2243 Gas Professional Greensmower

TECHNICAL MANUAL

John Deere
Lawn & Grounds Care Division

TM1473 (01MAY96)

Litho in U.S.A


JOHN DEERE
2243
M73972

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
- Component Location
- System Schematic
- Theory of Operation
- Troubleshooting Chart
- Diagnostics
- Tests & Adjustments
- Repair

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

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

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

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

RECOGNIZE SAFETY INFORMATION

T81389

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.

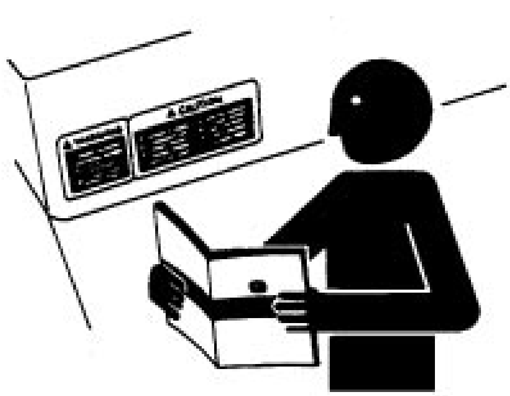
Follow recommended precautions and safe servicing practices.

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

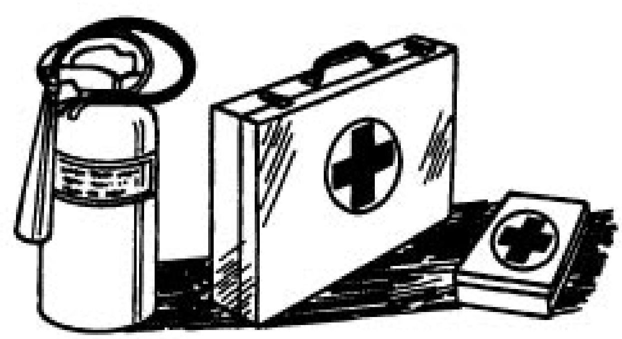


TS201

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**



TS291

TS227

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.

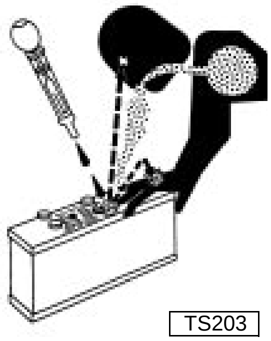
Be prepared if a fire starts.

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

TS204



TS203

- **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.

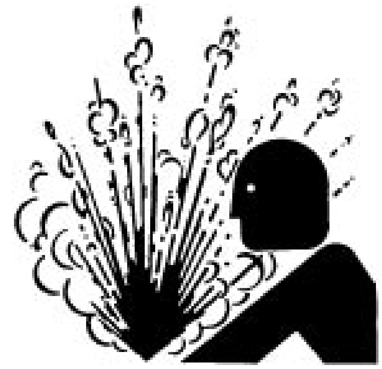
- **If you spill acid on yourself:**

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15-30 minutes.
4. Get medical attention immediately.

- **If acid is swallowed:**

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 1.9 L (2 quarts).
3. Get medical attention immediately.

SERVICE COOLING SYSTEM SAFELY



TS281

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.

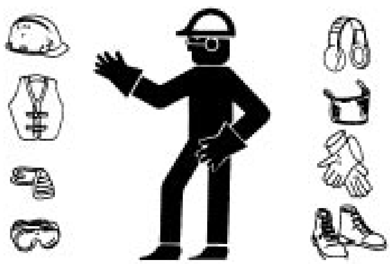
USE SAFE SERVICE PROCEDURES

- **WEAR PROTECTIVE CLOTHING**

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

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

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

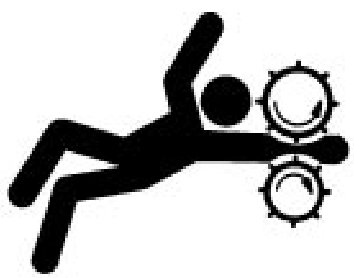


TS206

- **SERVICE MACHINE SAFELY**

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

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

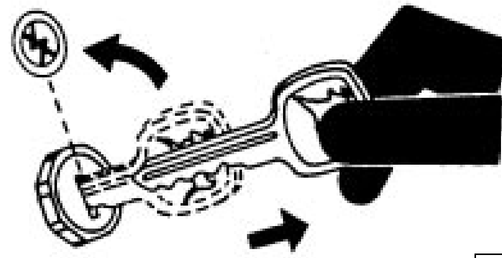


TS228

- **USE PROPER TOOLS**

Use tools appropriate to the work. Makeshift tools 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. Use only service parts meeting John Deere specifications.

- **PARK MACHINE SAFELY**

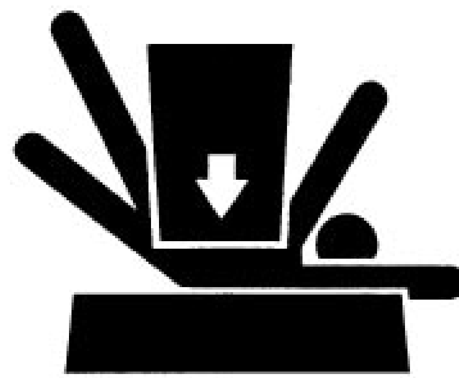


TS230

- **Before working on the machine:**

1. Lower all equipment to the ground.
2. Stop the machine 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**



TS229

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 A CLEAN AREA**

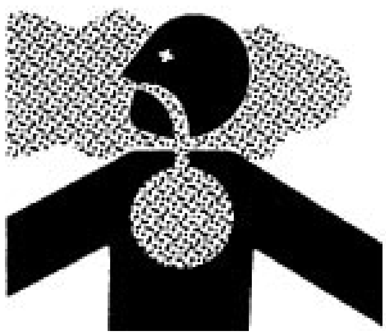
- **Before starting a job:**

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

• ILLUMINATE WORK AREA SAFELY

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

• WORK IN A VENTILATED AREA



TS220

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.

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.

• 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.

• SERVICE TIRES SAFELY

TS952

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

Do not attempt to mount 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 tire 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 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

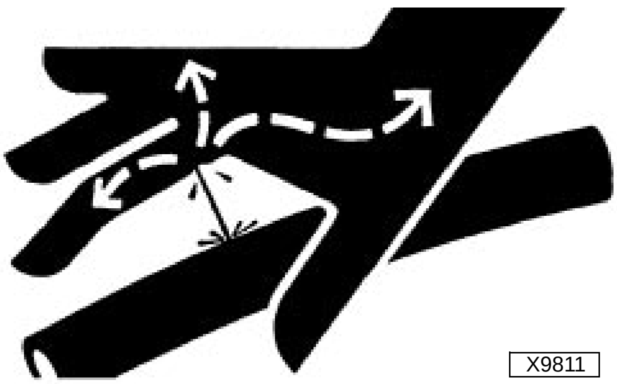
TS283

TS275

Keep hands and feet away while machine is running. Shut off power to service, lubricate or unlatch cutting units.

USE CARE AROUND HIGH-PRESSURE FLUID LINES

- **AVOID HIGH-PRESSURE FLUIDS**



X9811

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.

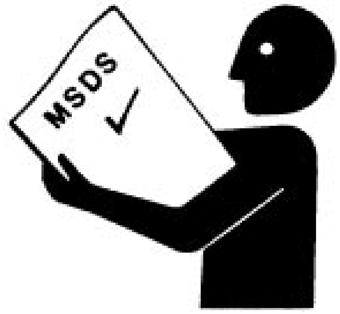
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical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

- **AVOID HEATING NEAR PRESSURIZED FLUID LINES**

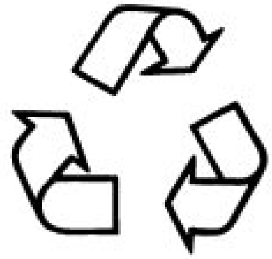
TS953

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.

HANDLE CHEMICAL PRODUCTS SAFELY



TS1132



TS1133

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

TS231

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

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VEHICLE SPECIFICATIONS

ENGINE

Make	John Deere “K” Series, Liquid Cooled
Type	Gasoline
Model	FC590V-AS02
Aspiration	Natural
Horsepower (SAEJ1940)	13.4 kW (18 hp)
Cylinders	2, V-Twin
Displacement	585 cm^3 (35.7 cu in.)
Stroke/Cycle	4 Cycle
Bore	74 mm (2.90 in.)
Stroke	68 mm (2.70 in.)
Compression Ratio	8.7:1
Slow Idle	1550 ±75 rpm
Fast Idle	3400 ±75 rpm
Timing	14° BTDC
Valving	Overhead Valves
Lubrication	Pressurized
Oil Filter	Full Flow Filter
Cooling System	Liquid Cooled
Air Cleaner	Dual Stage Paper Air Filter and Foam Precleaner
Muffler	Horizontal discharge below frame
Engine Oil Capacity	
With Filter	1.9 L (4.0 pt)
Without Filter	1.7 L (3.6 pt)
Weight	81 kg (178.2 lbs)

FUEL SYSTEM

Fuel Tank Location	One on each side of machine
Fuel Tank Capacity (Total)	37.9 L (10 gal)
Fuel (min. octane)	Unleaded Gasoline, 87 Octane
Fuel Pump Location	On front of engine
Fuel Delivery	Float-type Side Draft Carburetor
Fuel Filter	Replaceable In-line

ELECTRICAL

Ignition	Electronic (CDI)
Type of Starter	Solenoid Shift
Charging System	Flywheel Alternator
Battery Type	BCI Group, 22F
Battery Voltage	12V
Battery Reserve Capacity at 25 amp	68 minutes
Battery Cold Cranking amps at 0° F	341 amps
Headlights	Optional
Warning Lights	Engine Oil Pressure, Battery Discharge, Engine Coolant Temperature, Hydraulic/Hydrostatic Oil Temperature
Gauges	Hourmeter
Ignition Interlock Switches	Neutral Start, Operator Presence, Parking Brake, Mow/Transport Lever

POWER TRAIN

Drive Wheels	Front
Traction Drive	Hydrostatic, 2 Pedal Control
Pump Type	Piston Traction Drive
Pump Drive	Belt
Transaxle	Motor Axle, Hydrostatic Pump Driven
Travel Speeds	
Forward	
Mowing Speed	0—6.4 km/h (0—4 mph)
Transport Speed	0—13.7 km/h (0—8.5 mph)
Reverse	0—4.8 km/h (0—3 mph)

STEERING

Type	Power, Hydraulic, Rear Wheel, Tilt Column

BRAKES

Type	Mechanical, Single Pedal, 2 Wheel Disk, 15.2 cm (6 in.) Dia. Disks
Park Brake	Brake Pedal Lock Lever

HYDRAULICS

Pump Type	Gear
Pump Drive	Belt
System	Mow (Reel Drive), Lift and Steering
Mow Control Valve	Electro-Hydraulic, One valve on/off
Lift Control Valve	Electro-Hydraulic, One valve raise/lower
Cutting Unit Lift	Front Cylinder, Rear Cylinder

Hydrostatic/Hydraulic System

Capacity (Total)	22.7 L (6.6 gal)
Hydraulic Reservoir Capacity	16.6 L (4.4 gal)
Filter	10 Micron, Replaceable
Optional Equipment	Oil Cooler, Mow/Backlap Valve

CUTTING UNITS

Number of Cutting Units	3
Cutting Unit Drive	Direct Hydraulic Motor
Reel Diameter	12.7 cm (5 in.)
Number of Blades	9
Front Rollers	Optional—Smooth or Grooved
Clip Frequency	5.6 mm (0.22 in.), 6.4 km/h (4.0 mph)
Bed Knife Adjustment	Reel-to-Bed Knife
Height of Cut	2.4—19 mm (3/32—3/4 in.)
Backlapping	Optional Hydraulic Valve, Variable Speed Adjustment Capability

WEIGHTS AND DIMENSIONS

Empty Weight (less attachments)	467 kg (1030 lb)
Cutting Unit Weight	34 kg (74 lb)
Wheel Base	1.30 m (4 ft 3 in.)
Tread Width	1.02 m (3 ft 4 in.)
Mowing Position Width	1.57 m (5 ft 2 in.)
Turning Radius (uncut circle)	0.46 m (1 ft 6 in.)
Overall Length	2.26 m (7 ft 5 in.)
Overall Width	1.83 m (6 ft)
Overall Height	1.26 m (4 ft 2 in.)

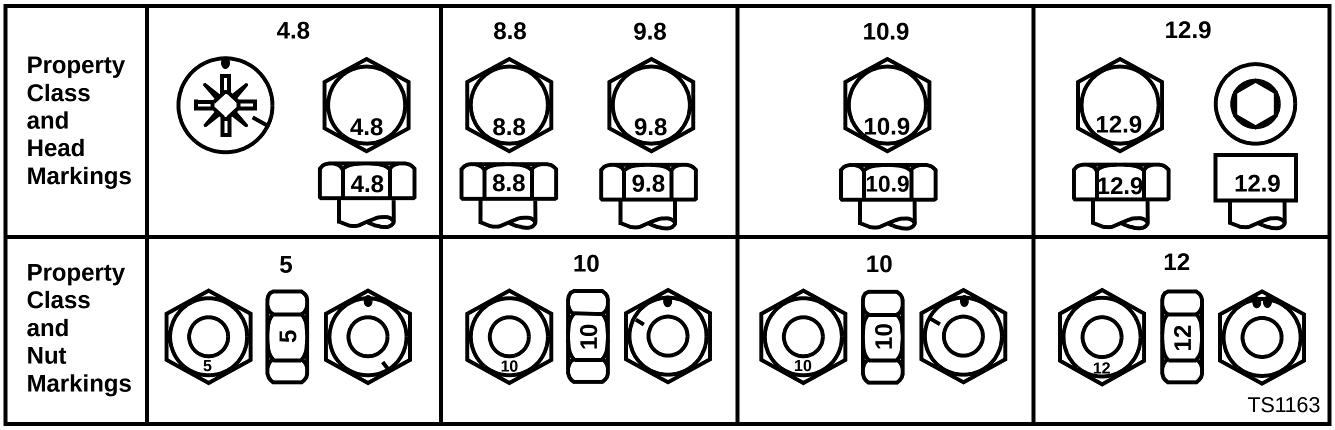
WHEELS AND TIRES

Standard	18 x 9.50-8.00 2 ply, Smooth
Optional	18 x 9.50-8.00 RS 2 ply, Turf

(Specifications and design subject to change without notice.)

REPAIR INFORMATION

METRIC FASTENER TORQUE VALUES



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

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

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

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

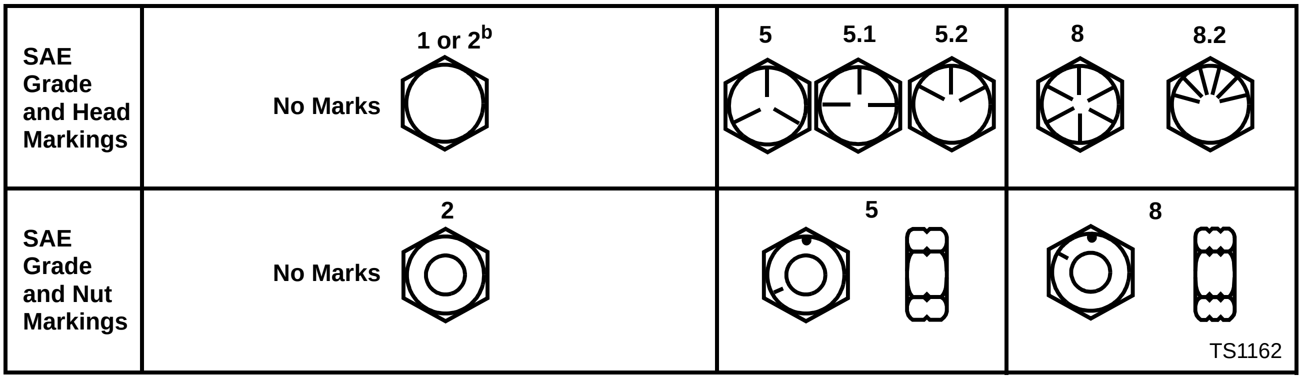
When bolt and nut combination fasteners are used, torque values should be applied to the **NUT** instead of the bolt head.

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

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

Reference: JDS—G200.

INCH FASTENER TORQUE VALUES



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

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

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

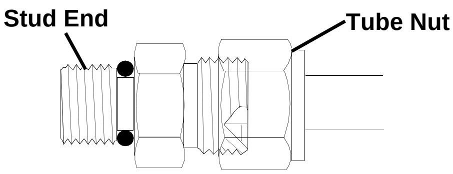
[a] *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.*

[b] *"Grade 2" applies for hex cap screws (not hex bolts) up to 152 mm (6-in.) long. "Grade 1" applies for hex cap screws over 152 mm (6-in.) long, and for all other types of bolts and screws of any length.*

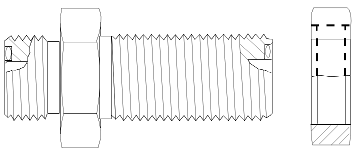
Reference: JDS—G200.

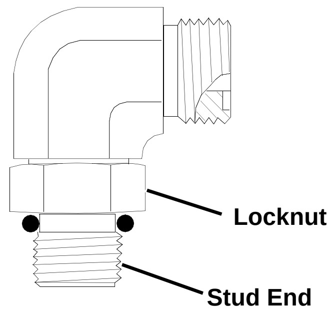
O-RING SEAL SERVICE RECOMMENDATIONS

FACE SEAL FITTINGS WITH INCH STUD ENDS TORQUE

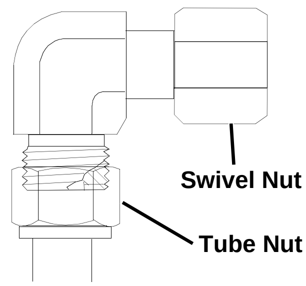


Stud Straight and Tube Nut


Bulkhead Union and Bulkhead Locknut



90 Adjustable Stud Elbow

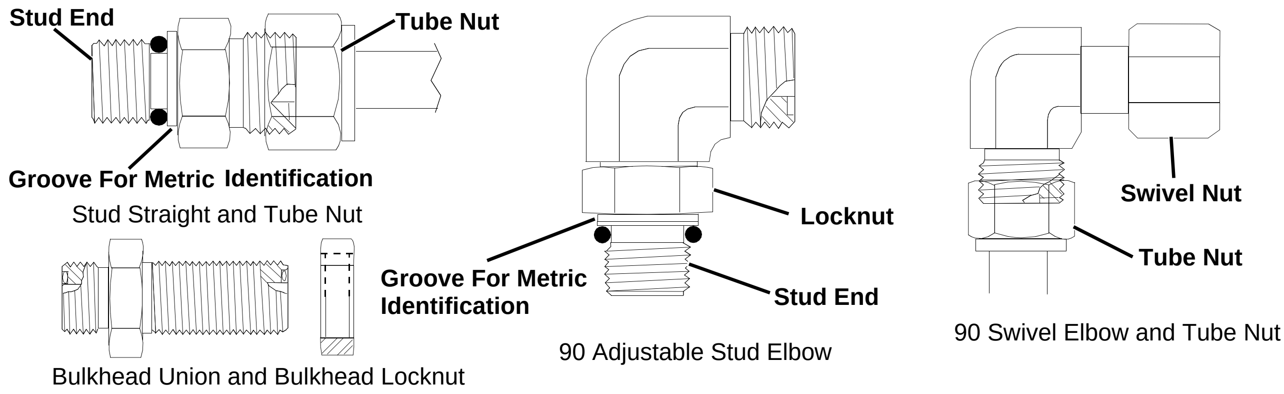


90 Swivel Elbow and Tube Nut

Nominal Tube O.D./Hose I.D.				Face Seal Tube/Hose End					O-ring Stud Ends		
Metric Tube O.D.	Inch Tube O.D.			Thread Size	Tube Nut/ Swivel Nut Torque		Bulkhead Locknut Torque		Thread Size	Straight Fitting or Locknut 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	1-5/16-12	142	105
32	-20	1.25	31.75	1-11/16-12	190	140	190	140	1-5/8-12	190	140
38	-24	1.50	38.10	2-12	217	160	217	160	1-7/8-12	217	160

NOTE: Torque tolerance is + 15 minus 20%.

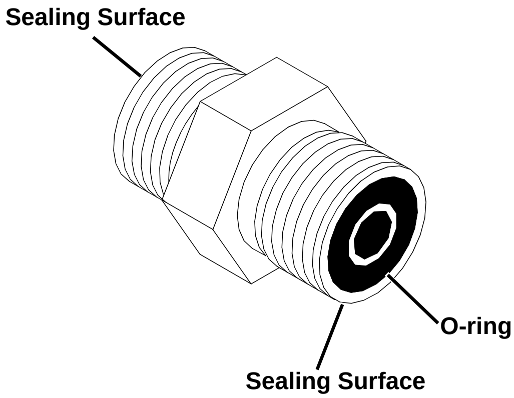
FACE SEAL FITTINGS WITH METRIC STUD ENDS TORQUE



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

NOTE: Torque tolerance is + 15 minus 20%.

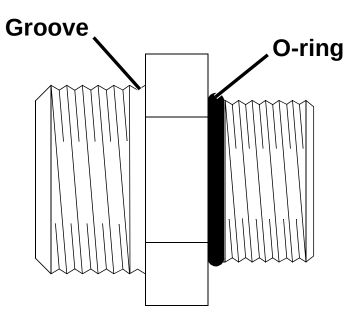
O-RING FACE SEAL FITTINGS



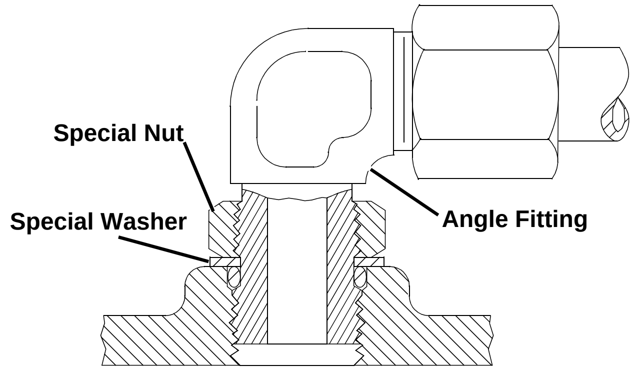
1. Inspect the fitting sealing surfaces. They must be free of dirt or defects.
2. Inspect the O-ring. It must be free of damage or defects.
3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
4. Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
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 boss O-ring boss seat. It must be free of dirt and defects. If repeated leaks occur, inspect for defects with a magnifying glass. Some raised defects can be removed with a slip stone.



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



3. For angle fittings, loosen special nut and push special washer 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 counter-clockwise a maximum of one turn.
6. Tighten straight fittings to torque value shown on chart. For angle fittings, tighten the special nut to value shown in the chart while holding body of fitting with a wrench.

STRAIGHT FITTING OR SPECIAL NUT TORQUE

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

a. Torque tolerance is ± 10 percent.
b. To be used if a torque wrench cannot be used. After tightening fitting by hand, put a mark on nut or boss; then tighten special nut or straight fitting the number of flats shown.

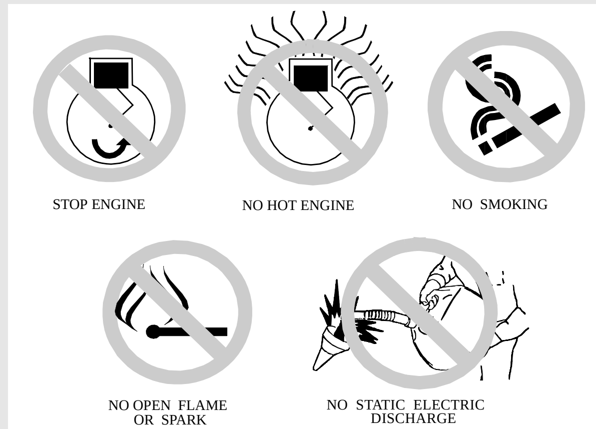
METRIC FASTENER TORQUE VALUE—GRADE 7

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

GASOLINE
4-CYCLE ENGINES—NORTH AMERICA

⚠ CAUTION

Gasoline is HIGHLY FLAMMABLE, handle it with care.



DO NOT refuel machine while:

- **indoors, always fill gas tank outdoors;**
- **machine is near an open flame or sparks;**
- **engine is running, STOP engine;**
- **engine is hot, allow it to cool sufficiently first;**
- **smoking.**

Help prevent fires:

- **fill gas tank to bottom of filler neck only;**
- **be sure fill cap is tight after fueling;**
- **clean up any gas spills IMMEDIATELY;**
- **keep machine clean and in good repair–free of excess grease, oil, debris, and faulty or damaged parts;**
- **any storage of machines with gas left in tank should be in an area that is well ventilated to prevent possible igniting of fumes by an open flame or spark, this includes any appliance with a pilot light.**

To prevent fire or explosion caused by STATIC ELECTRIC DISCHARGE during fueling:

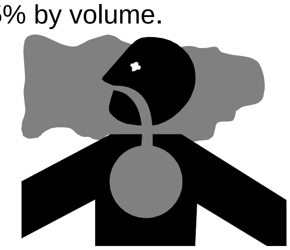
- **ONLY use a clean, approved POLYETHYLENE PLASTIC fuel container and funnel WITHOUT any metal screen or filter.**

To avoid engine damage:

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

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

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



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

⚠ WARNING

<u>California Proposition 65 Warning:</u> Gasoline engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

GASOLINE STORAGE

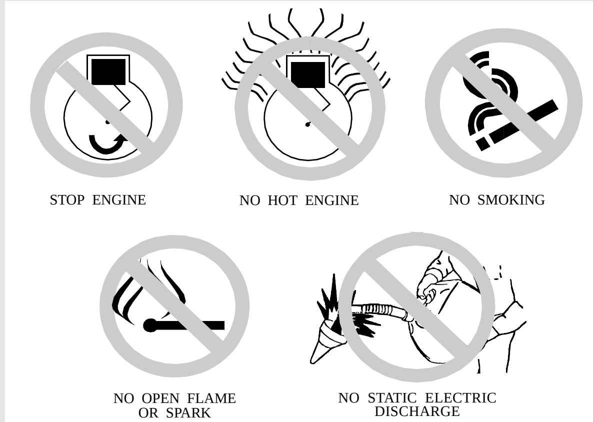
IMPORTANT: Keep all dirt, scale, water or other foreign material out of gasoline.

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

4-CYCLE ENGINES—EUROPE

CAUTION

Gasoline is HIGHLY FLAMMABLE, handle it with care.



DO NOT refuel machine while:

- **indoors, always fill gas tank outdoors;**
- **machine is near an open flame or sparks;**
- **engine is running, STOP engine;**
- **engine is hot, allow it to cool sufficiently first;**
- **smoking.**

Help prevent fires:

- **fill gas tank to bottom of filler neck only;**
- **be sure fill cap is tight after fueling;**
- **clean up any gas spills IMMEDIATELY;**
- **keep machine clean and in good repair–free of excess grease, oil, debris, and faulty or damaged parts;**
- **any storage of machines with gas left in tank should be in an area that is well ventilated to prevent possible igniting of fumes by an open flame or spark, this includes any appliance with a pilot light.**

To prevent fire or explosion caused by STATIC ELECTRIC DISCHARGE during fueling:

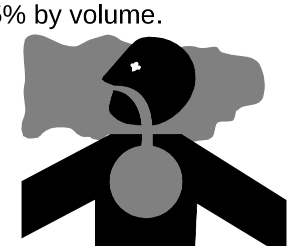
- **ONLY use a clean, approved POLYETHYLENE PLASTIC fuel container and funnel WITHOUT any metal screen or filter.**

To avoid engine damage:

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

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

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



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

GASOLINE STORAGE

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

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

OILS AND LUBRICANTS

BREAK-IN 4-CYCLE GASOLINE ENGINE OIL—NORTH AMERICA

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

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

- **BREAK–IN ENGINE OIL**.

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

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

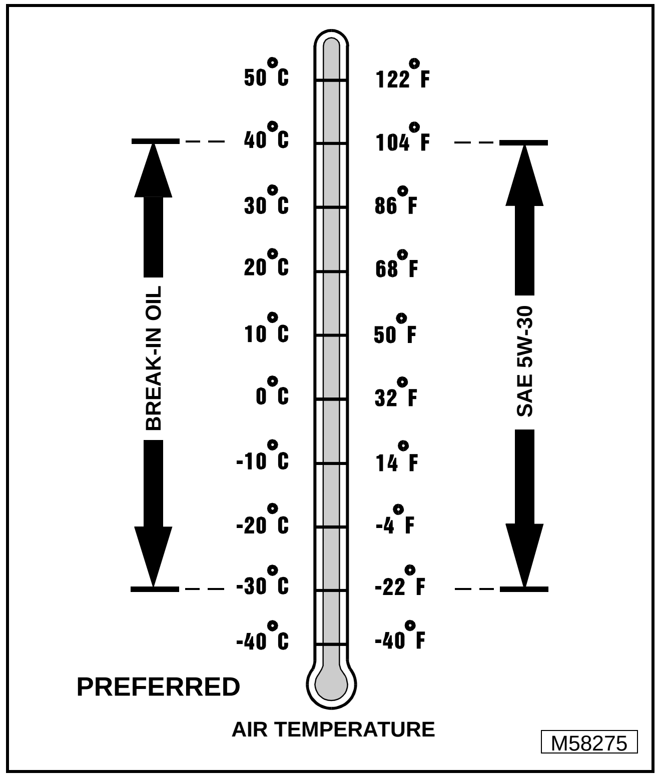
The following John Deere oil is **also recommended** as a break-in engine oil:

- **TORQ–GARD SUPREME®—SAE 5W-30.**

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

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

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



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

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

BREAK-IN 4-CYCLE GASOLINE ENGINE OIL—EUROPE

IMPORTANT: ONLY use a quality break-in oil in rebuilt or remanufactured engines for the first 5 hours (maximum) of operation. DO NOT use oils with heavier viscosity weights than SAE 5W-30 or oils meeting CCMC Specification G5—these oils will not allow rebuilt or remanufactured engines to break-in properly.

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

- **BREAK–IN ENGINE OIL**.

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

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

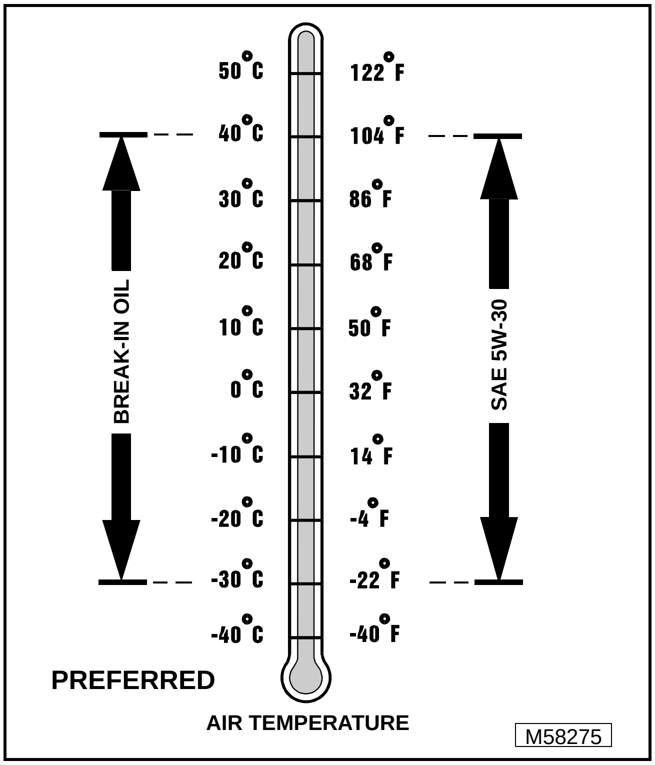
The following John Deere oil is **also recommended** as a break-in engine oil:

- **TORQ–GARD SUPREME®—SAE 5W-30.**

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

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

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



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

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

4-CYCLE GASOLINE ENGINE OIL—NORTH AMERICA

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

The following John Deere oils are **PREFERRED**:

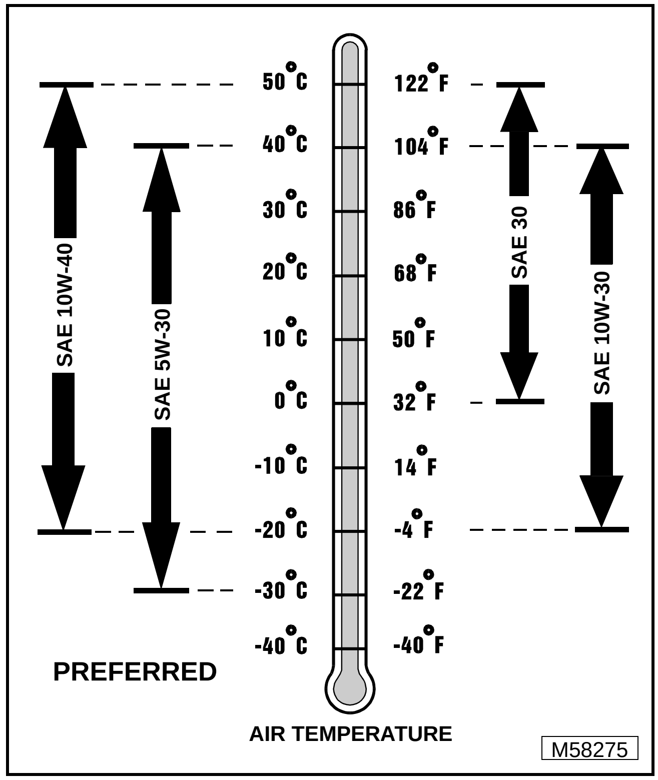
- **PLUS–4®—SAE 10W-40**;
- **TORQ–GARD SUPREME®—SAE 5W-30**.

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

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

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

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



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

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

4-CYCLE GASOLINE ENGINE OIL—EUROPE

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

The following John Deere oils are **PREFERRED**:

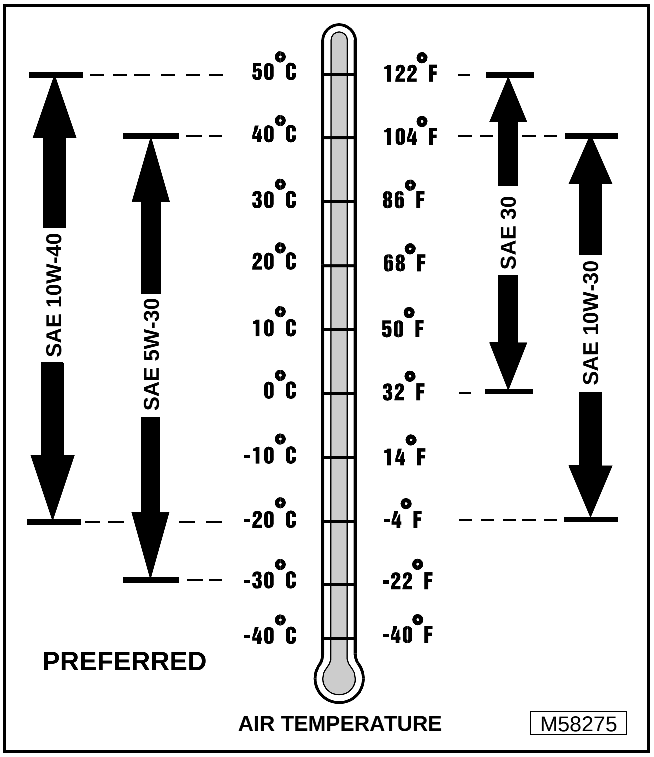
- **TORQ–GARD SUPREME®—SAE 10W-40;**
- **UNI–GARD™—SAE 10W-40;**
- **TORQ–GARD SUPREME®—SAE 5W-30;**
- **UNI–GARD™—SAE 5W-30.**

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

- **TORQ–GARD SUPREME®—SAE 10W-30;**
- **UNI–GARD™—SAE 10W-30;**
- **TORQ–GARD SUPREME®—SAE 30;**
- **UNI–GARD™—SAE 30.**

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

- CCMC Specification G4 or higher.



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

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

HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA

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 or hydraulic system failures.

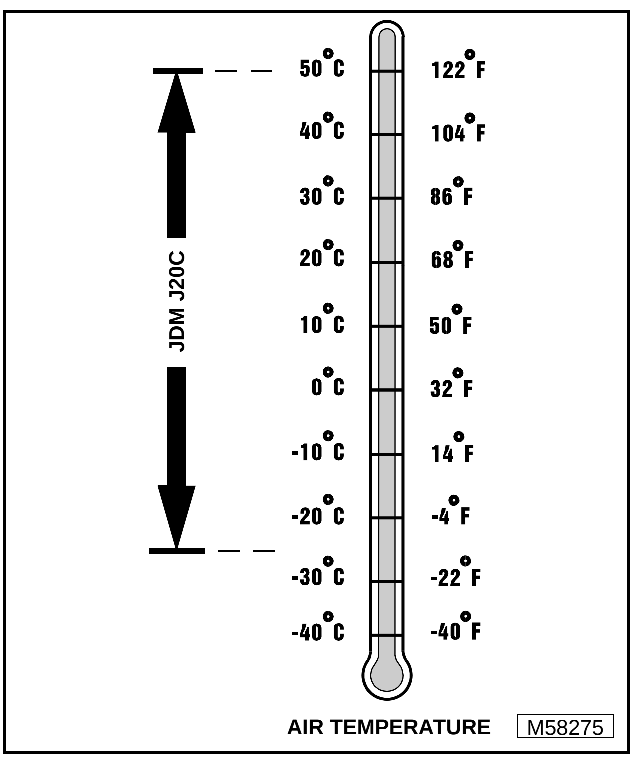
IMPORTANT: DO NOT use engine oil or “Type F” (Red) Automatic Transmission Fluid in this transmission. DO NOT mix any other oils in this transmission. DO NOT use BIO–HY–GARD® in this transmission.

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

- **HY–GARD®—JDM J20C**.

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

- John Deere Standard JDM J20C.



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

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

HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE

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

- **HY–GARD®—JDM J20C**.

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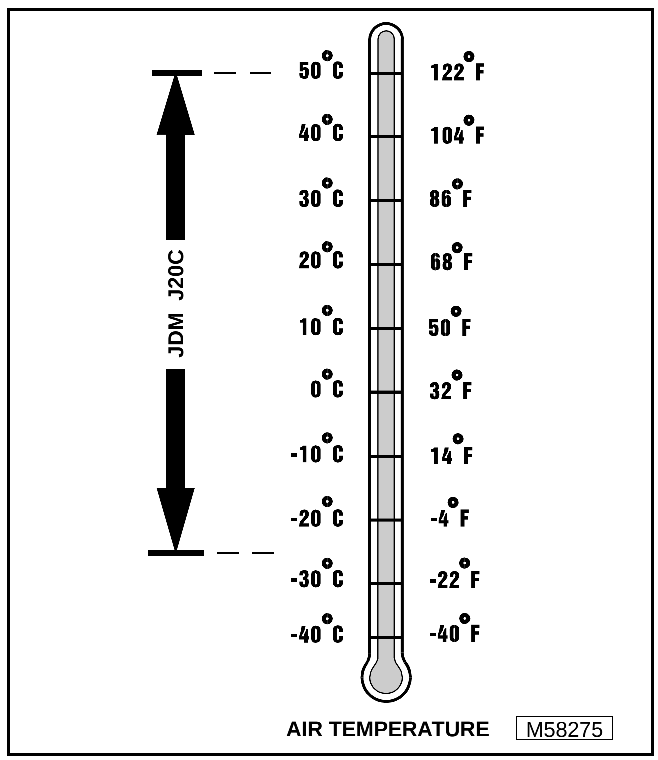

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- Module DX,ANTI in JDS–G135;
- Section 530, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide.

ANTI-CORROSION GREASE

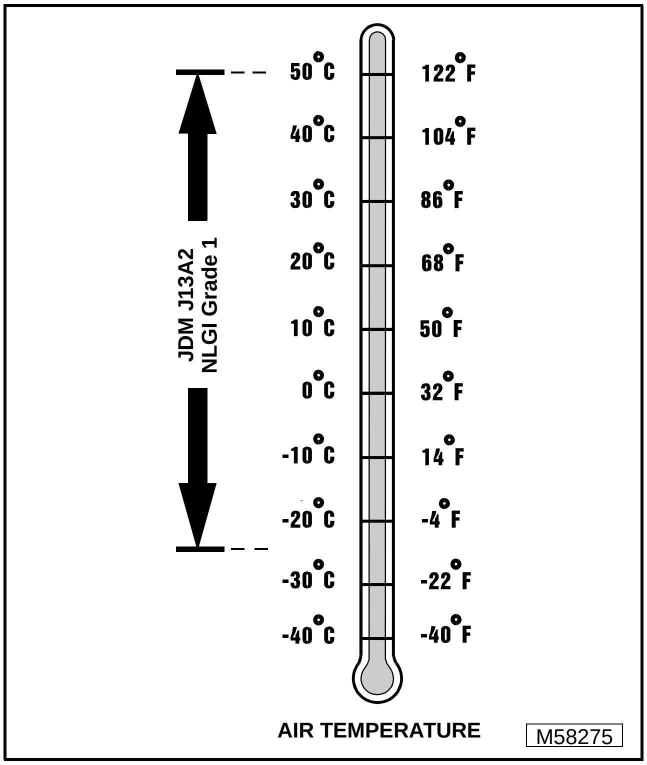
This anti-corrosion grease is formulated to provide the best protection against absorbing moisture, which is one of the major causes of corrosion. This grease is also superior in its resistance to separation and migration.

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

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

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

- John Deere Standard JDM J13A2, NLGI Grade 1.



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

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

GREASE—NORTH AMERICA

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

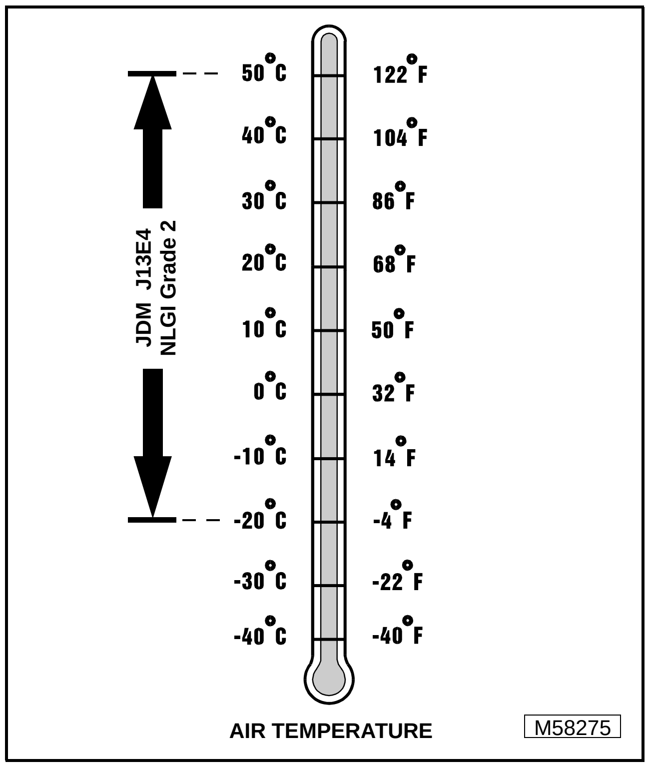
IMPORTANT: ONLY use a quality grease in this application. DO NOT mix any other greases in this application. DO NOT use any BIO–GREASE in this application.

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

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

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

- John Deere Standard JDM J13E4, NLGI Grade 2.



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

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

GREASE—EUROPE

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

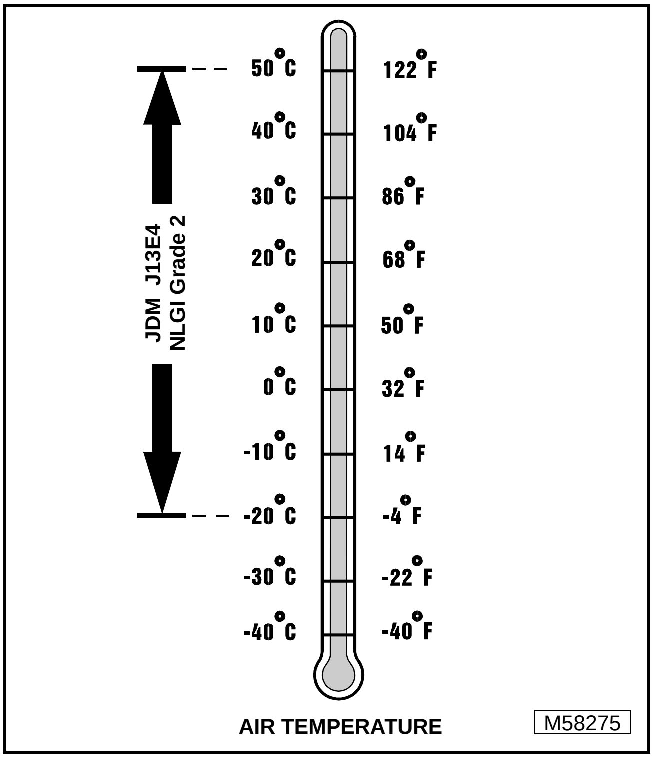
IMPORTANT: ONLY use a quality grease in this application. DO NOT mix any other greases in this application. DO NOT use any BIO–GREASE in this application.

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

- **GREASE–GARD™—JDM J13E4, NLGI Grade 2.**

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

- John Deere Standard JDM J13E4, NLGI Grade 2.



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

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

REEL SUPPORT GREASE—NORTH AMERICA

Use the following reel support greases based on the air temperature range. Operating outside of the recommended grease air temperature range may cause premature reel support failure.

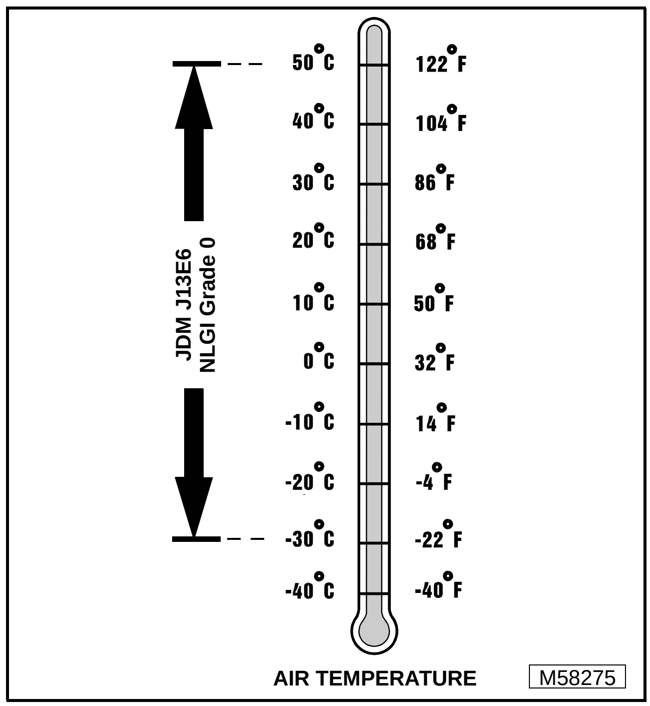
The following John Deere grease is **PREFERRED**:

- **CORN HEAD GREASE—JDM J13E6, NLGI Grade 0 (Polyurea Grease).**

Other greases may be used if above John Deere greases are not available, provided they **meet the following compatibility specifications only**:

- <u>Polyurea</u> Grease—NLGI Grade 0;
- <u>Calcium Complex</u> Grease—NLGI Grade 0.

IMPORTANT: DO NOT mix any other greases (including calcium, lithium, lithium complex, and lithium 12-hydroxy based greases) with above recommended greases, they are NOT COMPATIBLE. For best results, completely remove all non-compatible grease from housing and fill with above preferred grease or one of the other greases, which are compatible with each other. DO NOT use any BIO–GREASE.



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

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

REEL SUPPORT GREASE—EUROPE

Use the following reel support greases based on the air temperature range. Operating outside of the recommended grease air temperature range may cause premature reel support failure.

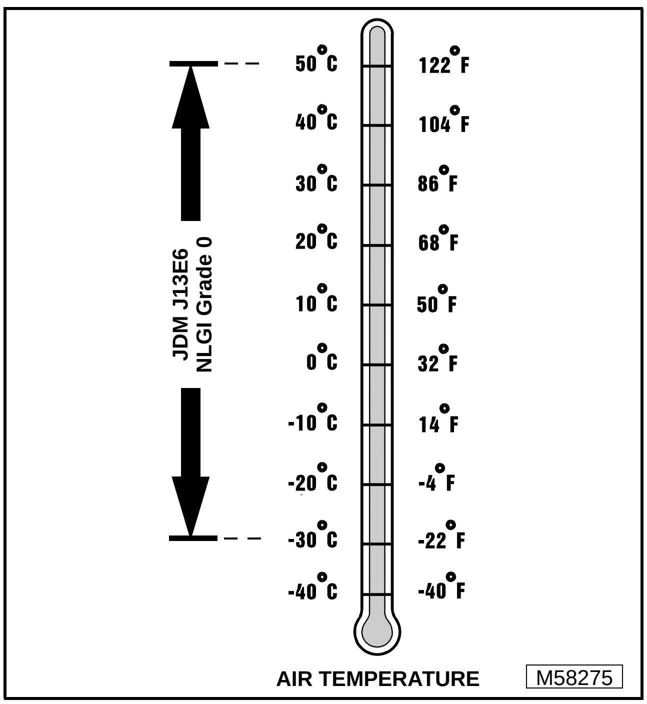
The following John Deere grease is **PREFERRED**:

- **GREASE–GARD®—JDM J13E6, NLGI Grade 0.**

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

- Polyurea Grease—NLGI Grade 0;
- Calcium Complex Grease—NLGI Grade 0.

IMPORTANT: DO NOT mix any other greases (including calcium, lithium, lithium complex, and lithium 12-hydroxy based greases) with above recommended greases, they are NOT COMPATIBLE. For best results, completely remove all non-compatible grease from housing and fill with above preferred grease or one of the other greases, which are compatible with each other. DO NOT use any BIO–GREASE.



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

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

ALTERNATIVE LUBRICANTS

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

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

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

SYNTHETIC LUBRICANTS

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

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

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

LUBRICANT STORAGE

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

MIXING OF LUBRICANTS

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

OIL FILTERS

IMPORTANT: 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.

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

- Module DX,FILT in JDS–G135;
- Section 540, Lubricants & Hydraulics, of the John Deere Merchandise Sales Guide;
- Lawn & Grounds Care Tune-Up Guide PI672.

COOLANT

DIESEL AND GASOLINE ENGINE COOLANT—NORTH AMERICA

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:**

- **PRE-DILUTED DIESEL ENGINE ANTI-FREEZE/ 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**:

- **DIESEL ENGINE ANTI-FREEZE/SUMMER COOLANT CONCENTRATE™ (TY16034).**

If either of above recommended engine coolants are available use any Automobile and Light Duty Engine Service **ethylene glycol base coolant**, meeting the following specification:

- ASTM D3306 (JDM H24C1).

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

IMPORTANT: 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–Table 1) 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.

Water Quality

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

DIESEL AND GASOLINE ENGINE COOLANT DRAIN INTERVAL—NORTH AMERICA

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.

GASOLINE ENGINE COOLANT—EUROPE

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).

ONLY use a quality Automobile and Light Duty Engine Service **ethylene glycol base coolant**, meeting the following specification:

- ASTM D3306 (JDM H24C1).

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

IMPORTANT: 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–Table 1) is generally acceptable. DO NOT use salt water. Deionized or distilled water is best to use. Coolant that is not mixed to these specified levels and water purity can cause excessive scale, sludge deposits, and increased corrosion potential.

Water Quality

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

Mix 50 percent anti-freeze concentrate with 50 percent distilled or deionized water. This mixture 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.

GASOLINE ENGINE COOLANT DRAIN INTERVAL—EUROPE

If a quality Automobile and Light Duty Engine Service **ethylene glycol base coolant** is being used, drain and flush the cooling system and refill with fresh coolant mixture every **24 months or 2,000 hours** of operation, whichever comes first.

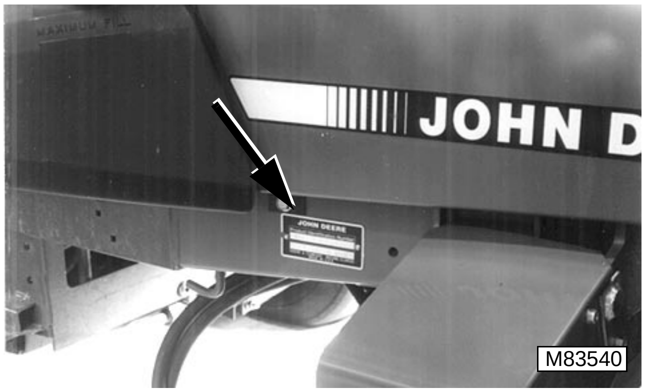
If a quality Automobile and Light Duty Engine Service coolant **is not** being used; drain, flush, and refill the cooling system according to instructions found on product container or in equipment operator’s manual or technical manual.

SERIAL NUMBER LOCATION

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

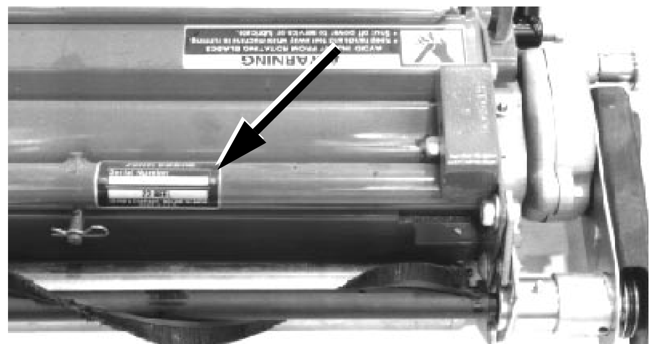
The location of the machine identification number and component serial numbers are shown.

MACHINE IDENTIFICATION NUMBER



M83540

CUTTING UNIT SERIAL NUMBER



M82707

ENGINE SERIAL NUMBER

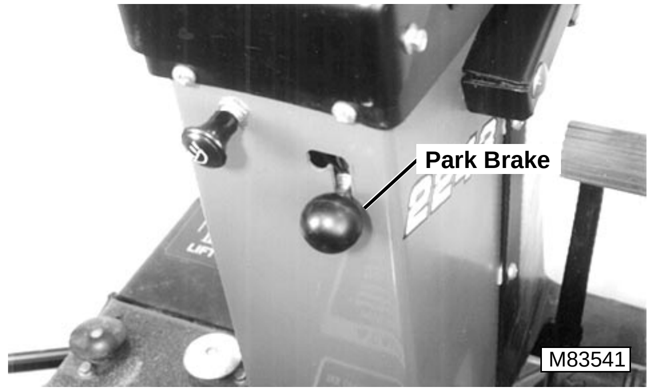
M53952

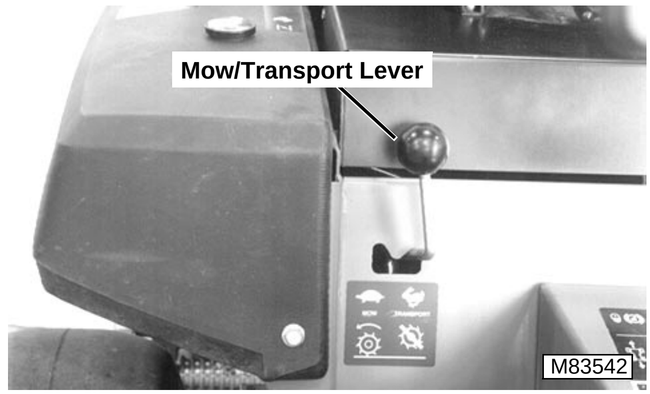
INTERLOCK SYSTEM

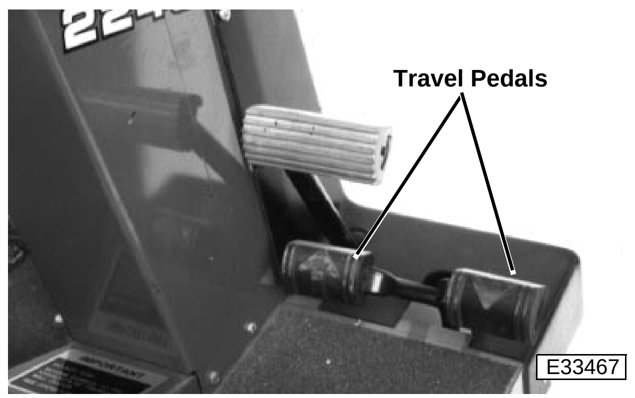
It is important to understand the interlock system and how it works. Before performing the checkout procedures, become familiar with the interlock system so that an interlock function will not be taken as a machine problem.

1. For the starter to engage and the engine to run, the following conditions must be met simultaneously:
   - Operator on seat and/or parking brake engaged.
   - Mow/Transport lever in TRANSPORT position.
   - Travel pedals in NEUTRAL position.
2. If the operator is mowing (mow/transport lever in MOW position and/or ground drive engaged) and the driver leaves the seat, engine will stop.
3. If the operator has stopped mowing (mow/transport lever in TRANSPORT position) and leaves the seat with ground drive in neutral, but without the parking brake engaged, the engine will stop.
4. Provision has been made to allow service of the reels to be performed by one person (with optional mow/backlap valve assembly). Complete the following steps:
   - Place mow/backlap switch in BACKLAP position.
   - Move travel pedals to NEUTRAL position.
   - Engage park brake.
   - Move mow/transport lever to TRANSPORT position.

The machine can then be started from either the ground or seat. The seat can then be raised and the knob on the mow/backlap valve assembly can then be turned to operate the reel motors in the reverse direction for backlapping.







OPERATIONAL CHECKOUT PROCEDURES

The procedures covered in this group are used to give a quick checkout of all the systems and components on the unit. These checkouts should be run to 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 the checkout. All the checkouts should be done and all the steps of each checkout should be followed.

Each checkout lists:

- 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, go to the group listed in the “If Not Normal” paragraph to determine the cause and repair the malfunction.

The paragraph that accompanies each checkout procedure is included to help conduct the checkout.

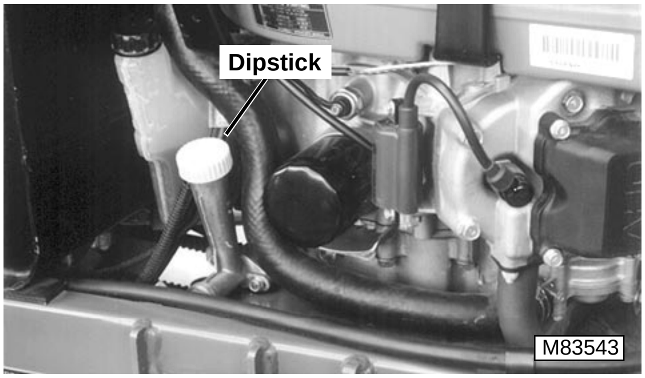
ENGINE OIL CHECK

Conditions:

- Engine stopped.
- Machine on level surface.
- Key switch in OFF position.
- Engine oil cold.

Procedure:

1. Raise engine hood.



2. Before removing dipstick, clean around dipstick.
3. Wipe dipstick with clean rag.
4. Install dipstick. Allow dipstick to rest on top of tube.
5. Remove dipstick and check oil level.
6. Install dipstick and tighten cap.

Normal:

- Oil level is between ADD and FULL marks.

If Not Normal:

- Oil level is below ADD, add oil until level is between FULL and ADD. (See 4-CYCLE GASOLINE ENGINE OIL—NORTH AMERICA on page 2-16, or 4-CYCLE GASOLINE ENGINE OIL—EUROPE on page 2-17.)
- Oil level is above FULL, drain excess oil until level is between full and add.
- Find cause of overfill and correct.

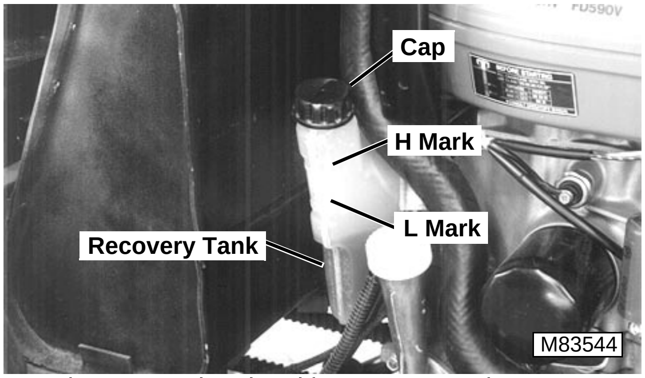
ENGINE COOLANT LEVEL CHECK

Conditions:

- Machine on level surface.
- Engine stopped.

Procedure:

1. Lift engine hood



2. Observe coolant level in recovery tank.

Normal:

- Hot engine—Coolant level up to “H” mark on recovery tank.
- Cold engine—Coolant level up to “L” mark on recovery tank.

If Not Normal:

- Allow system to cool, remove recovery tank cap. Add ethylene glycol (without stop-leak additive) antifreeze and water in the ratio specified on the antifreeze container. Add until level is up to proper mark, depending on engine temperature.
- Check for leaks.

HYDRAULIC RESERVOIR OIL LEVEL CHECK

Conditions:

- Machine on level surface.
- Lower cutting units to ground.
- Engine stopped.
- Hydraulic oil cold.

Procedure:

1. Raise engine hood.
2. Remove reservoir cap.
3. Lift filler neck screen and check oil level on screen.
4. Install screen and cap.

Normal:

- Hydraulic oil level from bottom to 25 mm (1.0 in.) above bottom of filler neck screen.

If Not Normal:

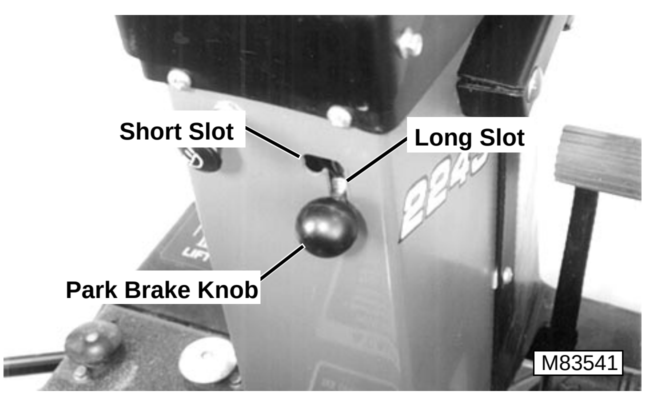
- Add hydraulic oil until level is between bottom of screen and 25 mm (1.0 in.) above the bottom of the screen. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)
- Check for leaks.

PARK BRAKE LOCK CHECK

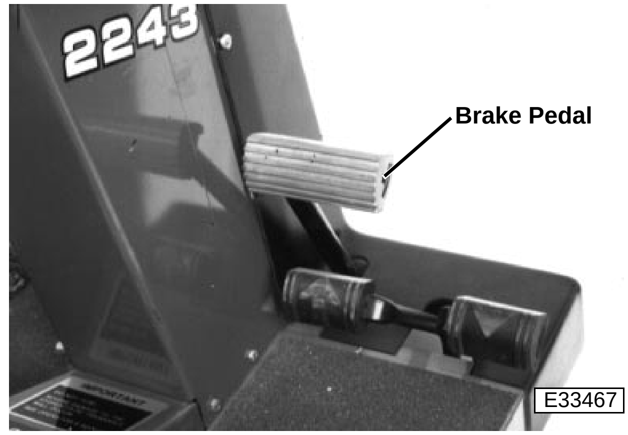
Conditions:

- Operator on seat.
- Engine stopped.

Procedure:



1. Move parking brake knob into long slot.



2. Push brake pedal down and release pedal.

Normal:

- Pedal must stay down.

If Not Normal:

- Adjust brake linkage. (See BRAKE LINKAGE ADJUSTMENT on page 7-8.)

Procedure:

1. Push down and hold pedal.
2. Move park brake knob into short slot.
3. Release pedal.

Normal:

- Pedal must return to full up position and brakes release.

If Not Normal:

- Adjust brake linkage. (See BRAKE LINKAGE ADJUSTMENT on PAGE 7-8.)

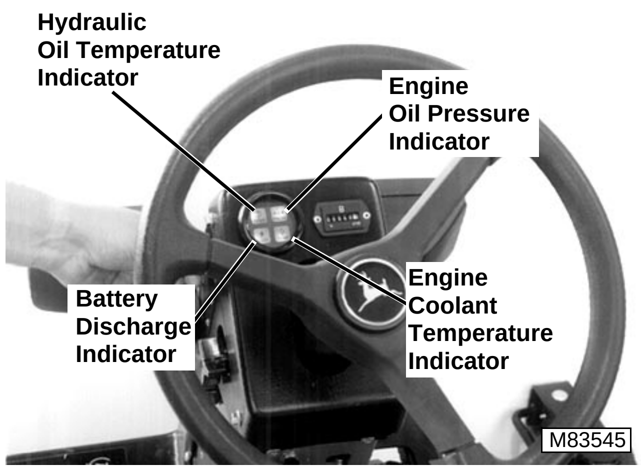
INDICATOR LAMPS CHECK—ENGINE OFF

Conditions:

- Park brake locked.
- Engine Stopped.
- Travel pedals in NEUTRAL position.

Procedure:

Turn key switch to a position between RUN and START.



Normal:

- Hydraulic oil temperature indicator must come on.
- Engine oil pressure indicator must come on.
- Battery discharge indicator must come on.
- Engine coolant temperature indicator must come on.
- Hourmeter must be operating (clicking).

If Not Normal:

- Go to Circuit Operation and Diagnosis in ELECTRICAL section.

START CIRCUIT CHECK

Conditions:

- Operator on seat.
- Park brake engaged.
- Travel pedals in NEUTRAL position.
- Mow/transport lever in TRANSPORT position.
- Fuel control lever in CHOICE position.

Procedure:

Turn key switch to START and release when engine starts or hold switch for 20 seconds maximum.

Normal:

- Starter must turn flywheel and engine must start.

If Not Normal:

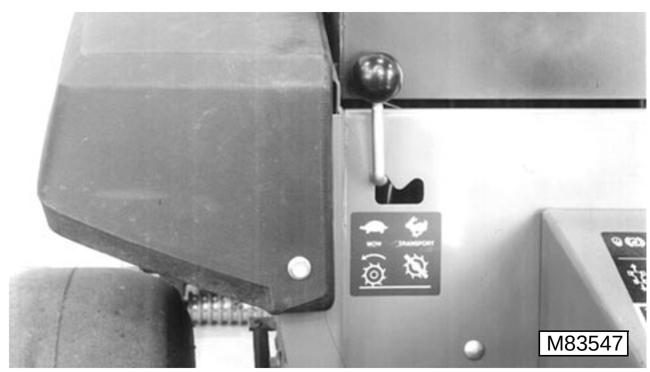
- Go to Circuit Operation and Diagnosis in ELECTRICAL section.

MOW/TRANSPORT LEVER INTERLOCK CHECK

Conditions:

- Operator on seat.
- Park brake locked.
- Travel pedals in NEUTRAL position.

Procedure:



1. Move mow/transport lever to MOW position .
2. Turn key switch to START.

Normal:

- Starter must NOT turn flywheel.

If Not Normal:

- Check mow/transport switch wire connections.
- Check or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)

Procedure:

1. Move mow/transport lever to TRANSPORT position.
2. Turn key switch to START position.

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check mow/transport switch wire connections.
- Check or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)

HYDROSTATIC DRIVE NEUTRAL INTERLOCK CHECK

Conditions:

- Operator on seat.
- Park brake locked.
- Mow/transport lever in TRANSPORT position.

Procedure:

1. Move travel pedals out of neutral position.
2. Turn key switch to START.

Normal:

- Starter must NOT turn flywheel.

If Not Normal:

- Check transmission switch wire connections.
- Check or adjust travel/neutral switch. (See INTERLOCK SWITCH TEST on page 4-222 and TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)

Procedure:

1. Release and allow travel pedals to return to neutral position.
2. Turn key switch to START.

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check travel/neutral switch wire connections.
- Check or adjust travel/neutral switch. (See INTERLOCK SWITCH TEST on page 4-222 and TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)

PARK BRAKE INTERLOCK CHECK

Conditions:

- Operator on seat.
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

1. Unlock park brake pedal.
2. Turn key switch to START position.

Normal:

- Starter must not turn flywheel.

If Not Normal:

- Check brake switch wire connections.
- Check or adjust brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and PARK BRAKE SWITCH ADJUSTMENT on page 4-226)

Procedure:

1. Lock parking brake pedal.
2. Turn key switch to START position.

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check brake switch wire connections.
- Check or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

SEAT SWITCH INTERLOCK CHECK

Conditions:

- Operator not on seat.
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

1. Unlock park brake.
2. Turn key switch to START.

Normal:

- Starter must not turn flywheel.

If Not Normal:

- Check or replace seat switch. (See SEAT SWITCH TEST on page 4-222.)

Conditions:

- Operator on seat.
- Park brake locked.
- Travel pedals in NEUTRAL position.

Procedure:

1. Operator return to seat.
2. Turn key switch to START position.

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check or replace seat switch. (See SEAT SWITCH TEST on page 4-222.)

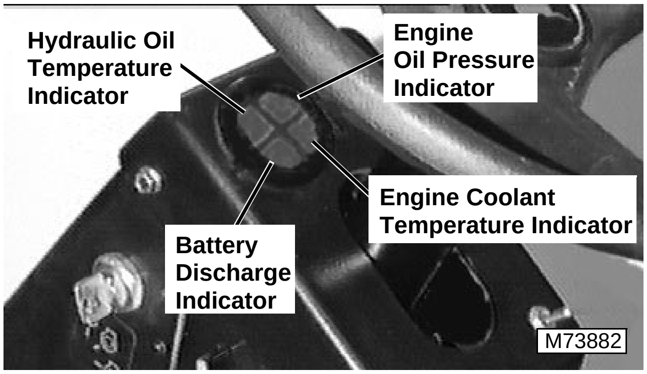
INDICATOR LAMP CHECK—ENGINE RUNNING

Conditions:

- Operator on seat.
- Park brake locked
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

Run engine at full throttle.



Normal:

- Hydraulic oil temperature, engine oil pressure and engine coolant temperature indicator must go out within 5 seconds after engine starts.
- Battery discharge indicator must go out within 10 seconds after engine starts.

If Not Normal:

- Go to ELECTRICAL section.

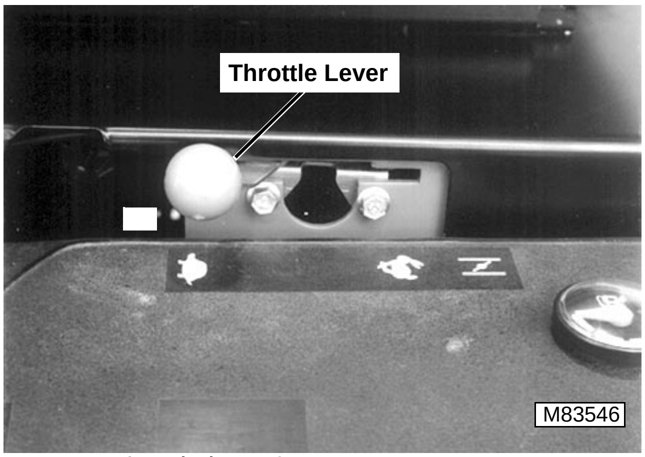
THROTTLE LEVER CHECK

Conditions:

- Operator on seat.
- Park brake engaged.
- Travel pedals in NEUTRAL position.
- Mow/transport lever in TRANSPORT position.

Procedure:

1. Start engine and operate at **slow idle (1550 ±75 rpm)**.



2. Move throttle lever from SLOW to FAST to SLOW positions.

Normal:

- Engine must accelerate and decelerate SMOOTHLY without hesitation.

If Not Normal:

- Adjust throttle cable. (See THROTTLE CABLE CHECK AND ADJUSTMENT on page 3-29.)

STEERING CHECK

Conditions:

- Operator on seat.
- Park brake engaged.
- Travel pedals in NEUTRAL position.
- Mow/transport lever in TRANSPORT position.

Procedure:

1. Start engine and operate at **fast idle (3400 ±75 rpm)**.
2. Turn steering wheel full left, then full right.

Normal:

- Smooth, constant force felt on steering wheel.
- Rear steering wheel must stop turning when steering wheel is stopped.

If Not Normal:

- Go to STEERING section.

TRANSAXLE FORWARD AND REVERSE CHECK

Conditions:

- Operator on seat.
- Mow/transport lever in TRANSPORT position.

Procedure:

CAUTION

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

1. Start and operate engine at **fast idle (3400 ±75 rpm)**.
2. Slowly move forward travel pedal through full range.
3. Slowly move reverse travel pedal through full range.

Normal:

- Machine ground speed MUST accelerate SMOOTHLY through full range of forward and reverse directions.

If Not Normal:

- Go to HYDROSTATIC POWER TRAIN section.

TRANSAXLE NEUTRAL RETURN CHECK

Conditions:

- Operator on seat.
- Mow/transport lever in TRANSPORT position.

Procedure:

> **CAUTION**
>
> **Perform this check in a large, flat and open area away from people and/or stationary objects or structures.**

1. Start and operate engine at **fast idle (3400 ±75 rpm)**.
2. Slowly move forward travel pedal, then remove foot from pedal.
3. Slowly move reverse travel pedal, then remove foot from pedal.

Normal:

- Machine MUST slow and stop.

If Not Normal:

- Check return spring.

TRANSAXLE NEUTRAL CREEP CHECK

Conditions:

- Operator on seat.
- Park brake pedal unlocked.
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

Start and run engine at **fast idle (3400 ±75 rpm)**.

Normal:

- Machine must NOT creep forward or backwards.

If Not Normal:

- Adjust hydrostatic linkage. (See HYDROSTATIC TRANSAXLE CONTROL LINKAGE ADJUSTMENT on page 5-22.)

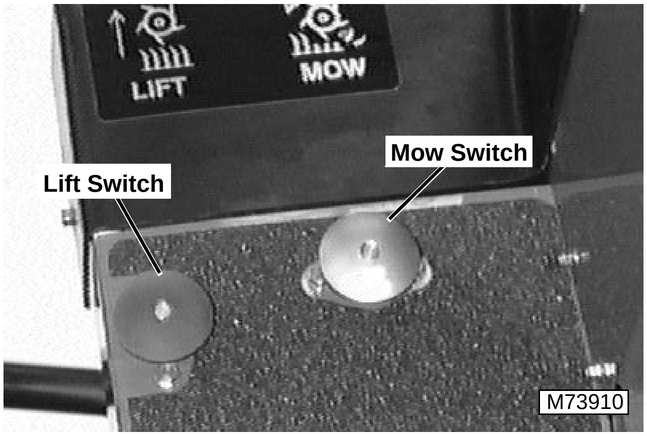
CUTTING UNIT LIFT CHECK

Conditions:

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

Procedure:

1. Start and operate engine at **fast idle (3400 ±75 rpm)**.
2. Move mow/transport lever to MOW position.



3. Press mow switch.

Normal:

- Cutting units lower smoothly to the ground and reels will rotate.

If Not Normal:

- Go to HYDRAULICS section.

Procedure:

Press lift switch.

Normal:

- Cutting units will raise smoothly and reels stop rotating.

If Not Normal:

- Go to HYDRAULICS section.

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CONTENTS

Page

ENGINE (FD590V)

Page

REPAIR, continued

CONTENTS

ENGINE DESIGNATION

F D 5 9 0 V

Four Cycle — F

Model Designation/ Variation A, B, C, D, etc. — D

Displacement — 590

V - Vertical
G - Gear Drive off Camshaft
R - Gear Box Drive
D - Direct Drive

TEST AND ADJUSTMENT SPECIFICATIONS

Governor Arm Clamp Nut Torque . . . . 7.8 N•m (69 lb-in.)

Fast Idle . . . . .3400 ±75 rpm

Slow Idle . . . . .1550 ±75 rpm

Cylinder, Compression Pressure

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

Valve Clearance (Cold) . . . . 0.25 mm (0.010 in.)

Jam Nut Torque. . . . . 9 N•m (79 lb-in.)

Rocker Arm Cover Cap Screw Torque . . . . 6 N•m (53 lb-in.)

Spark Plug Torque. . . . . 17 N•m (150 lb-in.)

Minimum Crankcase Vacuum at Fast Idle. . . . . .18 cm (7 in.) of Water

Minimum Engine Oil Pressure at Fast Idle . . . . 276 kPa (40 psi)

Fuel Pump

- Minimum Pressure at Slow Idle . . . . 2.45 kPa (0.36 psi)
- Minimum Flow Volume at Slow Idle . . . . 800 ml/60 seconds (27.1 oz/60 seconds)

Spark Plug Gap. . . . . 0.6—0.7 mm (0.024—0.028 in.)

Cooling System

- Pressure for Minimum at 15 Seconds . . . . 90 kPa (13 psi)

Radiator Cap Opening Pressure. . . . . 73—103 kPa (10.5—15 psi)

REPAIR SPECIFICATIONS

Engine Oil Capacity

- Without Filter . . . . 1.7 L (3.6 US. pt)
- With Filter . . . . 1.9 L (4.0 US. pt)

Engine Mounting Cap Screw Torque. . . . . 41 N•m (30 lb-ft)

Carburetor

- Mounting Stud Nut Torque . . . . 8 N•m (71 lb-in.)
- Intake Elbow Mounting Cap Screw Torque. . . . . 8 N•m (71 lb-in.)

REPAIR SPECIFICATIONS, continued

- Intake Manifold Mounting Cap Screws
  - Initial Torque . . . . .3 N•m (27 lb-in.)
  - Final Torque . . . . .6 N•m (53 lb-in.)
- Fuel Pump
  - Mounting Cap Screw Torque. . . . . .17 N•m (150 lb-in.)
  - Maximum Fuel Pump Push Rod Bend . . . . 0.05 mm (0.002 in.)
- Cooling Fan Mounting Cap Screw Torque. . . . . .6 N•m (53 lb-in.)
- Cooling Air Duct Mounting Cap Screw Torque . . . . .6 N•m (53 lb-in.)
- Thermostat
  - Housing Cap Screw Torque . . . . .6 N•m (53 lb-in.)
  - Begin Opening . . . . 82°C (180°F)
  - Fully Open. . . . . 95°C (203°F)
- Coolant Pump
  - Mounting Cap Screw Torque
    - Cover-to-Crankcase . . . . .21 N•m (186 lb-in.)
    - Pump-to-Cover . . . . .9 N•m (78 lb-in.)
  - Minimum Impeller Shaft O.D. . . . . 9.94 mm (0.391 in.)
  - Maximum Shaft Bore I.D. . . . . 10.09 mm (0.397 in.)
- Overflow Reservoir Mounting Cap Screw Torque . . . . .4 N•m (35 lb-in.)
- Flywheel Mounting Nut Torque . . . . .120 N•m (87 lb-ft)
- Rocker Arm Assembly
  - Minimum Shaft O.D. . . . . 11.95 mm (0.470 in.)
  - Maximum Bearing I.D. . . . . 12.07 mm (0.475 in.)
  - Maximum Push Rod Bend . . . . 0.80 mm (0.031 in.)
- Cylinder Head
  - Cap Screw Torque in Sequence
    - Initial Torque . . . . .13 N•m (115 lb-in.)
    - Final Torque . . . . .21 N•m (186 lb-in.)
  - Spark Plug Torque. . . . . .17 N•m (150 lb-in.)
  - Maximum Cylinder Head Distortion. . . . . 0.06 mm (0.002 in.) or less
- Maximum Valve Guide I.D. . . . . 6.05 mm (0.238 in.)
- Valve Seat Width . . . . .0.50—1.10 mm (0.020—0.043 in.)
- Minimum Valve Spring Free Length. 29.70 mm (1.170 in.)

REPAIR SPECIFICATIONS, continued

- Intake and Exhaust Valves
  - Minimum Valve Stem O.D.
    - Intake . . . 5.94 mm (0.234 in.)
    - Exhaust . . . 5.92 mm (0.233 in.)
  - Maximum Valve Stem Bend . . . 0.03 mm (0.001 in.)
  - Valve Seating Surface (Standard) . . . 0.80 mm (0.031 in.)
  - Seat Width Tolerance . . . 0.50—1.10 mm (0.020—0.043 in.)
  - Valve Seat and Face Angle . . . 45°
  - Minimum Valve Margin . . . 0.60 mm (0.024 in.)
  - Valve Narrowing Angle . . . 30°
- Crankcase Cover
  - Oil Capacity (w/Filter) . . . 1.9 L (4.0 U.S. pt)
  - Mounting Cap Screw Torque . . . 21 N•m (186 lb-in.)
  - Oil Drain Plug Torque . . . 25 N•m (221 lb-in.)
- Piston
  - Connecting Rod Cap Screw Torque . . . 21 N•m (186 lb-in.)
  - Piston Ring Groove Side Clearance
    - Compression Rings . . . 0.10 mm (0.004 in.)
    - Oil Control Rings . . . Not Measured
  - Piston Pin
    - Minimum Pin O.D. . . . 16.98 mm (0.668 in.)
    - Maximum Bore I.D. . . . 17.04 mm (0.671 in.)
  - Piston O.D.
    - Standard Piston . . . 73.935—73.950 mm (2.9108—2.9114 in.)
    - 0.50 mm (0.020 in.) Oversize Piston . . . 74.46—74.48 mm (2.934—2.935 in.)
  - Piston-to-Cylinder Clearance . . . 0.015—0.170 mm (0.00118—0.0059 in.)
  - Cylinder Bore I.D.
    - Standard Size Bore
      - Standard . . . 73.98—74.00 mm (2.915—2.916 in.)
      - Wear Limit . . . 74.07 mm (2.918 in.)
    - 0.50 mm (0.020 in.) Oversize Bore
      - Standard . . . 74.48—74.50 mm (2.932—2.933 in.)
      - Wear Limit . . . 74.57 mm (2.935 in.)
  - Piston Ring End Gap (Maximum)
    - Compression Rings . . . 1.00 mm (0.040 in.)
    - Oil Control Rings . . . Not Measured
  - Connecting Rod Bearing I.D. (Maximum)
    - Crankshaft Bearing
      - Standard . . . 34.06 mm (1.341 in.)
      - Undersized . . . 33.56 mm (1.321 in.)
    - Piston Pin Bearing . . . 17.05 mm (0.671 in.)

REPAIR SPECIFICATIONS, continued

Piston Pin Bearing I.D. . . . . 17.05 mm (0.671 in.)

Camshaft

- Minimum PTO Side Journal O.D. . . . . 15.91 mm (0.626 in.)
- Minimum Flywheel Side Journal O.D. . . . . 15.91 mm (0.626 in.)
- Minimum Cam Lobe Height . . . . 25.23 mm (0.993 in.)
- Minimum Fuel Pump Lobe Height . . . . 19.50 mm (0.760 in.)

Crankshaft

- Connecting Rod Cap Screw Torque . . . . 21 N•m (186 lb-in.)
- Maximum Total Indicated Runout (TIR) . . . . 0.05 mm (0.002 in.)
- Minimum Main Bearing Journal O.D. . . . . 33.91 mm (1.335 in.)
- Minimum Connecting Rod Journal O.D.
  - Standard. . . . . 33.91 mm (1.335 in.)
  - Undersized . . . . 33.48—33.47 mm (1.3181—1.3176 in.)
- Maximum Crankcase and Cover Bearing I. D.s . . . . . . 34.04 mm (1.341 in.)

Oil Pump

- Mounting Cap Screw Torque . . . . 7.8 N•m (69 lb-in.)
- Rotor Shaft
  - Minimum Shaft O.D. . . . . 10.92 mm (0.430 in.)
  - Maximum Shaft Bearing I.D. . . . . 11.07 mm (0.436 in.)
- Outer Rotor
  - Minimum Rotor O.D. . . . . 40.47 mm (1.593 in.)
  - Maximum Bearing I.D. . . . . 40.80 mm (1.606 in.)
  - Maximum Thickness . . . . 9.83 mm (0.387 in.)
- Maximum Inner and Outer Rotor Clearance . . . . 0.30 mm (0.012 in.)
- Maximum Bearing Depth . . . . 10.23 mm (0.403 in.)
- Minimum Spring Free Length . . . . 19.50 mm (0.770 in.)

Breather Reed Valve Tip Air Gap . . . . 0.2 mm (0.008 in.)

Governor

- Governor Mounting Shaft Height . . . . 32.2—32.8 mm (1.267—1.291 in.)
- Governor Lever-to-Shaft Position . . . . 7 mm (0.276 in.) from end of shaft
- Governor Lever Nut Torque . . . . 7.8 N•m (69 lb-in.)
- Governor Shaft Seal Depth . . . . . . 1 mm (0.040 in.) below crankcase surface

Radiator Support Bracket
Mounting Cap Screw Torque. . . . . 15 N•m (133 lb-in.)

Starter

- Maximum Amperage (No Load) . . . . 50 amps at 6000 rpm
- Minimum Brush Length. . . . . 6 mm (0.240 in.)

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).

45M7036 Pin
Used to hold throttle arm during adjustment.

JDM71 Vibration Tachometer
Used to check idle speed.

JDM59 Compression Gauge
Used to check engine compression.

JT05703 Barb Fitting
Used to connect U-tube manometer to engine for Crankcase Vacuum Test.

JT05699 Line
Used to connect U-tube manometer to engine for Crankcase Vacuum Test.

JT05698 U-Tube Manometer
Used to check engine crankshaft vacuum.

JT03344 Pressure Gauge Assembly
Used to read engine oil pressure when performing Engine Oil Pressure Test.

JT03017 Hose Assembly
Used to connect pressure gauge to engine when performing Engine Oil Pressure Test.

JT03349 Connector
Used to connect pressure gauge to engine when performing Engine Oil Pressure Test.

JDG356 Pressure Gauge
Used to check fuel pump performance.

D-05351ST Spark Tester
Used to check overall condition of ignition system.

D05104ST Cooling System Pressure Pump
Used to check cooling system pressure.

JDG692 Radiator Pressure Test Kit (Adapters)
Used to adapt D05104ST Cooling System Pressure Pump to cooling system when performing Cooling System Pressure Test. Also used when performing Radiator Cap Pressure Test.

JDG472 Adaptor
Used to connect compressed air source to cylinder when performing Cylinder Leak-down Test.

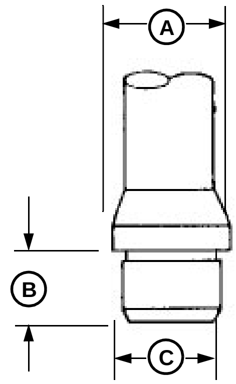
JT05712 Current Gun
Used to check starter performance.

JT05719 Hand-Held Digital Tachometer
Used to check starter performance.

DEALER FABRICATED TOOLS

DFMX1 Bushing Tool

Bushing tool is used to install crankshaft bearing shell in crankcase.



A—40 mm (1.575 in.)
B—26 mm (1.024 in.)
C—33.8 mm (1.331 in.)

M46456

OTHER MATERIALS

Number	Name	Use
M79292	MPG-2® Multipurpose Polymer Grease	Apply to engine crankshaft.
LOCTITE® PRODUCTS U.S./ Canadian/ LOCTITE No.		
T43512/ TY9473/ 242	Thread Lock and Sealer (Medium Strength)	Apply to threads of throttle and choke plate screws.
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean cylinder head.
	Valve Guide Cleaner	Clean valve guides.
	Stanisol (or Kerosene)	Finish ream valve guides.
	Prussian Blue Compound	Check valve seat contact.
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.
	Mineral Spirits	Clean armature.

MPG-2 is a registered trademark of DuBois USA.
LOCTITE is a registered trademark of the Loctite Corp.
SCOTCH-BRITE is a registered trademark of the 3M Co.

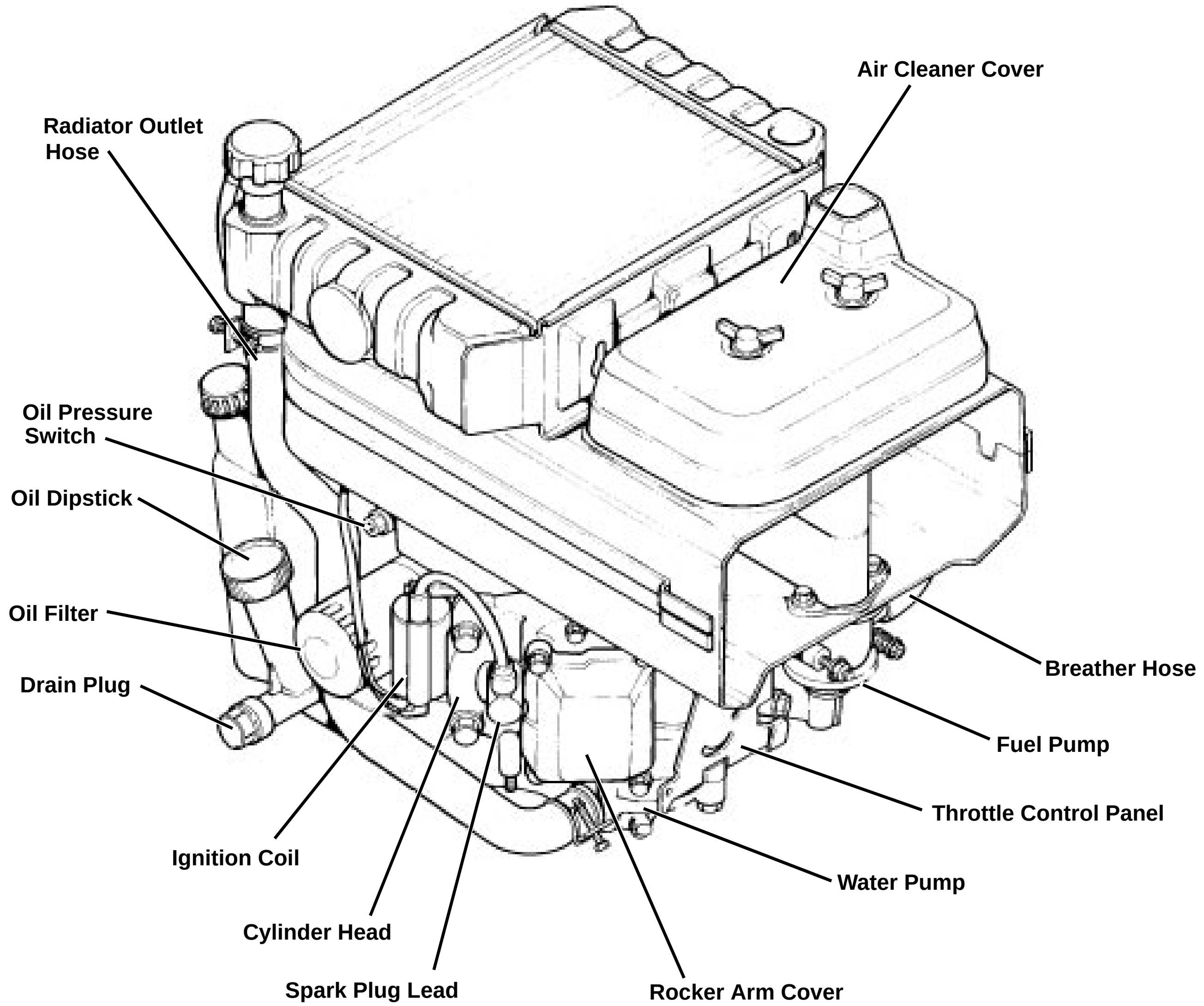
SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Carburetor
  - Gasket Kit
  - Jet Kit
- Air Cleaner Bolt and Washer Kit
- Coolant Pump
  - Repair Kit
  - Gasket Kit
- Dipstick Tube Gasket Kit
- Rocker Arm and Shaft Kit
- Intake Valve Kit
- Exhaust Valve Kit
- Camshaft and Tappet Kit
- Piston Ring Kit (Standard)
- Piston Ring Kit (Oversize)
- Oversized Piston
- Undersized Connecting Rod
- Engine Overhaul Gasket Kit
- Short Block Kit
- Oil Pump Kit
- Throttle Control Panel Kit
- Starter
  - Clutch Kit
  - Brush Kit

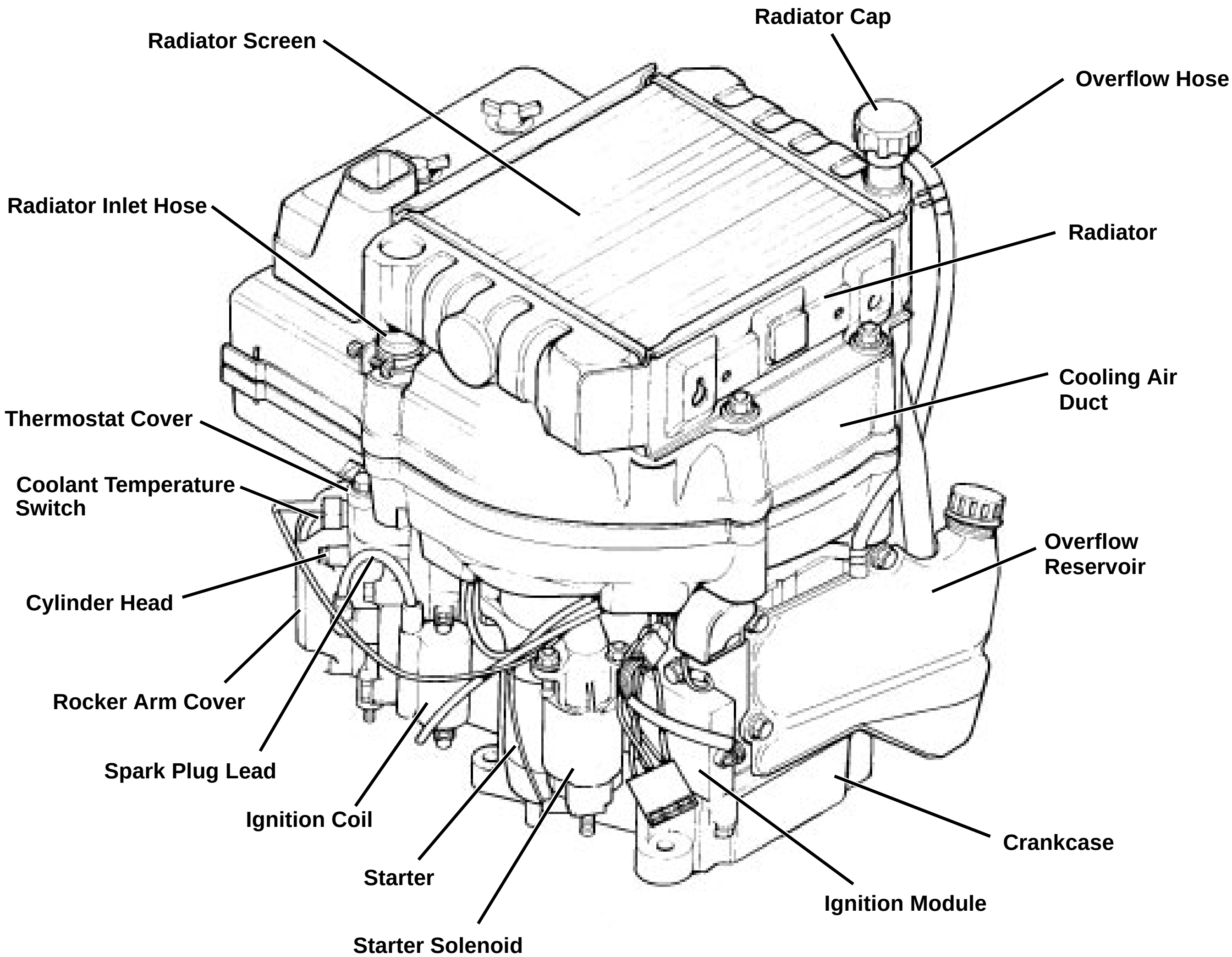
COMPONENT LOCATION AND OPERATION

EXTERIOR ENGINE COMPONENTS



Right-Hand Side Shown

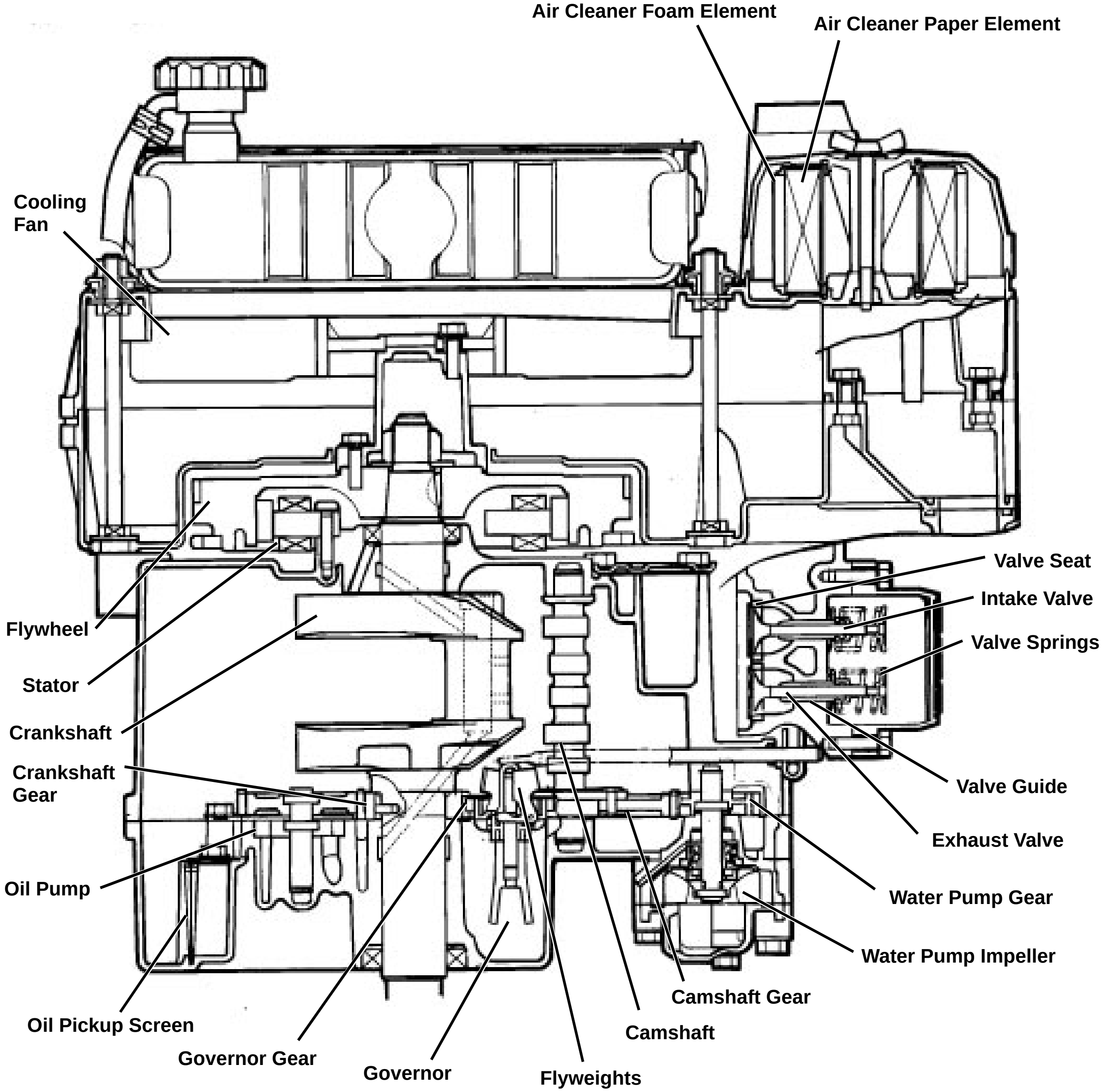
EXTERIOR ENGINE COMPONENTS, continued



Left-Hand Side Shown

M83314

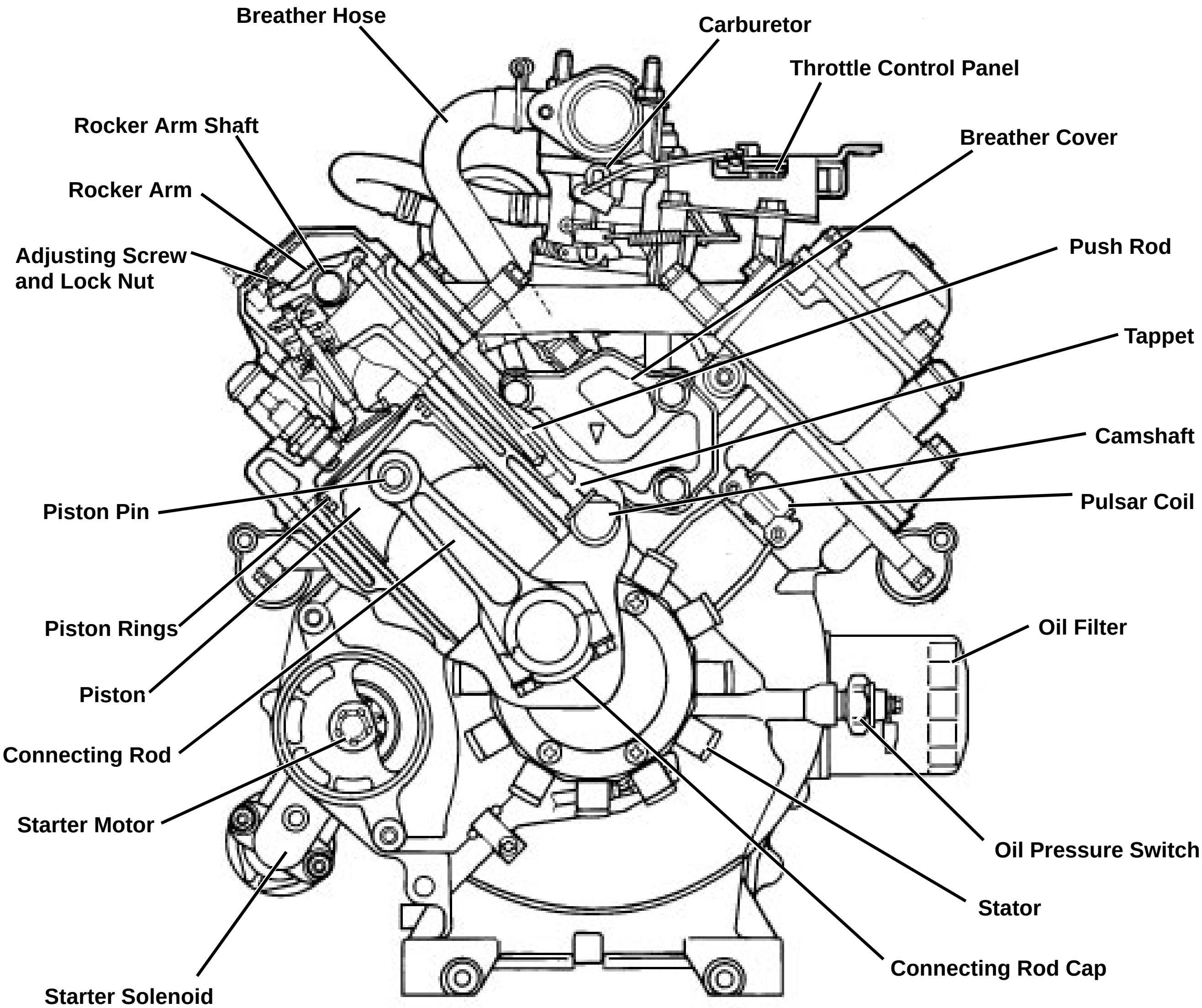
INTERNAL ENGINE COMPONENTS



Side View Cutaway

M45646

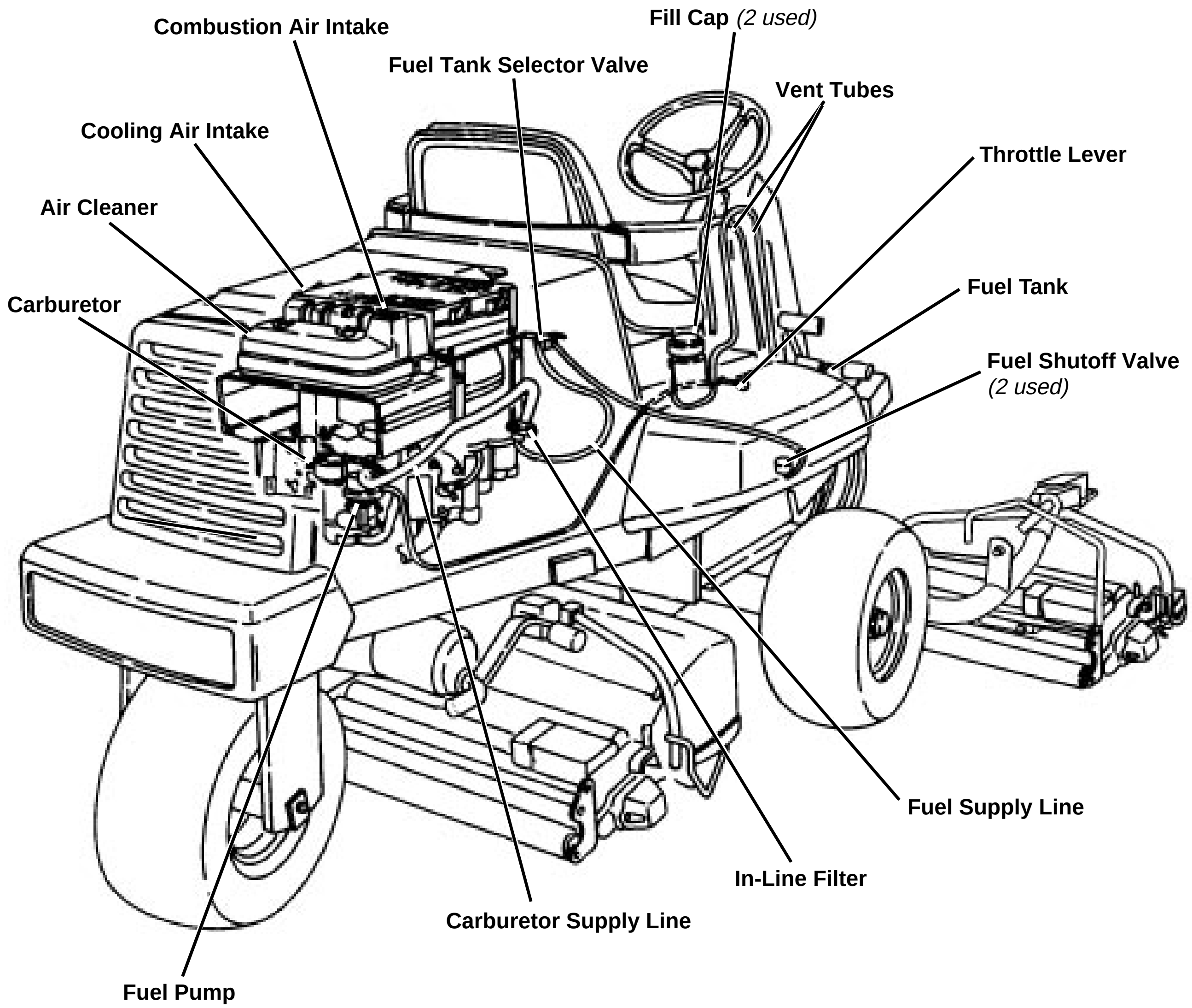
INTERNAL ENGINE COMPONENTS, continued



Top View Cutaway

M83315AE

FUEL AND AIR SYSTEM COMPONENTS



M83568

LUBRICATION SYSTEM OPERATION

Function:

To provide pressurized oil to lubricate internal engine components.

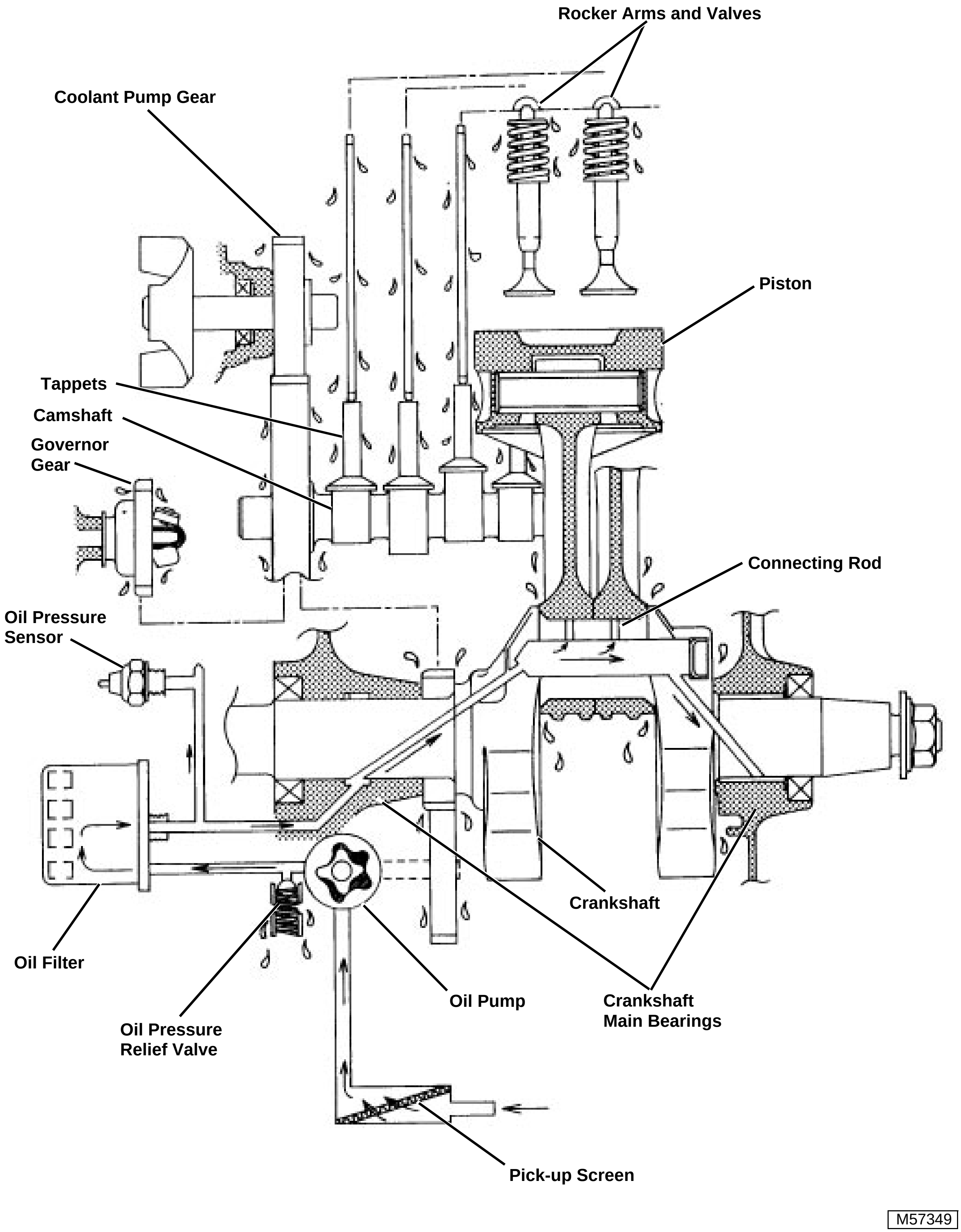
Theory of Operation:

A positive displacement gerotor pump is used to pressurize the lubrication system. The lubrication system is protected by an oil pressure relief valve, low oil pressure switch, and a oil filter with bypass.

The oil pump draws oil from the sump through the pick-up screen. Pressure oil from the pump flows through the pump outlet passage past the oil pressure relief valve. The oil pressure relief valve limits the oil pressure to approximately 296 kPa (43 psi) and protects the oil pump from damage if an oil passage becomes blocked. If the oil pressure exceeds 296 kPa (43 psi), the relief valve opens allowing oil to return to the sump. The relief valve is not adjustable.

Pressure oil from the relief valve flows to the oil filter. The filter contains a bypass valve which opens if the element becomes plugged to ensure engine lubrication.

An oil pressure switch mounted above the oil filter turns on a warning light if oil pressure is below 28 kPa (4 psi). Filtered pressure oil flows through a passage in the oil sump to the crankshaft main bearing (PTO side). Drilled passages in the crankshaft distribute oil from the main bearings to the connecting rod journals and crankshaft main bearings (flywheel side). A drilled passage in the connecting rods allows oil from the connecting rod journal to lubricate the piston and cylinder walls.


Rocker Arms and Valves
Coolant Pump Gear
Piston
Tappets
Camshaft
Governor Gear
Connecting Rod
Oil Pressure Sensor
Crankshaft
Oil Filter
Oil Pump
Crankshaft Main Bearings
Oil Pressure Relief Valve
Pick-up Screen
M57349

COOLING SYSTEM OPERATION

Function:

Remove heat from engine.

Theory of Operation:

The engine is liquid-cooled and uses a pressurized, fin-type radiator, coolant pump, and thermostat to regulate engine temperature. The cooling system is protected by a coolant temperature switch that activates a warning light on the dash if the engine temperature exceeds 111°C (232°F). The coolant pump is driven by the camshaft gear.

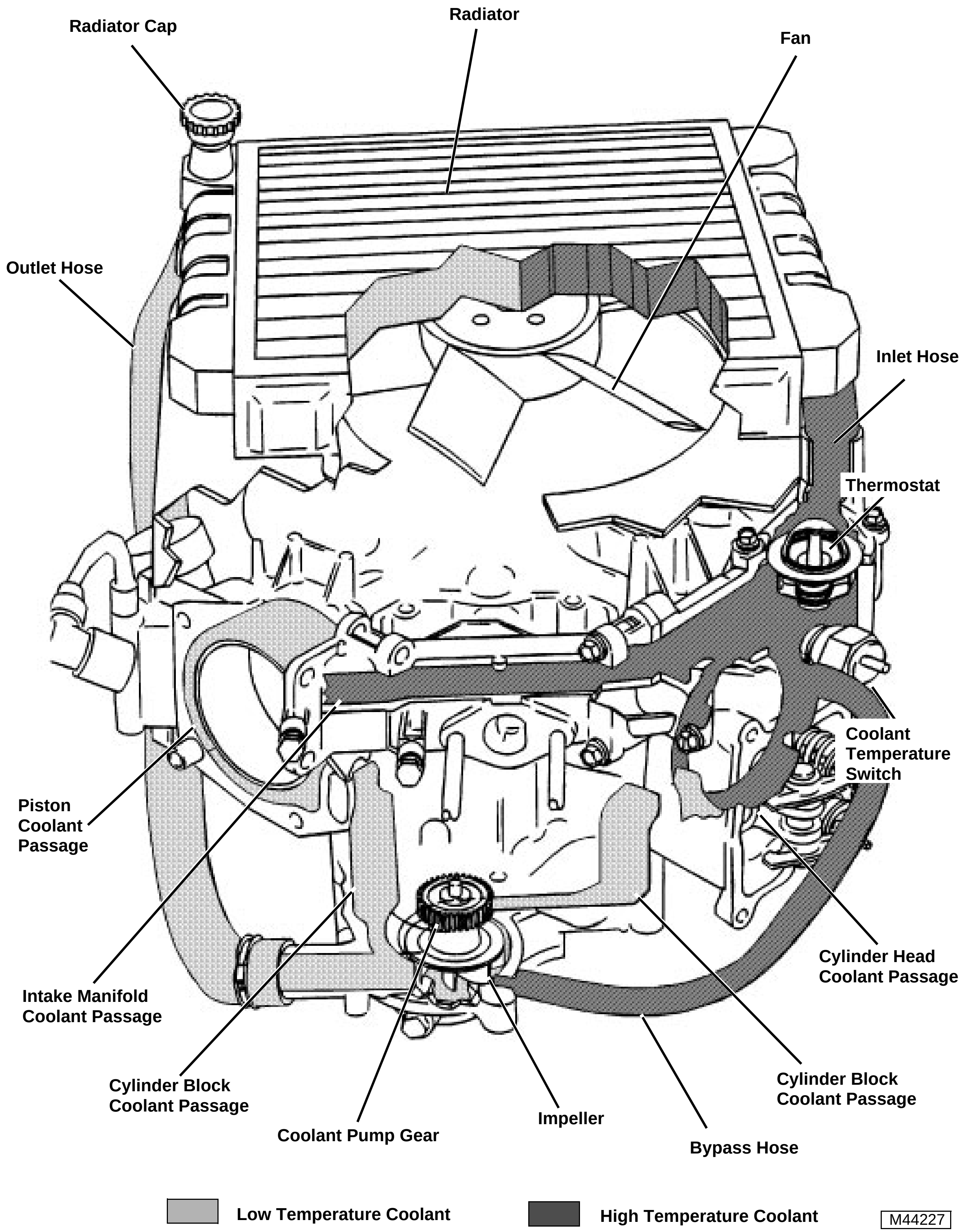
When the engine temperature is below 82°C (180°F), the thermostat is closed. When the thermostat is closed coolant flow into the radiator is stopped. The coolant pump must now draw coolant from the bypass hose which is between the cylinder head and coolant pump. The impeller forces the low temperature coolant through the cylinder block coolant passage to the piston coolant passage. Coolant flows around the piston coolant passage, and then through the right cylinder head, intake manifold, and left cylinder head to the bypass hose. The engine heat is transferred to the coolant and the coolant temperature increases. Since the high temperature coolant bypasses the radiator, the engine warms up to operating temperature quickly.

When the coolant temperature reaches 82°C (180°F), the thermostat begins to open and is fully open at 95°C (203°F). High temperature coolant from the left cylinder head flows through the thermostat to the radiator. The radiator is cooled by a radiator fan that is mounted to the flywheel. The radiator fan pulls air in from the front of the engine and forces air upward through the radiator fins. The coolant temperature decreases as the coolant flows from the radiator inlet to the outlet.

With the thermostat open, the coolant pump draws low temperature coolant from the radiator through the radiator outlet hose instead of the bypass hose. The low temperature coolant is circulated through the engine to provide constant cooling.

A coolant temperature switch mounted in the left cylinder head activates a warning light on the dash if the coolant temperature exceeds 111°C (232°F).

The radiator cap maintains a constant pressure of 88 kPa (13 psi) inside the radiator which actually raises the boiling point of the coolant. The radiator cap contains a pressure valve and vacuum valve. When the coolant is hot and pressure is above 88 kPa (13 psi), the pressure valve opens allowing some coolant to flow to the overflow reservoir. After the engine has stopped, the coolant cools and the pressure inside the radiator decreases to create a partial vacuum. The vacuum opens the vacuum valve and some coolant flows from the overflow reservoir to radiator.


Radiator Cap
Radiator
Fan
Outlet Hose
Inlet Hose
Thermostat
Coolant Temperature Switch
Piston Coolant Passage
Cylinder Head Coolant Passage
Intake Manifold Coolant Passage
Cylinder Block Coolant Passage
Cylinder Block Coolant Passage
Impeller
Coolant Pump Gear
Bypass Hose
Low Temperature Coolant
High Temperature Coolant
M44227

TROUBLESHOOTING

ENGINE AND FUEL SYSTEM TROUBLESHOOTING CHART

CHECK OR SOLUTION / PROBLEM OR SYMPTOM	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.	Engine RPM low or engine stalls.
Weak or faulty spark plug.	●	●	●	●	●	●						
Faulty high tension leads.	●	●	●	●	●	●						
Faulty ignition module.	●	●	●	●	●	●			●			
Faulty ignition coil.	●	●	●	●	●	●						
Faulty pulser coil.	●	●	●	●	●	●		●				
Contaminated fuel or faulty fuel supply system.	●	●	●						●			
Fuel shut-off solenoid not allowing fuel into main jet.	●											
Defective fuel pump.	●	●	●	●								
Air being drawn in through a hole in fuel line(s).	●	●	●					●				
Clogged fuel line or filter.	●	●	●	●								
Fuel tank vent line clogged.	●	●	●	●								
Vapor lock.		●	●									
Improper use of choke.	●					●						
Air filter restricted.	●	●				●						
Defective breather valve.		●					●					
Float level too high.	●					●						
Poor compression. Worn piston/ piston rings stuck or not seated. Worn cylinder bore.	●	●				●	●					
Cylinder head loose.	●	●				●		●		●		
Worn or burnt valves or improper clearance.	●	●			●	●						
Worn valve stem(s) or valve guide(s).							●					

ENGINE AND FUEL SYSTEM TROUBLESHOOTING CHART, continued

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.	Engine RPM low or engine stalls.
Warped cylinder head.	●	●		●	●			●	●			
Broken valve spring.	●	●				●						
Defective head gasket.	●	●						●		●		●
Low oil level.		●										
Too much oil in crankcase.		●					●					
Carburetor out of adjustment.		●	●	●	●	●		●	●			●
Air/fuel passages clogged.		●			●							●
Carbon deposits in exhaust pipe/ muffler.		●										
Carbon deposits in combustion chamber.		●							●			
Lack of coolant.			●						●		●	
Governor linkage out of adjustment.			●									
Faulty governor spring.			●									
Governor gear assembly binding or broken.			●									
Air being drawn through carburetor or intake manifold flanges.					●				●			●
Incorrect timing gear alignment.					●							
Plugged oil ring groove.							●					
Oil leakage along governor shaft.							●					
Defective oil seal.							●					
Drain-back hole in breather chamber plugged.							●					
Incorrect oil viscosity.							●					
Carburetor flange loose or leaking at gasket.			●									●
Carburetor body and throttle shaft worn.			●									●

ENGINE AND FUEL SYSTEM TROUBLESHOOTING CHART, continued

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Engine cranks but will not start.	Loss of power.	Engine runs erratically.	Engine misses at high rpm.	Engine misses at low rpm.	Excessive fuel consumption.	Excessive oil consumption.	Engine backfires.	Engine knocks.	Coolant leakage.	Engine overheats.	Engine RPM low or engine stalls.
Intake valve burned or sticking.								●				
Excessive engine load.									●		●	
Fan belt slippage.											●	
Defective radiator hose or clamp.										●	●	
Broken or missing fan shroud.											●	
Defective radiator.										●	●	
Cracked or porous casting.										●	●	
Loose stud bolts and cap screw.										●	●	
Engine overheating.										●		
Damaged water pump seals.										●	●	
Improperly installed gasket.										●	●	
Improper or defective radiator cap.										●	●	
Battery weak or discharged.	●											

ENGINE TROUBLESHOOTING GUIDE

Engine Hard To Start

Remove spark plugs and check spark by cranking engine while having the plugs grounded against engine block.

CAUTION:
Keep the plugs as far away as possible from the plug holes.

To avoid electric shock, do not hold plugs. Make sure to hold plug caps.

- NO → Are sparks produced when spark plugs are replaced?
  - YES → • Faulty spark plugs. — Replace
  - NO → Are sparks produced between high tension lead and engine block with plug caps removed?
    - YES → • Faulty contact of plug caps. — Correct
    - NO → Are sparks produced between high tension lead and engine block when igniter is replaced?
      - YES → • Faulty igniter. — Replace
      - NO →
        - • Faulty ignition coils. — Replace
        - • Faulty high tension cords. — Replace
        - • Faulty pulser coils. — Replace
- YES → Is compression sufficient?
  - YES → Crank engine several times, then remove spark plugs and observe electrodes. Are they wet?
    - NO →
      - • No fuel in the tank. — Add
      - • Dust or air in fuel pipe or filter. — Clean
      - • Plugged air hole in tank cap. — Clean
      - • Plugged fuel line. — Clean
    - YES →
      - • Excessive use of choke. — Open choke
      - • Clogged air cleaner. — Clean
      - • Fuel level too high in float bowl. — Adjust
  - NO →
    - • Worn piston/piston rings. — Replace
    - • Stuck piston rings. — Clean or replace
    - • Worn cylinder bore. — Bore or replace
    - • Insufficient cylinder head tightening. — Retighten
    - • Faulty contact of valve seat. — Lap
    - • Plunged-up valve. — Adjust
    - • Warped cylinder head. — Repair or replace
    - • Broken valve spring. — Replace
    - • Stuck valve. — Clean or grind
    - • Burned head gasket. — Replace

Check carburetor. →
- • Check for plugged fuel line.
- • Check for plugged air passage.
- • Check float level.
- • Check carburetor setting.

Engine Has Low Power

Is engine overheated? — YES →

• Low oil level.	Add
• Too much oil in crankcase.	Adjust level
• Excessive engine load.	Adjust load
• Carburetor not properly adjusted.	Adjust
• Carbon deposit in combustion chamber.	Clean
• Lack of coolant.	Fill
• Cooling system clog.	Clean
• Damaged cooling fan.	Replace
• Malfunction of water pump or thermostat.	Replace
• Aeration in cooling system.	Purge air
• Dirt and insects lodged in radiator.	Clean
• Damaged radiator.	Replace
• Deteriorated coolant.	Replace

NO ↓

Is the spark condition normal? — NO →

• Wrong spark plugs.	Replace
• Faulty spark plugs.	Replace
• Faulty igniter.	Replace
• Faulty ignition coils.	Replace
• Faulty high tension cords.	Replace
• Faulty pulser coils.	Replace

YES ↓

Is lubricating condition normal? — NO →

• Too much or too little oil in crankcase.	Correct
• Excessively contaminated lubricating oil.	Change
• Defective oil filter.	Replace
• Faulty relief valve.	Replace
• Faulty oil pump.	Replace
• Clogged oil system.	Clean

YES ↓

Is unusual smoke emitted out of muffler? — YES →

• Plugged air cleaner.	Clean
• Carbon deposit in exhaust holes and muffler.	Clean
• Carburetor not properly adjusted.	Adjust
• Too much oil in crankcase.	Correct
• Worn piston/piston rings.	Replace
• Worn cylinder bores.	Repair
• Defective breather valve.	Replace

NO ↓

Is compression sufficient? — NO → • Same as **Hard To Start**.

Engine Runs Erratically

Problem in fuel system (lack of fuel). →

• Dust or water in fuel pipe.	Clean
• Air or vapor lock in fuel line.	Clean
• Plugged air vent of fuel tank cap.	Clean
• Plugged air/fuel passages in carburetor.	Clean
• Too little opening of carburetor pilot air-screw.	Correct

Problem in governor system. →

• Incorrect governor linkage adjustment.	Correct
• Faulty governor spring.	Replace
• Governor gear assembly malfunction.	Check

Engine Malfunctions at High Speed

Is revolution fluctuation of relatively large period produced when a load is applied?

YES →

• Plugged air hole in tank cap.	Clean
• Dust and air in fuel filter or fuel pipe.	Clean

Engine Malfunctions at Low Speed

Remove spark plugs and check spark by cranking engine while having the plugs grounded against engine block.

CAUTION:
Keep the plugs as far away as possible from the plug holes.

To avoid electric shock, do not hold plugs. Make sure to hold plug caps.

WEAK →

• Faulty plug insulation.	Replace
• Fouled electrodes.	Clean
• Faulty igniter.	Replace
• Faulty ignition coils.	Replace
• Faulty high tension cords.	Replace
• Faulty pulser coils.	Replace

STRONG ↓

Is unusual smoke emitted out of muffler?

YES → • Overrich fuel in pilot system. — Turn in pilot screw

NO ↓

Gradually open throttle valve by hand. Does engine speed drop or does engine stall at a certain position?

YES → • Passages in carburetor plugged. — Disassemble and clean

NO ↓

Is air drawn through carburetor or intake manifold flanges?

YES →

• Loose flange nuts.	Tighten
• Damaged gasket.	Replace

NO ↓

Are valve clearances of normal values?

NO →

• Compression leakage.	Adjust
• Wrong valve timing.	Adjust

YES ↓

Is alignment of timing gear marks correct?

NO → • Largely deviated valve timing. — Correct

Fuel Consumption Is Excessive

Is compression sufficient?

YES →

• High fuel level in carburetor float chamber (including overflow).	Adjust
• Faulty igniter.	Replace
• High idling R.P.M.	Adjust
• Choke partially closed.	Open
• Excessive backed off carburetor pilot screw.	Adjust

NO → • Same as **Hard To Start**.

Oil Consumption Is Excessive

Is compression sufficient?

YES

• Plugged oil ring groove.	Clean
• High oil level.	Adjust
• Worn valve stems and valve guides.	Replace
• Oil leakage along governor shaft.	Replace
• Oil seals leaking.	Replace
• Oil leakage from mounting surface.	Replace gasket
• Drain plug leaking.	Retighten or replace gasket
• Breather valve clogged.	Clean
• Drain-back hole in breather chamber plugged.	Clean
• Incorrect oil viscosity.	Correct

NO

• Worn piston rings.	Replace
• Stuck piston rings.	Clean or replace
• Worn cylinder bores.	Bore or replace
• Broken piston rings.	Replace

Engine Runs Erratically

• Dirt or water in fuel line.	Clean
• Carburetor not properly adjusted.	Adjust
• Spark plugs fouled, pitted, or gapped incorrectly.	Replace or adjust
• Carburetor flange leaking at gasket.	Tighten or replace
• Carburetor body and throttle shaft worn.	Replace
• Restricted gas tank vent.	Clean
• Governor malfunctioning.	Adjust

Engine Backfires

• Loose carburetor or intake manifold.	Tighten
• Loose cylinder head or leaking head gasket.	Tighten
• Burned or sticking intake valves.	Replace
• Faulty pulser coils.	Replace
• Carburetor not properly adjusted.	Adjust

Engine Knocks

• Stale fuel.	Change
• Excessive carbon deposit in engine.	Clean
• Excessive engine load.	Adjust
• Engine overheating.	See **Engine Has Low Power**
• Faulty igniter.	Replace

Coolant Leakage

• Deteriorated radiator hose.	Replace
• Mechanical failure of radiator.	Repair or replace
• Loose cylinder heads.	Tighten
• Cracked or porous casting.	Replace
• Loose stud bolts and cap screw.	Repair
• Engine overheating.	See **Engine Has Low Power**
• Damaged water pump seals.	Replace
• Improperly installed gasket.	Correct or replace
• Malfunction radiator cap.	Replace

STARTER MOTOR TROUBLESHOOTING GUIDE

1. Disconnect spark plug caps, and ground the cap terminals.
2. Turn engine switch to “START” position and check condition.

> **CAUTION**
>
> **Engine may be cranked in this test. Do not touch any rotating parts of engine and equipment during test.**

IMPORTANT: If starter does not stop by engine switch “OFF”, disconnect negative (-) lead from battery as soon as possible.

Starter Does Not Rotate

Is click sound from solenoid (switch)?	NO	• Faulty battery.	Charge or replace
		• Faulty leads or connection.	Repair or replace
		• Melted fuse.	Replace
		• Faulty engine switch.	Repair or replace
		• Faulty solenoid (switch).	Replace
	YES	• Weak battery.	Charge or replace
		• Faulty leads or connection. (Solenoid to motor)	Repair or replace
		• Faulty solenoid (switch). (Main terminal in solenoid)	Replace
		• Faulty starter motor.	Repair or replace

Starter Rotates Slow

Is battery normal and charged?	NO	• Weak battery.	Charge or replace
	YES	• Faulty leads or connection. (Solenoid to motor)	Repair or replace
		• Faulty solenoid (switch). (Main terminal in solenoid)	Replace
		• Faulty starter motor.	Repair or replace
		• Faulty engine.	Repair or replace

Starter Rotates But Can Not Crank Engine

Does pinion mesh with ring gear?	NO	• Worn pinion or ring gear.	Replace
		• Incorrect starter alignment.	Correct
	YES	• Faulty clutch.	Replace

Starter Does Not Stop In Engine Switch "OFF"

Can stop starter by engine switch "OFF"?

NO →
- Faulty engine switch. — Repair or replace
- Faulty solenoid (switch). — Replace

YES →
- Faulty pinion or ring gear — Repair or replace
- Incorrect starter alignment. — Correct
- Faulty pinion return mechanism. — Repair or replace

CHECKS, TESTS AND ADJUSTMENTS

THROTTLE CABLE CHECK AND ADJUSTMENT

Reason:

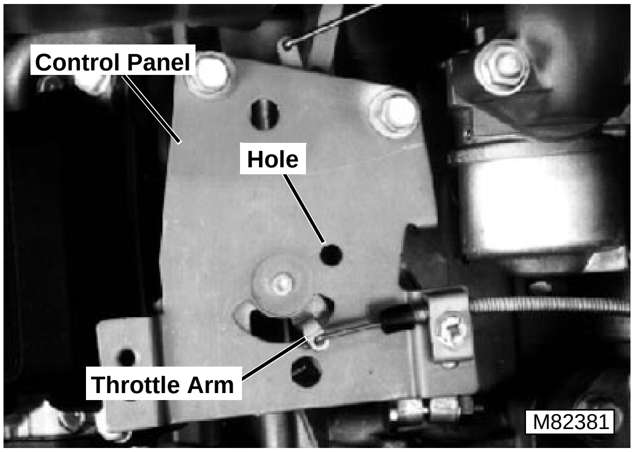
To make sure the throttle control arm is indexed properly to ensure accurate choke and engine speed settings.

Equipment:

- 6 mm (15/64-in.) Drill Bit or 45M7036 Pin

CHECK Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.
6. Move throttle control lever from LOW idle to FAST idle position. A solid "detent" should be felt to assure that control lever is in the FAST idle position.



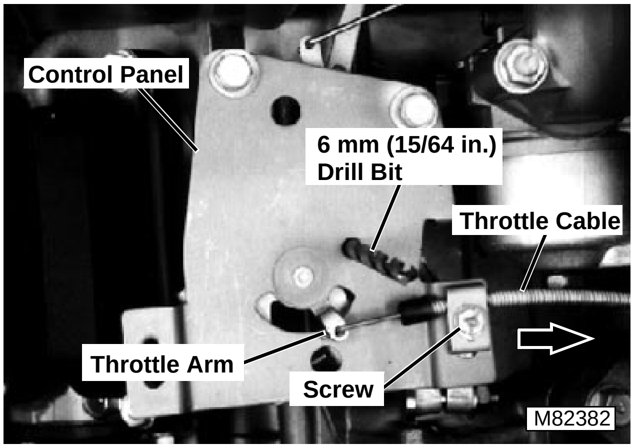
7. Check holes in control panel and throttle arm. They MUST be in visual alignment.
8. Move throttle control lever into CHOKE position, then back into FAST idle position. Again, holes in control panel and throttle arm MUST be aligned.

Results:

- If holes align in both positions, throttle cable is OK. Check and adjust choke plate.
- If holes DO NOT align in either position, perform ADJUSTMENT Procedure.

ADJUSTMENT Procedure:

1. Move throttle control lever to FAST idle position.



2. Loosen screw.
3. Align hole in throttle arm with hole in control panel. Insert a 6 mm (15/64 in.) drill bit or 45M7036 Pin through holes to keep throttle arm from moving. Be sure drill bit is perpendicular to the control panel.
4. Pull throttle cable toward carburetor (arrow) and tighten screw.
5. Remove drill bit.
6. Repeat CHECK Procedure.
7. Move throttle control lever through full range to be sure linkage is not binding.

CHOKE PLATE CHECK AND ADJUSTMENT

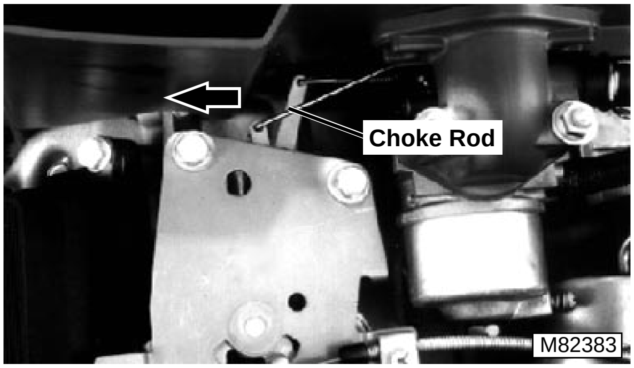
Reason:

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.

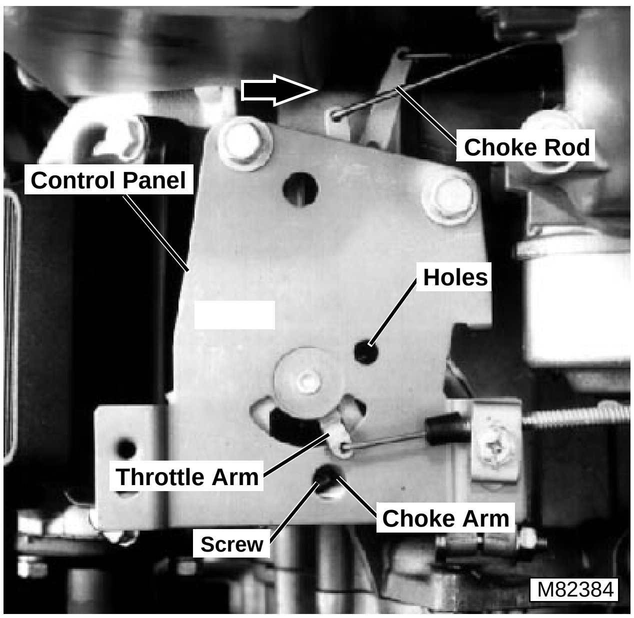
CHECK Procedure:

IMPORTANT: Check and adjust throttle cable before adjusting choke, to ensure accurate choke adjustment.

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.
6. Check and adjust throttle cable.
7. Move throttle control lever to full CHOKE position.



8. Try to move choke rod away from carburetor (arrow). Choke rod should NOT move. If choke rod moves to the **left**, the choke plate is not fully closed.
9. Move throttle control lever to FAST idle position.



10. Check holes in control panel and throttle arm. They MUST be in visual alignment. Check for gap between screw and choke arm.
11. Try to move choke rod toward carburetor (arrow). Choke rod should NOT move. If choke rod moves to the **right**, the choke plate is not fully open.

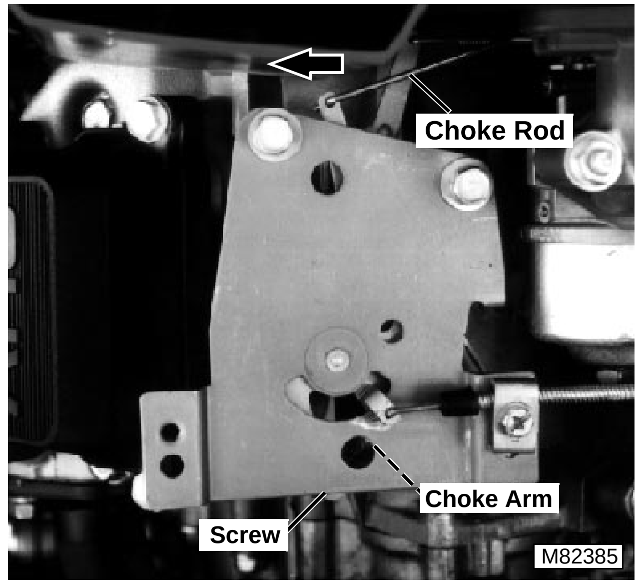
Results:

- If choke rod DOES NOT move in either direction with throttle control lever in the specific positions, choke operation is OK.
- If choke rod MOVES in either direction with throttle control lever in the specific positions, perform ADJUSTMENT procedure.

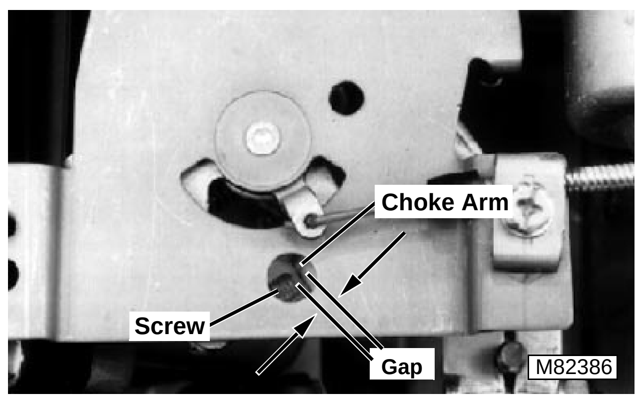
ADJUSTMENT Procedure:

If choke plate is not closed when throttle control is in full choke position:

1. Move throttle control lever to full CHOKE position.



2. Push and hold choke rod away from carburetor (arrow) to close choke plate.
3. Turn screw (on backside of control panel) clockwise until it is tight against choke arm.
4. Move throttle control lever to FAST idle position.



NOTE: Amount of gap may vary from approximately 0.25 to 3 mm (0.01 to 0.12 in.).

5. Check for "gap" between screw and choke arm. Amount of gap should be approximately **0.25 to 3 mm (0.01 to 0.12 in.)**.
6. Repeat CHECK Procedure.

GOVERNOR ADJUSTMENT

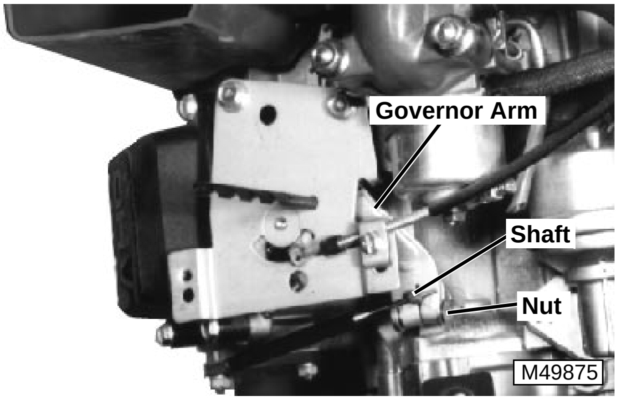
Reason:

To ensure proper operation of the governor.

Procedure:

NOTE: Adjust throttle cable and choke plate before adjusting governor linkage.

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.)
6. Adjust throttle cable and choke plate. (See THROTTLE CABLE CHECK AND ADJUSTMENT on page 3-29 and CHOKE PLATE CHECK AND ADJUSTMENT on page 3-29.)
7. Move throttle control lever to FAST idle position.



8. Loosen nut.
9. Hold governor arm fully counterclockwise.
10. Using a small pin, rotate shaft counter-clockwise as far as it will go.
11. Tighten nut to **7.8 N•m (69 lb-in.)**.
12. Move throttle control lever through full range to be sure linkage is not binding.

FAST IDLE SPEED ADJUSTMENT

Reason:

To set engine fast idle speed.

Equipment:

- 6 mm (15/64 in.) Drill Bit or 45M7036 Pin
- JDM71 Vibration Tachometer

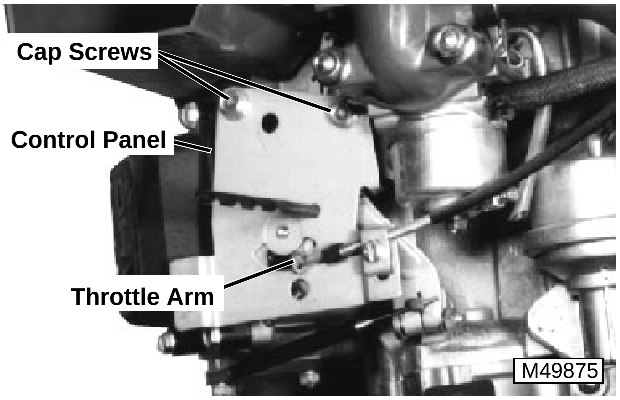
Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Start and run engine at MEDIUM idle for five minutes.
6. Raise engine hood.
7. Remove intake screen. (See INTAKE SCREEN—Removal/Installation on page 3-41.)
8. Set JDM71 Vibration Tachometer dial for 3400 rpm and set on cooling air duct.

CAUTION

Engine will be HOT. Be careful not to burn hands.

9. Move throttle control lever to FAST idle position.



10. Align hole in throttle arm with hole in throttle control panel. Put a 6 mm (15/64-in.) drill bit or 45M7036 Pin through holes to keep throttle arm from moving. Be sure drill bit is perpendicular to the throttle control panel.
11. Check engine rpm at Vibration Tachometer. Fast idle speed setting should be **3400 ±75 rpm**.

Results:

- If fast idle speed does not meet the specifications:

  Loosen cap screws.

  Move throttle control panel away from carburetor to increase rpm or toward carburetor to decrease rpm.

  Hold throttle control panel and tighten cap screws.

  Remove drill bit.

SLOW IDLE SPEED ADJUSTMENT (ENGINE S.N. —054261)

Reason:

To verify proper slow idle speed setting.

Equipment:

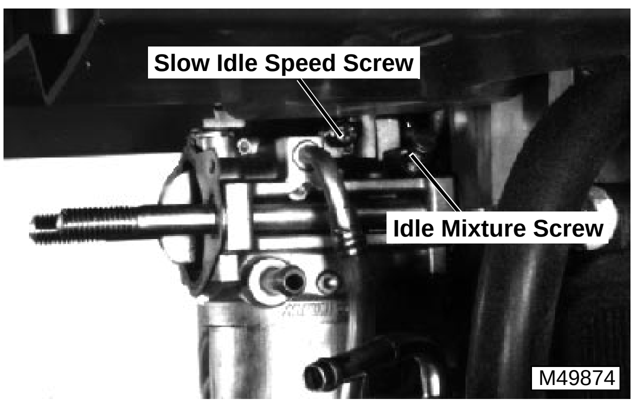
- JDM71 Vibration Tachometer

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.

IMPORTANT: Forcing the idle mixture screw tight will damage the needle and seat.

NOTE: Breather elbow and fuel line removed for photo, DO NOT remove for adjustment.



6. Turn idle mixture screw clockwise until lightly seated, then counterclockwise 1-3/8 turns.
7. Start and run engine at medium idle for five minutes.
8. Move throttle control lever to SLOW idle position.
9. Set JDM71 Vibration Tachometer dial for 1550 rpm and place on cooling air duct.
10. Turn slow idle speed screw until slow idle speed is **1550 ±75 rpm**.
11. Turn idle mixture screw clockwise until engine speed drops, then counterclockwise until engine speed increases and begins to drop again.
12. Adjust idle mixture screw for highest engine speed between drops, then turn screw counterclockwise an additional 1/4 turn.
13. Turn slow idle speed screw to get idle speed of **1550 ±75 rpm**.
14. Move throttle control lever between SLOW and FAST idle several times. If engine does not accelerate smoothly, adjust slow idle mixture screw about 1/8 turn richer.

SLOW IDLE SPEED ADJUSTMENT (ENGINE S.N. 054262—)

WARNING

Do not attempt to adjust the carburetor unless you are a factory trained technician with authorization to service CARB/EPA Certified engines.

Reason:

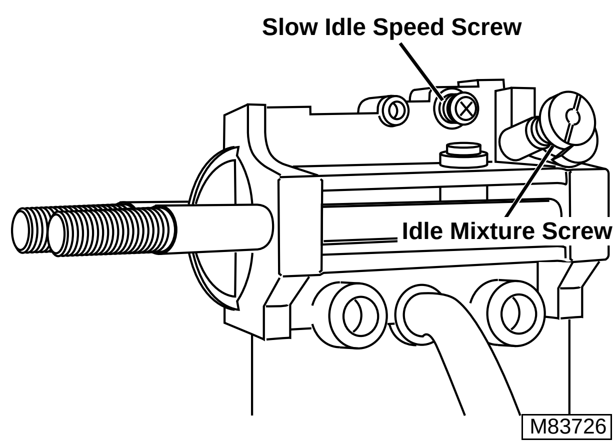
To set engine slow idle mixture and rpm. This insures the engine meets the CARB/EPA emissions requirements.

Equipment:

- JDM71 Vibration Tachometer
- or JTO7270 Digital Pulse Tachometer

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.



6. Turn slow idle mixture screw to midpoint between tab stops.
7. Start and run engine at medium idle for five minutes to obtain normal operating temperature.
8. Move throttle lever to SLOW idle position.
9. Set JDM71 Vibration Tachometer dial for 1550 rpm and place on cooling air duct.

10. JTO7270 Digital Pulse Tachometer around spark plug lead to check engine rpm.
11. Turn slow idle stop screw on carburetor until slow idle speed is **1450 ± 75 rpm**.
12. Adjust slow idle mixture screw for highest engine speed between tab stops.
13. Repeat Step 11 to verify slow idle speed.
14. Turn slow idle stop screw on throttle control arm to get an idle speed of **100 rpm** higher than carburetor setting.

CYLINDER COMPRESSION PRESSURE TEST

Reason:

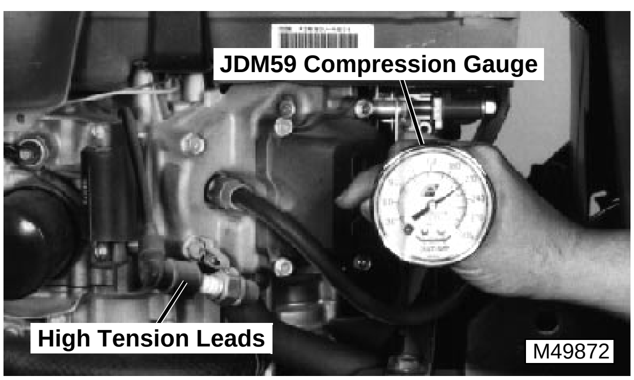
To determine the condition of the pistons, rings, cylinder walls, and valves.

Test Equipment:

- JDM59 Compression Gauge

Procedure:

1. Run engine for five minutes to bring engine to operating temperature.
2. Park machine on level surface.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage parking brake.
6. Raise engine hood.
7. Remove spark plugs.



8. Install JDM59 Compression Gauge in one spark plug hole.
9. Ground high tension leads or disconnect positive lead from ignition coil.
10. Move throttle control lever to FAST idle position.

IMPORTANT: DO NOT overheat starting motor during test. Starter duty cycle is 5 seconds ON, 10 seconds OFF.

11. Crank engine for three to five compression strokes.
12. Record pressure reading.
13. Repeat test with other cylinder.

Specifications:

Minimum Compression . . . . . 1171 kPa (170 psi)
Maximum difference 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 above specification, adjust valves and check fuel and air intake systems. Check exhaust for restriction.
- If below specification, squirt clean engine oil into cylinder and repeat test.
- If compression pressure DOES NOT increase after retest; check for leaking valves, valve seats, or cylinder head gaskets.
- If compression pressure INCREASES after retest; check rings, pistons, and cylinder bores for broken rings, scoring, wear or damage. Replace as necessary.

VALVE CLEARANCE, CHECK AND ADJUSTMENT

Reason:

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

Equipment:

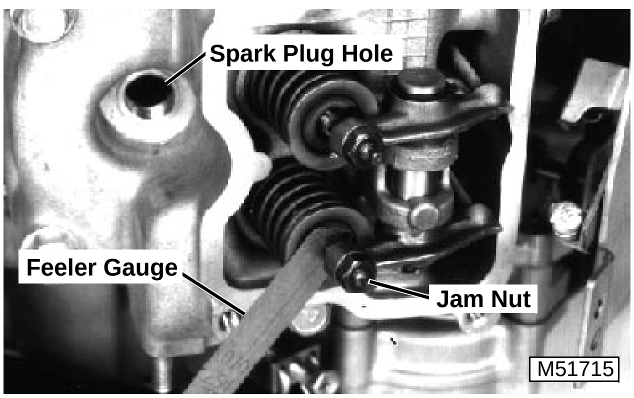
- Feeler Gauge (blade-type)

Procedure:

IMPORTANT: Make adjustment when engine is cold.

NOTE: Check valve clearance for each cylinder separately.

1. Park machine on level surface.
2. Turn key switch OFF. Allow engine to cool.
3. Move forward/reverse pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise hood.
6. Remove spark plug.
7. Remove rocker arm cover.



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).
9. Use a blade-type feeler gauge to measure valve clearance. Valve clearance should be **0.25 mm (0.010 in.)**.

Specifications:

Valve Clearance (cold) . . . . . 0.25 mm (0.010 in.)
Jam Nut Torque . . . . 9 N•m (79 lb-in.)
Rocker Arm Cover Cap Screw Torque . . . . 6 N•m (53 lb-in.)
Spark Plug Torque . . . . 17 N•m (150 lb-in.)

Results:

- If valve clearance does not meet the specifications, loosen jam nut. Turn adjustment screw to adjust valve clearance to specifications. Hold screw and tighten nut to proper torque. Check clearance again.

CRANKCASE VACUUM TEST

Reason:

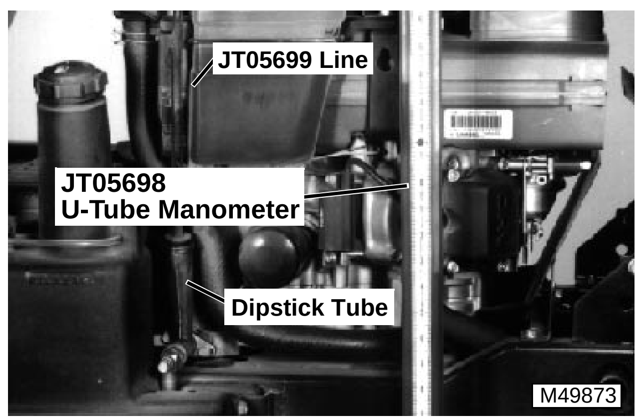
To check operation of the breather and condition of seals, gaskets, rings, pistons, and cylinder walls.

Test Equipment:

- JT05703 Barb Fitting
- JT05699 Line
- JT05698 U-Tube Manometer

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.
6. Remove dipstick and install appropriate plug from U-Tube Manometer Kit.
7. Insert large diameter end of JT05703 Barb Fitting into JT05699 Line.



8. Insert small end of barbed fitting into plug in dipstick tube.

IMPORTANT: DO NOT make connection between JT05698 U-Tube Manometer and JT05699 Line BEFORE engine is running or fluid in Manometer could be drawn into crankcase. DO NOT turn engine OFF until line has been disconnected from Manometer.

9. Start and run engine at **slow idle (1550 ±75 rpm)**.

10. Connect clear tube to Manometer.
11. Run engine at **fast idle (3400 ±75 rpm)**.
12. Open Manometer vent and record crankcase vacuum reading. Manometer should show a **minimum vacuum of 18 cm (7 in.) of water**.
13. Run engine at **slow idle (1550 ±75 rpm)**. DO NOT TURN ENGINE OFF!
14. Disconnect Line from Manometer.
15. Turn engine OFF.
16. Remove barbed fitting from dipstick tube and install dipstick.

Results:

- If crankcase vacuum is BELOW specification, check the following:

  Breather reed valve clearance and condition.

  Seals and gaskets for leakage.

  Valve cover gasket for leakage.

  Valve and valve seats for wear or damage.

  Head warpage.

  Rings, pistons, and cylinder walls for wear or damage.

ENGINE OIL PRESSURE TEST

Reason:

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

Test Equipment:

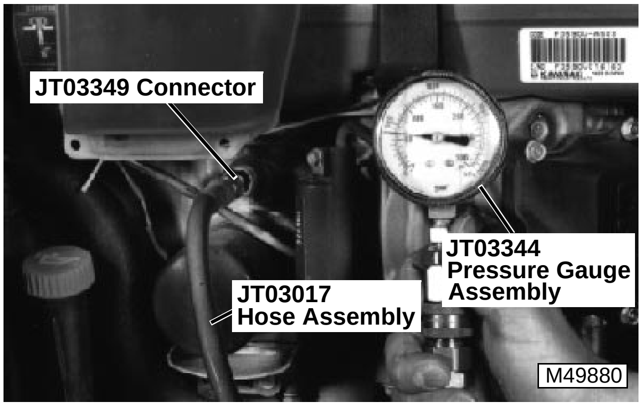
- JT03344 Pressure Gauge Assembly
- JT03017 Hose Assembly
- JT03349 Connector

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF. Allow engine to cool.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.

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

6. Check engine oil level, bring level to full mark.
7. Remove oil pressure switch.



8. Install JT03349 Connector.
9. Connect JT03017 Hose Assembly and JT03344 Pressure Gauge Assembly.

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

10. Monitor oil pressure while cranking engine. If no oil pressure is present, discontinue cranking engine. Determine and correct cause before running engine.
11. Start and run engine at MEDIUM idle for five minutes to heat engine oil to normal operating temperature.
12. Run engine at **fast idle (3400 ±75 rpm)** and check oil pressure. Gauge should read a **minimum oil pressure of 276 kPa (40 psi)**.

Results:

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

  Oil pressure relief valve for broken or worn spring.

  Oil pressure relief valve for stuck or damaged valve.

  Worn or damaged oil pump.

  Oil pump suction screen or oil passages plugged.

  Excessive wear of connecting rod and main bearing journals.

FUEL PUMP TEST

Reason:

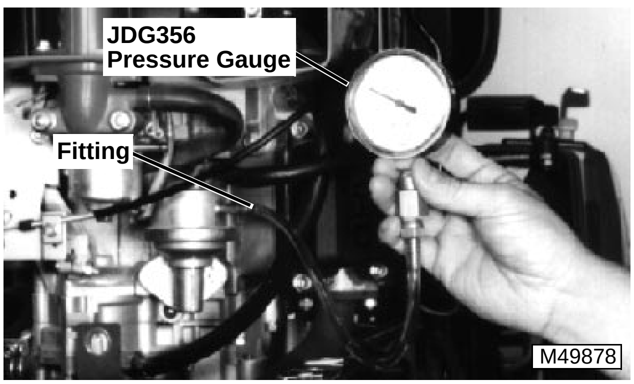
To check condition of fuel pump.

Test Equipment:

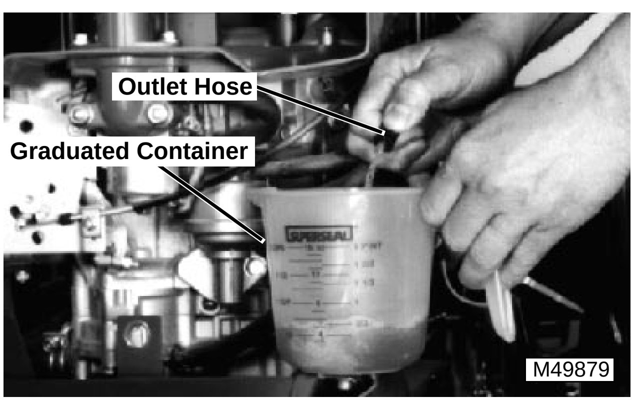
- JDG356 Pressure Gauge
- Graduated Container

Procedure:

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Engage parking brake.
4. Raise engine hood.
5. Start engine and run at **slow idle (1550 ±75 rpm**) for one minute to fill carburetor with fuel.
6. Stop the engine.



7. Disconnect fuel pump outlet hose from fitting.
8. Connect JDG356 Pressure Gauge to fuel pump outlet.
9. Start engine and run at **slow idle (1550 ±75 rpm)** for 15 seconds. Minimum Pressure should be **2.45 kPa (0.36 psi)**.
10. Stop engine.
11. Remove pressure gauge and connect fuel pump outlet hose to fuel pump.



12. Disconnect fuel pump outlet hose from carburetor and place it in graduated container.
13. Start and run engine at **slow idle (1550 ±75 rpm)** for 60 seconds, then stop engine and record container measurement. Minimum flow should be **800 ml/60 seconds (2.71 oz/60 seconds)**.

Results:

- If fuel pressure and/or flow does not meet specifications, check the following:
  Fuel lines, filter and fuel tank cap for restrictions.
  Check crankcase vacuum.
  Replace fuel pump.
  Check camshaft lobe and retest.

SPARK TEST

Reason:

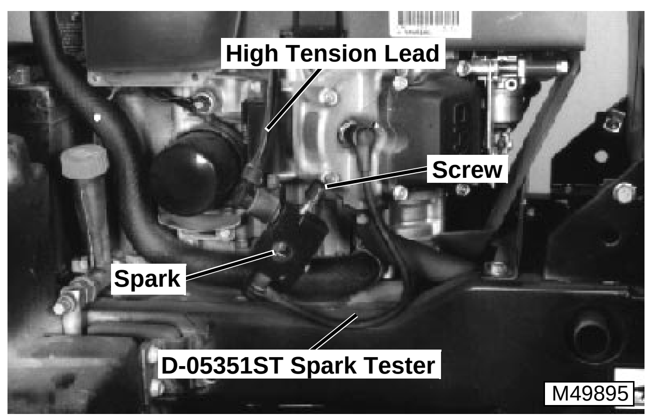
Check overall condition of ignition system.

Test Equipment:

- D-05351ST Spark Tester

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Mow/transport lever in TRANSPORT position.
6. Raise engine hood.



7. Remove high tension lead from spark plug.
8. Connect D-05351ST Spark Tester to spark plug.
9. Connect high tension lead to Spark Tester.

IMPORTANT: Do not adjust spark tester gap beyond 5.0 mm (0.200 in.) (5 turns), as damage to ignition components could occur.

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

Results:

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

SPARK PLUG GAP ADJUSTMENT

Test Equipment:

- Feeler Gauge

Procedure:

1. Park machine on level surface.
2. Turn key switch OFF.
3. Move travel pedals to NEUTRAL position.
4. Engage parking brake.
5. Raise engine hood.

CAUTION

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

6. Remove spark plug.

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

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

M48365

9. Check spark plug gap using a feeler gauge. Set gap to **0.6—0.7 mm (0.024—0.028 in.)**.
10. Install and tighten spark plug to **17 N•m (150 lb-in.)**.

CYLINDER LEAK-DOWN TEST

Reason:

To determine if compression pressure is leaking from cylinder.

Test Equipment:

- JDG472 Adapter

Procedure:

1. Run engine for five minutes to bring to operating temperature.
2. Remove spark plugs.
3. Remove rocker arm covers.
4. 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).
5. Install JDG472 Adapter in spark plug hole of cylinder to be tested.
6. Connect hose from compressed air source to Adapter.
7. Apply **1379 kPa (200 psi) maximum** air pressure into cylinder.
8. Check for bubbles in recovery tank or air escaping from muffler, air cleaner or oil fill opening.
9. Repeat for other cylinder.

Results:

- If bubbles are present in recovery tank, check for cracks in cylinder head and block. Check for damaged head gasket.
- If air escapes from muffler, check for worn or misadjusted exhaust valve.
- If air escapes from air cleaner, check for worn or misadjusted intake valve.

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

- If air escapes from engine oil fill, check for worn piston rings.

COOLING SYSTEM PRESSURE TEST

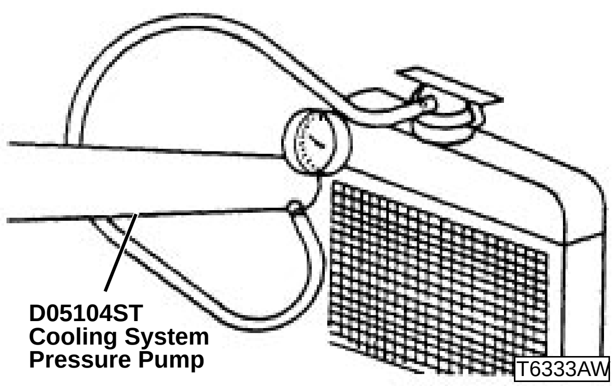
Reason:

Inspect cooling system for leaks.

Test Equipment:

- D05104ST Cooling System Pressure Pump
- JDG692 Radiator Pressure Test Kit (Adapters)

Procedure:



1. Remove radiator cap and attach D05104ST Cooling System Pressure Pump to radiator.

IMPORTANT: Do not exceed a maximum pressure of 117 kPa (17 psi) during test or damage to cooling system can occur.

2. Apply **90 kPa (13 psi) pressure** to cooling system. Pressure should hold steady for a **minimum of 15 seconds**.

Results:

- Pressure should hold to specifications. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.
- If 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. Perform CYLINDER LEAK-DOWN TEST on page 3-37.

RADIATOR CAP PRESSURE TEST

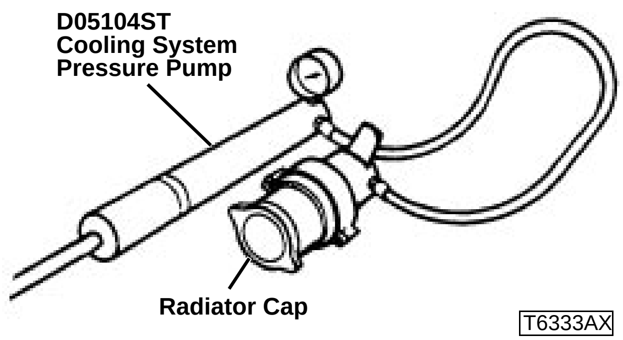
Reason:

To test radiator cap for operation in correct pressure range.

Test Equipment:

- D05104ST Cooling System Pressure Pump
- JDG692 Radiator Pressure Test Kit (Adapters)

Procedure:



1. Wet sealing surfaces of radiator cap and install on D05104ST Cooling System Pressure Pump.
2. Apply pressure. Pressure valve in cap should open at **73—103 kPa (10.5—15 psi)**.

Results:

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

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REPAIR

FUEL TANK

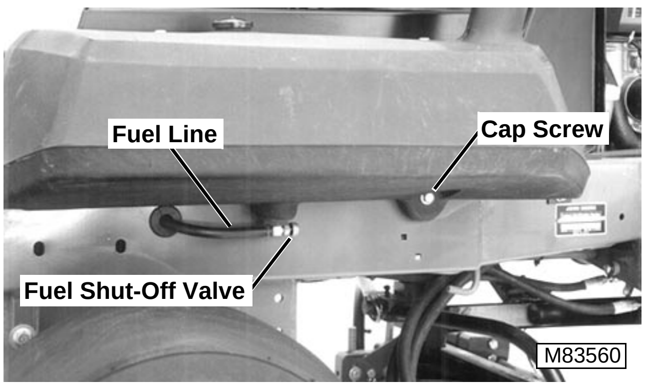
Removal/Installation

NOTE: The procedure describes removing the left tank. The procedure is the same for the right tank.

CAUTION

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

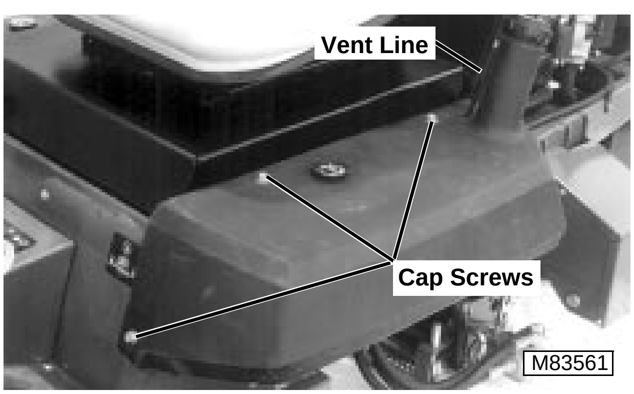
1. Place fuel selector valve in closed position.



2. Close fuel shut-off valve.
3. Disconnect fuel line.

*NOTE: Fuel tank capacity is approximate **19 L (5 gal)** (each)**.***

4. Drain fuel into a properly marked container.
5. Remove cap screw.



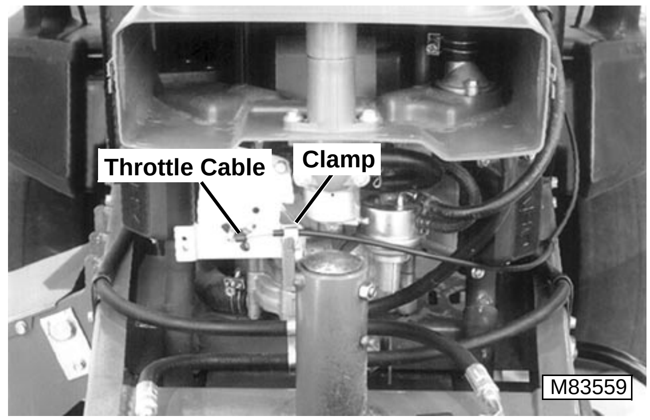
6. Disconnect vent line from filler neck.
7. Remove three cap screws.
8. Remove fuel tank.
9. Inspect fuel tank for wear or damage. Replace if necessary.

Installation is done in the reverse order of removal.

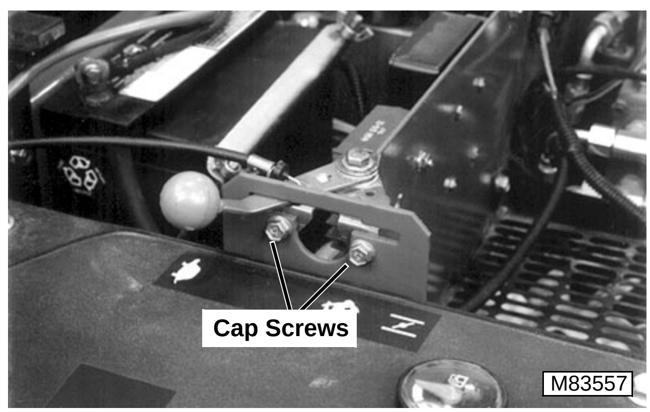
THROTTLE CONTROL LEVER AND CABLE

Removal/Installation

1. Raise and lock seat platform.
2. Raise engine hood.



3. Loosen clamp and disconnect throttle cable at control plate.



4. Remove cap screw and throttle control lever and cable assembly.
5. Replace throttle control lever and cable assembly as required.

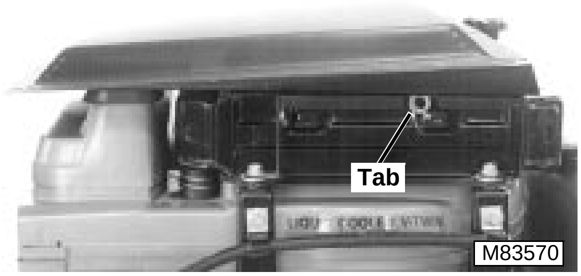
Installation is done in the reverse order of removal.

- Adjust throttle control cable and choke plate. (See THROTTLE CABLE CHECK AND ADJUSTMENT on page 3-29 and CHOKE PLATE CHECK AND ADJUSTMENT on page 3-29.)

INTAKE SCREEN

Removal/Installation

1. Raise engine hood.



2. Turn tabs on both sides of intake screen.
3. Remove intake screen.

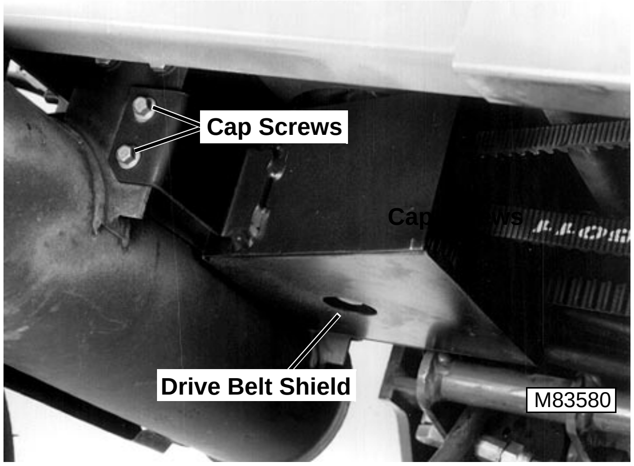
Installation is done in the reverse order of removal.

MUFFLER

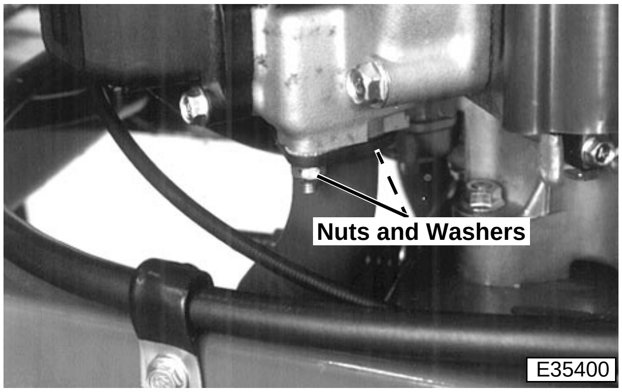
Removal/Installation

1. Raise engine hood.

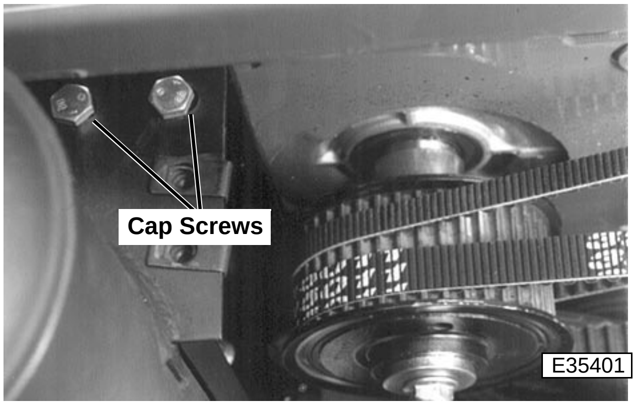
> **CAUTION**
>
> **To prevent possible burns, allow engine to cool before removing muffler.**



2. Remove four cap screws and drive belt shield.



3. Remove nuts and washers from both exhaust manifolds.



4. Remove cap screws and nuts securing muffler to engine adjustment strap. Remove muffler and gaskets.

Installation is done in the reverse order of removal.

- Use new gaskets for installation.

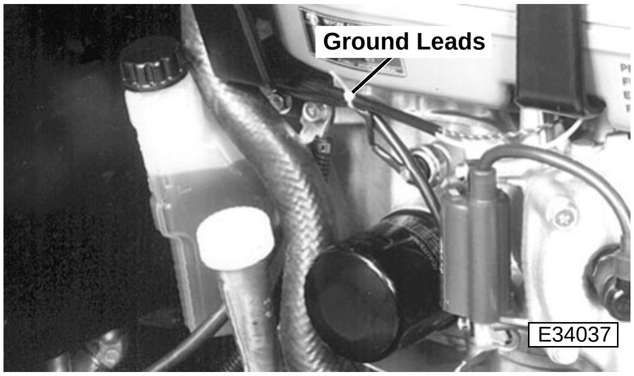
ENGINE

Removal/Installation

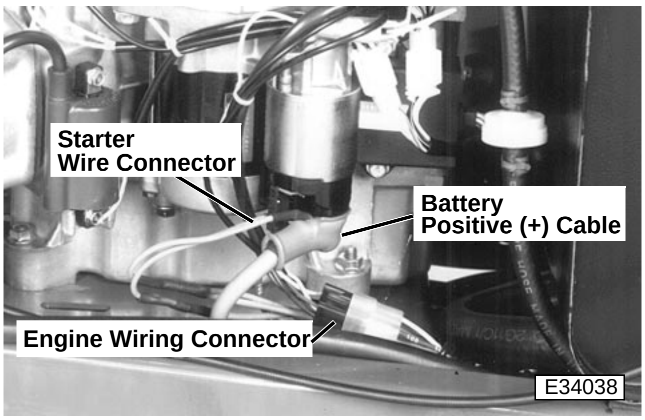
1. Remove engine hood. (See ENGINE HOOD—Removal/Installation on page 10-5.)
2. Remove muffler. (See MUFFLER —Removal/ Installation on page 3-41.)
3. Remove intake screen. (See INTAKE SCREEN —Removal/Installation on page 3-41.)
4. Disconnect negative (–) battery cable at battery.

NOTE: Engine oil capacity is approximately **1.9 L (4.0 U.S. pt)**.

5. Drain engine oil.



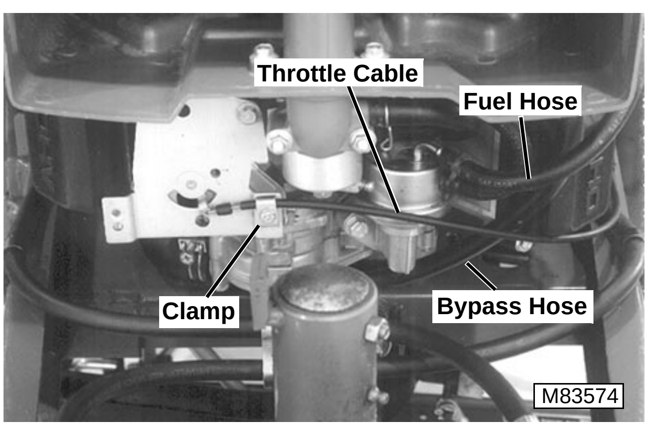
6. Disconnect ground leads from engine.



7. On right-hand side of engine, label and disconnect the following:
   Starter wire connector
   Engine wiring connector
   Positive (+) battery cable

CAUTION

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



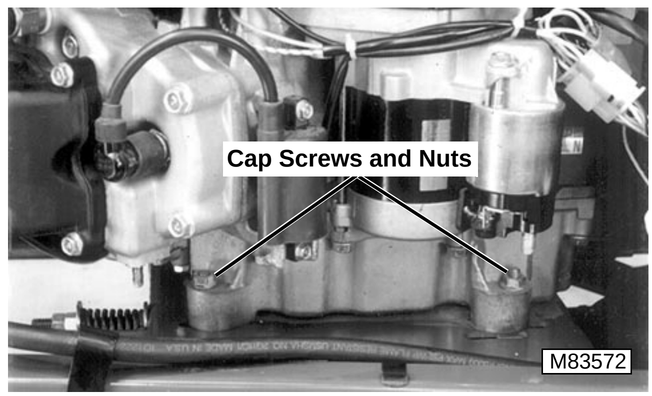
8. Loosen clamp and disconnect throttle cable at control plate.

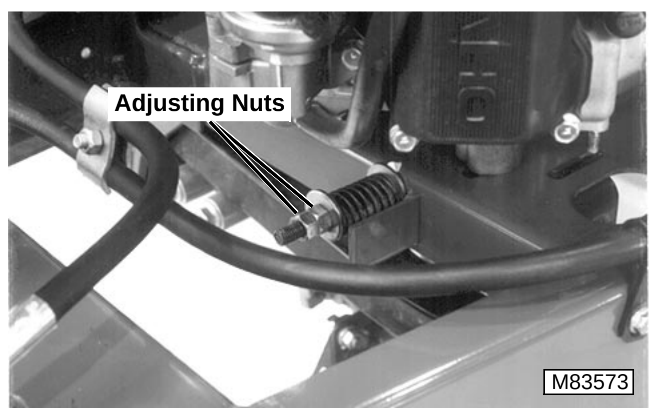
9. Disconnect fuel hose. Wipe up spilled fuel IMMEDIATELY.

CAUTION

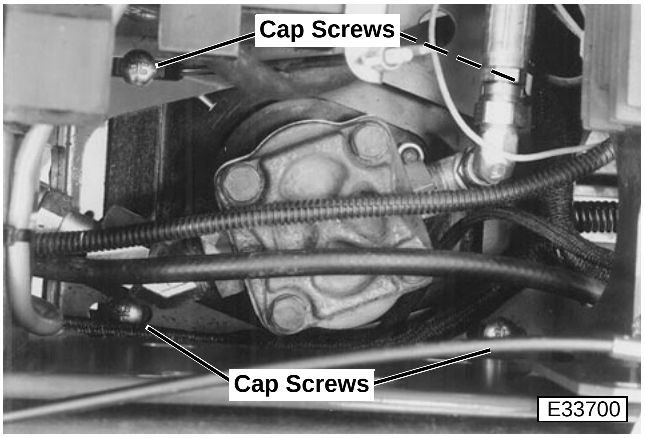
Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

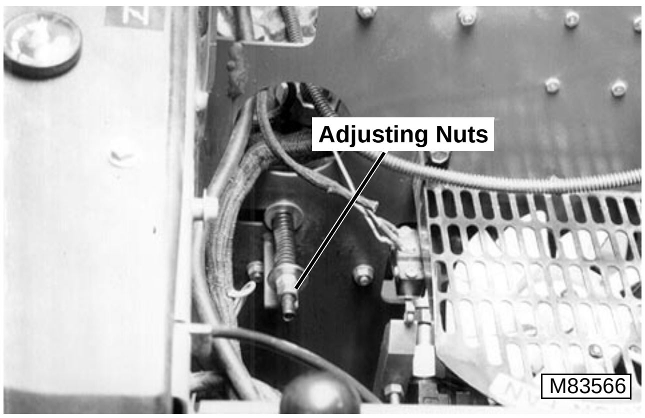
10. Loosen radiator cap to relieve pressure, then close tightly.
11. Disconnect bypass hose from cylinder head to drain cooling system. Capacity is approximately **3.04 L (3.2 U.S. qt.)**.
12. Reconnect bypass hose.





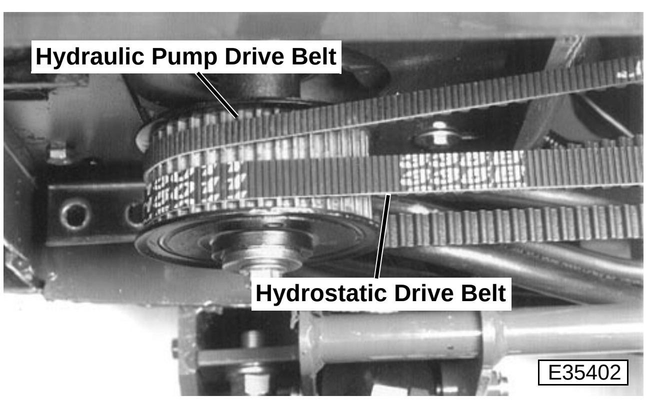
13. Loosen four engine cap screws and nut and belt tension adjusting nuts. Engine should be free to move back and forth, but not tip. Move engine as far forward as possible.





NOTE: Hydraulic pump sheave shield can be removed to gain access to pump cap screws and nuts.

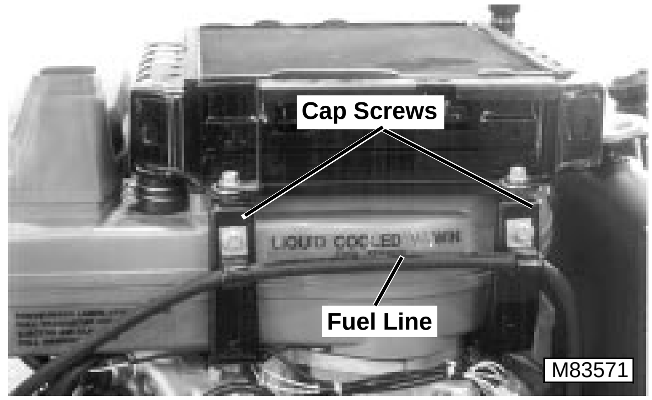
14. Loosen four hydraulic pump round-head bolts and nuts and adjusting nuts. Pump should be able to move back and forth, but not tip. Move pump as far rearward as possible.



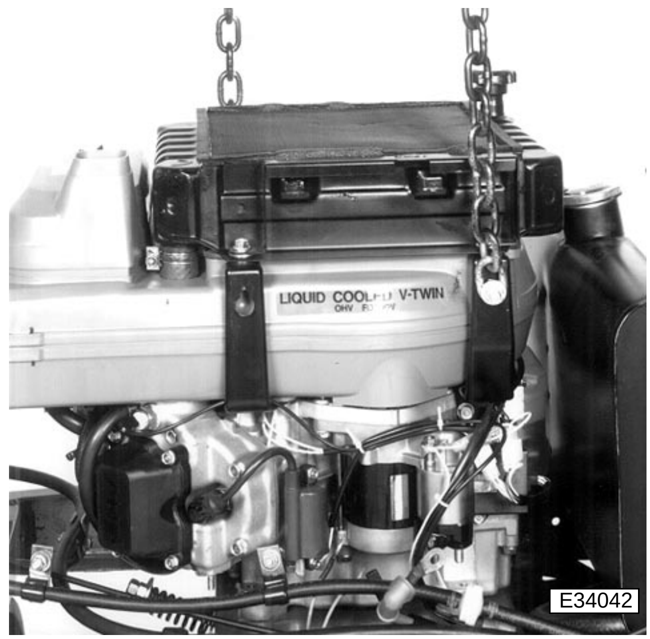
IMPORTANT: For maximum belt life, handle and install positive drive belts with care. Observe the following instructions to prevent damage to the belt tensile members.

- **DO NOT twist belt.**
- **DO NOT back bend belt.**
- **DO NOT crimp belt.**
- **DO NOT store on hook.**

15. Remove belts.



16. Loosen cap screws. Remove fuel line from engine by lifting straps from brackets.



IMPORTANT: When removing engine make sure hoist chains are vertical and do not come in contact with radiator, or damage may occur.

17. Remove four mounting cap screws and nuts.
18. Attach lifting device to radiator brackets, front bracket on one side and rear bracket on the other.

NOTE: When lifting engine make sure drive sheave clears frame.

19. Lift engine from frame.
20. Remove drive pulley.

Installation is done in the reverse order of removal.

- Apply MPG-2® Multipurpose Polymer Grease to engine crankshaft.
- Tighten engine mounting cap screws to **41 N•m (30 lb-ft.)**.
- Adjust drive belt tension. (See DRIVE BELT ADJUSTMENT on page 5-21.)

NOTE: If the engine has been rebuilt (cylinder rebored or deglazed, etc.), break-in oil should be used for the first 5 hours (maximum) of operation. (See BREAK-IN ENGINE OIL—NORTH AMERICA on page 2-14, or *BREAK-IN ENGINE OIL—EUROPE* on page 2-15.)

- Fill engine to proper level with oil of correct specifications. (See 4-CYCLE GASOLINE ENGINE OIL—NORTH AMERICA on page 2-16, or 4-CYCLE GASOLINE ENGINE OIL—EUROPE on page 2-17.)
- Fill engine cooling system to proper level with coolant of correct specifications. (See DIESEL AND GASOLINE ENGINE COOLANT—NORTH AMERICA on page 2-23, or GASOLINE ENGINE COOLANT—EUROPE on page 2-24.)
- Adjust throttle cable and choke plate. (See THROTTLE CABLE CHECK AND ADJUSTMENT on page 3-29 and CHOKE PLATE CHECK AND ADJUSTMENT on page 3-29.)

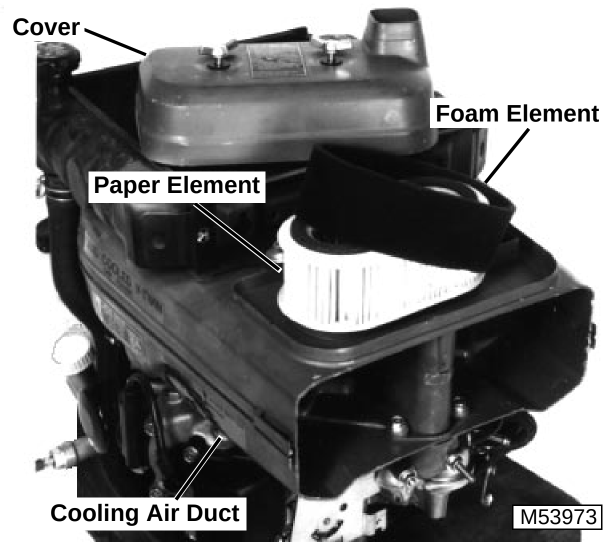
AIR CLEANER ASSEMBLY

Service

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

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

1. Remove and disassemble air cleaner.



2. Wash foam element in detergent and water. Dry element.
3. Apply 12—15 drops of clean engine oil to foam element. Squeeze out excess oil.

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

4. Gently tap paper element to remove dust.
5. Inspect paper element.
   - Element is still usable if you can see light through it and element appears clean.
   - Replace if oily, dirty, or damaged in any way.
6. Inspect cover and top half of air duct for damage. Replace parts as necessary.
7. Assemble and install air cleaner and cover.

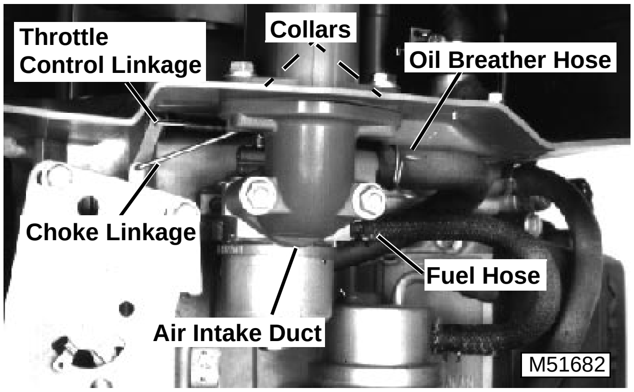
CARBURETOR

Removal/Installation

CAUTION

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. Drain fuel from carburetor. Wipe up spilled fuel IMMEDIATELY.



2. Disconnect oil breather and fuel hoses.

NOTE: Remove collars in air duct.

3. Disconnect linkages and remove carburetor with gaskets. Discard gasket.

Installation is done in the reverse order of removal.

- Use new gasket for installation.
- Tighten caps screws and nuts to **8 N•m (71 lb-in.)**.

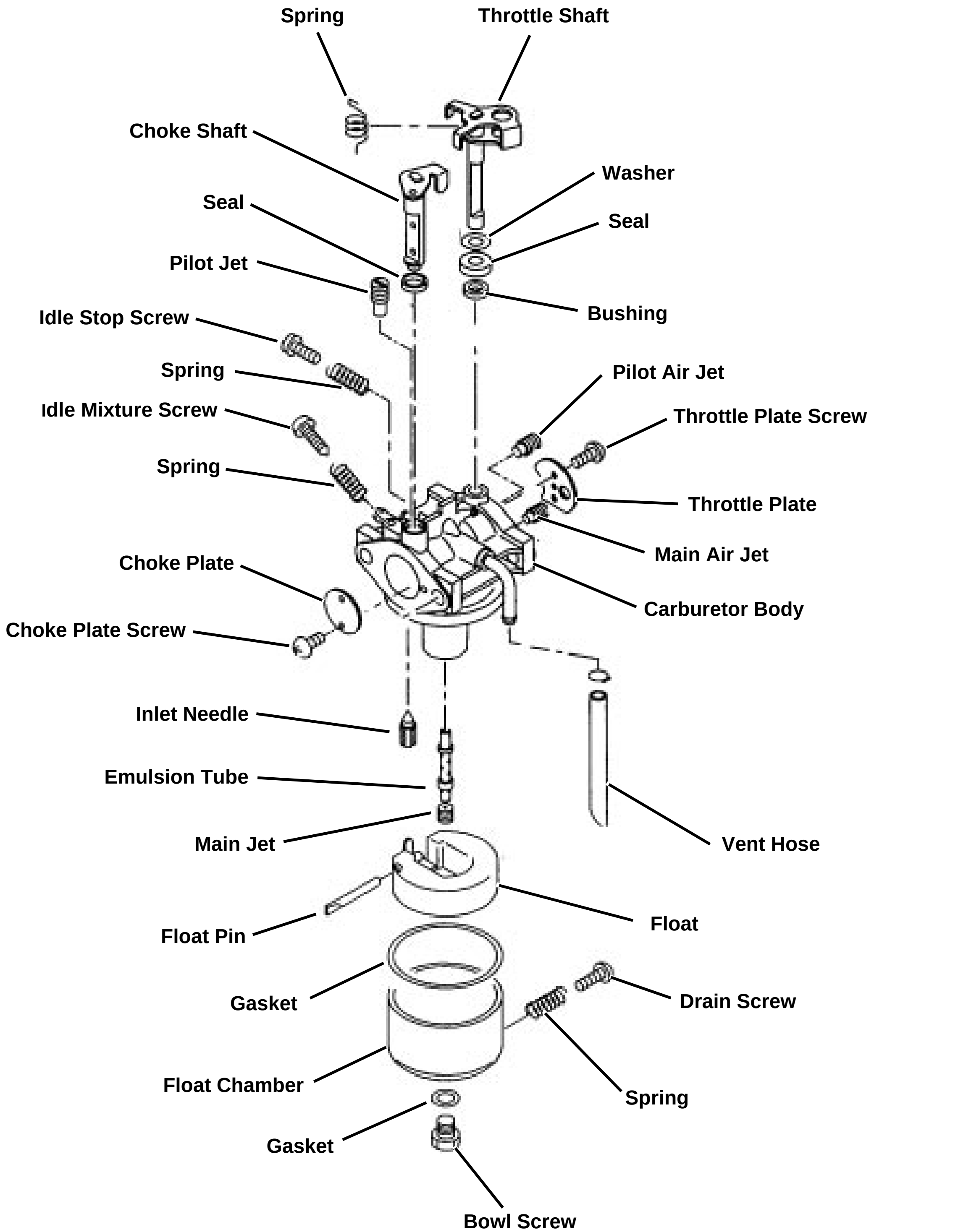
Disassembly/Assembly

CAUTION

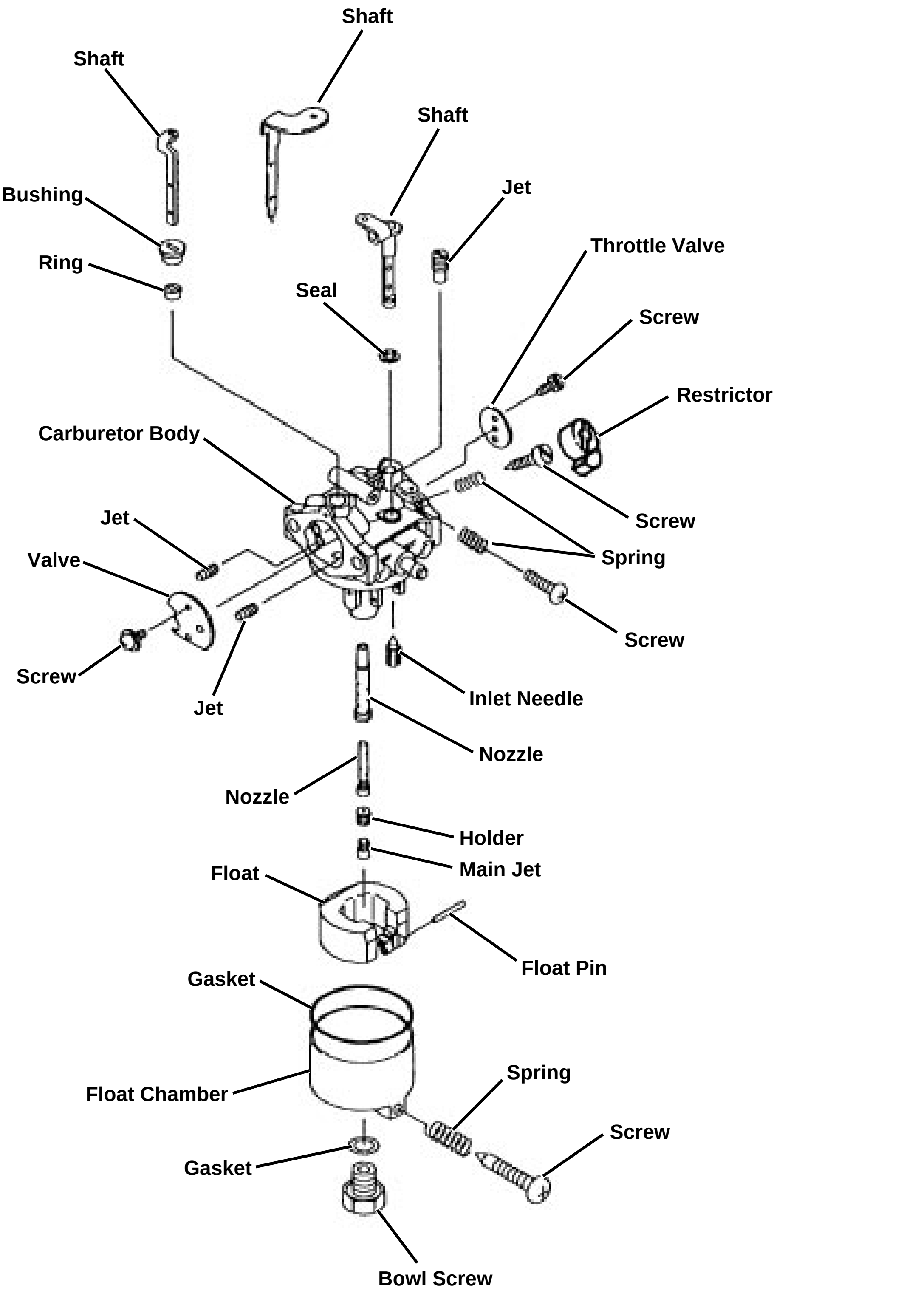
Gasoline is extremely flammable. Do not smoke. Always work in a ventilated area away from open flame or spark producing equipment, this includes equipment that utilizes pilot lights

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

IMPORTANT: To remove float, use a long-nosed pliers on the deformed end of the pin (18). Do not strike opposite end of pin. Damage to pin holder may result.



Carburetor (Engine S.N. —054261)



Carburetor (Engine S.N. 054262—)

Clean/Inspect/Rebuild

IMPORTANT: Do not clean holes or passages with small drills 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

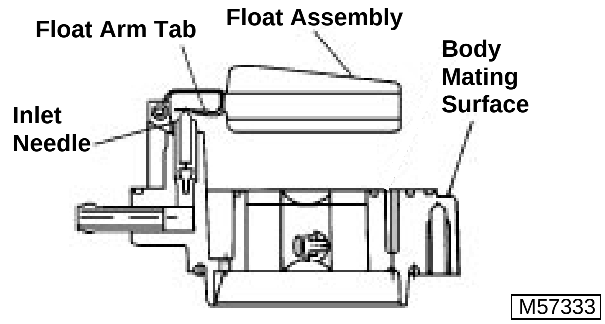
Reduce compressed air to less than 210 kPa (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

IMPORTANT: 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 the carburetor body for wear or damage. Verify all sealing surfaces and flanges are smooth and free of nick or burrs. Replace as necessary.
   - Inspect the inlet needle for wear or damage. The tip should be smooth, without any grooves, scratches or tears. If worn or damaged, replace the float assembly and carburetor body as a set.
   - Inspect the idle mixture screw for wear or damage, replace if necessary.
4. Turn the idle mixture screw in until it lightly seats, then back it out 1-3/8 turns.
5. Install the choke plate with the metering hole toward the fuel inlet joint of the carburetor.
6. Apply thread lock and sealer (medium strength) to threads of throttle and choke plate screws.
7. Verify that the float pin extends the same distance on both sides of the float hinge bracket when reassembling the carburetor.
8. Verify that the throttle and choke shafts move freely and that the shaft bosses are not elongated or worn. If shaft bosses have any of these conditions, replace the carburetor.

Float Level Adjustment

NOTE: Plastic floats are non-adjustable.

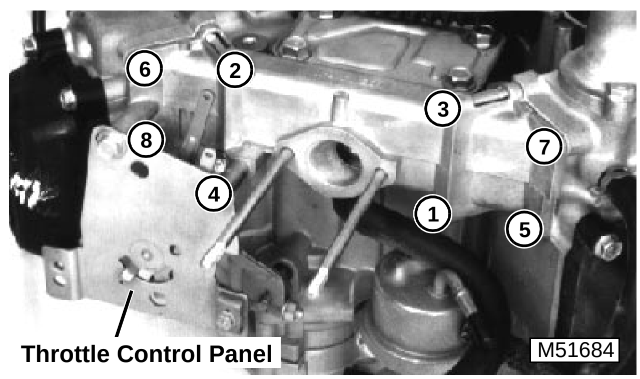


1. Adjust float level. Hold carburetor upside down at eye level with float assembly installed.
2. Gently support the float with a finger and lower it slowly until the float arm tab just touches the inlet needle. The float lower surface should be parallel with the body mating surface.
3. If necessary,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

INTAKE MANIFOLD

Removal/Installation

1. Remove cooling air duct. (See COOLING AIR DUCT—Removal/Installation on page 3-51.)
2. Remove carburetor. (See CARBURETOR —Removal/Installation on page 3-45.)



3. Remove throttle control panel.

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

4. Loosen mounting cap screws in sequence shown.
5. Remove cap screws, intake manifold, and gaskets.

Installation is done in the reverse order of removal.

- Install new gaskets.
- Tighten cap screws in sequence shown to initial torque of **3 N•m (27 lb-in.)** then to final torque of **6 N•m (53 lb-in.)**.

Inspection

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

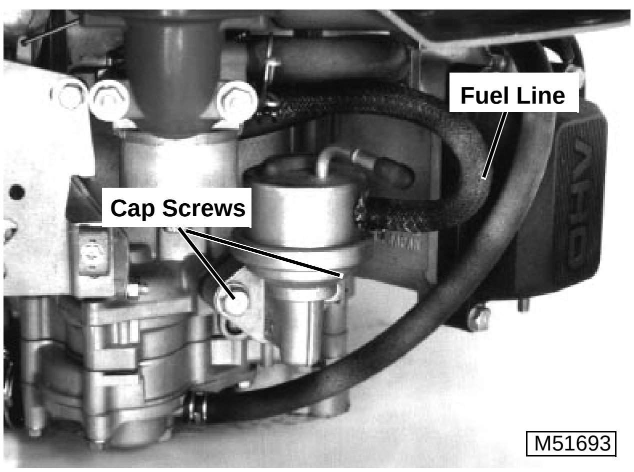
NOTE: Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light engine oil. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace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

FUEL PUMP

Removal/Installation

CAUTION

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.



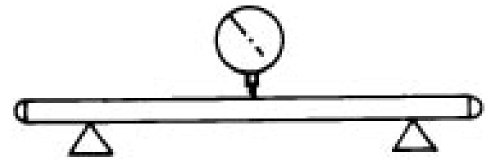
1. Disconnect fuel line.
2. Remove cap screws.
3. Remove fuel pump, gaskets, insulator, and push rod.
4. Inspect all parts for wear or damage, replace if necessary. (See Inspection procedure.)

Installation is done in the reverse order of removal.

- Tighten cap screws to **17 N•m (150 lb-in.)**.

Inspection

- Inspect pump and insulator for wear or damage, replace if necessary.



- Inspect push rod for bend using V-blocks and a dial indicator. Replace if variation is **greater than 0.05 mm (0.002 in.)**.

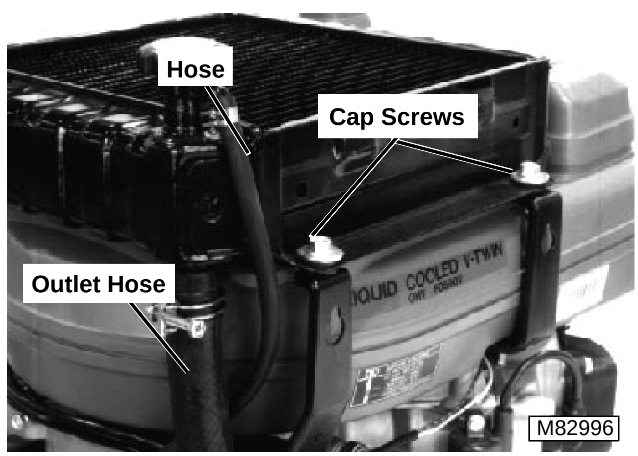
RADIATOR

Removal/Installation

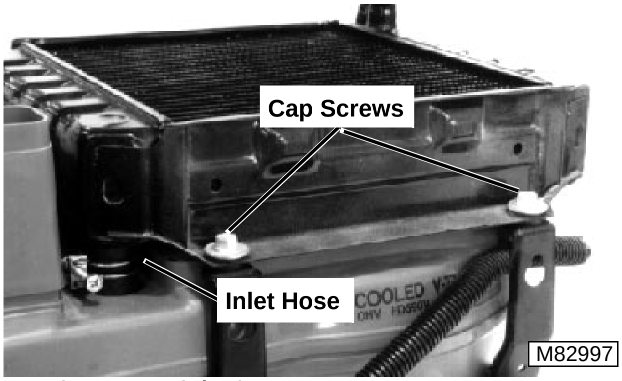
CAUTION

Explosive release of fluids from pressurized cooling system can cause serious burns. Shut off engine. Only remove filler cap when cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing cap.

1. Loosen radiator cap to relieve pressure. Then close tightly.
2. Disconnect bypass hose from cylinder head to drain cooling system. Capacity is approximately **3.04 L (3.2 U.S. qt)**.
3. Reconnect bypass hose.



4. Remove hose from overflow reservoir.
5. Disconnect outlet hose.
6. Remove two caps screws.



7. Disconnect inlet hose.
8. Remove two cap screws.
9. Remove radiator.

Installation is done in the reverse order of removal.

- Before installing radiator, inspect rubber seal for cracks or damage. Replace if necessary. Make sure seal is properly seated in groove.
- Fill engine cooling system to proper level with coolant of correct specifications. (See DIESEL AND GASOLINE ENGINE COOLANT—NORTH AMERICA on page 2-23, or GASOLINE ENGINE COOLANT—EUROPE on page 2-24.)

Inspection

Remove deflection screen.

- Inspect rubber dampeners for excessive wear or damage. Replace if necessary.

CAUTION

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.

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

COOLING FAN

Removal/Installation

1. Remove radiator. (See RADIATOR—Removal/ Installation on page 3-49.)

2. Remove four cap screws and cooling fan.

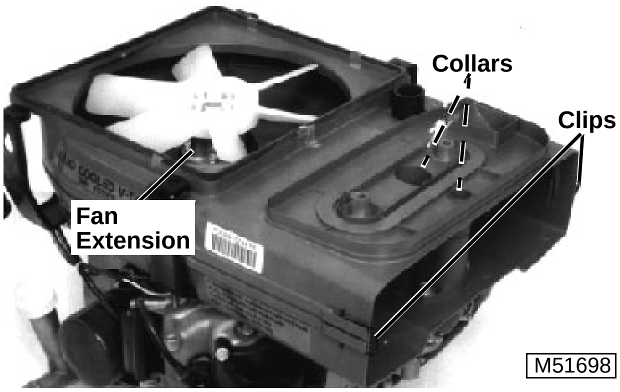
Installation is done in the reverse order of removal.

- Tighten cap screws to **6 N•m (53 lb-in.)**.

COOLING AIR DUCT

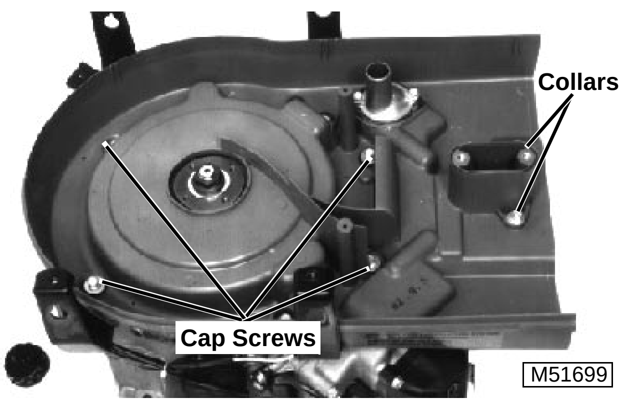
Removal/Installation

1. Remove radiator. (See RADIATOR—Removal/ Installation on page 3-49.)
2. Remove air cleaner assembly. (See AIR CLEANER ASSEMBLY—Service on page 3-44.)



IMPORTANT: Remove cap screws and collars carefully. Parts may fall into the air intake.

3. Remove cap screws and collars.
4. Remove retaining clips.
5. Remove cooling fan and fan extension.
6. Remove top half of air duct.



7. Remove caps screws.
8. Remove cap screws and collars.
9. Remove lower half of air duct.

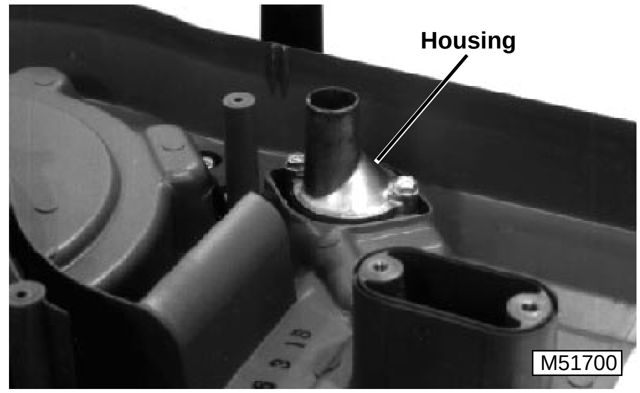
Installation is done in the reverse order of removal.

- Tighten all cap screws to **6 N•m (53 lb-in.)**.

THERMOSTAT

Removal/Installation

1. Remove top half of cooling air duct.



2. Remove housing, gasket, and thermostat.
3. Test thermostat. (See Opening Test procedure.)

Installation is done in the reverse order of removal.

- Use new gasket for installation.
- Tighten housing cap screws to **6 N•m (53 lb-in.)**.

Opening Test

Reason:

To determine opening temperature of the thermostat.

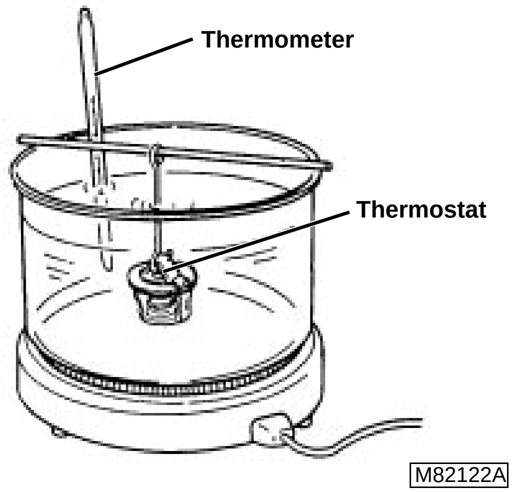
Test Equipment:

- Thermometer
- Glass Container
- Heating Unit

Procedure:

CAUTION

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.



1. Suspend thermostat and a 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.

Specifications:

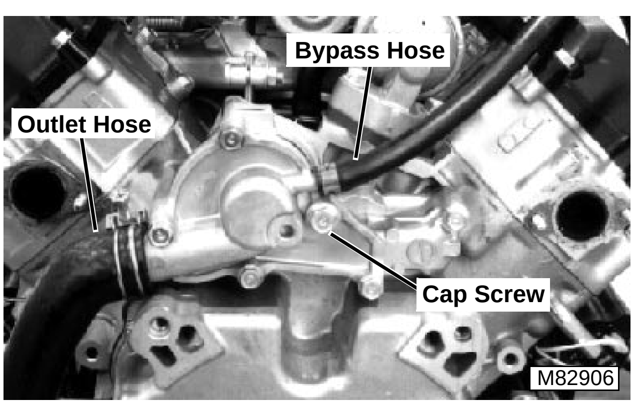
Begin Opening . . . . 82°C (180°F)
Fully Open. . . . . 95°C (203°F)

Results:

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

COOLANT PUMP

Removal/Installation



NOTE: Note length and position of mounting cap screws to aid in installation.

1. Disconnect bypass and outlet hoses. Remove mounting cap screws, pump and gaskets.
2. Inspect all parts for wear or damage. (See Disassembly/Inspection/Assembly procedure.)

Installation is done in the reverse order of removal.

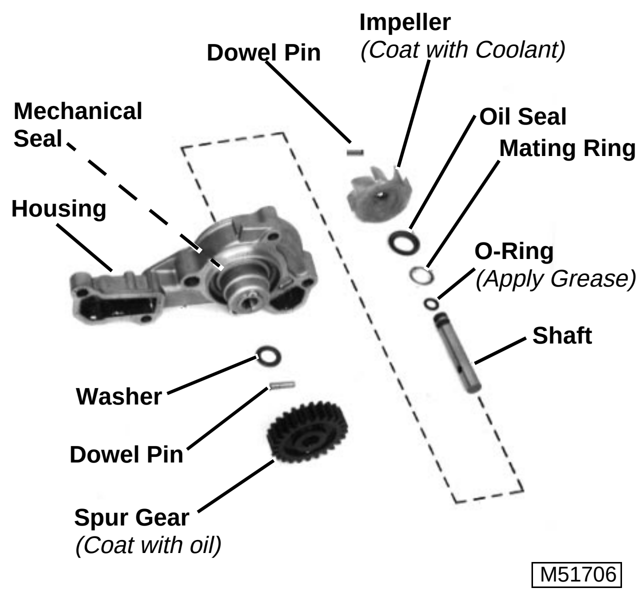
- Use new gaskets for installation.

NOTE: Cap screw attaches crankcase cover to crankcase.

- Tighten cap screw to **21 N•m (186 lb-in.)**.
- Tighten remaining cap screws to **9 N•m (78 lb-in.)**.

Disassembly/Inspection/Assembly

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



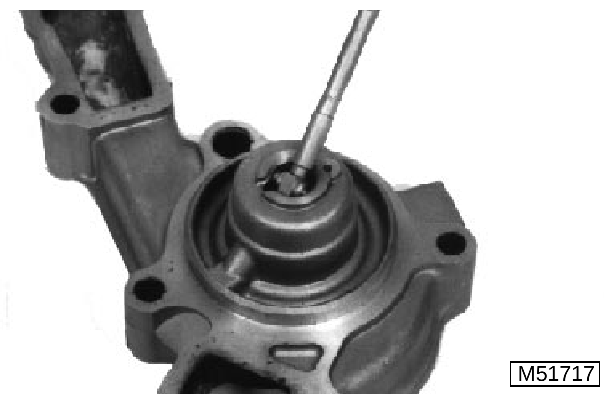
1. Remove spur gear with puller.
2. Remove impeller assembly from housing. Disassemble impeller assembly.

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

3. Drive old mechanical seal from housing.

M51716

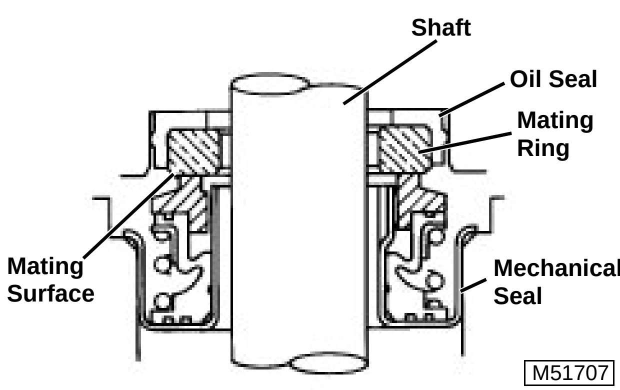
4. Measure outside diameter of impeller shaft. If shaft diameter is **less than 9.94 mm (0.391 in.)**, or shows any signs of corrosion, replace shaft.



M51717

5. Measure inside diameter of pump shaft bore in housing. Replace housing if shaft bore is **greater than 10.09 mm (0.397 in.)**.

Assembly is done in the reverse order of disassembly.

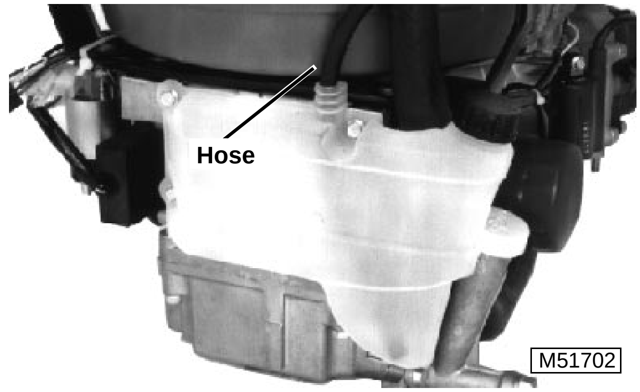


M51707

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

OVERFLOW RESERVOIR

Removal/Installation



M51702

1. Remove hose.
2. Remove cap screw and reservoir.

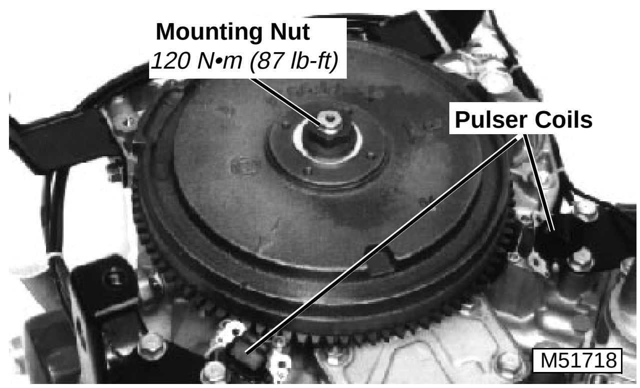
Installation is done in the reverse order of removal.

- Tighten mounting cap screws to **4 N•m (35 lb-in.)**.

FLYWHEEL

Removal/Installation

1. Remove cooling air duct. (See COOLING AIR DUCT—Removal/Installation on page 3-51.)



M51718

2. Move pulser coils away from flywheel.
3. Hold flywheel and remove mounting nut and washers.
4. Remove flywheel using a flywheel puller.

Installation is done in the reverse order of removal.

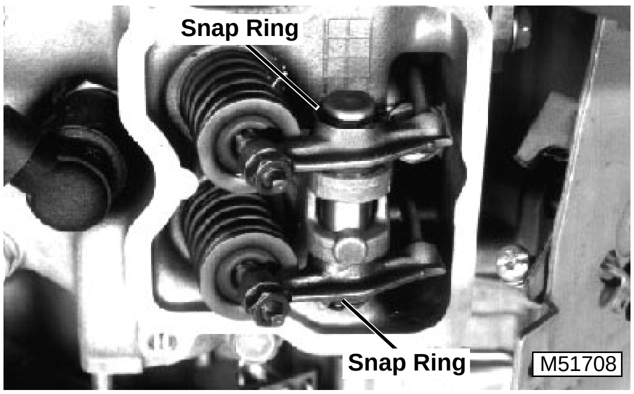
- Tighten nut to **120 N•m (87 lb-ft)**.

ROCKER ARM ASSEMBLY

Removal/Installation

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

1. Remove rocker arm cover.
2. Turn crankshaft until piston is at highest position on compression stroke.



3. Remove snap rings, shaft and arms.

IMPORTANT: Mark push rods for reassembly in original locations.

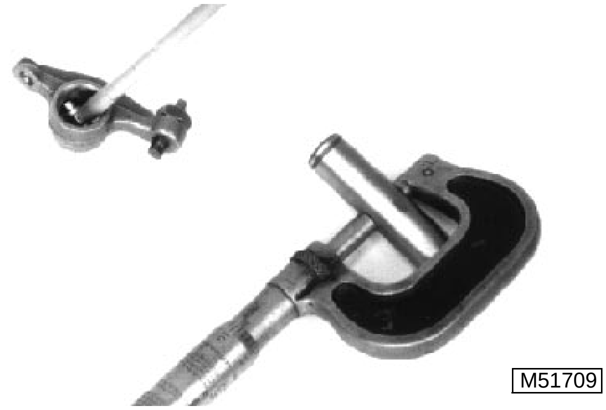
4. Remove push rods.
5. Inspect all parts for wear or damage. (See Inspection procedures.)

Installation is done in the reverse order of removal.

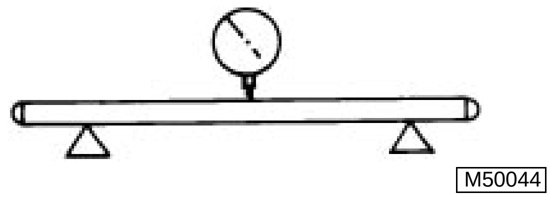
IMPORTANT: Align rocker arms over push rods during assembly.

- Adjust valve clearance. (See VALVE CLEARANCE CHECK AND ADJUSTMENT on page 3-34.)

Inspection



- Measure outer diameter of rocker arm shaft. Replace if shaft diameter measures **less than 11.95 mm (0.470 in.)**.
- Measure inner diameter of rocker arm bearing. Replace bearing if inside diameter is **greater than 12.07 mm (0.475 in.)**.



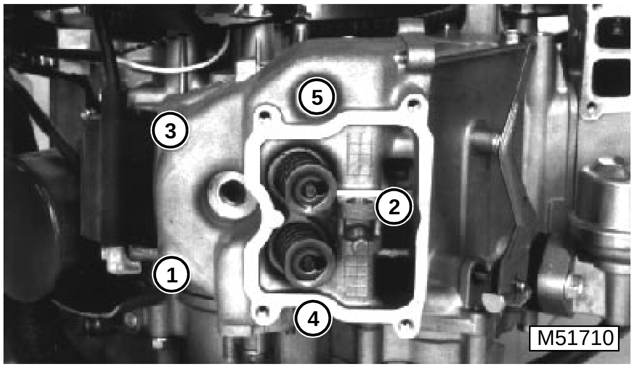
- Inspect push rod for bend using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace if variation is **greater than 0.80 mm (0.031 in.)**.

CYLINDER HEAD AND VALVES

Removal/Installation

NOTE: Number one cylinder head shown. Number two cylinder head is the same, except it has a thermostat housing, a coolant by-pass port, and a thermo-switch port.

1. Remove intake manifold. (See INTAKE MANIFOLD—Removal/Installation on page 3-48.)
2. Remove rocker arm assembly, and push rods.(See ROCKER ARM ASSEMBLY—Removal/ Installation on page 3-54.)
3. Remove spark plug.



IMPORTANT: Loosen cylinder head bolts 1/4 turn at a time, in the sequence shown to avoid warping the cylinder head.

4. Remove cylinder head assembly and gasket.
5. Disassemble and inspect cylinder head and valves. (See Inspection/Replacement procedures.)

Installation is done in the reverse order of removal.

- Use new gaskets for installation.

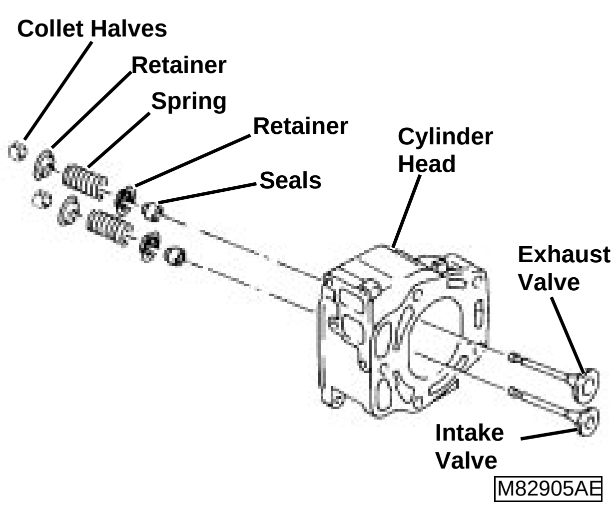
IMPORTANT: Torque should be applied in the sequence shown, in 3 N•m (27 lb-in.) increments. Install intake manifold before tightening mounting cap screws to final torque.

Torque Specifications:

Initial Torque . . . . 13 N•m (115 lb-in.)
Final Torque . . . . 21 N•m (186 lb-in.)
Spark Plug . . . . 17 N•m (150 lb-in.)

- Adjust valve clearance. (See VALVE CLEARANCE CHECK AND ADJUSTMENT on page 3-34.)

Disassembly/Assembly



- Inspect all parts for wear or damage. (See Inspection/Replacement procedures.)

IMPORTANT: Bottom spring retainer can only be removed with valve stem seal. Removal of retainer or seal damages stem seal. Inspect seal. If seal is not damaged, do not remove it.

- If necessary to replace stem seal, remove with screwdriver.
- Apply clean engine oil on intake and exhaust valve stems during assembly.

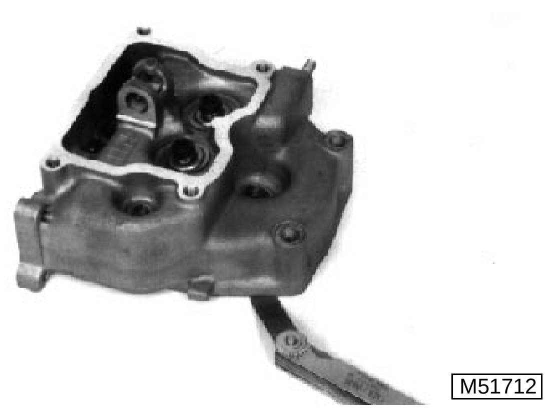
Inspection/Replacement

Cylinder Head:

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

> **CAUTION**
>
> **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.**

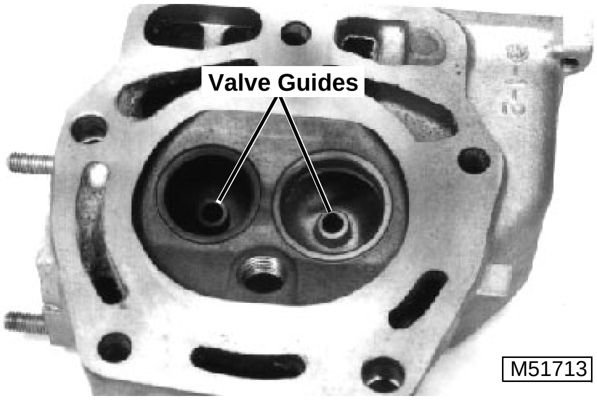
2. Clean head with a suitable solvent and dry with compressed air.
3. Inspect head for cracks or damage.
4. Inspect gasket surface for burrs and nicks.



5. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is **more than 0.06 mm (0.002 in.)**.

Valve Guides:

NOTE: Intake and exhaust valve guides cannot be replaced, replace head if worn.

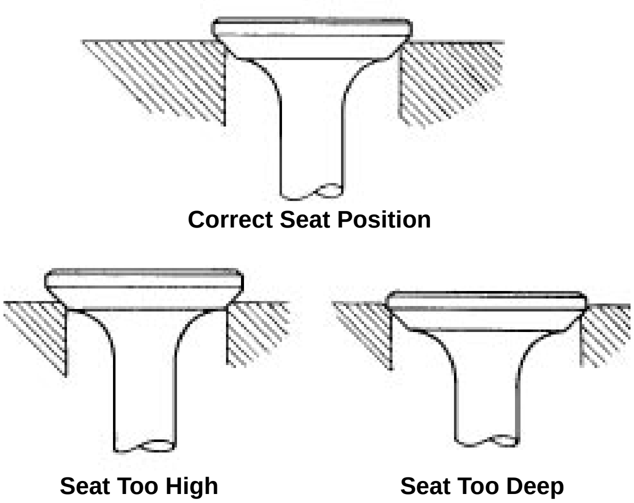


M51713

1. Clean inside of valve guides with valve guide cleaner.
2. Measure inside diameter of valve guides. Replace cylinder head if inside diameter is **greater than 6.05 mm (0.238 in.)**.

Valve Seats:

1. If valve seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be re-faced using a seat cutter.

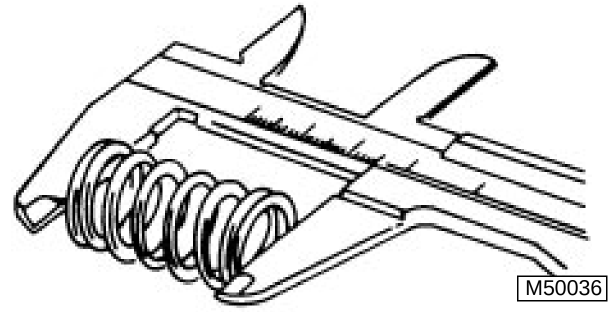


M18615

2. Check valve seating pattern for correct width and evenness all around. If valve seat width is not within **0.50—1.10 mm (0.020—0.043 in.)**, recondition valve seat. (See RECONDITION VALVE SEATS on page 3-58.)
3. Lap valve after reconditioning with lapping compound and recheck valve seating surface for proper width and evenness of seating pattern. (See LAP VALVES on page 3-58.)

Valve Springs:

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

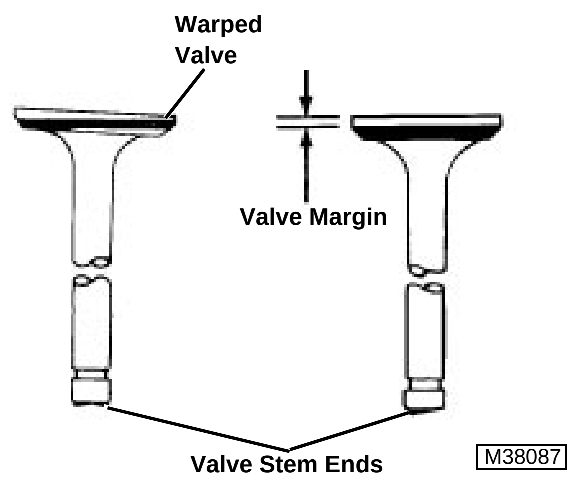


M50036

2. Measure spring free length. Replace spring if measurement is **less than 29.70 mm (1.170 in.)**.

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 stems for defects. Replace if necessary.



M38087

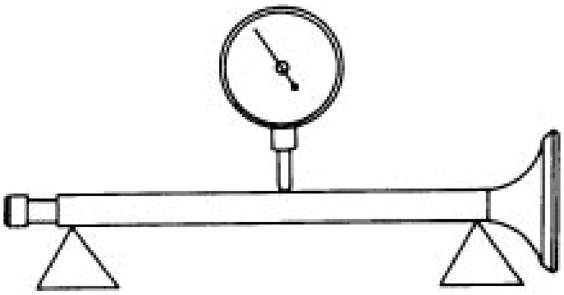
3. Replace warped valves or valves with less than **0.60 mm (0.024 in.)** margin. Valve stem ends should be ground square before checking valve to tappet clearance.

M53961

4. Measure outside diameter of valve stem. Replace valve if diameter is **less than specifications**.

Minimum Valve Stem O.D. Specifications:

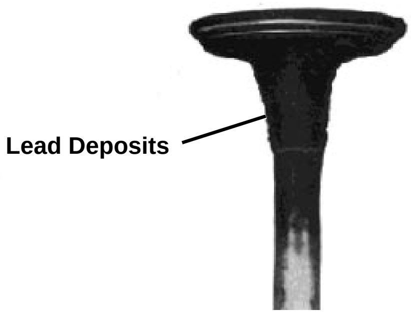
Intake	**5.94 mm (0.234 in.)**
Exhaust	**5.92 mm (0.233 in.)**



M51753

5. Check valve stem for bend using V-blocks and a dial indicator. Turn valve slowly and read variation on indicator. Replace if variation is **greater than 0.03 mm (0.001 in.)**.

ANALYZE VALVES



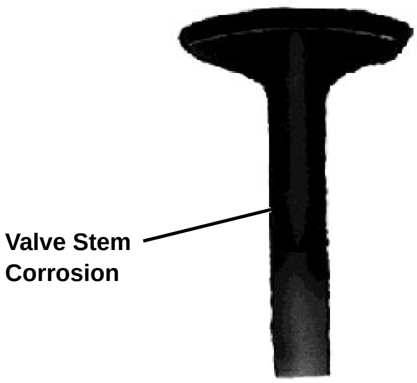
M29934

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

IMPORTANT: Do not grind the exhaust valve or life will be shortened.

Grind the intake valve and resurface the seat to correct this condition.

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

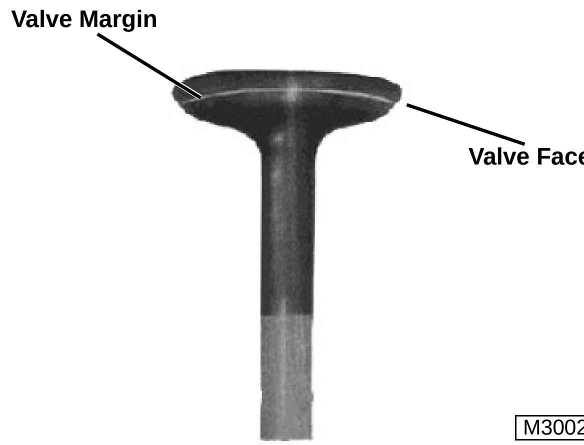


M5563

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

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

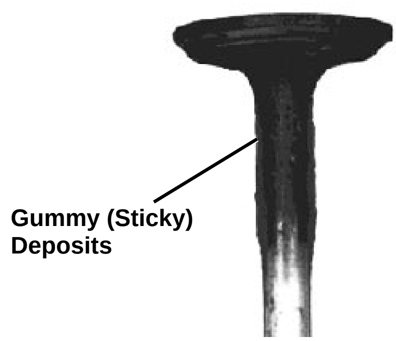
Corroded or pitted valves collect deposits and may cause sticking valves. Replace badly corroded or pitted valves.



M30024

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

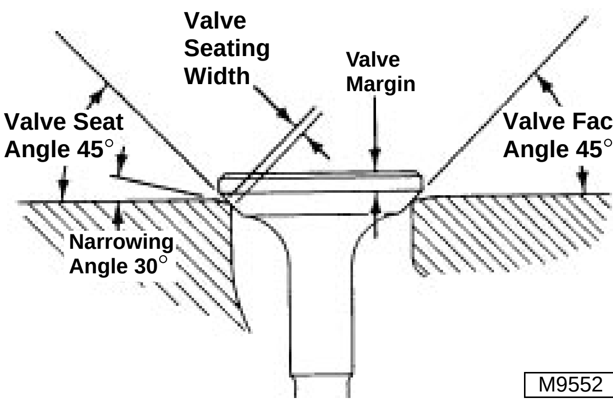
Using old or stale gasoline is a common cause for sticky valves.

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

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

RECONDITION VALVE SEATS

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

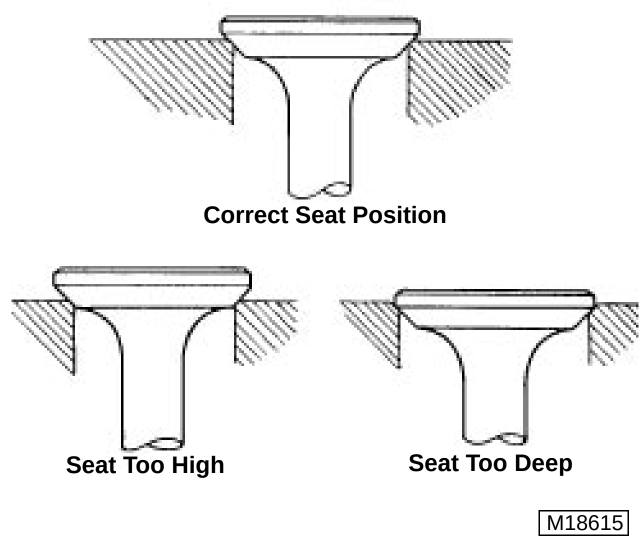


2. To recondition seat, cut at 45° angle to clean up seat. Cut narrowing angle at 30°. Finish cut at 45° to establish seating surface width.
3. Cut valve seating surface as close as possible to specifications.

Specifications:

Valve Seating Surface (Standard)	**0.80 mm (0.031 in.)**
Seat Width Tolerance	**0.50—1.10 mm (0.020—0.043 in.)**
Valve Seat Angle	**45°**
Valve Face Angle	**45°**
Valve Margin	**0.60 mm (0.024 in.)**
Valve Narrowing Angle	**30°**

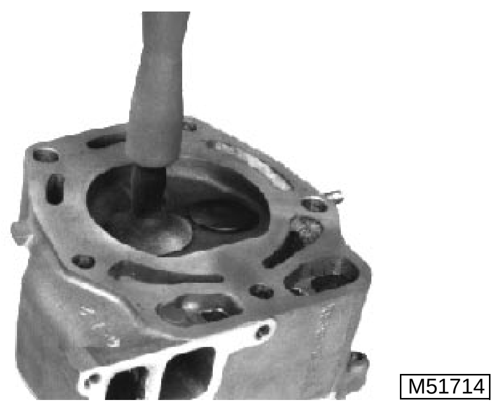
4. Lap valves to seats after re-facing. (See LAP VALVES on page 3-58.)
5. Center valve seat on the valve face.
6. Check seat for good contact using Prussian Blue Compound.



LAP VALVES

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

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



2. Grip top 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 the valve face.
4. Wash all parts in solvent to remove lapping compound. Dry parts.
5. Check position of lap mark on valve face. Lap mark must be on or near the center of valve face.

CRANKCASE COVER

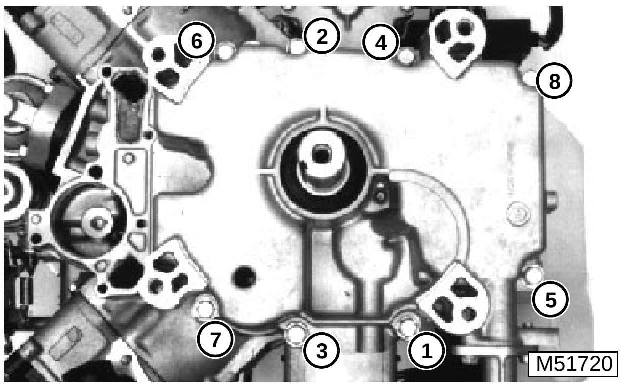
Removal/Installation

1. Drain oil from crankcase. Capacity is approximately **1.9 L (4.0 U.S. pt)**.
2. Remove coolant pump. (See COOLANT PUMP—Removal/Installation on page 3-52.)
3. Remove crankcase cover and gasket.
4. Clean crankcase and crankcase cover gasket surfaces.

Installation is done in the reverse order of removal.

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

• Use new gasket for installation.



• Tighten mounting cap screws to specifications using the sequence shown.

Torque Specifications:

Mounting Cap Screws . . . . . . 21 N•m (186 lb-in.)
Oil Drain Plug . . . . 25 N•m (221 lb-in.)

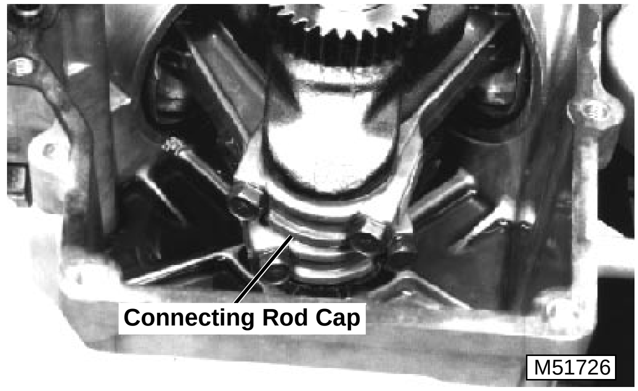
• Fill engine to proper level with oil of correct specifications. (See 4-CYCLE GASOLINE ENGINE OIL—NORTH AMERICA on page 2-16, or 4-CYCLE GASOLINE ENGINE OIL—EUROPE on page 2-17.)

PISTON AND CONNECTING ROD

Removal

NOTE: No. 1 cylinder is the right-hand cylinder viewed from the flywheel. No. 2 cylinder is the left-hand cylinder viewed from the flywheel.

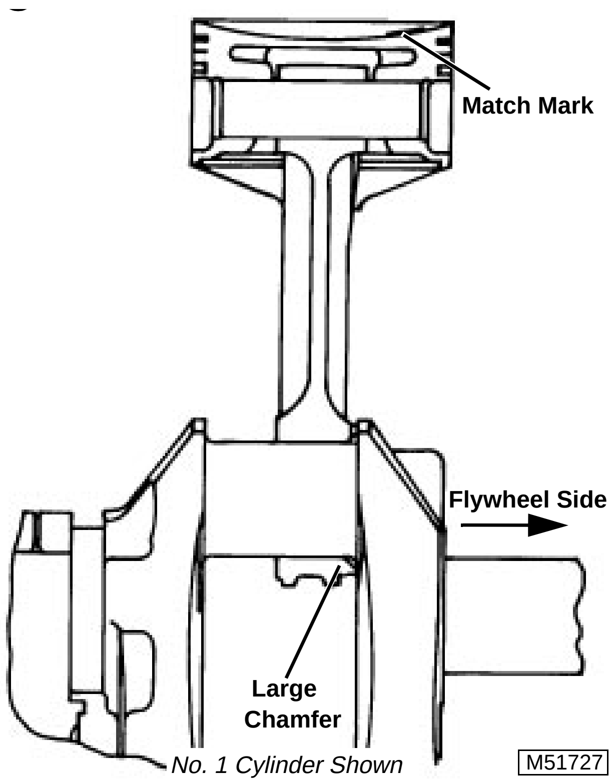
1. Remove cylinder head.
2. Remove crankcase cover.
3. Check cylinder bore for carbon and varnish ridges. These ridges can cause piston damage if not removed.
4. If necessary, remove ridges from the top of the cylinder bore with a ridge reamer.
5. Turn crankshaft to expose connecting rod end caps.



6. Remove connecting rod cap.
7. Push piston and connecting rod assembly from cylinder bore.
8. Disassemble and inspect all parts for wear or damage. (See Disassembly and Inspection procedures.)

Installation

1. Deglaze cylinder bore. (See DEGLAZE CYLINDER BORE on page 3-68.)
2. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end caps.
3. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.



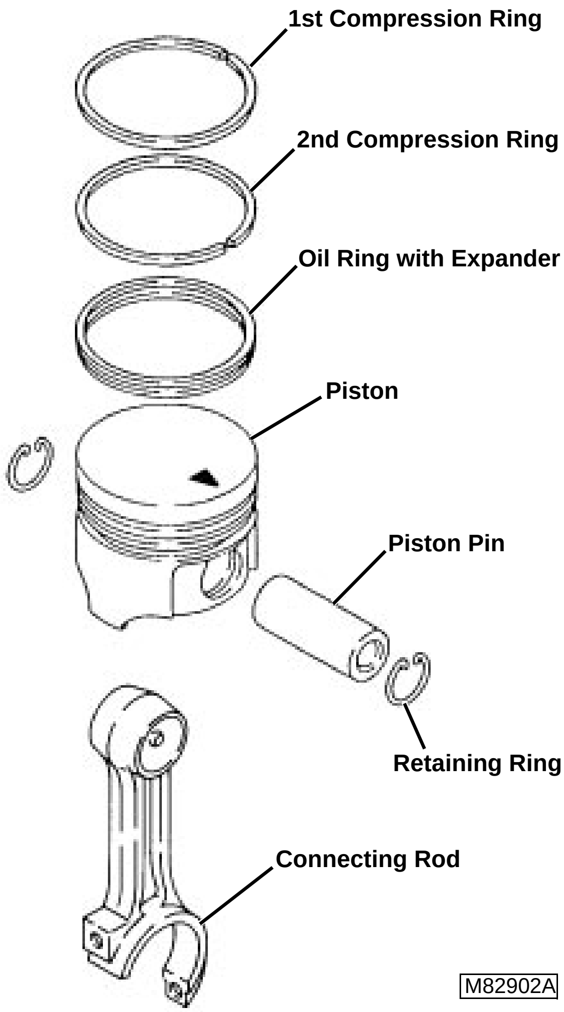
No. 1 Cylinder Shown

IMPORTANT: Match mark on pistons must face flywheel. Large chamfer of connecting rods must be against crankshaft web. (Opposite each other.)

4. Install piston and connecting rod assembly in cylinder bore with arrow match mark on piston head facing the flywheel side of the engine.
5. Apply a light film of clean engine oil to cap bearing surface and cap screws. Install connecting rod cap with chamfer facing crank web. Tighten cap screws to **21 N•m (186 lb-in.)**.
6. Install crankcase cover and cylinder head.

Disassembly

IMPORTANT: Note location of arrow match mark on piston head in relation to MADE IN JAPAN on connecting rod. No 1 piston is opposite of No. 2 piston. Keep parts together as a set.



- Analyze piston and piston ring wear. (See ANALYZE PISTON RINGS AND PISTON WEAR on page 3-63.)
- Mark each piston and connecting rod to aid in assembly.
- Remove piston rings with a piston ring expander.
- Inspect all parts for wear or damage. Replace as necessary. (See Inspection procedures.)

IMPORTANT: Do not reuse piston pin retaining rings. Always use new for assembly.

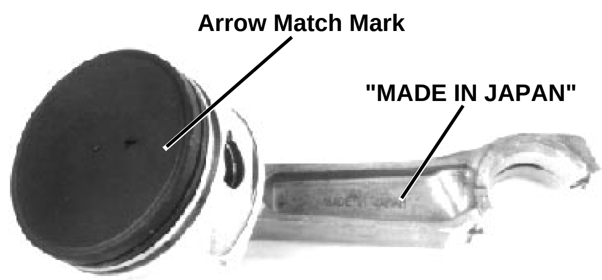
Assembly

- 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.



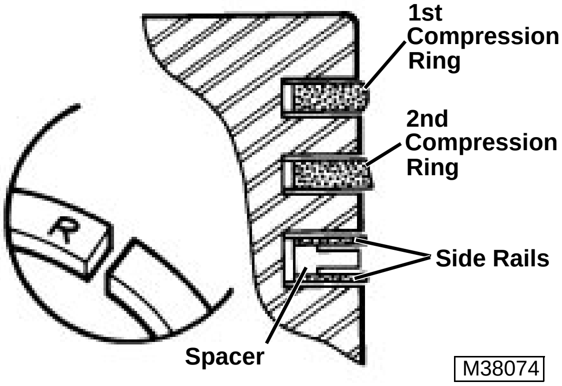
No. 1 Piston Shown

M38111

1. Assemble pistons to connecting rods:
   - No. 1 piston: Align arrow match mark on piston head with "MADE IN JAPAN" on connecting rod.
   - No. 2 piston: Align arrow match mark on piston head opposite "MADE IN JAPAN" on connecting rod.

IMPORTANT: 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 PISTON RINGS END GAP on page 3-62.)



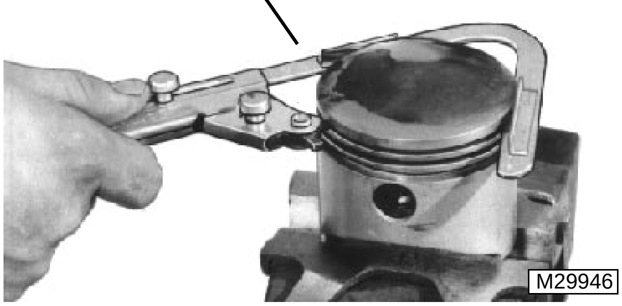
4. Install oil control and compression rings:
- Oil ring: Install spacer, then side rails. Position lower side rail end gap approximately 45° away from arrow match mark on top of piston. Align upper side rail end gap 180° to lower side rail end gap.
- Install second compression ring in middle groove 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 in top groove. Ring should turn freely in groove. Turn ring until gap is aligned with upper oil ring side rail end gap.

Inspection

Piston:

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

1. Remove all deposits from the piston.



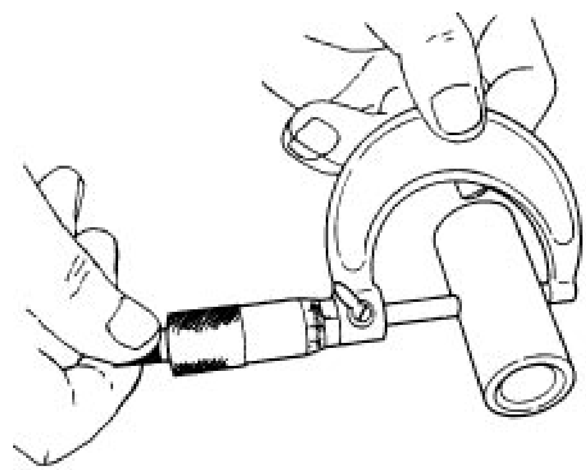
2. Clean carbon from piston ring grooves with a ring groove cleaner. If cleaning tool is not available, break an old ring and use it to carefully clean groove.
3. Check that all oil return passages in grooves are open.
4. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

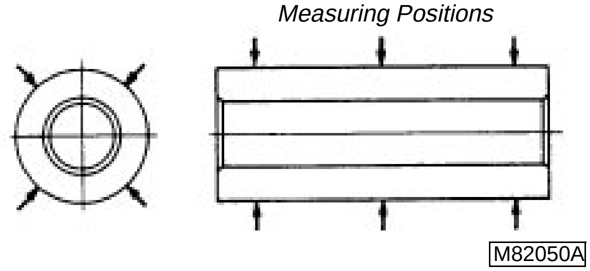
5. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specifications.

Ring Groove Side Clearance Specifications:

Compression Rings . . . . . . 0.10 mm (0.004 in.)
Oil Control Rings . . . . .Not Measured



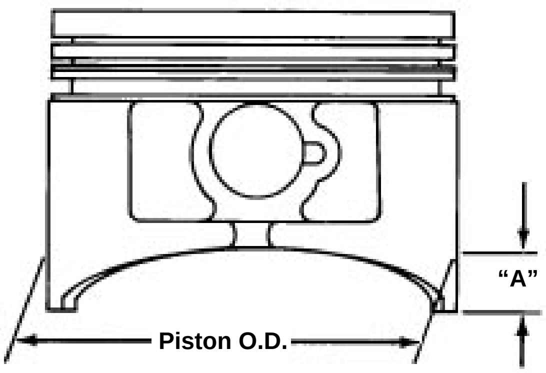
Measuring Positions



6. Measure piston pin diameter at six places. Replace pin if measurement is **less than 16.98 mm (0.668 in.)**.

M80427

7. Measure piston pin bore diameter in piston. Replace piston if measurement is **greater than 17.04 mm (0.671 in.)**.



M53956

8. Measure piston O.D. perpendicular to piston pin at distance "A". If piston diameter is less than specifications, 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.

Piston Specifications:

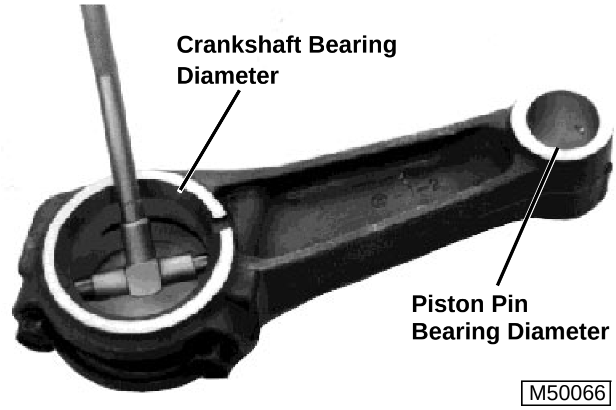
Distance "A" . . . . 11 mm (0.433 in.)
Piston O.D.
Standard Piston . . . . 73.935—73.950 mm (2.9108—2.9114 in.)

0.50 mm (0.020 in.)
Oversize Piston . . . . 74.46—74.48 mm (2.934—2.935 in.)

9. Measure cylinder bore diameter. (See CYLINDER BLOCK—Inspection on page 3-68.)
10. Subtract piston O.D. measurement from cylinder bore measurement to determine piston-to-cylinder bore clearance.
11. Replace piston and/or rebore cylinder block if clearance is not within **0.015—0.170 mm (0.00118—0.0059 in.)**.

Connecting Rod:

1. Analyze crankshaft and connecting rod wear. (See ANALYZE CRANKSHAFT AND CONNECTING ROD WEAR on page 3-67.)
2. Clean and inspect rod. Replace if scored.
3. Install connecting rod cap. Tighten to **21 N•m (186 lb-in.)**.



M50066

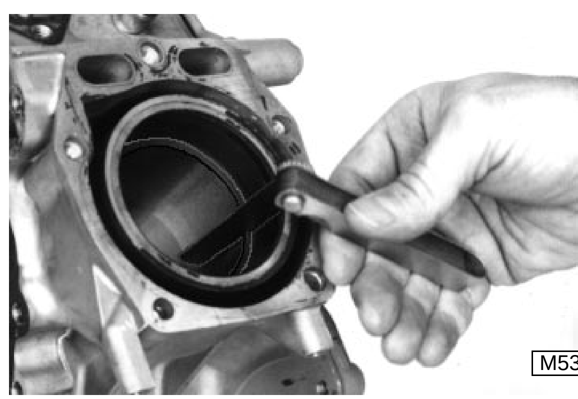
4. Measure connecting rod crankshaft bearing diameter and piston pin bearing diameter. Replace connecting rod if either measurement is greater than specifications.

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

Connecting Rod Bearing I.D. (Wear Limit):

Crankshaft Bearing
Standard . . . . 34.06 mm (1.341 in.)
Undersized . . . . 33.56 mm (1.321 in.)
Piston Pin Bearing . . . . 17.05 mm (0.671 in.)

Piston Rings:



M53962

1. 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.

End Gap Specifications (Maximum):

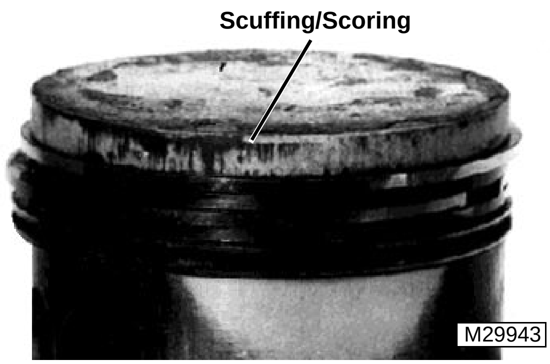
Compression Rings . . . . 1.00 mm (0.040 in.)

Oil Control Ring (Side Rails) . . . . .Not Measured

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.

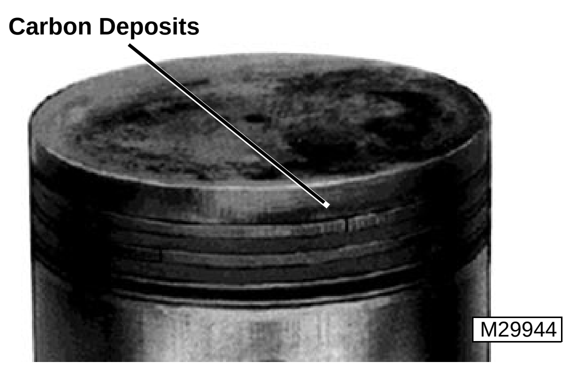
Ring end gaps should be staggered on the piston during installation. End gaps in alignment can also cause oil consumption and blow-by.



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

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

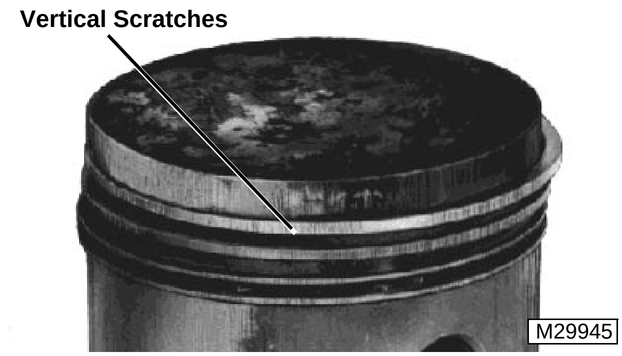
- Engine overheating.
- Lack of cylinder lubrication.
- Improper combustion.
- Wrong bearing or piston clearance.
- Too much oil in crankcase causing fluid friction.



The engine operating at abnormally high temperatures may cause varnish, lacquer or carbon deposits to form in the piston grooves making the 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:

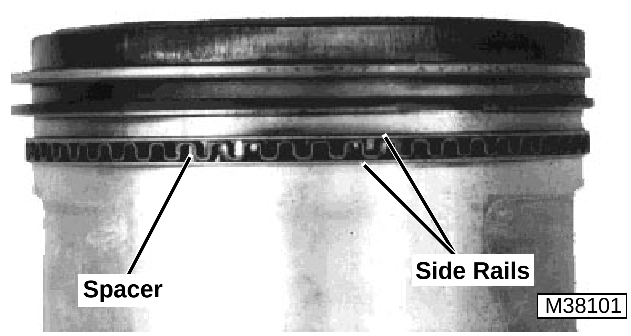
- Overheating
- Incorrect ignition timing.
- Lean fuel mixture.
- Incorrect oil.
- Low oil supply.
- Stale fuel.



Vertical scratches 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 gasket between air cleaner and carburetor.
- Air leak around carburetor-to-cylinder head gasket.
- Air leak around throttle shaft, or choke shaft.
- Failure to properly clean cylinder bore after reconditioning engine.
- Air leak at breather hose.



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

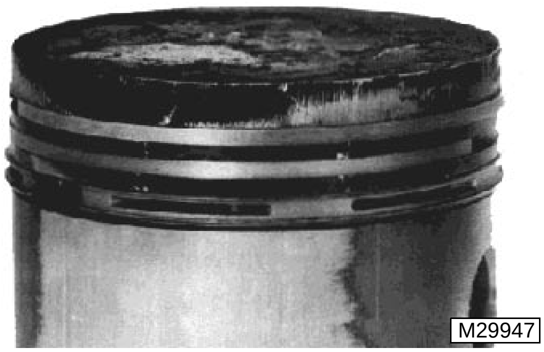
- High oil consumption.
- Increased deposits in combustion chamber.
- Sticking compression rings.

Increased oil consumption may be caused by:

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

ANALYZE PISTON WEAR

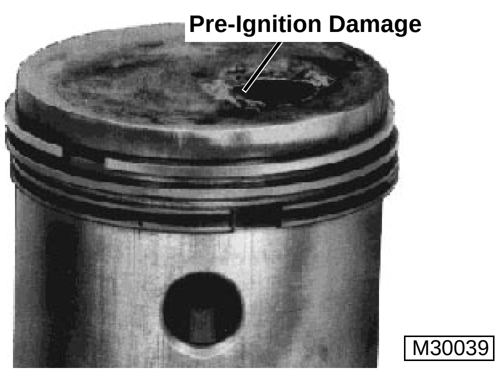
Detonation, is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called knock, spark knock, or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.



M29947

The following is a list of possible causes for detonation.

- 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 to piston, rings and valves result 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 extending across the skirt of the piston. Contact with the cylinder wall shows on the bottom of skirt at left and rings lands on 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.
- Excessive oil consumption.

M29949

A broken retaining ring cased the damage shown. Retaining rings loosen or break due to:

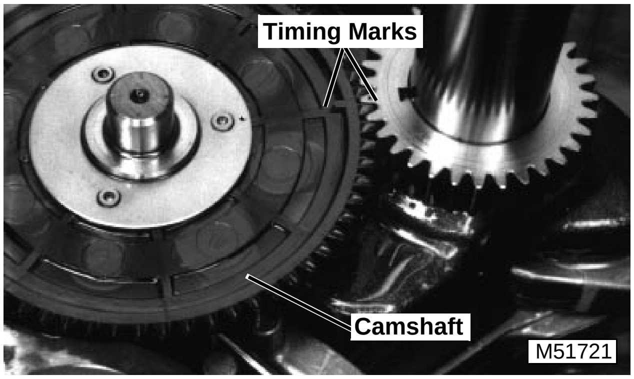
- Rod misalignment.
- Excessive crankshaft end play.
- Crankshaft journal taper.
- Weak retaining rings.
- Incorrectly installed retaining rings.

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

CAMSHAFT AND TAPPETS

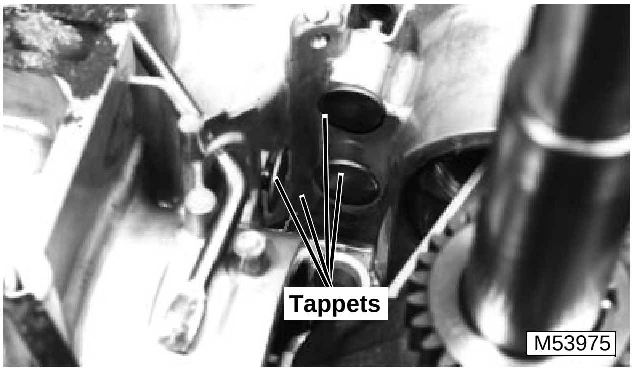
Removal/Installation

1. Remove fuel pump. (See FUEL PUMP—Removal/ Installation on page 3-49.)
2. Remove rocker arm assemblies. (See ROCKER ARM ASSEMBLY—Removal/Installation on page 3-54.)
3. Remove crankcase cover. (See CRANKCASE COVER—Removal/Installation on page 3-59.)



IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

4. Rotate crankshaft until timing marks align.
5. Remove and inspect camshaft. (See Inspection procedures.)



NOTE: Mark tappets so they can be installed in their original guides during assembly.

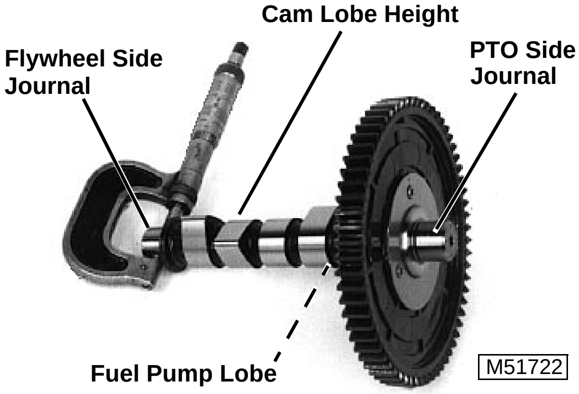
6. Remove and inspect tappets for wear or damage. Replace if necessary.

Installation is done in the reverse order of removal.

- Align timing marks when installing camshaft.

Inspection

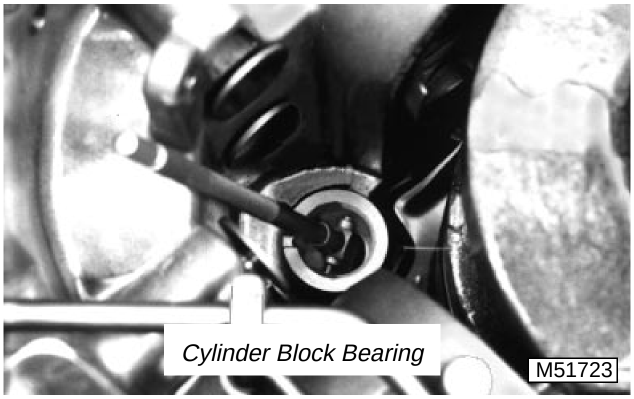
1. Inspect camshaft for worn or broken teeth.
2. Check for loose rivets holding the gear to camshaft. Replace camshaft if loose.



3. Measure flywheel side journal, PTO side journal, cam lobe height, and fuel pump lobe. Replace camshaft if any measurement is less than specifications.

Camshaft Specifications (Minimum)

PTO Side Journal	**15.91 mm (0.626 in.)**
Flywheel Side Journal	**15.91 mm (0.626 in.)**
Cam Lobe Height	**25.23 mm (0.993 in.)**
Fuel Pump Lobe Height	**19.50 mm (0.760 in.)**



4. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if either diameter is **greater than 16.07 mm (0.633 in.)**.

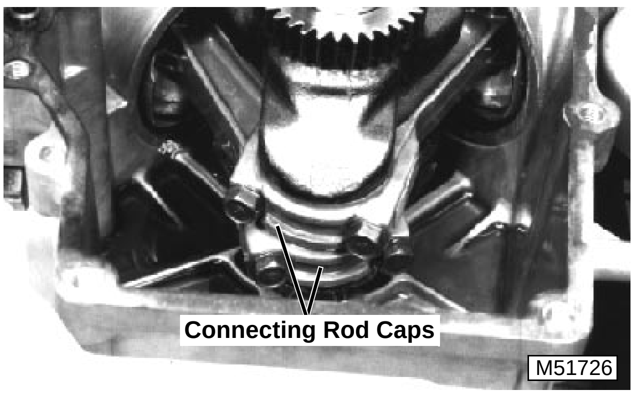
CRANKSHAFT AND MAIN BEARINGS

Removal/Installation

1. Remove flywheel. See FLYWHEEL—Removal/ Installation on page 3-53.)
2. Remove camshaft. See CAMSHAFT AND TAPPETS—Removal/Installation on page 3-65.)

IMPORTANT: Connecting rod caps must be installed on the same connecting rods they were removed from.

3. Mark connecting rod caps to aid in installation.



4. Remove connecting rod caps and push pistons to top of cylinder.
5. Remove crankshaft.
6. Inspect crankshaft for wear or damage. (See Inspection procedures.)

Installation is done in the reverse order of removal.

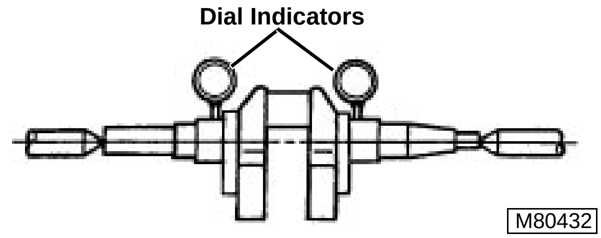
- Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.
- Apply a light film of clean engine oil on crankshaft bearing surfaces before installation.
- Pack oil seals with lithium base grease.
- Install connecting rod caps and tighten to **21 N•m (186 lb-in.)**.

Inspection

1. Analyze crankshaft and connecting rod wear. (See ANALYZE CRANKSHAFT AND CONNECTING ROD WEAR on page 3-67.)

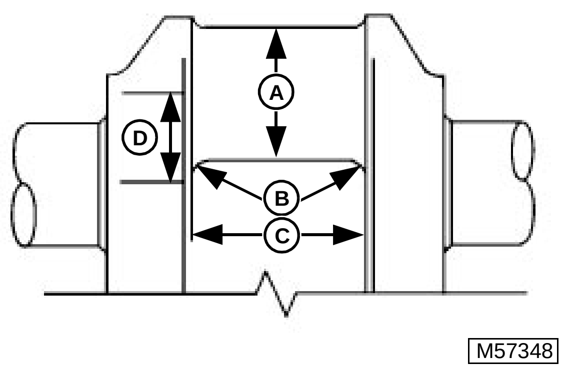
IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

2. Clean and inspect crankshaft. Replace if scratched or damaged.



3. Place crankshaft into an alignment jig and slowly rotate crankshaft. Use dial indicators to measure maximum Total Indicated Runout (T.I.R.). If runout exceeds **0.05 mm (0.002 in.)**, replace crankshaft.

4. Measure main bearing journal diameters. If either journal O.D. is **less than 33.91 mm (1.335 in.)**, replace crankshaft.



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

5. Measure connecting rod journal diameter (A) and inspect journal radii (B) for cracks. Connecting rod journal can be resized to accept undersized rod. Have grinding done by a reliable repair shop.

If undersized journal diameter is less than specifications, replace crankshaft.

Connecting Rod Journal O.D. (Wear Limit):

Standard . . . . 33.91 mm (1.335 in.)
Undersized . . . . 33.48—33.47 mm (1.3181—1.3176 in.)

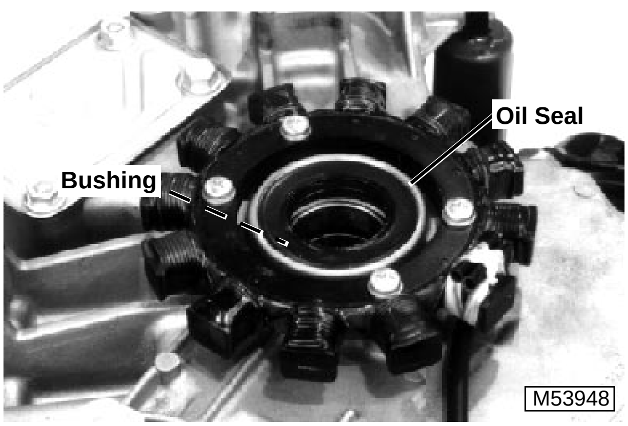
Resizing Specifications:

A. . . . . 33.48—33.47 mm (1.3181—1.3176 in.)
B. . . . . 2.30—2.70 mm (0.090—0.110 in.)
C (Maximum). . . . . 44.40 mm (1.748 in.)
D. . . . . 34.00—33.95 mm (1.3386—1.3366 in.)

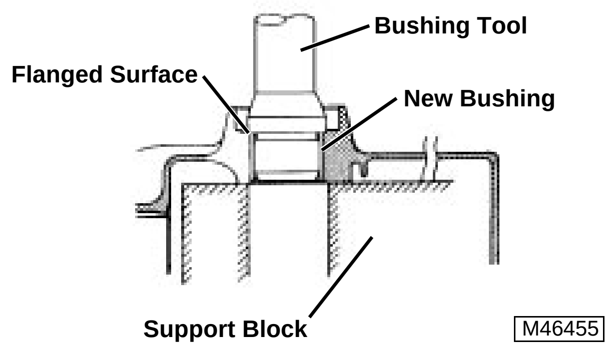
6. Measure crankshaft main bearing diameter in crankcase and crankcase cover. Replace cover or bushing in crankcase if diameter is **greater than 34.07 mm (1.341 in.)**.

Journal Bushing Replacement

1. Place crankcase on bench with oil seal up.



2. Remove oil seal with a screwdriver.
3. Remove bushing using a driver set and press.



4. Install new bushing using DFMX1 Bushing Tool. (See DEALER FABRICATED TOOLS on page 3-9 for instructions to make tool.)
   - Coat the bushing and bore with a light film of engine oil. Press in new bushing, flush with the flanged surface.
   - No finish reaming is required.
5. Install a new seal with spring loaded lip toward the inside of the engine. Press seal in until flush with hub.
6. Pack space between seal lip and dust lip with lithium based grease.

CRANKSHAFT OIL SEALS

Replacement

Flywheel End: Remove crankshaft.

PTO End: Remove crankcase cover.

- 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.

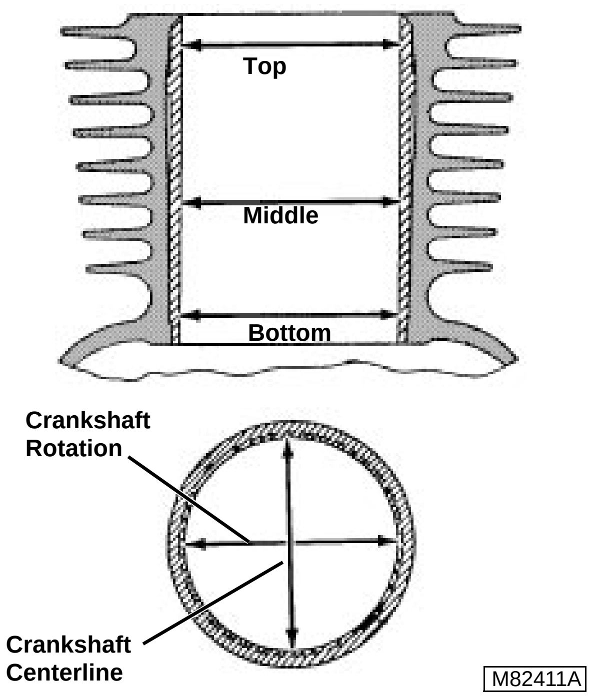
CYLINDER BLOCK

Inspection

1. Clean block and check for cracks.

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

A bare block is available for service.



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

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.

Cylinder Bore I.D.:

Standard Size Bore:

Standard . . . . 73.98—74.00 mm (2.915—2.916 in.)

Wear Limit . . . . 74.07 mm (2.918 in.)

0.50 mm (0.020 in.) Oversized Bore:

Standard . . . . 74.48—74.50 mm (2.932—2.933 in.)

Wear Limit . . . . 74.57 mm (2.935 in.)

3. If cylinder bores exceed wear limit, rebore cylinder or replace cylinder block. (See Rebore Cylinder Block on page 3-68.)

NOTE: If cylinders are resized, oversize pistons and rings must be installed.

Deglaze Cylinder Bore

1. Deglaze cylinder bore using a rigid hone with a 220 to 300 grit stone.
2. Use hone as instructed by manufacture to obtain a 45° crosshatch pattern.

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

3. Clean cylinder walls using clean white rags and warm soapy water. Continue to clean cylinder until white rags show no discoloration.
4. Dry cylinder and apply a light coat of engine oil.

Rebore Cylinder Block

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

NOTE: The cylinder block can be resized to use 0.50 mm (0.020 in.) oversize pistons and rings. Have a reliable repair shop resize the block, or use a drill press and honing tool.

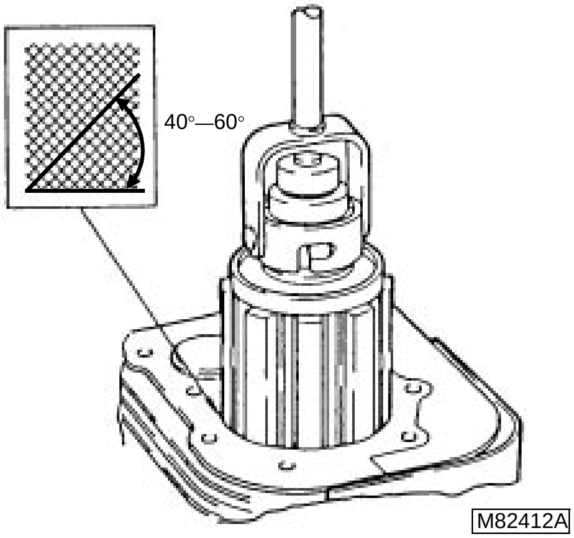
Resize cylinder with a honing tool to initial and final bore specifications.

1. Align center of bore to drill press center.
2. Lower and raise hone until end extends 20—25 mm (0.75—1.0 in.) past ends of cylinder.
3. Adjust hone so lower end is even with end of cylinder bore.

4. Adjust hone stones until they contact narrowest point of cylinder walls.
5. Coat inside of cylinder with honing oil. Turn hone by hand. Adjust if too tight.
6. Run drill press between 200—250 rpm. Move hone up and down in cylinder approximately 20 times per minute.

NOTE: Measure bore when cylinder is cool.

7. Stop press and check cylinder diameter.



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

8. Check bore for size, taper and out-of-round.
9. If cylinder bores exceed wear limit, rebore cylinder or replace block.
10. Hone the cylinder an additional 0.007—0.009 mm (0.0003—0.0004 in.) for final bore specifications. This allows for shrinkage when cylinder cools.

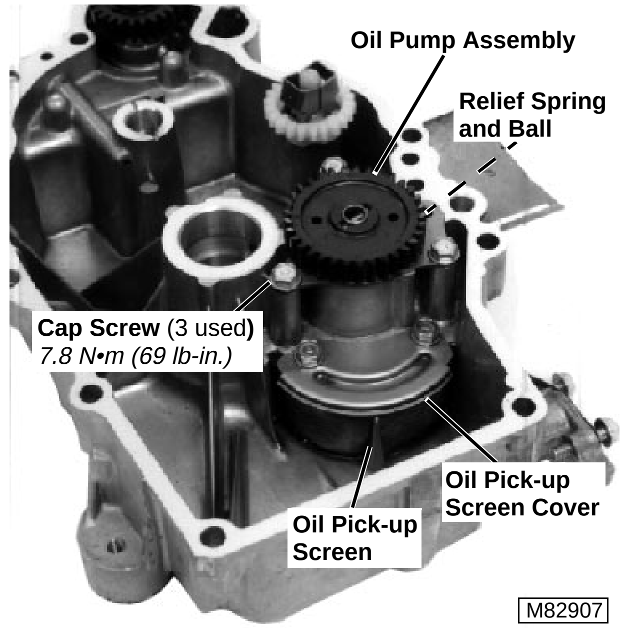
IMPORTANT: DO NOT use gasoline, kerosene, or commercial solvents to clean cylinder bores. Solvents will not remove all abrasives from cylinder walls.

11. Clean cylinder walls using clean white rags and water. Continue to clean cylinder until white rags show no discoloration.
12. Dry cylinder. Apply a light coat of engine oil to cylinder walls.

OIL PUMP

Disassembly/Assembly

1. Remove crankcase cover.



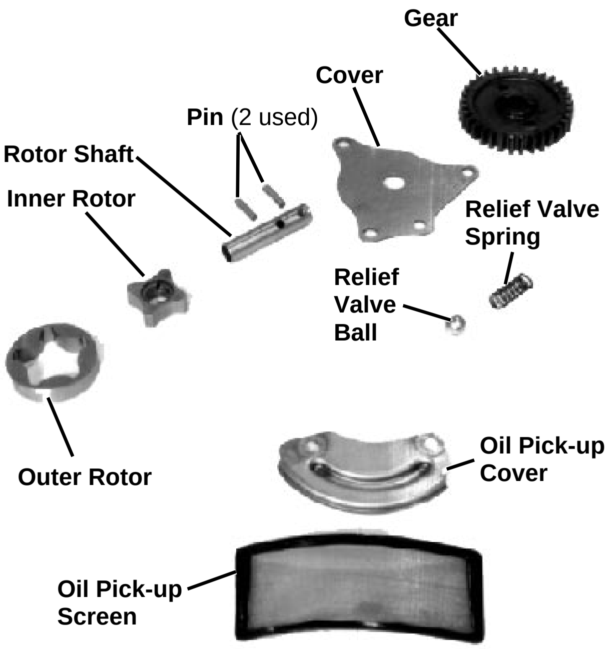
IMPORTANT: Oil pressure relief valve spring will be loose when oil pump assembly is removed.

2. Remove three cap screws and oil pump assembly.
3. Remove relief spring and ball.
4. Remove oil pick-up cover and screen.
5. Inspect all parts for wear. (See Inspection procedure.)

Assembly is done in the reverse order of disassembly.

- Fill rotor housing with engine oil for initial lubrication.
- Install oil pump assembly so that hole in the plate is centered over relief valve.
- Tighten cap screws to **7.8 N•m (69 lb-in.)**.

Inspection



M82998

1. Inspect all parts. Replace if worn or damaged.

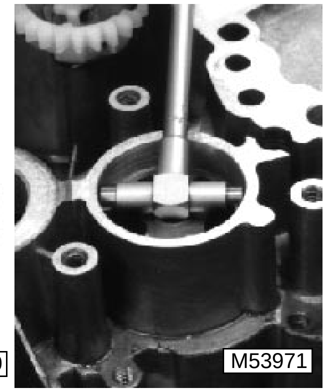

M53968


M53969

NOTE: Rotors and rotor shaft are replaced as a kit. If any of the parts show signs of wear or are scored, replace.

2. Measure rotor shaft diameter. If shaft O.D. is **less than 10.92 mm (0.430 in.)**, replace both shaft and outer rotor.
3. Measure rotor shaft bearing. If bearing I.D. is **greater than 11.07 mm (0.436 in.)**, replace crankcase cover.


M53970


M53971

4. Measure outside diameter of outer rotor. If O.D. is **less than 40.47 mm (1.593 in.)**, replace both outer rotor and shaft.
5. Measure inside diameter of rotor bearing. If I.D. is **greater than 40.80 mm (1.606 in.)**, replace crankcase cover.


M80015


M82908

6. Measure thickness of outer rotor. If thickness is **less than 9.83 mm (0.387 in.)**, replace rotor.
7. Measure outer rotor bearing depth. If depth is **greater than 10.23 mm (0.403 in.)**, replace crankcase cover.
8. Measure inner to outer rotor clearance. If clearance is **greater than 0.3 mm (0.012 in.)**, replace both rotors.

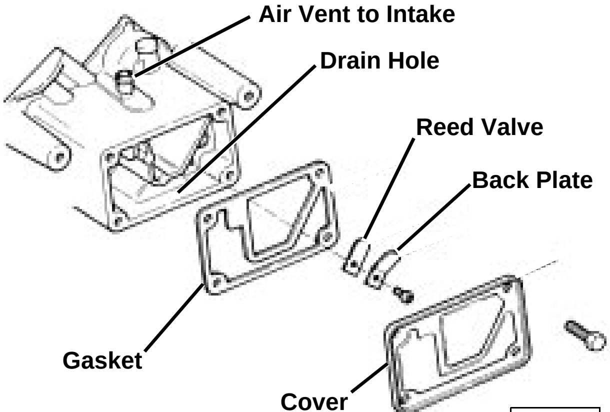

M50083

9. Measure relief valve spring. If free length is **less than 19.50 mm (0.770 in.)**, replace spring.

BREATHER

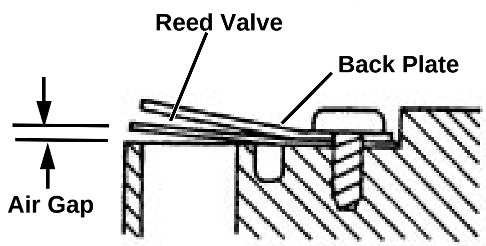
Inspection/Replacement

1. Remove flywheel. (See FLYWHEEL—Removal/ Installation on page 3-53.)



M54277

2. Remove breather cover and gasket.
3. Check that drain hole in bottom of breather chamber is open.



M51757

4. Inspect reed valve for breakage, hairline cracks or distortion, replace if necessary.
5. Inspect back plate for damage or a rough contact surface, replace if necessary.
6. Check reed valve tip air gap. Gap should be **0.2 mm (0.008 in.)**.

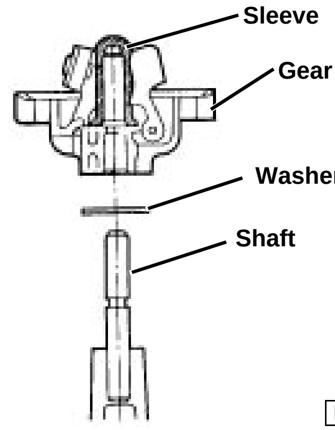
GOVERNOR

Inspection/Replacement

1. Remove crankcase cover. (See CRANKCASE COVER—Removal/Installation on page 3-59.)

IMPORTANT: Do not remove governor assembly or shaft unless damaged. Removal damages the assembly.

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



M51762

To replace governor:

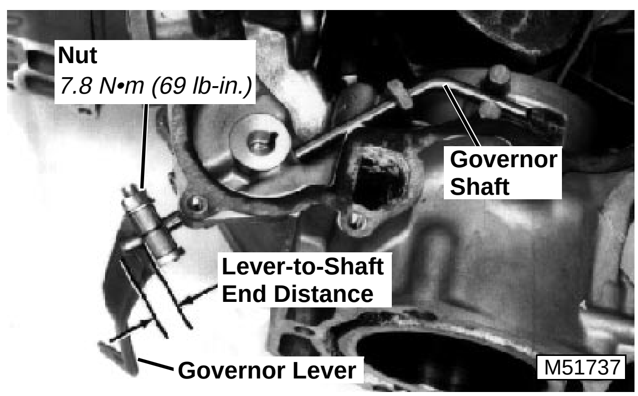
Use two screwdrivers to pry governor assembly from shaft. Do Not damage crankcase sealing surfaces.

- If shaft is removed, press shaft back into block until it protrudes **32.2—32.8 mm (1.267—1.291 in.)**.
- Install sleeve onto governor gear.
- Install governor assembly onto shaft. Push down on assembly until it snaps into place. Check assembly for freedom of movement.

Governor Shaft

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

1. Remove camshaft. (See CAMSHAFT AND TAPPETS—Removal/Installation on page 3-65.)



M51737

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

To replace governor shaft:

- Scribe a mark across shaft and lever to aid in installation.
- Loosen nut on lever.
- Remove lever and shaft.
- Install governor lever and align marks made during removal. Position lever **7 mm (0.276 in.)** from end of shaft.

• Tighten nut to **7.8 N•m (69 lb-in.)**.

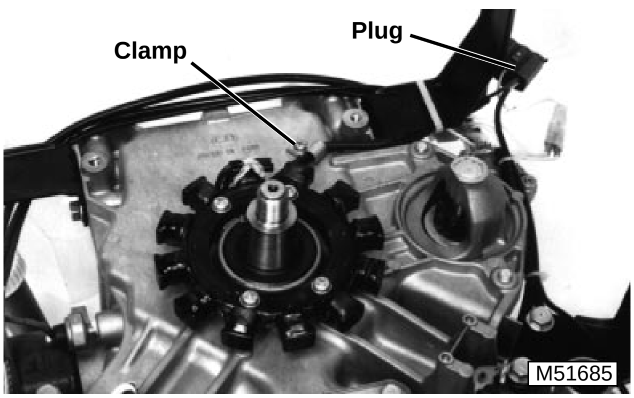
Governor Shaft Seal

1. Remove governor shaft.
2. Remove damaged seal using a screwdriver.
3. Install seal with lip toward engine using a driver set. Press in seal until **1 mm (0.040 in.) below crankcase surface**.

STATOR

Removal/Installation

1. Remove flywheel. (See FLYWHEEL—Removal/ Installation on page 3-53.)
2. Cut wire tie from wiring harness.



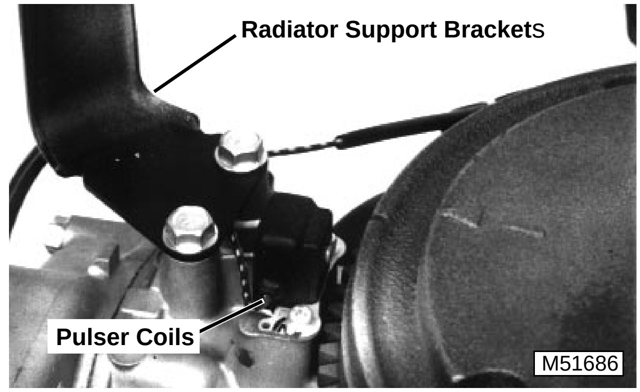
3. Remove stator wiring lead pins from plug.
4. Remove clamp.
5. Remove stator.

Installation is done in the reverse order of removal.

PULSER COILS

Replacement

1. Remove cooling air duct. (See COOLING AIR DUCT—Removal/Installation on page 3-51.)
2. Cut wire ties from wiring harness.



3. Remove radiator support brackets.
4. Remove pulser coils.
5. Disconnect wiring harness from ignition module.

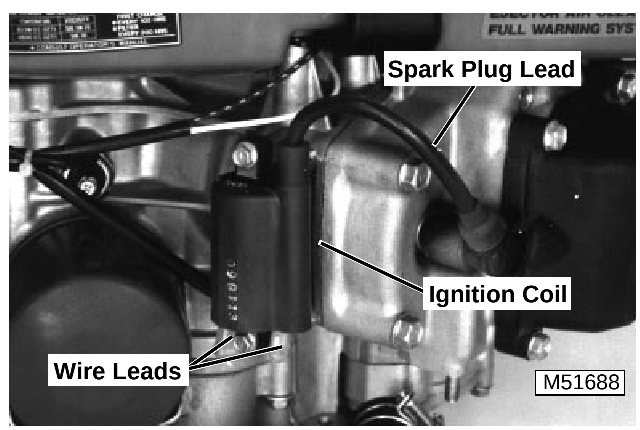
Installation is done in the reverse order of removal.

NOTE: Pulser coils are mounted in a fixed position.

• Tighten radiator support cap screws to **15 N•m (133 lb-in.)**.
• Install new wire ties where needed.

IGNITION COILS

Replacement

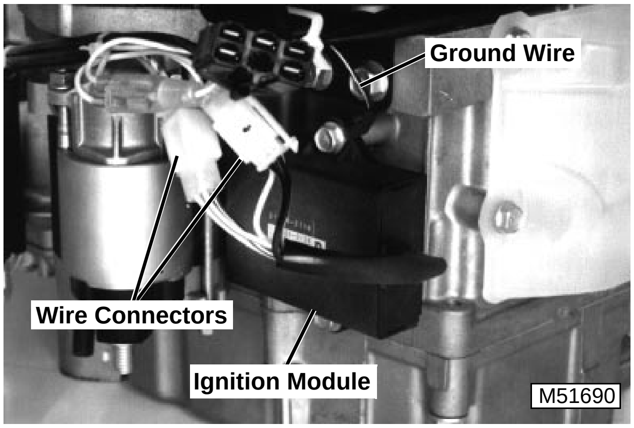


1. Disconnect wiring leads and spark plug lead.
2. Remove cap screws and coil.

Installation is done in the reverse order of removal.

IGNITION MODULE

Replacement



1. Disconnect wiring connectors.
2. Remove cap screws and ignition module.

Installation is done in the reverse order of removal.

- When installing ignition module, put ground wire under cap screw.

STARTER

Analyze Condition

The starter overheats because of:

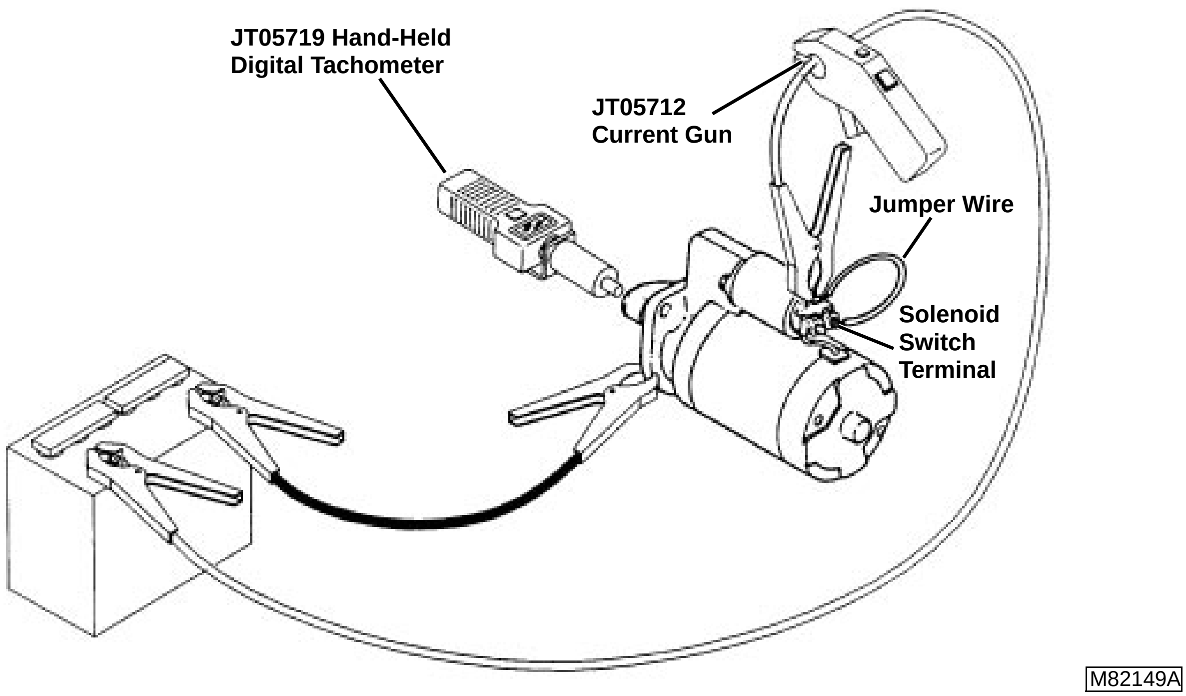
- Long cranking.
- Armature binding.

The starter operates poorly because of:

- Armature binding.
- Dirty or damaged starter drive.
- Badly worn brushes or weak brush springs.
- Excessive voltage drop in cranking system.
- Battery or wiring defective.
- Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

No-Load Amperage Draw and RPM Test



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: Complete this test in 20 seconds or less to prevent starter damage.

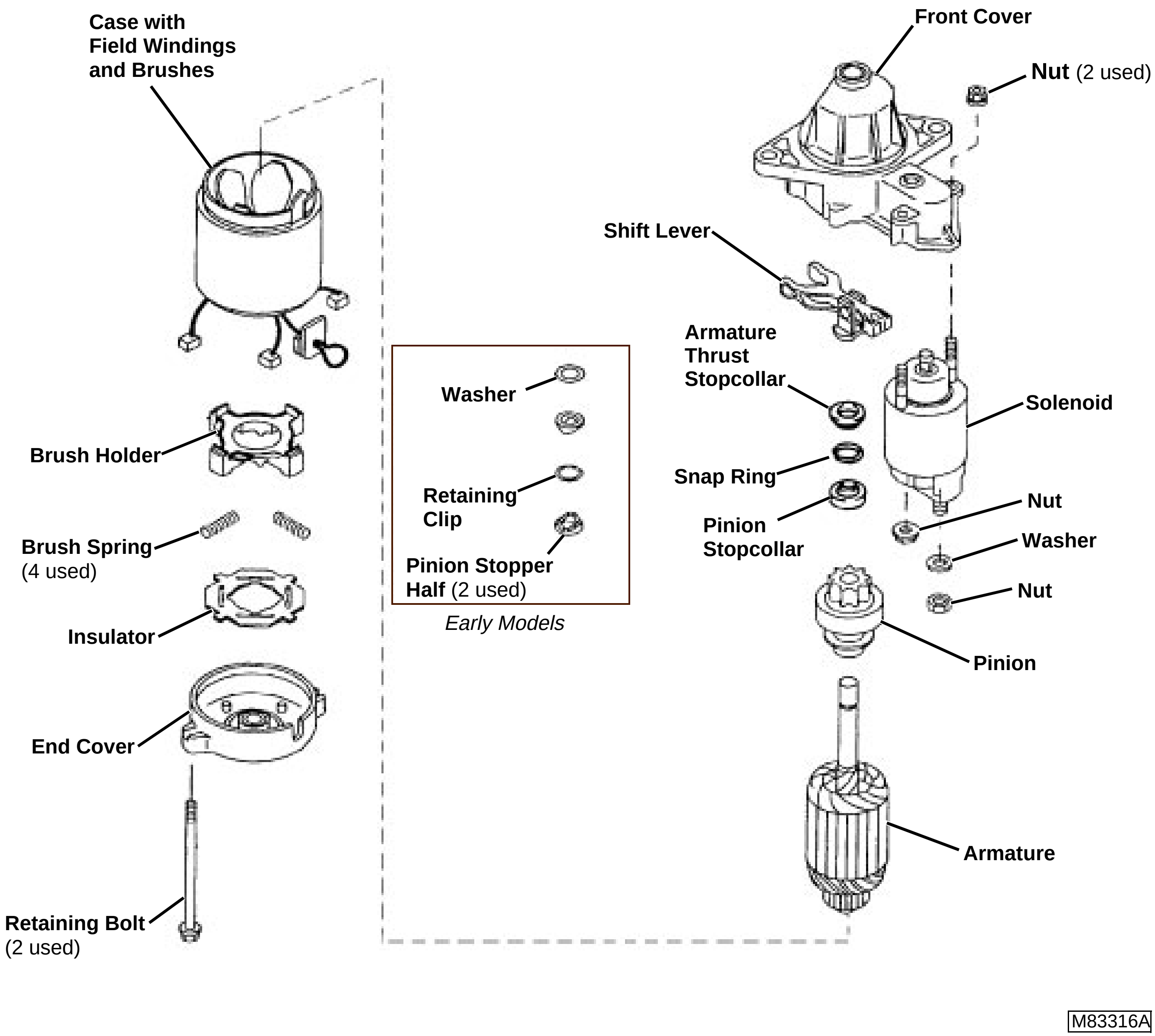
NOTE: Check that battery is fully charged and of proper size to ensure accuracy of test.

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.

Disassembly/Assembly



1. Mark body and covers to aid in alignment for assembly.
2. Separate pinion stopper halves to remove retaining clip to remove starter drive.
3. Inspect parts for wear or damage.
4. Test solenoid, starter armature and case with field windings and brushes. (See Inspection/Test procedures.)

Assembly is done in the reverse order of disassembly.

- Apply a very light coating of multipurpose grease to:

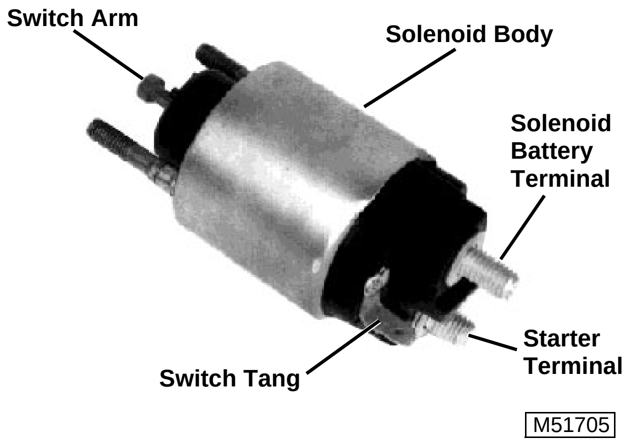
  Sliding surfaces of armature and solenoid shift lever pivots.

  Armature shaft spline.

  Points where shaft contacts cover.
- Always replace retaining clip with new.

Inspection/Test

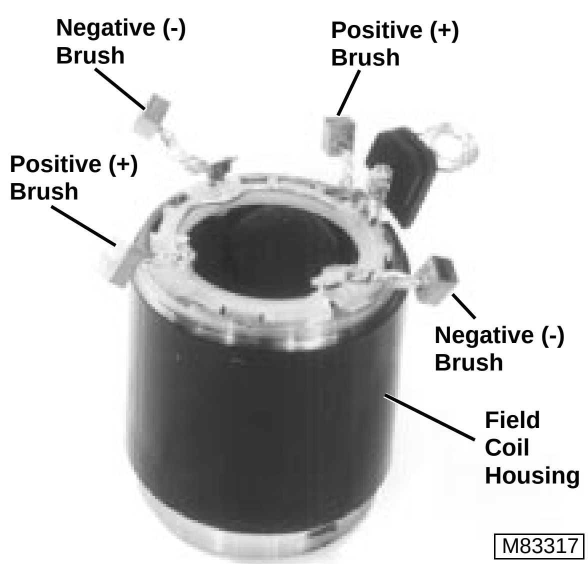
1. Measure brush lengths. If any one brush length is less than **6 mm (0.240 in.)**, replace case with field windings and brushes.
2. Inspect brush springs for wear or damage. Replace if necessary.



3. Test solenoid:

- Check solenoid battery and starter terminals for continuity. There should be no continuity.
- Depress switch arm. There should be continuity when arm is fully depressed.
- Test for open circuits between starter terminal and switch tang. There should be no continuity.
- Test for open circuits between switch tang and solenoid body. There should be no continuity.

If solenoid fails any test, it is defective and must be replaced.



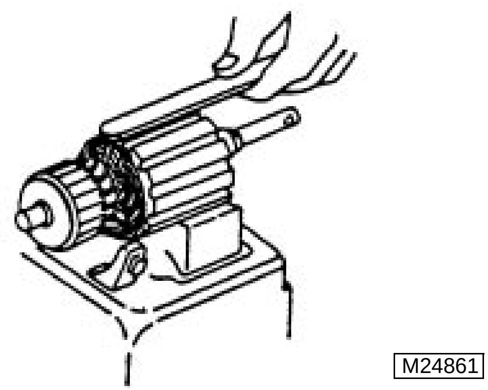
4. Test brush/field coil winding housing assembly:

- There should be continuity between positive (+) brushes.
- There should be continuity between negative (-) (field coil) brushes and bare-metal area of the housing.
- There should NOT be continuity between positive (+) brushes and bare-metal areas of the housing.

If case assembly fails any test, it is defective and must be replaced.

5. Test starter armature:

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.



Locate short circuit by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.

NOTE: Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.

If test indicates shorted circuit windings, clean commutator of dust and filings. Check armature again. If test still indicates a short circuit, replace armature.

Test for grounded windings using an ohmmeter.

- Touch probes on each commutator bar. Armature windings are connected in parallel, so each commutator bar must be checked.

If test indicates continuity, a winding is grounded and the armature must be replaced.

M50113

Test for open circuit windings using an ohmmeter.

- Touch probes on two different commutator bars. If test shows no continuity, there is an open circuit and the armature must be replaced.

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CONTENTS

Page

ELECTRICAL

Page

THEORY AND DIAGNOSIS, continued

Page

Page

TEST AND ADJUSTMENTS (Continued)

REPAIR

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SPECIFICATIONS

TEST AND ADJUSTMENT SPECIFICATIONS

Starter:

Maximum Amperage (no-load). . . . . 60 Amps at 7000 rpm
Maximum Amperage (load) . . . . 72 amps at 500 rpm
Minimum RPM (no-load) . . . . 7000 rpm

Stator:

Voltage Output (unregulated at fast idle) . . . . 26 volts AC
Resistance . . . . 0.12—0.19 ohms
Amperage (regulated) . . . . 20 amps

Battery:

Specific Gravity (minimum) 1.225 with less than 50 point variation between cells.
Voltage (minimum) . . . . 12.4 volts
Cold Cranking Amps. . . . . 491 amps. at -18°C (0°F)
Amperage (regulated) . . . . 15 amps at 13.5—15 volts

Coolant Temperature Switch:

Resistance . . . . Infinity (open) below 111°C (232°F),
. . . . 0 ohms at 111°C (232°F) or above.

Hydraulic Oil Temperature Switch:

Resistance . . . . Infinity (open) below 96°C (205°F),
. . . . approximately 0 ohms (continuity) at 96°C (205°F) or above

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).

JT05719 Hand-Held Digital Tachometer
Use to check starter No-load RPM.

JT05712 Current Gun
Use to check starter amperage draw.

JT05685 Battery Tester
Use to test battery performance.

THEORY AND DIAGNOSTIC INFORMATION

THEORY OF OPERATION INFORMATION

The theory of operation stories divide the electrical system into individual circuits by function. Each circuit is isolated from the main schematic and only shows 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 operating position, with power, or battery positive into them across the top, and 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 symptom or system from the quick check or troubleshooting chart and follow the test procedures under that heading.

The diagnostic procedure lists:

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

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

WIRE COLOR ABBREVIATION CHART

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

READING ELECTRICAL SCHEMATICS

The electrical 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 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.

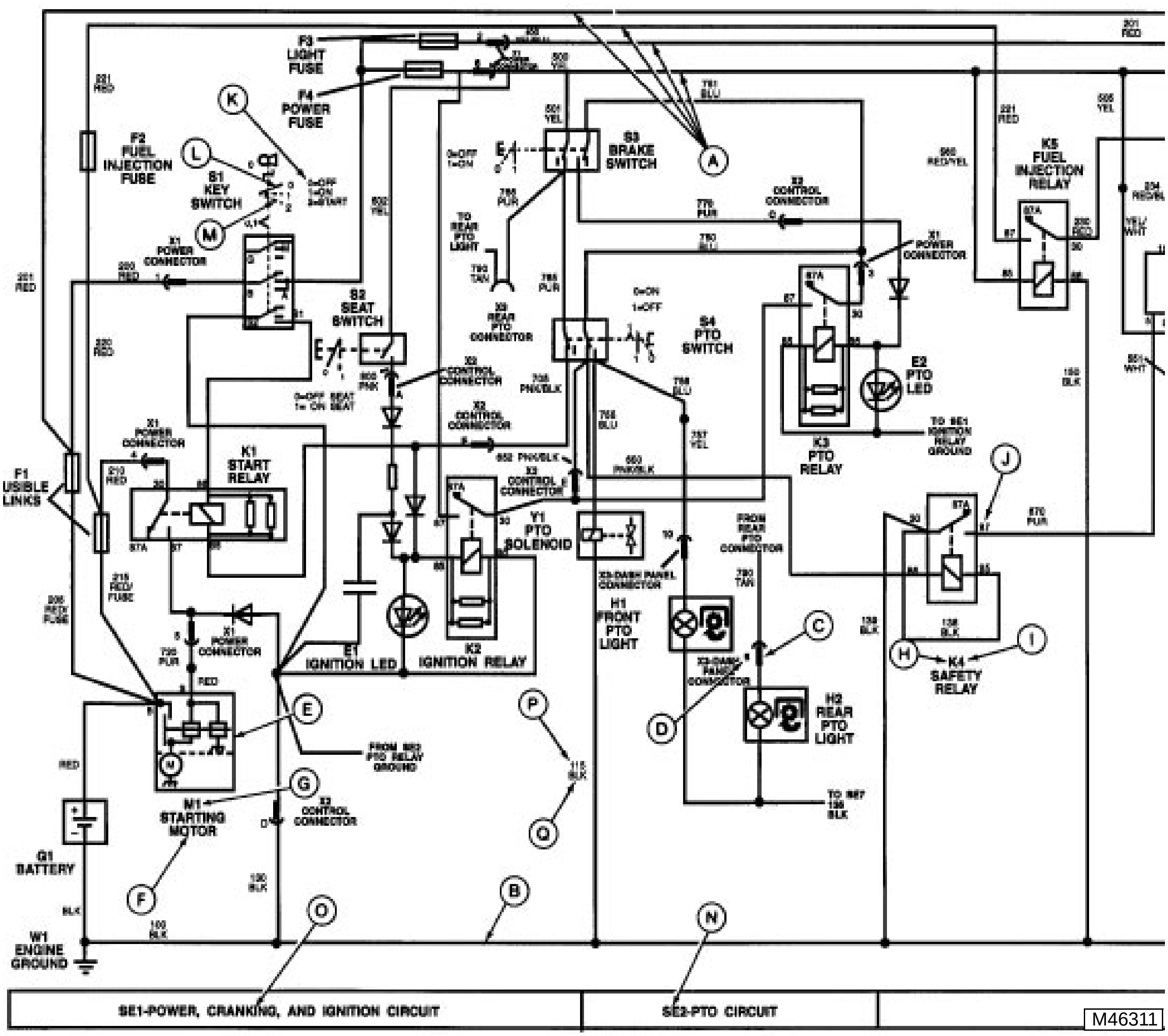
Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

The identifying letter is always the same for a specific component, but the identifying numbers are number 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 dashed lines (M) represent other switch positions.

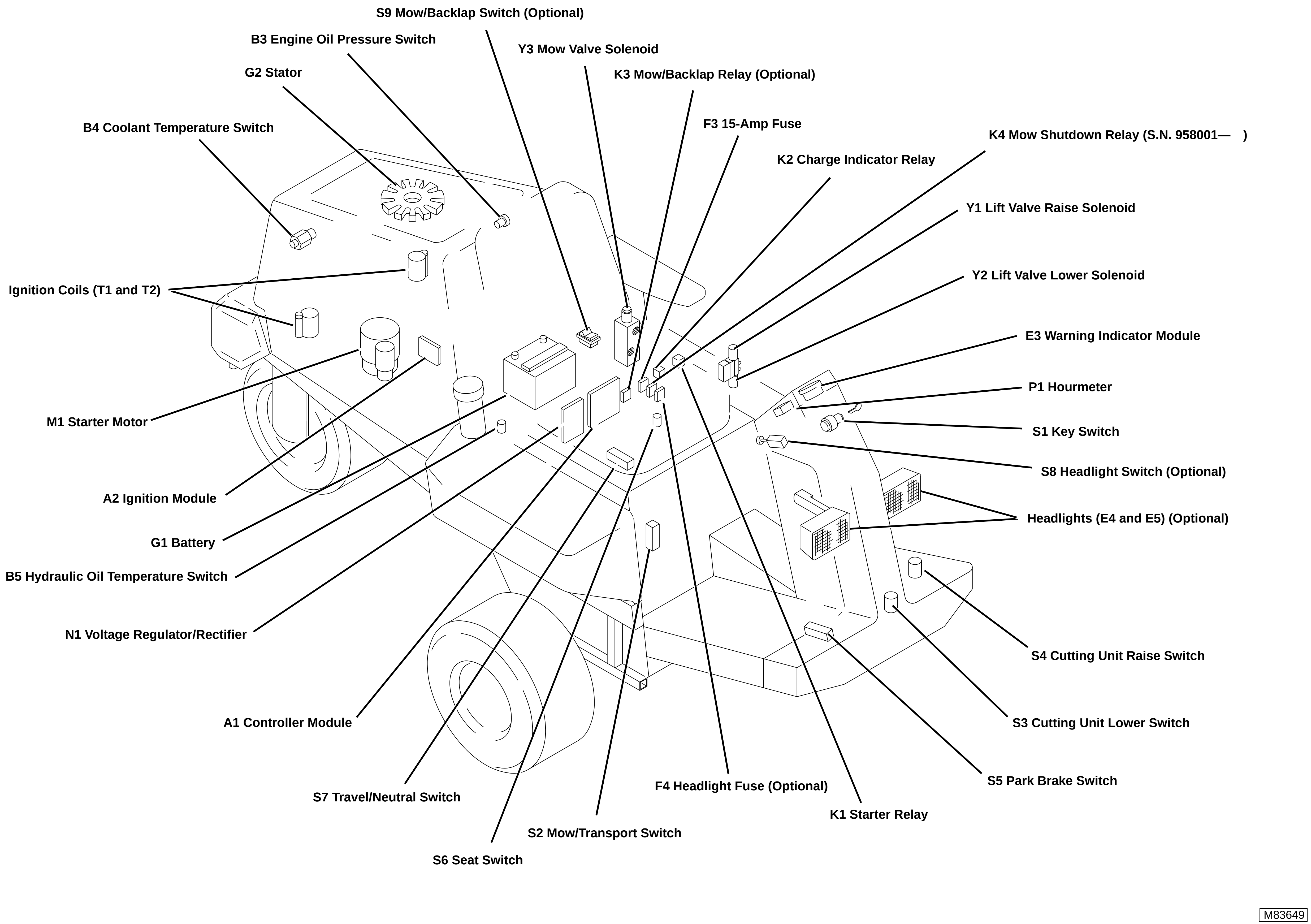
Each circuit is identified at the bottom of the drawing by a section number (N) and section name (O).

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

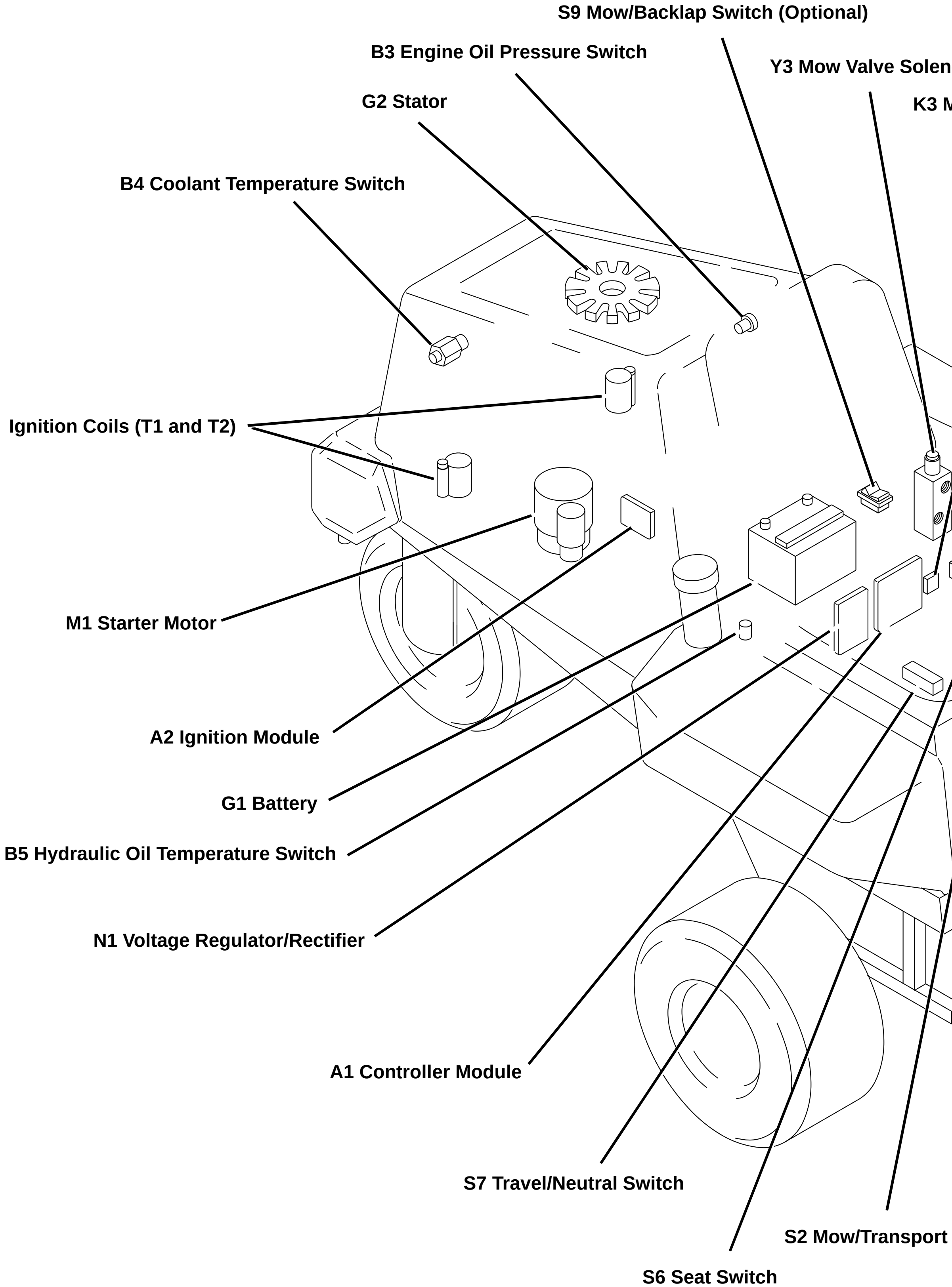
The same component name and identification code are used consistently throughout all diagrams in this section. Components can easily be cross-referenced.



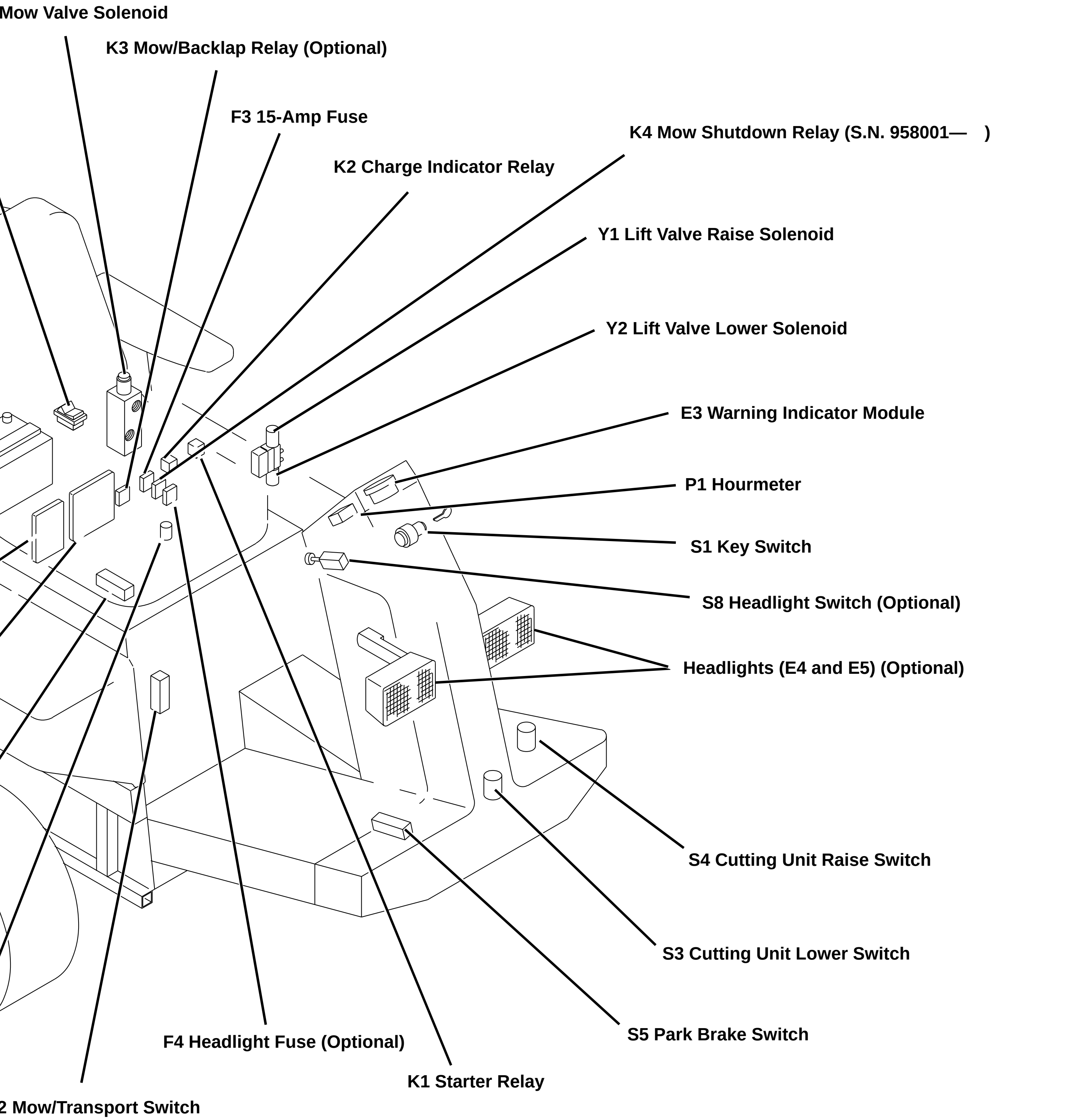
COMPONENT LOCATION



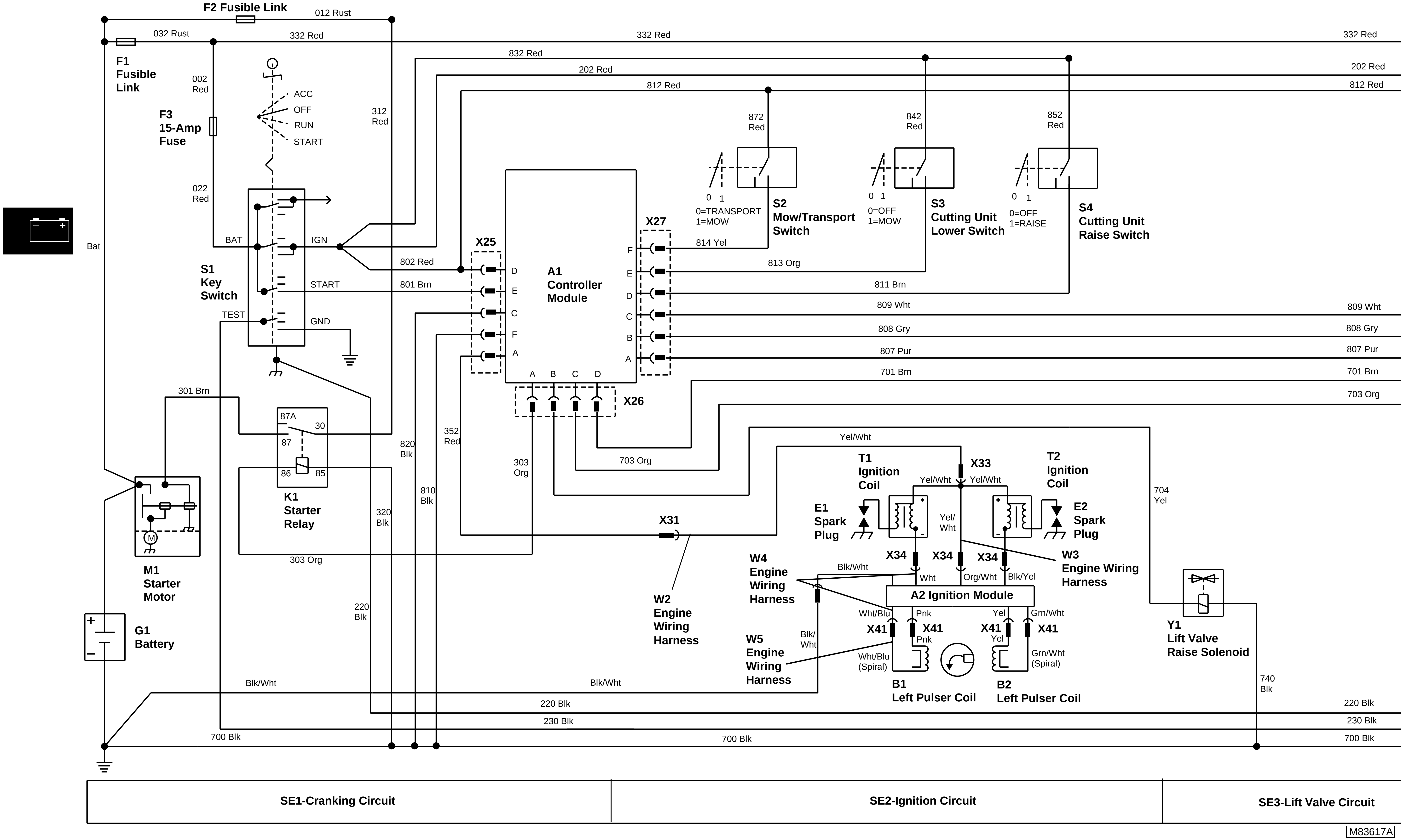
COMPONENT LOCATION



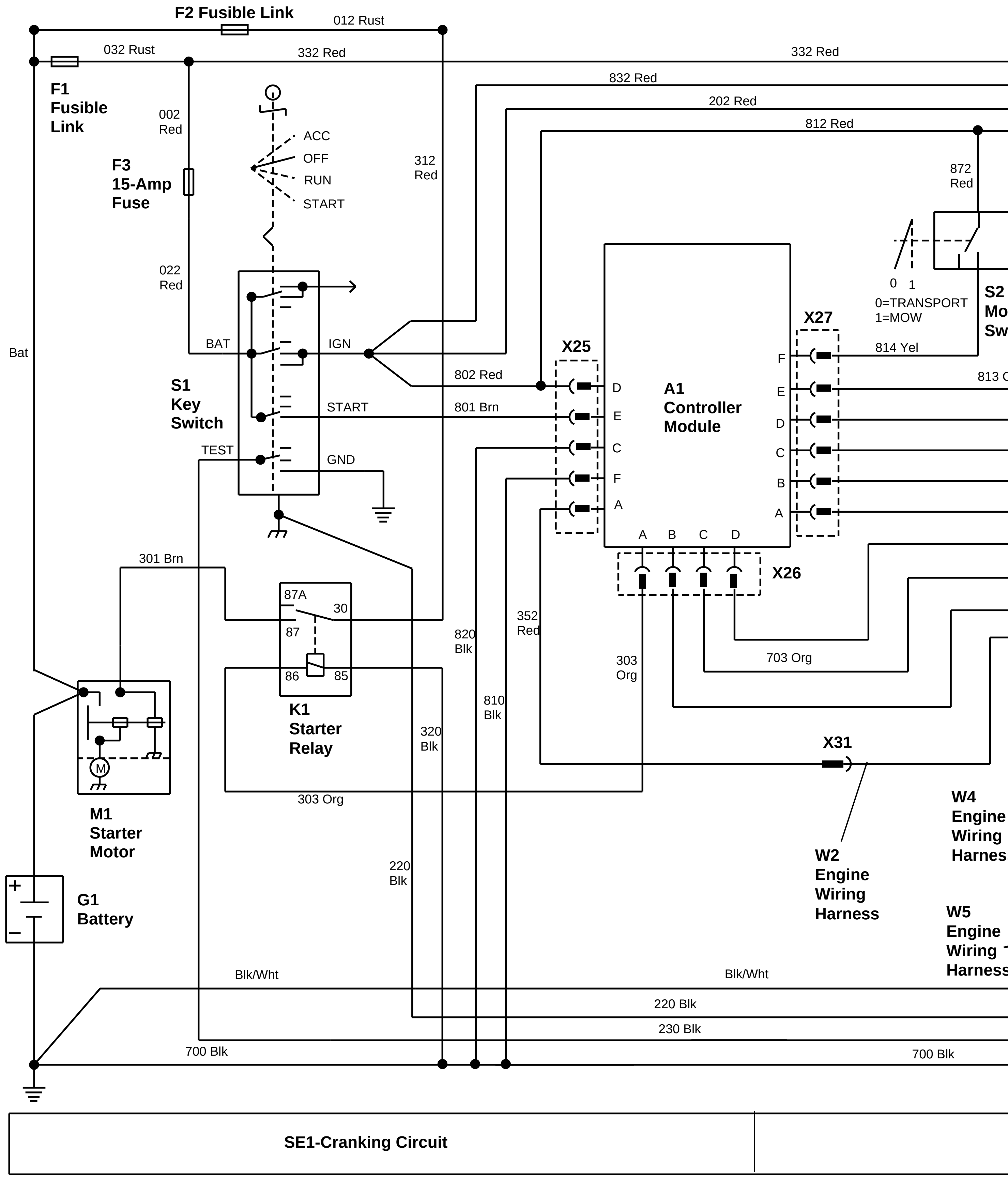
ptional)


Mow Valve Solenoid
K3 Mow/Backlap Relay (Optional)
F3 15-Amp Fuse
K4 Mow Shutdown Relay (S.N. 958001—)
K2 Charge Indicator Relay
Y1 Lift Valve Raise Solenoid
Y2 Lift Valve Lower Solenoid
E3 Warning Indicator Module
P1 Hourmeter
S1 Key Switch
S8 Headlight Switch (Optional)
Headlights (E4 and E5) (Optional)
S4 Cutting Unit Raise Switch
S3 Cutting Unit Lower Switch
S5 Park Brake Switch
F4 Headlight Fuse (Optional)
K1 Starter Relay
2 Mow/Transport Switch
M83649

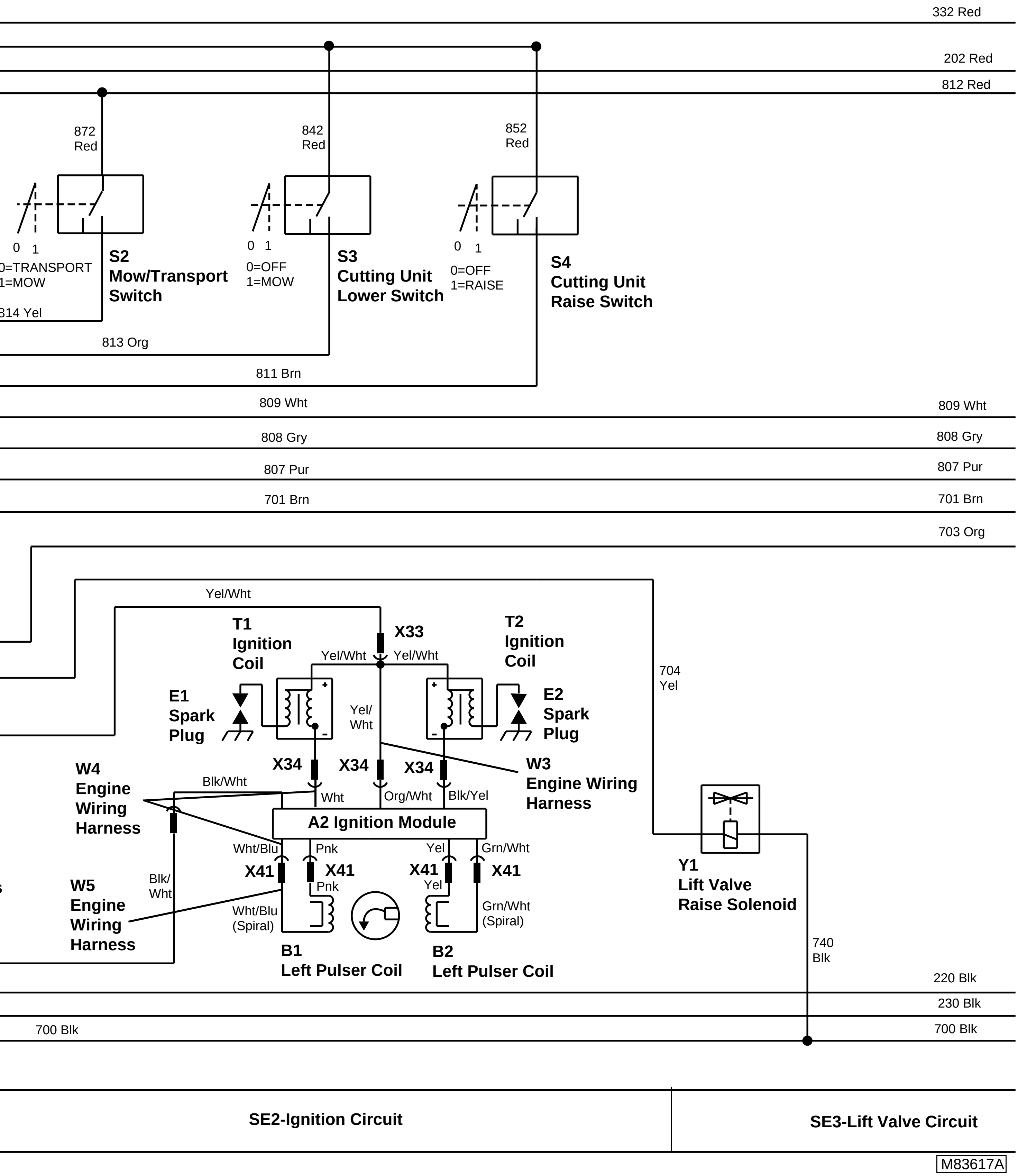
ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. —957000)



ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. —957000)



Bat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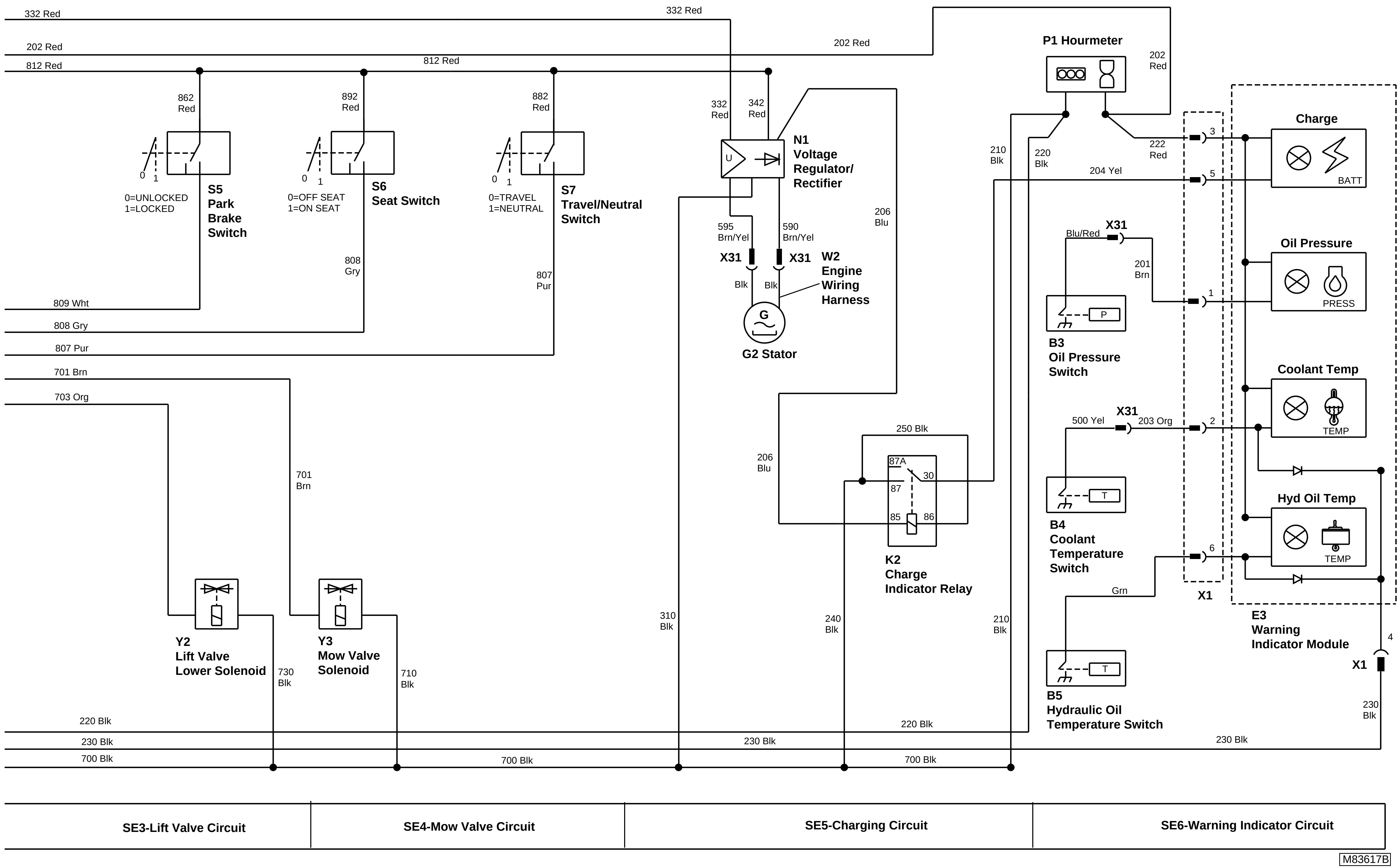
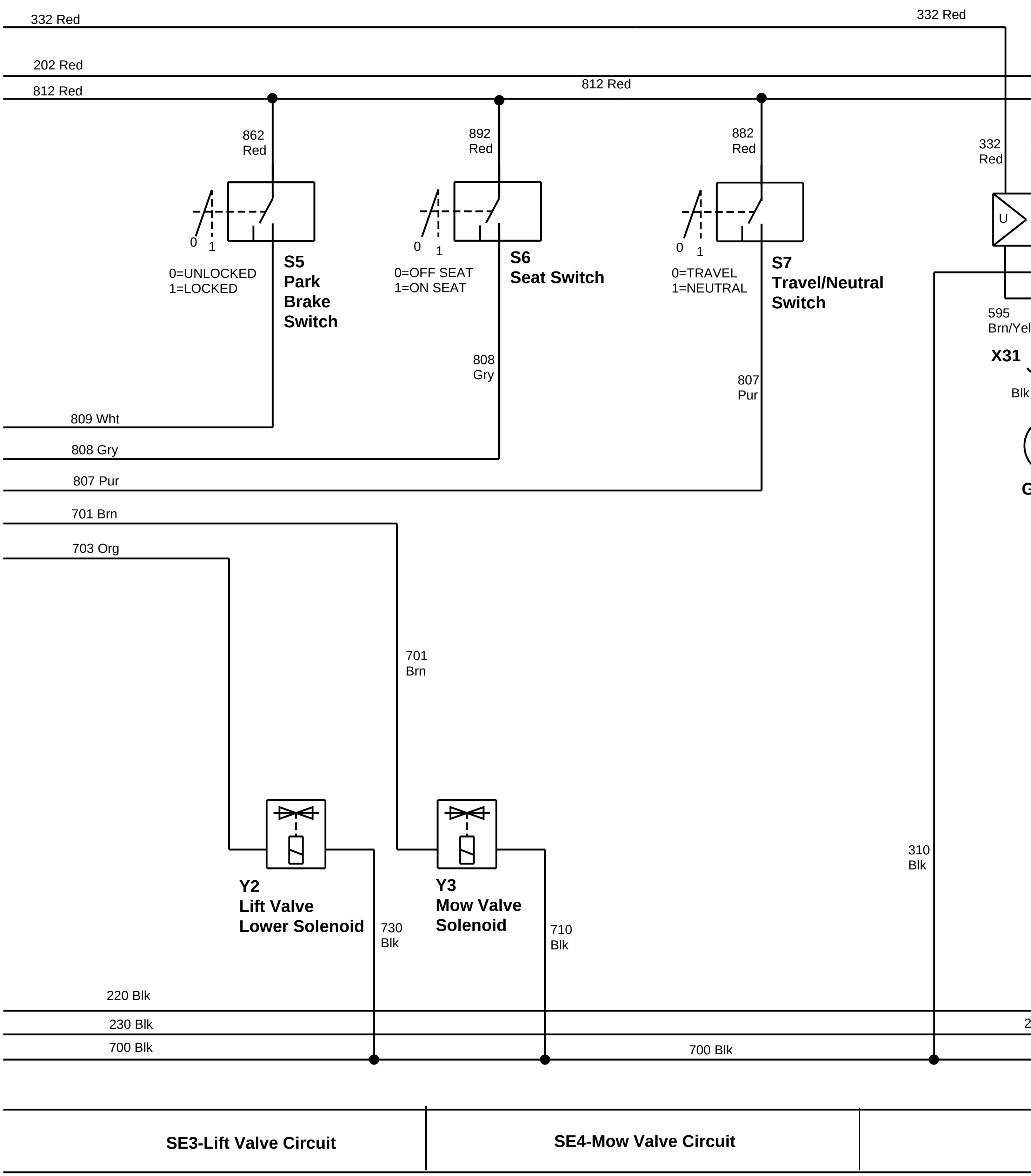
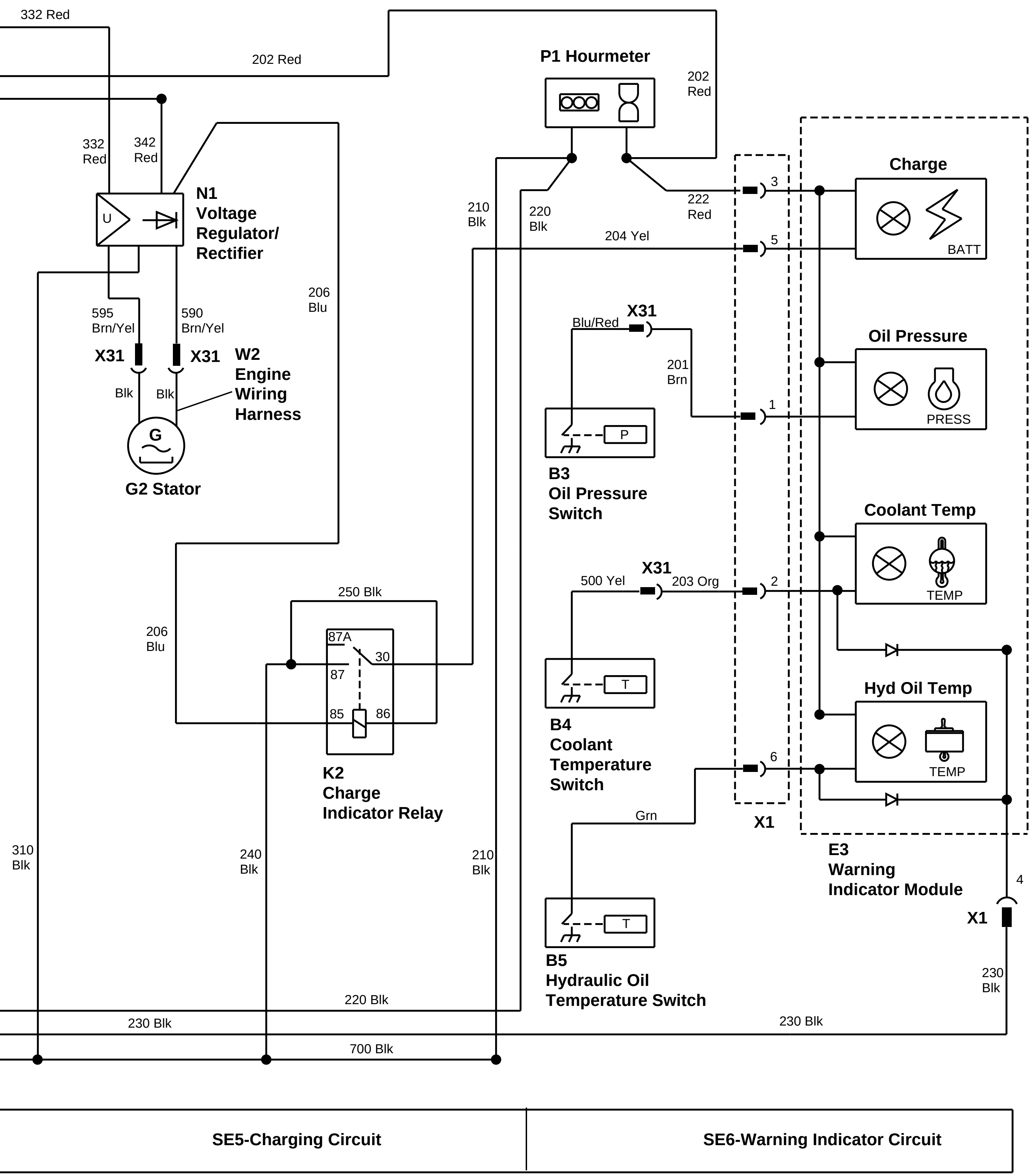
202 Red
812 Red
872
Red
842
Red
852
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=OFF
1=MOW
S3
Cutting Unit
Lower Switch
0 1
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
814 Yel
813 Org
811 Brn
809 Wht
808 Gry
807 Pur
701 Brn
703 Org
Yel/Wht
T1
Ignition
Coil
X33
Yel/Wht
Yel/Wht
T2
Ignition
Coil
704
Yel
E1
Spark
Plug
Yel/
Wht
E2
Spark
Plug
X34
X34
X34
W3
Engine Wiring
Harness
W4
Engine
Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
X41
X41
X41
X41
Pnk
Yel
W5
Engine
Wiring
Harness
Blk/
Wht
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Left Pulser Coil
Y1
Lift Valve
Raise Solenoid
740
Blk
220 Blk
230 Blk
700 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83617A

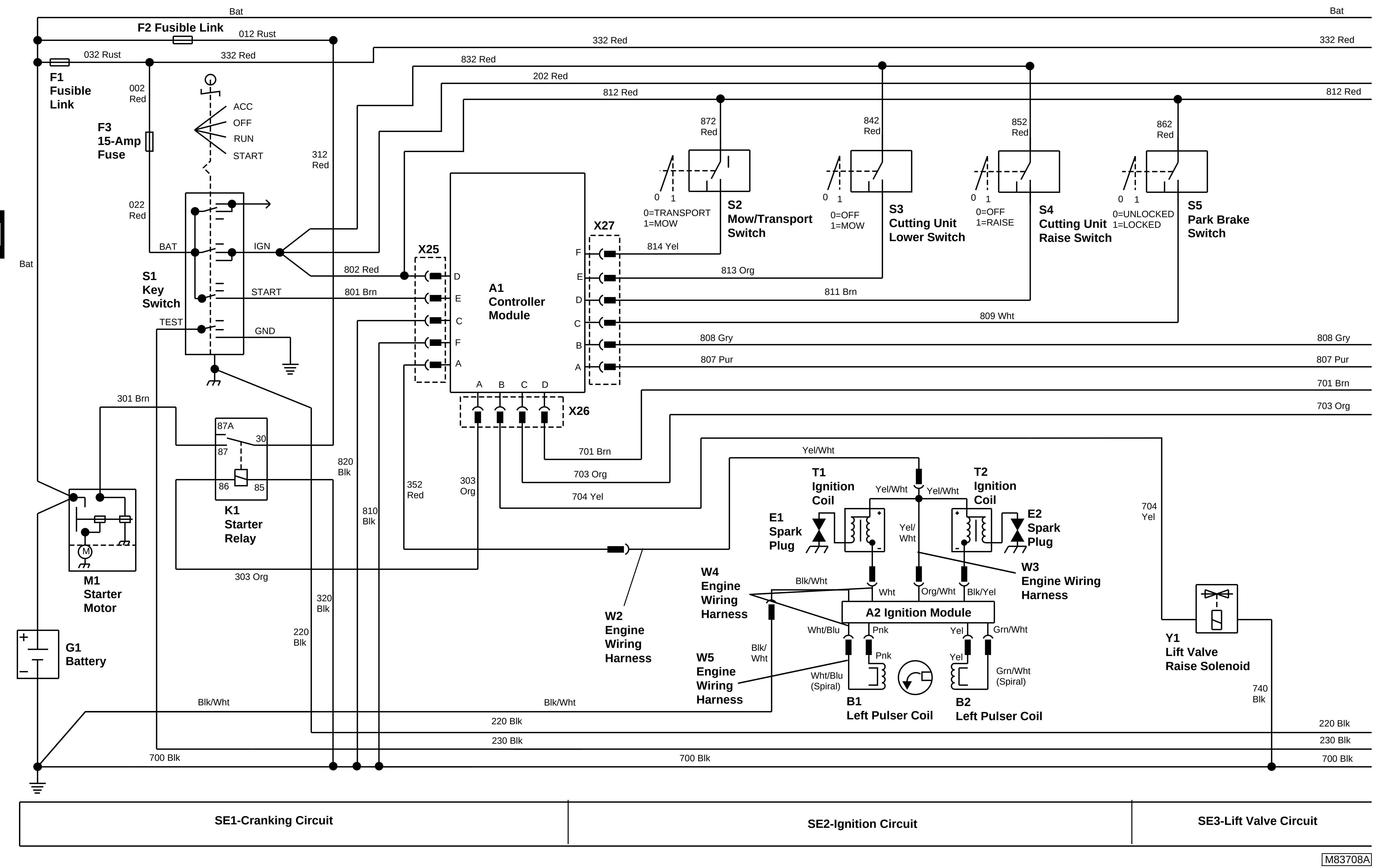

332 Red
202 Red
812 Red
862 Red
892 Red
882 Red
332 Red
342 Red
P1 Hourmeter
202 Red
S5 Park Brake Switch
0=UNLOCKED
1=LOCKED
S6 Seat Switch
0=OFF SEAT
1=ON SEAT
S7 Travel/Neutral Switch
0=TRAVEL
1=NEUTRAL
N1 Voltage Regulator/ Rectifier
595 Brn/Yel
590 Brn/Yel
X31
W2 Engine Wiring Harness
Blk
G2 Stator
206 Blu
210 Blk
220 Blk
222 Red
204 Yel
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
Blu/Red
201 Brn
B3 Oil Pressure Switch
500 Yel
203 Org
B4 Coolant Temperature Switch
Grn
B5 Hydraulic Oil Temperature Switch
X1
E3 Warning Indicator Module
230 Blk
808 Gry
807 Pur
809 Wht
808 Gry
807 Pur
701 Brn
703 Org
701 Brn
250 Blk
87A
30
87
85
86
K2 Charge Indicator Relay
Y2 Lift Valve Lower Solenoid
Y3 Mow Valve Solenoid
730 Blk
710 Blk
310 Blk
240 Blk
210 Blk
220 Blk
230 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit
M83617B


332 Red
332 Red
202 Red
812 Red
812 Red
862
Red
892
Red
882
Red
332
Red
U
0 1
0=UNLOCKED
1=LOCKED
S5
Park
Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
595
Brn/Yel
X31
Blk
808
Gry
807
Pur
809 Wht
808 Gry
807 Pur
701 Brn
703 Org
701
Brn
310
Blk
Y2
Lift Valve
Lower Solenoid
730
Blk
Y3
Mow Valve
Solenoid
710
Blk
220 Blk
230 Blk
700 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit

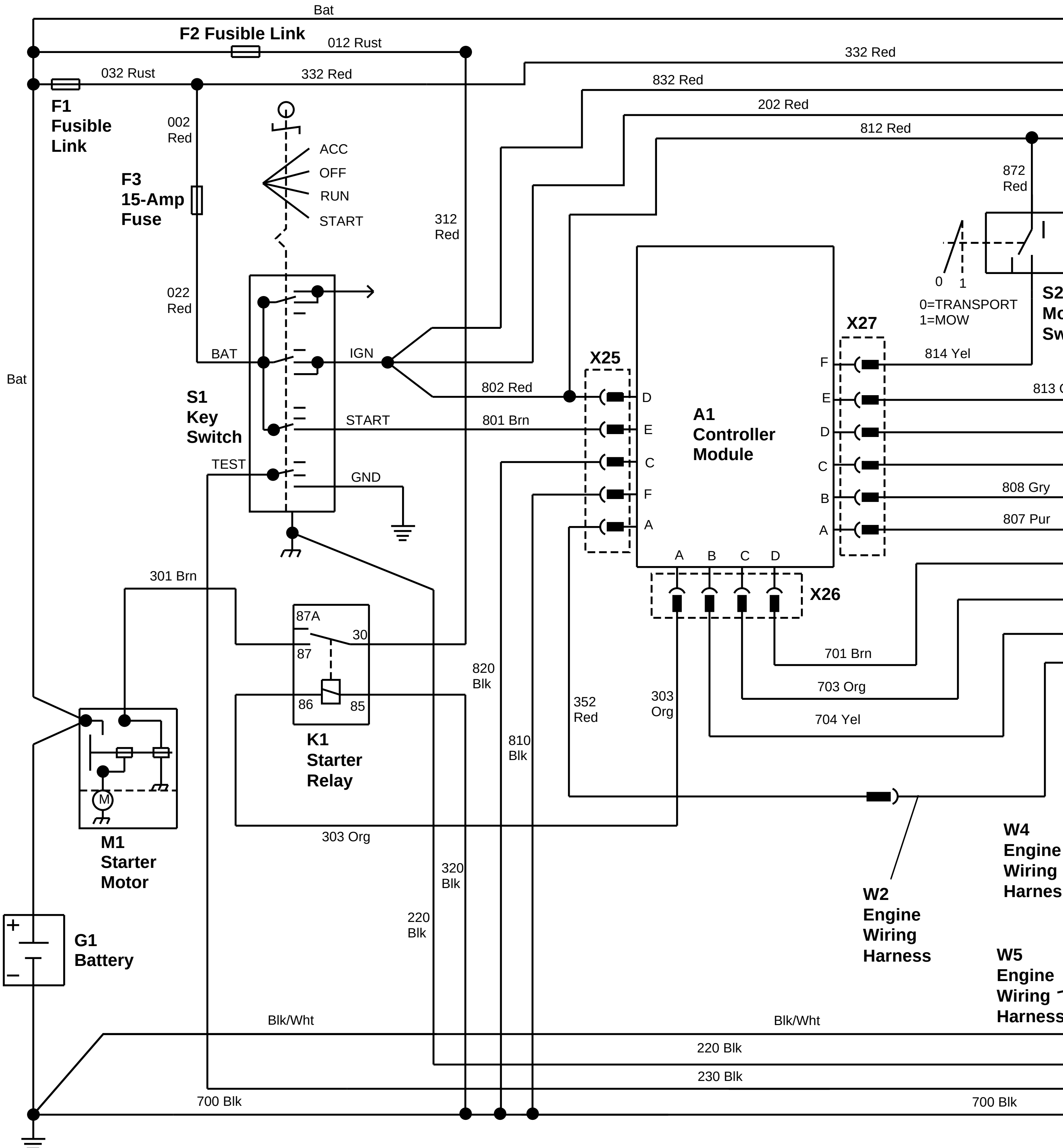

332 Red
202 Red
P1 Hourmeter
202 Red
332 Red
342 Red
N1 Voltage Regulator/ Rectifier
U
206 Blu
210 Blk
220 Blk
222 Red
204 Yel
595 Brn/Yel
590 Brn/Yel
X31
X31
W2 Engine Wiring Harness
Blk
Blk
G
G2 Stator
Charge
BATT
3
5
Blu/Red
X31
201 Brn
1
Oil Pressure
PRESS
P
B3 Oil Pressure Switch
Coolant Temp
TEMP
500 Yel
X31
203 Org
2
250 Blk
206 Blu
87A
30
87
85
86
K2 Charge Indicator Relay
T
B4 Coolant Temperature Switch
Hyd Oil Temp
TEMP
6
Grn
X1
E3 Warning Indicator Module
4
X1
310 Blk
240 Blk
210 Blk
T
B5 Hydraulic Oil Temperature Switch
230 Blk
220 Blk
230 Blk
230 Blk
700 Blk
SE5-Charging Circuit
SE6-Warning Indicator Circuit

M83617B

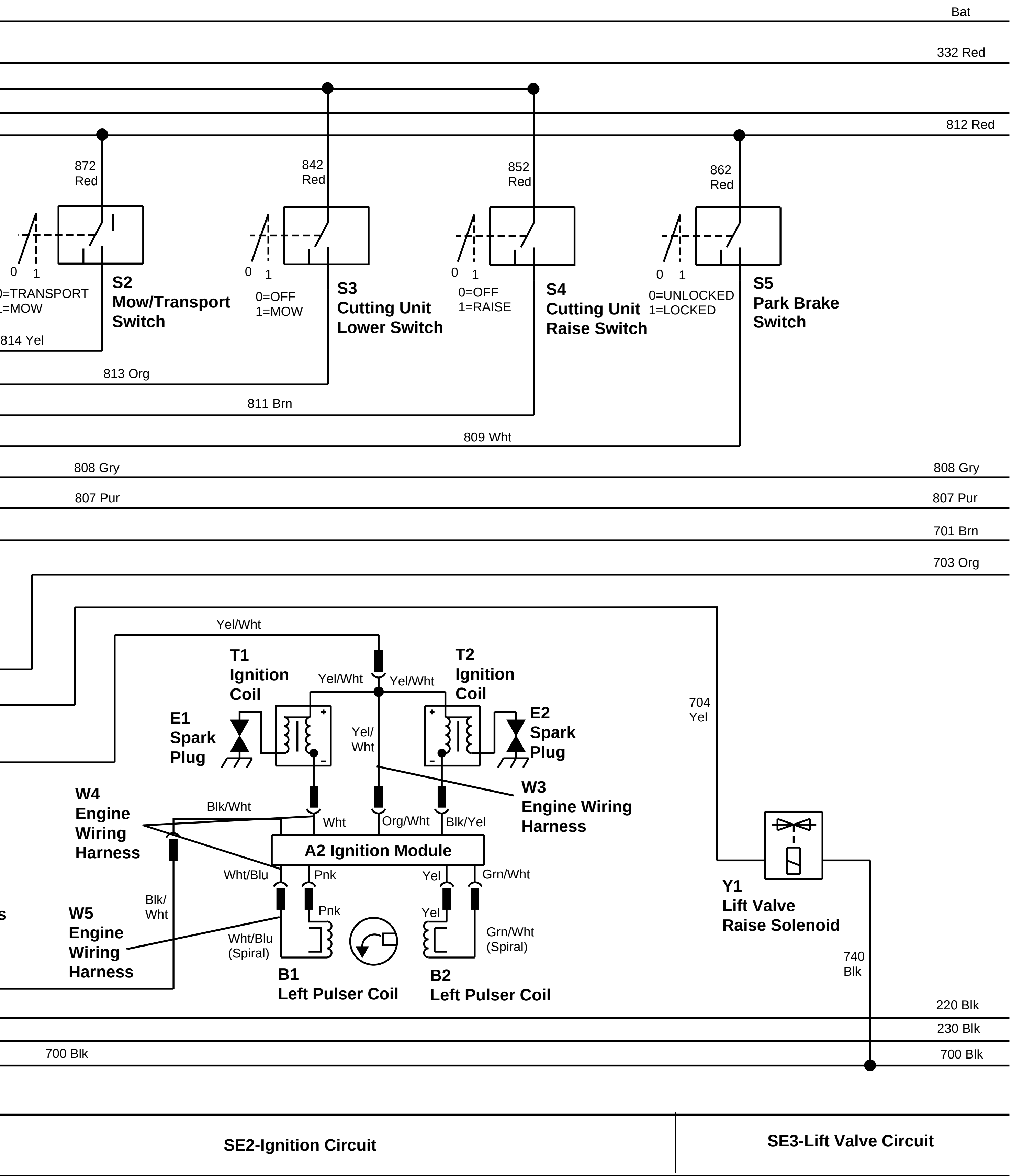
ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. —957000)



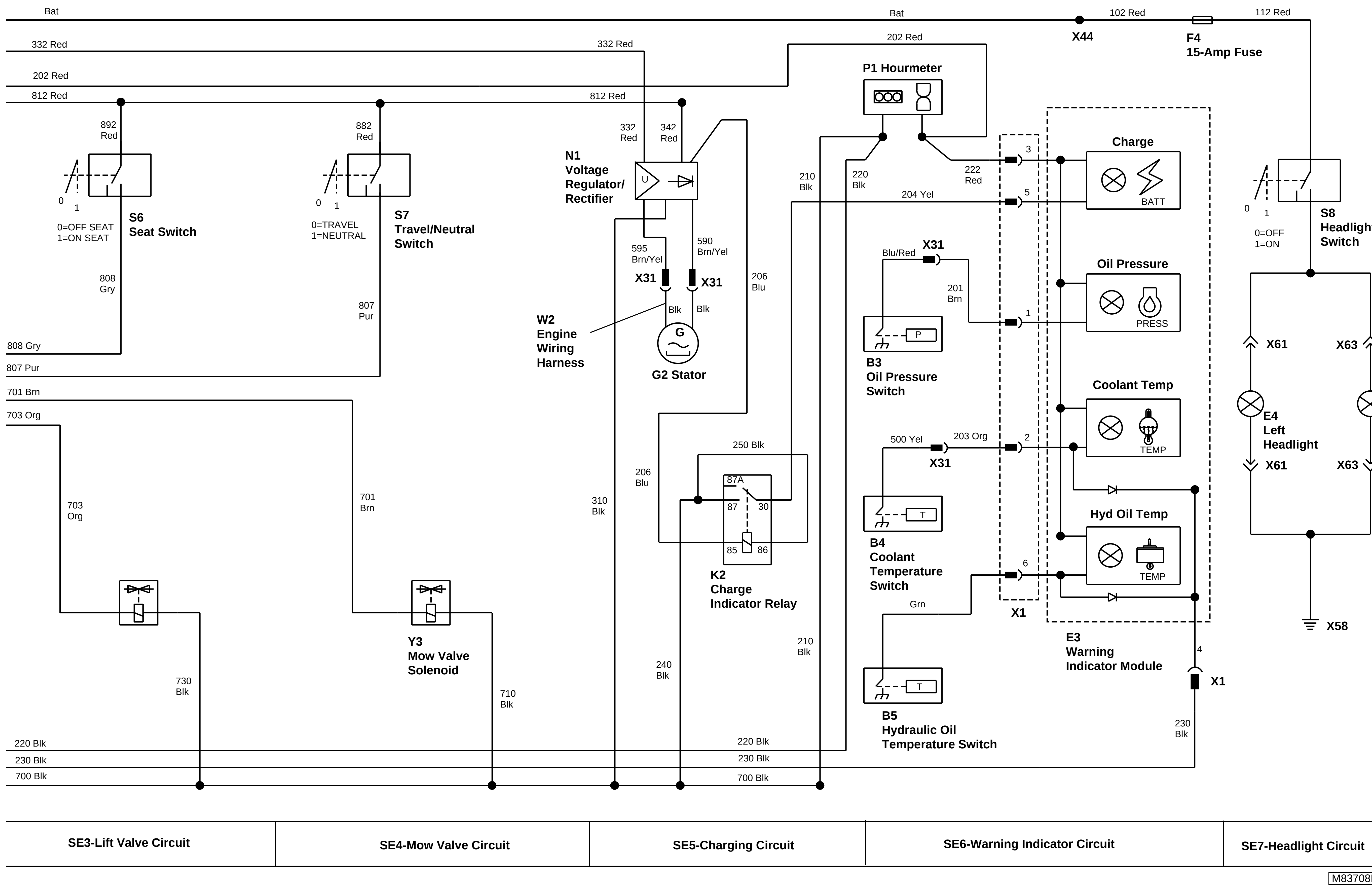
ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. —957000)

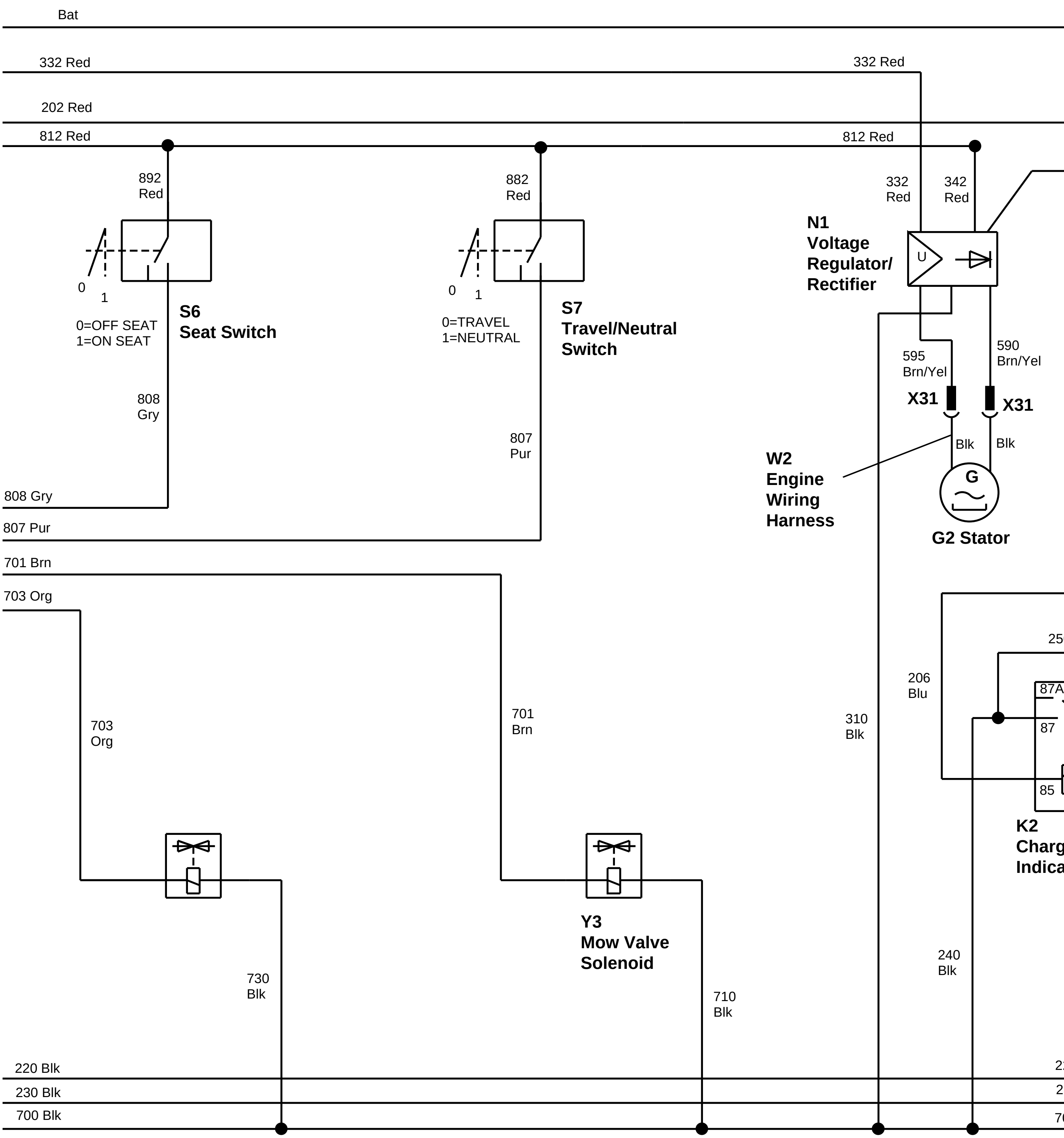


SE1-Cranking Circuit

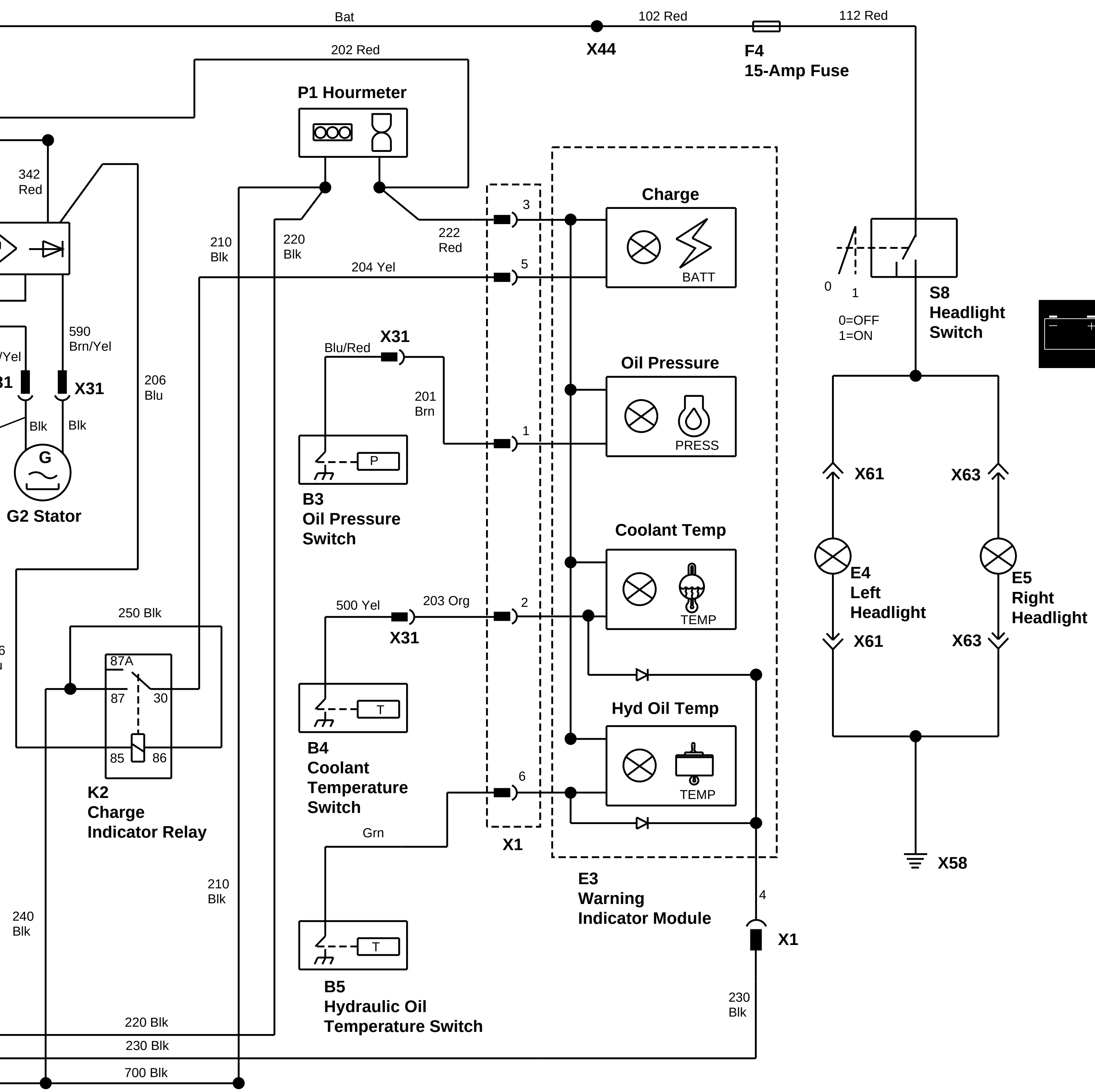

Bat
332 Red
812 Red
872
Red
842
Red
852
Red
862
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0=OFF
1=MOW
S3
Cutting Unit
Lower Switch
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
814 Yel
813 Org
811 Brn
809 Wht
808 Gry
807 Pur
701 Brn
703 Org
Yel/Wht
T1
Ignition
Coil
T2
Ignition
Coil
E1
Spark
Plug
E2
Spark
Plug
Yel/
Wht
W3
Engine Wiring
Harness
W4
Engine
Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
Blk/
Wht
W5
Engine
Wiring
Harness
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Left Pulser Coil
704
Yel
Y1
Lift Valve
Raise Solenoid
740
Blk
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit

M83708A


Bat
332 Red
202 Red
812 Red
102 Red
112 Red
X44
F4
15-Amp Fuse
P1 Hourmeter
892
Red
882
Red
332
Red
342
Red
S6
Seat Switch
0=OFF SEAT
1=ON SEAT
S7
Travel/Neutral
Switch
0=TRAVEL
1=NEUTRAL
N1
Voltage
Regulator/
Rectifier
595
Brn/Yel
590
Brn/Yel
X31
Blk
W2
Engine
Wiring
Harness
G2 Stator
206
Blu
210
Blk
220
Blk
222
Red
204 Yel
Blu/Red
201
Brn
B3
Oil Pressure
Switch
500 Yel
203 Org
B4
Coolant
Temperature
Switch
Grn
B5
Hydraulic Oil
Temperature Switch
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
E3
Warning
Indicator Module
230
Blk
S8
Headlight
Switch
0=OFF
1=ON
X61
X63
E4
Left
Headlight
E5
Right
Headlight
X58
808 Gry
807 Pur
701 Brn
703 Org
808
Gry
807
Pur
703
Org
701
Brn
250 Blk
K2
Charge
Indicator Relay
310
Blk
240
Blk
Y3
Mow Valve
Solenoid
730
Blk
710
Blk
220 Blk
230 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit
SE7-Headlight Circuit
M83708B



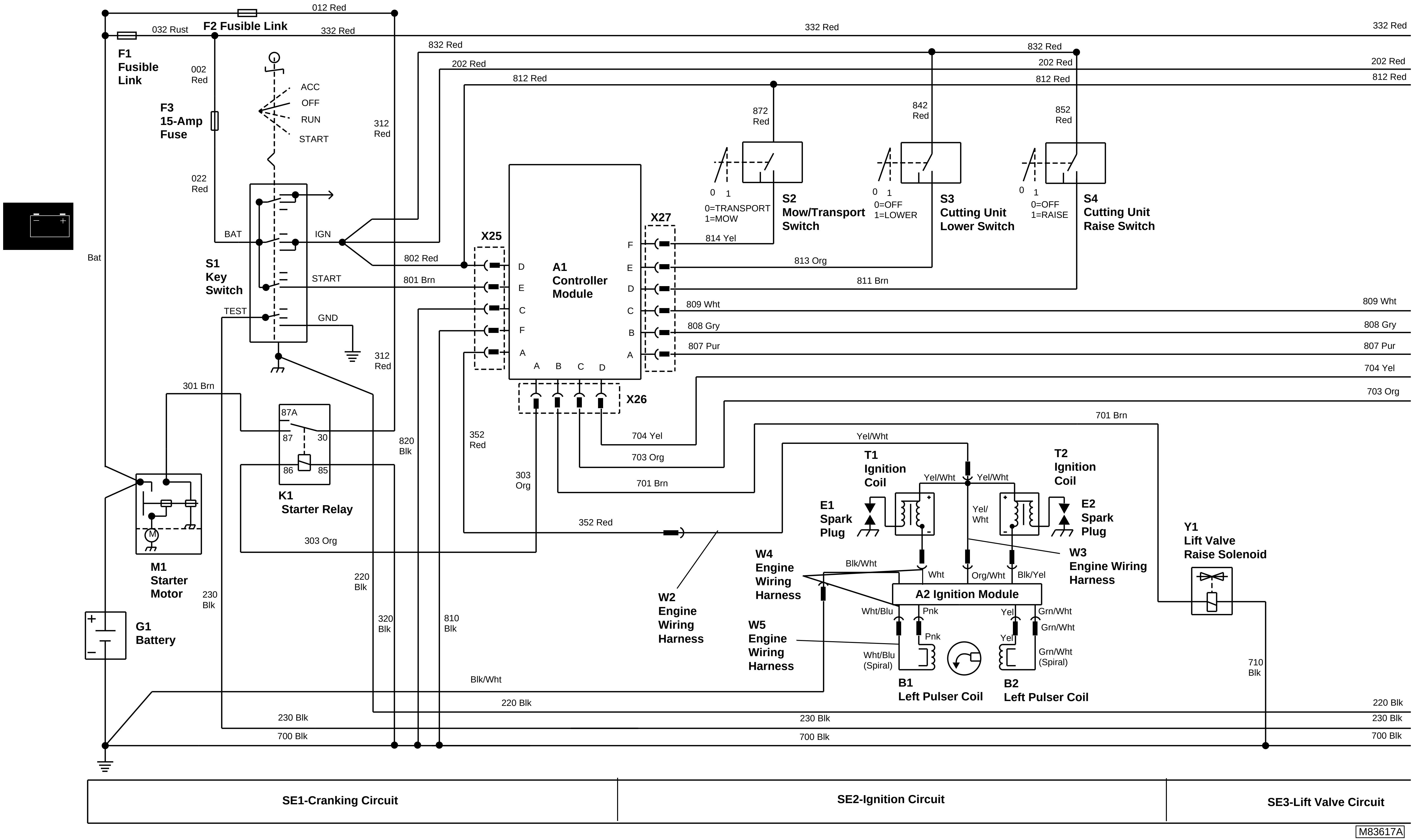
SE3-Lift Valve Circuit	SE4-Mow Valve Circuit	SE5-Chargin



SE5-Charging Circuit	SE6-Warning Indicator Circuit	SE7-Headlight Circuit

M83708B

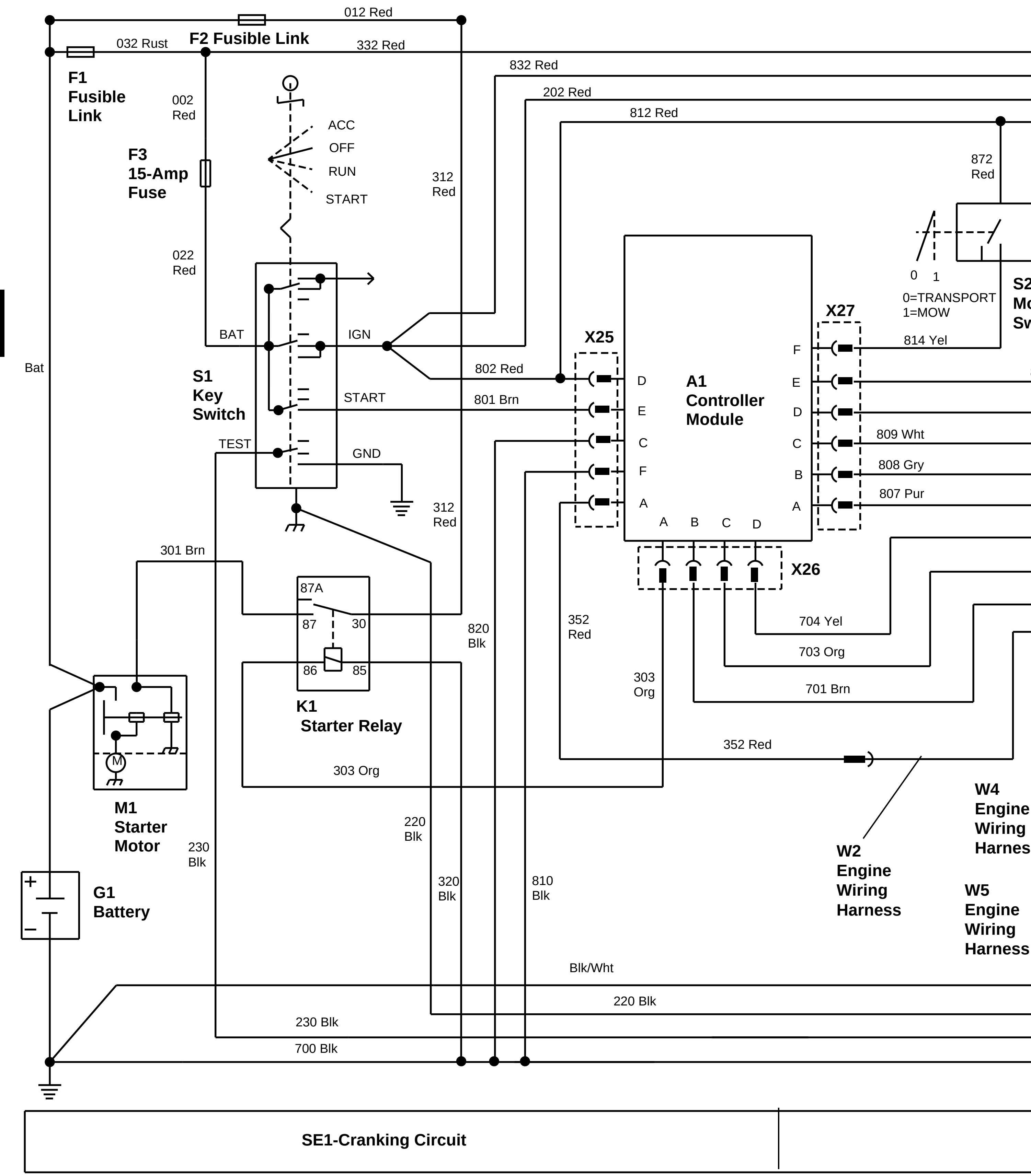
ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 957001—958000)



SE1-Cranking Circuit	SE2-Ignition Circuit	SE3-Lift Valve Circuit

M83617A

ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 957001—958000)



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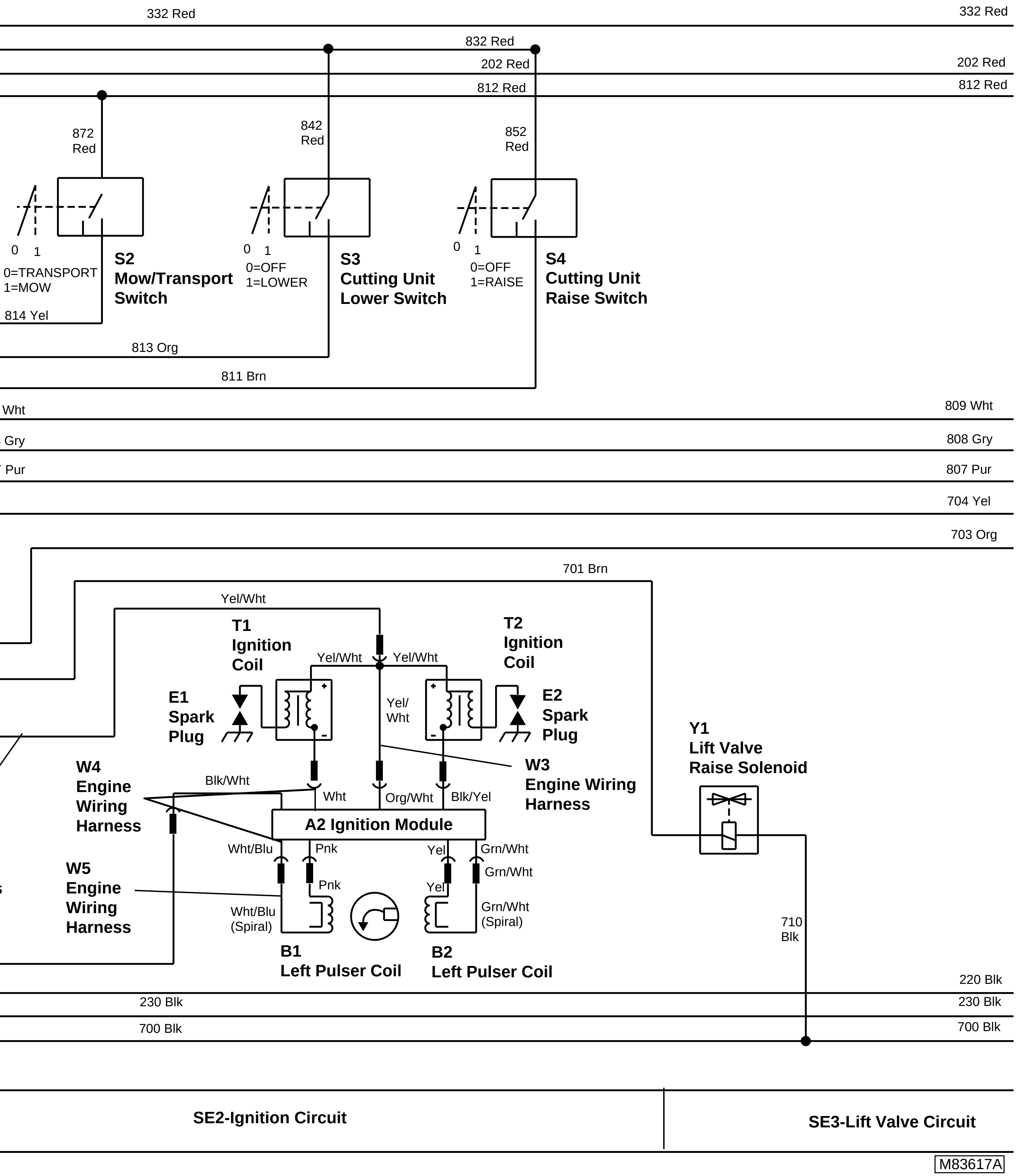
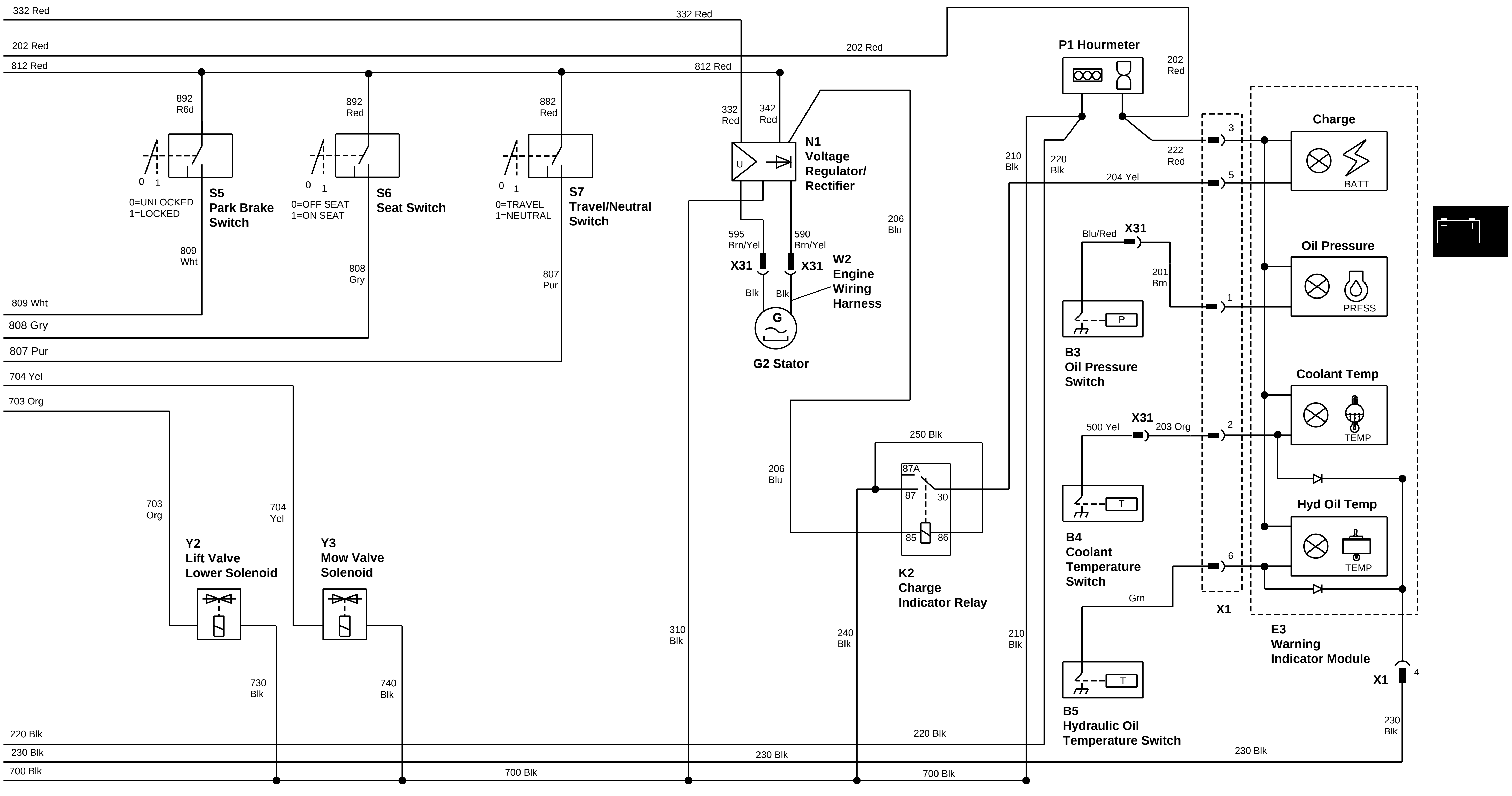
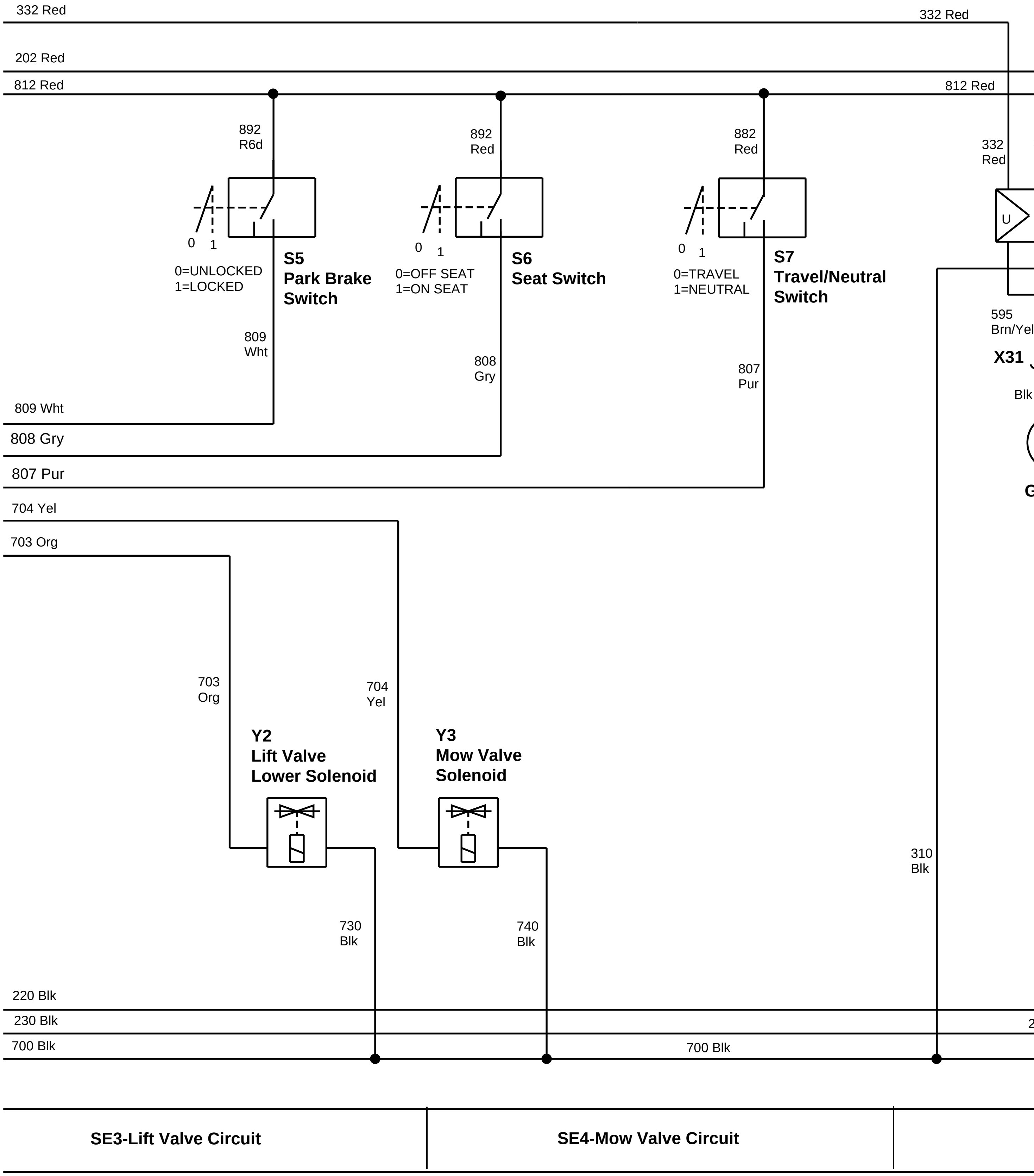
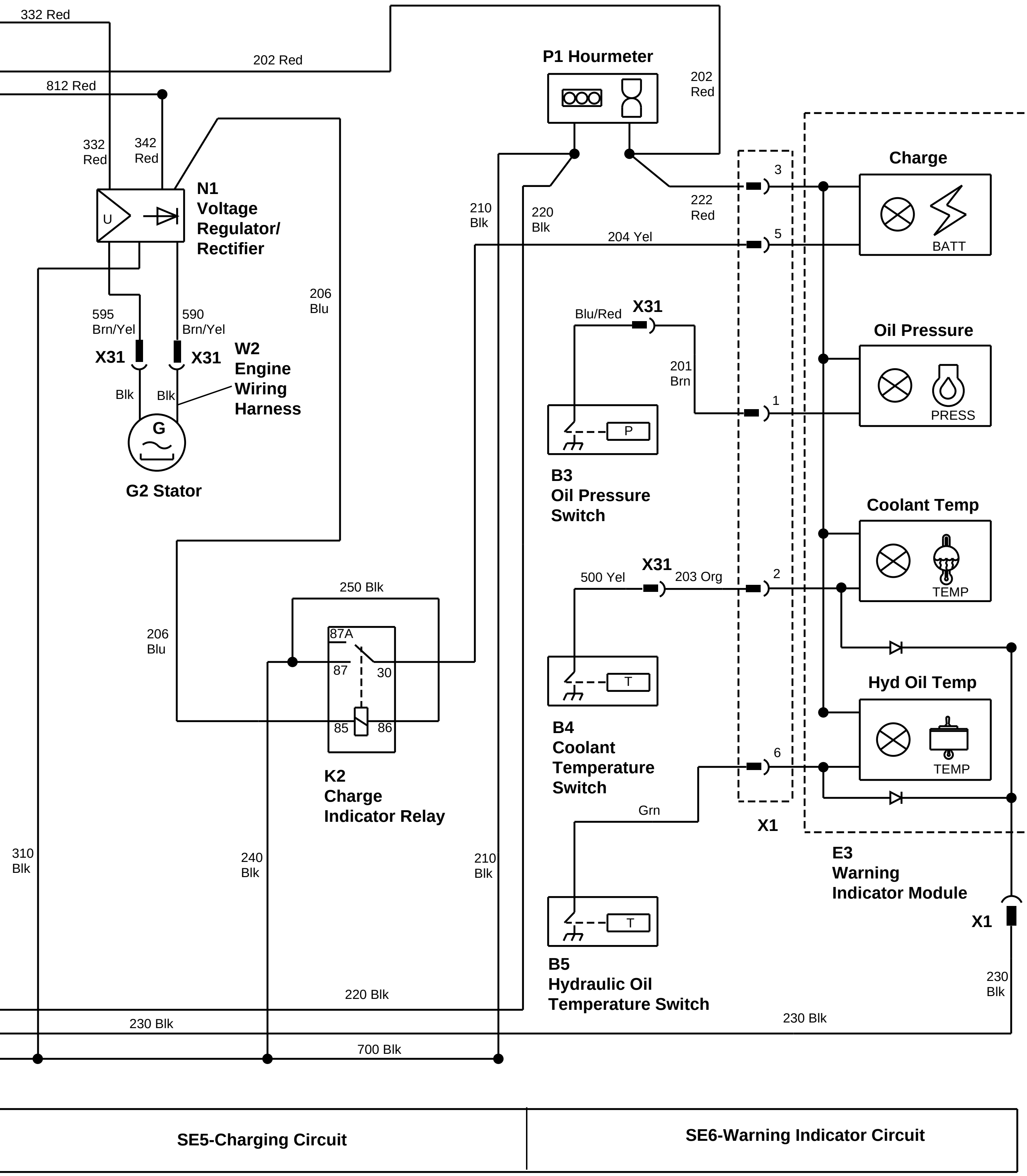

332 Red
832 Red
202 Red
812 Red
872
Red
842
Red
852
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
814 Yel
813 Org
811 Brn
Wht
809 Wht
Gry
808 Gry
Pur
807 Pur
704 Yel
703 Org
701 Brn
Yel/Wht
T1
Ignition
Coil
T2
Ignition
Coil
E1
Spark
Plug
E2
Spark
Plug
Yel/
Wht
W3
Engine Wiring
Harness
W4
Engine
Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Left Pulser Coil
Y1
Lift Valve
Raise Solenoid
710
Blk
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83617A



SE3-Lift Valve Circuit	SE4-Mow Valve Circuit	SE5-Charging Circuit	SE6-Warning Indicator Circuit

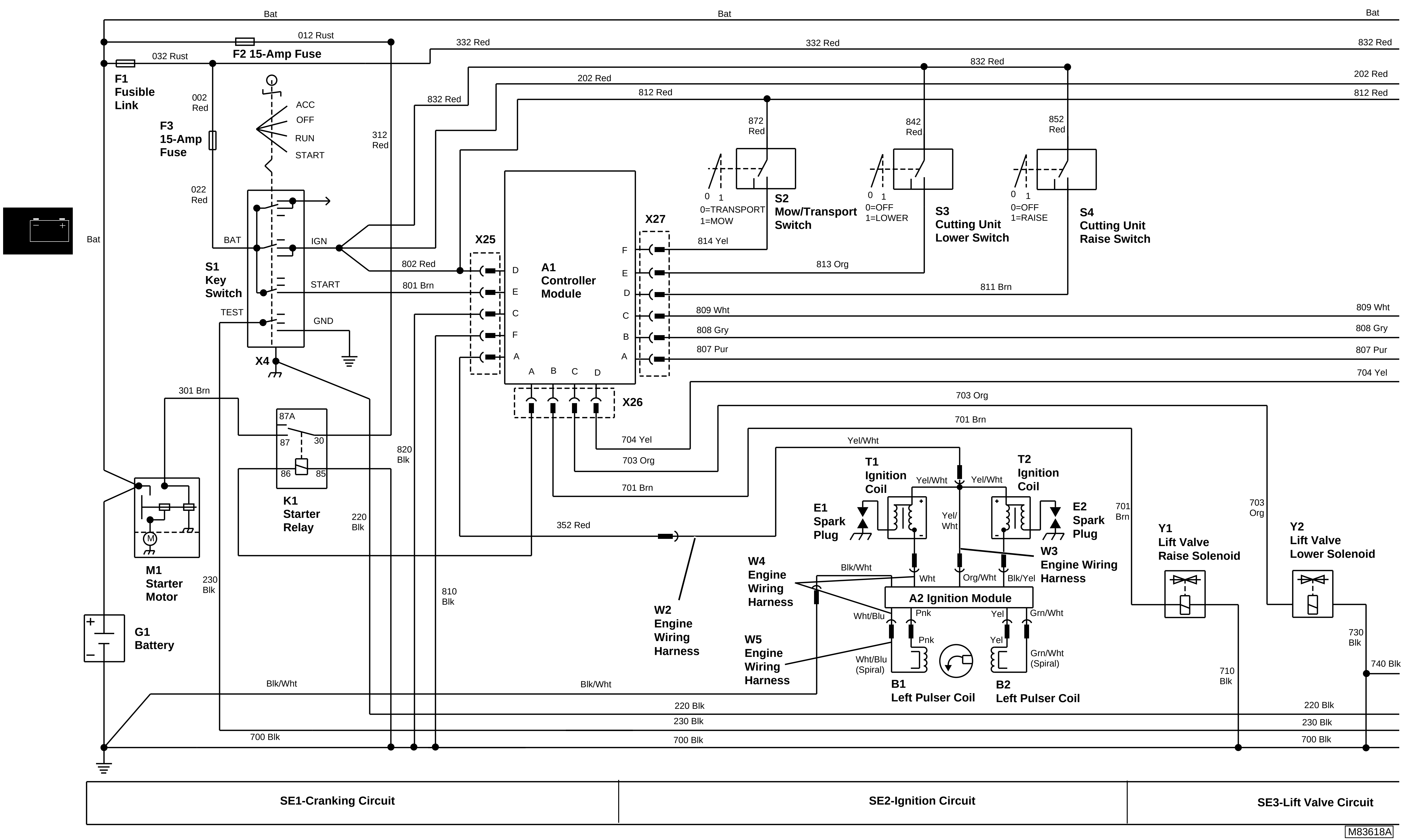
M83617B


332 Red
332 Red
202 Red
812 Red
812 Red
892
R6d
892
Red
882
Red
332
Red
U
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
595
Brn/Yel
X31
Blk
809
Wht
808
Gry
807
Pur
809 Wht
808 Gry
807 Pur
704 Yel
703 Org
703
Org
704
Yel
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
310
Blk
730
Blk
740
Blk
220 Blk
230 Blk
700 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit

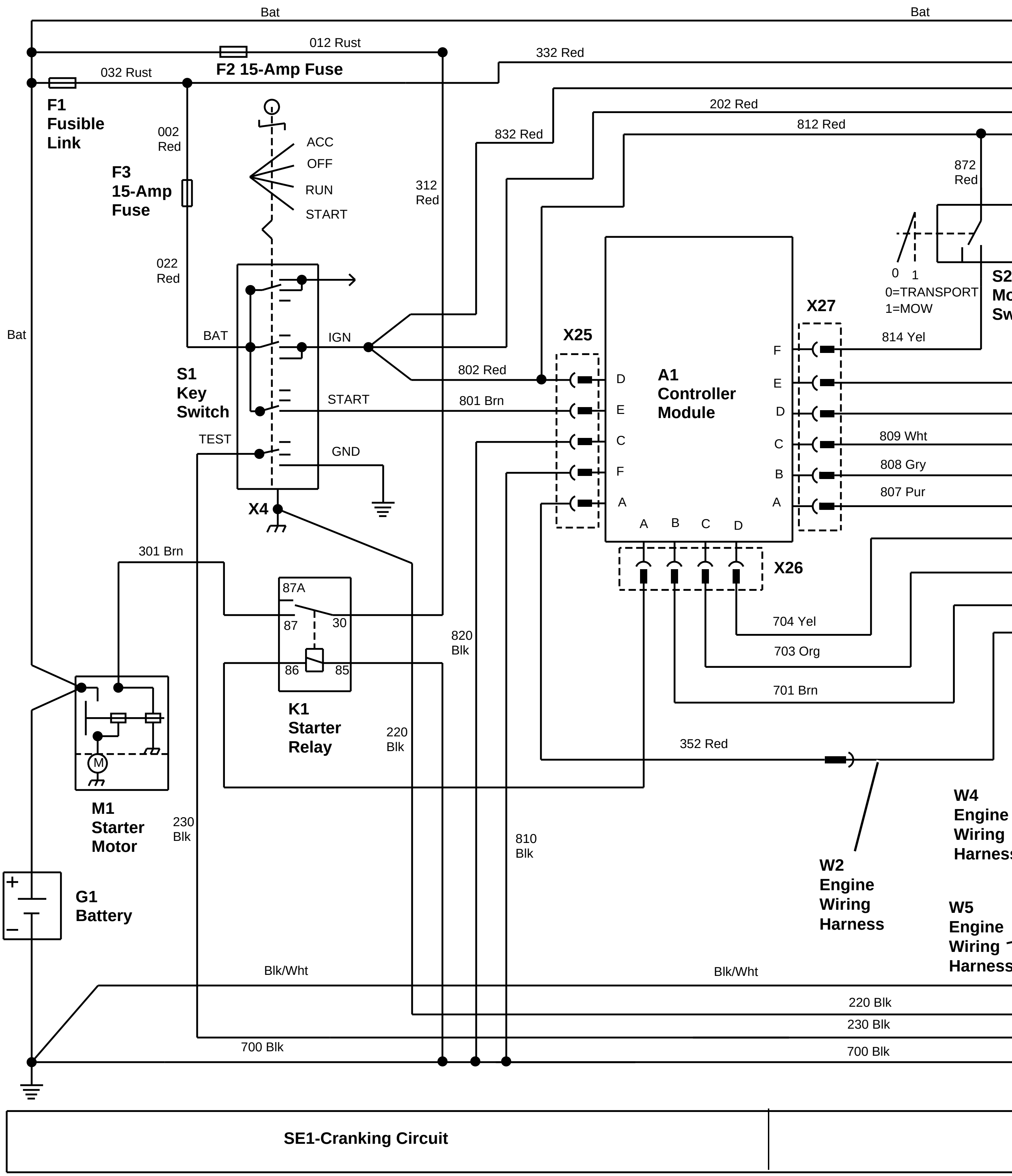

332 Red
202 Red
812 Red
332 Red
342 Red
P1 Hourmeter
202 Red
N1 Voltage Regulator/ Rectifier
U
210 Blk
220 Blk
222 Red
204 Yel
3
5
Charge
BATT
206 Blu
595 Brn/Yel
590 Brn/Yel
X31
X31
W2 Engine Wiring Harness
Blk
Blk
G
G2 Stator
Blu/Red
X31
201 Brn
1
Oil Pressure
PRESS
P
B3 Oil Pressure Switch
Coolant Temp
TEMP
500 Yel
X31
203 Org
2
250 Blk
206 Blu
87A
87
30
85
86
T
B4 Coolant Temperature Switch
Hyd Oil Temp
TEMP
6
Grn
X1
K2 Charge Indicator Relay
310 Blk
240 Blk
210 Blk
E3 Warning Indicator Module
X1
4
T
B5 Hydraulic Oil Temperature Switch
230 Blk
220 Blk
230 Blk
230 Blk
700 Blk
SE5-Charging Circuit
SE6-Warning Indicator Circuit

M83617B

ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 957001—958000)



ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 957001—958000)



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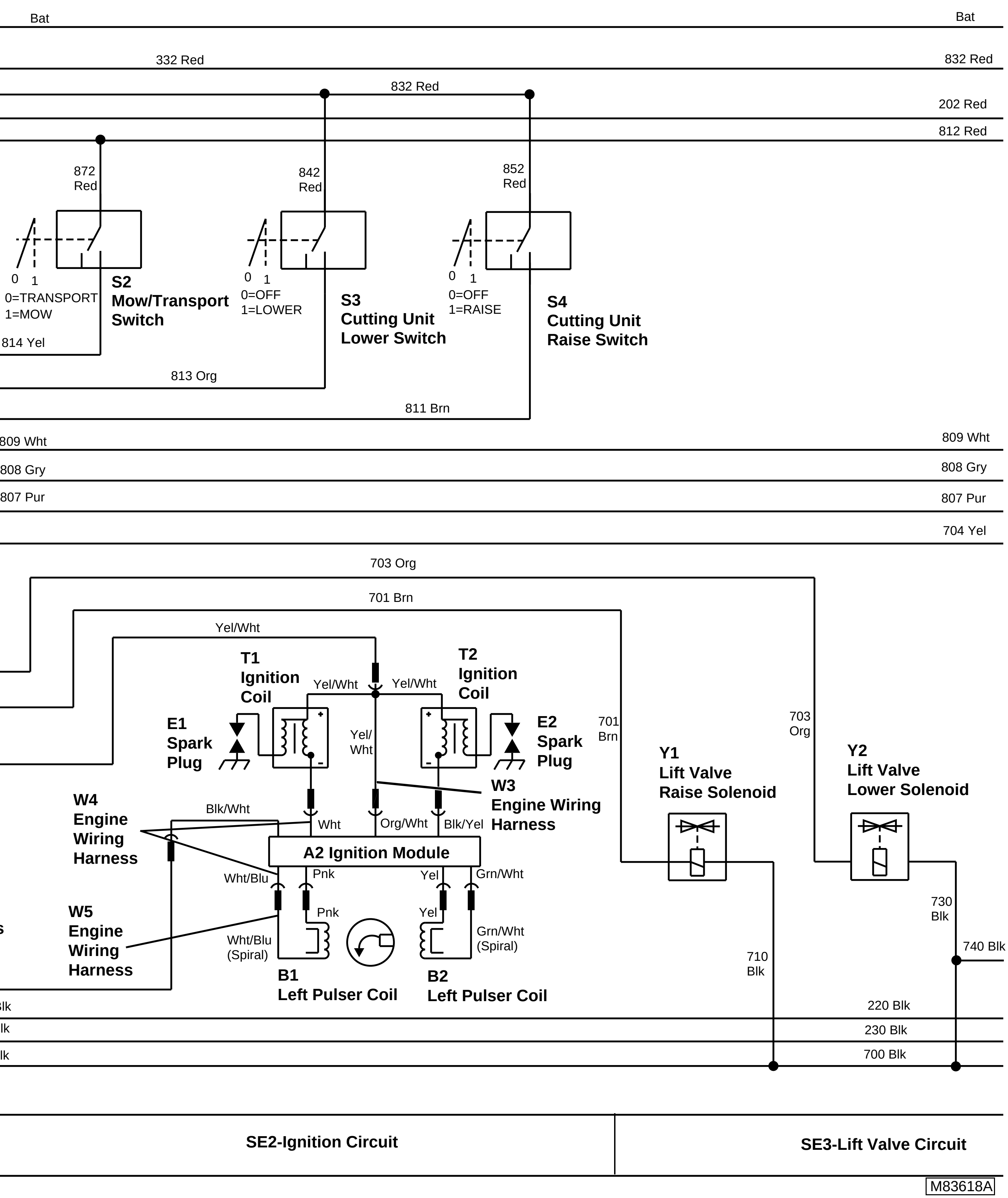
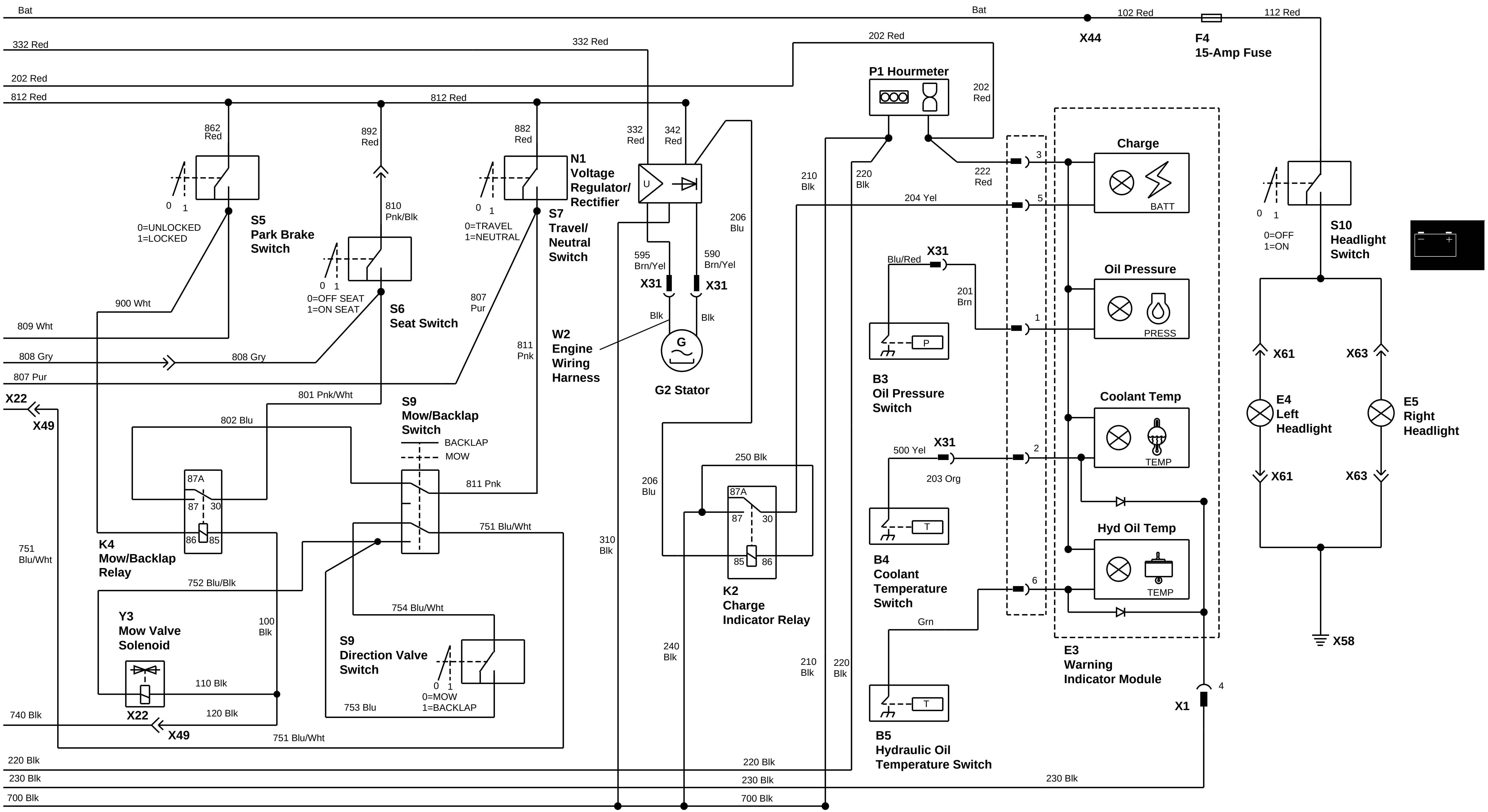
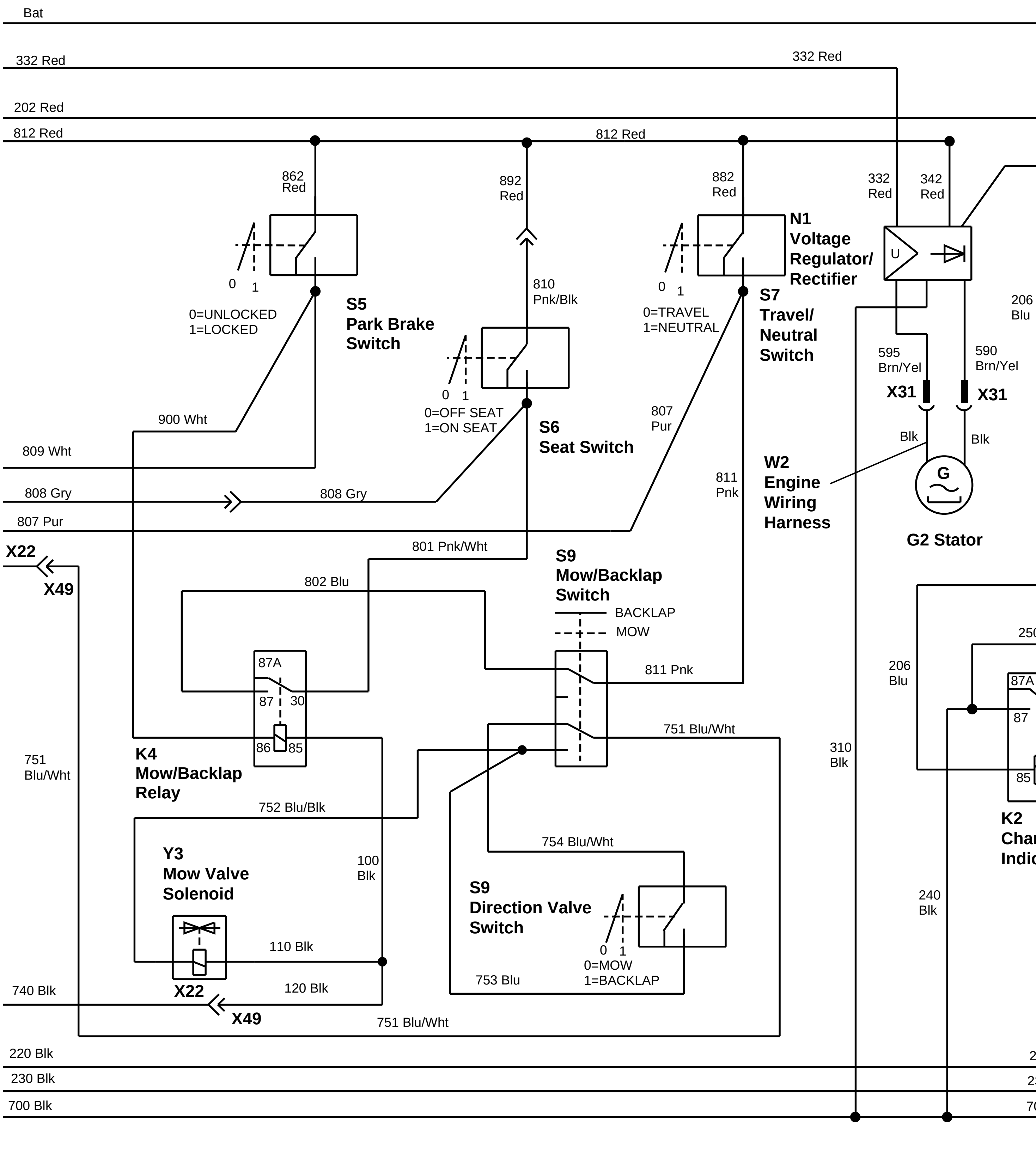


Bat
Bat
332 Red
832 Red
832 Red
202 Red
812 Red
872 Red
842 Red
852 Red
0 1
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0 1
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch
0 1
0=OFF
1=RAISE
S4 Cutting Unit Raise Switch
814 Yel
813 Org
811 Brn
809 Wht
809 Wht
808 Gry
808 Gry
807 Pur
807 Pur
704 Yel
703 Org
701 Brn
Yel/Wht
T1 Ignition Coil
Yel/Wht
Yel/Wht
T2 Ignition Coil
E1 Spark Plug
Yel/ Wht
E2 Spark Plug
701 Brn
703 Org
Y1 Lift Valve Raise Solenoid
Y2 Lift Valve Lower Solenoid
W4 Engine Wiring Harness
Blk/Wht
W3 Engine Wiring Harness
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
Pnk
Yel
W5 Engine Wiring Harness
Wht/Blu (Spiral)
Grn/Wht (Spiral)
730 Blk
740 Blk
710 Blk
B1 Left Pulser Coil
B2 Left Pulser Coil
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83618A

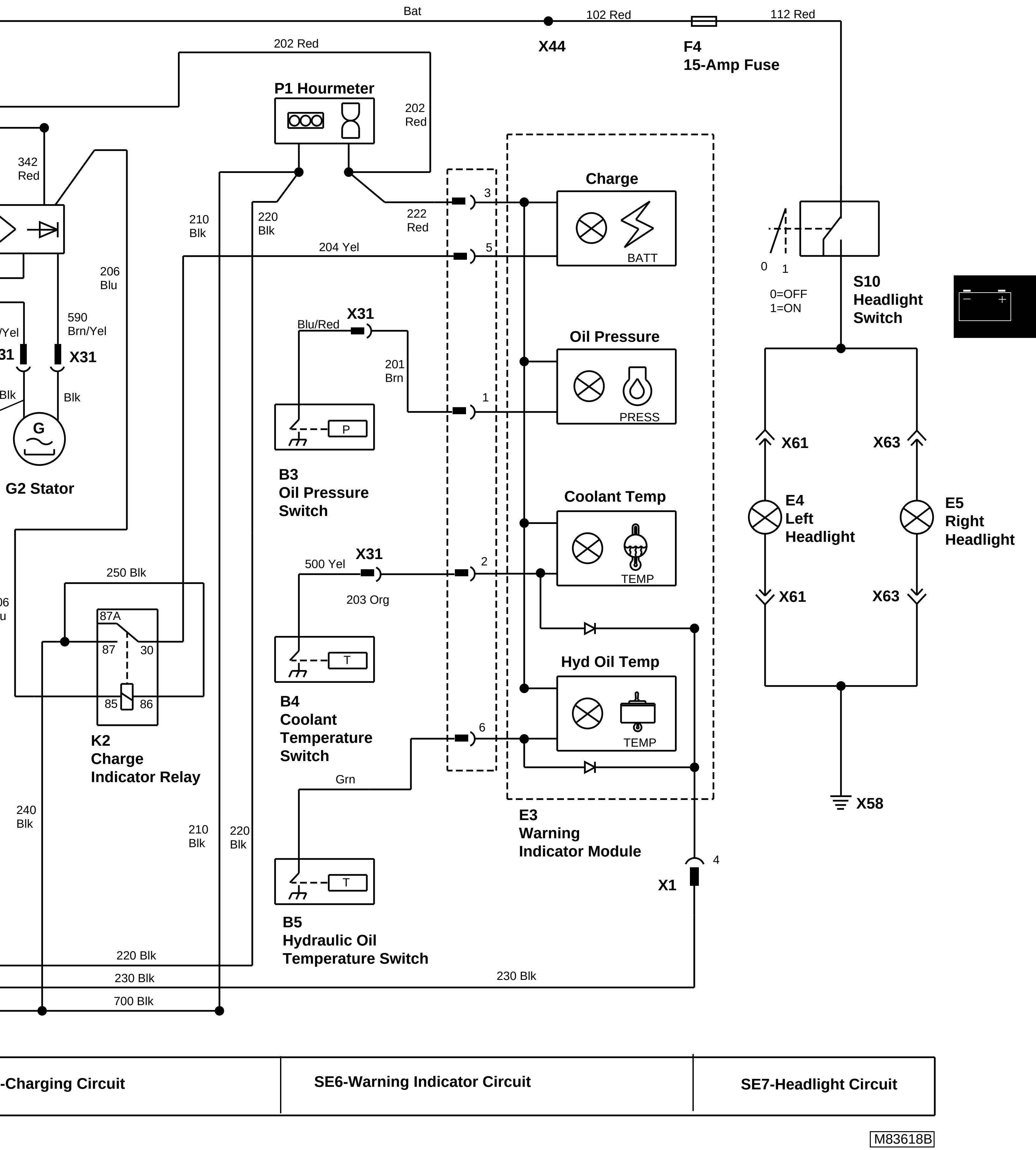


SE3-Lift Valve Circuit	SE4-Mow Valve Circuit	SE5-Charging Circuit	SE6-Warning Indicator Circuit	SE7-Headlight Circuit

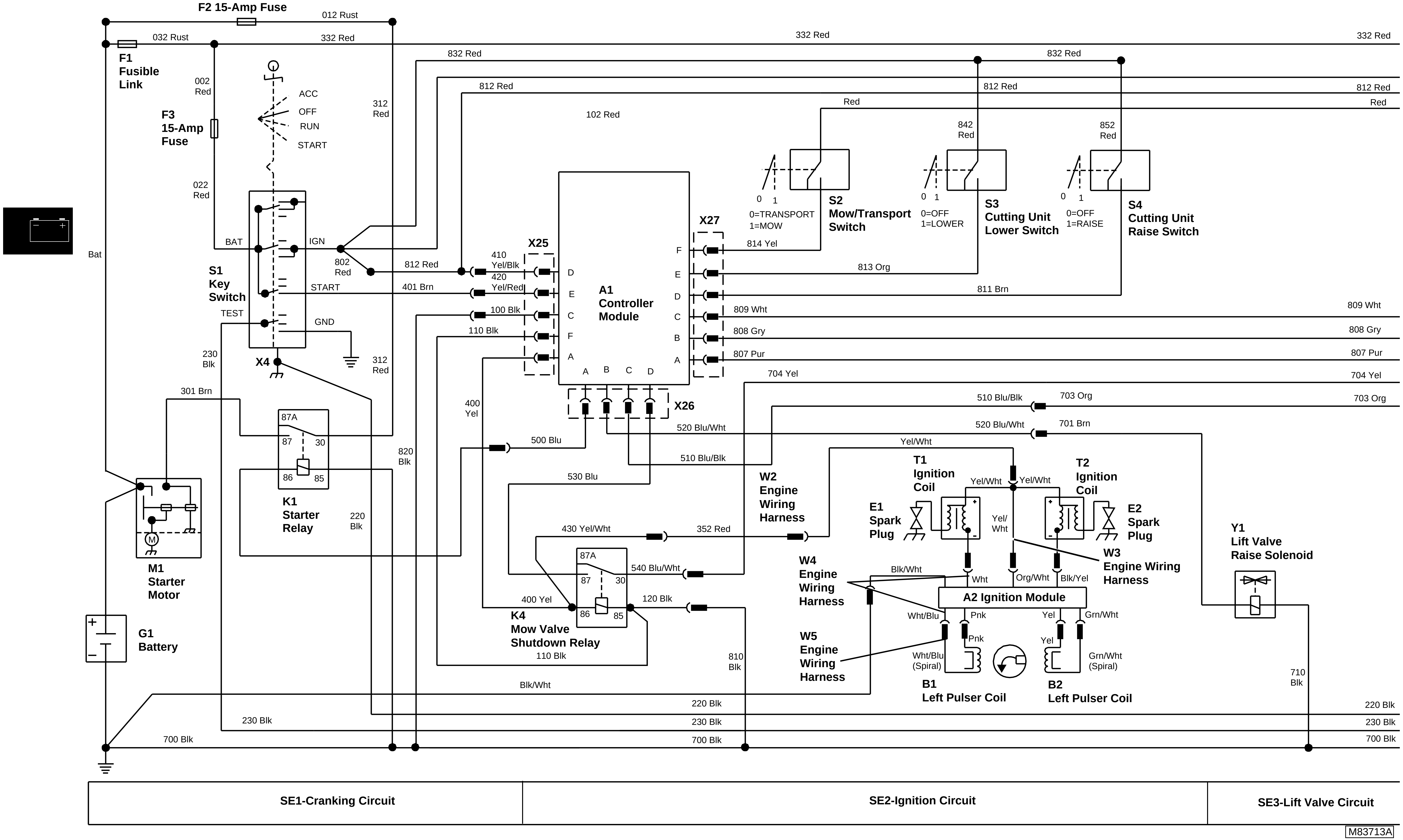
M83618B



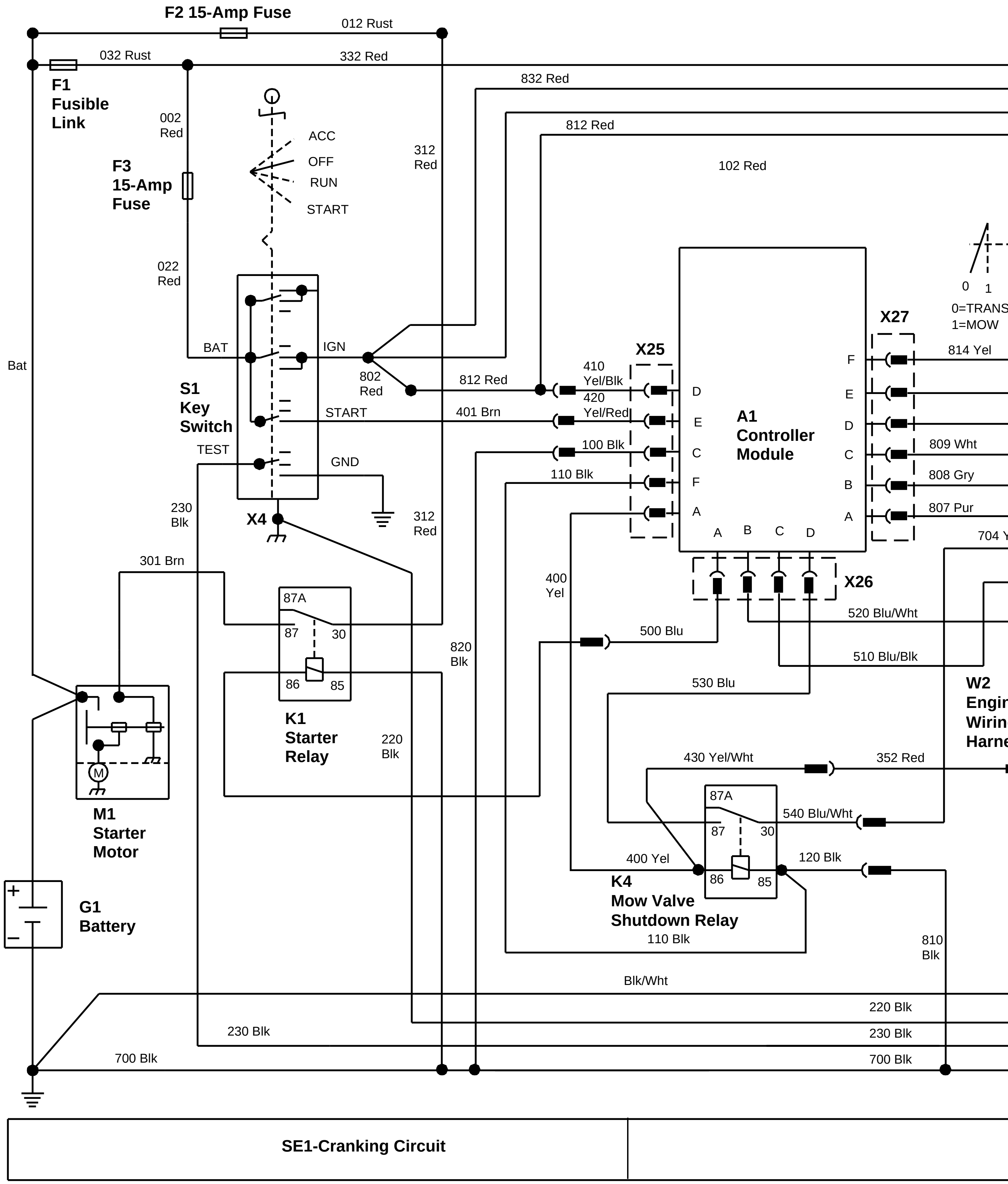
SE3-Lift Valve Circuit	SE4-Mow Valve Circuit	SE5-Charging Circuit


Bat
102 Red
112 Red
202 Red
X44
F4
15-Amp Fuse
P1 Hourmeter
202
Red
342
Red
210
Blk
220
Blk
222
Red
204 Yel
206
Blu
590
Brn/Yel
/Yel
31
X31
Blk
Blk
G
G2 Stator
Charge
BATT
3
5
Oil Pressure
PRESS
1
X31
Blu/Red
201
Brn
P
B3
Oil Pressure
Switch
Coolant Temp
TEMP
2
X31
500 Yel
203 Org
T
B4
Coolant
Temperature
Switch
Hyd Oil Temp
TEMP
6
Grn
T
B5
Hydraulic Oil
Temperature Switch
250 Blk
06
u
87A
87
30
85
86
K2
Charge
Indicator Relay
240
Blk
210
Blk
220
Blk
E3
Warning
Indicator Module
4
X1
220 Blk
230 Blk
700 Blk
230 Blk
0
1
0=OFF
1=ON
S10
Headlight
Switch
X61
X63
E4
Left
Headlight
E5
Right
Headlight
X61
X63
X58
-Charging Circuit
SE6-Warning Indicator Circuit
SE7-Headlight Circuit
M83618B

ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 958001—958XXX)



ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 958001—958XXX)



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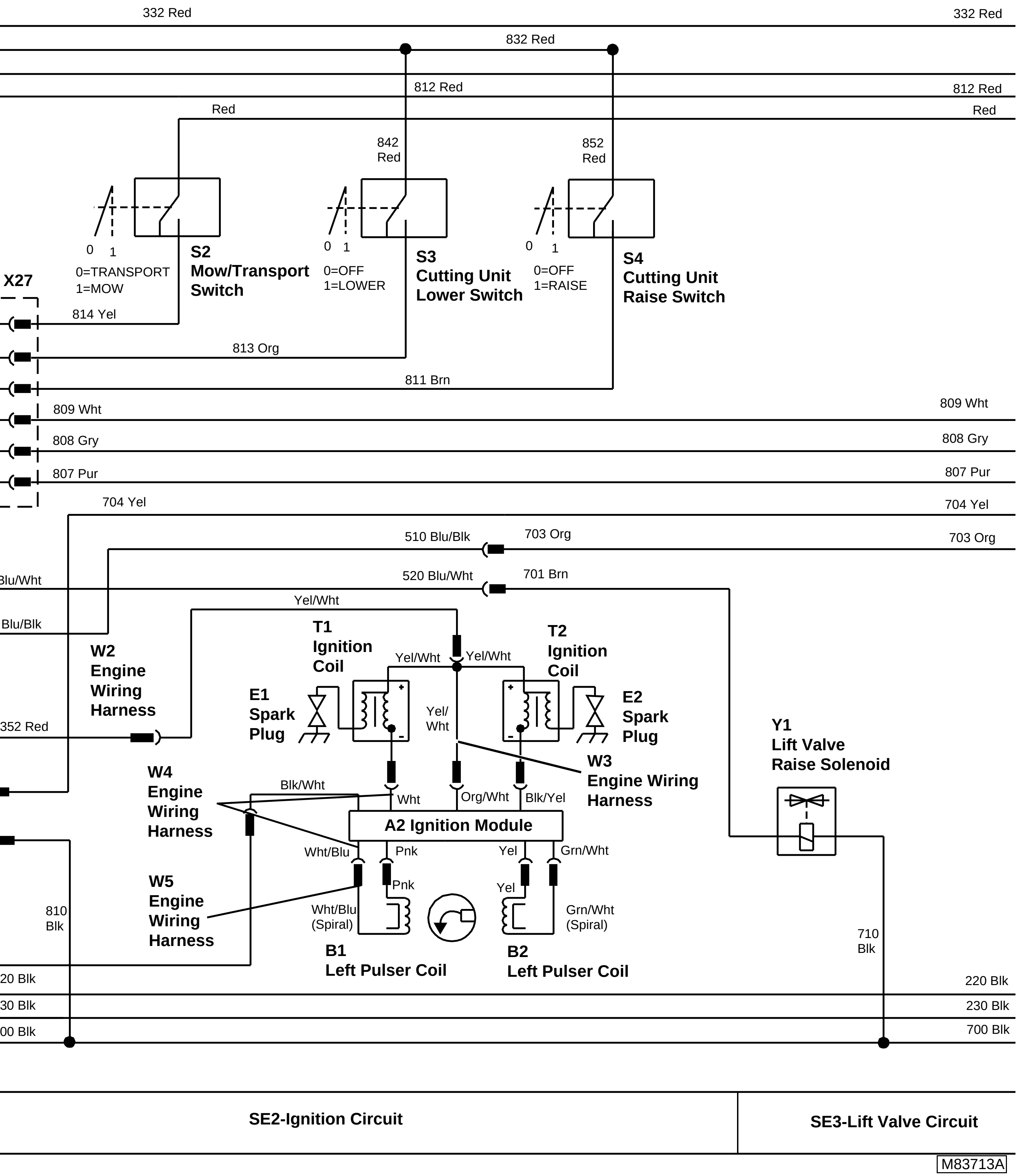
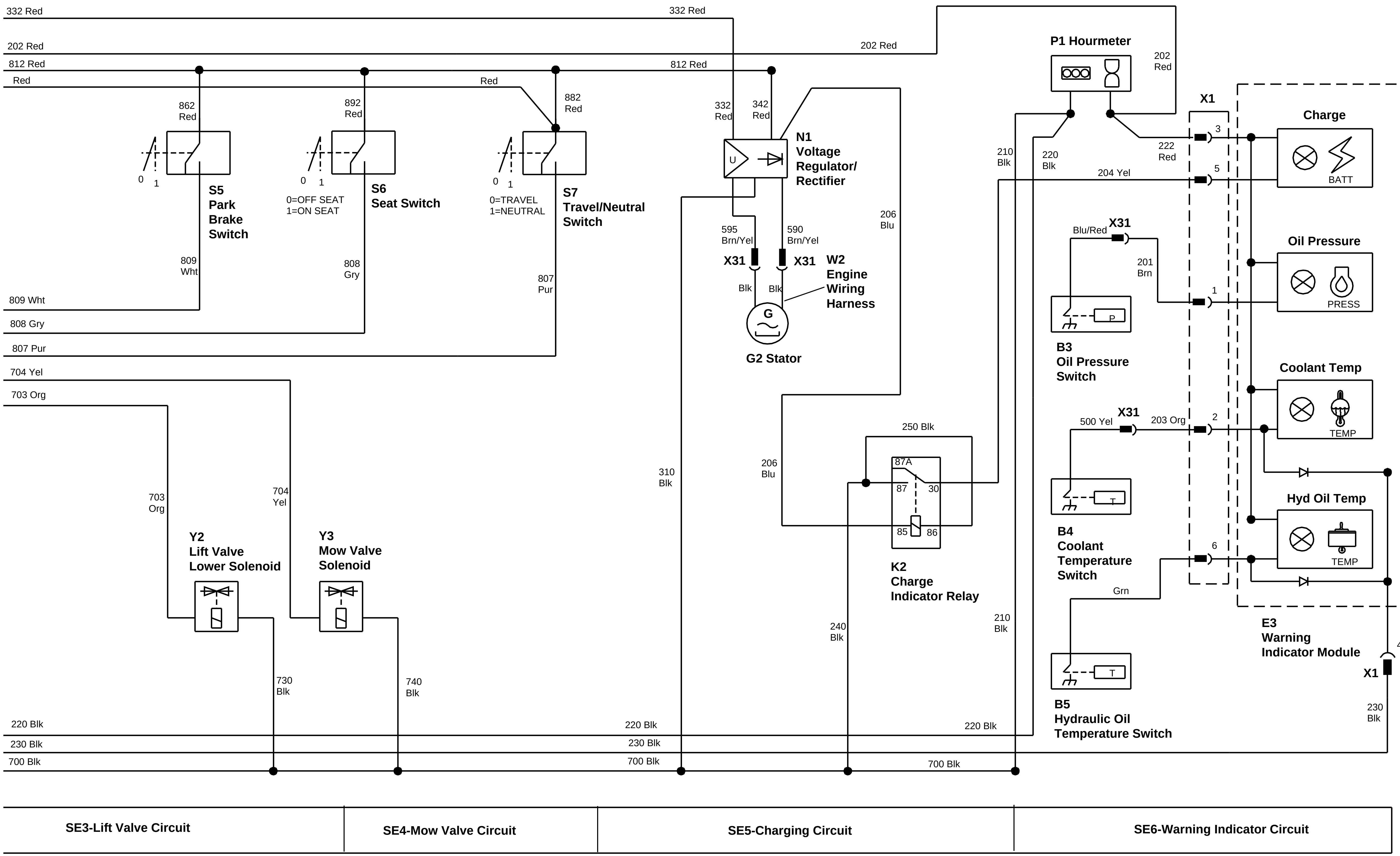
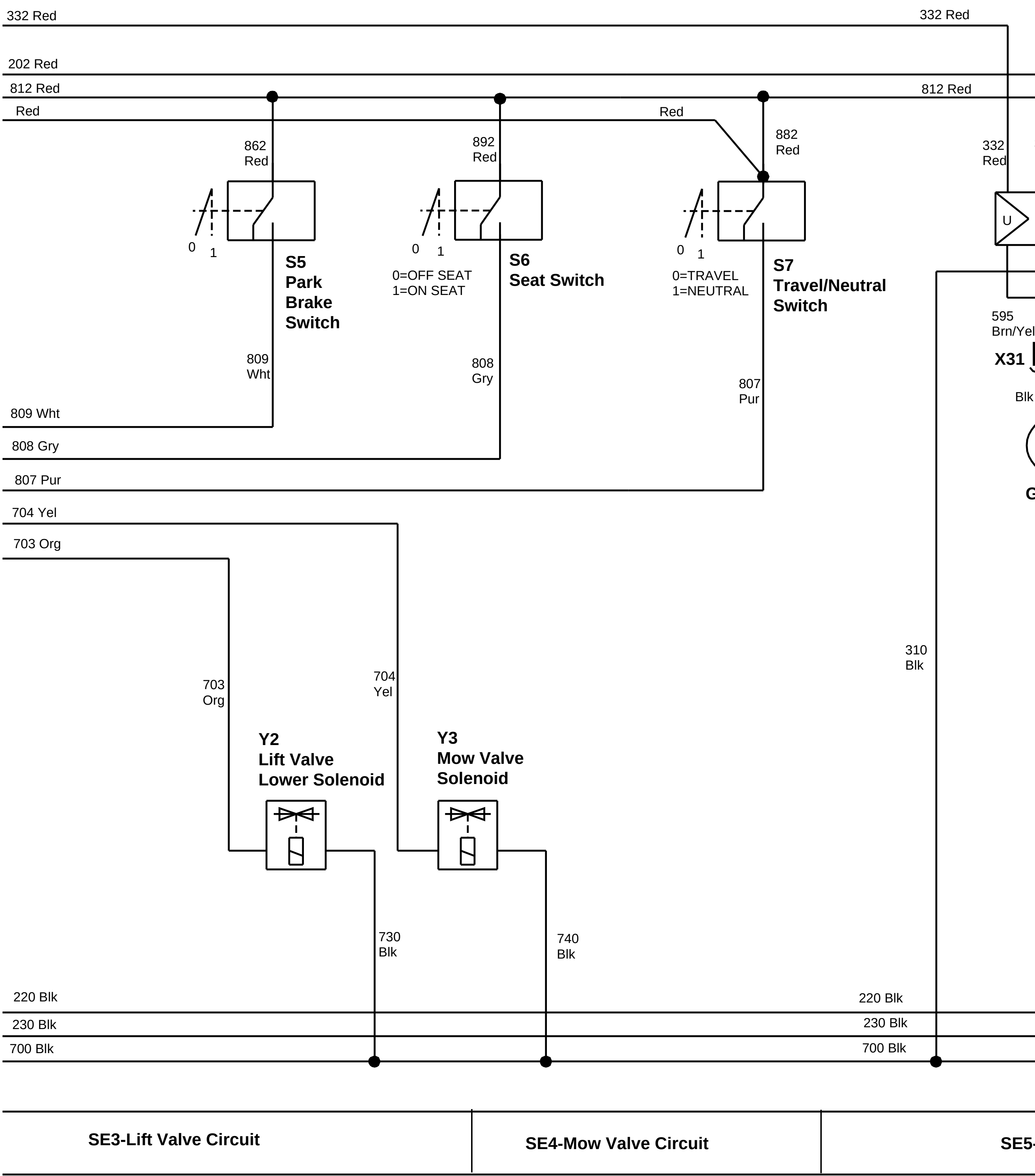
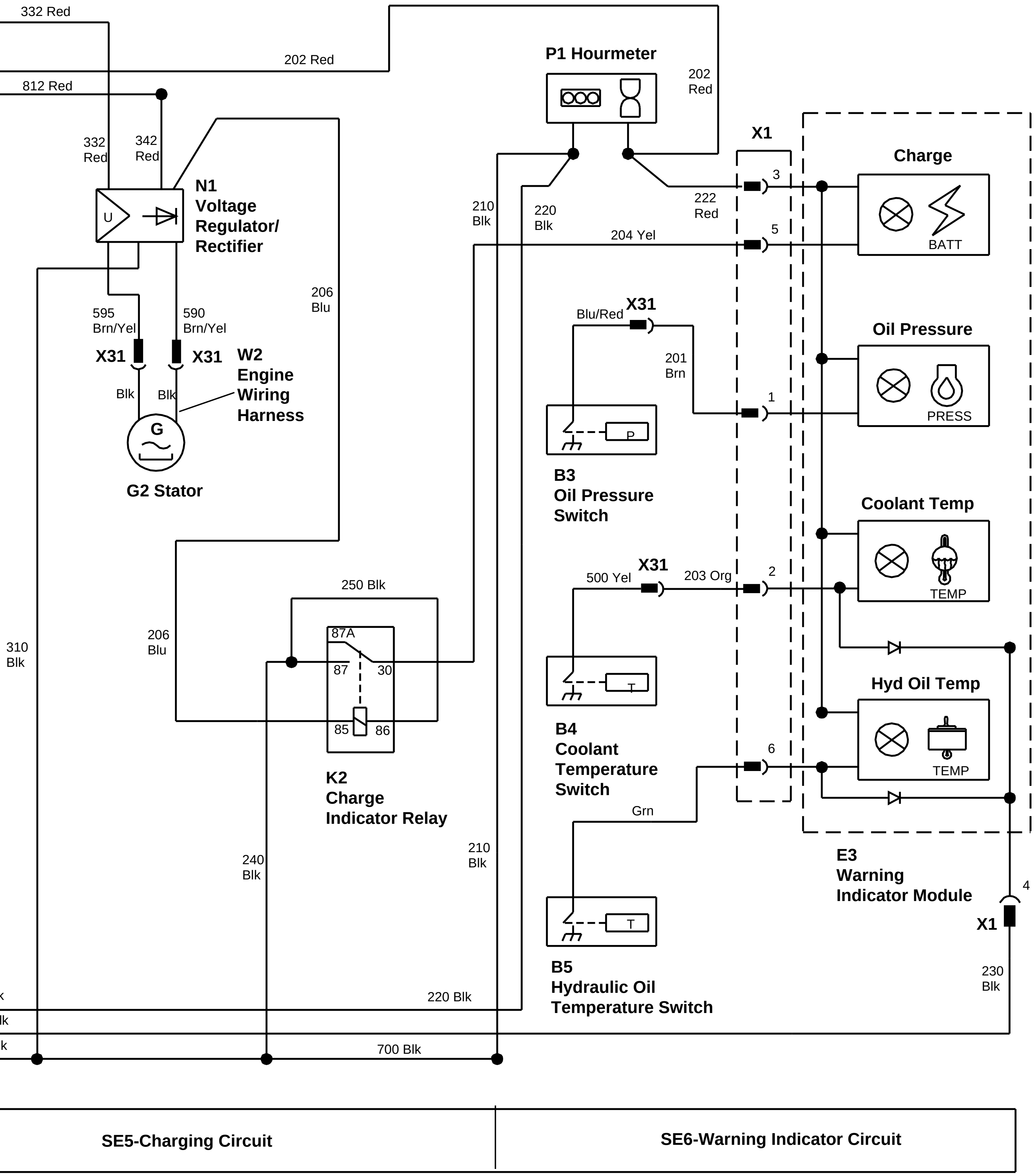

332 Red
832 Red
812 Red
Red
842 Red
852 Red
0 1
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch
0=OFF
1=RAISE
S4 Cutting Unit Raise Switch
X27
814 Yel
813 Org
811 Brn
809 Wht
808 Gry
807 Pur
704 Yel
510 Blu/Blk
703 Org
520 Blu/Wht
701 Brn
Blu/Wht
Blu/Blk
Yel/Wht
T1 Ignition Coil
T2 Ignition Coil
W2 Engine Wiring Harness
E1 Spark Plug
E2 Spark Plug
Yel/Wht
Yel/ Wht
352 Red
Y1 Lift Valve Raise Solenoid
W3 Engine Wiring Harness
W4 Engine Wiring Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
W5 Engine Wiring Harness
810 Blk
Wht/Blu (Spiral)
Grn/Wht (Spiral)
B1 Left Pulser Coil
B2 Left Pulser Coil
710 Blk
20 Blk
30 Blk
00 Blk
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83713A


332 Red
202 Red
812 Red
Red
862 Red
892 Red
882 Red
332 Red
342 Red
S5
Park
Brake
Switch
S6
Seat Switch
0=OFF SEAT
1=ON SEAT
S7
Travel/Neutral
Switch
0=TRAVEL
1=NEUTRAL
N1
Voltage
Regulator/
Rectifier
P1 Hourmeter
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
E3
Warning
Indicator Module
595 Brn/Yel
590 Brn/Yel
X31
W2
Engine
Wiring
Harness
G2 Stator
206 Blu
210 Blk
220 Blk
204 Yel
222 Red
Blu/Red
201 Brn
B3
Oil Pressure
Switch
500 Yel
203 Org
B4
Coolant
Temperature
Switch
Grn
B5
Hydraulic Oil
Temperature Switch
250 Blk
87A
87
30
85
86
K2
Charge
Indicator Relay
809 Wht
808 Gry
807 Pur
704 Yel
703 Org
310 Blk
240 Blk
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
730 Blk
740 Blk
230 Blk
220 Blk
230 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit

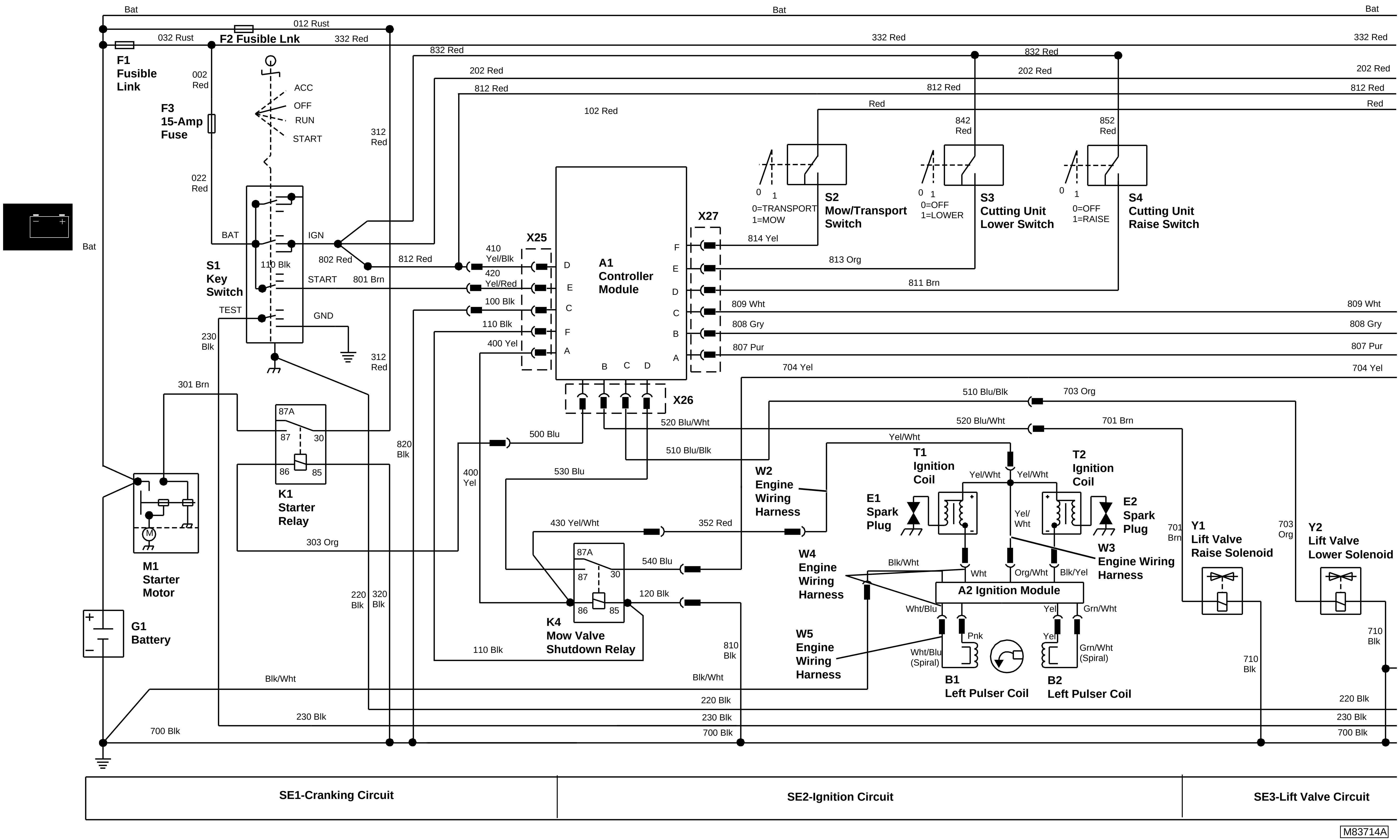
M83713B


332 Red
332 Red
202 Red
812 Red
812 Red
Red
Red
862
Red
892
Red
882
Red
332
Red
U
0
1
S5
Park
Brake
Switch
0
1
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
0
1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
595
Brn/Yel
X31
Blk
809
Wht
808
Gry
807
Pur
809 Wht
808 Gry
807 Pur
704 Yel
703 Org
310
Blk
703
Org
704
Yel
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
730
Blk
740
Blk
220 Blk
220 Blk
230 Blk
230 Blk
700 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit

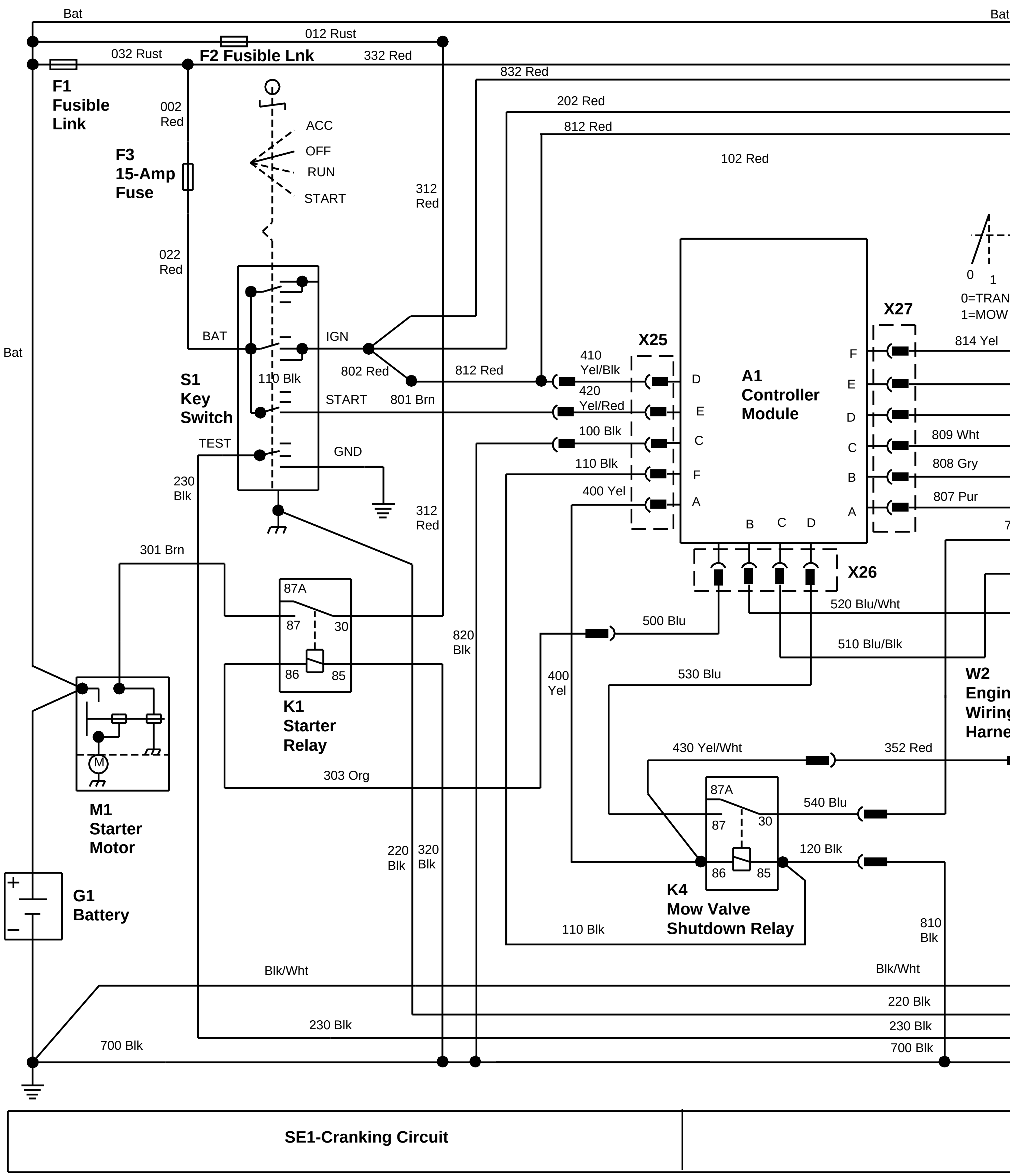

332 Red
202 Red
812 Red
332 Red
342 Red
N1 Voltage Regulator/ Rectifier
U
595 Brn/Yel
590 Brn/Yel
X31
X31
Blk
Blk
W2 Engine Wiring Harness
G
G2 Stator
206 Blu
206 Blu
310 Blk
P1 Hourmeter
202 Red
210 Blk
220 Blk
222 Red
204 Yel
X1
3
5
Charge
BATT
Blu/Red
X31
201 Brn
1
Oil Pressure
PRESS
P
B3 Oil Pressure Switch
Coolant Temp
TEMP
500 Yel
X31
203 Org
2
T
B4 Coolant Temperature Switch
Hyd Oil Temp
TEMP
6
Grn
T
B5 Hydraulic Oil Temperature Switch
250 Blk
87A
87
30
85
86
K2 Charge Indicator Relay
240 Blk
210 Blk
E3 Warning Indicator Module
4
X1
230 Blk
220 Blk
700 Blk
SE5-Charging Circuit
SE6-Warning Indicator Circuit

M83713B

ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 958001—958XXX)



ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 958001—958XXX)



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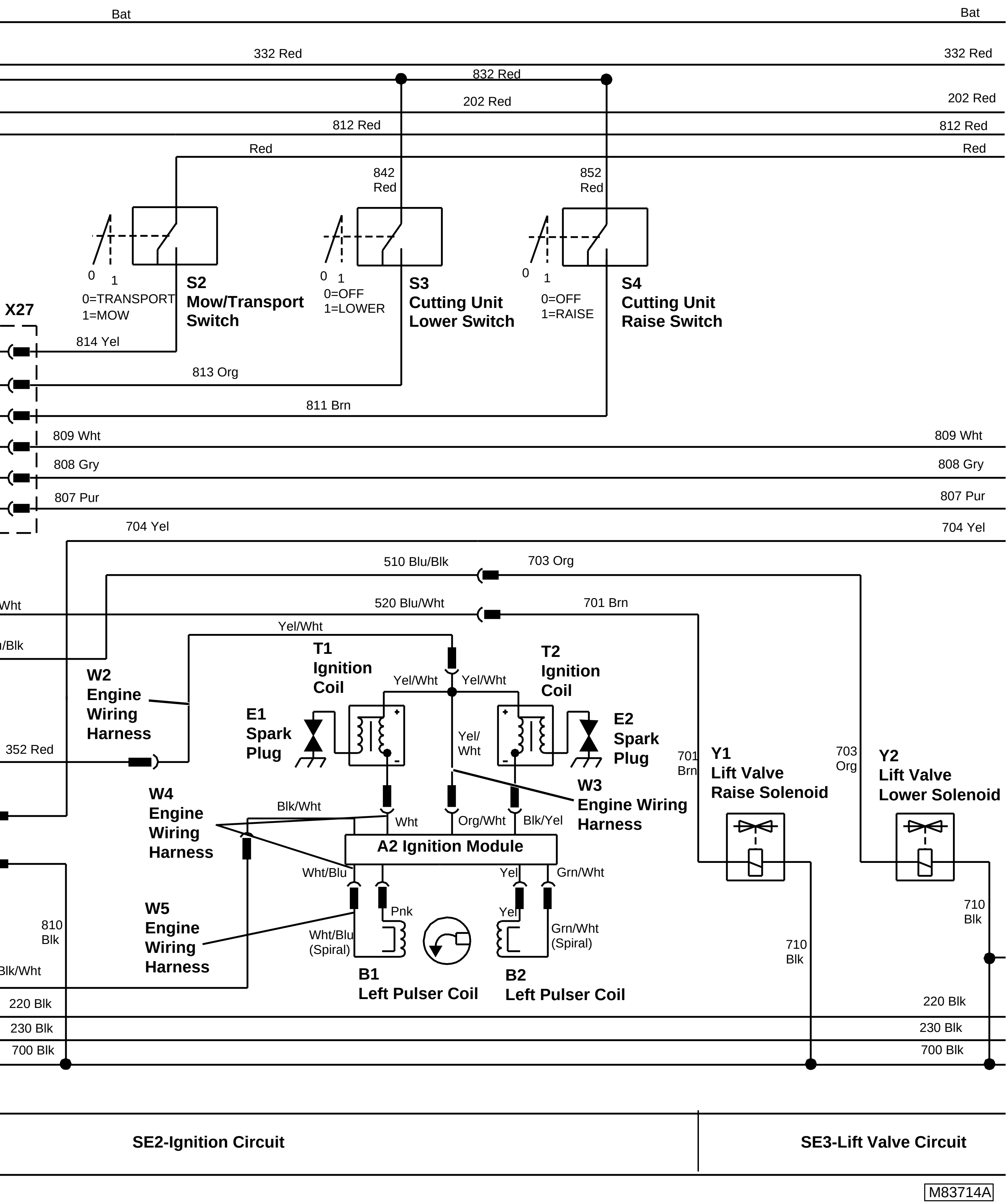
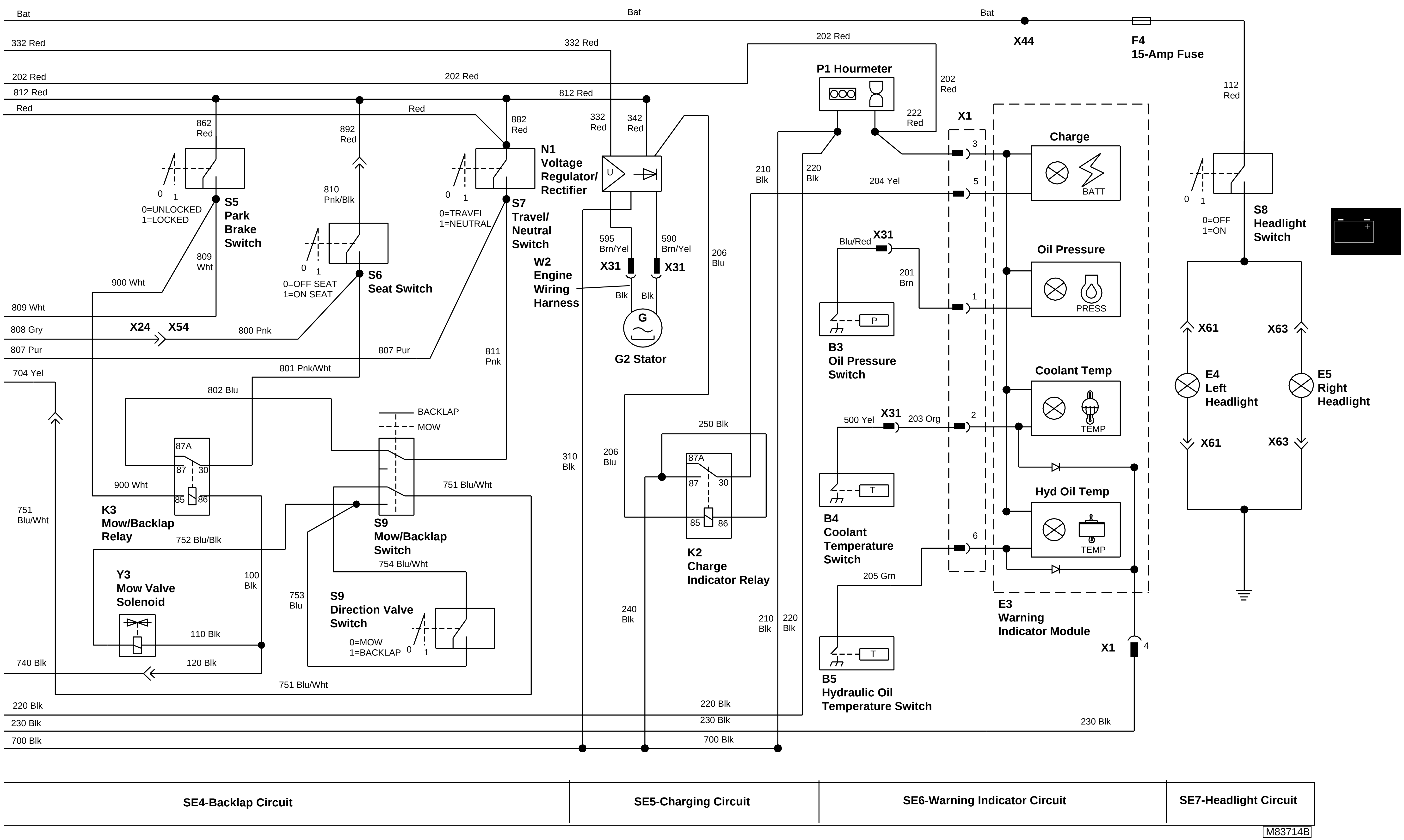
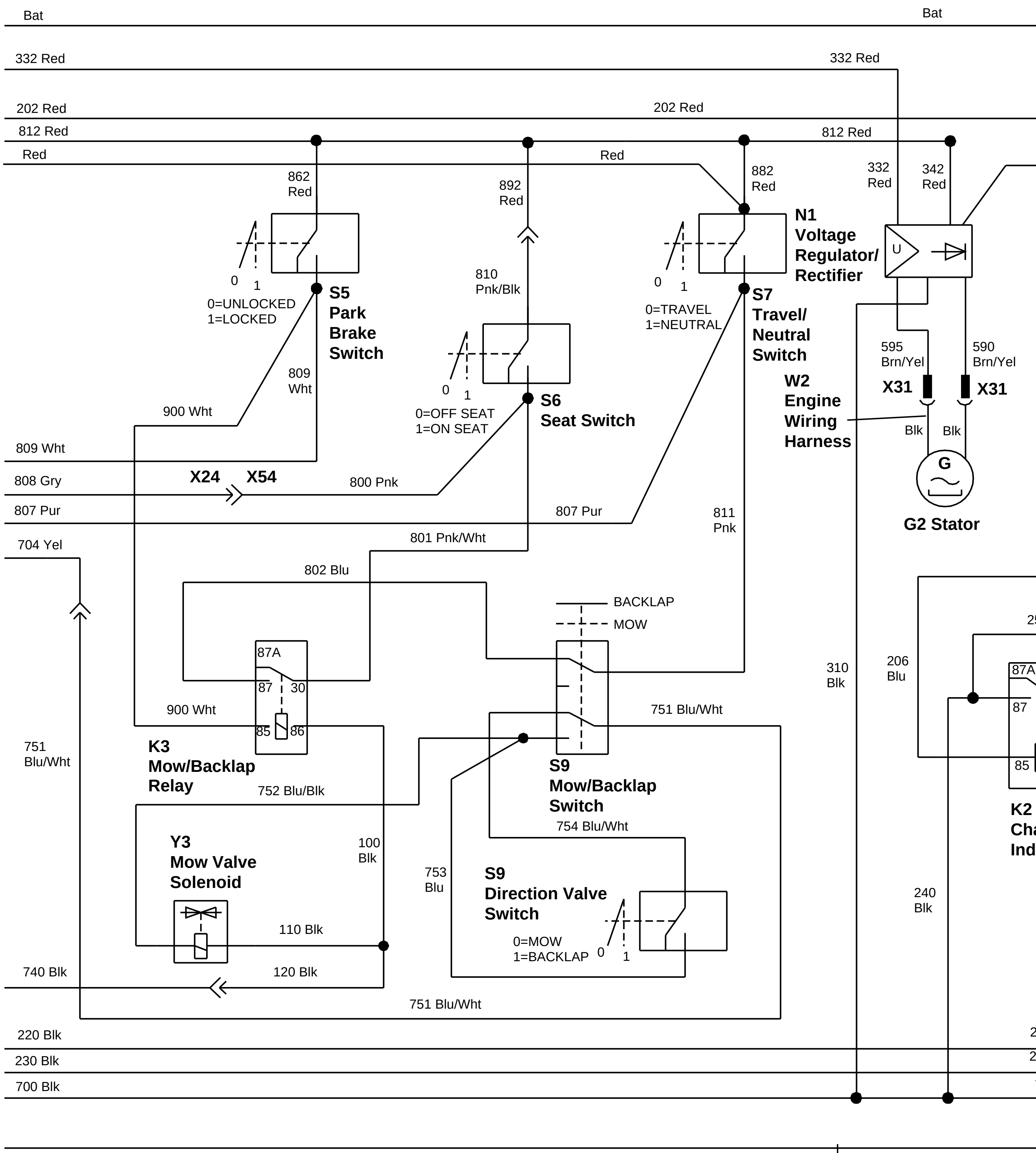

Bat
332 Red
832 Red
202 Red
812 Red
Red
842 Red
852 Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport Switch
0=OFF
1=LOWER
S3
Cutting Unit Lower Switch
0=OFF
1=RAISE
S4
Cutting Unit Raise Switch
X27
814 Yel
813 Org
811 Brn
809 Wht
808 Gry
807 Pur
704 Yel
510 Blu/Blk
703 Org
Wht
520 Blu/Wht
701 Brn
n/Blk
Yel/Wht
T1
Ignition Coil
T2
Ignition Coil
W2
Engine Wiring Harness
E1
Spark Plug
E2
Spark Plug
352 Red
Yel/Wht
Yel/Wht
701 Brn
703 Org
Y1
Lift Valve Raise Solenoid
Y2
Lift Valve Lower Solenoid
W3
Engine Wiring Harness
W4
Engine Wiring Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Yel
Grn/Wht
Pnk
Yel
810 Blk
W5
Engine Wiring Harness
Wht/Blu (Spiral)
Grn/Wht (Spiral)
710 Blk
710 Blk
Blk/Wht
B1
Left Pulser Coil
B2
Left Pulser Coil
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83714A

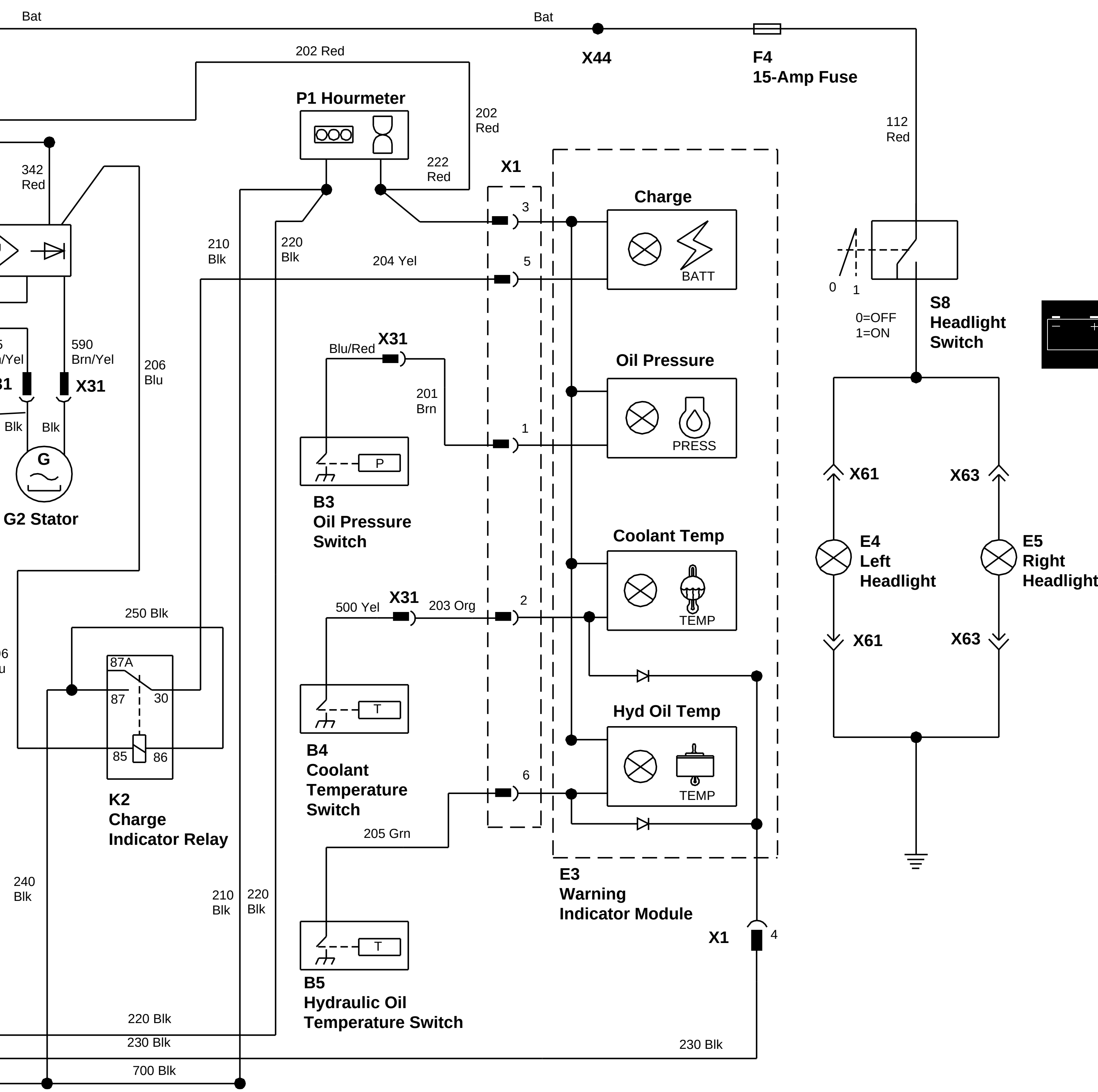


Bat
332 Red
202 Red
812 Red
Red
862 Red
892 Red
882 Red
332 Red
342 Red
202 Red
P1 Hourmeter
202 Red
222 Red
X44
F4
15-Amp Fuse
112 Red
X1
0=UNLOCKED
1=LOCKED
S5
Park
Brake
Switch
810 Pnk/Blk
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
N1
Voltage
Regulator/
Rectifier
210 Blk
220 Blk
204 Yel
Charge
BATT
0=OFF
1=ON
S8
Headlight
Switch
809 Wht
900 Wht
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
W2
Engine
Wiring
Harness
595 Brn/Yel
590 Brn/Yel
X31
206 Blu
Blu/Red
201 Brn
Oil Pressure
PRESS
809 Wht
808 Gry
X24
X54
800 Pnk
807 Pur
807 Pur
811 Pnk
G2 Stator
B3
Oil Pressure
Switch
X61
X63
E4
Left
Headlight
E5
Right
Headlight
704 Yel
801 Pnk/Wht
802 Blu
BACKLAP
MOW
Coolant Temp
TEMP
500 Yel
203 Org
250 Blk
900 Wht
751 Blu/Wht
K3
Mow/Backlap
Relay
752 Blu/Blk
S9
Mow/Backlap
Switch
310 Blk
206 Blu
K2
Charge
Indicator Relay
Hyd Oil Temp
B4
Coolant
Temperature
Switch
754 Blu/Wht
Y3
Mow Valve
Solenoid
100 Blk
753 Blu
S9
Direction Valve
Switch
0=MOW
1=BACKLAP
205 Grn
E3
Warning
Indicator Module
110 Blk
240 Blk
210 Blk
220 Blk
740 Blk
120 Blk
751 Blu/Wht
B5
Hydraulic Oil
Temperature Switch
220 Blk
230 Blk
700 Blk
230 Blk
SE4-Backlap Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit
SE7-Headlight Circuit
M83714B



SE4-Backlap Circuit

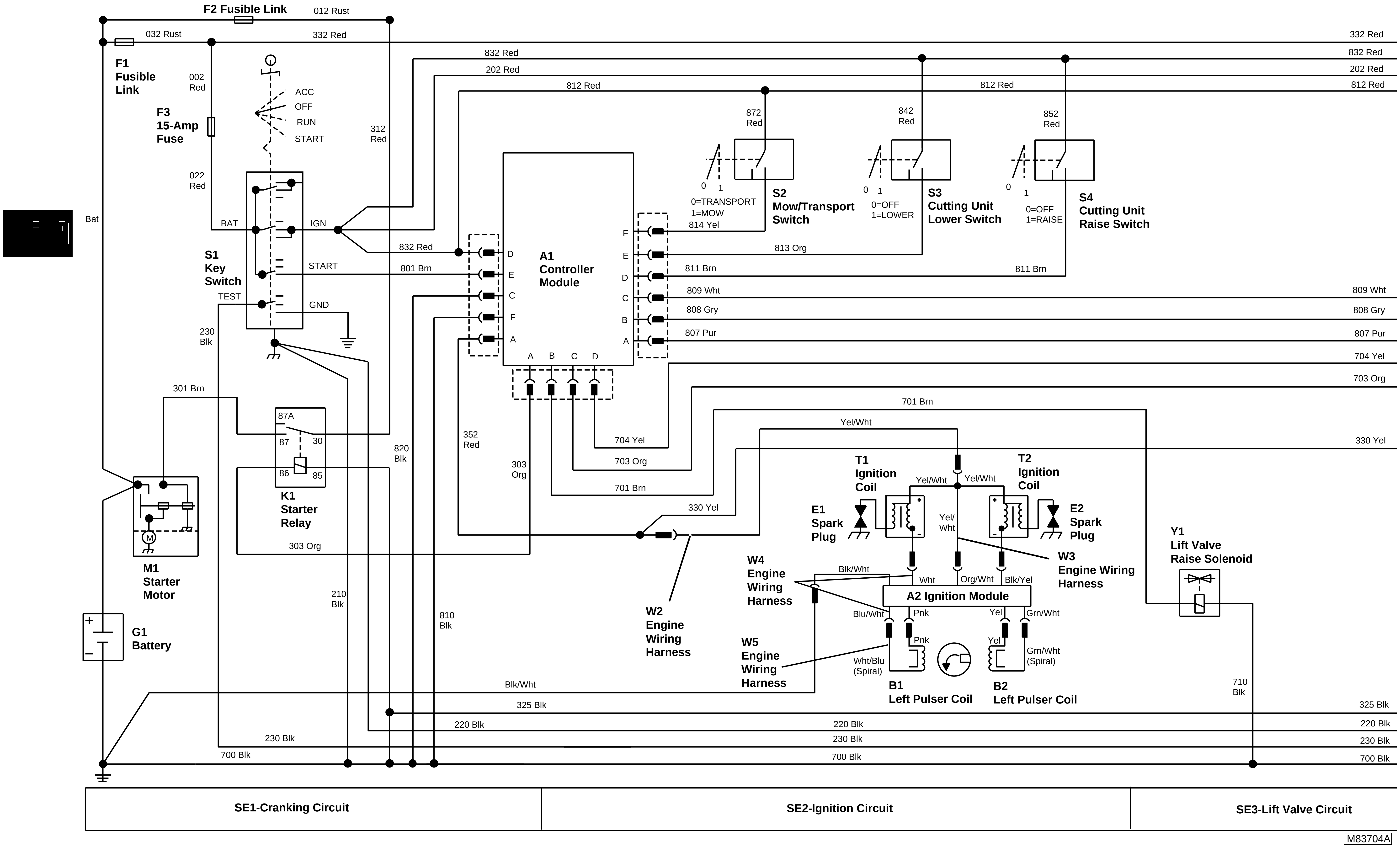
SE5-Charging



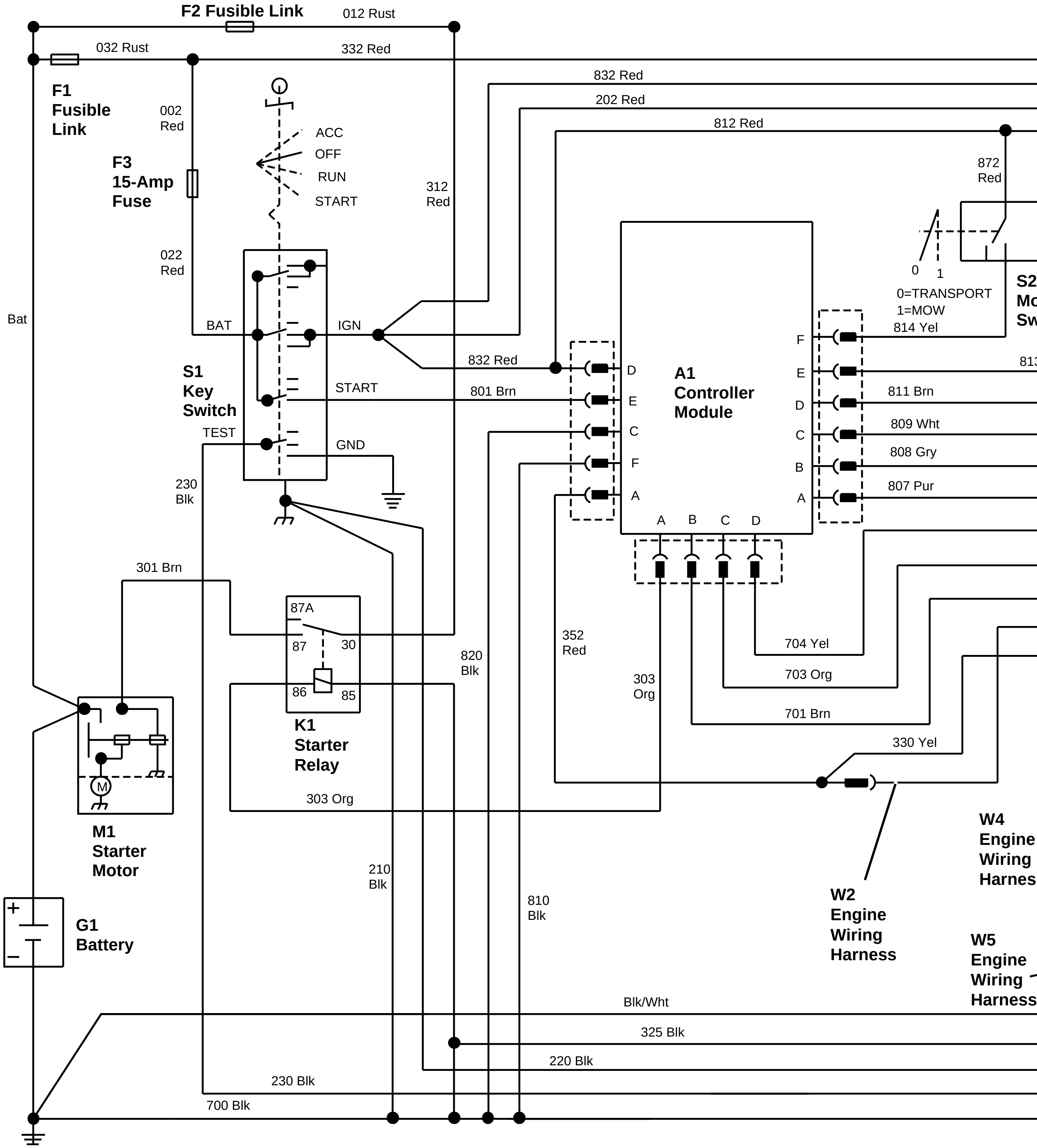
SE5-Charging Circuit	SE6-Warning Indicator Circuit	SE7-Headlight Circuit

M83714B

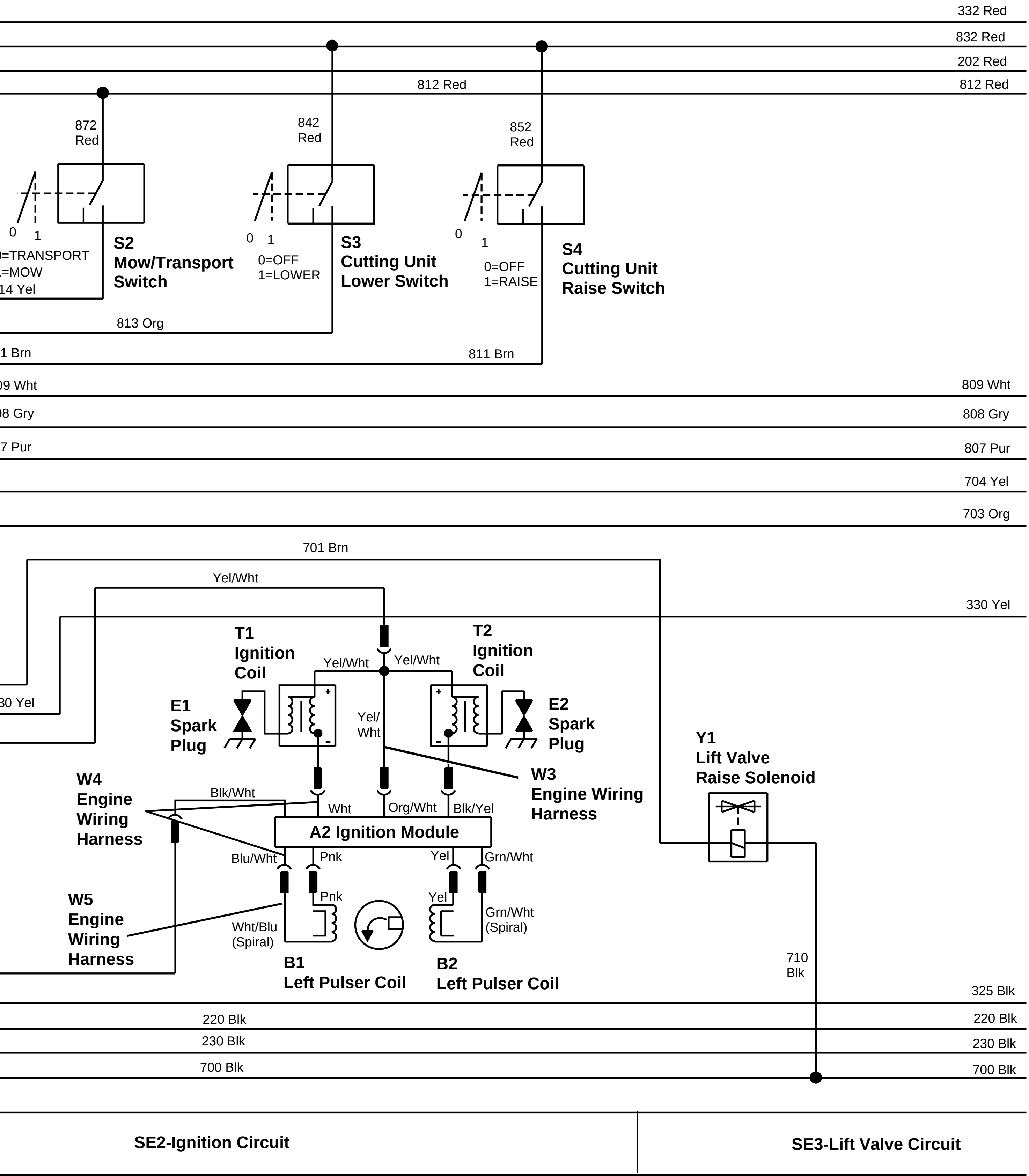
ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 958XXX—)



ELECTRICAL SCHEMATIC—STANDARD EQUIPMENT (S.N. 958XXX—)

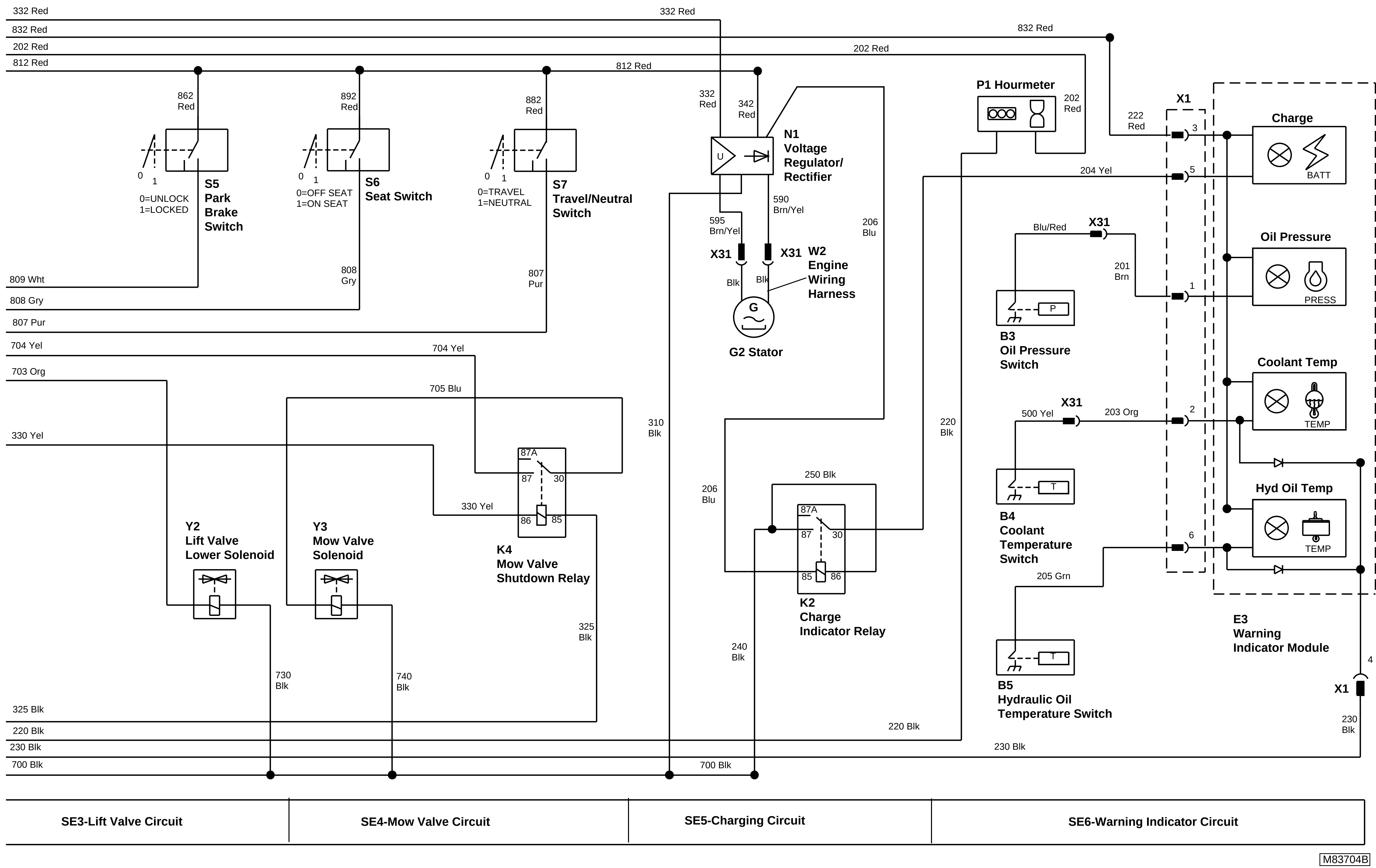


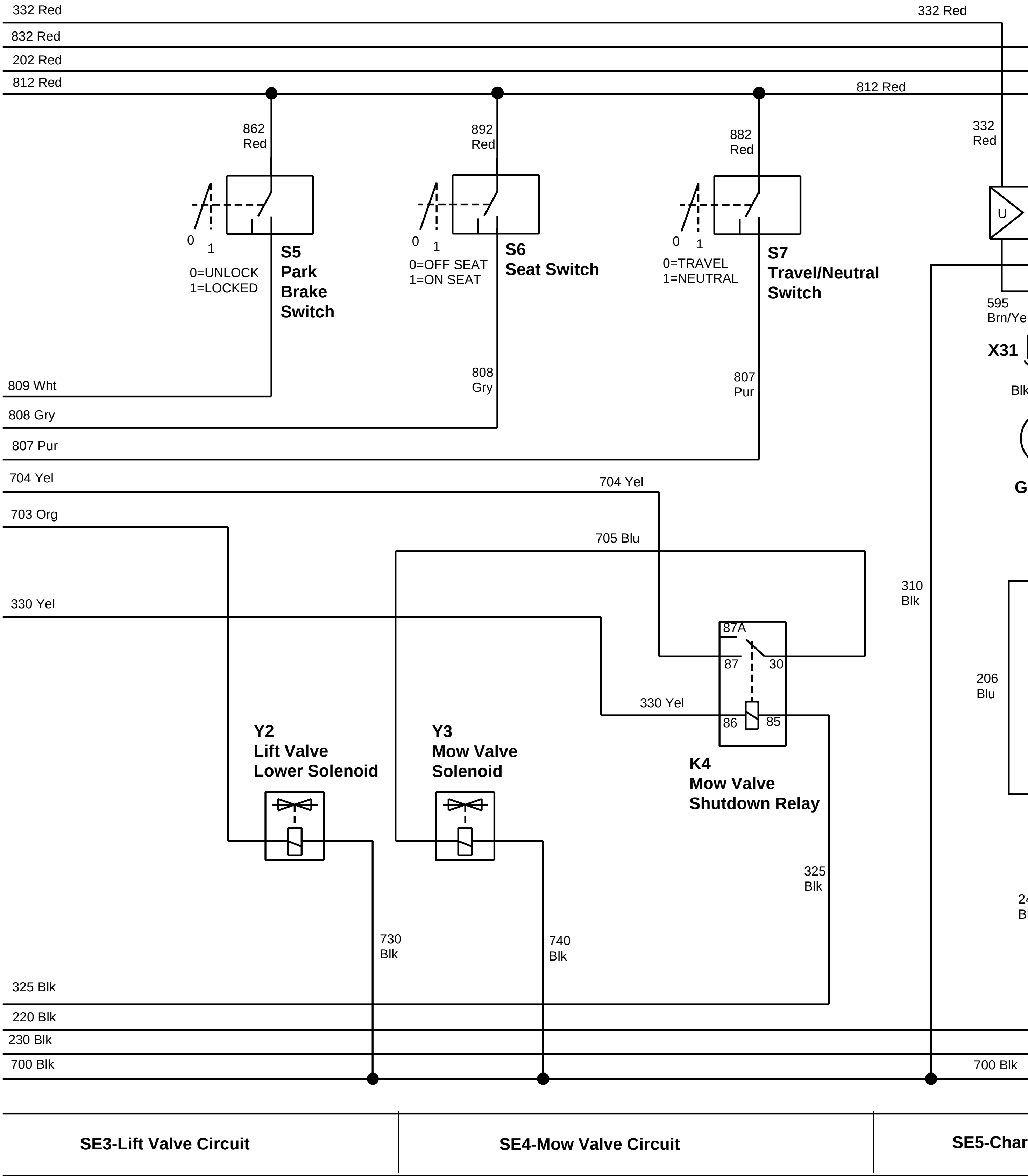
SE1-Cranking Circuit

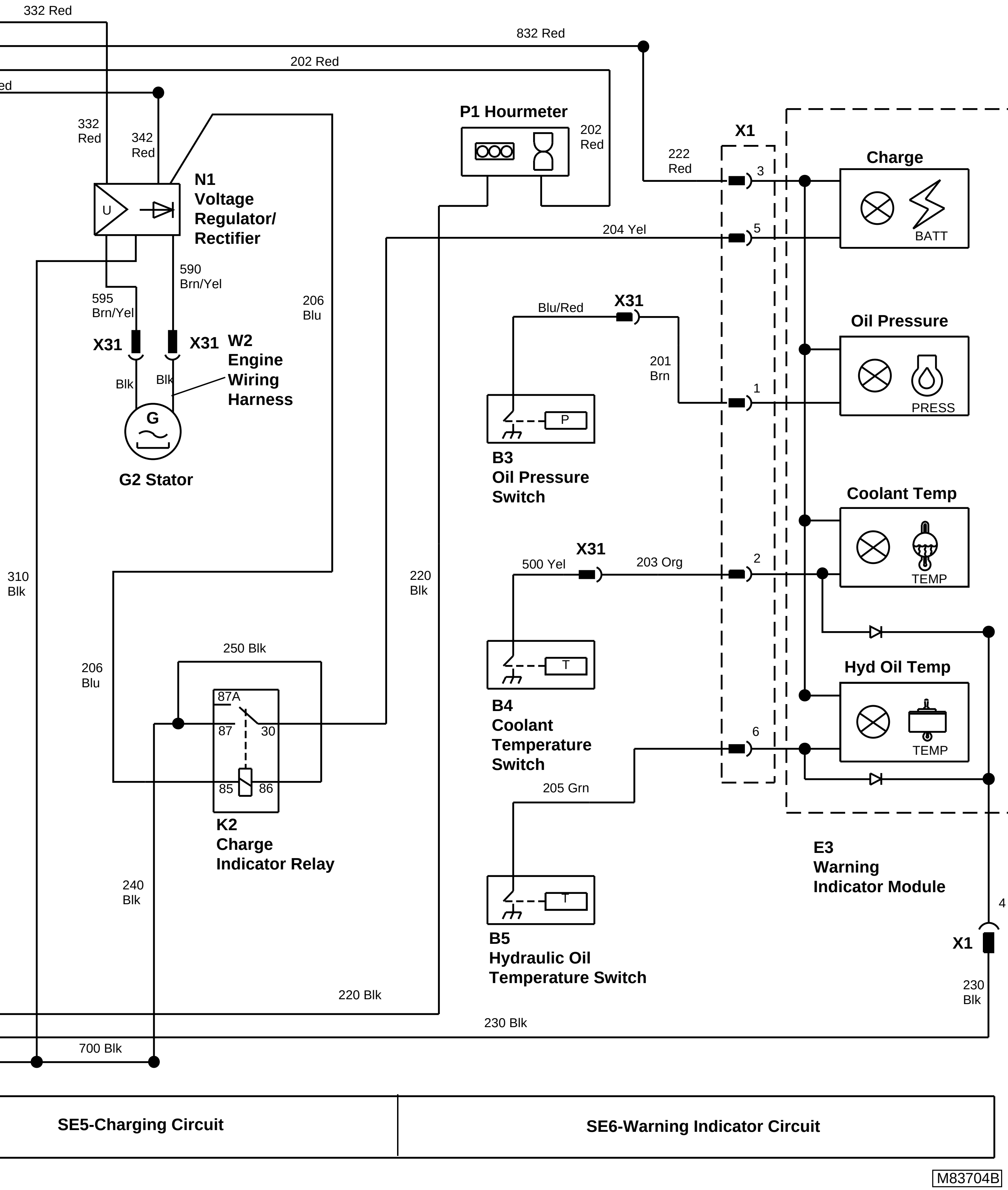


332 Red
832 Red
202 Red
812 Red
812 Red
872
Red
842
Red
852
Red
0
1
S2
Mow/Transport
Switch
0=TRANSPORT
1=MOW
14 Yel
0
1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
0
1
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
813 Org
1 Brn
811 Brn
09 Wht
809 Wht
08 Gry
808 Gry
7 Pur
807 Pur
704 Yel
703 Org
701 Brn
Yel/Wht
330 Yel
T1
Ignition
Coil
Yel/Wht
Yel/Wht
T2
Ignition
Coil
30 Yel
E1
Spark
Plug
Yel/
Wht
E2
Spark
Plug
Y1
Lift Valve
Raise Solenoid
W4
Engine
Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
W3
Engine Wiring
Harness
A2 Ignition Module
Blu/Wht
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Pnk
Yel
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Left Pulser Coil
710
Blk
325 Blk
220 Blk
220 Blk
230 Blk
230 Blk
700 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit

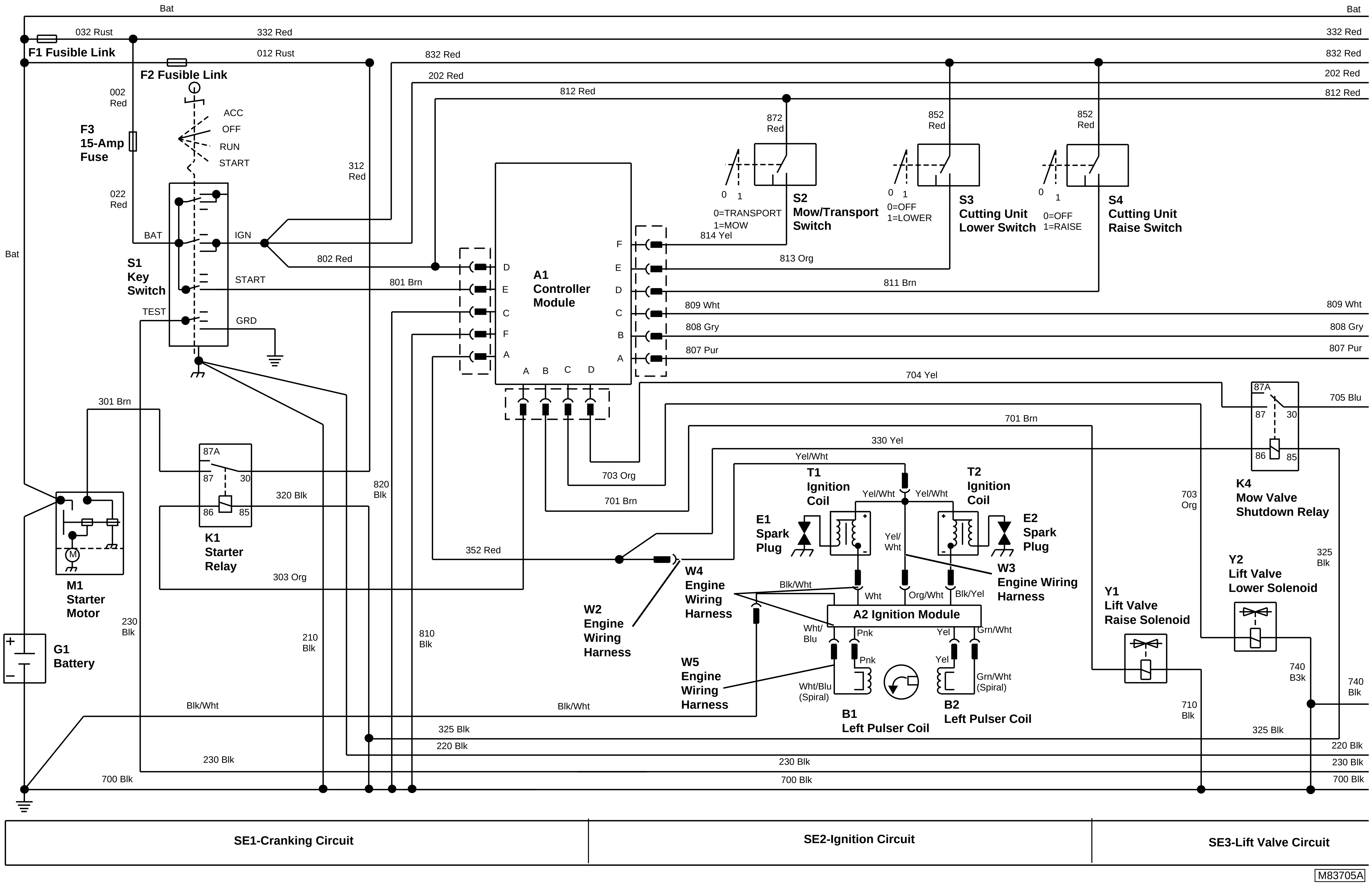
M83704A


332 Red
832 Red
202 Red
812 Red
862 Red
892 Red
882 Red
332 Red
342 Red
0 1
0=UNLOCK
1=LOCKED
S5
Park
Brake
Switch
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
N1
Voltage
Regulator/
Rectifier
595 Brn/Yel
590 Brn/Yel
X31
W2
Engine
Wiring
Harness
Blk
G
G2 Stator
206 Blu
P1 Hourmeter
202 Red
222 Red
X1
Charge
BATT
204 Yel
Blu/Red
201 Brn
Oil Pressure
PRESS
P
B3
Oil Pressure
Switch
Coolant Temp
TEMP
500 Yel
203 Org
T
B4
Coolant
Temperature
Switch
Hyd Oil Temp
205 Grn
B5
Hydraulic Oil
Temperature Switch
E3
Warning
Indicator Module
809 Wht
808 Gry
807 Pur
704 Yel
703 Org
705 Blu
330 Yel
310 Blk
220 Blk
250 Blk
87A
87
30
86
85
K4
Mow Valve
Shutdown Relay
K2
Charge
Indicator Relay
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
325 Blk
730 Blk
740 Blk
240 Blk
230 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit
M83704B

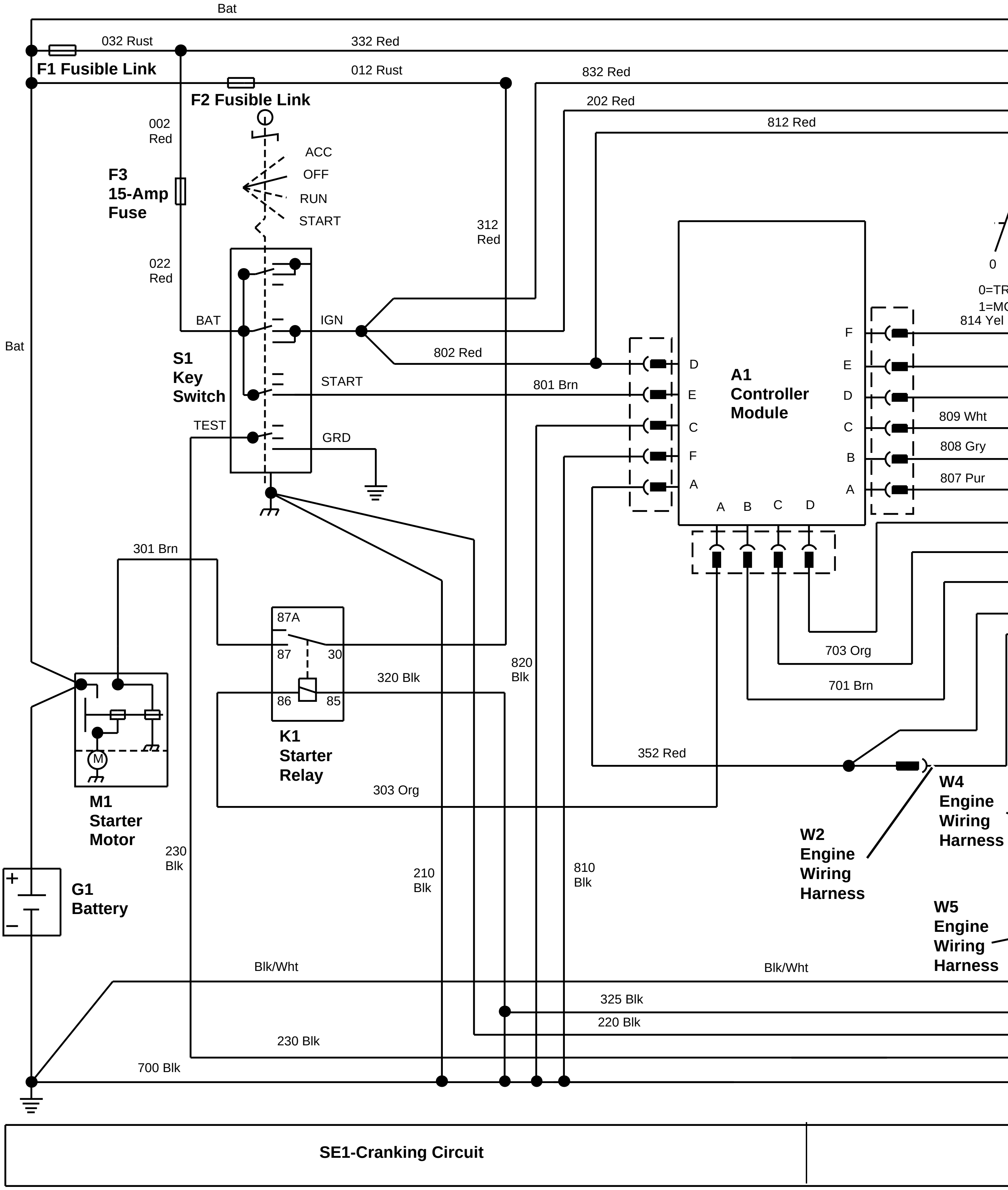

332 Red
832 Red
202 Red
812 Red
332 Red
812 Red
862
Red
892
Red
882
Red
332
Red
U
0 1
0=UNLOCK
1=LOCKED
S5
Park
Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
595
Brn/Yel
X31
Blk
G
809 Wht
808
Gry
807
Pur
808 Gry
807 Pur
704 Yel
704 Yel
703 Org
705 Blu
310
Blk
330 Yel
87A
87
30
206
Blu
330 Yel
86
85
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
K4
Mow Valve
Shutdown Relay
325
Blk
730
Blk
740
Blk
325 Blk
220 Blk
230 Blk
700 Blk
700 Blk
SE3-Lift Valve Circuit
SE4-Mow Valve Circuit
SE5-Char

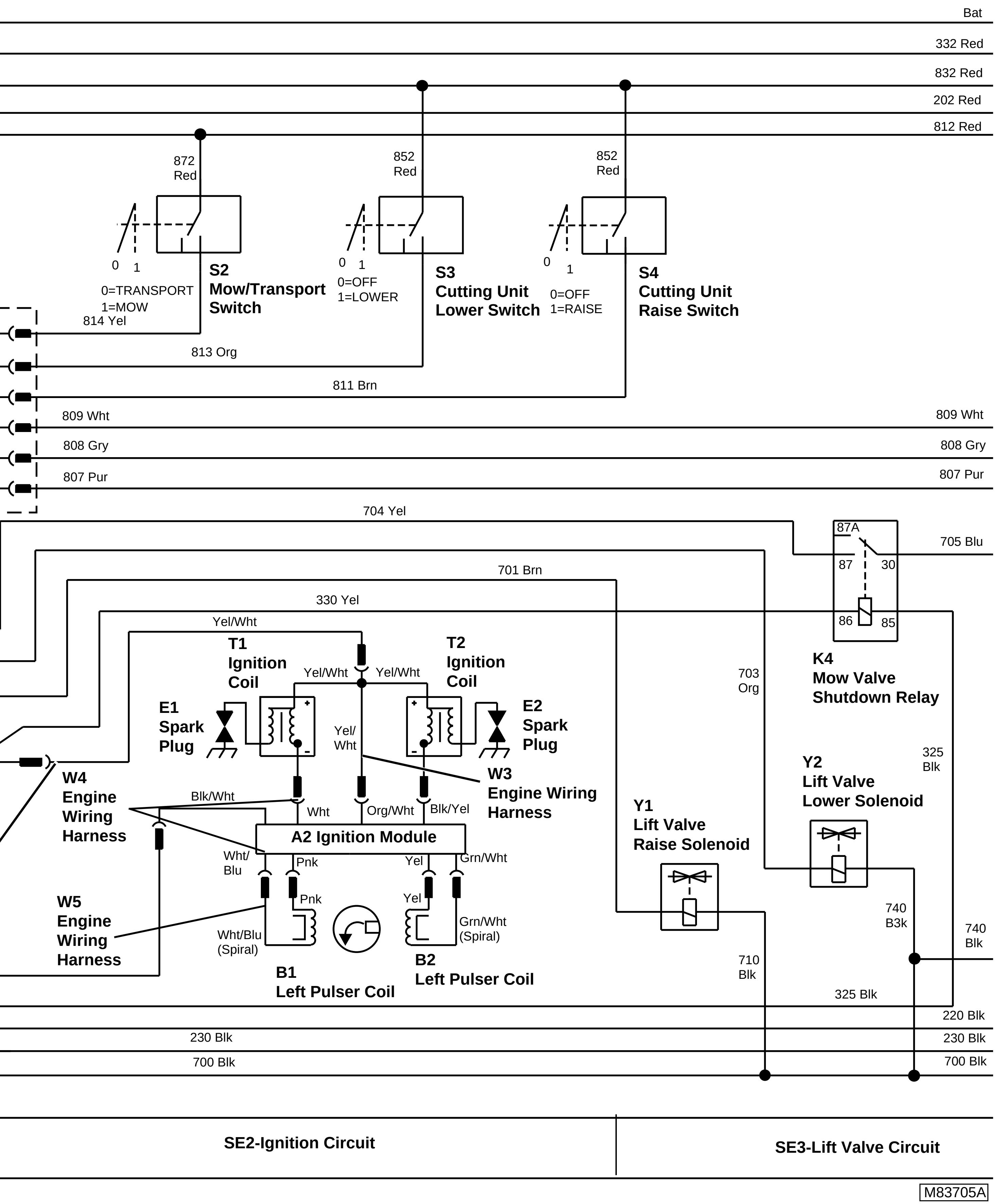

332 Red
832 Red
202 Red
ed
332 Red
342 Red
N1 Voltage Regulator/ Rectifier
U
590 Brn/Yel
595 Brn/Yel
206 Blu
X31
X31
W2 Engine Wiring Harness
Blk
Blk
G
G2 Stator
P1 Hourmeter
202 Red
222 Red
X1
3
5
204 Yel
Charge
BATT
Oil Pressure
PRESS
Blu/Red
X31
201 Brn
1
P
B3 Oil Pressure Switch
Coolant Temp
TEMP
X31
500 Yel
203 Org
2
310 Blk
220 Blk
206 Blu
250 Blk
87A
87
30
85
86
K2 Charge Indicator Relay
T
B4 Coolant Temperature Switch
Hyd Oil Temp
TEMP
6
205 Grn
E3 Warning Indicator Module
240 Blk
T
B5 Hydraulic Oil Temperature Switch
4
X1
230 Blk
220 Blk
230 Blk
700 Blk
SE5-Charging Circuit
SE6-Warning Indicator Circuit
M83704B

ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 958XXX—)

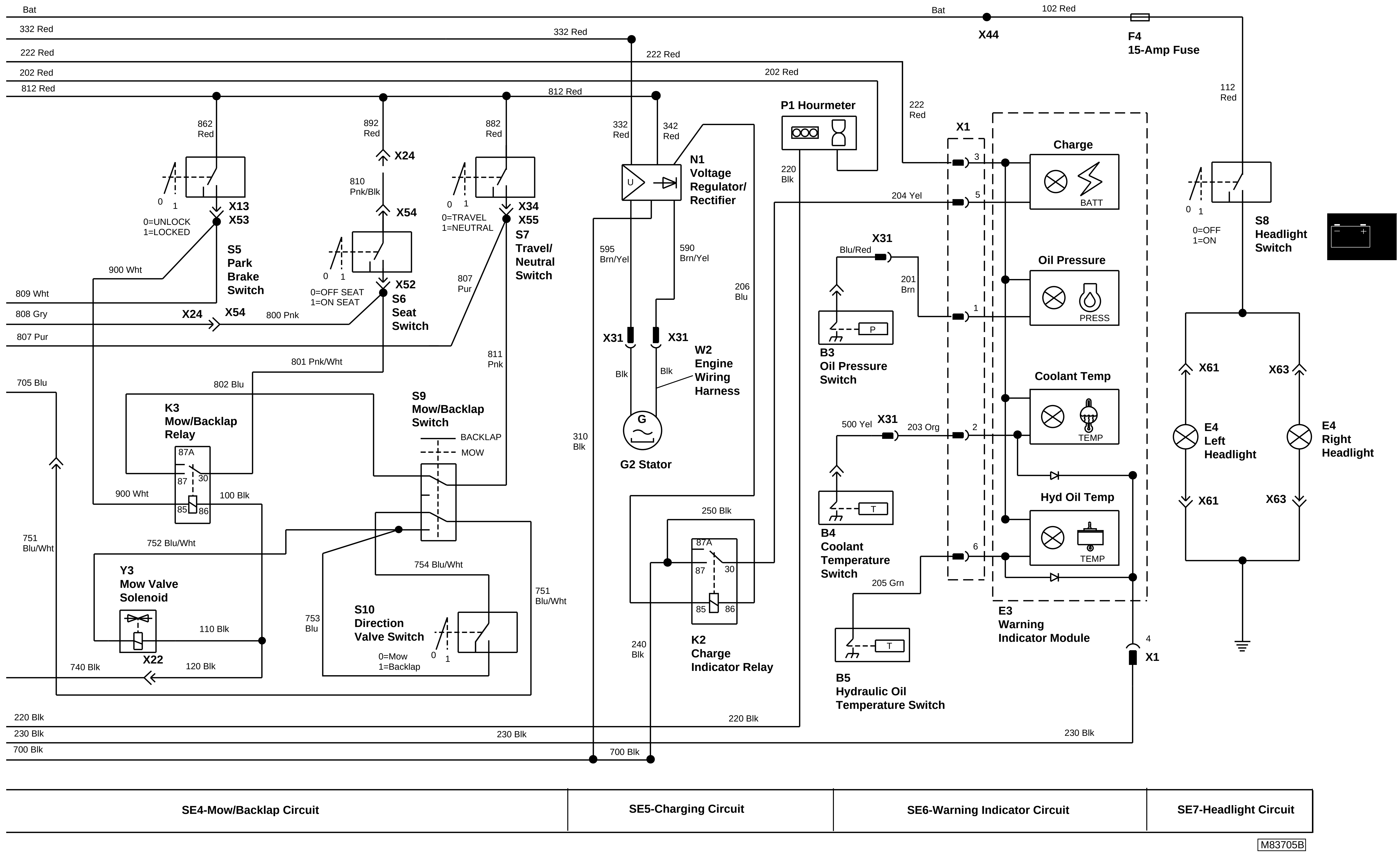


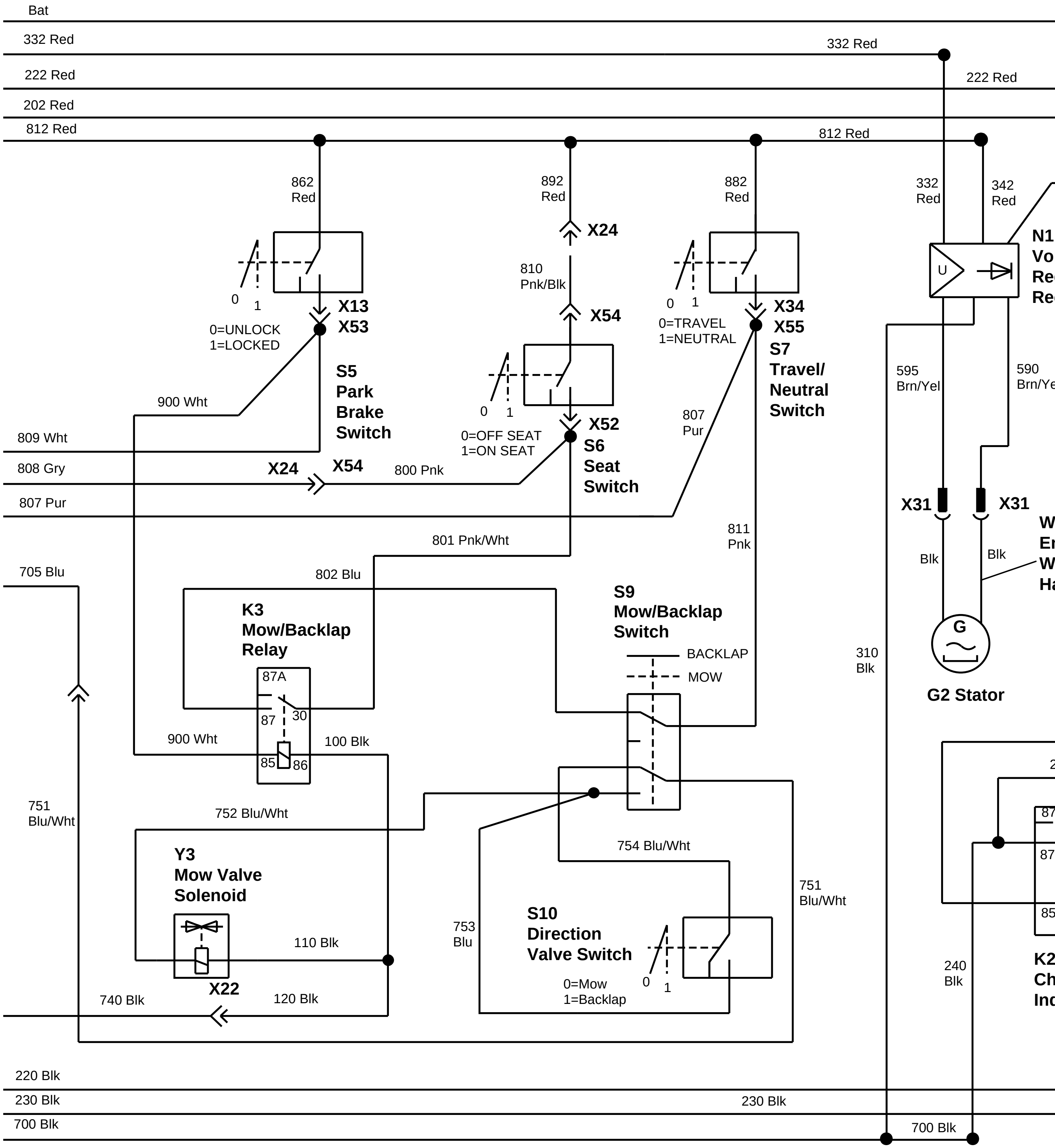
ELECTRICAL SCHEMATIC—OPTIONAL EQUIPMENT (S.N. 958XXX—)



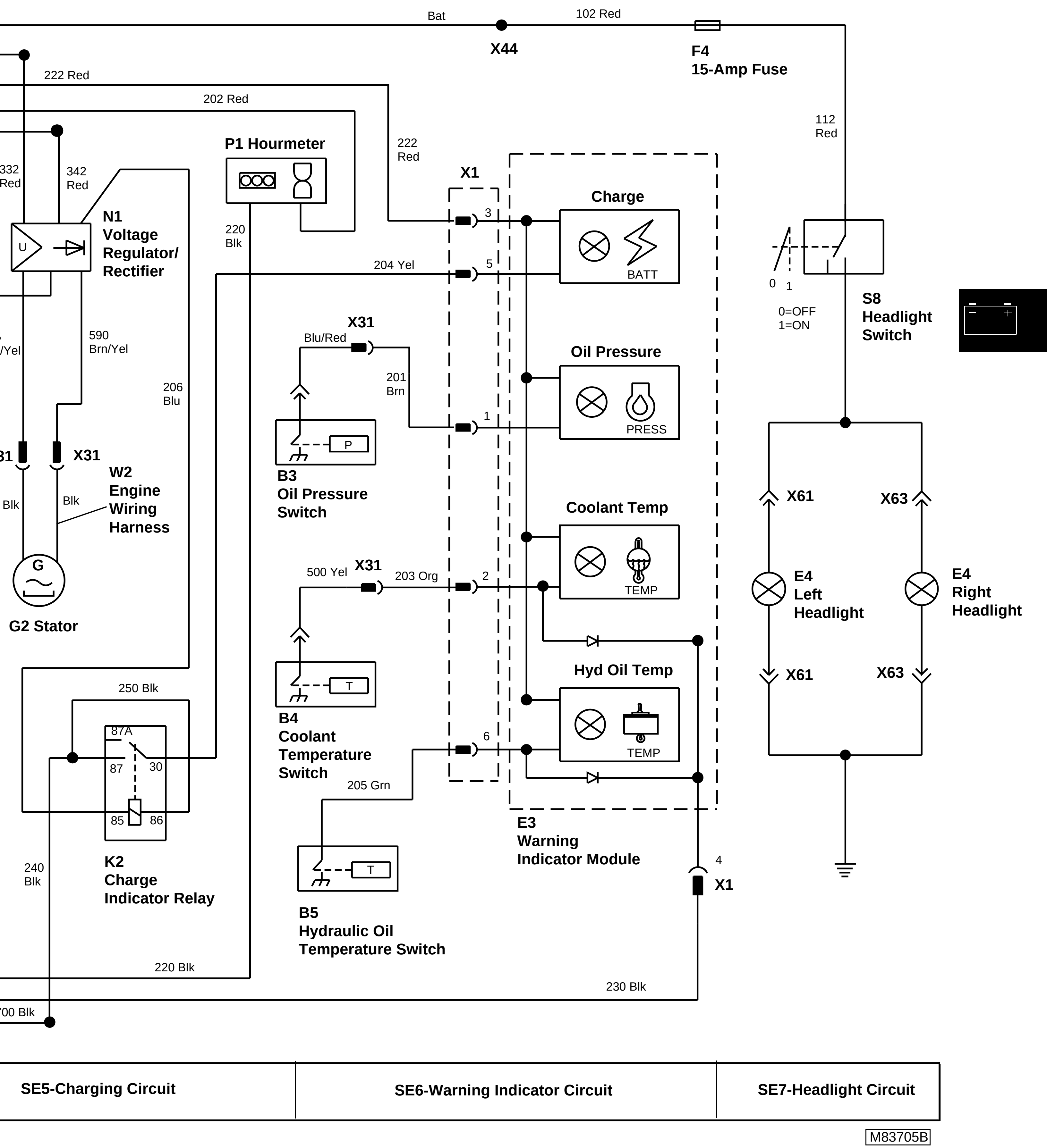


Bat
332 Red
832 Red
202 Red
812 Red
872
Red
852
Red
852
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
0 1
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
814 Yel
813 Org
811 Brn
809 Wht
808 Gry
807 Pur
704 Yel
87A
705 Blu
87
30
701 Brn
330 Yel
86
85
Yel/Wht
T1
Ignition
Coil
T2
Ignition
Coil
K4
Mow Valve
Shutdown Relay
703
Org
E1
Spark
Plug
E2
Spark
Plug
Yel/
Wht
W3
Engine Wiring
Harness
325
Blk
Y2
Lift Valve
Lower Solenoid
W4
Engine
Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Y1
Lift Valve
Raise Solenoid
Wht/
Blu
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
740
B3k
740
Blk
710
Blk
B1
Left Pulser Coil
B2
Left Pulser Coil
325 Blk
220 Blk
230 Blk
700 Blk
SE2-Ignition Circuit
SE3-Lift Valve Circuit
M83705A

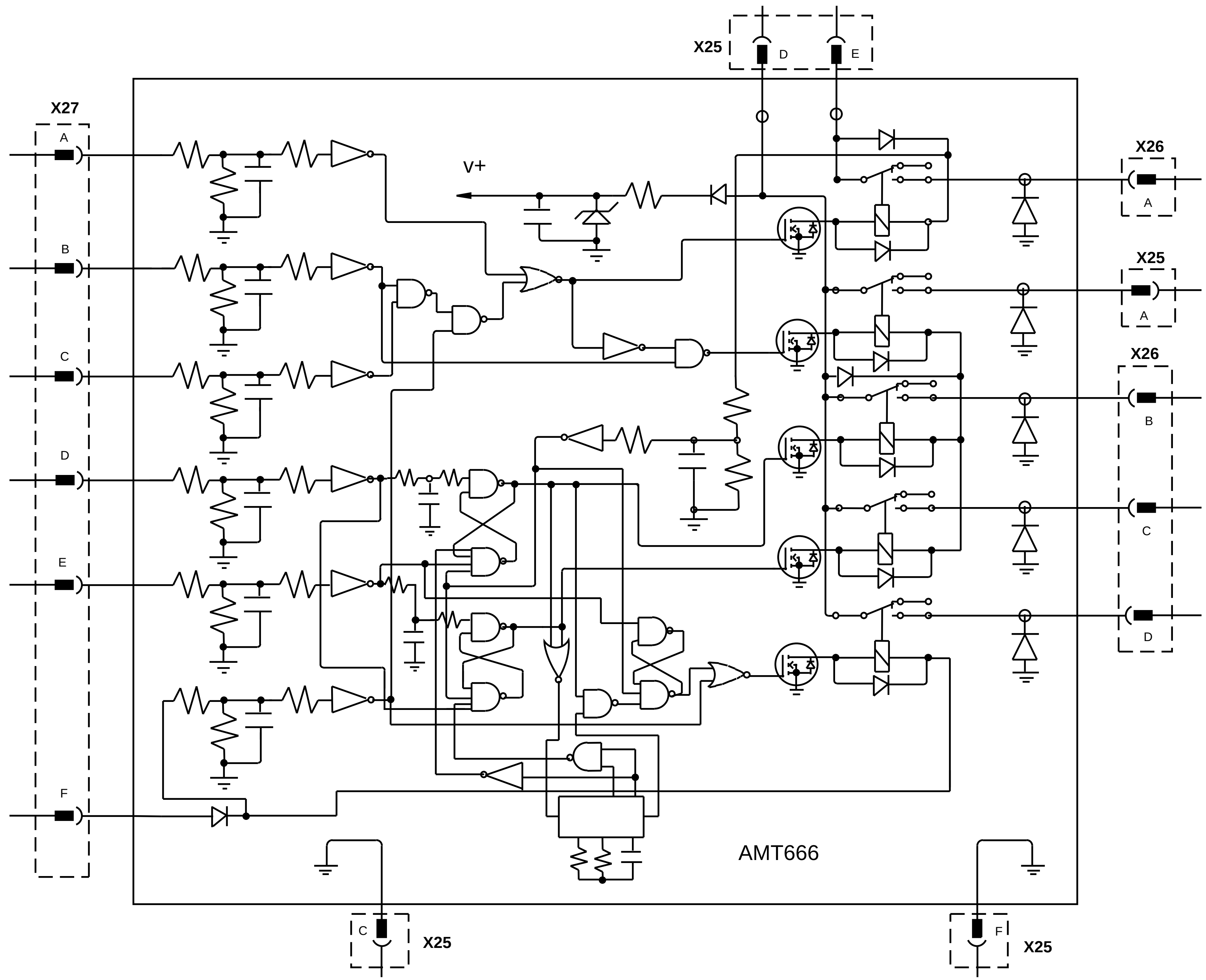

Bat
332 Red
222 Red
202 Red
812 Red
102 Red
X44
F4
15-Amp Fuse
112 Red
862 Red
892 Red
882 Red
332 Red
342 Red
X24
810 Pnk/Blk
X54
X13
X53
X34
X55
0=UNLOCK
1=LOCKED
S5
Park
Brake
Switch
0=OFF SEAT
1=ON SEAT
X52
S6
Seat
Switch
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
N1
Voltage
Regulator/
Rectifier
P1 Hourmeter
220 Blk
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
204 Yel
222 Red
S8
Headlight
Switch
0=OFF
1=ON
900 Wht
809 Wht
808 Gry
807 Pur
800 Pnk
801 Pnk/Wht
811 Pnk
595 Brn/Yel
590 Brn/Yel
206 Blu
X31
Blu/Red
201 Brn
B3
Oil Pressure
Switch
W2
Engine
Wiring
Harness
Blk
G
G2 Stator
705 Blu
802 Blu
K3
Mow/Backlap
Relay
87A
87
30
85
86
S9
Mow/Backlap
Switch
BACKLAP
MOW
310 Blk
500 Yel
203 Org
B4
Coolant
Temperature
Switch
205 Grn
B5
Hydraulic Oil
Temperature Switch
X61
X63
E4
Left
Headlight
E4
Right
Headlight
E3
Warning
Indicator Module
900 Wht
100 Blk
751 Blu/Wht
752 Blu/Wht
754 Blu/Wht
250 Blk
Y3
Mow Valve
Solenoid
110 Blk
X22
740 Blk
120 Blk
753 Blu
S10
Direction
Valve Switch
0=Mow
1=Backlap
K2
Charge
Indicator Relay
240 Blk
220 Blk
230 Blk
700 Blk
SE4-Mow/Backlap Circuit
SE5-Charging Circuit
SE6-Warning Indicator Circuit
SE7-Headlight Circuit
M83705B



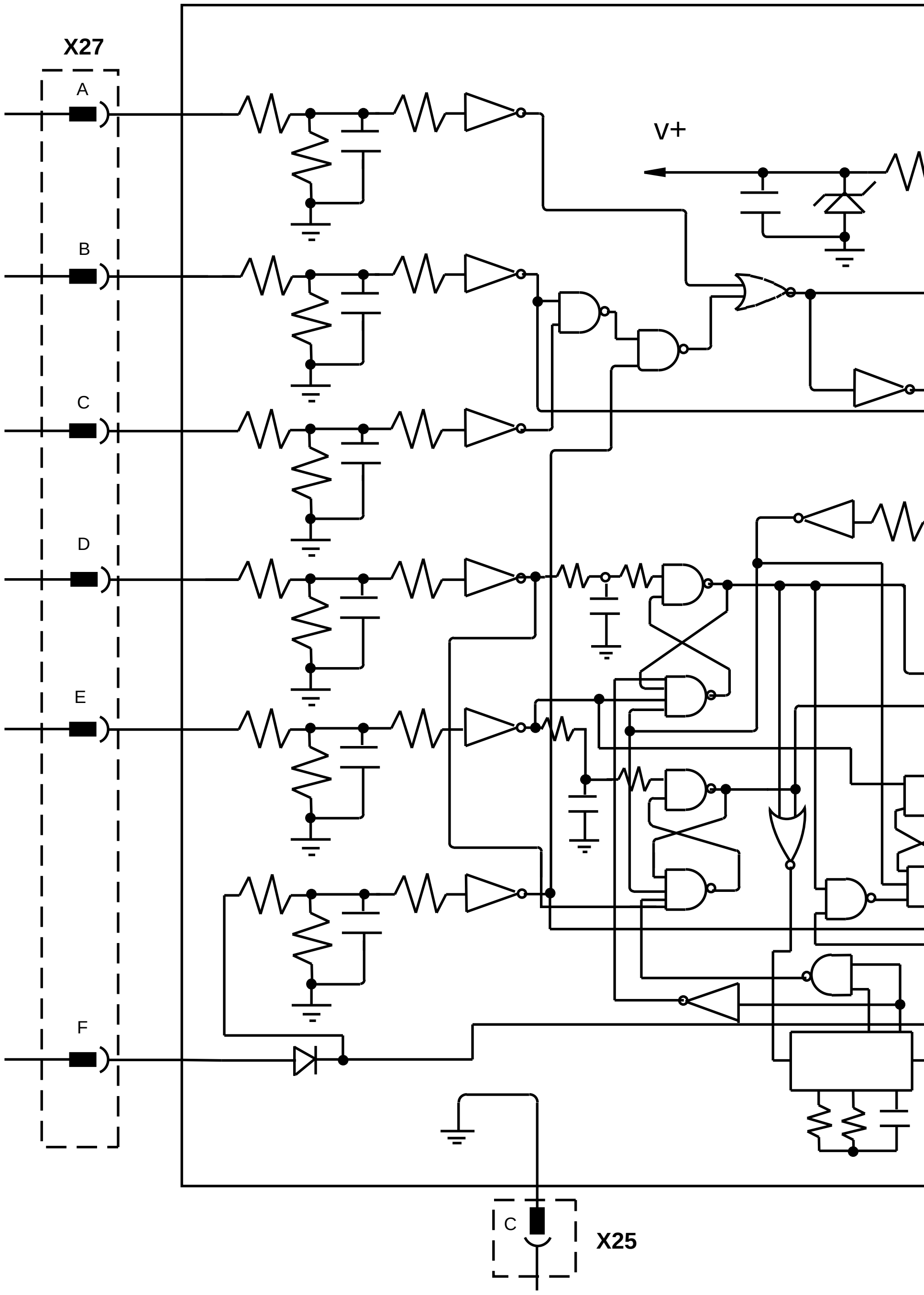
SE4-Mow/Backlap Circuit	SE5-Charging

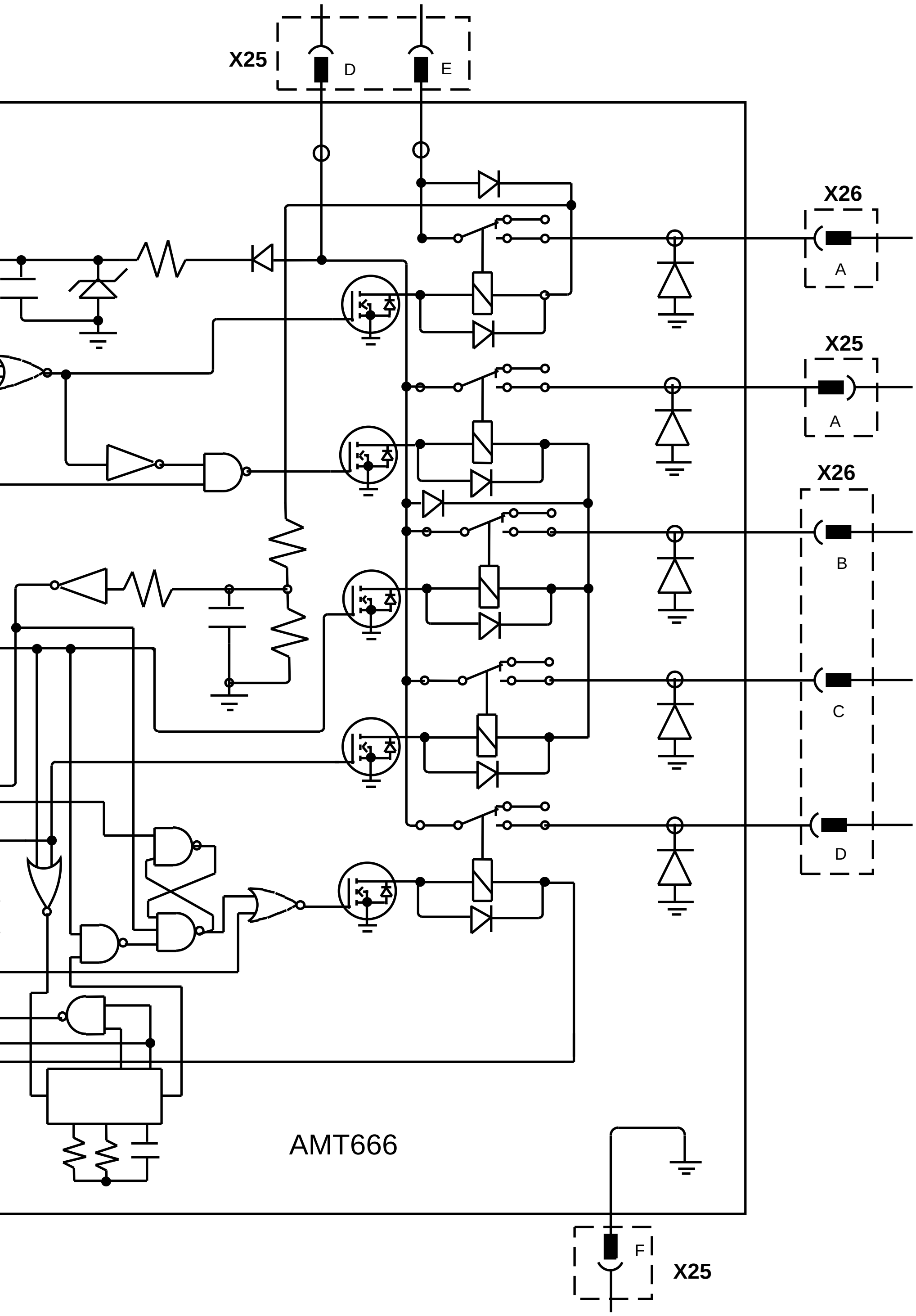

Bat
102 Red
X44
F4
15-Amp Fuse
222 Red
202 Red
112
Red
P1 Hourmeter
222
Red
X1
332
Red
342
Red
N1
Voltage
Regulator/
Rectifier
220
Blk
Charge
3
BATT
204 Yel
5
0 1
0=OFF
1=ON
S8
Headlight
Switch
X31
Blu/Red
590
Brn/Yel
/Yel
Oil Pressure
206
Blu
201
Brn
1
PRESS
P
31
X31
W2
Engine
Wiring
Harness
B3
Oil Pressure
Switch
X61
X63
Blk
Blk
Coolant Temp
G
500 Yel
X31
203 Org
2
TEMP
E4
Left
Headlight
E4
Right
Headlight
G2 Stator
Hyd Oil Temp
X61
X63
250 Blk
T
B4
Coolant
Temperature
Switch
87A
87
30
6
TEMP
205 Grn
85
86
E3
Warning
Indicator Module
240
Blk
K2
Charge
Indicator Relay
T
4
X1
B5
Hydraulic Oil
Temperature Switch
220 Blk
230 Blk
700 Blk
SE5-Charging Circuit
SE6-Warning Indicator Circuit
SE7-Headlight Circuit
M83705B

AMT666 CONTROLLER MODULE SCHEMATIC



AMT666 CONTROLLER MODULE SCHEMATIC





M83716

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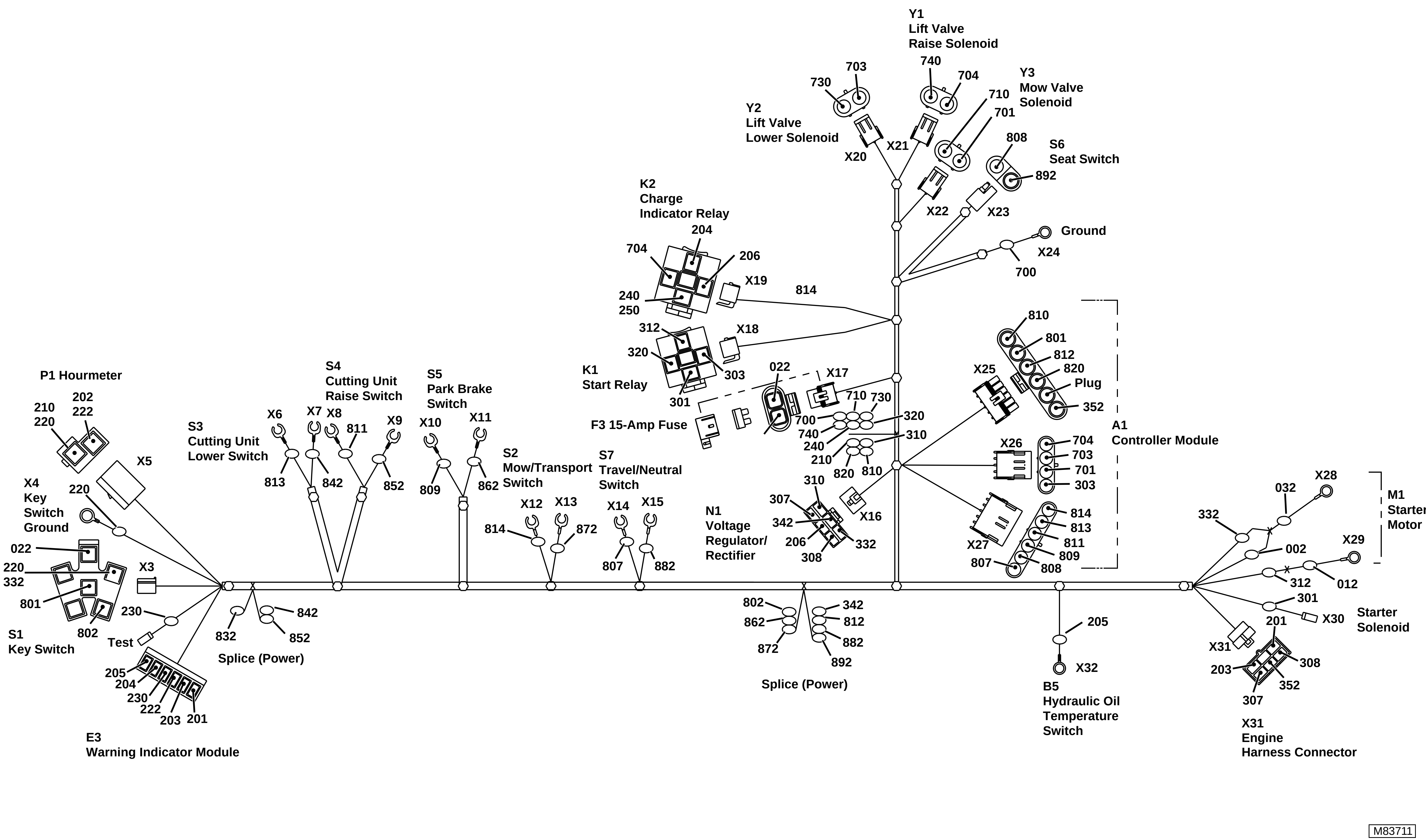
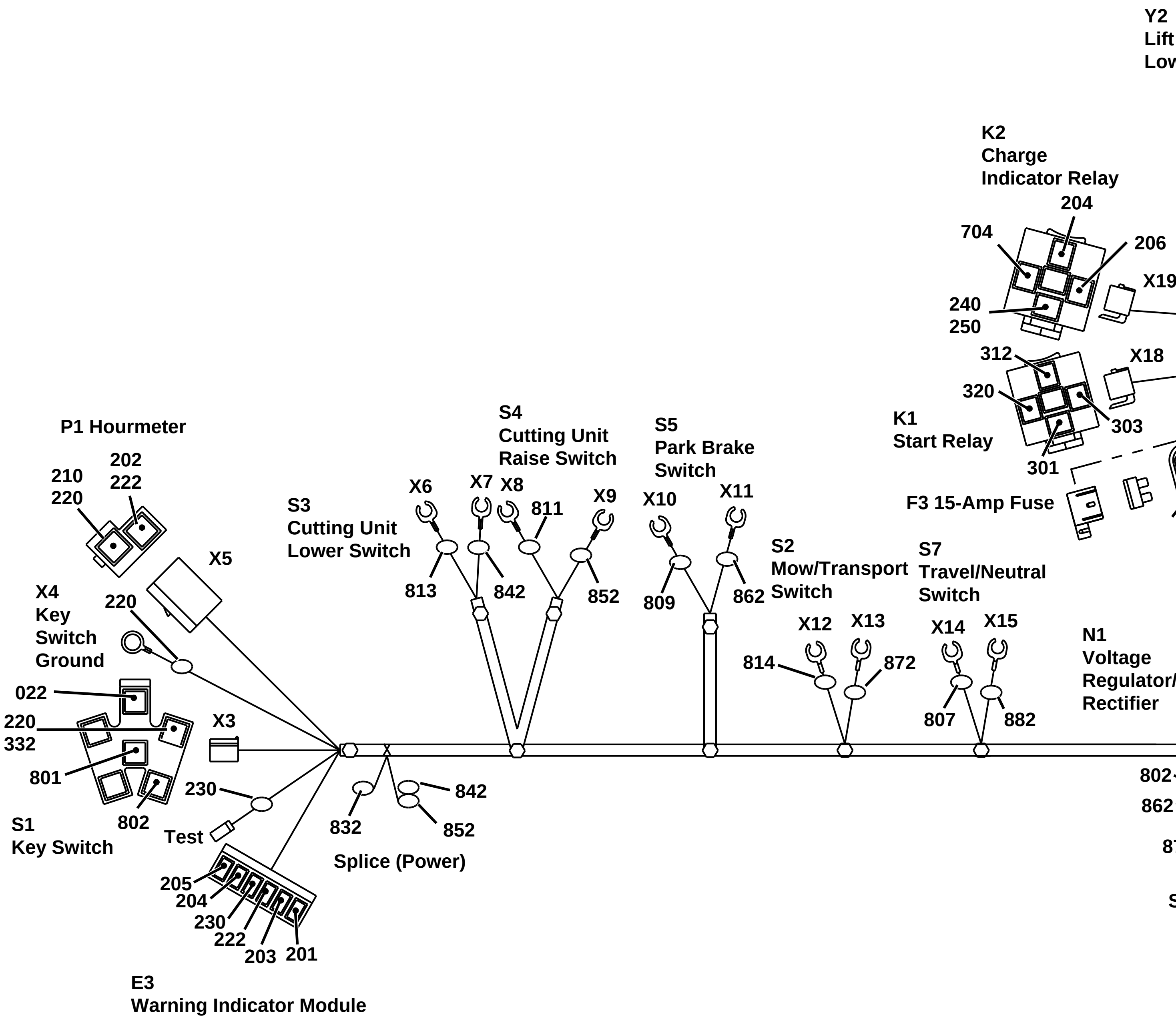
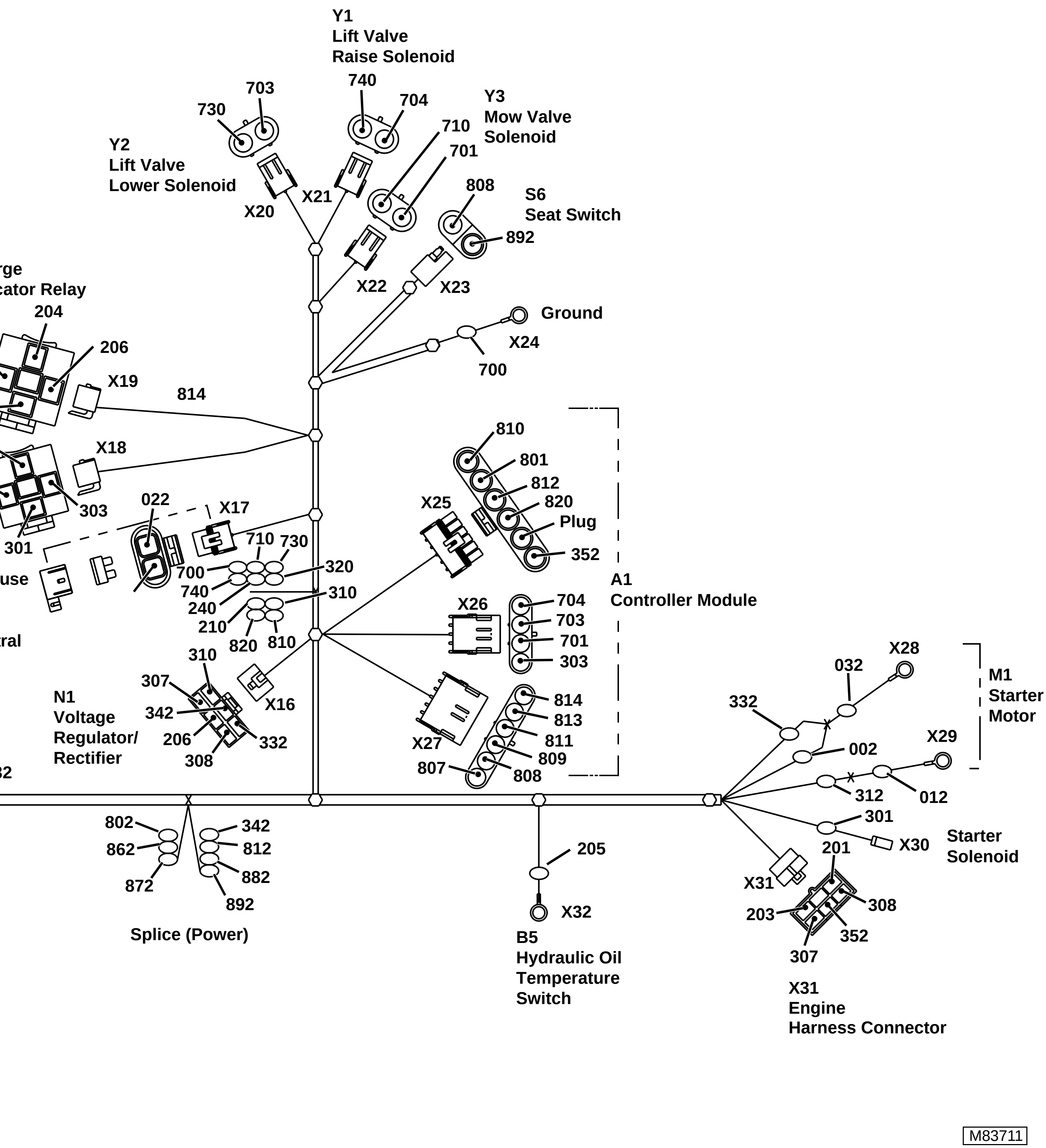
MAIN WIRING HARNESS (S.N. —957000)



MAIN WIRING HARNESS (S.N. —957000)



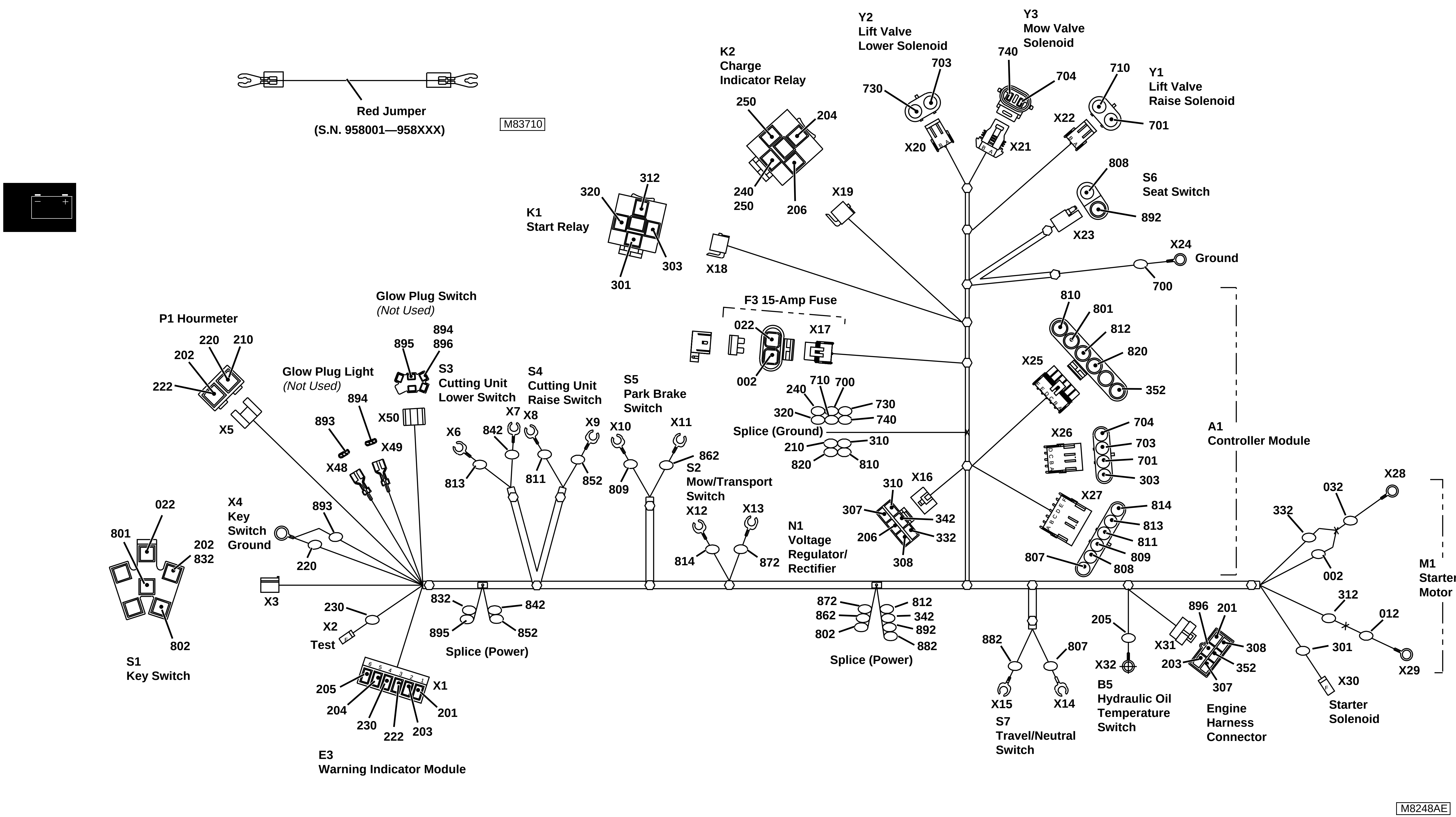


Y1
Lift Valve
Raise Solenoid
740
704
703
730
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
710
701
X20
X21
808
S6
Seat Switch
892
X22
X23
Ground
X24
700
rge
cator Relay
204
206
X19
814
X18
303
301
022
X17
710
730
700
740
240
210
320
310
820
810
X25
810
801
812
820
Plug
352
A1
Controller Module
X26
704
703
701
303
310
307
342
206
308
332
X16
N1
Voltage
Regulator/
Rectifier
X27
814
813
811
809
807
808
X28
032
332
M1
Starter
Motor
002
X29
312
012
301
X30
Starter
Solenoid
201
X31
308
203
352
307
X31
Engine
Harness Connector
802
862
872
342
812
882
892
Splice (Power)
205
X32
B5
Hydraulic Oil
Temperature
Switch
use
tral
32
M83711

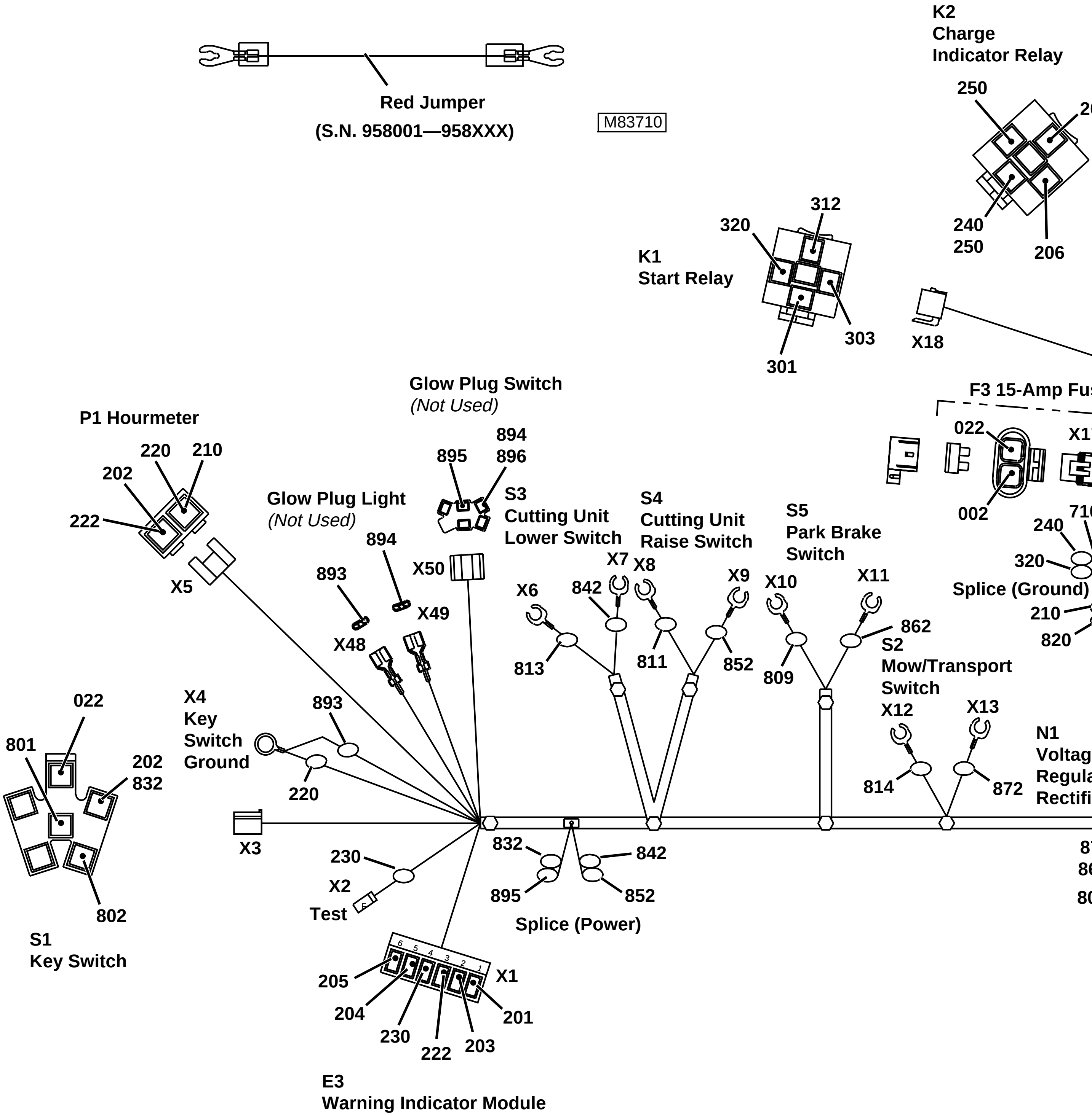
WIRE COLOR CODES

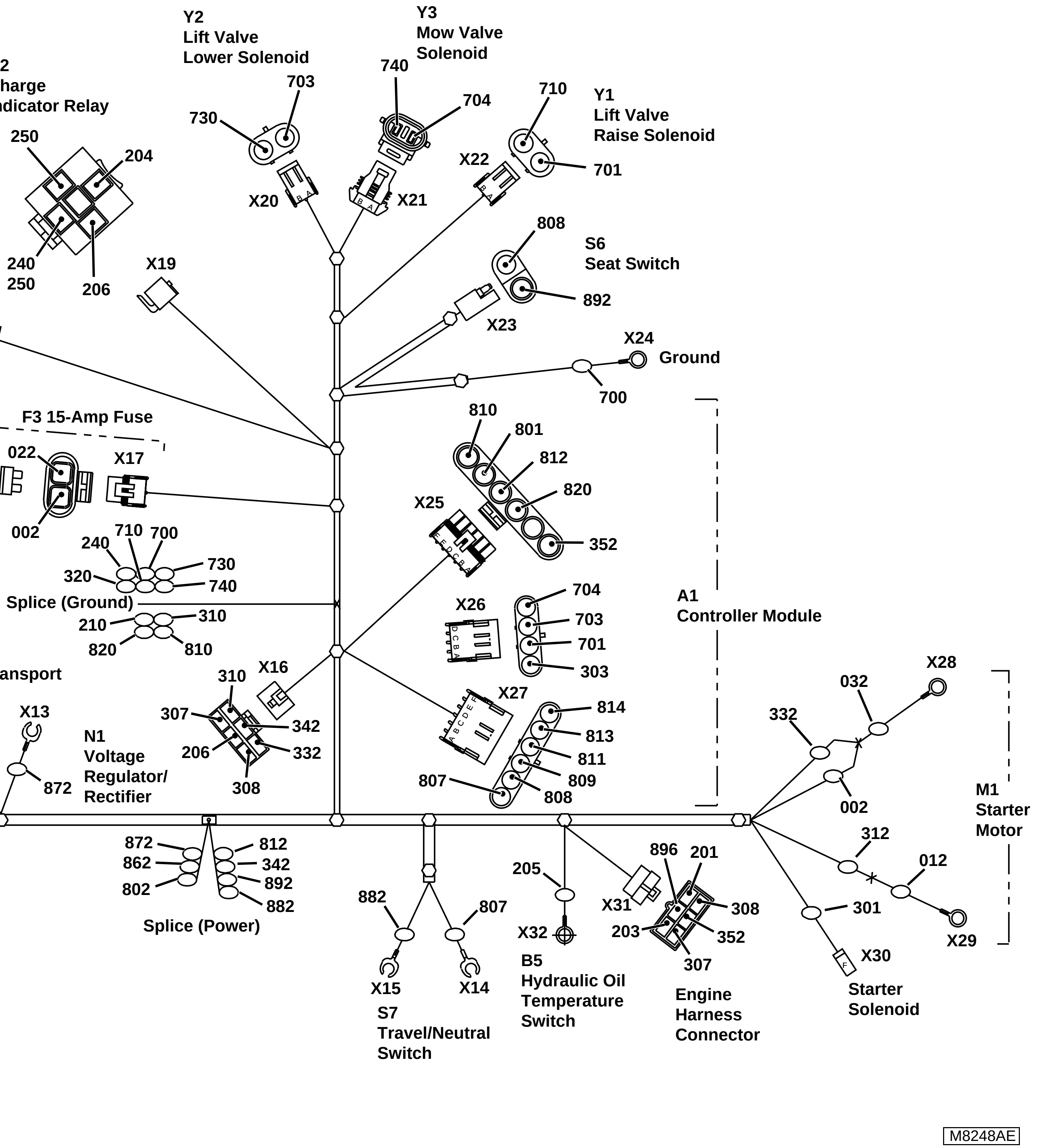
Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
002, 022, 312, 802	2.0	Red	210, 220, 230, 310, 710, 730, 740, 810, 820	1.0	Blk	701, 801, 811	1.0	Brn
012, 032	0.8	Rust	240, 250, 320, 893	0.8	Blk	704, 814	1.0	Yel
201	0.8	Brn	301	2.0	Brn	807	1.0	Pur
202, 222, 332, 342, 352, 812, 832, 842, 852, 862, 872, 882, 892	1.0	Red	303, 703, 813	1.0	Org	808	1.0	Gry
203	0.8	Org	307	3.0	Pur	809	1.0	Wht
204	0.8	Yel	308	2.0	Gry	894	0.8	Pur
205	1.0	Grn	310	3.0	Blk	895, 896	0.8	Red
206	0.8	Blu	700	2.0	Blk			

MAIN WIRING HARNESS (S.N. 957001—958XXX)



MAIN WIRING HARNESS (S.N. 957001—958XXX)



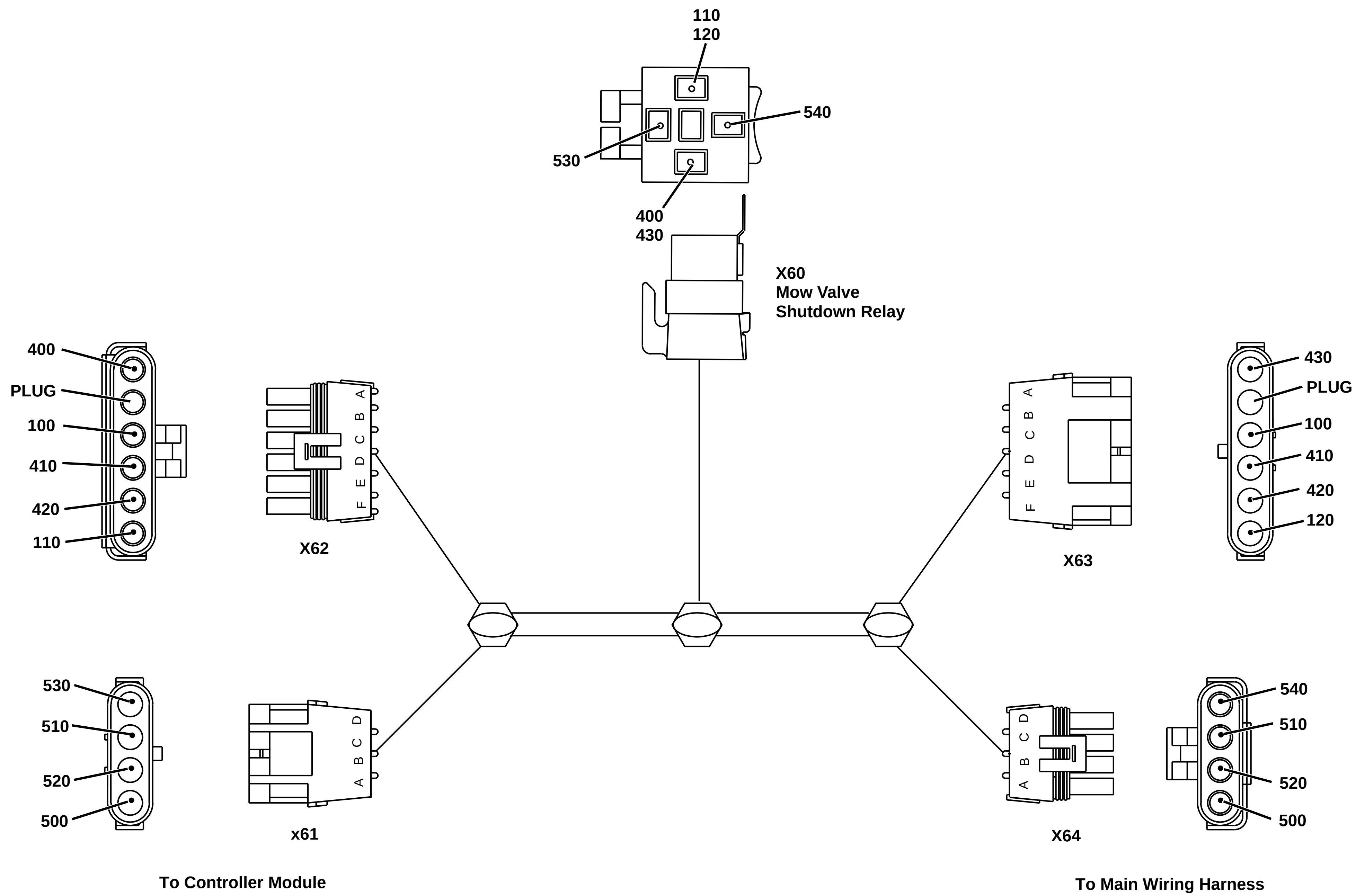

Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
2
harge
ndicator Relay
703
740
704
710
Y1
Lift Valve
Raise Solenoid
730
250
204
701
X22
X20
X21
808
S6
Seat Switch
240
250
206
X19
892
X23
X24
Ground
700
F3 15-Amp Fuse
810
801
812
022
X17
820
X25
002
352
240
710
700
730
320
740
Splice (Ground)
704
X26
A1
Controller Module
703
310
210
701
820
810
303
ansport
310
X16
X27
X28
032
814
X13
307
342
332
N1
Voltage
Regulator/
Rectifier
206
332
813
811
872
308
807
809
808
002
M1
Starter
Motor
872
812
862
342
802
892
882
Splice (Power)
312
205
896
201
012
882
807
X31
308
301
X29
X32
203
352
307
X30
X15
X14
B5
Hydraulic Oil
Temperature
Switch
Engine
Harness
Connector
Starter
Solenoid
S7
Travel/Neutral
Switch
M8248AE

WIRE COLOR CODES

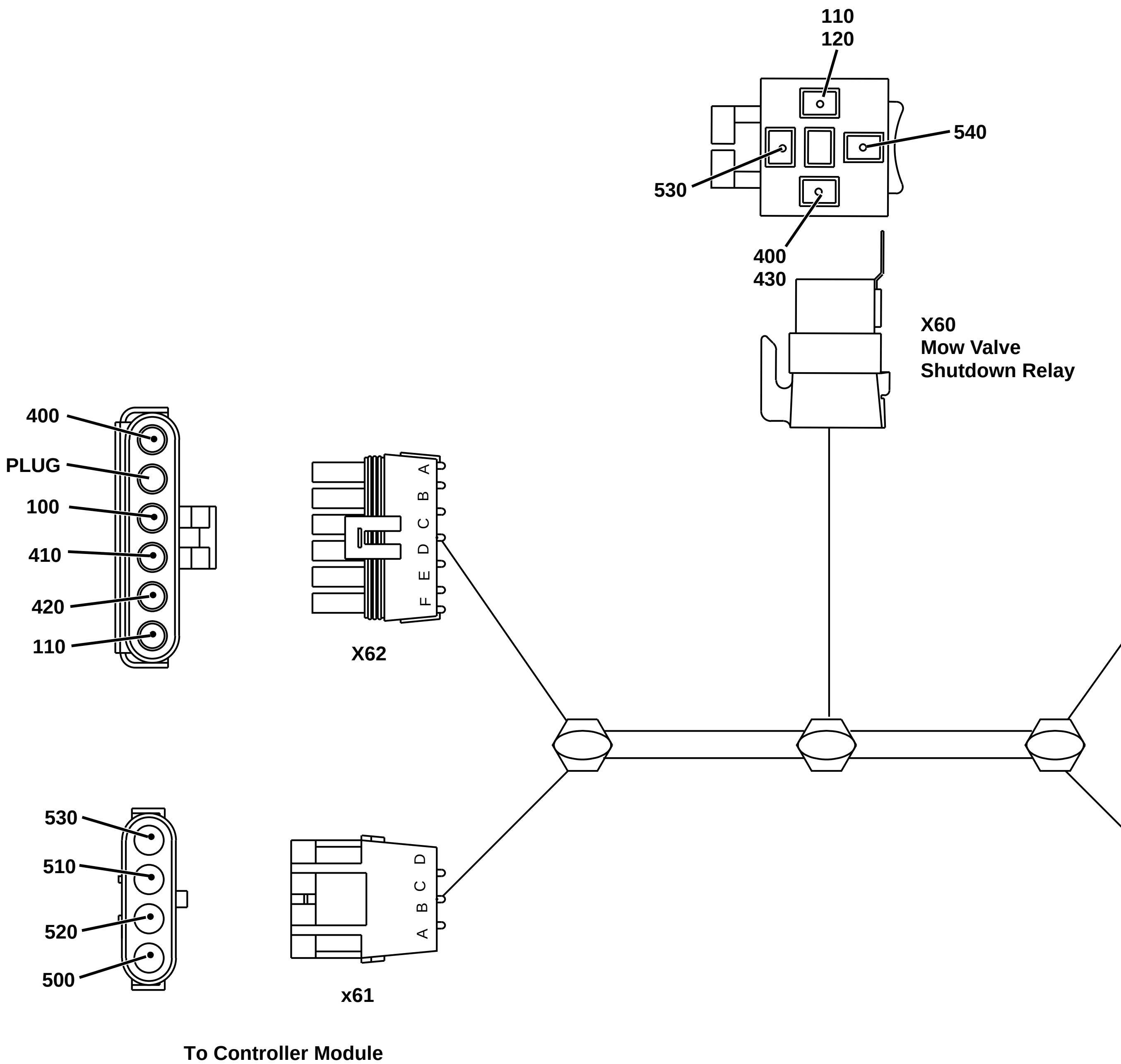
Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
002, 022, 312, 802	2.0	Red	222	0.5	Red	700	2.0	Blk
012, 032	0.8	Rust	230	0.5	Blk	701, 801, 811	1.0	Brn
201	0.5	Brn	240, 250, 320, 893	0.8	Blk	704, 814	1.0	Yel
202, 342, 352, 812, 832, 842, 852, 862, 872, 882, 892	1.0	Red	301	2.0	Brn	807	1.0	Pur
203	0.5	Org	303, 703, 813	1.0	Org	808	1.0	Gry
204	0.5	Yel	307	3.0	Pur	809	1.0	Wht
205	0.5	Grn	308	3.0	Gry	894	0.8	Pur
206	0.8	Blu	310	3.0	Blk	895, 896	0.8	Red
210, 220, 710, 730, 740, 810, 820	1.0	Blk	332	3.0	Red			

MOW VALVE SHUTDOWN RELAY HARNESS (S.N. 958001—958XXX)

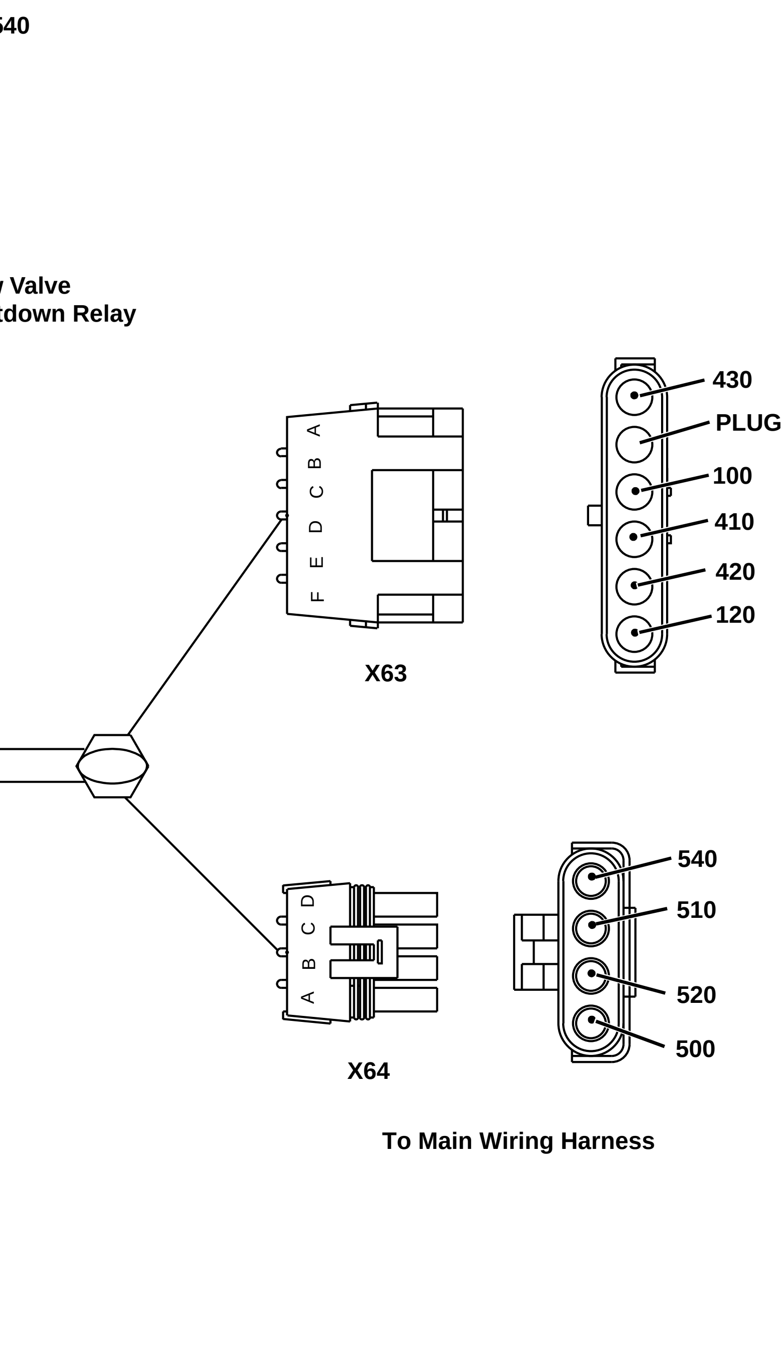
Circuit Number	Wire Size	Color
100, 110 120	0.8	Black
400	0.8	Yellow
410	0.8	Yellow/ Black
420	0.8	Yellow/ Black
430	0.8	Yellow/ White
500, 530	0.8	Blue
510	0.8	Blue/Black
520, 540	0.8	Blue/White



MOW VALVE SHUTDOWN RELAY HARNESS (S.N. 958001—958XXX)



Circuit Number	Wire Size	Color
100, 110 120	0.8	Black
400	0.8	Yellow
410	0.8	Yellow/ Black
420	0.8	Yellow/ Black
430	0.8	Yellow/ White
500, 530	0.8	Blue
510	0.8	Blue/Black
520, 540	0.8	Blue/White



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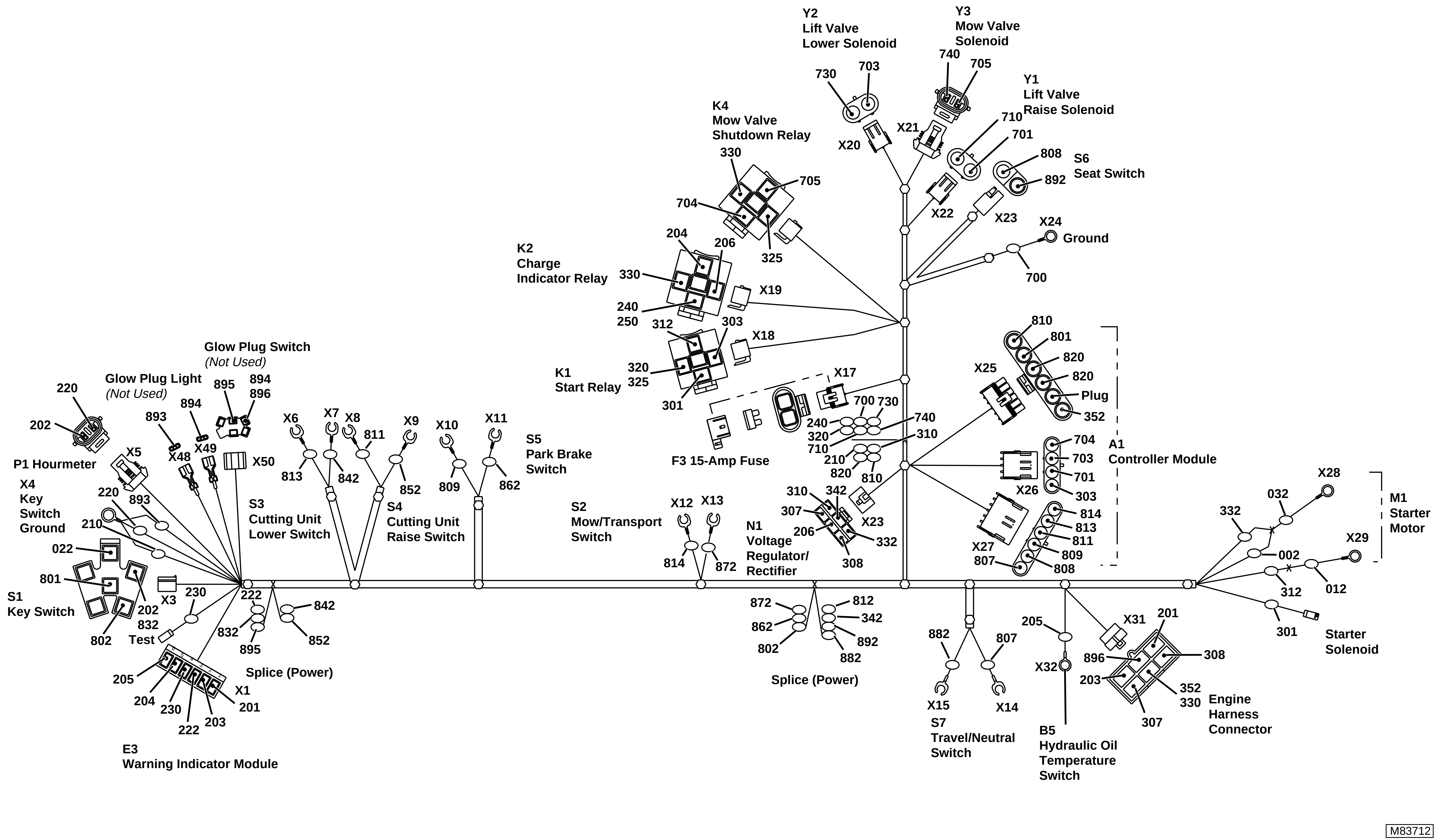
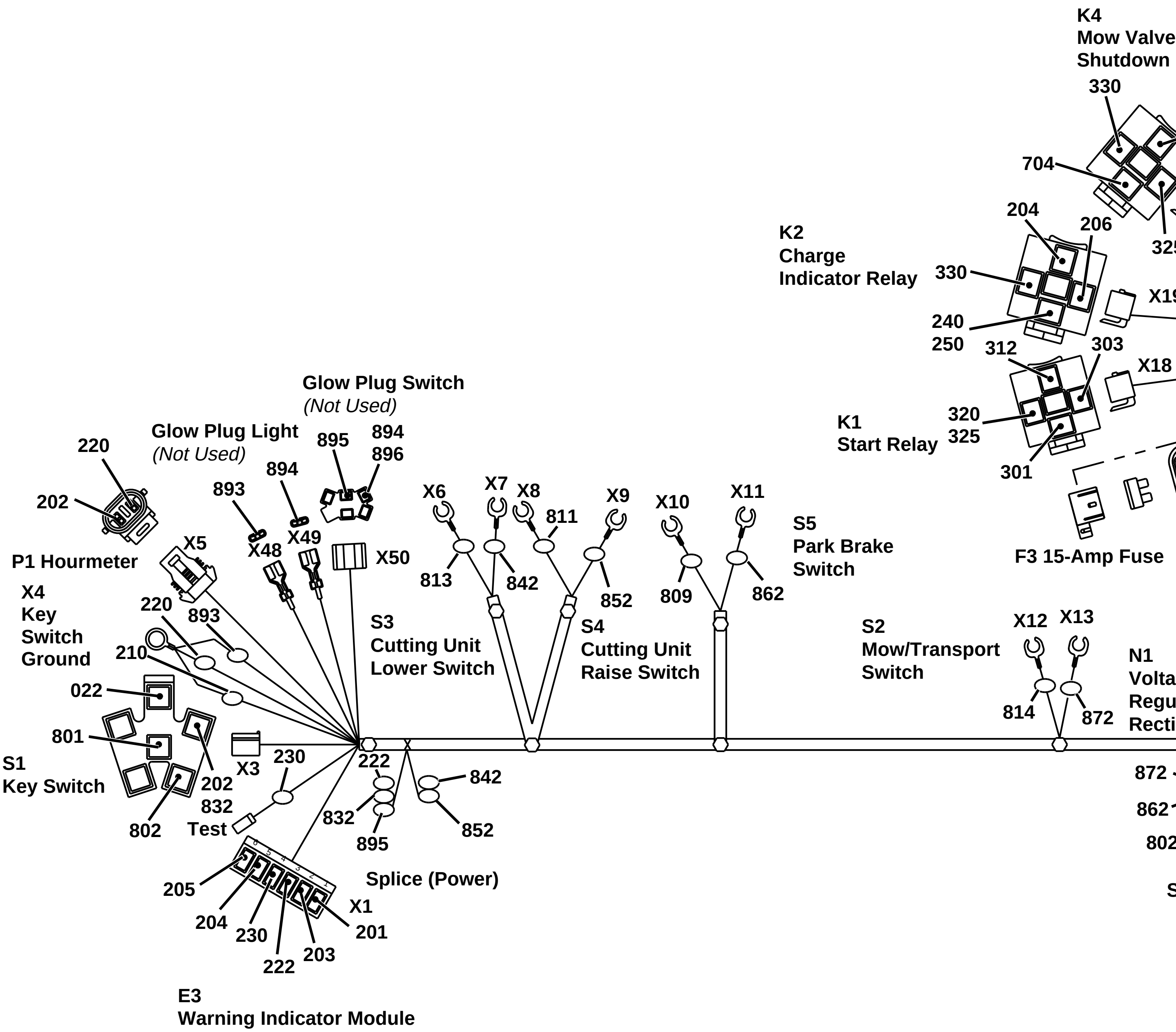
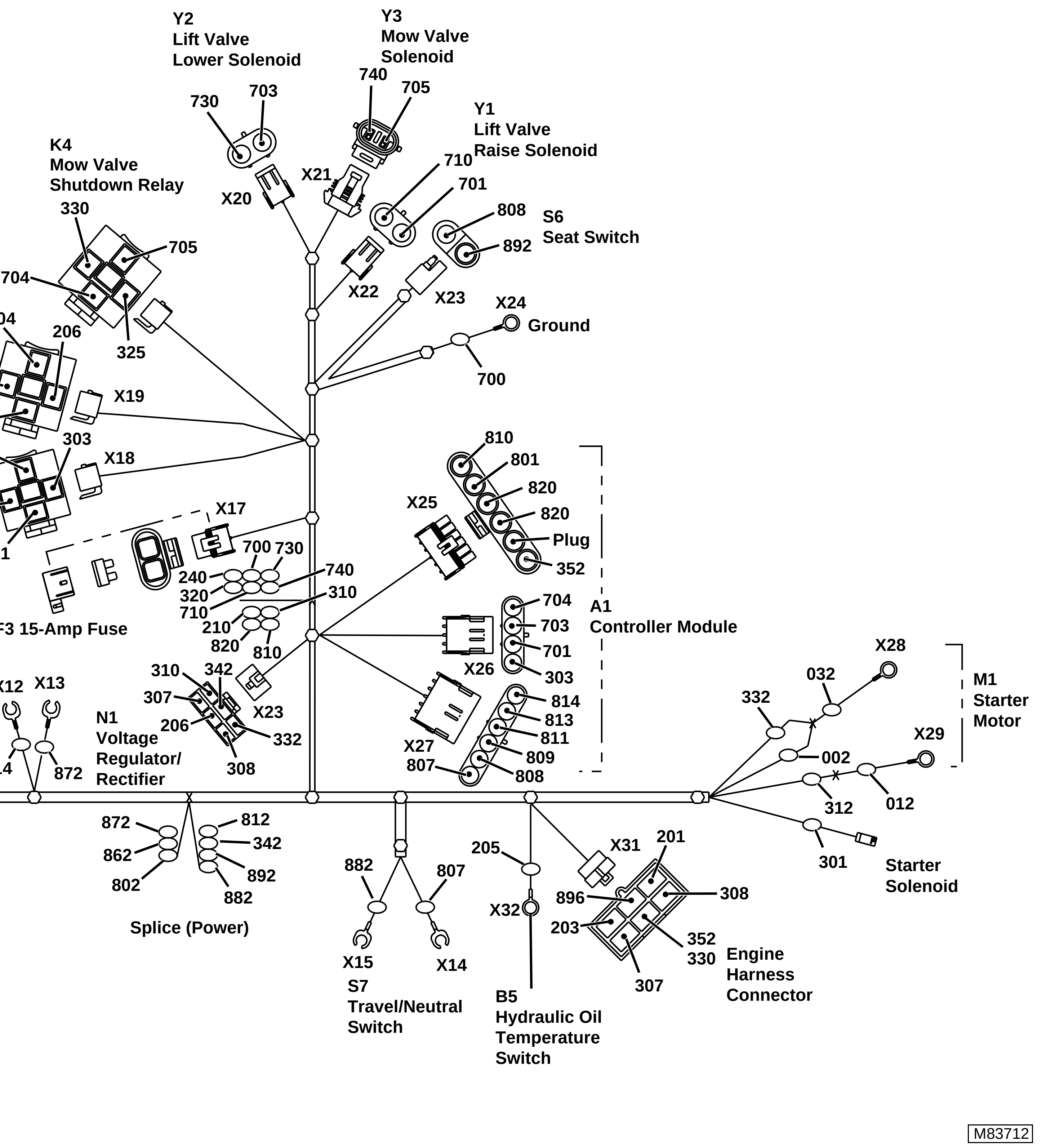
MAIN WIRING HARNESS (S.N. 958XXX—)



MAIN WIRING HARNESS (S.N. 958XXX—)

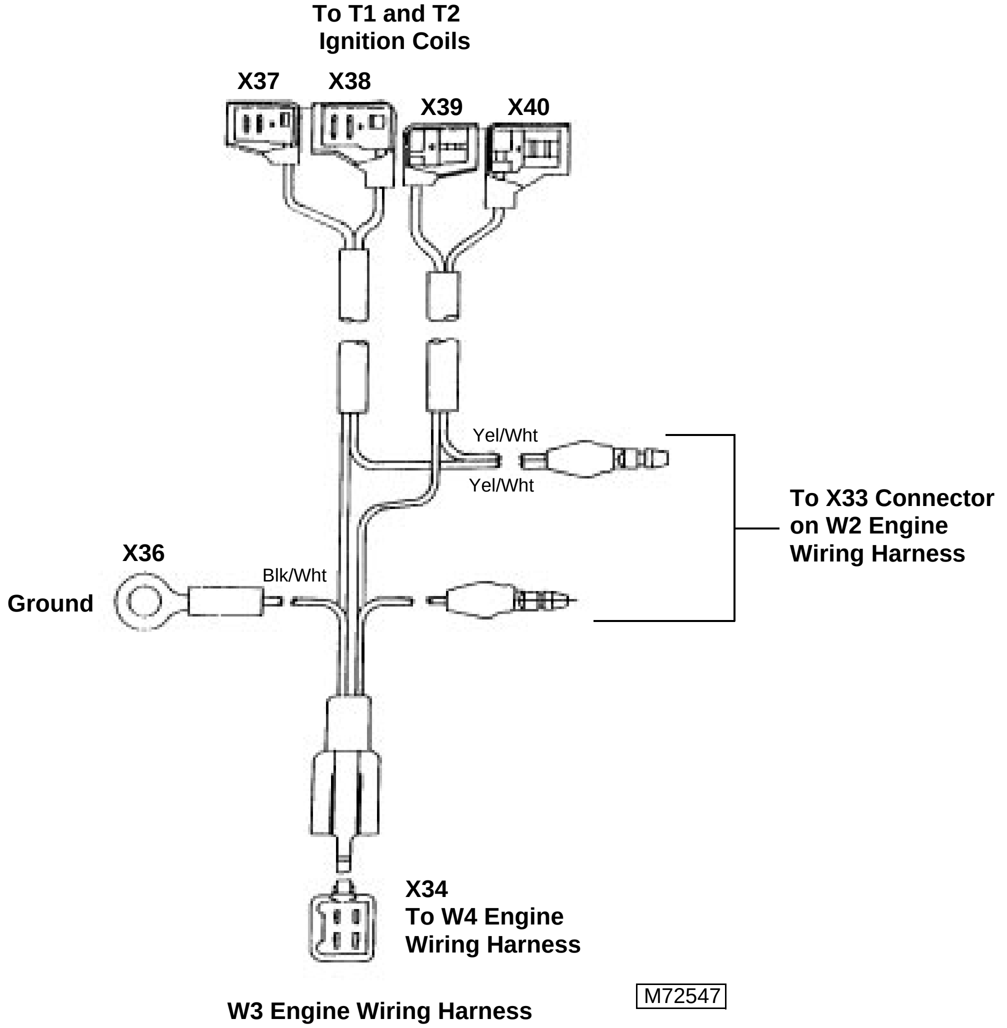



Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
730
703
740
705
Y1
Lift Valve
Raise Solenoid
K4
Mow Valve
Shutdown Relay
X20
X21
710
701
330
705
808
S6
Seat Switch
892
704
X22
X23
X24
Ground
04
206
325
700
X19
303
X18
810
801
820
820
Plug
352
X25
X17
700
730
740
240
320
710
310
210
820
810
F3 15-Amp Fuse
704
703
701
303
A1
Controller Module
X26
X28
310
342
307
X23
206
332
308
N1
Voltage
Regulator/
Rectifier
X12
X13
872
814
813
811
809
808
807
X27
332
032
M1
Starter
Motor
X29
002
312
012
872
862
802
812
342
892
882
Splice (Power)
882
807
X15
X14
S7
Travel/Neutral
Switch
205
X32
B5
Hydraulic Oil
Temperature
Switch
X31
201
896
308
203
352
330
307
Engine
Harness
Connector
301
Starter
Solenoid
M83712

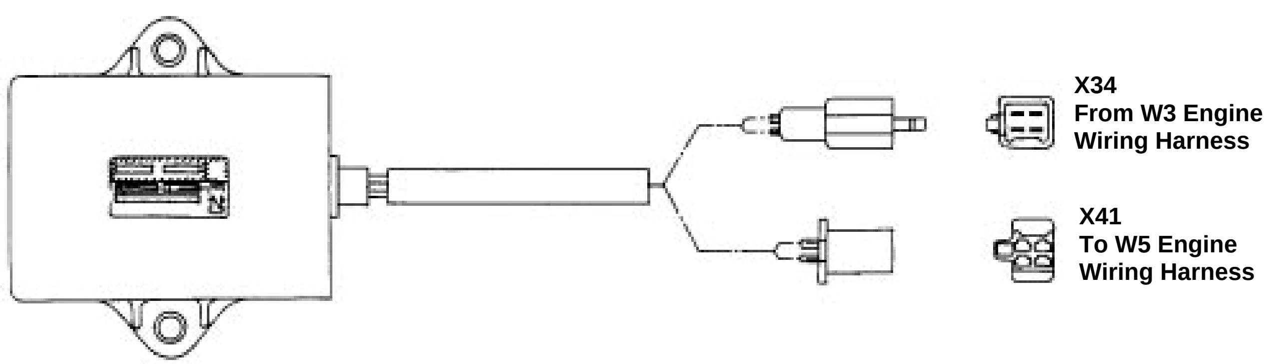
WIRE COLOR CODES (S.N. 958XXX—)

Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
002, 022, 312, 802	2.0	Red	222	0.5	Red	701, 801, 811	1.0	Brn
012, 032	0.8	Rust	230	0.5	Blk	704, 814	1.0	Yel
201	0.5	Brn	301	2.0	Brn	705	1.0	Blu
202, 342, 352, 812, 832, 842, 852, 862, 872, 882, 892	1.0	Red	303, 703, 813	1.0	Org	807	1.0	Pur
203	0.5	Org	307	5.0	Pur	808	1.0	Gry
204	0.5	Yel	308	5.0	Gry	809	1.0	Wht
205	0.5	Grn	310	3.0	Blk	894	0.8	Pur
206	0.8	Blu	330	0.8	Yel	895, 896	0.8	Red
210, 220, 710, 730, 740, 810, 820	1.0	Blk	332	3.0	Red			
240, 250, 320, 325, 893	0.8	Blk	700	2.0	Blk			

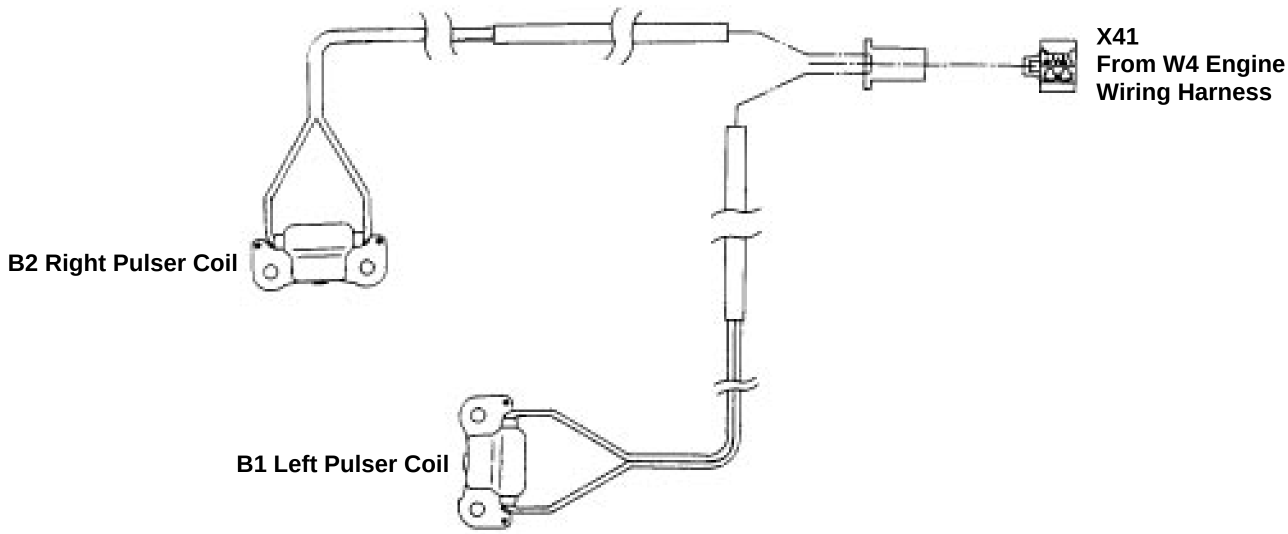
ENGINE WIRING HARNESSES



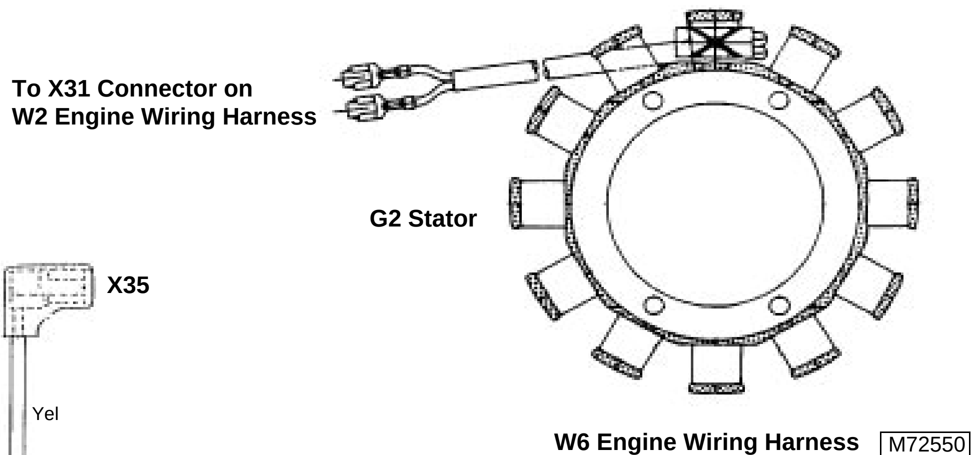
W3 Engine Wiring Harness



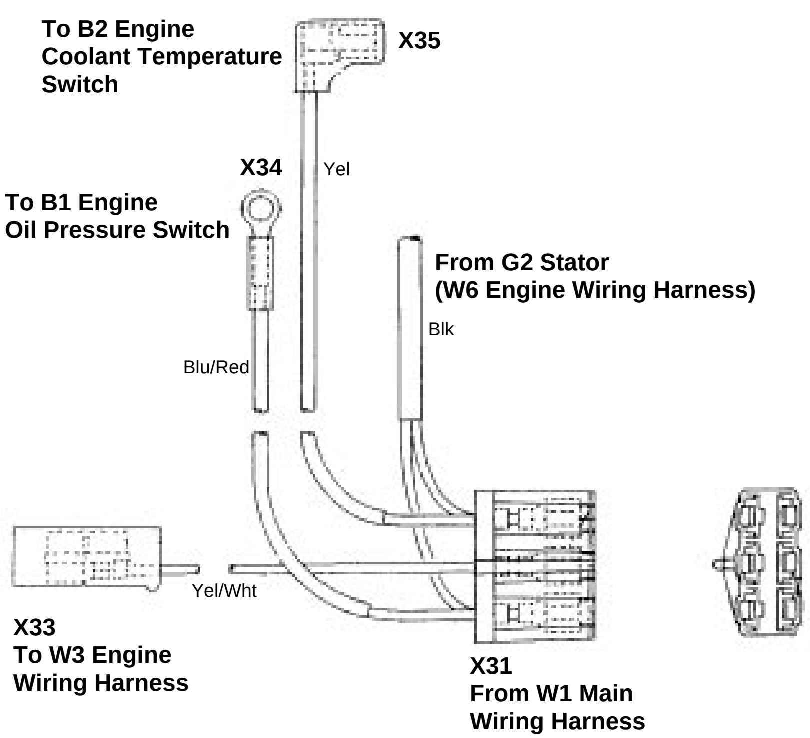
W4 Engine Wiring Harness



W5 Engine Wiring Harness

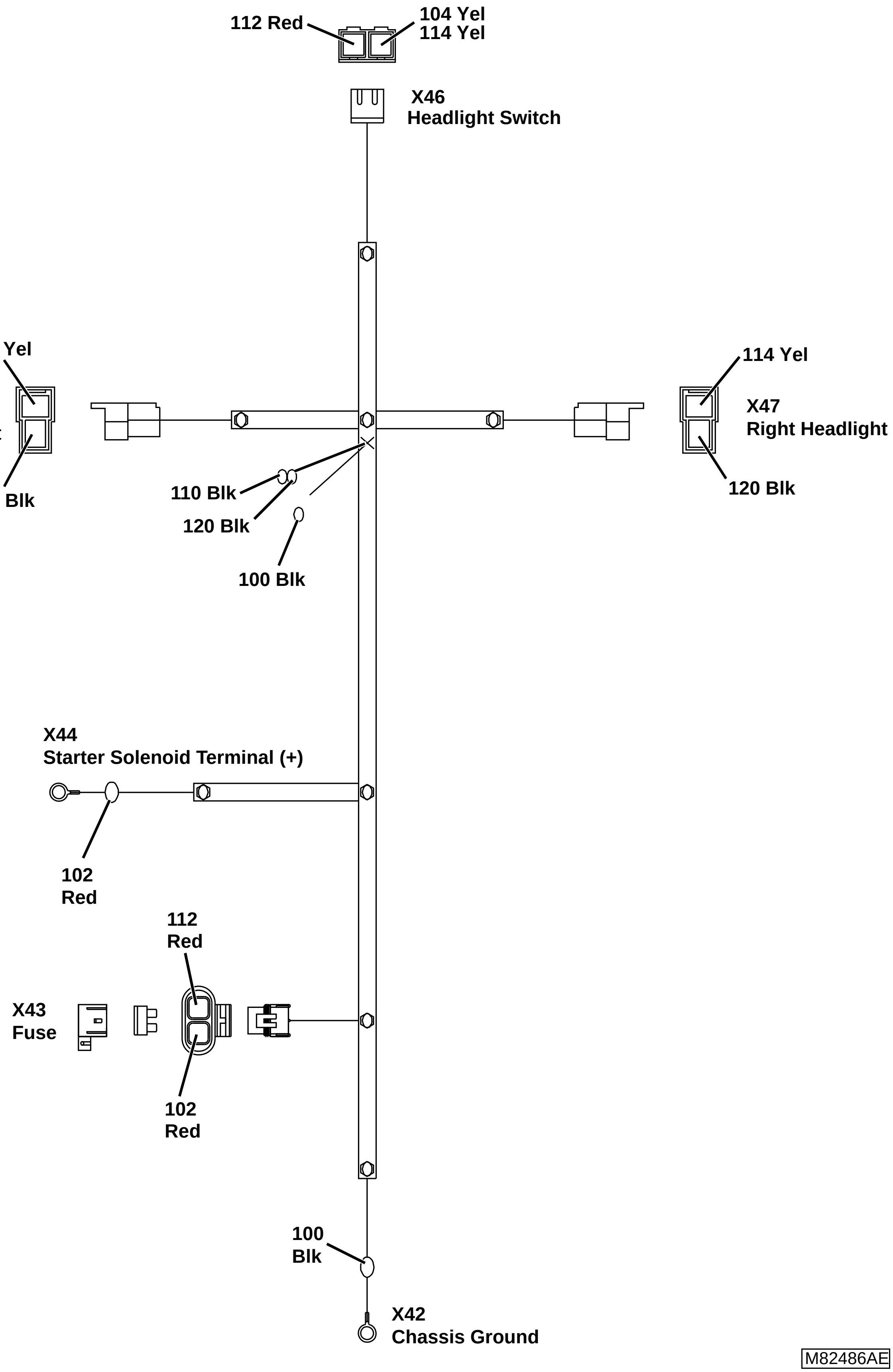


W6 Engine Wiring Harness

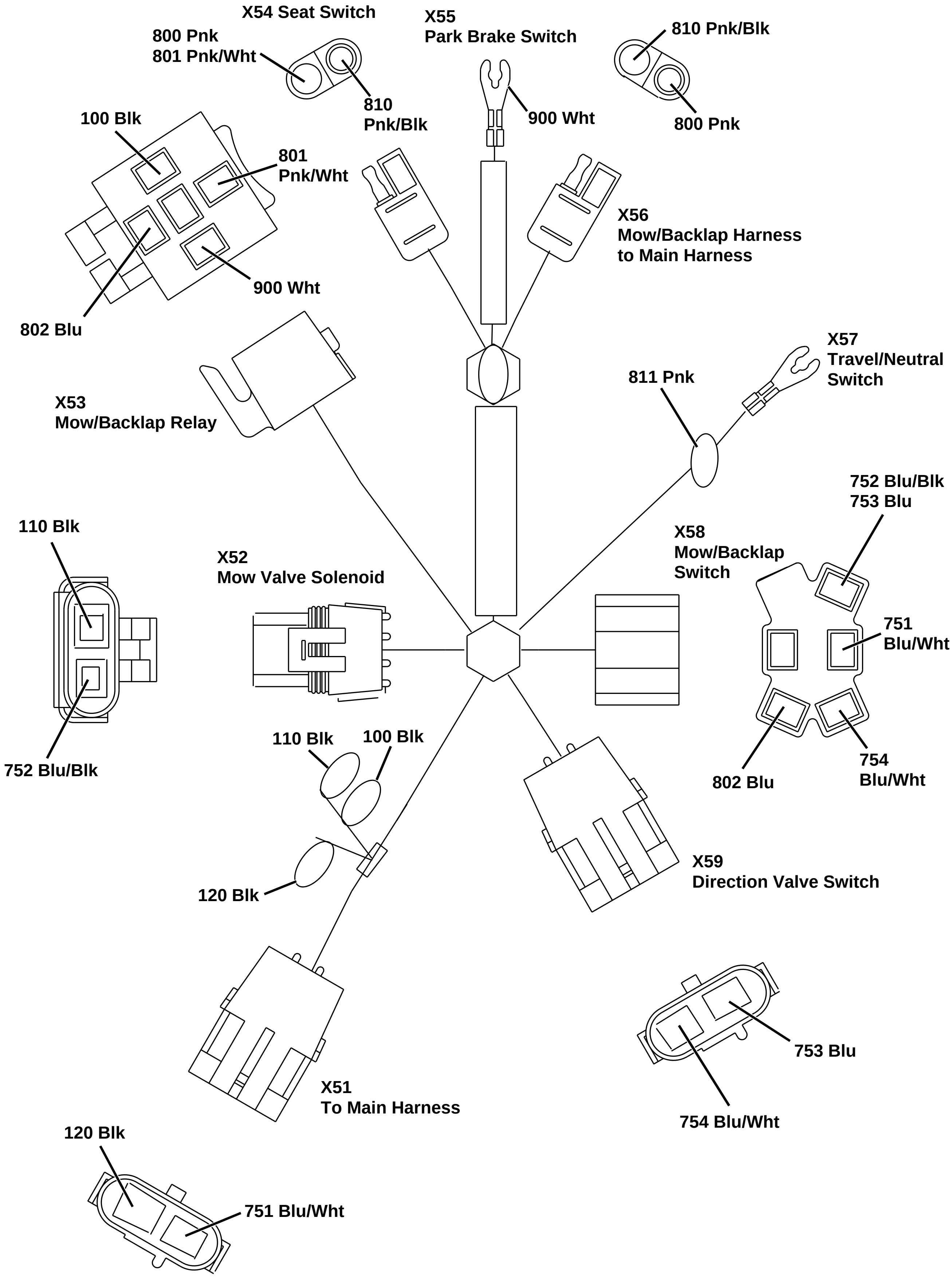


W2 Engine Wiring Harness

OPTIONAL EQUIPMENT HARNESSES
LIGHTING KIT WIRING HARNESS



BACKLAPPING WIRING HARNESS (S.N. 957001—)



TROUBLESHOOTING

ELECTRICAL SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Battery will not take a charge.	Starter does not work.	Starter cranks slowly.	Entire electrical system does not work.	Dead battery.	Battery light goes on when engine is running.	Indicator lights do not come on in “START” position.				
Loose or corroded connections.	●	●	●	●							
Dead cell in battery.	●										
Sulfated or worn out battery. Test battery.	●	●	●	●	●						
Electrolyte level low.	●										
Faulty starter. Test starter.		●									
Engine oil too heavy.			●								
Blown fuse.				●							
Melted fusible link(s). Visually check or test link(s) for continuity.				●							
Shorted starter solenoid. Test solenoid.					●						
Ignition switch wired wrong.					●						
Low engine speed.						●					
Faulty voltage regulator. Test regulator.						●					
Faulty battery. Test battery.						●					
Faulty alternator.						●					
Grounded wire in circuit. Check harness for continuity.						●					
Faulty bulb.							●				
Faulty wiring. Check wiring harness for continuity.							●				
Faulty engine or hydraulic oil temperature switches or battery light relay. Test switches or relay.							●				

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CIRCUIT OPERATION AND DIAGNOSIS

CONTROLLER MODULE OPERATION

Function:

To allow safe operation of the machine by monitoring the interlock switches.

Operating Conditions:

- Key switch in the RUN or START position.

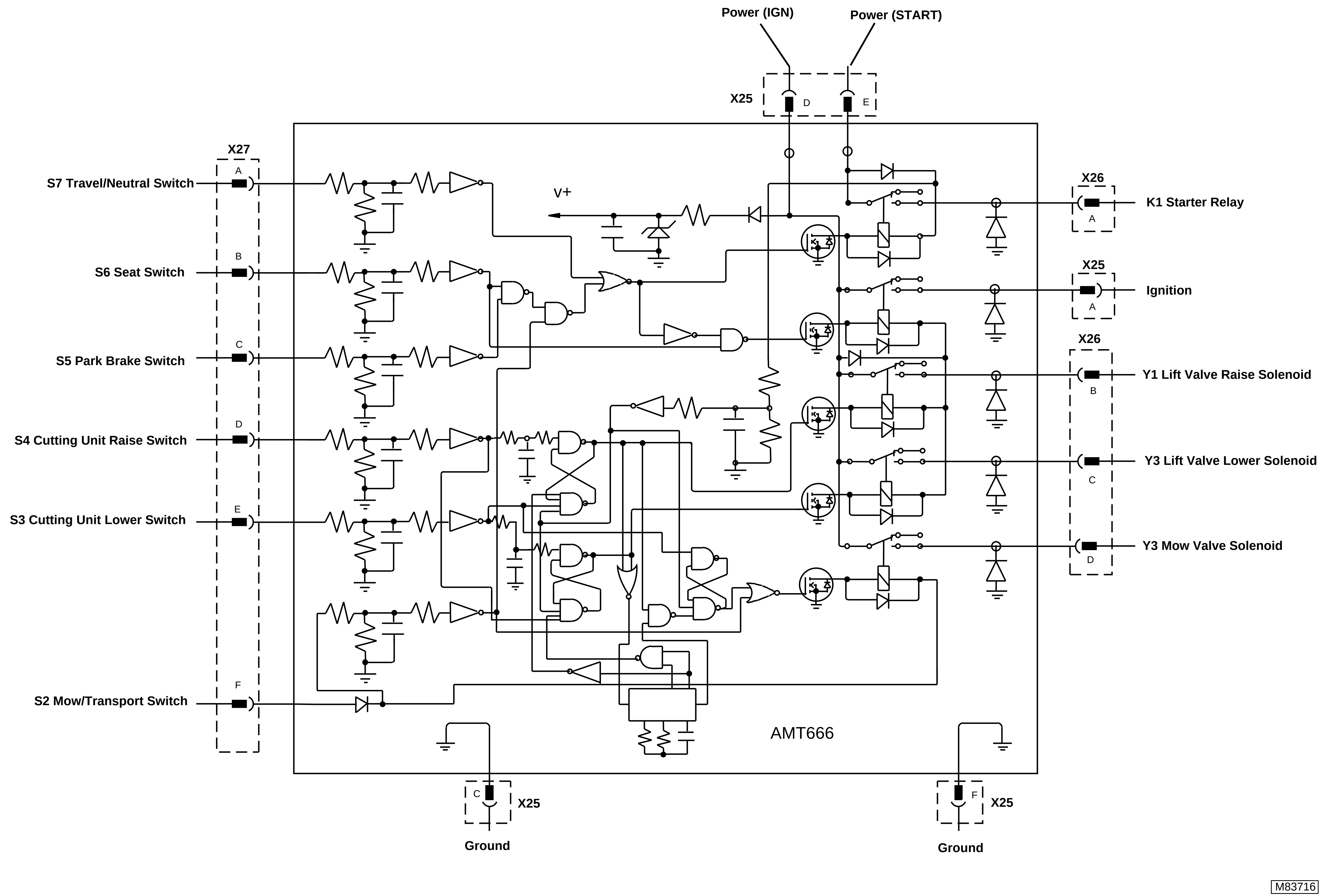
Theory of Operation:

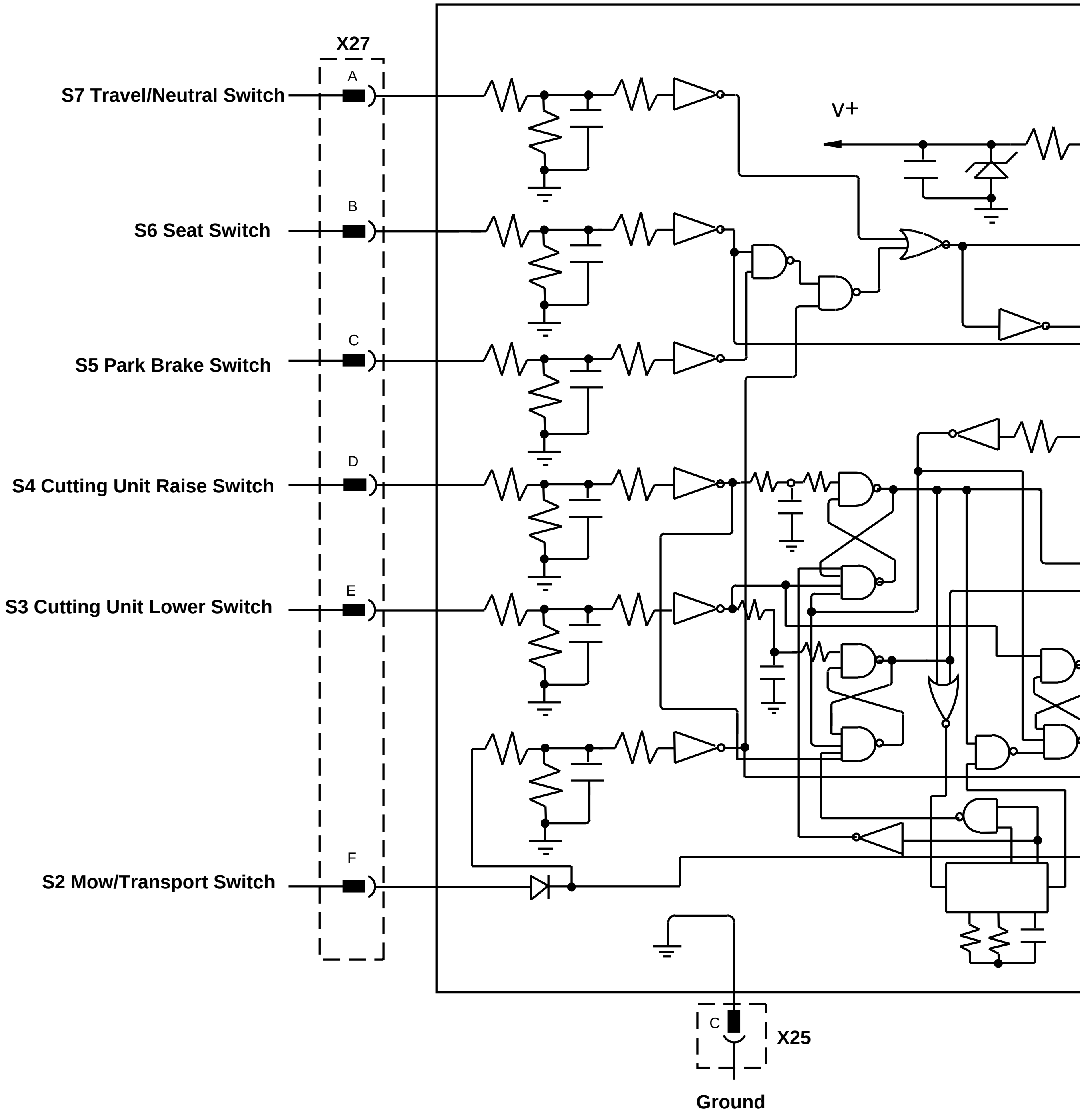
With the key switch in the START position, current is supplied to the controller module at terminals D (red wire No. 812 [S.N. —958000 and S.N. 958XXX—] or yellow/black wire No. 410 [S.N. 958001—958XXX]) and E (brown wire No. 801 [S.N. —958000 and S.N. 958XXX—] or yellow/red wire No. 420 [S.N. 958001—958XXX]) of the X25 connector.

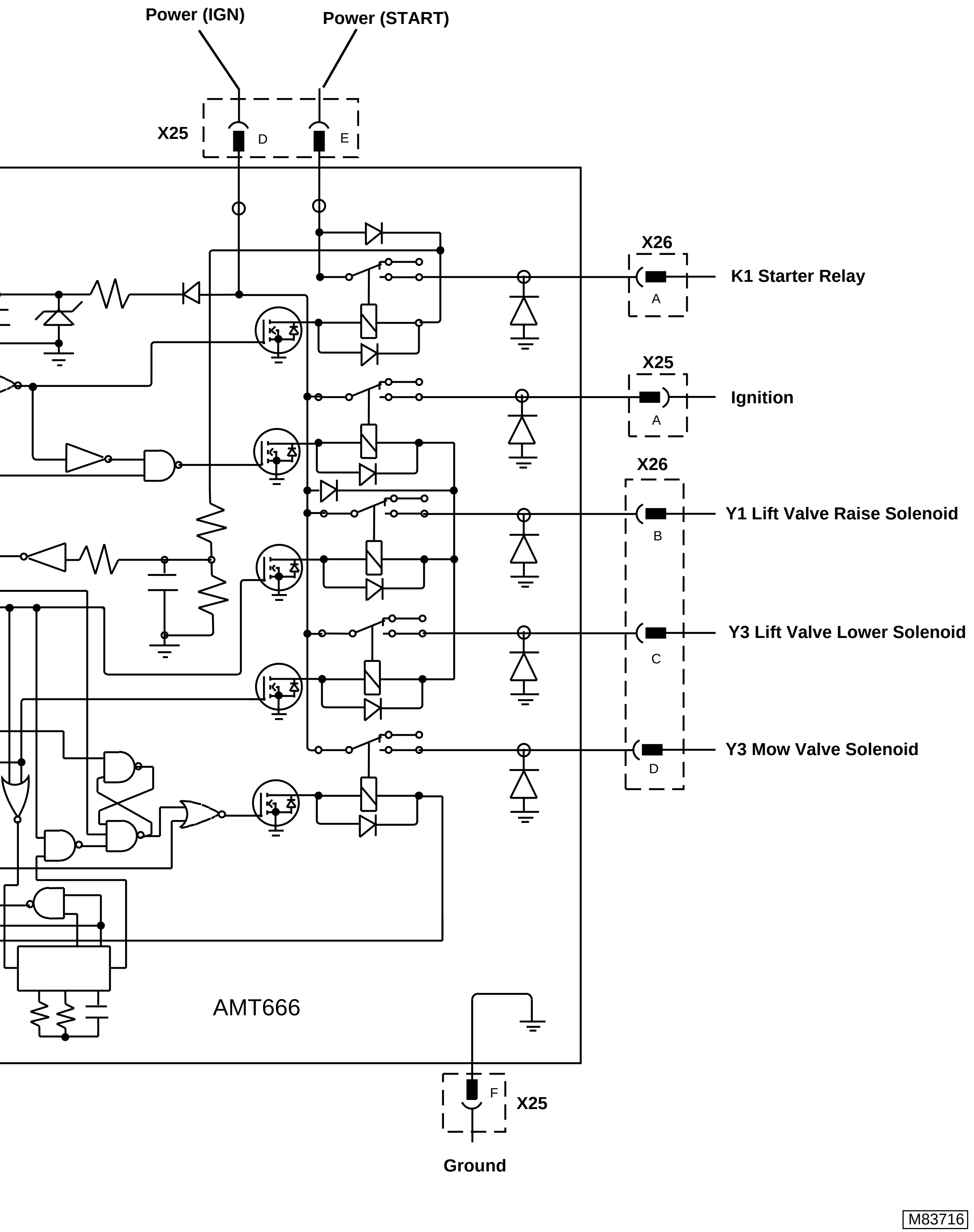
With the key switch in the RUN position, current is supplied to the controller module only to terminal D (red wire No. 812 [S.N. —958000 and S.N. 958XXX—] or yellow/black wire No. 410 [S.N. 958001—958XXX]) of the X25 connector.

A path to gound is provided by black wires No. 810 , 820 and 700 (S.N. —958000 and S.N. 958XXX—) or black wires No. 100, 820, 110, 810 and 700 (S.N. 958001—958XXX).

During mower operation, the controller module recieves current from various interlock switches. If the correct series of interlock switches are activated (or deactivated), the contoller module will activate (or deactivate) various devices, such as the mow valve solenoid, lift valve raise or lower solenoid, etc. (See individual circuit operation stories for further information.)


Power (IGN)
Power (START)
X25
D
E
X27
A
S7 Travel/Neutral Switch
B
S6 Seat Switch
C
S5 Park Brake Switch
D
S4 Cutting Unit Raise Switch
E
S3 Cutting Unit Lower Switch
F
S2 Mow/Transport Switch
V+
X26
A
K1 Starter Relay
X25
A
Ignition
X26
B
Y1 Lift Valve Raise Solenoid
C
Y3 Lift Valve Lower Solenoid
D
Y3 Mow Valve Solenoid
AMT666
C
X25
Ground
F
X25
Ground
M83716


X27
A
S7 Travel/Neutral Switch
B
S6 Seat Switch
C
S5 Park Brake Switch
D
S4 Cutting Unit Raise Switch
E
S3 Cutting Unit Lower Switch
F
S2 Mow/Transport Switch
V+
C
X25
Ground



Power (IGN)
Power (START)
X25
D
E
X26
A
K1 Starter Relay
X25
A
Ignition
X26
B
Y1 Lift Valve Raise Solenoid
C
Y3 Lift Valve Lower Solenoid
D
Y3 Mow Valve Solenoid
AMT666
F
X25
Ground
M83716

POWER CIRCUIT OPERATION (S.N. —958000 and S.N. 958XXX—)

Function:

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

Operating Conditions, Unswitched Circuits:

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

- Battery positive terminal.
- BAT terminal of Starter Solenoid bolt.
- Terminal 30 of Starter Relay.
- BAT terminal of Key Switch.
- Terminal 1 of Voltage Regulator/Rectifier.
- Common terminal of Optional Headlight Switch.

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

The battery cables and the starter tie point connections must be in good condition for the mower electrical system to function properly.

The ground cable connections are equally important as the positive cable. Starter operation depends on these cables and connections to carry the high current necessary for its operation.

The connection between the starter and key switch is protected by a fusible link and 15-amp main power fuse. The connection between the starter and starter relay is protected by a fusible link. These devices incorporate a short piece of wire that is designed to fail (open) if the current load is excessive or a short circuit occurs, protecting the wiring harness from damage.

Switched Circuits:

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

- IGN terminal of Key Switch.
- Terminal D of Controller Module, six terminal female connector.
- Terminal 5 of Voltage Regulator/Rectifier.
- Common terminal of Mow/Transport Switch.
- Common terminal of Seat Switch.
- Common terminal of Park Brake Switch.
- Common terminal of Travel/Neutral Switch.
- Positive terminal of Hourmeter.
- Common terminal of Cutting Unit Lower Switch.
- Common terminal of Cutting Unit Raise Switch.
- Terminal 3 of Warning Indicator Module.

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

- All components listed in RUN position.
- START terminal of Key Switch.
- Terminal E of Controller Module, six terminal female connector.

These circuits are controlled by the key switch and are protected by the fusible link and 15-amp main power fuse.

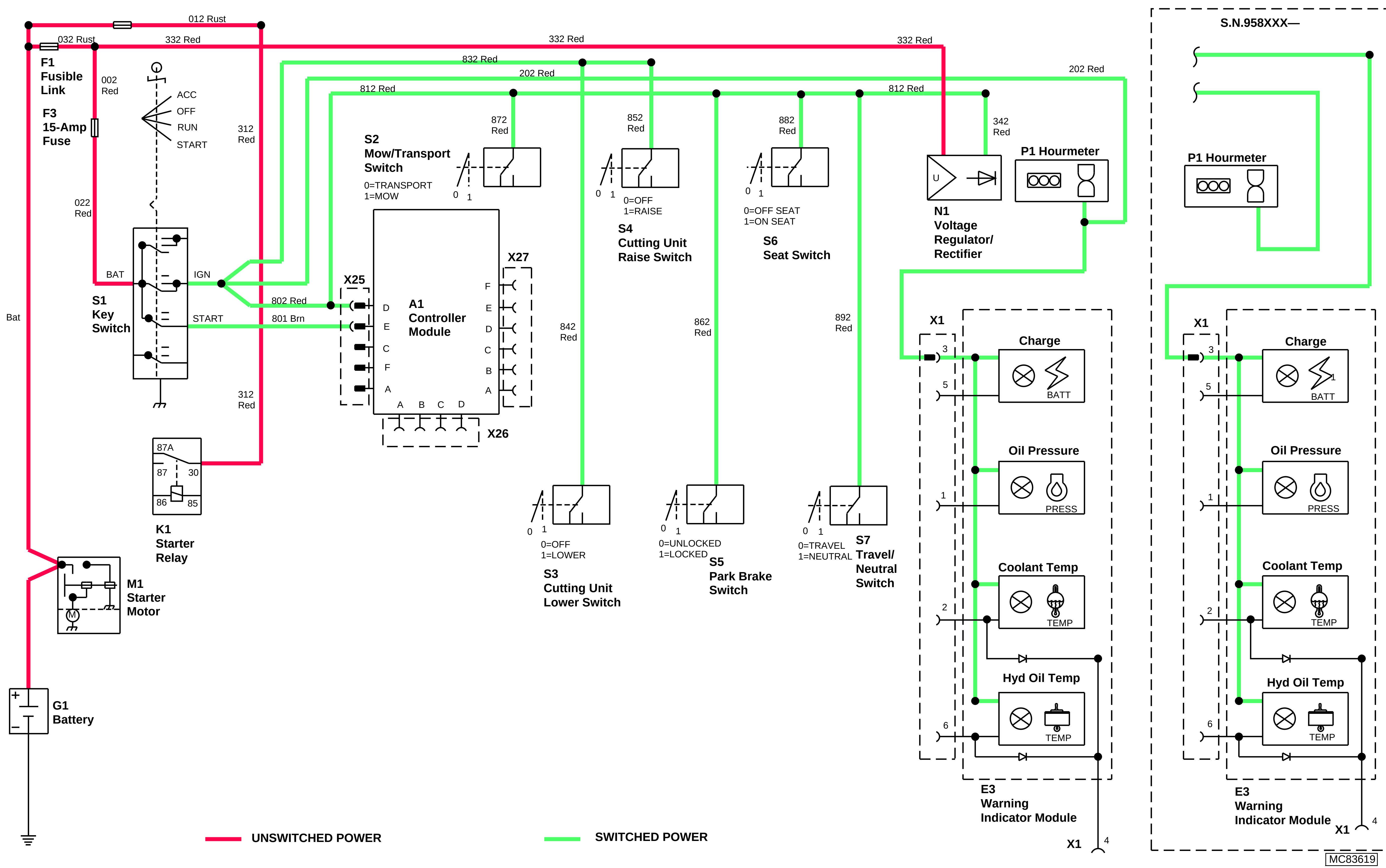
Optional Headlight Circuit:

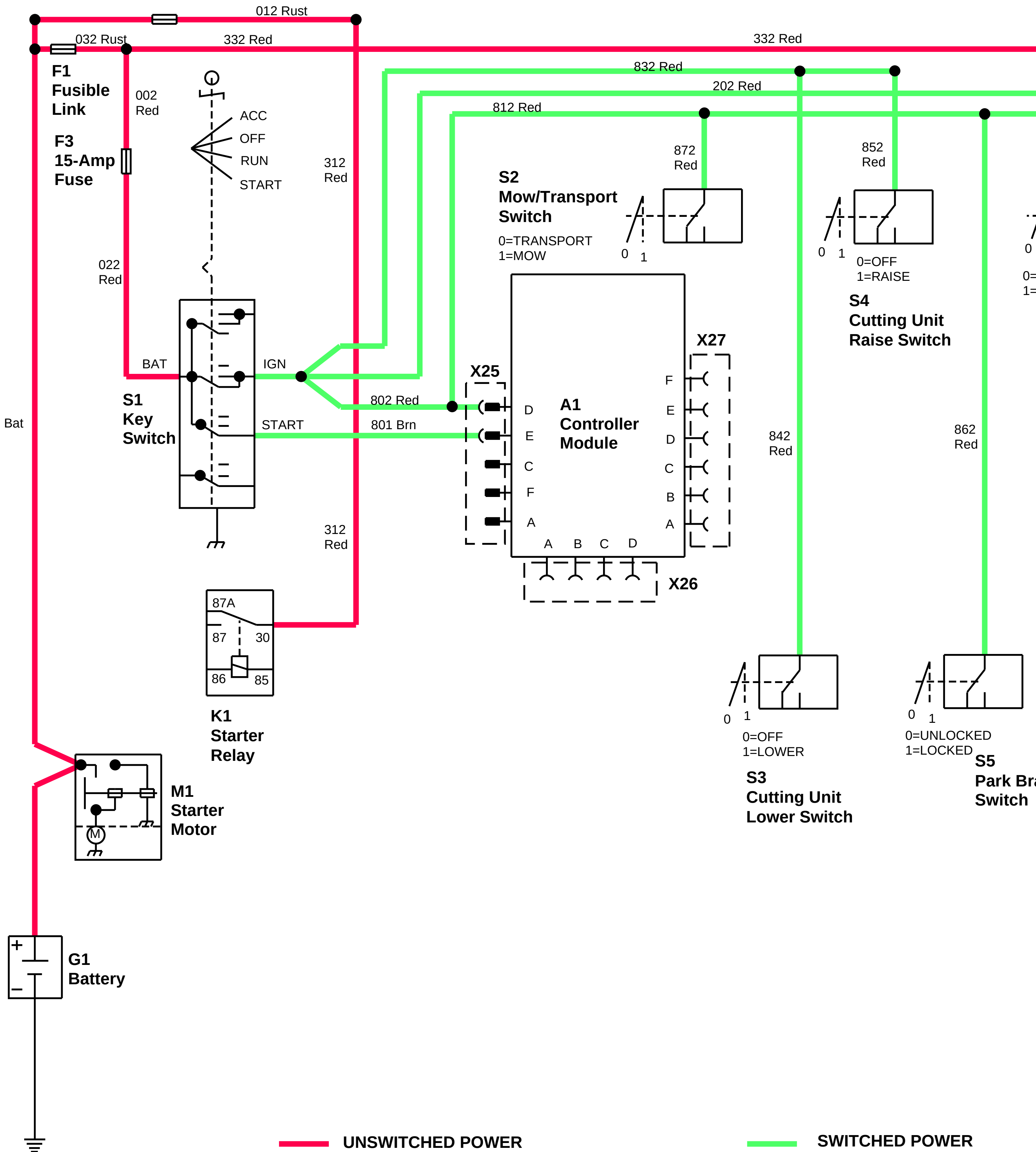
See appropriate schematics and diagnostic procedure for this kit.

When optional kit is installed, the positive lead for this kit is connected directly to the starter solenoid bolt. This lead also includes a 15-amp fuse to protect the wiring harness.

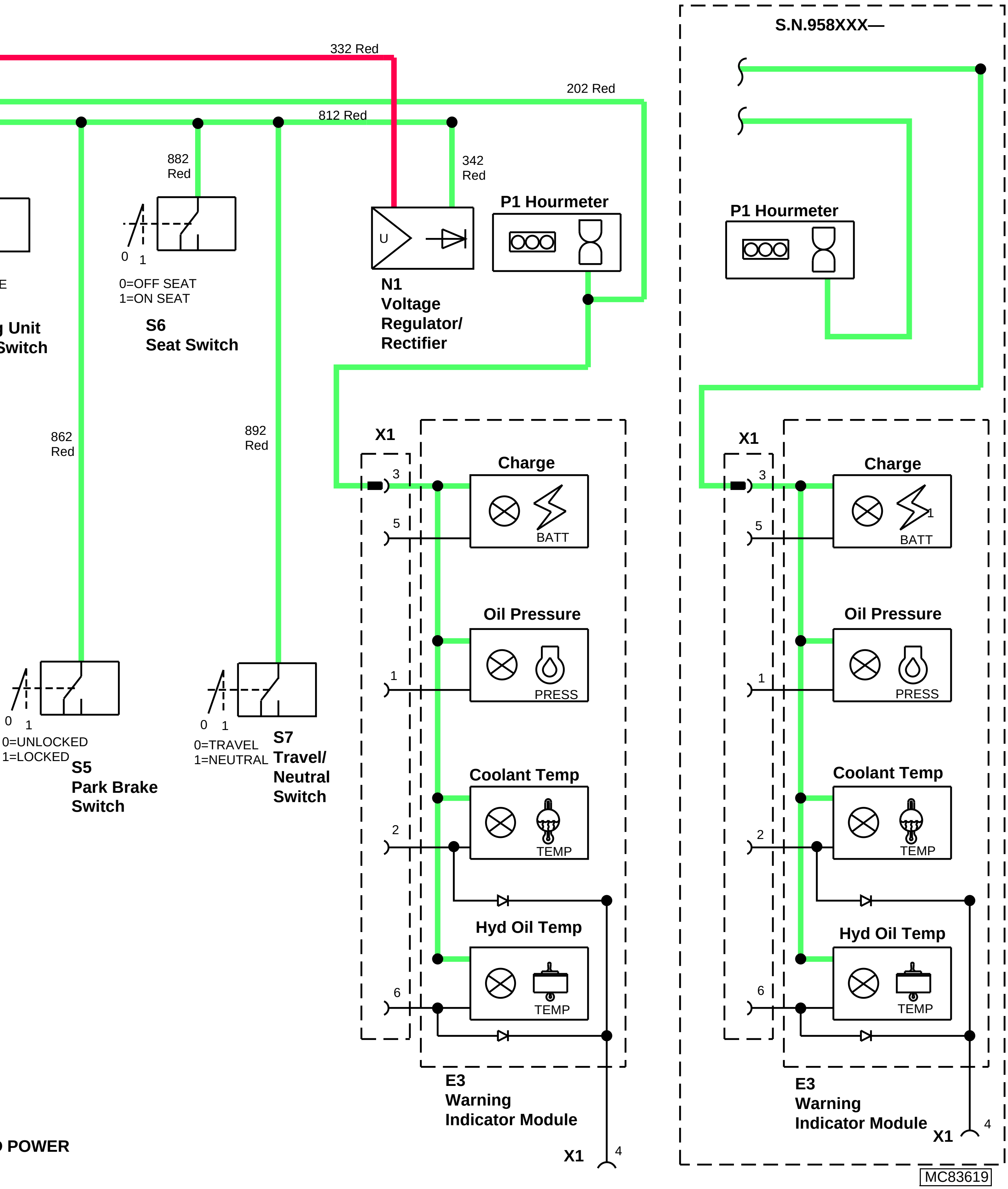
Optional Mow/Backlap Circuit (S.N. 957001—):

See appropriate schematics and diagnostic procedure for this option.


012 Rust
032 Rust
332 Red
832 Red
202 Red
812 Red
F1 Fusible Link
002 Red
F3 15-Amp Fuse
ACC
OFF
RUN
START
312 Red
022 Red
BAT
IGN
START
S1 Key Switch
Bat
802 Red
801 Brn
X25
A1 Controller Module
X27
X26
S2 Mow/Transport Switch
0=TRANSPORT
1=MOW
872 Red
852 Red
0=OFF
1=RAISE
S4 Cutting Unit Raise Switch
882 Red
0=OFF SEAT
1=ON SEAT
S6 Seat Switch
342 Red
N1 Voltage Regulator/ Rectifier
P1 Hourmeter
87A
87
30
86
85
K1 Starter Relay
M1 Starter Motor
842 Red
862 Red
892 Red
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch
0=UNLOCKED
1=LOCKED
S5 Park Brake Switch
0=TRAVEL
1=NEUTRAL
S7 Travel/ Neutral Switch
G1 Battery
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
E3 Warning Indicator Module
S.N.958XXX—
UNSWITCHED POWER
SWITCHED POWER
MC83619



UNSWITCHED POWER **SWITCHED POWER**


S.N.958XXX—
332 Red
202 Red
812 Red
882
Red
342
Red
P1 Hourmeter
N1
Voltage
Regulator/
Rectifier
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
E
g Unit
Switch
862
Red
892
Red
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
E3
Warning
Indicator Module
X1
P1 Hourmeter
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
E3
Warning
Indicator Module
X1
D POWER
MC83619

POWER CIRCUIT OPERATION (S.N. 958001—958XXX)

Function:

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

Operating Conditions, Unswitched Circuits:

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

- Battery positive terminal.
- BAT terminal of Starter Solenoid bolt.
- Terminal 30 of Starter Relay.
- BAT terminal of Key Switch.
- Terminal 1 of Voltage Regulator/Rectifier.
- Common terminal of Optional Headlight Switch.

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

The battery cables and the starter tie point connections must be in good condition for the mower electrical system to function properly.

The ground cable connections are equally important as the positive cable. Starter operation depends on these cables and connections to carry the high current necessary for its operation.

The connection between the starter and key switch is protected by a fusible link and 15-amp main power fuse. The connection between the starter and starter relay is protected by a fusible link. These devices incorporate a short piece of wire that is designed to fail (open) if the current load is excessive or a short circuit occurs, protecting the wiring harness from damage.

Switched Circuits:

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

- IGN terminal of Key Switch.
- Terminal D of Controller Module, six terminal female connector.
- Terminal 5 of Voltage Regulator/Rectifier.
- Common terminal of Mow/Transport Switch.
- Common terminal of Seat Switch.
- Common terminal of Park Brake Switch.
- Common terminal of Travel/Neutral Switch.
- Positive terminal of Hourmeter.
- Common terminal of Cutting Unit Lower Switch.
- Common terminal of Cutting Unit Raise Switch.
- Terminal 3 of Warning Indicator Module.

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

- All components listed in RUN position.
- START terminal of Key Switch.
- Terminal E of Controller Module, six terminal female connector.

These circuits are controlled by the key switch and are protected by the fusible link and 15-amp main power fuse.

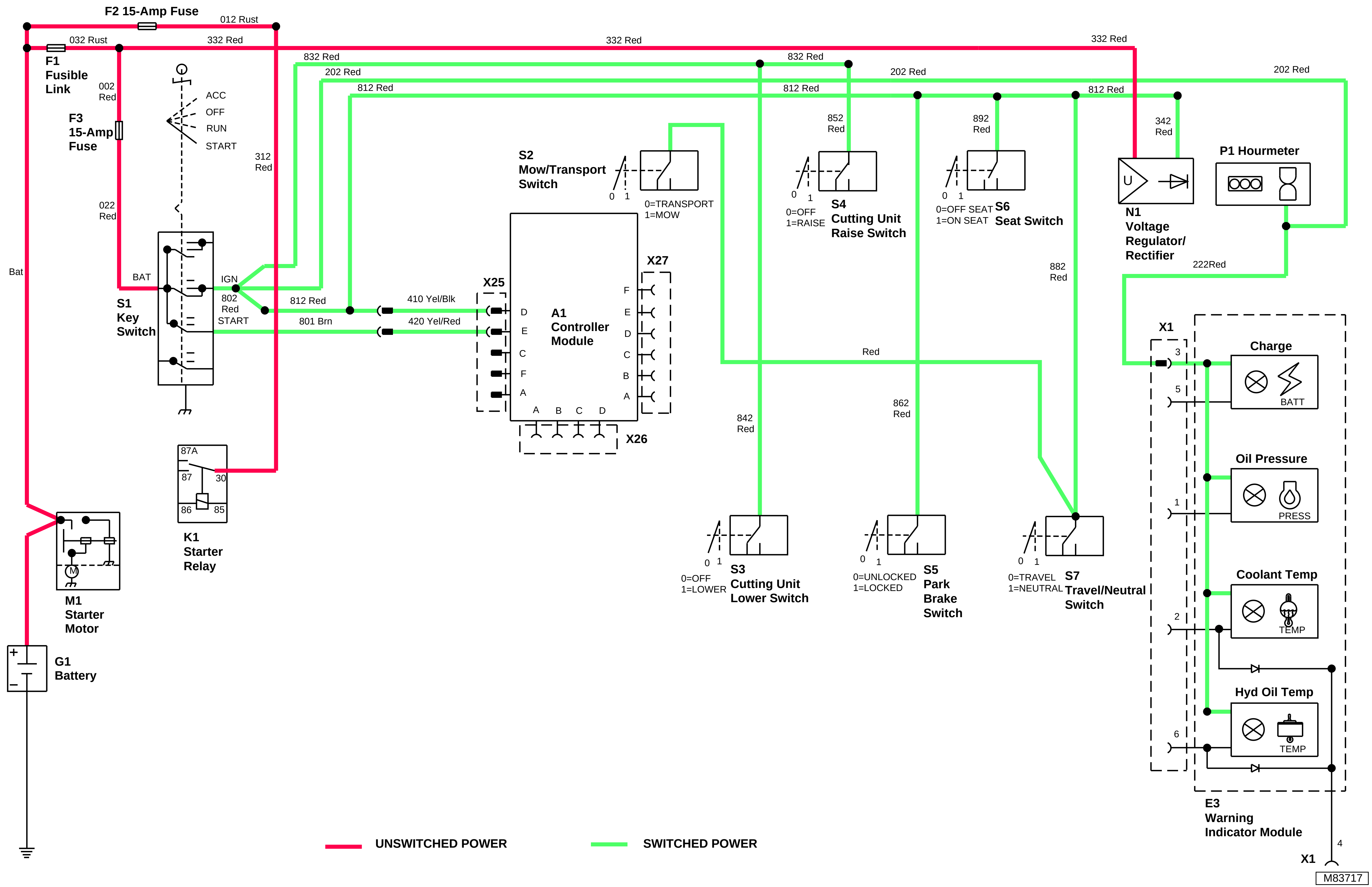
Optional Headlight Circuit:

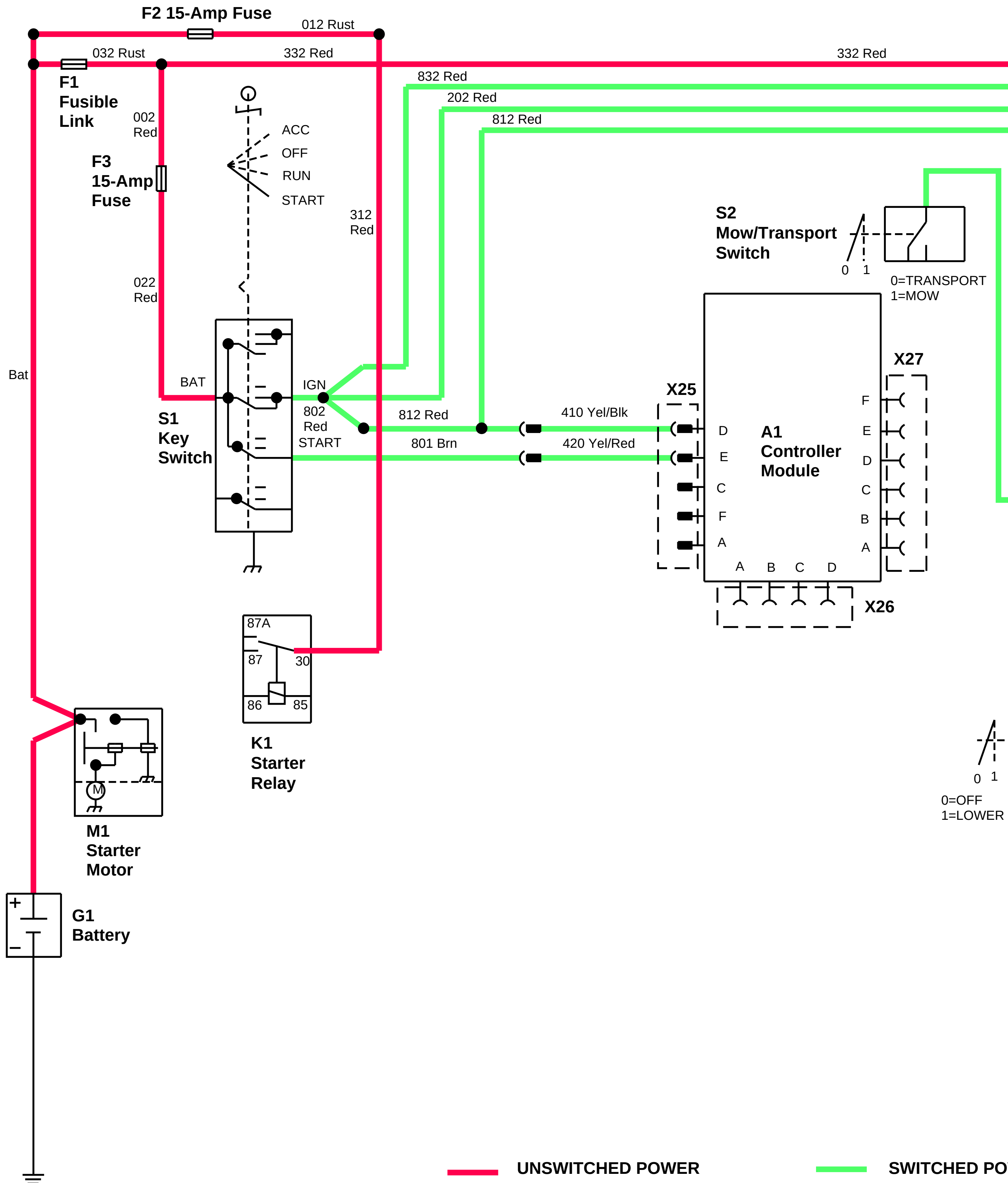
See appropriate schematics and diagnostic procedure for this kit.

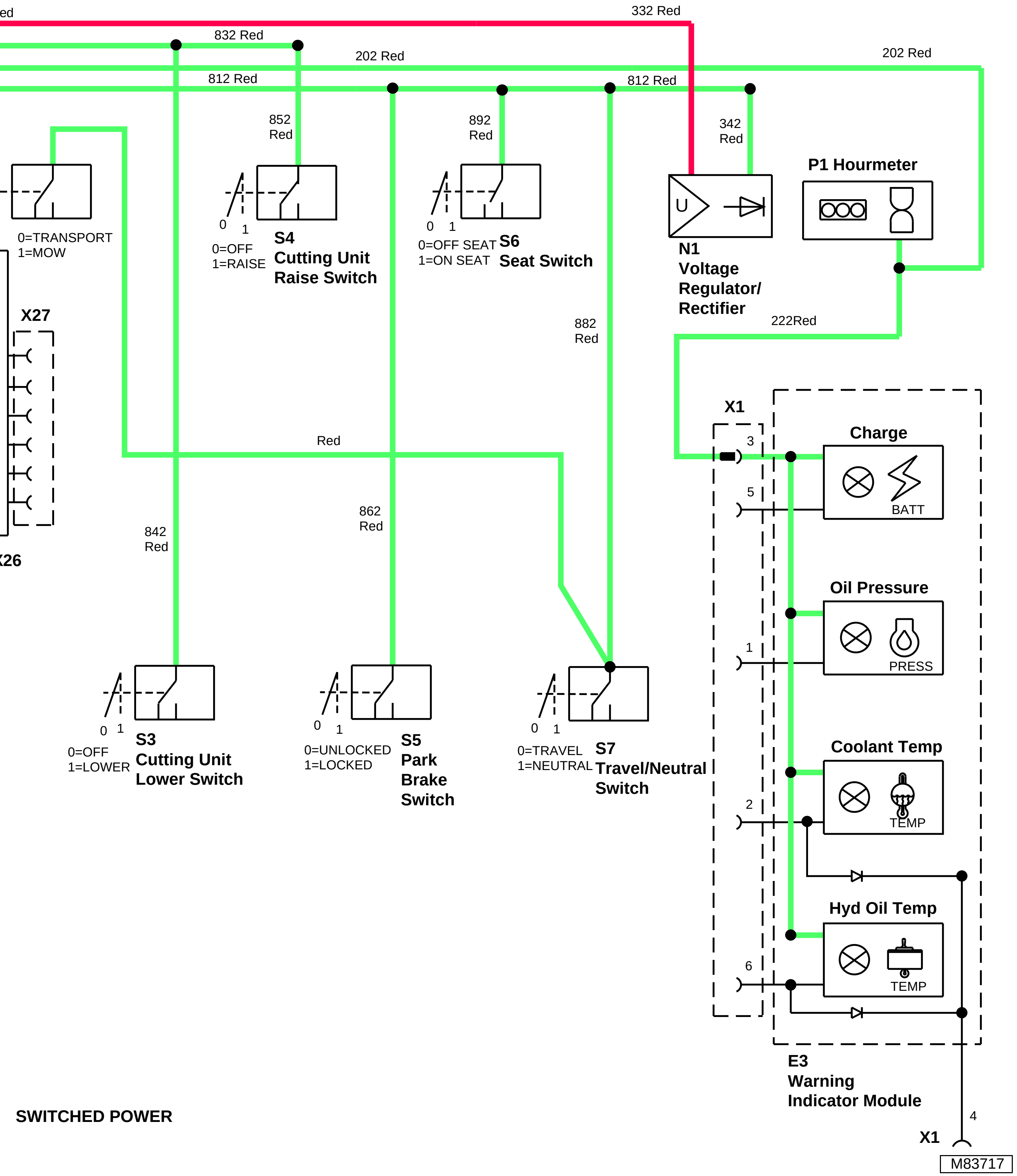
When optional kit is installed, the positive lead for this kit is connected directly to the starter solenoid bolt. This lead also includes a 15-amp fuse to protect the wiring harness.

Optional Mow/Backlap Circuit (S.N. 958001—958XXX):

See appropriate schematics and diagnostic procedure for this option.


F2 15-Amp Fuse
012 Rust
032 Rust
332 Red
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
Bat
832 Red
202 Red
812 Red
ACC
OFF
RUN
START
312 Red
BAT
IGN
802 Red
START
S1 Key Switch
812 Red
801 Brn
410 Yel/Blk
420 Yel/Red
X25
D
E
C
F
A
A1 Controller Module
A B C D
X26
X27
F
E
D
C
B
A
S2 Mow/Transport Switch
0 1
0=TRANSPORT
1=MOW
852 Red
S4 Cutting Unit Raise Switch
0=OFF
1=RAISE
892 Red
S6 Seat Switch
0=OFF SEAT
1=ON SEAT
342 Red
N1 Voltage Regulator/ Rectifier
P1 Hourmeter
222Red
882 Red
Red
842 Red
862 Red
87A
87
30
86
85
K1 Starter Relay
M1 Starter Motor
G1 Battery
S3 Cutting Unit Lower Switch
0=OFF
1=LOWER
S5 Park Brake Switch
0=UNLOCKED
1=LOCKED
S7 Travel/Neutral Switch
0=TRAVEL
1=NEUTRAL
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
E3 Warning Indicator Module
UNSWITCHED POWER
SWITCHED POWER
M83717


F2 15-Amp Fuse
012 Rust
032 Rust
332 Red
332 Red
F1
Fusible
Link
832 Red
202 Red
812 Red
002
Red
ACC
OFF
RUN
START
F3
15-Amp
Fuse
312
Red
S2
Mow/Transport
Switch
0 1
0=TRANSPORT
1=MOW
022
Red
X27
Bat
BAT
IGN
X25
802
Red
START
812 Red
410 Yel/Blk
801 Brn
420 Yel/Red
S1
Key
Switch
A1
Controller
Module
D
E
C
F
A
F
E
D
C
B
A
A B C D
X26
87A
87
30
86
85
K1
Starter
Relay
M
M1
Starter
Motor
0 1
0=OFF
1=LOWER
G1
Battery
UNSWITCHED POWER
SWITCHED PO



SWITCHED POWER

POWER CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

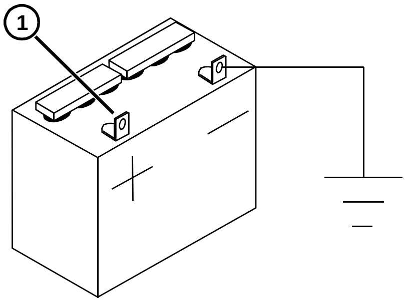
Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal.	Battery voltage.	Test rust wire No. 032, red wire(s) No. 022, 002 and connections. Test fusible link (F1) and 15 amp fuse (F3).
4. Starter relay—Terminal 30.	Battery voltage.	Test red wire No. 312, and rust wire No. 012 and connections. Replace fusible link.
5. Voltage regulator/rectifier—Terminal 1.	Battery voltage.	Test red wire No. 332, rust wire No. 032 and connections. Test fusible link.

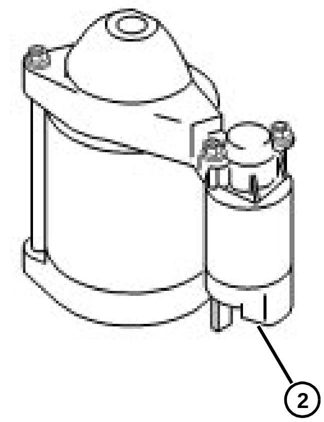
Test Condition:

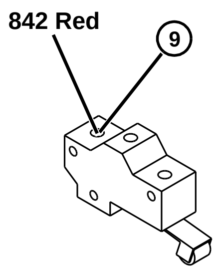
- Key switch in RUN position.

Test Location	Normal	If Not Normal
6. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
7. Park brake switch—COMMON terminal.	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
8. Mow/transport switch—COMMON terminal (S.N. —958000 and S.N. 958XXX—958XXX).	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
Mow/transport switch—COMMON terminal (S.N. 958001—958XXX).	Battery voltage.	Test red jumper from travel/neutral switch, red wires No. 802, 812, 882 and connections.
9. Cutting unit lower switch—COMMON terminal.	Battery voltage.	Test red wires No. 832, 842 and connections.

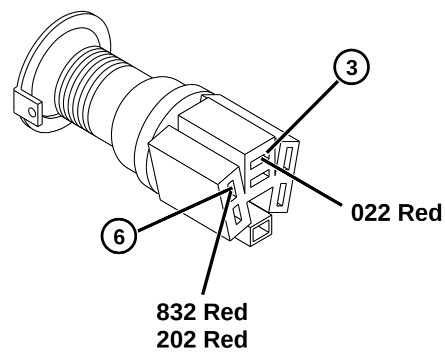
Continued on page 4-50.

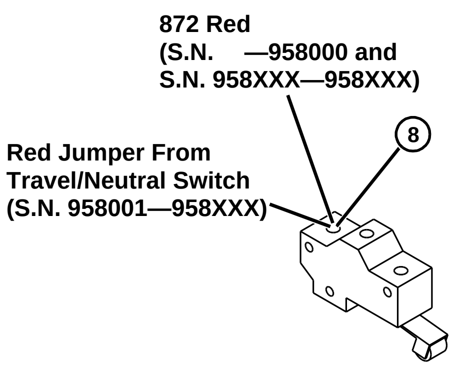




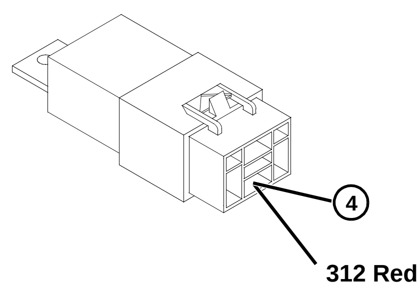


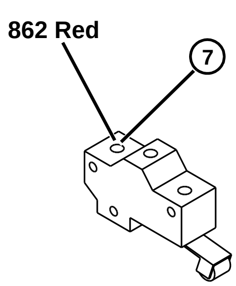
S3 Cutting Unit Lower Switch



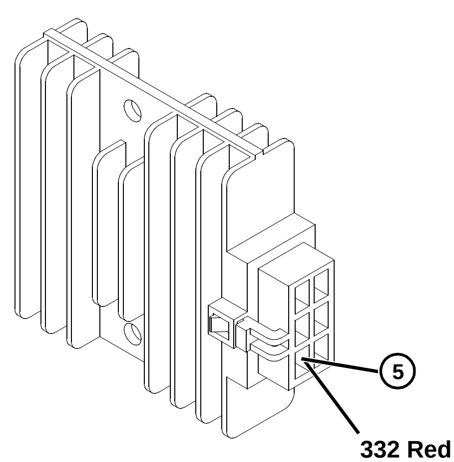


S2 Mow/Transport Switch





S5 Park Brake Switch



POWER CIRCUIT DIAGNOSIS, continued

Test Condition:

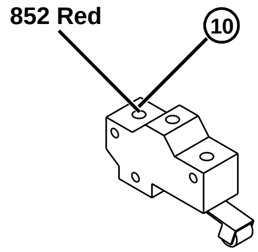
- Key switch in RUN position.

Test Location	Normal	If Not Normal
10. Cutting unit raise switch—Common terminal.	Battery voltage.	Test red wires No. 832, 852 and connections.
11. Seat switch—Common terminal.	Battery voltage.	Test red wires No. 802, 812, 892 and connections.
12. Travel/neutral switch—Common terminal.	Battery voltage.	Test red wires No. 802, 812, 882 and connections.
13. Hourmeter—Positive (+) terminal.	Battery voltage.	Test red wire No. 202 and connections.
14. Voltage regulator/rectifier.	Battery voltage.	Test red wires No. 342, 812 and connections.
15. Controller module—Terminal D of six pin female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 812, 802 and connections.
Controller module—Terminal D of six pin female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/black wire No. 410, red wires No. 812, 802, and connections.
16. Warning indicator module—Terminal 3 (S.N. —958XXX).	Battery voltage.	Test red wires No. 222, 202 and connections.
Warning indicator module—Terminal 3 (S.N. 958XXX—).	Battery voltage.	Test red wires No. 222, 832 and connections.

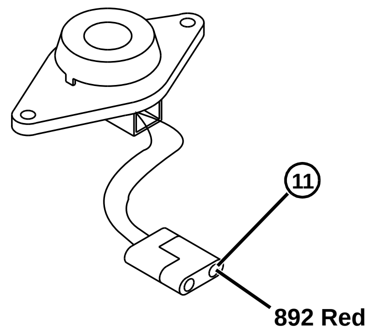
Test Condition:

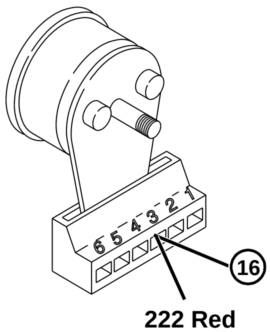
- Key switch in START position.

Test Location	Normal	If Not Normal
17. Controller—Terminal E of six pin female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test brown wire No. 801 and connections.
Controller—Terminal E of six pin female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/black wire No. 420, brown wire No. 801, and connections.

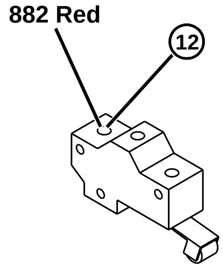


S4 Cutting Unit Raise Switch

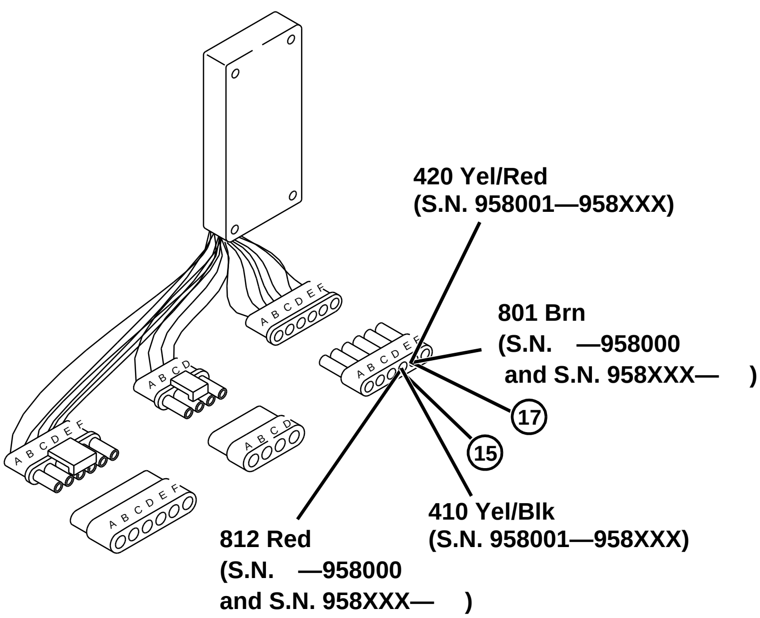


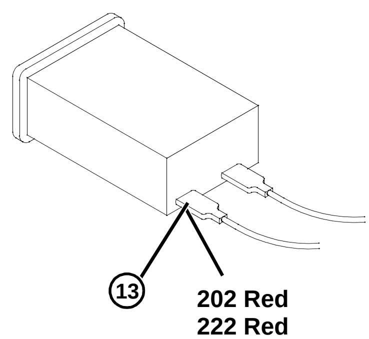


812 Red

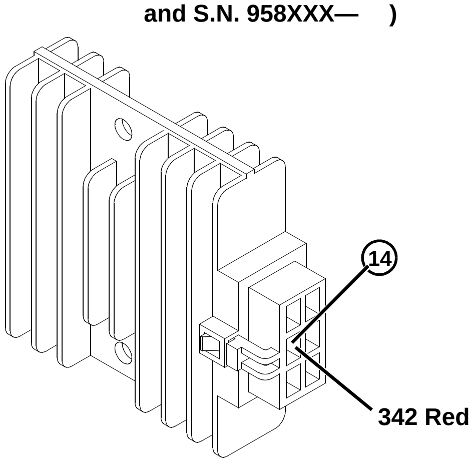


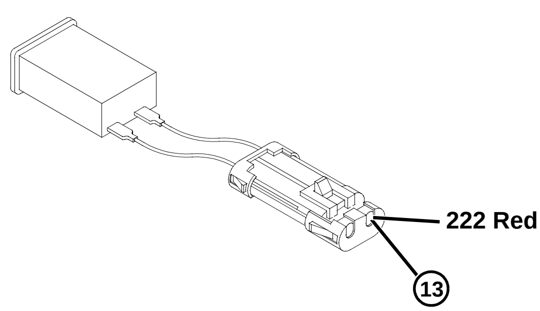
S7 Travel/Neutral Switch





P1 Hourmeter
(S.N. — 958XXX)





P1 Hourmeter
(S.N. 958XXX—)

INTERLOCK SWITCH SYSTEM OPERATION—START

Function:

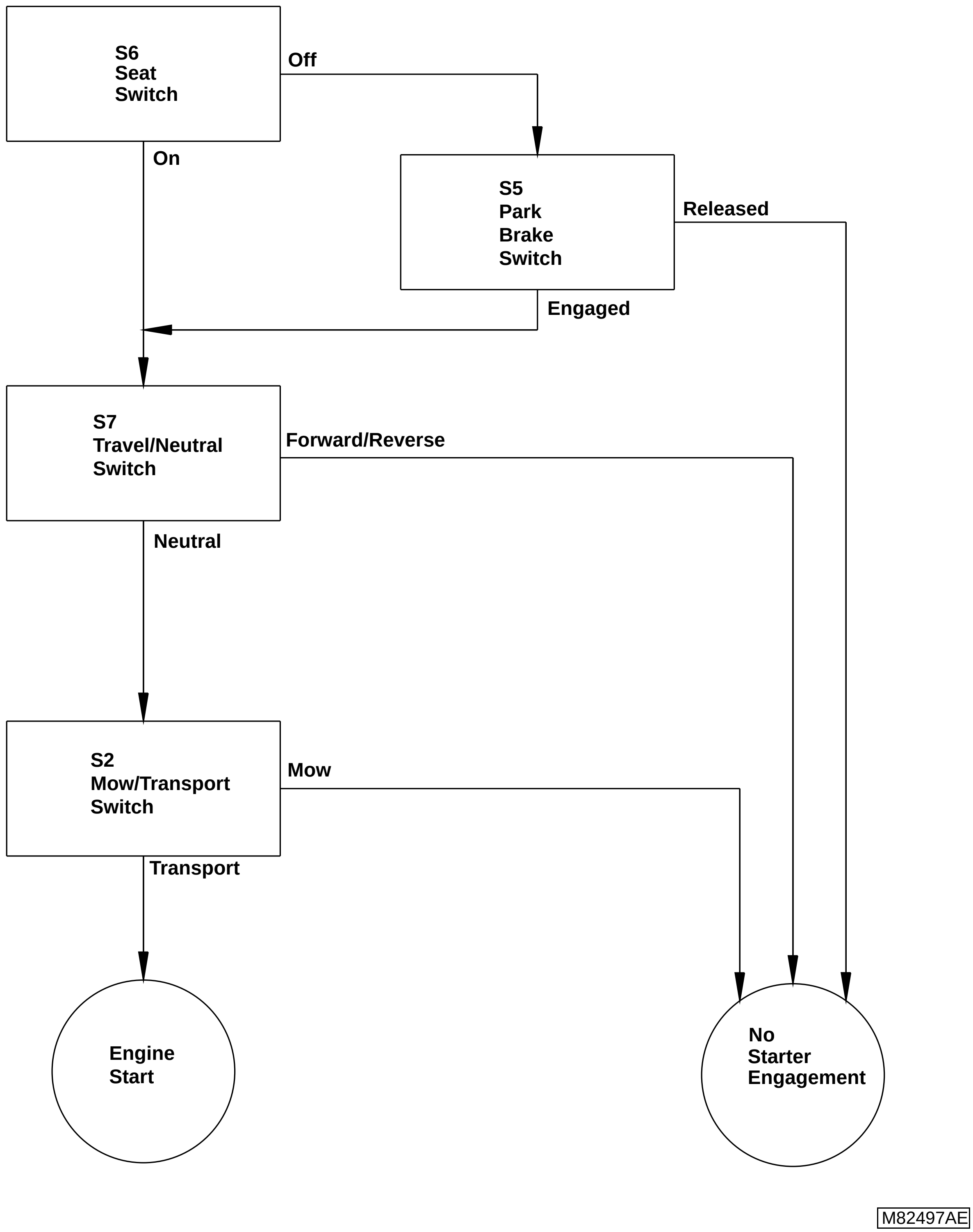
To prevent the mower from being started in an unsafe manner.

Operating Conditions:

- Operator on seat or park brake LOCKED.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in TRANSPORT position.

Theory of Operation:

As the key switch is moved to the START position, battery voltage is applied to the controller module. At this time the controller module checks for signals from the interlock system switches to indicate if the mower can be started safely. If any switch is not in the indicated position, the controller module will prevent the engine from being started.


S6
Seat
Switch
Off
On
S5
Park
Brake
Switch
Released
Engaged
S7
Travel/Neutral
Switch
Forward/Reverse
Neutral
S2
Mow/Transport
Switch
Mow
Transport
Engine
Start
No
Starter
Engagement
M82497AE

INTERLOCK SWITCH SYSTEM OPERATION—RUN

Function:

To stop the engine in the event the operator exits the seat.

Operating Conditions:

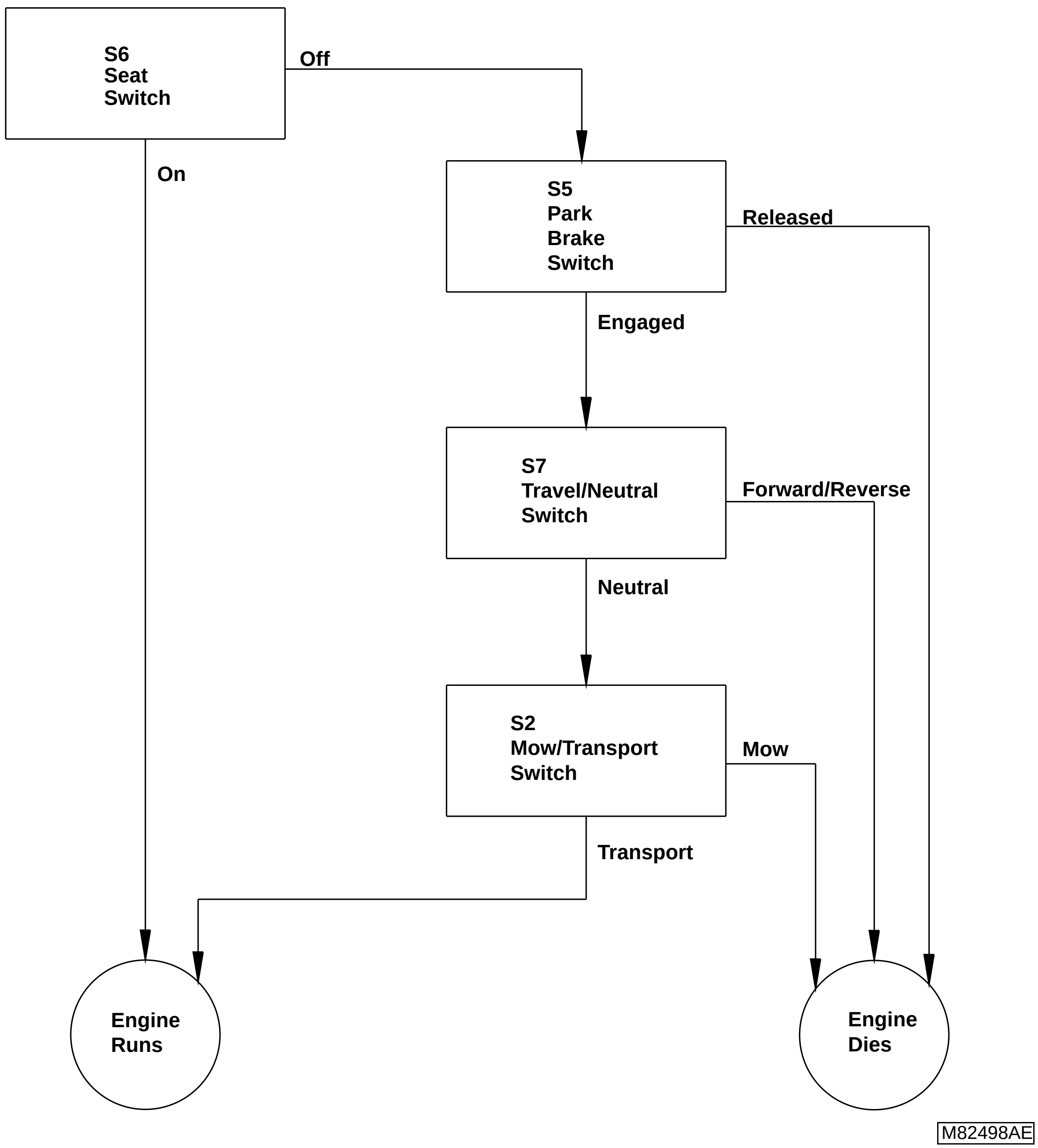
- Operator on seat.
- Park brake RELEASED.
- Either forward or reverse travel pedal PRESSED.
- Mow/transport lever in MOW or TRANSPORT position.

Theory of Operation:

While the mower is in operation, if the operator exits the seat, the interlock system is designed to automatically stop the engine. This prevents the operator from making contact with moving parts or accidental movement of the mower while unattended.

If it is desired to allow the engine to remain running while the operator is not in the seat the following conditions must be met:

- Park brake must be LOCKED.
- Travel pedals in NEUTRAL position.
- Mow/transport lever in TRANSPORT position.


S6
Seat
Switch
Off
On
S5
Park
Brake
Switch
Released
Engaged
S7
Travel/Neutral
Switch
Forward/Reverse
Neutral
S2
Mow/Transport
Switch
Mow
Transport
Engine
Runs
Engine
Dies
M82498AE

INTERLOCK SWITCH SYSTEM OPERATION—BACKLAP

Function:

To allow the cutting units to be driven when the operator is not in the seat. This is necessary to perform the backlapping procedure. This becomes necessary, as the seat platform must be raised to gain access to the Mow/Backlapping valve adjustment knob.

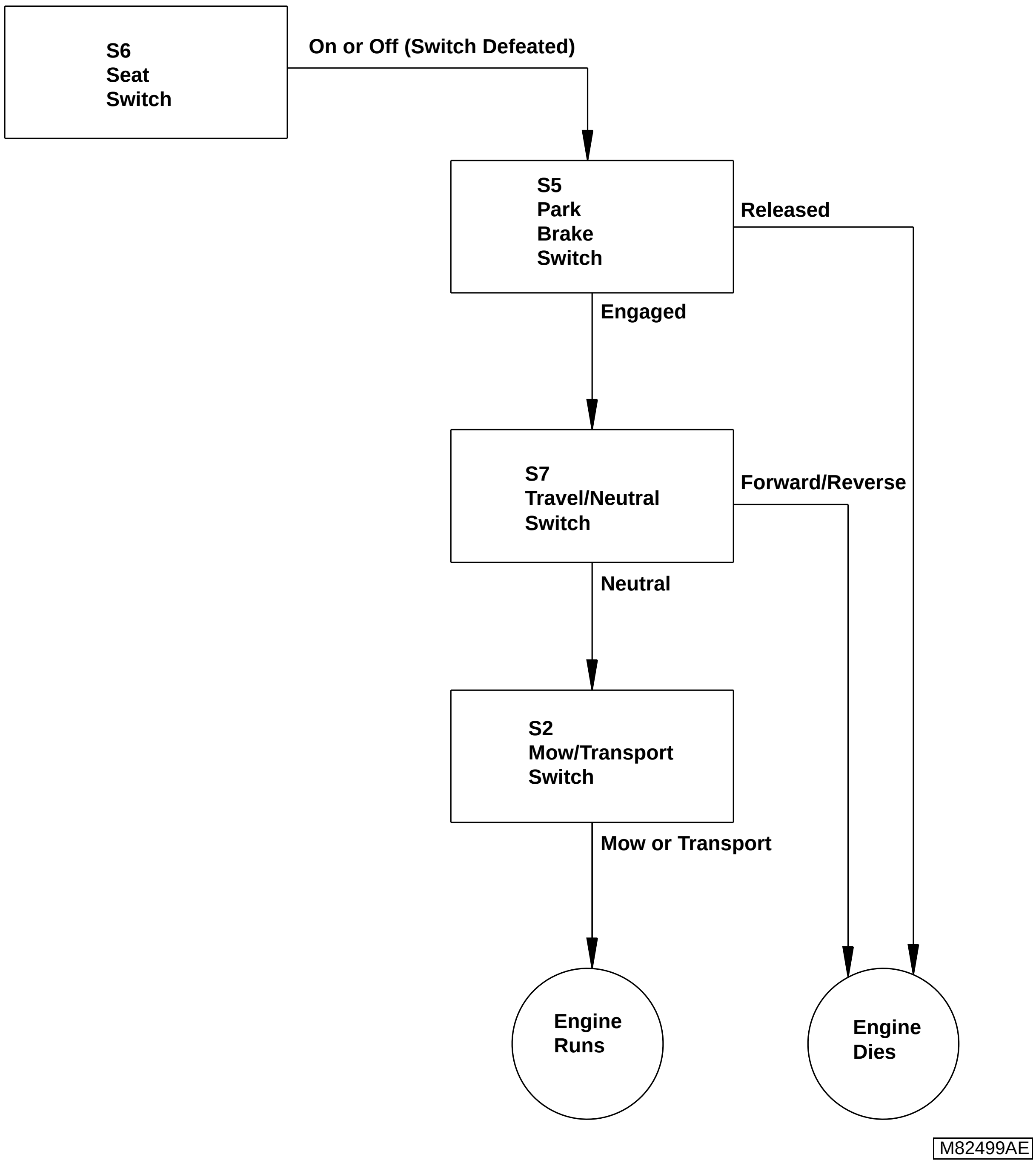
Operating Conditions:

- Travel pedals in NEUTRAL.
- Park brake LOCKED.
- Backlapping switch in BACKLAP position.

Theory of Operation:

With the backlapping switch in the BACKLAP position the seat and mow/transport switches are defeated, allowing the engine to be started with the operator on or off the seat and the mow/transport switch in either the mow or transport position.

This allows the seat platform to be raised to gain access to the mow/backlap valve adjustment knob.


S6
Seat
Switch
On or Off (Switch Defeated)
S5
Park
Brake
Switch
Released
Engaged
S7
Travel/Neutral
Switch
Forward/Reverse
Neutral
S2
Mow/Transport
Switch
Mow or Transport
Engine
Runs
Engine
Dies
M82499AE

CRANKING CIRCUIT OPERATION (S.N. —958000 and S.N. 958XXX—)

Function:

To energize the starter solenoid and engage the starter motor.

Operating Conditions:

To crank the engine, the following conditions must be met:

- Key switch in the START position.
- Travel pedals in NEUTRAL position (travel/neutral switch in NEUTRAL position).
- Mow/transport switch in TRANSPORT position.
- Operator on seat or park brake LOCKED.

Theory of Operation:

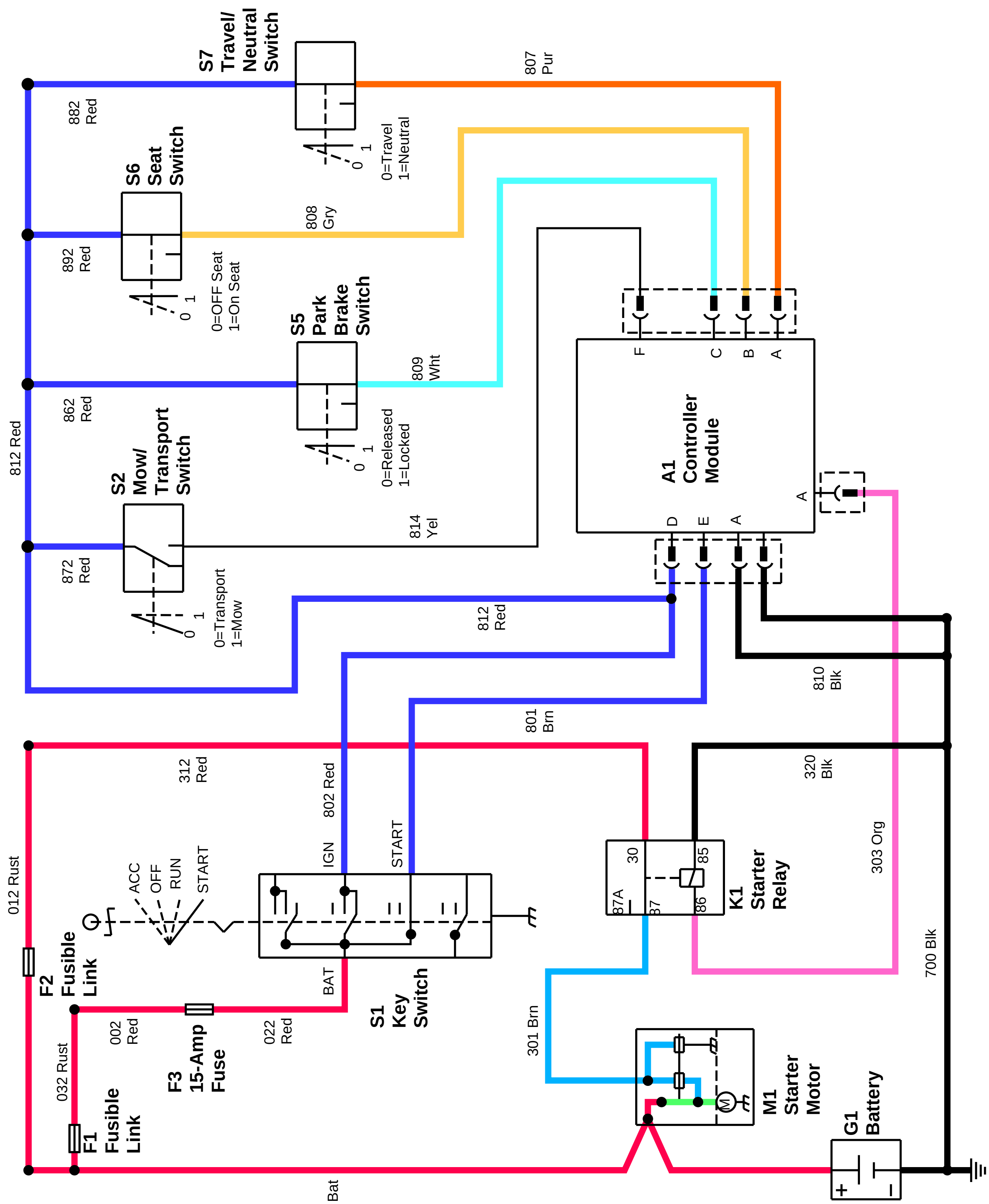
The power circuit provides current to the key switch and protects the cranking circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, key switch (S1), current is also supplied to fusible link (F2) and to terminal 30 of the starter relay (K1) (rust wire No. 012 and red wire No. 312).

With the key switch in the START position, current is supplied to the controller module (brown wire No. 801 and red wire No. 812), mow/transport switch (red wires No. 812 and 872), park brake switch (red wires No. 812 and 862), seat switch (red wires No. 812 and 892) and travel/neutral switch (red wires No. 812 and 882).

With the interlock switches in the correct position, the controller module engages the starter relay allowing current to flow through the relay to the starter (brown wire No. 301), energizing the starter solenoid, suppling current is supplied to the starter motor (M1).

The ground circuit provides a path to ground for the interlock circuit, controller module, and starter relay coil, completing the circuit, allowing the starter to operate.

As the key switch is moved to the RUN position, power supply to the starter and starter relay is broken, turning off the starter.



POWER CIRCUIT
PARK BRAKE CIRCUIT
SEAT SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
STARTER RELAY CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
STARTER POWER CIRCUIT
GROUND CIRCUIT

MC83640

CRANKING CIRCUIT OPERATION (S.N. 958001—958XXX)

Function:

To energize the starter solenoid and engage the starter motor.

Operating Conditions:

To crank the engine, the following conditions must be met:

- Key switch in the START position.
- Travel pedals in NEUTRAL position (travel/neutral switch in NEUTRAL position).
- Mow/transport switch in TRANSPORT position.
- Operator on seat or park brake LOCKED.

Theory of Operation:

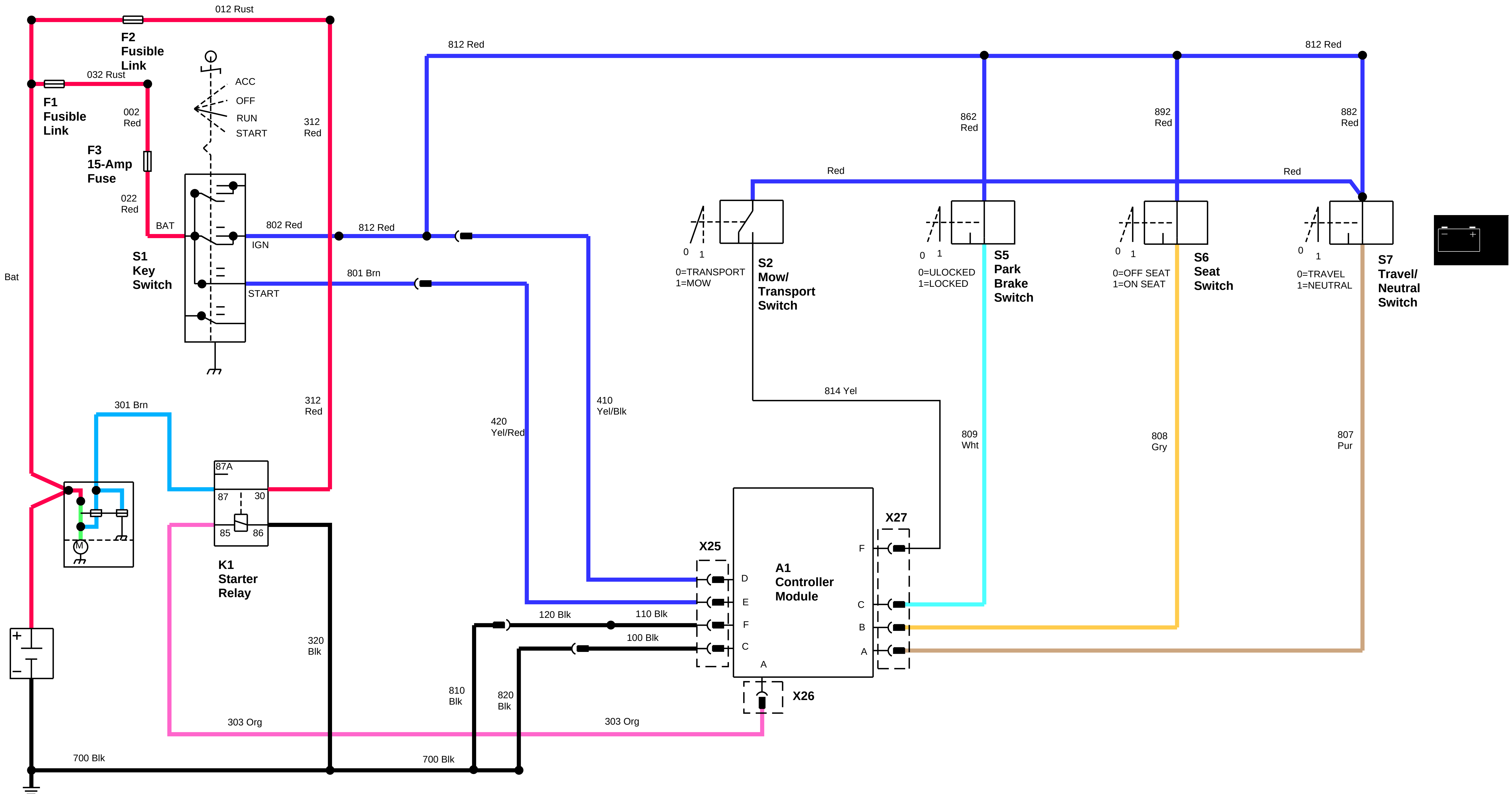
The power circuit provides current to the key switch and protects the cranking circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link, key switch (S1), current is also supplied to fusible link (F2) and to terminal 30 of the starter relay (K1) (rust wire No. 012 and red wire No. 312).

With the key switch in the START position, current is supplied to the controller module (brown wire No. 801 and yellow/red wire No. 420) and (red wires No. 802 and 812 and yellow/black wire No. 410), travel/neutral switch (red wires No. 812 and 882), mow/transport switch (red jumper wire from travel/neutral switch), park brake switch (red wires No. 812 and 862) and seat switch (red wires No. 812 and 892).

With the interlock switches in the correct position, the controller module engages the starter relay allowing current to flow through the relay to the starter (brown wire No. 301), energizing the starter solenoid, suppling current is supplied to the starter motor (M1).

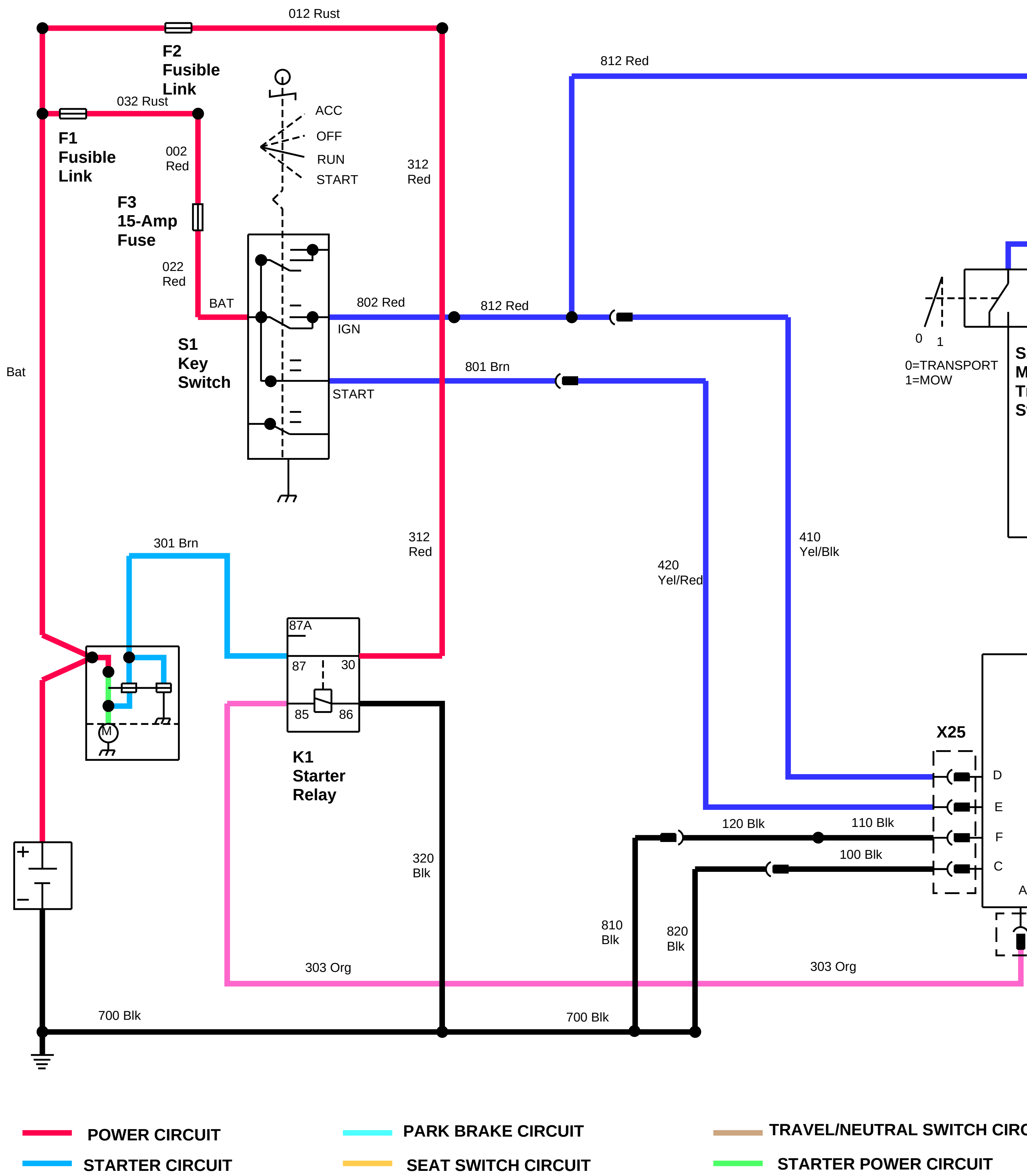
The ground circuit provides a path to ground for the interlock circuit, controller module, and starter relay coil, completing the circuit, allowing the starter to operate.

As the key switch is moved to the RUN position, power supply to the starter and starter relay is broken, turning off the starter.

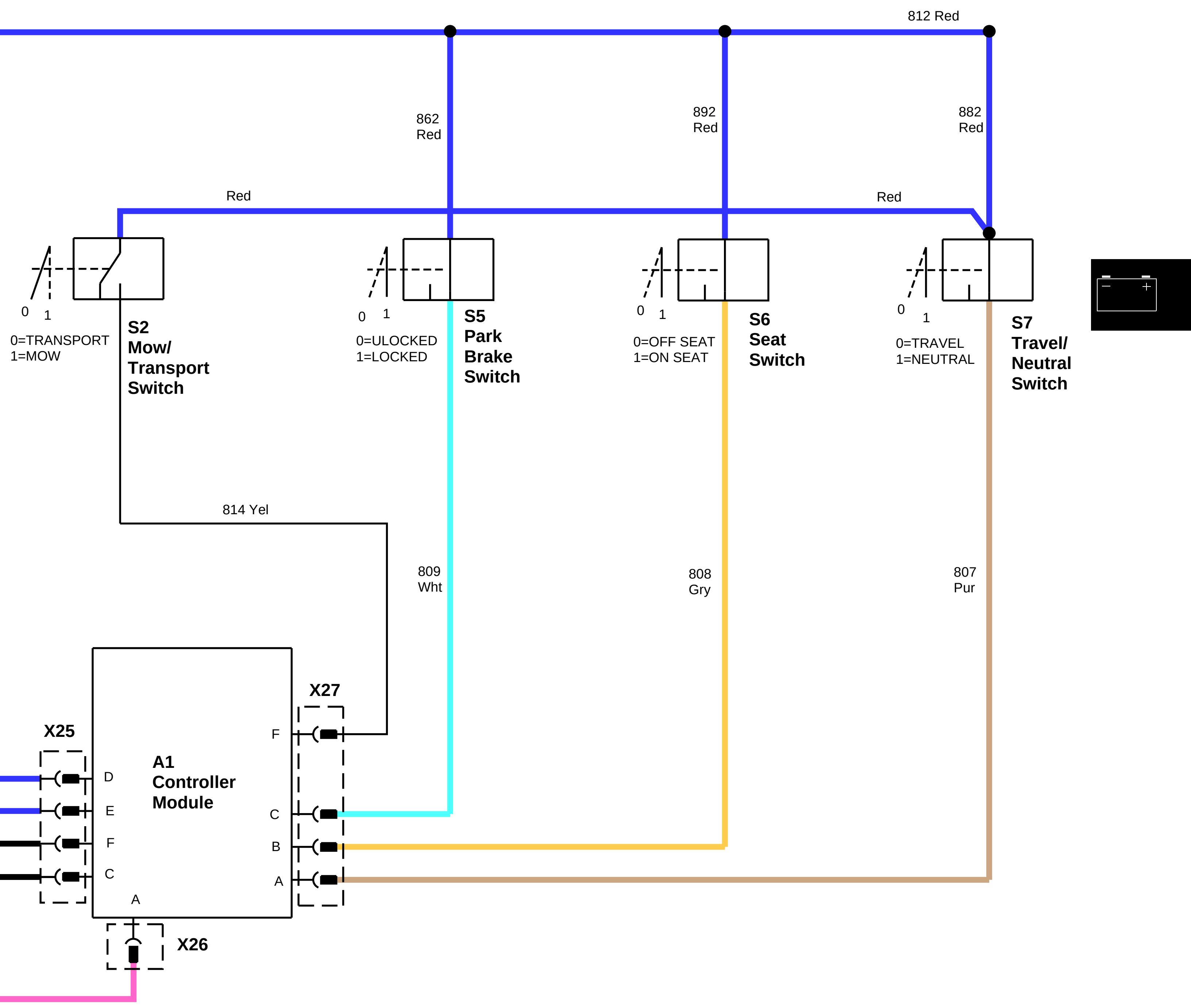


POWER CIRCUIT
STARTER CIRCUIT
PARK BRAKE CIRCUIT
SEAT SWITCH CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
STARTER POWER CIRCUIT
STARTER RELAY CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT

M83718



012 Rust
F2 Fusible Link
032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
BAT
S1 Key Switch
ACC
OFF
RUN
START
312 Red
812 Red
802 Red
812 Red
IGN
801 Brn
START
Bat
0 1
0=TRANSPORT
1=MOW
301 Brn
312 Red
420 Yel/Red
410 Yel/Blk
87A
87
30
85
86
K1 Starter Relay
X25
D
E
F
C
A
120 Blk
110 Blk
100 Blk
320 Blk
810 Blk
820 Blk
303 Org
303 Org
700 Blk
700 Blk
M
POWER CIRCUIT
STARTER CIRCUIT
PARK BRAKE CIRCUIT
SEAT SWITCH CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRC
STARTER POWER CIRCUIT



AL SWITCH CIRCUIT

ER CIRCUIT

STARTER RELAY CIRCUIT

INTERLOCK SWITCH POWER CIRCUIT

GROUND CIRCUIT

M83718

CRANKING CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position.
- Travel pedals in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.
- Park brake LOCKED or operator on seat.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal	Battery voltage.	Test rust wire No. 032, red wire(s) No. 022, 002 and connections. Test fusible link (F1) and 15 amp fuse (F3).
4. Starter relay—Terminal 30	Battery voltage.	Test red wire no. 312, and rust wire No. 012 and connections. Test fusible link (F2).

Test Conditions:

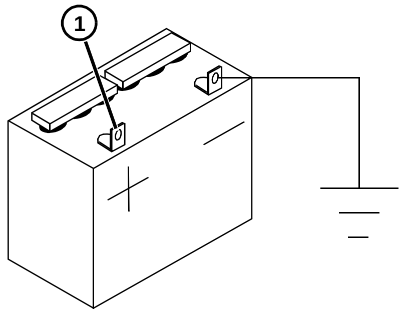
CAUTION

Disconnect and ground spark plug high tension leads to prevent engine from starting during remaining tests.

- Hold key switch in START position.
- Travel pedals in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.
- Park brake LOCKED.

Test Location	Normal	If Not Normal
5. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
6. Key switch—START terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
7. Controller module—Terminal E of six terminal female connector (S.N. — 958000 and S.N. 958XXX—).	Battery voltage.	Test brown wire No. 801 and connections.
Controller module—Terminal E of six terminal female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/black wire No. 420, brown wire No. 801 and connections.

Continued on page 4-64.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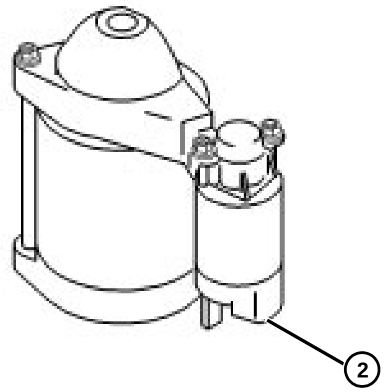
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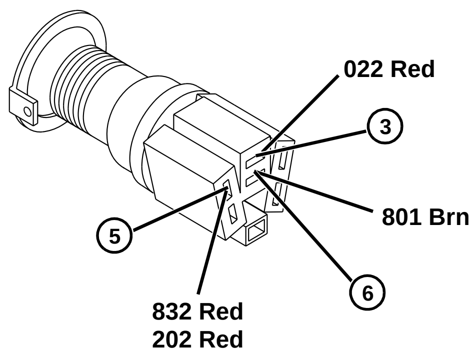
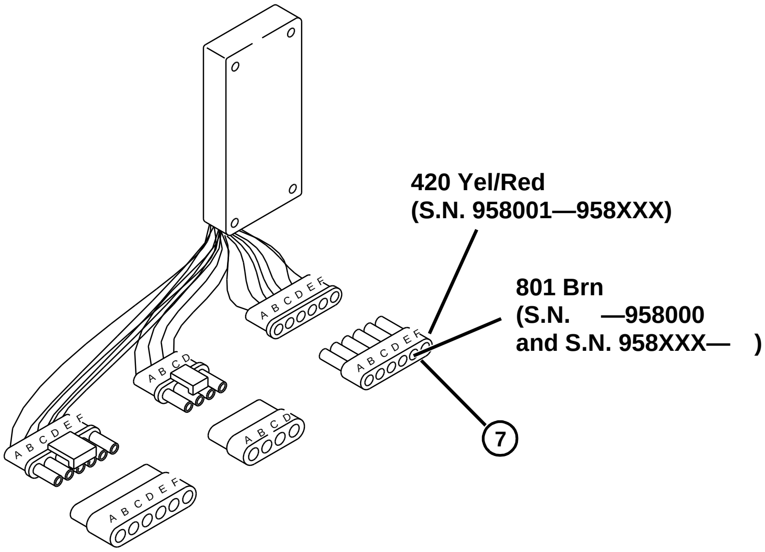
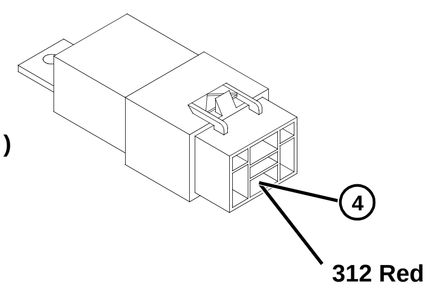

022 Red
3
801 Brn
5
6
832 Red
202 Red


420 Yel/Red
(S.N. 958001—958XXX)
801 Brn
(S.N. —958000
and S.N. 958XXX—)
7


4
312 Red

CRANKING CIRCUIT DIAGNOSIS, continued

Test Conditions:

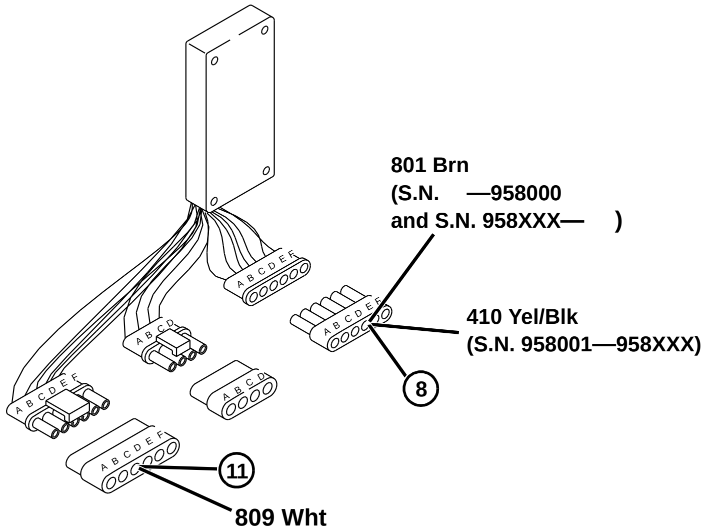
CAUTION

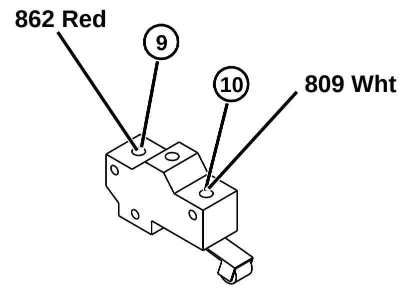
Disconnect and ground spark plug high tension leads to prevent engine from starting during remaining tests.

- Hold key switch in START position.
- Travel pedals in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.
- Park brake LOCKED.

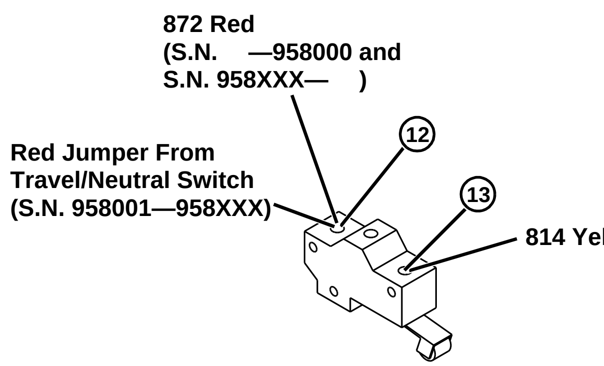
Test Location	Normal	If Not Normal
8. Controller module—Terminal D of six terminal female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 812, 802 and connections.
Controller module—Terminal D of six terminal female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/black wire No. 410, red wires No. 812, 802 and connections.
9. Park brake switch—COMMON terminal	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal.	Battery voltage.	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)
11. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
12. Mow/transport switch—COMMON terminal (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
Mow/transport switch—COMMON terminal. (S.N. 958001—958XXX)	Battery voltage.	Test red jumper from travel/neutral switch, red wires No. 802, 812, 882 and connections.
13. Mow/transport switch—NORMALLY CLOSED terminal	No voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)

Continued on page 4-66.





S5 Park Brake Switch



S2 Mow/Transport Switch

CRANKING CIRCUIT DIAGNOSIS, continued

Test Conditions:

CAUTION

Disconnect and ground spark plug high tension leads to prevent engine from starting during remaining tests.

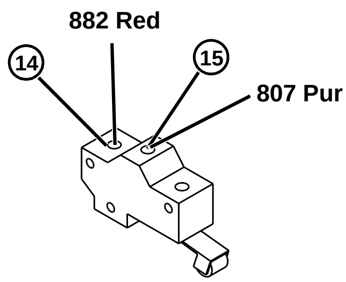
- Hold key switch in START position.
- Travel pedals in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.
- Park brake LOCKED.

14. Travel/neutral switch—COMMON terminal	Battery voltage.	Test red wires No. 802, 812, 882 and connections.
15. Travel/neutral switch—NORMALLY OPEN terminal	Battery voltage.	Test and/or adjust travel/neutral switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)
16. Controller module—Terminal A of six terminal male connector	Battery voltage.	Test purple wire No. 807 and connections.

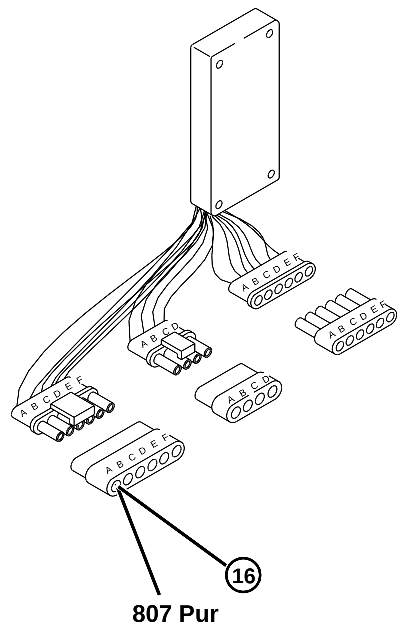
NOTE: With park brake engaged, the seat switch does not have to be activated for operation. Seat switch should however be tested.

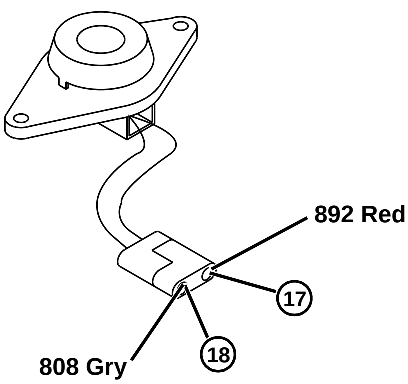
Test Location	Normal	If Not Normal
17. Seat switch	Battery voltage.	Test red wires No. 802, 812, 892 and connections.
18. Seat switch (seat occupied)	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)

Continued on page 4-68.



S7 Travel/Neutral Switch





CRANKING CIRCUIT DIAGNOSIS, continued

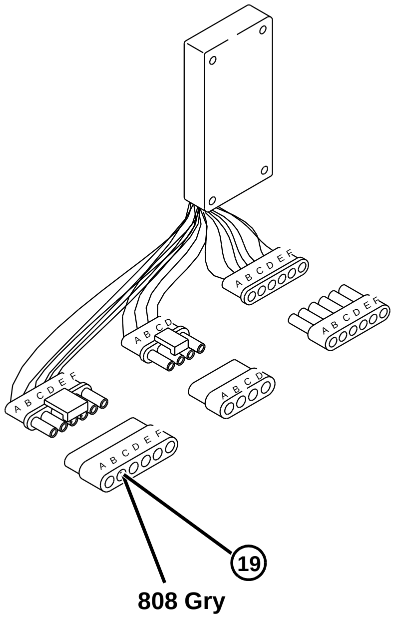
Test Conditions:

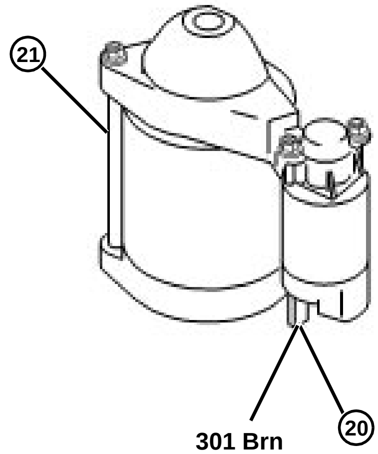
CAUTION

Disconnect and ground spark plug high tension leads to prevent engine from starting during remaining tests.

- Spark plug leads disconnected and grounded.
- Key switch in START position.

Test/Check Point	Normal	If Not Normal
19. Controller module—Terminal B of six terminal male connector	Battery voltage.	Test gray wire No. 808 and connections.
20. Starter solenoid—Terminal S.	Battery voltage.	Test brown wire No. 301.
21. Starter motor.	Greater than 0—less than 0.2 volts.	Greater than 0.2 volts—check starter motor and engine ground circuit. 0 volts—test starter solenoid and motor. (See STARTER SOLENOID TEST on page 4-215 and STARTER—Inspection/Test on page 3-76.)


19
808 Gry


21
20
301 Brn

IGNITION CIRCUIT OPERATION (S.N. —958000 and S.N. 958XXX—)

Function:

At the correct time, supplies a spark that ignites the fuel/air mixture in the engine.

Operating Conditions—Starting:

- Key switch in the START position.
- Operator on seat. (Seat switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

or

- Key switch in the START position.
- Park brake ENGAGED. (Brake switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

Operating Conditions—Running:

- Key switch in the RUN position.
- Operator on seat. (Seat switch CLOSED.)

or

- Key switch in the RUN position.
- Park brake ENGAGED (brake switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

System Operation:

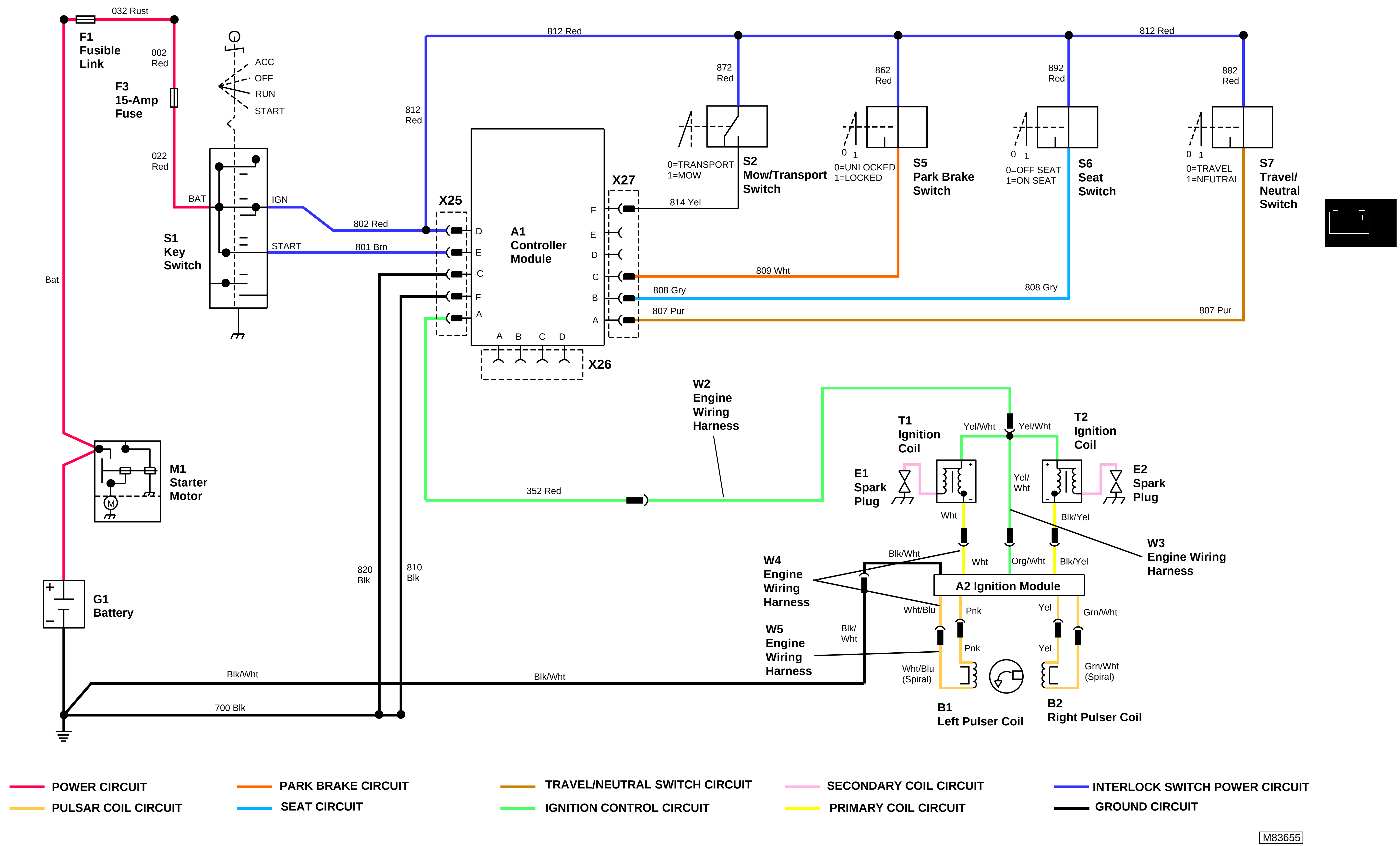
The engine is equipped with a solid state, transistorized, battery ignition system and has no moving parts. The power circuit provides current to the key switch (S1) and protects the ignition circuit with a 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (F1) and key switch. With the key switch in the START or RUN position, current flows to the 15-amp fuse (F3), controller module (A1), mow/transport switch (S2), park brake switch (S5), seat switch (S6) and travel/neutral switch (S7).

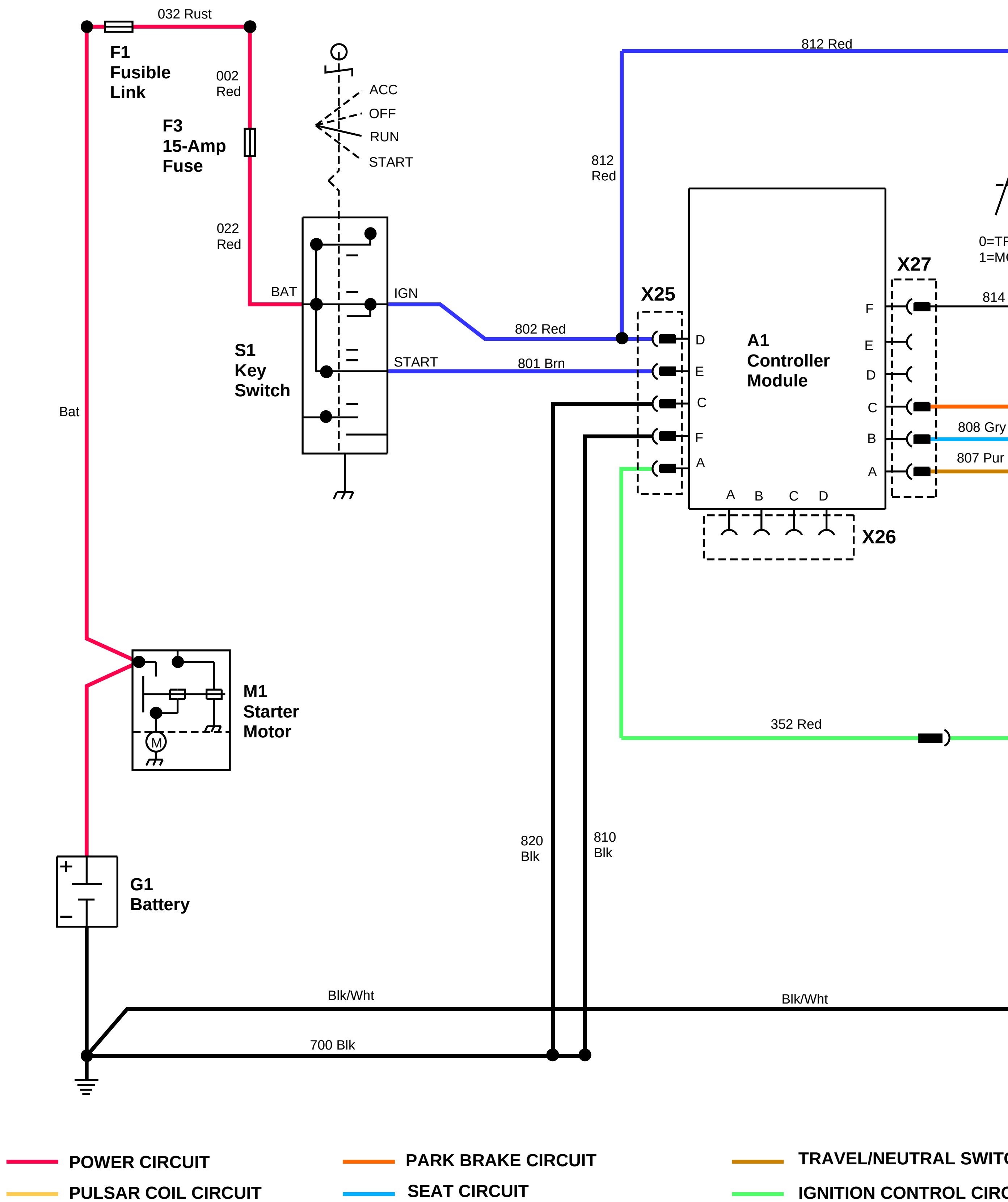
The interlock switches are used to prevent the engine from running whenever the operator leaves the seat while the transmission is in engaged and/or reel drive system is engaged. (See INTERLOCK SWITCH SYSTEM OPERATION—START on page 4-52 or INTERLOCK SWITCH SYSTEM OPERATION—RUN on page 4-54).

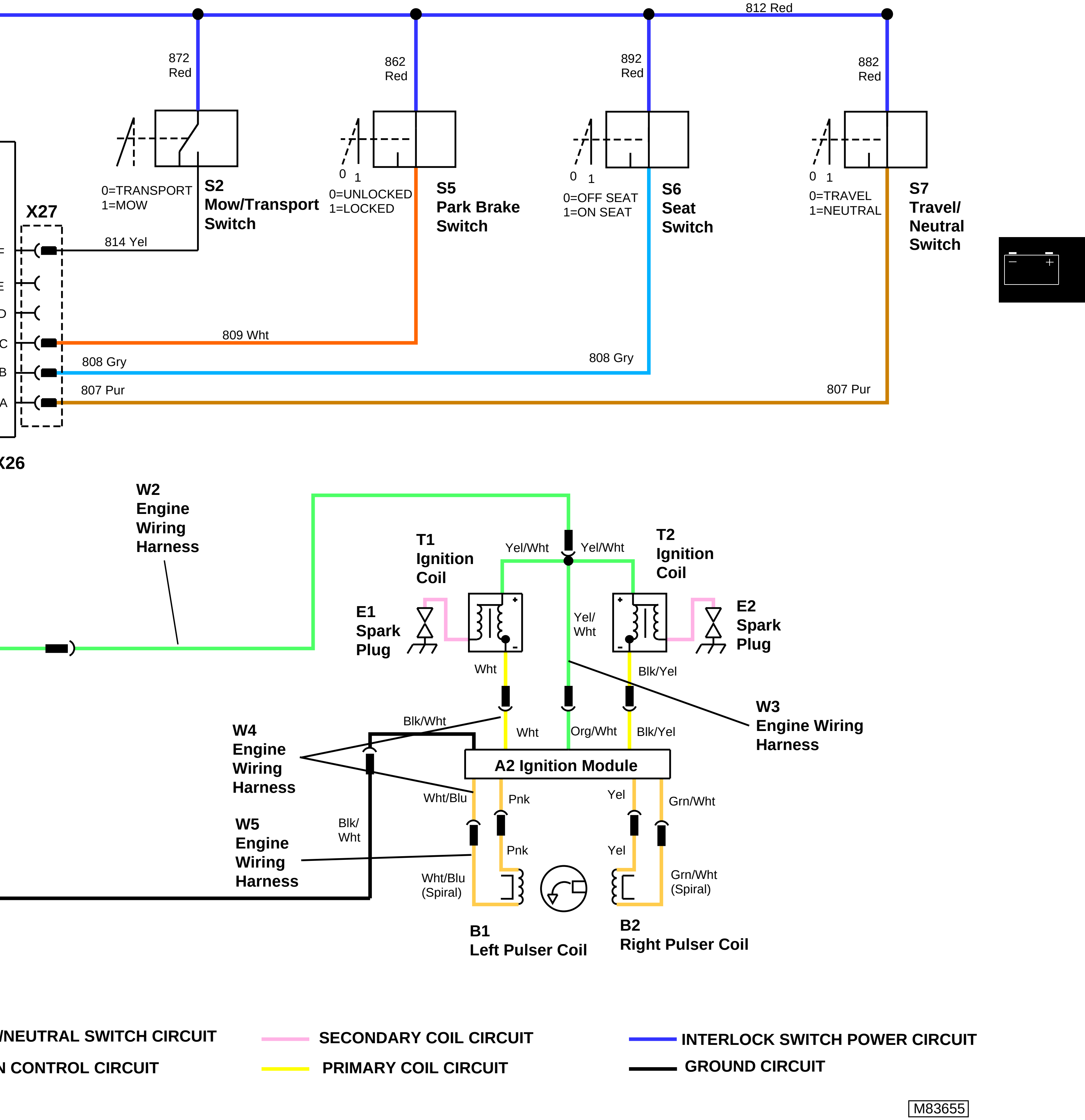
With the interlock switches in the correct position, the controller module allows current to flow to the ignition coils (T1 and T2) and the ignition module (A2) energizing the system. The triggering signals are generated as an extended segment on the outside edge of the flywheel moves past each of the pulser coils (B1 and B2). These triggering signals are transferred to the ignition module. The ignition module acts as an electronic switch controlling the timing of the flow of current (Ignition Circuit) to the primary windings of the ignition coils.

The ignition coils consist of iron cores with 2 sets of wires wound around them. The primary windings are connected to the ignition module. The secondary windings are connected to the spark plugs (E1 and E2) through high tension leads. There are many more windings in the secondary windings of the coils than in 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 a signal from the pulser coil is received at the ignition module, current flow to the primary winding is stopped. As the voltage in the primary winding drops from battery voltage to 0 volts, a strong magnetic field is created around the wires of both the primary and secondary windings. This 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 to the primary windings due to the greater number of windings. The high voltage of the secondary windings creates a spark at the spark plugs.


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
ACC
OFF
RUN
START
BAT
IGN
START
S1
Key
Switch
Bat
802 Red
801 Brn
812
Red
812 Red
872
Red
862
Red
892
Red
882
Red
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
X25
X27
A1
Controller
Module
814 Yel
809 Wht
808 Gry
807 Pur
X26
W2
Engine
Wiring
Harness
352 Red
T1
Ignition
Coil
T2
Ignition
Coil
Yel/Wht
E1
Spark
Plug
E2
Spark
Plug
Wht
Blk/Yel
Org/Wht
Blk/Wht
W3
Engine Wiring
Harness
W4
Engine
Wiring
Harness
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Right Pulser Coil
M1
Starter
Motor
G1
Battery
820
Blk
810
Blk
700 Blk
POWER CIRCUIT
PULSAR COIL CIRCUIT
PARK BRAKE CIRCUIT
SEAT CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
IGNITION CONTROL CIRCUIT
SECONDARY COIL CIRCUIT
PRIMARY COIL CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83655


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
ACC
OFF
RUN
START
BAT
IGN
START
S1
Key
Switch
812 Red
812
Red
802 Red
801 Brn
X25
D
E
C
F
A
A1
Controller
Module
X27
F
E
D
C
B
A
0=TR
1=MO
814
808 Gry
807 Pur
A B C D
X26
Bat
M1
Starter
Motor
352 Red
820
Blk
810
Blk
G1
Battery
Blk/Wht
Blk/Wht
700 Blk
POWER CIRCUIT
PULSAR COIL CIRCUIT
PARK BRAKE CIRCUIT
SEAT CIRCUIT
TRAVEL/NEUTRAL SWITC
IGNITION CONTROL CIRC


812 Red
872 Red
862 Red
892 Red
882 Red
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
X27
814 Yel
F
E
D
C
B
A
809 Wht
808 Gry
808 Gry
807 Pur
807 Pur
X26
W2
Engine
Wiring
Harness
T1
Ignition
Coil
Yel/Wht
Yel/Wht
T2
Ignition
Coil
E1
Spark
Plug
Yel/
Wht
E2
Spark
Plug
Wht
Blk/Yel
W3
Engine Wiring
Harness
Blk/Wht
W4
Engine
Wiring
Harness
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Blk/
Wht
Pnk
Yel
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Right Pulser Coil
/NEUTRAL SWITCH CIRCUIT
N CONTROL CIRCUIT
SECONDARY COIL CIRCUIT
PRIMARY COIL CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83655

IGNITION CIRCUIT OPERATION (S.N. 958001—958XXX)

Function:

At the correct time, supplies a spark that ignites the fuel/air mixture in the engine.

Operating Conditions—Starting:

- Key switch in the START position.
- Operator on seat. (Seat switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

or

- Key switch in the START position.
- Park brake ENGAGED. (Brake switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

Operating Conditions—Running:

- Key switch in the RUN position.
- Operator on seat. (Seat switch CLOSED.)

or

- Key switch in the RUN position.
- Park brake ENGAGED (brake switch CLOSED.)
- Travel/neutral switch in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.

System Operation:

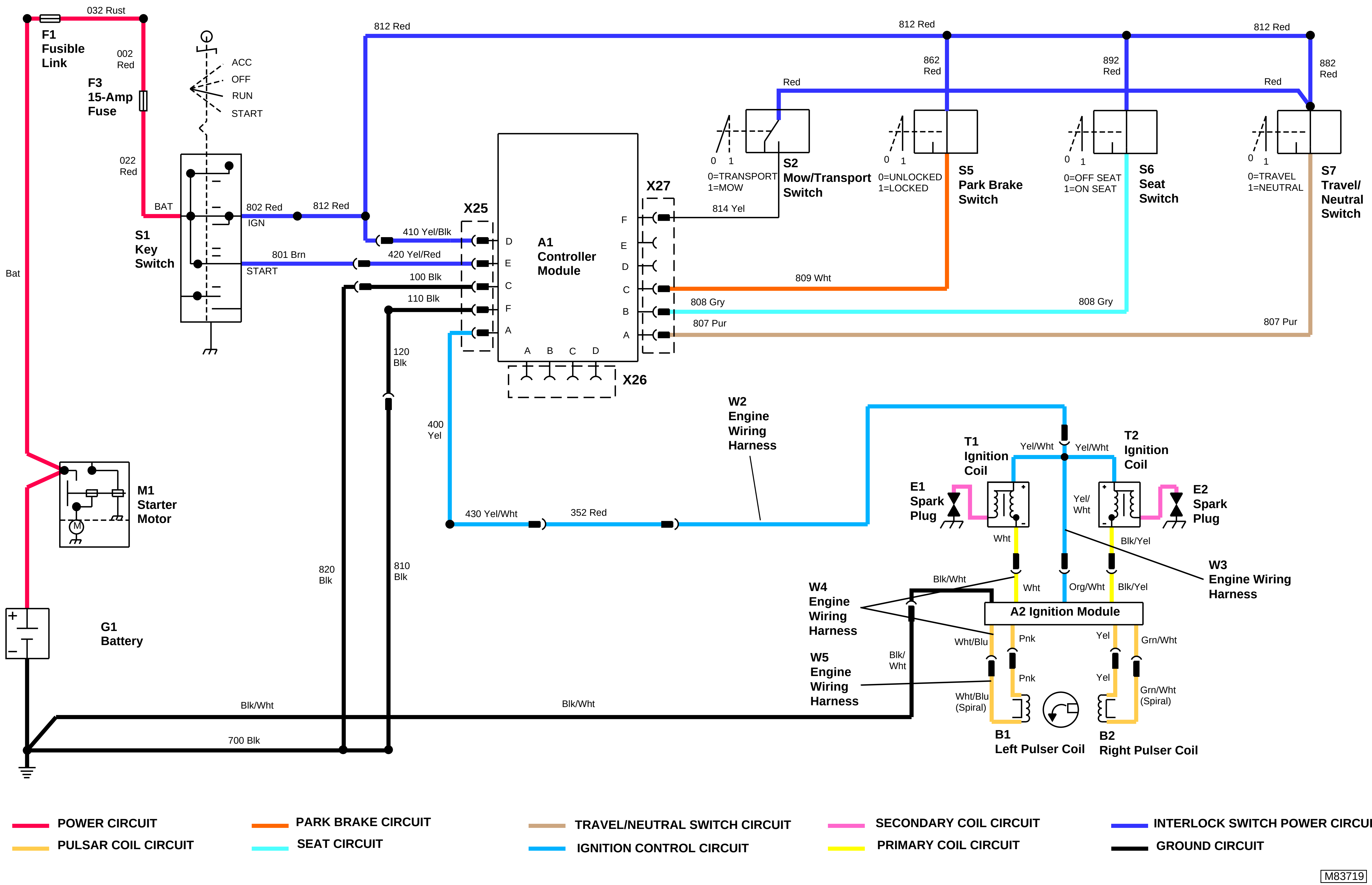
The engine is equipped with a solid state, transistorized, battery ignition system and has no moving parts. The power circuit provides current to the key switch (S1) and protects the ignition circuit with a 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link (F1) and key switch. With the key switch in the START or RUN position, current flows to the 15-amp fuse (F3), controller module (A1) (yellow/black wire No. 410, red wires No. 812 and 802) and (yellow/red wire No. 420, brown wire No. 801), travel/neutral switch (S7) (red wires No. 882, 812 and 802), park brake switch (S5) (red wires No. 892, 812 and 802), seat switch (S6) (red wires No. 892, 812 and 802) and mow/transport switch (S2) (red wires No. 882, 812 and 802 and red jumper from travel/neutral switch).

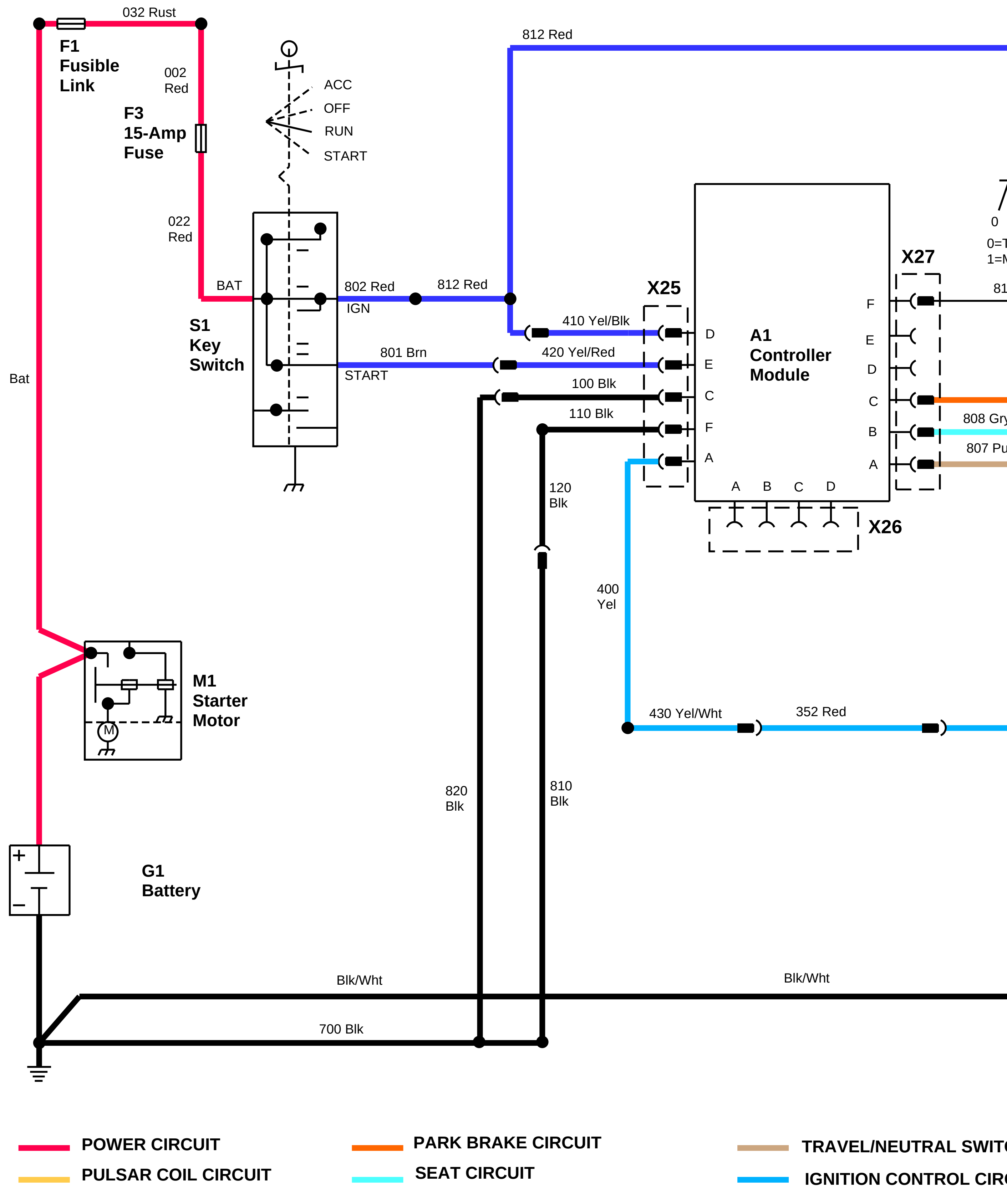
The interlock switches are used to prevent the engine from running whenever the operator leaves the seat while the transmission is in engaged and/or reel drive system is engaged. (See INTERLOCK SWITCH SYSTEM OPERATION—START on page 4-52 or INTERLOCK SWITCH SYSTEM OPERATION—RUN on page 4-54).

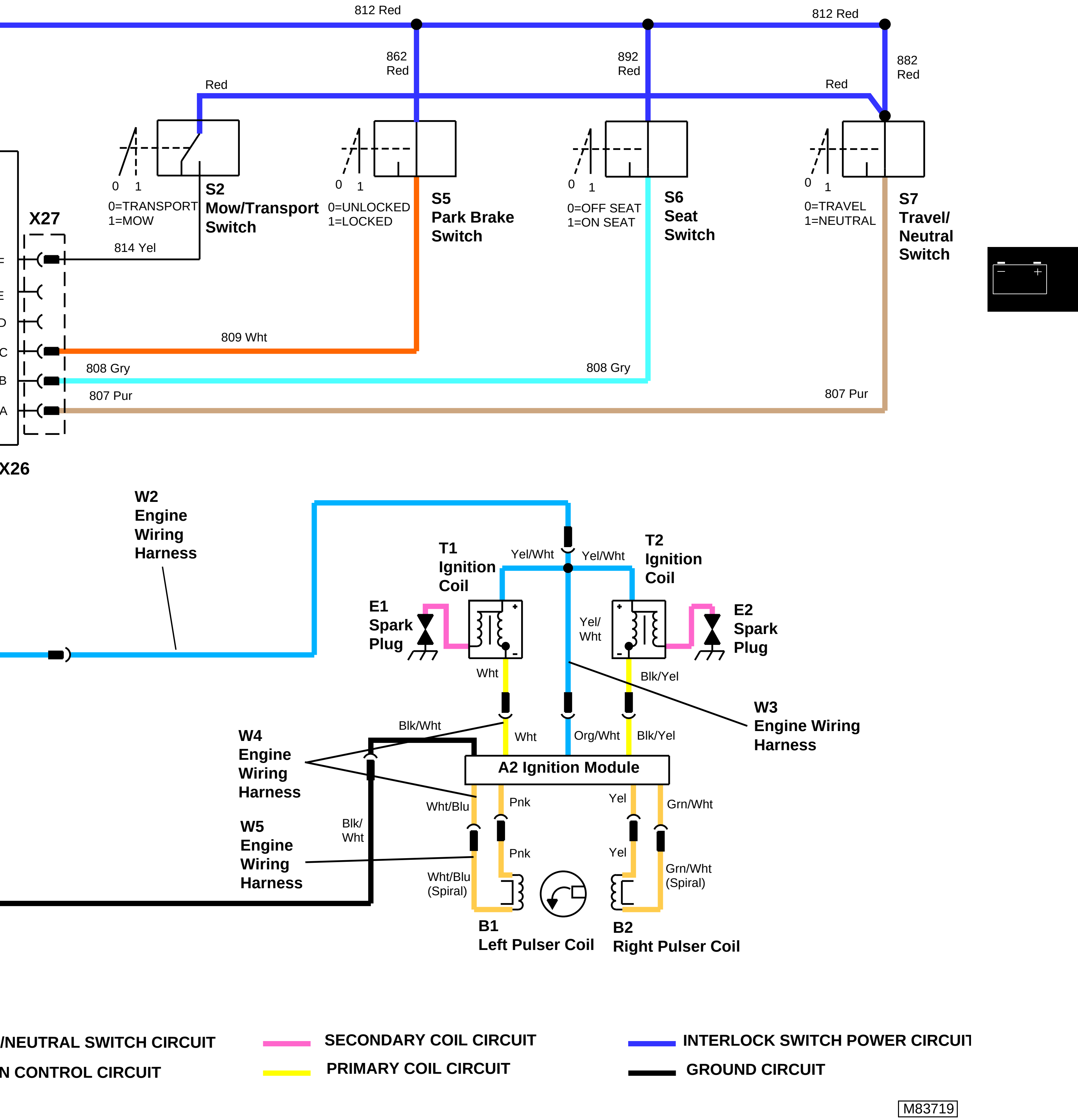
With the interlock switches in the correct position, the controller module allows current to flow to the ignition coils (T1 and T2) and the ignition module (A2) energizing the system. The triggering signals are generated as an extended segment on the outside edge of the flywheel moves past each of the pulser coils (B1 and B2). These triggering signals are transferred to the ignition module. The ignition module acts as an electronic switch controlling the timing of the flow of current (Ignition Circuit) to the primary windings of the ignition coils.

The ignition coils consist of iron cores with 2 sets of wires wound around them. The primary windings are connected to the ignition module. The secondary windings are connected to the spark plugs (E1 and E2) through high tension leads. There are many more windings in the secondary windings of the coils than in 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 a signal from the pulser coil is received at the ignition module, current flow to the primary winding is stopped. As the voltage in the primary winding drops from battery voltage to 0 volts, a strong magnetic field is created around the wires of both the primary and secondary windings. This 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 to the primary windings due to the greater number of windings. The high voltage of the secondary windings creates a spark at the spark plugs.


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
BAT
S1
Key
Switch
Bat
ACC
OFF
RUN
START
802 Red
IGN
812 Red
801 Brn
START
812 Red
812 Red
812 Red
812 Red
862
Red
892
Red
882
Red
Red
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
X25
410 Yel/Blk
420 Yel/Red
100 Blk
110 Blk
D
E
C
F
A
A1
Controller
Module
A B C D
X26
X27
F
E
D
C
B
A
814 Yel
809 Wht
808 Gry
808 Gry
807 Pur
807 Pur
120
Blk
400
Yel
820
Blk
810
Blk
430 Yel/Wht
352 Red
W2
Engine
Wiring
Harness
T1
Ignition
Coil
T2
Ignition
Coil
Yel/Wht
Yel/Wht
Yel/
Wht
E1
Spark
Plug
E2
Spark
Plug
Wht
Blk/Yel
W3
Engine Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
A2 Ignition Module
W4
Engine
Wiring
Harness
W5
Engine
Wiring
Harness
Blk/
Wht
Wht/Blu
Pnk
Yel
Grn/Wht
Pnk
Yel
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Right Pulser Coil
M1
Starter
Motor
M
G1
Battery
Blk/Wht
Blk/Wht
700 Blk
POWER CIRCUIT
PULSAR COIL CIRCUIT
PARK BRAKE CIRCUIT
SEAT CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
IGNITION CONTROL CIRCUIT
SECONDARY COIL CIRCUIT
PRIMARY COIL CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83719


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
ACC
OFF
RUN
START
812 Red
BAT
S1
Key
Switch
802 Red
IGN
812 Red
801 Brn
START
X25
410 Yel/Blk
420 Yel/Red
100 Blk
110 Blk
A1
Controller
Module
X27
X26
0
Bat
120
Blk
400
Yel
M1
Starter
Motor
430 Yel/Wht
352 Red
820
Blk
810
Blk
808 Gry
807 Pu
G1
Battery
Blk/Wht
Blk/Wht
700 Blk
POWER CIRCUIT
PARK BRAKE CIRCUIT
TRAVEL/NEUTRAL SWIT
PULSAR COIL CIRCUIT
SEAT CIRCUIT
IGNITION CONTROL CIR


812 Red
812 Red
862
Red
892
Red
882
Red
Red
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
X27
814 Yel
F
E
D
C
B
A
809 Wht
808 Gry
808 Gry
807 Pur
807 Pur
X26
W2
Engine
Wiring
Harness
T1
Ignition
Coil
Yel/Wht
Yel/Wht
T2
Ignition
Coil
E1
Spark
Plug
Yel/
Wht
E2
Spark
Plug
Wht
Blk/Yel
W3
Engine Wiring
Harness
Blk/Wht
Wht
Org/Wht
Blk/Yel
W4
Engine
Wiring
Harness
A2 Ignition Module
Wht/Blu
Pnk
Yel
Grn/Wht
W5
Engine
Wiring
Harness
Blk/
Wht
Pnk
Yel
Wht/Blu
(Spiral)
Grn/Wht
(Spiral)
B1
Left Pulser Coil
B2
Right Pulser Coil
/NEUTRAL SWITCH CIRCUIT
N CONTROL CIRCUIT
SECONDARY COIL CIRCUIT
PRIMARY COIL CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83719

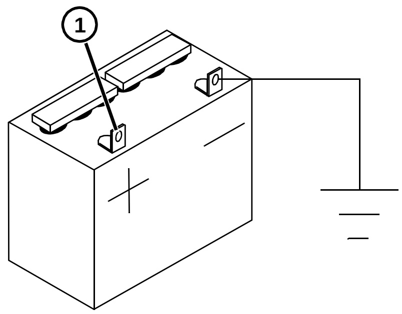
IGNITION CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position.
- Travel pedals in NEUTRAL position.
- Mow/transport switch in TRANSPORT position.
- Park brake ENGAGED or operator on seat.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal.	Battery voltage.	Test rust wire No. 032, red wire(s) No. 022, 002 and connections. Test fusible link (F1) and 15 amp fuse (F3).
4. Engine ground.	Maximum 0.1 ohms resistance.	Check battery negative (–) cable and shielded engine ground connection.
5. Controller module—Terminal C of six terminal female connector (S.N. — 958000 and S.N. 958XXX—).	Maximum 0.1 ohms resistance.	Check black wires No. 820 and 700 and connections.
Controller module—Terminal C of six terminal female connector (S.N. 958001—958XXX).	Maximum 0.1 ohms resistance.	Check black wires No. 100, 820, 700 and connections.
6. Controller module—Terminal F of six terminal female connector (S.N. — 958000 and S.N. 958XXX—).	Maximum 0.1 ohms resistance.	Check black wires No. 810, 700 and connections.
Controller module—Terminal F of six terminal female connector (S.N. 958001—958XXX).	Maximum 0.1 ohms resistance.	Check black wires No. 110, 120, 810, 700 and connections.
7. Ignition module.	Maximum 0.1 ohms resistance.	Check black/white wire and ground connection.
8. Ignition coil-resistance.	Primary—3.4—4.6 ohms. Core—infinite (open circuit).	Secondary—10.4—15.6 K ohms. Replace ignition coil (T1 or T2).

Continued on page 4-76.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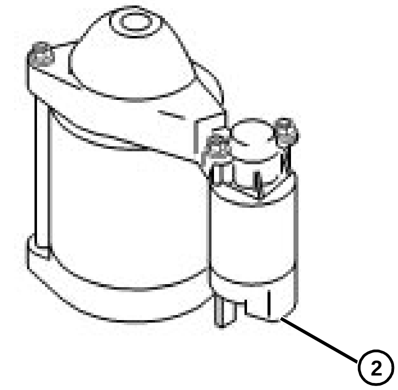
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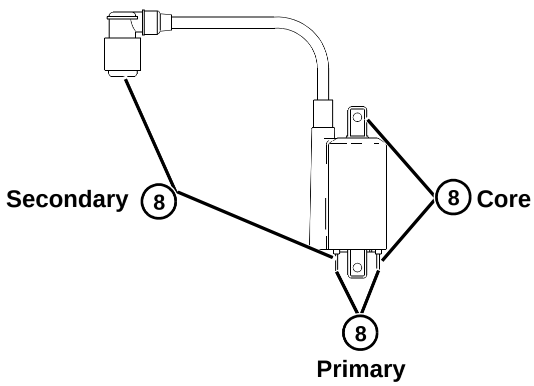
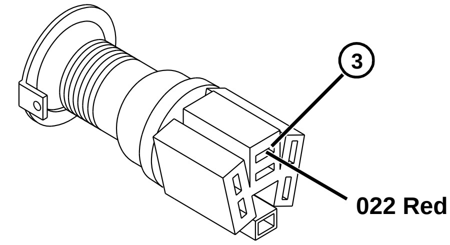
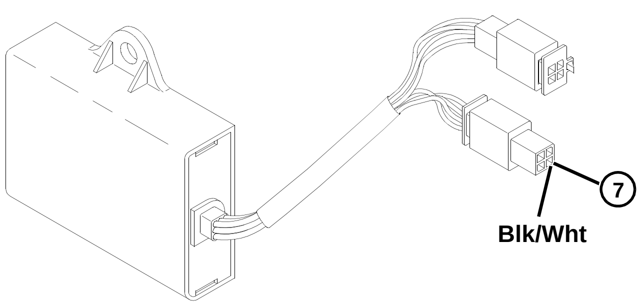
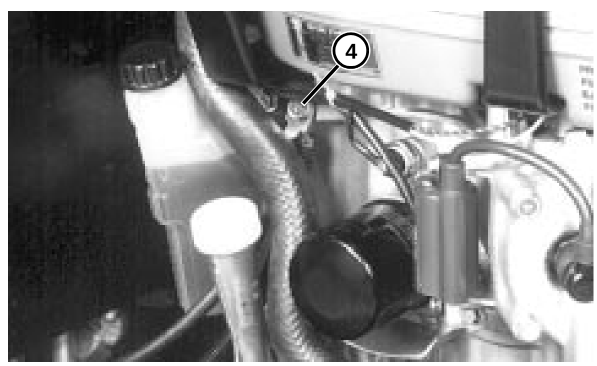

Secondary 8
8 Core
8
Primary


3
022 Red


7
Blk/Wht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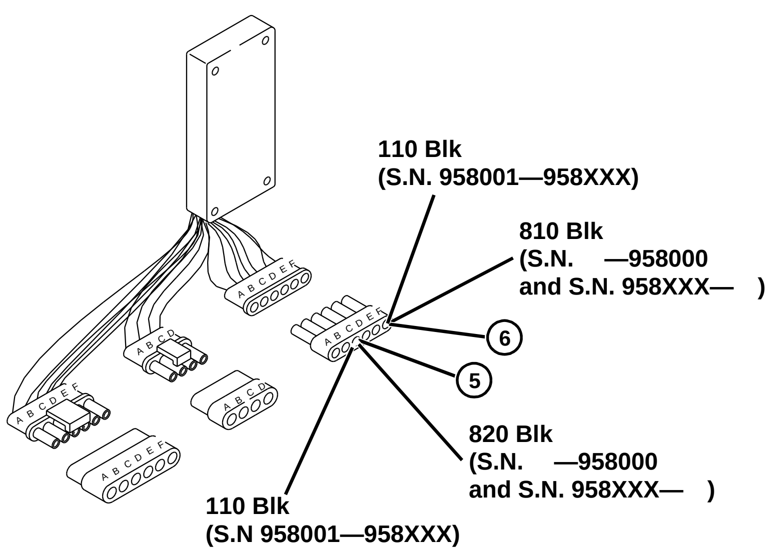

110 Blk
(S.N. 958001—958XXX)
810 Blk
(S.N. —958000
and S.N. 958XXX—)
6
5
820 Blk
(S.N. —958000
and S.N. 958XXX—)
110 Blk
(S.N 958001—958XXX)

IGNITION CIRCUIT DIAGNOSIS, continued

Test Conditions:

- Park brake ENGAGED. (Brake switch CLOSED.)
- Mow/transport switch in TRANSPORT position.
- Travel pedals in NEUTRAL position. (Travel/neutral switch CLOSED.)
- Key switch in START position.

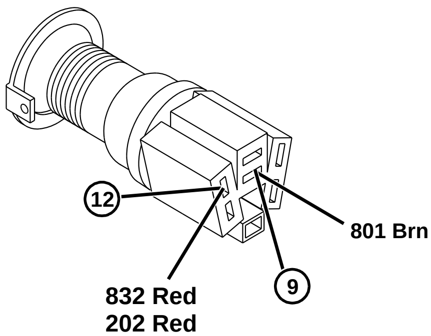
Test/Check Point	Normal	If Not Normal
9. Key switch—START terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
10. Controller module—Terminal E of six terminal female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test brown wire No. 801 and connections.
Controller module—Terminal E of six terminal female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/red wire No. 420, brown wire No. 801 and connections.
11. Spark plug/Spark Tester. (Perform SPARK TEST on page 3-36.)	Spark test indicates hot blue spark.	Spark weak or no spark present, install new plug and repeat test. If spark is still weak or not present, continue testing components.

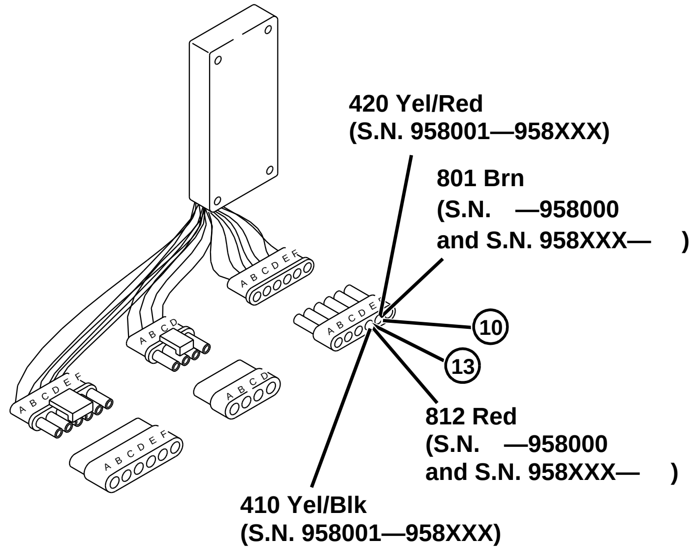
Test Conditions:

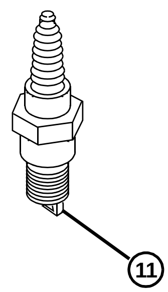
- Key switch in RUN position (engine not running).
- Park brake ENGAGED. (Brake switch CLOSED.)
- Operator on Seat. (Seat switch CLOSED.)
- Mow/transport switch in TRANSPORT position.
- Travel pedals in NEUTRAL position. (Travel/neutral switch CLOSED.)

Test Location	Normal	If Not Normal
12. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
13. Controller module—Terminal D of six terminal female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wire No. 812, 802 and connections.
Controller module—Terminal D of six terminal female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/blk wire No. 410, red wires No. 812, 802 and connections.

Continued on page 4-78.


12
801 Brn
9
832 Red
202 Red


420 Yel/Red
(S.N. 958001—958XXX)
801 Brn
(S.N. —958000
and S.N. 958XXX—)
10
13
812 Red
(S.N. —958000
and S.N. 958XXX—)
410 Yel/Blk
(S.N. 958001—958XXX)


11

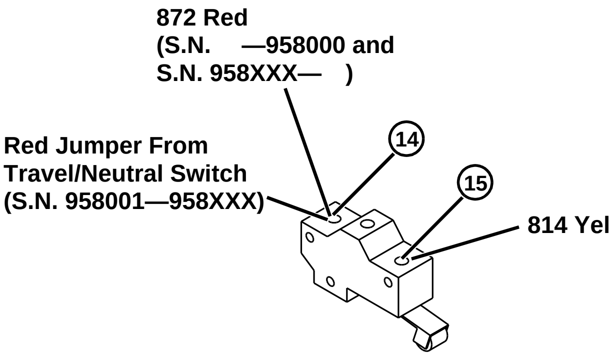
IGNITION CIRCUIT DIAGNOSIS, continued

Test Conditions:

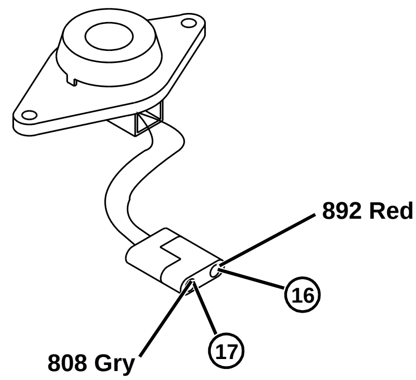
- Key switch in RUN position (engine not running).
- Park brake ENGAGED. (Brake switch CLOSED.)
- Operator on Seat. (Seat switch CLOSED.)
- Mow/transport switch in TRANSPORT position.
- Travel pedals in NEUTRAL position. (Travel/neutral switch CLOSED.)

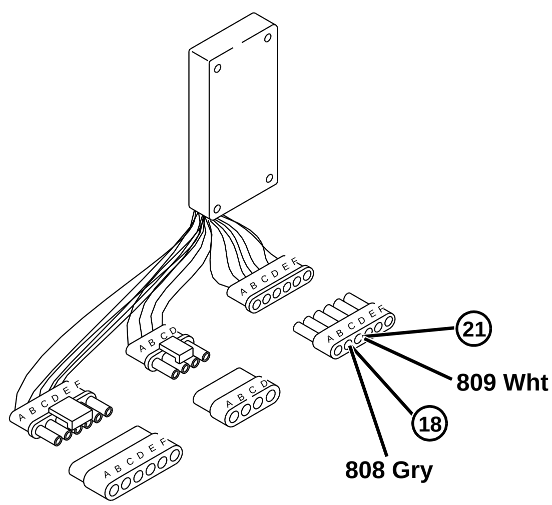
Test Location	Normal	If Not Normal
14. Mow/transport switch—COMMON terminal (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
Mow/transport switch—COMMON terminal (S.N. 958001—958XXX).	Battery voltage.	Test red jumper from travel/neutral switch, red wires No. 802, 812, 872 and connections.
15. Mow/transport switch—NORMALLY CLOSED terminal	No voltage (open circuit).	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
16. Seat switch.	Battery voltage.	Test red wires No. 893, 812 802 and connections.
17. Seat switch.	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
18. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808 and connections.
19. Park brake switch—COMMON terminal.	Battery voltage.	Test red wires No. 862, 812, 802 and connections.
20. Park brake switch—NORMALLY CLOSED terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)
21. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
22. Travel/neutral switch—COMMON terminal.	Battery voltage.	Test red wires No. 892, 812, 802 and connections.
23. Travel/neutral switch—NORMALLY OPEN terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)

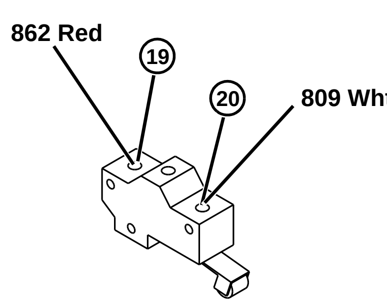
Continued on page 4-80.



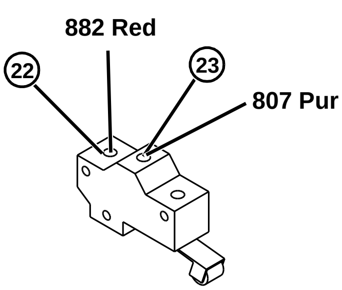
S2 Mow/Transport Switch







S5 Park Brake Switch



S7 Travel/Neutral Switch

IGNITION CIRCUIT DIAGNOSIS, continued

Test Conditions:

- Key switch in RUN position (engine not running).
- Park brake ENGAGED. (Brake switch CLOSED.)
- Operator on Seat. (Seat switch CLOSED.)
- Mow/transport switch in TRANSPORT position.
- Travel pedals in NEUTRAL position. (Travel/neutral switch CLOSED.)

Test/Check Point	Normal	If Not Normal
24. Controller module—Terminal A of six terminal male connector.	Battery voltage.	Test purple wire No. 807 and connections.

Test Conditions:

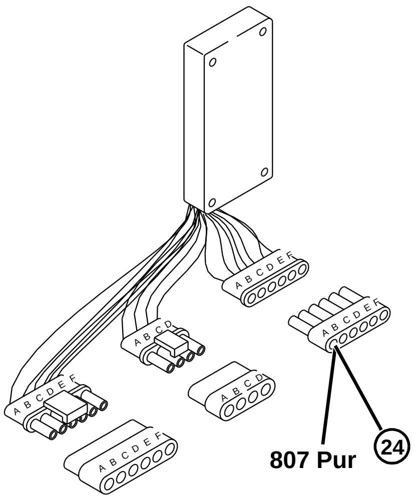
- Plug leads disconnected and grounded.
- Key switch in START position.
- Meter set for AC voltage for step 17.
- Voltage test light connected to battery negative (–) terminal (checking for current pulses) for step 26.

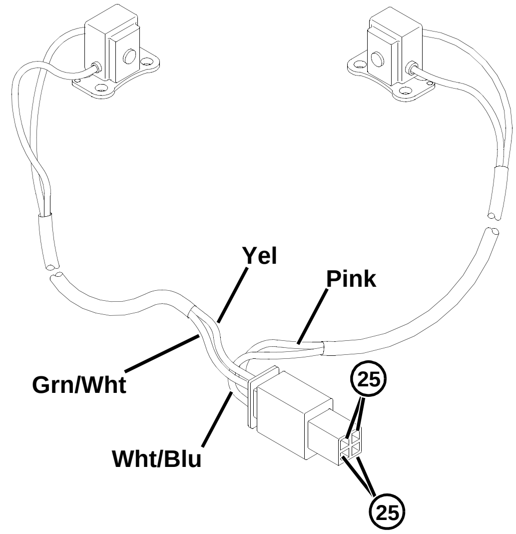
Test/Check Point	Normal	If Not Normal
25. Left and right pulser coils white/blue and pink leads, then green/white and yellow leads.	0.1—1 VAC.	Check pulser coil connections and test pulser coil resistance.
26. Ignition coil negative (–) terminal.	Rapidly flashing light, not steady glow.	Flashing light—check ignition module, go to step 27. Light steady glow—check ignition coil ground circuit.

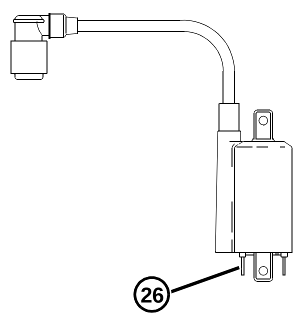
Test Conditions:

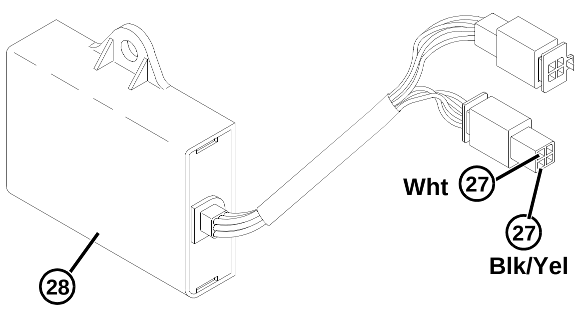
- Key switch in RUN position.

Test/Check Point	Normal	If Not Normal
27. Ignition module.	Battery voltage.	Check white and black/yellow wires, If OK, replace ignition module.
28. Ignition module.	Spark produced.	Replace ignition module (A1).


807 Pur
24


Yel
Pink
Grn/Wht
25
Wht/Blu
25


26


Wht
27
27
Blk/Yel
28

CHARGING CIRCUIT OPERATION

Function:

To maintain battery voltage. A warning light will alert the operator if the charging circuit is not functioning.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.

Theory of Operation:

The charging system is a permanent magnet and stator design. Charging output is controlled by a regulator/ rectifier.

The power/charging circuit provides current to the key switch 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, key switch (S1) (rust wire No. 032 and red wires No. 002 and 022) and voltage regulator/rectifier (N1) (red wire 332). The voltage sensing circuit allows the voltage regulator/rectifier to monitor battery voltage

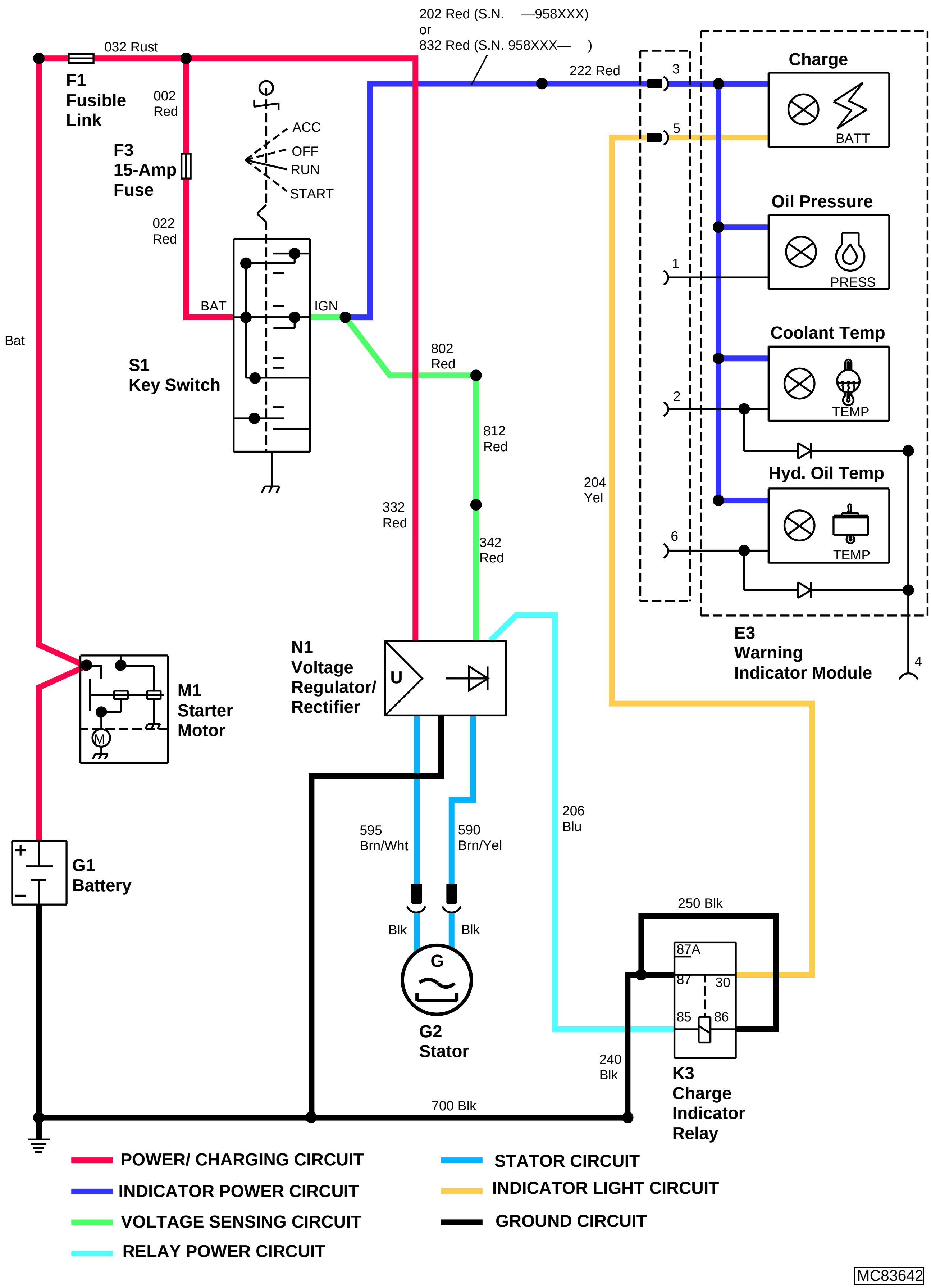
With the key switch in the RUN position, current flows to the voltage regulator/rectifier (red wires No. 802, 812 and 342—voltage sensing circuit) and warning indicator module terminal 3 (red wires No. 202 and 222 [S.N. —958XXX] or red wires No. 832 and 202 [S.N. 958XXX—]).

As the flywheel turns, a permanent magnet located in the flywheel induces AC current in the stator windings (G2). The AC current flows to the regulator/rectifier (brown/yellow wire No. 590 and brown/white wire 595). 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 the DC current to flow to the battery to charge it through the power/charging circuit (rust wire No. 032 and red wires No. 002 and 022). When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

If the voltage output from the stator is less than the battery voltage, the voltage regulator/rectifier routes battery voltage to charge indicator relay (blue wire No. 206) energizing the relay, completing the circuit and lighting the battery discharge light (yellow wire No. 204).

The ground circuit provides a path to ground for the regulator/rectifier and warning indicator module/ battery discharge light.


202 Red (S.N. —958XXX)
or
832 Red (S.N. 958XXX—)
032 Rust
222 Red
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
BAT
IGN
Bat
S1
Key Switch
802
Red
812
Red
332
Red
342
Red
204
Yel
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd. Oil Temp
TEMP
3
5
1
2
6
4
E3
Warning
Indicator Module
N1
Voltage
Regulator/
Rectifier
U
M1
Starter
Motor
M
206
Blu
595
Brn/Wht
590
Brn/Yel
G1
Battery
Blk
Blk
G
G2
Stator
250 Blk
87A
87
30
85
86
240
Blk
K3
Charge
Indicator
Relay
700 Blk
POWER/ CHARGING CIRCUIT
INDICATOR POWER CIRCUIT
VOLTAGE SENSING CIRCUIT
RELAY POWER CIRCUIT
STATOR CIRCUIT
INDICATOR LIGHT CIRCUIT
GROUND CIRCUIT
MC83642

CHARGING CIRCUIT DIAGNOSIS

The test should be performed in the order shown to simplify diagnostics.

Test Conditions:

- Key switch in OFF position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal.	Battery voltage.	Test rust wire No. 032, red wires no. 022, and 002, fusible link (F1) and 15 amp main fuse (F3) and battery positive (+) cable.

Test Conditions:

- Key switch in RUN position—Engine running.

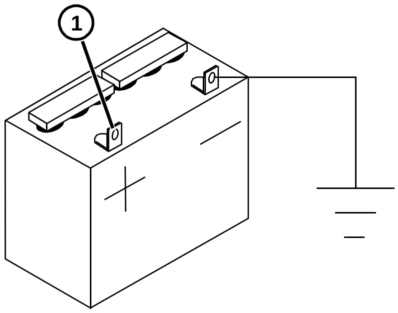
Test Location	Normal	If Not Normal
4. Stator connector. (Perform UNREGULATED VOLTAGE OUTPUT TEST on page 4-215.)	Voltage output to specifications.	Check brown/white wire No. 595, brown/ yellow wire No. 590 and black wires. If OK, replace voltage regulator/rectifier. Voltage regulator/rectifier.

Test Conditions:

- Disconnect battery positive (+) cable for following continuity tests.
- Key switch in RUN position—Engine not running.

Test Location	Normal	If Not Normal
5. Starter/Battery positive (+) connection to regulator/rectifier Terminal 1	Continuity.	Test red wires No. 332, and 032, fusible link, positive (+) battery cable and connections.
6. Starter/Battery positive (+) connection to regulator/rectifier Terminal 2	Continuity.	Test rust wire No. 032, red wires No. 002, 022, 802, 812 and 342, yellow wire No. 500, 15 amp main fuse, fusible link, positive (+) battery cable and connections.
7. Voltage regulator/rectifier—Terminal 3.	Continuity.	Test black wires No. 310 and 700 and connections.
8. Charge indicator relay—Terminal 86.	Continuity.	Test black wires No. 250, 240, 700 and connections.

Continued on page 4-86.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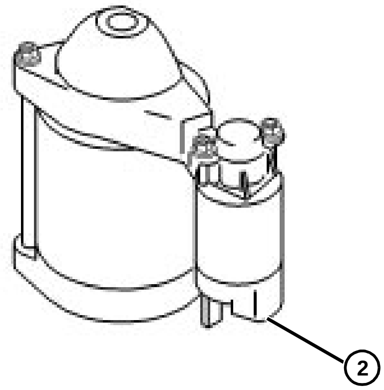
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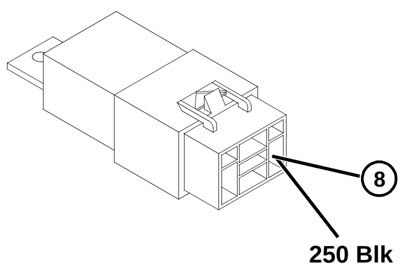
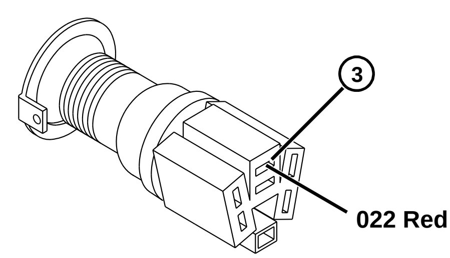
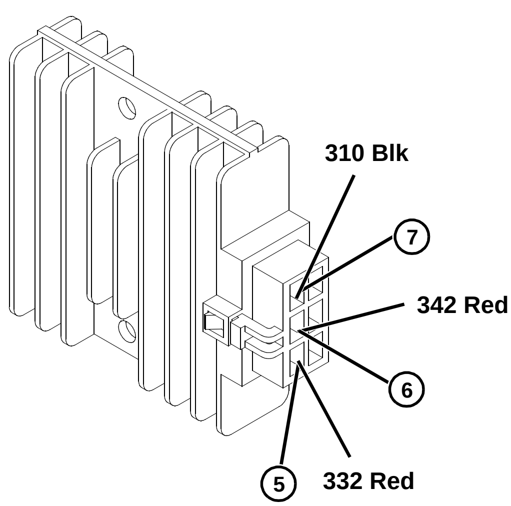
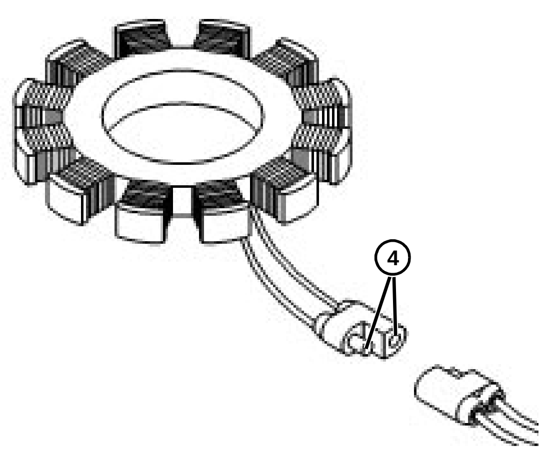

8
250 Blk


3
022 Red


310 Blk
7
342 Red
6
5
332 Red

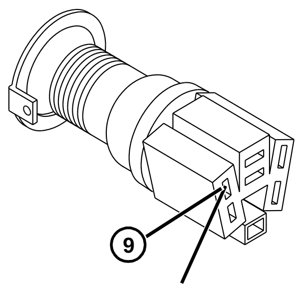

4

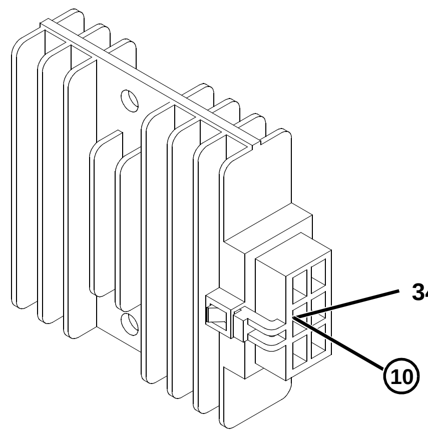
CHARGING CIRCUIT DIAGNOSIS, continued

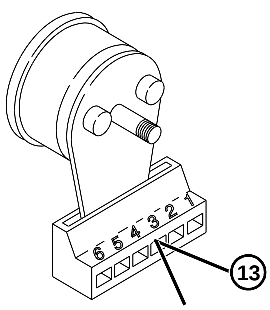
Test Conditions

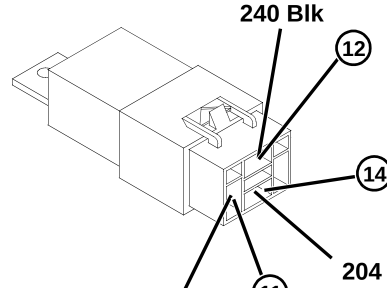
- Connect battery cables for following voltage tests.
- Key switch in RUN position—Engine not running.

Test Location	Normal	If Not Normal
9. Key switch—IGN Terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
10. Voltage regulator/rectifier—Terminal 2.	Battery voltage.	Test red wires No. 342, 812, 802 and connections.
11. Charge indicator relay—Terminal 85.	Battery voltage.	Test blue wire No. 206 and connections.
12. Charge indicator relay—Terminal 87.	Less than 0.2 volt.	Test relay, black wires No. 240, and 700 and connections.
13. Warning indicator module connector—Terminal 3 (S.N. — 958XXX).	Battery voltage.	Test red wires No. 222 and 202 and connections.
Warning indicator module connector—Terminal 3 (S.N. 958XXX—).	Battery voltage.	Test red wires No. 222, 832 and connections
14. Charge indicator relay—Terminal 30.	Less than 0.2 volt.	Test battery indicator bulb, module, yellow wire No. 204, and connections.


9
832 Red
202 Red


342 Red
10


6 5 4 3 2 1
13
222 Red


240 Blk
12
14
204 Yel
11
206 Blu

LOW ENGINE OIL PRESSURE WARNING LIGHT CIRCUIT OPERATION (S.N —958XXX)

Function:

To illuminate a lamp in the warning indicator module if engine oil pressure is below minimum operating pressure.

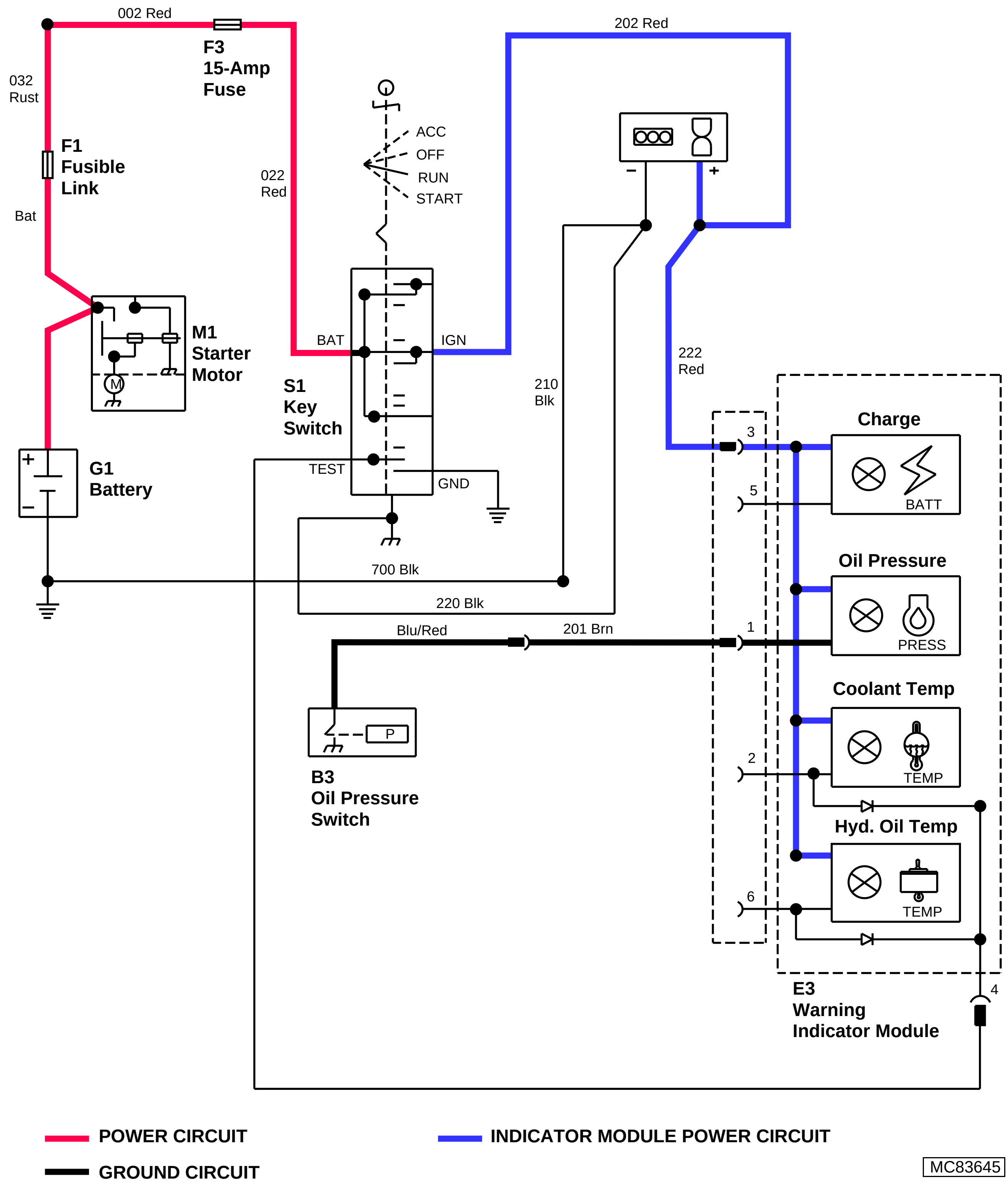
Operating Conditions:

- Key switch in the RUN position.
- Engine running.

Theory of Operation:

The power circuit provides current to the key switch and protects the low engine 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) and oil pressure warning lamp (red wires No. 202 and 222). When engine oil pressure drops below minimum operating pressure, the switch (B3) closes, completing circuit to ground and lighting the oil pressure light.


002 Red
F3
15-Amp
Fuse
032
Rust
F1
Fusible
Link
Bat
022
Red
ACC
OFF
RUN
START
202 Red
M1
Starter
Motor
BAT
IGN
S1
Key
Switch
TEST
GND
G1
Battery
210
Blk
222
Red
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd. Oil Temp
TEMP
700 Blk
220 Blk
Blu/Red
201 Brn
B3
Oil Pressure
Switch
E3
Warning
Indicator Module
POWER CIRCUIT
INDICATOR MODULE POWER CIRCUIT
GROUND CIRCUIT
MC83645

LOW ENGINE OIL PRESSURE WARNING LIGHT CIRCUIT OPERATION (S.N. 958XXX—)

Function:

To illuminate a lamp in the warning indicator module if engine oil pressure is below minimum operating pressure.

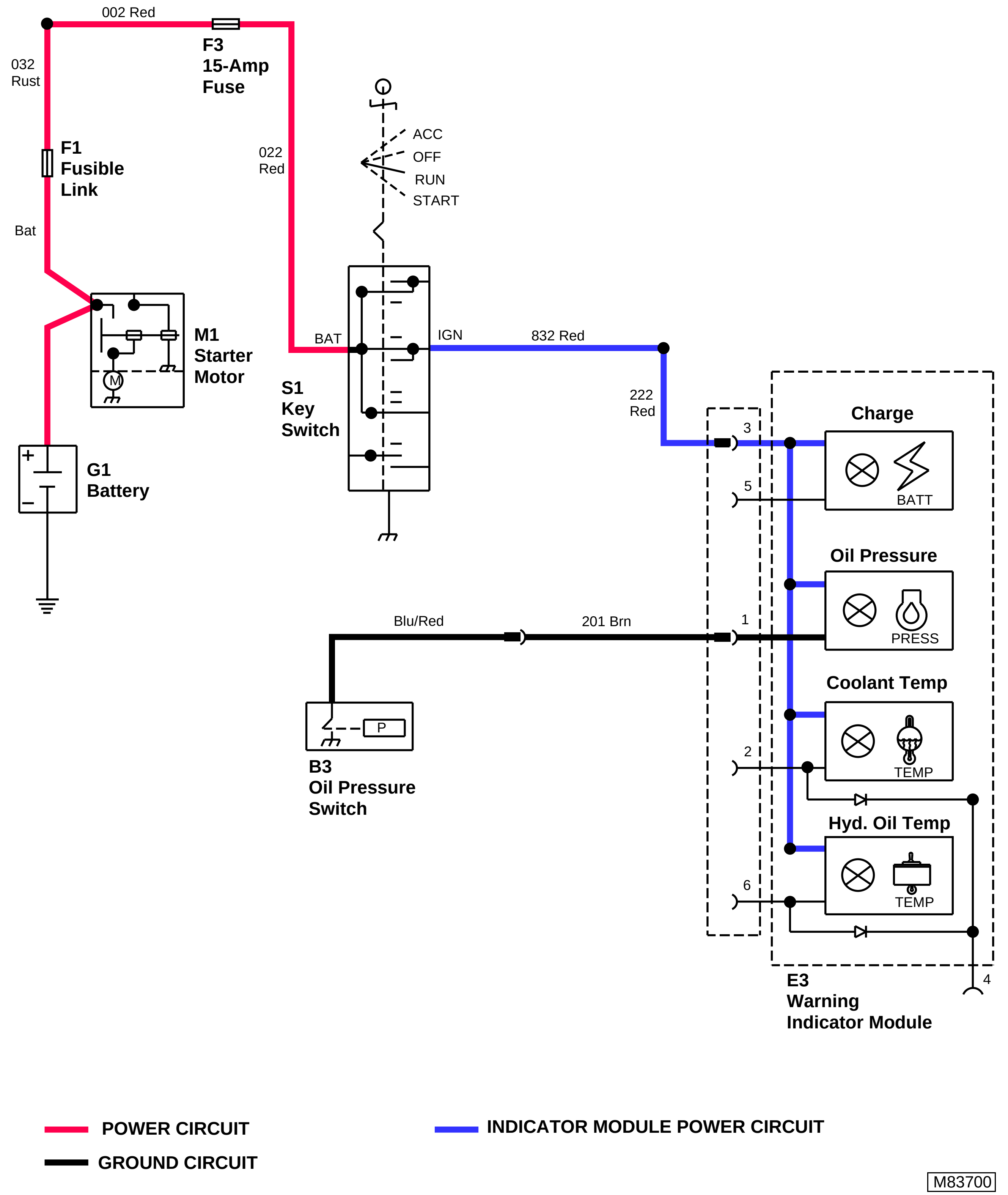
Operating Conditions:

- Key switch in the RUN position.
- Engine running.

Theory of Operation:

The power circuit provides current to the key switch and protects the low engine 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) and oil pressure warning lamp (red wires No. 832 and 222). When engine oil pressure drops below minimum operating pressure, the switch (B3) closes, completing circuit to ground and lighting the oil pressure light.

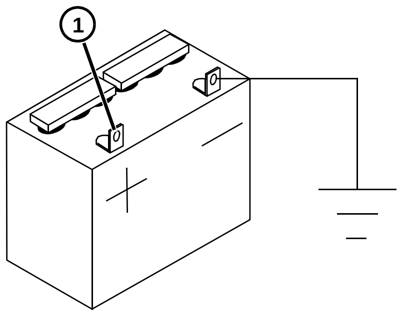

002 Red
032
Rust
F3
15-Amp
Fuse
F1
Fusible
Link
022
Red
ACC
OFF
RUN
START
Bat
M
M1
Starter
Motor
BAT
IGN
832 Red
S1
Key
Switch
222
Red
Charge
3
5
BATT
G1
Battery
Oil Pressure
PRESS
Blu/Red
201 Brn
1
P
Coolant Temp
2
TEMP
B3
Oil Pressure
Switch
Hyd. Oil Temp
6
TEMP
4
E3
Warning
Indicator Module
POWER CIRCUIT
INDICATOR MODULE POWER CIRCUIT
GROUND CIRCUIT
M83700

LOW ENGINE OIL PRESSURE WARNING CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in RUN position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal.	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002 and 022, fusible link (F1), 15 amp main fuse (F3) and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Warning indicator module—Terminal 3 (S.N. —958XXX).	Battery voltage.	Test red wires No. 222 and 202 and connections.
Warning indicator module—Terminal 3 (S.N. 958XXX—).	Battery voltage.	Test red wires No. 222, 832 and connections.
6. Warning indicator module—Terminal 1.	Less than 0.2 volt.	Test warning light module, bulb, brown wire No. 201, engine connector, blue/red wire, oil pressure switch and engine ground.
7. Engine oil pressure switch.	Continuity between terminal and ground.	Test switch. (See ENGINE OIL PRESSURE SWITCH TEST on page 4-219.)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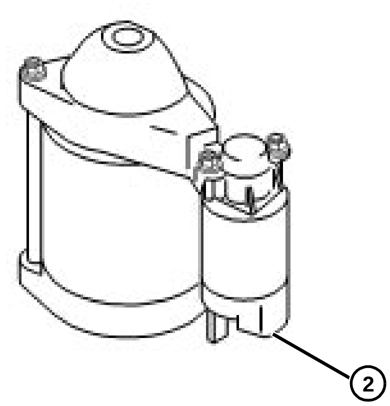
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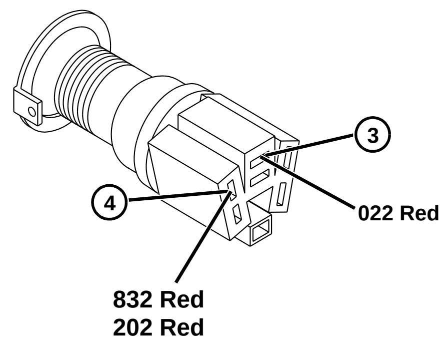
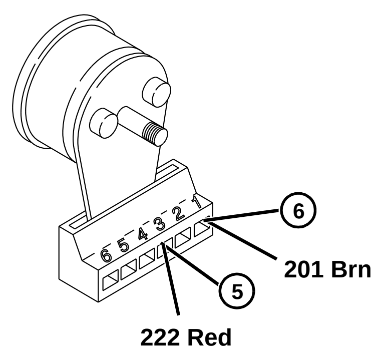
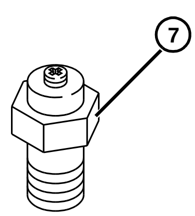

3
4
022 Red
832 Red
202 Red


6 5 4 3 2 1
6
201 Brn
5
222 Red


7

COOLANT TEMPERATURE WARNING LIGHT CIRCUIT OPERATION (S.N. —958XXX)

Function:

To illuminate a lamp in the warning indicator module if engine coolant temperature exceeds normal operating temperature.

Operating Conditions:

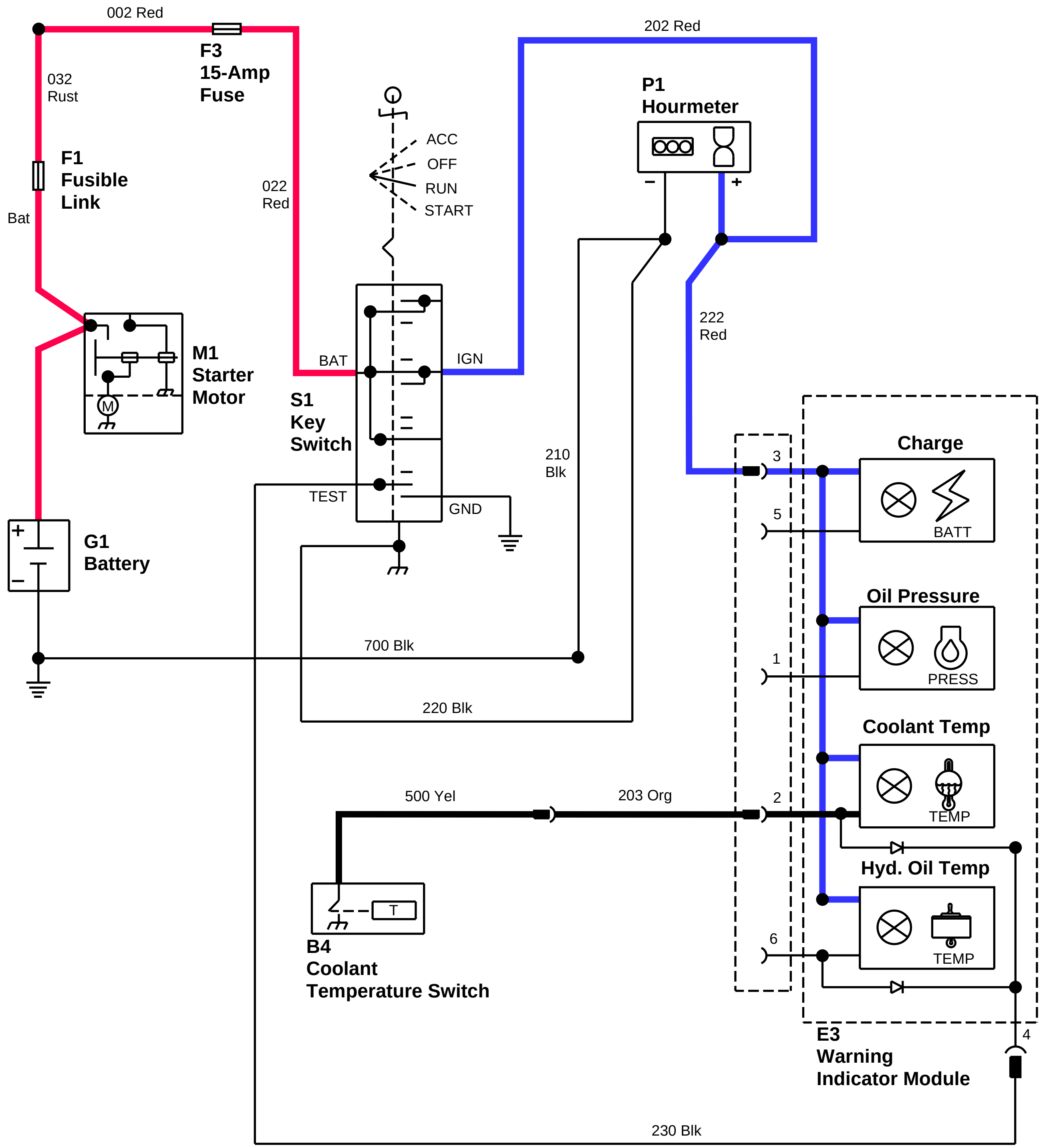
- Key switch in the RUN position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) and water temperature warning lamp (red wires No. 202 and 222). When engine coolant temperature exceeds normal operating temperature, the switch (B4) closes, completing circuit to ground and lighting the coolant temperature light.

When the key switch is positioned between RUN and START positions, a path to ground is provided through the key switch to allow bulb check (black wires No. 230, 220, 210 and 700).



POWER CIRCUIT

INDICATOR MODULE POWER CIRCUIT

GROUND CIRCUIT

MC83643

COOLANT TEMPERATURE WARNING LIGHT CIRCUIT OPERATION (S.N. 958XXX—)

Function:

To illuminate a lamp in the warning indicator module if engine coolant temperature exceeds normal operating temperature.

Operating Conditions:

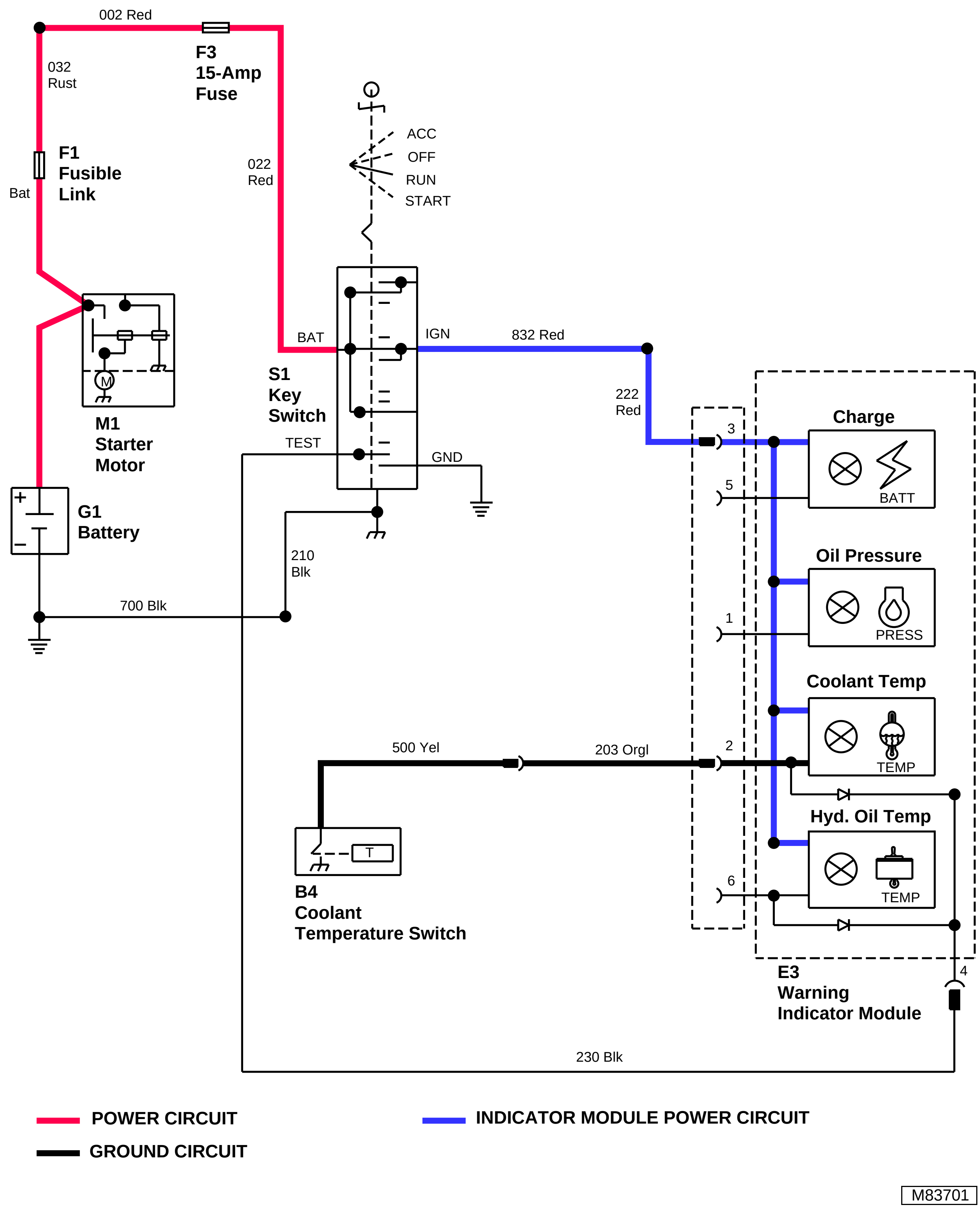
- Key switch in the RUN position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) and water temperature warning lamp (red wires No. 832 and 222). When engine coolant temperature exceeds normal operating temperature, the switch (B4) closes, completing circuit to ground and lighting the coolant temperature light.

When the key switch is positioned between RUN and START positions, a path to ground is provided through the key switch to allow bulb check (black wires No. 230, 210 and 700).

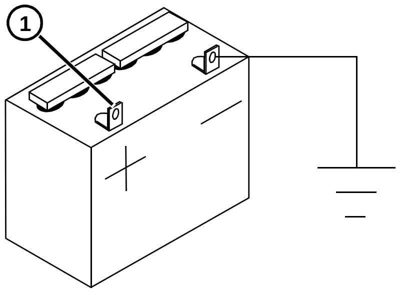

002 Red
032
Rust
F3
15-Amp
Fuse
F1
Fusible
Link
Bat
022
Red
ACC
OFF
RUN
START
BAT
IGN
832 Red
S1
Key
Switch
TEST
GND
M1
Starter
Motor
M
G1
Battery
210
Blk
700 Blk
222
Red
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd. Oil Temp
TEMP
3
5
1
2
6
4
500 Yel
203 Orgl
T
B4
Coolant
Temperature Switch
E3
Warning
Indicator Module
230 Blk
POWER CIRCUIT
GROUND CIRCUIT
INDICATOR MODULE POWER CIRCUIT
M83701

COOLANT TEMPERATURE WARNING LIGHT CIRCUIT DIAGNOSIS

Test Conditions:

- To test the circuit, disconnect the yellow wire at the coolant temperature switch and ground this wire.
- Turn the key switch to the RUN position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link (F1), rust wire No. 032, red wires No. 002, and 022, 15 amp main fuse (F3) and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Warning indicator module—Terminal 3 (S.N. — 958XXX).	Battery voltage.	Test red wires No. 222 and 202 and connections.
Warning indicator module—Terminal 3 (S.N. 958XXX—).	Battery voltage.	Test red wires No. 222, 832 and connections.
6. Warning indicator module—Terminal 2.	Less than 0.2 volt.	Test warning indicator module, bulb, orange wire No. 203, engine connector, yellow wire No. 500 and engine ground.
7. Coolant temperature switch.	Resistance within specification.	Test switch. (See COOLANT TEMPERATURE SWITCH TEST on page 4-220.)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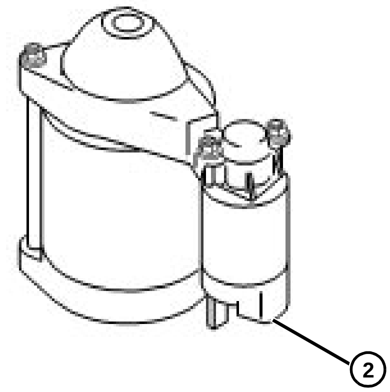
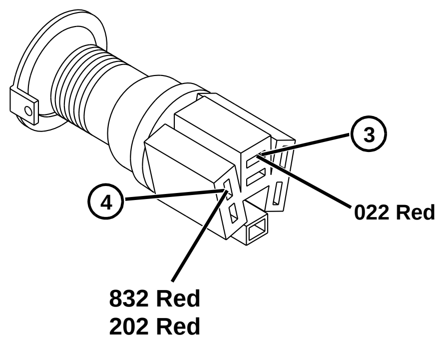
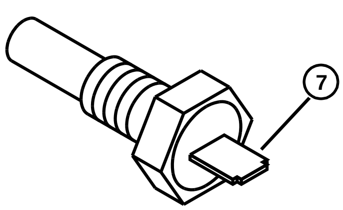

2


3
022 Red
4
832 Red
202 Red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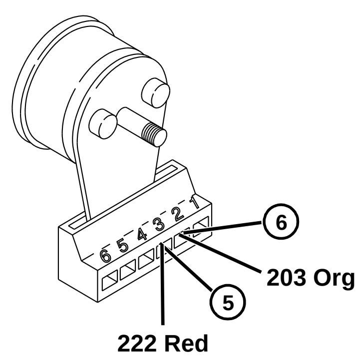

6 5 4 3 2 1
6
203 Org
5
222 Red

HYDRAULIC OIL TEMPERATURE WARNING LIGHT CIRCUIT OPERATION (S.N. —958XXX)

Function:

To illuminate a lamp in the warning indicator module if hydraulic oil temperature exceeds specifications.

Operating Conditions:

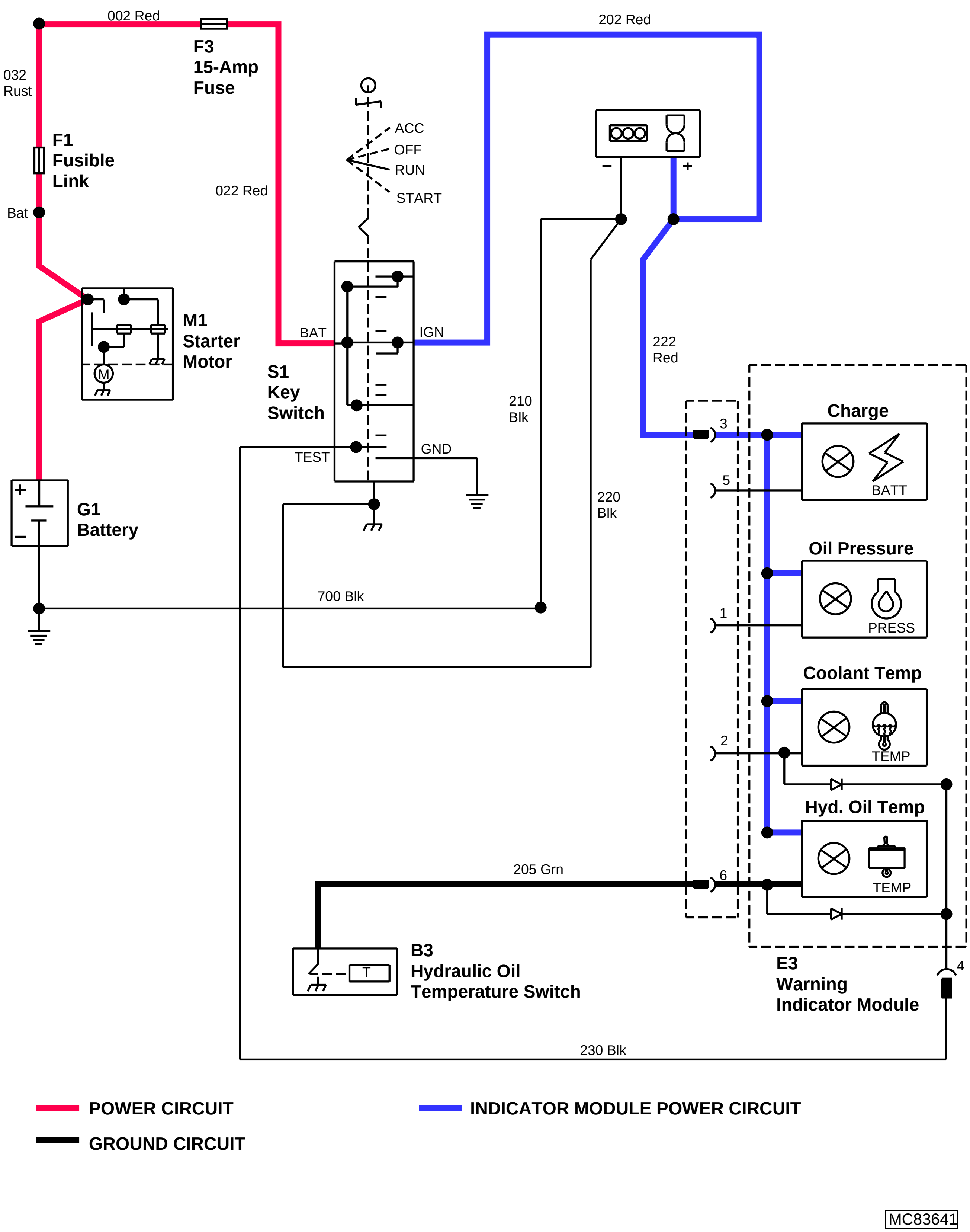
- Key switch in the RUN position.

Theory of Operation:

The power circuit provides current to the key switch and protects the hourmeter 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 (S1).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) (red wires No. 202 and 222), hydraulic oil temperature warning lamp and hydraulic oil temperature switch (B5). When hydraulic oil temperature exceeds specification, the switch closes completing circuit to ground and lighting the hydraulic oil temperature indicator.

When key switch is positioned between RUN and START positions, a path to ground is provided through the key switch to allow bulb check (black wires No. 230, 220, 210 and 700).



002 Red
F3
15-Amp
Fuse
032
Rust
F1
Fusible
Link
Bat
022 Red
ACC
OFF
RUN
START
202 Red
M1
Starter
Motor
BAT
IGN
S1
Key
Switch
TEST
GND
210
Blk
222
Red
220
Blk
G1
Battery
700 Blk
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd. Oil Temp
TEMP
205 Grn
B3
Hydraulic Oil
Temperature Switch
E3
Warning
Indicator Module
230 Blk
POWER CIRCUIT
INDICATOR MODULE POWER CIRCUIT
GROUND CIRCUIT
MC83641

HYDRAULIC OIL TEMPERATURE WARNING LIGHT CIRCUIT OPERATION (S.N. 958XXX—)

Function:

To illuminate a lamp in the warning indicator module if hydraulic oil temperature exceeds specifications.

Operating Conditions:

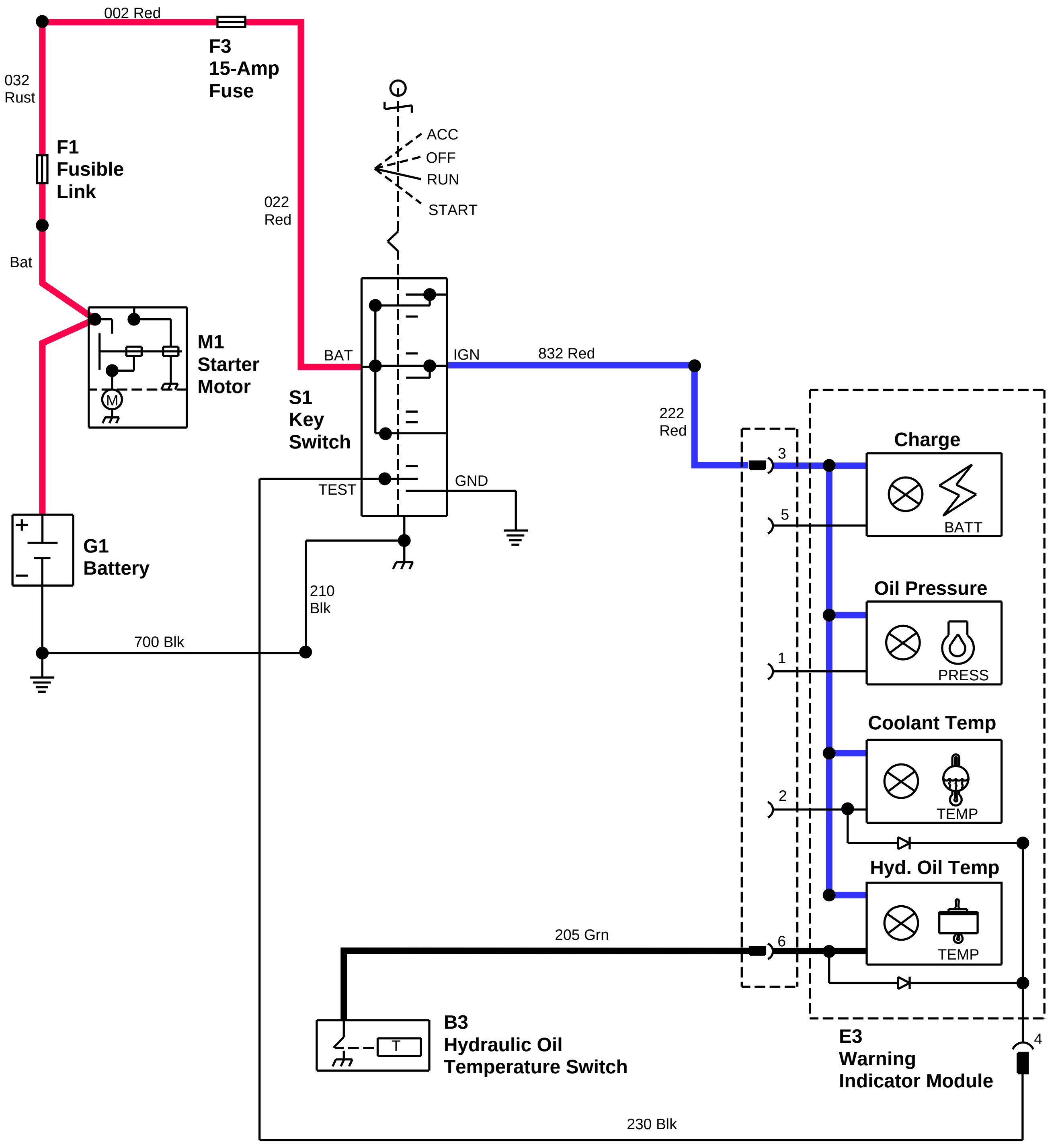
- Key switch in the RUN position.

Theory of Operation:

The power circuit provides current to the key switch and protects the hourmeter 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 (S1).

With the key switch in the RUN position, current is supplied to the warning indicator module (E3) (red wires No. 832 and 222), hydraulic oil temperature warning lamp and hydraulic oil temperature switch (B5). When hydraulic oil temperature exceeds specification, the switch closes completing circuit to ground and lighting the hydraulic oil temperature indicator.

When key switch is positioned between RUN and START positions, a path to ground is provided through the key switch to allow bulb check (black wires No. 230, 210 and 700).



POWER CIRCUIT

INDICATOR MODULE POWER CIRCUIT

GROUND CIRCUIT

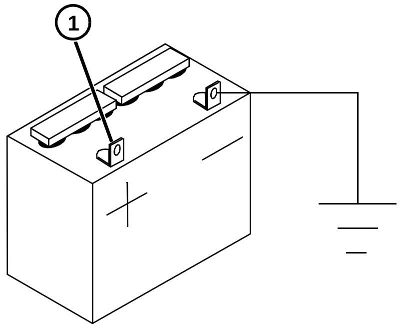
M83702

HYDRAULIC OIL TEMPERATURE WARNING LIGHT CIRCUIT DIAGNOSIS

Test Conditions:

- To test the circuit, remove green wire No. 205 at the hydraulic oil temperature switch and ground this wire.
- Turn the key switch to the RUN position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link (F1), rust wire no. 032, red wires No. 002 and 022, 15 amp fuse (F3), and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Warning indicator module—Terminal 3 (S.N. —958XXX).	Battery voltage.	Test red wires No. 222 and 202 and connections.
Warning indicator module—Terminal 3 (S.N. 958XXX—).	Battery voltage.	Test red wires No. 222, 832 and connections.
6. Warning indicator module—Terminal 6.	Less than 0.2 volts.	Test green wire No. 205 and engine ground.
7. Hydraulic oil temperature switch.	Resistance within specification.	Test switch. (See HYDRAULIC OIL TEMPERATURE SWITCH TEST on page 4-220.)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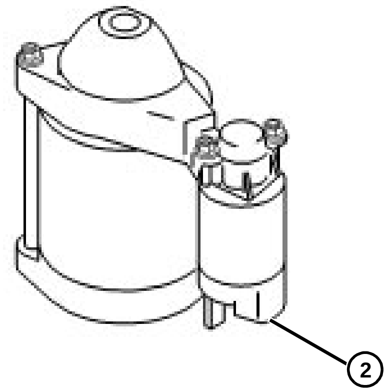
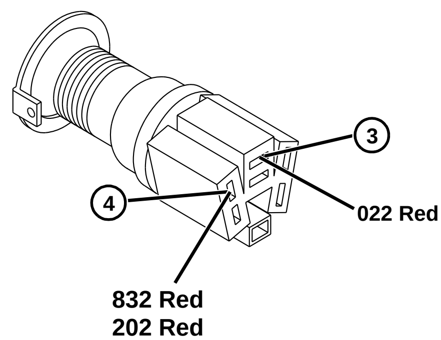
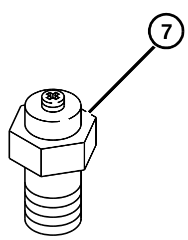
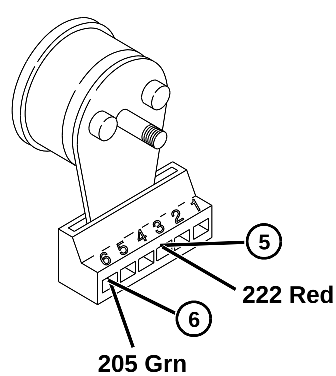

2


3
4
022 Red
832 Red
202 Red


7


6 5 4 3 2 1
5
222 Red
6
205 Grn

HOURMETER CIRCUIT OPERATION

Function:

To record the number of hours the key switch is on the RUN position.

Operating Conditions:

- Key switch in the RUN position.

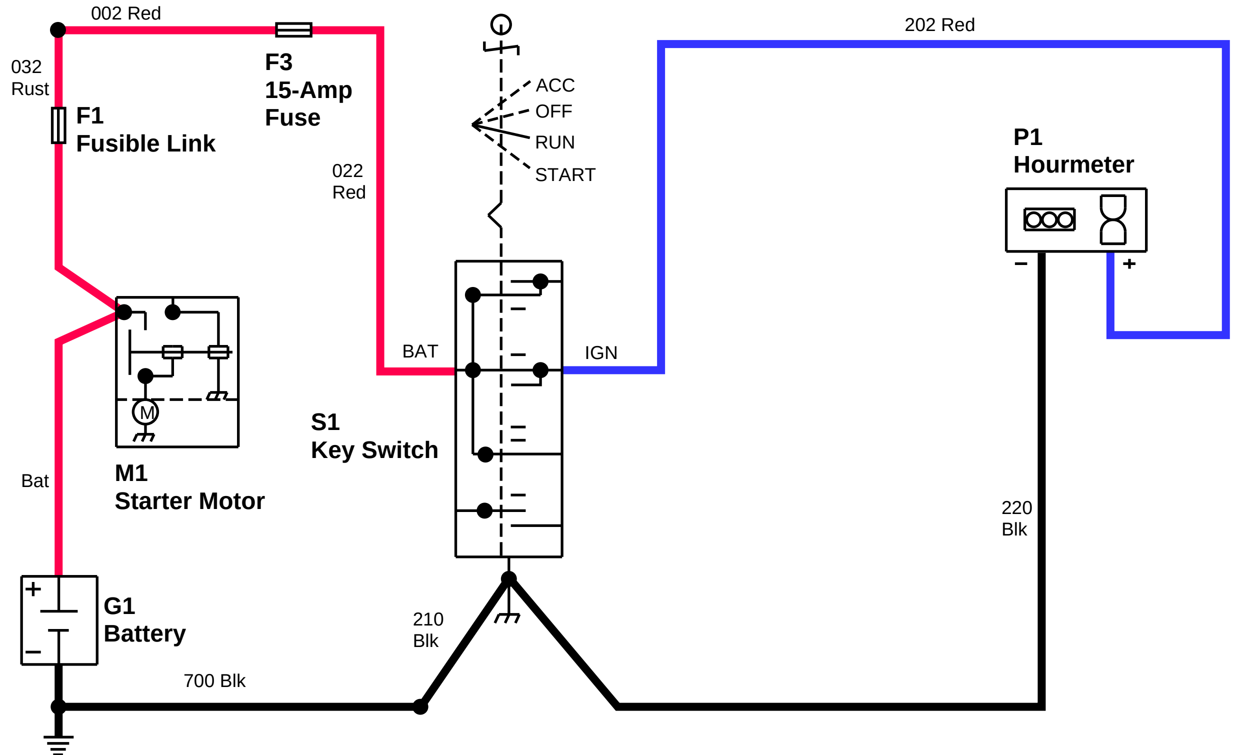
Theory of Operation:

The power circuit provides current to the key switch and protects the hourmeter 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 (S1) (rust wire No. 032 and red wires No. 002 and 022).

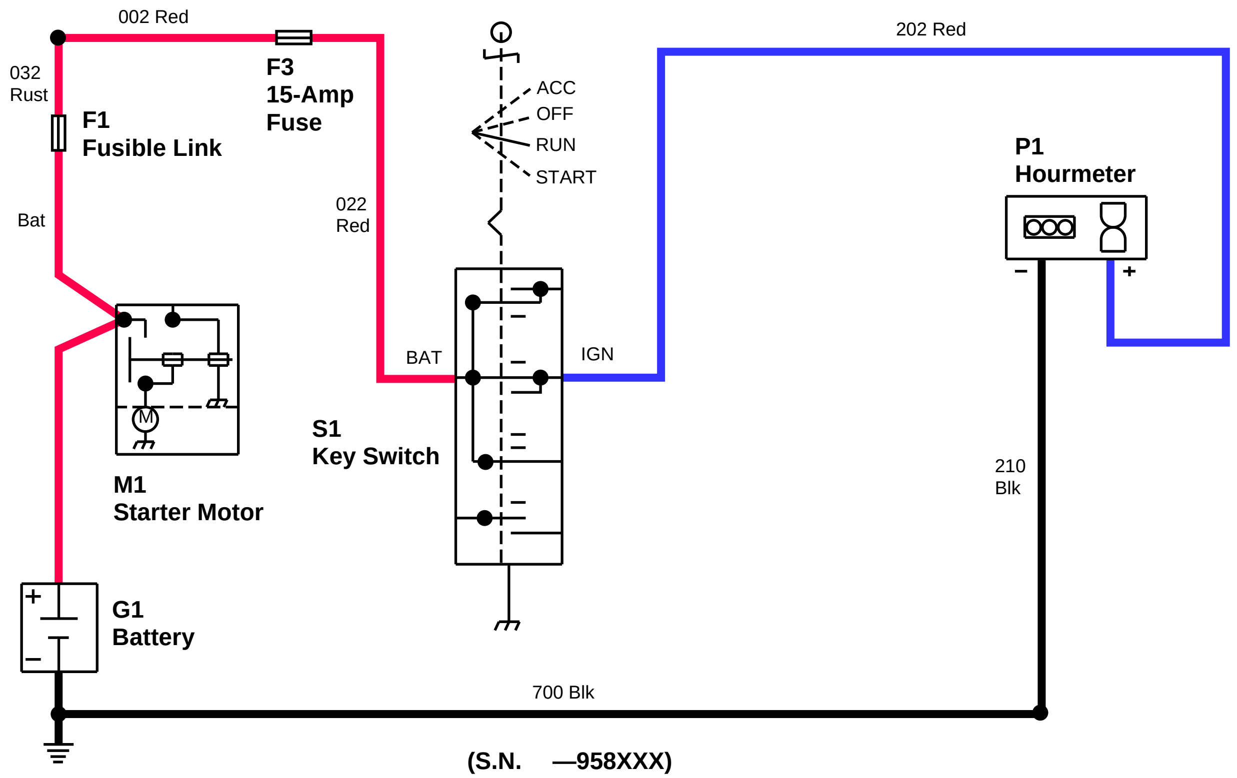
With the key switch in the RUN position, current is supplied to the hourmeter (P1)(red wire No. 202).

The hourmeter will record the number of hours the machine is running (key switch in RUN position) in 1/10 hour increments.

The ground circuit (black wires No. 210 and 700 [S.N. —958XXX], or black wires No. 220, 210 and 700 [S.N. 958XXX—]) provides a path to ground for the hourmeter.



(S.N. 958XXX—)



(S.N. —958XXX)

POWER CIRCUIT
HOURMETER POWER CIRCUIT
GROUND CIRCUIT

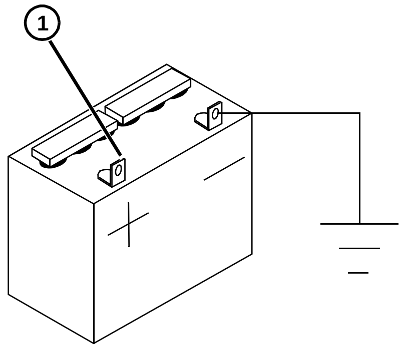
MC83644

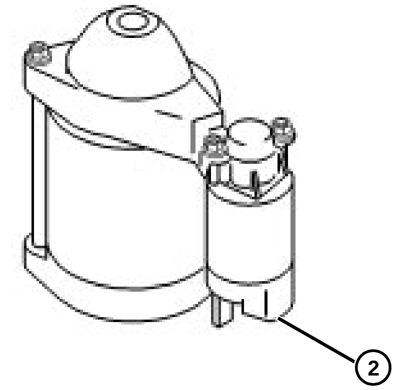
HOURMETER CIRCUIT DIAGNOSIS

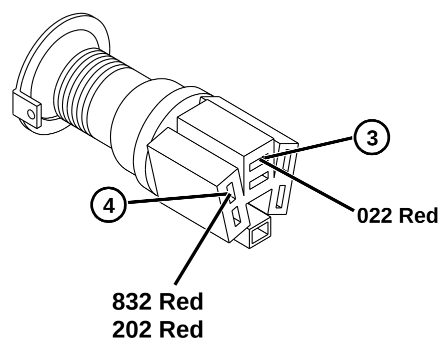
Test Conditions:

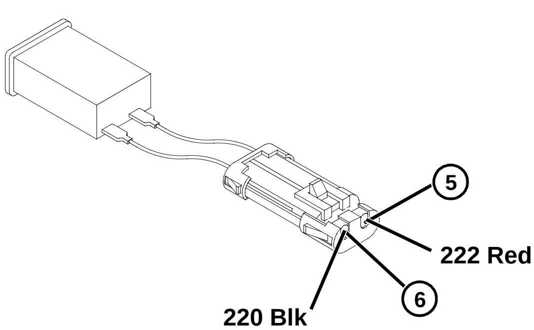
- Key switch in RUN position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—Battery terminal.	Battery voltage.	Test battery cable, fusible link (F1), rust wire No. 032, red wires No. 002 and 022, 15-amp fuse (F3), and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Hourmeter—Positive (+) terminal.	Battery voltage.	Test red wire No. 202 and connections.
6. Hourmeter—Negative (-) terminal (S.N. —958XXX).	Less than 0.2 volt.	Test ground circuit black wires No. 210 and 700 and connections.
Hourmeter—Negative (-) terminal (S.N. 958XXX—).	Less than 0.2 volt.	Test ground circuit black wires No. 220, 210 and 700 and connections.

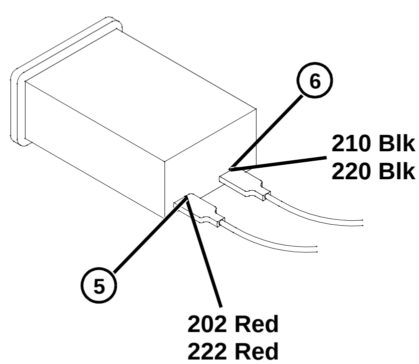








P1 Hourmeter
(S.N. 958XXX—)



P1 Hourmeter
(S.N. —958XXX)

CUTTING UNIT—LOWER CIRCUIT OPERATION (S.N —958000 and S.N. 958XXX—)

Function:

To lower cutting units without operating reel mowers.

CAUTION

If mow/transport lever is in MOW position the reels will start when cutting units are lowered.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in TRANSPORT position.
- Cutting unit lower switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

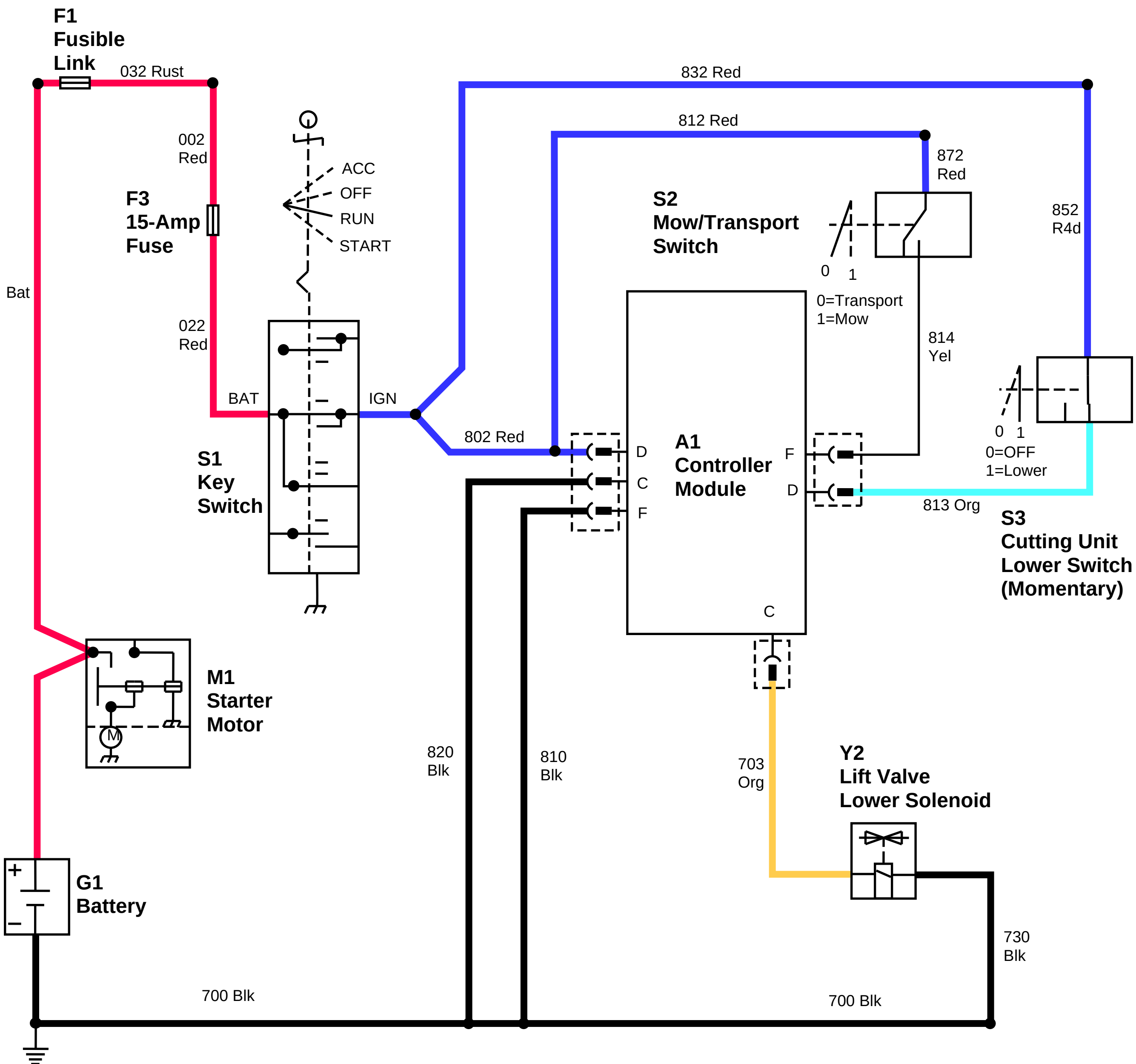
With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), and cutting unit lower switch (S3) (red wires no. 832 and 842).

As the lower switch is engaged, current is routed to the controller module (orange wire No. 813). The controller module then routes current to the lift valve lower solenoid (Y2) (orange wire No. 703).

The ground circuit connected to the lower solenoid (black wires No. 730 and 700) complete the circuit and allow the cutting units to be lowered. Black wires No. 810, 820 and 700 provide a ground circuit for the controller module.

NOTE: Cutting units can be lowered while operator is off the seat if controller module senses voltage from the park brake and travel/neutral switches and no voltage from the mow/transport switch.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.



POWER CIRCUIT

SWITCH POWER CIRCUIT

CUTTING UNIT LOWER SWITCH CIRCUIT

LIFT VALVE LOWER SOLENOID CIRCUIT

GROUND CIRCUIT

MC83646

CUTTING UNIT—LOWER CIRCUIT OPERATION (S.N 958001—958XXX)

Function:

To lower cutting units without operating reel mowers.

CAUTION

If mow/transport lever is in MOW position the reels will start when cutting units are lowered.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in TRANSPORT position.
- Cutting unit lower switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

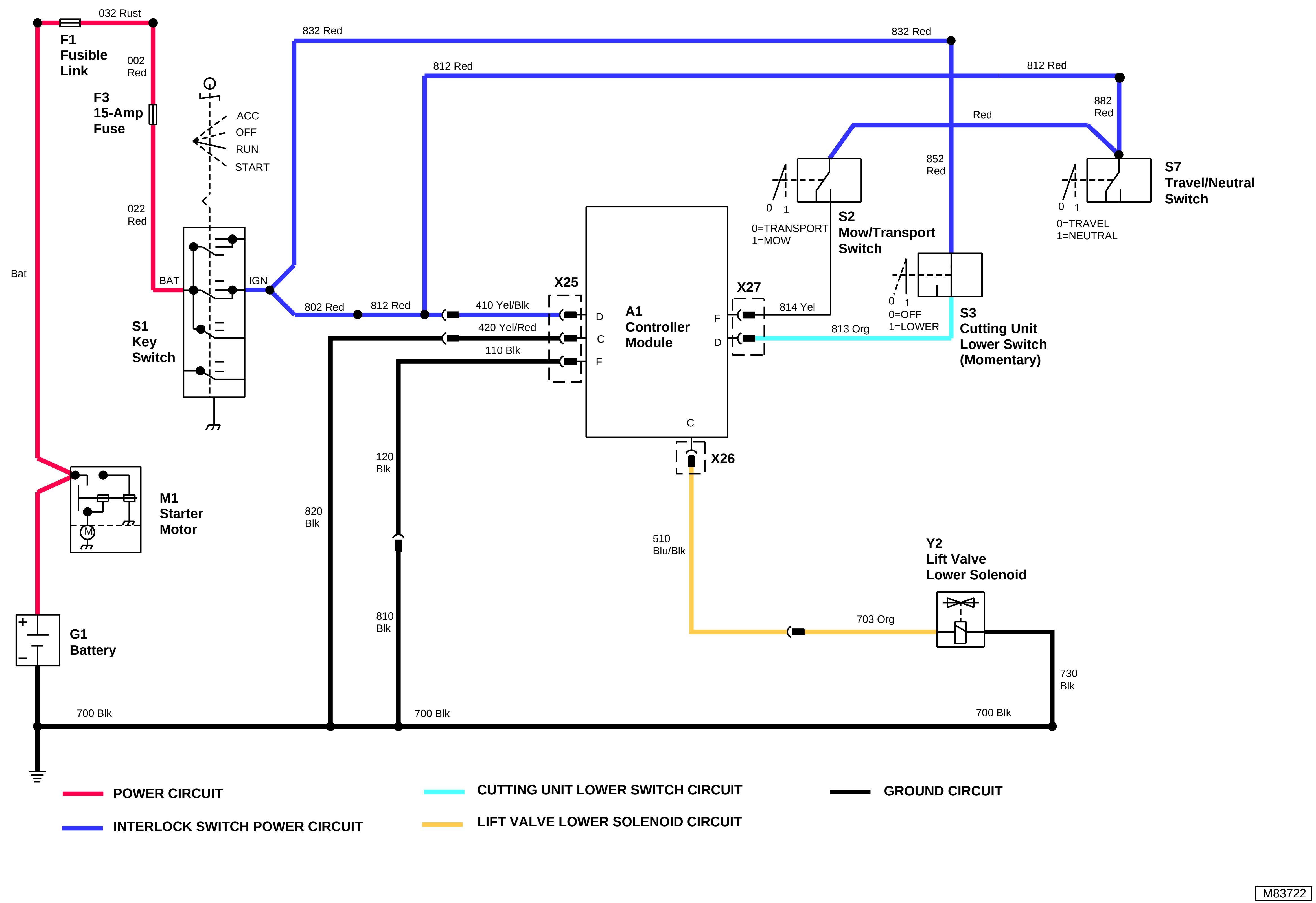
With the key switch in the RUN position, current is supplied to the controller module (red wires No. 802, No. 410), travel/neutral switch (S7) (red wires No. 812 and 882) and mow/transport switch (S2) (red jumper from travel/neutral switch). Current is also supplied to cutting unit lower switch(S3) (red wires No. 832 and 842).

As the lower switch is engaged, current is routed to the controller module (orange wire No. 813). The controller module then routes current to the lift valve lower solenoid (Y2) (orange wire No. 703 and blue/black wire No. 510).

The ground circuit connected to the lower solenoid (black wires No. 730 and 700) complete the circuit and allow the cutting units to be lowered. A ground circuit for the controller module is provided by yellow/black wire No. 420, yellow/red wire No. 420 and black wires No. 120, 810, 820 and 700.

NOTE: Cutting units can be lowered while operator is off the seat if controller module senses voltage from the park brake and travel/neutral switches and no voltage from the mow/transport switch.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
Bat
BAT
IGN
ACC
OFF
RUN
START
S1 Key Switch
832 Red
812 Red
802 Red
410 Yel/Blk
420 Yel/Red
110 Blk
X25
D
C
F
A1 Controller Module
X27
814 Yel
813 Org
X26
C
852 Red
882 Red
Red
0 1
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch (Momentary)
0=TRAVEL
1=NEUTRAL
S7 Travel/Neutral Switch
M1 Starter Motor
820 Blk
120 Blk
810 Blk
510 Blu/Blk
703 Org
Y2 Lift Valve Lower Solenoid
730 Blk
G1 Battery
700 Blk
POWER CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
GROUND CIRCUIT
M83722

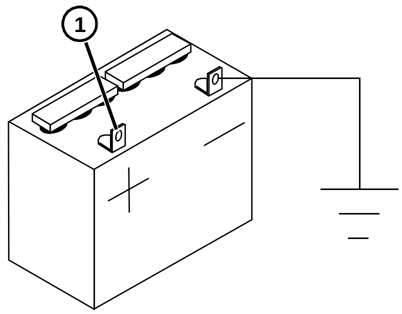
CUTTING UNIT—LOWER CIRCUIT DIAGNOSIS

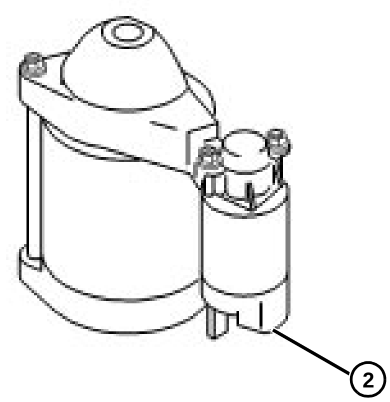
Test Conditions:

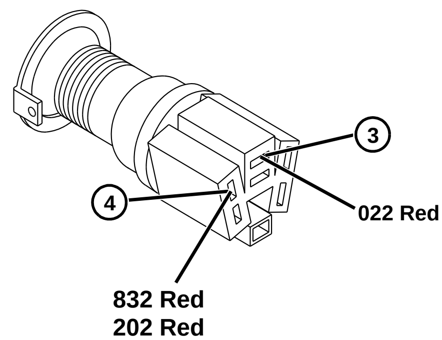
- Key switch in RUN position (engine not running).
- Mow/transport lever in TRANSPORT position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

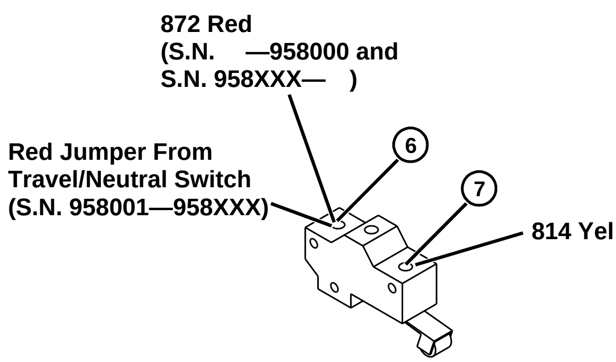
Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link (F1), rust wire no. 032, red wires No. 002 and 022, 15-amp fuse (F3), and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 802 and 812 and connections.
Controller module—Terminal D of six terminal female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/blk wire No. 410, red wires No. 812, 802 and connections.
6. Mow/transport switch—COMMON terminal (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
Mow/transport switch—COMMON terminal (S.N. 958001—958XXX).	Battery voltage.	Test red jumper from travel/neutral switch, red wires No. 802, 812, 872 and connections.
7. Mow/transport switch—NORMALLY CLOSED terminal.	No voltage (open circuit).	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)

Continued on page 4-116.

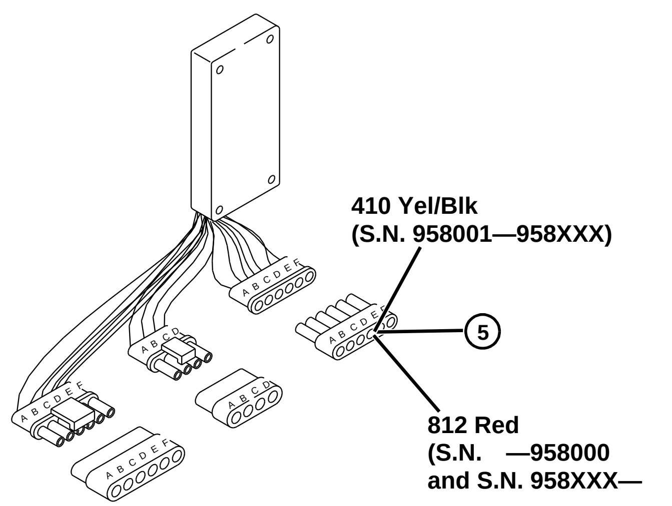








S2 Mow/Transport Switch



CUTTING UNIT—LOWER CIRCUIT DIAGNOSIS, continued

Test Conditions:

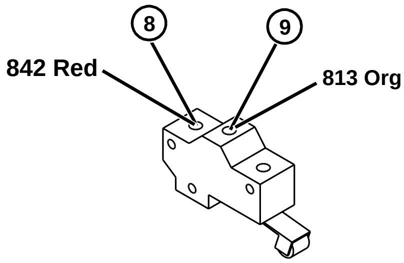
- Key switch in RUN position (engine not running).
- Mow/transport lever in TRANSPORT position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

NOTE: For test point 9—10, push lower pedal and hold down to close switch.

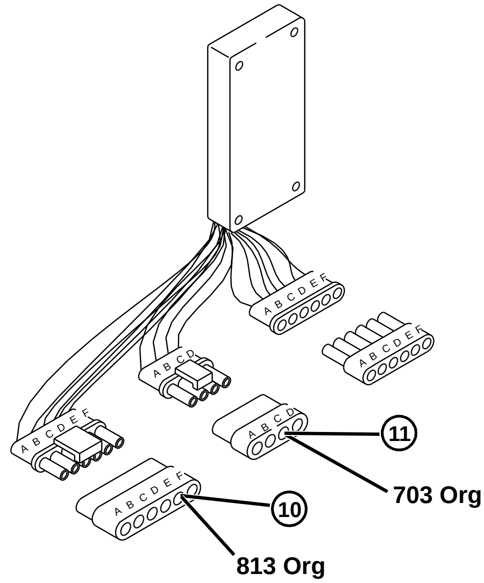
Test Location	Normal	If Not Normal
8. Cutting unit lower switch—COMMON Terminal.	Battery voltage.	Test red wires No. 832 and 842 and connections.
9. Cutting unit lower switch—NORMALLY OPEN Terminal.	Battery voltage.	Test cutting unit lower switch. (See INTERLOCK SWITCH TEST on page 4-222.)
10. Controller module—Terminal E of six terminal male connector.	Battery voltage.	Test orange wire No. 813 and connections.

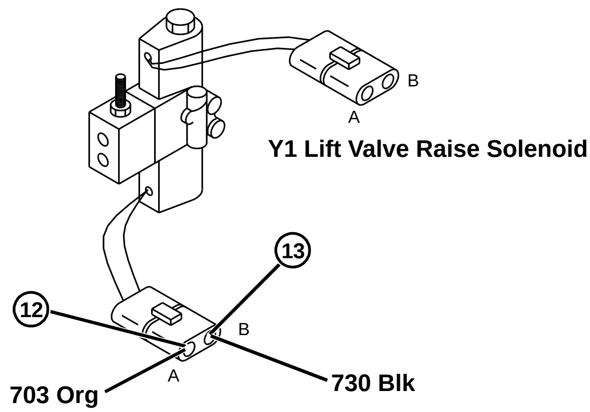
NOTE: At test points 11 and 12, voltage is applied for only six seconds after mow pedal is pushed. Push mow pedal again, if time expires before all checks can be made.

Test Location	Normal	If Not Normal
11. Controller module—Terminal C of four terminal male connector.	Battery voltage.	Test or replace controller module.
12. Lift valve lower solenoid.	Battery voltage.	Test orange wire No. 703 and connections.
13. Lift valve lower solenoid.	Less than 0.2 volt.	Test black wires No. 730 and 700, lower solenoid and ground connections.



S3 Cutting Unit Lower Switch





Y2 Lift Valve Lower Solenoid

CUTTING UNIT—RAISE CIRCUIT OPERATION (S.N. —958000 and S.N. 958XXX—)

Function:

To raise cutting units with mow/transport lever in the TRANSPORT position.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the TRANSPORT position.
- Cutting unit raise switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

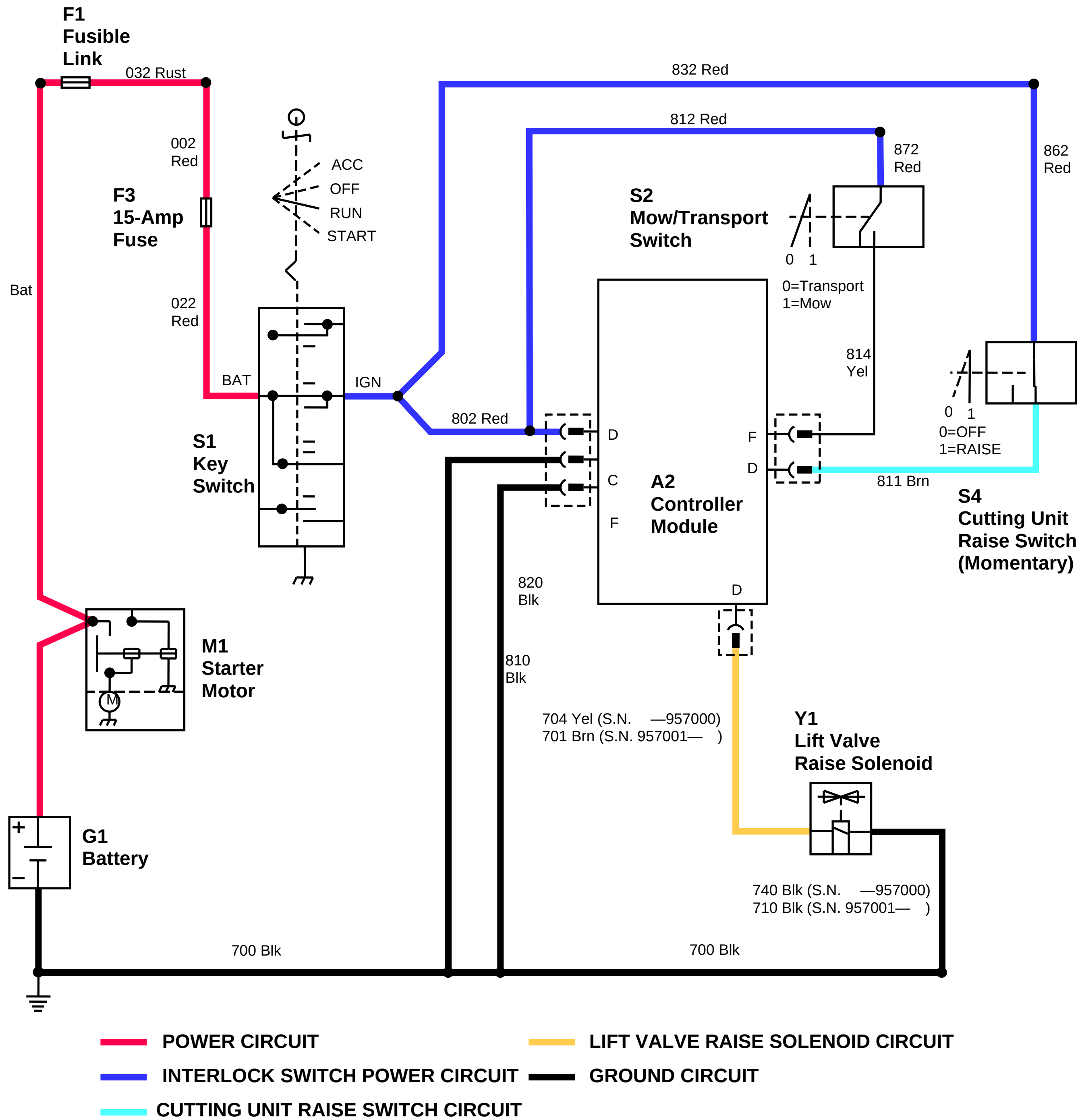
With the key switch in the RUN position, current is supplied to the controller module (A1) (red wire No. 812), mow/transport switch (S2) (red wires No. 812 and 872), and cutting unit lift switch (S4) (red wires No. 832 and 852).

As the raise switch is engaged, current is routed to the controller module (brown wire No. 811). The controller module then routes current to the raise solenoid (yellow wire No. 704 [S.N. —958000], or brown wire No. 701 [S.N. 958XXX—]).

The ground circuit connected to the raise solenoid (black wires No. 740 and 700 [S.N. —957000], or black wires No. 710 and 700 [S.N. 957001—]) complete the circuit and allow the cutting units to be raised. Black wires No. 810, 820 and 700 provide a ground circuit for the controller module.

NOTE: Cutting units can be raised while operator is off the seat if controller module senses voltage from the parking brake and travel/neutral switches and no voltage from the mow/transport switch.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have been fully raised. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


F1
Fusible
Link
032 Rust
832 Red
812 Red
002
Red
ACC
OFF
RUN
START
872
Red
862
Red
F3
15-Amp
Fuse
S2
Mow/Transport
Switch
0 1
0=Transport
1=Mow
Bat
022
Red
814
Yel
BAT
IGN
0 1
0=OFF
1=RAISE
802 Red
D
F
D
C
F
S1
Key
Switch
A2
Controller
Module
811 Brn
S4
Cutting Unit
Raise Switch
(Momentary)
820
Blk
D
M1
Starter
Motor
M
810
Blk
704 Yel (S.N. —957000)
701 Brn (S.N. 957001—)
Y1
Lift Valve
Raise Solenoid
G1
Battery
740 Blk (S.N. —957000)
710 Blk (S.N. 957001—)
700 Blk
700 Blk
POWER CIRCUIT
LIFT VALVE RAISE SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
CUTTING UNIT RAISE SWITCH CIRCUIT

MC83646

CUTTING UNIT—RAISE CIRCUIT OPERATION (S.N. 958001—958XXX)

Function:

To raise cutting units with mow/transport lever in the TRANSPORT position.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the TRANSPORT position.
- Cutting unit raise switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

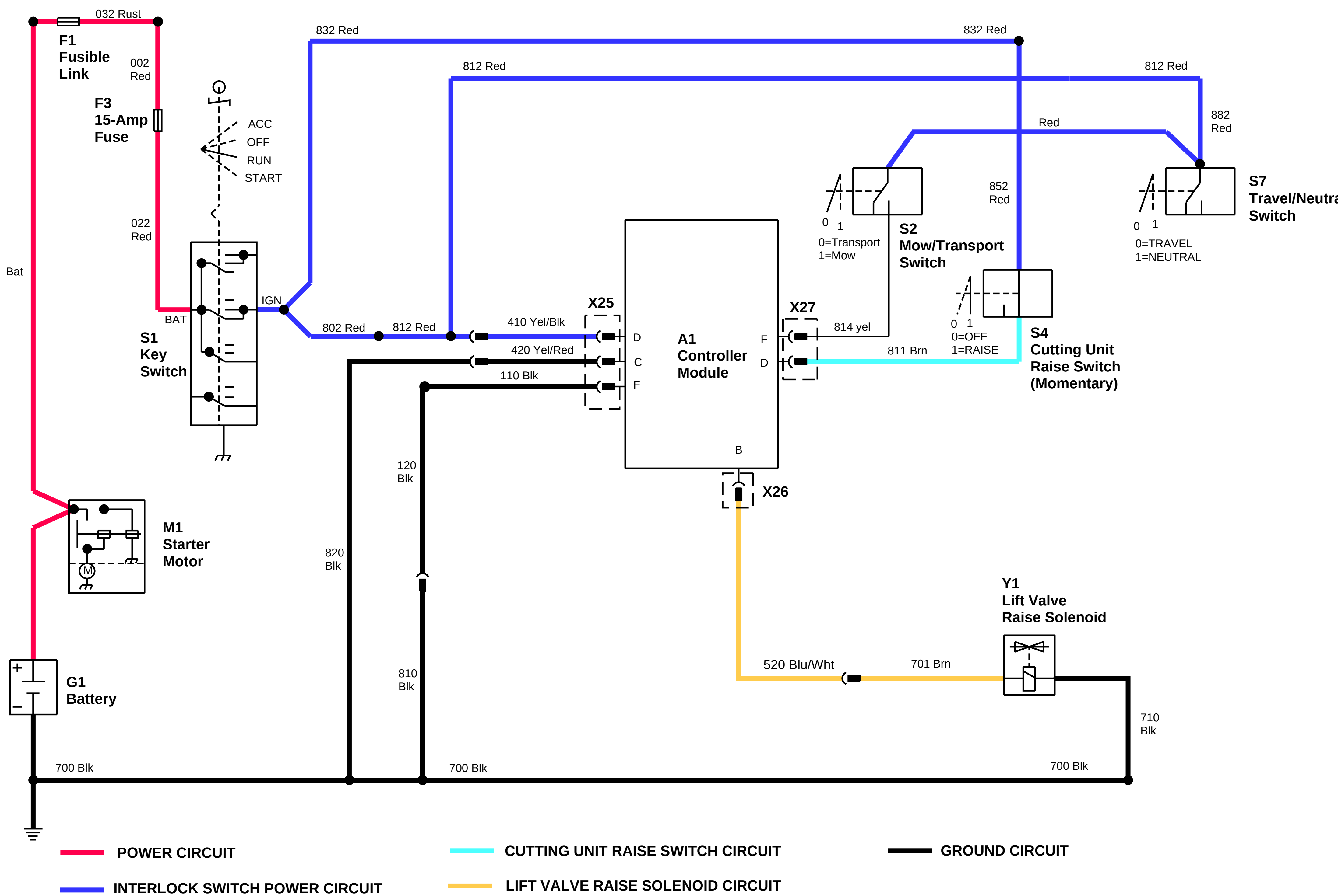
With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802, 812 and yellow/black wire No. 410), travle neutral switch (S7) (red wires No. 882, 812 and 802) and mow/ transport switch (S2) (red jumper from travel/neutral switch), and cutting unit raise switch (S4) (red wires No. 832 and 852).

As the raise switch is engaged, current is routed to the controller module (brown wire No. 811). The controller module then routes current to the raise solenoid (brown wire No. 701 and blue/white wire No. 520).

The ground circuit connected to the raise solenoid (black wires No. 710 and 700) complete the circuit and allow the cutting units to be raised. A ground Circuit for the controller module is provided by yellow/balck wire No. 420 and black wires No. 420, 820, 110, 120, 810 and 700.

NOTE: Cutting units can be raised while operator is off the seat if controller module senses voltage from the parking brake and travel/neutral switches and no voltage from the mow/ transport switch.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have been fully raised. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.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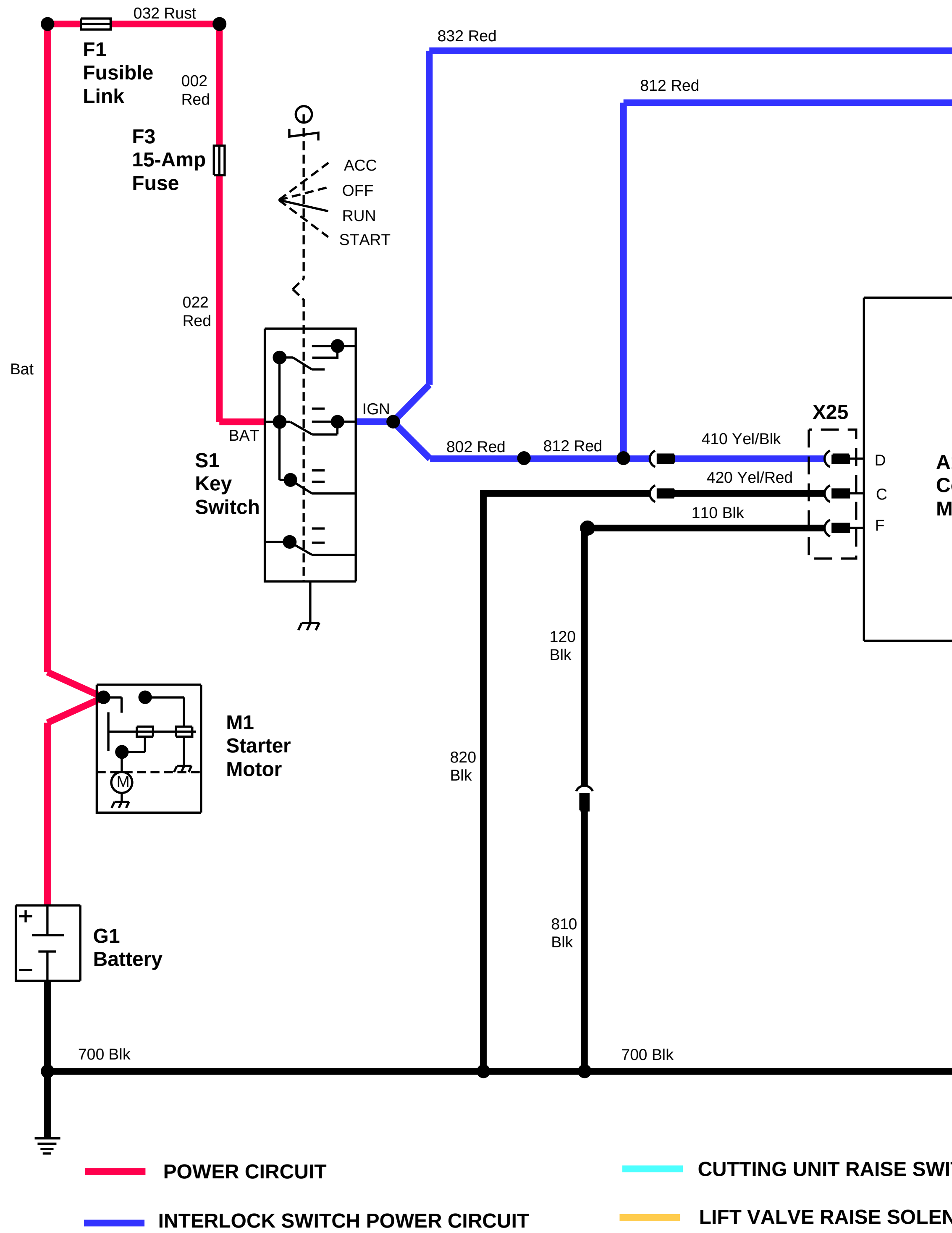
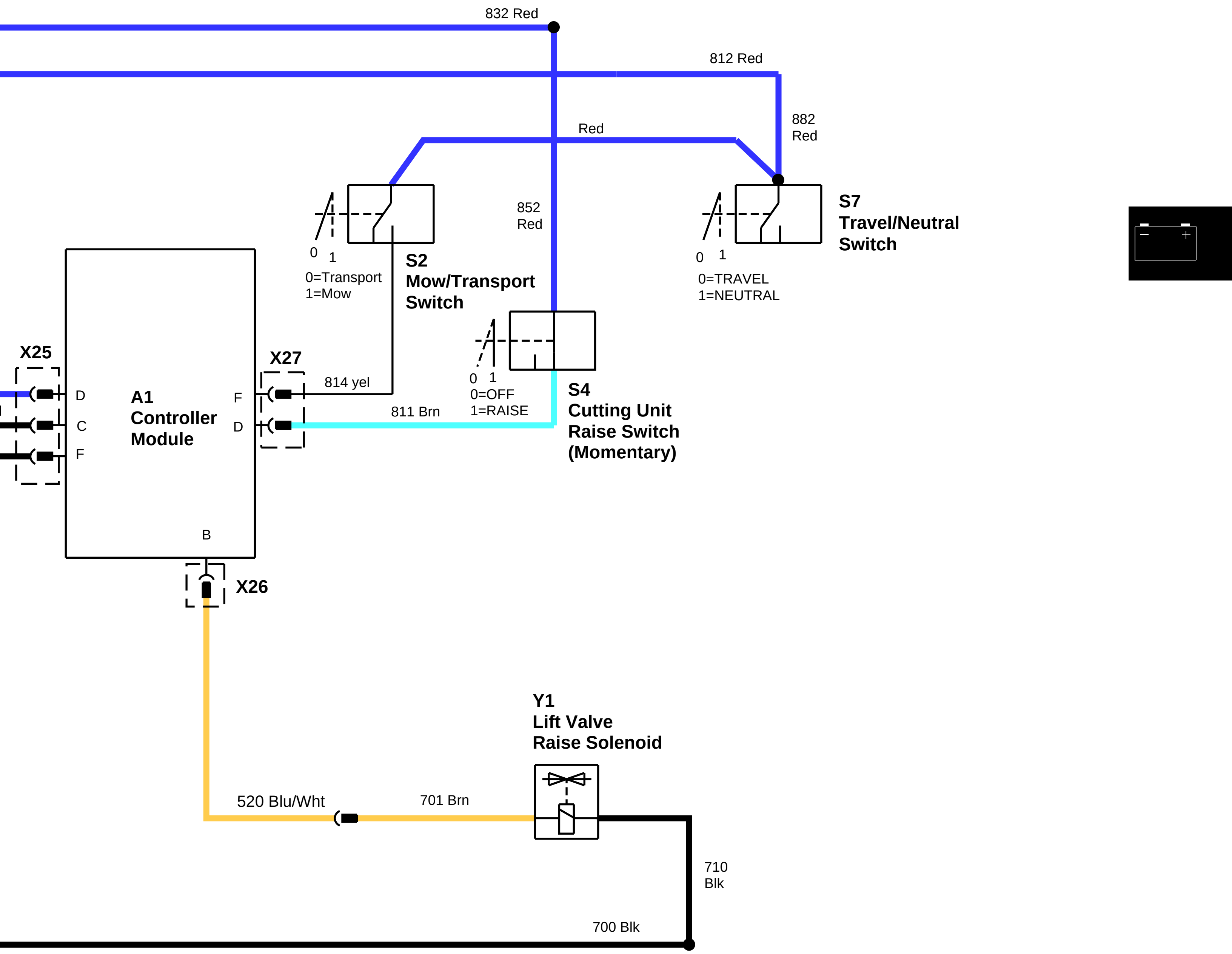
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
Bat
ACC
OFF
RUN
START
BAT
IGN
S1
Key
Switch
832 Red
812 Red
802 Red
812 Red
410 Yel/Blk
420 Yel/Red
110 Blk
X25
D
C
F
A1
Controller
Module
B
X26
X27
F
D
814 yel
811 Brn
Red
852
Red
882
Red
0 1
0=Transport
1=Mow
S2
Mow/Transport
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral
Switch
0 1
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
(Momentary)
M1
Starter
Motor
M
120
Blk
820
Blk
810
Blk
Y1
Lift Valve
Raise Solenoid
520 Blu/Wht
701 Brn
710
Blk
G1
Battery
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
CUTTING UNIT RAISE SWITCH CIRCUIT
LIFT VALVE RAISE SOLENOID CIRCUIT
GROUND CIRCUIT

M83722


032 Rust
F1
Fusible
Link
002
Red
832 Red
812 Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
Bat
IGN
BAT
S1
Key
Switch
802 Red
812 Red
410 Yel/Blk
X25
D
420 Yel/Red
C
110 Blk
F
120
Blk
M1
Starter
Motor
820
Blk
810
Blk
G1
Battery
700 Blk
700 Blk
POWER CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
CUTTING UNIT RAISE SWI
LIFT VALVE RAISE SOLEN



UNIT RAISE SWITCH CIRCUIT

GROUND CIRCUIT

VE RAISE SOLENOID CIRCUIT

M83722

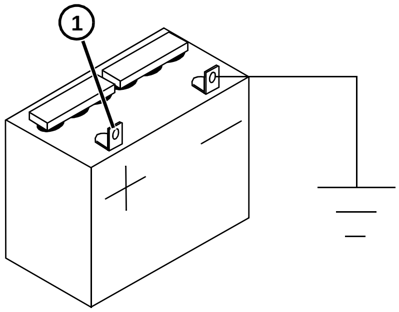
CUTTING UNIT—RAISE CIRCUIT DIAGNOSIS

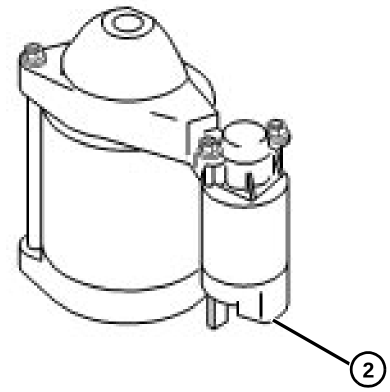
Test Conditions:

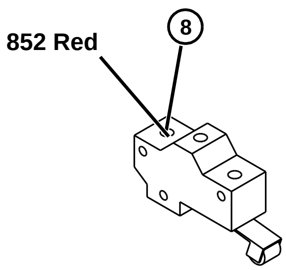
- Key switch in RUN position.
- Mow/transport lever in TRANSPORT position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector (S.N. —958000 and S.N. 958XXX—).	Battery voltage.	Test red wires No. 802, 812 and connections.
Controller module—Terminal D of six pin female connector (S.N. 958001—958XXX).	Battery voltage.	Test yellow/black wire No. 410, red wires No. 812, 802, and connections.
6. Mow/transport switch—COMMON terminal (S.N. —958000 and S.N. 958XXX—)	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
Mow/transport switch—COMMON terminal. (S.N. 958001—958XXX)	Battery voltage.	Test red jumper from travel/neutral switch, red wires No. 802, 812, 882 and connections.
7. Mow/transport switch—NORMALLY CLOSED terminal.	No voltage (open circuit).	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Cutting unit raise switch—COMMON terminal.	Battery voltage.	Test red wires No. 832 and 852 and connections.

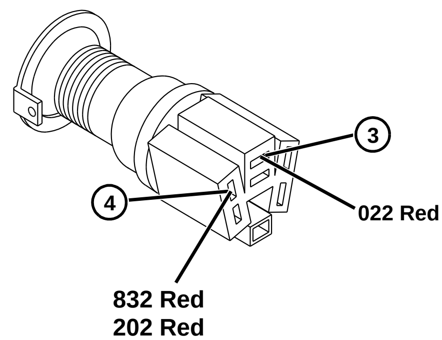
Continued on page 4-124.

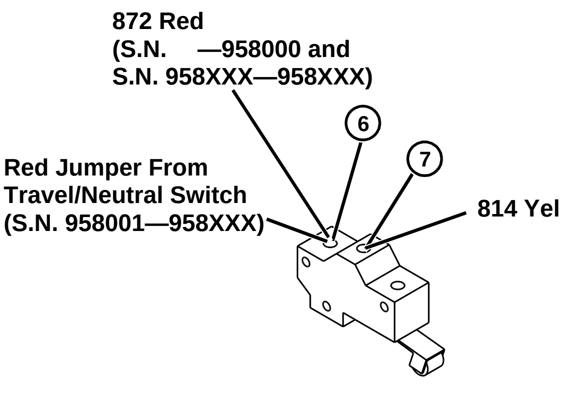




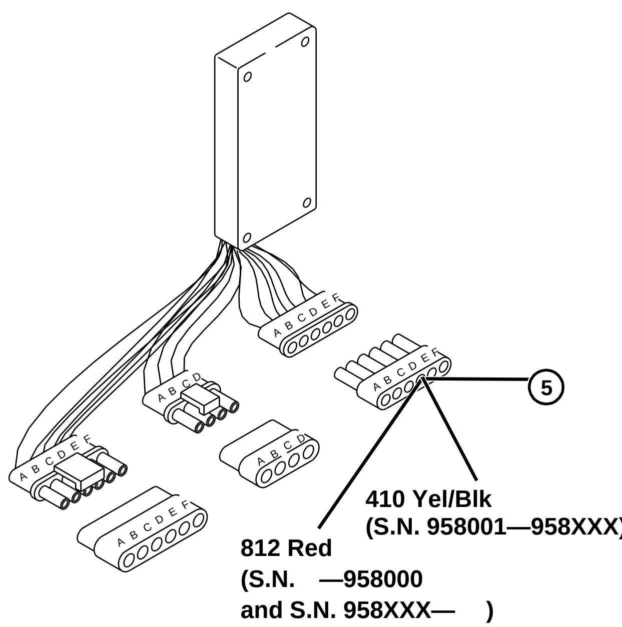


S4 Cutting Unit Raise Switch





S2 Mow/Transport Switch



CUTTING UNIT—RAISE CIRCUIT DIAGNOSIS, continued

Test Conditions:

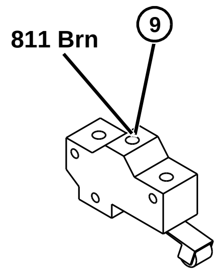
- Key switch in RUN position.
- Mow/transport lever in TRANSPORT position.

NOTE: For test point 9 and 10, push raise pedal and hold down to close switch.

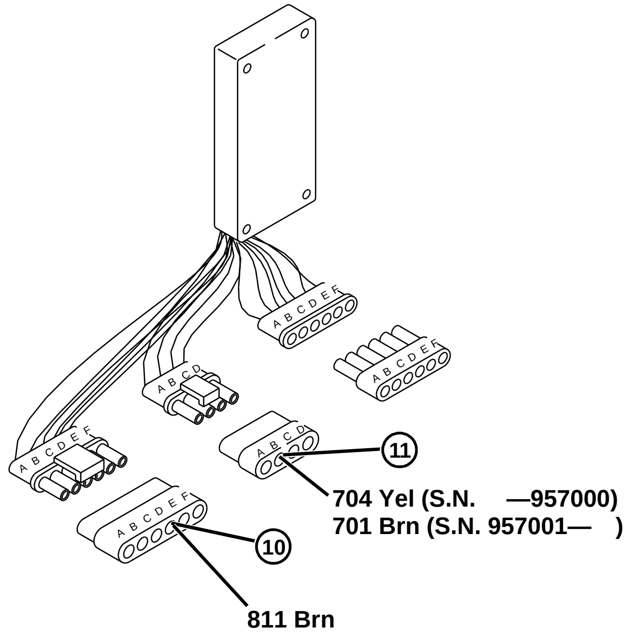
Test Location	Normal	If Not Normal
9. Cutting unit raise switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit raise switch. (See INTERLOCK SWITCH TEST on page 4-222.)
10. Controller module—Terminal D of six terminal male connector	Battery voltage.	Test brown wire No. 811 and connections.

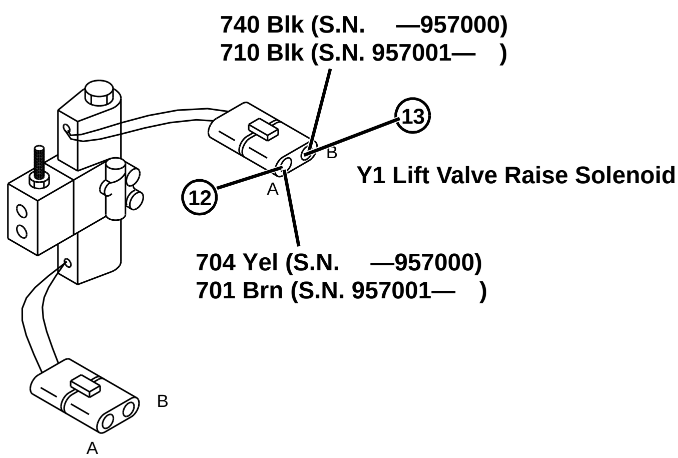
NOTE: At test points 11, 12, and 13 voltage is applied for only six seconds after mow pedal is pushed. Push raise pedal again, if time expires before all test points can be checked.

Test Location	Normal	If Not Normal
11. Controller module—Terminal B of four terminal male connector	Battery voltage.	Test or replace controller module.
12. Lift valve raise solenoid (S.N. —957000)	Battery voltage.	Test brown wire No. 704 and connections.
Lift valve raise solenoid (S.N. 957001—)	Battery voltage.	Test yellow wire No. 701 and connections.
13. Lift valve raise solenoid (S.N. —957000)	Less than 0.2 volt.	Test black wires No. 740 and 700, raise solenoid and ground connections.
Lift valve raise solenoid	Less than 0.2 volt.	Test black wires No. 710 and 700, raise solenoid and ground connections.



S4 Cutting Unit Raise Switch





Y2 Lift Valve Lower Solenoid

MOW CIRCUIT—ENGAGE OPERATION (S.N. —958000)

Function:

To operate reel motors when cutting units are lowered.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Operator on seat.
- Mow/transport lever in the MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

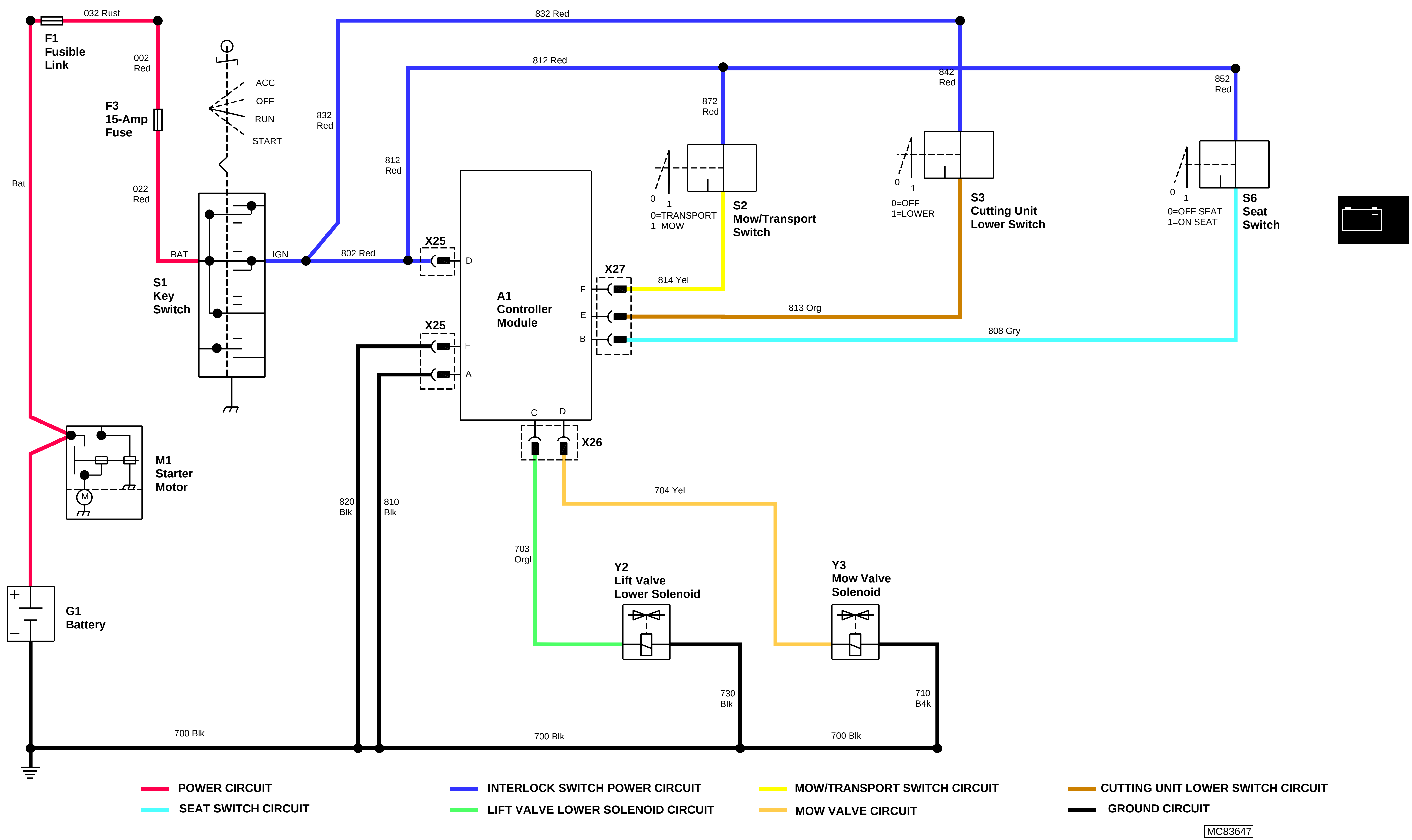
With the key switch in the RUN position, current is supplied to the controller module (A1) (red wire No. 812) and mow/transport switch (S2) (red wires No. 802, 812 and 872) and seat switch (S7) (red wires No. 802, 812 and 892). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842).

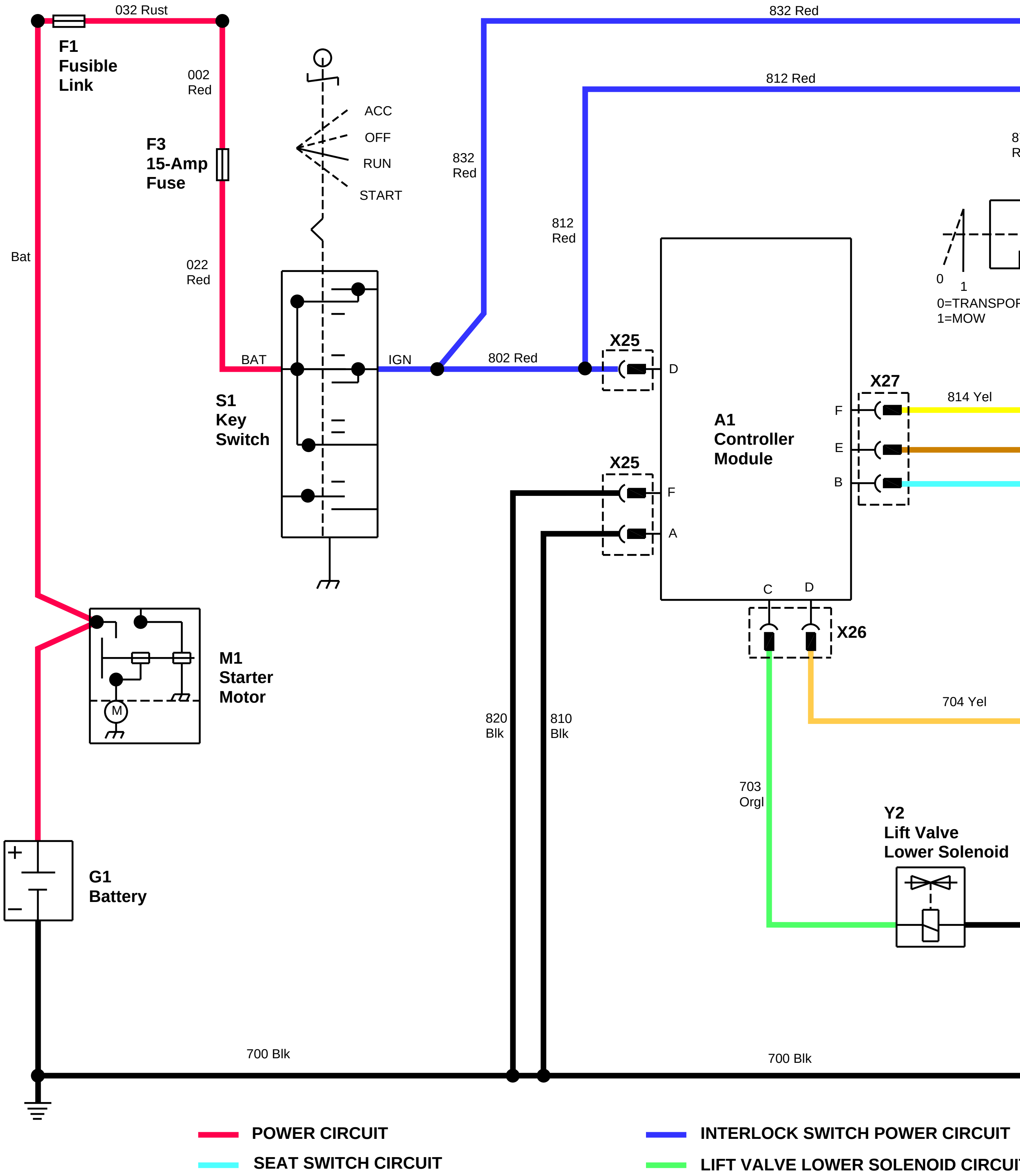
NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

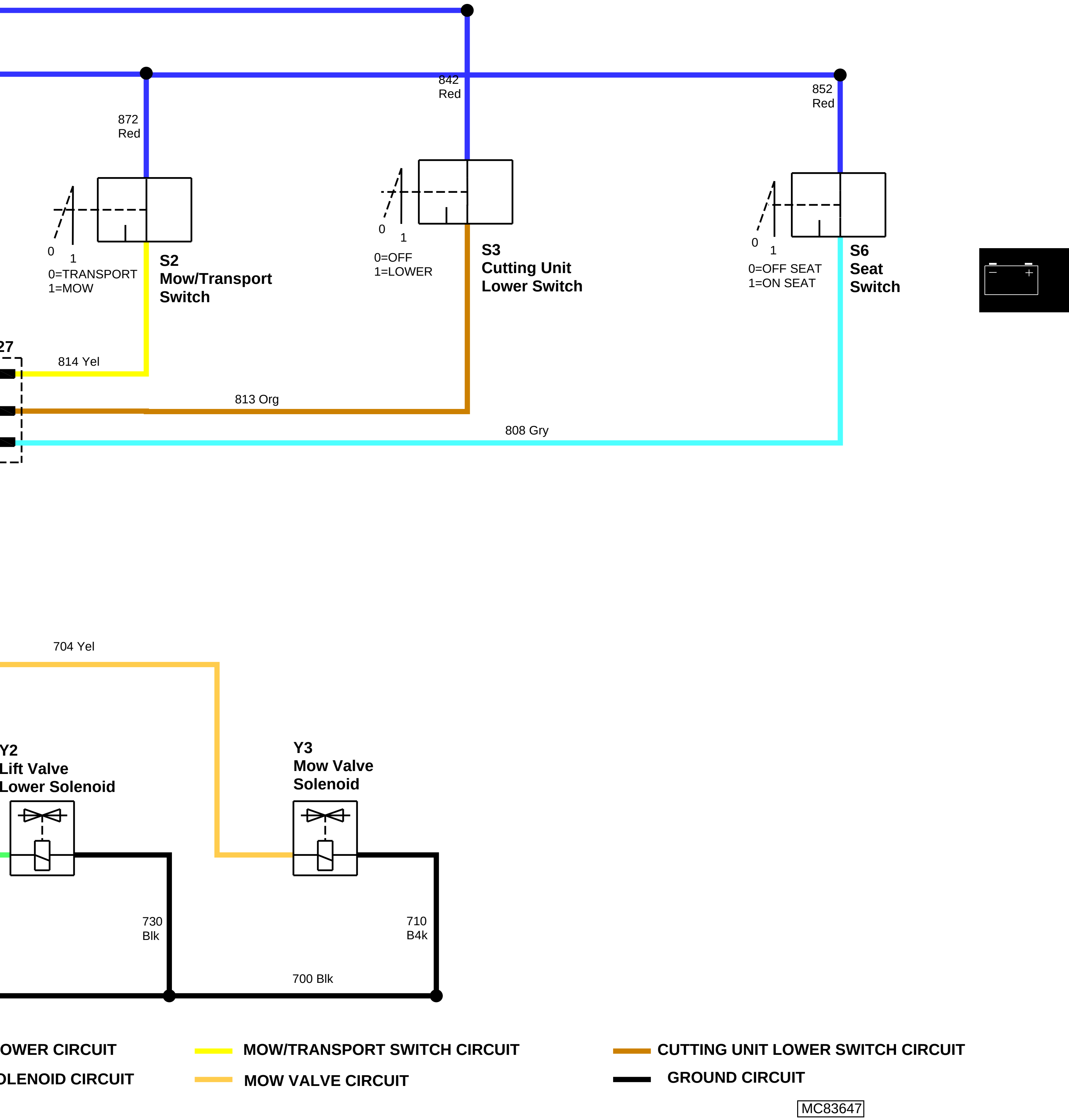
With the operator on the seat current is sent to the controller module (gray wire No. 808). As the mow/ transport lever is moved to the MOW position, the mow/ transport switch is released sending current to the controller module (yellow wire No. 814). The controller module then routes current to the lift valve lower solenoid (Y2) (orange wire No. 703). A path to ground (black wires No. 730 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

Current is also supplied to the mow valve solenoid (Y3) (yellow wire No. 704). A path to ground (black wires No. 710) completes the circuit, energizing the mow valve lower solenoid, engaging the cutting units.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
022
Red
Bat
ACC
OFF
RUN
START
BAT
IGN
S1
Key
Switch
832 Red
832
Red
812 Red
812
Red
802 Red
X25
D
A1
Controller
Module
X25
F
A
872
Red
842
Red
852
Red
0
1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0
1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
0
1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
X27
F
E
B
814 Yel
813 Org
808 Gry
C
D
X26
704 Yel
M1
Starter
Motor
820
Blk
810
Blk
703
Orgl
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
G1
Battery
730
Blk
710
B4k
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
SEAT SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
MOW VALVE CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
GROUND CIRCUIT
MC83647


032 Rust
832 Red
812 Red
F1
Fusible
Link
002
Red
ACC
OFF
RUN
START
F3
15-Amp
Fuse
832
Red
812
Red
Bat
022
Red
0
1
0=TRANSPOR
1=MOW
X25
BAT
IGN
802 Red
D
X27
S1
Key
Switch
814 Yel
F
A1
Controller
Module
E
B
X25
F
A
C
D
X26
M1
Starter
Motor
704 Yel
820
Blk
810
Blk
703
Orgl
Y2
Lift Valve
Lower Solenoid
G1
Battery
700 Blk
700 Blk
POWER CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
SEAT SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUI



872
Red
842
Red
852
Red
0
1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0
1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
0
1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
27
814 Yel
813 Org
808 Gry
704 Yel
Y2
Lift Valve
Lower Solenoid
Y3
Mow Valve
Solenoid
730
Blk
710
B4k
700 Blk
OWER CIRCUIT
OLENOID CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
MOW VALVE CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
GROUND CIRCUIT
MC83647

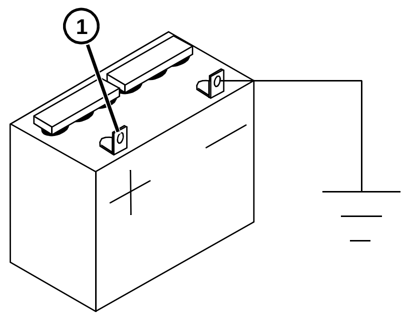
MOW CIRCUIT—ENGAGE DIAGNOSIS (S.N. —958000)

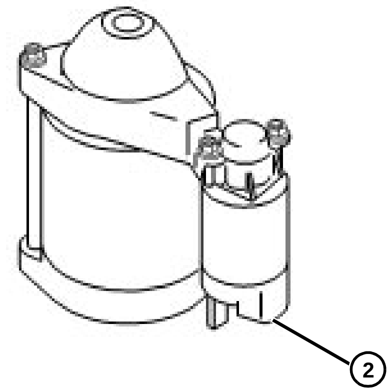
Test Conditions:

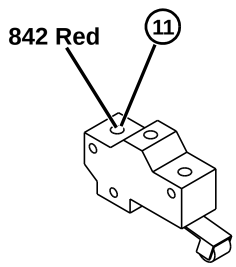
- Key switch in RUN position (engine not running).
- Mow/transport lever in MOW position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Mow/transport switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 872 and connections.
7. Mow/transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
9. Seat switch	Battery voltage.	Test red wires No. 802, 812, 892 and connections.
10. Seat switch (seat occupied)	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
11. Cutting unit lower switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

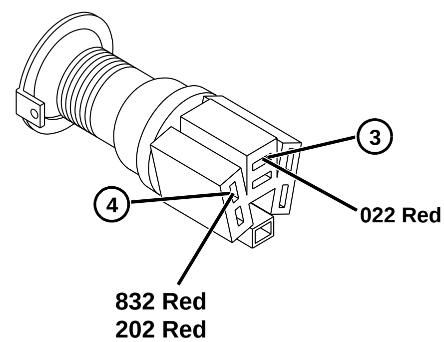
Continued on page 4-130.

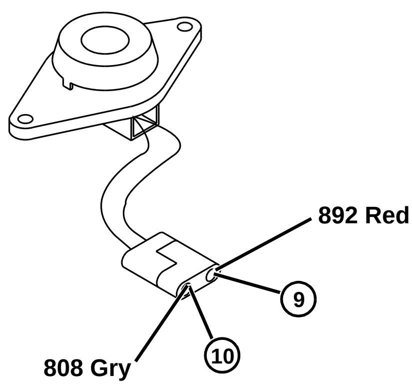


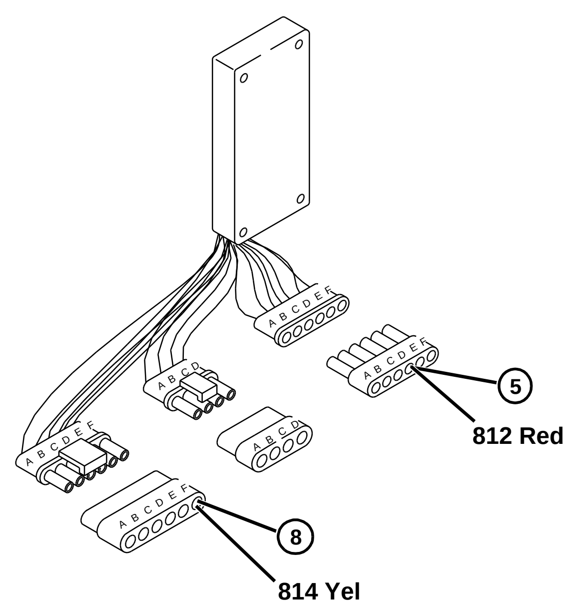


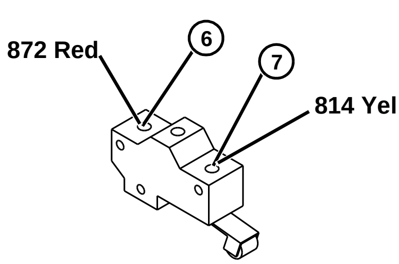


S3 Cutting Unit Lower Switch









S2 Mow/Transport Switch

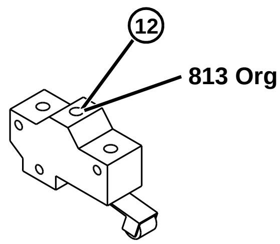
MOW CIRCUIT—ENGAGE DIAGNOSIS, continued

Test Conditions:

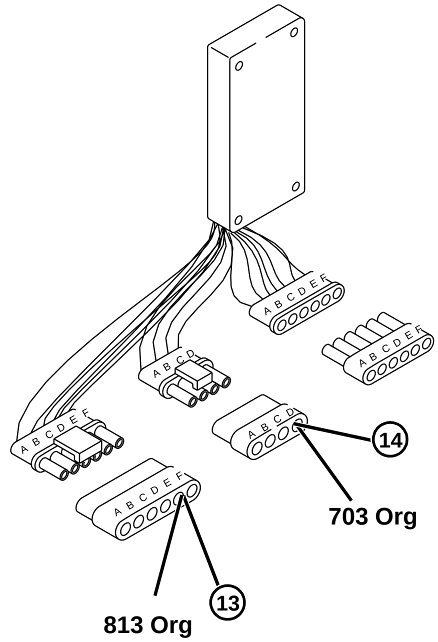
- Key switch in RUN position (engine not running).
- Mow/transport lever in MOW position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

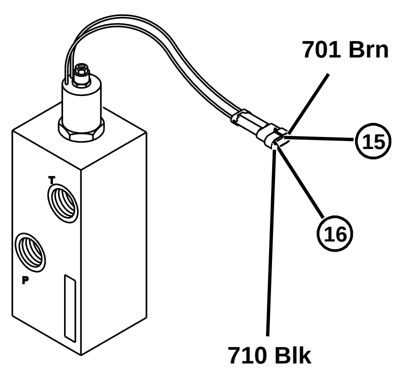
NOTE: For test points 12—16, push lower pedal and hold down to close switch.

Test Location	Normal	If Not Normal
12. Cutting unit lower switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit mow switch. (See INTERLOCK SWITCH TEST on page 4-222 .)
13. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
14. Controller module—Terminal D of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
15. Mow valve solenoid	Battery voltage.	Test brown wire No. 701 and connections.
16. Mow valve solenoid	Less than 0.2 volt.	Test black wires No. 710 and 700, mow solenoid and ground connections.



S3 Cutting Unit Lower Switch





MOW CIRCUIT—ENGAGE OPERATION (S.N. 958001—958XXX)

Function:

To operate reel motors when cutting units are lowered.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wire No. 802, 812 and yelow/black wire No. 410), seat switch (S6) (red wires No. 892, 812 and 802), travel/neutral switch (S7) (red wires No. 882, 812 and 802) and mow/transport switch (S2) (red jumper from travel/neutral switch). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842).

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

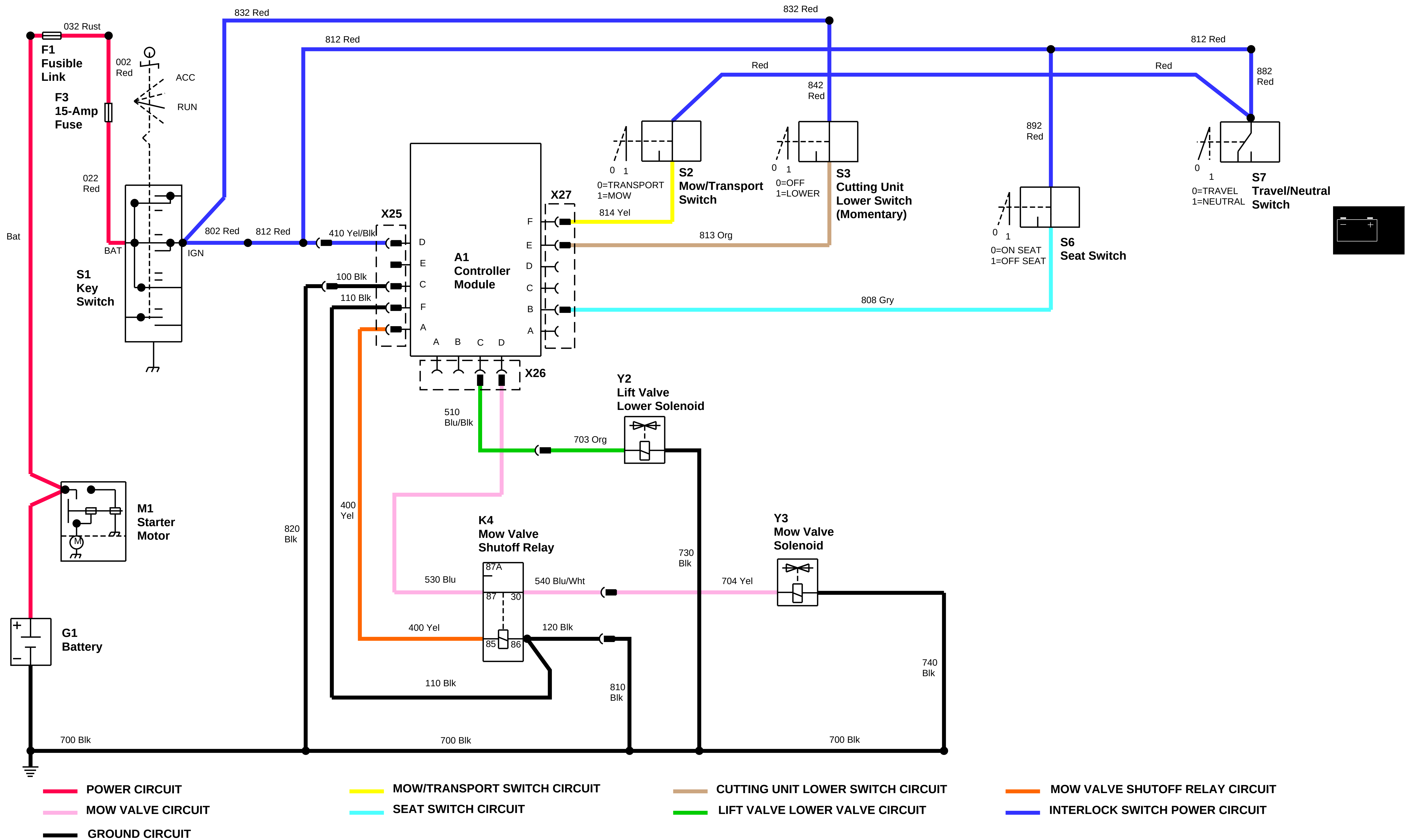
As the mow/transport lever is moved to the MOW position, the mow/transport switch is released sending current to the controller module (yellow wire No. 814).

When the cutting unit lower switch is depressed, current is sent to the controller module (orange wire No. 813) The controller module then routes current to the lift valve lower solenoid (Y2) (orange wire No. 703 and blue/black wire No. 510). A path to ground (black wires No. 730 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

With the operator on the seat, current is routed to the controller module (pink wire No. 800). Current is then supplied to the coil of the mow valve shutoff relay (K4) (yellow wire No. 400), energizing the relay. A path to ground for the relay is provided by black wires No. 120, 810 and 700. Current is also provided to terminal 87 of the relay (blue wire No. 530).

When the mow shutoff relay is energized, current is also supplied to the mow valve solenoid (Y3) (yellow wire No. 704 and blue/wht wire No. 540). A path to ground (black wires No. 740 and 700) completes the circuit, energizing the mow valve lower solenoid, engaging the cutting units.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.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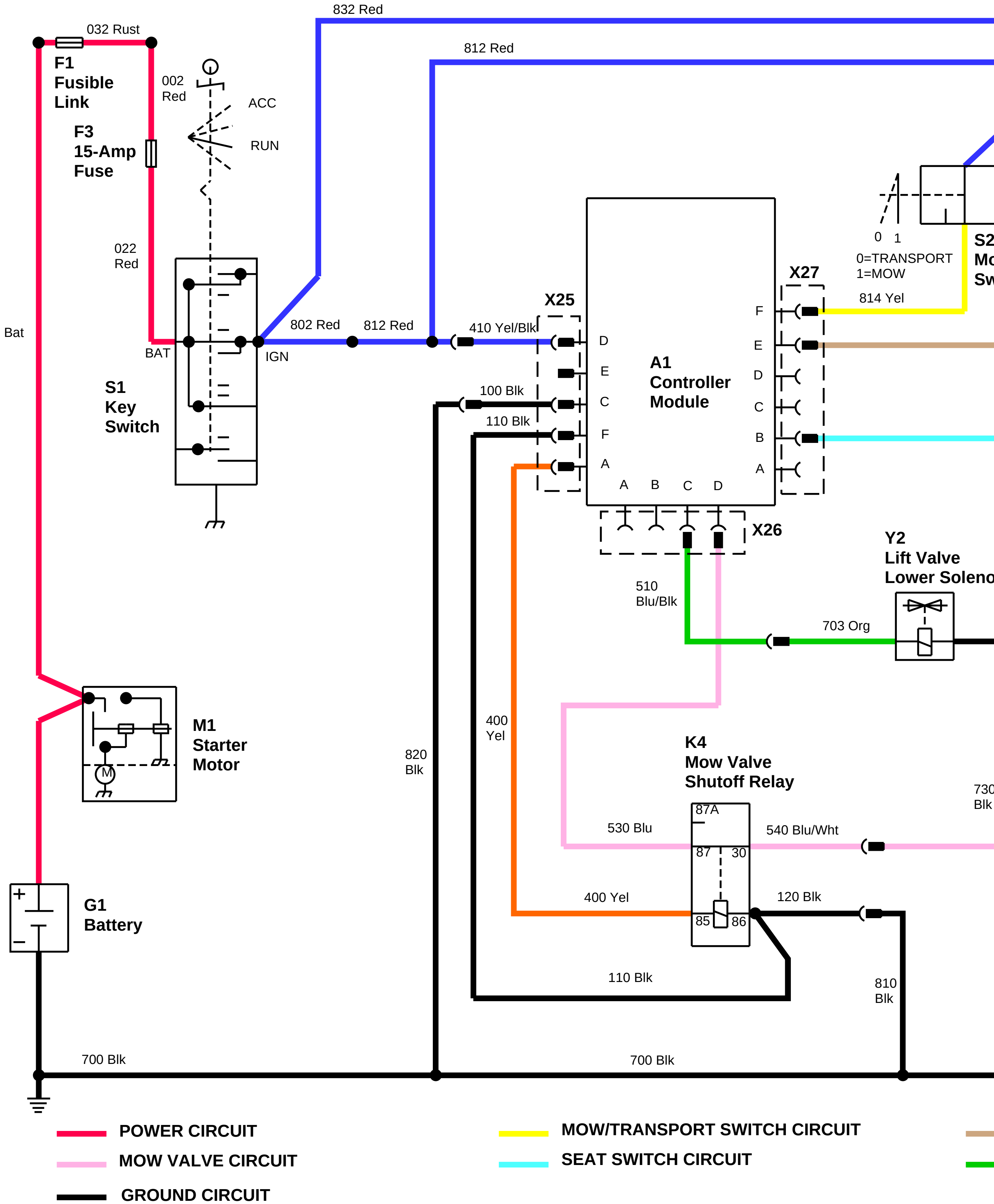
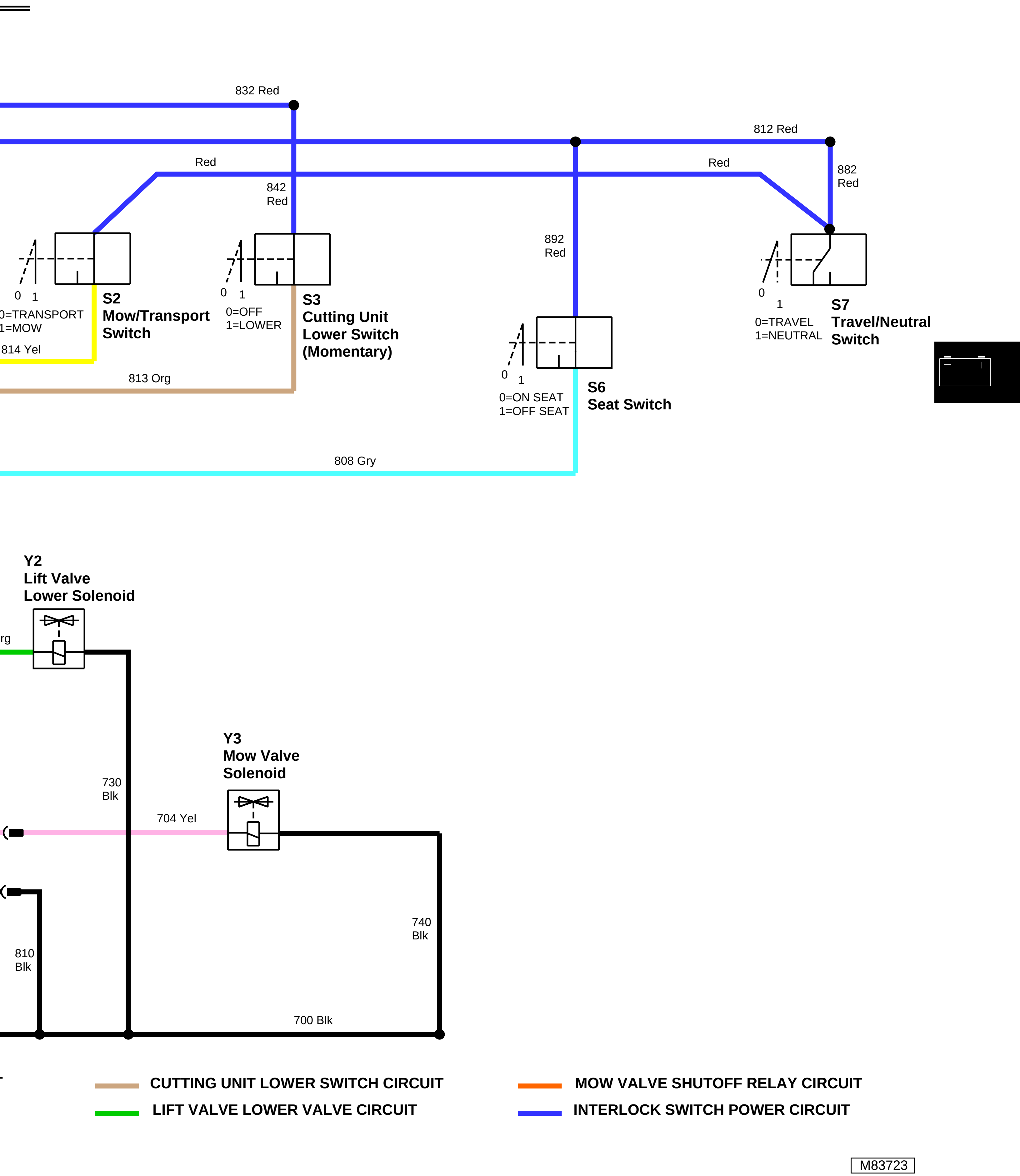
F1 Fusible Link
002 Red
ACC
RUN
F3 15-Amp Fuse
022 Red
Bat
BAT
IGN
S1 Key Switch
832 Red
812 Red
802 Red
812 Red
410 Yel/Blk
X25
100 Blk
110 Blk
A1 Controller Module
X27
X26
Red
842 Red
882 Red
892 Red
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch (Momentary)
0=ON SEAT
1=OFF SEAT
S6 Seat Switch
0=TRAVEL
1=NEUTRAL
S7 Travel/Neutral Switch
814 Yel
813 Org
808 Gry
510 Blu/Blk
703 Org
Y2 Lift Valve Lower Solenoid
M1 Starter Motor
820 Blk
400 Yel
K4 Mow Valve Shutoff Relay
530 Blu
540 Blu/Wht
704 Yel
730 Blk
Y3 Mow Valve Solenoid
400 Yel
120 Blk
110 Blk
810 Blk
740 Blk
G1 Battery
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
GROUND CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER VALVE CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT

M83723


832 Red
812 Red
032 Rust
F1
Fusible
Link
002
Red
ACC
RUN
F3
15-Amp
Fuse
022
Red
Bat
BAT
IGN
802 Red
812 Red
410 Yel/Blk
X25
S1
Key
Switch
100 Blk
110 Blk
D
E
C
F
A
A1
Controller
Module
A
B
C
D
X26
X27
F
E
D
C
B
A
0
1
0=TRANSPORT
1=MOW
814 Yel
S2
Mo
Sw
Y2
Lift Valve
Lower Soleno
510
Blu/Blk
703 Org
M1
Starter
Motor
820
Blk
400
Yel
K4
Mow Valve
Shutoff Relay
730
Blk
87A
87
30
85
86
530 Blu
540 Blu/Wht
400 Yel
120 Blk
110 Blk
810
Blk
G1
Battery
700 Blk
700 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
GROUND CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT


832 Red
812 Red
Red
Red
842 Red
882 Red
892 Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport Switch
814 Yel
0 1
0=OFF
1=LOWER
S3
Cutting Unit Lower Switch (Momentary)
813 Org
0 1
0=ON SEAT
1=OFF SEAT
S6
Seat Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/Neutral Switch
808 Gry
Y2
Lift Valve Lower Solenoid
rg
Y3
Mow Valve Solenoid
730 Blk
704 Yel
740 Blk
810 Blk
700 Blk
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER VALVE CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
M83723

MOW CIRCUIT—ENGAGE OPERATION (S.N. 958XXX—)

Function:

To operate reel motors when cutting units are lowered.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Operator on seat.
- Mow/transport lever in the MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812) and mow/transport switch (S2) (red wires No. 872, 812 and 802) and seat switch (S6) (red wires No. 892, 812 and 802). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842).

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

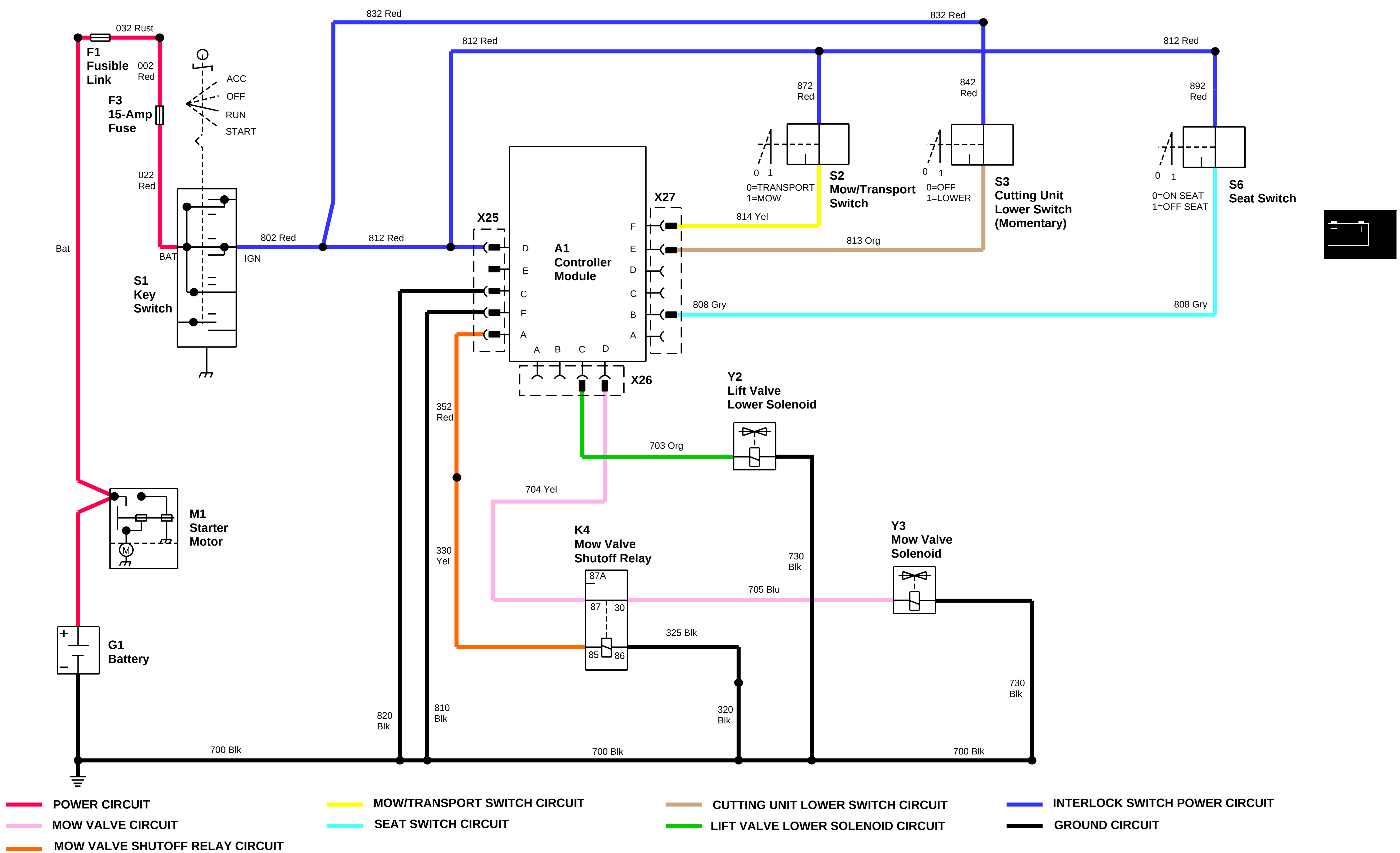
As the mow/transport lever is moved to the MOW position, the mow/transport switch is released sending current to the controller module (yellow wire No. 814).

When the cutting unit lower switch is depressed, current is sent to the controller module (orange wire No. 813), The controller module then routes current to the lift valve lower solenoid (Y2) (orange wire No. 703). A path to ground (black wires No. 730 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

With the operator on the seat, current is routed to the controller module (gray wire No. 808). Current is then supplied to the coil of the mow valve shutoff relay (K4) (yellow wire No. 330 and red wire No. 352), energizing the relay. A path to ground for the relay is provided by black wires No. 325, 320 and 700. Current is also provided to terminal 87 of the relay (yellow wire No. 704).

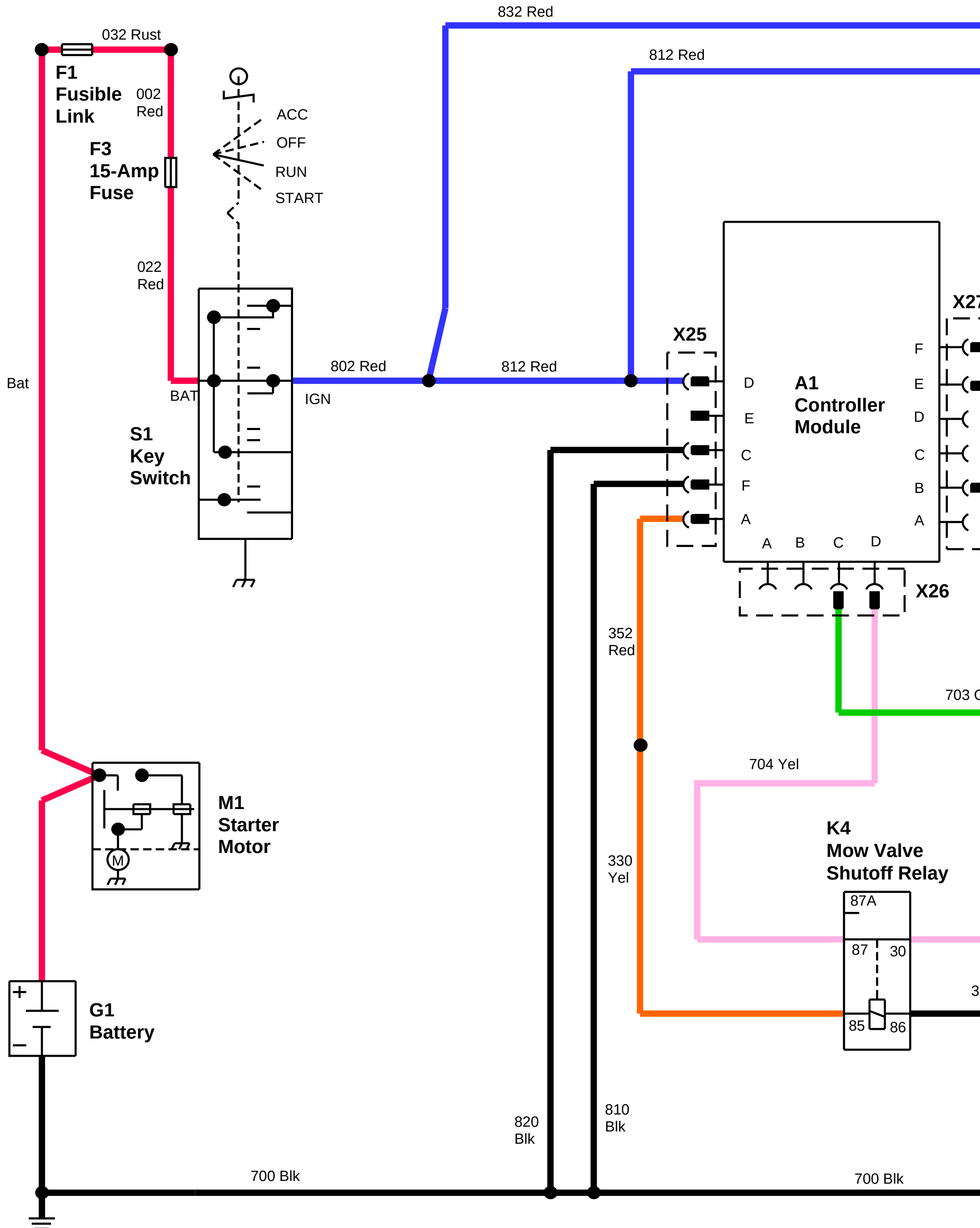
When the mow shutoff relay is energized, current is also supplied to the mow valve solenoid (Y3) (blue wire No. 705). A path to ground (black wires No. 740 and 700 completes the circuit, energizing the mow valve lower solenoid, engaging the cutting units.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.



832 Red
032 Rust
812 Red
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
Bat
BAT
IGN
802 Red
812 Red
S1
Key
Switch
X25
D
E
C
F
A
A1
Controller
Module
X27
F
E
D
C
B
A
A B C D
X26
872
Red
842
Red
892
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
0=ON SEAT
1=OFF SEAT
S6
Seat Switch
814 Yel
813 Org
808 Gry
808 Gry
Y2
Lift Valve
Lower Solenoid
703 Org
352
Red
704 Yel
M1
Starter
Motor
M
K4
Mow Valve
Shutoff Relay
87A
87
30
85
86
330
Yel
730
Blk
705 Blu
Y3
Mow Valve
Solenoid
325 Blk
G1
Battery
+
−
320
Blk
730
Blk
820
Blk
810
Blk
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT

M83703



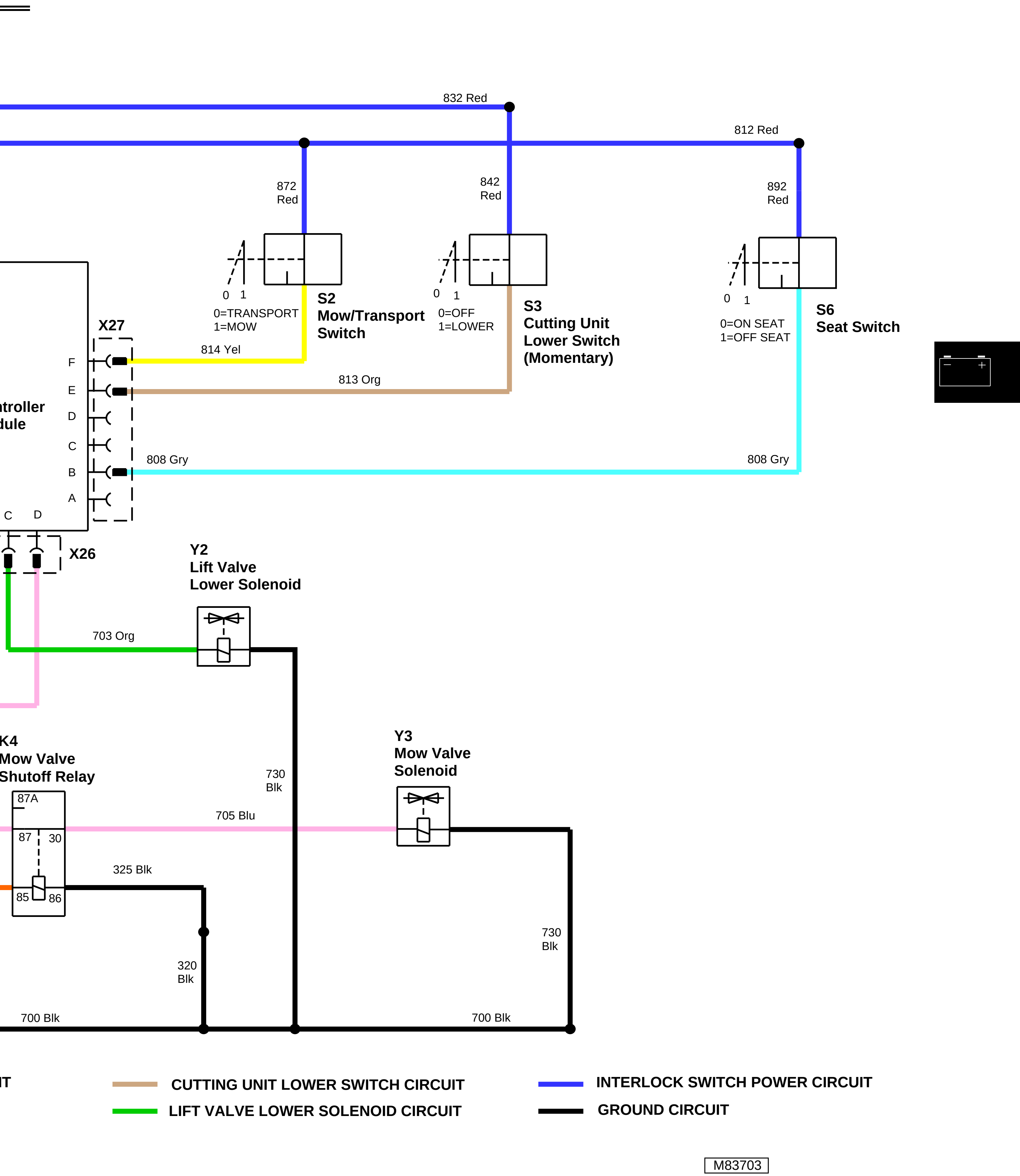
POWER CIRCUIT

MOW VALVE CIRCUIT

MOW VALVE SHUTOFF RELAY CIRCUIT

MOW/TRANSPORT SWITCH CIRCUIT

SEAT SWITCH CIRCUIT


832 Red
812 Red
872 Red
842 Red
892 Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0 1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
0 1
0=ON SEAT
1=OFF SEAT
S6
Seat Switch
X27
814 Yel
813 Org
F
E
D
C
B
A
troller
dule
808 Gry
808 Gry
C D
X26
Y2
Lift Valve
Lower Solenoid
703 Org
K4
Mow Valve
Shutoff Relay
87A
87
30
85
86
730
Blk
705 Blu
Y3
Mow Valve
Solenoid
325 Blk
320
Blk
730
Blk
700 Blk
700 Blk
IT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83703

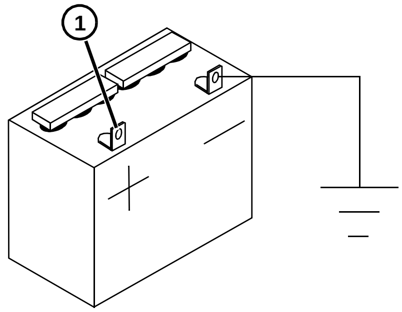
MOW CIRCUIT—ENGAGE DIAGNOSIS (S.N. 958001—)

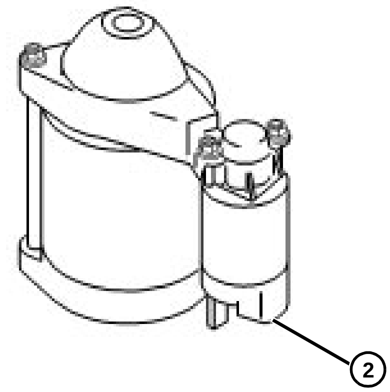
Test Conditions:

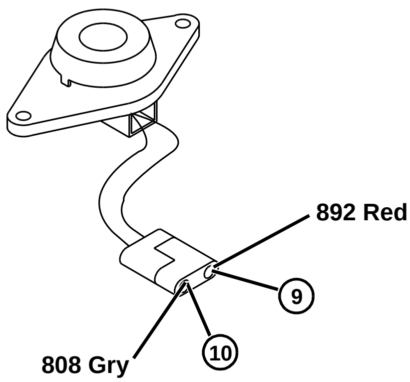
- Key switch in RUN position (engine not running).
- Mow/transport lever in MOW position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

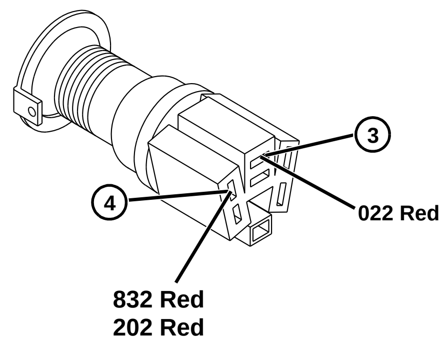
Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector (S.N. 958001—958XXX)	Battery voltage.	Test red wires No. 802, 812, yellow/black wire No. 410 and connections.
Controller module—Terminal D of six terminal female connector (S.N. 958XXX—)	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Mow/transport switch—COMMON terminal (S.N. 958001—958XXX)	Battery voltage.	Test red wires no. 812, 882 and red jumper from travel/neutral switch and connections.
Mow/transport switch—COMMON terminal (S.N. 958XXX—)	Battery voltage.	Test red wires no. 812 and 872 and connections.
7. Mow/transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
9. Seat switch.	Battery voltage.	Test red wires No. 892, 812 and 802 and connections.
10. Seat switch.	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
11. Controller module—Terminal B of six terminal male connector	Battery voltage.	Test pink wire No. 800 and connections.

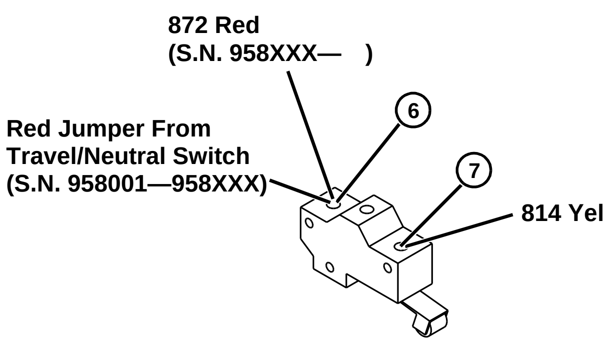
Continued on page 4-138.



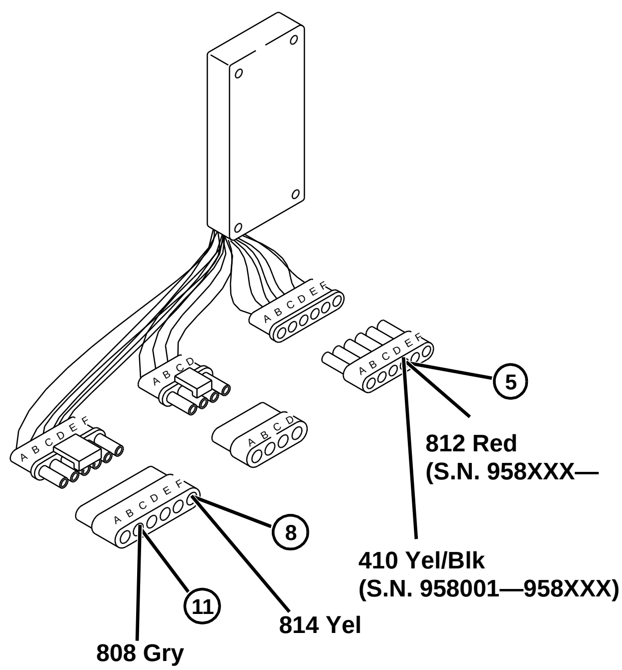








S2 Mow/Transport Switch



MOW CIRCUIT—ENGAGE DIAGNOSIS (S.N. 958001—), continued

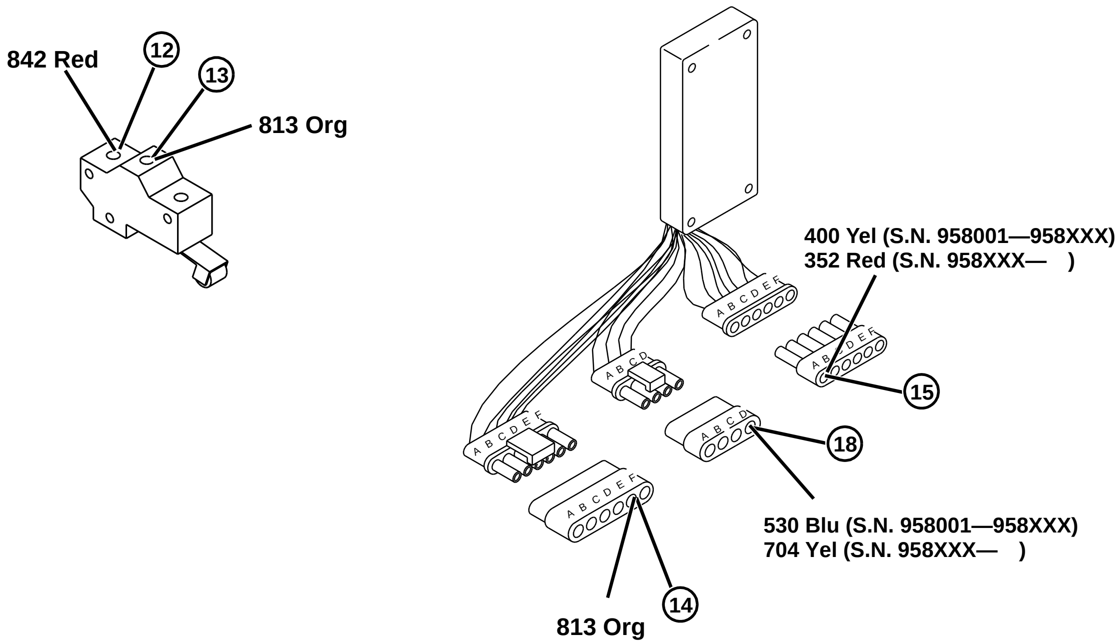
Test Conditions:

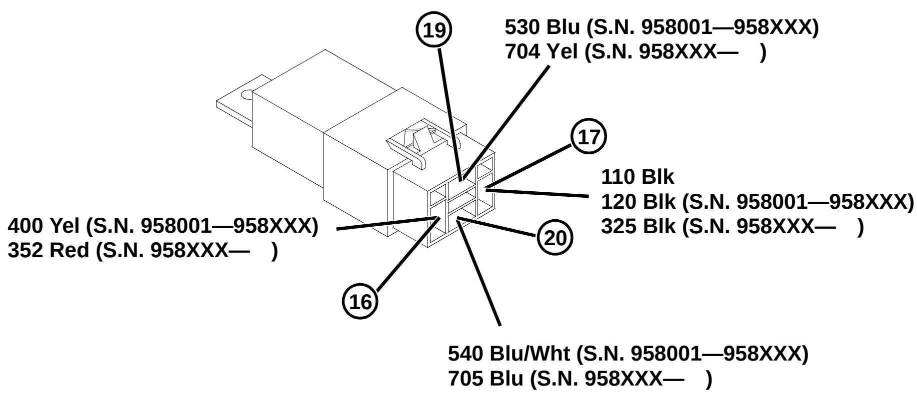
- Key switch in RUN position (engine not running).
- Mow/transport lever in MOW position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

NOTE: For test points 12—20, push lower pedal and hold down to close switch.

Test Location	Normal	If Not Normal
12. Cutting unit lower switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.
13. Cutting unit lower switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit mow switch. (See INTERLOCK SWITCH TEST on page 4-222 .)
14. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
15. Controller module—Terminal A of six terminal female connector	Battery voltage.	Test or replace controller module.
16. Mow valve shutoff relay — Terminal 85 (S.N. 958001—958XXX)	Battery voltage.	Test yellow wire No. 400 and connections.
Mow valve shutoff relay — Terminal 85 (S.N. 958XXX—)	Battery voltage.	Test red wire No. 352, yellow wire No. 330 and connections.
17. Mow valve shutoff relay — Terminal 86 (S.N. 958001—958XXX)	Less than 0.2 volt.	Test black wires No. 120, 810, 700 and connections.
Mow valve shutoff relay — Terminal 86 (S.N. 958XXX—)	Less than 0.2 volt.	Test black wires No. 320, 325, 700 and connections.
18. Controller module—Terminal D of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
19. Mow valve shutoff relay — Terminal 87 (S.N. 958001—958XXX)	Battery voltage.	Test blue wire No. 530 and connections.
Mow valve shutoff relay — Terminal 87 (S.N. 958XXX—)	Battery voltage.	Test yellow wire No. 704 and connections.
20. Mow valve shutoff relay — Terminal 30	Battery voltage.	Test relay. (See RELAY TEST on page 4-???.)

Continued on page 4-140.


842 Red
12
13
813 Org
400 Yel (S.N. 958001—958XXX)
352 Red (S.N. 958XXX—)
15
18
530 Blu (S.N. 958001—958XXX)
704 Yel (S.N. 958XXX—)
14
813 Org


19
530 Blu (S.N. 958001—958XXX)
704 Yel (S.N. 958XXX—)
17
110 Blk
120 Blk (S.N. 958001—958XXX)
325 Blk (S.N. 958XXX—)
400 Yel (S.N. 958001—958XXX)
352 Red (S.N. 958XXX—)
20
16
540 Blu/Wht (S.N. 958001—958XXX)
705 Blu (S.N. 958XXX—)

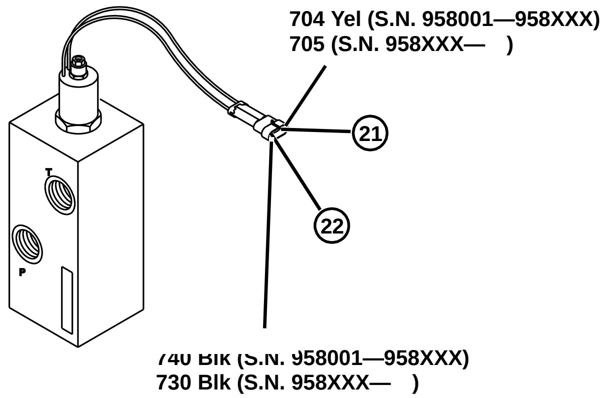
MOW CIRCUIT—ENGAGE DIAGNOSIS (S.N. 958001—), continued

Test Conditions:

- Key switch in RUN position (engine not running).
- Mow/transport lever in MOW position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

NOTE: For test points 21—22, push lower pedal and hold down to close switch.

Test Location	Normal	If Not Normal
21. Mow valve solenoid (S.N. 958001—958XXX)	Battery voltage.	Test blue/white wire No. 540, yellow wire No. 704 and connections.
Mow valve solenoid (S.N. 958XXX—)	Battery voltage.	Test blue wire No. 705 and connections.
22. Mow valve solenoid (S.N. 958001—958XXX)	Less than 0.2 volt.	Test black wires No. 740 and 700, mow solenoid and ground connections.
Mow valve solenoid (S.N. 958XXX—)	Less than 0.2 volt.	Test black wires No. 730 and 700, mow solenoid and ground connections.


704 Yel (S.N. 958001—958XXX)
705 (S.N. 958XXX—)
21
22
740 Blk (S.N. 958001—958XXX)
730 Blk (S.N. 958XXX—)

MOW CIRCUIT—DISENGAGE OPERATION (S.N. —958000)

Function:

To stop reel motors when cutting units are raised.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the MOW position.
- Cutting unit raise switch ENGAGED.

Theory of Operation:

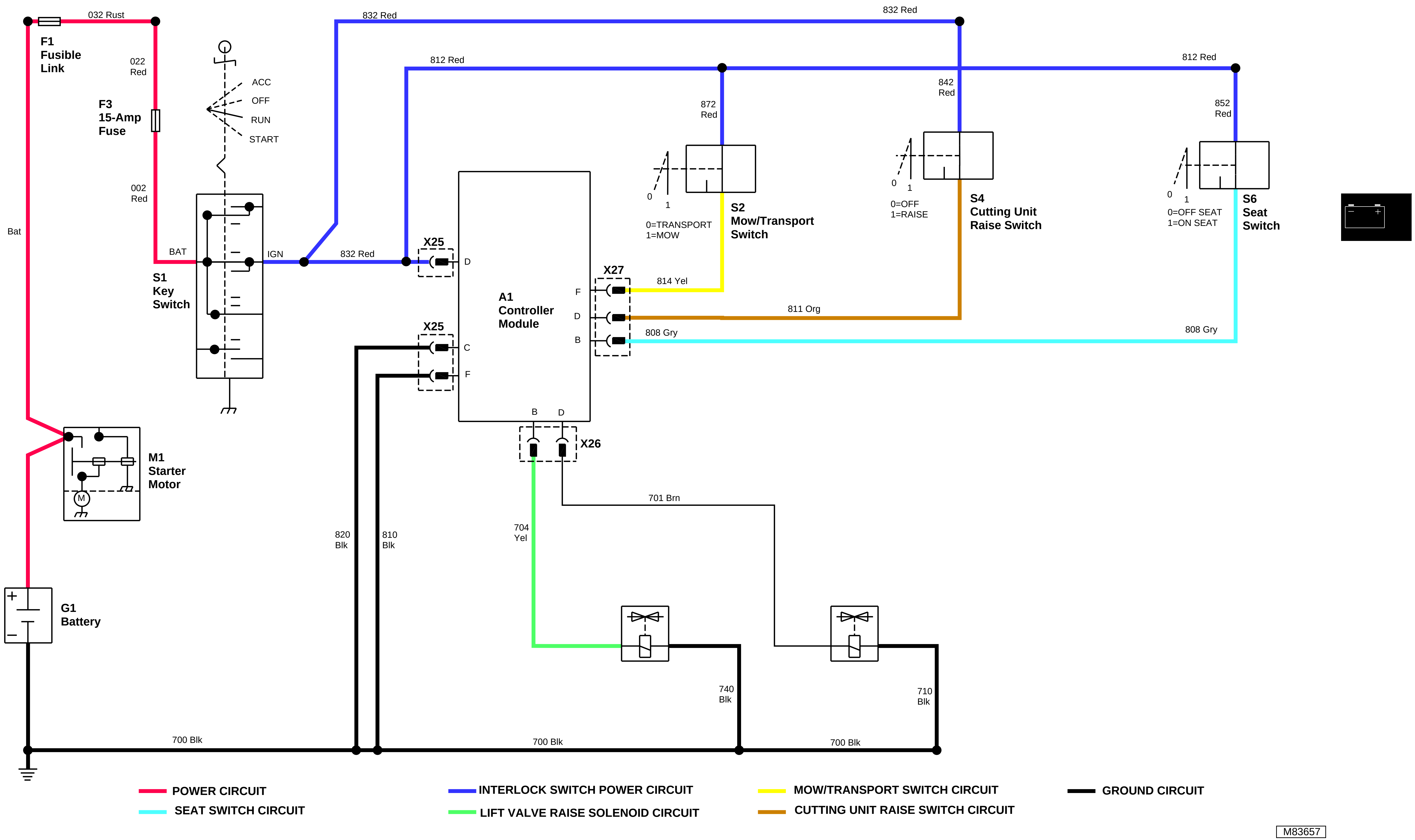
The power circuit provides current to the key switch and protects the cutting unit lower circuit with a fusible link (F1) and 15-amp fuse (F3). Current flows from the battery (G1) positive (+) terminal to the fusible link and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), and cutting unit raise switch (S4) (red wires No. 832 and 852).

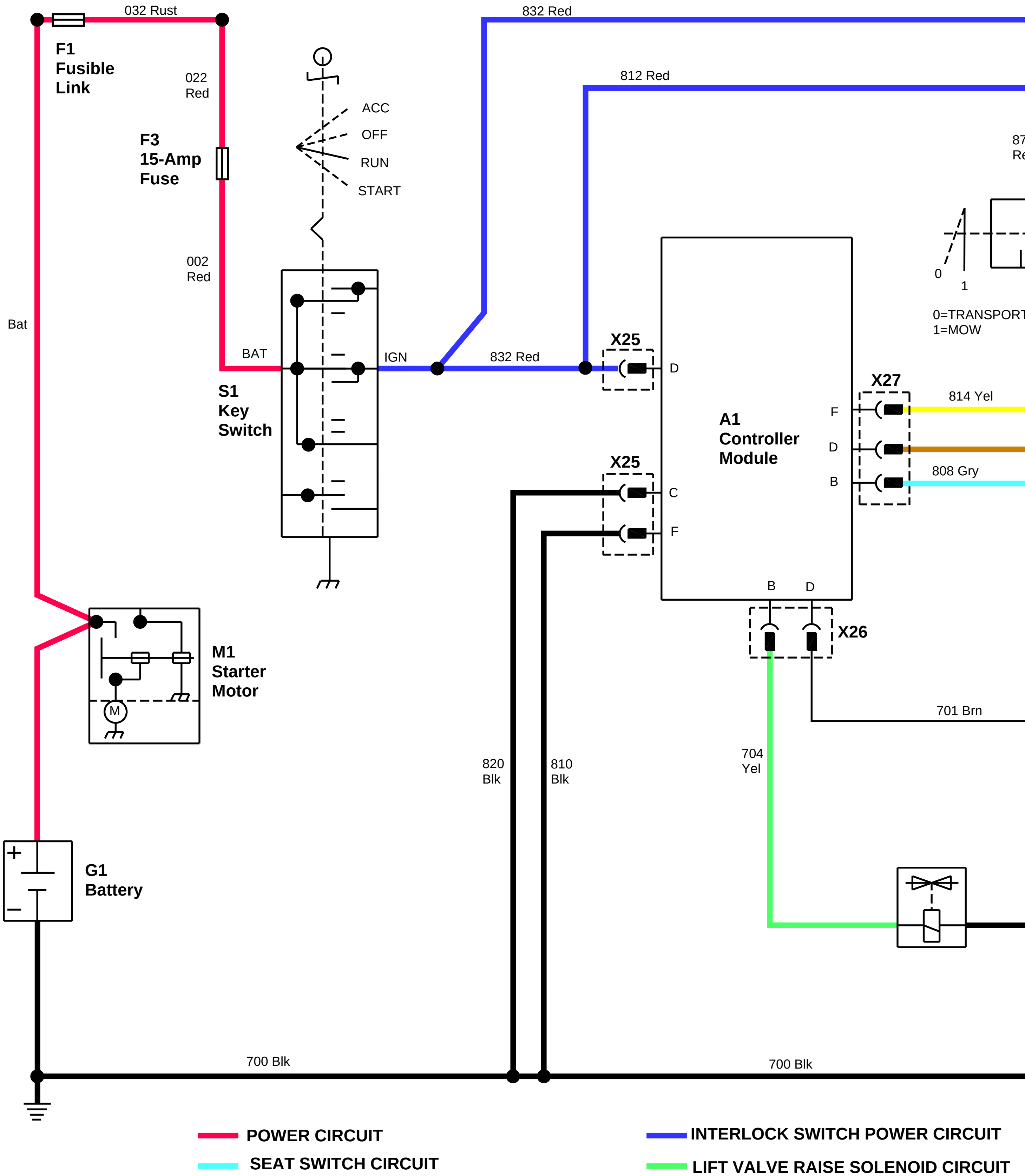
When the raise switch is engaged, current is routed to the controller module (brown wire No. 811). The controller module then routes current to the lift valve raise solenoid (Y1) (yellow wire No. 704) and disengages the mow solenoid (Y3).

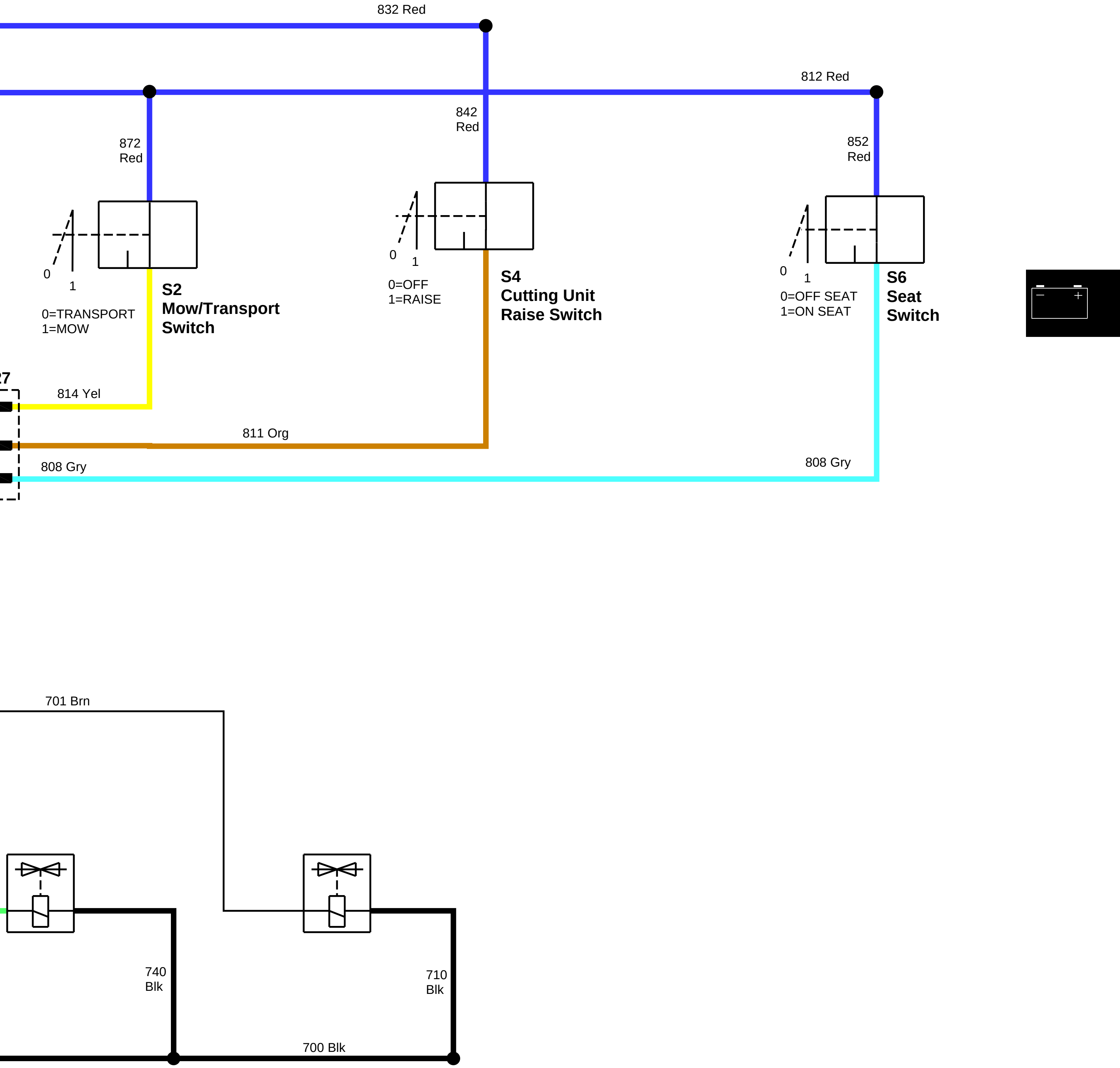
A time delay in the controller module keeps the solenoid energized for four seconds to ensure that the cutting units are fully raised.

The ground circuit connected to the lift valve raise solenoid (black wires No. 710 and 700) complete the circuit and allow the cutting units to be raised.



032 Rust
F1 Fusible Link
022 Red
F3 15-Amp Fuse
002 Red
Bat
BAT
ACC
OFF
RUN
START
IGN
S1 Key Switch
832 Red
812 Red
832 Red
812 Red
872 Red
842 Red
852 Red
0
1
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=RAISE
S4 Cutting Unit Raise Switch
0=OFF SEAT
1=ON SEAT
S6 Seat Switch
X25
D
A1 Controller Module
X27
F
D
B
814 Yel
811 Org
808 Gry
808 Gry
X25
C
F
B
D
X26
M1 Starter Motor
M
701 Brn
820 Blk
810 Blk
704 Yel
G1 Battery
740 Blk
710 Blk
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
SEAT SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
LIFT VALVE RAISE SOLENOID CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
CUTTING UNIT RAISE SWITCH CIRCUIT
GROUND CIRCUIT
M83657


032 Rust
832 Red
812 Red
F1
Fusible
Link
022
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
002
Red
Bat
BAT
IGN
832 Red
S1
Key
Switch
X25
D
X25
C
F
A1
Controller
Module
X27
F
D
B
814 Yel
808 Gry
0
1
0=TRANSPORT
1=MOW
B
D
X26
701 Brn
M1
Starter
Motor
M
820
Blk
810
Blk
704
Yel
G1
Battery
700 Blk
700 Blk
POWER CIRCUIT
SEAT SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
LIFT VALVE RAISE SOLENOID CIRCUIT



WER CIRCUIT

ENOID CIRCUIT

MOW/TRANSPORT SWITCH CIRCUIT

CUTTING UNIT RAISE SWITCH CIRCUIT

GROUND CIRCUIT

M83657

MOW CIRCUIT—DISENGAGE DIAGNOSIS (S.N. —958000)

Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in MOW position.
- Controller module activated by lower pedal to simulate cutting units lowered and reels operating.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

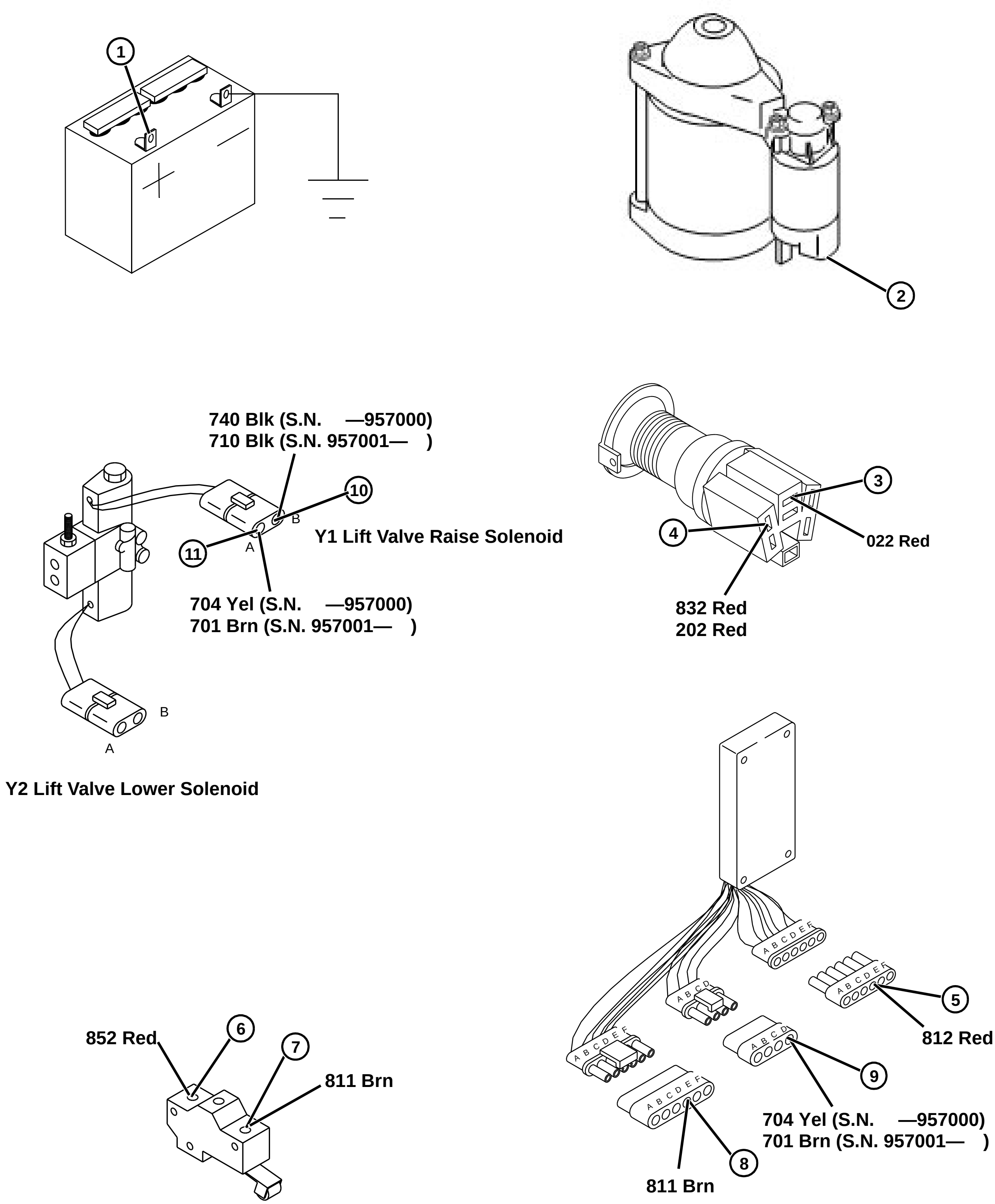
Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Cutting unit raise switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 852 and connections.

NOTE: For test points 7 and 8, push lift pedal and hold down to close switch.

Test Location	Normal	If Not Normal
7. Cutting unit raise switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit raise switch. (See INTERLOCK SWITCH TEST on page 4-222.)
8. Controller module—Terminal D of six terminal male connector	Battery voltage.	Test brown wire No. 811 and connections.

NOTE: At test point 9, voltage is applied for only four seconds after raise pedal is pushed. Push raise pedal again if time expires before test point can be checked.

Test Location	Normal	If Not Normal
9. Controller module—Terminal D of four terminal male connector	No voltage 1.0 second after lift pedal is pressed.	Test or replace controller module.
10. Lift valve raise solenoid	Battery voltage.	Test yellow wire No. 704 (S.N. —957000) or brown wire No. 701 (S.N. 957001—) or and connections.
11. Lift valve raise solenoid	Less than 0.2 volt.	Test black wires No. 710 (S.N. —957000) or black wire 710 (S.N. 957001—) and 700, mow solenoid, and ground connections.


1
2
740 Blk (S.N. —957000)
710 Blk (S.N. 957001—)
10
B
11
A
Y1 Lift Valve Raise Solenoid
704 Yel (S.N. —957000)
701 Brn (S.N. 957001—)
3
4
022 Red
832 Red
202 Red
B
A
Y2 Lift Valve Lower Solenoid
852 Red
6
7
811 Brn
5
812 Red
9
704 Yel (S.N. —957000)
701 Brn (S.N. 957001—)
8
811 Brn

MOW CIRCUIT—DISENGAGE OPERATION (S.N. 958001—958XXX)

Function:

To stop reel motors when cutting units are raised.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the MOW position.
- Cutting unit raise switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812 and yellow/black wire No. 410), seat switch (S6) (red wires No. 892, 812 and 802), travel/neutral switch (S7) (red wires No. 882, 812 and 802) and mow/transport switch (S2) (red jumper from travel/neutral switch). Current is alo supplied to the cutting unit raise switch (S4) (red wires No. 832 and 852).

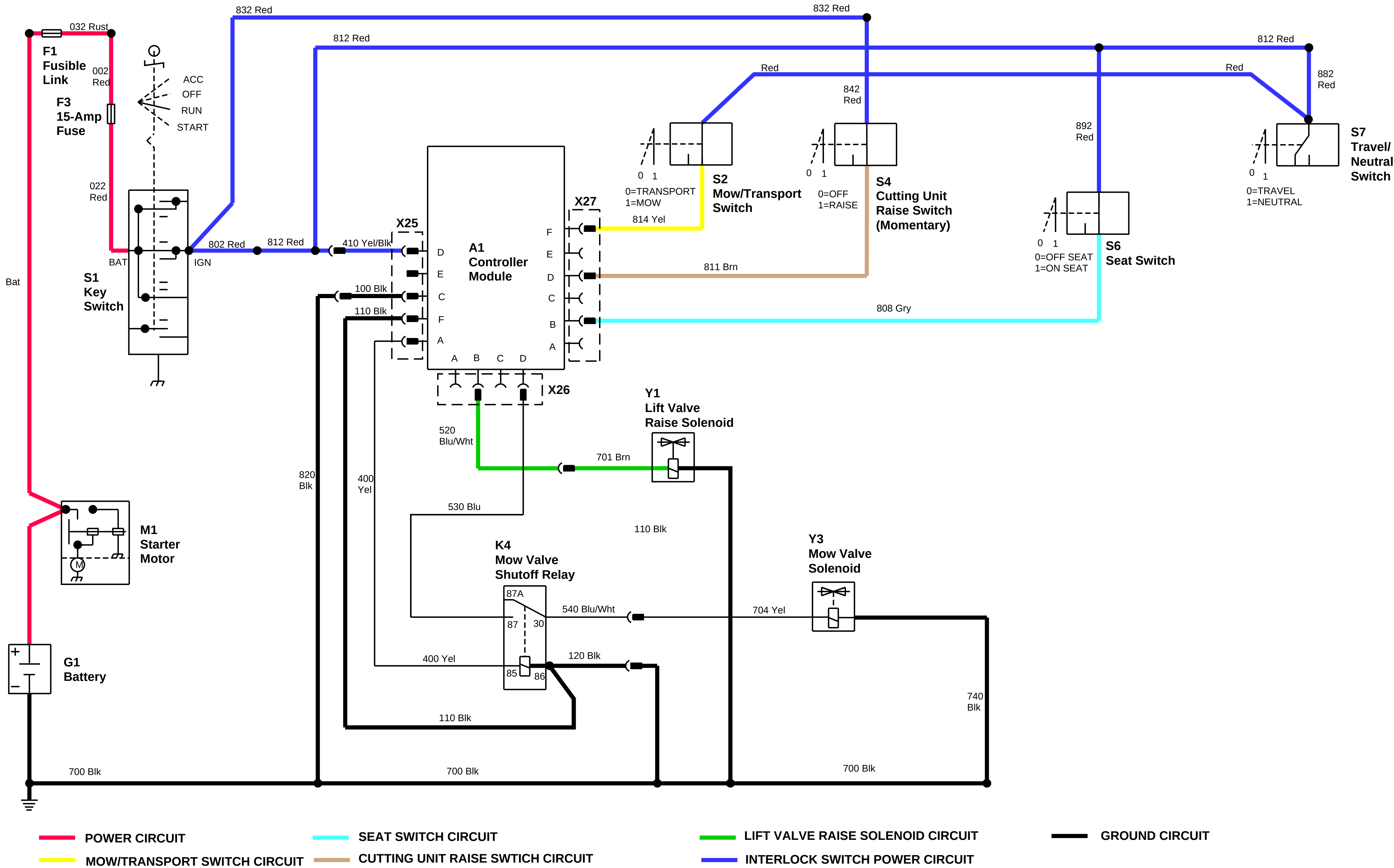
When the mow/transport switch is in the MOW position, current is routed to the controller module (yellow wire No. 814).

With the operator on the seat, current is routed to the controller module (gray wire No. 808).

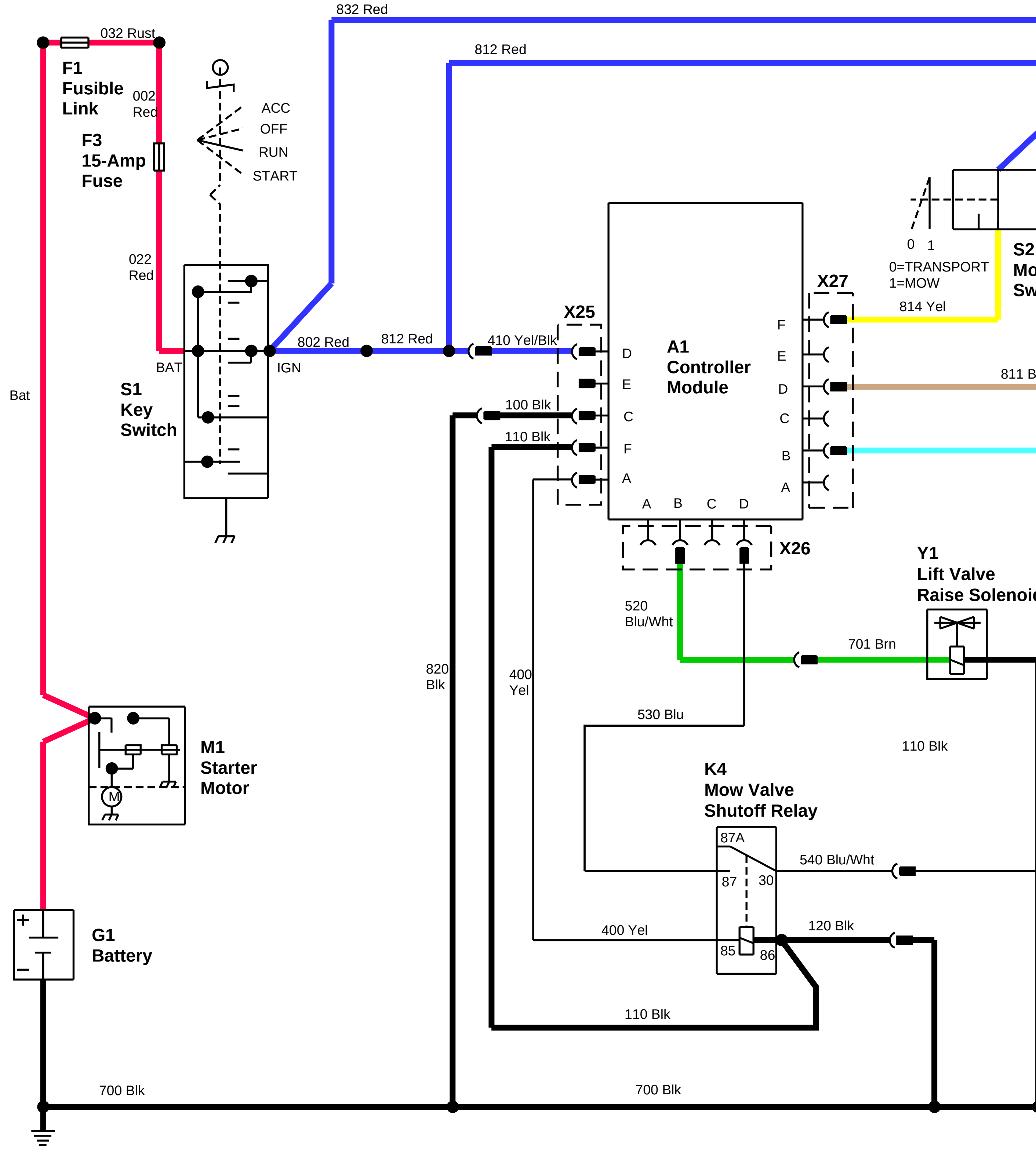
When the cutting unit raise switch is engaged, current is routed to the controller module (brown wire No. 811). The controller module then routes current to the lift valve raise solenoid (Y1) (brown wire No. 701and blue/white wire No. 520), The ground circuit connected to the lift valve raise solenoid (black wires No. 710 and 700) complete the circuit and allow the cutting units to be raised.

A time delay in the controller module keeps the solenoid energized for four seconds to ensure that the cutting units are fully raised.

When the cutting unit raise switch is engaged, the contoller stops current flow to the mow valve shutoff relay, causing it to de-energized and stop current flow to the mow valve, stopping the reel motors.


832 Red
812 Red
032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
BAT
IGN
S1
Key
Switch
Bat
802 Red
812 Red
410 Yel/Blk
X25
D
E
C
F
A
100 Blk
110 Blk
A1
Controller
Module
X27
F
E
D
C
B
A
X26
Red
842
Red
892
Red
882
Red
S2
Mow/Transport
Switch
0 1
0=TRANSPORT
1=MOW
814 Yel
S4
Cutting Unit
Raise Switch
(Momentary)
0=OFF
1=RAISE
811 Brn
S6
Seat Switch
0=OFF SEAT
1=ON SEAT
808 Gry
S7
Travel/
Neutral
Switch
0=TRAVEL
1=NEUTRAL
Y1
Lift Valve
Raise Solenoid
520
Blu/Wht
701 Brn
820
Blk
400
Yel
530 Blu
110 Blk
M1
Starter
Motor
K4
Mow Valve
Shutoff Relay
87A
87
30
85
86
540 Blu/Wht
704 Yel
Y3
Mow Valve
Solenoid
400 Yel
120 Blk
110 Blk
740
Blk
G1
Battery
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT RAISE SWTICH CIRCUIT
LIFT VALVE RAISE SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT

M83724

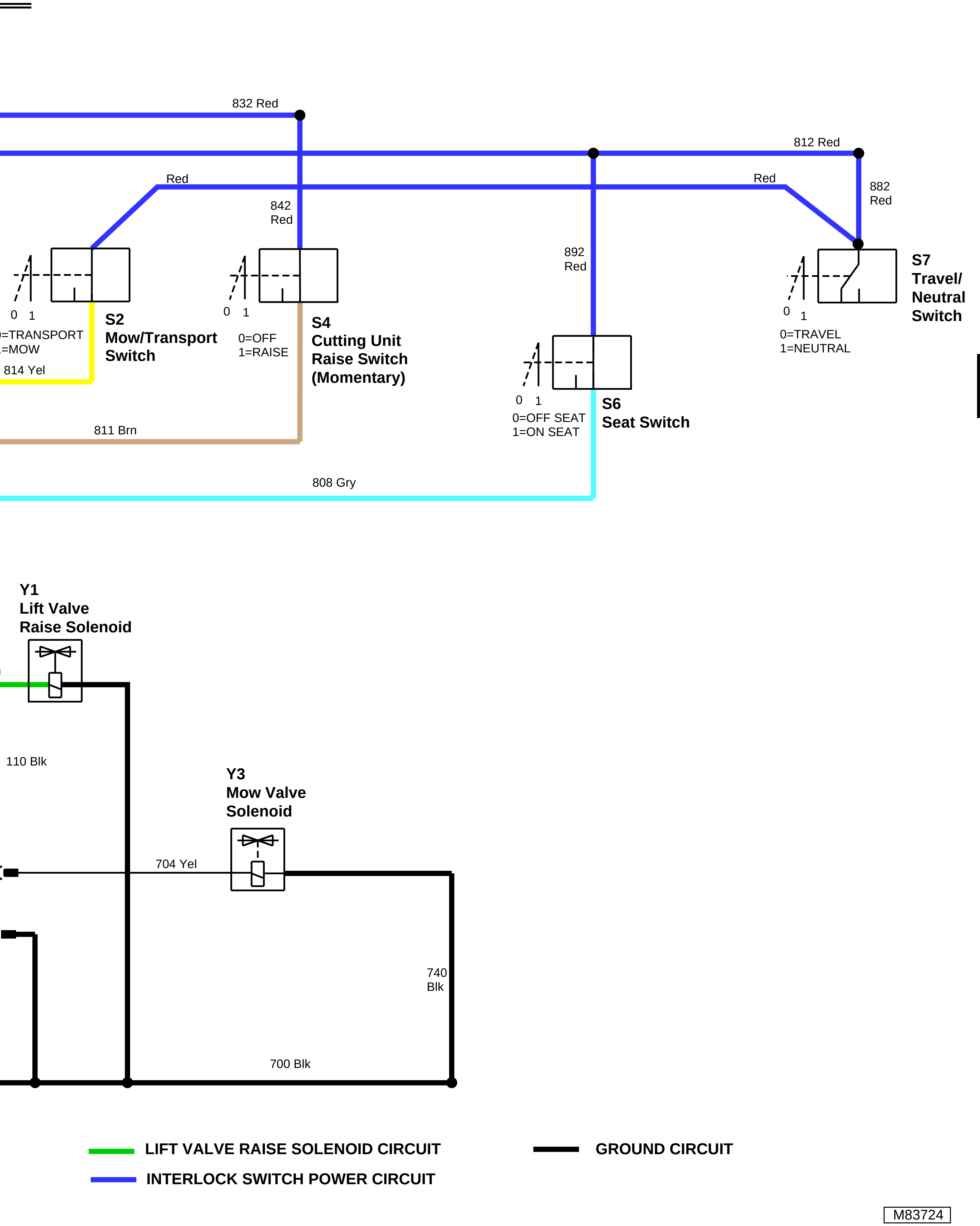


POWER CIRCUIT

MOW/TRANSPORT SWITCH CIRCUIT

SEAT SWITCH CIRCUIT

CUTTING UNIT RAISE SWTICH CIRCUIT


832 Red
812 Red
Red
Red
842
Red
882
Red
892
Red
0 1
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
814 Yel
0 1
0=OFF
1=RAISE
S4
Cutting Unit
Raise Switch
(Momentary)
811 Brn
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat Switch
808 Gry
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
Y1
Lift Valve
Raise Solenoid
110 Blk
Y3
Mow Valve
Solenoid
704 Yel
740
Blk
700 Blk
LIFT VALVE RAISE SOLENOID CIRCUIT
GROUND CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
M83724

MOW CIRCUIT—DISENGAGE OPERATION (S.N. 958XXX—)

Function:

To stop reel motors when cutting units are raised.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Mow/transport lever in the MOW position.
- Cutting unit raise switch ENGAGED.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), seat switch (S6) (red wires No. 892 , 812 and 802) and cutting unit raise switch (S4) (red wires No. 832 and 852).

When the mow/transport switch is in the MOW position, current is routed to the controller module (yellow wire No. 814).

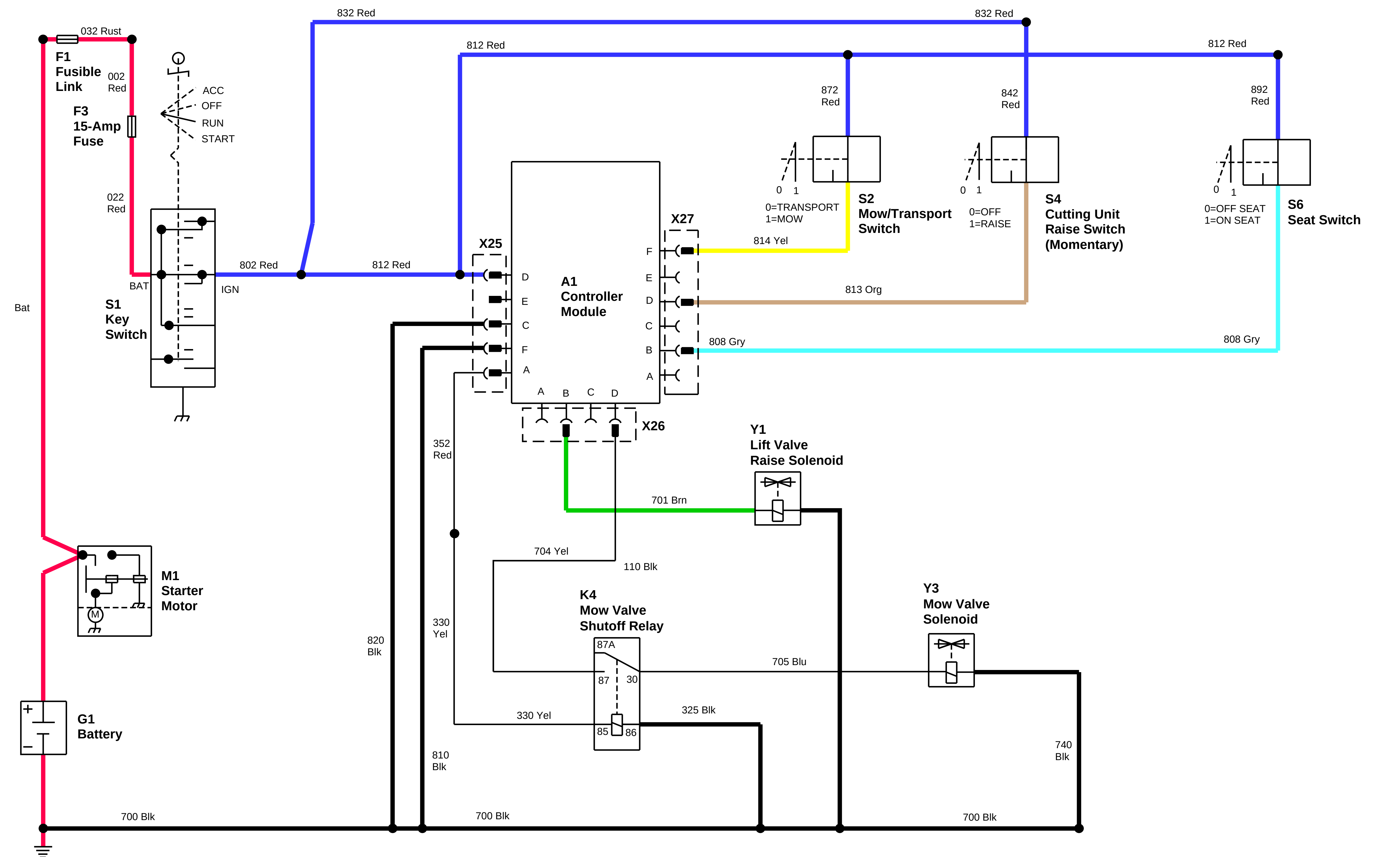
With the operator on the seat, current is routed to the controller module (gray wire No. 808).

When the raise switch is engaged, current is routed to the controller module (brown wire No. 811). The controller module then routes current to the lift valve raise solenoid (Y1) (brown wire No. 701). The ground circuit connected to the lift valve raise solenoid (black wires No. 710 and 700) complete the circuit and allow the cutting units to be raised.

A time delay in the controller module keeps the solenoid energized for four seconds to ensure that the cutting units are fully raised.

The ground circuit connected to the lift valve raise solenoid (black wires No. 710 and 700) complete the circuit and allow the cutting units to be raised.

When the cutting unit raise switch is engaged, the contoller stops current flow to the mow valve shutoff relay, causing it to de-energized and stop current flow to the mow valve, stopping the reel motors.



POWER CIRCUIT

MOW/TRANSPORT SWITCH CIRCUIT

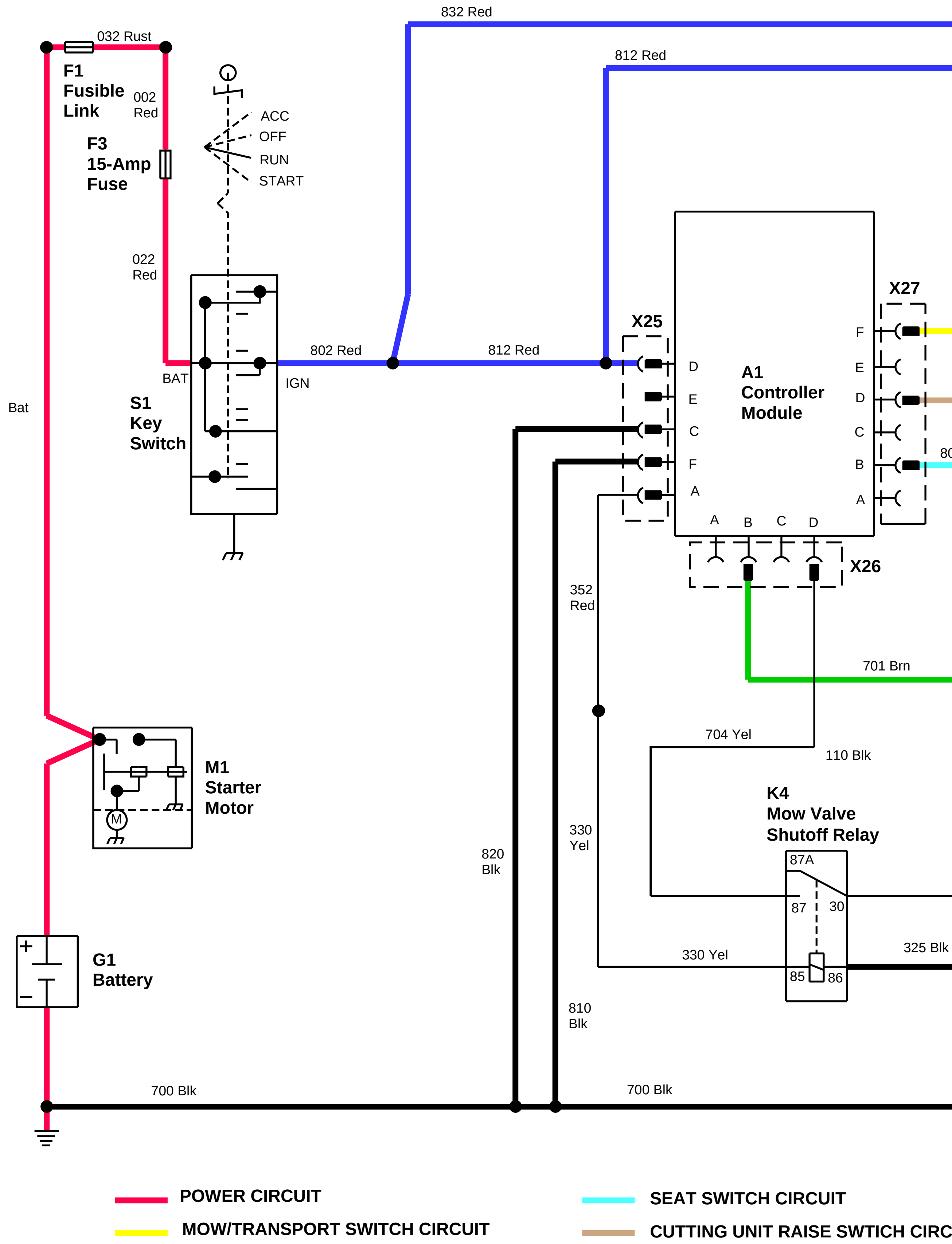
SEAT SWITCH CIRCUIT

CUTTING UNIT RAISE SWTICH CIRCUIT

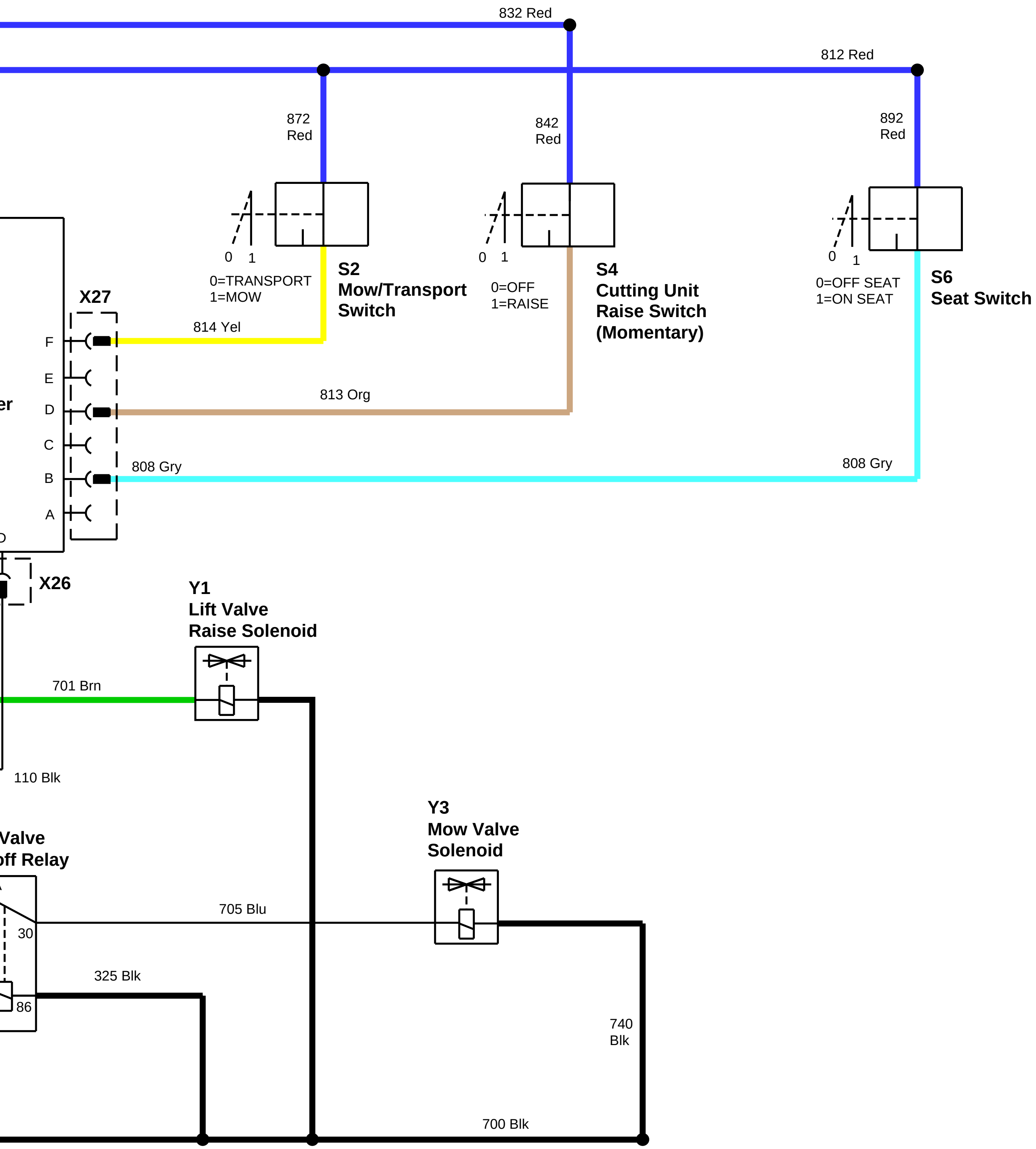
INTERLOCK SWITCH POWER CIRCUIT

LIFT VALVE RAISE SOLENOID CIRCUIT

GROUND CIRCUIT



832 Red
812 Red
032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
BAT
802 Red
812 Red
IGN
S1
Key
Switch
Bat
X25
X27
A1
Controller
Module
X26
352
Red
701 Brn
704 Yel
110 Blk
M1
Starter
Motor
K4
Mow Valve
Shutoff Relay
87A
87
30
85
86
330
Yel
820
Blk
330 Yel
325 Blk
810
Blk
G1
Battery
700 Blk
700 Blk
POWER CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT RAISE SWTICH CIRC



CUIT

SE SWTICH CIRCUIT

INTERLOCK SWITCH POWER CIRCUIT

LIFT VALVE RAISE SOLENOID CIRCUIT

GROUND CIRCUIT

M83725

MOW CIRCUIT—DISENGAGE DIAGNOSIS (S.N. 958001—)

Test Conditions:

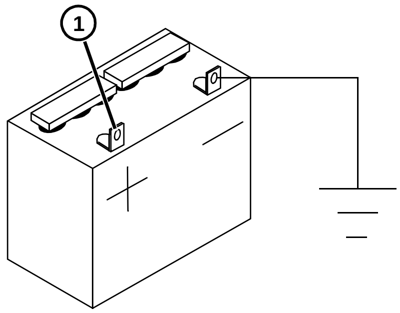
- Key switch in RUN position.
- Mow/transport lever in MOW position.
- Controller module activated by lower pedal to simulate cutting units lowered and reels operating.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

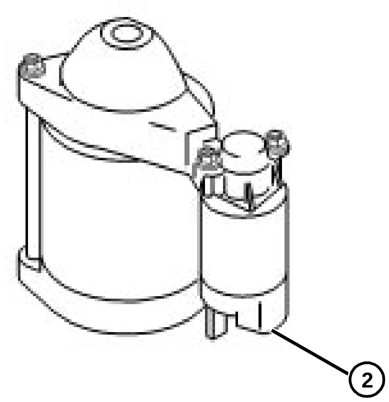
Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector (S.N.958001—958XXX).	Battery voltage.	Test red wires No. 802, 812, yellow/black wire No. 410 and connections.
Controller module—Terminal D of six terminal female connector (S.N. 958XXX—).	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Cutting unit raise switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 852 and connections.

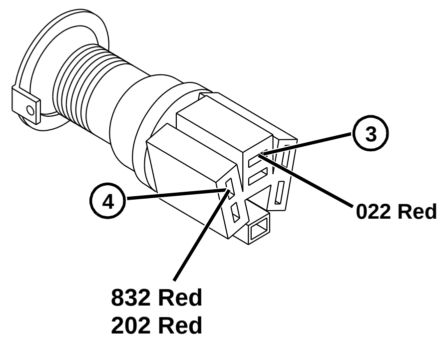
NOTE: For test points 7 and 8, push lift pedal and hold down to close switch.

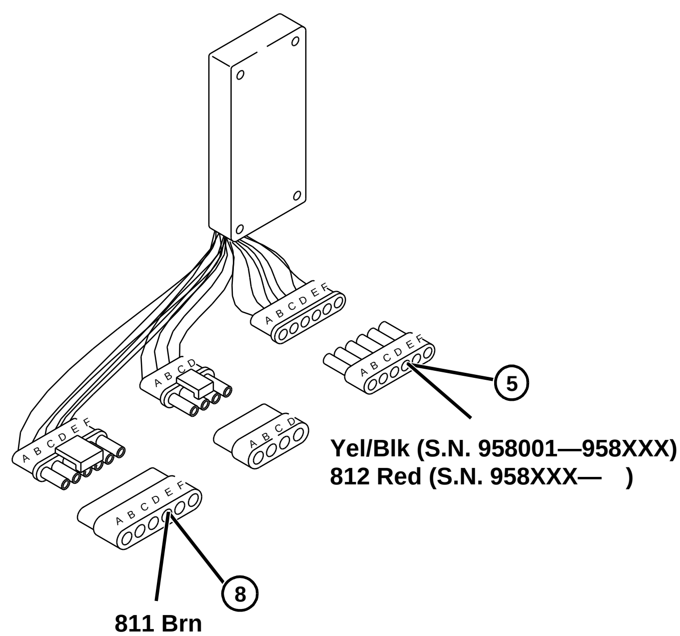
Test Location	Normal	If Not Normal
7. Cutting unit raise switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit raise switch. (See INTERLOCK SWITCH TEST on page 4-222.)
8. Controller module—Terminal D of six terminal male connector	Battery voltage.	Test brown wire No. 811 and connections.

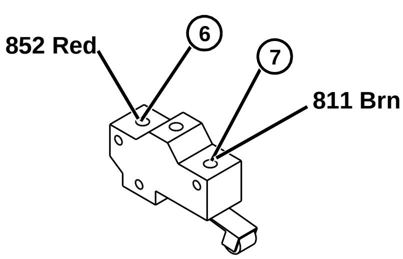
Continued on page 4-152.


1


2


3
4
022 Red
832 Red
202 Red


5
Yel/Blk (S.N. 958001—958XXX)
812 Red (S.N. 958XXX—)
8
811 Brn


852 Red
6
7
811 Brn

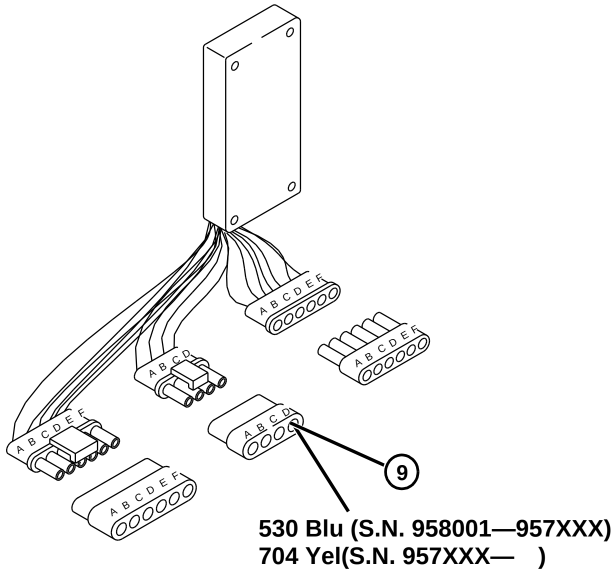
MOW CIRCUIT—DISENGAGE DIAGNOSIS (S.N. 958001—), continued

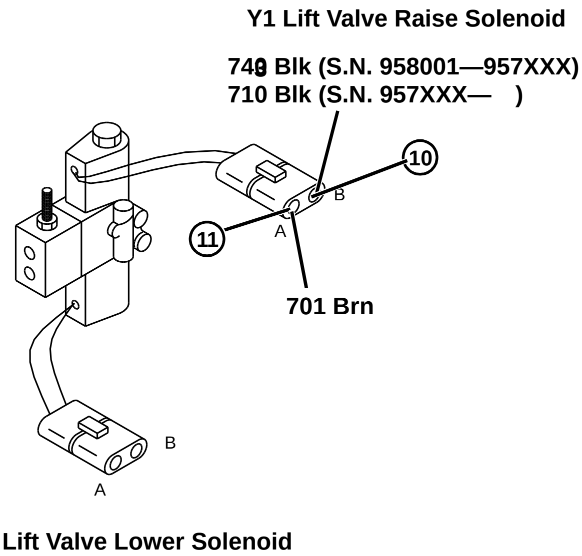
Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in MOW position.
- Controller module activated by lower pedal to simulate cutting units lowered and reels operating.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

NOTE: At test point 9, voltage is applied for only four seconds after raise pedal is pushed. Push raise pedal again if time expires before test point can be checked.

Test Location	Normal	If Not Normal
9. Controller module—Terminal D of four terminal male connector	No voltage 1.0 second after lift pedal is pressed.	Test or replace controller module.
10. Lift valve raise solenoid (S.N.958001—958XXX).	Battery voltage.	Test brown wire No. 701 and blue/white wire No. 520 and connections.
Lift valve raise solenoid (S.N. 958XXX—).	Battery voltage.	Test brown wire No. 701 and connections.
11. Lift valve raise solenoid. (S.N.958001—958XXX).	Less than 0.2 volt.	Test black wires No. 730 and 700, mow solenoid, and ground connections.
Lift valve raise solenoid. (S.N. 958XXX—).	Less than 0.2 volt.	Test black wires No. 710 and 700 mow solenoid, and ground connections.


A B C D E F
A B C D E F
A B C D
A B C D E F
A B C D
A B C D E F
9
530 Blu (S.N. 958001—957XXX)
704 Yel(S.N. 957XXX—)


Y1 Lift Valve Raise Solenoid
740 Blk (S.N. 958001—957XXX)
710 Blk (S.N. 957XXX—)
10
B
11
A
701 Brn
B
A
Y2 Lift Valve Lower Solenoid

OPTIONAL HEADLIGHT CIRCUIT OPERATION

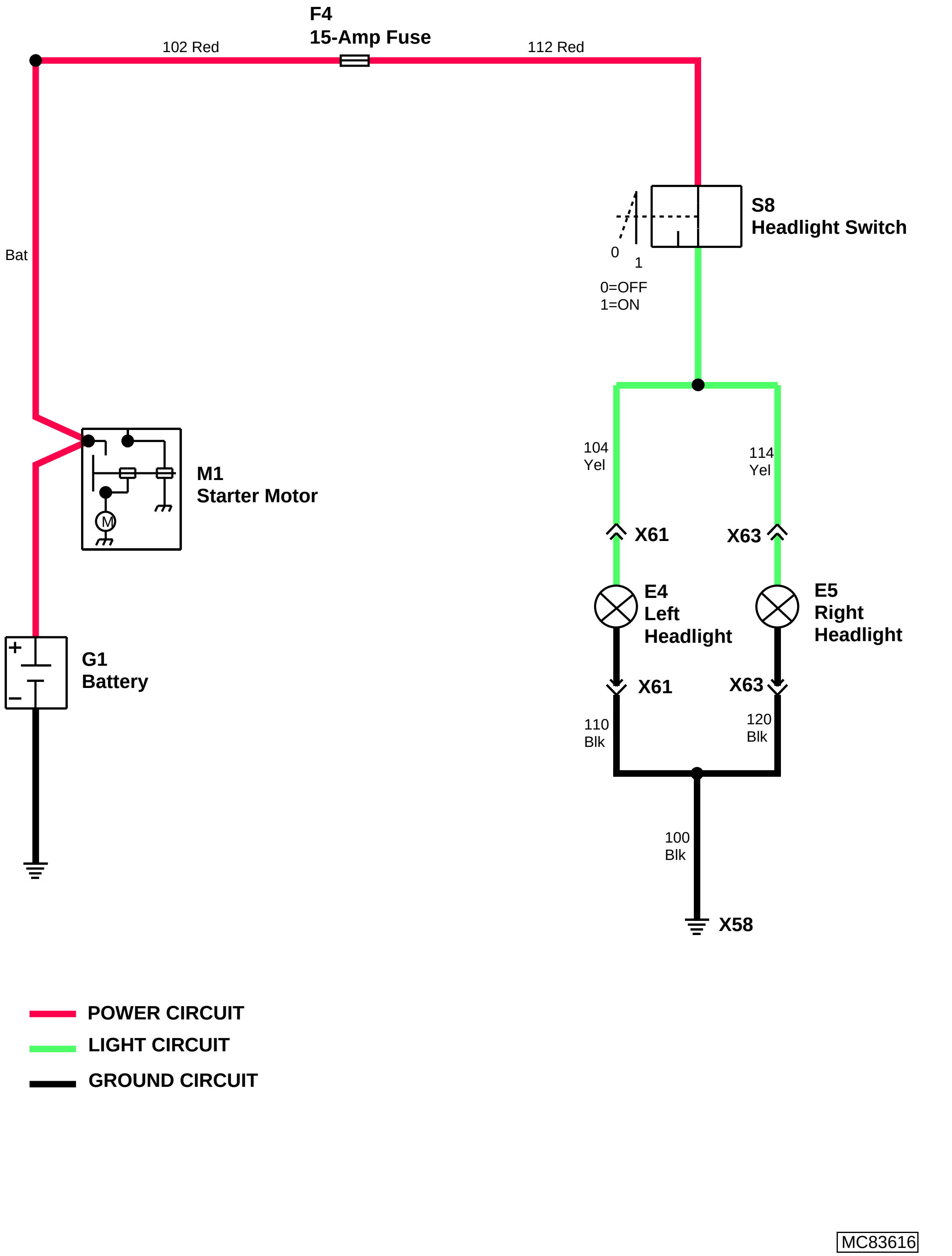
Function:

To illuminate the headlights when the operator turns the switch ON.

Theory of Operation:

Current voltage is supplied to the headlight switch (S8) through red wires No. 102 and 112. The circuit is protected by a 15 amp fuse (F4). When the headlight switch is in the ON position, current is supplied to the headlights through yellow wires No. 104 and 114.

The ground circuit (black wires No. 110, 120 and 100) provide a path to ground for headlight circuit to complete the circuit.

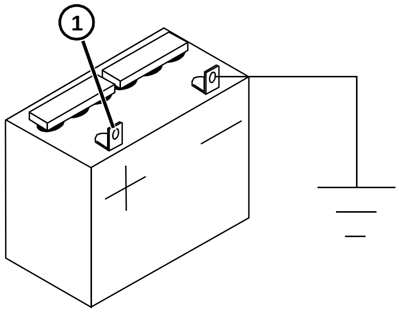

F4
15-Amp Fuse
102 Red
112 Red
Bat
S8
Headlight Switch
0
1
0=OFF
1=ON
M1
Starter Motor
M
104
Yel
114
Yel
X61
X63
E4
Left
Headlight
E5
Right
Headlight
X61
X63
110
Blk
120
Blk
100
Blk
X58
G1
Battery
POWER CIRCUIT
LIGHT CIRCUIT
GROUND CIRCUIT
MC83616

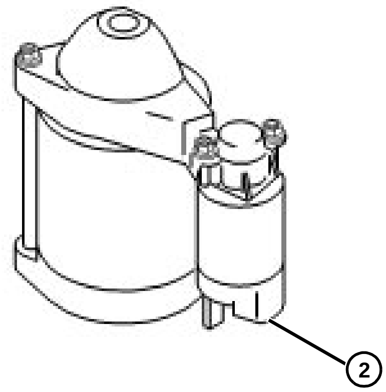
OPTIONAL HEADLIGHT CIRCUIT DIAGNOSIS

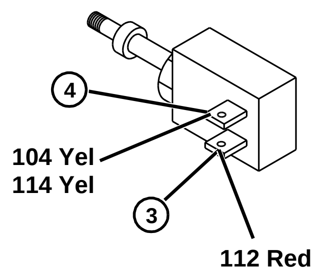
Test Conditions:

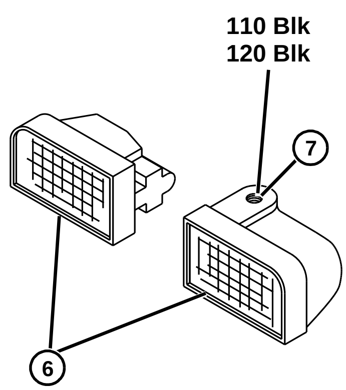
- Headlight switch in ON position.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 5-211.)
2. Starter solenoid—battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Headlight switch.	Battery voltage.	Test red wires No. 102 and 112, 15 amp headlight fuse (F4) and connections.
4. Headlight switch.	Battery voltage.	Test headlight switch. (See OPTIONAL HEADLIGHT SWITCH TEST on page 4-225.)
5. Headlights.	Battery voltage.	Less than 12 volts - Test yellow wires No. 104 and 114. If 12 volts - Test bulbs.
6. Headlight ground.	Less than 0.2 volt	Test ground circuit, black wires No. 100, 110 and 120.


1


2


4
104 Yel
114 Yel
3
112 Red


110 Blk
120 Blk
7
6

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION—MOW (S.N. 957001—958000)

Function:

To operate reel motors when cutting units are lowered. Mow/transport lever in the MOW position.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Operator in seat.
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.

Theory of Operation:

NOTE: The mow circuit will operate with the travel/neutral switch in either the TRAVEL or NEUTRAL position.

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), park brake switch (S5) (red wires No. S6) (red wires No. 812 and 892, and pink/black wire No. 810), and travel/neutral switch (S7) (red wires No. 812 and 882). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842),

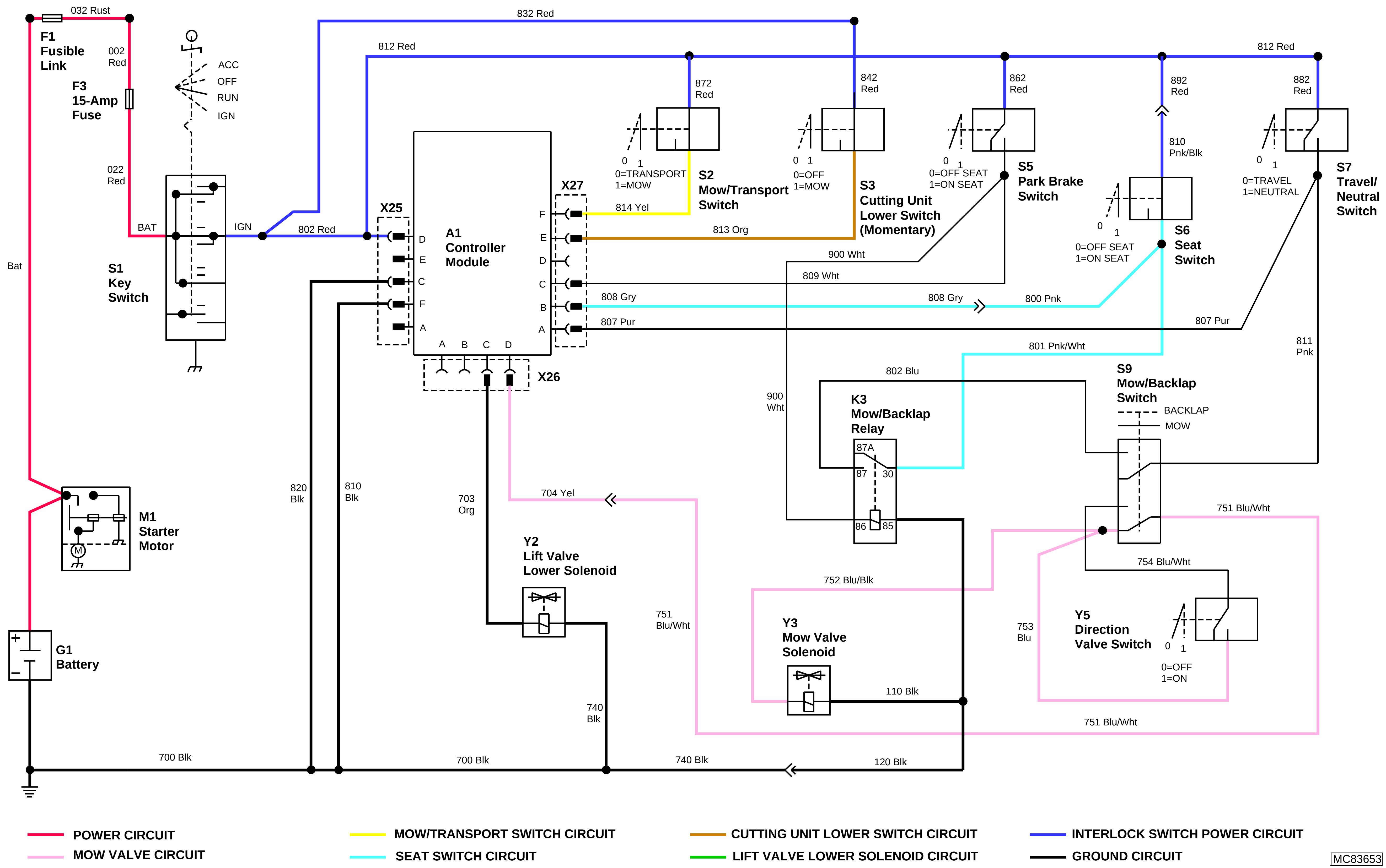
NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

With the mow/transport lever in the MOW position, the mow/transport switch is released, routing current to the controller module (yellow wire No. 814). The controller module then supplies current to the lift valve lower solenoid (Y2) (orange wire No. 703). A path to ground (black wires No. 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

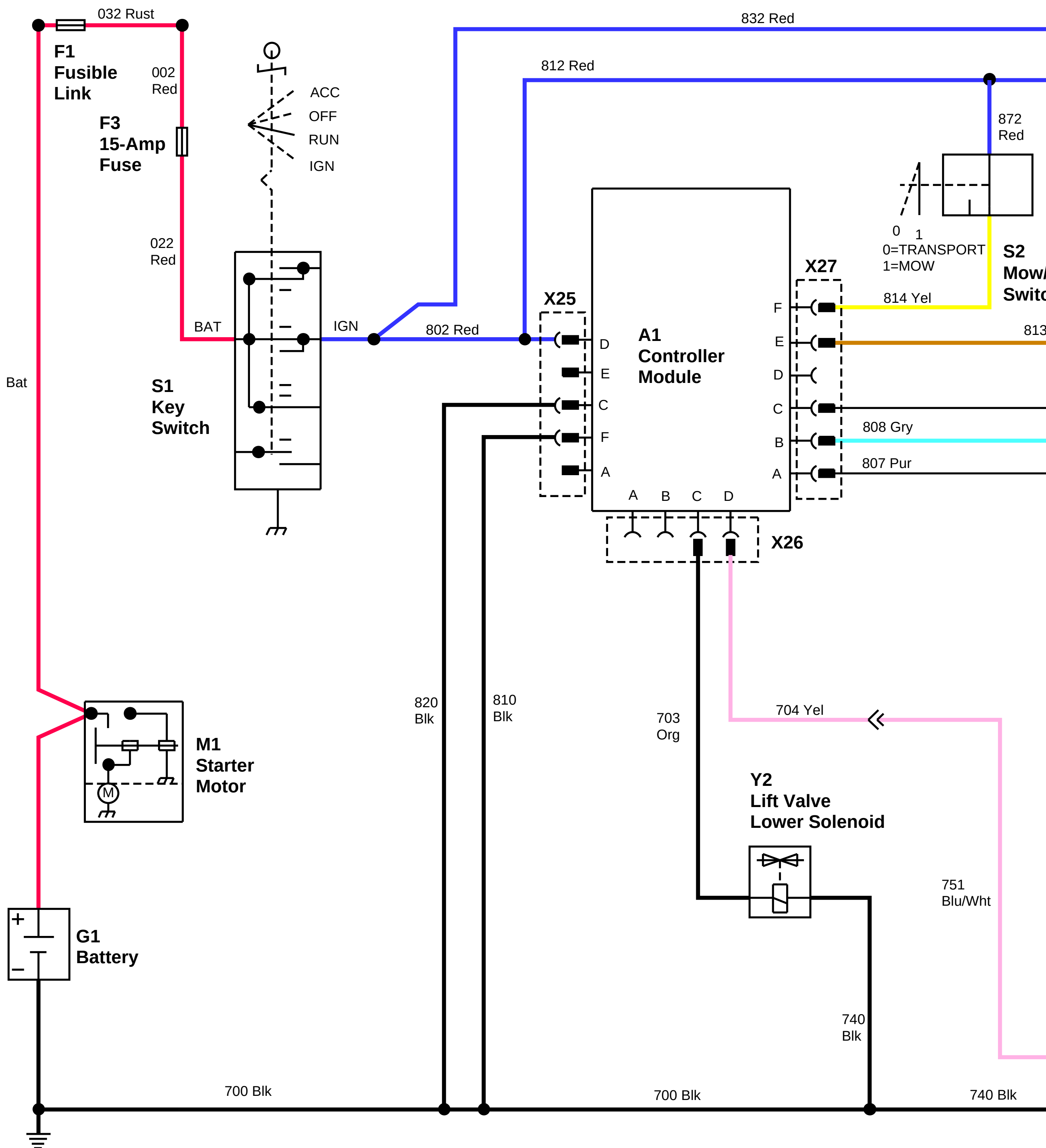
Current is also supplied to the mow/backlap switch (S9) (yellow wire No. 704 and blue/white wire No. 751). Current is routed through the mow/backlap switch to the direction valve solenoid (Y5) and mow valve solenoid (Y3) (blue/black wire No. 752).

With the mow/backlap switch in the MOW position, there is no path to ground for the direction valve solenoid and it remains in the MOW position. A path to ground for the mow valve solenoid (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid and engaging the cutting unit motors.

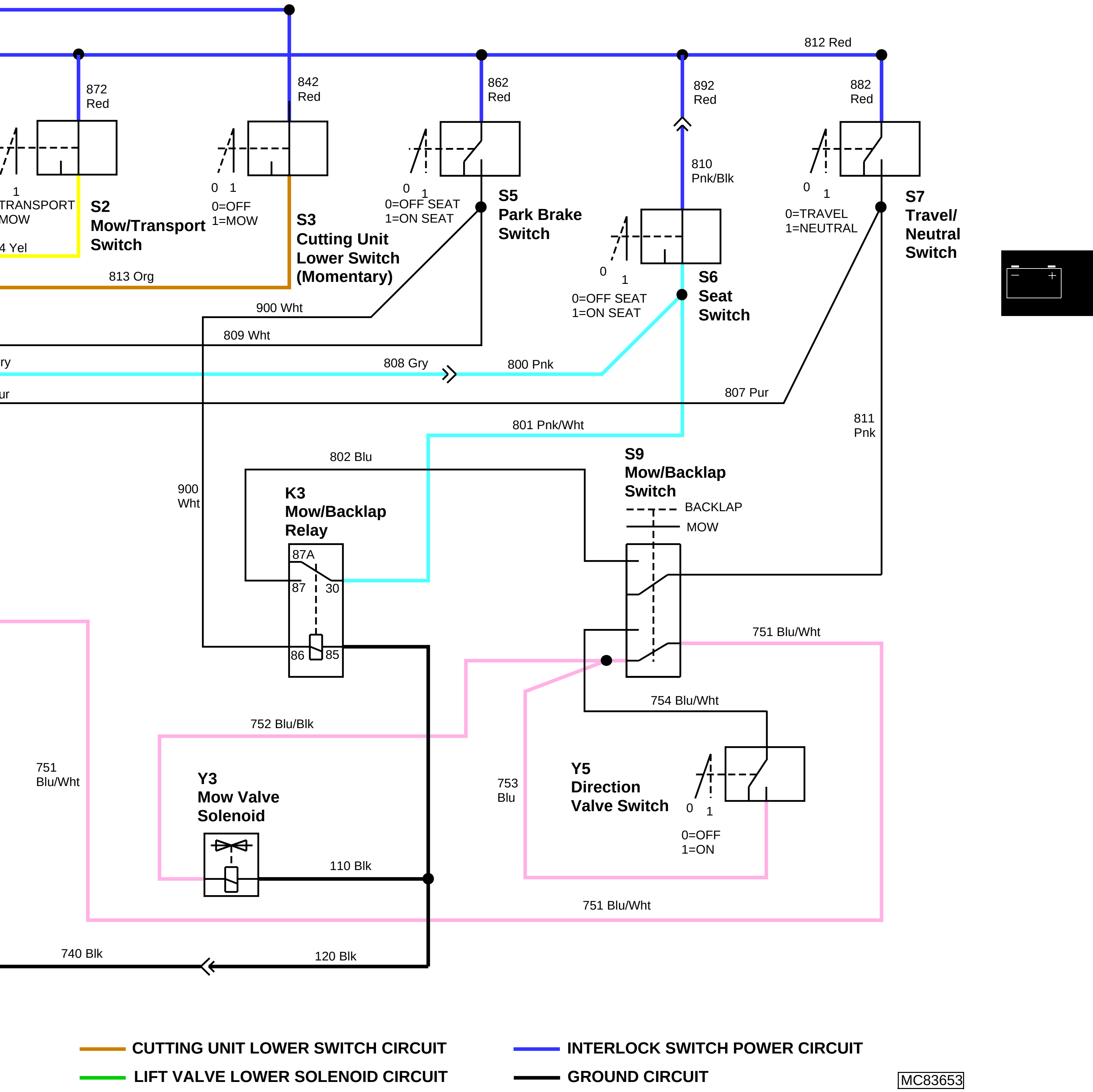
A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.



032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
ACC
OFF
RUN
IGN
BAT
IGN
S1 Key Switch
Bat
832 Red
812 Red
802 Red
X25
A1 Controller Module
X27
X26
814 Yel
813 Org
872 Red
0=TRANSPORT 1=MOW
S2 Mow/Transport Switch
842 Red
0=OFF 1=MOW
S3 Cutting Unit Lower Switch (Momentary)
862 Red
0=OFF SEAT 1=ON SEAT
S5 Park Brake Switch
892 Red
810 Pnk/Blk
S6 Seat Switch
0=OFF SEAT 1=ON SEAT
882 Red
0=TRAVEL 1=NEUTRAL
S7 Travel/ Neutral Switch
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
811 Pnk
802 Blu
900 Wht
K3 Mow/Backlap Relay
87A
87
30
86
85
S9 Mow/Backlap Switch
BACKLAP
MOW
751 Blu/Wht
754 Blu/Wht
M1 Starter Motor
820 Blk
810 Blk
703 Org
704 Yel
Y2 Lift Valve Lower Solenoid
751 Blu/Wht
752 Blu/Blk
Y3 Mow Valve Solenoid
753 Blu
Y5 Direction Valve Switch
0=OFF 1=ON
110 Blk
740 Blk
751 Blu/Wht
G1 Battery
700 Blk
700 Blk
740 Blk
120 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
MC83653



POWER CIRCUIT
MOW VALVE CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT



812 Red
872 Red
842 Red
862 Red
892 Red
882 Red
1
TRANSPORT
MOW
S2
Mow/Transport
Switch
4 Yel
0 1
0=OFF
1=MOW
S3
Cutting Unit
Lower Switch
(Momentary)
813 Org
0 1
0=OFF SEAT
1=ON SEAT
S5
Park Brake
Switch
810
Pnk/Blk
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
900 Wht
809 Wht
ry
808 Gry
800 Pnk
ur
807 Pur
801 Pnk/Wht
811
Pnk
802 Blu
900
Wht
K3
Mow/Backlap
Relay
87A
87
30
86
85
S9
Mow/Backlap
Switch
BACKLAP
MOW
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
751
Blu/Wht
Y3
Mow Valve
Solenoid
110 Blk
753
Blu
Y5
Direction
Valve Switch
0 1
0=OFF
1=ON
751 Blu/Wht
740 Blk
120 Blk
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
MC83653

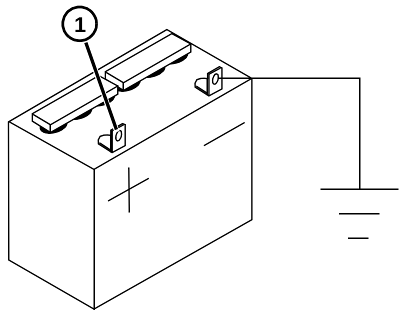
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 957001—958000)

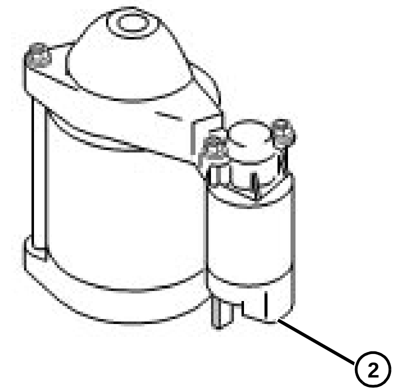
Test Conditions:

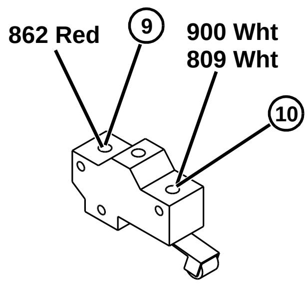
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—terminal D of six terminal female connector.	Battery voltage.	Test red wires No. 802, 812 and connections.
6. Mow/Transport switch—COMMON terminal.	Battery voltage.	Test red wires No. 812, 872 and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—terminal F of six terminal male connector.	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal.	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal.	No voltage (open circuit).	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

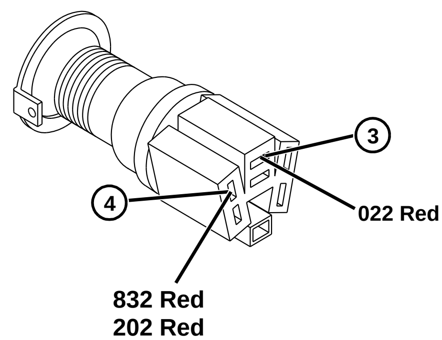
Contined on page 4-162.

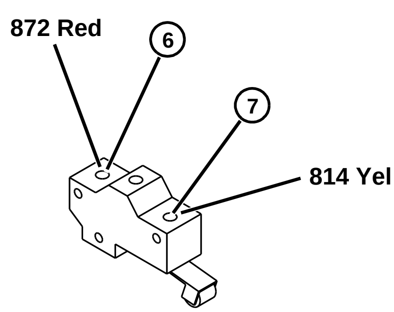




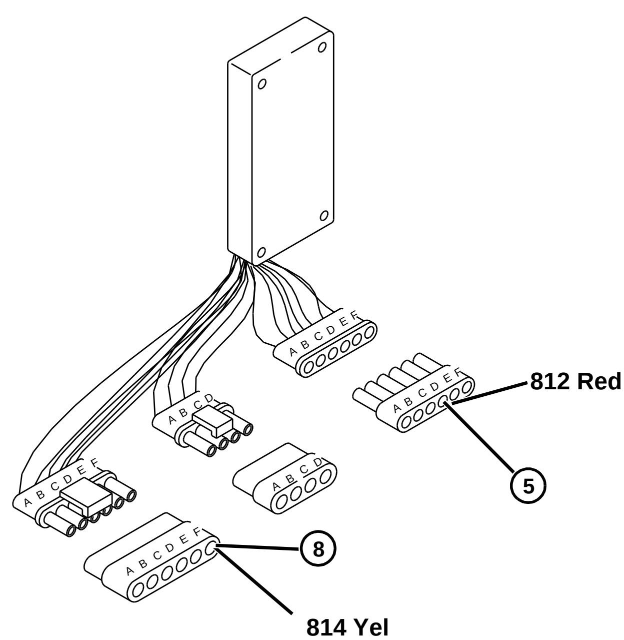


S5 Park Brake Switch





S2 Mow/Transport Switch



OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 957001—958000), continued

Test Conditions:

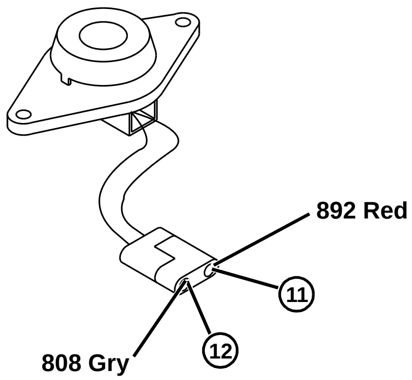
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

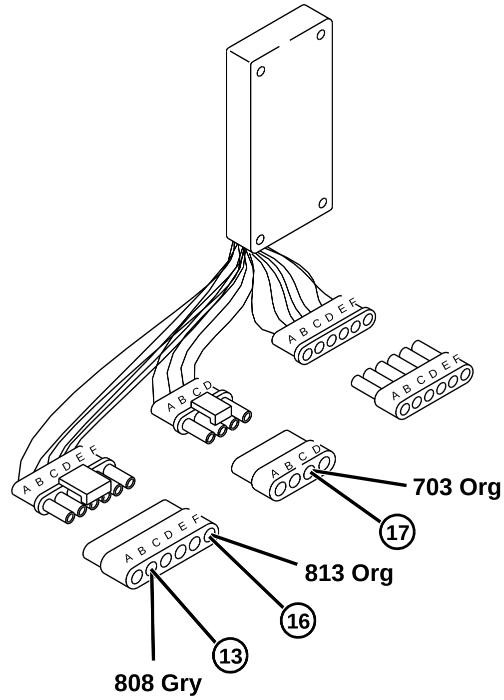
Test Location	Normal	If Not Normal
11. Seat switch.	Battery voltage.	Test pink/black wire No. 810, red wires No. 892, 812 and 802 and connections.
12. Seat switch.	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
13. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808 and pink wire No. 800 and connections.
14. Cutting unit lower switch—COMMON terminal.	Battery voltage.	Test red wires No. 842 and 832 and connections.

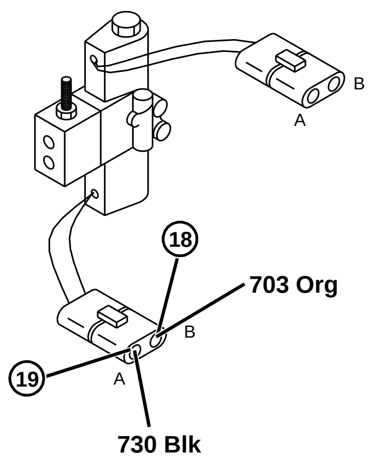
NOTE: For test points 15—17 push lower pedal and hold down to close switch.

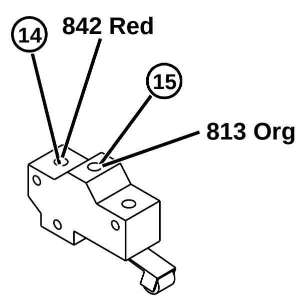
Test Location	Normal	If Not Normal
15. Cutting unit lower switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit lower switch. (See INTERLOCK SWITCH TEST on page 4-222.)
16. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
17. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
18. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
19. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 730 and 700, lift valve lower solenoid and ground connections.

Continued on page 4-164.


892 Red
11
808 Gry
12


703 Org
17
813 Org
16
13
808 Gry


B
A
18
703 Org
B
19
A
730 Blk

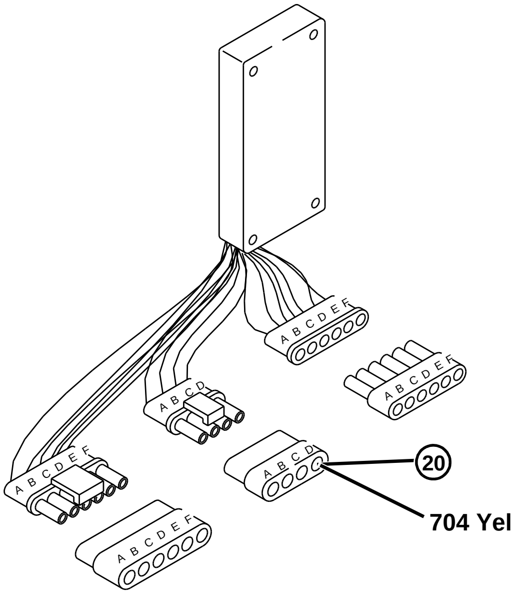

14
842 Red
15
813 Org

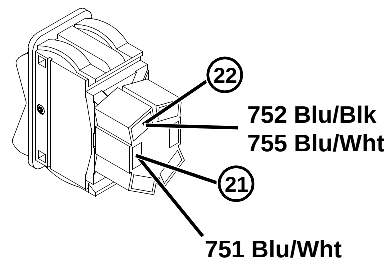
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 957001—958000), continued

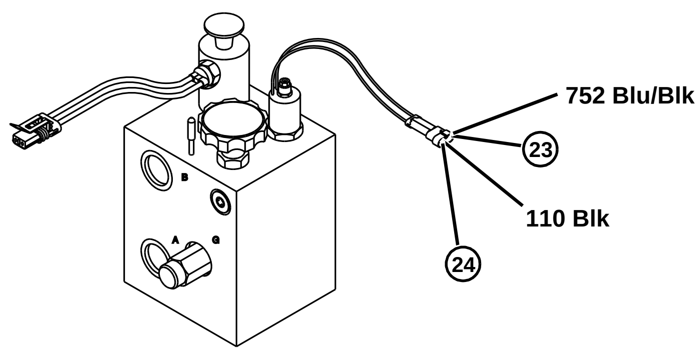
Test Conditions:

- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
20. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
21. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751 and yellow wire No. 704 and connections.
22. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
23. Mow valve solenoid.	Battery voltage.	Test blue/black wire No. 752 and connections.
24. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740 and 700 and connections.


20
704 Yel


22
752 Blu/Blk
755 Blu/Wht
21
751 Blu/Wht


752 Blu/Blk
23
110 Blk
24

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION —BACKLAP (S.N. 957001—958000)

Function:

To allow the reel motors to be driven in reverse to permit reel backlapping.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Park brake LOCKED.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), park brake switch (S5) (red wires No. 812 and 862), seat switch (S6) (red wires No. 812 and 892, and pink/black wire No. 810), and travel/neutral switch (S7) (red wires No. 812 and 882). Current is also supplied to cutting unit lower switch (S3) (red wires No. 832 and 842).

As the mow/transport lever is moved to the MOW position, the mow/transport switch is released, routing battery voltage to the controller module (yellow wire No. 814). The controller then supplies battery voltage to the lift valve lower solenoid (Y2) (orange wire No. 703). A path to ground (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lower the cutting units.

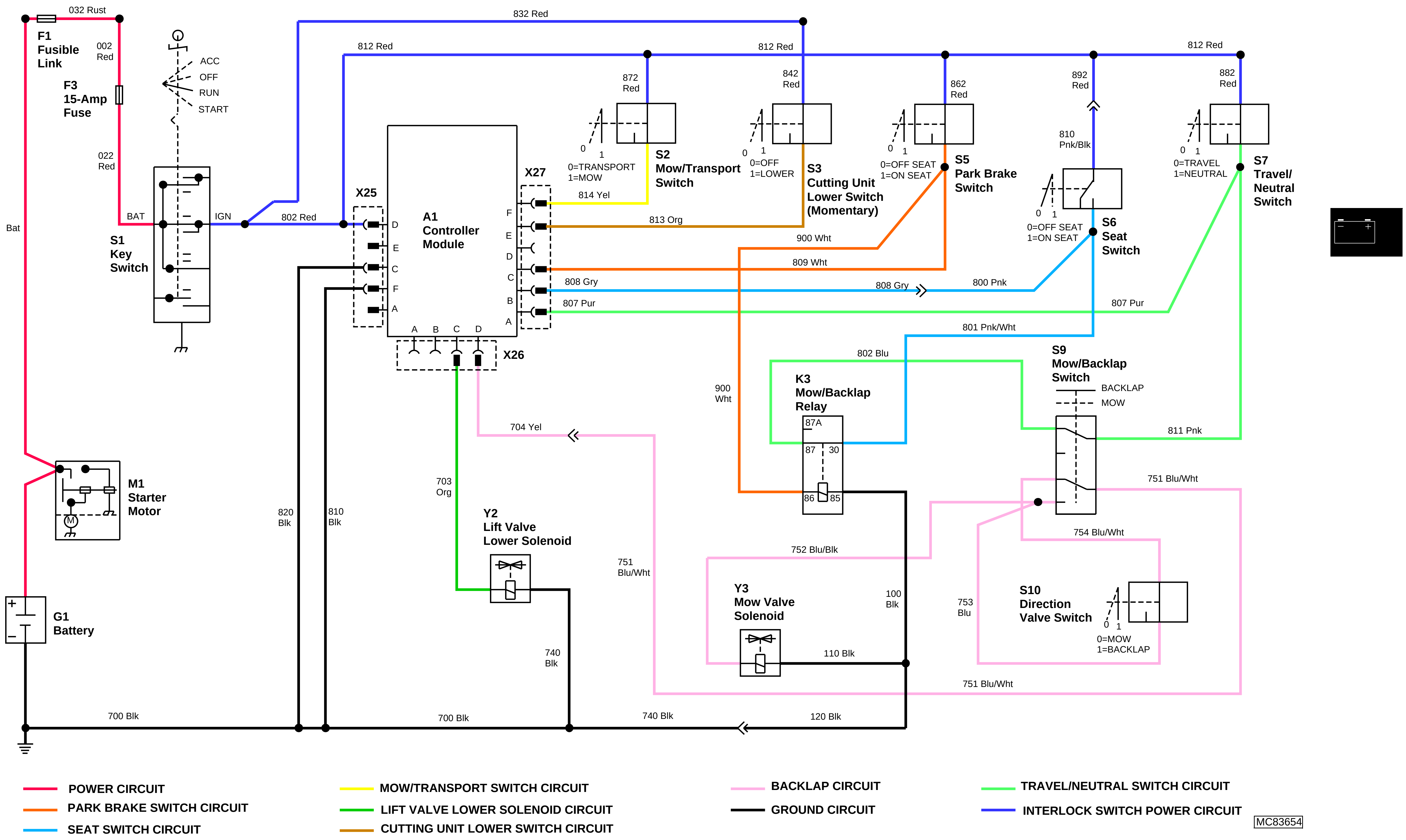
Current is also supplied to the mow/backlap switch (S9) (yellow wire No. 704, blue/white wire No. 751). Current is routed through the mow/backlap switch to the direction valve switch (S10) (blue/white wire No. 754), energizing the switch, allowing the valve to move to the BACKLAP position.

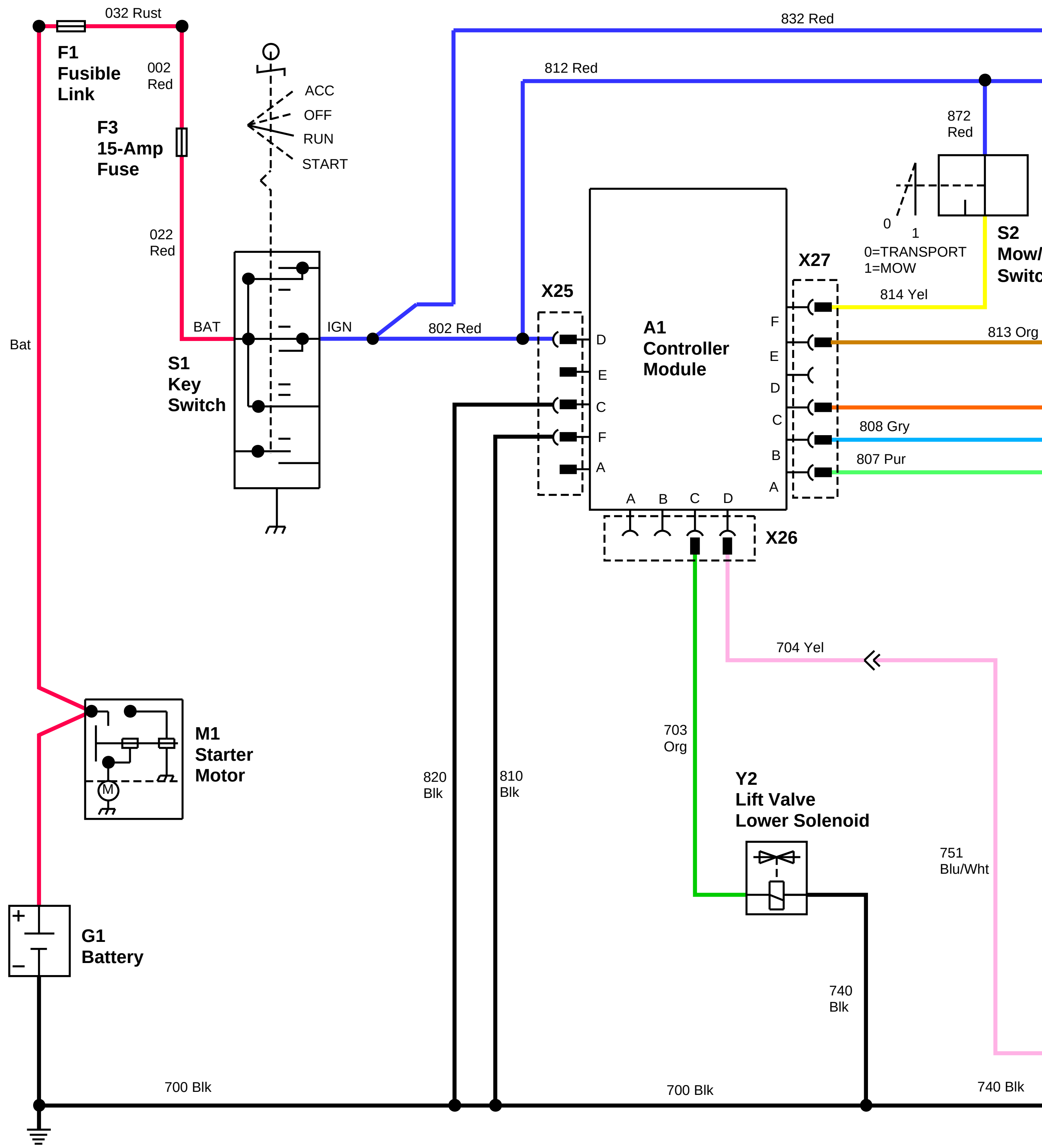
Current is also supplied to the mow valve solenoid (Y3) (blue wire No. 753, blue/black wire No. 752). A path to ground (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid, engaging the cutting units.

When the park brake switch is in the LOCKED position, current is routed to the controller module (white wire No. 809) and to terminal 86 of the mow/backlap relay (K4) (white wire No. 900). A path to ground (black wires No. 100, 120, 740 and 700) completes the circuit, energizing the relay.

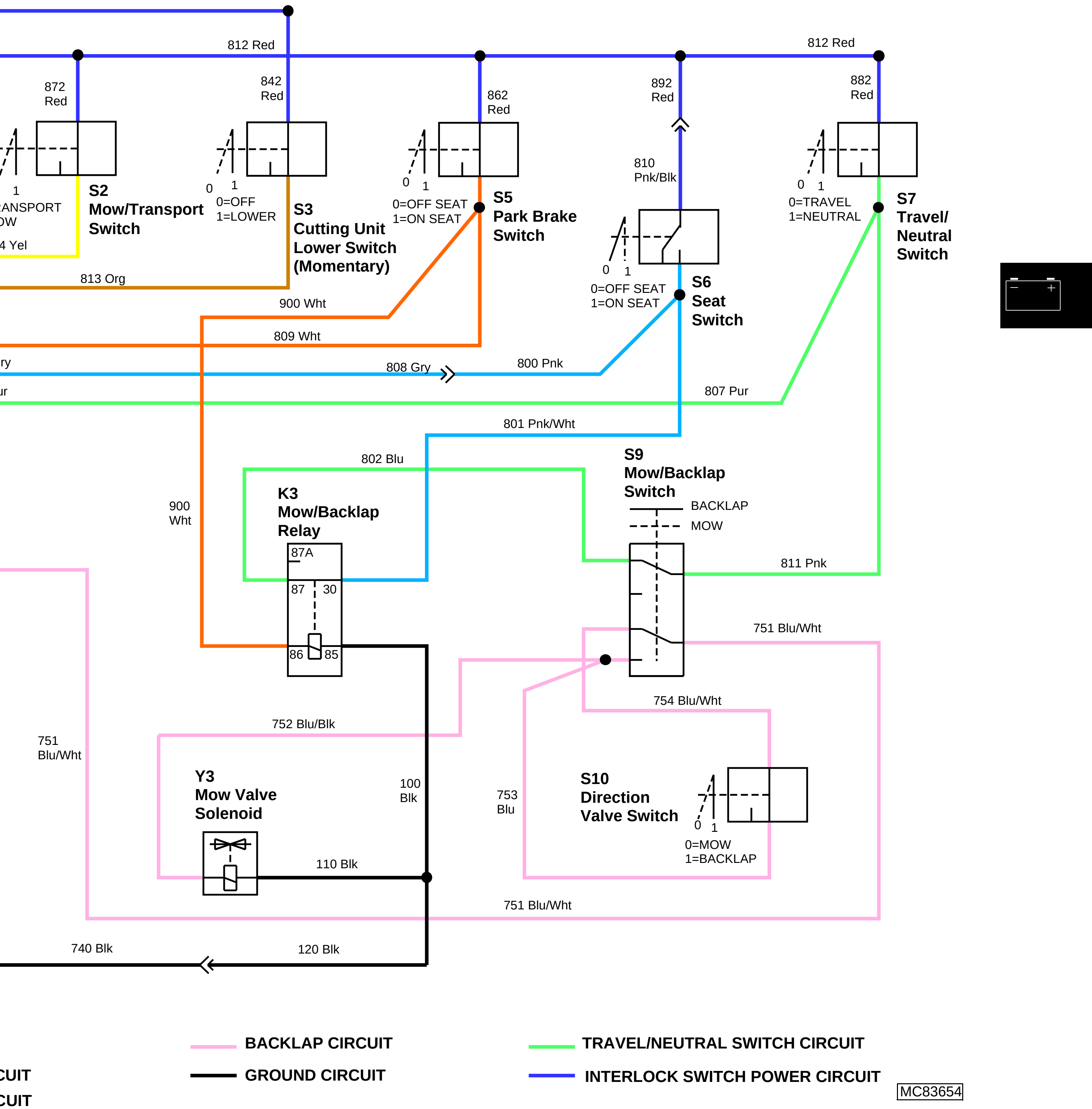
With the travel/neutral switch in the NEUTRAL position current is supplied to the controller module (purple wire No. 807) and the mow/backlap switch (pink wire No. 811). Current is routed through the switch to terminal 87 of the mow/backlap relay (blue wire 802). When the relay energized, voltage is routed to the controller module (pink/white wire No. 801, pink wire No. 800, and gray wire No. 808). This connection allows the reels to be engaged with the operator out of the seat.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
Bat
BAT
IGN
ACC
OFF
RUN
START
S1 Key Switch
832 Red
812 Red
802 Red
X25
A1 Controller Module
X27
X26
872 Red
842 Red
862 Red
892 Red
882 Red
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch (Momentary)
0=OFF SEAT
1=ON SEAT
S5 Park Brake Switch
810 Pnk/Blk
S6 Seat Switch
0=TRAVEL
1=NEUTRAL
S7 Travel/ Neutral Switch
814 Yel
813 Org
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
802 Blu
K3 Mow/Backlap Relay
87A
87
30
86
85
S9 Mow/Backlap Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
753 Blu
S10 Direction Valve Switch
0=MOW
1=BACKLAP
Y3 Mow Valve Solenoid
100 Blk
110 Blk
120 Blk
704 Yel
703 Org
Y2 Lift Valve Lower Solenoid
740 Blk
820 Blk
810 Blk
M1 Starter Motor
G1 Battery
700 Blk
740 Blk
POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
BACKLAP CIRCUIT
GROUND CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
MC83654



POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT

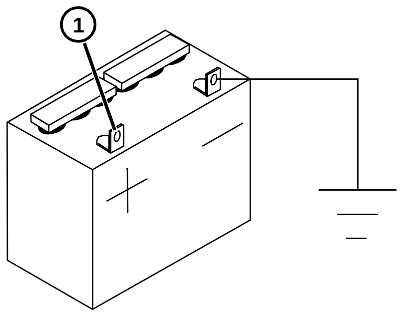

812 Red
812 Red
872
Red
842
Red
862
Red
892
Red
882
Red
1
ANSPORT
OW
S2
Mow/Transport
Switch
4 Yel
0
1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
813 Org
0
1
0=OFF SEAT
1=ON SEAT
S5
Park Brake
Switch
810
Pnk/Blk
0
1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0
1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
900 Wht
809 Wht
ry
808 Gry
800 Pnk
ur
807 Pur
801 Pnk/Wht
802 Blu
900
Wht
K3
Mow/Backlap
Relay
87A
87
30
86
85
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
751
Blu/Wht
Y3
Mow Valve
Solenoid
100
Blk
110 Blk
753
Blu
S10
Direction
Valve Switch
0
1
0=MOW
1=BACKLAP
751 Blu/Wht
740 Blk
120 Blk
BACKLAP CIRCUIT
GROUND CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
CUIT
CUIT
MC83654

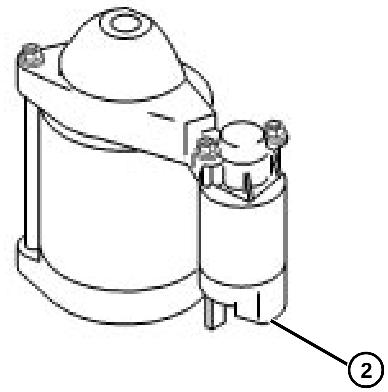
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 957001—958000)

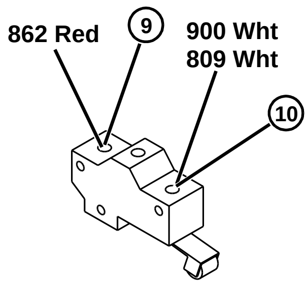
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Mow/Transport switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 872 and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

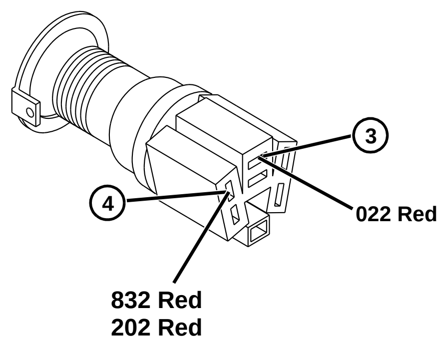
Continued on page 4-170.

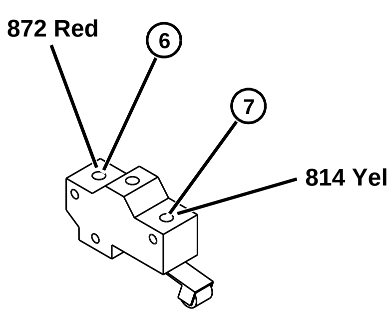




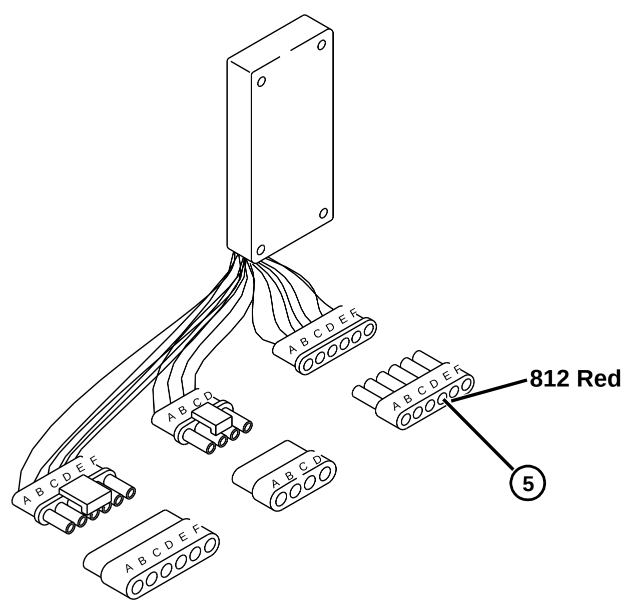


S5 Park Brake Switch





S2 Mow/Transport Switch



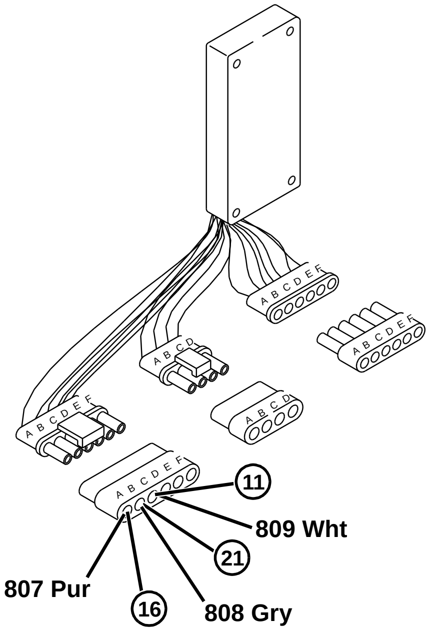
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 957001—958000), continued

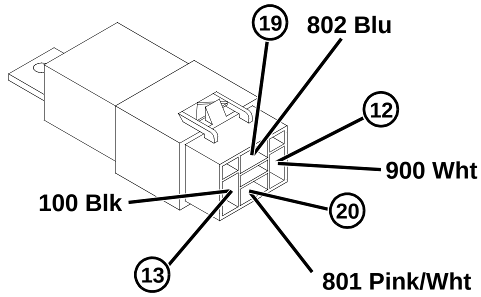
Test Conditions:

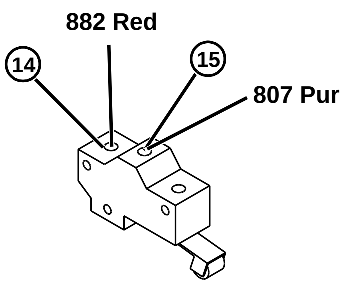
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
11. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
12. Mow/backlap relay—Terminal 86.	Battery voltage.	Test white wire No. 900 and connections.
13. Mow/backlap relay—Terminal 85.	Less than 0.2 volt.	Test black wires No. 100, 120, 740 and 700 and connections.
14. Travel/neutral switch—COMMON terminal.	Battery voltage.	Test red wires No. 882, 812 and 802 and connections.
15. Travel/neutral switch—NORMALLY OPEN terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)
16. Controller module—Terminal A of six terminal male connector.	Battery voltage.	Test purple wire No. 807 and connections.
17. Mow/backlap switch.	Battery voltage.	Test pink wire No. 811 and connections.
18. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
19. Mow/backlap relay—Terminal 87.	Battery voltage.	Test blue wire No. 802 and connections.
20. Mow/backlap relay—Terminal 30.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
21. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808, pink wire No. 800, pink/white wire No. 801 and connections.
22. Cutting unit lower switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

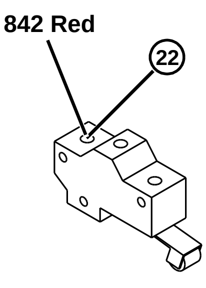
Continued on page 4-172.



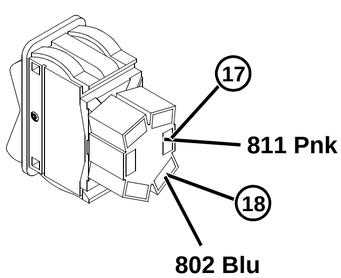




S7 Travel/Neutral Switch



S3 Cutting Unit Lower Switch



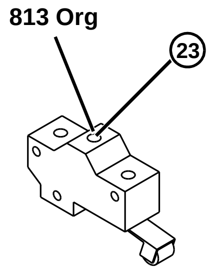
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 957001—958000), continued

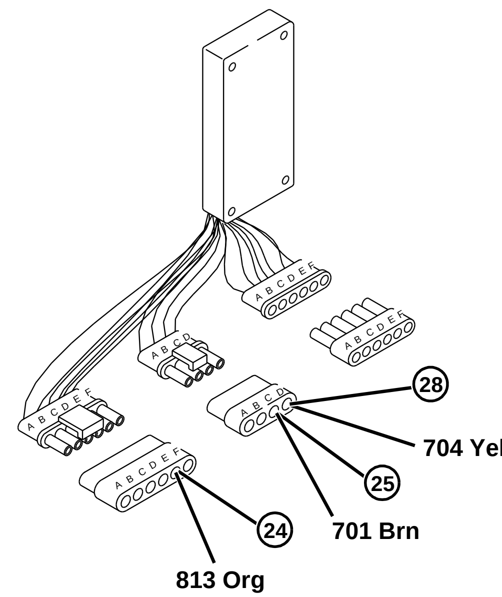
Test Conditions:

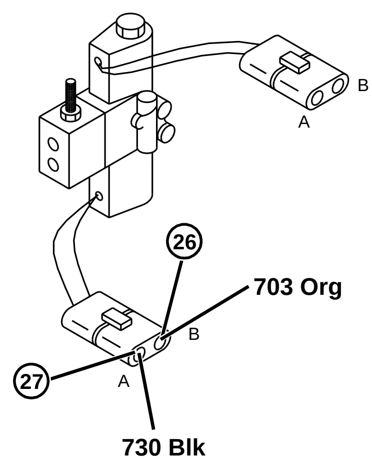
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

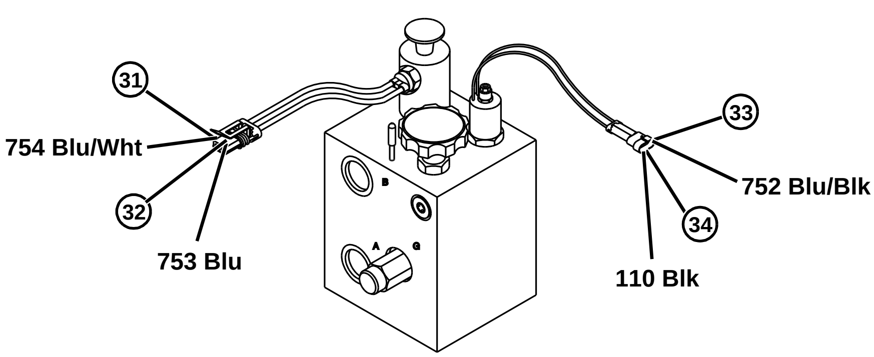
NOTE: For test points 23— 27, push mow pedal and hold down to close switch.

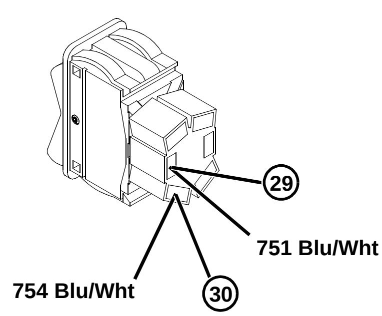
Test Location	Normal	If Not Normal
23. Cutting unit lower switch—NORMALLY OPEN Terminal	Battery voltage.	Test cutting unit mow switch.
24. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
25. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
26. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
27. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 730 and 700, lift valve lower solenoid and ground connections.
28. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
29. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751, yellow wire No. 704 and connections.
30. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
31. Direction valve switch.	Battery voltage.	Test blue/white wire No. 754 and connections.
32. Direction valve switch.	Battery voltage.	Test solenoid. (See SOLENOID COIL TEST on page 4-224.).
33. Mow valve solenoid.	Battery voltage.	Test blue/black wire 752, blue wire No. 753 and connections.
34. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740, 700 and connections.


813 Org
23


28
704 Yel
25
701 Brn
24
813 Org


B
A
26
703 Org
B
27
A
730 Blk


31
754 Blu/Wht
32
753 Blu
33
752 Blu/Blk
34
110 Blk


29
751 Blu/Wht
754 Blu/Wht
30

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION—MOW (S.N. 958001—958XXX)

Function:

To operate reel motors when cutting units are lowered. Mow/transport lever in the MOW position.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Operator in seat.
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.

Theory of Operation:

NOTE: The mow circuit will operate with the travel/neutral switch in either the TRAVEL or NEUTRAL position.

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812 and yellow/black wire No. 410), park brake switch (S6) (red wires No. 802, 812 and 862) seat switch (S6) (red wires No. 802, 812, 892 and pink/black wire No. 810), travel/neutral switch (S7) (red wires No. 802, 812 and 882) and mow/transport switch (S2) (red jumper from travel/neutral switch). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842),

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

With the operator on the seat, the seat switch is closed and current is routed to the controller module (pink wire No. 800 and gray wire No. 808). With the mow/transport lever in the MOW position, the mow/transport switch is released, routing current to the controller module (yellow wire No. 814). The controller module then supplies current to the lift valve lower solenoid (Y2) (orange wire No. 703 and blue/black wire No. 410). A path to ground (black wires No. 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

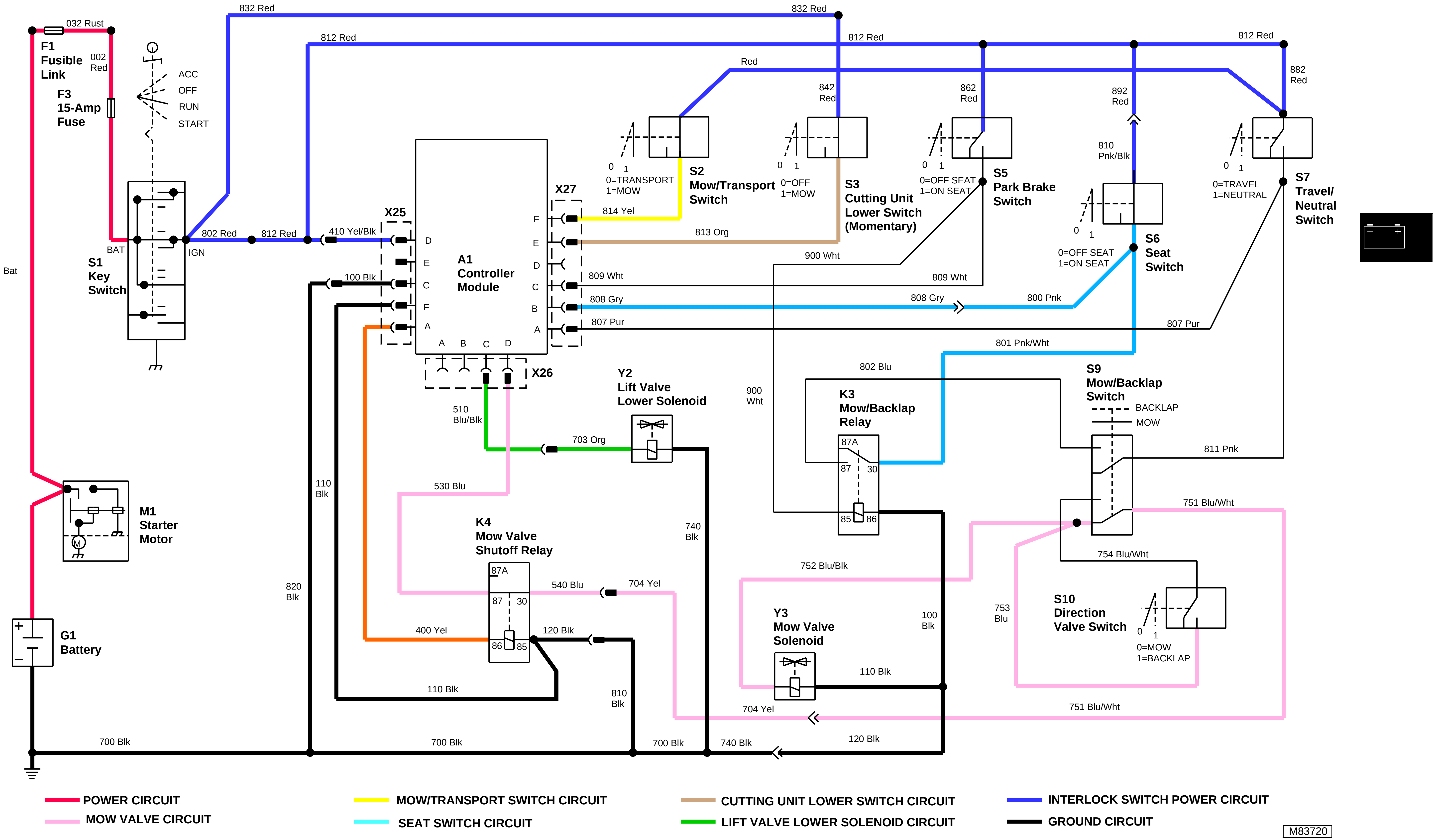
Current is also supplied to the coil of the mow valve shutoff relay (K4) (blue wire No. 530), energizing the relay.

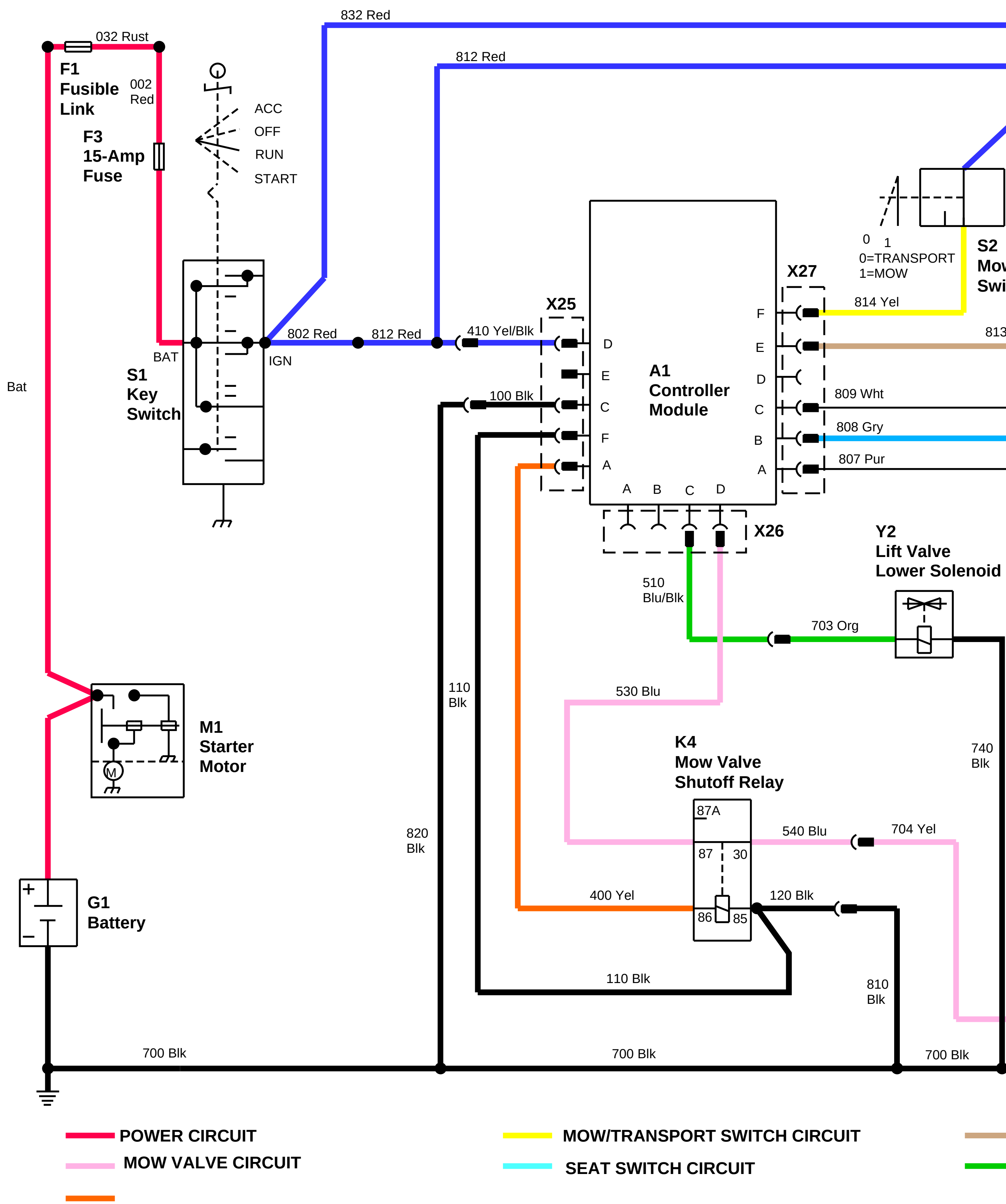
When the mow valve shuttoff relay is energized, a path to ground for the mow valve circuit is provided through the controller module and mow valve shuttoff relay (yellow wire No. 400 and black wires No. 120, 810 and 700), allowing the mow valve circuit to energize.

Current is also supplied to the mow/backlap switch (S9) (yellow wire No. 704 and blue/white wires No. 540 and 751). Current is routed through the mow/backlap switch to the direction valve solenoid (Y5) and mow valve solenoid (Y3) (blue/black wire No. 752).

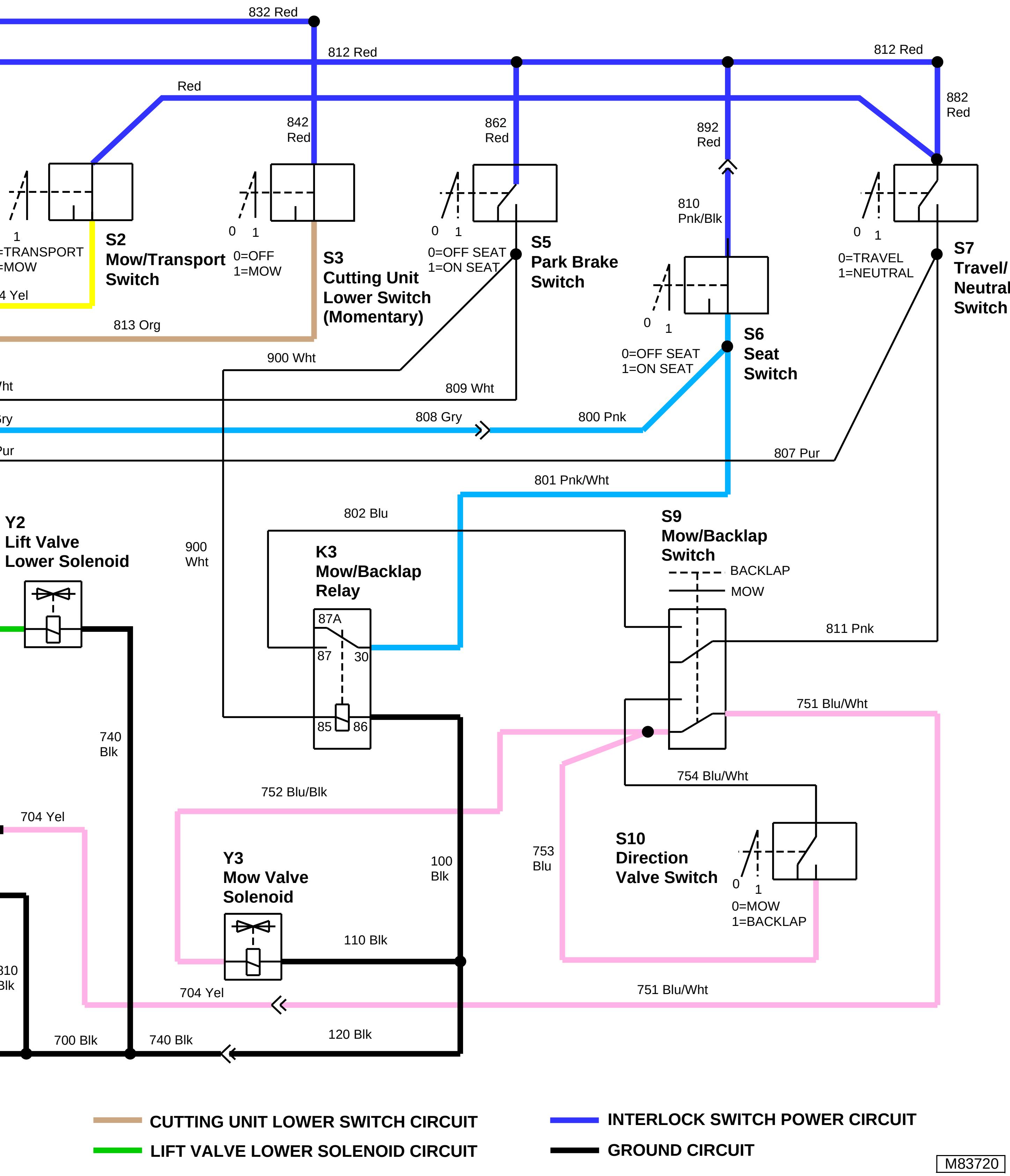
With the mow/backlap switch in the MOW position, there is no path to ground for the direction valve solenoid and it remains in the MOW position. A path to ground for the mow valve solenoid (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid and engaging the cutting unit motors.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
832 Red
812 Red
Red
842
Red
862
Red
892
Red
882
Red
810
Pnk/Blk
BAT
IGN
S1
Key
Switch
Bat
802 Red
812 Red
410 Yel/Blk
X25
100 Blk
A1
Controller
Module
X27
X26
814 Yel
813 Org
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
0=TRANSPORT
1=MOW
S2
Mow/Transport
Switch
0=OFF
1=MOW
S3
Cutting Unit
Lower Switch
(Momentary)
0=OFF SEAT
1=ON SEAT
S5
Park Brake
Switch
S6
Seat
Switch
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
510
Blu/Blk
703 Org
Y2
Lift Valve
Lower Solenoid
900
Wht
802 Blu
K3
Mow/Backlap
Relay
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
753
Blu
S10
Direction
Valve Switch
0=MOW
1=BACKLAP
M1
Starter
Motor
110
Blk
530 Blu
K4
Mow Valve
Shutoff Relay
740
Blk
540 Blu
704 Yel
820
Blk
400 Yel
120 Blk
810
Blk
110 Blk
Y3
Mow Valve
Solenoid
100
Blk
110 Blk
704 Yel
751 Blu/Wht
G1
Battery
700 Blk
700 Blk
700 Blk
740 Blk
120 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83720



832 Red
812 Red
032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
ACC
OFF
RUN
START
802 Red
812 Red
410 Yel/Blk
BAT
IGN
S1 Key Switch
Bat
100 Blk
X25
D
E
C
F
A
A1 Controller Module
X27
F
E
D
C
B
A
0 1
0=TRANSPORT
1=MOW
S2 Mow Swi
814 Yel
813
809 Wht
808 Gry
807 Pur
A B C D
X26
Y2 Lift Valve Lower Solenoid
510 Blu/Blk
703 Org
530 Blu
110 Blk
M1 Starter Motor
K4 Mow Valve Shutoff Relay
740 Blk
87A
87
30
86
85
540 Blu
704 Yel
820 Blk
400 Yel
120 Blk
G1 Battery
110 Blk
810 Blk
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT


832 Red
812 Red
812 Red
Red
842 Red
862 Red
892 Red
882 Red
810 Pnk/Blk
1
=TRANSPORT
=MOW
S2
Mow/Transport
Switch
0 1
0=OFF
1=MOW
S3
Cutting Unit
Lower Switch
(Momentary)
0 1
0=OFF SEAT
1=ON SEAT
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
4 Yel
813 Org
900 Wht
Vht
809 Wht
Gry
808 Gry
800 Pnk
Pur
807 Pur
801 Pnk/Wht
802 Blu
Y2
Lift Valve
Lower Solenoid
900
Wht
K3
Mow/Backlap
Relay
87A
87
30
85
86
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
754 Blu/Wht
740
Blk
752 Blu/Blk
704 Yel
Y3
Mow Valve
Solenoid
100
Blk
753
Blu
S10
Direction
Valve Switch
0 1
0=MOW
1=BACKLAP
110 Blk
310
Blk
704 Yel
751 Blu/Wht
700 Blk
740 Blk
120 Blk
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83720

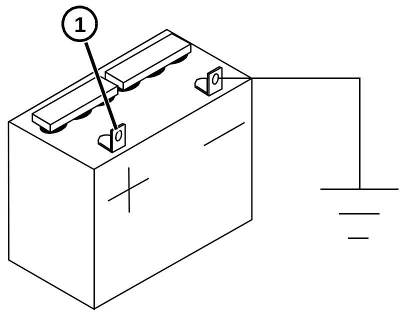
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958001—958XXX)

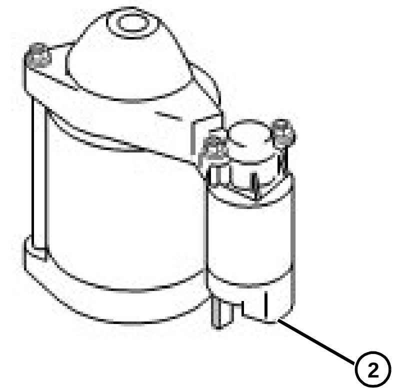
Test Conditions:

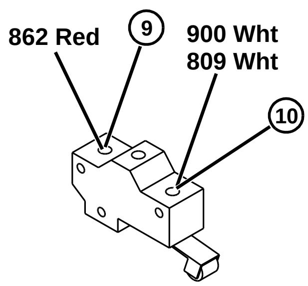
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—terminal D of six terminal female connector.	Battery voltage.	Test red wires No. 802, 812 and yellow/black wire No. 410 and connections.
6. Mow/Transport switch—COMMON terminal.	Battery voltage.	Test red wires No. 812, 882, red jumper from travel/neutral switch and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—terminal F of six terminal male connector.	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal.	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal.	No voltage (open circuit).	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

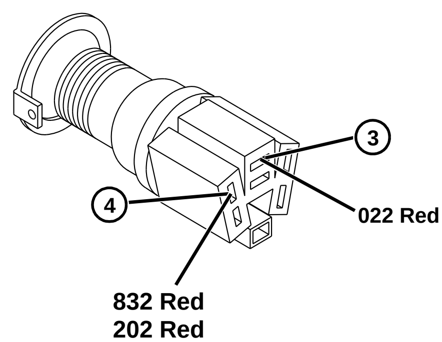
Continued on page 4-178.

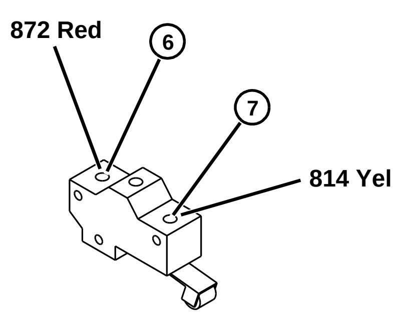




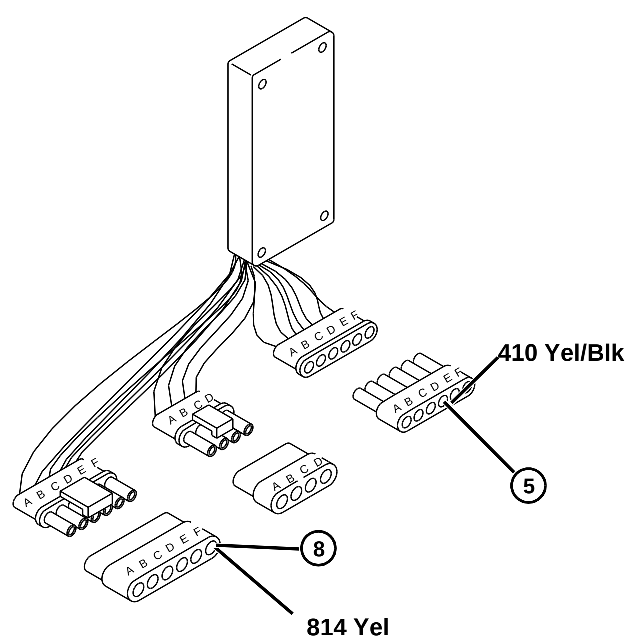


S5 Park Brake Switch





S2 Mow/Transport Switch



OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958001—958XXX), continued

Test Conditions:

- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

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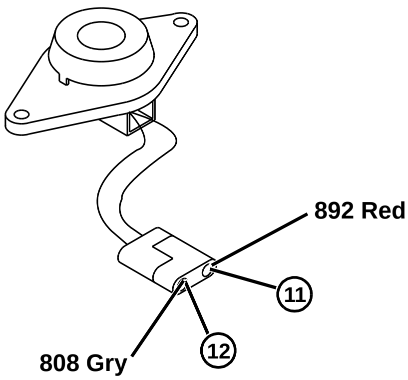
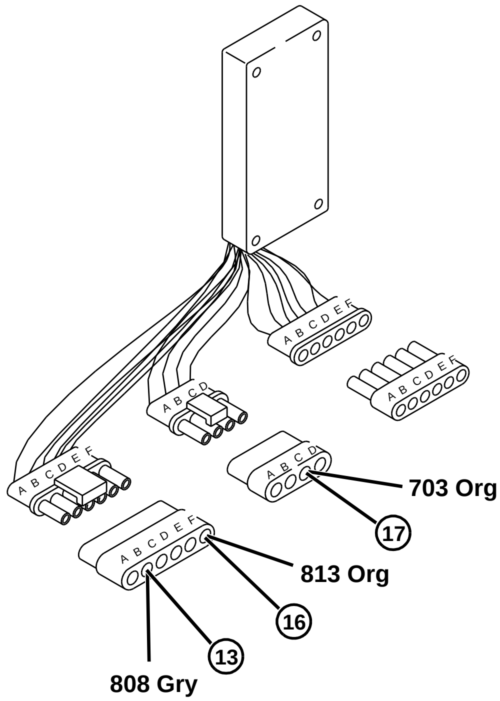
Test Location	Normal	If Not Normal
11. Seat switch.	Battery voltage.	Test pink/black wire No. 810, red wires No. 892, 812 and 802 and connections.
12. Seat switch.	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
13. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808 and pink wire No. 800 and connections.
14. Cutting unit lower switch—COMMON terminal.	Battery voltage.	Test red wires No. 842 and 832 and connections.

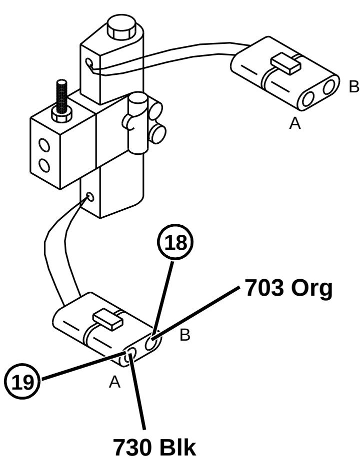
NOTE: For test points 15—17 push lower pedal and hold down to close switch.

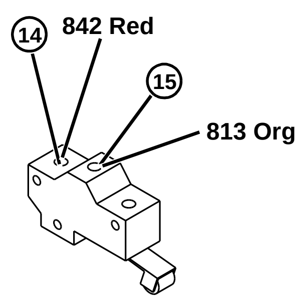
Test Location	Normal	If Not Normal
15. Cutting unit lower switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit lower switch. (See INTERLOCK SWITCH TEST on page 4-222.)
16. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
17. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
18. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703, blue/black wire No. 510 and connections.
19. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 740 and 700, lift valve lower solenoid and ground connections.

Continued on page 4-180.









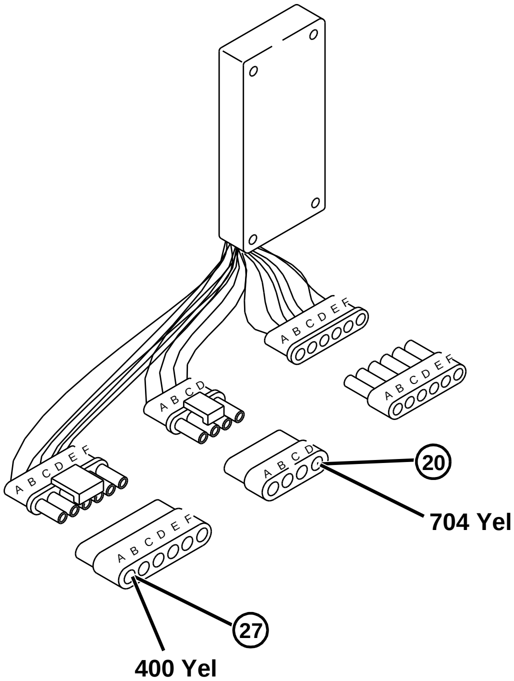
S3 Cutting Unit Lower Switch

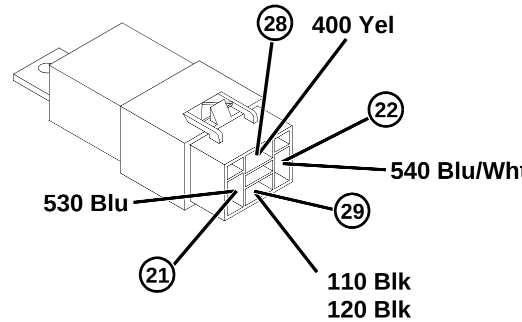
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958001—958XXX), continued

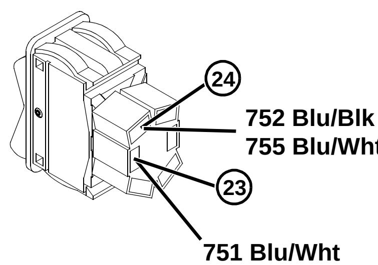
Test Conditions:

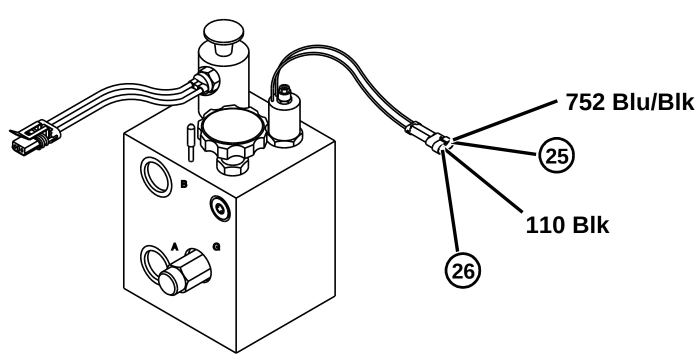
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
20. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
21. Mow valve shutoff relay — Terminal 85.	Battery voltage.	Test blue wire No. 530 and connections.
22. Mow valve shutoff relay — Terminal 86.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
23. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751, yellow wire No. 704, blue/white wire No. 540 and connections.
24. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
25. Mow valve solenoid.	Battery voltage.	Test blue/black wire No. 752 and connections.
26. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740 and 700 and connections.
27. Controller module—Terminal A of six terminal female connector.	Battery voltage.	Test or replace controller module.
28. Mow valve shutoff relay — Terminal 87.	Battery voltage.	Test yellow wire No. 400 and connections.
29. Mow valve shutoff relay — Terminal 30.	Less than 0.2 volt.	Test black wires No. 120, 810, 700 and connections.


A B C D E F
A B C D E F
A B C D
A B C D E F
A B C D
20
704 Yel
A B C D E F
27
400 Yel


28
400 Yel
22
540 Blu/Wht
530 Blu
29
21
110 Blk
120 Blk


24
752 Blu/Blk
755 Blu/Wht
23
751 Blu/Wht


752 Blu/Blk
25
110 Blk
26

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION —BACKLAP (S.N. 958001—958XXX)

Function:

To allow the reel motors to be driven in reverse to permit reel backlapping.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Park brake LOCKED.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (red wires No. 802, 812 and yellow/black wire No. 410), park brake switch (S5) (red wires No. 802, 812 and 862), seat switch (S6) (red wires No. 802, 812 and 892, and pink/black wire No. 810), and travel/neutral switch (S7) (red wires No. 802, 812 and 882) and mow/transport switch (S2) (red jumper from travel/neutral switch). Current is also supplied to cutting unit lower switch (S3) (red wires No. 832 and 842).

When the park brake switch is in the LOCKED position, current is routed to the controller module (white wire No. 809) and to terminal 86 of the mow/backlap relay (K3) (white wire No. 900). A path to ground (black wires No. 100, 120, 740 and 700) completes the circuit, energizing the relay.

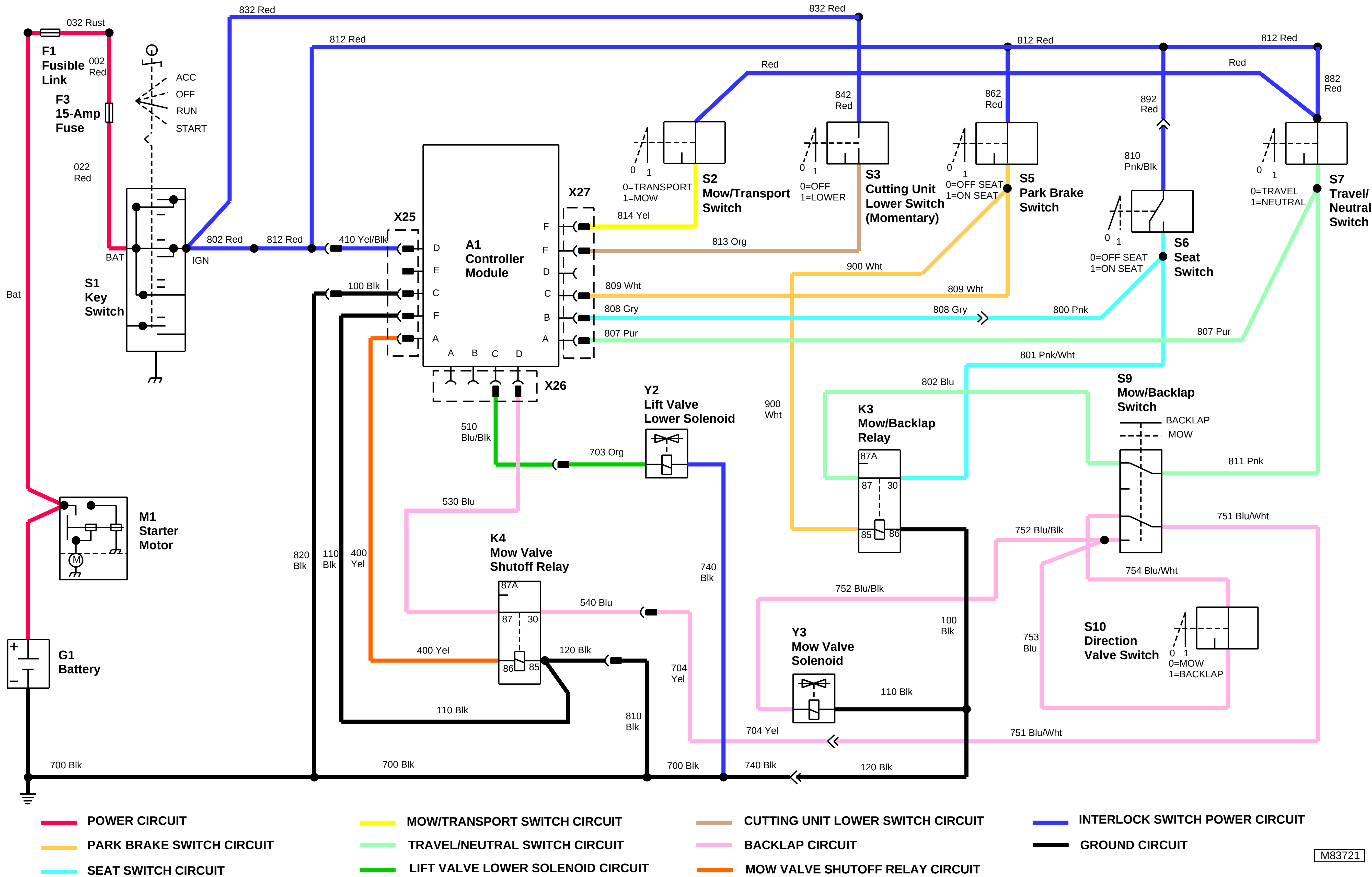
With the travel/neutral switch in the NEUTRAL position current is supplied to the controller module (purple wire No. 807) and the mow/backlap switch (pink wire No. 811). Current is routed through the switch to terminal 87 of the mow/backlap relay (blue wire 802). When the relay is energized, voltage is routed to the controller module (pink/white wire No. 801, pink wire No. 800, and gray wire No. 808). This connection allows the reels to be engaged with the operator out of the seat.

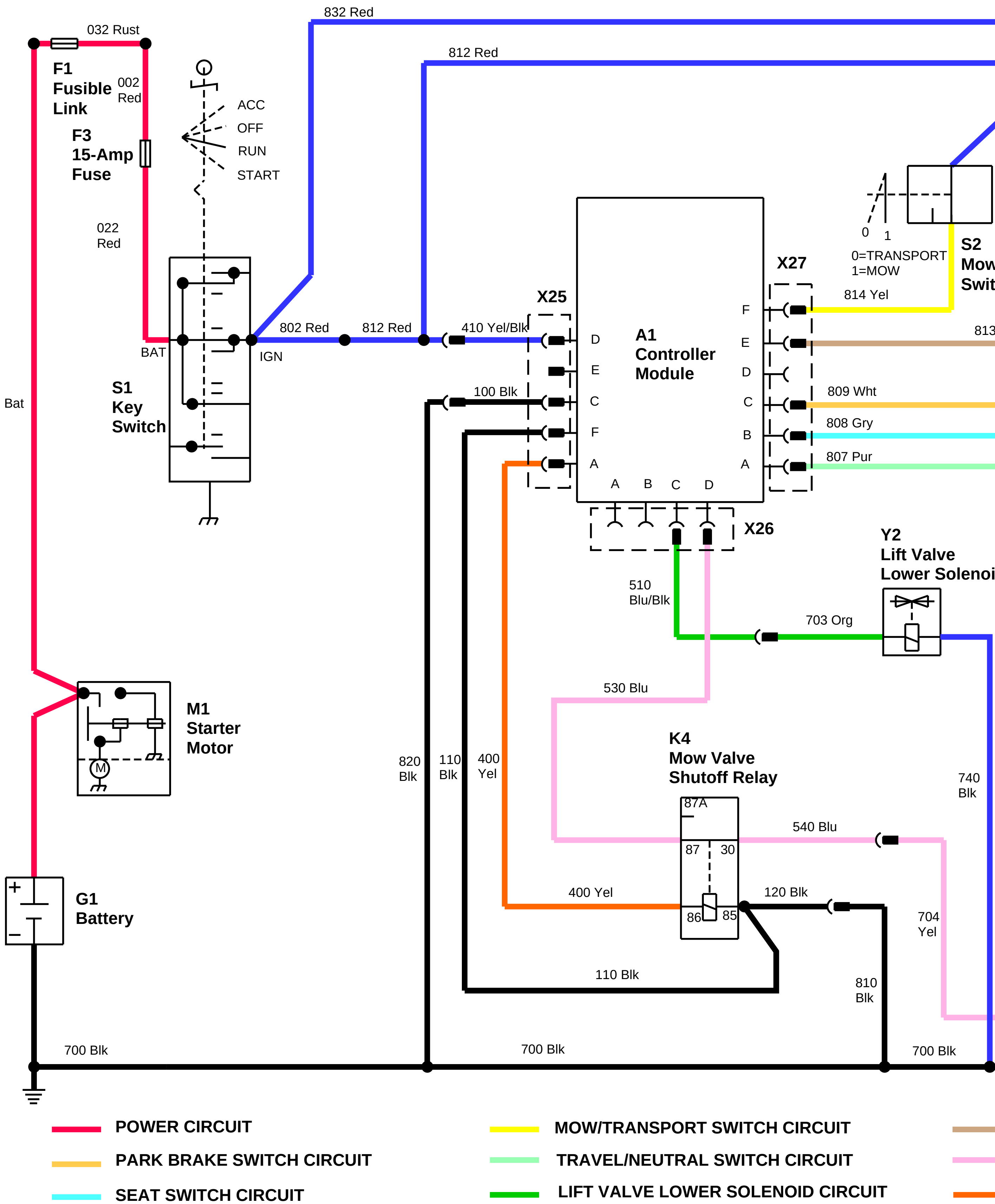
As the mow/transport lever is moved to the MOW position, the mow/transport switch is released, routing battery voltage to the controller module (yellow wire No. 814). The controller then supplies battery voltage to the lift valve lower solenoid (blue/black wire No. 510 and orange wire No. 703). A path to ground (black wires No. 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lower the cutting units.

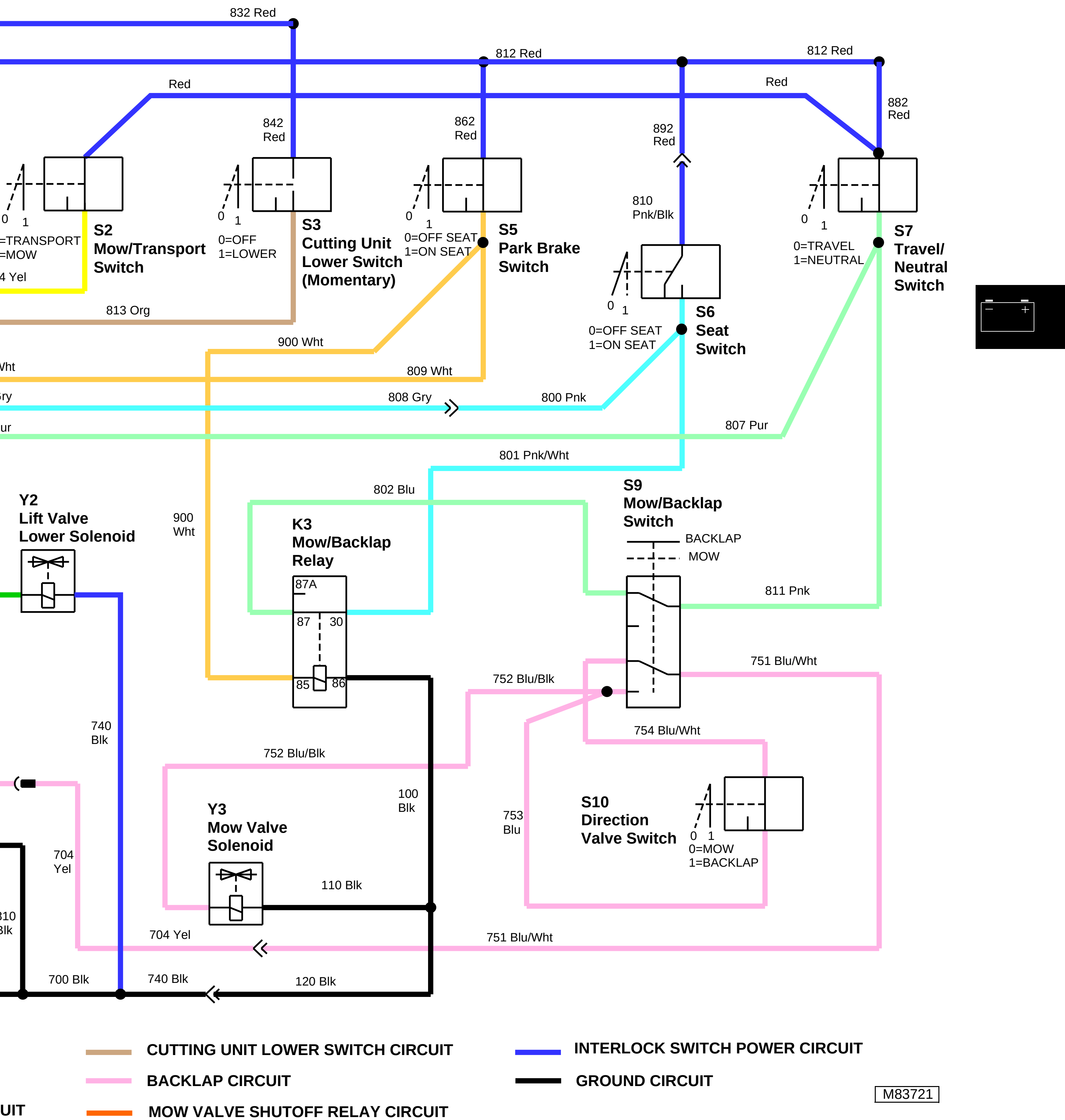
Current is also supplied to the coil of the mow valve shutoff relay (K4) (blue wire No. 530) and to the mow/backlap switch (S10) (blue/white wires No. 540, 751 and yellow wire No. 704).

With the mow/backlap switch in the BACKLAP position, current is routed through the mow/backlap switch to the direction valve switch (blue/white wire No. 754), energizing the switch, allowing the valve to move to the BACKLAP position. Current is then supplied to the mow valve solenoid (blue wire No. 753, blue/black wire No. 752). A path to ground (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid, engaging the cutting units.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


F1
Fusible
Link
F3
15-Amp
Fuse
032 Rust
002
Red
022
Red
Bat
BAT
IGN
ACC
OFF
RUN
START
S1
Key
Switch
832 Red
812 Red
802 Red
410 Yel/Blk
100 Blk
X25
X27
X26
A1
Controller
Module
814 Yel
813 Org
809 Wht
808 Gry
807 Pur
900 Wht
800 Pnk
801 Pnk/Wht
802 Blu
Red
842
Red
862
Red
892
Red
882
Red
810
Pnk/Blk
S2
Mow/Transport
Switch
0=TRANSPORT
1=MOW
S3
Cutting Unit
Lower Switch
(Momentary)
0=OFF
1=LOWER
S5
Park Brake
Switch
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
S7
Travel/
Neutral
Switch
0=TRAVEL
1=NEUTRAL
M1
Starter
Motor
G1
Battery
Y2
Lift Valve
Lower Solenoid
510
Blu/Blk
703 Org
530 Blu
540 Blu
K4
Mow Valve
Shutoff Relay
400 Yel
120 Blk
110 Blk
820
Blk
110
Blk
400
Yel
740
Blk
704
Yel
810
Blk
K3
Mow/Backlap
Relay
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
752 Blu/Blk
754 Blu/Wht
753
Blu
S10
Direction
Valve Switch
0=MOW
1=BACKLAP
Y3
Mow Valve
Solenoid
100
Blk
704 Yel
740 Blk
700 Blk
POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
BACKLAP CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83721


832 Red
812 Red
032 Rust
F1
Fusible
Link
002
Red
F3
15-Amp
Fuse
ACC
OFF
RUN
START
022
Red
BAT
IGN
S1
Key
Switch
Bat
802 Red
812 Red
410 Yel/Blk
X25
D
E
C
F
A
100 Blk
A1
Controller
Module
X27
F
E
D
C
B
A
A
B
C
D
X26
0
1
0=TRANSPORT
1=MOW
S2
Mow
Swit
814 Yel
813
809 Wht
808 Gry
807 Pur
Y2
Lift Valve
Lower Solenoi
510
Blu/Blk
703 Org
530 Blu
M1
Starter
Motor
M
K4
Mow Valve
Shutoff Relay
87A
87
30
86
85
820
Blk
110
Blk
400
Yel
740
Blk
540 Blu
400 Yel
120 Blk
704
Yel
110 Blk
810
Blk
G1
Battery
700 Blk
700 Blk
700 Blk
POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT

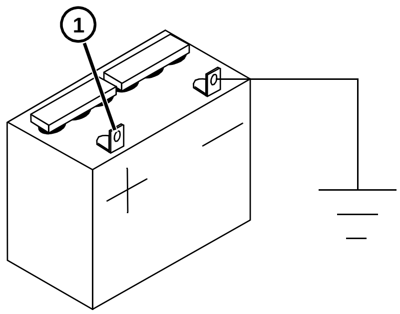

832 Red
812 Red
812 Red
Red
Red
842
Red
862
Red
892
Red
882
Red
0 1
=TRANSPORT
=MOW
S2
Mow/Transport
Switch
4 Yel
0 1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
0 1
0=OFF SEAT
1=ON SEAT
S5
Park Brake
Switch
810
Pnk/Blk
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
813 Org
900 Wht
Wht
809 Wht
ry
808 Gry
800 Pnk
ur
807 Pur
801 Pnk/Wht
802 Blu
Y2
Lift Valve
Lower Solenoid
900
Wht
K3
Mow/Backlap
Relay
87A
87
30
85
86
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
751 Blu/Wht
752 Blu/Blk
754 Blu/Wht
740
Blk
752 Blu/Blk
100
Blk
Y3
Mow Valve
Solenoid
753
Blu
S10
Direction
Valve Switch
0 1
0=MOW
1=BACKLAP
704
Yel
110 Blk
310
Blk
704 Yel
751 Blu/Wht
700 Blk
740 Blk
120 Blk
CUTTING UNIT LOWER SWITCH CIRCUIT
BACKLAP CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
UIT
M83721

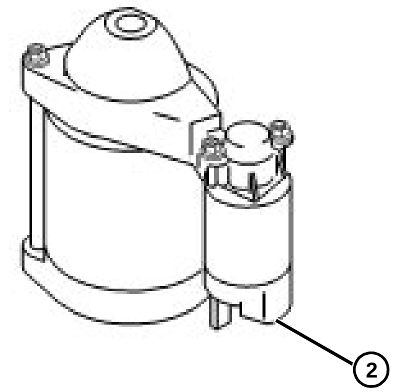
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958001—958XXX)

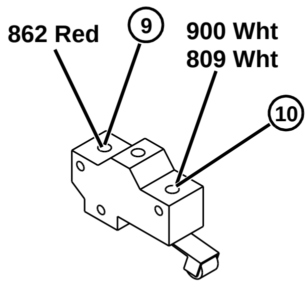
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812, yellow/black wire No. 410 and connections.
6. Mow/Transport switch—COMMON terminal	Battery voltage.	Test red wires No. 812, 882, red jumper from travel/neutral switch and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

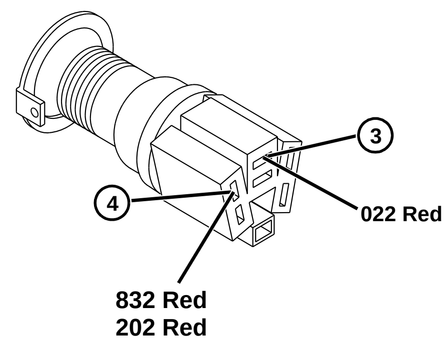
Continued on page 4-186.

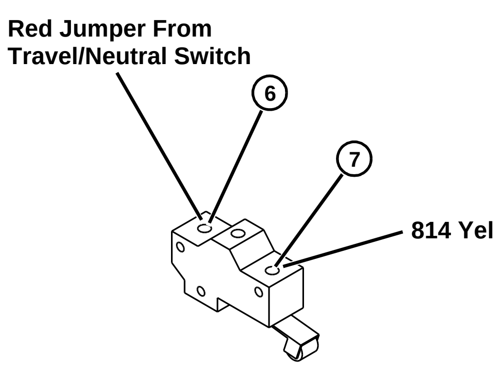




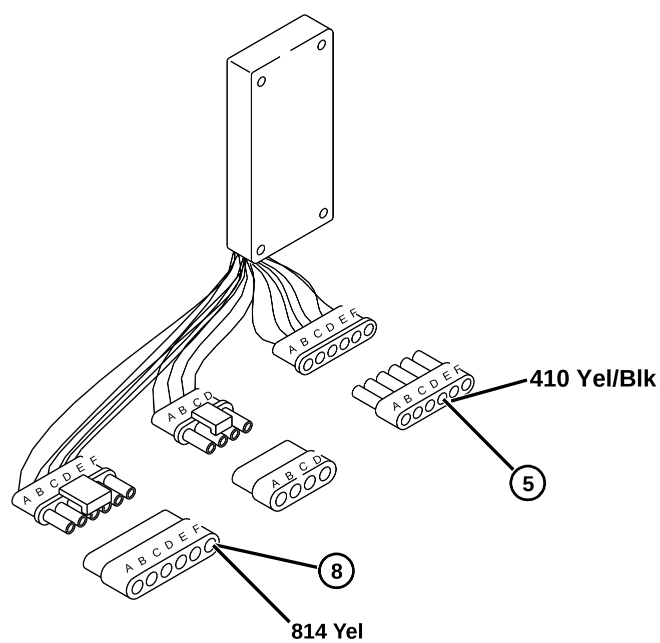


S5 Park Brake Switch





S2 Mow/Transport Switch



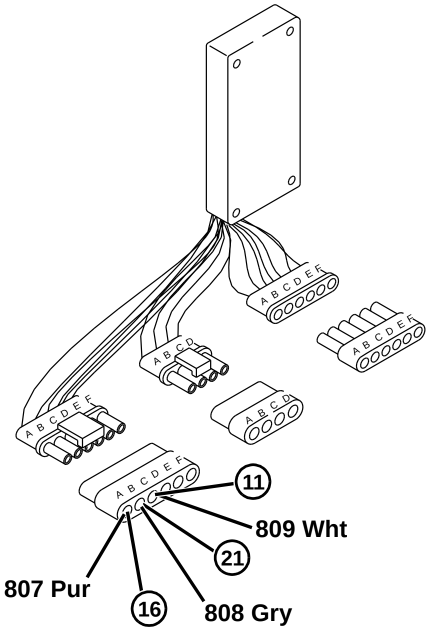
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958001—958XXX), continued

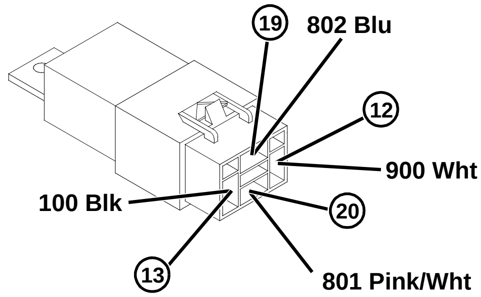
Test Conditions:

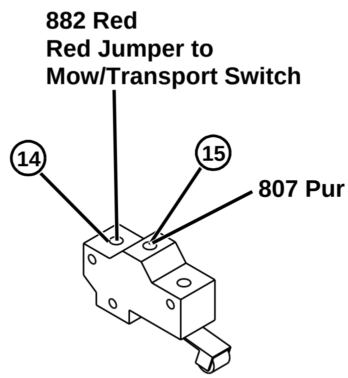
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
11. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
12. Mow/backlap relay—Terminal 86.	Battery voltage.	Test white wire No. 900 and connections.
13. Mow/backlap relay—Terminal 85.	Less than 0.2 volt.	Test black wires No. 100, 120, 740 and 700 and connections.
14. Travel/neutral switch—COMMON terminal.	Battery voltage.	Test red wires No. 882, 812 and 802 and connections.
15. Travel/neutral switch—NORMALLY OPEN terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)
16. Controller module—Terminal A of six terminal male connector.	Battery voltage.	Test purple wire No. 807 and connections.
17. Mow/backlap switch.	Battery voltage.	Test pink wire No. 811 and connections.
18. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
19. Mow/backlap relay—Terminal 87.	Battery voltage.	Test blue wire No. 802 and connections.
20. Mow/backlap relay—Terminal 30.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
21. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808, pink wire No. 800, pink/white wire No. 801 and connections.
22. Cutting unit lower switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

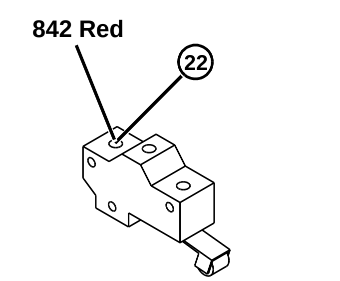
Continued on page 4-188.



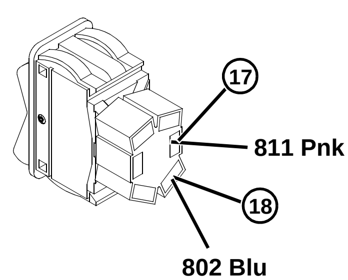




S7 Travel/Neutral Switch



S3 Cutting Unit Lower Switch



OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958001—958XXX), continued

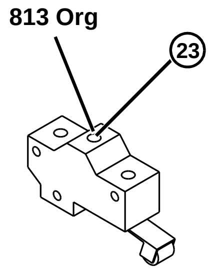
Test Conditions:

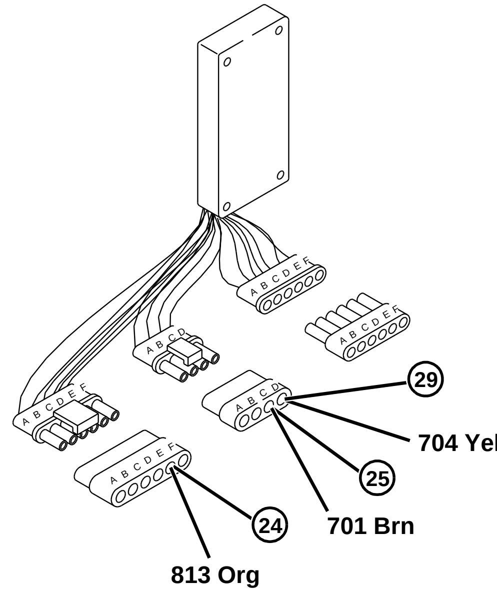
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

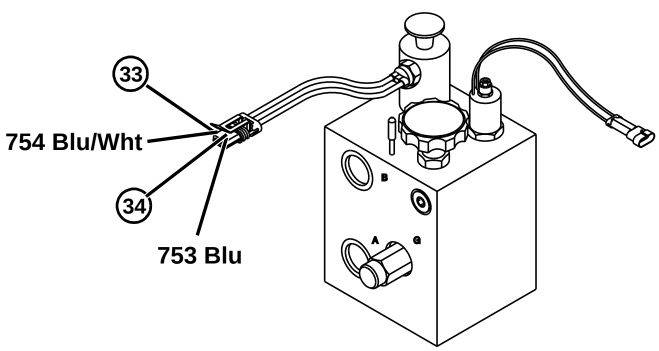
NOTE: For test points 23— 27, push mow pedal and hold down to close switch.

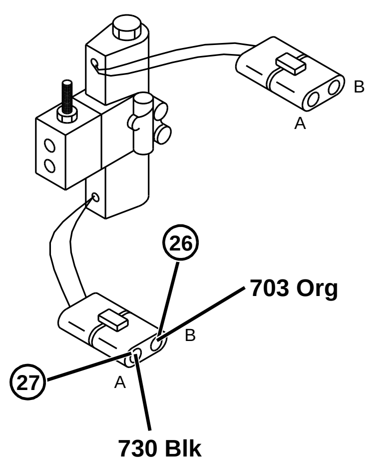
Test Location	Normal	If Not Normal
23. Cutting unit lower switch—NORMALLY OPEN Terminal	Battery voltage.	Test cutting unit mow switch.
24. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
25. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
26. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
27. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 740 and 700, lift valve lower solenoid and ground connections.
28. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
29. Mow valve shutoff relay — Terminal 85.	Battery voltage.	Test blue wire No. 530 and connections.
30. Mow valve shutoff relay — Terminal 86.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
31. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751, yellow wire No. 704 and connections.
32. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
33. Direction valve switch.	Battery voltage.	Test blue/white wire No. 754 and connections.
34. Direction valve switch.	Battery voltage.	Test switch

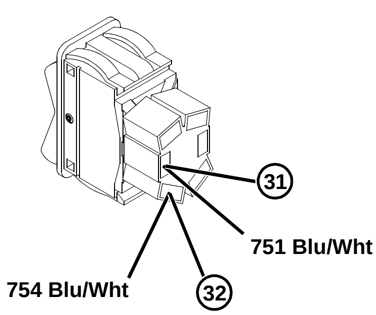
Continued on page 4-190.

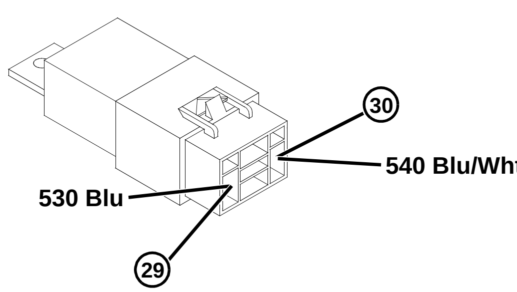

813 Org
23


29
704 Yel
25
701 Brn
24
813 Org


33
754 Blu/Wht
34
753 Blu


B
A
26
703 Org
B
27
A
730 Blk


31
751 Blu/Wht
754 Blu/Wht
32

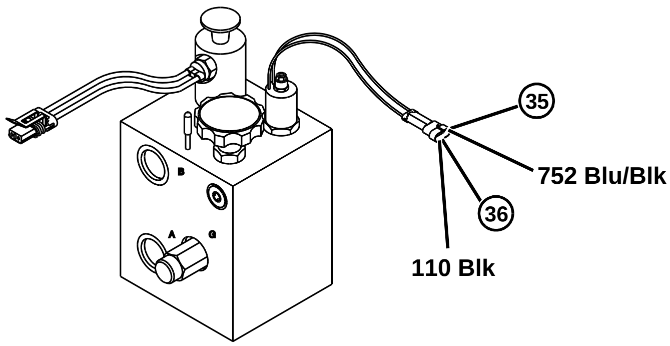

30
540 Blu/Wht
530 Blu
29

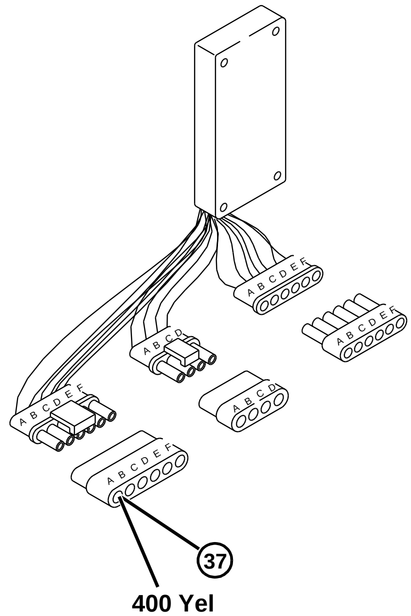
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958001—958XXX), continued

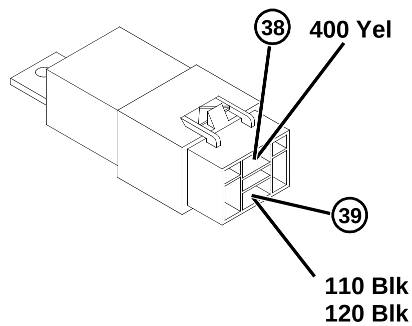
Test Conditions:

- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
35. Mow valve solenoid.	Battery voltage.	Test blue/black wire 752, blue wire No. 753 and connections.
36. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740, 700 and connections.
37. Controller module—Terminal A of six terminal female connector.	Battery voltage.	Test or replace controller module.
38. Mow valve shutoff relay — Terminal 87.	Battery voltage.	Test yellow wire No. 400 and connections.
39. Mow valve shutoff relay — Terminal 30.	Less than 0.2 volt.	Test black wires No. 110, 120, 810, 700 and connections.


35
752 Blu/Blk
36
110 Blk


37
400 Yel


38
400 Yel
39
110 Blk
120 Blk

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION—MOW (S.N. 958XXX—)

Function:

To operate reel motors when cutting units are lowered. Mow/transport lever in the MOW position.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Operator in seat.
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.

Theory of Operation:

NOTE: The mow circuit will operate with the travel/neutral switch in either the TRAVEL or NEUTRAL position.

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (A1) (red wires No. 802 and 812), mow/transport switch (S2) (red wires No. 812 and 872), park brake switch (S5) (red wires No. S6) (red wires No. 812 and 892, and pink/black wire No. 810), and travel/neutral switch (S7) (red wires No. 812 and 882). Current is also supplied to the cutting unit lower switch (S3) (red wires No. 832 and 842),

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

With the operator on the seat, the seat switch is closed and current is routed to the controller module (pink wire No. 800 and gray wire No. 808). With the mow/transport lever in the MOW position, the mow/transport switch is released, routing current to the controller module (yellow wire No. 814). The controller module then supplies current to the lift valve lower solenoid (Y2) (orange wire No. 703). A path to ground (black wires No. 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lowering the cutting units.

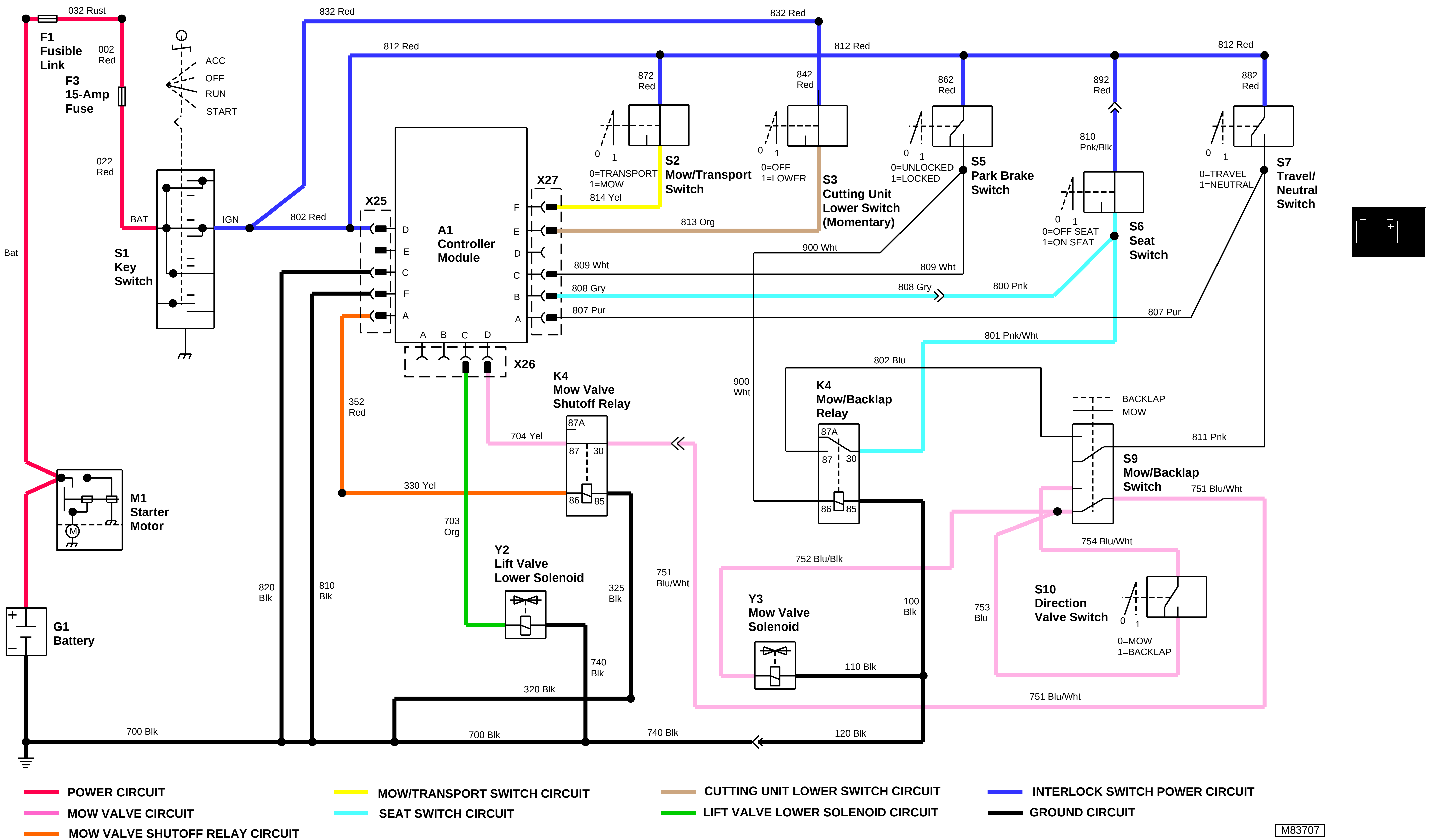
Current is also supplied to the coil of the mow valve shutoff relay (K4) (blue wire No. 530), energizing the relay.

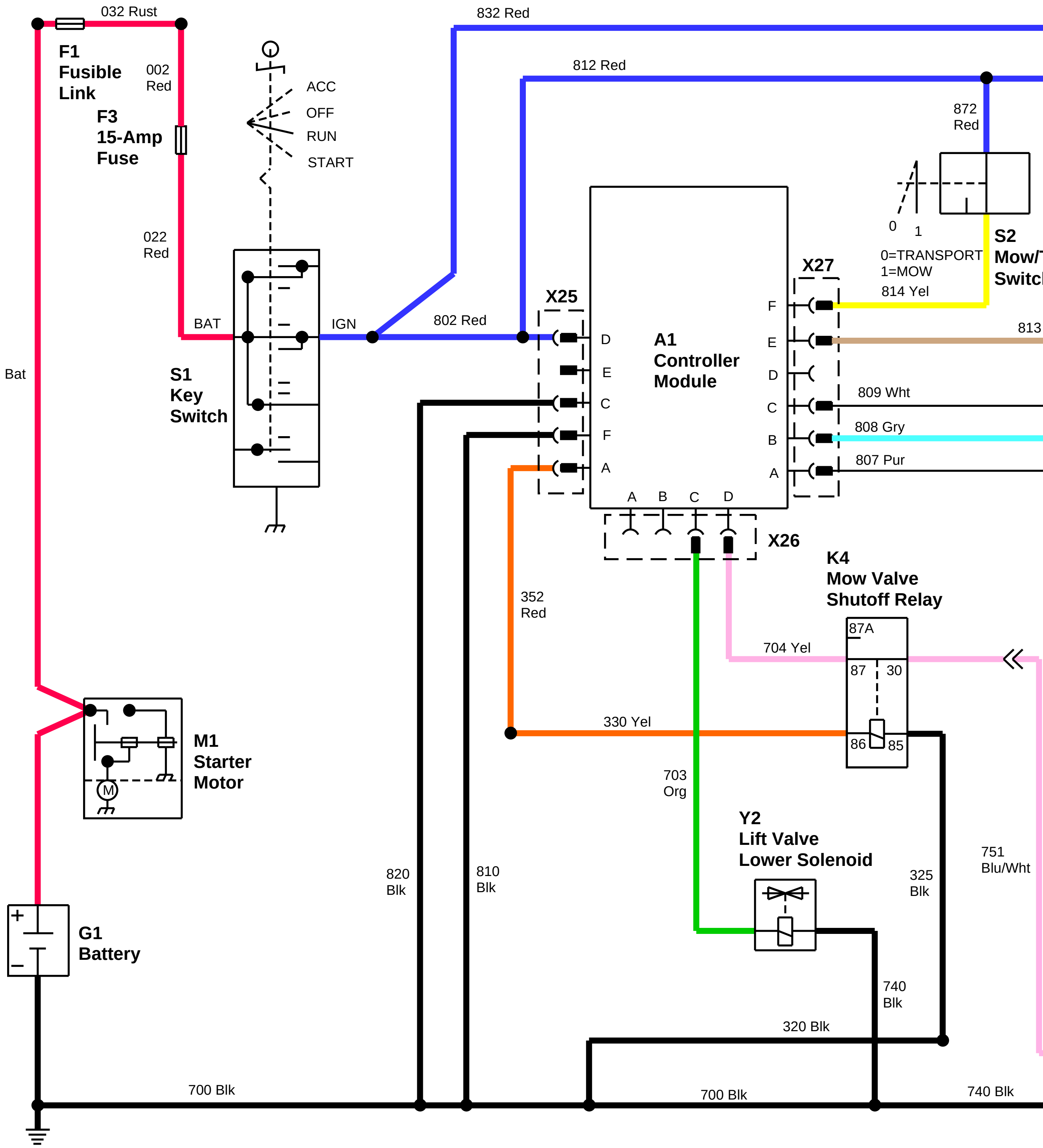
When the mow valve shuttoff relay is energized, a path to ground for the mow valve circuit is provided through the controller module and mow valve shuttoff relay (yellow wire No. 400 and black wires No. 120, 810 and 700), allowing the mow valve circuit to energize.

Current is then supplied to the mow/backlap switch (S9) (yellow wire No. 704 and blue/white wire No. 751). Current is routed through the mow/backlap switch to the direction valve solenoid (Y5) and mow valve solenoid (Y3) (blue/black wire No. 752).

With the mow/backlap switch in the MOW position, there is no path to ground for the direction valve solenoid and it remains in the MOW position. A path to ground for the mow valve solenoid (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid and engaging the cutting unit motors.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
Bat
BAT
IGN
ACC
OFF
RUN
START
S1 Key Switch
832 Red
812 Red
802 Red
X25
X27
X26
A1 Controller Module
872 Red
842 Red
862 Red
892 Red
882 Red
0=TRANSPORT 1=MOW
S2 Mow/Transport Switch
814 Yel
0=OFF 1=LOWER
S3 Cutting Unit Lower Switch (Momentary)
813 Org
0=UNLOCKED 1=LOCKED
S5 Park Brake Switch
810 Pnk/Blk
0=OFF SEAT 1=ON SEAT
S6 Seat Switch
0=TRAVEL 1=NEUTRAL
S7 Travel/ Neutral Switch
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
802 Blu
352 Red
K4 Mow Valve Shutoff Relay
704 Yel
330 Yel
703 Org
K4 Mow/Backlap Relay
BACKLAP
MOW
811 Pnk
S9 Mow/Backlap Switch
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
M1 Starter Motor
Y2 Lift Valve Lower Solenoid
Y3 Mow Valve Solenoid
S10 Direction Valve Switch
0=MOW 1=BACKLAP
753 Blu
820 Blk
810 Blk
325 Blk
740 Blk
100 Blk
110 Blk
320 Blk
G1 Battery
700 Blk
740 Blk
120 Blk
POWER CIRCUIT
MOW VALVE CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83707



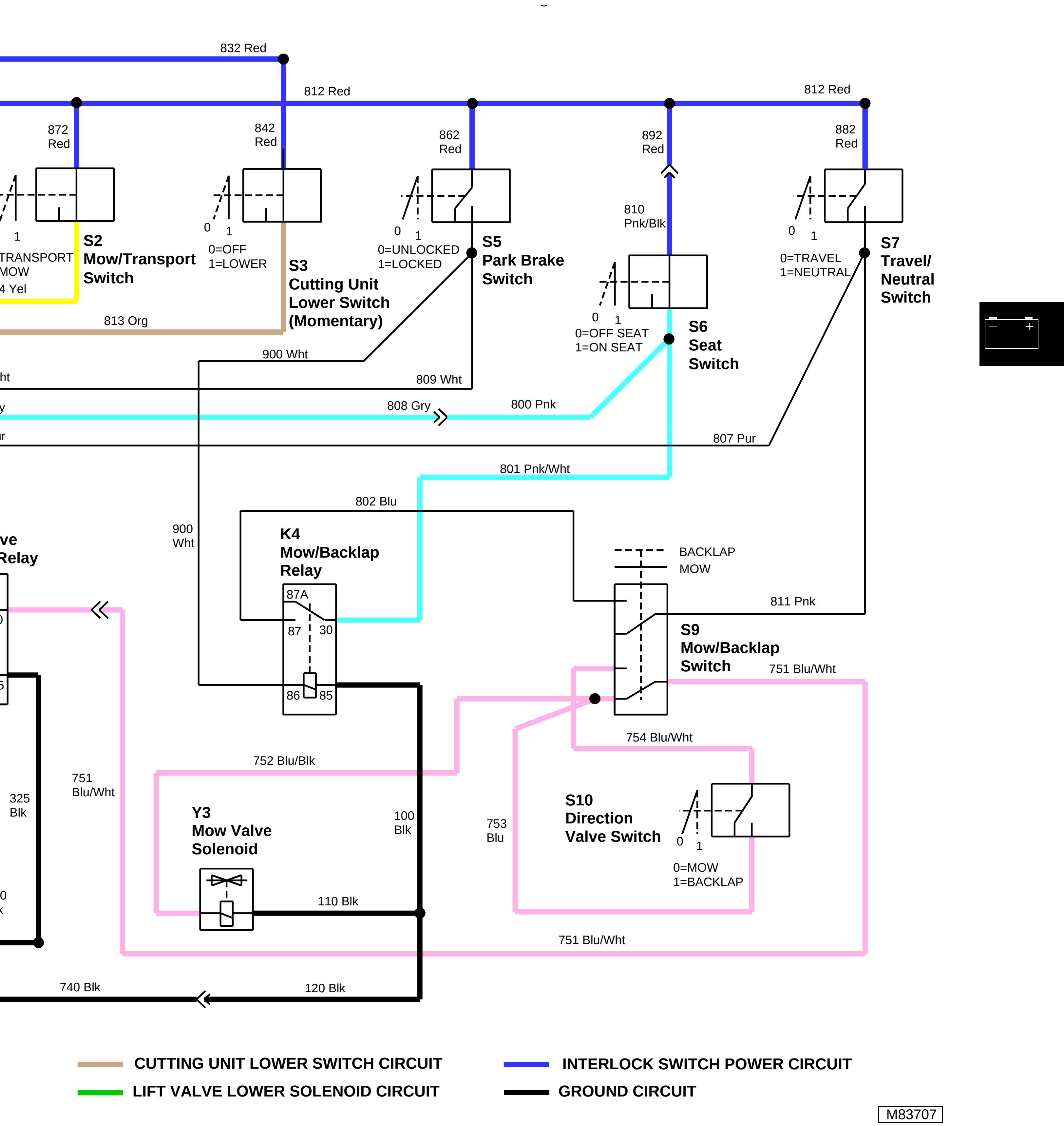
POWER CIRCUIT

MOW VALVE CIRCUIT

MOW VALVE SHUTOFF RELAY CIRCUIT

MOW/TRANSPORT SWITCH CIRCUIT

SEAT SWITCH CIRCUIT



832 Red
812 Red
812 Red
872 Red
842 Red
862 Red
892 Red
882 Red
810 Pnk/Blk
1
TRANSPORT
MOW
4 Yel
S2
Mow/Transport
Switch
0 1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
813 Org
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
802 Blu
900 Wht
K4
Mow/Backlap
Relay
87A
87
30
86
85
BACKLAP
MOW
811 Pnk
S9
Mow/Backlap
Switch
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
751 Blu/Wht
325 Blk
Y3
Mow Valve
Solenoid
100 Blk
753 Blu
S10
Direction
Valve Switch
0 1
0=MOW
1=BACKLAP
110 Blk
751 Blu/Wht
740 Blk
120 Blk
ve
Relay
CUTTING UNIT LOWER SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
GROUND CIRCUIT
M83707

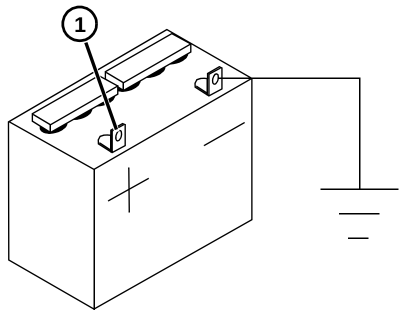
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958XXX—)

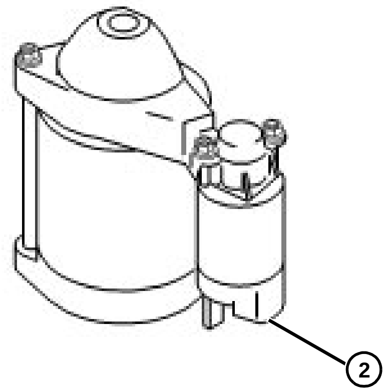
Test Conditions:

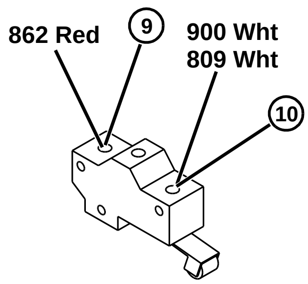
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post.	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal.	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal.	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—terminal D of six terminal female connector.	Battery voltage.	Test red wires No. 802, 812 and connections.
6. Mow/Transport switch—COMMON terminal.	Battery voltage.	Test red wires No. 812, 872 and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—terminal F of six terminal male connector.	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal.	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal.	No voltage (open circuit).	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

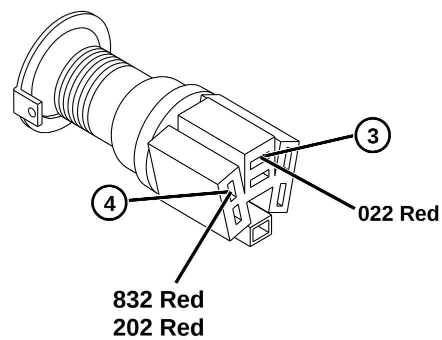
Continued on page 4-196.

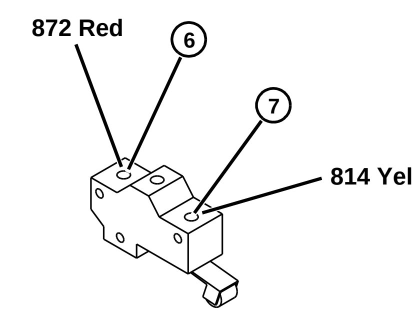




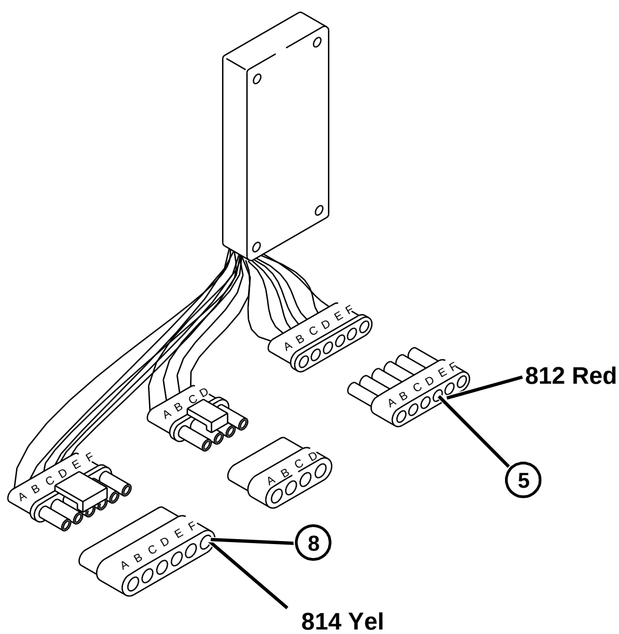


S5 Park Brake Switch





S2 Mow/Transport Switch



OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958XXX—), continued

Test Conditions:

- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

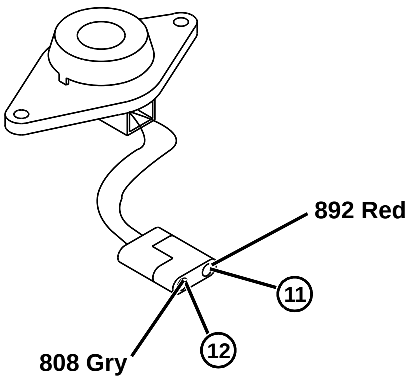
.

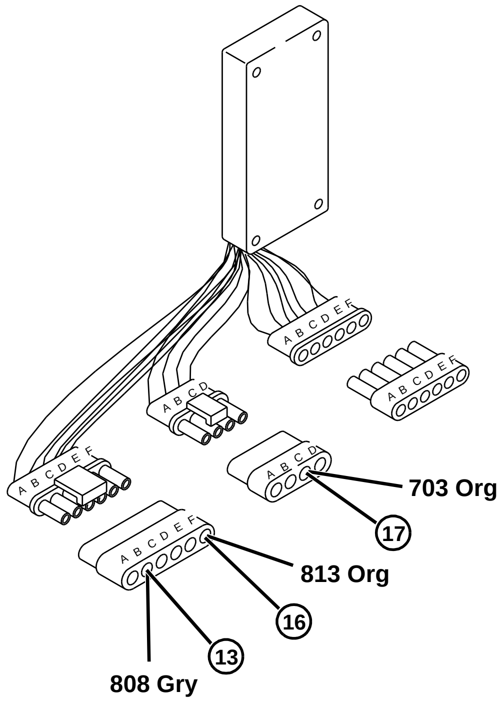
Test Location	Normal	If Not Normal
11. Seat switch.	Battery voltage.	Test pink/black wire No. 810, red wires No. 892, 812 and 802 and connections.
12. Seat switch.	Battery voltage.	Test seat switch. (See SEAT SWITCH TEST on page 4-222.)
13. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808 and pink wire No. 800 and connections.
14. Cutting unit lower switch—COMMON terminal.	Battery voltage.	Test red wires No. 842 and 832 and connections.

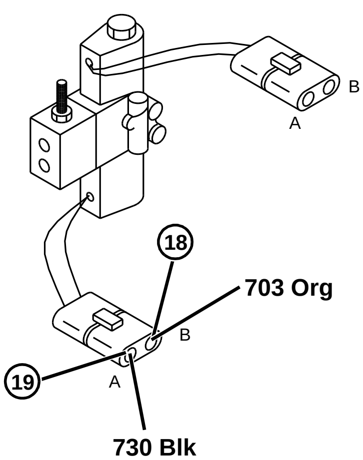
NOTE: For test points 15—17 push lower pedal and hold down to close switch.

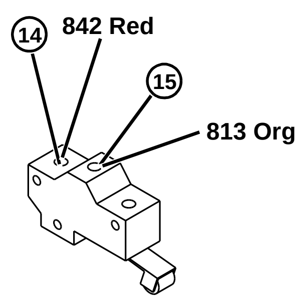
Test Location	Normal	If Not Normal
15. Cutting unit lower switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit lower switch. (See INTERLOCK SWITCH TEST on page 4-222.)
16. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
17. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
18. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
19. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 730 and 700, lift valve lower solenoid and ground connections.

Continued on page 4-198.


892 Red
11
808 Gry
12


703 Org
17
813 Org
16
13
808 Gry


B
A
18
703 Org
B
19
A
730 Blk

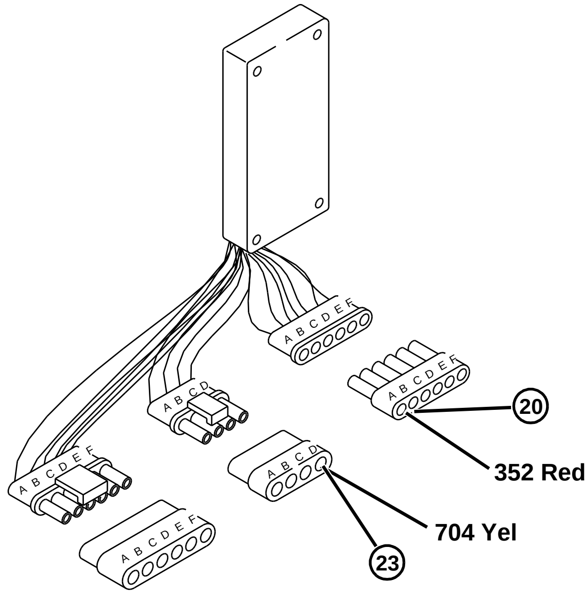

14
842 Red
15
813 Org

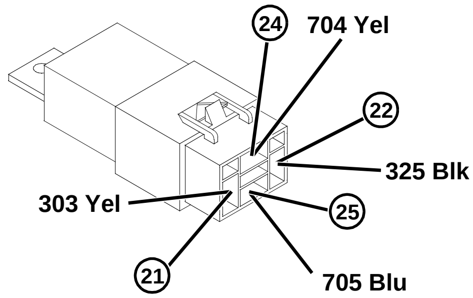
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW (S.N. 958XXX—), continued

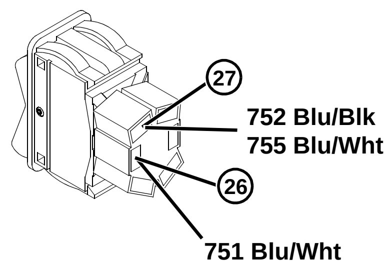
Test Conditions:

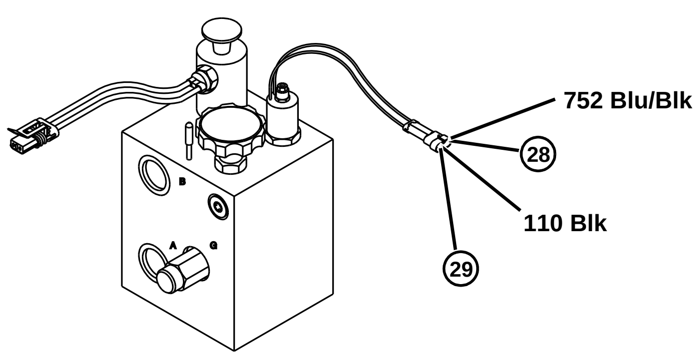
- Key switch in RUN position (engine not running).
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.
- Park brake RELEASED.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
20. Controller module—terminal A of six terminal female connector.	Battery voltage.	Test or replace controller module.
21. Mow valve shutoff relay — Terminal 85.	Battery voltage.	Test red wire No. 352, yellow wire No. 330 and connections.
22. Mow valve shutoff relay — Terminal 86.	Less than 0.2 volt.	Test black wires No. 320, 325, 700 and connections.
23. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
24. Mow valve shutoff relay — Terminal 87.	Battery voltage.	Test yellow wire No. 704 and connections.
25. Mow valve shutoff relay — Terminal 30.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
26. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751, blue wire No. 705 and connections.
27. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
28. Mow valve solenoid.	Battery voltage.	Test blue/black wire No. 752 and connections.
29. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740 and 700 and connections.


20
352 Red
704 Yel
23


24
704 Yel
22
325 Blk
303 Yel
25
21
705 Blu


27
752 Blu/Blk
755 Blu/Wht
26
751 Blu/Wht


752 Blu/Blk
28
110 Blk
29

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION —BACKLAP (S.N. 958XXX—)

Function:

To allow the reel motors to be driven in reverse to permit reel backlapping.

Operating Conditions:

- Key switch in the RUN position.
- Engine running.
- Park brake LOCKED.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.

Theory of Operation:

The power circuit provides current to the key switch 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 and key switch (S1) (rust wire No. 032 and red wires No. 002 and 022).

With the key switch in the RUN position, current is supplied to the controller module (red wires No. 802 and 812), mow/transport switch (red wires No. 812 and 872), park brake switch (red wires No. 812 and 862), seat switch (red wires No. 812 and 892, and pink/black wire No. 810), and travel/neutral switch (red wires No. 812 and 882). Current is also supplied to cutting unit lower switch (red wires No. 832 and 842).

As the mow/transport lever is moved to the MOW position, the mow/transport switch is released, routing battery voltage to the controller module (yellow wire No. 814). The controller then supplies battery voltage to the lift valve lower solenoid (orange wire No. 703). A path to ground (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the lift valve lower solenoid, lower the cutting units.

Current is also supplied to the coil of the mow valve shutoff relay (K4) (blue wire No. 530), energizing the relay.

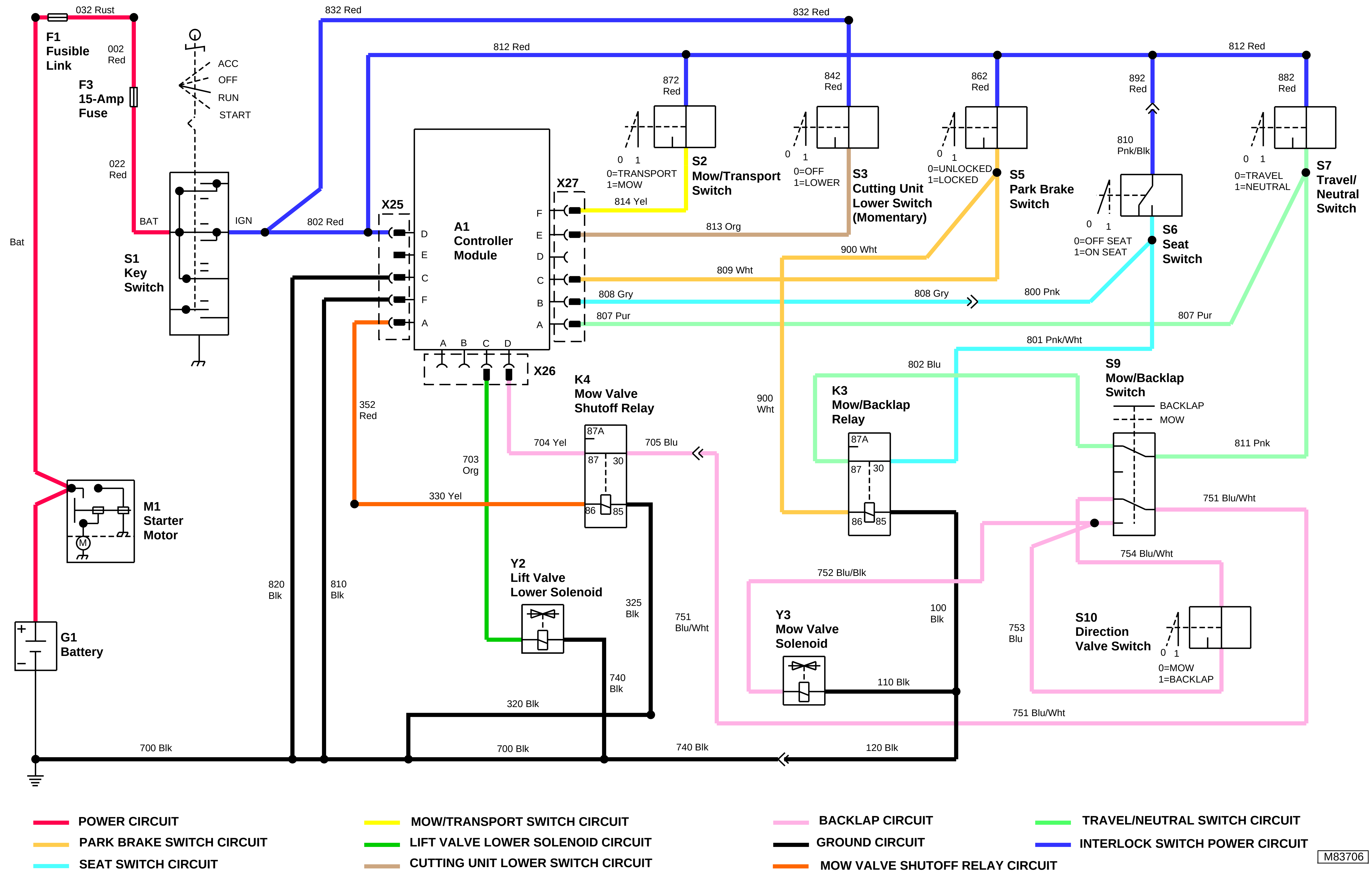
When the mow valve shuttoff relay is energized, a path to ground for the mow valve circuit is provided through the controller module and mow valve shuttoff relay (yellow wire No. 400 and black wires No. 120, 810 and 700), allowing the mow valve circuit to energize. Current is then supplied to the mow/backlap switch (yellow wire No. 704, blue/white wire No. 751). Current is routed through the mow/backlap switch to the direction valve switch (blue/white wire No. 754), energizing the switch, allowing the valve to move to the BACKLAP position.

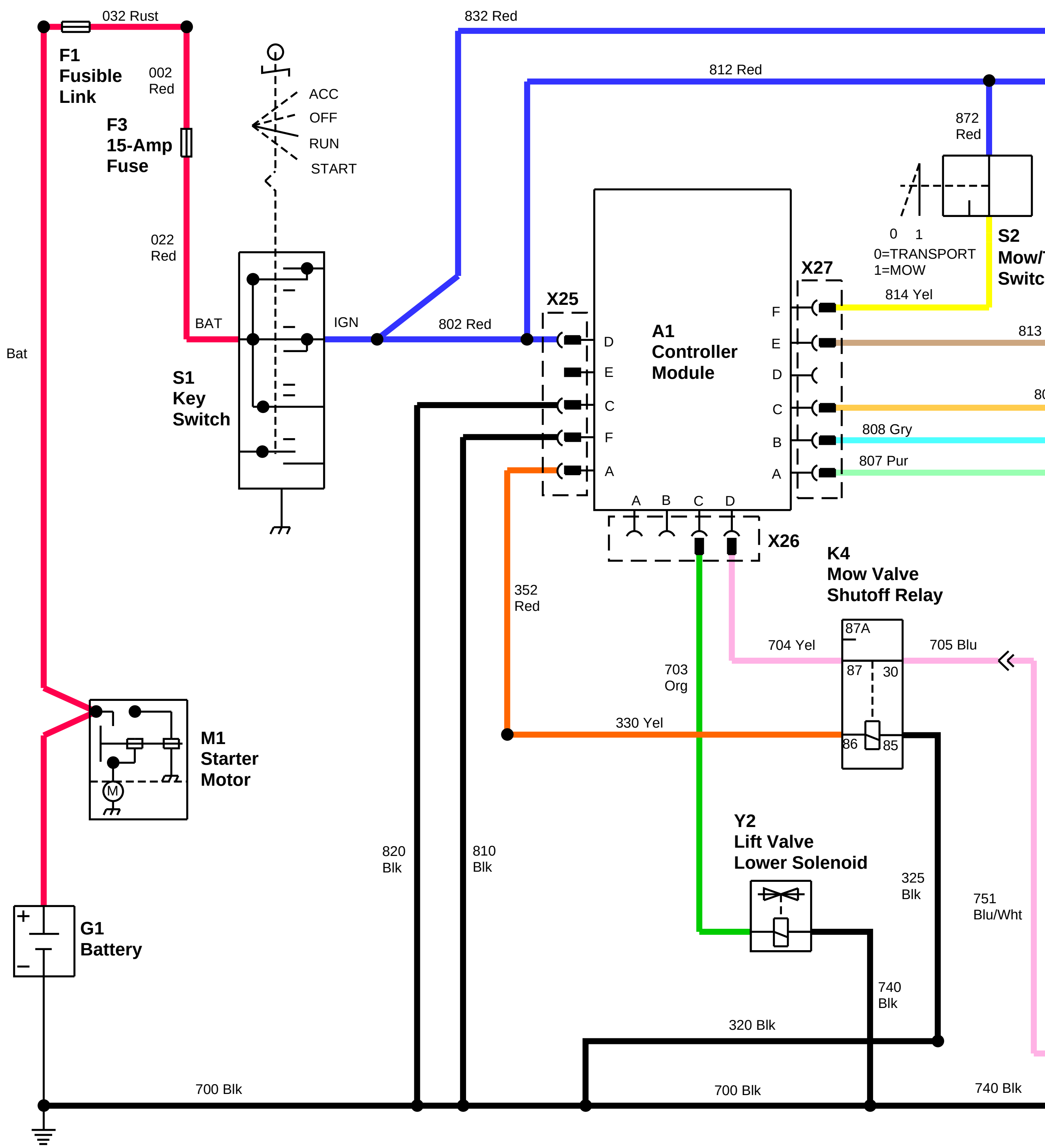
Current is also supplied to the mow valve solenoid (blue wire No. 753, blue/black wire No. 752). A path to ground (black wires No. 110, 120, 740 and 700) completes the circuit, energizing the mow valve solenoid, engaging the cutting units.

When the park brake switch is in the LOCKED position, current is routed to the controller module (white wire No. 809) and to terminal 86 of the mow/backlap relay (K4) (white wire No. 900). A path to ground (black wires No. 100, 120, 740 and 700) completes the circuit, energizing the relay.

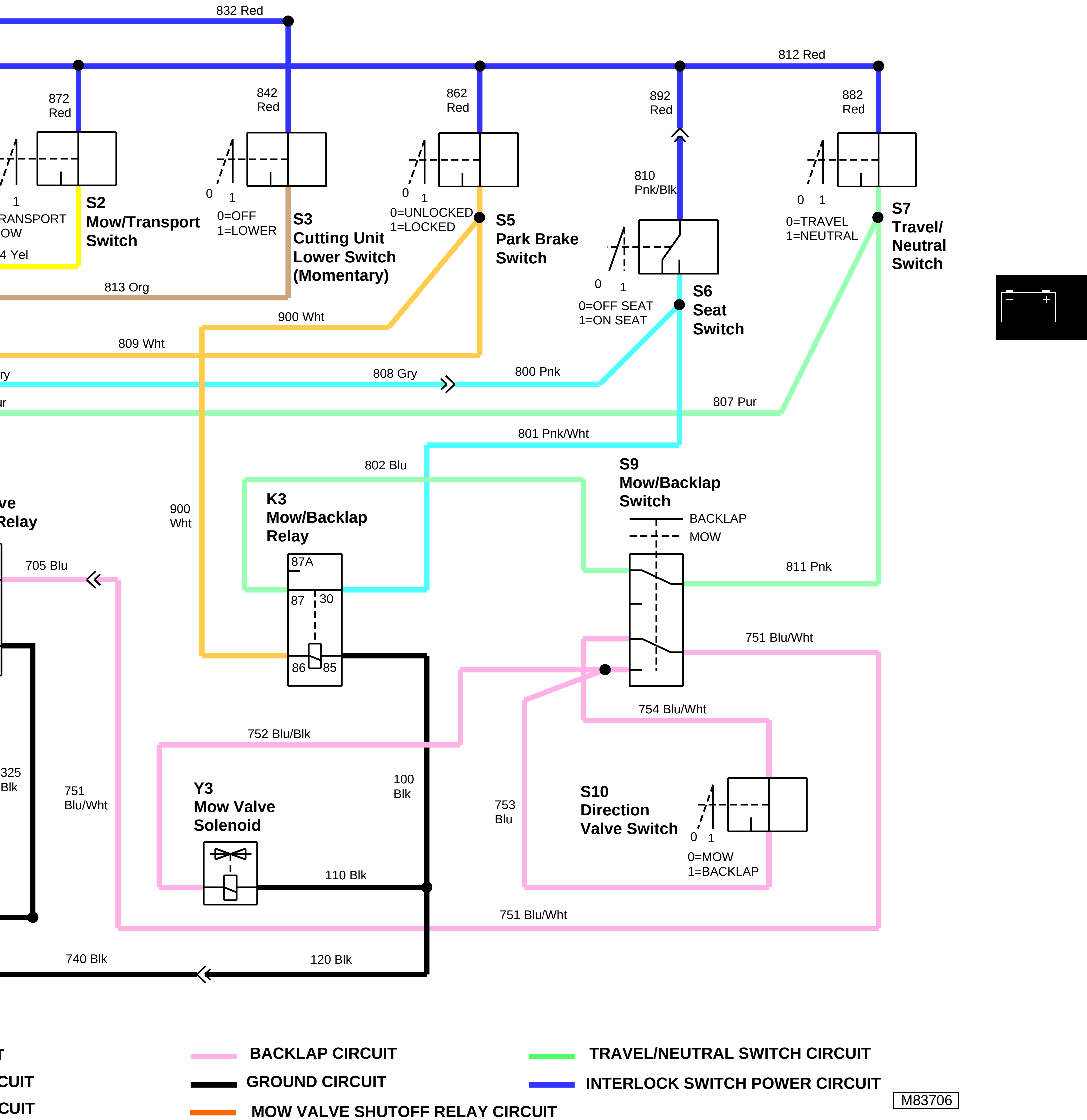
With the travel/neutral switch in the NEUTRAL position current is supplied to the controller module (purple wire No. 807) and the mow/backlap switch (pink wire No. 811). Current is routed through the switch to terminal 87 of the mow/backlap relay (blue wire 802). When the relay energized, voltage is routed to the controller module (pink/white wire No. 801, pink wire No. 800, and gray wire No. 808). This connection allows the reels to be engaged with the operator out of the seat.

A time delay in the controller module keeps the solenoid energized for six seconds to ensure the cutting units have had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


032 Rust
F1 Fusible Link
002 Red
F3 15-Amp Fuse
022 Red
Bat
BAT
IGN
ACC
OFF
RUN
START
S1 Key Switch
832 Red
812 Red
802 Red
X25
A1 Controller Module
X27
X26
872 Red
842 Red
862 Red
892 Red
882 Red
0=TRANSPORT
1=MOW
S2 Mow/Transport Switch
0=OFF
1=LOWER
S3 Cutting Unit Lower Switch (Momentary)
0=UNLOCKED
1=LOCKED
S5 Park Brake Switch
810 Pnk/Blk
0=OFF SEAT
1=ON SEAT
S6 Seat Switch
0=TRAVEL
1=NEUTRAL
S7 Travel/ Neutral Switch
814 Yel
813 Org
900 Wht
809 Wht
808 Gry
800 Pnk
807 Pur
801 Pnk/Wht
802 Blu
S9 Mow/Backlap Switch
BACKLAP
MOW
811 Pnk
K4 Mow Valve Shutoff Relay
K3 Mow/Backlap Relay
352 Red
703 Org
704 Yel
705 Blu
330 Yel
M1 Starter Motor
Y2 Lift Valve Lower Solenoid
325 Blk
740 Blk
320 Blk
751 Blu/Wht
752 Blu/Blk
754 Blu/Wht
753 Blu
Y3 Mow Valve Solenoid
100 Blk
110 Blk
S10 Direction Valve Switch
0=MOW
1=BACKLAP
820 Blk
810 Blk
G1 Battery
700 Blk
120 Blk
POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT
BACKLAP CIRCUIT
GROUND CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
M83706



POWER CIRCUIT
PARK BRAKE SWITCH CIRCUIT
SEAT SWITCH CIRCUIT
MOW/TRANSPORT SWITCH CIRCUIT
LIFT VALVE LOWER SOLENOID CIRCUIT
CUTTING UNIT LOWER SWITCH CIRCUIT

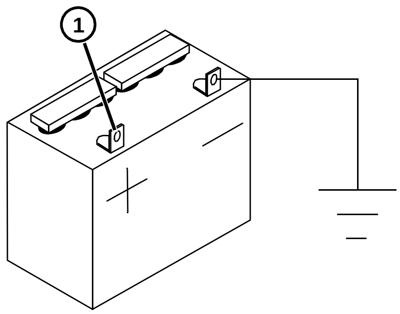

832 Red
812 Red
872
Red
842
Red
862
Red
892
Red
882
Red
1
RANSPORT
OW
4 Yel
S2
Mow/Transport
Switch
0 1
0=OFF
1=LOWER
S3
Cutting Unit
Lower Switch
(Momentary)
0 1
0=UNLOCKED
1=LOCKED
S5
Park Brake
Switch
810
Pnk/Blk
0 1
0=OFF SEAT
1=ON SEAT
S6
Seat
Switch
0 1
0=TRAVEL
1=NEUTRAL
S7
Travel/
Neutral
Switch
813 Org
900 Wht
809 Wht
ry
808 Gry
800 Pnk
ur
807 Pur
801 Pnk/Wht
802 Blu
ve
Relay
900
Wht
K3
Mow/Backlap
Relay
87A
87
30
86
85
S9
Mow/Backlap
Switch
BACKLAP
MOW
811 Pnk
705 Blu
751 Blu/Wht
754 Blu/Wht
752 Blu/Blk
325
Blk
751
Blu/Wht
Y3
Mow Valve
Solenoid
100
Blk
110 Blk
753
Blu
S10
Direction
Valve Switch
0 1
0=MOW
1=BACKLAP
751 Blu/Wht
740 Blk
120 Blk
T
CUIT
CUIT
BACKLAP CIRCUIT
GROUND CIRCUIT
MOW VALVE SHUTOFF RELAY CIRCUIT
TRAVEL/NEUTRAL SWITCH CIRCUIT
INTERLOCK SWITCH POWER CIRCUIT
M83706

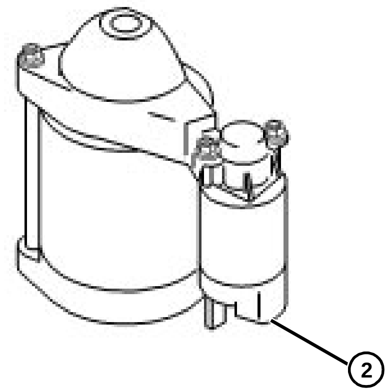
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958XXX—)

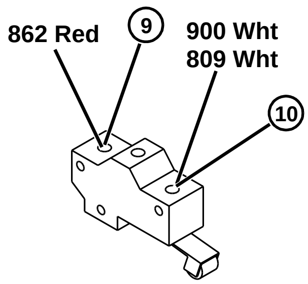
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	11.8—13.2 volts.	Test battery. (See BATTERY TEST on page 4-211.)
2. Starter solenoid—Battery terminal.	Battery voltage.	Check battery positive (+) cable and clamp. Clean and tighten connections.
3. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
4. Key switch—IGN terminal	Battery voltage.	Test key switch. (See KEY SWITCH TEST on page 4-221.)
5. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
6. Mow/Transport switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 872 and connections.
7. Mow/Transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)
8. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
9. Park brake switch—COMMON terminal	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
10. Park brake switch—NORMALLY CLOSED terminal	Battery voltage.	Test and/or adjust park brake switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or PARK BRAKE SWITCH ADJUSTMENT on page 4-226.)

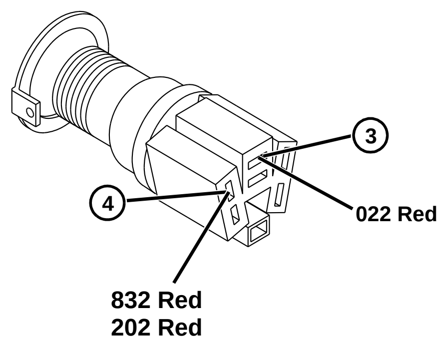
Continued on page 4-204.

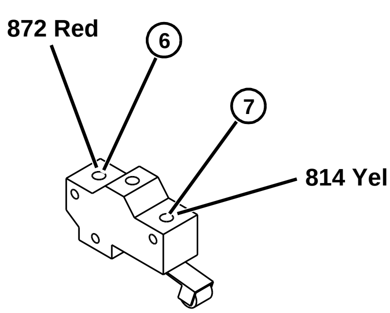




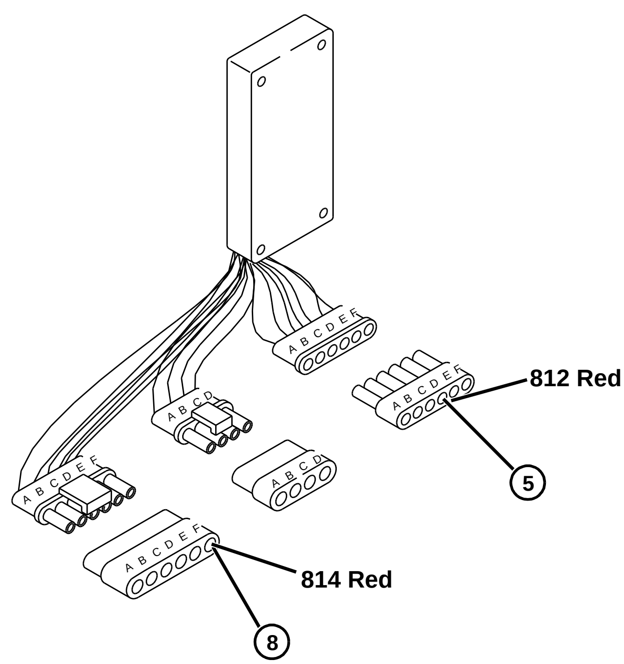


S5 Park Brake Switch





S2 Mow/Transport Switch



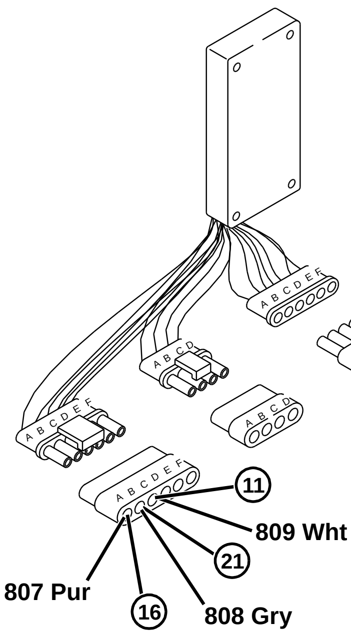
OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958XXX—), continued

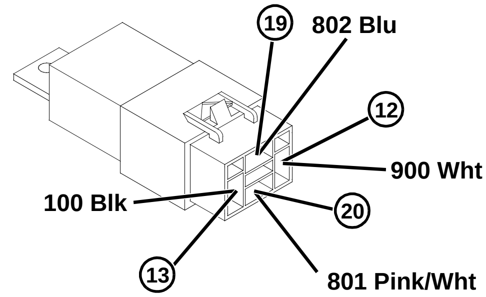
Test Conditions:

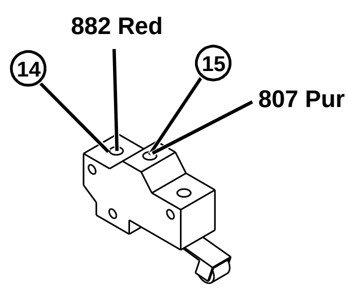
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

Test Location	Normal	If Not Normal
11. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
12. Mow/backlap relay—Terminal 86.	Battery voltage.	Test white wire No. 900 and connections.
13. Mow/backlap relay—Terminal 85.	Less than 0.2 volt.	Test black wires No. 100, 120, 740 and 700 and connections.
14. Travel/neutral switch—COMMON terminal.	Battery voltage.	Test red wires No. 882, 812 and 802 and connections.
15. Travel/neutral switch—NORMALLY OPEN terminal.	Battery voltage.	Test and/or adjust mow/transport switch. (See INTERLOCK SWITCH TEST on page 4-222 and/or TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)
16. Controller module—Terminal A of six terminal male connector.	Battery voltage.	Test purple wire No. 807 and connections.
17. Mow/backlap switch.	Battery voltage.	Test pink wire No. 811 and connections.
18. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)
19. Mow/backlap relay—Terminal 87.	Battery voltage.	Test blue wire No. 802 and connections.
20. Mow/backlap relay—Terminal 30.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
21. Controller module—Terminal B of six terminal male connector.	Battery voltage.	Test gray wire No. 808, pink wire No. 800, pink/white wire No. 801 and connections.
22. Cutting unit lower switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

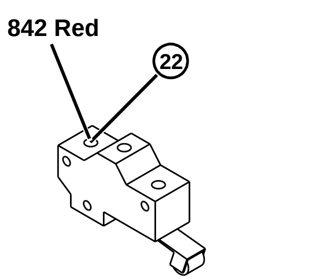
Continued on page 4-206.



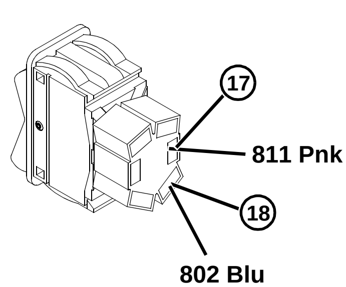




S7 Travel/Neutral Switch



S3 Cutting Unit Lower Switch



OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958XXX—), continued

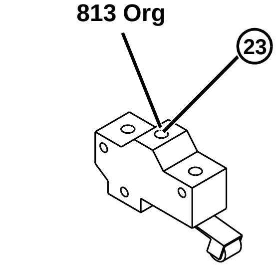
Test Conditions:

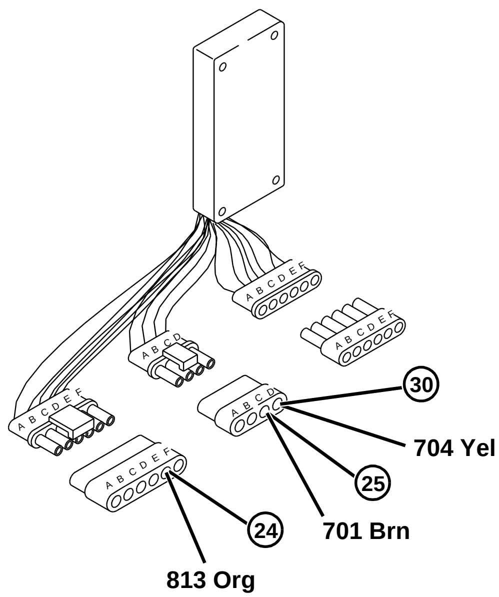
- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

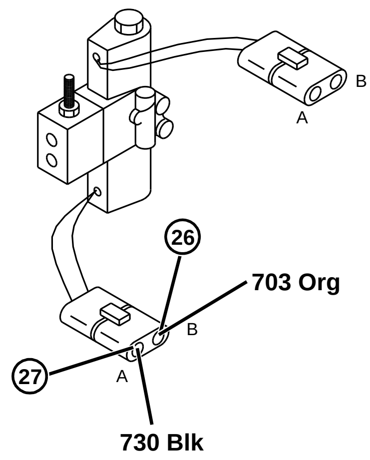
NOTE: For test points 23—27, push mow pedal and hold down to close switch.

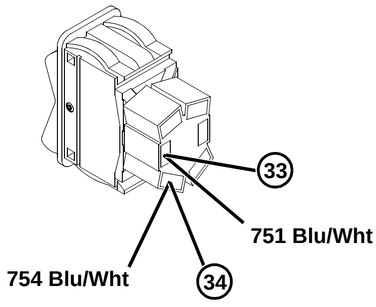
Test Location	Normal	If Not Normal
23. Cutting unit lower switch—NORMALLY OPEN Terminal	Battery voltage.	Test cutting unit mow switch.
24. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
25. Controller module—Terminal C of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
26. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
27. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 730 and 700, lift valve lower solenoid and ground connections.
28. Mow valve shutoff relay — Terminal 85.	Battery voltage.	Test red wire No. 352, yellow wire No. 330 and connections.
29. Mow valve shutoff relay — Terminal 86.	Less than 0.2 volt.	Test black wires No. 320, 325, 700 and connections.
30. Controller module—terminal D of four terminal male connector	Battery voltage.	Test or replace controller module.
31. Mow valve shutoff relay — Terminal 87.	Battery voltage.	Test yellow wire No. 704 and connections.
32. Mow valve shutoff relay — Terminal 30.	Battery voltage.	Test relay. (See RELAY TEST on page 4-223.)
33. Mow/backlap switch.	Battery voltage.	Test blue/white wire No. 751, blue wire No. 705 and connections.
34. Mow/backlap switch.	Battery voltage.	Test mow/backlap switch. (See OPTIONAL MOW/BACKLAP SWITCH TEST on page 4-225.)

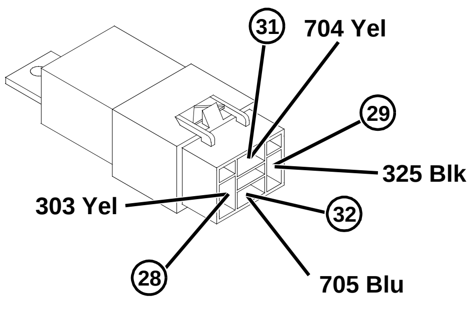
Continued on page 4-208.


813 Org
23


30
704 Yel
25
24
701 Brn
813 Org


B
A
26
703 Org
B
27
A
730 Blk


33
751 Blu/Wht
754 Blu/Wht
34

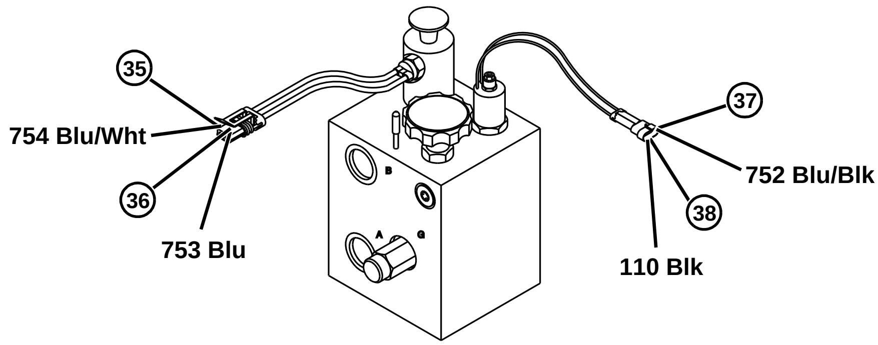

31
704 Yel
29
325 Blk
303 Yel
32
28
705 Blu

OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—BACKLAP (S.N. 958XXX—), continued

Test Conditions:

- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.
- Park brake LOCKED.
- Engage mow system by depressing cutting unit lower switch.
- Check connection(s) for corrosion and looseness when checking/testing.
- Meter negative (–) lead on battery negative (–) terminal.

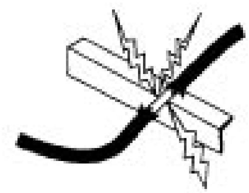
Test Location	Normal	If Not Normal
35. Direction valve switch.	Battery voltage.	Test blue/white wire No. 754 and connections.
36. Direction valve switch.	Battery voltage.	Test switch.
37. Mow valve solenoid.	Battery voltage.	Test blue/black wire 752, blue wire No. 753 and connections.
38. Mow valve solenoid.	Less than 0.2 volt.	Test black wires No. 110, 120, 740, 700 and connections.


35
754 Blu/Wht
36
753 Blu
37
752 Blu/Blk
38
110 Blk

TESTS AND ADJUSTMENTS

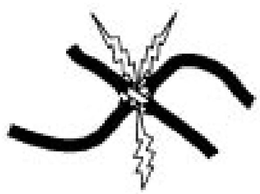
COMMON CIRCUIT TESTS

Shorted/Grounded Circuit:



M85602

A shorted circuit on the ground side of a component (i.e. improper wire-to-wire or wire to ground contact) may result in improper component operation.



M85600

A shorted circuit on the power side of a component or contact of two power circuits (i.e. improper wire-to-wire or wire to ground contact) may result in blown fusible links and fuses.

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

High Resistance or Open Circuit:

M85601

High resistance or open circuits usually result in slow, dim, or no component operation (i.e. poor, corroded, or severed 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 ground connections of the circuit for corrosion.
2. If terminals are not loose or corroded, the problem is in the component or wiring.

GROUND CIRCUIT TESTS

Reason:

To check for open circuits, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

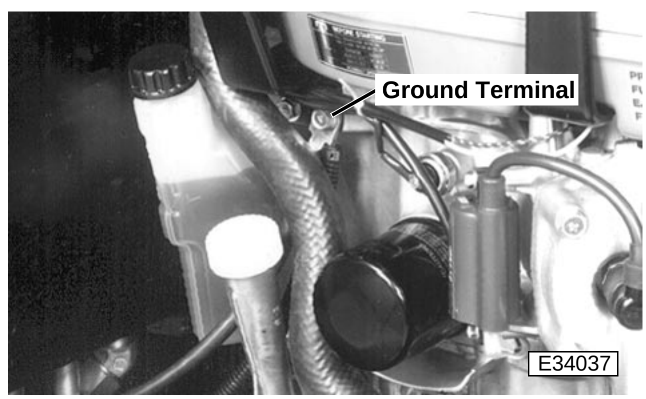
Test Equipment:

- Ohmmeter or Voltmeter.

NOTE: The voltmeter method checks ground connections under load.

Procedure—OHMMETER METHOD:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.
7. Connect ohmmeter negative (black) lead to negative (–) terminal of battery. Connect meter positive (red) lead to negative (–) terminal of battery and record reading.



E34037

8. Connect ohmmeter red lead to ground terminal of circuit or component to be tested that is closest to the battery negative terminal. **Resistance reading must be the same or very close to as 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 ohms**. The problem is between the last two test points. If a problem is indicated, disconnect the wiring harness connector to isolate the wire or component and check resistance again. **Maximum allowable resistance in the circuit is 0.1 ohms**. Check both sides of the connectors closely, as disconnecting and connection may **temporarily** solve problem.

Procedure—VOLTMETER METHOD:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch to ON position.
5. Engage park brake.
6. Raise engine hood.
7. Connect voltmeter negative (black) lead to negative terminal of battery.
8. Connect voltmeter positive (red) lead to ground terminal of circuit or component to be tested. Be sure that component circuit is activated (key ON, switches CLOSED) so that voltage will be present at the component. Record voltage. **Voltage must be greater than 0, but less than 1 volt**. Some components will have a very small voltage reading on the ground side and still be operating correctly.

Results:

- If voltage is 0, the component is open.
- If voltage is greater than 1 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

BATTERY TEST

CAUTION

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

Avoid the hazard by:

1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoid 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 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 1.9 L (2 qts.).
3. Get medical attention immediately.

Reason:

To check condition of battery and determine battery voltage.

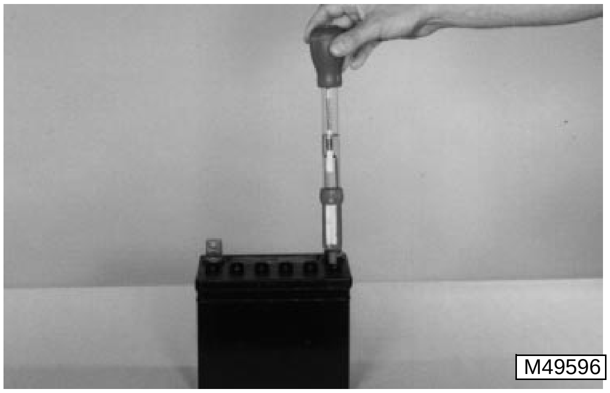
Test Equipment:

- Hydrometer
- Voltmeter or JTO5685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.
7. Clean cable ends, battery terminals and top of battery. (See BATTERY—Cleaning on page 4-228.)
8. Remove battery. (See BATTERY—Removal/ Installation on page 4-228.)

9. Inspect battery terminals and case for breakage or cracks.
10. Check electrolyte level in each battery cell. Add clean, soft water as needed. If water is added, charge battery for **20 minutes at 10 amps**.
11. Remove surface charge by placing a small load on the battery for 15 seconds.



M49596

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

Results:

- If all cells 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 amp.
- 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.

13. Use a voltmeter or JTO5685 Battery Tester to check for a **minimum battery voltage of 12.4 volts**.

Results:

- 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 12.)

14. Install battery. (See BATTERY—Removal/ Installation on page 4-228.)

CHARGE BATTERY

Reason:

To increase battery charge after the battery has been discharged.

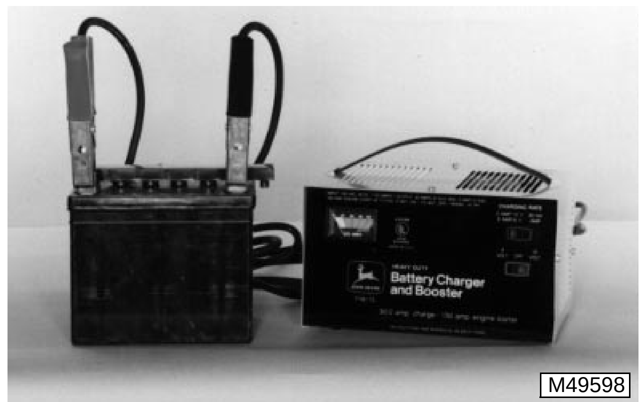
Test Equipment:

- Battery charger (variable rate).

Procedure:

NOTE: See BATTERY TEST on page 4-211 before charging battery.

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Seat platform RAISED and LOCKED.
7. Clean cable ends, battery terminals and top of battery.
8. Remove battery. (See BATTERY—Removal/ Installation on page 4-228.)



M49598

9. Connect variable rate charger to battery.
10. 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.
11. Check if battery is accepting 10 amp charge rate after 10 minutes at boost setting.

Results:

- If battery WILL NOT accept 10 amp charge after 10 minutes at boost setting, replace battery.
- If battery is accepting 10 amp charge after 10 minutes at boost setting, and battery did NOT need water, go to Steps 12 and 13.
- 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.

12. Set charger at 15—25 amps.

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

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

Results:

- If MORE THAN 50 point variation between cells, replace battery.
- If LESS THAN 50 point variation between cells, go to Step 13 and 14.

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

14. Continue to charge battery until specific gravity is **1.230—1.265 points.**
15. Load test battery.
16. Install battery. (See BATTERY—Removal/ Installation on page 4-228.)

BATTERY LOAD TEST

Reason:

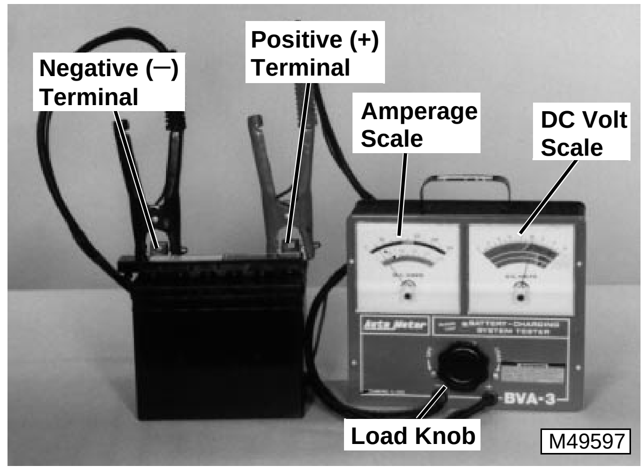
To check condition of battery under load.

Test Equipment:

- JTO5685 Battery Tester.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.
7. Clean cable ends, battery terminals and top of battery. (See BATTERY—Cleaning on page 4-228.)
8. Remove battery. (See BATTERY—Removal/ Installation on page 4-228.)



9. Turn load knob counterclockwise to OFF position.
10. Connect tester positive (red) cable to battery positive (+) terminal.
11. Connect tester negative (black) cable to battery negative (–) terminal.
12. Turn load knob of tester clockwise (in) until amperage reading is equal to:
   - cold cranking amperage rating of battery (use blue scale).

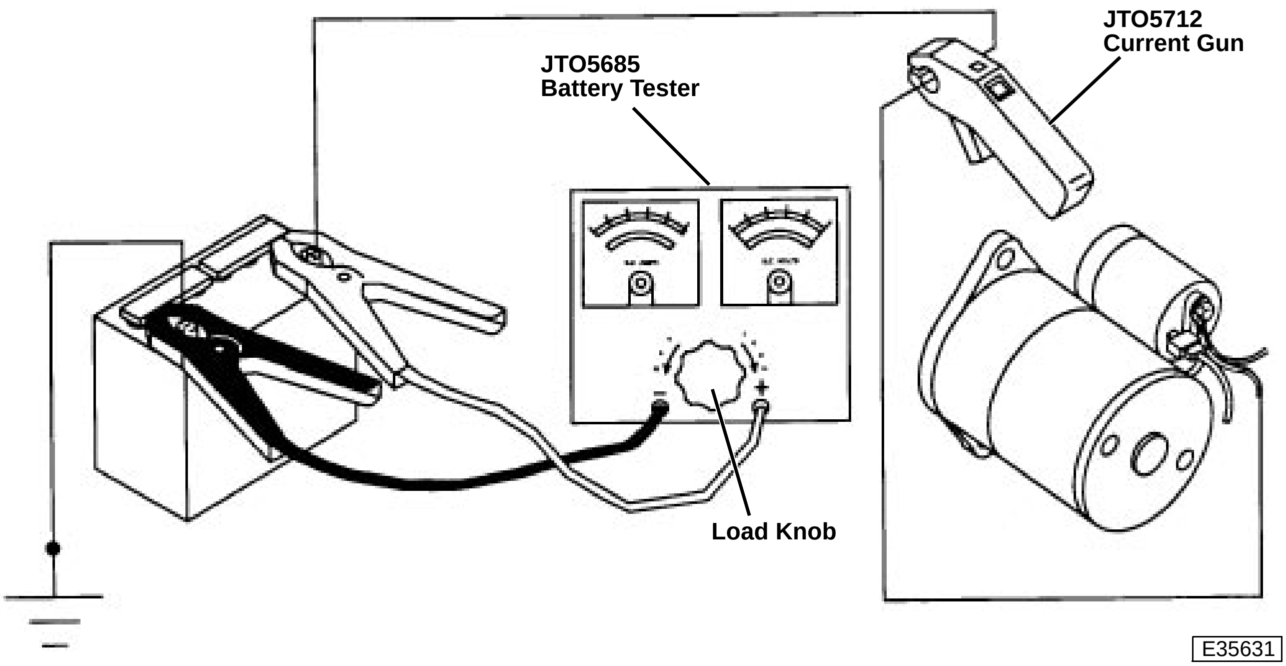
   or

   - three times ampere hour rating (use black scale).
13. Hold for 15 seconds and turn load knob of tester counterclockwise (out) into OFF position.
14. Repeat Steps 8 and 9 above and read condition of battery at DC Volts scale.

Results:

- If battery DOES NOT pass test and has NOT been charged, charge battery and retest.
- If battery DOES NOT pass test and HAS BEEN charged, replace battery.

REGULATED AMPERAGE AND VOLTAGE TESTS



Reason:

To determine the regulated voltage (charging) output of the regulator/rectifier.

Test Equipment:

- JTO5712 Current Gun
- JTO5685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.
7. Disconnect two pin connector from stator.

NOTE: Battery must be in a good state of charge.

8. Put JTO5712 Current Gun around positive (red) battery cable going to starter so current-flow arrow cable points toward battery. Set current gun for DC current.

IMPORTANT: Turn load knob fully counterclockwise (out) into OFF position BEFORE making any test connections.

1. Connect battery tester to battery.

IMPORTANT: Perform this test quickly to prevent damage to battery tester. DO NOT apply full load to battery for more than 5—10 seconds.

2. Turn load knob clockwise (in) until voltage on voltage tester scale reads **11 volts for 5 seconds only** to partially drain battery.
3. Quickly turn load knob completely counter-clockwise (out) to OFF position.
4. Start and run engine at **fast idle (3400 ±75 rpm)**. Battery voltage should read **between 12.2—14.7 volt DC**.
5. Turn load knob clockwise (in) until voltage on tester voltage scale reads 11 volts and look at current gun for a minimum reading of **13.5 amps**.
6. Quickly turn load knob completely counter-clockwise (out) to OFF position.
7. After load test, voltmeter should return to a **maximum of 14.7 volts DC**.

Results:

- If current gun amp reading is BELOW specification, test for unregulated voltage output. If unregulated voltage output test meets specifications and you have verified voltage to ground to regulator/ rectifier, replace regulator/rectifier.
- If at any time voltage increase exceeds **14.7 volts DC**, replace regulator/rectifier.

UNREGULATED VOLTAGE OUTPUT TEST

Reason:

To measure stator output.

Test Equipment:

- Voltmeter

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.

CAUTION

Engine parts may be hot. Allow engine to cool before servicing.

7. Disconnect two pin connector from stator.
8. Connect voltmeter, set to 50 volt AC scale, to stator outputs.
9. Start and run engine at fast idle. The meter should read a **minimum of 26 volts AC at FAST idle (3400 ±75 rpm)**.

Results:

- If voltage is less than specifications, test flywheel magnet. (See FLYWHEEL MAGNET TEST if flywheel magnet tests good, replace stator.

STARTER SOLENOID TEST

Reason:

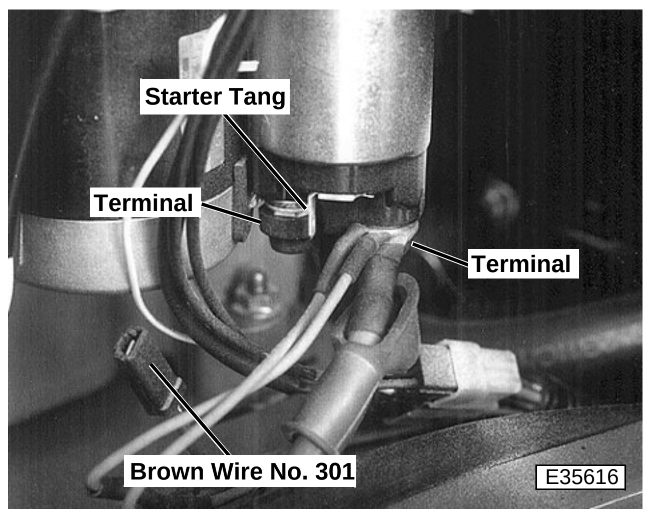
To determine if starter or starter motor is defective.

Test Equipment:

- Jumper wire.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.
7. Remove spark plug high tension leads and ground to engine.



8. Disconnect brown wire No. 301 from starter solenoid terminal.
9. Connect jumper wire to positive (+) battery terminal and briefly jump to starter solenoid terminal.

Results:

- Starter runs—solenoid is good, test cranking circuit wiring.
- Starter DOES NOT run—go to Step 10.

10. Remove rubber boot from terminal(s).
11. Connect jumper wire between starter solenoid large terminals.

Results:

- Starter runs—replace solenoid.
- Starter DOES NOT run—check battery cables, then replace starter.

STARTER LOADED AMPERAGE DRAW TEST

Reason:

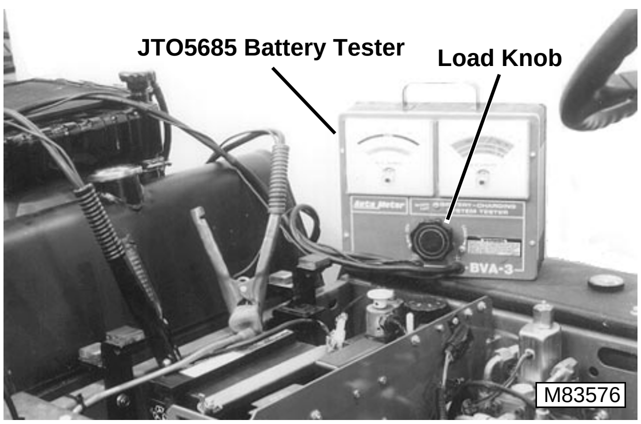
To determine the amperage required to crank the engine and check starter motor operation under load.

Test Equipment:

- JTO5685 Battery Tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.
7. Test ground connections. (See GROUND CIRCUIT TEST on page 4-210)
8. Test battery. (See BATTERY TEST on page 4-211.)



IMPORTANT: Turn load knob fully counter-clockwise before making any test connections.

9. Connect JTO5685 Battery Tester to battery.
10. Crank engine and read voltage.
11. Turn key switch to the OFF position. Adjust load knob until battery voltage reads the same as when cranking.
12. Read amperage on meter.
13. Turn load knob fully counterclockwise.

Results:

- If **amperage is greater than 72 amps,** test starter No-Load RPM and Amperage to determine if the starter is binding or damaged.
- If the starter is good, check internal engine components for binding or damage.

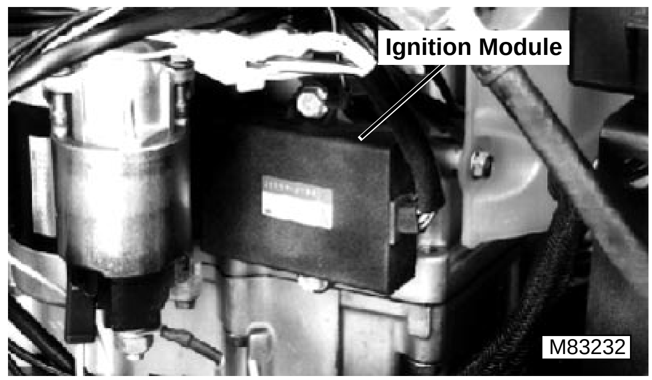
IGNITION MODULE TEST

Reason:

To determine if the ignition module is defective.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.



8. 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 solve the problem, check other ignition components.

IGNITION COIL TEST

Reason:

To check the primary and secondary windings of the ignition coil.

Test Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.

3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.
8. Disconnect wires from ignition coil terminals.

9. Unscrew spark plug cap from high tension leads.
10. Set ohmmeter to 1x ohms scale.

Primary Windings:

NOTE: Resistance value may vary between ohmmeters.

11. Connect one ohmmeter lead to coil positive (+) (wide) terminal.
12. Connect the other ohmmeter lead to coil negative (–) terminal.
13. Measure resistance across primary windings. Resistance should measure **3.4—4.6 ohms**.

Secondary Windings:

14. Set ohmmeter to 10Kx (10,000) ohms scale.
15. Connect one ohmmeter lead to coil positive (+) (wide) terminal.

NOTE: Test spark plug cap resistance before installing on high tension lead. (See SPARK PLUG CAP TEST on page 4-218.)

16. Connect the other ohmmeter lead to high tension lead.
17. Measure resistance across secondary windings. Resistance should measure **10,400—15,600 ohms**.

Open Circuit Test:

18. Connect the other ohmmeter lead to high tension lead.
19. Connect one ohmmeter lead to coil positive (+) (wide) terminal or coil negative (–) terminal.

NOTE: DO NOT connect ohmmeter lead to ignition coil mounting screws, as this will result in an inaccurate reading.

20. Connect the other ohmmeter lead to coil core.
21. Measure resistance from primary leads to coil core. There should be no continuity (open circuit) between coil primary terminal and coil core.
22. Connect one ohmmeter lead to high tension lead.

NOTE: DO NOT connect ohmmeter lead to ignition coil mounting screws, as this will result in an inaccurate reading.

23. Connect other ohmmeter lead to coil core.
24. Measure resistance from high tension lead to coil core. There should be no continuity (open circuit) between high tension lead and coil core.
25. Repeat test procedure for other ignition coil.

Results:

- If the ohmmeter readings are not within specifications, replace the coil.
- If the ohmmeter readings are within specifications, the coils are probably good. If the system still does not perform properly after all test/checks, replace the coil with a known good coil.

PULSER COIL TEST

Reason:

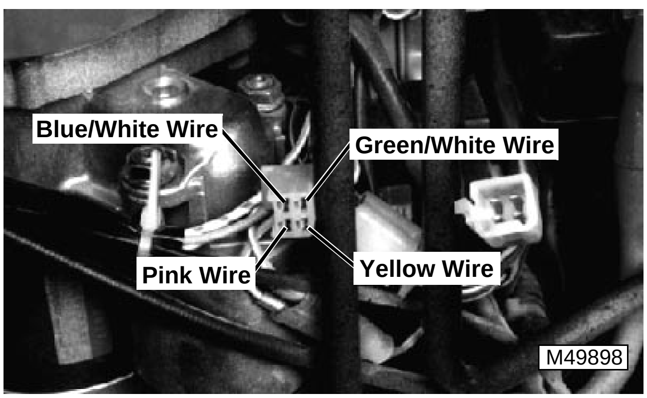
To check if the pulser coil is operating properly.

Test Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.
8. Disconnect pulser coil connector.
9. Set ohmmeter to 1x ohms scale.



10. Connect one ohmmeter lead to blue/white wire. Connect other meter lead to pink wire.

NOTE: Resistance value may vary between ohmmeters.

11. Measure resistance. Resistance should read **88—132 ohms**.
12. Connect one ohmmeter lead to green/white wire. Connect other meter lead to yellow wire.
13. Measure resistance. Resistance should read **88—132 ohms**.

Results:

- If either pulser coil is out of specification, replace pulser coil/harness assembly.

SPARK PLUG CAP TEST

Reason:

To check if the spark plug cap resistance is within specifications.

Test Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.

8. Connect one ohmmeter lead to spark plug side of spark plug cap.
9. Connect other meter lead to high tension side of spark plug cap.
10. Measure resistance. Resistance should measure within 10% of value marked on the cap.

Results:

- If resistance is not within specifications, replace cap.

ENGINE OIL PRESSURE SWITCH TEST

Reason:

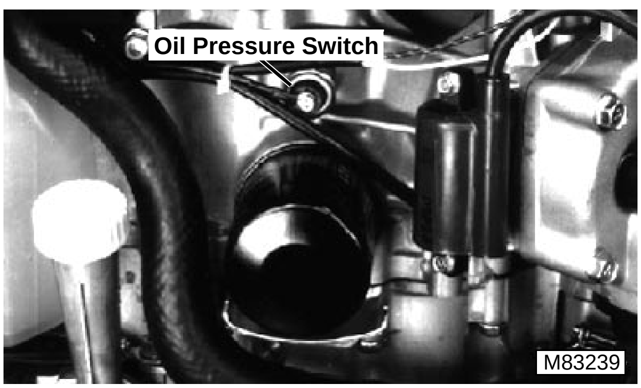
To determine if engine oil pressure switch is functioning properly, to warn operator that oil pressure has dropped below minimum operating pressure.

Test Equipment:

- Ohmmeter

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.



8. Disconnect wire from oil pressure switch.
9. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal of switch.
10. Set ohmmeter for 1X scale.
11. Measure resistance between terminal and engine block.

Results:

- There should be continuity between terminal and ground.
- If there is NO continuity between terminal and ground, replace the switch.

NOTE: Be sure to apply Pipe Sealant with TEFLON® to threads of switch anytime it is installed.

12. Start and run engine.
13. Measure resistance between terminal and engine block.

Results:

- There is NO continuity between terminal and ground, replace the switch.
- If the switch DOES have continuity to engine block (ground) with engine running, check oil pressure.
- If oil pressure is to specification, replace the oil pressure switch.

COOLANT TEMPERATURE SWITCH TEST

Reason:

To verify coolant temperature switch is functioning properly, to warn operator when engine coolant exceeds normal operating temperature.

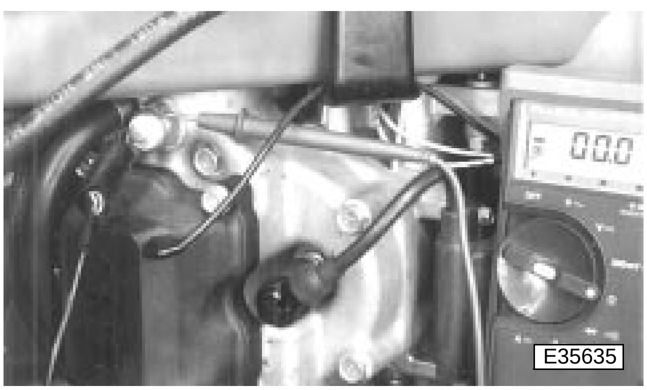
Test Equipment:

- Ohmmeter
- JT05800 Digital Thermometer
- Glass Container
- Heating Unit

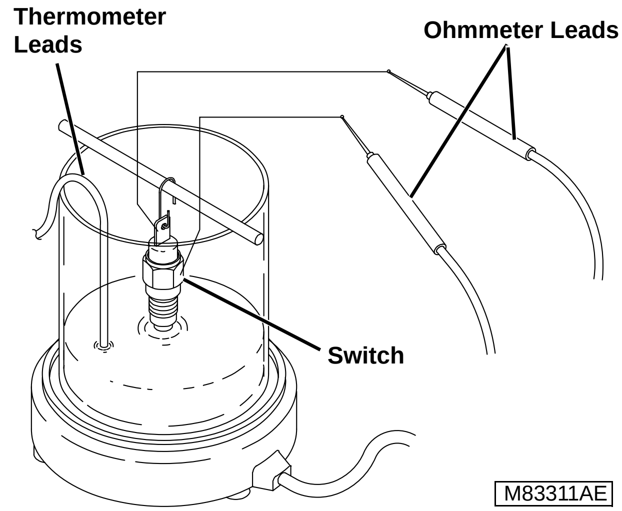
Procedure:

NOTE: Perform test with engine at room temperature.

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.



8. Disconnect yellow wire No. 500 from coolant temperature switch.
9. Measure resistance between terminal and switch body. Switch should read **Infinite Resistance (Open) below 111°C (232°F)**.
10. If resistance does not meet specification, drain engine coolant and remove coolant temperature switch.



11. Connect ohmmeter leads to switch terminal and body.
12. Suspend switch in a container of engine coolant solution.
13. Place digital thermometer leads in coolant solution.
14. Heat and stir the coolant solution. Observe temperature of coolant when continuity occurs. Continuity (approximately 0 ohms) should occur at approximately **111°C (232°F)**.

Results:

- If resistance does not meet specification, replace coolant temperature switch.

HYDRAULIC OIL TEMPERATURE SWITCH TEST

Reason:

To verify hydraulic oil temperature switch is functioning properly, to warn operator when hydraulic oil exceeds specifications.

Test Equipment:

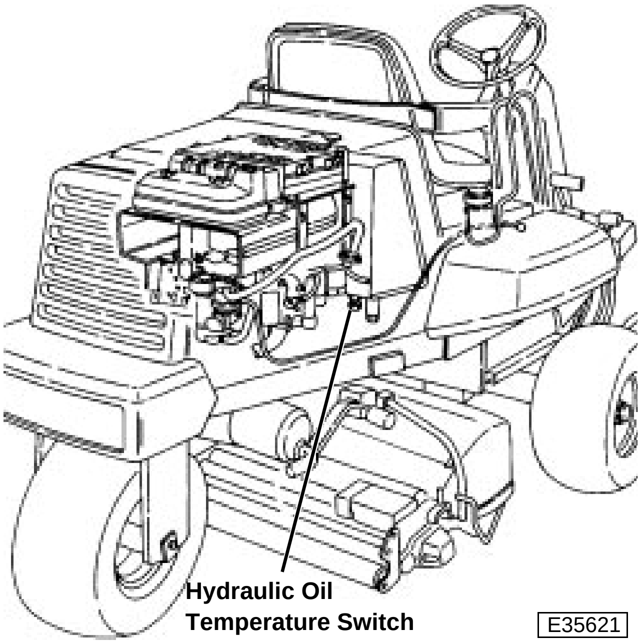
- Ohmmeter
- JT05800 Digital Thermometer
- Glass Container
- Heating Unit

Procedure:

NOTE: Perform test with hydraulic oil at room temperature.

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.

4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.



8. Disconnect green wire No. 205 from hydraulic oil temperature switch.
9. Measure resistance between terminal and switch body. Switch should read **Infinite Resistance (Open) below 96°C (205°F)**.
10. If resistance does not meet specification, drain hydraulic reservoir and remove hydraulic temperature switch.
11. Suspend switch in a container of hydraulic oil.
12. Connect ohmmeter leads to switch terminal and body.
13. Place digital thermometer leads in hydraulic oil.

CAUTION

DO NOT heat oil over 182°C (360°F). Oil fumes or oil can ignite above 193°C (380°F). DO NOT allow flame or heating element to come into direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

14. Heat and stir the hydraulic oil. Observe temperature of hydraulic oil when continuity occurs. Continuity (approximately 0 ohms.) should occur at approximately **96°C (205°F)**.

Results:

- If resistance does not meet specification, replace hydraulic oil temperature switch.

KEY SWITCH TEST

Reason:

To verify key switch functions are operating properly.

Test Equipment:

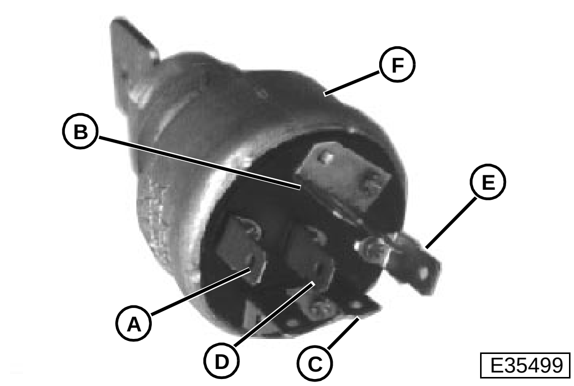
- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.

NOTE: Cover may be removed for greater access.

7. Disconnect key switch connector from harness.
8. Use an ohmmeter or continuity tester to test switch continuity 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	A and B
RUN	C and D
START	C and D E and F

Results:

- If any continuity is NOT correct, replace the switch.

SEAT SWITCH TEST

Reason:

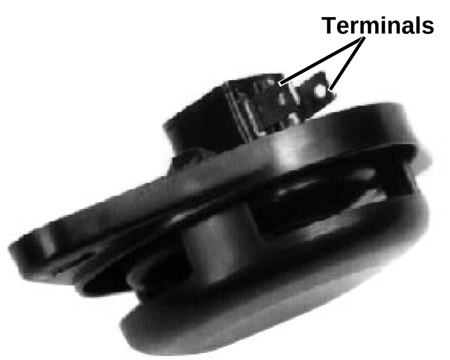
To verify seat switch functions are operating properly.

Test Equipment:

• Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Disconnect seat switch connector from harness.



E35625

8. Check continuity across switch terminals. There should be no continuity. Depress plunger and continuity should exist between terminals.

Results:

• If continuity is not correct, replace seat switch.

INTERLOCK SWITCH TEST

Reason:

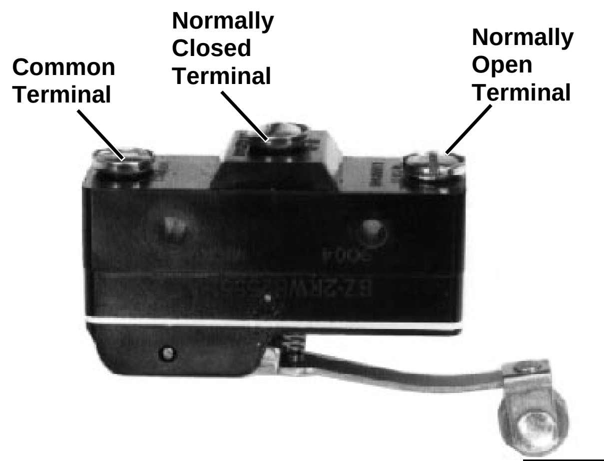
To verify interlock switch functions are operating properly.

Test Equipment:

• Ohmmeter or continuity tester

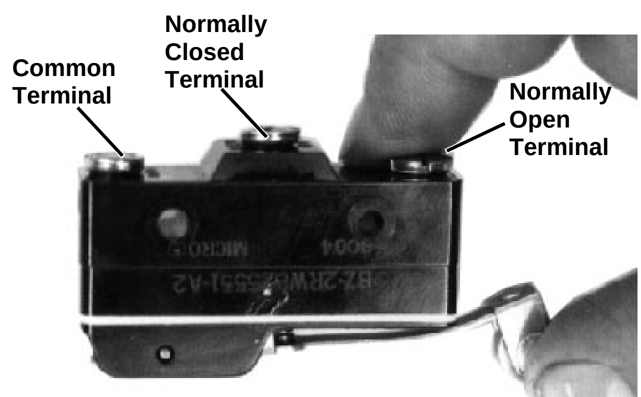
Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Move travel pedals to NEUTRAL position.
6. Engage park brake.
7. Raise engine hood.
8. Disconnect interlock switch from harness.



E35626

9. With no force against switch actuator lever, use an ohmmeter to check for the following:
   • Continuity exists between common terminal and normally closed terminal.
   • NO continuity exists between common terminal and normally open terminal.



E35627

10. While applying force against switch actuator lever, use an ohmmeter to check for the following:
   • NO Continuity exists between common terminal and normally closed terminal.
   • Continuity exists between common terminal and normally open terminal.

Results:

• If switch fails any part of steps 9 and 10, replace interlock switch(es).

RELAY TEST

Reason:

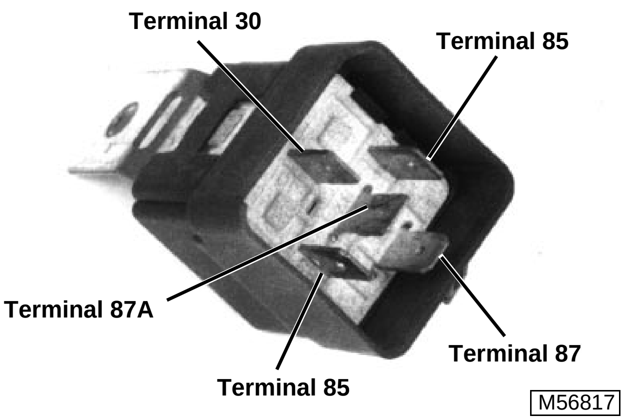
To check relay terminal continuity in the energized and de-energized condition.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Raise engine hood.
7. Disconnect relay connector from harness.



8. Check terminal continuity using an ohmmeter or continuity tester.

Results:

- There should be continuity between terminals 87A and 30, and between terminals 85 and 86.
- There should NOT be continuity between terminals 87 and 30.

9. Connect a jumper wire from battery positive (+) terminal to relay terminal 85. Connect a jumper wire from relay terminal 86 and ground (-).

Results:

- There should be continuity between terminals 87 and 30.
- If continuity is NOT correct, replace relay.

FUSE TEST

Reason:

To verify that fuse has continuity.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove fuse from connector.

2. Check visually for broken filament.
3. Connect ohmmeter or continuity tester to each end of fuse.
4. Check for continuity.

Results:

- If continuity is not indicated, replace fuse.

BULB TEST

Reason:

To verify that bulb has continuity.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove bulb from socket.

2. Check visually for broken filament.
3. Connect ohmmeter or continuity tester to each terminal of bulb.
4. Check for continuity.

Results:

- If continuity is not indicated, replace bulb.

DIODE TEST

Reason:

To verify that diode has proper continuity.

Test Equipment:

- Diode tester, ohmmeter or continuity tester

Procedure:

1. Remove diode from connector.
2. Connect diode tester, ohmmeter, or continuity tester lead to each lead of diode. Check for continuity.
3. Reverse test leads. Check for continuity.

Results:

- Diode must have continuity in one direction only. Replace defective diode.

SOLENOID COIL TEST

Reason:

To verify that the solenoid coils are operating properly.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.
7. Disconnect solenoid connector.

8. Using an ohmmeter or continuity tester, check if continuity exists between terminals. Replace coil if continuity is not present.


E35629

9. Check for grounds or shorts by connecting tester to one coil terminal and the other to bare metal of coil case.

Results:

- Replace coil if continuity is present.

OPTIONAL HEADLIGHT SWITCH TEST

Reason:

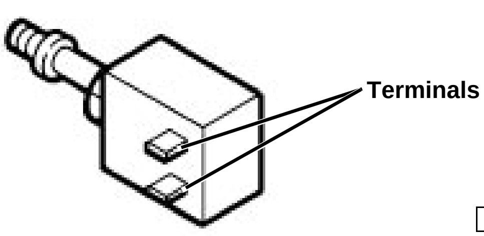
To verify headlight switch terminals have continuity when the headlight switch is ON.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Disconnect headlight switch connector.



E35630

7. Move headlight switch to the ON position and then to the OFF position. Check continuity between terminals.

Results:

- If NO continuity with switch in ON position, replace switch.
- If continuity exists with switch in OFF position, replace switch.

OPTIONAL MOW/BACKLAP SWITCH TEST

Reason:

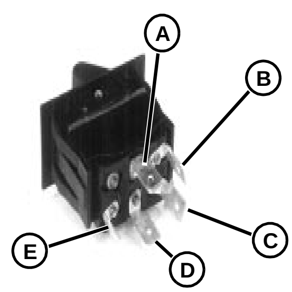
To verify mow/backlap valve switch terminals have continuity when the mow/backlapping switch is ON.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.
7. Disconnect leads from mow/backlap switch.
8. Check continuity.



M82586

With the switch in the MOW position:

- There should be continuity between terminals (D and E).
- There should not be continuity between any other terminals.

With the switch in the BACKLAP position:

- There should be continuity between terminals (A and B) and (C and D).
- There should not be continuity between any other terminals.

Results:

- If continuity is NOT correct, replace switch.

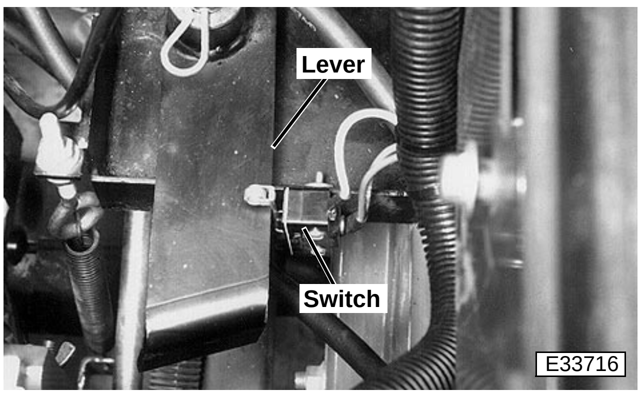
MOW/TRANSPORT SWITCH ADJUSTMENT

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.
7. Loosen switch mounting screws.



8. Align switch so switch is compressed against lever and a “click” is heard from the switch. Tighten mounting screws.
9. Using an ohmmeter or continuity tester, check for continuity between common and normally closed terminals. In the TRANSPORT position, continuity must NOT be present. Move switch closer to lever or replace mow/transport switch if continuity exists.

TRAVEL/NEUTRAL SWITCH ADJUSTMENT

CAUTION

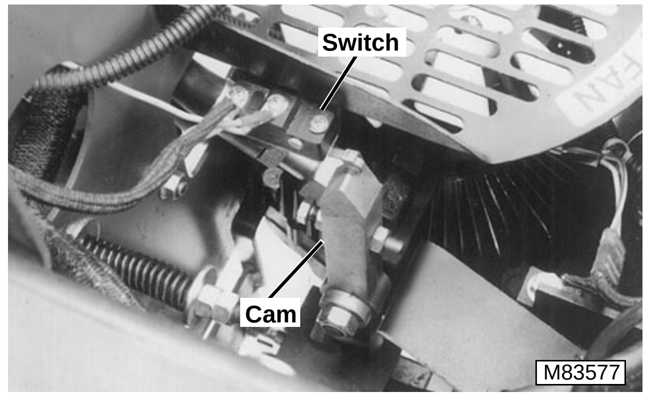
To prevent bodily injury or machine damage, travel/neutral switch must be adjusted properly. Machine may move when started, if not adjusted properly.

Test Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Seat platform RAISED and LOCKED.



7. Loosen switch mounting screws.
8. Align switch so switch lever is compressed against cam and a “click” is heard from the switch.
9. Tighten mounting screws.

NOTE: When forward or reverse pedals are depressed, the lever moves out of the neutral position and the switch should “click”, opening the circuit.

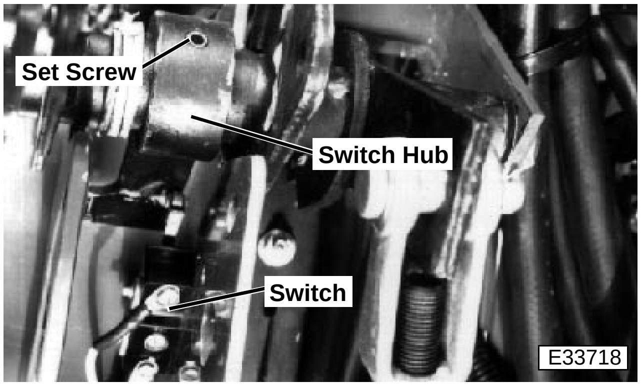
10. Using an ohmmeter or continuity tester, check for continuity between common and normally open terminals. In the NEUTRAL position, there must be continuity between terminals. If continuity does not exist, move switch closer to lever or replace travel/neutral switch.

PARK BRAKE SWITCH ADJUSTMENT

NOTE: Parking brake switch is located under the right side of the platform.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Release park brake.



6. Loosen set screw.
7. Turn switch hub until switch actuator is compressed and a “click” is heard from the switch.
8. Using an ohmmeter or continuity tester, check for continuity between common and normally closed terminals. With parking brake released, continuity must not be present. If there is continuity, move switch hub closer to switch or replace parking brake switch.

REPAIR

BATTERY

Removal/Installation

CAUTION

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

Avoid the hazard by:

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

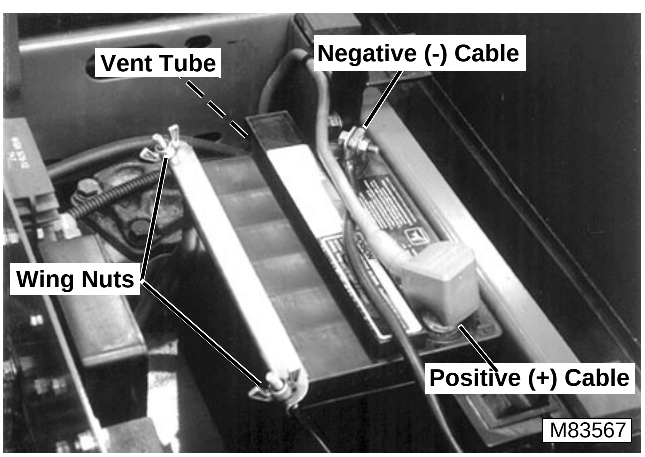
If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 15—30 minutes. Get medical attention immediately.

If acid is swallowed:

1. Do not induce vomiting.
2. Drink large amounts of water or milk, but do not exceed 1.9 L (2 qts.).
3. Get medical attention immediately.

1. Raise and lock seat platform.



2. Disconnect battery cables, negative (–) cable first.
3. DIsconnect vent tube.
4. Remove wing nuts and bracket.
5. Remove battery.

Installation is done in the reverse order of removal.

- Clean battery if dirty. (See Cleaning procedure.)

6. Inspect battery terminals and case for breakage or cracks. Replace if needed.

- Test battery condition. (See BATTERY TEST on page 4-211)
- Connect negative (–) cable last.

Cleaning

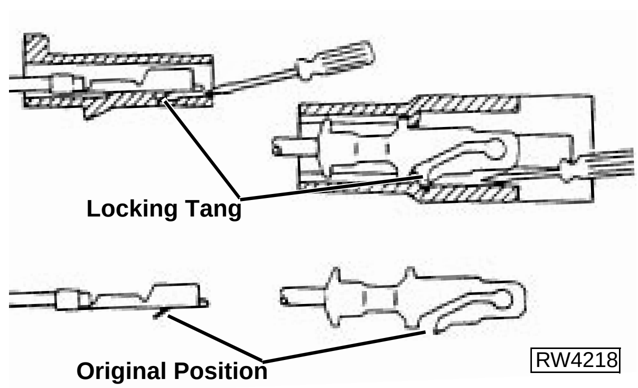
1. Remove battery from machine. (See Removal/ Installation procedure.)

NOTE: Keep cleaning solution of out 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.

CONNECTOR BODY—BLADE TERMINALS

Replacement

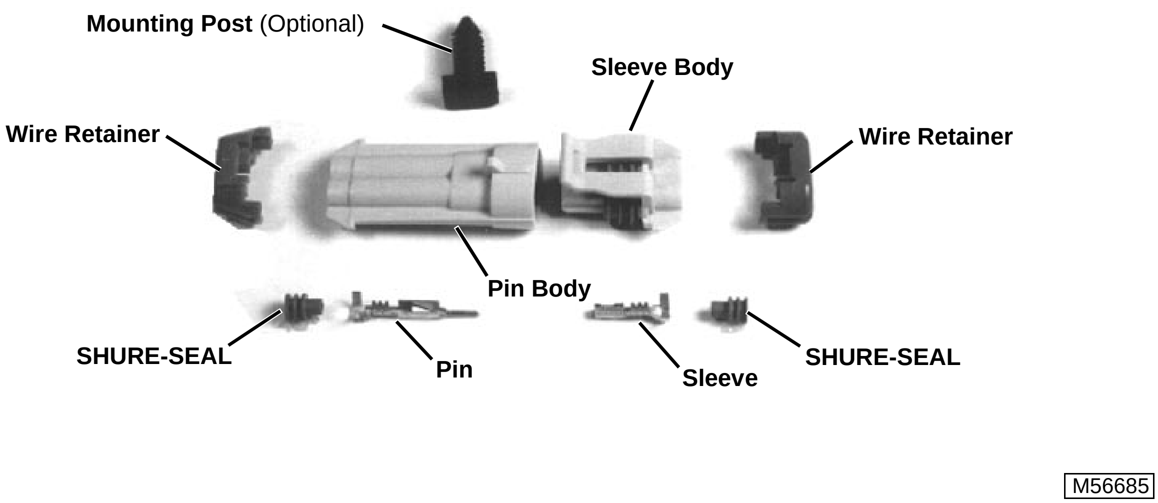


Use a small screwdriver to depress locking tang terminal. Slide connector body off.

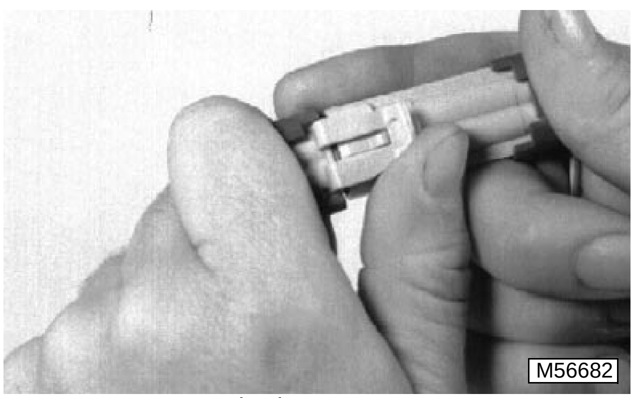
Be sure to bend locking tang back to its original position before installing connector body.

METRO-PACK™ CONNECTORS

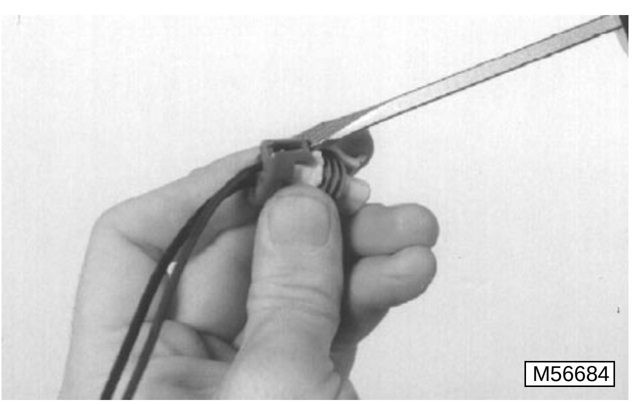
Removal



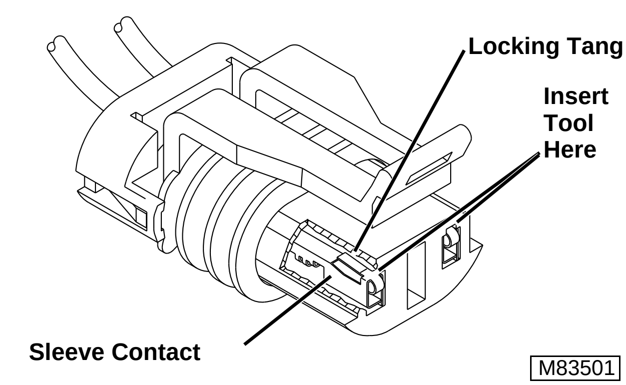
IMPORTANT: Identify wire number/color locations with connector terminal letters.

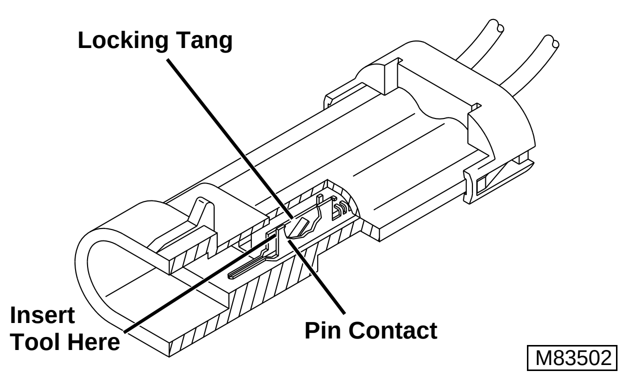


1. Open connector body.



2. Remove retainer on wire end of connector with a screwdriver.





IMPORTANT: 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 tool in slot between terminal contact and connector body. To remove pin contact from body (long connector half) insert tool in center of contact.

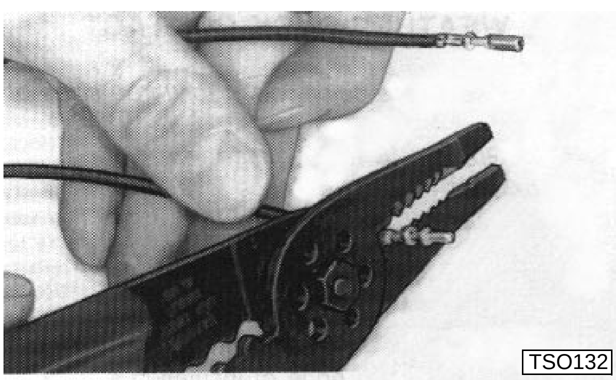
3. Use JDG777 Terminal Removal Tool to depress locking tang. Remove contact from connector body.

M56689

4. Hold the removal tool fully seated and pull wire from connector body.

Replacement

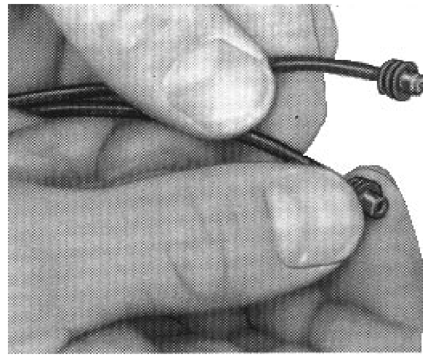
1. Remove wire from connector.



TSO132

2. Use JDG145 Universal Electrical Pliers to cut wire as close as possible to connector.

IMPORTANT: METRO-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.



TSO136

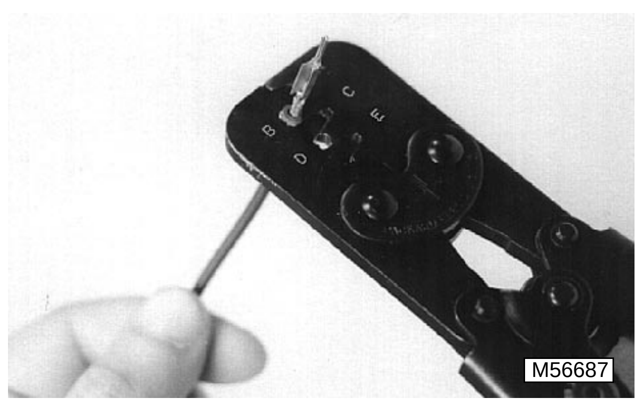
NOTE: Cables seals are available for three sizes of wire:

- Large - 1.0 mm (16 gauge) wire
- Medium - 0.8 mm (18 gauge) wire
- Small - 0.5 mm (20 gauge) wire

3. Remove enough insulation to expose 6 mm (0.25 in.) of wire. Align cable seal with edge of insulation.

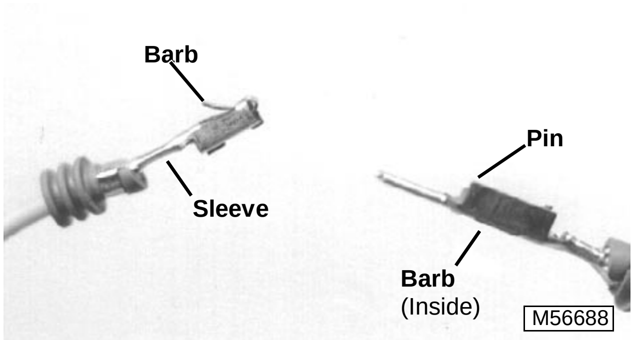
M56686

4. Place proper size contact on wire and use JDG865 Crimper to crimp contact in place with a "W" type crimp.



M56687

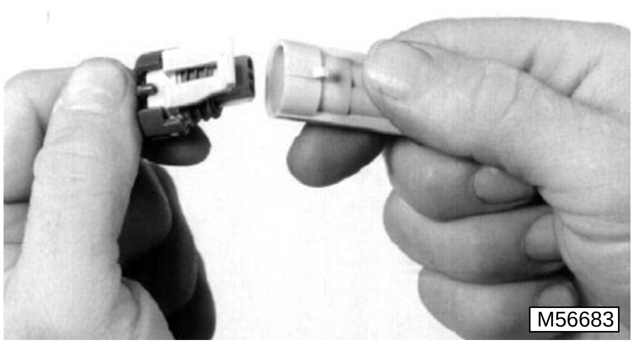
5. Use JDG865 Crimper to secure cable seal to contact as shown.



IMPORTANT: 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.

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.



9. Transfer remaining wires to correct terminal in new connector.
10. Place retainer on wire end of connector and snap in place.
11. Close connector body.

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CONTENTS

CONTENTS

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REPAIR-Continued

SPECIFICATIONS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydrostatic Charge Pump Flow Rate . . . . 7.6 L/min (4 gpm)
Mowing Speed . . . . 6.5 km/h (4 mph)

REPAIR SPECIFICATIONS

Transaxle

Transaxle-to-Frame (Axle Perch) Cap Screw Torque . . . . 95 N•m (70 lb-ft)
Hydrostatic Charge Pump-to-Frame Cap Screw Torque . . . . . . 115 N•m (85 lb-ft)
Transaxle Sheave Cap Screw Torque . . . . 12 N•m (180 lb-in.)

Transaxle—Motor Axle

Axle Housing-to-Manifold Cap Screw Torque . . . . 60 N•m (44 lb-ft)
End Cap-to-Axle Housing Cap Screw Torque . . . . 30 N•m (22 lb-ft)

Transaxle—Hydrostatic Charge Pump

Trunnion Cover-to-Housing Cap Screw Torque . . . . 5 N•m (42 lb-in.)
Seal Cover-to-Housing Cap Screw Torque . . . . 5 N•m (42 lb-in.)
Control Shaft Side Play (Maximum) . . . . 0.125 mm (0.006 in.)
Pintle-to-Mantle Socket-Head Screw Torque . . . . 23 N•m (190 lb-in.)
Charge Pump Socket-Head Screw Torque . . . . 33 N•m (24 lb-ft)
Pump Cover Assembly-to-Transaxle Cap Screw Torque . . . . . . 27 N•m (20 lb-in.)

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).

JT05469 Flowmeter Kit
Use to check hydrostatic charge pump performance.

JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
Used to connect Flowmeter Kit when performing Hydrostatic Charge Pump Test.

JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
Used to connect Flowmeter Kit when performing Hydrostatic Charge Pump Test.

JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
Used to connect Flowmeter Kit when performing Hydrostatic Charge Pump Test.

JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
Used to connect Flowmeter Kit when performing Hydrostatic Charge Pump Test.

38H1160 11/16 M ORFS x 11/16 M ORB Adapter Fitting
Used to connect Flowmeter Kit when performing Hydrostatic Charge Pump Test.

OTHER MATERIALS

Number	Name	Use
M79292	MPG-2® Multipurpose Polymer Grease	Prevents parts from seizing. Apply to splines of hydrostatic pump drive shaft.

SERVICE PARTS KITS

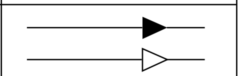
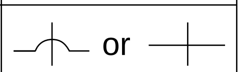
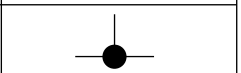
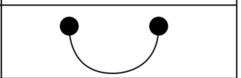
The following kits are available through your parts catalog:

- Transaxle Seal Kit
- Hydrostatic Pump Seal Kit

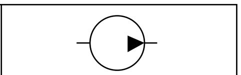
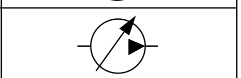
MPG-2® is a registered trademark of DuBois USA.

JIC HYDRAULIC CIRCUIT SYMBOLS

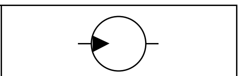
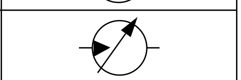
LINES

1		Working (Main) Lines
2		Pilot Control Lines
3		Drain Line
4		Hydraulic / Pneumatic } Flow Direction
5		Crossing Lines
6		Joining Lines
7		Flexible Line

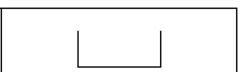
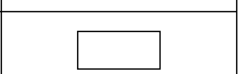
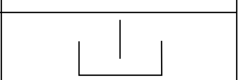
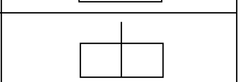
PUMPS

8		Fixed Displacement
9		Variable Displacement

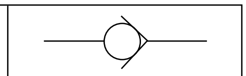
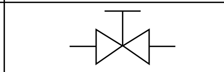
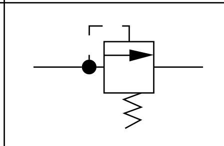
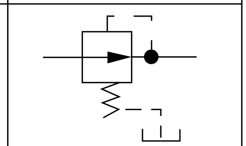
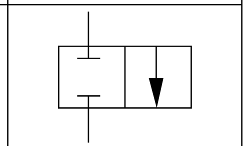
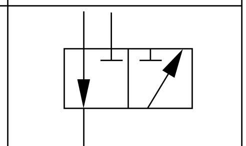
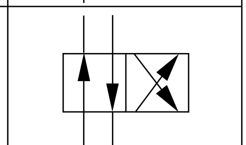
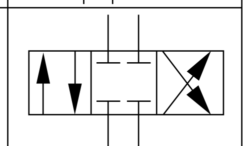
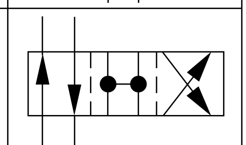
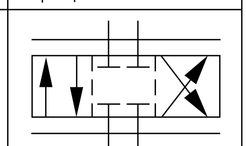
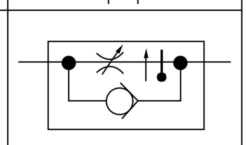
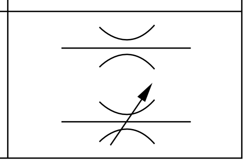
MOTORS

10		Fixed Displacement
11		Variable Displacement

RESERVOIR

12		Vented Reservoir
13		Pressurized Reservoir
14		Reservoir Return -Above Fluid Level
15		Reservoir Return -Below Fluid Level

VALVES

16		Check Valve
17		Manual On/Off Valve
19		Pressure Relief Valve
20		Pressure Reduction Valve
21		Two Position, Two Connection Valve
22		Two Position, Three Connection Valve
23		Two Position, Four Connection Valve
24		Three Position, Four Connection Valve
25		Two Position, Four Connection Valve with Transmission
26		Three Position, Four Connection Valve with Infinite Positioning
27		Adjustable Flow Control Valve (Temperature and Pressure Compensated)
18		Fixed / Variable } Orifice

M82612AE

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 Thru 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

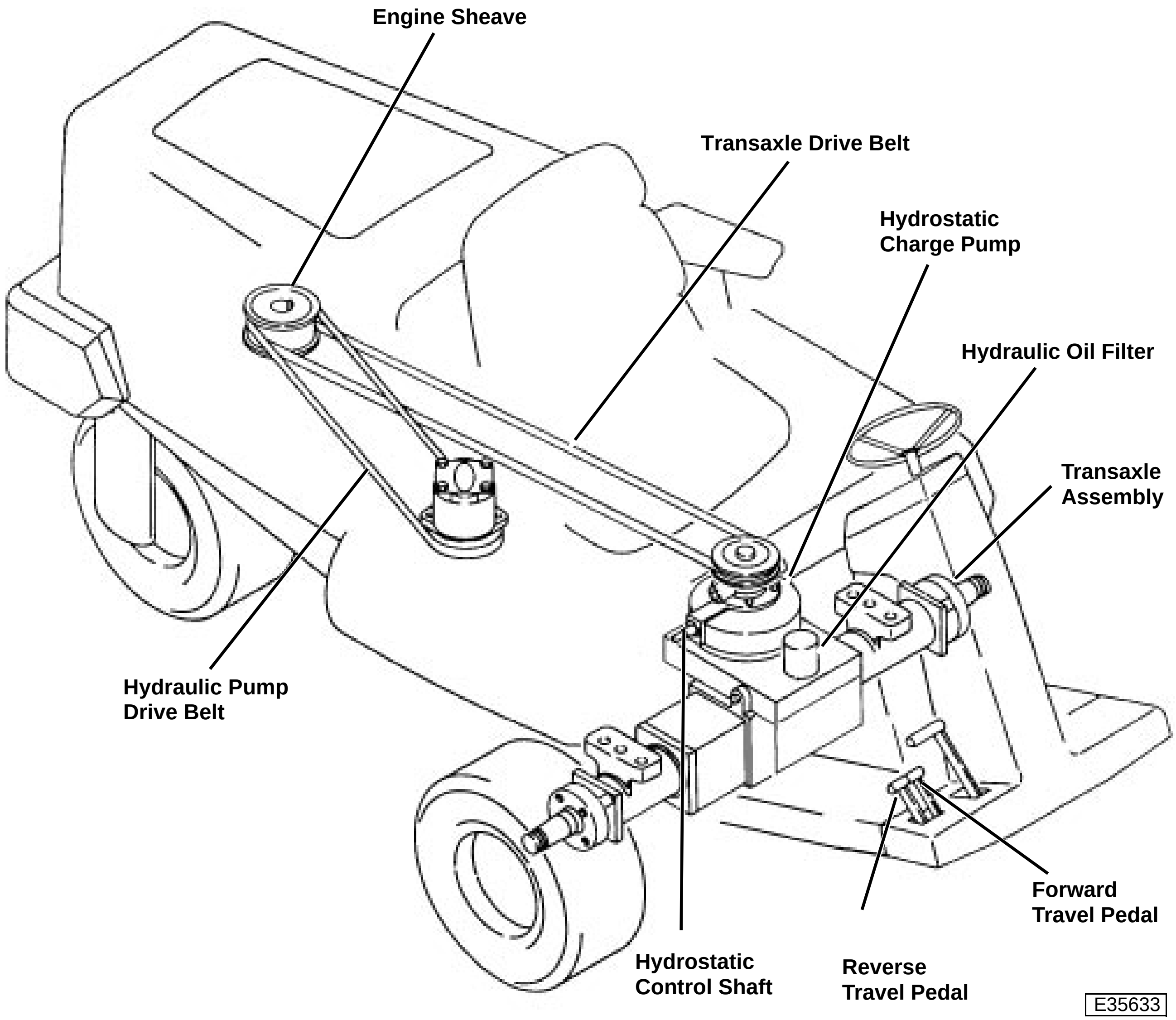
M82613AE

HYDRAULIC/HYDROSTATIC SCHEMATIC

See HYDRAULICS Section, pages 8-7 and 8-8 for complete machine hydraulic/hydrostatic schematics.

COMPONENT LOCATION AND OPERATION

POWER TRAIN COMPONENT LOCATION



HYDROSTATIC CHARGE PUMP OPERATION

Function:

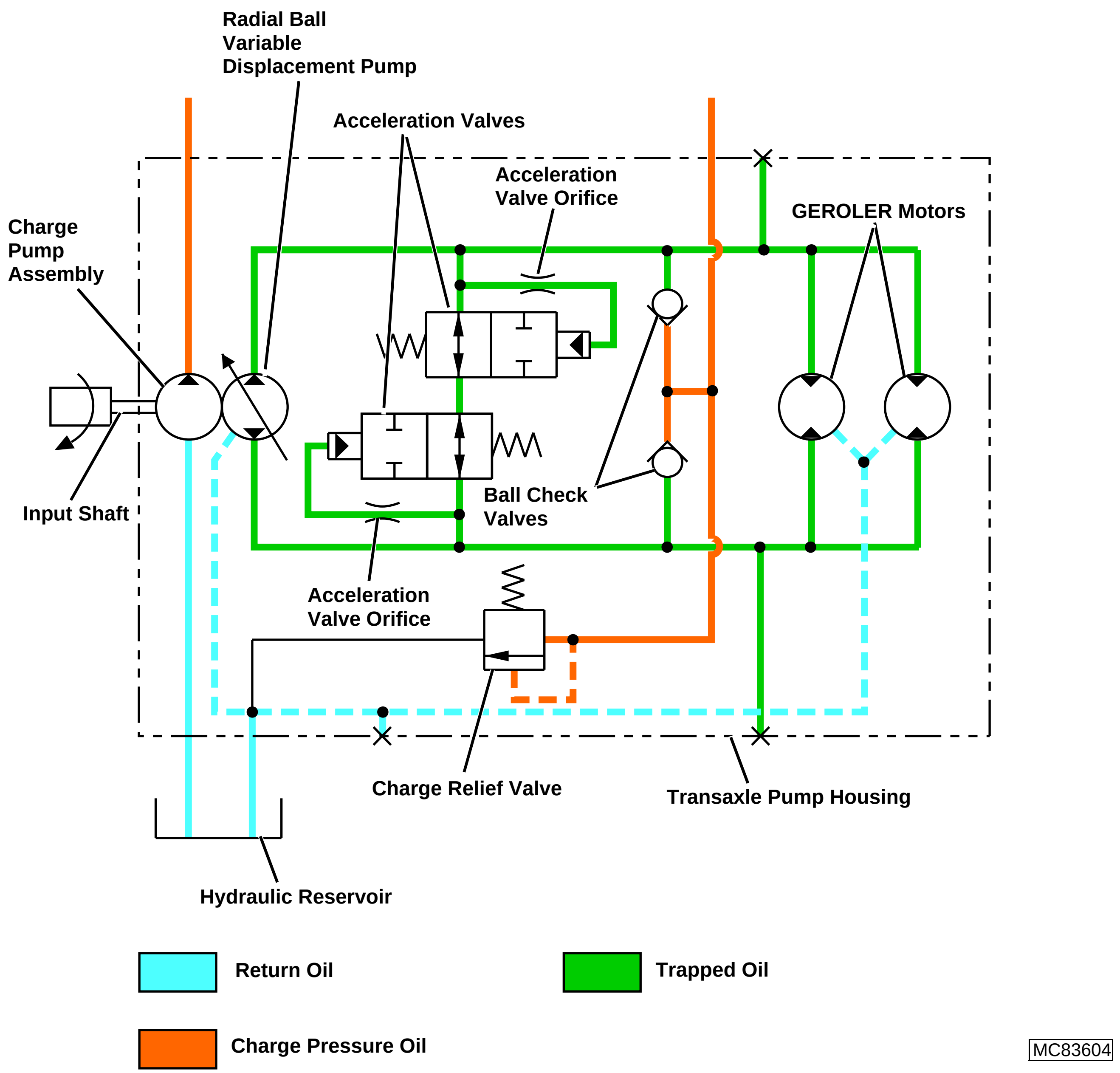
The hydrostatic charge pump provides hydraulic oil pressure to the transaxle assembly.

Theory of Operation:

With the engine running, the drive belt turns the input shaft in a clockwise direction. The charge pump assembly has a carrier and rollers that rotate in an eccentric pump housing. This action draws oil from the hydraulic reservoir and discharges oil to the steering valve, providing oil for steering priority. From the steering valve, oil is then routed to the cutting unit lift valve and finally to the filter on the transaxle.

Oil from the filter is routed to port where the charge relief valve creates a restriction, "charging" oil to 20—30 psi. This charge pressure oil forces oil into the hydrostatic closed loop through forward or reverse check valves only as oil is needed for makeup oil. Makeup oil is needed because of normal pump and motor leakage used for lubrication and cooling. The charge pressure oil also supplies lubrication and cooling for motor balance ring, splines, and bearings. Remaining charge oil is returned to the reservoir.

When transaxle is in the neutral position, as shown, the oil trapped in the closed loop is at the same pressure as the charge pressure oil.


Radial Ball Variable Displacement Pump
Acceleration Valves
Acceleration Valve Orifice
GEROLER Motors
Charge Pump Assembly
Input Shaft
Ball Check Valves
Acceleration Valve Orifice
Charge Relief Valve
Transaxle Pump Housing
Hydraulic Reservoir
Return Oil
Trapped Oil
Charge Pressure Oil
MC83604

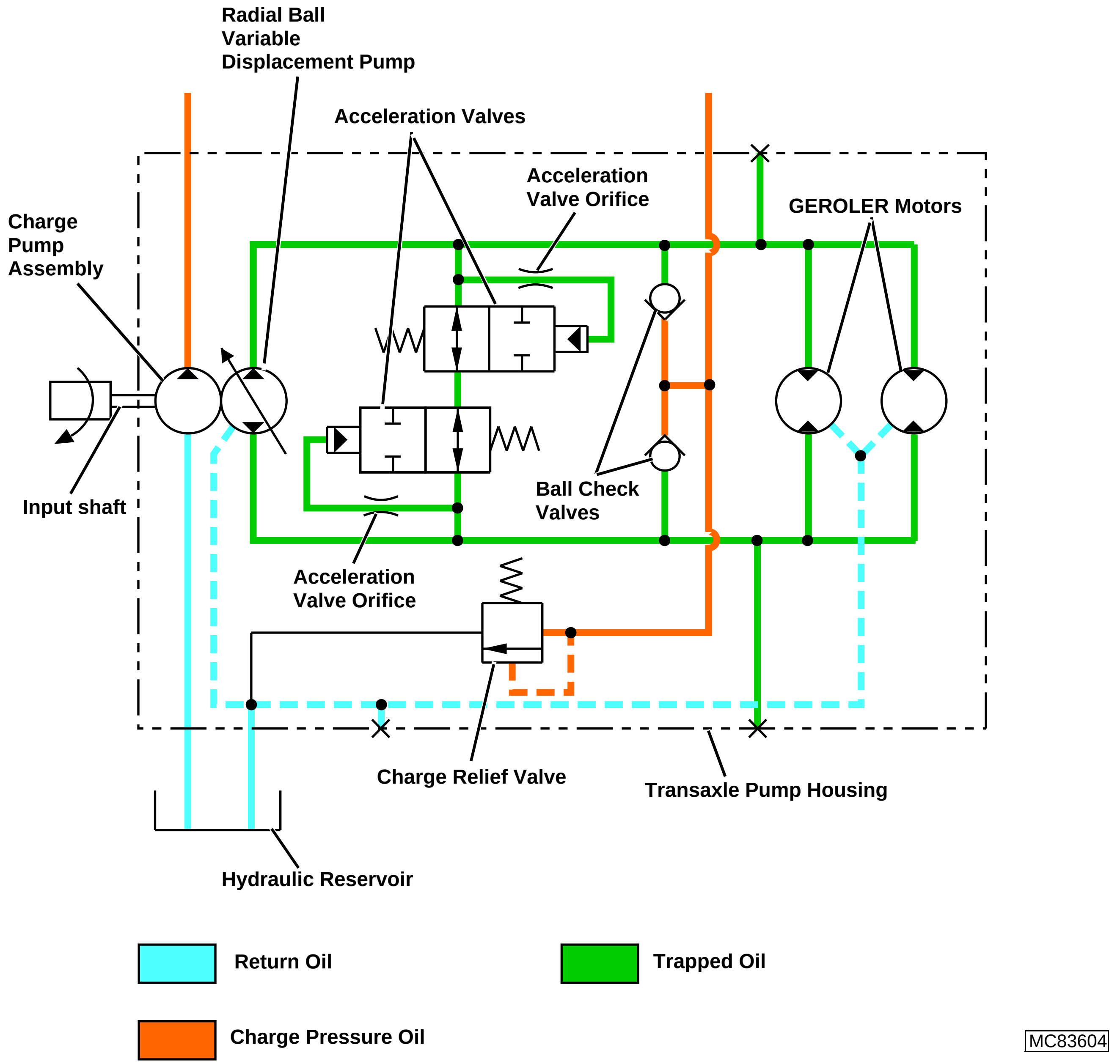
TRANSAXLE OPERATION—NEUTRAL

Function:

To drive the machine using hydraulic motors.

Theory of Operation:

With the control shaft in the neutral position and the engine turning the input shaft, the charge pump supplies oil to lubricate the radial ball, variable displacement pump. The pump balls follow a concentric race which does not allow the balls to move in and out of their rotor bores. This action also traps the oil in the motor circuits, providing dynamic braking action.


Radial Ball
Variable
Displacement Pump
Acceleration Valves
Acceleration
Valve Orifice
Charge
Pump
Assembly
GEROLER Motors
Input shaft
Ball Check
Valves
Acceleration
Valve Orifice
Charge Relief Valve
Transaxle Pump Housing
Hydraulic Reservoir
Return Oil
Trapped Oil
Charge Pressure Oil
MC83604

TRANSAXLE OPERATION—TRAVEL

Function:

The transaxle uses the pressurized oil from the hydrostatic charge pump to power the Geroler® motors to drive the machine in forward or reverse.

Theory of Operation:

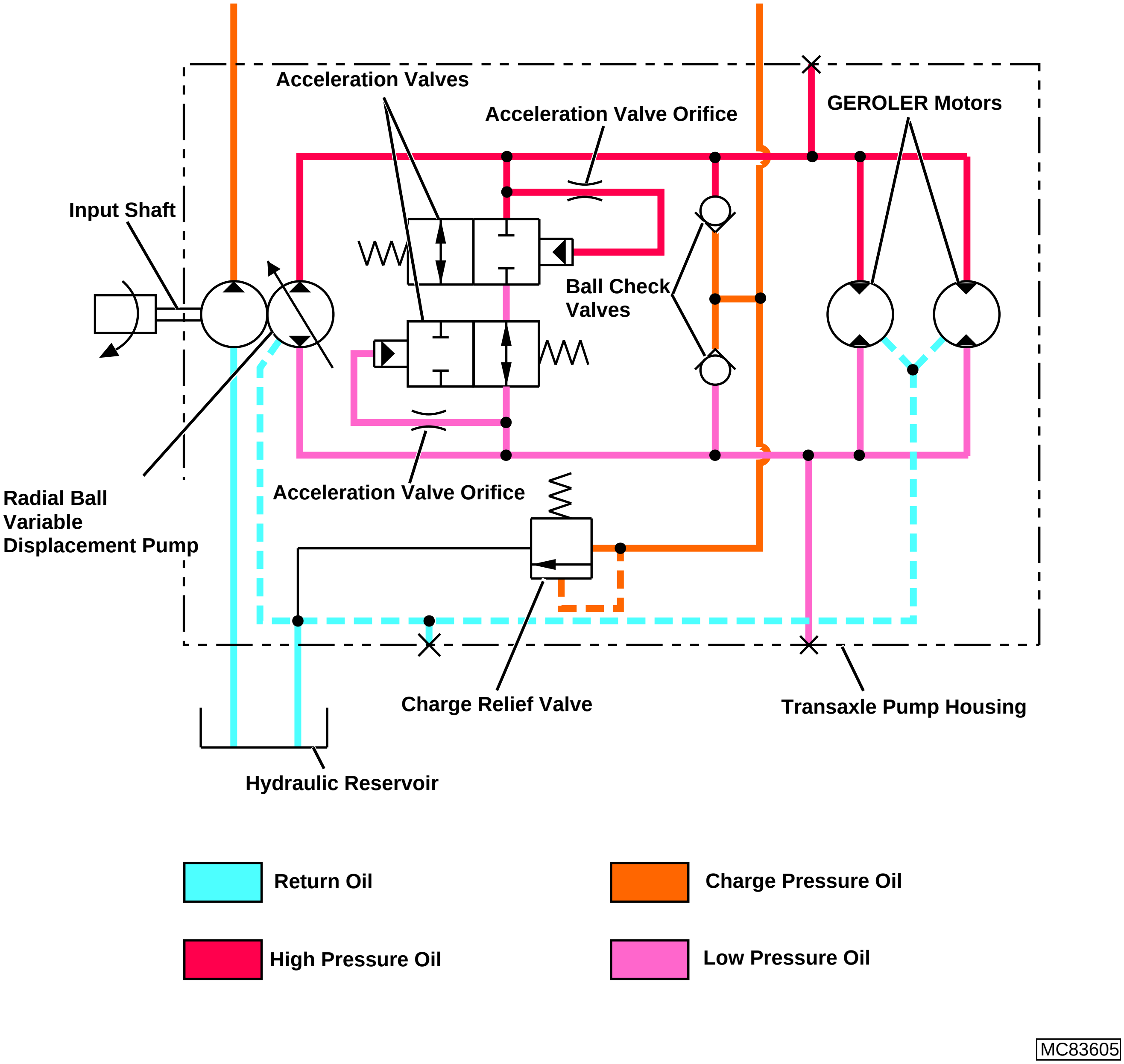
As the control shaft is rotated clockwise, the pump race moves which makes an elliptical path for the pump balls to follow. The balls move in and out of the rotor bores, creating a pumping action. Because the circuit is a closed loop, oil is drawn from one side of the loop and discharged to the opposite. The pressure difference causes the geroler motors to rotate and turn the axle shafts. Proper timing of the valve with the geroler motor provides motor rotation so both axle shafts turn in the forward direction.

When the control shaft is rotated further clockwise the elliptical path is larger, balls move farther back and forth, moving more oil. This action increases the travel speed.

By moving the control shaft counterclockwise, the flow of oil is reversed and the mower travels in the reverse direction.

Acceleration valves are used to provide smooth starts and stops. Forward or reverse movement is less aggressive because the acceleration valves allow oil to bypass the motors until the closed loop pressure increases enough to close the acceleration valve. As the pressure builds, oil pressure flows through a small orifice in the acceleration valve and pushes the acceleration valve down and the damper piston up. The dampener piston pushes pump race ring against button to provide smooth movement of control shaft.

Geroler® is a registered trademark of the EATON Corporation.


Acceleration Valves
Acceleration Valve Orifice
GEROLER Motors
Input Shaft
Ball Check
Valves
Radial Ball
Variable
Displacement Pump
Acceleration Valve Orifice
Charge Relief Valve
Transaxle Pump Housing
Hydraulic Reservoir
Return Oil
Charge Pressure Oil
High Pressure Oil
Low Pressure Oil
MC83605

TROUBLESHOOTING

HYDROSTATIC POWER TRAIN TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Machine will not move forward or backward.	Noisy system.	Accelerates slowly.	Machine moves with engine running and travel control pedals in neutral.								
Low oil level.	●	●	●									
Wrong oil.	●											
Control linkage out of adjustment or loose.	●		●	●								
Parking brake engaged.		●	●									
Low charge pressure.	●	●	●									
Internal hydrostatic pump or motor damage.	●	●										
Air in system.		●	●									

DIAGNOSIS

MACHINE WILL NOT MOVE FORWARD OR BACKWARD

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Transaxle—Hydrostatic charge pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC TRANSAXLE CONTROL LINKAGE ADJUSTMENT on page 5-22.)
	No internal damage.	Disassemble, inspect and repair or replace pump as necessary. (See TRANSAXLE—HYDROSTATIC CHARGE PUMP—Disassembly/ Inspection on page 5-31.)
3. Transaxle—Motor Axle.	No internal damage.	Disassemble, inspect, and repair or replace transaxle as necessary. (See TRANSAXLE—HYDROSTATIC MOTOR AXLE—Disassembly/ Inspection on page 5-28.)

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Transaxle—Hydrostatic charge pump.	Charge pump pressure and flow volume are at correct specifications.	Test hydrostatic pump charge pressure and flow volume. (See HYDROSTATIC CHARGE PUMP TEST on page 5-19.)

MACHINE ACCELERATES SLOWLY

Test Conditions:

- Key switch in OFF position.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
2. Hoses from hydraulic reservoir to hydrostatic charge pump.	No sharp bends or restrictions.	Replace hose.
3. Transaxle—Hydrostatic charge pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC TRANSAXLE CONTROL LINKAGE ADJUSTMENT on page 5-22.)

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Transaxle—Hydrostatic charge pump.	Charge pump pressure and flow volume are at correct specifications.	Test hydrostatic charge pump charge pressure and flow volume. (See HYDROSTATIC CHARGE PUMP TEST on page 5-19.)
5. Engine.	Fast Idle—3400 ±75 rpm.	Adjust engine fast idle speed. (See FAST IDLE SPEED ADJUSTMENT on page 3-31.)

HYDRAULIC DRIVE SYSTEM OPERATES ERRATICALLY

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
	Hydraulic oil level at correct level.	Fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Hoses from hydraulic reservoir to hydrostatic charge pump.	No sharp bends or restrictions.	Replace hose.

MACHINE MOVES WITH ENGINE RUNNING AND TRAVEL PEDALS IN NEUTRAL

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Transaxle—Hydrostatic charge pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC CONTROL LINKAGE ADJUSTMENT on page 5-22.)

EXCESSIVE HYDROSTATIC CHARGE PUMP NOISE

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil clean and not foamy. (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
	Hydraulic oil level at correct level.	Fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Transaxle—Hydrostatic charge pump.	No internal damage.	Disassemble, inspect, and repair or replace pump as necessary. (See TRANSAXLE—HYDROSTATIC CHARGE PUMP—Disassembly/Inspection on page 5-31.)

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
3. Transaxle—Hydrostatic charge pump.	Charge pressure at correct specification.	Test hydrostatic pump charge pressure. (See HYDROSTATIC PUMP CHARGE TEST on page 5-19.)

TEST AND ADJUSTMENTS

HYDROSTATIC CHARGE PUMP TEST

Reason:

To verify pump flow and pressure to ensure maximum performance.

Test Equipment:

- JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
- JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
- JT05469 Flowmeter Kit
- JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
- JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
- 38H1160 11/16 M ORFS x 11/16 M ORB Adapter Fitting

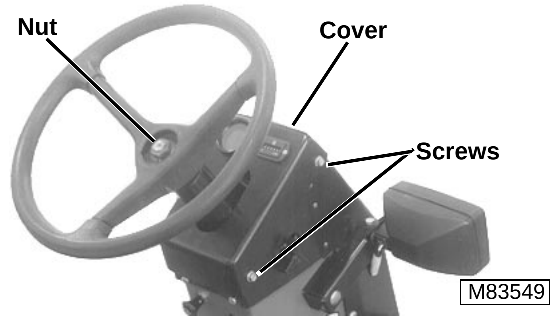
Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

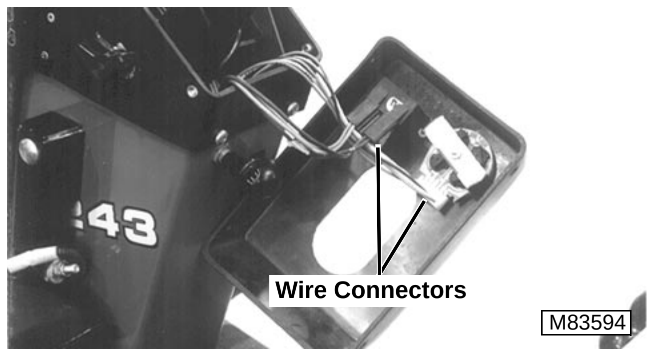
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch OFF.
6. Engage parking brake.
7. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.



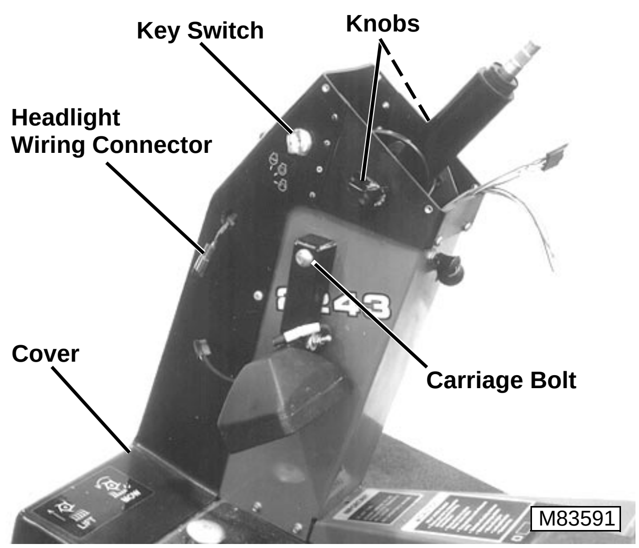
IMPORTANT: Do not use a hammer on end of steering shaft, damage can occur to steering valve or shaft.

NOTE: If steering wheel can not be pulled off easily, use a knife-edge puller to remove.

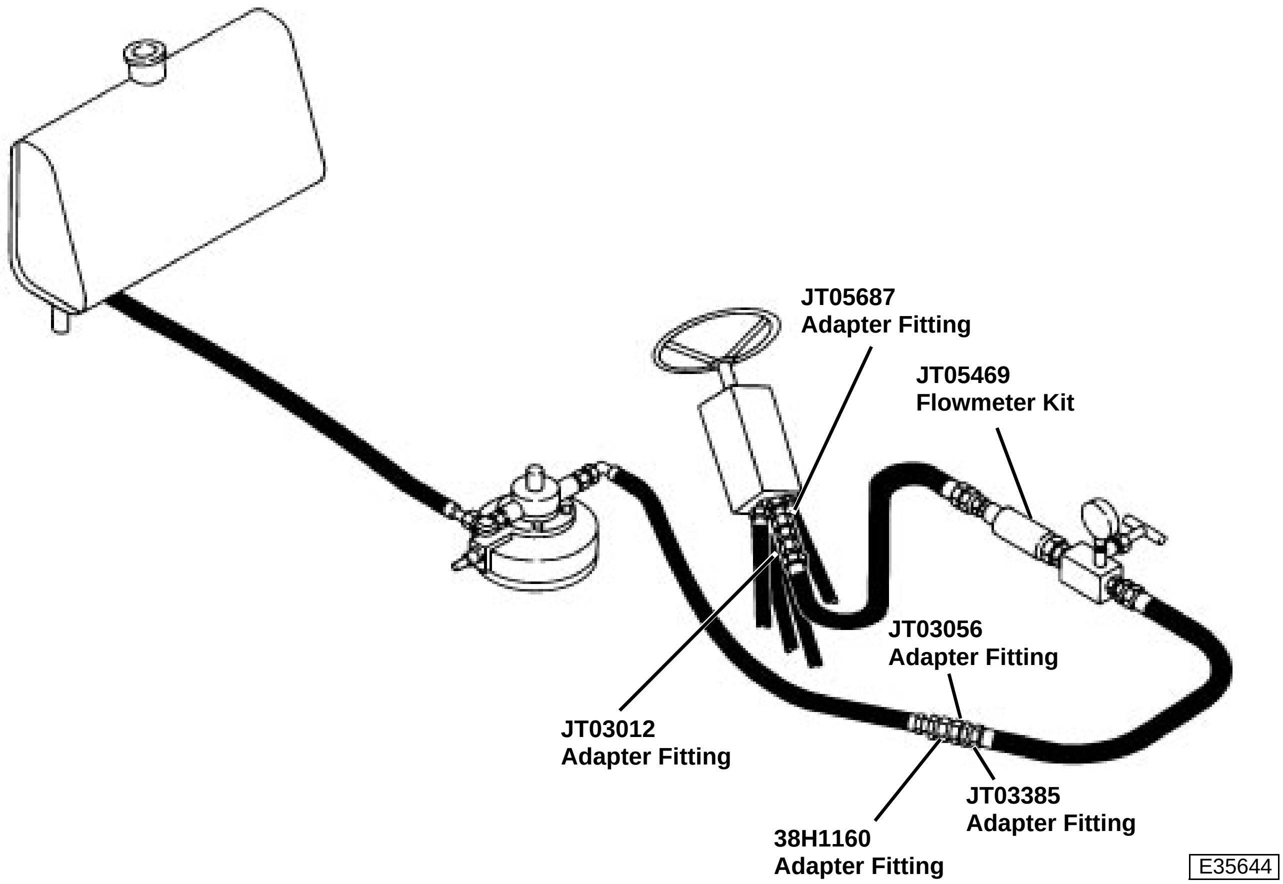
8. Remove steering wheel cap and nut. Remove steering wheel.
9. Remove four screws.



10. Disconnect hourmeter and gauge wire connectors and remove cover.



11. Remove two knobs.
12. Remove key switch.



13. If equipped with optional headlights:
   • Loosen nut on carriage bolt and rotate headlight assembly down 90°.
   • Disconnect wiring connector.
   • Repeat for remaining headlight.
14. Remove eight screws and cover.
15. Disconnect hose from “IN” port of steering valve.
16. Connect JT05469 Flowmeter Kit to steering valve and charge pump outlet hose fitting using JT05687, JT03012, JT03385, JT03056 and 38H1160 Adapter Fittings.

IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage can occur to hydraulic components.

17. Open flowmeter valve fully.
18. Start and run engine at **fast idle (3400 ±75 rpm)**.
19. Turn flowmeter valve 345 kPa (50 psi) is registered on flowmeter pressure gauge. Check and record the flow rate. Flow rate should read **15.1 L/min (4 gpm)**.
20. Adjust flowmeter valve until 5516 kPa (50 psi) is registered on gauge. Check and record the flow rate. Flow rate should read **7.6 L/min (2 gpm)**.
21. Repair or replace charge pump if flow is not within specifications. (See TRANSAXLE—HYDROSTATIC PUMP—Disassembly/Inspection on page 5-31.)

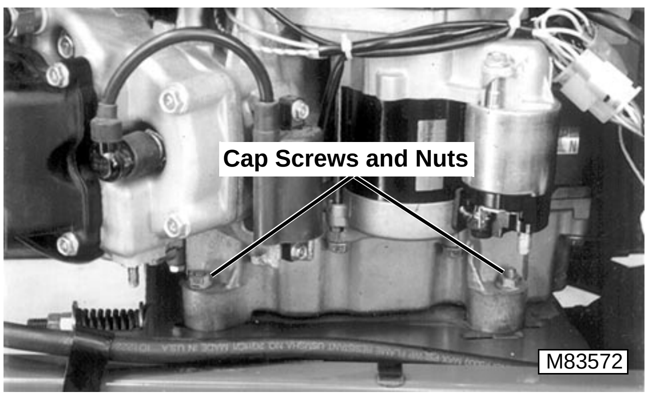
DRIVE BELT ADJUSTMENT

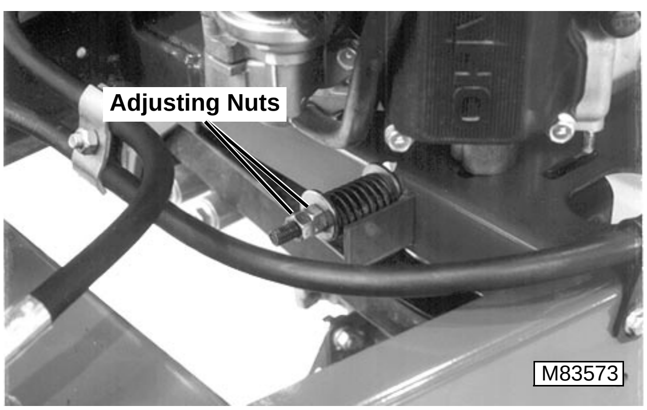
Reason:

To maintain correct belt tension for maximum performance.

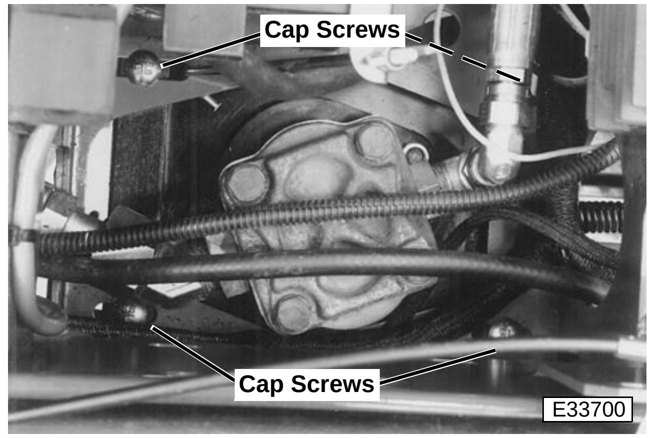
Procedure:

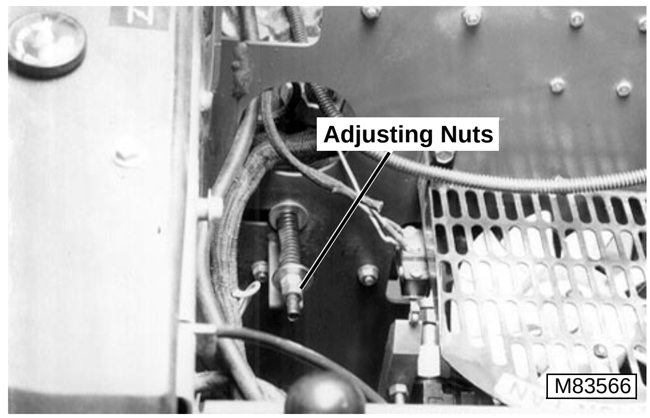
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch OFF.
6. Engage park brake.
7. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)





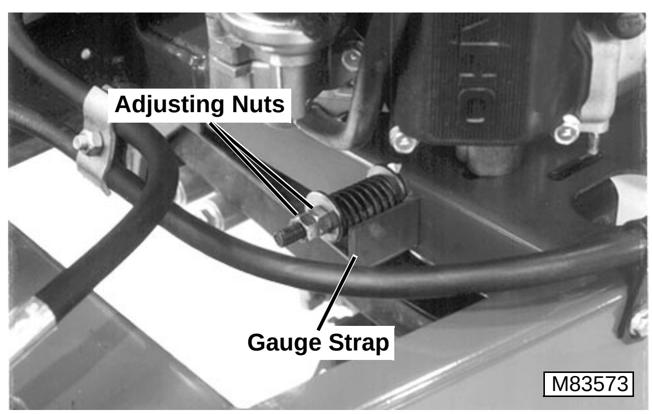
8. Loosen four engine cap screws and nuts and belt tension adjusting nuts. Engine should be free to move back and forth, but not tip. Move engine as far forward as possible.





NOTE: Hydraulic pump sheave shield can be removed to gain access to pump cap screws and nuts.

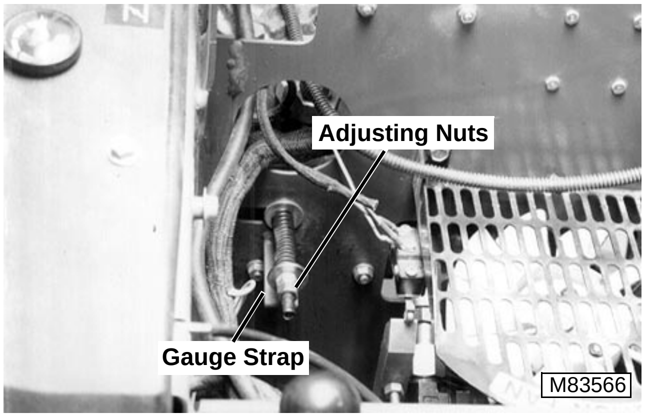
9. Loosen four hydraulic pump round-head bolts and nuts and adjusting nuts. Pump should be able to move back and forth, but not tip. Move pump as far rearward as possible.



IMPORTANT: For proper belt tension, hydrostatic drive belt MUST be adjusted first.

NOTE: Shake engine periodically while making adjustment.

10. Adjust hydrostatic drive belt tension using spring, washer and nut assembly. Adjust spring, washer and nut assembly on engine until rear surface of washer is flush with end of gauge strap.
11. Tighten lock nut on adjuster assembly and four engine cap screws and nuts.



NOTE: Shake pump periodically while making adjustment.

12. Adjust hydraulic pump drive belt using spring, washer and nut assembly. Adjust spring, washer and nut assembly on engine until rear surface of washer is flush with end of gauge strap.
13. Tighten lock nut on adjuster assembly and four pump cap screws and nuts.

MOWING SPEED ADJUSTMENT

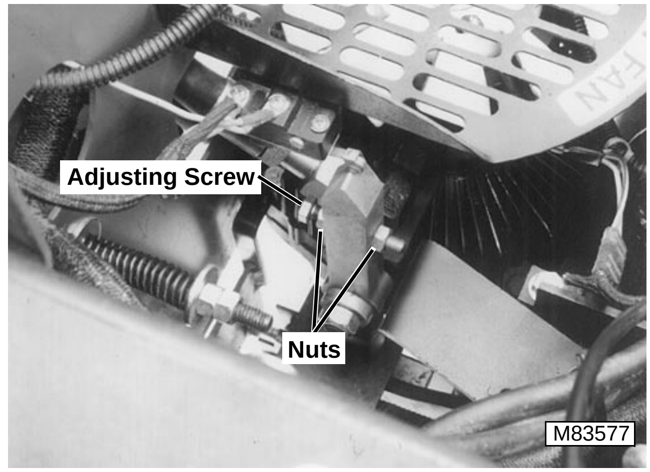
Reason:

To ensure that the machine is set at the correct mowing speed for maximum performance.

Procedure:

*NOTE: The correct mowing speed is **6.5 km/h (4 mph)**. This can be determined by traveling 30.5 m (100 ft) in 17 seconds.*

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to MOW position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage parking brake.
7. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)



8. Loosen two nuts on adjusting screw.
9. Turn adjusting screw to adjust mowing speed:
   - Turn screw clockwise (in) to reduce speed.
   - Turn screw counterclockwise (out) to increase speed.
10. Hold adjusting screw while tightening nuts.

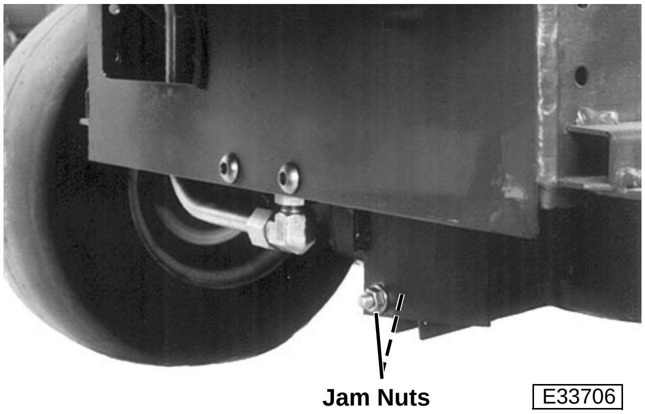
HYDROSTATIC TRANSAXLE CONTROL LINKAGE ADJUSTMENT

Reason:

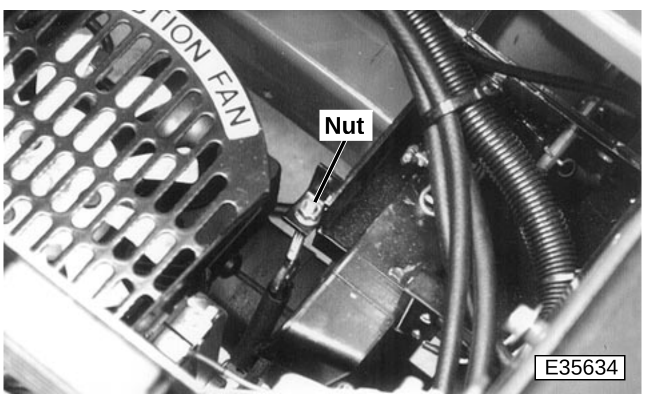
If the mower creeps forward or backward with travel pedals in neutral position, parking brake released, and the engine running, the control linkage must be adjusted.

Procedure:

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Turn key switch to OFF position.
5. Raise and lock seat platform.
6. Securely block rear wheel.
7. Lift machine high enough to remove drive wheels off the floor. Place jackstands under transaxle.
8. Start and run engine at **slow idle (1550 ±75 rpm)**.



9. Loosen jam nuts.
10. Adjust threaded pivot rod to stop wheel movement:
    - If machine creeps forward—turn nuts so threaded rod moves forward.
    - If machine creeps backward—turn nuts so threaded rod moves rearward.
11. Tighten jam nuts.
12. Stop engine.
13. Adjust travel/neutral switch after adjusting control linkage. (See TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226).



14. Adjust cam centering roller spring tension:
    - Standard spring tension is set when approximately three threads are visible above nut.
    - Turn nut clockwise to increase spring tension, providing quicker return-to-neutral (stopping) response.
    - Turn nut counterclockwise to reduce spring tension, providing slow return-to-neutral (stopping) response.

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REPAIR

TRANSAXLE

Removal/Installation

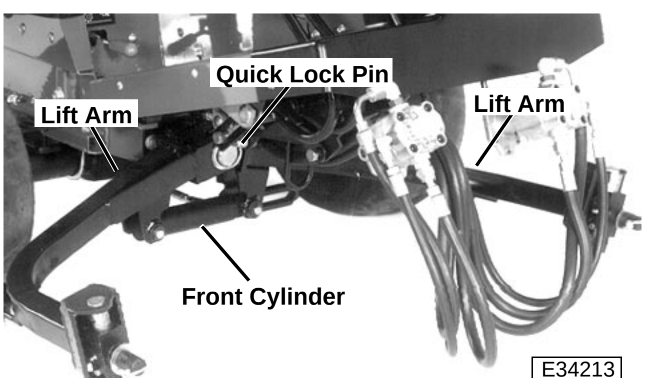
CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

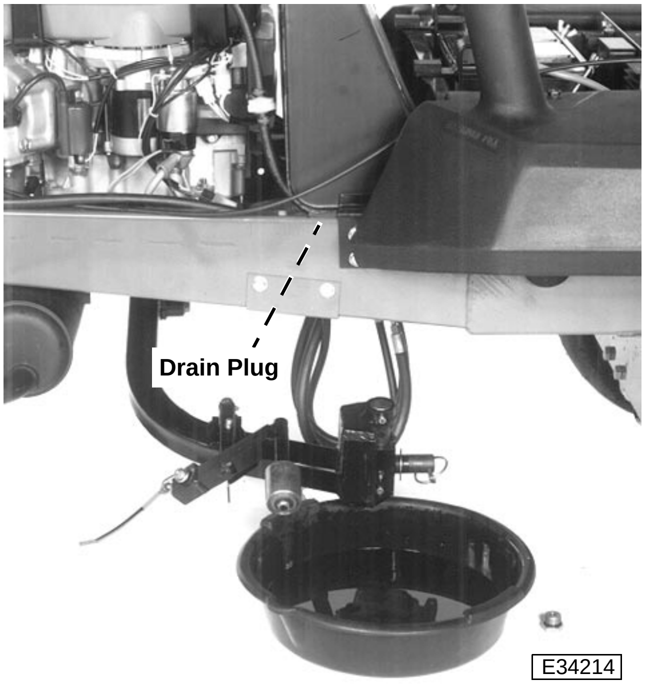
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
7. Disconnect negative (–) cable from battery.
8. Remove cutting units from lift arms. (See REEL MOWER—Removal/Installation on page 9-26.)

NOTE: Do not disconnect hydraulic hoses to front cylinder.



E34213

9. Remove front cylinder. (See FRONT LIFT CYLINDER—Removal/Installation on page 8-57.) Attach lift cylinder to bottom side of operators platform with tie straps.
10. Remove quick lock pin and washers. Slide front lift arms from machine.

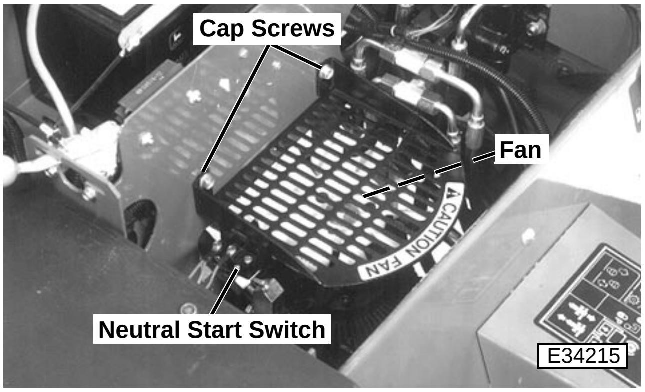


E34214

IMPORTANT: Prevent dirt from getting in reservoir.

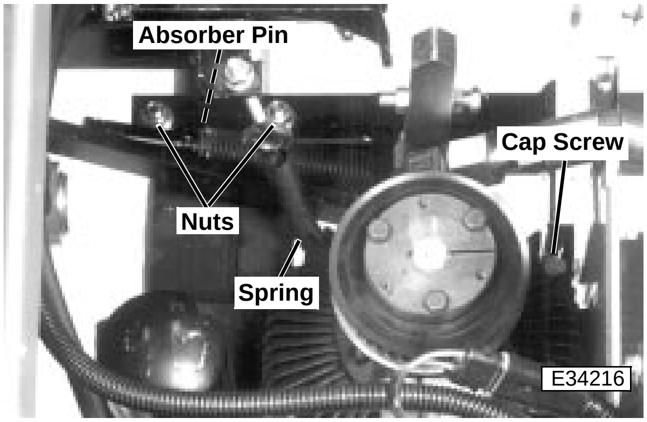
*NOTE: Hydraulic reservoir capacity is **16.6 L (4.4 gal)**. The total capacity of the hydrostatic and reel drive system is **22.7 L (6.6 gal)**.*

11. Remove drain plug from bottom of reservoir to drain oil.

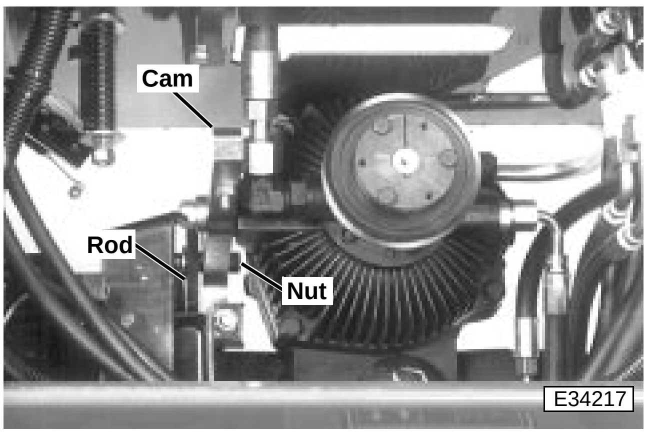


E34215

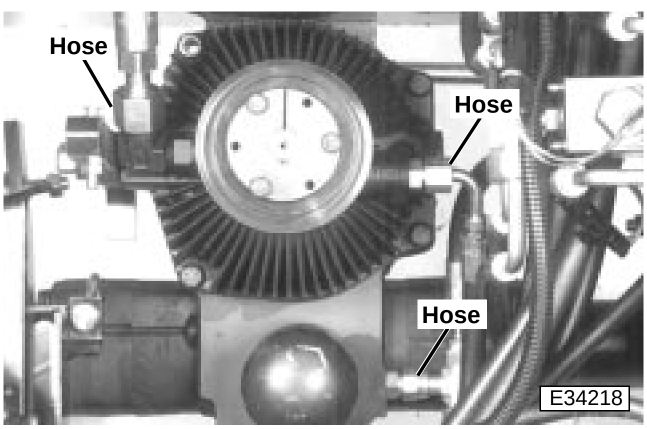
12. Remove neutral start switch from shield.
13. Remove cap screws to remove shield.
14. Remove center cap screw to remove fan.
15. Remove belt from hydrostatic pump. (See DRIVE BELTS—Replacement on page 5-46.)



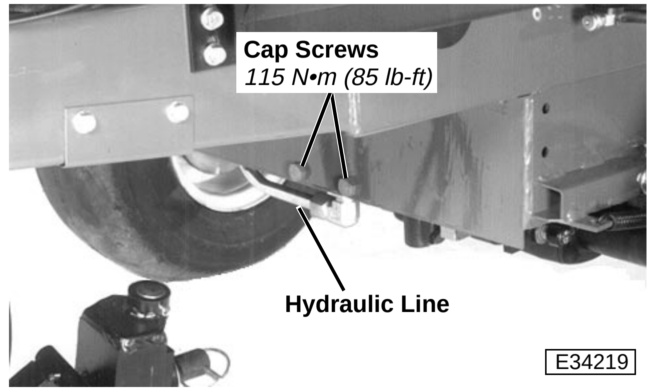
16. Remove spring, absorber pin, cap screw and nuts.
17. Remove hydrostatic control support assembly.



18. Remove nut to separate rod and absorber from cam.



19. Disconnect hydraulic hoses.



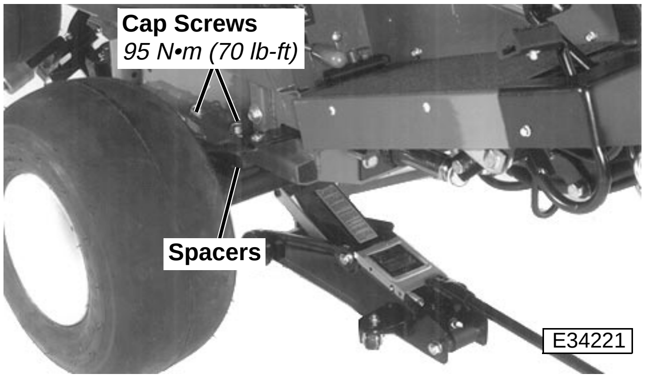
20. Disconnect and remove hydraulic line.
21. Remove cap screws.

NOTE: Front tires must be at least 76 mm (3 in.) off the ground.

22. Lift and support machine with jackstands as shown.
23. Remove brake return springs and washers from each side of machine.

CAUTION

Approximate weight of transaxle and wheels is 53 kg (117 lbs).



24. Support transaxle with floor jack.
25. Remove two mounting cap screws and nuts and spacers from each side of machine.
26. Lower transaxle to ground and roll away from frame.
27. Remove the following items if transaxle is to be repaired:
   - Wheels (See FRONT WHEELS—Removal/ Installation on page 10-3.)
   - Brake assemblies (See BRAKES—Removal/ Inspection/Installation on page 7-9.)
   - Hydraulic fittings.
   - Transaxle drive sheave. (See TRANSAXLE DRIVE SHEAVE—Removal/Installation on page 5-45.)

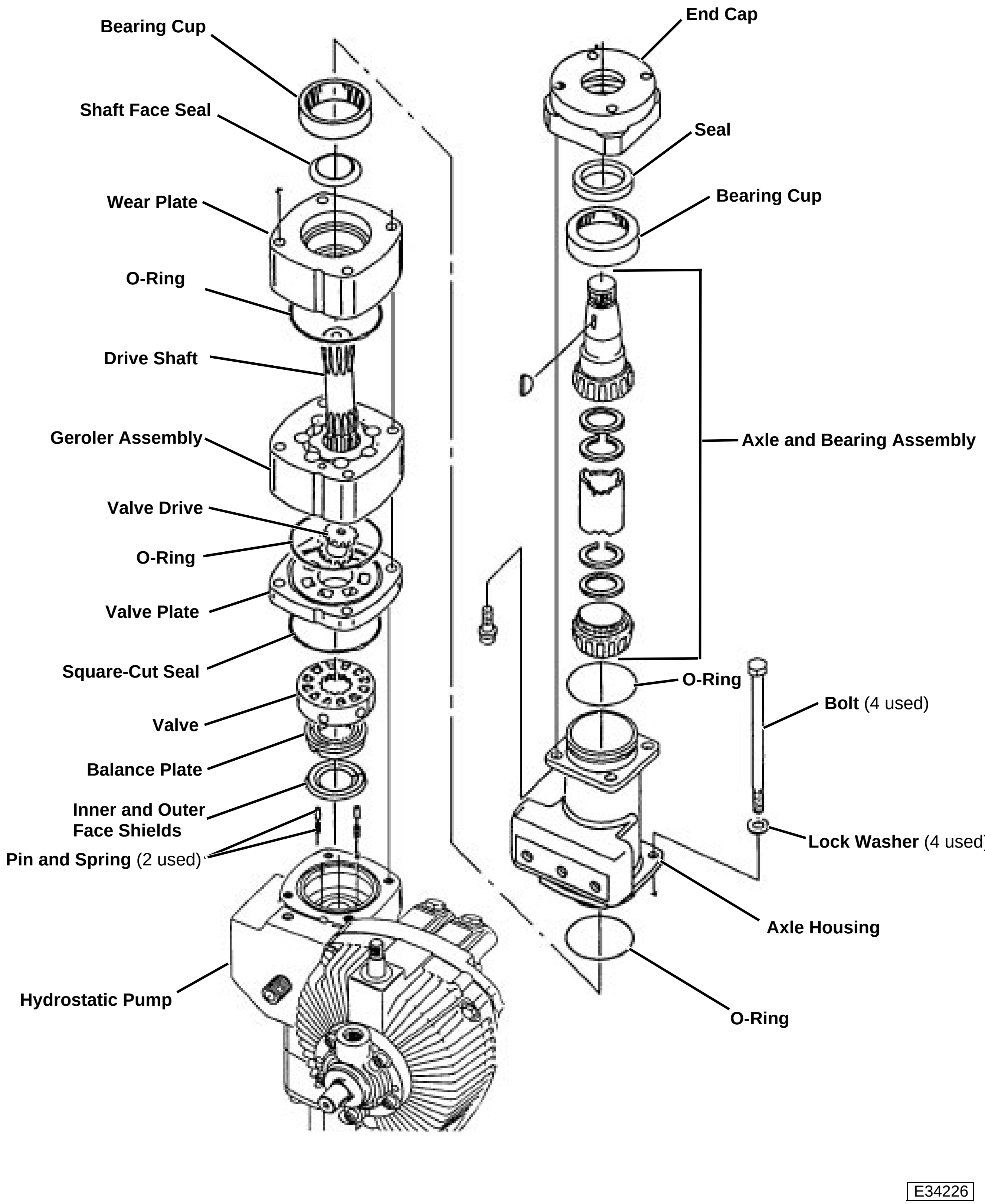
Installation is done in the reverse order of removal.

IMPORTANT: Be sure there is clearance between drive belt, hoses and frame to avoid damage to belts or hoses during mower operation.

- Tighten transaxle mounting cap screws to **95 N•m (70 lb-ft)**.
- Tighten transaxle rear mounting cap screws to **115 N•m (85 lb-ft)**.
- Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)
- Adjust brake linkage. (See BRAKE LINKAGE ADJUSTMENT on page 7-10.)
- Bleed hydraulic system. (See BLEED HYDRAULIC SYSTEM on page 8-35.)

TRANSAXLE—MOTOR AXLE

Disassembly/Inspection



1. Remove oil filter from transaxle.
2. Secure transaxle so axle is in a vertical upright position.
3. Remove four socket head cap screws and remove end cap.

NOTE: Bearing cup is press fit in end cap. Remove cup only if replacement is necessary.

4. Remove seal from end cap. Remove bearing cup from end cap only if necessary.
5. Remove axle and bearing assembly from axle housing. Inspect bearings for damage. Replace if necessary.
6. Remove O-ring from axle housing.
7. Remove axle housing retaining bolts and washers.
8. Remove axle housing from wear plate.

IMPORTANT: DO NOT damage wear or valve plates. Damaged plates can cause transaxle failures.

9. Remove wear plate and square-cut seal from Geroler.

NOTE: Bearing cup is press fit in wear plate. Remove cup only if replacement is necessary.

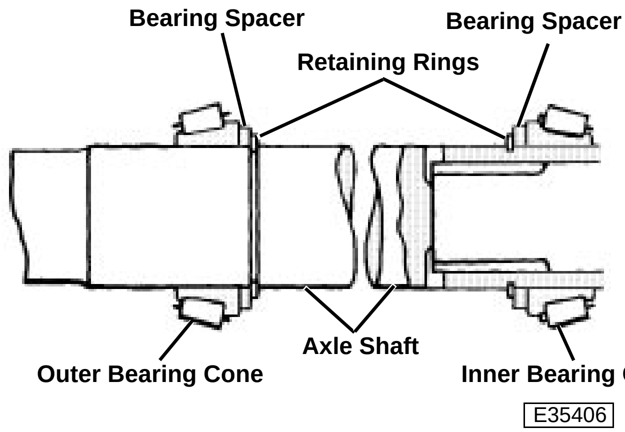
10. Remove shaft face seal from wear plate. Remove bearing cup from wear plate only if necessary.
11. Remove drive shaft.

IMPORTANT: Rolls and star are loose in Geroler assembly. Parts will separate and fall if care is not taken during removal.

12. Remove Geroler assembly and square-cut seal from valve plate, making sure rolls and star are kept intact.
13. Remove valve plate from pump manifold.
14. Remove square-cut seal, valve, balance plate and inner and outer face seals.

IMPORTANT: Carefully remove pins and springs, so as to drop these parts into the manifold's internal passages.

15. Remove pins and springs.



16. Remove retaining rings from groove in axle shaft.
17. Slide retaining rings and bearing spacers away from bearing cones.
18. Use a bearing puller and press to remove bearing cones.

IMPORTANT: Absolute cleanliness is essential when working on transaxle. 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.

CAUTION

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.

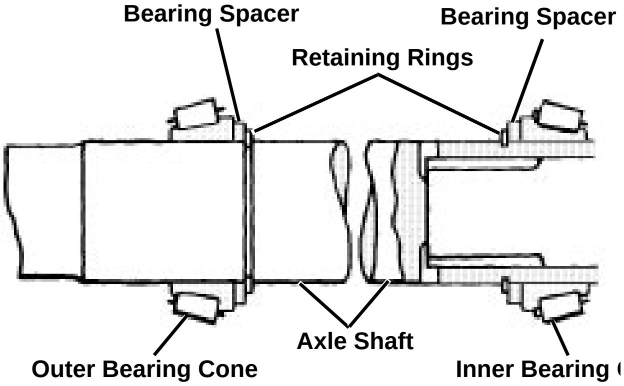
19. Clean all metal parts with solvent and blow-dry with compressed air.
20. Inspect all parts for damage, nicks, or unusual wear patterns. Replace parts as necessary.

Assembly

IMPORTANT: Always use new seals and O-rings. Damaged or used parts will leak.

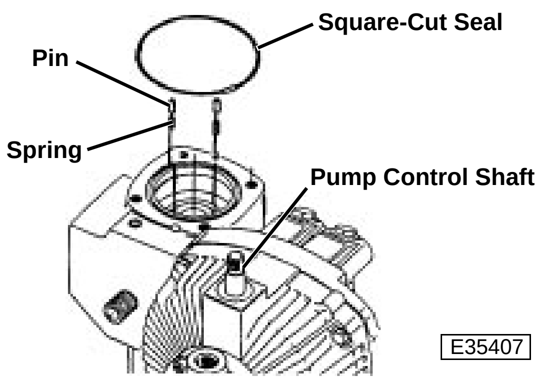
NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.



E35406

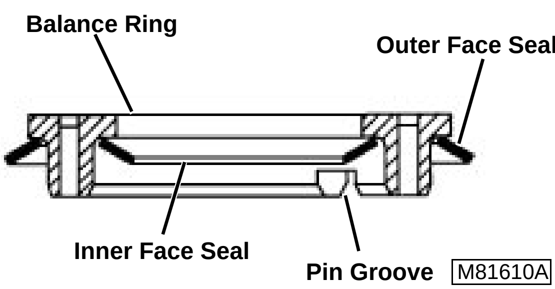
1. Install retaining rings and bearing spacers on axle shaft.
2. Use a press and install bearing cones tight against bearing spacers.



E35407

NOTE: Assemble right motor axle first.

3. Secure transaxle hydrostatic pump and manifold assembly so that the pump control shaft is vertical a pointing up.
4. Apply petroleum jelly on springs and pins to hold in place. Install springs and pins in bores in manifold.
5. Install square-cut seal in manifold.



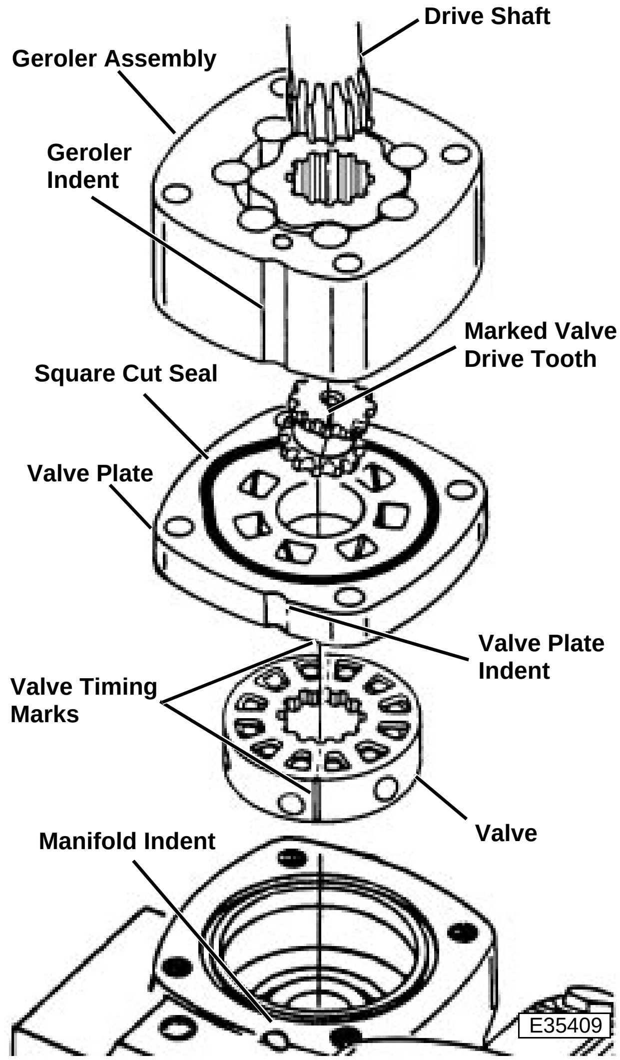
M81610A

IMPORTANT: DO NOT force or cut face seals during installation. Any damage to the seals will effect transaxle operation.

6. Apply petroleum jelly on new inner and outer face seals. Install seals on balance ring as follows:
   - Install inner face seal with cone pointing away from balance ring.
   - Install outer face seal with cone pointing toward balance ring.

NOTE: When properly installed, balance ring should be centered in bore, have spring resistance felt when pushed down and should not rotate.

7. Install balance plate assembly in transaxle, aligning pin grooves with pins in manifold.

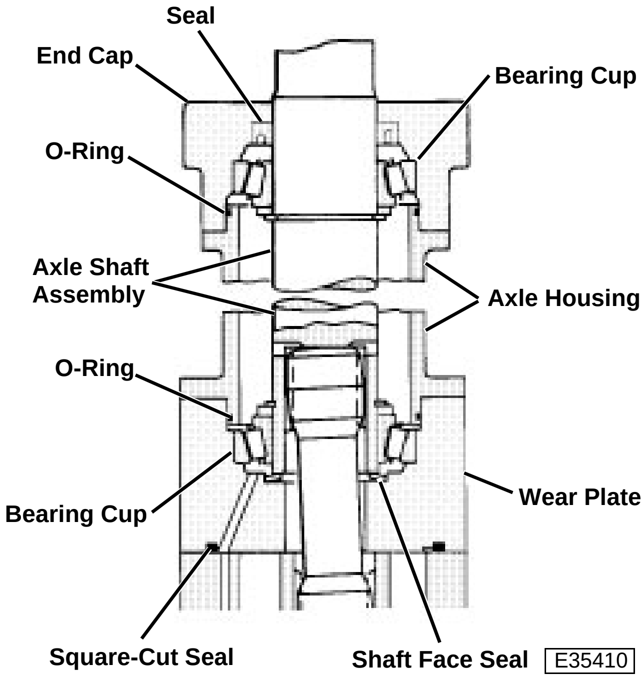


E35409

IMPORTANT: Motor axles must be timed correctly for proper machine travel. Follow steps 6 through 12 closely.

8. Apply clean hydraulic oil to vale and install valve in manifold with splined side of valve up.
9. Put a mark on one tooth of valve drive using a felt marker or pen.

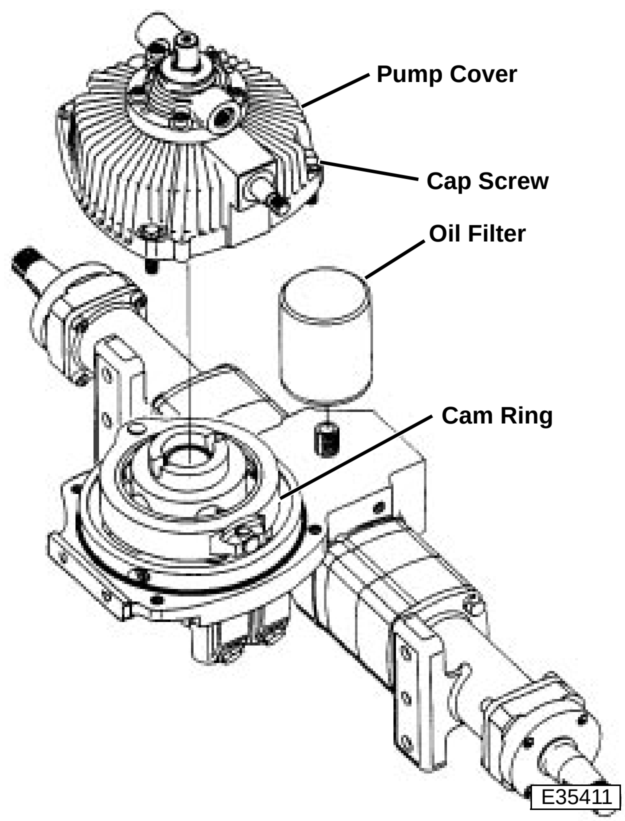
10. Install valve drive in valve, aligning marked tooth with either one or two timing grooves in valve.
11. Apply clean hydraulic oil to valve plate and square-cut seal. Install valve plate and seal over valve drive. Align valve plate indent with indent on manifold.
12. Carefully install Geroler assembly:
   - For right axle motor, align marked drive tooth with any Geroler star point.
   - For left axle motor, align marked drive tooth with Geroler star valley.
13. Rotate Geroler outer housing to align indent with valve plate indent. Make sure seal is not disturbed while rotating.
14. Install drive shaft



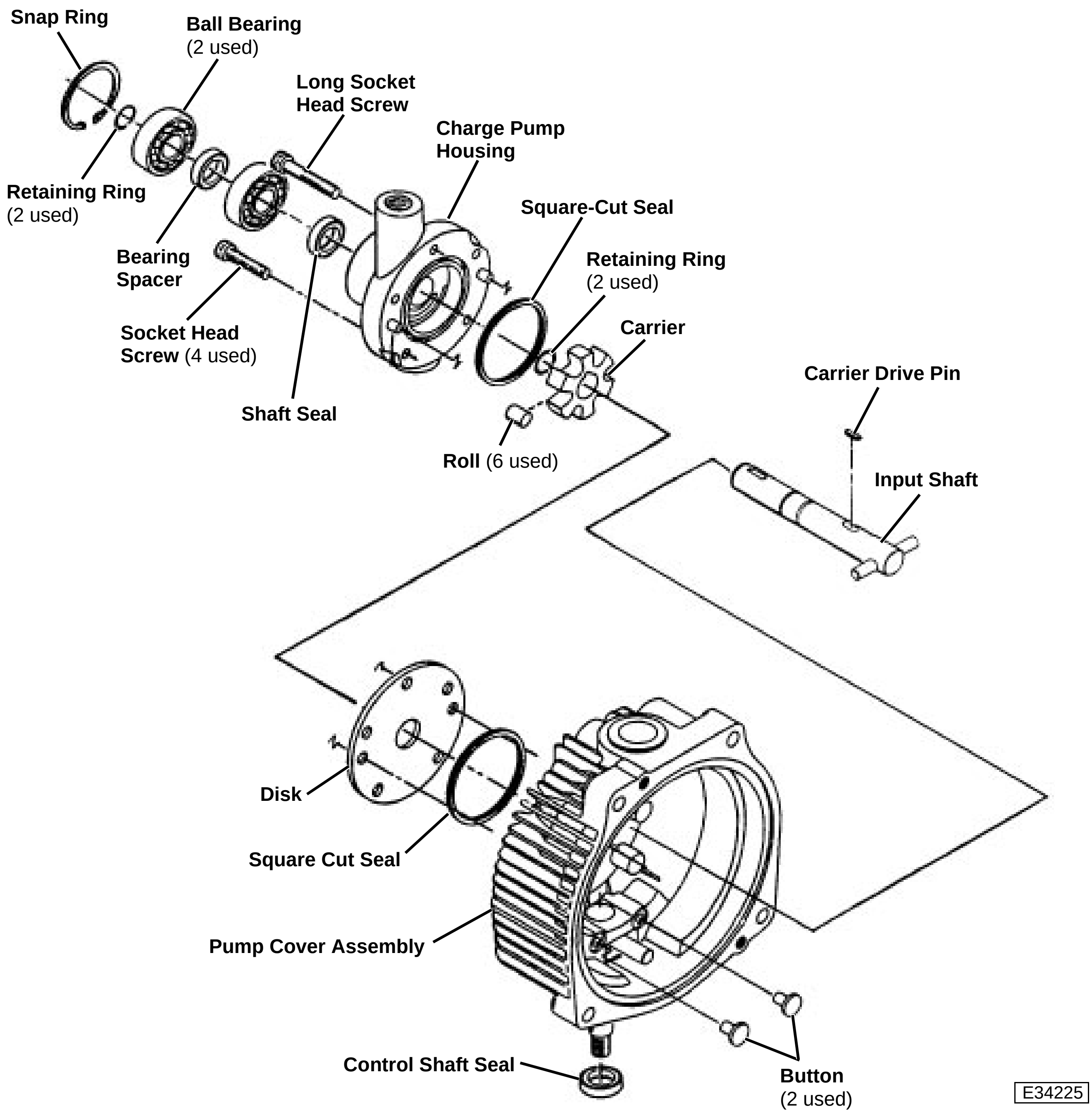
15. Install bearing cup in wear plate using a press. Push cup to bottom of bore.
16. Install shaft face seal in wear plate with I.D. seal lip up.
17. Apply hydrostatic oil to mating surfaces of wear plate and to square cut seal. Install wear plate and seal, aligning indent on wear plate with Geroler housing.
18. Apply petroleum jelly to O-rings and install on axle housing.
19. Install axle housing with transaxle mounting pads towards filter. Install and tighten washers and bolts to **60 N·m (44 lb-ft)**.
20. Apply hydrostatic oil to axle shaft assembly. Install shaft while aligning splines.
21. Install bearing cup in end cap using a press. Push cup to bottom of bore.
22. Use a disk driver to install seal to bottom of bore. Seal lips must be towards bearing cup.
23. Apply petroleum jelly to seal lips. Install end cap while protecting seal
24. lips. Install and tighten socket head screws to **30 N·m (22 lb-ft)**.
25. Turn transaxle 180° and repeat steps 2 through 21 for left motor axle.
26. Install new oil filter.

TRANSAXLE—HYDROSTATIC CHARGE PUMP

Disassembly/Inspection



1. Remove oil filter.
2. Remove four cap screws.
3. Tap cover gently on each side to remove cover from pump manifold.
4. If cam ring remains inside cover, slide ring from cover and install on pump rotor to keep balls in respective bores.



5. Remove buttons from cover.

IMPORTANT: Make sure input shaft is free of paint, burrs, or nicks before removing charge pump assembly.

6. Remove snap ring and upper retaining ring.

IMPORTANT: Do not hit or tap on bearing puller while removing charge pump housing. Apply steady pull only.

7. Remove socket head screws. Carefully remove charge pump housing assembly using a two jaw bearing puller.

NOTE: Ball bearings are a matched set.

8. Remove seal, bearings, spacer, and shaft seal from charge pump housing.

IMPORTANT: Mark top of carrier to indicate top surface. Do not damage surface when marking.

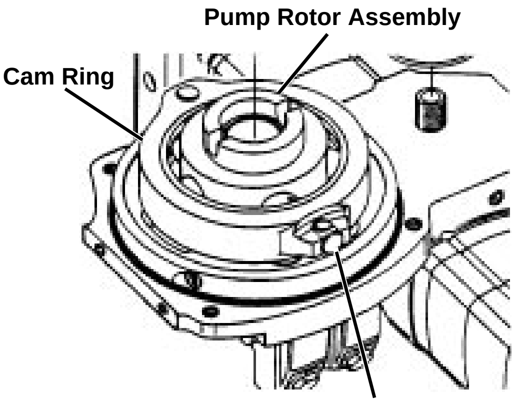
9. Remove six rolls, lower retaining ring, carrier, pin, and input shaft.

NOTE: If any defects are found in charge pump, the charge pump housing, rolls and carrier must be replaced as a set.

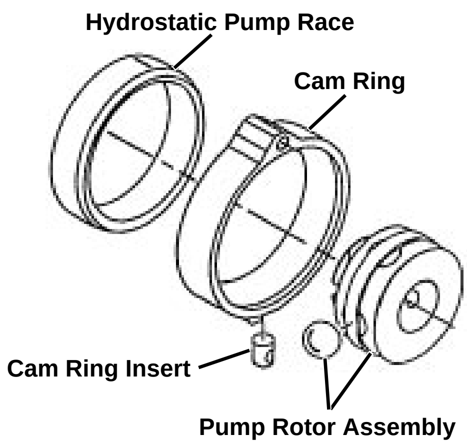
10. Remove disk and seal.

IMPORTANT: DO NOT scratch control shaft or distort seal bore when removing seal.

11. Remove seal using a sharp, narrow edged tool to pierce top metal part of seal.
12. Inspect pump cover assembly, especially around control shaft area. Replace cover assembly if broken, cracked, loose pin, or side play of control shaft exceeds **0.125 mm (0.006 in.)**. (See Replace Pump Control Shaft on page 5-35.)



E35412



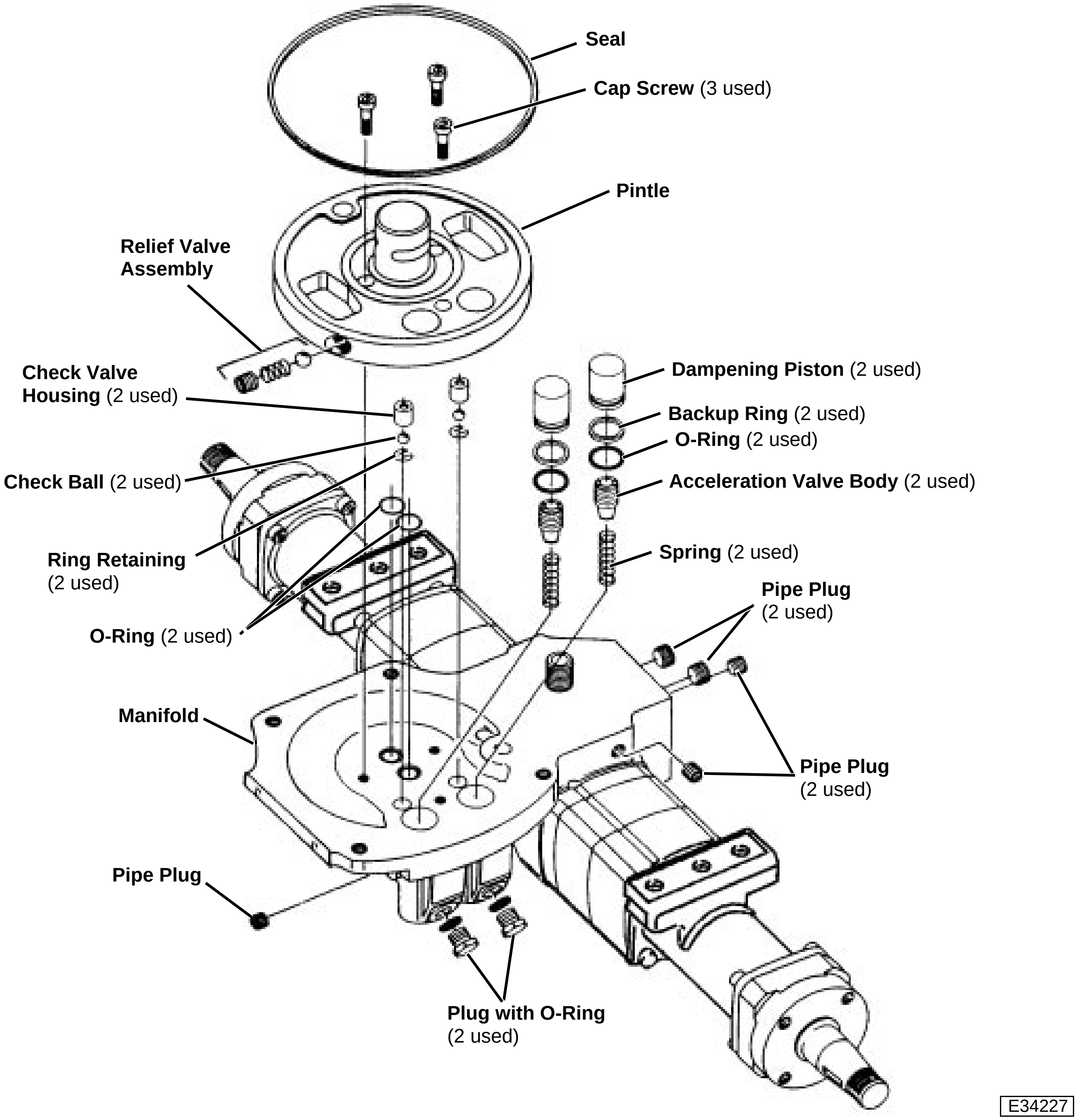
E35413

IMPORTANT: Use care when removing cam ring. Ball pistons MUST remain in place as balls are matched to piston bores.

13. Carefully removing cam ring, with pump race and insert.
14. Use a wide rubber band to hold ball pistons in place. Remove pump rotor assembly.
15. Inspect area where ball pistons contact pump race. This area must be smooth and free of all irregularities.

NOTE: Pump race is a press fit in cam ring. Use a press to remove race if necessary.

16. Inspect rotor assembly, removing piston balls one at a time and keeping each ball with its matched bore. Rotor bushing, mating pintle journal rotor bores and ball pistons must be free of wear or scoring.



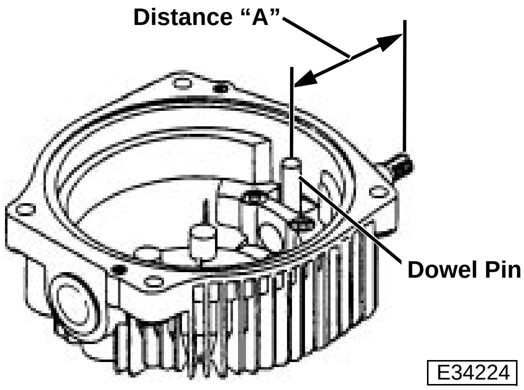
17. Remove large seal from around pintle assembly.
18. Place clean lint-free towel around journal of pintle. Remove three socket head screws to remove pintle assembly from manifold.
19. Remove relief valve assembly which includes a plug, spring and ball. Inspect and replace any defective parts.
20. Remove and inspect two O-rings from manifold.
21. Remove plugs with O-rings dampening pistons, O-rings and back-up rings. Remove acceleration valve bodies and springs.

NOTE: Flush-type pipe plugs without seals need not be removed.

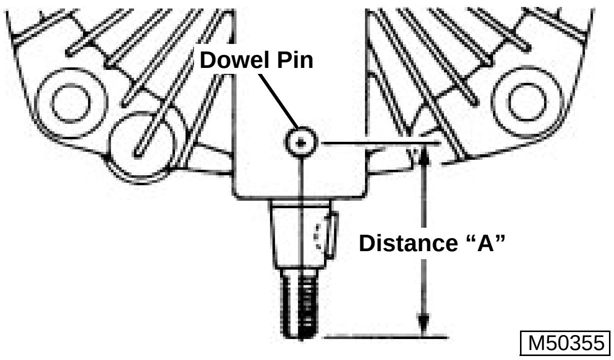
IMPORTANT: Removal of check valves is not recommended, unless a problem is suspected.

22. Inspect check valve balls for free movement. If balls do not move freely or seat properly. (See Replace Check Valves on page 5-35.)

Replace Pump Control Shaft



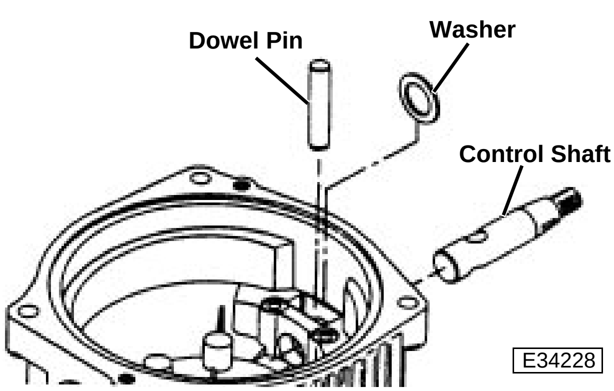
E34224



M50355

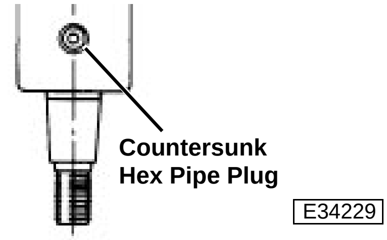
IMPORTANT: Removal of the control shaft from cover is not recommended. However, if dowel is loose or broken, use the following steps to replace control shaft.

1. Measure distance between center of dowel pin and end of shaft.
2. Turn cover over. Use dimension to locate position of dowel pin in cover. Drill 11/32 in. hole diameter hole at center point of dowel pin. Drill hole exactly in line with center of shaft.



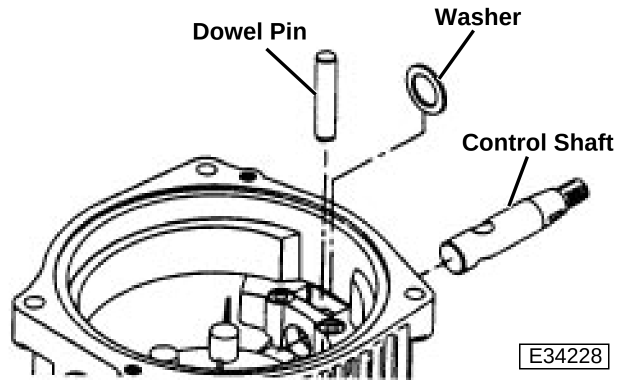
E34228

3. Press damaged pin from control shaft. Remove control shaft and washer.



E34229

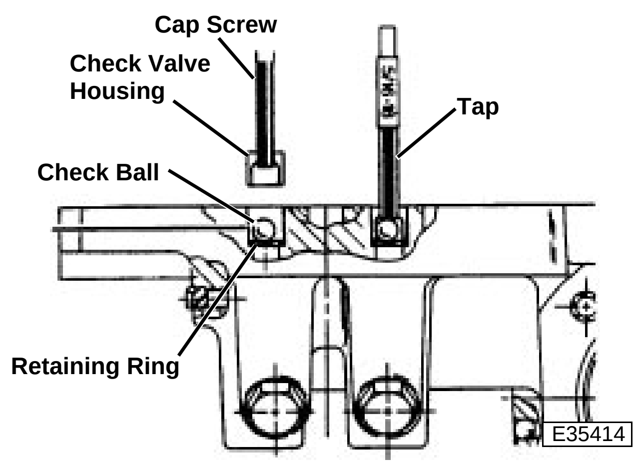
4. Tap drilled hole using 1/8 in. pipe tap. Install 1/8 in. diameter countersunk hex pipe plug. Apply pipe sealant with teflon to threads of plug.



E34228

5. Install new control shaft and washer in cover. Push new dowel pin through shaft until **31.75 mm (1-1/4 in.)** of dowel pin extends above the shaft.

Replace Check Valves



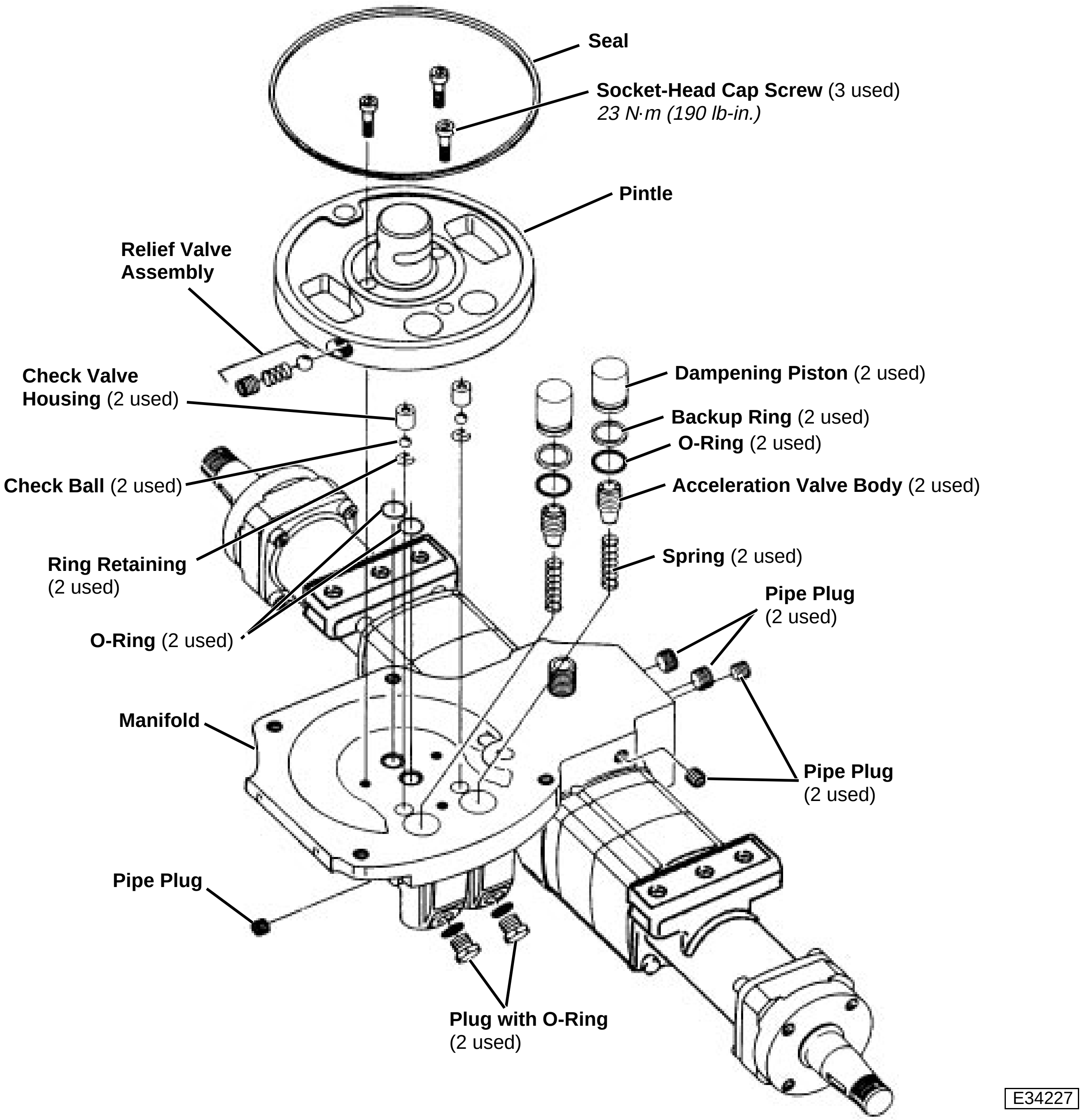
E35414

1. Tap holes in check valve housings using a 5/16-18 NC tap.
2. Pull check valve housings from manifold using a 5/16-18 cap screw.
3. Remove check balls and retaining rings.
4. Install new retaining rings and balls.

IMPORTANT: To prevent retaining rings from dislodging, do not DRIVE in check valve housings. Use a steady pushing motion.

5. Install new check valve housings.

Assembly


Seal
Socket-Head Cap Screw (3 used)
23 N·m (190 lb-in.)
Pintle
Relief Valve Assembly
Check Valve Housing (2 used)
Dampening Piston (2 used)
Backup Ring (2 used)
O-Ring (2 used)
Check Ball (2 used)
Acceleration Valve Body (2 used)
Spring (2 used)
Ring Retaining (2 used)
Pipe Plug (2 used)
O-Ring (2 used)
Manifold
Pipe Plug (2 used)
Pipe Plug
Plug with O-Ring (2 used)
E34227

1. Before assembling the transaxle, clean all parts with clean solvent and blow dry with low pressure compressed air. Replace all seals. Lubricate the seals with petroleum jelly for seal retention lubrication during assembly. Lubricate bearings and finished part surfaces with clean hydraulic fluid to provide lubrication at start-up.
2. Support and secure manifold with pump mounting surface up.

IMPORTANT: Tapered end of both acceleration valves must point downward toward manifold.

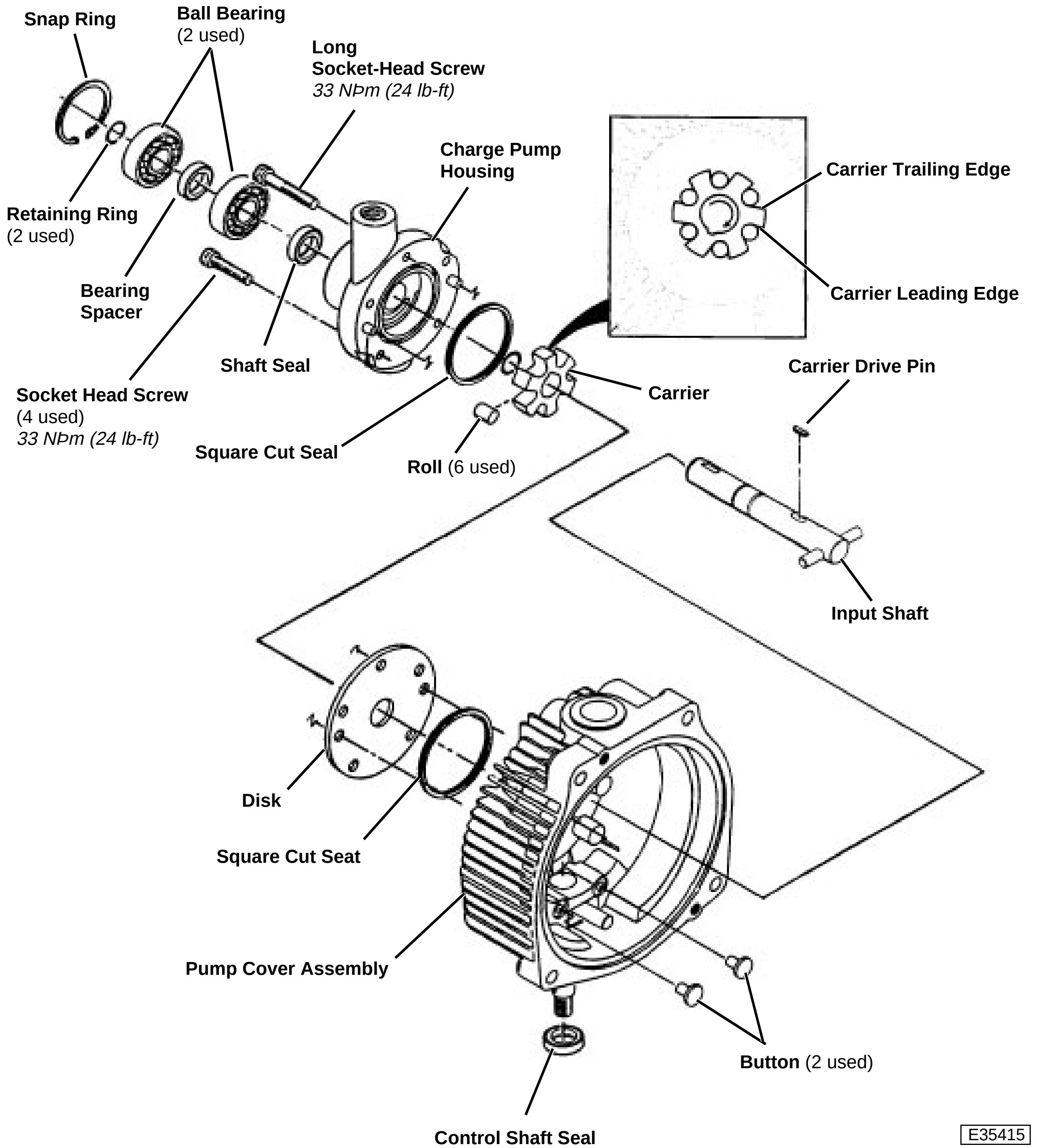
3. Install two acceleration valve springs and two acceleration valve bodies in manifold bores.

IMPORTANT: Back-up ring must be located next to longer end of dampening piston.

4. Install O-ring and back-up ring on dampening pistons.
5. Install dampening pistons. Make sure end with O-ring is toward manifold.
6. Apply petroleum jelly to O-ring and install in counterbore located in face of manifold.
7. Install ball, spring, and plug of relief valve assembly. Install plug until just below surface of pintle. Do not tighten plug.

IMPORTANT: When installing pintle assembly, be extremely careful not to dislodge two O-ring seals from counterbores in manifold.

8. Align pintle assembly with dampening pistons and install pintle assembly on manifold. Tighten socket head screws to **23 N·m (190 lb-in.)**
9. Install large seal around pintle assembly.



IMPORTANT: Be carefully not to damage inner portion of seal. Excessive pressure or driving of seal will damage rubber portion of seal.

10. Lubricate inside diameter of new shaft seal with clean lubricant. Then press or tap seal in bore until completely seated.
11. Install input shaft in cover assembly and hold in place.
12. Install new seal in groove of cover. Install pump disk.
13. Install carrier drive pin in keyway of input shaft.

IMPORTANT: For correct carrier rotation, leading edge of carrier must rotate in clockwise direction.

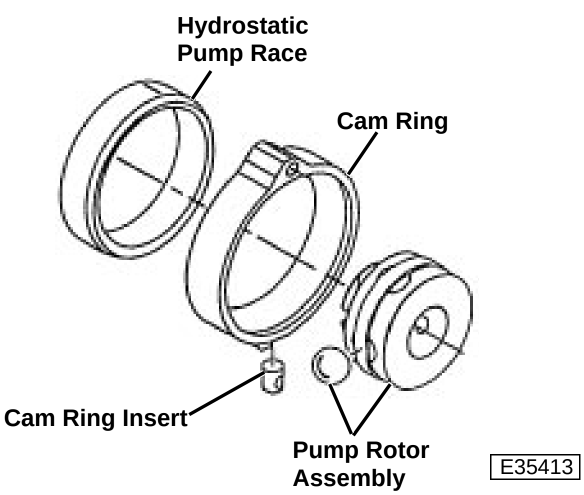
14. Install carrier over input shaft with marked side up. Make sure carrier keyway fits over carrier drive pin.
15. Install six carrier rolls in carrier. Use small amount of petroleum jelly to hold rolls in place.

IMPORTANT: Excessive pressure on seal could damage rubber sealing portion or distort housing counterbore.

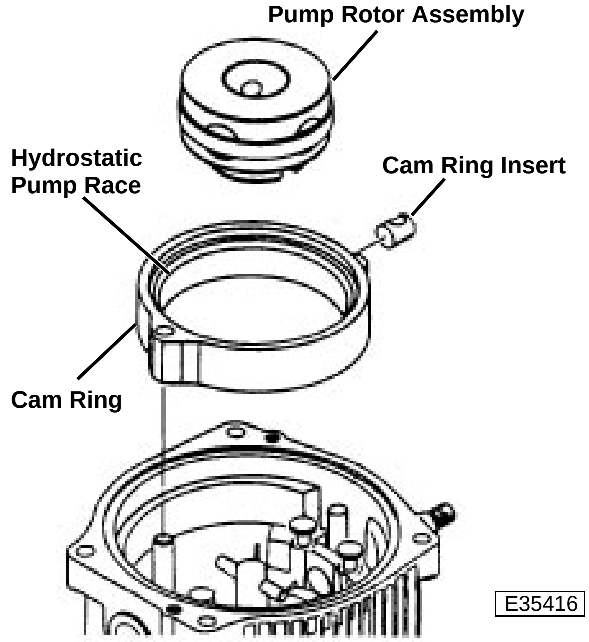
16. Install new shaft seal in charge pump housing with seal lip into bore first. Make sure seal is tight against bottom of bore.
17. Install new seal in pump housing.

IMPORTANT: If elbow fitting was removed from pump housing inlet, install elbow before installing pump housing.

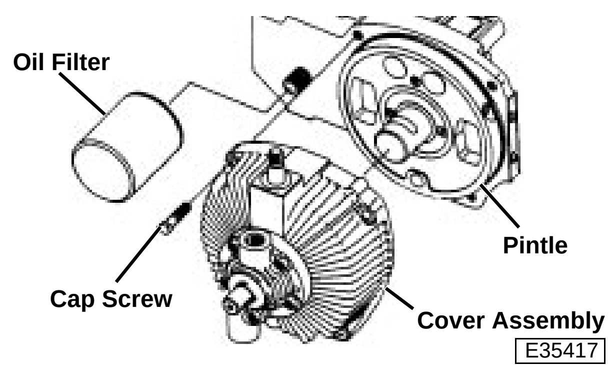
18. Align charge pump dowel pins with holes in cover. Protect shaft seal lip from keyways and retaining ring grooves. Guide pump over shaft, carrier and rolls until pins engage holes.
19. Install socket head screws. Install long socket head screw in thicker section of charge pump housing. Tighten screws to **33 N·m (24 lb-ft)**.
20. Install lower retaining ring in lower groove of input shaft.
21. While supporting bottom of input shaft, install bearings and spacer. Push lower bearing tight against lower retaining ring.
22. Install upper retaining ring and snap ring. Check input shaft for free rotation. If rotation is not smooth or stiff, check assembly.
23. Install two buttons.



24. If removed, use a press to install hydrostatic pump race in cam ring. Top of race must be flush with top of cam ring.
25. Install cam ring insert with hole of insert farthest away from cam ring.



26. Install cam ring assembly with the flush side into the cover first. Align cam ring with pins in cover and push ring all the way into cover.
27. Check cam ring for free movement from stop to stop. If binding occurs, remove cam ring, rotate 180° and install cam ring. Check for free movement again.
28. Make sure each ball is installed in matching bore of pump rotor.
29. Align slot in pump rotor assembly with input shaft cross pin. Install rotor assembly on shaft. Remove rubber band after rotor assembly is installed in cover.

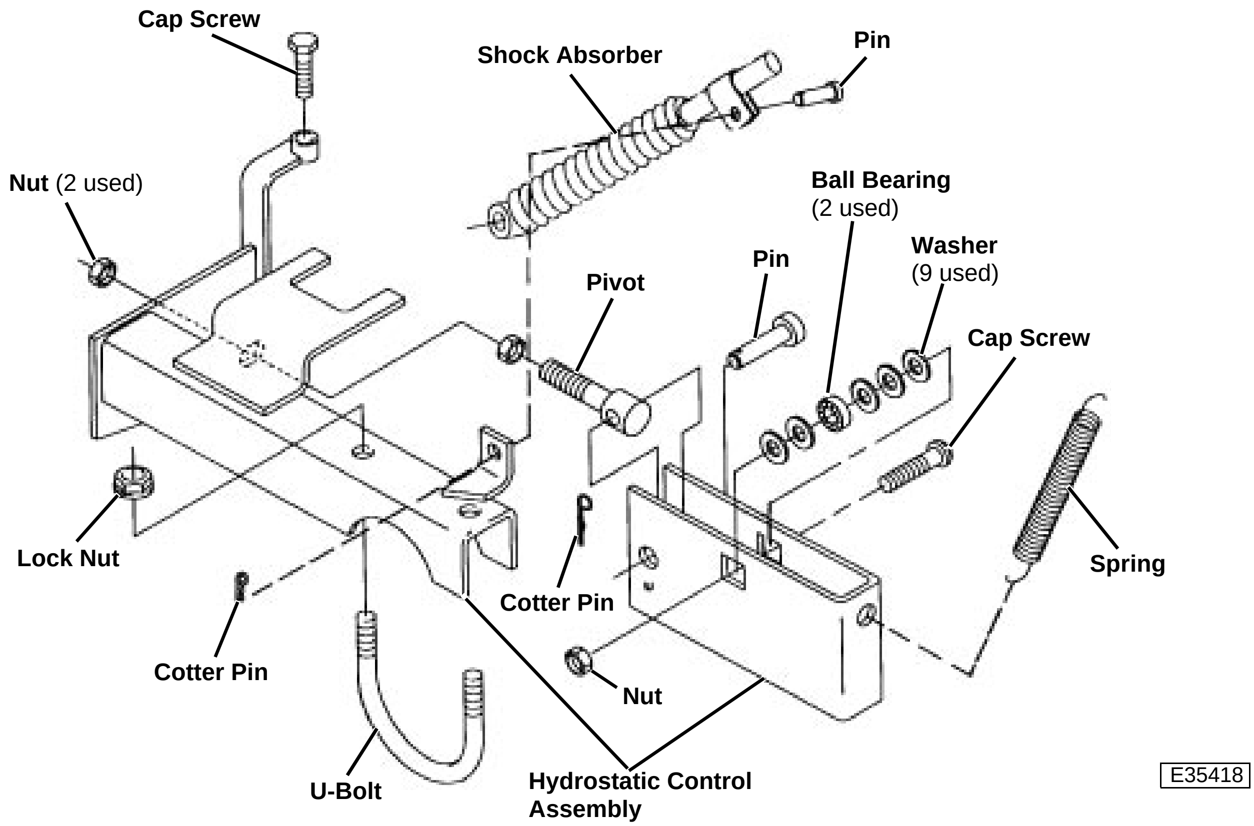


IMPORTANT: DO NOT force cover assembly onto manifold assembly. Pump rotor-to-pintle journal is a slip fit.

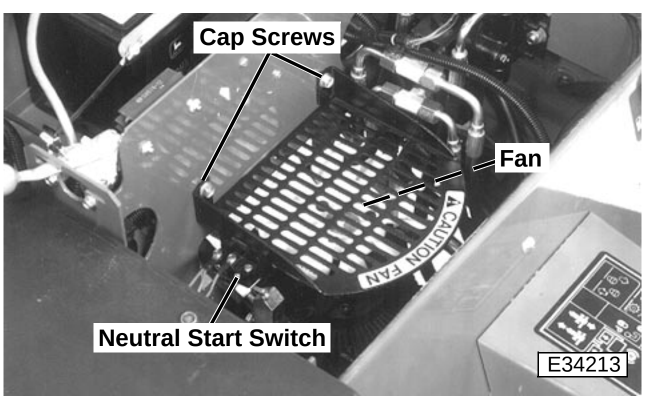
30. Align cam ring pivot pin in cover assembly with hole in pintle. Install cover assembly on pintle.
31. Install and tighten four cap screws to **27 N·m (20 lb-ft)**.
32. Apply a thin film of clean hydrostatic oil to seal of new oil filter. Install filter hand tight.

HYDROSTATIC TRANSAXLE CONTROL LINKAGE

Removal/Inspection/Installation



1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)



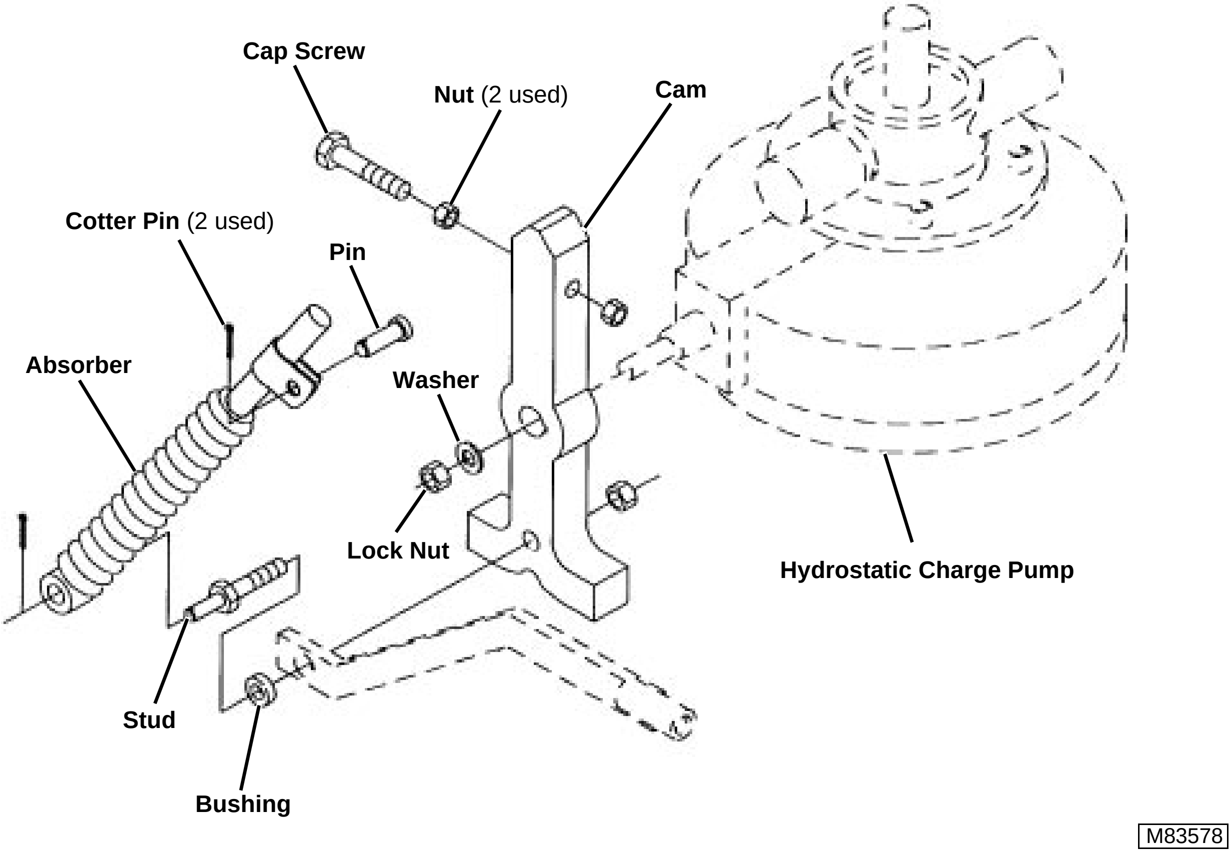
2. Remove neutal start switch from shield.
3. Remove cap screws to remove shield.
4. Remove center cap screw to remove fan.
5. Remove spring, absorber pin, cap screw and U-bolts.
6. Remove hydrostatic control assembly.
7. Remove cap screw, nut, washers and bearing.
8. Inspect all parts for wear or damage. Replace parts as necessary:
   - Inspect hydrostatic control assembly for cracks, distortion or wear.
   - Inspect ball bearing, bearing must roll smoothly.

Installation is done in the reverse order of removal.

- Adjust travel/neutral switch. (See TRAVEL/NEUTRAL SWITCH ADJUSTMENT on page 4-226.)
- Adjust hydrostatic control linkage. (See HYDROSTATIC TRANSAXLE CONTROL LINKAGE ADJUSTMENT on page 5-22.)

PUMP CENTERING CAM

Removal/Inspection/Installation

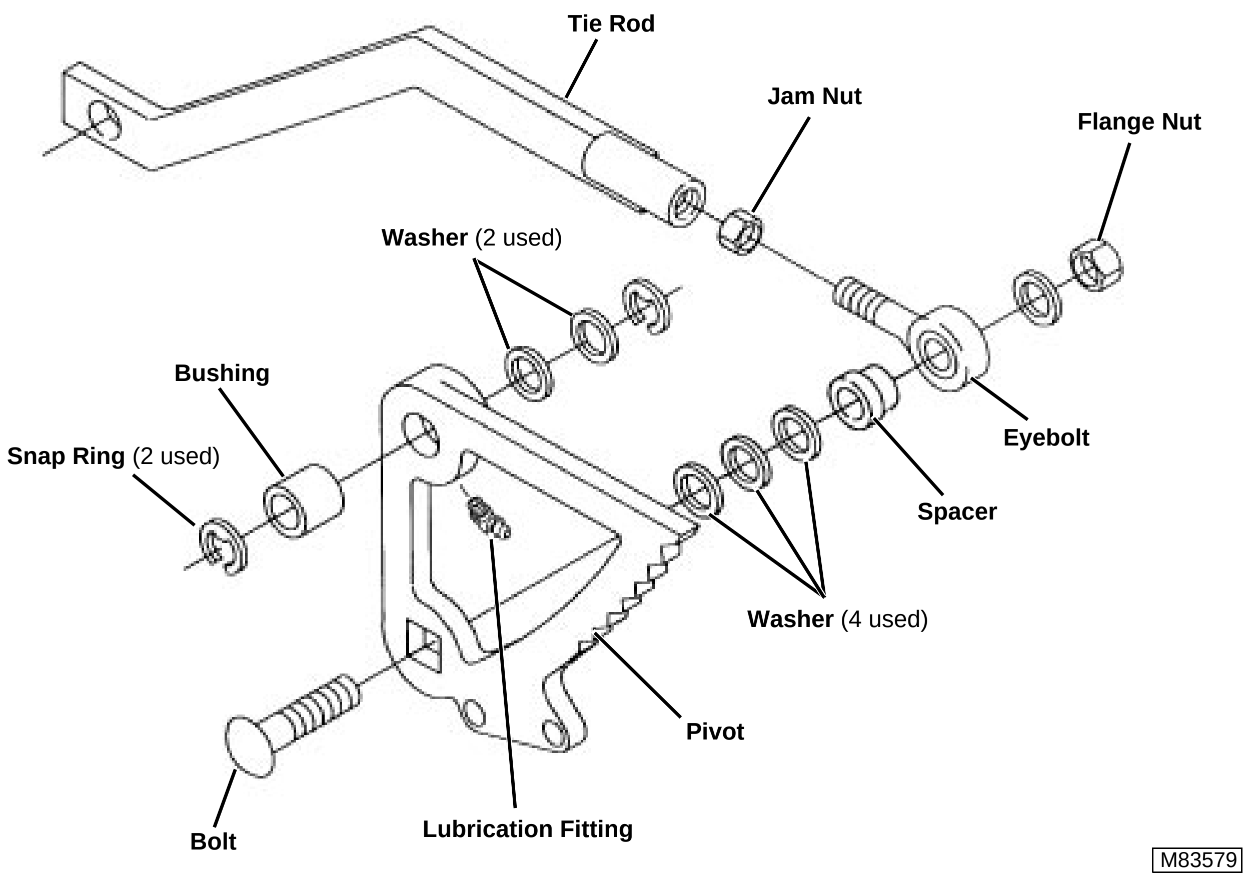


Inspect all parts for wear or damage. Replace parts as necessary.

Installation is done in the reverse order of removal.

FOOT CONTROL

Removal/Inspection/Installation

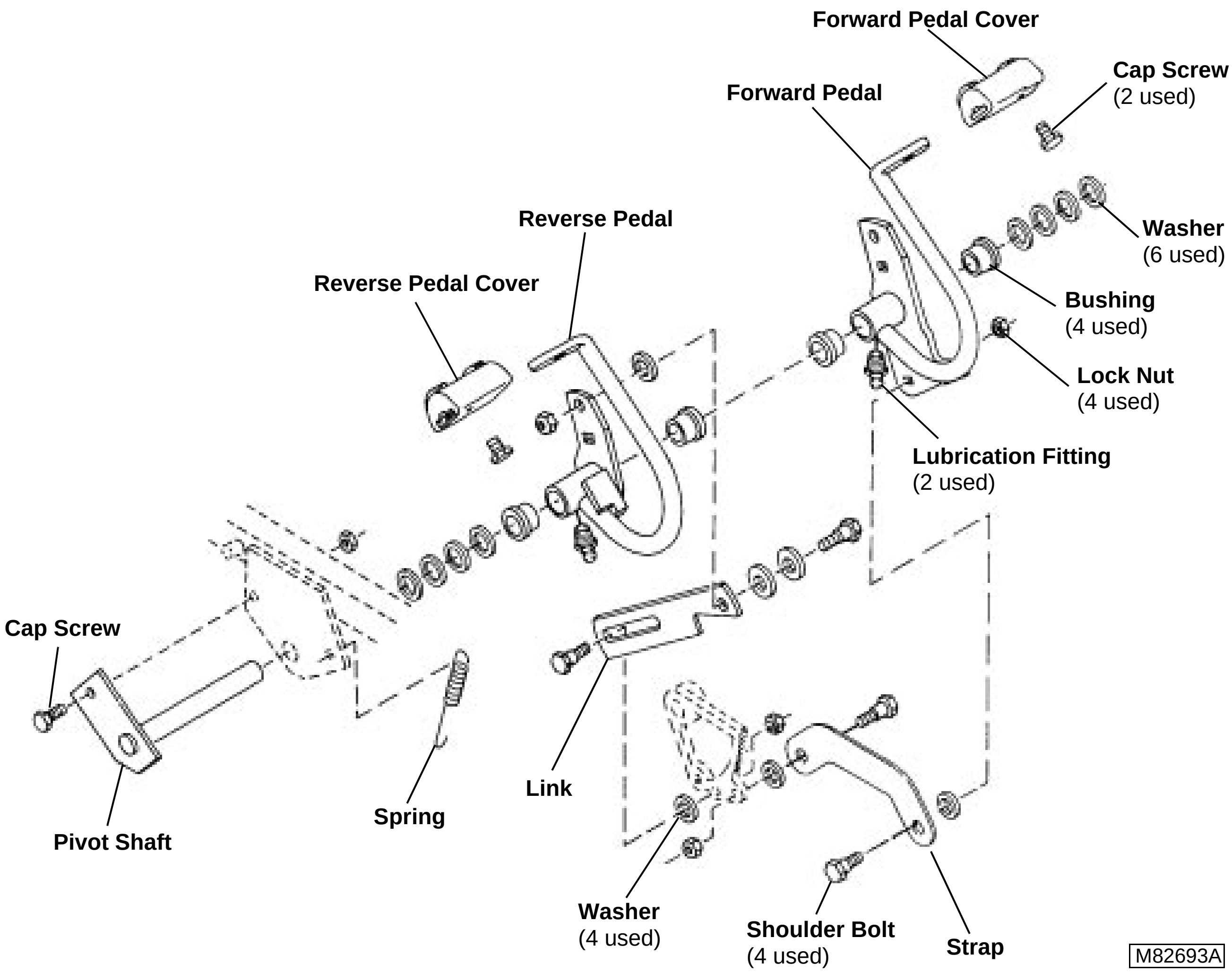


Inspect all parts for wear or damage. Replace parts as necessary.

Installation is done in the reverse order of removal.

FORWARD/REVERSE TRAVEL PEDALS

Removal/Inspection/Installation



Remove:

- Hose cover
- Right foot platform.

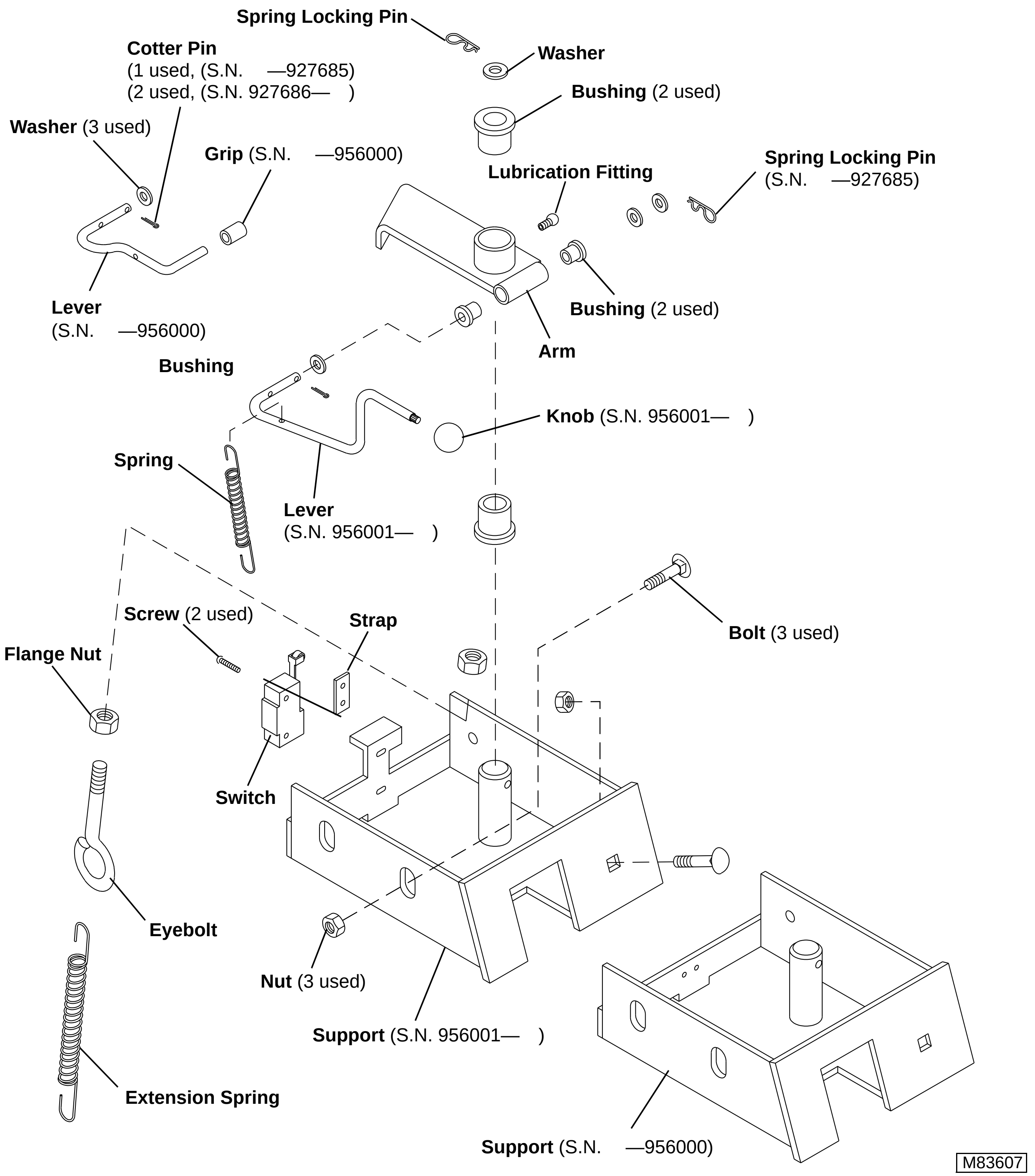
Inspect all parts for wear or damage. Replace parts as necessary.

Installation is done in the reverse order of removal.

- Apply multipurpose grease to pivot shaft and lubrication fittings.

MOW/TRANSPORT LEVER LINKAGE

Removal/Inspection/Installation



1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Inspect all parts for wear or damage. Replace parts as necessary.

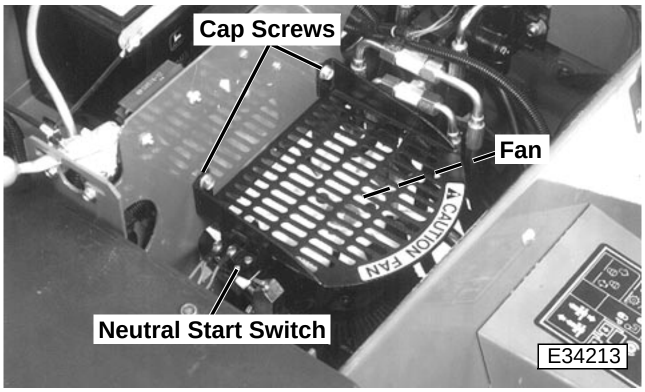
Installation is done in the reverse order of removal.

- Adjust mow/transport switch. (See MOW/TRANSPORT SWITCH ADJUSTMENT on page 4-226.)

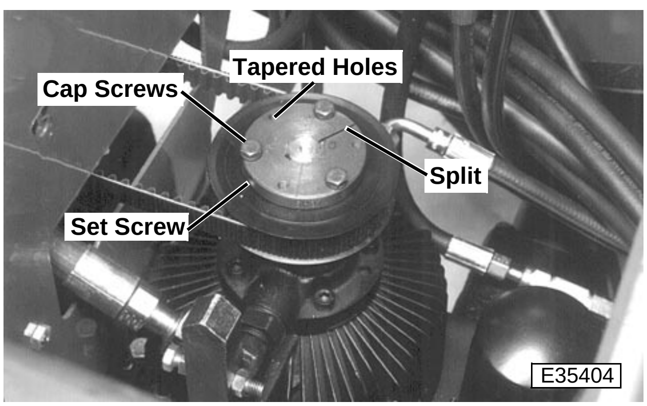
TRANSAXLE DRIVE SHEAVE

Removal

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)



6. Remove neutal start switch from shield.
7. Remove cap screws to remove shield.
8. Remove center cap screw to remove fan.
9. Remove hydrostatic drive belt. (See DRIVE BELTS—Replacement on page 5-46.)



10. Remove cap screws and install in tapered holes in bushing flange. Turn cap screws against sheave to brake tapered bore grip.

IMPORTANT: If the bushing is tight on shaft it can be loosened by carefully inserting a small wedge or screwdriver in spilt part of flange. Excessive wedging may break bushing.

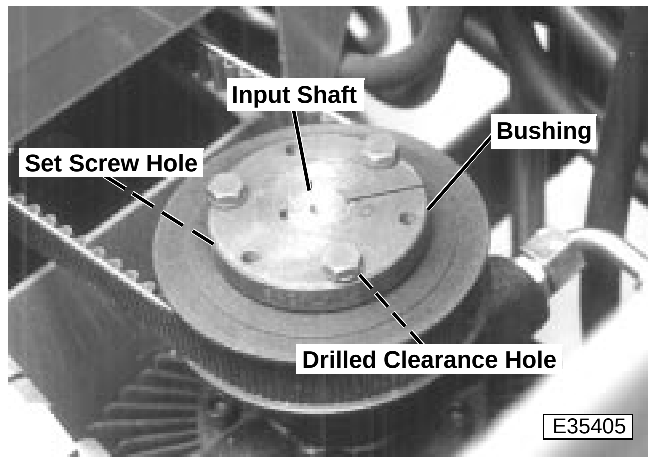
11. Loosen set screw and slide bushing from shaft.

Installation

IMPORTANT: DO NOT tap on pump shaft or bushing as pump damage may result.

IMPORTANT: DO NOT use anti-seize lubricant on shaft or tapered bore surfaces as damage to bushing and/or sheave may occur.

NOTE: Be sure shaft and tapered bore surfaces are free of paint, grease and dirt.



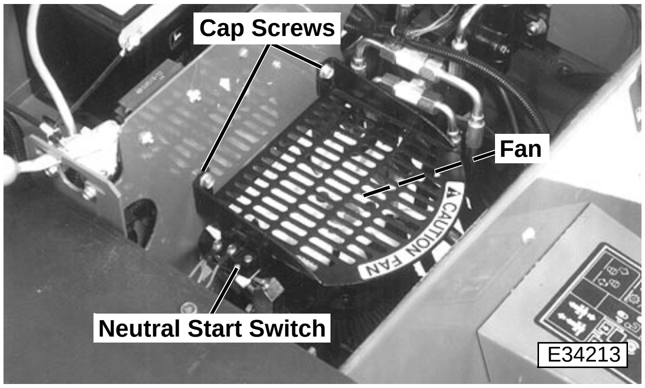
1. Install sheave on pump shaft with large tapered bore end up.
2. Install key in shaft. Install bushing on shaft with top of bushing flange flush with top of shaft.

IMPORTANT: DO NOT use excessive force when tightening set screw.

3. Install set screw in hole and tighten against shaft.
4. Install cap screws in bushing flange drilled holes and tapped holes in sheave and tighten to FINGER-TIGHT ONLY while holding sheave and bushing together

NOTE: The bushing should seat deeply in the sheave tapered bore. If the bushing does not seat correctly, reverse the above steps and turn sheave over.

5. Tighten cap screws evenly and in a criss-cross pattern to **12 N•m (180 lb-in.)**. There must be a gap between the sheave and bushing flange to insure satisfactory tapered bore and press fit.
6. Install hydrostatic drive belt. (See DRIVE BELTS—Replacement on page 5-46.)

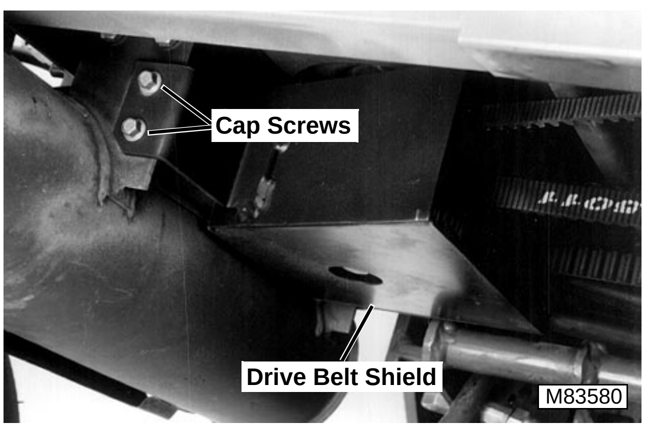


7. Install fan, drive belt shield and neutral start switch.
8. Install seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)

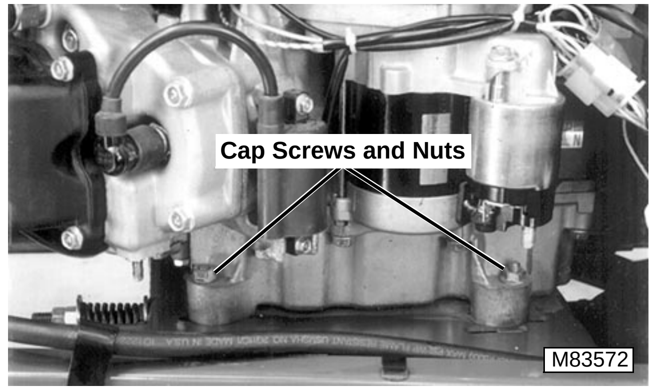
DRIVE BELTS

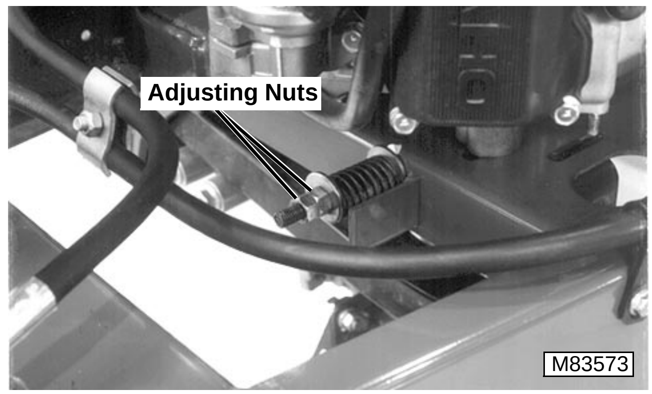
Replacement

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch OFF.
6. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)

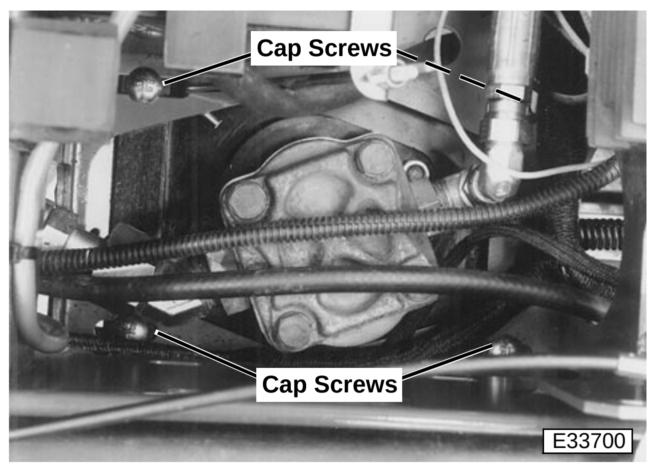


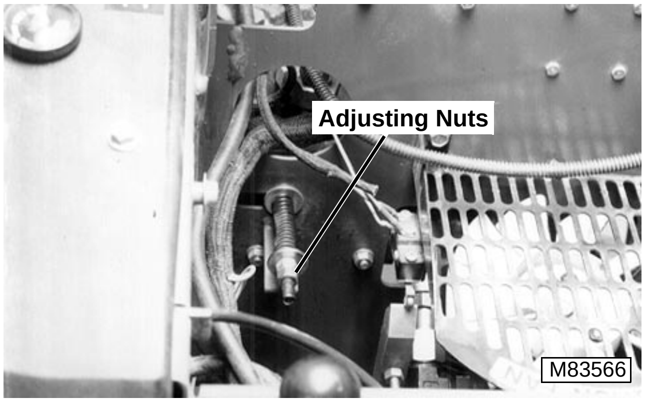
7. Remove four cap screws to remove drive belt shield.





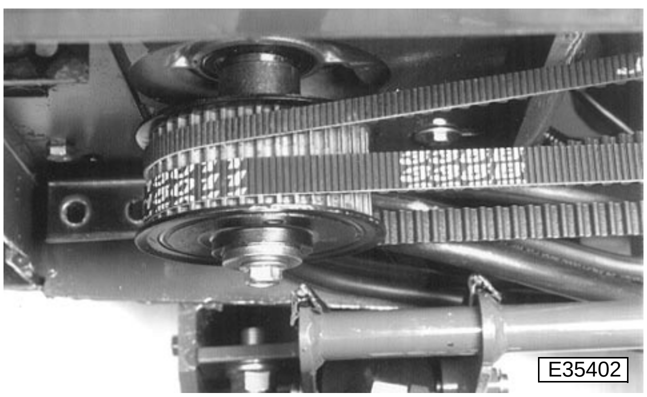
8. Loosen four engine cap screws and adjusting nuts. Engine should be free to move back and forth, but not tip. Move engine as far forward as possible.





NOTE: Hydraulic pump sheave shield can be removed to gain access to pump cap screws and nuts.

9. Loosen four hydraulic pump cap screws and nuts and adjusting nuts. Pump should be able to move back and forth, but not tip. Move pump as far rearward as possible.



IMPORTANT: For maximum belt life, handle and install positive drive belts with care. Follow the instructions below to prevent damage to the belt tensile members.

- **DO NOT twist belt.**
- **DO NOT back bend belt.**
- **DO NOT crimp belt.**
- **DO NOT store on hook.**

10. Remove belts.

IMPORTANT: DO NOT use tools to pry belts over side of sprockets. Damage to belts may occur.

11. Install 10 mm (13/32 in.) wide hydraulic pump drive belt first, then install 16 mm (5/8 in.) wide hydrostatic drive belt.
12. Adjust drive belt. (See DRIVE BELT ADJUSTMENT on page 5-21.)

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CONTENTS

SPECIFICATIONS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydraulic Oil Operating Temperature . . . . 43°C (110°F)
Steering Valve Relief Valve Setting . . . . 5000 kPa (725 psi)

REPAIR SPECIFICATIONS

Steering Wheel-to-Shaft Nut Torque . . . . 38 N•m (28 lb-ft)
Rotor-to-Stator Clearance (Maximum) . . . . 0.08 mm (0.003 in.)
Steering Column Bushing Depth (Below Top Of Tube) . . . . 2.5 mm (0.100 in.)
Commutator Cover Cap Screw Torque . . . . 1.4 N•m (12 lb-in.)
Relief Valve Plug Torque . . . . 14 N•m (124 lb-in.)
Steering Cylinder Rod Eye Torque . . . . 15 N•m (133 lb-in.)

SPECIAL OR ESSENTIAL TOOLS

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

JT03345 20000 kPa (3000 psi) Pressure Gauge
Used to read steering valve relief pressure when performing Steering Relief Valve Test.

JT03421 9/16 M 37° x 11/16 F ORFS Adapter Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

JT03017 Hose Assembly
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

203836 9/16 m 37° M x 9/16 F 37° Tee Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

JT03005 1/2 F NPT X 9/16 F 37° Adapter Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

JT03242 1/2 M NPT x 7/8 F 37° Adapter Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

JTO3056 7/8 M 37° x 9/16 F ORB Adapter Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting
Used to connect JT03345 pressure gauge when performing Steering Relief Valve Test.

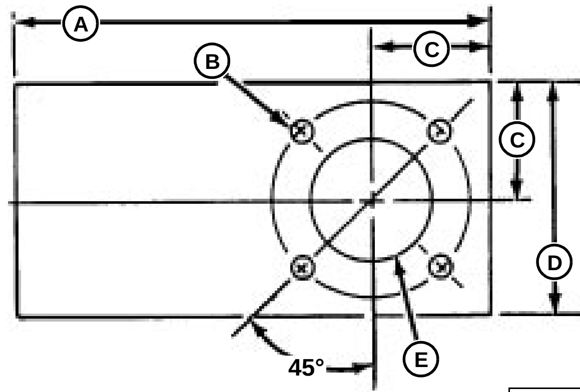
DEALER FABRICATED TOOLS

DFMX3A Steering Valve Fixture

Steering valve fixture is used to hold steering valve during servicing.

Material required: One piece of 5 x 102 x 203 mm (3/16 x 4 x 8 in.) 1020 mild steel flat stock.

Holes (B) are equally spaced on an 83 mm (3.250 in.) diameter circle.



M36877

A— 203 mm (8.0 in.)
B— 9.5 mm (0.375 in.) Diameter Hole (4)
C— 51 mm (2.0 in.)
D— 102 mm (4.0 in.)
E— 51 mm (2.0 in.) Diameter Hole

DFMX4A Alignment Shims

Alignment shims are used to align steering valve metering assembly with drive plates during assembly.

Material required: Six pieces of 13 x 38 mm (1/2 x 1-1/2 in.) 0.18 mm (0.007 in.) shim stock.

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS U.S./ Canadian/ LOCTITE No.		
TY6305/ TY9485/ 764	Clean and Cure Primer	Cleans parts and speeds cure of sealant.
TY9369/ NA/ 222	Thread Lock and Sealer (Low Strength)	Retain metering assembly screws.
T43512/ TY9473/ 242	Thread Lock and Sealer (Medium Strength)	Retain rod eye on steering cylinder.

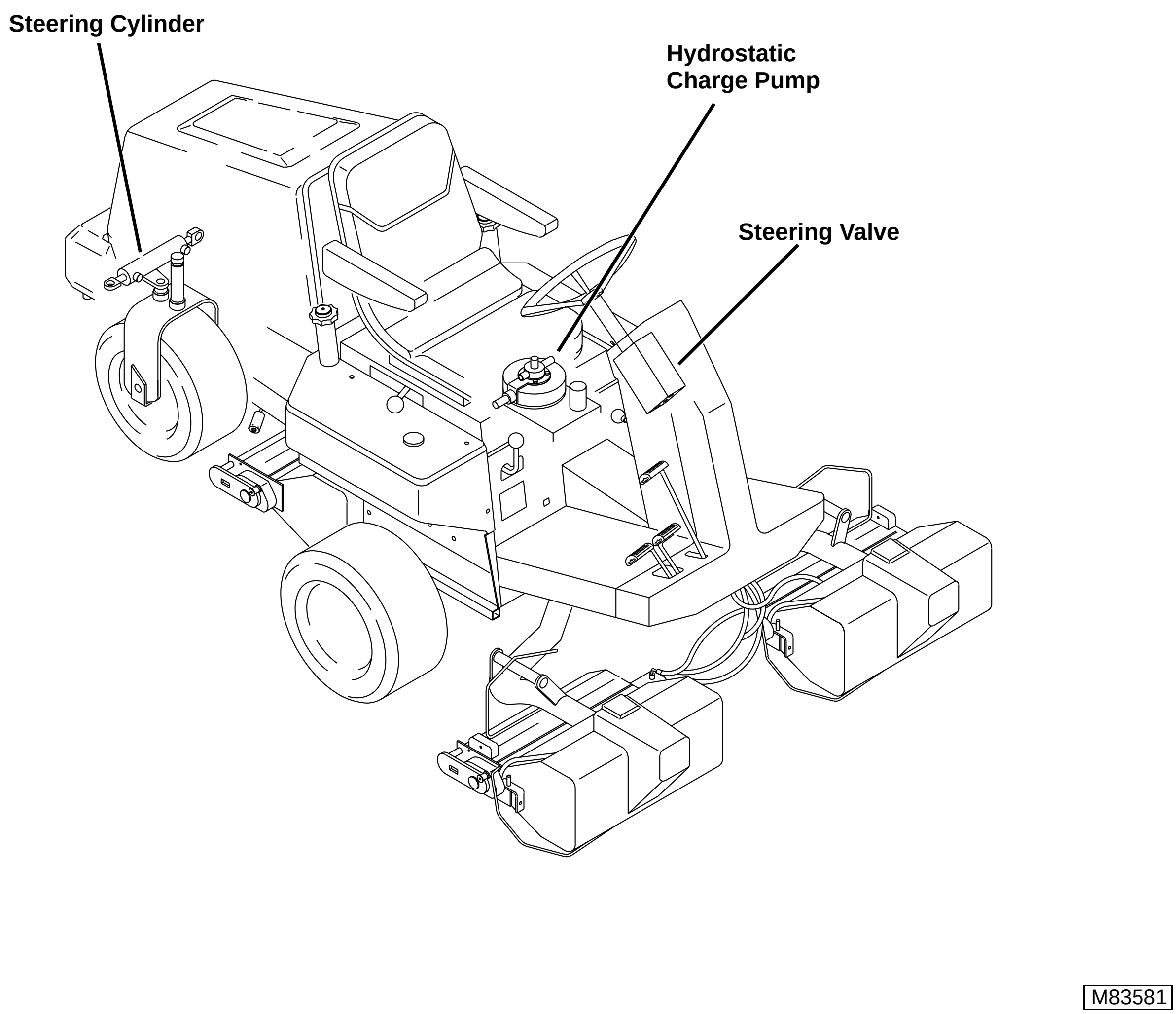
SERVICE PARTS KITS

The following kits are available through your parts catalog:

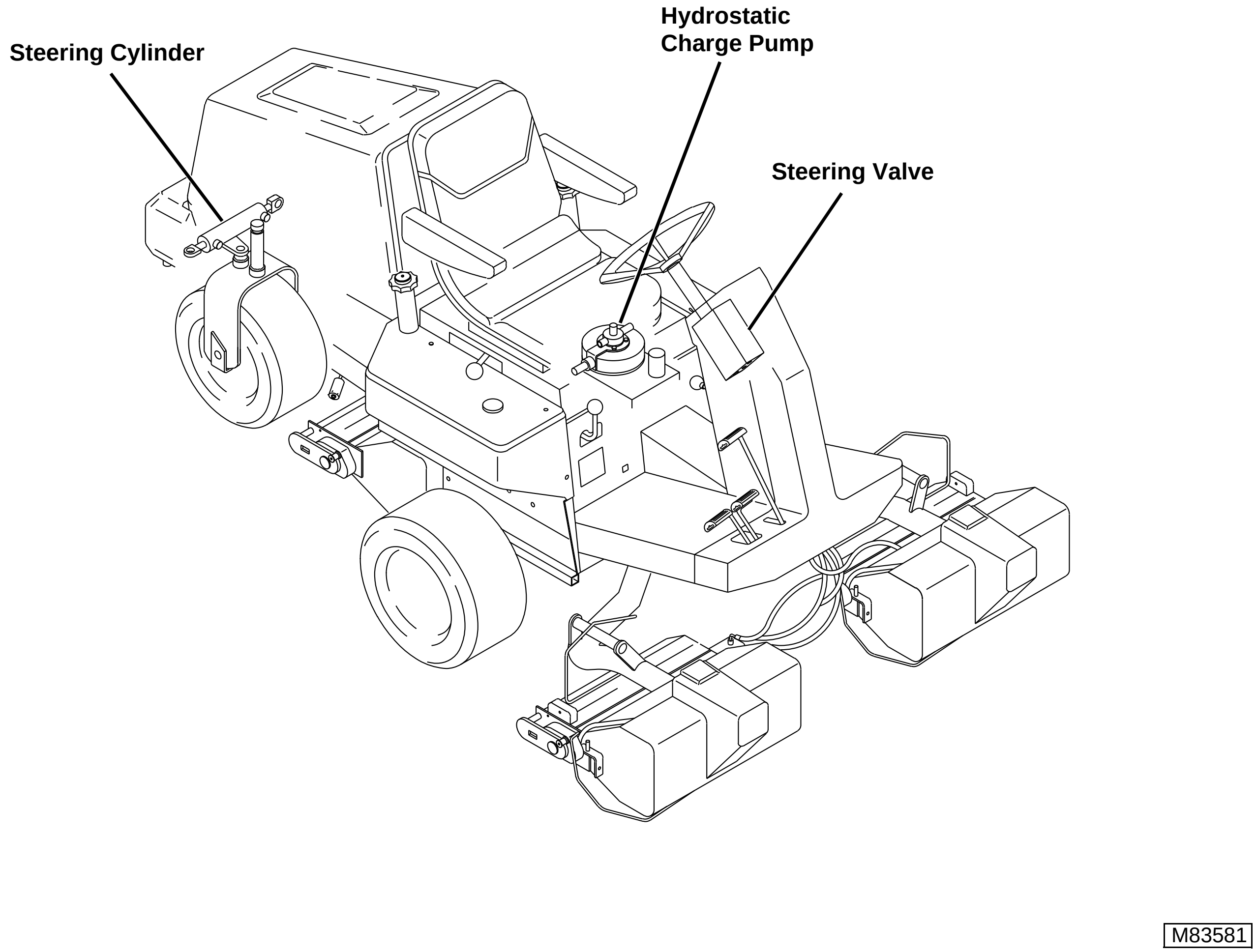
- Steering Valve Seal Kit
- Steering Valve Spring Kit
- Steering Valve Needle Roller Kit
- Steering Cylinder Seal Kit

COMPONENT LOCATION AND OPERATION

STEERING SYSTEM COMPONENT LOCATION



STEERING SYSTEM OPERATION



Function:

Offer hydraulic steering for ease of operation.

Theory of Operation:

The hydrostatic charge pump takes filtered oil from the reservoir and pressurizes it. Pressurized oil is supplied to the steering valve. As the steering wheel is turned, the steering valve distributes oil through pressure hoses and to the steering cylinder as needed.

Under neutral steering conditions (no steering wheel movement) pressurized oil is routed to the steering valve “IN” port. In this position no oil is being used by the steering system, allowing full pressure available to the steering valve “AUX” port for use by the cutting unit lift system. Oil passing through the steering valve and exiting the “OUT” port is routed to the hydrostatic charge pump to provide “make-up” oil if needed. (See STEERING VALVE OPERATION—NEUTRAL on page 6-6 for further information.

When the steering wheel is turned, pressurized oil is routed through the steering valve to the steering cylinder through the pressure hoses. The steering cylinder converts the hydraulic pressure to mechanical movement to turn the wheel as desired. As the steering wheel is turned the volume of oil available at the “AUX” port varies in response to the requirements of the steering system. (See STEERING VALVE OPERATION—POWER TURN on page 6-7 for further information.)

STEERING VALVE OPERATION—NEUTRAL

Function:

To block pressurized oil flow to the steering cylinder when no turning action is desired. A secondary function is to control oil flow to the cutting unit lift system through the "AUX" port.

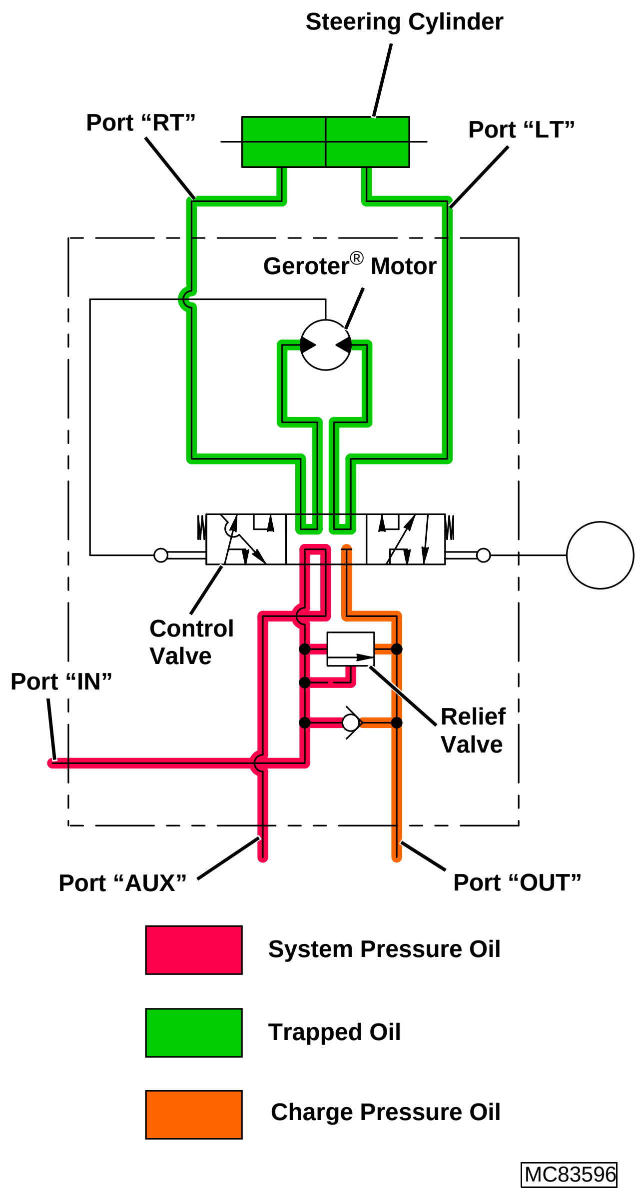
Theory of Operation:

All oil flow produced by the hydrostatic charge pump is routed to the steering valve. The steering valve is an open center type valve. The design (5-line) steering valve provides "power beyond" to cutting unit lift valves only after satisfying steering valve needs.

The steering valve consists of a self-centering fluid control valve section and a Geroter® motor section. These are hydraulically and mechanically interconnected inside the unit.

Whenever the steering wheel is not moving, the steering valve moves to the neutral position. In this position, system oil entering the steering valve through port "IN" is allowed to flow through the control valve and out port "AUX". In this position the control valve is blocking pressurized oil from entering the Geroter, and stops oil flow from cylinder to the port "OUT". As the oil exits the "OUT" port of the steering valve oil is considered as "make-up oil" for the hydrostatic charge 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 oil flow will give the operator a feel of any steer wheel direction change because of the mechanical connection between the metering section and steering wheel.



Geroter® is a registered trademark of the EATON Corporation.

STEERING VALVE OPERATION—POWER TURN

Function:

Supply pressurized oil to the proper side of the steering cylinder to turn the wheel, when the engine is running.

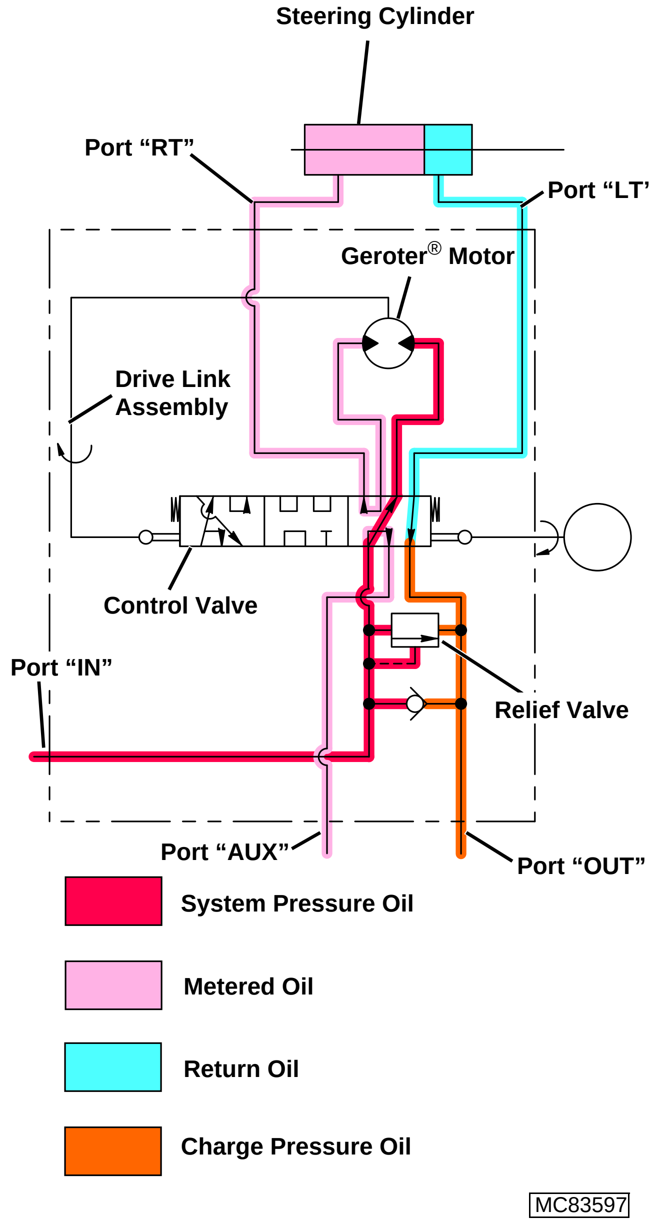
Theory of Operation:

NOTE: Right-hand turn shown.

As the steering wheel is turned to the right, the control valve is shifted by the drive link assembly. This shifting opens the steering cylinder ports “LT” and “RT”. Oil flow to the “AUX” port is reduced giving the steering valve priority over the cutting unit lift system components. Flow is sufficient enough to raise or lower cutting units for tight maneuvering situations.

Oil flows from port “IN” directly to the inlet of the metering section, Geroter®motor. As the steering wheel is turned, system oil is forced through the Geroter, motor and control valve. Metered oil is routed to port “RT” and the right side of the steering cylinder. Return oil from the other end of the cylinder is routed back to port “LT” through the control valve and “OUT” port. As the oil exits the “OUT” port of the steering valve oil is considered as “make-up oil” for the hydrostatic charge pump.

If the steering wheel is held against stop, the relief valve opens at 5000 kPa (725 psi) and sends oil to the “OUT” port. At this time there is not enough oil flow to the “AUX” port to lift or lower the cutting units.



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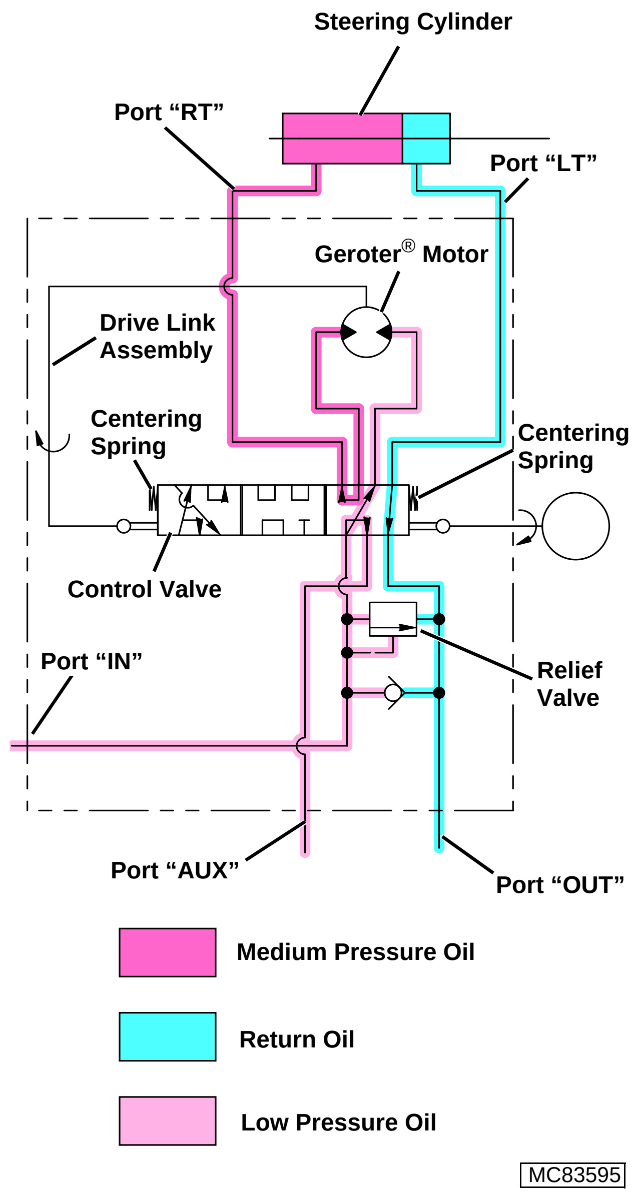
STEERING VALVE OPERATION—MANUAL TURN



Function:

To provide manual steering if hydraulic pressure is not available.

Theory of Operation:

NOTE: Right-hand turn shown.

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 Geroter® motor and check valve. The Geroter motor now acts as a pump moving oil from one side of the Geroter to the other as the steering wheel is moved. The check valve opens allowing oil to be drawn from the return side of the steering cylinder. Hydraulic oil is forced by the Geroter motor, to either end of the steering cylinder, depending on which way the steering wheel is turned.

When the rotation of the wheel stops, the centering springs move the valve plate back to the center (neutral) position, and will remain there until the steering wheel is moved again.

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STEERING CYLINDER OPERATION

Function:

To convert applied hydraulic pressure to mechanical motion to turn the wheel.

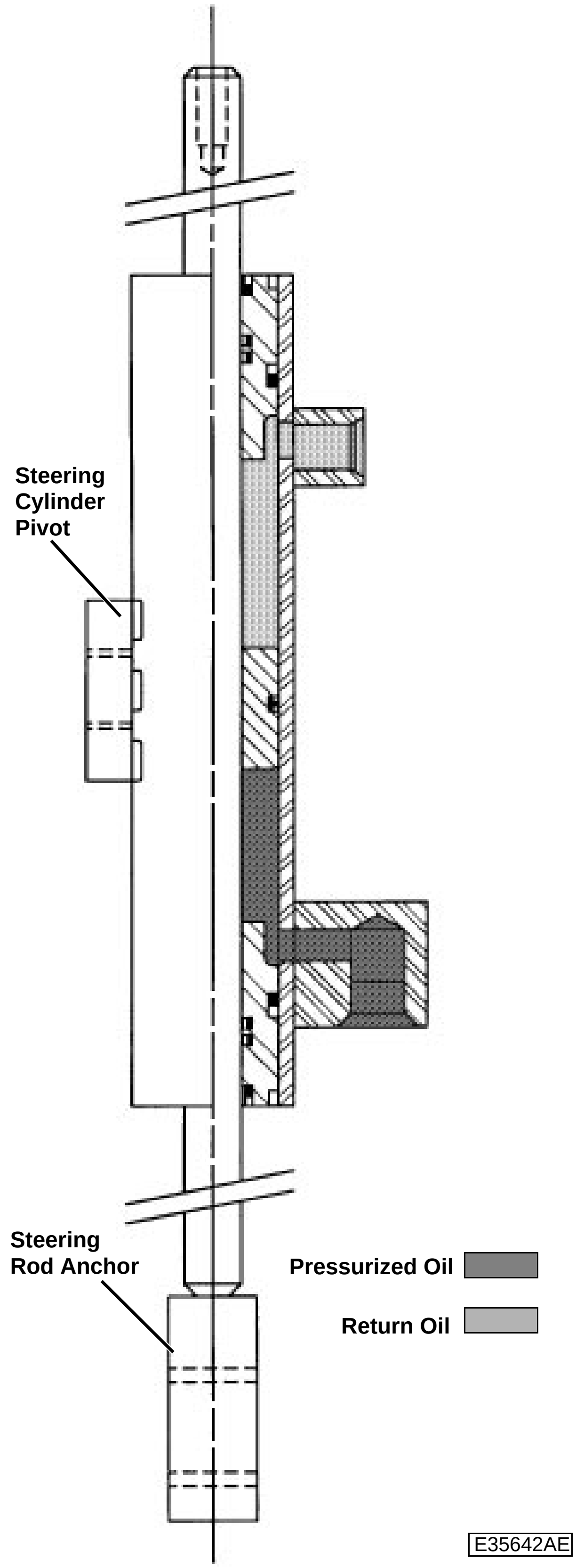
Theory of Operation:

The steering cylinder is a double acting, double rod end design.

One end of the rod is attached to the frame which prevents the cylinder from moving. The cylinder is attached to the steering wheel clevis at the pivot.

As pressurized oil enters the cylinder, the steering cylinder moves because the rod and piston assembly is attached to the frame. The cylinder movement pivots the steering wheel clevis causing the machine to turn.

To turn in the other direction, pressurized oil is applied to the other port, moving the cylinder in the opposite direction.



TROUBLESHOOTING

STEERING SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Steering wander.	High steering effort in one direction.	High steering effort in both directions.	Lash (lost motion) at steering wheel.								
Loose or worn steering cylinder ends.	●											
Worn wheel bearings or steering clevis bearing.	●											
Leakage past steering cylinder piston.	●											
Low oil level.		●	●									
Low hydraulic pressure. Inspect hydraulic pump.		●										
Excessive oil heat causes valve plate to stick. (See “oil overheats” in HYDRAULICS section.)		●										
Steering cylinder ends binding.			●									
Steering clevis binding.			●									
Restriction in oil return hose.			●									
Steering wheel loose on column.				●								
Steering linkage loose or worn.				●								
Steering valve loose.				●								
Air in hydraulic system.				●								

DIAGNOSIS

STEERING WANDER

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Tires.	Correct size and pressure.	Inflate to correct pressure. (See Operator's Manual for correct pressure.)
2. Rear wheel.	Bearings clean and not worn.	Replace bearings. (See REAR WHEEL—Disassemble/Assemble Hub on page 10-3.)
3. Steering cylinder.	No internal/external oil leakage.	Test steering system. (See STEERING CYLINDER LEAKAGE TEST on page 6-18.)
4. Steering valve.	No internal/external oil leakage.	Test steering system. (See STEERING VALVE LEAKAGE TEST on page 6-17.)
5. Steering spindle.	Bushings clean and not worn.	Replace bushings and/or spindle. (See STEERING CLEVIS on page 6-36.)

STEERING SHIMMY

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Wheels.	Properly mounted and secure.	Repair.
2. Rear wheel.	Bearings clean and not worn.	Replace bearings. (See REAR WHEEL—Disassemble/Assemble Hub on page 10-3.)
3. Steering spindle.	Bushings clean and not worn.	Replace bushings. (See STEERING CLEVIS on page 6-36.)
4. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

SLUGGISH STEERING RESPONSE

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
2. Steering cylinder.	No internal/external oil leakage.	Test steering system. (See STEERING CYLINDER LEAKAGE TEST on page 6-18.)
3. Steering valve.	No internal/external oil leakage.	Test steering system. (See STEERING VALVE LEAKAGE TEST on page 6-17.)
4. Pressure hoses from steering valve to steering cylinder.	No external oil leakage.	Test steering system. (See STEERING SYSTEM LEAKAGE TEST on page 6-17.)
5. Pressure hoses from steering valve to steering cylinder.	No sharp bends or restrictions.	Replace hoses.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position..
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
6. Steering valve—“IN” port.	Input pressure is at specified pressure at fast idle.	Test hydraulic pump pressure and flow. (See HYDROSTATIC CHARGE PUMP TEST on page 5-19.)
7. Steering valve—“IN” port.	Steering relief valve releases at specified pressure.	Test steering relief valve pressure. (See STEERING VALVE RELIEF VALVE TEST on page 6-19.)
8. Engine.	Slow idle—1550 ±75 rpm. Fast idle—3400 ±75 rpm.	Adjust engine idle speed. (See FAST IDLE SPEED ADJUSTMENT on page 3-31 and/or SLOW IDLE SPEED ADJUSTMENT on page 3-32.)

HIGH STEERING EFFORT IN ONE DIRECTION

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Steering cylinder.	No internal/external oil leakage.	Test steering system/steering cylinder. (See STEERING CYLINDER LEAKAGE TEST on page 6-18.)
	Cylinder rod not bent.	Replace cylinder.
2. Steering valve.	No external oil leaks or visible damage.	Test steering system/steering valve. (See STEERING VALVE LEAKAGE TEST on page 6-17.)
	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary. (See STEERING VALVE—Disassembly on page 6-23 and STEERING VALVE—Inspection on page 6-28.)
3. Steering spindle.	Free to rotate, lubricated.	Repair. (See STEERING CLEVIS on page 6-36.)
4. Pressure hoses from steering valve to steering cylinder.	No sharp bends or restrictions.	Replace hoses.

HIGH STEERING EFFORT IN BOTH DIRECTIONS

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Wheels.	Properly mounted and secure.	Repair.
2. Rear wheel.	Bearings clean and not worn.	Replace bearings. (See REAR WHEEL—Disassemble/Assemble Hub on page 10-3.)
	Properly inflated tire.	Inflate to correct pressure. (See Operator's Manual for correct pressure.)
3. Steering clevis.	Bushings clean and not worn.	Replace bushings. (See STEERING CLEVIS on page 6-36.)
4. Steering valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary. (See STEERING VALVE—Disassembly on page 6-23 and STEERING VALVE—Inspection on page 6-28.)
5. Steering cylinder.	Cylinder rod not bent.	Replace cylinder.
6. Pressure hoses from steering valve to steering cylinder.	No sharp bends or restrictions.	Replace hoses.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
7. Pressure hoses from steering valve to steering cylinder.	No external oil leakage.	Test steering system. (See STEERING SYSTEM LEAKAGE TEST on page 6-17.)
8. Steering valve.	No external oil leaks or visible damage.	Test steering system. (See STEERING VALVE LEAKAGE TEST on page 6-17.)
9. Steering valve—"IN" port.	Input pressure is at specified pressure at fast idle.	Test hydraulic pump pressure and flow. (See HYDROSTATIC CHARGE PUMP TEST on page 5-19.)
10. Engine.	Slow idle—1550 ±75 rpm. Fast Idle—3400 ±75 rpm.	Adjust engine idle speed. (See FAST IDLE SPEED ADJUSTMENT on page 3-31 and/or SLOW IDLE SPEED ADJUSTMENT on page 3-32.)

STEERING EFFORT IS ERRATIC

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
2. Pressure hoses from steering valve to steering cylinder.	No external oil leakage.	Test steering system. (See STEERING SYSTEM LEAKAGE TEST on page 6-17.)
3. Steering valve.	No external oil leaks or visible damage.	Test steering system/steering valve. (See STEERING VALVE LEAKAGE TEST on page 6-17.)
4. Steering cylinder.	No internal/external oil leakage.	Test steering system/steering cylinder. (See STEERING CYLINDER LEAKAGE TEST on page 6-18.)

WHEEL CONTINUES TO TURN AFTER STEERING WHEEL HAS STOPPED

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Steering valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary. (See STEERING VALVE—Disassembly on page 6-23 and STEERING VALVE—Inspection on page 6-28.)

LOST MOTION AT STEERING WHEEL

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
2. Steering valve.	Securely mounted.	Tighten mounting nuts.

CHECKS, TEST AND ADJUSTMENTS

MANUAL STEERING CHECK

Reason:

To check operation of the steering system with power removed.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Turn steering wheel full left and full right (wheel will turn hard).
7. Check wheel movement, wheel must move full left and full right.

M36949

Results:

- If wheel does not move completely, inspect steering valve check valve.

STEERING SYSTEM LEAKAGE TEST

Reason:

To check the steering system for internal leakage.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Engage park brake.
5. Heat hydraulic oil to **43°C (110°F)**. (See HYDRAULIC OIL WARM-UP PROCEDURE on page 8-35.)
6. Start engine and run at **slow idle (1550 ±75 rpm)**.

M82607

7. With steering wheel in a maximum right position, turn steering wheel to the right with a constant torque of **6.8 N•m (72 lb-in.)**.
8. Observe the number of rotations of the steering wheel that occurs in one minute.
9. Repeat the procedure for left-hand turn.

Results:

- If rpm is **greater than 6 rpm**, perform STEERING VALVE LEAKAGE TEST.

STEERING VALVE LEAKAGE TEST

Reason:

To check the steering valve and cylinder for internal leakage.

Procedure:

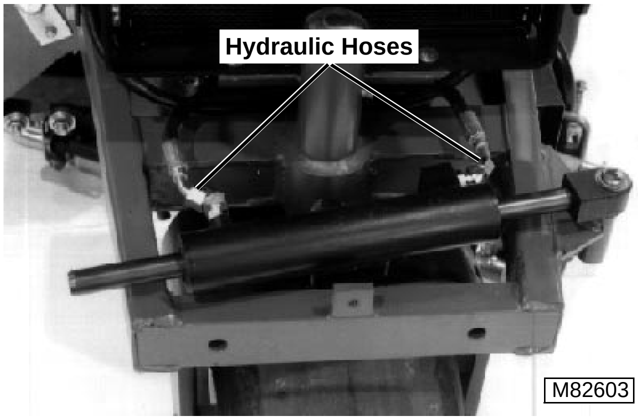
CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.

3. Lower cutting units to the ground.
4. Engage park brake.
5. Heat hydraulic oil to **43°C (110°F)**. (See HYDRAULIC OIL WARM-UP PROCEDURE on page 8-35.)
6. Stop engine.
7. Remove engine hood. (See ENGINE HOOD—Removal/installation on page 10-5.)

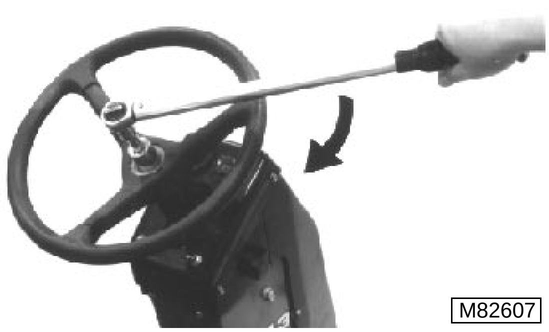


CAUTION

To avoid injury from escaping hydraulic oil under pressure, relieve the pressure in the system by stopping the engine and operating all hydraulic control valves.

IMPORTANT: O-Ring seal (ORS) plugs must be used to plug pressurized hydraulic hoses.

8. Disconnect hydraulic hoses from steering cylinder. Install O-ring seal plugs.
9. Start engine and run at **slow idle (1550 ±75 rpm)**.



10. With steering wheel in a maximum right position, turn steering wheel to the right with a constant torque of **6.8 N•m (72 lb-in.)**.
11. Observe the number of rotations of the steering wheel that occurs in one minute.
12. Repeat the procedure for left-hand turn.

Results:

- If rpm is **equal to or less than 6 rpm**, replace steering cylinder.
- If rpm is **greater than 6 rpm**, repair steering valve.

STEERING CYLINDER LEAKAGE TEST

Reason:

To check for internal leakage in the steering cylinder.

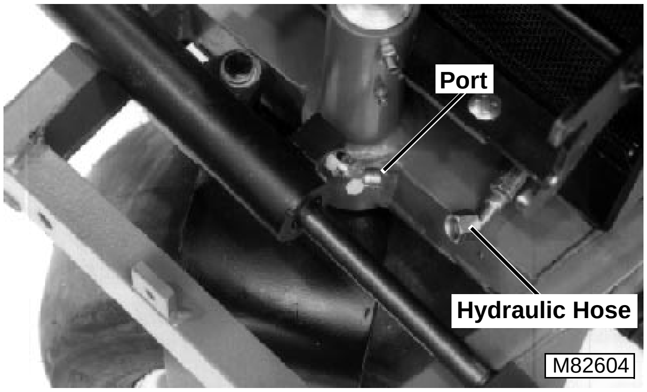
CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Remove ENGINE hood. (See ENGINE HOOD—Removal/installation on page 10-5.)
7. Turn steering wheel to full left to fully extend cylinder end.



8. Disconnect hydraulic hose (extended end).
9. Start engine and run at fast idle.
10. Continue to turn steering wheel to the left.
11. Watch for any flow of oil out of the cylinder at port.
12. Repeat steps 8—11 for right turn and opposite end of cylinder.

Results:

- If any flow of oil out of the cylinder occurred, there is internal leakage in the cylinder. Repair or replace cylinder. (See STEERING CYLINDER—Repair on page 6-34.)

STEERING RELIEF VALVE TEST

Reason:

To determine if the steering relief valve opens at the correct pressure.

Test Equipment:

- JT03421 9/16 M 37° x 11/16 F ORFS Adapter Fitting
- JT03345 20000 kPa (3000 psi) Pressure Gauge
- JT03017 Hose Assembly
- 203836 9/16 m 37° M x 9/16 F 37° Tee Fitting
- JT03005 1/2 F NPT X 9/16 F 37° Adapter Fitting
- JT03242 1/2 M NPT x 7/8 F 37° Adapter Fitting
- JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
- 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

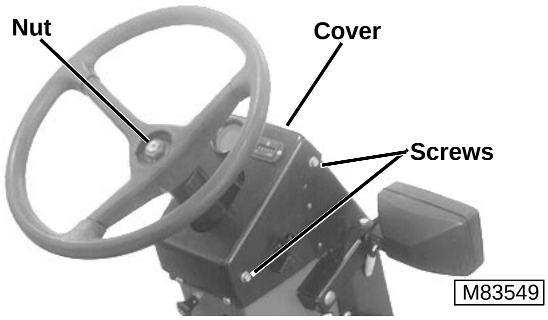
Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

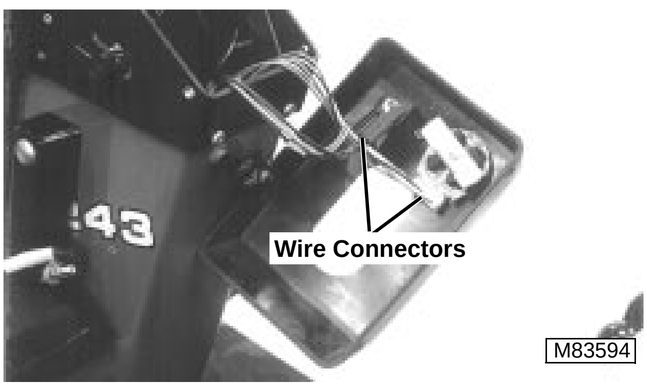
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.
6. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.



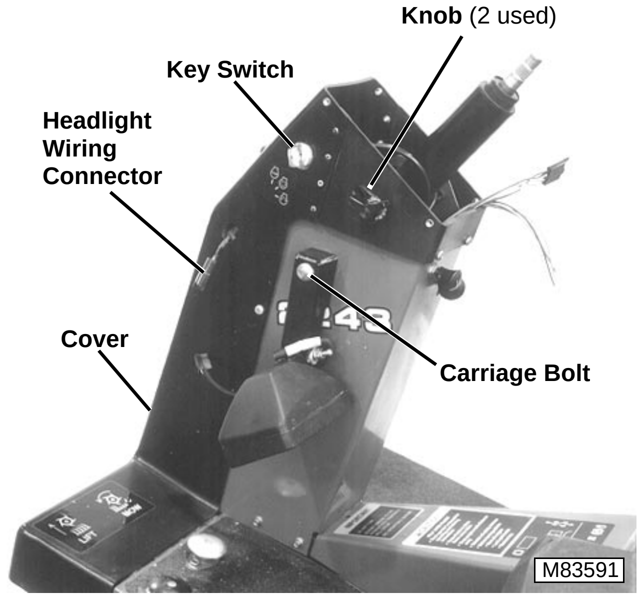
IMPORTANT: Do not use a hammer on end of steering shaft, damage can occur to steering valve or shaft.

NOTE: If steering wheel can not be pulled off easily, use a knife-edge puller to remove.

7. Remove steering wheel cap and nut. Remove steering wheel.
8. Remove four screws.



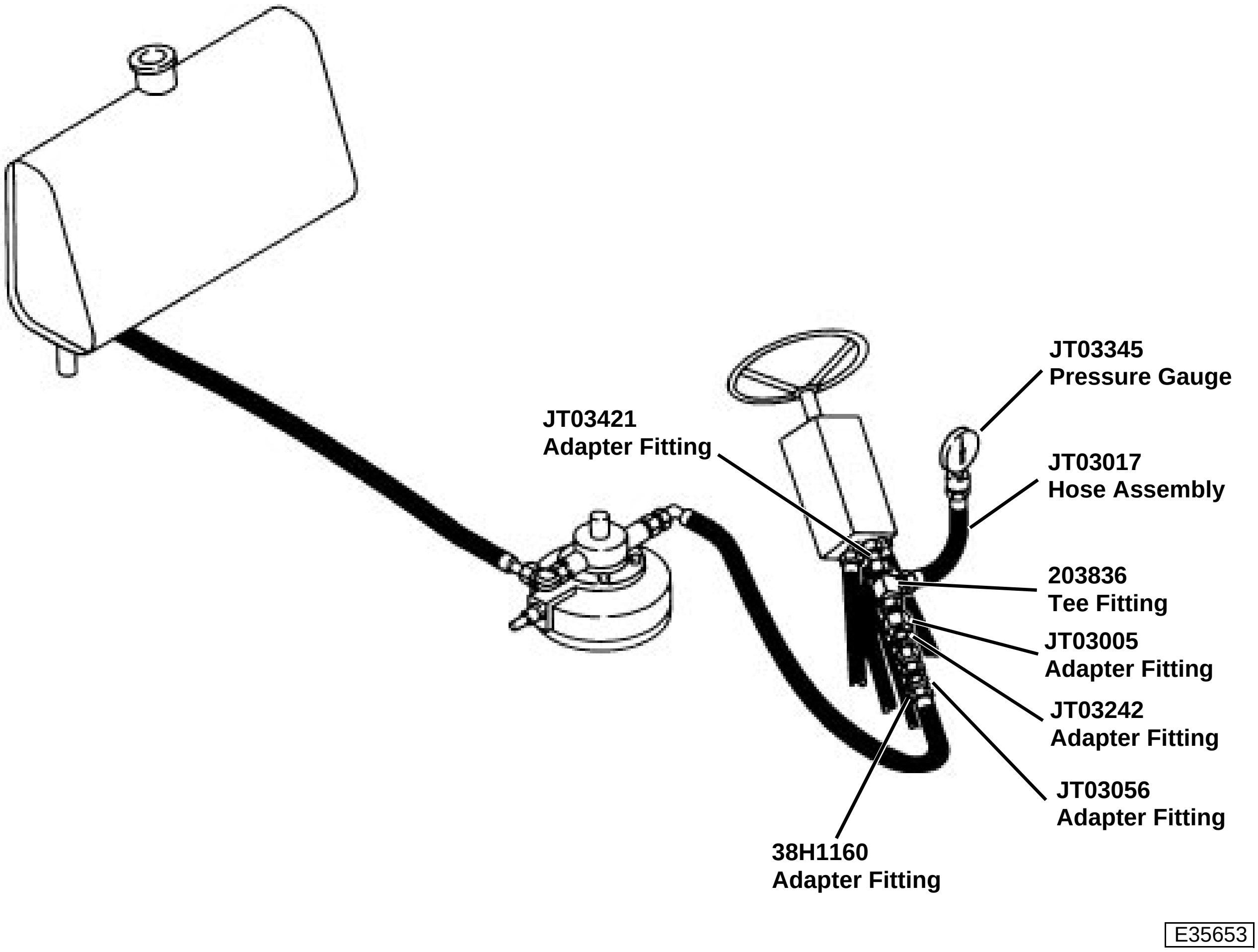
9. Disconnect hourmeter and gauge wire connectors and remove cover.



10. Remove two knobs.
11. Remove key switch.
12. If equipped with optional headlights:
    - Loosen nut on carriage bolt and rotate headlight assembly down 90°.
    - Disconnect wiring connector.
    - Repeat for remaining headlight.
13. Remove eight screws and cover.
14. Remove steering column cover.
15. Disconnect hose connected to steering valve “IN” port from hydrostatic charge pump.
16. Install 203836 tee fitting and JT03345 gauge to steering valve and hydrostatic charge pump hose using JT03421, JT03005, JT03242 and JT03056 Adapter Fittings and JT03017 Hose Assembly
17. Start engine and run at **fast idle (3400 ±75 rpm)**.
18. Turn steering wheel in one direction and hold against stop.
19. Check pressure reading, steering relief valve should open at **5000 kPa (725 psi)**.

Results:

- If pressure is not to specification, replace steering relief valve assembly. (See STEERING VALVE—Disassembly on page 6-23.)


JT03345
Pressure Gauge
JT03421
Adapter Fitting
JT03017
Hose Assembly
203836
Tee Fitting
JT03005
Adapter Fitting
JT03242
Adapter Fitting
JT03056
Adapter Fitting
38H1160
Adapter Fitting
E35653

REPAIR

STEERING VALVE AND COLUMN

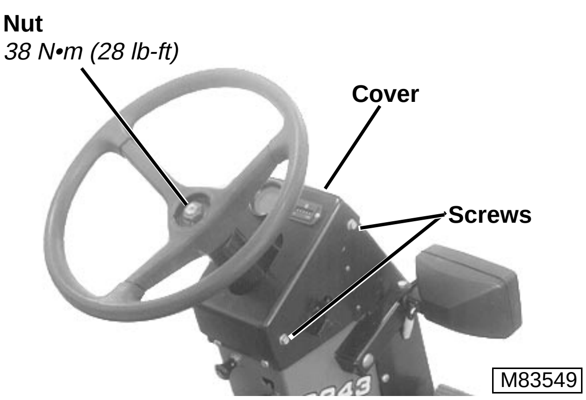
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

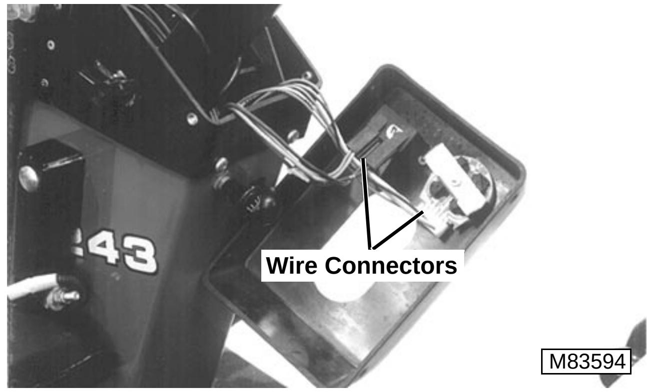
1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.



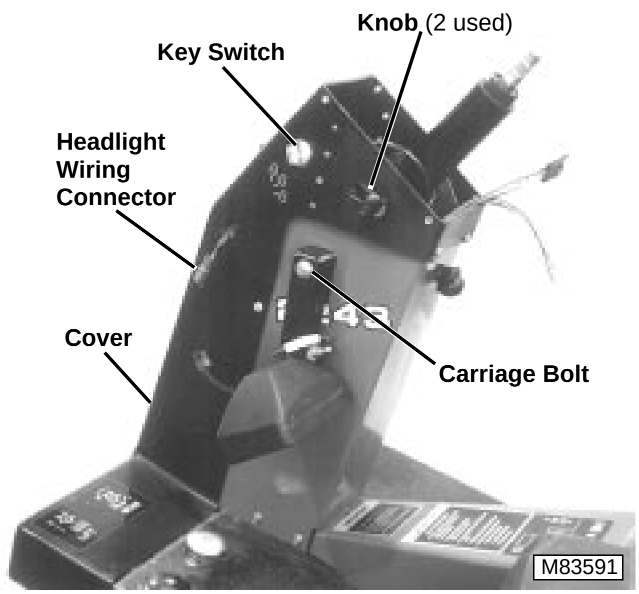
IMPORTANT: Do not use a hammer on end of steering shaft, damage can occur to steering valve or shaft.

NOTE: If steering wheel can not be pulled off easily, use a knife-edge puller to remove.

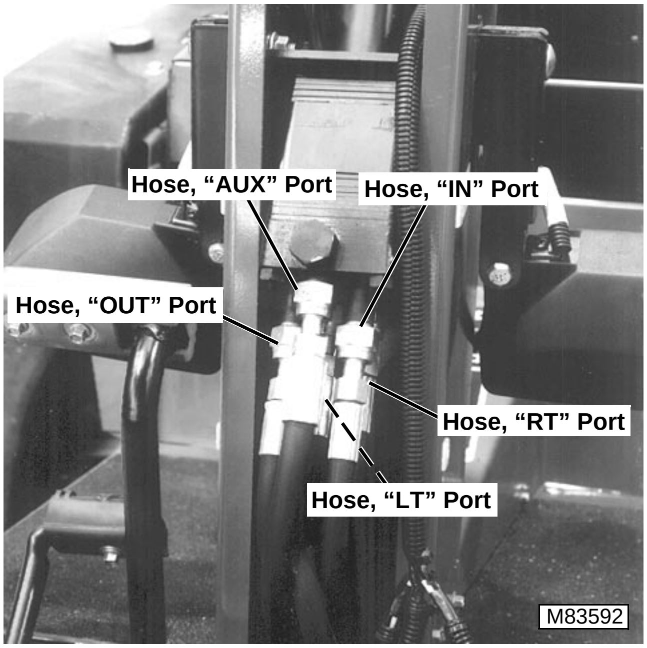
2. Remove steering wheel cap and nut. Remove steering wheel.
3. Remove four screws.



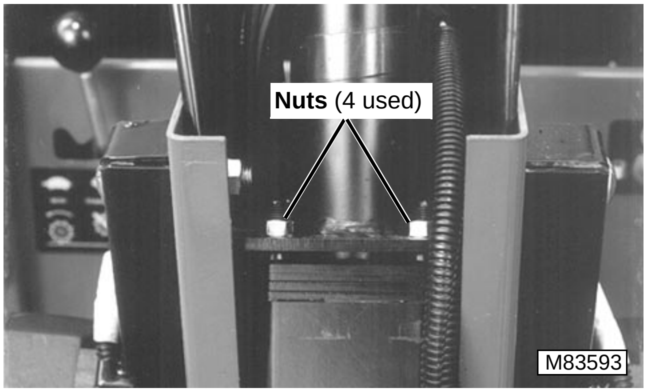
4. Disconnect hourmeter and gauge wire connectors and remove cover.



5. Remove two knobs.
6. Remove key switch.
7. If equipped with optional headlights:
 - Loosen nut on carriage bolt and rotate headlight assembly down 90°.
 - Disconnect wiring connector.
 - Repeat for remaining headlight.
8. Remove eight screws and cover.



9. Disconnect five hydraulic hoses.



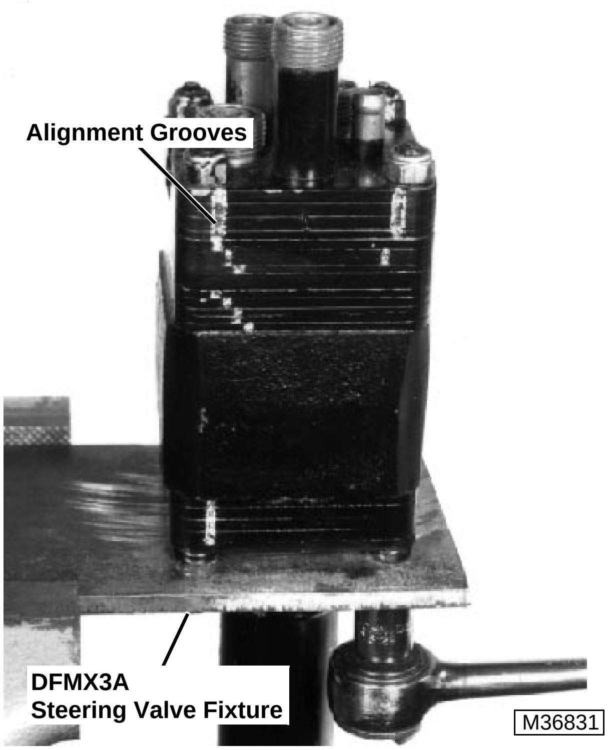
10. Remove four nuts.
11. Slide steering valve and column assembly from steering column tube support.

Installation is performed in the reverse order of removal.

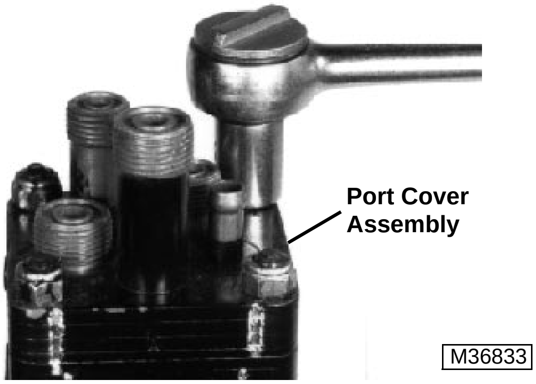
- Install steering valve and column assembly with relief valve plug facing away from machine.
- Tighten steering wheel-to-shaft nut to **38 N•m (28 lb-ft.)**.
- Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

Disassembly

IMPORTANT: Use DFMX3A Steering Valve Fixture when servicing control valve. Holding control valve in a vise can damage valve.

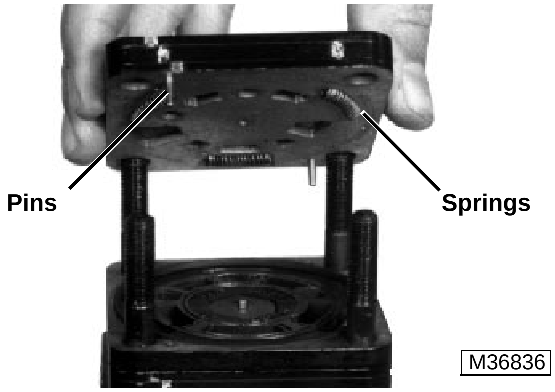


1. Install DFMX3A Steering Valve Fixture in a vice. (See DEALER FABRICATED TOOLS on page 6-3 for instructions to make this fixture).
2. Install steering control valve, with steering column down, in fixture. Fasten valve to fixture using four 5/16-24 UNF nuts.
3. Check position of alignment grooves to aid in assembly.
4. Loosen relief valve plug one turn.



IMPORTANT: Do not damage fittings during nut removal. Do not nick or scratch the machined surfaces of the steering valve.

5. Remove nuts to remove port cover assembly (four plates bonded together).
6. Remove seal ring and five O-rings.
7. Remove relief valve assembly.



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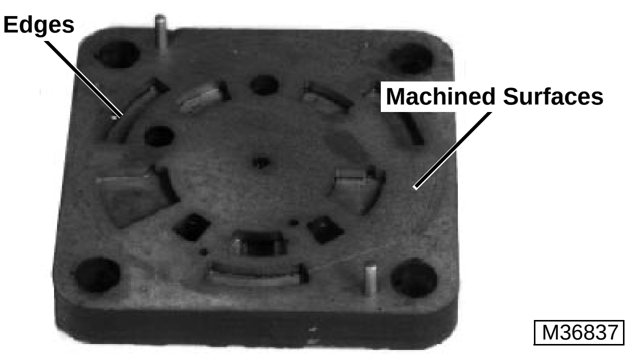
IMPORTANT: Do not interchange springs. The steering valve has two sets of springs. Keep springs with respective manifold.

NOTE: Port manifold has three springs which may come loose during disassembly.

8. Carefully remove port manifold (three plates bonded together).
9. Remove three springs.

NOTE: If one spring is damaged, all six springs in valve must be replaced.

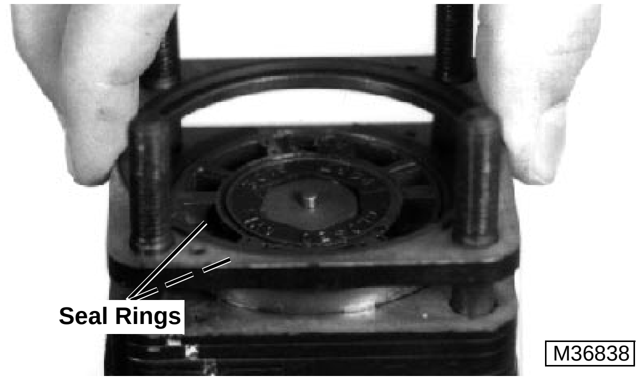
10. Inspect springs and pins for distortion, wear, or damage.



M36837

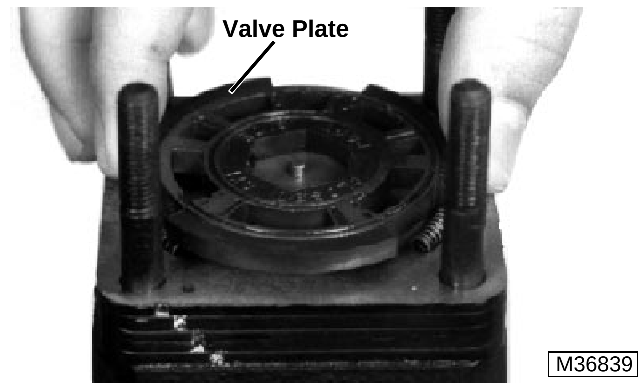
11. Inspect port manifold machined surfaces for scratches or scoring. A polished pattern from the rotation of the valve plate and hex drive assembly is normal. All edges must be sharp, free of nicks and burrs.

NOTE: Scoring is indicated by fine scratches or grooves cut into the manifold. When these scratches can be detected by feel finger nail or lead pencil, the manifold should be replaced.



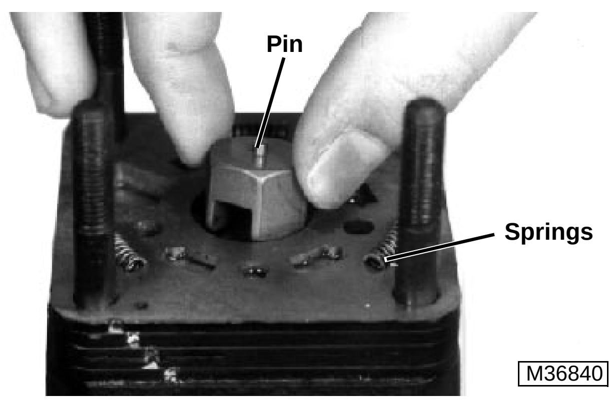
M36838

12. Remove the valve ring and two seal rings. Check valve ring for nicks and scoring. If the valve ring is damaged, it must be replaced.



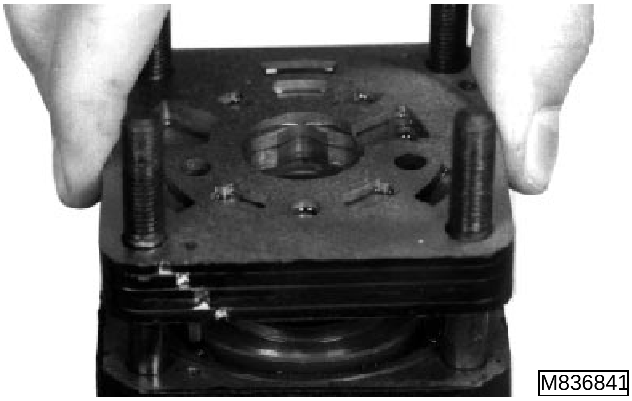
M36839

13. Remove valve plate. Inspect the slots and machined surfaces for nicks or wear. If the valve plate is scored or the edges are not sharp, the valve plate and valve ring must both be replaced.

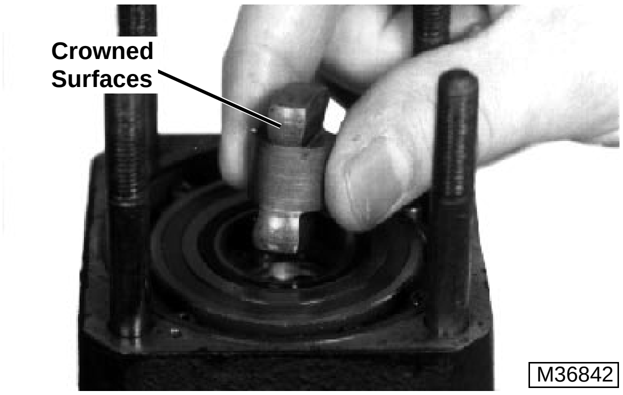


M36840

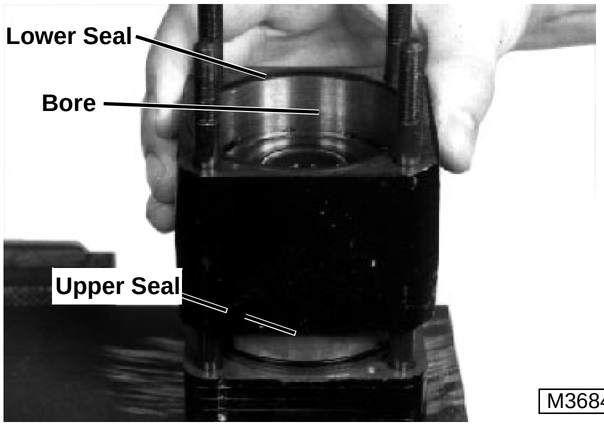
14. Remove and inspect hex drive assembly. Check sides and slot for wear, grooves, or scoring. Pin should be tight and show no wear or damage.
15. Remove three springs.
16. Inspect spring for broken coils, wear, or damage.



17. Remove the isolation manifold (four plates bonded together). Check manifold surface, holes, and edges for nicks or usual wear. A polished pattern from the rotation of the valve plate and commutator is normal.



18. Remove drive link. Check the four crowned surfaces for wear or scoring.

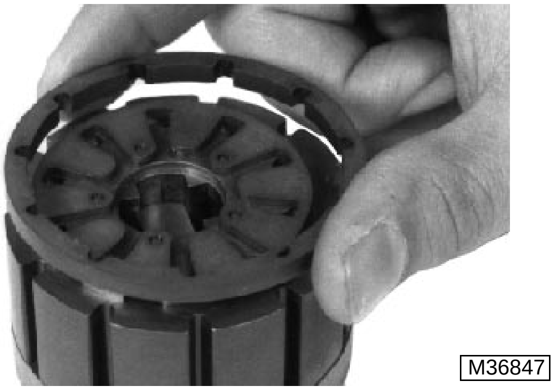


19. Remove metering ring and upper and lower seals. If bore is scored, the metering ring must be replaced.

IMPORTANT: Do not clamp metering assembly in a vice.

20. Remove metering assembly. Put assembly on a clean surface.

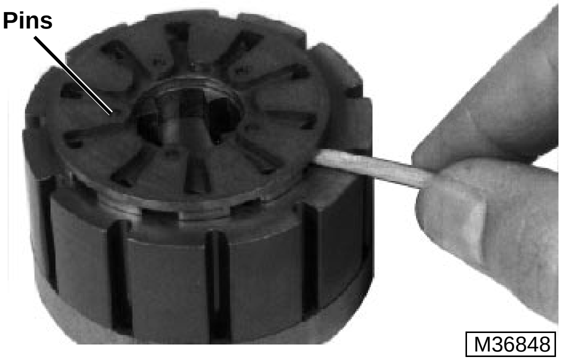
21. Remove commutator seal.
22. Remove 11 screws to remove commutator cover. Inspect screws for damage and replace if necessary.
23. Check commutator cover machined surface for nicks, burrs, scoring, or unusual wear. A polished pattern due to rotation of the commutator is normal.



IMPORTANT: Handle commutator ring with care; it is easily broken.

24. Remove commutator ring and inspect for wear, burrs, cracking, or scoring.

NOTE: The commutator ring and commutator are a matched set. If either is worn or damaged, both must be replaced.



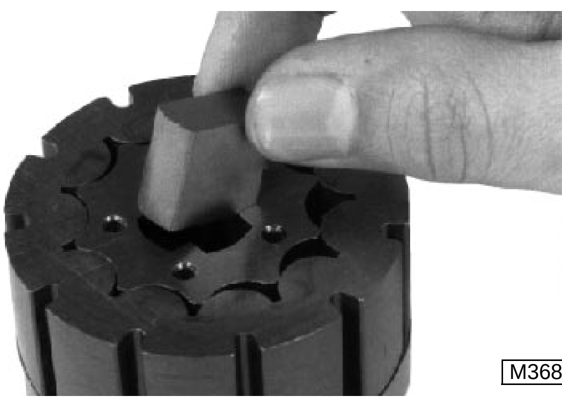
M36848

IMPORTANT: DO NOT use a screwdriver to remove commutator. Commutator can be damaged.

25. Remove commutator and five pins using a wood dowel or equivalent.

NOTE: The commutator is made up of two plates bonded together. It is a permanent assembly and cannot be disassembled.

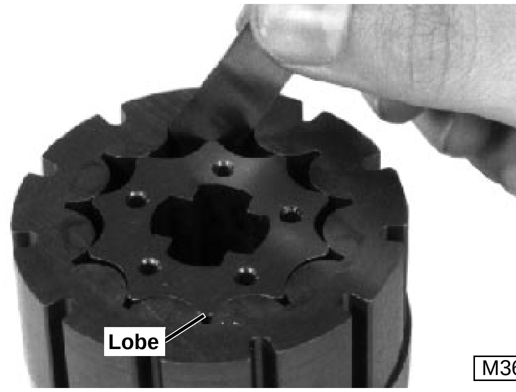
26. Check commutator machined surface, holes and edges for nicks. Edges must be sharp.



M36849

27. Remove drive link spacer. Check spacer for grooves, wear, or damage.
28. The rotor should rotate and orbit freely within the stator. Check commutator side of stator face for grooves or scoring.

NOTE: Stator and rotor are a matched set. If either are worn or damaged, both must be replaced.



M36850

29. Measure rotor-to-stator clearance. Center rotor lobe between stator lobes and check clearance directly opposite lobe.

    If rotor-to-stator clearance is more than **0.08 mm (0.003 in.)**, replace rotor and stator.

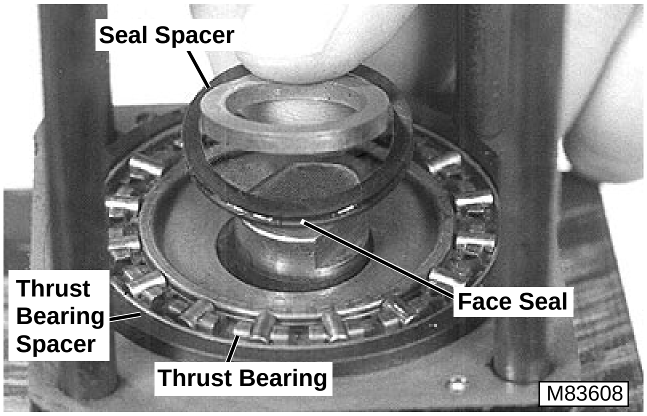
M36851

M36852

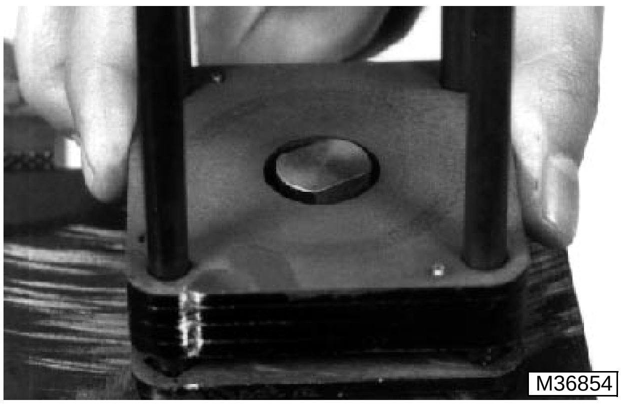
30. Lift the rotor and stator drive plate.
31. Check the drive plate side of the rotor assembly for nicks, grooves, or scoring. A spiral pattern due to rotor movement is normal.

    The thrust bearing side of the plate should also show a normal wear pattern without grooves, flaking, or dents.

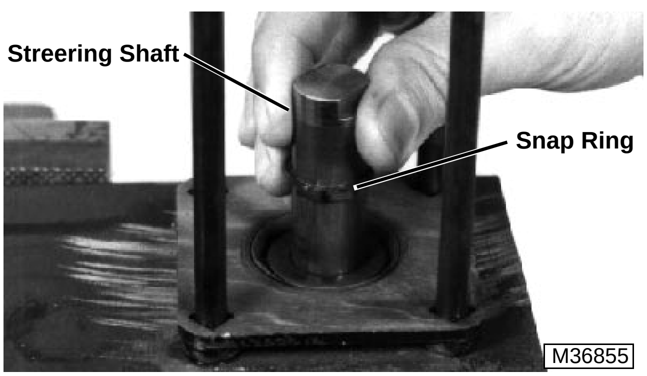
    The flat side of the input shaft hole should not be grooved or worn.



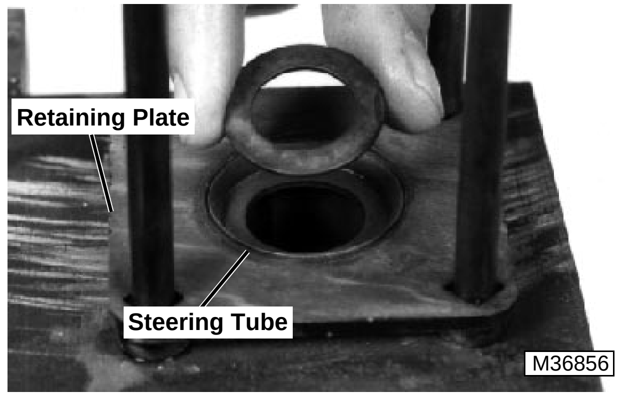
32. Remove seal spacer, face seal, thrust bearing and thrust bearing washer.
33. Inspect parts for wear or damage. Replace if necessary.



34. Remove upper cover plate (four plates bonded together).
35. Check plate surface for grooves, dents, or metal flakes. A polished pattern due to the action of the seal is normal.

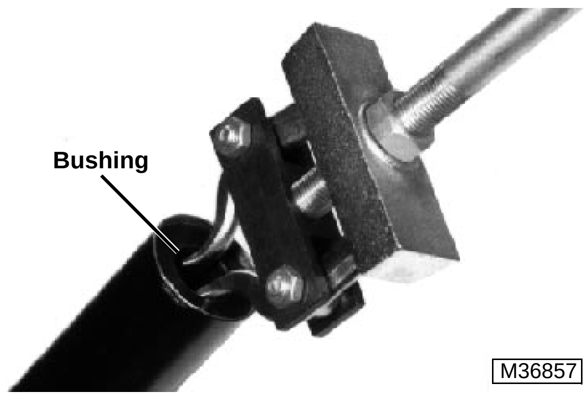


36. Remove steering shaft and snap ring.
37. Inspect steering shaft serrations, threads, and flats for grooves, wear, or damage.



NOTE: Steering tube and retaining plate are a matched set. If either part is worn or damaged, both must be replaced.

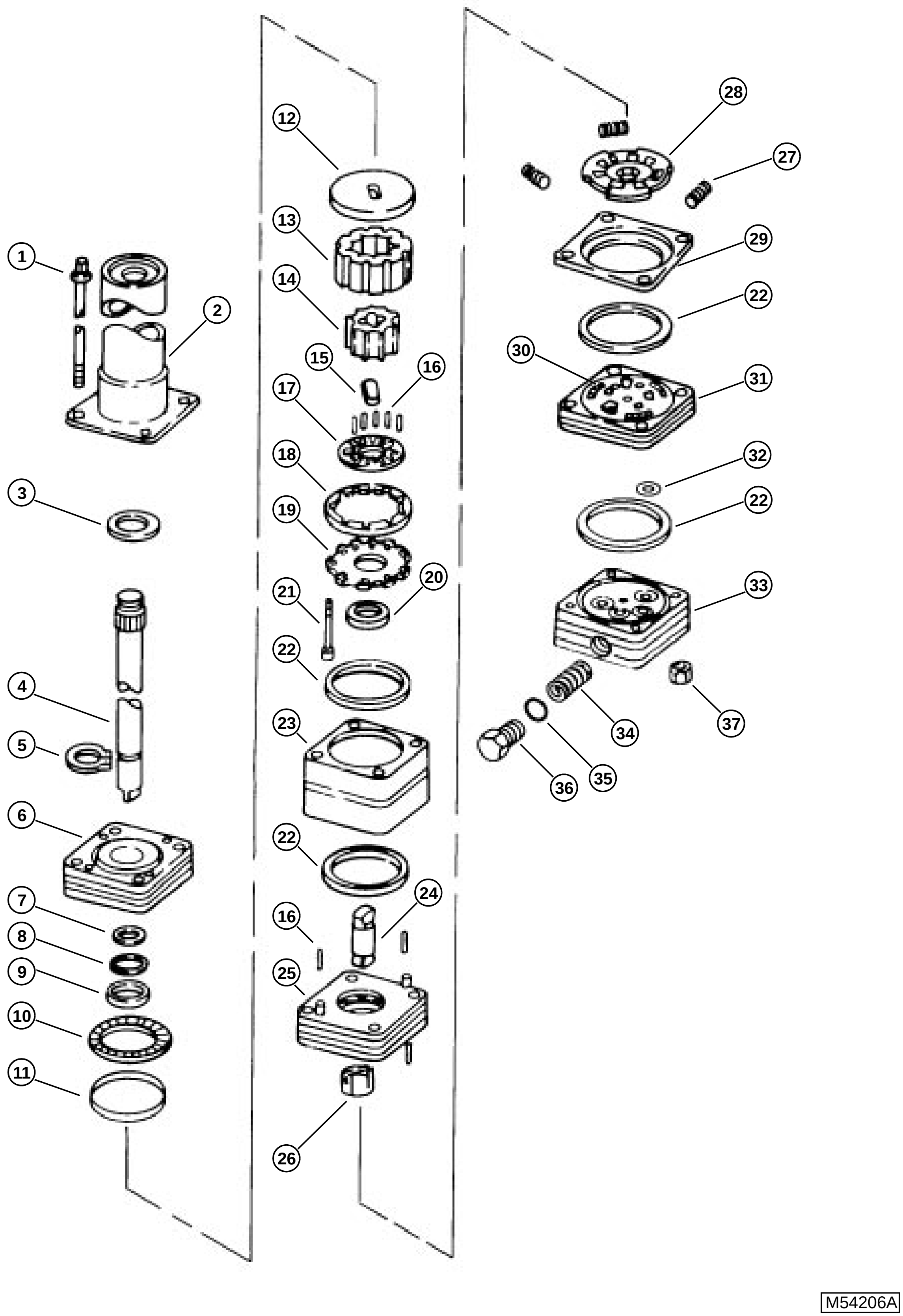
38. Remove washer and steering tube.



IMPORTANT: Hold steering tube in a soft-jaw vice. Be careful not to crush steering tube.

39. Inspect bushing for wear or damage. If bushing replacement is necessary, straighten crimped area of steering tube using a punch.
40. Remove bushing using a 2-jaw puller and slide hammer.

Inspection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1—Cap Screw (4 used)
2—Cover
3—Washer
4—Shaft
5—Snap Ring
6—Cover Plate
7—Spacer
8—Seal
9—Seal
10—Bearing
11—Spacer
12—Drive Plate
13—Stator
14—Rotor
15—Spacer
16—Pin (8 used)
17—Commutator
18—Commutator Ring
19—Commutator Cover
20—Seal
21—Screw (11 used)
22—Seal
23—Metering Ring
24—Drive Link
25—Isolation Manifold
26—Hex Drive
27—13 mm (0.500 in.) Spring (3 used)
28—Valve Plate
29—Valve Ring
30—19 mm (0.750 in.) Spring (3 used)
31—Port Manifold
32—O-Ring (5 used)
33—Port Cover
34—Relief Valve
35—O-Ring
36—Plug
37—Nut (4 used)

NOTE: Seal kits are available for steering valve repair.

Scoring is indicated by fine scratches or grooves cut into machined surfaces. When these scratches can be detected by catching a finger nail or lead pencil, the part should be replaced.

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

IMPORTANT: If replacing with new parts, the following assemblies must be replaced as matched sets:

Valve Plate (28) and Valve Ring (29)

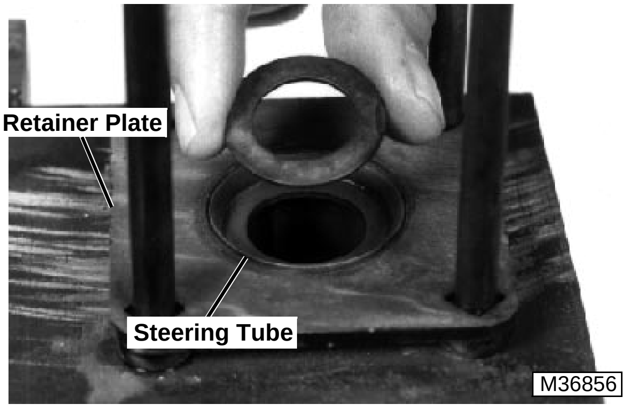
Commutator (17) and Commutator Ring (18)

Stator (13) and Rotor (14)

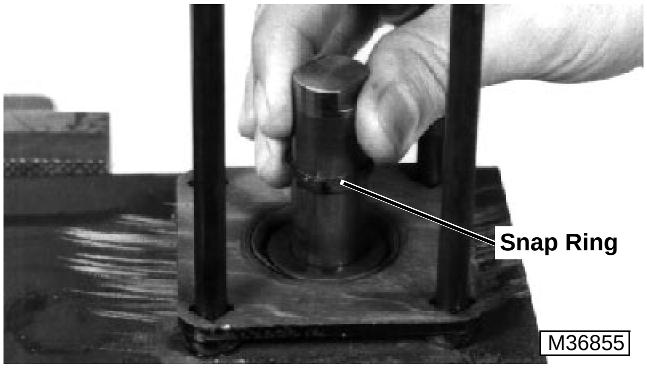
Assembly

NOTE: Apply clean hydrostatic oil to all internal parts of steering valve during assembly.

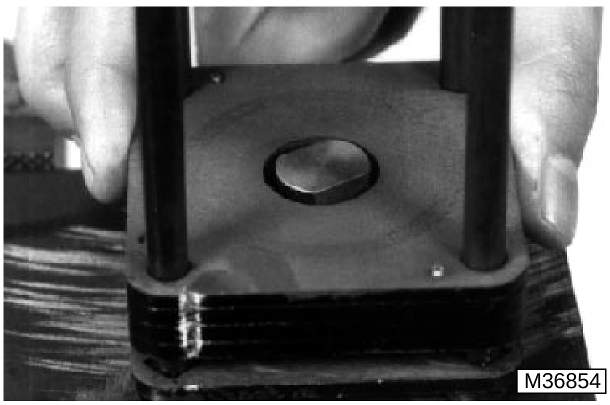
1. Install bushing into steering tube with recess facing into tube, using a driver set. Install bushing **2.5 mm (0.100 in.) below top of steering tube**.
2. Slightly bend edges of steering tube over bushing using a punch.
3. Apply multipurpose grease to inside of bushing.



4. Install steering tube on bolts. Be sure the square holes in the steering tube are seated on the square shoulders of the bolts.
5. Apply clean multipurpose grease on the retainer plate and washer.
6. Install washer.

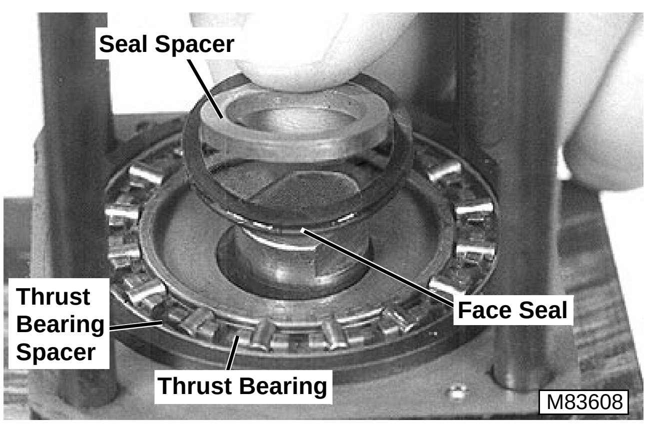


7. Install snap ring on steering shaft.
8. Install steering shaft with threaded end down into steering tube.

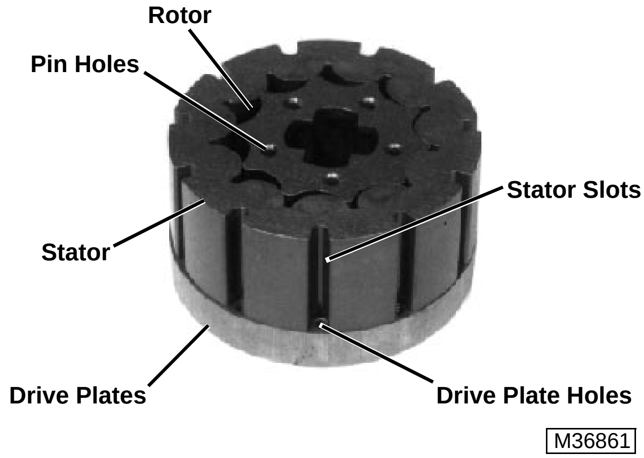


IMPORTANT: Alignment grooves must be on only one side of steering valve for proper valve operation

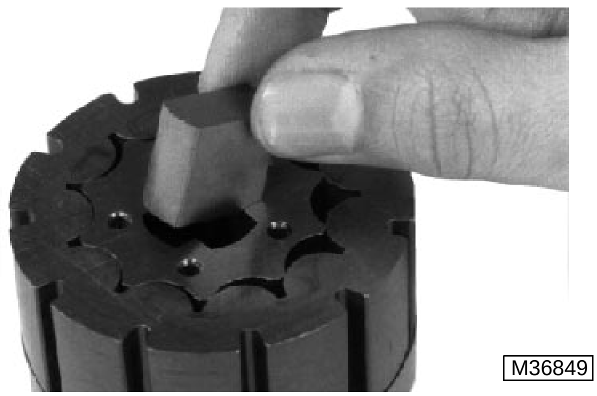
9. Install upper cover plate over four bolts with the highly polished surface up.



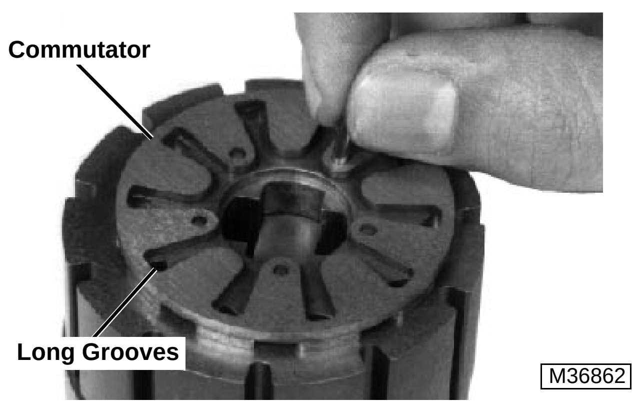
10. Apply multipurpose grease on face of the upper cover plate, steering shaft end, and thrust bearing.
11. Install thrust bearing washer, thrust bearing, face seal and seal spacer.



12. Put drive plate on a clean surface with slot downward.
13. Install and turn stator until the stator slots are aligned with drive plate holes.
14. Install rotor with five pin holes up.



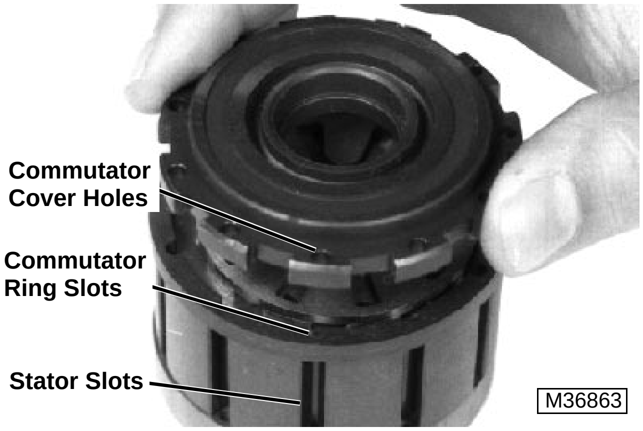
15. Apply multipurpose grease to spacer.
16. Install spacer in rotor drive slot.



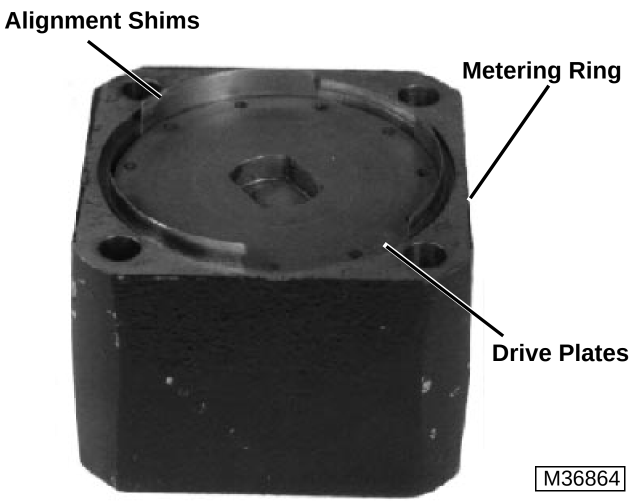
17. Install commutator on rotor, with long grooves upward.

IMPORTANT: Pins must be installed below the surface of the commutator to prevent commutator cover damage.

18. Align commutator holes with rotor holes and install five pins.
19. Put a few drops of clean hydrostatic oil into each groove of the commutator.

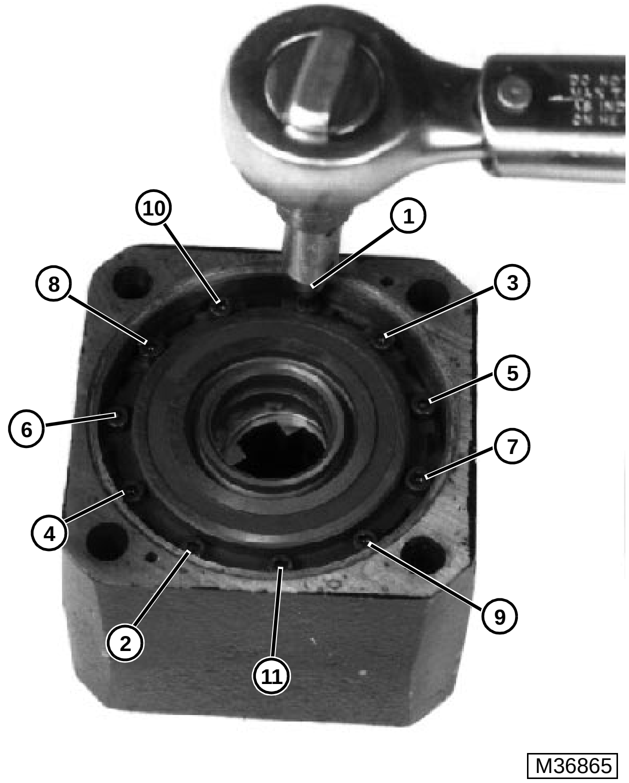


20. Align commutator ring slots with stator slots and install commutator ring.
21. Align commutator cover holes with commutator ring slots. Install commutator cover with flat surfaces toward commutator.
22. Clean screw threads using Clean and Cure Primer. Apply Thread Lock and Sealer (low strength) to threads of commutator cover-to-commutator screws.
23. Install 11 screws into metering assembly. DO NOT tighten screws at this time.



IMPORTANT: The following procedure must be used to minimize an out-of-round condition between commutator ring and drive plate. The commutator ring is self-centering when the drive plate is shimmed. Use DFMX4A Alignment Shims.

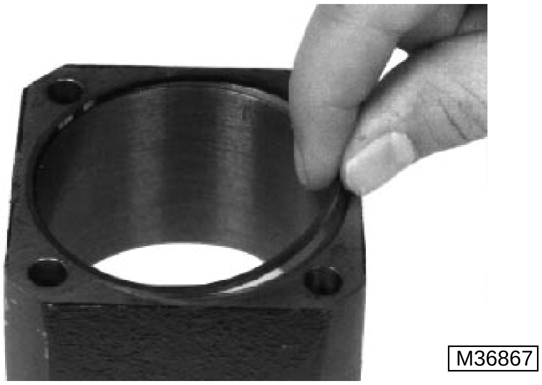
24. Install metering assembly, with drive plates up into metering ring.
25. Install two DFMX4A Alignment Shims each between the drive plate and metering ring 120° apart. (See DEALER FABRICATED TOOLS on page 6-3 for instructions to make shims.)



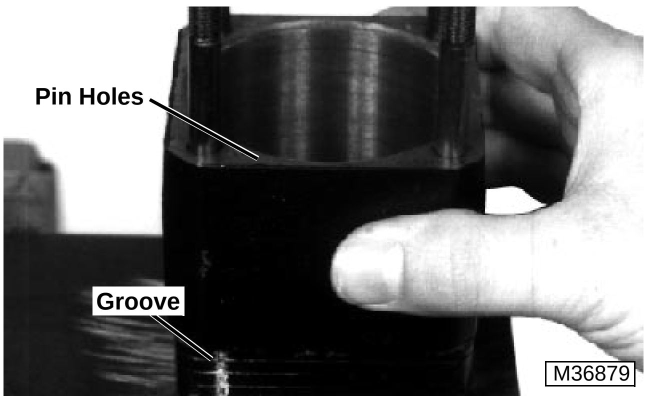
26. Turn metering ring over on a flat surface and push metering assembly down. Tighten 11 screws in several steps and in the sequence shown to **1.4 N•m (12 lb-in.)**.
27. Remove Shims and meting assembly from metering ring.

28. Install LARGE end of drive link into the slot in the rotor. Hold the drive link and rotate the metering assembly by hand. The rotor should turn freely inside the stator.

    If the rotor binds or does not move, disassemble and inspect to find the cause.

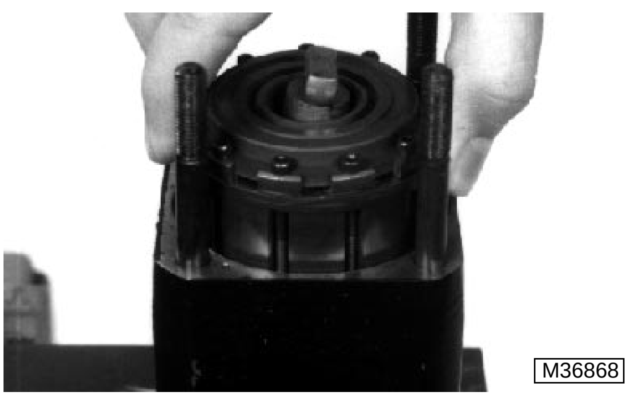


29. Apply multipurpose grease to seal ring. Install seal ring on metering ring end without pin holes.

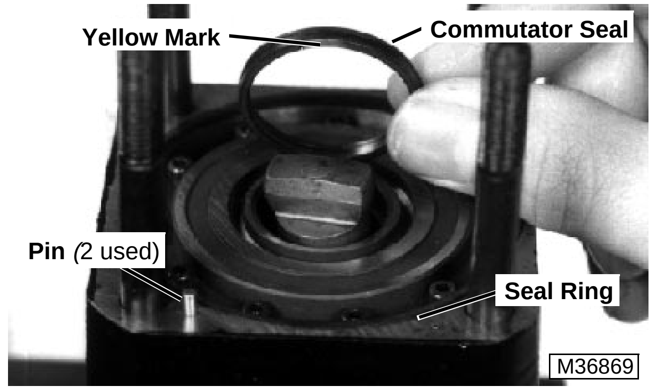


IMPORTANT: Align pin holes in metering ring with groove on upper cover plate so that remaining parts can be aligned correctly.

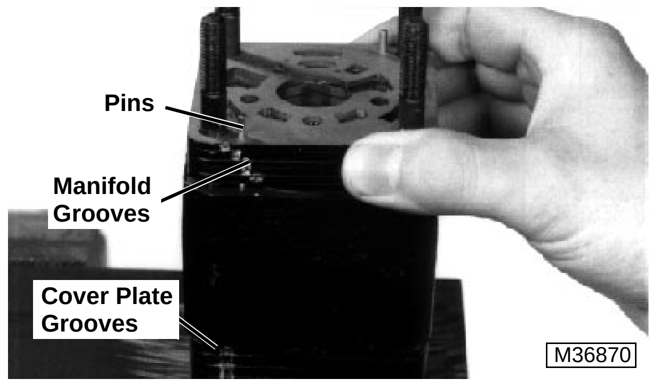
30. Install metering ring over bolts with pin holes up.



31. Apply multipurpose grease on drive plate surface.
32. Install metering assembly with drive plate down into metering ring. Turn metering assembly until the steering shaft engages the plate hole. When properly seated, the metering assembly is below the surface of the metering ring.

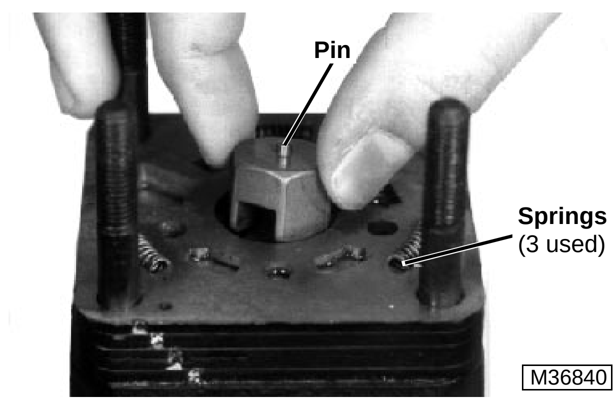


33. Apply multipurpose grease on commutator seal and seal ring.
34. Install commutator seal with yellow mark down into commutator cover.
35. Install seal ring and pins.

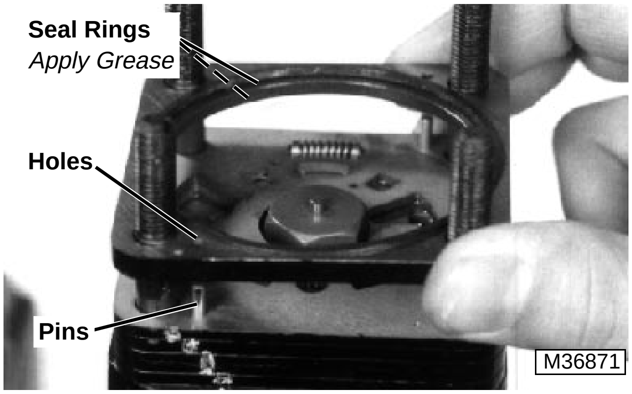


IMPORTANT: Align grooves in isolation manifold with groove in upper cover plate.

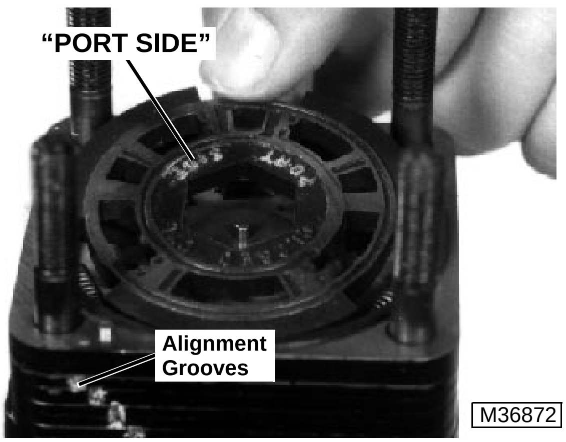
36. Install isolation manifold, with recessed slots up, on metering ring.
37. Install pins.



38. Install three 13 mm (0.500 in.) springs in recessed slots of the isolation manifold.
39. Install hex drive assembly on drive link with pin up.

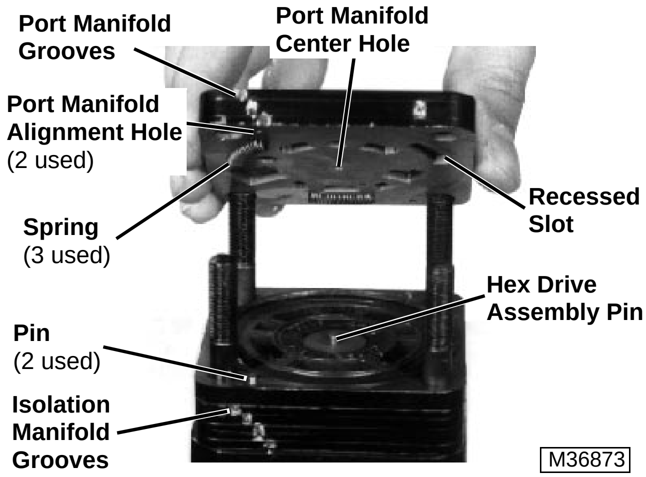


40. Apply multipurpose grease to seal rings. Install seal rings on valve ring.
41. Align valve ring holes with pins to install valve ring.



IMPORTANT: Valve plate must be installed with "PORT SIDE" directly opposite (12 o'clock position) from alignment grooves for proper operation. Valve plate springs slots and springs must be aligned to prevent spring damage when installing port manifold.

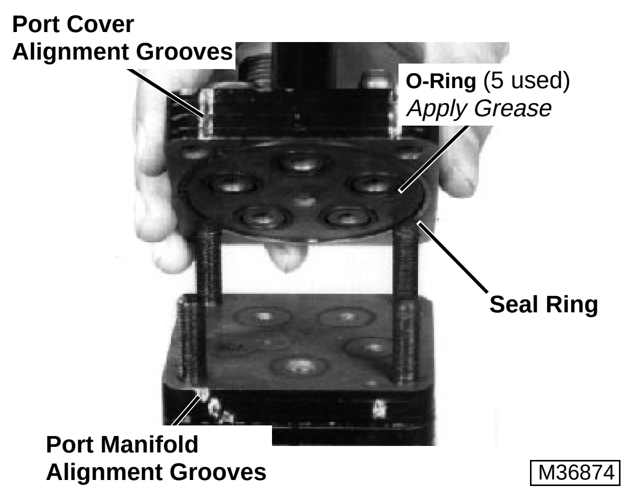
42. Install valve plate, with "PORT SIDE" up, on isolation manifold. Turn valve plate to make sure springs are centered in the valve plate spring slots.
43. Apply clean hydrostatic oil to valve plate.



44. Install three 19 mm (0.750 in.) springs in recessed slots of the port manifold.

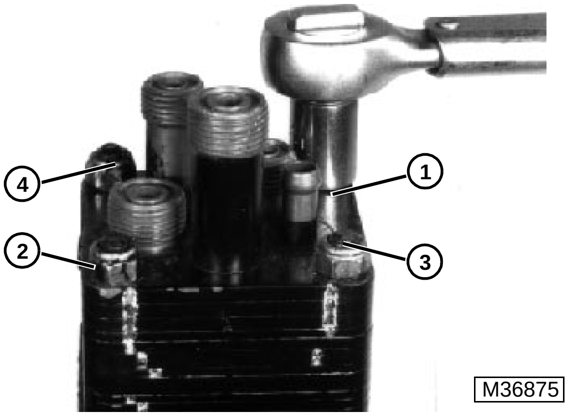
IMPORTANT: Align grooves in port manifold with grooves in isolation manifold. Be careful not to damage springs while installing port manifold.

45. Install port manifold with springs toward valve plate. Be sure pins engage alignment holes in port manifold. Be sure hex drive assembly pin engages center hole in port manifold.
46. Apply multipurpose grease to five O-rings and seal ring. Install O-rings and seal ring in port cover.



IMPORTANT: Align grooves in port cover with grooves in port manifold.

47. Install port cover.



48. Install and tighten four nuts in the sequence shown. Tighten in several steps to **30 N•m (22 lb-ft.)**.
49. Install relief valve assembly. Tighten to **14 N•m (124 lb-in.)**.

STEERING CYLINDER

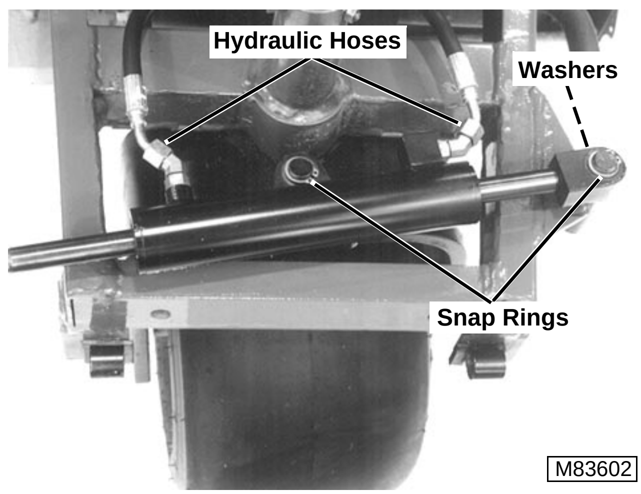
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Remove engine hood. (See ENGINE HOOD—Removal/Installation on page 10-5.)

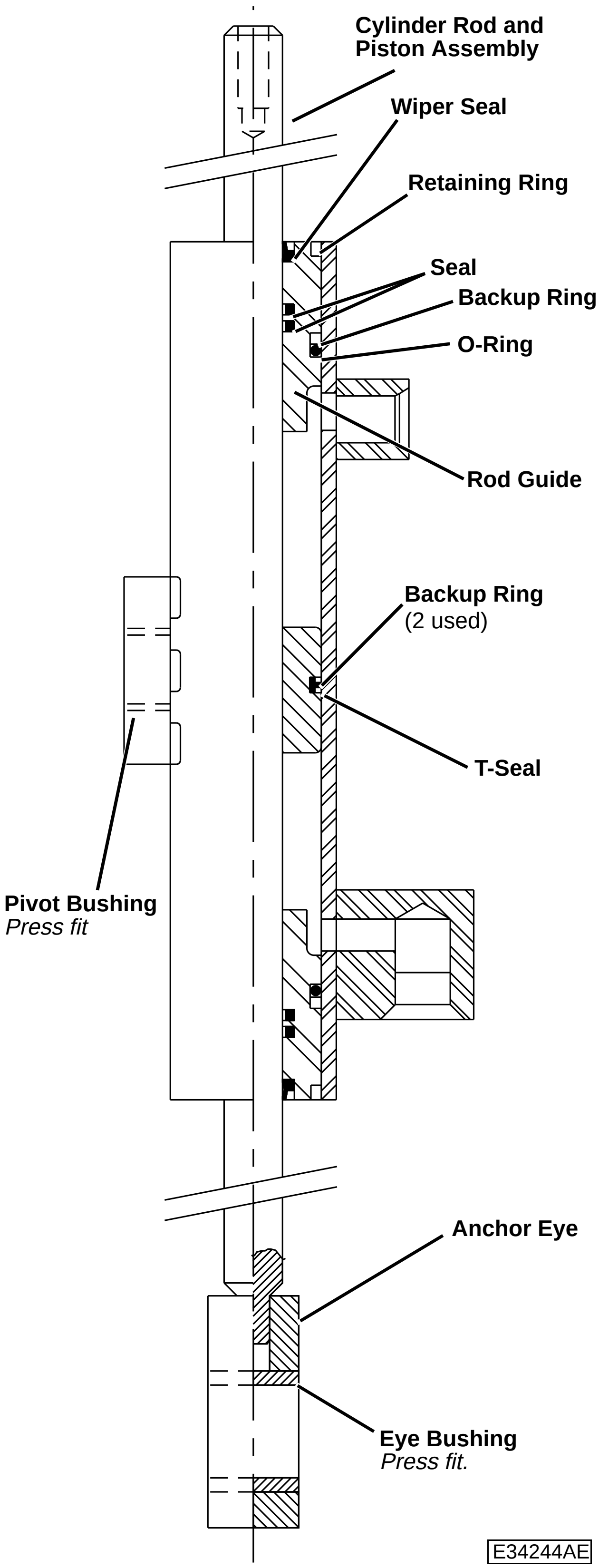


2. Disconnect hydraulic hoses.
3. Remove snap rings.
4. Remove steering cylinder.
5. Remove washers, if equipped.

Installation is performed in the reverse order of removal.

- Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

Repair



NOTE: Rod guides on both ends of cylinder are the same.

IMPORTANT: Replace all seals and O-rings. Used parts will leak.

Do not dry parts with cloth or paper. Lint from cloth or paper can contaminate hydraulic system. Wash all parts in solvent and dry with compressed air.

- Inspect all parts for wear or damage. Replace complete cylinder if necessary.
- When installing new T-seal and back rings on piston, make sure cuts of backup rings are not aligned.
- Lubricate all internal parts with clean hydraulic oil during assembly.
- Apply thread lock and sealer (medium strength) to threaded end of cylinder rod. Tighten anchor eye to **15 N•m (133 lb-in.)**.

STEERING CLEVIS

Removal/Installation

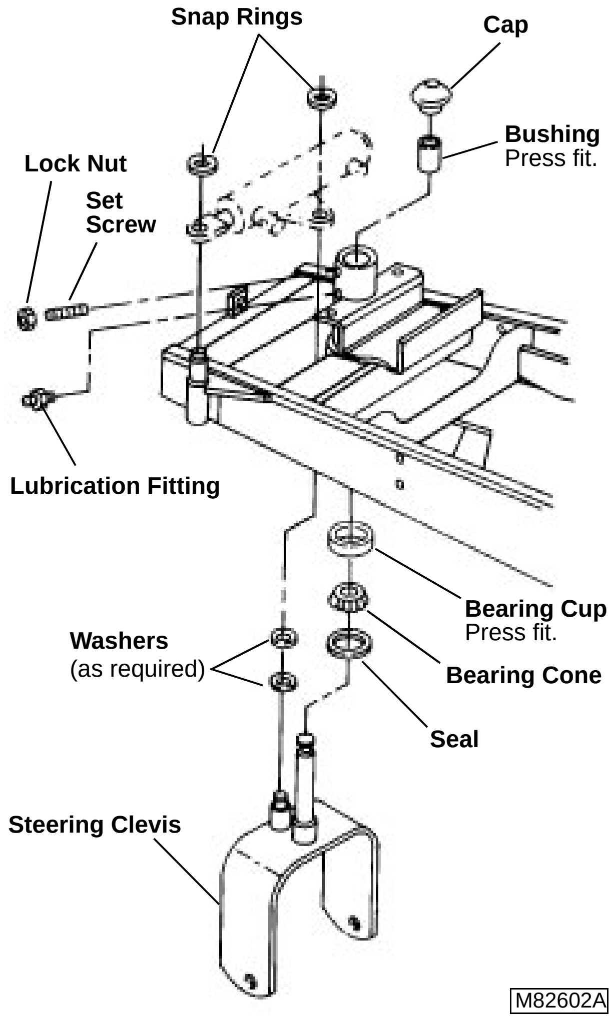
1. Remove rear wheel. (See REAR WHEEL—Removal/Installation on page 10-3.)
2. Remove engine hood. (See ENGINE HOOD—Removal/Installation on page 10-5.)

NOTE: Steering cylinder hydraulic hoses do not have to be disconnected.

3. Remove two snap rings, steering cylinder and washers, if equipped.
4. Loosen lock nut and remove set screw.
5. Remove cap. If necessary, remove steering clevis using a brass drift hammer.
6. Remove seal and bearing cone using a brass drift and hammer.

NOTE: Remove seal and bearing cup only if replacement is necessary.

Bearing cup and cone are matched and must be replaces as a set.



Installation is done in the reverse order of removal.

- Pack bearing cone with multipurpose grease.
- Install seal with smaller O.D. facing away from frame. Push seal flush with bottom of frame.
- Install steering clevis in frame. Install set screw and lock nut. Make sure set screw fits into groove in clevis. Tighten set screw fully, then back out 1/4 to 1/2 turn. Tighten lock nut while holding set screw.
- Apply multipurpose grease to lubrication fitting.

CONTENTS

Page

BRAKES

SPECIFICATIONS

ADJUSTMENT SPECIFICATIONS

Center rod pin center to yoke hole center . . . . 362 ±1.5 mm (14.250 ±0.060 in.)

Outer brake rod minimum length (Initial adjustment) . . . . 27 mm (1-1/16 in.) of threaded rod should extend through pivot.

REPAIR SPECIFICATIONS

Axle shaft slotted nut torque . . . . 237 N•m (175 lb-ft) plus additional turn to align slot and hole.

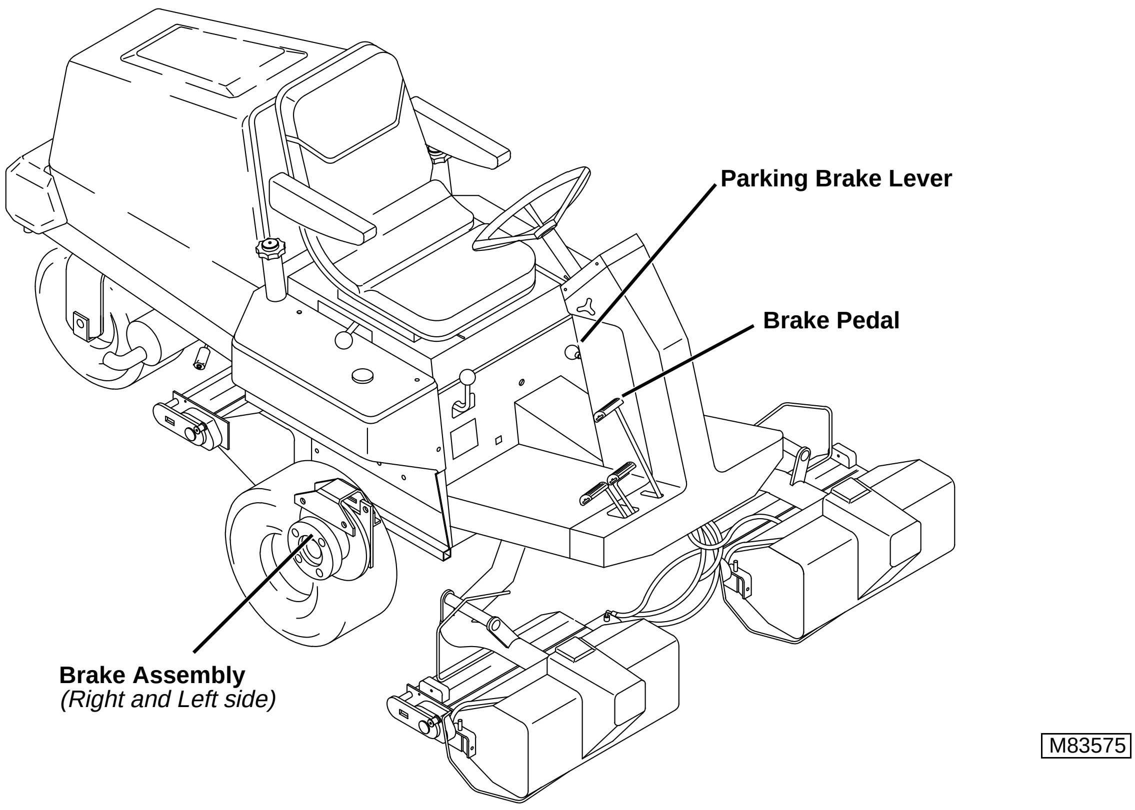
OTHER MATERIALS

Number	Name	Use
M79292	MPG-2® Multipurpose Polymer Grease	Lubricate axle shaft.

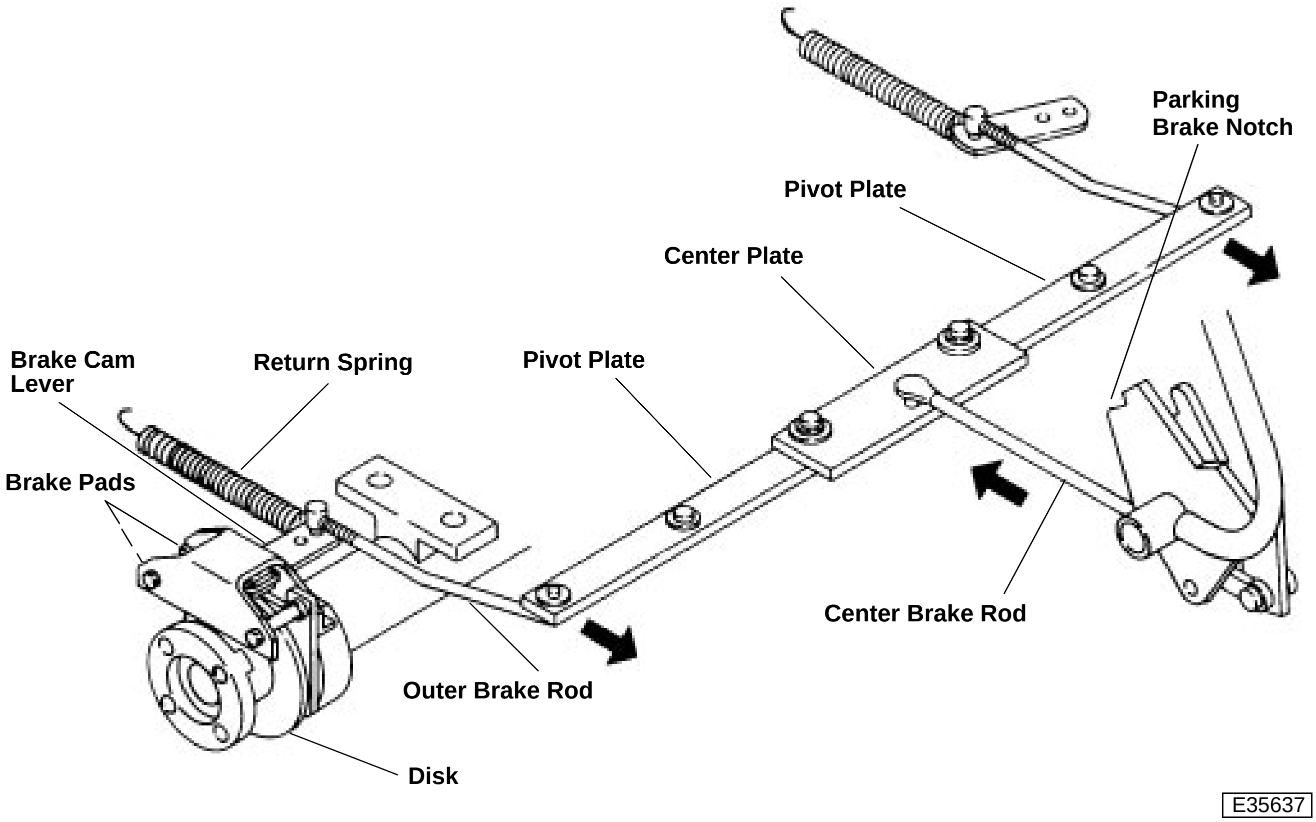
MPG-2® is a registered trademark of DuBois USA.

COMPONENT LOCATION AND OPERATION

BRAKE SYSTEM COMPONENTS



BRAKE SYSTEM OPERATION



Function:

To provide a means of stopping the mower and also prevent movement when mower is not in use.

Theory of Operation:

The brakes are mechanical disk type. The brake cam lever force brake pads against a disk that is part of the wheel hub.

When the pedal is pressed, center rod pushes the center plate rearward. Both pivot plates rotate, pulling the outer brake rods and cam levers forward, the end of brake lever pushes the brake pad against the disk, slowing wheel rotation.

As the brake pedal is released, return spring pulls brake lever rearward. Pressure on brake pads is removed, allowing the wheel to rotate freely.

When the parking brake is applied, a plate engages the parking brake notch on the brake pedal. The brakes remain engaged until the plate is lifted from the notch.

TROUBLESHOOTING

BRAKE SYSTEM TROUBLESHOOTING CHART

CHECK OR SOLUTION / PROBLEM OR SYMPTOM	Brakes do not hold.	Brakes do not work.	Brakes drag.							
Linkage loose or not adjusted correctly.	●									
Brake pads worn.	●									
Linkage adjustment incorrect.		●	●							
Return spring damaged or broken.			●							

DIAGNOSIS

BRAKE SYSTEM DIAGNOSIS

Test Conditions:

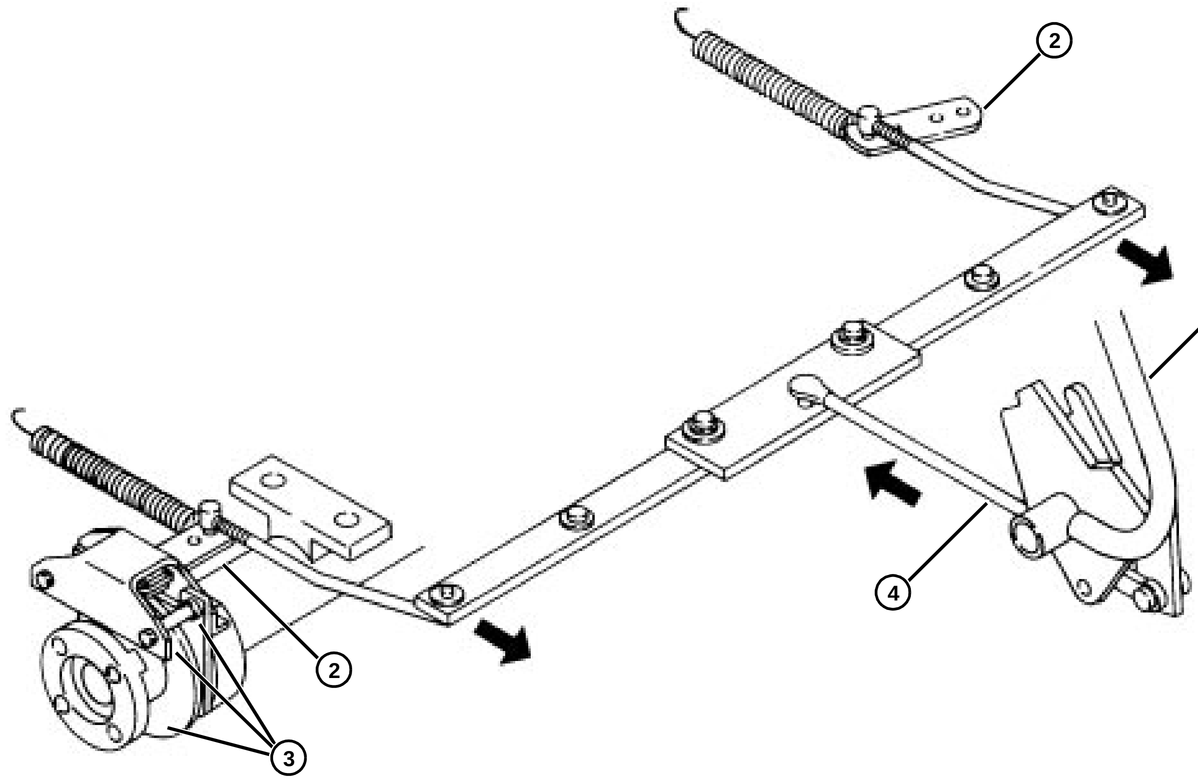
• Key switch OFF and transmission in NEUTRAL.

Test/Check Point	Normal	If Not Normal
1. Brake pedal and linkage.	Linkage not binding or damaged. Returns to disengaged position after pedal is released.	Check brake linkage.
2. Brake cam levers.	Moves freely, returns to disengaged position after pedal released.	Check brake pedal return springs.
3. Brake pads and disks.	No excessive scoring or uneven wear.	Replace brake pads or wheel hub.
4. Center brake rod.	Dimension between pin and center hole of yoke to specified length.	Adjust center brake lever rod. (See CENTER BRAKE ROD ADJUSTMENT on page 7-8).

Test Conditions:

• Engine running at operating temperature.
• Minimum of 50 feet of open and flat pavement away from any people.
• Operator in seat.
• Mow/Transport lever in TRANSPORT position.
• Forward or reverse travel pedal depressed.

5. Application of brakes.	Machine slows and stops as brake is applied.	Adjust brake. Replace pads and/or wheel hub if necessary. (See CENTER BRAKE ROD ADJUSTMENTon page 7-8 and BRAKE LINKAGE ADJUSTMENT on page 7-8.)



E35637

ADJUSTMENTS

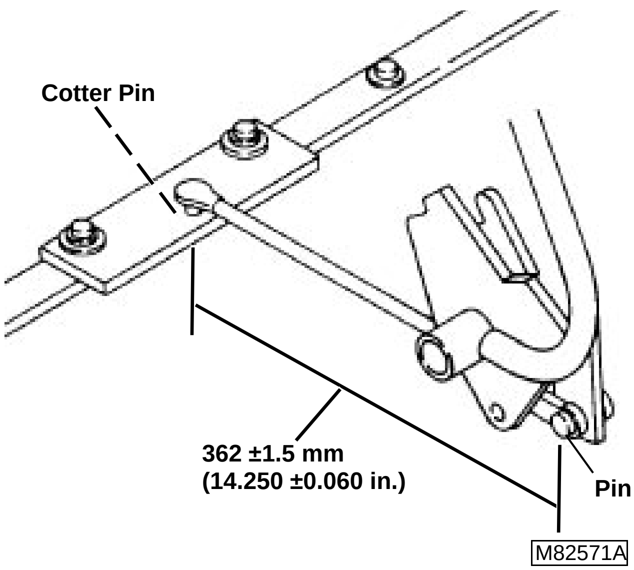
CENTER BRAKE ROD ADJUSTMENT

Reason:

To ensure center brake rod is adjusted to proper length.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Parking brake in UNLOCKED position, and wheels blocked.



6. Remove cotter pin.
7. Remove cotter pin and pin, and remove center brake rod from machine.
8. Adjust assembled length of center brake rod to **362 ±1.5 mm (14.250 ±0.060 in.)** from center of pin to center of hole in yoke.

BRAKE LINKAGE ADJUSTMENT

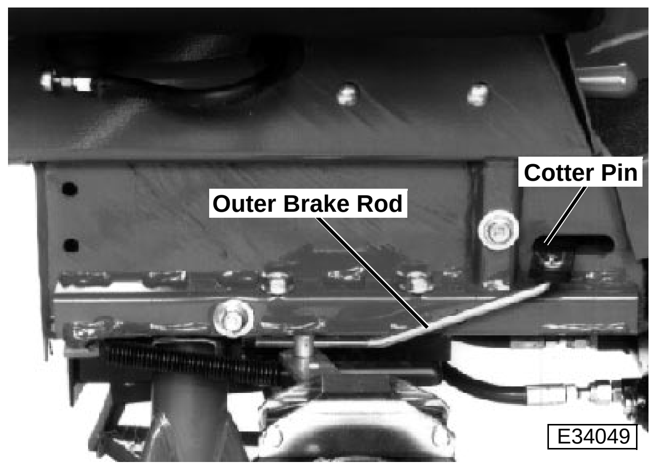
Reason:

To ensure brake linkage is properly adjusted.

Procedure:

NOTE: Center brake rod adjustment should be verified before performing brake linkage adjustment procedure.

1. Adjust center brake rod.



2. Remove cotter pin.
3. Adjust outer brake rod to minimum length possible and still be able to replace rod in lever and install cotter pin.

*NOTE: Initial adjustment on rod is **27 mm (1-1/16 in.) of threaded rod through pivot**.*

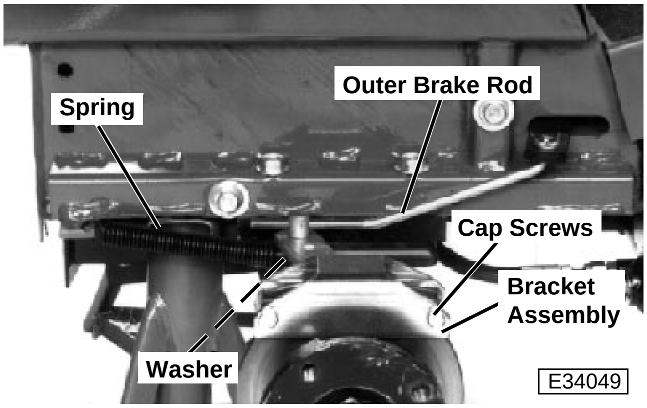
4. Repeat procedure on opposite side.

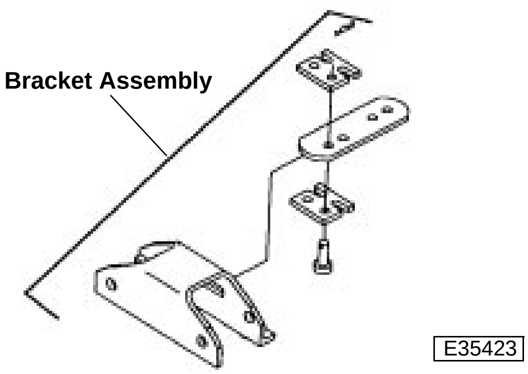
REPAIR

BRAKES

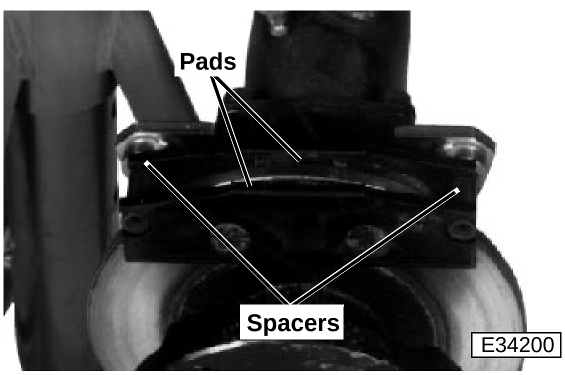
Removal/Inspection/Installation

1. Disconnect negative (–) cable from battery.
2. Lift front of machine. Place support stands under frame.
3. Remove wheel. (See FRONT WHEELS—Removal/ Installation on page 10-3.)

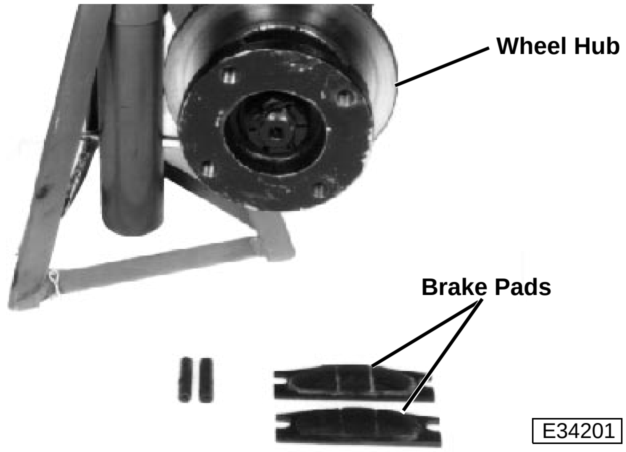




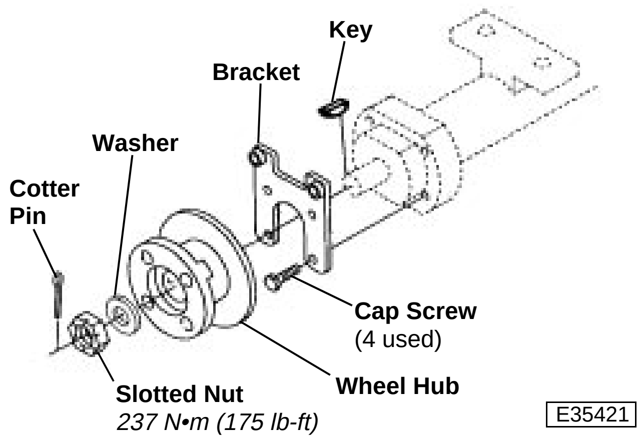
4. Remove spring, and washer located under brake lever.
5. Lift pivot pin and outer brake rod from brake lever.
6. Remove cap screws, nuts, and bracket assembly.



7.Remove pads and spacers.



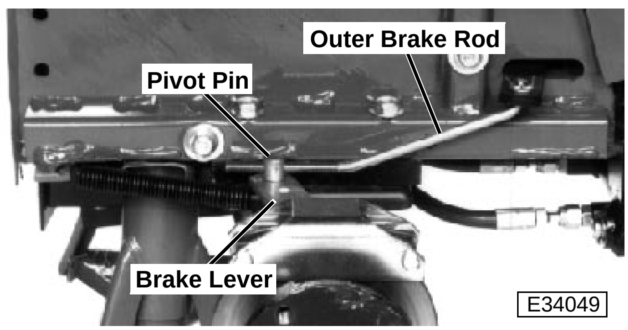
8. Inspect lining on brake pads for wear or oil contamination. Replace pads if worn or contaminated. Inspect axle oil seals if pads are oily.
9. Inspect wheel hub for excessive wear, cracks, or brake disk scoring.



10. Remove cotter pin to remove slotted nut.
11. Pull wheel hub and key from axle shaft.

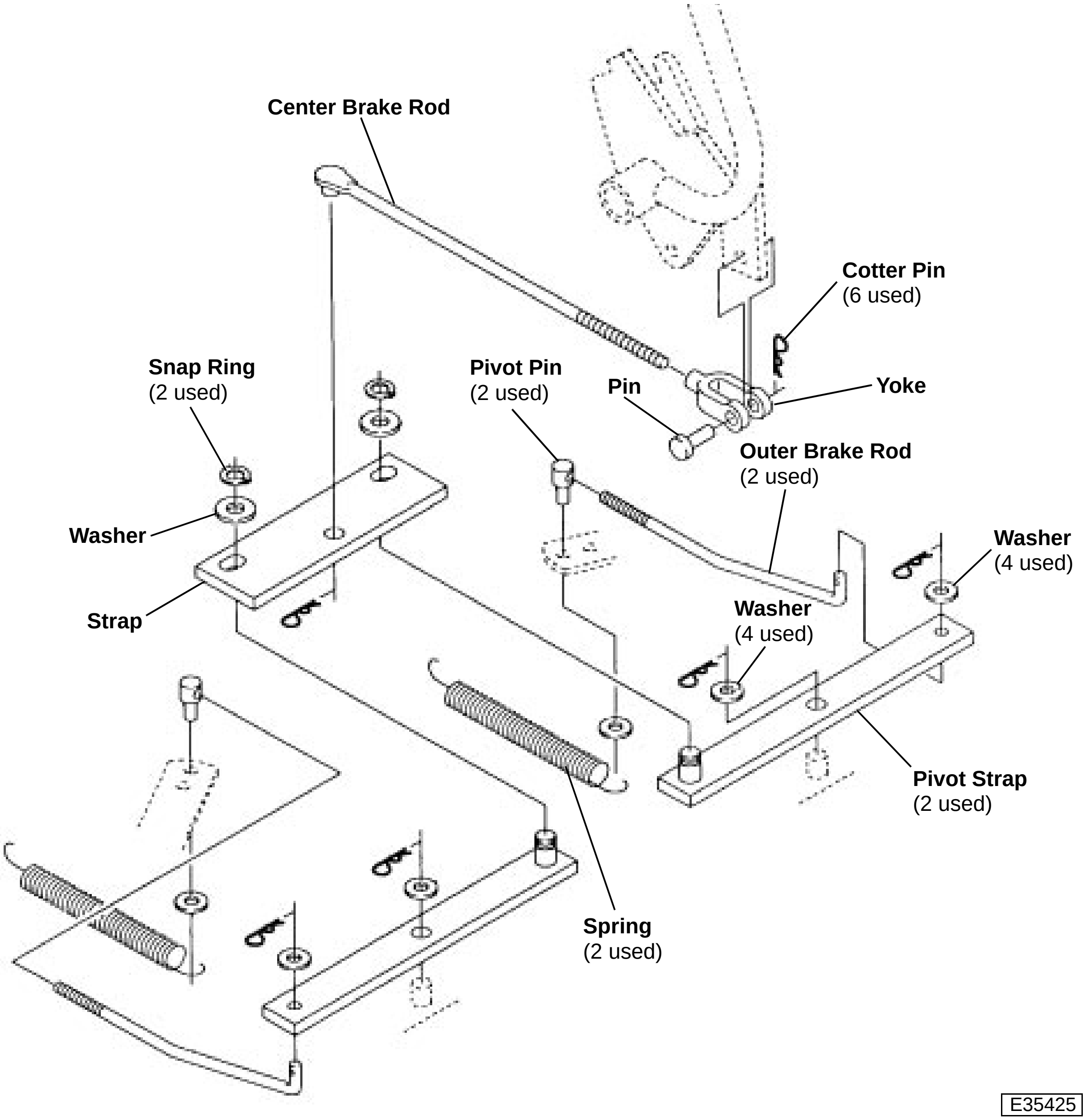
Installation is performed in the reverse order of removal.

- Apply MPG-2® Multipurpose Polymer Grease to tapered section of axle shaft.
- Tighten slotted nut to **237 N•m (175 lb-ft)**.



- Connect outer brake rod. Insert pivot pin into hole in brake lever nearest to machine frame.

BRAKE LINKAGE



- Replace worn or damaged parts.
- Adjust Center Brake Rod and Brake Linkage. (See CENTER BRAKE ROD ADJUSTMENT on page 7-8.)

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HYDRAULICS

CONTENTS

Page

SPECIFICATIONS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydraulic Oil Operating Temperature. . . . . 43°C (110°F)
Reel Drive System Oil Flow Volume . . . . 22 L/min (5.8 gpm) at fast idle
Mow Valve Assembly Relief Pressure . . . . 18960 kPa (2750 psi) at fast idle
Rear Lift Linkage Pin Clearance (Top of Pin to Battery Box) . . 120 mm (4.75 in.)
Rear Lift Linkage Clamp Screws Torque . . . . 129 N•m (95 lb-ft)

REPAIR SPECIFICATIONS

Hydraulic Pump

Pump Section Socket Head Cap Screw Torque: . . . . 63 N•m (48 lb-ft)

Mow Valve (S.N. —957000)

Plunger Tube Assembly Torque . . . . 11 N•m (100 lb-in.)
Tie Rod Nut Torque (in steps):
First Step . . . . 6 N•m (50 lb-in.)
Second Step . . . . 10 N•m (90 lb-in.)
Final Step. . . . . 13 N•m (115 lb-in.)

Lift Valve

Plunger Tube Assembly Torque . . . . 11 N•m (100 lb-in.)
Tie Rod Nut Torque (in steps):
First Step . . . . 6 N•m (50 lb-in.)
Second Step . . . . 10 N•m (90 lb-in.)
Final Step. . . . . 13 N•m (115 lb-in.)

Reel Motor

Body-to-Mounting Flange Socket Head Cap Screw Torque. . . 24 N•m (210 lb-in.)

Front Lift Cylinder

Piston-to-Rod Torque . . . . 61 N•m (45 lb-ft)

Rear Lift Cylinder

Piston-to-Rod Torque . . . . 75 N•m (55 lb-ft)

Optional Mow/Backlap Valve

Mow Valve Torque . . . . 31 N•m (23 lb-ft)
Solenoid Coil Retaining Nut Torque . . . . 8 N•m (70 lb-in.)
Flow Restrictor 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)

Optional Oil Cooler

Oil Line-to-Oil Cooler Connector Torque . . . . 46 N•m (44 lb-ft)
Oil Line-to-Hydraulic Hose Connector Torque . . . . 24 N•m (18 lb-ft)

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).

JT054469 Flowmeter Kit
Used to check hydraulic system flow.

JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
Used with Flowmeter kit.

JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
Used with Flowmeter kit.

JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
Used with Flowmeter kit.

JT03385 7/8 M 37° x 9/16 F ORB Adapter Fitting
Used with Flowmeter kit.

138H1160 11/16 M ORFS x 11/16 HORB Adapter Fitting
Used with Flowmeter kit.

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS U.S./ Canadian/ LOCTITE No.		
T43512 TY9473/ 242	Thread Lock and Sealer (Medium Strength)	Retain piston on rod for lift cylinders.

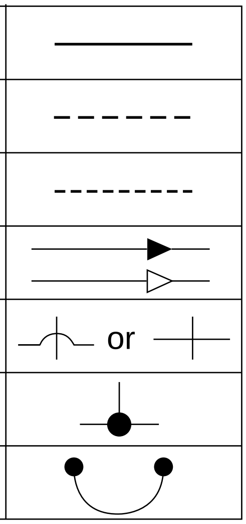
SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Hydraulic Pump Seal Kit
- Reel Motor Seal Kit
- Rear Lift Cylinder Seal Kit
- Front Lift Cylinder Seal Kit
- Optional Mow/Backlap Valve O-Ring Kit

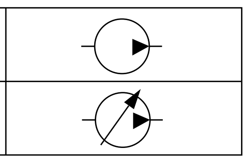
JIC HYDRAULIC CIRCUIT SYMBOLS

LINES



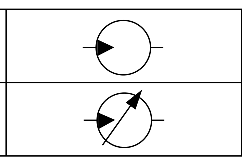
1	Working (Main) Lines
2	Pilot Control Lines
3	Drain Line
4	Hydraulic / Pneumatic } Flow Direction
5	Crossing Lines
6	Joining Lines
7	Flexible Line

PUMPS



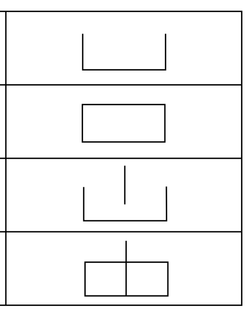
8	Fixed Displacement
9	Variable Displacement

MOTORS

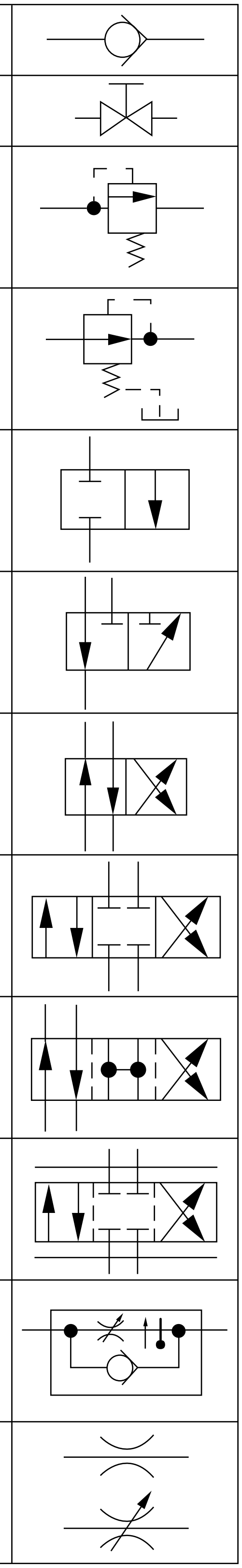


10	Fixed Displacement
11	Variable Displacement

RESERVOIR



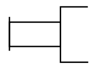
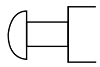
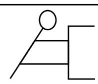
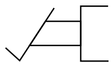
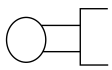
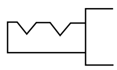
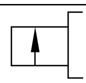
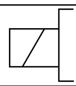
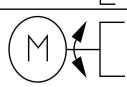
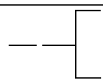
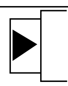
12	Vented Reservoir
13	Pressurized Reservoir
14	Reservoir Return -Above Fluid Level
15	Reservoir Return -Below Fluid Level



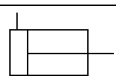
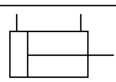
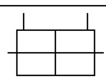
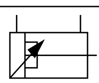
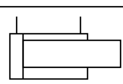
16	Check Valve
17	Manual On/Off Valve
19	Pressure Relief Valve
20	Pressure Reduction Valve
21	Two Position, Two Connection Valve
22	Two Position, Three Connection Valve
23	Two Position, Four Connection Valve
24	Three Position, Four Connection Valve
25	Two Position, Four Connection Valve with Transmission
26	Three Position, Four Connection Valve with Infinite Positioning
27	Adjustable Flow Control Valve (Temperature and Pressure Compensated)
18	Fixed / Variable } Orifice

M82612AE

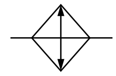
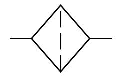
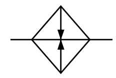
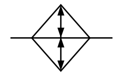
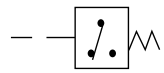
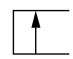
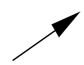
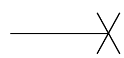
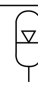
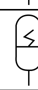
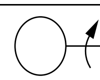
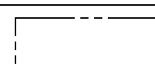
VALVE OPERATORS

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

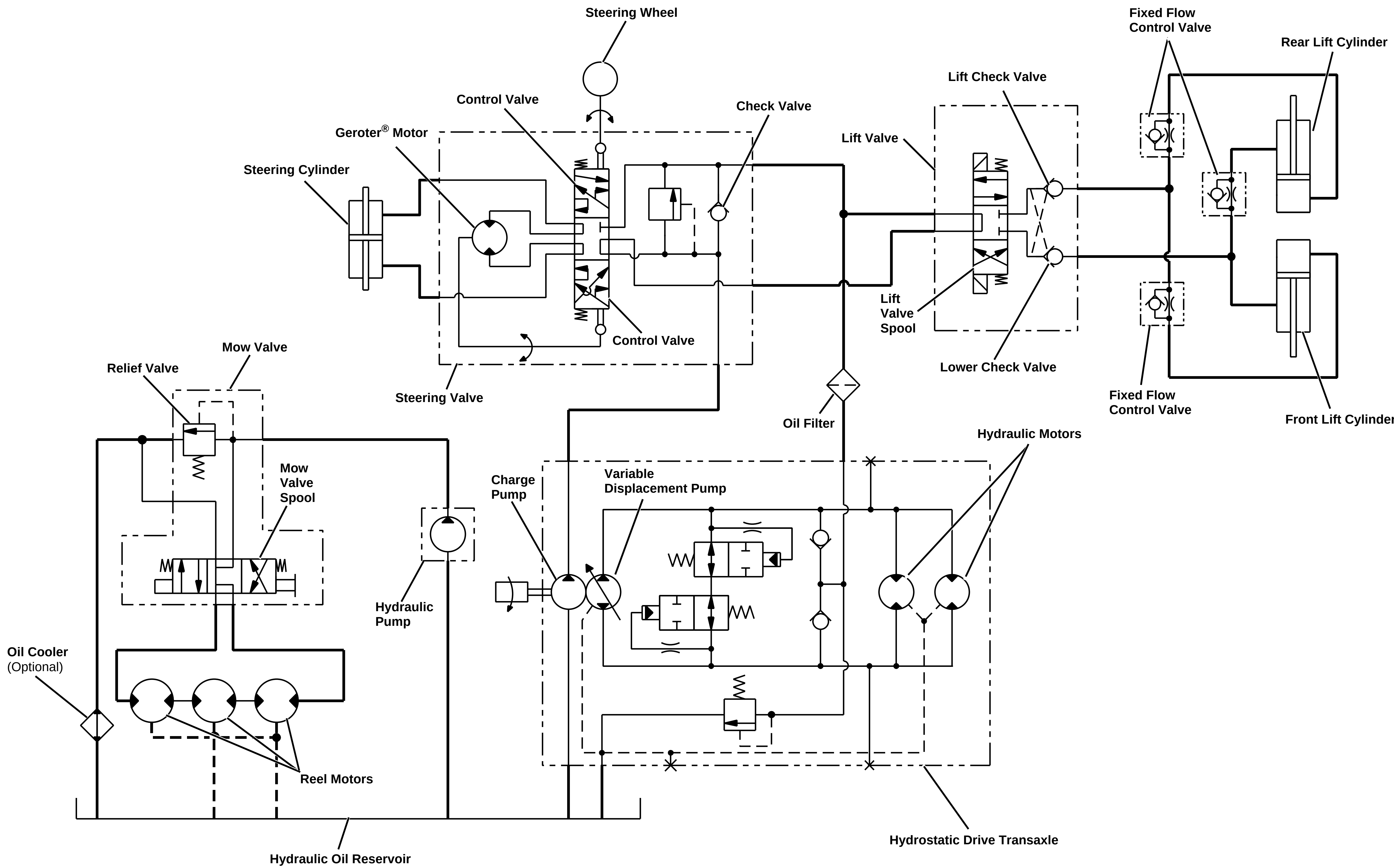
40		Single Acting
41		Double Acting, Single Rod
42		Double Acting, Double Rod
43		Double Acting, Adj. Cushion, Extend Only
44		Double Acting, Differential Piston

MISCELLANEOUS

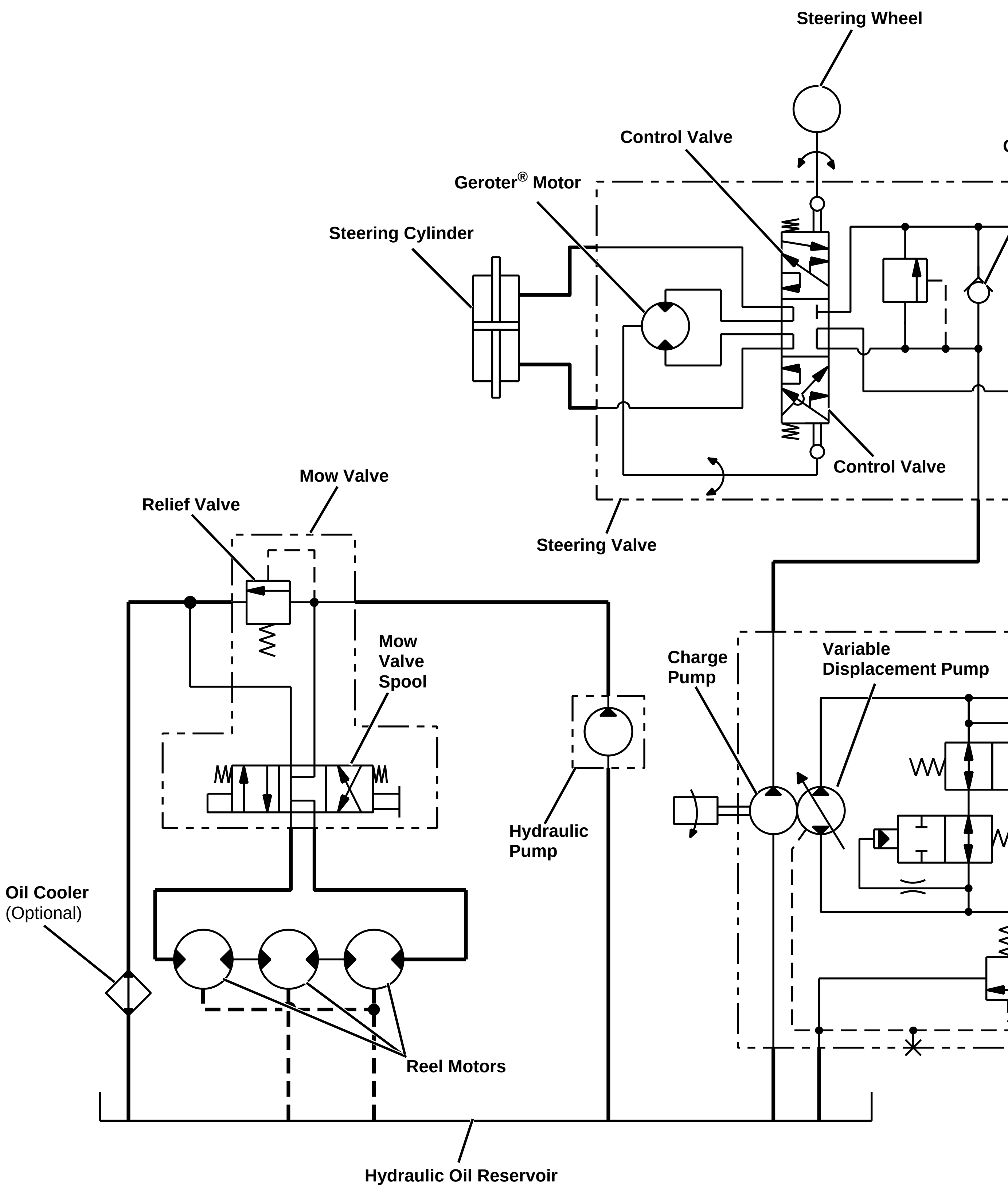
45		Cooler
46		Filter, Strainer
47		Heater
48		Temperature Controller
49		Pressure Switch
50		Pressure Indicator
51		Temperature Indicator
52		Pressure Compensated
53		Variable Component (Symbol Thru Component)
54		Plug, Test Port, Pressure Supply Test
55		Gas Charged Accumulator
56		Spring Loaded Accumulator
57		Electric Motor
58		Shaft Rotation (Arrow on Near Side of Shaft)
59		Component Outline

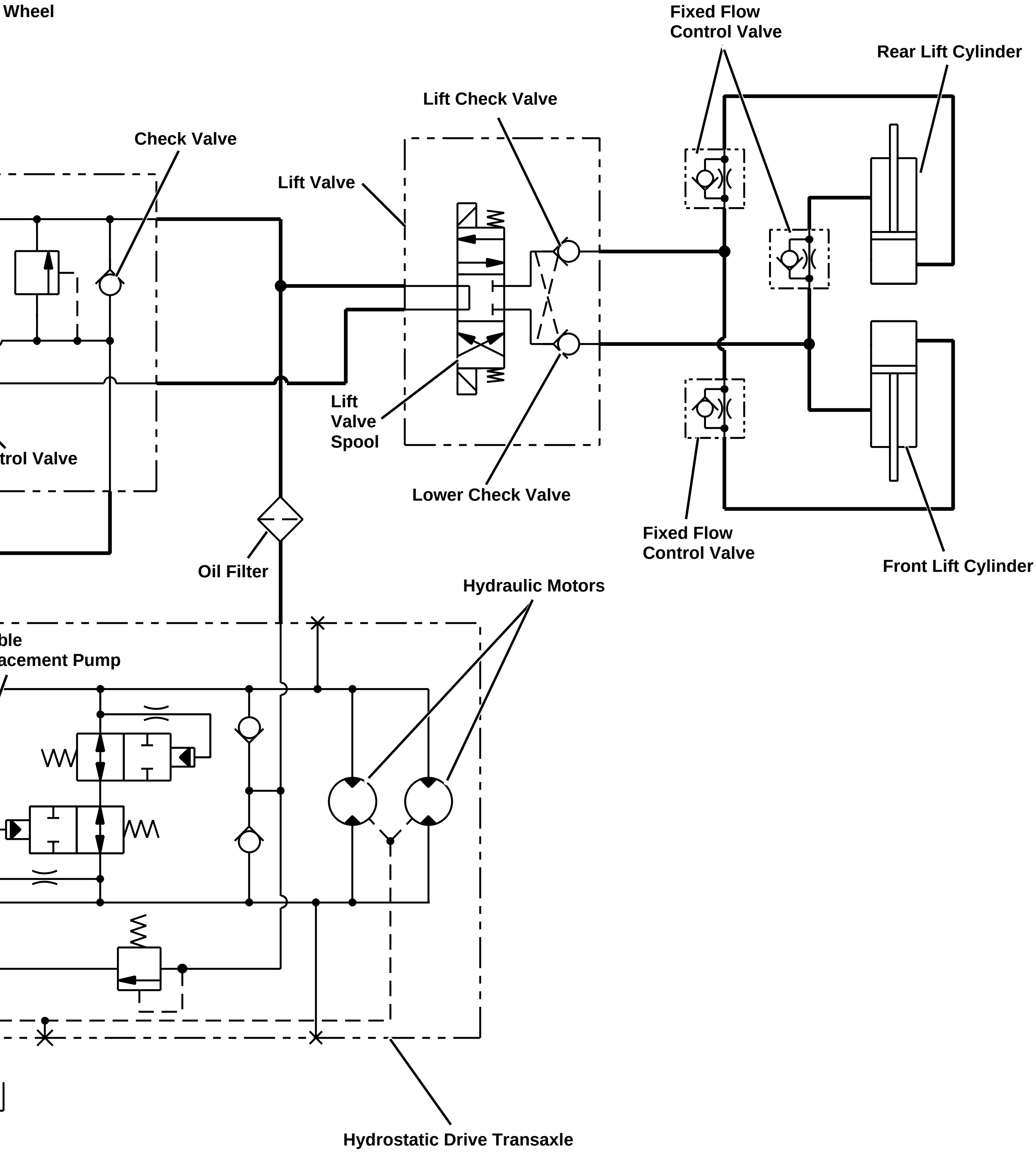
M82613AE

HYDRAULIC/HYDROSTATIC SCHEMATIC (S.N. —957000)



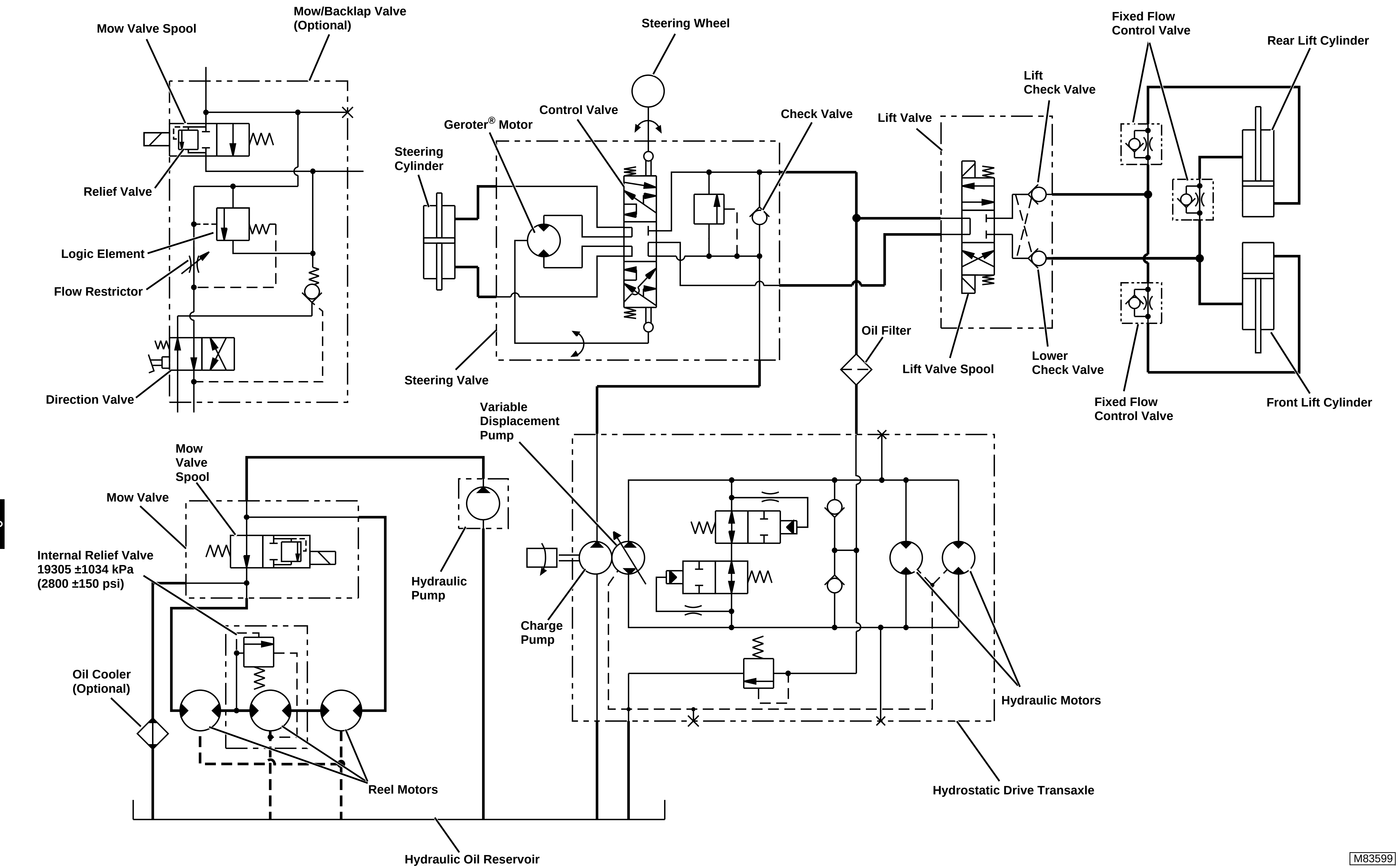
HYDRAULIC/HYDROSTATIC SCHEMATIC (S.N. —957000)



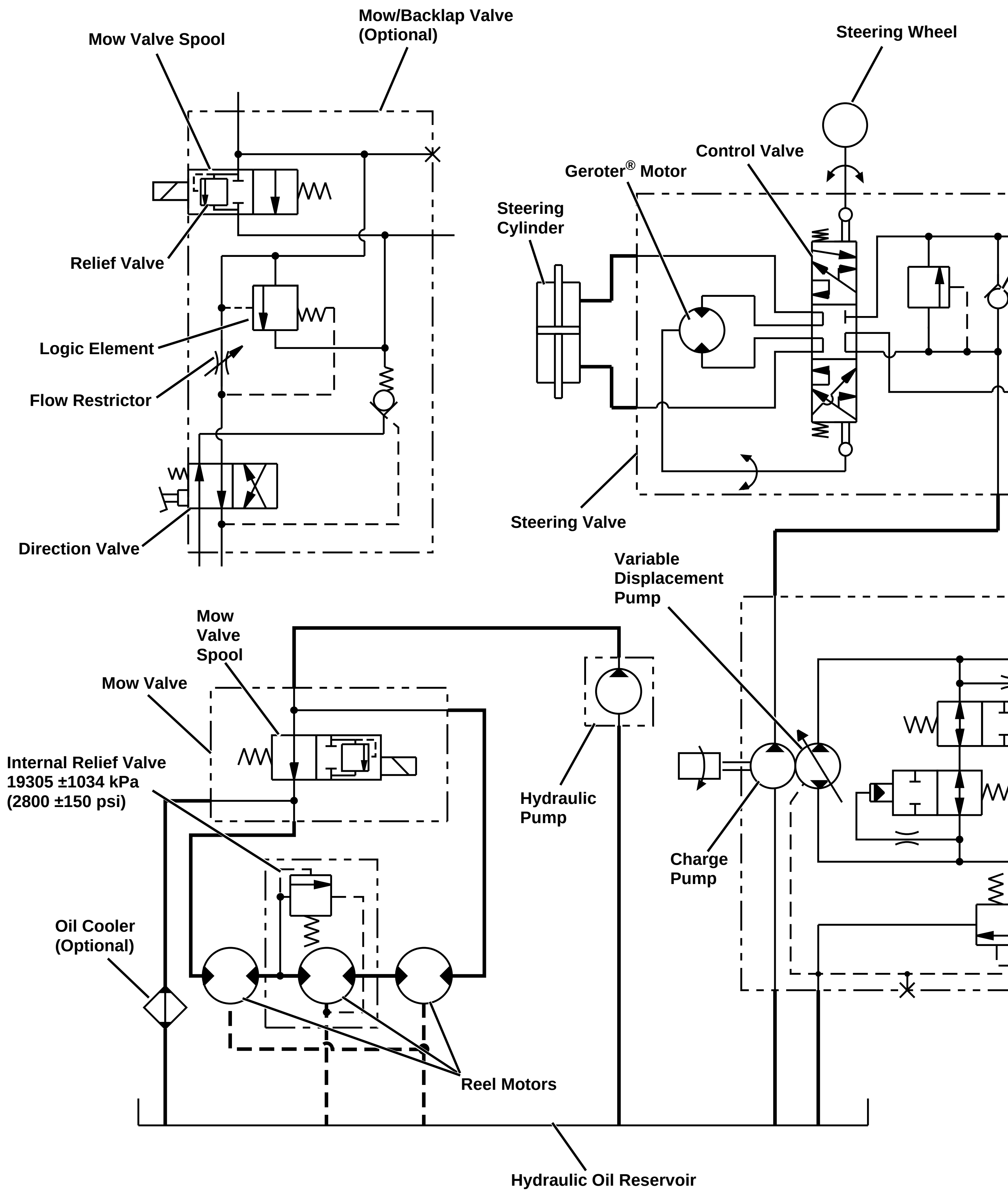


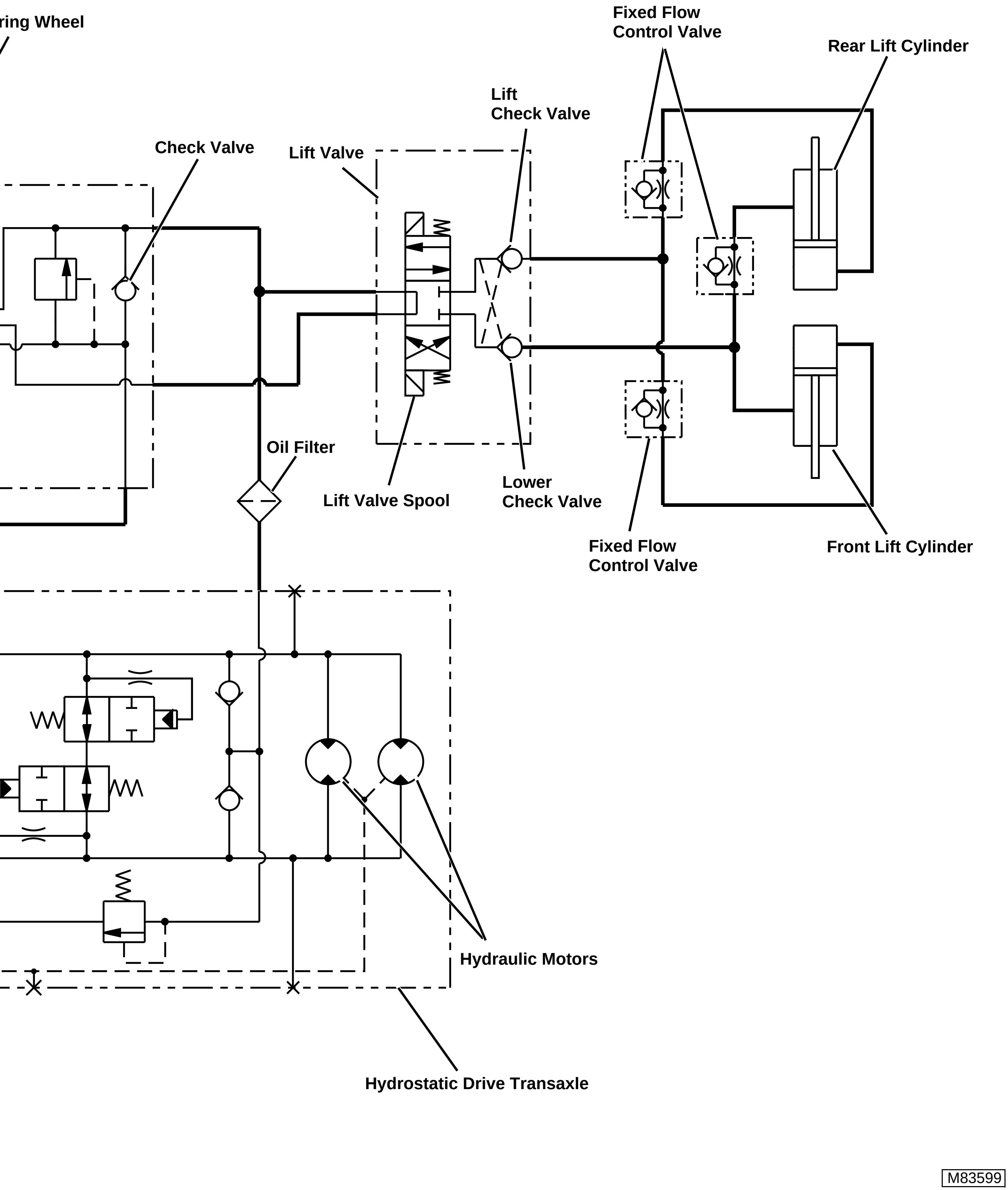
Wheel
Fixed Flow Control Valve
Rear Lift Cylinder
Lift Check Valve
Check Valve
Lift Valve
Lift Valve Spool
trol Valve
Lower Check Valve
Fixed Flow Control Valve
Front Lift Cylinder
Oil Filter
Hydraulic Motors
ble
acement Pump
Hydrostatic Drive Transaxle

HYDRAULIC/HYDROSTATIC SCHEMATIC (S.N. 957001—)



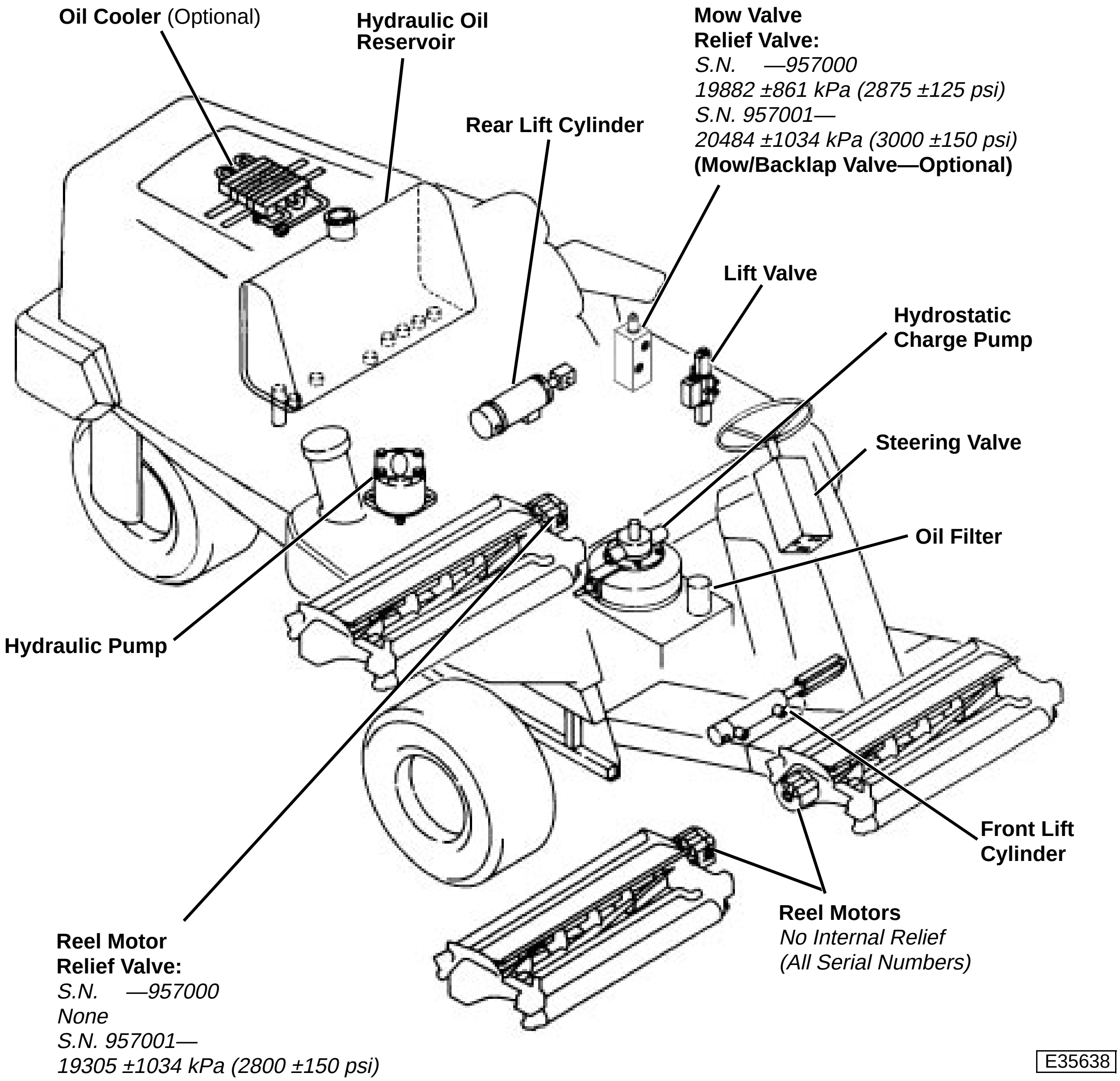
HYDRAULIC/HYDROSTATIC SCHEMATIC (S.N. 957001—)




ring Wheel
Fixed Flow
Control Valve
Rear Lift Cylinder
Lift
Check Valve
Check Valve
Lift Valve
Oil Filter
Lift Valve Spool
Lower
Check Valve
Fixed Flow
Control Valve
Front Lift Cylinder
Hydraulic Motors
Hydrostatic Drive Transaxle
M83599

COMPONENT LOCATION AND OPERATION

HYDRAULIC COMPONENTS



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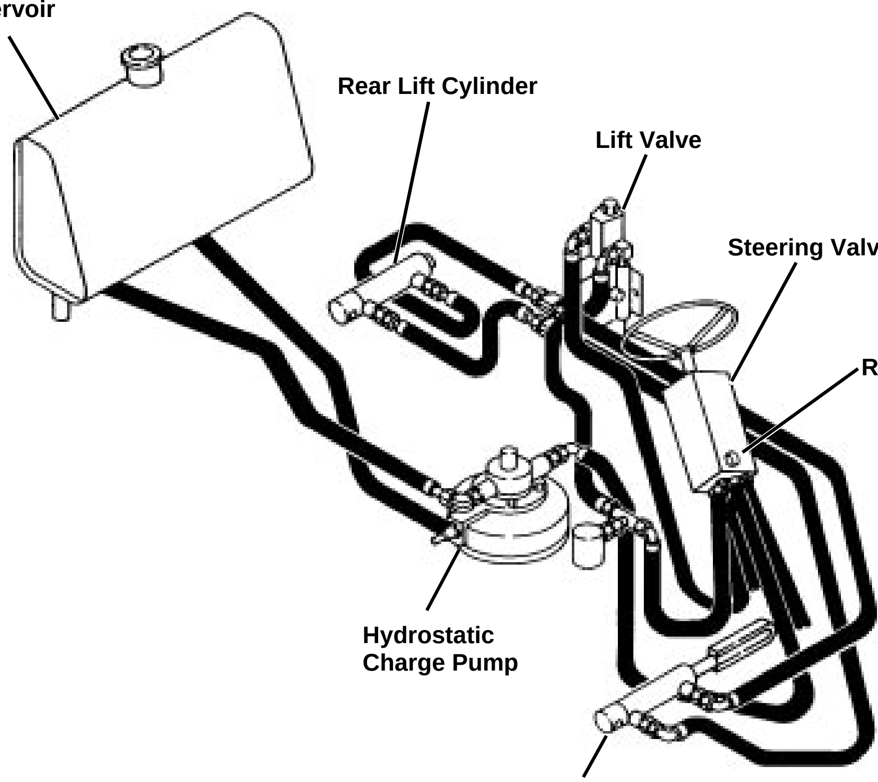
LIFT SYSTEM OPERATION



Function:

To lift or lower the cutting units.

Theory of Operation:

Oil is pressurized by the hydrostatic charge pump and routed through the steering valve. The only time oil does not flow through the steering valve is when a full right or left turn is made. At this time the steering cylinder piston is bottomed, causing the relief valve to open, routing oil to the hydrostatic pump. From the steering valve, high pressure oil is routed to the lift valve.

When the lower switch is depressed, oil is routed to the rod ends of the lift cylinders, lowering the cutting units.

When the raise switch is pushed, oil is routed to the cylinder ends of the lift cylinders, raising the cutting units.

The lift system is protected by the 5000 kPa (725 psi) relief valve located in the steering valve. The lift system goes over relief at the end of the lift or lower cycles when the cylinder pistons are bottomed. Excess oil dumps across the relief to the hydrostatic pump.

The system will stay in relief after the cylinders have completed their stoke because of the time delay built into the controller which continues to energize the lift or lower solenoids.

LIFT VALVE ASSEMBLY—LOWER OPERATION

Function:

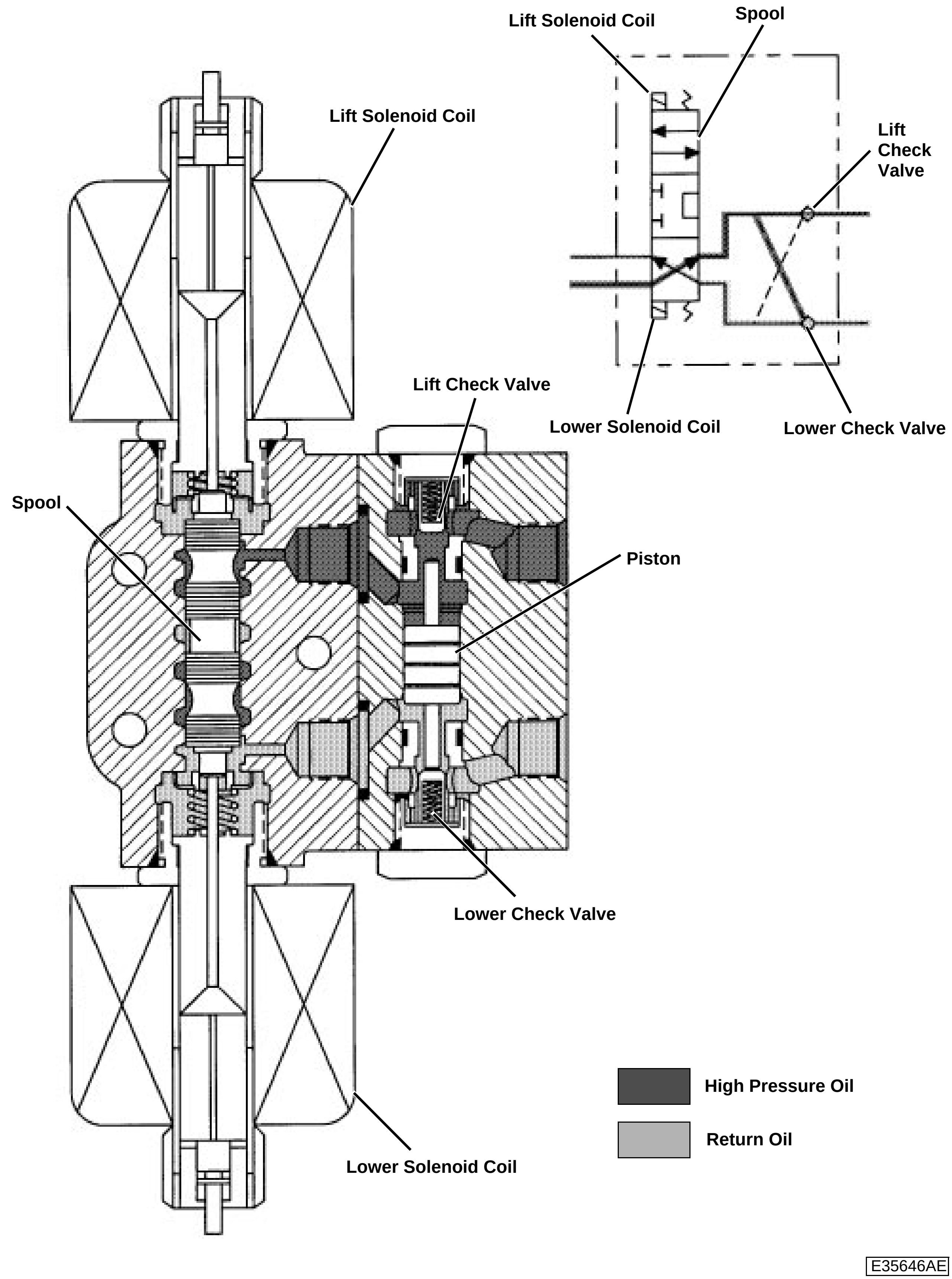
To lower the cutting units as the mow system is engaged.

Theory of Operation:

When the lower switch is depressed, the controller energizes lower solenoid coil of the lift valve. The solenoid pushes spool up allowing high pressure oil to flow into the upper port of the valve.

High pressure oil flows into the lock valve portion of the lift valve, pushing piston down and upper lift check valve up. High pressure oil can now flow out of the rod end of the lift cylinders. The downward motion of the piston pushes against lower check valve opening the passageway for return oil from the cylinders.

When the solenoid is de-energized, springs return the spool to center and pressurized oil is routed directly to return in the center two passages. Check valves close trapping oil in hydraulic hoses and cylinders.


Lift Solenoid Coil
Spool
Lift Check Valve
Lower Solenoid Coil
Lower Check Valve
Lift Solenoid Coil
Lift Check Valve
Spool
Piston
Lower Check Valve
Lower Solenoid Coil
High Pressure Oil
Return Oil
E35646AE

LIFT VALVE ASSEMBLY—RAISE OPERATION

Function:

To raise the cutting units when the mow system is disengaged.

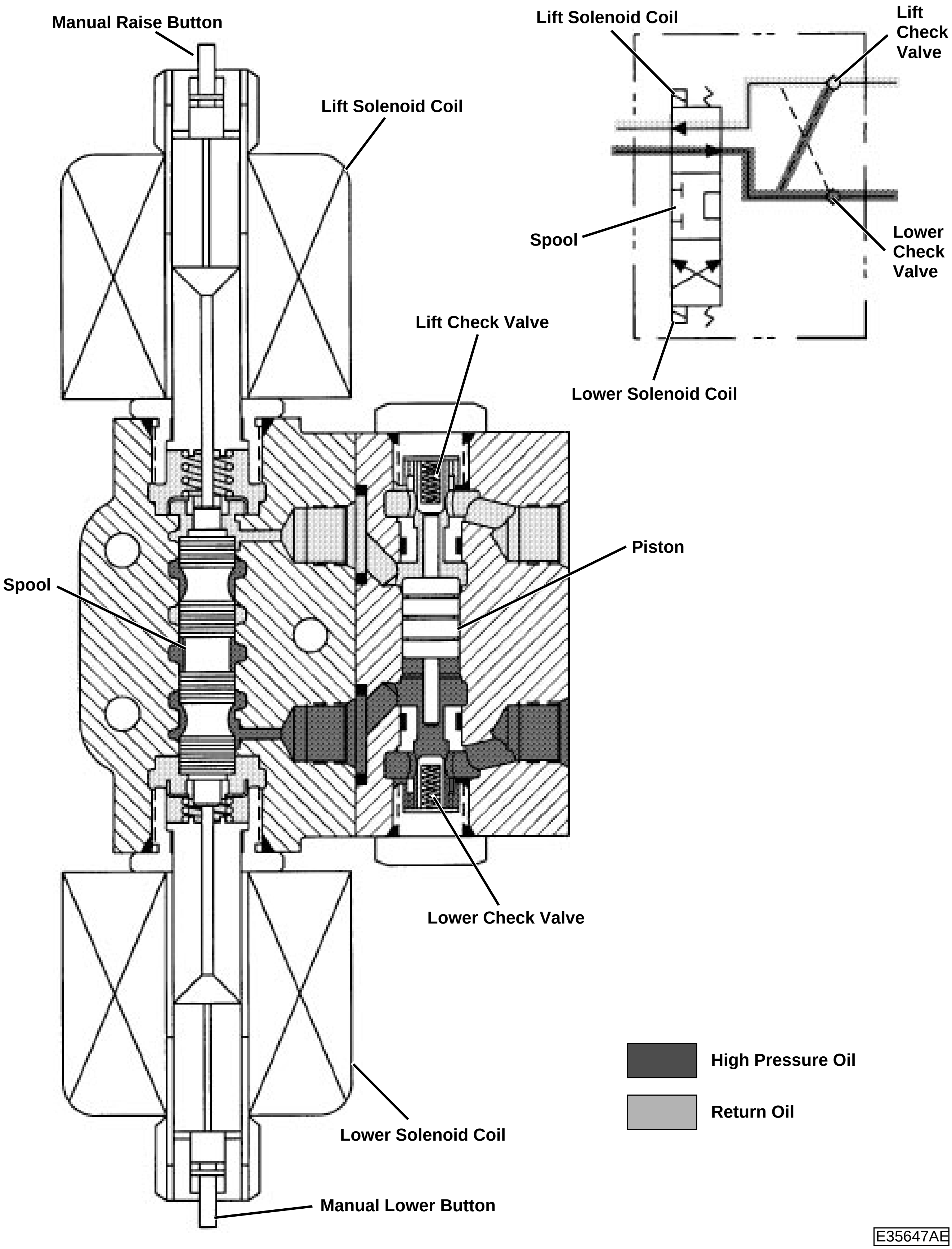
Theory of Operation:

When the raise switch is depressed, the controller energizes the upper solenoid coil. The solenoid pushes spool down allowing pressurized oil to flow into the lower port.

High pressure oil pushes piston down and lower check valve down. Pressurized oil flows to the cylinder end of the lift cylinders, raising the cutting units. Piston also pushes lift check valve, opening the upper port to return oil from the cylinders.

If there is a problem with the electrical system, the cutting units can be raised by pushing manual raise button or lowered by pushing manual lower button.

NOTE: When manually raising or lowering cutting units, pressurized oil from the hydraulic pump must be present to open check valves in the lock portion of the valve.


Manual Raise Button
Lift Solenoid Coil
Lift Solenoid Coil
Lift Check Valve
Spool
Lower Check Valve
Lower Solenoid Coil
Lift Check Valve
Piston
Spool
Lower Check Valve
Lower Solenoid Coil
Manual Lower Button
High Pressure Oil
Return Oil
E35647AE

FRONT LIFT CYLINDER OPERATION

Function:

To lift (or lower) the front cutting units.

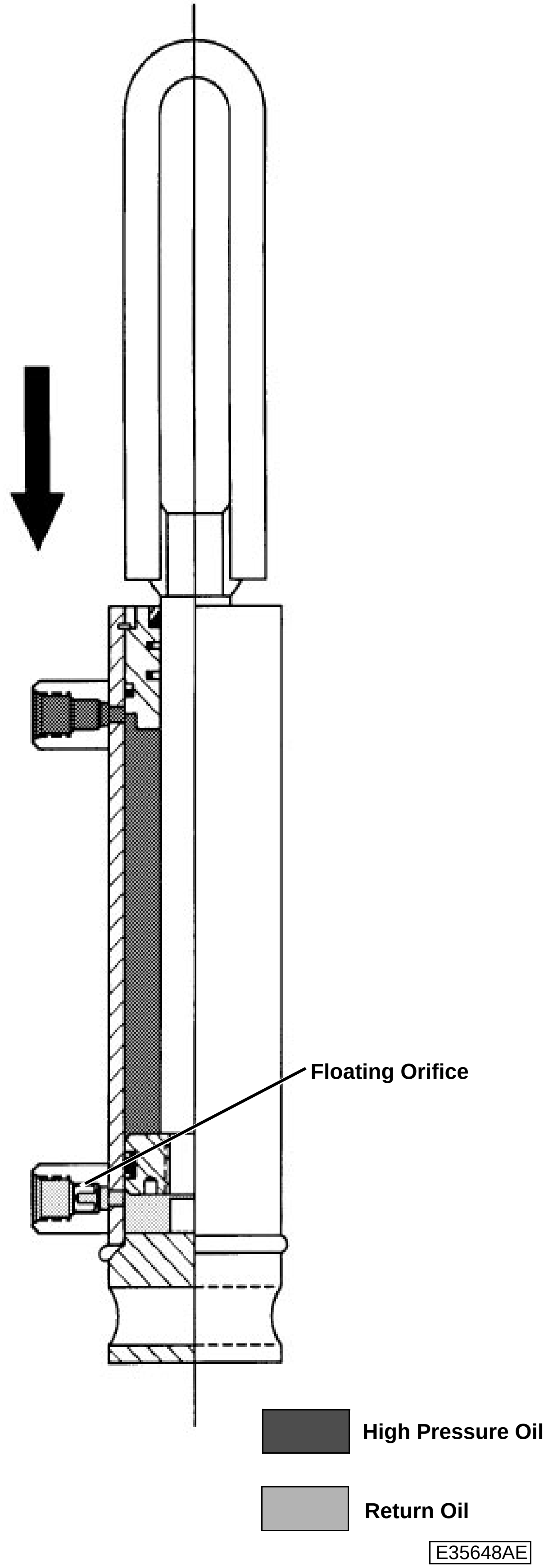
Theory of Operation:

NOTE: Lower operation shown.

The lift cylinder is a double-action, single rod design. This design allows positive control when raising or lowering of the cutting units.

Floating orifice is installed with the slot towards the cylinder. When oil flow pushes on the flat side of the orifice, oil flows through the orifice hole as well around the hex of the orifice and through the slot. When the oil flow pushes on the slotted side of the orifice, the orifice seals itself against the hydraulic fitting. This forces all oil flow to go through the small hole of the orifice only.

The orifice prevents the cutting units from hitting the green too hard when lowered.



REAR LIFT CYLINDER OPERATION

Function:

To lift (or lower) the front cutting units.

Theory of Operation:

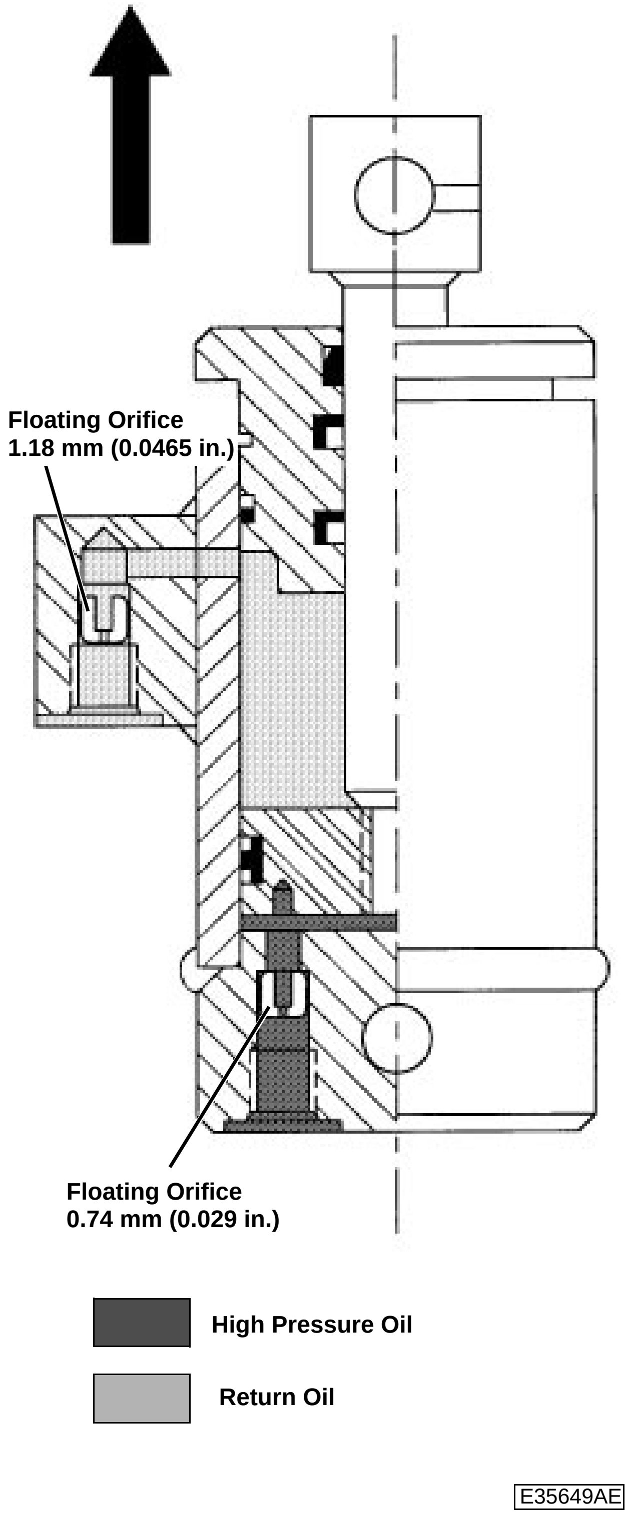
NOTE: Raise operation shown.

The lift cylinder is a double-action, single rod design. This design allows positive control when raising or lowering of the cutting units.

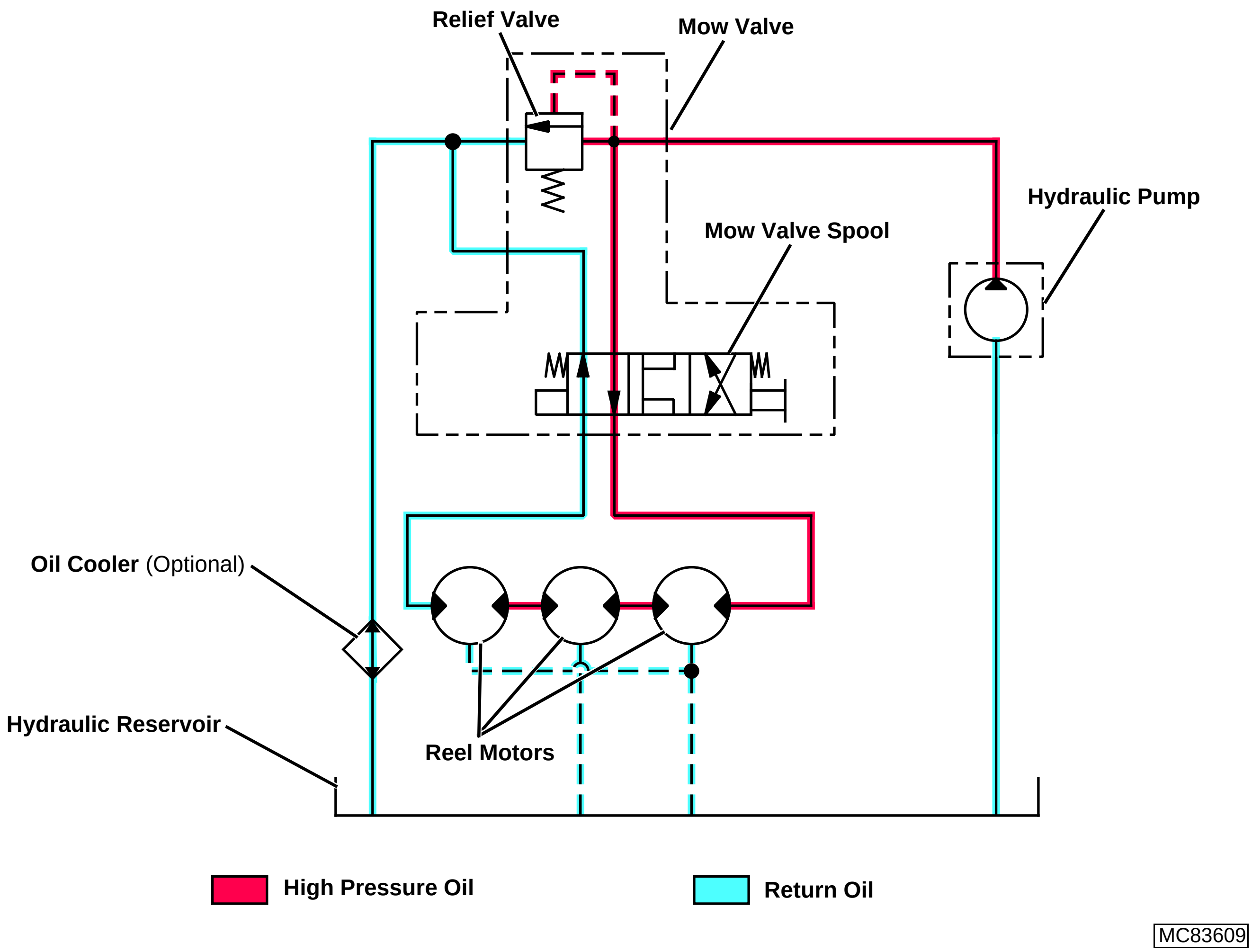
Two different size floating orifices and are used in the lift cylinder ports:

Floating orifices are installed with the slot towards the cylinder. When oil flow pushes on the flat side of the orifice, oil flows through the orifice hole as well around the hex of the orifice and through the slot. When the oil flow pushes on the slotted side of the orifice, the orifice seals itself against the hydraulic fitting. This forces all oil flow to go through the small hole of the orifice only.

The orifices are used to sequence the rear cutting unit, with respect to the front cutting units. Ideally the rear cutting unit should raise and lower so that it contacts the ground at the same point that the front units make contact.



REEL DRIVE SYSTEM OPERATION—MOW (S.N. —957000)



Function:

To drive the cutting unit reels with hydraulic motors.

Theory of Operation:

The mow system is an independent hydraulic circuit consisting of the hydraulic oil reservoir, hydraulic pump, mow valve, and three hydraulic reel motors.

The hydraulic pump draws oil from the reservoir and pressurizes it. The oil is then routed to the mow valve. When the mow valve is in the neutral position, the oil bypasses the reel drive system and is routed to the optional oil cooler (if equipped) and hydraulic reservoir.

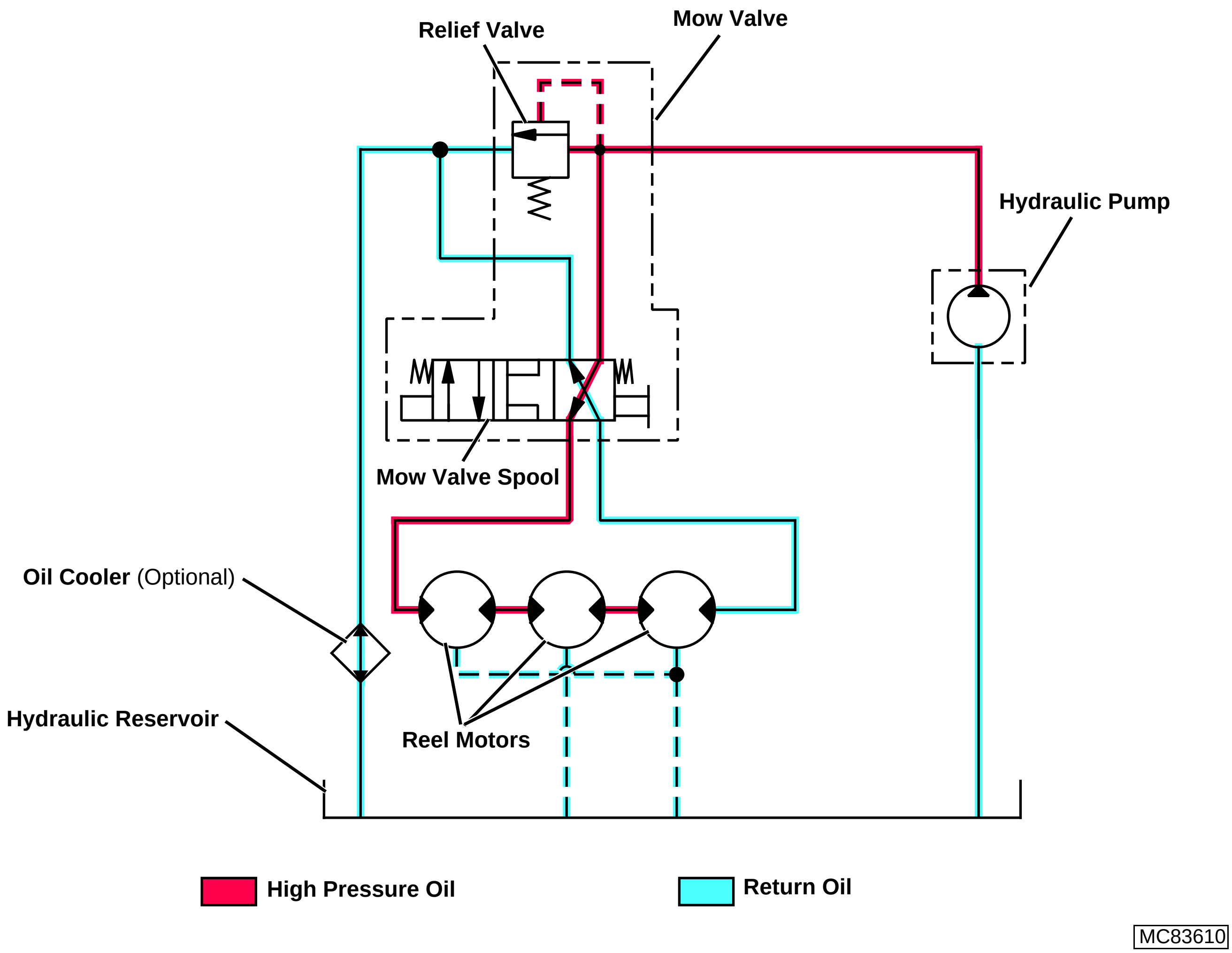
When the mow solenoid is energized, the mow valve spool shifts position, routing oil to the hydraulic reel motors in series: first to the left front motor, then to the rear (center) motor, then to the right front motor, and finally back to the mow valve. Oil is then routed to the optional oil cooler (if equipped) and hydraulic reservoir.

Total system pressure required to operate the reel motors is divided equally between the motors. The maximum system pressure of 20684 kPa (3000 psi) is controlled by a relief valve in the inlet section of the mow solenoid valve.

Reel motors are bi-directional. Pressurized oil is allowed to leak past the moving gears in the motors for lubrication and cooling. This leak-off oil is routed directly back to the reservoir.

To ensure proper cutting unit motor rotation, position the motor so that the leak-off port is to the top and connect the inlet hose to the front port and the outlet hose to the rear port.

REEL DRIVE SYSTEM OPERATION—BACKLAP (S.N. —957000)



Function:

To drive the cutting unit reels with hydraulic motors.

Theory of Operation:

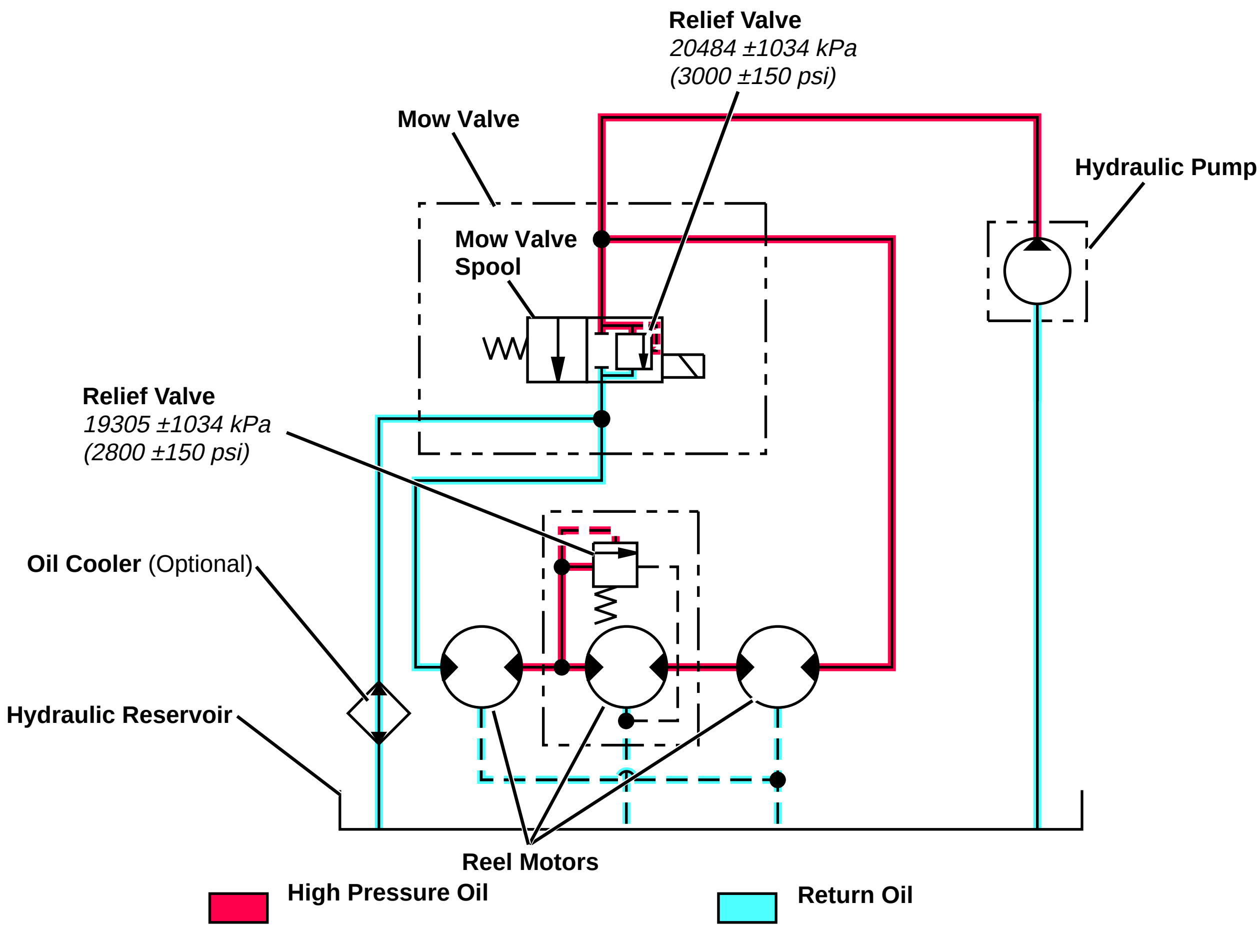
The mow system is an independent hydraulic circuit consisting of the hydraulic oil reservoir, hydraulic pump, mow valve, and three hydraulic reel motors.

The hydraulic pump draws oil from the reservoir and pressurizes it. The oil is then routed to the mow valve. When the mow valve is in the neutral position, the oil bypasses the reel drive system and is routed to the optional oil cooler (if equipped) and hydraulic reservoir.

As the knob on the mow valve is turned clockwise, the mow valve spool is pushed down, allowing oil to flow to the lower port of the mow valve. This oil flow reverses the reels for backlapping. As the knob is turned more, the speed of the reels will increase.

The knob must be turned counterclockwise as far as possible after completing the backlapping procedure. This will ensure full spool travel when the mow solenoid is engaged.

REEL DRIVE SYSTEM OPERATION—MOW (S.N. 957001—)



MC83611

Function:

To drive the cutting unit reels with hydraulic motors.

Theory of Operation:

NOTE: In some applications, the standard mow valve assembly may be replaced by the optional mow/backlap valve assembly. This will allow the reel motors to be driven in reverse to permit reel "backlapping". See OPTIONAL MOW/BACKLAP VALVE ASSEMBLY OPERATION for further information.

The mow system is an independent hydraulic circuit consisting of the hydraulic oil reservoir, hydraulic pump, mow valve, and three hydraulic reel motors.

The hydraulic pump draws oil from the reservoir and pressurizes it. The oil is then routed to the mow valve (or optional Mow/Backlap valve). When the mow valve is in the neutral position, the oil bypasses the reel drive system and is routed to the optional oil cooler (if equipped) and hydraulic reservoir.

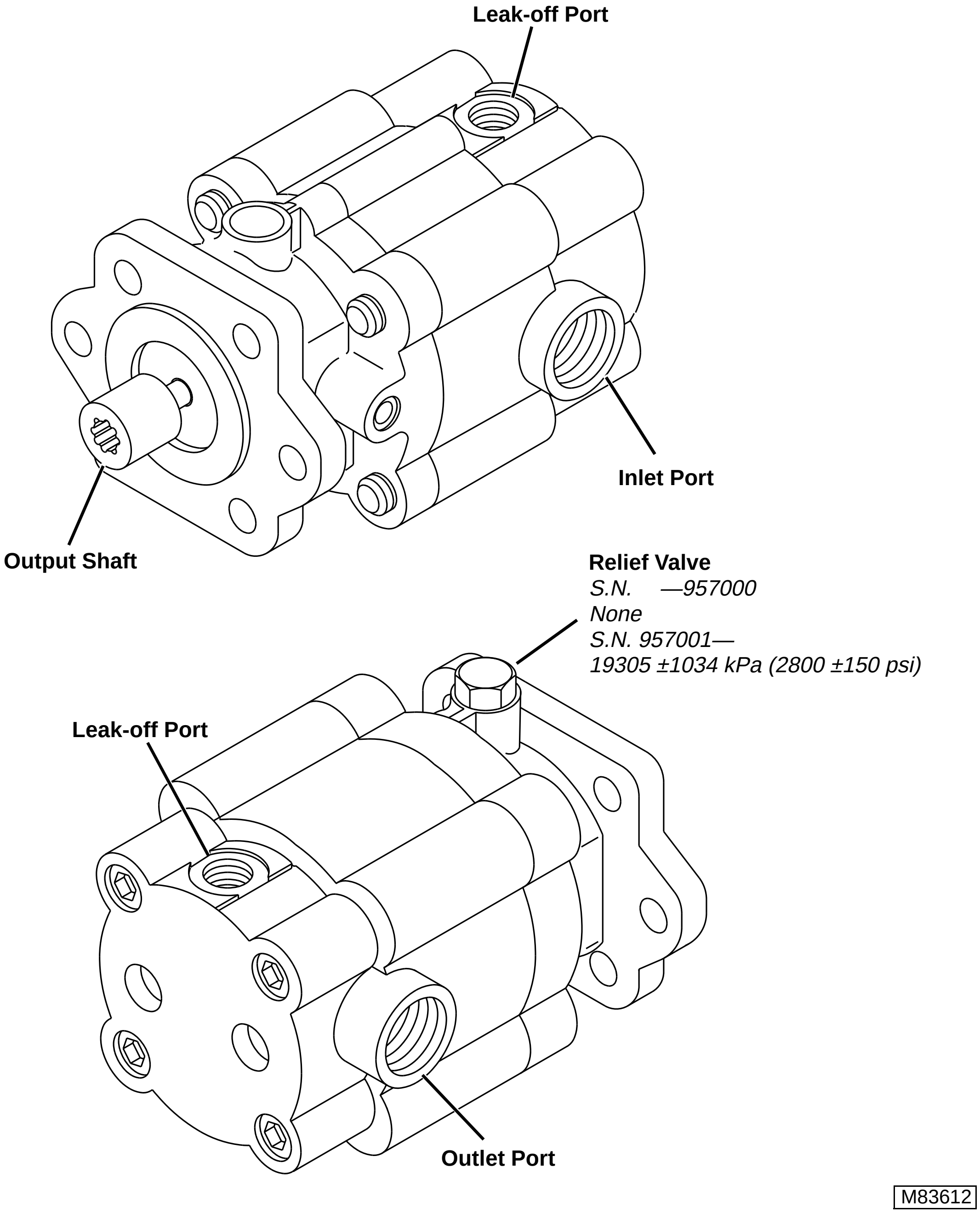
When the mow solenoid is energized, oil is routed to the hydraulic reel motors in series: first to the left front motor, then to the rear (center) motor, then to the right front motor, and finally back to the mow valve. Oil is then routed to the optional oil cooler (if equipped) and hydraulic reservoir.

Total system pressure required to operate the reel motors is divided equally between the motors. The maximum system pressure of 20684 kPa (3000 psi) is controlled by a relief valve in the inlet section of the mow solenoid valve.

Reel motors are bi-directional. Pressurized oil is allowed to leak past the moving gears in the motors for lubrication and cooling. This leak-off oil is routed directly back to the reservoir.

To ensure proper cutting unit motor rotation, position the motor so that the leak-off port is to the top and connect the inlet hose to the front port and the outlet hose to the rear port.

REEL MOTOR OPERATION



Function:

To drive the cutting unit reels by hydraulic pressure.

Theory of Operation:

When the mow system is energized, oil is routed to the hydraulic reel motors in series: first to the left front motor, then to the rear (center) motor, then to the right front motor, and finally back to the mow valve. Oil is then returned to then routed to the optional oil cooler (if equipped) and hydraulic reservoir.

High pressure oil enters the motor at inlet port, and is applied to the gears, causing the gears and output shaft to turn, driving the reel. Oil then exits the reel motor through outlet port.

Motors are bi-directional. High pressure oil is allowed to leak past the moving gears of the motors for lubrication and cooling. This leak-off oil is routed directly back to the reservoir.

To ensure proper motor rotation for any cutting unit, position the motor leak-off port to the top and connect the inlet hose to the front (inlet) port and the outlet hose the rear port.

OPTIONAL MOW/BACKLAP VALVE ASSEMBLY (S.N. 957001—)

General Overview

Function:

To control the flow direction, maintain proper oil flow volume, and allow adjustment of the reel motor speed.

Theory of Operation:

High pressure oil supplied by the hydraulic pump enters the valve assembly at Port “P” and is applied to the lower port of mow valve. When the mow system is not active, oil flows through the mow valve and exits the valve assembly at port “T”, returning to the hydraulic reservoir via the optional oil cooler (if equipped).

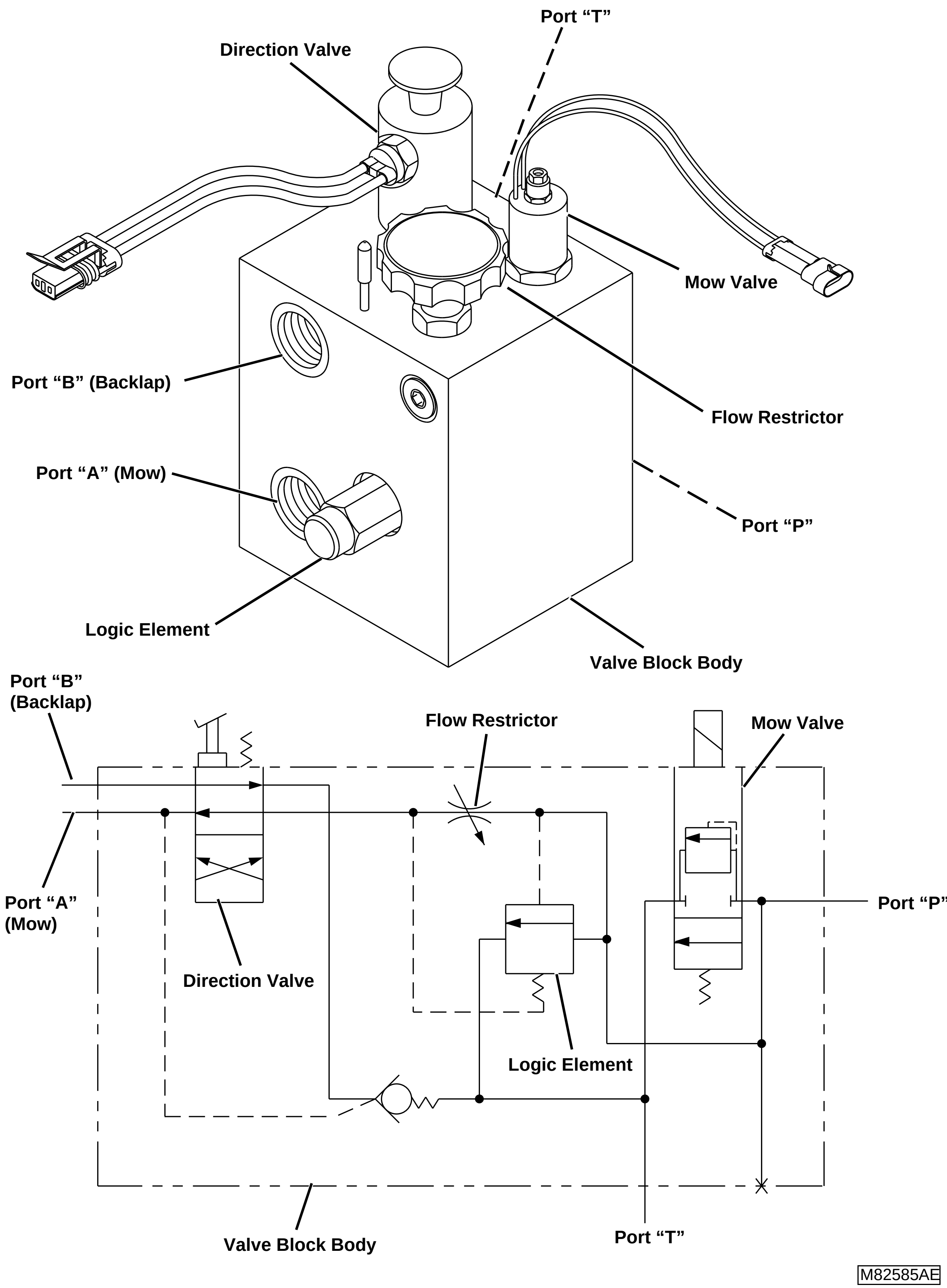
When the mow system is active, the mow valve closes diverting oil flow to logic element, flow restrictor, and direction valve.

The logic element maintains proper oil flow volume by compensating for flow irregularities.

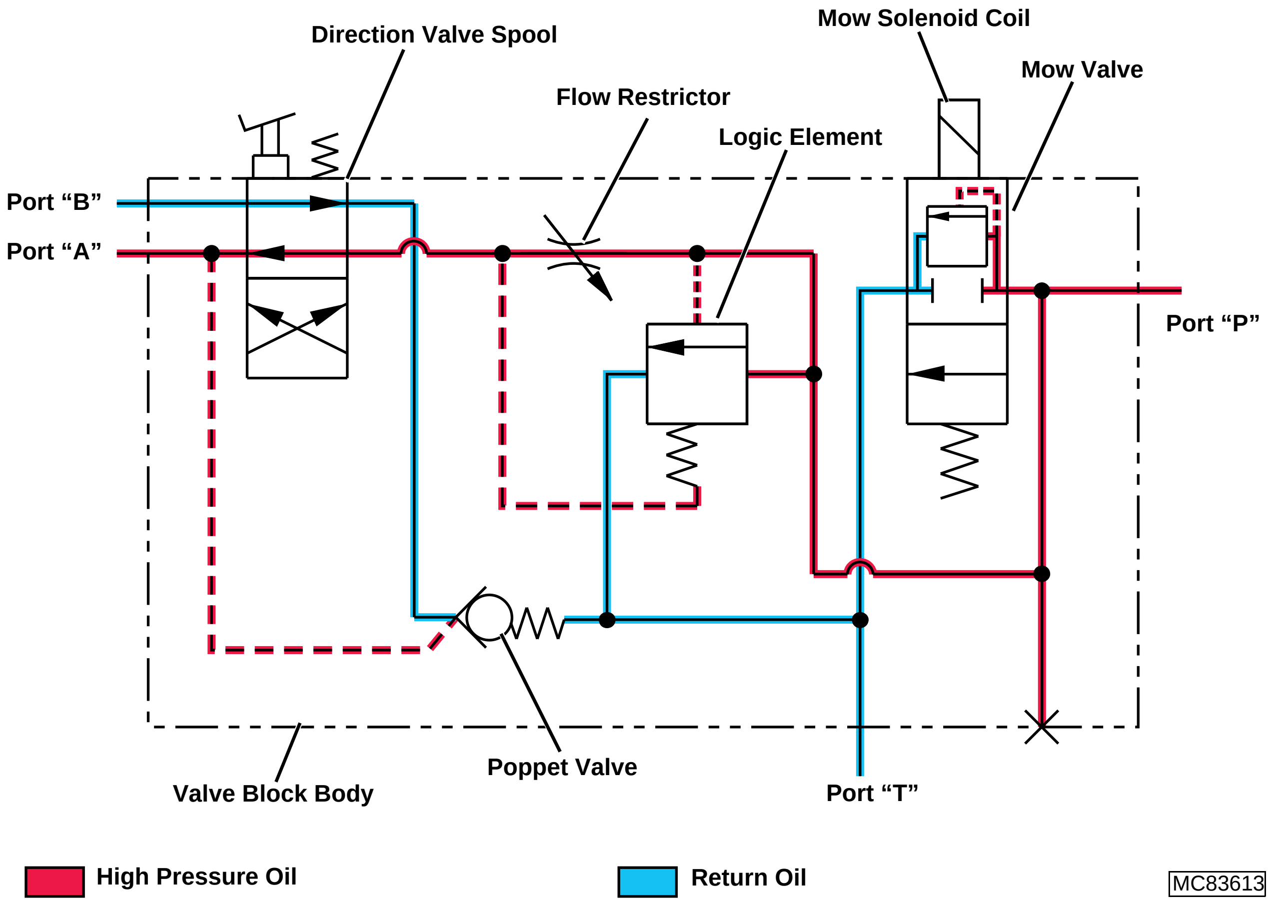
The flow restrictor allows adjustment of oil flow volume to the reel motors. This allows the speed of the motors to be controlled.

The direction valve controls the direction of oil flow to the reel motors.

See OPTIONAL MOW/BACKLAP VALVE ASSEMBLY—Mow Operation on page 8-24 or OPTIONAL MOW/BACKLAP VALVE ASSEMBLY—Backlap Operation on page 8-25 for more information.


Port “T”
Direction Valve
Mow Valve
Port “B” (Backlap)
Flow Restrictor
Port “A” (Mow)
Port “P”
Logic Element
Valve Block Body
Port “B”
(Backlap)
Flow Restrictor
Mow Valve
Port “A”
(Mow)
Port “P”
Direction Valve
Logic Element
Valve Block Body
Port “T”
M82585AE

OPTIONAL MOW/BACKLAP VALVE ASSEMBLY (S.N. 957001—)



Mow Operation

Function:

To control the flow direction and maintain proper oil flow volume to drive the reel motors.

Theory of Operation:

High pressure oil supplied by the hydraulic pump enters the valve assembly at Port "P" and is applied to the lower port of mow valve. When the mow system is not active, oil flows through the mow valve and exits the valve assembly at port "T", returning to the hydraulic reservoir via the optional oil cooler (if equipped).

When the controller energizes mow solenoid coil, the coil moves armature down applying pressure against spring and relief poppet. The poppet closes the seat orifice allowing pressure to build within the spool cavity. This forces the spool down to close off the ports. Pressurized oil then by-passes the mow valve and directs high pressure oil to the logic element, flow restrictor, and direction valve.

The logic element is designed to maintain a proper oil flow volume.

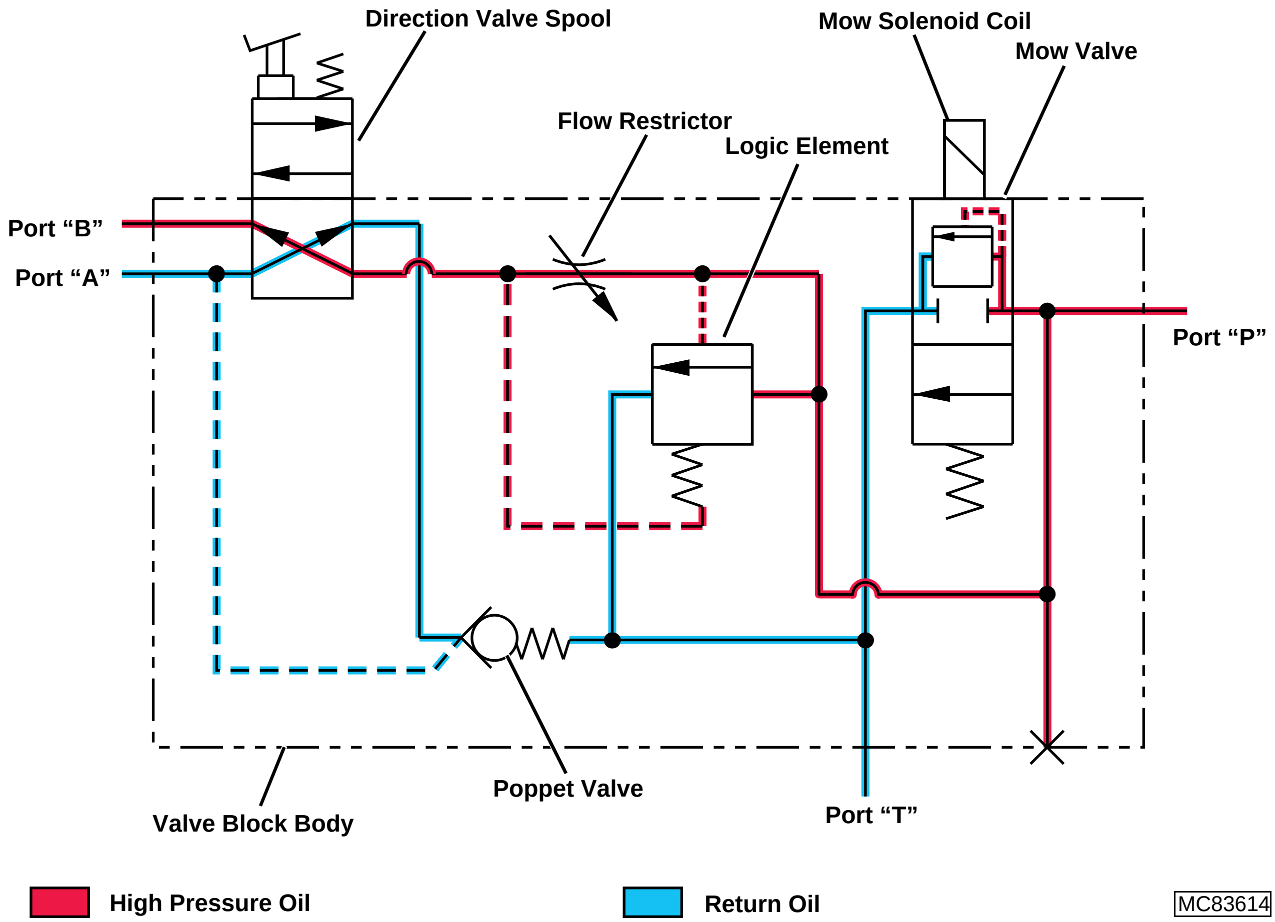
NOTE: During the MOW operation, the flow restrictor knob should be turned fully counterclockwise.

The flow restrictor allows adjustment of the volume of oil flowing to the reel motors. This allows the speed of the motors to be controlled. As adjustment knob is turned (clockwise—restrict, counterclockwise—increase) stem position moves, adjusting the aperture at exit port. This results in an increase (or decrease) of oil flow volume through the valve.

With the direction valve in the MOW position, high pressure oil from the flow restrictor is directed by spool to port "A", exiting the valve block assembly driving the reel motors.

Oil returning from the reel motors enters the valve block assembly at port "B". Oil enters the valve and is directed against poppet valve. As pressure is applied, the poppet valve opens to allow oil to exit at port "T", exiting the valve block assembly, returning to the hydraulic reservoir via the optional oil cooler (if equipped).

OPTIONAL MOW/BACKLAP VALVE ASSEMBLY (S.N. 957001—)



Backlap Operation

Function:

To control the flow direction, maintain proper oil flow volume, and allow adjustment of the reel motor speed.

Theory of Operation:

Oil returning from the reel motors enters the valve block assembly at port "A". Oil enters the valve cartridge body and exits through poppet valve allowing the oil to exit the valve assembly at port "T", returning to the hydraulic reservoir via the optional oil cooler (if equipped).

When the controller energizes mow solenoid coil, the coil moves armature down applying pressure against spring and relief poppet. The poppet closes the seat orifice allowing pressure to build within the spool cavity. This forces the spool down to close off the ports. Pressurized oil then by-passes the mow valve and directs high pressure oil to the logic element, flow restrictor, and direction valve.

The logic element is designed to maintain a proper oil flow volume.

The flow restrictor allows adjustment of the volume of oil flowing to the reel motors. This allows the speed of the motors to be controlled. In the BACKLAP mode the speed of the reels must be reduced to prevent lapping compound from being thrown from the reels.

As adjustment knob is turned (clockwise—restrict, counterclockwise—increase) stem position moves, adjusting the aperture at exit port. This results in an increase (or decrease) of oil flow volume through the valve.

With the direction valve in the BACKLAP position, high pressure oil from the flow restrictor is directed by spool to port "B", exiting the valve block assembly and driving the reel motors in reverse.

Oil returning from the reel motors enters the valve block assembly at port "A". Oil enters the valve and is directed against poppet valve. As pressure is applied, the poppet valve opens to allow oil to exit at port "T", exiting the valve block assembly, returning to the hydraulic reservoir via the optional oil cooler (if equipped)

TROUBLESHOOTING

HYDRAULIC SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Hydraulic reel drive system inoperative.	Slow reel speed.	Reel drive system operates erratically.	Lift arms will not raise or lower.	Excessive hydraulic pump noise.	Hydraulic oil overheats.	Foaming oil.	Frequent failure of hydraulic hoses and O-rings				
Low oil level.	●	●	●	●	●	●	●					
Faulty relief valve.	●		●									
Clogged/restricted hoses.	●	●	●	●								
Wrong oil.	●	●	●		●	●	●					
Worn/damaged pump or motor(s).	●	●			●							
Oil overheated.		●										
Worn or stuck relief valve.		●										
Reels too tight against bed knife. (See ATTACHMENTS section for adjustment procedure.)		●										
Air leaks.					●		●					
Lift valve solenoids faulty. (See ELECTRICAL section for test procedure.)				●								
Mow valve solenoid faulty. (See ELECTRICAL section for test procedure.)	●											
Lift valve damaged or binding.				●								
Component high-pressure internal leak.						●						
Dirty/contaminated oil.						●		●				
Park brake engaged.						●						
High ambient temperatures working under heavy loads (Install optional oil cooler).						●						
Connections not tight.								●				

DIAGNOSIS

HYDRAULIC REEL DRIVE SYSTEM INOPERATIVE

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Hydraulic pump.	No internal damage.	Disassemble, inspect, and replace pump as necessary.
3. Reel motors.	Pressure hoses connected correctly.	Connect pressure hoses to proper port connections.
	No internal damage.	Repair or replace reel motor(s). (See REEL MOTOR—Disassembly/ Assembly on page 8-55.)
4. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
5. Mow valve (S.N. —957000)	Valve operates smoothly without sticking.	Disassemble, inspect and clean and/or repair mow valve. (See MOW VALVE (S.N. —957000)—Disassembly/ Assembly page 8-50.)
6. Mow valve (S.N. 957001—)	Valve operates smoothly without sticking.	Disassemble, inspect and clean and/or repair mow valve. (See MOW VALVE (S.N. 957001—)—Repair on page 8-52.)
7. Mow valve solenoid.	Solenoid operates properly.	Check electrical system. (See MOW CIRCUIT—ENGAGE DIAGNOSIS on page 4-132 or 4-134.)

HYDRAULIC REEL DRIVE SYSTEM INOPERATIVE (Continued)

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
8. Mow valve.	Mow relief valve opens at correct specification.	Test mow relief valve pressure. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38, or MOW VALVE RELIEF VALVE TEST (S.N. 957001—) on page 8-40.)

SLOW REEL DRIVE

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
3. Cutting unit reels.	Reel/bed knife clearance adjusted properly.	Adjust reel/bed knife clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)
	Reels move freely without binding (reel bearings not worn or seized).	Disassemble, inspect and clean or replace parts as necessary. (See PIVOT ARM—Disassembly/Inspection on page 9-31.)

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
4. Hydraulic pump.	Hydraulic pump not worn and oil inlet not restricted.	Test hydraulic pump oil flow. (See HYDRAULIC REEL SYSTEM OIL FLOW TEST on page 8-36.)
5. Mow valve.	Mow relief valve opens at correct specification.	Test mow relief valve pressure. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38, or MOW VALVE RELIEF VALVE TEST (S.N. 957001—) on page 8-40.)
6. Engine crankshaft pulley.	Fast idle—3400 ±75 rpm.	Adjust engine fast idle speed. (See FAST IDLE SPEED ADJUSTMENT on page 3-31.)

REEL DRIVE SYSTEM OPERATES ERRATICALLY

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic oil not contaminated.	Remove contaminates, if necessary drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
3. Mow valve. (S.N. —957000)	Valve operates smoothly without sticking.	Disassemble, inspect and clean and/or repair mow valve. (See MOW VALVE (S.N. —957000)—Disassembly/ Assembly page 8-50.)
4. Mow Valve (S.N. 957001—)	Valve operates smoothly without sticking.	Disassemble, inspect and clean and/or repair mow valve. (See MOW VALVE (S.N. 957001—)—Repair on page 8-52.)

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
5. Mow valve.	Mow relief valve opens at correct specification.	Test mow relief valve pressure. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38, or MOW VALVE RELIEF VALVE TEST (S.N. 957001—) on page 8-40.)

LIFT ARMS WILL NOT RAISE OR LOWER

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
3. Lift valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean and/or repair mow valve. (See LIFT VALVE—Repair on page 8-54.)
4. Lift valve raise solenoid	Solenoid operates properly.	Check electrical system. (See CUTTING UNIT—RAISE CIRCUIT DIAGNOSIS on page 4-120 or 4-126.)
5. Lift valve lower solenoid	Solenoid operates properly.	Check electrical system. (See CUTTING UNIT—LOWER CIRCUIT DIAGNOSIS on page 4-112 or 4-118.)

EXCESSIVE HYDRAULIC PUMP NOISE

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Hydraulic pump.	No internal damage.	Disassemble, inspect, and replace pump as necessary.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
3. Hydraulic pump.	Hydraulic pump not worn and oil inlet not restricted.	Test hydraulic pump oil flow. (See HYDRAULIC REEL DRIVE SYSTEM OIL FLOW TEST on page 8-36.)

HYDRAULIC OIL OVERHEATS

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir	Hydraulic oil level to correct level.	Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
	Hydraulic oil not contaminated.	Remove contaminates, if necessary drain system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Park brake.	Not engaged.	Release park brake.
3. Hydraulic pressure hoses.	No sharp bends or restrictions.	Replace hoses.
4. Oil filter—Transaxle.	Not plugged.	Replace oil filter.
5. Transaxle—Motor axle.	No internal damage/leakage.	Repair motor axle. (See TRANSAXLE—MOTOR AXLE—Disassembly/ Inspection on page 5-28.)
6. Transaxle—hydrostatic charge pump.	No internal damage/leakage.	Repair hydrostatic charge pump. (See TRANSAXLE—HYDROSTATIC CHARGE PUMP—Disassembly/ Inspection on page 5-31.)
7. Hydraulic pump.	No internal damage/leakage.	Disassemble, inspect, and replace pump as necessary.
8. Reel Motors	No internal damage/leakage.	Repair reel drive motors. (See REEL MOTOR—Disassembly/Assembly on page 8-56.)
9. Oil cooler (if equipped).	Fins not plugged and coolers not obstructed.	Clear fins and/or remove obstructions.

HYDRAULIC OIL OVERHEATS (Continued)

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
10. Mow valve.	Mow relief valve opens at correct specification.	Test mow relief valve pressure. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38, or MOW VALVE RELIEF VALVE TEST (S.N. 957001—) on page 8-40.)

FREQUENT FAILURE OF HYDRAULIC HOSES AND O-RINGS

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Oil clean and free of contamination.	Drain hydraulic system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Hydraulic connections.	Connection tightened to correct specifications.	Tighten connections to specifications.

HYDRAULIC OIL FOAMS

Test Conditions:

- Key switch in OFF position.
- Park brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil clean and not foamy. (No air in system)	Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)
	Hydraulic reservoir filled with oil of correct specifications.	Drain hydraulic system and fill hydraulic oil reservoir to correct level with specified oil. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
2. Hydraulic pressure hoses.	No sharp bends or restrictions.	Replace hoses.
3. Hydraulic suction hoses.	No air leaks.	Replace hoses.

TESTS AND ADJUSTMENTS

HYDRAULIC OIL WARM-UP PROCEDURE

Reason:

When performing hydraulic tests, the oil must be heated to a specified temperature for the test to be accurate.

Test Equipment:

- JDG282 Temperature Gauge

Procedure:

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Install JDG282 Temperature Gauge or measuring device on transaxle.
8. Start engine and run at full throttle.
9. Heat hydraulic oil to **43°C (110°F)**.
10. Periodically cycle all hydraulic functions to distribute heated oil.

HYDRAULIC SYSTEM BLEEDING PROCEDURE

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

Reason:

To assure that air is purged from the hydraulic system any time a hydraulic hose or line is disconnected.

Procedure:

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Make sure hydraulic reservoir is full. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)
8. Start engine and run at **slow idle (1550 ±75 rpm)** for 10 minutes.
9. Run engine at **fast idle (3400 ±75 rpm)** for one minute.
10. Turn steering wheel full left and hold for five seconds.
11. Turn steering wheel to straight forward and hold for ten seconds.
12. Turn steering wheel full right and hold for five seconds.
13. Return steering wheel to straight forward. Travel machine forward about 20 feet and make two hard left turns.
14. Make two hard right turns.
15. Travel machine in reverse for 10 feet.
16. Cycle cutting units up and down three times.
17. Shut engine off and inspect hydraulic components for leaks.
18. Check and fill reservoir as necessary. (See HYDRAULIC RESERVOIR OIL LEVEL CHECK on page 2-28.)

HYDRAULIC REEL DRIVE SYSTEM OIL FLOW TEST (S.N. —957000)

Reason:

To determine if the reel motors are receiving the correct oil flow volume.

Test Equipment:

- JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
- JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
- JT05469 Flowmeter Kit
- JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
- JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
- 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Disconnect hose from “IN” port of steering valve.
8. Connect JT05469 Flowmeter Kit to steering valve and hydraulic pump outlet using JT05687, JT03012, JT03385, JT03056 and 38H1160 adapter fittings.

IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage may occur to hydraulic components.

9. Open flowmeter valve fully.

CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

10. Start engine and operate at **fast idle (3400 ±75 rpm)**.

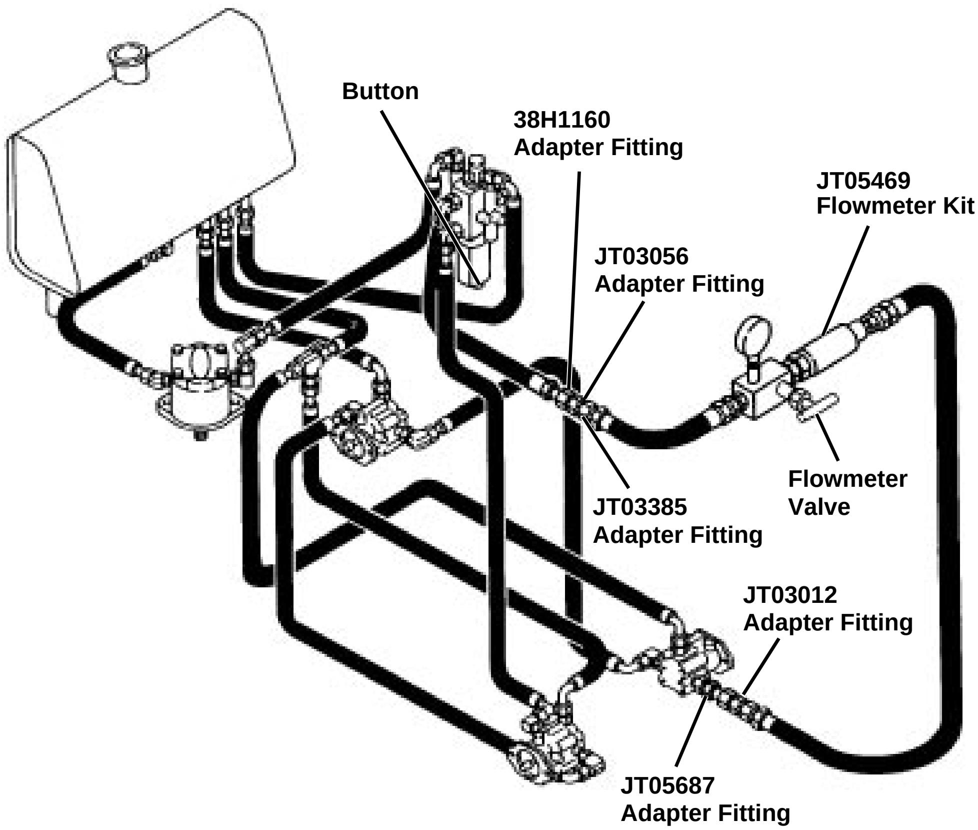
NOTE: (S.N. —957000): Cutting units can be manually engaged by pushing button on solenoid valve. Button MUST be fully depressed and held to get full oil flow and an accurate reading.

11. Move mow/transport lever to MOW position.
12. Engage cutting units by pushing the mow switch button.
13. Check flowmeter reading, oil flow should read **22 L/min (5.8 gpm)**.

Results:

If flow is less than specification:

- Check for restriction to pump inlet.
- Test mow valve relief valve. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38.)
- Inspect hydraulic pump for wear or damage.


Button
38H1160
Adapter Fitting
JT05469
Flowmeter Kit
JT03056
Adapter Fitting
Flowmeter
Valve
JT03385
Adapter Fitting
JT03012
Adapter Fitting
JT05687
Adapter Fitting

E35656

MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. — 957000)

Reason:

To determine if the mow relief valve opens at the correct pressure.

Test Equipment:

- JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
- JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
- JT05469 Flowmeter Kit
- JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
- JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
- 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Disconnect hose from inlet port of left front reel motor.

NOTE: If a flowmeter is not available, install a pressure gauge. Use a wooden block in the reel of the left cutting unit to stall reel and stop the oil flow.

8. Connect JT05469 Flowmeter Kit to meter and mower valve outlet hose using JT05687, JT03012, JT03385, JT03056 and 38H1160 Adapter Fittings.

IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage may occur to hydraulic components.

9. Open flowmeter valve fully.

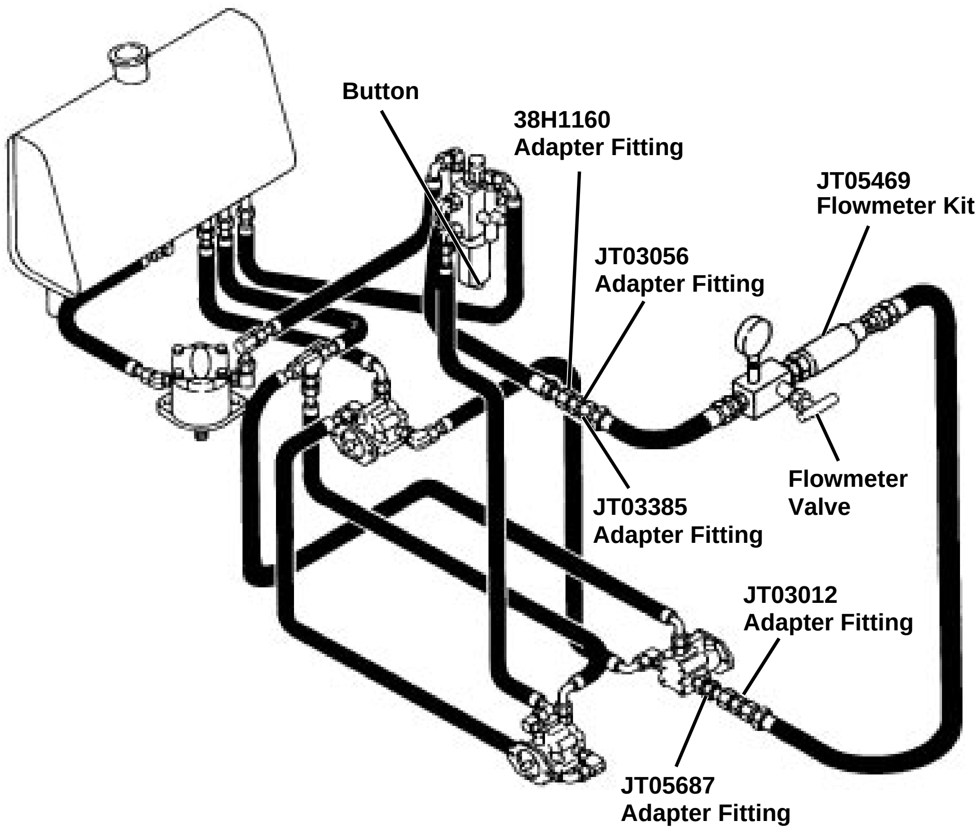
CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

10. Start engine and operate at **fast idle (3400 ±75 rpm)**.

NOTE: (S.N. —957000): Cutting units can be manually engaged by pushing button on solenoid valve. Button MUST be fully depressed and held to get full oil flow and an accurate reading.

11. Move mow/transport lever to MOW position.
12. Engage cutting units by pushing the mow switch button.
13. Close flowmeter valve to stop oil flow completely. Check pressure reading, pressure should read **19822 ±861 kPa (2875 ±125 psi)**.
14. If pressure is below specification:
    - Remove hex cap from bottom of mow valve inlet section.
    - Loosen lock nut and turn adjusting screw into valve section until pressure is to specification.
15. If pressure is above specifications:
    - Remove hex cap from bottom of mow valve inlet section.
    - Loosen locknut and turn adjusting screw counterclockwise until pressure is to specification.
16. If specification can not be obtained, inspect and repair relief valve assembly. (See MOW VALVE (S.N. —957000)—Repair on page 8-49.)


Button
38H1160
Adapter Fitting
JT05469
Flowmeter Kit
JT03056
Adapter Fitting
Flowmeter
Valve
JT03385
Adapter Fitting
JT03012
Adapter Fitting
JT05687
Adapter Fitting

E35656

MOW VALVE RELIEF VALVE TEST (S.N. 957001—)

Reason:

To determine if the mow relief valve opens at the correct pressure.

Test Equipment:

- JT05687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
- JT03012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
- JT05469 Flowmeter Kit
- JT03385 3/4 F NPT x 7/8 M 37° Adapter Fitting
- JT03056 7/8 M 37° x 9/16 F ORB Adapter Fitting
- 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Disconnect hose connected to inlet port of left front reel motor.

NOTE: If a flowmeter is not available, install a pressure gauge. Use a wooden block in the reel of the left cutting unit to stall reel and stop the oil flow.

8. Connect JT05469 Flowmeter Kit to reel motor inlet and mow valve outlet hose using JT05687, JT03012, JT03385, JT03056 and 38H1160 Adapter Fittings.

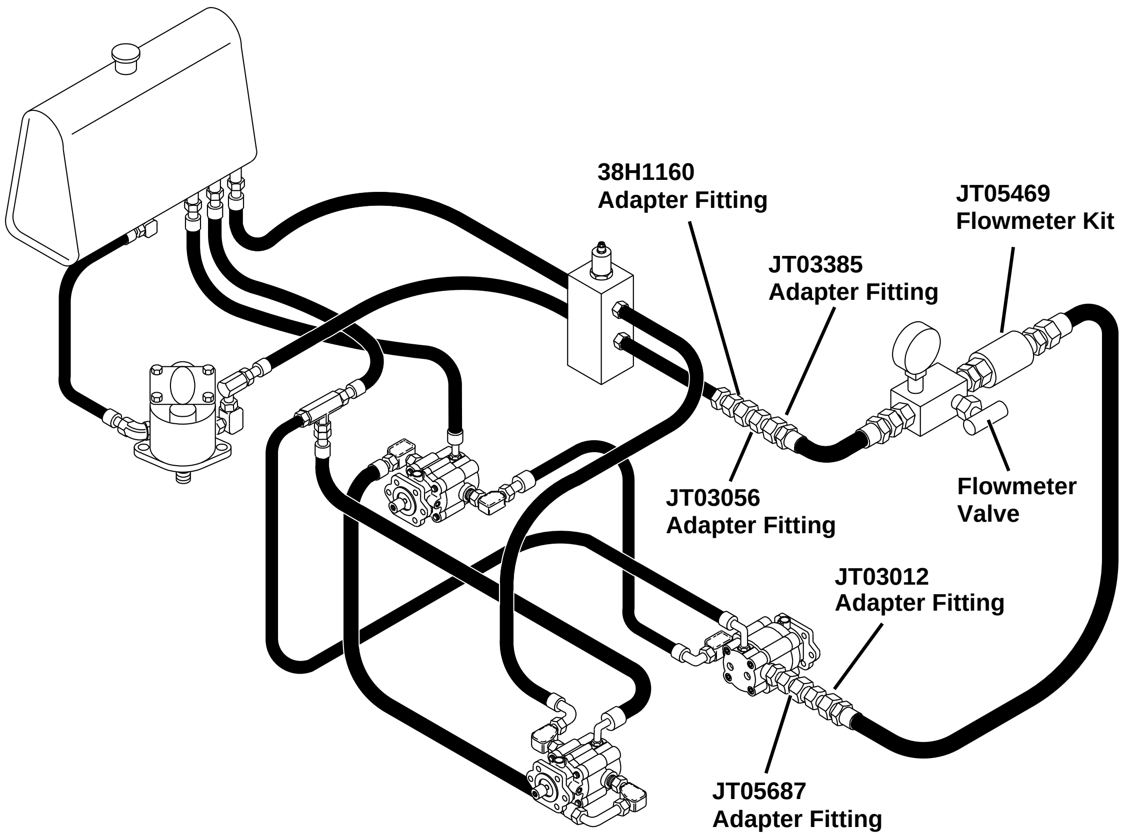
IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage may occur to hydraulic components.

9. Open flowmeter valve fully.

CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

10. Start engine and operate at **fast idle (3400 ±75 rpm)**.
11. Move mow/transport lever to MOW position.
12. Engage cutting units by pushing the mow switch button.
13. Close flowmeter valve to stop oil flow completely.
14. Check pressure gauge reading, mow relief valve should open at **20684 ±1034 kPa (3000 ±150 psi)**.
15. If pressure is not within specification, loosen jam nut. With the mow valve in relief, turn the adjusting screw with a 3/32-inch allen wrench to achieve specified pressure:
    - Clockwise to RAISE pressure.
    - Counterclockwise to LOWER pressure.
16. Tighten jam nut and recheck relief pressure.
17. If specified relief pressure cannot be achieved, replace mow valve cartridge.


38H1160
Adapter Fitting
JT05469
Flowmeter Kit
JT03385
Adapter Fitting
JT03056
Adapter Fitting
Flowmeter
Valve
JT03012
Adapter Fitting
JT05687
Adapter Fitting

M83600

REAR LIFT LINKAGE ADJUSTMENT

Reason:

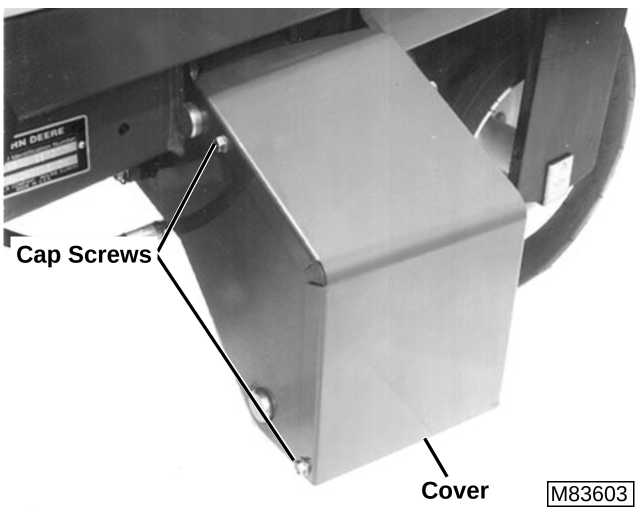
To ensure that the rear cutting unit is being raised to the proper height to provide clearance when not in use.

Procedure:

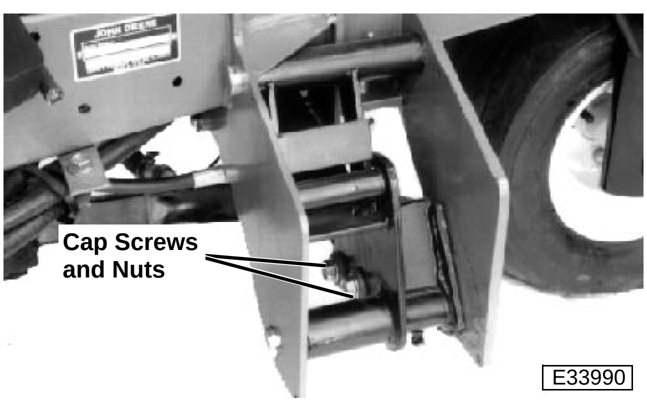
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.

NOTE: Pull cutting unit out from left side.

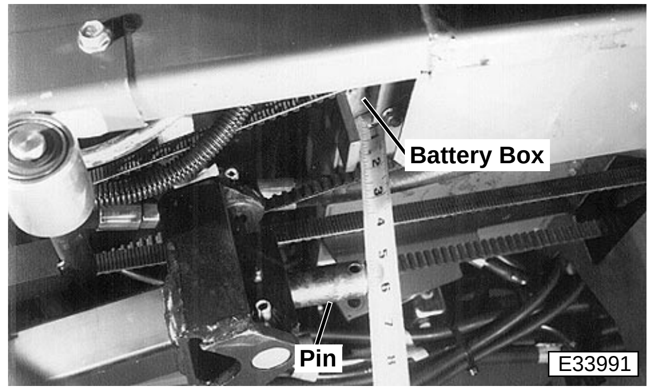
7. Pull two pins to remove center (rear) cutting unit.



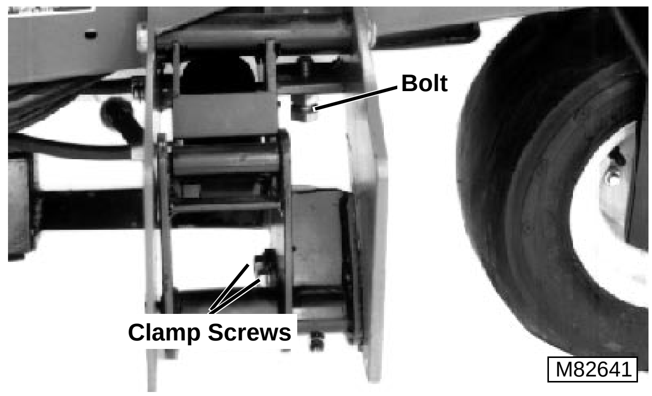
8. Remove four cap screws and cover.



9. Loosen two clamps, cap screws and nuts.
10. Raise and support center cutting arm.



11. Make sure pin is at the bottom of the V-notch. Adjust arm until top of pin is **120 mm (4.75 in.) below battery box**.



12. Adjust bolt until it touches the center cutting unit arm and back off (away from arm) 1/2 turn. Tighten lock nut.
13. Tighten clamp screws and nuts to **129 N•m (95 lb-ft)**.
14. Install linkage shield.

RAISE/LOWER CUTTING UNITS MANUALLY

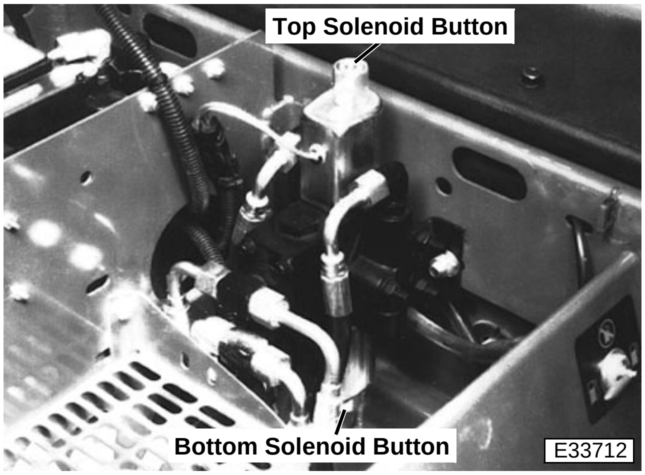
Reason:

To allow the cutting units to be raised or lowered without activating the mow or lift switch.

Procedure:

> **CAUTION**
>
> **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. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Start engine and operate at **slow idle (1550 ±75 rpm)**.
8. Get off machine and raise seat platform.



9. Press top solenoid button to raise cutting units. Press bottom solenoid bottom to lower cutting units.

ROTATE CUTTING UNIT REELS MANUALLY (S.N. —957000)

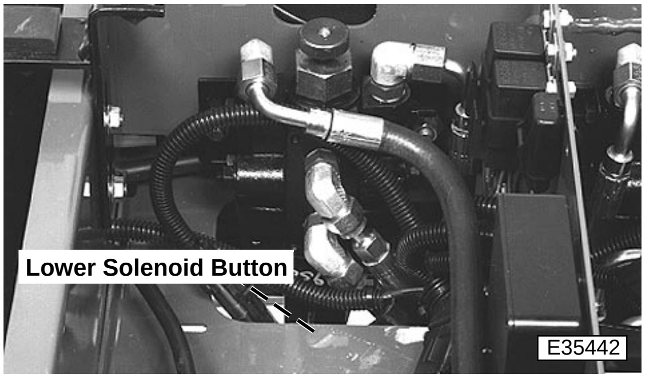
Reason:

To allow the cutting units to be activate without depressing the mow switch.

Procedure:

> **CAUTION**
>
> **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. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Start engine and operate at **slow idle (1550 ±75 rpm)**.
8. Get off machine and raise seat platform.



NOTE: Battery removed for clarity of photograph.

Solenoid button can be reached from bottom of mower.

9. Push lower solenoid button to start forward reel rotation.

MOW/BACKLAP VALVE RELIEF ADJUSTMENT (S.N. 957001—)

Reason:

To determine if the mow relief valve opens at the correct pressure.

Test Equipment:

- JT03362 0—70,000 kPa (0—10,000 psi) Pressure Gauge
- RE48122 Diagnostic Coupler
- AMT846 Hydraulic Dialogistic Hose
- AMT1043 Swivel Run Tee
- MT1531 Adaptor

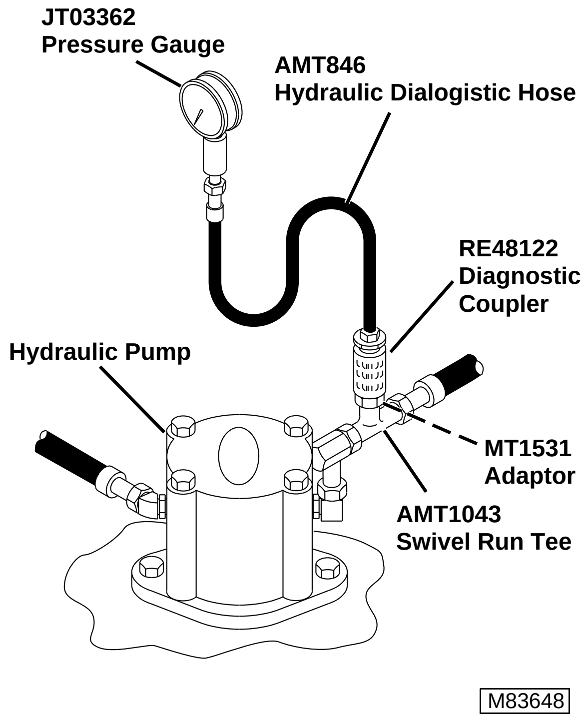
Procedure:

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

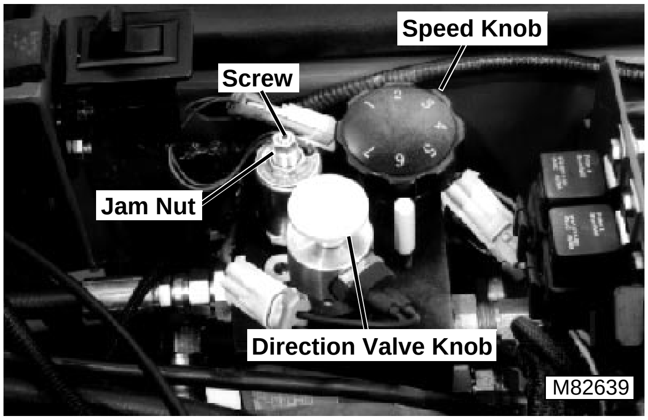
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Raise seat platform.



8. Disconnect hose connected to outlet port of hydraulic pump.
9. Install AMT1043 Swivel Run Tee between outlet port of hydraulic pump and hose to mow valve—Port “P”.
10. Install MT1531 Adaptor on Swivel Tee fitting.
11. Connect JT03362 Pressure Gauge to adaptor using RE48122 Diagnostic Coupler and AMT846 Hydraulic Diagnostic Hose.
12. Use wooden blocks in the reels of the cutting units to stall the reels.
13. Place mow/backlap switch in **BACKLAP** position.
14. Start and run engine at **fast idle (3400 ±75 rpm)**.

CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.



15. Place direction valve in BACKLAP position by pulling knob up.
16. Turn speed knob to slow speed (as this will help prevent wood blocks from jumping out of the reels).
17. Move Mow/Transport lever to MOW position.
18. Engage cutting unit circuit, by pushing the mow switch button.
19. With mow valve in relief, loosen jam nut. Then use a 3/32-inch allen wrench to turn the screw to adjust relief pressure to **20,684 ±1034 kPa (3000 ±150 psi)**:
    - Clockwise to raise pressure.
    - Counterclockwise to lower pressure.
20. Tighten jam nut and recheck relief pressure.
21. If the specified relief pressure cannot be achieved, replace mow valve cartridge.

REPAIR

HYDRAULIC PUMP

Removal/Installation

CAUTION

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.

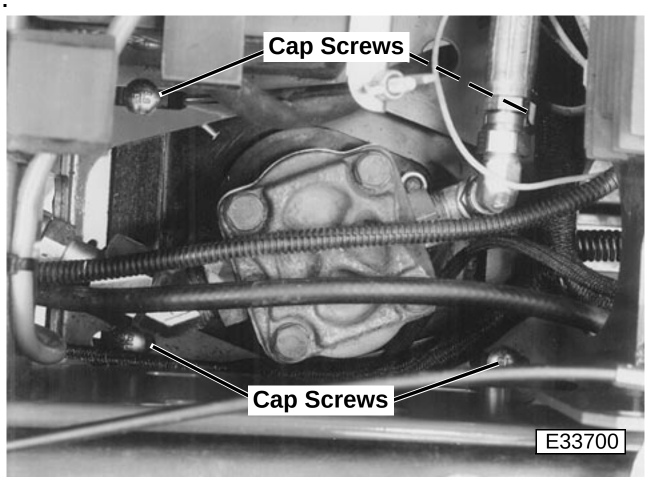
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

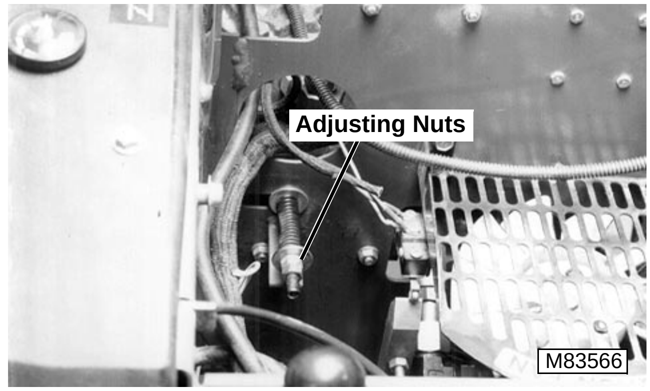
1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Raise engine hood.

NOTE: Hydraulic reservoir capacity is approximately **16.6 L (4.4 gal)**.

3. Remove drain plug and drain hydraulic reservoir.
4. Remove lower pump sheave shield

.



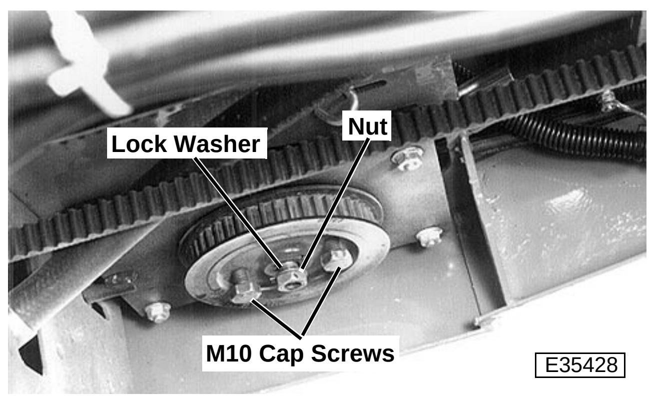


5. Loosen four nuts and cap screws and adjusting nuts. Pump should move freely back and forth. Move the pump as far to the rear as possible.

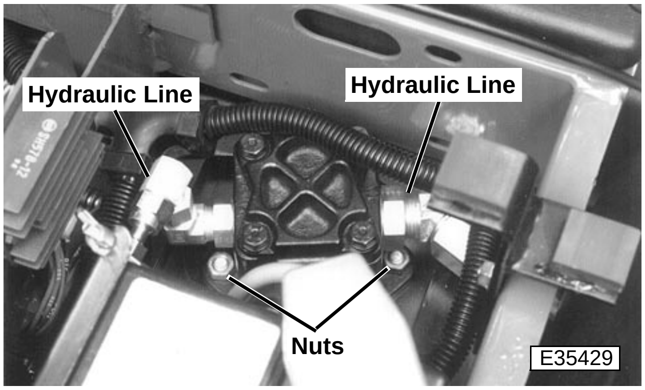
IMPORTANT: For maximum belt life, handle and install positive drive belts with care. Follow the instructions below to prevent damage to the belt tensile members.

- **DO NOT twist belt.**
- **DO NOT back bend belt.**
- **DO NOT crimp belt.**
- **DO NOT store on hook.**

6. Remove drive belt from pump sheave.

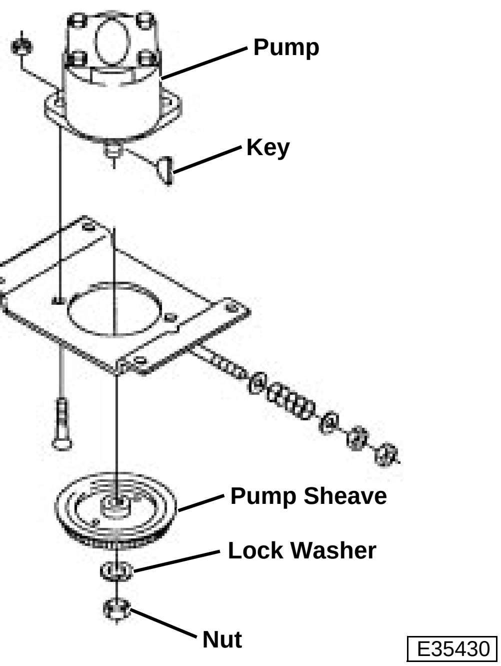


7. Loosen nut and lock washer.
8. Install two M10 cap screws in pump sheave. Tighten cap screws evenly to loosen sheave from pump shaft. Remove nut, lockwasher, sheave and key.



9. Disconnect hydraulic lines.
10. Remove two nuts and screws to remove hydraulic pump.

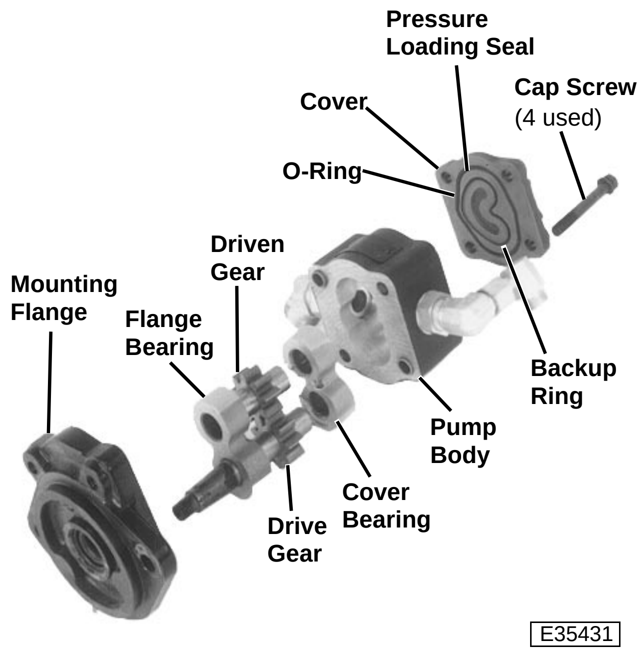
Installation is done in the reverse order of removal.



- Install key, sheave, lock washer and nut. Position large tapered bore side of sheave on pump shaft first. Tighten to **47 N•m (35 lb-ft).**
- Install pump with larger port toward hydraulic reservoir.
- Adjust drive belt. (See DRIVE BELT ADJUSTMENT on page 5-21.)
- Fill hydraulic oil reservoir to correct level with oil of proper specifications. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)
- Bleed hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

Replace Seals

1. Thoroughly clean and dry outside of pump.



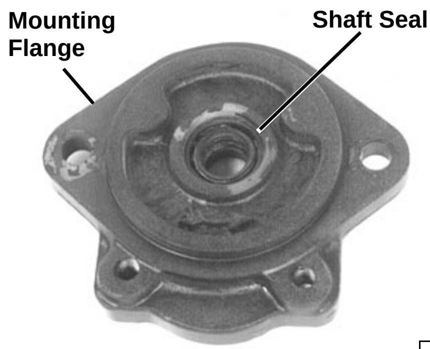
2. Put an alignment mark across pump cover, body and flange to aid in assembly.

IMPORTANT: Perform repair procedures with pump in a vise. Excessive clamping pressure on pump housing will cause distortion.

3. Install mounting flange in a soft-jaw vice with the cap screws up.
4. Remove four cap screws and lock washers.
5. Remove cover with O-rings, pressure loading seal and backup ring.

IMPORTANT: Keep gears meshed and bearings on gear shafts. A wear pattern has been formed between the gears and bearing assemblies. To keep internal leakage to a minimum, gears and bearings must be installed in the same position as which they are removed.

6. Carefully lift pump body from mounting flange.
7. Remove drive and driven gears and flange and cover bearings as an assembly.
8. Remove O-ring, pressure loading seal and backup ring from mounting flange.



E35423

9. Remove shaft seal from mounting flange.

IMPORTANT: Absolute cleanliness is essential when working on 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.

CAUTION

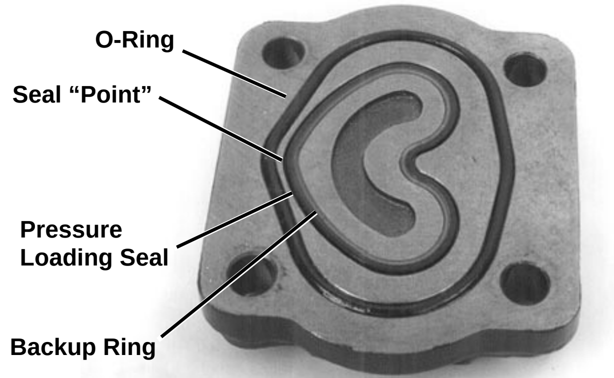
Reduce compressed air to less than 210 kPa (2 bar) (30 psi) when using for cleaning purposes. Clear area of bystanders, guard against flying chips, and wear personal protection equipment including eye protection.

10. Clean all metal parts with solvent and blow-dry with compressed air.
11. Inspect all parts for damage, nicks, or unusual wear patterns. Replace entire pump if any part is damaged or worn.

NOTE: Lubricate all seals with petroleum jelly during assembly.

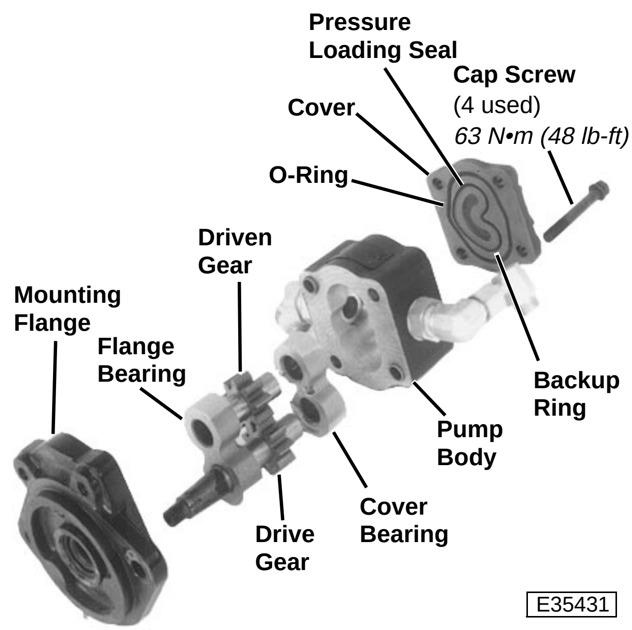
Apply clean hydrostatic/hydraulic oil to all internal parts during assembly.

12. Install a new shaft seal in mounting flange with spring side toward pump body. Push seal squarely to the bottom of the bore. Apply petroleum jelly to seal lips.

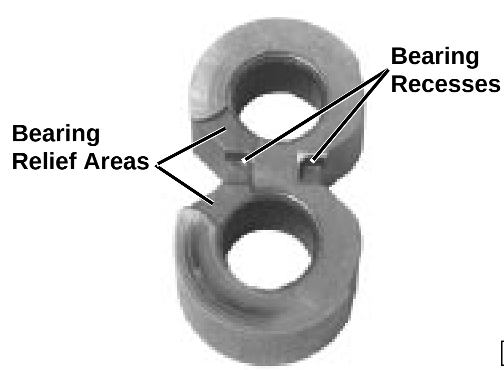


E35433

13. Install pressure loading seal and backup ring in mounting flange and cover. Use a small amount of petroleum jelly to keep O-rings in place.



E35431



E35434

14. Make sure gears and bearings are assembled correctly:
   - Bearing faces with recesses must be toward gears.
   - Large relief area of bearings must be toward inlet (larger) port of pump body.
   - Apply hydraulic oil to gears and bearings.

15. Cover spline of drive gears with tape to protect seal lips. Install gear and bearing assembly on mounting flange. Keep relieved area on the same side as the "point" of the flange seal.
16. Install pump body so "point" of seal is on the same side as the inlet (large) port.
17. Install four cap screws and lock washers. Tighten cap screws to **63 N•m (48 lb-ft)**.

MOW VALVE (S.N. —957000)

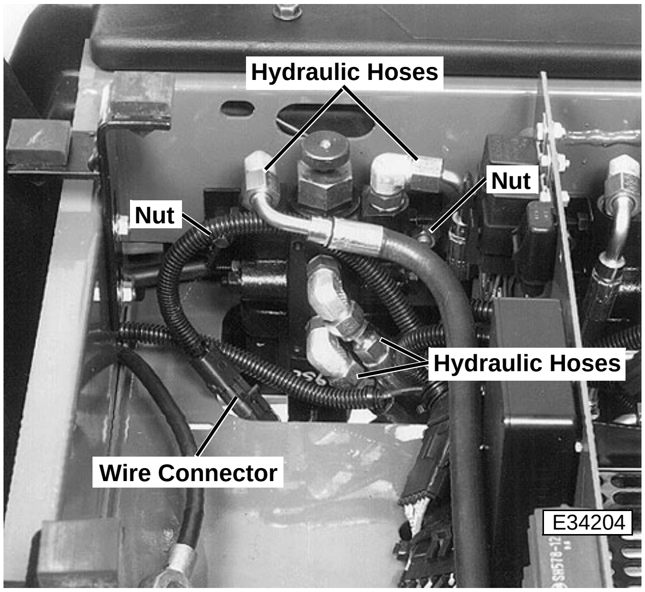
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Remove battery. (See BATTERY—Removal/Installation on page 4-228.)
3. Raise engine hood.



4. Disconnect wire connector.

IMPORTANT: Label hoses for assembly. Cutting units can rotate backward if hoses are not connected properly.

5. Disconnect four hydraulic hoses.

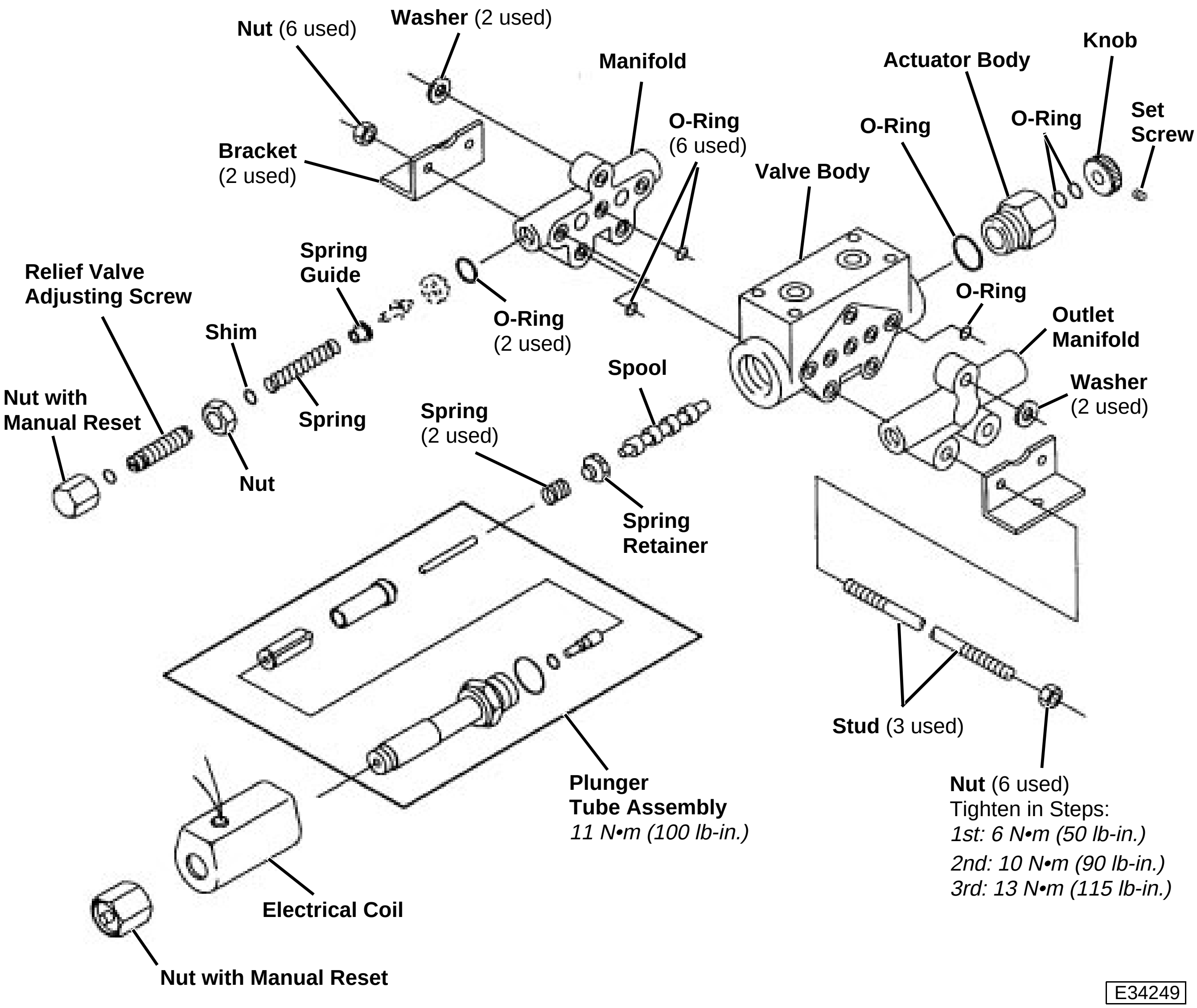
IMPORTANT: Use caution not to let cap screws for nuts fall from mounting hole. Fuel tank must be removed to install cap screw.

IMPORTANT: DO NOT lift mow valve by the solenoid. Damage to the spool valve can result, causing the valve to bind. Lift by center housing or brackets only.

6. Remove nuts to remove mow valve.

Installation is done in the reverse order of removal.

Disassembly/Assembly



IMPORTANT: Note the position of the spool in the valve body. Spool can not be turned end-for-end. Spool must be install in the same position as removed for the valve to function properly.

1. Disassemble parts as shown.

IMPORTANT: Absolute cleanliness is essential when working on valve. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry clean parts. Lint will clog passages in hydraulic system and cause damage

CAUTION

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 all parts with solvent and blow dry with compressed air.
3. Inspect all parts for wear or damage. Replace parts as needed.

Assembly is done in the reverse order of removal.

- Apply clean hydraulic oil to all parts before assembly.

IMPORTANT: Always use new O-rings. Damaged or used parts will leak.

NOTE: Lubricate O-rings with petroleum jelly during assembly.

- Use new O-rings when assembling mow valve.
- Tighten plunger tube assembly to **11 N•m (100 lb-in.)**.

IMPORTANT: Tighten tie rod nuts equally. DO NOT over-tighten. Spool binding or leaks will occur.

- Tighten tie rod nut in three equal steps of **5.6 N•m (50 lb-in.)**, **10 N•m (90 lb-in.)** and finally to **13 N•m (115 lb-in.)**.
- Adjust relief valve after installation. (See MOW VALVE RELIEF VALVE TEST AND ADJUSTMENT (S.N. —957000) on page 8-38.)

MOW VALVE (S.N. 957001—)

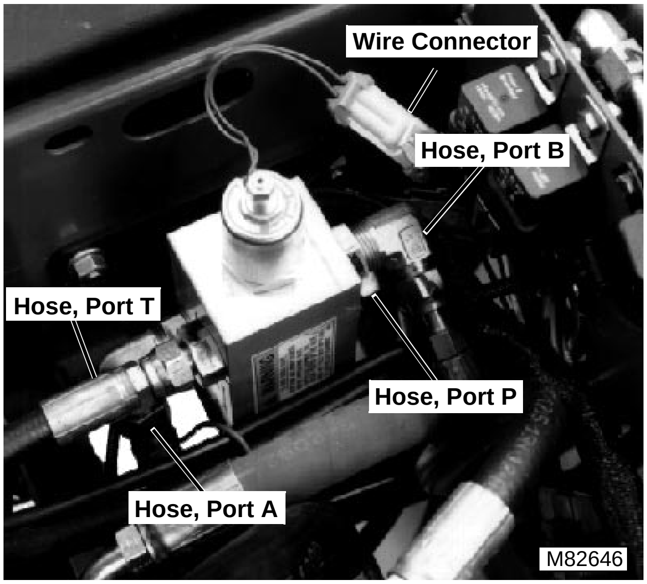
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Raise engine hood.



NOTE: Tag hoses to aid in installation. Cutting units can rotate backwards if hoses are not connected correctly.

3. Tag and disconnect hoses.

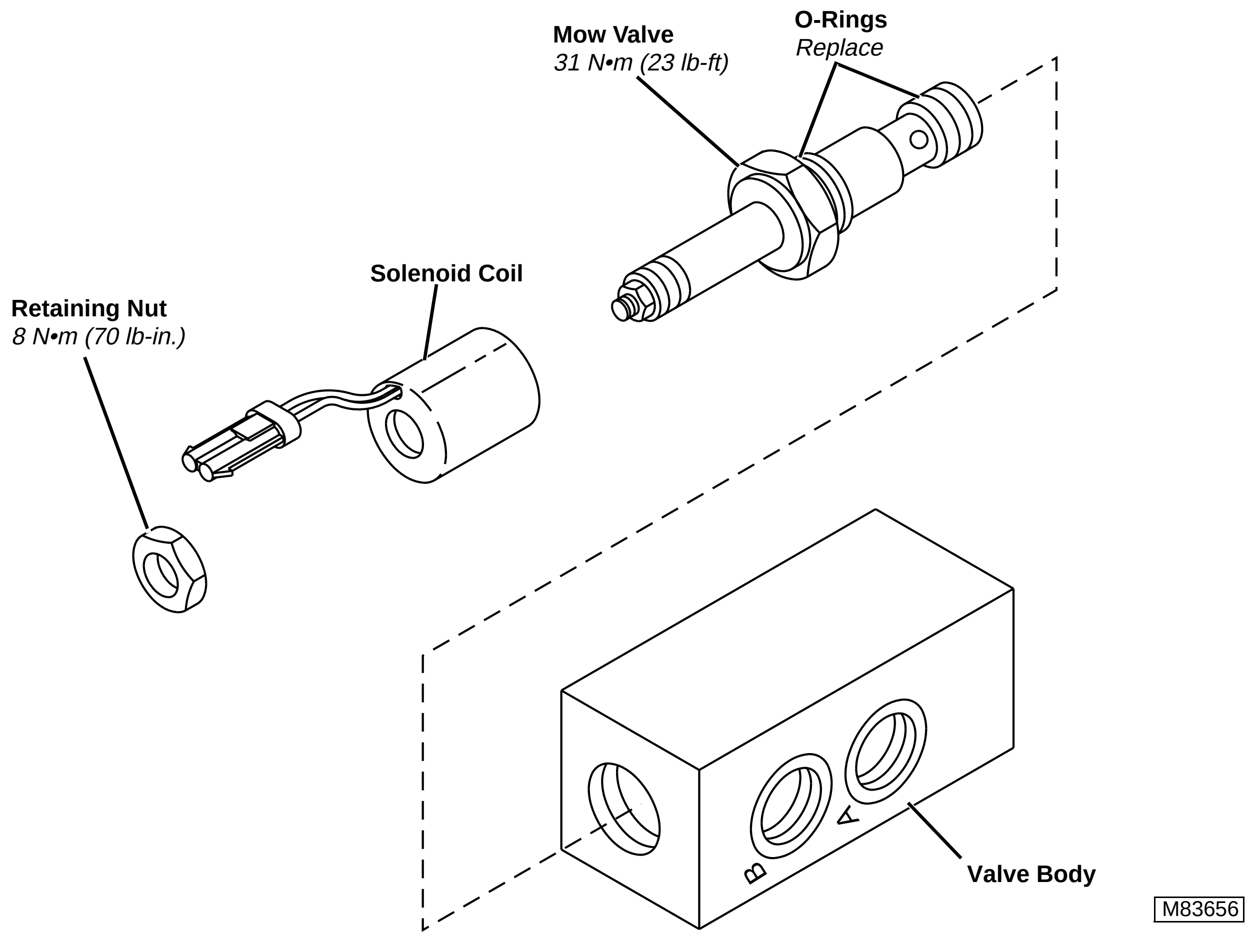
IMPORTANT: DO NOT lift mow valve by the solenoid. Damage to the spool valve can result, causing the valve to bind. Lift by housing only.

4. Remove two cap screws from bottom of mow valve and remove mow valve.
5. Note location and orientation of fittings in valve. Remove fittings.

Installation is done in the reverse order of removal.

- Install valve block with ports A and B facing front of machine.
- Elbow fittings should point downward toward right-hand side of machine.
- Run machine, test operation of mow valve and check for leaks.
- Add clean hydraulic oil to hydraulic reservoir as necessary. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)

Repair



IMPORTANT: Absolute cleanliness is essential when working on valve. 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.

IMPORTANT: Always use new O-rings. Damaged or used parts will leak.

- Lubricate all O-rings with petroleum jelly during assembly.
- Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.
- Tighten mow valve to **31 N•m (23 lb-ft).**
- Tighten solenoid coil retaining nut to **8 N•m (70 lb-in.).**

LIFT VALVE

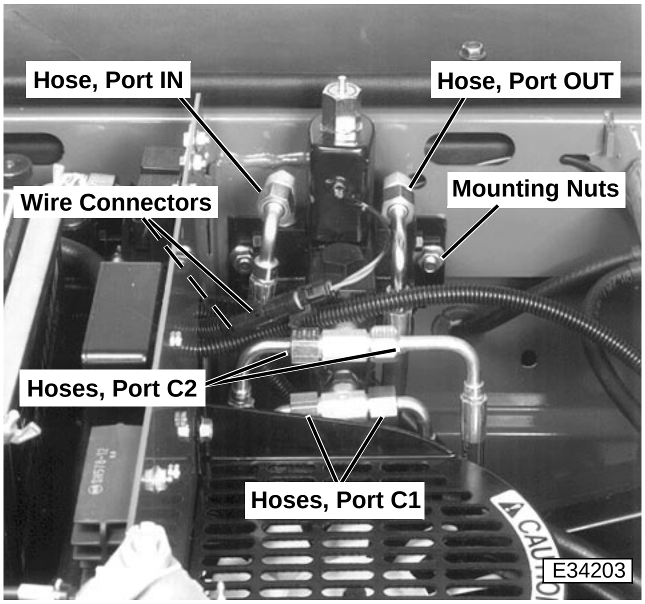
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Raise engine hood.



3. Disconnect wire connectors.

NOTE: Tag hoses to aid in installation. Lift/lower operation can be affected if hoses are not connected correctly.

4. Tag and disconnect six hydraulic hoses.

IMPORTANT: Use care not to let cap screws for nuts fall from mounting holes. Fuel tank must be removed to install cap screws back into mounting holes.

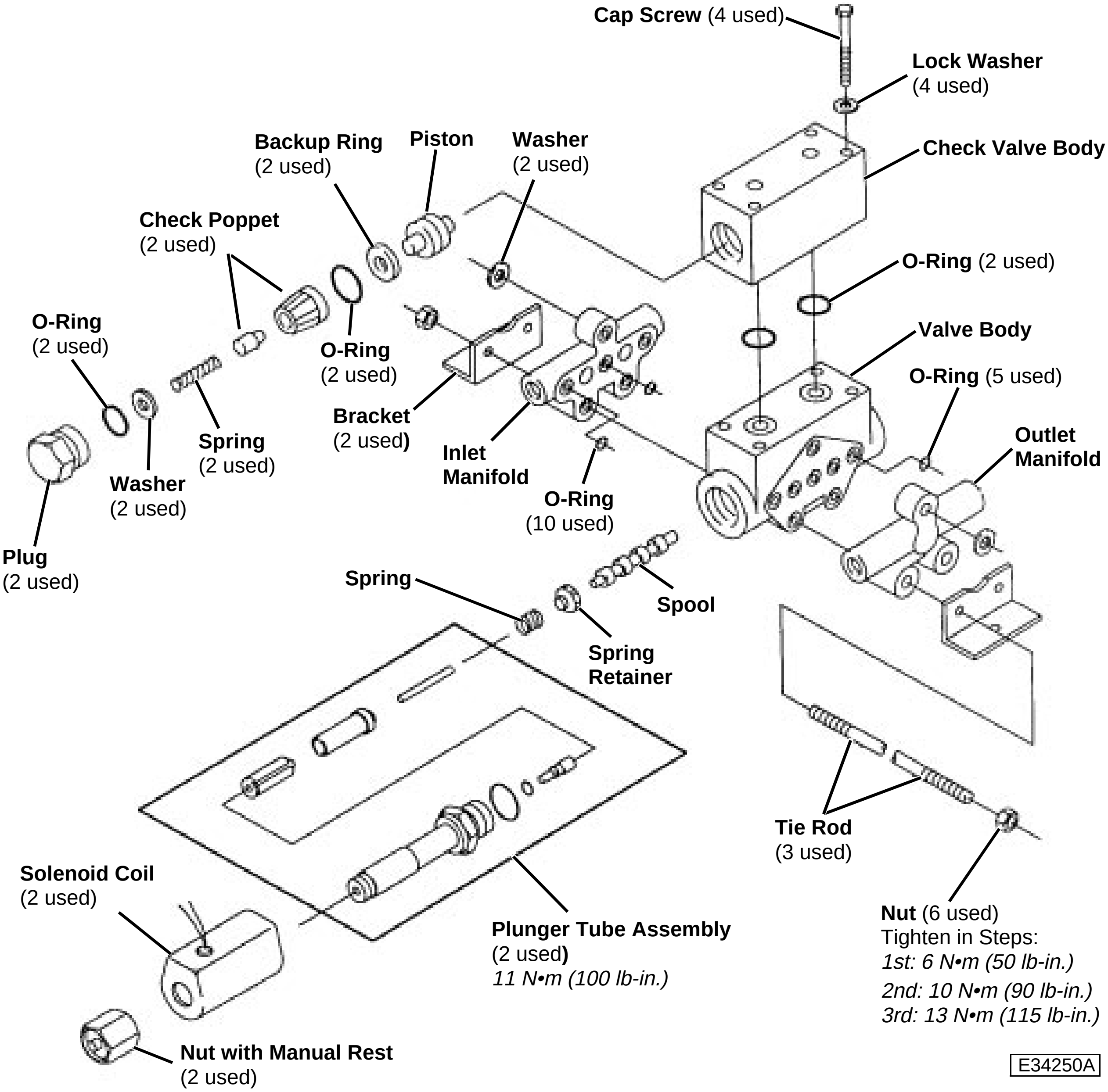
IMPORTANT: DO NOT lift valve by the solenoid. Damage to the spool valve can result, causing the valve to bind. Lift by housing or brackets only.

5. Remove two mounting nuts. Remove lift valve assembly.

Installation is done in the reverse order of removal.

- Install lift valve assembly, port C2 on top.
- Run machine, test operation of lift valve and check for leaks.
- Add clean hydraulic oil to hydraulic reservoir as necessary. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)

Repair



IMPORTANT: Note the position of spool in valve body. Spool can not be turned end-for-end. Spool must be installed in the same position as removed for the valve to function properly.

Absolute cleanliness is essential when working on valve. 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.

Always use new O-rings. Damaged or used parts will leak.

- Lubricate all O-rings with petroleum jelly during assembly.
- Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.

IMPORTANT: Do not over-tighten nuts. Spool binding or leaks will occur.

- Tighten plunger tube assembly to **11 N•m (100 lb-in.)**.
- Tighten tie rod nuts in three steps of **6 N•m (50 lb-in.), 10 N•m (90 lb-in.) and finally 13 N•m (115 lb-in.)**.

REEL MOTOR

Removal/Installation

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage park brake.

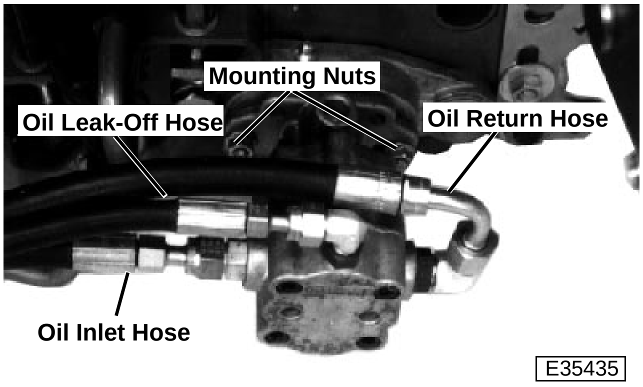
CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

NOTE: Approximate capacity of hydraulic reservoir is ***16.6 L (4.4 gal)****.*

6. Drain hydraulic reservoir.

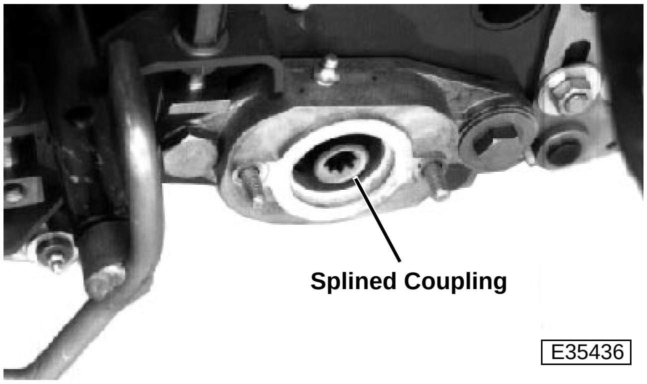


7. Disconnect oil inlet, oil return and oil leak-off hoses.
8. Remove mounting nuts and reel motor.

Installation is done in the reverse order of removal.

NOTE: All motor hoses are routed to the front of the machine.

IMPORTANT: To maintain proper motor rotation, position all motors with leak-off port to the top. All inlet ports will then be toward the front of the machine.



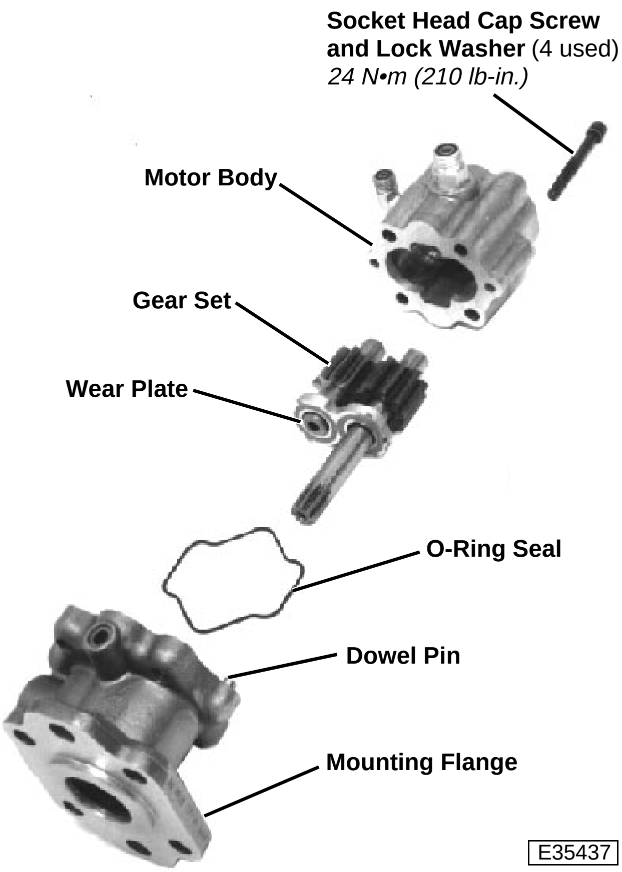
- Make sure splined coupling is in position on reel shaft before installing reel motor.
- Apply multipurpose grease to splines of motor shaft.
- Fill hydraulic reservoir with proper oil. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)

Disassembly/Assembly

1. Thoroughly clean and dry outside of motor.

IMPORTANT: Perform repair procedures with motor in a vise. Clamp across mounting flange only. Excessive clamping pressure on motor housing will cause distortion.

2. Put motor in a soft-jawed vise with mounting flange facing down.

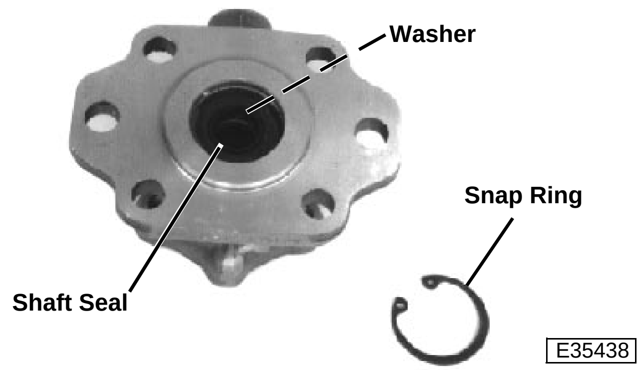


3. Remove four socket head cap screws and lock washers.

IMPORTANT: NEVER pry components apart. Use a plastic hammer and lightly tap on drive shaft to separate mounting flange and motor body.

Do not allow gears to disengage or parts to drop. Wear pattern will be disturbed or damage to parts will occur causing internal leakage.

4. Remove motor from vice. With drive shaft up, remove mounting flange and seal from motor body.
5. Remove wear plate and gear set as an assembly.
6. Put an alignment mark across mating teeth of gear set to aid in assembly.
7. Separate wear plate and gear set.
8. Inspect dowel pin for wear or damage. Replace if necessary.



9. Remove snap ring, shaft seal and washer.

> **CAUTION**
>
> **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: Absolute cleanliness is essential when working on 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.

10. Clean all metal parts with solvent and blow-dry with compressed air.
11. Inspect all parts for damage, nicks, or unusual wear patterns. Replace as necessary.

Assembly is done in the reverse order of disassembly.

IMPORTANT: Always use new seals. Damaged or used parts will leak.

NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply clean hydraulic/hydrostatic oil on all internal parts during assembly.

- Install new shaft seal with metal case facing away from pump. Push seal to bottom of bore. Apply petroleum jelly to seal lips.
- Install new O-ring seal with flat side of seal toward mounting flange.
- Install wear plate with molded plastic insert side away from gear set.
- Tighten socket head cap screws to **24 N•m (210 lb-in.)**.

FRONT LIFT CYLINDER

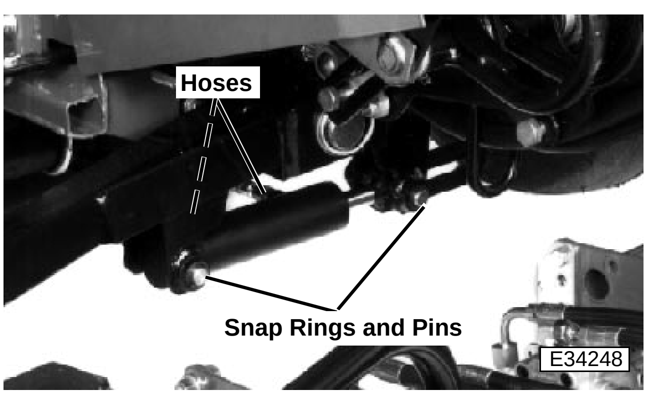
Removal/Installation

CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.



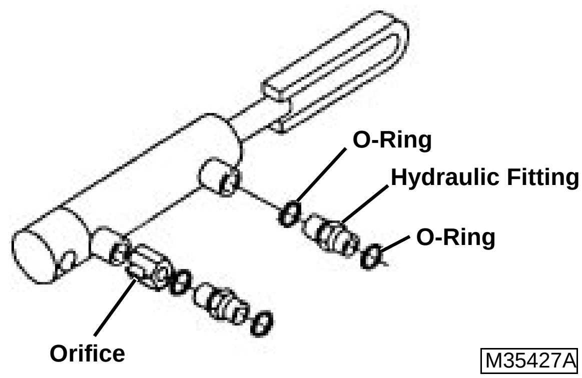
7. Disconnect hydraulic hoses.
8. Remove snap rings and pins and front lift cylinder.

Installation is done in the reverse order of removal.

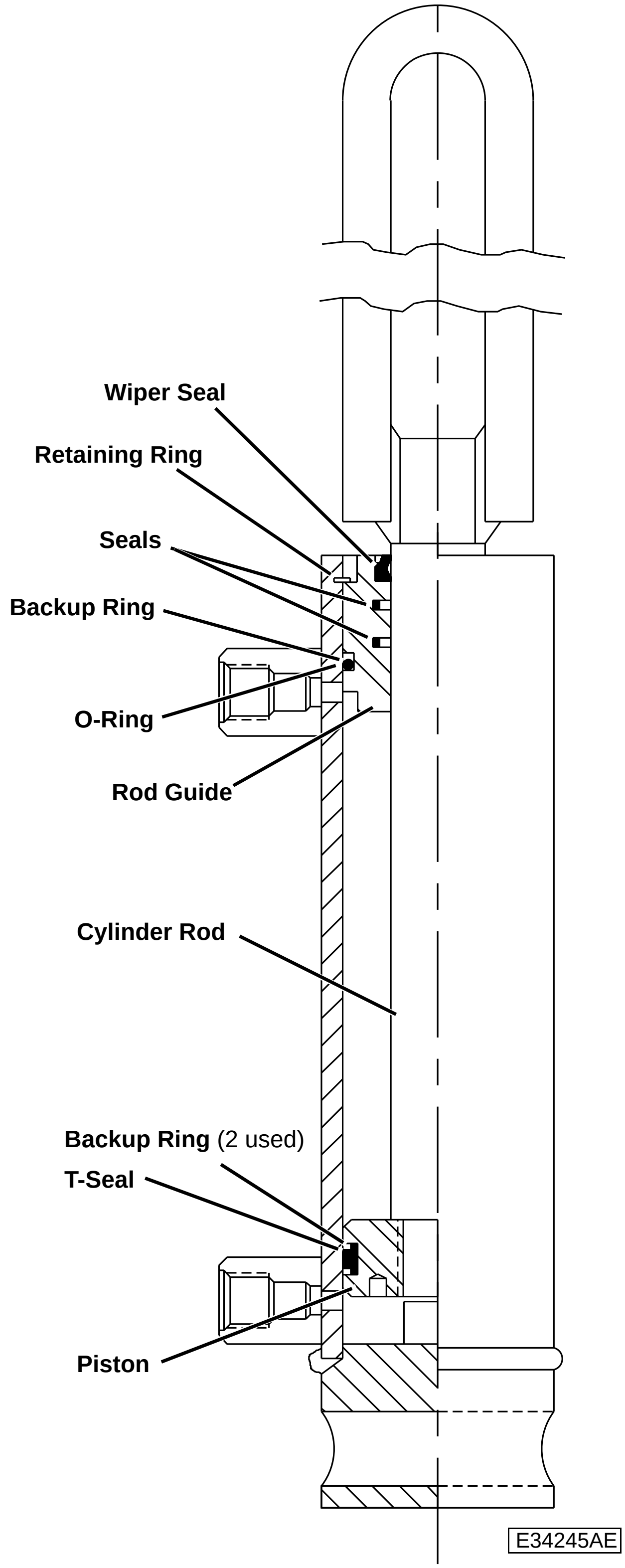
- Cycle lift system several times to bleed air from system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE on page 8-35.)

Disassembly/Assembly

1. Thoroughly clean outside of cylinder before disassembly. Remove any paint or debris on cylinder rod.



2. Remove O-rings, hydraulic fittings and orifice.



3. Remove retaining ring.
4. Pull out cylinder rod, rod guide, and piston as an assembly.
5. Remove piston from cylinder rod.
6. Remove and discard all seals, O-rings and backup rings.

CAUTION

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: Absolute cleanliness is essential when working on cylinder. 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.

7. Clean all metal parts with solvent and blow-dry with compressed air.
8. Inspect all parts for wear or damage. Replace complete cylinder if necessary.

Assembly is done in the reverse order of disassembly.

IMPORTANT: Always use new seals, O-rings and backup rings. Damaged or used parts will leak.

NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply clean hydraulic/hydrostatic oil on all internal parts during assembly.

- Apply thread lock and sealer (medium strength) to threads of cylinder rod.
- Tighten piston to **61 N•m (45 lb-ft)**.
- Make sure cuts of backup rings around T-seal are not aligned.

IMPORTANT: Groove in orifice must be toward hydraulic cylinder for proper operation.

Be sure orifice is squarely installed in cylinder port. Damage or distortion can occur when fitting is tightened.

- Install orifice with groove facing toward cylinder.

REAR LIFT CYLINDER

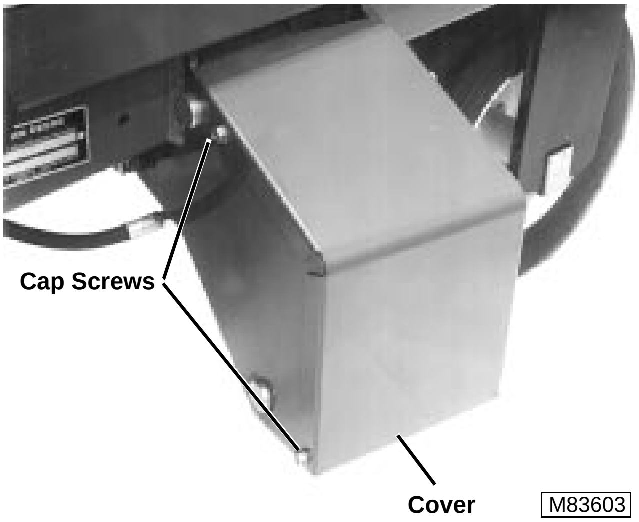
Removal/Installation

CAUTION

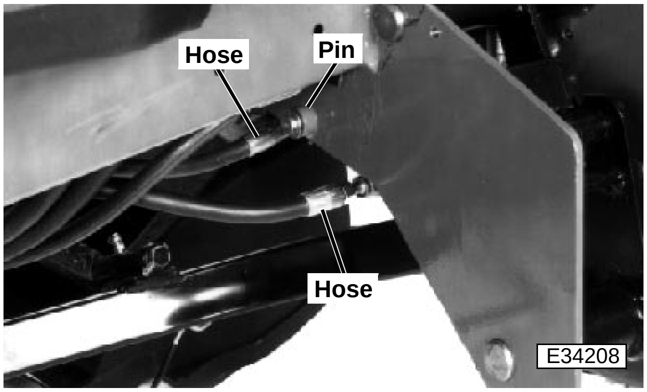
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

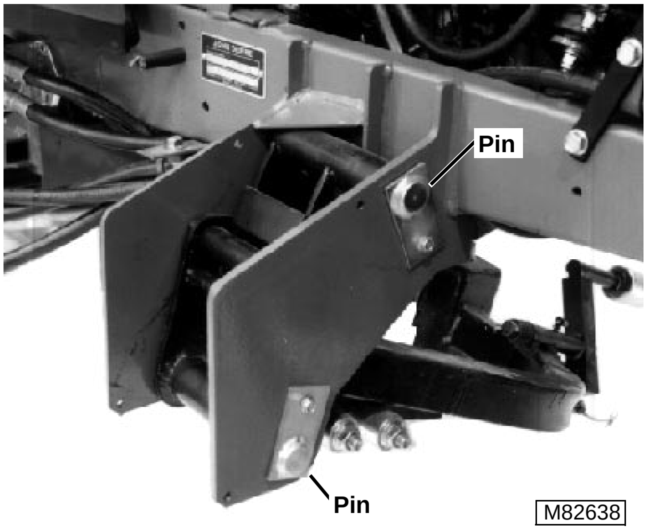
1. Park machine on level surface.
2. Move travel pedals to NEUTRAL position.
3. Move Mow/Transport lever to TRANSPORT position.
4. Lower cutting units to the ground.
5. Turn key switch to OFF position.
6. Engage park brake.
7. Raise engine hood.
8. Remove center cutting unit from lift arm.



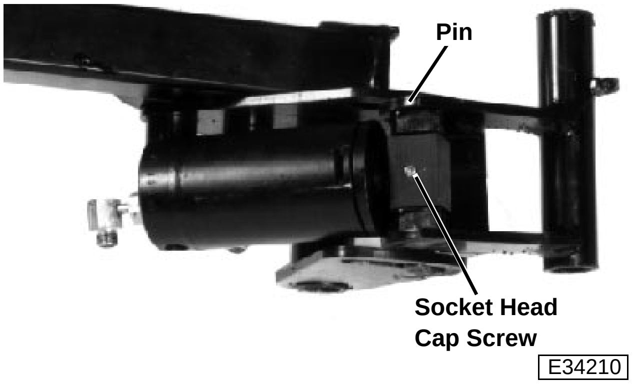
9. Remove four cap screws and rear lift arm cover.



10. Disconnect hydraulic hoses.
11. Remove snap ring to remove pin.



12. Remove pins and rear lift arm assembly.



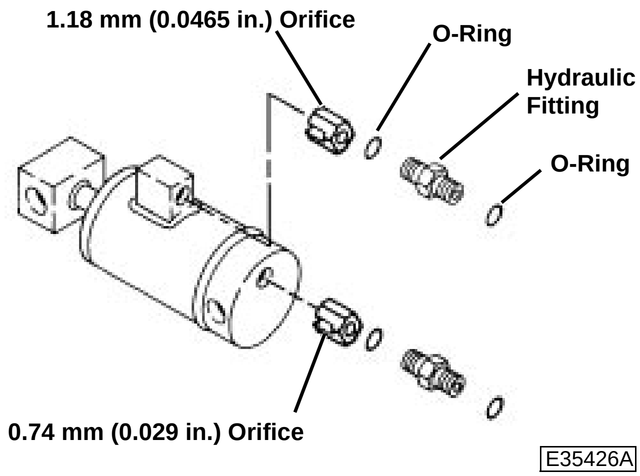
13. Loosen socket head cap screw. Remove pin to remove rear lift cylinder.

Installation is performed in the reverse order of removal.

- Cycle lift system several times to bleed air from system.
- Adjust rear lift linkage. (See REAR LIFT LINKAGE ADJUSTMENT on page 8-42.)

Disassembly/Assembly

1. Thoroughly clean outside of cylinder before disassembly. Remove any paint or debris on cylinder rod.



IMPORTANT: Mark or tag orifices so the proper sized orifice can be installed in the corresponding cylinder port.

2. Remove O-rings, hydraulic fittings and orifices.
3. Pry lock wire out of notch in cylinder body. Turn cylinder rod guide to remove lock wire.
4. Pull out cylinder rod, rod guide, and piston as an assembly.
5. Remove piston from cylinder rod.
6. Remove and discard all seals, O-rings and backup rings.

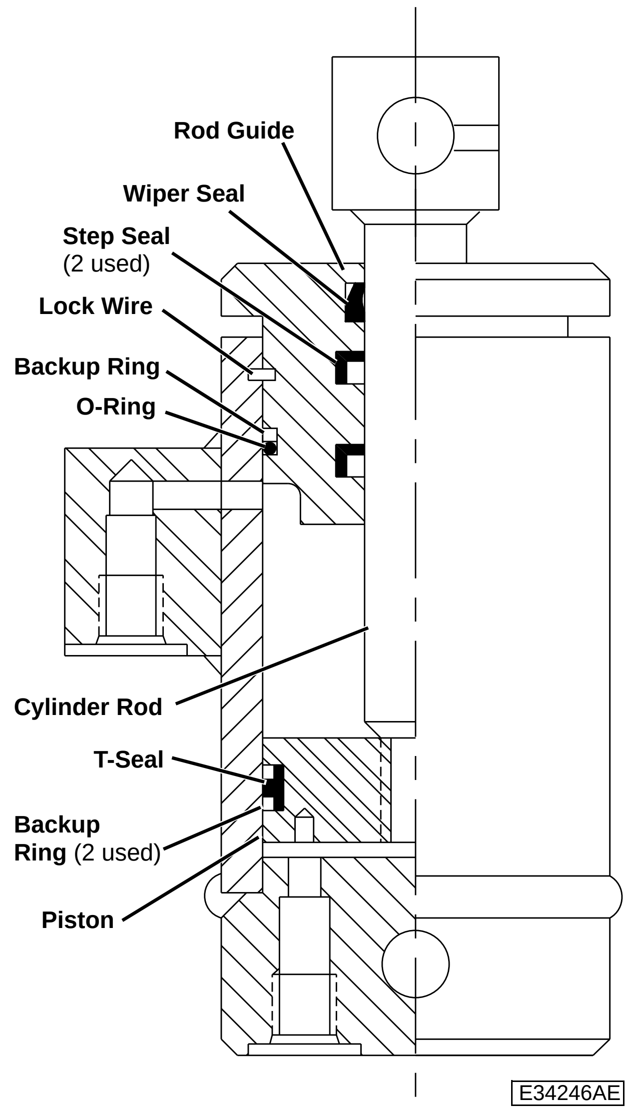
CAUTION

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: Absolute cleanliness is essential when working on cylinder. 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.

7. Clean all metal parts with solvent and blow-dry with compressed air.
8. Inspect all parts for wear or damage. Replace complete cylinder if necessary.



Assembly is done in the reverse order of disassembly.

IMPORTANT: Always use new seals, O-rings and backup rings. Damaged or used parts will leak.

NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply clean hydraulic/hydrostatic oil on all internal parts during assembly.

- Apply thread lock and sealer (medium strength) to threads of cylinder rod.
- Tighten piston to **75 N•m (55 lb-ft)**.
- Make sure cuts of backup rings around T-seal are not aligned.

- If necessary, turn rod guide to pull lock wire into groove.

IMPORTANT: Groove in orifices must be toward hydraulic cylinder for proper operation.

Be sure orifices are squarely installed in cylinder ports. Damage or distortion can occur when fittings are tightened.

- Install orifices with groove facing toward cylinder.

OPTIONAL MOW/BACKLAP VALVE (S.N. 957001—)

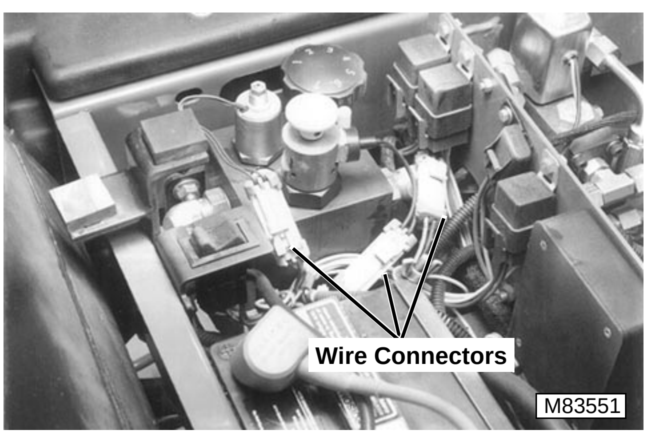
Removal/Installation

CAUTION

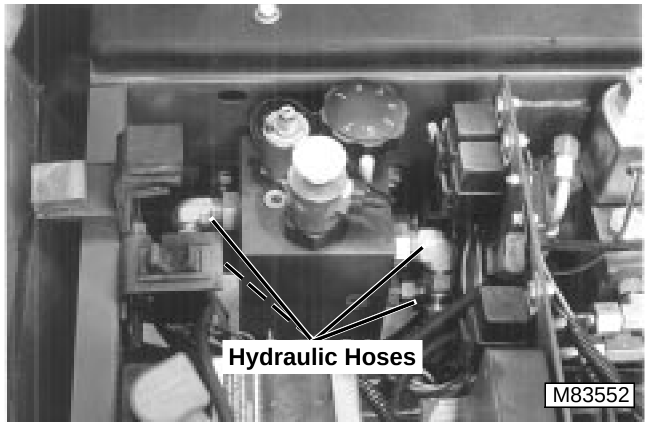
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

1. Remove seat platform. (See SEAT PLATFORM—Removal/Installation on page 10-5.)
2. Raise engine hood.



3. Disconnect wire connectors.



NOTE: Tag hoses to aid in installation. Cutting units can rotate backwards if hoses are not connected correctly.

4. Tag and disconnect hoses.

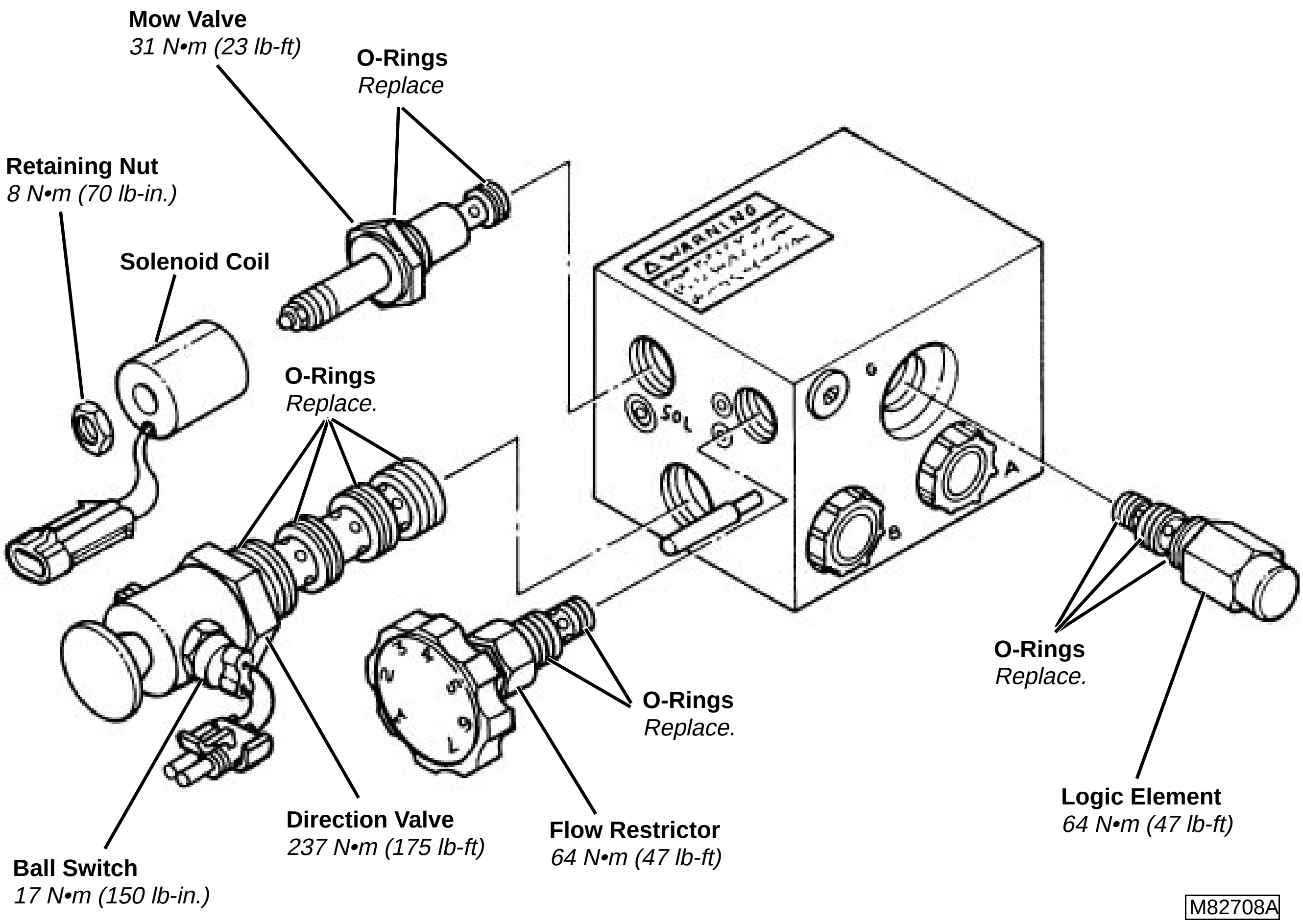
IMPORTANT: DO NOT lift mow/backlap valve by solenoids. Damage to the spool valve can result, causing the valve to bind. Lift by housing only.

5. Remove two cap screws at bottom of mow/backlap valve assembly and remove valve.
6. Note location and orientation of fittings in valve. Remove fittings.

Installation is done in the reverse order of removal.

- Elbow fittings should point downward toward right-hand side of machine.
- Run machine, test operation of valve and check for leaks.
- Add clean hydraulic oil to hydraulic reservoir as necessary. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)
- Bleed air from hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE, page 8-35.)

Repair



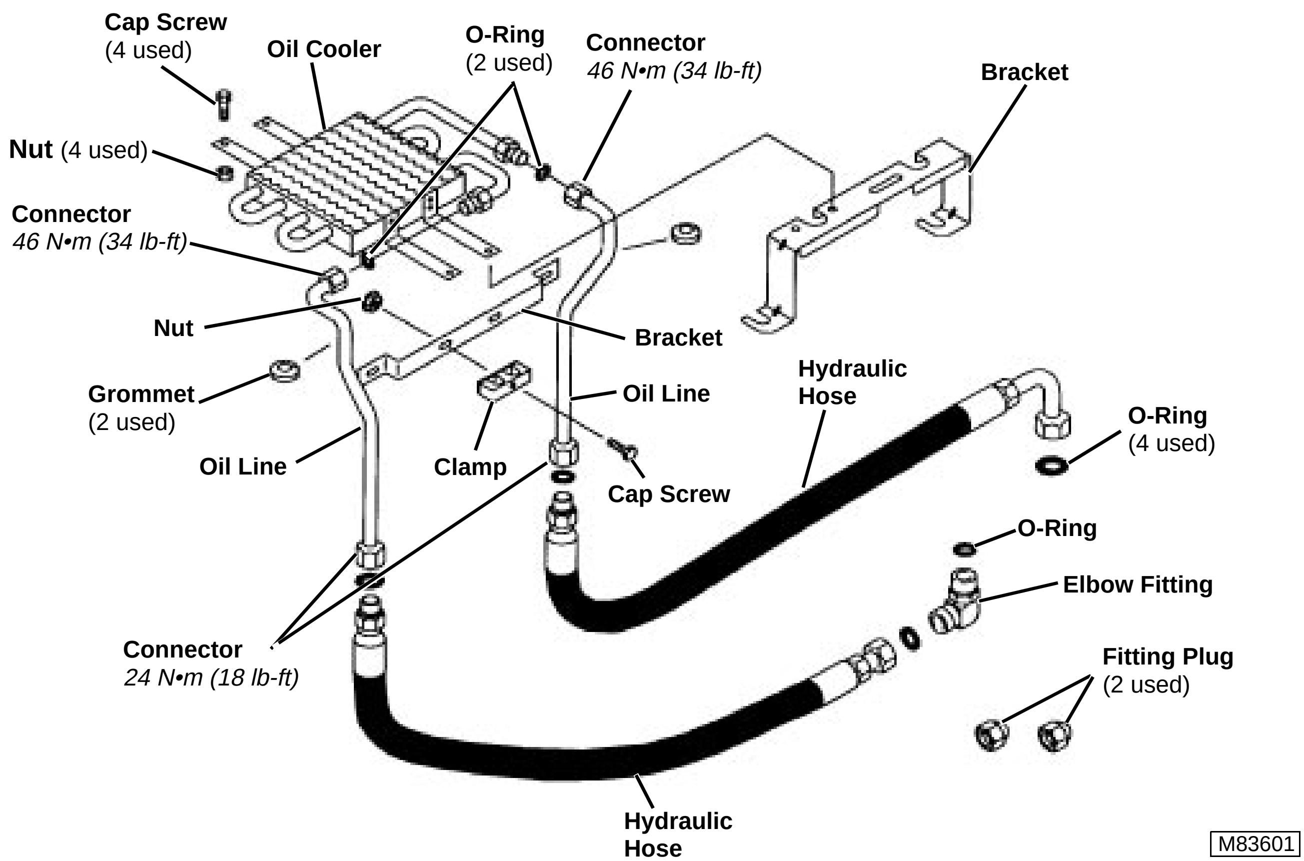
IMPORTANT: Absolute cleanliness is essential when working on valve. Contamination can result in serious damage or inadequate operation.

DO NOT use shop towels or rags to dry cleaned parts. Lint will clog passages in the hydraulic/ hydrostatic system and cause damage.

IMPORTANT: Always use new O-rings. Damaged or used parts will leak.

- Lubricate all O-rings with petroleum jelly during assembly.
- Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.
- Tighten mow valve to **31 N•m (23 lb-ft).**
- Tighten flow restrictor to **64 N•m (47 lb-ft)**.
- Tighten logic element to **64 N•m (47 lb-ft).**
- Tighten ball switch to **17 N•m (150 lb-in.).**
- Tighten solenoid coil retaining nut to **8 N•m (70 lb-in.).**

OPTIONAL OIL COOLER



CAUTION

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 removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

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

Installation is done in the reverse order of removal.

- Run engine and check for leaks at oil cooler connections. Check level of hydraulic oil in reservoir. Add oil if necessary. (See HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—NORTH AMERICA on page 2-18, or HYDROSTATIC TRANSMISSION AND HYDRAULIC OIL—EUROPE on page 2-18.)
- Tighten oil line-to-oil cooler connectors to **46 N•m (34 lb-ft).**
- Tighten oil line-to-hydraulic hose connectors to **24 N•m (18 lb-ft).**
- Bleed air from hydraulic system. (See HYDRAULIC SYSTEM BLEEDING PROCEDURE, page 8-35.)

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CONTENTS

Page

SPECIFICATIONS

GENERAL SPECIFCATIONS

22-Inch Reel Mowers

Make . . . . John Deere
Size . . . . 55.9 cm (22 in.)
Backlapping. . . . . .On machine variable speed
Clip Ratio. . . . . .See Performance Variables
Front Rollers . . . . Optional (smooth or grooved)
Reel Diameter . . . . 12.7 cm (5 in.)
Bed Knife Adjustment . . . . Reel to Bed Knife
Height-of-Cut. . . . . 2.4 to 19mm (3/32 to 3/4 in.)
Number of Blades . . . .(standard) 9 (greens)
Number of Blades (optional) . . . . 5 (fairways)
Cutting Unit Drive . . . . Hydraulic
Bed Knife Standard. . . . . .3mm (1/8 in.)
Tournament . . . . 2.38 mm (3/32 in.)
Fairway . . . . 6.5 mm (1/4 in.)

Options:

Greens Tender Conditioner . . . . Standard spacing 6.5 mm (1/4 in.)
Rear Roller Power Brush . . . . .Optional
Rear Solid Roller Scraper . . . . .Optional

REPAIR SPECIFICATIONS

22-Inch Reel Mowers

Bed Knife Top surface, ...5° Relief Angle
Front Surface, ...5° Relief Angle
Reel. . . . . .Spin Grind 20° Relief Grind
Roller. . . . . Smooth, Grooved

Bed Knife Support

Mounting Bolts
(Lower) . . . . 47 N•m (35 lb-ft.)
(Upper) . . . . 81 N•m (60 lb-ft.)
Mounting Screws . . . . 6 N•m (53 lb-in.)

Reel Mounting

Pivot Arm
(Forward). . . . . 47 N•m (35 lb-ft.)
(Rear) . . . . 81 N•m (60 lb-ft.)

Roller Mounting

Bolts . . . . 47 N•m (35 lb-ft.)
Reel/Bed Knife Clearance. . . . . 0—0.025 mm (0—0.001 in.)

22-Inch Vertical Cutting Units

Reel Mounting Pivot Arm
(Forward). . . . . 47 N•m (35 lb-ft.)
(Rear) . . . . 81 N•m (60 lb-ft.)
Roller Mounting Bolts . . . . 47 N•m (35 lb-ft.)

SPECIAL OR ESSENTIAL TOOLS

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

JDG795 Roller Bearing Puller
Used to remove bearings from rollers.

JDG243 or JDG506 Bearing Installer
Used to install bearings.

Two Bolt Gage Bar
Used to perform Height-of-Cut, Rear Roller/Bed Knife and Greens Tender Conditioner Adjustments.

DEALER FABRICATED TOOLS

E32285

- 2" or 4" Paint brush, attach a piece of rubber hose to the handle to extend its length. This will be used to apply backlapping compound.

OTHER MATERIALS

Number	Name	Use
M79292	MPG-2® Multipurpose Polymer Grease	Apply to engine crankshaft.
	Lapping Compound	Used in backlapping Procedure.

MPG-2® is a registered trademark of DuBois USA.

COMPONENT LOCATION AND APPLICATION

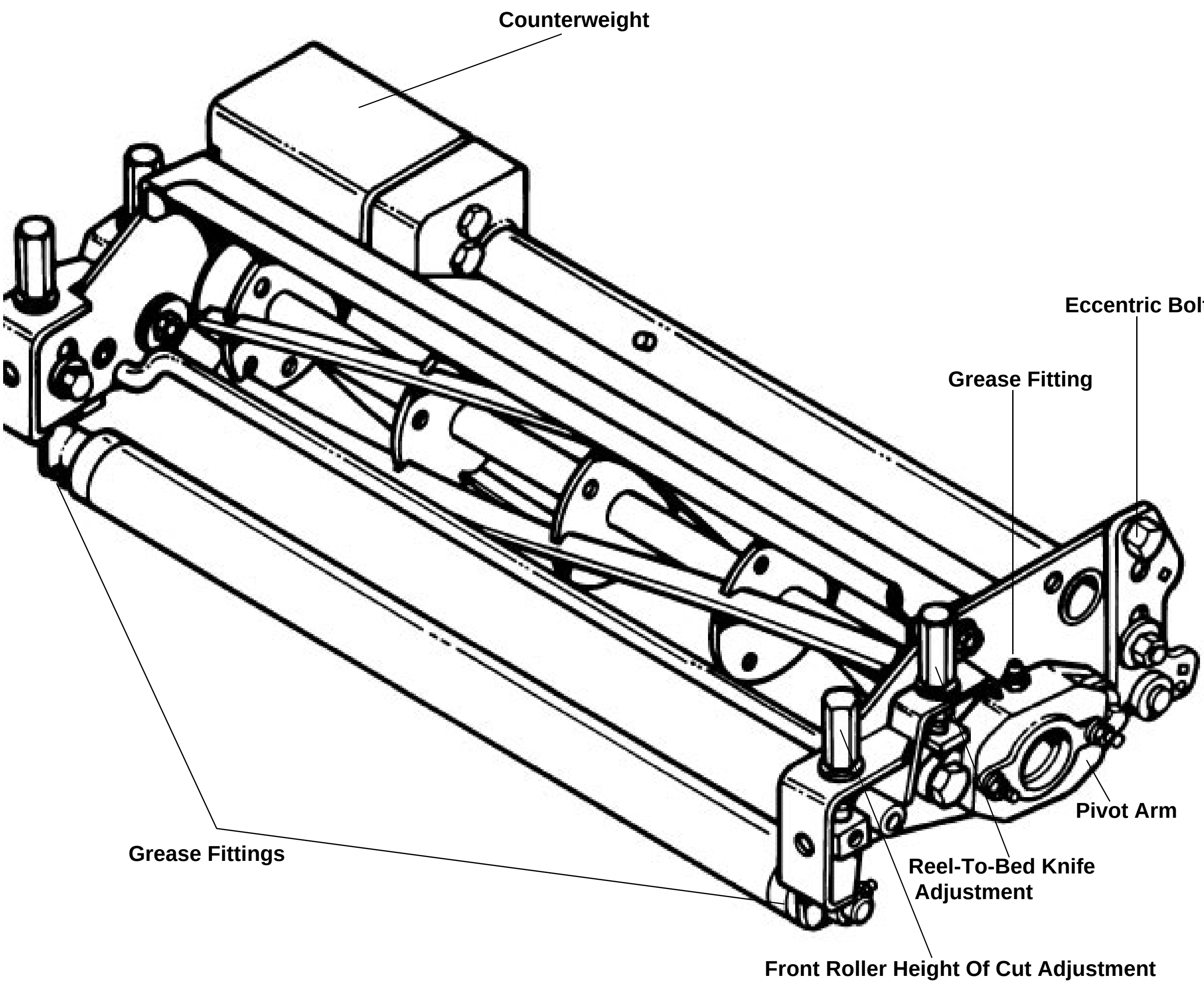
22-INCH REEL MOWERS

The 22-Inch Reel Mowers manufactured by John Deere prior to 1992 were made at the John Deere Ottumwa factory. They can be identified by a yellow reel, purchased from Tsuchiya. The reel mowers with black reels are made at the John Deere Horicon Works. The reels of those latest units are also made by John Deere.

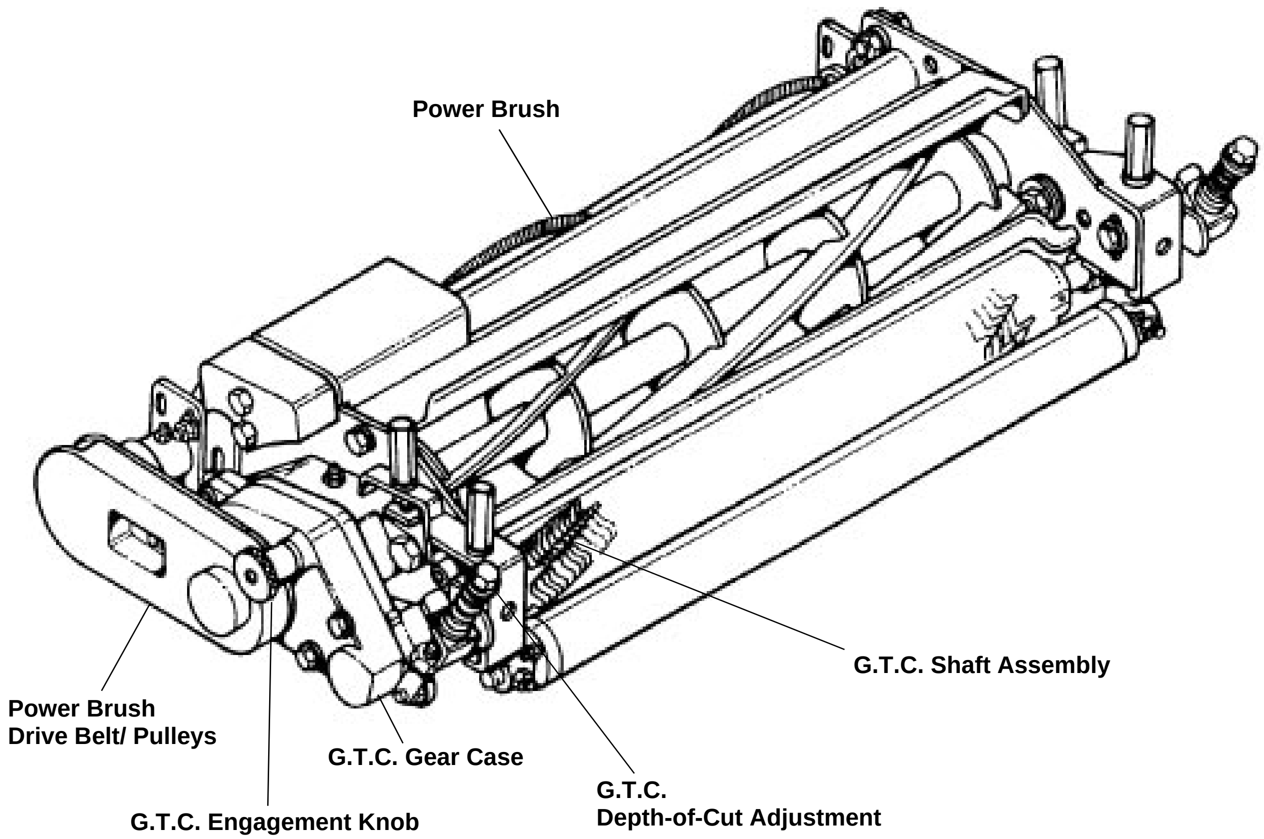
Two reels are available from John Deere. A 9-blade reel for greens and tees and a 5-blade reel for tee collars and fairway mowing applications. A Greens Tender Conditioner can be mounted to the 22-Inch Cutting Unit for slicing stolons, providing grain control and a truer playing surface. There is also a Power Brush Attachment for the 22-Inch Cutting Unit. It is used to keep the rear roller clear of cut-grass build-up that affects cutting height.

22-Inch reel mowers are used only on the 2243 Professional Greens Mower.

COMPONENT LOCATION



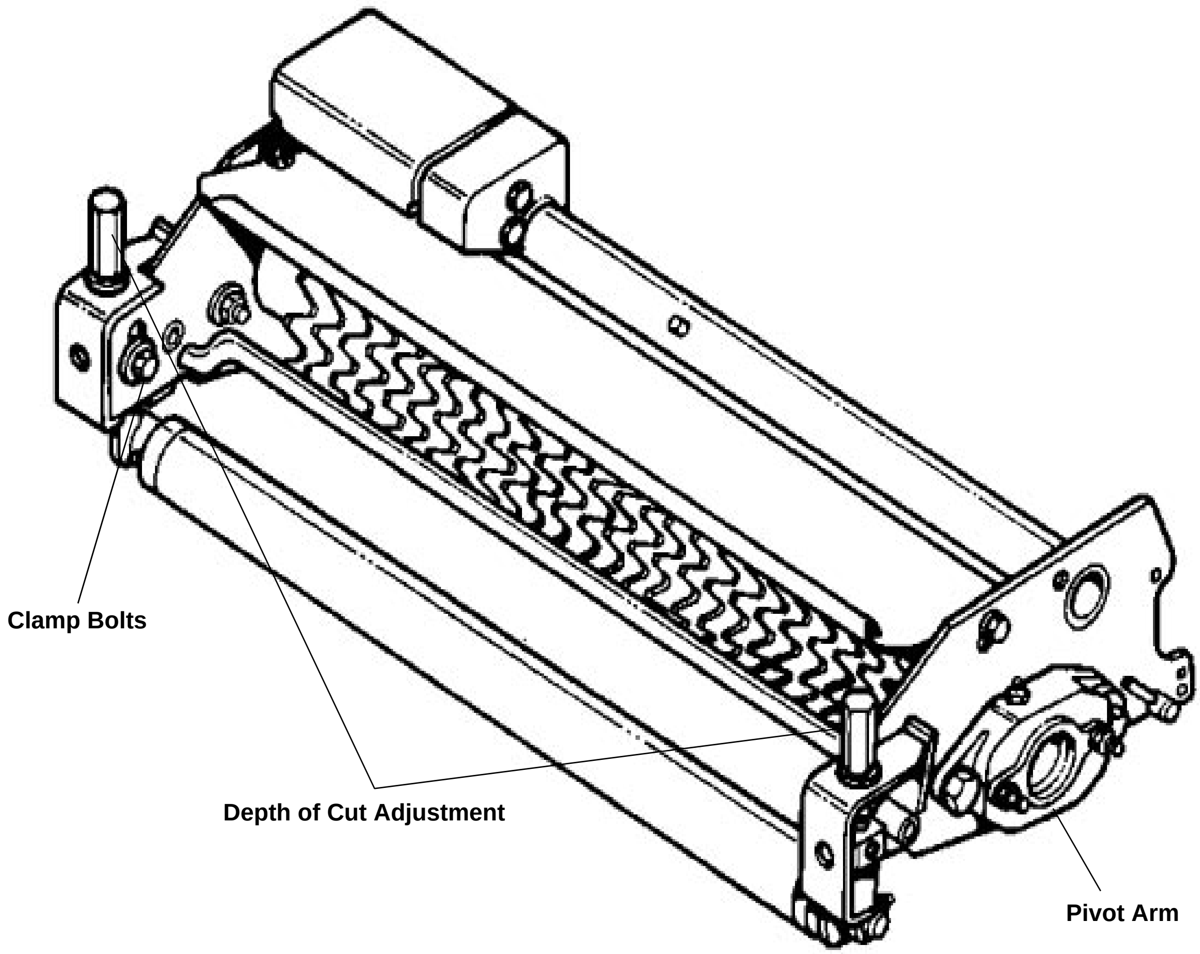
GREENS TENDER CONDITIONER (G.T.C.) AND POWER BRUSH COMPONENT LOCATION



22-INCH VERTICAL CUTTING UNITS

The 22-Inch Vertical Cutting Unit is built at the John Deere Horicon Works. The frame is similar to the 22-Inch reel mower and can be easily identified by the star-shaped vertical knives indexed in a Helix pattern. 22-Inch Vertical Cutting Units are used only on the 2243 Professional Greens Mower.

COMPONENT LOCATION



VERTICAL CUTTING UNIT OPERATION

The 22-Inch 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 spaced 3/4" apart from the factory. Spacing is accomplished by placing three 1/4" spacers together between each blade. If a closer spacing is desired, spacers can be removed and blades added.

The Helix in the cutters is formed by indexing the center hexagonal cut-out 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 lines must be reversed at the cutting unit motor.

CAUTION

Pay close attention to engine and transmission operating temperatures to avoid exceeding the temperature limits of the machine.

Always torque oil lines in accordance with machine specifications and check for leaks after connecting oil lines.

TROUBLESHOOTING—22-INCH REEL MOWERS

22-INCH REEL MOWERS TROUBLESHOOTING CHART

Problem or Symptom / Check or Solution	Marcelling	Streaking	H.O.C. Changes	Poor Cut Quality	Reels Do Not Rotate	Unit Not Cutting						
Ground speed too high	●											
Engine RPM too low	●											
Reels are dull	●											
Incorrect number of blades for conditions	●					●						
Incorrect or inconsistent reel/ bed knife clearance		●		●	●	●						
Damaged reel or bed knife		●										
Roller clamp bolt loose			●									
Roller bearing worn			●									
Roller out-of-round			●									
Traction pivot arms worn			●									
Reel/bed knife dull				●		●						
Reel bearings worn or seized					●							
Machine speed too slow						●						
Grass too wet			●									
Changing soil conditions			●									
Cut grass collecting on roller			●									
Excessive grass growth				●		●						
Reel motors not operating properly (See HYDRAULICS section)					●							

DIAGNOSIS—22-INCH REEL MOWERS

MARCELLING

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Ground speed too high	Speed correct for conditions/application	See PERFORMANCE VARIABLES on page 9-17 and MOWING SPEED ADJUSTMENT on page 5-22
2. Engine rpm too low	Engine slow and fast idle speed adjusted properly.	Adjust engine idle speed. (See FAST IDLE SPEED ADJUSTMENT on page 3-31 and SLOW IDLE SPEED ADJUSTMENT on page 3-32.)
3. Reels	Properly sharpened and backlapped	See BACKLAPPING (S.N. —957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)
4. Reels	Correct number of blades for application	See PERFORMANCE VARIABLES on page 9-17.

STREAKING

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Reel/bed knife	Properly sharpened and backlapped	See BACKLAPPING (S.N. —957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)
2. Reel/bed knife	Clearance properly adjusted across bed knife	Adjust clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-14.)
3. Reel	Reel not damaged or nicked	Replace reel or perform backlapping procedure. (See REEL—Removal on page 9-34) or (See BACKLAPPING (S.N. —957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)
4. Bed knife	Bed knife not damaged or nicked	Grind or replace bed knife. (See BED KNIFE—Removal/Installation on page 9-33.)

H.O.C. Changes[a]

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Roller clamp bolts	Properly tightened	Adjust cutting height. See HEIGHT-OF-CUT ADJUSTMENT on page 9-22.
2. Roller bearings	Not worn	Replace bearings. See ROLLER—Bearing Replacement on page 9-31.
3. Roller	Not damaged or out-of-round	Replace roller.
4. Roller	Clean, no grass collecting on roller	Install scraper or Power Brush on roller.
5. Traction unit pivot arms	Not worn or damaged	Repair or replace pivot arms.

[a]May have causes related to conditions, see Operator’s Manual for more information.

POOR QUALITY OF CUT[a]

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Reel/bed knife	Clearance properly adjusted across bed knife	Adjust clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-14.)
2. Reel/bed knife	Properly sharpened and backlapped	See BACKLAPPING (S.N. —957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)

REEL DOES NOT ROTATE

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Reel/bed knife	Clearance properly adjusted across bed knife	Adjust clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-14.)
2. Reel bearings	Not worn or seized	Replace bearings. (See PIVOT ARM—Disassembly/Inspection on page 9-31.)
3. Hydraulic system	Operating properly	See HYDRAULIC SECTION—DIAGNOSIS.

[a]May have causes related to conditions, see Operator's Manual for more information.

UNITS NOT CUTTING[a]

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Reel/bed knife	Clearance properly adjusted across bed knife	Adjust clearance. See REEL-TO-BED KNIFE ADJUSTMENT on page 9-14.
2. Reels	Correct number of blades for application	Replace reel with reel having correct number of blades for application. (See PERFORMANCE VARIABLES on page 9-17.)
3. Reels/bed knife	Properly sharpened and backlapped	See BACKLAPPING (S.N. —957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)
4. Engine rpm too low	Speed correct for conditions/application	See PERFORMANCE VARIABLES on page 9-17.

[a]May have causes related to conditions, see Operator's Manual for more information.

DIAGNOSIS—22-INCH VERTICAL CUTTING UNITS

Test Conditions:

- Machine parked on a level surface.
- Key switch OFF position.
- Transmission in NEUTRAL.
- Cutting units lowered to the ground.

Test/Check Point	Normal	If Not Normal
1. Reel/Cutting blades	Blades sharp, not damaged	Replace blades. (See REEL—Disassembly on page 9-41.)
2. Reel bearings	Not seized or damaged	Replace bearings. (See PIVOT ARM—Disassembly/Inspection on page 9-44.)
3. Knives	Adjusted properly	Adjust cutting depth. (See DEPTH-OF-CUT ADJUSTMENT on page 9-25.)
4. Engine rpm too low	Speed correct for conditions/application	See PERFORMANCE VARIABLES on page 9-17 and MOWING SPEED ADJUSTMENT on page 5-22
5. Cutting units	Floats with terrain	Lubricate pivot points.

INFORMATION—22-INCH REEL MOWERS

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 0.05 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 rollover, becoming dull.

Contact between the reel and bed knife generates heat. Heat generated through this contact will distort the shape of the bed knife. Distortion causes the bed knife to draw closer to the reel, resulting in more rollover of the cutting surfaces and more heat generated in the bed knife.

Drag produced by an improperly adjusted cutting unit may result in an unacceptable clip ratio, undue strain on drive mechanisms and premature wear of the cutting unit.

REEL/BED KNIFE GRINDING

Reasons for grinding:

To restore the cylindrical shape of a reel that has become cone-shaped due to improper adjustment of the 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).

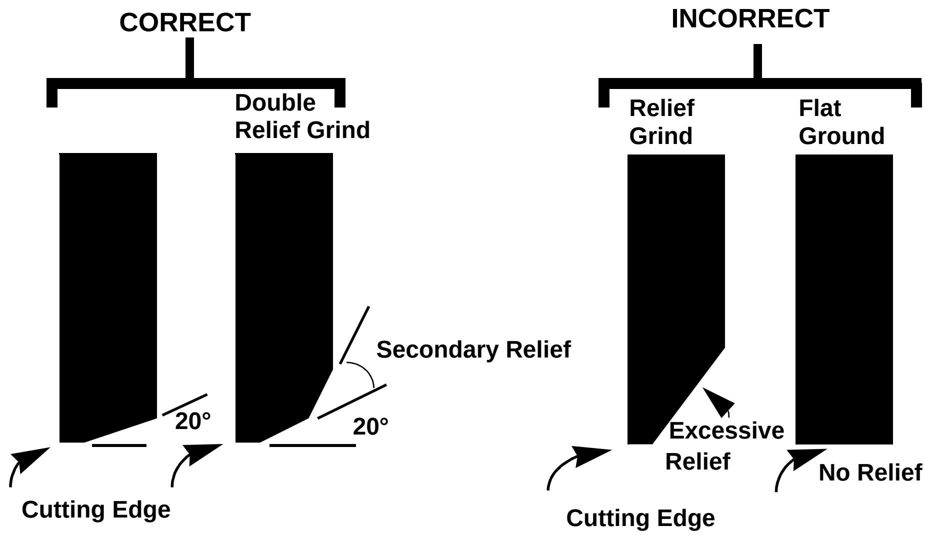
Cutting action begins as the bed knife positions the grass to be cut at the cutting edge. The reel then pulls the grass towards the bed knife where it is sheared by the cutting edges as they pass one another.

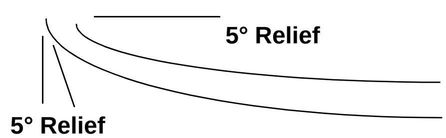
In order for the grass to be cut at the proper height, it must contact the bed knife at the cutting edge. This is accomplished by grinding a 5° relief angle on the front face of the bed knife. Without a relief angle, the blade of grass will contact the lower edge of the bed knife and be bent over at 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 spingrinding 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, 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





John Deere recommends Relief Grinding the reel and bed knife for these reasons:

- Reduced blade contact area, results in less friction, requiring less horsepower to drive the reel.
- Ensures longer wear life.
- Less time is required to backlap.
- Reduces pulling and tearing of the grass as the unit gets dull by use.
- Provides an area for backlapping compound to be trapped to more effectively backlap reels.
- Relief grinding removes metal from the trailing edge of the blade forming an angle (Relief Angle) to reduce the contact.
- Area of the cutting edges.
- Because of the relief grind it is possible, with backlapping, to true a reel (make it round) if a blade is 0.025—0.05 mm (0.001—0.002 in.) too high.

BACKLAPPING

This procedure is used to maintain a sharp cutting edge between grindings. See Reel/Bed Knife Grinding, in this section, to determine if grinding is necessary.

Backlapping, when compared to grinding, removes a very small amount of metal, requires less time and will effect a smooth, clean cut.

The backlapping procedure is accomplished by spinning the reel backwards while applying special abrasive compounds to the reel.

Usually, course compounds are used initially, followed by a fine abrasive "tournament grade" for final honing. Recommended grits for greens and tees when using the 22" cutting units are 120, 180 and 220.

Recommended compounds for fairways are 60, 80 and 100 grit. Reel sharpening compounds should not be toxic, oily or greasy.

The cutting unit should be inspected, lightly backlapped, adjusted and checked every 20 hours. of operation for a uniform cut along the complete length of the bed knife.

It is important that the adjustment allows the reel to turn freely without dragging against the bed knife. Metal-to-metal contact will generate heat, causing the reel to expand and intensifying the dragging that produces more heat. This viscous cycle will quickly "shut-down" a mower.

GREENS TENDER CONDITIONER (G.T.C.)

The conditioning process involves shallow vertical cutting. The blades are adjusted to cut runners and lift horizontal leaf material. It is important not to use a G.T.C. for three days following Top Dressing. It is also important that frequent and thorough observations be performed or stress to the plants may occur. Stress has occurred when a yellow or brown tint is observed in the color of the grass.

Grass is conditioned initially with the blades set 0.79 mm (1/32 in.) below height-of-cut.

The green is then examined closely for inconsistencies or appearance of over-aggressiveness. G.T.C. penetration should be decreased if indications are present.

After 1 to 2 hours the green is checked for stress. If visible stress is observed, G.T.C. penetration is decreased to 0.25 mm (1/64 in.) below height-of-cut.

Conditioning is continued at this setting for three to five days checking frequently for signs of stress. If no stress is observed, G.T.C. penetration is increased by 0.25 mm (0.010 in.) while observing every two to three days for signs of stress.

Stress is a cumulative result of many factors such as irrigation, temperature, humidity, chemical application etc. Conditioning aggressiveness will require adjustment and monitoring as these factors vary. Conditioning frequency may also need to be reduced in some cases.

SMOOTH ROLLER

The roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward.

A smooth roller is always used on the rear of a cutting unit to establish the cutting height range. A front roller used in conjunction with a rear roller is needed to achieve more exact cutting heights.

GROOVED ROLLER

The grooved roller is used as a ground sensing device to detect changes in the contour of the turf as the mower moves forward. The main advantage in using a grooved roller rather than a smooth one comes when cutting long grass that is very wet. Grass that is wet will tend to stay down rather than spring up after the roller passes. Grooved rollers will not bend the grass over, allowing it to be cut rather than passed over.

Along with advantages come disadvantages. Because of the reduced contact area, inherent with a grooved roller, the roller may penetrate deeper into the soil, (especially in wet conditions) lowering the effective cutting height and possibly scalping the turf. Serious consideration should be given to mowing Greens with a smooth roller attached, especially when the turf is very wet.

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 are an infinite number of shear points across the bed knife.

Clip Ratio (CR) - The forward distance traveled between successive cutting contacts at any one shear point.

Cutting Height (CH) - The distance above the soil line that grasses are clipped.

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 affect that blows the grass down without cutting it. CR is controlled by the Performance Variables, (the number of blades selected, ground speed and reel speed).

Of these Performance Variables, only two, in most cases, are we able to change. We can use a reel with a different number of blades, and/or we can change the vehicle ground speed.

Since we know the number of blades the reel has, what the reel speed is, the cutting height and the clip ratio (since CR must equal CH), let's find the vehicle ground speed.

Here's the formula:

$\text{MPH} = (\text{Reel rpm}) \times (\text{CR or CH}) \times (\text{Number of Reel Blades}) \div 1056$

Example

Using:

2243 Professional Greens Mower at a tested reel speed of 2100 RPM

9 blade reel on a 22-inch cutting unit

$\text{CH} = \text{CR}\ (0.14)$

Find: MPH (Vehicle Speed)

$(2100) \times (0.14) \times (9) \div 1056 = 2.5\ \text{MPH}$

NOTE: To calculate MPH, multiply 0.68148 x ft. traveled/sec. Another way to calculate speed is to measure off an 88 ft. distance, record the length of time, in seconds, it takes to travel that distance and divide 60 by that time.

ADJUSTMENTS—22-INCH REEL MOWERS

BACKLAPPING AND REEL-TO-BED KNIFE ADJUSTMENT

It is best to think of backlapping and reel-to-bed knife adjustments as one procedure. Although backlapping removes only a small amount of metal, the clearance between the reel and bed knife increases due to backlapping and must be readjusted.

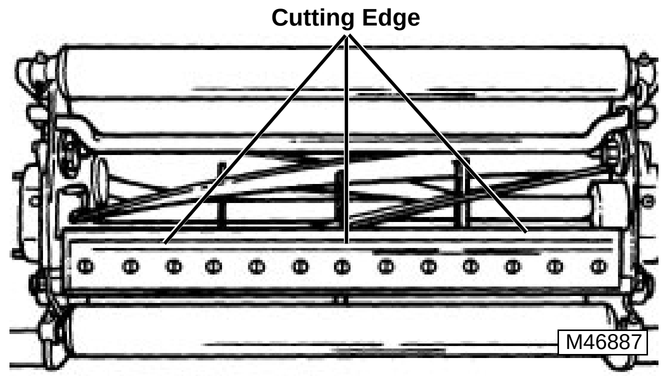
Another very important point to remember is that adjustments can only be successful if the frame integrity (straitness and strength) is maintained. Attaching bolts must be secure and bearings must be well lubricated and not worn.

REEL AND BED KNIFE INSPECTION

CAUTION

Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.
Never allow more than one person at a time, to work on any one cutting unit. Never allow work to be accomplished on more than one cutting unit at the same time. Serious personal injury could result.

1. Visually inspect cutting unit for damage. Chipped paint, dents or gouges may indicate the need for a closer look at the frame for distortion, broken weldments or other damage that could prevent proper adjustment. Repair or replace parts as necessary.
2. Inspect for vertical or lateral movement in the reel or bearings supporting the reel, repair or replace as necessary.
3. While rotating the reel in the reverse direction by hand, inspect each blade cutting edge for nicks, gouges or distortion. Ensure the cutting edge land does not exceed more than 3/4 of the blade thickness. See REEL/BED KNIFE GRINDING on page 9-14 to restore the relief angle and cutting edge before continuing with this procedure.



4. Inspect the bed knife cutting edge for nicks, gouges or distortion. Inspect leading edge of bed knife for relief to prevent catching of knife. A small relief or dub needs to be added after several backlappings.
5. Inspect the bed knife for uneven wear (indicated by uneven land width across the length of the bed knife). Ensure the cutting edge land does not exceed 3/4 of the cutting edge. Replace the bed knife if the cutting edge starts curling upward.

REEL-TO-BED KNIFE ADJUSTMENT

Reason:

To ensure correct contact between bed and reel knife.

Equipment:

- 0.025 mm (0.001 in.) Feeler Gauge (Blade Type)
- 0.050 mm (0.002 in.) Feeler Gauge (Blade Type)

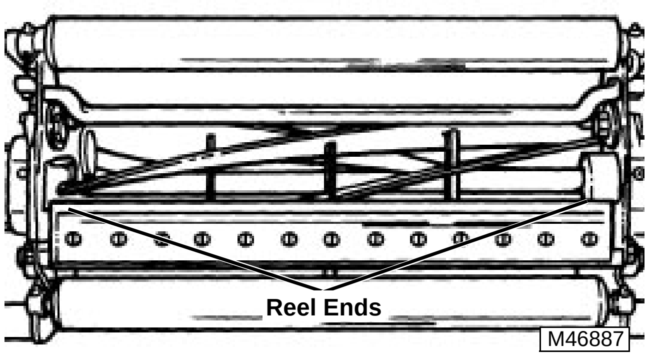
Procedure:

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage park brake.
6. Move mow/transport lever to TRANSPORT position.

CAUTION

Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.

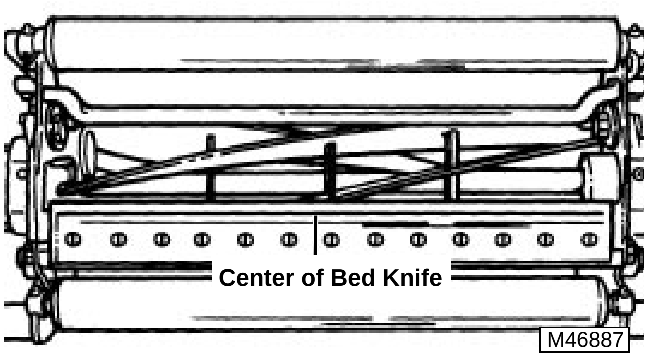
NOTE: Each flat on the adjustment nut represents 0.025 mm (0.001 in.) movement of the reel. The lower nut will lower the reel when turned counterclockwise and the upper nut will raise the reel when turned clockwise (as viewed from the top of the unit looking down).



7. Adjust ends of reel to set drag with a 0.025 mm (0.001 in.) feeler gauge.
8. Now inspect the entire length of the bed knife with a 0.05 mm (0.002 in.) feeler gauge. It should not go in anywhere. Go to step 11.
9. If the reel is contacting anywhere, go to step 10.

> **CAUTION**
>
> **Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.**

NOTE: Always rotate the reel in the reverse direction to avoid damaging or dulling the cutting edges of the reel or bed knife.



10. Slowly rotate the reel backwards watching for contact between the reel and bed knife at the center of the bed knife. If contact is made, grind the reel and bed knife to eliminate the "Frown" in the bed knife or the out-of-round condition of the reel.
11. Measure the clearance at the center of the bed knife. If the clearance exceeds **0.05 mm (0.002 in.)**, grind the reel and bed knife to eliminate the "Smile" in the bed knife or the out-of-round condition of the reel.
12. When properly adjusted and sharpened, each reel blade should cut a piece of paper held at 90° to the top surface of the bed knife along the entire length of the bed knife with **0—0.025 mm (0—0.001in.)** clearance.

BACKLAPPING (S.N. —957000)

Reason:

To ensure consistent cutting action.

Equipment:

- Long-Handled Brush (Dealer Fabricated)

Procedure:

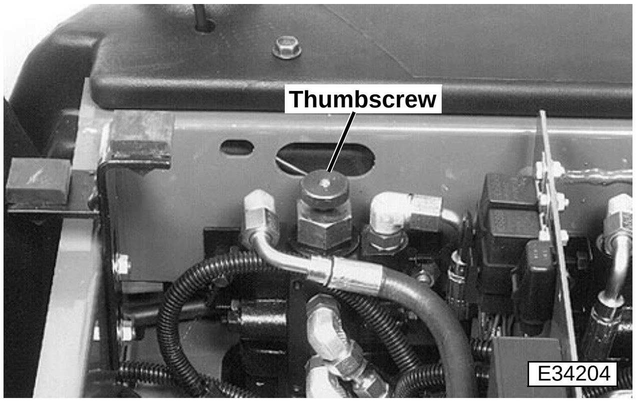
> **CAUTION**
>
> **Disengage GREENS TENDER CONDITIONER before backlapping. Severe personal injury may result from rotating knives.**

NOTE: The reel-to-bed knife contact should be adjusted before performing backlapping procedure. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)

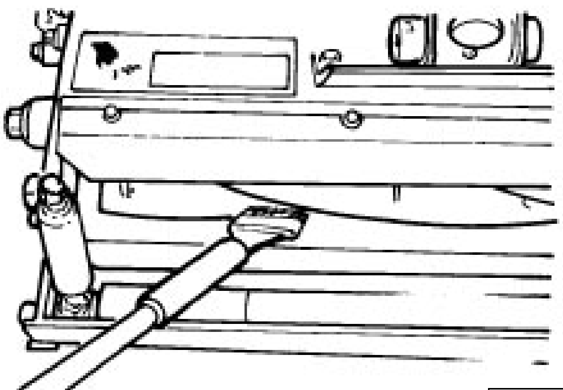
> **CAUTION**
>
> **Avoid injury from rotating blades. keep hands and feet away from blades while machine is running.**
> **Always wear protective gloves when working on or near the reel or bed knife. Severe personal injury can result from contact with the sharp cutting edges.**
> **Never allow more 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. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage park brake.
6. Move mow/transport lever to TRANSPORT position.
7. Raise and lock seat platform.

8. Start and run engine at **slow idle (1550 ±75 rpm).**



9. Turn thumbscrew clockwise (inward) until desired reel speed is achieved. Reel must be turning backward slow enough so compound will not be thrown from the reel blades.



IMPORTANT: Never operate cutting unit in the Forward direction until abrasive compounds are removed from the cutting unit. The abrasive compound will dull the cutting edges

10. Apply 120 grit compound to the rotating reel evenly from one side to the other and back again with a long handled brush. (See DEALER FABRICATED TOOLS on page 9-4 for instructions for making this tool.)
11. Allow the reel to spin until quiet. If desired, follow with a 220 grit compound to achieve a “Tournament Grade" finish.
12. Stop reels by turning thumbscrew counterclockwise as far as possible.

CAUTION

Never use pressure washers or steam cleaners to rinse the abrasives from the cutting unit. The abrasives may be forced past the seals and damage the bearings.

13. Rinse the lapping compound off the cutting unit with water and repeat the Adjustment Procedure before returning the unit to service.
14. Add a relief if needed, to the leading edge of the knife, to prevent the edge from "catching" the reel and curling it up.

BACKLAPPING (S.N. 957001—)

NOTE: Machine must be equipped with optional Mow/ Backlapping valve assembly to perform Backlapping procedure.

Reason:

To ensure consistent cutting action.

Equipment:

• Long-Handled Brush (Dealer Fabricated)

Procedure:

CAUTION

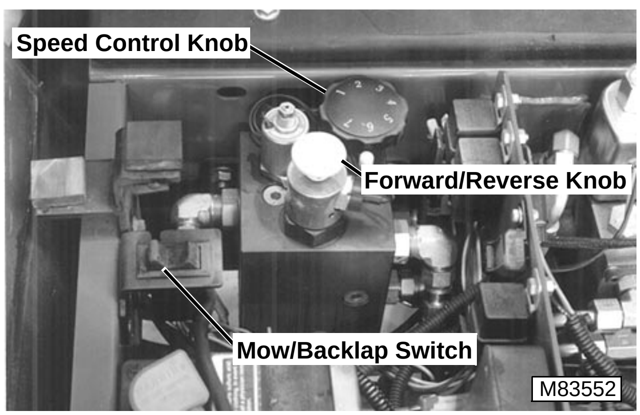
Disengage GREENS TENDER CONDITIONER before backlapping. Severe personal injury may result from rotating knives.

NOTE: The reel-to-bed knife contact should be adjusted before performing backlapping procedure. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)

⚠ CAUTION

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.

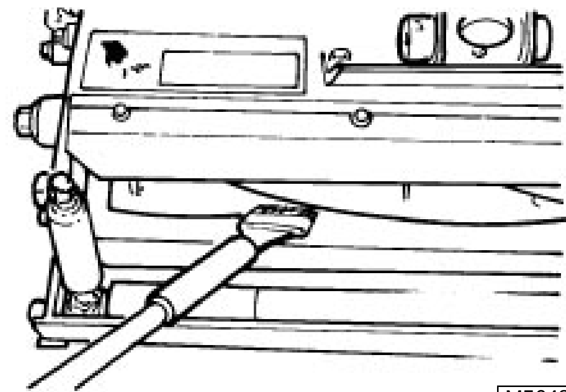
1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage park brake.
6. Move mow/transport lever to TRANSPORT position.
7. Raise and lock seat platform.
8. Start and run engine at **slow idle (1550 ±75 rpm).**



9. Place mow/backlap switch in BACKLAP position.
10. Turn the speed control knob clockwise to the 2 position.
11. Move mow/transport lever to MOW position.

NOTE: The cutting units will rotate backward when Forward/Reverse knob is pulled up.

12. Put machine in the Backlap mode by pulling the Forward/Reverse knob up.
13. Push mow switch, cutting units will start.
14. Turn the speed control knob to adjust reel speed. Reel must be turning backward slow enough so compound will not be thrown from the reel blades.
    - Turn knob clockwise to decrease reel speed.
    - Turn knob counterclockwise to increase reel speed.



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IMPORTANT: Never operate cutting unit in the Forward direction until abrasive compounds are removed from the cutting unit. The abrasive compound will dull the cutting edges

15. Apply 120 grit compound to the rotating reel evenly from one side to the other and back again with a long handled brush. (See DEALER FABRICATED TOOLS on page 9-4 for instruction for making this tool.)
16. Allow the reel to spin until quiet. If desired, follow with a 220 grit compound to achieve a “Tournament Grade" finish.

⚠ CAUTION

Never use pressure washers or steam cleaners to rinse the abrasives from the cutting unit. The abrasives may be forced past the seals and damage the bearings.

17. Rinse the lapping compound off the cutting unit with water and repeat the Adjustment Procedure before returning the unit to service.
18. Add a relief if needed, to the leading edge of the knife, to prevent the edge from "catching" the reel and curling it up.

HEIGHT-OF-CUT (H.O.C.) ADJUSTMENT

Reason:

To set desired cutting height.

IMPORTANT: 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. When mowing greens it is best to set the height-of-cut 0.5—1.00 mm (0.020—0.040 in.) higher for the initial cut and lower it as needed after a test cut.

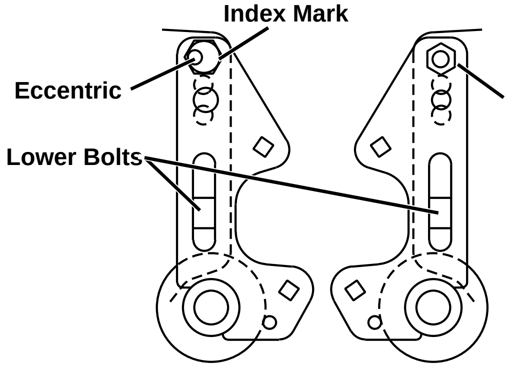
Use the table below to ensure the rear roller mounting brackets are positioned correctly for the H.O.C. range desired. Use the following procedure to change the H.O.C. range (if needed) before continuing with the adjustment at step 11.

H.O.C. RANGE	BRACKET HOLE	FRAME PLATE HOLE
2—10 mm (3/32—3/8 in.)	Top	Top
5—16 mm (3/16—5/8 in.)	Bottom	Bottom
10—19 mm (3/8—3/4 in.)	Top	Middle

Procedure:

1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage park brake.
6. Move mow/transport lever to TRANSPORT position.

Rear Roller (H.O.C.) Range



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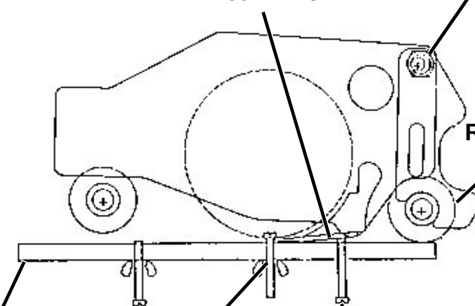
7. Loosen lower rear roller support bolts and remove upper bolt and eccentric.
8. Align the upper holes in the roller support with the proper hole in the frame side plate as shown in the table above.
9. Install upper bolt and nut on the right side and tighten.
10. Install the eccentric and nut on the left side. DO NOT tighten at this time. Ensure the Index Mark on the eccentric faces the rear of the cutting unit.

Rear Roller/Bed Knife Adjustment

NOTE: It may be necessary to raise the front roller height to allow enough room for the gauge bar to be installed.



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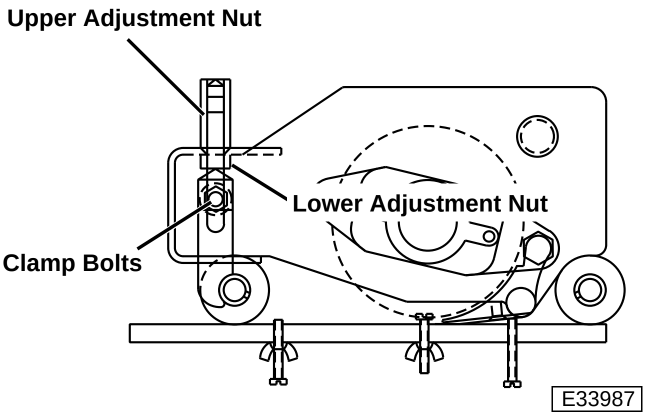
11. Set center gauge screw to desired height-of-cut. Position the gauge bar approximately **51 mm (2 in.)** from the right end (fixed end of roller) of the bed knife.
12. Hook the center gauge screw on the cutting edge of the bed knife and hold the end of the bar flat against the rear roller.
13. Turn the rear gauge screw in until it just makes contact with the bed knife. Tighten the wing nut to lock the position of the screw.
14. Move the gauge bar to approximately **51 mm (2 in.)** from the left end of the bed knife.
15. Use the eccentric bolt to adjust the roller up or down until the rear gauge screw just makes contact with the bed knife.
16. Tighten all rear roller support hardware and recheck with the gauge bar to ensure the roller has not moved.
17. Ensure the rear gauge screw is backed out and will not contact the bed knife.



18. Loosen the front roller clamp bolts 1/4 to 1/2 turn.

NOTE: It may be necessary to adjust the front roller height to allow enough room for the gauge bar to be installed.

19. Position the gauge bar **51 mm (2 in.)** from either end of the bed knife.
20. Hook the center gauge screw on the cutting edge of the bed knife and hold the end of the bar flat against the rear roller.

NOTE: One flat on the adjustment nut equals 0.25 mm (0.010 in.) of roller movement. Turning the upper adjustment nut clockwise raises the roller and turning the lower adjustment nut counterclockwise lowers the roller. Remember to loosen the opposite nut to allow movement of the adjusting nut.

IMPORTANT: Alternate turns of the adjustment nuts equally on both sides to prevent binding the adjustment mechanism.

21. While holding the roller mounting brackets against the rear of the frame guide slots, use the adjustment nuts to bring the roller down to the gauge bar.

IMPORTANT: The roller should just touch the gauge bar, forcing the roller against the gauge bar will bend it and raise the H.O.C.

22. After the adjustment is made tighten, the clamp bolts and tighten the opposite nut of the one used for adjustment.
23. Use the gauge bar to ensure the roller has not moved after tightening the clamp bolts and adjuster nuts.

GREENS TENDER CONDITIONER (G.T.C.) ADJUSTMENT

Reason:

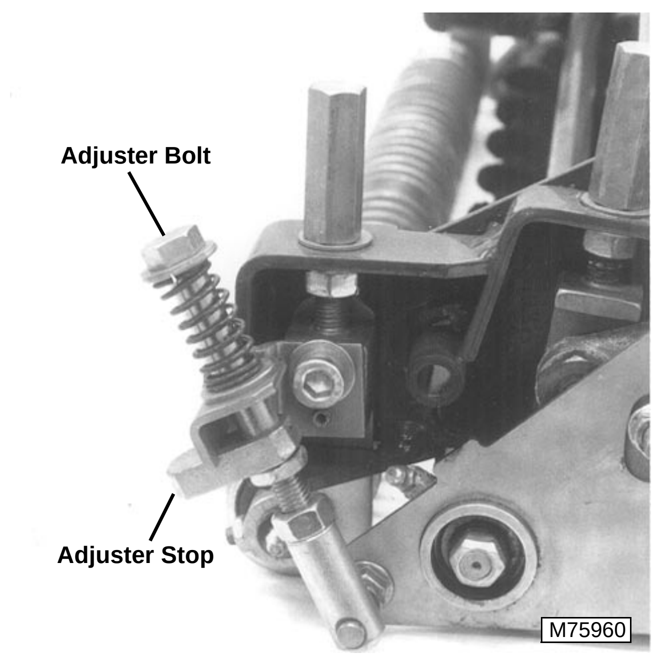
To set desired cutting height.

Procedure:

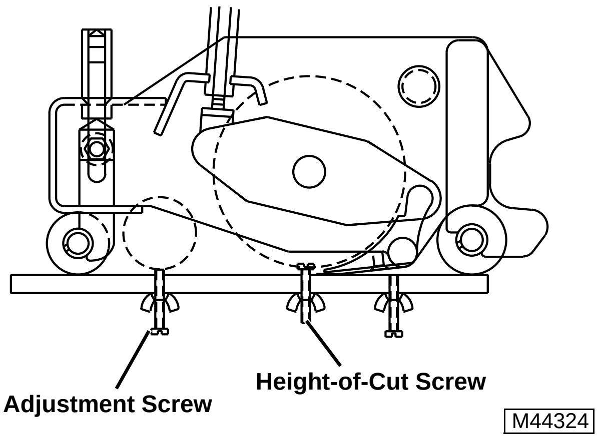
NOTE: Height of cut must be set prior to adjusting G.T.C.

> **CAUTION**
>
> **Before adjusting machine:**
> **Disengage all power.**
> **Shut off engine.**
> **Remove key.**
> **Wait until all moving parts have stopped.**

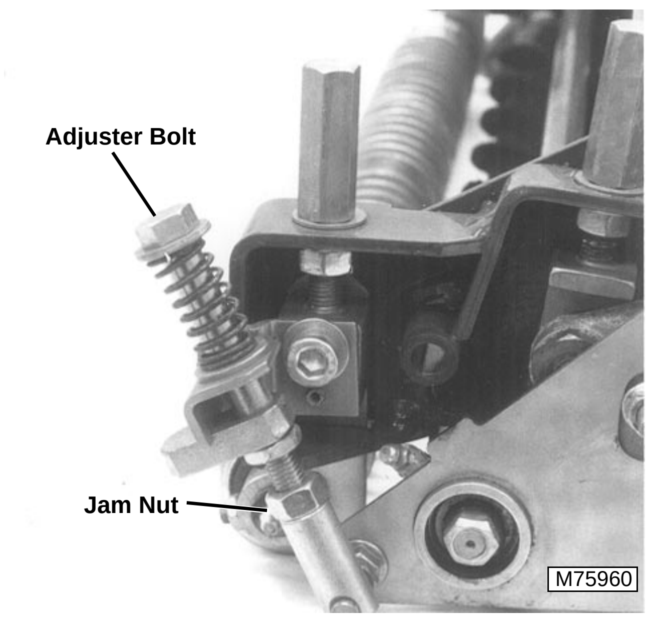
1. Park machine on level surface.
2. Lower cutting units to the ground.
3. Turn key switch OFF.
4. Move travel pedals to NEUTRAL position.
5. Engage park brake.
6. Move mow/transport lever to TRANSPORT position.



7. Press down on G.T.C. adjuster bolts and swing adjuster stops around toward the front of the cutting unit. This is the operating position.



8. Set G.T.C. adjustment screw on the gauge bar to equal the height-of-cut, less the penetration desired below the height-of-cut.
9. Place preset gauge bar on cutting unit. Hook height-of-cut screw on bed knife. The ends should rest firmly on the front and rear rollers.



10. Loosen jam nut . Repeat on opposite side.
11. Turn adjuster bolt to raise or lower G.T.C. Alternate from end to end until the teeth touch the screw on the gauge bar.
12. Remove gauge bar.

ADJUSTMENTS—22-INCH VERTICAL CUTTING UNITS

DEPTH-OF-CUT ADJUSTMENT

Reason:

To set desired cutting depth.

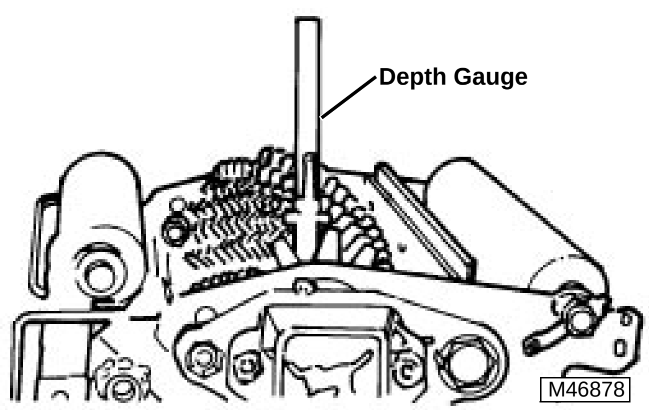
Procedure:

1. Remove cutting units from machine. (See CUTTING UNITS—Removal/Installation on page 9-39.)
2. Place cutting units upside-down on a solid workbench.

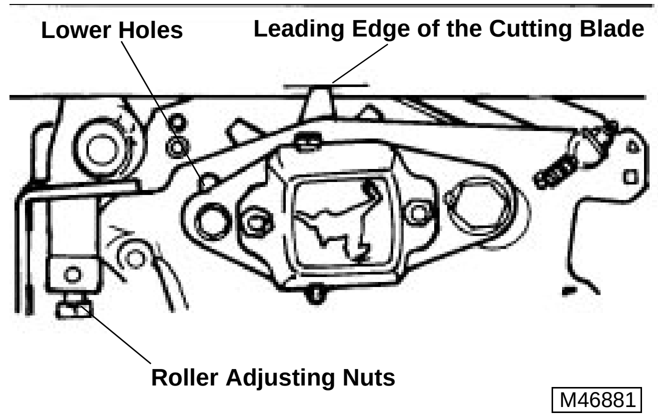
> **CAUTION**
>
> **Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.**

IMPORTANT: 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.

.



3. Mark the desired cutting depth on gauge bar.
4. Place the gauge bar across the front and rear rollers approximately two inches in from the end of the rollers.



IMPORTANT: Adjust both ends of the roller evenly to avoid binding the adjustment mechanisms.

NOTE: When checking the cutting depth of the blade against the mark on the gauge bar, rotate the reel back and forth to ensure the blade travel does not extend beyond the mark on the gauge bar.

5. Adjust the front roller height to bring the leading edge of the cutting blade even with the mark on the gauge bar.

NOTE: If the desired cutting depth cannot be achieved with roller adjustment, move the pivot arms to the lower holes in the cutter frame and repeat Step three.

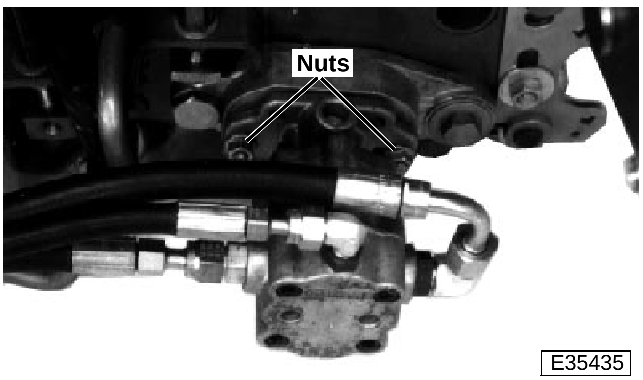
6. Tighten roller adjusting nuts and recheck depth of cut. Readjust if necessary.
7. Adjust scraper to just touch gauge bar (roller height).

REPAIR—22-INCH REEL MOWERS

REEL MOWER

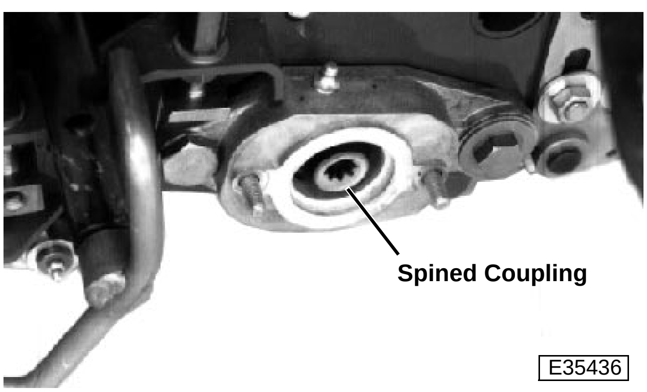
Removal/Installation

> **CAUTION**
>
> **STOP engine. Remove ignition key. Wait for all moving parts to STOP**

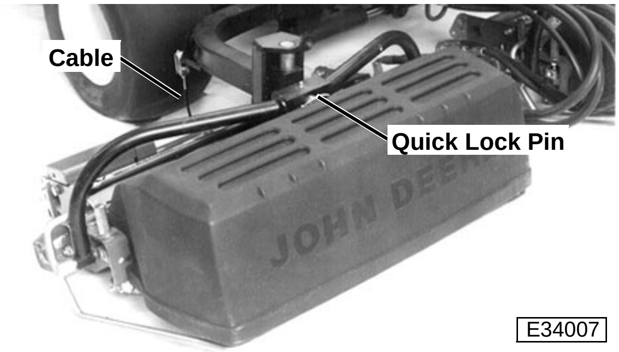


NOTE: It is not necessary to remove hoses from hydraulic motors.

1. Remove two nuts and pull reel motor from cutting unit. Hang motor from hook on mower frame.



2. Remove spined coupling



3. Remove quick lock pin and washer.
4. Disconnect cable from cutting unit.
5. Slide cutting unit from mower.

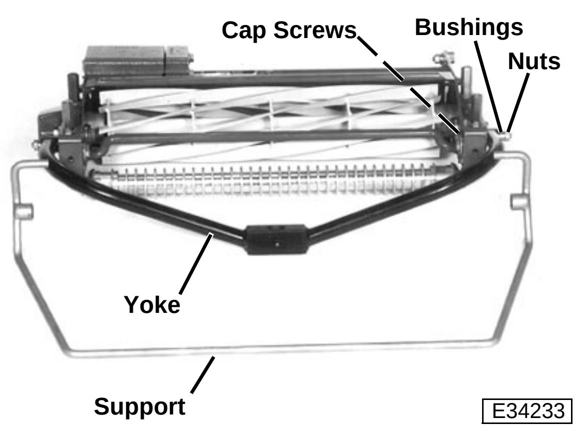
Installation is done in the reverse order of removal.

- Apply grease to splined coupling.
- Make sure splines are aligned before tightening motor mounting nuts.

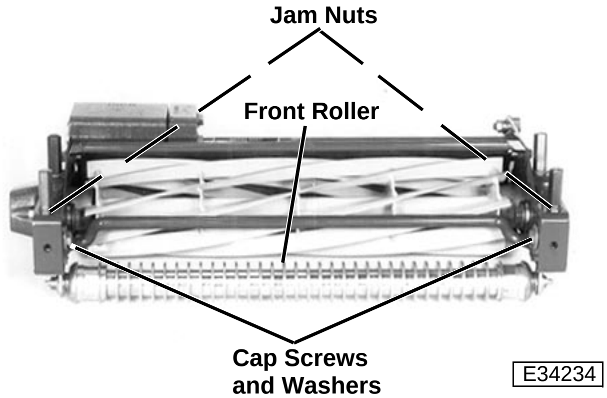
Disassembly

NOTE: Bed knife and reels can be removed for service without disassembling the entire cutting unit. (See BED KNIFE—Removal/Installation on page 9-33 or REEL—Removal/Installation on page 9-34.)

> **CAUTION**
>
> **Always wear protective gloves when working on or near a reel or G.T.C. Serious personal injury can result from contact with sharp cutting edges.**



1. Remove grass catcher and support.
2. Remove two nuts, bushings and cap screws to remove yoke.

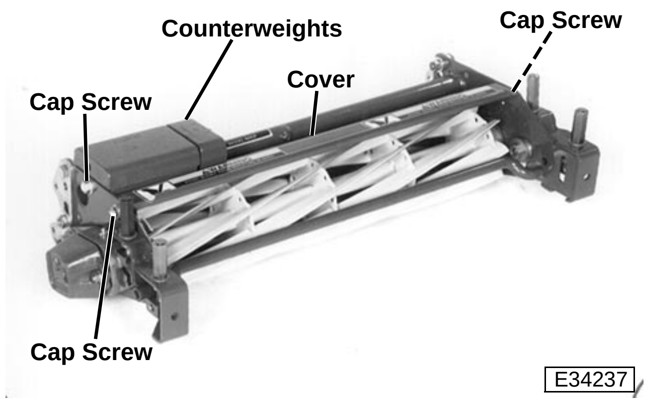


E34234

3. Loosen jam nut on height-of-cut adjusters.
4. Remove cap screws and washers.

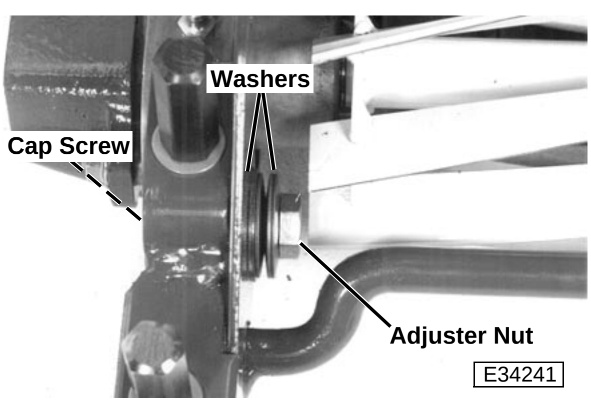
NOTE: Grooved roller shown in photo.

5. Remove front roller with brackets. Replace bearings if necessary. (See ROLLER—Bearing Replacement on page 9-31 or AET10558 GROOVED ROLLER—Bearing Replacement on page 9-33.)



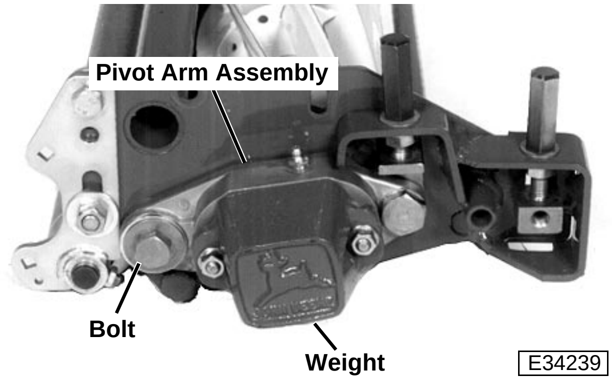
E34237

6. Remove cap screw to remove counterweights.
7. Remove two cap screws to remove cover.



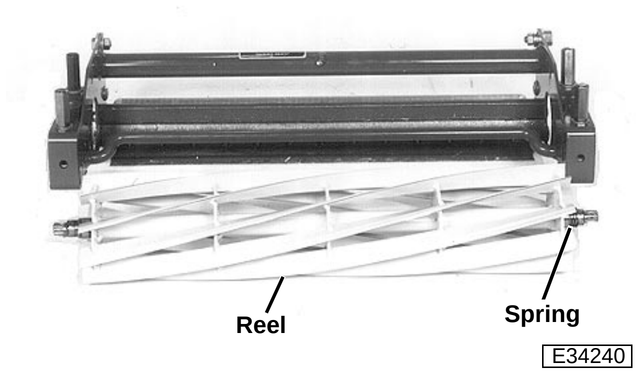
E34241

8. Remove adjuster nut, four washers and cap screw from each side of cutting unit.



E34239

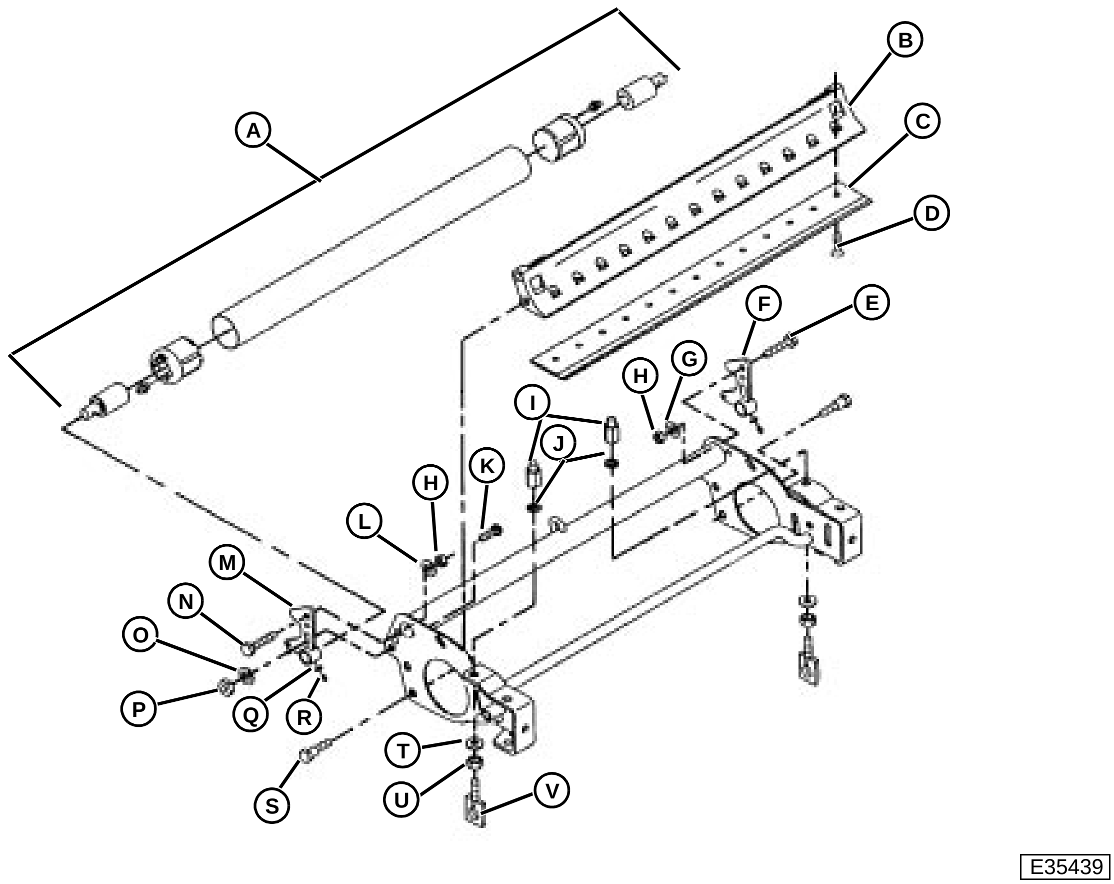
9. Remove two nuts to remove weight.
10. Remove bolt and two washers from each side of cutting unit. Remove pivot arm assembly from each side.
11. Inspect pivot arm assemblies. (See PIVOT ARM—Disassembly/Inspection on page 9-31.)



E34240

NOTE: Spring is located on left side only.

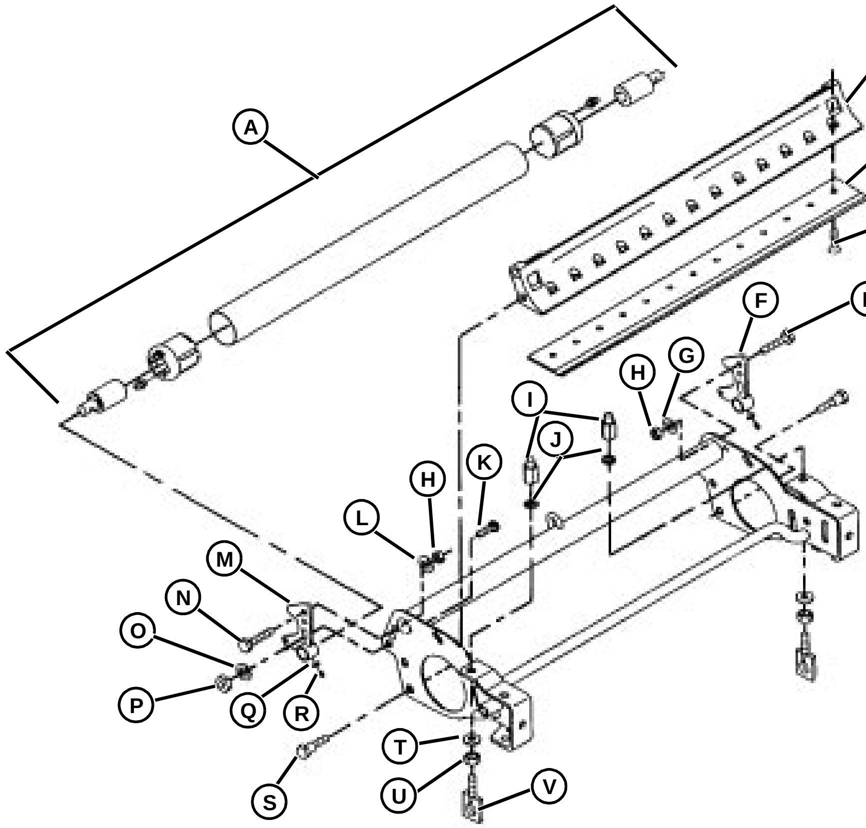
12. Remove reel and spring.



A—Rear Roller Assembly
B—Shoe
C—Bed Knife
D—Screw (13 used)
E—Eccentric Cap Screw
F—Roller Bracket (L.H.)
G—Washer
H—Nut (6 used)
I—Long Nut (2 used)
J—Washer (2 used)
K—Bolt (2 used)
L—Washer
M—Roller Bracket (R.H.)
N—Cap Screw
O—Washer (3 used)
P—Nut (2 used)
Q—Nut (2 used)
R—Set Screw (as required)
S—Cap Screw (2 used)
T—Washer (2 used)
U—Nut (6 used)
V—Adjuster (2 used)

13. Remove cap screws (E) and (N), washers (G) and (L) and nuts (H) from each end of the cutting unit.
14. Remove bolt (K), washer (O) and nut (P) from each end of the cutting unit to remove rear roller assembly (A) and brackets. Replace bearings if necessary. (See ROLLER—Bearing Replacement on page 9-31, or AET10558 GROOVED ROLLER—Bearing Replacement on page 9-33.)
15. Remove two cap screws (S) to remove shoe (B), bed knife (C) and screws (D). Discard screws if removed.
16. Inspect all parts for wear or damage. Replace parts as necessary.

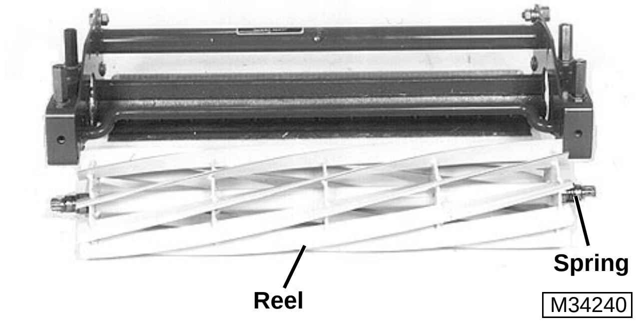
Assembly



E35439

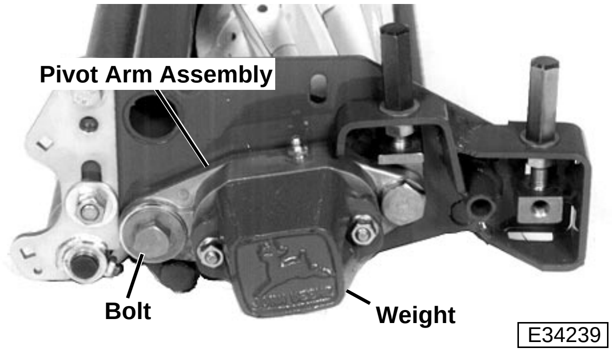
A—Rear Roller Assembly
B—Shoe
C—Bed Knife
D—Screw (13 used)
E—Eccentric Cap Screw
F—Roller Bracket (L.H.)
G—Washer
H—Nut (6 used)
I—Long Nut (2 used)
J—Washer (2 used)
K—Bolt (2 used)
L—Washer
M—Roller Bracket (R.H.)
N—Cap Screw
O—Washer (3 used)
P—Nut (2 used)
Q—Nut (2 used)
R—Set Screw (as required)
S—Cap Screw (2 used)
T—Washer (2 used)
U—Nut (6 used)
V—Adjuster (2 used)

1. Install adjuster parts (I, J, T, U and V).
2. Assemble shoe (B), bed knife (C) and new screws (D). Tighten screws to **6.5 N•m (58 lb-ft)**.
3. Install shoe assembly and cap screws (S). Starting at the center screw, alternate tightening bed screws working toward the ends of the knife. Tighten cap screws to **47 N•m (35 lb-ft)**.
4. Install brackets (F) and (M) on rear roller assembly (A). Position holes in end of the roller shaft 90° to set screw (R). Tighten set screw and lock nut (Q).
5. Install rear roller assembly using bolt (K), cap screws (E) and (N), washers (G, L and O). Tighten nut (P) and cap screws (E) and (N) to **47 N•m (35 lb-ft)**.



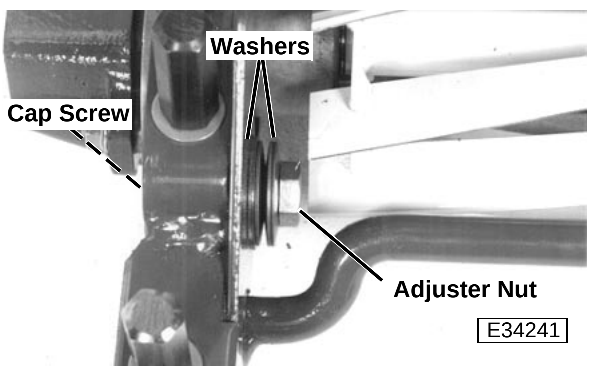
M34240

6. Install spring on reel. The spring must be installed on the grooved end of the reel shaft.
7. Install reel and spring with grooved end of reel to the left side.



IMPORTANT: Be certain that the keyed washer located inside the left pivot arm assembly engages the groove of the reel shaft.

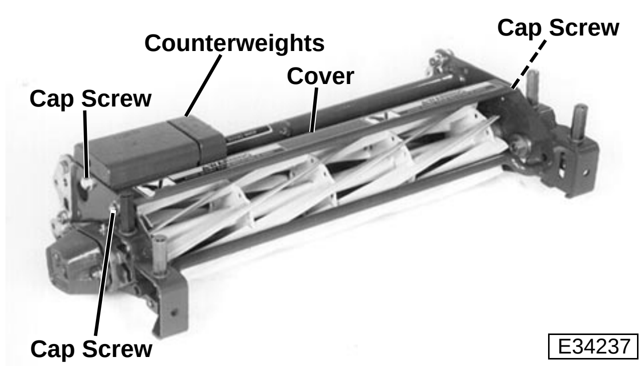
8. Install pivot arm assemblies on cutting unit. Install two washers and bolts. Tighten bolt to **81 N•m (60 lb-ft).**



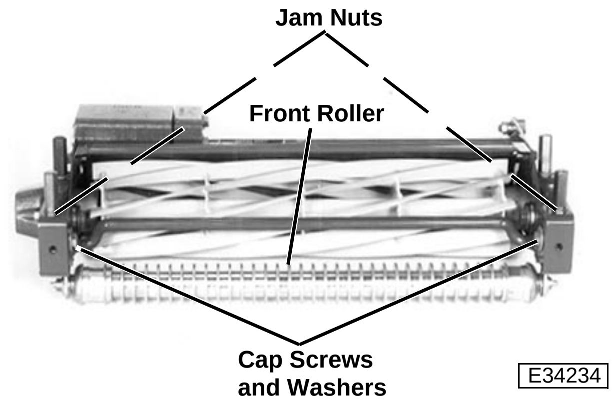
9. Install cap screw, four washers and adjuster nut on each side of cutting unit. Note position of washers.

NOTE: Weight is installed on right side for right front and rear cutting units; left side for left front cutting unit.

10. Secure weight with two nuts.

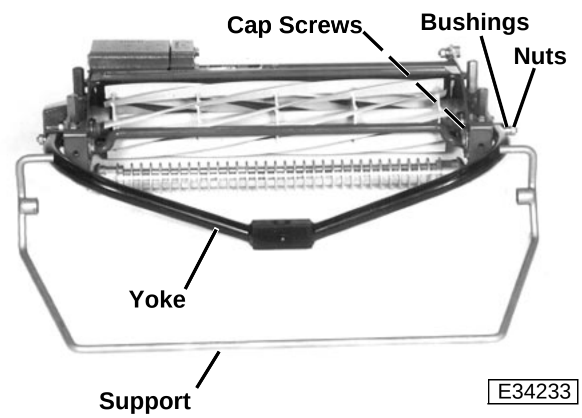


11. Install cover and secure with two cap screws.
12. Install counterweight and secure with cap screw.



NOTE: Jam nuts will be tightened during adjustment of cutting unit.

13. Insert roller brackets through frame slots.
14. Apply MPG-2® Multipurpose Polymer Grease to threads of cap screws. Install cap screws and washers.
15. Center roller between the mounting brackets and tighten set screws and jam nuts.

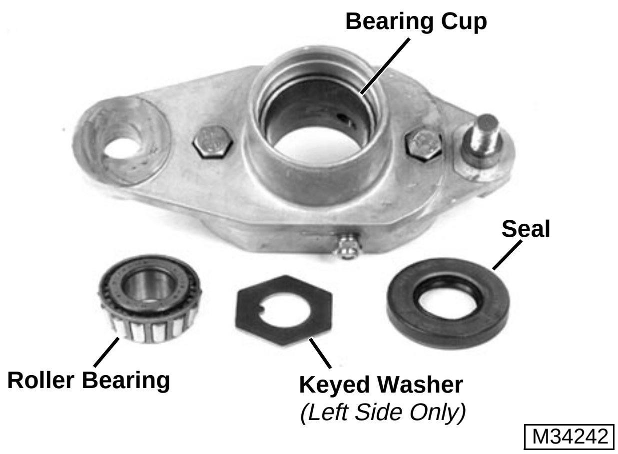


16. Install yoke, two cap screws, bushings and nuts.
17. Install grass catcher support and grass catcher.
18. Adjust reel-to-bed knife clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)
19. Adjust rear roller. (See HEIGHT-OF-CUT ADJUSTMENT—Rear Roller (H.O.C.) Range on page 9-22.)
20. Adjust front roller. (See HEIGHT-OF-CUT ADJUSTMENT on page 9-22.)

PIVOT ARM

Disassembly/Inspection

NOTE: Left or right positions are determined by standing at the rear of the unit and looking forward.



1. Remove seals, tapered roller bearings and keyed washer (left side only) from pivot arms.
2. Clean bearings and pivot arms with solvent.

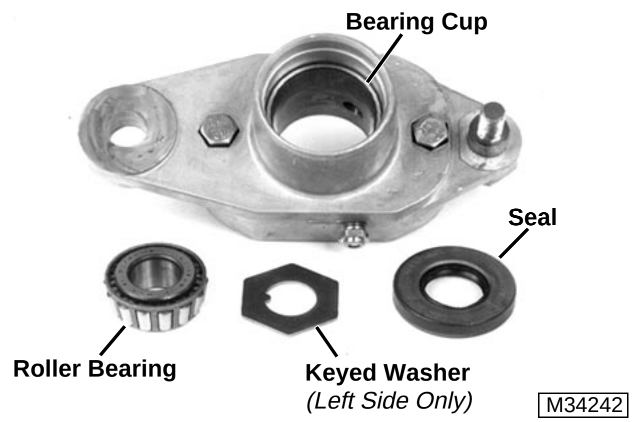
IMPORTANT: Always replace bearings and bearing cups as a set.

3. Inspect bearings and bearing cups for scoring, pitting or bluing from overheating.
4. Inspect reel bearing surfaces and seal contact surfaces for corrosion. Use crocus cloth to smooth and polish the surface for better sealing.
5. Inspect splined shaft (motor side) of reel for wear.

NOTE: If the splines on one side of the reel shaft are worn, the splines on the opposite side can be utilized by simply transferring the cutting unit to the other side of the mower.

Assembly

NOTE: Left or right positions are determined by standing at rear of unit and looking forward.

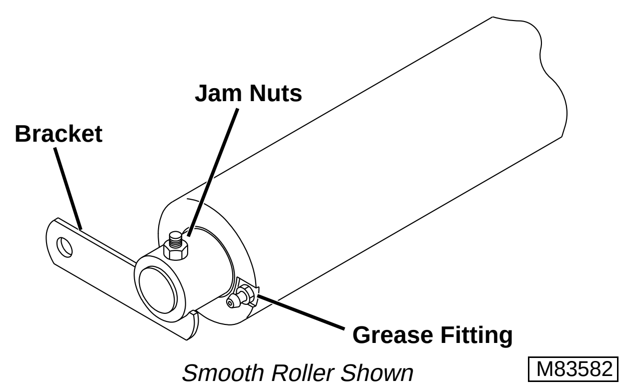


1. Install the bearing cups using a suitable driver or a press (Tapered end facing outside of case).
2. Pack bearings with multipurpose grease and position in bearing cups.
3. Install keyed washer (Left side only).
4. Install grease seals flush with end of case, apply grease to lip of seal.

ROLLER

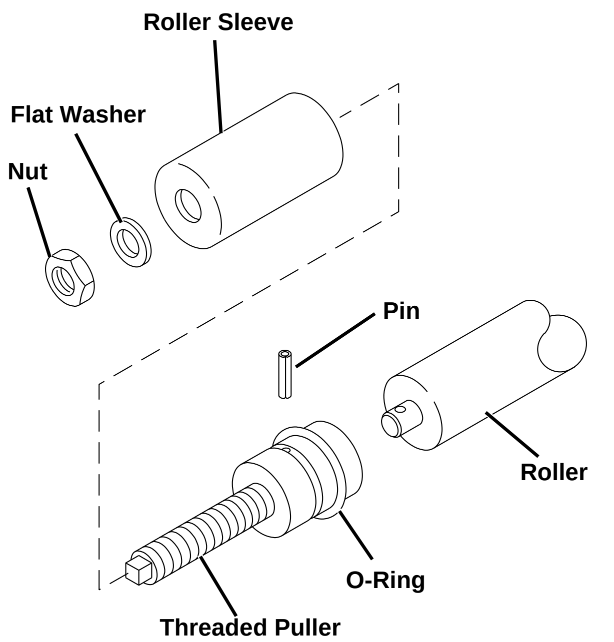
Bearing Replacement

NOTE: This procedure applies to both smooth and grooved rollers, except for AET10558 Grooved Rollers. (See AET10558 GROOVED ROLLER—Bearing Replacement on page 9-33.)



Smooth Roller Shown

1. Loosen jam nuts and remove set screw.
2. Remove brackets from bearing shafts. It may be necessary to press the bearing shaft from the bracket.
3. Remove grease fitting.

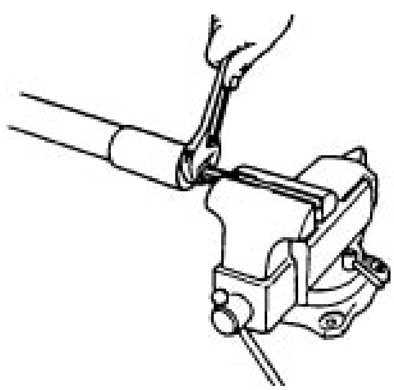


M83583

CAUTION

Wear approved eye protection when using JDG795 Roller Bearing Puller.

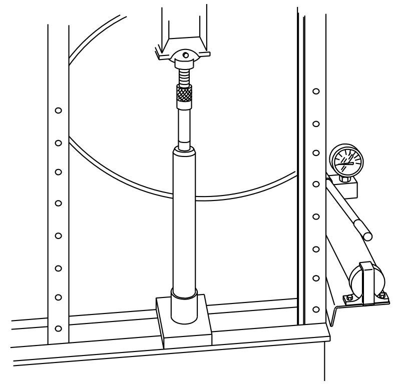
4. Attach threaded puller to the bearing by inserting the pin through the hole in the bearing shaft and puller. Slide the O-ring over the pin to keep it in position.
5. Slide roller sleeve over the threaded puller with the concave end of the roller sleeve against the end of the roller. Install flat washer and nut on threaded puller.



M83584

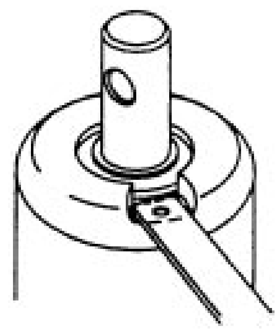
6. Clamp the hex end of the threaded puller in a vice or hold it with a wrench. Turn nut counterclockwise until the bearing is removed from the roller.

IMPORTANT: DO NOT press on center shaft of bearing when installing bearing. Bearings will set and become tight. Bearings must only be installed by pressing on outside race of bearing.



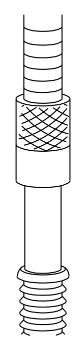
M83586

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 over the new bearing in the top end of the roller.



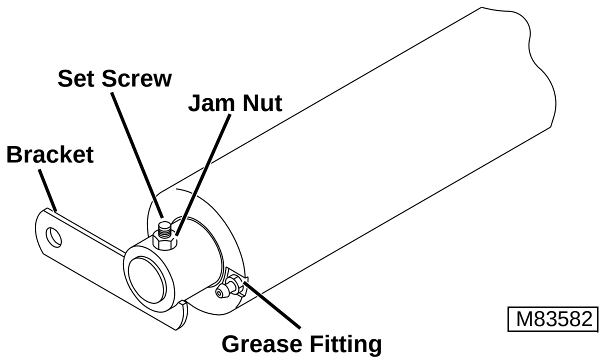
M83585

9. **Smooth Rollers:** Place a 0.89 mm (0.035 in.) feeler gauge in the slot where the grease fitting was located. Press the bearing into the roller until the top of the outside bearing race is flush with the top of the feeler gauge. Install the grease fitting.



M83587

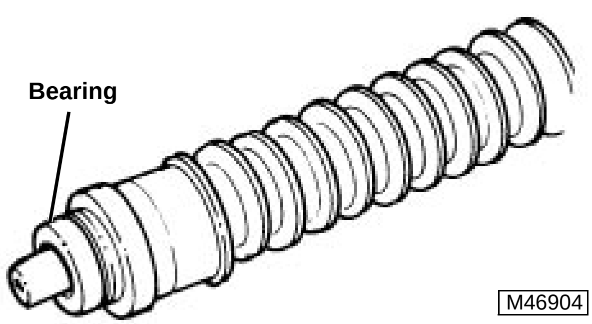
10. **Grooved Rollers:** Press bearing into roller until the top of the outside bearing race is flush with the end of the roller.



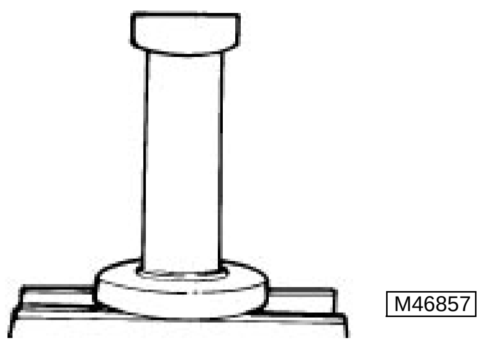
11. Install brackets.
12. Install set screws and tighten jam nuts.
13. Install grease fitting (if removed).

AET10558 GROOVED ROLLER

Bearing Replacement



1. Secure roller in a vice. Remove grease fittings.
2. Use a hammer and a block of wood to knock out the opposite end bearing.
3. Remove bearing from shaft and repeat step 2 to knock out the other end bearing.
4. Clean roller end cap and bearing shaft with crocus cloth. Pack bearings with grease.



5. Install bearing shaft and bearings (sealed end of bearing towards inside). Apply grease to lip of seal and install with seal lip facing the bearing.
6. Install opposite seal.
7. Install grease fittings and lubricate (Do not over-lubricate, a shot of grease is fine).

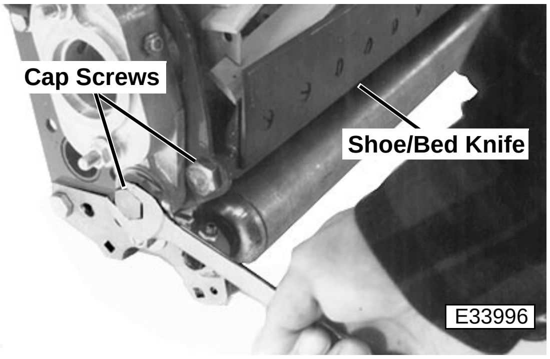
BED KNIFE

Removal/Installation

CAUTION

Always wear protective gloves when working on or near a reel or bed knife. Serious personal injury can result from contact with sharp cutting edges.

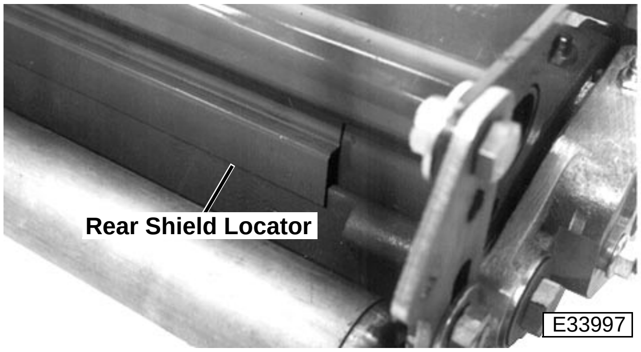
1. Remove cutting units form machine. (See REEL MOWER—Removal/Installation on page 9-26.)
2. Loosen the lower reel adjuster nuts and turn the top adjuster nuts clockwise to obtain maximum clearance between the reel and the bed knife.



3. Remove two cap screws on each side of cutting unit.
4. Remove shoe/bed knife from cutting unit housing.

IMPORTANT: DO NOT reuse screws if bed knife is removed from shoe.

5. Using an impact driver, remove and discard the bed knife mounting screws.
6. Remove debris and corrosion from bottom surface of shoe. Check the bed knife mounting surface with a straight edge for distortion, straighten or replace as necessary.
7. Install bed knife using new screws. Starting at the center screw, alternate tightening bed screws working toward the ends of the knife. Tighten screws to **6.5 N•m (58 lb-ft).**
8. Place shoe and bed knife in a suitable grinder. Grind until nicks are are removed from the entire top surface of the bed knife lip.
9. Raise the reel at least **3 mm (0.125 in.)**. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)



10. Install shoe/bed knife assembly. The assembly must slip into rear shield locator. Put bottom cap screws in first and tighten to **81 N•m (60 lb-ft).** Install and tighten the upper cap screws to **47 N•m (35 lb-ft)**.
11. Adjust reel-to-bed knife clearance. (See REEL-TO-BED KNIFE ADJUSTMENT on page 9-18.)
12. Adjust cutting height. (See HEIGHT-OF-CUT ADJUSTMENT on page 9-22.)
13. Backlap reel. (See BACKLAPPING (S.N. — 957000) on page 9-19 or BACKLAPPING (S.N. 957001—) on page 9-20.)

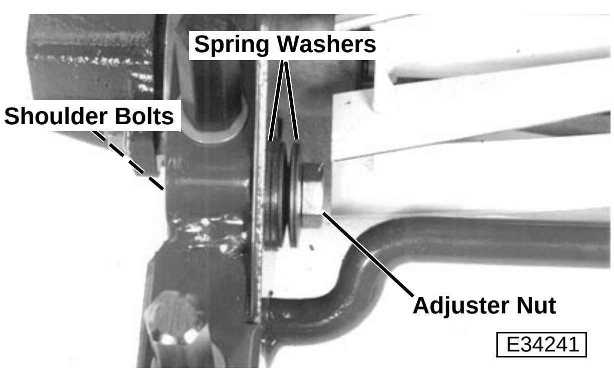
REEL

Removal

CAUTION

Always wear glove protection when handling reels. Serious personal injury can result from contact with the sharp cutting edges of the reel.

1. Remove G.T.C. (if equipped). (See G.T.C. — Removal on page 9-35.)
2. Remove bed knife/shoe assembly. (See BED KNIFE—Removal/Installation on page 9-33.)



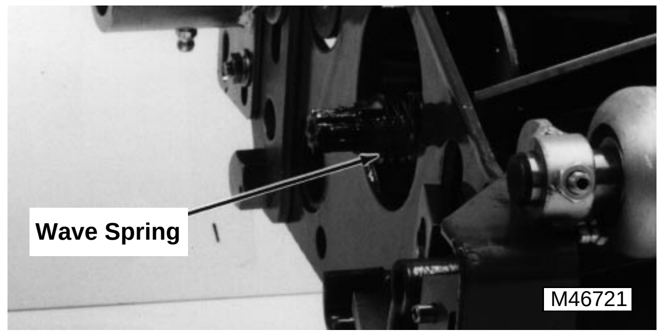
3. Remove shoulder bolts, four spring washers and adjuster nuts from each side of cutting unit.
4. Remove pivot arms and carefully remove reel from frame.

Installation

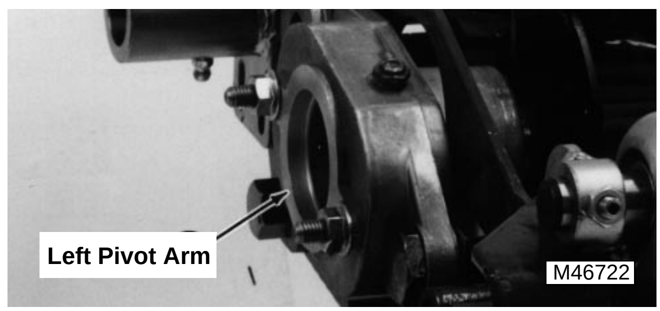
CAUTION

Always wear glove protection when handling reels. Serious personal injury can result from contact with the sharp cutting edges of the reel.

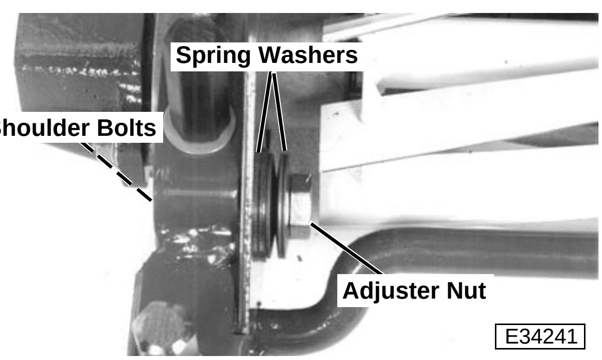
1. Position reel in frame assembly (reel shaft end with keyway must be used on the left side).



2. Install wave spring on left end of shaft.



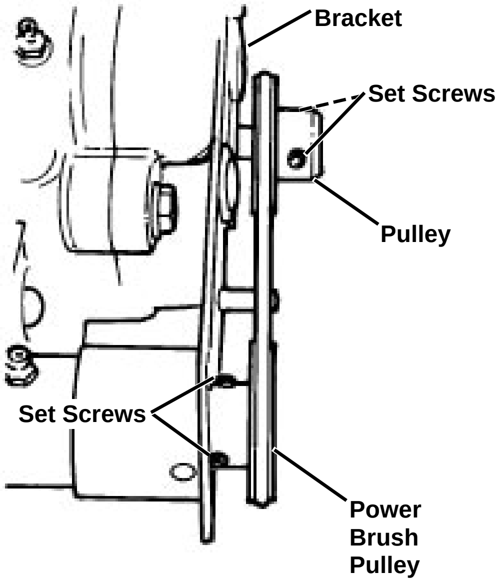
3. Slide left pivot arm on to reel shaft, ensure keyed washer engages slot on shaft.
4. Slide right pivot arm on to reel shaft.



5. Install shoulder bolts through adjusters and secure with four spring washers (per side) and adjuster nuts. After bed knife is installed tighten nuts to **50 N•m (35 lb-ft.)**.
6. Refer to bed knife/shoe assembly. (See BED KNIFE—Removal/Installation on page 9-33
7. Install G.T.C. (if equipped). (See G.T.C.—Assembly on page 9-35.)

GREENS TENDER CONDITIONER (G.T.C.)

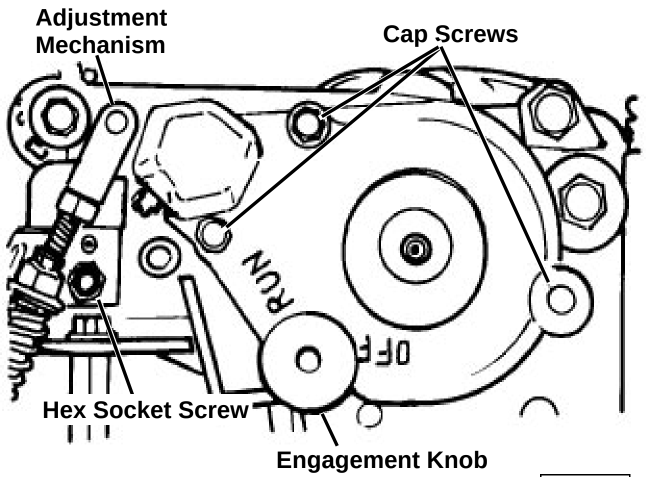
Removal



M46880

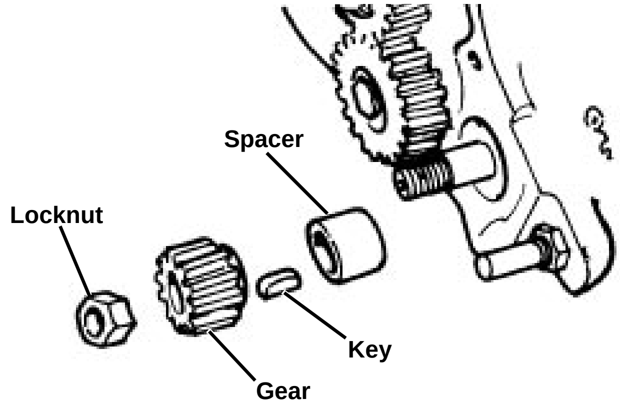
NOTE: There are two set screws in each belt pulley and an access hole in the guard mounting bracket for the set screws in the power brush pulley.

1. Remove Power Brush guard, belt, pulleys, keys and guard mount (if equipped).



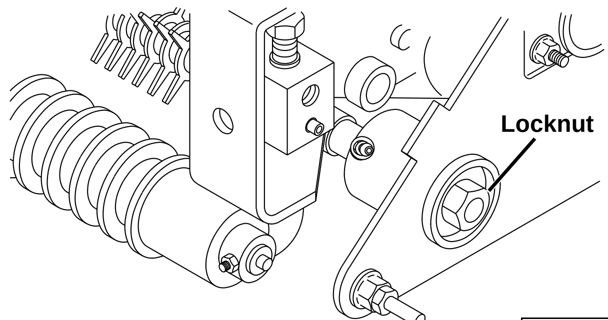
M46879

2. Remove hex socket screws and remove G.T.C. adjustment mechanisms. It is easier to remove the cover if the engagement knob is turned past the "OFF" detent position.
3. Remove three cap screws and remove G.T.C. gear case cover and gasket.



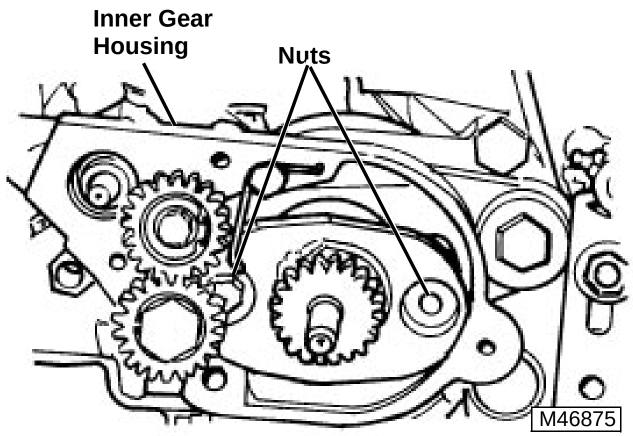
M46877

4. Remove M10 locknut, gear, key and spacer.



M83588

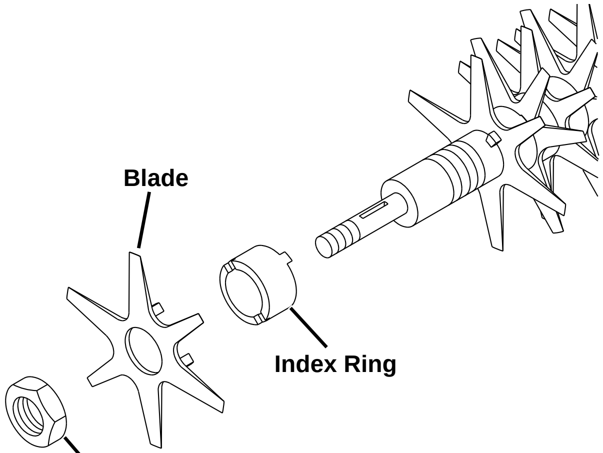
5. Remove M10 lock nut from the opposite side of G.T.C. shaft and remove bracket.



M46875

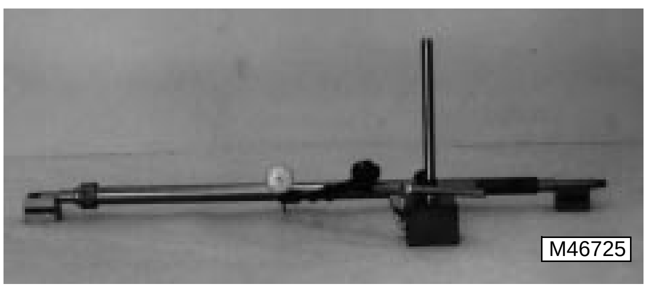
6. Remove two nuts and remove inner gear housing. Remove G.T.C.

Disassembly/Inspection



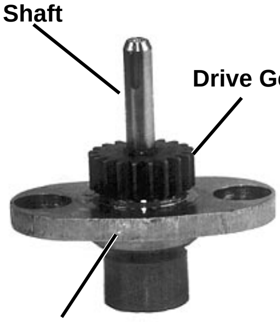
M83589

1. Remove locknut.
2. Remove blades and index rings. Inspect blades for excessive wear, broken or cracked cutting teeth and distortion. Inspect index rings for missing or bent index teeth. Replace parts as necessary.



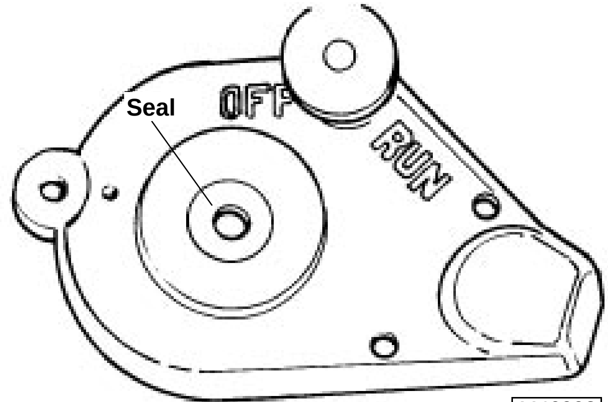
M46725

3. Remove debris or corrosion from shaft and place on V-blocks. Check run-out at the center of the shaft. Run-out should not exceed **1.5 mm (1/16 in.)**. Straighten or replace shaft if necessary.



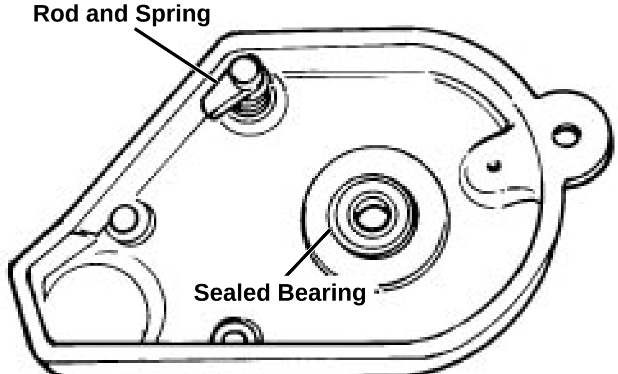
M46727

4. Inspect shaft bearings for freedom of movement and excessive play. Replace bearings as necessary.
5. Inspect drive gear for wear and freedom of movement. Unusual wear patterns may indicate a bent shaft or worn bearings. Replace gear, shaft or bearings as necessary.



M46903

6. Inspect seal in cover for wear or distortion. Replace seal if necessary.

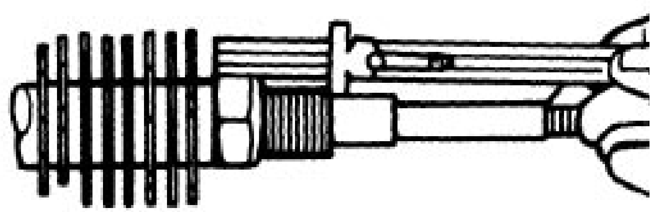


M46902

7. Ensure sealed bearing in cover moves freely. Replace bearing if necessary.
8. Inspect engagement rod and spring for condition and binding. Replace shaft or spring if necessary.

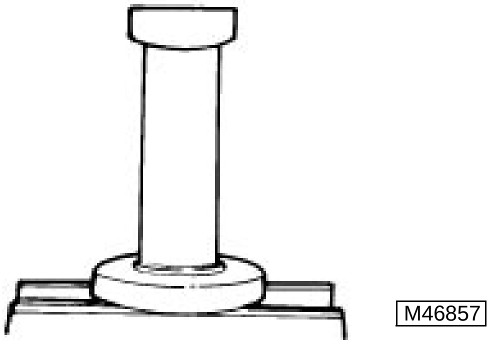
Assembly

1. Place index rings and blades on shaft rotating occasionally to align blades and index rings.

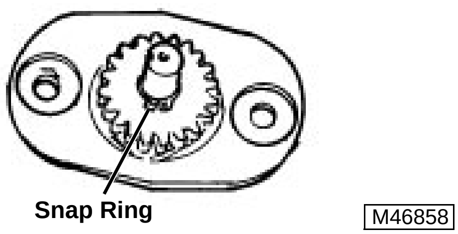


M46886

2. Continue assembly, of all 72 spacers and blades, until approximately **38 mm (1.50 in.)** of exposed thread is left.
3. Stand the shaft on end and shake it slightly to ensure blades and index rings are aligned.
4. With shaft on end, install locking nut and torque to approximately **47 N•m (35 lb-ft.)**.

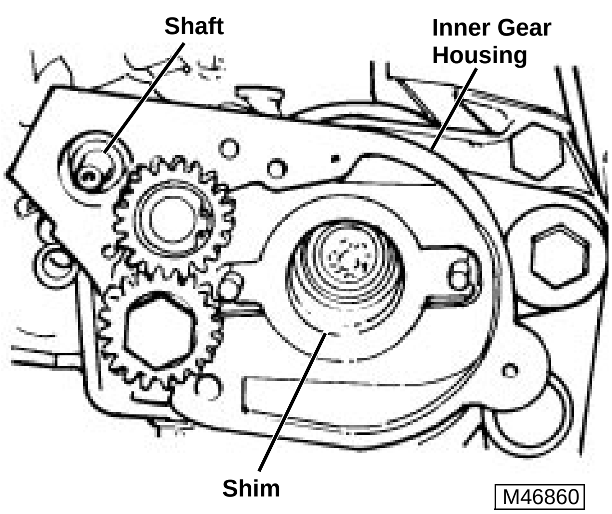


5. Press bearing into housing.

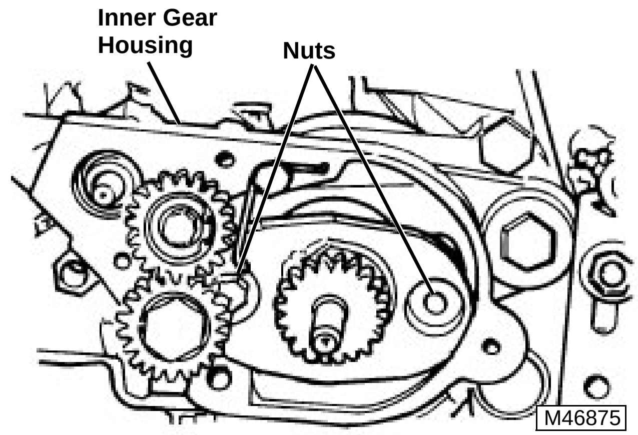


6. Install drive shaft, key, gear and snap ring.

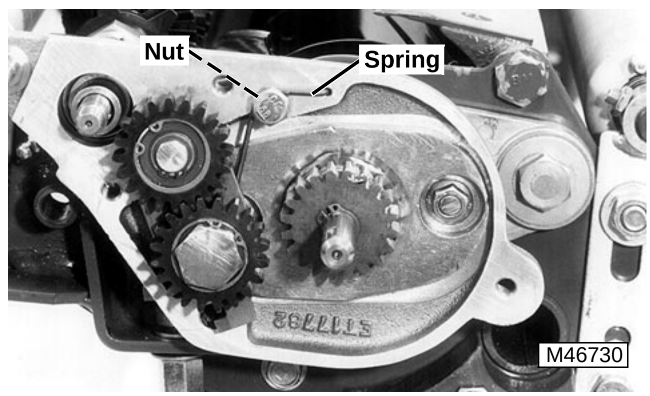
NOTE: There are two bearings and one washer between each bearing. If the washer is not centered, the G.T.C. shaft cannot be installed through both bearings. To hold the washers in position, give each grease fitting a shot of grease, then center the washers.



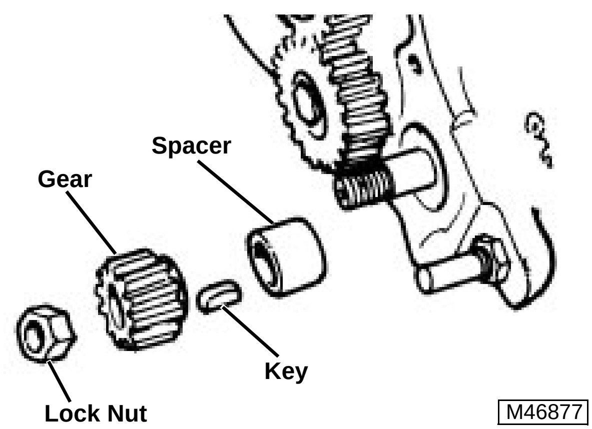
7. Slide keyed G.T.C. shaft end through bearings of inner gear housing.
8. Install shim over studs and position inner gear housing over shim.



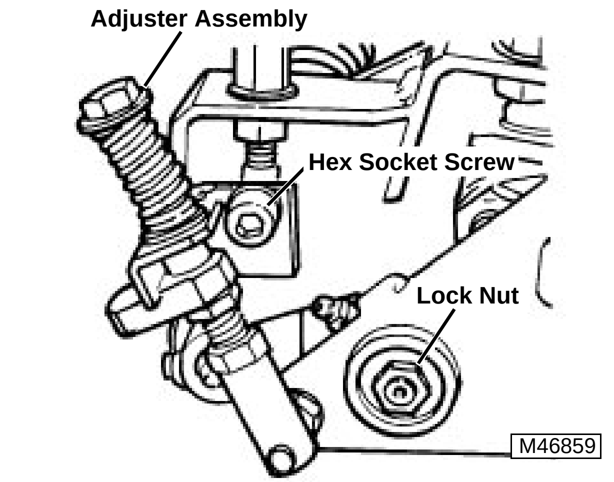
9. Secure gear drive assembly to inner gear housing with two nuts.



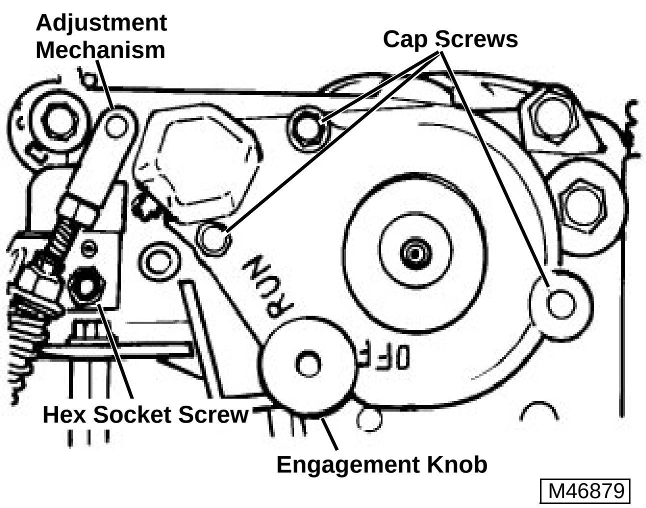
10. Position spring and secure with cap screw, ensure spring can move freely and install nut to lock cap screw in place.



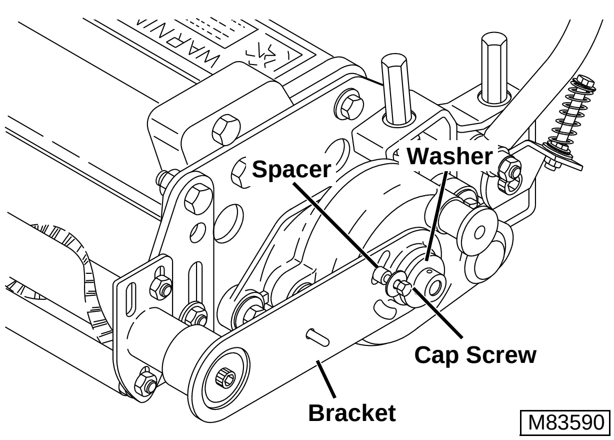
11. Slide spacer on shaft. Insert key in shaft slot. Slide gear over key and secure with lock nut.



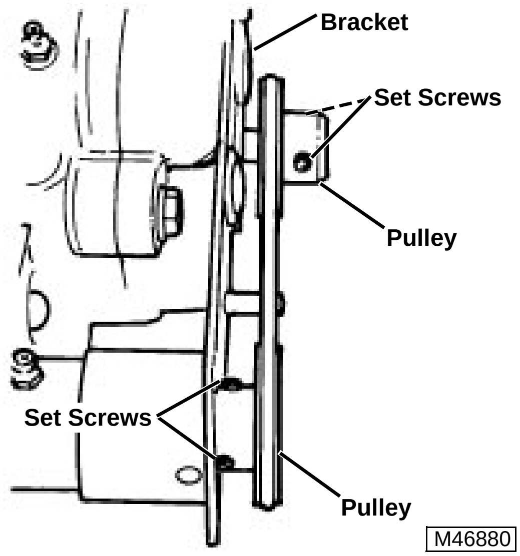
12. Position opposite bearing arm on G.T.C. shaft and secure with lock nut.
13. Install adjuster assembly and secure with hex socket screw.



14. Install gasket and gear case cover, secure with three cap screws and washers.
15. Ensure G.T.C. engages and disengages when rotating engagement knob from OFF to RUN position.



16. Position belt guard bracket and secure with spacer, washer and cap screw.



NOTE: There are two set screws in each belt pulley and an access hole in the guard mounting bracket for the set screws in the power brush pulley.

17. Insert keys into shafts and install pulleys. Secure with two set screws each.
18. Install drive belt. Adjust pulleys to align belt and ensure pulleys do not contact belt guard or guard bracket.
19. Install belt guard and secure with nut.
20. Adjust Greens Tender Conditioner. (See GREENS TENDER CONDITIONER (G.T.C.) ADJUSTMENT on page 9-23.)

REPAIR—22-INCH VERTICAL CUTTING UNITS

VERTICAL CUTTING UNITS

Removal/Installation

NOTE: Vertical cutting units are removed and installed in the manner as reel mowers. (See REEL MOWER—Removal/Installation on page 9-26.)

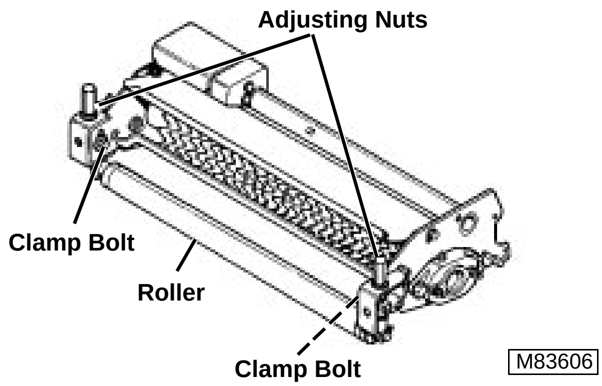
FRONT ROLLER

Removal/Installation

1. Remove cutting unit from the tractor. If the cutting unit is not removed from the machine, rest the cutting unit on wood blocks and be sure to observe the following **Caution:**

CAUTION

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.
Always wear protective gloves when working on or near reel or gtc. Serious personal injury can result from contact with sharp cutting edges.



2. Loosen depth-of-cut adjusting nuts.
3. Make note of washers and remove clamp bolts and washers.
4. Remove front roller with brackets.

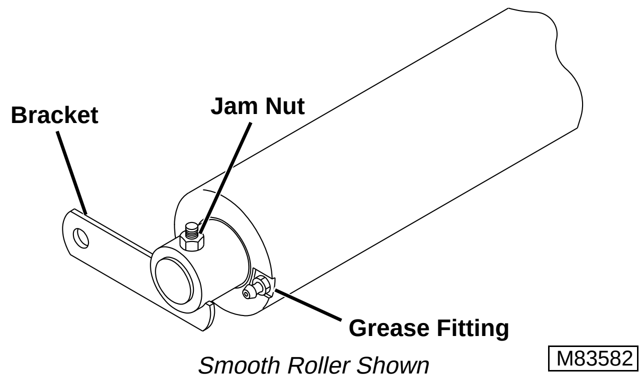
Installation is done in the reverse order of removal.

- Apply MPG-2® Multipurpose Polymer Grease to clamp bolt threads.
- Center the roller between the mounting brackets and install set screws and nuts.
- Adjust cutting depth. (See DEPTH-OF-CUT ADJUSTMENT on page 9-25.)

ROLLER

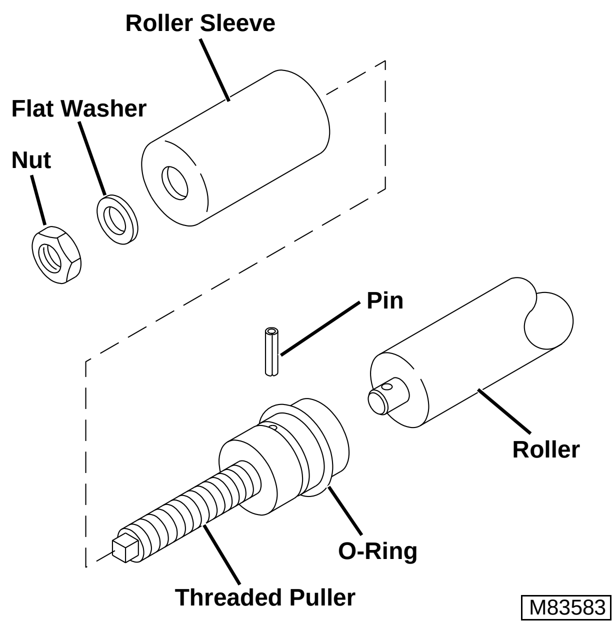
Bearing Replacement

NOTE: This procedure applies to both smooth and grooved rollers, except for AET10558 Grooved Rollers. (See AET10558 GROOVED ROLLER—Bearing Replacement on page 9-33.)



Smooth Roller Shown

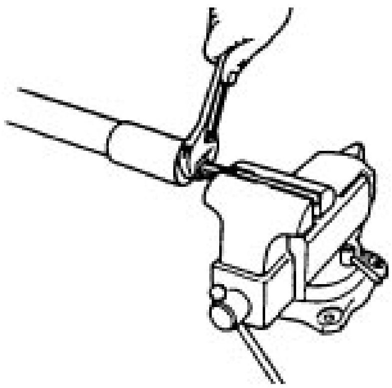
1. Loosen jam nuts and remove set screw.
2. Remove brackets from bearing shafts. It may be necessary to press the bearing shaft from the bracket.
3. Remove grease fitting.



CAUTION

Wear approved eye protection when using JDG795 Roller Bearing Puller.

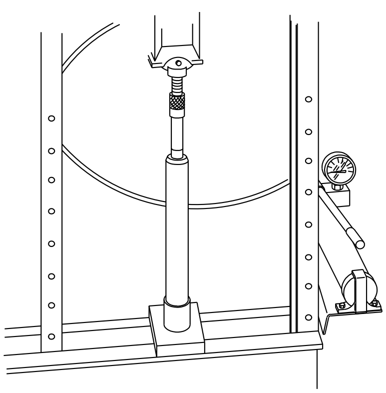
4. Attach threaded puller to the bearing by inserting the pin through the hole in the bearing shaft and puller. Slide the O-ring over the pin to keep it in position.
5. Slide roller sleeve over the threaded puller with the concave end of the roller sleeve against the end of the roller. Install flat washer and nut on threaded puller.



M83584

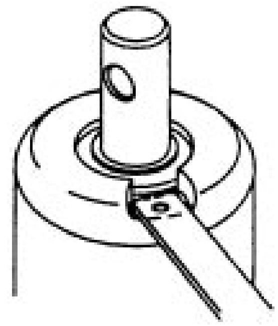
6. Clamp the hex end of the threaded puller in a vice or hold it with a wrench. Turn nut counterclockwise until the bearing is removed from the roller.

IMPORTANT: DO NOT press on center shaft of bearing when installing bearing. Bearings will set and become tight. Bearings must only be installed by pressing on outside race of bearing.



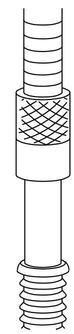
M83586

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 over the new bearing in the top end of the roller.



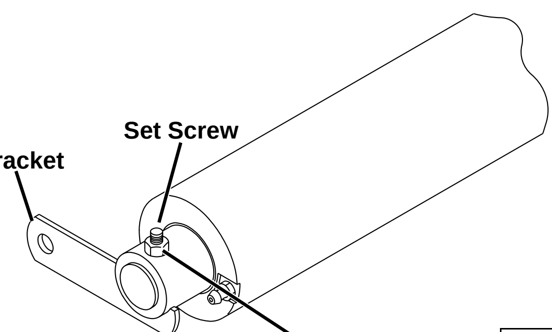
M83585

9. **Smooth Rollers:** Place a 0.89 mm (0.035 in.) feeler gauge in the slot where the grease fitting was located. Press the bearing into the roller until the top of the outside bearing race is flush with the top of the feeler gauge. Install the grease fitting.



M83587

10. **Grooved Rollers:** Press bearing into roller until the top of the outside bearing is flush with end of the roller.

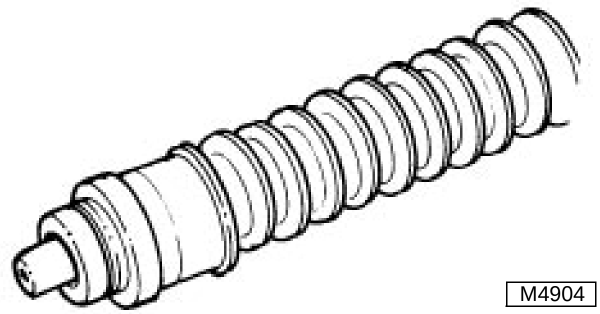


M83582

11. Install brackets.
12. Install set screws and tighten jam nuts.

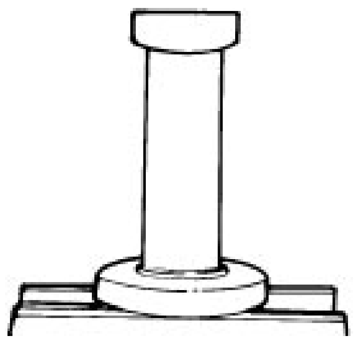
AET10558 GROOVED ROLLER

Bearing Replacement



M4904

1. Secure roller in a vice. Remove grease fittings.
2. Use a hammer and a block of wood to knock out the opposite end bearing.
3. Remove bearing from shaft and repeat step 2 to knock out the other end bearing.
4. Clean roller end cap and bearing shaft with crocus cloth. Pack bearings with grease.

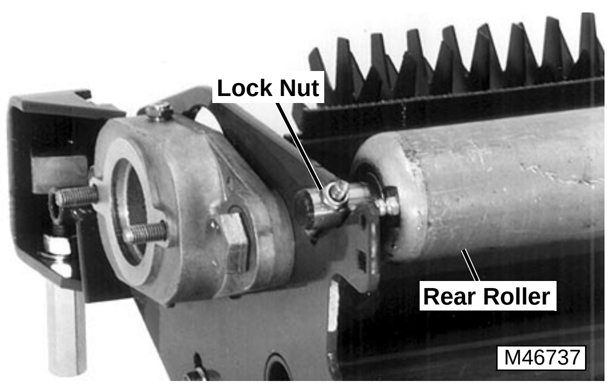


M46857

5. Install bearing shaft and bearings (sealed end of bearing towards inside). Apply grease to lip of seal and install with seal lip facing the bearing.
6. Install opposite seal.
7. Install grease fittings and lubricate (Do not over-lubricate, a shot of grease is fine).

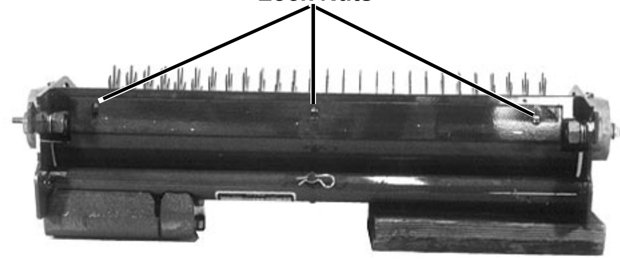
REEL

Removal



M46737

1. Remove lock nut and rear roller.



M46749

2. Remove three lock nuts, scraper support bracket and rubber scraper.
3. Carefully pry deflector shield away from frame to allow access for a wrench to remove cap screws and nuts from pivot arms.

M46739

4. Remove cap screws, nuts and spacers securing pivot arms to frame.
5. Remove pivot arms and reel.

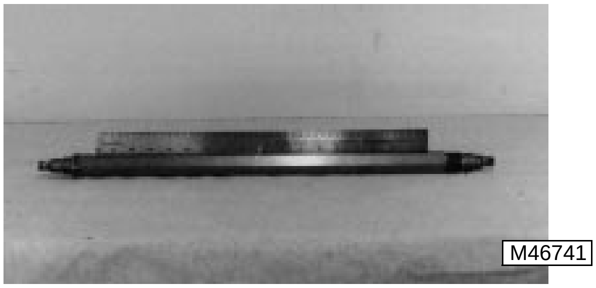
Disassembly

CAUTION

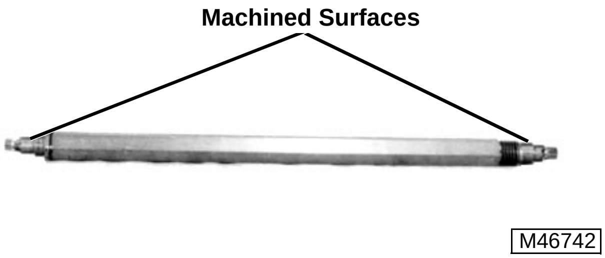
Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.

M46740

1. Remove set screw.
2. Remove nut and remove cutting blades and spacers from reel shaft.



3. Using a straight edge, check shaft for straightness. Shaft runout should not exceed **0.50 mm (0.020 in.)**.

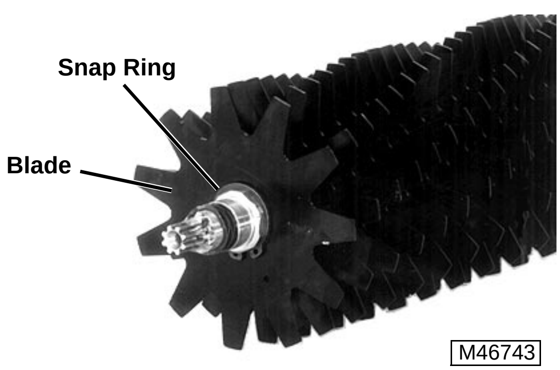


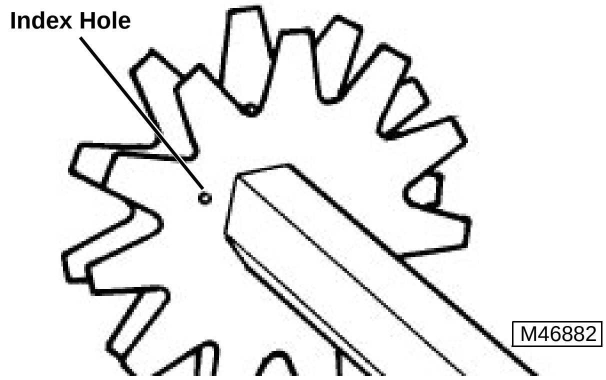
4. Inspect machined surfaces of shaft for wear. Replace shaft if worn.

NOTE: If the splines on one side of the reel shaft are worn, the splines on the opposite end can be utilized by simply transferring the cutting unit to the other side of the mower.

Assembly

> **CAUTION**
>
> **Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.**

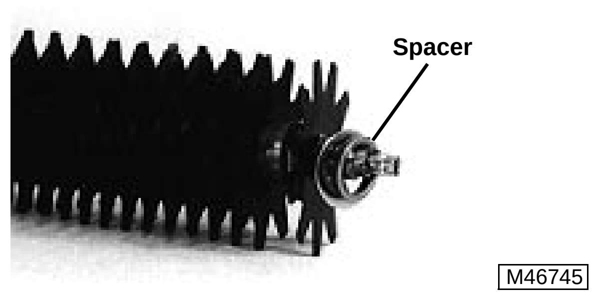




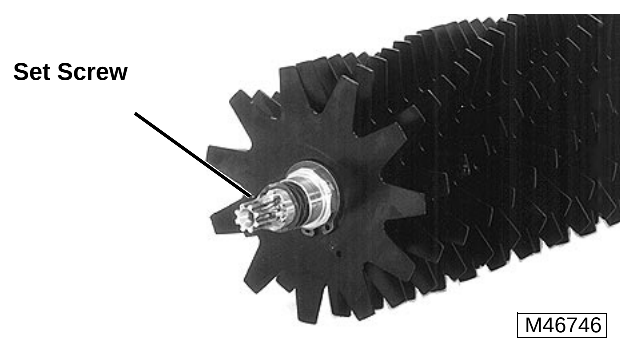
1. Install snap ring in groove on shaft. (Sharp edge of snap ring facing away from the blades.)

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.

2. Assemble blades and spacers starting with a blade against the snap ring. Ensure the index hole (of the next blade) is placed on the next flat (counterclockwise) on the shaft as shown. This will establish the proper helix pattern needed.



3. After the last cutting blade is positioned, install a washer, a spacer and nut. Tighten the nut until a slight deflection of the the cutting blade, next to the snap ring, is observed.

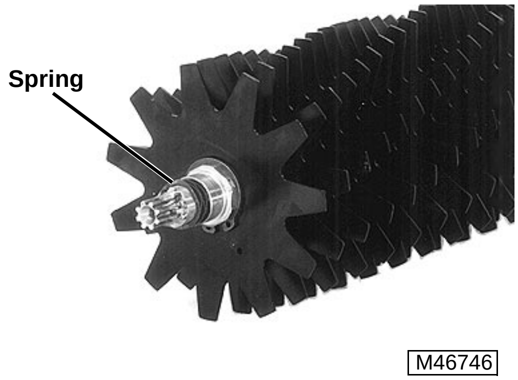


4. Install the set screw.

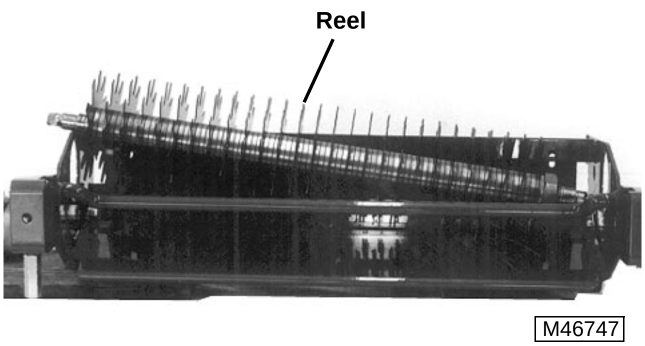
Installation

CAUTION

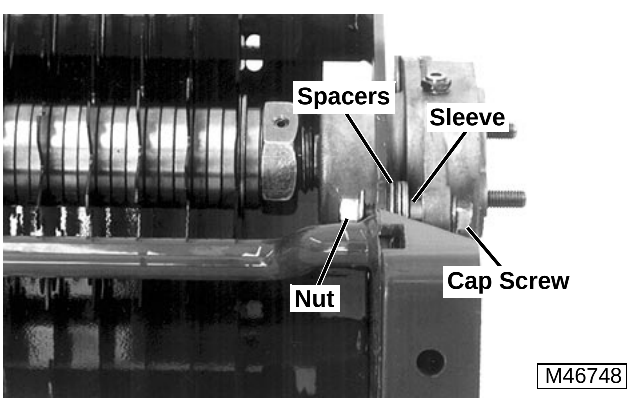
Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.



1. Install spring on keyed end of reel shaft.

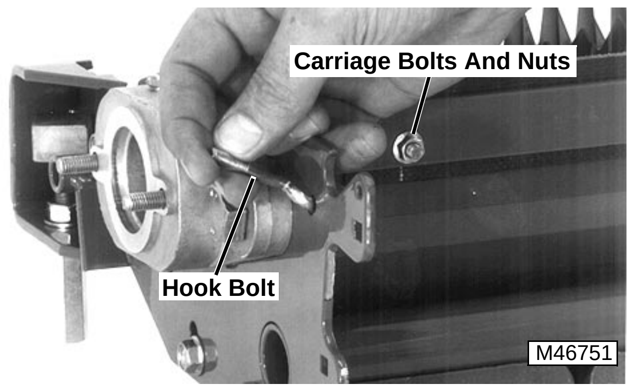


2. Position reel into frame (shaft end with keyway on left side of frame).
3. Slide pivot arms over shaft ends. Make sure keyed washer in pivot arm engages keyway of reel shaft (left side only).

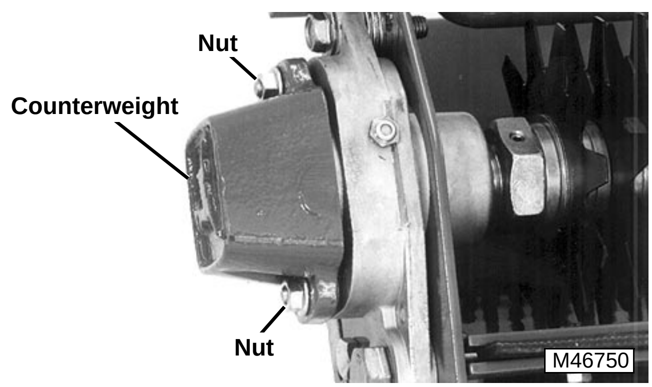


4. Install cap screw, sleeve, three spacers and nut in front pivot arm mount. Repeat on opposite end.

5. Install cap screw, washers and nut in rear pivot arm mount. Repeat on opposite end.



6. Install rubber scraper, scraper support and secure with carriage bolts and nuts.
7. Install hook bolt and roller. Secure with self locking nuts



CAUTION

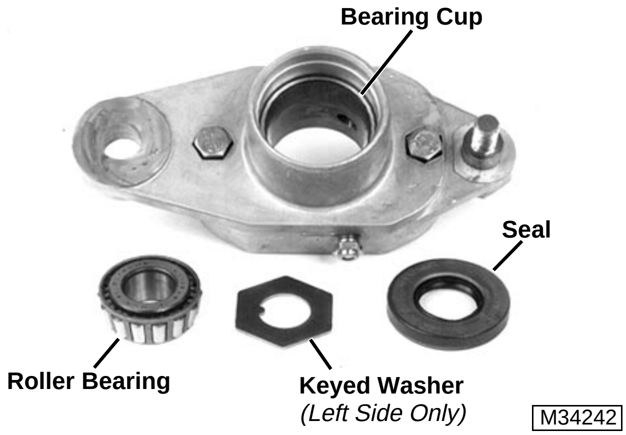
Alternate from side to side when tightening nuts on counterweight to avoid damaging the machined surface of the pivot arm.

8. Install counterweight and secure with two nuts.
9. Adjust cutting depth. See DEPTH-OF-CUT ADJUSTMENT on page 9-25.

PIVOT ARM

Disassembly/Inspection

NOTE: Left or right positions are determined by standing at the rear of the unit and looking forward.



1. Remove seals, tapered roller bearings and keyed washer (left side only) from pivot arms.
2. Clean bearings and pivot arms with solvent.

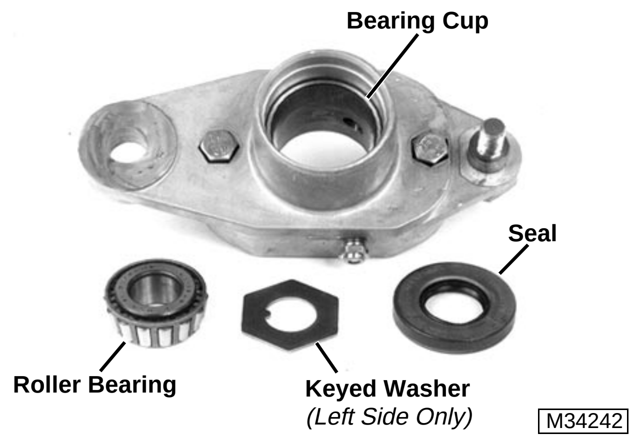
IMPORTANT: Always replace bearings and bearing cups as a set.

3. Inspect bearings and bearing cups for scoring, pitting or bluing from overheating.
4. Inspect reel bearing surfaces and seal contact surfaces for corrosion. Use crocus cloth to smooth and polish the surface for better sealing.
5. Inspect splined shaft (motor side) of reel for wear.

NOTE: If the splines on one side of the reel shaft are worn, the splines on the opposite side can be utilized by simply transferring the cutting unit to the other side of the mower.

Assembly

NOTE: Left or right positions are determined by standing at rear of unit and looking forward.



1. Install the bearing cups using a suitable driver or a press (Tapered end facing outside of case).
2. Pack bearings with multipurpose grease and position in bearing cups.
3. Install keyed washer (Left side only).
4. Install grease seals flush with end of case, apply grease to lip of seal.

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MISCELLANEOUS

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SPECIFICATIONS

REPAIR SPECIFICATIONS

Front Wheel Bolt Torque . . . . 88 N•m (65 lb-ft)

Tire Pressure . . . . 69—83 kPa (10—12 psi)

OTHER MATERIALS

Number	Name	Use
M79292	MPG-2® Multipurpose Polymer Grease	Lubricate roller shaft end of roller cam on Center Lift Arm assembly.

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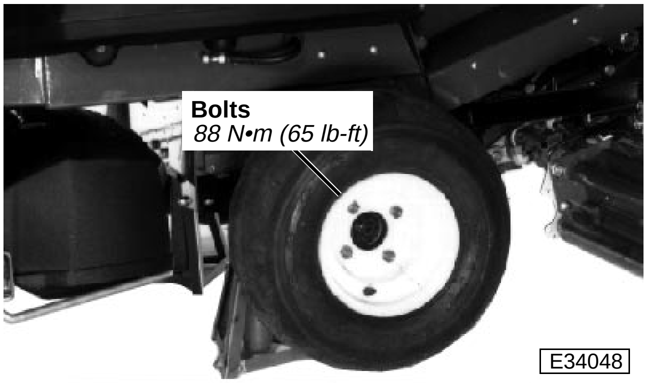
MPG-2® *is a registered trademark of DuBois USA.*

REPAIR

FRONT WHEELS

Removal/Installation

21. Lift machine high enough to remove weight from wheel. Place jackstand under machine frame.



22. Remove four wheel bolts and remove wheel assembly.

Installation is done in the reverse order of removal.

- Tighten wheel bolts in a criss-cross pattern to **88 N•m (65 lb-ft)**.

REAR WHEEL

Removal/Installation

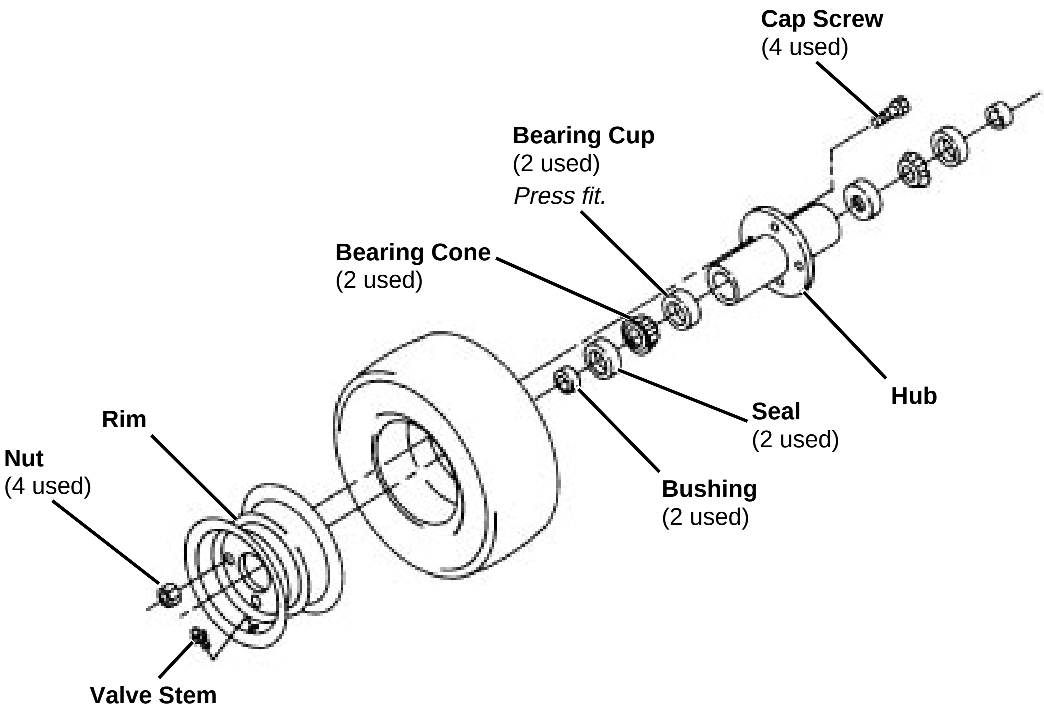
1. Lift machine high enough to remove weight from wheel. Place jackstand under machine frame.

2. Remove nut, washer, axle bolt and rear wheel assembly.

Installation is done in the reverse order of removal.

M

Disassemble/Assemble Hub



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- Remove seals and bearing cones using a brass drift and hammer.

NOTE: Remove bearing cups only if replacement is necessary.

Bearing cups and cones are matched and must be replaced as a set.

Assembly is done in the reverse order of disassembly.

- Pack bearing cones with multipurpose grease.
- Install seals with metal side facing away from hub. Push seals into bore until flush with end of hub.
- Install wheel on hub with valve stem facing away from hub.

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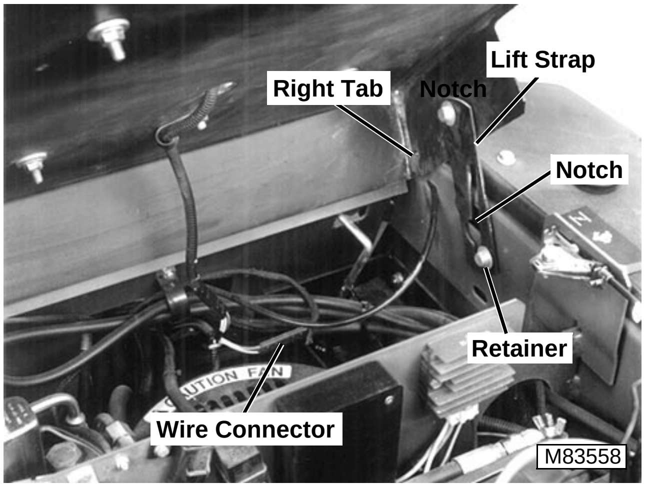
SEAT PLATFORM

Removal/Installation



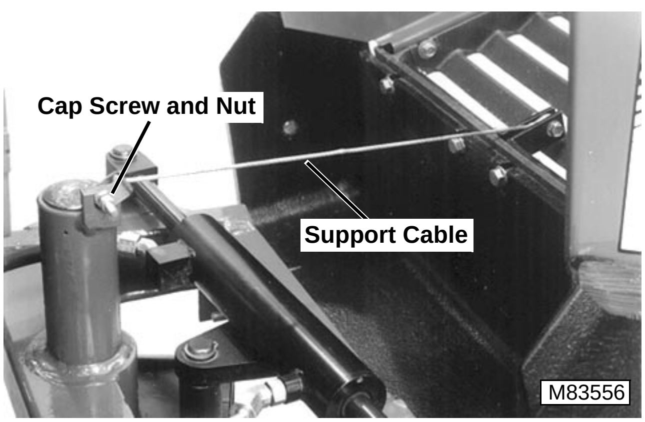
1. Lift seat and disconnect wire connector.
2. Lower seat to notch, lift strap over retainer.
3. With seat at approximately 30°, lift left front corner of seat platform from tab, then slide platform from right tab to remove.

Installation is done in the reverse order of removal.

ENGINE HOOD

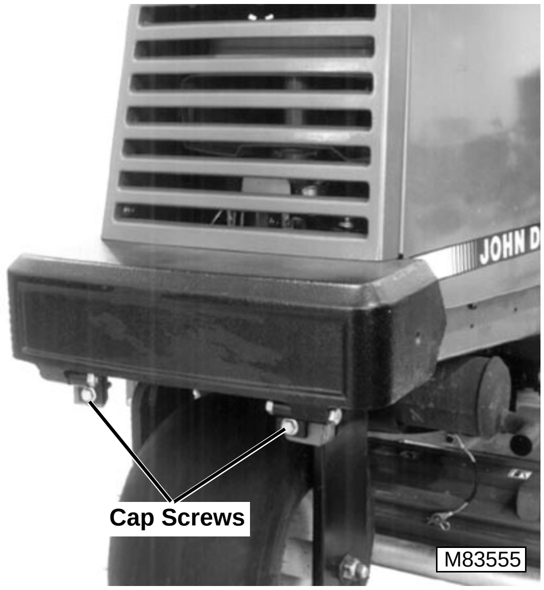
Removal/Installation

1. Raise hood.



IMPORTANT: Support hood to prevent it from falling back when cable is removed.

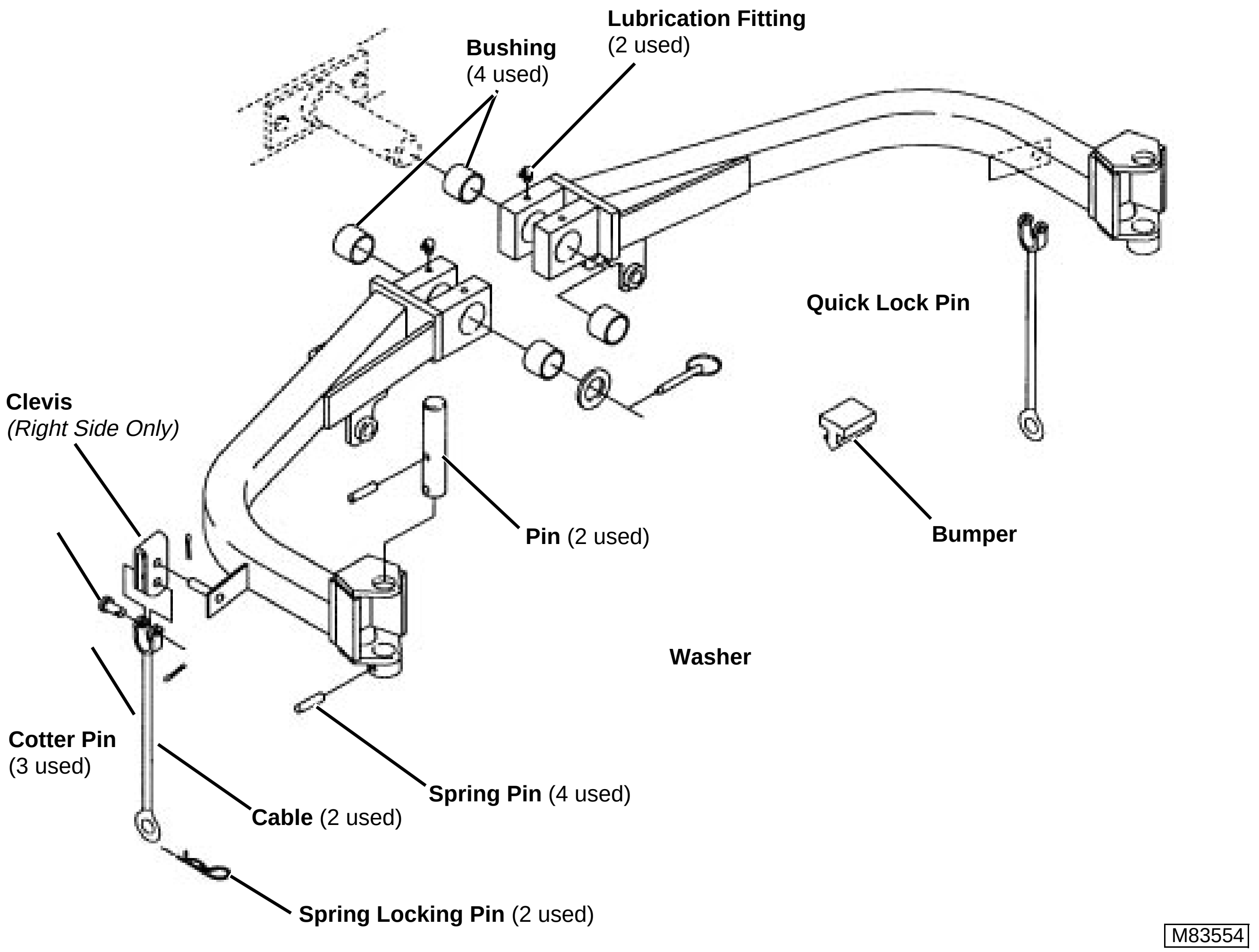
2. Remove cap screw and nut to disconnect support cable.
3. Close hood.



4. Remove two cap screws.
5. Remove hood and bumper assembly.

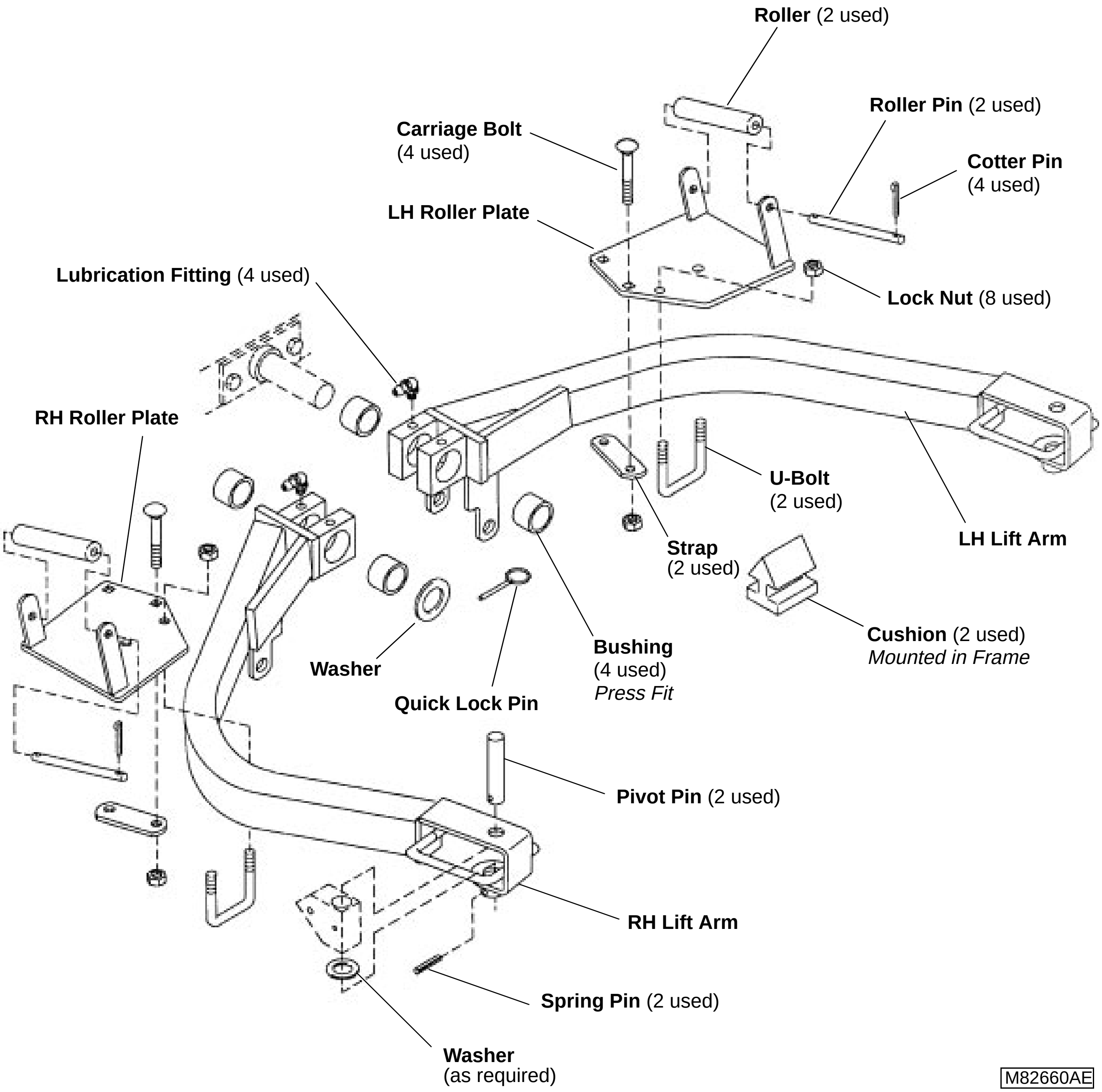
Installation is done in the reverse order of removal.

FRONT LIFT ARMS (S.N. —930262)



- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.

FRONT LIFT ARMS (S.N. 930262—956000)



- Note locate of roller plates-to-lift arms. Scribe a mark on lift arms along roller plate to aid in assembly.
- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.

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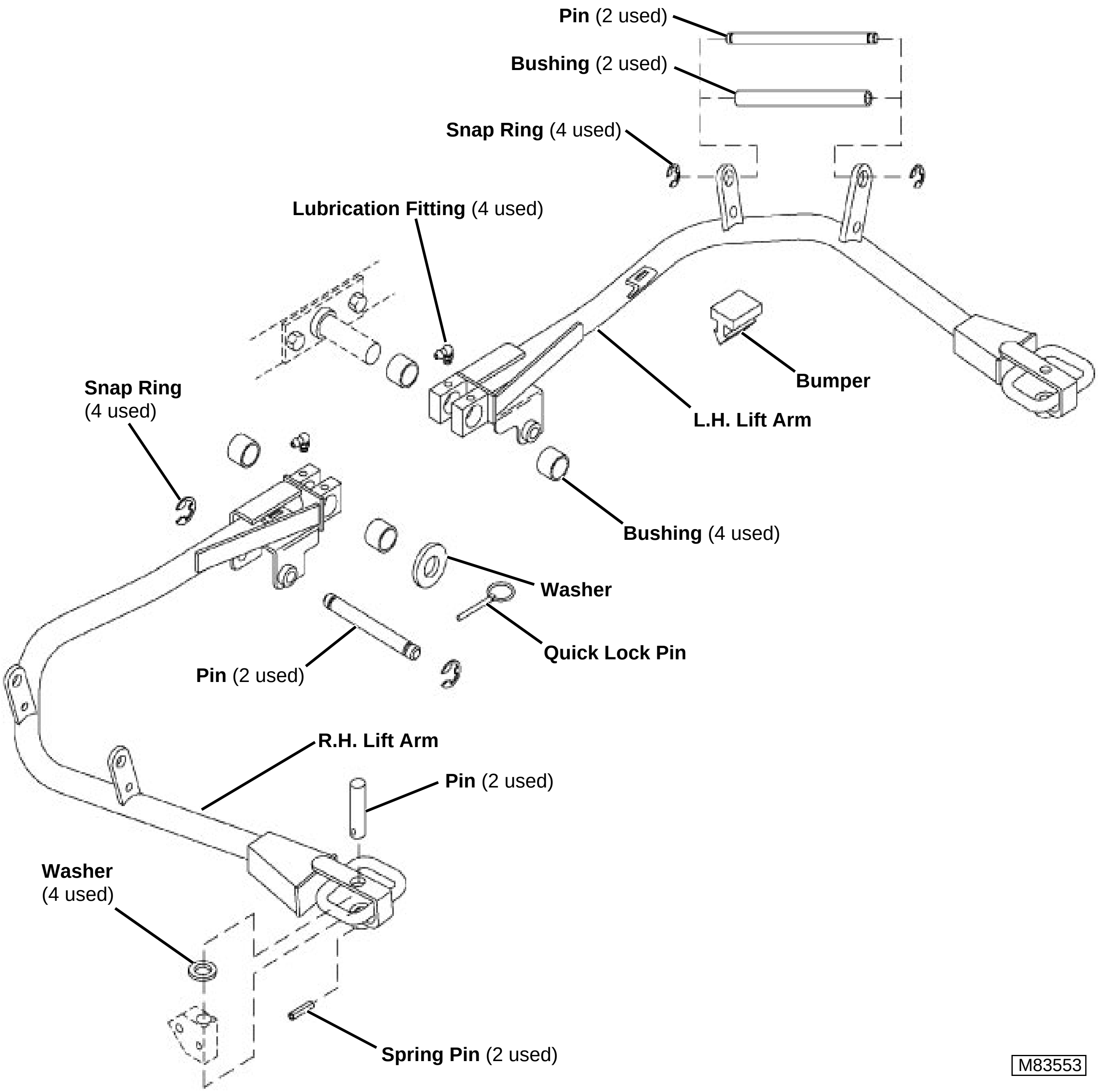
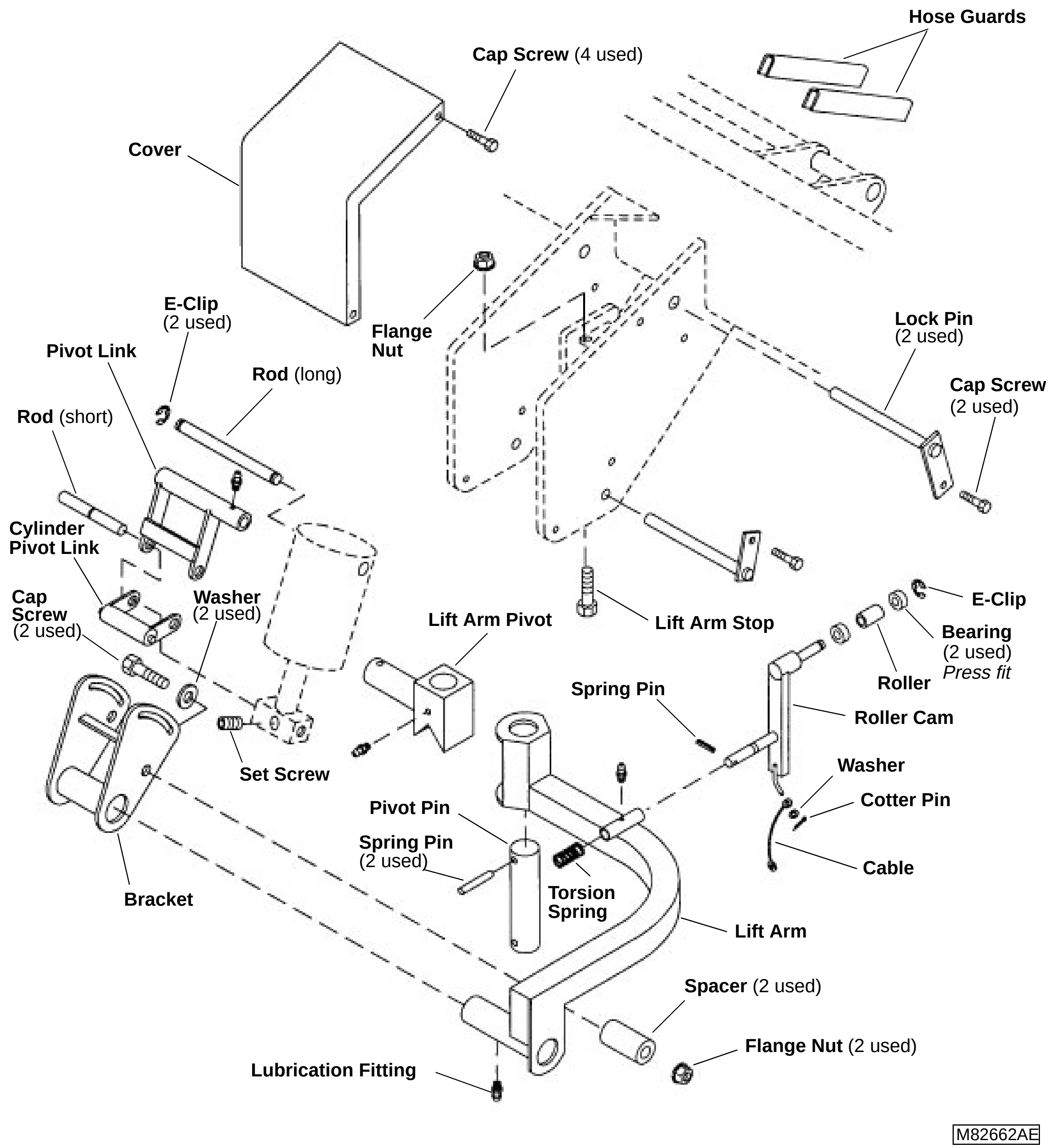
FRONT LIFT ARMS (S.N. 956001—)



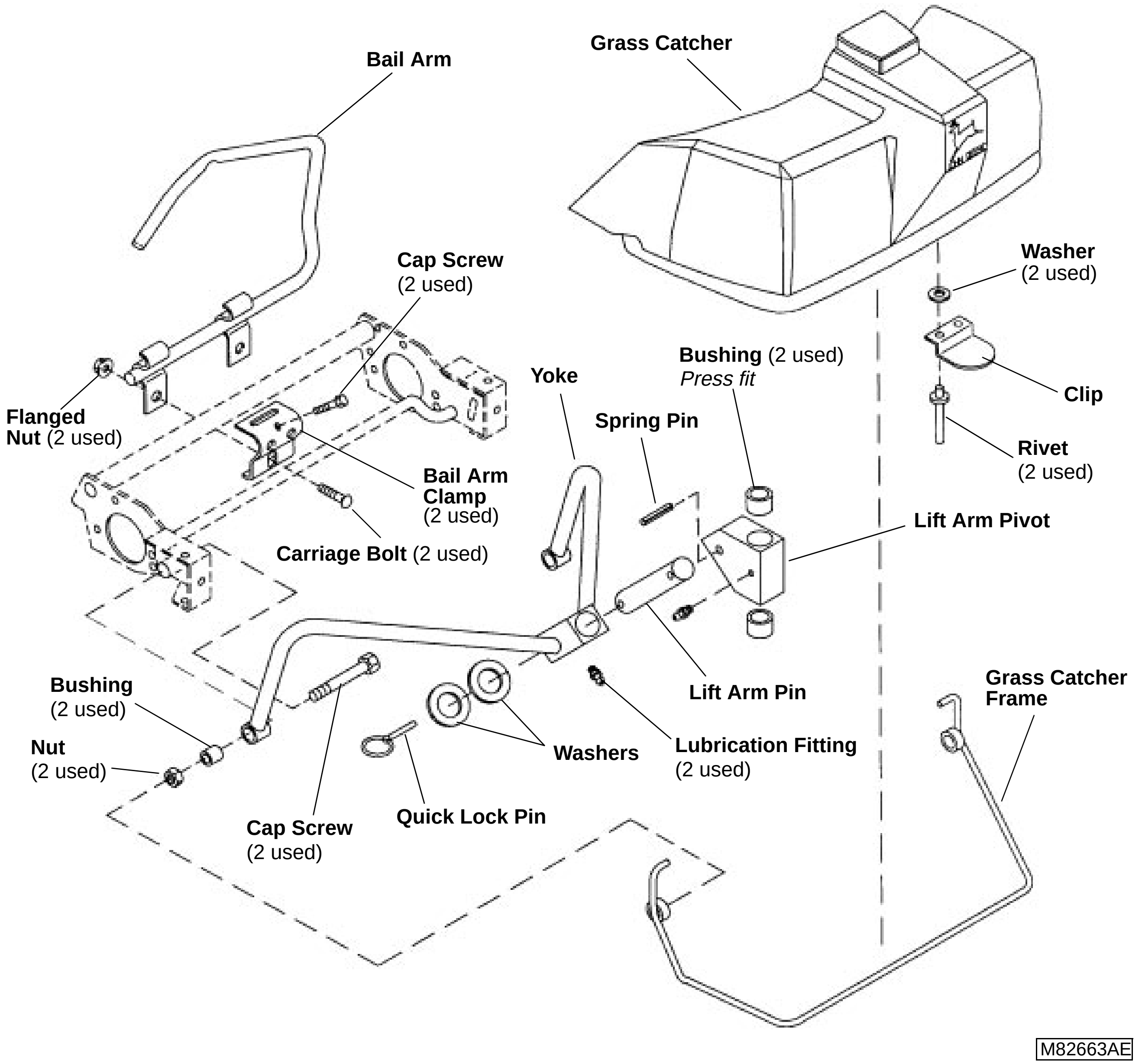
- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.

CENTER LIFT ARM



- Inspect all parts for wear or damage. Replace parts as needed.
- Apply MPG-2® Multipurpose Polymer Grease to roller shaft end of roller cam.
- Adjust rear lift linkage. (See REAR LIFT LINKAGE ADJUSTMENT on page 8-42.)
- Apply multipurpose grease to lubrication fittings.

YOKE AND BAIL—FRONT CUTTING UNITS



- Inspect all parts for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.

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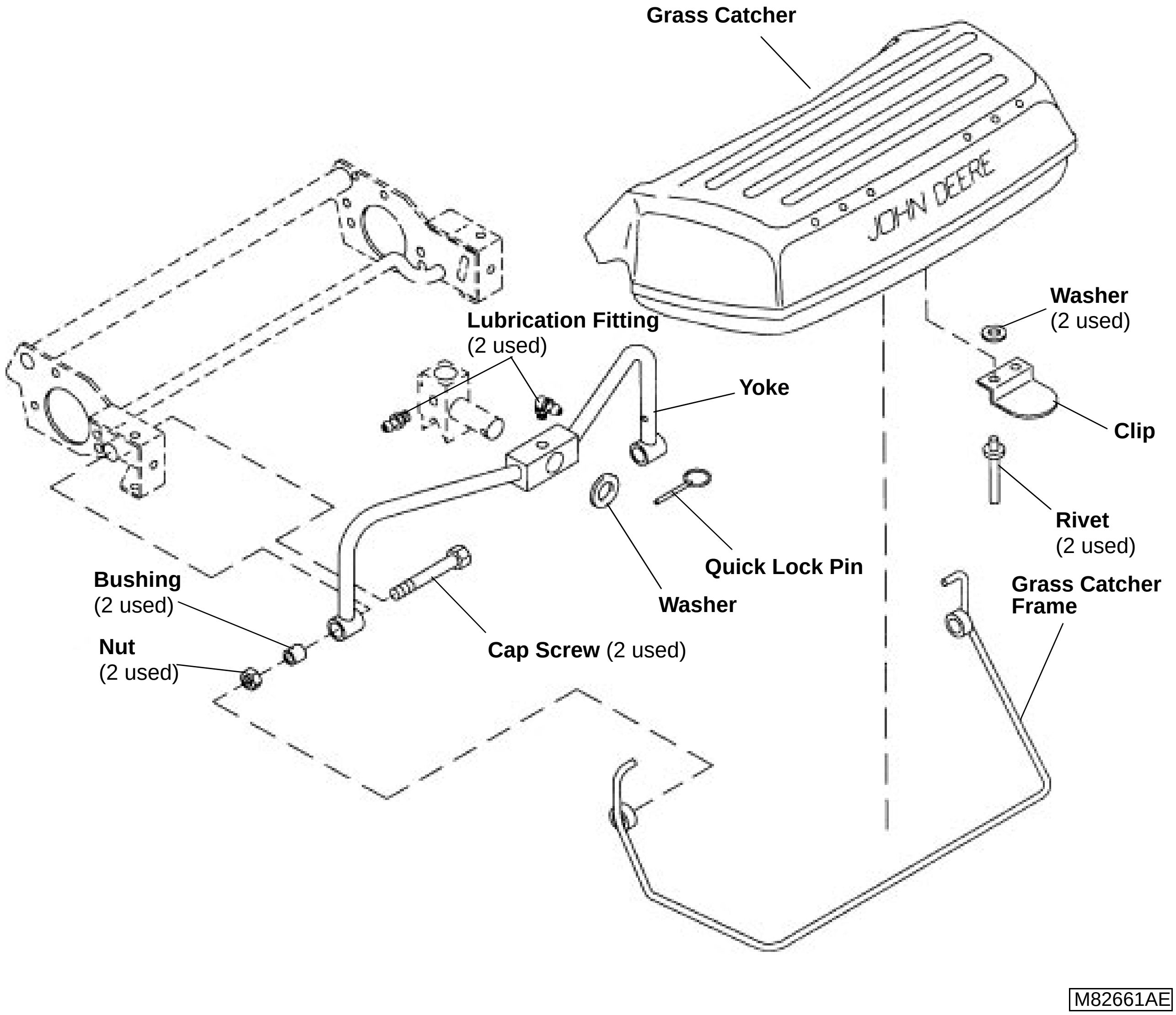
YOKE—CENTER CUTTING UNIT



- Inspect all pats for wear or damage. Replace parts as needed.
- Apply multipurpose grease to lubrication fittings.

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Numerics

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