2243 Diesel Professional Greensmower

TECHNICAL MANUAL

John Deere
Lawn & Grounds Care Division

TM1562 (01MAY94)

Litho in U.S.A

M82380

This technical manual is written for an experieced 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 and 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.

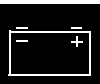
We appreciate your input on this manual. To help, there are postage paid post cards included at the back. If you find any errors or want to comment on the layout of the manual please fill out one of the cards and mail it back to us.

Safety

Specifications and General Information

Engine (Diesel)

Electrical



Power Train (Hydrostatic)

Steering

Brakes

Hydraulics

Miscellaneous

M

Attachments

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.

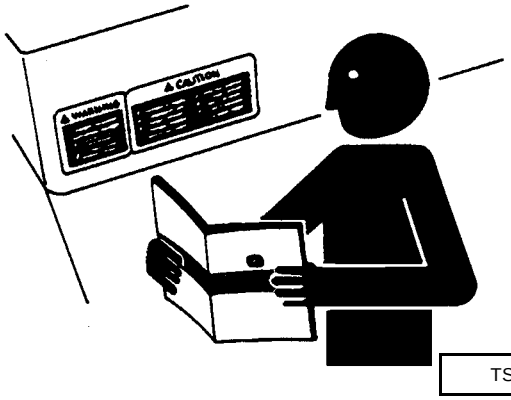
Follow recommended precautions and safe servicing practices.

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

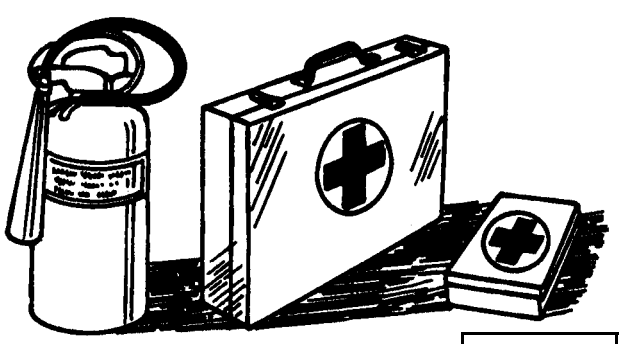


TS201

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.

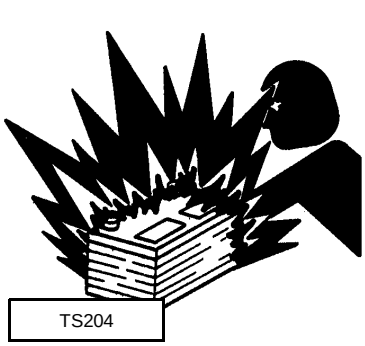
Do not store oily rags; they can ignite and burn spontaneously.

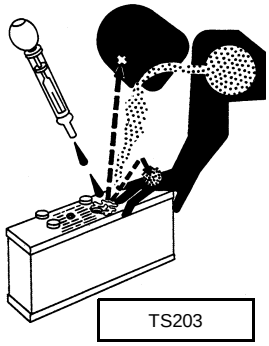
Be prepared if a fire starts.

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.

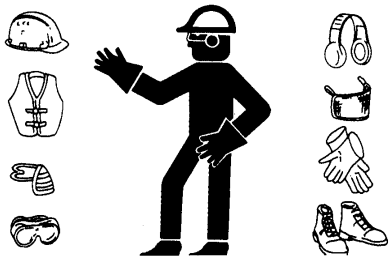
USE SAFE SERVICE PROCEDURES

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.

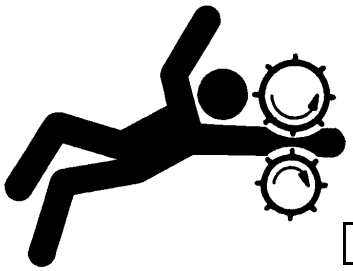
Operating equipment safely requires the full attention of the operator. Do not wear radio or music headphones while operating machine.


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.

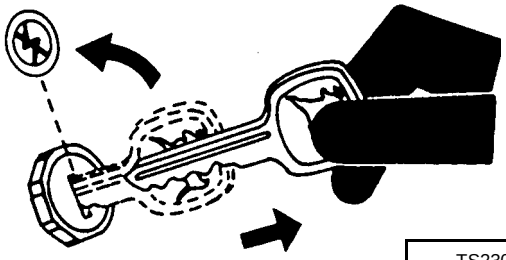


TS228

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

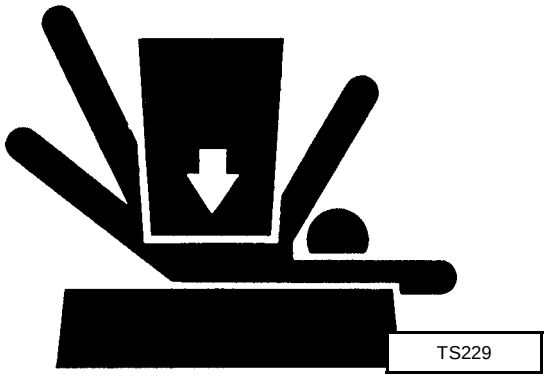


TS230

- **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

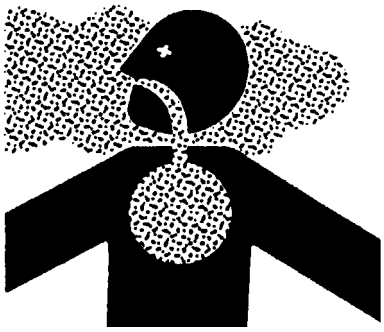
- **Before starting a job:**

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

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.

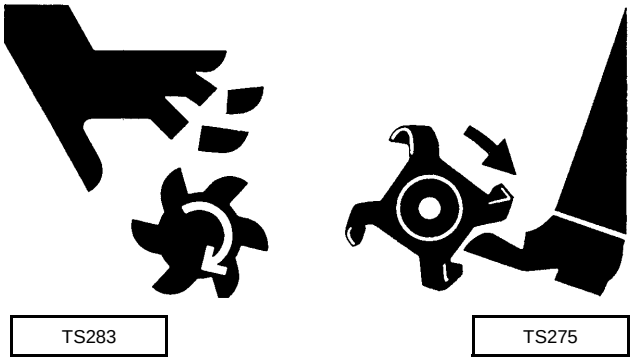
Do not attempt to mount tire unless you have the proper equipment and experience to perform the job.

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.

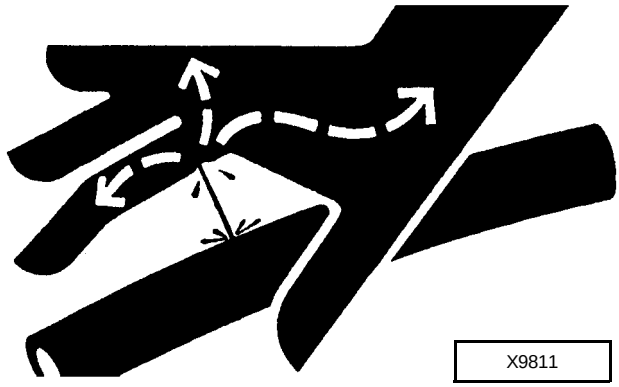
AVOID INJURY FROM ROTATING BLADES



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



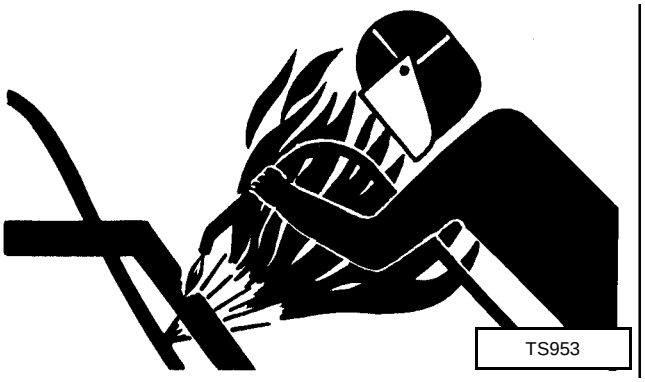
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.

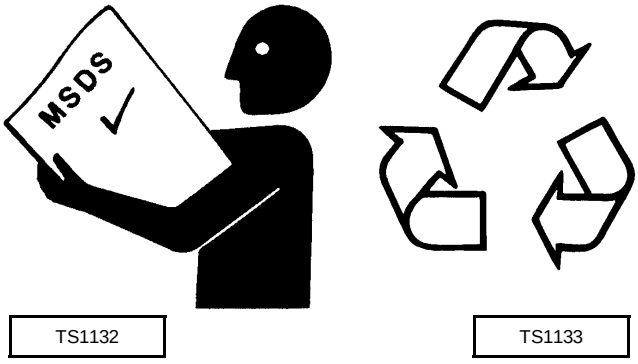
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury should reference a knowledgeable medical source. Such information is available from Deere & Company Medical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

Avoid Heating Near Pressurized Fluid Lines



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



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.

CONTENTS

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SPECIFICATIONS AND GENERAL INFORMATION

Page

Operational Checkout Procedures Contionued

VEHICLE SPECIFICATIONS

ENGINE

Make	Yanmar
Type	Diesel
Model	3TNE68
Aspriation	Natural
Horsepower (SAEJ1940)	13.4 kW (18 hp)
Cylinders	3
Displacement	585 cm3 (35.7 cu in.)
Stroke/Cycle	4 Cycle
Bore	68 mm (2.68 in.)
Stroke	72 mm (2.83 in.)
Compression Ratio	23:1
Slow Idle	1400± 75 rpm
Fast Idle	2975± 75 rpm
Firing Order	1-3-2-1
Timing	14° BTDC
Valving	Overhead Valves
Combustion System	Indirect Injection
Lubrication	Pressurized
Oil Filter	Full Flow Filter
Cooling System	Liquid Cooled
Air Cleaner	Semi-Cyclone Dry Type Dual Stage
Muffler	Horizontal discharge below frame
Engine Oil Capacity	2.3 L (2.4 qt)
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)	Diesel #1 or #2
Fuel Pump Location	On Left-hand side of engine
Fuel Delivery	Inline Indirect Injection
Fuel Shut-Off	Fuel Shutoff Solenoid
Fuel Filter	Replaceable 5 Micron

ELECTRICAL

Ignition	Electronic
Type of Starter	Solenoid Shift
Charging System	16 amp Alternator, Regulated
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
Indicator Lights	Pre-Heat Indicator (Glow Plugs)
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	Flex Coupler on Engine Flywheel to Driven Coupler on Pump Shaft
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
Parking Brake	Brake Pedal Lock Lever

HYDRAULICS

Pump Type	Double Gear
Pump Drive	Driven Coupler from Hydrostatic Pump Shaft
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
Oil Cooler	Standard (Part of Radiator)
Optional Equipment	Auxiliary 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

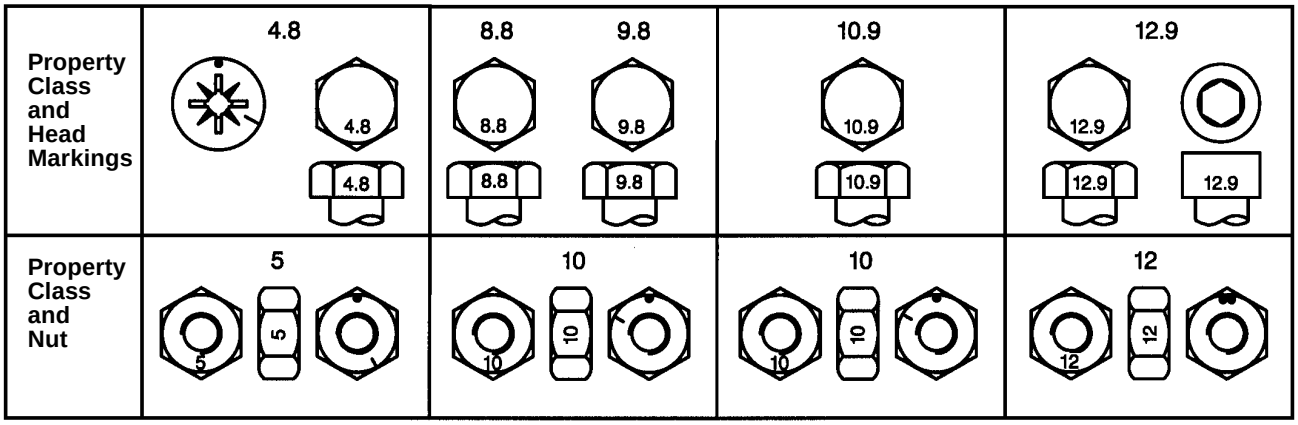
Empty Weight (less attachments)	467 kg (1030 lb)
Cutting Unit Weight	34 kg (74 lb)
Wheel Base	1.30 m (4 ft 3 in.)
Tread Width	1.02 m (3 ft 4 in.)
Mowing Position Width	1.57 m (5 ft 2 in.)
Turning Radius (uncut circle)	0.60 m (23.6 in.)
Overall Length	2.26 m (7 ft 5 in.)
Overall Width	1.83 m (6 ft)
Overall 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.)

METRIC BOLT AND CAP SCREW 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	Nm	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm	lb-ft	Nm	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	190
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 values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

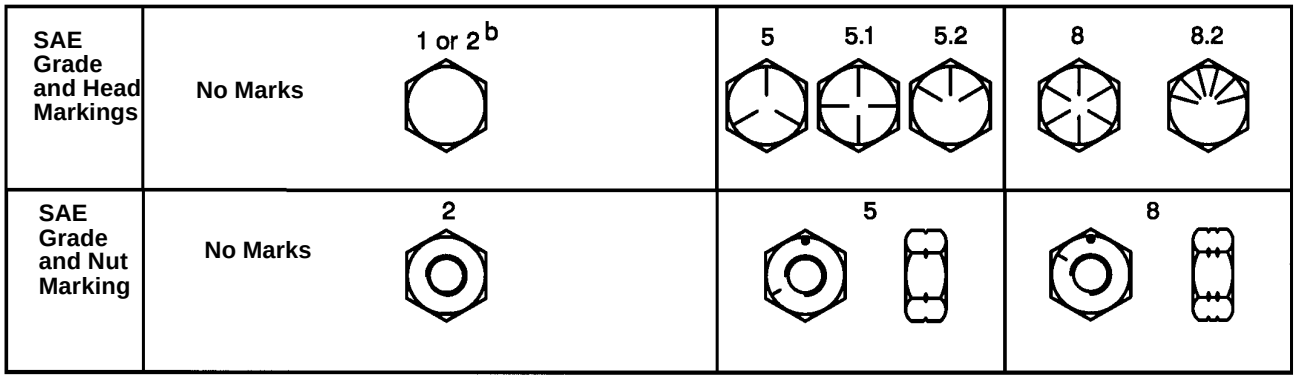
Shear bolts are designed to fail under predetermined loads. Always replace shear bolts with identical grade.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original. Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to 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 without any lubrication.*

UNIFIED INCH BOLT AND CAP SCREW TORQUE VALUES



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

DO NOT use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically.

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

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, these should only be tightened to the strength of the original. Make sure fasteners threads are clean and that you properly start thread engagement. This will prevent them from failing when tightening.

Tighten plastic insert or crimped steel-type lock nuts to approximately 50 percent of the dry torque shown in the chart, applied to the nut, not to the bolt head. Tighten toothed or serrated-type lock nuts to the full torque value.

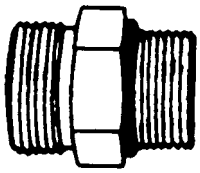
a *"Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated without any lubrication.*

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.*

SERVICE RECOMMENDATIONS FOR O-RING BOSS FITTINGS

STRAIGHT FITTING

1. Inspect O-ring boss seal for dirt or defects.
2. Lubricate O-rings with petroleum jelly. Place electrical tape over threads to protect O-ring. Slide O-ring over tape and into O-ring groove of fitting. Remove tape.
3. Tighten fitting to torque value shown on chart.



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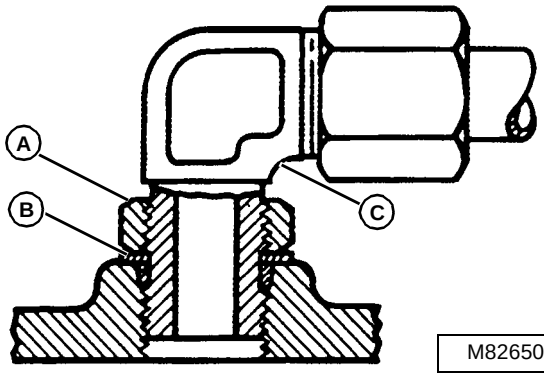
ANGLE FITTING

1. Back-off lock nut (A) and back-up washer (B) completely to head-end (C) of fitting.
2. Turn fitting into threaded boss until back-up washer contacts face of boss.
3. Turn fitting head-end counterclockwise to proper index (maximum of one turn).
4. Hold fitting head-end with a wrench and tighten locknut and back-up washer to proper torque value.



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NOTE: Do not allow hoses to twist when tightening fittings.

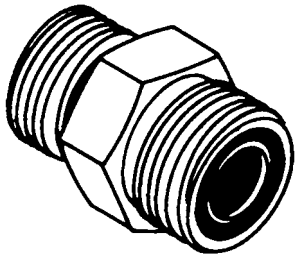
TORQUE VALUE

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

NOTE: Torque tolerance is ± 10%

SERVICE RECOMMENDATIONS FOR FLAT FACE O-RING 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.



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FLAT FACE O-RING SEAL FITTING TORQUE

Nominal Tube O.D.		Dash Size	Thread Size (in.)	Swivel Nut Torque		Bulkhead Nut Torque	
mm	(in.)			N•m	(lb-ft)	N•m	(lb-ft)
6.35	0.250	-4	9/16-18	16	12	5.0	3.5
9.52	0.375	-6	11/16-16	24	18	9.0	6.5
12.70	0.500	-8	13/16-16	50	51	17.0	12.5
15.88	0.625	-10	1-14	69	51	17.0	12.5
19.05	0.750	-12	1-3/16-12	102	75	17.0	12.5
22.22	0.875	-14	1-3/16-12	102	75	17.0	12.5
25.40	1.000	-16	1-7/16-12	142	105	17.0	12.5
31.75	1.250	-20	1-11/16-12	190	140	17.0	12.5
38.10	1.500	-24	2-12	217	160	17.0	12.5

NOTE: Torque tolerance is +15 -20%.

DIESEL FUEL

Use either Grade No. 1-D or Grade No. 2-D fuel as defined by ASTM Designation D975 for diesel fuels. In European countries, use ISO 1585 commercial diesel fuel.

NOTE: At altitudes above 1500 m (5000 ft) use Grade 1-D for all temperatures. If engine is operated under "stand-by" conditions, use grade 1-D for all temperatures.

If engine is operated at temperatures of -40° to -57°C (-40° to -70°F), Grade DF-A arctic fuel is recommended.

Fuel sulfur content of less than 0.5 percent is preferred, to prevent higher wear from corrosive combustion products.

IMPORTANT: If fuel sulfur content exceeds 0.5 percent, the engine oil drain interval must be reduced by 50 percent.

Cetane number should be no less than 45 to assure satisfactory starting and overall performance. At low temperatures and/or high altitude, a cetane number of more than 45 is recommended.

NOTE: Excessive white smoke at start-up could be the result of low cetane fuel.

Cloud point should be at least 6°C (10°F) below lowest expected air temperature at time of starting. Wax can separate from fuel when temperature decreases to cloud point and may plug filter.

DIESEL ENGINE OIL

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

IMPORTANT: John Deere TORQ-GARD SUPREME PLUS-50™ engine oil is not recommended during engine break-in (first 100 hours on a new or overhauled engine). The superior lubricating properties of this oil will not allow the engine to properly wear during break-in period. Use SAE 10W 30.

John Deere TORQ-GARD SUPREME PLUS-50™ engine oil is recommended at all other times. This oil is specially formulated to provide superior protection against high temperature thickening and wear as well as exceptional cold weather starting performance; these properties may result in longer engine life.

NOTE: When John Deere TORQ-GARD SUPREME PLUS-50™ engine oil and a John Deere oil filter are used, the change interval may be extended by 50 hours. ALWAYS follow recommendations in the operator's manual.

John Deere TORQ-GARD SUPREME® engine oil is also recommended but standard operator's manual oil change intervals must be maintained. Other oils may be used if they meet one or more of the following specifications:

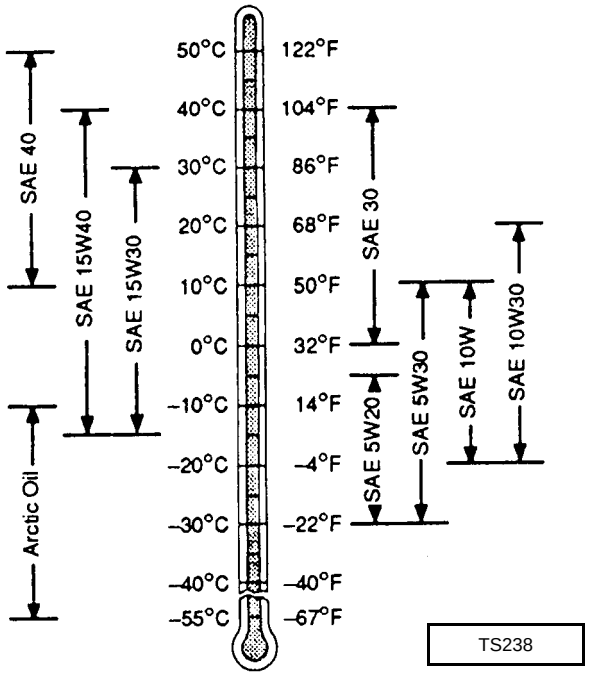
- API Service Classification CE or CD
- Military Specification MIL-L-2104E or MIL-L-2104D or MIL-L-2104C

In European countries, oils meeting CCMC Specification D4 or D5 may be used.

SAE 5W20, SAE 5W30, and arctic oil viscosity grades meeting API Service Classification CC may be used, but oil and filter must be changed at one-half the normal interval.

Oils meeting Military Specification MIL-L-46167B may be used as arctic oils.

NOTE: Some increase in oil consumption may be expected when low viscosity oils are used. Check oil levels more frequently.

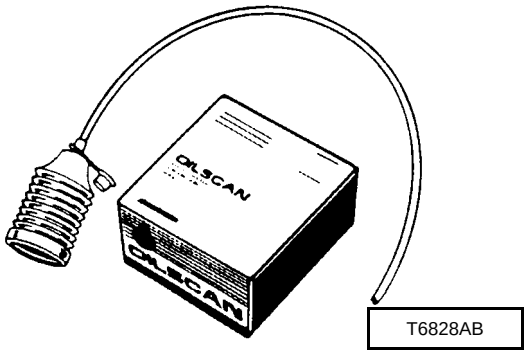


OILSCAN® AND COOLSCAN™

OILSCAN and COOLSCAN are John Deere sampling programs to help you monitor machine performance and identify potential problems before they cause serious damage.

Oil and coolant samples should be taken from each system prior to its recommended change interval.

Check with your John Deere dealer for the availability of OILSCAN and COOLSCAN kits.



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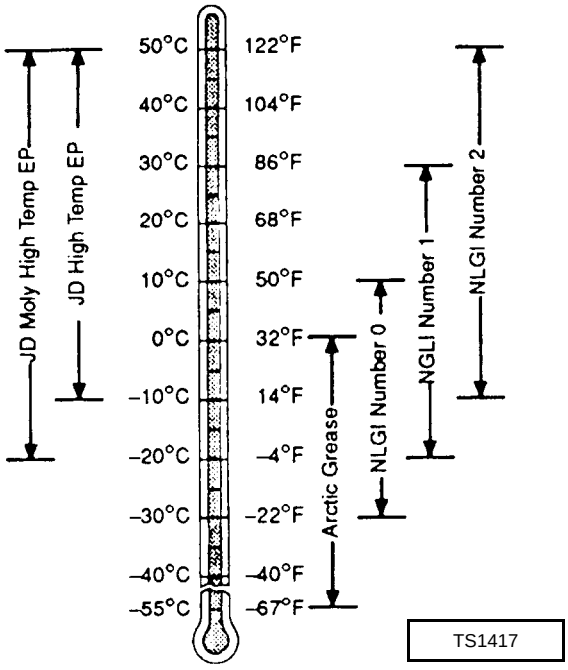

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ENGINE COOLANT RECOMMENDATIONS

GREASE

Use grease based on the expected air temperature range during the service interval.

The following greases are preferred:

- John Deere MOLY HIGH TEMPERATURE EP GREASE
- John Deere HIGH TEMPERATURE EP GREASE
- John Deere GREASE-GARD™

Other greases may be used if they meet one of the following:

- SAE Multipurpose EP Grease with a maximum of 5% molybdenum disulfide
- SAE Multipurpose EP Grease

Grease meeting Military Specification MIL-G-10294F may be used as arctic grease.

C CAUTION

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

Shut off engine. Remove the radiator filler cap only when the cap is cool enough to touch with bare hands. Slowly loosen cap to first stop to relieve pressure before removing completely.

- Always maintain engine coolant at correct level.
- Coolant make-up should be mixed at same concentrations as original coolant, including inhibitors.
- In tropical areas where antifreeze of John Deere Cooling Fluid is not available, use water meeting quality specifications outlined in this group and John Deere RE23182 Liquid Coolant Conditioner. The liquid coolant conditioner should be added in the amount recommended on the label for your cooling system capacity.

IMPORTANT: John Deere Liquid Coolant Conditioner does not protect against freezing.

In certain geographical areas where water quality is unacceptable, John Deere Engine Cooling Fluid is marketed for use in the engine cooling system. It protects the engine from corrosion and freezing down to -37°C (-35°F).

John Deere Engine Cooling Fluid or John Deere Low Silicate Antifreeze are recommended for all John Deere Diesel Engines. John Deere Cooling Fluid is ready to use as it is without dilution or mixing. John Deere Low Silicate Antifreeze is concentrated and should be mixed minimum 40% - maximum 60% antifreeze and distilled to deionized water. Consult your John Deere Parts Network for local availability.


TS281

ENGINE COOLANT SPECIFICATIONS

Water Quality

Distilled, de-ioned, or soft water is preferred for use in cooling systems. Mineral (hard/tap) water should NEVER be put in a cooling system unless first tested. However, water that meets the following water quality specifications is acceptable.

Water Quality Specifications

Item	Parts Per Million	Grains Per Gallon
Chlorides (maximum)	40	2.5
Sulfates (maximum)	100	5.9
Total Dissolved Solids (maximum)	340	20
Total Hardness (maximum)	170	10
pH Level	5.5 - 9.0	

If Chlorides, Sulfates, or Total Dissolved Solids are higher than the above given specifications, the water must be distilled, de-mineralized, or de-ionized before using in cooling system.

If Total Hardness is higher than the above given specification, and all other parameters are within the given specifications, the water must be softened before using in cooling system.

Ethylene Glycol Concentrate (Antifreeze)

IMPORTANT: DO NOT use methyl alcohol or methoxy propanol base concentrate. This concentrate is not compatible with additives used in supplemental coolant additives. Damage can occur to rubber seals on cylinder liners which are in contact with coolant.

DO NOT use ethylene glycol concentrate sealer or stop-leak additives.

DO NOT use concentrate containing less than 10% ethylene glycol.

DO NOT use concentrate containing more than 0.1% anhydrous metasilicate. This type of concentrate, which is intended for use in aluminum engines, may cause a gel-like deposit to form that reduces heat transfer and coolant flow. Check container label or consult with supplier before using.

John Deere Low Silicate Antifreeze is the ethylene glycol concentrate recommended for all John Deere Diesel Engines. This product is concentrated and should be mixed 50/50 with quality water. Add to the mixture 3% (by volume) supplemental coolant additives (SCA's).

John Deere Low Silicate Antifreeze is available in the following sizes:

- TY6377 - 208 L (55 U.S. Gal) container
- TY15886 - 3.8 L (1 U.S. Gal) container

Contact your John Deere Parts Network for local availability.

If John Deere Low Silicate Antifreeze is not available, use an ethylene glycol concentrate meeting ASTM D 4985, SAEJ1941, General Motors Performance Specification GM1899M, or formulated to GM6038M.

Supplemental Coolant Additives (SCA's)

IMPORTANT: Ethylene glycol concentrate (antifreeze) DOES NOT contain sufficient additives to prevent liner erosion or pitting which could occur in wet sleeve diesel engines. ALWAYS mix the coolant solution with a supplemental coolant additive such as John Deere Liquid Coolant Conditioner or spin-on coolant filter conditioner element.

C CAUTION

John Deere Liquid Coolant Conditioner contains alkali. Avoid contact with eyes. Avoid prolonged or repeated contact with skin. Do not take internally. In case of contact, immediately wash skin with soap and water. For eyes, flush with large amounts of water for at least 15 minutes. Call physician. KEEP OUT OF REACH OF CHILDREN.

- John Deere Liquid Coolant Conditioner

IMPORTANT: ALWAYS mix the 50/50 solution of ethylene glycol concentrate with quality water in a separate container BEFORE adding the SCA's. Then add solution to the radiator. NEVER pour cold water into a hot engine, as it may crack cylinder block or head.

John Deere Liquid Coolant Conditioner MUST be added at a rate of 3% (by volume) to the coolant solution. When adding John Deere Liquid Coolant Conditioner, follow the supplier's recommendations printed on the container.

John Deere Liquid Coolant Conditioner is available in the following sizes:

- RE23182 473 mL (16 oz) container
- RE35992 3.8 L (1 gal) container

Contact your John Deere Parts Network for availability.

Other approved SCA's are:

- NALCOOL 3000®
- FLEETGARD®-DCA008-78L DCA2 in 473 mL (16 oz) container
- FLEETGARD®-DCA60-78L DCA4 in 473 mL (16 oz) container

IMPORTANT: John Deere Liquid Coolant Conditioner does NOT protect against freezing.

DO NOT over-concentrate coolant solutions with supplemental coolant additives, as this can cause silicate-dropout. When this happens, a gel-type deposit is created which retards heat transfer and coolant flow. DO NOT use soluble oil.

JOHN DEERE ENGINE COOLING FLUID

In certain regions of the world, John Deere Engine Cooling Fluid is marketed for use in the engine cooling system. John Deere Cooling Fluid is premixed and contains the proper mixture of quality water, low silicate antifreeze to protect the engine from freezing down to -37°C (-35°F), and supplemental coolant additives (SCA's).

IMPORTANT: Additional SCA's should NOT be added to the Cooling Fluid.

John Deere Engine Cooling Fluid is available in the following sizes:

- AL66606 (formally DD14134) - 5 L (1.3 U.S. Gal) can
- AL66607 (formally DD14345) - 20 L (5.3 U.S. Gal) can
- AL67171 (formally DD14136) - 60 L (15.9 U.S. Gal) drum
- AL66608 (formally DD14346) 200 L (53 U.S. Gal) drum

Contact your John Deere Parts Network for local availability.

CHECK EFFECTIVENESS OF COOLANT SOLUTION

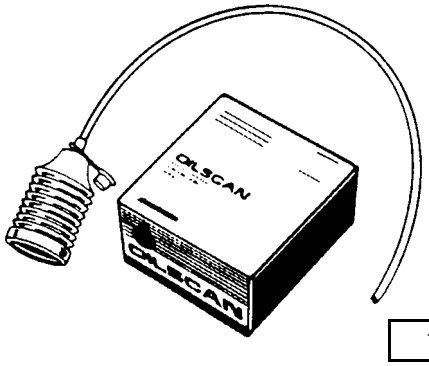
Prior to the recommended change interval or if concentration of coolant solution is in question, a coolant sample should be taken and a COOLSCAN analysis performed.

COOLSCAN is a John Deere sampling program to help you monitor the effectiveness of your engine's coolant solution and identify potential problems before they cause serious damage.

NALCOOL 3000® is a registered trademark of the NALCO Company.
FLEETGARD® is a registered trademark of the Cummins Engine Company.

Check with your John Deere dealer for the availability of DS0251 COOLSCAN kit. Refer to instructions provided with kit.

Usually recharging your engine coolant with the recommended amount of John Deere Liquid Coolant Conditioner at the appropriate time is adequate. However, with a COOLSCAN analysis report, you will be given a more thorough evaluation of your engine coolant condition along with a detailed service recommendation.



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HYDRAULIC/HYDROSTATIC DRIVE OIL

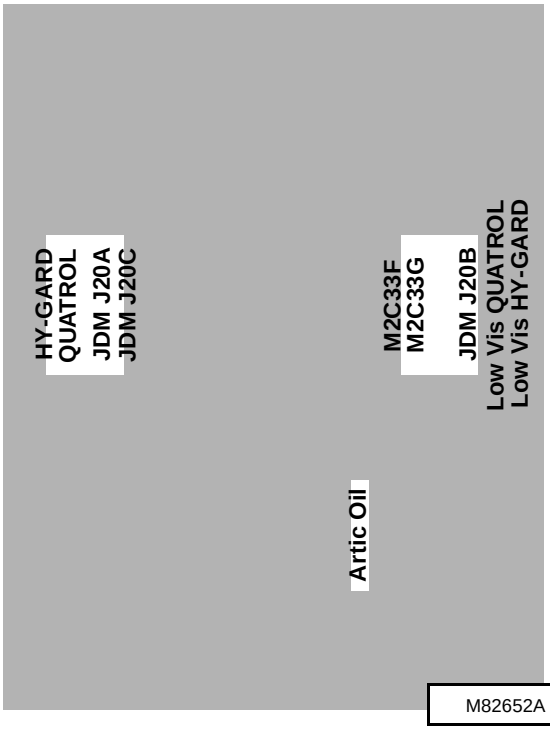
Use oil viscosity based on the expected air temperature range during the period between oil changes.

John Deere HY-GARD® Transmission/Hydraulic Oil is recommended.

Other oils may be used if they are QUATROL® oils or if they meet John Deere Standard JDM J20A, J20B or J20C.

Automatic transmission fluids of Type M2C33F or M2C33G may also be used.

Oils meeting Military Specification MIL-L-46167A may be used as artic oils.



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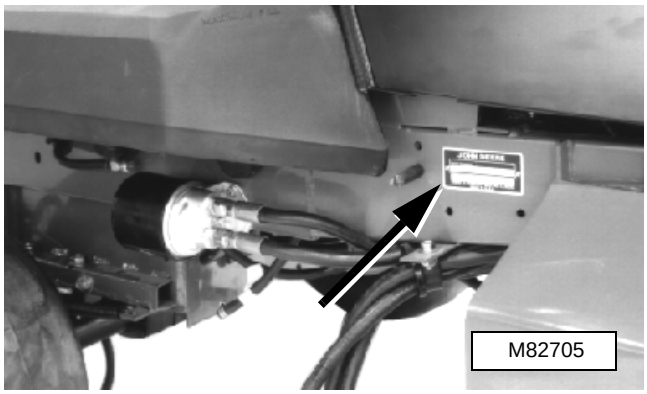
When ordering parts or submitting a warranty claim, it is IMPORTANT that you include the machine product identification number and the component serial numbers.

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

MACHINE IDENTIFICATION NUMBER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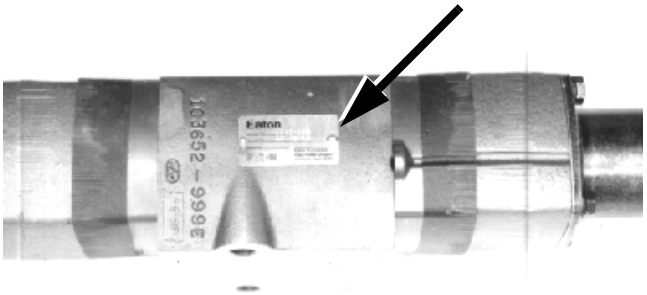
TRANSAXLE SERIAL NUMBER



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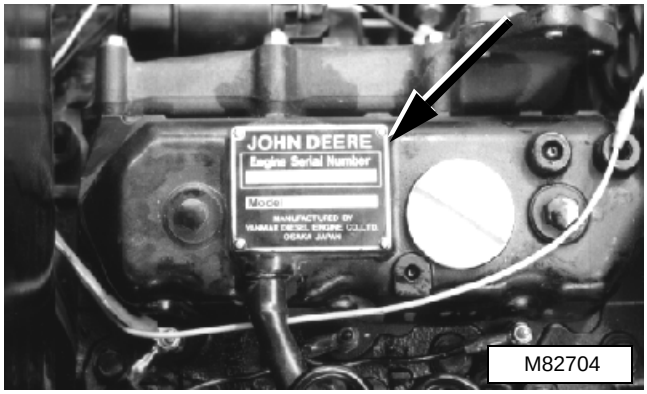
ENGINE SERIAL NUMBER



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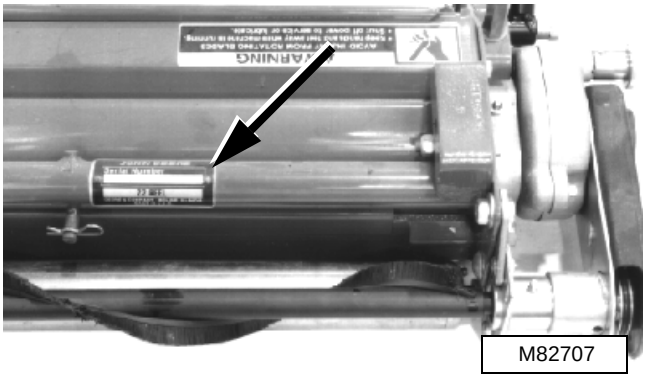
CUTTING UNIT SERIAL NUMBER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INTERLOCK SYSTEM

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 (A) engaged.
   - Mow/Transport lever (B) in TRANSPORT position.
   - Travel pedals (C) in NEUTRAL position.

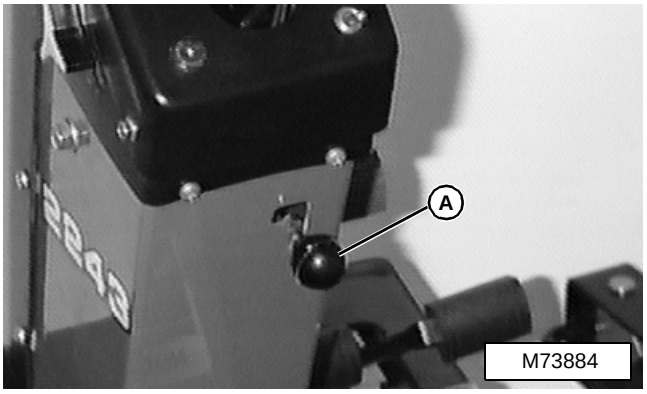
2. If the operator is mowing (mow/transport lever in MOW position and/or ground drive engaged) and the driver leaves the seat, engine will stop.

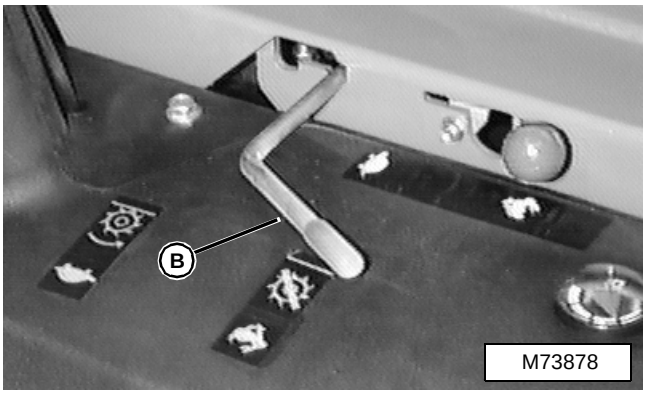
3. If the operator has stopped mowing (mow/transport lever in TRANSPORT position) and leaves the seat with ground drive in neutral, but without the parking brake engaged, the engine will stop.

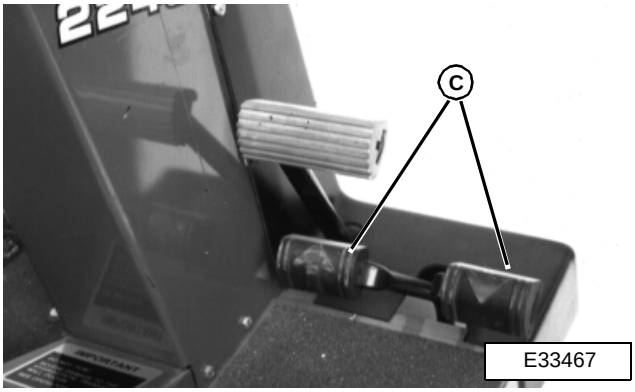
4. Provision has been made to allow service of the reels to be performed by one person (with optional mow/backlap valve assembly). Complete the following steps:

   - Place mow/backlap switch in BACKLAP position.
   - Move travel pedals in NEUTRAL position.
   - Engage parking 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.

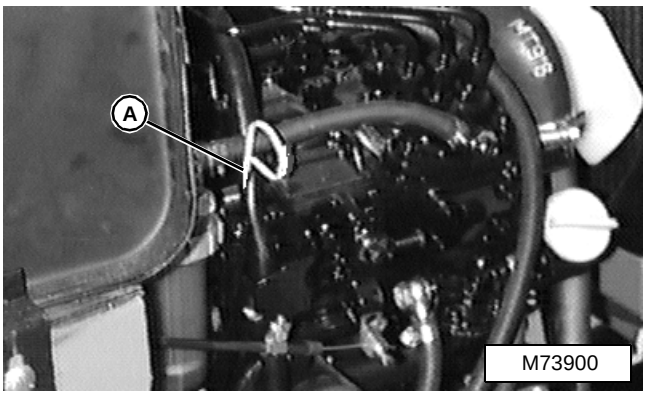
ENGINE OIL CHECK

Conditions:

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

Procedure:

1. Lift engine hood.
2. Before removing dipstick (A), 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.



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.
- Oil level is above FULL, drain excess oil until level is between full and add.
- Find cause of overfill and correct.

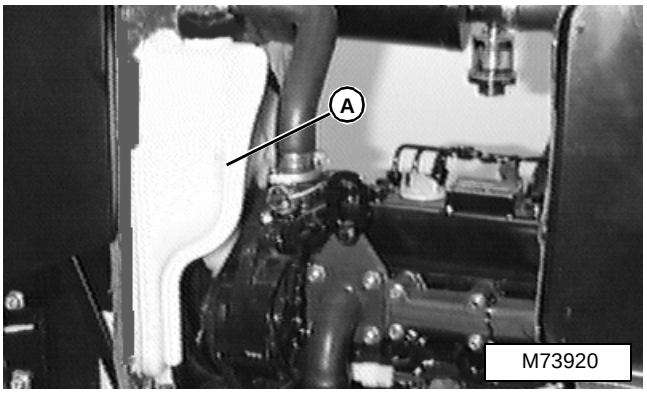
ENGINE COOLANT LEVEL CHECK

Conditions:

- Machine on level surface.
- Engine stopped.

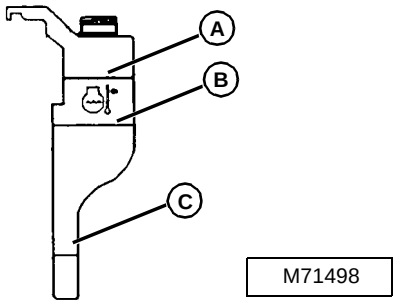
Procedure:

1. Lift engine hood.
2. Observe coolant level in recovery tank (A).



Normal:

- Hot engine—Coolant level between lines (A and B) on recovery tank.
- Cold engine—Coolant level above line (C).



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. Lift 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.
- Check for leaks.

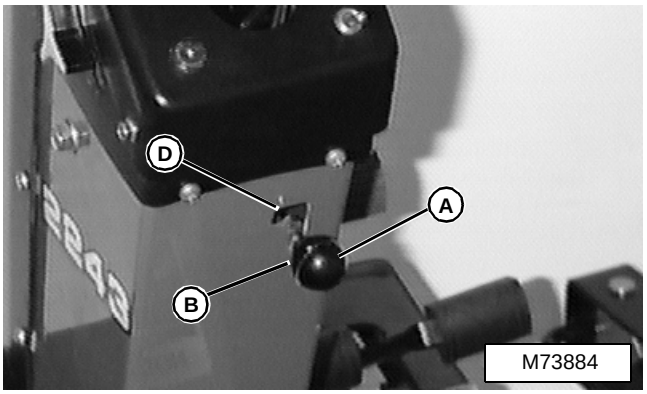
PARKING BRAKE LOCK CHECK

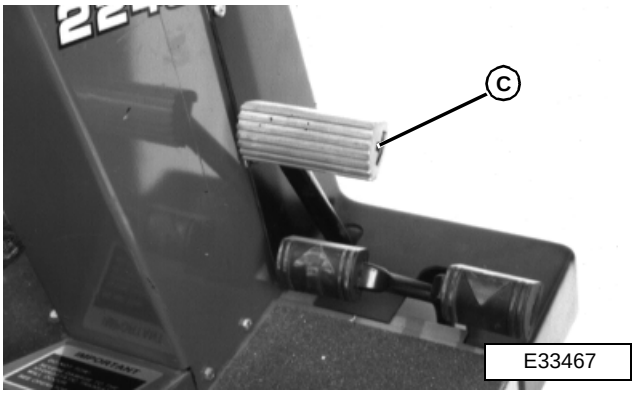
Conditions:

- Operator on seat.
- Engine stopped.

Procedure:

1. Move parking brake knob (A) into long slot (B).
2. Push brake pedal (C) down and release pedal.





A— Parking Brake Knob
B— Long Slot
C— Brake Pedal
D— Short Slot

Normal:

- Pedal must stay down.

If Not Normal:

- Adjust park brake. See procedure in BRAKES section.

Procedure:

1. Push down and hold pedal (C).
2. Move parking brake knob into short slot (D).
3. Release pedal.

Normal:

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

If Not Normal:

- Adjust parking brake. See procedure in BRAKES section.

INDICATOR LAMPS CHECK—ENGINE OFF

Conditions:

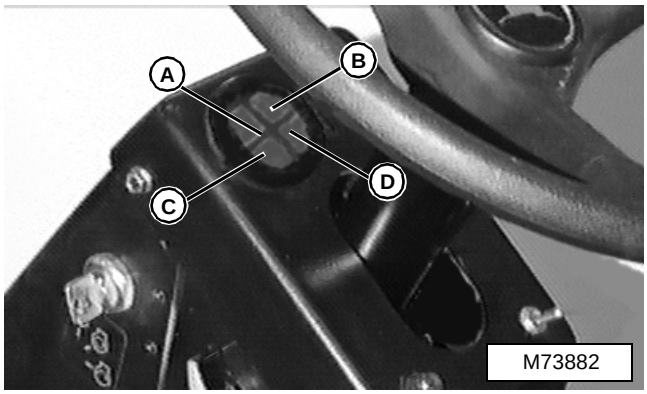
- Parking brake locked.
- Engine Stopped.
- Travel pedals in NEUTRAL position.

Procedure:

Turn key switch to a position between RUN and START.

Normal:

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



A— Hydraulic Oil Temperature Indicator
B— Engine Oil Pressure Indicator
C— Battery Discharge Indicator
D— Engine Coolant Temperature Indicator

If Not Normal:

- Go to Theory and Diagnosis in ELECTRICAL section.

START CIRCUIT CHECK

Conditions:

- Operator on seat.
- Parking 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 Theory and Diagnosis in ELECTRICAL section.

MOW/TRANSPORT LEVER INTERLOCK CHECK

Conditions:

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

Procedure:

1. Move mow/transport lever to MOW position (A).
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 procedure in ELECTRICAL section.

Procedure:

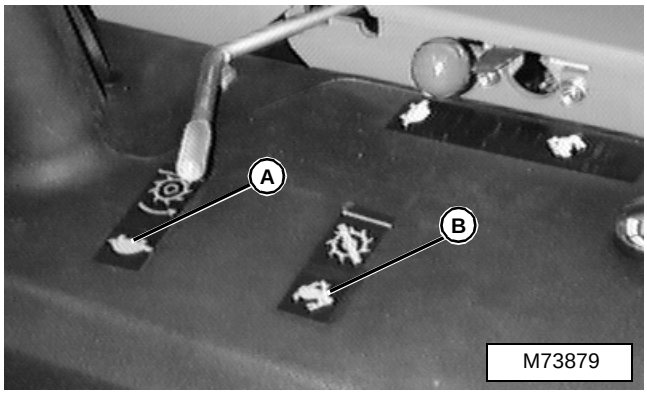
1. Move mow/transport lever to TRANSPORT position (B).
2. Turn key switch to START.

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check mow/transport switch wire connections.
- Check or adjust mow/transport switch. See procedure in ELECTRICAL section.



HYDROSTATIC DRIVE NEUTRAL INTERLOCK CHECK

Conditions:

- Operator on seat.
- Parking 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 procedure in ELECTRICAL section.

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 procedure in ELECTRICAL section.

PARKING BRAKE INTERLOCK CHECK

Conditions:

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

Procedure:

1. Unlock parking brake pedal.
2. Turn key switch to START.

Normal:

- Starter must not turn flywheel.

If Not Normal:

- Check brake switch wire connections.
- Check or adjust brake switch. See procedure in ELECTRICAL section.

Procedure:

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

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check brake switch wire connections.
- Check or adjust brake switch. See procedure in ELECTRICAL section.

SEAT SWITCH INTERLOCK CHECK

Conditions:

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

Procedure:

1. Unlock parking brake pedal
2. Turn key switch to START.

Normal:

- Starter must not turn flywheel.

If Not Normal:

- Check or replace seat switch. See procedure in ELECTRICAL section.

Conditions:

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

Procedure:

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

Normal:

- Starter must turn flywheel.

If Not Normal:

- Check or replace seat switch. See procedure in ELECTRICAL section.

INDICATOR LAMP CHECK—ENGINE RUNNING

Conditions:

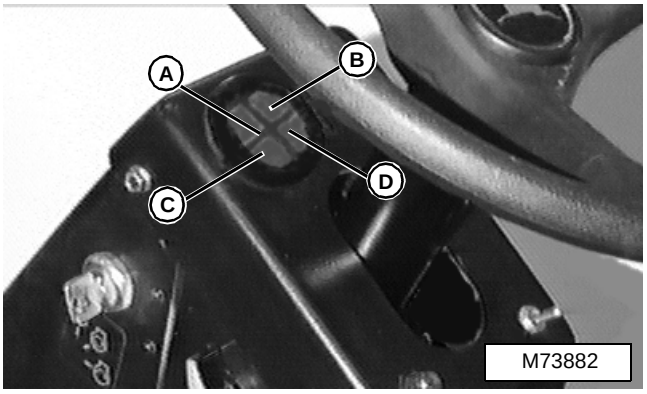
- Operator on seat.
- Parking brake locked
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

Run engine at full throttle.

Normal:

- Hydraulic oil temperature (A), engine oil pressure (B) and engine coolant temperature (D) indicator must go out within 5 seconds after engine starts.
- Battery discharge indicator (C) must go out within 10 seconds after engine starts.



A— Hydraulic Oil Temperature Indicator
B— Engine Oil Pressure Indicator
C— Battery Discharge Indicator
D— Engine Coolant Temperature Indicator

If Not Normal:

- Go to ELECTRICAL section.

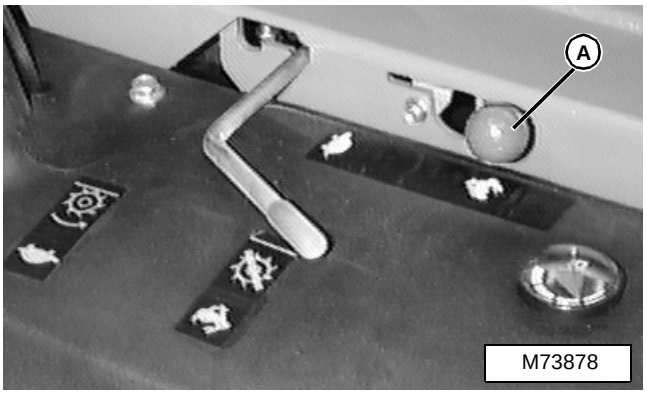
THROTTLE LEVER CHECK

Conditions:

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

Procedure:

1. Start engine and operate at **slow idle (1400± 75 rpm)**.
2. Move throttle lever (A) from SLOW to FAST to SLOW positions.



Normal:

- Engine must accelerate and decelerate SMOOTHLY without hesitation.

If Not Normal:

- Adjust throttle cable. See procedure in ENGINE section.

STEERING CHECK

Conditions:

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

Procedure:

1. Start engine and operate at **fast idle (2975± 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:

c 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 (2975± 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 POWER TRAIN section.

TRANSAXLE NEUTRAL RETURN CHECK

Conditions:

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

Procedure:

c 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 (2975± 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.
- Parking brake pedal unlocked.
- Mow/transport lever in TRANSPORT position.
- Travel pedals in NEUTRAL position.

Procedure:

Start and run engine at **fast idle (2975± 75 rpm)**.

Normal:

- Machine must NOT creep forward or backwards.

If Not Normal:

- Adjust hydrostatic linkage. See procedure in POWER TRAIN section.

CUTTING UNIT LIFT CHECK

Conditions:

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

Procedure:

1. Start and operate engine at **fast idle (2975± 75 rpm)**.
2. Move mow/transport lever to MOW position.
3. Press mow switch (A).

Normal:

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

If Not Normal:

- Go to HYDRAULICS section.

Procedure:

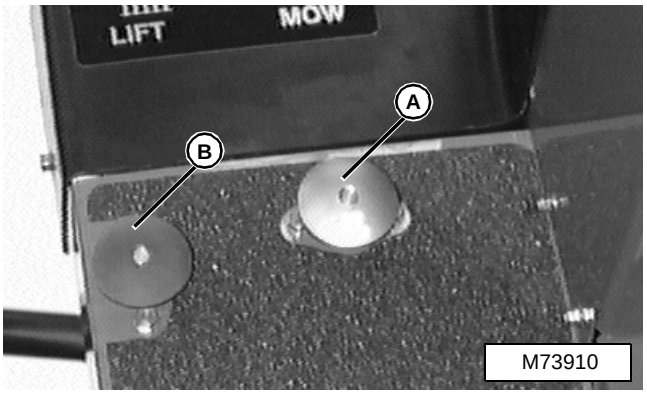
Press lift switch (B).

Normal:

- Cutting units will raise smoothly and reels stop rotating.

If Not Normal:

- Go to HYDRAULICS section.



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ENGINE (Diesel)

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TEST AND ADJUSTMENT SPECIFICATIONS

Checks, Tests and Adjustments

Valve Clearance . . . . . 20 mm (0.008 in.)

Connecting Rod Side Play
Standard Clearance . . . . . 0.20—0.40 mm (0.0079—0.0157 in.)

Connecting Rod Bearing Clearance
Standard Clearance . . . . . 0.033—0.059 mm (0.0013—0.0023 in.)

Crankshaft End Play
Standard Clearance . . . . . 0.090—0.271 mm (0.004—0.011 in.)

Crankshaft Main Bearing Clearance
Main Bearing Cap Cap Screw Torque . . . . . 54 N•m (40 lb-ft)
Standard Clearance . . . . . 0.033—0.059 mm (0.0013—0.0023 in.)

Valve Lift (Intake and Exhaust) . . . . . 7.5 mm (0.300 in.)
Camshaft End Play
Standard Clearance . . . . . 0.05—0.25 mm (0.0020—0.0098 in.)
Wear Limit . . . . . 0.40 mm (0.016 in.)

Timing Gear Backlash—Standard Backlash
All . . . . . 0.04—0.12 mm (0.0016—0.0047 in.)

Fuel Injection Nozzle
Opening Pressure . . . . . 11722 ± 480 kPa (1700 ± 70 psi)
Leakage at 11032 kPa (1600 psi). . . . . Minimum of 10 Seconds

Chatter and Spray Pattern at
11722 ± 480 kPa (1700 ± 70 psi)
Slow Hand Lever Movement . . . . . Chatter Sound
Slow Hand Lever Movement . . . . . Fine Stream Spray Pattern
Fast Hand Lever Movement . . . . . Fine Atomized Spray Pattern

Thermostat
Begin Opening . . . . . 71° C (160°F)
Fully Open . . . . . 85° C (184° F)
Minimum Lift Height . . . . . 8 mm (0.310 in.)

Coolant Temperature Switch Continuity . . . . . 107—113° C (225—235° F)

Starter No-Load Amp Draw/RPM
Maximum Starter Amperage—Hitachi 0.8 kW . . . . . 60 Amps at 7000 rpm
Minimum Starter RPM—Hitachi 0.8 kW . . . . . 7000 rpm

Fuel Injection Pump Static Timing
Injection Pump Timing . . . . . 14° BTDC (Before Top Dead Center)

Distance on Outer Surface of
Crankshaft Pulley for Every 0.1 mm (0.004 in.)
of Shim Thickness . . . . . 1° or 1 mm (3/64 in.)

Engine Crankshaft Position . . . . . No. 1 Cylinder on TDC Compression Stroke

Total Shim Pack Thickness (New Shims) . . . . . 0.5 mm (0.020 in.)

Delivery Valve Fitting Torque . . . . . 51 N•m (38 lb-ft)

Fan/Alternator Drive Belt Tension
Applied Force . . . . . 98 N (22 lb-force)
Deflection . . . . . 10—15 mm (0.400—0.600 in.)

Operational Tests

Radiator, Bubble Test
- Maximum Air Pressure Into Cylinder . . . . . 2448 kPa (355 psi)

Cooling System
- Maximum Pressure . . . . . 117 kPa (17 psi)
- Minimum Pressure after 15 Seconds . . . . . 90 kPa (13 psi)

Radiator Cap
- Valve Opening Pressure . . . . . 90 kPa (13 psi)

Cylinder, Compression Pressure
- Compression Pressure . . . . . 3233 kPa (469 psi)
- Maximum Difference Between Cylinders . . . . . 241 kPa (35 psi)

Engine Oil Pressure
- Idle Speed
  - Fast . . . . . 2975 ± 75 rpm
  - Slow . . . . . 1400 ± 75 rpm
- Engine Oil Pressure . . . . . 294—392 kPa (43—57 psi)

Air Intake System Holding Pressure . . . . . 34—69 kPa (5—10 psi)

Minimum Fuel Supply Pump Pressure . . . . . 29 kPa (4.3 psi)

Fuel System Holding Pressure (Maximum) . . . . . 103 kPa (15 psi)

Fast Idle . . . . . 2975 ± 75 rpm

Slow Idle . . . . . 1400 ± 75 rpm

REPAIR SPECIFICATIONS

Rocker Arm Cover
- Special Nut Torque . . . . . 18 N•m (160 lb-in.)

Rocker Arm Assembly
- Mounting Cap Screw and Nut Torque . . . . . 26 N•m (226 lb-in.)
- Rocker Arm Shaft O.D.
  - Standard . . . . . 9.97—9.99 mm (0.3925—0.3933 in.)
  - Wear Limit . . . . . 9.95 mm (0.3920 in.)
- Rocker Arm and Shaft Support I.D.'s
  - Clearance . . . . . 0.14 mm (0.005 in.)
  - Standard . . . . . 10.00—10.02 mm (0.3937—0.3945 in.)
  - Wear Limit . . . . . 10.09 mm (0.3972 in.)
- Push Rod Length
  - Standard . . . . . 110—111 mm (4.346—4.386 in.)
- Push Rod Bend
  - Wear Limit . . . . . 0.03 mm (0.001 in.)

Cylinder Head and Valves
- Mounting Cap Screw Torque
  - First . . . . . 13 N•m (114 lb-in.)
  - Second . . . . . 26 N•m (229 lb-in.)
  - Final . . . . . 39 N•m (28 lb-ft)
- Cylinder Head Distortion
  - Standard . . . . . 0.05 mm (0.002 in.) or less
  - Wear Limit . . . . . 0.15 mm (0.006 in.)
  - Maximum Amount of Metal to be Removed . . . . . 0.20 mm (0.008 in.)

Cylinder Head and Valves, continued
- Valve Seat Width
  - Intake Valve
    - Standard . . . . . 1.15 mm (0.045 in.)
    - Wear Limit . . . . . 1.65 mm (0.065 in.)
  - Exhaust Valve
    - Standard . . . . . 1.41 mm (0.056 in.)
    - Wear Limit . . . . . 1.91 mm (0.075 in.)

Intake and Exhaust Valves
- Valve Faces
  - Minimum Margin . . . . . 0.51 mm (0.020 in.)
  - Exhaust Angle . . . . . 45°
  - Intake Angle . . . . . 30°
- Valve Stem O.D.
  - Distance A . . . . . 20 mm (0.787 in.)
  - Distance B . . . . . 40 mm (1.575 in.)
- Intake Valve
  - Standard . . . . . 5.46—5.48 mm (0.2149—0.2157 in.)
  - Wear Limit . . . . . 5.40 mm (0.2126 in.)
- Exhaust Valve
  - Standard . . . . . 5.44—5.46 mm (0.2142—0.2149 in.)
  - Wear Limit . . . . . 5.40 mm (0.2126 in.)
- Valve Recession
  - Intake Valve . . . . . 0.40 mm (0.016 in.)
  - Exhaust Valve . . . . . 0.85 mm (0.033 in.)

Valve Guides
- Valve Guide I.D.
  - Maximum Clearance . . . . . 0.20 mm (0.008 in.)
  - Standard . . . . . 5.50—5.52 mm (0.216—0.217 in.)
  - Wear Limit . . . . . 5.58 mm (0.220 in.)
- Valve Guide Height . . . . . 7 mm (0.276 in.)

Valve Springs
- Spring Free Length
  - Wear Limit . . . . . 28 mm (1.102 in.)
- Maximum Spring Inclination . . . . . 0.80 mm (0.032 in.)

Exhaust Manifold
- Mounting Cap Screw and Nut Torque . . . . . 11 N•m (97 lb-in.)

Intake Manifold
- Mounting Cap Screw Torque . . . . . 11 N•m (97 lb-in.)

Valve Seat Angles
- Valve Seat Surface
  - Exhaust Valve . . . . . 45°
  - Intake Valve . . . . . 30°
- Lower Seat Surface . . . . . 70°
- Upper Seat Surface . . . . . 15°

Piston-to-Cylinder Head Clearance . . . . . 0.610—0.730 mm (0.024—0.028 in.)

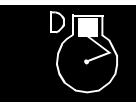
Piston and Connecting Rod Cap Screw Torque . . . . . 23 N•m (203 lb-in.)

Connecting Rod Bearing I.D.
- Clearance . . . . . 0.033—0.059 mm (0.0014—0.0023 in.)
- Standard . . . . . 39—39.016 mm (1.535—1.536 in.)

Piston Ring Groove Clearance
- First Compression Ring—Standard . . . . . 0.065—0.100 mm (0.0026—0.0039 in.)
- Second Compression Ring—Standard . . . . . 0.090—0.125 mm (0.0035—0.0049 in.)
- Oil Ring—Standard . . . . . 0.020—0.055 mm (0.0008—0.0022 in.)

Piston Ring End Gap
- Standard
  - First Compression Ring . . . . . 0.100—0.250 mm (0.004—0.010 in.)
  - Second Compression Ring and Oil Ring . . . . . 0.150—0.350 mm (0.006—0.014 in.)
- Wear Limit . . . . . 1.50 mm (0.0591 in.)

Piston Pin



- Pin O.D.
  - Standard . . . . . 19.991—20.00 mm (0.787—0.788 in.)
  - Wear Limit . . . . . 19.900 mm (0.783 in.)
- Bore I.D.
  - Clearance . . . . . 0.017 mm (0.0007 in.)
  - Standard . . . . . 20.00—20.008 mm (0.787—0.788 in.)
  - Wear Limit . . . . . 20.02 mm (0.788 in.)
- Bushing I.D.
  - Clearance . . . . . 0.110 mm (0.0043 in.)
  - Standard . . . . . 20.025—20.038 mm (0.788—0.789 in.)

Piston O.D.
- Distance A . . . . . 5 mm (0.197 in.)
- Standard Size Piston
  - Standard . . . . . 67.960—67.990 mm (2.676—2.767 in.)
  - Wear Limit . . . . . 67.90 mm (2.673 in.)
- 0.25 mm (0.010 in.) Oversize Piston
  - Standard . . . . . 68.21—68.24 mm (2.685—2.687 in.)

Cylinder Bore I.D.
- Standard Size Bore
  - Clearance . . . . . 0.25 mm (0.010 in.)
  - Standard . . . . . 68.00—68.03 mm (2.677—2.678 in.)
  - Wear Limit . . . . . 68.20 mm (2.685 in.)
- 0.25 mm (0.010 in.) Oversize Bore
  - Standard . . . . . 68.25—68.28 mm (2.687—2.688 in.)
  - Wear Limit . . . . . 68.45 mm (2.695 in.)
- Degalzing . . . . . 30—40° cross-hatch pattern
- Reboring . . . . . 30—40° cross-hatch pattern

Crankshaft Rear Oil Seal
- Seal Case-to-Block Cap Screw Torque . . . . . 11 N•m (96 lb-in.)
- Oil Pan-to-Seal Case Cap Screw Torque . . . . . 9 N•m (78 lb-in.)

Crankshaft and Main Bearings
- Main Bearing Cap Screw Torque . . . . . 54 N•m (40 lb-ft)
- Crankshaft Maximum Bend . . . . . 0.02 mm (0.0007 in.)
- Connecting Rod Journal O.D.
  - Standard . . . . . 35.97—35.98 mm (1.4161—1.4165 in.)
  - Wear Limit . . . . . 35.92 mm (1.414 in.)
- Main Bearing Journal O.D.
  - Standard . . . . . 39.97—39.98 mm (1.5736—1.5740 in.)
  - Wear Limit . . . . . 39.90 mm (1.571 in.)
- Main Bearing I.D.
  - Clearance . . . . . 0.033—0.059 mm (0.0013—0.0023 in.)
  - Standard . . . . . 40.00—40.042 mm (1.575—1.577 in.)

Flex Drive Coupler-to-Flywheel Cap Screw Torque . . . . . 28 N•m (20 lb-ft)

Flywheel
- Maximum Distortion . . . . . 0.02 mm (0.0008 in.)
- Mounting Cap Screw Torque . . . . . 83 N•m (61 lb-ft)
- Flywheel Housing Mounting Cap Screw Torque . . . . . 49 N•m (36 lb-ft)

Camshaft
- Mounting Cap Screw Torque . . . . . 11 N•m (96 lb-in.)
- Camshaft Side Gap—Standard . . . . . 0.05—0.25 mm (0.0020—0.0098 in.)
- Maximum Camshaft Bend . . . . . 0.02 mm (0.001 in.)

Lobe Height
- Standard . . . . . 29.97—30.03 mm (1.180—1.182 in.)
- Wear Limit . . . . . 29.75 mm (1.171 in.)

Journal O.D.
- Gear Housing and Flywheel Ends
  - Standard . . . . . 35.94—35.96 mm (1.4150—1.4157 in.)
  - Wear Limit . . . . . 35.85 mm (1.4114 in.)
- Intermediate
  - Standard . . . . . 35.91—35.94 mm (1.4138—1.4150 in.)
  - Wear Limit . . . . . 35.85 mm (1.4114 in.)

Bushing I.D.
- Clearance . . . . . 0.18 mm (0.007 in.)
- Standard . . . . . 36.00—36.065 mm (1.417—1.420 in.)
- Wear Limit . . . . . 36.10 mm (1.421 in.)

Bore I.D.
- Clearance . . . . . 0.18 mm (0.007 in.)
- Standard . . . . . 36.00—36.025 mm (1.417—1.418 in.)
- Wear Limit . . . . . 36.10 mm (1.421 in.)

Cam Followers
- O.D.
  - Standard . . . . . 17.950—17.968 mm (0.7067—0.7074 in.)
  - Wear Limit . . . . . 17.93 mm (0.706 in.)

Bore I.D.
- Clearance . . . . . 0.032—0.068 mm (0.0013—0.0027 in.)
- Standard . . . . . 18.00—18.018 mm (0.7087—0.7094 in.)
- Wear Limit . . . . . 18.05 mm (0.711 in.)

Timing Gear Cover
- Fan Mounting Cap Screw Torque . . . . . 11 N•m (96 lb-in.)
- Cover Mounting Cap Screw Torque . . . . . 9 N•m (78 lb-in.)
- Crankshaft Pulley Cap Screw Torque . . . . . 115 N•m (85 lb-ft)

Idler Gear
- Shaft O.D
  - Standard . . . . . 19.959—19.980 mm (0.786—0.787 in.)
  - Wear Limit . . . . . 19.93 mm (0.785 in.)

Bushing I.D.
- Clearance . . . . . 0.020—0.062 mm (0.0008—0.0024 in.)
- Standard . . . . . 20.00—20.021 mm (0.787—0.788 in.)

Timing Gear Housing Cap Screw Torque
- Aluminum Housing-to-Block . . . . . 9 N•m (78 lb-in.)
- Cast Iron Housing-to-Block. . . . . 11 N•m (96 lb-in.)

Oil Pan and Strainer Mounting Cap Screw Torque
- Oil Pan-to-Block . . . . . 11 N•m (96 lb-in.)
- Oil Pan-to-Seal Case . . . . . 9 N•m (78 lb-in.)
- Oil Pan-to-Timing Gear Housing . . . . . 9 N•m (78 lb-in.)
- Oil Strainer-to-Block . . . . . 11 N•m (96 lb-in.)

Oil Pump
- Mounting Cap Screw Torque . . . . . 9 N•m (78 lb-in.)
- Rotor Shaft O.D.-to-Backing Plate I.D. Clearance
  - Standard . . . . . 0.013—0.043 mm (0.0005—0.0017 in.)
  - Wear Limit . . . . . 0.20 mm (0.0078 in.)
- Rotor Recess
  - Standard . . . . . 0.03—0.09 mm (0.0011—0.0035 in.)
  - Wear Limit . . . . . 0.13 mm (0.0057 in.)
- Outer Rotor-to-Pump Body Clearance
  - Standard . . . . . 0.10—0.16 mm (0.0039—0.0063 in.)
  - Wear Limit . . . . . 0.25 mm (0.010 in.)
- Inner-to-Outer Rotor Clearance
  - Wear Limit . . . . . 0.15 mm (0.0059 in.)

Oil Pressure Regulating Valve
- Spring
  - Compressed Length . . . . . 14.70 mm (0.580 in.) @12 N (2.7 lb-force)
  - Free Length . . . . . 21.90—24.50 mm (0.860—0.960 in.)
- Housing-to-Valve Body Retaining Nut Torque . . . . . 30 N•m (22 lb-ft)

Thermostat
- Thermostat Cover Cap Screw Torque . . . . . 9 N•m (78 lb-in.)

Water Pump
- Mounting Cap Screw Torque . . . . . 26 N•m (226 lb-in.)
- Fan Mounting Cap Screw Torque . . . . . 11 N•m (96 lb-in.)
- Plate-to-Housing Screw Torque . . . . . 9 N•m (78 lb-in.)

Fuel Injection Pump
- Mounting Nut Torque . . . . . 20 N•m (180 lb-in.)

Fuel Injection Pump Camshaft
- Bearing Retaining Screw Torque . . . . . 20 N•m (180 lb-in.)
- Minimum Lobe Height . . . . . 30.90 mm (1.217 in.)

Fuel Control and Governor Linkage
- Governor Shaft O.D. (Minimum) . . . . . 7.90 mm (0.311 in.)
- Governor Shaft Bore I.D.
  - Wear Limit . . . . . 8.15 mm (0.321 in.)
  - Clearance . . . . . 0.18 mm (0.007 in.)
- Sleeve I.D. (Maximum) . . . . . 8.20 mm (0.323 in.)
- Injection Pump Camshaft O.D.
  - Clearance . . . . . 0.15 mm (0.006 in.)
  - Wear Limit . . . . . 7.90 mm (0.311 in.)

Fuel Injection Nozzles
- Mounting Nut Torque . . . . . 40 N•m (30 lb-ft)
- Nozzle Fitting Torque . . . . . 40 N•m (30 lb-ft)
- Nozzle Torque . . . . . 50 N•m (37 lb-ft)
- Separator Plate Nozzle Contact
  Surface Maximum Wear . . . . . 0.10 mm (0.0039 in.)

Starter—Hitachi 0.8 kW
- Cover Bushing (Reamed Out) . . . . . 12.50—12.53 mm (0.492—0.493 in.)
- Minimum Brush Length . . . . . 7.70 mm (0.303 in.)

Alternator—Kokosan 20A
- Flywheel Assembly-to-Coil Plate
  Assembly Nut Torque . . . . . 27 N•m (20 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).

JDG529 or JDST28 Belt Tension Gauge
Use to check fan/alternator drive belt tension.

JDG472 Adaptor
Use to apply air pressure to cylinder when performing Radiator Bubble Test.

D05104ST Cooling System Pressure Pump
Used to pressurize cooling system when performing Cooling System Pressure Test. Also used when performing Radiator Cap Pressure Test.

JDG692 Radiator Pressure Test Kit (Adaptors)
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.

JT01682 Compression Gauge Assembly
Used to read cylinder compression pressure when performing Cylinder Compression Pressure Test.

JDG472 Adaptor
Adapts JT692 Compression Gauge Assembly to cylinder injector port.

JT03017 Hose Assembly
Adapts JT05577 Pressure Gauge to JT03349 Connector.

JT05577 Pressure Gauge (100 psi)
Used to read engine oil pressure when performing Engine Oil Pressure Test.

JT03349 Connector
Allows connection of the JT05577 Pressure Gauge and JT3017 Hose assembly to the engine oil pressure sender port when performing Engine Oil Pressure Test.

JT05719 Hand Held Digital Tachometer
Used to set engine idle speed.

JDF13 Nozzle Cleaning Kit
Used to clean fuel injection nozzles.

JDG504 Valve Guide Driver
Used to remove and install valve guides in cylinder head.

D15001NU Magnetic Follower Holder Kit
Hold cam followers when removing and installing camshaft.

D01109AA Diesel Fuel Injection Nozzle Tester
Used to test fuel injection nozzle performance.

D01110AA Adaptor Set
Used to connect fuel injector to D011109AA Diesel Fuel Injection Nozzle Tester.

23622 Straight Adaptor
Used to connect fuel injector to D011109AA Diesel Fuel Injection Nozzle Tester.

DEALER FABRICATED TOOLS

DFMX1A Fuel Injector Timing Tool

No. 1 fuel injection line cut off at first bend.

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS U.S./ Canadian/ LOCTITE No.		
TY9369/ N/A/ #222	Thread Lock and Sealer (Low Strength)	Apply to threads of studs in timing gear housing.
TY9370/ TY9477/ #242	Thread Lock and Sealer (Medium Strength)	Apply to threads of crankshaft pulley cap screw.
TY15130/ N/A/ #395	John Deere Form-In-Place Gasket	Seals rear oil seal case, camshaft plug, timing gear cover and housing, and oil pan to engine block.

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Cylinder Head Gasket Kit
- Cylinder Block Gasket Kit
- Oversized Pistons and Rings
- Undersized Connecting Rod Bearing Inserts
- Undersized Main Bearing Inserts
- Fuel Injector Nozzle Shim Pack

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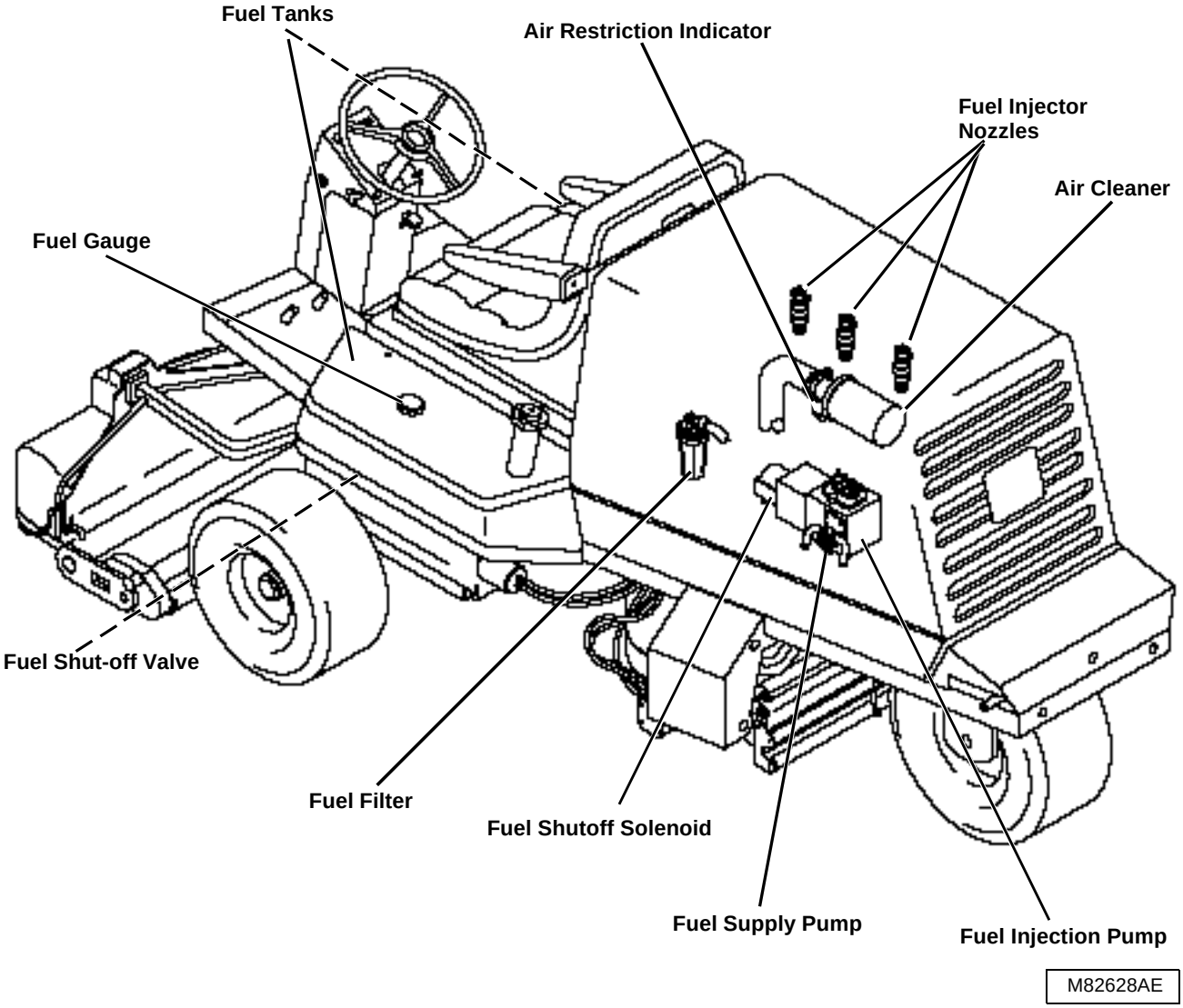
FUEL/AIR SYSTEM COMPONENTS



ENGINE AND FUEL SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Engine will not crank.	Engine cranks but will not start or starts hard.	Engine will not stay running, or stalls frequently.	Engine runs rough, misses, noisy, vibrates or low on power. Fuel in oil. Oil level high.	Engine surges, or has uneven or uncontrolled rpm.	Oil in the coolant or coolant in the oil.	Engine has low oil pressure.	Engine operating temperature is incorrect.	Lack of fuel at injection pump.	Exhaust smoke blue or uses too much oil.	Exhaust smoke white.	Exhaust smoke black or grey or uses too much fuel.
Fuel pump screen, fuel filter, or fuel line restricted. Fuel dirty, contains water or wrong grade.		●	●	●	●				●		●	●
Air filter elements dirty or plugged. Replace.		●	●	●	●			●		●		●
Fuel shut-off valve turned off, or restricted.		●	●	●	●			●	●			
Muffler or exhaust manifold leak.			●	●								
Defective glow plugs.		●										
Injection pump or governor malfunctioning. Injection pump timing incorrect.		●		●	●						●	●
Defective cranking components or connectors.	●			●								
Low compression from worn rings, cylinder bore, piston, valves or warped head.		●	●	●		●				●		●
Valve clearance incorrect.	●	●	●	●				●				●
Burned or warped valves and valve seats. Defective valve spring.		●	●	●	●					●		●
Starter cranking rpm too slow. Damaged starter. Excessive engine load.	●	●							●			
Fuel pump leaking or not operating. See Fuel Supply Pump Pressure Test.		●	●	●	●				●		●	
Engine oil viscosity or level incorrect.	●	●					●	●		●		
Injector pressure incorrect or leaking.		●	●	●	●			●			●	●
Cylinder head gaskets leaking or damaged.	●	●	●		●	●	●	●		●		●
Radiator.				●		●		●				

ENGINE SYSTEM DIAGNOSIS

Conditions:

- Engine mounted on level surface.
- Key switch off unless indicated otherwise.

Test Location	Normal	If Not Normal
1. Engine dipstick and exterior engine surface- engine oil check.	Oil level between “ADD” and “FULL” marks. Oil not burnt, or contaminated with metal particles, fuel, or coolant. No external leakage, filter clean.	Change oil and inspect for source of contamination. Check gaskets, seals, plugs, cylinder head, block, and intake manifold and breather. Change oil filter.
2. Recovery tank and radiator.	Coolant level between marks on tank when engine is warm.	Add proper coolant mix.
- Cooling System Check.	Coolant in radiator full to top.	
	Coolant not contaminated with oil, fuel or discolored brown.	Drain and flush system. Check for source of contamination.
	Radiator screen free of debris.	Clean or replace.
	Hoses not cracked or leaking, clamps and radiator cap tight.	Pressure test radiator and cap.
	Fan belt tight, not glazed or cracked.	Replace and adjust belt tension.
	Fan blades not damaged or warped.	Replace fan.
3. Fuel tanks, pump, pump screen, lines, filter, filter shutoff valves.	Fuel level correct, not contaminated, correct grade of fuel, no water.	Drain and clean fuel tanks. Add fresh fuel.
	Fuel pump screen and in-line filter free of debris.	Replace filters.
- Fuel System Check	Fuel shutoff valves in “ON” position.	Move to “ON” position.
	Fuel hoses not cracked or leaking.	Replace.
	Fuel hose clamps tight.	Replace or tighten.
	Fuel tanks do not have vacuum.	Replace fuel tank check valves.
4. Air filters and air intake.	Air filter hose not cracked, clamps tight.	Replace and tighten clamps.
- Air Intake System Check	Elements not plugged. Air filter housing sealed, no dirt tracking inside filter elements.	Replace elements or housing.
5. Fuel shutoff solenoid. (Key in RUN position.)	Fuel shutoff solenoid must engage.	If solenoid will not pull in and hold in, see Fuel Shutoff Circuit Test Points in ELECTRICAL section.
6. Glow plug indicator light. (Key in RUN position.)	Indicator light should come on when switch is depressed.	See Glow Plug Circuit Test Points in ELECTRICAL section.

ENGINE SYSTEM DIAGNOSIS - Continued

Test Location	Normal	If Not Normal
7. Fuel filter, fuel pump. (Engine cranking.)	Fuel level increases in filter. Fuel pump operating. Fuel present in return hose at fuel pump.	Test fuel pump pressure. (See procedure in this section.) Replace fuel filter.
8. Throttle lever and cable.	Linkage not binding and adjusted correctly.	Repair, replace or adjust cable.
9. Intake and exhaust valves.	Cold engine. Valve clearance within specification. Valves not sticking.	Check and adjust. (See procedure in this section.) Check valve guides and stems.
10. Fuel at injectors. (Key in START position - engine cranking.)	Crack fuel injection lines at injectors. Fuel shutoff solenoid pulled in. Engine must crank.	Check spray pattern and cracking pressure. (See procedure in this section.) Replace injectors. See Cranking Circuit Test Points in ELECTRICAL section.
11. Injector ports. (Key in START position.)	Cylinder compression within specification. Pressure difference between cylinders within specification.	Perform cylinder compression test. (See procedure in this section.)
12. Flywheel and starter.	Minimum cranking rpm within specification.	See Starter Amp Draw Test in ELECTRICAL section.
13. Injection pump timing inspection. (Key OFF.)	Timing should be correct. Remove pump as the LAST possible solution.	Perform injection pump static timing adjustment. (See procedure in this section.) Have pump tested by a qualified Service Repair Shop.
14. Injection pump idle settings. (Engine running).	Engine runs smooth under load. Engine rpm to specification.	Adjust idle speeds. (See procedures in this section.)
15. Oil pressure sender port.	Oil pressure in specification.	Test engine oil pressure. (See procedure in this section.)
16. Thermostat. (Engine at operating temperature.)	Clean from corrosion, rust, or debris. Opening temperature within specification.	Replace thermostat. Perform thermostat opening test. (See procedure in this section.)
17. Muffler.	Not restricted.	Replace muffler.

VALVE CLEARANCE, CHECK AND ADJUSTMENT

Reason:

To achieve correct engine operation.

Equipment:

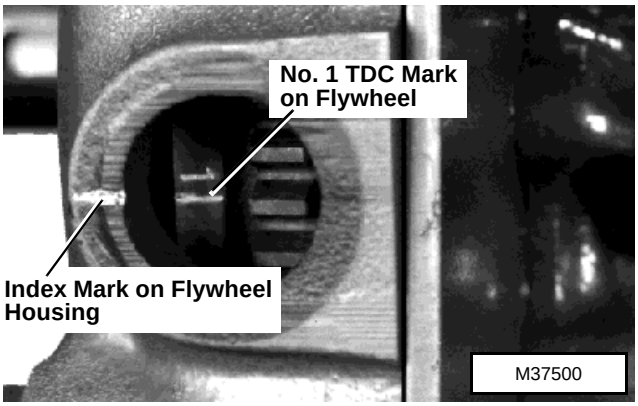
- Feeler Gauge

Procedure:

1. Remove rocker arm cover.
2. Remove plug from timing hole in flywheel housing.

NOTE: "Top Dead Center (TDC)" is the piston at its highest point.

3. Turn crankshaft pulley clockwise until No.1 cylinder TDC mark on flywheel aligns with index mark on flywheel housing.

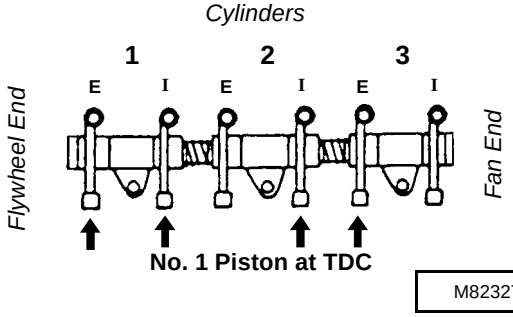


NOTE: No. 1 cylinder is the closest to the flywheel.

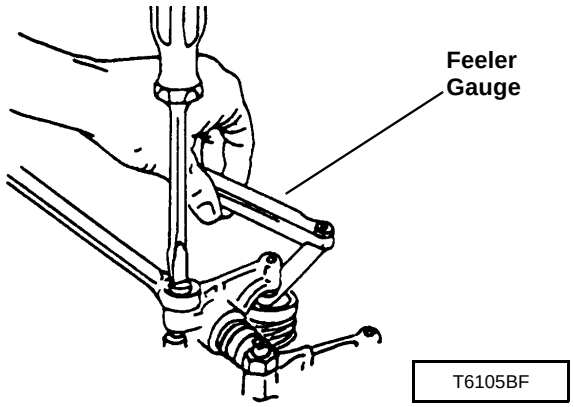
4. Try to move both No. 1 cylinder rocker arms or push rods.

If rocker arm push rods are not loose, rotate flywheel one revolution (360°). If both rocker arm push rods are loose, the piston is at TDC on compression stroke.

5. Measure and adjust valve clearance on the valves (arrows) with No. 1 piston at TDC.

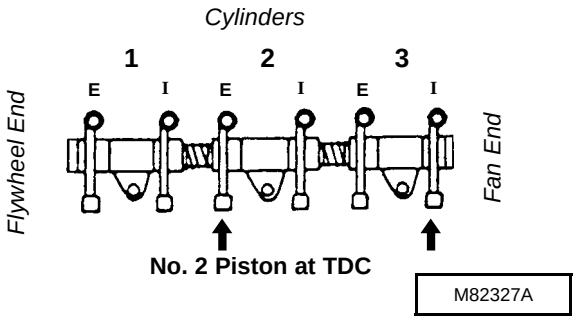


To adjust valves, loosen nut and turn adjusting screw until clearance is **0.20 mm (0.008 in.)**. Hold screw while tightening nut.



6. Turn crankshaft pulley one revolution (360°). This puts the piston in No. 2 cylinder at TDC compression stroke.

7. Measure and adjust valve clearance on the valves (arrows) with No. 2 piston at TDC.



CONNECTING ROD SIDE PLAY CHECK

Reason:

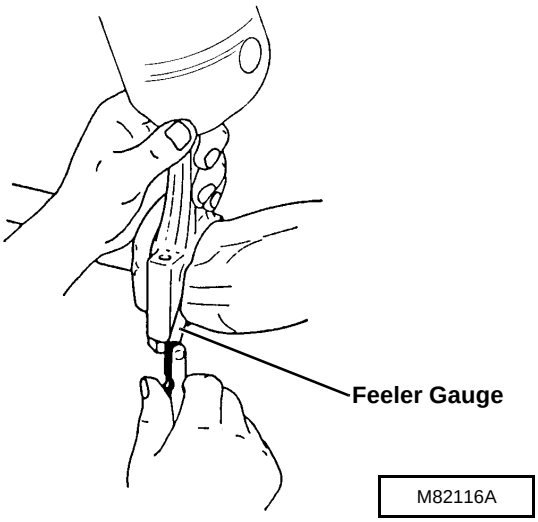
To determine proper side clearance between crankshaft and connecting rod.

Equipment:

- Feeler Gauge

Procedure:

1. Insert a feeler gauge, according to specifications, between connecting rod cap and crankshaft.



Specifications:

Standard Clearance . . . . . 0.20—0.40 mm (0.0079—0.0157 in.)

Results:

- If side play exceeds specification, replace connecting rod and connecting rod cap.

CONNECTING ROD BEARING CLEARANCE CHECK

Reason:

To measure oil clearance between connecting rod bearing and crankshaft journal.

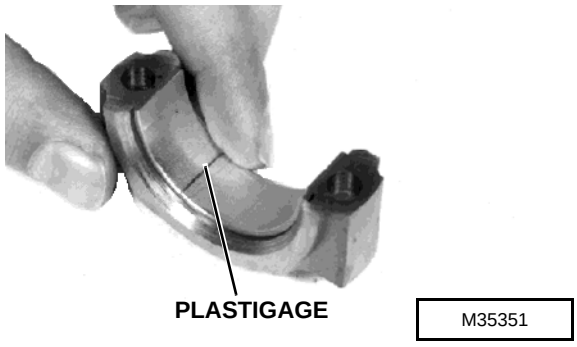
Equipment:

- PLASTIGAGE®

Procedure:

IMPORTANT: Connecting rod caps must be installed on the same connecting rod and in the same direction to prevent crankshaft and connecting rod damage.

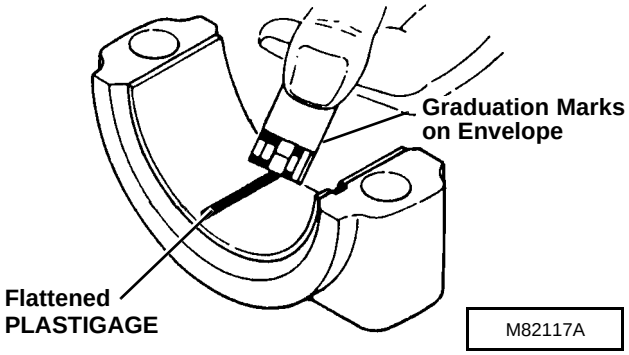
1. Remove connecting rod cap.
2. Wipe oil from bearing insert and crankshaft journal.
3. Put a piece of PLASTIGAGE, or an equivalent, along the full length of the bearing insert approximately 6 mm (0.250 in.) off center.



4. Turn crankshaft approximately 30° from bottom dead center.
5. Install connecting rod end cap and original cap screws. Tighten cap screws to **23 N•m (203 lb-in.)**.
6. Remove cap screws and connecting rod cap.

NOTE: The flattened PLASTIGAGE will be found on either the bearing insert or crankshaft journal.

7. Use the graduation marks on the envelope to compare the width of the flattened PLASTIGAGE at its widest point.
8. Determine bearing clearance. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used.
9. Remove PLASTIGAGE.



Specifications:

Standard Clearance . . . . . 0.033—0.059 mm (0.0013—0.0023 in.)

Results:

- If clearance exceeds specification, replace bearing inserts.

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CRANKSHAFT, END PLAY CHECK

Reason:

To determine proper side clearance between crankshaft and engine block.

Equipment:

- Dial Indicator

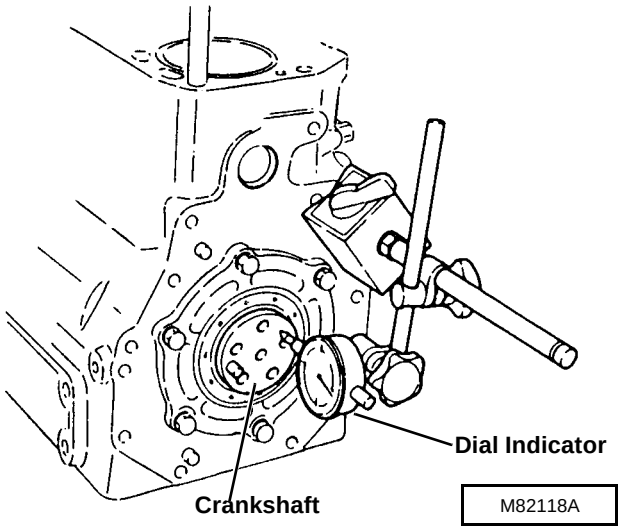
Procedure:

NOTE: Crankshaft end play can be measured at front end or rear end of crankshaft. Procedure is performed from the rear end. The flywheel is removed to show detail.

1. Fasten dial indicator to engine and position indicator tip on end of crankshaft.

IMPORTANT: Do not use excessive force when moving crankshaft to avoid damaging bearings.

2. Push crankshaft toward rear as far as possible.
3. Zero the dial indicator.
4. Using a bar, gently pry the crankshaft as far forward as possible.



Specifications:

Standard Clearance . . . . . 0.090—0.271 mm (0.004—0.011 in.)

Results:

- If end play exceeds specification, replace thrust bearings.

CRANKSHAFT MAIN BEARING, CLEARANCE CHECK

Reason:

To measure oil clearance between main bearing and crankshaft journal.

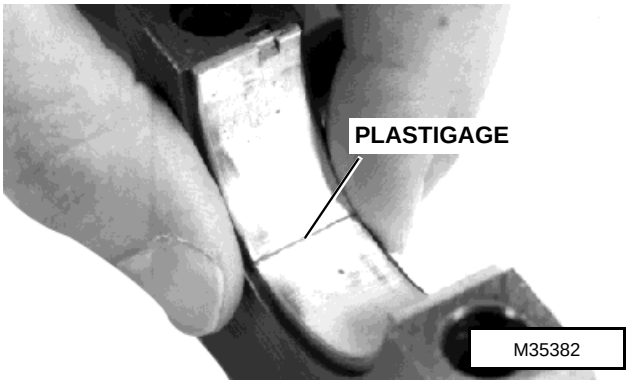
Equipment:

- PLASTIGAGE®

Procedure:

IMPORTANT: Main bearing caps must be installed on the same main bearing and in the same direction to prevent crankshaft and main bearing damage.

1. Remove main bearing cap.
2. Wipe oil from bearing insert and crankshaft journal.
3. Put a piece of PLASTIGAGE, or an equivalent, along the full length of the bearing insert approximately 6 mm (0.250 in.) off center.



4. Install main bearing cap and cap screws. Tighten cap screws to **54 N•m (40 lb-ft)**.
5. Remove cap screws and main bearing cap.

NOTE: The flattened PLASTIGAGE will be found on either the bearing insert or crankshaft journal.

6. Use the graduation marks on the envelope to compare the width of the flattened PLASTIGAGE at its widest point.
7. Determine main bearing clearance. The number within the graduation marks indicates the bearing clearance in inches or millimeters depending on which side of the envelope is used.
8. Remove PLASTIGAGE.

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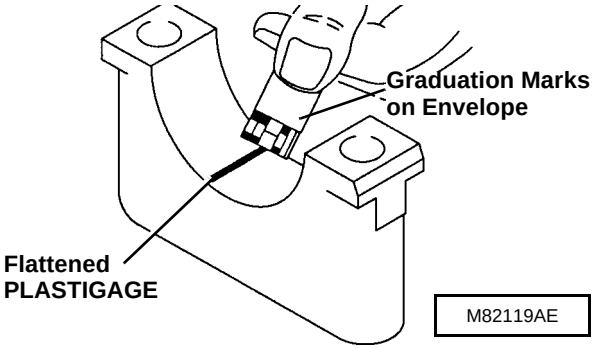


Specifications:

Standard Clearance . . . . . 0.033—0.059 mm (0.0013—0.0023 in.)

Results:

- If clearance exceeds specification, replace bearing inserts.

VALVE LIFT CHECK

Reason:

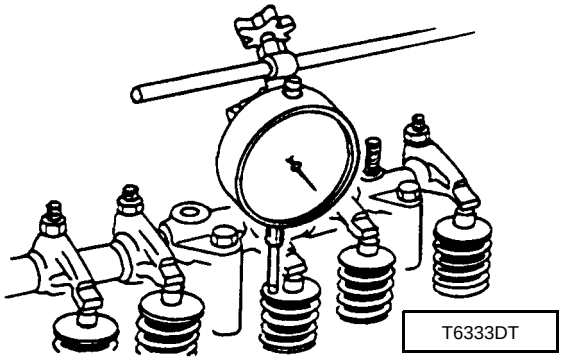
Can indicate excessive wear on cam lobes, followers, and/or push rods.

Equipment:

- Dial Indicator

Procedure:

1. Adjust valve clearance. (See procedure in this section.)
2. Fasten dial indicator to engine and position indicator tip on valve retainer. Valve must be fully closed and rocker arm must move freely.
3. Zero the dial indicator.
4. Manually turn crankshaft pulley clockwise (from fan end).



5. Observe dial indicator as valve is moved to the full open position. Valve lift (intake and exhaust) should be **7.5 mm (0.300 in.).**

Repeat for each valve.

Results:

- If valve lift is less than specification, remove and inspect camshaft, followers and push rods.

CAMSHAFT END PLAY CHECK

Reason:

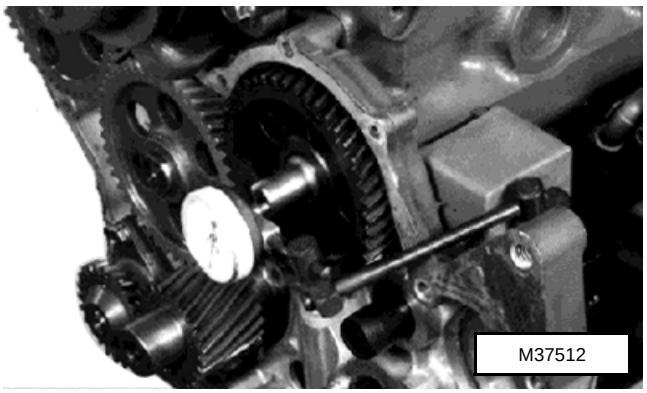
To determine proper side clearance between camshaft gear end journal and thrust plate.

Equipment:

- Dial Indicator

Procedure:

1. Remove timing gear cover. (See procedure in this section.)
2. Fasten dial indicator to engine and position indicator tip on end of camshaft.
3. Push camshaft toward the rear as far as possible.
4. Zero the dial indicator.
5. Pull camshaft forward as far as possible.



Specifications:

Standard Clearance . . . . . 0.05—0.25 mm (0.0020—0.0098 in.)

Wear Limit . . . . . 0.40 mm (0.016 in.)

Results:

If end play exceeds wear limit, remove camshaft and replace thrust plate. (See procedure in this section.)

TIMING GEAR BACKLASH, CHECK

Reason:

To check for wear between meshing gears, resulting in excessive noise and poor engine performance.

Equipment:

- Dial Indicator

Procedure:

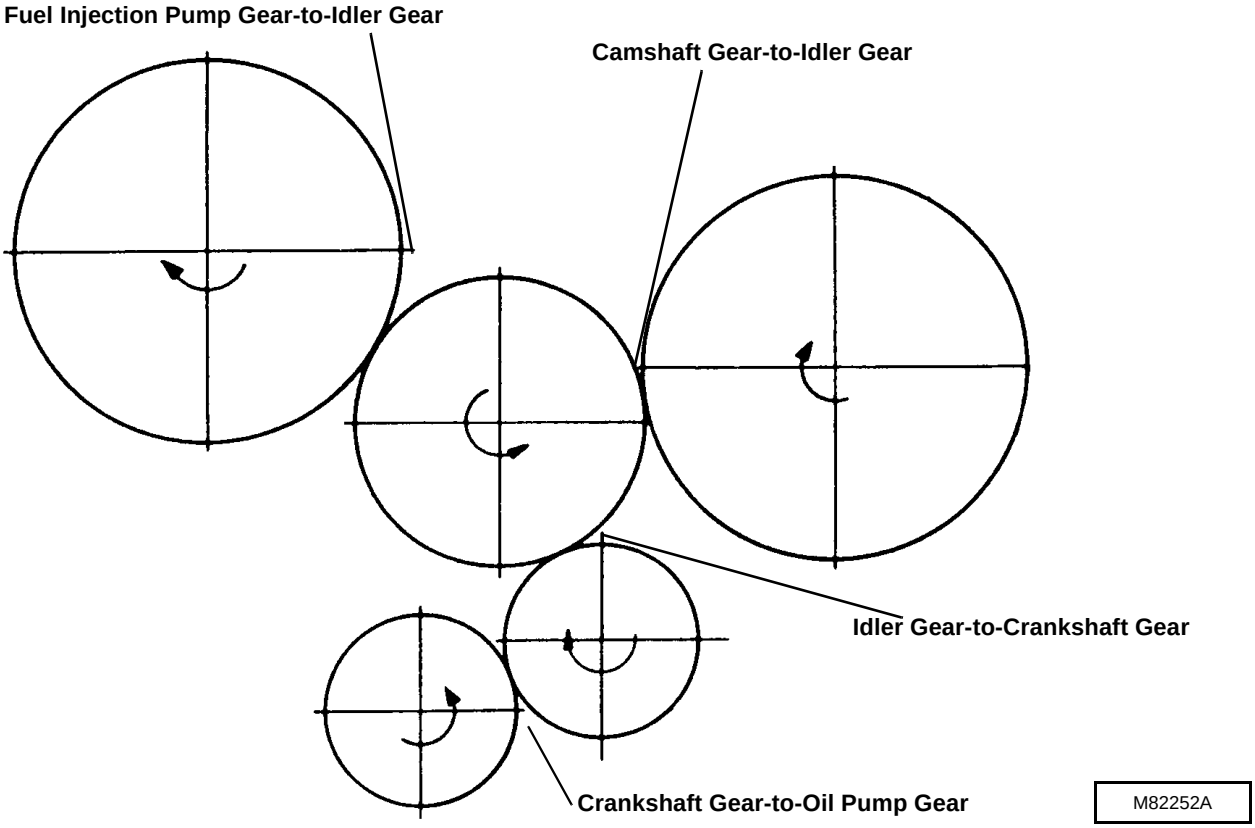
1. Measure backlash between meshing gears.

Specifications:

Standard Backlash . . . . . 0.04—0.12 mm (0.0016—0.0047 in.)

Results:

- If backlash exceeds specification, replace meshing gears as a set.



FUEL INJECTION NOZZLE TEST (PINTLE-TYPE)

c CAUTION y

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 knowledgable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

Reason:

To determine opening pressure, leakage, chatter and spray pattern of the fuel injection nozzle.

Equipment:

- D01109AA Diesel Fuel Injection Nozzle Tester
- D01110AA Adapter Set
- 23622 Straight Adapter
- Container

Connections:

1. Connect fuel injection nozzle to D01109AA Diesel Fuel Injection Nozzle Tester using parts from D01110AA Adapter Set and 23622 Straight Adapter.

IMPORTANT: Use clean filtered diesel fuel when testing injection nozzles to get best test results.

Procedure 1:

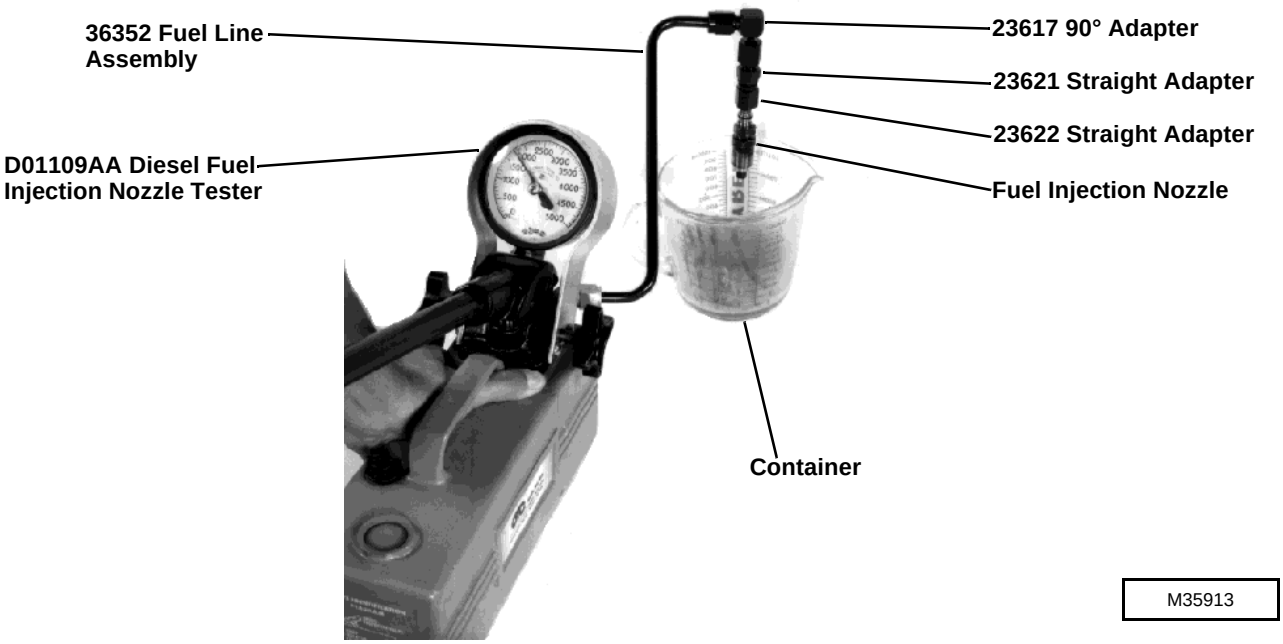
Test fuel injection nozzle **opening pressure** following the Nozzle Tester manufacturer's instructions.

Specifications:

Opening Pressure . . . . . 11722 ± 480 kPa (1700 ± 70 psi)

Results:

- If pressure reading does not meet specification, disassemble injection nozzle and inspect nozzle assembly for contamination or stuck valve. If necessary, add or remove shims to change opening pressure.



Procedure 2:

Test fuel injection nozzle **leakage** following the Nozzle Tester manufacturer's instructions.

1. Dry nozzle completely using a lint-free cloth.
2. Pressurize nozzle to **11032 kPa (1600 psi)**.
3. Watch for leakage from nozzle spray orifice. Leakage time should be a **minimum of 10 seconds**.

Results:

- If leakage time does not meet specification, disassemble injection nozzle and inspect nozzle assembly for contamination. Inspect valve seating surface. Replace nozzle assembly if necessary.

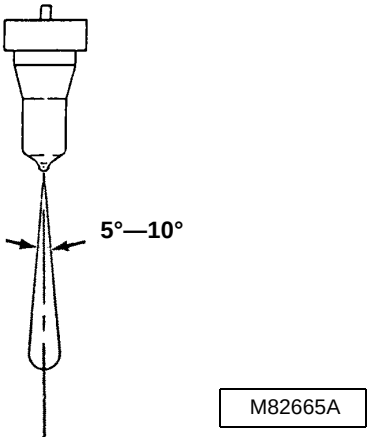
Procedure 3:

Test fuel injection nozzle **chatter and spray pattern** following the Nozzle Tester manufacturer's instructions.

1. Pressurize nozzle to **1722 ± 480 kPa (1700 ± 70 psi)**.
2. Listen for “chatter” sound and watch spray pattern.

Specifications:

Slow Hand
Lever Movement . . . . . Chatter Sound
Slow Hand
Lever Movement . . . . . Fine Stream Spray Pattern
Fast Hand
Lever Movement . . . . . Fine Atomized Spray Pattern



Results:

- If nozzle chatter or spray pattern does not meet specifications, disassemble injection nozzle and inspect nozzle assembly for contamination. Inspect valve seating surface. Replace nozzle assembly if necessary.
- If there is excessive difference in spray angle or injection angle, incomplete atomization or sluggish starting/stopping of injection, disassemble injection nozzle and inspect nozzle assembly for contamination. Replace nozzle assembly if necessary.

THERMOSTAT OPENING TEST

Reason:

To determine opening temperature of thermostat.

Equipment:

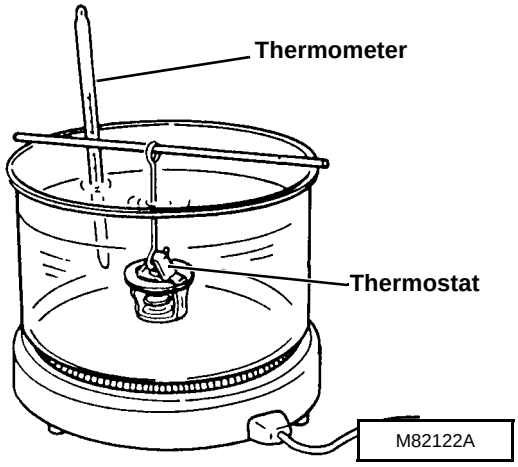
- Thermometer
- Glass Container
- Heating Unit

Procedure:

C CAUTION

DO NOT allow thermostat or thermometer to rest against the side or bottom of 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 thermometer and compare temperatures with specifications.
3. Remove thermostat and observe its closing action as it cools.



Specifications:

Begin Opening . . . . . 71° C (160° F)

Fully Open. . . . . 85° C (184° F)

Minimum Lift Height. . . . . 8 mm (0.310 in.)

Results:

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

COOLANT TEMPERATURE SWITCH TEST

Reason:

To determine operating temperature of switch.

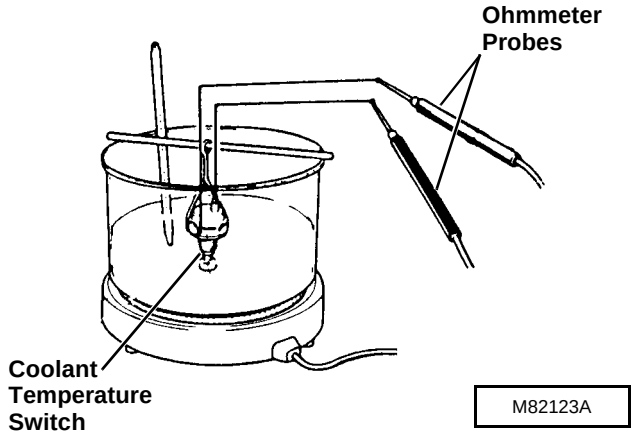
Equipment:

- Thermometer
- Glass Container
- Heating Unit
- Ohmmeter

Procedure:

> **C CAUTION**
>
> **DO NOT allow thermostat or thermometer to rest against the side or bottom of glass container when heating water. Either may rupture if overheated.**

1. Connect lead wires from ohmmeter probes, to switch terminal and body.
2. Suspend switch and a thermometer in a container of water.
3. Heat and stir the water. Observe water temperature when continuity occurs. Water temperature should be **107—113° C (225—235°F)**.



Results:

- If continuity does not occur within temperature listed, replace switch.

INJECTION PUMP STATIC TIMING ADJUSTMENT

Reason:

To make sure that injection pump timing is set to manufacturers specification.

Equipment:

- DFMX1A Timing Tool (No. 1 fuel injection line cut off at first bend)
- External fuel supply

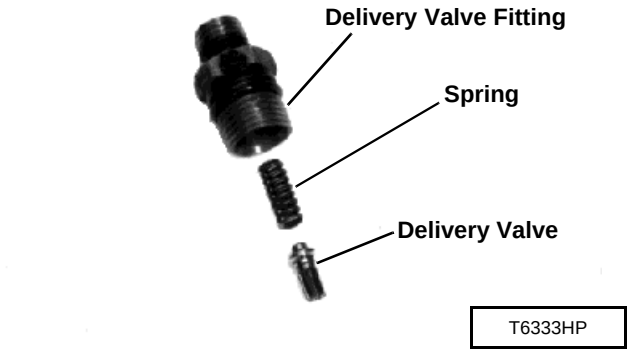
Procedure:

IMPORTANT: Injection pump timing should be correct. Once timing is set, it will not normally change during the life of the engine, unless it was altered.

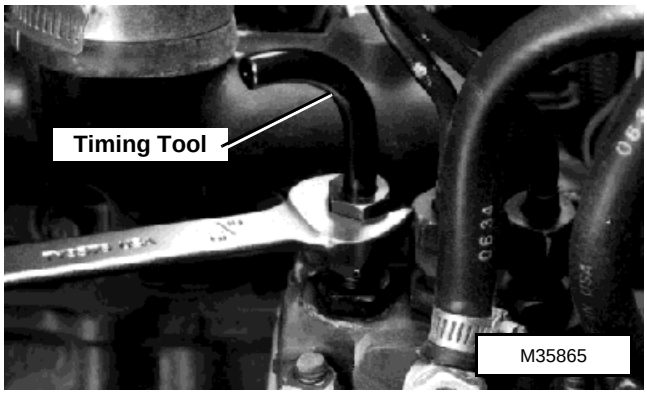
Check and adjust timing only as the last option. Check fuel, fuel supply system, injectors, air intake system and cylinder compression before continuing.

NOTE: The flywheel turns counterclockwise (as viewed from the flywheel end). The number one fuel injection line is toward the flywheel.

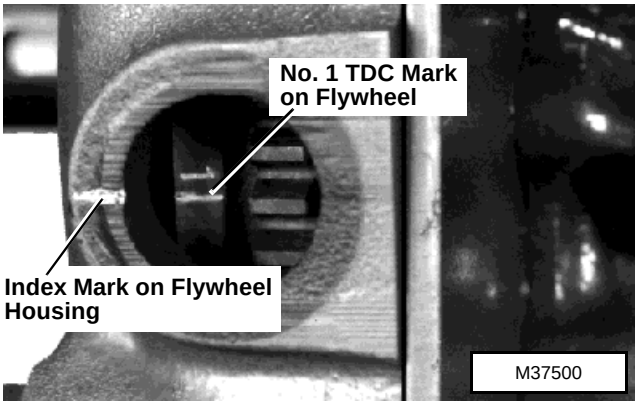
1. Remove the number one fuel injection line and delivery valve fitting.
2. Remove spring and delivery valve. Do not remove delivery valve seat.
3. Install delivery valve fitting and tighten to **51 N•m (38 lb-ft)**.



4. Install DFMX1A Timing Tool.



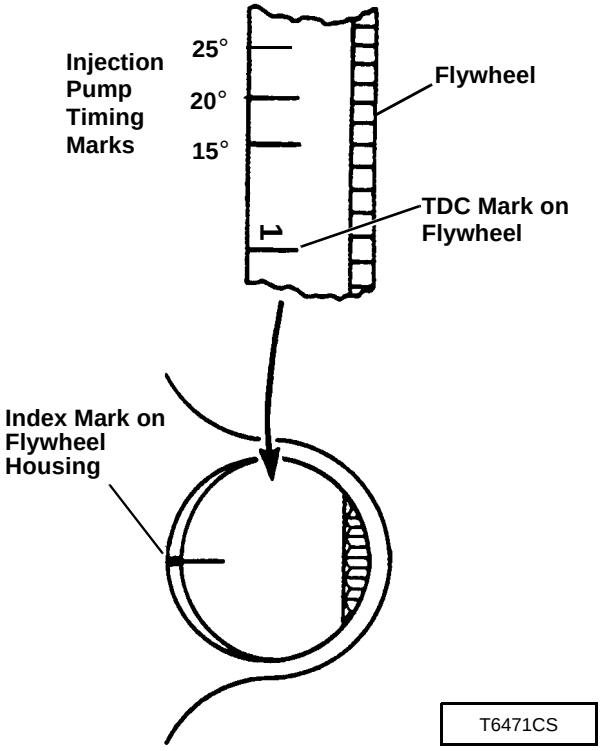
5. Remove glow plugs to aid turning crankshaft pulley.
6. Remove plug from flywheel housing.
7. Turn crankshaft pulley in either direction until the No. 1 cylinder top dead center (TDC) mark aligns with the index mark on the flywheel housing.



8. Put a container under Timing Tool to collect any fuel.
9. Turn key switch to ON position. DO NOT start engine.
10. Turn flywheel clockwise (as viewed from the flywheel end) until fuel flows in a stream.
11. Slowly turn flywheel counterclockwise until fuel flow changes from a stream and then stops completely. This is the point of injection timing at which the pump is set.

NOTE: If the fuel flow does not stop, the number one piston is on the exhaust stroke instead of the compression stroke. Turn flywheel one revolution and repeat Steps 7—11.

12. Check timing mark on flywheel. The index mark must line up with the 14° mark on flywheel.



Specifications:

Injection Pump Timing . . . . . .14° BTDC (Before Top Dead Center)

Engine Crankshaft Position . . . . . No.1 Cylinder on TDC Compression Stroke

Distance On Outer Surface Of Flywheel Per 1° Of Rotation . . . . . 2.62 mm (0.100 in.)

Results:

- If timing is not according to specifications:
- Remove injection pump and shims. (See procedure in this section.)
- Install new shim(s) with a total shim pack thickness of **0.5 mm (0.020 in.)**.
- Install injection pump and recheck timing.

- If engine performance is poor, check air cleaners, fuel filter, fuel supply, injectors and cylinder compression before removing pump for service. Check all timing gears for wear. Retest performance.
- If performance did not change, have pump tested by a diesel injection service. When reinstalling injection pump, use same thickness of shim pack removed. If shim pack thickness is unknown or new pump is installed, replace with **0.5 mm (0.020 in.)** shim pack thickness.
- If timing is OK:
- Install rubber plug in flywheel housing.
- Remove Timing Tool.
- Remove delivery valve fitting.
- Install delivery valve and spring.
- Install new o-ring and delivery valve fitting. Tighten to **51 N•m (38 lb-ft)**.
- Install number one injection line.

FAN/ALTERNATOR DRIVE BELT ADJUSTMENT

Reason:

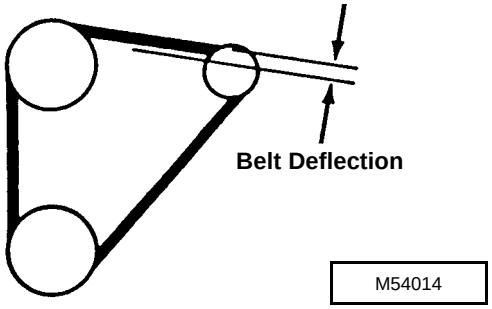
To keep proper tension on belt to drive water pump and alternator. To prevent shortened belt and bearing life.

Equipment:

- JDG529 or JDST28 Belt Tension Gauge
- Straight Edge

Procedure:

1. Check belt tension between fan and alternator using Belt Tension Gauge and a straight edge.



Specifications:

Applied Force . . . . . 98 N (22 lb-force)
Deflection . . . . . 10—15 mm (0.400—0.600 in.)

Results:

- If deflection is not within specifications:
- Loosen both alternator mounting cap screws/nuts.
- Apply force to FRONT alternator housing only (near the belt) until tension is correct.
- Tighten cap screws/nuts.

RADIATOR, BUBBLE TEST

Reason:

To determine if compression pressure is leaking from cylinder.

Equipment:

- JDG472 Adapter

Procedure:

1. With coolant at proper level and radiator cap tight, run engine for 5 minutes to bring to operating temperature.
2. Remove cap from recovery tank.
3. Check for bubbles coming from overflow hose at bottom of tank.

If bubbles are present, isolate source of compression leak:

- Remove injection nozzles.
- Install JDG472 Adapter in injection port of cylinder to be tested.
- Move piston to bottom of stroke with intake and exhaust valves closed.
- Connect hose from compressed air source to adapter.
- Apply **2448 kPa (355 psi)** maximum air pressure into cylinder.
- Check for bubbles in recovery tank or air escaping from muffler, air cleaner or oil fill opening.
- Repeat for each cylinder.

Results:

- If bubbles are present, check for cracks in cylinder head and block. Check for damaged head gasket.
- If air escapes from muffler, check for worn exhaust valve.
- If air escapes from air cleaner, check for worn intake valve.
- If air escapes from engine oil fill, check for worn piston rings.

COOLING SYSTEM, PRESSURE TEST

Reason:

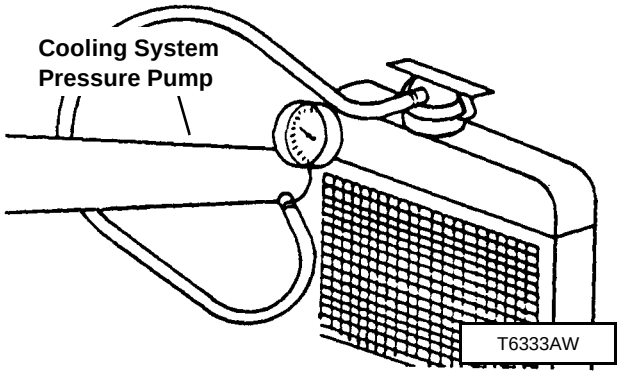
Inspect cooling system for leaks.

Equipment:

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

Procedure:

1. Remove cap and attach pressure pump to radiator.
2. Apply **117 kPa (17 psi) maximum pressure** to cooling system.
3. Check for leaks throughout cooling system.



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 *RADIATOR BUBBLE TEST*.

RADIATOR CAP, PRESSURE TEST

Reason:

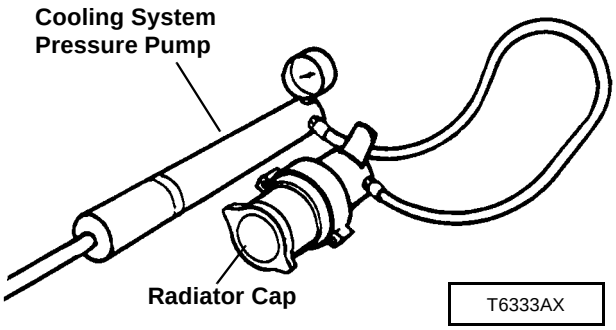
Test radiator cap for operating in correct pressure range.

Equipment:

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

Procedure:

1. Install radiator cap on pressure pump.
2. Apply pressure. Pressure valve in cap should open at **90 kPa (13 psi)**.



Results:

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

CYLINDER, COMPRESSION PRESSURE TEST

Reason:

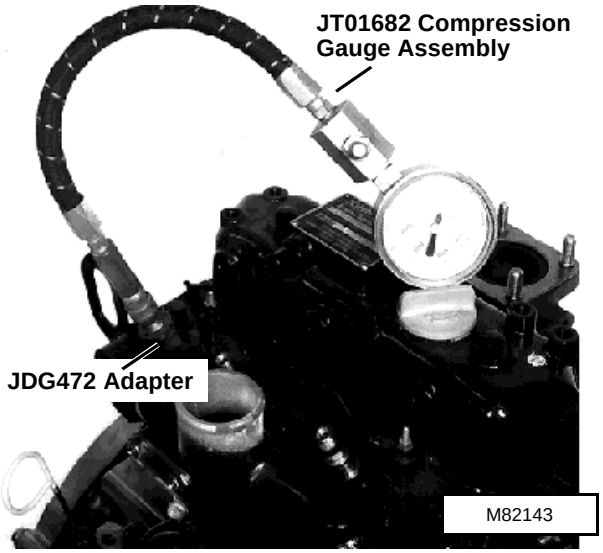
To determine the condition of the pistons, rings, cylinder walls and valves.

Equipment:

- JT01682 Compression Gauge Assembly
- JDG472 Adapter

Procedure:

1. Run engine for 5 minutes to bring to operating temperature. Shut off engine.
2. Remove injection nozzles. (See procedure in this section.)
3. Install Adapter and Compression Gauge Assembly in injector port.
4. Disconnect fuel shut-off solenoid connector.
5. Crank engine for three seconds with starter.
6. Record pressure reading for each cylinder.



Specifications:

Compression Pressure . . . . . 3233 kPa (469 psi)

Maximum Difference Between Cylinders . . . . . 241 kPa (35 psi)

NOTE: Pressure listed is for 300 m (1000 ft) above sea level. For naturally aspirated engines, reduce specification an additional 4% for each 300 m (1000 ft) of altitude.

Results:

- If pressure reading is below specification, squirt approximately two teaspoons of clean engine oil into cylinders through injector ports and repeat test.
- If pressure increases significantly, check piston, rings and cylinder walls for wear or damage.
- If pressure does not increase significantly after retest, check for leaking valves, valve seats or cylinder head gasket.

ENGINE OIL PRESSURE TEST

Reason:

To determine if engine bearings or lubrication system components are worn.

Equipment:

- JT03017 Hose Assembly
- JT05577 Pressure Gauge (100 psi)
- JT03349 Connector

Procedure:

1. Remove oil pressure sender.
2. Install Connector.
3. Connect Hose Assembly and Pressure Gauge.

IMPORTANT: Do not run if no pressure present.

4. Start engine. If pressure reading is below 69 kPa (10 psi), STOP ENGINE.
5. Run engine approximately five minutes to heat oil, then check oil pressure at fast and/or slow idle.

Specifications

Idle Speed
Fast . . . . . 2975 ± 75 rpm
Slow . . . . . 1400 ± 75 rpm
Engine Oil Pressure . . . . . .294—392 kPa (43—57 psi)

Results:

- If oil pressure is not within specifications, inspect oil pressure regulating valve parts for wear or damage. Add or remove shims as necessary. (See procedure in this section.)
- If oil pressure does not increase, see “Engine Has Low Oil Pressure” in TROUBLESHOOTING.

AIR INTAKE SYSTEM LEAKAGE TEST

Reason:

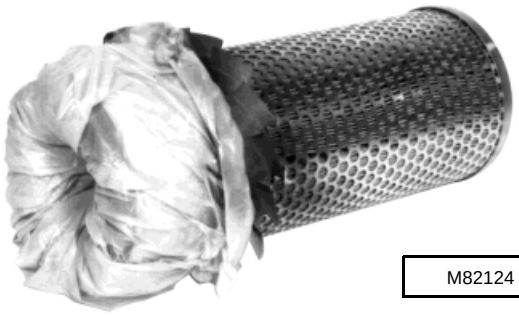
Check for leaks in air intake system.

Equipment:

- Air Pressure Regulator

Procedure:

1. Remove air cleaner restriction indicator and install test fitting.
2. Connect air pressure regulator to manifold using hose and fitting from air cleaner.
3. Remove air cleaner cover and main filter element.
4. Put large plastic bag into and over end of main filter element. Install main filter element and cover.
5. Pressurize air intake system between **34—69 kPa (5 - 10 psi)**. If air intake system cannot be pressurized, turn engine slightly to close valves.
6. Spray soap solution over all connections from air cleaner to intake manifold and check for leaks.



M82124

Results:

- Find leaks and repair or replace parts as necessary.

FUEL SUPPLY PUMP PRESSURE TEST

Reason:

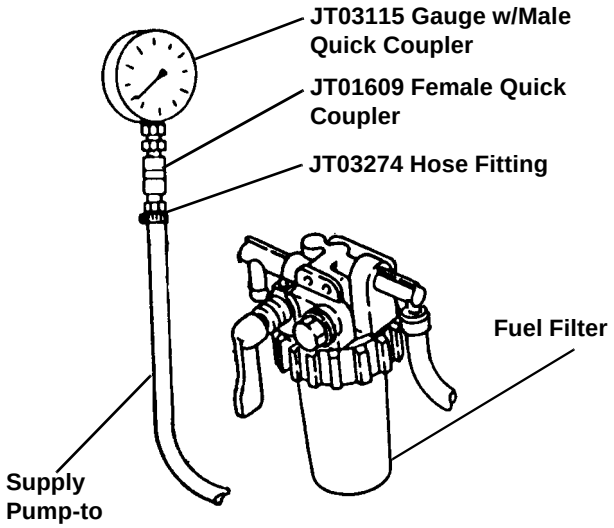
To determine supply pump operating pressure.

Equipment:

- JT03274 Hose Fitting
- JT01609 Female Quick Coupler
- JT03115 Gauge w/Male Quick Coupler (0—150 psi)

Procedure:

1. Disconnect supply pump-to-filter hose.
2. Install Hose Fitting, Coupler and Gauge.
3. Disconnect wire connector to fuel shutoff solenoid.
4. Crank engine using the starter. Do not run starter for more than 10 seconds at a time. Gauge should read more than **29 kPa (4.3 psi)**.



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Results:

- If pressure is below specification, replace fuel supply pump.

FUEL DRAIN BACK TEST

Reason:

Determines if air is entering the fuel system at connections, allowing fuel to siphon back to tank.

Procedure:

1. Disconnect fuel supply line and return line at fuel tanks.

IMPORTANT: Fuel return line MUST extend below fuel level in fuel tank before performing this test. Fill fuel tanks if necessary.

2. Drain all fuel from the system, including fuel supply pump, injection pump and filter.

3. Plug end of fuel return hose.

4. Pressurize fuel system at fuel supply line, to a maximum pressure of **103 kPa (15 psi).**

5. Apply liquid soap and water solution to all joints and connections in the fuel system and inspect for leaks.

Results:

- Find leaks and repair or replace parts as necessary.

BLEED FUEL SYSTEM

Reason:

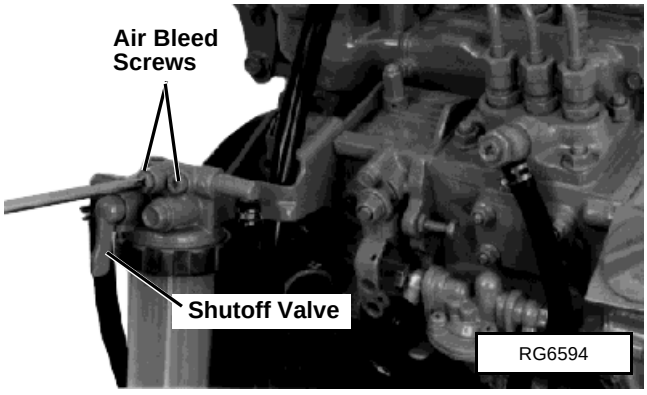
Any time the fuel system has been opened up for service (lines disconnected or filter removed), it will be necessary to bleed air from the system.

Procedure:

IMPORTANT: Modification or alteration of the injection pump, pump timing, or the injection nozzles in any way not approved by the manufacturer will terminate the warranty obligation.

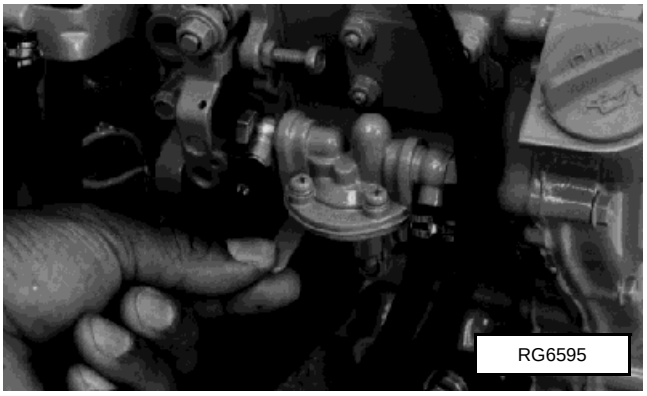
1. Turn fuel filter shutoff valve to “OPEN” position.

2. Loosen both air bleed screws on fuel filter base.



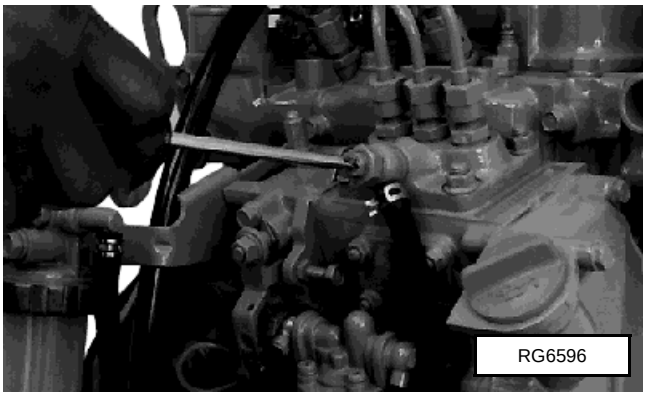
3. Turn ignition switch to “ON” position.

4. Operate hand primer lever of fuel supply pump until fuel flows free of air bubbles. Tighten bleed screws.



5. Loosen bleed screw on injection pump. Operate hand primer and tighten bleed screw when fuel flows free of air bubbles.

6. Start engine. If engine does not start after several attempts, proceed with steps 7 through 10.

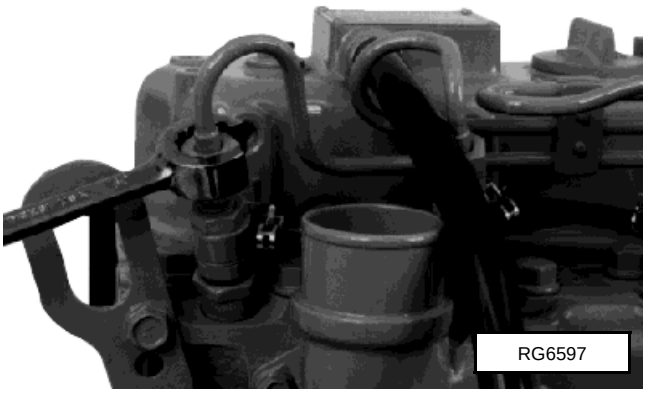


7. Loosen all three injector line nuts using a 17 mm wrench. Be sure not to loosen bottom nut of injector.

8. Crank engine over with starter.

9. When fuel appears at injectors, tighten line nuts.

10. Start engine. If engine does not start, repeat bleed procedure.



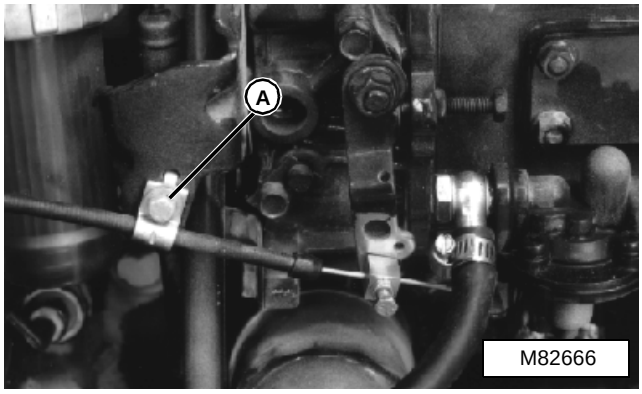
THROTTLE CABLE ADJUSTMENT

Reason:

To insure that the throttle lever cable moves the governor lever completely to slow and fast idle positions.

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 parking brake.
6. Raise hood.
7. Loosen throttle cable clamp (A).



8. Move throttle lever toward fast idle position until throttle lever is **2—3 mm (0.080—0.120 in.) away from frame slot**.
9. Hold throttle control lever against fast idle stop. Pull throttle cable tight. Tighten cable clamp.
10. Move throttle lever through full range. Check to be governor control lever moves through complete range and linkage is not binding.

SLOW IDLE ADJUSTMENT

Reason:

To achieve proper slow idle rpm setting. Provides adequate rpm to keep engine running smoothly without stalling.

Equipment:

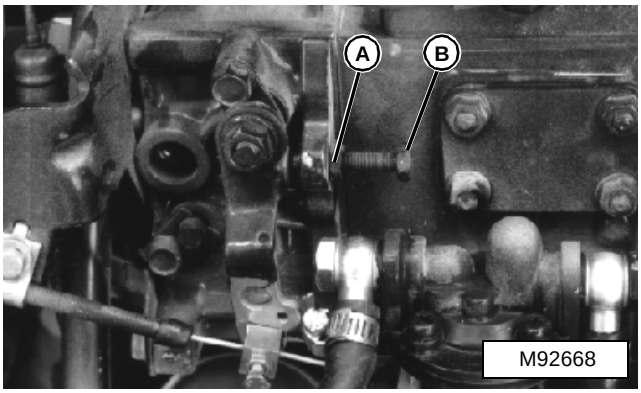
- JT05719 Hand Held Digital Tachometer.

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Place travel pedals in NEUTRAL.
5. Engage parking brake.
6. Start engine and run for five minutes.
7. Raise hood.
8. Place throttle control lever in slow idle position.
9. Use JT05719 Hand Held Tachometer to check engine speed at crankshaft pulley.
10. Visually check that the injection pump throttle lever is against the slow idle stop screw. Check slow idle speed, slow idle speed should be **1400 ± 75 rpm**.
11. After slow idle speed adjustment, adjust throttle cable.

Results:

- If slow idle rpm is not according to specifications, loosen nut (A) and turn screw (B). After adjustment, tighten nut.



FAST IDLE ADJUSTMENT

Reason:

To achieve proper fast idle speed setting. This insures that the engine is running at proper rpm's for peak performance.

Equipment:

- JT05719 Hand Held Digital Tachometer.

Procedure:

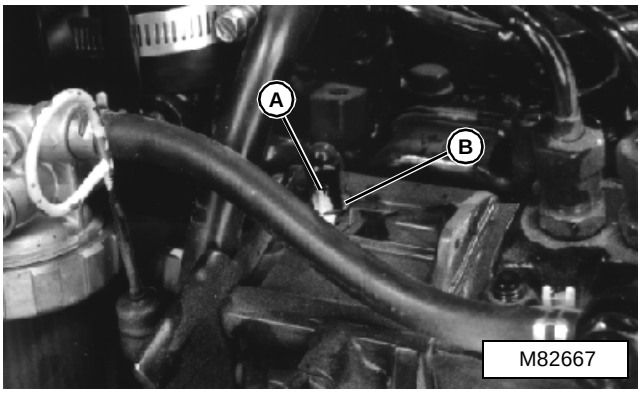
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Place travel pedals in NEUTRAL.
5. Engage parking brake.
6. Start engine and run for five minutes.
7. Raise hood.
8. Place throttle control lever in fast idle position.
9. Use JT05719 Hand Held Tachometer to check engine speed at crankshaft pulley.
10. Push against injection pump throttle lever to insure it is against the fast idle stop screw. Check fast idle speed, fast idle speed should be **2975 ± 75 rpm**.
11. After fast idle speed adjustment, adjust throttle cable.

Results:

- If fast idle rpm is not according to specifications, remove cap nut (A), loosen nut (B) and turn screw. After adjustment, tighten nut and install cap nut.

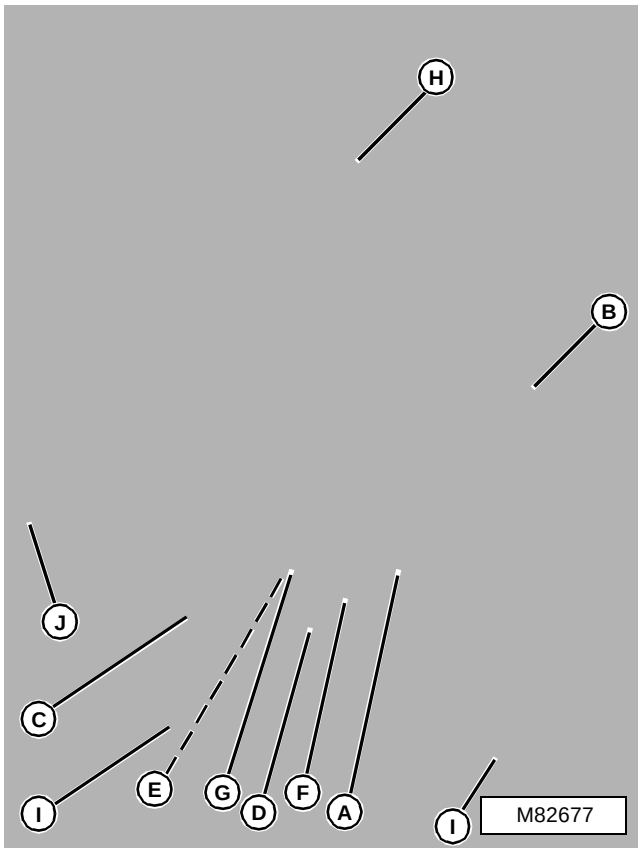
NOTE: Make sure air cleaner is clean and not restricted. Replace air cleaner element as necessary.

- If engine still does not meet fast idle speed specifications after adjustment, have pump inspected by a diesel injection service.



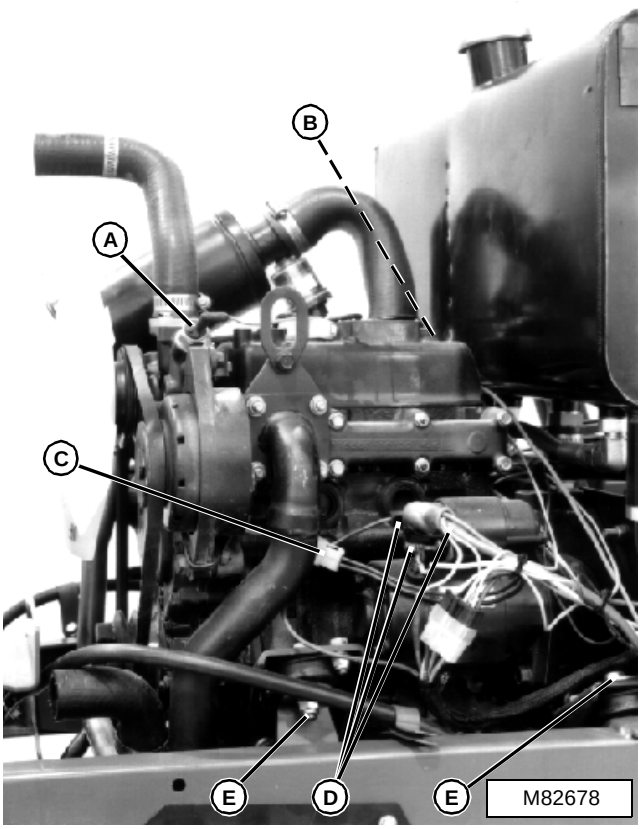
ENGINE—REMOVAL/INSTALLATION

1. Remove radiator. (See procedure in this section.)
2. Remove seat. (See procedure in MISCELLANEOUS section.)
3. Close fuel shut-off valves located on bottom of each fuel tank.
4. On left-hand side of engine, label and disconnect the following:
   - Fuel supply hose (A)
   - Fuel return hose (B)
   - Wire leads from engine ground connection (C)
   - Oil pressure sending unit wire lead (D)
   - Fuel shutoff solenoid wire connector (E)
5. Loosen throttle cable lock screw (F) and clamp (G). Move throttle cable away from engine.
6. Remove air cleaner and hose (H).
7. Remove mounting bracket (J) from both sides of machine.
8. Remove engine mount cap screws and flat washers (I).



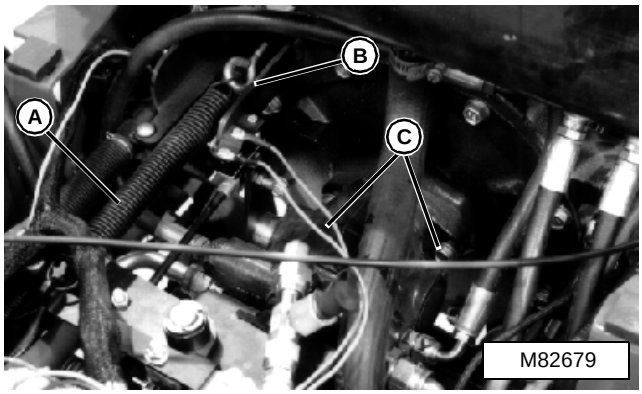
A— Fuel Supply Hose
B— Fuel Return Hose
C— Wire Leads, Engine Ground Connection
D— Oil Pressure Sending Unit Wire Lead
E— Fuel Shutoff Solenoid Wire Connector
F— Throttle Cable Lock Screw
G— Throttle Cable Clamp
H— Air Cleaner and Hose
I— Cap Screws and Flat Washers
J— Mounting Bracket

9. On right-hand side of engine, label and disconnect the following:
   - Coolant temperature switch wire lead (A)
   - Glow plug wire lead (B)
   - Alternator wire harness (C)
   - Starter Connections (D)
10. Remove engine mount cap screws and flat washers (E).



A— Coolant Temperature Switch Wire Lead
B— Glow Plug Wire Lead
C— Alternator Wire Harness
D— Starter Wire Leads
E— Cap Screws and Flat Washers

11. Connect a hoist to lifting eyes on engine.
12. Support hydraulic and hydrostatic pumps using wood blocks or a hoist.
13. Remove spring (A).
14. Remove two cap screws and bracket (B).
15. Remove two cap screws (C).



16. Separate engine from hydrostatic pump and remove engine.
17. Inspect rubber isolators on engine mounts for wear or damage. Replace as necessary.

Installation is done in the reverse order of removal.

- To prevent possible damage to flex coupler on flywheel, use caution when installing engine.
- Tighten engine mount cap screws securely. Do not compress rubber mounts.
- Bleed fuel system.
- Adjust throttle cable.

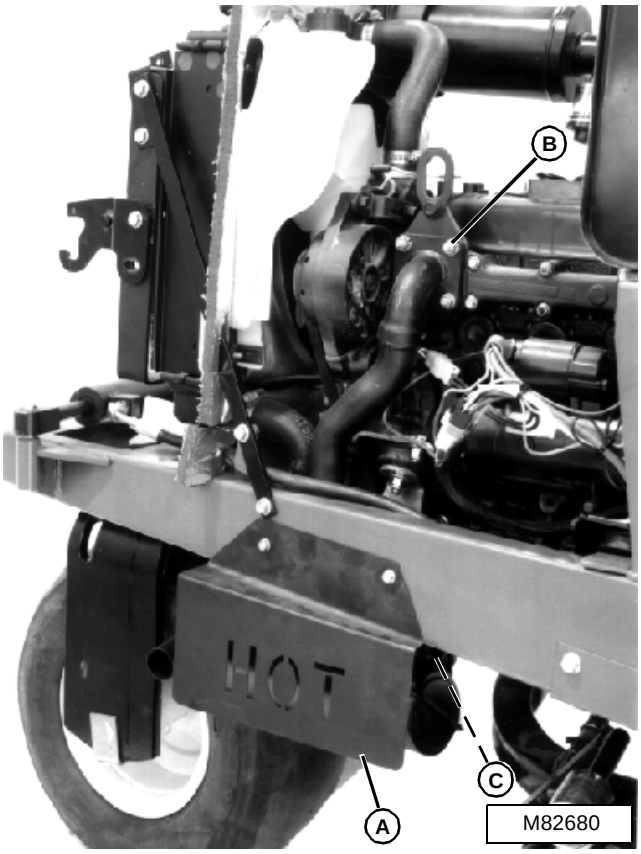
MUFFLER

Removal/Installation

C CAUTION

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

1. Remove heat shield (A).
2. Remove four nuts (B).
3. Remove two cap screws (C).
4. Remove muffler and gasket.



Installation is done in the reverse order of removal.

- Install new gasket on exhaust manifold with metal side of gasket facing out.

RADIATOR

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.
6. Disconnect battery negative (-) cable.
7. Remove hood.
8. Remove auxiliary hydraulic oil cooler, if equipped. (See procedure in HYDRAULICS section.)

c CAUTION U

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.

9. Drain coolant from radiator. Capacity is approximately 4 L (4.2 U.S. qt).
10. Remove upper and lower radiator hoses.
11. Pull hose (B) from recovery tank (C). Remove screw (A) and recovery tank.
12. Remove screw (D).
13. Remove three cap screws and brace (E).

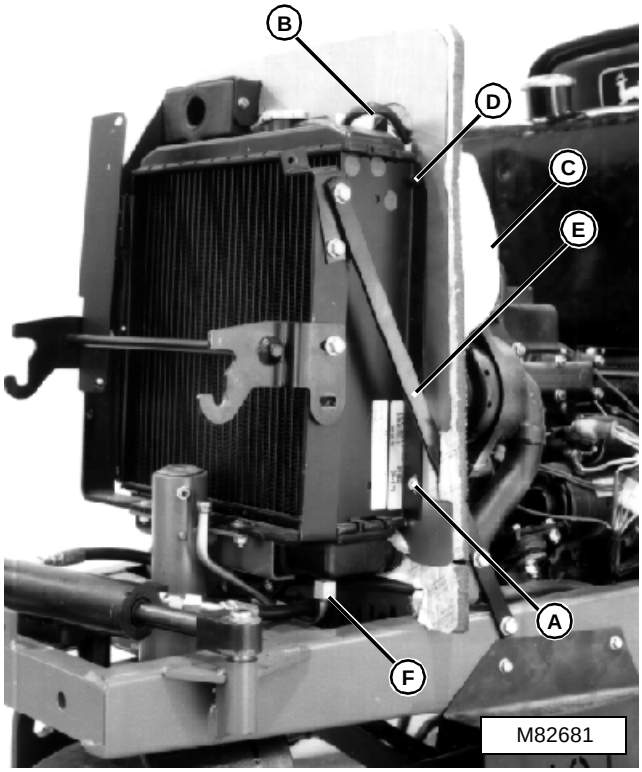
c CAUTION y

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 may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

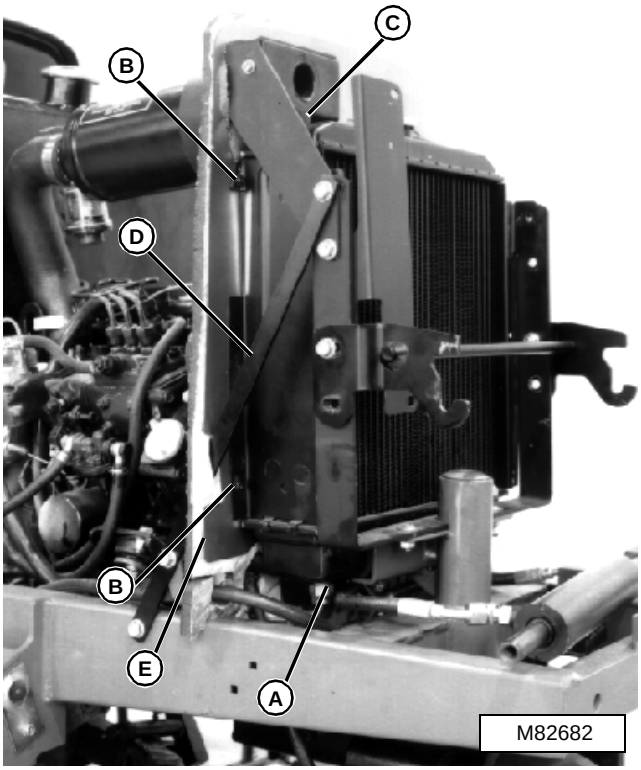
NOTE: If machine is equipped with an auxiliary hydraulic oil cooler, a steel tube is used in place of hose to connect cooler to radiator.

14. Disconnect hose or tube (F), if equipped.



A— Screw
B— Hose
C— Recovery Tank
D— Screw
E— Brace
F— Hose/Tube

15. Disconnect hydraulic hose (A).
16. Remove two screws (B).
17. Remove four cap screws and bracket (C).
18. Remove four cap screws and brace (D).
19. Remove radiator, heat shield (E) and fan shroud.

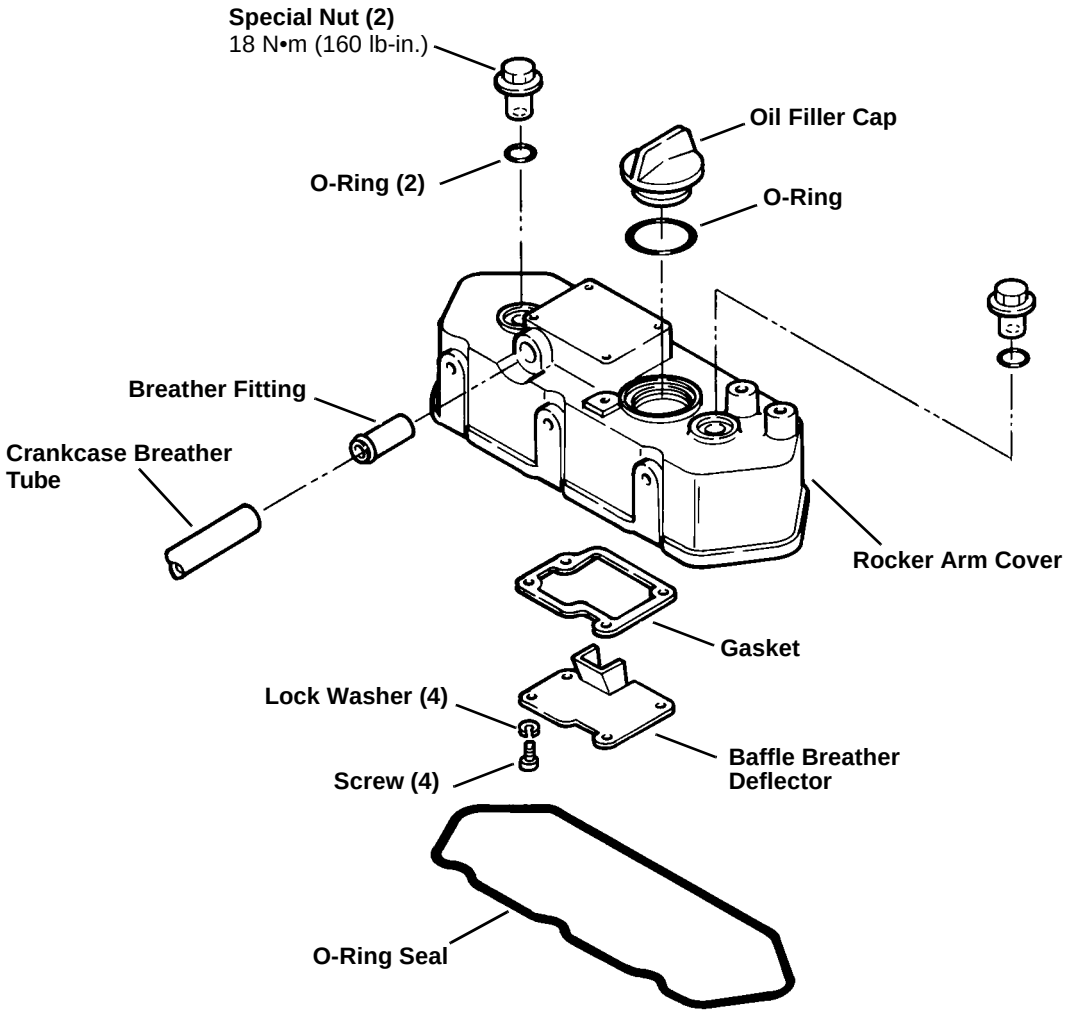


A— Hydraulic Hose
B— Screws
C— Bracket
D— Brace
E— Heat Shield

Installation is done in the reverse order of removal.

- Make sure radiator flange fits inside mounting bracket.
- Close drain cock on bottom of radiator and fill radiator with proper mix of coolant. (See SPECIFICATIONS AND GENERAL INFORMATION section.)
- Run engine and check for leaks at coolant and hydraulic hoses. Add coolant to recovery tank and hydraulic oil to reservoir as necessary.

ROCKER ARM COVER



ROCKER ARM ASSEMBLY

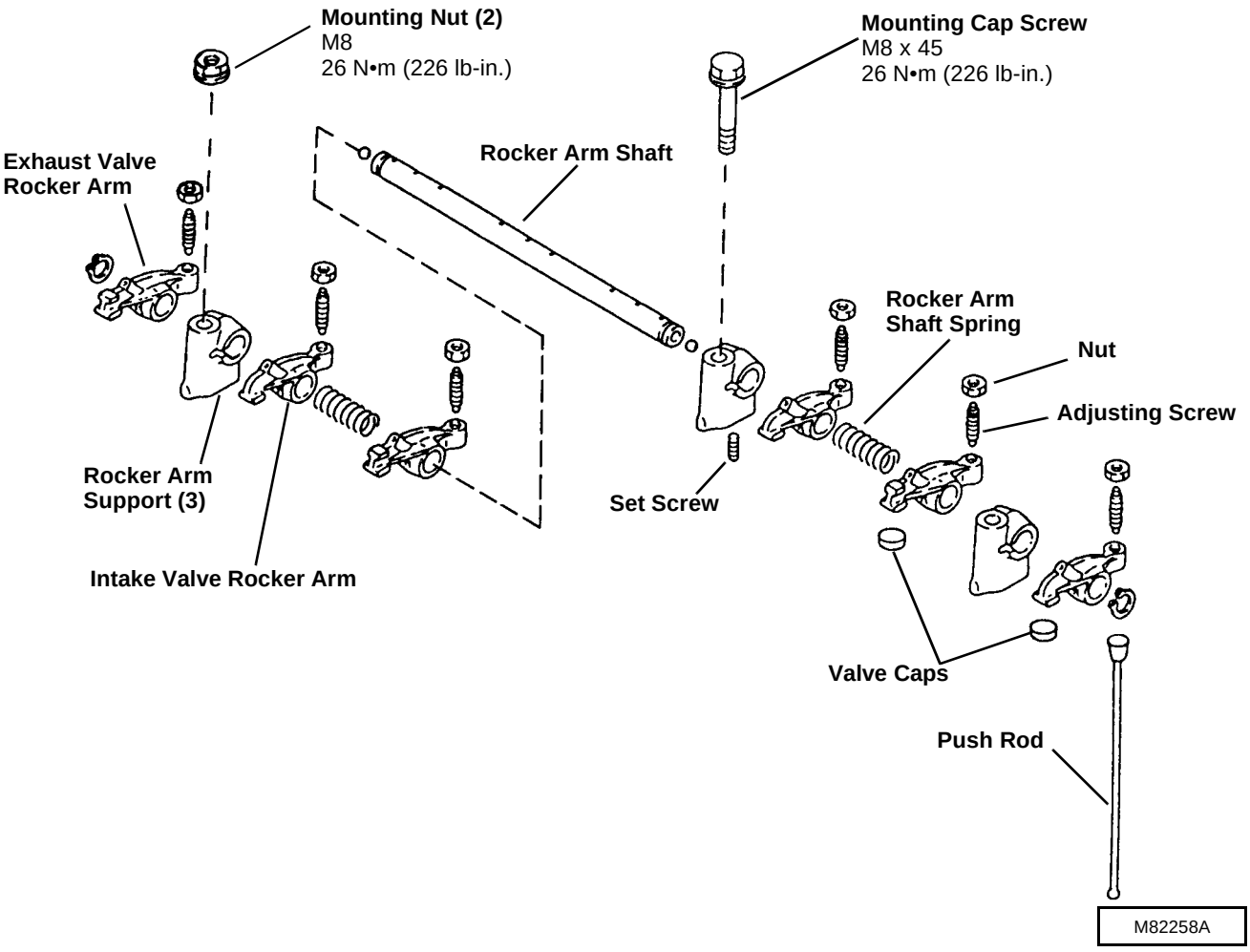
Removal/Installation and Disassembly/Assembly

1. Remove rocker arm cover.

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

IMPORTANT: Install center rocker arm support on shaft, aligning set screw hole in support with center hole in shaft.

- Lubricate all parts with clean oil during assembly.
- Adjust valve clearance. (See *Checks, Tests and Adjustments* in this section.)



Inspection

- Measure outer diameter of rocker arm shaft at each rocker arm location.

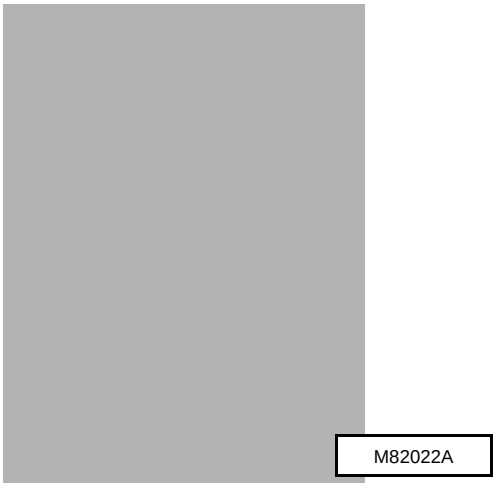
Rocker Arm Shaft O.D.

Standard . . . . . 9.97—9.99 mm (0.3925—0.3933 in.)

Wear Limit. . . . . 9.95 mm (0.3920 in.)

Replace rocker arm shaft if less than wear limit.

- Measure inner diameters of rocker arms and supports.



Rocker Arm and Shaft Support I.D.'s

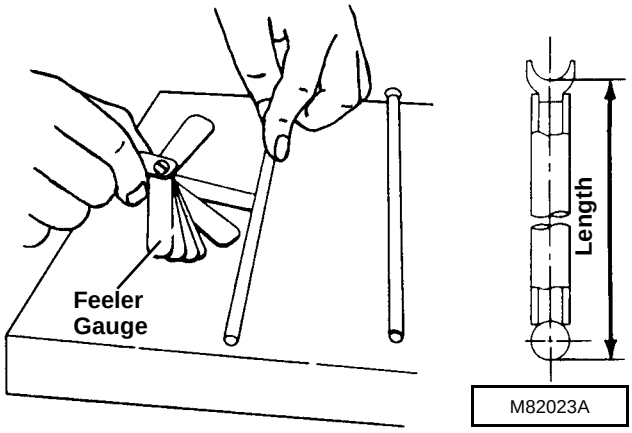
Standard . . . . . 10.00—10.02 mm (0.3937—0.3945 in.)

Wear Limit. . . . . 10.09 mm (0.3972 in.)
Clearance . . . . . 0.14 mm (0.005 in.)

Replace rocker arms or supports if I.D. is more than wear limit.

If shaft and support/arm clearance (support/arm I.D. minus shaft O.D.) exceed wear limit, replace all parts.

- Measure length and bending of push rod.



Push Rod Length . . . . . 110—111 mm (4.346—4.380 in.)

Push Rod Bend
Wear Limit . . . . . 0.03 mm (0.001 in.)

Replace push rod if not within specifications.

CYLINDER HEAD AND VALVES

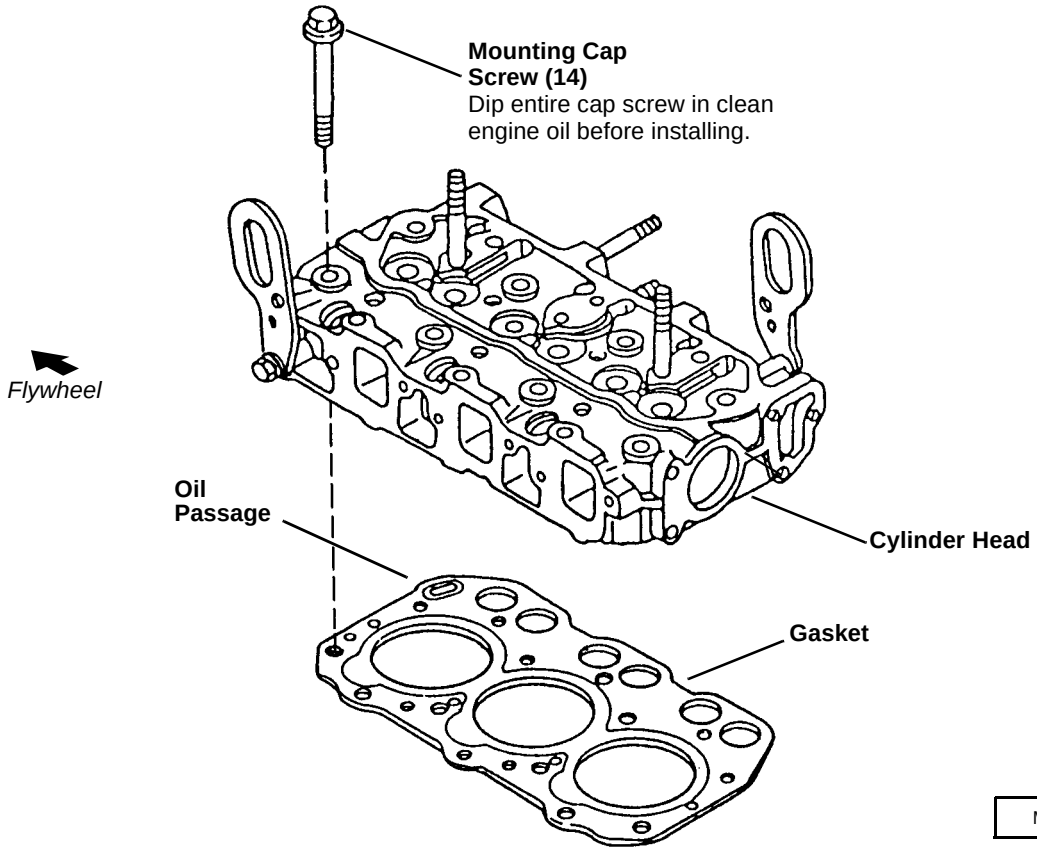
Removal/Installation

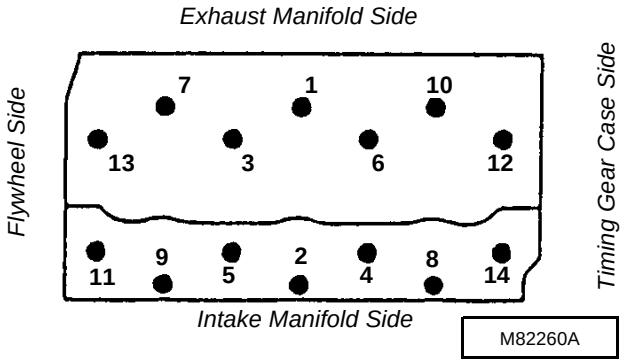
1. Remove rocker arm assembly, push rods and valve caps.
2. Remove exhaust and intake manifolds.
3. Remove water pump.
4. Remove fuel injection nozzles.
5. Remove glow plugs.
6. Disassemble and inspect cylinder head and valves.

IMPORTANT: Oil passage in gasket must be located over oil passage in cylinder block. Install gasket as shown.

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

IMPORTANT: Cylinder head mounting cap screws must be checked for proper torque after 50 hours of engine operation.





Torque Specifications:

First	**13 N•m (114 lb-in.)**
Second	**26 N•m (229 lb-in.)**
Final	**39 N•m (28 lb-ft)**

Disassembly/Assembly

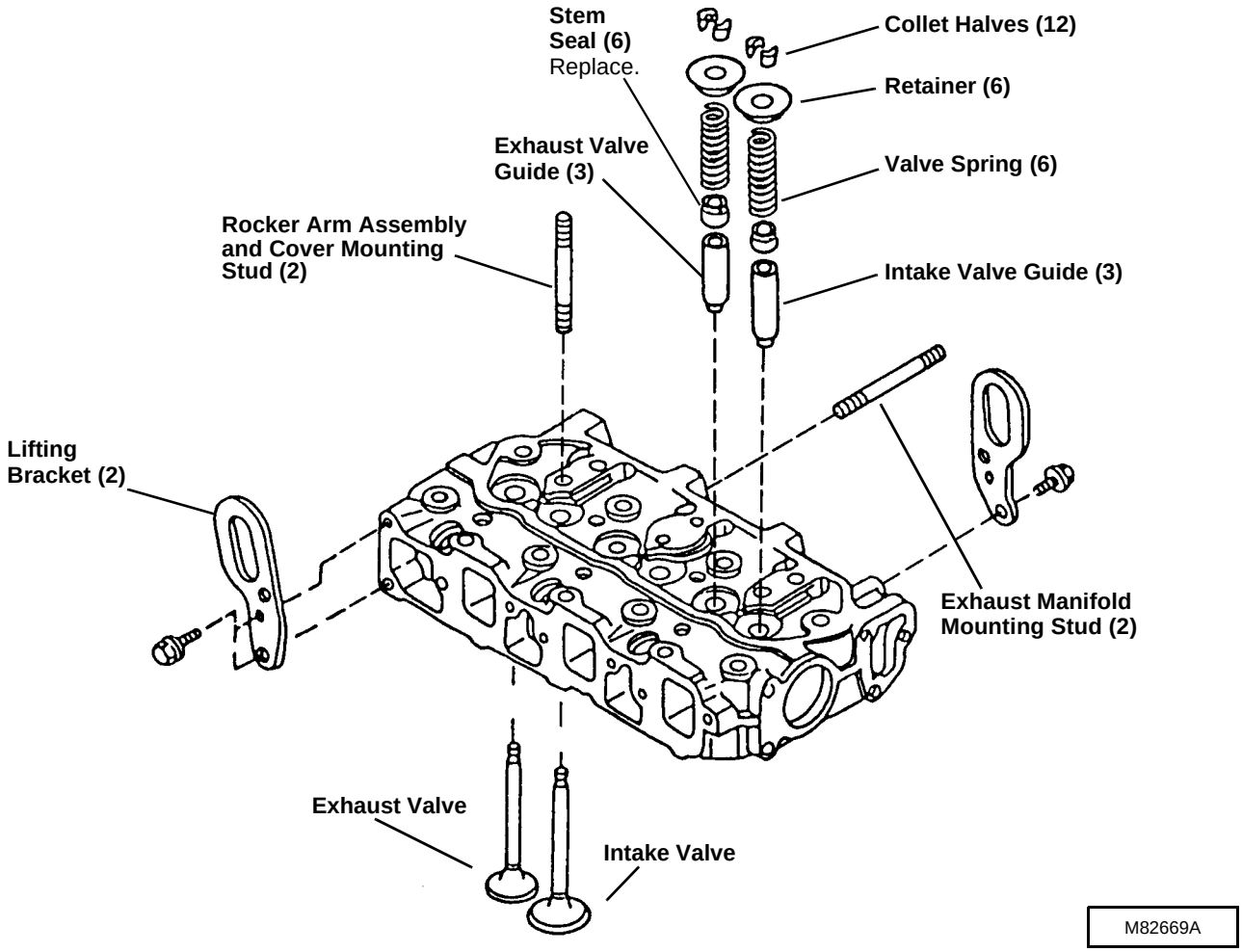
- Compress valve springs using a valve spring compressor.
- Intake and exhaust valve guides are press fit. Remove guides only if replacement is necessary. (See *Inspection/Replacement* procedures.)
- Inspect all parts for wear or damage. (See *Inspection/Replacement* procedures.)

IMPORTANT: Do not reuse stem seals if removed. Used seals will leak.

- Apply clean engine oil on intake and exhaust valve stems during assembly.
- Install springs with smaller pitch end or paint mark toward cylinder head.

*NOTE: If new valves are installed, measure valve recession. (See **Inspection/Replacement** procedures.)*

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

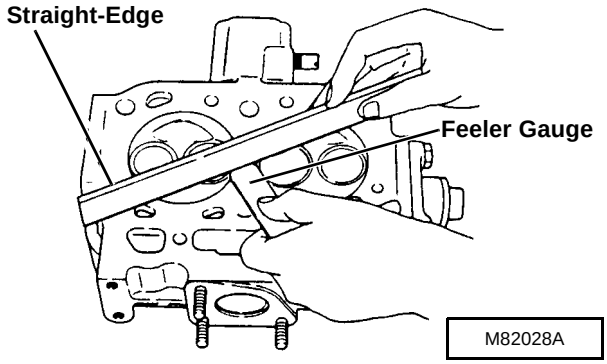


Inspection/Replacement

Before inspection, thoroughly clean all components of carbon or dirt.

Cylinder Head:

- Measure cylinder head flatness. Place a straight-edge along each of the four sides and each diagonal. Measure clearance between straight edge and combustion surface with a feeler gauge.



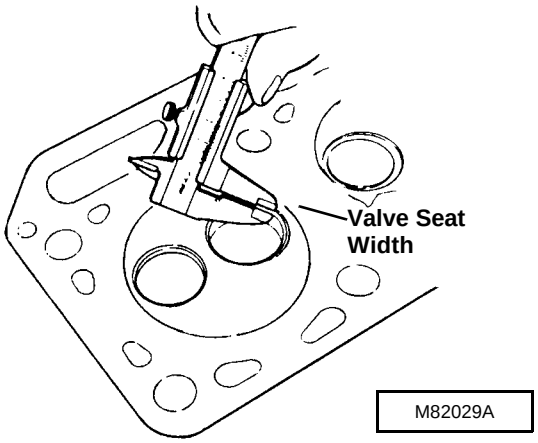
Cylinder Head Distortion:

Standard. . . . . .0.05 mm (0.002 in.) or less
Wear Limit . . . . . 0.15 mm (0.006 in.)

If distortion exceeds the wear limit, resurface or replace cylinder head. Remove only enough metal to make cylinder head flat; but do not remove more than **0.20 mm (0.008 in.)**.

If cylinder head was resurfaced:

- Measure piston-to-cylinder head clearance.
- Measure valve recession.
- Measure valve seat width.



Valve Seat Width:

Intake Valve

Standard . . . . . 1.15 mm (0.045 in.)
Wear Limit. . . . . 1.65 mm (0.065 in.)

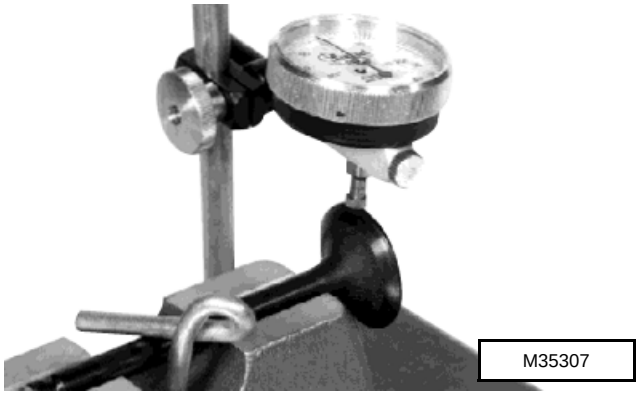
Exhaust Valve

Standard . . . . . 1.41 mm (0.056 in.)
Wear Limit. . . . . 1.91 mm (0.075 in.)

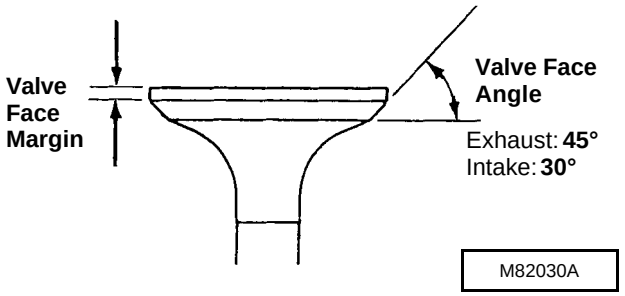
If necessary, grind valve seats to meet specifications. (See *GRIND VALVE SEATS* procedure.)

Intake and Exhaust Valves:

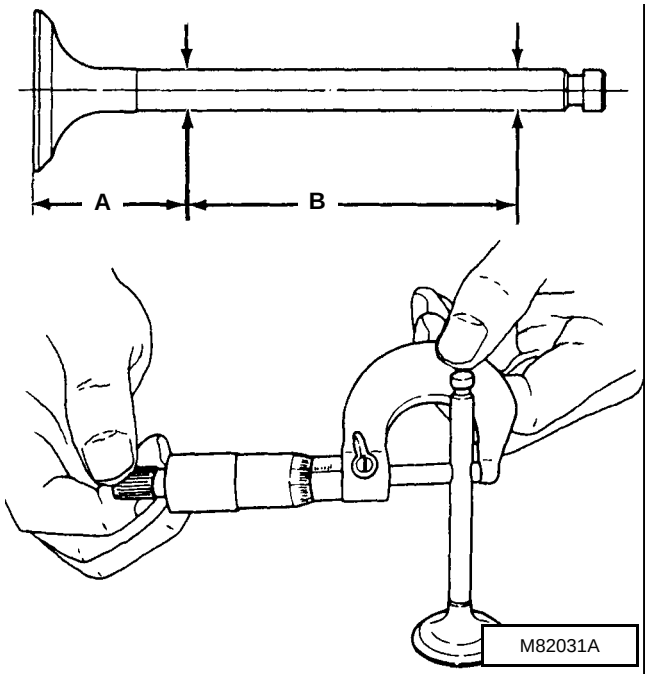
- Check valve for out-of-round, bent or warped condition using a valve inspection center. Replace valve if necessary.



If valve faces are worn, burned or pitted, grind valves to proper face angle. If valve face margin is less than **0.51 mm (0.020 in.)** after grinding, replace valve.



- Measure valve stem diameter at two locations shown. Replace valve if measurement exceeds wear limit.



Valve Stem O.D.:

Distance A . . . . . 20 mm (0.787 in.)
Distance B . . . . . 40 mm (1.575 in.)

Intake Valve

Standard. . . . . 5.46—5.48 mm (0.2149—0.2157 in.)

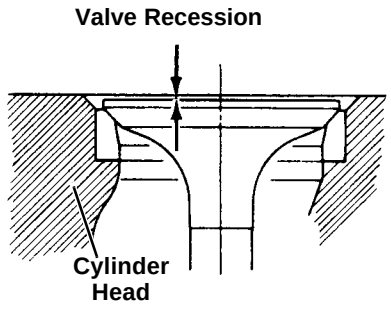
Wear Limit . . . . . 5.40 mm (0.2126 in.)

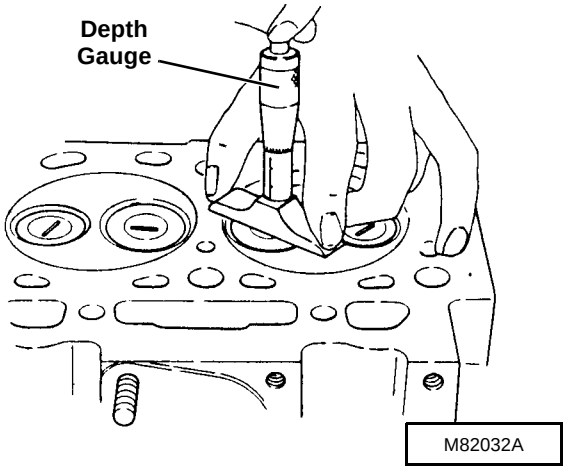
Exhaust Valve

Standard. . . . . 5.44—5.46 mm (0.2142—0.2149 in.)

Wear Limit . . . . . 5.40 mm (0.2126 in.)

- Measure valve recession using a depth gauge. Replace valve or cylinder head if measurement exceeds specification.





Valve Recession:

Intake Valve. . . . . 0.40 mm (0.016 in.)
Exhaust Valve . . . . . 0.85 mm (0.033 in.)

Valve Guides:

- Clean valve guides using a valve guide brush.
- Measure valve guide inside diameter.

Valve Guide I.D.:

Standard . . . . . 5.50—5.52 mm (0.216—0.217 in.)

Wear Limit. . . . . 5.58 mm (0.220 in.)

If diameter exceeds wear limit, knurl or replace guide.

If diameter is less than wear limit, determine guide-to-stem clearance (guide diameter minus stem diameter).

If clearance exceeds **0.15 mm (0.006 in.)** but is less than **0.20 mm (0.008 in.)**, knurl valve guides.

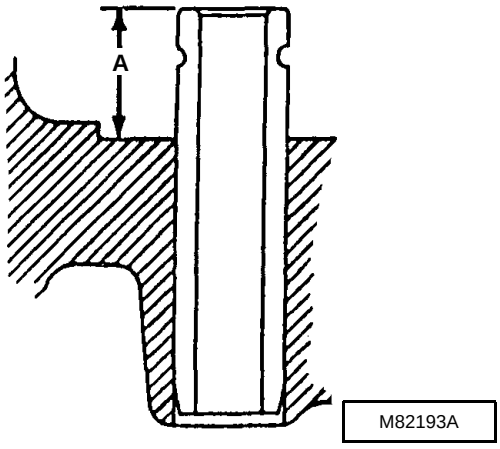
- Knurl valve guides using a 5.50 mm Valve Guide Knurler

If clearance exceeds **0.20 mm (0.008 in.)**, replace valve guides.

- Replace valve guides using a JDG504 Valve Guide Driver

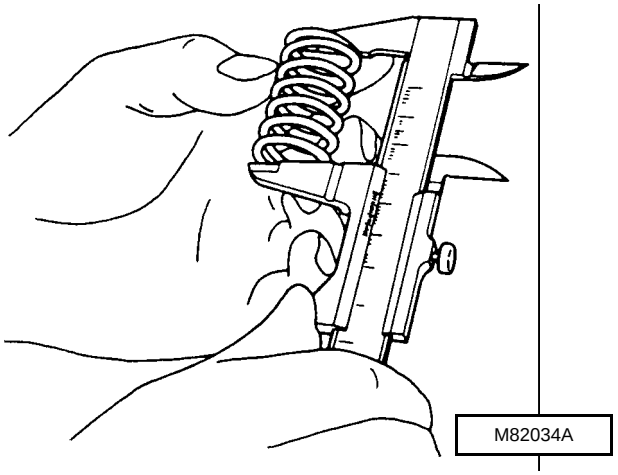
Intake and exhaust valve guides are different. The exhaust valve guide has one groove and the intake valve guide has none. Install valve guides with tapered ends down. Push valve guides down until top of valve guides are **7 mm (0.276 in.)** (A) from top of cylinder head.

- Ream inside diameter of valve guides using a 5.50 mm Valve Guide Reamer

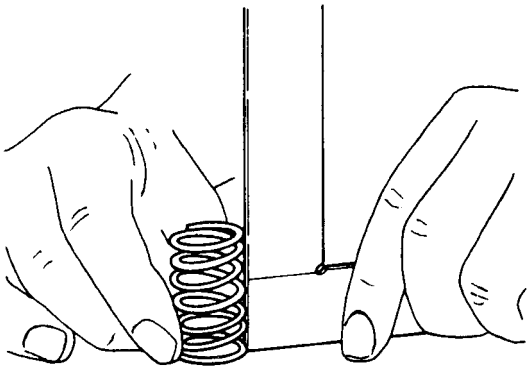


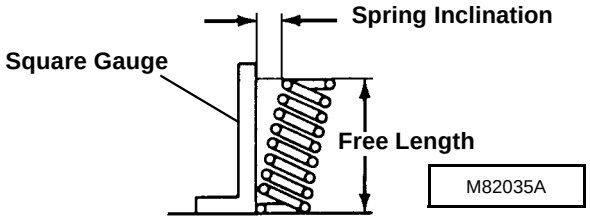
Valve Springs:

- Measure spring free length. Replace spring if measurement exceeds **28 mm (1.102 in.)**.



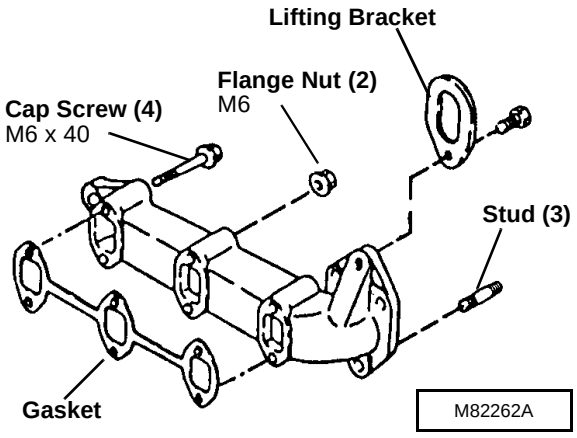
- Measure spring inclination. Replace spring if measurement exceeds **0.80 mm (0.032 in.)**.





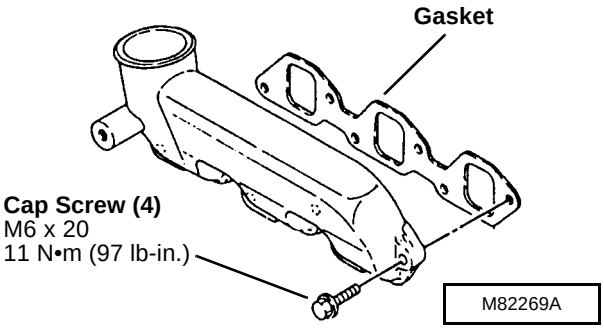
EXHAUST MANIFOLD

- Remove muffler and gasket.
- Tighten all mounting hardware to **11 N•m (97 lb-in.)**.



INTAKE MANIFOLD

1. Remove fuel filter assembly mounting cap screw(s), if equipped.
2. Remove fuel injection lines, if necessary.

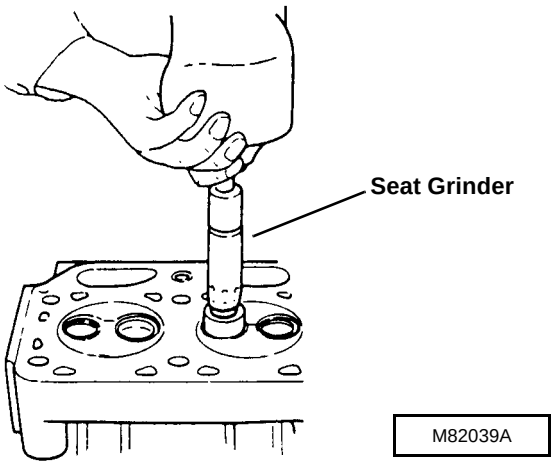


GRIND VALVE SEATS

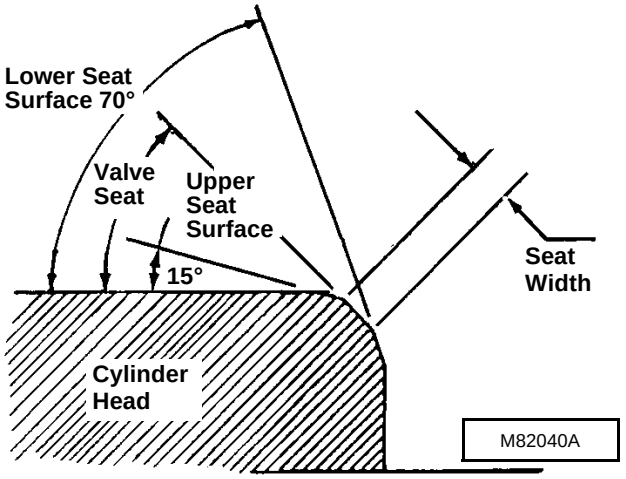
IMPORTANT: Valve seats should never be cut. Cutting a valve seat can damage its sealing surface, which may result in leaks or valve/seat failure. Valve seats should be ground and lapped.

NOTE: LIGHTLY grind valve seats for a few seconds only to avoid excessive valve seat width.

1. Grind intake valve seat using a 30° seat grinder and exhaust valve seat using a 45° seat grinder. Follow tool manufacturers instructions.



2. Measure valve seat width after grinding.
3. If seat is too wide after grinding, grind lower seat surface using a 70° seat grinder until seat width is close to specifications.
4. Grind upper seat surface using a 15° seat grinder until seat width is narrowed to specifications.
5. If valve seats are ground, measure valve recession and check contact pattern between the seat and valve with bluing dye.
6. Lap valves.



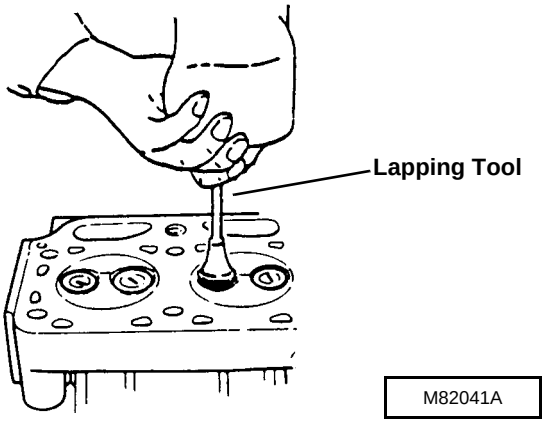
If valve recession exceeds maximum specifications or seats cannot be reconditioned, replace valves, and/or cylinder head.

LAP VALVES

NOTE: Use a rubber type lapping tool for valves without a lapping tool groove slit.

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

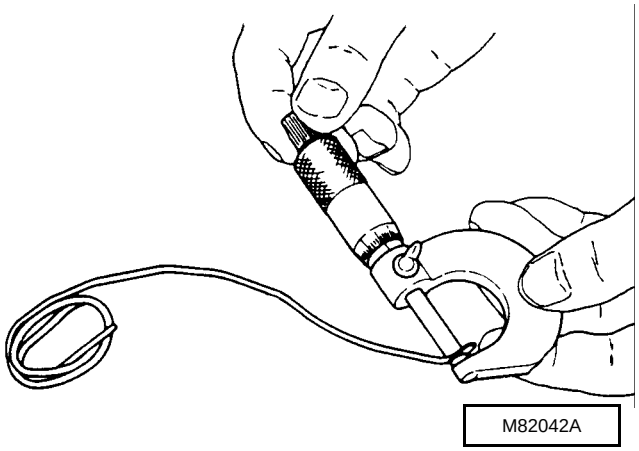
1. Apply small amount of fine lapping compound to face of valve.
2. Turn valve to lap valve to seat.
3. Lift valve from seat every 8 to 10 strokes. Lap until a uniform ring appears around the surface of the valve face.
4. Wash all parts in solvent to remove lapping compound. Dry parts.
5. Check position of lap mark on valve face. Lap mark must be on or near center of valve face.



MEASURE PISTON-TO-CYLINDER HEAD CLEARANCE

1. Place three 10 mm (0.400 in.) long pieces of 1.50 mm (0.060 in.) diameter soft wire in three positions on the flat part of the piston head.
2. Install cylinder head and old gasket. Install cylinder head cap screws and tighten in proper sequence to specified torque. (See *CYLINDER HEAD AND VALVES—Removal/Installation* in this group.)
3. Slowly turn crankshaft one complete revolution.
4. Remove cylinder head and gasket.
5. Measure thickness of flattened section of each piece of wire. Calculate average thickness of wires to obtain piston-to-cylinder head clearance of **0.610—0.730 mm (0.024—0.028 in.)**.

If clearance is less than specifications, replace cylinder head.



PISTON AND CONNECTING ROD

Removal

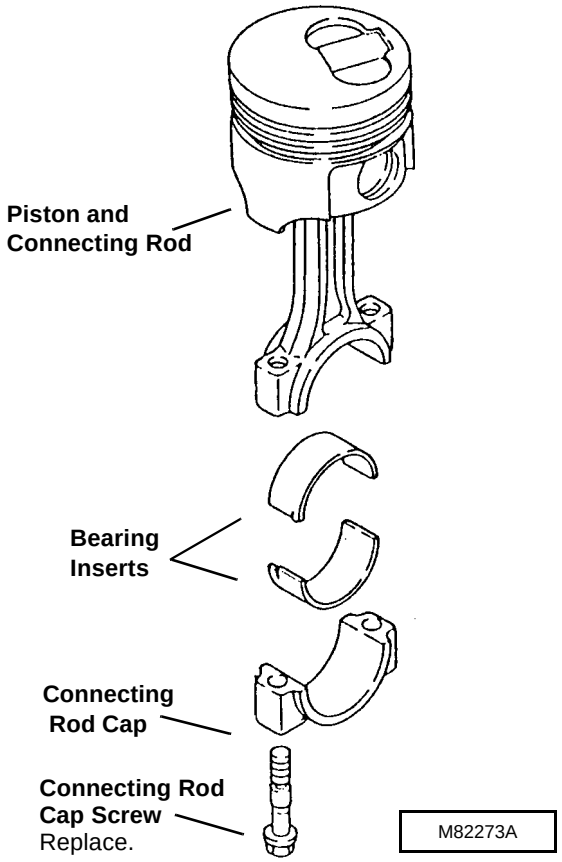
1. Remove oil pan and strainer tube.
2. Remove cylinder head.
3. Check cylinder bore for ridges. These ridges can cause damage to piston if ridge is not removed.
4. If necessary, remove ridge from top of cylinder bore using a ridge reamer.
5. Measure connecting rod side play. (See *Checks, Tests and Adjustments* in this section.)
6. Measure connecting rod bearing clearance. (See *Checks, Tests and Adjustments* in this section.)

IMPORTANT: Keep connecting rods and caps together. Rods and caps are a matched set. Note alignment marks on each part.

7. Remove two cap screws, connecting rod cap and bearing inserts.

IMPORTANT: Pistons and cylinders are matched. Pistons must be installed in the cylinders from which they are removed.

8. Note connecting rod alignment mark in relation to the cylinders. Starting at flywheel end with cylinder number one, then two, etc.
9. Push piston and connecting rod out of cylinder bore using a wooden dowl.
10. Disassemble and inspect all parts for wear or damage. (See *Disassembly* and *Inspection/ Replacement* procedures.)



Installation

- Apply clean engine oil on all parts during installation.
- Never reuse connecting rod cap screws, replace with new.

IMPORTANT: Pistons must be installed in cylinders from which they were removed and in the same direction. Be careful not to damage crankshaft rod journal while installing piston.

1. If new piston rings were installed, deglaze cylinder bore.

2. Install piston and connecting rod into the cylinder from which it was removed, with piston recess on top of piston toward fuel injection pump.

IMPORTANT: Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surface.

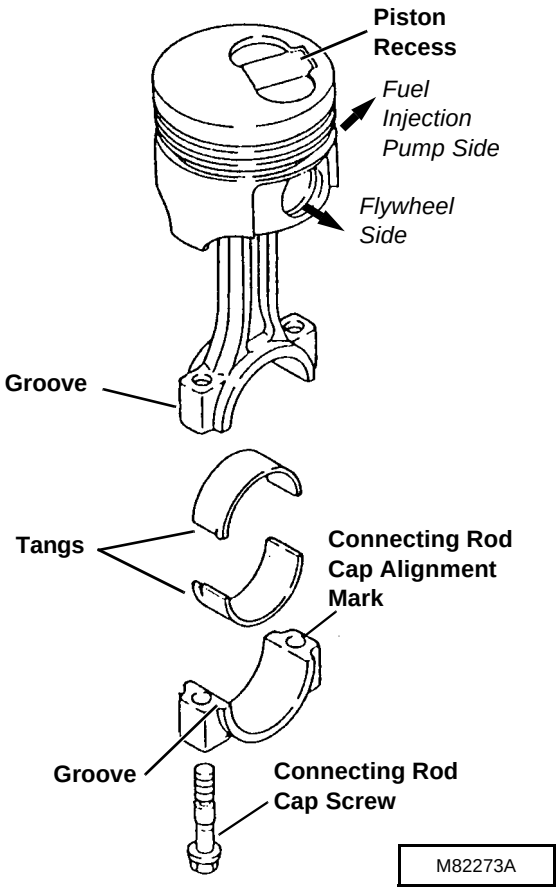
3. Install bearing inserts on connecting rod and rod cap, aligning tangs with grooves.

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

4. Match the connecting rods to caps using alignment marks. Install caps.

5. Dip entire connecting rod cap screws in clean engine oil. Install new cap screws and tighten to **23 N•m (203 lb-in.)**.

6. If a new piston and connecting rod were installed, stamp a number corresponding to the cylinder number on the connecting rod cap and connecting rod.



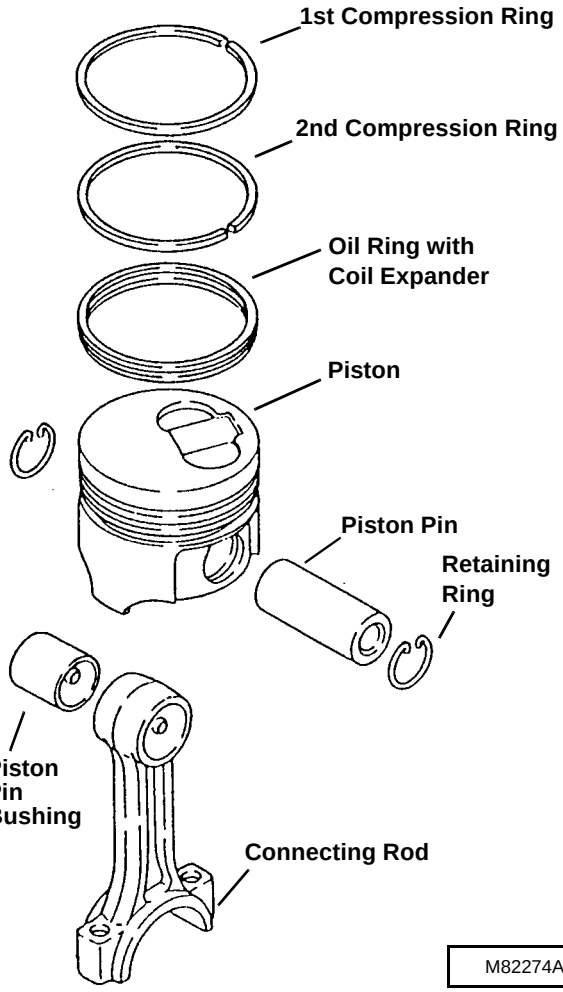
7. Install cylinder head.

8. Install oil pan and strainer tube.

Disassembly

IMPORTANT: Pistons must be installed on the same connecting rod they were removed from.

- Put a mark on each piston and connecting rod to aid in assembly.
- Piston pin bushing is press fit in connecting rod. Remove bushing only if replacement is necessary. (See *Inspection/Replacement* procedures.)
- Inspect all parts for wear or damage. Replace as necessary. (See *Inspection/Replacement* procedures.)



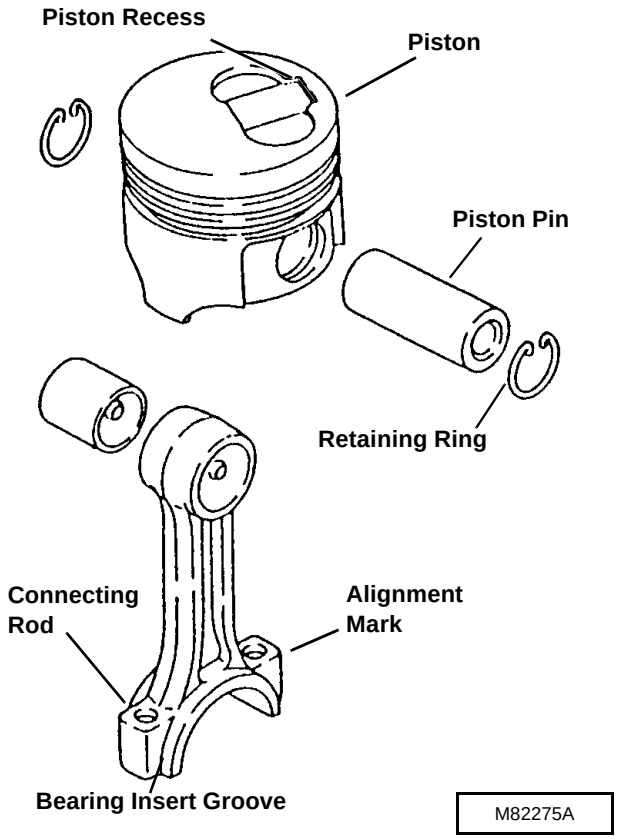
Assembly

- Apply clean engine oil to all parts during assembly.

IMPORTANT: Pistons must be installed on the same connecting rod they were removed from.

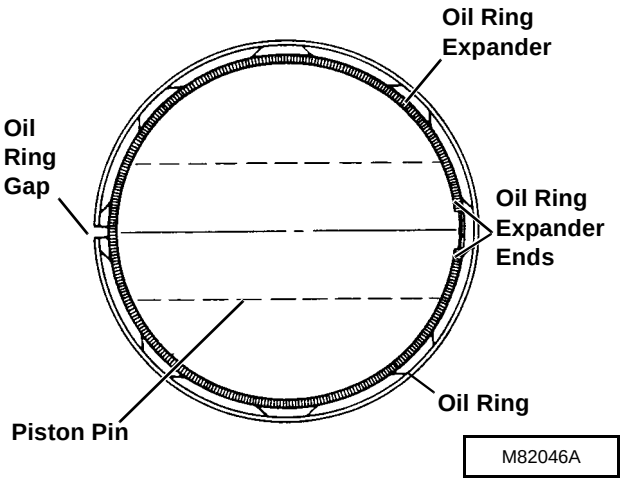
1. Assemble piston to connecting rod with piston recess on same side as connecting rod “punched” alignment mark. If a new connecting rod is used, assemble piston to connecting rod with piston recess opposite connecting rod bearing insert groove.

2. Install piston pin and snap rings.



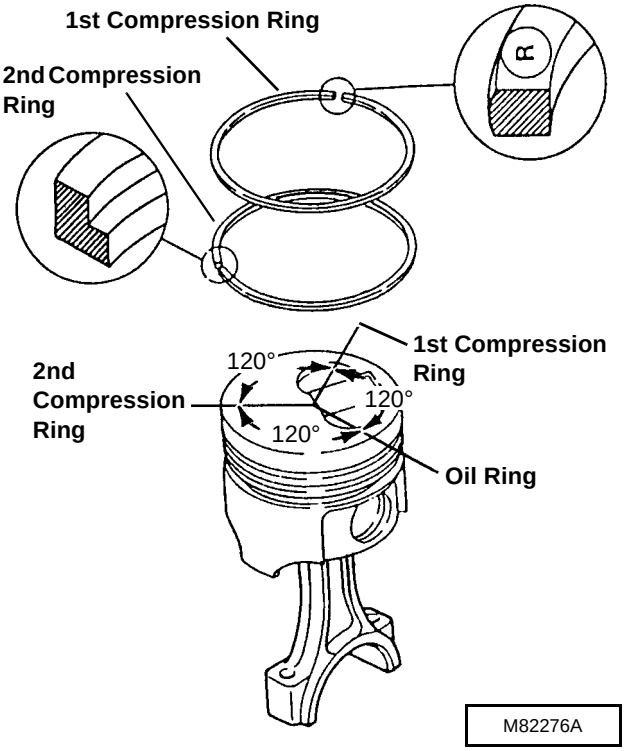
3. Install oil ring expander in bottom ring groove of piston with ends above either end of piston pin.

4. Install oil ring over expander with ring gap opposite (180^{o}) of expander ends.



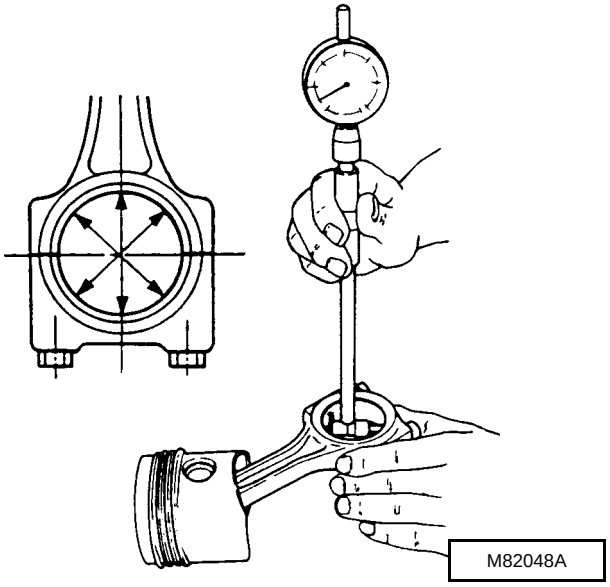
5. Install second compression ring, with chamfer toward top of piston, in middle groove. Turn ring until gap is 120^{o} away from oil ring gap.

6. Install first compression ring (chrome plated), with manufacturer's mark “T”, “R” or “RN” (near ring gap) toward top of piston, in top groove. Turn ring until gap is 120^{o} away from second ring gap.



Inspection/Replacement

1. Inspect all parts for wear or damage. Replace as necessary.
2. Measure crankshaft connecting rod journal diameter.
3. Install connecting rod cap and bearing inserts on connecting rod. Install old connecting rod cap screws and tighten to **24 N•m (212 lb-in.)**.
4. Measure connecting rod bearing diameter.



Connecting Rod Bearing I.D.:

Standard . . . . . 39.00—39.016 mm (1.535—1.536 in.)

Clearance . . . . . 0.033—0.059 mm (0.0014—0.0023 in.)

If bearing diameter exceeds wear limit, replace bearing inserts.

If bearing clearance (bearing I.D. minus crankshaft journal O.D.) exceeds specification, grind crankshaft connecting rod journals and install undersized bearing inserts, or replace bearing inserts and crankshaft.

5. With rings installed on piston, measure piston ring groove clearance. Measure several places around each piston.

Piston Ring Groove Clearance:

First Compression Ring

Standard. . . . . 0.060—0.100 mm (0.0023—0.0039 in.)

Wear Limit . . . . . 0.20 mm (0.0079 in.)

Second Compression Ring

Standard. . . . . 0.090—0.125 mm (0.0035—0.0049 in.)

Wear Limit . . . . . 0.20 mm (0.0079 in.)

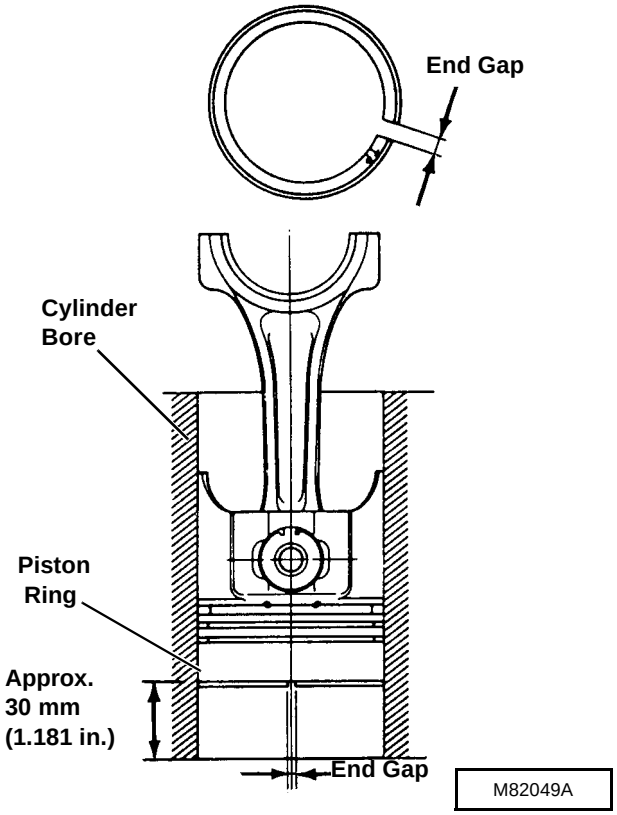
Oil Ring

Standard. . . . . 0.020—0.055 mm (0.0008—0.0022 in.)

Wear Limit . . . . . 0.20 mm (0.0079 in.)

If clearance exceeds wear limit, replace rings or piston.

6. Measure piston ring end gap. Push ring into cylinder bore, using a piston, until ring is approximately **30 mm (1.181 in.)** from bottom of cylinder bore.



Piston Ring End Gap:

Standard

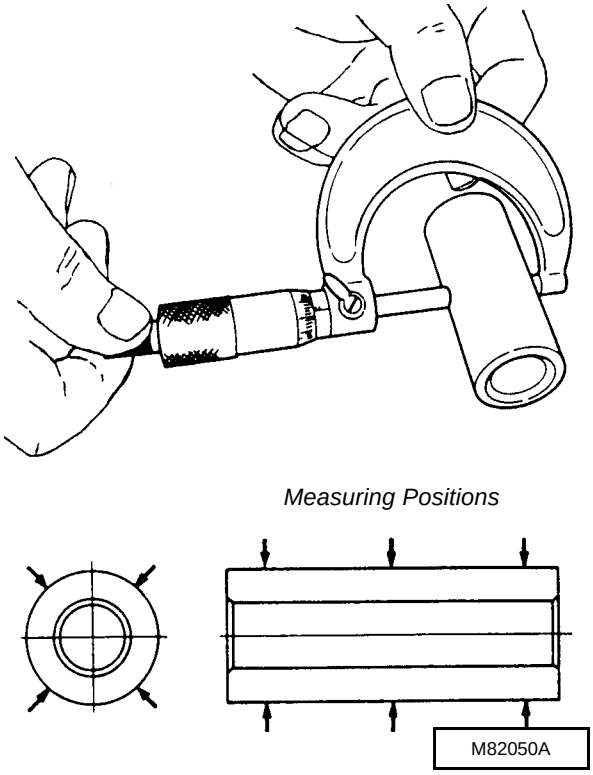
First Compression Ring . . . . . 0.100—0.250 mm (0.003—0.009 in.)

Second Compression Ring and Oil Ring . . . . . 0.15—0.35 mm (0.006—0.013 in.)

Wear Limit. . . . . 1.50 mm (0.0591 in.)

If end gap exceeds wear limit, replace rings.

7. Measure piston pin diameter. Measure diameter at six places.



Measuring Positions

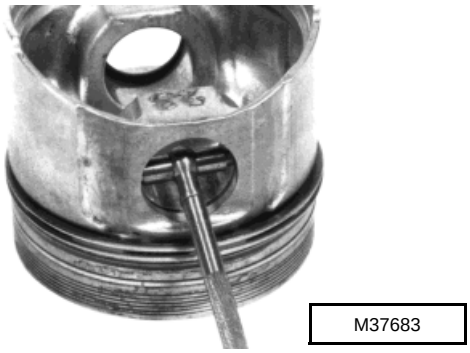
Piston Pin O.D.:

Standard. . . . . 19.991—20.00 mm (0.787—0.788 in.)

Wear Limit . . . . . 19.900 mm (0.783 in.)

If pin diameter is less than wear limit, replace pin.

8. Measure piston pin bore diameter in piston.



Piston Pin Bore I.D.:

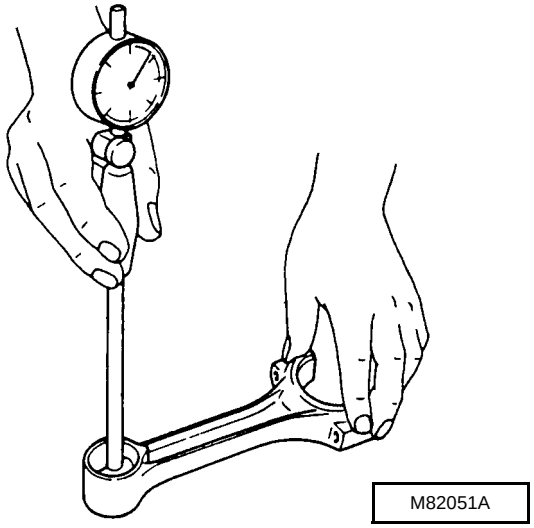
Standard . . . . . 20.00—20.008 mm (0.787—0.788 in.)

Wear Limit. . . . . 20.02 mm (0.788 in.)
Clearance . . . . . 0.017 mm (0.0007 in.)

If piston pin bore exceeds wear limit, replace piston.

If bore clearance (bore I.D. minus pin O.D.) exceeds specification, replace piston, piston pin or both.

9. Measure piston pin bushing diameter in connecting rod.



M82051A

Piston Pin Bushing I.D.:

Standard . . . . . 20.000—20.038 mm (0.787—0.789 in.)

Clearance . . . . . 0.17 mm (0.0067 in.)

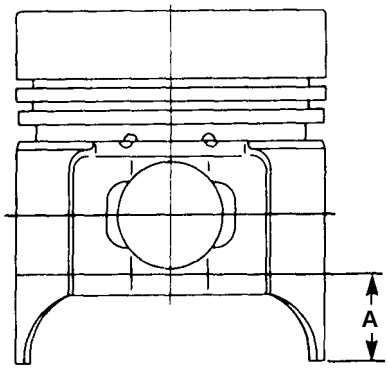
If bushing diameter exceeds wear limit, replace bushing.

If bushing clearance (bushing I.D. minus pin O.D.) exceeds specification, replace bushing, piston pin or both.

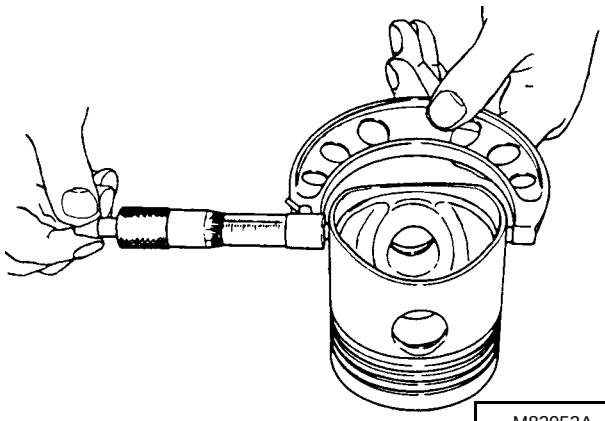
Piston pin bushing is press fit. Replace bushing using a driver set. When installing bushing, make sure to align oil hole in bushing with hole in connecting rod.

10. Measure piston diameter perpendicular to piston pin bore at distance A.

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



M82200A



M82052A

Piston O.D.:

Distance A . . . . . 5 mm (0.197 in.)

Standard Size Piston

Standard. . . . . 67.960—67.990 mm (2.676—2.768 in.)

Wear Limit . . . . . 67.90 mm (2.673 in.)

0.25 mm (0.010 in.) Oversize Piston

Standard. . . . . 68.21—68.24 mm (2.685—2.687 in.)

If piston diameter is less than wear limit, install a new piston.

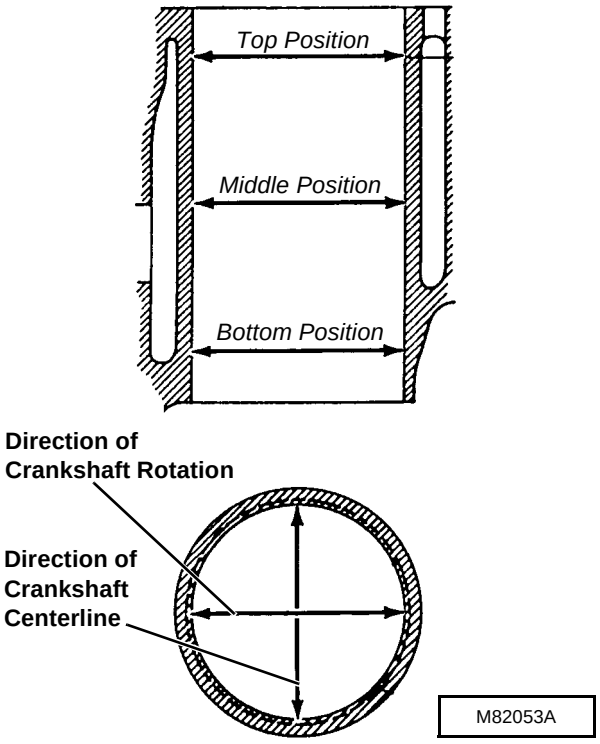
11. Measure cylinder bore diameter.

CYLINDER BORE

Inspection

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

NOTE: If engine has had a previous major overhaul, oversize pistons and rings may have been installed.



Cylinder Bore I.D.:

Standard Size Bore

Standard . . . . . 68.00—68.03 mm (2.677—2.678 in.)

Wear Limit . . . . . 68.20 mm (2.685 in.)

0.25 mm (0.010 in.) Oversize Bore

Standard . . . . . 68.25—68.28 mm (2.687—2.688 in.)

Wear Limit. . . . . 68.45 mm (2.695 in.)

If cylinder bore exceeds wear limit, replace cylinder block or have cylinder rebored. (See *Reboring* procedure.)

If cylinder is rebored, oversize pistons and rings must be installed. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.

If clearance (cylinder bore I.D. minus piston O.D.) exceeds specification, replace cylinder block, piston or both; or rebore cylinder and install oversize piston and rings.

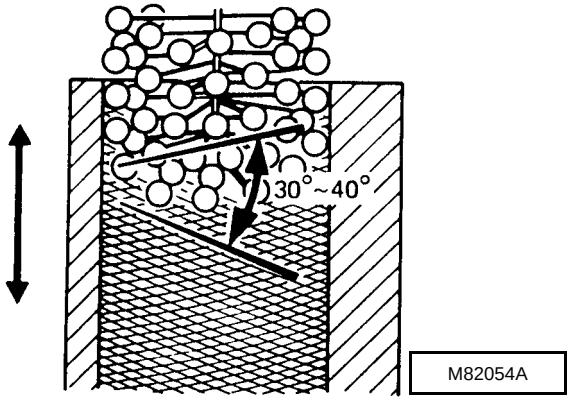
Deglazing

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

1. Deglaze cylinder bores using a flex-hone with 180 grit stones.
2. Use flex-hone as instructed by manufacturer to obtain a **30—40° cross-hatch pattern** as shown.

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

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



Reboring

NOTE: The cylinder block can be rebored to use oversize pistons and rings. Pistons and rings are available in 0.25 mm (0.010 in.) oversize.

1. Align center of bore to drill press center.

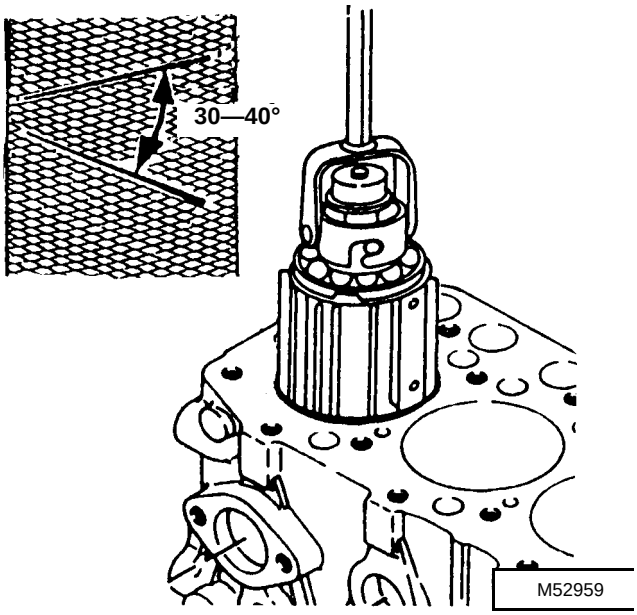
IMPORTANT: Check stone for wear or damage. Use a rigid hone with 300 grit stones.

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

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

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

5. Run drill press at about 250 RPM. Move hone up and down in order to obtain a **30—40°crosshatch pattern.**



NOTE: Measure bore when cylinder is cool.

6. Stop press and check cylinder diameter.

NOTE: Finish should not be smooth. It should have a 30—40° crosshatch pattern.

7. Remove rigid hone when cylinder is within 0.03 mm (0.001 in.) of desired size.

8. Use a flex hone with 180 grit stones for honing to final size.

9. Check bore for size, taper and out-of-round. (See *Inspection* procedures.)

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

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

11. Dry cylinder and apply engine oil.

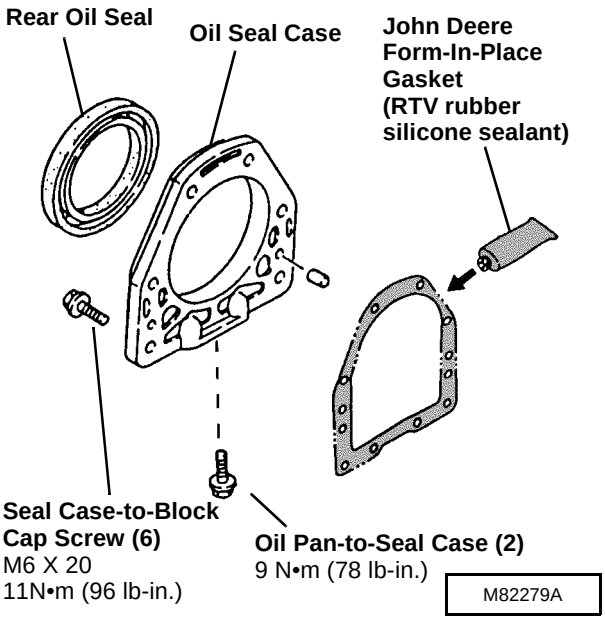
CRANKSHAFT REAR OIL SEAL

Replacement

1. Remove flywheel housing.

- Replace oil seal using a driver set. Install seal, with lip toward cylinder block. Install seal flush with surface of oil seal case.

NOTE: If crankshaft is grooved at oil seal contact point, seal can be installed 3 mm (0.120 in.) farther into oil seal case.

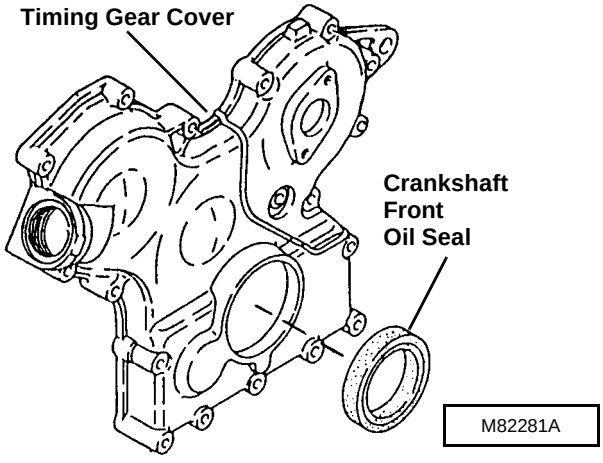


CRANKSHAFT FRONT OIL SEAL

Replacement

- Remove timing gear cover.

- Replace oil seal using a driver set. Install seal with lip toward inside of gear housing cover. Install seal flush with surface of cover.



CRANKSHAFT AND MAIN BEARINGS

Removal

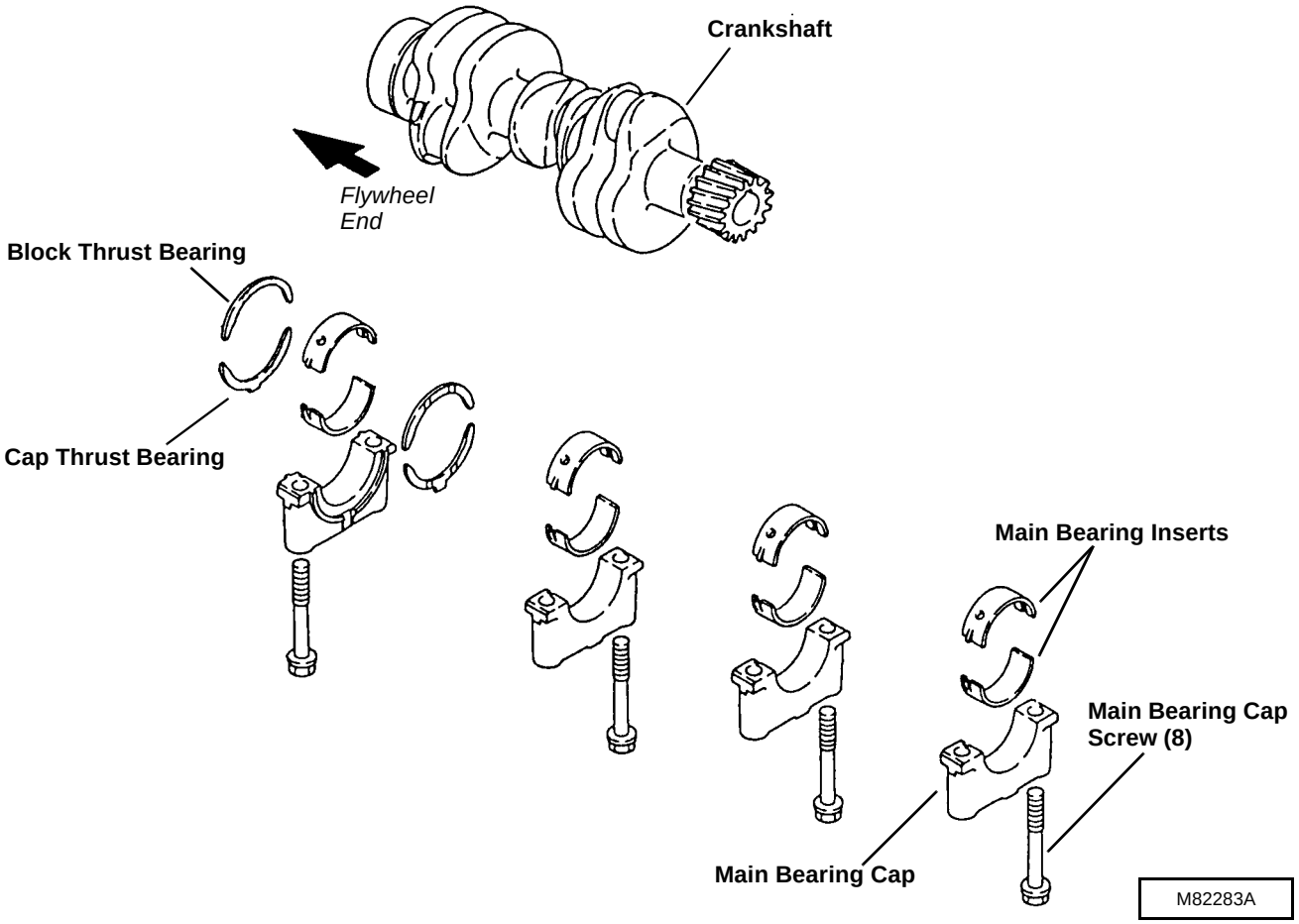
1. Check crankshaft end play. (See *Checks, Tests and Adjustments* in this section.)
2. Remove rear oil seal.
3. Remove flywheel housing.
4. Remove timing gear housing.
5. Check crankshaft bearing clearance. (See *Checks, Tests and Adjustments* in this section.)

IMPORTANT: Connecting rod end caps must be installed on the same connecting rods from which they were removed. Note alignment marks on caps and rods.

6. Remove connecting rod cap screws and end caps.
7. Push pistons and connecting rods away from crankshaft.

IMPORTANT: Main bearing caps must be installed on the same main bearings from which they were removed.

8. Remove main bearing cap screws, caps and cap thrust bearings.
9. Remove crankshaft.
10. Remove block thrust bearings and main bearing inserts.
11. Inspect all parts for wear or damage. (See *Inspection/Replacement* procedures.)



Installation

- Apply clean engine oil on all parts during installation.

IMPORTANT: Do not touch bearing insert surfaces. Oil and acid from your finger will corrode the bearing surface.

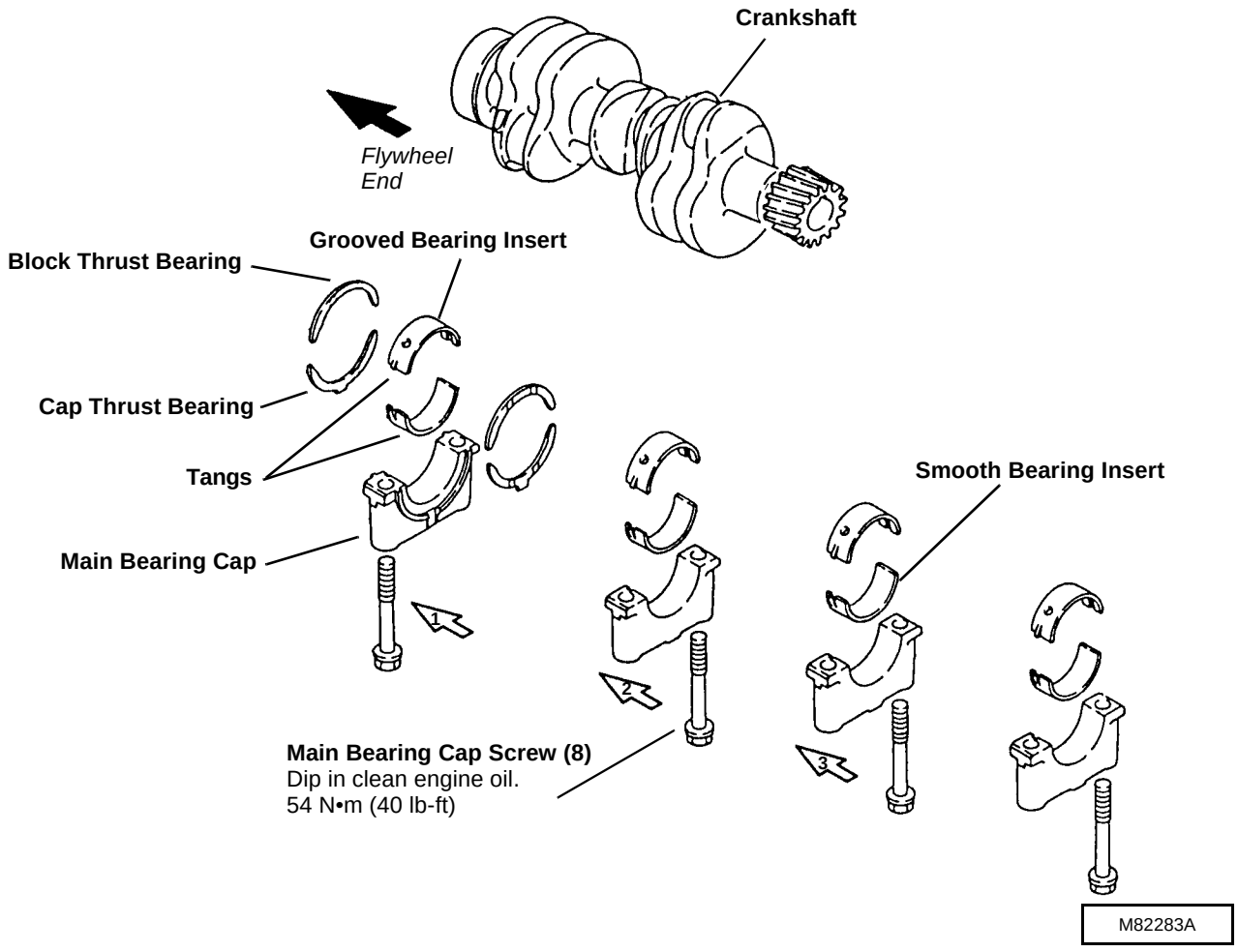
1. Install grooved bearing inserts in crankshaft bearing bores, aligning tangs with slots in bores.
2. Install block thrust bearings with oil grooves facing away from engine block.

NOTE: Main bearing caps have "raised arrows" that are stamped with numbers. Both correspond to their location on the engine block. The number "1" main bearing bore is at flywheel end. Install bearing caps beginning with number 1, then 2, etc. The main bearing cap at gear train end does not have a number. Also install bearing caps with the "arrow" toward the flywheel end.

3. Install crankshaft.
4. Install smooth bearing inserts in main bearing caps, aligning tangs with slots in caps.
5. Install cap thrust bearings, with oil grooves facing away from cap, in the number "1" main bearing cap.
6. Install main bearing caps in their original locations with arrows pointing toward flywheel side of engine.

IMPORTANT: DO NOT use high speed power tools or air wrenches to tighten main bearing cap screws.

7. Dip entire main bearing cap screws in clean engine oil. Install cap screws and tighten. DO NOT tighten to specifications.
8. Using a soft-faced hammer, tap the front end of the crankshaft then the rear end of the crankshaft to align the thrust bearings.



9. Tighten main bearing cap screws to specifications. When tightening, start at center main bearing cap and work your way out, alternating to the ends. Turn crankshaft by hand. If it does not turn easily, disassemble the parts and find the cause.

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

Never reuse connecting rod cap screws, replace with new.

10. Match the connecting rod caps to the rods using alignment marks. Install caps.

11. Dip entire connecting rod cap screws in clean engine oil. Install new cap screws and tighten to **23 N•m (203 lb-in.)**.

12. Install timing gear housing.

13. Install flywheel housing.

14. Install rear oil seal.

Inspection/Replacement

1. Inspect crankshaft gear for chipped or broken teeth. Replace if necessary.

To replace gear:

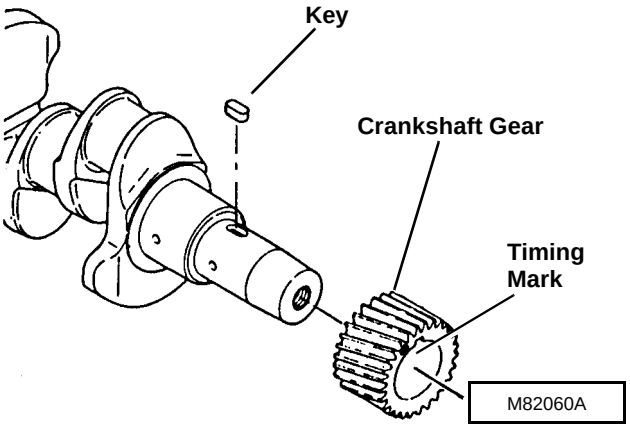
Remove gear from crankshaft using a knife-edge puller and a press.

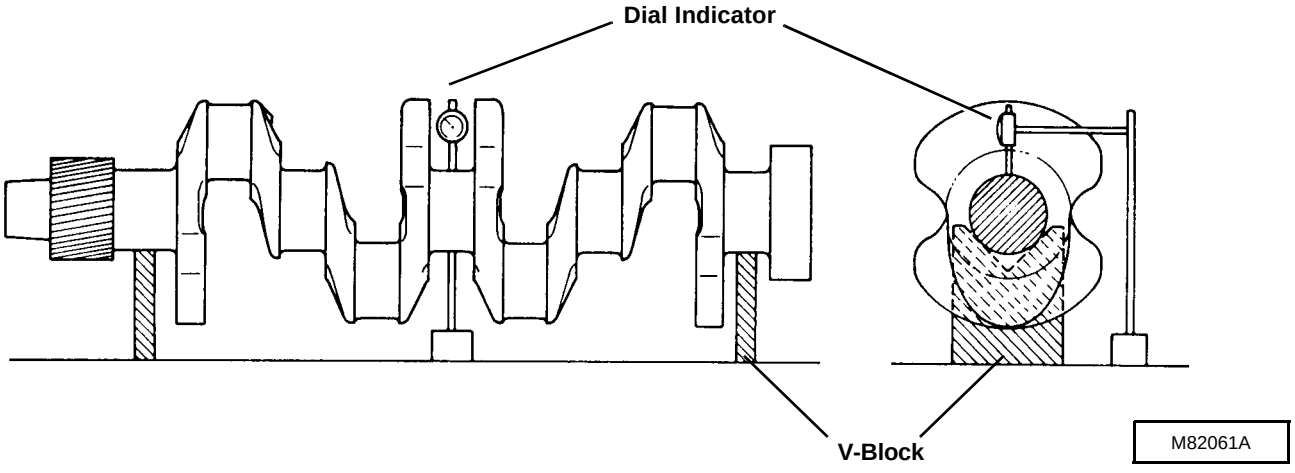
C CAUTION

DO NOT heat oil over 182° C (360° F). Oil fumes or oil can ignite above 193° C (380° F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

Heat gear to approximately 150°C (300°F). Install gear with timing mark "A" toward press table. Align slot in gear with key in shaft. Press crankshaft into gear until gear is tight against crankshaft shoulder.

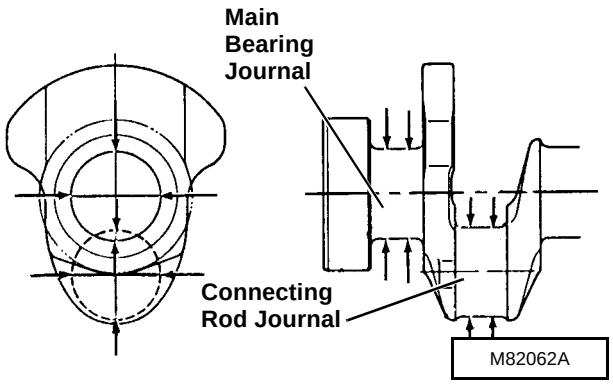
2. Inspect crankshaft for bend using v-blocks and a dial indicator. Turn crankshaft slowly and read variation on indicator. If variation is greater than **0.02 mm (0.0007 in.)**, replace crankshaft.





3. Measure crankshaft connecting rod journal and main bearing journal diameters. Measure several places around each journal.

NOTE: If engine has had a previous major overhaul, journals may have been ground and undersized bearing inserts installed.



Connecting Rod Journal O.D.:

Standard . . . . . 35.97—35.98 mm (1.4161—1.4165 in.)

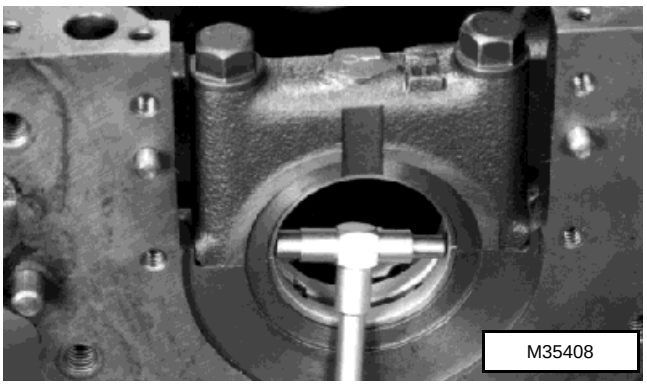
Wear Limit . . . . . 35.92 mm (1.414 in.)

If journal diameter is less than wear limit, replace crankshaft or have journals ground undersize by a qualified machine shop.

If journals are ground, undersize bearing inserts must be installed. Bearing inserts are available in 0.25 mm (0.010 in.) undersize.

4. Install bearing inserts and main bearing cap on main bearing. Tighten main bearing cap screws to **54 N•m (40 lb-ft)**.

5. Measure main bearing diameter.



Main Bearing I.D.:

Standard . . . . . 40.00—40.042 mm (1.575—1.577 in.)

Wear Limit . . . . . 40.07 mm (1.578 in.)
Clearance . . . . . 0.15 mm (0.0059 in.)

If bearing diameter exceeds wear limit, replace bearing inserts.

If bearing clearance (bearing I.D. minus crankshaft main bearing journal O.D.) exceeds specification, replace bearing inserts and crankshaft or have crankshaft journals ground undersize by a qualified machine shop and install undersized bearing inserts.

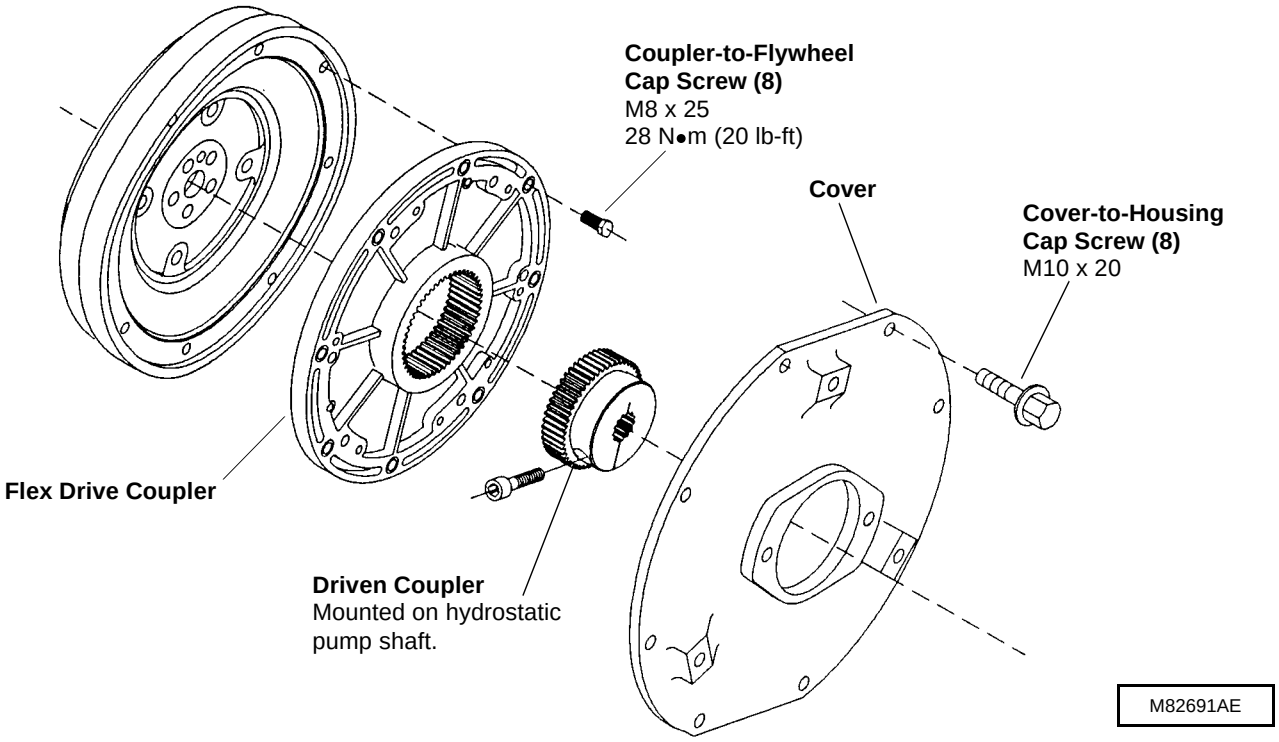
Bearing inserts are available in 0.25 mm (0.010 in.) undersize.

6. Clean and inspect oil passages in main bearing journals, connecting rod journals and main bearing bores in cylinder block.

7. Inspect crankshaft for cracks or damage. Replace if necessary.

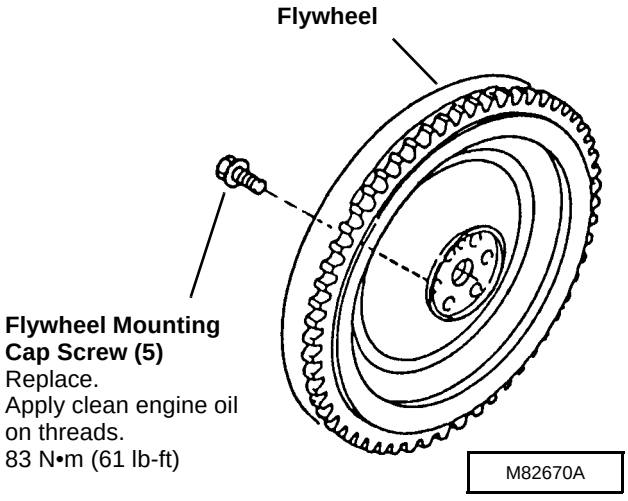
FLYWHEEL FLEX DRIVE COUPLER

Removal/Installation



FLYWHEEL

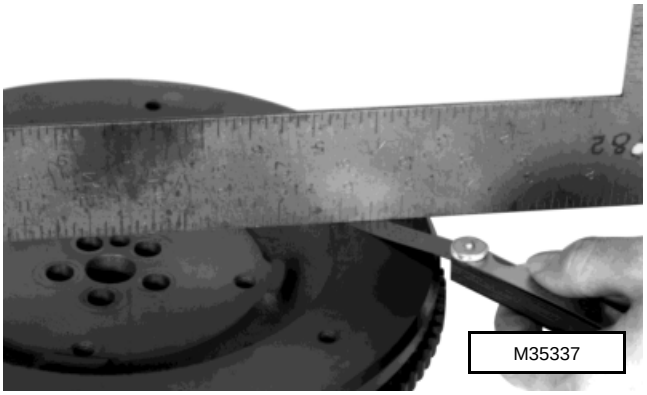
1. Remove flywheel flex drive coupler.
2. Remove starter.



3. Remove mounting cap screws and flywheel.

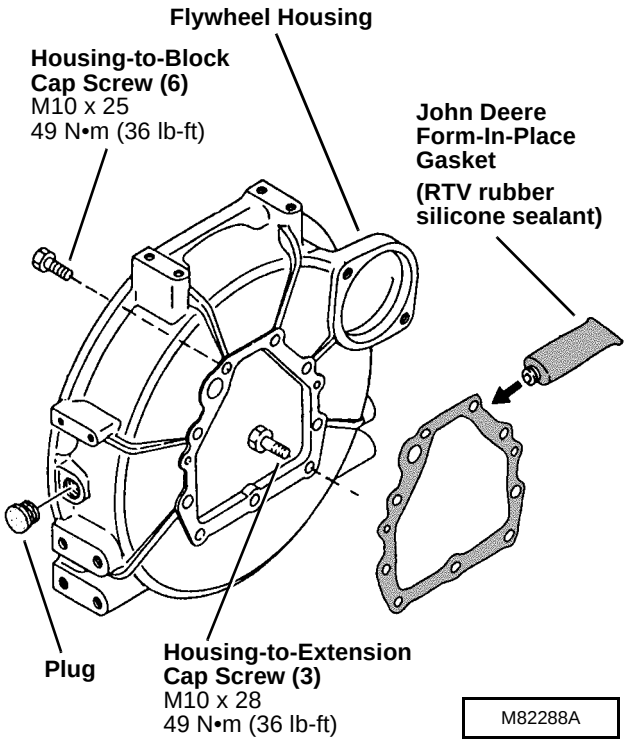
IMPORTANT: Never reuse flywheel mounting cap screws. Always install new.

- Measure flywheel flatness. Place a straight edge across flywheel surface opposite of ring gear. Measure clearance between straight edge and flywheel surface with a feeler gauge. If clearance exceeds **0.02 mm (0.0008 in.)**, replace flywheel.



FLYWHEEL HOUSING

- Remove flywheel.



CAMSHAFT

Removal

1. Remove rocker arm assembly and push rods.
2. Remove timing gear cover.
3. Check camshaft end play. (See *Checks, Tests and Adjustments* in this section.)
4. Check backlash of timing gears. (See *Checks, Tests and Adjustments* in this section.)

NOTE: If a magnetic follower holder kit is not available, turn engine until oil pan is upward, to hold cam followers away from camshaft.

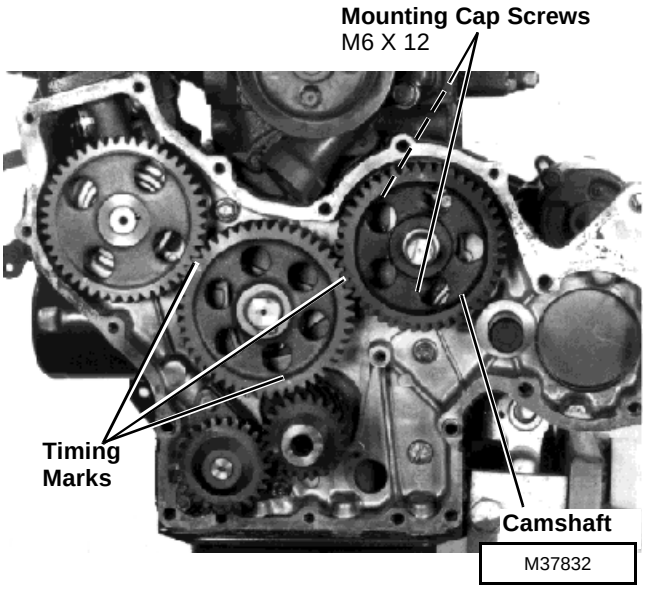
5. Hold cam followers away from camshaft using a magnetic follower holder kit such as D15001NU.

NOTE: Due to the odd number of teeth on the idler gear, timing marks will only align periodically.

6. Rotate crankshaft and align timing marks.

IMPORTANT: DO NOT allow camshaft lobes to hit bearing surfaces while removing camshaft. Machined surfaces can be damaged.

7. Remove two cap screws and camshaft.
8. Inspect all parts for wear or damage. (See *Inspection/Replacement* procedures.)



Installation

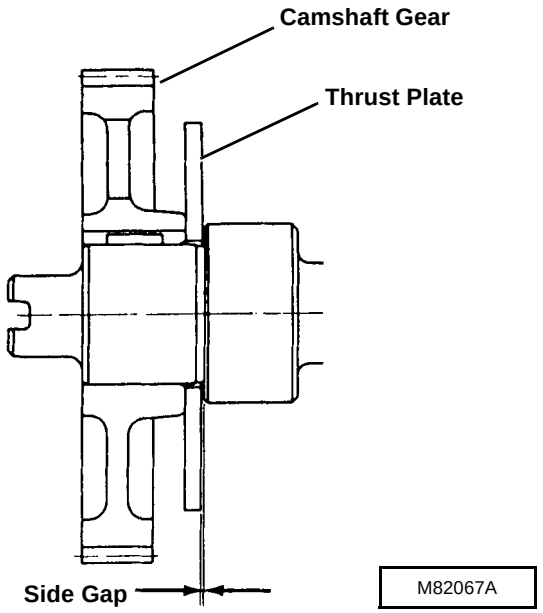
- Apply clean engine oil on all parts during installation.

IMPORTANT: DO NOT allow camshaft lobes to hit bearing surfaces while installing camshaft. Machined surfaces can be damaged.

1. Rotate crankshaft to align timing marks.
2. Install camshaft.
3. Install and tighten mounting cap screws to **11 N•m (96 lb-in.)**.
4. Install timing gear cover.
5. Install push rods and rocker arm assembly. (See *Cylinder Head, Valves and Manifolds* in this section.)

Inspection/Replacement

1. Check camshaft side gap using a feeler gauge.



If side gap is not within **0.05—0.25 mm (0.0020—0.0098 in.)**, remove gear and replace thrust plate.

2. Inspect gear for chipped or broken teeth. Replace if necessary.

To remove/replace gear:

Remove gear from camshaft using a knife-edge puller and a press.

C CAUTION

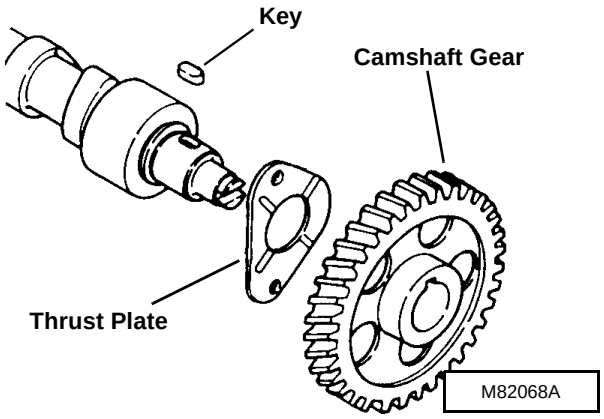
DO NOT heat oil over 182° C (360° F). Oil fumes or oil can ignite above 193° C (380° F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns

Heat gear to approximately 150°C (300°F).

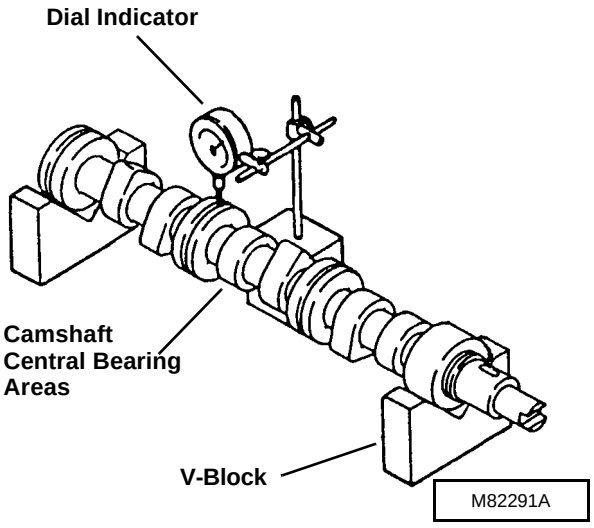
IMPORTANT: Be sure thrust plate is not between camshaft gear and camshaft shoulder while installing gear.

Install thrust plate if removed. Install gear with timing mark “C” side toward press table. Align slot in gear with key in shaft. Press camshaft into gear until gear is tight against camshaft shoulder.

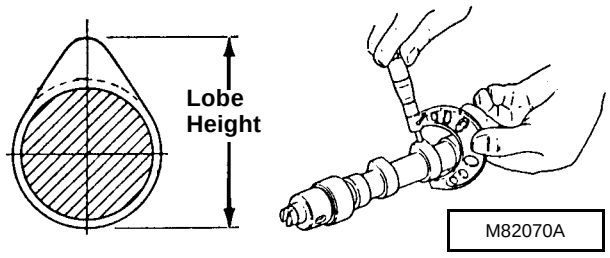
Thrust plate must spin freely on camshaft.



3. Inspect camshaft for bend using v-blocks and a dial indicator. Turn camshaft slowly and read variation on indicator. If variation is greater than **0.02 mm (0.001 in.)**, replace camshaft.



4. Measure camshaft lobe height.



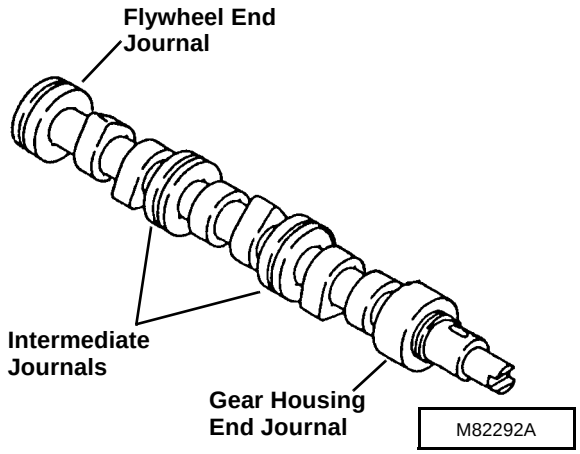
Lobe Height:

Standard . . . . . 29.97—30.03 mm (1.180—1.182 in.)

Wear Limit . . . . . 29.75 mm (1.171 in.)

If lobe height is less than wear limit, replace camshaft.

5. Measure camshaft end and intermediate journal diameters.



Camshaft Journal O.D.:

Gear Housing and Flywheel Ends

Standard . . . . . 35.94—35.96 mm (1.4150—1.4157 in.)

Wear Limit. . . . . 35.85 mm (1.4114 in.)

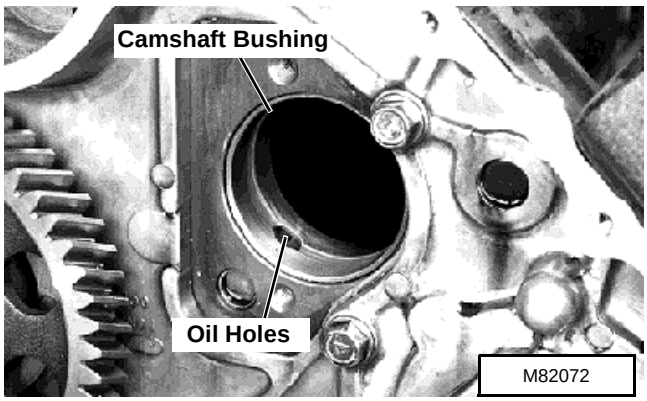
Intermediate

Standard . . . . . 35.91—35.94 mm (1.4138—1.4150 in.)

Wear Limit. . . . . 35.85 mm (1.4114 in.)

If journal diameters are less than wear limit, replace camshaft.

6. Measure camshaft bushing diameter at gear housing end.



Camshaft Bushing I.D.:

Standard . . . . . 36.00—36.065 mm (1.417—1.420 in.)

Wear Limit. . . . . 36.10 mm (1.421 in.)
Clearance . . . . . 0.18 mm (0.007 in.)

If bushing diameter exceeds wear limit, replace bushing.

If bushing clearance (bushing I.D. minus camshaft journal O.D.) exceeds specification, replace bushing, camshaft or both.

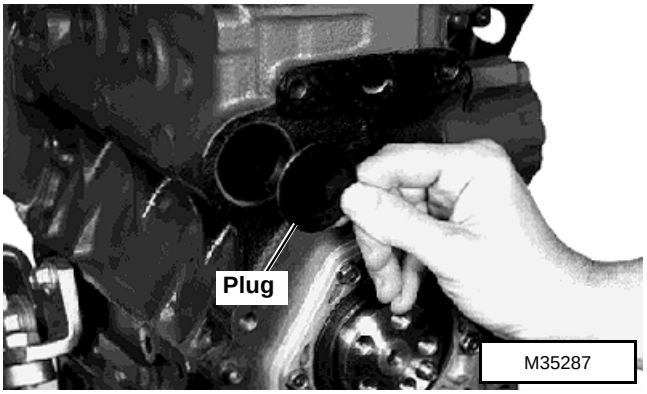
To replace bushing:

Remove bushing using a chisel. Be careful not to push bushing inside of engine. Align oil holes in new bushing and cylinder block. Install bushing using a driver set.

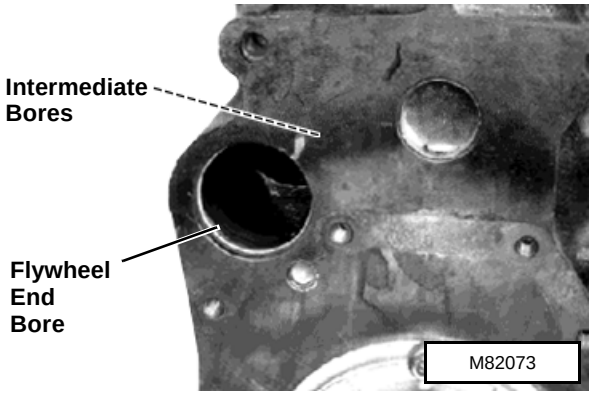
NOTE: Flywheel housing must be removed to measure camshaft intermediate and flywheel end bearing diameters.

7. Measure intermediate and flywheel end camshaft bore diameters using the following procedures:

- Remove flywheel housing.
- Remove plug using a long wooden dowel. Insert wooden dowel through gear housing side.



- Measure intermediate and flywheel end camshaft bore diameters.



Camshaft Bore I.D.:

Standard. . . . . 36.00—36.025 mm (1.417—1.418 in.)

Wear Limit . . . . . 36.10 mm (1.421 in.)
Clearance. . . . . 0.18 mm (0.007 in.)

If bore diameter exceeds wear limit, replace cylinder block.

If bore clearance (bore I.D. minus camshaft journal O.D.) exceeds specification, replace camshaft, cylinder block or both.

- Apply John Deere Form-In Place Gasket, or an equivalent, on outer edge of plug. Install plug until it bottoms in bore.

- Install flywheel housing.

CAM FOLLOWERS

Removal/Installation

1. Remove cylinder head.

IMPORTANT: Cam followers must be installed in the same bores from which they were removed.

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

3. Remove cam followers.

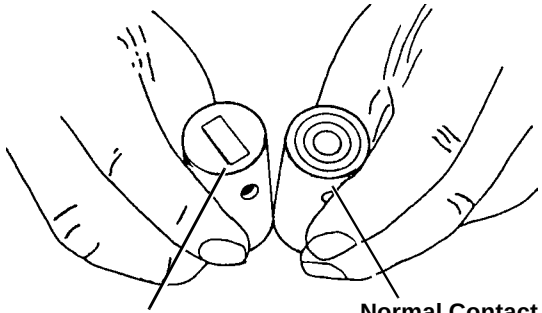
4. Inspect all parts for wear or damage. (See *Inspection* procedures.)

5. Apply clean engine oil on all parts during installation.

Installation is done in the reverse order of removal.

Inspection

- Inspect cam follower contact surface for abnormal wear. Replace if necessary.



M82293A

- Measure cam follower diameter.


M35268

Cam Follower O.D.:

Standard . . . . . 17.950—17.968 mm (0.7067—0.7074 in.)

Wear Limit . . . . . 17.93 mm (0.706 in.)

If diameter is less than wear limit, replace cam follower.

- Measure cam follower bore diameter in cylinder block.

Cam Follower Bore I.D.:

Standard . . . . . 18.00—18.018 mm (0.7087—0.7094 in.)

Wear Limit . . . . . 18.05 mm (0.711 in.)

Clearance . . . . . 0.032—0.068 mm (0.0013—0.0027 in.)

If cam follower bore diameter exceeds wear limit, replace cylinder block.

If bore clearance (bore I.D. minus follower stem O.D.) exceeds specification, replace cam follower, cylinder block or both.

TIMING GEAR COVER

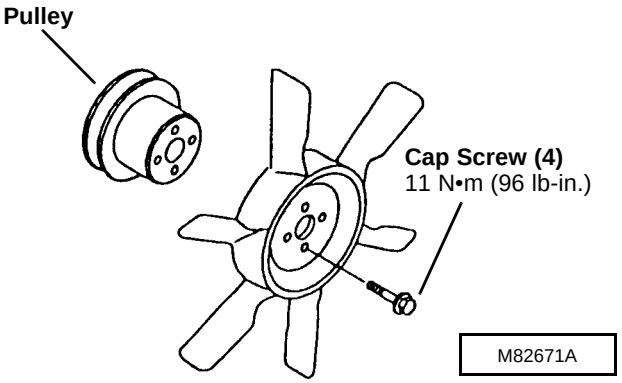
Removal/Installation

1. Remove alternator and belt.

2. Remove fan and pulley.

3. Remove crankshaft pulley cap screw and washer.

4. Remove crankshaft pulley using a two-jaw puller kit.

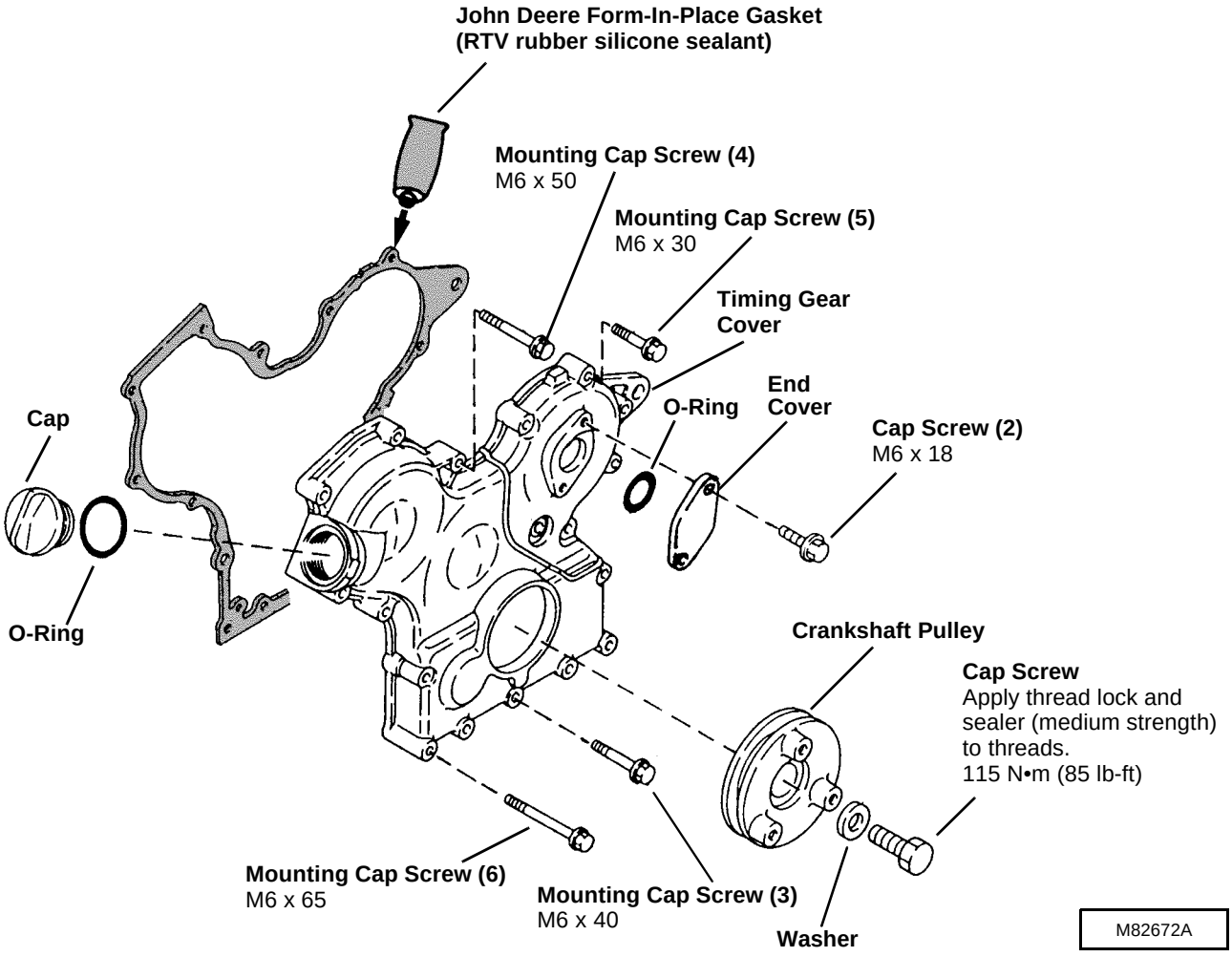


NOTE: It is not necessary to remove end cover and o-ring to remove timing gear cover.

5. Remove 18 mounting cap screws and timing gear cover.

Installation is done in the reverse order of removal.

- Tighten all mounting cap screws to **9 N•m (78 lb-in.)**
- Adjust fan/alternator drive belt tension. (See *Checks, Tests and Adjustments* in this section.)



IDLER GEAR

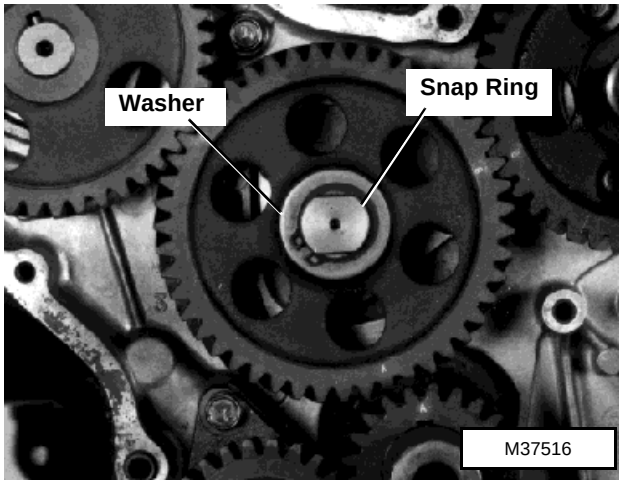
Removal/Installation

1. Remove timing gear cover.
2. Check backlash of timing gears. (See *Checks, Tests and Adjustments* in this section.)

NOTE: Due to the odd number of teeth on the idler gear, timing marks will only align periodically. When all timing marks on gears are aligned, the piston closest to the water pump is at TDC on compression stroke. Number one cylinder is closest to the flywheel.

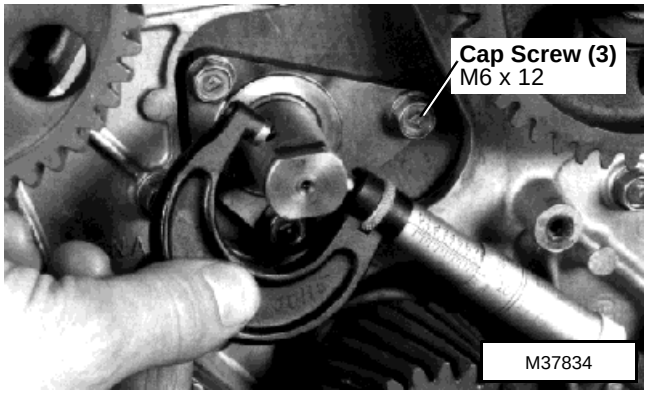
3. Rotate crankshaft and align timing marks.
4. Remove snap ring, washer and gear.
5. Inspect all parts for wear or damage. (See *Inspection/Replacement* procedures.)

Installation is done in the reverse order of removal.



Inspection/Replacement

- Inspect gear for chipped or broken teeth. Replace if necessary.
- Measure idler gear shaft diameter.



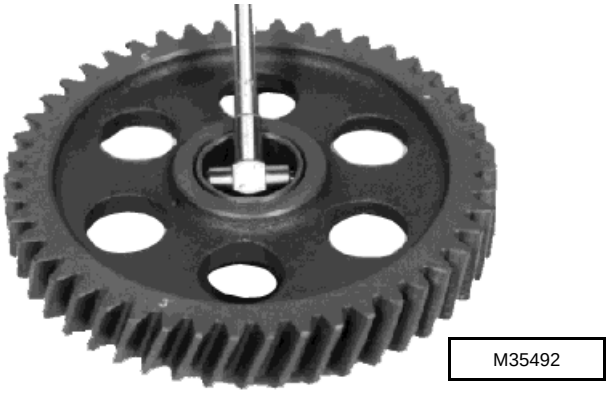
Idler Gear Shaft O.D.:

Standard . . . . . 19.959—19.980 mm (0.786—0.787 in.)

Wear Limit . . . . . 19.93 mm (0.785 in.)

If shaft diameter is less than wear limit, remove three cap screws and replace idler gear shaft.

- Measure idler gear bushing diameter.



Idler Gear Bushing I.D.:

Standard . . . . . 20.00—20.021 mm (0.787—0.788 in.)

Clearance . . . . . 0.020—0.062 (0.008—0.0024 in.)

If bushing diameter is not within specifications, replace bushing.

To replace bushing:

Replace bushing using a driver set. Align oil holes in bushing and idler gear. Install bushing flush with surface of idler gear.

If bushing clearance (bushing I.D. minus shaft O.D.) exceeds specification, replace bushing, shaft or both.

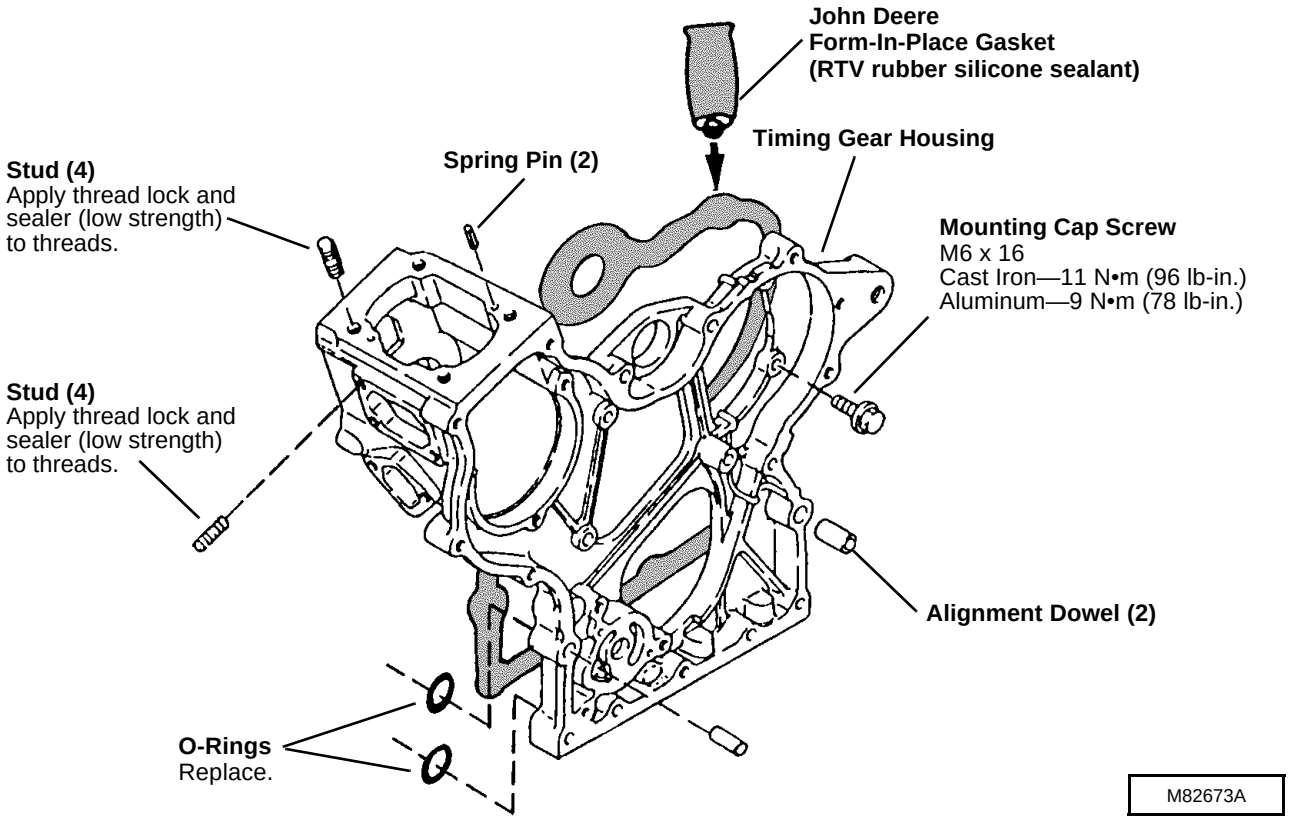
TIMING GEAR HOUSING

Removal/Installation

1. Remove the following:
   - Idler gear.
   - Injection pump camshaft.
   - Engine camshaft.
   - Oil pump.
   - Water pump.
   - Mounting cap screws and housing.

Installation is done in the reverse order of removal.

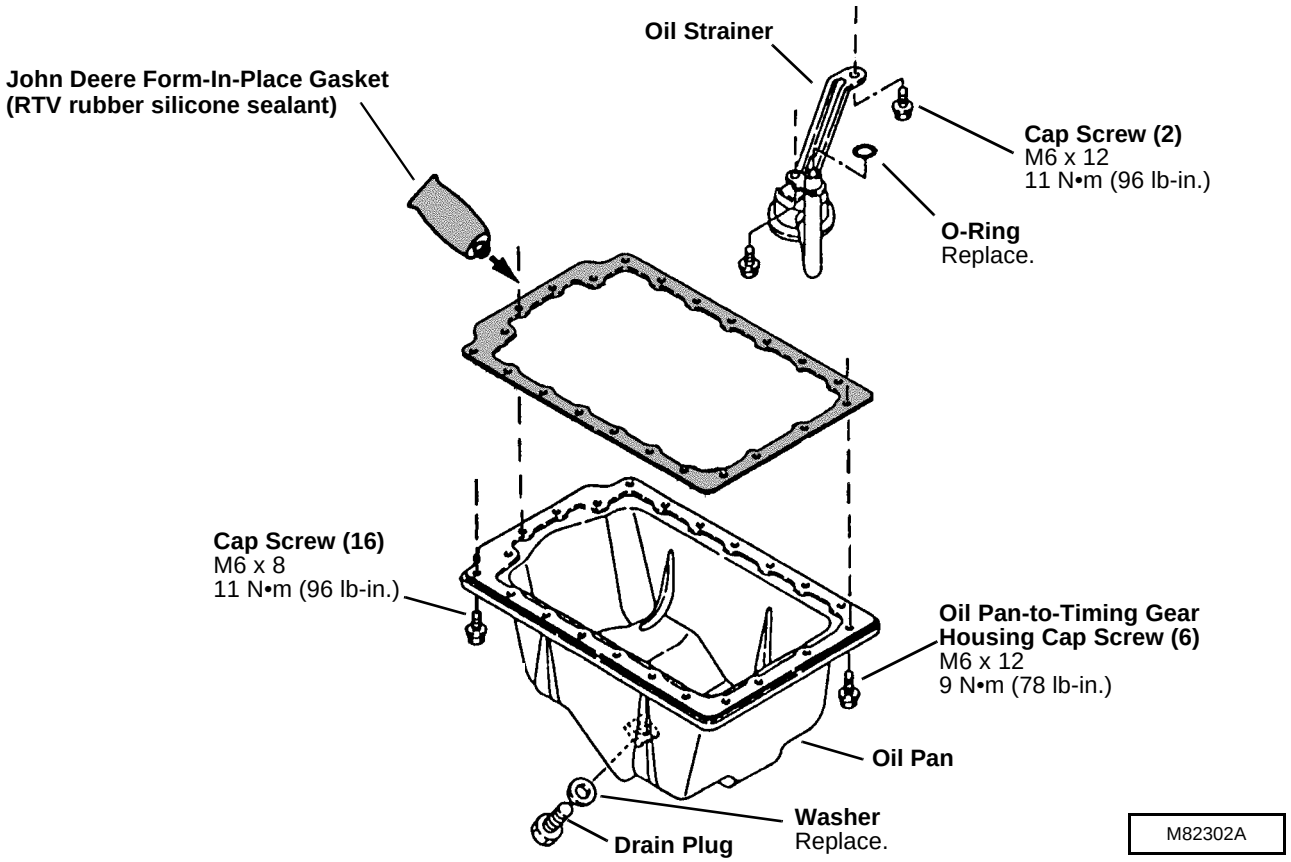
- Replace O-rings.


John Deere
Form-In-Place Gasket
(RTV rubber silicone sealant)
Timing Gear Housing
Spring Pin (2)
Stud (4)
Apply thread lock and sealer (low strength) to threads.
Mounting Cap Screw
M6 x 16
Cast Iron—11 N•m (96 lb-in.)
Aluminum—9 N•m (78 lb-in.)
Stud (4)
Apply thread lock and sealer (low strength) to threads.
Alignment Dowel (2)
O-Rings
Replace.
M82673A

OIL PAN AND STRAINER

Removal/Installation

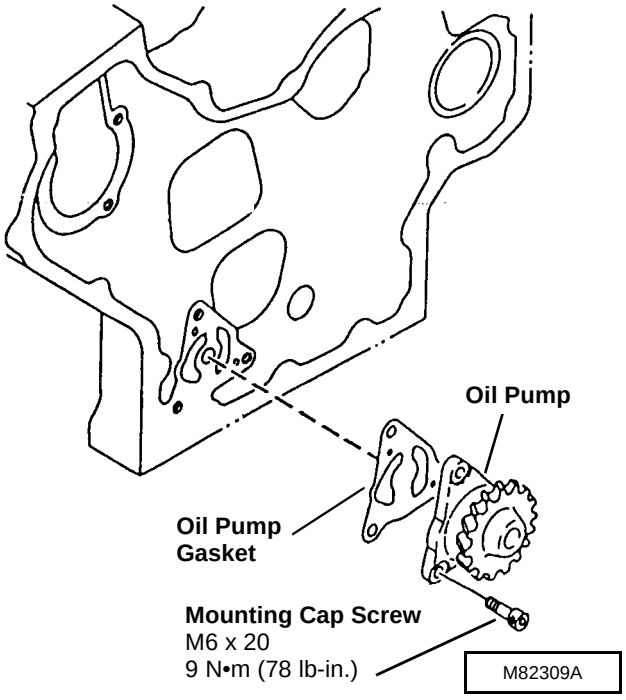
- Approximate crankcase oil capacity is 2.4 L (2.5 qt).
- Fill engine with proper engine oil. (See *SPECIFICATIONS AND GENERAL INFORMATION* section.)



OIL PUMP

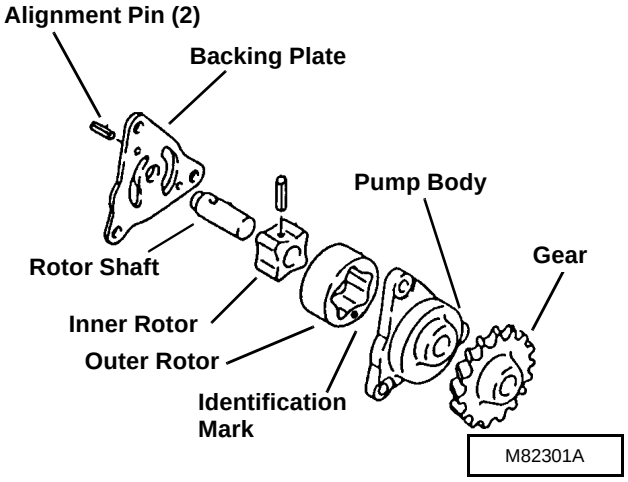
Removal/Installation

1. Remove timing gear cover.
2. Check oil pump gear backlash. Replace entire oil pump assembly if backlash is more than **0.25 mm (0.010 in.)**.
3. Remove four mounting cap screws, oil pump and gasket.
4. Inspect all parts for wear or damage. (See *Disassembly/Assembly* procedures).



Disassembly/Assembly

- Gear is press fit on rotor shaft. Remove gear using a knife edge puller and a press.
- Inspect parts for wear or damage. (See *Inspection* procedures.)
- Coat all parts with clean engine oil.
- Install outer rotor with identification mark facing toward rotor shaft assembly.



Inspection

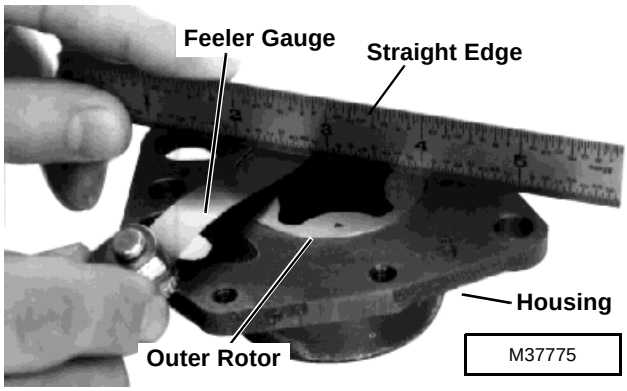
- Check rotor shaft outer diameter and the shaft hole diameter in backing plate. If clearance is more than wear limit, replace entire assembly.

Rotor Shaft and Plate Clearance:

Standard . . . . . 0.013—0.043 mm (0.0006—0.0017 in.)

Wear Limit . . . . . 0.20 mm (0.0078 in.)

- Check rotor recess. If rotors are below face of pump housing more than specifications, replace rotor assembly.

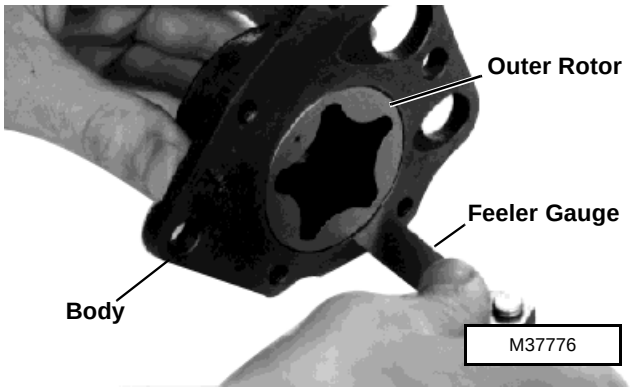


Rotor Recess Clearance:

Standard . . . . . 0.03—0.09 mm (0.0011—0.0035 in.)

Wear Limit. . . . . 0.13 mm (0.0051 in.)

- Check outer rotor-to-pump body clearance. If clearance is more than wear limit, replace entire assembly.

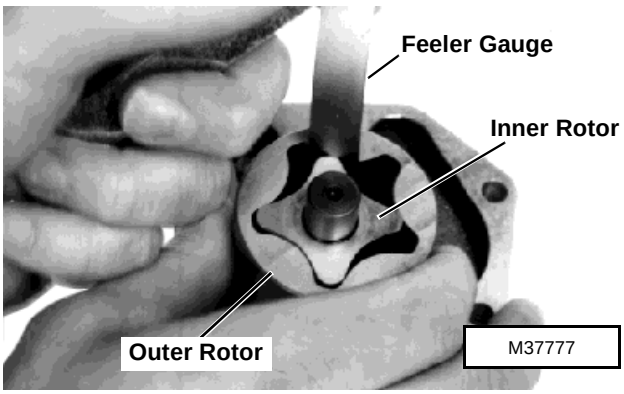


Outer Rotor-to-Pump Body Clearance:

Standard . . . . . 0.10—0.16 mm (0.0039—0.0063 in.)

Wear Limit. . . . . 0.25 mm (0.0010 in.)

- Check inner-to-outer rotor clearance. If clearance is more than **0.15 mm (0.0059 in.)**, replace rotor assembly.



OIL PRESSURE REGULATING VALVE

Removal/Installation

1. Remove oil filter and o-ring.
2. Remove retaining nut and valve assembly.
3. If adjusting pressure only, remove cap and add shims. Each 1 mm (0.039 in.) of shim thickness increases oil pressure 13.8 kPa (2 psi).

NOTE: Valve components are not serviced individually. Replace complete regulating valve if any components are defective.

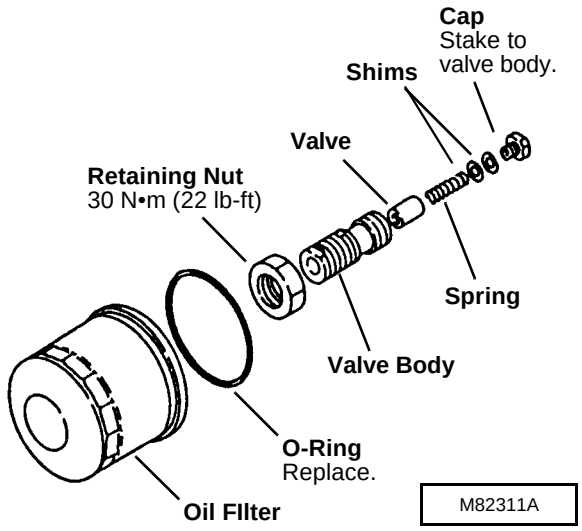
4. Inspect all parts for wear or damage. Replace complete valve if necessary.
5. Check spring free and compressed lengths.

Spring Specifications:

Free Length . . . . . 21.90—24.50 mm (0.860—0.960 in.)

Compressed Length . . . . . 14.70 mm (0.580 in.) @12 N (2.7 lb-force)

Installation is done in the reverse order of removal.

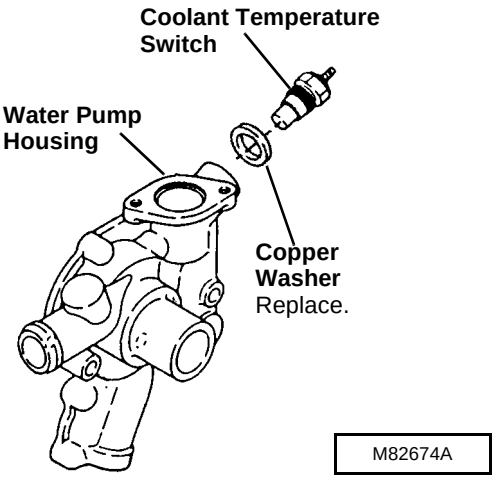


COOLANT TEMPERATURE SWITCH

Replacement

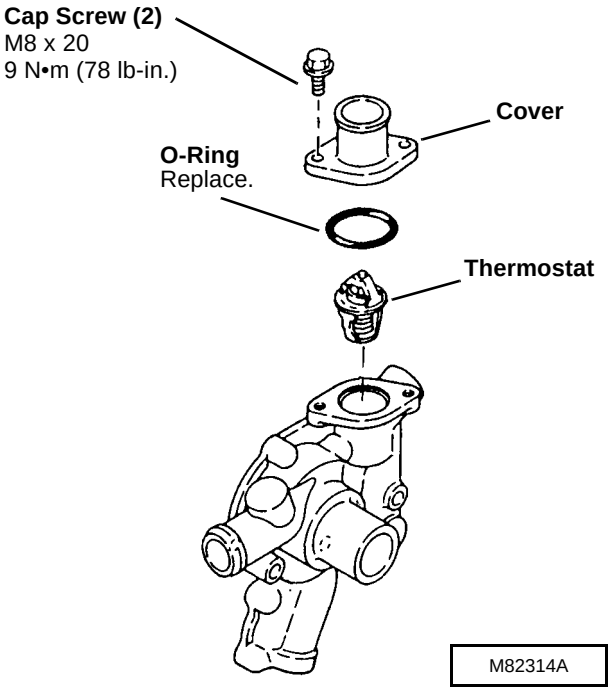
1. Open engine drain valve to drain coolant.
2. Remove switch and washer.
3. Test switch. (See *Checks, Tests and Adjustments* in this section.)

Installation is done in reverse order of removal.



THERMOSTAT

- Replace gaskets.
- Test thermostat. (See *Checks, Tests and Adjustments* in this section.)



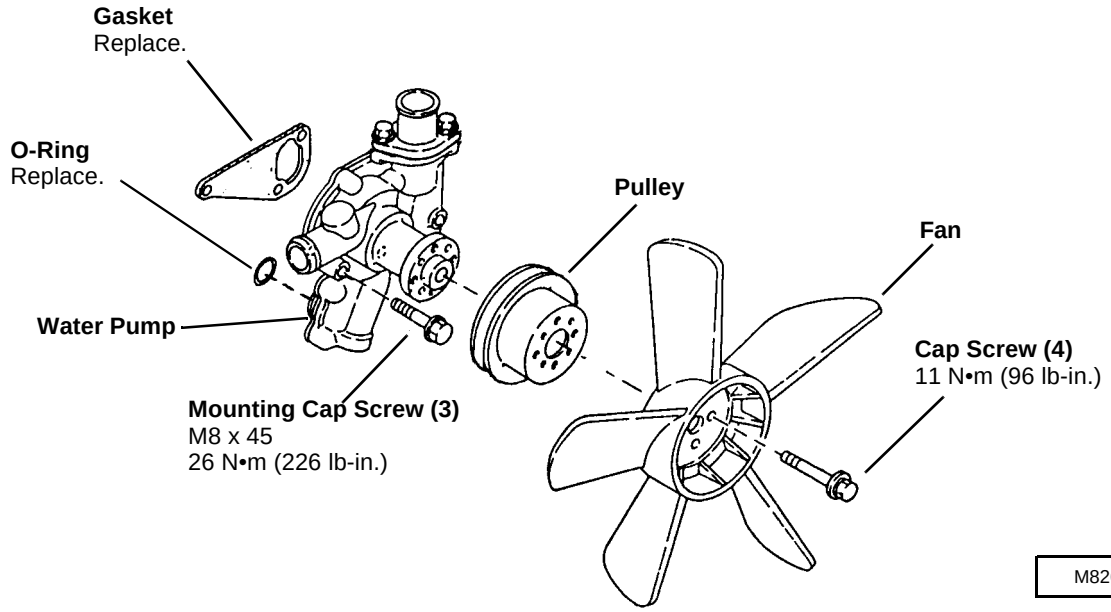
WATER PUMP

Removal/Installation

1. Open engine drain valve to drain coolant.
2. Remove fan/alternator drive belt.
3. Remove fan and pulley.
4. Remove three mounting cap screws, pump and gasket.
5. Inspect all parts for wear or damage. (See *Disassembly/Assembly* procedures.)

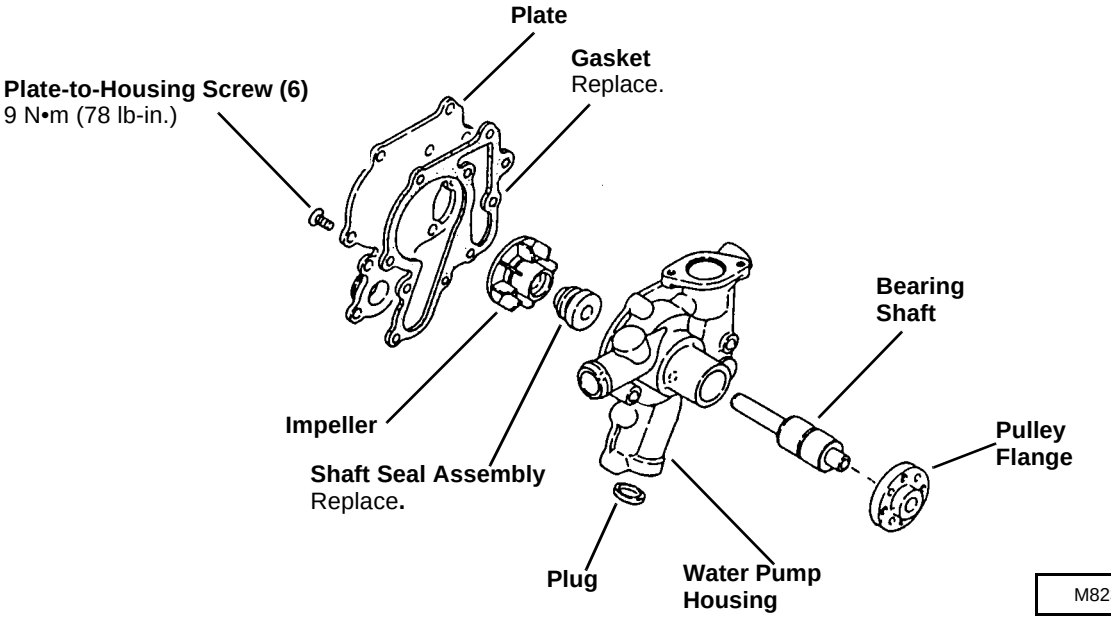
Installation is done in the reverse order of removal.

- Adjust fan/alternator drive belt tension. (See *Checks, Tests and Adjustments* in this section.)

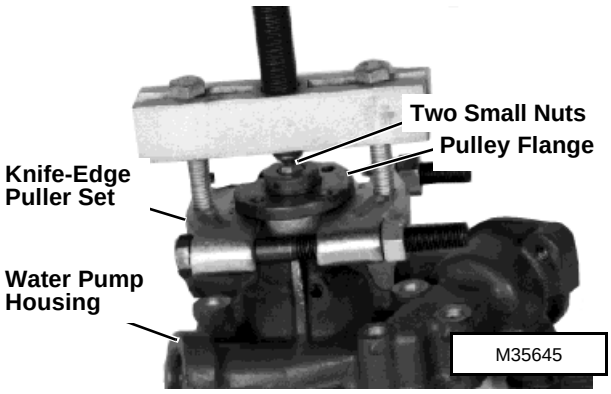


Disassembly

1. Remove thermostat.
2. Remove coolant temperature switch.
3. Apply heat to six plate-to-housing screws. Remove screws, plate and gasket.



4. Remove flange using a knife-edge puller set and two small nuts.



5. Place water pump assembly on a press table. Install supports under water pump housing, staying clear of impeller. Press bearing shaft assembly through water pump housing using a piece of pipe or a deep socket.

IMPORTANT: Impeller bore is tapered. When pressing bearing shaft from impeller, allow enough clearance between cap screw and impeller bore to prevent cap screw from binding.

6. Remove impeller from bearing shaft using a knife-edge puller, a 3/8 in. cap screw and a press.

7. Remove shaft seal assembly; (seal, ceramic seal and seal cup).

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

Assembly

1. Install bearing shaft into pump housing, long end down, using a piece of pipe or deep socket, press shaft into pump housing until bearing surface is flush with pump housing surface.

2. Install new shaft seal over impeller side of bearing shaft, rubber seal side away from pump housing. Push shaft seal into pump housing, until it stops, using a 25 mm or 1 in. socket and a press.

IMPORTANT: Support pump housing on bearing shaft only. DO NOT support on housing or damage to housing will occur.

3. Place water pump housing on a press table. Support housing on bearing shaft using a driver disk. Install pulley flange onto shaft with straight hub facing away from housing.

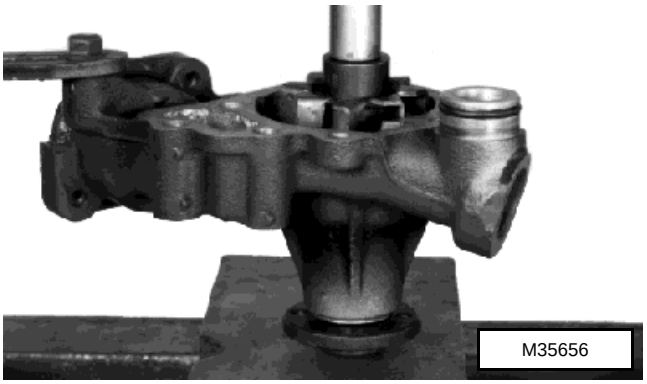
   Press pulley flange onto bearing shaft until flange is flush with end of shaft.

IMPORTANT: DO NOT touch lapped sealing surface of ceramic seal with bare hands. It must be clean and dry.

4. Install seal cup and ceramic seal in impeller.

5. Install a knife-edge puller around bearing shaft, between pulley flange and pump housing. Place pump housing, with knife-edge puller down, on a press table. Install impeller with ceramic seal toward shaft seal.

   Press impeller on bearing shaft until top of impeller is even with end of shaft.



6. Install new gasket, plate and six screws. Tighten to specifications.

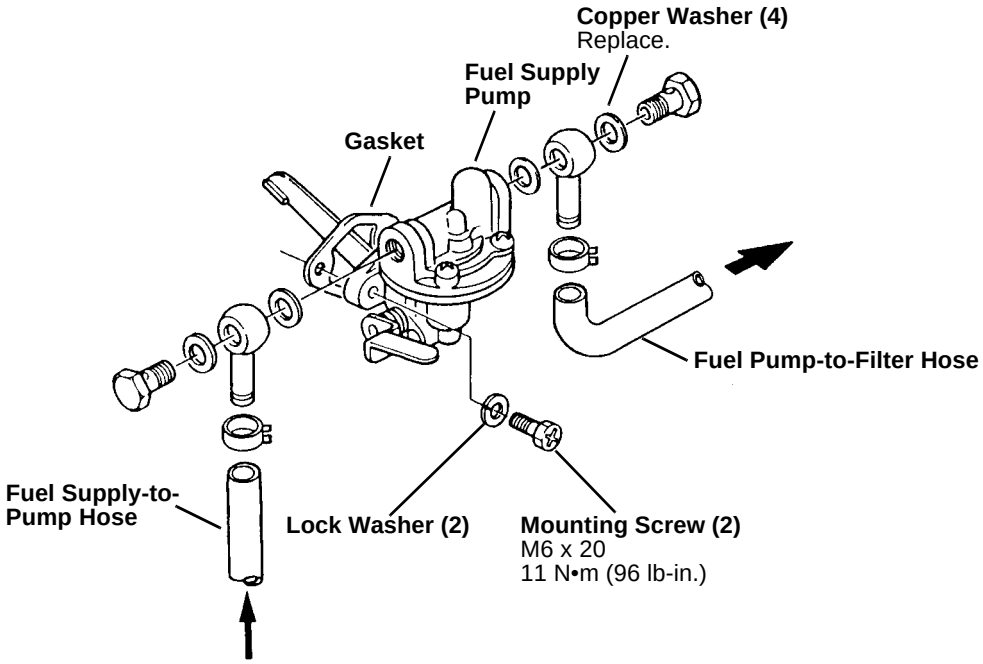
7. Install coolant temperature switch.

8. Install thermostat.

FUEL SUPPLY PUMP

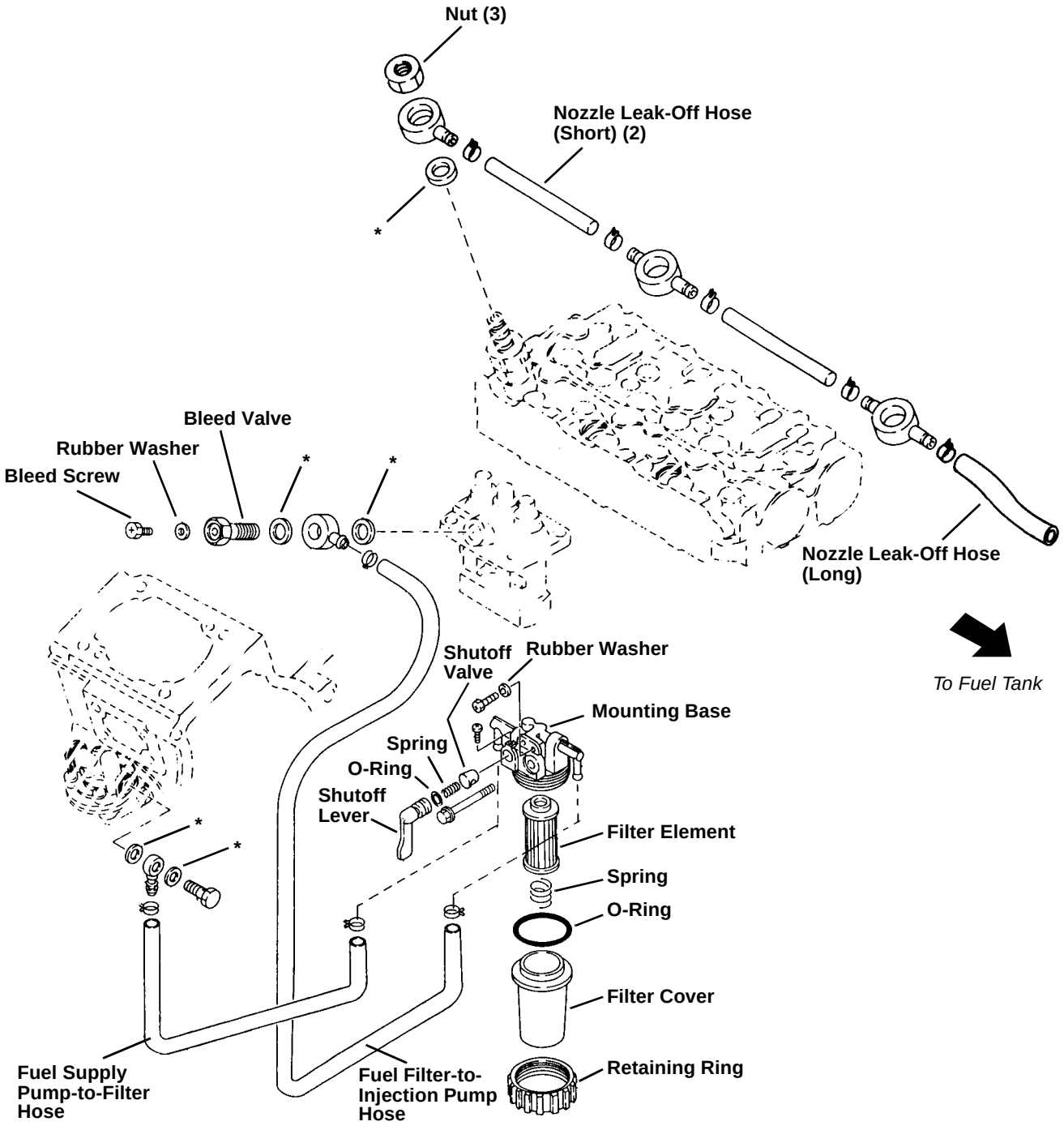
Replacement

IMPORTANT: Replace all copper washers. Damaged or used washers may leak.



FUEL FILTER ASSEMBLY

IMPORTANT: Replace all copper washers. Damaged or used washers may leak.



FUEL INJECTION PUMP

Removal

c CAUTION y

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 knowledgable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

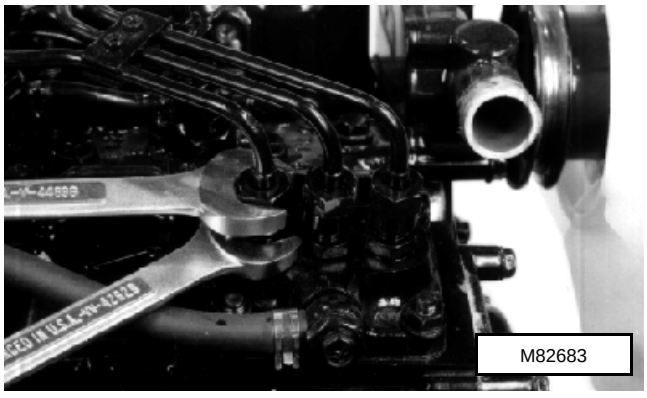
IMPORTANT: Never steam clean or pour cold water on injection pump while the pump is running or warm. Doing so can damage the pump.

1. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner.

IMPORTANT: When removing injection lines, DO NOT turn pump delivery valve fittings. Turning fittings may damage pump internally.

2. Loosen fuel injection line connectors slightly to release pressure in the fuel system. When loosening connectors, use another wrench to keep delivery valves from loosening.

3. Loosen line clamp and remove fuel injection lines.

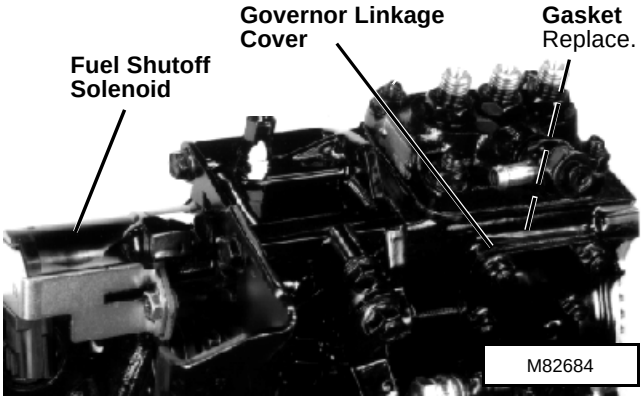


4. Disconnect hose from supply pump.

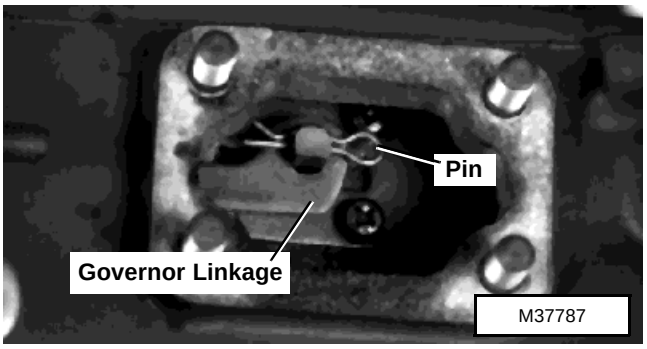
5. Disconnect leak-off hoses to/from injection pump.

6. Remove two cap screws to remove fuel shutoff solenoid.

7. Remove four nuts, cover and gasket.

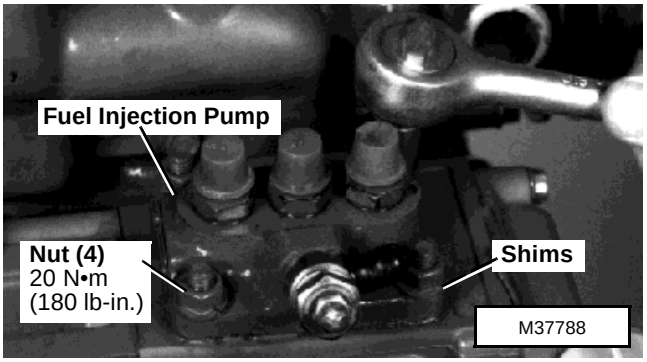


8. Remove pin and washer, if equipped. Disconnect governor linkage.



IMPORTANT: If injection pump is being removed to be serviced or replaced, the same number and thickness of new shims must be installed when pump is assembled.

9. Remove four nuts to remove fuel injection pump and shims.



DO NOT attempt to service the injection pump except for fuel delivery valves. If unit is in need of repair, it must be serviced by a qualified fuel injection repair shop. If replacement is necessary, replace entire unit.

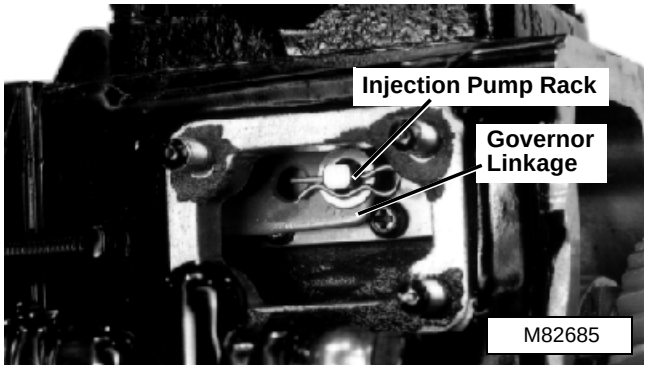
Installation

Installation is done in the reverse order of removal.

IMPORTANT: If a serviced or replacement fuel injection pump is installed, measure old shim thickness and install new shims of the same thickness.

NOTE: Governor linkage may have two holes. Connect governor linkage to injection pump rack using hole closest to injection pump gear.

- When connecting governor linkage to injection pump rack, attach link to rack at hole closest to injection pump gear.

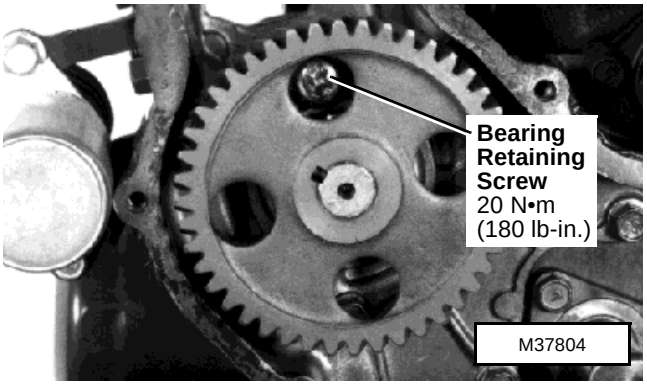


- Bleed the fuel system. (See *Checks, Tests and Adjustments* in this section.)
- If new injection pump is being installed, check and adjust injection pump timing. (See *Checks, Tests and Adjustments* in this section.)

FUEL INJECTION PUMP CAMSHAFT

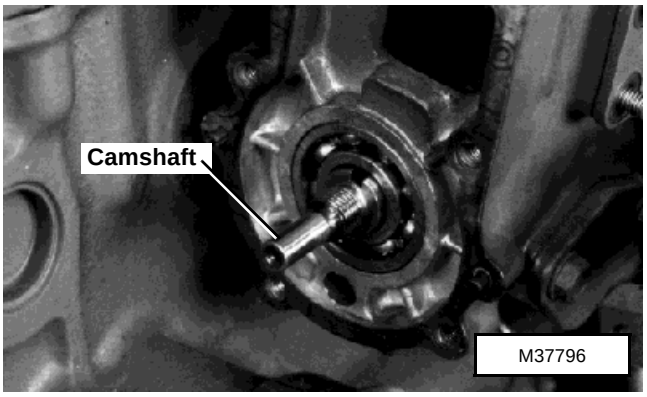
Removal

1. Remove fuel injection pump.
2. Remove fuel supply pump.
3. Remove fuel control and governor linkage.
4. Remove idler gear.
5. Remove bearing retaining screw.



IMPORTANT: DO NOT allow fuel injection pump camshaft lobes to hit bearing surfaces while removing camshaft. Machined surfaces may be damaged.

6. Tap the rear of camshaft with plastic hammer to remove from housing.

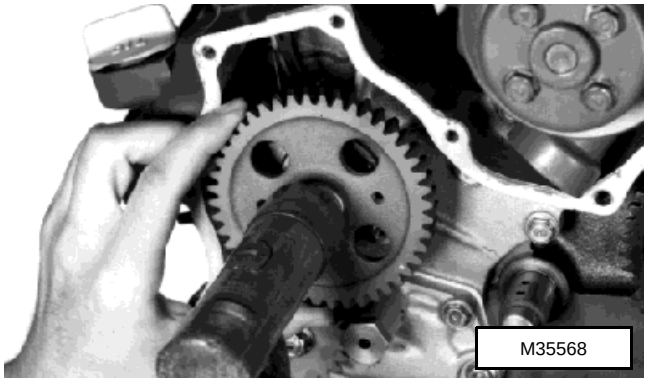


7. Disassemble and inspect all parts for wear or damage. (See *Disassembly* and *Inspection* procedures.)

Installation

Installation is done in reverse order of removal.

- After installing camshaft assembly into housing, tap on end of camshaft gear with a plastic hammer to seat bearings in bores.



Disassembly

NOTE: Gear and bearings are press fit on shaft.

IMPORTANT: Hold camshaft while removing gear and bearings. Shaft can be damaged if dropped.

1. Remove gear using knife edge puller and a press.
2. Remove key.

3. Remove bearings using a knife edge puller and a press.
4. Inspect all parts for wear or damage. (See *Inspection* procedures.)

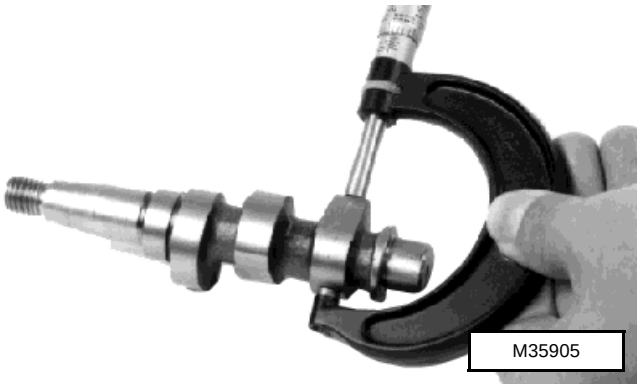
Assembly

NOTE: Install large bearing on gear end.

1. Install bearings on ends of camshaft using a 3/4 in. deep well socket and a press. Press until bearing races bottom on camshaft shoulders.
2. Install key.
3. Put camshaft gear on a flat surface and press camshaft assembly into gear. Press until gear face is flush with end of shaft.

Inspection

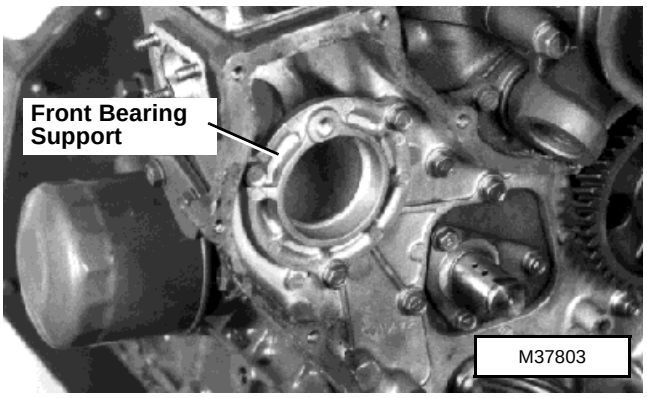
- Measure height of each camshaft lobe. Replace camshaft if lobe height is less than **30.90 mm (1.217 in.)**.



- Inspect camshaft bearing supports in timing gear housing. Check for cracks, damage or indications that bearings have spun in support.

- If rear bearing bore is damaged, replace timing gear housing.

- If front bearing bore is damaged, remove three cap screws and replace support.

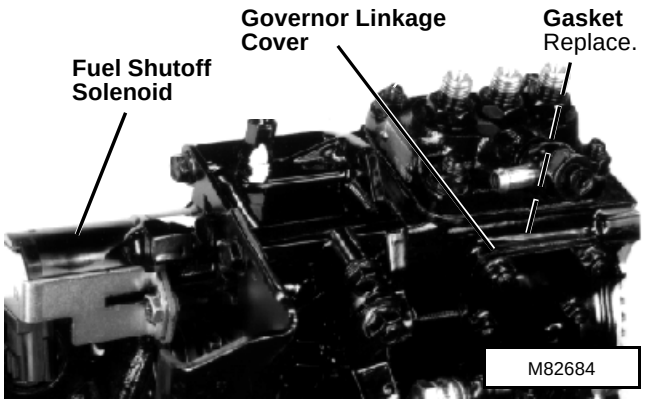


- Inspect all parts for wear or damage. Replace as necessary.

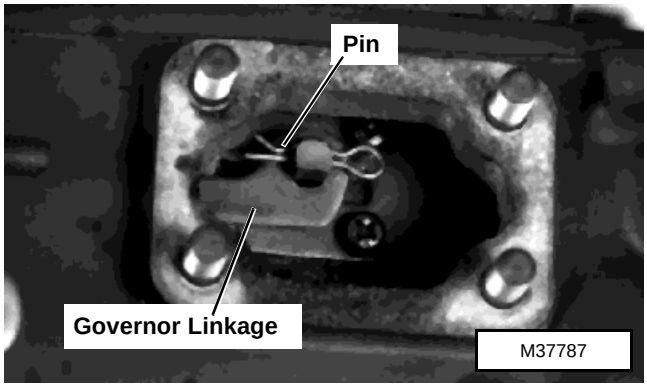
FUEL CONTROL AND GOVERNOR LINKAGE

Removal

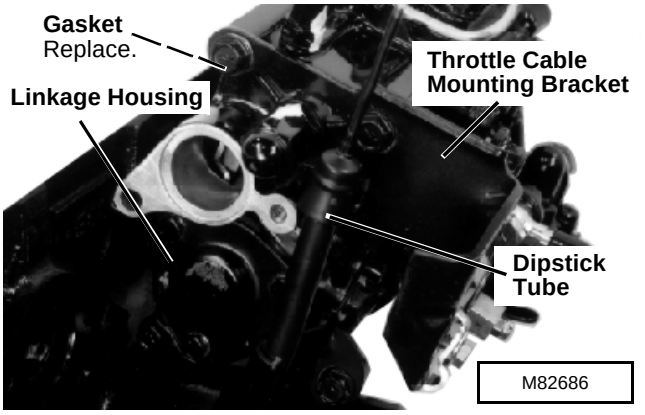
1. Disconnect fuel shutoff solenoid.
2. Remove two cap screws and shutoff solenoid.
3. Remove four nuts, cover and gasket.



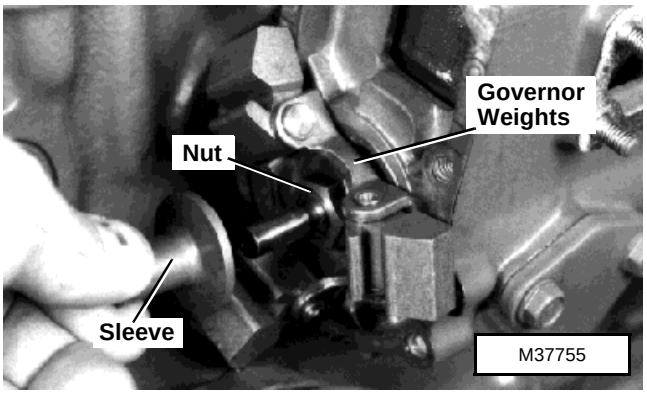
4. Remove pin and washer, if equipped, to disconnect governor linkage.



5. Remove dipstick tube.
6. Remove three cap screws and throttle cable mounting bracket.
7. Remove three cap screws, linkage housing and gasket.



8. Remove sleeve.
9. Remove nut and governor weights.



10. Disassemble and inspect all parts for wear or damage. (See *Disassembly* and *Inspection* procedures.)

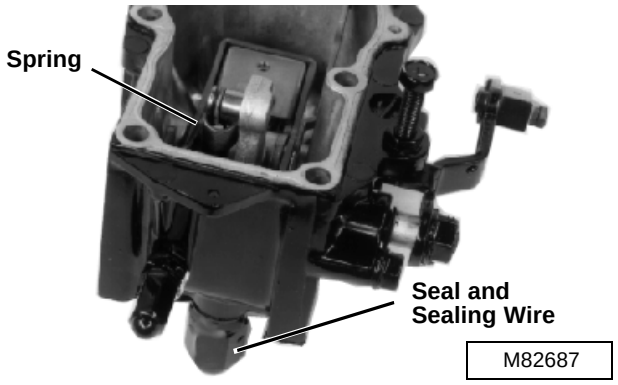
Installation

Installation is done in the reverse order of removal.

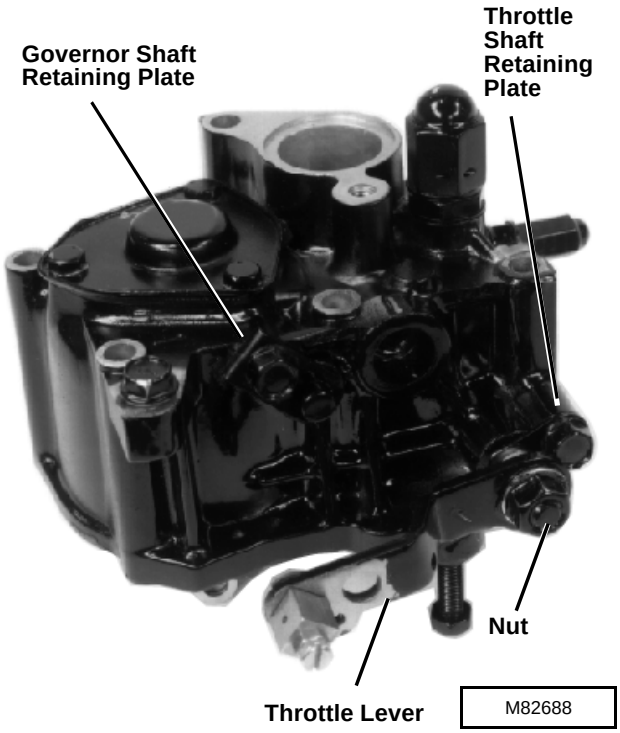
- Governor linkage may have two holes. Connect governor linkage to injection pump rack using hole closest to injection pump gear.
- Adjust fuel shutoff solenoid. (See *Checks, Tests and Adjustments* in this section.)
- Check and adjust slow and fast idle settings. (See *Checks, Tests and Adjustments* in this section.)

Disassembly

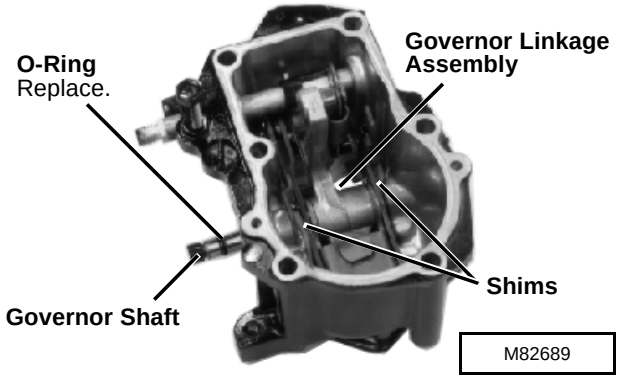
1. Remove spring.
2. remove seal and sealing wire.



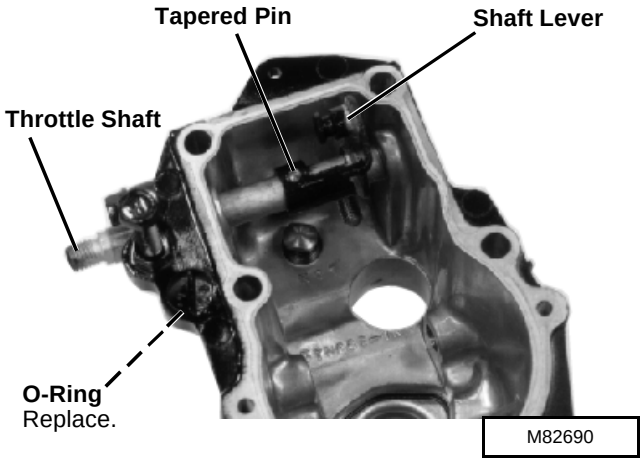
3. Remove nut and throttle lever.
4. Remove cap screw and throttle shaft retaining plate.
5. Remove cap screw and governor shaft retaining plate.



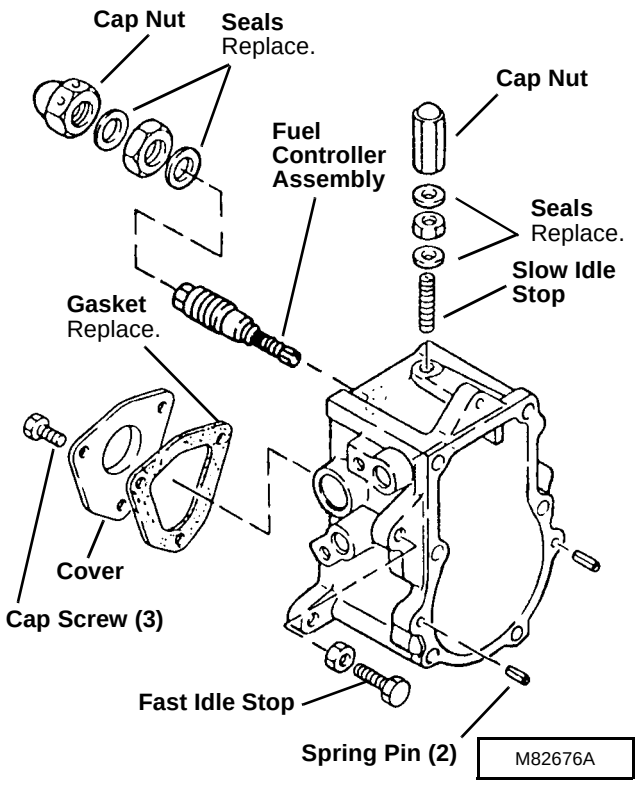
6. Remove governor shaft, governor linkage assembly, shims and O-ring.



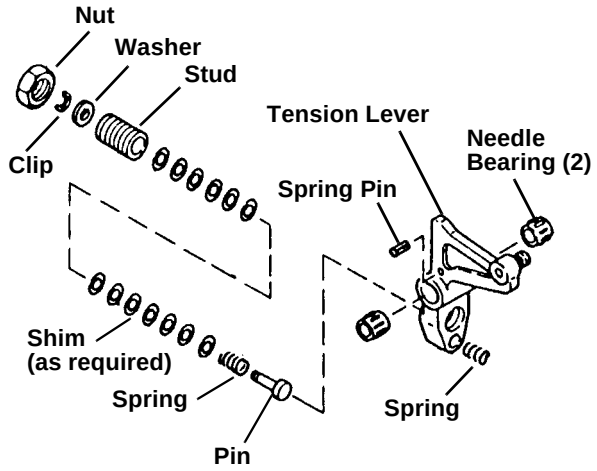
7. Rotate throttle shaft assembly as shown.
8. Remove tapered pin from tapered hole using a punch.
9. Remove throttle shaft, shaft lever and O-ring.

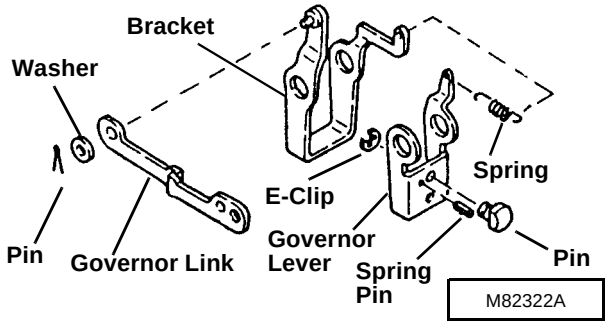


10. Remove cover, gasket, fuel controller assembly, fast idle stop and slow idle stop.



11. Disassemble governor linkage assembly.





12. Inspect all parts for wear or damage. Replace as necessary. (See *Inspection* procedures.)

Assembly

Assembly is done in the reverse order of disassembly.

- Apply clean engine oil on all internal parts.
- When installing throttle shaft:
  - Install new O-ring, throttle shaft and shaft lever.
  - Install tapered pin in tapered hole.
- Seal and sealing wire are not installed until governor linkage housing installation procedures have been completed and fast and slow idle adjustments have been made. Idle adjustments are made after engine has been installed in the machine.

Inspection

1. Measure governor shaft diameter. If O.D. is less than **8.01 mm (0.315 in.)**, replace governor shaft.

2. Measure governor shaft bore diameter in governor linkage.

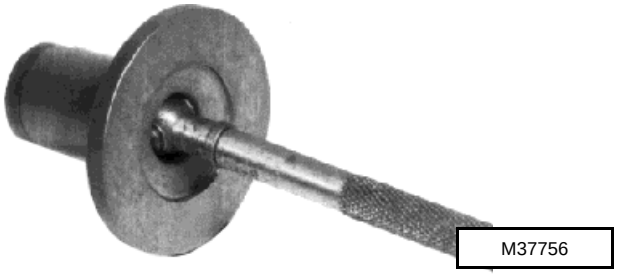
Governor Shaft Bore I.D.:

Wear Limit . . . . . 8.50 mm (0.299 in.)
Clearance . . . . . 0.09 mm (0.003 in.)

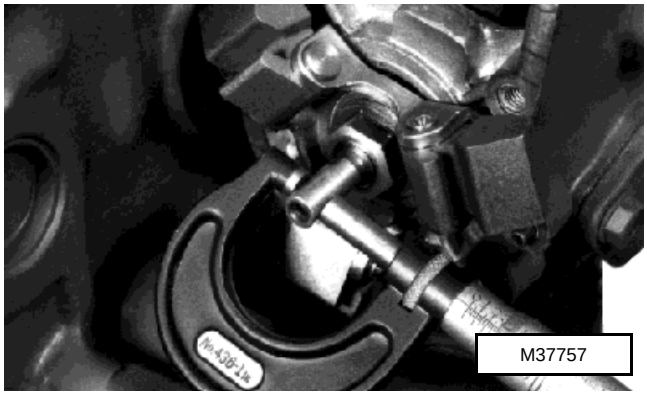
If shaft bore exceeds wear limit, replace governor linkage.

If bore clearance (bore I.D. minus shaft O.D.) exceeds specification, replace governor shaft, governor linkage or both.

3. Measure inside diameter of sleeve. If I.D. is **more than 9.00 mm (0.354 in.)**, replace sleeve.


M37756

4. Measure injection pump camshaft diameter.


M37757

Injection Pump Camshaft O.D.:

Wear Limit . . . . . 7.90 mm (0.311 in.)
Clearance . . . . . 0.15 mm (0.006 in.)

If camshaft diameter is less than wear limit, replace injection pump camshaft.

If clearance (sleeve I.D. minus camshaft O.D.) exceeds specification, replace sleeve, injection pump camshaft or both.

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

FUEL INJECTION NOZZLES (PINTLE-TYPE)

Removal/Installation

IMPORTANT: Never steam clean or pour cold water on injection pump while the pump is running or warm. Doing so can damage the pump.

1. Clean the injection pump lines and area around the pump using a parts cleaning solvent or steam cleaner.

NOTE: Nozzles are matched to the cylinders. If removing more than one nozzle, tag nozzles, according to the cylinder from which it was removed.

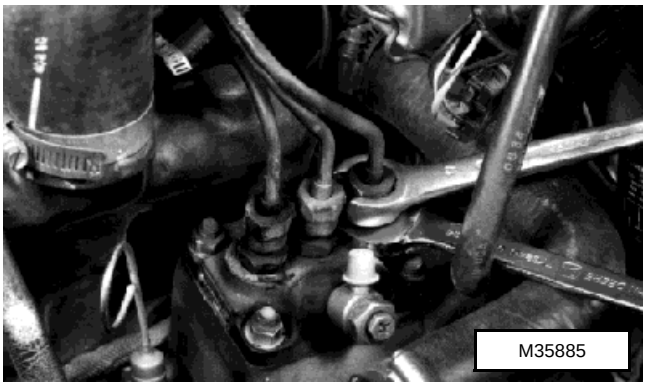
c CAUTION y

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 knowledgable source. Such information is available from the Deere & Company Medical Department in Moline, Illinois, U.S.A.

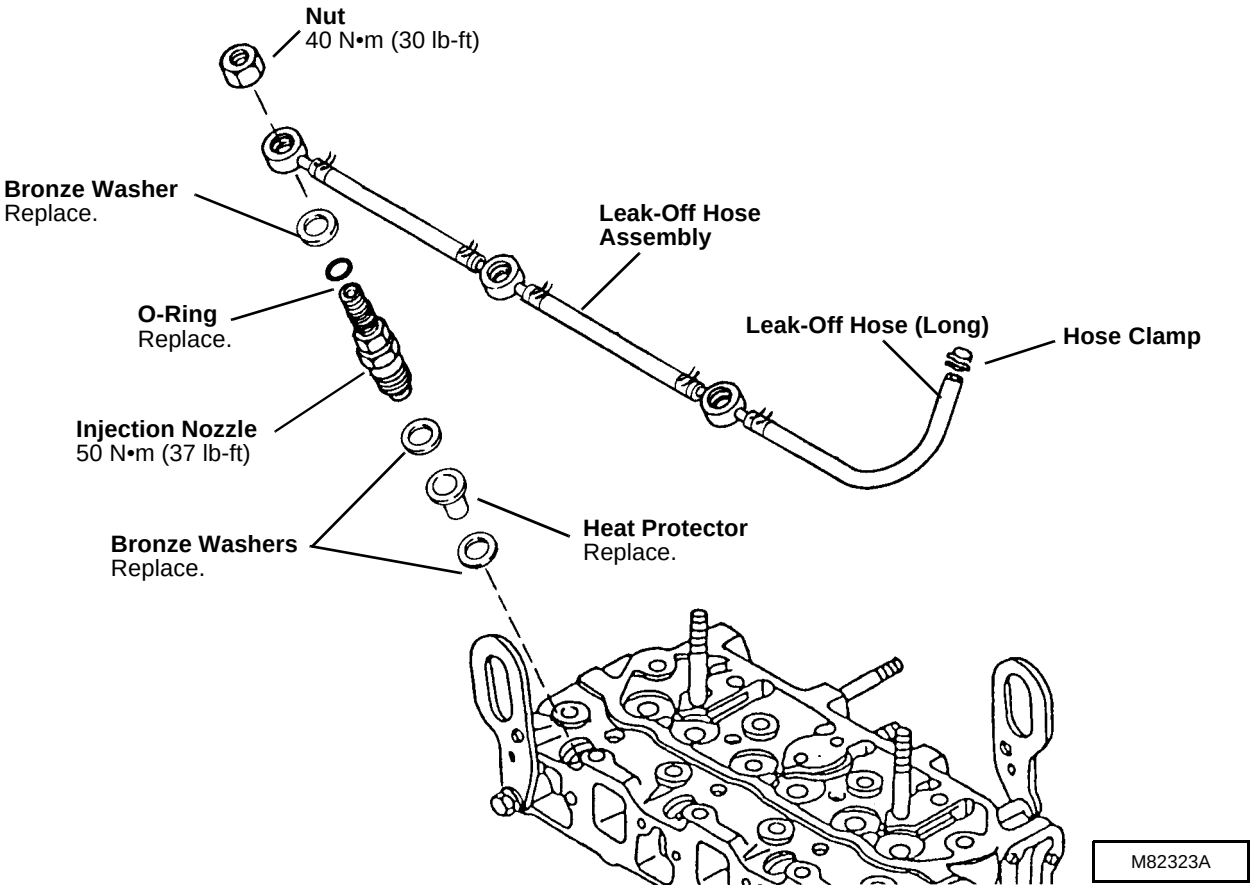
IMPORTANT: When removing injection lines, DO NOT turn pump delivery valve fittings. Turning fittings may damage pump internally.

2. Loosen fuel injection line connectors slightly to release pressure in the fuel system. When loosening connectors, use another wrench to keep delivery valves from loosening.


M35885

3. Loosen line clamp and remove fuel injection lines.
4. Disconnect long leak-off hose.
5. Remove nuts and leak-off hose assembly.
6. Remove bronze washers and O-rings.
7. Remove injection nozzle, washers and heat protector.
8. Test injection nozzles. (See *Checks, Tests and Adjustments* in this section.)

Installation is done in reverse order of removal.

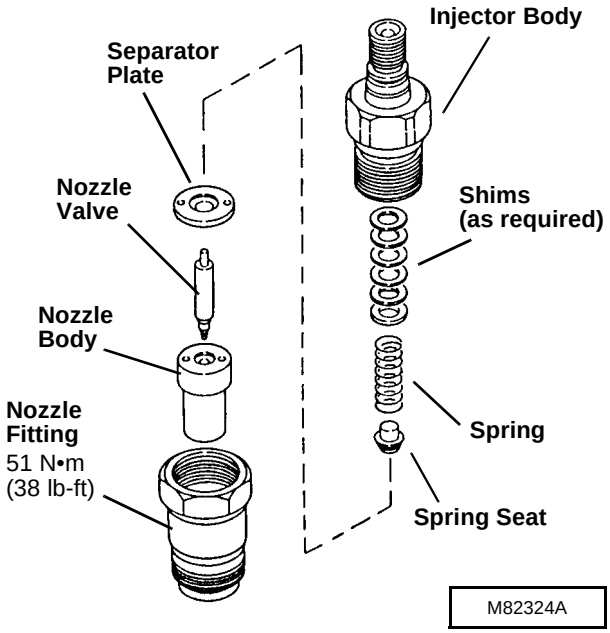


Disassembly/Assembly

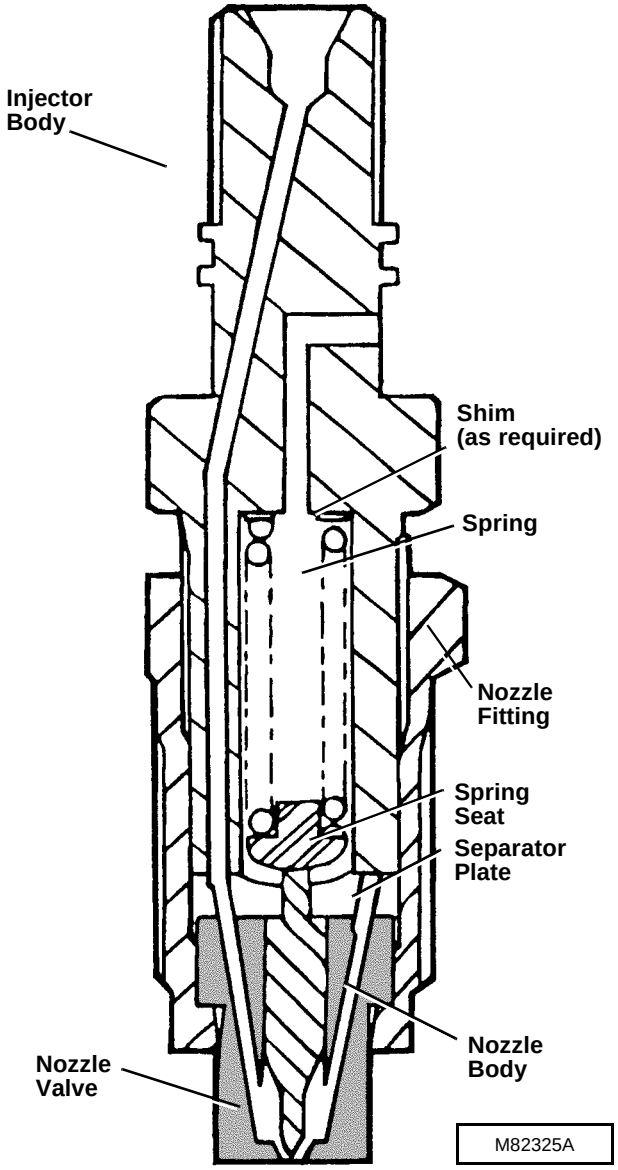
NOTE: If servicing more than one nozzle, keep parts for each nozzle separate from one another.

IMPORTANT: If injection nozzles are disassembled to be cleaned, the same number and thickness of shims must be installed.

- Clean and inspect nozzle assembly. (See *Cleaning/Inspection* procedures.)
- After assembly is complete, test injection nozzle. (See *Checks, Tests and Adjustments* in this section.)



CROSS SECTION



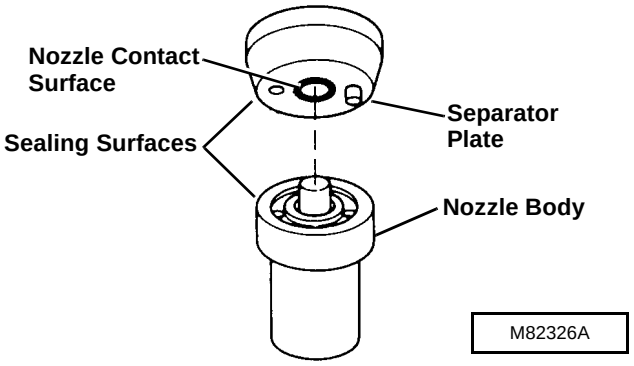
Cleaning/Inspection

NOTE: To clean nozzles properly, JDF13 Nozzle Cleaning Kit is recommended. The Cleaning Kit is available through the John Deere SERVICEGARD™ Catalog.

1. Remove anti-corrosive grease from new or reconditioned nozzles by washing them thoroughly in diesel fuel.

IMPORTANT: Never use a steel brush to clean nozzles as this will distort the spray hole.

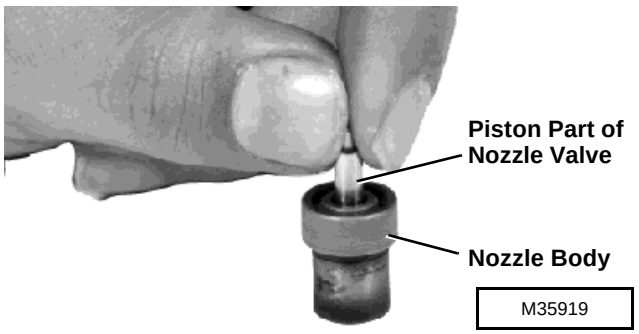
2. Remove carbon from used nozzles, and clean by washing in diesel fuel. If parts are coated with hardened carbon or lacquer, it may be necessary to use a brass wire brush (supplied in Nozzle Cleaning Kit).
3. After removing carbon or lacquer from the exterior of nozzle, inspect sealing surfaces between separator plate and nozzle body for nicks or scratches.
4. Inspect condition of separator plate and nozzle body. Contact area of separator plate (both parts) must not be scored or pitted. Use an inspection magnifier (No. 16487 or equivalent) to aid in making the inspection.
5. Check nozzle contact surface on separator plate for wear. If contact surface is more than **0.10 mm (0.0039 in.)**, replace nozzle assembly.



6. Inspect the piston (large) part of nozzle valve to see that it is not scratched or scored and that lower (tip) end of valve is not broken. If any of these conditions are present, replace the nozzle assembly.
7. Further inspect the nozzle assembly by performing a slide test. Use the following procedure:

- Dip the nozzle valve in clean diesel fuel. Insert valve in nozzle body.
- Hold nozzle vertical, and pull valve out about 1/3 of its engaged length.
- Release valve. Valve should slide down to its seat by its own weight.

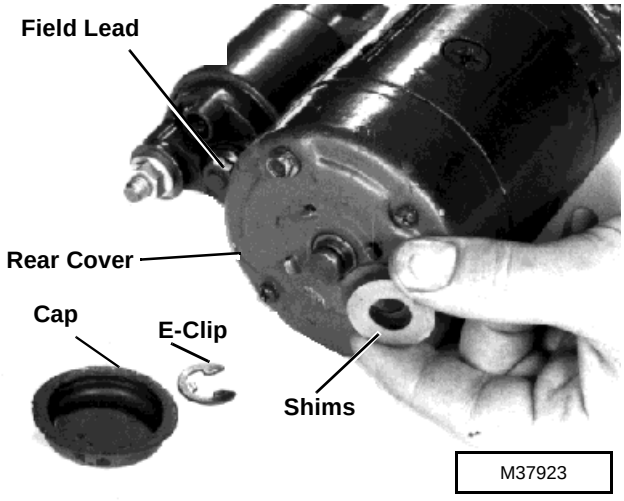
Replace nozzle assembly if the valve does not slide freely to its seat.



STARTER—HITACHI 0.8 kW

Disassembly/Inspection

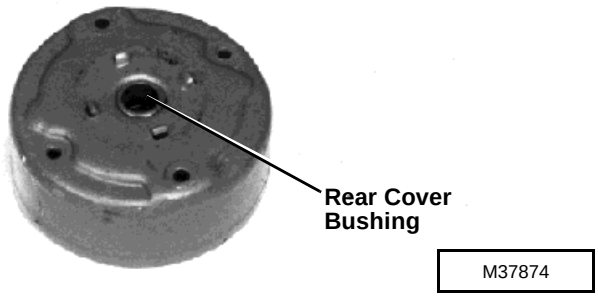
1. Disconnect field lead.
2. Remove two cap screws and two screws from rear cover.
3. Pry off plastic cap.
4. Remove e-clip, shims and rear cover.



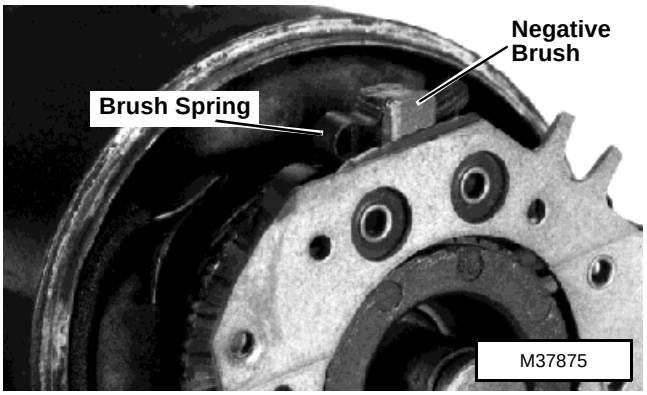
5. Inspect cover bushing for wear or damage. Replace if necessary.

To replace bushing:
Remove bushing using a blind-hole puller set. Install new bushing until it bottoms in cover bore using a driver set.

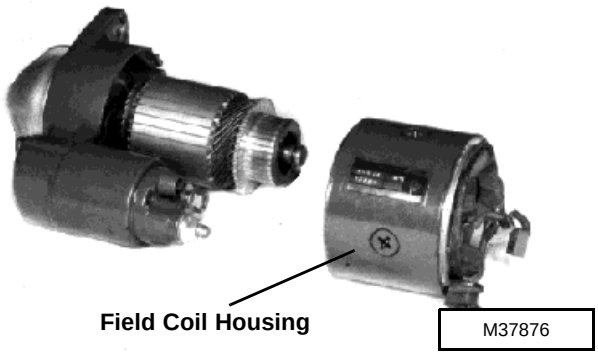
Ream out bushing to **12.50—12.53 mm (0.492—0.493 in.)**.



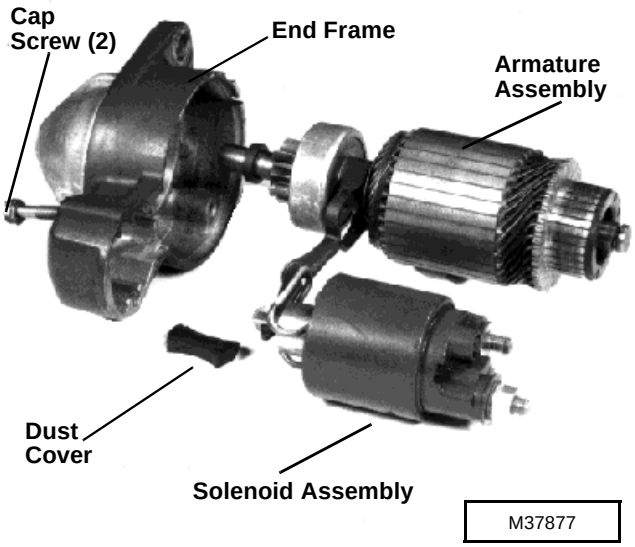
6. Remove field coil brushes from brush holder.
7. Pry brush springs away and pull negative brushes up enough to allow spring to hold brush in place.
8. Remove brush holder.



9. Remove field coil housing from armature/solenoid assembly.

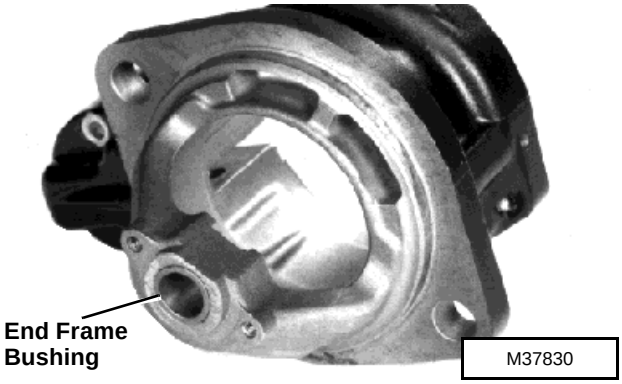


10. Remove two cap screws and pivot bolt, if equipped.
11. Remove dust cover.
12. Remove solenoid and armature assemblies from end frame.



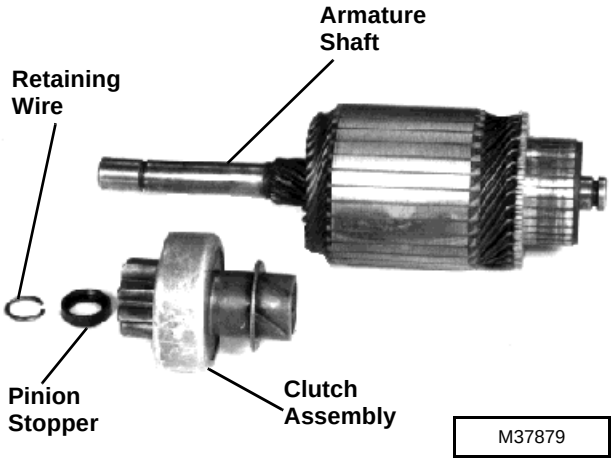
13. Inspect end frame bushing for wear or damage. Replace if necessary.

Replace bushing using a driver set. Install bushing flush with face of housing.



14. Slide pinion stopper away from retaining wire using a piece of pipe or deep socket. Remove retaining wire, pinion stopper, and clutch assembly from armature shaft.

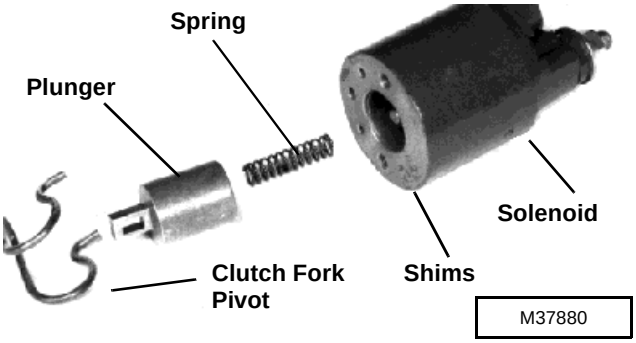
15. Inspect clutch assembly for wear or damage. Gear should rotate in one direction only. Replace if necessary.



16. Remove clutch fork pivot, plunger, spring and shim(s) from solenoid.

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

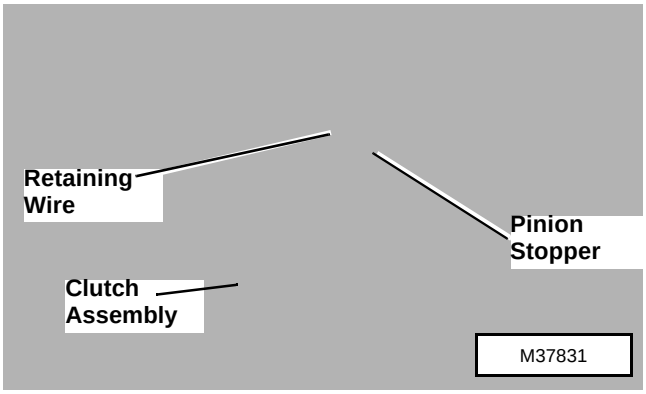
18. Inspect and test brushes, holder, field coil and armature. (See *Test* procedures.)



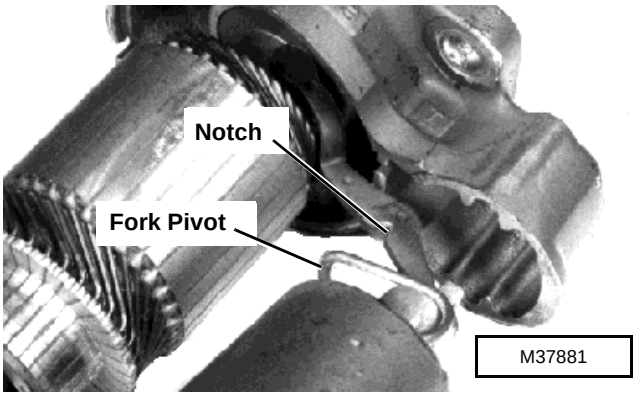
Assembly

Assembly is done in the reverse order of disassembly.

- After installing clutch assembly, pinion stopper and retaining wire on armature shaft, use two pliers to press pinion stopper over retaining wire.



- When installing solenoid and armature assemblies into end frame, make sure fork pivot seats in notch on clutch fork.



IMPORTANT: When installing rear cover, be sure field coil brush wires do not touch cover. Turn brush holder slightly to take up slack in brush wires. Press wires inward to clear rear cover.

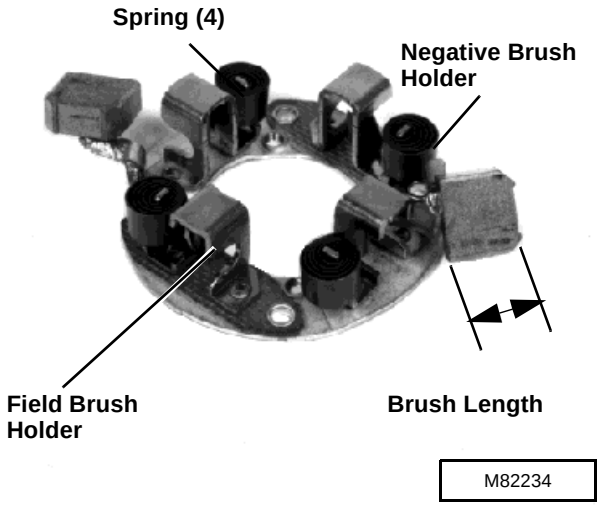
Test

1. Measure holder and field coil brush lengths. Minimum brush length is **7.70 mm (0.303 in.)**. Replace brush holder or field coil if brush length is below minimum.

NOTE: Test brush holder using an ohmmeter or test light.

2. Test brush holder:
   Touch one probe of tester to negative brush holder and other probe to field brush holder. If there is continuity, replace the brush holder.

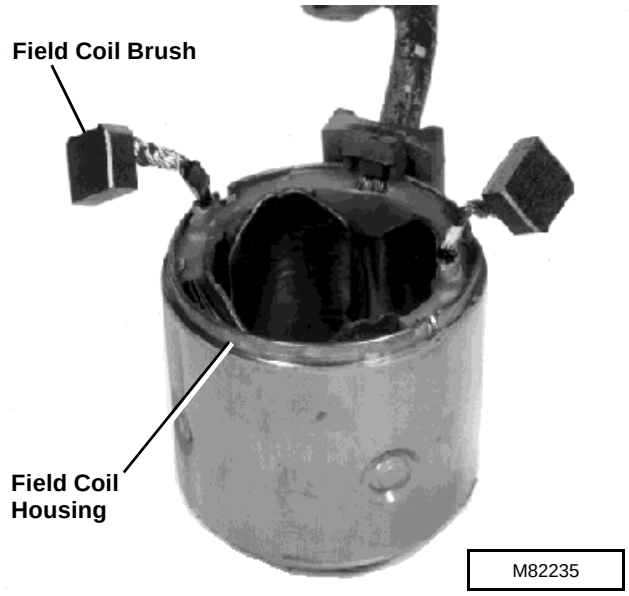
3. Inspect springs for wear or damage. Replace if necessary.



NOTE: Test field coil using an ohmmeter or test light.

4. Test for grounded field winding:
   Touch one probe of tester to field coil brush and other probe to field coil housing. Be sure the brush lead is not touching the frame. If there is continuity, the coil is grounded and the field coil housing assembly must be replaced.

5. Test for open field coil:
   Touch one probe of tester to each field coil brush. If there is no continuity, the field coil is open and the field coil housing assembly must be replaced.



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

6. Inspect armature. Look for signs of dragging against pole shoes.

7. Inspect commutator. Look for roughness, burned bars, or any material which might cause short circuits between bars. If necessary, clean and touch up with 400 sandpaper. NEVER use emery cloth. Clean all dust from armature when finished.

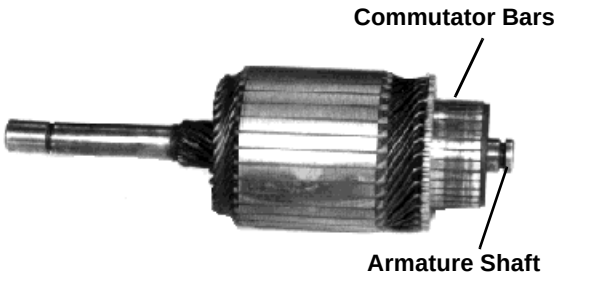
NOTE: Test armature windings using an ohmmeter or test light.

8. Test for grounded windings:
   Touch probes on one commutator bar and armature shaft. Armature windings are connected in series, so only one commutator bar needs to be checked.

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

9. Test for open circuited windings:
   Touch probes on two different commutator bars.

If test shows no continuity, there is an open circuit and the armature must be replaced.

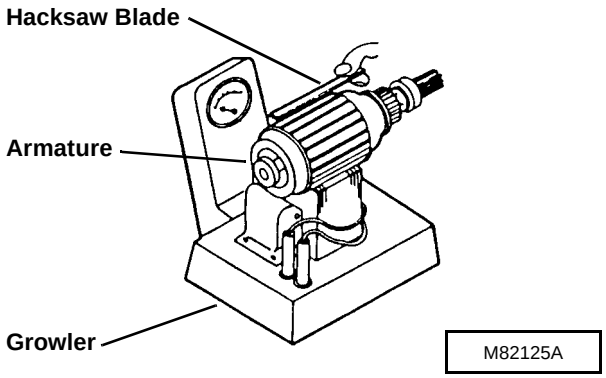


10. Test for short circuited windings using a growler. Put armature in a growler and hold a hacksaw blade above each slot while slowly rotating armature.

If coil is shorted, the blade will vibrate on the slot.

NOTE: A short circuit most often occurs because of copper dust or filings between two commutator segments.

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



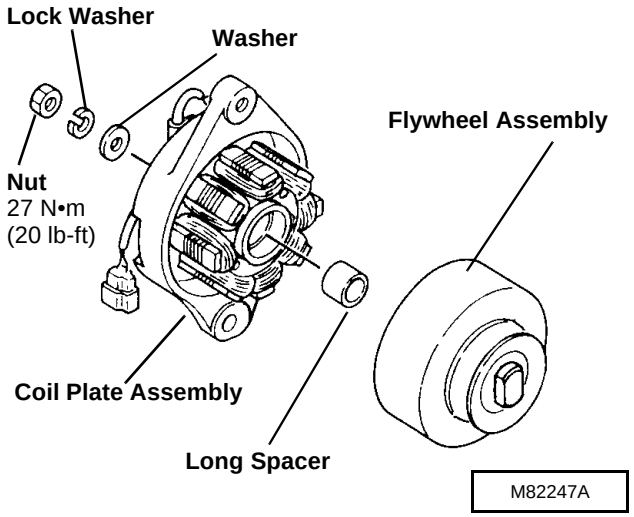
ALTERNATOR (STATOR)—KOKOSAN 20A

Disassembly/Inspection

1. Remove nut and washers.

2. Tap on end of shaft with a soft-faced hammer to separate flywheel assembly from coil plate assembly.

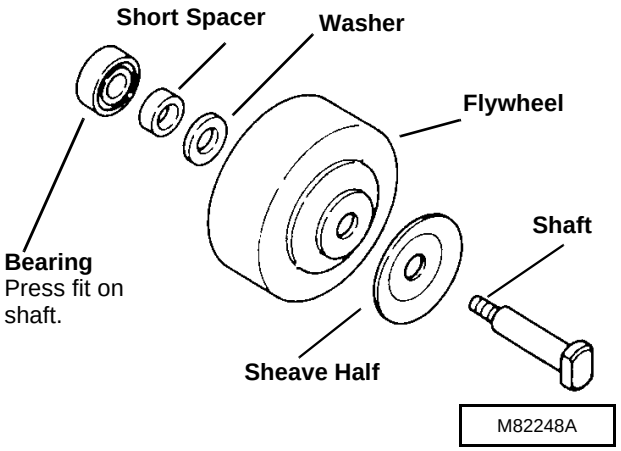
3. Remove long spacer.



NOTE: Bearing and flywheel are press fit on shaft.

4. Remove shaft from bearing, short spacer, washer, flywheel and sheave half, using a press.

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



NOTE: Remove bearing only if replacement is necessary.

6. Inspect bearing in coil plate for wear or damage. Replace if necessary.

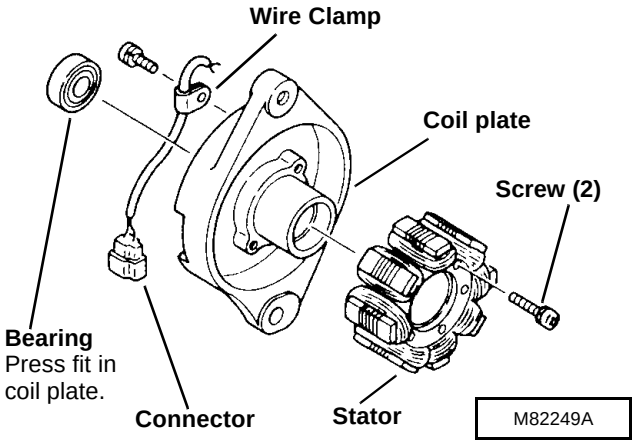
To replace bearing:
Remove bearing using a spark plug socket and a press. Install bearing into coil plate until it bottoms in bore using a 1 in. socket.

7. Remove wire clamp.

8. Remove connector from harness leads.

9. Remove two screws and stator.

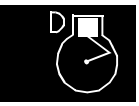
10. Inspect all parts for wear or damage. Replace as necessary.



Assembly

Assembly is done in the reverse order of disassembly.

- With sheave half on shaft, press shaft into flywheel until sheave half bottoms on flywheel face.
- With washer and short spacer installed, press new bearing onto shaft until it bottoms on spacer.



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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° (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

Glow Plug:

Resistance . . . . . 1.35—1.65 ohms.

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).

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 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.

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.

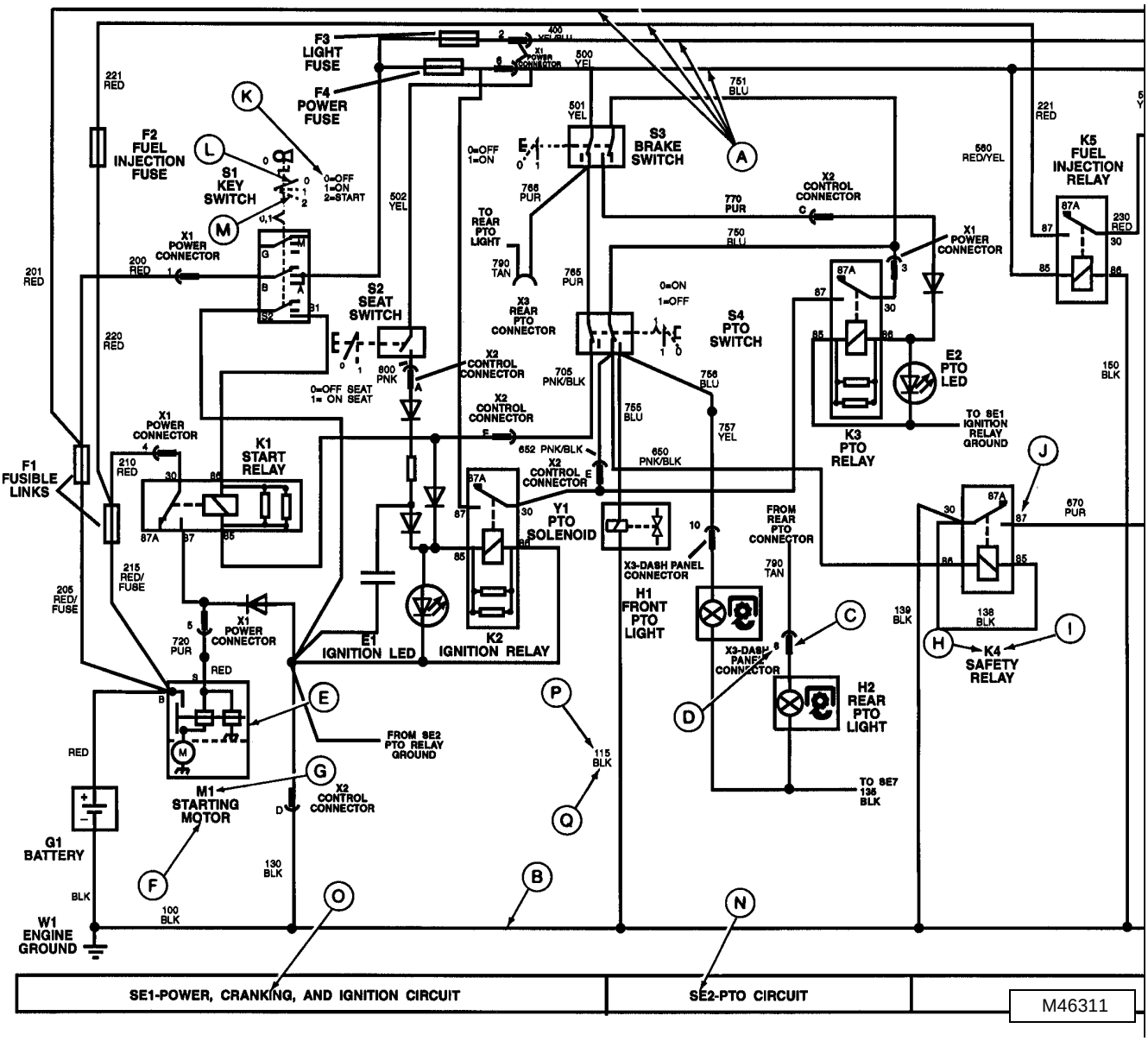
Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

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.



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

COMMON CIRCUIT TESTS

Shorted/Grounded Circuit:

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.

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.

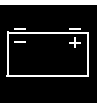
To test for a shorted or improperly wired circuit:

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:

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.



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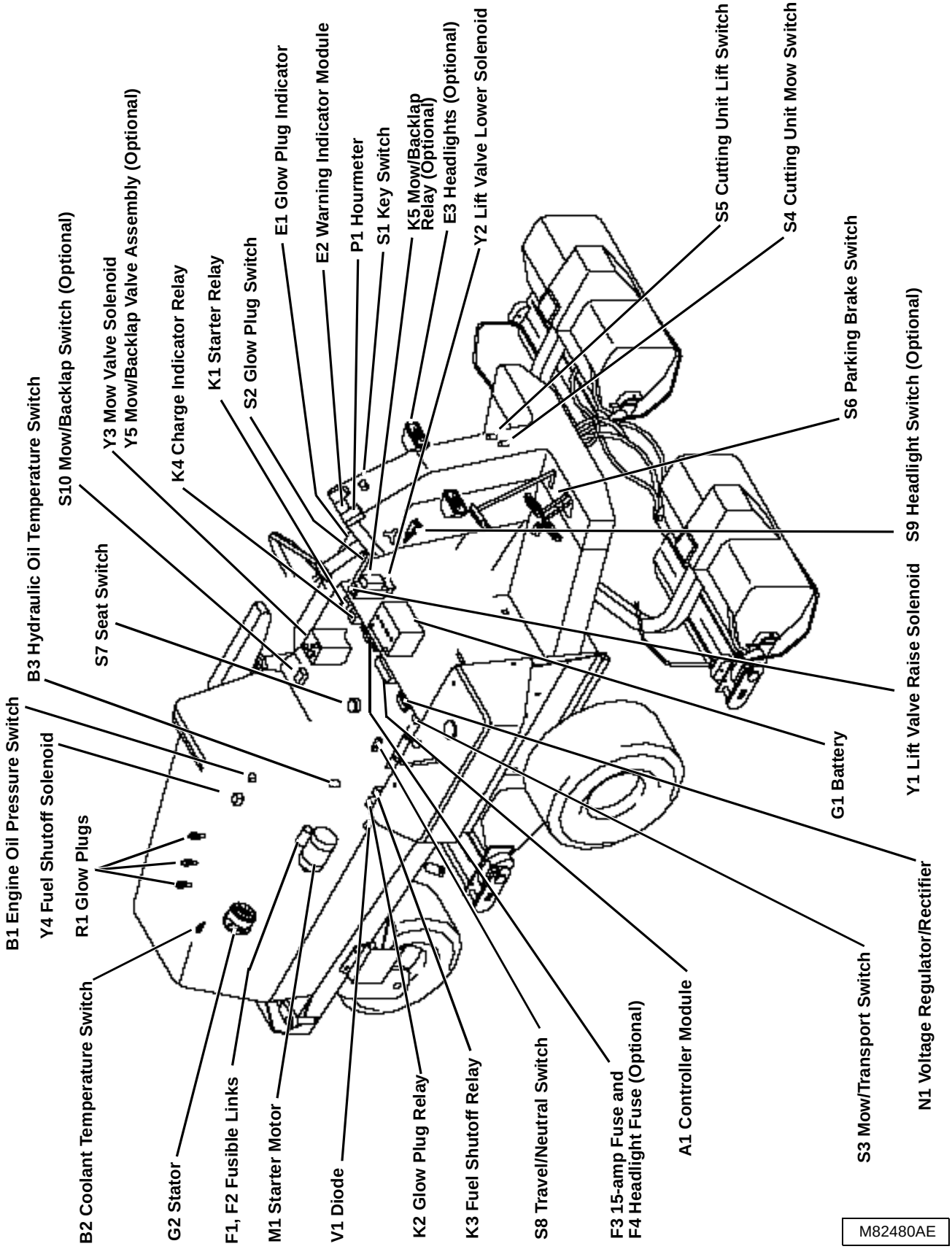
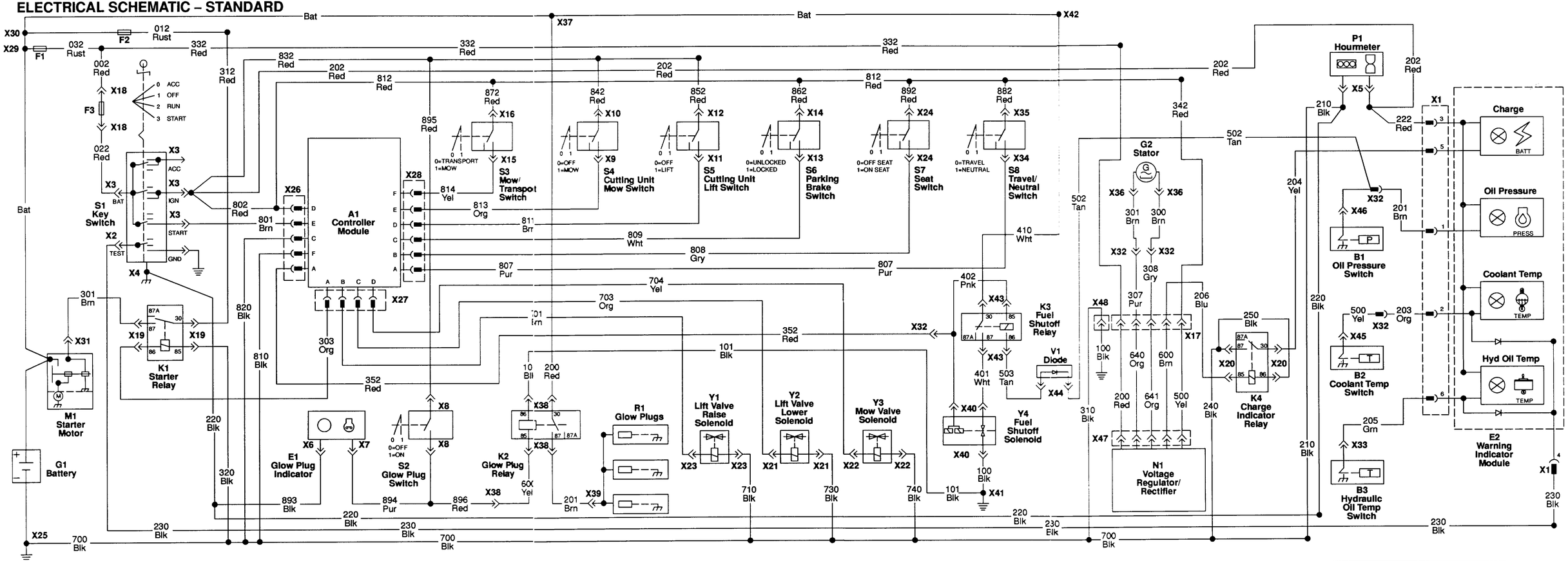
ELECTRICAL SYSTEM COMPONENTS



LEGEND FOR ELECTRICAL SCHEMATICS AND WIRING HARNESSES

A1—Controller Module
B1—Engine Oil Pressure Switch
B2—Coolant Temperature Switch
B3—Hydraulic Oil Temperature Switch
E1—Glow Plug Indicator
E2—Warning Indicator Module
E3—Headlights
F1—Fusible Link
F2—Fusible Link
F3—15-amp Fuse
F4—15-amp Headlight Fuse
G1—Battery
G2—Stator
K1—Starter Relay
K2—Glow Plug Relay
K3—Fuel Shutoff Relay
K4—Charge Indicator Relay
K5—Mow/Backlap Relay
M1—Starter Motor
N1—Voltage Regulator/Rectifier
P1—Hourmeter
R1—Glow Plug
S1—Key Switch
S2—Glow Plug Switch
S3—Mow/Transport Switch
S4—Cutting Unit Mow Switch
S5—Cutting Unit Lift Switch
S6—Parking Brake Switch
S7—Seat Switch
S8—Travel/Neutral Switch
S9—Headlight Switch
S10—Mow/Backlap Switch
X1 6-Wire Edge Connector, Warning Indicator Module
X2—1-Wire Push-on Connector, Warning Light Module to Key Switch Test
X3—Molded Connector at Key Switch
X4—2-Wire Eyelet Connector, Key Switch Ground
X5—4-Wire Molded Connector at Hourmeter
X6—1-Wire Connector at Glow Plug Indicator
X7—1-Wire Connector at Glow Plug Indicator
X8—Molded connector at Glow Plug Switch
X9—1-Wire Connector at Cutting Unit Mow Switch
X10—1-Wire Connector at Cutting Unit Mow Switch
X11—1-Wire Connector at Cutting Unit Lift Switch
X12—1-Wire Connector at Cutting Unit Lift Switch
X13—1-Wire Connector at Parking Brake Switch
X14—1-Wire Connector at Parking Brake Switch
X15—1-Wire Connector at Mow/Transport Switch
X16—1-Wire Connector at Mow/Transport Switch
X17—6-Wire Molded Connector, Main Harness to Voltage Regulator/Rectifier Harness
X18—2-Wire Weather Pack Connector, Fuse
X19—4-Wire Connector at Starter Relay
X20—4-Wire Connector, Charge Indicator Relay
X21—2-Wire Connector at Lift Valve Lower Solenoid
X22—2-Wire Weather Pack Connector at Mow Valve Solenoid
X23—2-Wire Connector at Lift Valve Raise Solenoid
X24—2-Wire Male/Female Connector at Seat Switch
X25—1-Wire Eyelet Connector, Chassis Ground
X26—6-Wire Connector at Controller Module
X27—4-Wire Connector at Controller Module
X28—6-Wire Connector at Controller Module
X29—1-Wire Eyelet Connector at Starter Solenoid
X30—1-Wire Eyelet Connector at Starter Solenoid
X31—1-Wire Push-on Connector Starter Relay to Starter Solenoid
X32—6-Wire Molded Connector, Main Harness to Engine Harness
X33—1-Wire Eyelet Connector at Hydraulic Oil Temperature Switch
X34—1-Wire Connector at Travel/Neutral Switch
X35—1-Wire Connector at Travel/Neutral Switch
X36—2-Wire Connector, Stator
X37—1-Wire Eyelet Connector, Glow Plug Relay to Starter Solenoid
X38—4-Wire Connector, Glow Plug Relay
X39—1-Wire Eyelet Connector, Glow Plug Relay to Glow Plugs
X40—3-Wire Molded Connector at Fuel Shutoff Solenoid
X41—2-Wire Eyelet Connector, Glow Plug Relay/Fuel Shutoff Solenoid to Chassis Ground
X42—1-Wire Eyelet Connector, Fuel Shutoff Relay to Starter Solenoid
X43—4-Wire Connector, Fuel Shutoff Relay
X44—2-Wire Male/Female Connector, Diode
X45—1-Wire Push-on Connector, Coolant Temperature Switch
X46—1-Wire Push-on Connector, Engine Oil Pressure Switch
X47—5-Wire Molded Connector, Voltage Regulator/ Rectifier
X48—1-Wire Eyelet Connector, Voltage Regulator Harness to Chassis Ground
X49—2-Wire Molded Connector, Mow/Backlap Harness to Main Harness
X50—2-Wire Weather Pack Connector at Mow Valve Solenoid
X51—4-Wire Connector, Mow/Backlap Relay
X52—2-Wire Male/Female Connector at Seat Switch
X53—1-Wire Connector at Parking Brake Switch
X54—2-Wire Male/Female Connector, Mow/Backlap Harness to Main Harness
X55—1-Wire Connector at Travel/Neutral Switch
X56—5-Wire Molded Connector, Mow/Backlap Switch
X57—2-Wire Connector at Direction Valve Switch
X58—1-Wire Eyelet Connector, Chassis Ground
X59—2-Wire Weather Pack Connector, Fuse
X60—1-Wire Eyelet Connector, Starter Solenoid Terminal (+)
X61—2-Wire Molded Connector, Left Headlight
X62—3-Wire Molded Connector, Headlight Switch
X63—2-Wire Molded Connector, Right Headlight
Y1—Lift Valve Raise Solenoid
Y2—Lift Valve Lower Solenoid
Y3—Mow Valve Solenoid
Y4—Fuel Shutoff Solenoid
Y5—Direction Valve Solenoid
V1—Diode

ELECTRICAL SCHEMATIC – STANDARD



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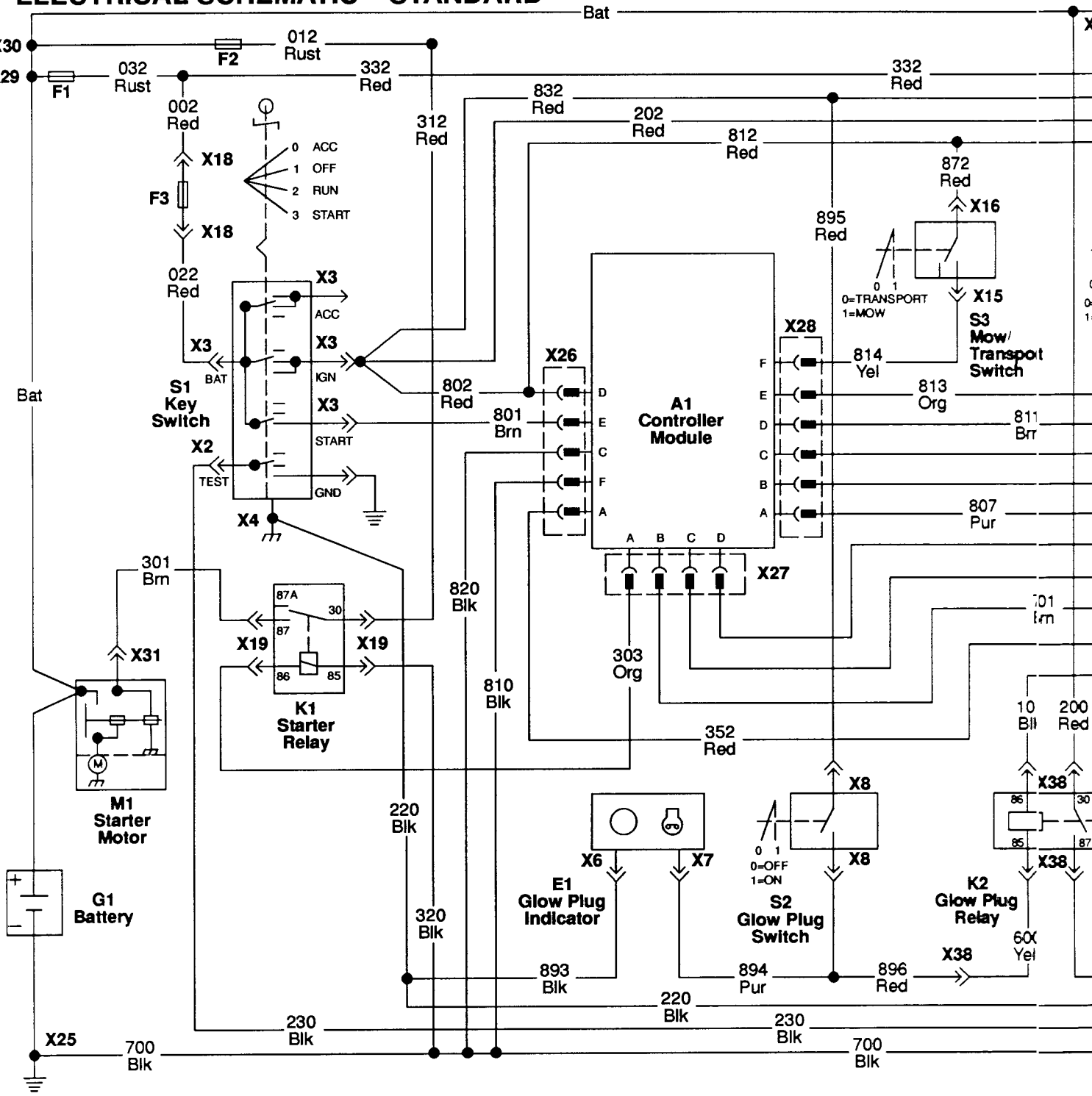
ELECTRICAL SCHEMATIC – STANDARD



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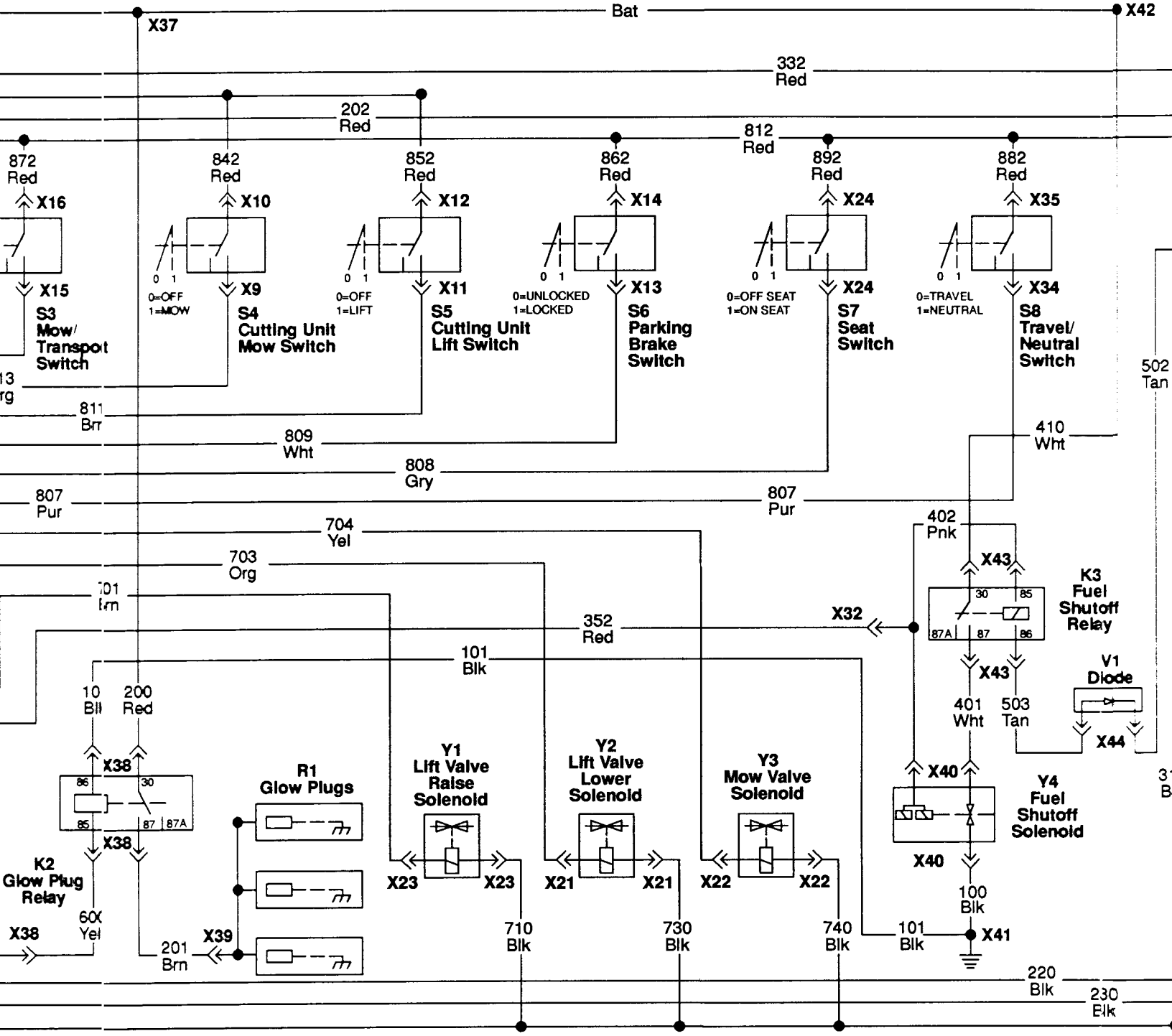
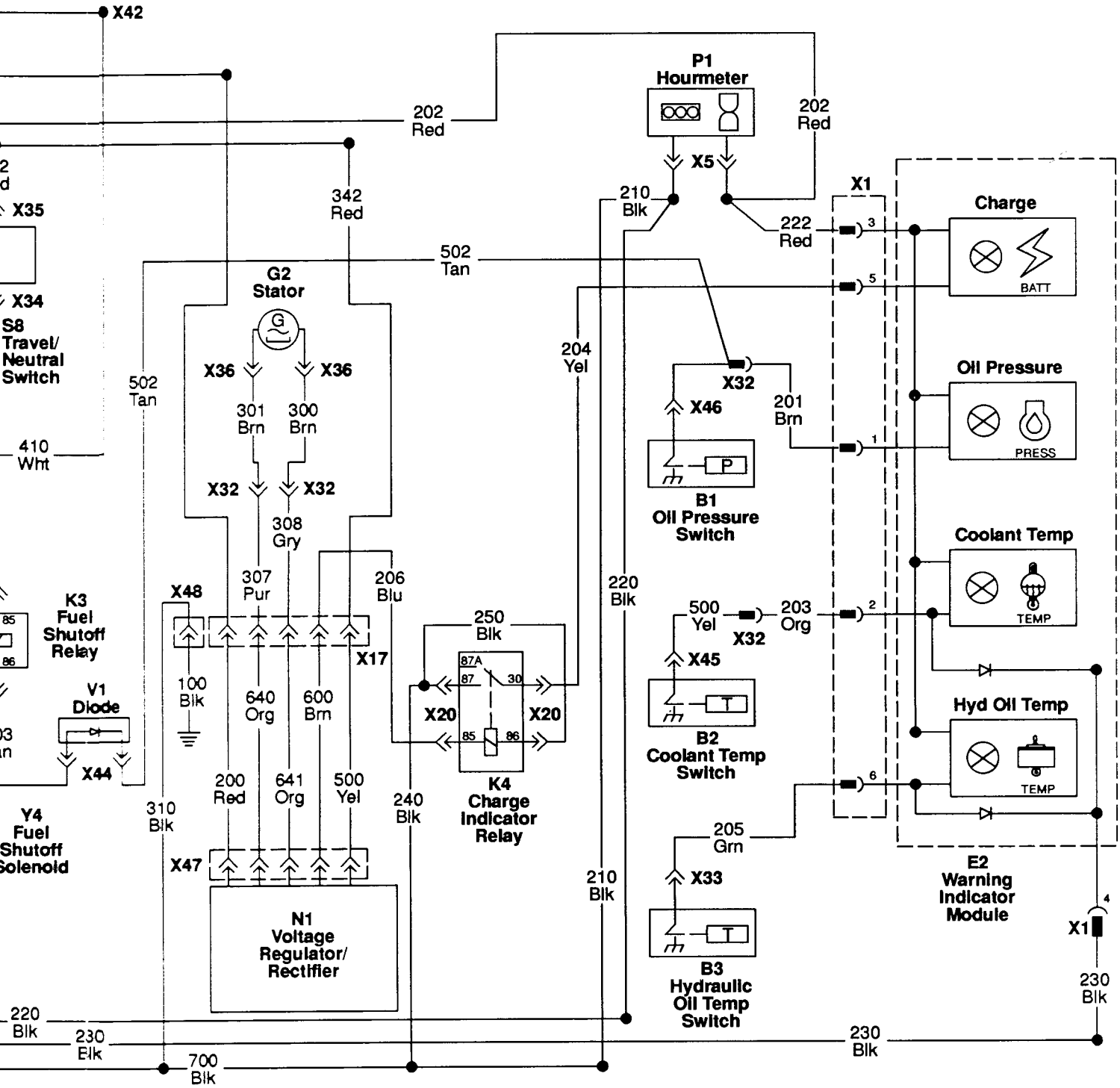
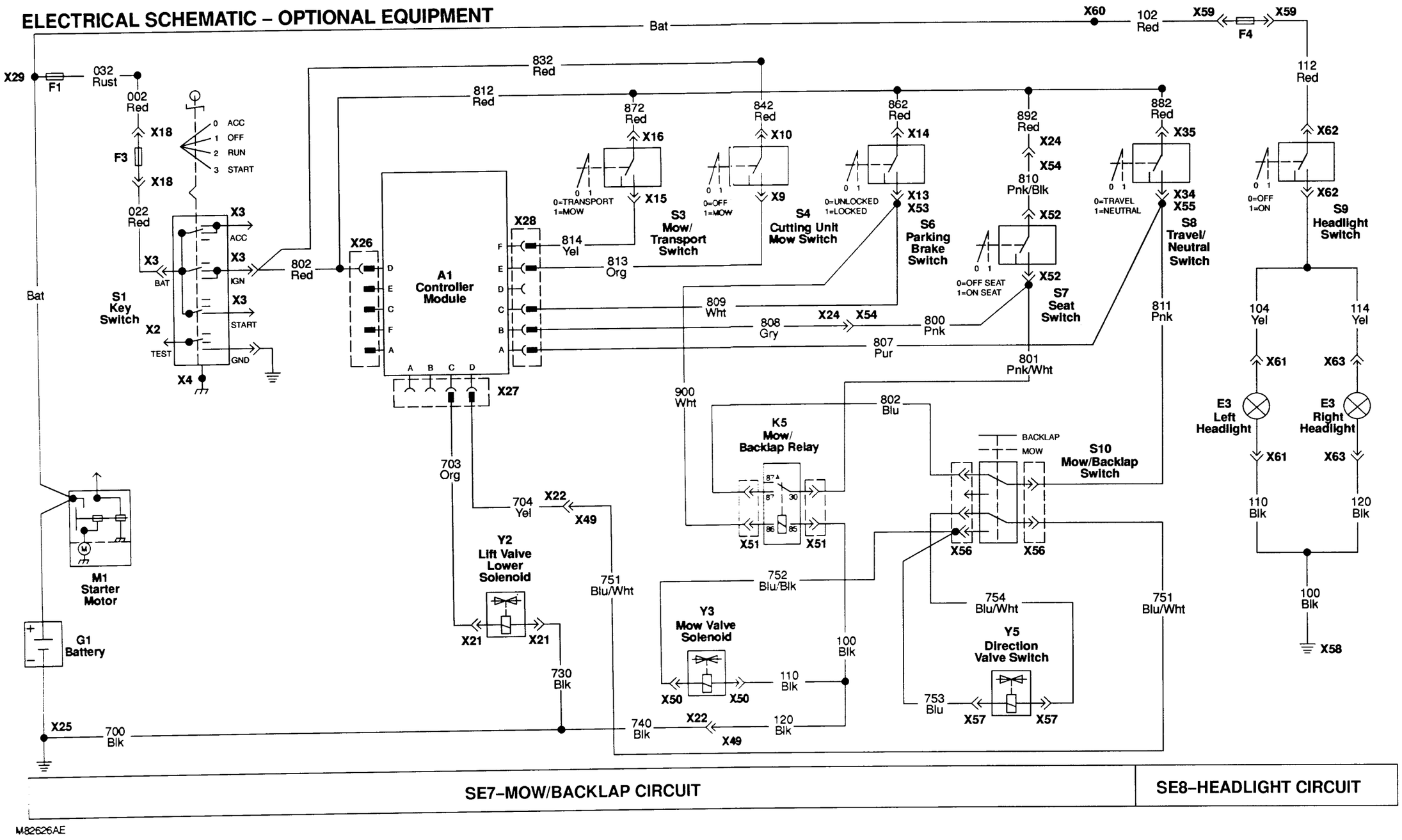


CIRCUIT	SE3–CUTTING UNIT CIRCUIT	SE4–FUEL SHUTOFF CIRCUI



UTOFF CIRCUIT	SE5–CHARGING CIRCUIT	SE6–WARNING INDICATOR CIRCUIT

ELECTRICAL SCHEMATIC – OPTIONAL EQUIPMENT



SE7–MOW/BACKLAP CIRCUIT

SE8–HEADLIGHT CIRCUIT

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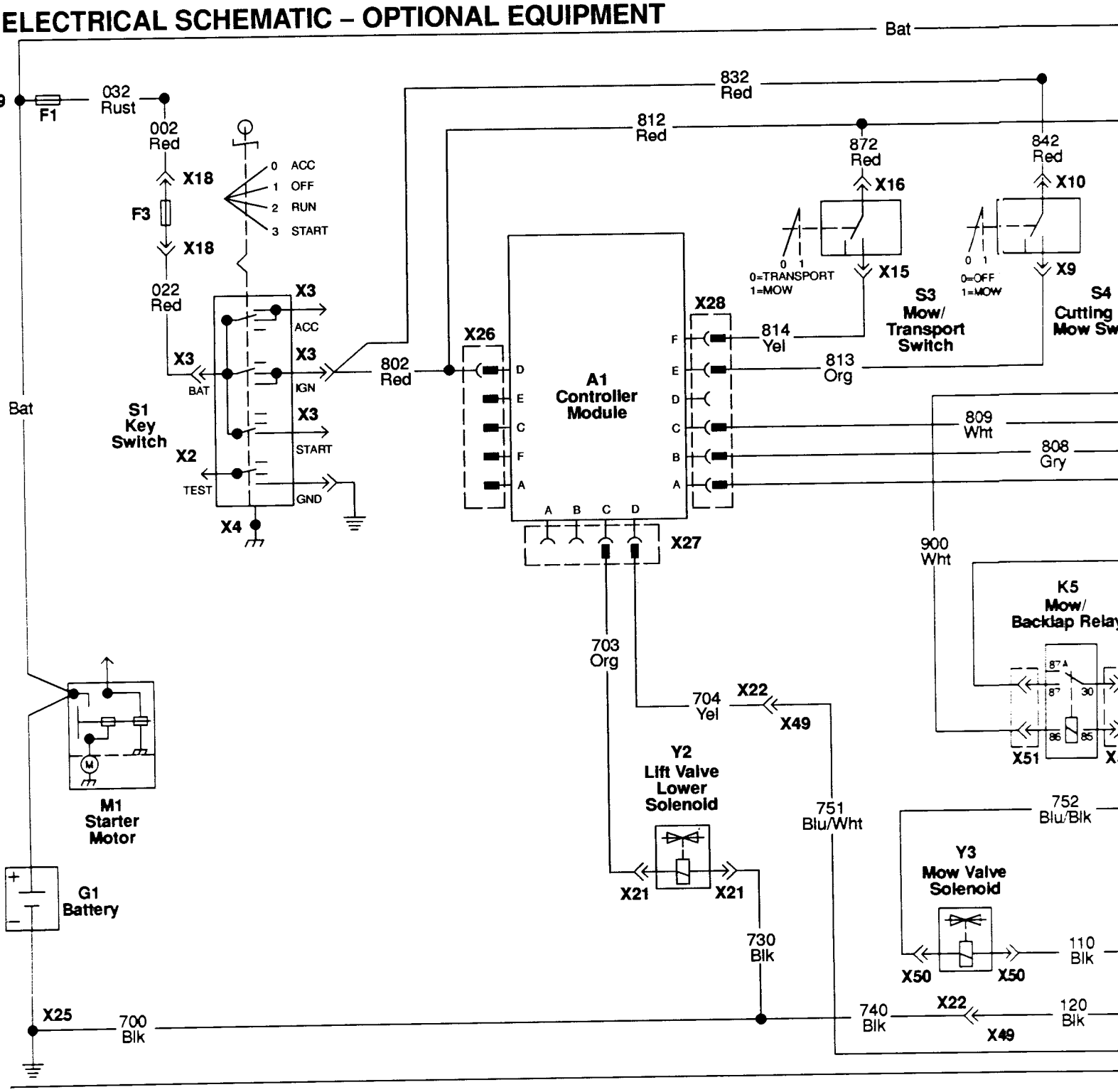
ELECTRICAL SCHEMATIC – OPTIONAL EQUIPMENT



SE7–MOW/BACKLAP CIRCUIT

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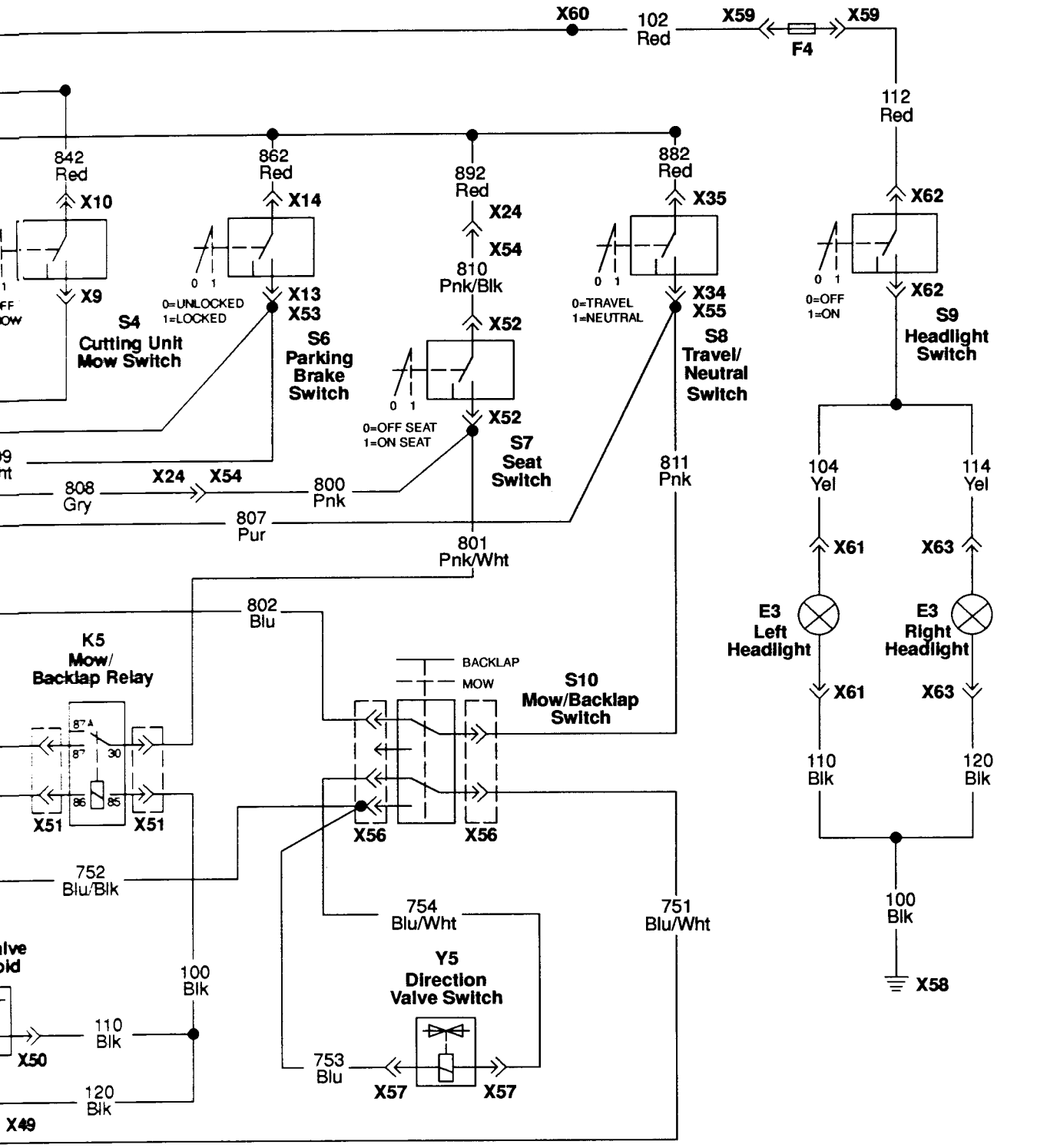
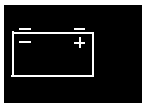


SE8–HEADLIGHT CIRCUIT



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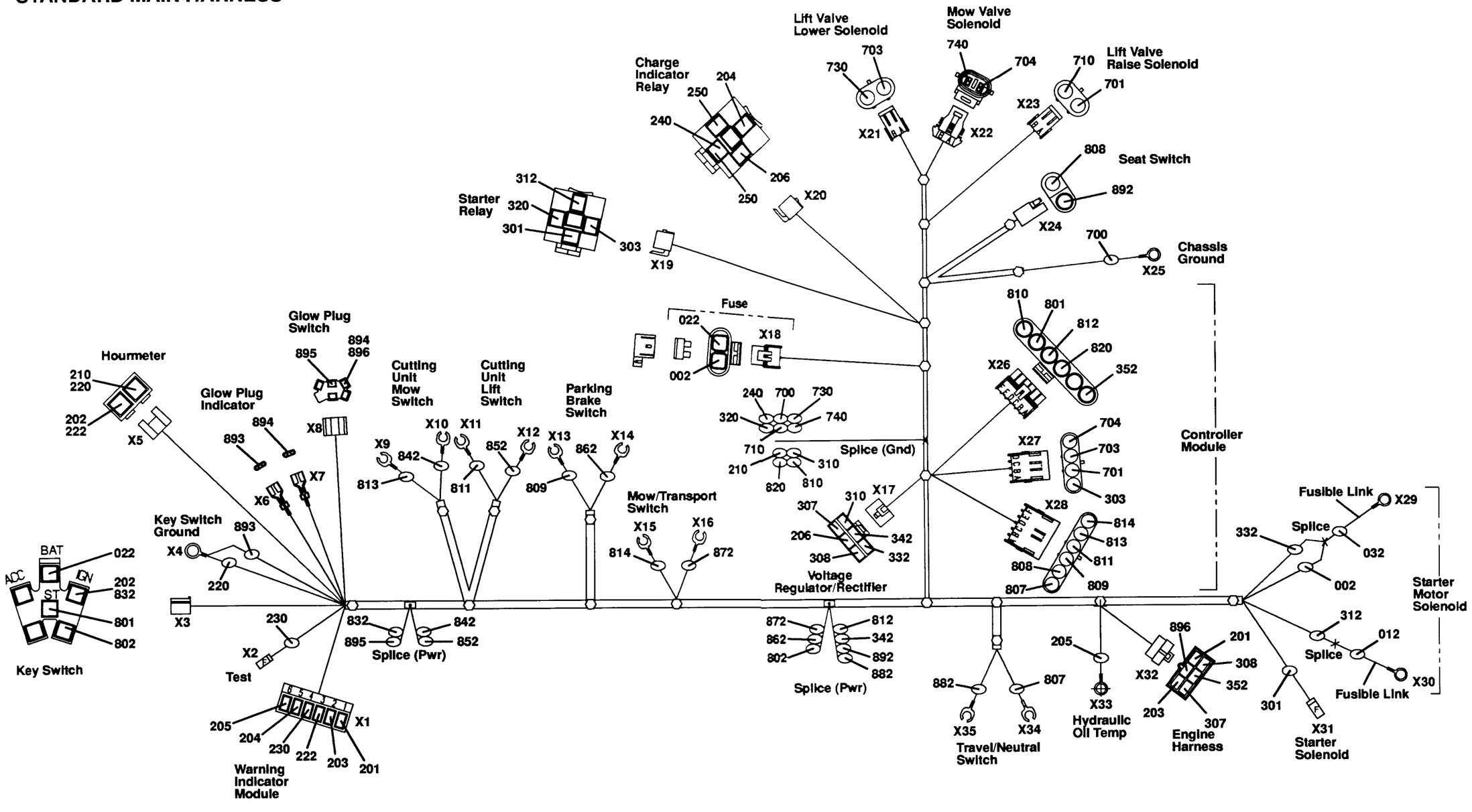
WIRE COLOR CODES

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			

STANDARD MAIN HARNESS



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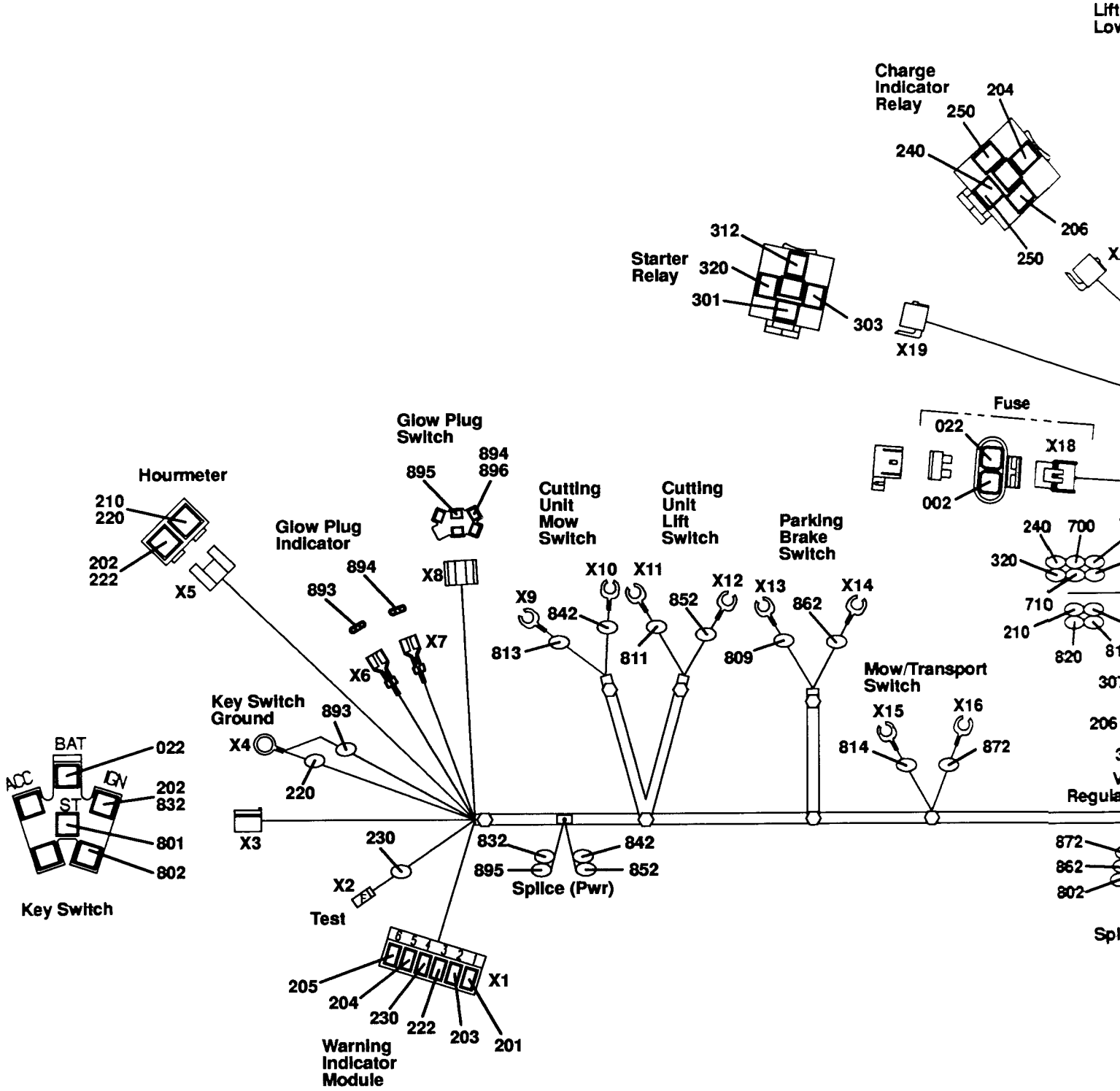
STANDARD MAIN HARNESS



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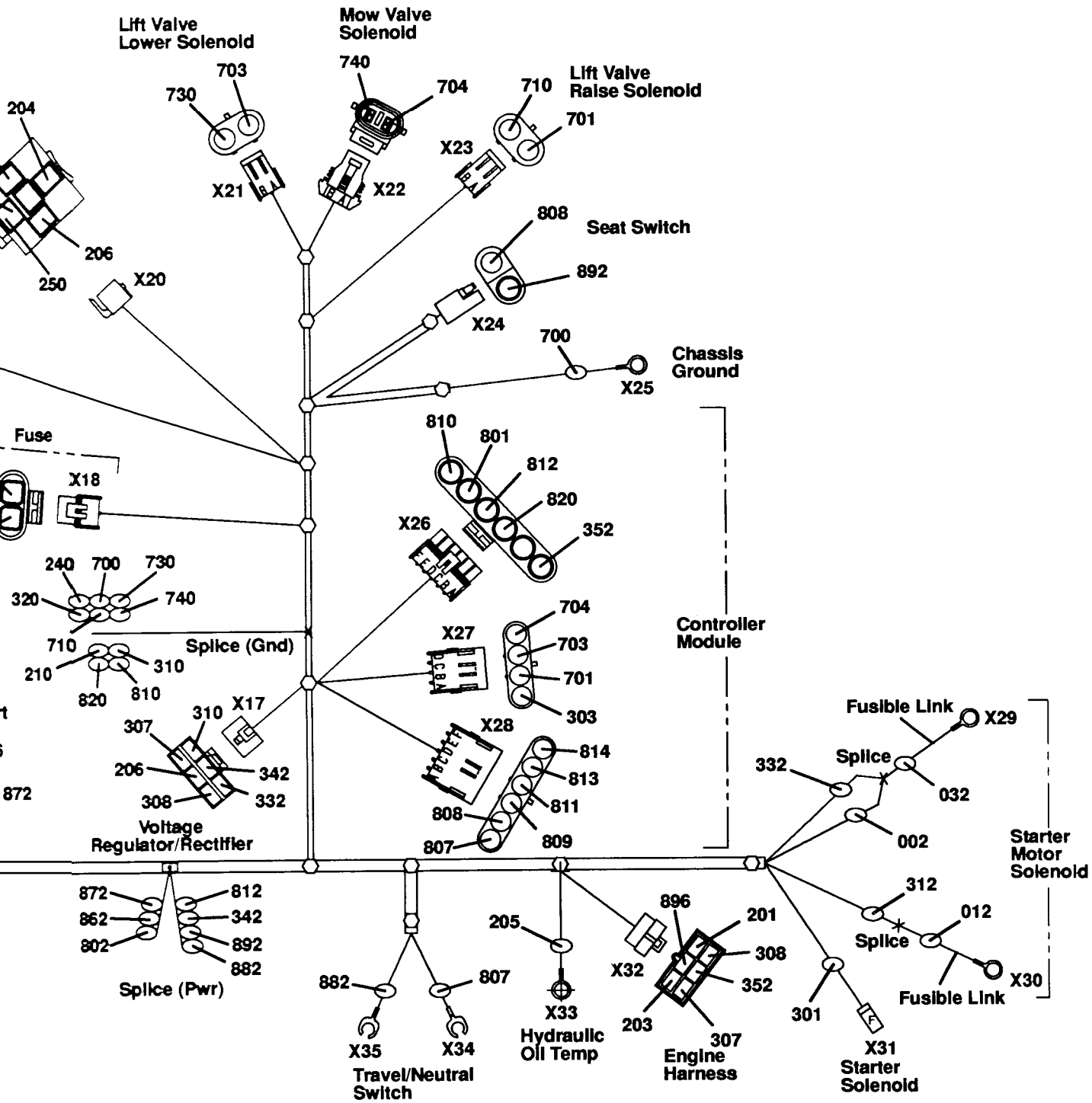
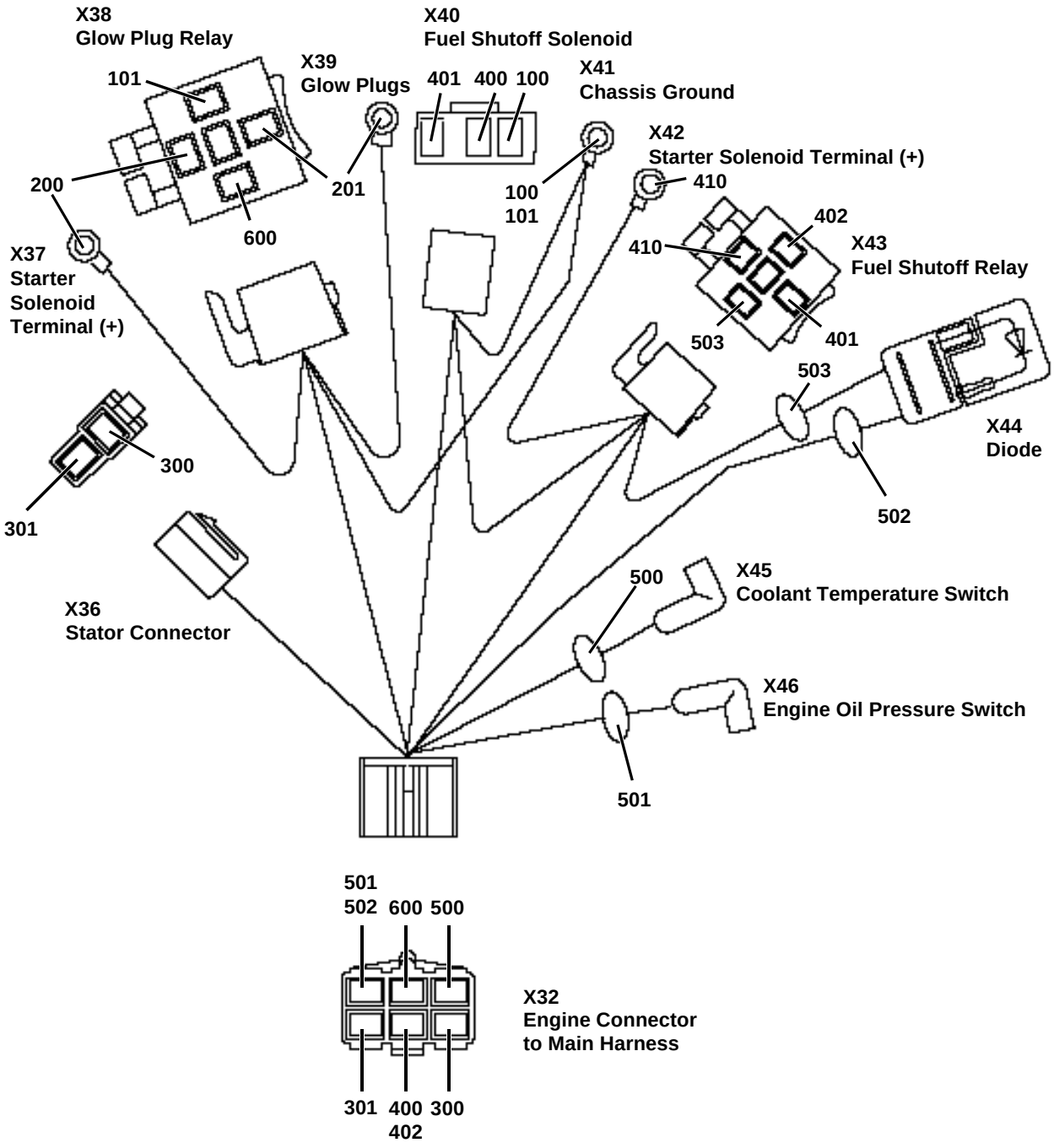

Lift Valve
Lower Solenoid
Mow Valve
Solenoid
Lift Valve
Raise Solenoid
703
730
740
704
710
701
204
X21
X22
X23
206
250
X20
808
Seat Switch
892
X24
700
X25
Chassis
Ground
Fuse
X18
810
801
812
820
352
X26
240
700
730
320
740
710
Splice (Gnd)
210
310
820
810
704
X27
703
701
303
Controller
Module
X17
310
307
206
342
308
332
Voltage
Regulator/Rectifier
X28
814
813
811
808
809
807
Fusible Link
X29
Splice
332
032
002
Starter
Motor
Solenoid
872
862
802
812
342
892
882
Splice (Pwr)
312
012
Splice
Fusible Link
X30
882
807
X35
X34
Travel/Neutral
Switch
205
X33
Hydraulic
Oil Temp
896
201
308
352
X32
203
307
Engine
Harness
301
X31
Starter
Solenoid

WIRE COLOR CODES

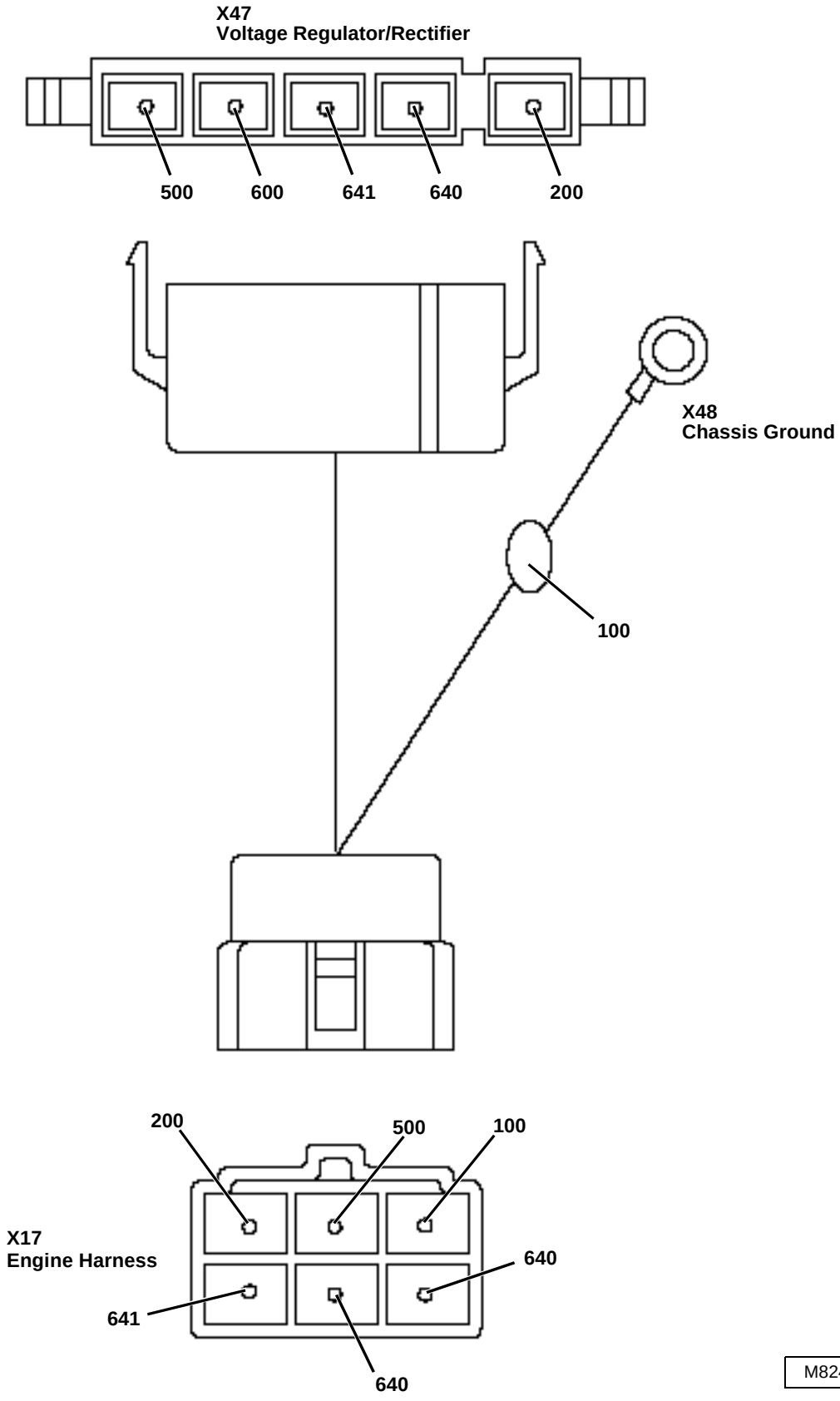
Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
100	1.0	Blk	300, 301	3.0	Brn	500	0.8	Org/Wht
101	0.8	Blk	400	1.0	Pnk/Blk	501	0.8	Tan
200	3.0	Red	401, 410	3.0	Wht	502, 503	1.0	Tan
201	3.0	Red/Wht	402	0.8	Pnk	600	0.8	Yel


X38
Glow Plug Relay
101
200
600
X39
Glow Plugs
201
X40
Fuel Shutoff Solenoid
401 400 100
X41
Chassis Ground
100
101
X42
Starter Solenoid Terminal (+)
410
410
402
X43
Fuel Shutoff Relay
503
401
X37
Starter
Solenoid
Terminal (+)
503
X44
Diode
300
301
502
X36
Stator Connector
500
X45
Coolant Temperature Switch
X46
Engine Oil Pressure Switch
501
501
502 600 500
X32
Engine Connector
to Main Harness
301 400 300
402

M82483AE

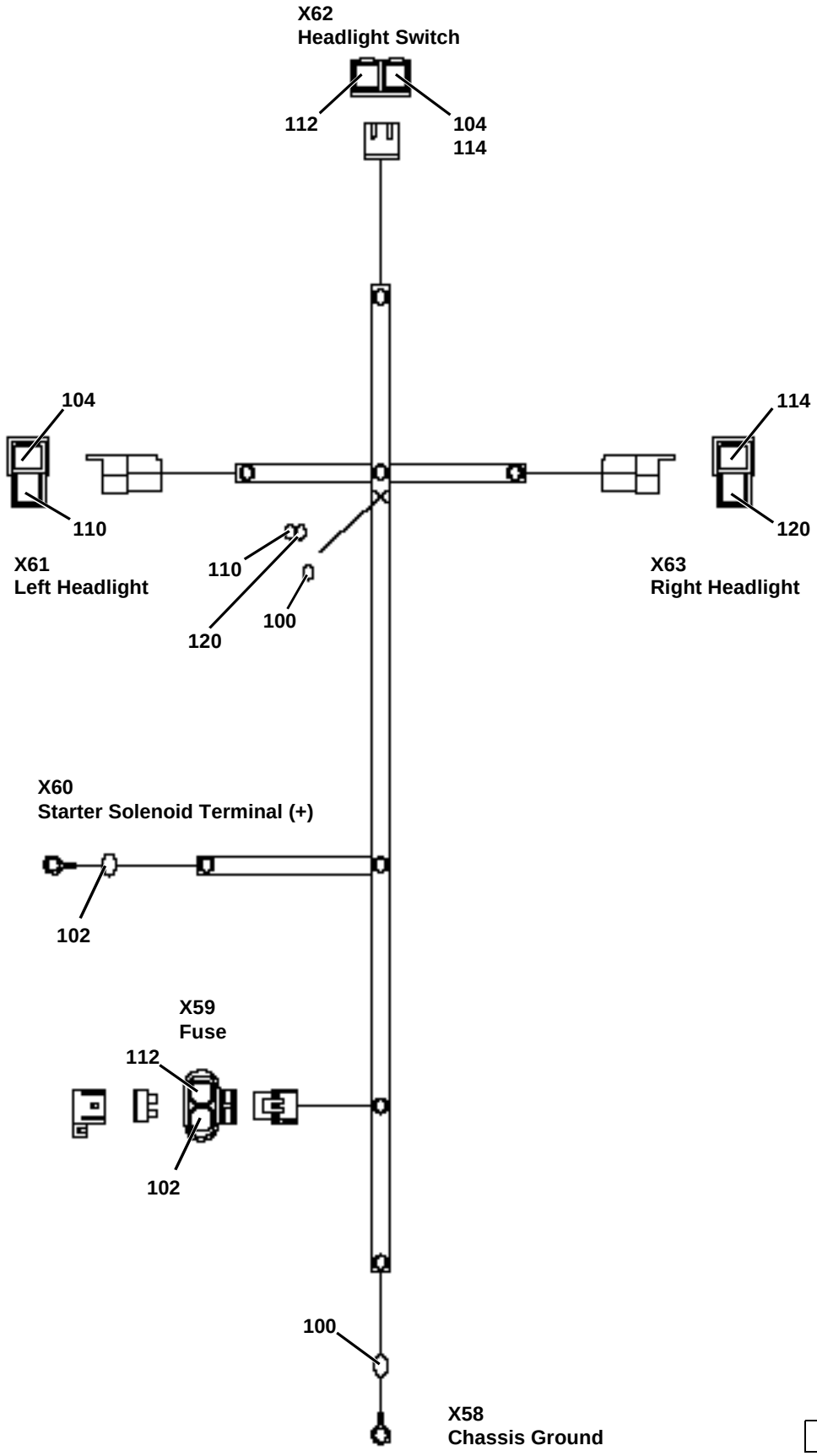
WIRE COLOR CODES

Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
100	3.0	Blk	500	0.8	Yel	640	2.0	Org
200	3.0	Red	600	0.8	Brn	641	2.0	Org


X47
Voltage Regulator/Rectifier
500
600
641
640
200
X48
Chassis Ground
100
200
500
100
X17
Engine Harness
640
641
640
M82484AE

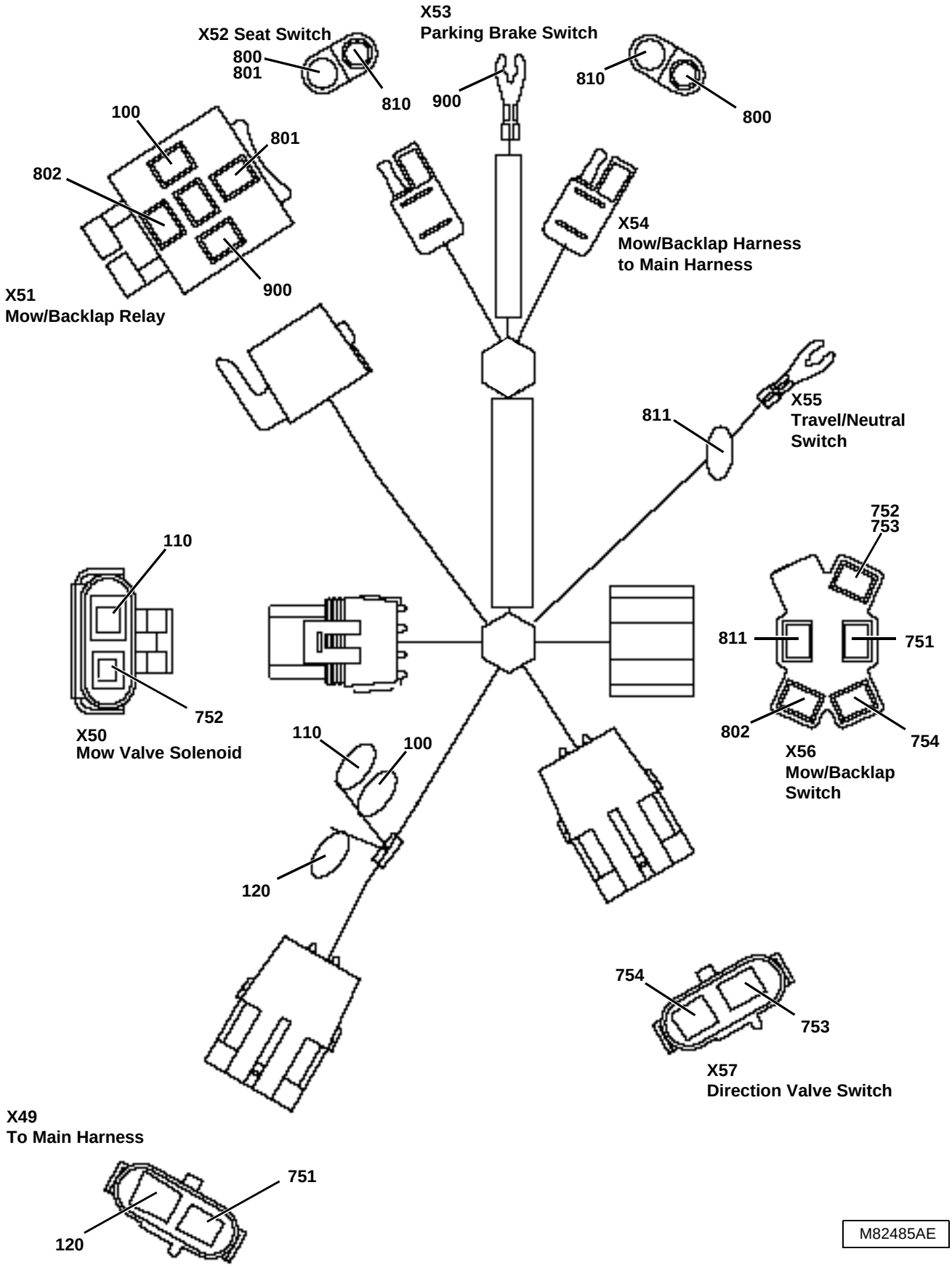
WIRE COLOR CODES

Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
110, 120	0.8	Blk	102, 112	1.0	Red
104, 114	1.0	Yel	100	1.0	Blk


X62
Headlight Switch
112
104
114
104
110
X61
Left Headlight
110
120
100
114
120
X63
Right Headlight
X60
Starter Solenoid Terminal (+)
102
X59
Fuse
112
102
100
X58
Chassis Ground
M82486AE

WIRE COLOR CODES

Circuit Number	Wire Size	Color	Circuit Number	Wire Size	Color
100, 110,120	0.8	Blk	800, 811	0.8	Pnk
753, 802	0.8	Blu	801	0.8	Pnk/Wht
751, 754	0.8	Blu/Wht	810	0.8	Pnk/Blk
752	0.8	Blu/Blk	900	0.8	Wht


X52 Seat Switch
800
801
810
X53
Parking Brake Switch
900
810
800
100
801
802
900
X51
Mow/Backlap Relay
X54
Mow/Backlap Harness
to Main Harness
811
X55
Travel/Neutral
Switch
752
753
110
811
751
752
X50
Mow Valve Solenoid
802
754
X56
Mow/Backlap
Switch
110
100
120
754
753
X57
Direction Valve Switch
X49
To Main Harness
751
120
M82485AE

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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.							●				

POWER CIRCUIT OPERATION

Function:

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

Operating Conditions, Unswitched Circuits:

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

- Battery positive terminal.
- BAT terminal of Starter Solenoid bolt.
- Terminal 1 of Starter Relay.
- BAT terminal of Key Switch.
- Terminal 1 of Voltage Regulator/Rectifier.
- Terminal 1 of Fuel Shutoff Relay.
- 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 START or RUN position:

- Terminals IGN and START of Key Switch.
- Terminals D and E 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 Parking Brake Switch.
- Common terminal of Travel/Neutral Switch.
- Positive terminal of Hourmeter.
- Common terminal of Cutting Unit Mow Switch.
- Common terminal of Cutting Unit Lift Switch.

These circuits are controlled by the key switch and are protected by the fusible link and 15 amp main power fuse.

Optional Headlight Circuit:

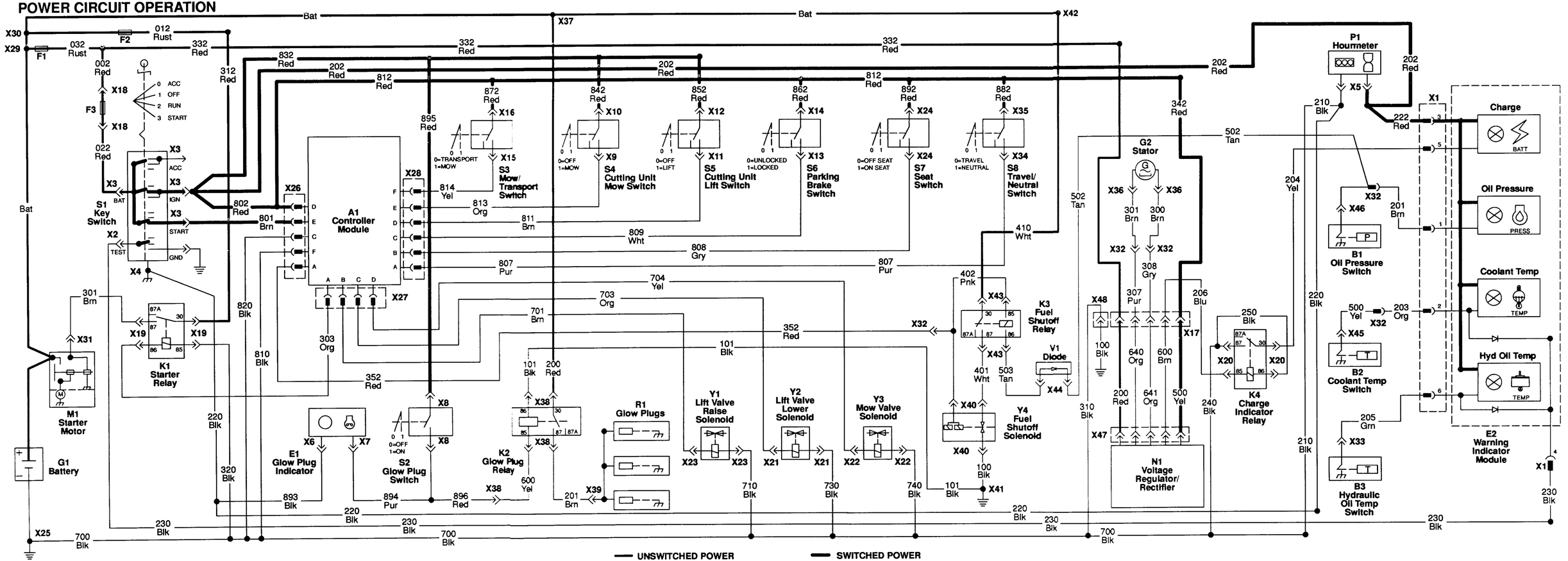
See appropriate schematics and diagnostic procedure for this kit.

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:

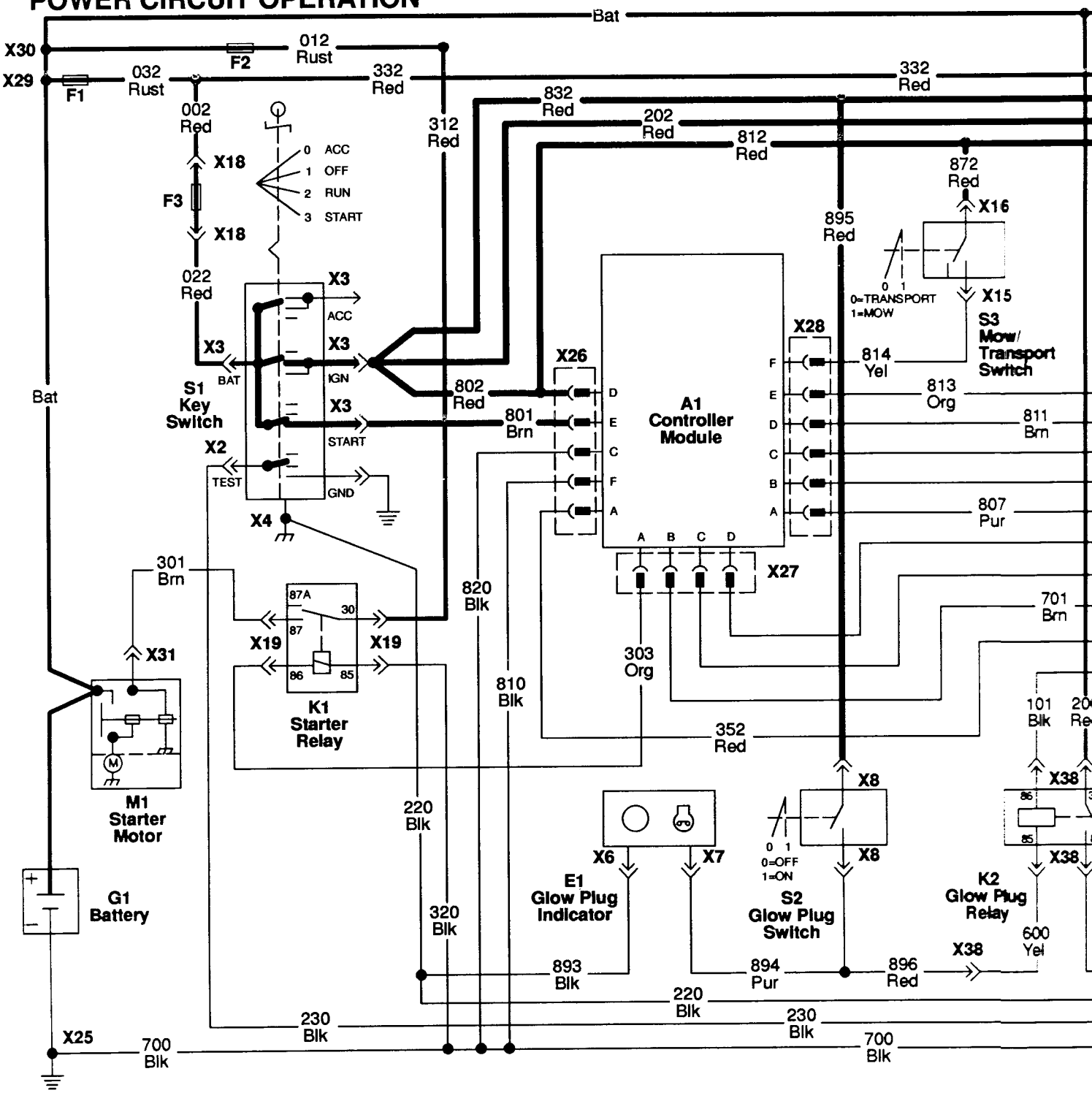
See appropriate schematics and diagnostic procedure for this option.

POWER CIRCUIT OPERATION

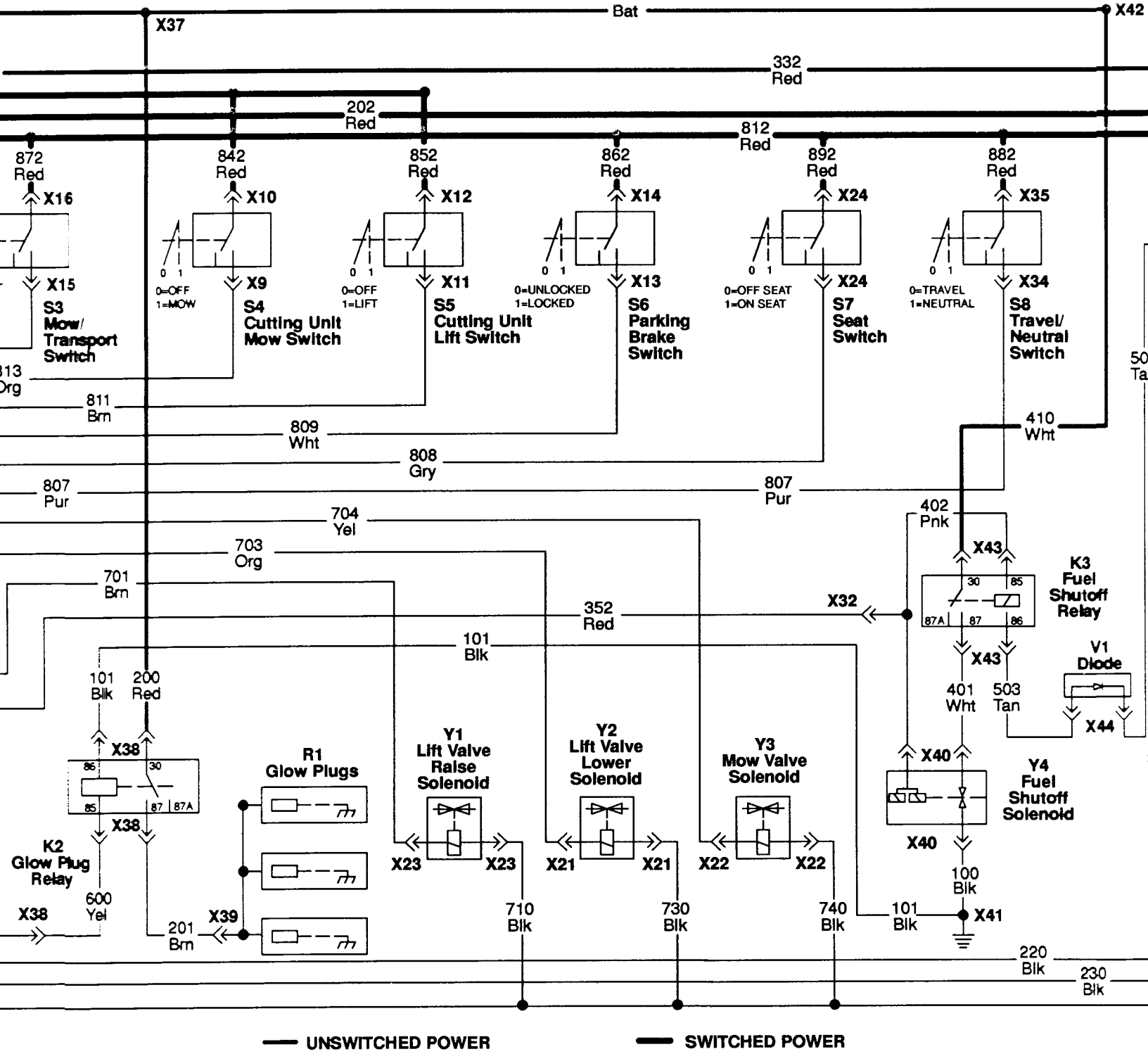


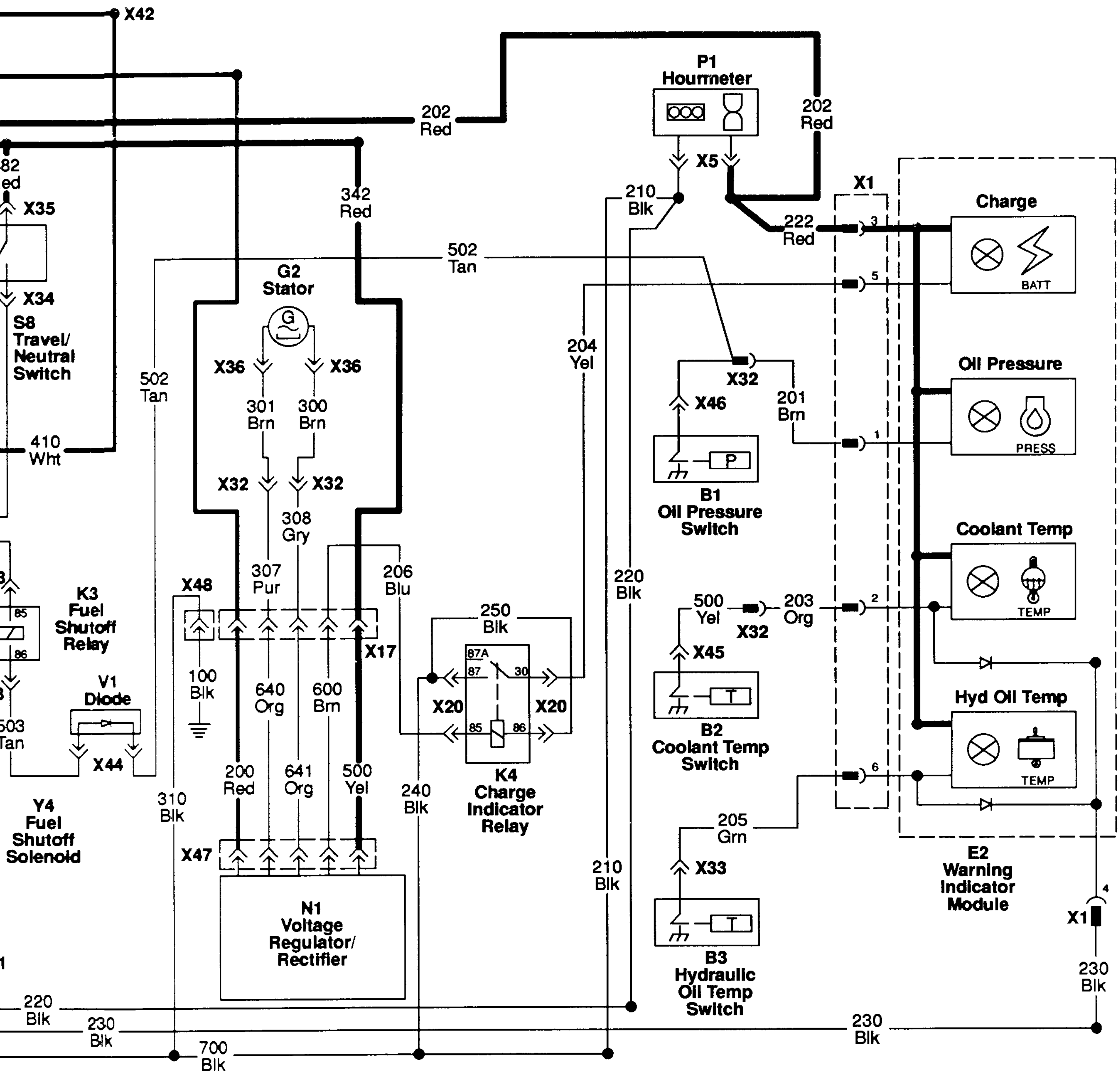
M82488AE

POWER CIRCUIT OPERATION



M82488AE


Bat
X42
X37
332
Red
202
Red
812
Red
872
Red
842
Red
852
Red
862
Red
892
Red
882
Red
X16
X10
X12
X14
X24
X35
X15
S3
Mow/
Transport
Switch
0=OFF
1=MOW
X9
S4
Cutting Unit
Mow Switch
0=OFF
1=LIFT
X11
S5
Cutting Unit
Lift Switch
0=UNLOCKED
1=LOCKED
X13
S6
Parking
Brake
Switch
0=OFF SEAT
1=ON SEAT
X24
S7
Seat
Switch
0=TRAVEL
1=NEUTRAL
X34
S8
Travel/
Neutral
Switch
811
Brn
809
Wht
808
Gry
807
Pur
807
Pur
410
Wht
704
Yel
703
Org
701
Brn
352
Red
101
Blk
X32
402
Pnk
X43
K3
Fuel
Shutoff
Relay
30
85
87A
87
86
X43
V1
Diode
401
Wht
503
Tan
X44
101
Blk
200
Red
X38
86
30
85
87
87A
X38
R1
Glow Plugs
Y1
Lift Valve
Raise
Solenoid
Y2
Lift Valve
Lower
Solenoid
Y3
Mow Valve
Solenoid
X40
Y4
Fuel
Shutoff
Solenoid
X40
K2
Glow Plug
Relay
600
Yel
X38
201
Brn
X39
X23
X23
X21
X21
X22
X22
710
Blk
730
Blk
740
Blk
100
Blk
101
Blk
X41
220
Blk
230
Blk
UNSWITCHED POWER
SWITCHED POWER


X42
202 Red
P1 Hourmeter
202 Red
X5
210 Blk
222 Red
X1
82 ed
X35
342 Red
502 Tan
X34
S8 Travel/ Neutral Switch
G2 Stator
X36
X36
204 Yel
X32
X46
201 Brn
B1 Oil Pressure Switch
502 Tan
301 Brn
300 Brn
410 Wht
X32
X32
308 Gry
307 Pur
206 Blu
220 Blk
500 Yel
203 Org
X32
X45
B2 Coolant Temp Switch
X48
K3 Fuel Shutoff Relay
X17
250 Blk
87A
87
30
85
86
X20
X20
100 Blk
640 Org
600 Brn
V1 Diode
503 Tan
X44
200 Red
641 Org
500 Yel
240 Blk
K4 Charge Indicator Relay
310 Blk
Y4 Fuel Shutoff Solenoid
X47
205 Grn
X33
210 Blk
B3 Hydraulic Oil Temp Switch
N1 Voltage Regulator/ Rectifier
220 Blk
230 Blk
700 Blk
230 Blk
230 Blk
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
E2 Warning Indicator Module
X1
4
3
5
1
2
6

POWER CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Key switch—BAT Terminal	Battery voltage.	Test red wire(s) No. 022, 002 and connections. Test 15 amp fuse and fusible link.
3. Starter relay—Terminal 30	Battery voltage.	Test red wire No. 312, and rust wire No. 012 and connections. Replace fusible link.
4. Fuel shutoff relay—Terminal 30	Battery voltage.	Test white wire No. 410 and connections.
5. Voltage regulator/ rectifier—Terminal 1	Battery voltage.	Test red wires No. 200 and No. 332 and connections.

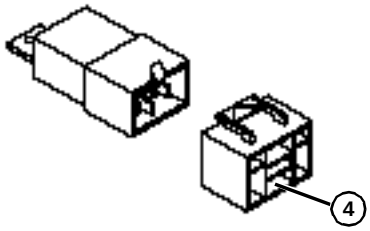
Test Condition:

- Key switch in RUN position.

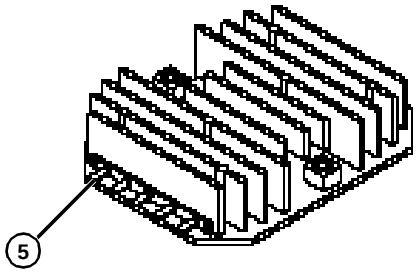
Test Location	Normal	If Not Normal
6. Key switch—IGN terminal	Battery voltage.	Test key switch.
7. Parking brake switch—Common terminal	Battery voltage.	Test red wires No. 802, 812, 862 and connections.
8. Mow/transport switch—Common terminal	Battery voltage.	Test red wires No. 802, 812, 872 and connections.
9. Cutting unit mow switch—Common terminal	Battery voltage.	Test red wires No. 832, 842 and connections.

3 Page Foldout 1600 x 628

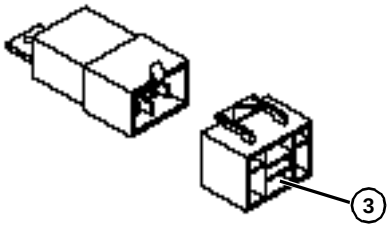
M82488AE



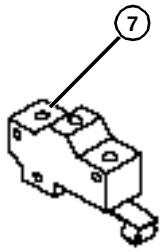
K3 Fuel Shutoff Relay M82491AE



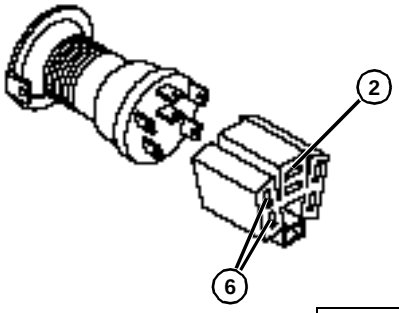
N1 Voltage Regulator/Rectifier M82492AE



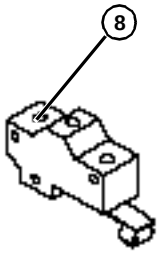
K1 Starter Relay M82491AE



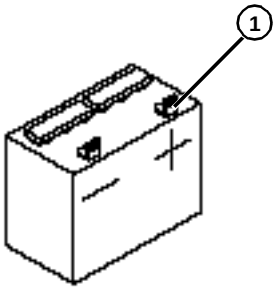
S6 Parking Brake Switch M82493AE



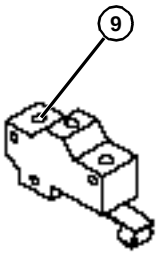
S1 Key Switch M82490AE



S3 Mow/Transport Switch M82493AE



G1 Battery M82489AE



S4 Cutting Unit Mow Switch M82493AE

POWER CIRCUIT DIAGNOSIS, continued

Test Condition:

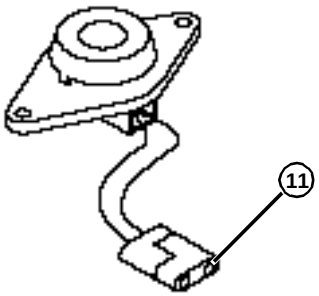
- Key switch in RUN position.

Test Location	Normal	If Not Normal
10. Cutting unit lift switch—Common terminal	Battery voltage.	Test red wires No. 832, 852 and connections.
11. Seat switch—Common terminal	Battery voltage.	Test red wires No. 812, 892 and connections.
12. Travel/neutral switch—Common terminal	Battery voltage.	Test red wires No. 812, 882 and connections.
13. Hourmeter—Positive (+) terminal	Battery voltage.	Test red wire No. 202 and connections.
14. Controller module—Terminal D of six pin female connector	Battery voltage.	Test red wire No. 812 and connections.

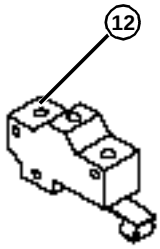
Test Condition:

- Key switch in START position.

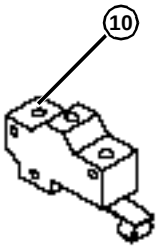
Test Location	Normal	If Not Normal
15. Controller—Terminal E of six pin female connector	Battery voltage.	Test red wire No. 801 and connections.



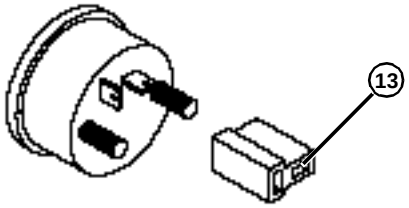
S7 Seat Switch M82494AE



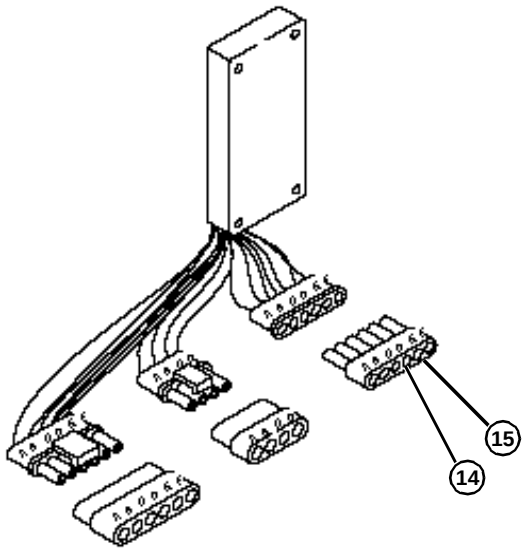
S8 Travel/Neutral Switch M82493AE



S5 Cutting Unit Lift Switch M82493AE



P1 Hourmeter M82495AE



A1 Controller Module M82496AE

INTERLOCK SWITCH SYSTEM OPERATION – START

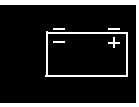
Function:

To prevent the mower from being started in an unsafe manner.

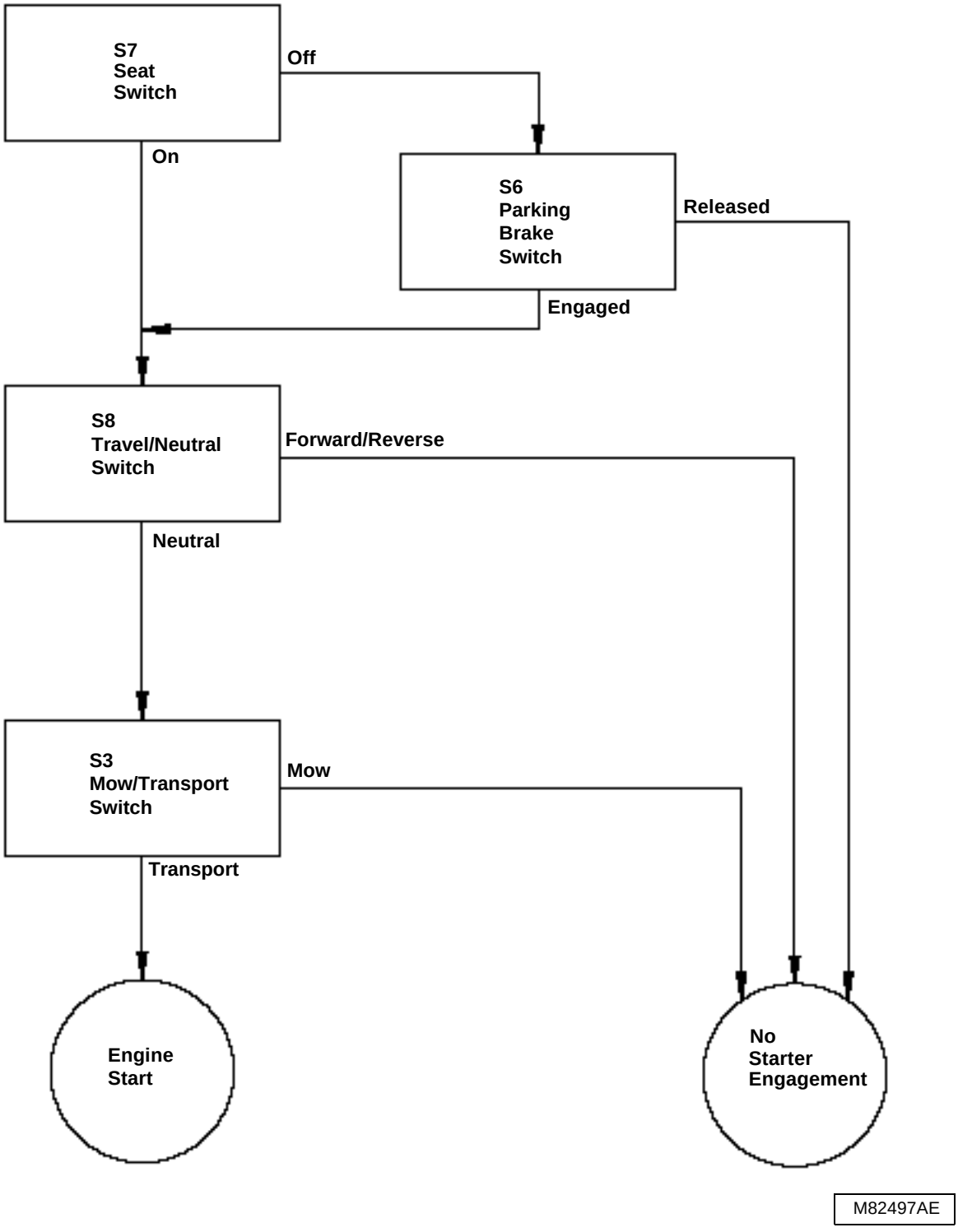
Operating Conditions:

- Operator on seat or parking 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.


S7
Seat
Switch
Off
On
S6
Parking
Brake
Switch
Released
Engaged
S8
Travel/Neutral
Switch
Forward/Reverse
Neutral
S3
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:

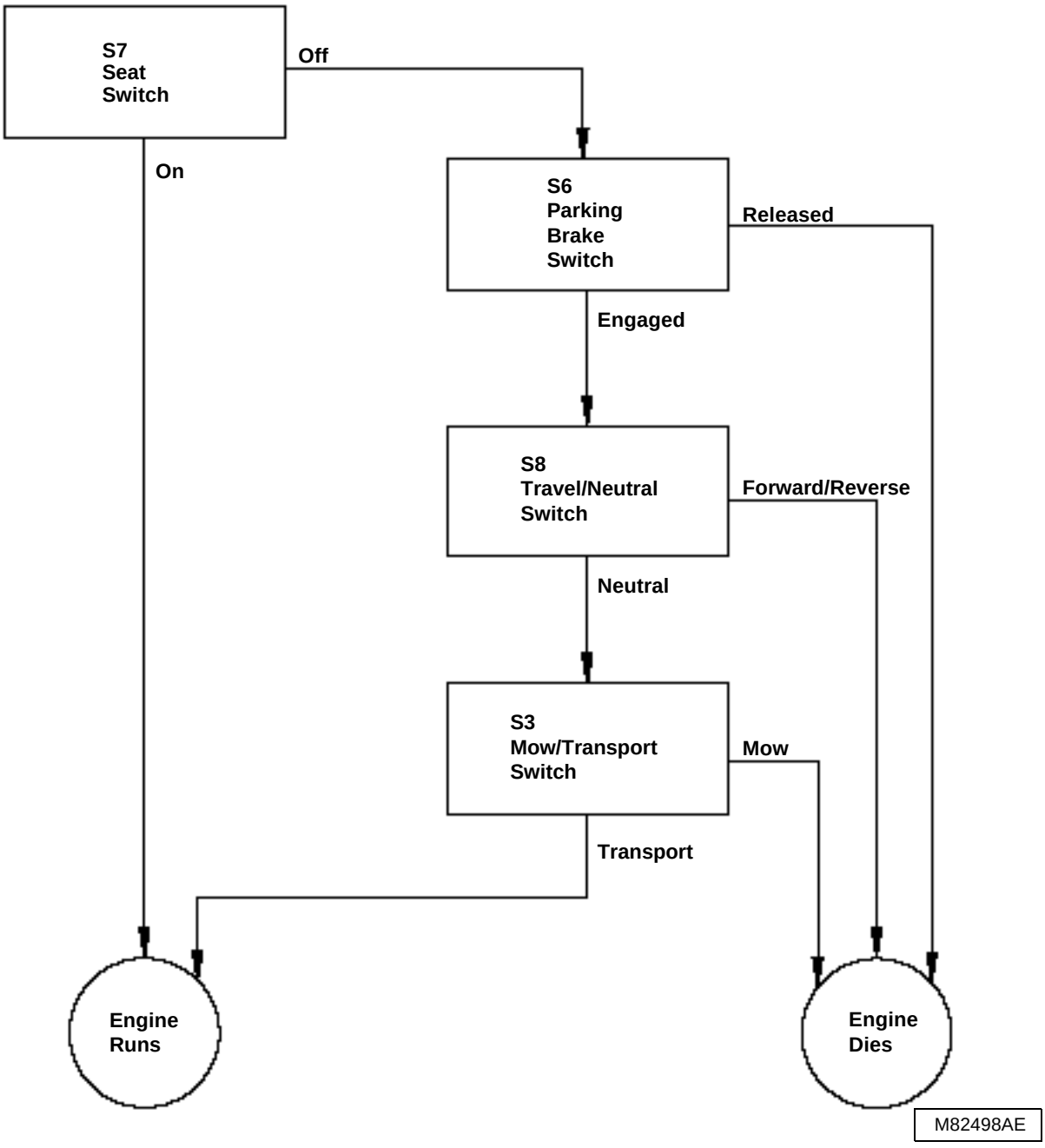
- Operator on seat.
- Parking brake released.
- Either forward or reverse travel pedal PRESSED.
- Mow/transport lever in MOW or TRANSPORT position.

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:

- Parking brake must be LOCKED.
- Tranvel pedals in NEUTRAL position.
- Mow/transport lever in TRANSPORT position.


S7
Seat
Switch
Off
On
S6
Parking
Brake
Switch
Released
Engaged
S8
Travel/Neutral
Switch
Forward/Reverse
Neutral
S3
Mow/Transport
Switch
Mow
Transport
Engine
Runs
Engine
Dies
M82498AE

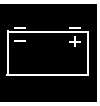
INTERLOCK SWITCH SYSTEM OPERATION – BACKLAP

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:

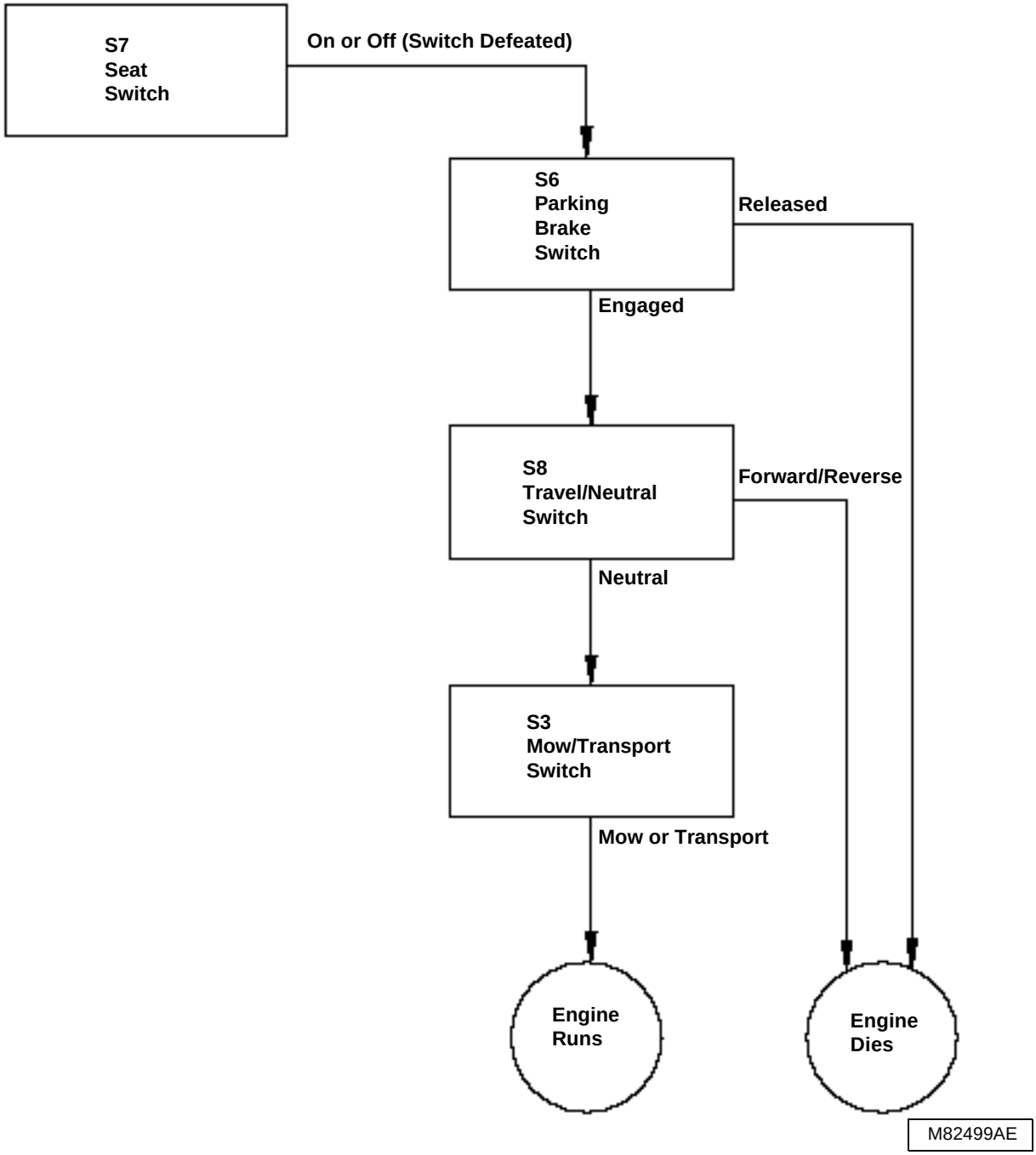
- Travel pedals in NEUTRAL.
- Parking brake LOCKED.
- Backlapping switch in BACKLAP position.



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.


S7
Seat
Switch
On or Off (Switch Defeated)
S6
Parking
Brake
Switch
Released
Engaged
S8
Travel/Neutral
Switch
Forward/Reverse
Neutral
S3
Mow/Transport
Switch
Mow or Transport
Engine
Runs
Engine
Dies
M82499AE

CRANKING CIRCUIT OPERATION

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 must be in NEUTRAL position.
- Mow/transport switch must be in the TRANSPORT position.
- Operator on seat or parking brake LOCKED.

Theory of Operation:

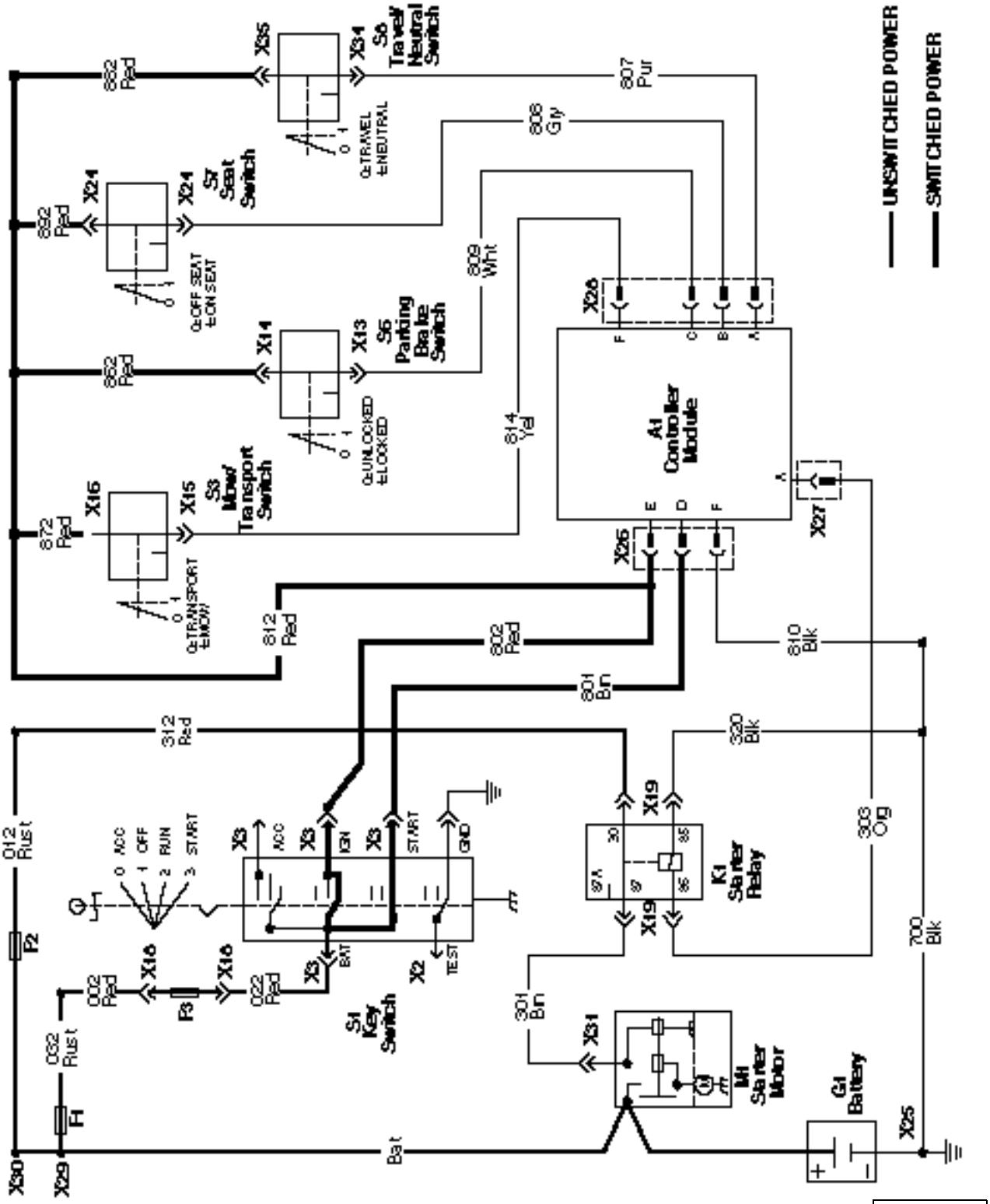
Current flows from the battery through the fusible links to provide power to the interlock circuit and through the 15 amp main fuse to provide power to the key switch. The controller module checks for voltage from the seat switch, travel/neutral switch, and parking brake switch.

With the mow/transport switch in the TRANSPORT position, the controller module then engages the starter relay allowing battery voltage to flow through the relay energizing the starter solenoid.

When the starter solenoid is energized, battery voltage is supplied to the starter motor.

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.


UNSWITCHED POWER
SWITCHED POWER
S6 Travel Neutral Switch
S7 Seat Switch
S6 Parking Brake Switch
S3 Mow/ Transport Switch
A1 Controller Module
S1 Key Switch
K1 Starter Relay
M1 Starter Motor
G1 Battery
F1
F2
F3
M82540AE

CRANKING CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position.
- Travel pedals must be in the NEUTRAL position.
- Mow/transport switch must be in the TRANSPORT position.
- Parking brake ENGAGED or operator on seat.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Key switch - Battery terminal	Battery voltage.	Test red wire(s) No. 022, 002 and connections. Test 15 amp fuse and fusible link. See power circuit diagnosis.
3. Starter relay - Terminal 30	Battery voltage.	Test red wire no. 312, and rust wire no. 012 and connections. Replace fusible link.

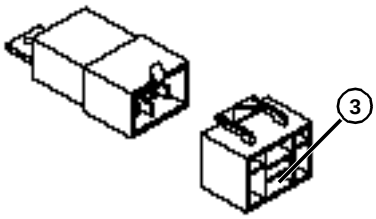
Test Conditions:

C CAUTION

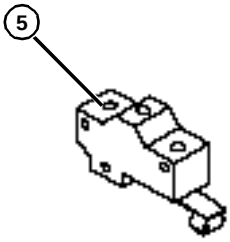
Disconnect fuel control solenoid wire connector to prevent engine from starting during remaining tests.

- Hold key switch in START position. If engine cranks, test Fuel Control Solenoid System.
- Travel pedals must be in the NEUTRAL position.
- Mow/transport switch must be in the TRANSPORT position.
- Parking brake ENGAGED.

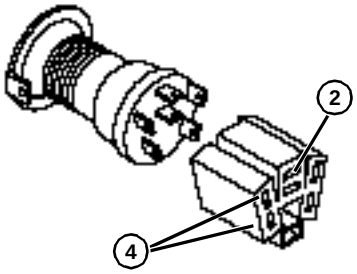
Test Location	Normal	If Not Normal
4. Key switch—IGN terminal	Battery voltage.	Test key switch.
5. Parking brake switch—Common terminal	Battery voltage.	Test red wires No. 802, 812, and 862 and connections.



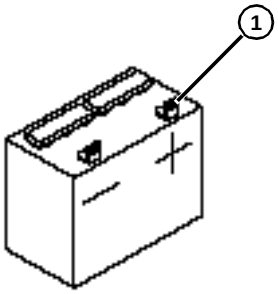
K1 Starter Relay M82491AE



S6 Parking Brake Switch M82493AE



S1 Key Switch M82490AE



G1 Battery M82489AE

CRANKING CIRCUIT DIAGNOSIS, continued

Test Conditions:

C CAUTION

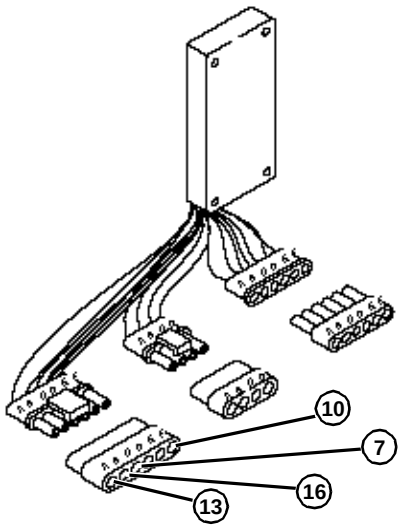
Disconnect fuel control solenoid wire connector to prevent engine from starting during remaining tests.

- Hold key switch in START position. If engine cranks, test Fuel Control Solenoid System.
- Travel pedals must be in the NEUTRAL position.
- Mow/transport switch must be in the TRANSPORT position.
- Parking brake engaged.

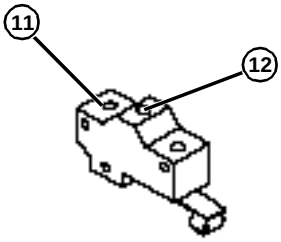
Test Location	Normal	If Not Normal
6. Parking brake switch—Normally closed terminal.	Battery voltage.	Test and/or adjust parking brake switch.
7. Controller module—Terminal C of six terminal male connector.	Battery voltage.	Test white wire No. 809 and connections.
8. Mow/transport switch—Common terminal	Battery voltage.	Test red wires No. 802, 812 and 872 and connections.
9. Mow/transport switch—Normally closed terminal	No voltage.	Test and/or adjust mow/transport switch.
10. Controller module—Terminal F of six terminal male connector	No voltage.	Test yellow wire No. 814 and connections.
11. Travel/neutral switch—Common terminal	Battery voltage.	Test red wire No. 882 and connections.
12. Travel/neutral switch—Normally open terminal	Battery voltage.	Test and/or adjust travel/neutral switch.
13. Controller module—Terminal A of six terminal male connector	Battery voltage.	Test purple wire No. 807 and connections.

NOTE: With parking brake engaged, the seat switch does not have to be activated for operation. Seat switch should however be tested.

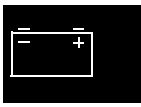
Test Location	Normal	If Not Normal
14. Seat switch	Battery voltage.	Test red wires No. 802, 812, 892 and connections.
15. Seat switch (seat occupied)	Battery voltage.	Test seat switch.
16. Controller module—Terminal B of six terminal male connector	Battery voltage.	Test gray wire No. 808 and connections.

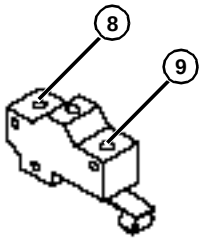


A1 Controller Module M82496AE

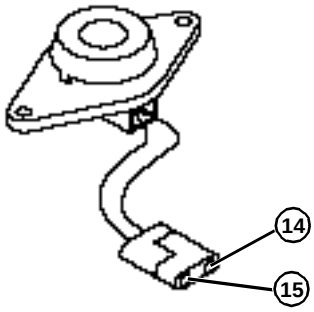


S8 Travel/Neutral Switch M82493AE

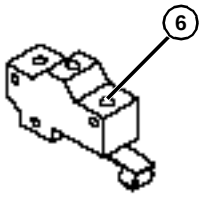




S3 Mow/Transport Switch M82493AE



S7 Seat Switch M82494AE



S6 Parking Brake Switch M82493AE

GLOW PLUG CIRCUIT OPERATION

Function:

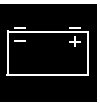
To provide current to the glow plugs to preheat the engine for better starting performance.

Operating Conditions:

- Key switch in the RUN position.
- Glow plug switch in ON position.

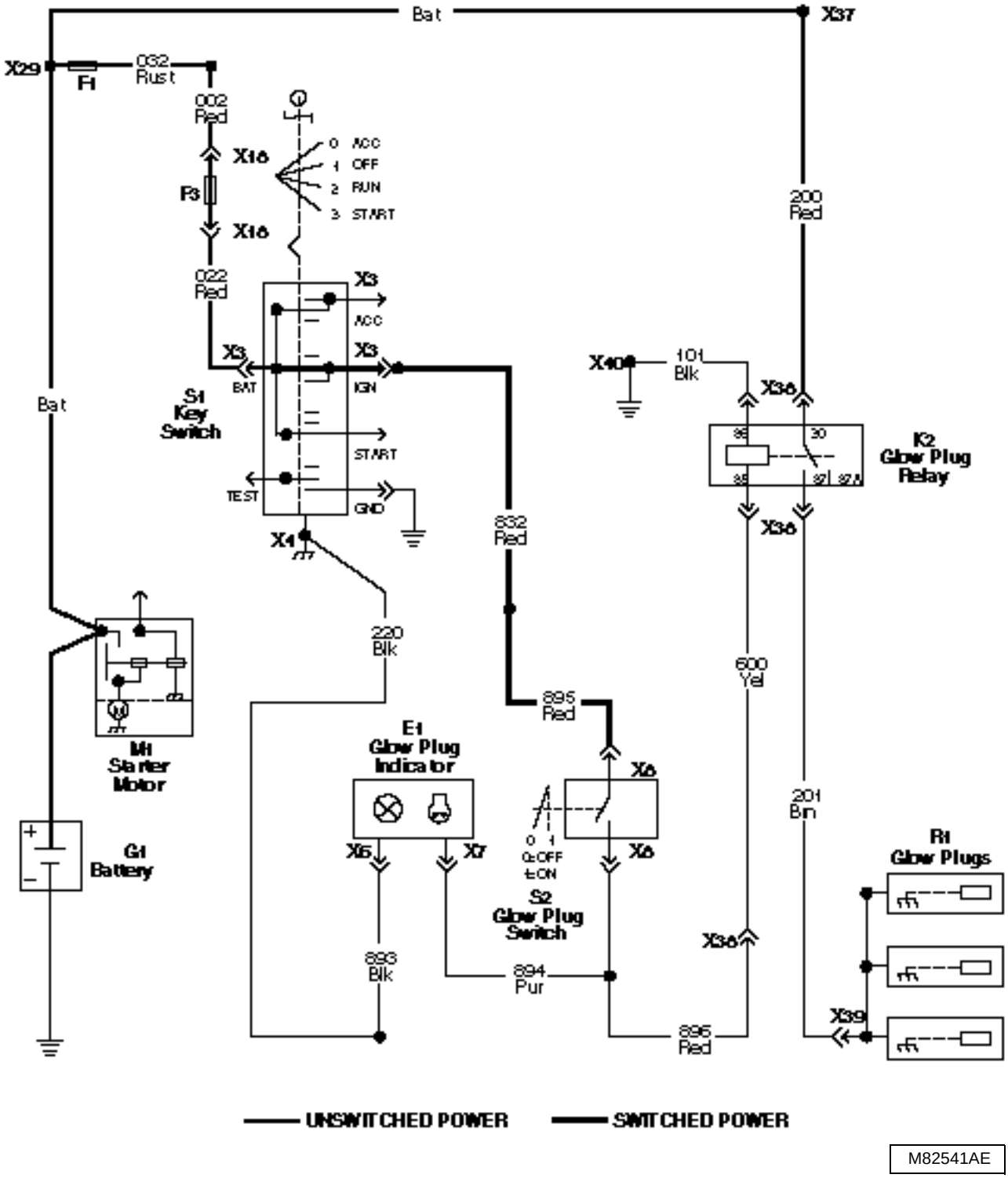
Theory of Operation:

With the key switch in the RUN or START position, battery voltage is supplied to the glow plug switch. When the glow plug switch is engaged, battery voltage is supplied to the glow plug indicator and glow plug relay (coil).



The glow plug indicator circuit is completed by a connection to the ignition switch case, turning the lamp ON.

The glow plug relay (coil) circuit is completed by connection to chassis ground, energizing the relay coil. As the relay coil is energized, a connection within the relay closes, routing battery voltage directly to the glow plugs preheating the engine cylinders.


Bat
X37
X29
F1
052
Rust
002
Red
X18
F3
X18
022
Red
X3
ACC
X3
BAT
IGN
START
TEST
GND
X4
S1
Key
Switch
0 ACC
1 OFF
2 RUN
3 START
200
Red
X40
101
Blk
X36
K2
Glow Plug
Relay
X36
832
Red
220
Blk
600
Yel
201
Brn
M1
Starter
Motor
G1
Battery
E1
Glow Plug
Indicator
X5
X7
X6
X6
0 1
0=OFF
1=ON
S2
Glow Plug
Switch
893
Blk
894
Pur
895
Red
X36
R1
Glow Plugs
X39
UNSWITCHED POWER
SWITCHED POWER

M82541AE

GLOW PLUG CIRCUIT DIAGNOSIS

Test Conditions:

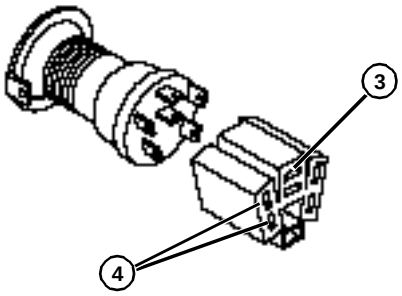
- Key switch in RUN position.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Starter connection	Battery voltage.	Check battery cable connection.
3. Key switch—BAT terminal	Battery voltage.	Test fusible link, 15 amp main power fuse, and red wires No. 032, 002, and 022.
4. Key switch—IGN terminal	Battery voltage.	Test key switch.
5. Glow plug switch	Battery voltage.	Test red wire(s) No. 832 and 895 and connections.

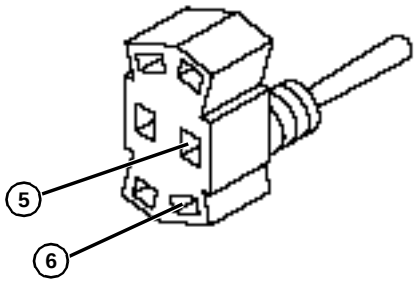
Test Conditions:

- Key switch in RUN position.
- Glow plug switch depressed.

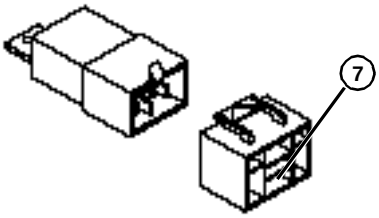
Test Location	Normal	If Not Normal
6. Glow plug switch	Battery voltage.	Replace glow plug switch.
7. Glow plug relay—Terminal 30	Battery voltage.	Test red wire No. 200 (engine harness) and connections.
8. Glow plug indicator	Battery voltage.	Test purple wire No. 894 and connections.
9. Glow plug indicator bulb	Good condition.	Replace bulb.
10. Glow plugs	Battery voltage.	Test brown wire No. 201, replace glow plug relay.
11. Glow plugs (Resistance)	Resistance to specification.	Test glow plugs.



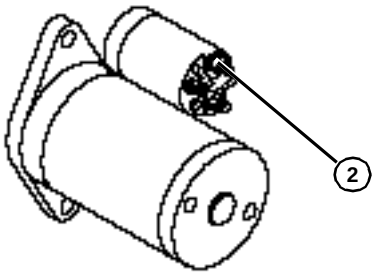
S1 Key Switch M82490AE



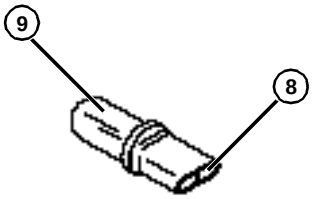
S2 Glow Plug Switch M82543AE



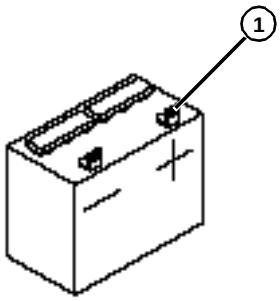
K2 Glow Plug Relay M82491AE



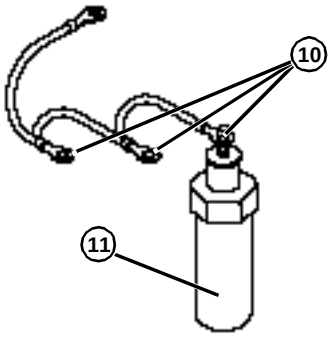
M1 Starter Motor M82542AE



E1 Glow Plug Indicator M82544AE



G1 Battery M82489AE



R1 Glow Plug M82545AE

FUEL SHUTOFF CIRCUIT OPERATION

Function:

To allow fuel to be delivered to the Fuel injector, when the key switch is ON, and oil pressure is at current specifications.

Operating Conditions:

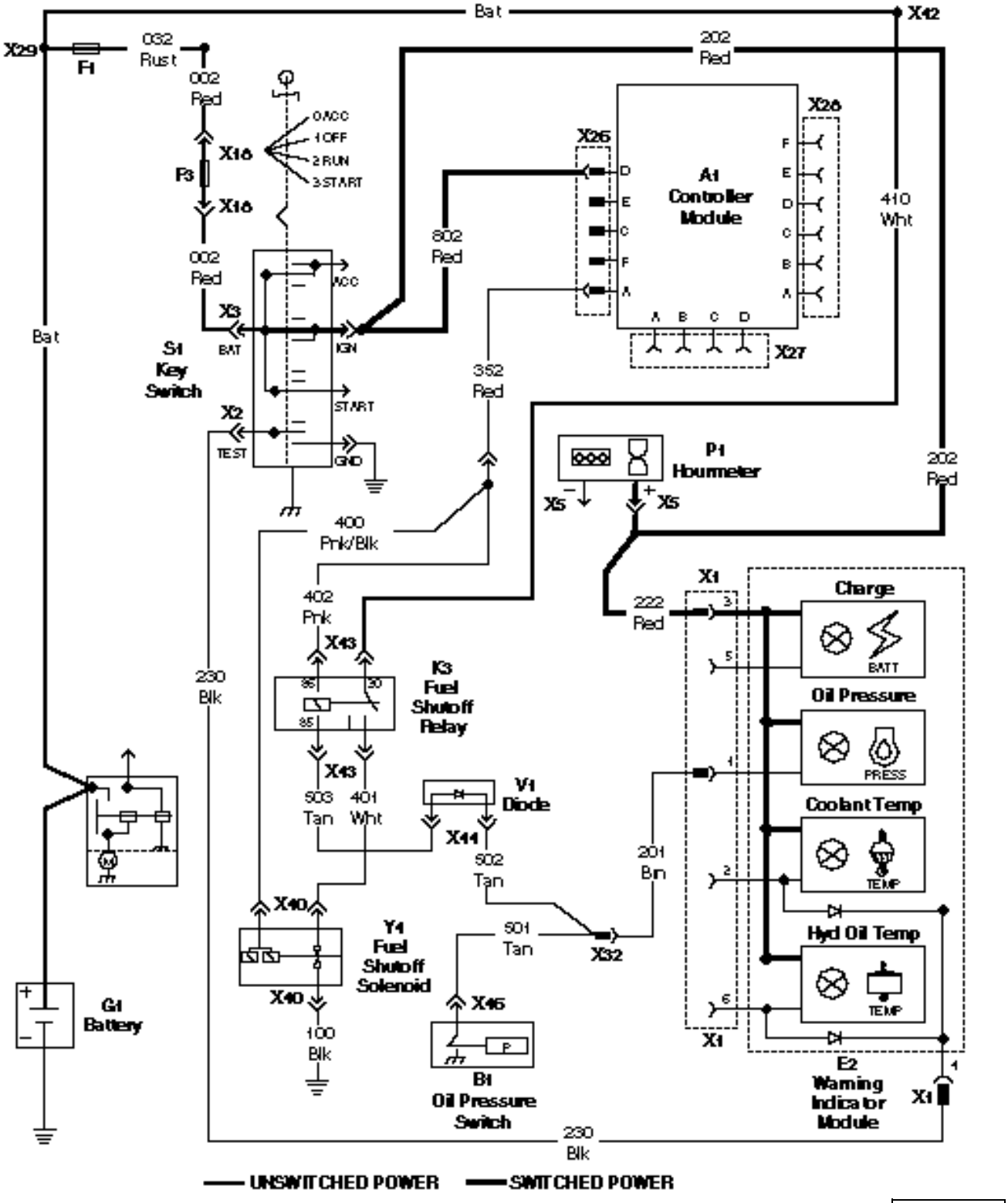
- Key switch in the START or RUN position.
- Travel pedals must be in the NEUTRAL position.
- Mow/transport lever must be in the TRANSPORT position.
- Parking brake ENGAGED or operator on seat.

Theory of Operation:

With the key switch in the START or RUN position battery voltage is supplied to the controller module, fuel solenoid hold-in coil and fuel shutoff relay. As the key switch is moved to the START position the fuel pull-in coil is energized.

When the engine oil pressure reaches the correct operating pressure, the oil pressure sensor de-energizes fuel shutoff relay, removing power from the fuel solenoid pull-in coil while cranking continues.

If power is interrupted (key switch moved to OFF position) the fuel solenoid hold-in coil will be de-energized stopping the fuel flow and causing the engine to stop.

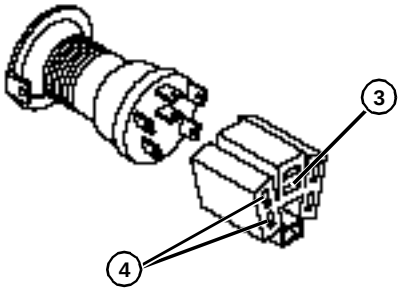

Bat
X42
X29
F1
032
Rust
002
Red
202
Red
X18
P3
0 ACC
1 OFF
2 RUN
3 START
X26
A1
Controller
Module
410
Wht
602
Red
X27
S1
Key
Switch
BAT
IGN
ACC
START
GND
X3
X2
TEST
352
Red
P1
Hourmeter
X5
400
Pnk/Blk
402
Pnk
X43
K3
Fuel
Shutoff
Relay
230
Blk
503
Tan
401
Wht
V1
Diode
X44
502
Tan
201
Brn
X1
222
Red
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
X40
Y1
Fuel
Shutoff
Solenoid
501
Tan
X32
X46
100
Blk
B1
Oil Pressure
Switch
G1
Battery
E2
Warning
Indicator
Module
UNSWITCHED POWER
SWITCHED POWER
M82546AE

FUEL SHUTOFF CIRCUIT DIAGNOSIS

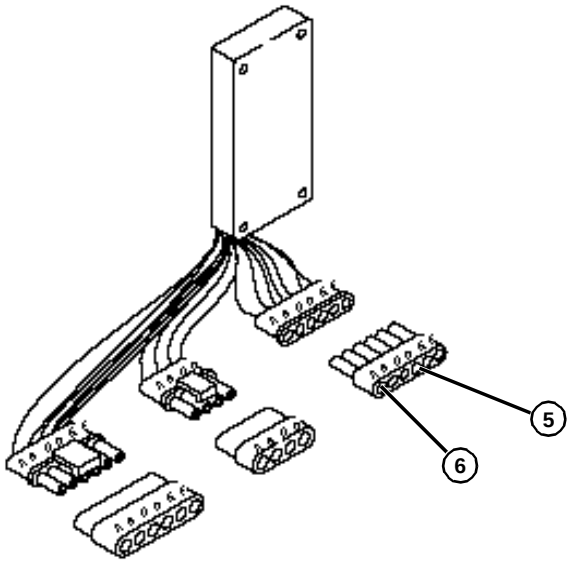
Test Conditions:

- Key switch in RUN position.
- Travel pedals must be in the NEUTRAL position.
- Mow/transport lever must be in the TRANSPORT position.
- Parking brake ENGAGED or operator on seat.

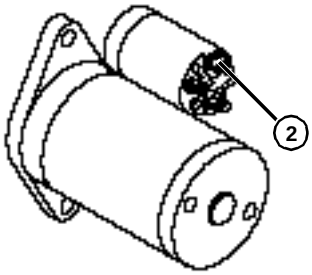
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Starter connection	Battery voltage.	Check battery cable connection.
3. Key switch—BAT terminal	Battery voltage.	Test fusible link, 15 amp main power fuse, and rust wire No. 032, red wires No. 002, and 022.
4. Key switch—IGN terminal	Battery voltage.	Test ignition switch.
5. Controller module—Terminal D of six pin female connector	Battery voltage.	Test red wires No. 802 and 812.
6. Controller module—Terminal A of six pin female connector	Battery voltage.	Replace controller module.
7. Engine connector	Battery voltage.	Test tan wires No. 502 and 503 and connections, diode.
8. Fuel shutoff solenoid	Battery voltage.	Test pink/black wire No. 400 and connections.
9. Fuel shutoff solenoid connector	Battery voltage.	Replace fuel shutoff solenoid.
10. Fuel shutoff solenoid connector	Battery voltage.	Test black wire No. 100 and connections.



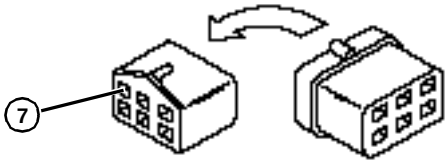
S1 Key Switch M82490AE



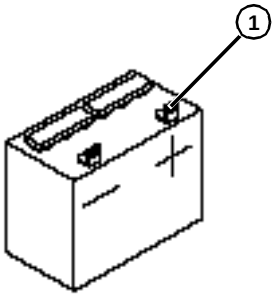
A1 Controller Module M82496AE



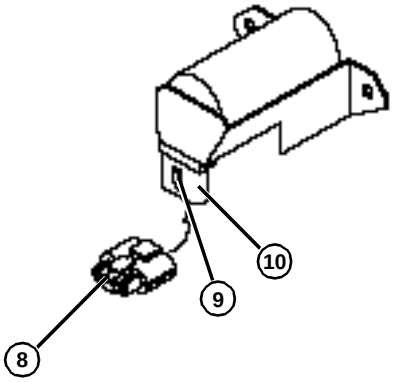
M1 Starter Motor M82542AE



X32 Engine Connector M82548AE



G1 Battery M82489AE



Y4 Fuel Shutoff Solenoid M82577AE

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.

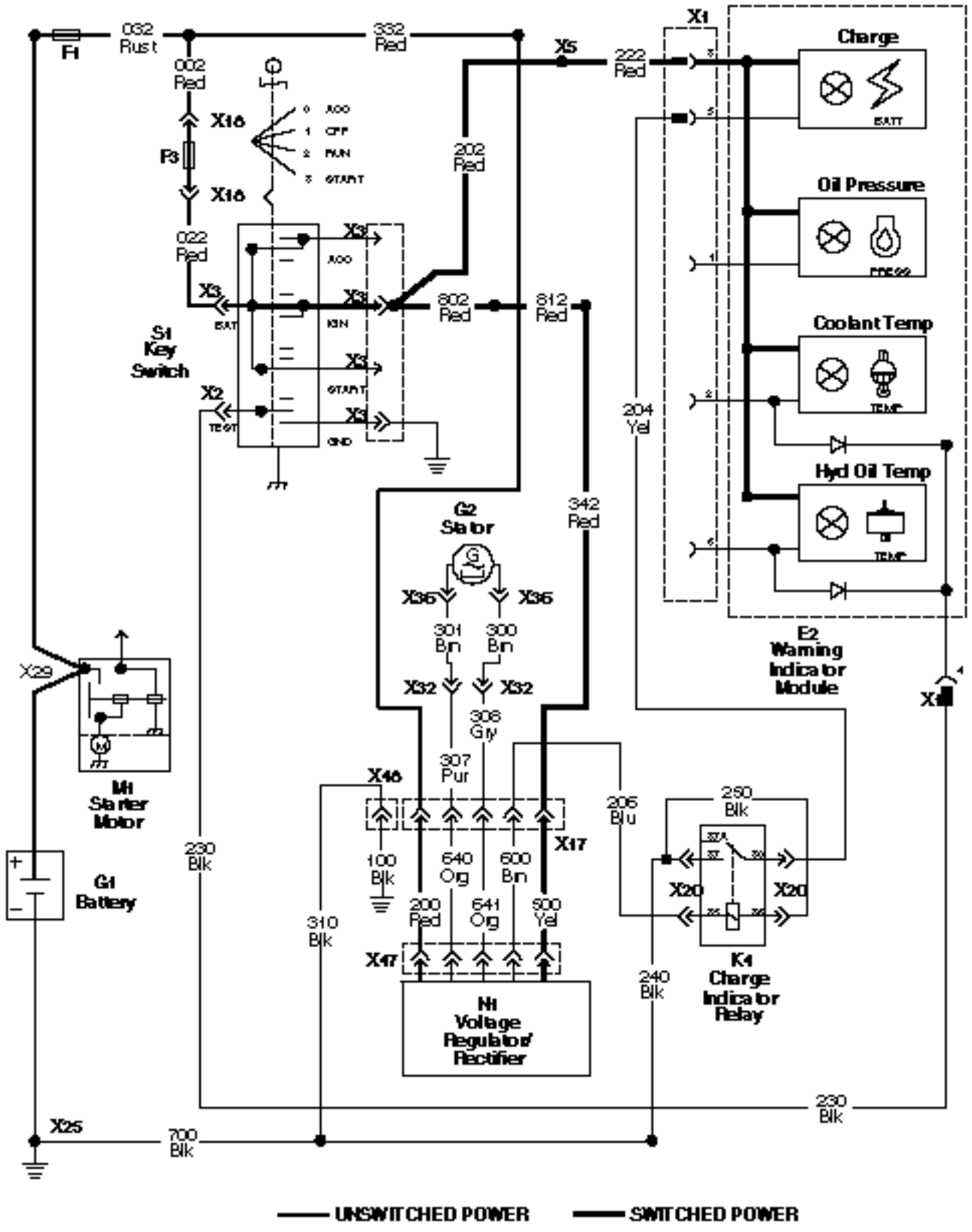
Theory of Operation:

With the engine running, the stator supplies an alternating current to the voltage regulator/rectifier.

The voltage regulator senses the battery voltage level and routes DC voltage to charge the battery as required.

If the voltage output from the stator is less than the battery voltage, the voltage regulator/rectifier routes battery voltage to charge indicator relay energizing the relay, completing the circuit and lighting the battery discharge light.

The ground circuit provides a path to ground for the regulator/rectifier and warning indicator module/ battery discharge light.


F1
032 Rust
332 Red
002 Red
X18
P3
022 Red
X5
222 Red
202 Red
X1
Charge
Oil Pressure
Coolant Temp
Hyd Oil Temp
204 Yel
S1 Key Switch
X2
X3
802 Red
812 Red
342 Red
G2 Stator
X36
301 Brn
300 Brn
X32
308 Gry
307 Pur
E2 Warning Indicator Module
X4
X29
M1 Starter Motor
G1 Battery
X46
X17
100 Blk
640 Org
600 Brn
200 Red
641 Org
500 Yel
X47
310 Blk
230 Blk
205 Blu
250 Blk
X20
K1 Charge Indicator Relay
240 Blk
N1 Voltage Regulator/ Rectifier
X25
700 Blk
230 Blk
UNSWITCHED POWER
SWITCHED POWER

M82547AE

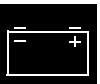
CHARGING CIRCUIT DIAGNOSIS

The test should be performed in the order shown to simplify diagnostics.

Test Conditions:

- Key switch in OFF position.

Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test rust wire No. 032, red wires no. 022, and 002, 15 amp main fuse, and fusible link, and battery positive cable.



Test Conditions:

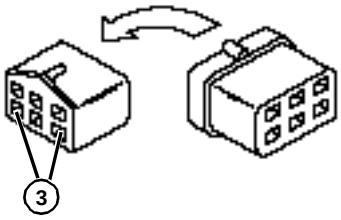
- Key switch in RUN position—Engine running.

Test Location	Normal	If Not Normal
3. Engine connector (perform Unregulated Voltage Output Test)	Minimum voltage to specification.	See Unregulated Voltage Output Test.
4. Voltage regulator/rectifier (perform Regulated Amperage and Voltage tests.)	To specification.	See Regulated Amperage and Voltage Tests.

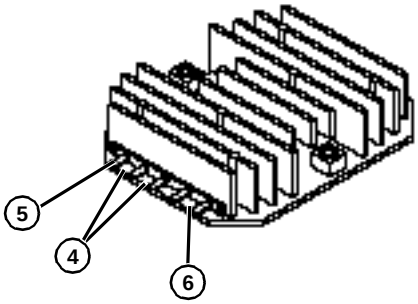
Test Conditions:

- Disconnect battery positive (+) cable for following continuity tests.
- Key switch in RUN position—Engine not running.

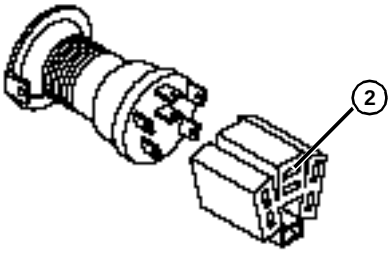
Test Location	Normal	If Not Normal
5. Starter/Battery positive (+) connection to regulator/rectifier Terminal 1	Continuity.	Test red wires No. 332, and 032, fusible link, positive (+) battery cable and connections.
6. Starter/Battery positive (+) connection to regulator/rectifier Terminal 5	Continuity.	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.



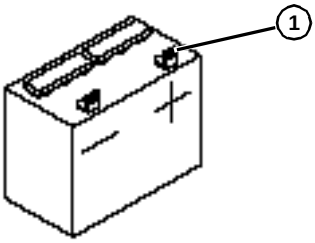
X32 Engine Connector M82548AE



N1 Voltage Regulator/Rectifier M82492AE



S1 Key Switch M82490AE



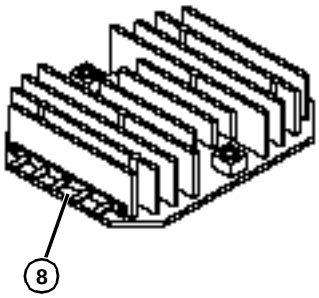
G1 Battery M82489AE

CHARGING CIRCUIT DIAGNOSIS, continued

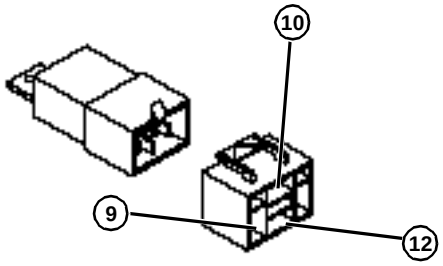
Test Conditions

- Connect battery cables for following voltage tests.
- Key switch in RUN position—Engine not running.

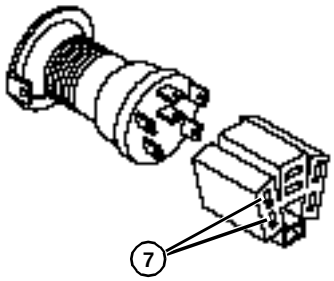
Test Location	Normal	If Not Normal
7. Key switch—IGN Terminal	Battery voltage.	Test key switch.
8. Voltage regulator/rectifier—Terminal 4	Battery voltage.	Replace voltage regulator/rectifier.
9. Charge indicator relay—Terminal 85	Battery voltage.	Test blue wire No. 206, brown wire No. 600, and connections.
10. Charge indicator relay—Terminal 87	Less than 0.2 volt.	Test relay, black wires No. 240, and 700 and connections.
11. Warning indicator module connector—Terminal 3	Battery voltage.	Test red wires No. 202, and 222, key switch, and connections.
12. Charge indicator relay - Terminal 30	Less than 0.2 volt.	Test battery indicator bulb, module, yellow wire No. 204, and connections.



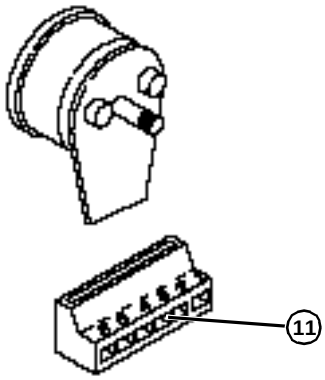
N1 Voltage Regulator/Rectifier M82492AE



K4 Charge Indicator Relay M82491AE



S1 Key Switch M82490AE



E2 Warning Indicator Module M82549AE

LOW ENGINE OIL PRESSURE WARNING CIRCUIT OPERATION

Function:

To illuminate a lamp in the warning indicator module if engine oil pressure is below minimum operating pressure.

Operating Conditions:

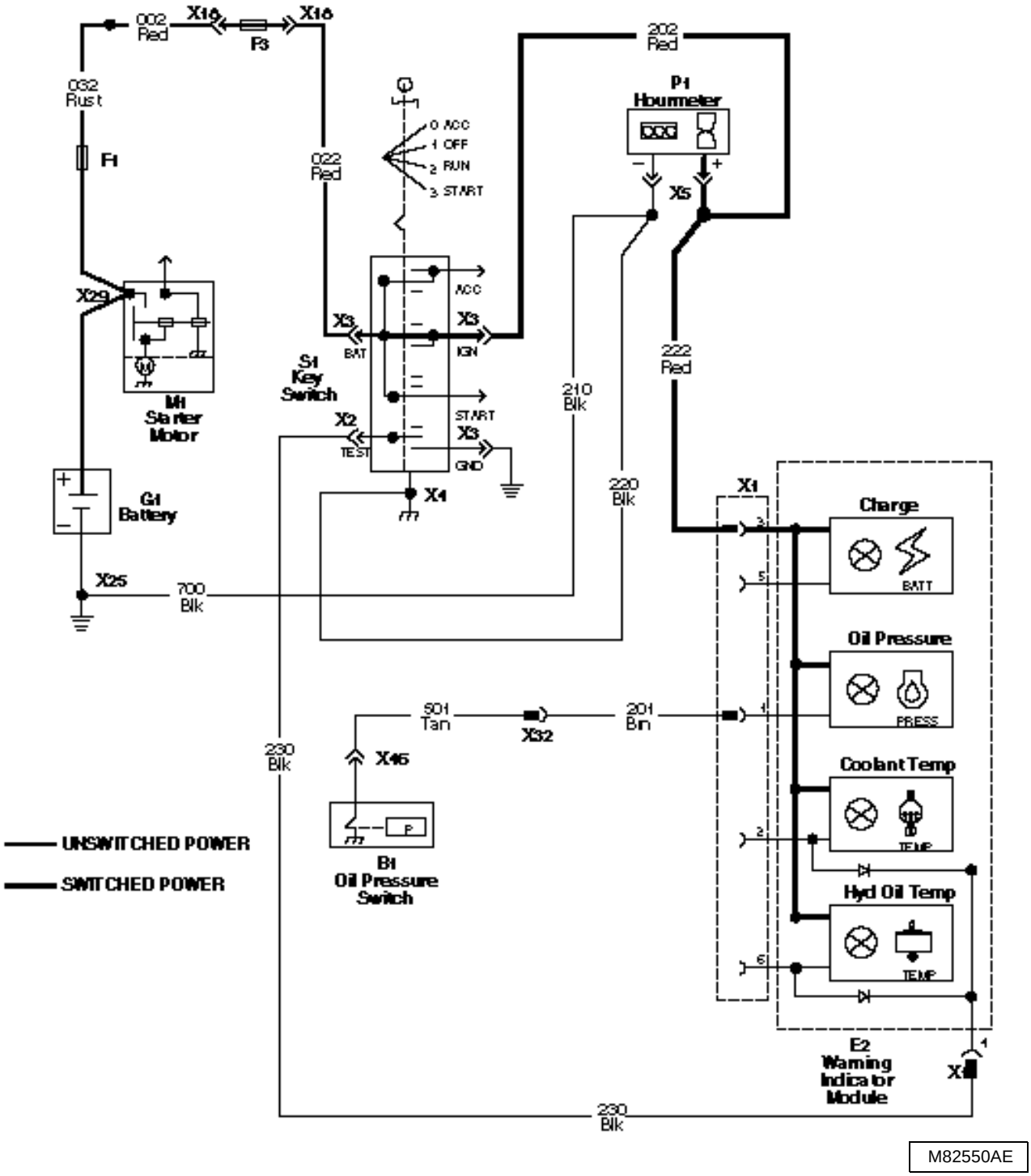
- Key switch in the RUN position.
- Engine running.

Theory of Operation:

With the key switch in the RUN position, battery voltage is supplied to the warning indicator module and oil pressure warning lamp. When engine oil pressure drops below minimum operating pressure, the switch closes, completing circuit to ground and lighting the oil pressure light.

The ground circuit provides a path to ground for the warning indicator module when oil pressure is low.

Check for bulb condition when key switch in the RUN position and the engine is not running. Wire Nos. 220, 230, and 700 provide ground circuit for bulb check.

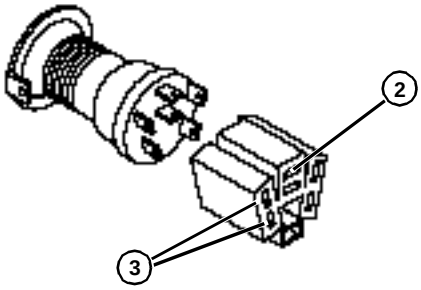

002 Red
X16
P3
X16
032 Rust
F1
022 Red
202 Red
P1 Hourmeter
0 ACC
1 OFF
2 RUN
3 START
X5
X29
M1 Starter Motor
X3
BAT
S1 Key Switch
ACC
X3
IGN
START
X2
TEST
X3
GND
X4
210 Blk
222 Red
220 Blk
G1 Battery
X25
700 Blk
X1
Charge
BATT
Oil Pressure
PRESS
501 Tan
X32
201 Brn
230 Blk
X46
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
B1 Oil Pressure Switch
UNSWITCHED POWER
SWITCHED POWER
E2 Warning Indicator Module
X1
230 Blk
M82550AE

LOW ENGINE OIL PRESSURE WARNING CIRCUIT DIAGNOSIS

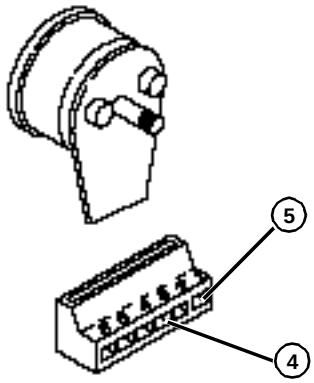
Test Conditions:

- Key switch in RUN position.

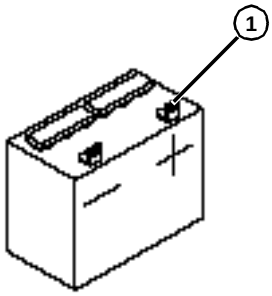
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and 022, 15 amp main fuse and connections.
3. Key switch—IGN terminal	Battery voltage.	Test ignition switch.
4. Warning indicator module—Terminal 3	Battery voltage.	Test red wires No. 222 and 202.
5. Warning indicator module—Terminal 1	Less than 0.2 volt.	Test warning light module, bulb, brown wire No. 201, engine connector, tan wire No. 501, oil pressure switch and engine ground.
6. Engine oil pressure switch	Continuity between terminal and ground.	Test switch.



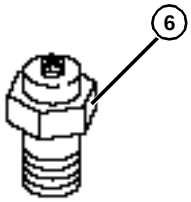
S1 Key Switch M82490AE



E2 Warning Indicator Module M82549AE



G1 Battery M82489AE



B1 Engine Oil Pressure Switch M82551AE

COOLANT TEMPERATURE WARNING CIRCUIT OPERATION

Function:

To illuminate a lamp in the warning indicator module if engine coolant temperature exceeds normal operating temperature.

Operating Conditions:

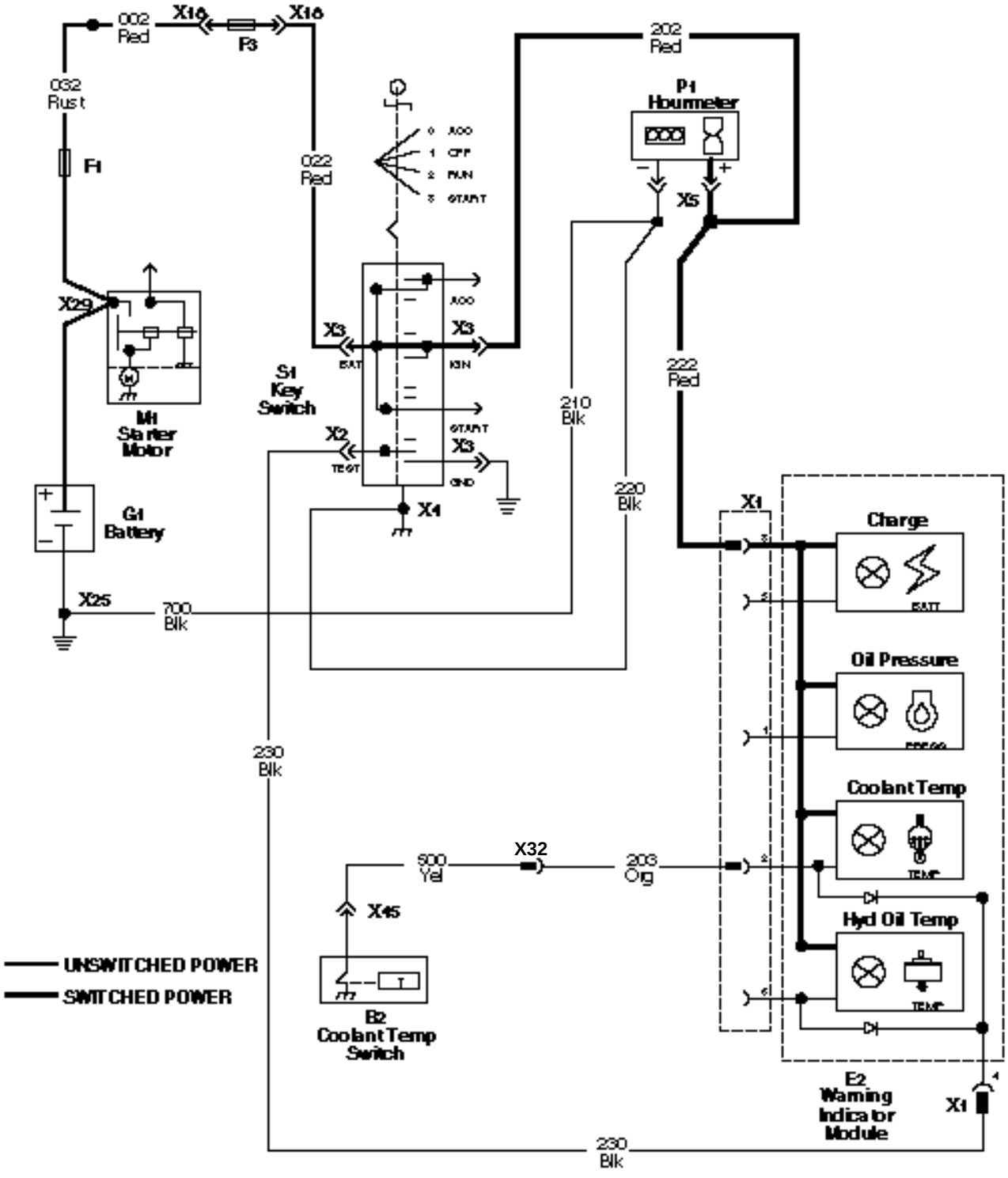
- Key switch in the RUN position.

Theory of Operation:

With the key switch in the RUN position, battery voltage is supplied to the warning indicator module and water temperature warning lamp. When engine coolant temperature exceeds normal operating temperature, the switch closes, completing circuit to ground and lighting the coolant temperature light.

The ground circuit provides a path to ground for the warning indicator module when coolant temperature exceeds normal operating temperature.

Check for bulb condition when key switch is positioned between RUN and START positions. Wire Nos. 220, 230, and 700 provide ground circuit for bulb check.

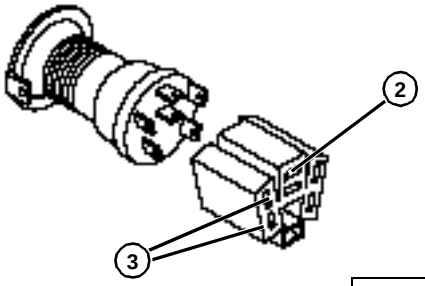

002 Red
X16
P3
X16
032 Rust
F1
022 Red
202 Red
P1 Hourmeter
X5
X29
M1 Starter Motor
S1 Key Switch
X3
X3
X2
X3
X4
210 Blk
222 Red
220 Blk
G1 Battery
X25
700 Blk
X1
Charge
Oil Pressure
Coolant Temp
Hyd Oil Temp
230 Blk
900 Yel
X32
203 Org
X45
B2 Coolant Temp Switch
UNSWITCHED POWER
SWITCHED POWER
E2 Warning Indicator Module
X1
230 Blk
M82552AE

COOLANT TEMPERATURE WARNING CIRCUIT DIAGNOSIS

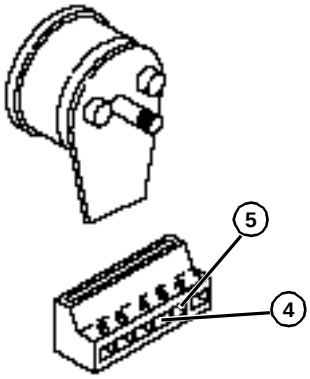
Test Conditions:

To test the circuit, disconnect the yellow wire at the coolant temperature switch. Ground this wire, and turn the key switch to the RUN position.

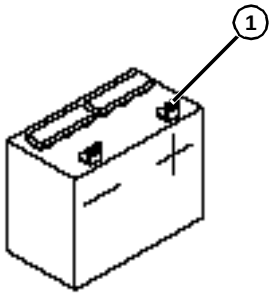
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and 022, 15 amp main fuse and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Warning indicator module—Terminal 3	Battery voltage.	Test red wires No. 222 and 202.
5. 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.
6. Coolant temperature switch	Resistance within specification.	Test switch.



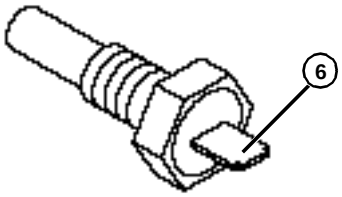
S1 Key Switch M82490AE



E2 Warning Indicator Module M82549AE



G1 Battery M82489AE



B2 Coolant Temperature Switch M82553AE

HYDRAULIC OIL TEMPERATURE WARNING CIRCUIT OPERATION

Function:

To illuminate a lamp in the warning indicator module if hydraulic oil temperature exceeds specifications.

Operating Conditions:

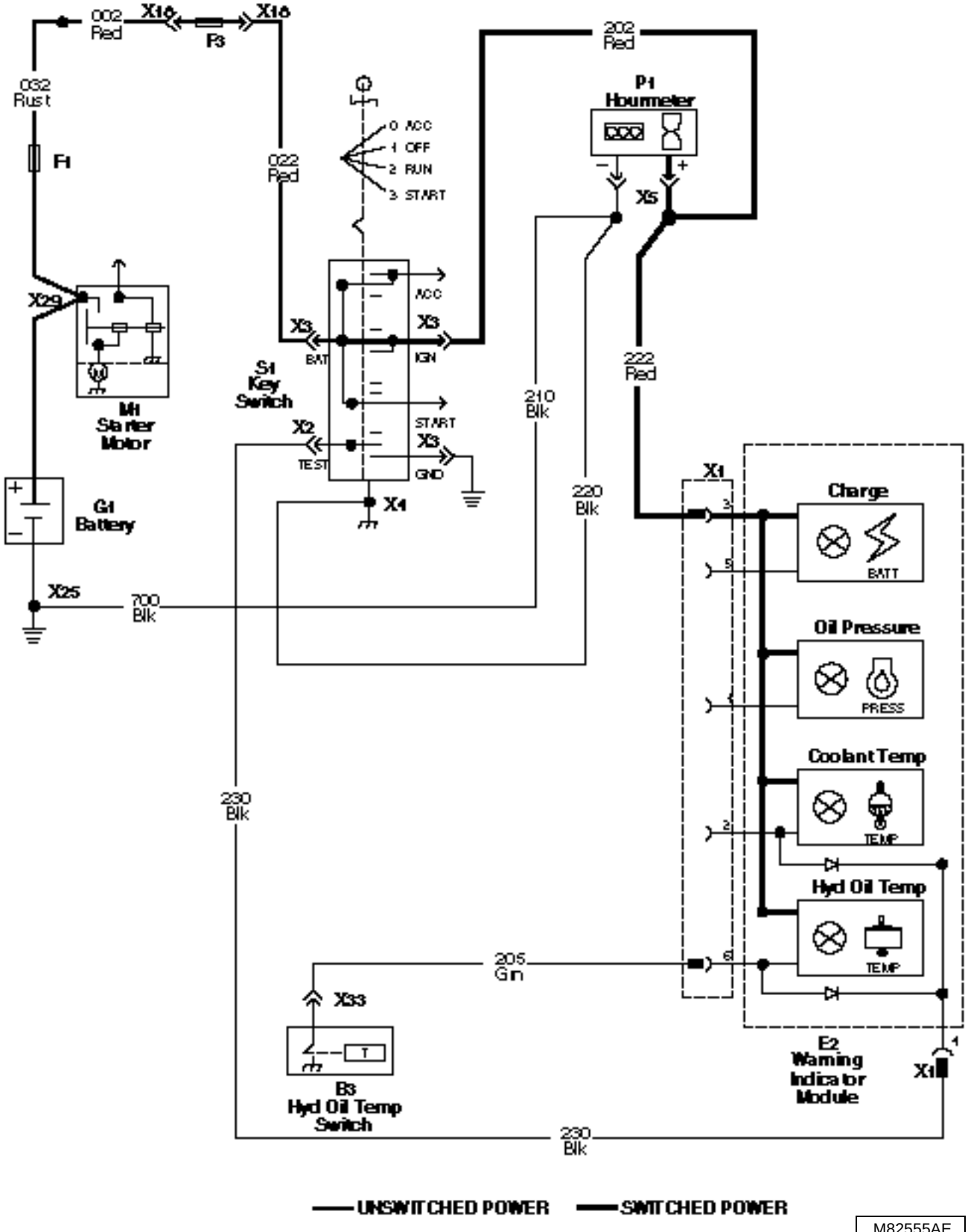
- Key switch in the RUN position.
- Engine running.

Theory of Operation:

With the key switch in the RUN position, battery voltage is supplied to the warning indicator module and hydraulic oil temperature warning lamp. When hydraulic oil temperature exceeds specification, the switch closes, completing circuit to ground and lighting the hydraulic oil temperature indicator.

The ground circuit provides a path to ground for the warning indicator module when hydraulic oil temperature is high.

Check for bulb condition when key switch is positioned between RUN and START positions. Wire Nos. 220, 230, and 700 provide ground circuit for bulb check.

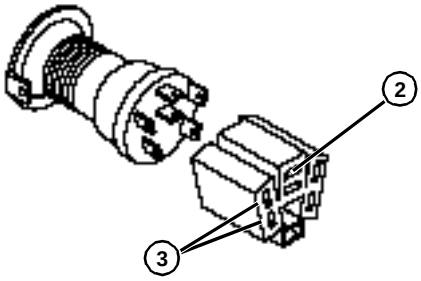

002 Red
X16
P3
X16
032 Rust
F1
022 Red
0 ACC
1 OFF
2 RUN
3 START
202 Red
P1 Hourmeter
X5
X29
M1 Starter Motor
X3
BAT
ACC
X3
IGN
S1 Key Switch
X2
TEST
START
X3
GND
X4
210 Blk
222 Red
220 Blk
G1 Battery
X25
700 Blk
X1
Charge
BATT
Oil Pressure
PRESS
Coolant Temp
TEMP
Hyd Oil Temp
TEMP
230 Blk
205 Grn
X33
T
B3 Hyd Oil Temp Switch
E2 Warning Indicator Module
X1
230 Blk
UNSWITCHED POWER
SWITCHED POWER
M82555AE

HYDRAULIC OIL TEMPERATURE WARNING CIRCUIT DIAGNOSIS

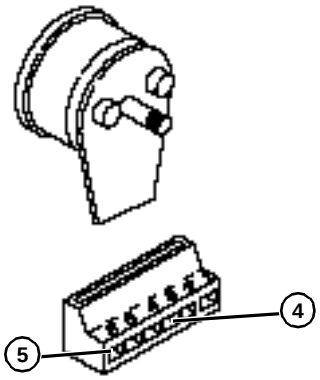
Test Conditions:

To test the circuit, remove green wire No. 205 at the hydraulic oil temperature switch. Ground this wire, and turn the key switch to the RUN position.

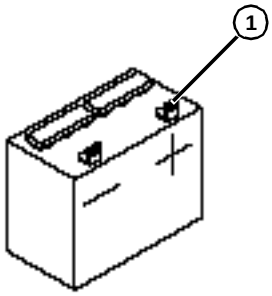
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Warning indicator module—Terminal 3	Battery voltage.	Test red wires No. 222 and 202.
5. Warning indicator module—Terminal 6	Less than 0.2 volts.	Test green wire No. 205 and engine ground.
6. Hydraulic oil temperature switch.	Resistance within specification.	Test switch.



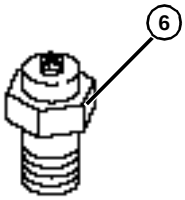
S1 Key Switch M82490AE



E2 Warning Indicator Module M82549AE



G1 Battery M82489AE



B3 Hydraulic Oil Temperature Switch M82551AE

HOURMETER CIRCUIT OPERATION

Function:

To record the number of hours the key switch is on the RUN position.

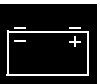
Operating Conditions:

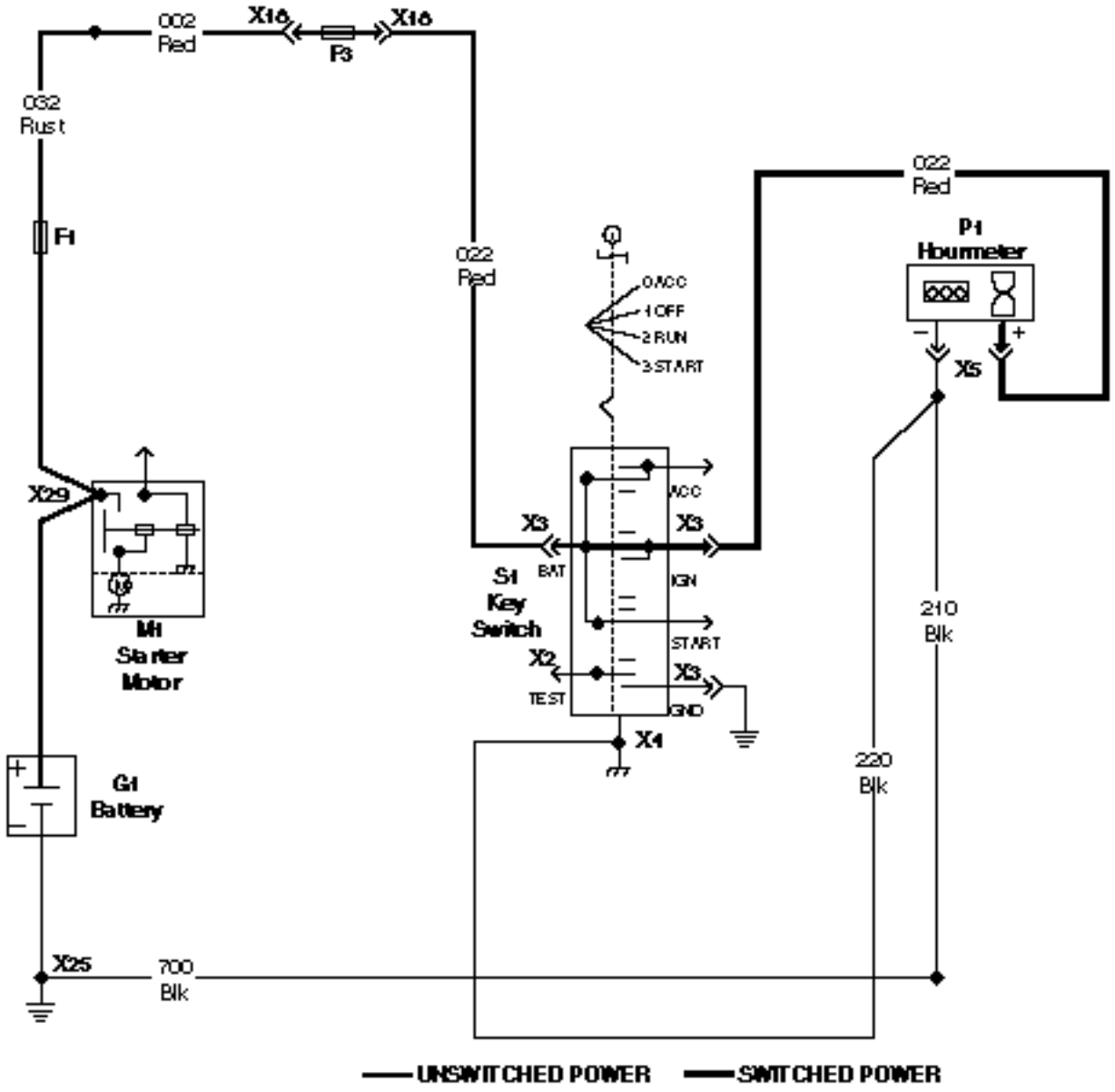
- Key switch in the RUN position.

Theory of Operation:

With the key switch in the RUN position, battery voltage is supplied to the hourmeter.

The ground circuit (Wires No. 210 and 700) provides a path to ground for the hourmeter.




002
Red
X16
X16
P3
032
Rust
F1
022
Red
022
Red
P1
Hourmeter
X5
0 ACC
1 OFF
2 RUN
3 START
X29
M1
Starter
Motor
X3
X3
ACC
BAT
IGN
S1
Key
Switch
START
X2
X3
TEST
GND
X4
210
Blk
220
Blk
G1
Battery
X25
700
Blk
UNSWITCHED POWER
SWITCHED POWER

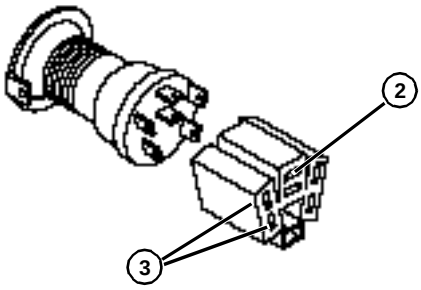
M82554AE

HOURMETER CIRCUIT DIAGNOSIS

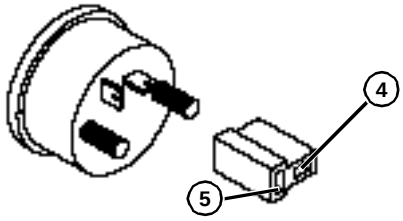
Test Conditions:

- Key switch in RUN position.

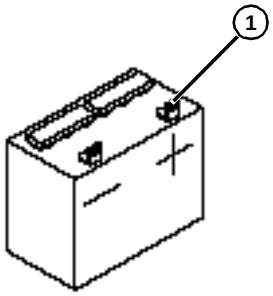
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Hourmeter—Positive (+) terminal	Battery voltage.	Test red wire No. 202.
5. Hourmeter—Negative (-) terminal	Less than 0.2 volt.	Test ground circuit black wires No. 220, 210, and 700 and connections.



S1 Key Switch M82490AE



P1 Hourmeter M82495AE



G1 Battery M82489AE

CUTTING UNIT—LOWER CIRCUIT OPERATION

Function:

To lower cutting units without operating reel mowers.

> **C 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 is in the TRANSPORT position.

Theory of Operation:

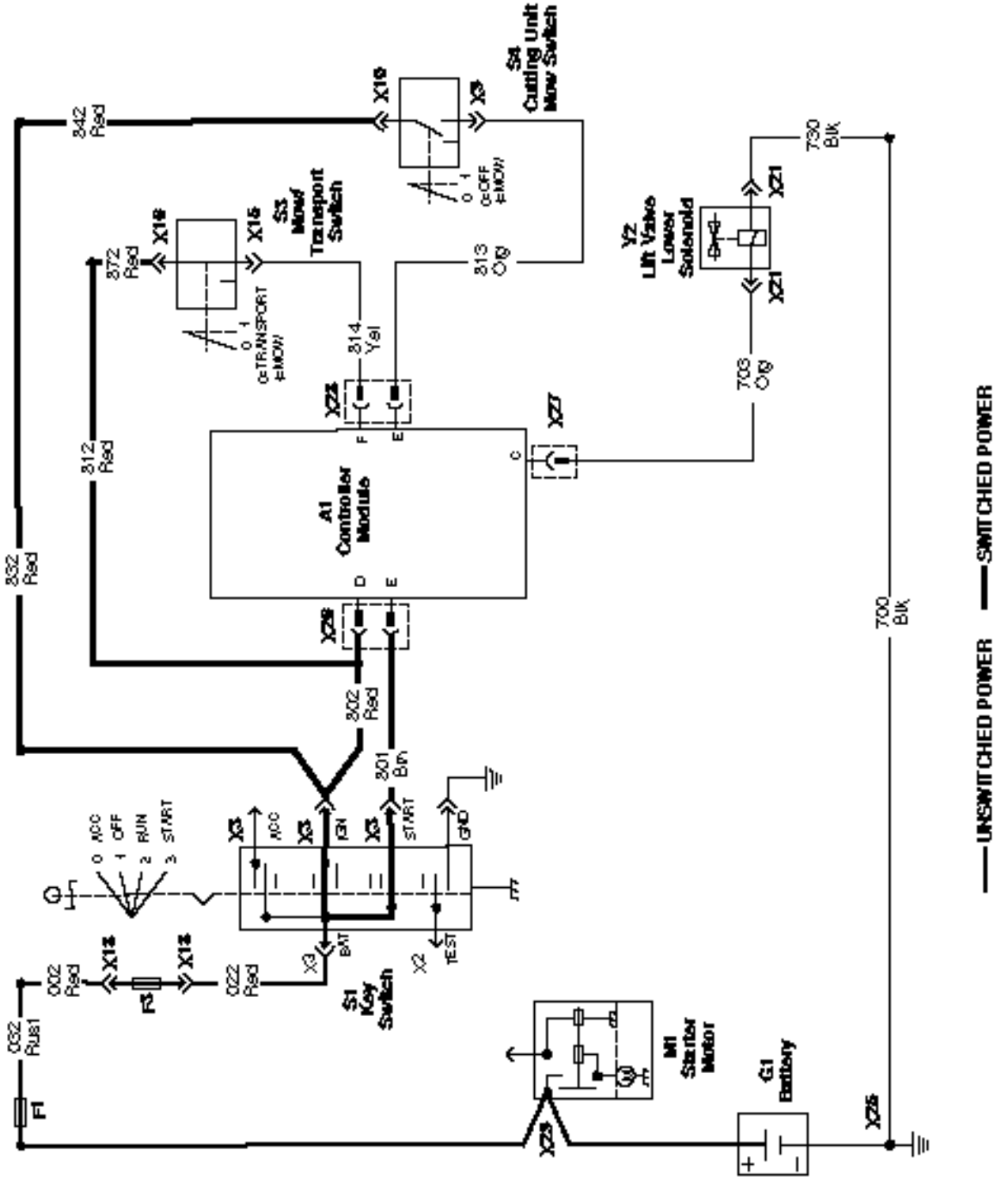
With the key switch in the RUN position, battery voltage is supplied to the controller module (brown wire No. 801 and red wire No. 802), mow/transport switch (red wires No. 812 and 872), and cutting unit mow switch (red wires no. 832 and 842).

As the mow switch is engaged, battery voltage is routed to the controller module (orange wire No. 813). The controller module then routes battery voltage to the lift valve lower solenoid (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.

NOTE: Cutting units can be lowered 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 had time to lower. The time delay keeps grass from being thrown onto the green while cutting heads are still in the air.


S4
Cutting Unit
Mow Switch
S3
Mow/
Transport
Switch
Y2
Lift Valve
Lower
Solenoid
A1
Controller
Module
S1
Key
Switch
M1
Starter
Motor
G1
Battery
F1
F2
342 Red
372 Red
313 Org
314 Yel
703 Org
730 Blk
312 Red
332 Red
302 Red
301 Brn
700 Blk
002 Red
032 Rus1
022 Red
ACC
OFF
RUN
START
GND
BAT
TEST
UNSWITCHED POWER
SWITCHED POWER
M82556AE

CUTTING UNIT—LOWER CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in TRANSPORT position.

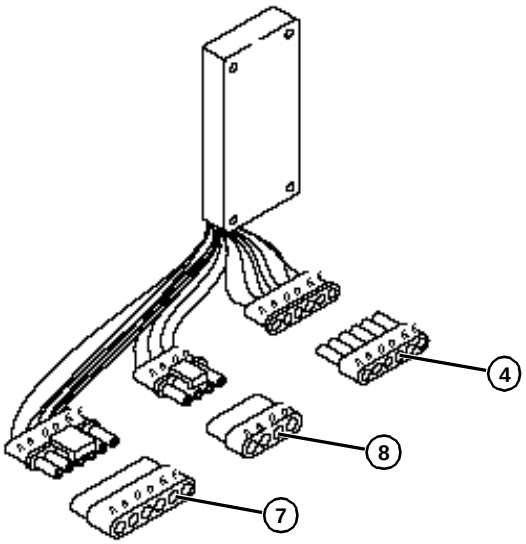
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
5. Cutting unit mow switch—COMMON Terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

NOTE: For test point 6 and 7, push mow pedal and hold down to close switch.

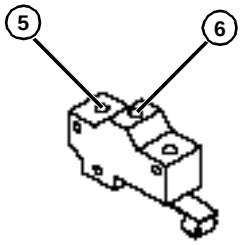
Test Location	Normal	If Not Normal
6. Cutting unit mow switch—NORMALLY OPEN Terminal	Battery voltage.	Test cutting unit mow switch.
7. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.

NOTE: At test points 8, 9, and 10 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.

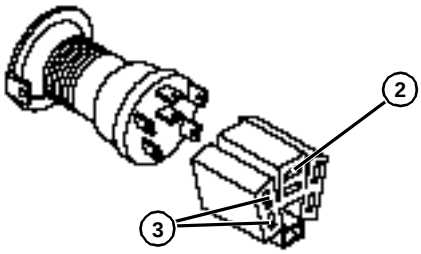
Test Location	Normal	If Not Normal
8. Controller module—Terminal C of four terminal male connector	Battery voltage.	Test or replace controller module.
9. Lift valve lower solenoid	Battery voltage.	Test orange wire No. 703 and connections.
10. Lift valve lower solenoid	Less than 0.2 volt.	Test black wires No. 730 and 700, lower solenoid and ground connections.



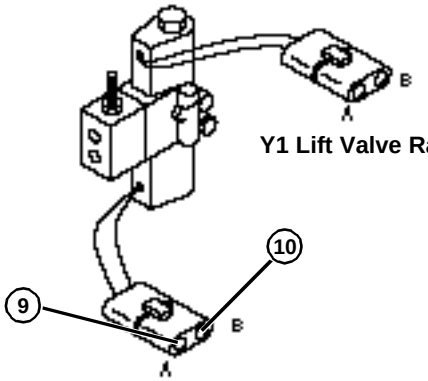
A1 Controller Module M82496AE



S4 Cutting Unit Mow Switch M82493AE

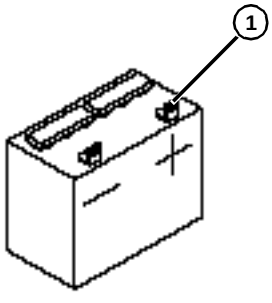


S1 Key Switch M82494AE



Y1 Lift Valve Raise Solenoid

Y2 Lift Valve Lower Solenoid M82557AE



G1 Battery M82493AE

CUTTING UNIT—RAISE CIRCUIT OPERATION

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.

Theory of Operation:

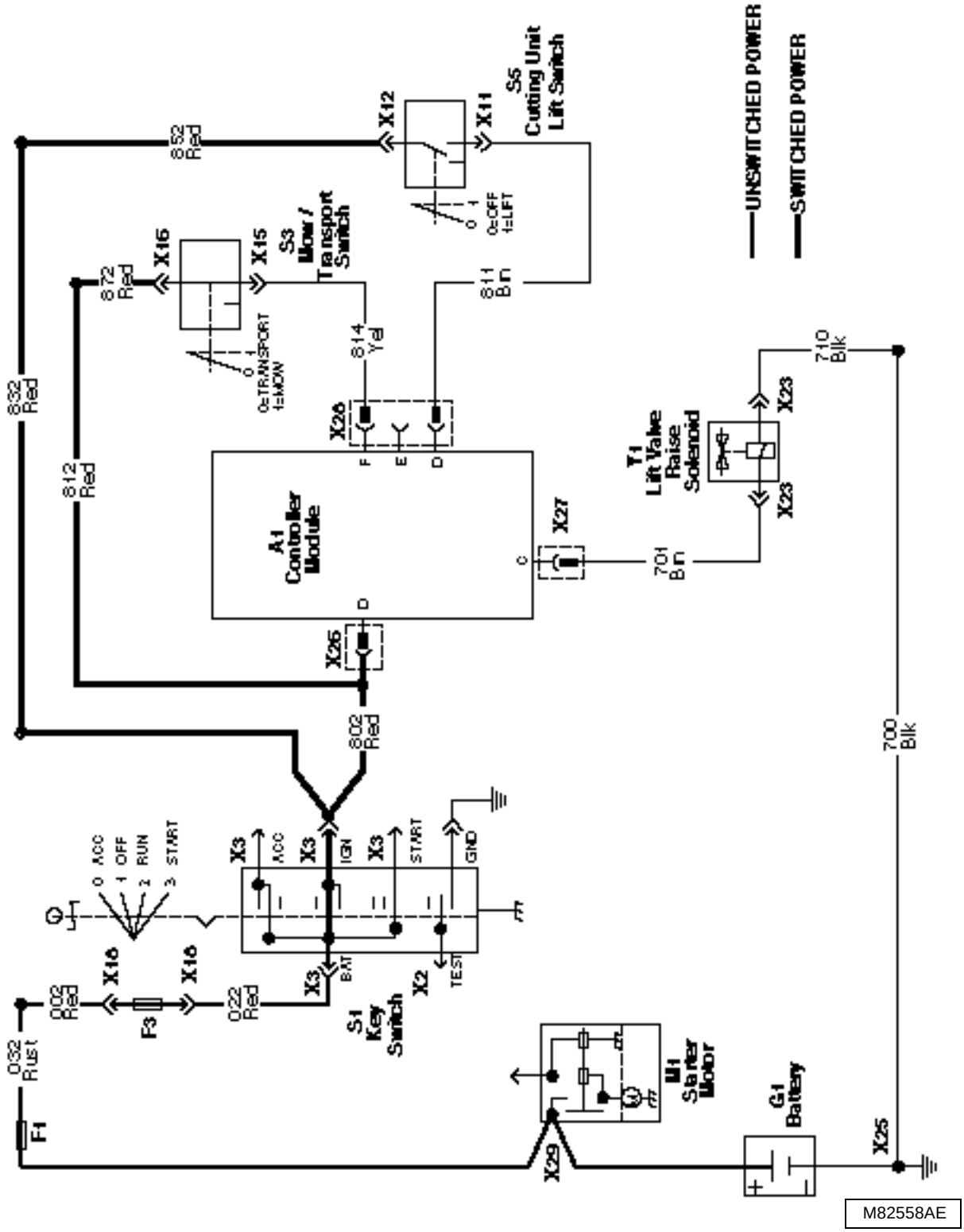
With the key switch in the RUN position, battery voltage is supplied to the controller module (red wire No. 802), mow/transport switch (red wires No. 812 and 872), and cutting unit lift switch (red wires No. 832 and 852).

As the raise switch is engaged, battery voltage is routed to the controller module (brown wire No. 811). The controller module then routes battery voltage to the raise solenoid (brown wire No. 701).

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.

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.


UNSWITCHED POWER
SWITCHED POWER
S5 Cutting Unit Lift Switch
X12
X11
852 Red
0=OFF 1=LIFT
S3 Mow / Transport Switch
X16
X15
872 Red
0=TRANSPORT 1=MOW
814 Yel
811 Brn
832 Red
812 Red
X26
F E D
A1 Controller Module
X27
701 Brn
T1 Lift Valve Raise Solenoid
X23
710 Blk
802 Red
X25
700 Blk
ACC OFF RUN START
X3 ACC
X3 IGN
X3 START
GND
X3 BAT
X2 TEST
S1 Key Switch
X16
002 Red
F3
022 Red
032 Rust
F1
M1 Starter Motor
X29
G1 Battery
M82558AE

CUTTING UNIT—RAISE CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in TRANSPORT position.

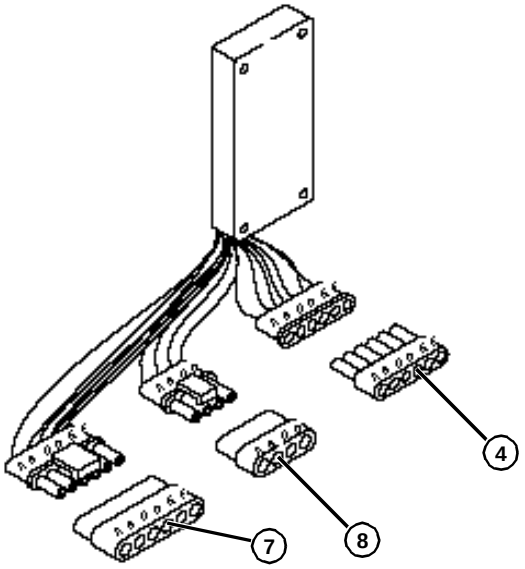
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
5. Cutting unit lift switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 852 and connections.

NOTE: For test point 6 and 7, push mow pedal and hold down to close switch.

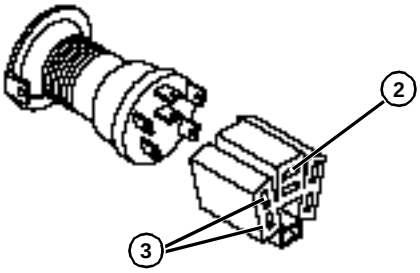
Test Location	Normal	If Not Normal
6. Cutting unit lift switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit lift switch.
7. Controller module—Terminal D of six terminal male connector	Battery voltage.	Test brown wire No. 811 and connections.

NOTE: At test points 8, 9, and 10 voltage is applied for only six seconds after mow pedal is pushed. Push rasise pedal again, if time expires before all test points can be checked.

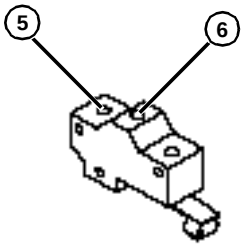
Test Location	Normal	If Not Normal
8. Controller module—Terminal B of four terminal male connector	Battery voltage.	Test or replace controller module.
9. Lift valve raise solenoid	Battery voltage.	Test brown wire No. 701 and connections.
10. Lift valve raise solenoid	Less than 0.2 volt.	Test black wires No. 710 and 700, raise solenoid and ground connections.



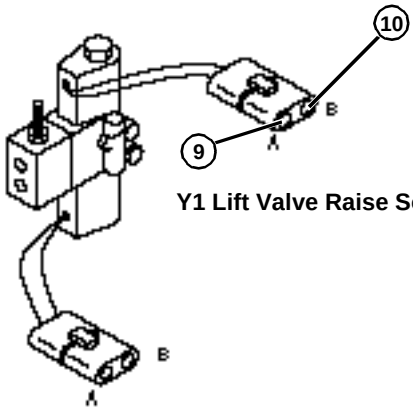
A1 Controller Module M82496AE



S1 Key Switch M82494AE

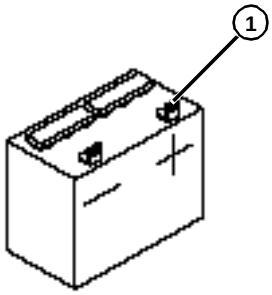


S5 Cutting Unit Lift Switch M82493AE



Y1 Lift Valve Raise Solenoid

Y2 Lift Valve Lower Solenoid M82557AE



G1 Battery M82493AE

MOW CIRCUIT–ENGAGE OPERATION

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:

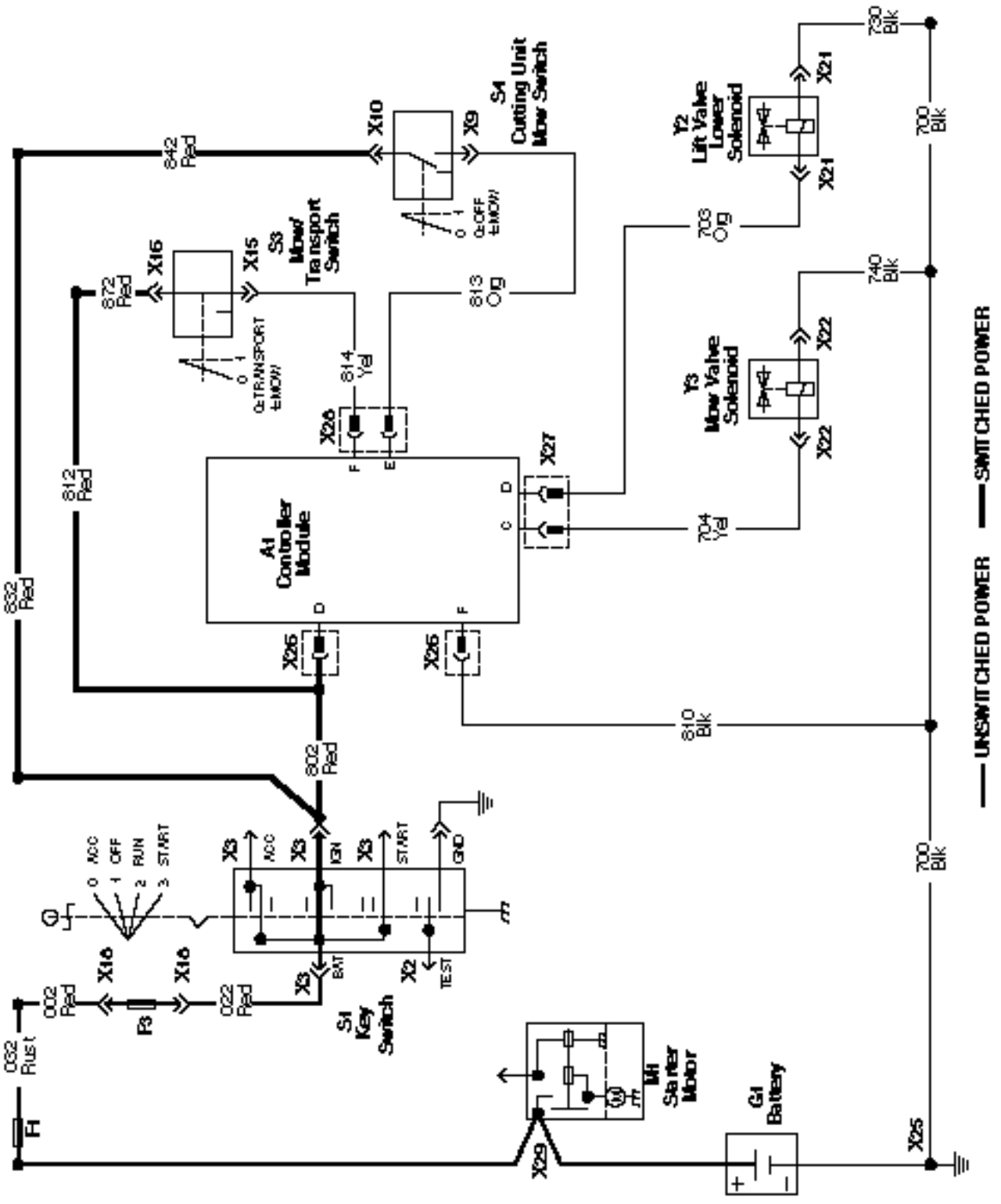
With the key switch in the RUN position, battery voltage is supplied to the controller module (red wire No. 802), cutting unit mow switch (red wires No. 832 and 842), and mow/transport switch (red wires No. 812 and 872).

As the mow/transport lever is moved to the mow position, the mow/transport switch is released. The controller module then routes battery voltage to the lift valve lower solenoid (orange wire No. 703) and to the mow valve solenoid (orange wire No. 704).

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

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.

The ground circuit connected to the lift valve lower solenoid (black wires No. 730 and 700) and mow valve solenoid (black wires No. 740 and 700) complete the circuit and allow the cutting units to be lowered and cutting unit motors to be engaged.


UNSWITCHED POWER
SWITCHED POWER
M82559AE

MOW CIRCUIT—ENGAGE DIAGNOSIS

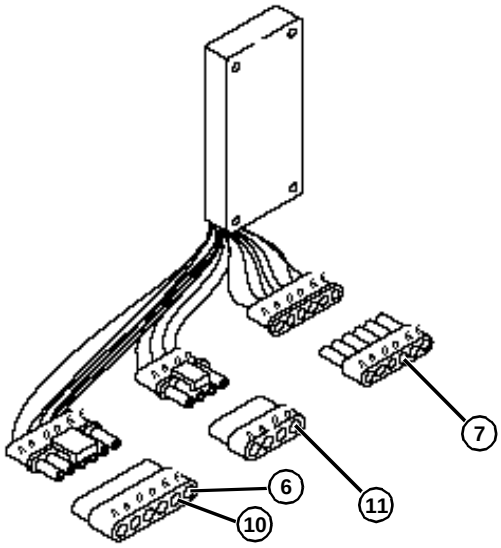
Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in MOW position.

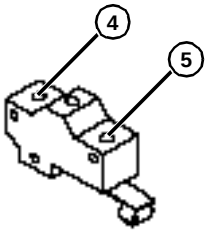
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Mow/transport switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 872 and connections.
5. Mow/transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test mow/transport switch.
6. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
7. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
8. Cutting unit mow switch—COMMONtTerminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

NOTE: For test points 9 and 10, push mow pedal and hold down to close switch.

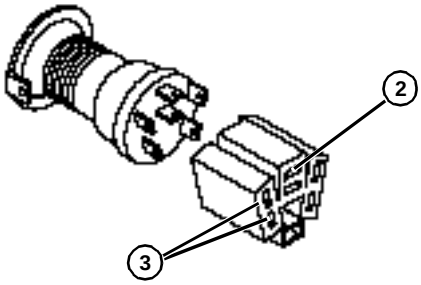
Test Location	Normal	If Not Normal
9. Cutting unit mow switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit mow switch.
10. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
11. Controller module—Terminal D of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
12. Mow valve solenoid	Battery voltage.	Test yellow wire No. 704 and connections.
13. Mow valve solenoid	Less than 0.2 volt.	Test black wires No. 740 and 700, mow solenoid, and ground connections.



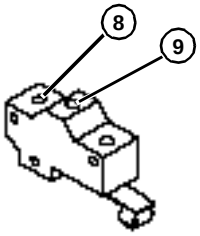
A1 Controller Module M82496AE



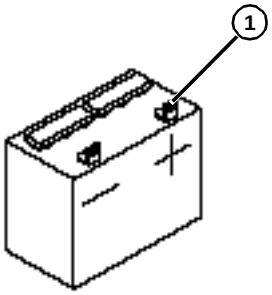
S3 Mow/Transport Switch M82493AE



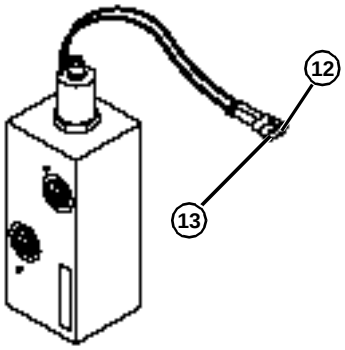
S1 Key Switch M82490AE



S5 Cutting Unit Mow Switch M82493AE



G1 Battery M82489AE



Y3 Mow Valve Solenoid M82560AE

MOW CIRCUIT—DISENGAGE OPERATION

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.

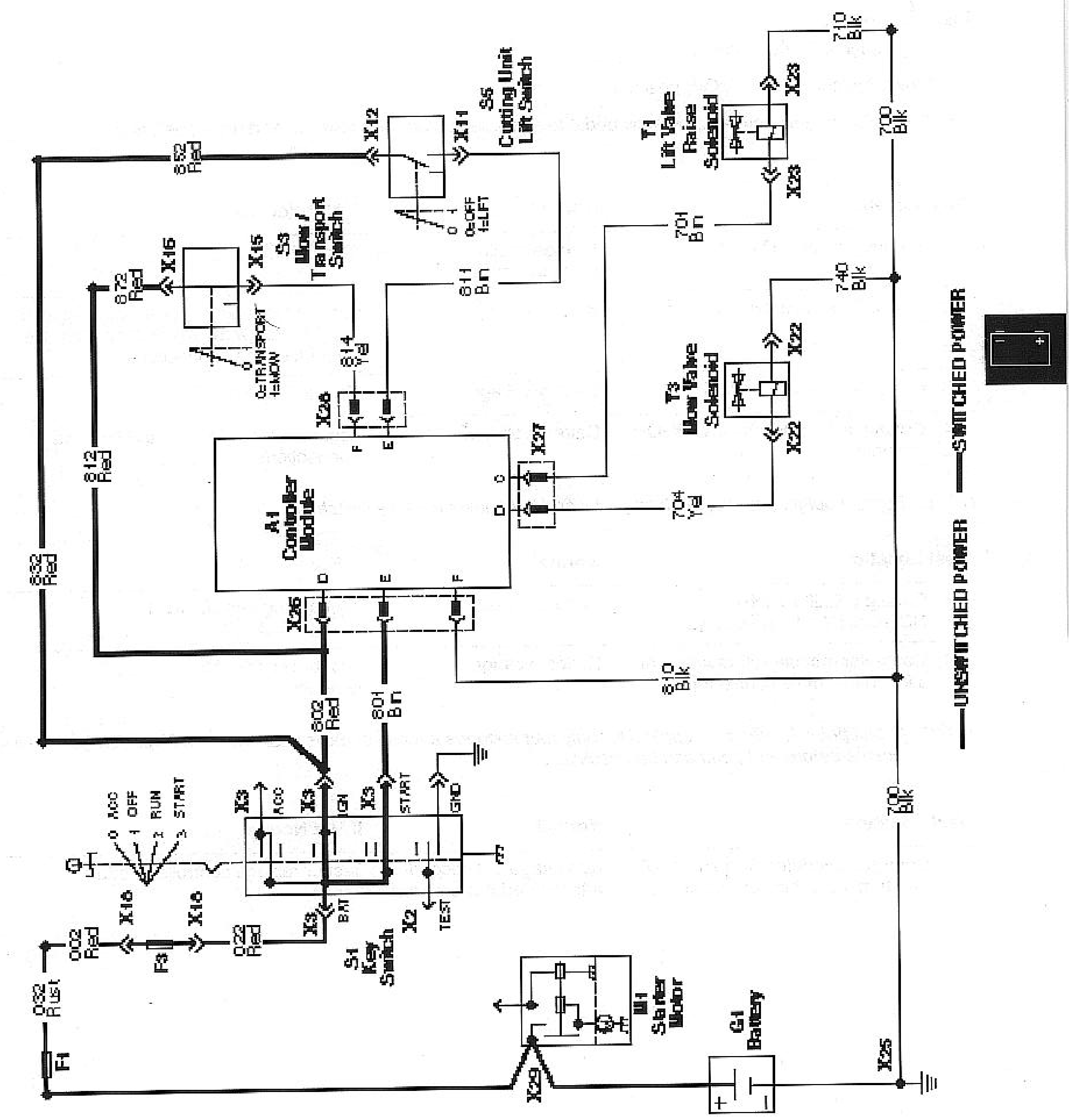
Theory of Operation:

With the key switch in the RUN position, battery voltage is supplied to the controller module (brown wire No. 801 and red wire No. 802), mow/transport switch (red wires No. 812 and 872), and cutting unit lift switch (red wires No. 832 and 852).

As the lift switch is engaged, battery voltage is routed to the controller module (brown wire no. 811). The controller module then routes battery voltage to the lift valve raise solenoid (brown wire No. 701) and disengages the mow solenoid.

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.


A1 Controller Module
S1 Key Switch
S3 Mow / Transport Switch
S5 Cutting Unit Lift Switch
T1 Lift Valve Raise Solenoid
T3 Mow Valve Solenoid
M1 Starter Motor
G1 Battery
F1
F3
0 ACC
1 OFF
2 RUN
3 START
0=TRANSPORT
1=MOW
0=OFF
1=LIFT
032 Rust
002 Red
022 Red
802 Red
801 Brn
812 Red
832 Red
852 Red
872 Red
811 Brn
814 Yel
701 Brn
704 Yel
700 Blk
710 Blk
740 Blk
810 Blk
UNSWITCHED POWER
SWITCHED POWER

M82561AE

MOW CIRCUIT—DISENGAGE DIAGNOSIS

Test Conditions:

- Key switch in RUN position.
- Mow/transport lever in MOW position.
- Controller module activated by mow pedal to simulate cutting units lowered and reels operating.

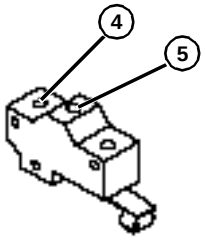
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire no. 032, red wires No. 002 and 022, 15 amp fuse, and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Cutting unit lift switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 852 and connections.

NOTE: For test points 5 and 6, push lift pedal and hold down to close switch.

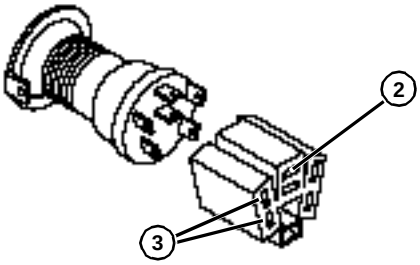
Test Location	Normal	If Not Normal
5. Cutting unit lift switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit lift switch.
6. Controller module—Terminal D of six terminal male connector	Battery voltage.	Test brown wire No. 811 and connections.

NOTE: At test point 7, voltage is applied for only four seconds after lift pedal is pushed. Push lift pedal again if time expires before test point can be checked.

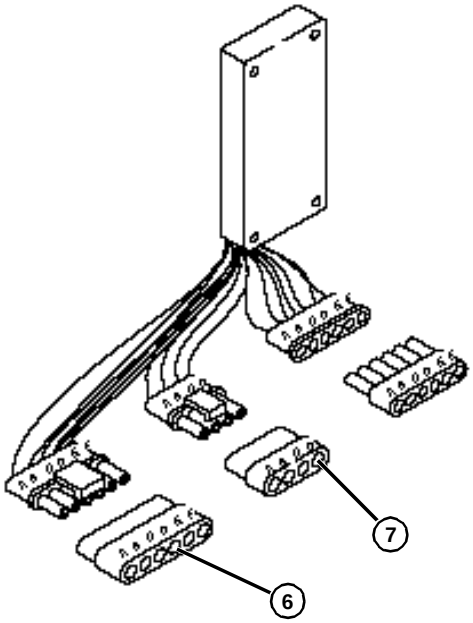
Test Location	Normal	If Not Normal
7. Controller module—Terminal D of four terminal male connector	No voltage 1.0 second after lift pedal is pressed.	Test or replace controller module.



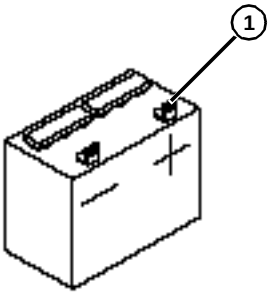
S5 Cutting Unit Lift Switch M82493AE



S1 Key Switch M82490AE



A1 Controller Module M82496AE



G1 Battery M82489AE

OPTIONAL HEADLIGHT CIRCUIT OPERATION

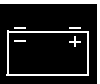
Function:

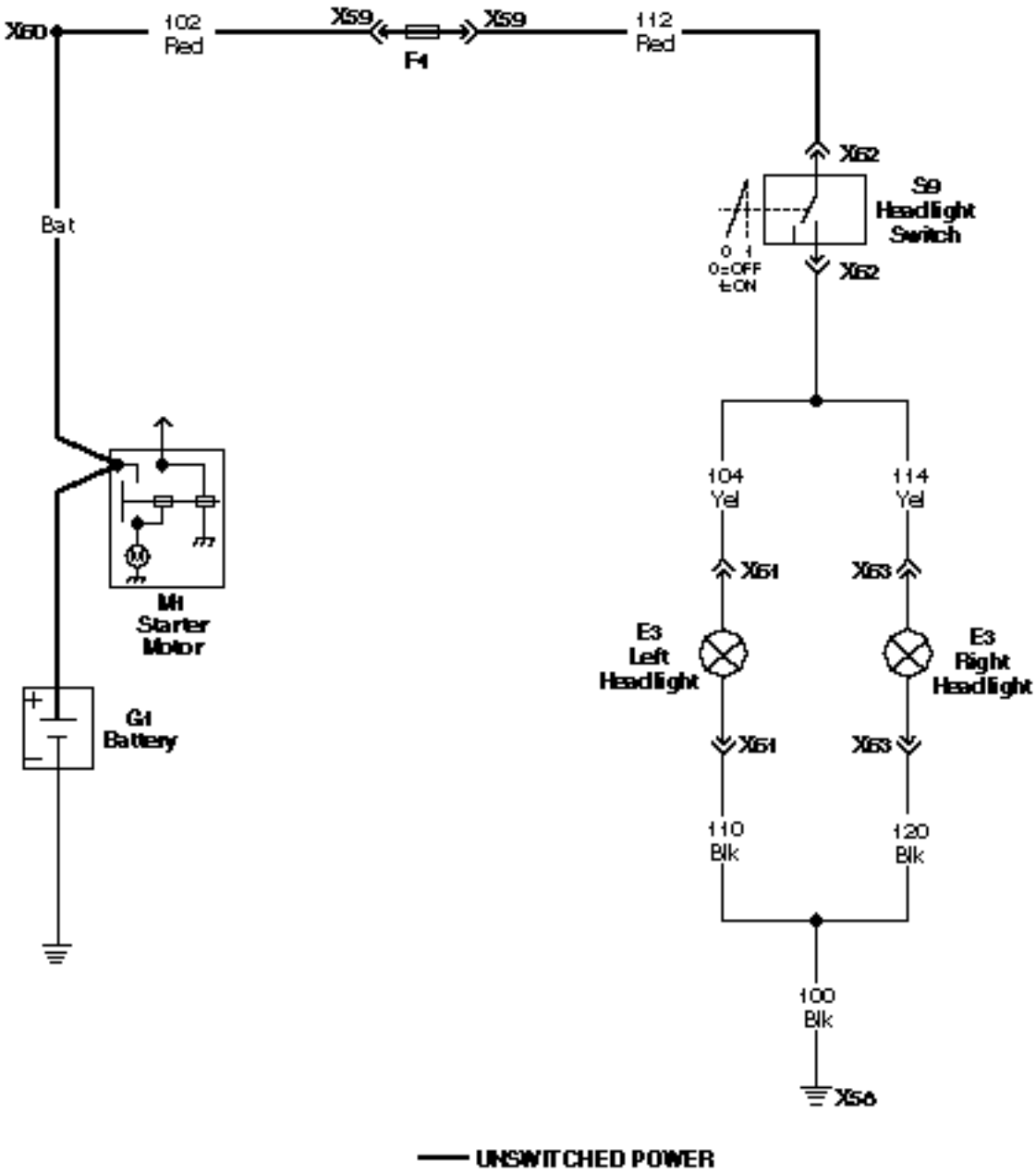
To illuminate the headlights when the operator turns the switch ON.

Theory of Operation:

Battery voltage flows through red wires No. 102 and 112, 15 amp fuse and with headlight switch in the ON position, battery voltage is supplied to the headlights through yellow wires No. 104 and 114.

The ground circuit (black wires No. 110, 120, 100 and 700) provide a path to ground for headlight circuit to complete the circuit.




X60
102
Red
X59
F4
X59
112
Red
X62
S9
Headlight
Switch
0 1
0=OFF
1=ON
X62
Bat
M1
Starter
Motor
G1
Battery
104
Yel
114
Yel
X61
X63
E3
Left
Headlight
E3
Right
Headlight
X61
X63
110
Blk
120
Blk
100
Blk
X56
UNSWITCHED POWER

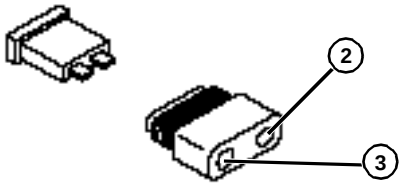
M82562AE

OPTIONAL HEADLIGHT CIRCUIT DIAGNOSIS

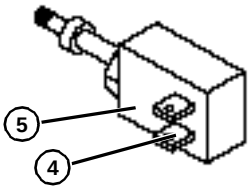
Test Conditions:

- Headlight switch in ON position.

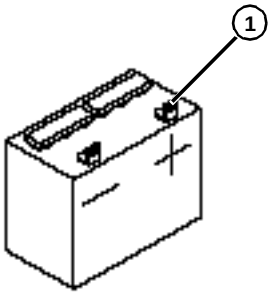
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specification.	Test battery.
2. 15 amp headlight fuse	Battery voltage.	Test red wire No. 102.
3. 15 amp headlight fuse	Battery voltage.	Test fuse, fuse holder.
4. Headlight switch	Battery voltage.	Test red wire no. 112.
5. Headlight switch	Battery voltage.	Test highlight switch.
6. Headlights	Battery voltage.	Less than 12 volts - Test yellow wires No. 104 and 114. If 12 volts - Test bulbs.
7. Headlight ground	Less than 0.2 volt	Test ground circuit, black wires No. 100, 110, 120, and 700.



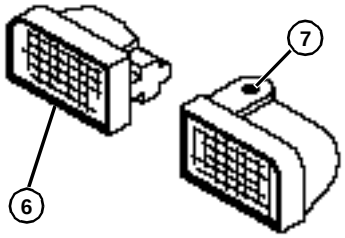
F4 Headlight Fuse M82564AE



S9 Headlight Switch M82563AE



G1 Battery M82489AE



E3 Headlights M82565AE

OPTIONAL MOW/BACKLAP VALVE CIRCUIT OPERATION

Mow 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.

Theory of Operation:

NOTE: Schematic is shown in the BACKLAP position.

With the key switch in the RUN position, battery voltage is supplied to the controller module (red wire No. 802), cutting unit mow switch (red wires No. 832 and No. 842), mow/transport switch (red wires No. 812 and 872), parking brake switch (red wires No. 812 and 862), seat switch (red wires No. 812 and No. 892, and pink/black wire No. 810), and travel/neutral switch (red wires No. 812 and No. 882).

With the mow/transport lever in the MOW position, the mow/transport switch is released, routing battery voltage to the controller module (yellow wire No. 814). The controller module then supplies battery voltage to the lift valve lower solenoid (orange wire No. 703) and mow/backlap switch (yellow wire No. 704 and blue/white wire No. 751). Battery voltage is routed through the mow/backlap switch to the mow valve solenoid (blue/black wire No. 752), engergizing the mow valve solenoid.

NOTE: The operator must be in the seat before moving mow/transport lever to MOW position, otherwise engine will stop.

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.

The ground circuit connected to the lift valve lower solenoid (black wires No. 730, and 700) and mow valve solenoid (black wires No. 110, No. 120, No. 740 and No. 700) complete the circuit and allow the cutting units to be lowered and cutting unit motors to be engaged.

Backlap 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.
- Parking brake LOCKED.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.

Theory of Operation:

NOTE: Power (battery voltage) distribution is the same as MOW operation.

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) and to the mow/backlap switch (yellow wire No. 704, blue/white wire No. 751). Battery voltage is routed through the mow/backlap switch to the direction vlave switch (blue/white wire No. 754), energizing the switch. Voltage is also supplied to the mow valve solenoid (blue wiere No. 753, blue/black wire No. 752), energizing the mow valve solenoid.

With the travel/neutral switch in the NEUTRAL position voltage is supplied to the mow/backlap switch (pink wire No. 811). Voltage is routed through the switch to terminal 87A of the mow/backlap relay (blue wire 802). With 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.

The ground circuit connected to the lift valve lower solenoid (black wires No. 110, 120, 740 and 700) complete the circuit and allow the cutting units to be lowered and cutting unit motors engaged.

2 Page Foldout
1060 x 628
M82587AE

OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS—MOW

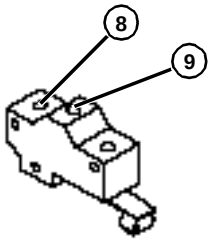
Test Conditions:

- Key switch in RUN position.
- Mow/backlap switch in MOW position.
- Mow/transport lever in MOW position.

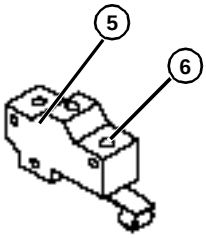
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications.	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Controller module—terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802, 812 and connections.
5. Mow/Transport switch—COMMON terminal	Battery voltage.	Test red wires No. 812, 872 and connections.
6. Mow/Transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test mow/transport switch.
7. Controller module—terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
8. Cutting unit mow switch—COMMON terminal	Battery voltage.	Test red wires No. 812 and 842 and connections.

NOTE: For test points 9 and 10, push mow pedal and hold down to close switch.

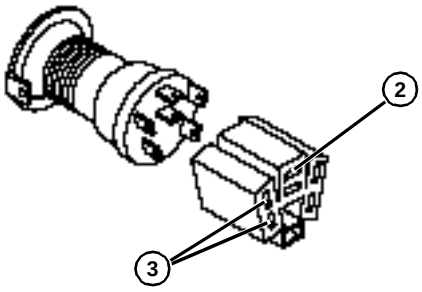
Test Location	Normal	If Not Normal
9. Cutting unit mow switch—NORMALLY OPEN terminal	Battery voltage.	Test cutting unit mow switch.
10. Controller module—terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
11. Controller module—terminal D of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
12. Mow valve solenoid	Battery voltage.	Test yellow wire No. 704, blue/white wire No. 751, mow/backlap switch, and blue/black wire No. 752.
13. Mow valve solenoid	Less than 0.2 volt.	Test black wires No. 110, 120, 740 and 700.



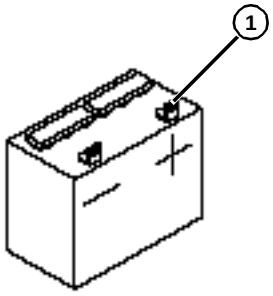
S4 Cutting Unit Mow Switch M82493AE



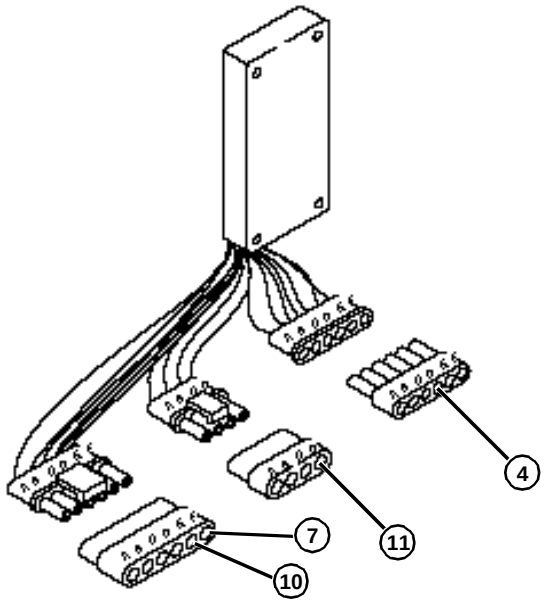
S3 Mow/Transport Switch M82493AE



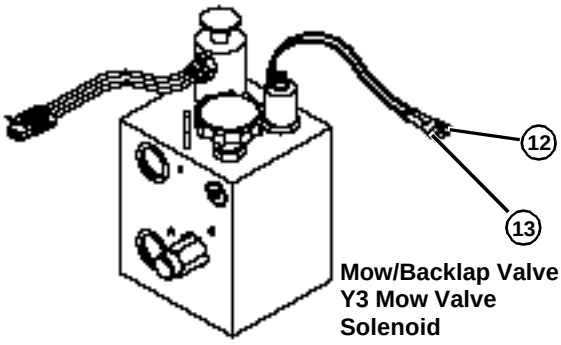
S1 Key Switch M82490AE



G1 Battery M82489AE



A1 Controller Module M82496AE



Mow/Backlap Valve – Y3 Mow Valve Solenoid

M82572AE

OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS – BACKLAP

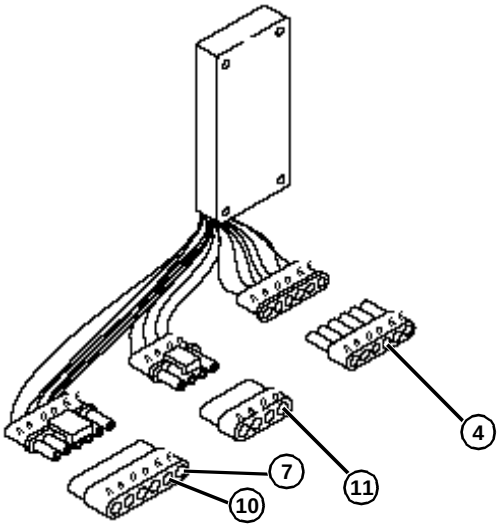
Test Conditions:

- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.

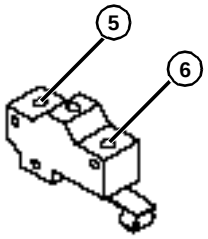
Test Location	Normal	If Not Normal
1. Battery positive (+) post	Voltage within specifications	Test battery.
2. Key switch—BAT terminal	Battery voltage.	Test battery cable, fusible link, rust wire No. 032, red wires No. 002, and No. 022, 15 amp fuse and connections.
3. Key switch—IGN terminal	Battery voltage.	Test key switch.
4. Controller module—Terminal D of six terminal female connector	Battery voltage.	Test red wires No. 802 and 812 and connections.
5. Mow/Transport switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 872 and connections.
6. Mow/Transport Switch—NORMALLY CLOSED terminal	Battery voltage.	Test mow/transport switch.
7. Controller module—Terminal F of six terminal male connector	Battery voltage.	Test yellow wire No. 814 and connections.
8. Cutting unit mow switch—COMMON terminal	Battery voltage.	Test red wires No. 832 and 842 and connections.

NOTE: For test points 9 and 10, push mow pedal and hold down to close switch.

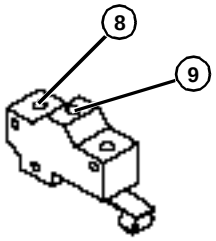
Test Location	Normal	If Not Normal
9. Cutting unit mow switch—NORMALLY OPEN Terminal	Battery voltage.	Test cutting unit mow switch.
10. Controller module—Terminal E of six terminal male connector	Battery voltage.	Test orange wire No. 813 and connections.
11. Controller module—Terminal D of four terminal male connector	Battery voltage 0.7 seconds after mow pedal is pushed.	Test or replace controller module.
12. Direction valve switch	Battery voltage.	Test yellow wire No. 704, blue/white wire No. 751, mow/backlap switch, and blue/white wire No. 754.
13. Mow valve solenoid	Battery voltage.	Test yellow wire No. 704 and blue/white wire 751. mow/backlap switch, blue/white wire No. 754, direction valve switch, blue wire No. 753 and blue/black wire No. 752.
14. Direction valve switch	Less than 0.2 volt.	Test blue wire No. 753, blue wire No. 752, mow valve solenoid and black wires No. 110, 120, 740 and 700.



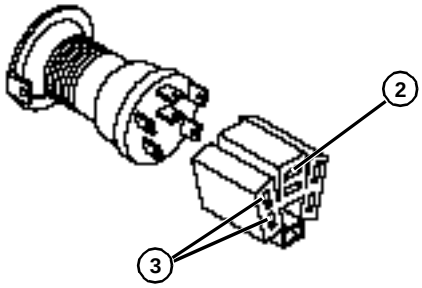
A1 Controller Module M82496AE



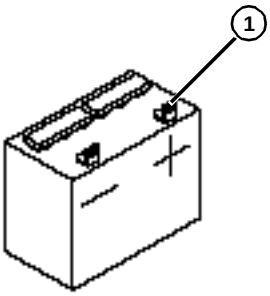
S3 Mow/Transport Switch M82493AE



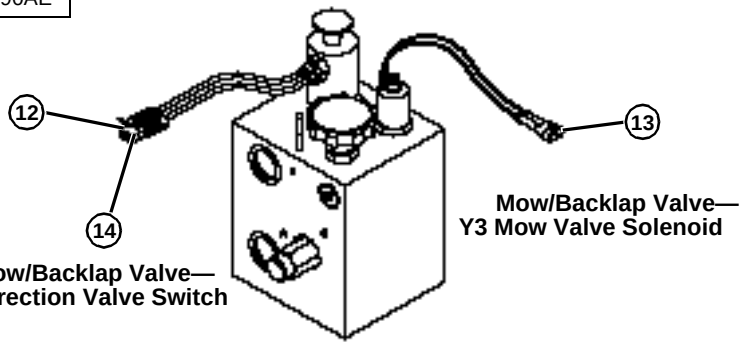
S4 Cutting Unit Mow Switch M82493AE



S1 Key Switch M82490AE



G1 Battery M82489AE



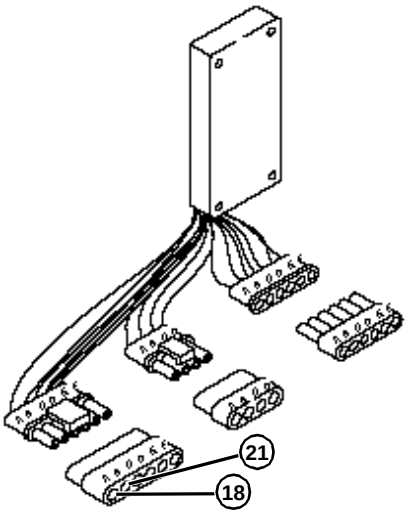
M82572AE

OPTIONAL MOW/BACKLAP VALVE CIRCUIT DIAGNOSIS, – BACKLAP continued

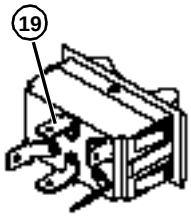
Test Conditions:

- Key switch in RUN position.
- Mow/backlap switch in BACKLAP position.
- Mow/transport lever in MOW position.
- Travel/neutral switch in NEUTRAL position.

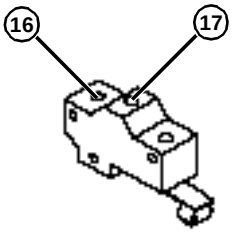
Test Location	Normal	If Not Normal
15. Mow/backlap relay—Terminal 86	Battery voltage.	Test white wire No. 900.
16. Travel/neutral switch—COMMON terminal	Battery voltage.	Test red wires no. 812 and 882 and connections.
17. Travel/neutral switch—NORMALLY OPEN terminal	Battery voltage.	Test red wires no. 812 and 882 and connections.
18. Controller module—Terminal A of six terminal male connector	Battery voltage.	Test purple wire No. 807, travel/neutral switch and connections.
19. Mow/backlap switch	Battery voltage.	Test pink wire No. 811.
20. Mow/backlap relay—Terminal 87	Battery voltage.	Test blue wire No. 802 and mow/backlap switch.
21. Controller module—Terminal B of six terminal male connector	Battery voltage.	Test pink/white wire No. 801, pink wire No. 800, gray wire No. 808, mow/backlap relay and connections.



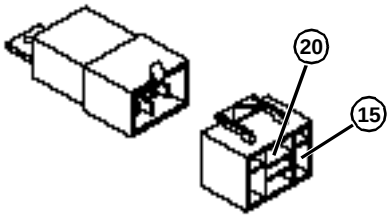
A1 Controller Module M82496AE



S10 Mow/Backlap Switch M82586AE



S8 Travel/Neutral Switch M82493AE



K5 Mow/backlap Relay M82491AE

GROUND CIRCUIT TEST

Reason:

To check for open circuits, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.

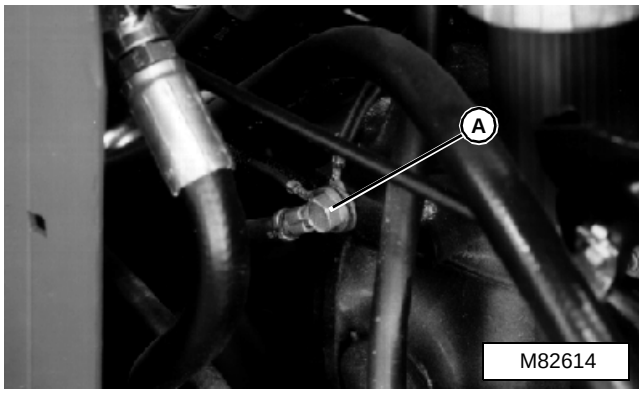
Equipment:

- 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 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.
8. Connect ohmmeter red lead to ground terminal of circuit (A and/or B) 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.

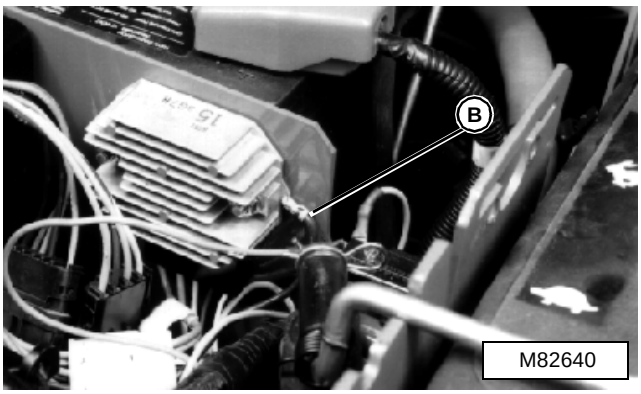


Procedure—VOLTMETER METHOD:

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 hood.
7. Connect voltmeter negative (black) lead to negative terminal of battery.
8. Connect voltmeter positive (red) lead to ground terminal of circuit (A and/or B) 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

C 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:

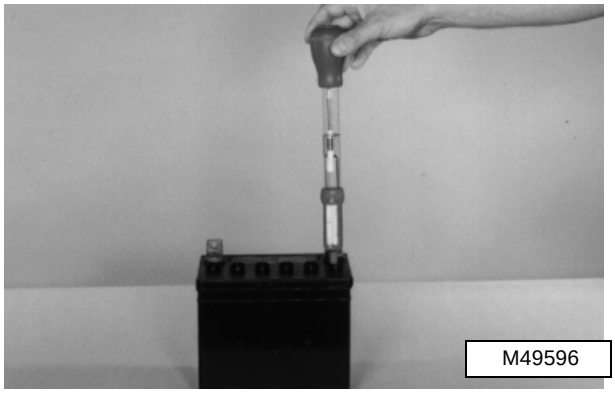
To check condition of battery and determine battery voltage.

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 parking brake.
6. Seat platform RAISED and LOCKED.
7. Clean cable ends, battery terminals and top of battery.
8. Remove battery.
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.



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.

CHARGE BATTERY

Reason:

To increase battery charge after the battery has been discharged.

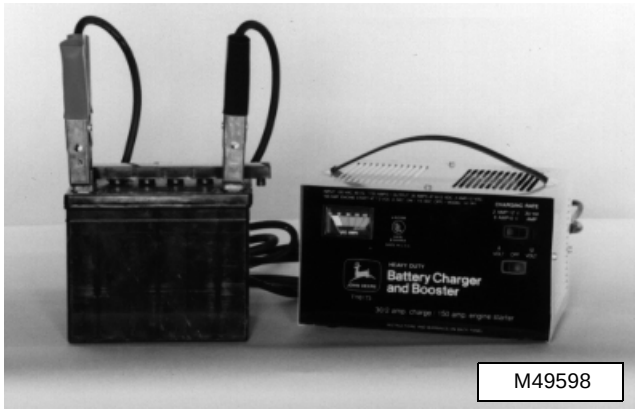
Equipment:

- Battery charger (variable rate).

Procedure:

NOTE: See BATTERY TEST in this group before charging battery.

1. Park machine on level surface.
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.
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.

LOAD TEST BATTERY

Reason:

To check condition of battery under load.

Equipment:

- JTO5685 Battery Tester.

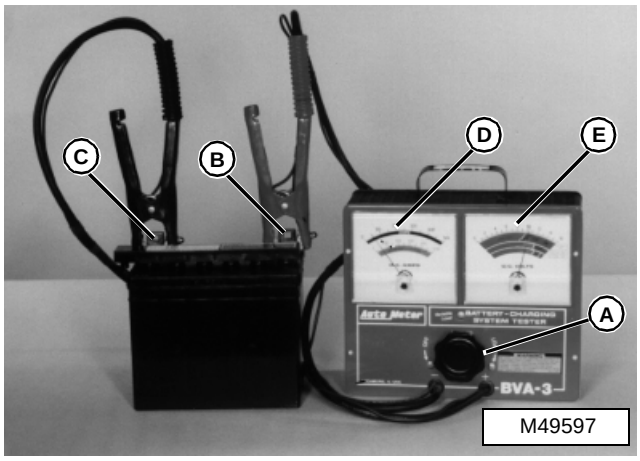
Procedure:

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 parking brake.
6. Seat platform RAISED and LOCKED.
7. Clean cable ends, battery terminals and top of battery.
8. Remove battery.

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

    or

    - three times ampere hour rating (use black scale).
13. Hold for 15 seconds and turn load knob (A) of tester counterclockwise (out) into OFF position.
14. Repeat Steps 8 and 9 above and read condition of battery at DC Volts scale (E).



Results:

- If battery DOES NOT pass test and has NOT been charged, charge battery and retest.
- If battery DOES NOT pass test and HAS BEEN charged, replace battery.

UNREGULATED VOLTAGE OUTPUT TEST

Reason:

To measure stator output.

Equipment:

- Voltmeter

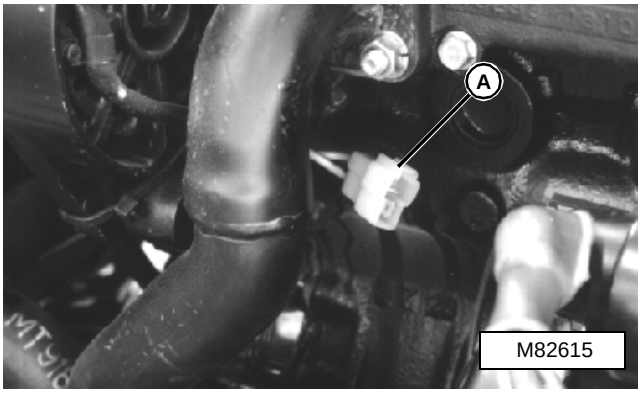
Procedure:

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 parking brake.
6. Raise hood.

C CAUTION

Engine parts may be hot. Allow engine to cool before servicing.

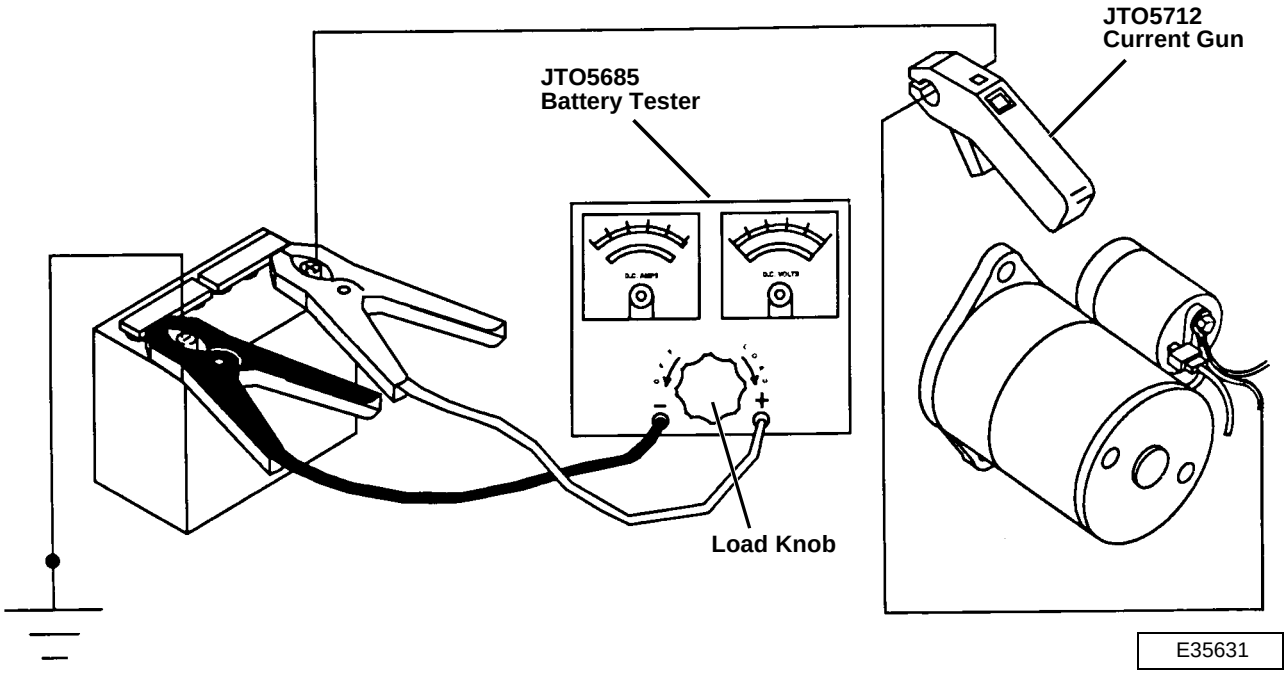
7. Disconnect two pin connector (A) from stator.
8. Connect voltmeter, set to read AC voltage, to stator outputs.
9. Start and run engine at fast idle. The meter should read a **minimum of 26 volts AC at FAST idle (2975 rpm ± 75 rpm)**.



Results:

- If reading is BELOW specification, test stator and flywheel magnets.

REGULATED AMPERAGE AND VOLTAGE TESTS



Reason:

To determine the regulated voltage (charging) output of the regulator/rectifier.

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 parking brake.
6. Raise 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.

9. 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.

10. Turn load knob clockwise (in) until voltage on voltage tester scale reads **11 volts for 5 seconds only** to partially drain battery.
11. Quickly turn load knob completely counter-clockwise (out) to OFF position.
12. Start and run engine at **fast idle (2975 ± 75 rpm)**. Battery voltage should read **between 12.2—14.7 volt DC**.
13. 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**.
14. Quickly turn load knob completely counter-clockwise (out) to OFF position.
15. 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.

STARTER SOLENOID TEST

Reason:

To determine if starter or starter motor is defective.

Equipment:

- Jumper wire.

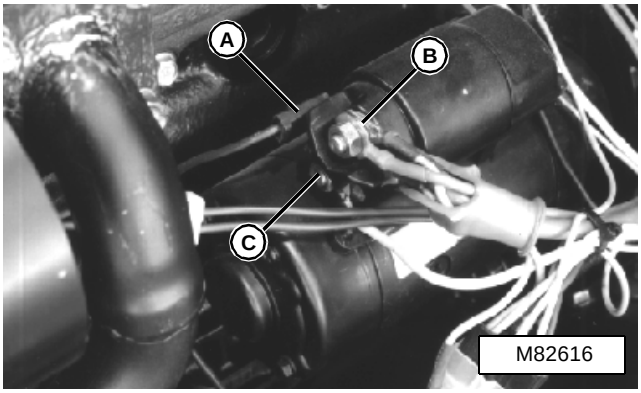
Procedure:

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 parking brake.
6. Raise hood.
7. Disconnect fuel shutoff solenoid wire connector.
8. Disconnect brown wire No. 301 from starter solenoid terminal (A).
9. Connect jumper wire to positive (+) battery terminal and briefly jump to starter solenoid terminal (A).

Results:

- Starter runs—solenoid is good, test cranking circuit wiring.
- Starter DOES NOT run—go to Step 10.

10. Remove rubber boot(s) from terminal(s) (B and C).
11. Connect jumper wire between starter solenoid large terminals (B and C).



Results:

- Starter runs—replace solenoid.
- Starter DOES NOT run—check battery cables, then replace starter.

STARTER NO-LOAD AMPERAGE DRAW AND RPM TESTS

Reason:

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

Equipment:

- JTO5712 Current Gun
- JTO5719 Hand-Held Digital Tachometer
- Jumper Cables
- Jumper wire

Procedure:

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

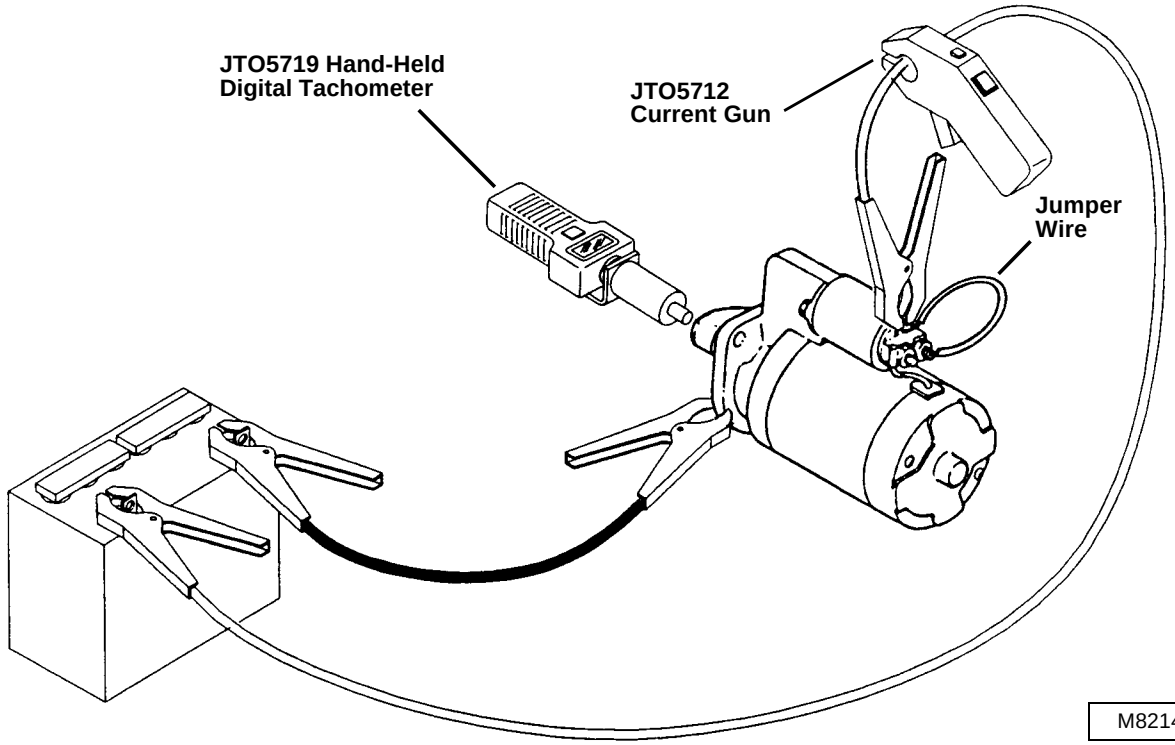
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Raise hood.
7. Remove starter assembly from mower and place starter in vice.
8. Connect jumper cables to a 12 volt battery.
9. Connect positive (+) cable to solenoid battery terminal on starter.
10. Connect negative (-) cable to starter body.
11. Attach Current Gun to positive (+) cable.

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

12. Use a jumper wire to briefly connect positive (+) starter terminal to solenoid terminal “S”. Starter should engage and run.
13. 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 60 Amps at 7000 rpm,** repair or replace starter.
- If **free-running rpm is less than 7000 rpm**, repair or replace starter.



STARTER AMP DRAW TEST

Reason:

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

Equipment:

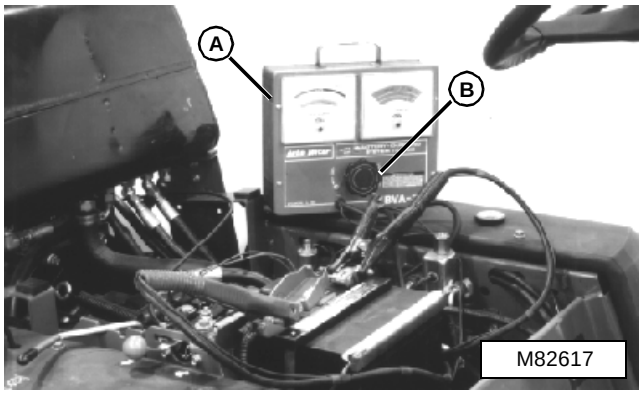
- JTO5685 Battery Tester

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 parking brake.
6. Raise hood.
7. Test ground connections and battery.
8. Disconnect fuel shutoff solenoid connector.

IMPORTANT: Turn load knob (B) fully counter-clockwise before making any test connections.

9. Connect JTO5685 Battery Tester (A) 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.

RELAY TEST

Reason:

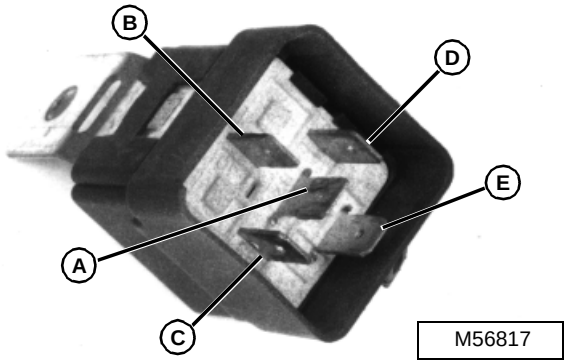
To check relay terminal continuity in the energized and de-energized condition.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Raise 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 (A) and 30 (B), and between terminals 85 (C) and 86 (D).
- There should NOT be continuity between terminals 87 (E) and 30 (B).

9. Connect a jumper wire from battery positive (+) terminal to relay terminal 85 (C). Connect a jumper wire from relay terminal 86 (D) and ground (-).

Results:

- There should be continuity between terminals 87 (E) and 30 (B).
- If continuity is NOT correct, replace relay.

COOLANT TEMPERATURE SWITCH TEST

Reason:

To verify coolant temperature switch is functioning properly, to warn operator when engine coolant exceeds normal operating temperature.

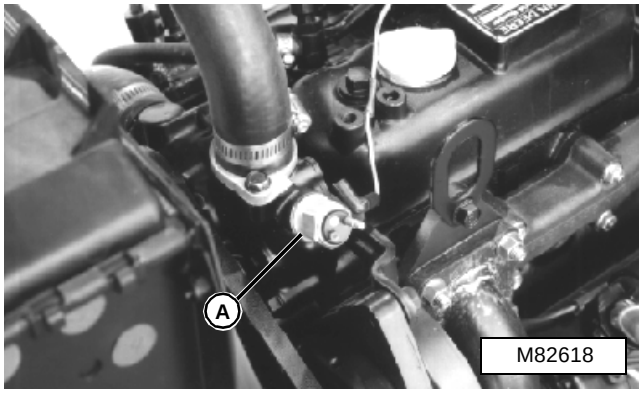
Equipment:

- Ohmmeter

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. Engage parking brake.
6. Raise hood.
7. Disconnect yellow wire No. 500 from coolant temperature switch (A).
8. Measure resistance between terminal and switch body.



9. If resistance does not meet specification, drain engine coolant and remove coolant temperature switch.
10. Place switch in water heated to approximately 96°C (205°F). Measure resistance while switch is heated.
11. If resistance does not meet specification, replace coolant temperature switch.

Specifications:

Resistance below 111°C (232°F) . . . . . .infinity (open)
Resistance at 111°C (232°F) and above . . . . . .approximately 0 ohms (continuity)

ENGINE OIL PRESSURE SWITCH TEST

Reason:

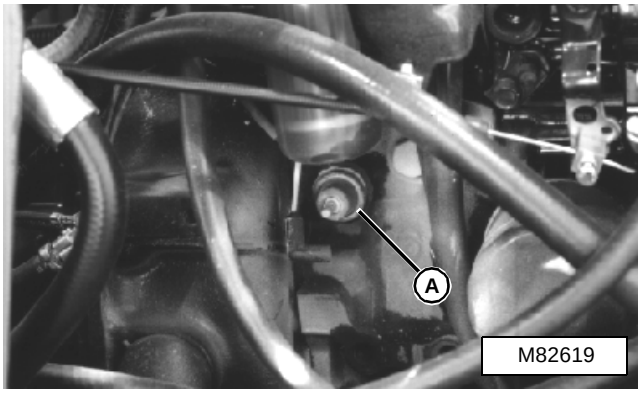
To determine if engine oil pressure switch is functioning properly, to warn operator that oil pressure has dropped below minimum operating pressure.

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. Engage parking brake.
6. Raise hood.
7. Disconnect tan wire no. 501 from oil pressure switch (A).
8. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal of switch.
9. Set ohmmeter for 1X scale.
10. 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.

® *TEFLON* is a registered trademark of the DuPont Company.

11. Start and run engine.

12. 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.

GLOW PLUG TEST

Reason:

To test operation of glow plugs.

Equipment:

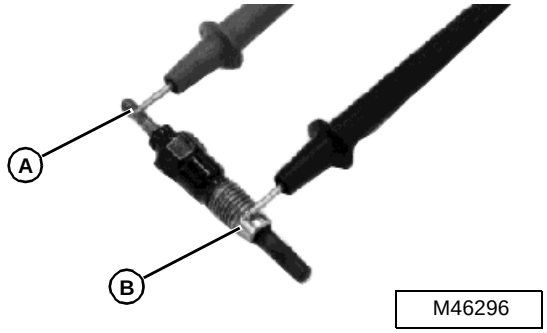
- Ohmmeter

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. Engage parking brake.
6. Raise hood.

NOTE: Cover glow plug hole to prevent debris from entering cylinder when glow plug is removed.

7. Remove glow plug lead. Remove glow plug.
8. Check continuity across terminal (A) and glow plug body (B). The reading should be between **1.35—1.65 ohms.**



M46296

Results:

- If glow plug does not have proper resistance, replace glow plug.

FUSE TEST

Reason:

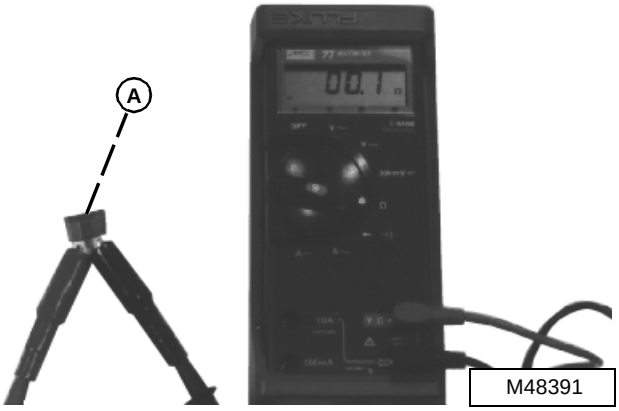
To verify that fuse has continuity.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove fuse from connector.
2. Check visually for broken filament (A).
3. Connect ohmmeter or continuity tester to each end of fuse.
4. Check for continuity.



M48391

Results:

- If continuity is not indicated, replace fuse.

BULB TEST

Reason:

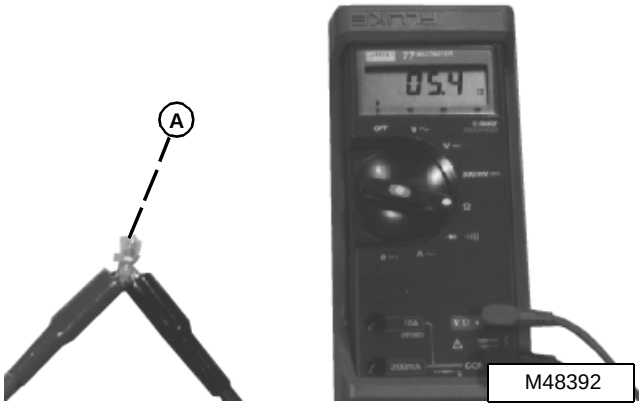
To verify that bulb has continuity.

Equipment:

- Ohmmeter or continuity tester

Procedure:

1. Remove bulb from socket.
2. Check visually for broken filament (A).
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.

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.

KEY SWITCH TEST

Reason:

To verify key switch functions are operating properly.

Equipment:

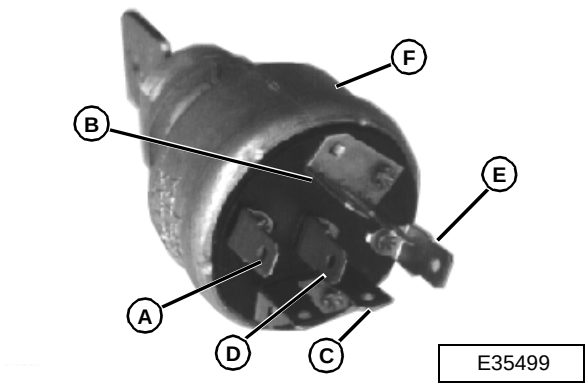
- Ohmmeter or continuity tester

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 parking brake.

NOTE: Cover may be removed for greater access.

6. Disconnect key switch connector from harness.
7. Use an ohmmeter or continuity tester to test switch continuity in OFF, RUN, and START positions.



E35499

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:

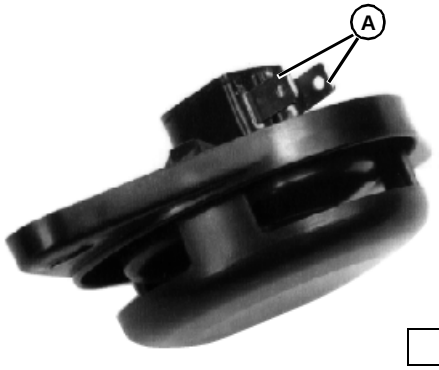
To verify seat switch functions are operating properly.

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 parking brake.
6. Disconnect seat switch connector from harness.
7. Check continuity across switch terminals. There should be no continuity. Depress plunger and continuity should exist between terminals.



E35625

Results:

- If continuity is not correct, replace seat switch.

INTERLOCK SWITCH TEST

Reason:

To verify interlock switch functions are operating properly.

Equipment:

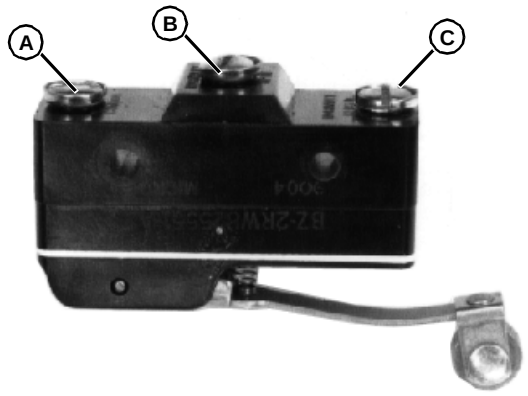
- Ohmmeter or continuity tester

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 parking brake.
6. Raise hood.
7. Disconnect interlock switch from harness.

8. With no force against switch actuator lever, use an ohmmeter to check for the following:

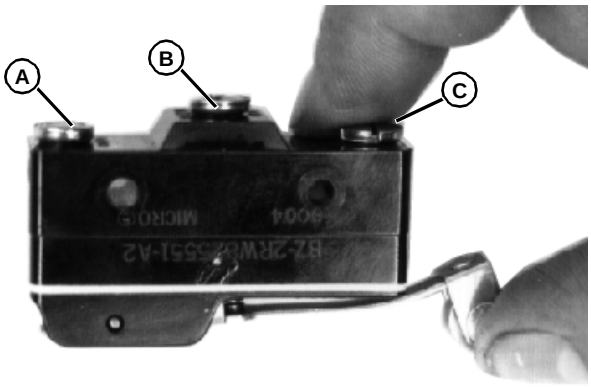
   - Continuity exists between common terminal (A) and normally closed terminal (B).
   - NO continuity exists between common terminal (A) and normally open terminal (C).



E35626

9. While applying force against switch actuator lever, use an ohmmeter to check for the following:

   - NO Continuity exists between common terminal (A) and normally closed terminal (B).
   - Continuity exists between common terminal (A) and normally open terminal (C).



E35627

Results:

- If switch fails any part of steps 8 and 9, replace interlock switch(es).

SOLENOID COIL TEST

Reason:

To verify that the solenoid coils are operating properly.

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 parking 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.

E35628

9. Check for grounds or shorts by connecting tester to one coil terminal and the other to bare metal of coil case.

E35629

Results:

- Replace coil if continuity is present.

HYDRAULIC OIL TEMPERATURE SWITCH TEST

Reason:

To verify hydraulic oil temperature switch is functioning properly, to warn operator when hydraulic oil exceeds specifications.

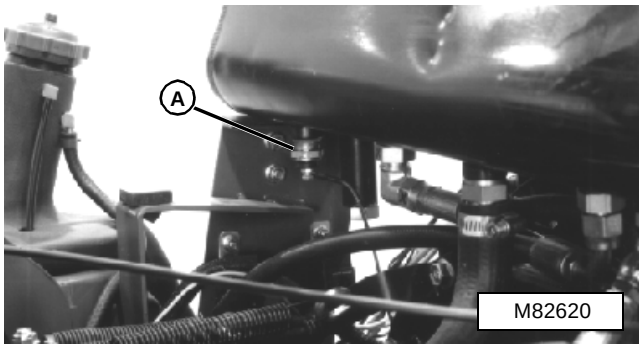
Equipment:

- Ohmmeter

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. Engage parking brake.
6. Raise hood.
7. Disconnect green wire No. 205 from hydraulic oil temperature switch (A).
8. Measure resistance between terminal and switch body.



9. If resistance does not meet specification, drain hydraulic reservoir and remove hydraulic temperature switch.
10. Place switch in water heated to approximately 96°C (205°F). Measure resistance while switch is heated.
11. If resistance does not meet specification, replace hydraulic oil temperature switch.

Specifications:

Resistance below 96°C (205°F) . . . . . .infinity (open)
Resistance at 96°C (205°F) and above . . . . . .approximately 0 ohms (continuity)

OPTIONAL HEADLIGHT SWITCH TEST

Reason:

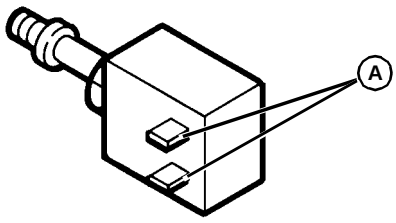
To verify headlight switch terminals have continuity when the headlight switch is ON.

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 parking brake.
6. Disconnect headlight switch connector.
7. Move headlight switch to the ON position and then to the OFF position. Check continuity between terminals (A).



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/backlapping valve switch terminals have continuity when the mow/backlapping switch is ON.

Equipment:

- Ohmmeter or continuity tester

Procedure:

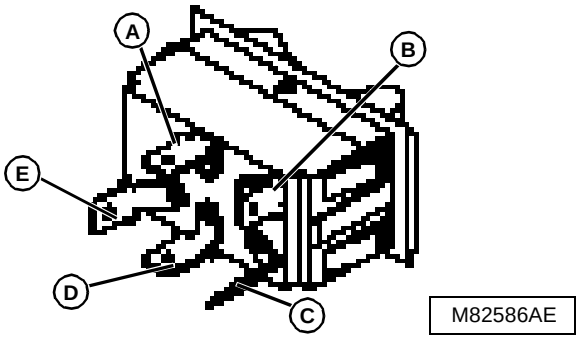
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Seat platform RAISED and LOCKED.
7. Disconnect leads from mow/backlapping switch.
8. Check continuity.

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.

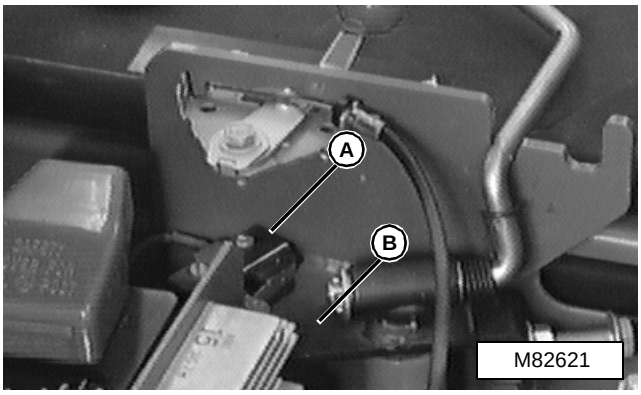
MOW/TRANSPORT SWITCH ADJUSTMENT

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 parking brake.
6. Seat platform RAISED and LOCKED.
7. Loosen switch mounting screws.
8. Align switch (A) so switch is compressed against lever (B) 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

C CAUTION

To prevent bodily injury or machine damage, travel/neutral switch must be adjusted properly. Machine may move when started, if not adjusted properly.

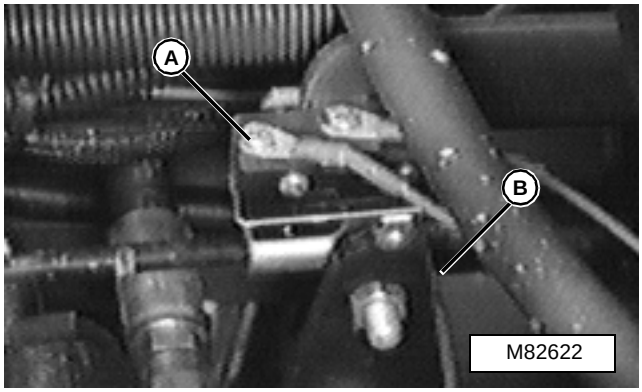
Equipment:

- 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 parking brake.
6. Seat platform RAISED and LOCKED.
7. Loosen switch mounting screws.
8. Align switch (A) so switch is compressed against lever (B) 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.



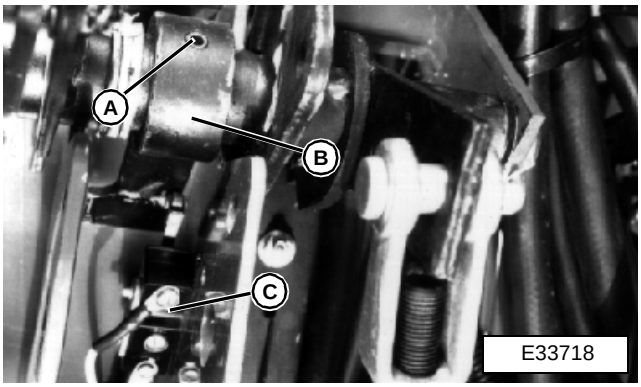
10. Using an ohmmeter or continuity tester, check for continuity between common and normally open terminals. In the NEUTRAL position, there must be continuity between terminals. If continuity does not exist, move switch closer to lever or replace mow/transport switch if continuity exists.

PARKING BRAKE SWITCH ADJUSTMENT

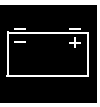
NOTE: Parking brake switch is located under the right side of the platform.

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 parking brake.
6. Loosen set screw (A).
7. Turn switch hub (B) until switch actuator is compressed and a “click” is heard from the switch (C).



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.



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POWER TRAIN

CONTENTS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydrostatic Pump

Inlet oil pressure	620—1241 kPa (90—180 psi)
Relief valve pressure	24133 kPa (3500 psi) at fast idle
Neutral control link length—shoulder to shoulder (Initial adjustment)	110 mm (4.331 in.)

REPAIR SPECIFICATIONS

Transaxle

Transaxle-to-Frame cap screw torque	95 N•m (70 lb-ft)
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)

Hydrostatic Pump

Trunion 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.)
Housing bearing depth	1.78 mm (0.070 in.) below seal bore
Backplate bearing height	1.91 mm (0.075 in.) above backplate
Backplate spring pin height	2.79 mm (0.110 in.) above backplate
Relief valve plug torque	136 N•m (100 lb-ft)
Freewheel valve torque	39 N•m (29 lb-ft)
Backplate-to-Housing cap screw torque	25 N•m (221 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).

JTO5637 Pressure Gauge,
0 to 40,000 kPa (6000 psi)

Use to check hydraulic system pressure (high pressure).

JTO7038 Pressure Gauge,
0 to 2000 kPa (300 psi)

Use to check hydraulic system pressure (low pressure).

BM18290 Hydraulic Diagnostic Kit

Use to perform various hydraulic system tests.

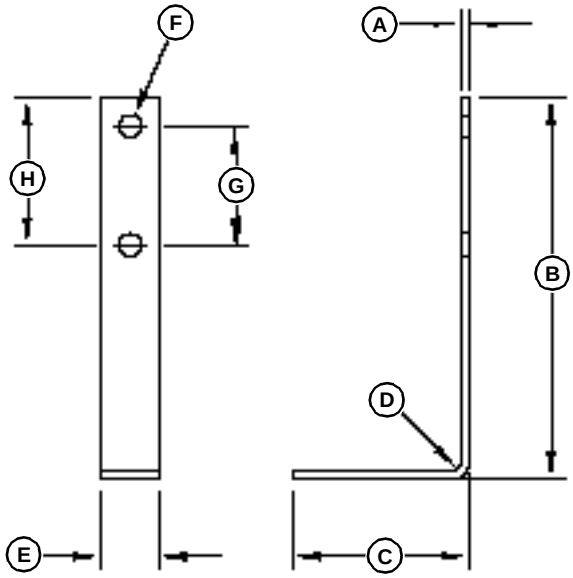
Hydraulic Diagnostic

Kit includes:

Part Number	Description	Qty Used
AMT846	Hose, 48” hydraulic diagnostic	1
MT1542	Nipple, -10 diagnostic	2
RE43774	Diagnostic Receptacle, 1/2” tube x 1/8” body	3
RE48122	Diagnostic Coupler, 1/8-27 NPTF x 1/8” body	1
XPD6-285	Cap, dust	5
38H1031	13/16 M x 13/16 F Swivel Run Tee	3
38H1032	1 M x 1 F Swivel Run Tee	2

DEALER FABRICATED TOOLS

DFMX2A Wheel Stop



M82596AE

A— 15.88 mm (0.625 in.)
B— 226.7 mm (8.925 in.)
C— 300.0 mm (11.811 in.)
D— 10 mm Radius (0.394 in. Radius)
E— 33.0 mm (1.299 in.)
F— 2 x 15 mm diameter (0.590 in.)
G— 101.6 mm (4.000 in.)
H— 115.1 mm (4.531 in.)

Wheel stops are used to stall transaxle during Hydrostatic Relief Valve Test.

Material required: 15.88 mm (0.625 in.) thick mild steel.

Quantity: 2 pieces

OTHER MATERIALS

Number	Name	Use
LOCTITE® PRODUCTS U.S./ Canadian/ LOCTITE No.		
T43512 TY9473/ 242	Thread Lock and Sealer (Medium Strength)	Retains charge pressure relief valve assembly in hydrostatic pump backplate.
PT569	John Deere NEVER-SEEZ®	Prevents parts from seizing. Apply to splines of hydrostatic pump drive shaft.

SERVICE PARTS KITS

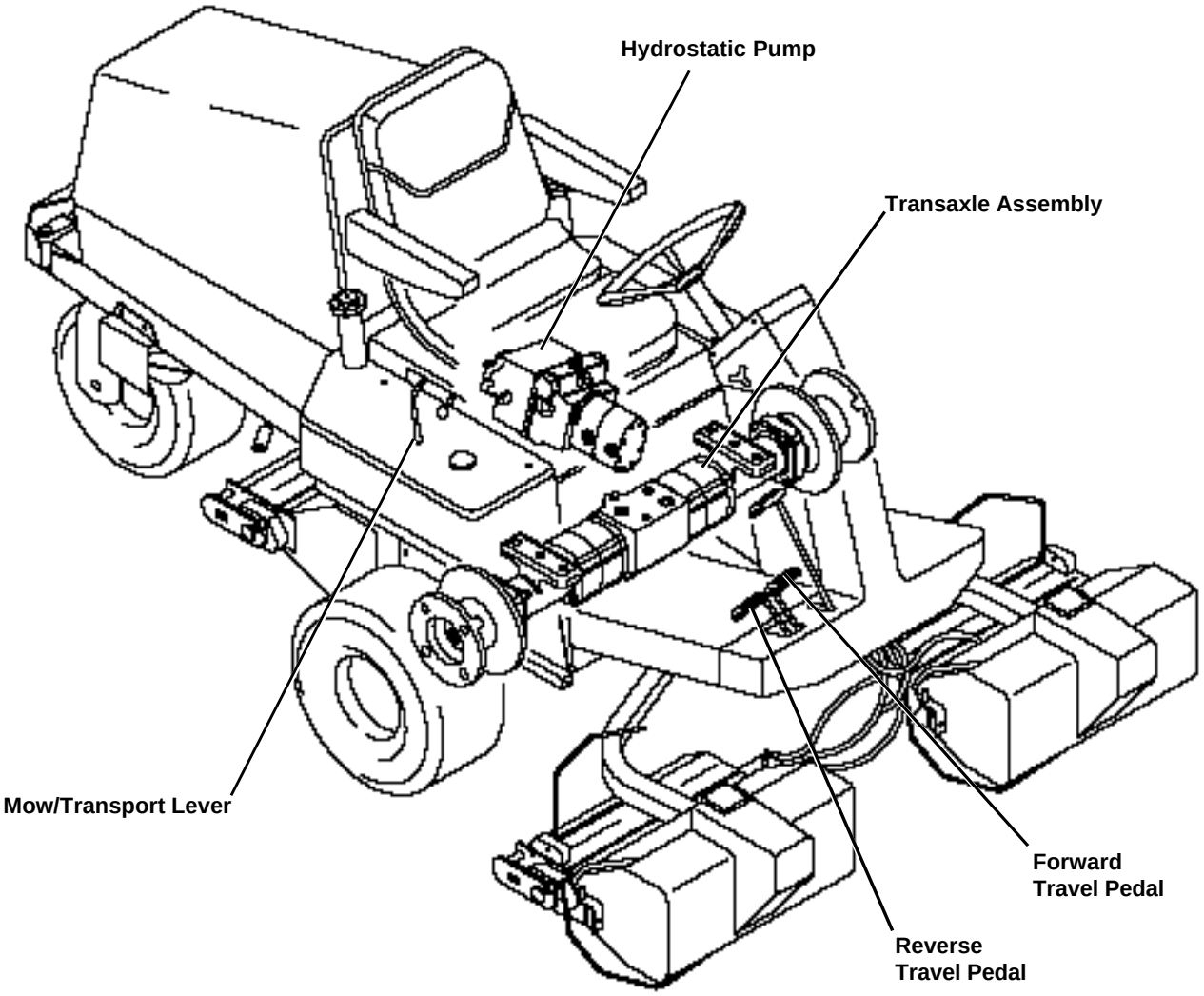
The following kits are available through your parts catalog:

- Transaxle Seal Kit
- Hydrostatic Pump Seal Kit

® *LOCTITE is a registered trademark of the Loctite Corp.*

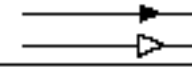
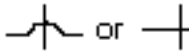
® *NEVER-SEEZ is a registered trademark of the Emhart Chemical Group.*

POWER TRAIN COMPONENTS

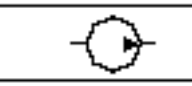
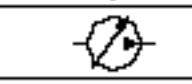


JIC HYDRAULIC CIRCUIT SYMBOLS

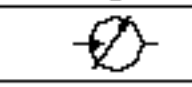
LINES

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

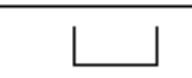
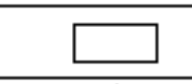
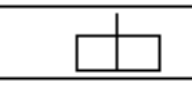
PUMPS

8		Fixed Displacement
9		Variable Displacement

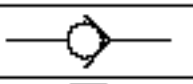
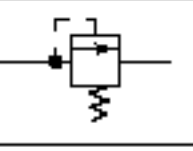
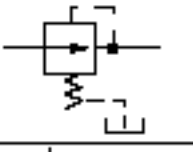
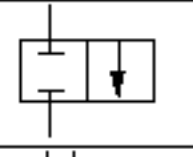
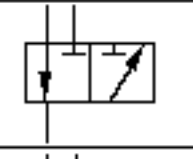
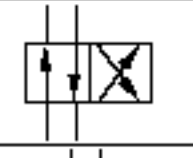
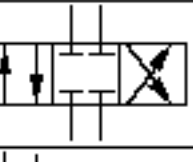
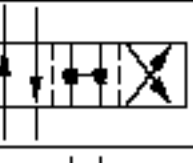
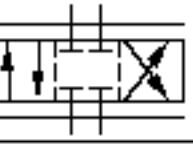
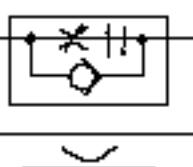
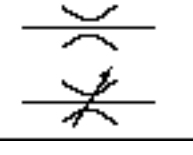
MOTORS

10		Fixed Displacement
11		Variable Displacement

RESERVOIR

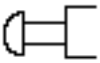
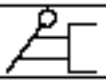
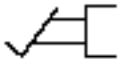
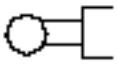
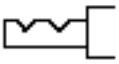
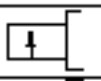
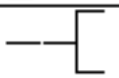
12		Vented Reservoir
13		Pressurized Reservoir
14		Reservoir Return -Above Fluid Level
15		Reservoir Return -Below Fluid Level

VALVES

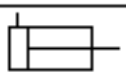
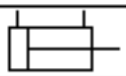
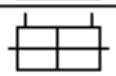
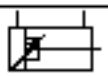
16		Check Valve
17		Manual On/Off Valve
19		Pressure Relief Valve
20		Pressure Reduction Valve
21		Two Position, Two Connection Valve
22		Two Position, Three Connection Valve
23		Two Position, Four Connection Valve
24		Three Position, Four Connection Valve
25		Two Position, Four Connection Valve with Transmission
26		Three Position, Four Connection Valve with Infinite Positioning
27		Adjustable Flow Control Valve (Temperature and Pressure Compensated)
18		Fixed, Variable } Orifice

M82612AE

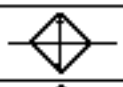
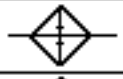
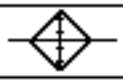
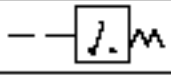
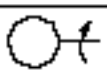
VALVE OPERATORS

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

Refer to HYDRAULICS section for complete machine hydraulic/hydrostatic schematic.

POWER TRAIN SYSTEM OPERATION

Function:

To drive the machine via hydraulic motors.

Theory of Operation:

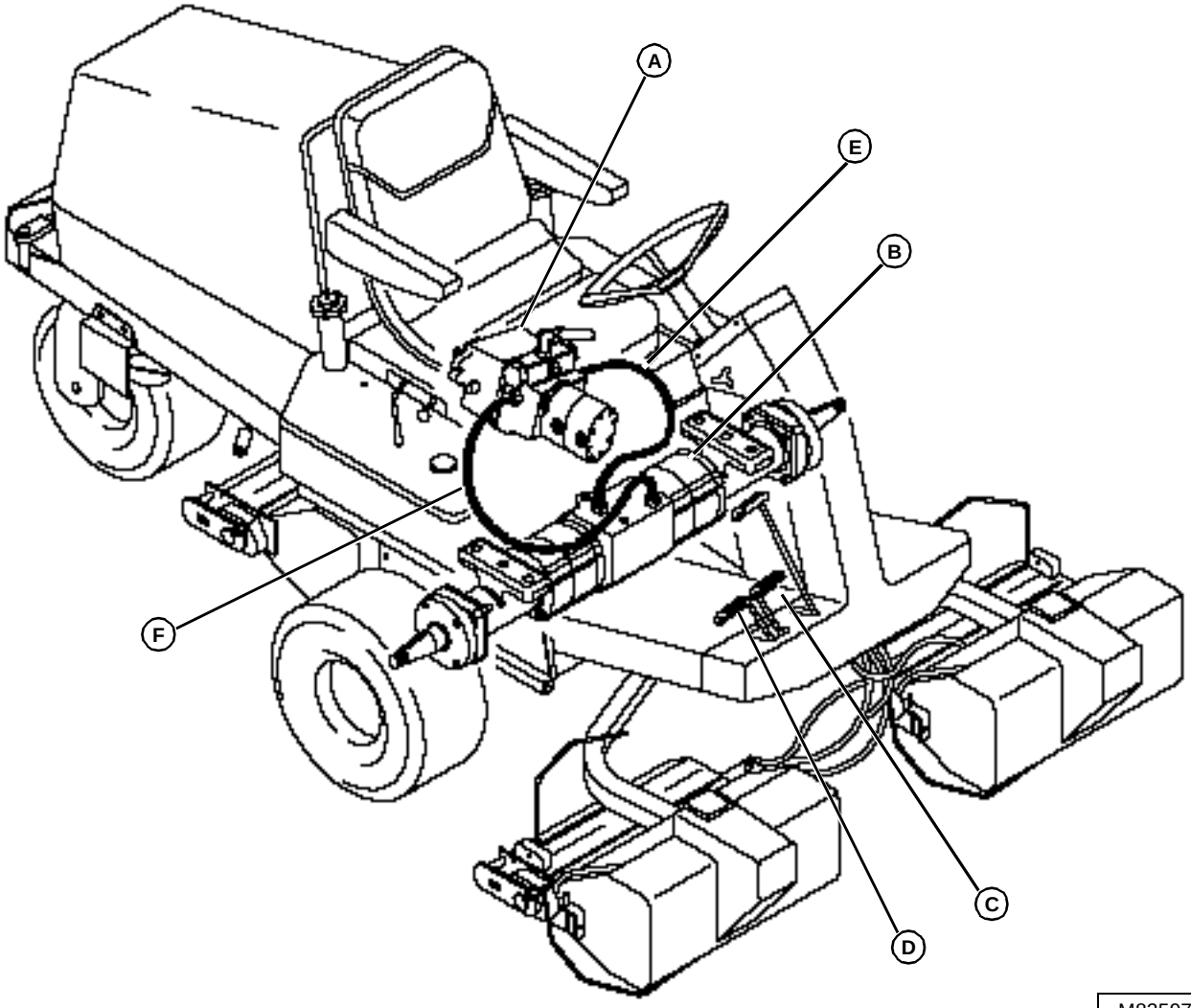
The hydrostatic pump (A) is driven by the engine to provide high pressure oil to the transaxle assembly (B).

As the forward travel pedal (C) is depressed, the hydrostatic control lever pivots to direct high pressure oil through the forward pressure line (E) to transaxle port “A”, driving the motors. Return oil exits the transaxle at port “D” and is returned to the hydrostatic pump through the reverse pressure line (F).

When driving in reverse, pressure oil flow applied to the transaxle is reversed.

See HYDROSTATIC PUMP and TRANSAXLE OPERATION for further information.

A— Hydrostatic Pump
B— Transaxle Assembly
C— Forward Travel Pedal
D— Reverse Travel Pedal
E— Pressure Line (Forward)
F— Pressure Line (Reverse)



M82597AE

HYDROSTATIC PUMP OPERATION—NEUTRAL

Function:

The Hydrostatic pump provides hydraulic oil pressure to the transaxle assembly.

Theory of Operation:

Charge pressure oil (A) is provided by the hydraulic pump via the steering valve. The charge pressure oil keeps the closed loop full by replenishing the oil lost through internal leakage.

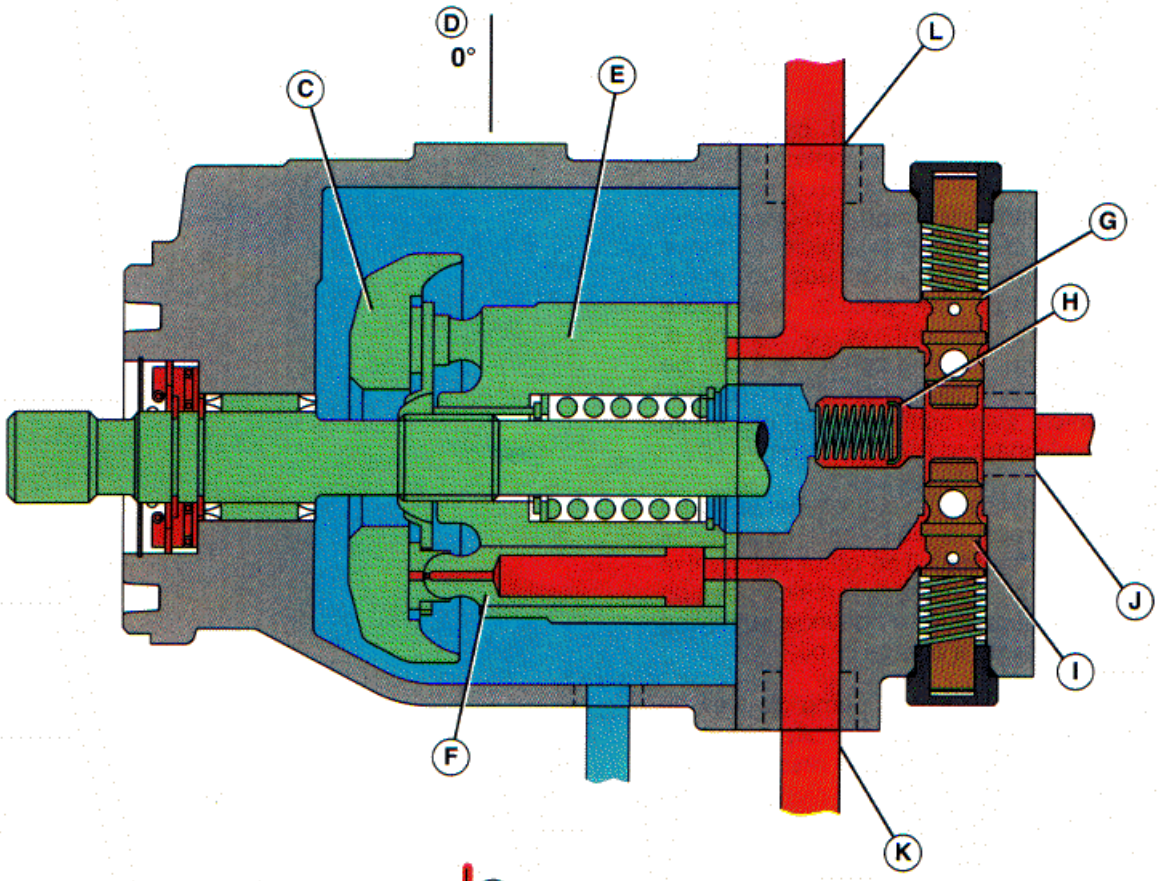
As the drive shaft of the hydrostatic pump is turned by the engine, the piston block (E) splined to the drive shaft also turns. The piston block contains nine piston assemblies (F) which have a free swiveling shoe swagged on the ball end of the piston assembly. The shoe end of the piston rides against the smooth surface off the camplate (C). With the camplate in the neutral position (0°) the piston assemblies do not reciprocate in the piston block, they merely rotate, no oil is being drawn in or discharged from the pump. The pump is in a zero displacement position and the vehicle remains stationary.

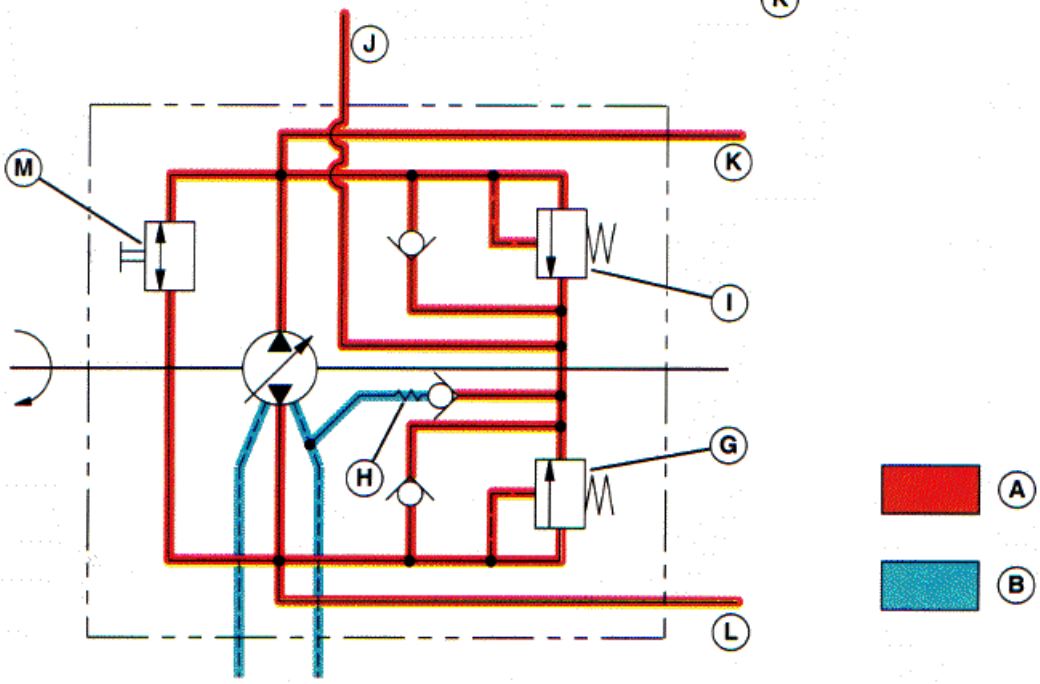
The two high pressure relief valves (G and I) are dual purpose valves. The primary function is to provide overload protection to the system, the secondary function serves as a charge check valve.

With the camplate in the neutral position (0°) the pressure of the charge oil (A), which ranges from 60 to 150 PSI, is able to unseat both relief valves (G and I), which serve as charge checks and supply oil to both side of the pump due to the balance in pressure.

Oil (B) that leaks internally in the pump collects in the body housing and is returned to the reservoir via a case drain in the pump housing. This, along with the case leakage from the transaxle, is the only oil returning to the reservoir in a closed loop system.

A— Charge Pressure Oil
B— Case Pressure Oil
C— Camplate
D— Cam Angle—Neutral Position 0°
E— Piston Block
F— Piston Assembly
G— High Pressure Relief Valve—Reverse
H— Charge Pressure Relief Valve
I— High Pressure Relief Valve—Forward
J— Port E (Inlet)
K— Port C (Forward)
L— Port D (Reverse)
M— Freewheel Valve





MC82567AE

HYDROSTATIC PUMP OPERATION—FORWARD

Function:

The Hydrostatic pump provides hydraulic oil pressure to the transaxle assembly.

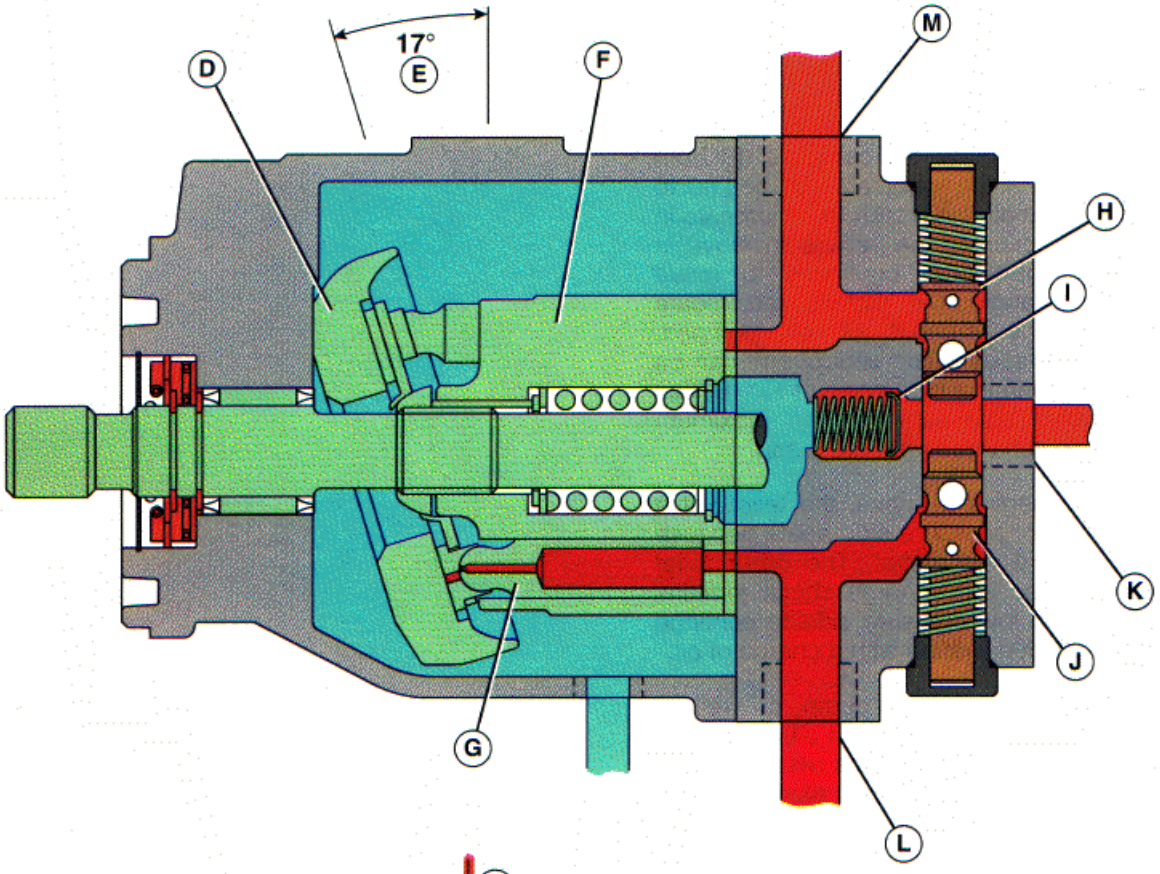
Theory of Operation:

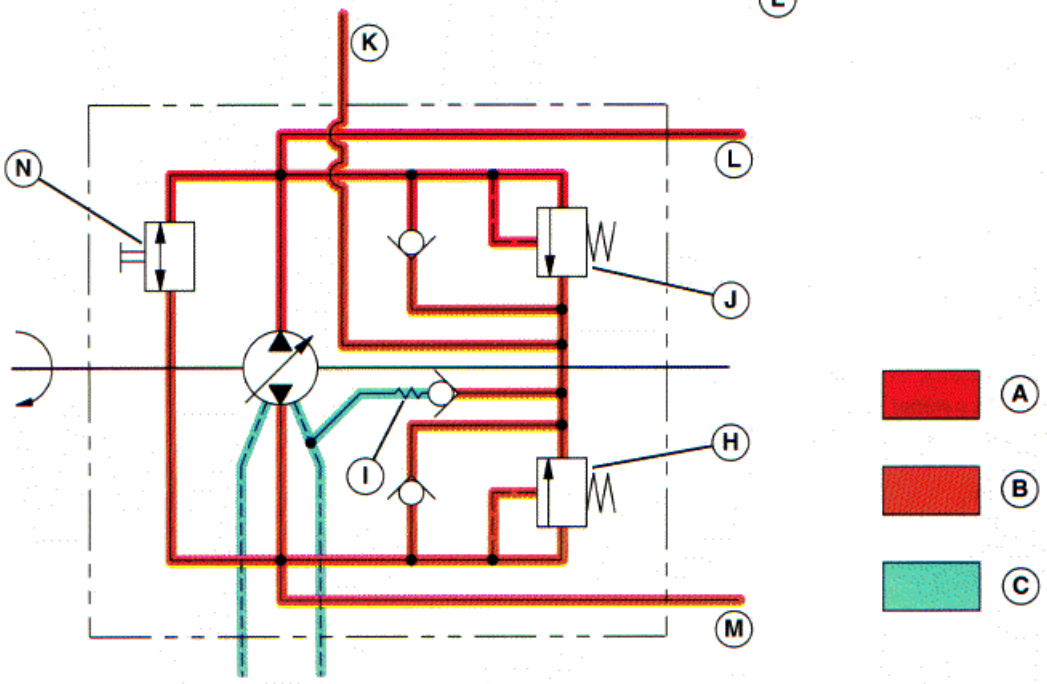
Depressing the forward travel pedal causing the camplate control arm to move the camplate (E) from the neutral position. As the camplate (D) begins to move, the piston assemblies (G) start to reciprocate in the piston block (F), causing the vehicle to move forward. As the control arm continues to move increasing the cam angle, the pistons reciprocate further increasing the amount of oil pumped, increasing the vehicle speed. The control arm can be moved forward until a full a cam angle of 17° (E) has been reached, which also achieves the maximum volume of oil being discharged from the pump.

When the camplate begins to move, the relief valve (J) on the discharge or pressure side seats because of the higher pressure differential. The other relief valve (H), which serves as a charge check remains open on the intake or low pressure side to continue supplying the closed loop system with a charge of oil.

Oil (C) that leaks internally in the pump as well as charge flow not being used as makeup oil, collects in the body housing and is returned to the reservoir via a case drain in the pump housing. This, along with the case leakage from the transaxle, is the only oil returning to the reservoir in a closed loop system.

A— High Pressure Oil
B— Charge Pressure Oil
C— Case Pressure Oil
D— Camplate
E— Cam Angle—Forward Position 17°
F— Piston Block
G— Piston Assembly
H— High Pressure Relief Valve—Reverse
I— Charge Pressure Relief Valve
J— High Pressure Relief Valve—Forward
K— Port E (Inlet)
L— Port C (Forward)
M— Port D (Reverse)
N— Freewheel Valve





MC82568AE

HYDROSTATIC PUMP OPERATION—REVERSE

Function:

The Hydrostatic pump provides hydraulic oil pressure to the transaxle assembly.

Theory of Operation:

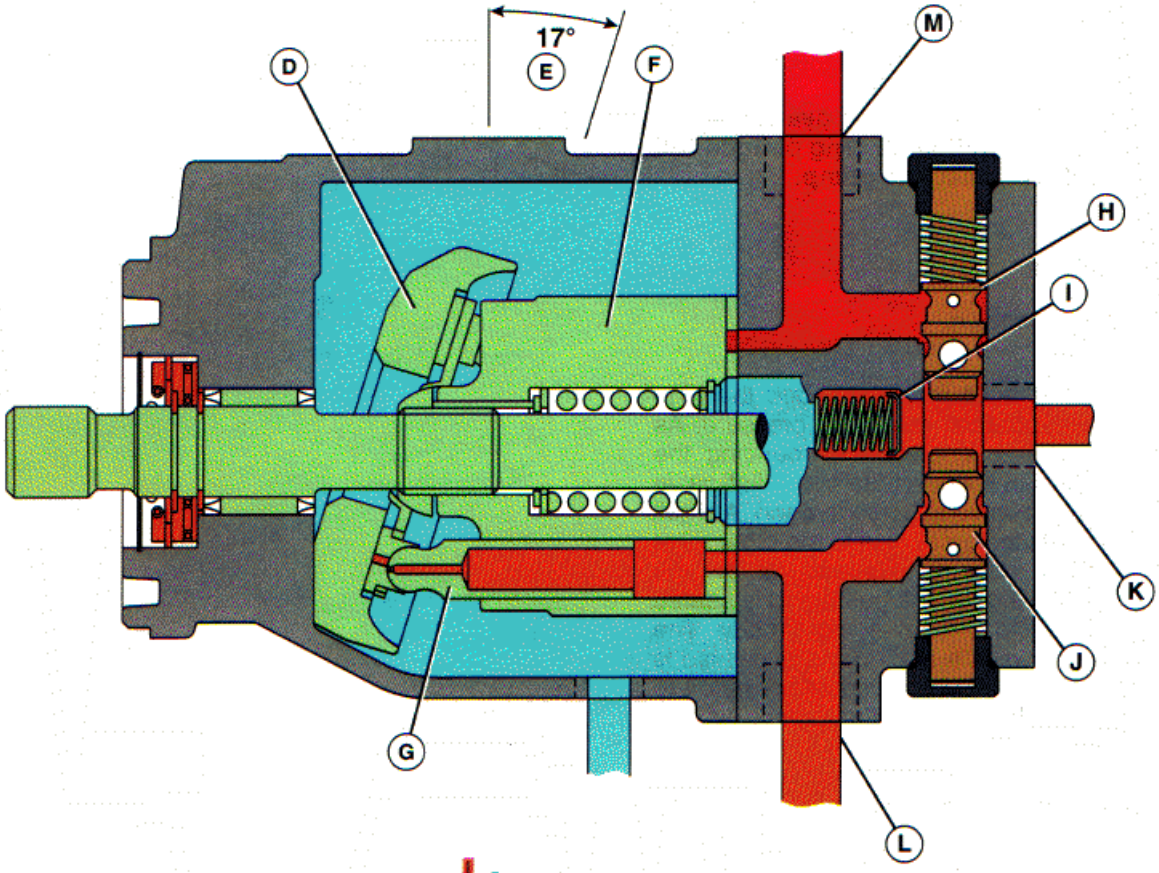
Depressing the reverse travel pedal causing the camplate control arm to move the camplate (F) from the neutral position. As the camplate (D) begins to move, the piston assemblies (G) start to reciprocate in the piston block (F), causing the vehicle to move in reverse. As the control arm continues to move increasing the cam angle, the pistons reciprocate further increasing the amount of oil pumped, increasing the vehicle speed. The control arm can be moved in reverse until a full a cam angle of 17° (E) has been reached, which also achieves the maximum volume of oil being discharged from the pump.

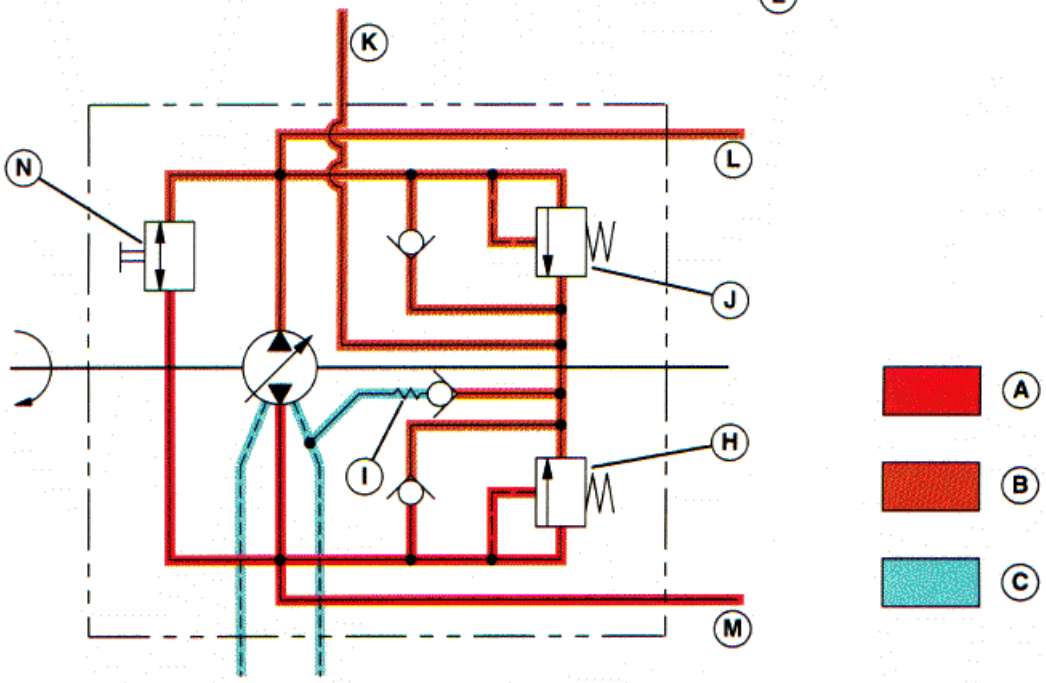
When the camplate begins to move, the relief valve (H) on the discharge or pressure side seats because of the higher pressure differential. The other relief valve (J), which serves as a charge check remains open on the intake or low pressure side to continue supplying the closed loop system with a charge of oil.

Oil (C) that leaks internally in the pump, as well as charge flow not being used as makeup oil, collects in the body housing and is returned to the reservoir via a case drain in the pump housing. This, along with the case leakage from the transaxle, is the only oil returning to the reservoir in a closed loop system.

In the reverse position the pump shaft still rotates in the same direction, but the discharge of oil from the pump is reversed.

A— High Pressure Oil
B— Charge Pressure Oil
C— Case Pressure Oil
D— Camplate
E— Cam Angle—Reverse Position 17°
F— Piston Block
G— Piston Assembly
H— High Pressure Relief Valve—Reverse
I— Charge Pressure Relief Valve
J— High Pressure Relief Valve—Forward
K— Port E (Inlet)
L— Port C (Forward)
M— Port D (Reverse)
N— Freewheel Valve





MC82569AE

HYDROSTATIC PUMP RELIEF VALVE OPERATION

Function:

To relieve the pressure side of the system of excessive pressure when the vehicle encounters heavy loads or stalls out.

IMPORTANT: Operation of vehicle in overloaded or stalled condition for long periods will result in damage to pump.

Theory of Operation:

NOTE: Forward drive shown.

In the event of a hydraulic motor stall-out, the high pressure oil (A) will approach maximum pressure. As maximum pressure is reached, oil surrounding the pilot operated relief valve (K) enters the relief valve body, causing the relief valve to begin to open. A small amount of oil (C) starts to flow across to the other relief valve (I). This relief valve is exposed to low (B) pressure on the intake side of the pump and is seated by spring tension within the relief valve body. The pressure of the small volume of oil being bypassed is enough to unseat the relief valve and allow the oil to recirculate to the intake side of the pump. As the pressure continues to build on the pressure side, the oil volume and speed through the relief valve increases, causing the pressure to drop within the relief valve. The surrounding pressure is then able to unseat the relief valve allowing maximum oil bypass.

The system relief valves function the same for both sides of the system.

A— High Pressure Oil

B— Charge Pressure Oil

C— Medium Pressure Oil

D— Case Pressure Oil

E— Camplate

F— Cam Angle—Forward Position 17°

G— Piston Block

H— Piston Assembly

I— High Pressure Relief Valve—Reverse

J— Charge Pressure Relief Valve

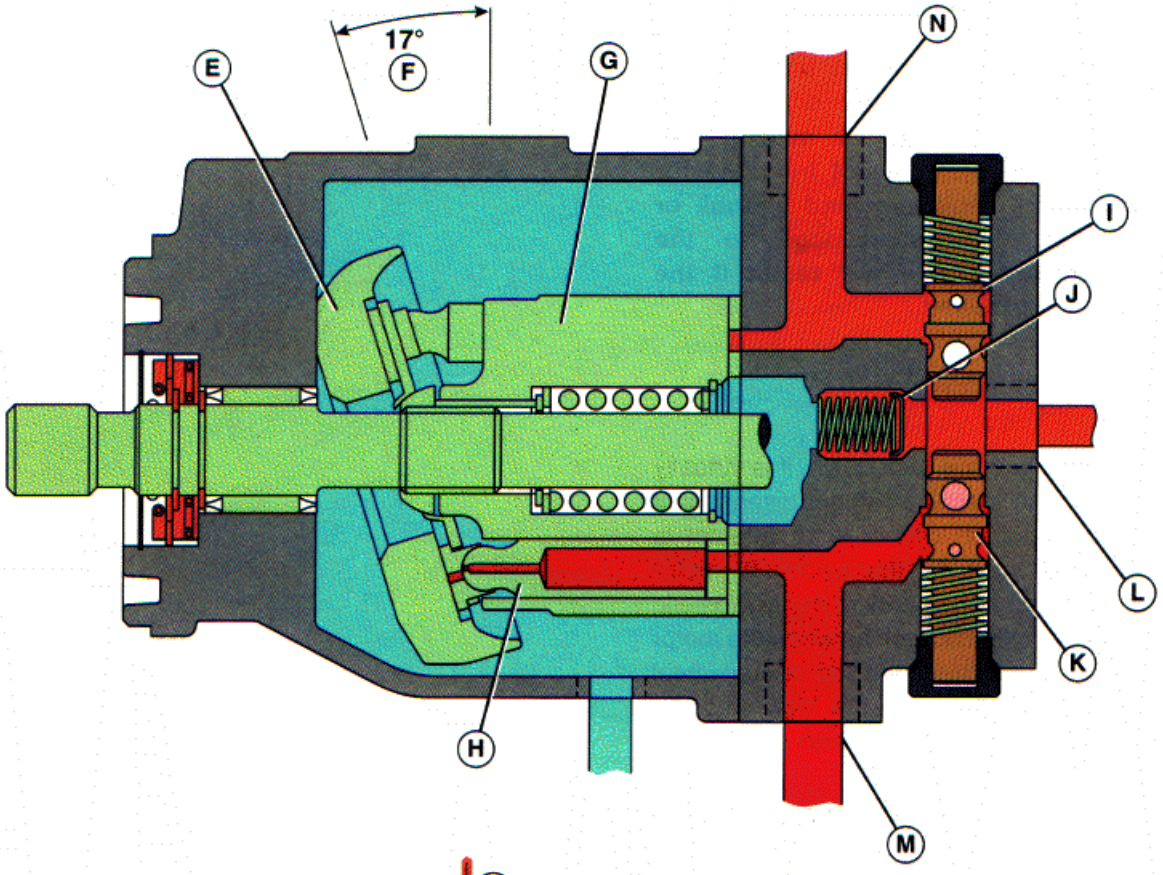
K— High Pressure Relief Valve—Forward

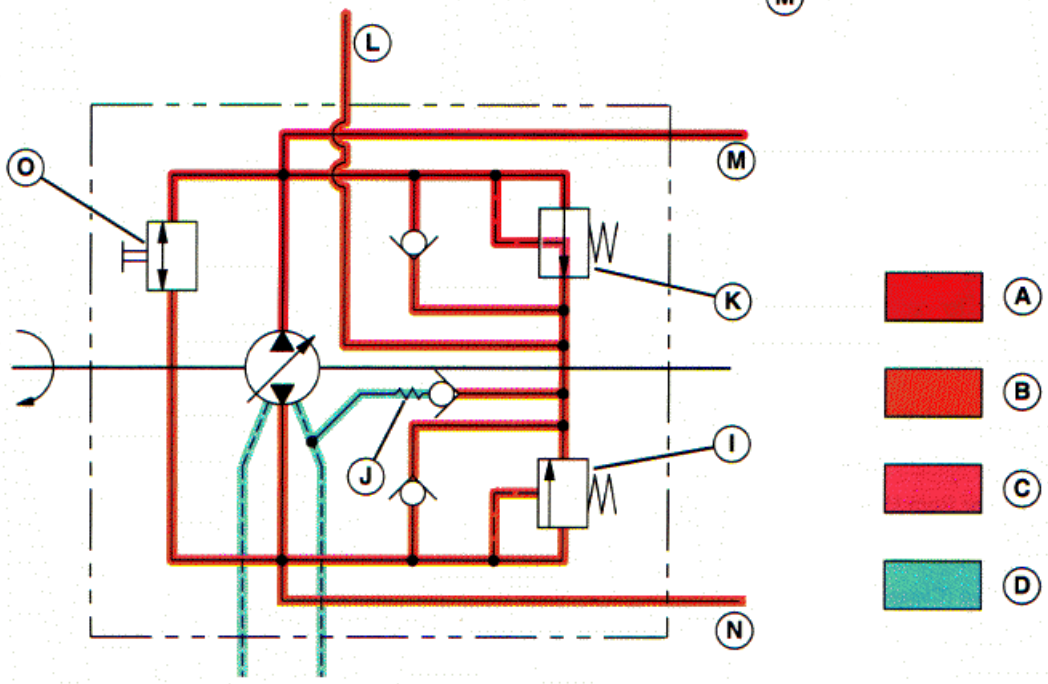
L— Port E (Inlet)

M— Port C (Forward)

N— Port D (Reverse)

O— Freewheel Valve





MC82570AE

HYDROSTATIC PUMP FREEWHEEL VALVE OPERATION

Function:

To allow the movement of a disabled machine.

IMPORTANT: The freewheel valve is intended for moving a vehicle for short distances only (maximum of 1/2 mile at less than 2 mph), it is not intended for towing a vehicle behind a truck or tractor. Serious damage to the hydrostatic drive will result if the vehicle is towed.

Theory of Operation:

When the hydrostatic pump is shut down, it is virtually impossible to move the machine without disengaging the hydrostatic closed loop circuit. If an attempt is made to move the machine the hydraulic motor becomes a pump, trying to pump oil to the hydrostatic pump. This creates a hydraulic lock between the motor and pump. To overcome this condition, a freewheel valve has been installed between the high pressure relief valves in the back plate of the piston pump.

The freewheel valve is a plug that includes a rotating stem with flat spade ends that fit between the ends of the high pressure relief valves. When the freewheel valve is in the “working” position (E), the relief valves are in the closed position. When the freewheel valve is rotated 90°, flat spade ends the relief valves to the “open” position (F). This allows the oil in the hydrostatic closed loop bypass around the high pressure relief valves inside the pump backplate. The bypassing of the oil inside the pump backplate will allow the motor to rotate freely when the vehicle is moved a short distance.

A— Static Oil Between Motor and Pump

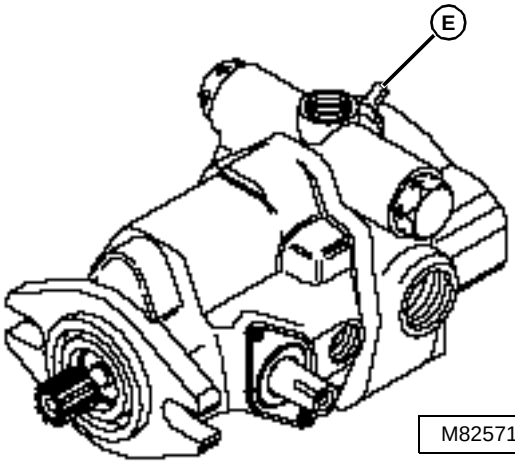
B— Static Non-Pressurized Oil in Charge Pump Circuit

C— Fluid Loop to or from Motor—Free Circulating

D— Charge Pressure Inlet (Inactive)

E— Freewheel Valve (Closed)

F— Freewheel Valve Turned 90° (Open)



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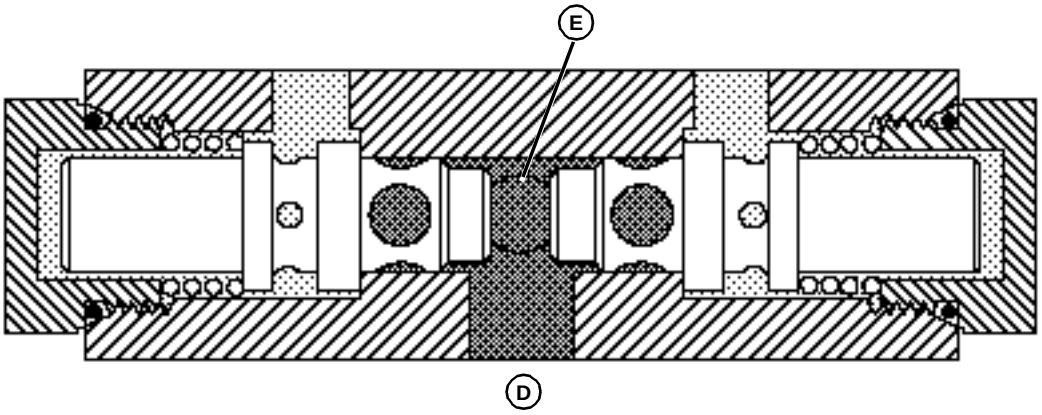

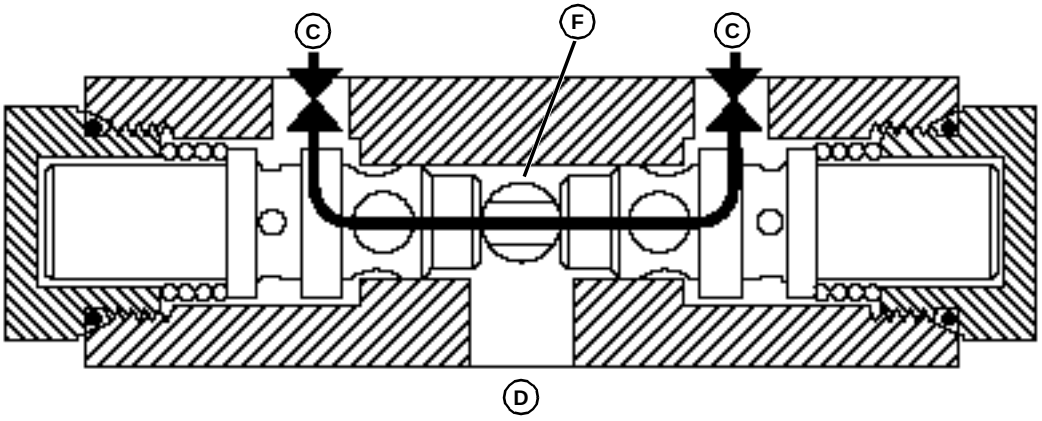

A

B

M82590AE

TRANSAXLE OPERATION—NEUTRAL

Function:

To drive the machine using hydraulic motors.

Theory of Operation:

Charge pressure oil (A) from the hydrostatic pump enters the transaxle at ports “A” and “D”. The oil is directed by the motor valve (F), to the Gerolor® motor (E). With pressure equal at both sides of the motor, no motor rotation will occur.

Oil (B) that leaks internally in the pump, collects in the body housing and is returned to the reservoir via a case drain in the pump housing. This is the only oil returning to the reservoir in a closed loop system.

Travel direction is controlled by changing oil flow direction applied to the transaxle. This is accomplished at the hydrostatic pump. (See HYDROSTATIC PUMP OPERATION—NEUTRAL for further information.)

A— Charge Pressure Oil

B— Case Pressure Oil

C— Gerolor Motor

D— Valve Plate

E— Motor Valve

F— Valve Drive

G— Drive Shaft

H— Axle-Shaft

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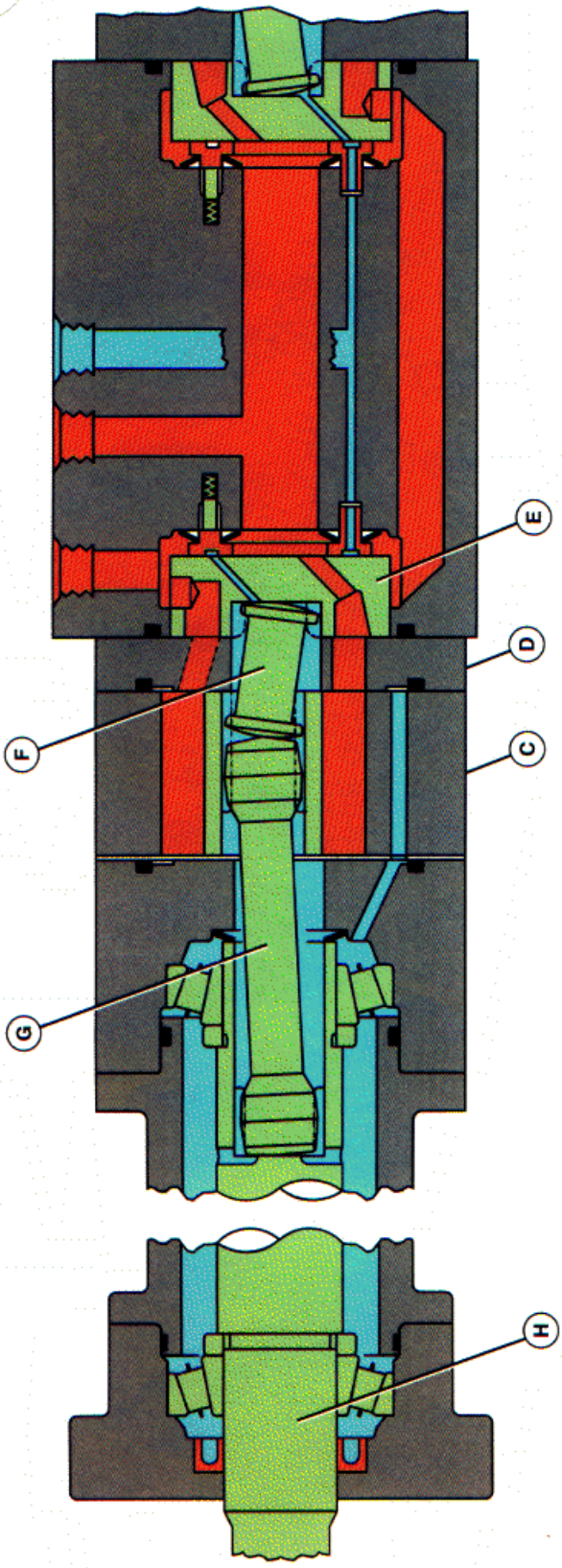
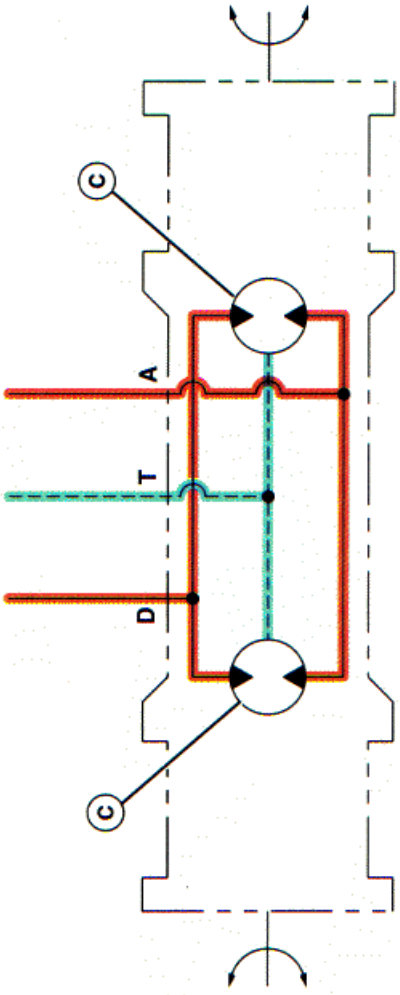




MC82588AE

TRANSAXLE OPERATION—TRAVEL

Function:

To drive the machine using hydraulic motors.

Theory of Operation:

NOTE: Forward travel shown.

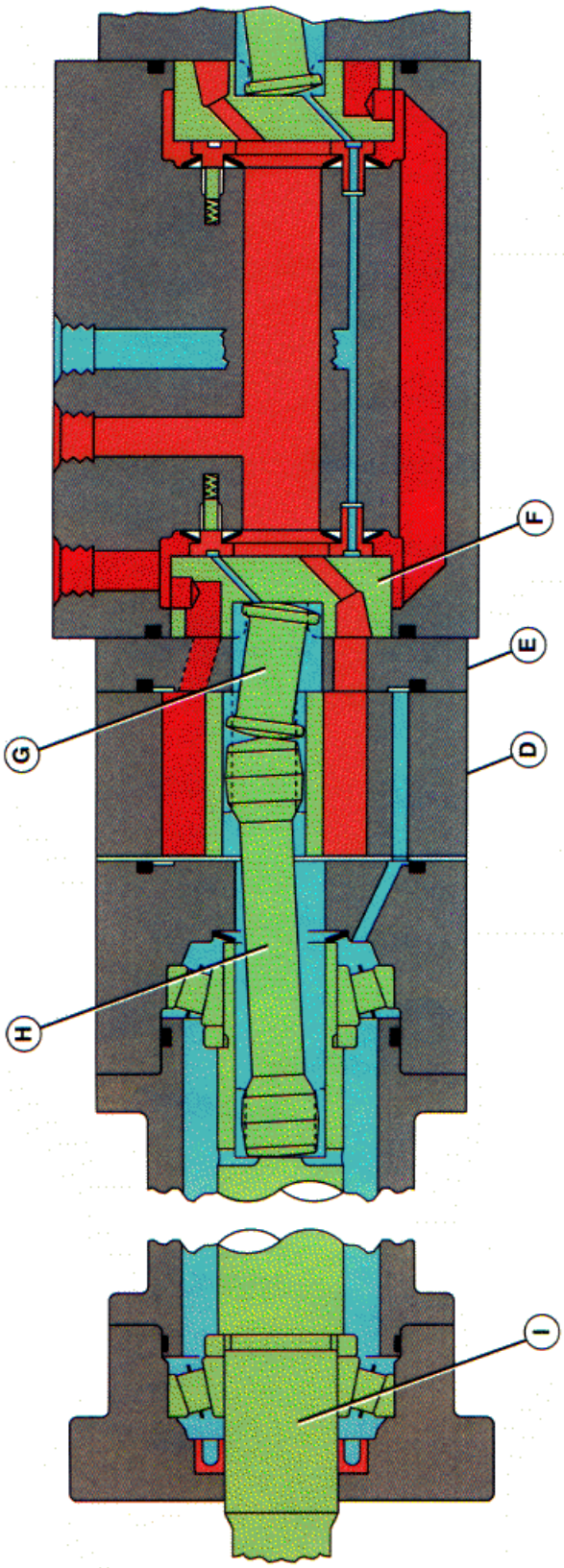
High pressure oil (A) from the hydrostatic pump enters the transaxle at port “A”. The oil is directed by the motor valve (F), forcing the Gerolor® motor (E), drive shaft (H), and axle-shaft (I) to turn. As the motor rotates, oil exits the motor and is routed to the hydrostatic pump through port “D” to charge the pump.

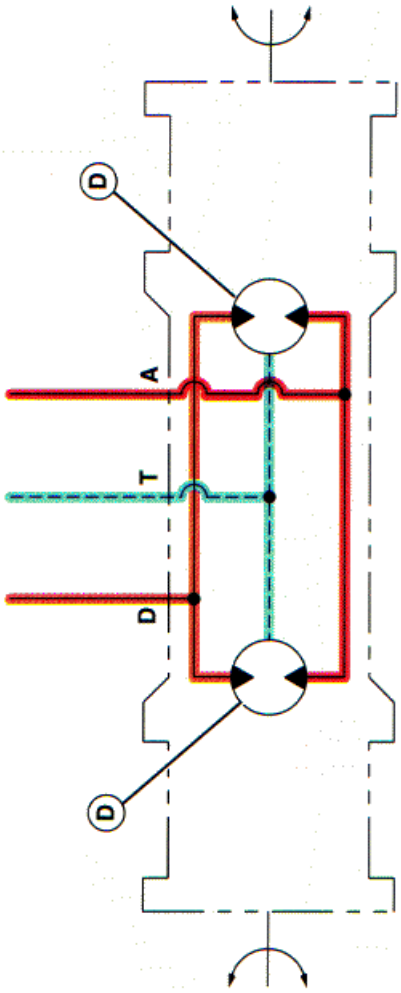
Oil (C) that leaks internally in the pump, collects in the body housing and is returned to the reservoir via a case drain in the pump housing. This is the only oil returning to the reservoir in a closed loop system.

Travel direction is controlled by changing oil flow direction applied to the transaxle. This is accomplished at the hydrostatic pump. (See HYDROSTATIC PUMP OPERATION—FORWARD/REVERSE for further information.)

A— High Pressure Oil
B— Charge Oil
C— Case Pressure Oil
D— Gerolor Motor
E— Motor Valve
F— Valve Drive
G— Drive Shaft
H— Axle-Shaft

Geroler® is a registered trademark of the EATON Corporation.





MC82589AE

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.		●	●									

MACHINE WILL NOT MOVE FORWARD OR BACKWARD

Test Conditions:

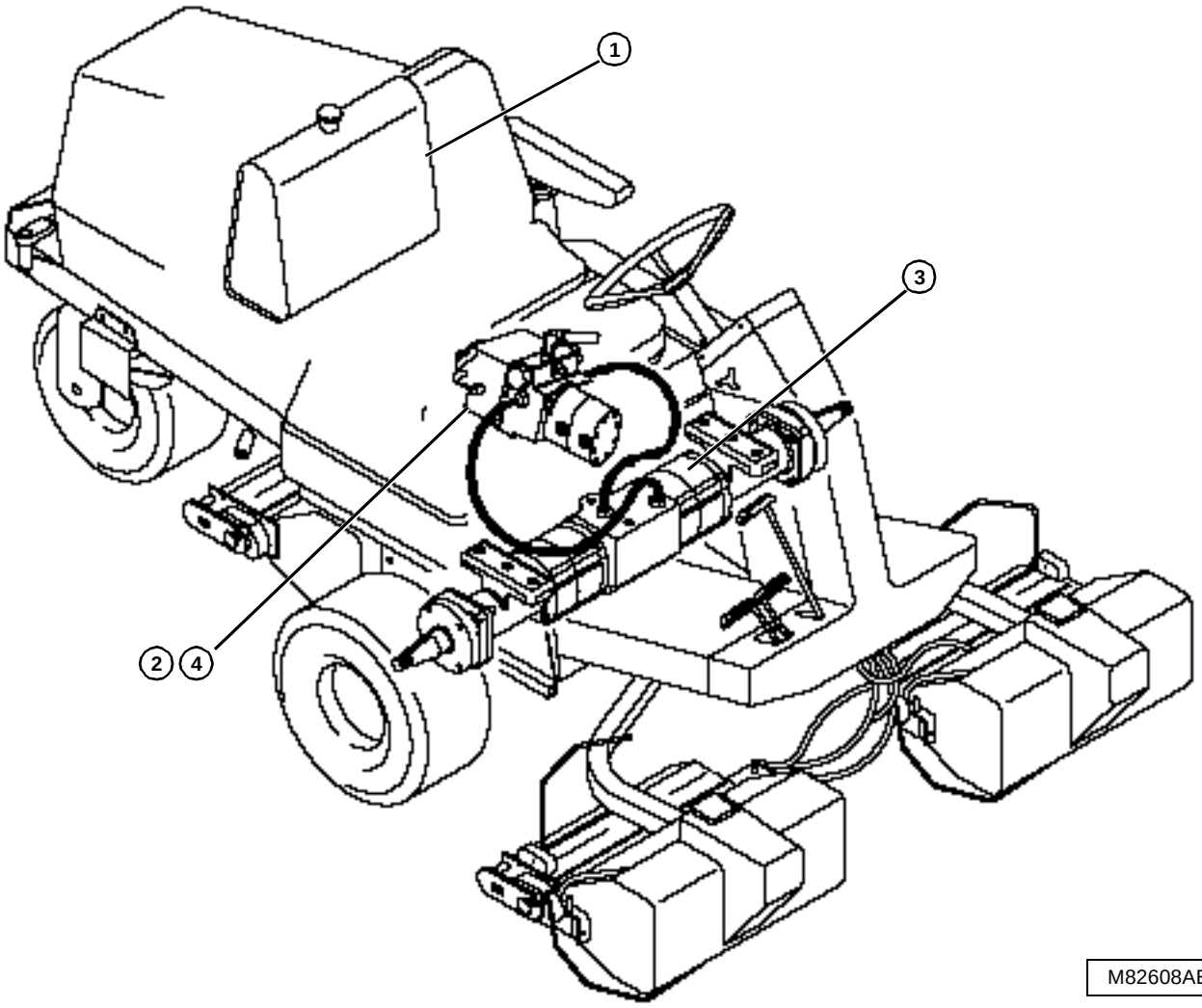
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil level to correct level.	Fill to correct level with specified oil.
	Hydraulic reservoir filled with oil of correct specifications.	Drain system and fill to correct level with specified oil.
2. Hydrostatic pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC CONTROL LINKAGE ADJUSTMENT.)
	No internal damage.	Disassemble, inspect and repair or replace pump as necessary.
3. Transaxle.	No internal damage.	Disassemble, inspect, and repair or replace transaxle as necessary.

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Hydrostatic pump.	Charge pressure at correct specification.	Test hydrostatic pump charge pressure. (See HYDROSTATIC PUMP CHARGE PRESSURE TEST.)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M82608AE

MACHINE ACCELERATES SLOWLY

Test Conditions:

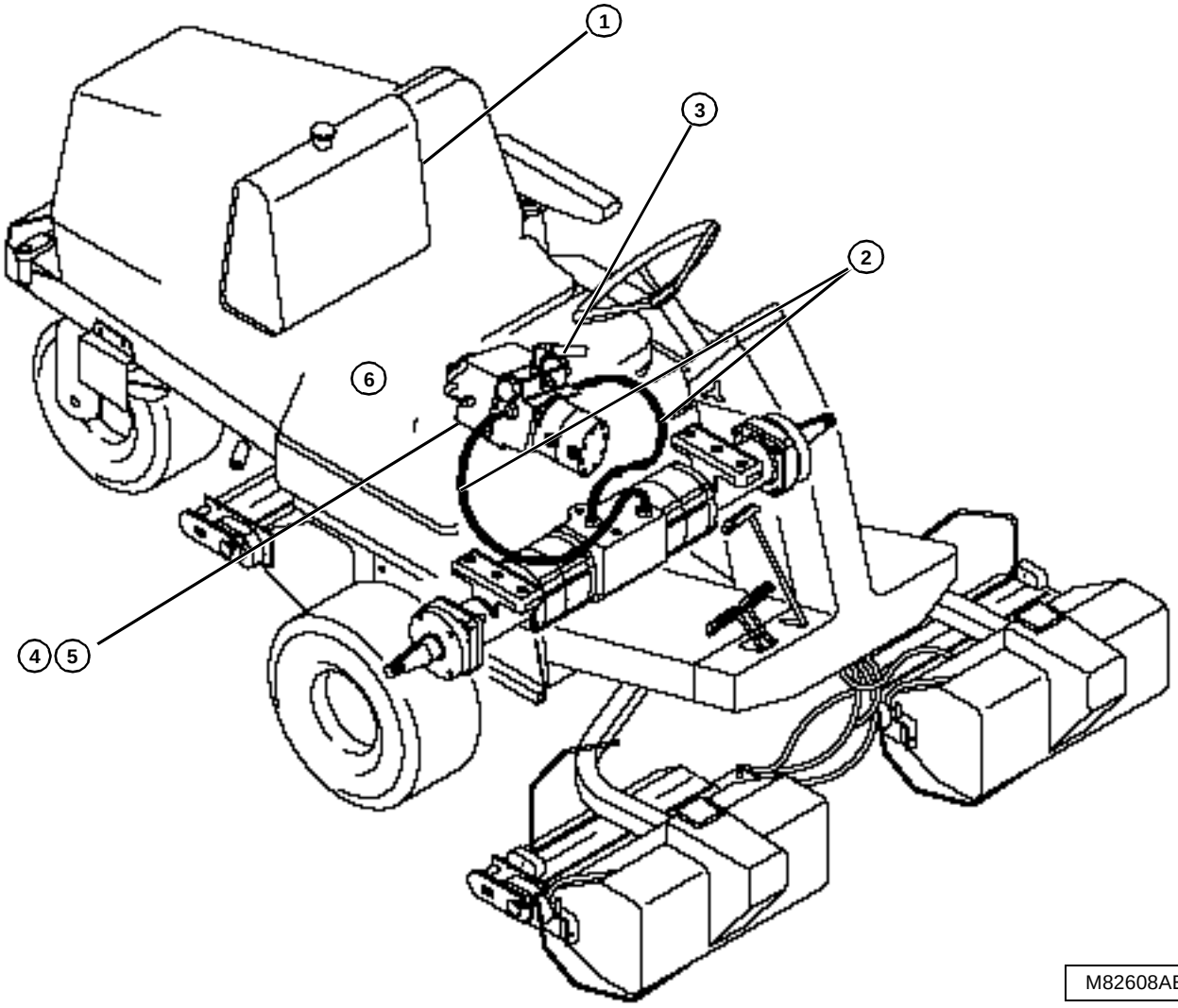
- Key switch in OFF position.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil level to correct level.	Fill to correct level with specified oil.
	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)
2. Pressure hoses from hydrostatic pump to transaxle.	No sharp bends or restrictions.	Replace hoses.
3. Pressure hose from steering valve to hydrostatic pump.	No sharp bends or restrictions.	Replace hose.
4. Hydrostatic pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC CONTROL LINKAGE ADJUSTMENT.)

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
5. Hydrostatic pump.	Charge pressure at correct specification.	Test hydrostatic pump charge pressure. (See HYDROSTATIC PUMP CHARGE PRESSURE TEST.)
6. Engine flywheel.	Fast idle rpm at correct specification.	Adjust fast idle. (See procedure in ENGINE section.)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HYDRAULIC DRIVE SYSTEM OPERATES ERRATICALLY

Test Conditions:

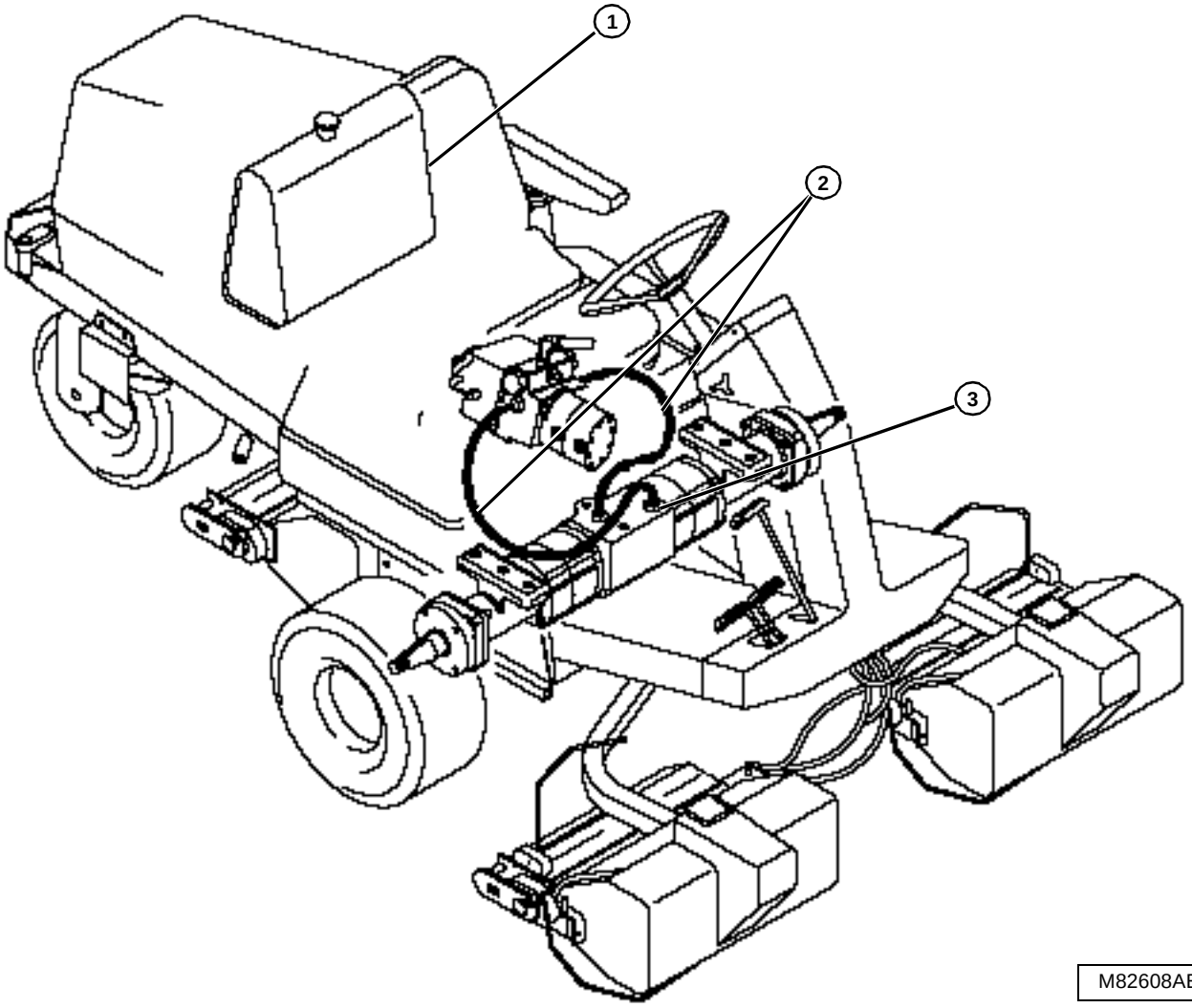
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)
	Hydraulic oil level at correct level.	Fill to correct level.
2. Pressure hoses from hydrostatic pump to transaxle.	No sharp bends or restrictions.	Replace hoses.

Test Conditions:

- Engine running.
- Forward/Reverse travel pedal depressed.
- Transaxle locked.

Test Location	Normal	If Not Normal
3. Transaxle/ Hydrostatic pump.	Hydrostatic pump relief valve opens at specified pressure.	Test hydrostatic pump relief valve pressure. (See HYDROSTATIC RELIEF VALVE TEST.)



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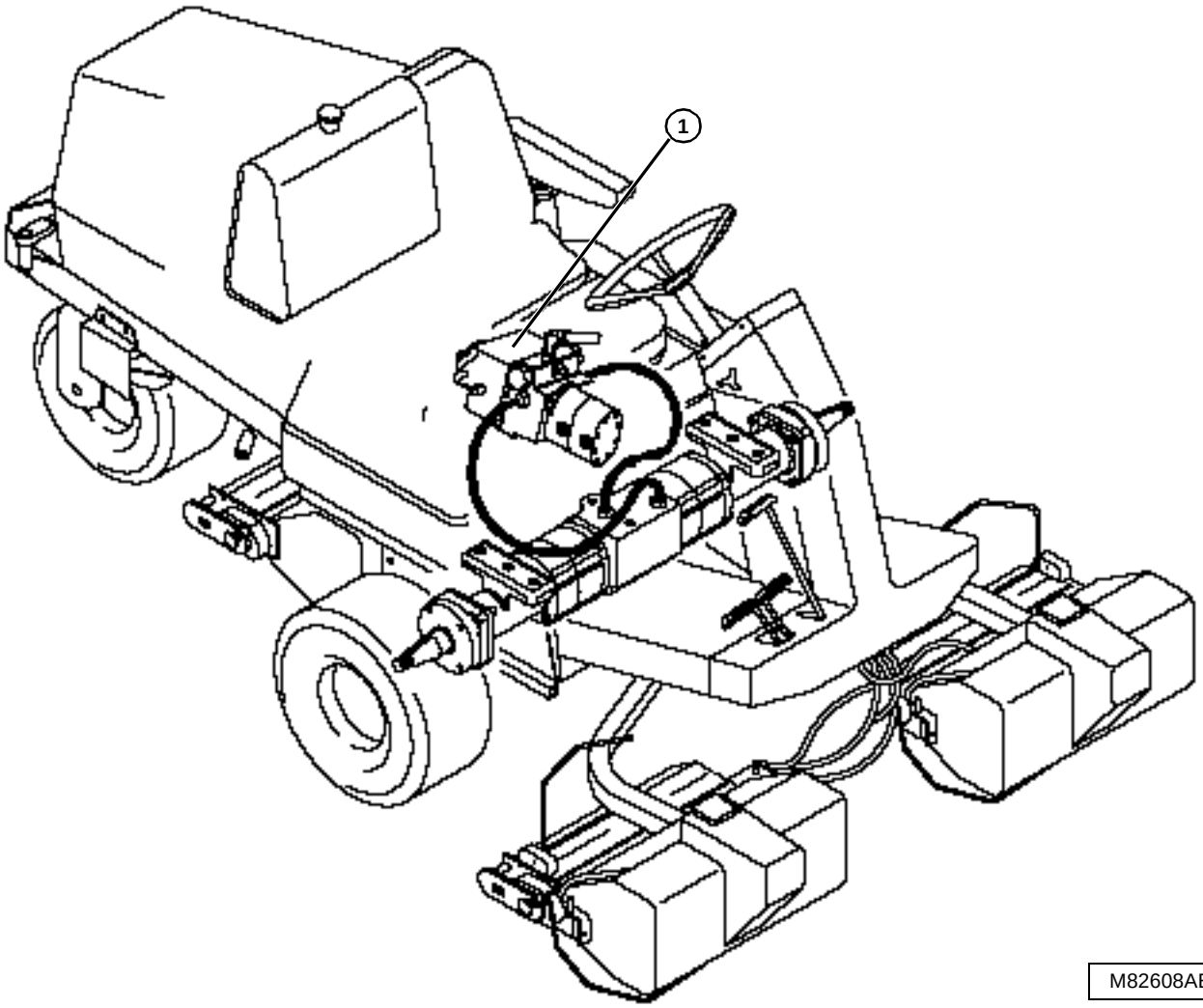
MACHINE MOVES WITH ENGINE RUNNING AND TRAVEL PEDALS IN NEUTRAL

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydrostatic pump.	Control linkage properly adjusted.	Adjust control linkage. (See HYDROSTATIC CONTROL LINKAGE ADJUSTMENT.)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EXCESSIVE HYDROSTATIC PUMP NOISE

Test Conditions:

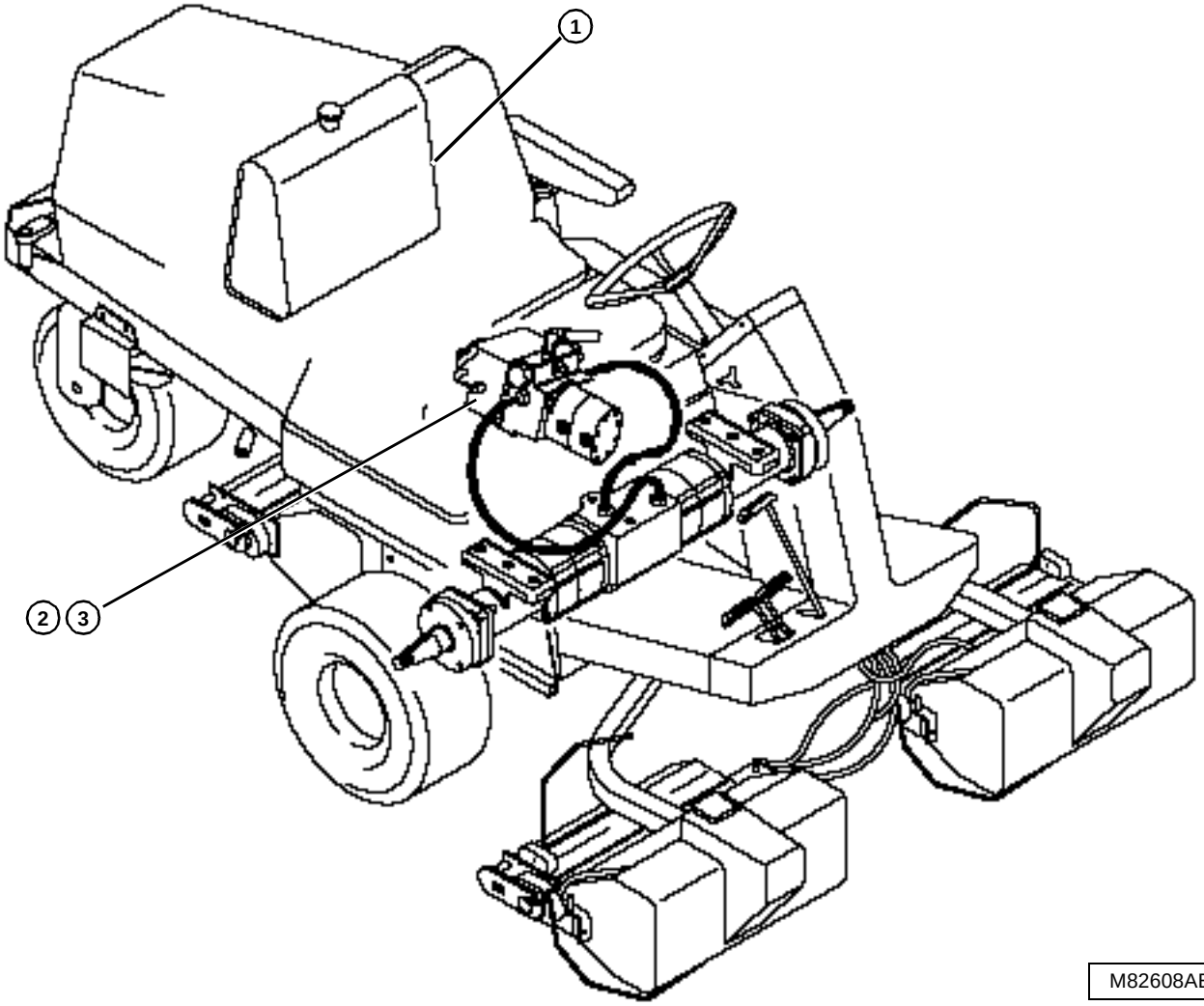
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Hydraulic oil clean and not foamy. (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)
	Hydraulic oil level at correct level.	Fill to correct level with specified oil.
2. Hydrostatic pump.	No internal damage.	Disassemble, inspect, and repair or replace pump as necessary.

Test Conditions:

- Engine running.
- Travel pedals must be in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
3. Hydrostatic pump.	Charge pressure at correct specification.	Test hydrostatic pump charge pressure. (See HYDROSTATIC PUMP CHARGE PRESSURE TEST.)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FREQUENT FAILURE OF HYDRAULIC HOSES AND O-RINGS

Test Conditions:

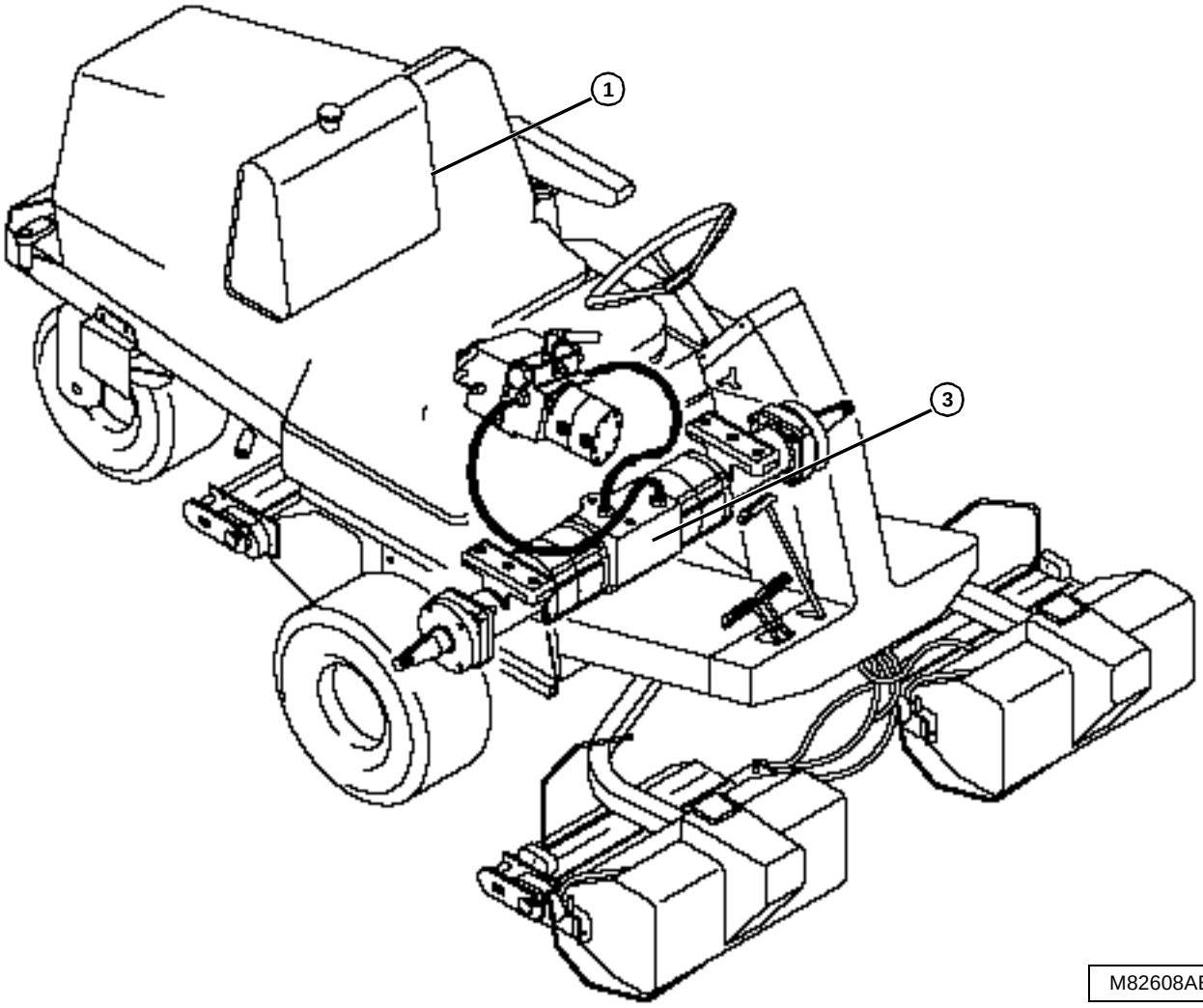
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir .	Oil clean and free of contamination.	Drain hydraulic system and fill to correct level with specified oil.
2. Hydraulic connections.	Connection tightened to correct specifications.	Tighten connections to specifications.

Test Conditions:

- Engine running.
- Forward/Reverse travel pedal depressed.
- Transaxle locked.

Test Location	Normal	If Not Normal
3. Transaxle/ Hydrostatic pump.	Hydrostatic pump relief valve opens at specified pressure.	Test hydrostatic pump relief valve pressure. (See HYDROSTATIC RELIEF VALVE TEST.)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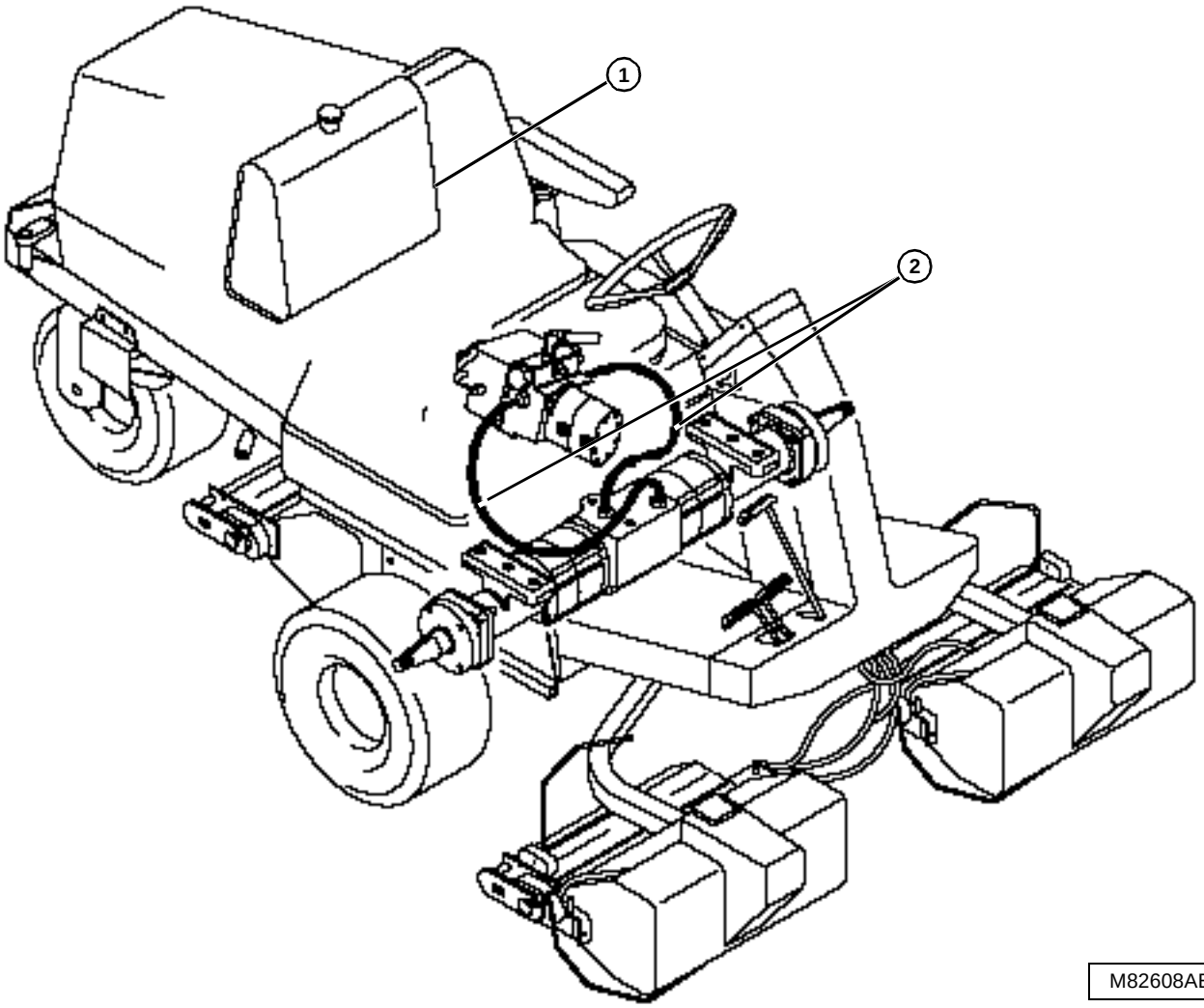
HYDRAULIC OIL FOAMS

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 procedure in HYDRAULICS section.)
2. Hydraulic pressure hoses.	No sharp bends or restrictions.	Replace hoses.
3. Hydraulic suction hoses.	No air leaks.	Replace hoses.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HYDROSTATIC PUMP CHARGE PRESSURE TEST

Reason:

To verify that the hydrostatic pump charge pressure is within specification.

Test Equipment:

A— JT07038 0 to 2000 kPa (300 psi) Pressure Gauge
B— RE48122 Diagnostic Coupler *
C— AMT846 Hydraulic Diagnostic Hose *
D— RE43774 1/2" tube x 1/8" body Diagnostic Receptacle *
E— XPD6-285 Dust Cap *
F— 38H1031 3/16 M x 13/16 F Swivel Run Tee *

* Included in BM18290 Diagnostic Kit.

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.

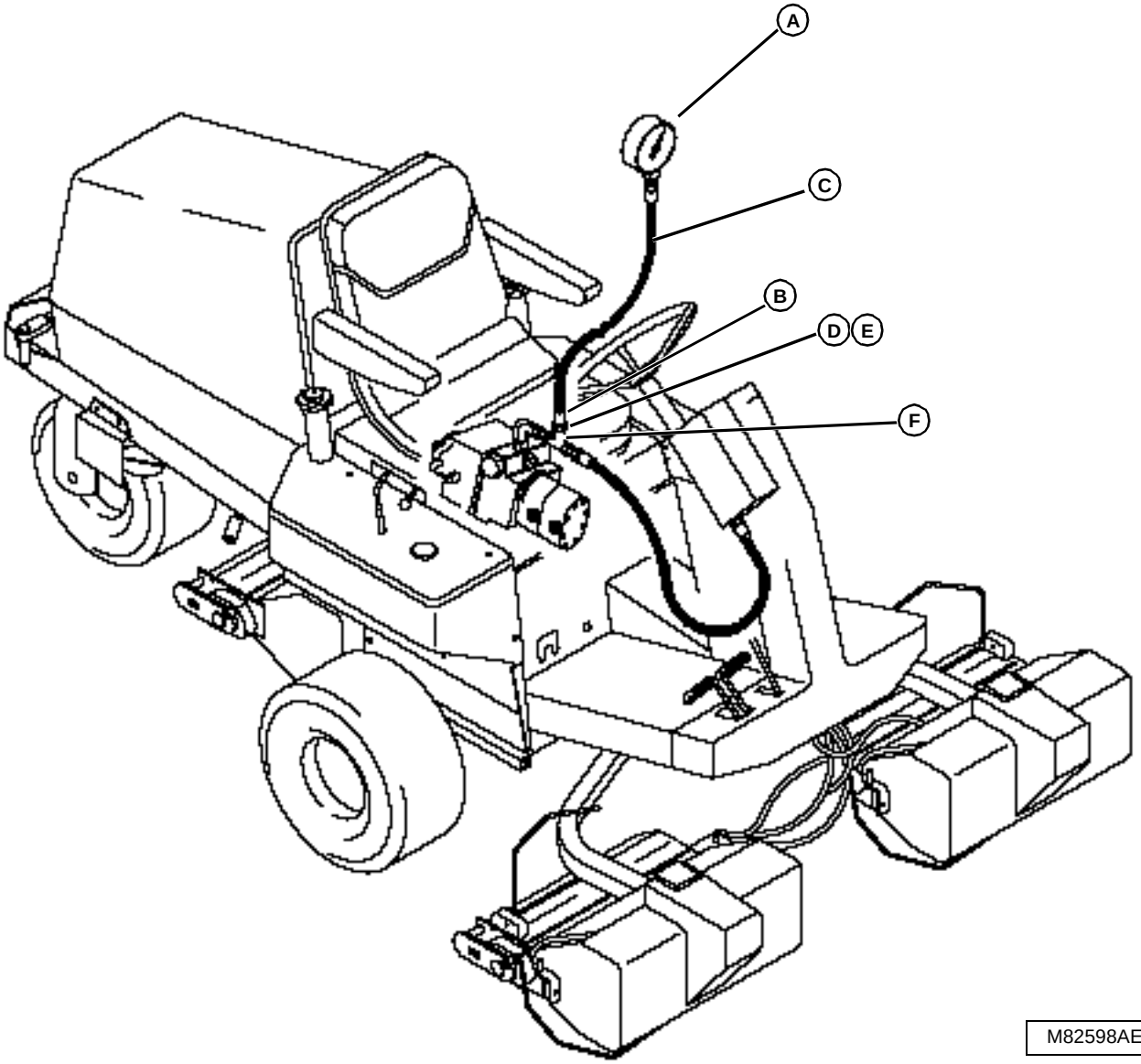
NOTE: Optional diagnostic kit (part number BM18290) must be installed on the machine to perform this test.

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. Raise and lock seat platform.
7. Disconnect hose from connector at hydrostatic pump port "E".
8. Install swivel tee (F), dust cap (E), and diagnostic receptacle (D) between connector on transaxle and hose.
9. Connect hydraulic diagnostic hose (C) and diagnostic coupler (C) to pressure gauge (A).
10. Connect pressure gauge assembly to diagnostic receptacle (ports A or D).
11. Start engine and run at **fast idle (2975 ± 75 rpm)**.
12. Position steering wheel in straight ahead position.
13. Check pressure gauge reading, gauge should read **620—1240 kPa (90—180 psi)**.

Results:

If pressure is below specification:

- Check suction hose for obstruction.
- Check hydraulic pump oil flow/pressure. (See HYDRAULIC PUMP OIL FLOW TEST.)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HYDROSTATIC PUMP RELIEF VALVE TEST

Reason:

To verify that the hydrostatic pump relief valves open at the specified pressure.

Test Equipment:

A— JT05637 0 to 40,000 kPa (6000 psi) Pressure Gauge
B— RE48122 Diagnostic Coupler *
C— AMT846 Hydraulic Diagnostic Hose *
D— RE43774 1/2" tube x 1/8" body Diagnostic Receptacle (2) *
E— XPD6-285 Dust Cap (2) *
F— 38H1032 1 M x 1 F Swivel Run Tee (2) *
G— DFMX2A Fabricated Wheel Stop
H— Jack stand (2)

* Included in BM18290 Diagnostic Kit.

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.

NOTE: Optional diagnostic kit (part number BM18290) must be installed on the machine to perform this test.

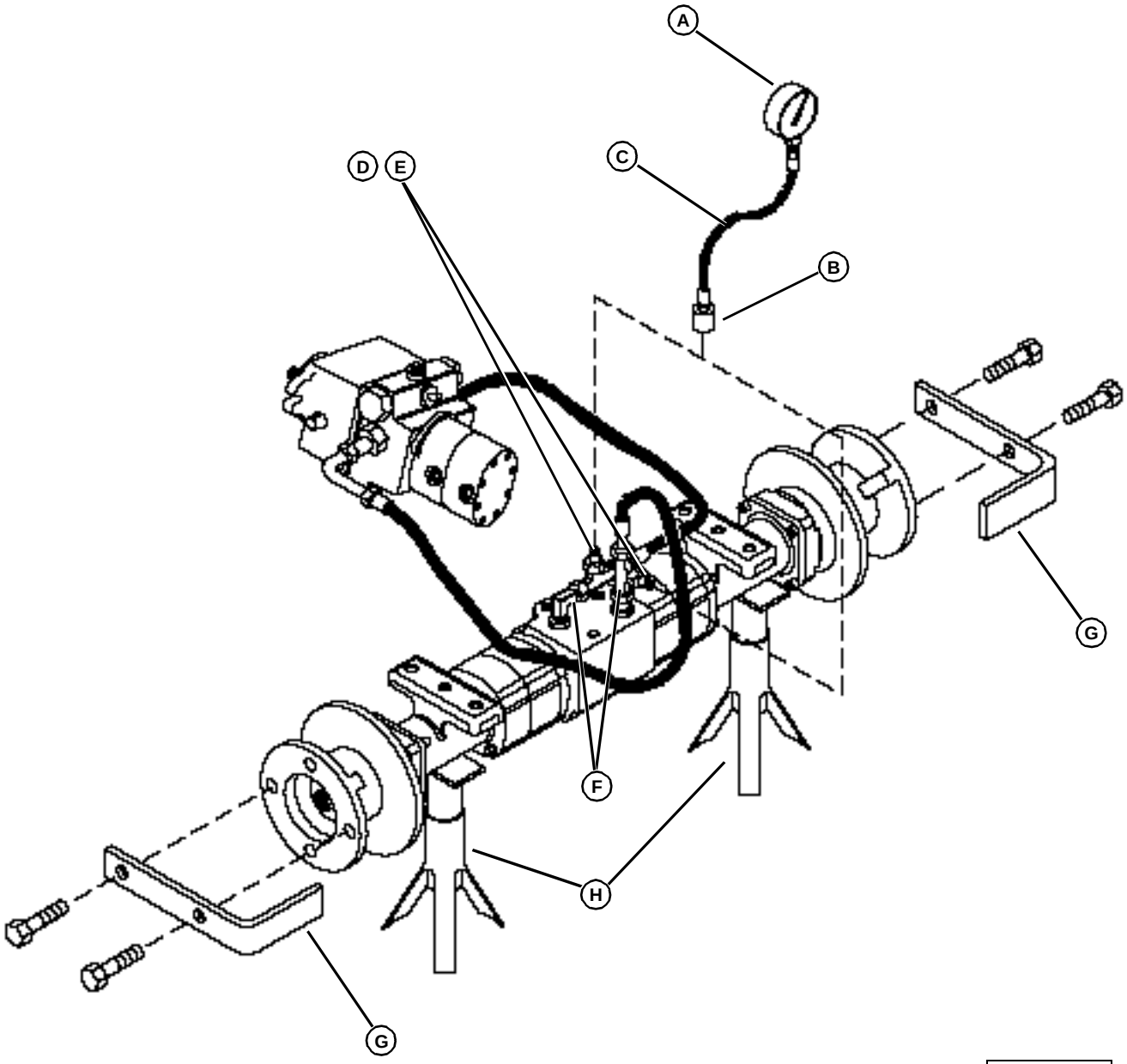
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Raise and lock seat platform.
7. Disconnect hose from connectors at transaxle ports (A and D).
8. Install swivel tee (F), dust cap (E), and diagnostic receptacle (D) between connectors on transaxle and hoses.
9. Lift machine high enough to remove weight from wheel. Place jack stand under transaxle.
10. Remove both drive wheels.
11. Install DFMX2A Wheel Stops.
12. Connect hydraulic diagnostic hose (C) and diagnostic coupler (C) to pressure gauge (A).
13. Connect pressure gauge assembly to diagnostic receptacle(Port A—Forward or Port D—Reverse).

NOTE: Test should be performed with transmission in each direction.

14. Start engine and allow it to reach normal operating temperature.
15. Run engine at **fast idle (2975 ± 75rpm)**.
16. Slowly depress forward travel pedal to advance wheel stops against frame. Depress travel pedal fully (repeat test procedure with reverse travel pedal depressed).
17. Check pressure gauge reading, the relief valve should open at **2413 kPa (3500 psi)**.

Results:

- If relief valves open below specified pressure, or do not open at all, replace relief valves and/or relief valve springs.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HYDROSTATIC CONTROL LINKAGE ADJUSTMENT

Reason:

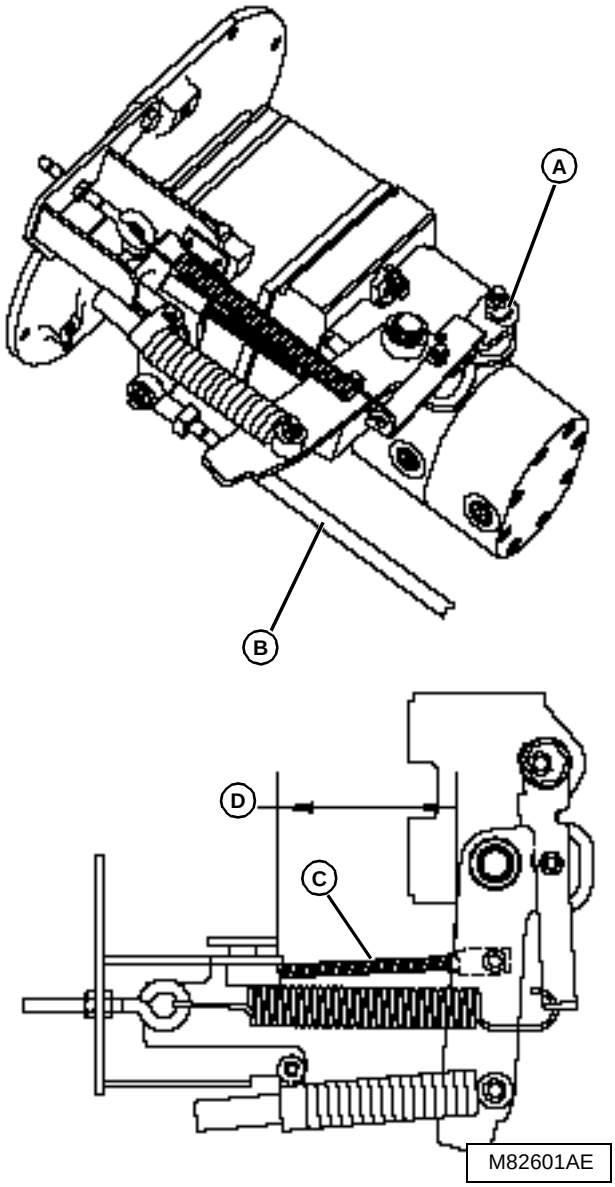
If the mower creeps forward or backward with travel pedals in neutral position, parking brake released, and the engine running, the control linkage must be adjusted.

Procedure:

1. Park machine on level surface.
2. Move 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. Lift machine high enough to remove lift drive wheels off floor. Place jack stands under transaxle.
8. Start engine and run at **slow idle (1400 ± 75 rpm)**.

*NOTE: Verify length of neutral control rod (C). The assembly should be adjusted initially to **110 mm (4.331 in.)** (D).*

9. Loosen jam nut slightly and turn eccentric cam (A) to stop wheel rotation:
   - Turn clockwise to stop forward creep.
   - Turn counter-clockwise to stop reverse creep.
10. Tighten jam nut.
11. Verify neutral setting by moving and releasing the forward and reverse pedals. If forward or reverse creep cannot be stopped by adjusting eccentric cam, reset neutral control rod.
    - If wheel continues to creep forward, lengthen neutral control rod by 2 mm (2 turns).
    - If wheel continues to creep in reverse, shorten neutral control rod by 2 mm (2 turns).
12. Adjust length of hydrostatic control rod (B) so that pedals line up when transmission is in neutral position.
13. Adjust travel/neutral switch after adjusting control linkage. (See ELECTRICAL section, Travel/ Neutral Switch Adjustment).



A— Eccentric Cam
B— Hydrostatic Control Rod
C— Neutral Control Rod
D— Neutral Control Rod Initial Adjustment 110 mm (4.331 in.)

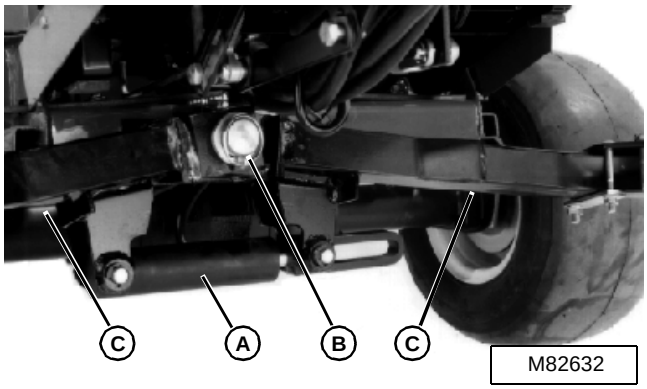
TRANSAXLE

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. Remove seat platform. (See procedure in MISCELLANEOUS section.)
6. Remove battery.
7. Remove reel motors by removing two flanged bolts from each motor. Attach motors to hooks on front and side of machine.
8. Remove cutting units from lift arms.

NOTE: Do not disconnect hydraulic hoses to front cylinder.

9. Remove front cylinder (A). (See procedure in HYDRAULICS section.) Attach lift cylinder to bottom side of operators platform with tie straps.
10. Remove quick lock pin (B) and washers. Slide front lift arms (C) from machine.

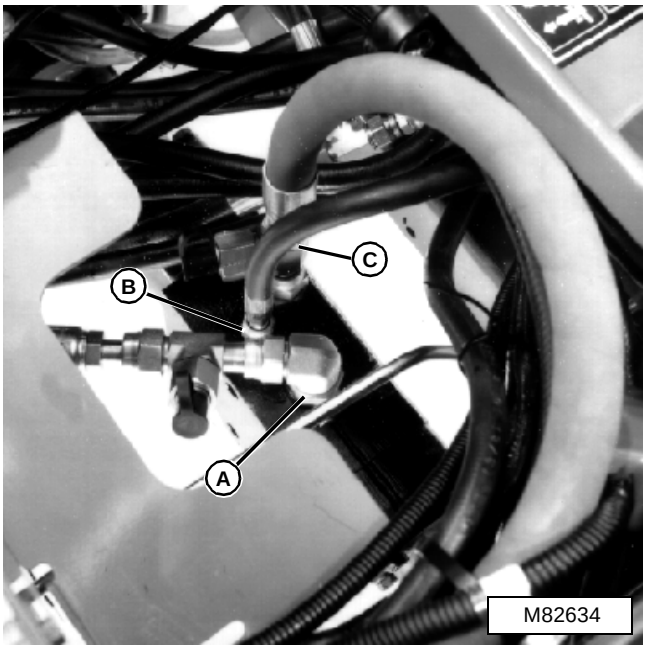


c CAUTION y

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.

11. Disconnect hydraulic hoses (A, B and C).

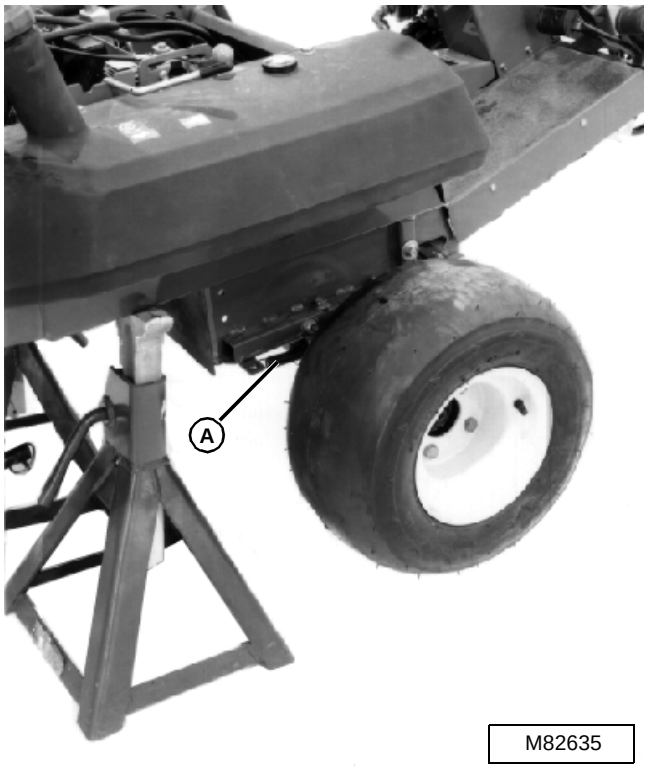


A— Hose, Transaxle Port A-to-Hydrostatic Pump Port C
B— Hose, Transaxle Port T-to-Reservoir
C— Hose, Transaxle Port D-to-Hydrostatic Pump Port D

NOTE: Front tires must be at least 76 mm (3 in.) off the ground.

12. Lift and support machine with jackstands as shown.

13. Remove brake return springs (A) and washers from each side of machine.



M82635

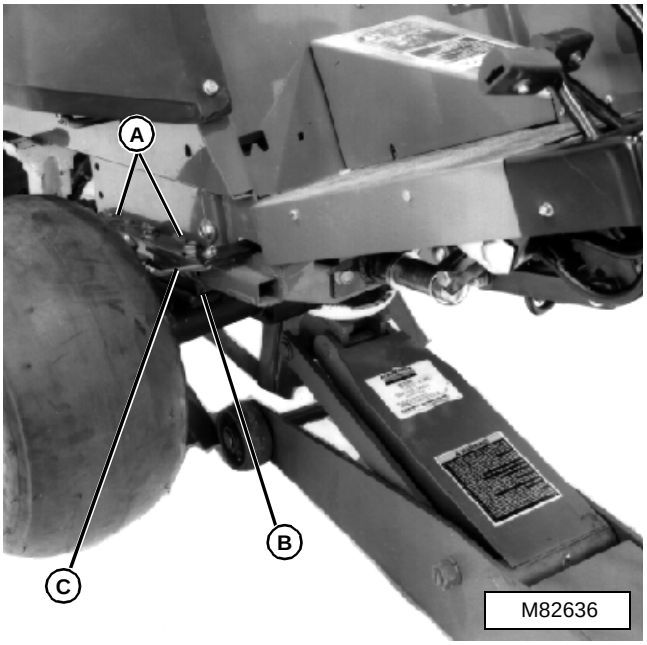
C CAUTION

Approximate weight of transaxle and wheels is 36.3 kg (95 lbs).

14. Remove cotter pin, washer and outer brake rod (C) from each side of machine.

15. Support transaxle with floor jack.

16. Remove two mounting cap screws and nuts (A) and spacers (B) from each side of machine.



M82636

17. Lower transaxle to ground and roll away from frame.

18. Remove wheels and brake assemblies if transaxle is in need of repair. (See procedure in BRAKES section.)

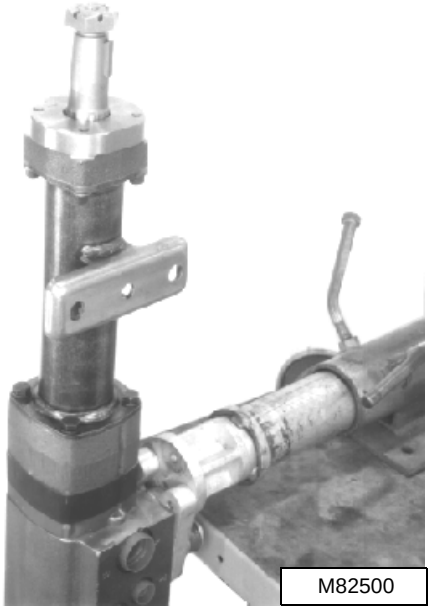
M82637

Installation is done in the reverse order of removal.

- Tighten transaxle mounting cap screws to **95 N•m (70 lb-ft)**.
- Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See SPECIFICATIONS AND GENERAL INFORMATION section.)
- Bleed hydraulic system. (See procedure in HYDRAULICS section.)
- Adjust brake linkage. (See procedure in BRAKES section.)

Disassembly/Inspection

1. Support transaxle in a vice or rollover stand so end to be worked on is up.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2. Remove slotted nut (A) and key (H).
3. Remove four socket head cap screws (O) and end cap (B).

IMPORTANT: Replace all seals and O-rings. Damaged or used parts will leak.

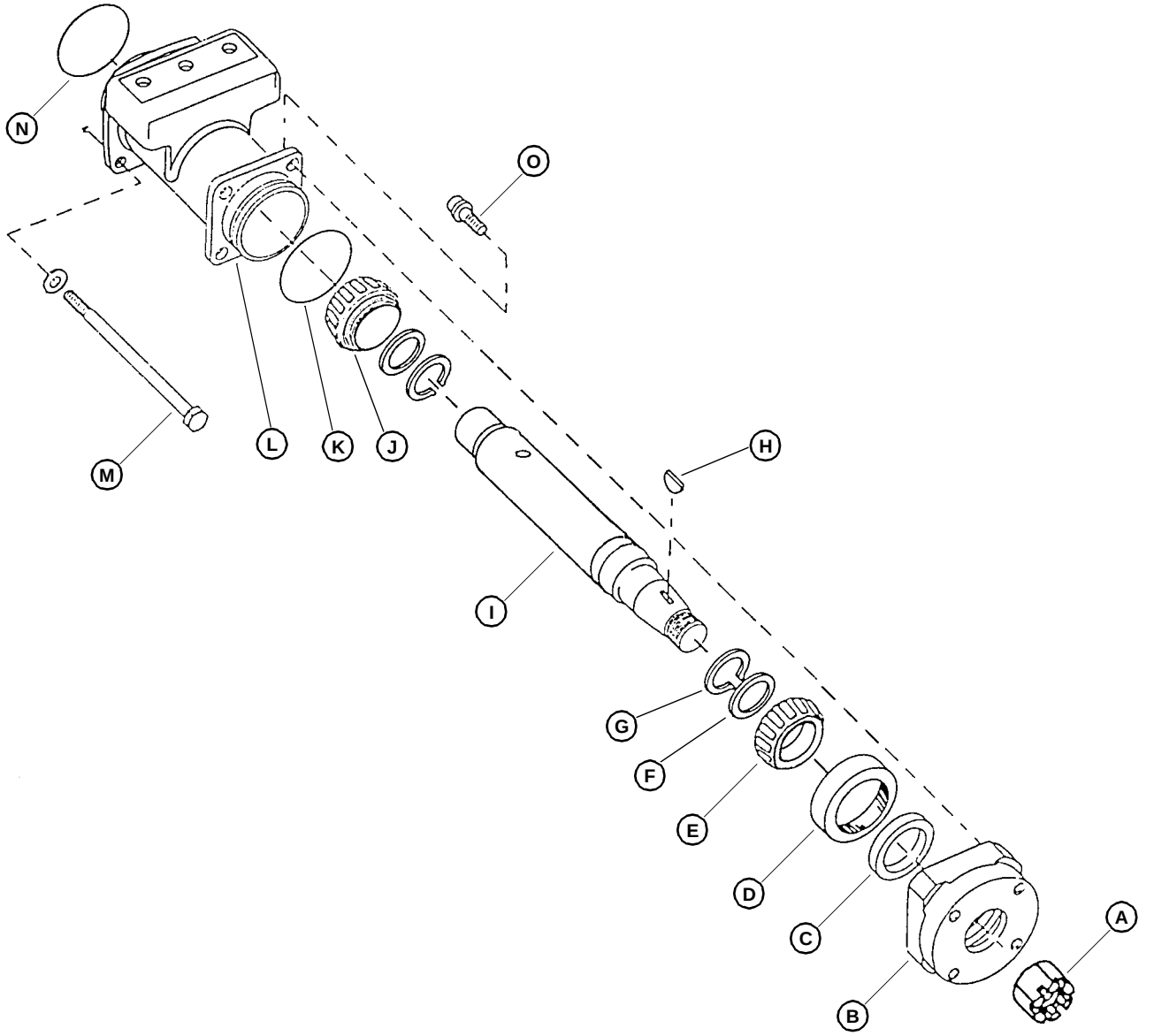
4. Pry out exclusion seal (C).
5. Remove axle shaft and bearing assembly from axle housing.

NOTE: Bearing cup (D) is press fit in end cap. Remove cup only if replacement is necessary.

Bearing cones (E and J) are press fit on axle shaft (I).

IMPORTANT: If either bearing cups or cones are worn or damaged, both parts must be replaced as a matched set.

6. Inspect bearing cup (D) for wear or damage. Remove cup using a driver set.
7. Remove bearing cones (E and J) using a bearing puller.
8. Remove spacers (F) and snap rings (G).
9. Remove four cap screws (L) and washers.
10. Remove axle housing (M).
11. Remove O-rings (K and N).

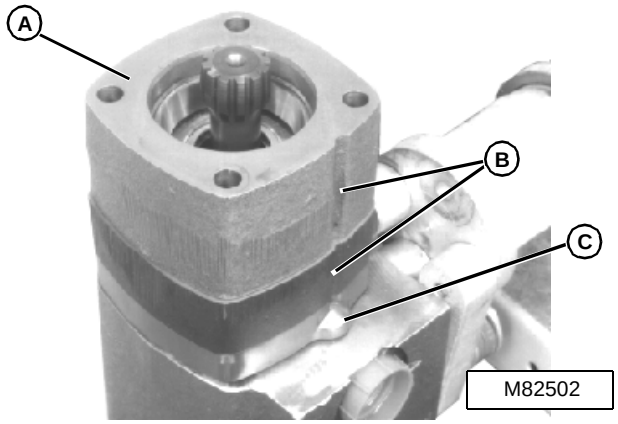


A— Slotted Nut
B— End Cap
C— Exclusion Seal
D— Bearing Cup
E— Bearing Cone
F— Spacer (2 used)
G— Snap Ring (2 used)
H— Key
I— Axle Shaft
J— Bearing Cone
K— O-Ring
L— Cap Screw (4 used)
M— Axle Housing
N— O-Ring
O— Socket Head Cap Screw (4 used)

NOTE: Note position of alignment grooves (B) and tab (C) to aid in assembly. It may be helpful to label individual sections in the order they are removed.

IMPORTANT: Be careful not to damage machined surfaces on valve parts. Scratched or nicked surfaces can cause early transaxle failure.

12. Remove wear plate (A).



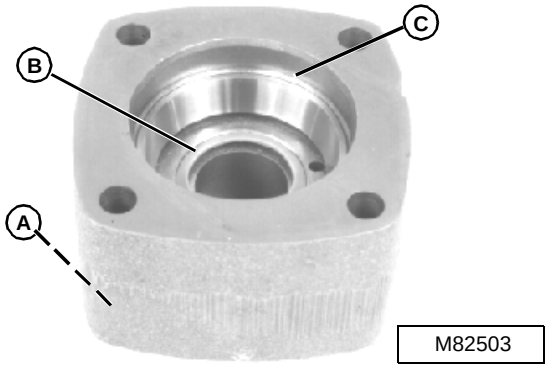
13. Remove shaft seal (B).

NOTE: Bearing cup (C) is press fit in wear plate. Remove cup only if replacement is necessary.

IMPORTANT: If either bearing cup or cone is worn or damaged, both parts must be replaced as a matched set.

14. Inspect bearing cup (C) for wear or damage. Remove cup using a puller set.

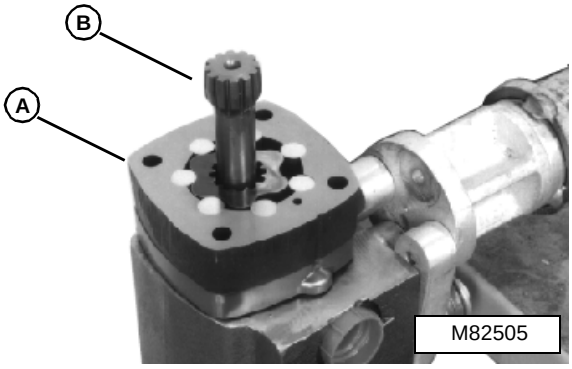
15. Turn wear plate over and remove square cut seal (A).



IMPORTANT: Rolls and star are loose in Geroler assembly. Parts will separate and fall out if care is not taken during removal.

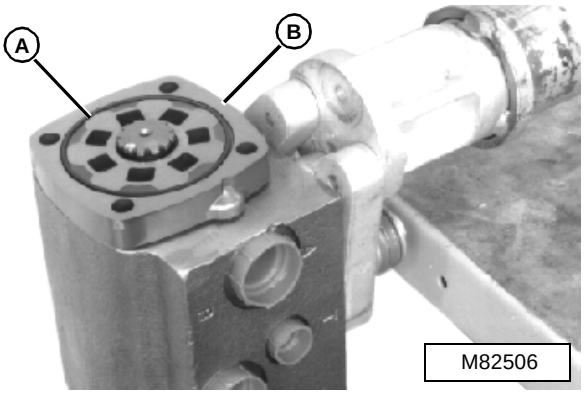
16. Remove drive shaft (B).

17. Remove Geroler assembly (A), making sure rolls and star are kept intact.



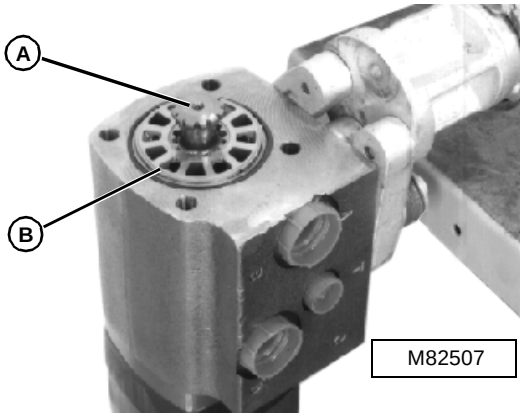
18. Remove square cut seal (A).

19. Remove valve plate (B).

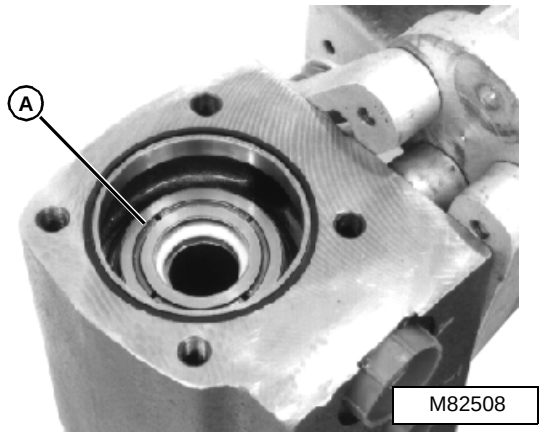


20. Remove valve drive (A).

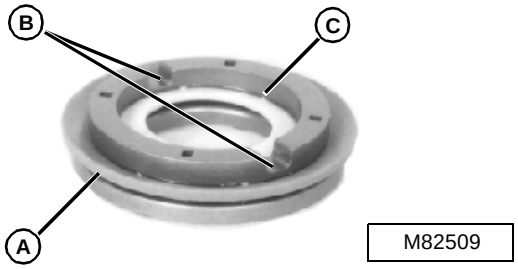
21. Remove valve (B).



22. Remove balance ring assembly (A).

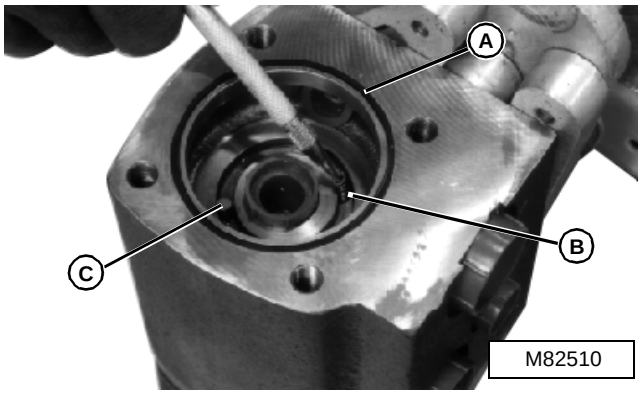


23. Position balance ring assembly so pin grooves (B) are up. Remove inner and outer face seals (C and A).



IMPORTANT: Install plugs into passages of manifold to prevent pins or springs from falling into openings.

24. Install plugs in manifold passages.
25. Remove pins (C).
26. Use a pencil or sharp pointed tool to remove springs (B).
27. Remove square cut seal (A).



28. Repeat steps 1 through 27 for opposite side.

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.

29. Clean all metal parts with solvent and blow-dry with compressed air.
30. Inspect all parts for damage, nicks, or unusual wear patterns. Replace parts as necessary.

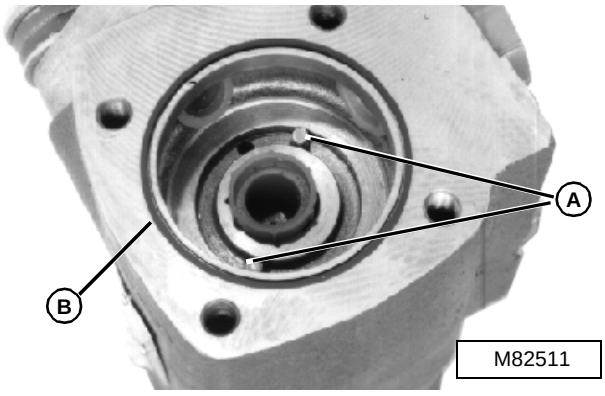
Assembly

IMPORTANT: Always use new seals and O-rings. Damaged or used parts will leak.

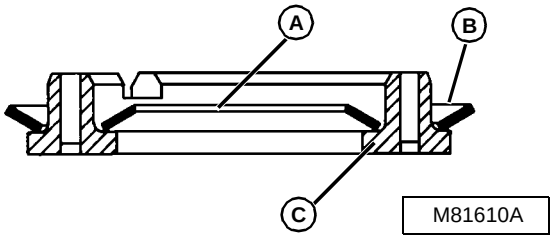
NOTE: Lubricate all seals and O-rings with petroleum jelly during assembly.

Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.

1. Support transaxle in a vice or rollover stand so end to be worked on is up.
2. Apply petroleum jelly on springs and pins (A) to hold in place. Install springs and pins in bores in manifold. Remove plugs from manifold passages.
3. Install new square cut seal (B).

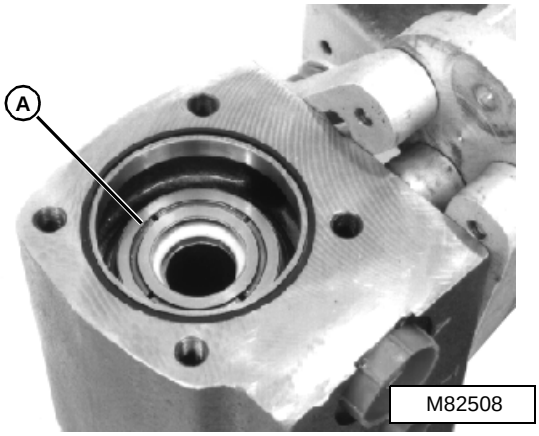


4. Apply petroleum jelly on new inner and outer face seals (A and B). Install seals on balance ring (C) as shown.



5. Align pin notches in balance ring with pins in manifold. Install balance ring assembly (A).

NOTE: When properly installed, balance ring should be centered in bore, have spring resistance felt when pushed down and should not rotate.



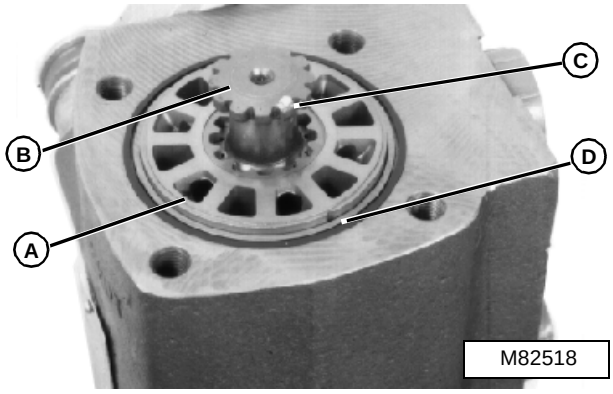
IMPORTANT: Motor axles must be timed correctly for proper machine travel. Follow steps 6 through 12 closely.

6. Install valve (A) with splined side up.

*NOTE: When properly installed, valve should extend above manifold approximately **3 mm (0.125 in.)** and have spring resistance felt when pushed down.*

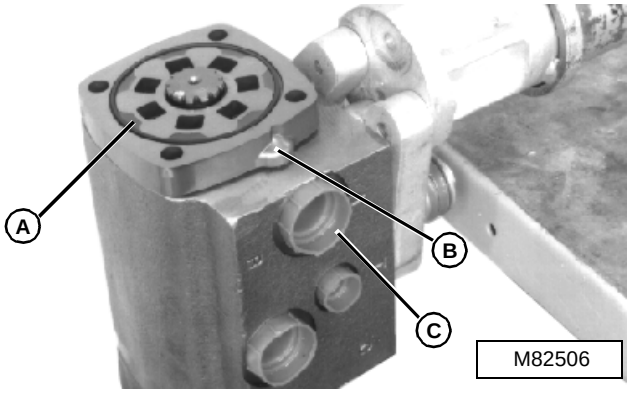
7. Put a mark (C) on one tooth of valve drive (B).

8. Align marked tooth with either of the two timing grooves (D) on outside diameter of valve. Install valve drive.



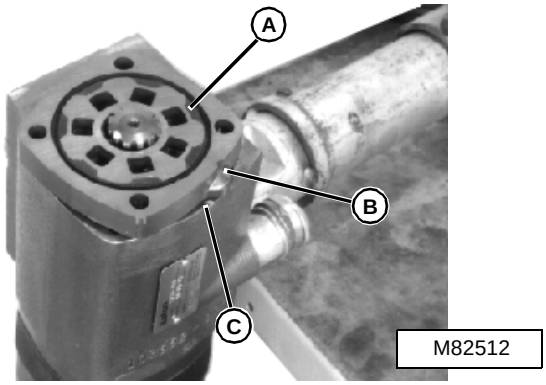
A— Valve
B— Valve Drive
C— Mark
D— Timing Groove

9. Right side axle motor assembly; Align tab (B) on valve plate with manifold port “A” (C). Install valve plate.



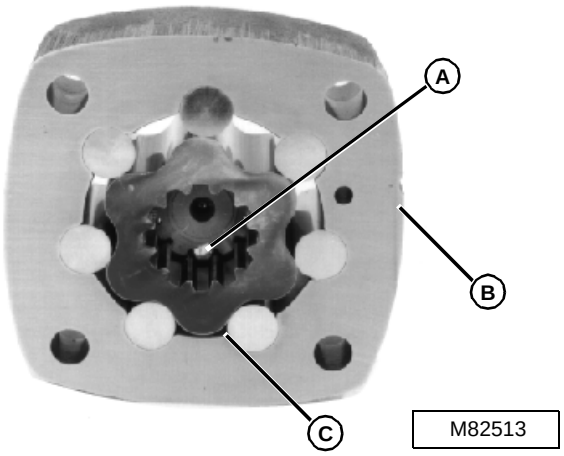
Left side axle motor assembly; Align tab (B) on valve plate with groove (C) on manifold. Install valve plate.

10. Install new square cut seal (A).



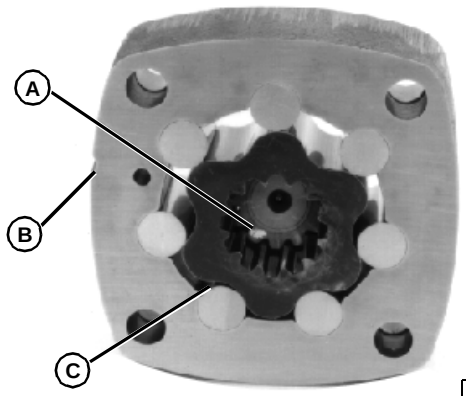
11. Install Geroler assembly as follows:

    - Right side axle motor; Align groove (B) on Geroler assembly with tab on valve plate and align valve drive marked tooth (A) with Geroler star point (C). Install Geroler assembly.



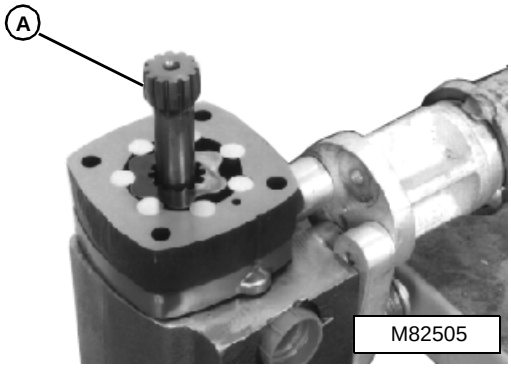
M82513

    - Left side axle motor; Align groove (B) on Geroler assembly with tab on valve plate and align valve drive marked tooth (A) with Geroler star valley (C).



M82514

12. Install drive shaft (A).

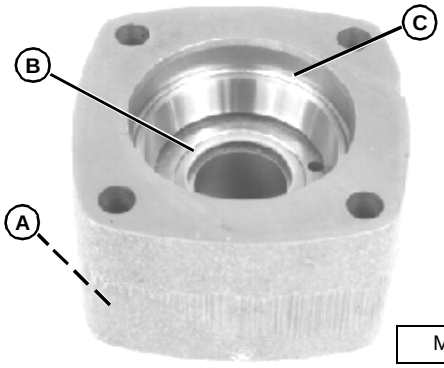


M82505

13. If removed, press bearing cup (C) into bore of wear plate. Press cup to bottom of bore.

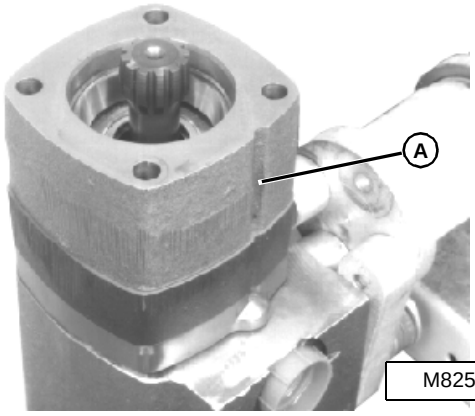
14. Install shaft seal (B) with inside lip facing toward bearing cup.

15. Install new square cut seal (A).



M82503

16. Align groove (A) on wear plate with groove on Geroler housing. Install wear plate.

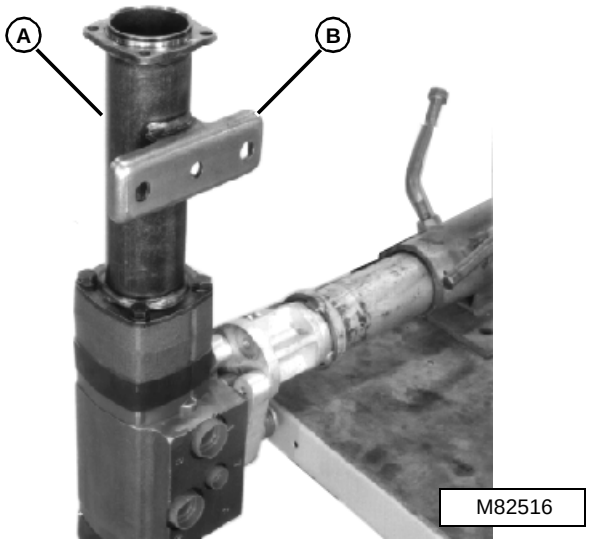


M82502

17. Install new O-rings (A) on axle housing.

M82515

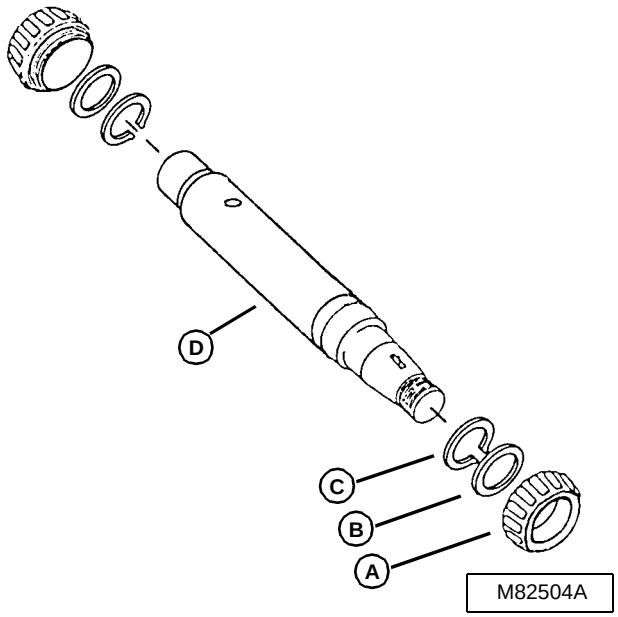
18. Install axle housing (A) with mounting pad (B) on same side as manifold ports. Install four washers and cap screws. Tighten cap screws to **60 N•m (44 lb-ft)**.



19. Install snap rings (C) and spacers (B).

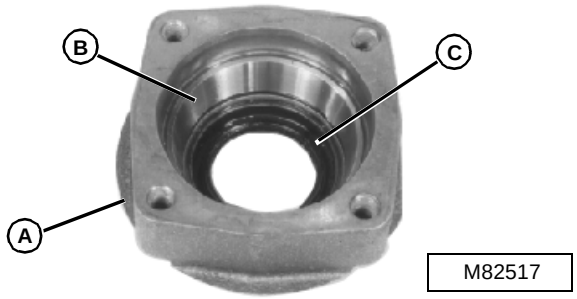
20. Press bearing cones (A) onto axle shaft (D). Install bearing cones tight against spacers.

21. Install axle shaft and bearing assembly into axle housing.



22. Install new exclusion seal (C) using a seal driver set. Install seal with lips facing away from end cap (A).

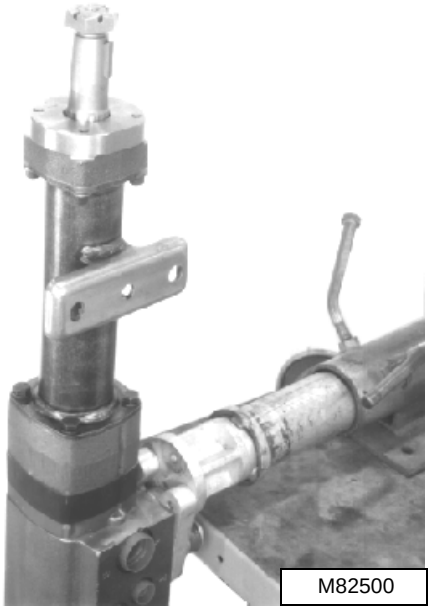
23. If removed, press bearing cup (B) into bore of end cap. Press cup to bottom of bore.



IMPORTANT: Put tape around end of axle shaft to prevent cutting seal. Damaged seal will leak.

24. Install end cap and four socket head screws. Tighten screws to **30 N•m (22 lb-ft)**.

25. Install key and slotted nut.



26. Repeat steps 1 through 25 for opposite side.

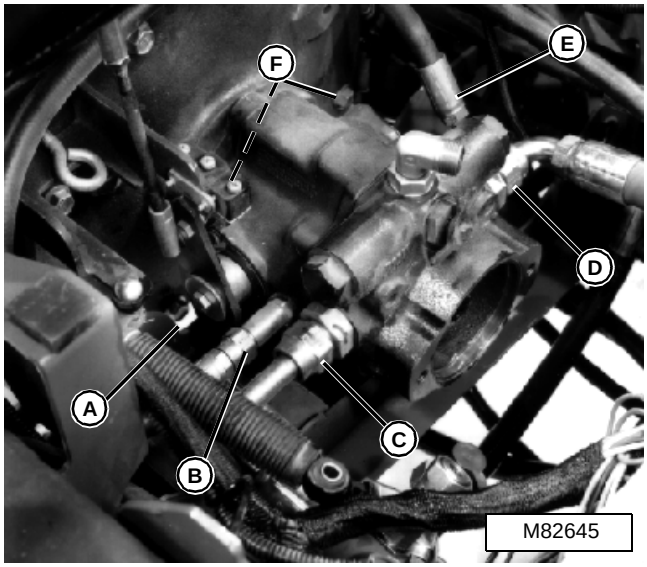
HYDROSTATIC PUMP

Removal/Installation

1. Remove hydraulic pump. (See procedure in HYDRAULICS section.)
2. Remove control arm (A).
3. Disconnect hydraulic hoses (B—E).

IMPORTANT: When separating pump from engine, slide pump slowly away from engine in a straight line. Damage to the flex drive coupler, mounted to engine flywheel, can occur.

4. Remove two mounting cap screws (F). Remove hydrostatic pump.



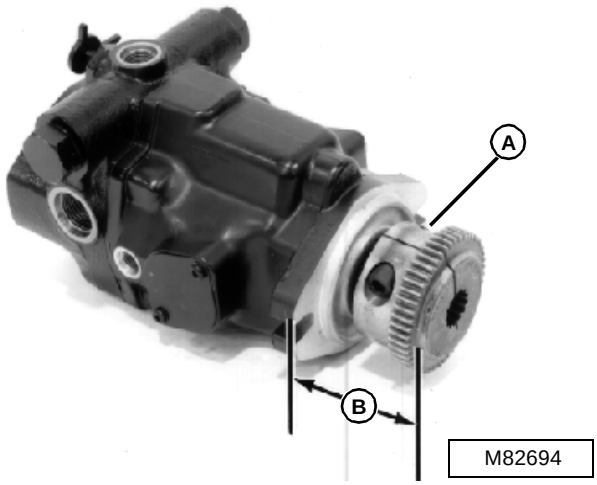
A— Control Arm
B— Hose, Hydrostatic Pump-to-Reservoir
C— Hose, Hydrostatic Pump Port D-to-Transaxle Port D
D— Hose, Hydrostatic Pump Port C-to-Transaxle Port A
E— Hose, Hydrostatic Pump-to-Reservoir
F— Mounting Cap Screws

Installation is done in the reverse order of removal.

- Adjust hydrostatic control linkage.
- Fill hydraulic oil reservoir to proper level with oil meeting specifications. (See SPECIFICATION AND GENERAL INFORMATION section.)
- Bleed hydraulic system. (See procedure in HYDRAULICS section.)

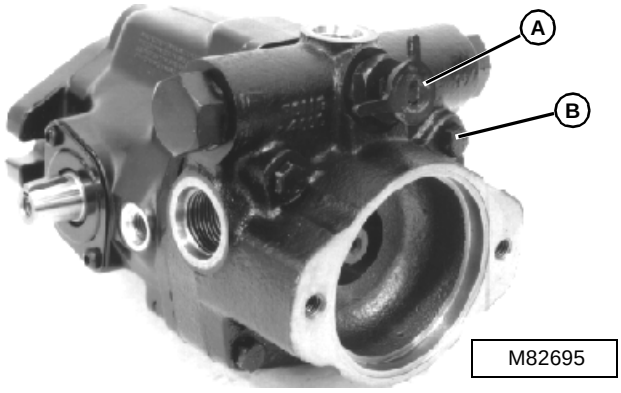
Diassembly/Inspection

1. Thoroughly clean and dry outside of pump.
2. Measure distance (B) between pump mounting flange and end of driven coupler (A) to aid in assembly.
3. Loosen socket head cap screw and remove driven coupler.

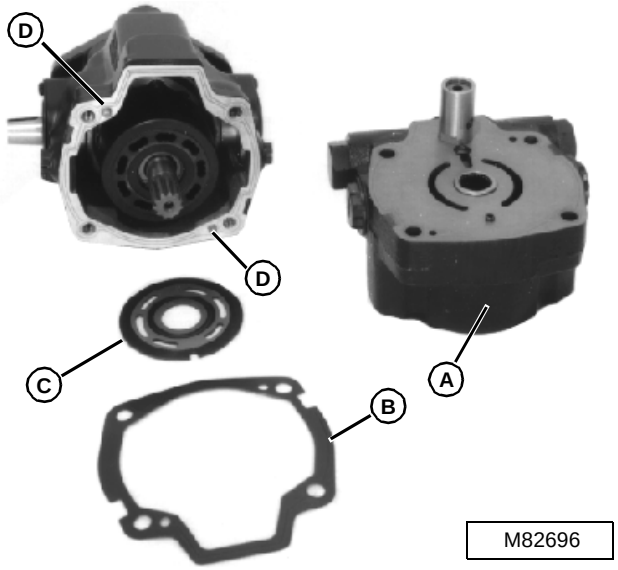


IMPORTANT: Perform all repair procedures with pump in a vise. Clamp across mounting flange only. Excessive clamping pressure on pump housing will cause distortion.

4. Put hydrostatic pump in a soft-jawed vise with mounting flange facing down.
5. Remove freewheel lever (A).
6. Remove four cap screws (B).



7. Remove backplate (A). Lift backplate straight up.
8. Remove gasket (B) and valve plate (C).
9. Inspect dowel pins (D) for wear or damage. Replace if necessary.

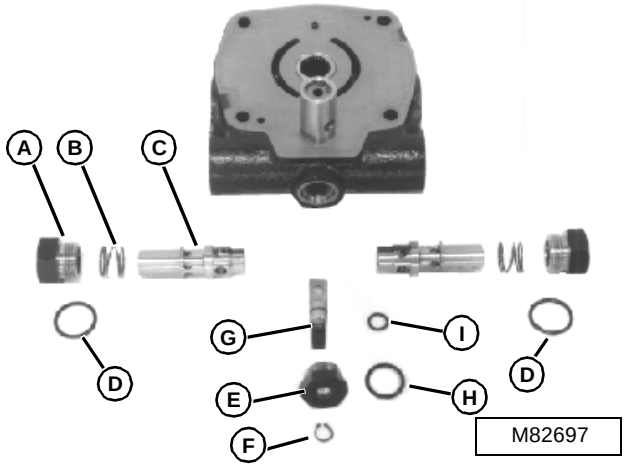


M82696

A— Backplate
B— Gasket
C— Valve Plate
D— Dowel Pins

IMPORTANT: Replace all seals and O-rings. Damaged parts will leak.

10. Mark relief valve assemblies in relation to the ports they are removed from to aid in assembly.
11. Remove parts (A—I).

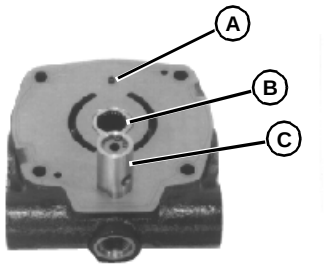


M82697

A— Plug (2 used)
B— Spring (2 used)
C— Relief Valve (2 used)
D— O-Ring (2 used)
E— Plug
F— Snap Ring
G— Freewheel Valve
H— O-Ring
I— O-Ring

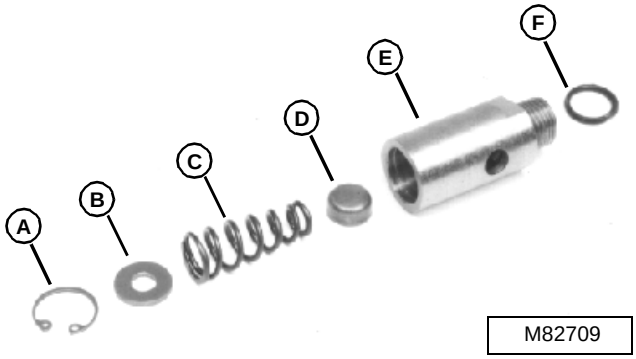
NOTE: Bearing (B) is press fit in backplate. Remove bearing only if replacement is necessary.

12. Inspect bearing (B) for wear or damage. If necessary, remove bearing using a blind-hole puller.
13. Inspect spring pin (A) for wear or damage. Replace if necessary.
14. Remove charge pressure relief valve assembly (C).



M82697

15. Disassemble parts (A—F). Inspect all parts for wear or damage. Replace as necessary.

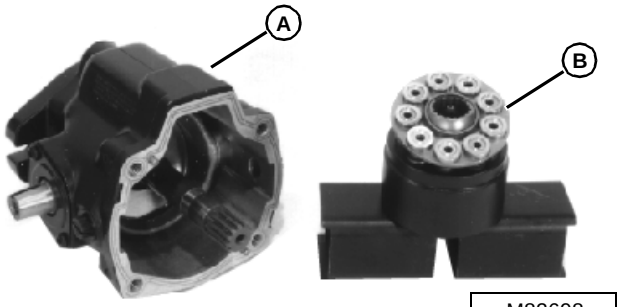


M82709

A— Snap Ring
B— Washer
C— Spring
D— Valve Cap
E— Housing
F— O-Ring

NOTE: A pair of support blocks, for drive shaft clearance, is required for removal of piston block assembly.

16. Remove pump housing from vise.
17. Hold piston block assembly (B) in position and turn housing upside down (mounting flange facing up). Lower housing and piston block assembly onto support blocks. Remove housing and shaft (A) from piston block assembly (B).



M82698

NOTE: Piston block components are not serviceable. Replace complete assembly if any parts are worn or damaged.

18. Remove parts (A, B and C).

C CAUTION

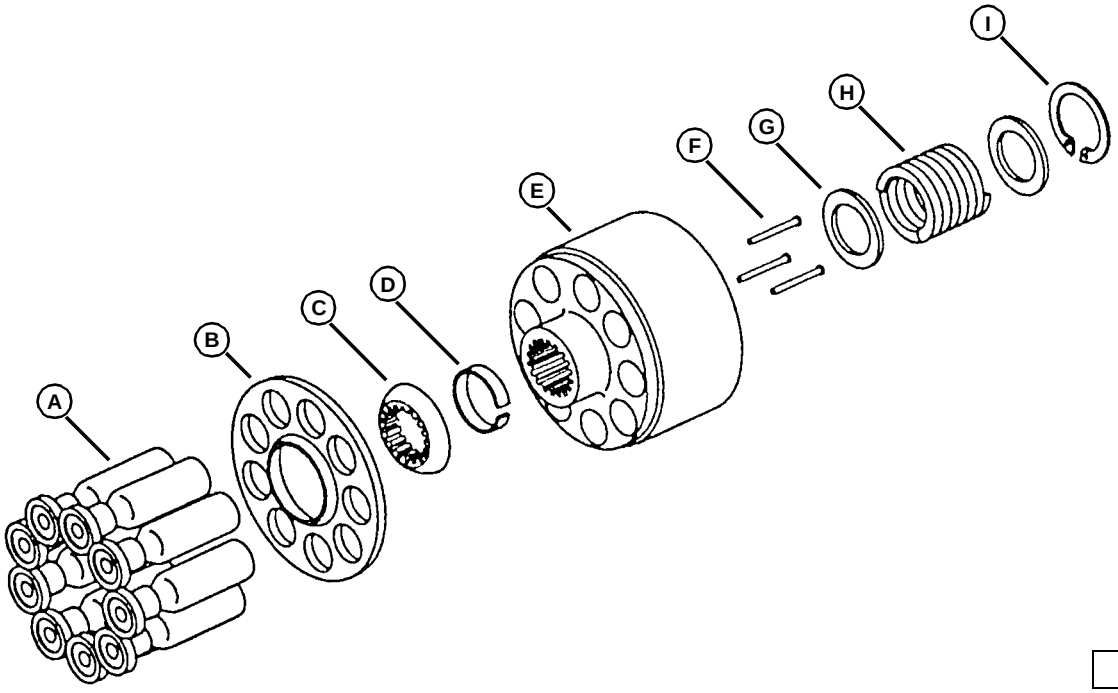
Spring in piston block is highly compressed. Do not disassemble piston block without compressing spring safely. Personal injury may result.

NOTE: The following items are required for disassembly of the piston block: Two flat washers (5/16 ID x 15/16 OD), one 5/16 x 2-7/8 NC cap screw, and one 5/16 NC nut.

19. Place one flat washer over a 5/16 x 2-7/8 in. cap screw and install screw through center of piston block (E). Place second flat washer over end of cap screw so that washer makes contact with three pins (F). Tighten cap screw and nut to compress spring (H). Remove retaining ring (I). Slowly remove nut, cap screw and flat washers. Remove spring (H), washers (G), pins (F) and retainer (D).

20. Inspect all parts for wear or damage. Replace complete piston block assembly if necessary.

A— Pistons (9 used)
B— Retainer
C— Ball Guide
D— Retainer
E— Piston Block
F— Pin (3 used)
G— Washer (2 used)
H— Spring
I— Retaining Ring



M82699A

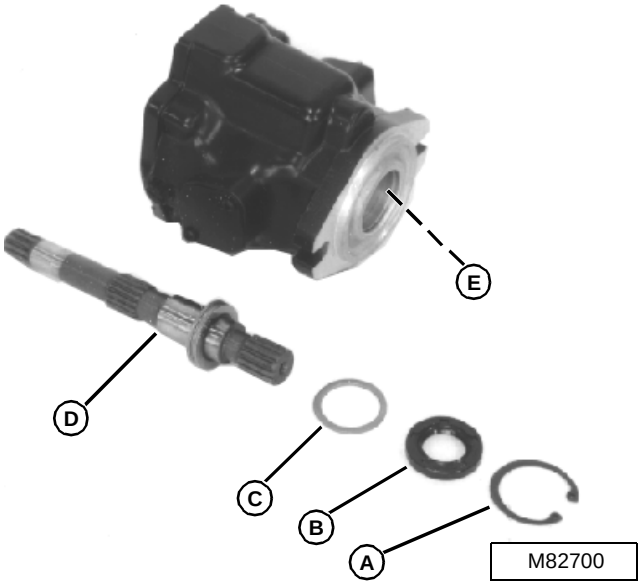
21. Remove snap ring (A).

NOTE: Shaft assembly (D) is press fit in housing.

22. Remove seal (B), washer (C) and shaft assembly (D).

NOTE: Bearing (E) is press fit in housing. Remove bearing only if replacement is necessary.

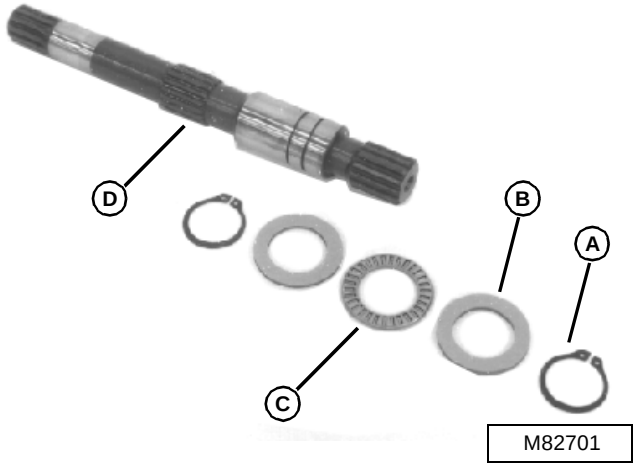
23. Inspect bearing (E) for wear or damage. If necessary, remove bearing using a blind-hole puller.



A— Snap Ring
B— Seal
C— Washer
D— Shaft Assembly
E— Bearing

24. Remove parts (A, B and C).

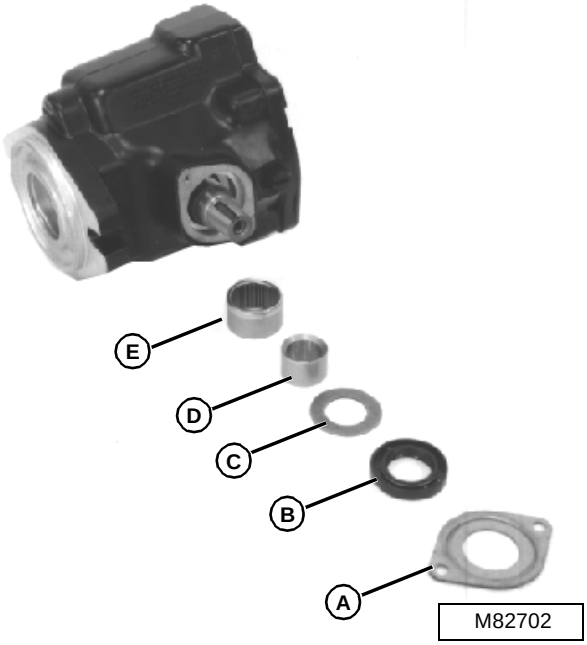
25. Inspect parts for wear or damage. Replace as necessary.



A— Snap Ring (2 used)
B— Washer (2 used)
C— Thrust Bearing
D— Drive Shaft

26. Remove two cap screws and cover (A).

27. Remove seal (B), washer (C), inner race (D) and bearing (E).

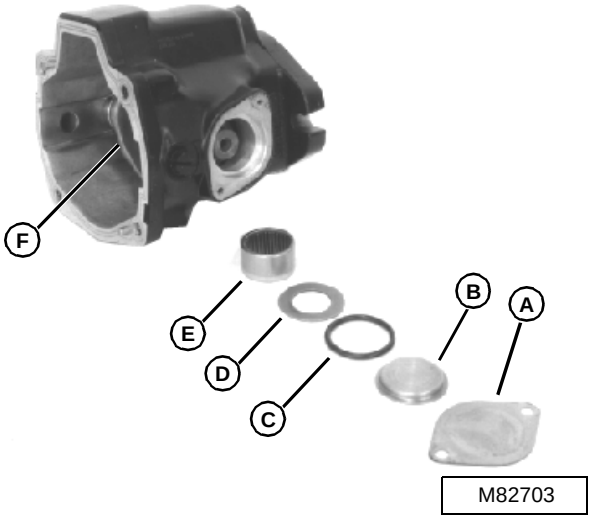


A— Seal Cover
B— B-Seal
C— Washer
D— Inner Race
E— Bearing

28. Remove two cap screws and cover (A).

29. Remove cover (B), O-ring (C), washer (D), and bearing (E).

30. Note position and orientation of camplate in housing to aid in assembly. Remove camplate (F).



A— Trunnion Cover
B— Cover
C— O-Ring
D— Washer
E— Bearing
F— Camplate

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.

31. Clean all metal parts with solvent and blow-dry with compressed air.

32. Inspect all parts for damage, nicks, or unusual wear patterns. Replace 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.

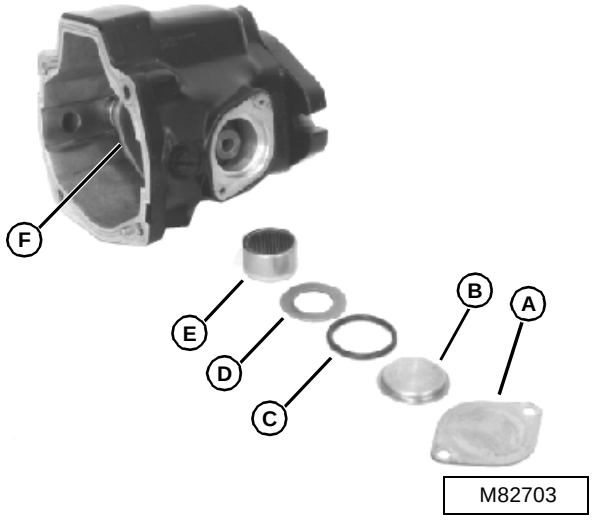
Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.

1. Install camplate (F).

2. Install bearing (E) with numbered end toward housing.

3. Install washer (D), new O-ring (C), and cover (B).

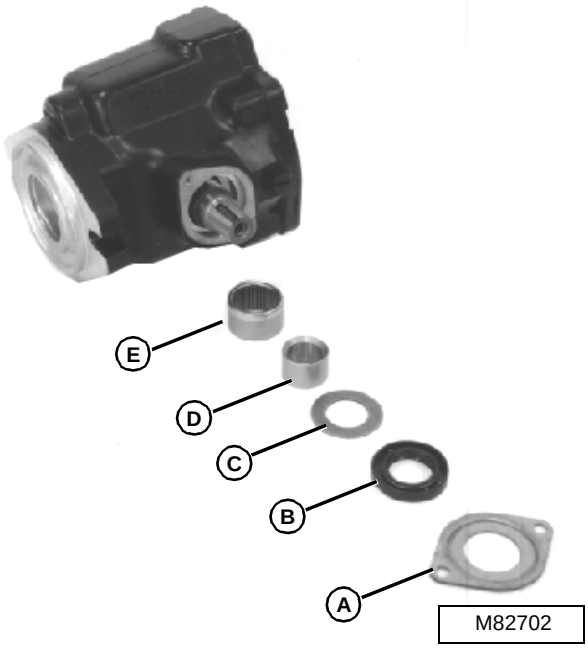
4. Install cover (A) and cap screws. Tighten cap screws to **5 N•m (42 lb-in.)**.



A— Trunnion Cover
B— Cover
C— O-Ring
D— Washer
E— Bearing
F— Camplate

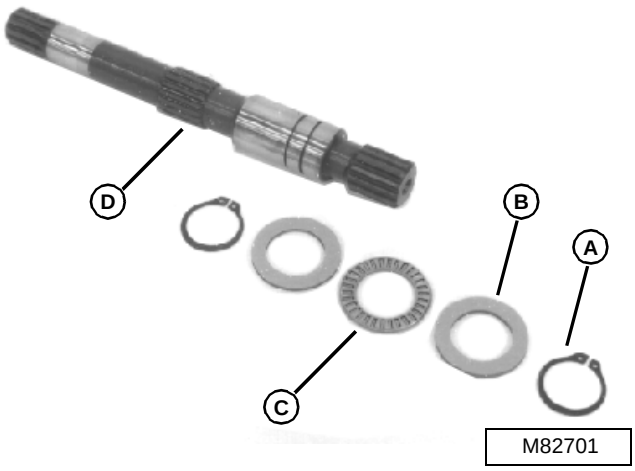
5. Install bearing (E) with numbered end toward housing.

6. Install inner race (D) with chamfer toward housing.
7. Install washer (C) and new seal (B). Install seal with lips toward housing.
8. Install cover (A) and cap screws. Tighten cap screws to **5 N•m (42 lb-in.)**.



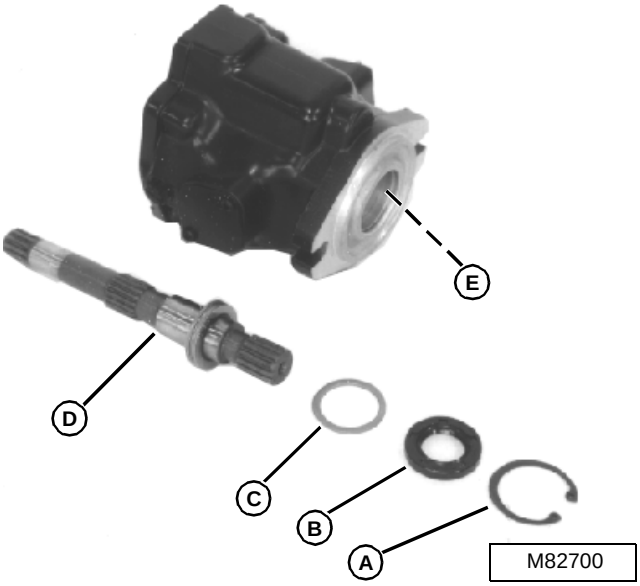
A— Seal Cover
B— Seal
C— Washer
D— Inner Race
E— Bearing

9. Install parts (A, B and C).



A— Snap Ring (2 used)
B— Washer (2 used)
C— Thrust Bearing
D— Drive Shaft

10. If removed, press bearing (E) into housing bore with numbered end facing away from housing. Install bearing until end is **1.78 mm (0.070 in.)** below seal bore.
11. Install shaft assembly (D), washer (C) and new seal (B). Install seal with lips toward housing.
12. Install snap ring (A).

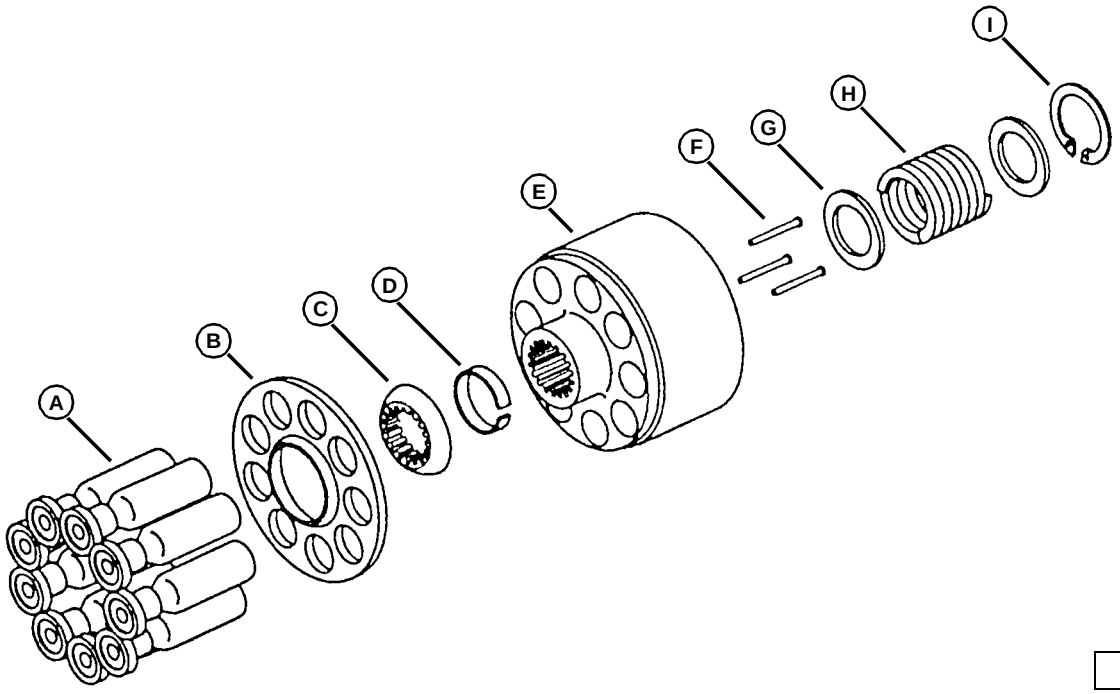


A— Snap Ring
B— Seal
C— Washer
D— Shaft Assembly
E— Bearing

13. Compress retainer (D) and install in spline of piston block (E). Install pins (F) in special grooves of piston block spline with head end of pins toward inside of piston block.

NOTE: The following items are required for assembly of the piston block: Two flat washers (5/16 ID x 15/16 OD), one 5/16 x 2-7/8 NC cap screw, and one 5/16 NC nut.

14. Install washers (G) and spring (H) in piston block.
15. Place one flat washer over a 5/16 x 2-7/8 in. cap screw and install screw through center of piston block (E). Place second flat washer over end of cap screw so that washer makes contact with three pins (F). Tighten cap screw and nut to compress spring (H). Install retaining ring (I). Slowly remove nut, cap screw and flat washers.
16. Install parts (A, B and C).



M82699A

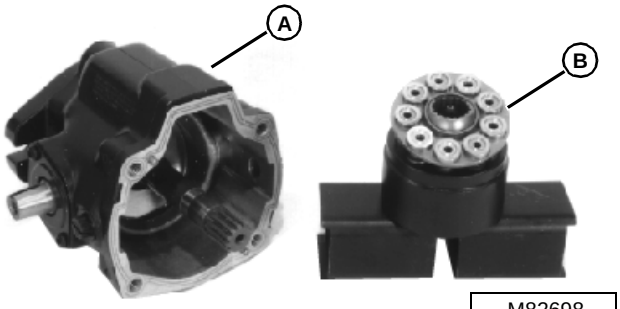
A— Pistons (9 used)
B— Retainer
C— Ball Guide
D— Retainer
E— Piston Block
F— Pin (3 used)
G— Washer (2 used)
H— Spring
I— Retaining Ring

NOTE: A pair of support blocks, for drive shaft clearance, is required for installation of piston block assembly.

17. Place piston block assembly (B) on support blocks. Align splines in piston block and ball guide. Align splines on drive shaft with piston block assembly and lower housing (A) over piston block assembly. Hold piston block assembly in position and turn upside down (mounting flange facing down). Make sure piston block splines are fully engaged and that piston shoes are in contact with camplate.

IMPORTANT: Perform remaining repair procedures with pump in a vise. Clamp across mounting flange only. Excessive clamping pressure on pump housing will cause distortion.

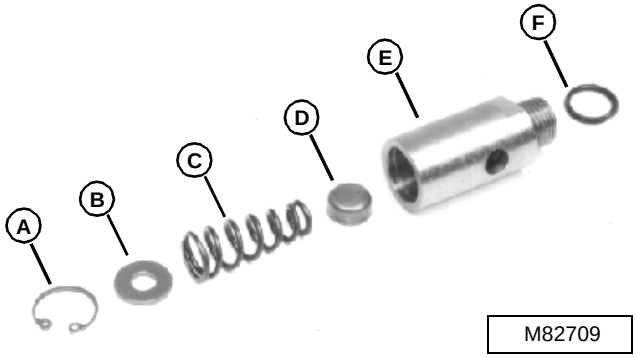
18. Put hydrostatic pump in a soft-jawed vise with mounting flange facing down.



M82698

19. Apply multipurpose grease to small end of spring (C).

20. Assemble parts (A—F).



M82709

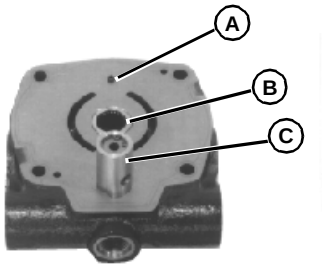
A— Snap Ring
B— Washer
C— Spring
D— Valve Cap
E— Housing
F— O-Ring

21. If removed, press bearing (B) into bore of backplate with numbered end facing away from backplate. Install bearing until end protrudes **1.91 mm (0.075 in.)** from surface of backplate.

22. If removed, install spring pin (A). End of spring pin should protrude **2.79 mm (0.110 in.)** from surface of backplate.

23. Apply thread lock and sealer (medium strength) to threads of relief valve assembly (C).

24. Install new o-ring and relief valve assembly.



M82697

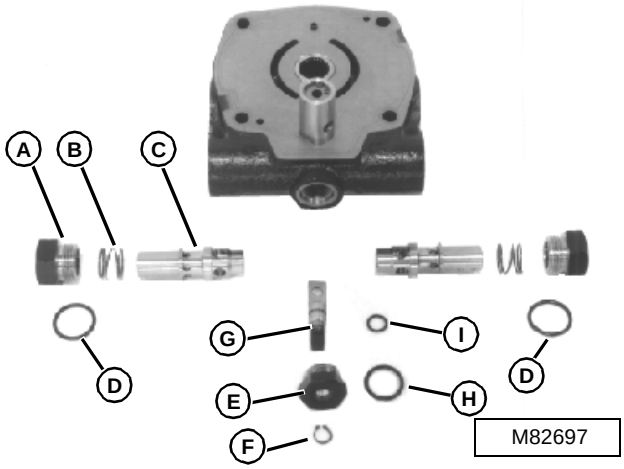
25. Install new O-rings (D) on plugs (A).

26. Install relief valves (C) and springs (B) into same bores they were removed from.

27. Install plugs (A). Tighten to **136 N•m (100 lb-ft)**.

28. Install new O-rings (H and I).

29. Assemble parts (E, F and G). Install freewheel valve assembly into backplate and tighten to **39 N•m (29 lb-ft)**.



M82697

A— Plug (2 used)
B— Spring (2 used)
C— Relief Valve (2 used)
D— O-Ring (2 used)
E— Plug
F— Snap Ring
G— Freewheel Valve
H— O-Ring
I— O-Ring

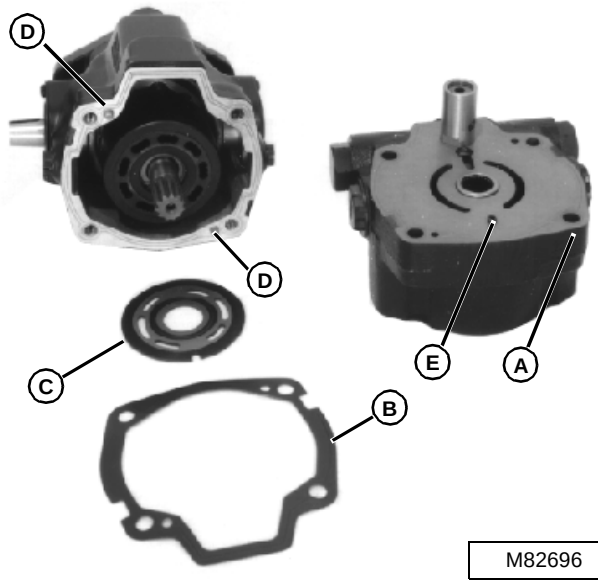
30. If removed, install dowel pins (D).

31. Install new gasket (B).

32. Apply a small amount of petroleum jelly to the steel side of valve plate (C) to hold in place.

33. Align notch in OD of valve plate (C) with spring pin (E) and place valve plate on backplate (A) (steel side down).

34. Carefully lower backplate onto housing.

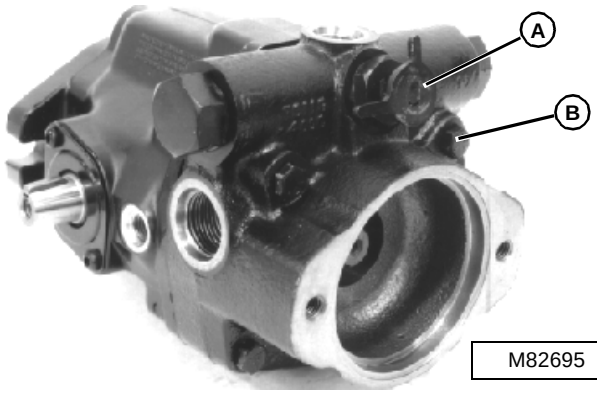


M82696

A— Backplate
B— Gasket
C— Valve Plate
D— Dowel Pins
E— Spring Pin

35. Install four cap screws (B). Tighten to **25 N•m (221 lb-in.)**.

36. Install freewheel lever (A) with “long arm” in position shown.



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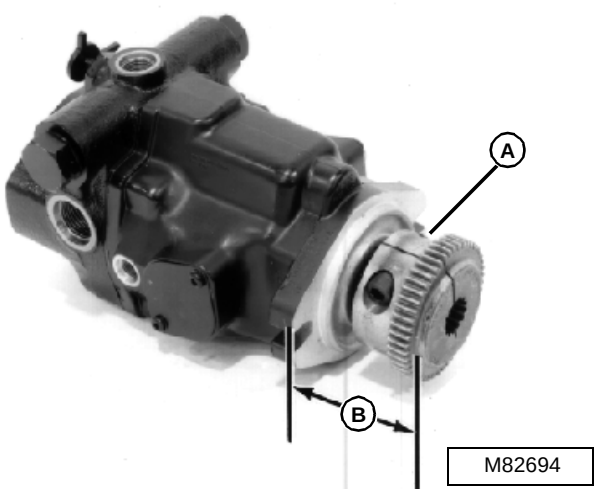
37. Apply NEVER-SEEZ lubricant, or an equivalent, to splines of drive shaft.

38. Install driven coupler (A).

39. Position coupler along drive shaft to distance (B), measured before disassembly. Tighten socket head cap screw.

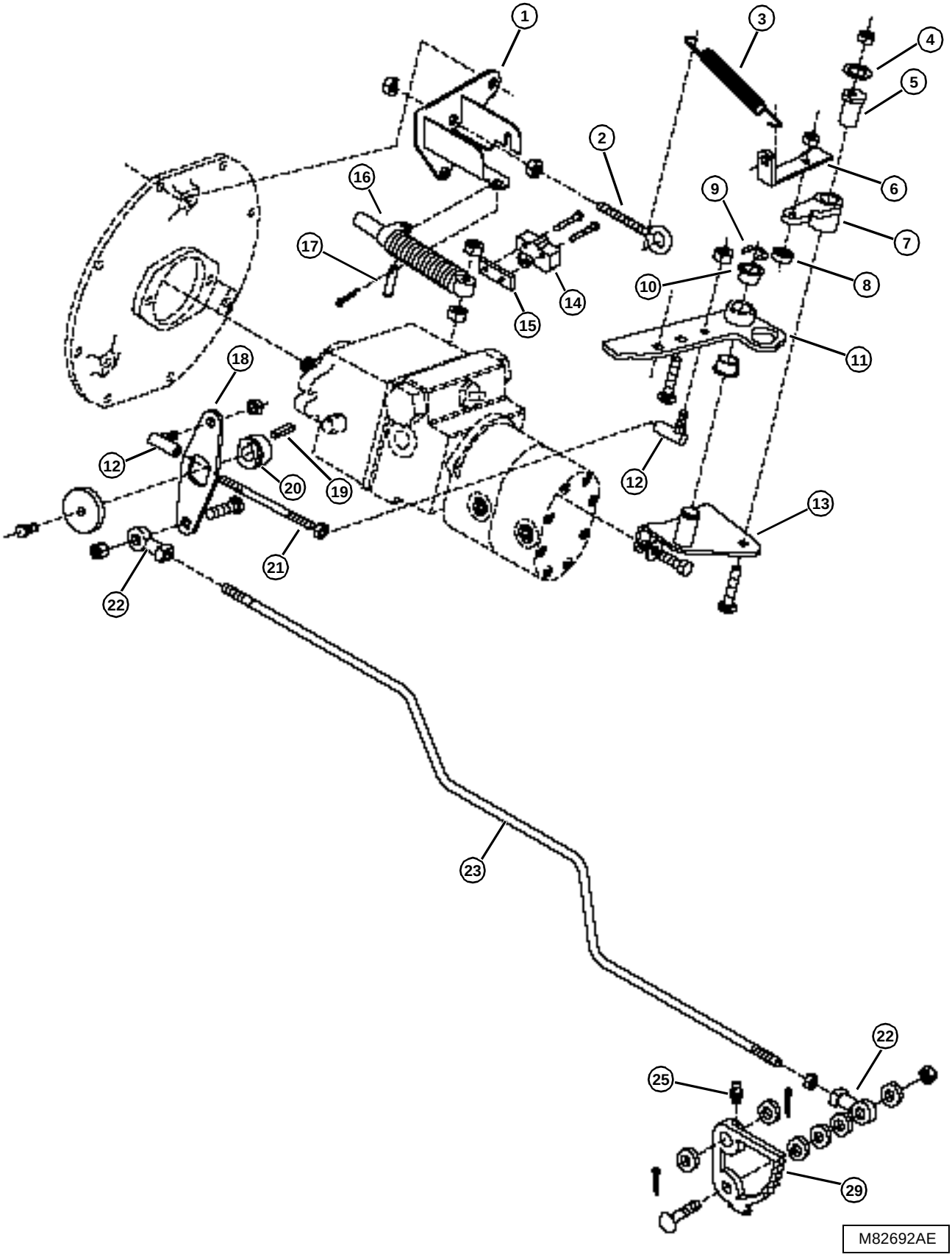


HYDROSTATIC CONTROL LINKAGE

Removal/Installation

1—Bracket
2—Eye Bolt
3—Spring
4—Shim
5—Eccentric Cam
6—Arm
7—Bracket
8—Ball Bearing
9—Snap Ring
10—Bushing (2)
11—Cam
12—Ball Joint
13—Bracket
14—Travel/Neutral Switch
15—Strap
16—Absorber
17—Pin
18—Control Arm
19—Shaft Key
20—Hub
21—Neutral Control Link
22—Tie Rod Ends (2)
23—Hydrostatic Control Rod
24—Pivot
25—Lubrication Fitting

- Remove seat platform. (See procedure in MISCELLANEOUS section.)
- Adjust Travel/Neutral switch. (See procedure in ELECTRICAL section.)
- Adjust hydrostatic control linkage.
- Apply multipurpose grease to eccentric cam and lubrication fitting.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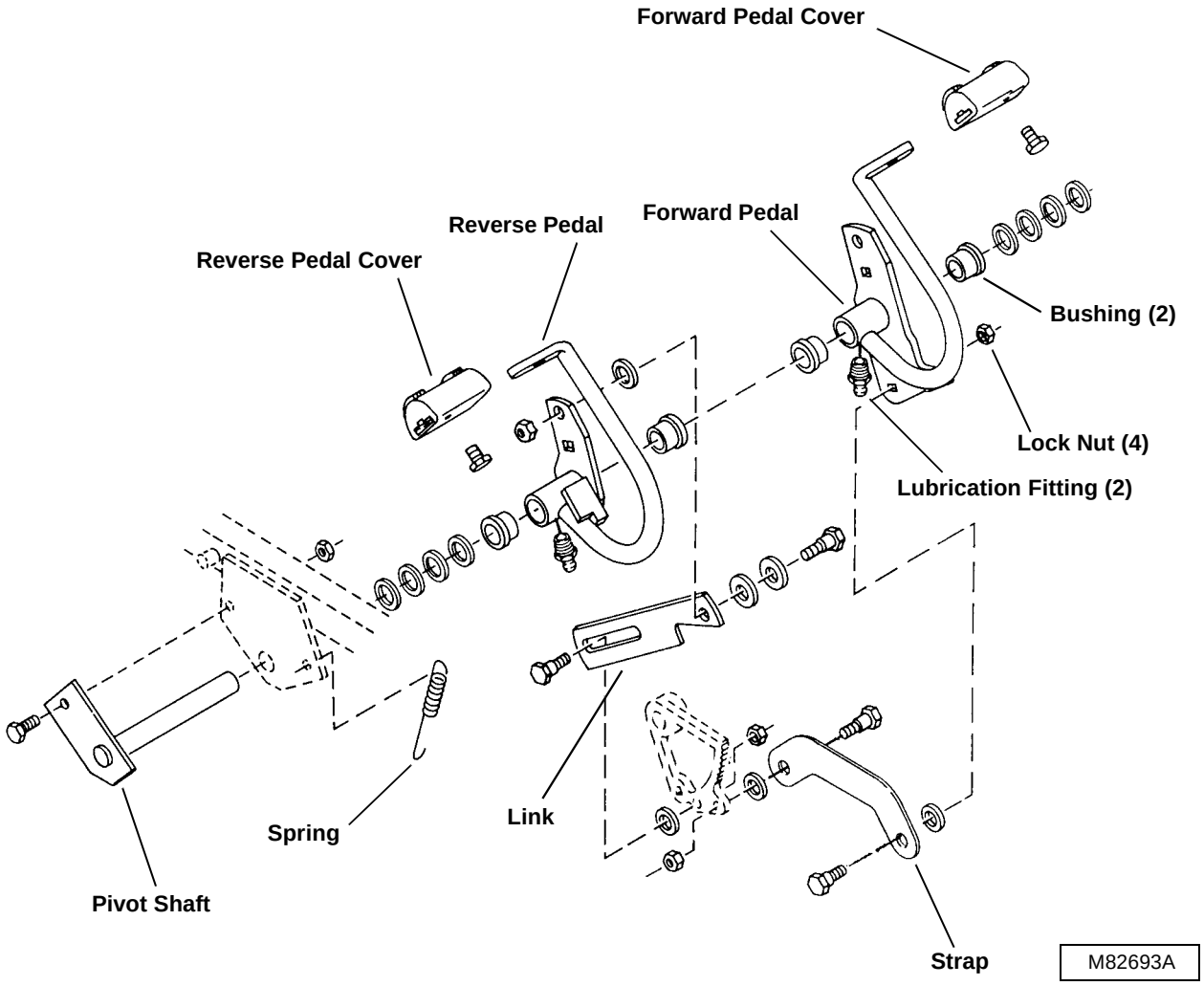
FORWARD/REVERSE TRAVEL PEDALS

Removal/Installation

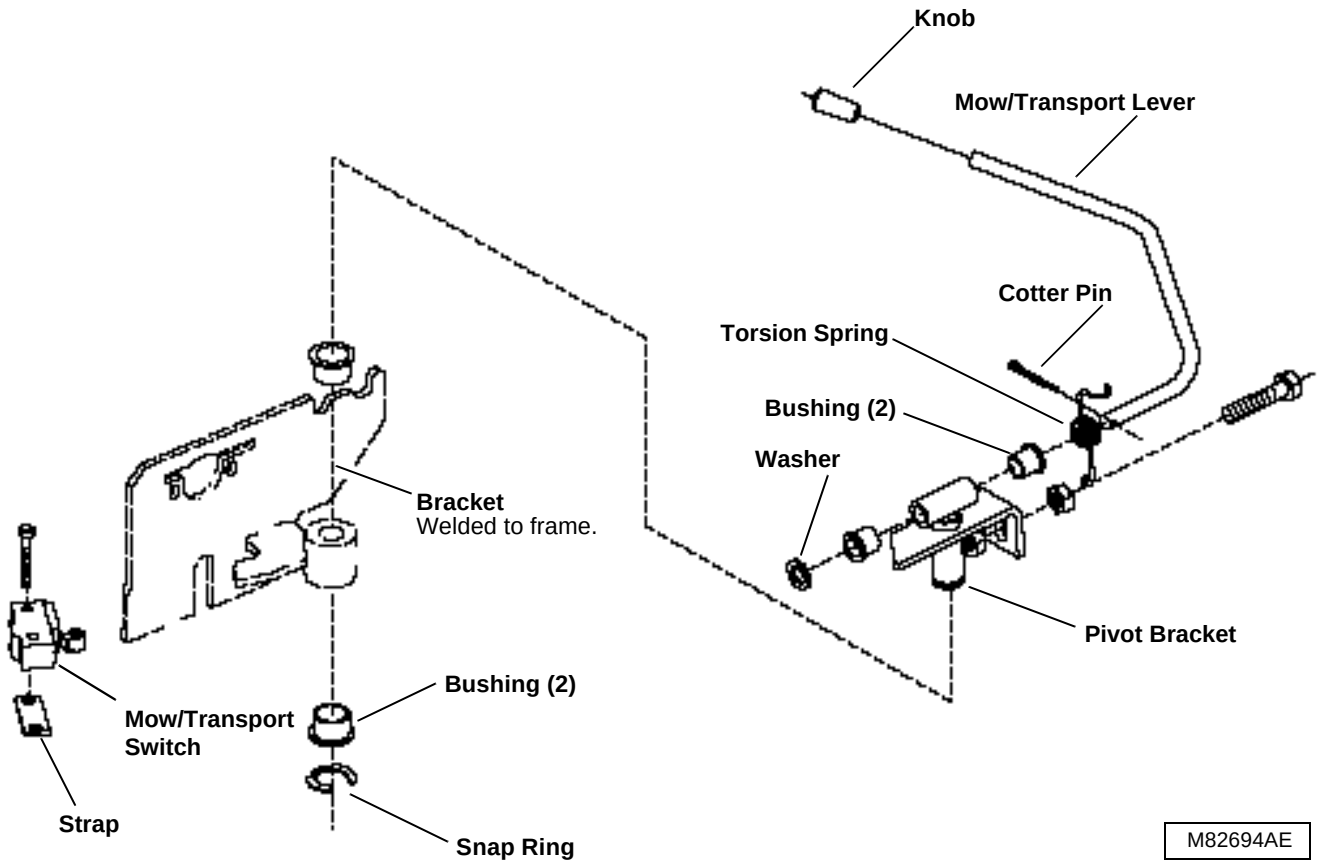
- Remove hose cover and right foot platform.
- Apply multipurpose grease to pivot shaft and lubrication fittings.



MOW/TRANSPORT LEVER LINKAGE

Removal/Installation

- Remove seat platform. (See procedure in MISCELLANEOUS section.)
- Adjust mow/transport switch. (See procedure in ELECTRICAL section.)



CONTENTS

CONTENTS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydraulic oil operating temperature . . . . . 43°C (110°F)

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.)

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.

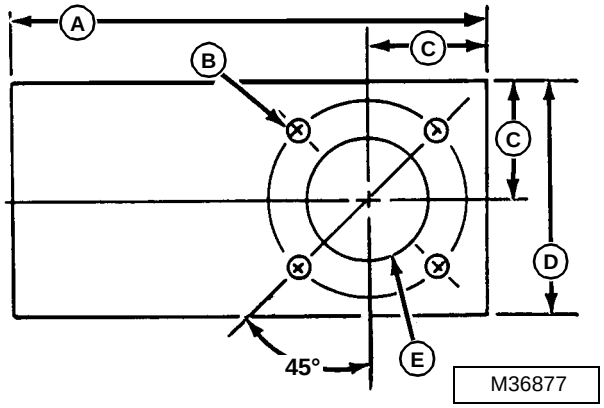
A— 203 mm (8.0 in.)

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.

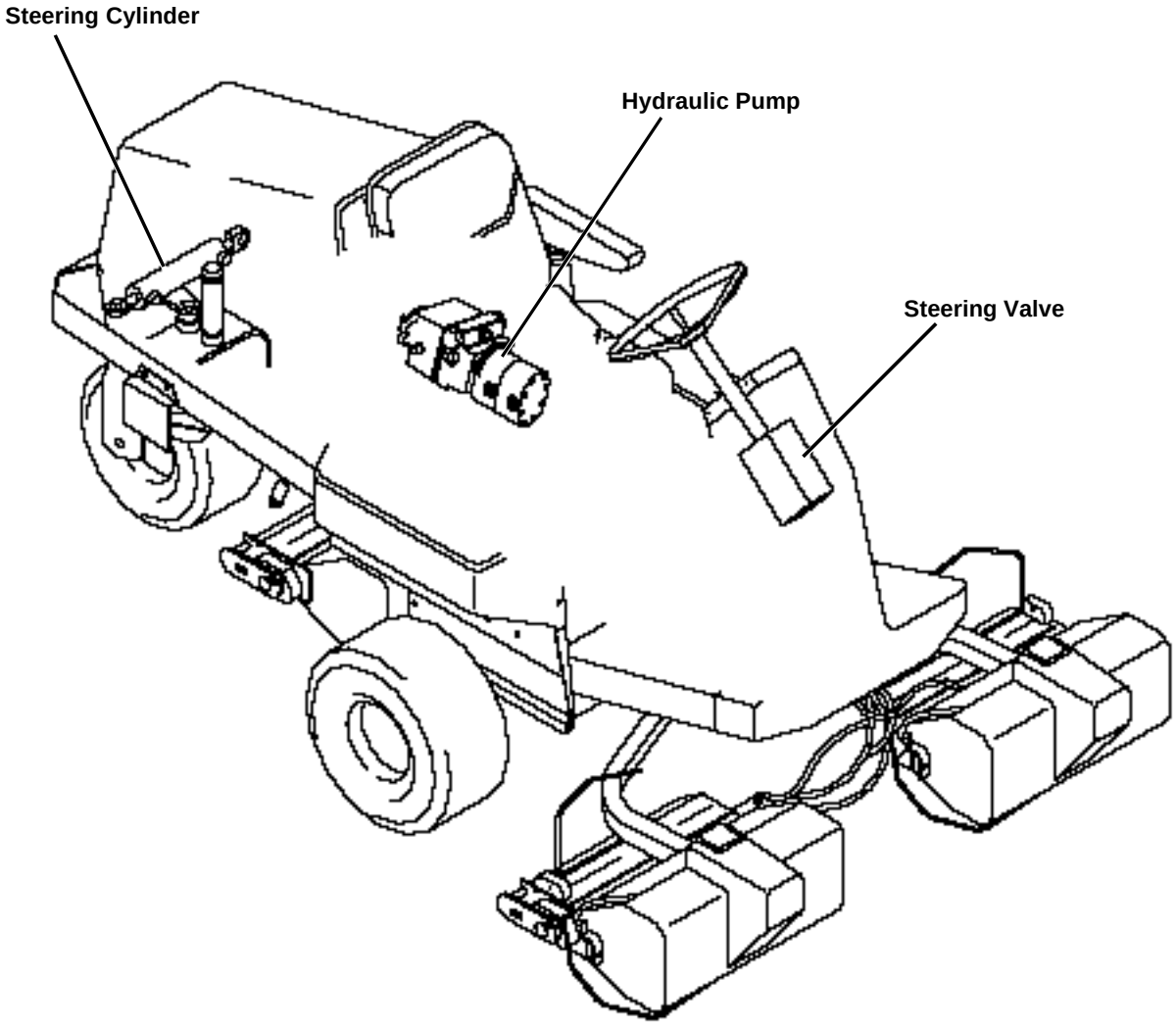
SERVICE PARTS KITS

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

® LOCTITE is a registered trademark of the Loctite Corp.

STEERING SYSTEM COMPONENTS



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STEERING SYSTEM OPERATION

Function:

Offer hydraulic steering for ease of operation.

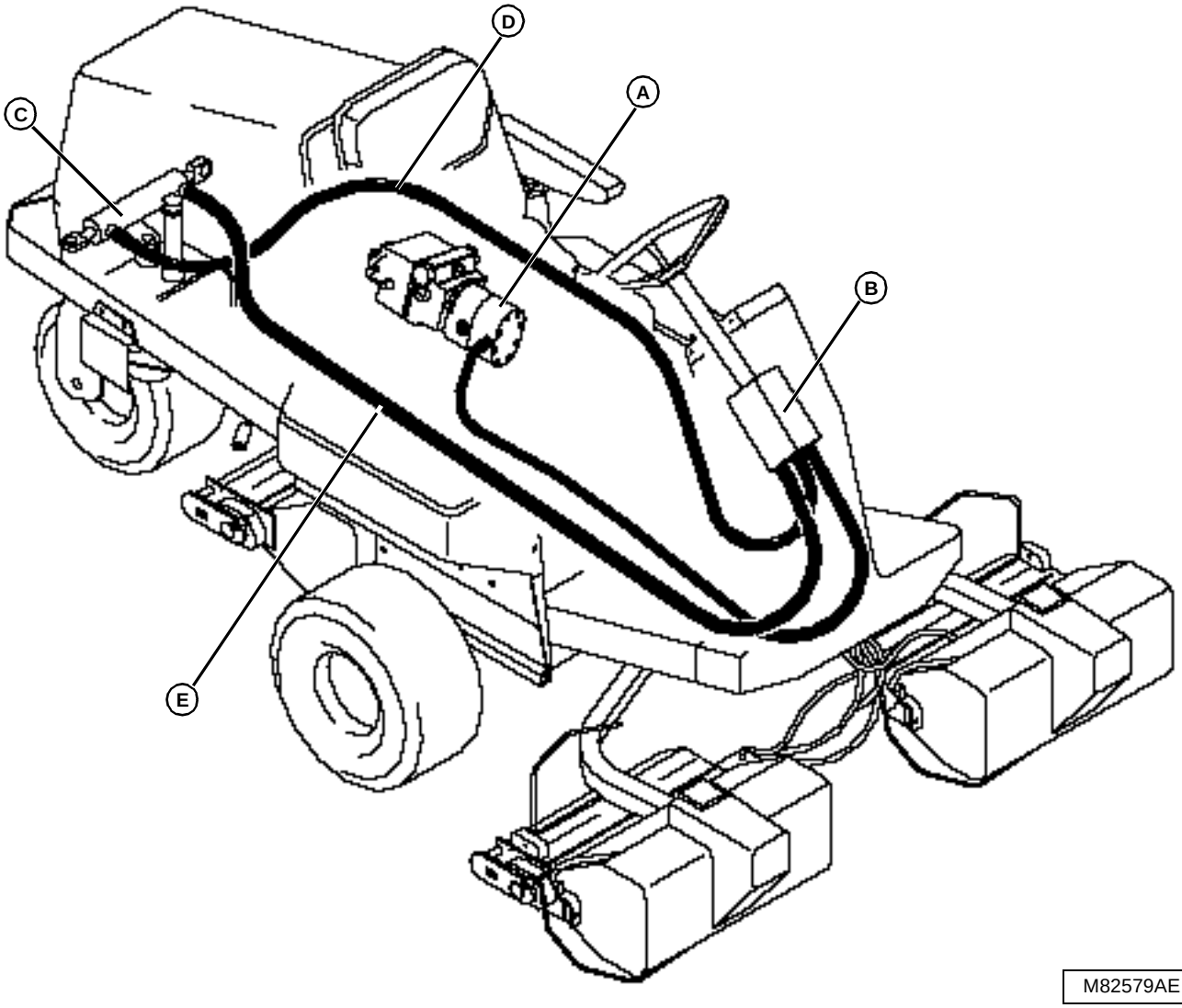
Theory of Operation:

The hydraulic pump (A) takes filtered oil from the reservoir and pressurizes it. Pressurized oil is supplied to the steering valve (B). As the steering wheel is turned, the steering valve distributes oil through pressure hoses (D and E) to the steering cylinder (C) 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 “charge” the hydrostatic pump. See Steering Valve Neutral Operation 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 (D and E). 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 Power Turn Operation for further information.

A— Hydraulic Pump
B— Steering Valve
C— Steering Cylinder
D— Pressure Line (Right Turn)
E— Pressure Line (Left Turn)



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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 hydraulic 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 (I) and a gerotor section (J). These are hydraulically and mechanically interconnected inside the unit.

MC82574AE
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Final size
240 x 466

Whenever the steering wheel is not moving, the steering valve moves to the neutral position. In this position, system oil (A) entering the steering valve through port “IN” (G) is allowed to flow through the control valve (I) and out port “AUX” (H). In this position the control valve is blocking pressurized oil from entering the gerotor (J), and stops oil flow from cylinder to the port “OUT” (F). As the oil exits the “OUT” port of the steering valve oil is considered as “charge oil” (C) for the hydrostatic pump.

While the steering valve is in the neutral position, trapped oil (B) 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.

A— System Pressure Oil
B— Trapped Oil
C— Charge Pressure Oil
D— Port “LT”
E— Port “RT”
F— Port “OUT”
G— Port “IN”
H— Port “AUX”
I— Control Valve
J— Gerotor
K— Relief Valve

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 (J) is shifted by the drive link assembly (K). This shifting opens the steering cylinder ports “LT” (E) and “RT” (F). Oil flow to the “AUX” port (I) 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” (H) directly to the inlet of the metering section, gerotor (K). As the steering wheel is turned, system oil (A) is forced through the gerotor motor (L) and control valve (J). Metered oil (B) is routed to port “RT” (F) and the right side of the steering cylinder (M). Return oil (C) from the other end of the cylinder is routed back to port “LT” (E) through the control valve and “OUT” port (G). As the oil exits the “OUT” port of the steering valve oil is considered as “charge oil” (D) for the hydrostatic pump.

If the steering wheel is held against stop, the relief valve (N) opens at 5000 kPa (725 psi) and sends oil to the “OUT” port (G). At this time there is not enough oil flow to the “AUX” port (I) to lift or lower the cutting units.

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Final Size
240 x 466

A— System Pressure Oil
B— Metered Oil
C— Return Oil
D— Charge Pressure Oil
E— Port “LT”
F— Port “RT”
G— Port “OUT”
H— Port “IN”
I— Port “AUX”
J— Control Valve
K— Drive Link Assembly
L— Gerotor Motor
M— Steering Cylinder
N— Relief Valve

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 gerotor (J) and check valve (L). The gerotor now acts as a pump moving oil from one side of the gerotor 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 gerotor, to either end of the steering cylinder (N), depending on which way the steering wheel is turned.

When the rotation of the wheel stops, the centering springs (M) move the valve plate back to the center (neutral) position, and will remain there until the steering wheel is moved again.

MC82576AE
[color art insert]
Final Size
240 x 466

A— Medium Pressure Oil
B— Return Oil
C— Low Pressure Oil
D— Port “LT”
E— Port “RT”
F— Port “OUT”
G— Port “IN”
H— Port “AUX”
I— Drive Link Assembly
J— Gerotor
K— Control Valve
L— Check Valve
M— Centering Springs
N— Steering Cylinder

STEERING CYLINDER OPERATION

Function:

To convert applied hydraulic pressure to mechanical motion to turn the wheel.

Theory of Operation:

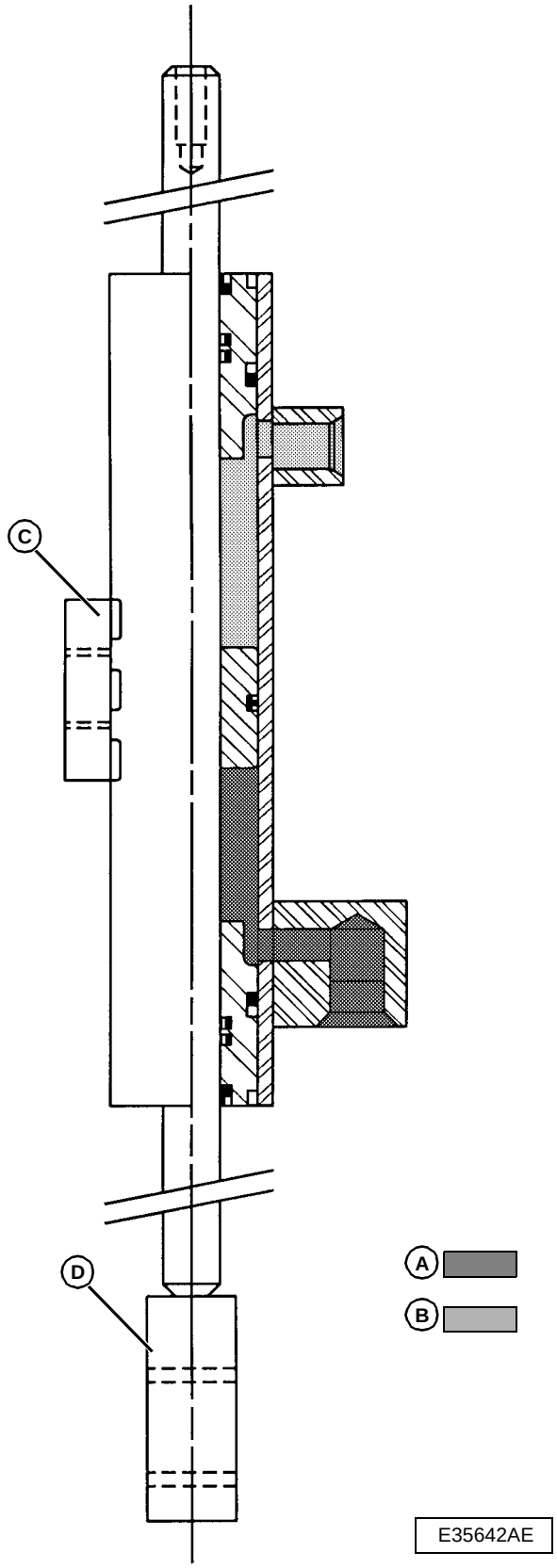
The steering cylinder is a double acting, double rod end design.

One end (D) 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 (C).

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.

A— Pressurized Oil
B— Return Oil
C— Steering Cylinder Pivot
D— Steering Rod Anchor



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.				●								

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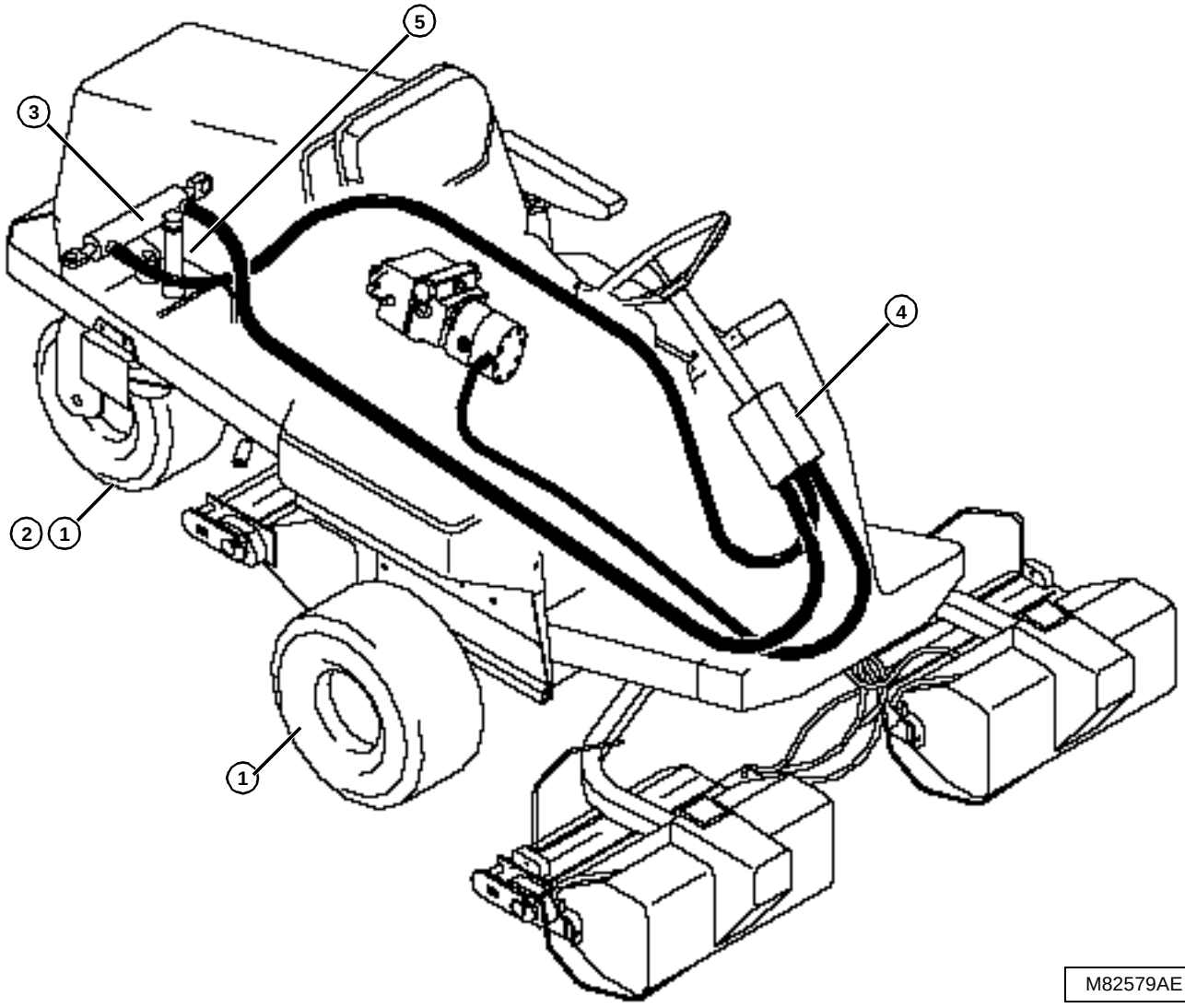
STEERING WANDER

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Tires.	Correct size and pressure.	See Operators Manual.
2. Rear wheel.	Bearings clean and not worn.	Replace bearings.
3. Steering cylinder.	No internal/external oil leakage.	Test steering system. (See Steering System Leakage test.)
4. Steering valve.	No internal/external oil leakage.	Test steering system. (See Steering System Leakage test.)
5. Steering spindle.	Bushings clean and not worn.	Replace bushings and/or spindle.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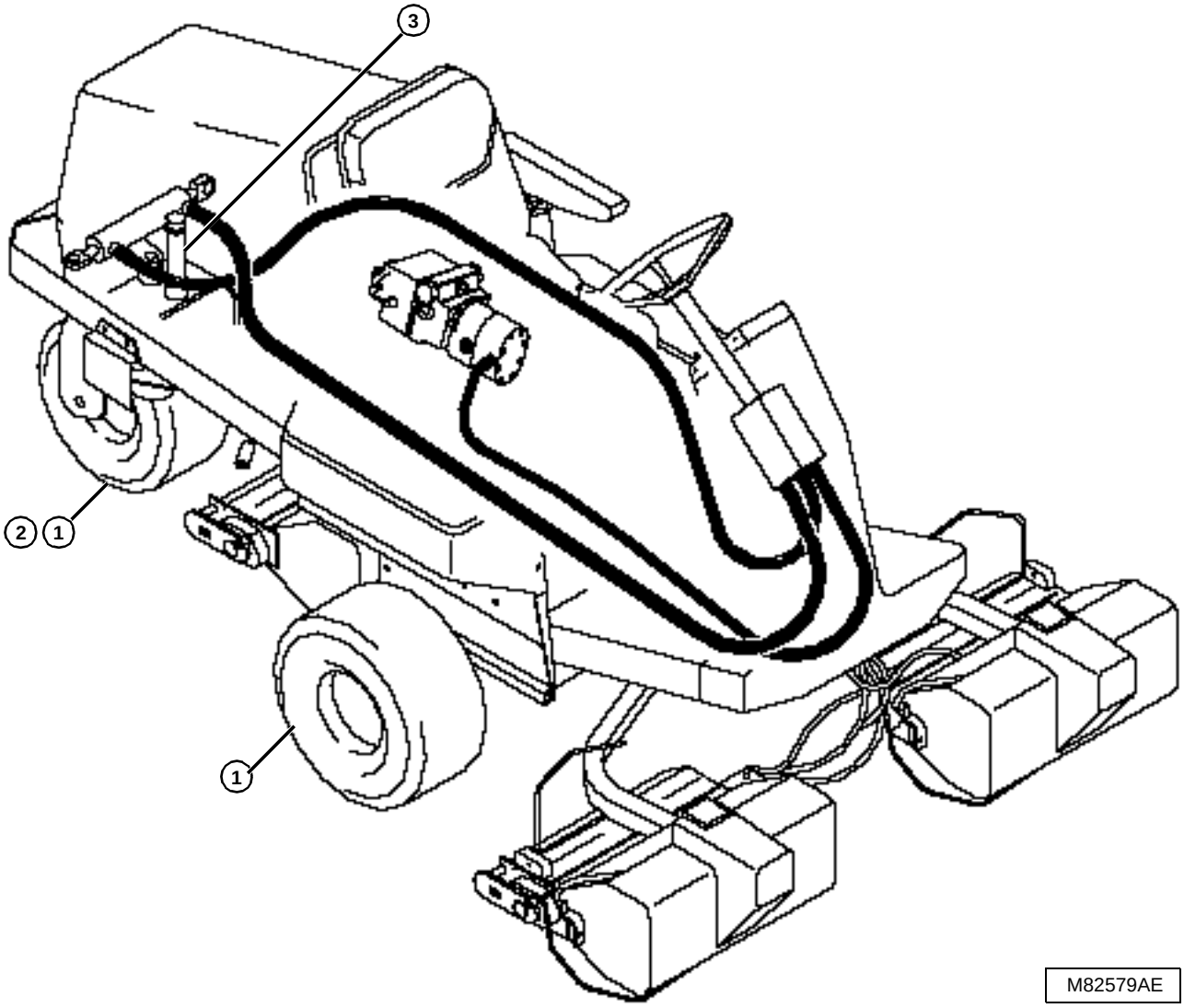
STEERING SHIMMY

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.
3. Steering spindle.	Bushings clean and not worn.	Replace bushings.
4. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)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STEERING SLUGGISH RESPONSE

Test Conditions:

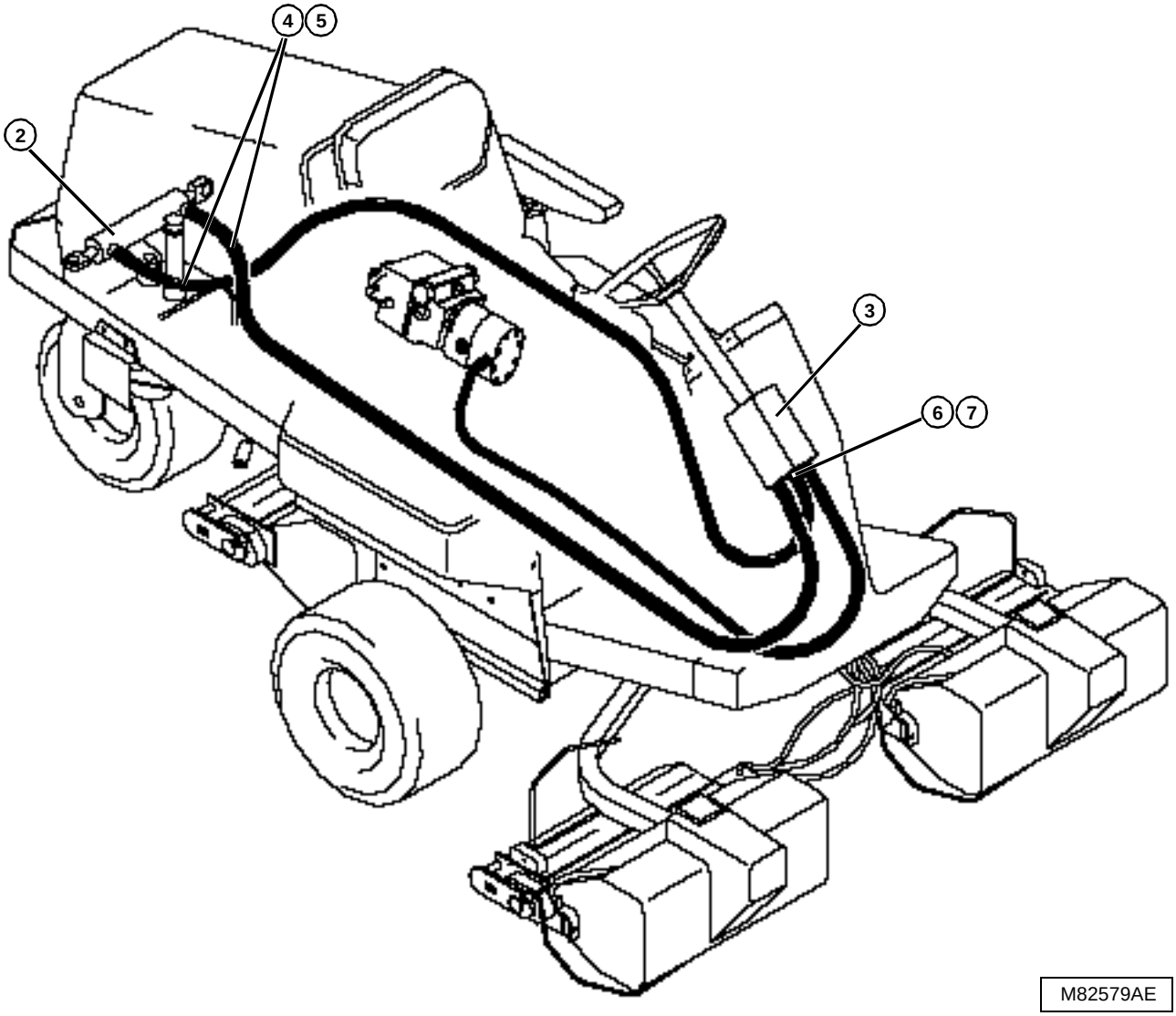
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)
2. Steering cylinder.	No internal/external oil leakage.	Test steering system. (See Steering System Leakage test.)
3. Steering valve.	No internal/external oil leakage.	Test steering system. (See Steering System Leakage test.)
4. Pressure hoses from steering valve to steering cylinder.	No external oil leakage.	Test steering system. (See Steering System Leakage test.)
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 procedures in HYDRAULICS section.)
7. Steering valve -- “IN” port.	Steering relief valve releases at specified pressure.	Test steering relief valve pressure. (See procedure in HYDRAULICS section.)
8. Engine flywheel.	Slow idle. Fast idle.	Adjust engine rpm. (See procedures in ENGINE section.)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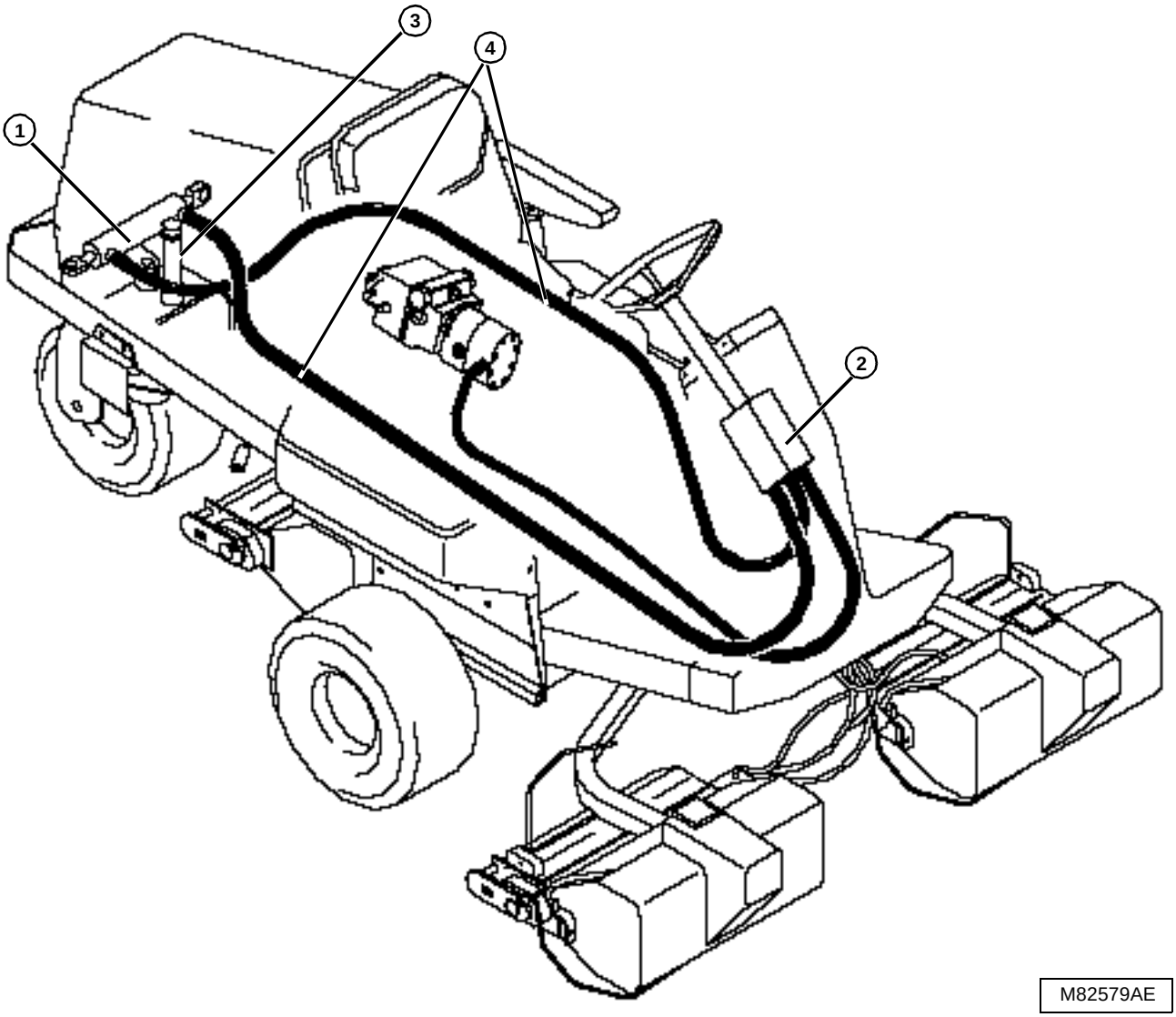
HIGH STEERING EFFORT IN ONE DIRECTION

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 System and Cylinder Leakage Tests.)
	Cylinder rod not bent.	Replace cylinder.
2. Steering valve.	No external oil leaks or visible damage.	Test steering system/steering valve. (See Steering System and Valve Leakage Test.)
	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary.
3. Steering spindle.	Free to rotate, lubricated.	Repair.
4. Pressure hoses from steering valve to steering cylinder.	No sharp bends or restrictions.	Replace hoses.



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HIGH STEERING EFFORT IN BOTH DIRECTIONS

Test Conditions:

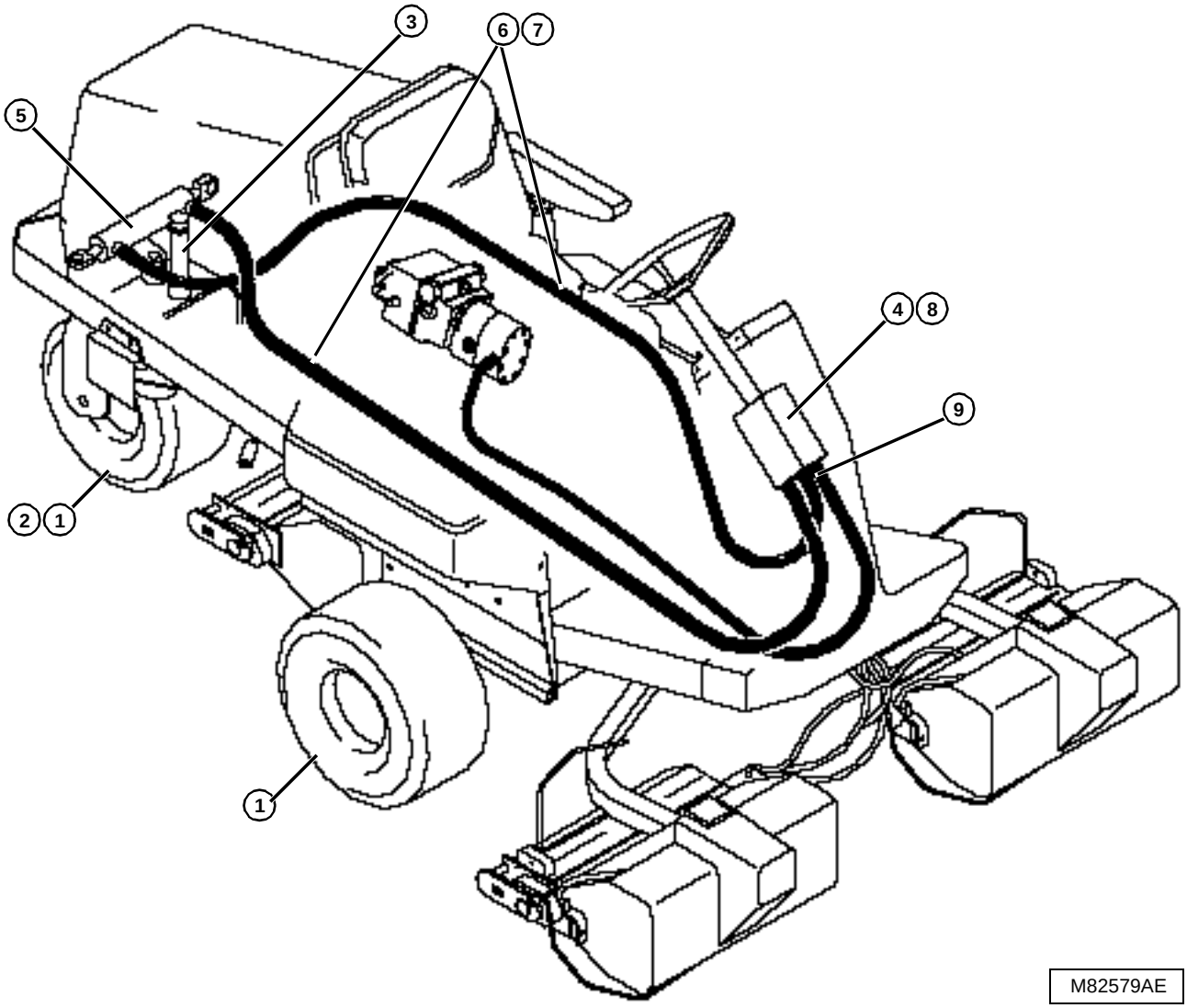
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Wheels.	Properly mounted and secure.	Repair.
2. Rear wheel.	Bearings clean and not worn.	Replace bearings.
	Properly inflated tire.	Inflated to proper pressure. (See Operators Manual.)
3. Steering clevis.	Bushings clean and not worn.	Replace bushings.
4. Steering valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary.
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.)
8. Steering valve.	No external oil leaks or visible damage.	Test steering system. (See Steering System Leakage Test.)
9. Steering valve-- “IN” port.	Input pressure is at specified pressure at fast idle.	Test hydraulic pump pressure and flow. (See procedures in HYDRAULICS section.)
10. Engine flywheel.	Slow idle. Fast Idle.	Adjust engine rpm. (See procedure in ENGINE section.)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STEERING EFFORT IS ERRATIC

Test Conditions:

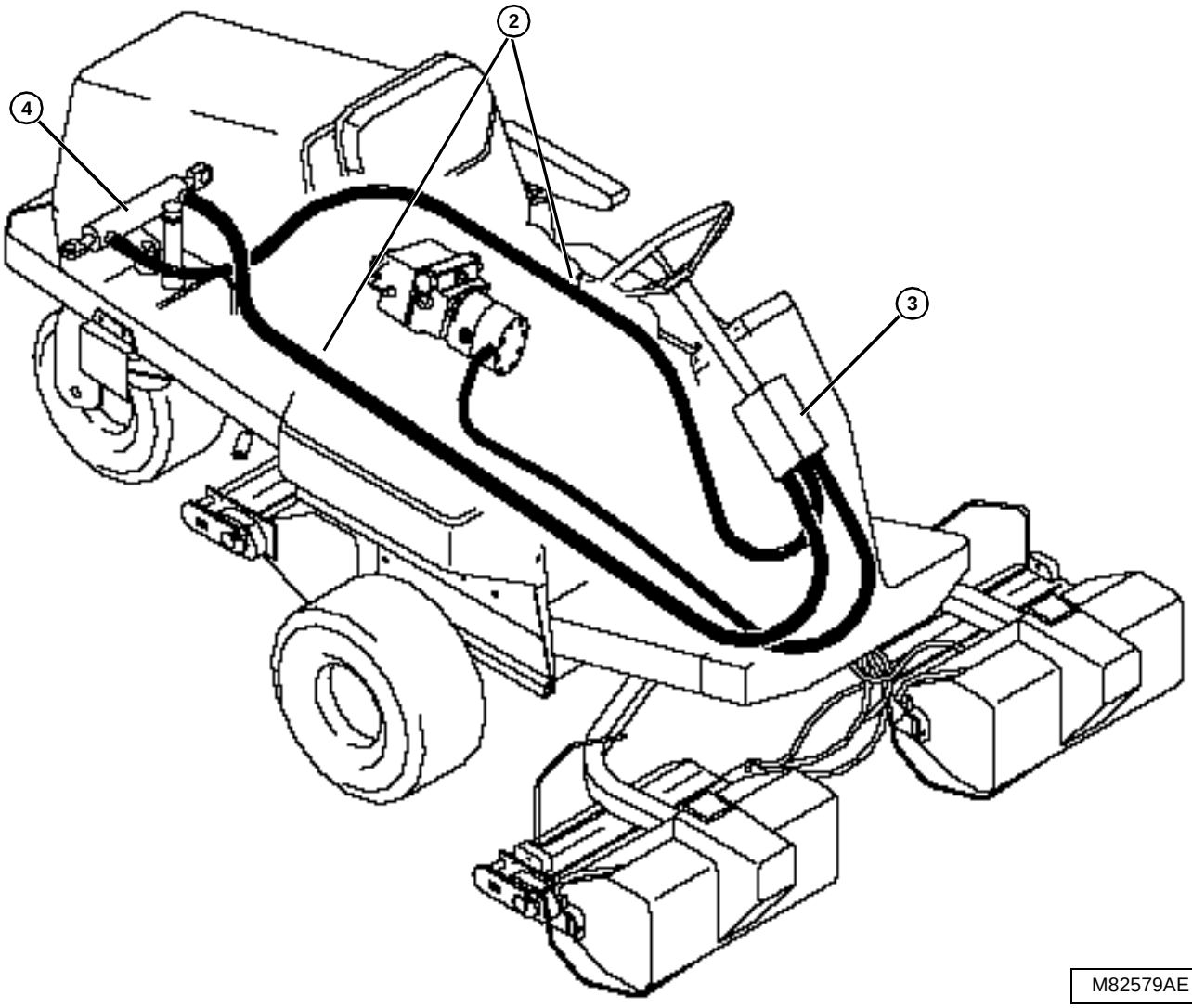
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic system.	Hydraulic oil clear and not foamy (No air in system).	Bleed hydraulic system. (See procedure in HYDRAULICS section.)

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.)
3. Steering valve.	No external oil leaks or visible damage.	Test steering system/steering valve. (See Steering System and Valve Leakage Test.)
4. Steering cylinder.	No internal/external oil leakage.	Test steering system/steering cylinder. (See Steering System and Cylinder Leakage Tests.)



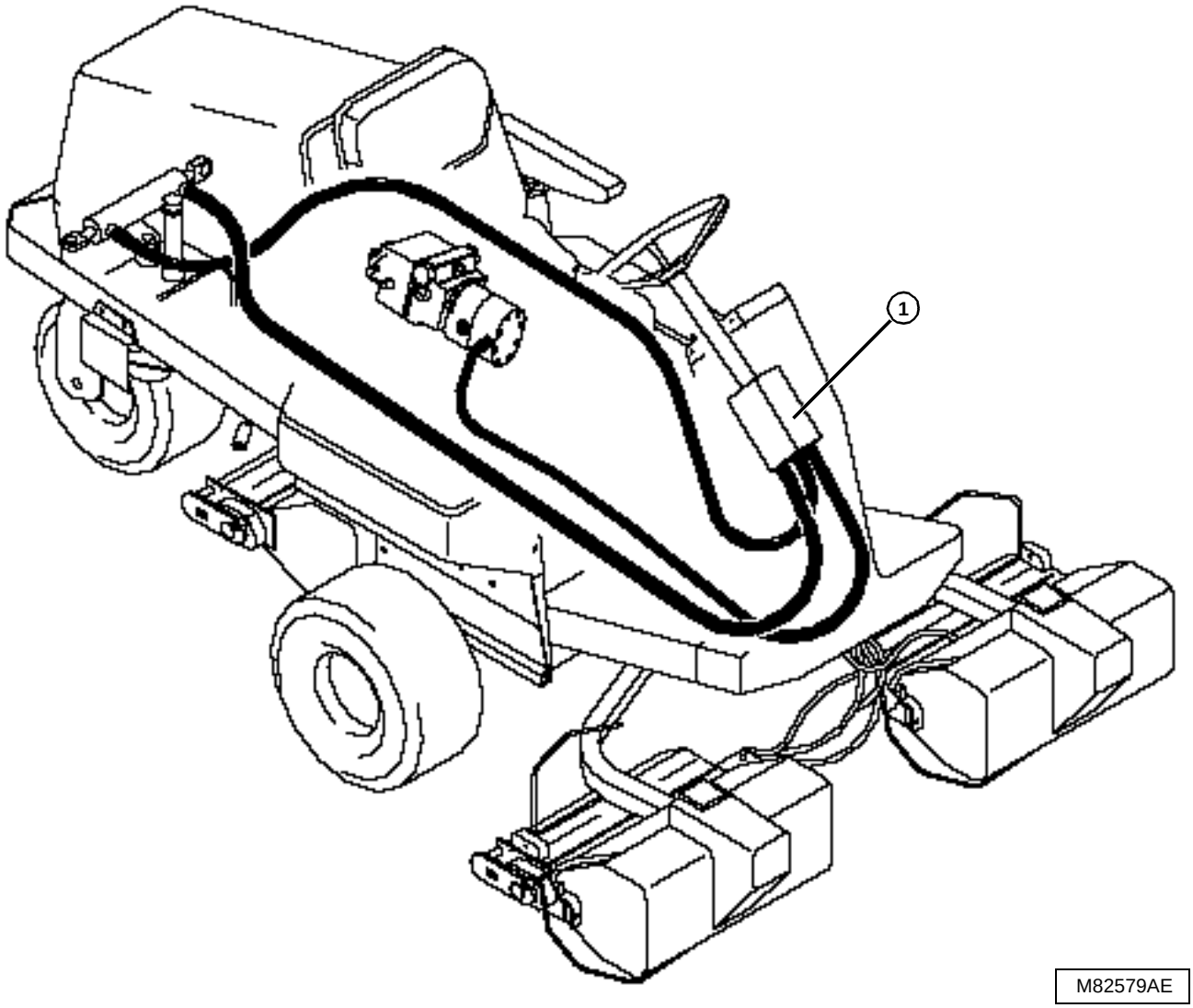
M82579AE

WHEELS CONTINUE 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.



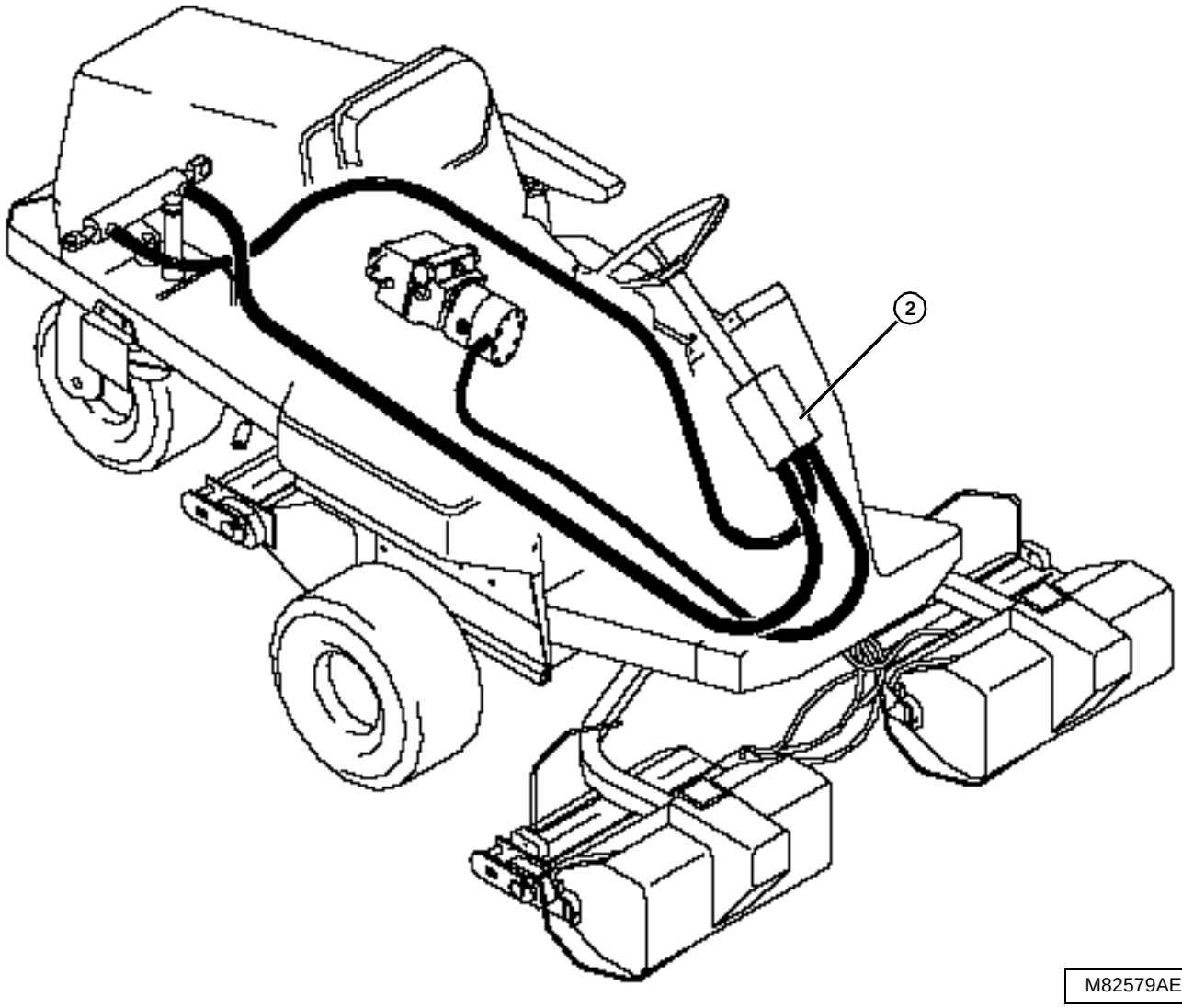
M82579AE

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 procedure in HYDRAULICS section.)
2. Steering valve.	Securely mounted.	Tighten mounting nuts.



M82579AE

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 parking 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.

HYDRAULIC OIL WARMUP PROCEDURE

Reason:

When performing hydraulic tests, the oil must be heated to a specified temperature for the test to be accurate.

Equipment:

- JDG282 Temperature Gauge

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 parking brake.
6. Start engine and run at full throttle.
7. Install JDG282 Temperature Gauge or measuring device on transaxle.
8. Heat hydraulic oil to **43°C (110°F)**.
9. Periodically cycle all hydraulic functions to distribute heated oil.

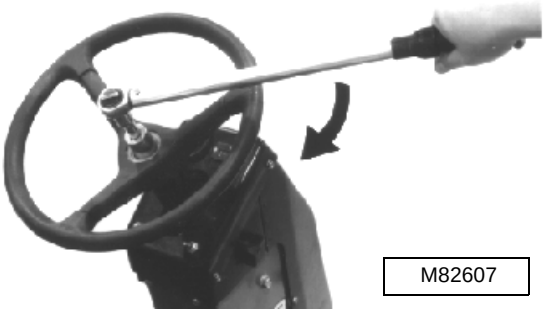
STEERING SYSTEM LEAKAGE TEST

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 parking brake.
5. Heat hydraulic oil to **43°C (110°F)**. (See HYDRAULIC OIL WARMUP PROCEDURE.)
6. Start engine and run at **slow idle (1400 ± 75 rpm)**.
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.)**.



M82607

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.

> **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.**

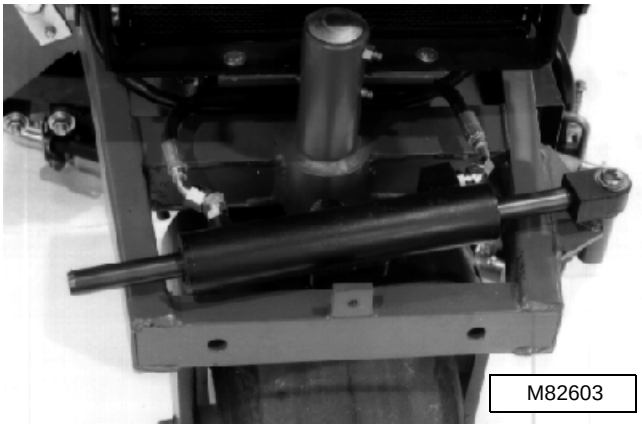
Procedure:

1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Engage parking brake.
5. Heat hydraulic oil to **43°C (110°F)**. (See HYDRAULIC OIL WARMUP PROCEDURE.)
6. Stop engine.
7. Remove hood.
8. Remove steering cylinder cover.

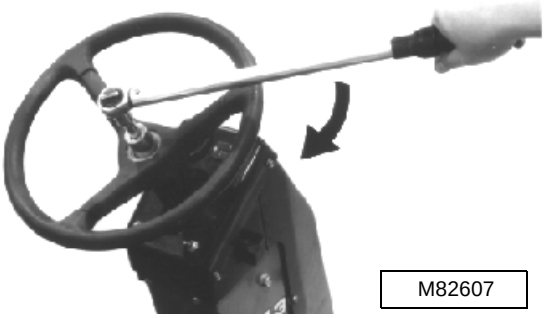
> **CAUTION**
>
> **To avoid injury from escaping hydraulic oil under pressure, relieve the pressure in the system by stopping the engine and operating all hydraulic control valves.**

IMPORTANT: O-Ring seal (ORS) plugs must be used to plug pressurized hydraulic hoses.

9. Disconnect hydraulic hoses from steering cylinder. Install O-ring seal plugs.



10. Start engine and run at **slow idle (1400 ± 75 rpm)**.
11. 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.)**.
12. Observe the number of rotations of the steering wheel that occurs in one minute.
13. 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.

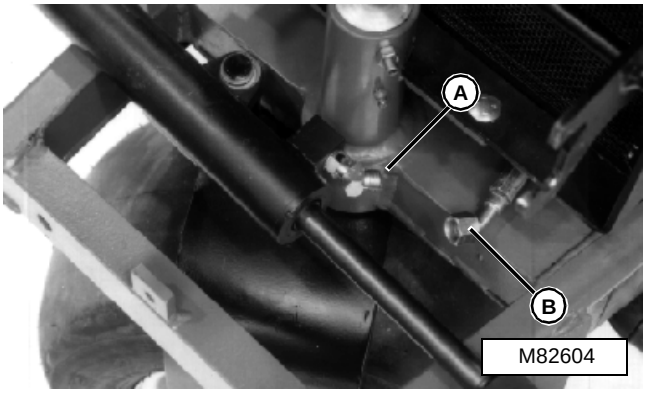
c CAUTION y

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 parking brake.
6. Remove hood.
7. Remove rear cover.
8. Turn steering wheel to full left to fully extend cylinder end.
9. Disconnect hydraulic hose (B) (extended end).
10. Start engine and run at fast idle.
11. Continue to turn steering wheel to the left.
12. Watch for any flow of oil out of the cylinder at port (A).
13. 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.

STEERING VALVE AND COLUMN

Removal/Installation

c CAUTION y

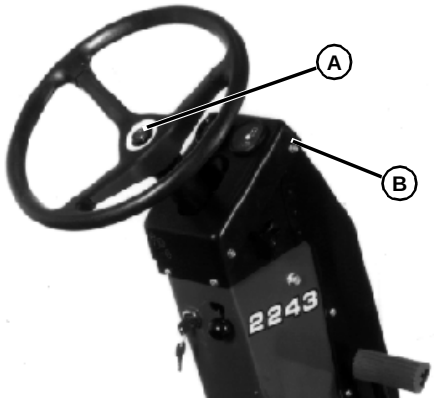
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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.

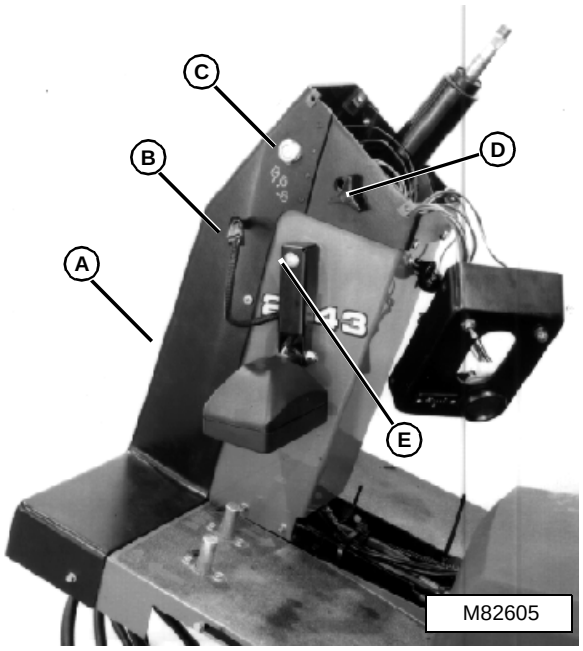
1. Turn steering wheel back and forth several times to relieve hydraulic pressure from system.

IMPORTANT: Do not use a hammer on end of steering shaft, damage can occur to steering valve or shaft.

2. Remove steering wheel cap and nut (A). Remove steering wheel.
3. Remove four screws and cover (B).

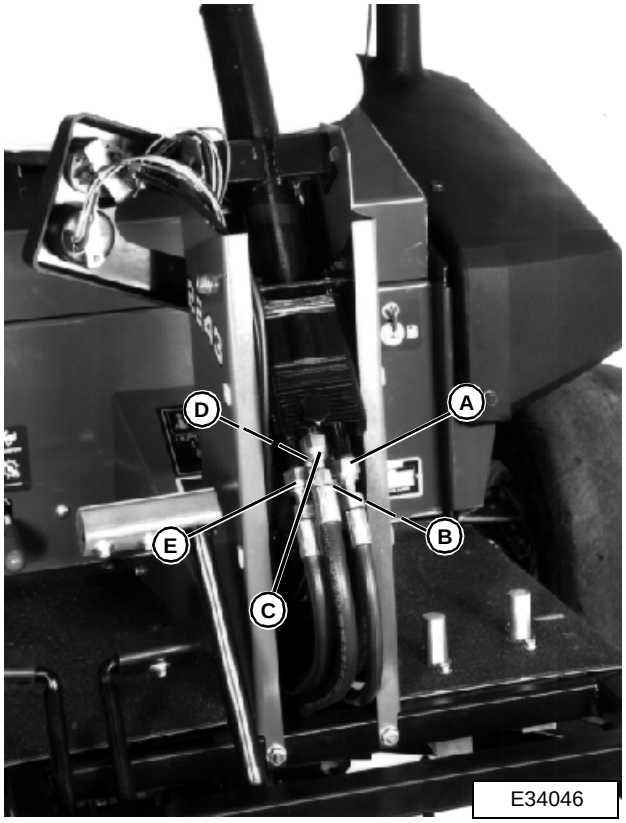


4. Remove two knobs (D).
5. Remove key switch (C).
6. If equipped with optional headlights:
   - Loosen nut on carraige bolt (E) and rotate headlight assembly down 90°.
   - Disconnect wiring connector (B).
   - Repeat for remaining headlight.
7. Remove eight screws and cover (A).



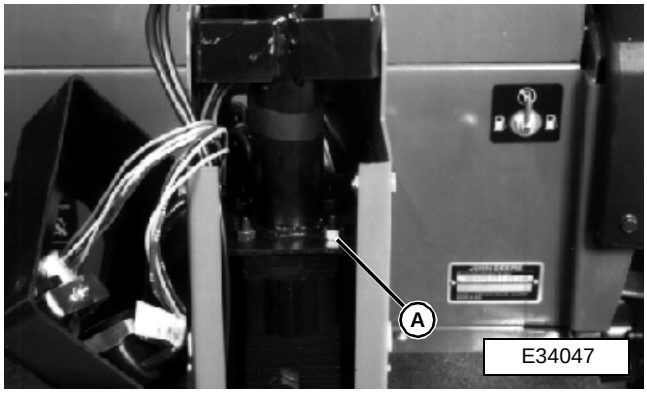
A— Cover
B— Headlight Wiring Connector
C— Key Switch
D— Knob (2 used)
E— Carraige Bolt

8. Disconnect five hydraulic hoses (A—E).



A— Hose, RT Port-to-Rod Anchor of Steering Cylinder
B— Hose, LT Port-to-Rod End of Steering Cylinder
C— Hose, Hydraulic Pump-to-IN Port
D— Hose, OUT Port-to-Hydrostatic Pump
E— Hose, AUX Port-to-Lift Valve

9. Remove four nuts (A).
10. Slide steering valve and column assembly from steering column tube support.



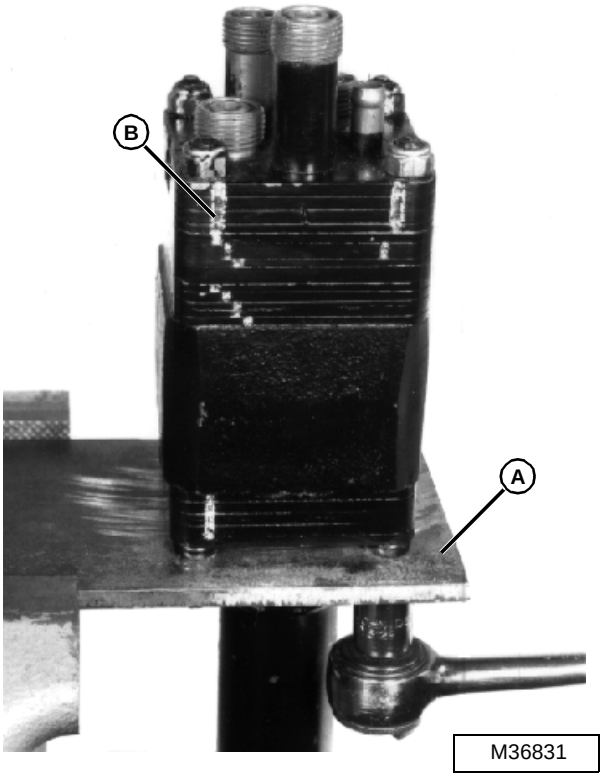
Installation is performed in the reverse order of removal.

- 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.)**.

Disassembly

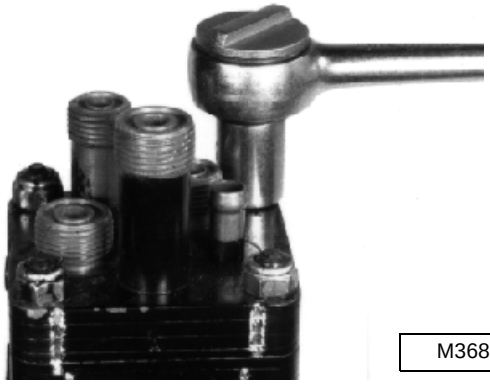
IMPORTANT: Use DFMX3A Steering Valve Fixture when servicing control valve. Holding control valve in a vise can damage valve.

1. Install DFMX3A Steering Valve Fixture (A) in a vice. (See DEALER FABRICATED TOOLS at the beginning of this section 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 (B) 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.


M36833

NOTE: Port manifold has three springs which may come loose during disassembly.

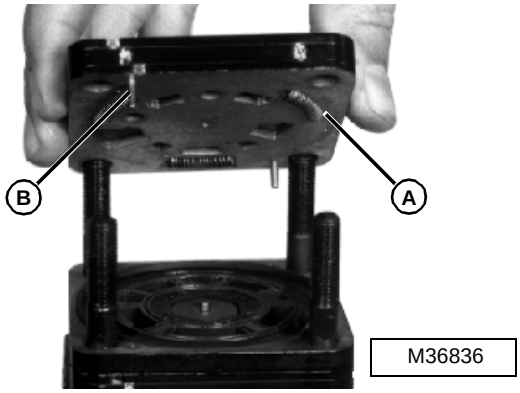
8. Carefully remove port manifold (three plates bonded together).

IMPORTANT: Do not interchange springs. The steering valve has two sets of springs. Keep springs with respective manifold.

9. Remove three springs (A).

NOTE: If one spring is damaged, all six springs in valve must be replaced.

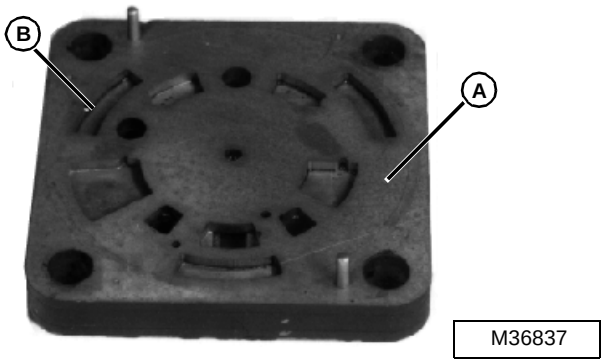
10. Inspect springs and pins (B) for distortion, wear, or damage.



M36836

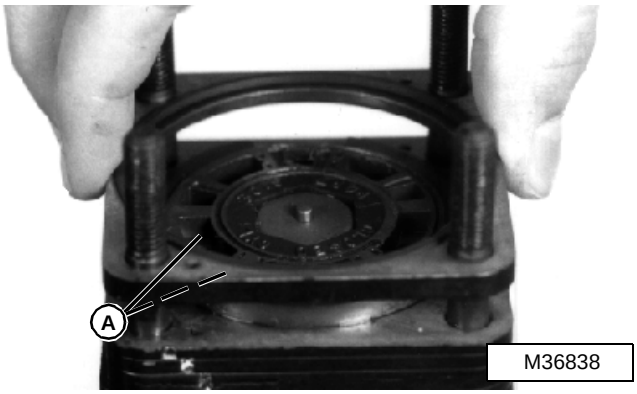
11. Inspect port manifold machined surfaces (A) for scratches or scoring. A polished pattern from the rotation of the valve plate and hex drive assembly is normal. All edges (B) must be sharp, free of nicks and burrs.

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.



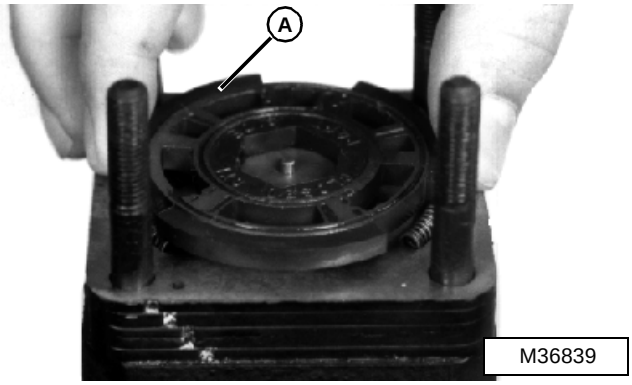
M36837

12. Remove the valve ring and two seal rings (A). Check valve ring for nicks and scoring. If the valve ring is damaged, it must be replaced.



M36838

13. Remove valve plate (A). 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.

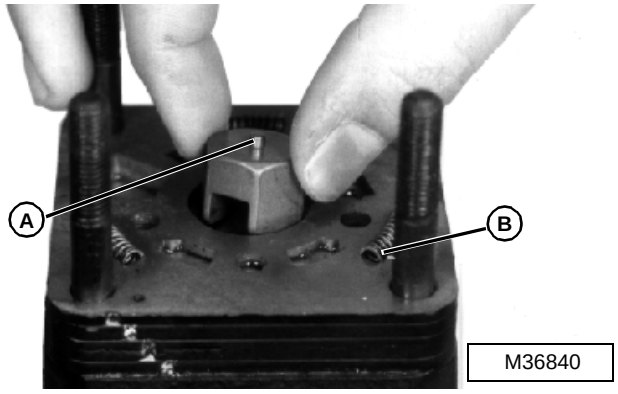


M36839

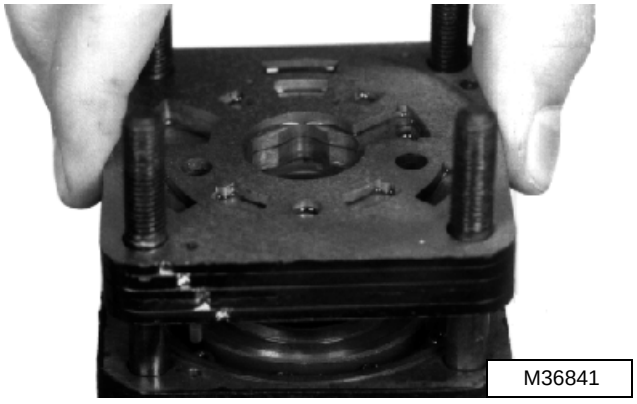
14. Remove and inspect hex drive assembly. Check sides and slot for wear, grooves, or scoring. Pin (A) should be tight and show no wear or damage.

15. Remove three springs (B).

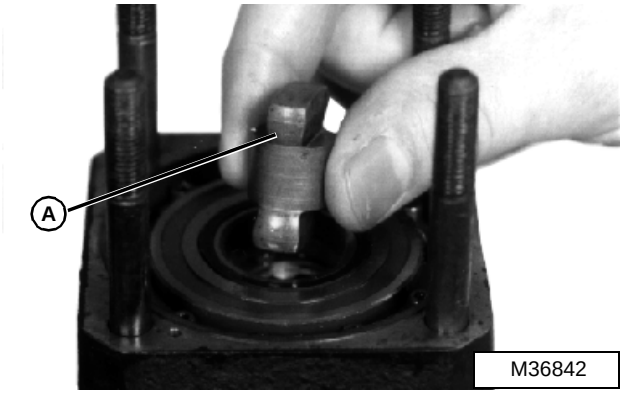
16. Inspect spring for broken coils, wear, or damage.



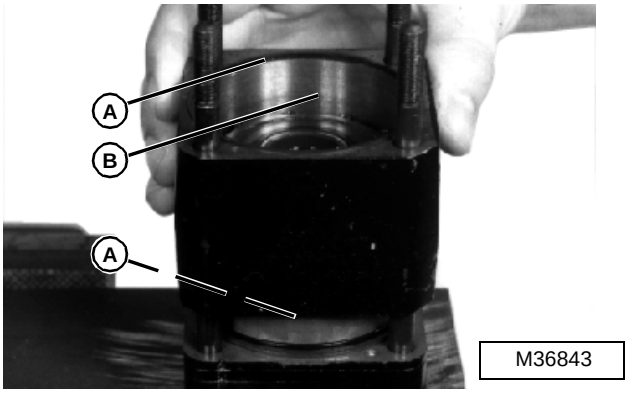
17. Remove the isolation manifold (four plates bonded together). Check manifold surface, holes, and edges for nicks or usual wear. A polished pattern from the rotation of the valve plate and commutator is normal.



18. Remove drive link. Check the four crowned surfaces (A) for wear or scoring.

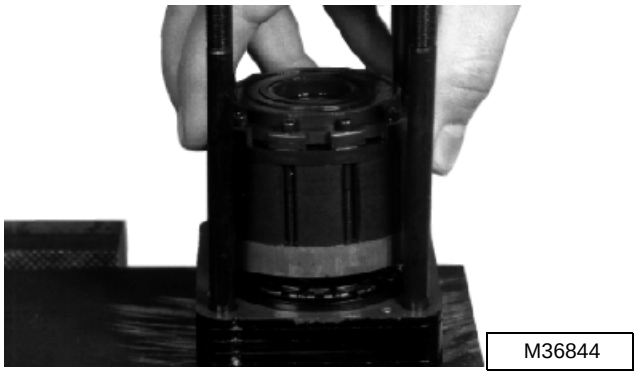


19. Remove metering ring and upper and lower seals (A). If bore (B) is scored, the metering ring must be replaced.



IMPORTANT: Do not clamp metering assembly in a vice.

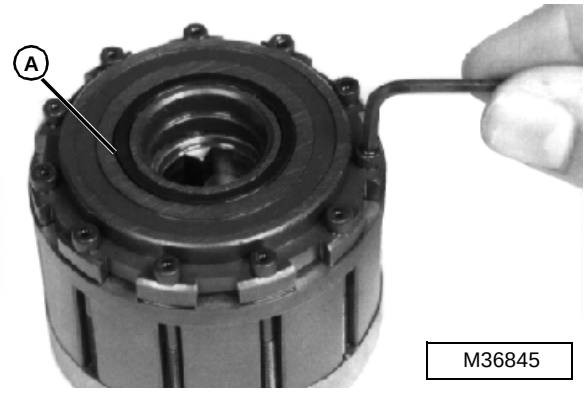
20. Remove metering assembly. Put assembly on a clean surface.



21. Remove commutator seal (A).

22. Remove 11 screws to remove commutator cover. Inspect screws for damage and replace if necessary.

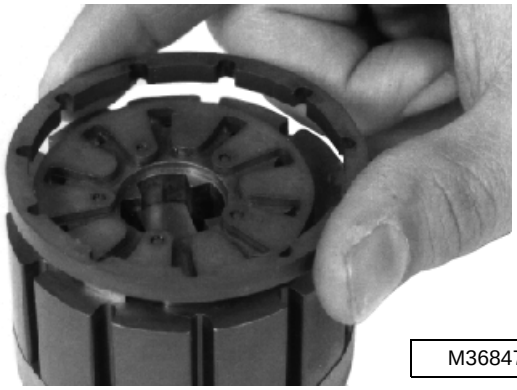
23. Check commutator cover machined surface for nicks, burrs, scoring, or unusual wear. A polished pattern due to rotation of the commutator is normal.



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.



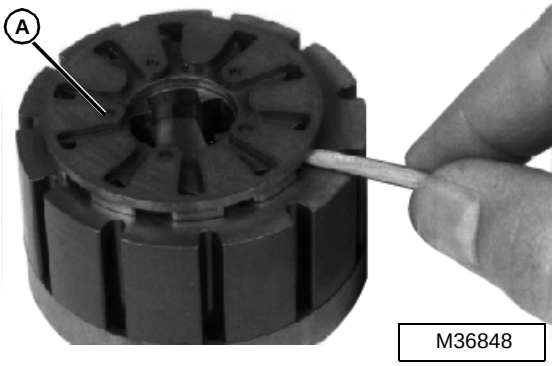
M36847

IMPORTANT: DO NOT use a screwdriver to remove commutator. Commutator can be damaged.

25. Remove commutator and five pins (A) 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.

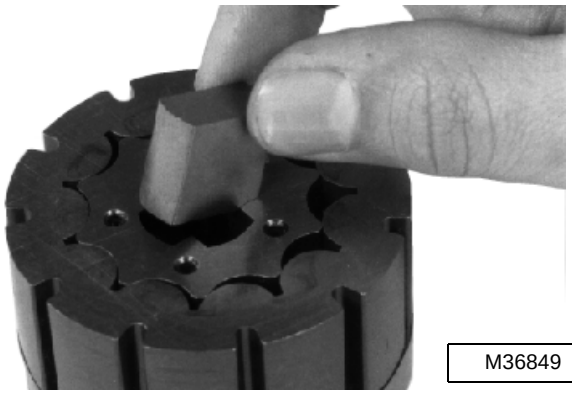


M36848

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.

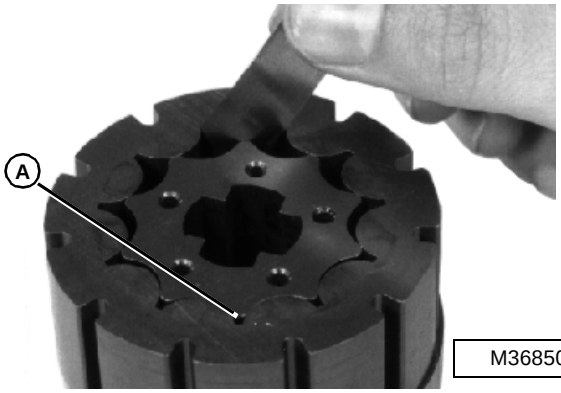
NOTE: Stator and rotor are a matched set. If either are worn or damaged, both must be replaced.



M36849

29. Measure rotor-to-stator clearance. Center rotor lobe (A) between stator lobes and check clearance directly opposite lobe (A).

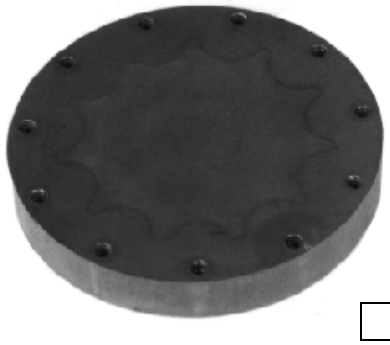
If rotor-to-stator clearance is more than **0.08 mm (0.003 in.)**, replace rotor and stator.



M36850

30. Lift the rotor and stator drive plate.

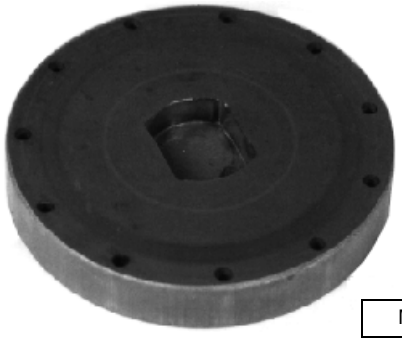
31. Check the drive plate side of the rotor assembly for nicks, grooves, or scoring. A spiral pattern due to rotor movement is normal.



M36851

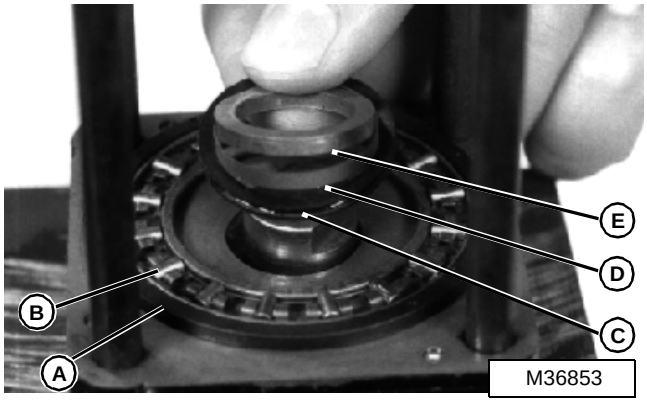
The thrust bearing side of the plate should also show a normal wear pattern without grooves, flaking, or dents.

The flat side of the input shaft hole should not be grooved or worn.


M36852

32. Remove parts (A—E).

33. Inspect parts for wear or damage. Replace if necessary.

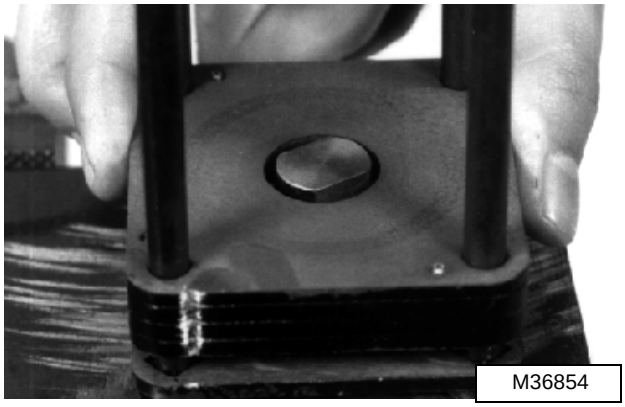


M36853

A— Thrust Bearing Spacer
B— Thrust Bearing
C— Face Seal
D— Backup Ring
E— Seal Spacer

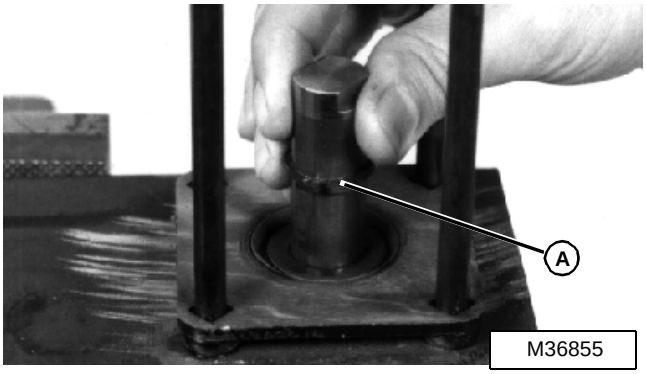
34. Remove upper cover plate (four plates bonded together).

35. Check plate surface for grooves, dents, or metal flakes. A polished pattern due to the action of the seal is normal.


M36854

36. Remove steering shaft and snap ring (A).

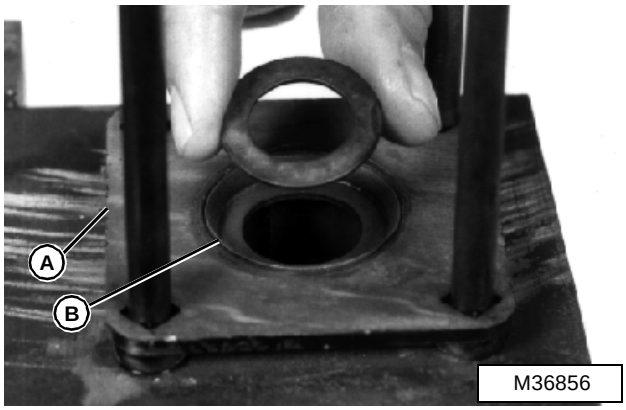
37. Inspect steering shaft serrations, threads, and flats for grooves, wear, or damage.



M36855

38. Remove washer and steering tube (A).

NOTE: Steering tube and retaining plate (B) are a matched set. If either part is worn or damaged, both must be replaced.

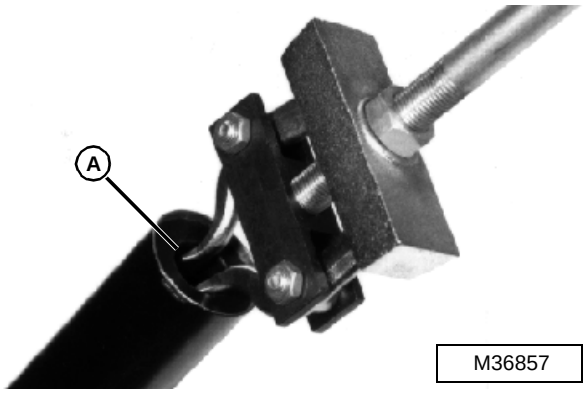


M36856

IMPORTANT: Hold steering tube in a soft-jaw vice. Be careful not to crush steering tube.

39. Inspect bushing (A) 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.



M36857

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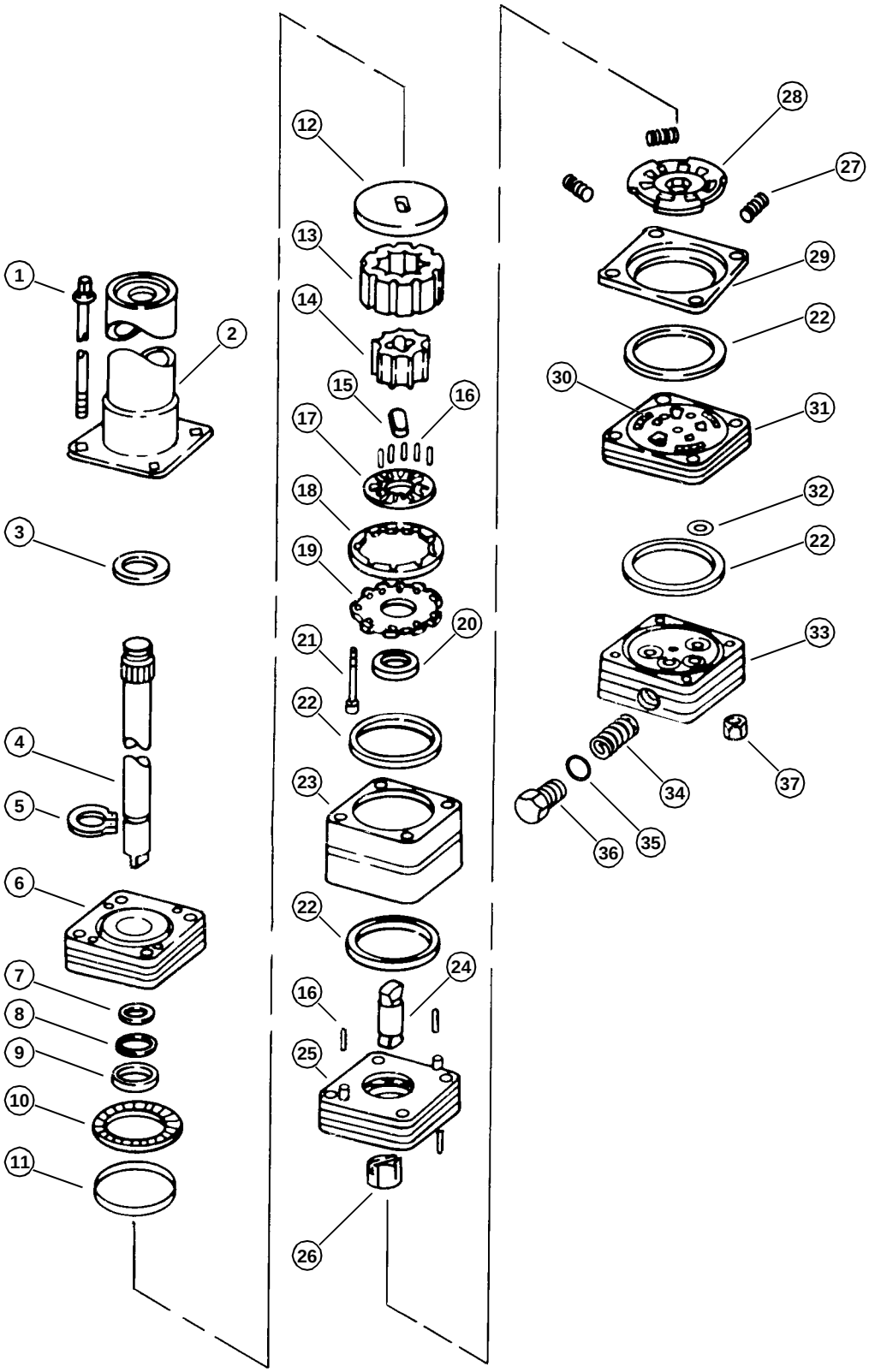
Inspection



M54206A

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 fingernail or lead pencil, the part should be replaced.

Inspect all parts for wear or damage. Replace 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)

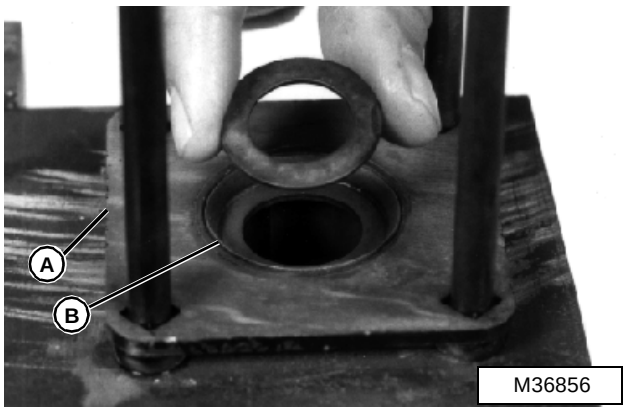
Assembly

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.

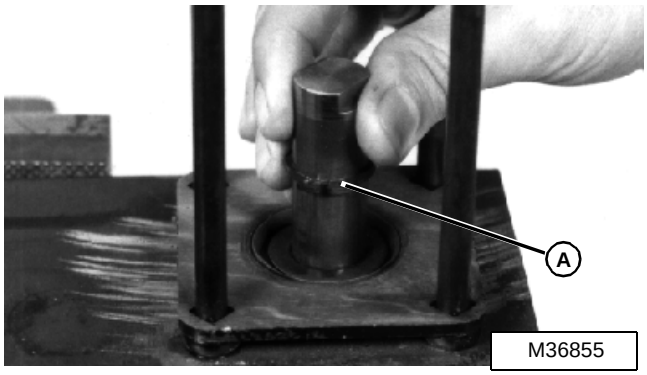

M36860

4. Install steering tube (A) 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 (B) and washer.
6. Install washer.



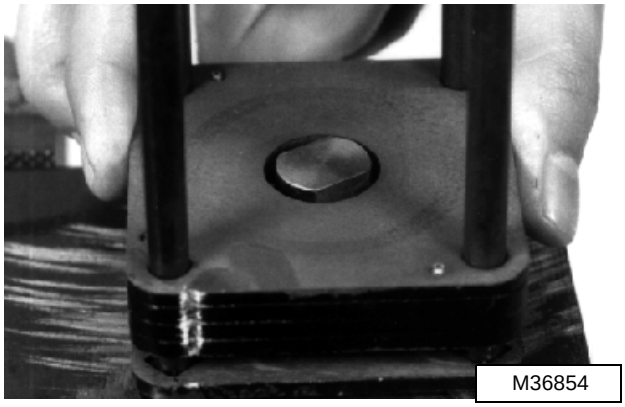
M36856

7. Install snap ring (A) on steering shaft.
8. Install steering shaft with threaded end down into steering tube.



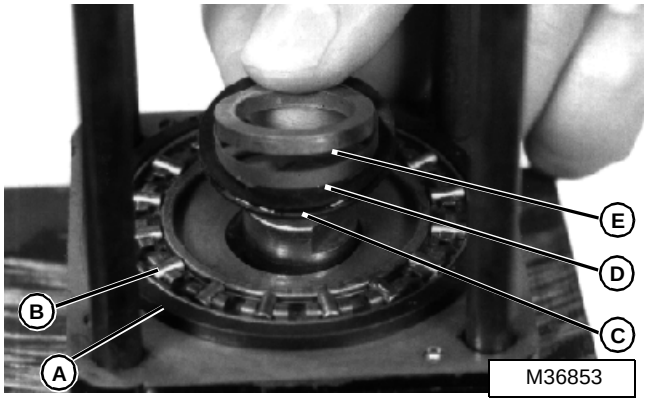
IMPORTANT: Alignment grooves must be on only one side of steering valve for proper valve operation

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 (B).

11. Install parts (A—E).

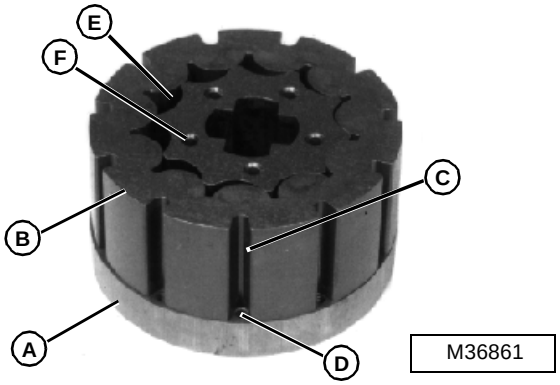


A— Thrust Bearing Spacer
B— Thrust Bearing
C— Face Seal
D— Backup Ring
E— Seal Spacer

12. Put drive plate (A) on a clean surface with slot downward.

13. Install and turn stator (B) until the stator slots (C) are aligned with drive plate holes (D).

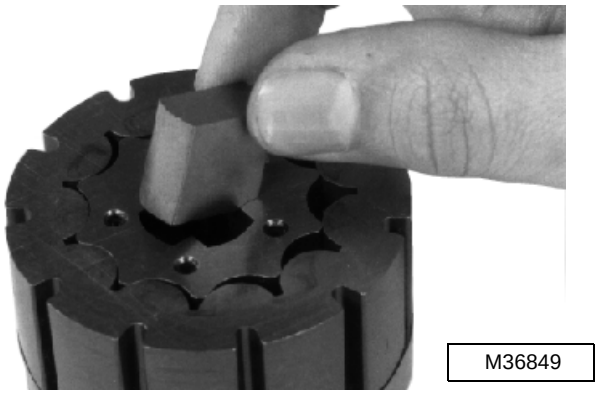
14. Install rotor (E) with five pin holes (F) up.



A— Drive Plates
B— Stator
C— Stator Slots
D— Drive Plate Holes
E— Rotor
F— Pin Holes

15. Apply multipurpose grease to spacer.

16. Install spacer in rotor drive slot.

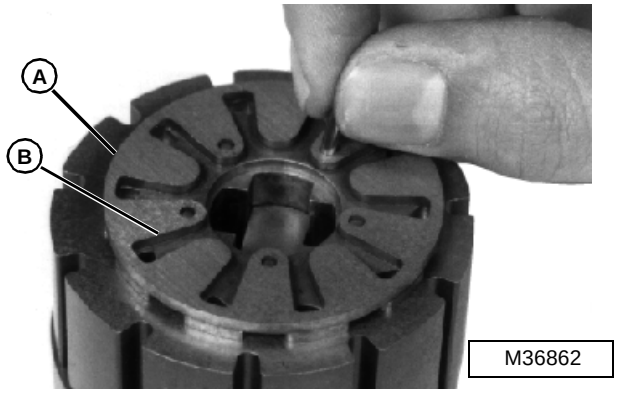


17. Install commutator (A) on rotor, with long grooves (B) upward.

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.

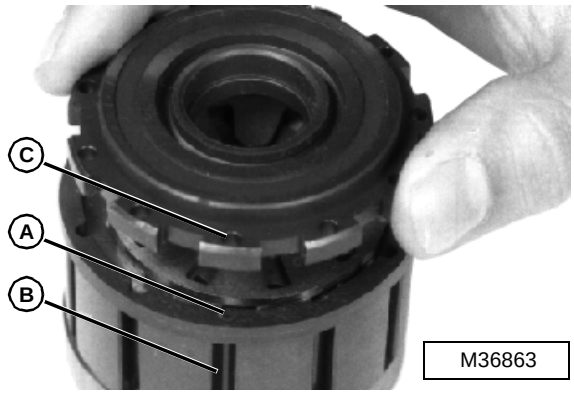


20. Align commutator ring slots (A) with stator slots (B) and install commutator ring.

21. Align commutator cover holes (C) 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.

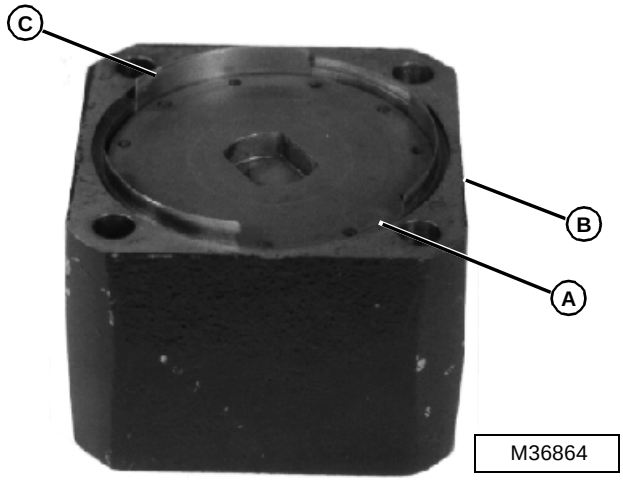
23. Install 11 screws into metering assembly. DO NOT tighten screws at this time.



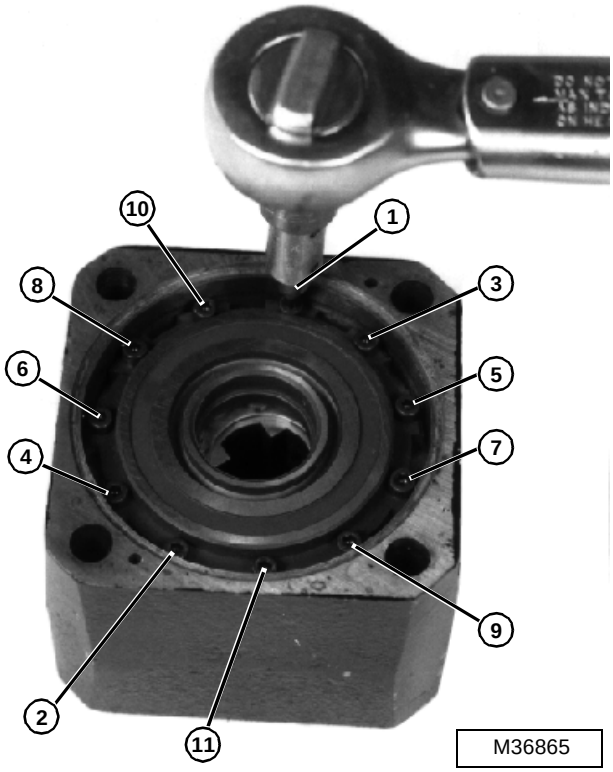
IMPORTANT: The following procedure must be used to minimize an out-of-round condition between commutator ring and drive plate. The commutator ring is self-centering when the drive plate is shimmed. Use DFMX4A Alignment Shims.

24. Install metering assembly, with drive plates (A) up into metering ring (B).

25. Install two DFMX4A Alignment Shims (C) each between the drive plate and metering ring 120° apart. (See DEALER FABRICATED TOOLS at the beginning of this section 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.)**.



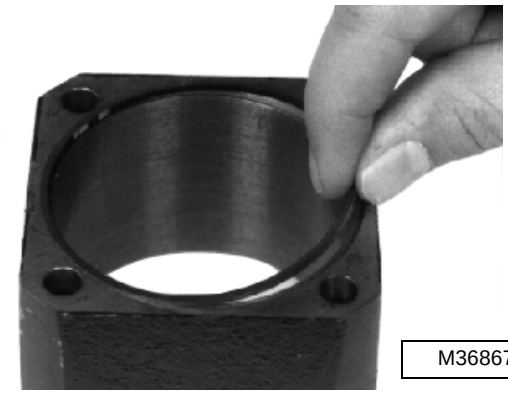
27. Remove Shims and meting assembly from metering ring.

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.

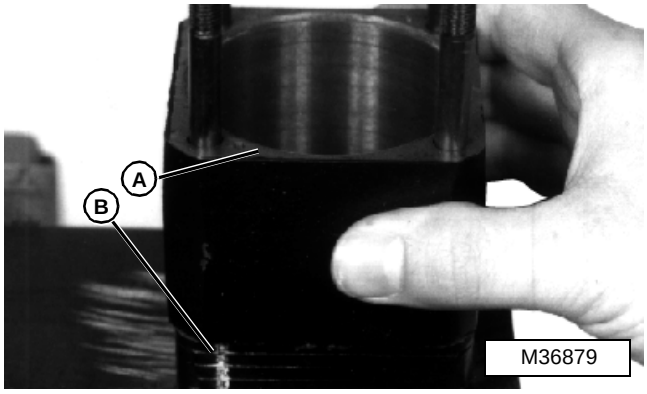

M36866

29. Apply multipurpose grease to seal ring. Install seal ring on metering ring end without pin holes.


M36867

IMPORTANT: Align pin holes (A) in metering ring with groove (B) on upper cover plate so that remaining parts can be aligned correctly.

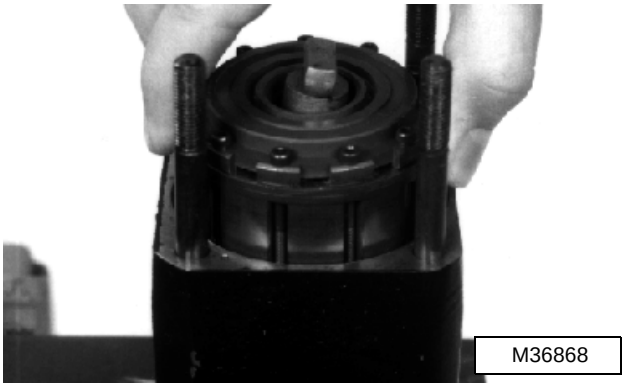
30. Install metering ring over bolts with pin holes up.



M36879

31. Apply multipurpose grease on drive plate surface.

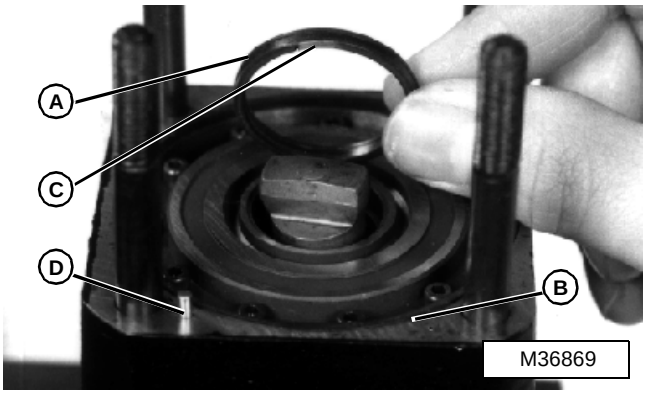
32. Install metering assembly with drive plate down into metering ring. Turn metering assembly until the steering shaft engages the plate hole. When properly seated, the metering assembly is below the surface of the metering ring.


M36868

33. Apply multipurpose grease on commutator seal (A) and seal ring (B).

34. Install commutator seal with yellow mark (C) down into commutator cover.

35. Install seal ring and pins (D).



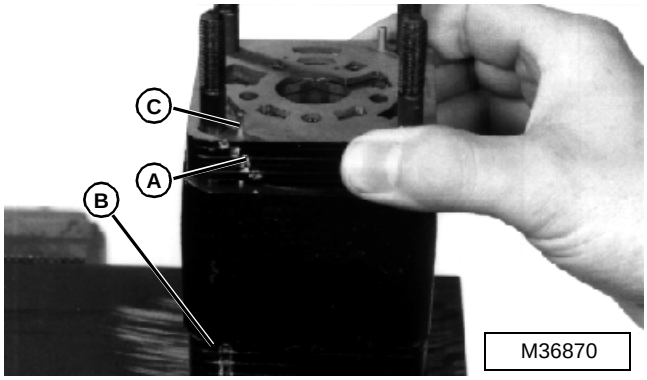
M36869

A— Commutator Seal
B— Seal Ring
C— Yellow Mark
D— Pin (2 used)

IMPORTANT: Align grooves (A) in isolation manifold with groove (B) in upper cover plate.

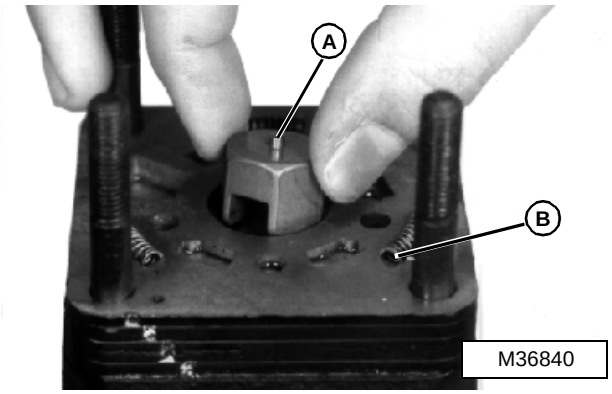
36. Install isolation manifold, with recessed slots up, on metering ring.

37. Install pins (C).



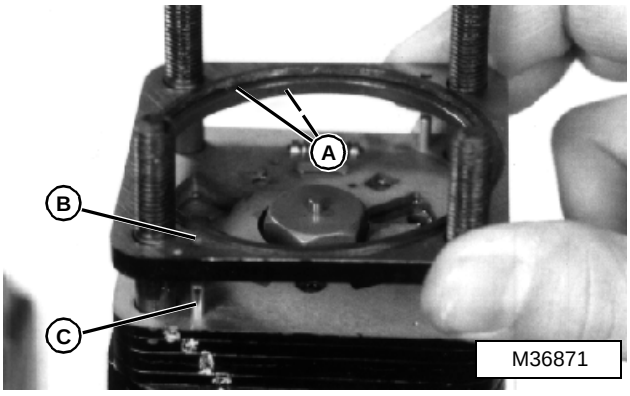
38. Install three 13 mm (0.500 in.) springs (B) in recessed slots of the isolation manifold.

39. Install hex drive assembly on drive link with pin (A) up.



40. Apply multipurpose grease to seal rings (A). Install seal rings on valve ring.

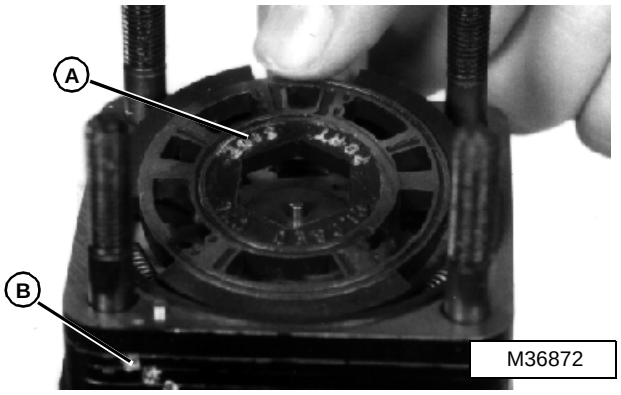
41. Align valve ring holes (B) with pins (C) to install valve ring.



IMPORTANT: Valve plate must be installed with "PORT SIDE" (A) directly opposite (12 o'clock position) from alignment grooves (B) 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" (A) up, on isolation manifold. Turn valve plate to make sure springs are centered in the valve plate spring slots.

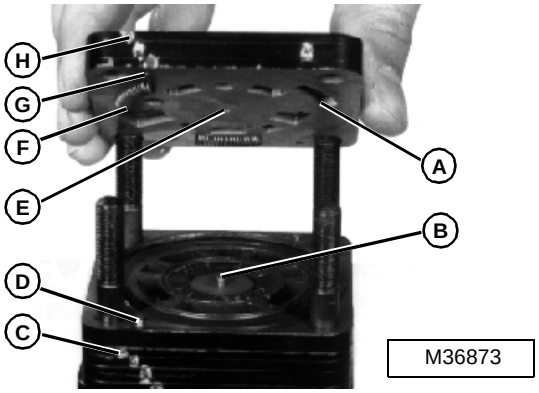
43. Apply clean hydrostatic oil to valve plate.



44. Install three 19 mm (0.750 in.) springs (F) in recessed slots (A) of the port manifold.

IMPORTANT: Align grooves (H) in port manifold with grooves (C) 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 (D) engage alignment holes (G) in port manifold. Be sure hex drive assembly pin (B) engages center hole (E) in port manifold.

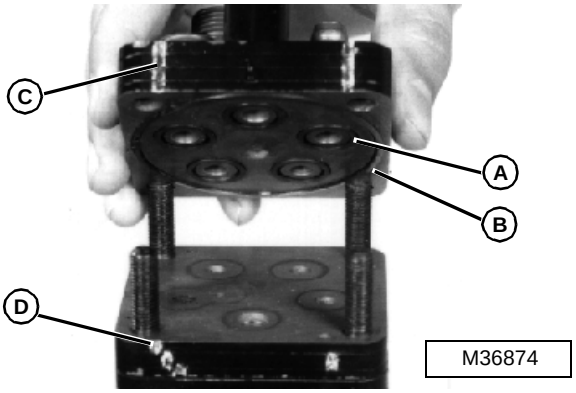


A— Recessed Slot
B— Hex Drive Assembly Pin
C— Isolation Manifold Grooves
D— Pin (2 used)
E— Port Manifold Center Hole
F— 19 mm (0.750 in.) Spring (3 used)
G— Port Manifold Alignment Hole (2 used)
H— Port Manifold Grooves

46. Apply multipurpose grease to five O-rings (A) and seal ring (B). Install O-rings and seal ring in port cover.

IMPORTANT: Align grooves (C) in port cover with grooves (D) in port manifold.

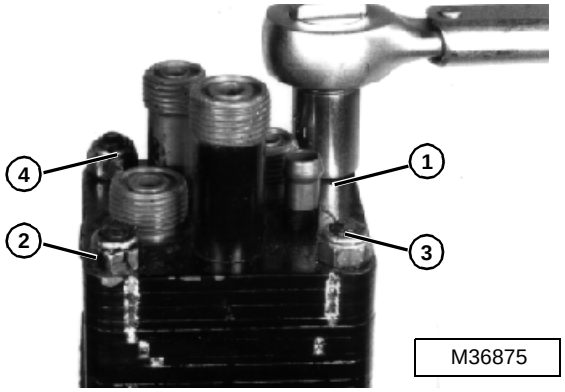
47. Install port cover.



A— O-Ring (5 used)
B— Seal Ring
C— Port Cover Alignment Grooves
D— Port Manifold Alignment Grooves

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

c CAUTION y

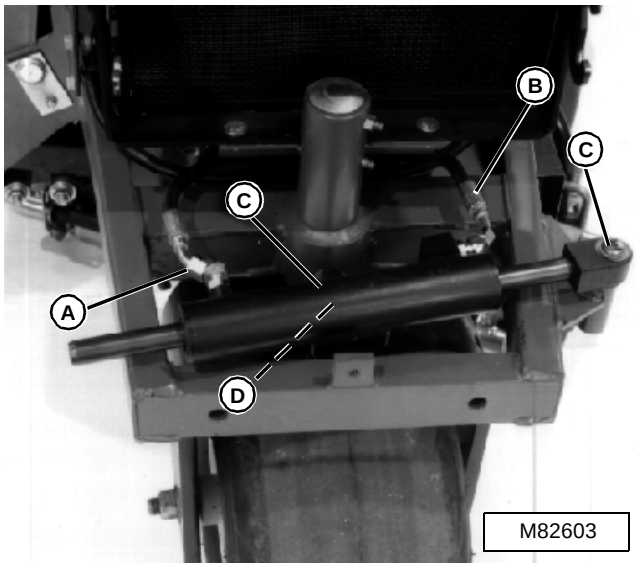
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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 hood.
2. Remove rear cover.
3. Disconnect hydraulic hoses (A and B).
4. Remove snap rings (C).

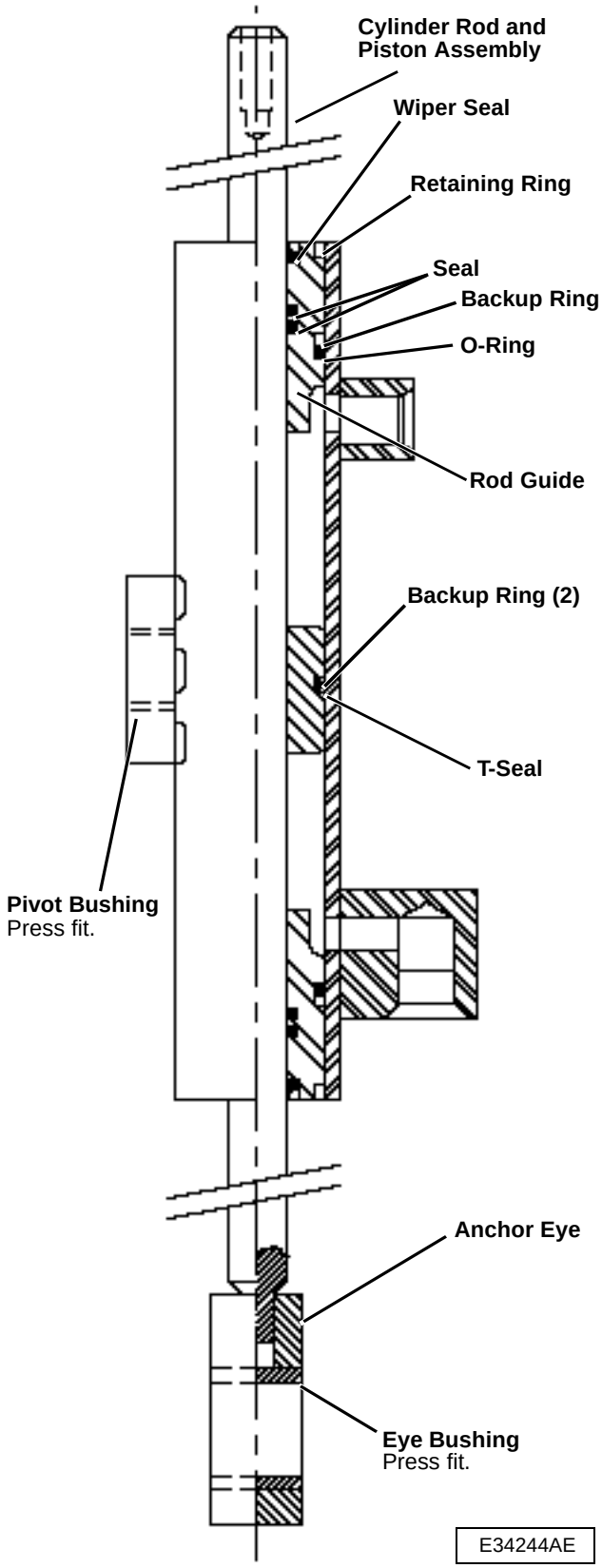
5. Remove steering cylinder.
6. Remove washers (D), if equipped.

Installation is performed in the reverse order of removal.



A— Hose, Rod End-to-Steering Valve Port LT
B— Hose, Rod Anchor-to-Steering Valve Port RT
C— Snap Rings
D— Washers (as required)

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 procedure in MISCELLANEOUS section.)
2. Remove hood.
3. Remove steering cylinder cover.

NOTE: Steering cylinder hydraulic hoses do not have to be disconnected.

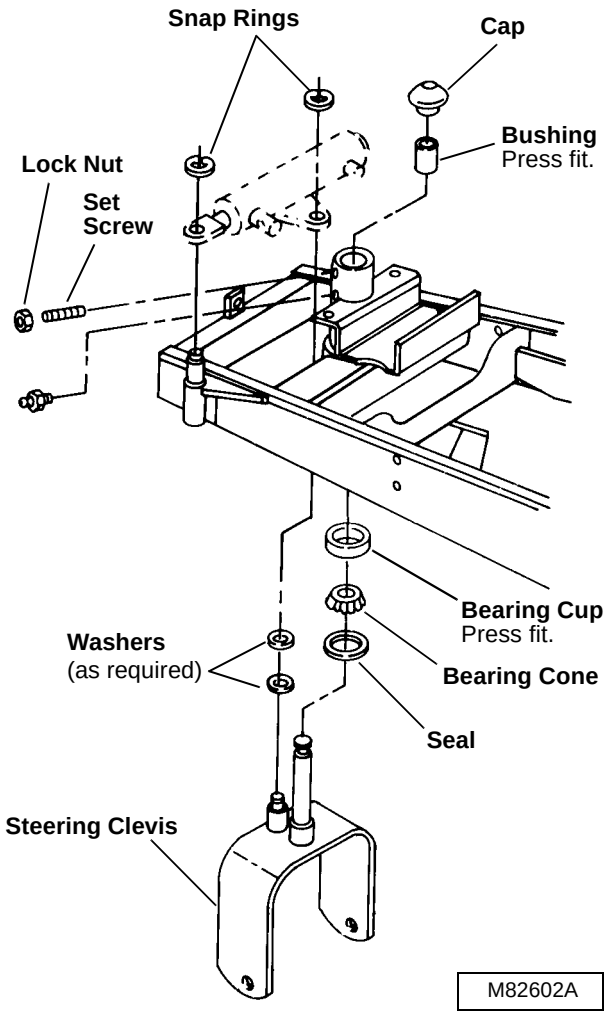
4. Remove two snap rings, steering cylinder and washers, if equipped.
5. Loosen lock nut and remove set screw.
6. Remove cap. If necessary, remove steering clevis using a brass drift hammer.
7. Remove seal and bearing cone using a brass drift and hammer.

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.



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BRAKES

TEST AND 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

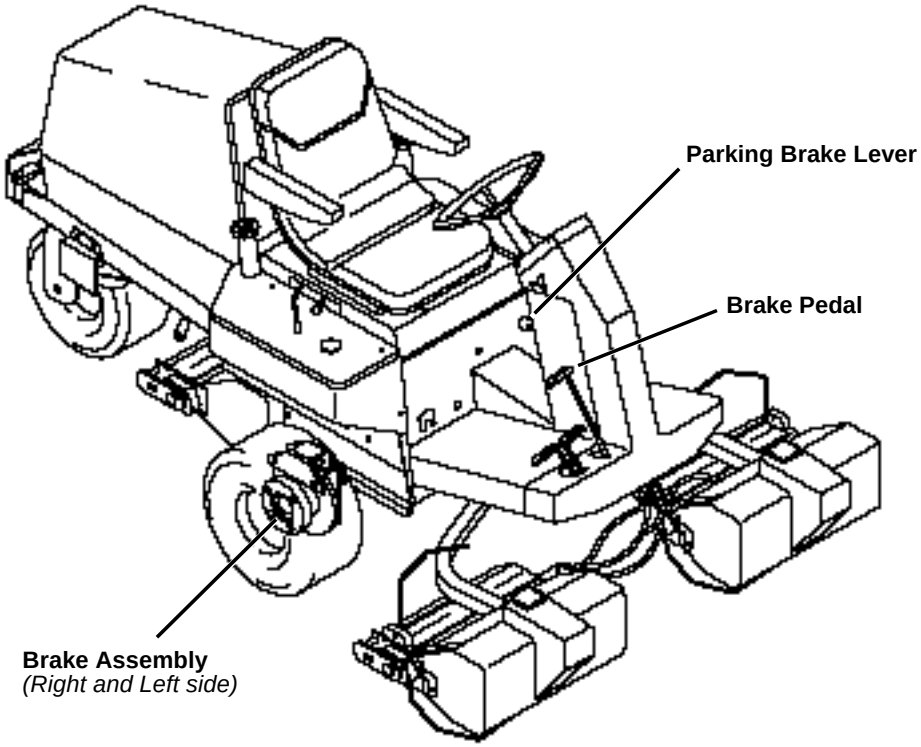
Axle shaft slotted nut torque	237 N•m (175 lb-ft) plus additional turn to align slot and hole.

OTHER MATERIALS

Number	Name	Use
PT569	NEVER-SEEZ® Lubricant	Lubricate axle shaft.

® NEVER-SEEZ is a registered trademark of the Emhart Chemical Group.

BRAKE SYSTEM COMPONENTS



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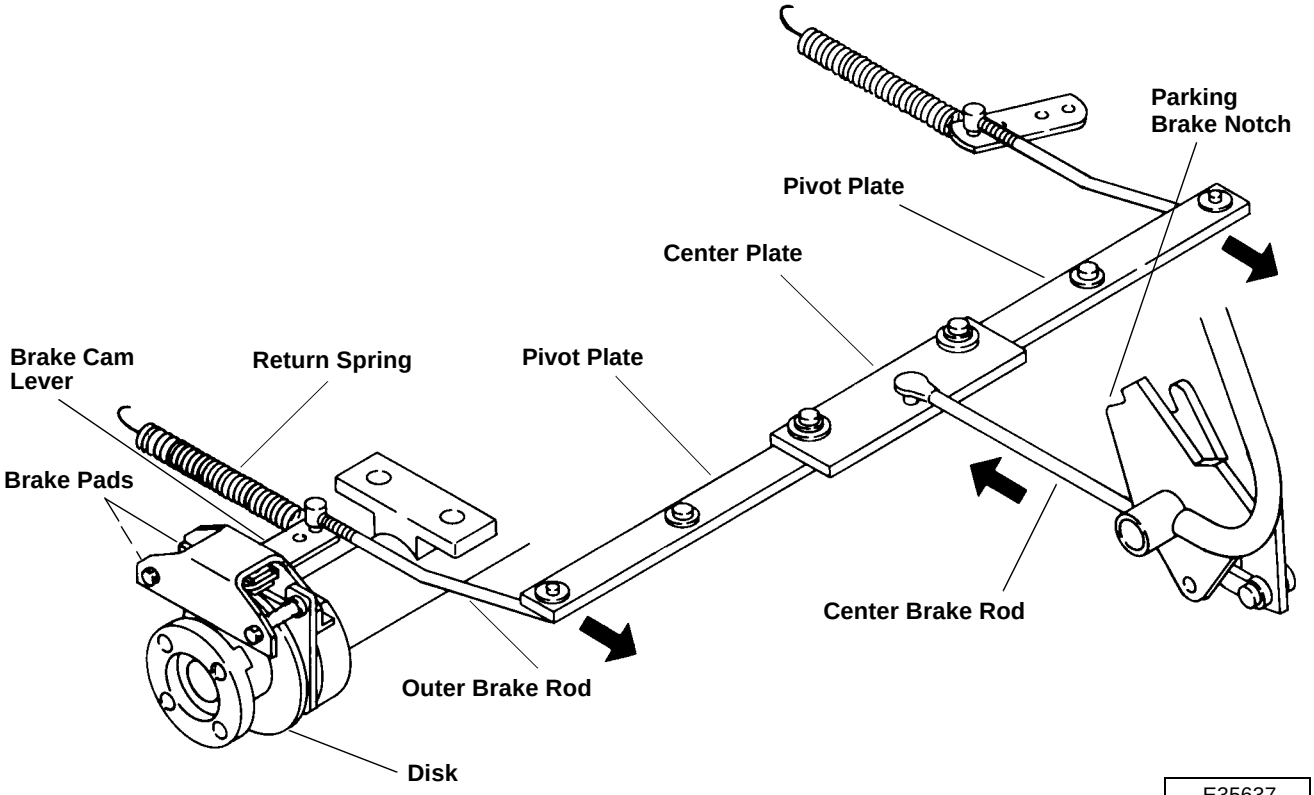
BRAKE SYSTEM OPERATION



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.

BRAKE SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	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.			●							

BRAKE SYSTEM DIAGNOSIS

Test Conditions:

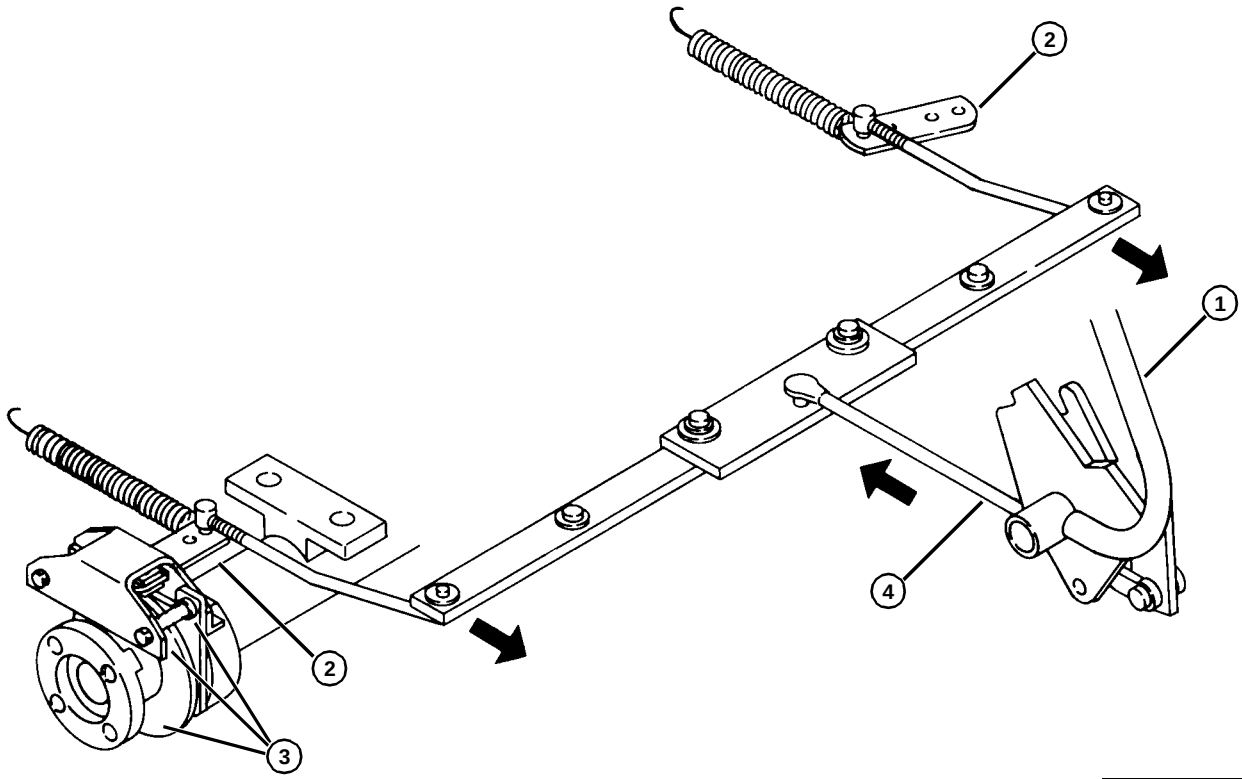
- Key switch OFF and transmission in NEUTRAL.

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).

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 Adjustment and Brake Linkage Adjustment).



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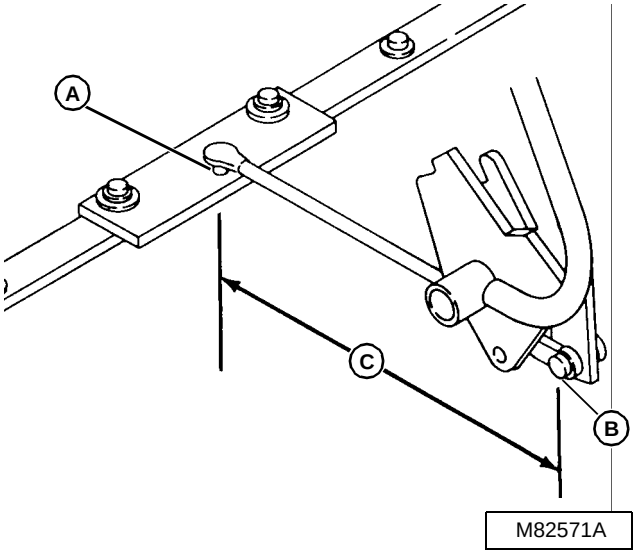
CENTER BRAKE ROD ADJUSTMENT

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 (A).
7. Remove cotter pin and pin (B), 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.)** (C) from center of pin to center of hole in yoke.



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BRAKE LINKAGE ADJUSTMENT

Reason:

To ensure brake linkage is properly adjusted.

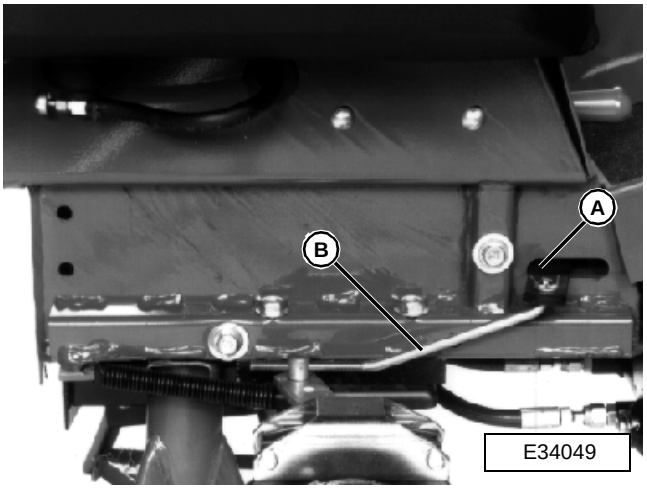
Procedure:

NOTE: Center brake rod adjustment should be verified before performing brake linkage adjustment procedure.

1. Adjust center brake rod.
2. Remove cotter pin (A).
3. Adjust outer brake rod (B) 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**.*

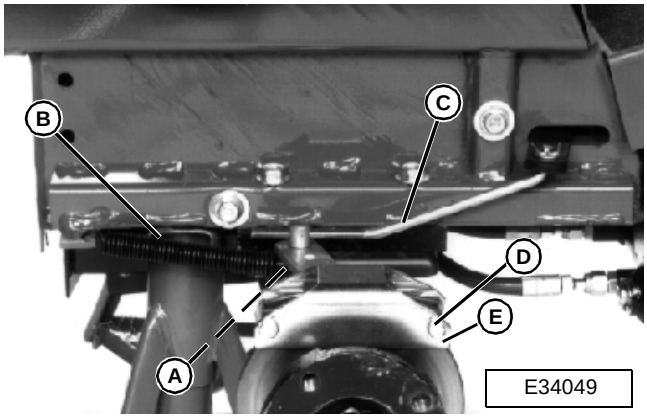
4. Repeat procedure on opposite side.



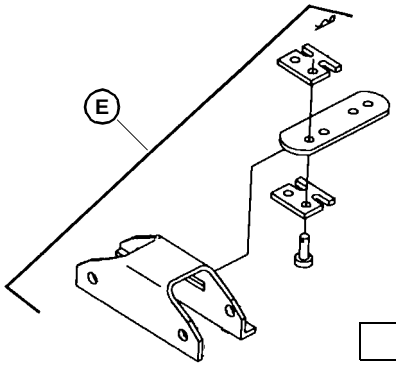
E34049

BRAKES

1. Disconnect negative (-) cable from battery.
2. Lift front of machine. Place support stands under frame.
3. Remove wheel.
4. Remove spring (B), and washer (A) located under brake lever.
5. Lift pivot pin and outer brake rod (C) from brake lever.
6. Remove cap screws (D), nuts, and bracket assembly (E).



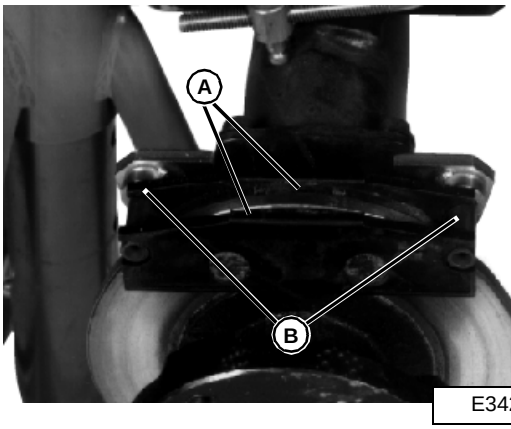
E34049



E35423

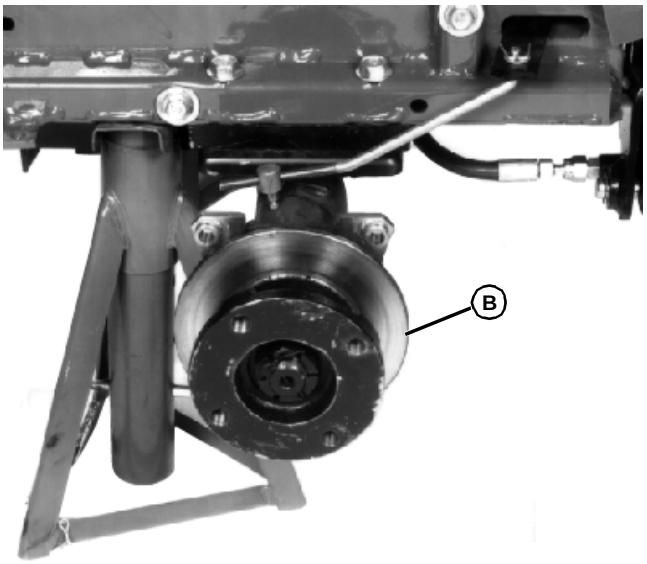
A— Washer
B— Spring
C— Outer Brake Rod
D— Cap Screw
E— Bracket Assembly

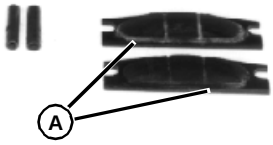
7. Remove pads (A) and spacers (B).



E34200

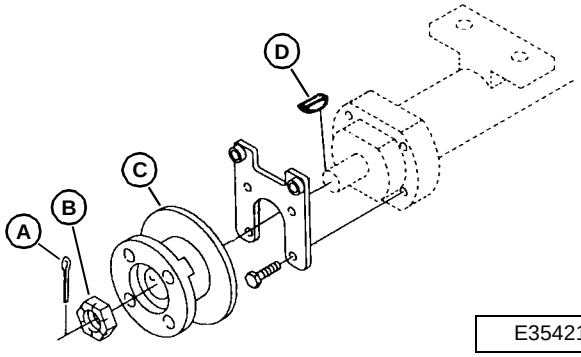
8. Inspect lining on brake pads (A) for wear or oil contamination. Replace pads if worn or contaminated. Inspect axle oil seals if pads are oily.
9. Inspect wheel hub (B) for excessive wear, cracks, or brake disk scoring.





E34201

10. Remove cotter pin (A) to remove slotted nut (B).
11. Pull wheel hub (C) and key (D) from axle shaft.

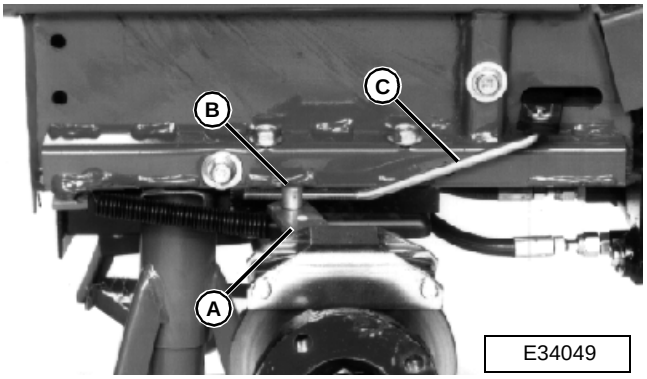


E35421

A— Cotter Pin
B— Slotted Nut
C— Wheel Hub
D— Key

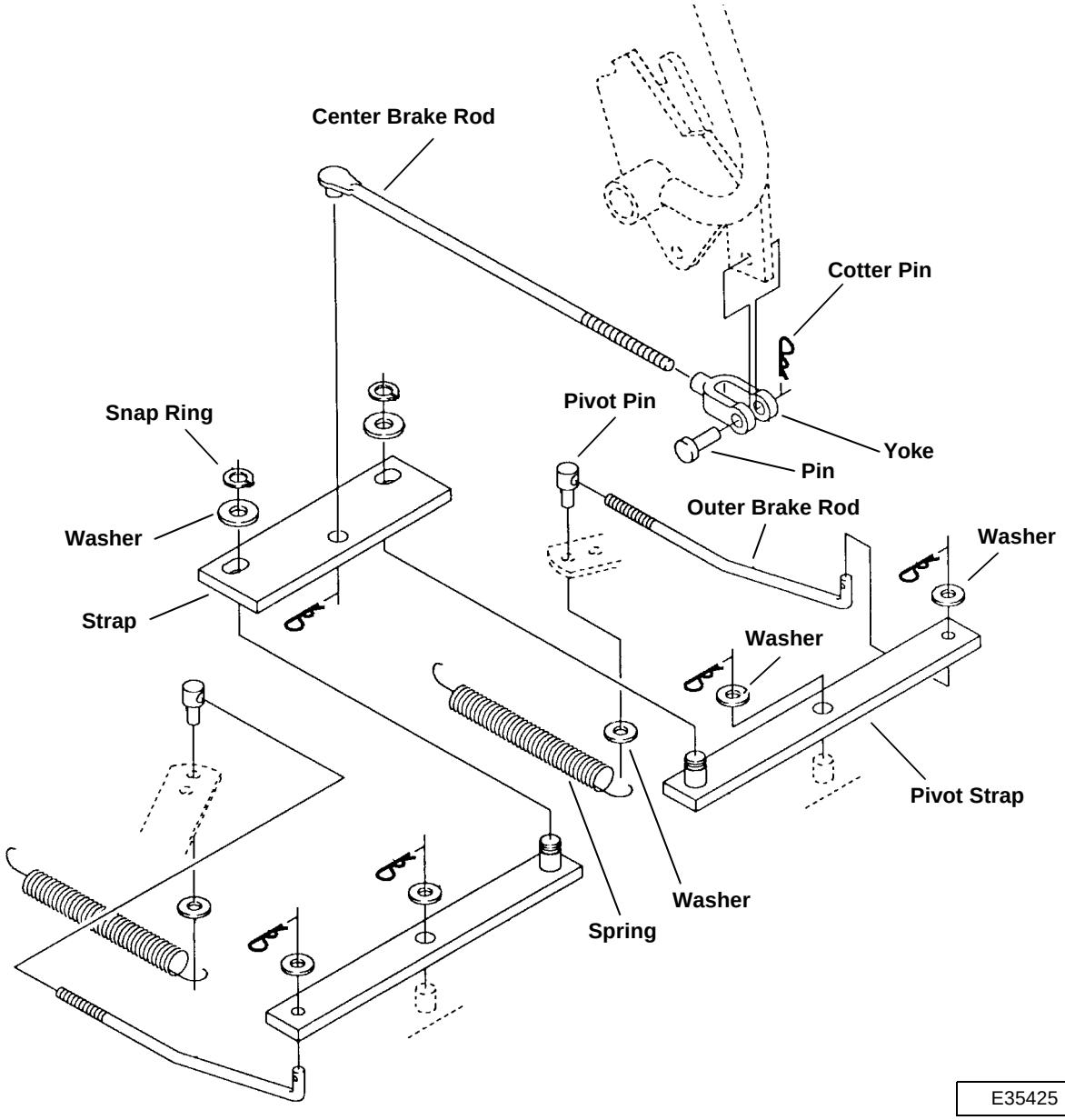
Installation is performed in the reverse order of removal.

- Apply NEVER-SEEZ lubricant to tapered section of axle shaft.
- Tighten slotted nut to **237 N•m (175 lb-ft)**.
- Connect outer brake rod (C). Insert pivot pin (B) into hole in brake lever (A) nearest to machine frame.



E34049

BRAKE LINKAGE



- Replace worn or damaged parts.
- Adjust Center Brake Rod and Brake Linkage.

CONTENTS

Page

HYDRAULICS

CONTENTS

TEST AND ADJUSTMENT SPECIFICATIONS

Hydraulic pump flow volume (fast idle)

- Flow rate at 1723 kPa (250 psi) . . . . . 15.5 L/min (4.1 gpm)
- Flow rate at 6895 kPa (1000 psi) . . . . . 13.2 L/min (3.5 gpm)

Reel drive system oil flow volume . . . . . 22 L/min (5.8 gpm) at fast idle

Steering valve inlet pressure . . . . . 2400 kPa (350 psi) at fast idle

Steering valve inlet pressure . . . . . 7585 kPa (1100 psi) at fast idle (with lift system engaged - 7 seconds)

Steering relief valve pressure. . . . . 5000 kPa (725 psi) at fast idle

Mow valve assembly relief pressure . . . . . 20684 kPa (3000 psi) at fast idle

Rear lift linkage pin clearance (top of pin to crossmember) . . . . . 40 mm (1.575 in.)

Rear lift linkage clamp screws torque . . . . . 129 N•m (95 lb-ft)

REPAIR SPECIFICATIONS

Hydraulic Pump

Pump section socket head cap screw torque:

- Large . . . . . 42 N•m (31 lb-ft)
- Small . . . . . 23 N•m (200 lb-in.)

Lift Valve

Plunger tube assembly torque . . . . . 11 N•m (100 lb-in.)

Tie rod nut torque:

- First . . . . . 6 N•m (50 lb-in.)
- Second . . . . . 10 N•m (90 lb-in.)
- Final . . . . . 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)

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).

JTO54469 Flowmeter Kit
Used to check hydraulic system flow.

JTO5687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
Used with Flowmeter kit.

JTO3012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
Used with Flowmeter kit.

JTO3385 3/4 F NPT x 7/8 M 37° Adapter Fitting
Used with Flowmeter kit.

JTO3385 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.

JTO5637 Pressure Gauge, 0 to 40,000 kPa (6000 psi)
Used to check hydraulic system pressure (high pressure).

JTO7038 Pressure Gauge, 0 to 2000 kPa (300 psi)
Used to check hydraulic system pressure (low pressure).

JTO5719 Hand-Held Digital Tachometer
Used to check reel motor speed.

BM18290 Hydraulic Diagnostic Kit
Used to perform various hydraulic system tests.

Hydraulic Diagnostic Kit includes:

Part Number	Description	Qty Used
AMT846	Hose, 48” hydraulic diagnostic	1
MT1542	Nipple, -10 diagnostic	2
RE43774	Diagnostic Receptacle, 1/2” tube x 1/8” body	3
RE48122	Diagnostic Coupler, 1/8-27 NPTF x 1/8” body	1
XPD6-285	Cap, dust	5
38H1031	13/16 M x 13/16 F Swivel Run Tee	3
38H1032	1 M x 1 F Swivel Run Test	2

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

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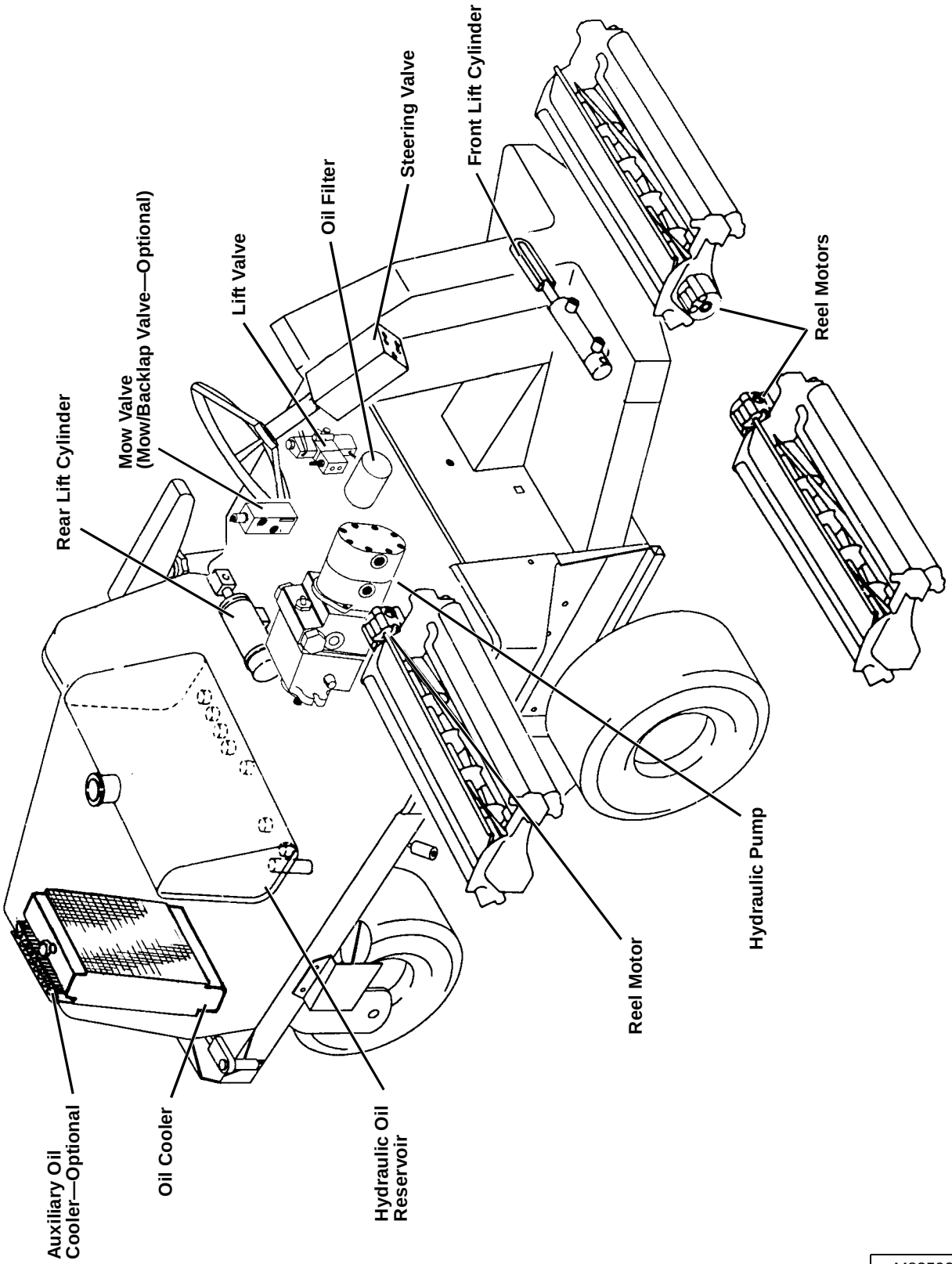
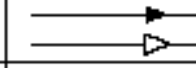
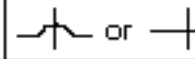
HYDRAULIC COMPONENTS

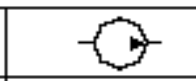
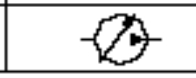


JIC HYDRAULIC CIRCUIT SYMBOLS

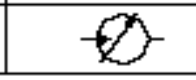
LINES

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

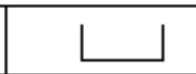
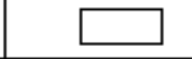
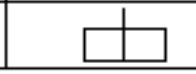
PUMPS

8		Fixed Displacement
9		Variable Displacement

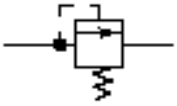
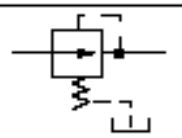
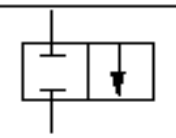
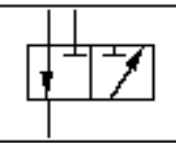
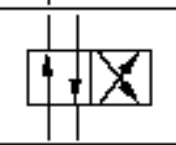
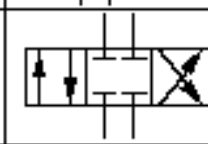
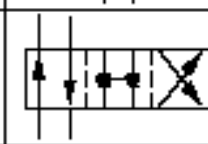
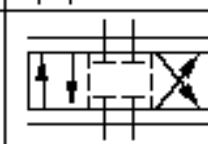
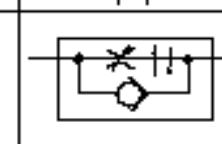
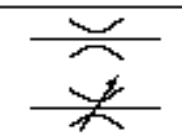
MOTORS

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

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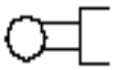
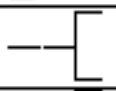
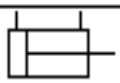
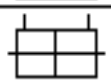
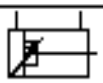
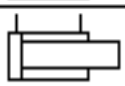
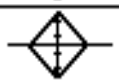
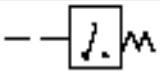
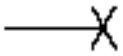
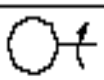
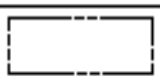
VALVE OPERATORS

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

LEGEND FOR HYDRAULIC/HYDROSTATIC SCHEMATIC

1—Engine
2—Hydrostatic Pump
3—Hydraulic Pump
4—Pressure Relief Valve (2 used)
5—Freewheel Valve
6—Steering Valve
7—Steering Cylinder
8—Control Valve
9—Fluid Metering Section
10—Steering System Relief Valve
11—Check Valve
12—Steering Wheel
13—Lift Valve
14—Lift Valve Spool
15—Lift Check Valve
16—Lower Check Valve
17—Fixed Flow Control Valve (3 used)
18—Rear Lift Cylinder
19—Front Lift Cylinder
20—Mow Valve
21—Mow Valve Spool
22—Relief Valve
23—Reel Motor (3 used)
24—Oil Cooler
25—Auxiliary Oil Cooler (Optional)
26—Oil Filter
27—Hydraulic Oil Reservoir
28—Hydrostatic Transaxle
29—GEROLER® Motor (2 used)
30—Mow/Backlap Valve (Optional)
31—Direction Valve
32—Flow Restrictor
33—Logic Element
34—Charge Pressure Relief Valve

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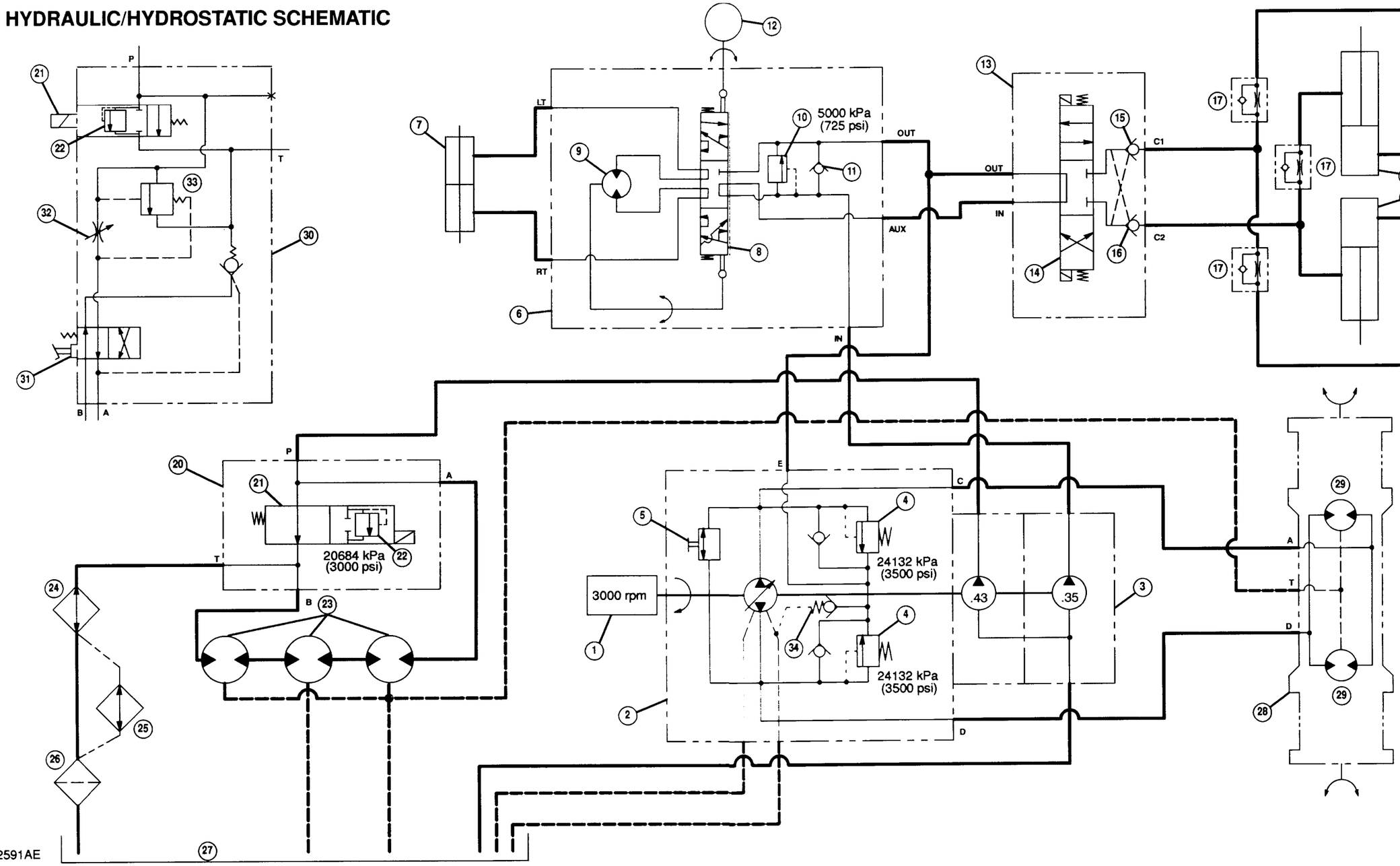
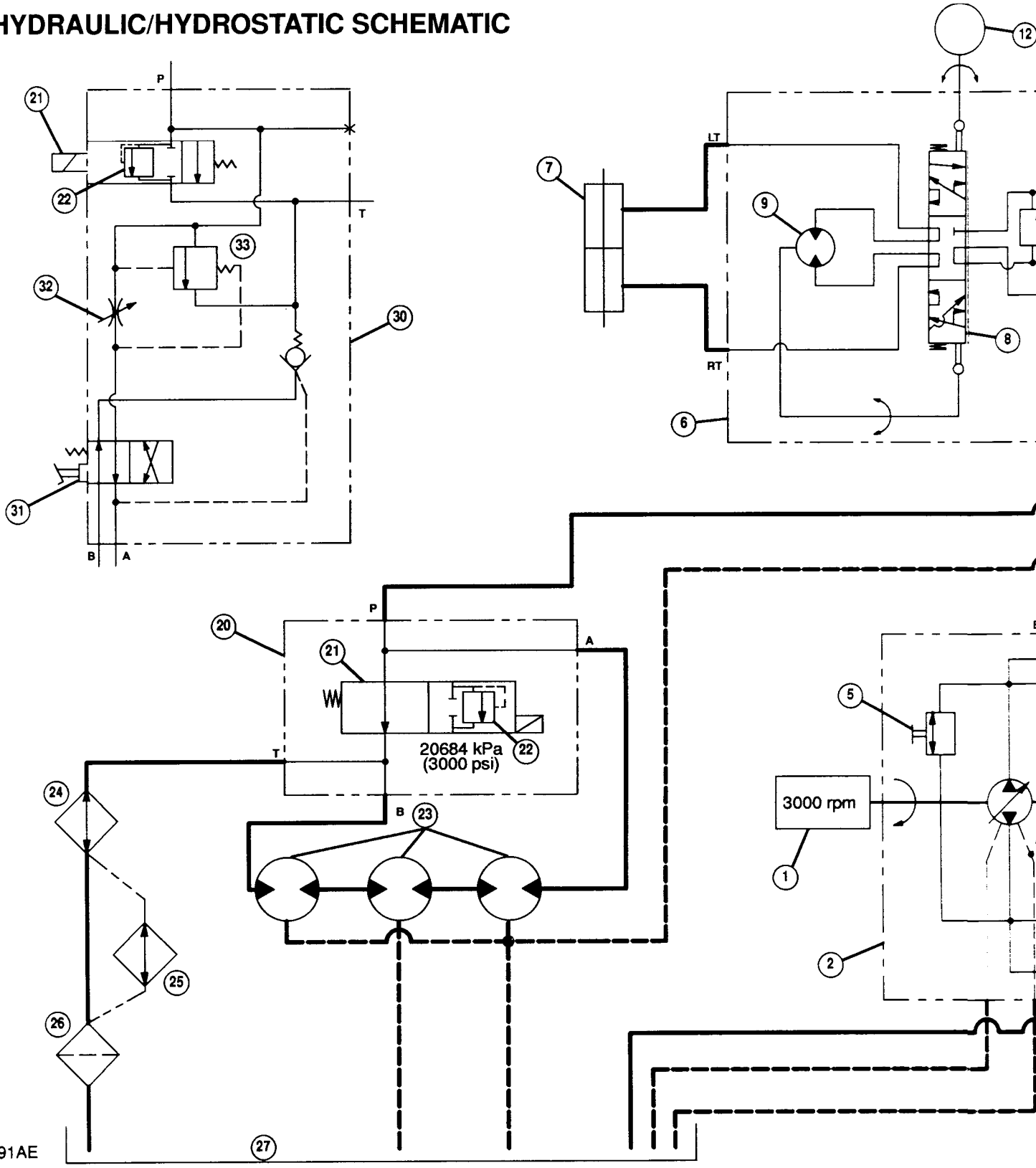
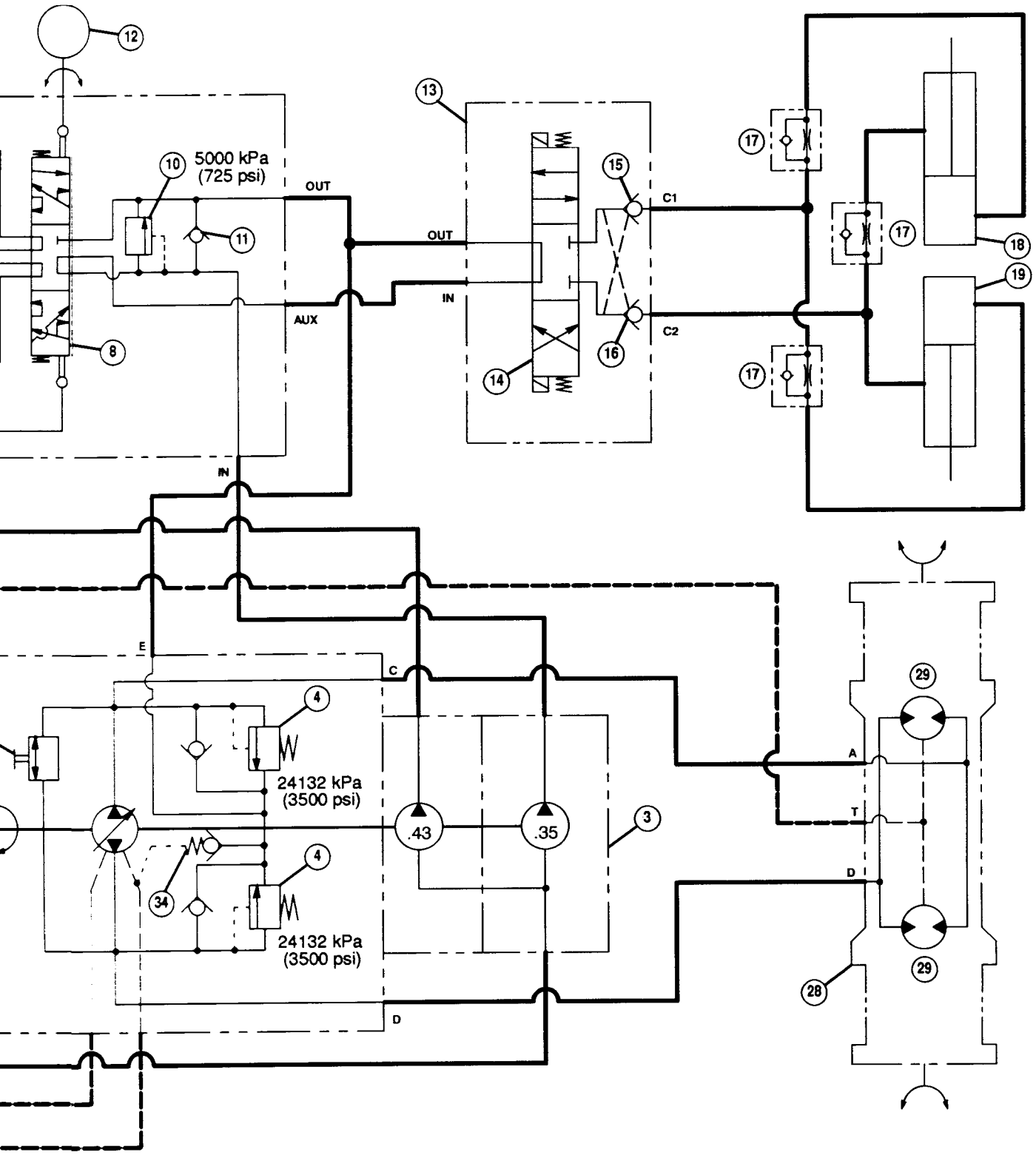
HYDRAULIC/HYDROSTATIC SCHEMATIC



HYDRAULIC/HYDROSTATIC SCHEMATIC




12
13
10
5000 kPa
(725 psi)
OUT
11
OUT
IN
AUX
8
15
C1
17
17
18
19
16
C2
14
17
IN
E
C
4
24132 kPa
(3500 psi)
.43
.35
3
4
34
24132 kPa
(3500 psi)
D
A
T
D
29
29
28

HYDRAULIC PUMP OPERATION

Function:

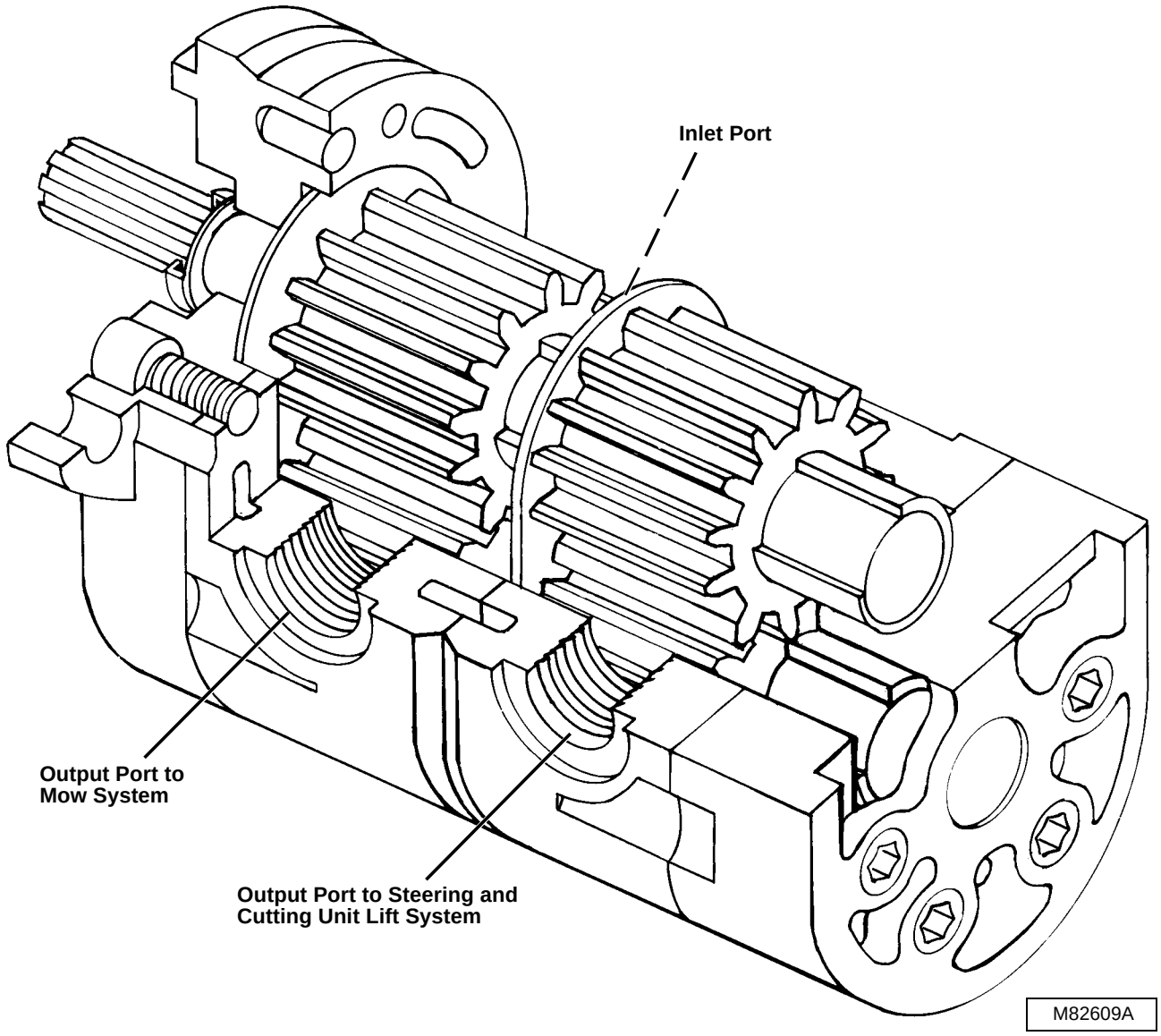
To provide high pressure oil to drive steering, reel drive, and cutting unit lift/lower systems.

Theory of Operation:

The hydraulic “pump” is actually two separate gear pumps with a common drive and oil supply.

The input shaft of the hydraulic pump is mated to the output shaft of the hydrostatic pump and is driven whenever the engine is running.

Low pressure oil from the hydraulic reservoir enters the pump at the inlet port and is supplied to both of the gear pumps. As the gear sets rotate, oil is pressurized and exits the pump at outlet ports to supply the mow system and the steering and cutting unit lift system.


Inlet Port
Output Port to
Mow System
Output Port to Steering and
Cutting Unit Lift System
M82609A

LIFT SYSTEM OPERATION

Function:

To lift or lower the cutting units.

Theory of Operation:

Oil is pressurized by the hydraulic pump (A) and routed through the steering valve (B). 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 (C) to open, routing oil to the hydrostatic pump. From the steering valve, high pressure oil is routed to the lift valve (D).

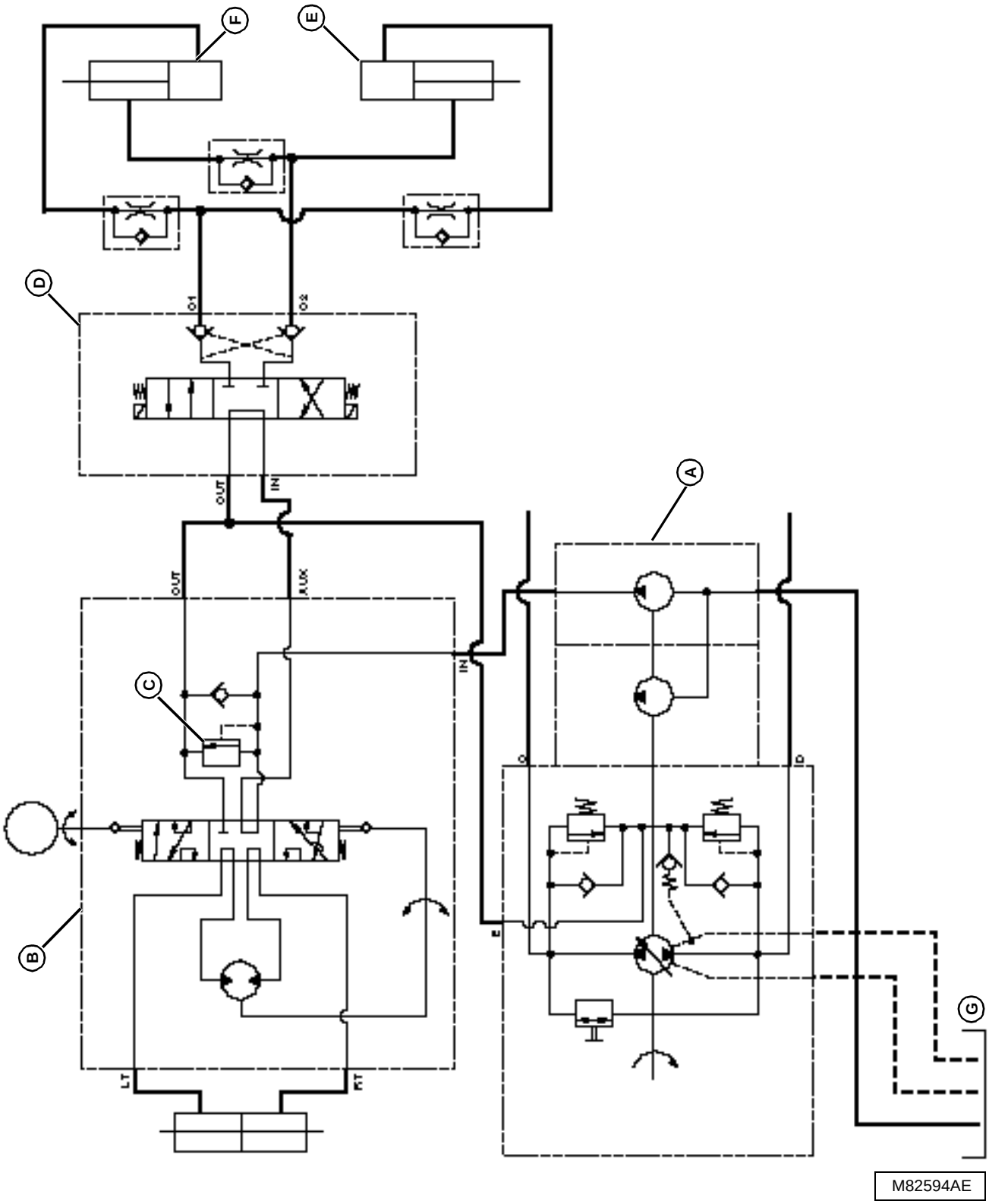
When the lower switch is depressed, oil is routed to the rod ends of the lift cylinders (E and F), lowering the cutting units.

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 (C) 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.

A— Hydraulic Pump
B— Steering Valve
C— Relief Valve
D— Lift Valve
E— Front Lift Cylinder
F— Rear Lift Cylinder
G— Hydraulic Oil Reservoir


F
E
D
O1
O2
OUT
IN
A
OUT
AUX
IN
C
B
LT
RT
G
M82594AE

LIFT VALVE ASSEMBLY—LOWER OPERATION

Function:

To lower the cutting units as the mow system is engaged.

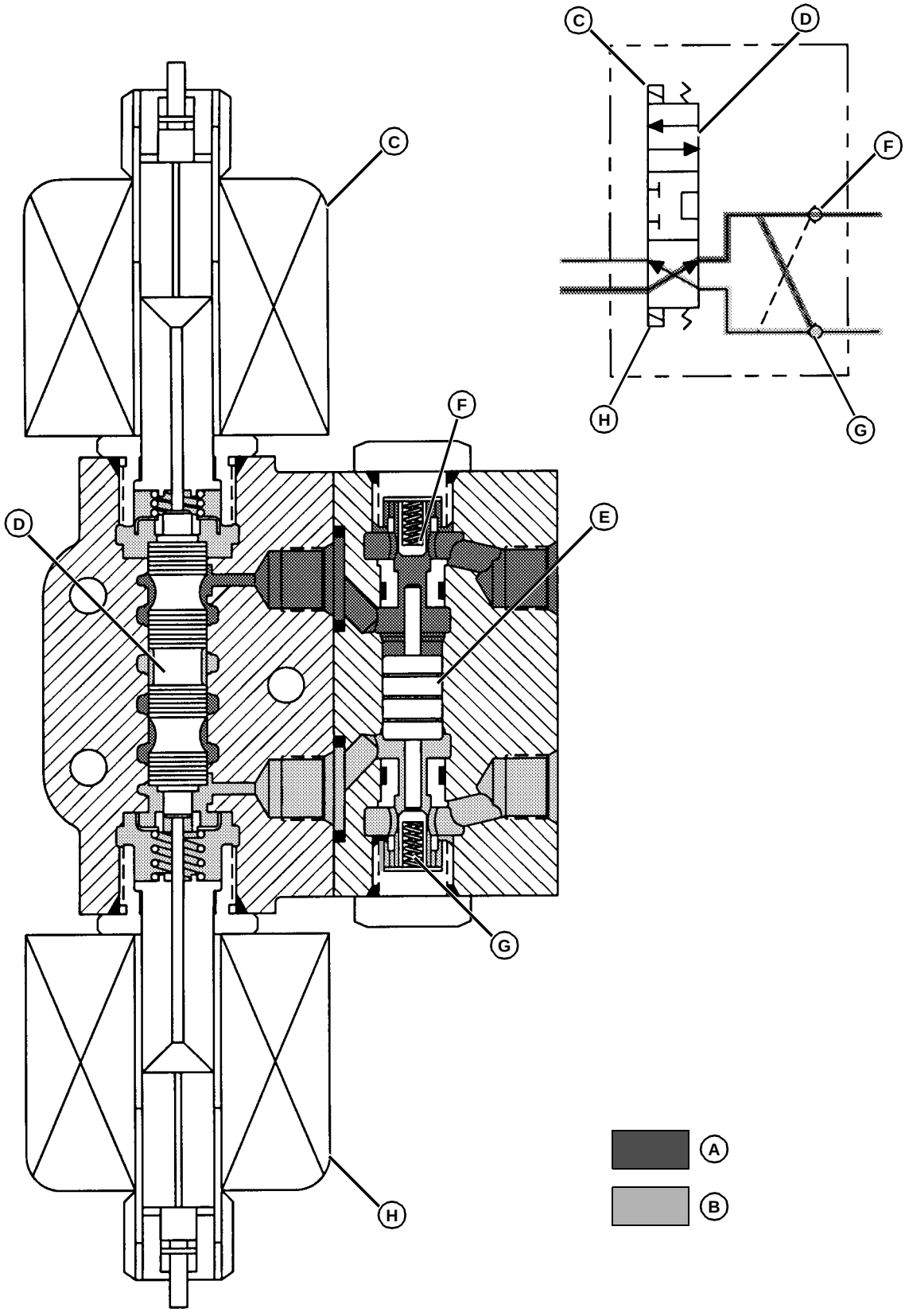
Theory of Operation:

When the lower switch is depressed, the controller energizes lower solenoid coil (H) of the lift valve. The solenoid pushes spool (D) up allowing high pressure oil (A) to flow into the upper port of the valve.

High pressure oil flows into the lock valve portion of the lift valve, pushing piston (E) down and upper lift check valve (F) 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 (G) opening the passageway for return oil (B) 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.

A— High Pressure Oil
B— Return Oil
C— Lift Solenoid Coil
D— Spool
E— Piston
F— Lift Check Valve
G— Lower Check Valve
H— Lower Solenoid Coil



E35646AE

LIFT VALVE ASSEMBLY—RAISE OPERATION

Function:

To raise the cutting units when the mow system is disengaged.

Theory of Operation:

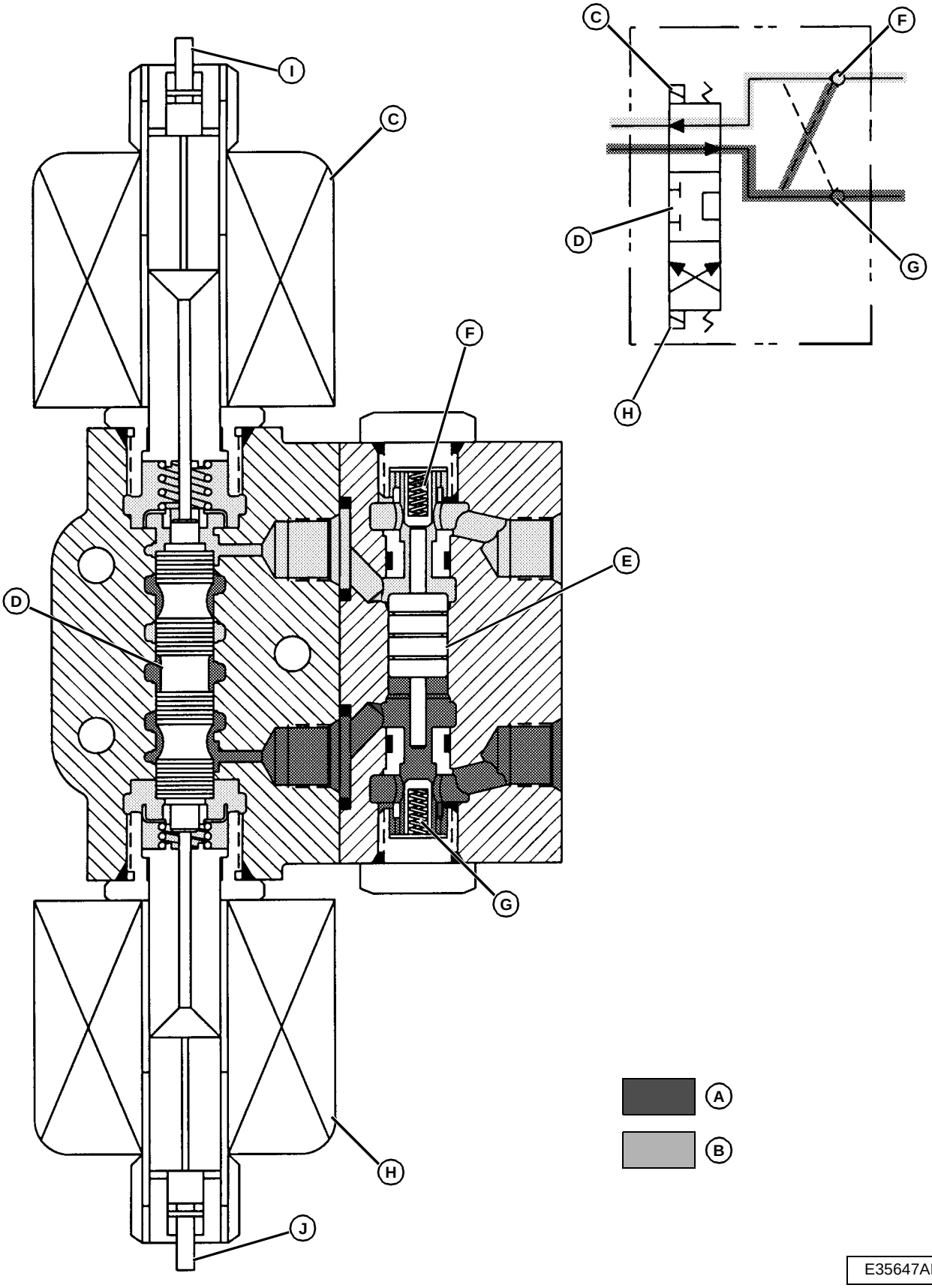
When the raise switch is depressed, the controller energizes the upper solenoid coil. The solenoid pushes spool (D) down allowing pressurized oil to flow into the lower port.

High pressure oil (A) pushes piston (E) down and lower check valve (G) down. Pressurized oil flows to the cylinder end of the lift cylinders, raising the cutting units. Piston (E) also pushes lift check valve (F), opening the upper port to return oil (B) from the cylinders.

If there is a problem with the electrical system, the cutting units can be raised by pushing manual raise button (I) or lowered by pushing manual lower button (J).

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.

A— High Pressure Oil
B— Return Oil
C— Lift Solenoid Coil
D— Spool
E— Piston
F— Lift Check Valve
G— Lower Check Valve
H— Lower Solenoid Coil
I— Manual Raise Button
J— Manual Lower Button


C
F
D
G
H
I
C
F
D
E
G
H
J
A
B
E35647AE

FRONT LIFT CYLINDER OPERATION

Function:

To lift (or lower) the front cutting units.

Theory of Operation:

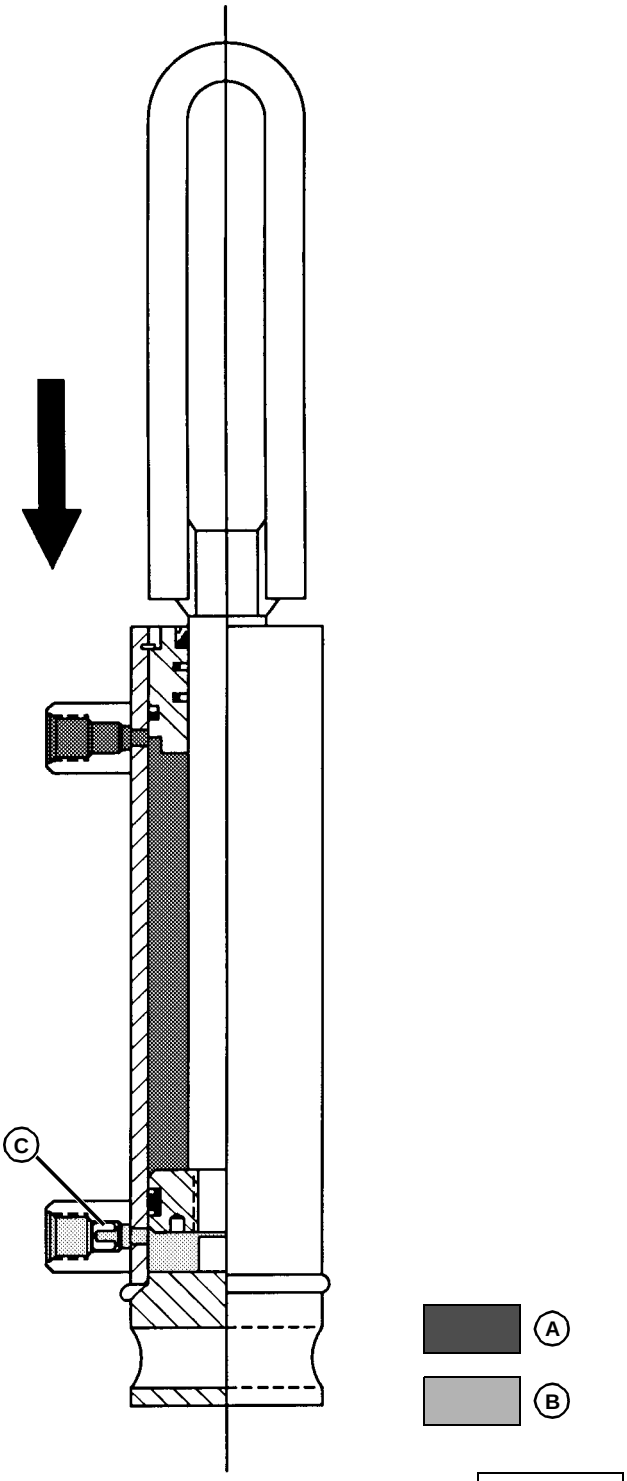
NOTE: Lower operation shown.

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 (C) 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.

A— High Pressure Oil
B— Return Oil
C— Floating Orifice—0.97 mm (0.038 in.)



REAR LIFT CYLINDER OPERATION

Function:

To lift (or lower) the front cutting units.

Theory of Operation:

NOTE: Raise operation shown.

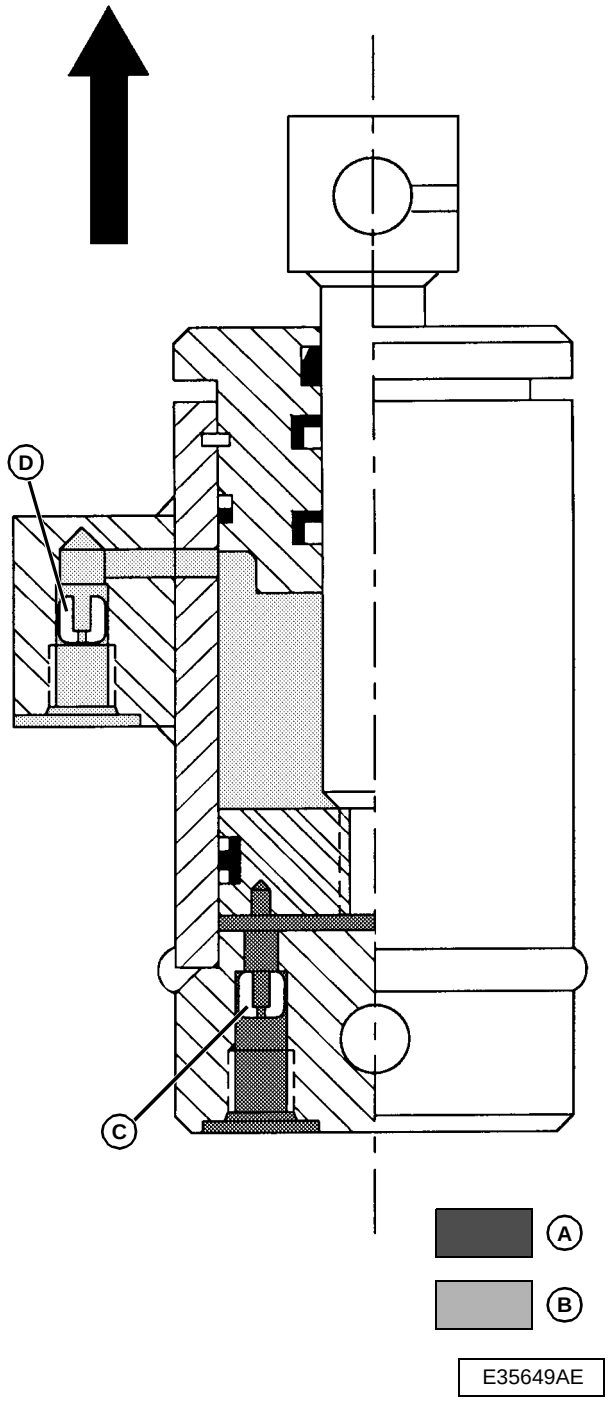
The lift cylinder is a double-action, single rod design. This design allows positive control when raising or lowering of the cutting units.

Two different size floating orifices (C and D) 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.

A— High Pressure Oil
B— Return Oil
C— Floating Orifice—1.02 mm (0.040 in.)
D— Floating Orifice—1.18 mm (0.0465 in.)



MOW SYSTEM OPERATION

Function:

To drive the cutting unit reels with hydraulic motors.

Theory of Operation:

NOTE: In some applications, the standard mow valve assembly (C) may be replaced by the optional mow/backlap valve assembly (H). This will allow the reel motors to be driven in reverse to permit reel "backlapping". See MOW/ BACKLAP VALVE ASSEMBLY OPERATION for further information.

The mow system is an independent hydraulic circuit consisting of the hydraulic oil reservoir (A), hydraulic pump (B), mow valve (C), and three hydraulic reel motors (D).

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 oil cooler (E), optional auxiliary oil cooler (F), hydraulic oil filter (G), and hydraulic reservoir (A).

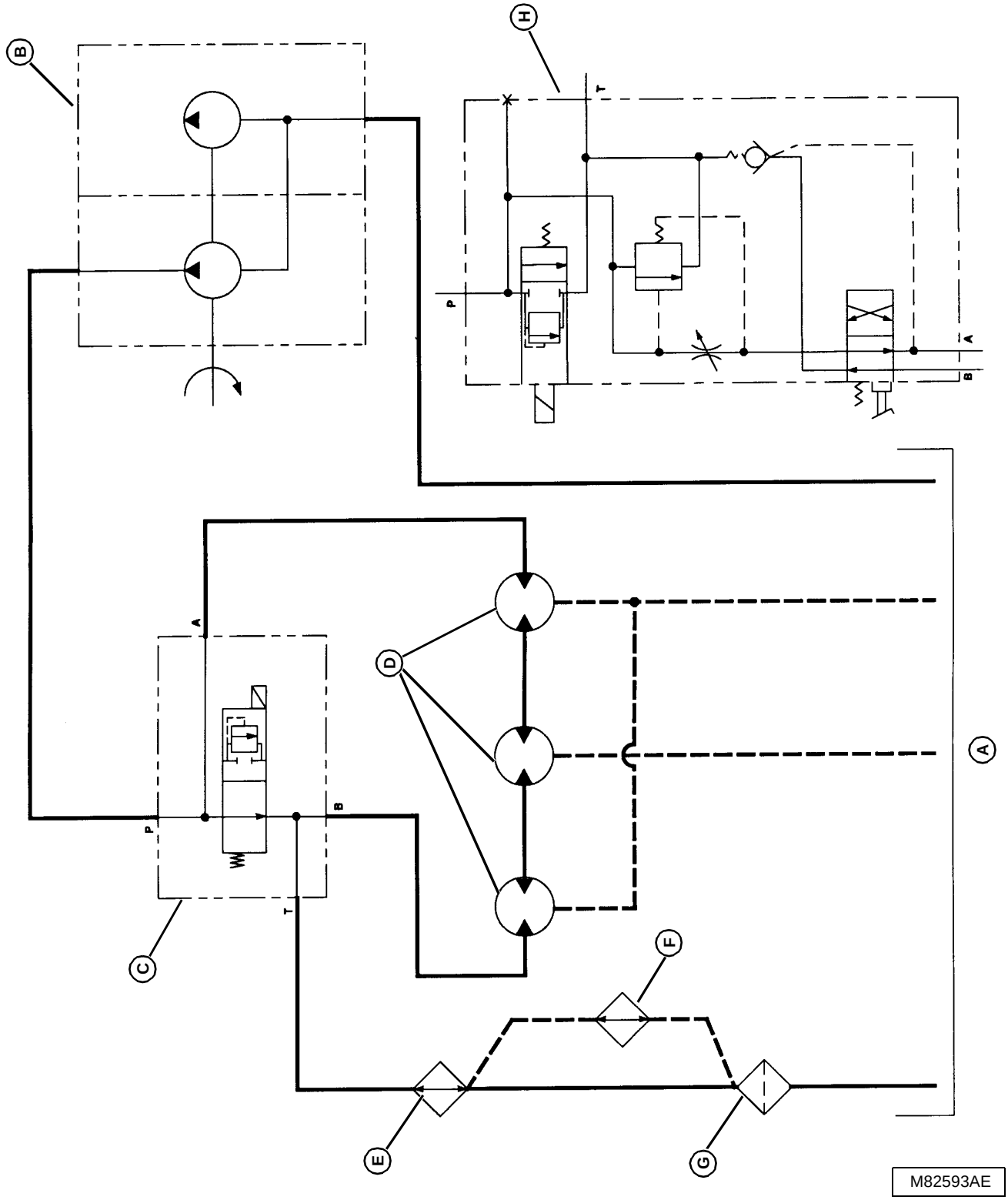
When the mow solenoid is energized, oil is routed to the hydraulic reel motors in series: first to the left front motor, then to the rear (center) motor, then to the right front motor, and finally back to the mow valve. Oil is then routed to the oil cooler, optional auxiliary oil cooler, hydraulic oil filter, 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.

A— Hydraulic Reservoir
B— Hydraulic Pump
C— Mow Valve
D— Hydraulic Reel Motors
E— Oil Cooler
F— Auxiliary Oil Cooler (Optional)
G— Hydraulic Oil Filter
H— Optional Mow/Backlap Valve


B
H
T
P
A
B
A
D
A
P
B
T
C
F
E
G
M82593AE

MOW VALVE ASSEMBLY OPERATION

Function:

To control the flow of high pressure oil to the reel motors.

Theory of Operation:

NOTE: Mow position shown.

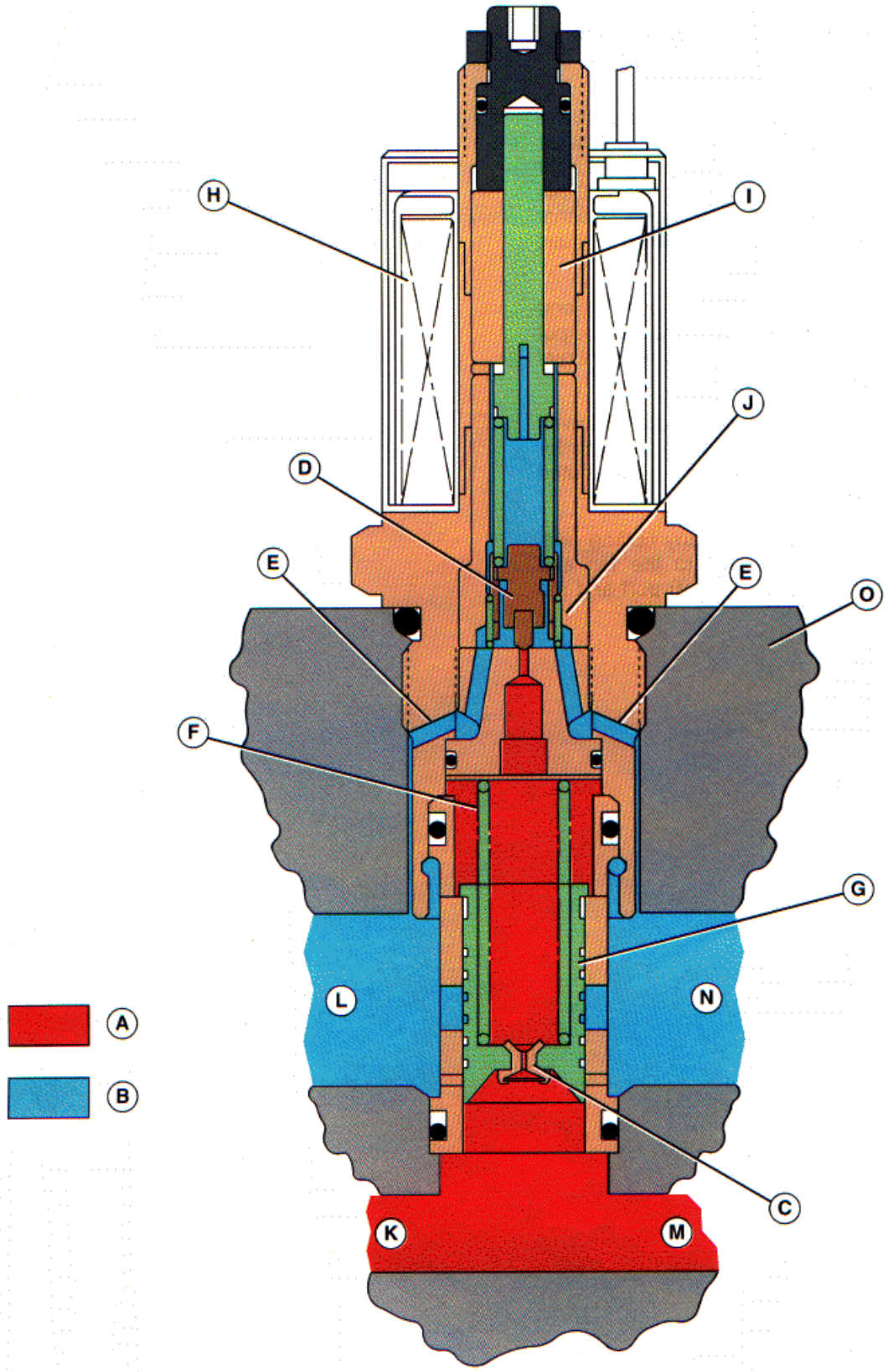
High pressure oil (A) enters the valve at the lower port through spool orifice (C), filling the spool cavity. With the mow system not active, relief poppet (D) is open to allow oil to flow through relief ports (E). The pressure overcomes spool spring (F), pushing spool (G) allowing oil to flow through port “T” (L).

When the controller energizes mow solenoid coil (H), the coil moves armature (I) down applying pressure against spring (J) and relief poppet (D). The poppet closes the seat orifice allowing pressure to build within the spool cavity. This forces the spool down to close off the upper ports. High pressure oil then by-passes the mow valve and is directed to port “A” (M) driving the reel motors.

Oil (B) returning from the reel motors enters the mow valve assembly at port “B” (N). With the spool blocking the upper ports, oil flows around the valve cartridge body and exits the valve assembly at port “T” (L).

The reel drive circuit is protected by a 20684 kPa (3000 psi) relief poppet (D). As pressure increases, the poppet is pushed off its seat and oil is allowed to flow into the return circuit through relief ports (E).

A— High Pressure Oil
B— Return Oil
C— Spool Orifice
D— Relief Poppet
E— Relief Ports
F— Spool Spring
G— Spool
H— Mow Solenoid Coil
I— Armature
J— Spring
K— Port “P”
L— Port “T”
M— Port “A”
N— Port “B”
O— Valve Block Body



MC82584AE

REEL MOTOR OPERATION

Function:

To drive the cutting unit reels by hydraulic pressure.

Theory of Operation:

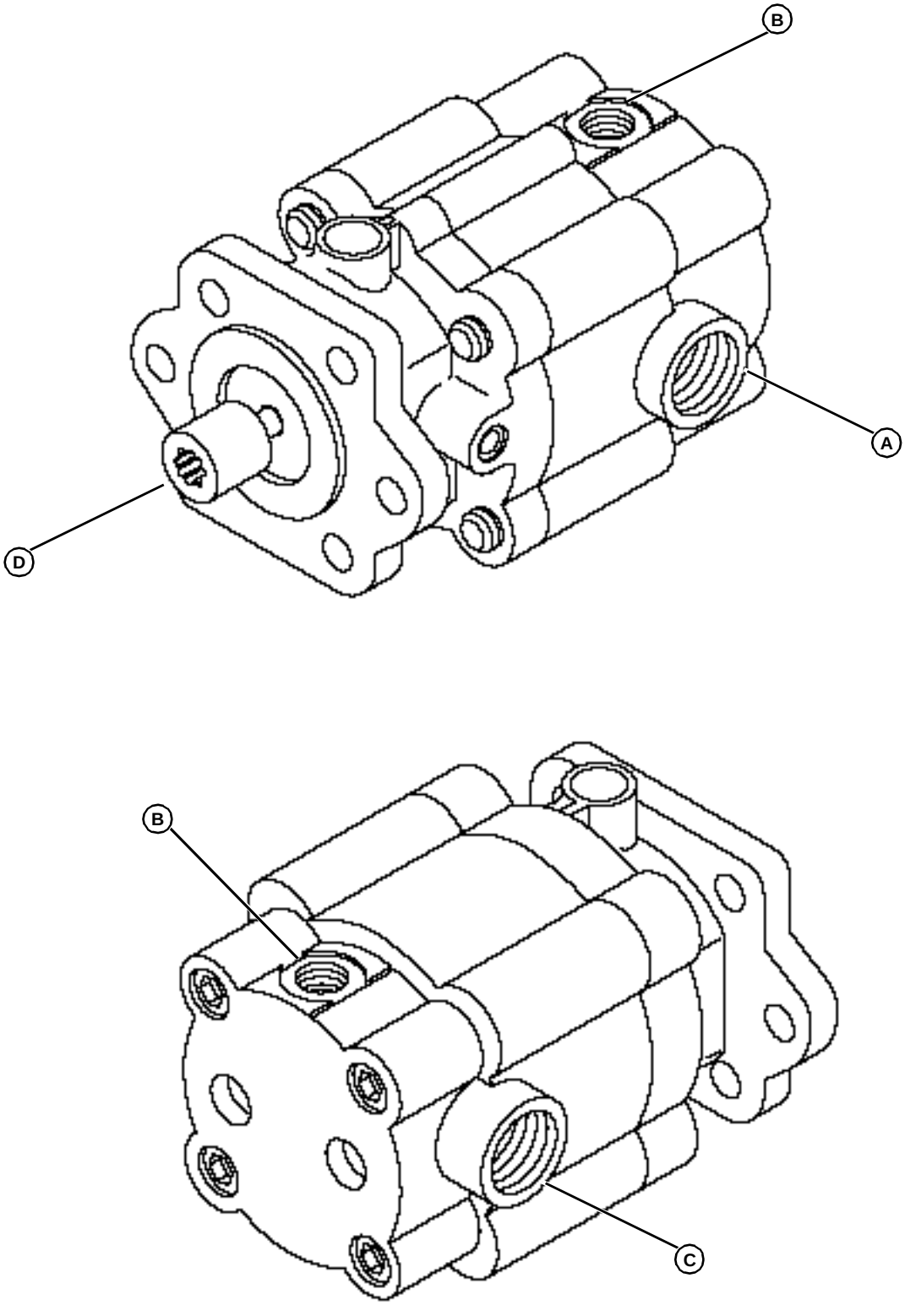
When the mow system is energized, oil is routed to the hydraulic reel motors in series: first to the left front motor, then to the rear (center) motor, then to the right front motor, and finally back to the mow valve. Oil is then returned to then routed to the oil cooler, optional auxiliary oil cooler, hydraulic oil filter, and hydraulic reservoir.

High pressure oil enters the motor at inlet port (A), and is applied to the gears, causing the gears and output shaft (D) to turn, driving the reel. Oil then exits the reel motor through outlet port (C).

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 (B) to the top and connect the inlet hose to the front (inlet) port and the outlet hose the rear port.

A— Inlet Port
B— Leak-off Port
C— Outlet Port
D— Output Shaft



M82610AE

OPTIONAL MOW/BACKLAP VALVE ASSEMBLY

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” (A) and is applied to the lower port of mow valve (E). When the mow system is not active, oil flows through the mow valve and exits the valve assembly at port “T” (B), returning to the hydraulic reservoir via the oil cooler(s) and oil filter.

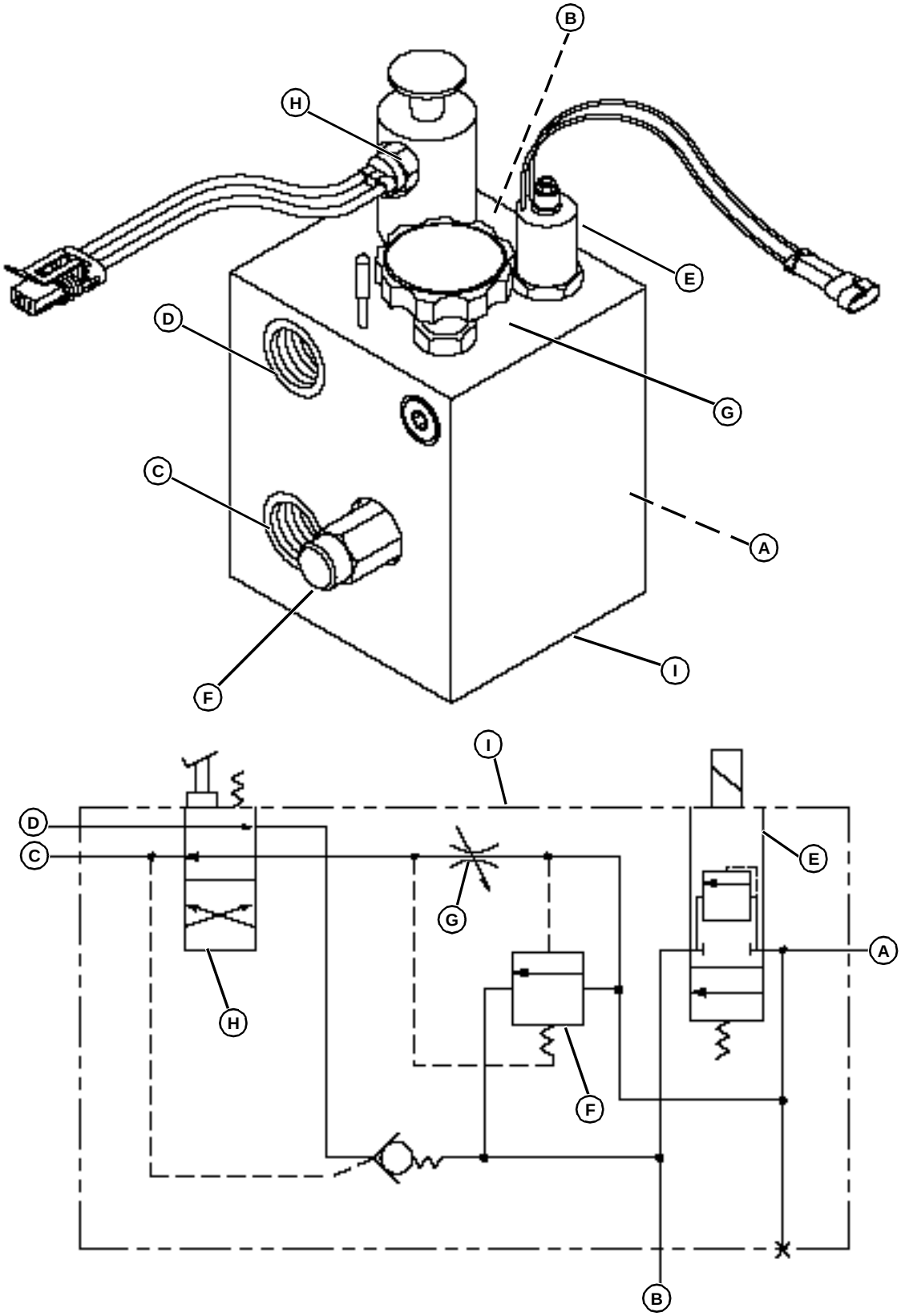
When the mow system is active, the mow valve closes diverting oil flow to logic element (F), flow restrictor (G), and direction valve (H). See MOW VALVE OPERATION for further information.

The logic element maintains proper oil flow volume by compensating for flow irregularities. See LOGIC ELEMENT OPERATION for further information.

The flow restrictor allows adjustment of oil flow volume to the reel motors. This allows the speed of the motors to be controlled. See FLOW RESTRICTOR OPERATION for further information.

The direction valve controls the direction of oil flow to the reel motors. See DIRECTION VALVE OPERATION—MOW and BACKLAP OPERATIONS for further information.

A— Port “P”
B— Port “T”
C— Port “A” (Mow)
D— Port “B” (Backlap)
E— Mow Valve
F— Logic Element
G— Flow Restrictor
H— Direction Valve
I— Valve Block Body



M82585AE

MOW VALVE OPERATION

Function:

To control the flow of high pressure oil to the logic element, flow restrictor, and direction valve.

Theory of Operation:

NOTE: Mow position shown.

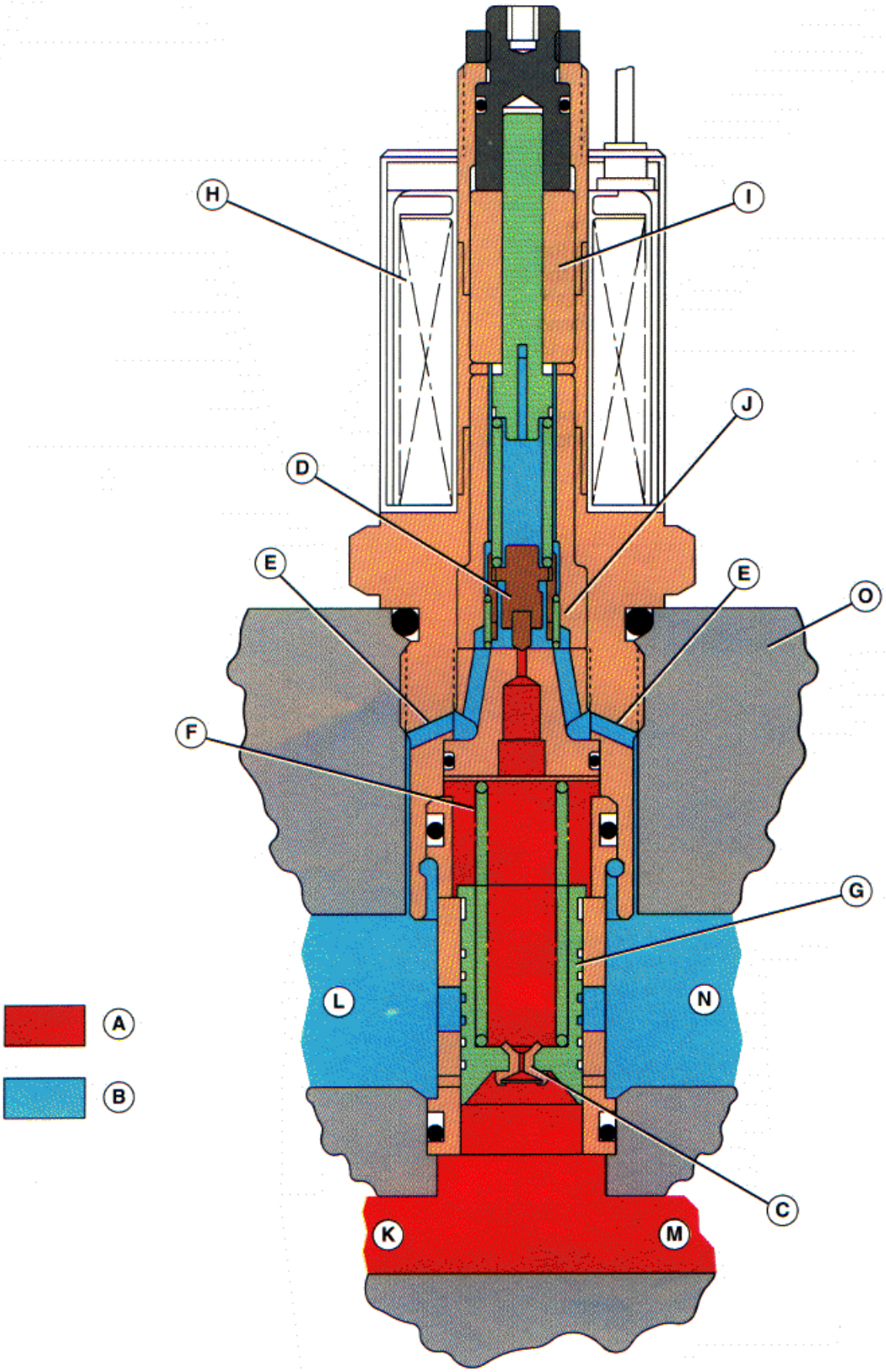
High pressure oil (A) enters the valve at the lower port through spool orifice (C), filling the spool cavity. With the mow system deactivated, relief poppet (D) is open to allow oil to flow through relief ports (E). The pressure overcomes spool spring (F), pushing spool (G) allowing oil to flow through port "T" (L).

When the controller energizes mow solenoid coil (H), the coil moves armature (I) down applying pressure against spring (J) and relief poppet (D). The poppet closes the seat orifice allowing pressure to build within the spool cavity. This forces the spool down to close off the upper ports. Pressurized oil then by-passes the mow valve and directs high pressure oil to the logic element, flow restrictor, and direction valve.

Oil (B) returning from the reel motors enters the mow/backlap valve assembly at port "B" (N). With the spool blocking the upper ports, oil flows around the valve cartridge body and exits the valve assembly at port "T" (L).

The reel drive circuit is protected by a 20684 kPa (3000 psi) relief poppet (D). As pressure increases, the poppet is pushed off its seat and oil is allowed to flow into the return circuit through relief ports (E).

A— High Pressure Oil
B— Return Oil
C— Spool Orifice
D— Relief Poppet
E— Relief Ports
F— Spool Spring
G— Spool
H— Mow Solenoid Coil
I— Armature
J— Spring
K— Port "P"
L— Port "T"
M— Port "A"
N— Port "B"
O— Valve Block Body



MC82584AE

LOGIC ELEMENT OPERATION

Function:

The logic element is designed to maintain proper oil flow volume by compensating for flow irregularities.

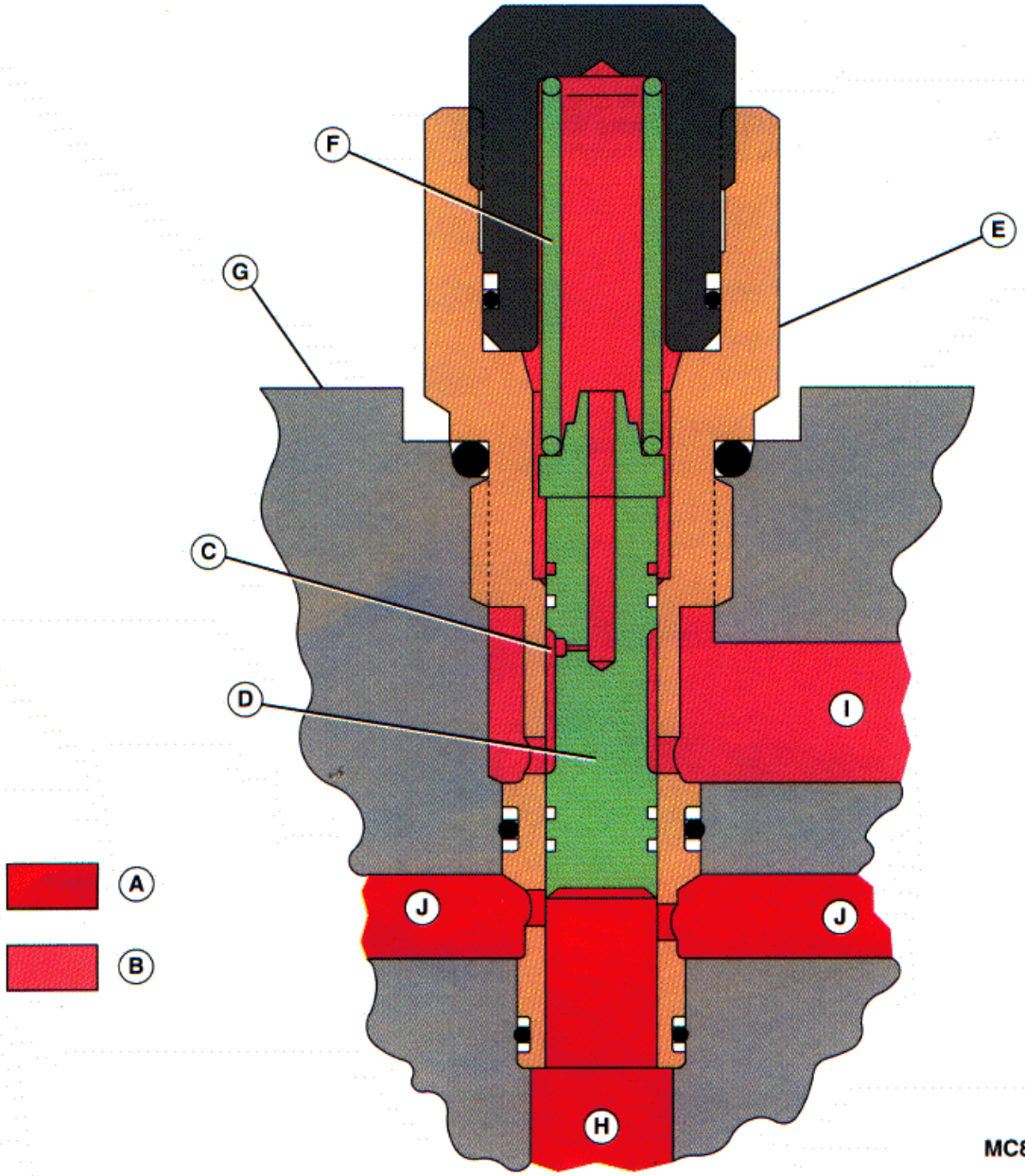
Theory of Operation:

Oil at the upper port enters orifice (C) filling the chamber, forcing the spool down to prevent additional oil from being directed to the direction valve.

If oil pressure drops at upper port (I), high pressure oil at lower port (H) pushes the spool up, uncovering the first port at middle port (J), increasing oil flow to the direction valve. As the pressure continues to increase, the spool will continue to move uncovering the second port allowing additional oil flow to the direction valve to maintain proper oil flow volume.

As flow volume equalizes, pressure to the upper port increases, forcing the spool down closing the middle chamber ports, stopping supplemental oil flow.

A— High Pressure Oil
B— Medium Pressure Oil
C— Orifice
D— Spool
E— Logic Element Body
F— Spring
G— Valve Block Body
H— Lower Port
I— Upper Port
J— Middle Port



MC82583AE

FLOW RESTRICTOR OPERATION

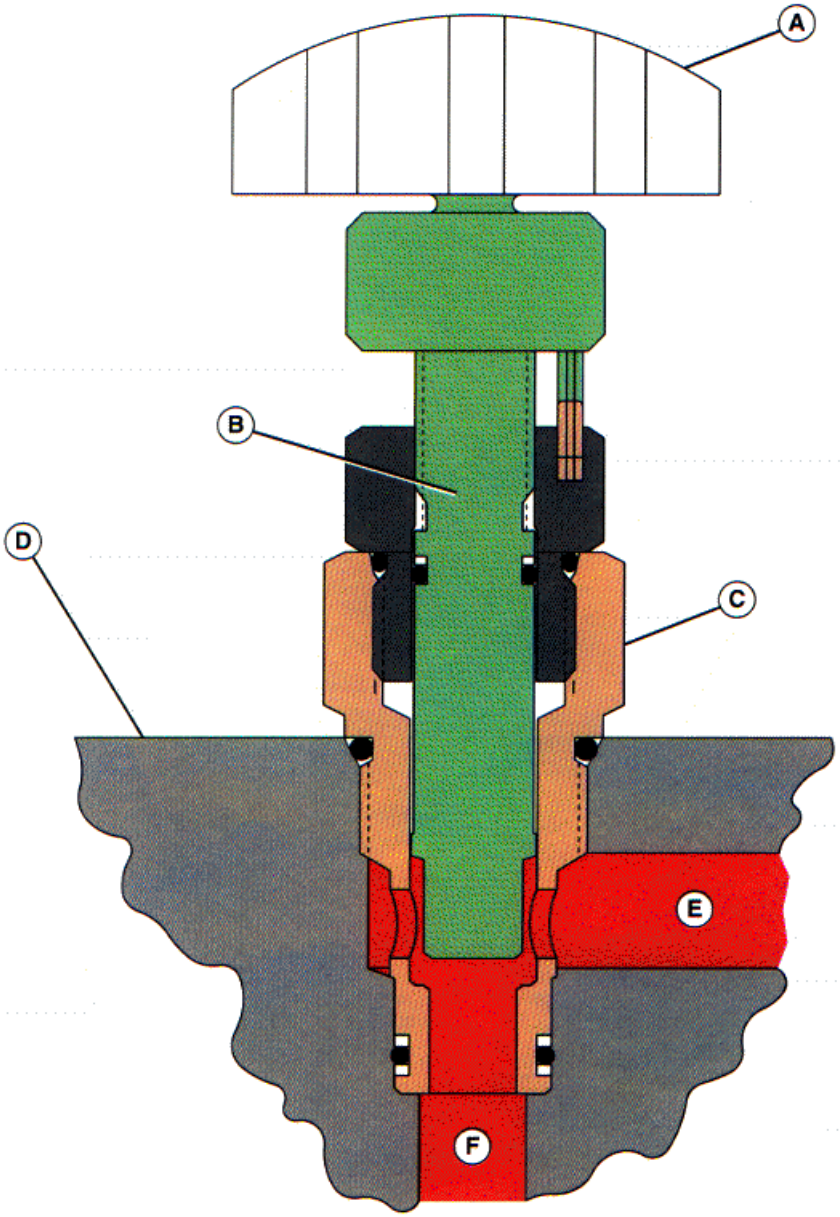
Function:

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.

Theory of Operation:

Oil enters valve cartridge body (C) at upper port (E). As adjustment knob (A) is turned (clockwise—restrict, counterclockwise—increase) stem (B) position moves, adjusting the aperture at lower port (F). This results in an increase (or decrease) of oil flow volume through the valve.

A— Adjustment Knob
B— Stem
C— Valve Cartridge Body
D— Valve Block Body
E— Upper Port
F— Lower Port



MC82580AE

DIRECTION VALVE OPERATION—MOW

Function:

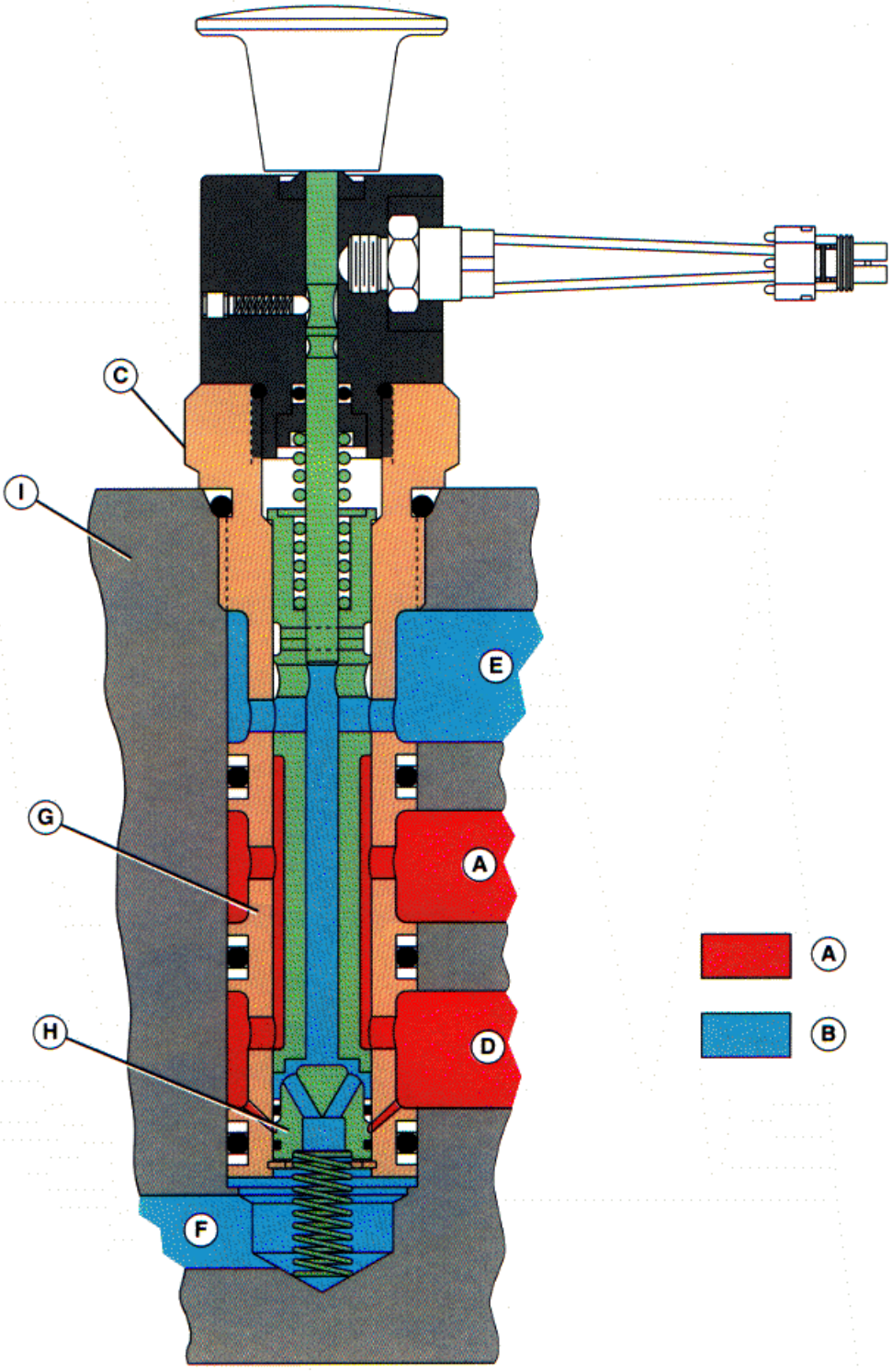
To control the direction of oil flow to the reel motors.

Theory of Operation:

With the direction valve in the MOW position, high pressure oil (A) from the flow restrictor/logic element enters valve cartridge body (C) at the middle port. Oil is then directed by spool (G) to port “A” (D), exiting the valve block assembly driving the reel motors.

Oil returning from the reel motors enters the valve block assembly at port “B” (E). Oil enters the valve cartridge body and is directed against poppet valve (H). As pressure is applied, the poppet valve opens to allow oil to exit at port “T” (F), exiting the valve block assembly.

A— High Pressure Oil
B— Return Oil
C— Valve Cartridge Body
D— Port “A”
E— Port “B”
F— Port “T”
G— Spool
H— Poppet Valve
I— Valve Block Body



MC82581AE

DIRECTION VALVE OPERATION—BACKLAP

Function:

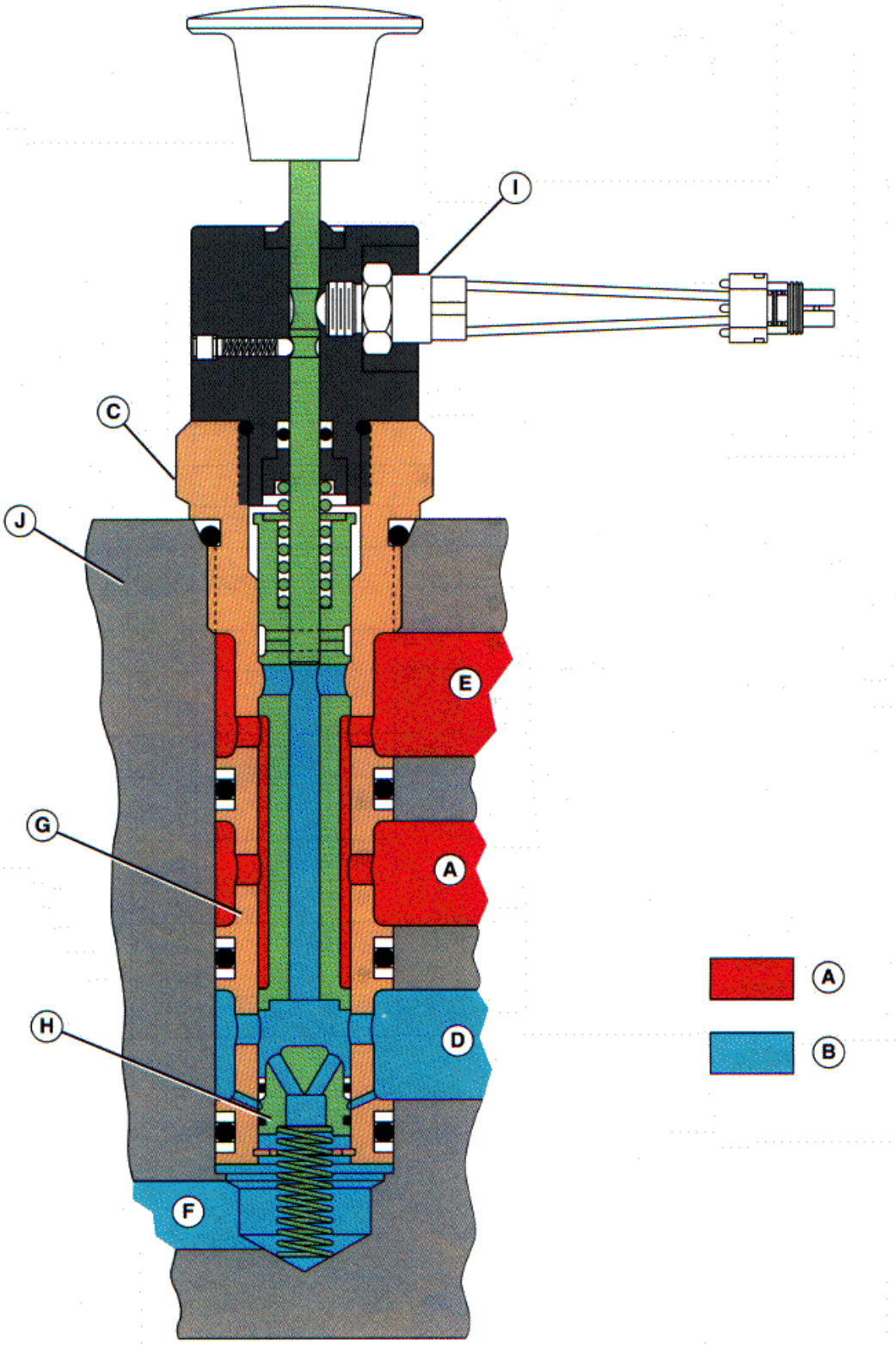
To control the direction of oil flow to the reel motors.

Theory of Operation:

With the direction valve in the BACKLAP position, ball switch (I) is energized, allowing spool (G) to change position. High pressure oil (A) from the flow restrictor/ logic element enters valve cartridge body (C) at the middle ports. Oil is then directed by the spool to port “B” (F), exiting the valve block assembly driving the reel motors in reverse.

Oil returning from the reel motors enters the valve block assembly at port “A” (D). Oil enters the valve cartridge body and exits through poppet valve (H) allowing the oil to exit the valve assembly at port “T” (F).

A— High Pressure Oil
B— Return Oil
C— Valve Cartridge Body
D— Port “A”
E— Port “B”
F— Port “T”
G— Spool
H— Poppet Valve
I— Ball Switch
J— Valve Block Body



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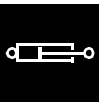
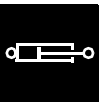
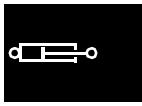


HYDRAULIC SYSTEM TROUBLESHOOTING CHART

PROBLEM OR SYMPTOM / CHECK OR SOLUTION	Hydraulic system fails to function.	Slow reel speed.	Noisy pump.	Oil overheats.	Foaming oil.							
Low oil level.	●	●	●	●	●							
Faulty relief valve.	●											
Faulty pump or motor(s).	●											
Clogged suction line.	●											
Wrong oil.		●	●	●	●							
Worn pump or motor(s).		●										
Oil overheats.		●										
Worn or stuck relief valve.		●										
Dirty relief valve.		●										
Reels too tight against bed knife. Adjust.		●										
Air leaks.			●		●							
Component high-pressure internal leak.				●								
Dirty oil.				●								
Parking brake engaged.				●								
High ambient temperatures working under heavy loads. Install optional auxiliary oil cooler.				●								





HYDRAULIC REEL DRIVE SYSTEM INOPERATIVE

Test Conditions:

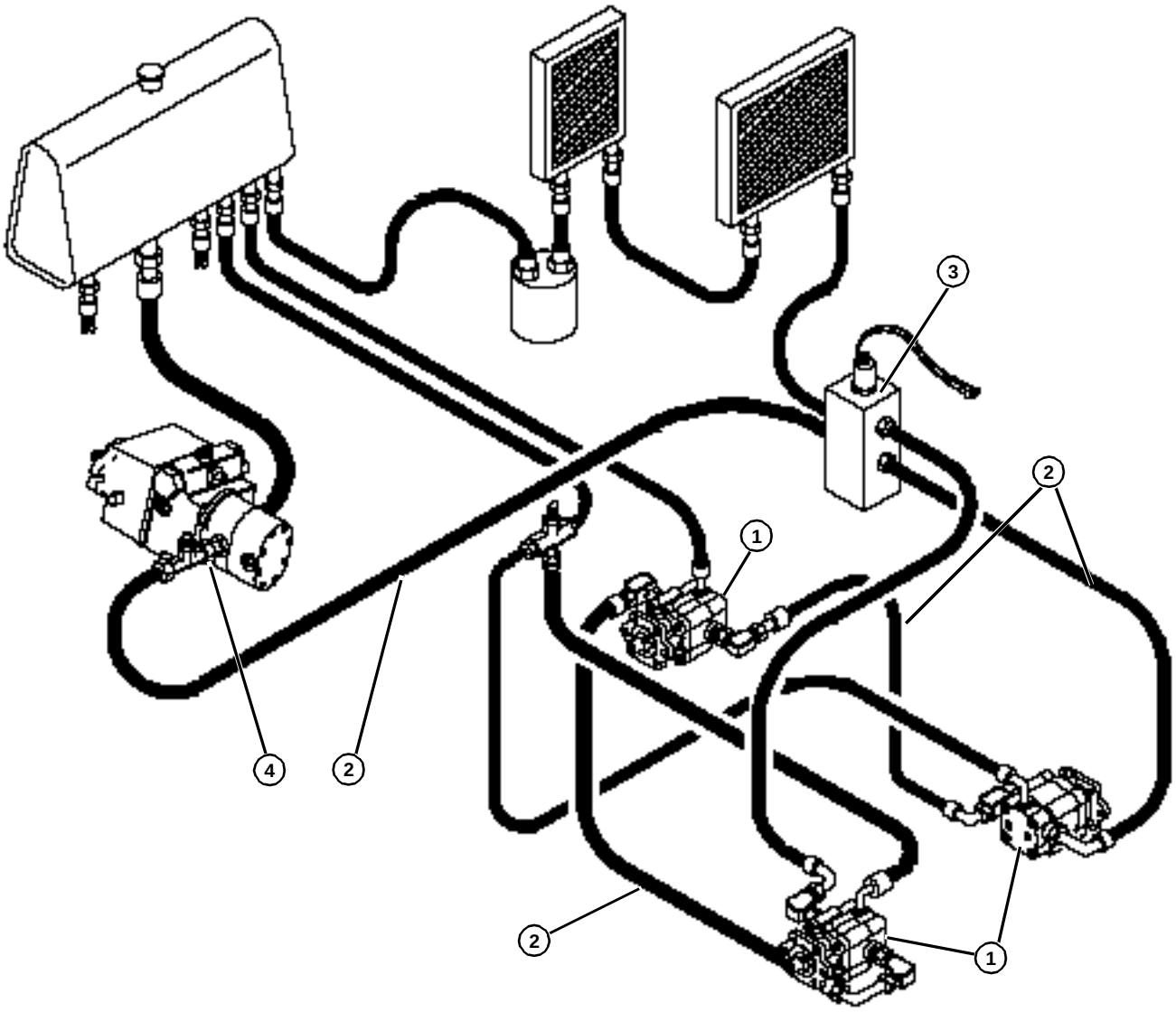
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Reel motors.	Pressure hoses connected correctly.	Connect pressure hoses to proper port connections.
2. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
3. Mow valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Mow valve/ Hydraulic pump.	Mow relief valve opens at correct specification.	Test mow relief valve pressure.



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LOW OR SLOW REEL DRIVE HYDRAULIC POWER

Test Conditions:

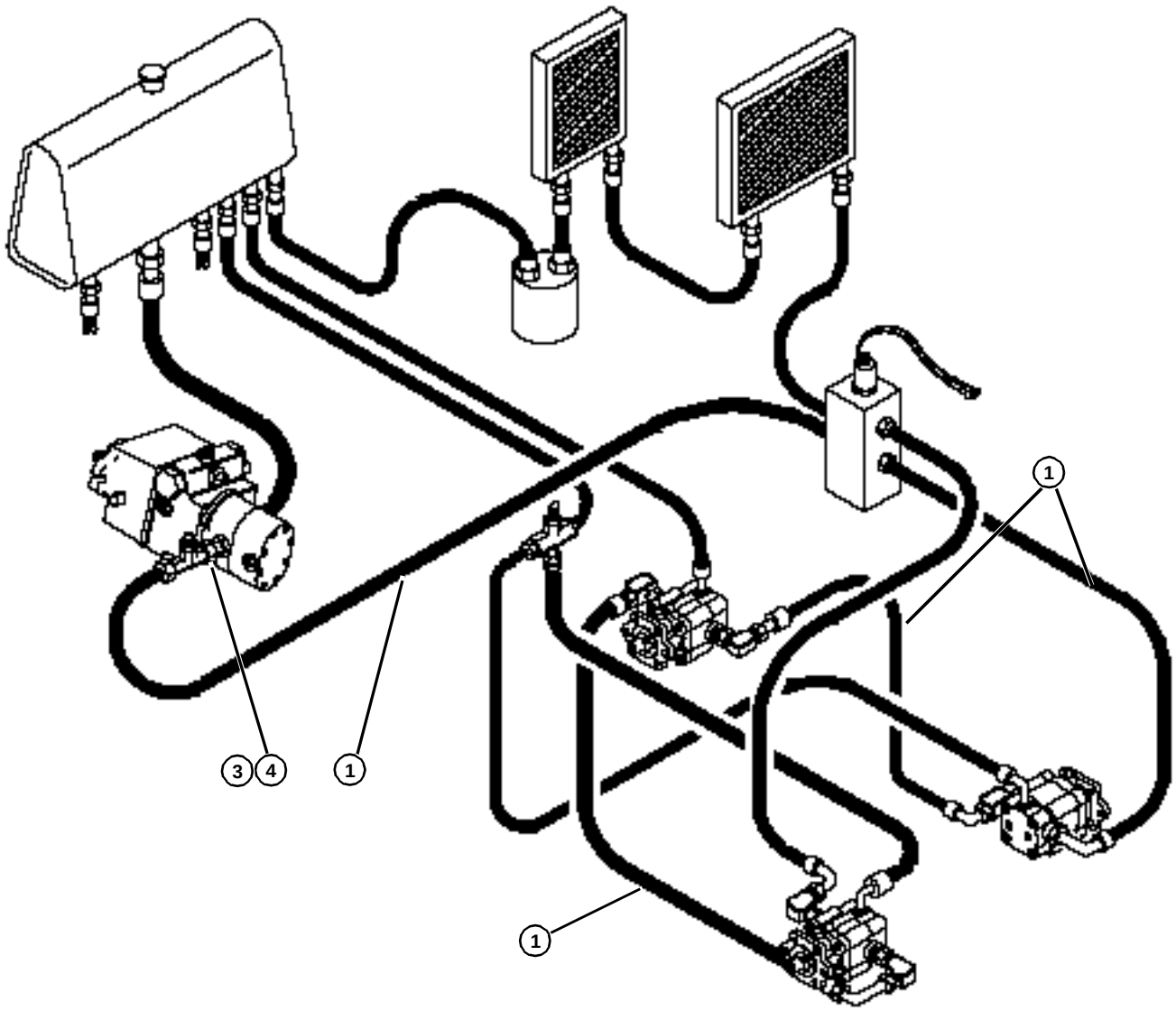
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
2. Cutting unit reels.	Reels move freely without binding.	Disassemble, inspect and clean or replace parts as necessary.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Parking 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.
4. Mow valve/ hydraulic pump.	Mow relief valve opens at correct specification.	Test mow relief valve pressure.
5. Engine crankshaft pulley.	Fast idle rpm at correct specification.	Adjust fast idle. (See procedure in ENGINE section.)



M82611AE

REEL DRIVE SYSTEM OPERATES ERRATICALLY

Test Conditions:

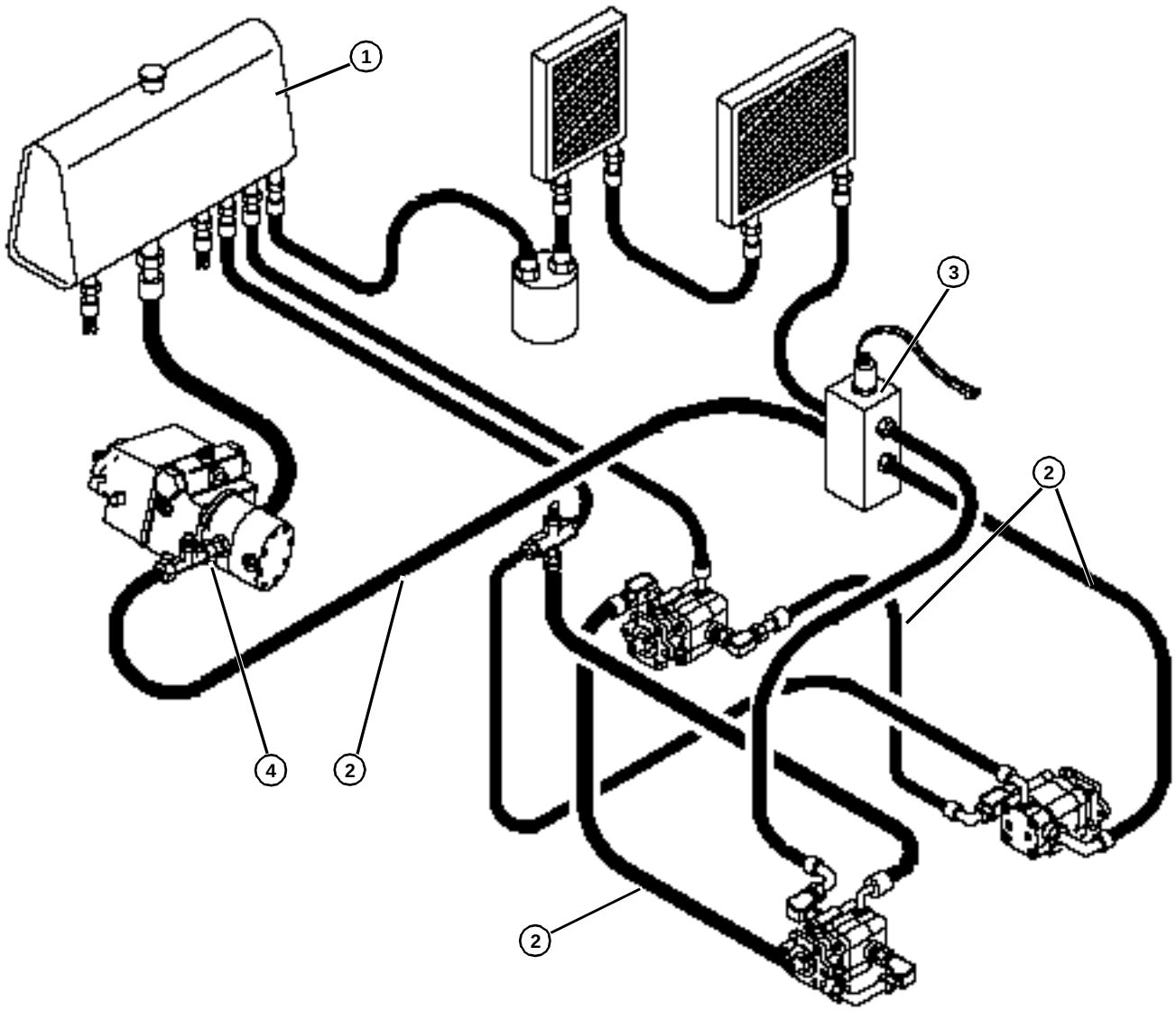
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system.
2. Pressure hoses from hydraulic pump to reel motors.	No sharp bends or restrictions.	Replace hoses.
3. Mow valve.	Valve operates smoothly without sticking.	Disassemble, inspect and clean or replace parts as necessary.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Mow/Transport lever in MOW position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Mow valve/ Hydraulic pump.	Mow relief valve opens at correct specification.	Test mow relief valve pressure.



M82611AE

EXCESSIVE HYDRAULIC PUMP NOISE

Test Conditions:

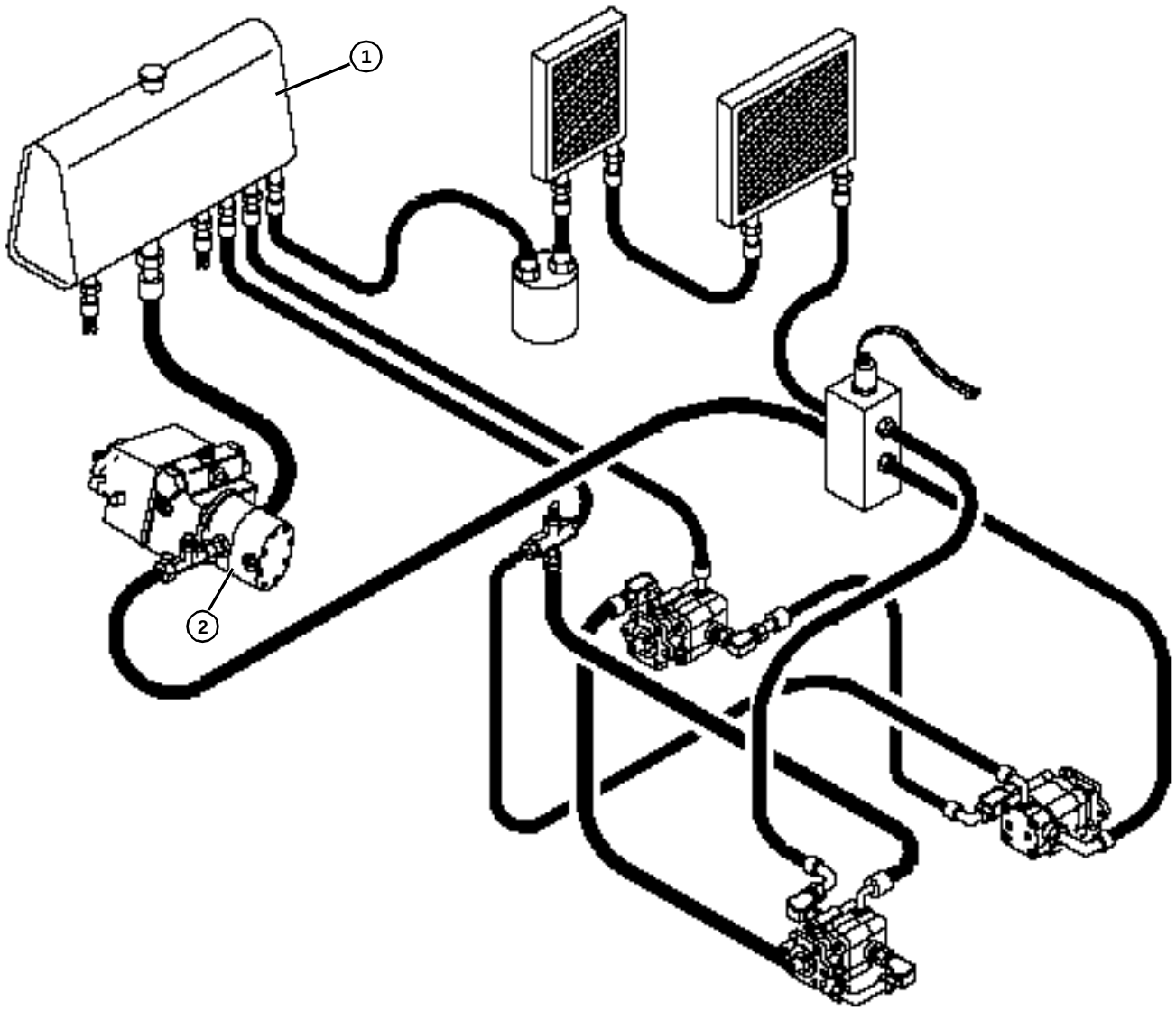
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic reservoir.	Hydraulic oil clean and not foamy (No air in system).	Bleed hydraulic system.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
2. Hydraulic pump.	Hydraulic pump not worn and oil inlet not restricted.	Test hydraulic pump oil flow.



M82611AE

FREQUENT FAILURE OF HYDRAULIC HOSES AND O-RINGS

Test Conditions:

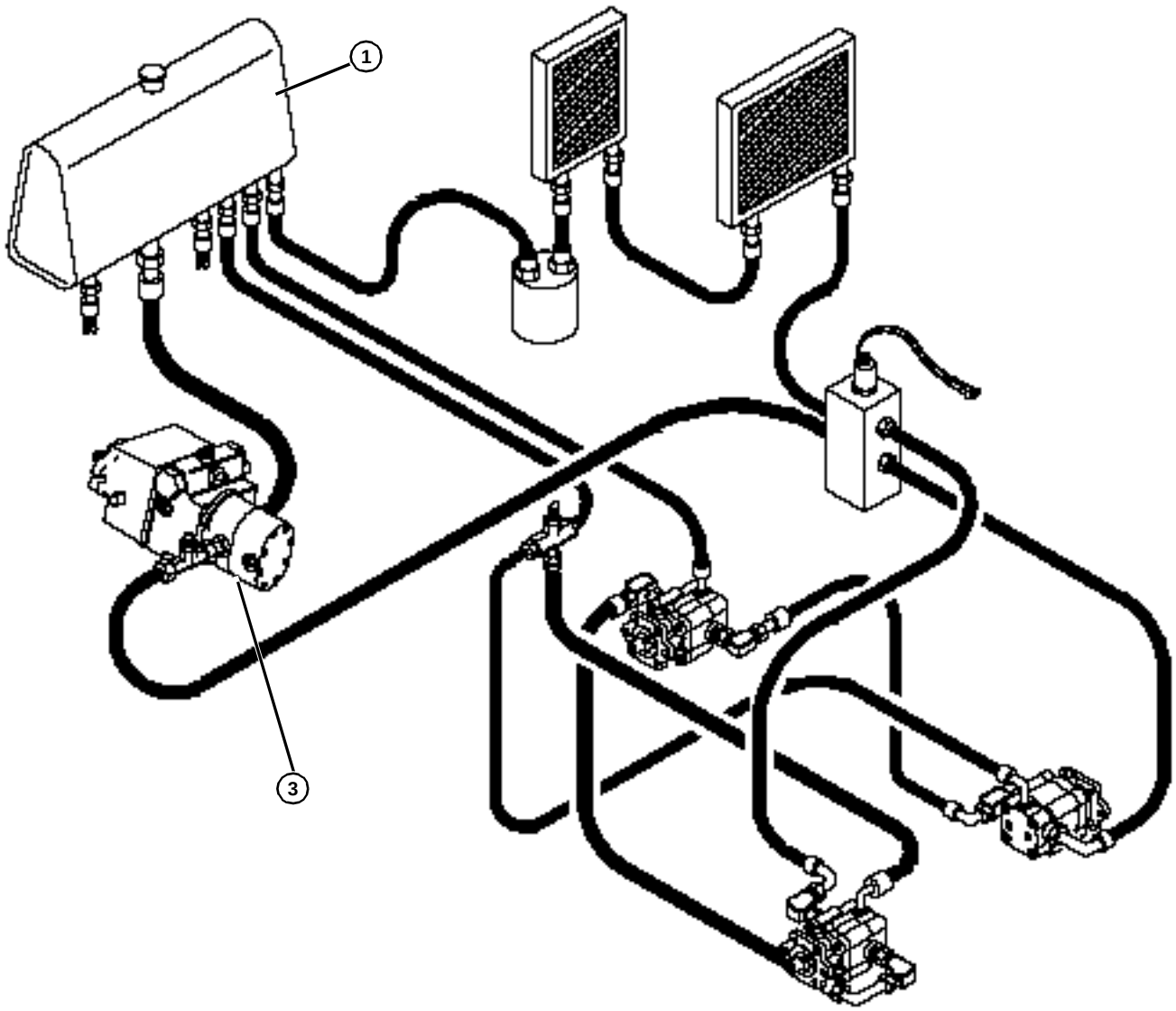
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic oil reservoir.	Oil clean and free of contamination.	Drain hydraulic system and replace oil.
2. Hydraulic connections.	Connection tightened to correct specifications.	Tighten connections to specifications.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position..
- Mow/Transport lever in MOW position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
3. Mow valve/ Hydraulic pump.	Mow relief valve opens at correct specification.	Test mow relief valve pressure.



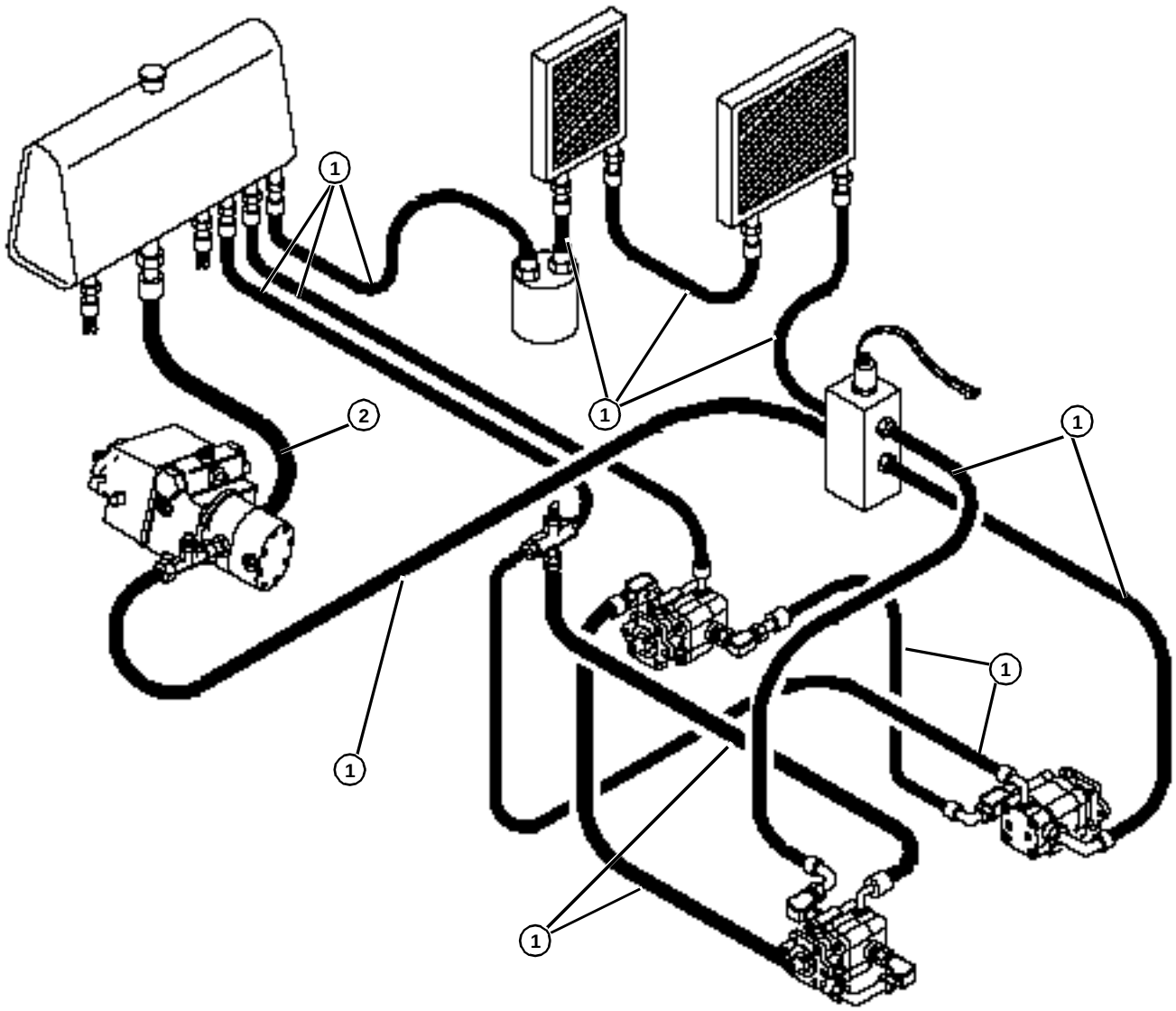
M82611AE

HYDRAULIC OIL FOAMS

Test Conditions:

- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic pressure hoses.	No sharp bends or restrictions.	Replace hoses.
2. Hydraulic suction hose.	No air leaks.	Replace hose.



M82611AE

HYDRAULIC OIL OVERHEATS

Test Conditions:

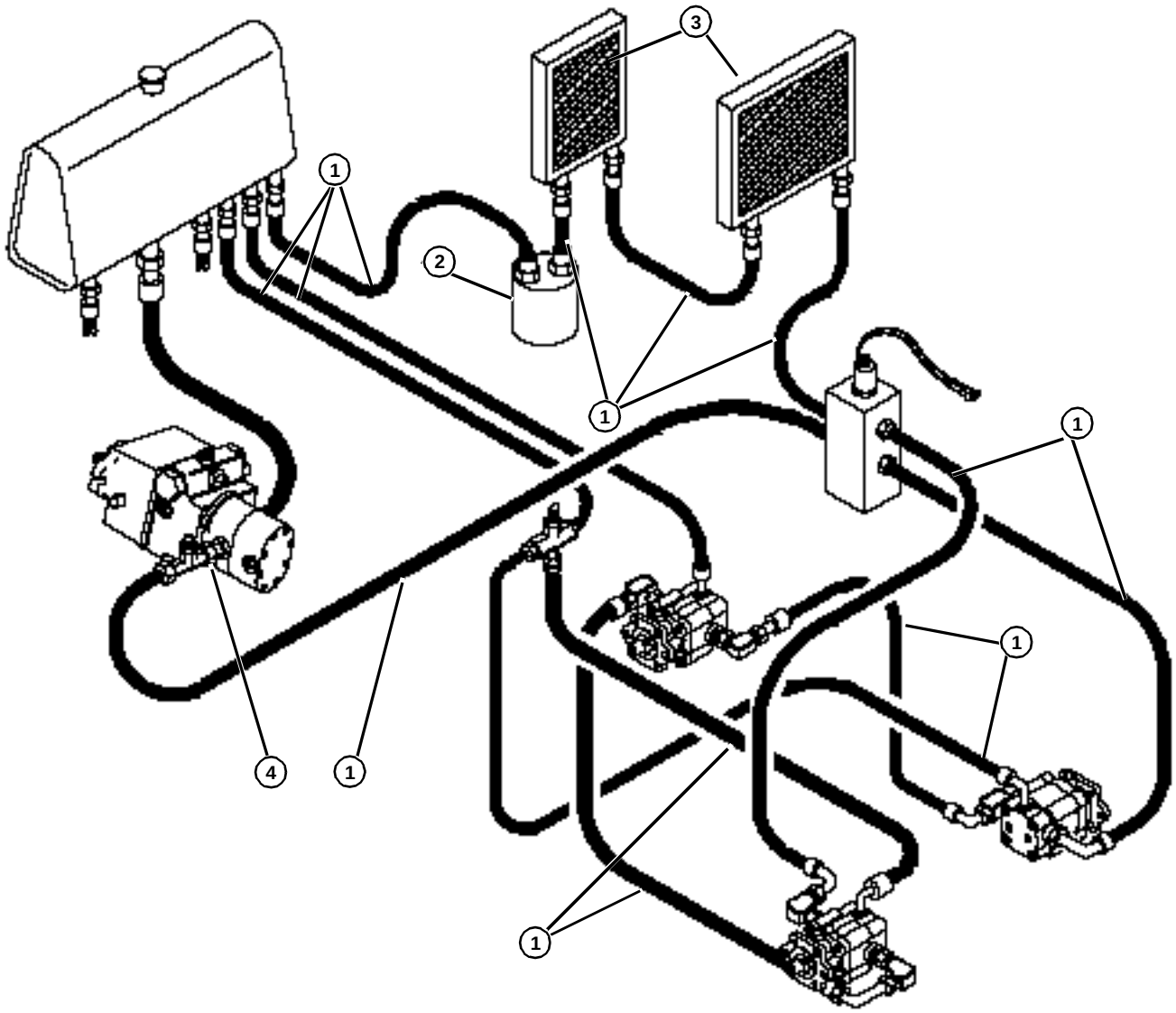
- Key switch in OFF position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
1. Hydraulic pressure hoses .	No sharp bends or restrictions.	Replace hoses.
2. Oil filter.	Not plugged.	Replace oil filter.
3. Oil coolers.	Fins not plugged and coolers not obstructed.	Clear fins and/or remove obstruction.

Test Conditions:

- Engine running.
- Travel pedals in NEUTRAL position..
- Mow/Transport lever in MOW position.
- Parking brake ENGAGED.

Test Location	Normal	If Not Normal
4. Mow valve/ Hydraulic pump.	Mow relief valve opens at correct specification.	Test mow relief valve pressure.



M82611AE

HYDRAULIC PUMP FLOW TEST

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 determine if the oil flow from the hydraulic pump is to correct specifications.

Test Equipment:

A— JTO5687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
B— JTO3012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
C— JTO5469 Flowmeter Kit
D— JTO3385 3/4 F NPT x 7/8 M 37° Adapter Fitting
E— JTO3056 7/8 M 37° x 9/16 F ORB Adapter Fitting
F— 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

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 parking brake.
6. Disconnect hose from IN port of steering valve.
7. Connect flowmeter kit (C) to steering valve and hydraulic pump outlet using fittings (A, B, and D—F).

IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage may occur to hydraulic components.

8. Open flowmeter valve (G) fully.
9. Start engine and operate at **fast idle (2975 ± 75 rpm)**.
10. Turn flowmeter valve until **1723 kPa (250 psi)** is registered on the flowmeter pressure gauge. Check and record the flow rate.
11. Adjust flowmeter valve until **6895 kPa (1000 psi)** is registered on gauge. Check and record flow rate.

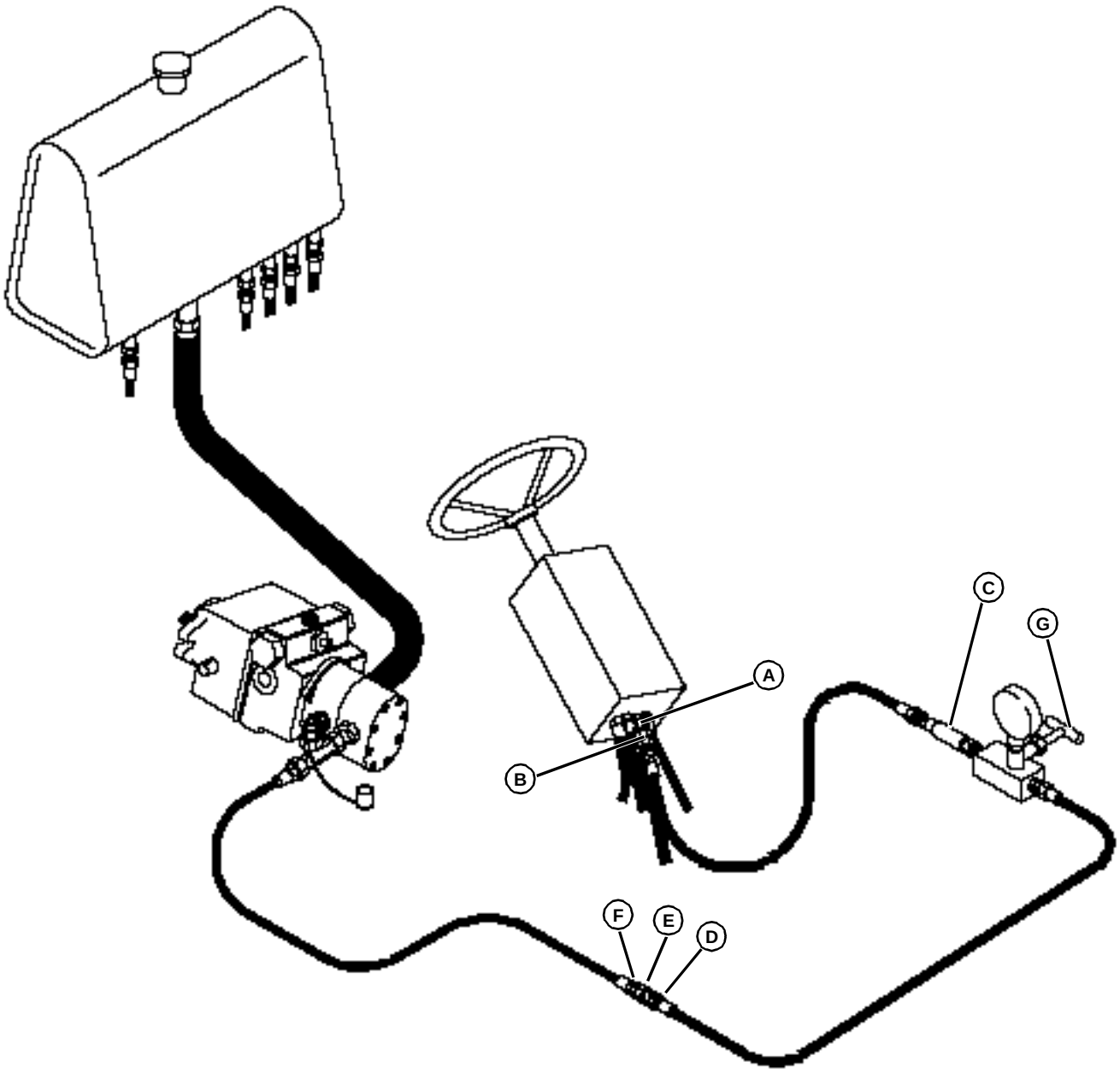
Specifications:

Pump Flow Rate at
1723 kPa (250 psi) . . . . . .15.5 L/min (4.1 gpm)

Pump Flow Rate at
6895 kPa (1000 psi) . . . . . .13.2 L/min (3.5 gpm)

Results:

- Repair or replace hydraulic pump if flow rate is not to specifications.



M82623AE

HYDRAULIC REEL DRIVE SYSTEM OIL FLOW TEST

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 determine if the reel motors are receiving the correct oil flow volume.

Test Equipment:

A— JTO5687 1-1/16 M 37° x 11/16 F ORFS Adapter Fitting
B— JTO3012 3/4 F NPT x 1-1/16 F 37° Adapter Fitting
C— JTO5469 Flowmeter Kit
D— JTO3385 3/4 F NPT x 7/8 M 37° Adapter Fitting
E— JTO3056 7/8 M 37° x 9/16 F ORB Adapter Fitting
F— 38H1160 11/16 M ORFS x 11/16 H ORB Adapter Fitting

Procedure:

CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

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. Disconnect hose from inlet port of front left reel motor.
7. Connect flowmeter kit (C) to reel motor inlet and to mow valve outlet hose using fittings (A, B, and D—F).

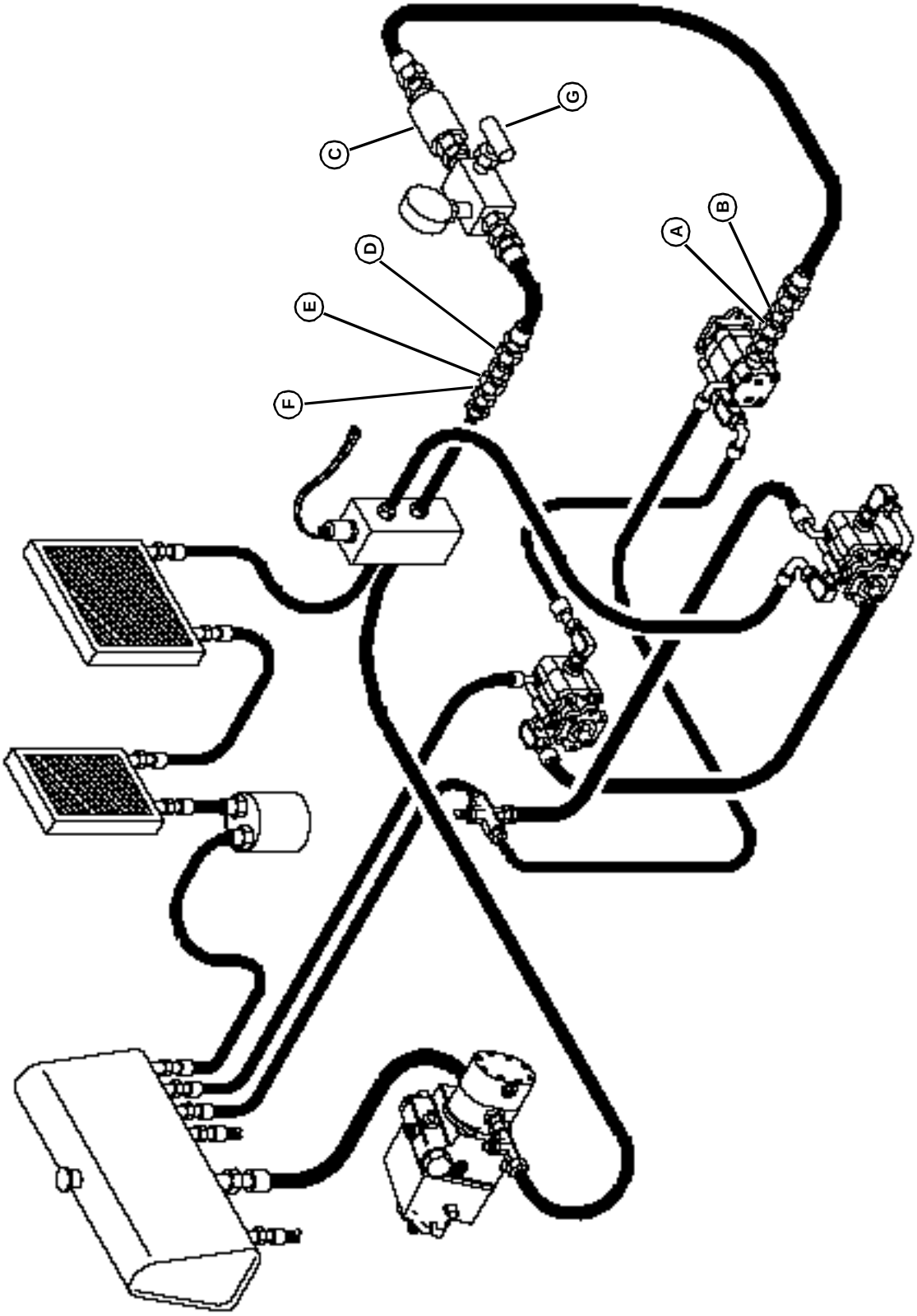
IMPORTANT: Valve of flowmeter MUST be open before starting engine, otherwise damage may occur to hydraulic components.

8. Open flowmeter valve (G) fully.
9. Start engine and operate at **fast idle (2975 ±75 rpm)**. Move mow/transport lever to MOW position.
10. Engage cutting units by pushing the mow switch button.
11. 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.
- Inspect hydraulic pump for wear or damage.



M82624AE

STEERING VALVE INLET PRESSURE TEST

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 determine if the hydraulic pump is delivering correct oil pressure to the steering valve.

Test Equipment:

A— JT07047 0 to 40,000 kPa (6000 psi) Pressure Gauge
B— RE48122 Diagnostic Coupler *
C— AMT846 Hydraulic Diagnostic Hose *
D— RE43774 1/2" tube x 1/8" body Diagnostic Receptacle *
E— XPD6-285 Dust Cap *
F— 38H1031 13/16 M x 13/16 F Swivel Run Tee *

* Included in BM18290 Diagnostic Kit.

Procedure:

NOTE: Optional diagnostic kit (part number BM18290) must be installed on the machine to perform this test.

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. Raise and lock seat platform.
7. Disconnect hose connected to steering valve "IN" port from hydraulic pump.
8. Install tee (F), dust cap (E), and diagnostic receptacle (D) to pump. Connect steering valve hose to swivel tee.
9. Connect hydraulic diagnostic hose (C) and diagnostic coupler (B) to pressure gauge (A).
10. Connect pressure gauge assembly to diagnostic receptacle.
11. Start engine and run at **fast idle (2975 ± 75 rpm)**.
12. Turn steering wheel to straight ahead position.
13. Check pressure reading, gauge should read **2400 kPa (350 psi)**.

CAUTION

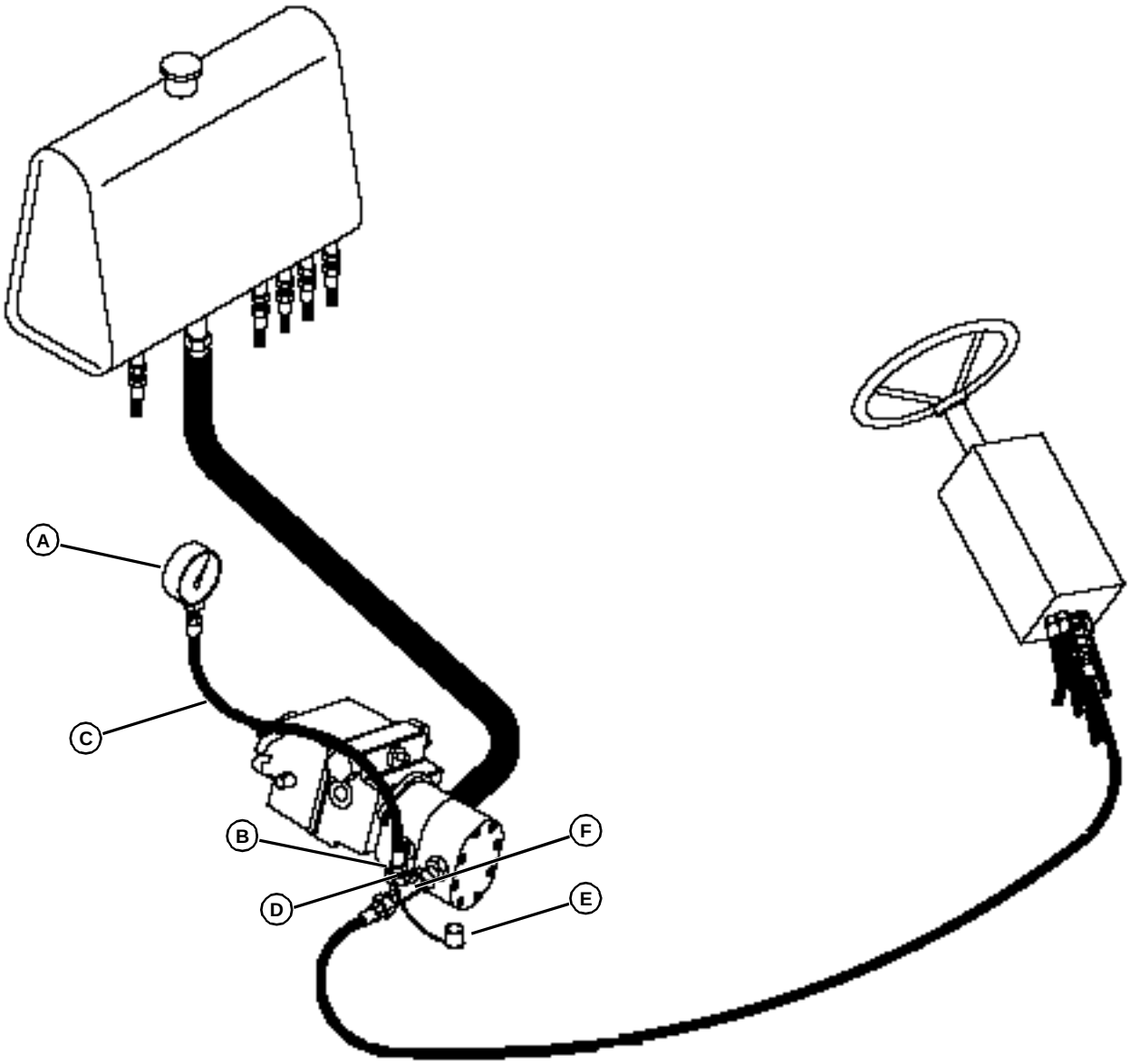
Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

14. Move mow/transport lever to MOW position. Depress lift pedal to lift cutting units. As pedal is depressed, pressure should increase to **7585 kPa (1100 psi) for seven seconds**.

Results:

If pressure is below specifications:

- Check inlet pressure hose for restrictions.
- Inspect hydraulic pump for wear or damage.



M82625AE

STEERING RELIEF VALVE TEST

c CAUTION y

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 determine if the steering relief valve opens at the correct pressure.

Test Equipment:

A— JT07047 0 to 40,000 kPa (6000 psi) Pressure Gauge
B— RE48122 Diagnostic Coupler *
C— AMT846 Hydraulic Diagnostic Hose *
D— RE43774 1/2" tube x 1/8" body Diagnostic Receptacle *
E— XPD6-285 Dust Cap *
F— 38H1031 13/16 M x 13/16 F Swivel Run Tee, *

* Included in BM18290 Diagnostic Kit.

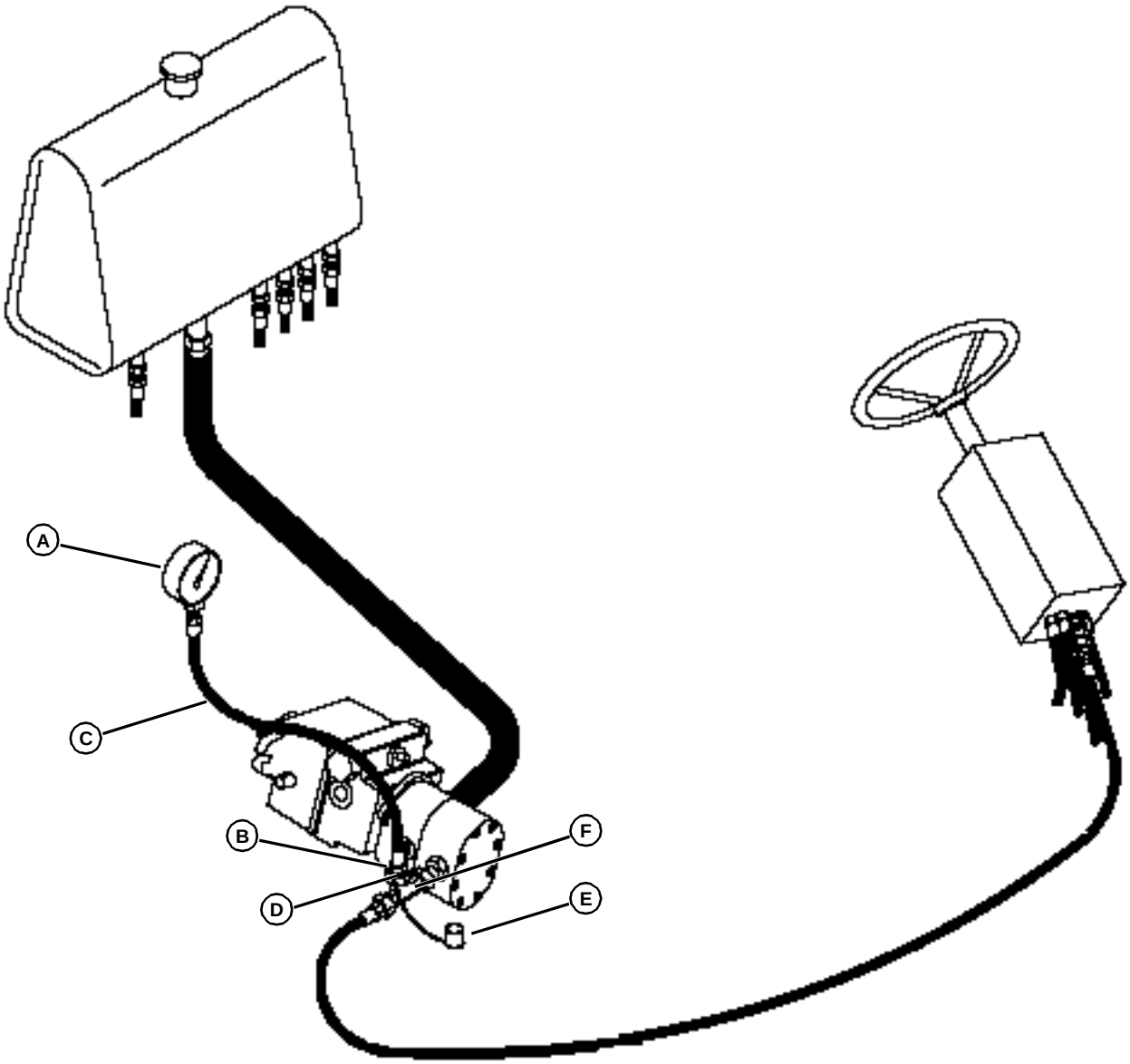
Procedure:

NOTE: Optional diagnostic kit (part number BM18290) must be installed on the machine to perform this test.

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. Raise and lock seat platform.
7. Disconnect hose connected to steering valve "IN" port from hydraulic pump.
8. Install tee (F), dust cap (E), and diagnostic receptacle (D) to pump. Connect steering valve hose to swivel tee.
9. Connect hydraulic diagnostic hose (C) and diagnostic coupler (B) to pressure gauge (A).
10. Connect pressure gauge assembly to diagnostic receptacle.
11. Start engine and run at **fast idle (2975 ± 75 rpm)**.
12. Turn steering wheel in one direction and hold against stop.
13. 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.



M82625AE

MOW VALVE RELIEF VALVE TEST

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 determine if the mow relief valve opens at the correct pressure.

Test Equipment:

A— JT07047 0 to 40,000 kPa (6000 psi) Pressure Gauge
B— RE48122 Diagnostic Coupler *
C— AMT846 Hydraulic Diagnostic Hose *
D— RE43774 1/2" tube x 1/8" body Diagnostic Receptacle *
E— XPD6-285 Dust Cap *
F— 38H1031 13/16 M x 13/16 F Swivel Run Tee, *

* Included in BM18290 Diagnostic Kit.

Procedure:

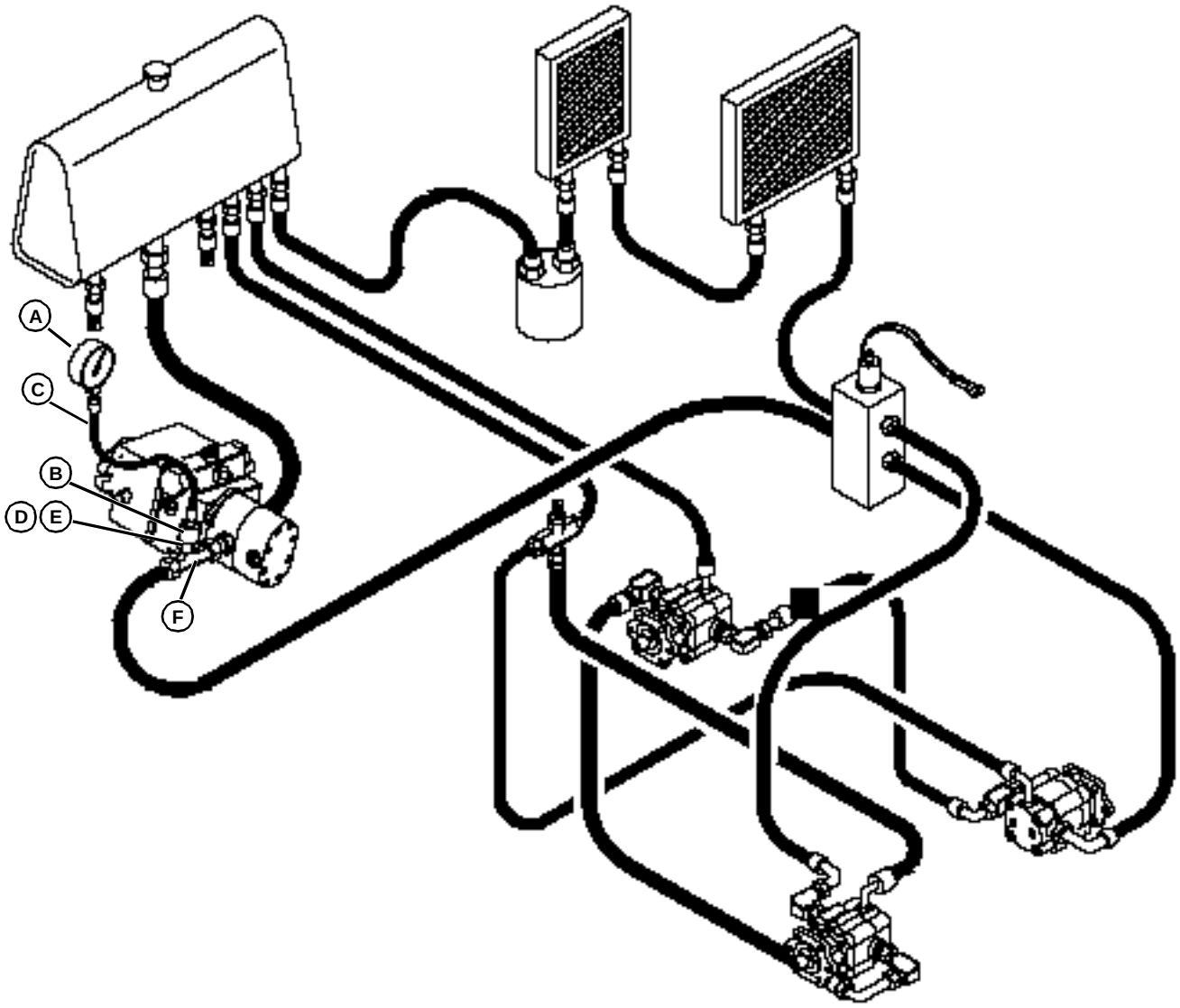
CAUTION

Avoid injury from rotating blades. Keep hands and feet away from cutting units while machine is running.

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. Disconnect hose connected to mow valve "P" port from hydraulic pump.
7. Install tee (F), dust cap (E), and diagnostic receptacle (D) to pump. Connect mow valve hose to swivel tee.
8. Connect hydraulic diagnostic hose (C) and diagnostic coupler (B) to pressure gauge (A).
9. Connect pressure gauge assembly to diagnostic receptacle.
10. Use a wooden block in the reel of the left cutting unit to stall reel and stop the oil flow.
11. Start engine and operate at **fast idle (2975 ± 75 rpm)**. Move mow/transport lever to MOW position.
12. Engage cutting units by pushing the mow switch button.
13. Check pressure gauge reading, mow relief valve should open at **20684 kPa (3000 psi)**.

Results:

- If pressure is below specification, replace mow valve.



M82627AE

REAR LIFT LINKAGE ADJUSTMENT

Reason:

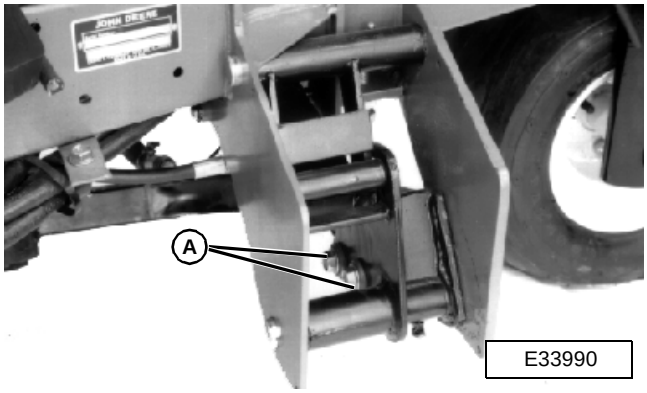
To ensure that the rear cutting unit is being raised to the proper height to provide clearance when not in use.

Procedure:

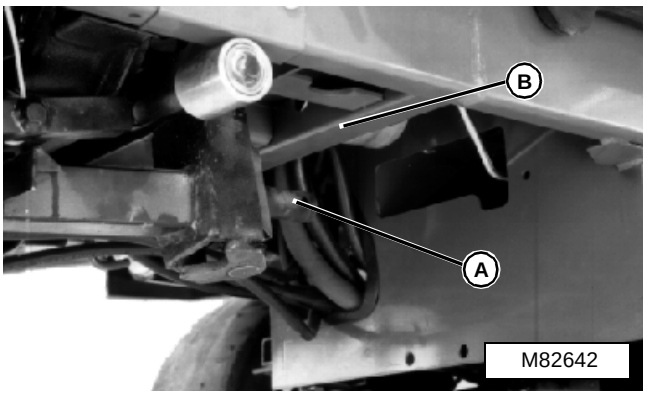
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.

NOTE: Pull cutting unit out from left side.

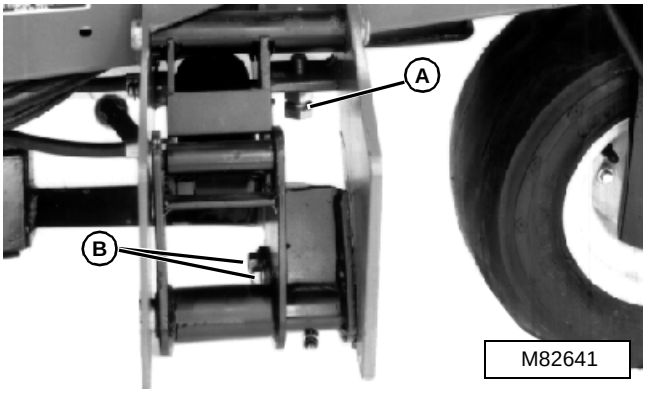
6. Pull two pins to remove center (rear) cutting unit.
7. Loosen two clamps cap screws and nuts (A).



8. Raise and support center cutting arm.
9. Make sure pin (A) is at the bottom of the V-notch. Adjust arm until top of pin (A) is **40 mm (1.575 in.) below crossmember**(B).



10. Adjust bolt (A) until it touches the center cutting unit arm and back off (away from arm) 1/2 turn. Tighten lock nut.
11. Tighten clamp screws (B) and nuts to **129 N•m (95 lb-ft)**.
12. Install linkage shield.



BLEED HYDRAULIC SYSTEM

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 Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Make sure hydraulic reservoir is full.
7. Start engine and run at **slow idle (1400 ± 75 rpm)** for 10 minutes.
8. Run engine at **fast idle (2975 ± 75 rpm)** for one minute.
9. Turn steering wheel full left and hold for five seconds.
10. Turn steering wheel to straight forward and hold for 10 seconds.
11. Turn steering wheel full right and hold for five seconds.
12. Return steering wheel to straight forward. Travel machine forward about 20 feet and make two hard left turns.
13. Make two hard right turns.
14. Travel machine in reverse for 10 feet.
15. Cycle cutting units up and down three times.
16. Shut engine off and inspect hydraulic components for leaks.
17. Check and fill reservoir as necessary.

HYDRAULIC PUMP

Removal/Installation

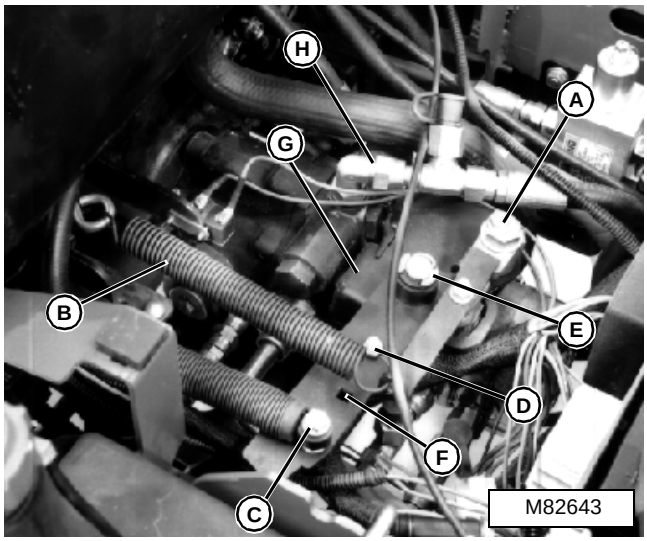
1. Remove seat platform. (See procedure in MISCELLANEOUS section.)
2. Raise and lock hood.
3. Hydraulic reservoir capacity is 16.6 L (4.4 gal). Drain hydraulic reservoir.
4. Remove parts (A—G).

c CAUTION y

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.

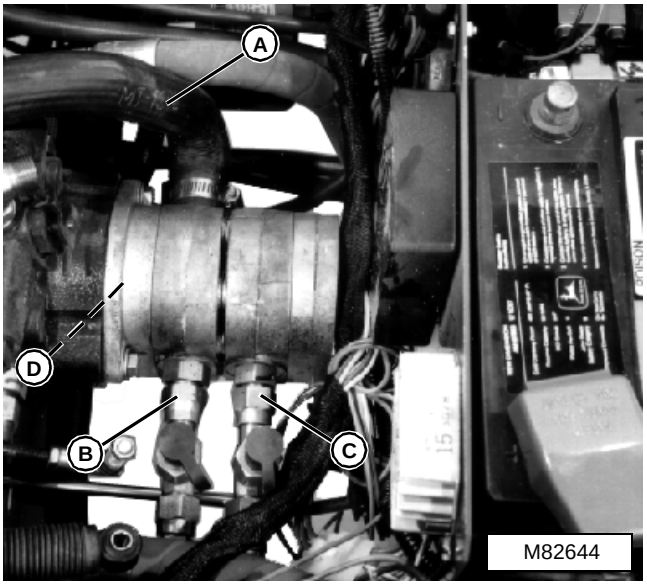
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

5. Disconnect hose (H).



A— Eccentric Cam Nut
B— Cam Arm Spring
C— Absorber Nut
D— Neutral Control Rod Nut
E— Snap Ring
F— Cam Lever
G— Bracket
H— Hose, Steering Valve Port OUT-to-Hydrostatic Pump Port E

6. Disconnect hoses (A, B and C).
7. Remove two cap screws and pump.
8. Remove drive coupler (D).



A— Supply Hose from Reservoir
B— Hose, Hydraulic Pump Rear Section-to-Mow Valve Port P
C— Hose, Hydraulic Pump Front Section-to-Steering Valve Port IN
D— Drive Coupler

Installation is done in the reverse order of removal.

- Adjust hydrostatic control linkage. (See procedure in POWER TRAIN section.)
- Fill hydraulic oil reservoir to proper level. (See SPECIFICATIONS AND GENERAL INFORMATION section.)
- Bleed hydraulic system.

Disassembly/Assembly

1. Thoroughly clean and dry outside of pump.
2. Put an alignment mark across all pump sections to aid in assembly.

IMPORTANT: Perform repair procedures with pump in a vise. Excessive clamping pressure on pump housing will cause distortion.

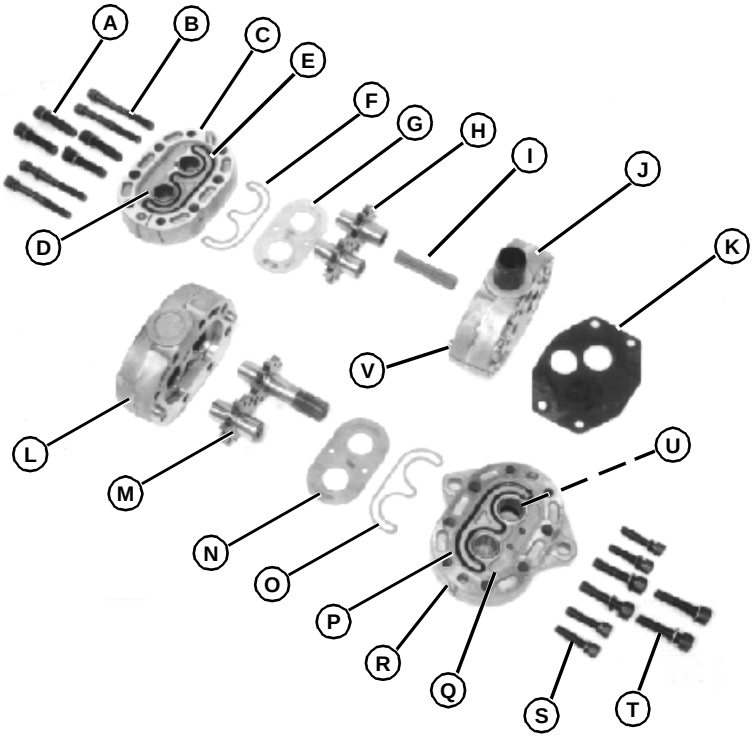
3. Hold pump in a soft-jaw vice using just enough pressure to prevent pump from rotating when removing socket head cap screws.
4. Loosen eight socket head cap screws on each end of pump.

5. Remove pump from vice. With cover (C) facing up, remove socket head cap screws and washers (A and B), cover (C), seals (E and F) and sealing ring (D).
6. Remove wear plate (G).
7. Put an alignment mark across mating teeth of rear gear set (H) to aid in assembly.
8. Remove rear gear set (H) and splined shaft (I).
9. Turn pump over so pump body (R) is up.
10. Remove socket head cap screws and washers (S and T), pump body (R), seals (O and P) and sealing ring (Q).
11. Remove wear plate (N).
12. Put an alignment mark across mating teeth of front gear set (M) to aid in assembly.
13. Remove front gear set (M).
14. Separate sections (J and L) and remove gasket (K).
15. Remove shaft seal (U).
16. Inspect dowel pins (V) for wear or damage. Replace if necessary.

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.

17. Clean all metal parts with solvent and blow-dry with compressed air.
18. Inspect all parts for damage, nicks, or unusual wear patterns. Replace as necessary.



M82519

A— 3/8 Socket Head Cap Screw (4 used)
B— 5/16 Socket Head Cap Screw (4 used)
C— Cover
D— Sealing Ring
E— Pre-Load Seal
F— Load Seal
G— Wear Plate
H— Rear Gear Set
I— Splined Shaft
J— Rear Section
K— Gasket
L— Front Section
M— Front Gear Set
N— Wear Plate
O— Load Seal
P— Pre-Load Seal
Q— Sealing Ring
R— Pump Body
S— 5/16 Socket Head Cap Screw (4 used)
T— 3/8 Socket Head Cap Screw (4 used)
U— Shaft Seal
V— Dowel Pin (4 used)

Assembly is done in the reverse order of disassembly.

IMPORTANT: Always use new seals. Damaged or used parts will leak.

NOTE: Lubricate all seals with petroleum jelly during assembly.

Apply clean hydrostatic/hydraulic oil on all internal parts during assembly.

- Install new shaft seal with lips facing toward pump body. Push seal to bottom of bore. Apply petroleum jelly to seal lips.
- Install wear plates with bronze surface facing gear sets.
- Tighten socket head cap screws finger-tight during pump assembly.
- Rotate pump shaft to make sure gears turn freely. Tighten socket head cap screws to:

Socket Head Cap Screws
(A and T) . . . . . 42 N•m (31 lb-ft)
Socket Head Cap Screws
(B and S) . . . . . 23 N•m (200 lb-in.)

MOW VALVE

Removal/Installation

1. Remove seat platform. (See procedure in MISCELLANEOUS section.)
2. Raise hood.
3. Disconnect wire connector (A).

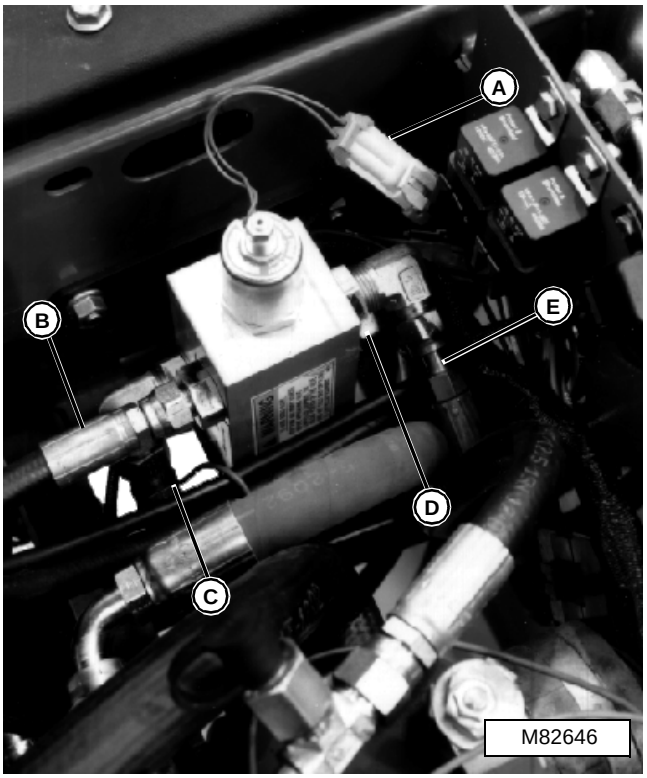
c CAUTION y

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: Tag hoses to aid in installation. Cutting units can rotate backwards if hoses are not connected correctly.

4. Tag and disconnect hoses (B—E).



A— Wire Connector
B— Hose, Port T-to-Oil Cooler
C— Hose, Hydraulic Pump-to-Port P
D— Hose, Port A-to-Left Front Reel Motor
E— Hose, Port B-to-Right Front Reel Motor

5. Remove two cap screws from bottom of mow valve and remove mow valve.

NOTE: Mow valve is non-serviceable.

6. 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 SPECIFICATIONS AND GENERAL INFORMATION section.)

LIFT VALVE

Removal/Installation

1. Remove seat platform. (See procedure in MISCELLANEOUS section.)
2. Raise hood.
3. Disconnect wire connectors (A).

c CAUTION y

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.

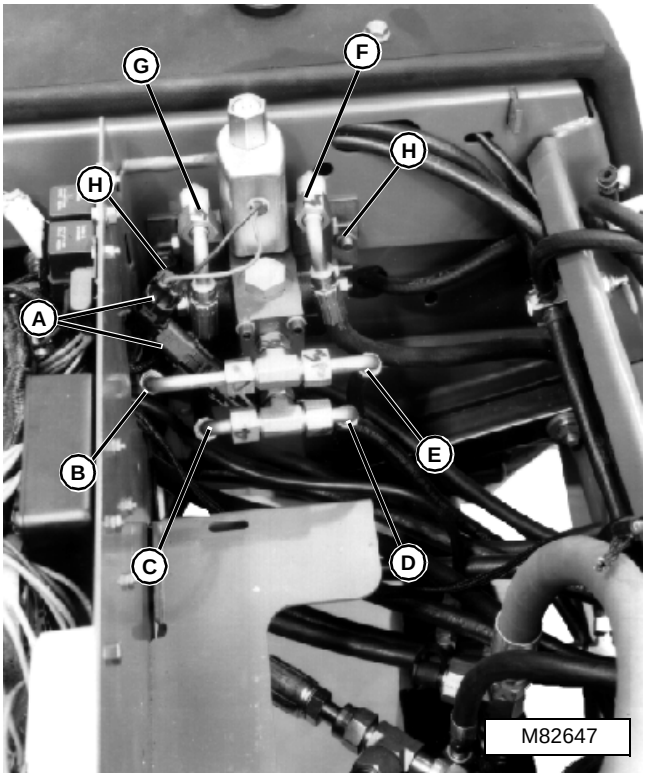
If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be removed within a few hours or gangrene may result. Doctors unfamiliar with this type of injury may call Deere & Company Medical Department in Moline, Illinois, or other knowledgeable medical source.

NOTE: Tag hoses to aid in installation. Lift/lower operation can be affected if hoses are not connected correctly.

4. Tag and disconnect hoses (B—G).

IMPORTANT: Use care not to let cap screws for nuts (H) fall from mounting holes. Fuel tank must be removed to install cap screws back into mounting holes.

5. Remove two nuts (H). Remove lift valve assembly.

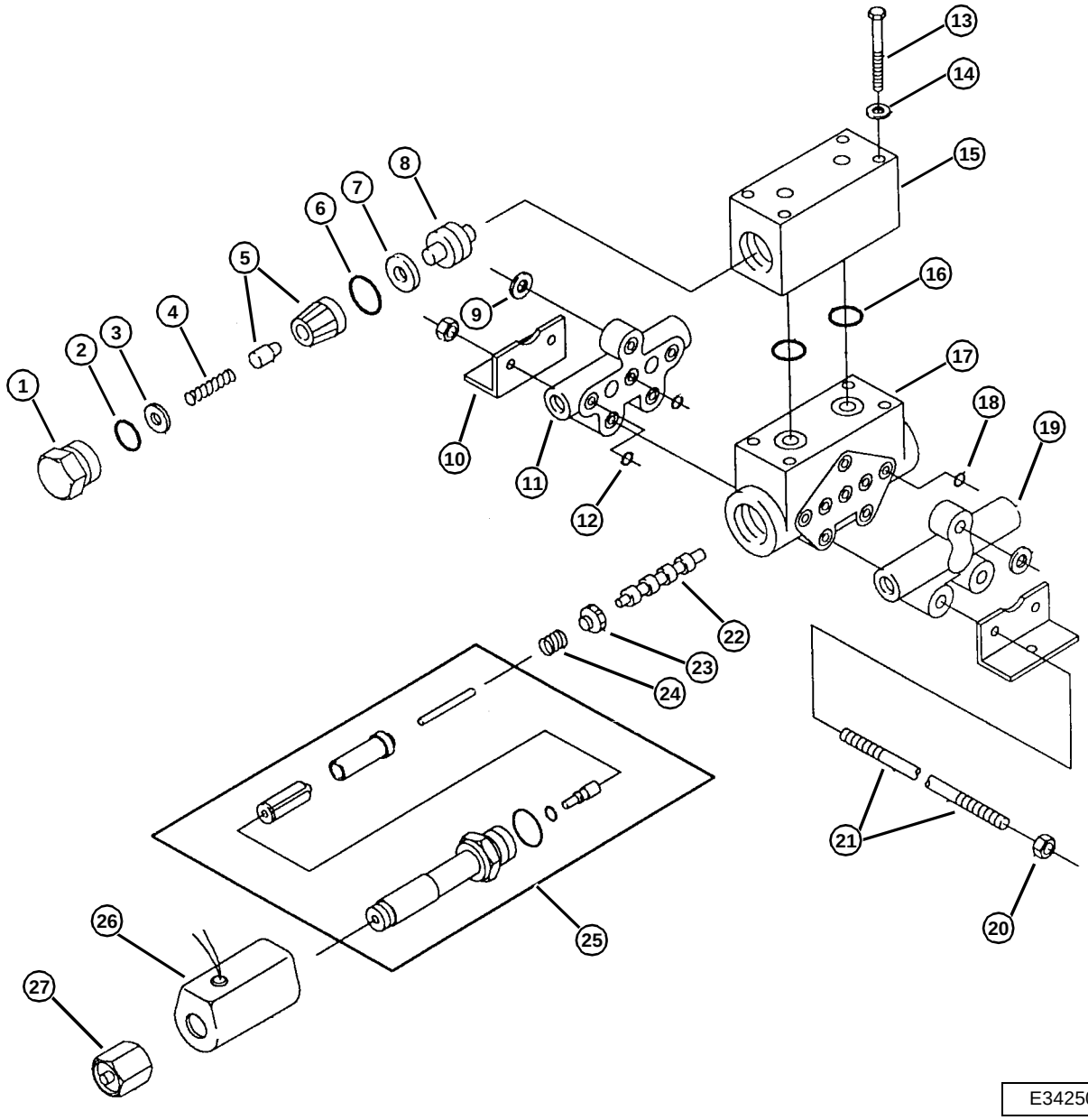


A— Wire Connectors
B— Hose, Port C2-to-Rear Lift Cylinder, Rod End
C— Hose, Port C1-to-Rear Lift Cylinder, Head End
D— Hose, Port C1-to-Front Lift Cylinder, Head End
E— Hose, Port C2-to-Front Lift Cylinder, Rod End
F— Hose, Port OUT-to-Tee between Steering Valve and Hydrostatic Pump
G— Hose, Steering Valve Port AUX-to-Port IN
H— Mounting Nuts

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 SPECIFICATIONS AND GENERAL INFORMATION section.)

Repair



1—Plug (2 used)
2—O-Ring (2 used)
3—Washer (2 used)
4—Spring (2 used)
5—Check Poppet (2 used)
6—O-Ring (2 used)
7—Backup Ring (2 used)
8—Piston
9—Washer (2 used)
10—Bracket (2 used)
11—Inlet Manifold
12—O-Ring (10 used)
13—Cap Screw (4 used)
14—Lock Washer (4 used)
15—Check Valve Body
16—O-Ring (2 used)
17—Valve Body
18—O-Ring (5 used)
19—Outlet Manifold
20—Nut (6 used)
21—Stud (3 used)
22—Spool
23—Spring Retainer
24—Spring
25—Plunger Tube Assembly (2 used)
26—Solenoid Coil (2 used)
27—Nut with Manual Rest (2 used)

IMPORTANT: Note the position of spool (22) in valve body (17). 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 (20). Spool binding or leaks will occur.

- Tighten plunger tube assembly (25) to **11 N•m (100 lb-in.)**.
- Tighten tie rod nuts (20) 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

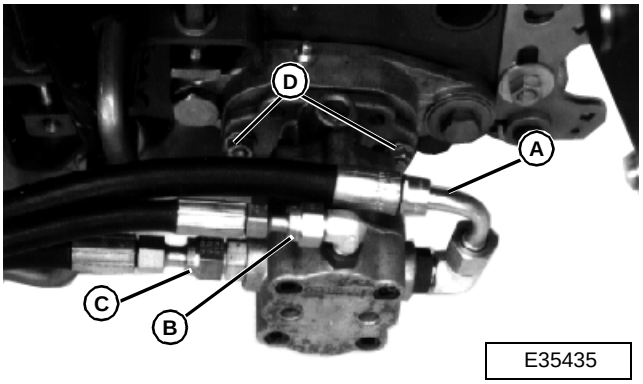
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.

c CAUTION y

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.

6. Approximate capacity of hydraulic reservoir is 16.6 L (4.4 gal). Drain hydraulic reservoir.
7. Disconnect hoses (A, B and C).
8. Remove mounting nuts (D) and reel motor.



E35435

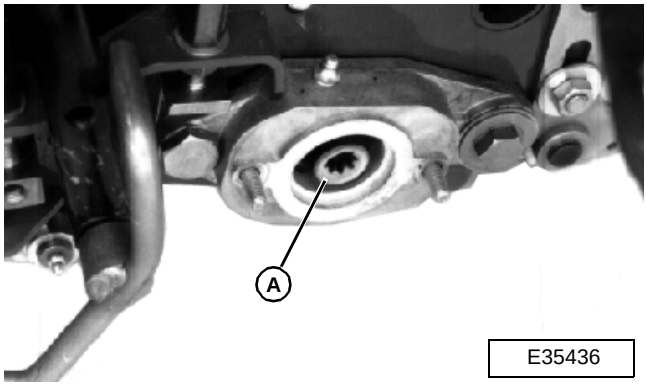
A— Hose, Oil Return
B— Hose, Oil Leak-off
C— Hose, Oil Inlet
D— Mounting Nuts

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 (A) 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 SPECIFICATIONS AND GENERAL INFORMATION section.)



E35436

Disassembly/Assembly

1. Thoroughly clean and dry outside of motor.

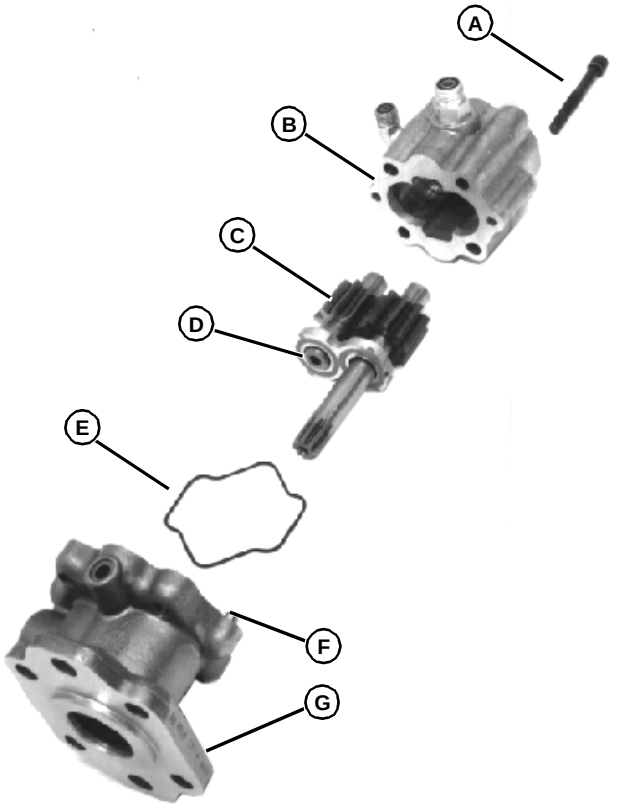
IMPORTANT: Perform repair procedures with motor in a vise. Clamp across mounting flange only. Excessive clamping pressure on motor housing will cause distortion.

2. Put motor in a soft-jawed vise with mounting flange facing down.
3. Remove four socket head cap screws and lock washers (A).

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.

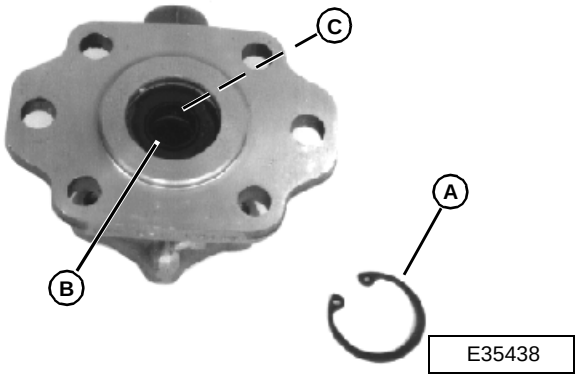
4. Remove motor from vice. With drive shaft up, remove mounting flange (G) and seal (E) from motor body (B).
5. Remove wear plate (D) and gear set (C) as an assembly.
6. Put an alignment mark across mating teeth of gear set to aid in assembly.
7. Separate wear plate (D) and gear set (C).
8. Inspect dowel pin (F) for wear or damage. Replace if necessary.



E35437

A— Socket Head Cap Screw and Lock Washer (4 used)
B— Motor Body
C— Gear Set
D— Wear Plate
E— O-Ring Seal
F— Dowel Pin
G— Mounting Flange

9. Remove snap ring (A), shaft seal (B) and washer (C).



E35438

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

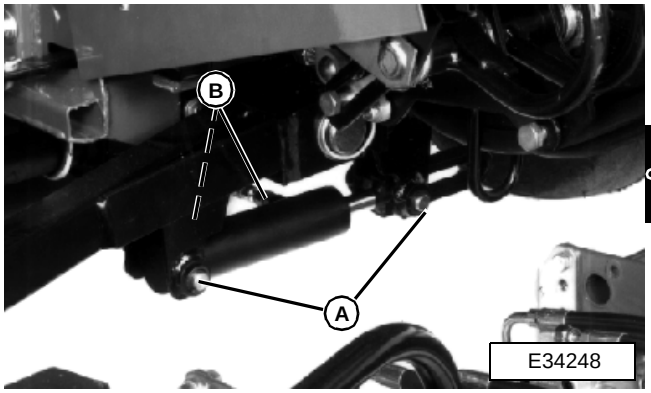
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Raise hood.

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.

7. Disconnect hydraulic hoses (B).
8. Remove snap rings and pins (A) and front lift cylinder.



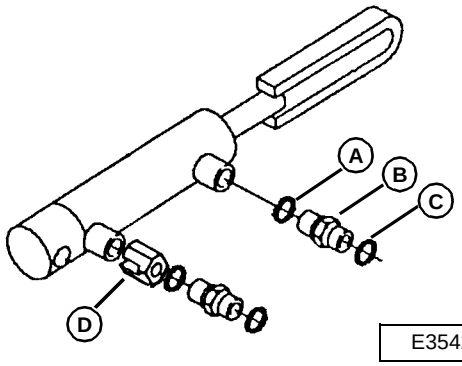
Installation is done in the reverse order of removal.

- Cycle lift system several times to bleed air from system.

Disassembly/Assembly

1. Thoroughly clean outside of cylinder before disassembly. Remove any paint or debris on cylinder rod.

2. Remove O-rings (A and C), hydraulic fittings (B) and orifice (D).



A— O-Ring

B— Hydraulic Fitting

C— O-Ring

D— 0.97 mm (0.038 in.) Orifice

3. Remove retaining ring.

4. Pull out cylinder rod, rod guide, and piston as an assembly.

5. Remove piston from cylinder rod.

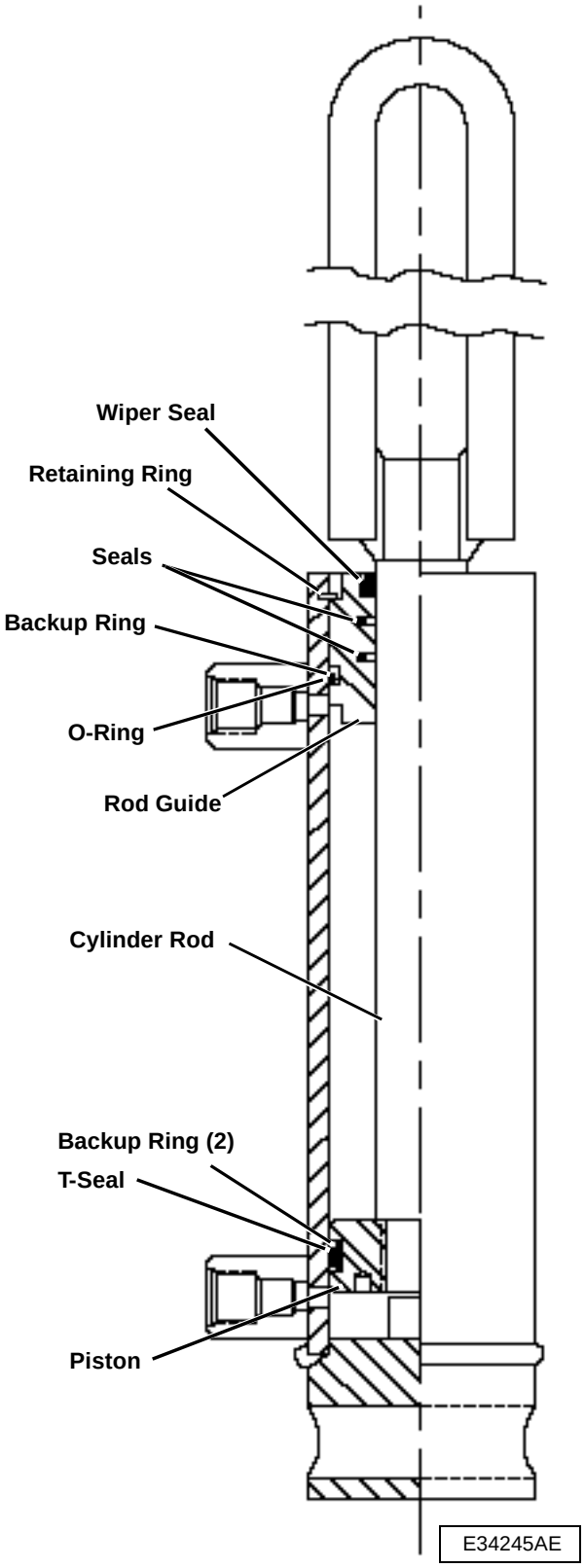
6. Remove and discard all seals, O-rings and backup rings.

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

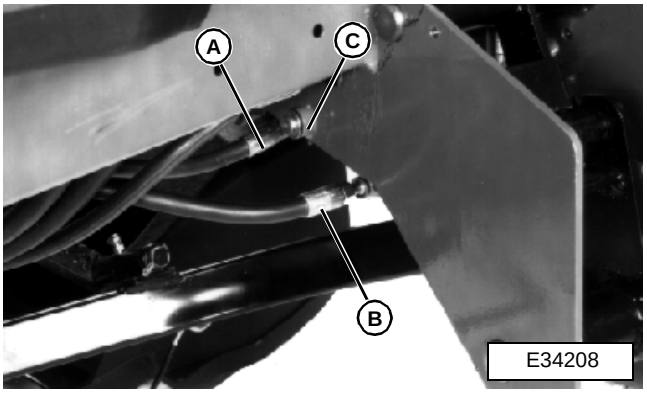
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Raise hood.
7. Remove center cutting unit from lift arm.
8. Remove rear lift arm cover.

CAUTION

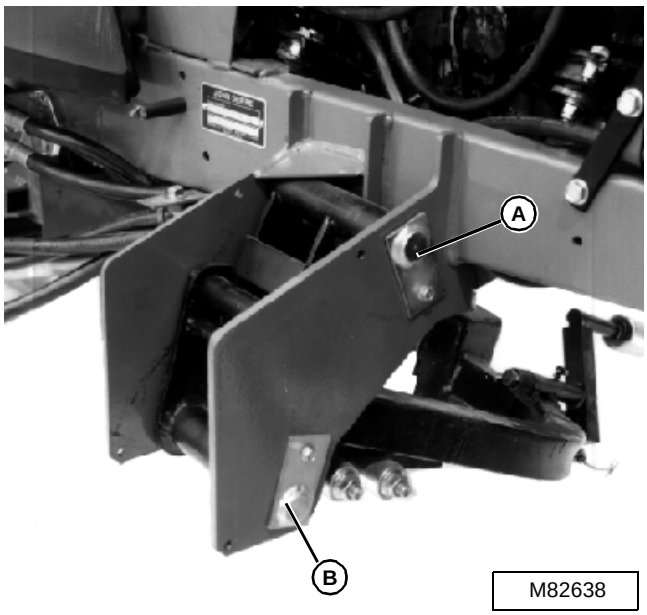
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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.

9. Disconnect hydraulic hoses (A and B).
10. Remove snap ring to remove pin (C).

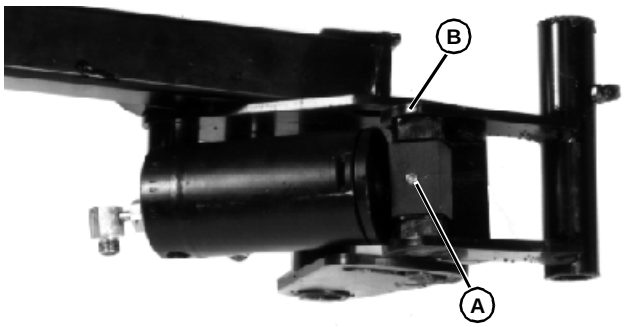


11. Remove pins (A and B) and rear lift arm assembly.



M82638

12. Loosen socket head cap screw (A). Remove pin (B) to remove rear lift cylinder.



E34210

Installation is performed in the reverse order of removal.

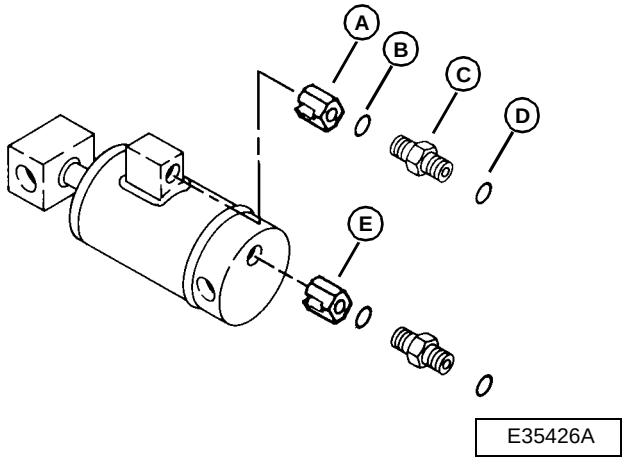
- Cycle lift system several times to bleed air from system.
- Adjust rear lift Linkage.

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 (B and D), hydraulic fittings (C) and orifices (A and E).



E35426A

A— 1.18 mm (0.0465 in.) Orifice

B— O-Ring

C— Hydraulic Fitting

D— O-Ring

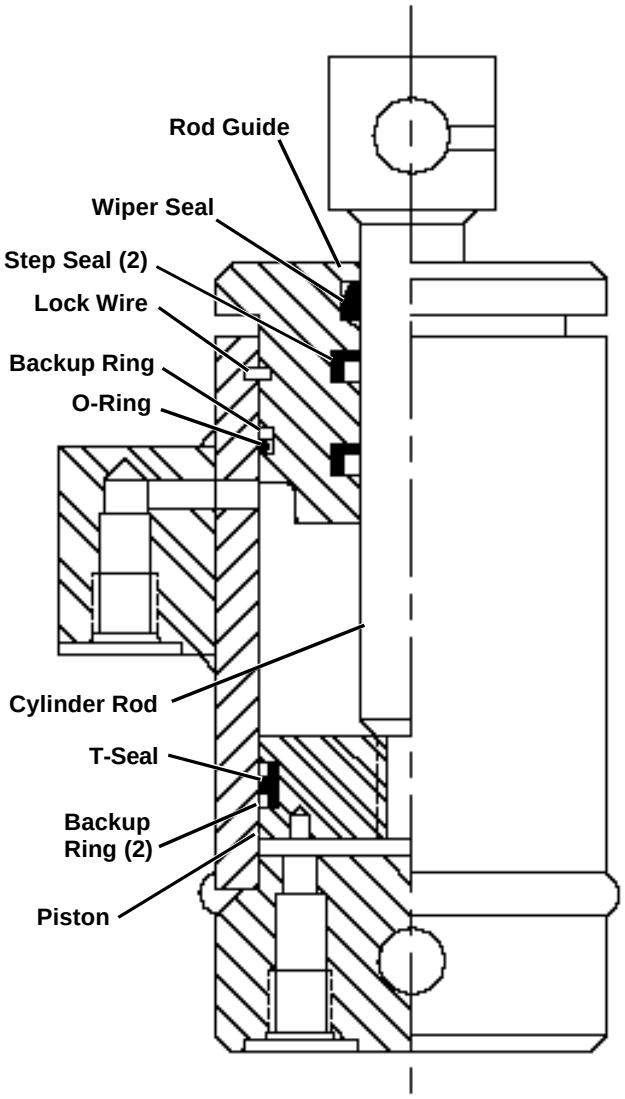
E— 1.02 mm (0.0400 in.) Orifice

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.

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

Removal/Installation

1. Remove seat platform. (See procedure in MISCELLANEOUS section.)
2. Raise hood.
3. Disconnect wire connectors (A, B and C).

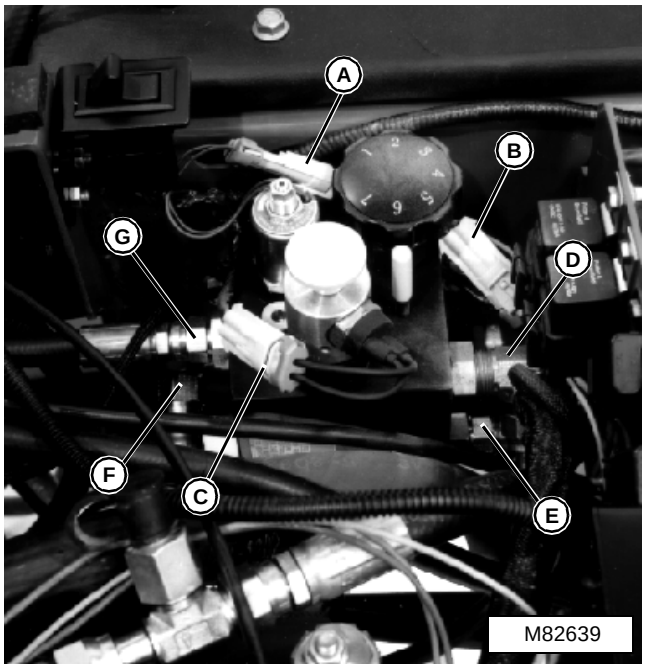
c CAUTION y

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: Tag hoses to aid in installation. Cutting units can rotate backwards if hoses are not connected correctly.

4. Tag and disconnect hoses (D—G).



A— Mow Valve Connector
B— Harness Connector
C— Direction Valve (Ball Switch) Connector
D— Hose, Port B-to-Right Front Reel Motor
E— Hose, Port A-to-Left Front Reel Motor
F— Hose, Hydraulic Pump-to-Port P
G— Hose, Port T-to-Oil Cooler

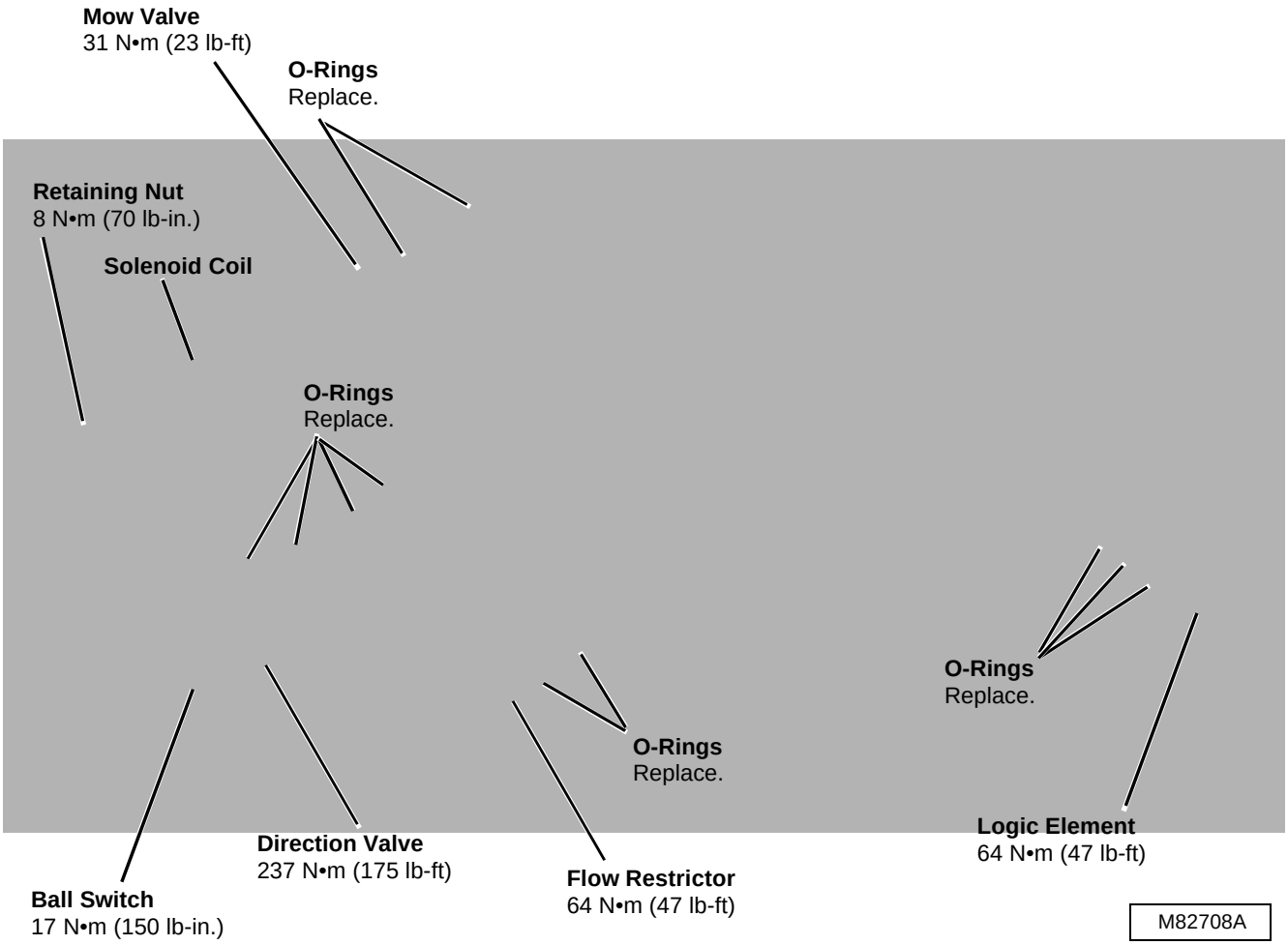
5. Remove two cap screws at bottom of mow/backlap valve assembly and remove valve.

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 SPECIFICATIONS AND GENERAL INFORMATION section.)

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.

OPTIONAL AUXILIARY OIL COOLER

Removal/Installation

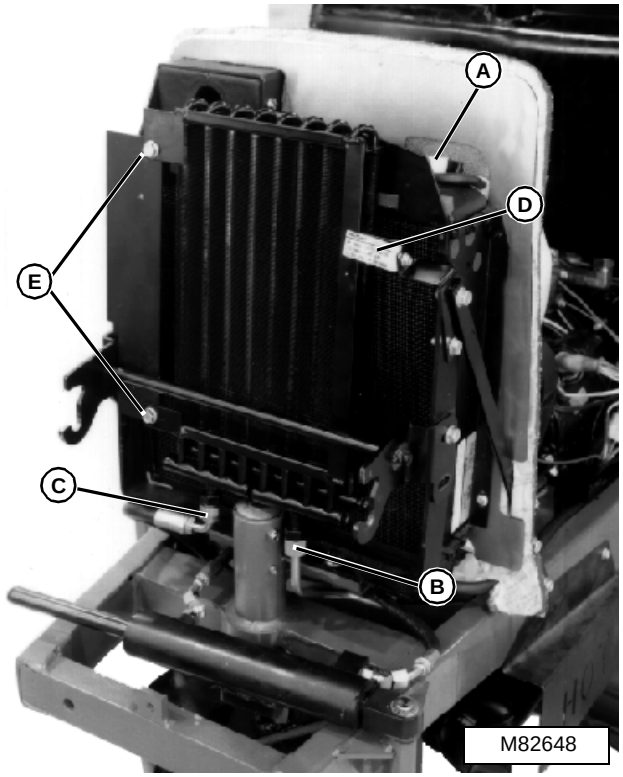
1. Park machine on level surface.
2. Move Mow/Transport lever to TRANSPORT position.
3. Lower cutting units to the ground.
4. Turn key switch OFF.
5. Engage parking brake.
6. Remove hood.
7. Remove steering cylinder cover.
8. Remove screen (A).

c CAUTION y

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.

9. Disconnect tube (B) and hydraulic hose (C). Plug hose end to prevent draining of oil from hydraulic reservoir.
10. Remove cap screws (D and E). Remove oil cooler.



A— Screen

B— Tube

C— Hydraulic Hose

D— Cap Screw

E— Cap Screws

Installation is done in the reverse order of removal.

- Install screen between oil cooler and radiator, with foam strip facing radiator.
- Run engine and check for leaks at oil cooler connections. Check level of hydraulic oil in reservoir. Add oil if necessary. (See SPECIFICATIONS AND GENERAL INFORMATION section.)

CONTENTS

Page

MISCELLANEOUS

M

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
PT569	NEVER-SEEZ® Lubricant	Lubricate roller shaft end of roller cam on Center Lift Arm assembly.

M

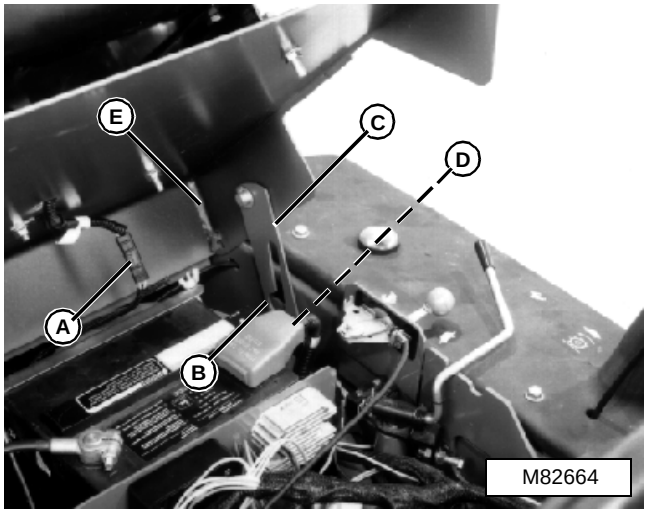
® NEVER-SEEZ is a registered trademark of the Emhart Chemical Group.

SEAT

Removal/Installation

1. Park machine on a 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. Lift seat and disconnect wire connector (A).
7. Lower seat to notch (B), lift strap (C) over retainer (D).
8. With seat at approximately 30°, lift left front corner of seat platform from tab, then slide platform from right tab (E) to remove.

Installation is done in the reverse order of removal.

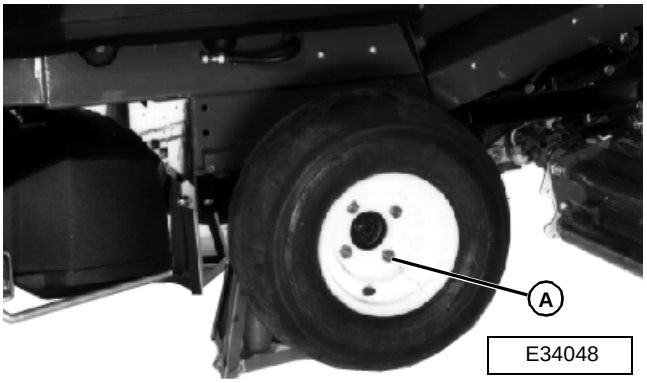


A— Wire Connector
B— Notch
C— Lift Strap
D— Retainer
E— Right Tab

FRONT WHEELS

Removal/Installation

1. Park machine on a 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. Lift machine high enough to remove weight from wheel. Place jackstand under machine frame.
7. Remove four wheel bolts (A) and remove wheel assembly.



Installation is done in the reverse order of removal.

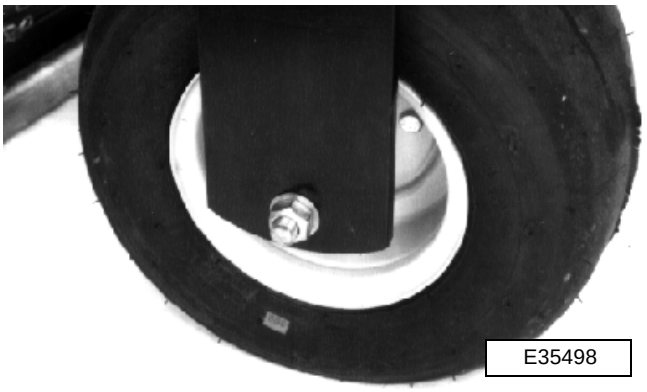
- Tighten wheel bolts in a criss-cross pattern to **88 N•m (65 lb-ft)**.

REAR WHEEL

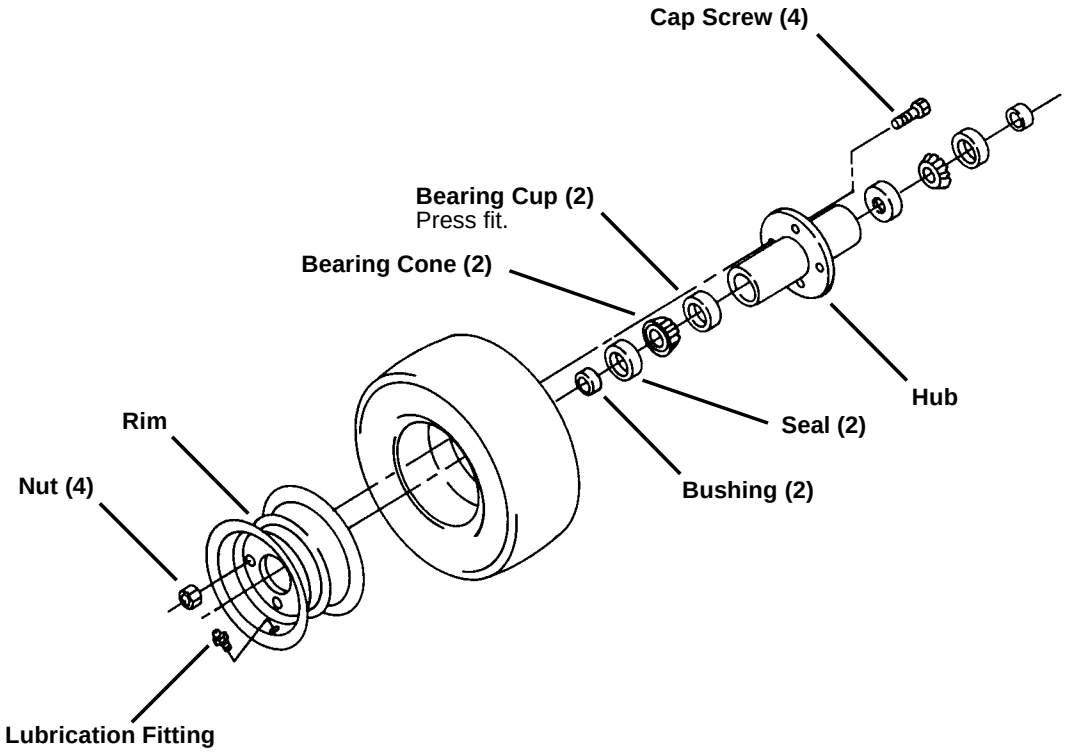
Removal/Installation

1. Park machine on a 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. Lift machine high enough to remove weight from wheel. Place jackstand under machine frame.
7. Remove nut, washer, axle bolt and rear wheel assembly.

Installation is done in the reverse order of removal.



Disassemble/Assemble Hub



- Remove seals and bearing cones using a brass drift and hammer.

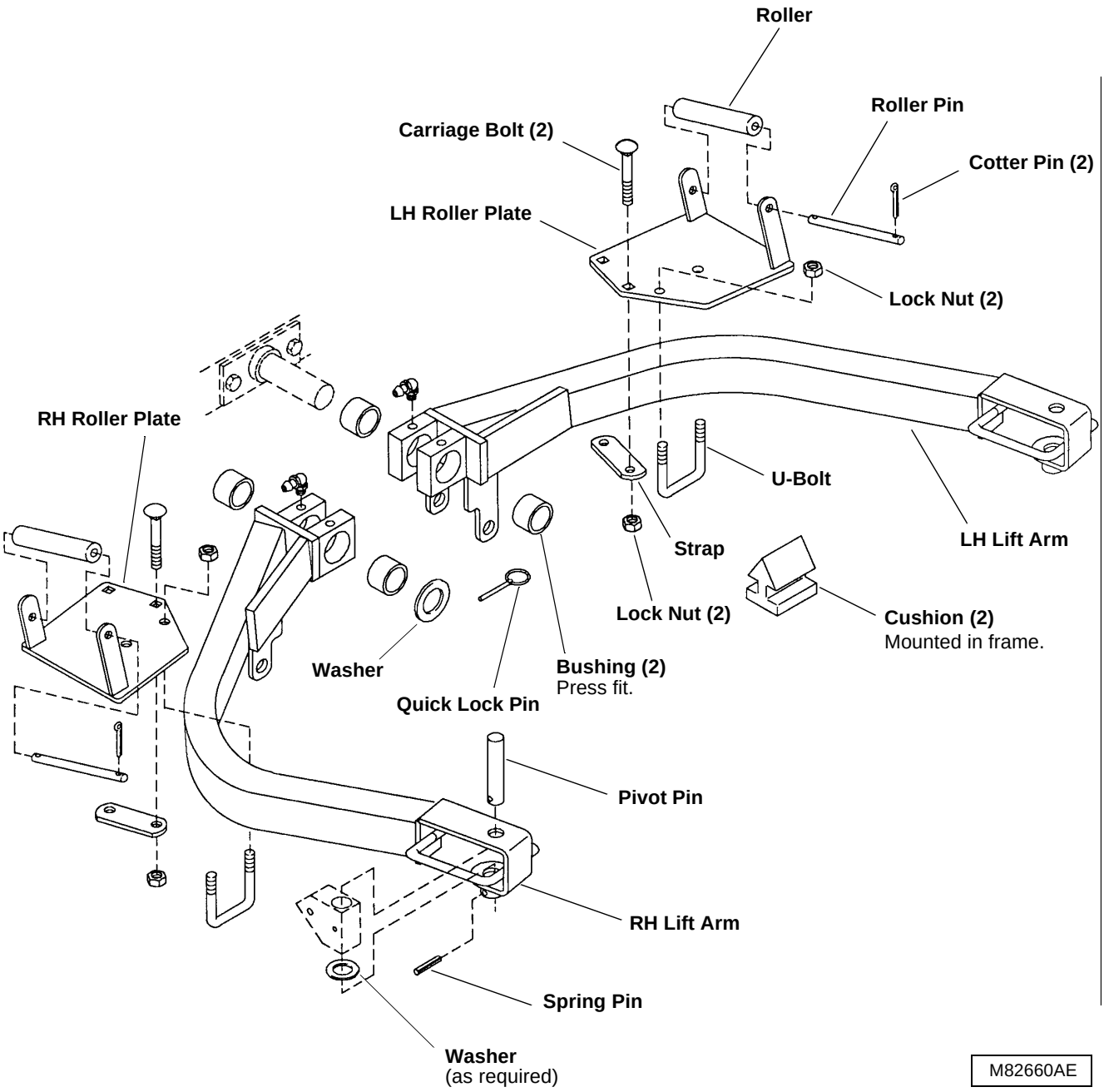
NOTE: Remove bearing cups only if replacement is necessary.

Bearing cups and cones are matched and must be replaced as a set.

- 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.
- Apply multipurpose to lubrication fitting.

M

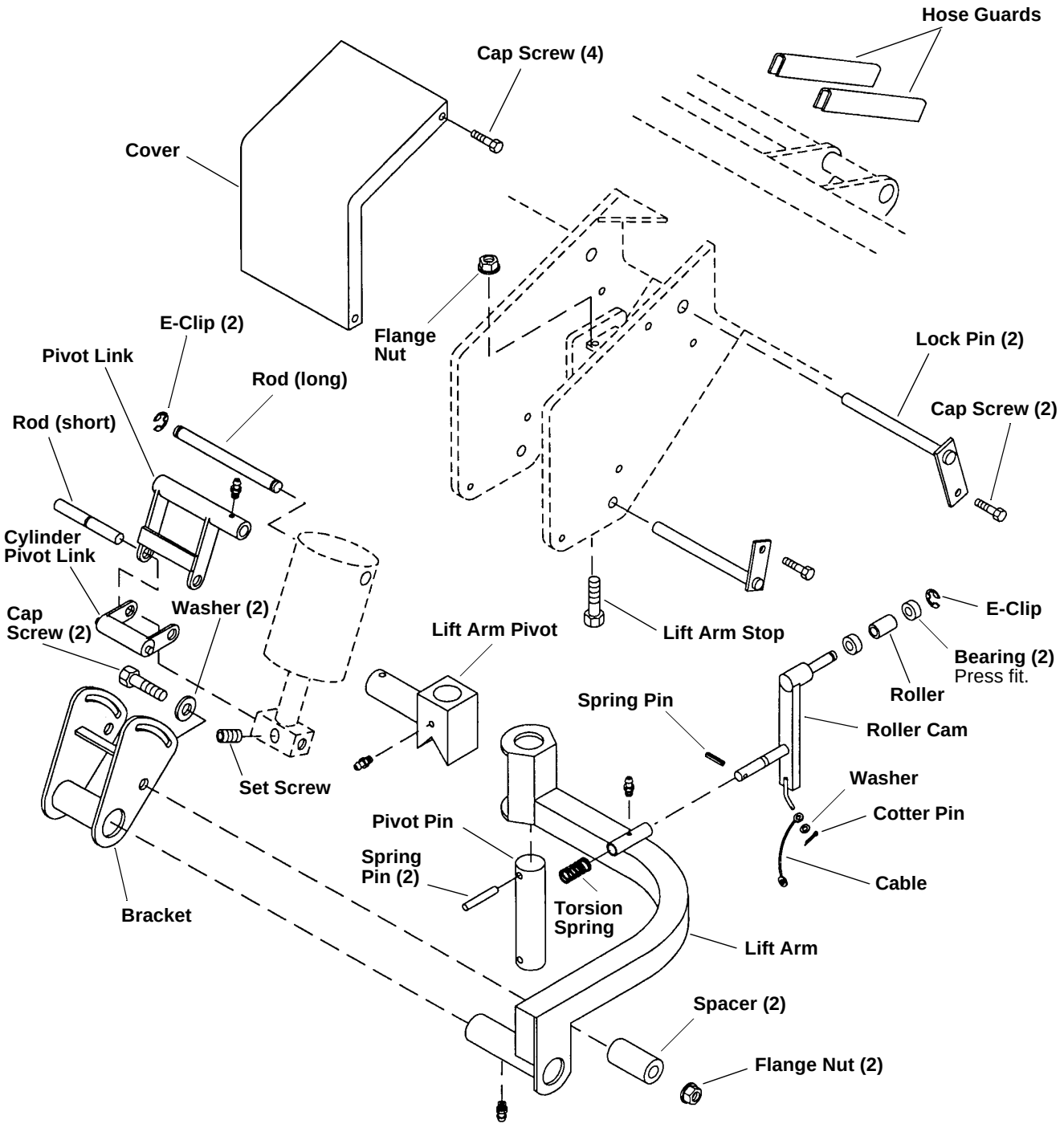
FRONT LIFT ARMS



- Note location of roller plates-to-lift arms. Scribe a mark on lift arms along roller plate to aid in assembly.
- Apply multipurpose grease to lubrication fittings.

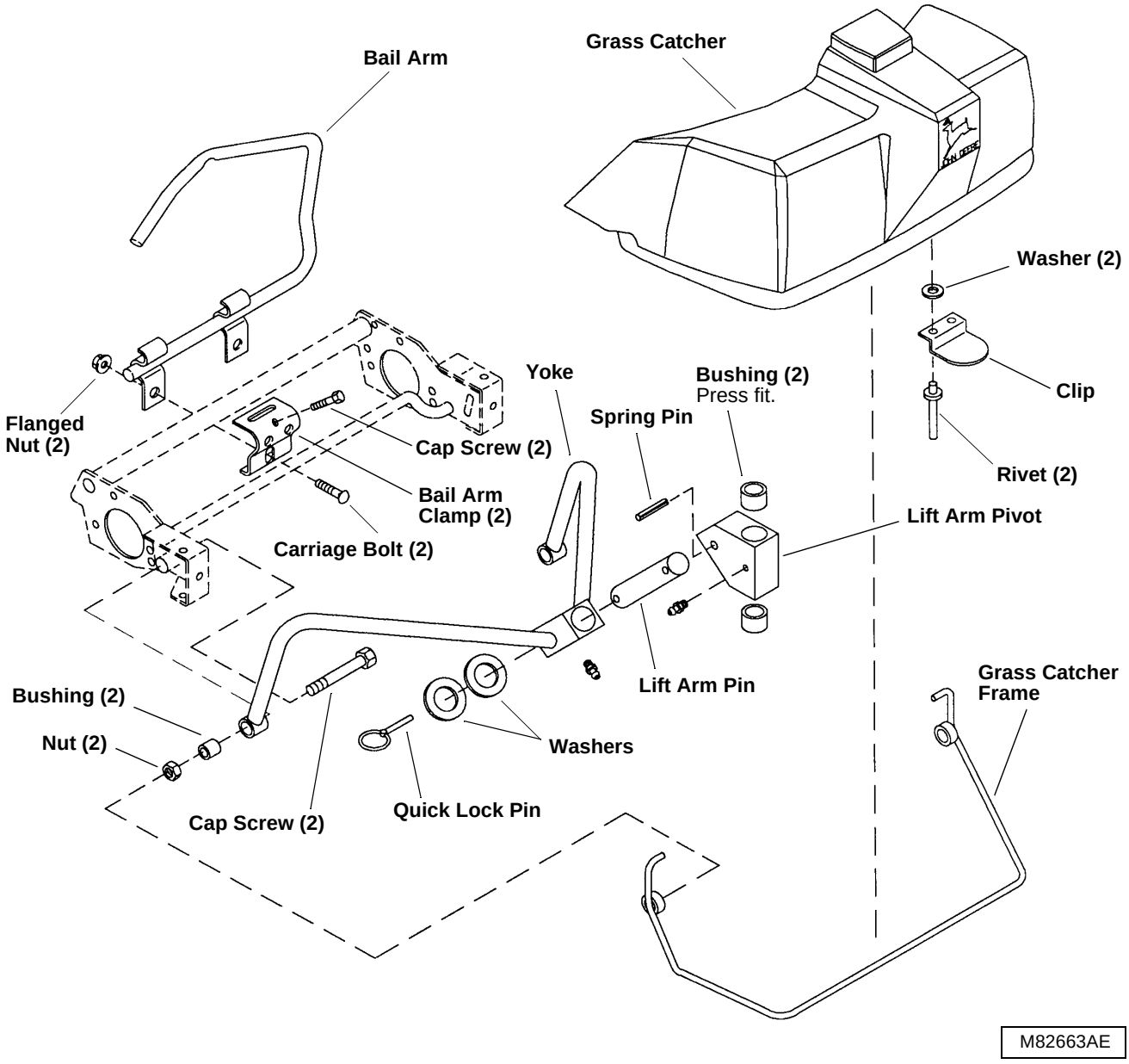
M

CENTER LIFT ARM



- Apply NEVER-SEEZ lubricant to roller shaft end of roller cam.
- Adjust rear lift linkage. (See procedure in HYDRAULICS section.)
- Apply multipurpose grease to lubrication fittings.

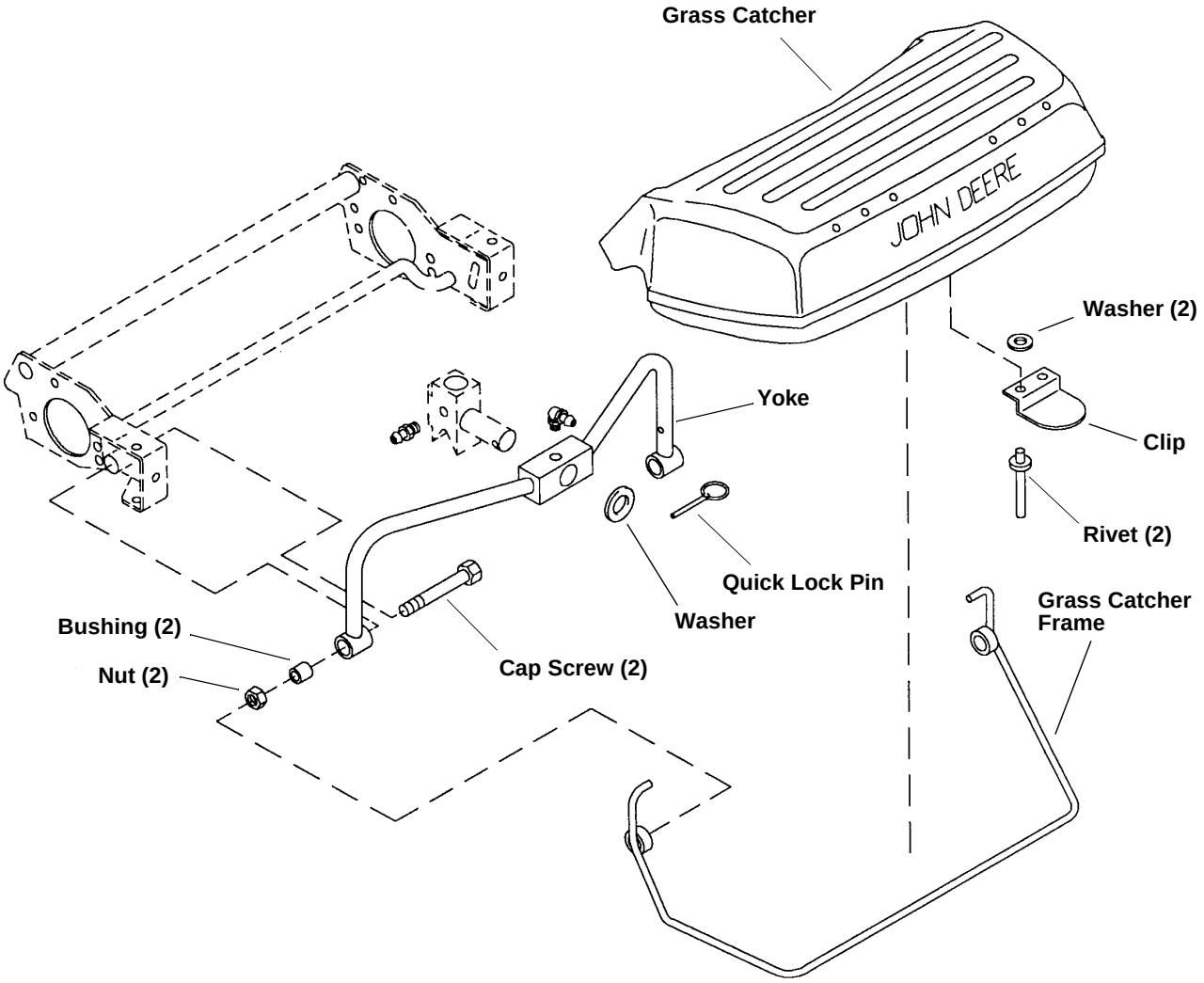
YOKE AND BAIL — FRONT CUTTING UNITS



- Apply multipurpose grease to lubrication fittings.

M

YOKE — CENTER CUTTING UNIT



M

- Apply multipurpose grease to lubrication fittings.

CONTENTS

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22 INCH REEL & 22 INCH VERTICAL MOWERS

Page

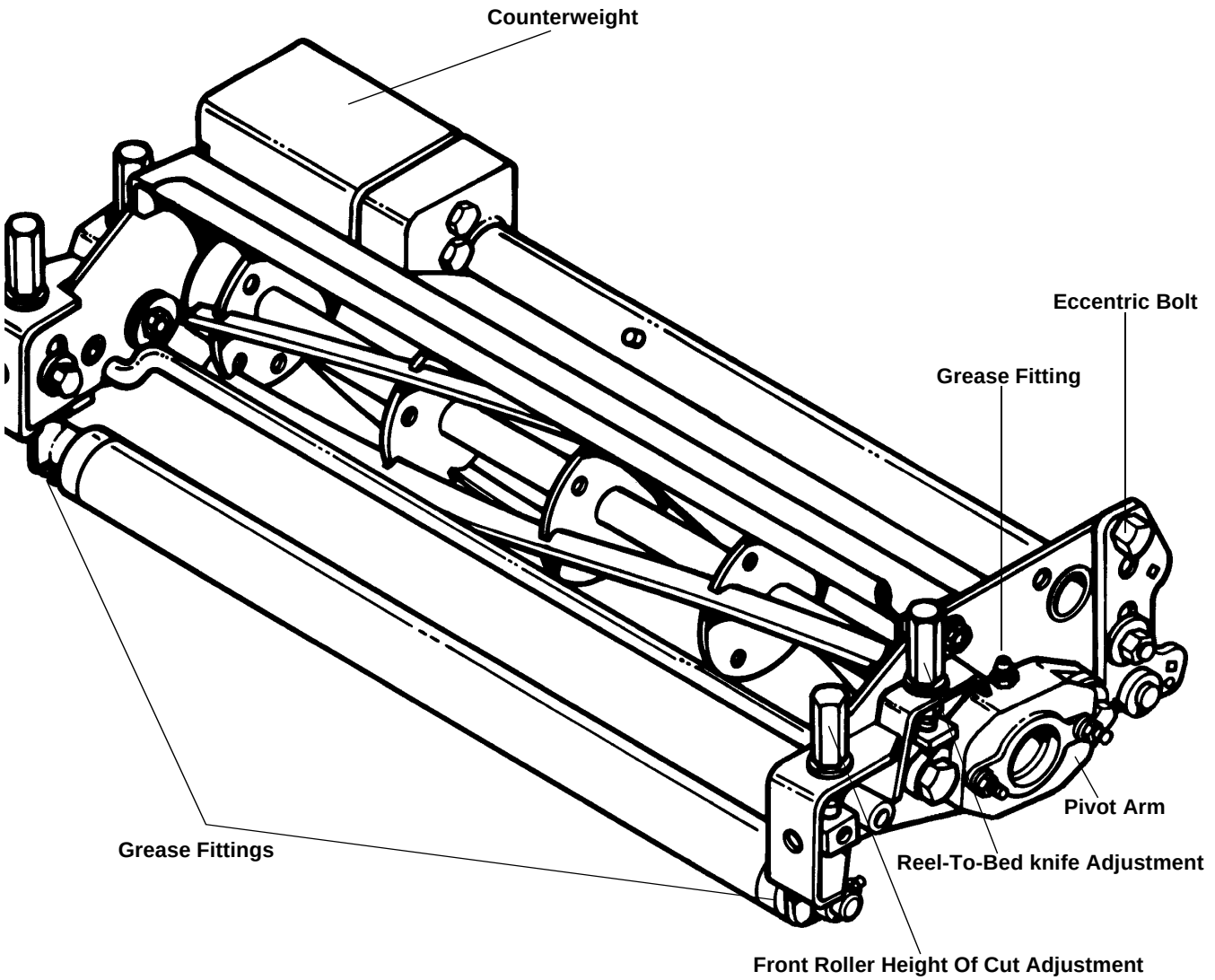
IDENTIFICATION AND APPLICATION

The 22-Inch Cutting Units 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 cutting units with black reels are made at the John Deere Horicon Works. The reels of those latest units are also made by John Deere.

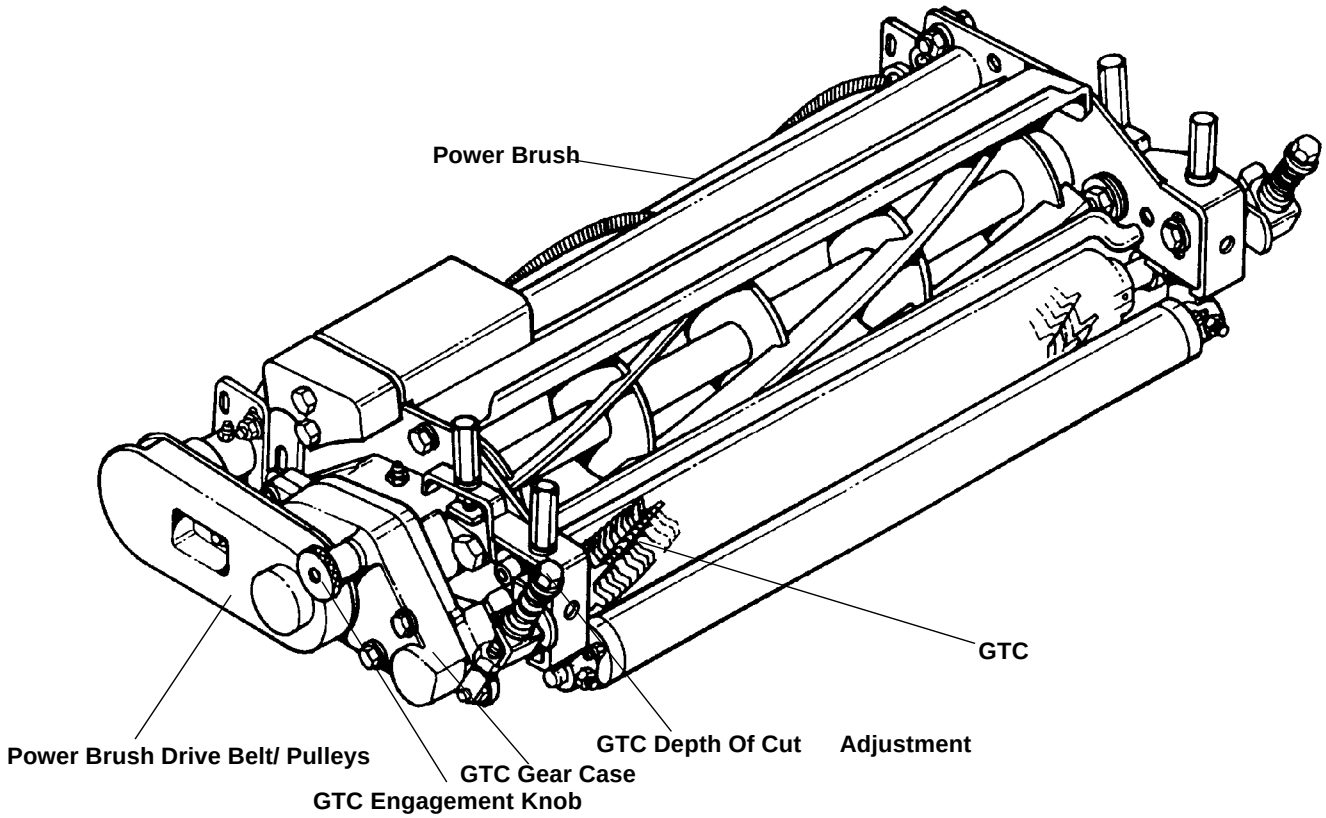
Two reels are available from John Deere. A 9-blade reel for greens and tees and a 5-blade reel for tee collars and fairway mowing applications. A Greens Tender Conditioner can be mounted to the 22-Inch Cutting Unit for slicing stolons, providing grain control and a truer playing surface. There is also 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 cutting units are used only on the 2243 Professional Greens Mower.

COMPONENT LOCATION



GTC AND POWER BRUSH COMPONENT LOCATION



GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
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

INFORMATION

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 .002 of an inch 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).

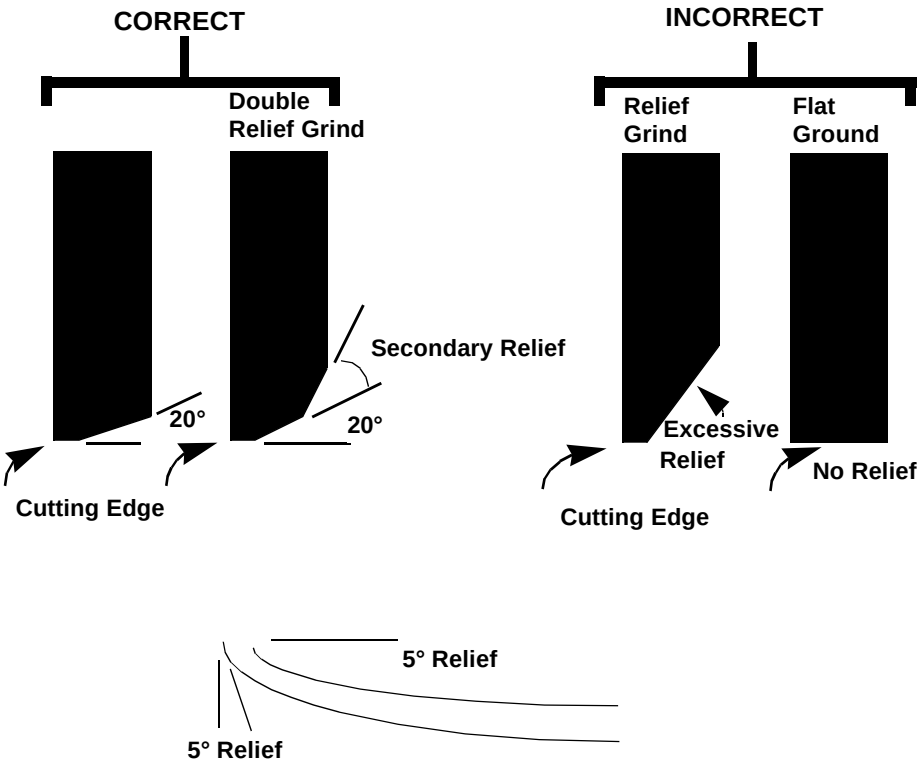
Cutting action begins as the bed knife positions the grass to be cut at the cutting edge. The reel then pulls the grass towards the bed knife where it is sheared by the cutting edges as they pass one another.

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 bedknife 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 0.001" to 0.002" 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 (GTC)

The conditioning process involves shallow vertical cutting. The blades are adjusted to cut runners and lift horizontal leaf material. It is important Not to use a GTC for three days following Top Dressing. It is also important that frequent and thorough observations be performed or stress to the plants may occur. Stress has occurred when a yellow or brown tint is observed in the color of the grass.

Grass is conditioned initially with the blades set 1/32 in. (0.79 mm) below height-of-cut.

The green is then examined closely for inconsistencies or appearance of over-aggressiveness. GTC penetration should be decreased if indications are present.

After 1 to 2 hours the green is checked for stress. If visible stress is observed, GTC penetration is decreased to 1/64 in. (0.25 mm) below height-of-cut.

Conditioning is continued at this setting for three to five days checking frequently for signs of stress. If no stress is observed, GTC penetration is increased by 0.010 in. (0.25 mm) 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 0.50" requires a CR of 0.40" to 0.60". 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:

MPH = (Reel rpm) x (CR or CH) x (Number of Reel Blades) ÷ 1056

Example

Using:

2243 Professional Greens Mower at a tested reel speed of 2100 RPM

9 blade reel on a 22" cutting unit

CH = CR (0.14)

Find: MPH (Vehicle Speed)

(2100) x (.14) x (9) ÷ 1056 = 2.5 MPH

NOTE: To calculate MPH, multiply .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.

REPAIR SPECIFICATIONS

ItemSpecification

Bed Knife Top surface,5° Relief Angle
Front Surface,5° Relief Angle
ReelSpin Grind 20° Relief Grind
RollerSmooth,Grooved

Bed Knife Support

Mounting Bolts
(Lower)47 N•m (35 lb-ft.)
(Upper)81 N•m (60 lb-ft.)
Mounting Screws6 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

Bolts47 N•m (35 lb-ft.)

Reel/Bed Knife

Clearance0-0.025 mm (0-0.001 in.)

TROUBLESHOOTING

Symptom	Problem	Solution
Marcelling	Ground speed too High	See Performance Variables,
	Engine rpm too Low	See Machine Operator's Manual
	Reels are dull	See Backlapping Procedure
	Wrong Number of	See Performance Variables,
	Reel Blades For Desired CR	
Streaking	Reel/Bed Knife Clearance	See Backlapping and Reel-
	inconsistent/Excessive	to-Bed Knife Adjustment
	Along Bed Knife	
	Nick(s) in Reel or Bed Knife	Grind Reel and Bed Knife
HOC Changes	Roller Clamp Bolts Loose	See HOC Adjustment
	Roller Bearings Worn	See Roller Removal
	Roller Out-Of-Round	See Roller Removal
	Cutting Unit Not Floating Properly	See Machine Operator's Manual
	Changing Soil Conditions	Use a Smooth Roller
	Grass Too Wet	Allow Sufficient Time To Dry
	Cut Grass Collecting	Install Scraper or Power
	on roller	Brush on Roller
	Traction Unit Pivot Arms Worn	Repair Or Replace

Poor Quality of Cut	Improper Reel to Bed Knife Clearance	See Reel-to-Bed Knife Adjustment
	Reel/Bed Knife Dull	See Backlapping and Reel-to-Bed Knife Adjustment
	Excessive grass growth	Mow more frequently
Reel Does Not Rotate	Improper Reel to Bed Knife Clearance	See Reel-to-Bed Knife Adjustment
	Reel Bearings Worn Or Seized	See Reel Removal
	Machine Not Operating Properly	See Machine Operator's Manual
Unit Not Cutting	Excessive Grass Growth along with wet conditions	
	Dull Cutting Unit	See Backlapping and Reel -To-Bed Knife Adjustment
	Incorrect Reel-To-Bed Knife Clearance	
	Machine Speed To Slow	See Performance Variables
	Too many Reel Blades	Too many reel blades, in highgrass, would fan the grass down without cutting it.

REPAIR

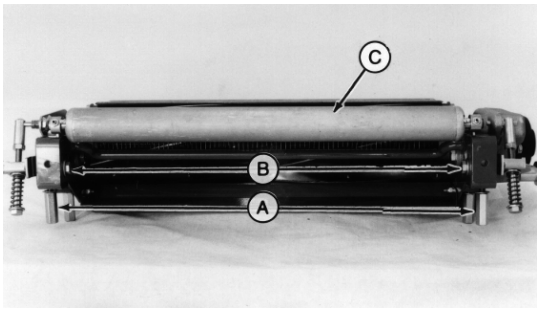
REMOVE FRONT ROLLER

1. Remove cutting unit from the tractor. If the cutting unit is not removed from the tractor, rest the cutting unit on wood blocks and be sure to observe the following **Caution**.

c 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 a reel or gtc. Serious personal injury can result fromcontact with sharp cutting edges.

2. Loosen height-of-cut adjusting nuts (A).



3. Make note of washers and remove cap screws and washers (B).

Remove front roller with brackets (C).

ROLLER DISASSEMBLY

NOTE: Smooth and machine grooved rollers have identical disassembly and assembly procedures

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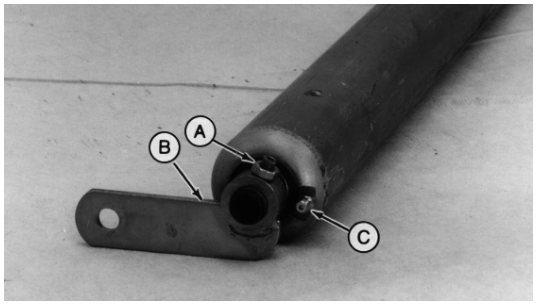


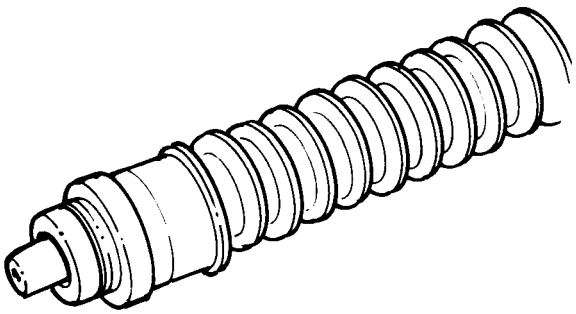
4. Loosen jam nuts (A) and remove set screws.
5. Remove brackets (B) from bearing shafts. It may be necessary to press the bearing shaft from the bracket if corroded.

ROLLER ASSEMBLY

1. Install grease fittings (C).
2. Position brackets (B) on roller as shown. Install set screws and jam nuts (A), Do Not tighten.

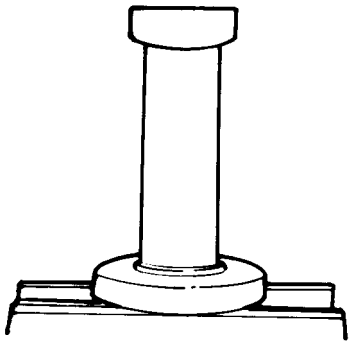
AET10558 GROOVED ROLLER DISASSEMBLY

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.

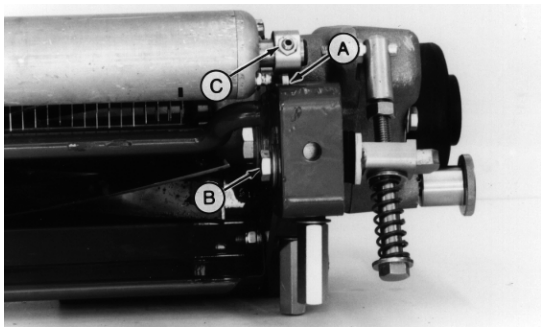
AET10558 GROOVED ROLLER ASSEMBLY



1. Clean roller end cap and bearing shaft with crocus cloth. Pack bearings with grease.
2. 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.

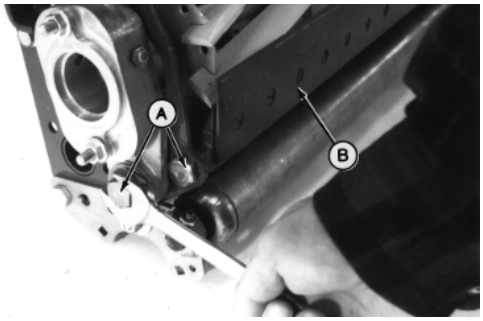
3. Install opposite seal.
4. Install grease fittings and lubricate (Do not over-lubricate, a shot of grease is fine).

ROLLER INSTALLATION



1. Insert bracket ends through frame slots (A).
2. Apply NEVER-SEEZ® to the threads of the clamp bolts (B) and install.
3. Center the roller between the mounting brackets and tighten the set screws and jam nuts (C).
4. Refer to (HOC) adjustments.

BED KNIFE/SUPPORT REMOVAL



1. Loosen the lower reel adjuster nuts and turn the top adjuster nuts clockwise to obtain maximum clearance between the reel and the bed knife.
2. Remove the four bed knife support mounting bolts (A) and remove the bed knife and support (B).

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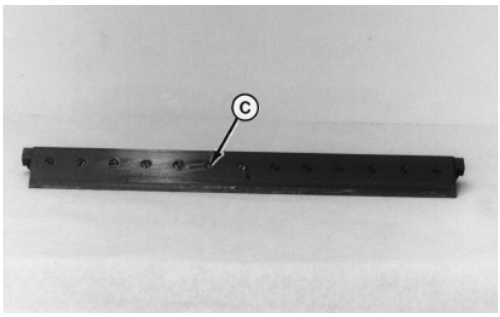
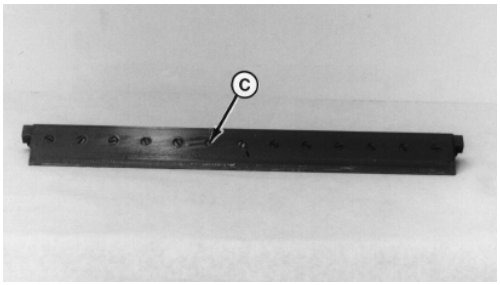


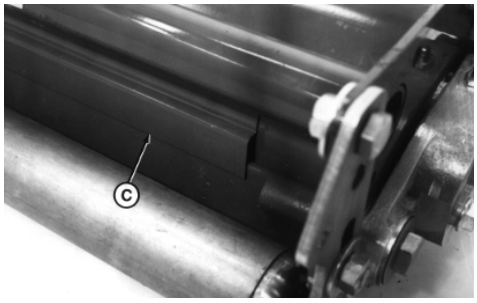
3. Using an impact driver, remove the bed knife mounting screws (C) and discard the mounting screws.

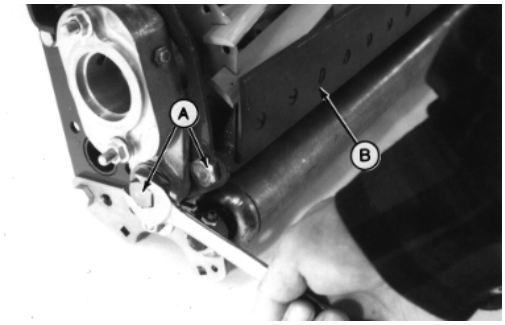
BED KNIFE/SUPPORT INSTALLATION

1. Use a scraper and a wire brush to remove scale and rust from the bed knife mounting surface.
2. Check the bed knife mounting surface with a straight edge for distortion, straighten or replace as necessary.



3. Position the bed knife on the support. Secure with new mounting screws (C) starting with the center screw and working your way toward the ends of the bed knife alternating from side to side. Tighten to 9 N•m (7 lb-ft.).
4. Clean the mounting screw threads and clean the bolt shoulders with crocus cloth. Apply NEVER-SEEZ® to the threads and shoulders of the mounting bolts.
5. Position the bed knife support (B) in the frame and rear shield locator (C). Secure with four mounting bolts (A). Tighten the bolts according to specifications.





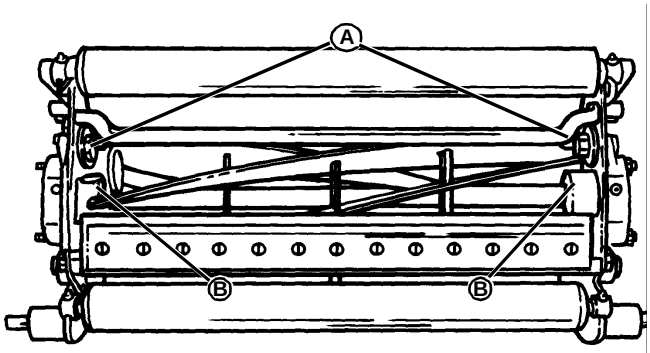
6. See Reel-to-bed knife clearance adjustment.

REEL REMOVAL

c CAUTION

Always wear glove protection when handling reels. Serious personal injury can result from contact with the sharp cutting edges of the reel.

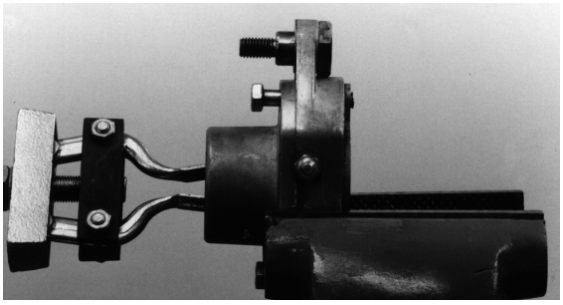
1. See GTC Removal (if equipped) and Bed Knife/ Support Removal before continuing this procedure
2. Remove remaining shouldered nuts and eight Bellville washers (A) securing left and right pivot arms (B) to frame.



3. Remove pivot arms and carefully remove reel from frame.

PIVOT ARM DISASSEMBLY AND 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 washer (left side only) from pivot arms.
2. Clean bearings and pivot arms with solvent.

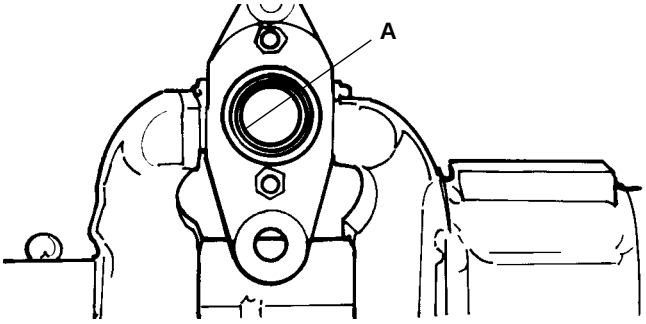
IMPORTANT: Always replace bearings and bearing cups as a set.

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.

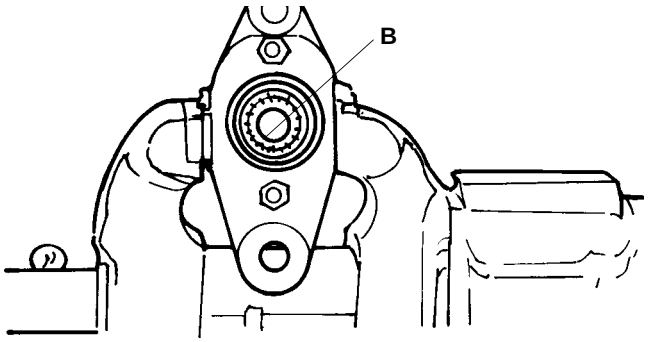
NOTE: If the splines on one side of the reel shaft are worn, the splines on the opposite side can be utilized by simply transferring the cutting unit to the other side of the mower.

PIVOT ARM ASSEMBLY

NOTE: Left or right positions are determined by standing at rear of unit and looking forward.

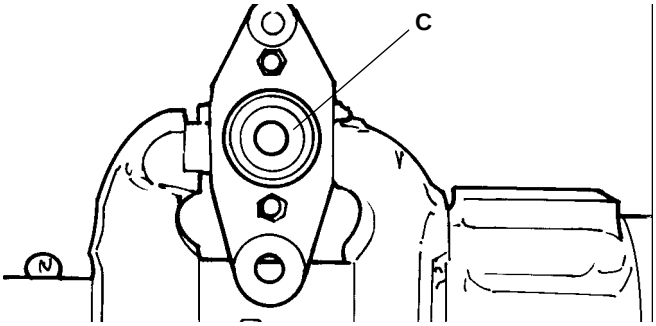


1. Install the bearing cups (A) using a suitable driver or a press (Tapered end facing outside of case).
2. Pack bearings (B) with multipurpose grease and position in bearing cups.



3. Install keyed washer (Left side only).

4. Install grease seals (C) flush with end of case, apply grease to lip of seal.

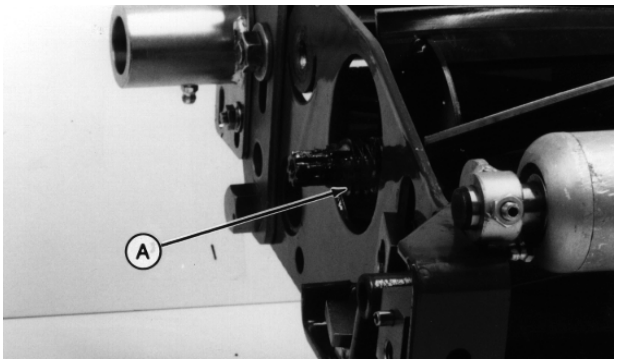


REEL INSTALLATION

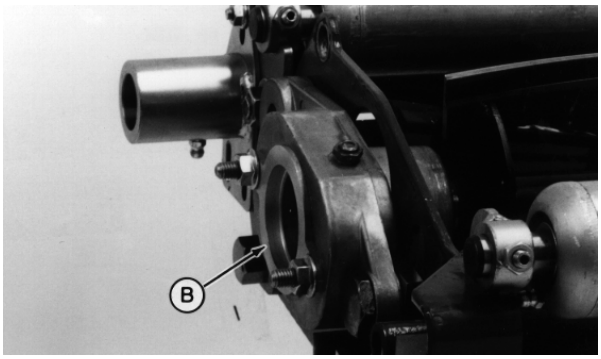
c CAUTION

Always wear glove protection when handling reels. Serious personal injury can result from contact with the sharp cutting edges of the reel.

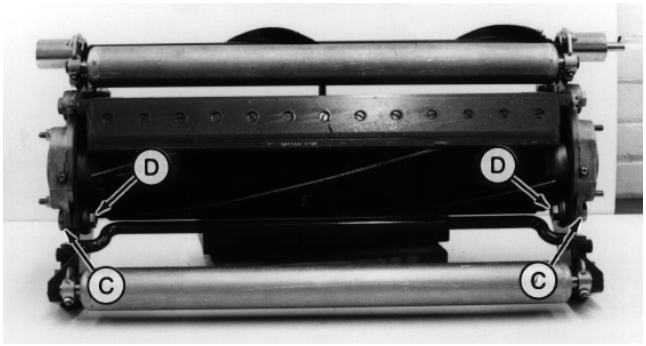
1. Position reel in frame assembly (reel shaft end with keyway must be used on the left side).



2. Install wave spring (A) on left end of shaft.

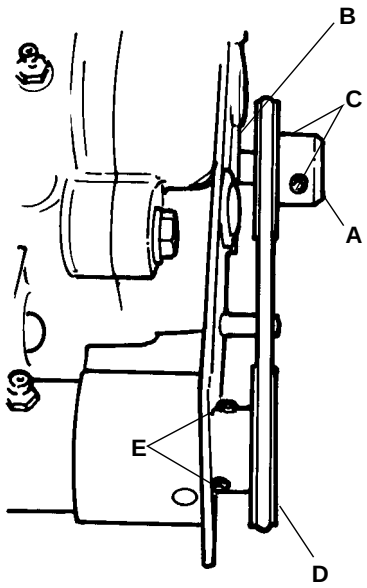


3. Slide left pivot arm (B) on to reel shaft, ensure key washer engages slot on shaft.
4. Slide right pivot arm on to reel shaft.

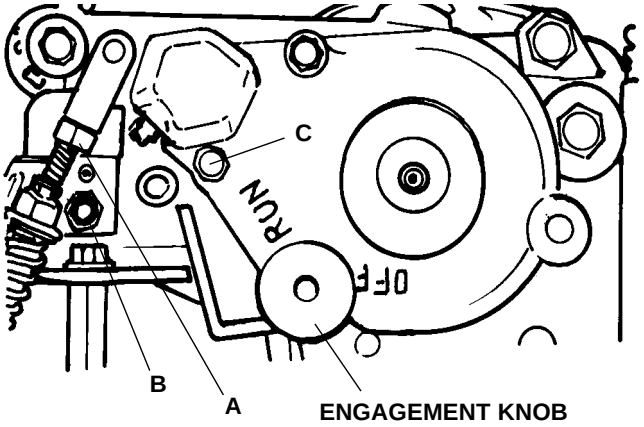


5. Install shoulder bolts (C) through adjusters and secure with four spring washers (per side) and shoulder nuts (D). After bed knife is installed tighten nuts (D) to 50 N•m (35 lb-ft.).
6. Refer to Bed Knife/Support and GTC Installation.

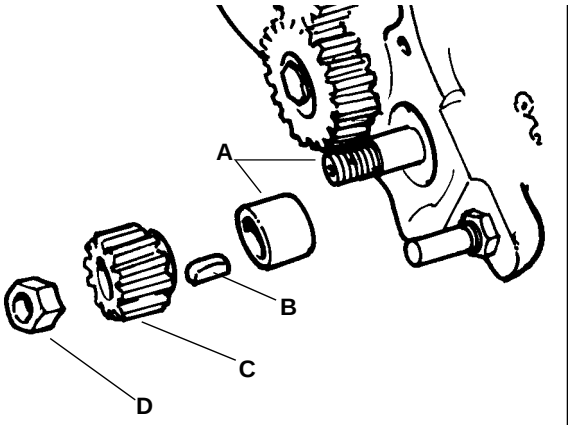
GREENS TENDER CONDITIONER (GTC) REMOVAL



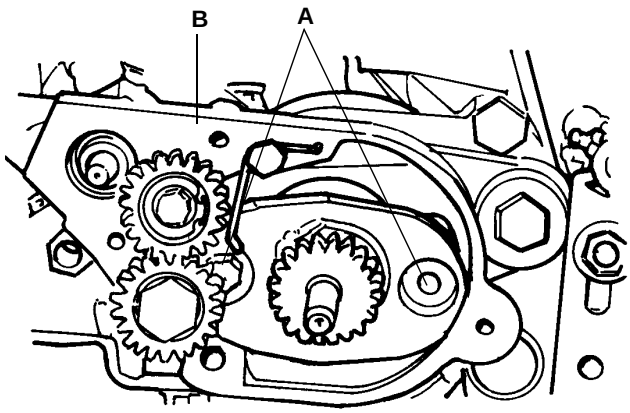
NOTE: There are two set screws (C,E) in each belt pulley and an access hole in the guard mounting bracket for the set screws (E) in the power brush pulley (D).



1. Remove Power Brush guard, belt, pulleys (A,D), keys and guard mount (if equipped).
2. Remove hex socket screws (B) and remove GTC adjustment mechanisms (A). It is easier to remove the cover if the engagement knob is turned past the "OFF" detent position.
3. Remove three cap screws (C) and remove GTC gear case cover and gasket.
4. Remove M10 locknut (D), Gear (C), key (B) and spacer (A).

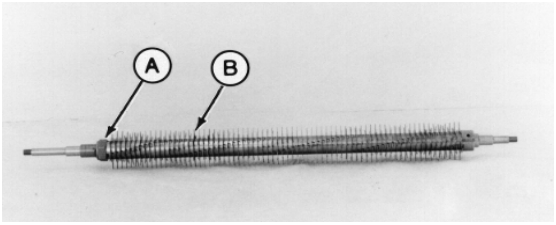


5. Remove M10 lock nut (A) from the opposite side of GTC shaft and remove bracket.
6. Remove two nuts (A) and remove inner gear housing (B). Remove GTC.

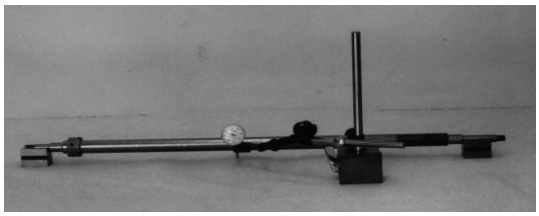


GREENS TENDER CONDITIONER (GTC) DISASSEMBLY AND INSPECTION

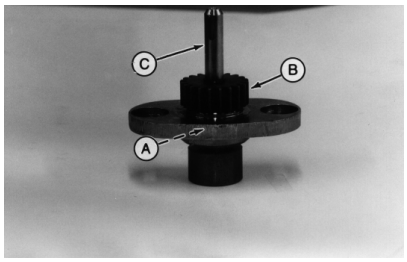
1. Remove locknut (A).



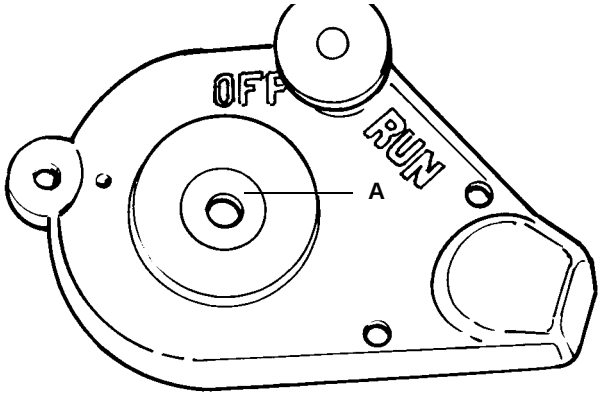
2. Remove blades and index rings (B). Inspect blades for excessive wear, broken or cracked cutting teeth and distortion. Inspect index rings for missing or bent index teeth. Obtain replacement parts for reassembly.
3. Remove debris or corrosion from shaft and place on V-blocks. Check run-out at the center of the shaft. Run-out should not exceed 1.5 mm (1/16 in.). Straighten or replace shaft if necessary.



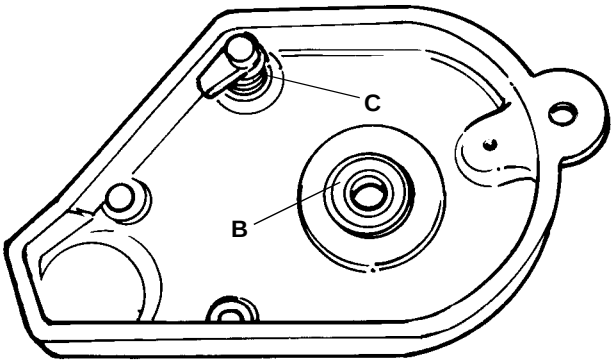
4. Inspect gears for wear and freedom of movement. Replace parts as necessary.



5. Inspect shaft bearings (A) for freedom of movement and excessive play. Replace bearings as necessary.
6. Inspect drive gear (B) for wear and freedom of movement. Unusual wear patterns may indicate a bent shaft (C) or worn bearings. Replace gear, shaft or bearings as necessary.



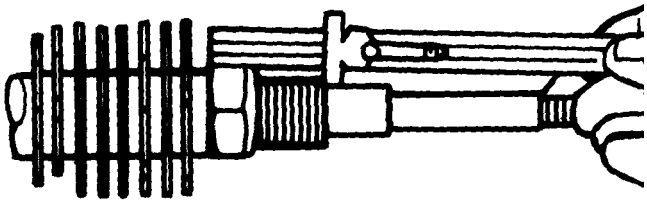
7. Inspect seal (A) in cover for wear or distortion. Replace seal if necessary.



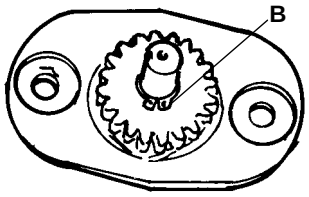
8. Ensure sealed bearing (B) in cover moves freely. Replace bearing if necessary.
9. Inspect engagement rod and spring (C) for condition and binding. Replace shaft or spring if necessary.

GREENS TENDER CONDITIONER (GTC) ASSEMBLY

1. Place index rings and blades on shaft rotating occasionally to align blades and index rings.
2. Continue assembly, of all 72 spacers and blades, until approximately 38 mm (1-1/2 in.) of exposed thread is left.



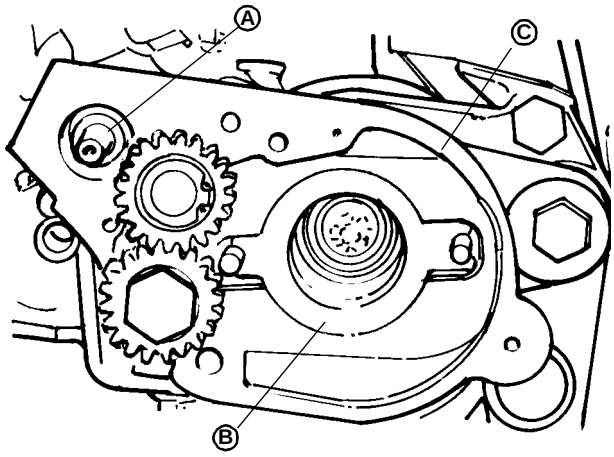
3. Stand the shaft on end and shake it slightly to ensure blades and index rings are aligned.
4. With shaft on end, install locking nut and torque to approximately 47 N•m (35 lb-ft.).
5. Press driveshaft bearing into housing.



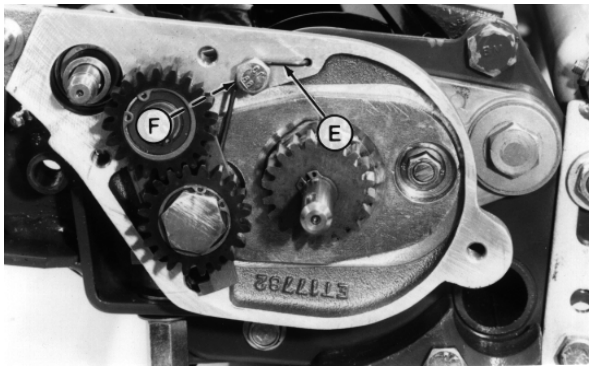
6. Install drive shaft, key, gear and snap ring (B).

NOTE: There are two bearings and one washer between each bearing. If the washer is not centered, the GTC 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.

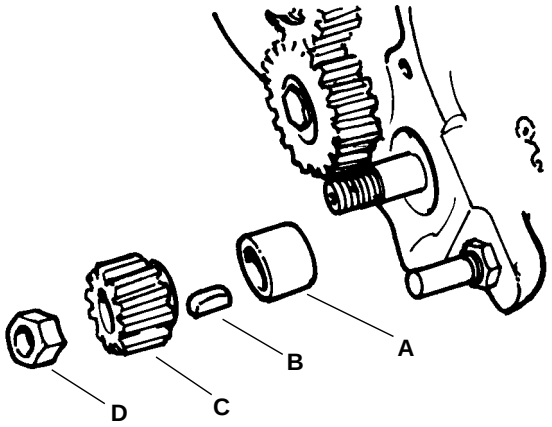
7. Slide keyed GTC shaft end (C) through bearings of gear housing.



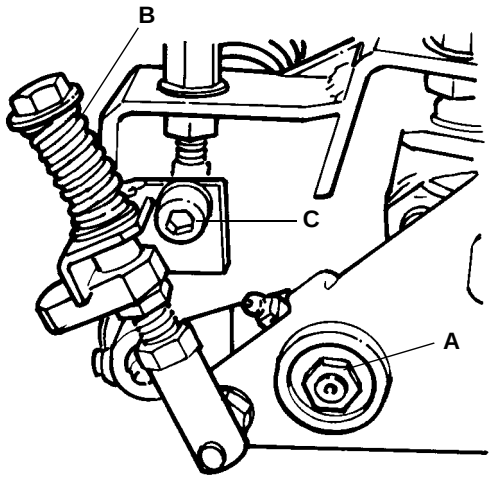
8. Install shim (B) over studs and position gear housing (C) over shim.
9. Secure gear drive assembly to gear housing (B) with two nuts (A).



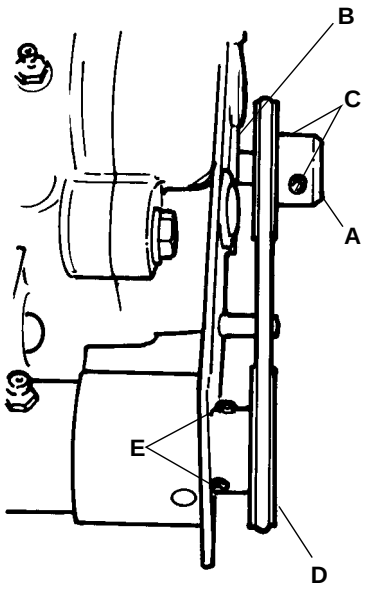
10. Position spring (E) and secure with cap screw, ensure spring can move freely and install nut (F) to lock cap screw in place.



11. Slide spacer (A) on shaft. Insert key (B) in shaft slot. Slide gear (C) over key and secure with lock nut (D).
12. Position opposite bearing arm on GTC shaft and secure with lock nut (A).



13. Install adjuster assembly and secure with hex socket screw (C).
14. Install gasket and gear case cover, secure with three cap screws and washers.
15. Ensure GTC engages and disengages when rotating knurled knob from OFF to RUN position.



16. Position belt guard bracket (D) and secure with spacer (C), washer (B) and cap screw (A).

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 (A,D). Secure with two set screws each (E,C).
18. Install drive belt. Adjust pulleys to align belt and ensure pulleys do not contact belt guard or guard bracket (B).
19. Install belt guard and secure with nut.
20. See Adjusting Greens Tender Conditioner.

Essential Tools:

- 0.001" Feeler Gauge
- 0.002" Feeler Gauge
- Lapping Compound
- Two Bolt Gauge Bar

FABRICATED TOOLS

- 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.

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 (straightness and strength) is maintained. Attaching bolts must be secure and bearings must be well lubricated and not worn.

REEL AND BED KNIFE INSPECTION

c 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 and Bed Knife grinding to restore the relief angle and cutting edge before continuing with this procedure.

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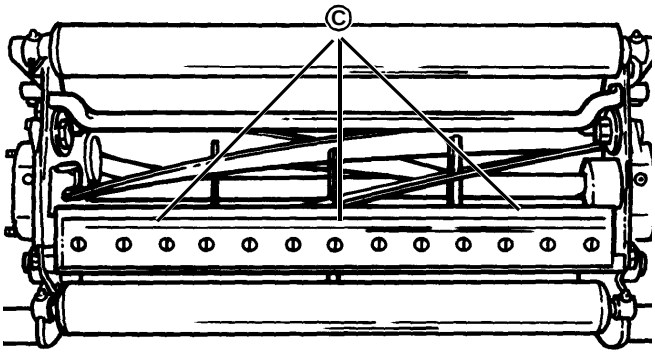


4. Inspect the bed knife cutting edge (C) for nicks, gouges or distortion. Inspect leading edge of bed knife for relief to prevent catching of knife. A small relief or dub needs to be added after several backlappings.
5. Inspect the bed knife for uneven wear (indicated by uneven land width across the 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

c 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 .001" 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)

1. Adjust ends of reel to set drag with a .001" feeler gauge (A).
2. Now inspect the entire length of the bed knife with a .002" feeler gauge. It should not go in anywhere. Go to step 5.
3. If the reel is contacting anywhere, go to step 4.

c 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.

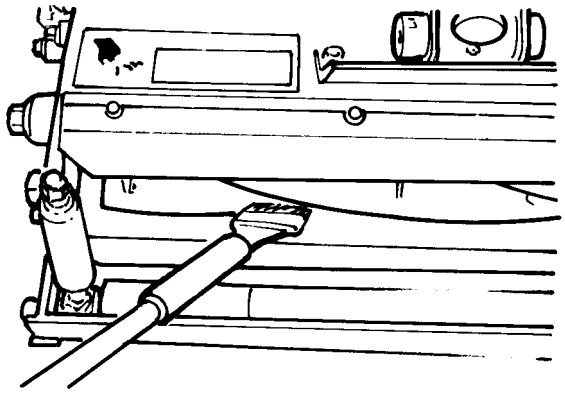
4. Slowly rotate the reel backwards watching for contact between the reel and bed knife at the center of the bed knife (A). If contact is made, grind the reel and bed knife to eliminate the "Frown" in the bed knife or the out-of-round condition of the reel.
5. Measure the clearance at the center of the bed knife (A). If the clearance exceeds .002 of an inch, grind the reel and bed knife to eliminate the "Smile" in the bed knife or the out-of-round condition of the reel.
6. 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 -.001" clearance.

BACKLAPPING

c 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. Put machine in the Backlapping Mode. Adjust machine speed to rotate reel at 100-200 rpm, or slow enough to prevent the backlapping compound from being thrown from the reel blades..



2. Apply 120 grit compound to the rotating reel evenly from one side to the other and back again with a long handled brush (see Fabricated Tools).
3. Allow the reel to spin until quiet. If desired, follow with a 220 grit compound to achieve a " Tournament Grade" finish.

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

> **c 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.**

4. Rinse the lapping compound off the cutting unit with water and repeat the Adjustment Procedure before returning the unit to service.
5. Add a relief if needed, to the leading edge of the knife, to prevent the edge from "catching" the reel and curling it up.

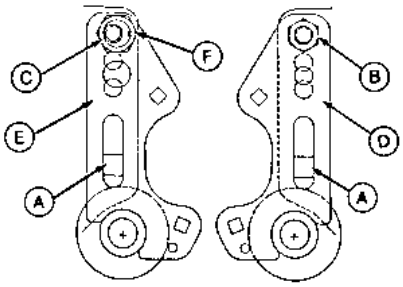
HEIGHT-OF-CUT (HOC) ADJUSTMENT

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 .020"-.040" 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 HOC range desired. Use the following procedure to change the (HOC) range (if needed) before continuing with the adjustment at step 5..

HOC RANGE	BRACKET HOLE	FRAME PLATE HOLE
3/32 - 3/8	Top	Top
3/16 - 5/8	Bottom	Bottom
3/8 - 3/4	Top	Middle

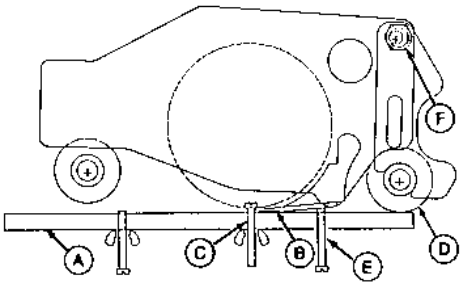
REAR ROLLER (HOC) RANGE



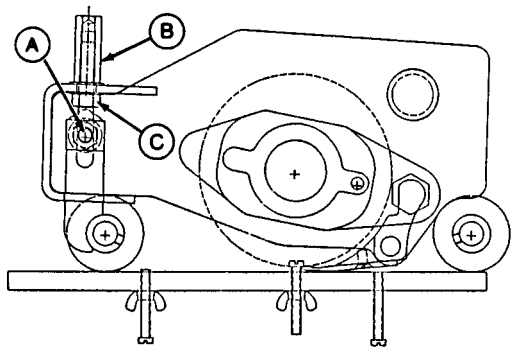
1. Loosen lower rear roller support bolts (A) and remove upper bolt (B) and eccentric (C).
2. Align the upper holes in the roller support with the proper hole in the frame side plate as shown in the table above.
3. Install bolt (B) and nut on the right side and tighten.
4. Install the eccentric (C) and nut on the left side. DO NOT tighten at this time. Ensure the Index Mark (F) 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.



5. Set center gauge screw (C) to desired height-of-cut. Position the gauge bar approximately (A) 51 mm (2 in.) from the right end (fixed end of roller) of the bed knife (B).
6. Hook the center edge screw (C) on the cutting edge of the bed knife and hold the end of the bar flat against the rear roller (D).
7. Turn the rear screw (E) in until it just makes contact with the bed knife. Tighten the wing nut to lock the position of the screw (E).
8. Move the gauge bar to approximately 51 mm (2 in.) from the left end of the bed knife.
9. Use the eccentric bolt (F) to adjust the roller up or down until the rear gauge screw (E) just makes contact with the bedknife.
10. Tighten all rear roller support hardware and recheck with the gauge bar to ensure the roller has not moved.
11. Ensure the rear gauge screw is backed out and will not contact the bed knife.



12. Loosen the front roller clamp bolts (A) 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.

13. Position the gauge bar 51 mm (2 in.) from either end of the bed knife.
14. 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 (B) clockwise raises the roller and turning the lower adjustment nut (C) 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.

15. 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.

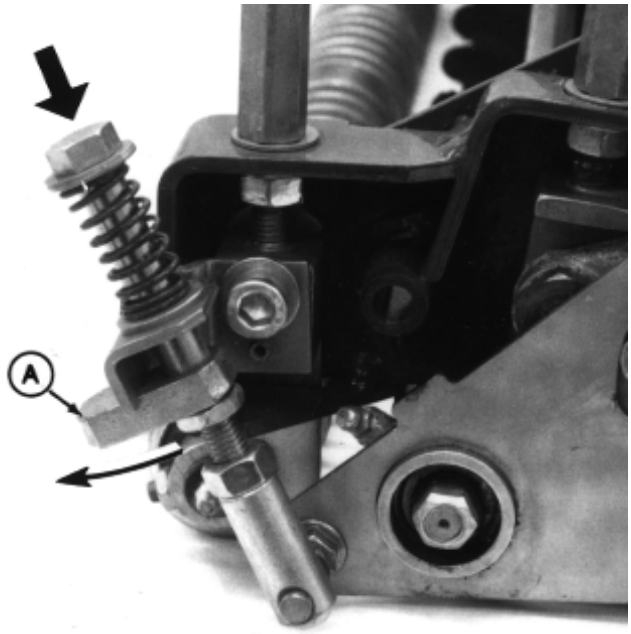
IMPORTANT: The roller should just touch the gauge bar, forcing the roller against the gauge bar will bend it and raise the HOC.

16. After the adjustment is made tighten, the clamp bolts (A) and tighten the opposite nut of the one used for adjustment.
17. Use the gauge bar to ensure the roller has not moved after tightening the clamp bolts and adjuster nuts.

ADJUSTING GREENS TENDER CONDITIONER (GTC)

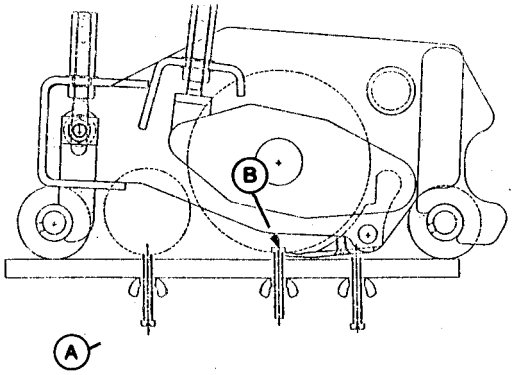
c CAUTION

Before adjusting machine:
Disengage all power.
Shut off engine.
Remove key.
Wait until all moving parts have stopped.

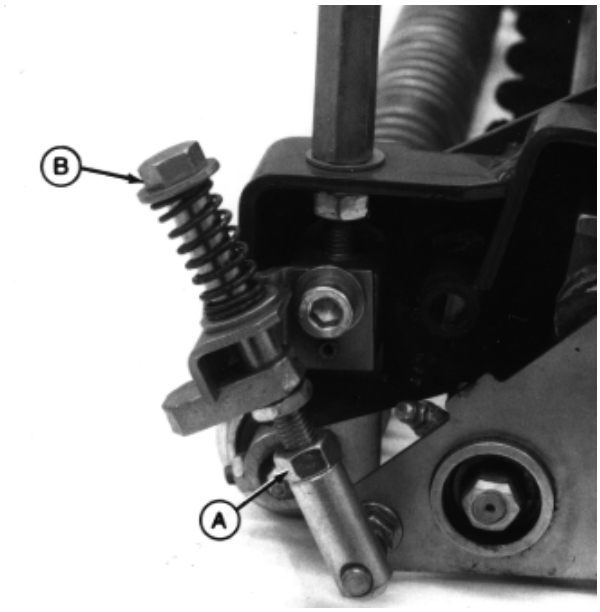


1. Press down on GTC adjuster bolts and swing adjuster stops (A) around toward the front of the cutting unit. This is the operating position.

NOTE: Height of cut must be set prior to adjusting GTC.



2. Set GTC adjustment screw (A) on the gauge bar to equal the height-of-cut, less the penetration desired below the height-of-cut.
3. Place preset gauge bar on cutting unit. Hook height-of-cut screw (B) on bed knife. The ends should rest firmly on the front and rear rollers.

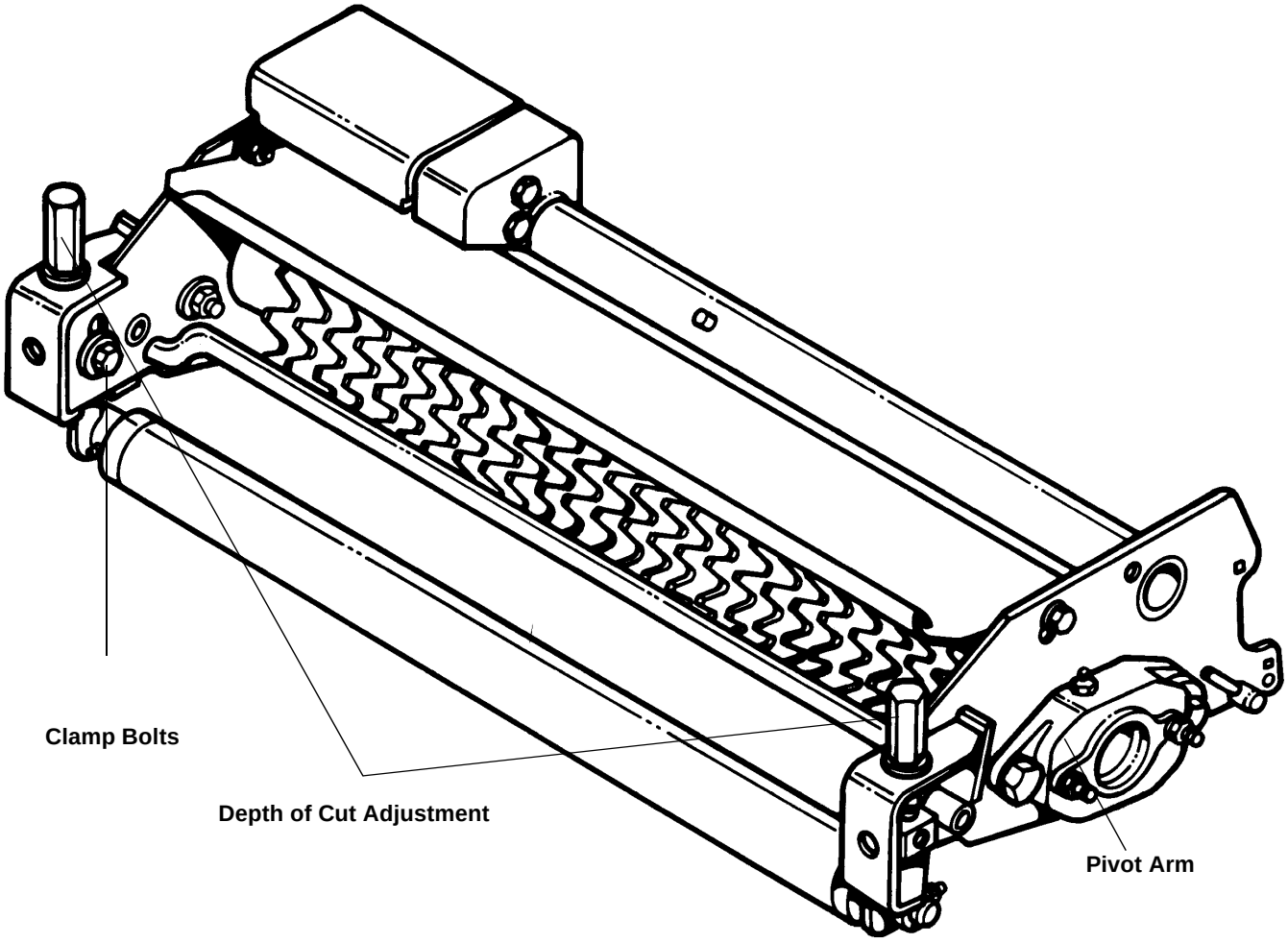


4. Loosen jam nut (A). Repeat on opposite side.
5. Turn adjuster bolt (B) to raise or lower GTC. Alternate from end to end until the teeth touch the screw on the gauge bar.
6. Remove gauge bar.

IDENTIFICATION AND APPLICATION

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 THEORY

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 (A) are positioned in a Helix pattern and are spaced 3/4" apart from the factory. Spacing is accomplished by placing three 1/4" spacers (B) 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 tractor 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

c 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

Symptom	Problem	Solution
Poor Performance	Dull Cutting Blades	Rotate or replace blades
	Ground Speed too fast	Reduce ground speed
	Engine Speed too slow	Increase engine rpm
	Cutting Unit not floating	Lubricate pivot points
	Reel bearing(s) seized	Remove and Inspect Reel Bearings
	Knives not set deep enough	Adjust

REPAIR SPECIFICATIONS

Item	Specification
Reel Mounting Pivot Arm (Forward)	47 N•m (35 lb-ft.)
Reel Mounting Pivot Arm (Rear)	81 N•m (60 lb-ft.)
Roller Mounting Bolts	47 N•m (35 lb-ft.)

REPAIR

REMOVE FRONT ROLLER

ESSENTIAL TOOLS

- Work Gloves
- Metric Open End/Box Wrenches

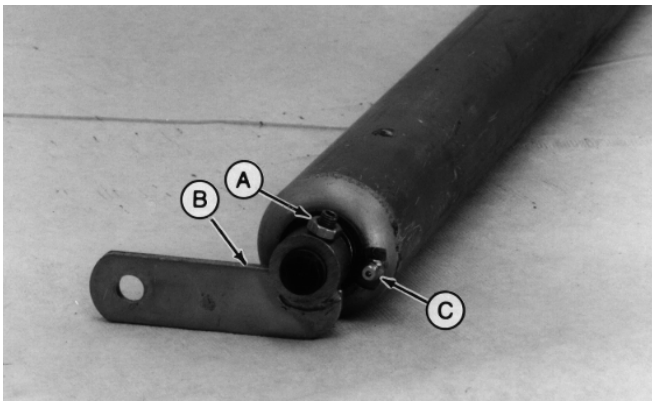
1. Remove cutting unit from the tractor. If the cutting unit is not removed from the tractor, rest the cutting unit on wood blocks and be sure to observe the following **Caution**

c 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.

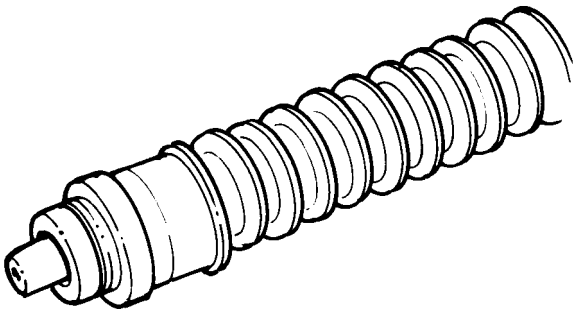
2. Loosen depth-of-cut adjusting nuts.
3. Make note of washers and remove clamp bolts and washers.
4. Remove front roller with brackets.

ROLLER DISASSEMBLY



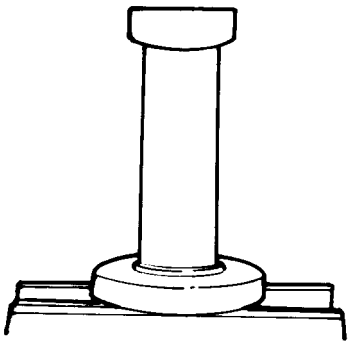
1. Loosen jam nuts (A) and remove set screws.
2. Remove brackets (B) from bearing shafts. It may be necessary to press the bearing shaft from the bracket.

AET10558 GROOVED ROLLER DISASSEMBLY



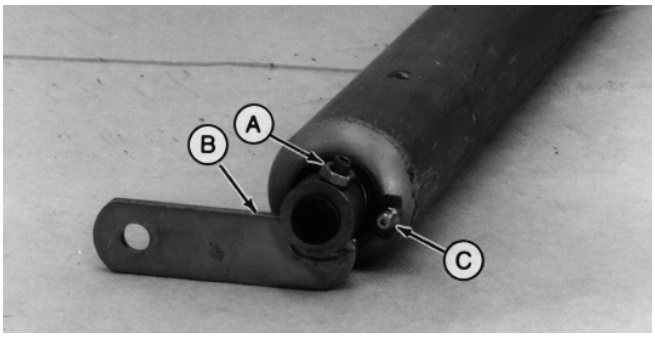
1. Secure roller in a vice. Remove grease fittings.
2. Use a hammer and a block of wood to knock out the opposite end bearing.
3. Remove bearing from shaft and repeat step 2 to knock out the other end bearing.

AET10558 GROOVED ROLLER ASSEMBLY



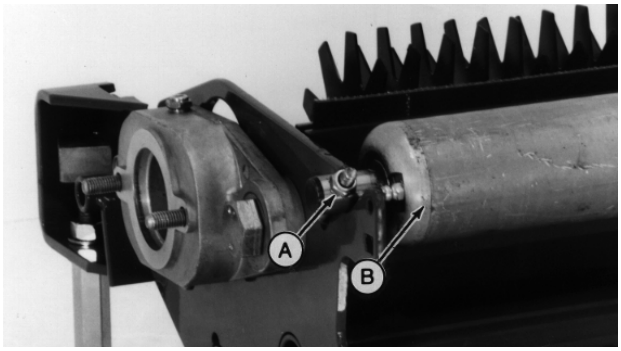
1. Clean roller end cap and bearing shaft with crocus cloth. Pack bearings with grease.
2. Install bearing shaft and bearings (sealed end of bearing towards inside). Apply grease to lip of seal and install with seal lip facing the bearing.
3. Install opposite seal.
4. Install grease fittings and lubricate (Do not over-lubricate, a shot of grease is fine).

ROLLER INSTALLATION



1. Position brackets (B) on bearing shaft as shown.
2. Apply NEVER-SEEZ® to the threads of the clamp bolts.
3. Insert bracket ends through frame slots.
4. Center the roller between the mounting brackets and install the set screws and nuts (A).
5. Refer to Depth of Cut Adjustments.

REEL REMOVAL



1. Remove lock nut (A) and rear roller (B)

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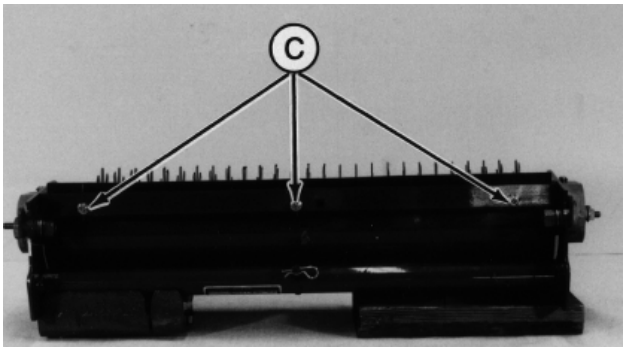
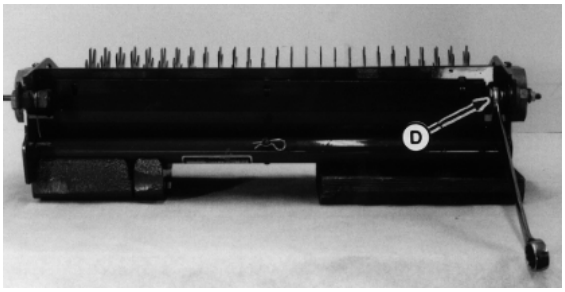


2. Remove three lock nuts (C), scraper support bracket and rubber scraper.
3. Carefully pry deflector shield away from frame to allow access for a wrench to remove cap screws and nuts (D) from pivot arms.

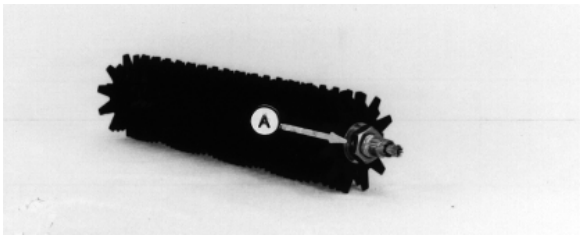


4. Remove cap screws, nuts and spacers securing pivot arms to frame.
5. Remove pivot arms and reel.

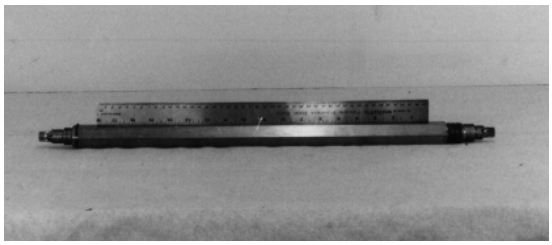
REEL DISASSEMBLY

> **c CAUTION**
>
> **Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.**

1. Remove set screw (A).

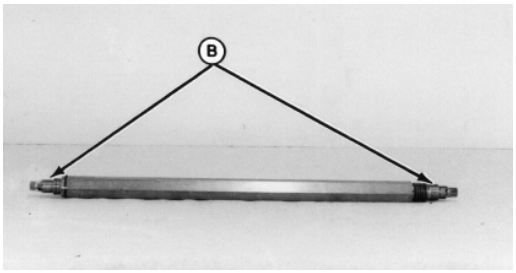


2. Remove nut and remove cutting blades and spacers from reel shaft.



3. Using a straight edge, check shaft for straightness. Shaft runout should not exceed .020".

4. Inspect machined surfaces (B) of shaft for wear. Replace shaft if worn.

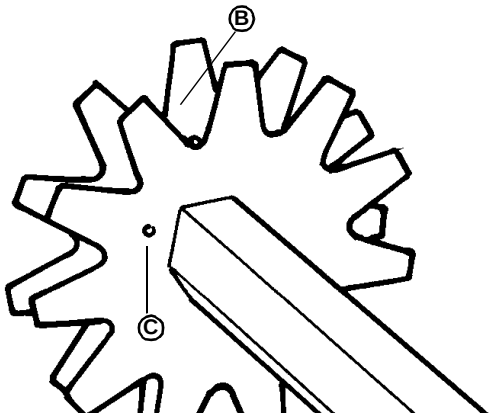


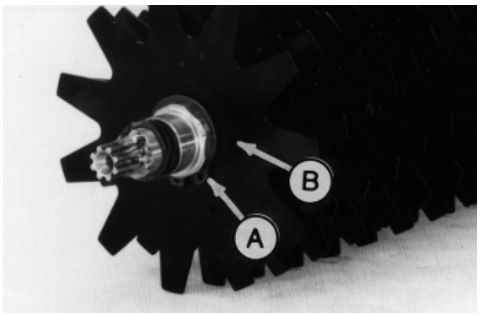
NOTE: If the splines on one side of the reel shaft are worn, the splines on the opposite end can be utilized by simply transferring the cutting unit to the other side of the mower.

REEL ASSEMBLY

> **c CAUTION**
>
> **Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.**

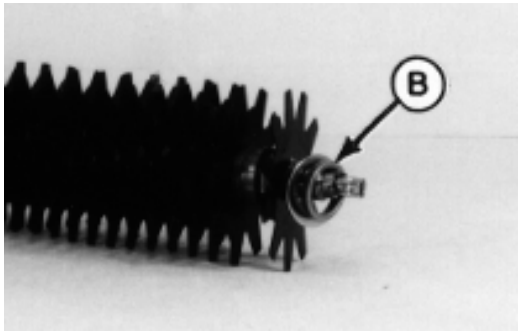
1. Install snap ring in groove on shaft. (Sharp edge of snap ring facing away from the blades.)



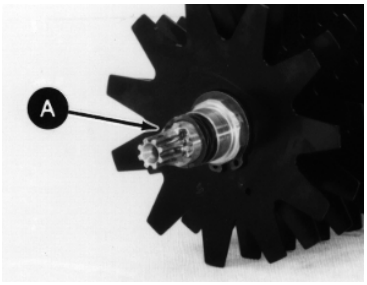


NOTE: The cutting unit is shipped with three 1/4" spacers between each cutting blade. Fewer spacers and more blades can be used if desired.

2. Assemble blades and spacers starting with a blade (B) against the snap ring. Ensure the index hole (of the next blade) (C) is placed on the next flat (counterclockwise) on the shaft as shown. This will establish the proper helix pattern needed.



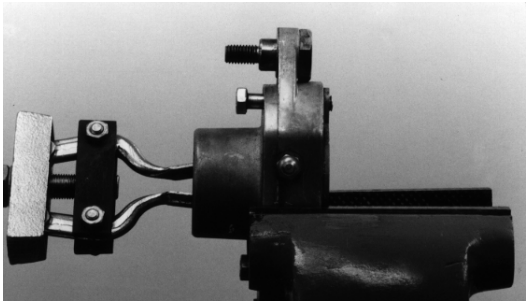
3. After the last cutting blade is positioned, install a washer, a spacer (B) and nut. Tighten the nut until a slight deflection of the the cutting blade, next to the snap ring, is observed.



4. Install the set screw (A).

PIVOT ARM DISASSEMBLY AND INSPECTION

NOTE: Left or right positions are determined by standing at the rear of the unit and looking forward.



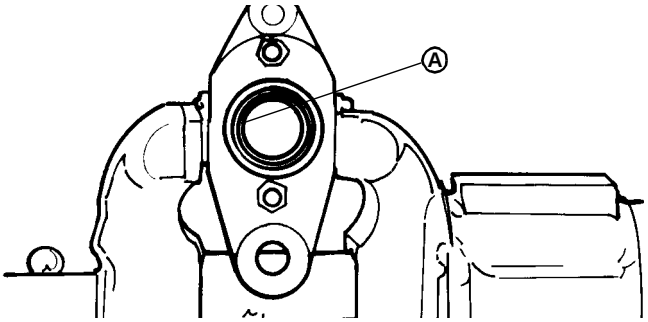
1. Remove seals, cone bearings and washer (left side only) from pivot arms.
2. Clean bearings and pivot arms with solvent.

IMPORTANT: Always replace bearings and bearing cups as a set.

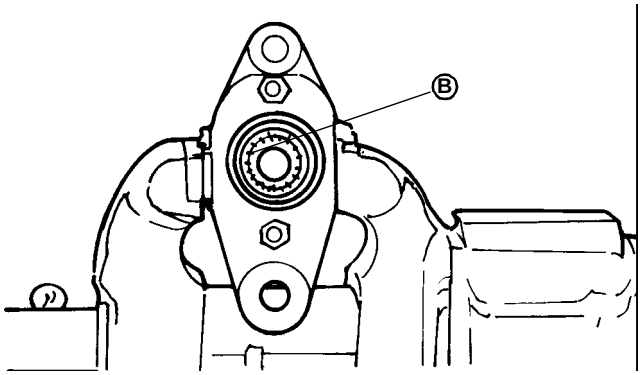
3. Inspect bearings and bearing cups for scoring, pitting or bluing from overheating.

PIVOT ARM ASSEMBLY

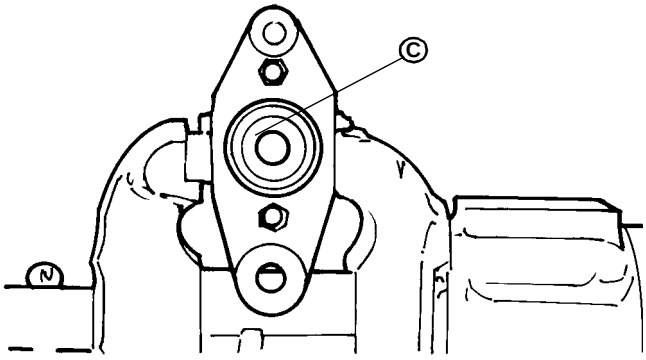
NOTE: Left or right positions are determined by standing at the rear of the unit and looking forward.



1. Install the bearing cups (A) using a suitable driver or a press (Tapered end facing outside of case).



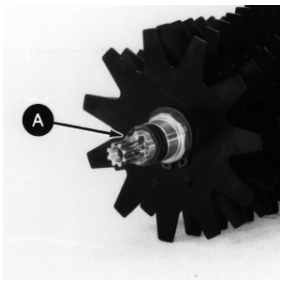
2. Pack bearings (B) with multipurpose grease and position in bearing cups.
3. Install keyed washer (Left side only).



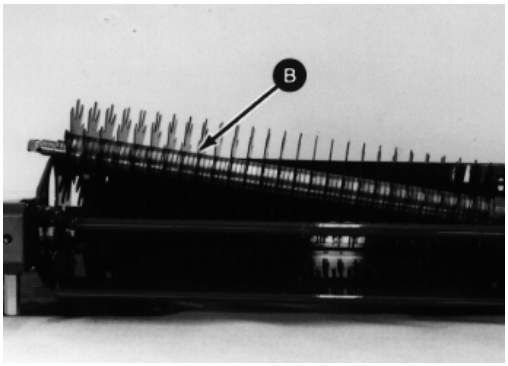
4. Install grease seals (C) flush with end of case, apply grease to lip of seal.

REEL INSTALLATION

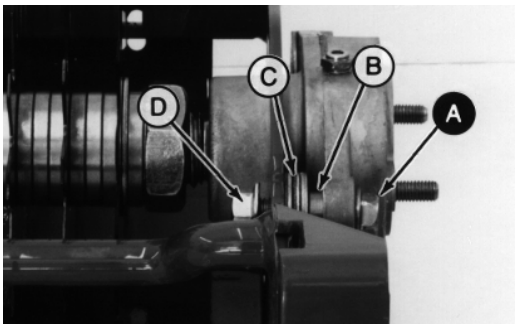
> **c CAUTION**
>
> **Always wear gloves when handling reel or cutting blades. Serious personal injury can result from contact with sharp cutting edges.**



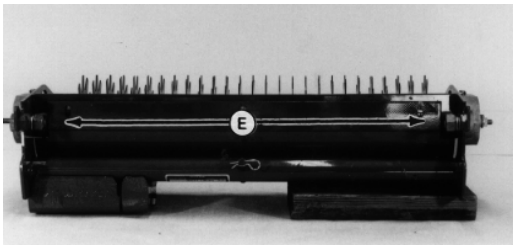
1. Install spring (A) on keyed end of reel shaft



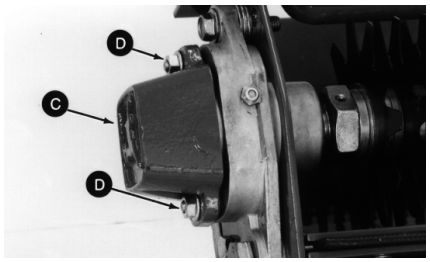
2. Position reel into frame (B) (shaft end with keyway on left side of frame).
3. Slide pivot arms over shaft ends. Ensure keyed washer in pivot arm engages keyway of reel shaft (left side only).



4. Install cap screw (A), sleeve (B), three spacers (C) and nut (D) in front pivot arm mount. Repeat on opposite end.



5. Install cap screw, washers and nut (E) in rear pivot arm mount. Repeat on opposite end.

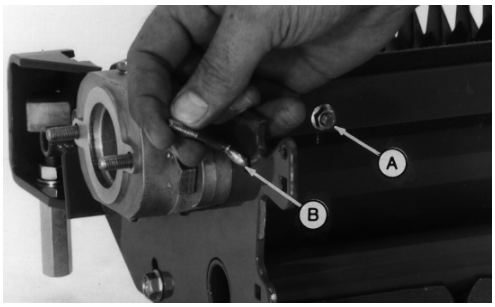


6. Install rubber scraper, scraper support and secure with carriage bolts and nuts (A).
7. Install hook bolt (B) and roller. Secure with self locking nuts.

c CAUTION

Alternate from side to side when tightening nuts on counterweight to avoid damaging the machined surface of the pivot arm.

8. Install counterweight (C) and secure with two nuts (D).



9. Refer to Depth of Cut Adjustment.

DEPTH OF CUT ADJUSTMENT

c 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.

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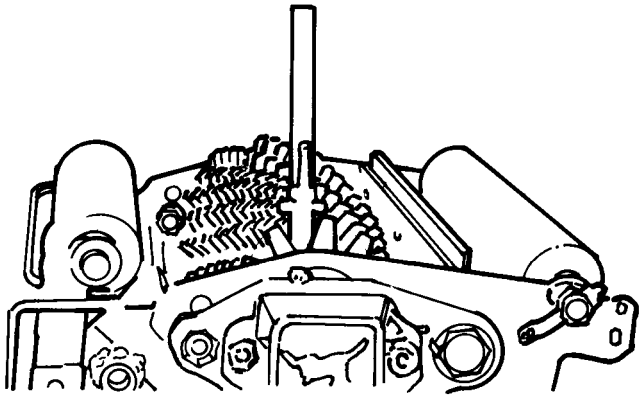
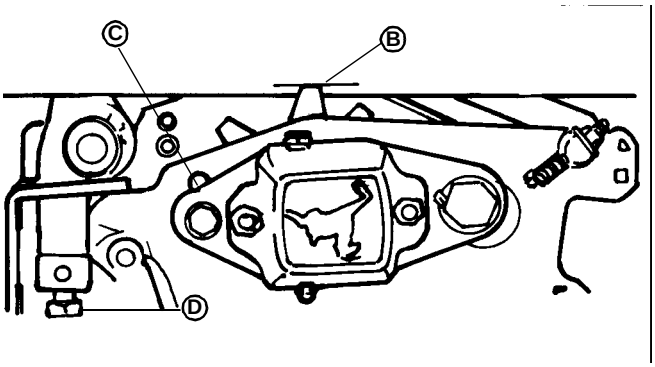


1. Mark the desired cutting depth on gauge bar.
2. Place the gauge bar across the front and rear rollers approximately two inches in from the end of the rollers.



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.

3. Adjust the front roller height to bring the leading edge of the cutting blade (B) 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 (C) in the cutter frame and repeat Step three.

4. Tighten roller adjusting nuts (D) and recheck depth of cut. Readjust if necessary.
5. Adjust scraper to just touch gauge bar (roller height).

A

B

C

D

E

F

G

H

I

K

L

M

O

P

R

S

T

U

V

W

Y