Note: Heavy Duty Shown

1. Loosen cap screws (A) on both sides of cutting unit.
2. Move brush up or down to achieve specification.
3. Tighten cap screws (A) on both sides of cutting unit.

Specification

Brush-to-Roller Clearance . . . . 0-1 mm (0-0.031 in.)

Repair

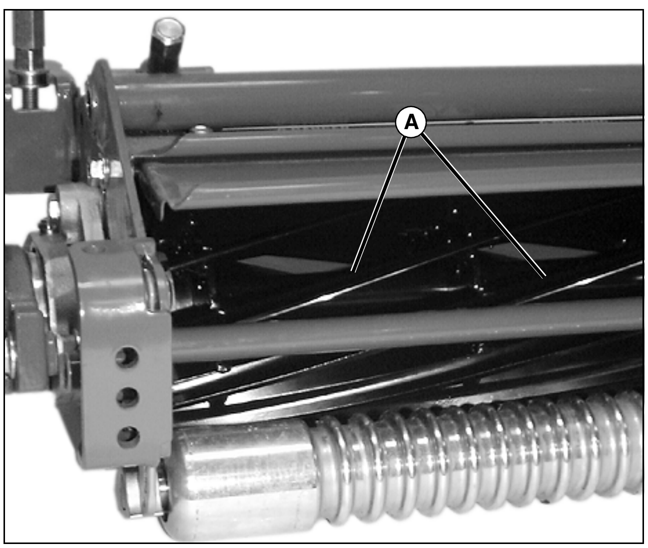
Inspect Reel and Bed Knife

CAUTION: Avoid injury! Avoid injury from rotating blades. Keep hands and feet away from blades while machine is running.
Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

Never allow more than one person at a time to work on any one cutting unit. Never allow work to be accomplished on more than one cutting unit at the same time. Serious personal injury could result.

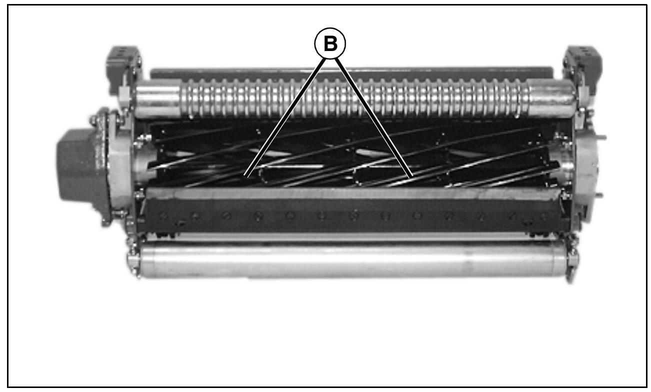
1. Visually inspect cutting unit for damage. Chipped paint, dents or gouges may indicate the need for a closer look at the frame for distortion, broken weldments or other damage that could prevent proper adjustment. Repair or replace parts as necessary.

2. Inspect for vertical or lateral movement in the reel or bearings supporting the reel. Repair or replace as necessary.



M84825

3. While rotating the reel in the reverse direction by hand, inspect each blade cutting edge (A) for nicks, gouges or distortion. Ensure the cutting edge land does not exceed more than 3/4 of the blade thickness. See “Reel and Bed Knife Grinding” on page 744 to restore the relief angle and cutting edge before continuing with this procedure.



M84823

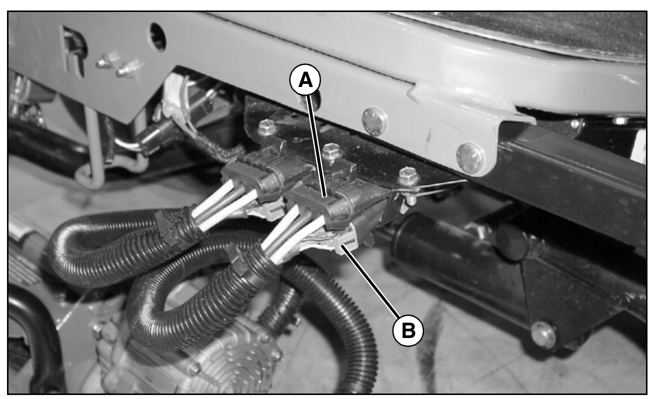
4. Inspect the bed knife cutting edge (B) for nicks, gouges or distortion.

5. Inspect the bed knife for uneven wear (indicated by uneven land width across the length of the bed knife). Ensure the cutting edge land does not exceed 3/4 of the cutting edge. Replace the bed knife if the cutting edge extends below 1.45 mm (0.057 in.) from the mounting surface.

Remove and Install Electric Reel Motor - Model 2500E

1. Park machine on a level surface and engage park brake.
2. Lower cutting units to the ground.
3. Move mow/transport lever to TRANSPORT position.
4. Stop engine.

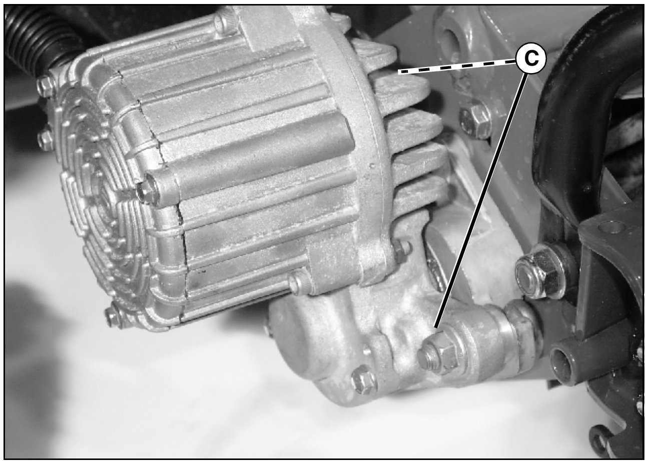
NOTE: Mark connectors before removing to ensure correct installation.



MX20335a

Picture Note: Left-Front Reel Motor Connector Shown

5. Disconnect electric motor wire connectors (A and B).

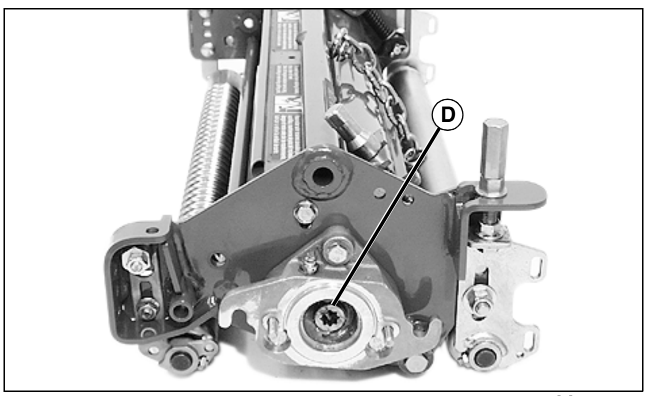


MX20336

6. Loosen reel motor mounting cap screws (C).
7. Remove reel motor.

Installation

Installation is done in reverse order of removal.



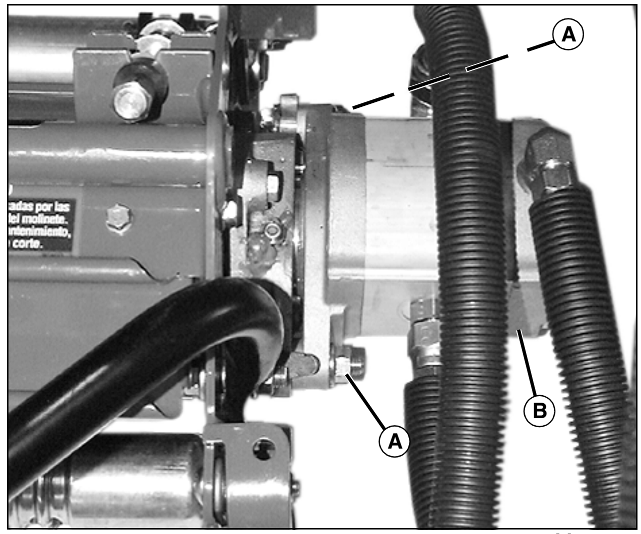
M84848

- Apply MPG-2 Multi-Purpose Grease to coupler (D).

Remove and Install Cutting Unit

1. Park machine on a level surface.
2. Lower cutting units to the ground.
3. Turn key switch to STOP position.
4. Engage park brake.

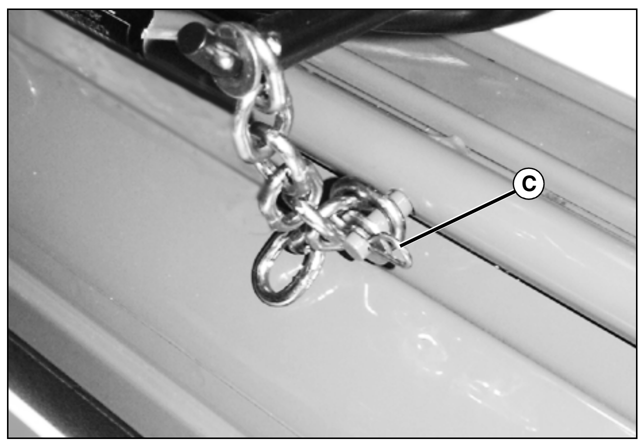
NOTE: Models 2500 and 2500A use a hydraulic reel motor as shown in the following photos. Model 2500E uses an electric reel motor. The repair procedures are similar.



M84609

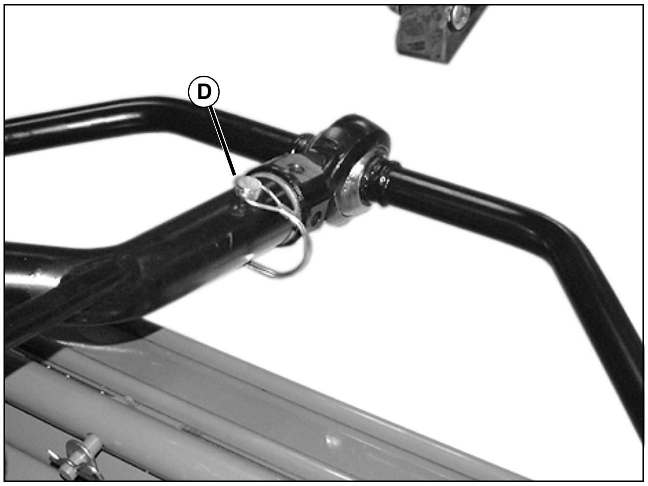
Picture Note: 2500/2500A Models Shown

5. Loosen reel motor mounting cap screws (A).
6. Remove the reel motor (B).



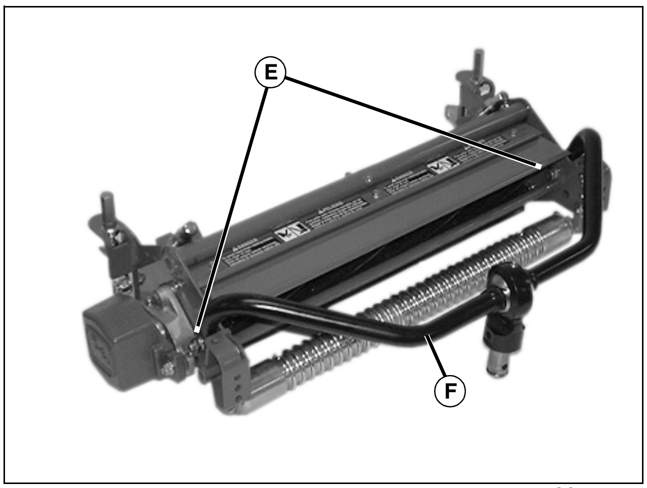
M84610

7. Remove spring clip (C) and washer.
8. Remove lift chain.



M84611

9. Remove retaining pin (D) and pull cutting unit forward to remove from machine.



M84822

10.If cutting unit is to be repaired, remove cap screws and nuts (E) from both sides of cutting unit.

11.Remove yoke (F).

Installation is done in reverse order of removal.

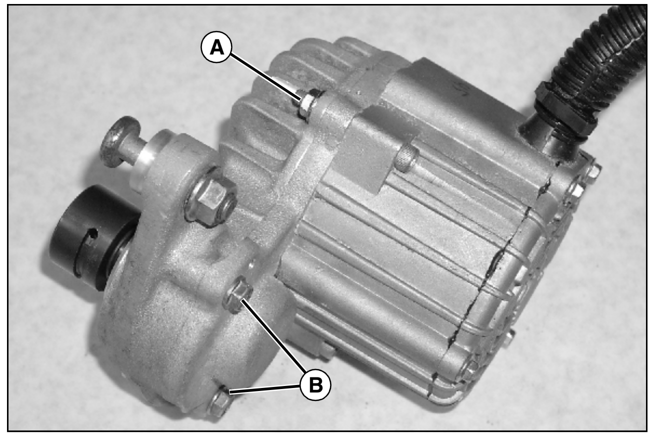
Remove and Install Reel Drive Belt - 2500E

Remove

1. Remove reel motor assembly. (See “Remove and Install Electric Reel Motor - Model 2500E” on page 764.)

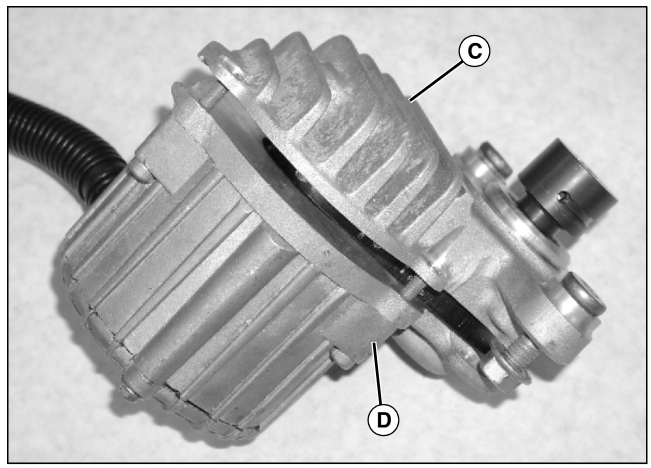
2. Thoroughly clean and dry outside of reel motor assembly.

IMPORTANT: Avoid damage! Do not use excessive force to remove drive cover. Be careful not to drop inner wave washer when separating assembly.



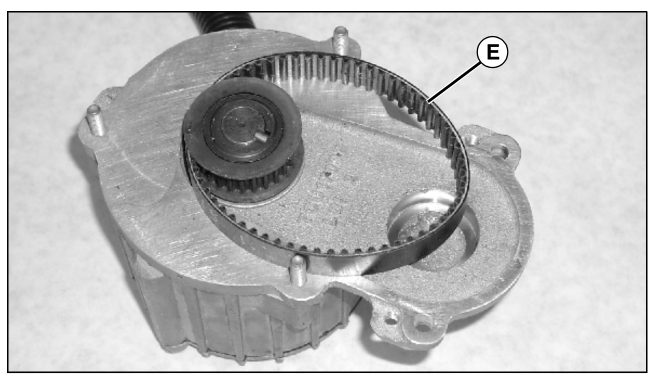
MX20430

3. Remove three nuts (A) and two cap screws (B).



MX20431

4. Separate drive cover (C) from reel motor (D).



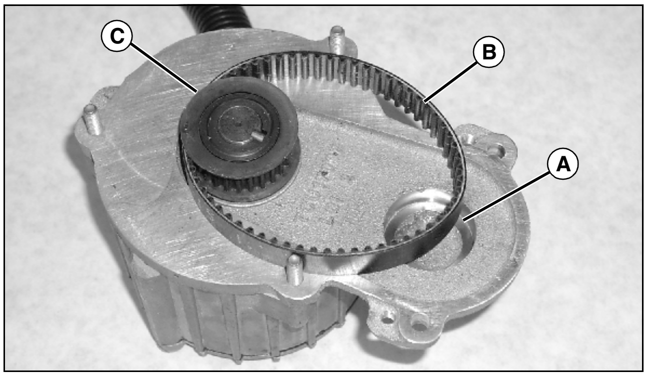
MX20432

5. Remove drive belt (E).

6. Clean and inspect drive belt. Replace belt if necessary.

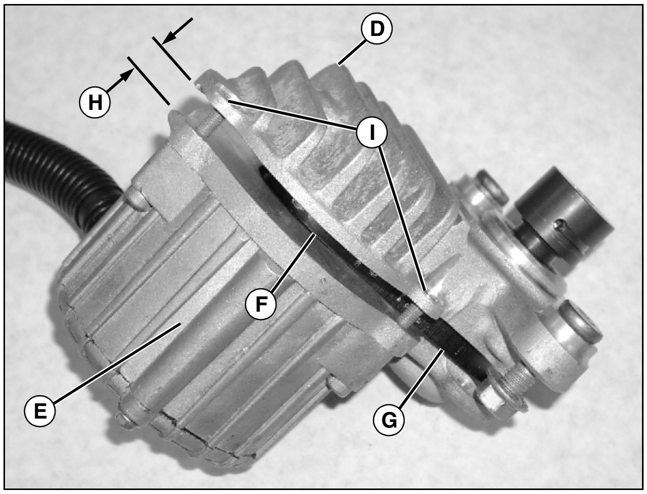
7. Inspect drive pulleys and bearings. Replace parts as needed.

Install



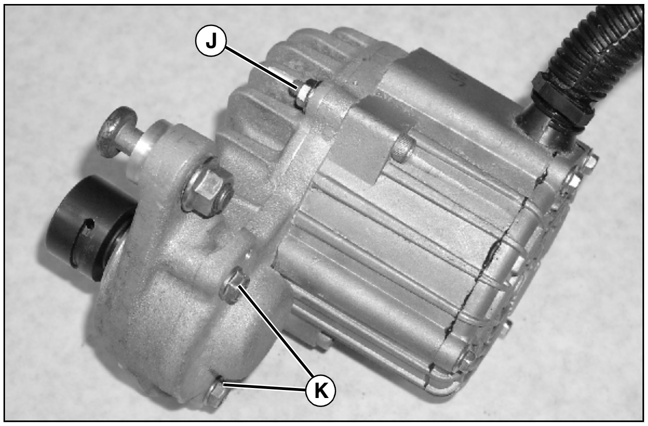
MX20432

1. Install wave washer (A), if removed.
2. Install drive belt (B) to drive pulley (C).



MX20431

3. Place drive cover (D) partially onto reel motor (E) while engaging drive belt (F) onto output pulley (G).
4. Position drive cover parallel (H) with reel motor and align with retaining studs (I).

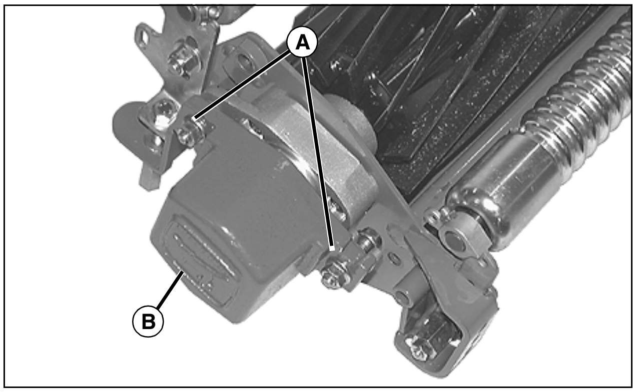


MX20430

5. Install three nuts (J) and two cap screws (K). Tighten in an alternating pattern.

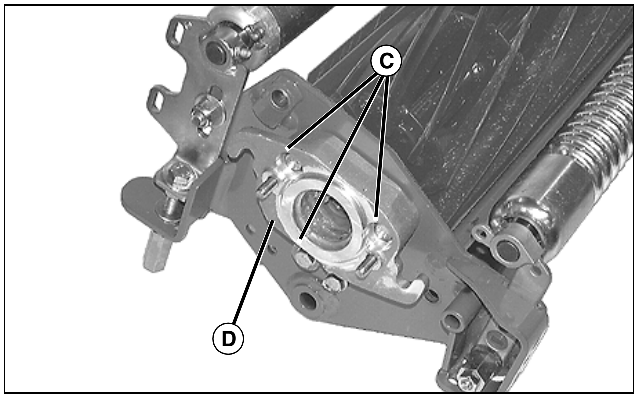
Remove Reel

1. Remove cutting units from mower. (See "Remove and Install Cutting Unit" on page 765.)
2. Remove greens and turf conditioner (if equipped). (See "Remove Greens and Turf Conditioner" on page 776.)
3. Remove bed knife. (See "Remove Bed Knife" on page 770.)
4. Place cutting unit upside-down on a stable working surface (rollers facing up).



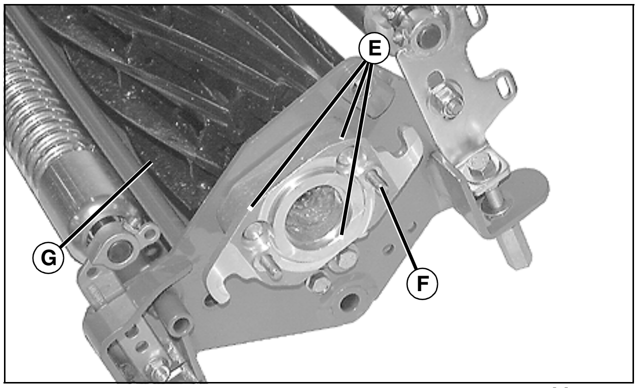
M98791

5. Loosen flange nuts (A).
6. Remove weight assembly (B).



M98798

7. Remove three cap screws and flange nuts (C).
8. Remove bearing housing (D).



M98799

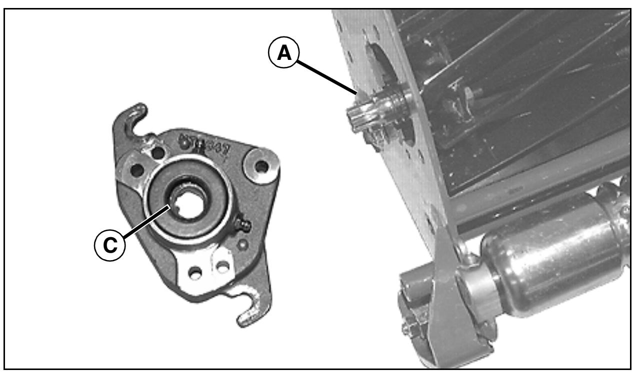
9. Remove three cap screws and nuts (E).

10. Remove bearing housing (F).

11. Remove reel (G).

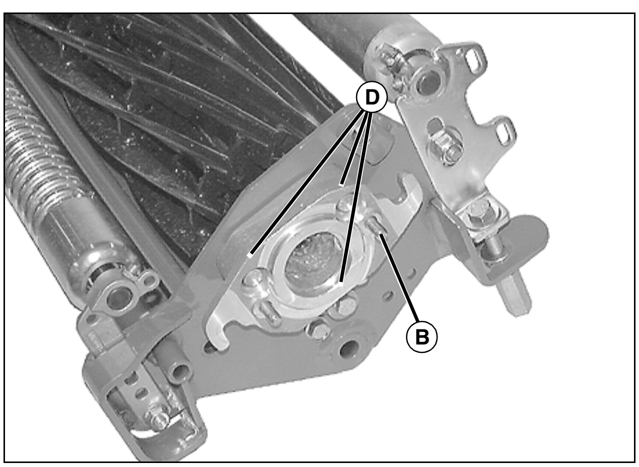
Install Reel

1. Install reel assembly in housing with the shaft end with the keyway on the left side of the frame.



M98800

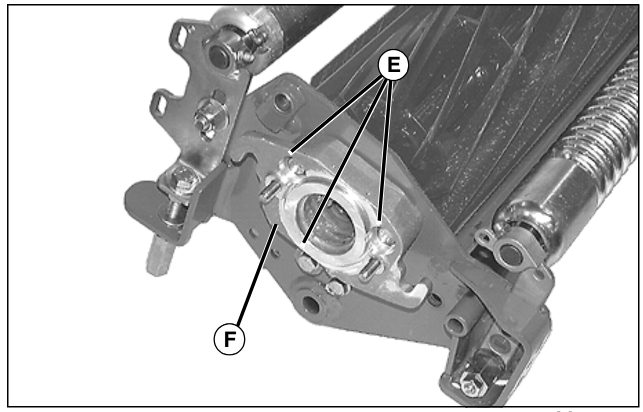
2. Align the tab (C) on the keyed washer with the keyway (A) on the reel shaft.



M98799

3. Install the bearing housing (B).

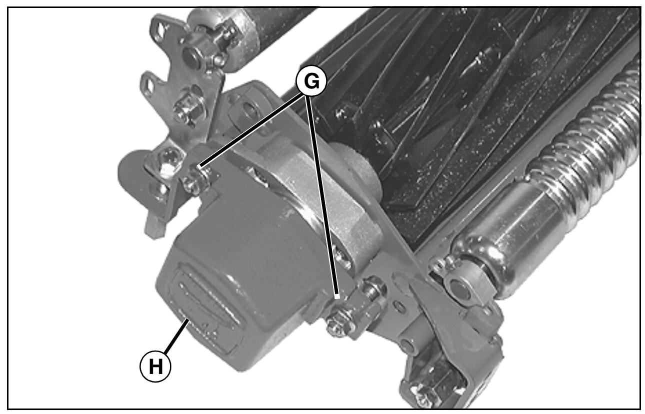
4. Install three cap screws and nuts (D).



M98798

5. Install bearing housing (F).

6. Install three cap screws and nuts (E).



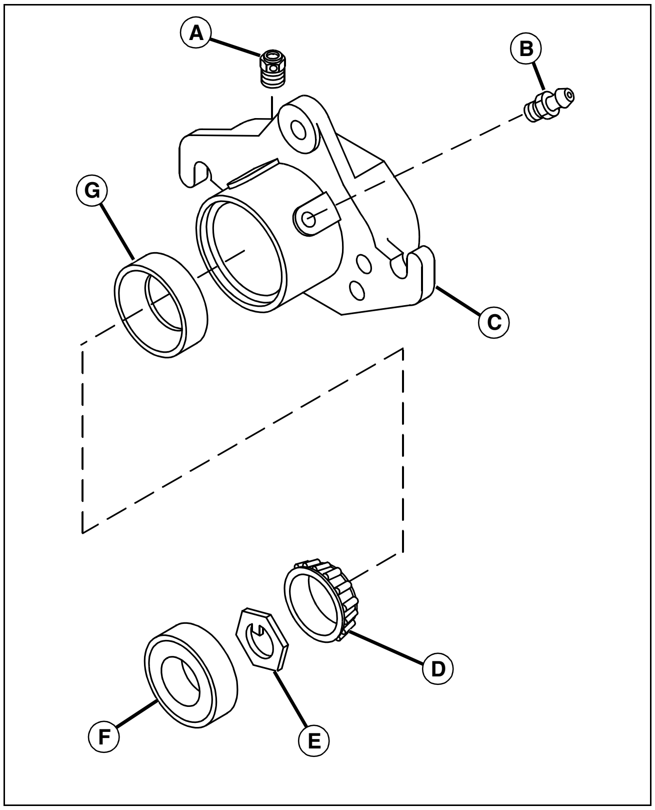
M98791

7. Install weight assembly (H) with flange nuts (G).

8. Adjust bed knife-to-reel clearance. (See “Adjust Reel-to-Bed Knife” on page 751.)

Disassemble and Inspect Bearing Housing

NOTE: LEFT or RIGHT positions are determined by standing at the rear of the unit and looking forward.



MIF M98496

1. Remove seal (F), keyed washer (E) (left side only), tapered roller bearing (D), bearing cup (G), breather (A) and grease fitting (B) from each housing (C).

2. Clean bearings and housing with solvent.

IMPORTANT: Avoid damage! Always replace bearings and bearing cups as a set.

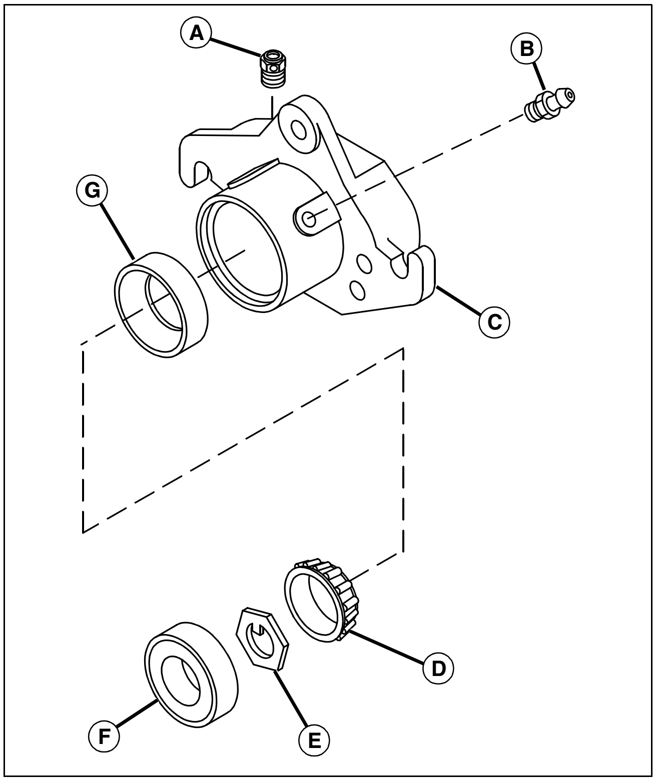
3. Inspect bearings and bearing cups for scoring, pitting or bluing from overheating. Replace as needed.

Assemble Bearing Housing

Other Material

Part No.	Part Name	Part Use
TY25083	John Deere Golf And Turf Cutting Unit Grease	Used to lubricate mower bearings and seals.

NOTE: LEFT or RIGHT positions are determined by standing at the rear of the unit and looking forward.



MIF M98496

1. Install bearing cups (G) into housing (C) using a suitable driver or a press (tapered end facing the outside of the housing).

2. Pack tapered roller bearings (D) with TY25083 John Deere golf and turf cutting unit grease and position in the bearing cups.

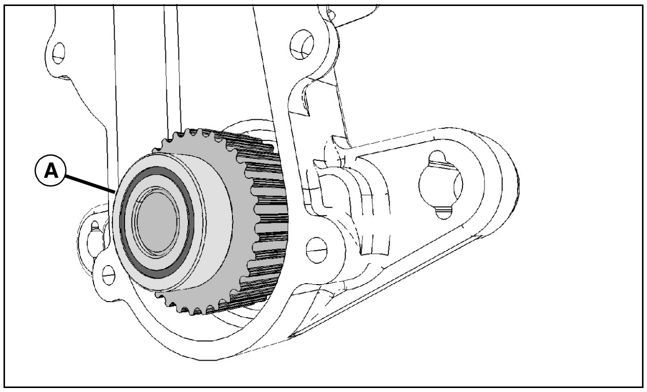
3. Install keyed washer (E) (left side only).

4. Install seal (F) flush with the face of the housing. Apply TY25083 John Deere special purpose golf and turf cutting unit grease to the seal lips.

5. Install breather (A) and grease fitting (B).

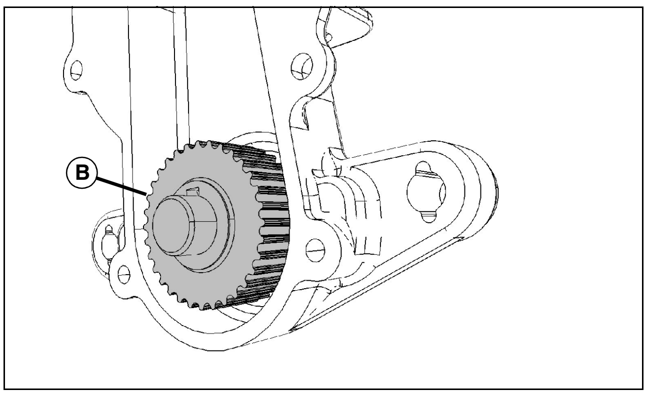
Repair Belt Drive Housing - 2500E

1. Remove electric reel drive motor and belt. (See “Remove and Install Reel Drive Belt - 2500E” on page 766.)



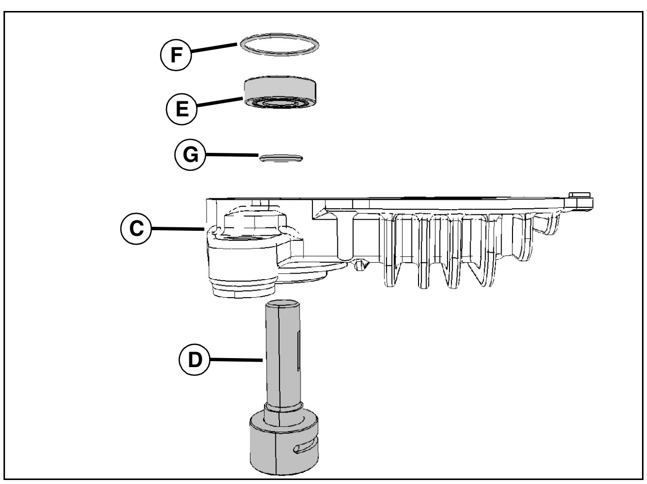
MX21544

2. Remove bearing (A) using a puller.



MX21545

3. Remove pulley (B) and key.



MX21546

4. Support outside housing (C) as close to the shaft as possible. Press shaft (D) through bearing (E), from the inside out.

5. Remove bearing (E) and O-rings (F-G) from housing.

6. Replace parts as necessary.

Assembly

Assembly is done in the reverse order of disassembly.

- Apply a small amount of lubricant to components to aid in assembly.
- Replace O-rings (F-G) with new parts.

IMPORTANT: Avoid damage! Bearing-to-housing clearance is very small, but can be assembled without tools. Do not force bearing into housing bore by using a press or driver. Ensure bearing is not cocked and it will install by hand.

- Install bearing (E) into housing (C) by hand. Support bearing and press shaft into it.

Remove Bed Knife

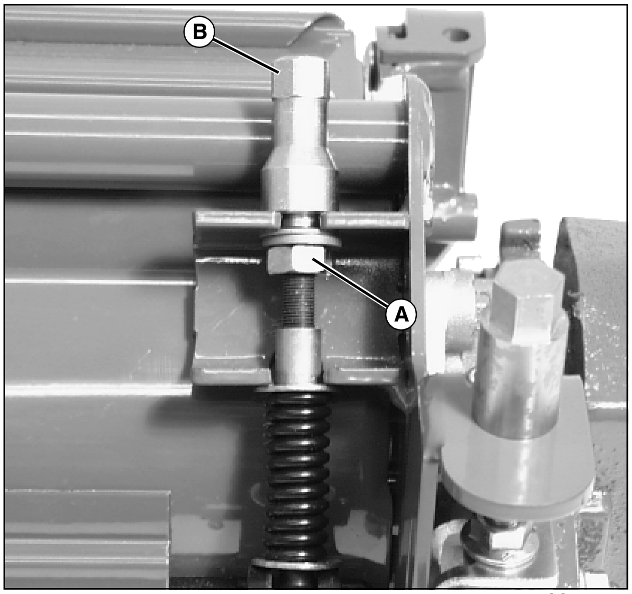
CAUTION: Avoid injury! Blades are sharp and rotate quickly:

- **Keeps hands and feet away from cutting reels while machine is running.**
- **Always wear gloves while working on cutting reels.**
- **Watch for rotation of cutting reels. Rotating one cutting reel can cause another blade or cutting reel to rotate.**

1. Remove the cutting unit from greensmower. (See “Remove and Install Cutting Unit” on page 765.)

2. Position cutting unit with the bottom side down on a flat surface or workbench.

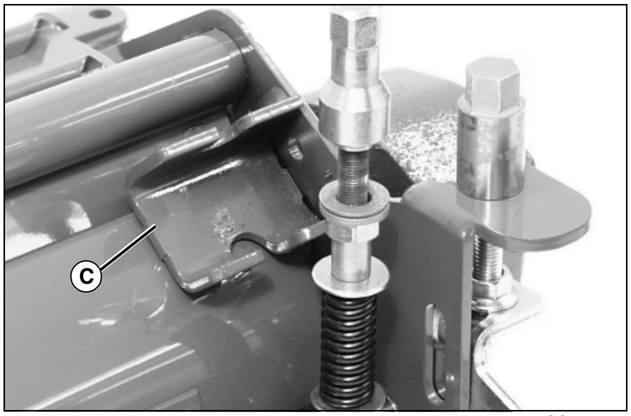
3. Relieve tension from bed knife tension springs on both sides of cutting unit.



M97412

- Turn jam nuts (A) counterclockwise until springs are completely compressed.

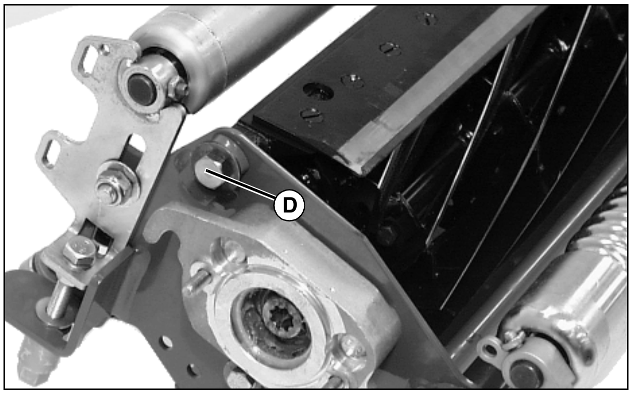
4. Loosen each adjuster (B).



M97413

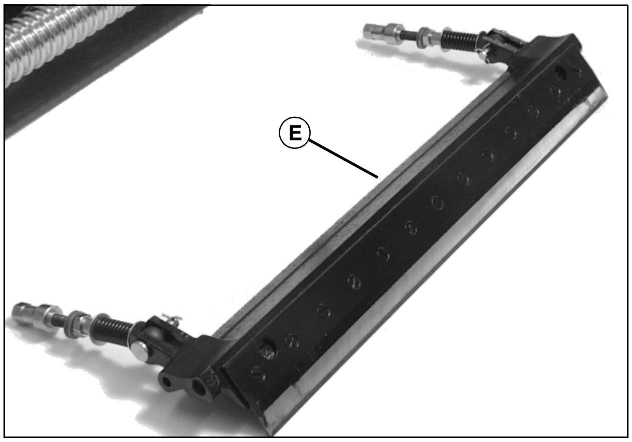
5. Rotate each adjustment assembly away from reel housing bracket (C).

6. Rotate cutting unit and position with bottom side up on flat surface or workbench as shown.



M97414

7. Remove shoulder bolt (D) from each end of cutting unit.



M97415

8. Slide bed knife assembly (E) out of the cutting unit housing.

9. If original bed knife is to be used again, grind the bed knife. (See “Grinding the Bed Knife” on page 755.)

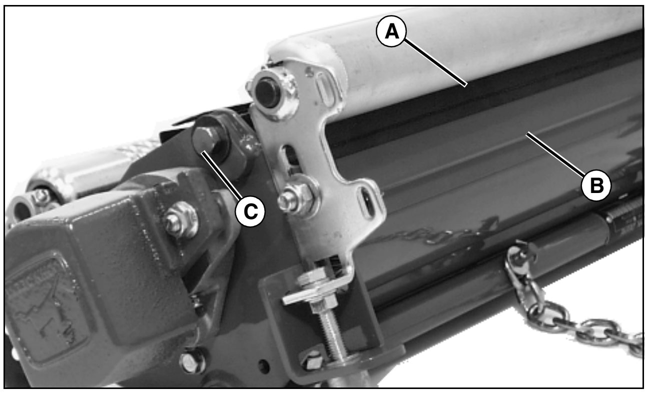
Install Bed Knife

1. Remove and discard thirteen screws attaching bed knife to assembly support. Discard bed knife.

NOTE: Remove debris, corrosion, and rust from bottom surface of bed knife support.

2. Install bed knife using new screws. Alternate tightening by starting with center screws and working out to the ends. Tighten screws to specification.

3. If installing a used bed knife, grind the bed knife. (See “Grinding the Bed Knife” on page 755.)



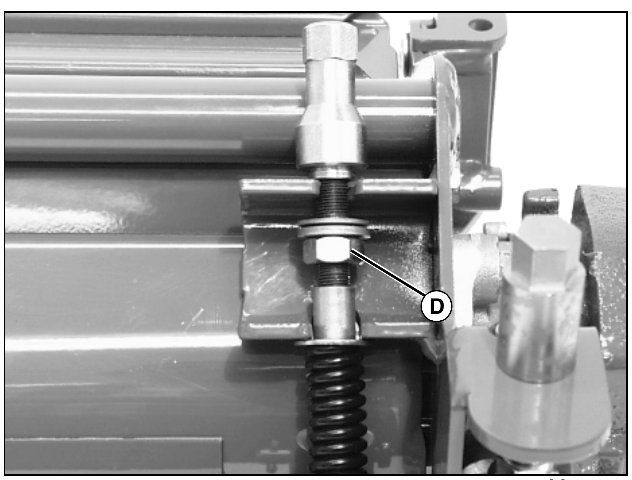
M97418

4. Slide bed knife and support assembly (A) into position inside locator shoe (B).

5. Install both shoulder bolts (C). Tighten hardware to specification.

6. Position cutting unit with bottom side down on flat surface or workbench.

7. Install each adjustment assembly inside housing mounting bracket.



M97419

- Restore bed knife spring tension by turning jam nuts (D) clockwise. Turn jam nuts only midway up the threaded adjustment.

8. Adjust bed knife-to-reel. (See “Adjust Reel-to-Bed Knife” on page 751.)

9. Set height-of-cut. (See “Adjust Height-of-Cut (HOC)” on page 759.)

10.Backlap reel. (See “Backlapping Procedure” on page 752.)

11.Check height-of-cut and adjust as necessary.

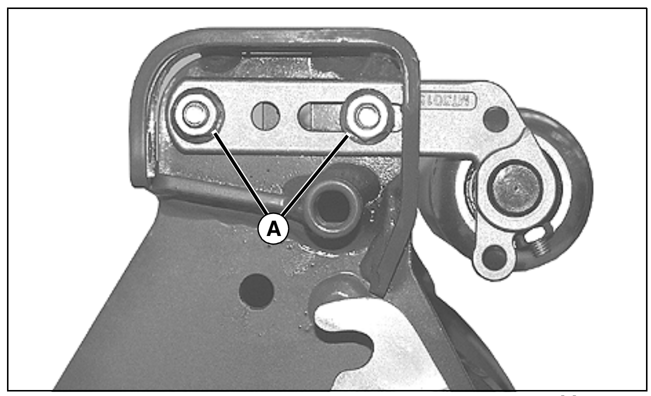
Specifications

Bed Knife Shoulder Bolt Torque . . . . . 55 N•m (40 lb-ft)
Bed Knife Mounting Screw Torque . . . 7 N•m (62 lb-in.)

Remove and Install Front Roller

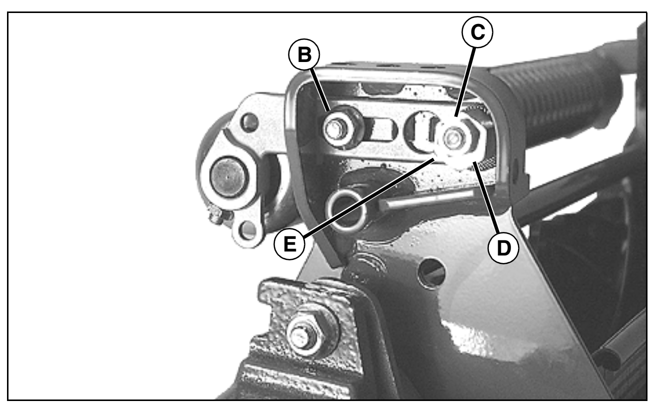
1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

2. Place cutting unit on a stable working surface with the front roller facing up.



M84841

3. Remove two flanged nuts and carriage bolts (A).



M84828

4. Remove lower flanged nut and carriage bolt (B).

5. Remove eccentric lock nut (C), eccentric adjuster (E), serrated washer (D) and carriage bolt.

6. Remove roller and bracket assembly.

Installation

Installation is done in the reverse order of removal.

NOTE: Roller brackets are offset. For standard use, the bracket should be installed on the roller with the offset to the rear of the cutting unit.

If Fairway Tender Conditioner (FTC) is installed, the bracket should be installed on the roller with the offset to the front of the cutting unit.

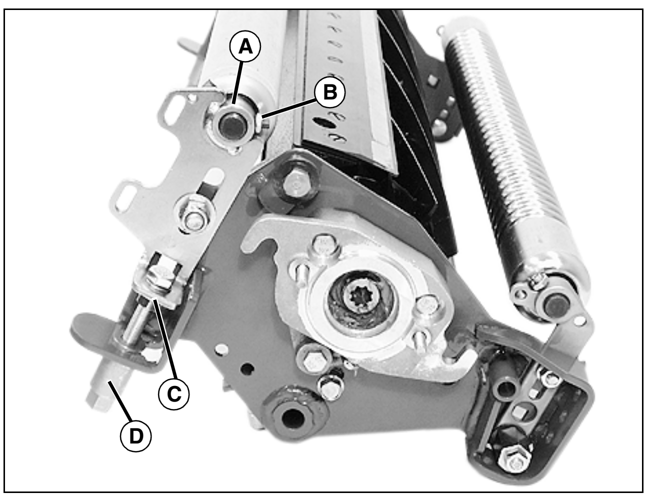
Install roller bracket with the larger holes and adjustment slot on the left side of the cutting unit, in the direction of travel.

•Adjust roller height. (See “Adjust Front Roller” on page 757.)

Remove Rear Roller

1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

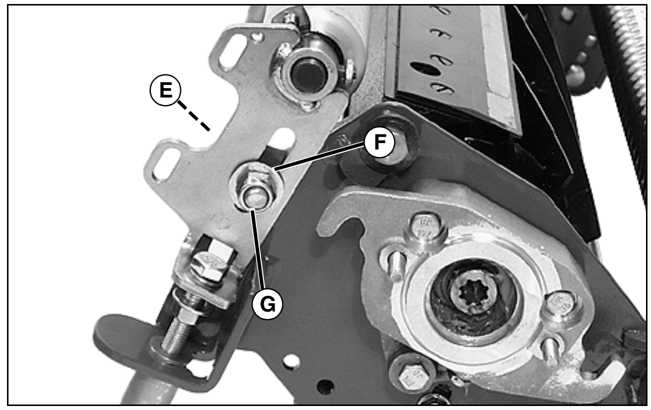
2. Place cutting unit upside-down on a stable working surface (rollers facing up).



M84849

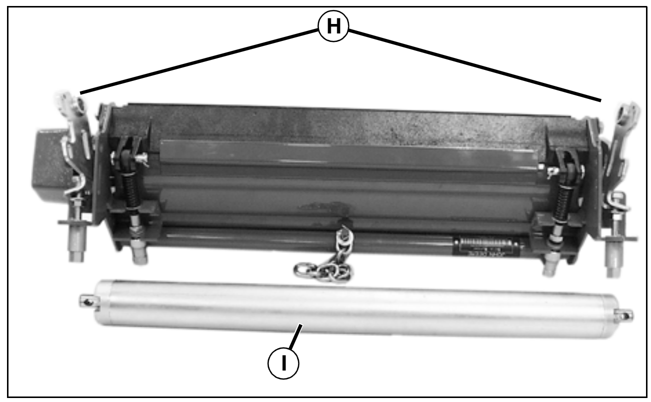
3. Loosen jam nut (A) and set screw (B) on both sides of cutting unit.

4. Loosen jam nut (C) on adjuster tower (D) from both sides of cutting unit.



M98490

5. Remove carriage bolt (E), flat washer (F) and lock nut (G) from both sides of cutting unit.



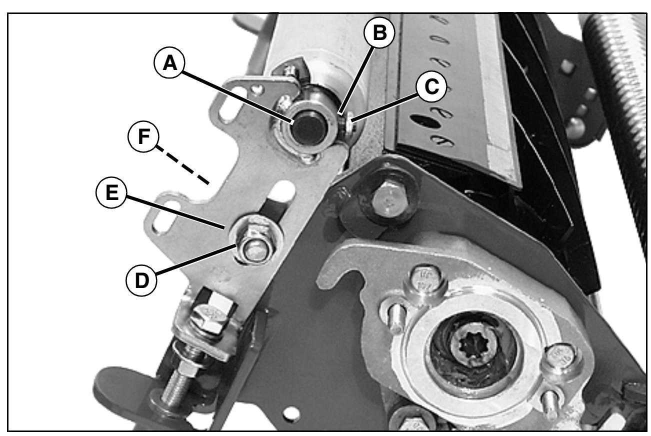
M84850

6. Move height-of-cut brackets (H) away from bearing spindle shaft ends.

7. Remove rear roller (I).

Install Rear Roller

NOTE: DO NOT tighten roller shaft set screws and jam nuts at this time.



M98490

1. Install roller bearing spindle shaft (A) into height-of-cut bracket on both sides of cutting unit.

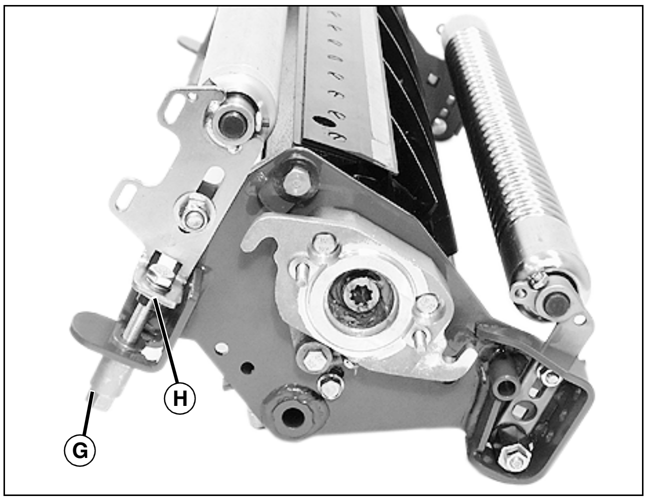
NOTE: Install carriage bolts with the flat washer and nut on the outside of the cutting unit.

2. Attach height-of-cut brackets to cutting unit frame using carriage bolt (F), flat washer (E) and lock nut (D) on both sides of cutting unit.

NOTE: DO NOT install set screws into holes in roller spindle shafts.

3. Center rear roller between height-of-cut brackets.

4. Tighten set screws (C) and jam nuts (B) on both sides of cutting unit.



M84849

5. Loosen bracket lock nuts approximately 1/4 turn (on both sides of cutting unit.

6. Tighten jam nut (H) on adjuster tower (G) on both sides of cutting unit.

7. Tighten bracket lock nuts (both sides of cutting unit).

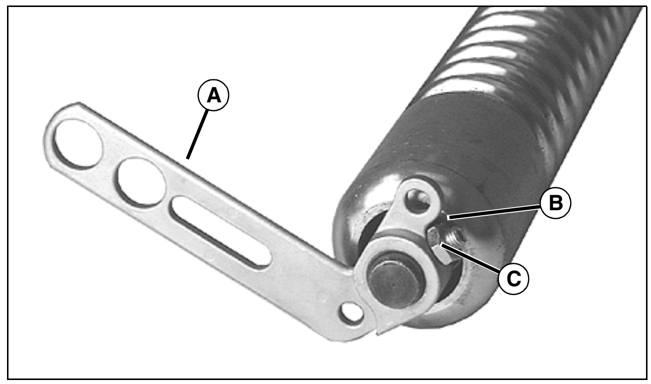
8. Adjust height-of-cut. (See “Adjust Height-of-Cut (HOC)” on page 759.)

Disassemble and Assemble Roller

Special or Required Tools

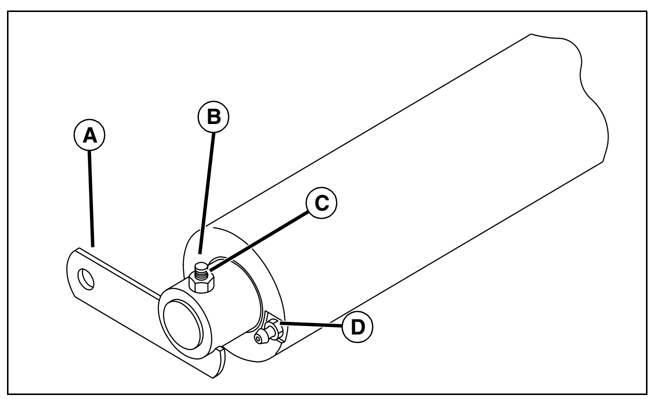
Tool Name	Tool No.	Tool Use
Roller Bearing Puller	JDG795	Used to remove bearings from rollers
Bearing Installer	JDG243	Used to install bearings on rollers
Bearing Installer	JDG506	Used to install bearings on rollers

NOTE: This procedure applies to both smooth and grooved rollers.



M84840

Picture Note: Grooved Roller Shown



M83582

Picture Note: Smooth Roller

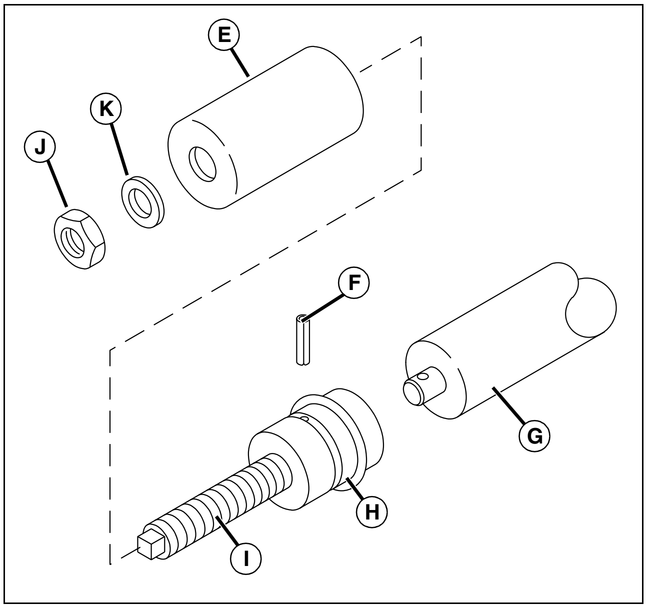
1. Loosen jam nut (C) and remove set screw (B).

NOTE: It may be necessary to press the bearing shaft from the bracket.

2. Remove brackets (A) from bearing shafts.

3. Remove grease fitting (D) (smooth rollers only).

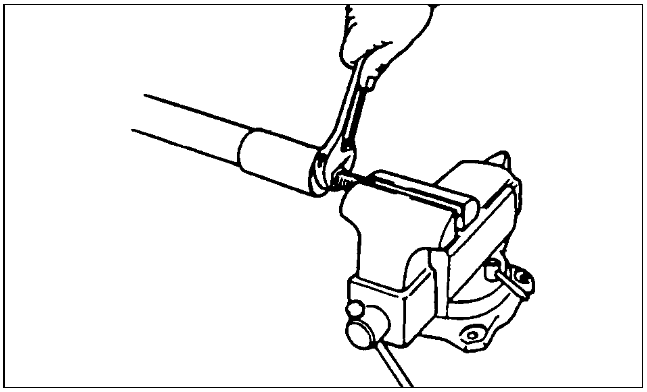
CAUTION: Avoid injury! Wear approved eye protection when using JDG795 Roller Bearing Puller.



M83583

4. Attach threaded puller (I) to the bearing by inserting the pin (F) through the hole in the bearing shaft and puller. Slide the O-ring (H) over the pin to keep it in position.

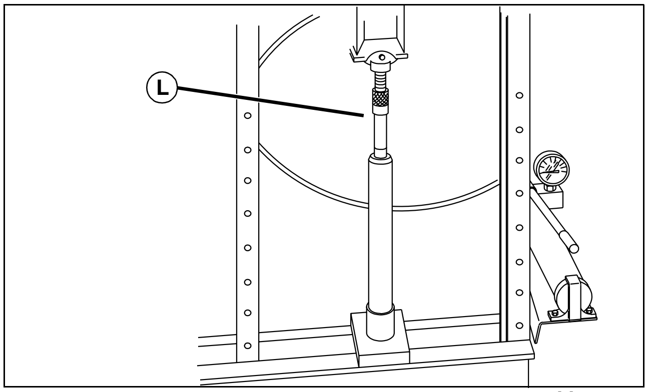
5. Slide roller sleeve (E) over the threaded puller with the concave end of the roller sleeve against the end of the roller (G). Install flat washer (K) and nut (J) on threaded puller.



M83584

6. Clamp the hex end of the threaded puller in a vise or hold it with a wrench. Turn nut counterclockwise until the bearing is removed from the roller.

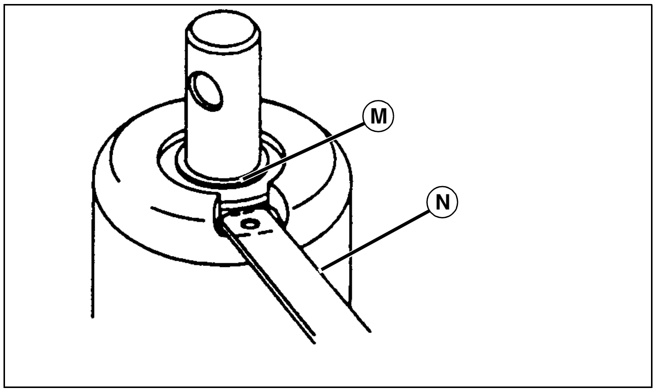
IMPORTANT: Avoid damage! DO NOT press on center shaft of bearing when installing bearing. Bearings will set and become tight. Bearings must only be installed by pressing on the outside of the bearing race.



M83586

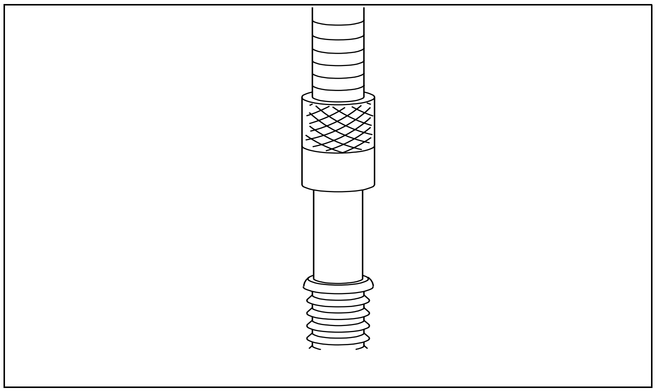
7. Position roller in a press using the roller sleeve to hold the roller while installing the bearing in the other end.

8. Position JD243 or JD506 Bearing Installer (L) over the new bearing in the top end of the roller.



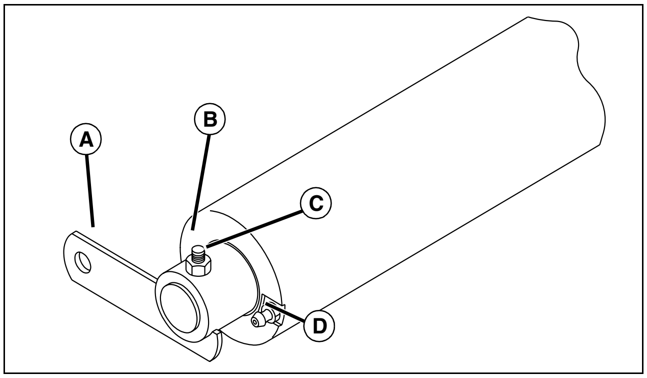
M83585

9. **Smooth Rollers Only:** Place an 0.89 mm (0.035 in.) feeler gauge (N) in the slot where the grease fitting was located. Press the bearing into the roller until the top of the outside bearing race (M) is flush with the top of the feeler gauge.



M83587

10. **Grooved Rollers:** Press bearing into roller until the top of the outside bearing is flush with the end of the roller.



M83582

Picture Note: Smooth Roller Shown

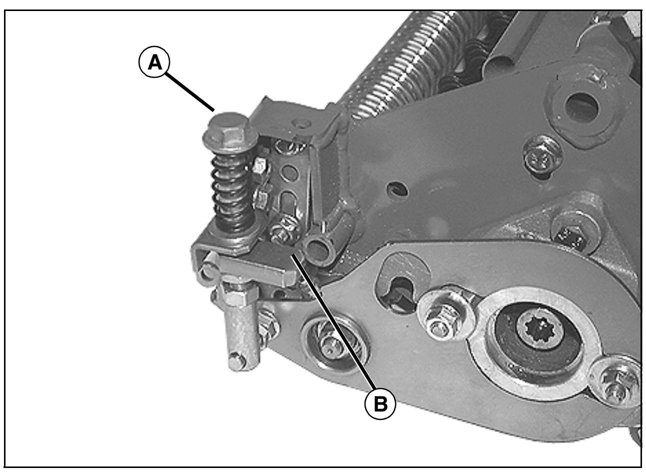
11.Install bracket (A) on both sides of roller.

12.Install set screw (B) and jam nut (C) on both sides of roller.

13.Install grease fitting (D) (smooth rollers only) on both sides of roller.

Remove Greens and Turf Conditioner

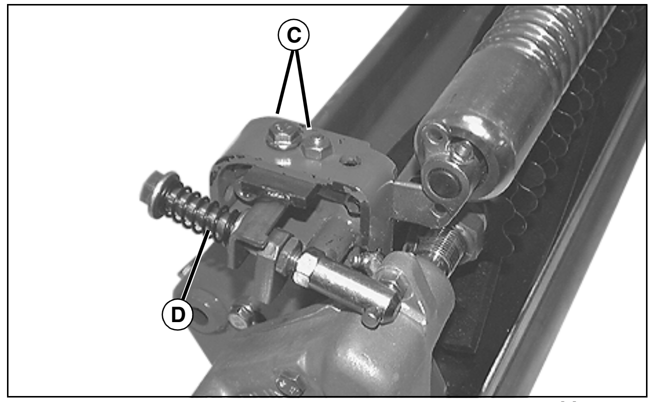
NOTE: The following procedures show GTC unit mounted on right-hand side of the cutting unit. The procedure for units mounted on the left side are the same.



M98560

Picture Note: GTC - Disengaged Position

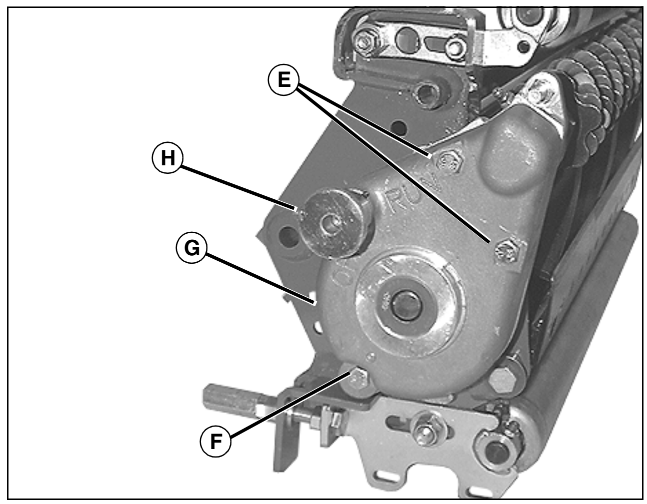
1. Press down on GTC adjuster bolt (A) and swing adjuster stop (B) toward the rear of the cutting unit (disengaged position). Repeat on other end of cutting unit.



M98565

2. Remove cap screws and nuts (C) from both sides of cutting unit.

3. Remove adjustment bracket assembly (D) from both sides of cutting unit.



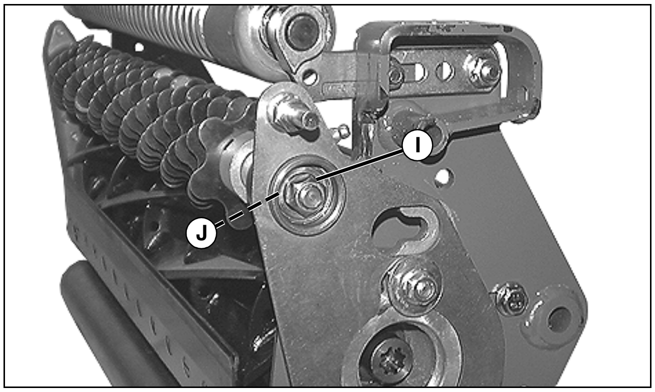
M98562

4. Move knob (H) to OFF position.

5. Remove two M8 x 50 hex-flange bolts (E) and one M8 x 30 hex bolt (F).

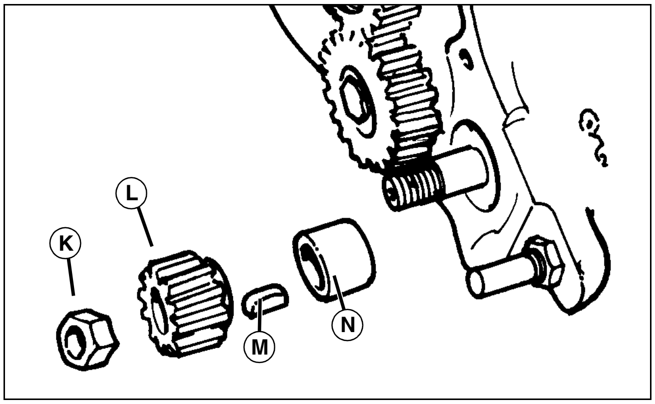
6. Remove GTC cover (G) and gasket.

NOTE: Hold gears on opposite side of cutting unit while loosening nut.



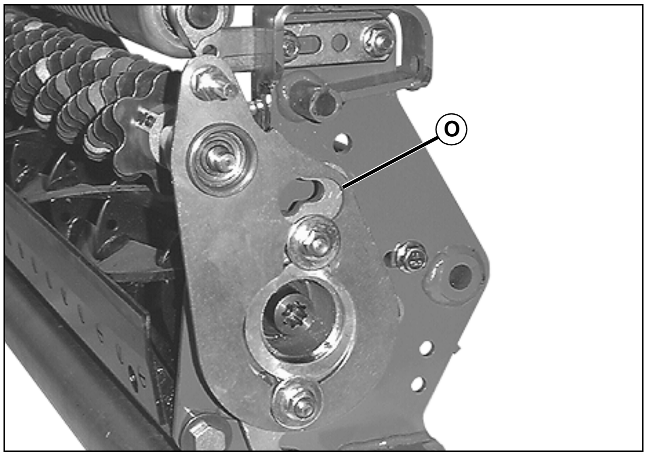
M98564

7. Remove nut (I) and spacer (J).



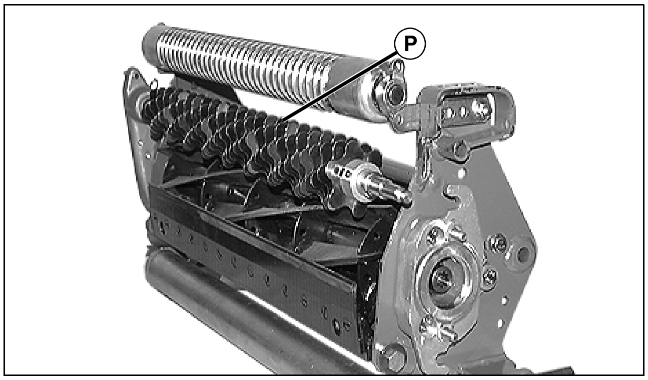
M46877

8. Remove nut (K), gear (L), key (M) and spacer (N).



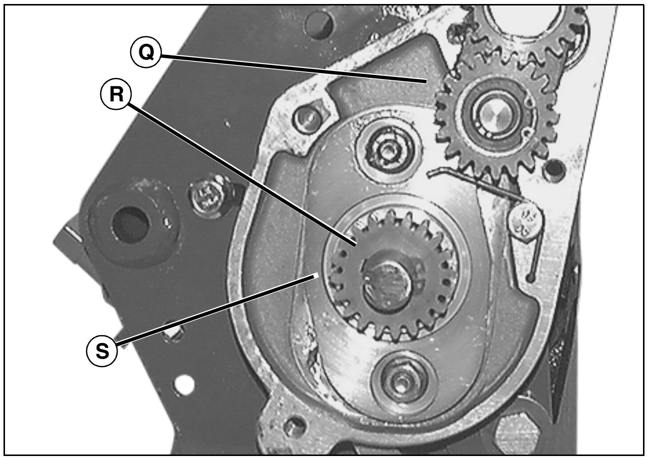
M98567

9. Remove bracket (O).



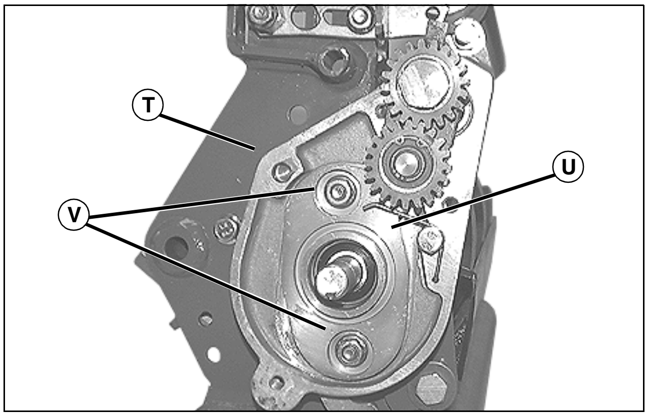
M98568

10. Remove GTC reel assembly (P).



M98569

11. Swing idler gear bracket (Q) away from main drive gear.
12. Remove retaining ring (R).
13. Remove gear (S).

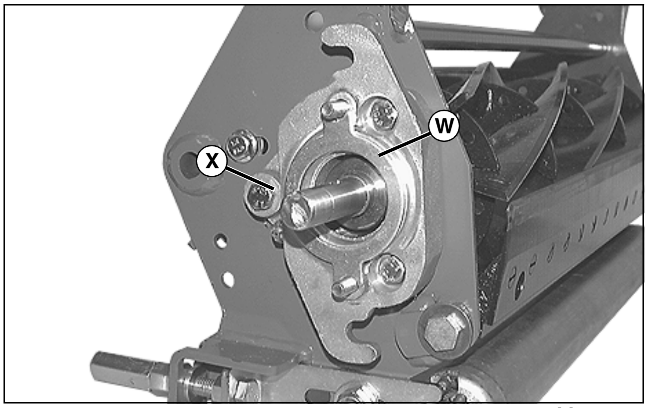


M98570

14. Remove two nuts (V).

NOTE: Spacer ring and shaft may come off with housings.

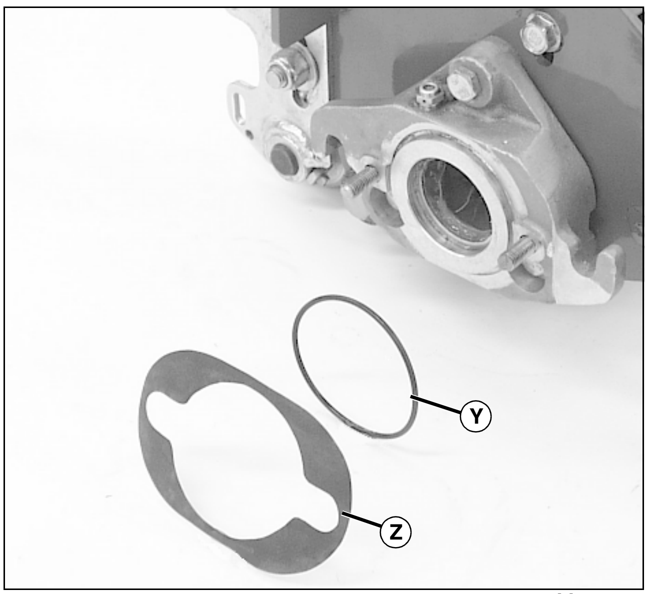
15. Remove bearing housing assembly (U).
16. Remove FTC housing (T).



M98591

17.Remove spacer ring (W).

18.Remove shaft (X).



M98066

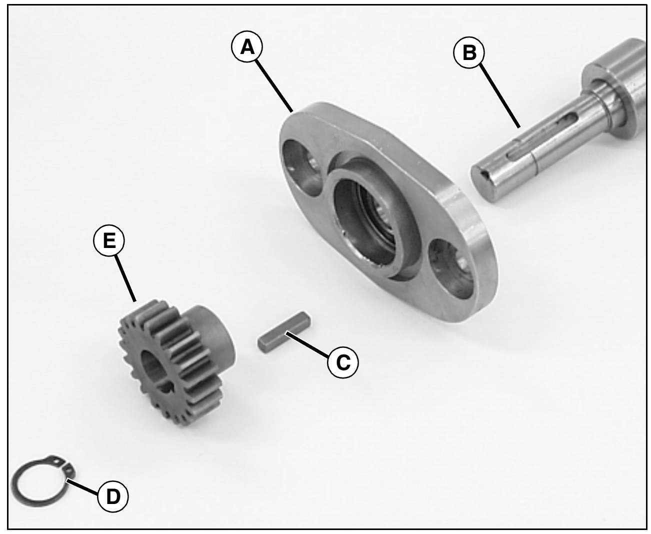
19.Remove gasket (Z) and O-ring (Y).

Install Greens and Turf Conditioner

Other Material

Part No.	Part Name	Part Use
AN102562	John Deere Corn Head Grease	Used to lubricate reel drive gearcase.
TY24425	John Deere Special Purpose HD Water Resistant Grease	Used to lubricate roller shaft bearing.

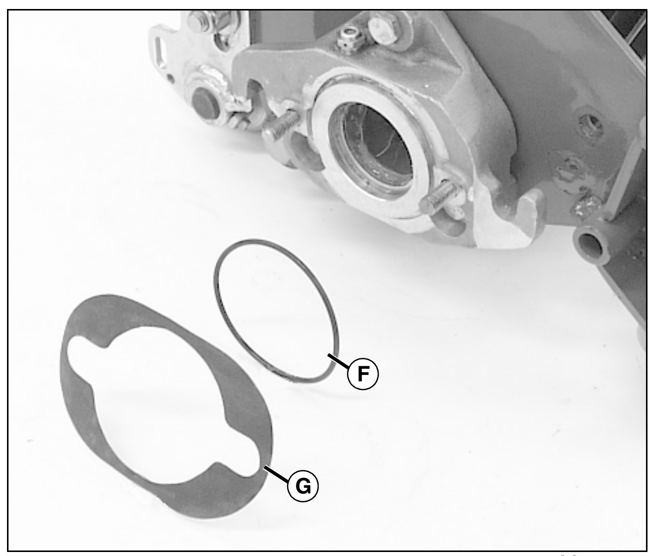
The following procedures show GTC unit mounted on right-hand side of the cutting unit. The procedure for units mounted on the left side is the same.



M98065

NOTE: If a rear roller brush kit is installed with the GTC, use the long, double key-slot drive shaft supplied with the brush kit.

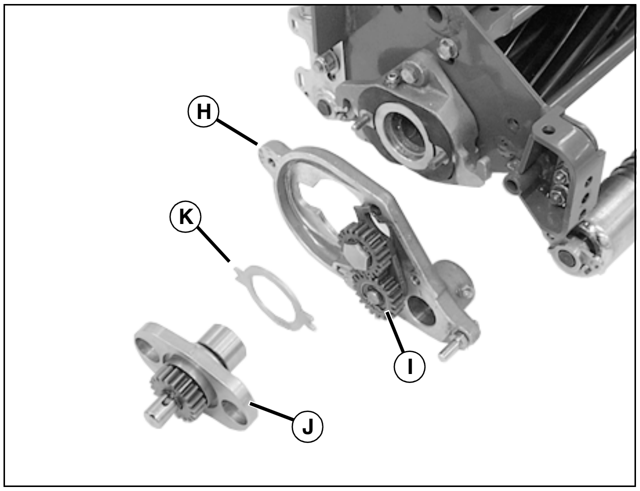
1. Install the drive shaft (B) into bearing housing (A).
2. Install square key (C) into drive shaft key slot.
3. Install main drive gear (E) on drive shaft.
4. Install snap ring (D).



M98066

5. Install O-ring (F) into groove in reel bearing housing.
6. Install gasket (G) over the bolts and O-ring.

NOTE: Slots in spacer ring must align with bolts projecting from reel bearing housing. If not assembled correctly, the GTC height cannot be adjusted.



M99034

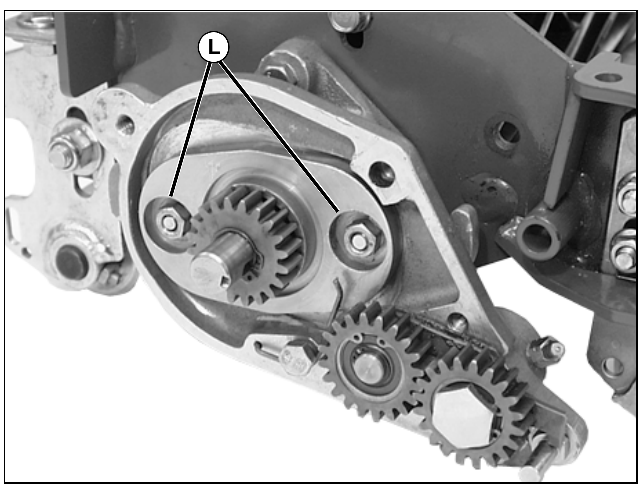
7. Position spacer ring (K) onto gear drive assembly (J).

NOTE: Apply AN102562 John Deere Corn Head Grease to the drive shaft end before installing the shaft onto the reel drive housing.

8. Rotate the idler gear bracket (I) away from the opening to gain clearance for installing the gear drive assembly (H).

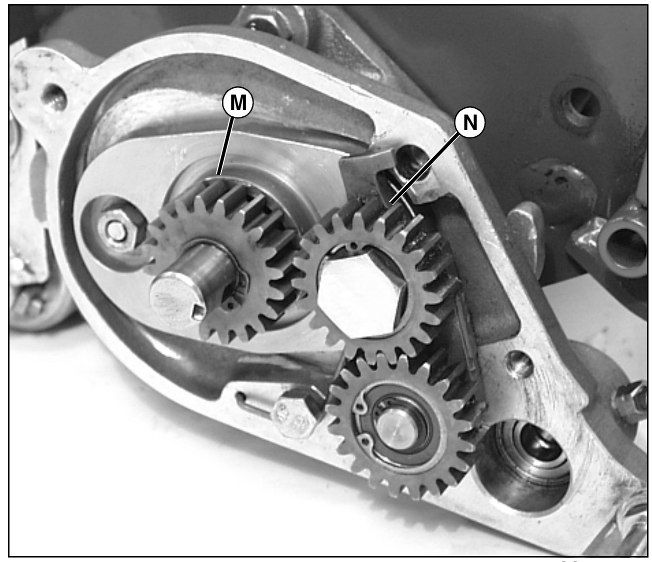
9. Install drive gear assembly with spacer ring into gear case assembly.

NOTE: Make sure that the torsion spring is positioned in front of the gear drive assembly bearing end cap.



M98088

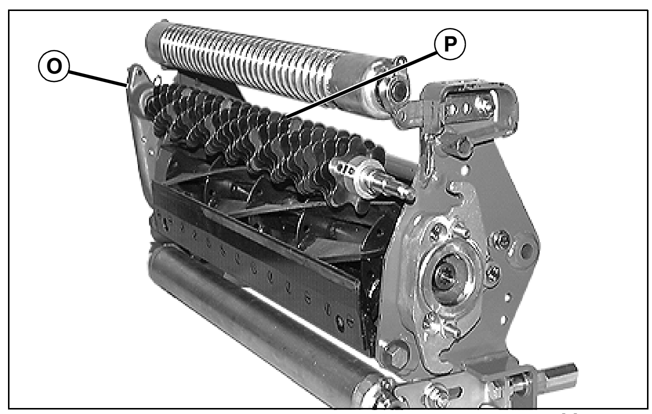
10. Secure the drive gear assembly using two hex lock nuts (L).



M98089

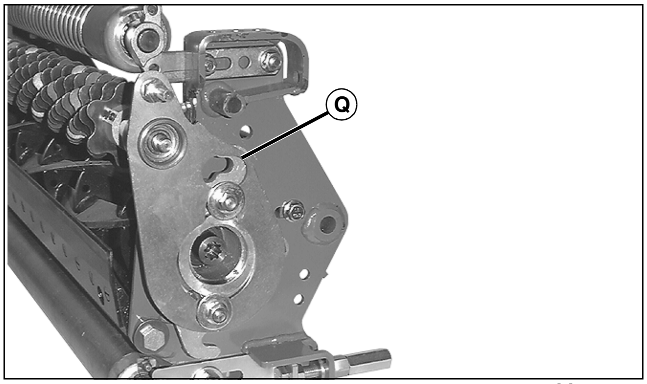
11. Rotate idler gear bracket (N) down to engage the main drive gear (M).

NOTE: There are two bearings and one washer in each arm bearing housing. If the washer is not centered in the housing, the shaft will not fit through both bearings. To hold the washers in position, lubricate each housing lubrication fitting using John Deere Special Purpose HD Water Resistant Grease, then center the washers.



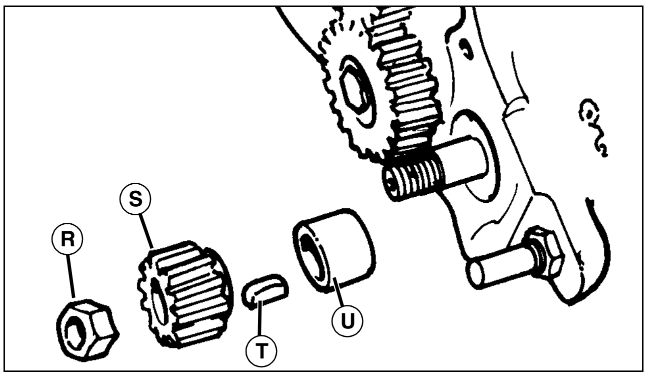
M98568

12. Slide the keyway end of the reel assembly (P) into the bearings in the GTC housing (O).



M98567

13.Install the bracket (Q).



M46877

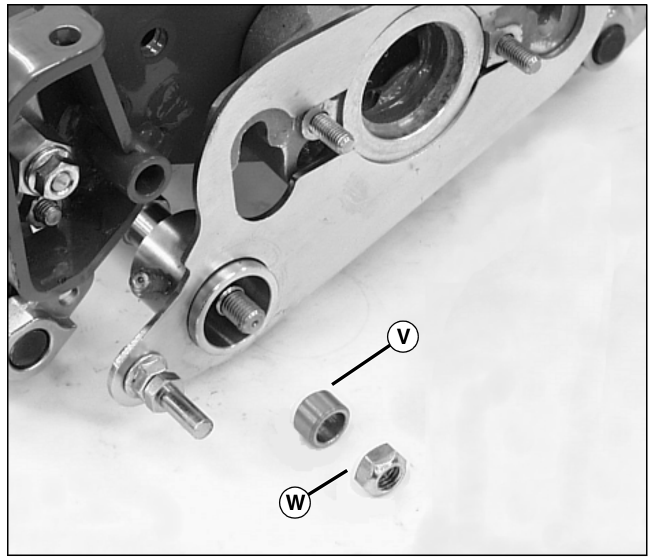
14.Slide large spacer (U) onto the GTC shaft (gear case assembly side).

15.Install key (T) in keyway slot.

16.Install gear (S) onto shaft.

NOTE: Tighten lock nut until there is no play of the conditioner shaft in the reel bearing housing. The shoulder of the shaft should be tight against the bearing.

17.Install and tighten the lock nut (R).

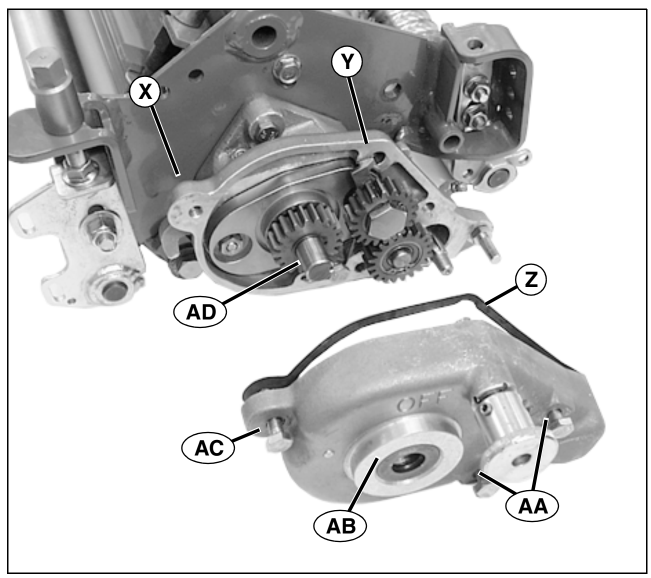


M98092

18.Install spacer (V) on conditioner shaft (bracket side).

NOTE: When properly tightened, the shoulder of the shaft and spacer should be against the bearings.

19.Install and tighten lock nut (W) against spacer.



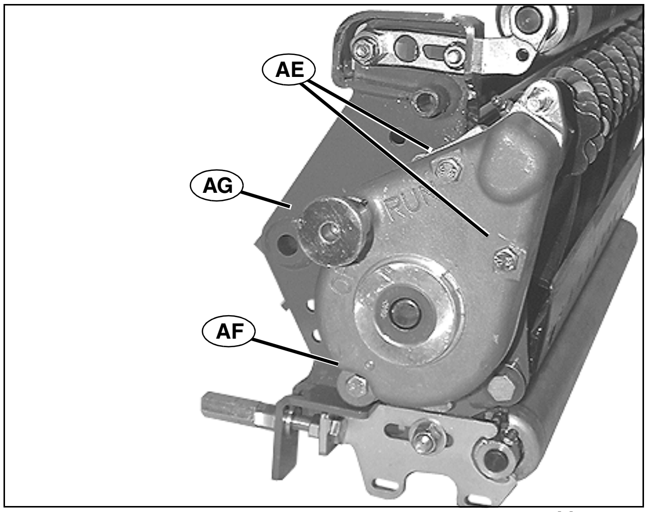
M99035

20.Fill gear case cover with approximately 240 mL (8 oz) of AN102562 John Deere Corn Head Grease.

21.Apply a light coat of AN102562 John Deere Corn Head Grease to the end of the drive shaft (AD).

22.Apply a light coat of AN102562 John Deere Corn Head Grease to the area between the seal (AB) and bearing and to the engagement hole (Y).

23.Install a new gasket (Z) and gear case cover on the gear case assembly (X). Secure the cover using two M8x50 hex-flange bolts (AA) and one M8x30 hex bolt (AC). DO NOT tighten bolts at this time.

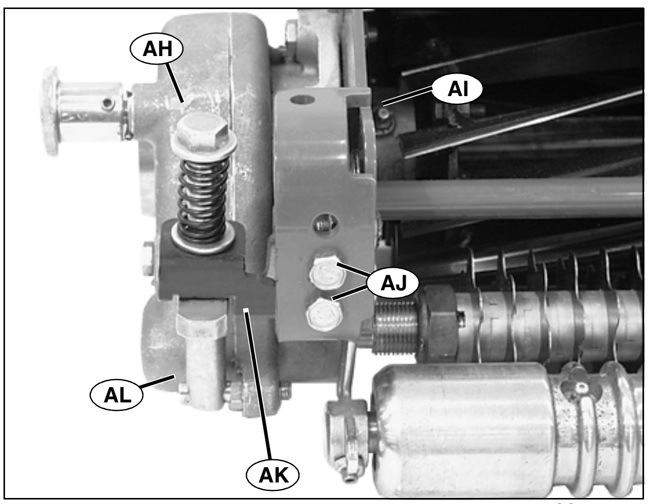


M98562

24.Turn engagement knob (AG) past the OFF position.

25.Tighten the M8x30 hex bolt (AF) first, then tighten the two M8x50 hex-flange bolts (AE).

26.Check engagement knob for free movement. If the knob does not move freely, remove and reinstall the cover.



M99036

27.Install adjuster assembly (AH) on the mounting bracket stud (AL).

NOTE: The alignment of the stop bracket and mounting holes used will determine the height of cut.

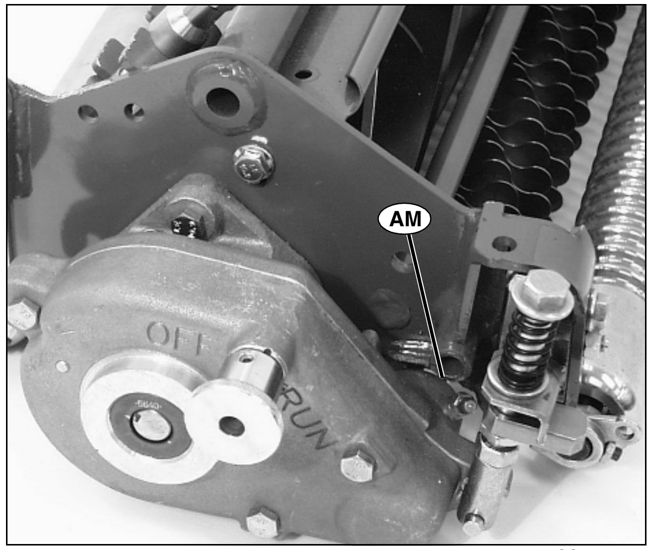
28.Secure the stop bracket (AK) to the cutting unit frame using two cap screws (AJ).

Height of Cut	Cutting Unit Frame Hole
0-12.70 mm (0-1/2 in.)	Top two holes
9.53-15.88 mm (3/8-5/8 in.)	Bottom two holes

29.Apply AN102562 John Deere Corn Head Grease to the lubrication fittings (AJ) until grease begins to escape from the roller bearing vent plug.

30.Repeat steps 28 and 30 for adjuster assembly on the other side of the cutting unit.

31.Press down on the adjuster assembly bolt and swing the adjuster stop toward the front of the cutting unit on both sides of the cutting unit (engaged position).

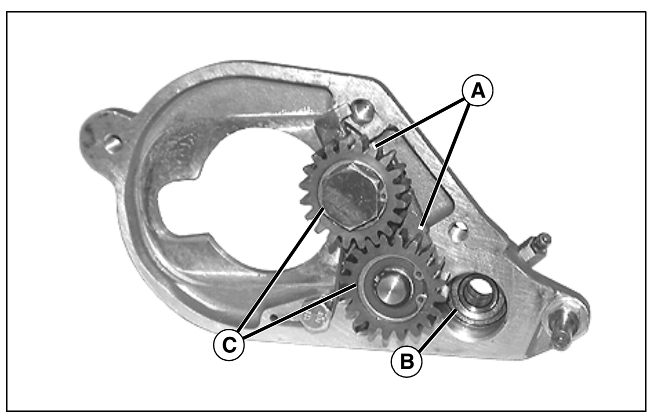


M97456

32.Apply TY24425 John Deere Special Purpose HD Water Resistant Grease to the lubrication fittings (AM).

Disassemble and Inspect Greens and Turf Conditioner

GTC Housing

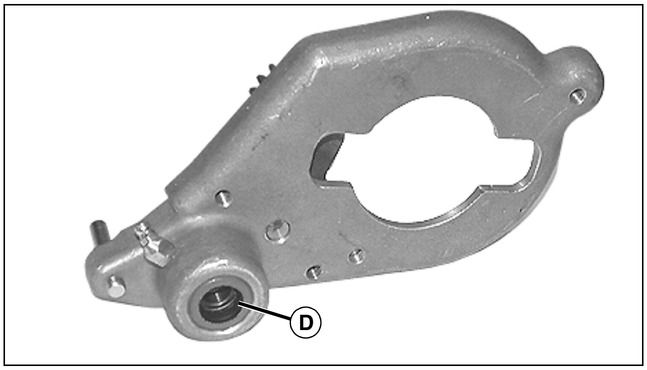


M98593

1. Inspect gears (A) for signs of wear or damage. Replace as needed.

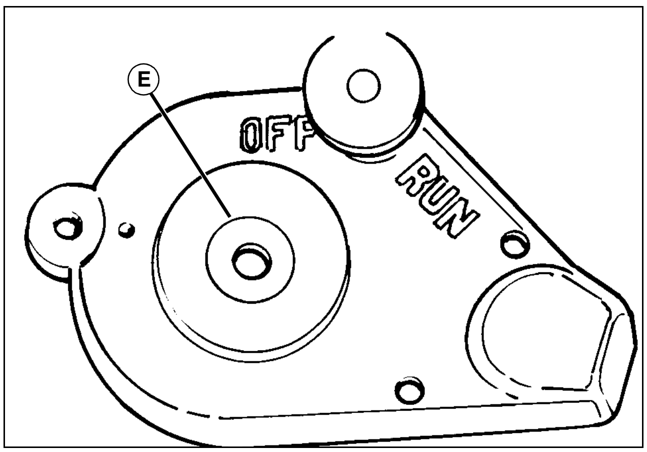
2. Inspect gear bearings (C) for free movement and excessive play. Replace bearing if it has excessive play or if it is noisy.

3. Inspect reel shaft bearing (B) for free movement and excessive play. Replace bearing if it has excessive play or if it is noisy.



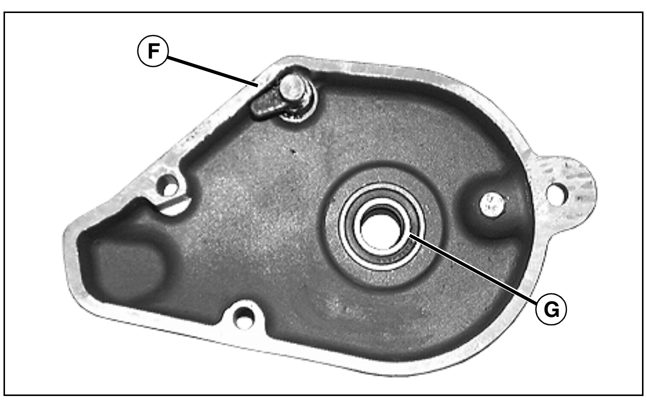
M98594

4. Inspect seal (D) for wear or damage. Replace bearing if it has excessive play or if it is noisy.



M46903

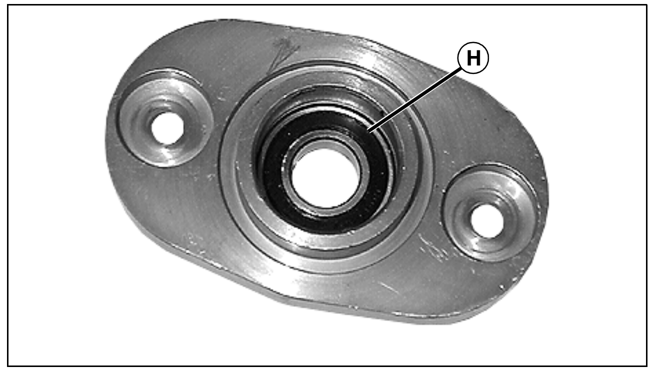
5. Inspect seal (E) in cover for wear or distortion. Replace seal as needed.



M98563

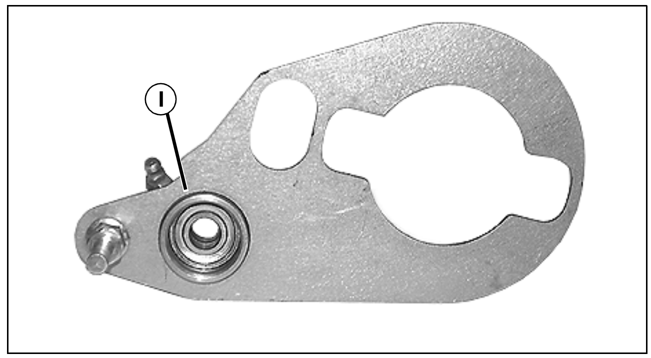
6. Inspect bearing (G) for free movement and excessive play. Replace bearing if it has excessive play or if it is noisy.

7. Inspect engagement pawl and spring (F) for wear or damage. Replace as needed.



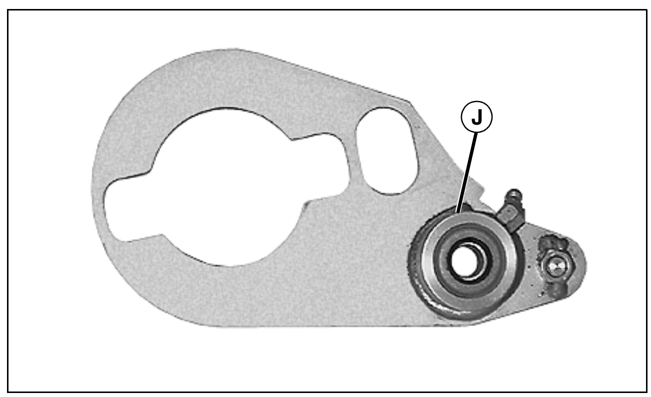
M98592

8. Inspect bearing (H) for free movement and excessive play. Replace bearing if it has excessive play or if it is noisy.



M98599

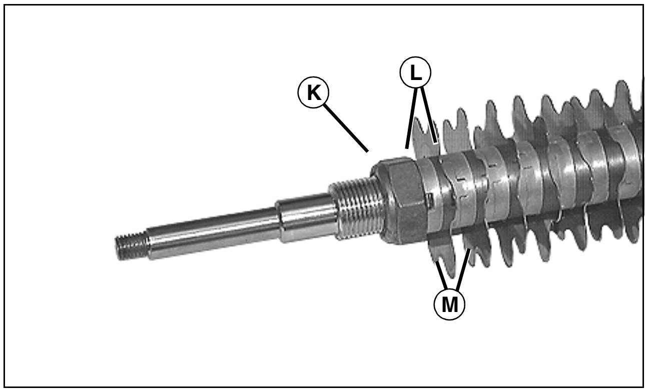
9. Inspect bearing (I) for free movement and excessive play. Replace bearing if it has excessive play or if it is noisy.



M98600

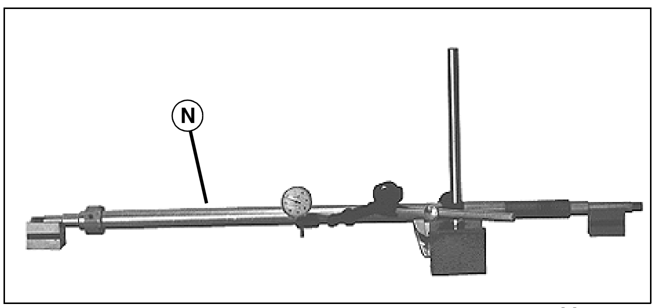
10.Inspect seal (J) in plate for wear or damage. Replace seal as needed.

GTC Shaft Assembly



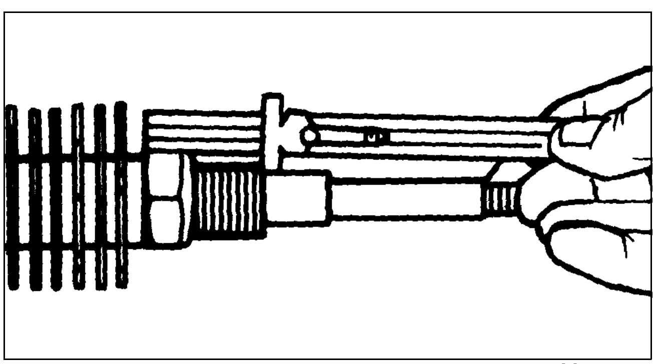
M98566

1. Remove lock nut (K).
2. Remove blades (M) and index rings (L).
3. Inspect blades for excessive wear and broken, cracked or distorted cutting teeth. Replace parts as needed.



M46725

4. Remove debris and/or corrosion from shaft (N) and place on V-blocks. Check runout at the center of the shaft. Runout should not exceed 1.4 mm (0.0625 in.). Straighten or replace shaft as needed.



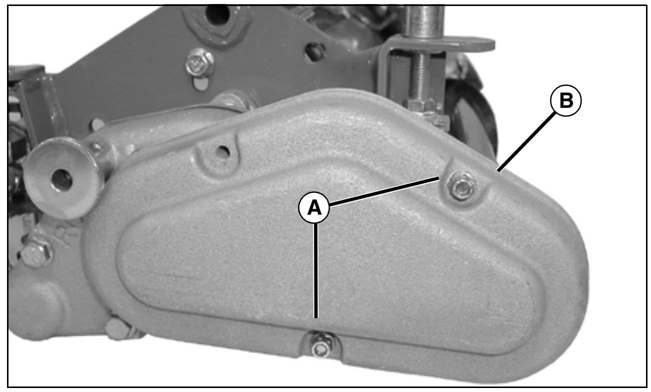
M46886

5. Install index rings and blades on shaft, rotating occasionally to align blades and index rings. Install all spacers and blades until approximately 38 mm (1.50 in.) of exposed thread is left.
6. Stand the shaft on end and shake it slightly to ensure the blades and index rings are aligned.
7. Install locking nut and tighten to specifications.

Specifications

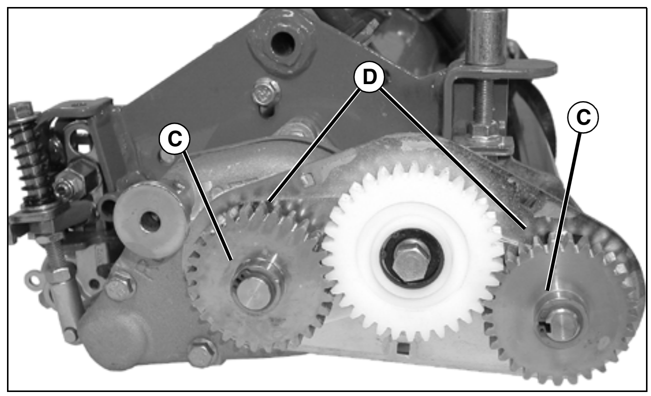
GTC Shaft Retaining Nut Torque . . . . 47 N•m (35 lb-ft)

Remove Power Brush



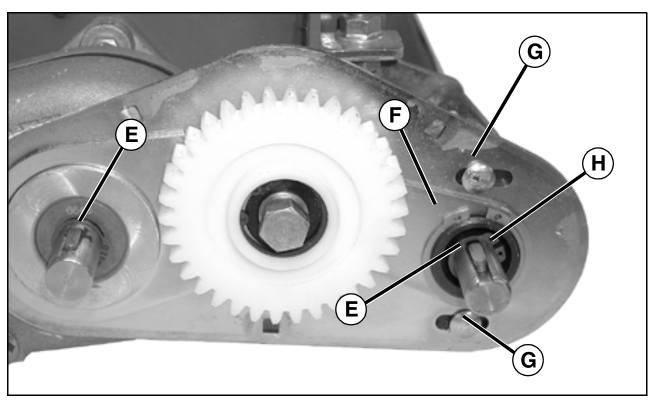
MX18345

1. Remove two carriage bolts and lock nuts (A).
2. Remove cover (B) and gasket.



MX18346

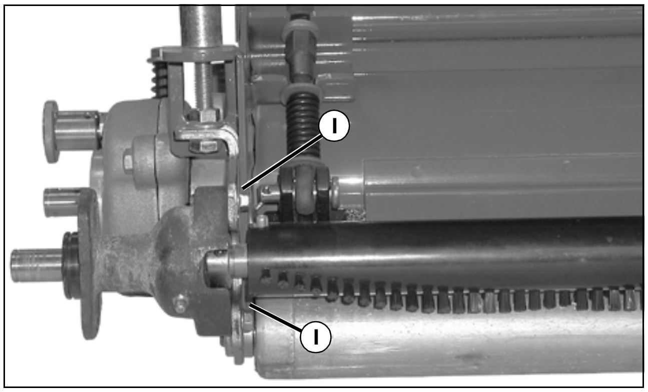
3. Remove snap rings (C).
4. Remove gears (D).



MX18347

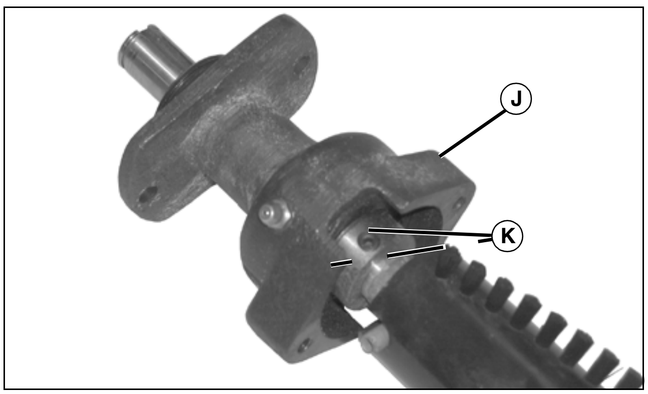
5. Remove keys (E) and snap ring (H).
6. Remove two carriage bolts (G) and nuts.
7. Remove snap ring (F).

8. Remove gear plate from cutting unit with attached idler gear.



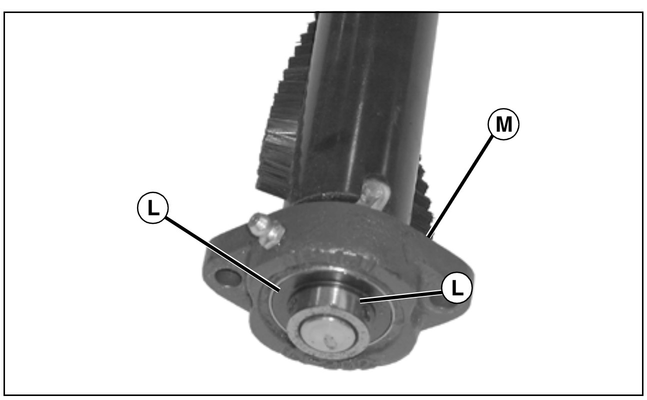
MX18348

9. Remove both cap screws (I) and remove two cap screws and nuts from opposite side of brush. Remove assembly from cutting unit.



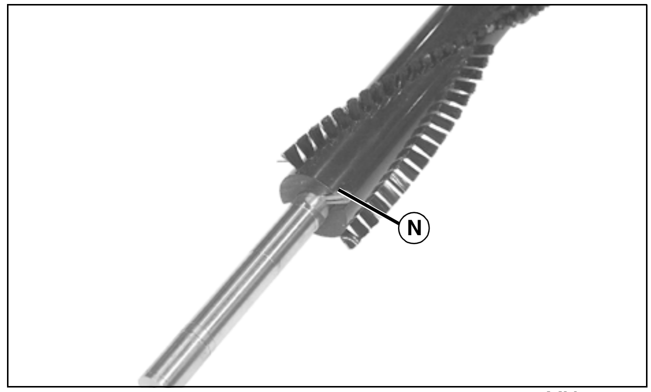
MX18349

10.Remove two set screws (K) and slide off drive housing (J).



MX18350

11.Loosen two set screws (L) and slide off bearing flange (M).

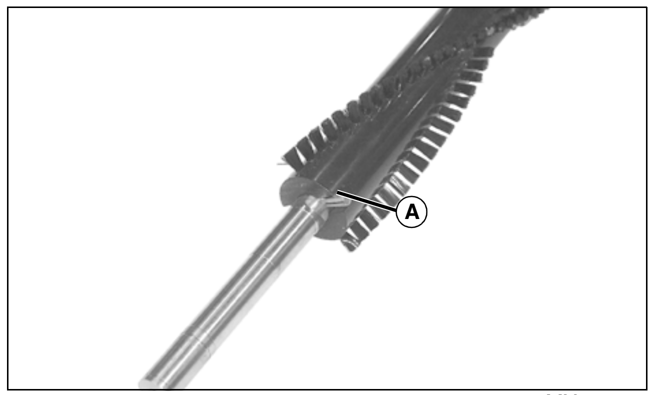


MX18318

12.Drive spring pin (N) from shaft using a punch.

13.Remove brush from shaft.

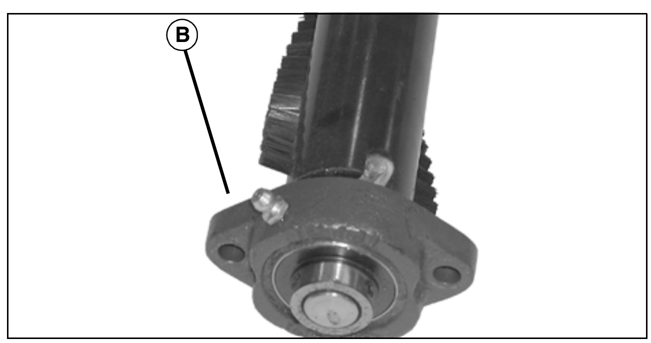
Install Power Brush



MX18318

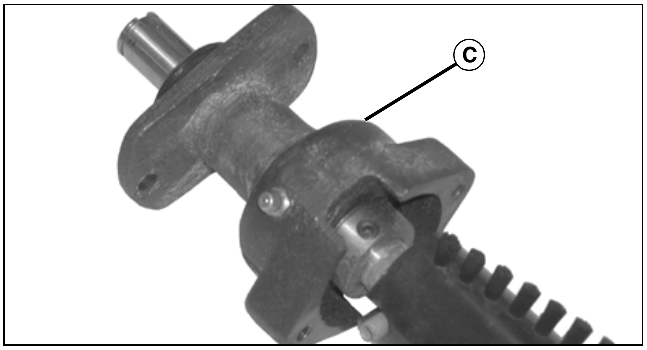
1. Install brush on shaft.
2. Install spring pin (A) to secure brush.

NOTE: The grease fittings will be more accessible for service if the drive housing and bearing flange are installed with the fittings to the rear of the unit.



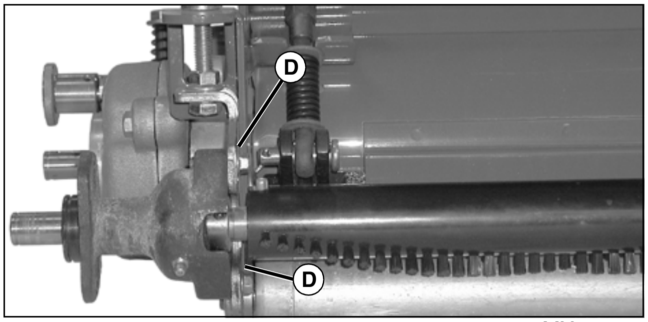
MX18350

3. Install bearing flange (B) to short shaft end of brush. Do not tighten set screws at this time.



MX18349

4. Install brush drive housing (C) on long end of brush. Do not tighten set screws at this time.



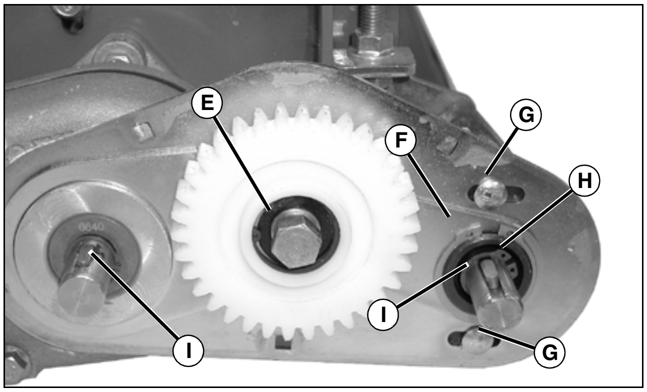
MX18348

5. Install brush assembly to cutting unit.

6. Install both cap screws (D) and two cap screws and nuts on opposite side of cutting unit, securing each bracket on cutting unit.

7. Adjust the brush to the roller with a clearance of 0-1 mm (0-0.031 in.) by raising or lowering brush. Tighten cap screws on both sides of cutting unit.

8. Position the brush between the housings so that the short end of the shaft is flush with the cast bearing. Apply thread locking compound and tighten the set screws in both bearings.



MX18347

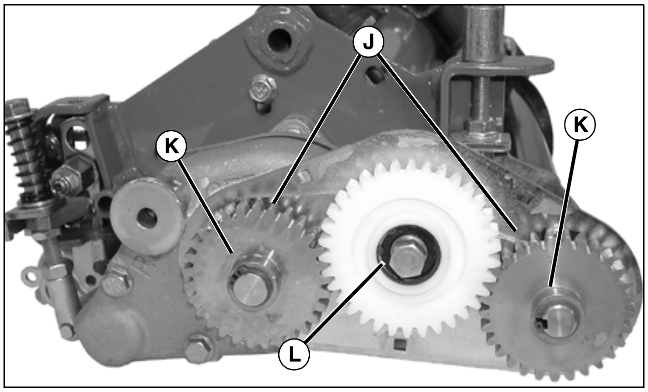
9. Loosen gear shaft bolt (E) before installing plate.

10.Install gear plate and snap ring (F).

11.Install two carriage bolts and nuts (G).

12.Install snap ring (H) on brush shaft.

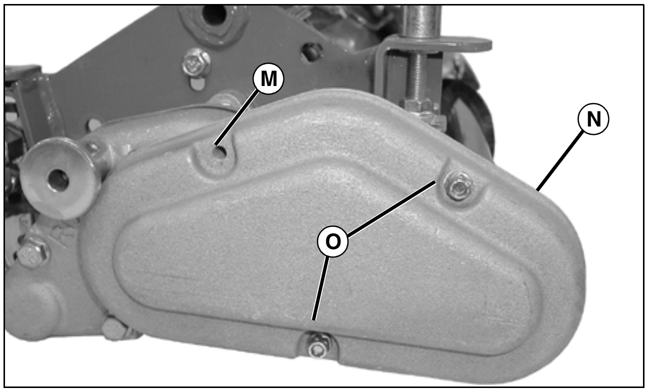
13.Install keys (I).



MX18346

14.Install gears (J) and snap rings (K).

15.Tighten gear shaft bolt (L).

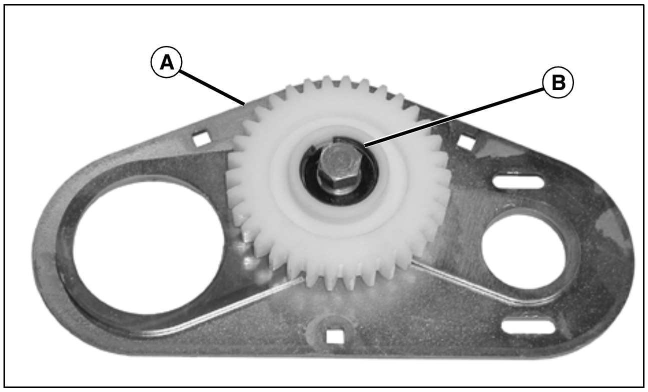


MX18345

16.Install gasket and cover (N).

17.Install two carriage bolts and lock nuts (O). Hole (M) is not used.

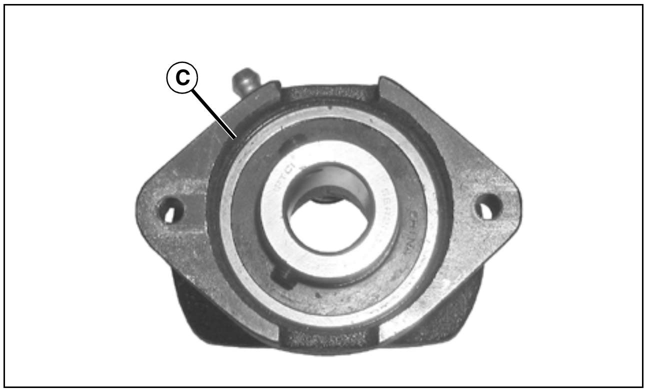
Disassemble and Inspect Power Brush



MX18351

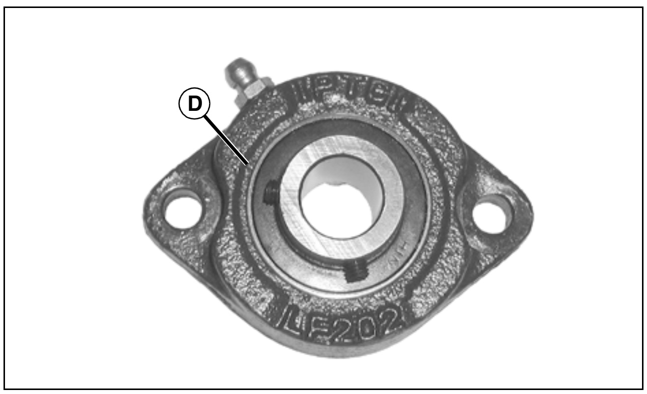
1. Inspect gear (A) for signs of wear or damage. Replace if needed.

2. Inspect bearing (B) for free movement and excessive play. Replace bearing if it has excessive play or is noisy.



MX18321

3. Inspect bearing (C) for free movement and excessive play. Replace bearing if it has excessive play or is noisy.



MX18322

4. Inspect bearings (D) for free movement and excessive play. Replace bearing if it has excessive play or is noisy.

Remove and Install Vertical Cutting Unit

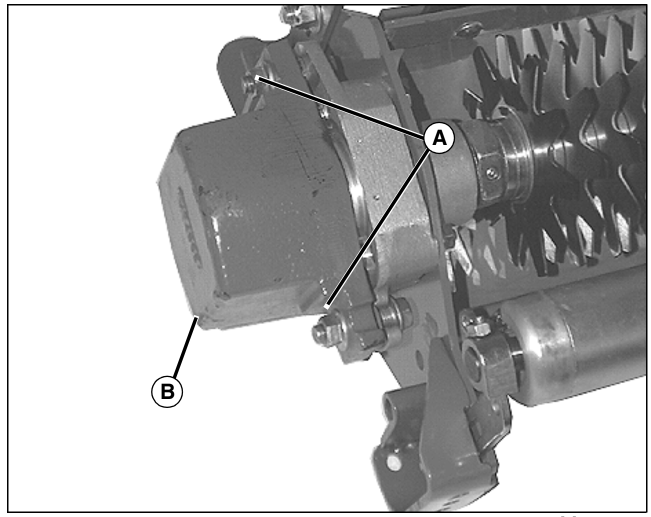
NOTE: Vertical cutting units are removed and installed in the same manner as reel mowers. (See "Remove and Install Cutting Unit" on page 765.)

Remove Reel Assembly - Vertical Cutting Unit

CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

1. Remove cutting units from mower. (See "Remove and Install Cutting Unit" on page 765.)

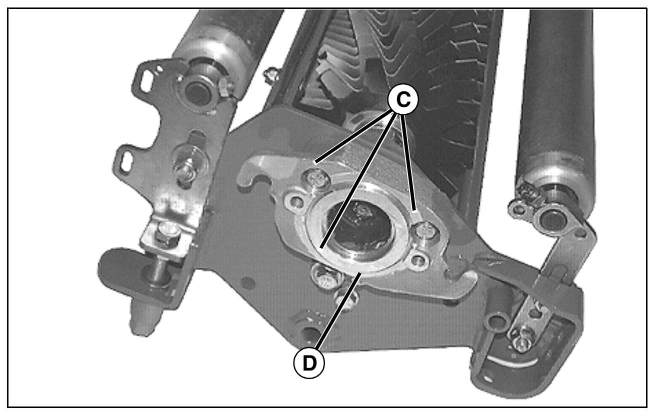
2. Place cutting unit upside-down on a stable working surface (rollers facing up).



M98492

3. Loosen flange nuts (A).

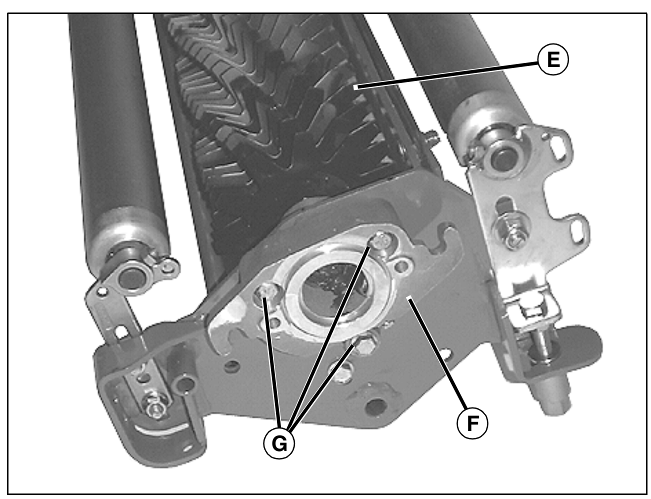
4. Remove weight assembly (B).



M98493

5. Remove three cap screws and nuts (C).

6. Remove bearing housing (D).



M98494

7. Remove three cap screws and nuts (G).

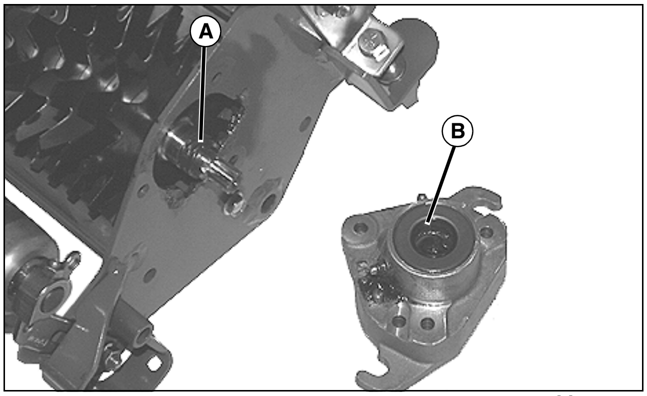
8. Remove reel assembly (E).

NOTE: Remove bearing housing only if repair is required.

9. Remove bearing housing (F).

Install Reel Assembly - Vertical Cutting Unit

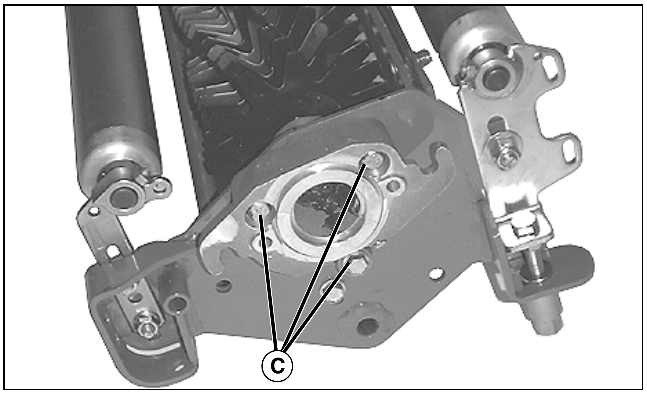
1. Install reel assembly in housing with the shaft end with the keyway on the left side of the frame.



M98495

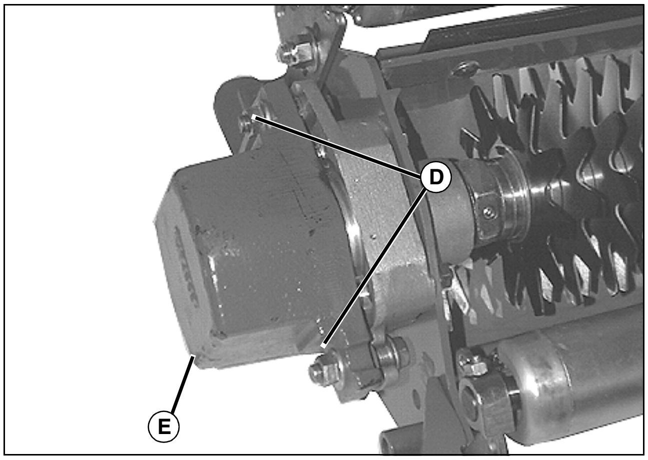
2. Align the tab (B) on the keyed washer with the keyway (A) on the reel shaft.

3. Install the bearing housing.



M98494

4. Install three cap screws and nuts (C).

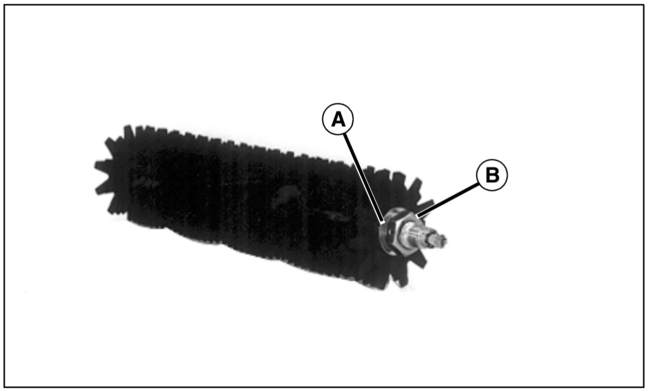


5. Install weight assembly (E).

6. Tighten flange nuts (D).

Disassemble and Inspect Reel Assembly - Vertical Cutting Unit

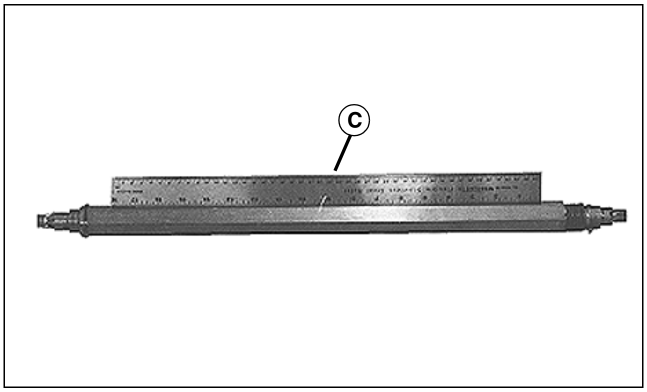
CAUTION: Avoid injury! Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.



M46740

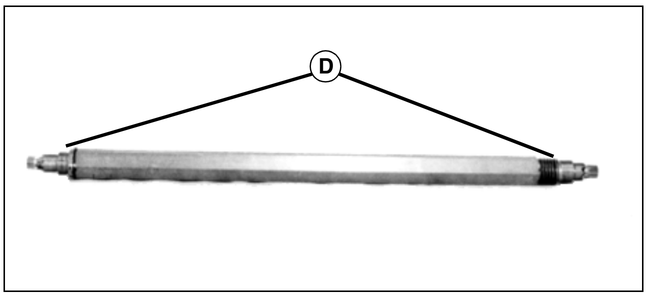
1. Remove set screw (A).

2. Remove nut (B) and remove cutting blades and spacers from reel shaft.



M46741

3. Using a straightedge (C), check shaft for straightness. Shaft runout should not exceed 0.50 mm (0.020 in.).

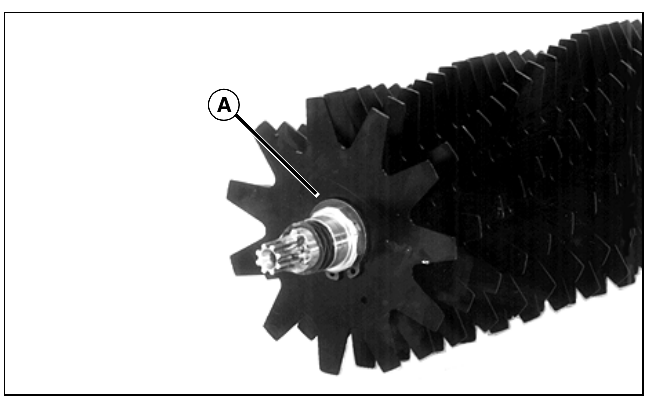


M46742

4. Inspect machined surfaces (D) of shaft for wear or damage. Replace shaft if needed.

Assemble Reel - Vertical Cutting Unit

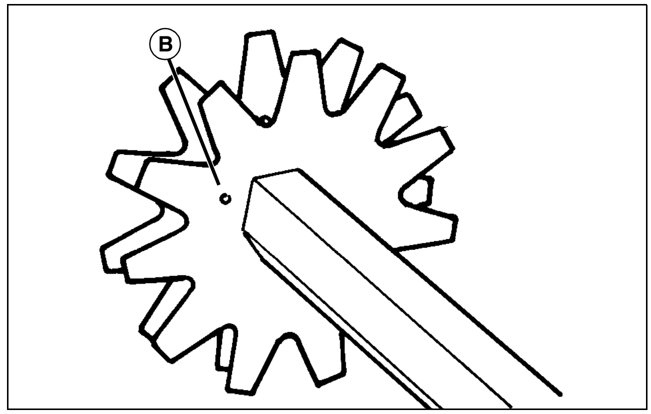
CAUTION: Avoid injury! Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.



M46743

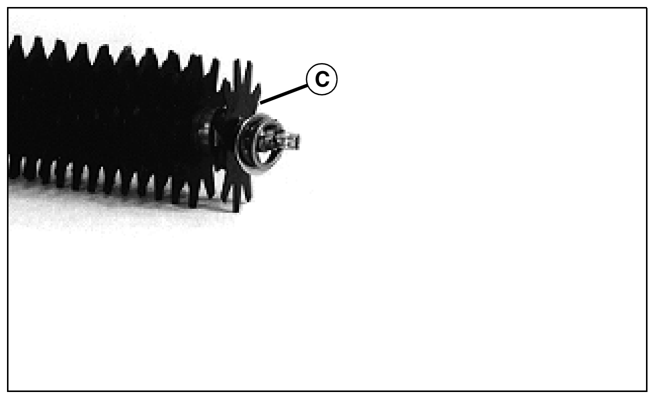
1. Install snap ring (A) in groove on shaft. (Sharp edge of snap ring facing away from the blades.)

NOTE: The cutting unit is shipped with three 6 mm (0.25 in.) spacers between each cutting blade. Fewer spacers and more blades can be used if desired.



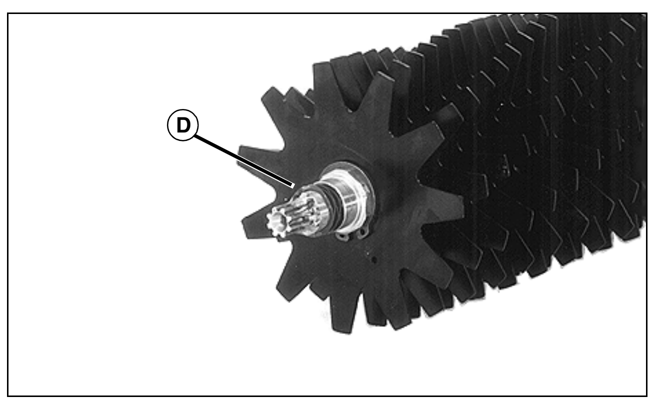
M46882

2. Assemble blades and spacers starting with a blade against the snap ring. Ensure that the index hole (B) of the next blade is placed on the next flat counterclockwise on the shaft as shown. This will establish the proper helix pattern.



M46745

3. After the last cutting blade is installed, install a washer, spacer (C) and nut. Tighten nut until a slight deflection of the cutting blade, next to the snap ring, is observed.

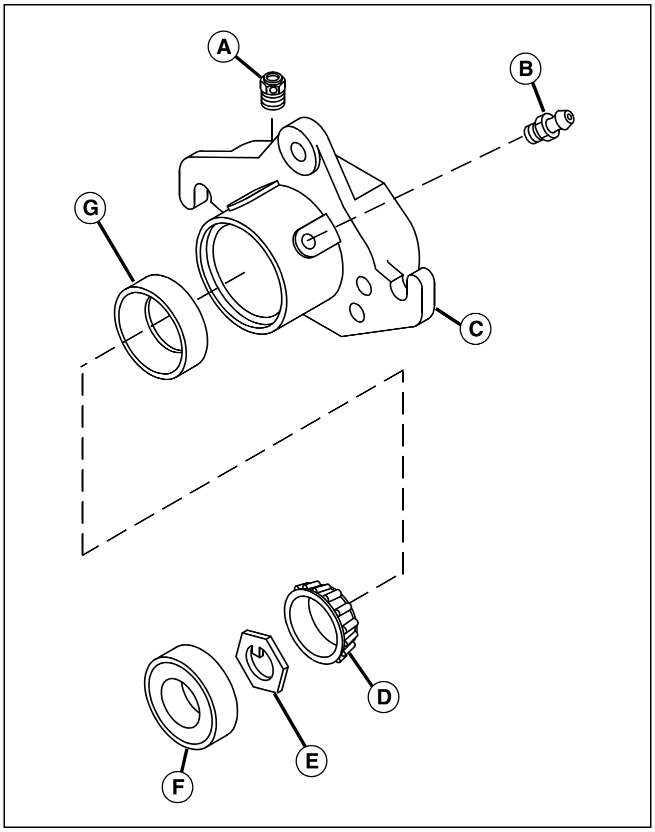


M46746

4. Install set screw (D).

Disassemble and Inspect Bearing Housing - Vertical Cutting Unit

NOTE: LEFT or RIGHT positions are determined by standing at the rear of the unit and looking forward.



MIF M98496

1. Remove seal (F), tapered roller bearing (D), keyed washer (E) (left side only) and bearing cup (G) from bearing housing (C).
2. Remove grease fitting (B) and breather (A).
3. Clean bearings and housing with solvent.

IMPORTANT: Avoid damage! Always replace bearings and bearing cups as a set.

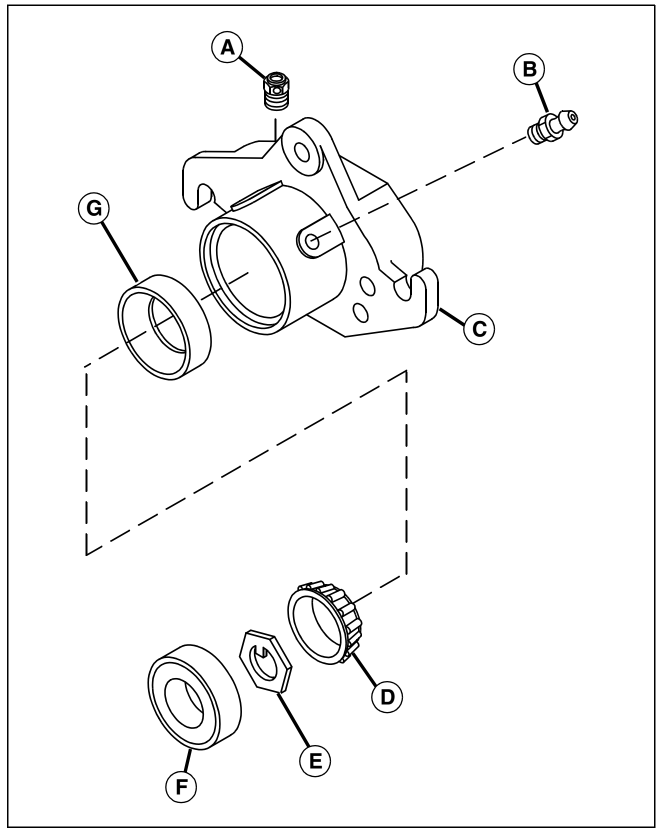
4. Inspect bearings and bearing cups for scoring, pitting or bluing from overheating. Replace as needed.

Assemble Bearing Housing - Vertical Cutting Unit

Other Material

Part No.	Part Name	Part Use
TY25083	John Deere Golf And Turf Cutting Unit Grease	Used to lubricate mower bearings and seals.

NOTE: LEFT or RIGHT positions are determined by standing at the rear of the unit and looking forward.



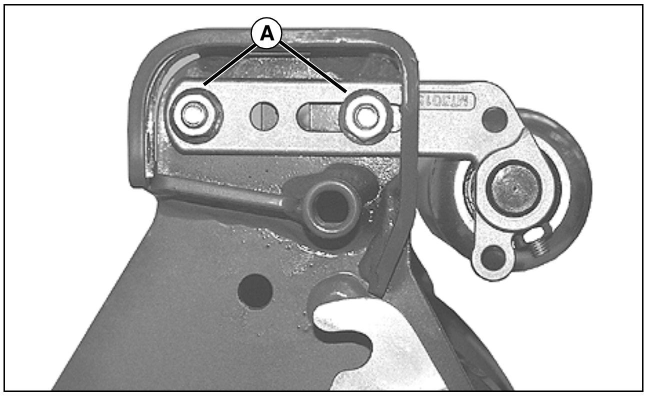
MIF M98496

1. Install bearing cup (G) into housing (C) using a suitable driver or a press (tapered end facing the outside of the housing).
2. Pack bearing (D) with TY25083 John Deere Golf And Turf Cutting Unit Grease and position in the bearing cups.
3. Install keyed washer (E) (left side only).
4. Install breather (A) and grease fitting (B).
5. Install seal (F) flush with the face of the housing. Apply TY25083 John Deere Golf And Turf Cutting Unit Grease to the seal lips.

Remove and Install Front Roller - Vertical Cutting Unit

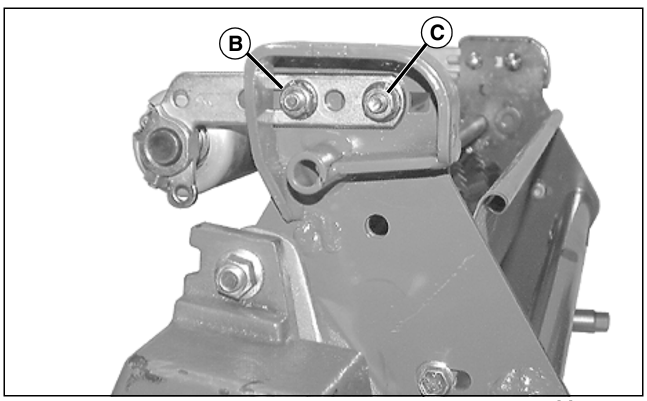
1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

2. Place cutting unit on a stable working surface with the front roller facing up.



M84841

3. Remove two flanged nuts and carriage bolts (A).



M98841

4. Remove lower flanged nut and carriage bolt (B) from both sides.

5. Remove nut, serrated washer and carriage bolt (C) from both sides.

6. Remove roller and bracket assembly.

Installation

Installation is done in the reverse order of removal.

NOTE: DO NOT install set screws into the holes in the roller bearing shafts.

Roller brackets are offset. For standard use, the bracket should be installed on the roller with the offset to the rear of the cutting unit.

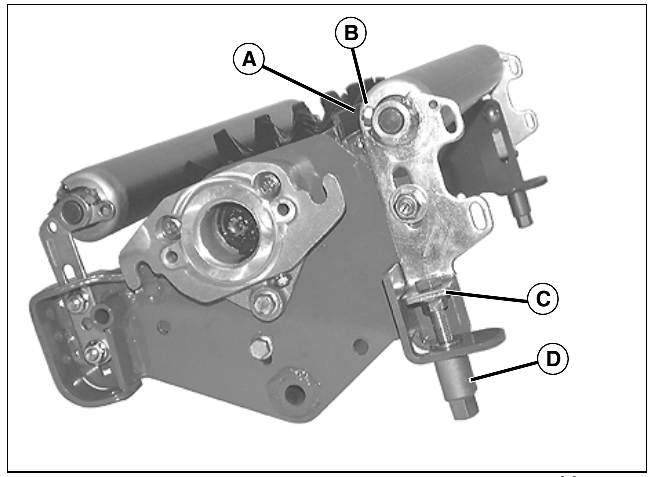
Install roller bracket with the larger holes and adjustment slot on the left side of the cutting unit, in the direction of travel.

- Adjust roller height. (See “Adjust Front Roller” on page 757.)

Remove Rear Roller - Vertical Cutting Unit

1. Remove cutting units from mower. (See “Remove and Install Cutting Unit” on page 765.)

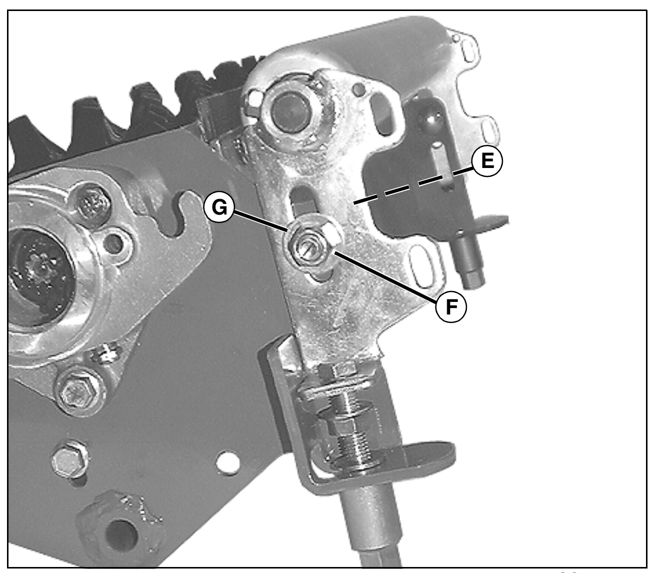
2. Place cutting unit upside-down on a stable working surface (rollers facing up).



M98842

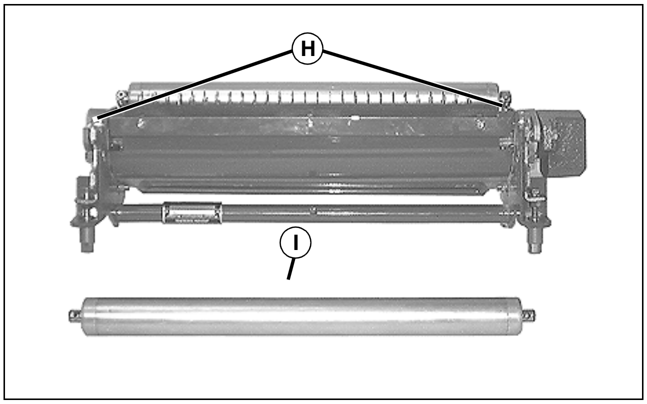
3. Loosen jam nut (B) and set screw (A) on both sides of cutting unit.

4. Loosen jam nut (C) on adjuster tower (D) on both sides of cutting unit.



M98843

5. Remove carriage bolt (E), flat washer (F) and lock nut (G) on both sides of cutting unit.

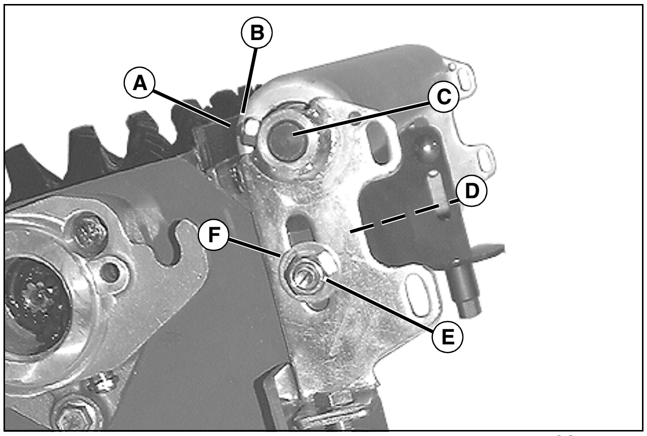


M98844

6. Move height-of-cut brackets (H) away from bearing spindle shaft ends.

7. Remove rear roller (I).

Install Rear Roller - Vertical Cutting Unit



M98843

NOTE: DO NOT tighten roller shaft set screws and jam nuts at this time.

1. Install roller bearing spindle shaft (C) into height-of-cut brackets on both sides of machine.

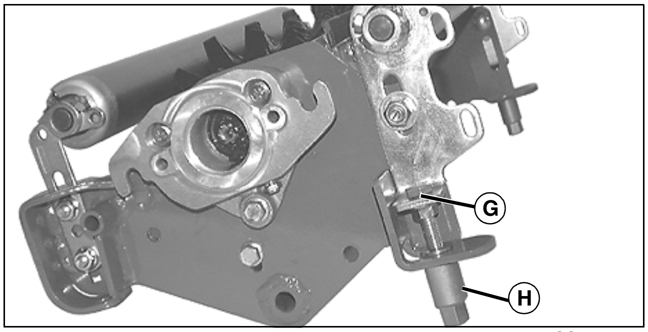
NOTE: Install carriage bolts with the flat washer and nut on the outside of the cutting unit.

2. Attach height-of-cut bracket to cutting unit frame using carriage bolt (D), flat washer (E) and lock nut (F) on both sides of cutting unit.

NOTE: DO NOT install set screws into holes in roller spindle shafts.

3. Center rear roller between height-of-cut brackets.

4. Tighten set screw (A) and jam nut (B) on both sides of cutting unit.



M98842

5. Loosen bracket lock nuts approximately 1/4 turn (both sides of cutting unit).

6. Tighten jam nut (G) on adjuster tower (H) on both sides of cutting unit.

7. Tighten bracket lock nuts (both sides of cutting unit).

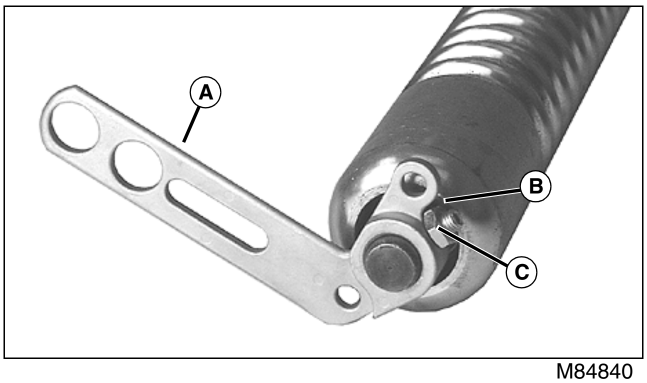
8. Adjust cutting depth. (See “Adjust Depth-of-Cut - Vertical Cutting Units” on page 762.)

Replace Roller Bearing - Vertical Cutting Unit

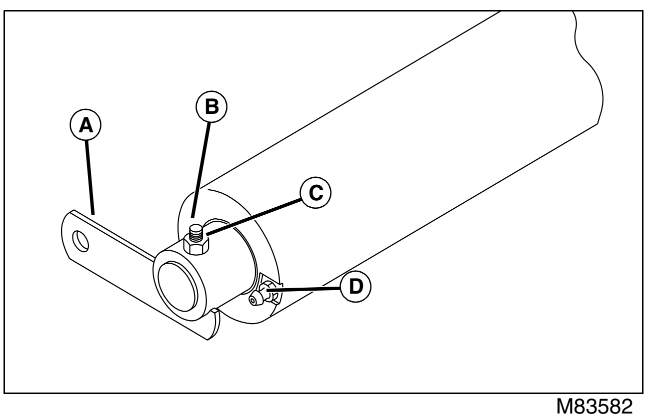
Special or Required Tools

Tool Name	Tool No.	Tool Use
Roller Bearing Puller	JDG795	Used to remove bearings from rollers
Bearing Installer	JDG243	Used to install bearings on rollers
Bearing Installer	JDG506	Used to install bearings on rollers

NOTE: This procedure applies to both smooth and grooved rollers.



Picture Note: Grooved Roller Shown



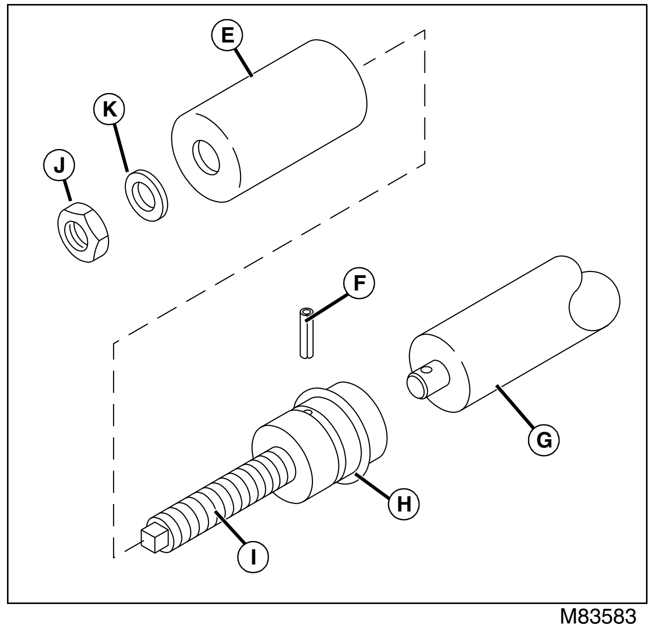
Picture Note: Smooth Roller Shown

1. Loosen jam nut (C) and remove set screw (B).

NOTE: It may be necessary to press the bearing shaft from the bracket.

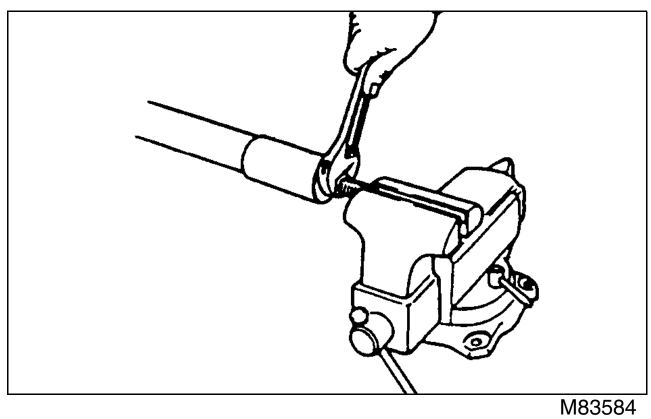
2. Remove bracket (A) from bearing shaft.
3. Remove grease fitting (D) (smooth rollers only).

CAUTION: Avoid injury! Wear approved eye protection when using roller bearing puller.



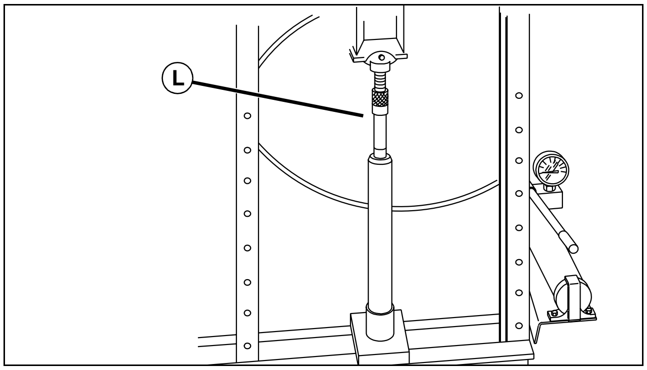
4. Attach JDG795 Roller Bearing Puller (I) to the bearing by inserting the pin (F) through the hole in the bearing shaft and puller. Slide the O-ring (H) over the pin to keep it in position.

5. Slide roller sleeve (E) over the threaded puller with the concave end of the roller sleeve against the end of the roller (G). Install flat washer (K) and nut (J) on threaded puller.



6. Clamp the hex end of the threaded puller in a vise or hold it with a wrench. Turn nut counterclockwise until the bearing is removed from the roller.

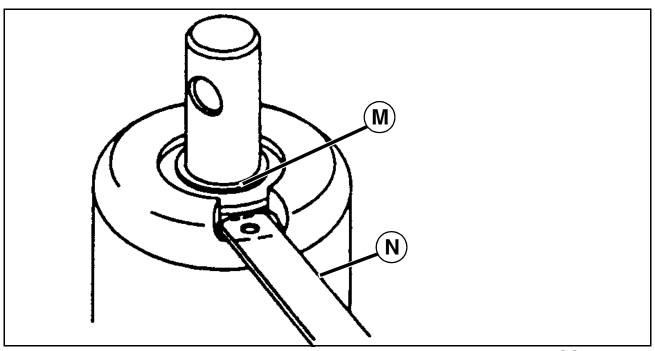
IMPORTANT: Avoid damage! DO NOT press on center shaft of bearing when installing bearing. Bearings will set and become tight. Bearings must only be installed by pressing on the outside of bearing race.



M83586

7. Position roller in a press using the roller sleeve to hold the roller while installing the bearing in the other end.

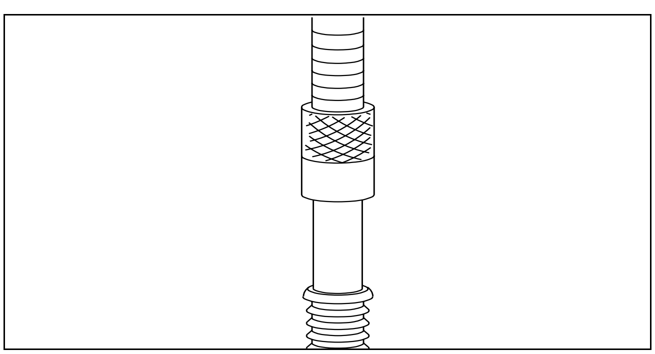
8. Position JD243 or JD506 Bearing Installer (L) over the new bearing in the top end of the roller.



M83585

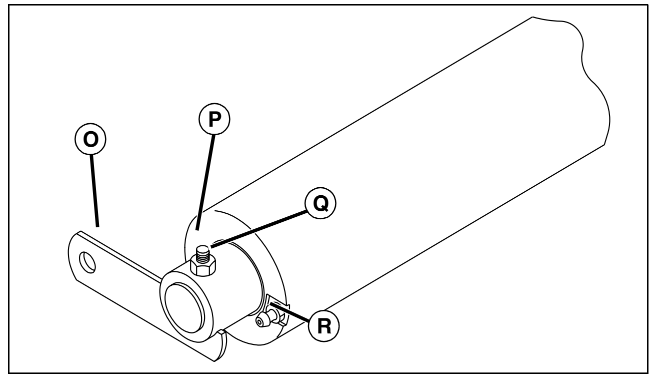
9. **Smooth Rollers:** Place a 0.89 mm (0.035 in.) feeler gauge (N) in the slot where the grease fitting was located. Press the bearing into the roller until the top of the outside bearing race (M) is flush with the top of the feeler gauge.

10. Install the grease fitting.



M83587

11. **Grooved Rollers:** Press bearing into roller until the top of the outside bearing is flush with the end of the roller.



M83582

Picture Note: Smooth Roller Shown

12. Install bracket (O) on both sides of roller.

13. Install set screw (P) and jam nut (Q) on both sides of roller.

14. Install grease fitting (R) (smooth rollers only) on both sides of roller.

Table of Contents

MISCELLANEOUS SPECIFICATIONS

Specifications

Repair Specifications

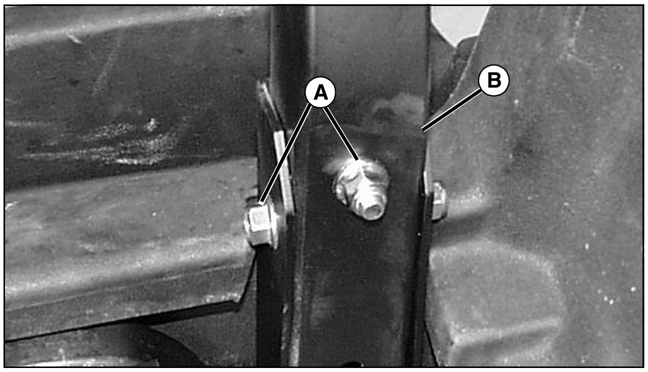
Operator Protective Device (OPD) Cap Screw Torque	**50 N•m (37 lb-ft)**
Front Wheel Bolt Torque	**88 N•m (65 lb-ft)**
Rear Wheel (Third Wheel Assist) Bolt Torque	**88 N•m (65 lb-ft)**
Rear Tire Inflation Pressure	**76 kPa (11 psi)**
Fuel Tank Mounting Cap Screws	**20 N•m (177 lb-in.)**

Repair

Remove and Install Operator Protective Device (OPD)

Removal

1. Lift seat and secure in upright position.



MX00223

2. Remove cap screws and nuts (A) (two on each side of machine).
3. Remove OPD frame (B) from machine.

Installation

Installation is done in the reverse order of removal.

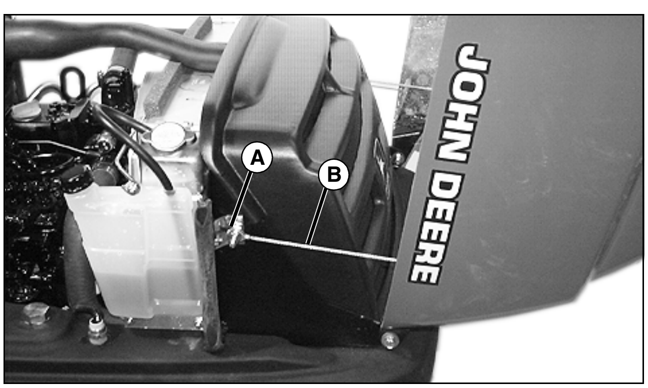
- Tighten cap screws and nuts to specification.

Specifications

Operator Protective Device (OPD) Cap Screw Torque . . . . 50 N•m (37 lb-ft)

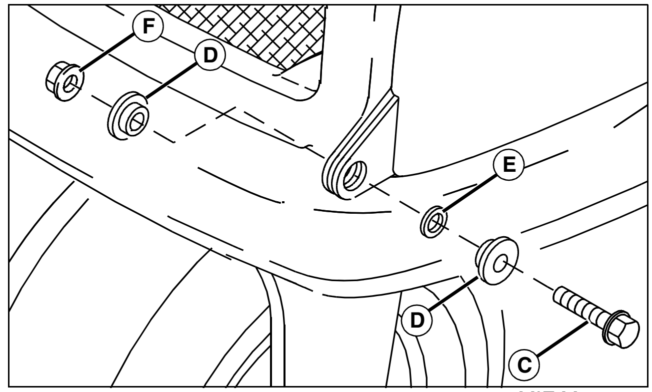
Remove and Install Cowling

IMPORTANT: Avoid damage! Support cowling to prevent it from falling back when cables are removed.



M84569

1. Remove nuts (A) and cables (B) from both sides of machine.



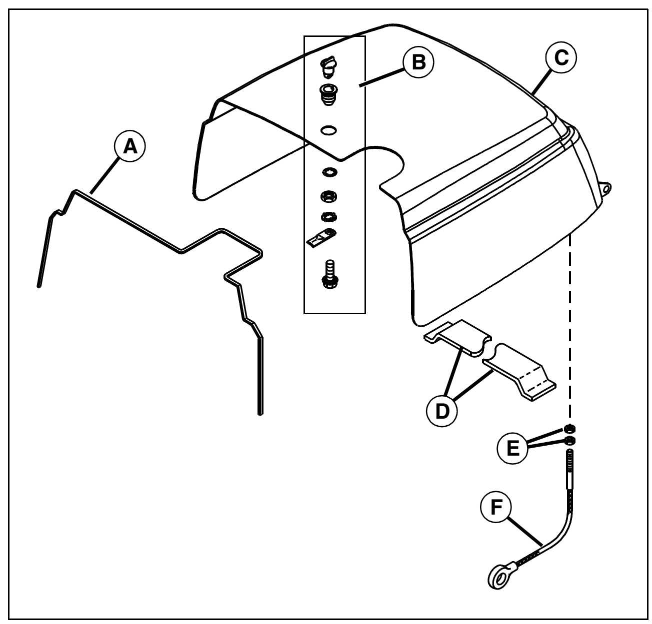
MIF M84606

2. Close cowling and remove cap screws (C), bushings (D), washers (E), and nuts (F).
3. Remove cowling.

Installation

Installation is done in reverse order of removal.

Disassemble and Assemble Cowling



MIF M84612

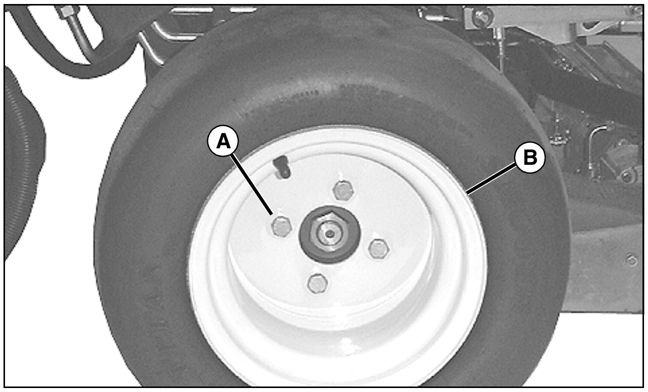
A - Seal
B - Latch Assembly
C - Cowling
D - Insulator Pad
E - Nut (4 used)
F - Cable (2 used)

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

Remove and Install Front Wheels

Removal

1. Lift front of machine until front wheels are off the ground. Place appropriate jackstands under frame of machine.



M84607

2. Remove bolts (A) and wheel (B).

Installation

- Install wheel and bolts. Tighten to specification.

Specifications

Front Wheel Bolt Torque . . . . 88 N•m (65 lb-ft)

Remove and Install Rear Wheel

Removal

1. Lift rear of machine until rear wheel is off the ground. Place appropriate jackstands under frame of machine.

M84608

2. Remove nut (A), axle bolt, and wheel.

Installation

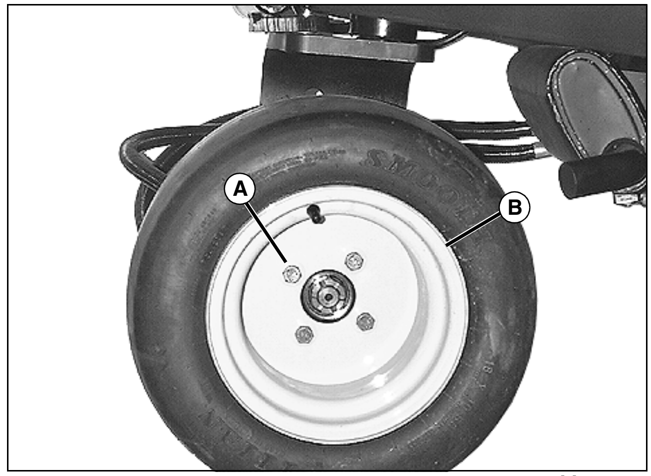
Installation is done in the reverse order of removal.

- Tighten nut until side-to-side free play is just eliminated. DO NOT overtighten.

Remove and Install Rear Wheel (Third Wheel Assist)

Removal

1. Lift rear of machine until rear wheel is off the ground. Place appropriate jackstands under frame of machine.



M98630

2. Remove bolts (A) and wheel (B).

Installation

- Install wheel and bolts. Tighten to specification.

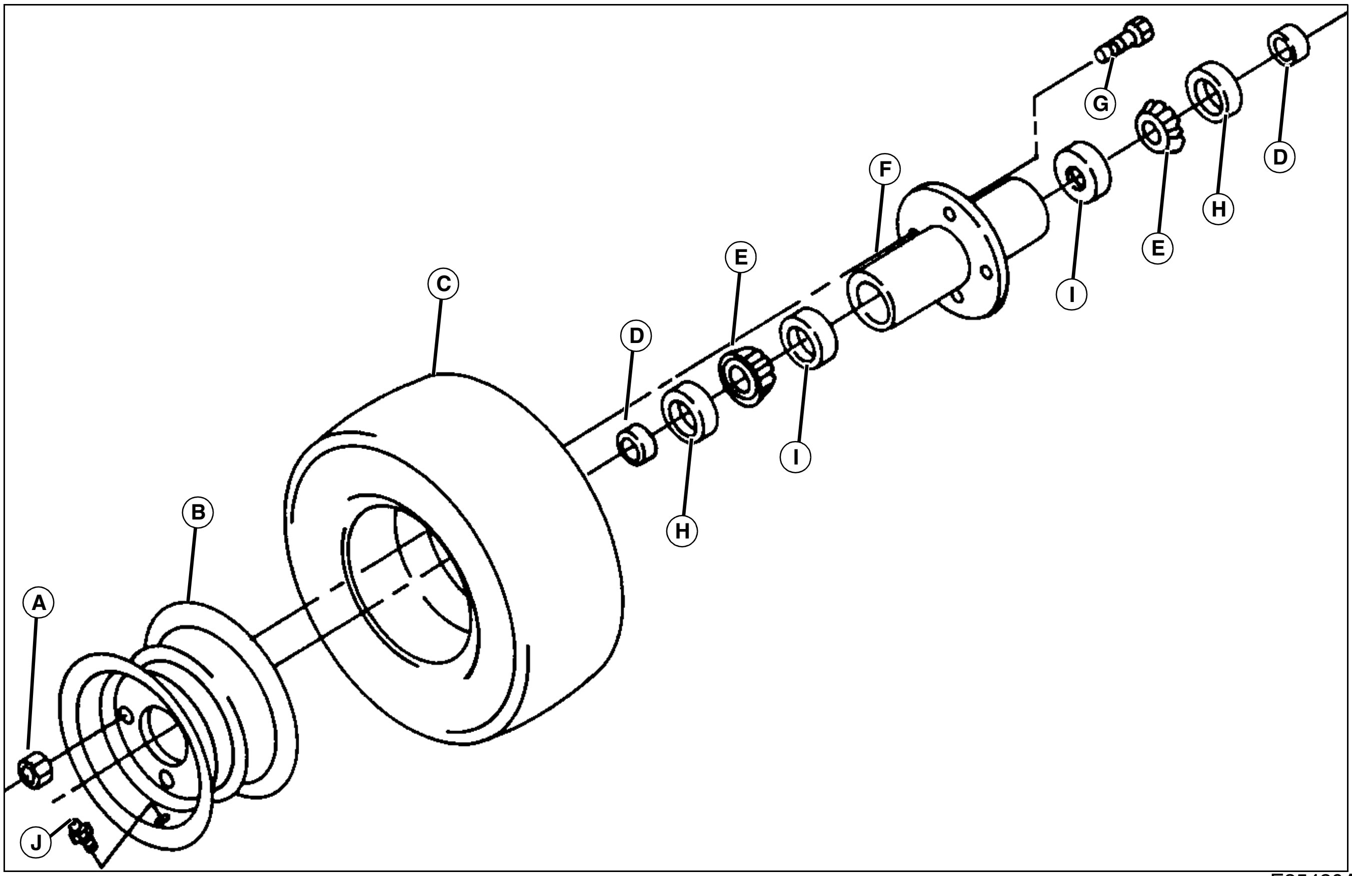
Specifications

Rear Wheel (Third Wheel Assist)
Bolt Torque . . . . 88 N•m (65 lb-ft)

Disassemble and Assemble Rear Wheel

Disassembly

NOTE: The wheel assembly for the Optional Third Wheel Assist does not include the hub, bearings, and seals.



E35420A

A - Nut (4 used)
B - Wheel
C - Tire
D - Bushing (2 used)
E - Bearing (2 used)
F - Hub
G - Cap Screw (4 used)
H - Seal (2 used)
I - Bearing Cup (2 used)
J - Valve Stem

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

Assembly

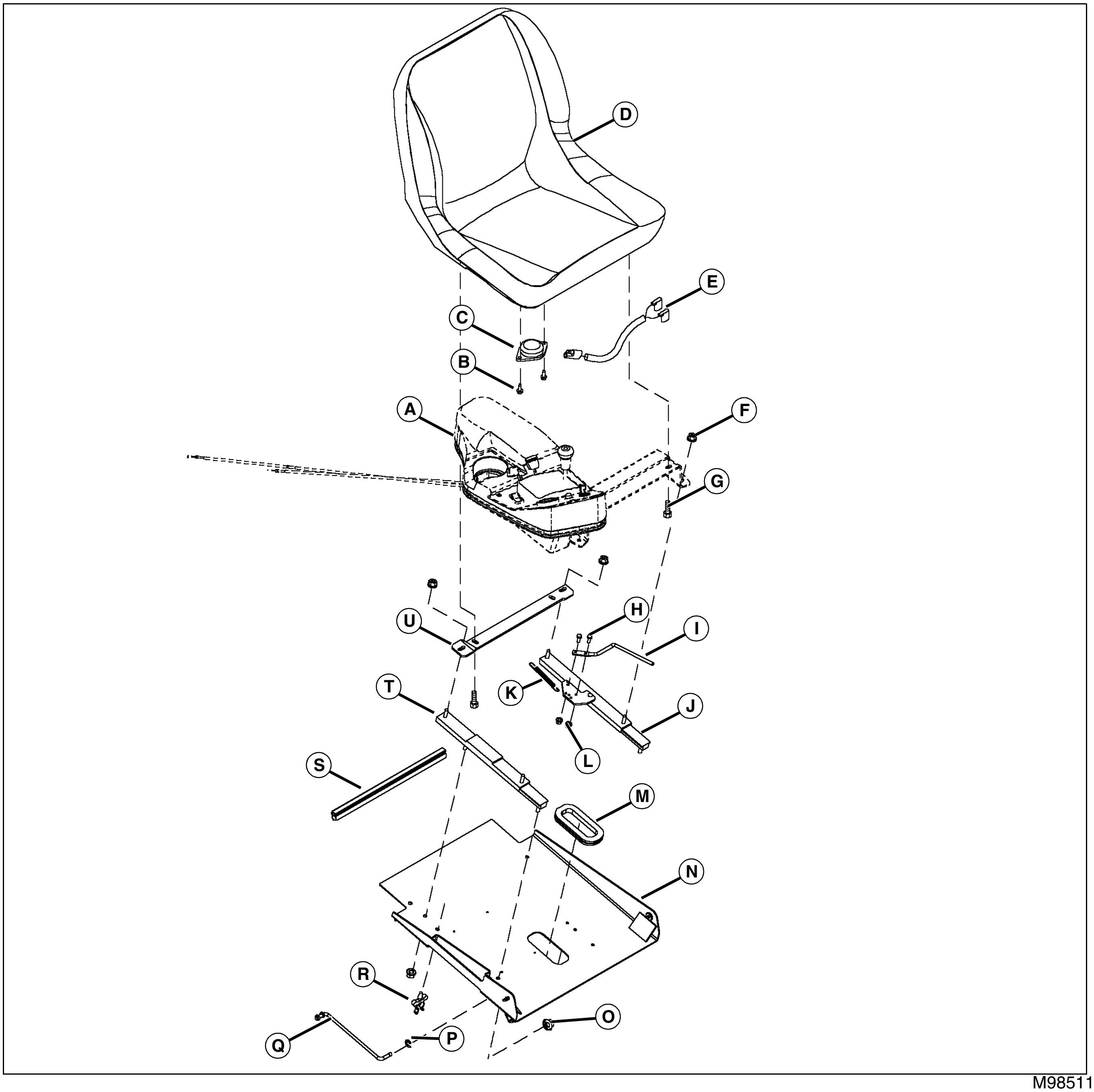
- Pack bearings with multipurpose grease. (See “Grease” on page 21.)
- Inflate tires to specification.

Specifications

Rear Tire Inflation Pressure . . . . 76 kPa (11 psi)

Disassemble and Assemble Seat and Platform

Disassembly



A - Console
B - Screw (2 used)
C - Seat Interlock Switch
D - Seat
E - Wiring Harness
F - Locknut (8 used)
G - Cap Screw (4 used)
H - Cap Screw (2 used)
I - Lever
J - Adjuster Slide
K - Spring
L - Locknut (2 used)
M - Grommet
N - Platform
O - Nut
P - Snap Ring

Q - Support Rod
R - Clip
S - Isolator
T - Slide
U - Strap

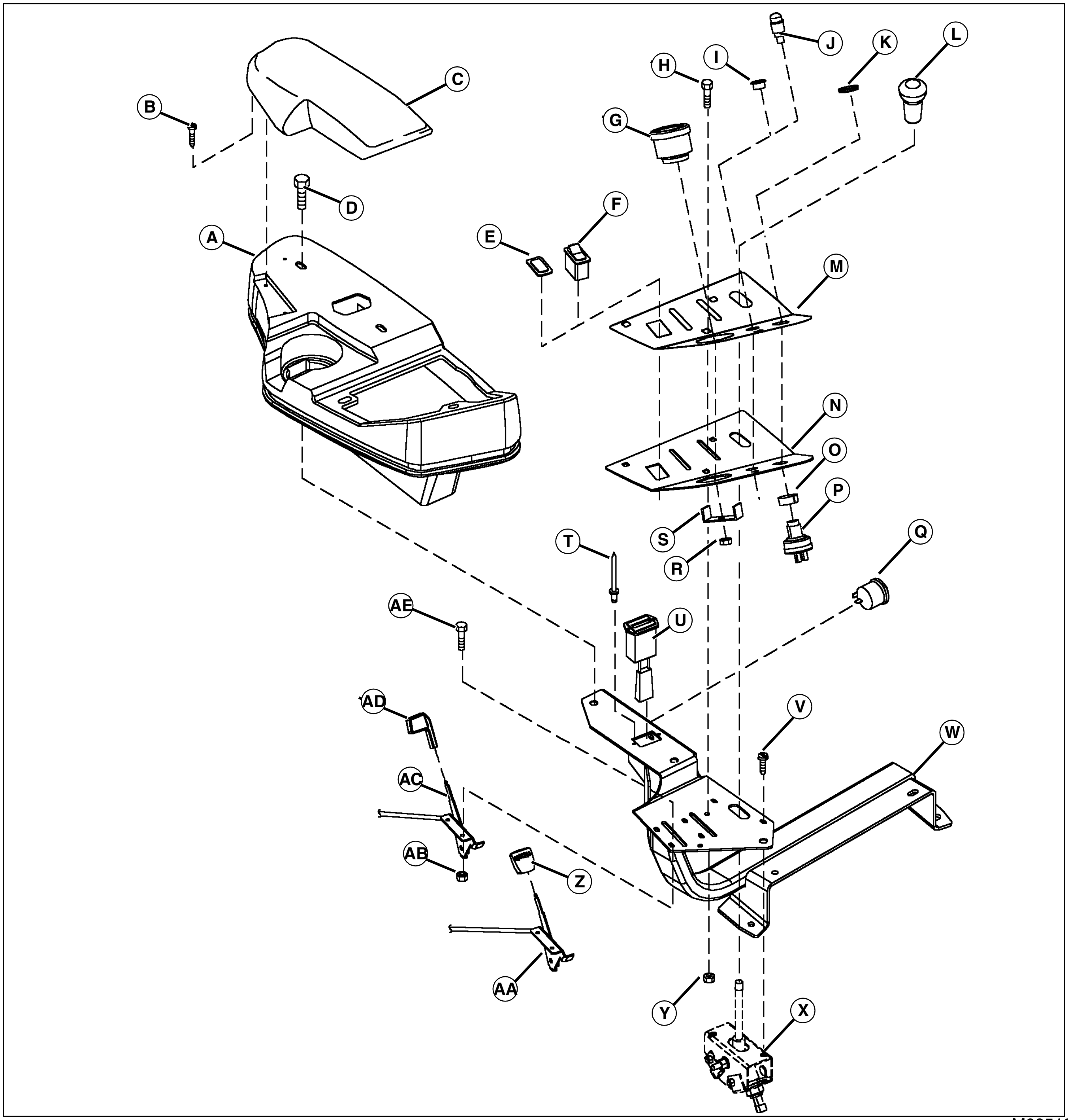
1. Disassemble and inspect all parts for wear or damage.
2. Replace parts as necessary.

Assembly

- Assemble parts as shown.

Disassemble and Assemble Console

Disassembly



A - Console
B - Screw (2 used)
C - Cushion
D - Cap Screw (2 used)
E - Plug
F - Rocker Switch
G - Instrument Cluster
H - Cap Screw (4 used)
I - Plug
J - Glow Plug Indicator Light (Diesel)
K - Nut
L - Knob
M - Label
N - Plate
O - Spacer
P - Key Switch
Q - Warning Buzzer
R - Nut
S - Bracket
T - Rivet (2 used)
U - Hour Meter
V - Screw (2 used)
W - Bracket
X - Lift/Lower Lever Assembly
Y - Flange Nut (4 used)
Z - Knob
AA- Mow/Transport Control Lever
AB- Flange Nut (4 used)
AC- Throttle Lever
AD- Knob
AE- Cap Screw (4 used)

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

Assembly

- Assemble parts as shown.

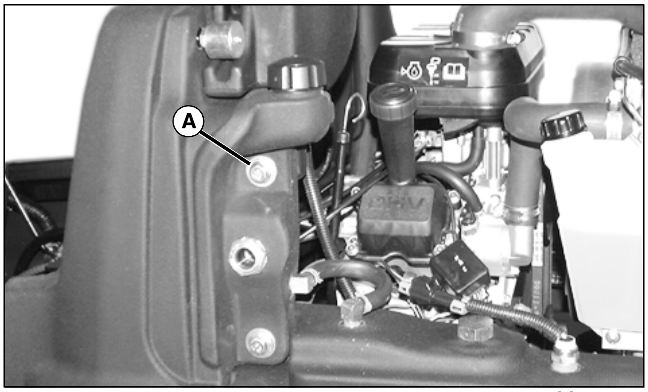
Remove and Install Fuel Tank - Gasoline

Removal

1. Park machine on a level surface and lower cutting units to the ground.

2. Turn key switch to STOP position and engage park brake.

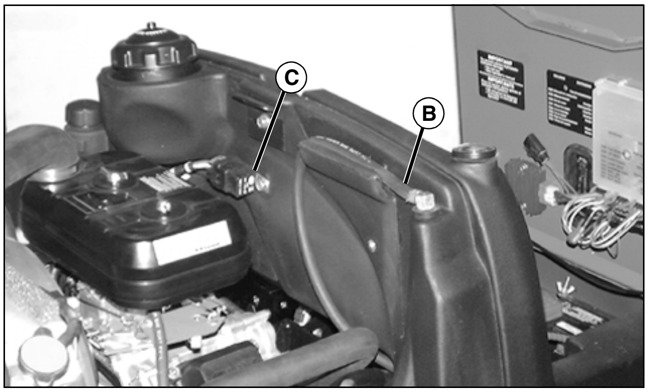
3. Raise cowling and seat platform.



M98472

4. Remove cap screw (A), washer, and nut.

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

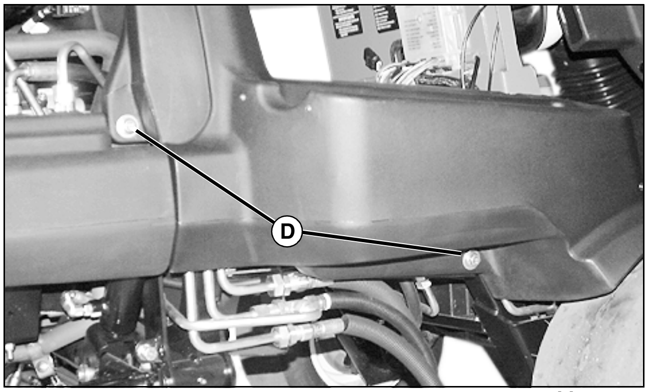


M98473

5. Disconnect fuel line (B) at tank.

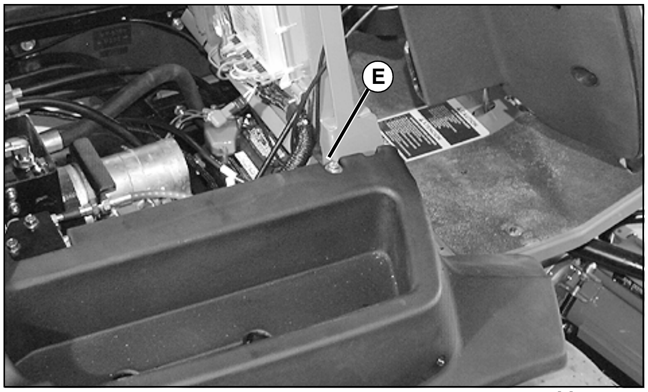
6. Remove relay bracket (C).

7. For 2500A, disconnect wire connector for fuel pump at fuel pickup line.



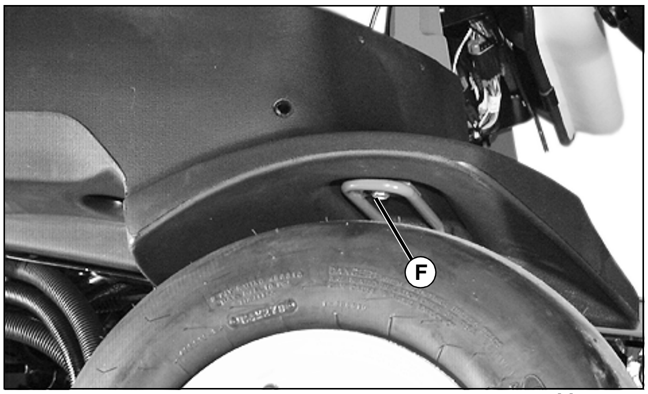
M98474

8. Remove cap screws (D), washers, and nuts.



M84588

9. Remove cap screw (E), washer, and nut.



M84589

10.Remove cap screw (F) and washer.

11.Remove fuel tank.

12.Inspect fuel tank for wear or damage. Repair or replace as necessary. (See “Disassemble and Assemble Fuel Tank” on page 805.)

13.Drain fuel into a properly marked container.

Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! Tighten all tank mounting cap screws until they touch the tank. DO NOT overtighten, as the tank could be damaged.

- Tighten cap screws (D-F) to specification.

Specifications

Fuel Tank Mounting Cap Screws. . . 20 N•m (177 lb-in.)

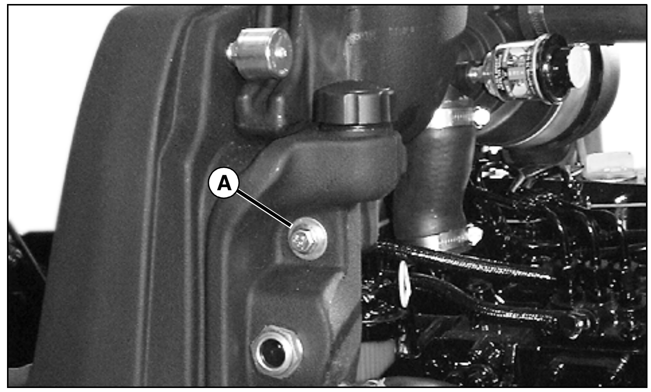
Remove and Install Fuel Tank - Diesel

Removal

1. Park machine on a level surface and lower cutting units to the ground.

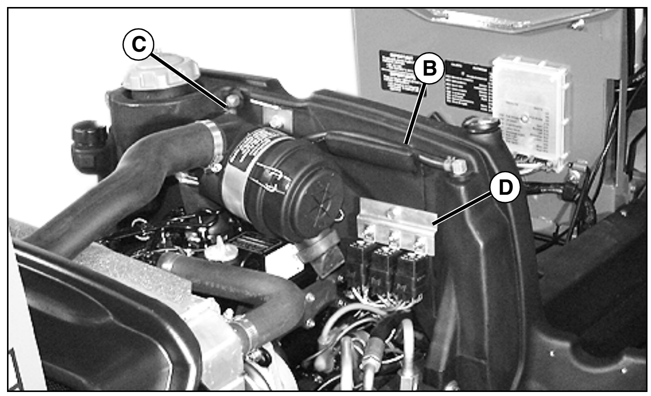
2. Turn key switch to STOP position and engage park brake.

3. Raise cowling and seat platform.



M84585

4. Remove cap screw (A), washer, and nut.

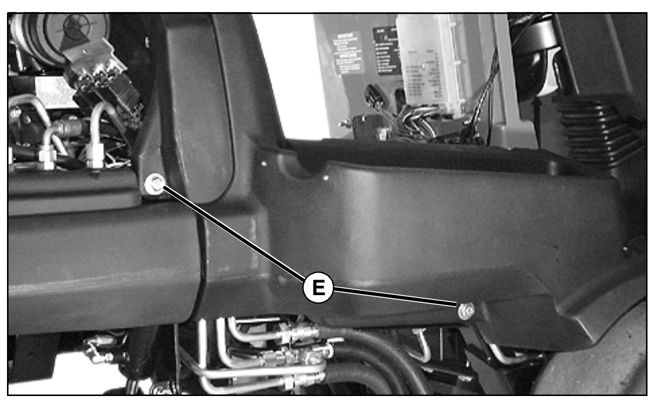


M84586

5. Disconnect fuel line (B) at tank.

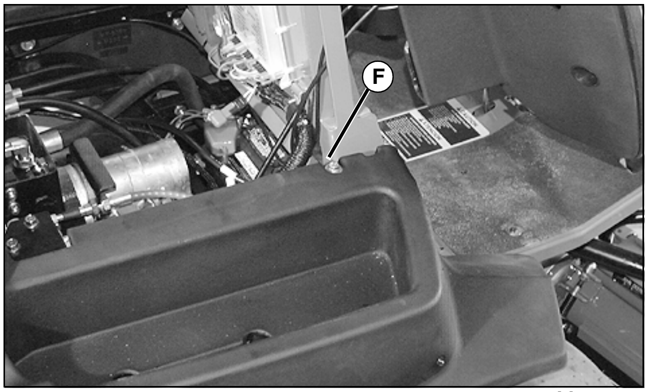
6. Disconnect fuel return line (C).

7. Remove relay bracket (D).



M84587

8. Remove cap screws (E), washers, and nuts.



M84588

9. Remove cap screw (F), washer, and nut.

M84589

10.Remove cap screw (G) and washer.

11.Remove fuel tank.

12.Inspect fuel tank for wear or damage. Repair or replace as necessary. (See “Disassemble and Assemble Fuel Tank” on page 805.)

13.Drain fuel into a properly marked container.

Installation

Installation is done in the reverse order of removal.

IMPORTANT: Avoid damage! Tighten all tank mounting cap screws until they touch the tank. DO NOT overtighten, as the tank could be damaged.

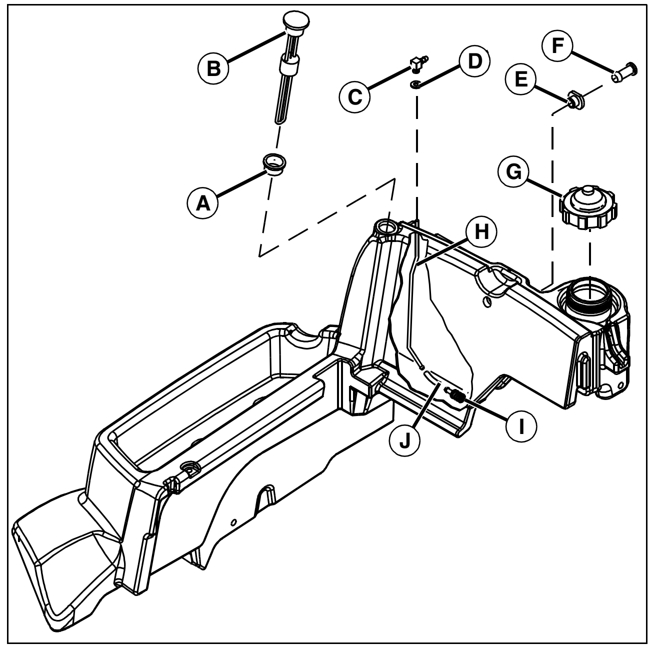
- Tighten cap screws (E-G) to specification.

Specifications

Fuel Tank Mounting Cap Screws. . . 20 N•m (177 lb-in.)

Disassemble and Assemble Fuel Tank

Disassembly



MIF M84584

A - Bushing
B - Fuel Gage
C - Elbow
D - Bushing
E - Bushing
F - Fitting
G - Cap
H - Fuel Pickup Tube
I - Fuel Pickup
J - Hose

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

Assembly

- Assemble parts as shown.

D

E

F

G

H

I

J

K

L