





TECHNICAL MANUAL

4500, 4600 and 4700 Compact Utility Tractors

TM1679 (27JUN00) English

John Deere Commercial and Consumer Equipment Division TM1679 (27JUN00)

Replaces TM1679 (01OCT99)

LITHO IN U.S.A. ENGLISH





COMPACT UTILITY TRACTOR

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

Specifications and Information

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

- Table of Contents
- Specifications
- Component Location
- · System Schematic
- Theory of Operation
- Troubleshooting Chart
- Diagnostics
- Tests & Adjustments
- Repair

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

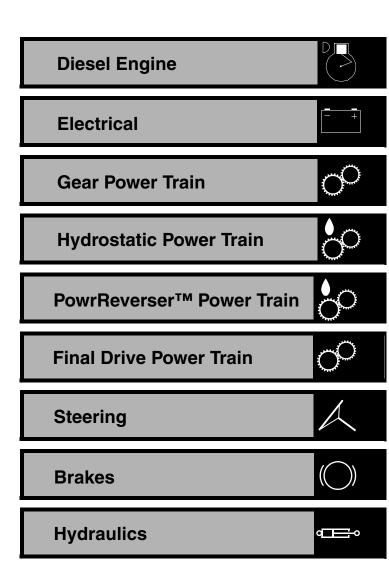
Each section will be identified with a symbol rather than a number. The groups and pages within a section will be consecutively numbered.

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

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

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John Deere Worldwide Commercial and
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Horicon, WI
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Previous Revisions 1998



Miscellaneous

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RECOGNIZE SAFETY INFORMATION



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

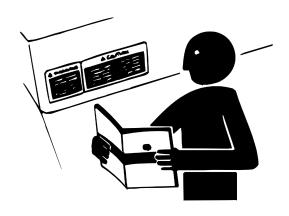
Follow recommended precautions and safe servicing practices.

Understand Signal Words

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

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

REPLACE SAFETY SIGNS

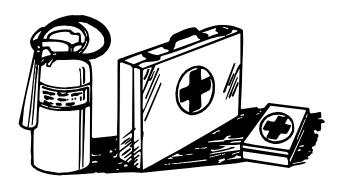


Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

HANDLE FLUIDS SAFELY-AVOID FIRES

Be Prepared For Emergencies





When you work around fuel, do not smoke or work near heaters or other fire hazards.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

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

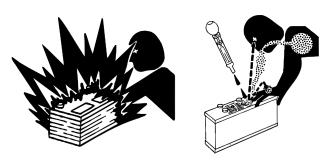
Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.

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USE CARE IN HANDLING AND SERVICING BATTERIES



Prevent Battery Explosions

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

Prevent Acid Burns

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

Avoid acid burns by:

- 1. Filling batteries in a well-ventilated area.
- 2. Wearing eye protection and rubber gloves.
- 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.
- Apply baking soda or lime to help neutralize the acid.
- 3. Flush your eyes with water for 10_15 minutes.
- 4. Get medical attention immediately.

• If acid is swallowed:

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

USE CARE AROUND HIGH-PRESSURE FLUID LINES

Avoid High-pressure Fluids





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

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

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

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

Avoid Heating Near Pressurized Fluid Lines



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.

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USE SAFE SERVICE PROCEDURES

Wear Protective Clothing



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

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

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

Service Machines Safely



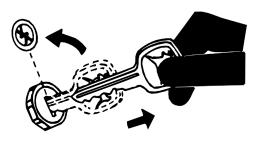
Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing, or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

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

Use Proper Tools

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

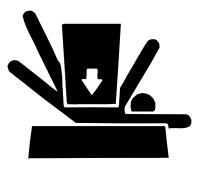
Park Machine Safely



Before working on the machine:

- 1. Lower all equipment to the ground.
- 2. Stop the engine and remove the key.
- 3. Disconnect the battery ground strap.
- 4. Hang a "DO NOT OPERATE" tag in operator station.

Support Machine Properly And Use Proper Lifting Equipment



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

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

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

Work In Clean Area

Before starting a job:

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

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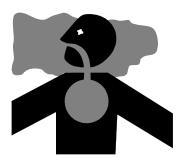
Using High Pressure Washers

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

Illuminate Work Area Safely

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

Work In Ventilated Area



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

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

WARNING: California Proposition 65

Warning:

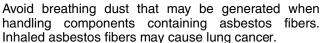
Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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

Remove Paint Before Welding Or Heating

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

Avoid Harmful Asbestos Dust





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

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

SERVICE TIRES SAFELY



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

Do not attempt to mount a tire unless you have the proper equipment and experience to perform the job. Always maintain the correct tire pressure. Do not inflate the tires above the recommended pressure. Never weld or heat a wheel and tire assembly. The heat can cause an increase in air pressure resulting in a tire explosion. Welding can structurally weaken or deform the wheel.

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

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

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AVOID INJURY FROM ROTATING BLADES, AUGERS AND PTO SHAFTS



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

SERVICE COOLING SYSTEM SAFELY



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

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

HANDLE CHEMICAL PRODUCTS SAFELY





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

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

Dispose of Waste Properly

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

LIVE WITH SAFETY



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

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GENERAL VEHICLE SPECIFICATIONS – ALL TRACTORS

	4500 Tractors	4600 Tractors	4700 Tractors
ENGINES			
Make	John Deere/Yanmar	John Deere/Yanmar	John Deere/Yanmar
Model	4TNE84-JTC45 4TNE84-EJTF45	4TNE84-JTC46 4TNE84-EJTF46	4TNE88-EJTF47
Туре	4-cycle Diesel	4-cycle Diesel	4-cycle Diesel
Bore and Stroke	84x90 mm (3.31x3.54 in.)	84x90 mm (3.31x3.54 in.)	88x90 mm (3.46x3.54 in.)
Cylinders	4	4	4
Valves	Overhead Valves	Overhead Valves	Overhead Valves
Displacement	1995 cm ³ (121.7 cu in.)	1995 cm ³ (121.7 cu in.)	2189 cm ³ (133.6 cu in.)
Compression Ratio	18.0:1	18.0:1	18.0:1
Gross Engine Power	29.1 kW (39 hp)	32.1 kW (43.0 hp)	35.8 kW (48 hp)
Net Engine Power	27.2 kW (36.5 hp)	30.1 kW (40.4 hp)	30.1 kW (40.4 hp)
Torque (at rated speed)	99.9 N•m (73.7 lb-ft)	106.7 N•m (78.7 lb-ft)	117.0 N•m (86.3 lb-ft)
Torque (maximum)	124.9 N•m (92.1 lb-ft)	133.3 N•m (98.3 lb-ft)	144.2 N•m (106.4 lb-ft)
Lubrication	Full pressure	Full pressure	Full pressure
Oil filter	Standard Single Element	Standard Single Element	Standard Single Element
Oil Capacity	4.81 L (5.08 qt)	4.81 L (5.08 qt)	4.81 L (5.08 qt)
Engine Rated Speed	2600 rpm	2600 rpm	2600 rpm
Engine Slow Idle Speed	950 ± 50 rpm	950 ± 50 rpm	950 ± 50 rpm
Cooling system	Liquid w/Pump & Radiator	Liquid w/Pump & Radiator	Liquid w/Pump & Radiator
Air cleaner	Dry-Type w/Safety Element	Dry-Type w/Safety Element	Dry-Type w/Safety Element
ELECTRICAL			
Volts	12 VDC	12 VDC	12 VDC
Battery Rating	45 amp-hr	45 amp-hr	45 amp-hr
Battery Size	600 Cold Cranking Amps	600 Cold Cranking Amps	600 Cold Cranking Amps
Alternator	40 amp	40 amp	40 amp
Regulator	Internal, Current Limiting	Internal, Current Limiting	Internal, Current Limiting
Starting Motor	2.0 kW (2.68 hp)	2.0 kW (2.68 hp)	2.0 kW (2.68 hp)
Headlights	37.5 W Halogen Bulb	37.5 W Halogen Bulb	37.5 W Halogen Bulb

^{*}Specifications and design subject to change without notice.



	4500 Tractors	4600 Tractors	4700 Tractors
Tail Lights	5 W Bayonet Base	5 W Bayonet Base	5 W Bayonet Base
Hazard Lights	Type 1156	Type 1156	Type 1156
Instrument Panel Lamps	1.7 W Bayonet Base	1.7 W Bayonet Base	1.7 W Bayonet Base
FUEL SYSTEM			
System Type	Direct Fuel Injection	Direct Fuel Injection	Direct Fuel Injection
Injection Pump	In-Line w/Solenoid Shutoff	In-Line w/Solenoid Shutoff	In-Line w/Solenoid Shutoff
Fuel type	Diesel	Diesel	Diesel
Fuel Tank Capacity	47.3 L (12.5 gal)	47.3 L (12.5 gal)	47.3 L (12.5 gal)
Fuel Filter	Clear Bowl Water Separator with Disposable Paper Element, Water Floating Red Ring	Clear Bowl Water Separator with Disposable Paper Element, Water Floating Red Ring	Clear Bowl Water Separator with Disposable Paper Element, Water Floating Red Ring
3-POINT HITCH			
Туре	Category One	Category One	Category One
Lift Capacity at 61.0 cm (24 in.) Behind Link Arms	1135 kg (2500 lb)	1135 kg (2500 lb)	1135 kg (2500 lb)

HYDRAULIC SYSTEM

	(Measurements Taken At 2600 Engine rpm)	(Measurements Taken At 2700 Engine rpm)	(Measurements Taken At 2700 Engine rpm)
Туре	Open System	Open System	Open System
Working Pressure	17237 kPa (2500 psi)	17237 kPa (2500 psi)	17237 kPa (2500 psi)
Pump	Dual Gear Type	Dual Gear Type	Dual Gear Type
PTO			
Туре	Continuous Live with Electric Released Hydraulic Clutch	Continuous Live with Electric Released Hydraulic Clutch	Continuous Live with Electric Released Hydraulic Clutch
Rotation Direction	Clockwise	Clockwise	Clockwise
Clutch	Multiple Wet Disk	Multiple Wet Disk	Multiple Wet Disk
Brake	Wet Disk	Wet Disk	Wet Disk

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1500 DDT

GENERAL VEHICLE SPECIFICATIONS* – 4500 TRACTORS

	4500 CS1	4500 PN1
FUEL SYSTEM		
Fuel Tank Capacity	47.3 L (12.5 gal)	47.3 L (12.5 gal)

AEOO CCT



DRIVE TRAIN

Type 9 x 3 Collar Shift 12 x 12 PowrReverser™

Mechanical Front Wheel Drive (MFWD)

N/A Yes

Front Axle Fluid Capacity N/A 7 liters (1.8 gal)

Differential Lock Standard; Foot Operated Standard; Foot Operated Number of Speeds 9 Forward, 3 Reverse 12 Forward, 12 Reverse

With Creeper: 24 Forward, 24 Reverse

Final Drive Planetary Planetary
Brakes Wet Disk Wet Disk

Steering Hydraulic Power Assist Hydraulic Power Assist

Drawbar Tongue Weight Vertical Capacity Rating

500 kg (1102 lb) 500 kg (1102 lb)

PTO (PTO Shaft Speed Measured at 2664 Engine rpm)

Rear Shaft Speed 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm

2 - Speed Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 24.6 kW (33.0 hp) 24.6 kW (33.0 hp)

CLUTCH

Type Dry, Single Disc Wet, Multiple Disk

HYDRAULIC SYSTEM

Front Pump Capacity 18.2 L/min (4.8 gpm) 18.2 L/min (4.8 gpm)

Rear Pump Capacity 37.5 L/min (9.9 gpm) 37.5 L/min (9.9 gpm)

Total Fluid Capacity 25.7 L (6.8 gal) 25.7 L (6.8 gal)

WEIGHT

2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) MFWD 1564 kg (3450 lbs) 1564 kg (3450 lbs)

GENERAL VEHICLE SPECIFICATIONS* – 4600 TRACTORS

FUEL SYSTEM Fuel Tank Capacity 47.3 L (12.5 gal) 37.9 L (10.0 gal) 47.3 L (12.5 gal) DRIVE TRAIN Type 9 x 3 Collar Shift 12 x 12 PowrReverser™ Hydrostatic Infinite Three Ranges Mechanical Front Wheel Drive (MFWD) Front Axle Fluid Capacity N/A 7 liters (1.8 gal) 7 liters (1.8 gal) Differential Lock Standard; Foot Operated Standard; Foot Operated Standard; Foot Operated Standard; Foot Operated Planetary Proward, 24 Reverse Drawbar Tongue Weight Vertical Capacity Rating PTO (PTO Shaft Speed S40 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) PTO (LUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 37. L (9.8 gal) 4150 lbs) 4150 lbs) 4150 lbs) 4150 lbs) 4150 lbs) WEIGHT W		4600 CST	4600 PRT	4600 Hydrostatic Drive
DRIVE TRAIN Type 9 x 3 Collar Shift 12 x 12 PowrReverser™ Hydrostatic Infinite Three Ranges Mechanical Front Wheel Drive (MFWD) N/A Option Standard Equipment Front Axle Fluid Capacity N/A 7 liters (1.8 gal) 7 liters (1.8 gal) Differential Lock Standard; Foot Operated Standard; Foot Operated Standard; Foot Operated Number of Speeds with Creeper 9 Forward, 3 Reverse 24 Forward, 12 Reverse 24 Forward, 24 Reverse Infinite Final Drive Planetary Planetary Planetary Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 540 rpm 540 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speed 540 rpm and 750 rpm 540 rpm and 750 rpm 740 rpm an	FUEL SYSTEM			
Type9 x 3 Collar Shift12 x 12 PowrReverser™ Three RangesHydrostatic Infinite Three RangesMechanical Front Wheel Drive (MFVD)N/AOptionStandard EquipmentFront Axle Fluid CapacityN/A7 liters (1.8 gal)7 liters (1.8 gal)Differential LockStandard; Foot OperatedStandard; Foot OperatedStandard; Foot OperatedNumber of Speeds with Creeper9 Forward, 3 Reverse 24 Forward, 12 Reverse 24 Forward, 24 Reverse 24 Forward, 24 ReverseInfiniteFinal DrivePlanetaryPlanetaryPlanetaryBrakesWet DiskWet DiskWet DiskSteeringHydraulic Power AssistHydraulic Power AssistHydraulic Power AssistDrawbar Tongue Weight Vertical Capacity Rating500 kg (1102 lb)500 kg (1102 lb)500 kg (1102 lb)PTO (PTO Shaft SpeedShaft Speed540 rpm540 rpm540 rpmMid Shaft Speed2100 rpm2100 rpm2100 rpm2 Speed PTO Shaft Speed540 rpm and 750 rpm540 rpm and 750 rpm540 rpm and 750 rpmPTO Output Power26.8 kW (36.0 hp)25.7 kW (34.5 hp)CLUTCHTypeDry, Single DiscWet, Multiple DiskN/AHYDRAULIC SYSTEMFront Pump Capacity18.9 L/min (5.0 gpm)18.9 L/min (5.0 gpm)39.0 L/min (10.3 gpm)Rear Pump Capacity39.0 L/min (10.3 gpm)39.0 L/min (10.3 gpm)39.0 L/min (10.3 gpm)Total Fluid Capacity37 L (9.8 gal)37 L (9.8 gal)39.0 L/min (10.2 gpm)<	Fuel Tank Capacity	47.3 L (12.5 gal)	37.9 L (10.0 gal)	47.3 L (12.5 gal)
Mechanical Front Wheel Drive (MFWD) N/A Option Standard Equipment Drive (MFWD) Front Axle Fluid Capacity N/A 7 liters (1.8 gal) 7 liters (1.8 gal) Differential Lock Standard; Foot Operated Standard; Foot Operated Standard; Foot Operated Number of Speeds with Creeper 9 Forward, 3 Reverse 24 Forward, 12 Reverse 24 Forward, 24 Reverse 24 Forward, 24 Reverse Infinite Final Drive Planetary Planetary Planetary Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 540 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speed 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk <td< td=""><td>DRIVE TRAIN</td><td></td><td></td><td></td></td<>	DRIVE TRAIN			
Drive (MFWD) Pront Axle Fluid Capacity N/A 7 liters (1.8 gal) 7 liters (1.8 gal) Differential Lock Standard; Foot Operated Standard; Foot Operated Standard; Foot Operated Number of Speeds with Creeper 9 Forward, 3 Reverse 24 Forward, 12 Reverse 24 Forward, 24 Reverse Infinite Final Drive Planetary Planetary Planetary Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed 540 rpm 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM 18.9 L/min (5.0 gpm) 18.9 L/min (10.3 gpm) </td <td>Туре</td> <td>9 x 3 Collar Shift</td> <td>12 x 12 PowrReverser™</td> <td></td>	Туре	9 x 3 Collar Shift	12 x 12 PowrReverser™	
Differential LockStandard; Foot OperatedStandard; Foot OperatedStandard; Foot OperatedStandard; Foot OperatedNumber of Speeds with Creeper9 Forward, 3 Reverse12 Forward, 12 Reverse 24 Forward, 24 ReverseInfiniteFinal DrivePlanetaryPlanetaryPlanetaryBrakesWet DiskWet DiskWet DiskSteeringHydraulic Power AssistHydraulic Power AssistHydraulic Power AssistDrawbar Tongue Weight Vertical Capacity Rating500 kg (1102 lb)500 kg (1102 lb)500 kg (1102 lb)PTO (PTO Shaft Speed Weasured at 2664 Engine rpmRear Shaft Speed540 rpm540 rpm540 rpmMid Shaft Speed2100 rpm2100 rpm2100 rpm2 Speed PTO Shaft Speeds540 rpm and 750 rpm540 rpm and 750 rpm540 rpm and 750 rpmPTO Output Power26.8 kW (36.0 hp)25.7 kW (34.5 hp)CLUTCHTypeDry, Single DiscWet, Multiple DiskN/AHYDRAULIC SYSTEMFront Pump Capacity18.9 L/min (5.0 gpm)18.9 L/min (5.0 gpm)18.9 L/min (5.0 gpm)Rear Pump Capacity39.0 L/min (10.3 gpm)39.0 L/min (10.3 gpm)39.0 L/min (10.3 gpm)Total Fluid Capacity37 L (9.8 gal)37 L (9.8 gal)35 L (9.25 gal)WEIGHT2WD1429 kg (3150 lbs)1429 kg (3150 lbs)1429 kg (3150 lbs)		N/A	Option	Standard Equipment
Number of Speeds with Creeper 9 Forward, 3 Reverse with Creeper 12 Forward, 24 Reverse 24 Forward, 24 Reverse 24 Forward, 24 Reverse Infinite Final Drive Planetary Planetary Planetary Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed Weasured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm)	Front Axle Fluid Capacity	N/A	7 liters (1.8 gal)	7 liters (1.8 gal)
with Creeper 24 Forward, 24 Reverse Final Drive Planetary Planetary Planetary Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed Weasured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 35 L (9.25 gal) WEIGHT WEIGHT	Differential Lock	Standard; Foot Operated	Standard; Foot Operated	Standard; Foot Operated
Brakes Wet Disk Wet Disk Wet Disk Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed Weasured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 39.0 L/min (10.3 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 35 L (9.25 gal) WEIGHT WEIGHT WEIGHT		9 Forward, 3 Reverse		Infinite
Steering Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Hydraulic Power Assist Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed Measured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Final Drive	Planetary	Planetary	Planetary
Drawbar Tongue Weight Vertical Capacity Rating 500 kg (1102 lb) 500 kg (1102 lb) 500 kg (1102 lb) PTO (PTO Shaft Speed Weasured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Brakes	Wet Disk	Wet Disk	Wet Disk
Vertical Capacity Rating PTO (PTO Shaft Speed Measured at 2664 Engine rpm) Rear Shaft Speed 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Steering	Hydraulic Power Assist	Hydraulic Power Assist	Hydraulic Power Assist
Rear Shaft Speed 540 rpm 540 rpm 540 rpm 540 rpm Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)		500 kg (1102 lb)	500 kg (1102 lb)	500 kg (1102 lb)
Mid Shaft Speed 2100 rpm 2100 rpm 2100 rpm 2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	PTO (PTO Shaft Speed N	Measured at 2664 Engine rp	m)	
2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm 540 rpm and 750 rpm PTO Output Power 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Rear Shaft Speed	540 rpm	540 rpm	540 rpm
PTO Output Power 26.8 kW (36.0 hp) 26.8 kW (36.0 hp) 25.7 kW (34.5 hp) CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Mid Shaft Speed	2100 rpm	2100 rpm	2100 rpm
CLUTCH Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	2 Speed PTO Shaft Speeds	s 540 rpm and 750 rpm	540 rpm and 750 rpm	540 rpm and 750 rpm
Type Dry, Single Disc Wet, Multiple Disk N/A HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	PTO Output Power	26.8 kW (36.0 hp)	26.8 kW (36.0 hp)	25.7 kW (34.5 hp)
HYDRAULIC SYSTEM Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	CLUTCH			
Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm) Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Туре	Dry, Single Disc	Wet, Multiple Disk	N/A
Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm) Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	HYDRAULIC SYST	ΓEM		
Total Fluid Capacity 37 L (9.8 gal) 37 L (9.8 gal) 35 L (9.25 gal) WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Front Pump Capacity	18.9 L/min (5.0 gpm)	18.9 L/min (5.0 gpm)	18.9 L/min (5.0 gpm)
WEIGHT 2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Rear Pump Capacity	39.0 L/min (10.3 gpm)	39.0 L/min (10.3 gpm)	39.0 L/min (10.3 gpm)
2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) 1429 kg (3150 lbs)	Total Fluid Capacity	37 L (9.8 gal)	37 L (9.8 gal)	35 L (9.25 gal)
	WEIGHT			
MEND N/A 1504 kg (0450 lbs) 1504 kg (0450 lbs)	2WD	1429 kg (3150 lbs)	1429 kg (3150 lbs)	1429 kg (3150 lbs)
MFWD N/A 1564 kg (3450 lbs) 1564 kg (3450 lbs)	MFWD	N/A	1564 kg (3450 lbs)	1564 kg (3450 lbs)

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GENERAL VEHICLE SPECIFICATIONS* – 4700 TRACTORS

4700 PRT 4700 Hydrostatic Drive

FUEL SYSTEM

Fuel Tank Capacity 37.9 L (10.0 gal) 47.3 L (12.5 gal)

DRIVE TRAIN

Type 12 x 12 Power Reverse Hydrostatic Infinite

Three Ranges

Mechanical Front Wheel

Drive (MFWD)

Option Standard Equipment

Front Axle Fluid Capacity 7 liters (1.8 gal) 7 liters (1.8 gal)

Differential Lock Standard; Foot Operated Standard; Foot Operated

Number of Speeds 12 Forward, 12 Reverse Infinite

with Creeper

24 Forward, 24 Reverse

.....

Final Drive Planetary Planetary

Brakes Wet Disk Wet Disk

Steering Hydraulic Power Assist Hydraulic Power Assist

Drawbar Tongue Weight

Vertical Capacity Rating

500 kg (1102 lb) 500 kg (1102 lb)

PTO (PTO Shaft Speed Measured at 2664 Engine rpm)

Rear Shaft Speed 540 rpm 540 rpm

Mid Shaft Speed 2100 rpm 2100 rpm

2 Speed PTO Shaft Speeds 540 rpm and 750 rpm 540 rpm and 750 rpm

PTO Output Power 29.8 kW (40.0 hp) 28.7 kW (38.5 hp)

CLUTCH

Type Wet, Multiple Disk N/A

HYDRAULIC SYSTEM

Front Pump Capacity 18.9 L/min (5.0 gpm) 18.9 L/min (5.0 gpm)

Rear Pump Capacity 39.0 L/min (10.3 gpm) 39.0 L/min (10.3 gpm)

Total Fluid Capacity 37 L (9.8 gal) 35 L (9.25 gal)

WEIGHT

2WD 1429 kg (3150 lbs) 1429 kg (3150 lbs) MFWD 1564 kg (3450 lbs) 1564 kg (3450 lbs)



FASTENER TORQUE VALUES

JIS FASTENER TORQUE VALUES



J.I.S. Grade and Head Markings	77	8.8T	(11T)
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	Grade	9 7T			Grade 8.8T				Grade 11T			
	Lubrio	cateda	Dry ^a		Lubrio	ateda	Dry ^a	Dry ^a Lı		Lubricated ^a D		
SIZE	N•m	lb-ft	N•m	lb-ft			N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
8mm			23-29	17-22			25-35	19-26			29-41	22-30
10mm			44-59	33-43			51-67	38-49			61-80	45-59
12mm			78-98	58-72			83-113	61-83			103-132	76-98
14mm			118-147	87-109			127-167	94-123			152-201	112-148
16mm			167-206	123-152								

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

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

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

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

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

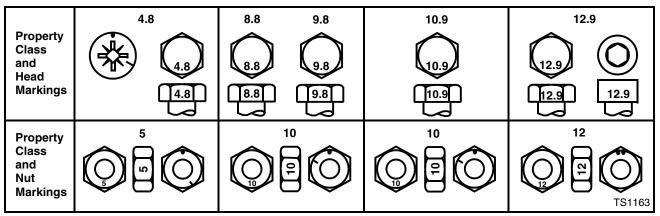
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^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication. At the time of printing, these numbers were not available.

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

Reference: JDS—G200.

METRIC FASTENER TORQUE VALUES





	Class 4	1.8			Class 8.8 or 9.8			Class 10.9			Class 12.9					
	Lubrica	ated ^a	Dry ^a		Lubrica	ited ^a	Dry ^a		Lubrica	ated ^a	Dry ^a		Lubrica	ated ^a	Dry ^a	
SIZE	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft	N•m	lb-ft
M6	48	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	109
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	580
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

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

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

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

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

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

Reference: JDS—G200.

INCH FASTENER TORQUE VALUES



SAE Grade and Head Markings	No Marks	5 5.1 5.2	8 8.2
SAE Grade and Nut Markings	No Marks	5	8 E TS1162

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

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

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

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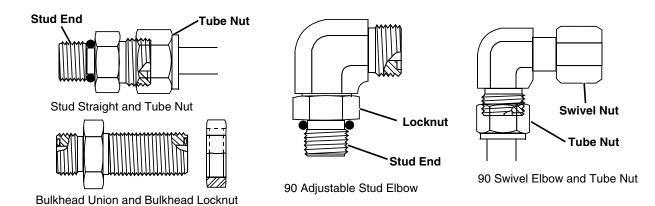
^a "Lubricated" means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. "Dry" means plain or zinc plated (yellow dichromate - Specification JDS117) without any lubrication.

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

Reference: JDS—G200.

O-RING SEAL SERVICE RECOMMENDATIONS

FACE SEAL FITTINGS WITH INCH STUD ENDS TORQUE



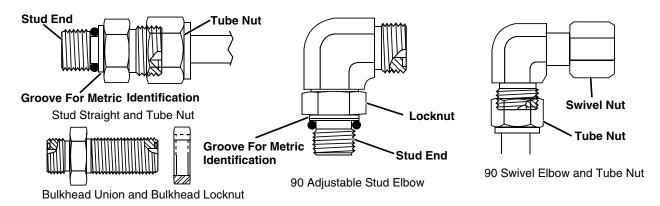
Nominal Tube OD/Hose ID				Face	Seal Tul	be/Hos	O-ring Stud Ends				
Metric Tube OD	Inc	ch Tube	OD	Thread Size	Tube I Swivel Torq	Nut	Bulkhead Locknut Torque		Thread Size	Straight Fitting of Locknut Torque	
mm	Dash Size	in.	mm	in.	N•m	lb-ft	N•m lb-ft		in.	N•m lb-ft	
	-3	0.188	4.76						3/8-24	8	6
6	-4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

NOTE: Torque tolerance is +15% / -20%.



FACE SEAL FITTINGS WITH METRIC STUD ENDS TORQUE



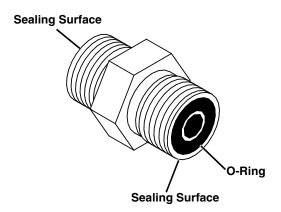


Nominal Tube OD/Hose ID				Face Seal Tube/Hose End						O-ring Stud Ends, Straight Fitting or Locknut					
Metric Tube OD	Inc	ch Tube	OD	Thread Size	Hex Size	Sw	wivel Locknut Nut Torque Size		Tube Nut/ Swivel Nut Torque		Hex Size	Gray Iron 11"		Alum Tor	inum que
mm	Dash Size	in.	mm	in.	mm	N•m	lb-ft	N•m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

NOTE: Torque tolerance is +15% / -20%.

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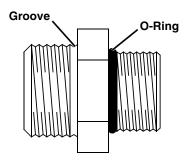
O-RING FACE SEAL FITTINGS



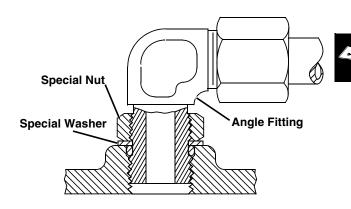
- Inspect the fitting sealing surfaces. They must be free of dirt or defects.
- Inspect the O-ring. It must be free of damage or defects.
- 3. Lubricate O-rings and install into groove using petroleum jelly to hold in place.
- Push O-ring into the groove with plenty of petroleum jelly so O-ring is not displaced during assembly.
- 5. Index angle fittings and tighten by hand pressing joint together to insure O-ring remains in place.
- 6. Tighten fitting or nut to torque value shown on the chart per dash size stamped on the fitting. Do not allow hoses to twist when tightening fittings.

O-RING BOSS FITTINGS

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



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



- For angle fittings, loosen special nut and push special washer against threads so O-ring can be installed into the groove of fitting.
- 4. Turn fitting into the boss by hand until special washer or washer face (straight fitting) contacts boss face and O-ring is squeezed into its seat.
- 5. To position angle fittings, turn the fitting counterclockwise a maximum of one turn.
- Tighten straight fittings to torque value shown on chart. For angle fittings, tighten the special nut to value shown in the chart while holding body of fitting with a wrench.

STRAIGHT FITTING OR SPECIAL NUT TORQUE

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

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

DIESEL FUEL SPECIFICATIONS

DIESEL FUEL

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

In North America, diesel fuel is usually specified to **ASTM D975** and sold as either **Grade 1** for cold air temperatures or **Grade 2** for warm air temperatures.

If diesel fuels being supplied in your area **DO NOT** meet any of the above specifications, use diesel fuels with the following equivalent properties:

• Cetane Number 40 (minimum)

A cetane number greater than 50 is preferred, especially for air temperatures below $-20~^{\circ}$ C ($-4~^{\circ}$ F) or elevations above 1500 m (5000 ft).

• Cold Filter Plugging Point (CFPP)

The temperature at which diesel fuel **begins to cloud or jell.** Use diesel fuels with a CFPP which is at least 5 °C (9 °F) below the expected low air temperature.

• Sulfur Content of 0.05% (maximum)

Diesel fuels for highway use in the United States now require sulfur content to be less than 0.05%.

If diesel fuel being used has a sulfur content greater than 0.5%, reduce the service interval for engine oil and filter by 50%.

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



WARNING

California Proposition 65 Warning: Diesel engine exhaust and some of its elements from this product are known to the State of California to cause cancer, birth defects, or other reproductive harm.

DIESEL FUEL LUBRICITY

Diesel fuel must have adequate lubricity to ensure proper operation and durability of fuel injection system components. Fuel lubricity should pass a **minimum of 3300 gram load level** as measured by the **BOCLE** scuffing test.

DIESEL FUEL STORAGE

IMPORTANT: DO NOT USE GALVANIZED CONTAINERS—diesel fuel stored in galvanized containers reacts with zinc coating in the container to form zinc flakes. If fuel contains water, a zinc gel will also form. The gel and

flakes will quickly plug fuel filters and damage fuel injectors and fuel pumps.

It is recommended that diesel fuel be stored **ONLY** in a clean, approved **POLYETHYLENE PLASTIC** container **WITHOUT** any metal screen or filter. This will help prevent any accidental sparks from occurring. Store fuel in an area that is well ventilated to prevent possible igniting of fumes by an open flame or spark, this includes any appliance with a pilot light.

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

Keep fuel in a safe, protected area and in a clean, properly marked ("DIESEL FUEL") container. DO NOT use deicers to attempt to remove water from fuel. DO NOT depend on fuel filters to remove water from fuel. It is recommended that a water separator be installed in the storage tank outlet. BE SURE to properly discard unstable or contaminated diesel fuel and/or their containers when necessary.

ENGINE OIL

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

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

- PLUS-50®—SAE 15W-40;
- TORQ-GARD SUPREME®-SAE 5W-30.
- TORQ-GARD SUPREME®—SAE 15W-40:
- UNI-GARD™—SAE 15W-40;
- UNI-GARD™—SAE 5W-30.

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

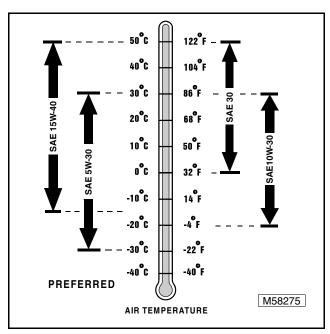
- TURF-GARD®-SAE 10W-30;
- PLUS-4®-SAE 10W-30;
- TORQ-GARD SUPREME®—SAE 30.
- UNI-GARD™—SAE 10W-30;
- UNI-GARD™—SAE 30.

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

- SAE 15W-40—API Service Classification CF-4 or higher;
- SAE 5W-30—API Service Classification CC or higher;
- SAE 10W-30—API Service Classification CF or higher;
- SAE 30—API Service Classification CF or higher.
- CCMC Specification D4 or Mercedes Benz MB228.1 or higher.

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IMPORTANT: If diesel fuel with sulfur content greater than 0.5% is used, reduce the service interval for oil and filter by 50%.



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

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

BREAK-IN ENGINE OIL

IMPORTANT: ONLY use this specified break-in oil in rebuilt or remanufactured engines for the <u>first 100 hours (maximum) of operation</u>. DO NOT use PLUS-50®, SAE 15W40 oil, oils meeting specifications API CG-4, API CF-4, or CCMC Specifications, these oils will not allow rebuilt or remanufactured engines to break-in properly.

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

• BREAK-IN ENGINE OIL.

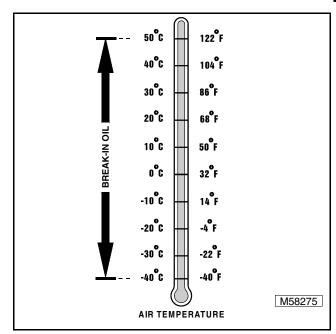
John Deere BREAK-IN ENGINE OIL is formulated with special additives for aluminum and cast iron type engines to allow the power cylinder components (pistons, rings, and liners as well) to "wear-in" while protecting other engine components, valve train and gears, from abnormal wear. Engine rebuild instructions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

John Deere BREAK-IN ENGINE OIL is also recommended for non-John Deere engines, both

aluminum and cast iron types.

If this preferred John Deere oil is not available, use a break-in engine oil meeting the following specification during the first 100 hours of operation:

- API Service Classification CE or higher.
- CCMC Specification D4 or higher.



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

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

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

TRANSMISSION & HYDRAULIC OIL



The same type of oil is recommended for all transmissions in the 45, 46, 4700 tractors. Use the appropriate oil viscosity based on these air temperature ranges. Operating outside of these recommended oil air temperature ranges may cause premature hydrostatic transmission or hydraulic system failures.

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

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

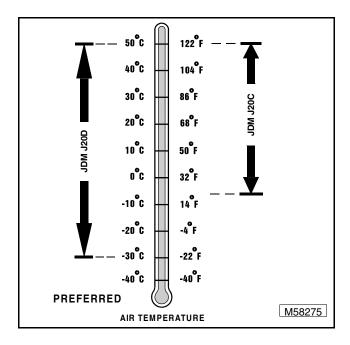
LOW VISCOSITY HY-GARD®—JDM J20D.

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

HY-GARD®—JDM J20C.

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

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



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

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

CHASSIS GREASE

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

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

- MOLY HIGH-TEMPERATURE EP GREASE®— JDM J25C, NLGI Grade 2;
- HIGH-TEMPERATURE EP GREASE®—JDM J13E4. NLGI Grade 2.
- GREASE-GARD™—JDM J25C, NLGI Grade 2.

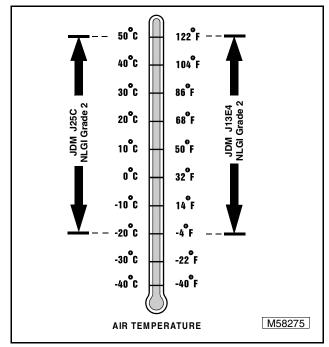
Other greases may be used if above preferred John Deere greases are not available, provided they meet one of the following specifications:

- John Deere Standard JDM J25C, NLGI Grade 2;
- John Deere Standard JDM J13E4, NLGI Grade 2.

IMPORTANT: If minimum air temperature should fall below -10 °C (14 °F), the grease must be heated to at least five degrees above the lower limit before start-up or components may be damaged.

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

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



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ALTERNATIVE LUBRICANTS

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

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

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

SYNTHETIC LUBRICANTS

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

The recommended temperature limits and service or lubricant change intervals should be maintained as shown in the operator's manual, unless otherwise stated on lubricant label.

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

LUBRICANT STORAGE

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

MIXING OF LUBRICANTS

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

OIL FILTERS

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



The following John Deere oil filters are PREFERRED:

 AUTOMOTIVE AND LIGHT TRUCK ENGINE OIL FILTERS.

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

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

ASTB Tested In Accordance With SAE J806.

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

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

COOLANT

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

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

- PRE-DILUTED DIESEL ENGINE ANTIFREEZE/ SUMMER COOLANT™ (TY16036).
- COOL-GARD COOLANT CONCENTRATE™.

This coolant satisfies specifications for "Automobile and Light Duty Engine Service" and is safe for use in equipment, including aluminum block gasoline engines and cooling systems.

The above preferred pre-diluted antifreeze provides:

- adequate heat transfer
- corrosion-resistant chemicals for the cooling system
- compatibility with cooling system hose and seal material
- protection during extreme cold and extreme hot weather operations
- chemically pure water for better service life
- compliance with ASTM D4656 (JDM H24C2) specifications

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

 DIESEL ENGINE ANTIFREEZE/SUMMER COOLANT CONCENTRATE™ (TY16034).

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

• ASTM D3306 (JDM H24C1).

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

IMPORTANT: To prevent engine damage, DO NOT use pure antifreeze or less than a 50% antifreeze mixture in the cooling system. DO NOT mix or add any additives/conditioners to the cooling system in equipment. Water used to dilute engine coolant concentrate must be of high quality—clean, clear, potable water (low in chloride and hardness—Table 1) is generally acceptable. DO NOT use salt water. Deionized or distilled water is ideal to use. Coolant that is not mixed to these specified levels and water purity can cause excessive scale, sludge deposits, and increased corrosion potential.

Table 1: Water Quality

Property	Requirements
Total Solids, Maximum	340 ppm (20 grns/gal)
Total Hardness, Max.	170 ppm (10 grns/gal)
Chloride (as CI), Max.	40 ppm (2.5 grns/gal)
Sulfate (as SO ₄), Max.	100 ppm (5.8 grns/gal)

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

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

COOLANT DRAIN INTERVAL

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

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

If above John Deere Automobile and Light Duty Engine

Service coolants **are not** being used; drain, flush, and refill the cooling system according to instructions found on product container or in equipment operator's manual or technical manual.

PRODUCT IDENTIFICATION LOCATIONS

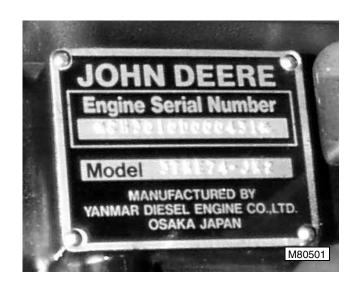
When ordering parts or submitting a warranty claim, it is IMPORTANT that you include the product identification number, and the component product identification numbers.

The location of the product identification numbers and component product identification numbers are shown.

PRODUCT IDENTIFICATION NUMBER



ENGINE PRODUCT IDENTIFICATION NUMBER



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CYLINDER HEAD AND VALVES
CYLINDER HEAD AND VALVES
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CYLINDER BORE
CRANKCASE EXTENSION HOUSING
BALANCER ASSEMBLY
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DIESEL ENGINE SPECIFICATIONS

SPECIFICATIONS

GENERAL SPECIFICATIONS - 4500, 4600, 4700

NOTE: Specifications without model designation are the same for all tractors.

Make	
Model	•
Type	4-cycle Diesel
Output Power	
Model 4500 @ 2600 RPM	
Model 4600 @ 2600 RPM	
Model 4700 @ 2600 RPM	35.8 kW (48 hp)
Torque (at rated speed)	
Model 4500 @ 2600 RPM	
Model 4600 @ 2600 RPM	
Model 4700 @ 2600 RPM	117 N•m (86.3 lb-ft)
Torque (maximum)	
Model 4500 @ 1700 RPM	
Model 4600 @ 1700 RPM	
Model 4700 @ 1700 RPM	,
Cylinders	
Bore 4500, 4600	,
Bore 4700	88 mm (3.46 in.)
Stroke	90 mm (3.54 in.)
Displacement 4500, 4600	1.995 L (121.7 cu in.)
Displacement 4700	· · · · · · · · · · · · · · · · · · ·
Firing Order	· · · · · · · · · · · · · · · · · · ·
Direction of Rotation	
Combustion System	` ,
Compression Ratio	
Cooling	·
Oil Capacity	
Governor	•
Low Idle	
EPAIR SPECIFICATIONS	
alve Train	
Rocker Arm Shaft OD	
Standard	15 07 - 15 08 mm (0 620 - 0 620 in)
Wear Limit	
Rocker Arm ID	
Standard	16 00 - 16 02 mm (0 630 - 0 631 in)
Wear Limit	16 09 mm (0.633 in)
Rocker Arm and Shaft Support Clearance	
Standard	0.02 - 0.05 mm (0.001 - 0.002 in.)
Wear Limit	
	(2.200)

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Cylinder Head and Valves
Cylinder Head Distortion



Int	ake Valve Seat Width (Non-Removable)						
	StandardWear Limit						
Ex	chaust Valve Seat Width (Non-Removable)					`	,
	Standard						
	Wear Limit			1.	94 mm	ı (0.0	76 in.)
Va	alve Stem OD				<i>,</i>		
	Intake Valve Exhaust Valve						
	Wear Limit						
Va	alve Head Thickness					. (0.0	,
	Intake	. 1.24	- 1.44	mm	(0.049	- 0.0	57 in.)
	Exhaust	. 1.35	- 1.55	5 mm	(0.053)	3 - 0.0)61in.)
	Wear Limit			0.	50 mm	ı (0.0	20 in.)
Va	alve Recession	0.01	0.51	ma ma	/n n1n	0.0	00 in \
	StandardWear Limit						
Va	alve Guide Stem-To-Guide Oil Clearance:				00 11111	1 (0.0	00 111.)
٧u	Intake	. 0.04	- 0.07	mm	(0.001	- 0.0	03 in.)
	Exhaust	. 0.05	- 0.08	mm	(0.002	- 0.0	03 in.)
	Wear Limit			0.	20 mm	ı (0.0	08 in.)
Va	alve Guide ID	_		0.00	/O O4 E		40. /
	Intake						
	Wear Limit						
Va	alve Guide Projection					•	,
	alve Springs Spring Free Length					•	,
	aximum Spring Inclination					•	
	alve Spring Tension (Measured With Spring					•	,
	Compressed 1.0 mm (0.039)	2.3	36 - 3.	.10 kg	ງ (5.20	- 6.8	3 lbs.)
Va	alve Seat Surface Angle						
	Exhaust Valve						
\/o	Intake Valve						30
va	Intake Valve						
	Opens				. 10° -	- 20°	BTDC
	Closes				. 40° -	· 50°	ABDC
	Exhaust Valve				54 0	040	
	Opens						
Pic	ston-to-Cylinder Head Clearance						
	•	. 0.00	0.70		(0.020	0.0	O 1 111.)
Conne	ecting Rod						
La	rge End Bearing ID	51	- 51.0	1mm	(2.008	3 - 2.0	008in.)
Oil	l Clearance	. 0.04	- 0.07	mm	(0.002	- 0.0	03 in.)
Piston	n Rings						
1st	t Compression Piston Ring						
	Piston Groove Width						
	Ring Width	. 1.97	- 1.99	mm	(0.078	- 0.0	78 in.)
0-	Minimum Side Clearance	. 0.08	- 0.11	mm	(0.003	- 0.0	04 in.)
211	d Compression Piston Ring Piston Groove Width	2 04 .	- 2 05	mm	ഗ റജറ	- 0.0	81 in \
	Ring Width						
	Minimum Side Clearance						
Oil	I Control Piston Ring						
	Piston Groove Width						
	Ring Width						
	William Glac Gloaranoc	. 0.00	0.00		(5.501	5.0	ر. ۱۱۱۰ <i>ک</i>

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Piston Ring End Gap (All)	
Standard	
Wear Limit	1.50 mm (0.059 in.)
Piston Pin	
Piston Pin Outside Diameter	
Piston Pin Bushing ID	6.00 - 26.01 mm (1.024 - 1.024 in.)
Piston Pin-To-Rod Bushing Oil Clearance	. 0.03 - 0.05 mm (0.001 - 0.002 in.)
Piston Pin-To-Piston Oil Clearance	0.00 - 0.02 mm (0 - 0.001 in.)
Piston	
4500 - 4600 Standard Piston OD	
4700 Standard Piston OD	7.95 - 87.98 mm (3.463 - 3.464 in.)
4500 - 4600 Oversize Piston - 0.25 mm (0.010 in.)	,
Standard OD	
Cylinder Bore ID	
4500 - 4600 Standard Size Bore	
Wear Limit	84.20 mm (3.315 in.) . 0.04 - 0.07 mm (0.002 - 0.003 in.)
4700 Standard Size Bore	
4500 - 4600 Oversize Bore – 0.25 mm (0.010 in.) 8	
Wear Limit	,
Wear Limit	
Cylinder Roundness	
Wear Limit	, , ,
Wear Limit	
Deglazing	
Reboring	30 - 40° crosshatch pattern
Crankshaft and Main Bearings	
Connecting Rod Crankshaft Journal OD 4	
Wear Limit	•
Wear Limit	0.16 mm (0.006 in.)
Main Bearing Journal Outside Diameter5 Wear Limit5	
Main Bearing Oil Clearance	. 0.04 - 0.07 mm (0.001 - 0.003 in.) 0.15 mm (0.006 in.)
Crankshaft Bend (Maximum)	
Crankshaft End Play	
Thrust Gap	
Camshaft	
Camshaft End Play	, ,
Standard	0 - 0.02 mm (0 - 0.001 in.)



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	Wear Limit
	Camshaft Side Gap
	Lobe Height (Intake and Exhaust)
	Standard
	Wear Limit
	Bearing Journal OD
	Flywheel Side and Gear Side
	Intermediate Journal
	Wear Limit- All
	Oil Clearance (Gear and Flywheel Ends) 0.04 - 0.13 mm (0.002 - 0.005 in.
	Oil Clearance (Intermediate) 0.07 - 0.12 mm (0.003 - 0.005 in.
іар	pets
	Stem OD
	Standard
	Wear Limit
	Bore ID
	Standard
	Wear Limit
	Oil Clearance (Maximum)0.05 mm (0.002 in.
ıaıe	r Gear
	Shaft O.D
	Standard
	Wear Limit
	Bushing ID
	Standard
	Wear Limit
	Clearance
~ ::	
OII	Pump
	Rotor Shaft OD to Side Cover Hole ID Clearance
	Standard
	Wear Limit
	Rotor Recess
	Standard
	Wear Limit
	Outer Rotor to Pump Body Clearance
	Standard
	Wear Limit
	Inner Rotor to Outer Rotor Clearance
	Wear Limit
TE	STS AND ADJUSTMENT SPECIFICATIONS
	Valva Clasrones 0.15 0.05 mm (0.006 0.010 in
	Valve Clearance
	Connecting Rod Side Play
	Connecting Rod Bearing Clearance 0.04 - 0.07 mm (0.002 - 0.003 in.
	Crankshaft End Play
	Crankshaft Main Bearing Clearance 0.04 - 0.07 mm (0.001 - 0.003 in.
	Camshaft End Play
	Timing Gear Backlash
	All Except Oil Pump Gear
	Oil Pump Gear
	Fuel Injection Nozzle
	Opening Pressure

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Thermostat
Opening Temperature 69.5 - 72.5° C (157 - 163° F) Fully Opened 85° C (185° F) Minimum Lift Height at 85° C (185° F) and above 8 mm (0.315 in.) Pressure Relief 88.3 ± 14.7 kPa, 12.8 ± 2.2 psi
Fuel Injection Pump Static Timing Adjustment
Injection Pump Timing (JTC46 Engines)
Fan/Alternator Drive Belt Tension
Applied Force 98 N (22 lb) Deflection 10 - 15 mm (0.4 - 0.6 in.)
OPERATIONAL TESTS
Cooling System Maximum Pressure
Valve Opening Pressure 0.9±0.15 kg/cm ² , 88.3±14.7 kPa, (12.8±2.2 psi) Cylinder
Compression Pressure
Oil Pressure Rated Speed
Oil Pressure Switch Opening Pressure
TORQUE VALUES, NON-STANDARD FASTENERS
Cylinder Head Bolts (Lubricating Oil Applied)



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SPECIAL TOOLS DIESEL ENGINE

SPECIAL TOOLS

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

Number	Name	Use
D15001NU	Magnetic Follower Holder Kit	Hold cam followers when removing and installing camshaft.
JDF13	Nozzle Cleaning Kit	Use to clean fuel injection nozzles.
D-20019WI	Valve Guide Knurler	Use to knurl inside diameter of valve guides
JDE118	Valve Guide Driver	Use to remove and install valve guides in cylinder head.
D-20021WI	Valve Guide Reamer	Use to ream out valve guides.
JDG529 or JDST28	Belt Tension Gauge	Use to measure and adjust belt tension.
D05104ST	Cooling System Pressure Pump	Use to test cooling system for leakage.
JDG692	Radiator Pressure Test Kit (Adapters)	Use in conjunction with Cooling System Pressure Pump.
JTO5719	Hand Held Digital Tachometer	Use to adjust engine idle speed.
JTO1682	Compression Gauge Assembly	Use to test cylinder compression.
JDG560	Adapter	Use in conjunction with JT01682.
D01109AA	Diesel Fuel Injection Nozzle Tester	Use to test fuel injection nozzles.
D01110AA 23622	Adapter Set Straight Adapter	Use with D01109AA.
JT03017 JT05577 JTO3349	Hose Assembly Pressure Gauge (100 psi) Connector	Use to test engine oil pressure.
JTO3274 JTO1609 JTO3115	Hose Fitting Female Quick Coupler Gauge w/Male Quick Coupler (0 - 150 psi)	Use to test fuel supply pump pressure.

OTHER MATERIALS

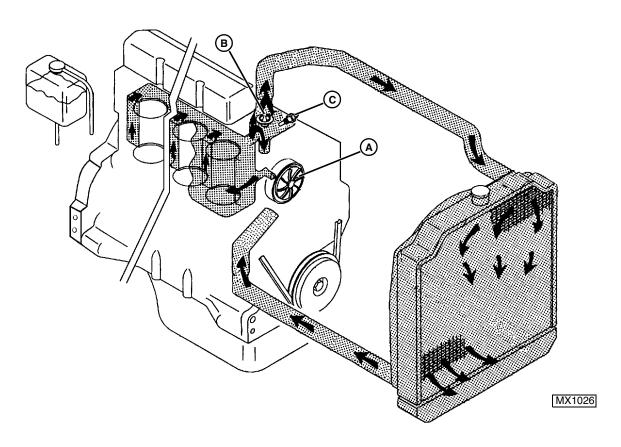
Number	Name	Use
TY15130 LOCTITE [®] No. 395 LOCTITE [®]	John Deere Form-In-Place Gasket	Seals crankcase extension, rear oil seal case and flywheel housing to engine block. Seals oil pan to timing gear housing and engine block.
TY9370 LOCTITE No. 242	Thread Lock and Sealer (Medium Strength)	Apply to threads of crankshaft pulley cap screw.

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THEORY OF OPERATION

COOLING SYSTEM OPERATION





Function:

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

Theory of Operation:

The pressurized cooling system includes the radiator, water pump, fan and thermostat (B).

During the warm-up period, the thermostat remains closed and the impeller type coolant pump draws coolant from the bypass tube. Coolant from the pump flows to the cylinder block water jacket and up through the cylinder head providing a fast warm-up.

Once the engine has reached operating temperature, the thermostat opens and coolant is pumped from the bottom of the radiator via the lower radiator hose into the cylinder block. Here it circulates through the block and around the cylinders.

From the block, coolant is then directed through the cylinder head, and into thermostat housing. With the thermostat open;

 warm engine coolant passes through the housing into the top of the radiator where it is circulated to dissipate heat.

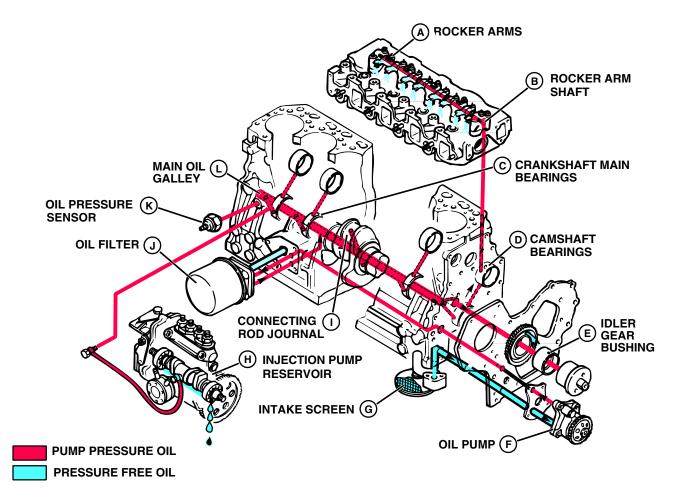
When coolant system pressure exceeds **48 kPa** (7 **psi)**, a valve in the radiator cap opens to allow coolant to discharge into the coolant recovery tank.

When temperature is reduced, a vacuum is produced in the radiator and coolant is drawn back out of the coolant recovery tank through a valve in the radiator cap.

A coolant temperature sensor (C) informs the operator of the engine coolant temperature and warns of a high temperature condition by lighting a lamp.

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LUBRICATION SYSTEM OPERATION



Function:

A full pressure system lubricates engine parts with filtered oil.

Theory of Operation:

The pressure lubrication system consists of a positive displacement gear-driven pump (F), oil strainer (G), full flow oil filter (J), oil pressure regulating valve and an electrical pressure warning switch. (K)

The pump draws lubrication oil from the oil pan through a strainer and a suction tube. The oil is then pumped through an oil passage to the oil filter and through the engine block main oil galley (L).

From the main oil galley, oil is forwarded under pressure to the crankshaft main bearing journals (C) and idler gear bushing (E). Drilled cross-passages in the crankshaft (I) distribute the oil from the main bearings to connecting rod bearings.

Lube oil holes in main bearing oil grooves direct oil to the camshaft bearings (D). A drilled passage from the rear camshaft bearing through the cylinder block and cylinder head supplies lubricating oil to the rocker arm shaft (B). The hollow shaft distributes oil to the rocker arms (A), cam followers and valves.

Lubrication oil is supplied to the fuel injection pump (H) from the main oil galley through external oil lines.

An oil pressure sensor (K) activates an indicator light to alert the operator to shut down the engine if oil pressure drops below specification.

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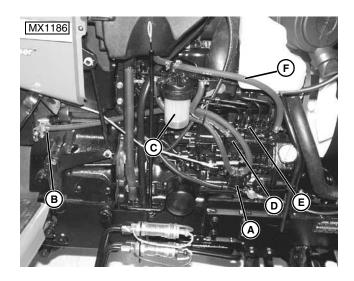
FUEL AND AIR SYSTEM OPERATION

Function:

Fuel system supplies fuel to injection nozzles.

The air intake system filters and supplies air needed for combustion.

Theory of Operation:



Fuel System:

A mechanical fuel transfer pump (A) draws fuel from the tank outlet (B). The low pressure fuel from the fuel pump flows through the filter/water separator (C) to the fuel the injector pump inlet (D). The injection pump then directs high pressure fuel through the injector lines (E) for combustion. Excess fuel is returned, along with fuel from the injectors, through the return line (F) to the fuel tank.

If the unit runs out of fuel, there are two air bleed lines that allow air to escape from the top of the filter and the injection pump. These two lines allow the system to be self bleeding.

The engine speed is controlled by the throttle lever and rod. The rod is connected to the injection pump governor control lever. The fuel shutoff solenoid controls the injection pump shutoff shaft. When the solenoid is retracted (key in the START or ON position), the engine can be started. When the key is turned off, return springs on the shutoff shaft, extend the solenoid, moving the shutoff linkage to the shutoff position. The solenoid also closes if the tractor is operated in an unsafe condition. (See "ENGINE SHUTOFF CIRCUIT OPERATION" in the Electrical section.)

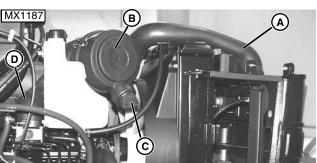
The injection pump meters fuel as determined by the governor and delivers it at high pressure to the injection nozzles.

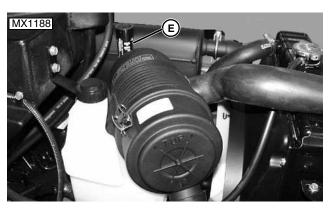
The injection nozzle prevents flow until high pressure is reached, opening the valve and spraying atomized fuel into the combustion chamber. Injection lines contain trapped fuel whenever injection is not taking place.

A small amount of fuel leaks past the nozzle valve to lubricate the fuel injection nozzle. This leakage combines with excess fuel from the injection pump and is returned to tank. Any air in the fuel system is bled out with return fuel to the fuel tank.

A fuel level sensor mounted in the fuel tank informs the operator of the fuel level.

Air Intake System:





Engine intake air enters the inlet hose (A) behind the grille, and flows into the air filter body (B). The air cleaner also has a rubber, one way, unloading valve (C), that ejects heavy dirt particles from the air stream during engine operation before they reach the filters. The operator can squeeze the valve to remove the large particles. The air cleaner elements filter the air, which then flows through hose (D) to the intake manifold.

An air filter restriction indicator (E) at the rear of the air cleaner informs the operator when the air filter needs servicing.



ENGINE SYSTEM DIAGNOSIS

Conditions:

- Machine parked on level surface
- Park brake engaged
- Key switch in OFF position
- Transmission in NEUTRAL

Test/Check Point	Normal	If Not Normal
Engine dipstick and exterior engine surface.	Oil level is between "L" and "H" marks. Oil filter clean.	Fill oil to correct level. Change oil and filter.
	Oil is not burnt, or contaminated with metal particles, fuel, or coolant.	Change oil and filter. Inspect for source of contamination.
	No external leakage.	Check gaskets, seals, plugs, cylinder head, block, intake manifold and breather.
2. Coolant tank and radiator.	Coolant level is between marks on tank when engine is warm. Coolant in radiator is full to top.	Add proper coolant.
	Coolant is 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.
	Water pump not leaking.	Inspect water pump.
	Hoses not cracked or leaking.	Pressure test radiator and cap.
	Clamps and radiator cap tight.	Tighten cap and clamps.
	Fan belt tight, not glazed or cracked.	Replace belt and adjust tension.
	Fan blades not damaged or warped.	Replace fan.
3. Fuel tank, pump, lines, filter shutoff valve.	Fuel level correct, not contaminated. Correct grade of fuel, no water in fuel.	Drain and clean fuel tank. Add fresh fuel.
	Fuel pump in-line filter free of debris.	Replace filters.
	Fuel shutoff valve in "ON" position.	Move to "ON" position.
	Fuel hoses not cracked or leaking.	Replace.
	Fuel hose clamps tight.	Replace or tighten clamp.
4. Air filter and air intake.	Air filter hose not cracked, clamps tight. Element not plugged. Air filter housing sealed, no dirt tracking inside filter element.	Replace and tighten clamps. Replace element or housing.
5. Fuel shutoff solenoid. (Key in RUN position.)	Fuel shutoff solenoid must pull in and stay in. Solenoid must bottom out. Shutoff shaft must still move slightly.	Clean any dirt from under solenoid boot. If solenoid will not pull in and hold in, See "FUEL SHUTOFF SOLENOID CIRCUIT DIAGNOSIS" in Electrical section.

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TROUBLESHOOTING CHART

	Problem or Symptom Cause		ne will	l not	Low e	engine ut	•	Poor exhau color	ust	combustion			Eng surç					Lub	ricat	ing C	Dil		Coo	lant	Intak mani pres	fold		Problem or Symptom		
			Engine starts but does not continue to run Exhaust smoke		Exhaust Color			Under load				stion sound			ne vibration	paeds wo	fuel consumption	oil consumption	crankcase	ase	e	on		temperature			rature too high	Solution		
			No smoke	Excess smoke	Normal	White	Black	White	Loud knocking	Misfiring	Uneven combustion	During Idling	Under Load	Excessive engine	Poor return to low	Excessive fuel	Excessive oil c	Fuel oil in cran	Water in crankcase	Low oil pressure	Low compression	Overheating	Low water temp	Low pressure	High pressure	Exhaust temperature				
	Improper intake or exhaust valve clearance	•	•		•						•														•	Adjust valve clearance				
	Compression leakage from valve seat				•		•		•		•						•					•			•		•	Grind valve seat, regrind valves		
	Seized intake/exhaust valve	•		•	•		•		•		•			•	•				•			•			•			Replace valve and check valve guide		
	Leaking cylinder head gasket				•															•			•					Replace head gasket		
	Broken or seized piston ring	•		•		•		•			•		•		•			•	•			•	•				•	Replace rings and check cylinder		
	Piston ring, piston or cylinder worn			•		•		•										•	•			•						Bore or hone cylinder & replace piston		
E E	Crankshaft pin or bearing seized	•	•								•		•	•	•							•						Regrind crank and replace bearings		
System	Piston ring end gaps not correct		•			•												•				•						Stagger piston ring gaps		
	Piston rings installed incorrectly					•		•										•				•						Install piston rings correctly		
Engine	Crankshaft pin or bearing worn				•						•		•	•	•						•							Regrind crank and replace bearings		
	Connecting rod bolt loose										•				•						•							Check for damage and re-torque bolts		
	Foreign matter in combustion chamber	•									•							•				•						Remove head and inspect for damage		
	Excessive timing gear backlash										•																	Measure timing gear backlash		
	Intake/exhaust valve guides worn					•												•				•						Check valve guides and stems		
	Governor not functioning properly		•										•	•	•	•												Repair or replace governor		
	Improper timing between injection pump, intake & exhaust valves	•				•	•	•	•		•																	Adjust valve clearance. Check valve timing		
	Engine running too cool							•									•							•				Check thermostat		
tem	Engine running too hot						•																•				•	Check thermostat, fan belt tension		
System	Coolant level low						•																•				•	Check cooling system for level/leaks		
ling	Cracked water jacket																			•	•		•					Repair or replace water jacket		
Cooling	Malfunctioning thermostat						•															•	•				Check or replace thermostat			
	Water pump/alternator belt loose						•																•					Adjust fan belt tension		

	Problem or Symptom	Engine will not start			Low o	engine ut	e	Poor exhau color	nstion			Eng					Lub	ricat	ing (Oil		Coc	lant	Intal man pres	ifold		Problem or Symptom				
	Cause		Engine starts but does not continue to run			ust Co	olor	Unde	during		punos			vibration	pee	consumption	nption						ē			too high					
			Exha smol							noise		stion			ne vik	low sp	consı	onsur	crankcase	ase	e.	on		temperature			rature	Solution			
			No smoke	Excess smoke	Normal	White	White Black White	White	Black	Loud knocking	Misfiring	Uneven combustion	During Idling	Under Load Excessive engine		Poor return to I	Excessive fuel	Excessive oil consumption	Fuel oil in cran	Water in crankcase	Low oil pressure	Low compression	Overheating	Low water temp	Low pressure	High pressure	Exhaust temperature				
System	Improper engine oil viscosity/type	•	•		•												•						Replace engine oil and filter								
Sys	External/internal oil leak																	•			•							Repair			
g Oil	Oil pump worn																											Check and repair oil pump			
Lubricating	Oil filter clogged																				•	•						Replace oil filter			
bric	Oil pressure relief valve worn																				•							Clean, adjust or replace relief valve			
ב	Oil level low																				•							Add oil			
	Advanced fuel injection pump timing							•	•	•					•													Check and adjust injection pump timing			
	Retarded fuel injection pump timing					•	•	•	•								•										•	Check and adjust injection pump timing			
	Wrong type of fuel				•	•	•	•	•			•																Drain and replace fuel			
1_	Water in fuel	•		•		•		•				•	•	•														Check and repair			
System	Fuel filter clogged	•	•		•																							Replace fuel filter			
	Air entering fuel system	•	•		•																							Check and repair fuel supply system			
Fuel	Clogged or cracked fuel lines	•	•		•																							Clean or replace fuel lines			
-	Fuel volume to injection pump low	•	•		•																							Check or replace fuel transfer pump			
	Uneven volume of fuel injected					•	•	•	•			•	•	•	•												•	Check fuel injector pump and injectors			
	Excessive volume of fuel injected								•								•	•				•	•			•	•	Check fuel injector pump and injectors			
	Poor fuel injection pattern					•	•	•	•			•	•	•	•		•											Clean or replace fuel injector nozzles			
ust	Clogged air filter			•			•		•			•													•			Clean or replace air filter			
xha	Engine at high altitude/temperature						•		•														•		•			Use higher output engine			
Air/Exhaust	Clogged exhaust pipe						•		•			•															•	Clean exhaust pipe			
	Starting motor defective	•																										Repair or replace starting motor			
rica	Alternator defective	•																										Repair or replace alternator			
Electrical	Open circuit in wiring	•																										Repair wiring			
"	Battery voltage low	•																										Recharge battery			

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TESTS AND ADJUSTMENTS

CYLINDER COMPRESSION TEST

Reason:

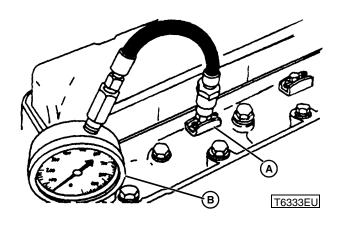
To determine the condition of the pistons, rings, cylinder walls and valves.

Equipment:

- JT01682 Compression Gauge Assembly
- JDG560 Adapter

Procedure:

1. Remove the injection nozzles.



- 2. Install the heat protector from end of injector and install JDG560 adapter (A).
- 3. Install JT01682 Compression Gauge Assembly (B) and JDG560 Adapter.
- 4. Disconnect the fuel control solenoid connector.

IMPORTANT: DO NOT overheat starting motor during test.

- 5. Crank the engine for five seconds with the starting motor. Minimum cranking speed is 250 rpm.
- 6. Record the pressure reading for each cylinder.

Compression Pressure:

Results:

- If the pressure reading is below specification, squirt clean engine oil into the cylinders through the injector ports and repeat the test.
- If the pressure increases significantly, check piston, rings, and cylinder walls for wear or damage.

 If the pressure does not increase significantly, check for leaking valves, valve seats or cylinder head gasket.

SLOW IDLE ADJUSTMENT

IMPORTANT: The slow idle adjustment is the only adjustment that can be made on this engine.

The fast idle and torque capsule adjustments are pre-set by the engine manufacturer to comply with strict EPA/CARB emissions requirements, and are adjustable ONLY by authorized diesel service facilities.



Reason:

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

Equipment:

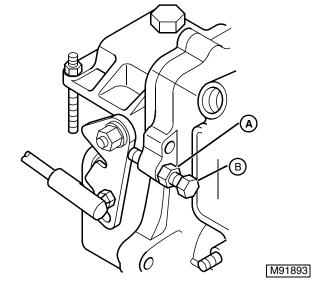
• JT05719 Hand Held Digital Tachometer

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

Procedure:

- Place a small piece of reflective tape on the crankshaft pulley.
- 2. Start the engine and run for 5 minutes to attain operating temperature.
- 3. Move the throttle lever to slow idle position.
- 4. Use JT05719 Hand Held Digital Tachometer to check engine speed at the crankshaft pulley.
- 5. Visually check that the injection pump throttle lever is against slow idle stop screw. Slow idle speed is 950 ± 50 rpm.

Results:



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

VALVE CLEARANCE CHECK AND ADJUSTMENT

Reason:

To achieve correct engine operation.

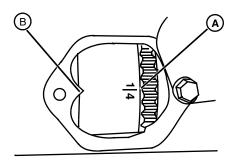
Equipment:

Feeler Gauge

Procedure:

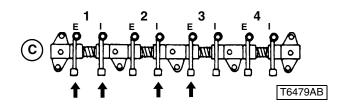
- 1. Remove the rocker arm cover.
- 2. Remove the access cover from the timing hole in the flywheel housing.

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



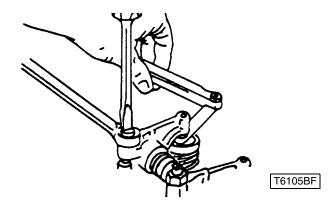
- Turn the crankshaft pulley clockwise until No.1 cylinder TDC mark on the flywheel (A) aligns with the index mark on the flywheel housing (B) or plate.
- 4. Try to move both No. 1 cylinder rocker arms or push rods.

NOTE: If the 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.

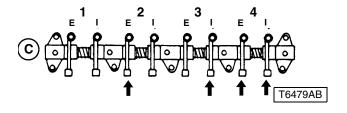


NOTE: No. 1 cylinder is the closest to the flywheel side of the engine (C).

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



- To adjust the valves, loosen the nut and turn the adjusting screw until the clearance is 0.15 - 0.25 mm (0.006 - 0.010in.). Hold the screw while tightening the nut.
- 7. Turn the crankshaft pulley one revolution (360°).



8. Measure and adjust the valve clearance on the valves (arrows) shown.

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CONNECTING ROD SIDE PLAY CHECK

Reason:

To determine proper side clearance between the crankshaft and the connecting rod.

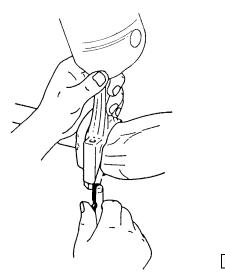
Equipment:

• Feeler Gauge

NOTE: The engine must be removed from the tractor to perform this test.

Procedure:

- 1. Remove the oil pan, crankcase extension, oil pickup, and balancer assembly.
- Insert a feeler gauge, according to specifications, between the connecting rod cap and the crankshaft.



M82116A

3. Connecting rod side play is **0.2 - 0.4 mm (0.008 - 0.016 in.).**

Results:

• If the side play exceeds specification, replace the bearing inserts or the connecting rod.

CONNECTING ROD BEARING CLEARANCE CHECK

Reason:

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

Equipment:

• PLASTIGAGE®

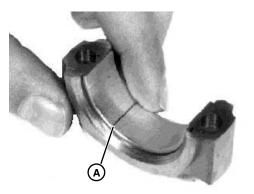
NOTE: The engine must be removed from the tractor to perform this test.

Procedure:

 Remove the oil pan, crankcase extension, oil pickup, and balancer assembly.

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

- 2. Remove the connecting rod cap.
- 3. Wipe oil from the bearing insert and the crankshaft journal.
- 4. Put a piece of PLASTIGAGE (A), or an equivalent, along the full length of the bearing insert approximately 6 mm (0.25 in.) off center.



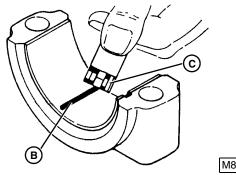
M35351

- Turn the crankshaft approximately 30° from bottom dead center.
- Install the connecting rod end cap and original rod bolts. Tighten the rod bolts to 44-54 N•m (33-40 lb-ft).
- 7. Remove the rod bolts and the connecting rod cap.

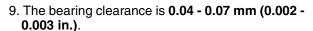
NOTE: The flattened PLASTIGAGE (B) will be found on either the bearing insert or crankshaft journal.

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









 Remove the PLASTIGAGE.
 ®PLASTIGAGE is a registered trademark of the DANA Corporation.

Results:

 If the clearance exceeds specification, replace bearing inserts.

CRANKSHAFT END PLAY CHECK

Reason:

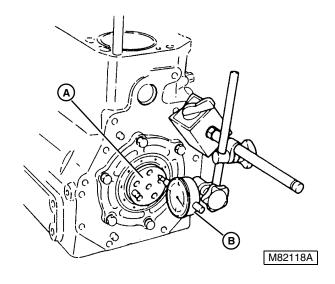
To determine proper side clearance between the crankshaft and the engine block.

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 the dial indicator (B) to engine and position indicator tip on end of crankshaft (A).

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

- 2. Push the 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.
- Crank shaft end play is 0.09 0.27 mm (0.004 0.011 in.).

Results:

 If the end play exceeds 0.33 mm (0.013 in.), replace the thrust bearings.

CRANKSHAFT MAIN BEARING CLEARANCE CHECK

Reason:

To measure oil clearance between main bearing and crankshaft journal.

Equipment:

PLASTIGAGE[®]

NOTE: The engine must be removed from the tractor to perform this test.

Procedure:

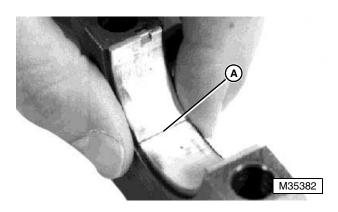
1. Remove the oil pan, oil pick-up, crankcase extension, and balancer assembly.

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DIESEL ENGINE VALVE LIFT CHECK

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

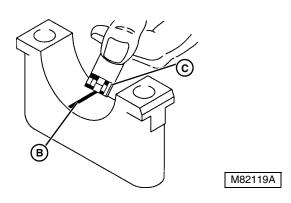
- 2. Remove the main bearing cap.
- Wipe oil from the bearing insert and the crankshaft journal.
- 4. Put a piece of PLASTIGAGE (A), or equivalent, along the full length of the bearing insert approximately 6 mm (0.25 in.) off center.



- 5. Install main bearing cap and bolts. Tighten bolts to **96 100 N•m (71 74 lb-ft)**.
- 6. Remove bolts and main bearing cap.

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

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



- 8. Main bearing clearance is **0.04 0.07 mm (0.001 0.003 in.)**.
- Remove PLASTIGAGE.
 PLASTIGAGE[®] is a registered trademark of the DANA Corporation.

Results:

• If the clearance exceeds **0.15 mm (0.006 in.)** replace the bearing inserts.

VALVE LIFT CHECK

Reason:

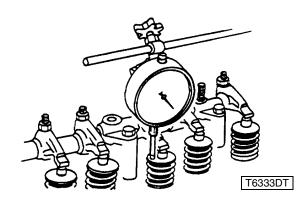
Check wear on cam lobes, followers, and/or push rods.

Equipment:

Dial Indicator

Procedure:

- Remove the rocker arm cover. (See "ROCKER COVER" on page 28.)
- Adjust the valve clearance. (See "VALVE CLEARANCE CHECK AND ADJUSTMENT" on page 16.)



- Fasten the dial indicator to the engine and position the indicator tip on the valve retainer. The valve must be fully closed and the rocker arm must move freely.
- 4. Zero the dial indicator.
- 5. Manually turn the crankshaft pulley clockwise (from the fan end).
- 6. Observe the dial indicator as the valve is moved to the full open position.
- 7. Repeat for each valve.

Results:

 The valve lift should be the same for all the valves. If one or more valves show less lift than the others, remove and inspect the camshaft, followers and push rods. (See "CAMSHAFT" on page 48.) If the camshaft, followers, and pushrods are within specification, remove cylinder head for inspection. (See "CYLINDER HEAD AND VALVES" on page 31.)

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CAMSHAFT END PLAY CHECK

Reason:

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

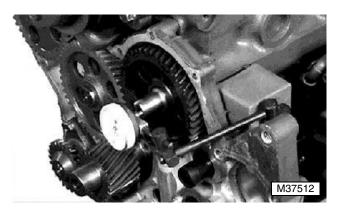
Equipment:

Dial Indicator

Procedure:



- Remove the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 2. Fasten the dial indicator to the engine and position indicator tip on end of camshaft.
- 3. Push the camshaft toward the rear as far as possible.
- 4. Zero the dial indicator.
- 5. Pull the camshaft forward as far as possible.



6. Standard end play is **0.05 - 0.25 mm (0.002 - 0.010 in.).**

Results:

• If the end play exceeds **0.25 mm (0.010 in.)**, remove the camshaft and replace the thrust plate. (See "CAMSHAFT" on page 48.)

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 the backlash between meshing gears.
- 2. The backlash for all gears, EXCEPT the oil pump gear, is 0.07 0.15 mm (0.003 0.005 in.).
- 3. The backlash for the oil pump gear is **0.11 0.19** mm (0.004 0.008 in.).

Results:

• If the backlash exceeds specifications, replace meshing gears as a set:

Idler Gear, Camshaft Gear, Crankshaft Gear, Oil Pump Gear AND/OR Idler Gear, Fuel Injection Pump Gear.

FUEL INJECTION NOZZLE TEST



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

Reason:

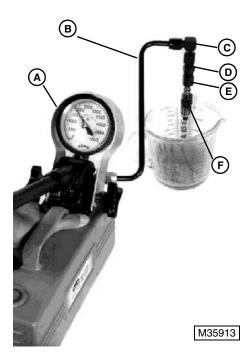
To determine opening pressure, leakage, chatter and spray pattern of the fuel injection nozzle.

Equipment:

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

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Connections:



 Connect the fuel injection nozzle (F) to D01109AA Diesel Fuel Injection Nozzle Tester (A) using parts 36352 (B), 23617 (C), 23621 (D) 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 the fuel injection nozzle **opening pressure** following the Nozzle Tester manufacturer's instructions.

The opening pressure is 19600 +1000/-0 kPa (2843 +145/-0 psi).

Results:

 If the pressure reading does not meet specification, disassemble the injection nozzle and inspect for contamination or a 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 the nozzle completely using a lint-free cloth.
- 2. Pressurize the nozzle to 19600 kPa (2843 psi).
- 3. Watch for leakage from nozzle spray orifice.

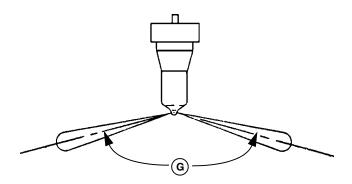
Results:

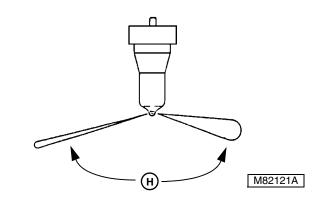
 Fuel should not leak from the nozzle when the nozzle is pressurized. If the injection nozzle leaks fuel, disassemble and inspect the nozzle assembly for contamination. Inspect the valve seating surface. Replace the nozzle assembly if necessary.

Procedure 3:

- Test the fuel injection nozzle chatter and spray pattern following the nozzle tester manufacturer's instructions.
- 2. Pressurize nozzle to 19600 kPa (2843 psi).
- 3. With slow hand lever movement there should be a "chatter" sound.
- 4. With fast hand lever movement the nozzle should exhibit an even, fine atomized spray pattern (G).
- 5. Place a sheet of white paper **30 cm (12 in.)** below the nozzle. The injection spray should form a perfect circle on the paper.







Results:

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

THERMOSTAT OPENING TEST

Reason:

To determine opening temperature of thermostat.

Equipment:

- Thermometer
- Glass Container
- Heating Unit

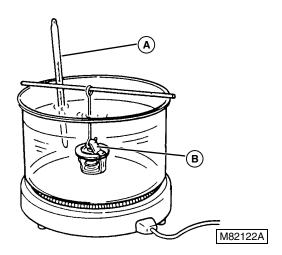
Procedure:





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

- Suspend the thermostat (B) and a thermometer (A) in a container of water.
- Heat and stir the water. Observe opening action of the thermostat and compare temperatures with specifications.
- Remove the thermostat and observe the closing action as it cools.



Results:

- The thermostat should begin opening at 69.5 72.5° C (157 163° F) and be fully open at 85° C (185° F).
- Replace the thermostat if the lift height is less than
 8 mm (0.315 in.), or if the closing action is not smooth and slow.

INJECTION PUMP STATIC TIMING ADJUSTMENT

Reason:

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

Equipment:

- Timing Tool (Made from high pressure pipe, nut and a clear plastic straw**)
 - ** straw from WD40, carburetor cleaner, brake parts cleaner, etc.
- External fuel supply

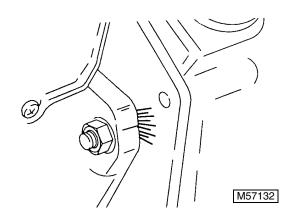
Procedure:

IMPORTANT: The injection pump timing should be correct. The timing is set at the factory, and will not normally change during the life of the engine. Check and adjust the timing only as the last option, or if there is reason to believe the timing has been altered.

Check the fuel, fuel supply system, injectors, air intake system and cylinder compression before continuing.

NOTE: If the injection pump has been removed from engine without disturbing engine crankshaft and pump gear, perform step 1 to obtain a close starting point, then perform the entire timing procedure.

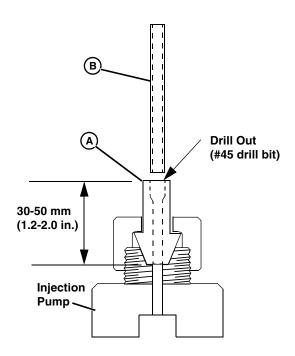
1. Align the arrow or line on the injection pump flange on the mark noted during pump removal.



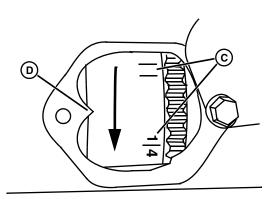
NOTE: Normal rotation, as viewed from the flywheel end, is counterclockwise. The number one fuel injection line is toward the flywheel.

2. Remove the number one fuel injection line.

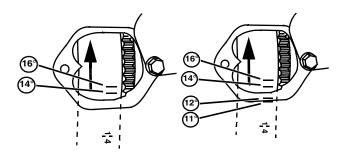
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- 3. Install the timing tool (A) and clear straw (B).
- 4. Remove the access panel from the flywheel housing.
- 5. Prime the pump to fill it with fuel.
- 6. Disconnect battery negative (–) terminal and remove fuel shutoff solenoid.
- 7. Turn the flywheel counterclockwise (as viewed from the flywheel end) until the timing tool straw has fuel showing.



- 8. Turn the crankshaft pulley clockwise (back) until the No. 1 cylinder top dead center (TDC) mark and pump timing marks (C) have gone past the index mark on the flywheel housing/plate (D) by at least 50 mm (2 in.).
- 9. Snap the straw with your finger until the level of the fuel, or a bubble, is set part way up the straw. This will be the point to watch for fuel movement.

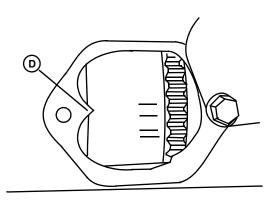


JTC45-6-7 Engines

EJTF45-6-7S Engines

10. Slowly turn the flywheel counterclockwise (as viewed from the flywheel end) until the fuel in the straw just starts to move. Stop rotating the flywheel the instant the fuel begins to move.

NOTE: If there is no fuel movement, engine may be on exhaust stroke. Rotate flywheel 360° and repeat test.



11. Check the injection pump timing marks on the flywheel. The index mark (D) on the flywheel housing must line with the correct timing mark on flywheel.

Timing Marks:

JTC45-6 Engines	14° B1	DC
EJTF45-6-7S Engines	12° B1	DC.

Results:

- If the timing is not within specifications, loosen the pump mounting bolts and turn the pump toward the engine block to retard the timing or away from the block to advance the timing. Recheck the timing.
 - If the timing did not change, remove pump and have tested by an authorized diesel injection service shop.
- If the timing is correct, remove timing tool, install number one injection line, install the access cover to the flywheel housing.



FAN/ALTERNATOR DRIVE BELT ADJUSTMENT

Reason:

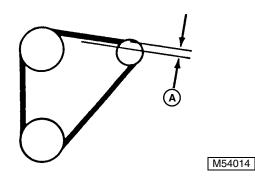
To keep proper tension on belt to drive water pump and alternator. To prevent shortened belt and bearing life.

Equipment:

- JDG529 or JDST28 BeltTension Gauge
- Straight Edge

Procedure:

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



2. With applied force of **98 N (22 lb-force)** the belt deflection (A) is **10 - 15 mm (0.4 - 0.6 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:

JDG560 Adapter

Procedure:

- 1. With the coolant at the proper level and the radiator cap tight, run the engine for 5 minutes to bring it to operating temperature.
- 2. Remove the cap from the recovery tank.
- 3. Check for bubbles coming from the overflow hose at the bottom of the tank.
- If bubbles are present, isolate the source of compression leak:

- 4. Remove the injection nozzles.
- 5. Install JDG560 Adapter in the injection port of the cylinder to be tested.
- 6. Move the piston to the bottom of the stroke with intake and exhaust valves closed.
- 7. Connect the hose from the compressed air source to adapter.
- 8. Apply shop air pressure into the cylinder.
- Check for bubbles in the recovery tank or air escaping from the muffler, air cleaner or oil fill opening.
- 10. Repeat for each cylinder.

Results:

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

COOLING SYSTEM PRESSURE TEST

Reason:

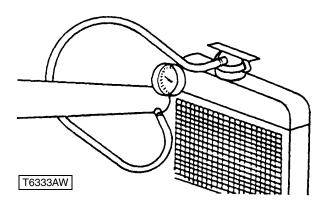
Inspect the cooling system for leaks.

Equipment:

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

Procedure:

- Remove the cap and attach the pressure pump (A) to radiator.
- 2. Apply pressure according to specifications, not to exceed **97 kPa** (**14 psi**).
- Check for leaks throughout the cooling system.
 After 15 seconds the minimum pressure is 88 kPa (12.8 psi).



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Results:

- Pressure should hold to specifications. If pressure decreases, check for leaks. Repair leaks or replace parts as necessary.
- If the pressure test still indicates leakage after all external leaks have been stopped, a defective head gasket, cracked block, or cylinder head may be the cause. (See "RADIATOR BUBBLE TEST" on page 24.)

RADIATOR CAP PRESSURE TEST

Reason:

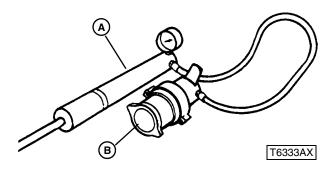
Test the radiator cap for operating in the correct pressure range.

Equipment:

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

Procedure:

- Install the radiator cap (B) on the pressure pump (A).
- 2. Apply pressure. Pressure valve in the cap should open at **88 kPa (12.8 psi)**.



Results:

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

ENGINE OIL PRESSURE TEST

Reason:

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

Equipment:

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

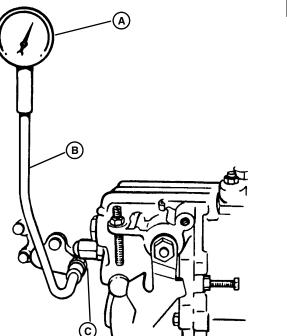
Procedure:

- 1. Remove the oil pressure sender.
- 2. Install JTO3349 Connector (C).

3. Connect JTO3017 Hose Assembly (B) and JTO5577 Pressure Gauge (A).

IMPORTANT: DO NOT run the engine if there is insufficient oil pressure!

- 4. Start the engine. If the pressure reading is below 60.0 kPa (8.7 psi), STOP THE ENGINE.
- 5. If the oil pressure is at least 60.0 kPa (8.7 psi), run the engine approximately five minutes to heat the oil. Check the oil pressure at rated speed. The oil pressure should be 338 ± 50 kPa (49 ± 7.2 psi).



Results:

 If the oil pressure is not within specifications, inspect the oil pump.

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 If the oil pump is within specifications, the engine may have parts worn beyond specifications. See "TROUBLESHOOTING CHART" on page 13 for more information.



AIR INTAKE SYSTEM LEAKAGE TEST

Reason:

Check for leaks in the air intake system.

Equipment:

Air Pressure Regulator

Procedure:



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



Results:

 Find leaks and repair or replace parts as necessary.

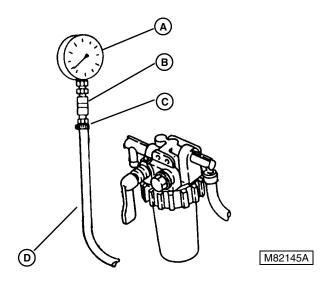
FUEL SUPPLY PUMP PRESSURE TEST

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 the supply pump-to-filter hose (D).
- 2. Install the hose fitting (C), coupler (B) and gauge (A).
- Crank the engine for five seconds with the starting motor.
- 4. The minimum fuel pressure is 29 kPa (4.3 psi).

Results:

• If the pressure is below specification, replace the fuel supply pump.

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FUEL SYSTEM LEAKAGE TEST

Reason:

Tests fuel system plumbing for external leakage. This test also determines if air is entering the fuel system at connections, allowing fuel to siphon back to tank.

Procedure:

- Disconnect fuel supply line and return line at fuel tank.
- 2. Place fuel return line into a suitable container to catch drained fuel.

CAUTION

DO NOT apply more than 15 psi air pressure to the fuel system. Damage to the injection pump or personal injury may result.

- Apply 34 69 kPa (5 10 psi) air pressure to fuel supply hose until all fuel is drained from the system.
- 4. Plug end of fuel return hose.
- Apply 34 69 kPa (5 10 psi) air pressure to fuel system at fuel supply line. DO NOT exceed maximum pressure of 103 kPa (15 psi).
- 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

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.

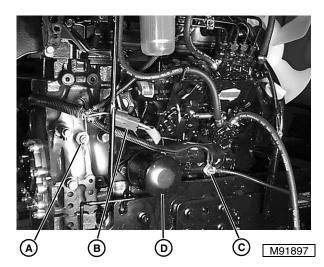
All engines are equipped with an automatic air venting system which makes the fuel system self-bleeding.

- Assure that all fuel line connections are securely tightened.
- Add fuel to the fuel tank.
- Pump the lever on the side of the fuel supply pump for a minute to allow fuel system to bleed most of the air back to the tank through the return lines.

REPAIR

ENGINE REMOVAL

- Split the tractor at the flywheel housing. (See "TRACTOR SPLITTING (FRONT)" in the appropriate Power Train section.)
- 2. Drain the coolant and lubrication oil.
- 3. Remove the battery.
- 4. Remove the muffler.
- 5. Disconnect the hydraulic cooler lines.
- 6. Remove the radiator hoses.
- 7. Remove the radiator and (oil cooler if equipped).
- 8. Remove the starting motor wires.
- Disconnect the wire for the intake air heater on the manifold.



- Disconnect the oil pressure switch (A), wiring harness (B), and ground wires (C) from the engine.
- 11. Remove the oil filter (D).
- 12. Install a second lifting bracket to the rear of the cylinder head.
- Install the engine hoist to the engine. Lift the engine slightly and safely support the tractor frame.

NOTE: Use more than one support to support the frame. The frame will pivot on the front axle, and could slip off of a single support.

- 14. Remove the dashboard bracket.
- 15. Disconnect the hydraulic lines from the hydraulic pump.
- 16. Remove the flywheel housing from the engine.

ROCKER COVER DIESEL ENGINE

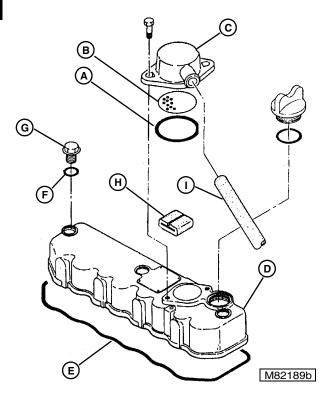
NOTE: The flywheel housing is heavy. Use an assistant, or proper tools to remove the flywheel housing. The starting motor can be removed with the flywheel housing.

17. Remove the cap screws that fasten the crankcase extension to the frame. Slide the engine out the back of the frame, and place the engine on a bench or engine stand.

ROCKER COVER

Removal/Installation:



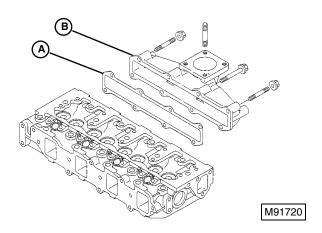


- 1. Remove the air cleaner.
- 2. Remove three rocker cover nuts (F).
- 3. Remove the breather hose (I).
- Remove the rocker cover (D) from the cylinder head
- 5. Remove the breather cap (C), plate (B) and baffle (H).
- Wash the baffle in a safe solvent and blow dry with air pressure. If the baffle comes apart or is deteriorated, replace it.
- 7. Install clean and dry baffle.
- 8. Install the breather plate and a new O-ring (A) before replacing breather cap.
- Inspect the rocker cover gasket (E) before reinstalling the rocker arm cover. Replace if damaged.

 Clean the cylinder head surface and install the rocker cover to the cylinder head. Install new Orings (F) and replace the rocker cover nuts.

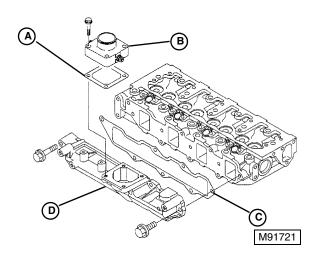
EXHAUST MANIFOLD

- 1. Remove the muffler and gasket.
- 2. Remove the exhaust manifold and gasket.



- 3. Clean the mating surfaces, and replace the exhaust manifold gasket.
- 4. Install the exhaust manifold. Tighten all fasteners to specification.

INTAKE MANIFOLD



- 1. Remove the fuel filter bracket (not shown).
- 2. Remove the intake air heater (B) and gasket (A).
- 3. Remove the fuel injection lines (not shown).
- 4. Remove the intake manifold (D).
- Clean the mating surfaces, and replace the intake manifold gasket (C).
- 6. Install the intake manifold.
- 7. Replace the intake air heater gasket, and install the intake air heater.

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- 8. Install the fuel injection lines.
- 9. Tighten all fasteners to specification.

ROCKER ARM ASSEMBLY

Removal/Installation and Disassembly/Assembly:

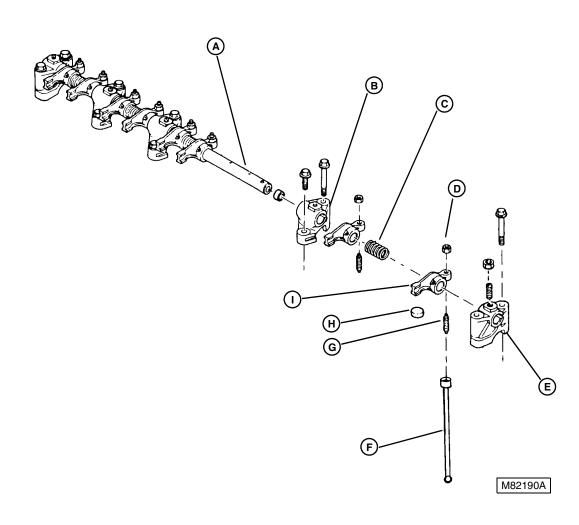
- Remove the rocker cover. (See "ROCKER COVER" on page 28.)
- 2. Remove the rocker arm end support (E) and rocker arm center support (B) mounting cap screws.
- 3. Lift the rocker arm assembly from the cylinder head and set the assembly on a bench.

NOTE: If the rocker arm assembly is to be disassembled, replace components in same location on the rocker arm shaft they were removed from.

- Note the positions of the rocker arm assembly components. Slide the components off the rocker arm shaft (A).
- 5. Lift the push rods (F) from the cylinder head and note the order of removal for reassembly.

- 6. Inspect the rocker arms (I), valve adjusting components (D, G), valve caps (H), and push rods.
- 7. Lubricate all parts with clean oil during assembly.
- 8. Reinstall the push rods to their original location in the cylinder head, with the ball shaped end down in head.
- 9. Assemble the rocker arm assembly components in the reverse order of removal.
- 10. Place the rocker arm assembly on the cylinder head. Align the rocker arms with the valves and push rods. Align the rocker arm end supports and center supports with the corresponding holes in the head.
- Install the rocker arm support mounting cap screws.
- 12. Adjust the valve clearance. (See "VALVE CLEARANCE CHECK AND ADJUSTMENT" on page 16.)



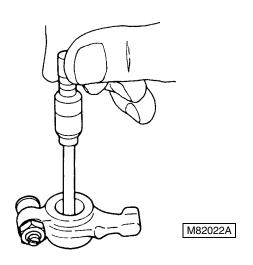


Inspection:



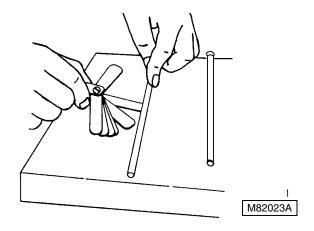
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- Measure the outer diameter of the rocker arm shaft.
- Standard OD is 15.97 15.98 mm (0.628 0.629 in.).
- Replace the rocker arm shaft if the OD is less than 15.95 mm (0.628 in.).



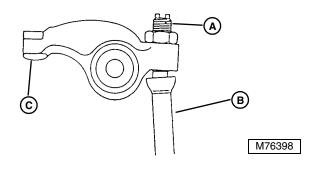
- 2. Measure the inner diameters of the rocker arms and supports.
- Standard ID is 16.00 16.02 mm (0.630 0.631 in.).
- Replace the rocker arms or supports if the ID is more than **16.09 mm (0.633 in.)**.
- 3. Measure the rocker arm shaft to rocker arm bushing oil clearance. Oil clearance is the difference between the OD of the rocker arm shaft and the ID of the rocker arms.
- Standard oil clearance is 0.02 0.05 mm (0.001 0.002 in.).
- If the clearance exceeds **0.14 mm (0.006 in.)** replace the rocker arm shaft and rocker arms.

Measure bending of push rod:



- Place the push rod on a flat surface. Use a feeler gauge to measure any gaps between the push rod and flat surface.
- Replace any push rod with more than (0.03 mm (0.001 in.) bend.

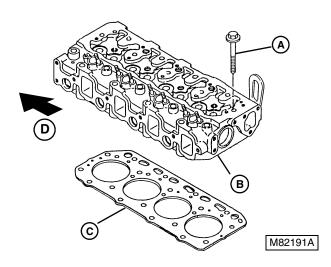
Inspect Rocker Arm Contact Surfaces:



- 1. Check the surface of the adjusting screw (A) that contacts the push rod (B) for wear. Replace the push rod or adjusting screw if the surface of either is worn and peeled.
- Check the surface that comes in contact with the valve cap (C) for wear. Replace rocker arm if necessary.

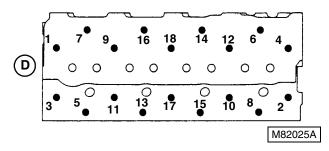
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CYLINDER HEAD AND VALVES



Removal:

- 1. Remove the rocker arm cover. (See "ROCKER COVER" on page 28.)
- 2. Remove the rocker arm assembly, push rods and valve caps. (See "ROCKER ARM ASSEMBLY" on page 29.)
- 3. Remove the exhaust and intake manifolds. (See "EXHAUST MANIFOLD" on page 28, and "INTAKE MANIFOLD" on page 28.)
- 4. Remove the water pump. (See "THERMOSTAT AND WATER PUMP DISASSEMBLY" on page 55.)
- 5. Remove the fuel injection nozzles. (See "FUEL INJECTION NOZZLES" on page 59.)



- 6. Remove the cylinder head bolts (A) in the order shown. Start at the flywheel end of the head (D).
- 7. Remove the cylinder head (B) from the engine block. The edge opposite the water pump hangs over the engine block. Use this edge to aid in removing the cylinder head. Before using force to remove head, verify that all the bolts are removed from the cylinder head.
- 8. Disassemble and inspect the cylinder head and valves. (See "CYLINDER HEAD AND VALVES" on page 32.)

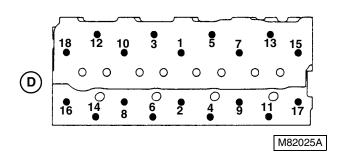
Installation:

 Reassemble the cylinder head and valves (See "CYLINDER HEAD ANDVALVES" on page 32.)

IMPORTANT: The oil passage in the gasket must be located over the oil passage in cylinder block.

- 2. Place a new cylinder head gasket (C) on the engine block. Dowels in the engine block will assist in aligning the gasket.
- Place the cylinder head on the engine block.Dowels in the engine block will again assist in alignment.





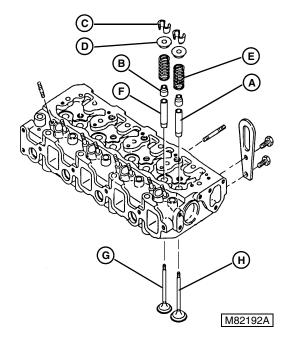
4. Dip the head bolts in clean engine oil, install and tighten in the sequence shown, in three stages of gradually-increasing torque. Torque the head bolts to 85 - 91 N•m (62 - 67 lb-ft).

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

- 5. Install the fuel injection nozzles. (See "FUEL INJECTION NOZZLES" on page 59.)
- 6. Install the water pump. (See "THERMOSTAT AND WATER PUMP DISASSEMBLY" on page 55.)
- 7. Install the exhaust and intake manifolds. (See "EXHAUST MANIFOLD" on page 28, and "INTAKE MANIFOLD" on page 28.)
- 8. Install the rocker arm assembly, push rods and valve caps. (See "ROCKER COVER" on page 28, and "ROCKER ARM ASSEMBLY" on page 29.)

CYLINDER HEAD AND VALVES

Disassembly/Assembly:



- Remove the valve caps from the valves. The valve caps should be installed on the valves they were removed from.
- 2. Compress the valve springs (E) using a valve spring compressor and remove the collet halves (C), retainer (D), valve spring (E) and valve stem seal (B) for each valve (G,H).
- 3. The intake and exhaust valve guides (A, F) are press fit. Replace the guides only if necessary. (See "Valve Guides:" on page 34.)
- 4. The valve seats are not replaceable. If inspection of the cylinder head reveals worn valve seats or damaged beyond repair, the cylinder head must be replaced. (See "CYLINDER HEAD AND VALVES" on page 32.)
- Inspect all remaining parts for wear or damage. (See "CYLINDER HEAD AND VALVES" on page 32.)

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

- 6. Install new valve stem seals over the valve guides.
- 7. Apply clean engine oil on intake and exhaust valve stems during assembly.
- 8. Install the springs with smaller pitch end or paint mark toward cylinder head.
- Compress valve springs and retainer until collet halves are able to be installed in grooves of valve stem
- 10. Carefully release tension on spring compressor.

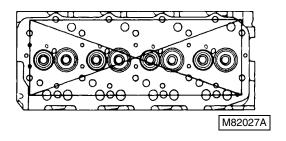
- 11. Repeat for remaining valves.
- 12. Measure valve recession if new valves were installed. (See "Valve Seats:" on page 33.)

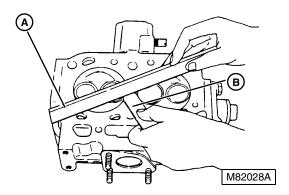
NOTE: After each valve has been assembled, tap on top of valve stem with a plastic hammer to seat the valve retainer and collet halves.

Inspection/Replacement:

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

Cylinder Head:



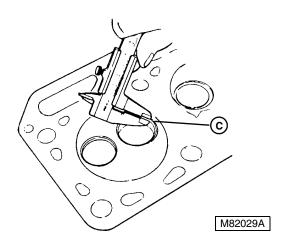


- 1. To measure the cylinder head flatness, place a straightedge (A) along each of the four sides and each diagonal. Measure clearance between straight edge and combustion surface with a feeler gauge (B).
- Standard distortion is **0.05 mm (0.002 in.)** or less.
- If the distortion exceeds 0.05 mm (0.006 in.), but is less than 0.15 mm (0.006 in.) resurface the cylinder head.
- If the distortion is **0.15 mm (0.006 in.) or more**, replace the cylinder head.
- 2. If cylinder head was resurfaced:
- Measure piston-to-cylinder head clearance. (See "Measure Piston-to-Cylinder Head Clearance:" on page 36.)
- Measure valve recession. (See "CYLINDER HEAD AND VALVES" on page 32.)
- Measure valve seat width. (See "Valve Seats:" on page 33.)

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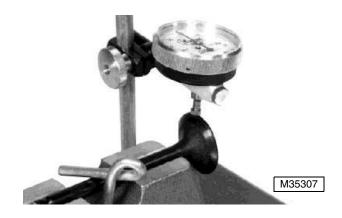


Valve Seats:

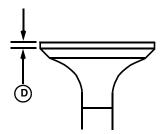


- 1. Measure the valve seat width (C).
- Standard intake valve seat width is 1.07 1.24 mm (0.042 - 0.049 in.).
- Intake valve seat wear limit is 1.74 mm (0.069 in.).
- Standard exhaust valve seat width is 1.24 1.45 mm (0.049 - 0.057 in.).
- Wear limit 1.94 mm (0.076 in.).
- If necessary, grind the valve seats to meet specifications. (See "Grind Valve Seats" on page 35.)

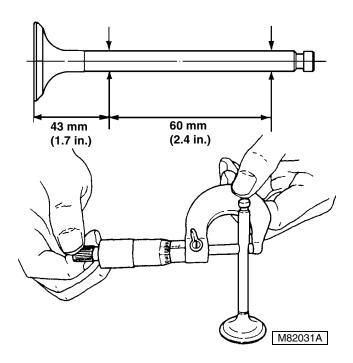
Intake and Exhaust Valves:



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



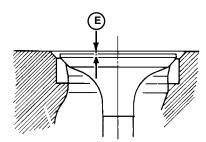
- 2. If the valve faces are worn, burned or pitted, grind valves to proper face angle.
- 3. Measure the valve head thickness.
- If the valve head thickness (D) is less than 0.50 mm (0.020 in.) after grinding, replace the valve.
- Standard valve head thickness for the intake valve is 1.24 1.44 mm (0.049 0.057 in.).
- Standard valve head thickness for the exhaust valve is 1.35 1.55 mm (0.053 0.061 in.).
- The wear limit for all valves is 0.50 mm (0.020 in.).



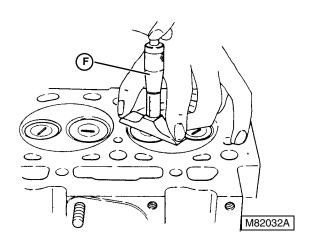
- 4. Measure the valve stem diameter at two locations shown.
- Standard intake valve stem OD is 7.96 7.98 mm (0.313 - 0.314 in.)
- Discard the valve if the OD is less than 7.90 mm (0.311 in.).
- Standard exhaust valve stem OD is 7.96 7.97 mm (0.313 - 0.314 in.)
- Discard the valve if the OD is less than 7.90 mm (0.311 in.).



Valve Recession:



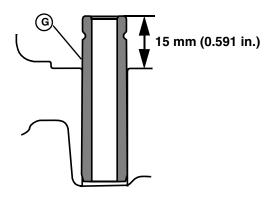




- 1. Measure valve recession (E) using a depth gauge (F) .
- Standard valve recession is 0.31 0.51 mm (0.012 0.020 in.).
- Replace valve or cylinder head if measurement exceeds 1.00 mm (0.039 in.).

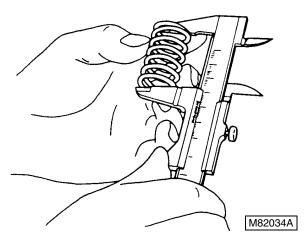
Valve Guides:

- Clean the valve guides (G) using a valve guide hrush
- 2. Measure valve guide inside diameter.
- Standard intake valve guide ID is 8.01 8.03 mm (0.315 - 0.316 in.).
- Standard exhaust valve guide ID is 8.02 8.03 mm (0.316 - 0.316 in.).
- The wear limit for either valve guide is **8.10 mm (0.319 in.)**. If the diameter exceeds wear limit, knurl or replace the guide.
- The oil clearance is 0.035 0.070 mm (0.001 0.003 in.)
- If the clearance exceeds 0.15 mm (0.006 in.) but is less than 0.20 mm (0.008 in.), knurl the valve guides using D-20019WI Valve Guide Knurler.



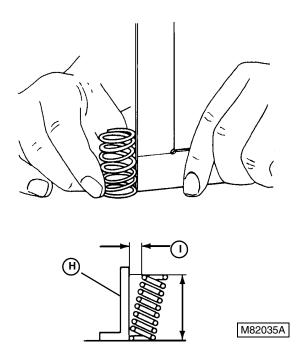
- If clearance exceeds 0.20 mm (0.008 in.), replace valve guides using JDE118 Valve Guide Driver.
- New valve guides must be cooled in a container of liquid nitrogen or equivalent before driving into cylinder head.
- The intake and exhaust valve guides are different.
 The exhaust valve guide has one 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 15 mm (0.591 in.) from top of cylinder head.
- Ream the inside diameter of valve guides using D-20021WI Valve Guide Reamer.

Valve Springs:



- 1. Measure valve spring free length.
- Standard length is 42 mm (1.654 in.).

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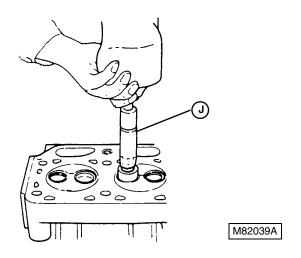


- 2. Use a square gauge (H) to measure spring inclination (I).
- 3. Replace spring if measurement exceeds 1.10 mm (0.044 in.).

Grind Valve Seats

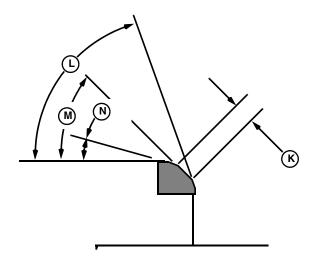
NOTE: LIGHTLY grind valve seats for only a few seconds to avoid excessive valve seat width.

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



- 2. Measure the valve seat width (K) after grinding.
- 3. If the seat is too wide after grinding, grind lower seat surface (L) using a 70° seat grinder until seat width is close to specifications.

- Grind the upper seat surface (N) using a 15° seat grinder until seat width is narrowed to specifications.
- 5. If valve seats (M) are ground, measure valve recession. (See "CYLINDER HEAD AND VALVES" on page 32.) Check contact pattern between the seat and valve with bluing dye.
- 6. Lap valves. (See "Lap Valves" on page 35.)

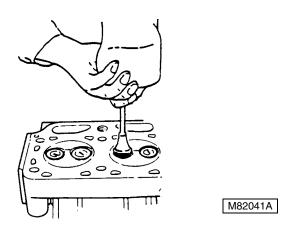




 If valve recession exceeds maximum specifications or seats cannot be reconditioned, replace valves or cylinder head.

Lap Valves

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



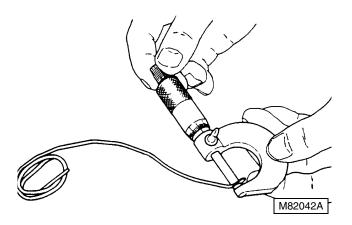
If the seat does not make proper contact, lap the valve into the seat:

- 1. Apply small amount of fine lapping compound to the face of the valve.
- 2. Turn the valve to lap the valve to the seat.

- Lift the valve from the 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 all parts.
- Check the position of the lap mark on the valve face. Lap marks must be on or near the center of the valve face.

Measure Piston-to-Cylinder Head Clearance:

- Place three 10 mm (0.4 in.) long pieces of 1.5 mm (0.06 in.) diameter soft wire in three positions on the flat part of the piston head.
- Install the cylinder head and old gasket. Install cylinder head bolts and tighten in proper sequence to specified torque. (See "CYLINDER HEAD AND VALVES" on page 31.)
- 3. Slowly turn the crankshaft one complete revolution.
- 4. Remove the cylinder head and gasket.



- Measure the thickness of the flattened section of each piece of wire. Calculate the average thickness of the wires to obtain piston-to-cylinder head clearance specification.
- If the clearance is less than 0.66 0.78 mm (0.026 0.031 in.), replace cylinder head. (See "CYLINDER HEAD AND VALVES" on page 31.)

PISTON AND CONNECTING ROD

NOTE: The engine must be removed from the tractor to perform this procedure.

Removal:

- 1. Remove the oil pan, crankcase extension, oil pickup, and balancer assembly.
- 2. Remove the cylinder head. (See "CYLINDER HEAD AND VALVES" on page 31.)
- Check the cylinder bore for ridges. These ridges can cause damage to piston if ridge is not removed.
- 4. If necessary, remove any ridge from the top of cylinder bore using a ridge reamer.
- Measure the connecting rod side play. (See "CONNECTING ROD SIDE PLAY CHECK" on page 17.)
- Measure the crankshaft end play. (See "CRANKSHAFT END PLAY CHECK" on page 18.)
- Measure the connecting rod bearing clearance.
 (See "CONNECTING ROD BEARING CLEARANCE CHECK" on page 17.)

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

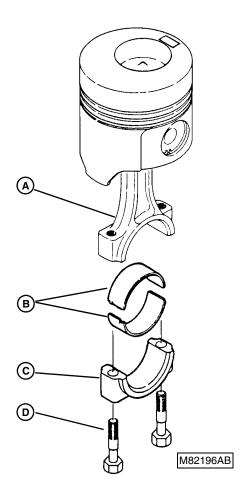
8. Remove the rod bolts (D), connecting rod cap (C) and bearing inserts (B) from the connecting rod (A).

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

- 9. Note the connecting rod alignment mark in relation to the cylinders. Starting at the flywheel end with cylinder number one, then two, etc.
- 10. Push the piston and connecting rod (A) out of the cylinder bore using a wooden dowel.
- Disassemble and inspect all parts for wear or damage. (See "PISTON AND CONNECTING ROD" on page 36.)
- 12. Inspect cylinder bore. (See "CYLINDER BORE" on page 41.)

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Installation:

- Apply clean engine oil to all parts during installation.
- Always replace the connecting rod bolts. DO NOT reuse the bolts.

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.

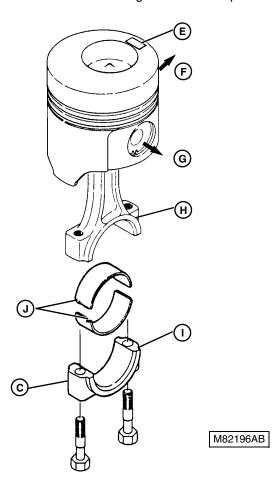
- 1. Assemble the piston and connecting rod. (See "PISTON AND CONNECTING ROD" on page 36.)
- Install the piston and connecting rod into the cylinder from which it was removed. The alignment mark on the connecting rod (H), rod cap (I), and/or the piston size mark on top of piston (E) should point toward the fuel injection pump (arrow F).

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

3. Install the bearing inserts to the connecting rod and rod cap, aligning the insert tangs (J) with grooves in the connecting rod and rod cap.

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 the rod caps.
- Dip the entire connecting rod bolt in clean engine oil. Install new bolts and tighten to 44 - 54 N•m (33 - 40 lb-ft).
- 6. If a new piston and connecting rod were installed, stamp a number corresponding to the cylinder number on the connecting rod and rod cap.



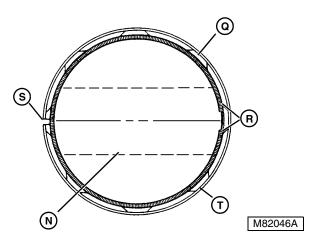
- 7. Install the cylinder head. (See "CYLINDER HEAD AND VALVES" on page 31.)
- 8. Install the balancer assembly, strainer tube and oil pan.

Disassembly:

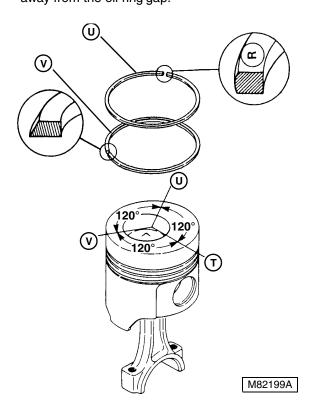
IMPORTANT: Pistons must be installed on the same connecting rod they were removed from.

 Put a mark on each piston and connecting rod to aid in assembly.

- Piston pin bushing (P) is a press fit in the connecting rod. Remove the bushing only if replacement is necessary. (See "PISTON AND CONNECTING ROD" on page 36.)
- Inspect all parts for wear or damage. Replace as necessary.
- Install an oil ring expander (Q) in bottom ring groove of piston with the ends above either end of the piston pin (R).
- 4. Install the oil ring (T) over the expander with the ring gap opposite (180°) of the expander ends (S).

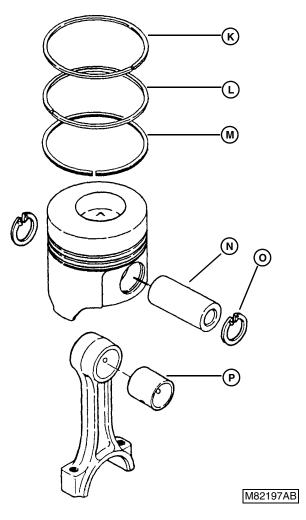


5. Install the second compression ring (V), with the small diameter of taper toward top of piston, in the middle groove. Turn the ring until the gap is 120° away from the oil ring gap.



6. Install the first compression ring (chrome plated, U), with manufacturer's mark "R", "T" or "RN" (near ring gap) toward the top of the piston, in the top groove. Turn ring until the gap is 120° away from the second ring gap.





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 the piston to the connecting rod with piston mark (E) on the same side as the connecting rod stamped mark (H). If a new connecting rod is used, assemble the piston to the connecting rod with piston mark opposite the connecting rod bearing insert groove. Be sure the oil hole in piston pin bushing is aligned with the hole in connecting rod.
- 2. Install the piston pin (N) and retaining/snap rings (O).

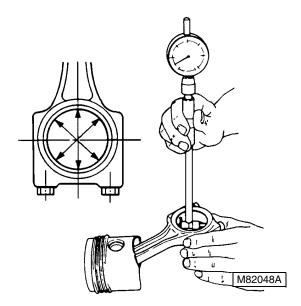
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Inspection/Replacement:

- Inspect all parts for wear or damage. Replace as necessary.
- Measure crankshaft connecting rod journal diameter.

Connecting Rod Bearing:

 Install connecting rod cap and bearing inserts on connecting rod. Install the old connecting rod bolts and tighten to 47 N•m (35 lb-ft).



- 2. Measure the connecting rod bearing diameter.
- If the bearing diameter is not within 51 51.01 mm (2.008 - 2.008 in.) replace the bearing inserts.
- If the bearing clearance (bearing ID minus crankshaft journal OD) exceeds 0.04 0.07 mm (0.002 0.003 in.) grind the crankshaft connecting rod journals and install undersized bearing inserts, or replace the bearing inserts and the crankshaft.

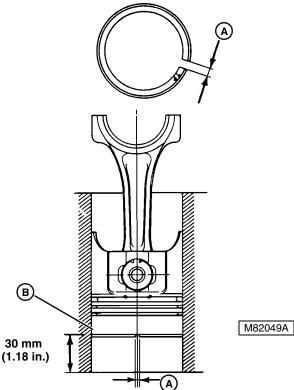
Piston Ring Groove:



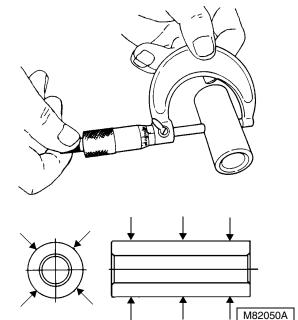
- With the rings installed on the piston, measure the piston ring groove clearance. Measure at several places around each piston.
- Replace the rings or the piston if the piston ring groove clearances exceed the maximum dimension:
- First compression ring 0.08 0.11 mm (0.003 0.004 in.)
- Second compression ring 0.05 0.08 mm (0.002 0.003 in.)
- Oil ring 0.03 0.06 mm (0.001 0.002 in.)

Piston Ring End Gap:



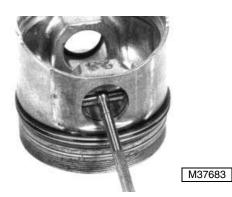


- Measure the piston ring end gap (A) by pushing the piston ring into the cylinder bore. Using a piston without rings (B), push the ring into the cylinder until the ring is approximately 30 mm (1.18 in.) from the bottom of cylinder bore.
- Standard piston ring end gap is 0.20 0.40 mm (0.008 - 0.016 in.).
- If the end gap exceeds 1.50 mm (0.059 in.), replace the rings.



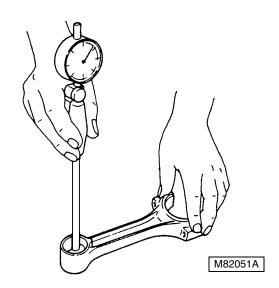
- Measure the piston pin diameter. Measure the diameter at six places.
- Standard piston pin diameter is 25.99 26.00 mm (1.023 1.024 in.)
- Replace the pin if the diameter is less than 25.90 mm (1.02 in.).

Piston Pin Bore:



- 1. Measure the piston pin bore diameter in the piston.
- Standard diameter is 26.00 26.01 mm (1.024 1.024 in.).
- Standard bore clearance (bore ID minus pin OD) is 0.02 mm (0.001 in.)
- If the piston pin bore exceeds 26.02 mm (1.024 in.), replace the piston.
- If the bore clearance exceeds **0.12 mm (0.005 in.)** replace the piston, piston pin or both.

Piston Pin Bushing:

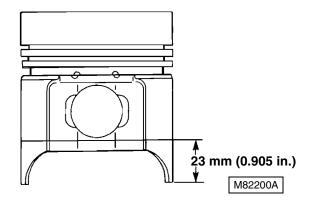


- Measure the piston pin bushing diameter in the connecting rod.
- If the bushing diameter exceeds 26.03 26.04 mm (1.025 1.025 in.), replace bushing.
- If the bushing clearance (bushing ID minus pin OD) exceeds 0.03 0.05 mm (0.001 0.002 in.) replace the bushing or the piston pin.

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

Piston Diameter:

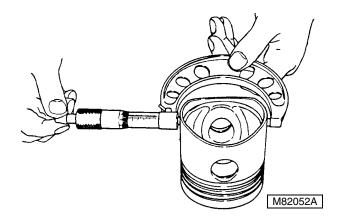
NOTE: If the engine has had a previous major overhaul, oversize pistons and rings may have been installed. Pistons and rings are available in **0.25 mm (0.010 in.)** oversize.

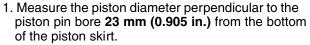


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DIESEL ENGINE CYLINDER BORE





- Standard size piston diameter is 83.95 83.98 mm (3.305 - 3.306 in.).
- If the standard piston diameter is less than **83.90** mm (3.303 in.), install a new piston.
- Oversize piston diameter is **84.20 84.23 mm** (3.315 3.316 in.).
- If the oversize piston diameter is less than 84.15 mm (3.313 in.), install a new piston.

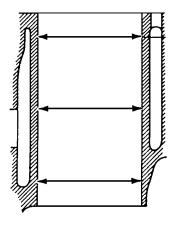
CYLINDER BORE

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

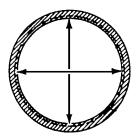
 Measure the cylinder bore diameter at three positions; top, middle and bottom. At these three positions, measure in both directions; along crankshaft center line and direction of crankshaft rotation.

Standard Cylinder Bore ID:

Bore 4500, 4600	. 84 mm (3.307 in.)
Bore 4700	. 88 mm (3.465 in.)







M82053A

Results:

- If the cylinder bore diameter is **0.20 mm (0.008 in.)** or more **over standard**, have the cylinder rebored. (See "CYLINDER BORE" on page 41.)
- If the cylinder is rebored, oversize pistons and rings must be installed.
- Oversize cylinder bore ID is 0.25 0.28 mm (0.010 0.011 in.).
- If the cylinder bore diameter is **0.45 mm (0.018 in.)** or more **over standard**, replace the cylinder block.
- The minimum piston to cylinder clearance is 0.04 0.07 mm (0.002 0.003 in.). If the clearance (cylinder bore ID minus piston OD) exceeds specification, replace the cylinder block, piston or both; or rebore cylinder and install oversize piston and rings.
- Slight uneven wear, flaws, or minor damage may be corrected by deglazing (See "CYLINDER BORE" on page 41.)

Deglazing:

IMPORTANT: If the 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.

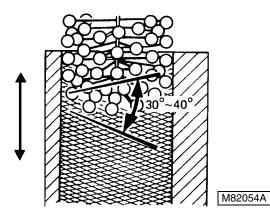
1. Deglaze the cylinder bores using a flex-hone with 180 grit stones.

CYLINDER BORE DIESEL ENGINE

 Use the flex-hone as instructed by the manufacturer to obtain a 30 - 40° crosshatch 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 the cylinder walls using a clean dry rag. Clean the cylinder walls using clean white rags and warm soapy water. Continue to clean the cylinder until white rags show no discoloration.



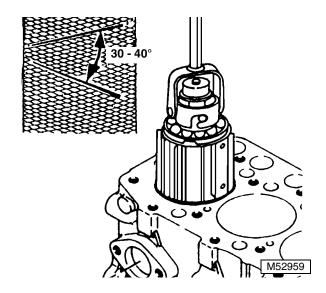
Reboring:

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 the hone so the lower end is even with the lower end of cylinder bore.
- Adjust the rigid hone stones until they contact the narrowest point of cylinder.
- 4. Coat the cylinder with honing oil. The hone should turn by hand. Adjust the hone if it is too tight.
- Run the drill press at about 250 RPM. Move the hone up and down in order to obtain a 30 - 40° crosshatch pattern.



NOTE: Measure the bore when the cylinder is cool.

6. Stop the press and check the cylinder diameter.

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

- 7. Remove the rigid hone when the 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 the 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.

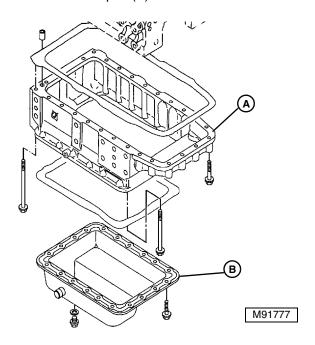
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CRANKCASE EXTENSION HOUSING

Removal and Installation

- 1. Remove the flywheel. (See "FLYWHEEL" on page 47.)
- 2. Remove the oil pan (B).



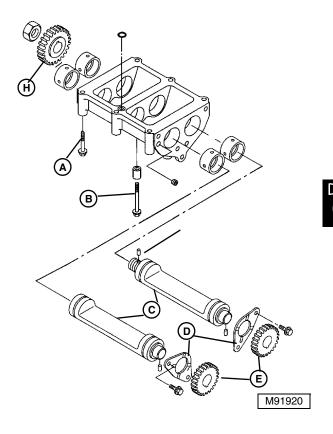
- 3. Remove the extension housing cap screws and extension housing (A).
- 4. Inspect the extension housing for cracks.
- 5. Installation is the reverse of removal.
- Seal the extension housing to the engine block, and the oil pan to the extension housing with John Deere Form-In-Place RTV Gasket Maker.

BALANCER ASSEMBLY

Removal and Disassembly:

- 1. Remove the engine from the tractor.
- 2. Remove the oil pan, the crankcase extension housing and oil pickup.
- 3. Mark the position of the balancer drive gear to aid in reassembly.

NOTE: If the crankshaft is turned when the balancer assembly is out of the crankcase, the balancer MUST be correctly timed to the crankshaft.



- Remove four short (A) and two long (B) cap screws that support the balancer. Remove the balancer assembly.
- Remove the timing gears (E) from the balancer shafts (C).
- 6. Remove the cap screws from the thrust plates (D), and remove the thrust plates and balancer shafts.
- 7. Inspect all parts for wear or damage. Replace any unserviceable components.

Reassembly and Installation

- 1. Install the balancer shafts to the balancer housing.
- 2. Install the thrust plates to the balancer housing.

3. Align the timing marks on the timing gears. Install the timing gears to the balance shafts.

NOTE: Be certain the marks on the timing gears are lined up correctly. Failure to align the timing marks may result in severe vibration.



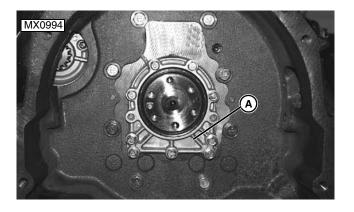
4. Install the balancer assembly to the engine.

NOTE: Be certain the timing marks (G) on the crankshaft gear (F) and balancer drive gear (H) are lined up correctly. Failure to align the timing marks may result in severe vibration.

CRANKSHAFT REAR OIL SEAL

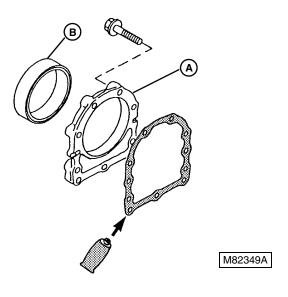
Replacement:

1. Remove the flywheel. (See "FLYWHEEL" on page 47.)



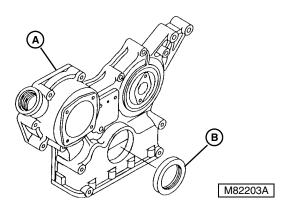
- 2. Remove the rear oil seal case (A).
- Replace the oil seal (B) using a driver set. Install the seal, with lip toward cylinder block. Install the seal flush with surface of oil seal case.

NOTE: If crankshaft is grooved at oil seal contact point, seal can be installed **3 mm (0.12 in.)** farther into oil seal case.



3. Apply a thin layer of John Deere Form- In -Place gasket and install oil seal case to engine block.

CRANKSHAFT FRONT OIL SEAL



- 1. Remove the timing gear cover (A). (See "TIMING GEAR COVER" on page 52.)
- Replace the oil seal (B) using a driver set. Install the seal with the lip toward inside of gear housing cover. Install the seal flush with the surface of the cover.

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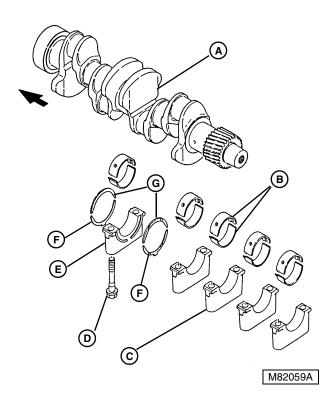
CRANKSHAFT AND MAIN BEARINGS

Removal:

- Check the crankshaft end play. (See "CRANKSHAFT END PLAY CHECK" on page 18.)
- 2. Remove the rear oil seal. (See "CRANKSHAFT REAR OIL SEAL" on page 44.)
- 3. Remove the flywheel housing. (See "FLYWHEEL HOUSING" on page 48.)
- Remove the crankcase extension housing. (See "CRANKCASE EXTENSION HOUSING" on page 43.)
- 5. Remove the timing gear cover mounting plate. (See "TIMING GEAR COVER" on page 52.)
- 6. Check the crankshaft rod and main bearing clearance. (See "CONNECTING ROD BEARING CLEARANCE CHECK" on page 17, and "CRANKSHAFT MAIN BEARING CLEARANCE CHECK" on page 18.)

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.

- 7. Remove the connecting rod bolts and end caps.
- 8. Push the pistons and connecting rods away from crankshaft.



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

- 9. Remove the main bearing bolts (D), caps (C, E) and cap thrust bearing (F).
- 10. Remove the crankshaft (A).
- 11. Remove the block thrust bearing (G) and main bearing inserts (B).
- 12. Inspect all parts for wear or damage.

Installation:

Apply clean engine oil on all parts during pinstallation.



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.
- 3. Install crankshaft.
- 4. Install smooth bearing inserts in main bearing caps, aligning tangs with slots in caps.

NOTE: Main bearing caps have "raised arrows" that are stamped with numbers. Both correspond to their location on the engine block. Install all bearing caps with the "arrow" toward the flywheel end. Install bearing caps beginning with thrust bearing cap (no number), number 1, then 2, etc. The main bearing cap at gear train end does not have a number.

- Install cap thrust bearings, with oil grooves facing away from cap, in the number "1" main bearing cap.
- Install the 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 bolts.

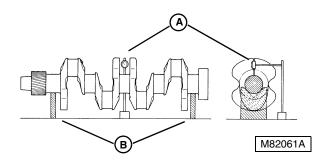
- 7. Dip entire main bearing bolts in clean engine oil. Install bolts and tighten. DO NOT tighten to specifications.
- 8. Using a soft-faced hammer, tap the front end of the crankshaft then the rear end of the crankshaft to align the thrust bearings.
- Tighten main bearing cap bolts to 96 100 N•m (71 74 lb-ft). 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.

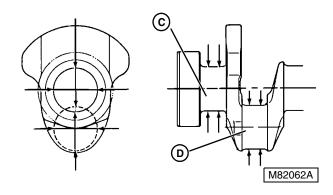
Never reuse connecting rod bolts, replace with new.

- Match the connecting rod caps to the rods using alignment marks. Install caps.
 Dip entire connecting rod bolts in clean engine oil. Install new bolts and tighten to 44 54 N•m (33 40 lb-ft).
- Install the timing gear cover mounting plate. (See "TIMING GEAR COVER MOUNTING PLATE" on page 53.)
- Install the crankcase extension housing. (See "CRANKCASE EXTENSION HOUSING" on page 43.)
- 13. Install the rear oil seal. (See "CRANKSHAFT REAR OIL SEAL" on page 44.)
- 14. Install the flywheel housing. (See "FLYWHEEL HOUSING" on page 48.)
- 15. Install the flywheel. (See "FLYWHEEL" on page 47.)
- 16. Install the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 17. Install the front oil seal. (See "CRANKSHAFT FRONT OIL SEAL" on page 44.)
- 18. Install the oil pan.

Crankshaft Inspection/Replacement:



 Inspect the crankshaft for bend using V-blocks (B) and a dial indicator (A). Turn the crankshaft slowly and read variations on the indicator. If the variation is greater than 0.02 mm (0.001 in.), replace the crankshaft.



2. Measure the crankshaft connecting rod journal (D) and main bearing journal (C) diameters. Measure several places around each journal.

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

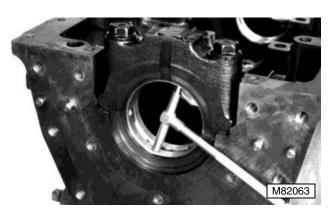
Connecting Rod Journal OD:

Standard 47.95 - 47.96 mm (1.888 - 1.888 in.) Wear Limit 47.91 mm (1.886 in.)

Main Bearing Journal OD:

Standard 53.95 - 53.96 mm (2.124 - 2.124 in.) Wear Limit 53.91 mm (2.122 in.)

- If the journal diameter is less than the wear limit, replace the crankshaft or have the journals ground undersize by a qualified machine shop.
- If journals are ground, undersized bearing inserts must be installed. Bearing inserts are available in 0.25 mm (0.010 in.) undersize.
- Install bearing inserts and main bearing cap on main bearing. Tighten main bearing bolts to 96 -100 N•m (71 - 74 lb-ft).



- 4. Measure the main bearing inner diameter.
- Standard main bearing ID is 53.99 54.03 mm (2.126 - 2.127 in.).

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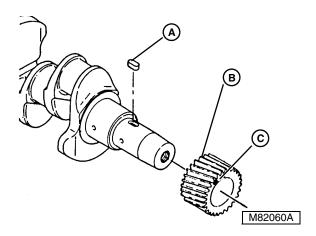
- If the bearing diameter exceeds 54.10 mm (2.130 in.), replace bearing inserts.
- If the bearing clearance (bearing ID minus crankshaft main bearing journal OD) exceeds 0.038 - 0.068 mm (0.002 - 0.003 in.), replace bearing inserts and crankshaft or have crankshaft journals ground undersize by a qualified machine shop and install undersized bearing inserts.
- 5. Clean and inspect the oil passages in the main bearing journals, connecting rod journals and main bearing bores in cylinder block.
- 6. Inspect the crankshaft for cracks or damage. Replace if necessary.

To replace timing gear:

- Inspect the crankshaft gear for chipped or broken teeth. Replace if necessary.
- 1. Remove the gear from crankshaft using a knifeedge puller and a press.

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.



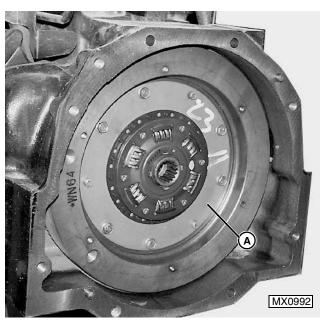
2. Heat gear (B) to approximately 150°C (302°F). Install gear with timing mark "A" toward press table. Align slot in gear (C) with key (A) in shaft. Press crankshaft into gear until gear is tight against crankshaft shoulder.

FLYWHEEL

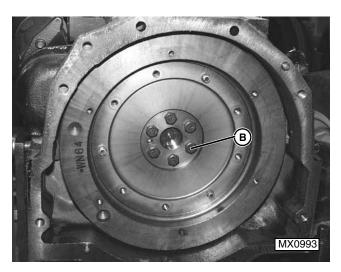
IMPORTANT: Always install new flywheel mounting bolts.

Removal:

1. Split the tractor (front).



2. Remove six dampener/coupling or pressure plate (collar shift not shown) mounting cap screws and remove the coupling (A) from the three alignment pins and flywheel.



3. Remove the flywheel mounting cap screws (B) and remove the flywheel from crankshaft.

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FLYWHEEL HOUSING DIESEL ENGINE

IMPORTANT: The flex plate must be installed with raised side of spline drive away from flywheel.

 Inspect the flywheel and ring gear for wear or damage. Replace any unserviceable flywheel or ring gear.

Installation:

- Installation of the flywheel and flex-plate is reverse of removal.
- Replace flywheel cap screws. Tighten to specification.



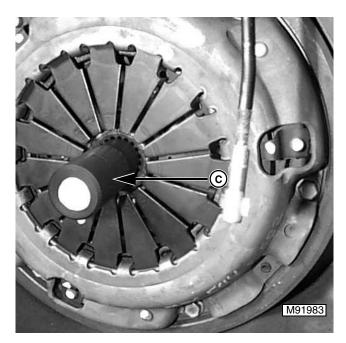
Clutch Installation - CST:

1. Installation of the clutch is the reverse of removal.



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Use clutch alignment tool (C) to center the clutch disc when assembling the clutch to the flywheel.



Specification:

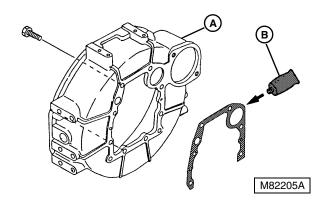
Flywheel Cap Screws. 83 - 88 Nem (62 - 65 lb-ft)

FLYWHEEL HOUSING

Removal:

- Remove the flywheel. (See "FLYWHEEL" on page 47.)
- 2. Remove the starting motor.

3. Remove the flywheel housing.



Installation:

- 1. Installation is the reverse of removal.
- Seal the flywheel housing to the engine with John Deere Form-In-Place RTV Gasket Maker.

CAMSHAFT

Removal:

- 1. Remove the rocker arm assembly and push rods. (See "ROCKER ARM ASSEMBLY" on page 29.)
- 2. Remove the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 3. Check the camshaft end play. (See "CAMSHAFT END PLAY CHECK" on page 20.)
- 4. Check the backlash of the timing gears. (See "TIMING GEAR BACKLASH CHECK" on page 20.)

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

Hold the cam followers away from the 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 thrust plate mounting cap screws, the thrust plate, and the camshaft.
- 8. Inspect all parts for wear or damage.

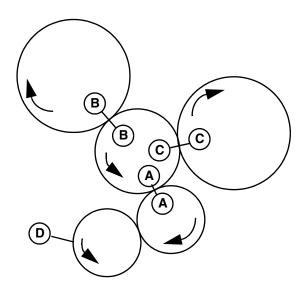
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DIESEL ENGINE CAMSHAFT

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.



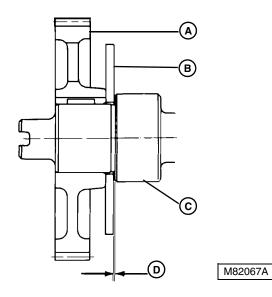
1. Rotate the crankshaft to align timing marks.

NOTE: The gears use letters to aid in correct timing. The fuel injection drive gear (B mark), the camshaft gear (C mark) and the crankshaft gear (A mark) all must be correctly timed to the corresponding marks on the center idler gear. It is not necessary to time the unmarked oil pump gear (D).

- 2. Install the camshaft.
- Install the thrust plate and cap screws. Tighten the thrust plate mounting cap screws to 26 N•m (226 Ib-in.).
- Install the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 5. Install the push rods and rocker arm assembly. (See "ROCKER COVER" on page 28.)

Camshaft Timing Gear

Inspection:





- 1. Check the camshaft side gap (D) using a feeler gauge.
- If the side gap exceeds 0.05 0.25 mm (0.002 0.010 in.), remove the gear (A) and replace thrust plate (B).
- Inspect the gear for chipped or broken teeth.
 Replace if necessary

Replacement:

1. Remove the gear (if required) from camshaft (C) using a knife-edge puller and a press.



CAUTION

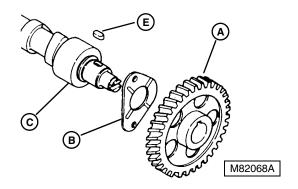
DO NOT heat oil over 182° C (360° F). Oil fumes or oil can ignite above 193° C (380° F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

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

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

- 3. Install the thrust plate (B). Install the gear (A) with timing mark "C" side toward press table. Align the slot in the gear with key in shaft. Press the camshaft into gear until gear is tight against camshaft shoulder.
- Thrust plate (B) must spin freely on camshaft.

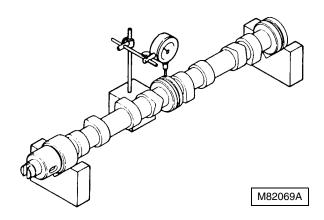
CAMSHAFT DIESEL ENGINE



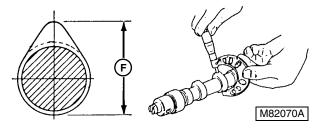


Camshaft Inspection:

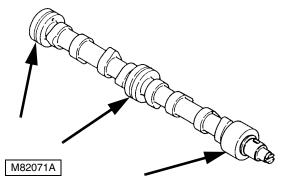
- Inspect the camshaft for bend using v-blocks and a dial indicator. Turn the camshaft slowly and read variation on indicator.
- If the variation is greater than 0.02 mm (0.001 in.), replace the camshaft.



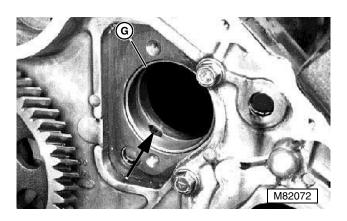
2. Measure the camshaft lobe height (F).



- The camshaft lobe height is 38.64 38.77 mm (1.521 - 1.526 in.).
- If the lobe height is less than 38.40 mm (1.512 in.), replace camshaft.



- 3. Measure the camshaft journal diameters.
- Gear housing and flywheel end camshaft journal OD is 44.93 - 44.95 mm (1.769 - 1.770 in.).
- Intermediate camshaft journal OD is 44.91 44.94 mm (1.768 - 1.769 in.).
- If journal diameters are less than 44.85 mm (1.766 in.), replace camshaft.



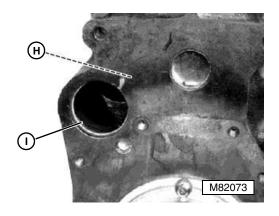
- 4. Measure the camshaft bushing (G) diameter at gear housing end.
- Standard camshaft bushing ID is 44.99 45.06 mm (1.771 - 1.774 in.).
- Replace the bushing If the diameter exceeds 45.10 mm (1.776 in.).
- If the bushing clearance (bushing ID minus camshaft journal OD) exceeds 0.20 mm (0.008 in.), replace bushing, camshaft or both.
- 5. Remove the camshaft bushing using appropriate bushing puller.
- 6. Align the oil holes (arrow) in new bushing and cylinder block. Install bushing using a driver set.

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

7. Remove the flywheel housing/plate and plug. (See "FLYWHEEL HOUSING" on page 48.)

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DIESEL ENGINE CAM FOLLOWERS



- 8. Measure the intermediate (H) and flywheel end (I) of the camshaft bore diameters.
- Standard camshaft bore ID is 45.00 45.025 mm (1.772 - 1.773 in.)
- If the bore diameter exceeds **45.10 mm (1.776 in.)**, replace cylinder block.
- If the bore clearance (bore ID minus camshaft journal OD) exceeds 0.20 mm (0.008 in.), replace camshaft, cylinder block or both.
- Apply John Deere Form-In Place Gasket, or an equivalent, on the outer edge of the plug. Install the plug until it bottoms in bore.
- Install the flywheel housing.

CAM FOLLOWERS

Removal/Installation:

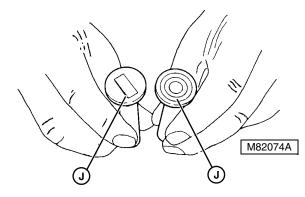
- Remove the camshaft. (See "CAMSHAFT" on page 48.)
- 2. Remove the oil pan and strainer.

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

- 3. Put a mark on each cam follower and the cylinder block bore to aid in installation.
- 4. Remove the cam followers.
- 5. Inspect all parts for wear or damage.
- Apply clean engine oil on all parts during installation.

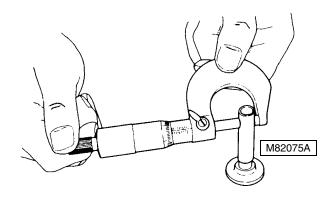
Installation is done in the reverse order of removal.

Inspection:



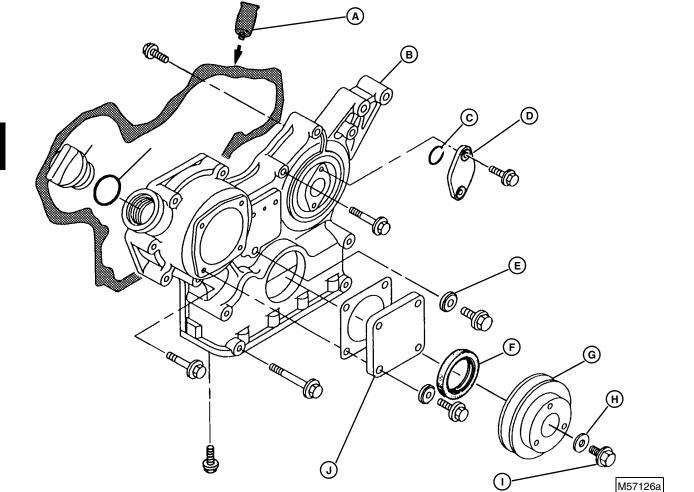


7. Inspect the cam follower contact surface for abnormal wear (J), compared to normal wear pattern (K). Replace if necessary.



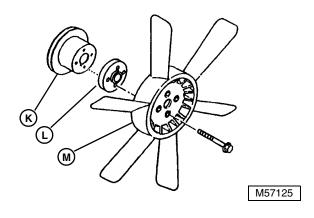
- 8. Measure the cam follower stem diameter.
- Standard cam follower stem OD is 11.98 11.99 mm (0.471 - 0.472 in.).
- If the stem diameter is less than 11.93 mm (0.470 in.), replace cam follower.
- 9. Measure the cam follower bore diameter in the cylinder block.
- Standard cam follower bore ID is 12.00 12.02 mm (0.472 - 0.473 in.).
- If the cam follower bore diameter exceeds 12.05 mm (0.474 in.), replace the cylinder block.
- If the bore clearance (bore ID minus follower stem OD) exceeds 0.10 mm (0.004 in.), replace the cam follower, cylinder block or both.

TIMING GEAR COVER



Removal:

1. Remove the alternator and belt.



2. Remove the fan (M), spacer (L), and pulley (K) from the water pump.

- 3. Remove crankshaft pulley cap screw (I) and washer (H).
- 4. Remove crankshaft pulley (G) using a two-jaw puller.

NOTE: It is not necessary to remove end cover (D) and O-ring (C), or fuel injection pump gear cover (J) to remove timing gear cover.

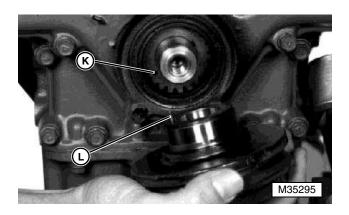
- 5. Remove the cap screws and timing gear cover (B).
- 6. Inspect the crankshaft oil seal (F) for wear or damage. Replace if necessary. (See CRANKSHAFT FRONT OIL SEAL" on page 44.

Installation:

- 1. Replace any seal washers (E).
- 2. Seal the cover to the engine with John Deere Form-In-Place RTV Gasket Maker (A).
- 3. Tighten all mounting cap screws.

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DIESEL ENGINE IDLER GEAR



- Align the pin in crankshaft pulley (L) with the hole in the crankshaft gear (K). Install the crankshaft pulley.
- 5. Install the pulley, spacer and fan to the water pump.
- 6. Adjust the fan/alternator drive belt tension.

IDLER GEAR

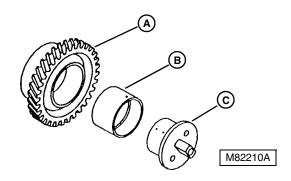
Removal/Installation:

- Remove the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 2. Check the backlash of timing gears. (See "TIMING GEAR BACKLASH CHECK" on page 20.)

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

- 3. Rotate the crankshaft and align the timing marks.
- 4. Remove two cap screws, shaft and gear.
- 5. Inspect all parts for wear or damage.

Installation is done in the reverse order of removal.



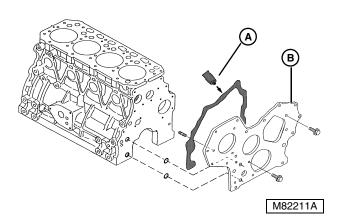
- Inspect the gear (A) for chipped or broken teeth. Replace if necessary.
- Measure the idler gear shaft (C) diameter.

- Standard idler gear shaft OD is 45.95 45.98 mm (1.809 - 1.810 in.).
- If the shaft diameter is less than **45.93 mm (1.808 in.)**, replace idler gear shaft.
- 7. Measure the idler gear bushing (B) diameter.
- Standard idler gear bushing ID is 46.00 46.03 mm (1.811 - 1.812 in.).
- Replace the bushing if the ID exceeds 46.08 mm (1.814 in.).
- If the bore clearance (bushing ID minus shaft OD) exceeds 0.15 mm (0.006 in.), replace bushing, shaft, or both.

Replace Bushing:

- 1. Replace the bushing using a driver set.
- 2. Align the oil holes in bushing and idler gear.
- 3. Install the bushing flush with surface of idler gear.

TIMING GEAR COVER MOUNTING PLATE



Removal/Installation:

- 1. Remove the camshaft. (See "CAMSHAFT" on page 48.)
- 2. Remove the idler gear. (See "IDLER GEAR" on page 53.)
- 3. Remove the fuel injection pump.
- 4. Remove the oil pump. (See "OIL PUMP" on page 54.)
- 5. Remove the mounting cap screws and plate (B).
- 6. Replace all O-rings.
- 7. Installation is the reverse of removal.
- Seal the cover to the engine with John Deere Form-In-Place RTV Gasket Maker (A).

OIL PAN AND STRAINER

Removal/Installation:

- 1. Remove the oil pan.
- 2. Remove the balancer assembly. (See "BALANCER ASSEMBLY" on page 43.)

OIL PUMP DIESEL ENGINE

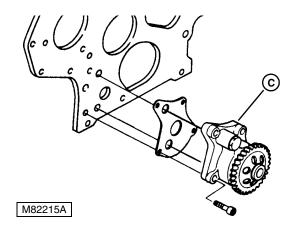
- 3. Remove the oil strainer gasket and oil strainer.
- Replace the oil strainer gasket and any unserviceable components.
- Install the oil strainer, balancer assembly, and oil pan.
- Tighten all cap screws.
- 7. Fill the engine with correct engine oil.

OIL PUMP

Removal/Installation:



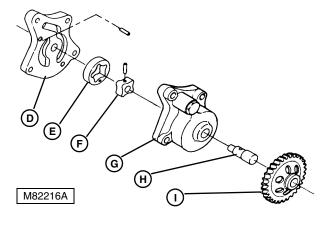
- 1. Remove the timing gear cover. (See "TIMING GEAR COVER" on page 52.)
- 2. Check the oil pump gear backlash. Replace the entire oil pump assembly if backlash is more than **0.12 mm (0.005 in.)**.



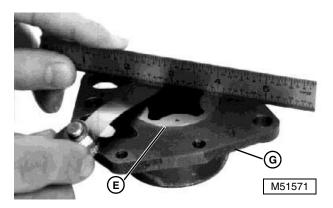
- 3. Remove the mounting cap screws, the oil pump assembly (C) and gasket from the mounting plate.
- 4. Inspect all parts for wear or damage.

Disassembly/Assembly:

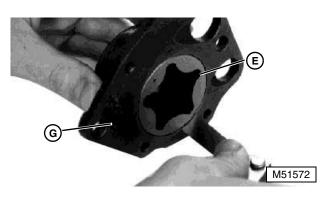
- 1. The gear (I) is press fit on rotor shaft (H). Remove gear using a knife edge puller and a press.
- 2. Inspect all parts for wear or damage.



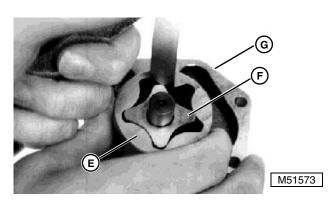
- Measure the rotor shaft outer diameter and the shaft hole diameter in cover.
- Clearance is 0.01 0.04 mm (0.001 0.002 in.).
- Replace the pump if the clearance exceeds 0.2 mm (0.008 in.).



- 4. Check the rotor recess with a straightedge and feeler gauge.
- Rotor recess is 0.03 0.09 mm (0.001 0.004 in.).
- Replace the pump if the recess exceeds **0.15 mm** (**0.006 in.**).

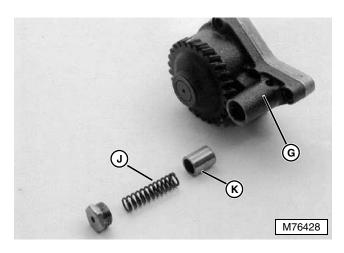


- Check the outer rotor (E) -to-pump body (G) clearance.
- Clearance is 0.10 0.16 mm (0.004 0.006 in.).
- Replace the pump if the clearance exceeds 0.25 mm (0.010 in.).



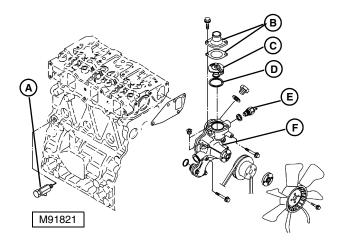
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- 6. Check inner (F) -to-outer rotor (E) clearance.
- Replace the pump if clearance is more than 0.15 mm (0.006 in.).
- 7. Coat all parts with clean engine oil.
- 8. Install the outer rotor with identification mark facing toward rotor shaft assembly.



- 9. Check the oil pressure relief valve. If the relief valve piston (K) is sticking in the pump body (G), clean parts to allow movement of the piston.
- Inspect the spring (K) for cracks. The spring is not serviceable. If damage is identified, replace the oil pump assembly.

THERMOSTAT AND WATER PUMP DISASSEMBLY



Procedure:

- 1. Open the engine drain valve (A) to drain coolant.
- 2. Disconnect the coolant temperature sensor (E) lead.
- 3. Disconnect the upper and lower radiator hoses.
- 4. Remove the fan/alternator drive belt.
- 5. Remove the cap screws, fan, spacer and pulley.

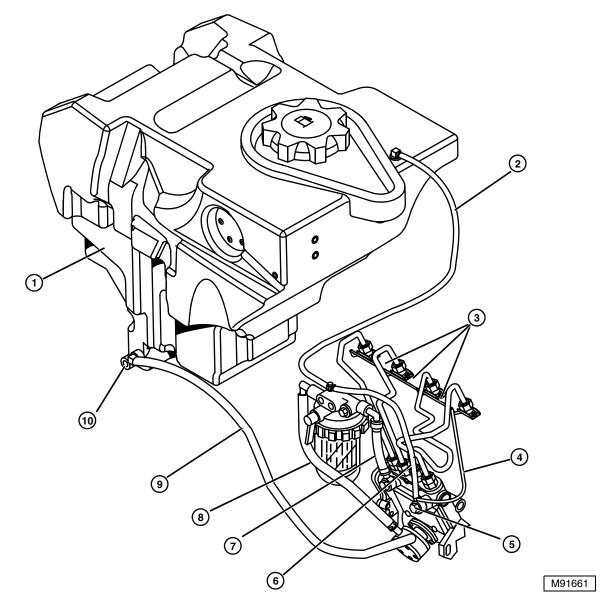
- 6. Remove the cap screws, pump (F) and gasket.
- 7. Inspect the pump for wear or damage.
- 8. Remove the thermostat cover and gasket (B), thermostat (C) and gasket (D). Test the thermostat for proper operation. (See "THERMOSTAT OPENING TEST" on page 22.)
- 9. Installation is done in the reverse order of removal.
- 10. Adjust the fan/alternator drive belt tension.

Inspection:

- 1. Inspect the water pump for coolant leakage. If origin of leak cannot be determined, perform cooling system pressure test. (See "COOLING SYSTEM PRESSURE TEST" on page 24.)
- If coolant is leaking at pulley flange:
 Shaft seal is defective. Replace water pump.
- If coolant is leaking between plate and pump housing:
 - Gasket between plate and pump housing is defective. Remove plate and replace gasket.
- If coolant is leaking between the plate and the engine block:
 - Remove the water pump and replace gasket.
- Inspect the water pump for worn bearing shaft by removing fan belt and checking for excessive movement of fan. Replace water pump if excessive movement is noticed.
- If the bearing shaft is making noise when operating. Check the fan belt tension. If adjustment does not relieve the noise, the bearing shaft is defective. Replace the water pump.



FUEL SUPPLY COMPONENT LOCATION

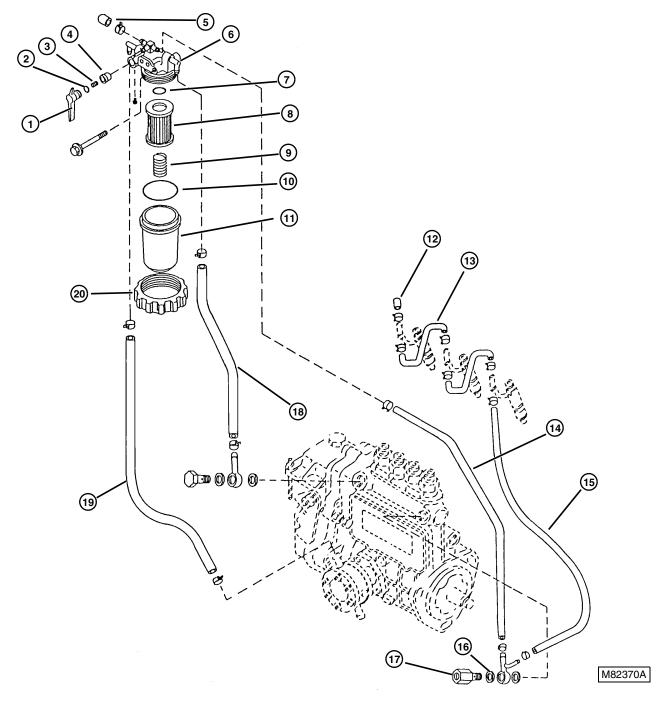




- 1. Fuel Tank
- 2. Hose (Injection Pump Bleed-off)
- 5. Air Vent Check Valve
- 6. Pump Hose
- 3. Hose (Nozzle Leakoff, short)
- 7. Hose (Filter-to-Injection Pump)
- 4. Hose (Nozzle Leakoff, long)
- 8. Hose (Transfer Pumpto-Filter)

9. Hose (Fuel Tank-to-Transfer Pump) 10. Delivery Valve

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- 1. Shutoff Lever
- 5. Hose
- 9. Spring
- 13. Hose (Nozzle Leak-Off, short
- 17. Air Vent Check Valve

- 2. O-ring
- 6. Filter Mounting Base
- 10. O-ring
- 14. Hose (Injection Pump Bleed-off)
- Hose (Filter-to-Injection Pump)

- 3. Spring
- 7. O-ring
- 11. Filter Cover
- 15. Hose (Nozzle Leak-Off, long)
- 19. Hose (Supply Pumpto-Filter)

- 4. Shutoff Valve
- 8. Filter Element
- 12. End Cap
- 16. Copper Washer (2 per Fitting, Replace)
- 20. Retaining Ring

FUEL INJECTION PUMP

Removal:



A CAUTION

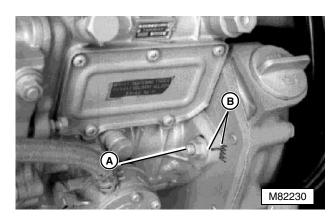
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by pressure relieving before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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

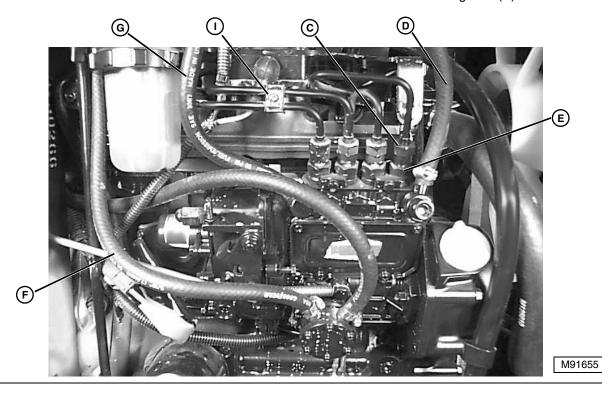
IMPORTANT: The fast idle and torque capsule adjustments are pre-set by the engine manufacturer to comply with strict EPA/CARB emissions requirements, and are adjustable by an authorized service facility. DO NOT remove or adjust these components. Tampering with the fast idle and torque capsule adjustments may result in severe fines or penalties.

IMPORTANT: Never steam clean or pour cold water on an 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 with parts cleaning solvent or steam cleaner.
- 2. Loosen the fuel injection line connectors (C) slightly to relieve pressure in the fuel system. Use another wrench to keep the delivery valves (E) from loosening.
- 3. Loosen the line clamp (I), and remove the fuel injection lines.
- 4. Disconnect the hoses to/from fuel filter (F, G).
- 5. Disconnect the pump hose (D).
- 6. Remove the external lube line.
- 7. Disconnect the fuel shutoff solenoid link.

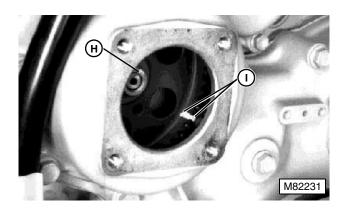


- 8. Mark the position of timing marks (B) on the injection pump and the gear cover mounting plate.
- 9. Remove three mounting nuts (A).



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- Remove four cap screws, washers, cover and gasket.
- 11. Use chalk or paint to mark injection pump gear to idler gear (I).
- 12. Remove nut and lock washer (H).



- 13. Pull gear from injection pump shaft using a two jaw puller.
- 14. Remove injection pump and O-ring.

IMPORTANT: DO NOT attempt to service the injection pump or governor. 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.

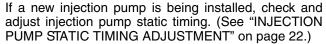
Installation:

- 1. Install new O-ring to injection pump.
- Put injection pump onto back of gear cover mounting plate. Align key on shaft with keyway in gear. Be sure to align marks on gears made during removal.
- 3. Install lock washer and nut. Tighten to specification.
- Install new gasket, cover, four washers and cap screws.
- 5. Install three mounting nuts. Do not tighten.
- Align marks on mounting plate and injection pump, to same place as when removed, and tighten mounting nuts to specifications.

- 7. Connect fuel shutoff solenoid link.
- 8. Connect hoses to/from fuel filter.
- 9. Install fuel injection lines and tighten line clamps.

IMPORTANT: If the oil has been drained out of fuel injection pump housing, add oil as necessary. The fuel injection pump can become damaged if operated dry or without proper amount of oil.

- Remove fill plug and add clean engine oil to housing. Add until oil begins to drip out of external lube line inlet.
- 11. Install external lube line. When installing line, put one copper washer between mounting bolt head and lube line and the other between lube line and housing.



FUEL INJECTION NOZZLES

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.

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

A

CAUTION

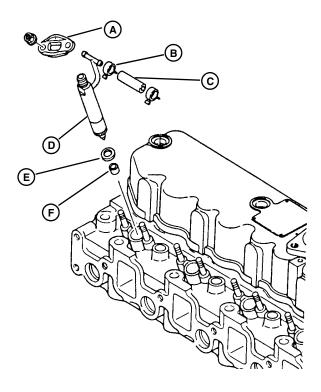
Escaping fluid under pressure can penetrate the skin causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

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

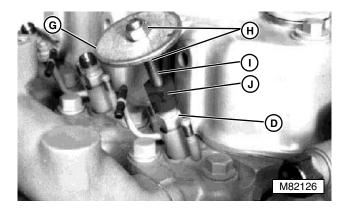
NOTE: Nozzles are matched to the cylinders. If removing more than one nozzle, tag nozzles, according to the cylinder from which it was removed.



- Loosen fuel injection line connectors-to-nozzles slightly to relieve pressure in the fuel system.
- 3. Loosen line clamp(s) and remove fuel injection lines



- 4. Remove clamps (B) and leakoff hoses (C).
- 5. Remove nuts and retaining plates (A).
- Remove injection nozzle (D), ring (E) and Teflon heat protector (F). If ring and protector stay in cylinder head, thread a cap screw into protector and pull from cylinder head.



If nozzles are stuck in cylinder head:

- Grind the head of a cap screw (I) so it fits inside a nut from an old injection line (J).
- Use two nuts (H) to attach a large flat washer (G) to the cap screw.
- Install assembly onto nozzle (D) and use a puller and slide hammer to pull nozzle from cylinder head.

7. Test injection nozzles. (See "FUEL INJECTION NOZZLE TEST" on page 20.)

Installation:

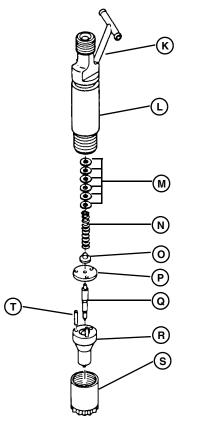
Installation is done in reverse order of removal.

 Install a new ring and heat protector when installing injection nozzles.

Disassembly/Assembly:

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

- 1. Remove retaining nut (S) and disassemble internal parts of injection nozzle. Keep parts organized for ease of assembly.
- 2. Clean and inspect nozzle assembly. (See "Cleaning/Inspection:" on page 61.)



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3. Carefully clamp injector body (L) in a soft-jaw vice.

NOTE: Insert the same number of shims (M) that were removed from injector. Number of shims will affect the opening pressure of the fuel nozzle and will be tested after assembly.

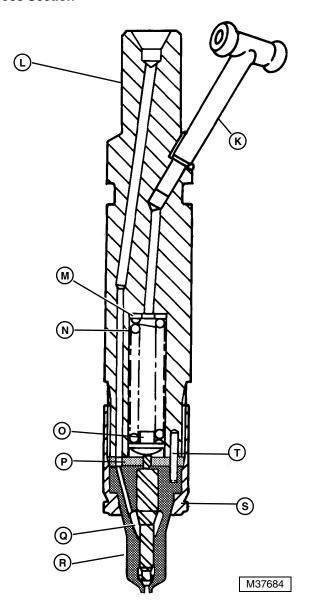
4. Reassemble fuel nozzle in the order shown above.

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- Tighten retaining nut to 6.8 8.8 N•m (60 78 lb-in.).
- After assembly is complete, test injection nozzle. (See "FUEL INJECTION NOZZLE TEST" on page 20.)

Cross Section



K. Return Pipe

P. Separator Plate

L. Injector Body

Q. Nozzle Valve

M. Shim(s)

R. Nozzle Body

N. Spring

S. Retaining Nut

O. Spring Seat

T. Index Pin

Cleaning/Inspection:

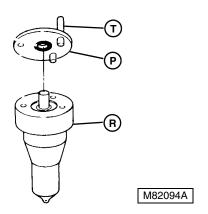
NOTE: To clean nozzles properly, JDF13 Nozzle Cleaning Kit is recommended. The Cleaning Kit is available through the John Deere SERVICEGARD™ Catalog.

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

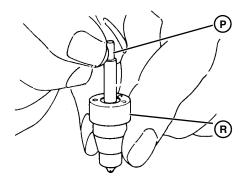
IMPORTANT: Never use a steel brush to clean nozzles as this will distort the spray hole.



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 (P) and nozzle body (R) for nicks or scratches.
- 4. 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 (0.004 in.)**, replace nozzle assembly.



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- Inspect the piston (large) part of nozzle valve (P) 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 (P) in clean diesel fuel. Insert valve in nozzle body (Q).
- 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.

FUEL FILTER ASSEMBLY

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

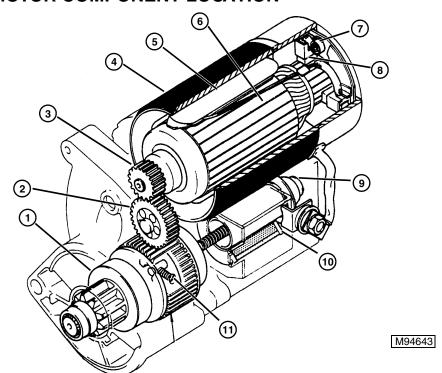
- 1. Remove the retaining ring from mounting base while holding on to filter cover.
- 2. Remove the filter cover from mounting base.
- 3. Remove and replace the O-rings and filter element.
- 4. Be sure the spring is in the filter cover and place the filter element in the filter cover.
- Before installing the filter cover and element in the mounting base, verify the O-ring is in the groove inside the mounting base.
- Install the filter cover and the element in the mounting base.

IMPORTANT: Tighten only enough to keep filter assembly from leaking. Overtightening the retaining nut may damage the filter cover or retaining ring.

7. Place the retaining ring over filter cover and screw on the mounting base to retain filter cover to mounting base.

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STARTING MOTOR COMPONENT LOCATION





1. Pinion

- 2. Idler Gear
- Drive Gear
- 4. Motor

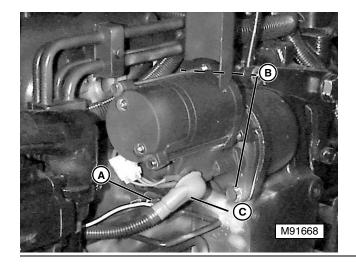
- 5. Field Coil
- 6. Armature
- 7. Brush Spring
- 8. Brush

- 9. Plunger
- 10. Solenoid
- 11. Overrunning Clutch

STARTING MOTOR

Removal:

IMPORTANT: Always disconnect the negative cable from the battery before working on any electrical components.



- 1. Remove the negative cable from the battery.
- Remove side panels as required to access starting motor.
- 3. Remove nut securing battery cable (C) and wires on the starting motor.
- 4. Disconnect starting motor solenoid wire (A).
- 5. Remove the two cap screws (B) securing starting motor to bell housing. Remove starting motor.

Installation:

Installation is done in the reverse order of removal.

IMPORTANT: DO NOT over tighten starting motor mounting cap screws!

 Torque starting motor mounting cap screws to 88 Nom (65 lb-ft).

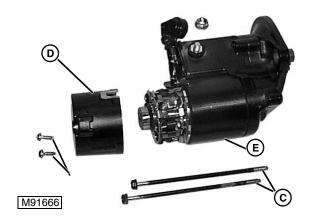
STARTING MOTOR **DIESEL ENGINE**

Disassembly:

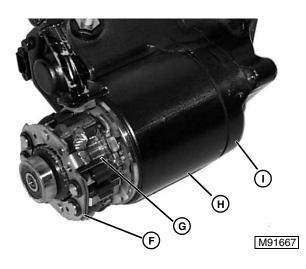


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- 1. Disconnect field lead (A).
- 2. Remove cover screws (B).
- 3. Remove cap screws (C) that secure motor to clutch housing.

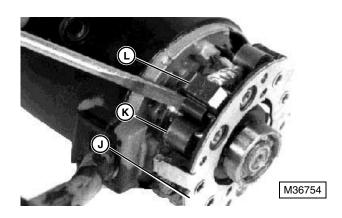


4. Separate cover (D) from motor (E).

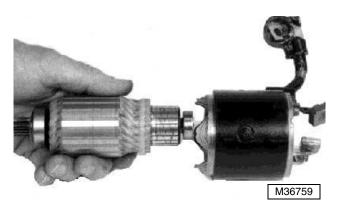


5. Remove motor (H), armature (G) and brush holder (F) as a unit from the clutch housing (I).

NOTE: Brushes are not serviceable separately. If brushes require replacement, the brush holder, with brushes attached, must be replaced.



- 6. Pry brush springs (K) away from the armature. Pull the brushes (L) outward, allowing the springs to hold the brushes in place.
- 7. Remove brush holder (J).



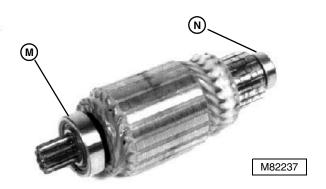
- 8. Remove armature from field coil housing.
- 9. Remove felt washer.
- 10. Remove the bearings.

NOTE: Bearings are press fit. Remove bearings using a knife-edge puller set.

Assembly:

Assembly is done in the reverse order of disassembly.

3 - 64 6/27/00 DIESEL ENGINE STARTING MOTOR

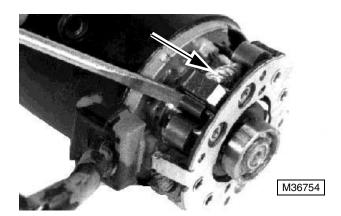


- 1. Install new housing bearing (M) tight against shoulder of shaft using a piece of pipe.
- 2. Install new rear cover bearing (N) tight against shoulder of shaft using a driver set.

IMPORTANT: Install both bearings with sealed side toward armature.

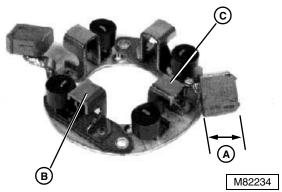
3. Inspect and test brushes, holder, field coil and armature. (See "Inspection/Test:" on page 65.)

NOTE: Apply multipurpose grease to bearing cup inside rear cover.



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.

Inspection/Test:

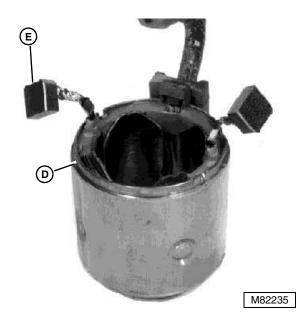




1. Measure brush lengths (A). Replace the brushes if the length is below **8.5 mm (0.335 in.)**.

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

- 2. Test brush holder:
- Touch one probe of tester to negative brush holder (C) and other probe to field brush holder (B).
- 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.

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

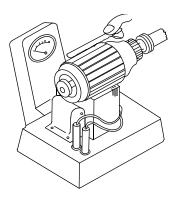
STARTING MOTOR DIESEL ENGINE

- 4. Test for grounded field winding:
- Touch one probe of tester to field coil brush (E) and other probe to field coil housing (D).
- 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.
- 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 (G) and armature shaft (F). 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 circuit windings:
- Touch probes on two different commutator bars.
- If test shows no continuity, there is an open circuit and the armature must be replaced.



- Test for short circuit 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 circuit windings, clean the commutator of dust and filings. Check the armature again. If the test still indicates a short circuit, replace the armature.
- Inspect armature cover and housing bearings for wear or damage. Replace bearings if necessary. (See "Assembly:" on page 64.)

Gear Train Disassembly/Inspection:

1. Remove motor from clutch housing.

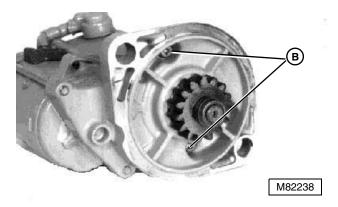


 Remove field wire and (2) motor-to-clutch housing cap screws (A).

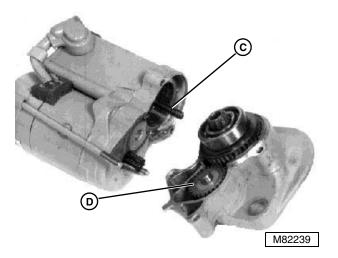


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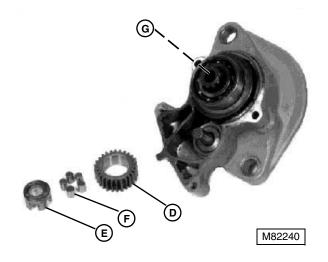
DIESEL ENGINE STARTING MOTOR



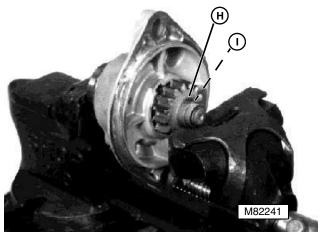
2. Remove (2) clutch housing-to-solenoid housing screws (B) to separate clutch housing from solenoid/motor assembly.



3. Remove plunger spring (C).



- 4. Remove retainer (E), five rollers (F) and pinion gear (D).
- 5. Remove steel ball (G).



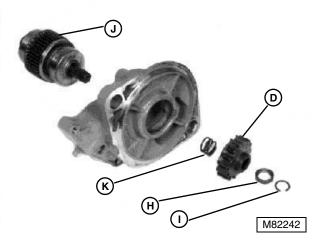


- Put clutch (housing) assembly into a soft-jawed vice, as shown.
- 7. Tighten vise slowly, until drive gear compresses.
- 8. Remove retainer (H) and circlip (I).

CAUTION

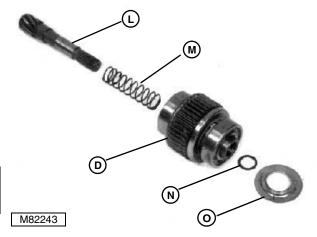
Shaft could be propelled from clutch unit with considerable force if spring is not allowed to extend fully while in vise.

9. While holding clutch assembly, slowly open vise until all spring compression is relieved.



10. Remove drive gear (D) , spring (K) and clutch assembly (J) from housing.

STARTING MOTOR DIESEL ENGINE



11. Remove large washer (O), toothed washer (N),

spring (M) and clutch shaft (L).

12. Inspect all parts for wear or damage.

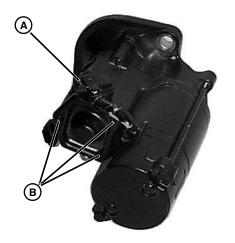
NOTE: The clutch has no serviceable components. If any of the parts show wear or damage, replace the clutch assembly.

Assembly:

Assembly is done in the reverse order of disassembly.

- Apply multipurpose grease to bearings, clutch shaft, springs, pinion gears, retainer, rollers and steel ball.
- Install large washer with flat side toward clutch assembly.
- Install retainer with cupped side away from clutch assembly.

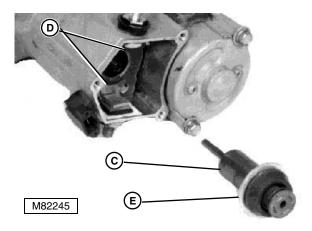
Solenoid Disassembly/Inspection:



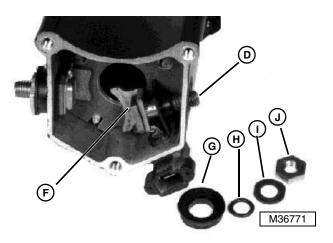
M82233A

- 1. Disconnect field lead (A).
- 2. Remove three screws and clip (B).

3. Remove cover and gasket.



- 4. Remove plunger (C).
- 5. Disassemble terminals and contact plates (D).
- Inspect copper washer (E) and contact plates (F) for burning or pitting. Clean burnt areas to improve electrical contact. Replace contacts or plunger if necessary.



- 7. Remove nut (J), washer (I), O-ring (H) and insulator (G) from each terminal in order shown, and inspect for wear or damage.
- 8. The solenoid is not serviceable. If replace solenoid assembly.

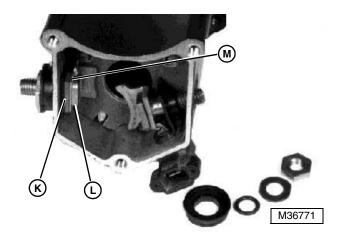
Assembly:

Assembly is done in the reverse order of disassembly.

NOTE: The assembly sequence of the left and right terminals is similar. Be sure solenoid terminal lead (M) is installed between terminal bolt (L) and small contact plate (K). Also, be sure smaller contact plate is on the left side.

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DIESEL ENGINE ALTERNATOR



ALTERNATOR

Specifications:

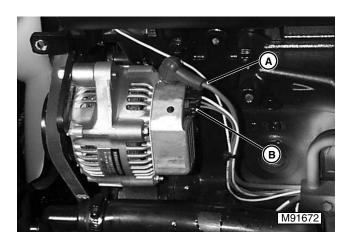
Exposed Brush Length:

.... 10 - 15 mm (0.4 - 0.6 in.) at 98 N (22 lb-force)

Removal:

IMPORTANT: Always disconnect the negative cable from the battery before working on any electrical components.

- 1. Remove the negative cable from the battery.
- 2. Remove left side panels as required to access alternator.



- 3. Lift red plastic protective cover from positive (red) lead from battery. Remove nut and washer and remove lead from alternator stud (A).
- 4. Remove wire harness connector (B) from alternator and move wiring harness to the side.

5. Remove mounting bolts and remove alternator.

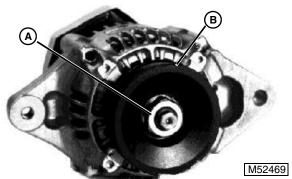
Installation:

Installation is done in the reverse order of removal.

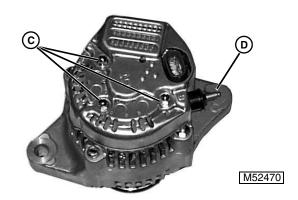
• Tighten drive belt. (See "FAN/ALTERNATOR DRIVE BELT ADJUSTMENT" on page 24.)

Disassembly:

NOTE: Clamp pulley in soft jaw vise and use an impact wrench to remove pulley nut.



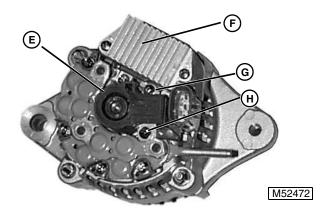
- 1. Remove pulley nut (A).
- 2. Use puller to remove pulley (B).



- Remove nut, washer and insulator from battery terminal post (D).
- 4. Remove three screws (C) securing cover to body. Remove cover.



ALTERNATOR DIESEL ENGINE

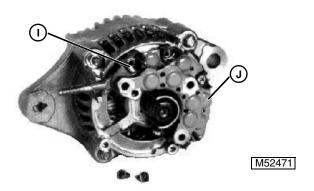




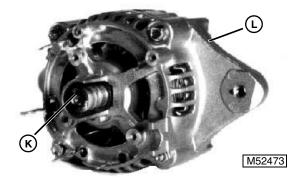
 Remove long (H) and short (G) screws securing brush holder (E) and cover to body. Remove brush holder and cover.

NOTE: Remember location of short screw.

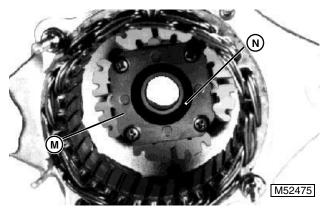
6. Remove the three screws securing regulator to body. Remove regulator (F).



- 7. Remove screw and straighten wire leads (I).
- 8. Remove rectifier (J).



- 9. Remove rear case assembly (L).
- 10. Press rotor shaft (K) from rear case.

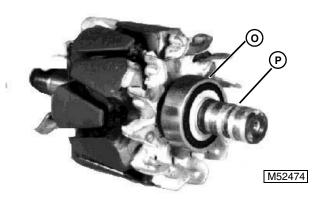


- 11. Remove retainer plate (M).
- 12. Press bearing (N) from case.

Inspection:

Equipment:

- Volt-Ohm-Amp Meter
- Bearing Puller Set
- Soldering Gun (120 Watt Capacity)
- Solder (Only 60-40 Resin Core)
- Sandpaper (No. 00 or 400-grit silicon carbide paper).



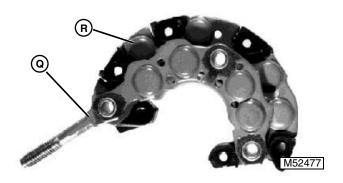
- 1. Inspect bearing (O) for smooth rotation. Replace if necessary.
- 2. Inspect slip rings (P) for dirt or rough spots. If necessary, use No. 00 sandpaper or 400-grit silicon carbide paper to polish rings.
- 3. Measure outer diameter of slip rings. Replace rotor if less than **14 mm (0.55 in.)**.
- 4. Check continuity between slip rings using ohmmeter or continuity tester. Replace rotor assembly if there is no continuity.
- 5. Check continuity between slip rings and rotor core . Replace rotor assembly if there is continuity.

NOTE: Use an ohmmeter that is sensitive to 0 - 1 ohm.

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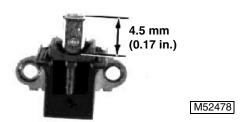
DIESEL ENGINE ALTERNATOR

- 6. Inspect stator for defective insulation, discoloration, or burned odor.
- 7. Check for continuity between each stator lead and body. Replace stator if there is continuity.

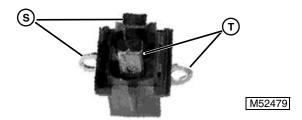


NOTE: Set ohmmeter to the K ohm range.

 Check continuity between main lead (Q) and each diode lead (R). Reverse ohmmeter leads and recheck. There is continuity in one direction, but not the other. Replace diodes or rectifier plate if bad.



 Measure length of brush protruding from holder.
 Dimension is 4.5 mm (0.17 in.) minimum. Replace brushes if worn below minimum. Maximum exposed new brush length is 10.5 mm (0.41 in.).

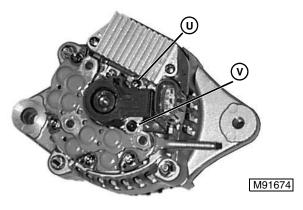


Check continuity between brush and terminal (S).
 Check continuity between brush and terminal (T).
 There should be continuity only at these points.

Assembly:

Assembly procedure is the reverse of disassembly.

NOTE: Check that rotor fan does not contact case and that rotor assembly turns smoothly in bearing.

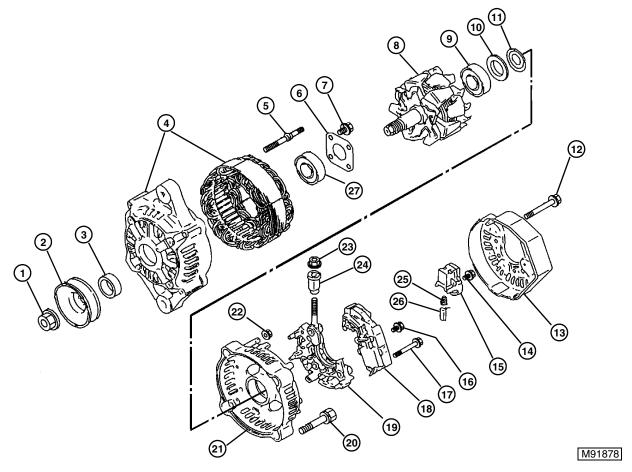




IMPORTANT: Check that short screw (U) is installed in regulator tab. Longer screw (V) will contact frame and cause damage to the charging system.

• Clamp pulley in soft jaw vise. Install pulley nut.

ALTERNATOR COMPONENT LOCATION





2. Pulley

3. Spacer

4. Frame Assembly

5. Stud

6. Plate

7. Screw (4 used)

8. Rotor

9. Bearing

10. Bearing Cover

11. Thrust Washer

12. Cap Screw

13. Rear Cover

14. Screw (6 used)

15. Brush Holder

16. Screw

17. Cap Screw w/ Washer

18. Voltage Regulator

19. Holder

20. Cap Screw

22. Nut (2 used)

23. Nut

24. Bushing

25. Spring

26. Brush

27. Bearing

21. Rear Frame

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READING ELECTRICAL SCHEMATICS

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

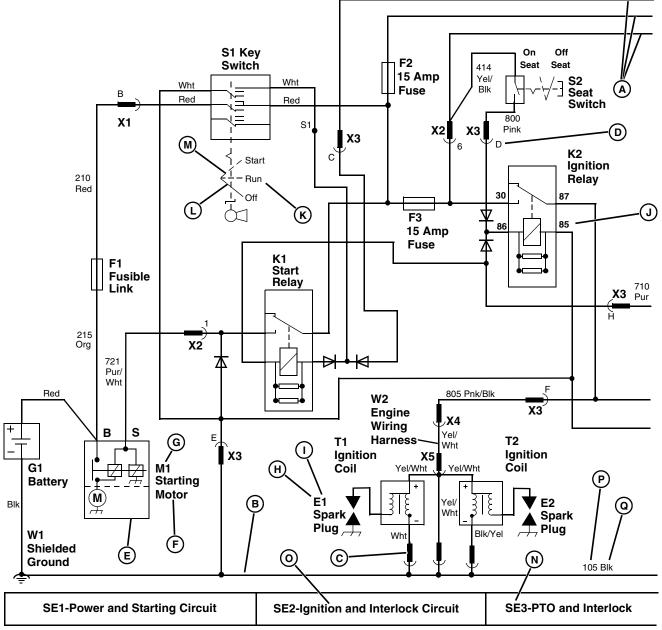
Each component is shown by a symbol (E), its name (F), and an identification code (G). The identification code contains a device identifying letter (H) and number (I).

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

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

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

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



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THEORY AND DIAGNOSTIC INFORMATION

THEORY OF OPERATION INFORMATION

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

- +

DIAGNOSTIC INFORMATION

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

The diagnostic procedure lists:

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

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

WIRE COLOR ABBREVIATION CHART

BlkBlack
3luBlue
3rn Brown
Grn Green
Gry Gray
Org Orange
PnkPink
Pur Purple
RedRed
Tan Tan
WhtWhite
YelYellow
Blk/WhtBlack/White
Blu/WhtBlue/White
Brn/Wht Brown/White
Brn/Yel
Ok Blu Dark Blue
Ok Brn/Lt Grn Dark Brown/Light Green
Dk Brn/Red Dark Brown/Red
Ok Brn/Yel Dark Brown/Yellow
Ok Grn Dark Green
_t Blue Light Blue
_t Grn Light Green
Org/Wht Orange/White
Pnk/BlkPink/Black
Pur/WhtPurple/White
Red/BlkRed/Black
Red/WhtRed/White
Wht/BlkWhite/Black
Wht/Red
Yel/BlkYellow/Black
Yel/RedYellow/Red
Yel/WhtYellow/White

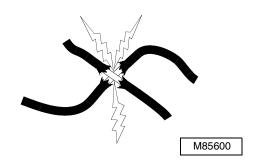
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COMMON CIRCUIT TESTS

Shorted Circuit:

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

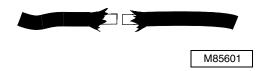
- 1. Turn component switch ON.
- 2. Start at the controlling switch of the component that should not be operating.
- Follow the circuit and disconnect wires at connectors until component stops operating.
- 4. Shorted or improper connections will be the last two wires disconnected.



High Resistance or Open Circuit:

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

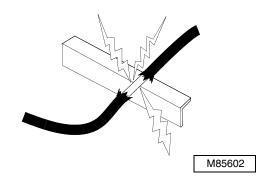
- Check all terminals and grounds of the circuit for corrosion.
- 2. If terminals are not corroded or loose, the problem is in the component or wiring.



Grounded Circuit:

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





CONDUCTORS FOR 12 VOLT CIRCUITS

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

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SPECIFICATIONS (NORTH AMERICAN AND EUROPEAN)

12 VDC
650 Amps
1.265 or above
1.9 L (2.0 qt)
325 amp for 15 seconds

Starting Motor:

Type	Solenoid Shift
Size	2.0 kW (2.68 hp)
Amp draw (on vehicle)	300 amps (max.)
No-load amp draw (free running)	325 amps for 15 seconds

Alternator:

Rating (Standard)	40 amps
Unregulated amperage	40 amps (min.)
Regulated voltage	
Unregulated voltage	50 VAC

Fuel Shutoff Solenoid (Dual Coil):

Voltage	VDC
Pull-in voltage	VDC
Hold voltage 3.0	VDC

PTO Solenoid:

Voltage	12 VDC
Amperage	1.5 amps

Sensors:

Fuel Gauge Sensor Resistance (var	iable)	approximate	ely 5 - 95 ohms
Engine Coolant Temperature (variab	ole)	. approximately	40 - 700 ohms
Engine Oil Pressure Switch	. Closes (Light from	ON to OFF) at 4	9 kPa (7.1 psi)

Manifold Heater:

Re	esistance (throug	h eler	ment))	approximatel	y 0.3	3 - ().5 (ohms

Lighting:

Headlights (halogen)	
Tail Light	5 Watts-Bayonet Base
Hazard Lights	32 Candle Power, Single Element, Type 1156
Instrument Panel Lamps	1.7 Watts-Bayonet Base

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NORTH AMERICAN ELECTRICAL SECTION

ELECTRICAL SCHEMATIC & WIRING HARNESS LEGEND

B1—Fuel Gauge Sensor (SE5, W1)

B2—Engine Oil Pressure Switch (SE5, W1)

B3—Engine Coolant Temperature Sensor (SE5, W1)

E1-LH Tail Light (SE4, W1)

E2-LH Hazard Light (SE6, W1)

E3—RH Tail Light (SE4, W1)

E4—RH Hazard Light (SE6, W1)

E5-LH Headlight (SE6, W1)

E6—RH Headlight (SE6, W1)

E7—LH Work Light (Option)(SE6, W1)

E8—RH Work Light (Option)(SE6, W1)

F1—Fuse - 30 amp (SE1, W1)

F2—Fuse - 30 amp (Option)(SE4, W1)

F3-Fuse - 30 amp (SE4, W1)

F4-Not Used

F5—Fuse - 10 amp (SE2, W1)

F6-Fuse - 20 amp (SE5, W1)

F7-Fuse - 20 amp (SE5, W1)

F8—Fuse - 20 amp (Option)(SE5, W1)

G1—Battery (SE1, W1)

G2—Alternator (SE3, W1)

H1—RH Turn Signal (SE5, W1)

H2-LH Turn Signal (SE5, W1)

H3—PTO Light (SE5, W1)

H4—Discharge Light (SE5, W1)

H5-Cold Start Light (SE5, W1)

H6—Park Brake Light (SE5, W1)

H7—Engine Oil Pressure Light (SE5, W1)

H8—Cruise Control Indicator Light (Option)(SE4, W1)

K1—Manifold Heater Relay (SE2, W1)

K2—Start Relay (SE1, W1)

K3-Fuel Shutoff Relay (SE2, W1)

K4-Engine Run Relay (SE2, W3)

K5-Safety Relay (SE2, W1)

K6—Safety Relay (SE2, W1)

K7—Accessory Relay (SE4, W1)

K8—Cruise Control Relay (Option)(SE5, W1)

M1—Starting Motor (SE1, W1)

P1—Engine Tachometer (SE5, W1)

P2—Hour Meter (Option)(SE5, W1)

P3—Fuel Gauge (SE4, W1)

P4—Engine Coolant Temperature Gauge (SE5, W1)

R1—Manifold Heater (SE2, W1)

R2—Variable Thermistor (SE2, W1)

S1—Key Switch (SE1, W1)

S2—Seat Switch (SE2, W1)

S3—Transmission Neutral Switch (Hydrostatic - HST

Only) (SE2, W1)

S4—Transmission Neutral Switch (PowrReverser™ -

PRT, and Gear - CST)(SE2, W1)

S5-PTO Switch (SE2, W1)

S6-Mid PTO Switch (SE2, W1)

S7—Park Brake Switch (SE2, W1)

S8—Turn Signal Switch (SE5, W3)

S9—Light Switch (SE5, W1)

S10—Cruise Control Switch (Option)(SE5, W1)

S11—Brake Switch (Option)(SE5, W1)

S12—Horn Switch (Option)

V1-Diode Block (SE2, W1)

W1—Battery Frame Ground (SE1, W1)

Y1—Starting Motor Solenoid (SE1, W1)

Y2-Fuel Shutoff Solenoid (SE2, W1)

Y3—Cruise Control Magnet (Option)(SE5, W1)

Y4-PTO Solenoid (SE2, W1)



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CONNECTORS:

- X1—W1 Main Wiring Harness to Fusible Link (SE1, W1)
- NOTE: X2 supplied with cap and jumper wire if X3 is connected to transmission neutral switch on PRT (PowrReverser™) and gear (CST) tractors.

X3 supplied with cap and jumper wire if X2 is connected to transmission neutral switch on hydrostatic (HST) tractors.

- X2—W1 Main Wiring Harness to W3 HST Neutral Start Wiring Harness (HST Only) (SE2, W1)
- X3—W1 Main Wiring Harness to S4 Transmission Neutral Switch Wiring Harness (PRT and CST Only) (SE2, W1)
- X4—W1 Main Wiring Harness to W2 Fuel Shutoff Solenoid Wiring Harness (SE2, W1)
- X5—W1 Main Wiring Harness to S6 Mid PTO Switch (Option) (SE2, W1)
- X6—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X7—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X8—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X9—W1 Main Wiring Harness to W6 Cruise Control Wiring Harness (SE4, W1)
- X10—W5 Cruise Control Wiring Harness to S10 Cruise Control Switch (SE5, W5)
- X11—W5 Cruise Control Wiring Harness to S11 Brake Switch (SE5, W5)
- X12—W5 Cruise Control Wiring Harness to W6 Cruise Control Magnet Wiring Harness (SE5, W5)
- X13—W1 Main Wiring Harness to W8 Trailer Connector Wiring Harness (SE4/SE5/SE6, W1)
- X15—W1 Main Wiring Harness to W4 PTO Solenoid Wiring Harness (SE2, W1)
- X16—W1 Main Wiring Harness to E8 RH Work Light (Option) (SE6, W1)
- X17—W1 Main Wiring Harness to E7 LH Work Light (Option) (SE6, W1)
- X18—W1 Main Wiring Harness to E1 LHTail Light (SE4, W1)
- X19—W1 Main Wiring Harness to E2 LH Hazard Light (SE4, W1)
- X20—W1 Main Wiring Harness to E1 LH Tail Light and E2 LH Hazard Light (SE4, W1)
- X21—W1 Main Wiring Harness to E3 RH Tail Light (SE4, W1)

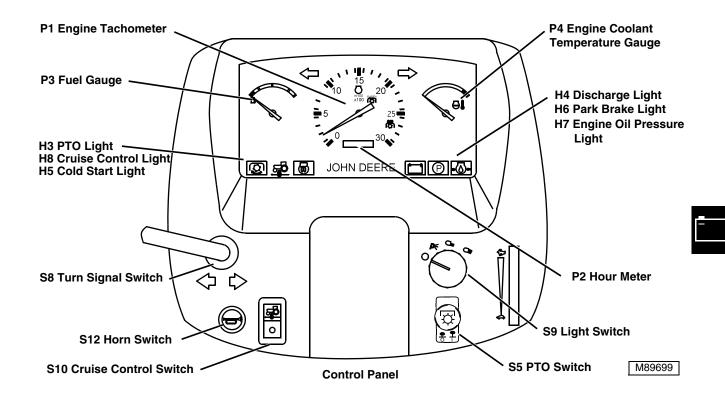
- X22—W1 Main Wiring Harness to E4 RH Hazard Light (SE4, W1)
- X23—W1 Main Wiring Harness to E3 RH Tail Light and E4 RH Hazard Light (SE4, W1)

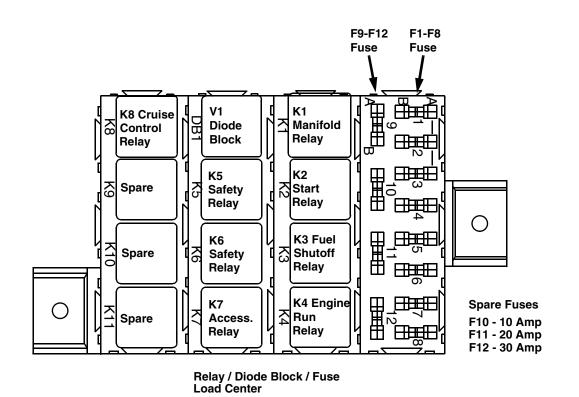
WIRING HARNESSES:

- W1-Main Wiring Harness
- W2—Fuel Shutoff Solenoid Wiring Harness
- W3—HST Transmission Neutral Start Wiring Harness (included in the W5 Wiring Harness protective wrap)
- W4—PTO Solenoid Wiring Harness
- W5—Cruise Control Wiring Harness
- W6—Cruise Control Magnet Wiring Harness

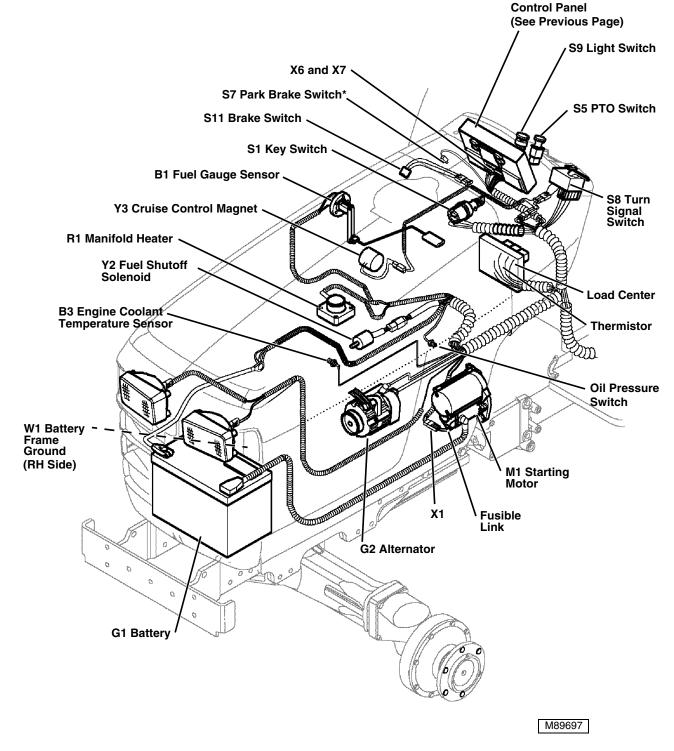
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COMPONENT LOCATION – CONTROLS & LOAD CENTER



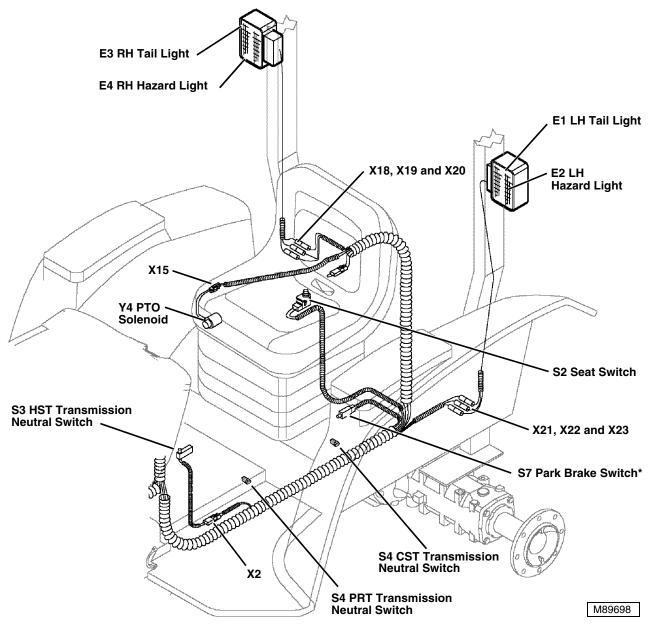


COMPONENT LOCATION – TRACTOR





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* Note: S7 Park brake switch location (front or rear) is based on park brake location - left of seat or dash mounted



SCHEMATICS AND WIRING HARNESSES

WIRE COLOR CODES - 4500/4600

Serial Number Breaks for Main Wiring Harness:

LV4500C350006-

LV4500P352037-

LV4600Cxxxxxx-

LV4600P362035-

LV4600H366017-



Circuit Number	Wire Size	Color	Termination Points
002A	5.0	Red	M1, G2
002B	5.0	Red	X1 (Fusible Link), K1(30)
002C	5.0	Red	X1 (Fusible Link), Splice 002
002D	5.0	Red	Splice 002, F2
002E	1.0	Red	Splice 002, K4(30)
010A	1.0	Blk	E6, Splice 010
010B	1.0	Blk	E5, Splice 010
010C	5.0	Blk	W1, Splice 010
010D	0.8	Blk	DB1-7, Splice 010
010E	0.5	Blk	DB1-7, K2(85)
010F	0.5	Blk	K2(85), K3(85)
010G	0.8	Blk	Splice 010, X23
010H	0.8	Blk	Splice 010, X17
010J	2.0	Blk	Splice 010, X13
010K	1.0	Blk	Splice 010, X16
010L	1.0	Blk	Splice 010, X20
010M	0.5	Blk	Splice 010, X15
010N	1.0	Blk	X4, W1
010T	(–)	Therm.	K3(85), R2
012	5.0	Red	S1, F1
050A	2.0	Blk	W1, Splice 050
050B	0.5	Blk	K1(85), Splice 050
050C	0.5	Blk	K1(85), K4(85)

Circuit Number	Wire Size	Color	Termination Points
050D	0.5	Blk	K4(85), K5(85)
050E	0.5	Blk	K5(85), K6(85)
050F	0.5	Blk	K6(85), K7(85)
050G	0.5	Blk	K7(85), K8(85)
050J	0.8	Blk	Splice 050, X9
050K	1.0	Blk	Splice 050, X6
050L	0.5	Blk	B1, Splice 050
072A	1.0	Red	X6, Splice 072
072B	1.0	Red	S1, Splice 072
072C	0.8	Red	Splice 072, F5
072D	0.8	Red	Splice 072, G2
103A	1.0	Org	S9, Splice 103
103B	1.0	Org	Splice 103, S8
103C	1.0	Org	Splice 103, F8
115A	1.0	Dk Grn	S8, Splice 115
115B	0.8	Dk Grn	X7, Splice 115
115C	0.8	Dk Grn	Splice 115, X22
115D	0.8	Dk Grn	Splice 115, X21
115E	1.0	Dk Grn	Splice 115, X13
118	1.0	Gry	F8, X13
119A	1.0	Wht	E6, Splice 119
119B	1.0	Wht	E5, Splice 119
119C	2.0	Wht	Splice 119, F7
119D	0.8	Wht	Splice 119, X6
122A	1.0	Red	S8, Splice 122
122B	3.0	Red	S9, Splice 122
122C	3.0	Red	Splice 122, F3
125A	1.0	Dk Grn	S8, Splice 125
125B	0.8	Dk Grn	X7, Splice 125
125C	0.8	Dk Grn	Splice 125, X19
125D	0.8	Dk Grn	Splice 125, X18
125E	1.0	Dk Grn	Splice 125, X13

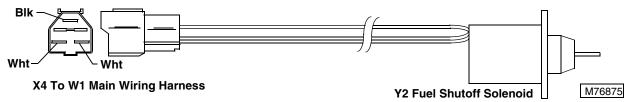
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Circuit Number	Wire Size	Color	Termination Points
138	2.0	Gry	S9, F7
143	2.0	Org	S9, F6
147A	2.0	Pur	F6, Splice 147
147B	0.8	Pur	Splice 147, X17
147C	2.0	Pur	Splice 147, X13
147D	0.8	Pur	Splice 147, X16
209	0.8	Wht	X9, S1
212	0.5	Red	K7(86), S1
222	2.0	Red	K7(87), X13
238	0.8	Gry	X9, K8(86)
247	0.8	Pur	X9, K8(87)
252	2.0	Red	K7(30), F2
264A	0.8	Yel	K8(30), X9
264B	0.8	Yel	K8(30), X6
302A	1.0	Red	DB1- 8, Splice 302
302B	1.0	Red	K4(87), Splice 302
302C	1.0	Red	Splice 302, X4
309	1.0	Wht	K2(87), M1
319	(+)	Therm.	K3(87a), R2
325	0.8	Dk Grn	X6, G2
329A	1.0	Wht	X4, K3(30)
329B	1.0	Wht	K3(30), K3(86)
334	0.8	Yel	X7, G2
347	0.5	Pur	X6, B2
353	0.5	Org	X6, B1
359	0.5	Wht	X6, B3
383	3.0	Org	K1(87), R1
385A	0.8	Dk Grn	X7, Splice 385
385B	0.8	Dk Grn	Splice 385, S1
385C	0.5	Dk Grn	Splice 385, K1(86)
505	0.5	Dk Grn	X2, X3
518A	0.5	Gry	DB1- 6, K2(86)

Circuit Number Wire Size Color Termination Points 518B 0.5 Gry K2(86), X2 521 0.5 Brn K4(86), DB1- 5 533 0.5 Org K5(87), K6(87a) 539A 0.5 Wht DB1- 1, DB1- 4 539B 0.5 Wht DB1- 4, S2 546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S7 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573B 0.5 Org K6(30), Splice 573 573B 0.5 Org		ı		I
521 0.5 Brn K4(86), DB1- 5 533 0.5 Org K5(87), K6(87a) 539A 0.5 Wht DB1- 1, DB1- 4 539B 0.5 Wht DB1- 4, S2 546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S7 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573B 0.5 Org K5(86), Splice 573 573B 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 57		_	Color	
533 0.5 Org K5(87), K6(87a) 539A 0.5 Wht DB1- 1, DB1- 4 539B 0.5 Wht DB1- 4, S2 546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S7 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574C 0.5 Yel Splice 5	518B	0.5	Gry	K2(86), X2
539A 0.5 Wht DB1- 1, DB1- 4 539B 0.5 Wht DB1- 4, S2 546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S7 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574, X15 586 0.5 Lt Blu S7, X	521	0.5	Brn	K4(86), DB1- 5
539B 0.5 Wht DB1- 4, S2 546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red S5, Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S2 562E 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	533	0.5	Org	K5(87), K6(87a)
546 0.5 Lt Blu K5(30), S7 556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red S5, Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S2 562E 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel Sp, Splice 574, X15 586 0.5 Lt Blu S7, X6	539A	0.5	Wht	DB1- 1, DB1- 4
556 0.5 Lt Blu K6(86), DB1- 2 562A 0.8 Red F5, Splice 562 562B 0.5 Red S5, Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562, S2 562E 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	539B	0.5	Wht	DB1- 4, S2
562A 0.8 Red F5, Splice 562 562B 0.5 Red S5, Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red Splice 562 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	546	0.5	Lt Blu	K5(30), S7
562B 0.5 Red S5, Splice 562 562C 0.5 Red Splice 562, S7 562D 0.5 Red S5, Splice 562 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	556	0.5	Lt Blu	K6(86), DB1-2
562C 0.5 Red Splice 562, S7 562D 0.5 Red S5, Splice 562 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	562A	0.8	Red	F5, Splice 562
562D 0.5 Red S5, Splice 562 562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574, X15 586 0.5 Lt Blu S7, X6	562B	0.5	Red	S5, Splice 562
562E 0.5 Red Splice 562, S2 562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574, X15 586 0.5 Lt Blu S7, X6	562C	0.5	Red	Splice 562, S7
562F 0.5 Red Splice 562, X5 572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574, X15 586 0.5 Lt Blu S7, X6	562D	0.5	Red	S5, Splice 562
572A 1.0 Red S1, K2(30) 572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	562E	0.5	Red	Splice 562, S2
572B 0.8 Red K2(30), DB1- 3 573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	562F	0.5	Red	Splice 562, X5
573A 0.5 Org K5(86), Splice 573 573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	572A	1.0	Red	S1, K2(30)
573B 0.5 Org K6(30), Splice 573 573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	572B	0.8	Red	K2(30), DB1-3
573D 0.5 Org Splice 573, S5 573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	573A	0.5	Org	K5(86), Splice 573
573E 0.5 Org Splice 573, X3 574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	573B	0.5	Org	K6(30), Splice 573
574A 0.5 Yel X7, Splice 574 574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	573D	0.5	Org	Splice 573, S5
574B 0.5 Yel S5, Splice 574 574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	573E	0.5	Org	Splice 573, X3
574C 0.5 Yel Splice 574, X15 586 0.5 Lt Blu S7, X6	574A	0.5	Yel	X7, Splice 574
586 0.5 Lt Blu S7, X6	574B	0.5	Yel	S5, Splice 574
	574C	0.5	Yel	Splice 574, X15
594A 0.5 Yel S7, K10 socket(86)	586	0.5	Lt Blu	S7, X6
	594A	0.5	Yel	S7, K10 socket(86)
594B 0.5 Yel K10 socket(86), X5	594B	0.5	Yel	K10 socket(86), X5

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W2 FUEL SHUTOFF SOLENOID WIRING HARNESS

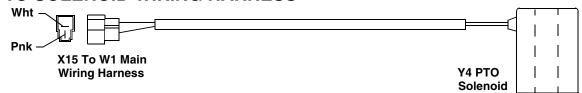


W3 HST NEUTRAL START WIRING HARNESS

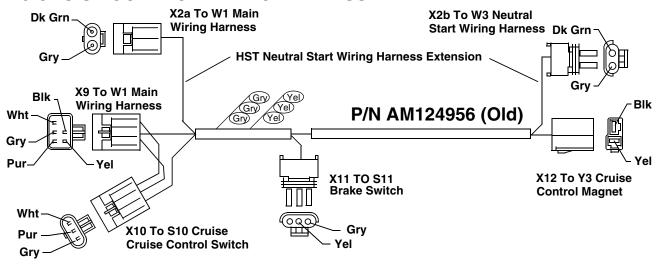


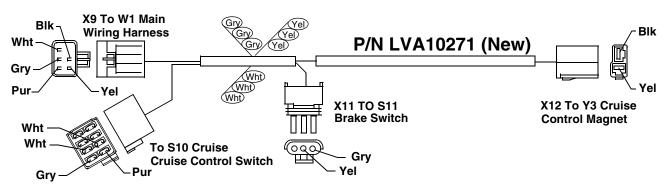


W4 PTO SOLENOID WIRING HARNESS



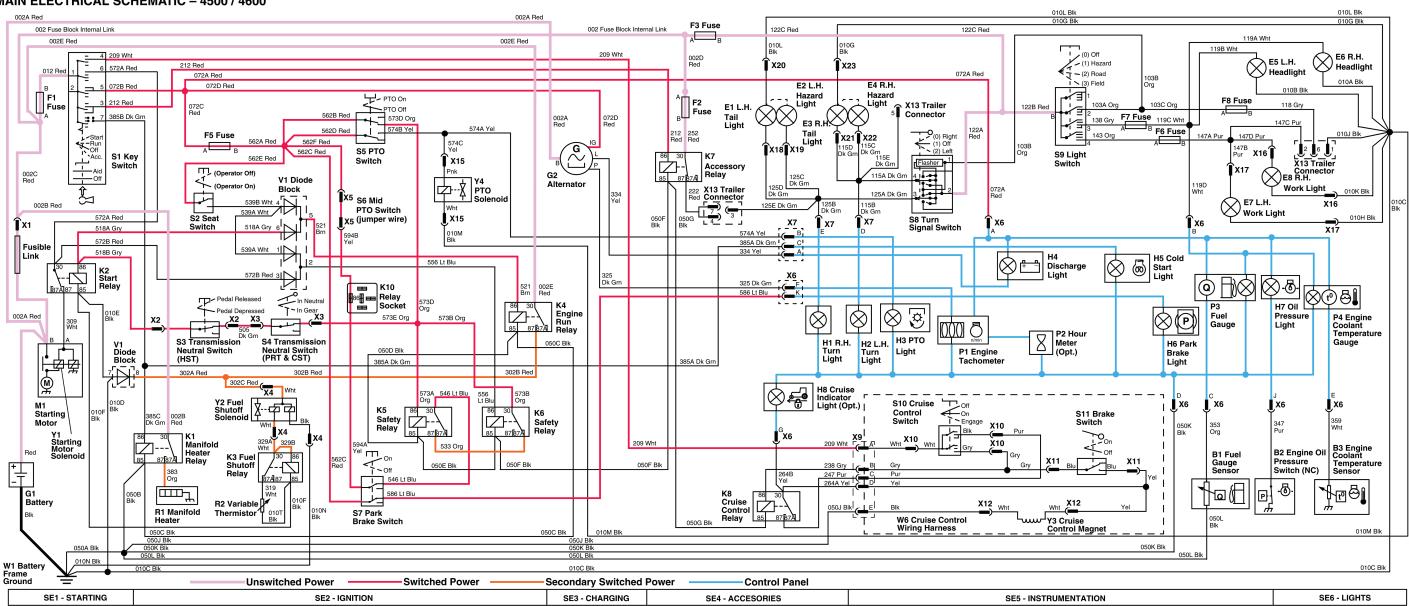
W5 CRUISE CONTROL WIRING HARNESS



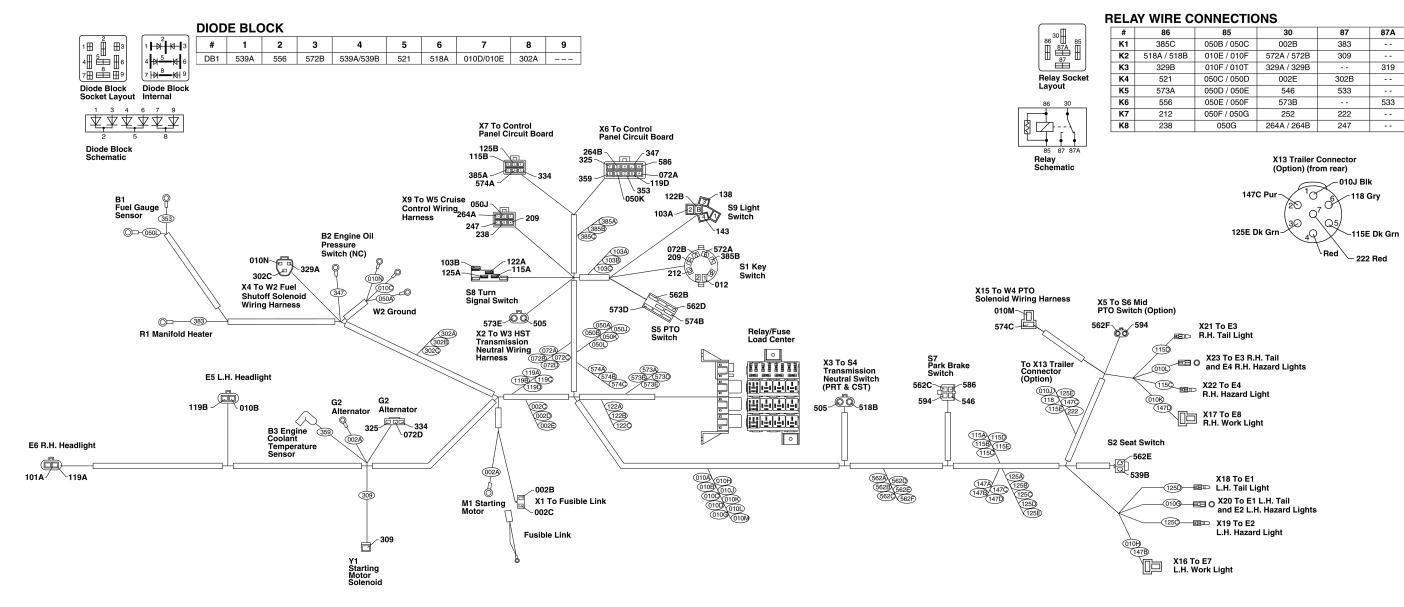


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MAIN ELECTRICAL SCHEMATIC - 4500 / 4600

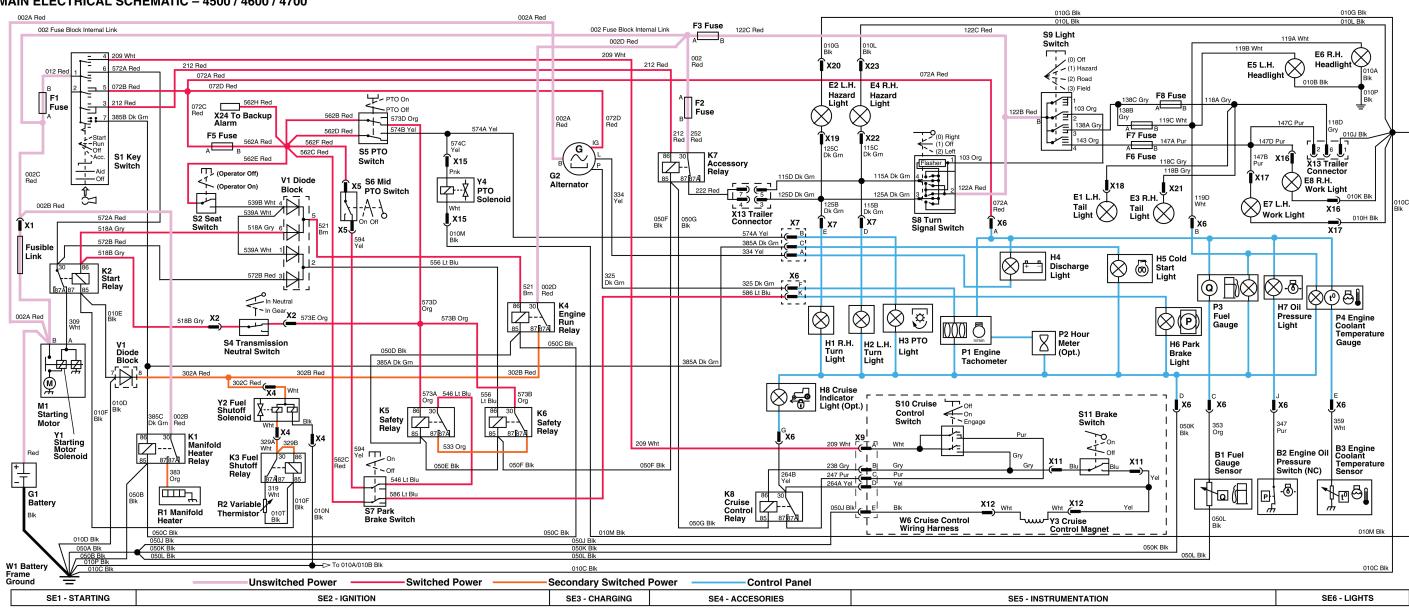


W1 MAIN WIRING HARNESS - 4500 / 4600



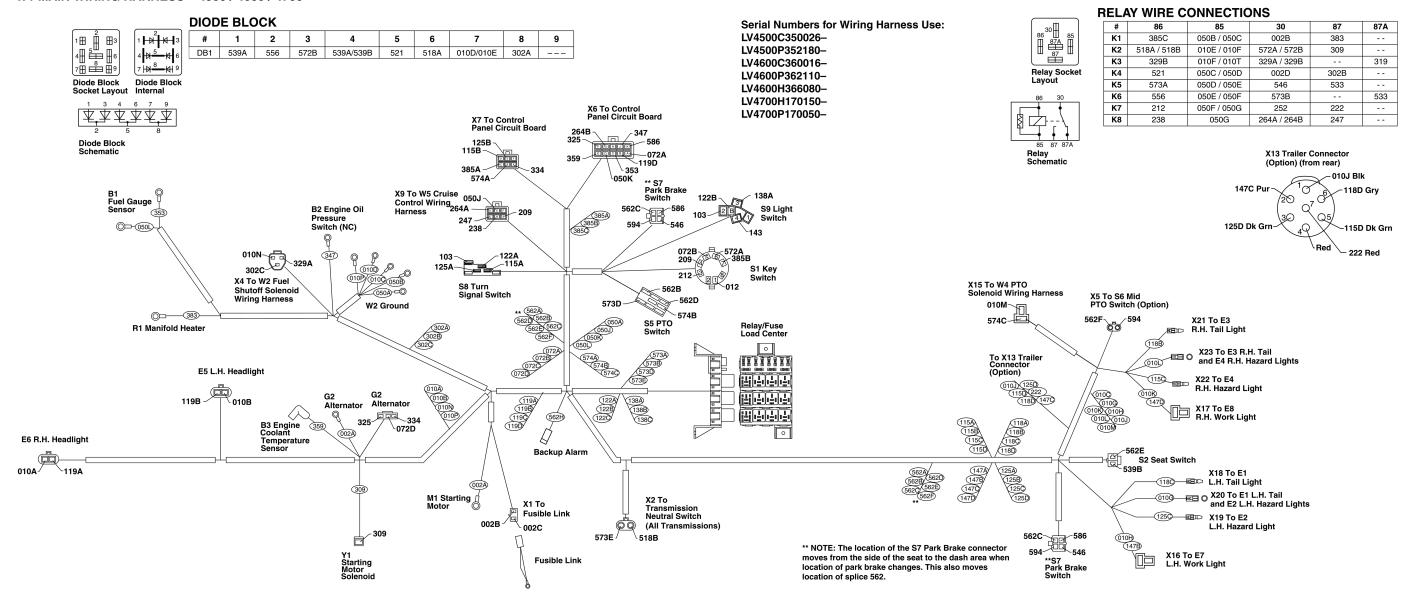
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MAIN ELECTRICAL SCHEMATIC - 4500 / 4600 / 4700



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W1 MAIN WIRING HARNESS - 4500 / 4600 / 4700



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WIRE COLOR CODES - 4500/4600/ 4700

Serial Number Breaks for Main Wiring Harness:

- -LV4500C350026
- -LV4500P352180
- -LV4600C360016
- -LV4600P362110
- -LV4600H366080
- -LV4700P170150
- -LV4700H175050

Circuit Number	Wire Size	Color	Termination Points
002A	5.0	Red	M1, G2
002B	5.0	Red	X1 (Fusible Link), K1(30)
002C	5.0	Red	X1 (Fusible Link), Splice 002 (F1)
002D	2.0	Red	F2, K4 (30)
010A	0.8	Blk	E6, Splice 010A
010B	0.8	Blk	E5, Splice 010A
010C	2.0	Blk	W1, Splice 010B
010D	0.8	Blk	DB1-7, W1
010E	0.8	Blk	DB1-7, K2(85)
010F	0.5	Blk	K2(85), K3(85)
010G	0.8	Blk	Splice 010B, X20
010H	0.8	Blk	Splice 010B, X17
010J	2.0	Blk	Splice 010B, X13
010K	0.8	Blk	Splice 010B, X16
010L	0.8	Blk	Splice 010B, X23
010M	0.8	Blk	Splice 010B, X15
010N	1.0	Blk	X4, Splice 010A
010P	1.0	Blk	Splice 010A, W1
010N	1.0	Blk	X4, W1
010T	0.8	Blk	K3(85), R2
012	5.0	Red	S1, F1
050A	1.0	Blk	W1, Splice 050

Circuit Number	Wire Size	Color	Termination Points
050B	0.8	Blk	K1(85), W1
050C	0.8	Blk	K1(85), K4(85)
050D	0.8	Blk	K4(85), K5(85)
050E	0.8	Blk	K5(85), K6(85)
050F	0.8	Blk	K6(85), K7(85)
050G	0.8	Blk	K7(85), K8(85)
050J	0.8	Blk	Splice 050, X9(E)
050K	0.8	Blk	Splice 050, X6(D)
050L	0.8	Blk	B1, Splice 050
072A	1.0	Red	X6(A), Splice 072
072B	1.0	Red	S1, Splice 072
072C	0.8	Red	Splice 072, F5
072D	0.8	Red	Splice 072, G2
103	1.0	Org	S9, S8
115A	1.0	Dk Grn	S8, Splice 115
115B	0.8	Dk Grn	Splice 115, X7(D)
115C	0.8	Dk Grn	Splice 115, X22
115D	1.0	Dk Grn	Splice 115, X13
118A	1.0	Gry	F8, Splice 118
118B	0.8	Gry	Splice 118, X21
118C	0.8	Gry	Splice 118, X18
118D	1.0	Gry	Splice 118, X13
119A	1.0	Wht	Splice 119, E6
119B	1.0	Wht	Splice 119, E5
119C	2.0	Wht	F7, Splice 119
119D	0.8	Wht	Splice 119, X6(B)
122A	1.0	Red	Splice 122, S8
122B	3.0	Red	Splice 122, S9
122C	3.0	Red	F3, Splice 122
125A	1.0	Dk Grn	S8, Splice 125
125B	0.8	Dk Grn	Splice 125, X7(E)
125C	0.8	Dk Grn	Splice 125, X19

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Circuit Number	Wire Size	Color	Termination Points
125D	0.8	Dk Grn	Splice 125, X13
138A	2.0	Gry	S9, Splice 138
138B	2.0	Gry	Splice 138, F7
138C	1.0	Gry	Splice 138, F8
143	2.0	Org	S9, F6
147A	2.0	Pur	F6, Splice 147
147B	0.8	Pur	Splice 147, X17
147C	2.0	Pur	Splice 147, X13
147D	0.8	Pur	Splice 147, X16
209	0.8	Wht	S1, X9(A)
212	0.5	Red	S1, K7(86)
222	2.0	Red	K7(87), X13
238	0.8	Gry	K8(86), X9(B)
247	0.8	Pur	X9(C), K8(87)
252	2.0	Red	F2, K7(30)
264A	0.8	Yel	K8(30), X9(D)
264B	0.8	Yel	K8(30), X6(G)
302A	1.0	Red	DB1- 8, Splice 302
302B	1.0	Red	K4(87), Splice 302
302C	1.0	Red	Splice 302, X4
309	1.0	Wht	K2(87), M1
319	0.8	Wht	K3(87a), R2(+)
325	0.8	Dk Grn	G2, X6(F)
329A	1.0	Wht	X4, K3(30)
329B	1.0	Wht	K3(30), K3(86)
334	0.8	Yel	G2, X7(A)
347	0.5	Pur	X6(J), B2
353	0.5	Org	X6(C), B1
359	0.5	Wht	X6(E), B3
383	3.0	Org	K1(87), R1
385A	0.8	Dk Grn	Splice 385, X7(C)
385B	0.8	Dk Grn	S1, Splice 385

Circuit Number	Wire Size	Color	Termination Points
385C	0.5	Dk Grn	Splice 385, K1(86)
505	0.5	Dk Grn	X2, X3
518A	0.5	Gry	DB1- 6, K2(86)
518B	0.5	Gry	K2(86), X2
521	0.5	Brn	DB1- 5, K4(86)
533	0.5	Org	K5(87), K6(87a)
539A	0.5	Wht	DB1- 4, DB1- 1
539B	0.5	Wht	S2, DB1- 4
546	0.5	Lt Blu	K5(30), S7
556	0.5	Lt Blu	K6(86), DB1- 2
562A	0.8	Red	F5, Splice 562
562B	0.5	Red	Splice 562, S5
562C	0.5	Red	Splice 562, S7
562D	0.5	Red	Splice 562, S5
562E	0.5	Red	Splice 562, S2
562F	0.5	Red	Splice 562, X5
562H	0.8	Red	Splice 562, X24
572A	1.0	Red	S1, K2(30)
572B	0.8	Red	K2(30), DB1- 3
573A	0.5	Org	Splice 573, K5(86)
573B	0.5	Org	Splice 573, K6(30)
573D	0.5	Org	S5, Splice 573
573E	0.5	Org	Splice 573, X2
574A	0.5	Yel	Splice 574, X7(B)
574B	0.5	Yel	S5, Splice 574
574C	0.5	Yel	Splice 574, X15
586	0.5	Lt Blu	S7, X6(K)
594	0.5	Yel	X5, S7

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TROUBLESHOOTING

Problem or Symptom Check or Solution	Starter cranking problems	Engine cranks but will not start	Engine will not shut off	Improper component operating with switch	Engine oil light problem	Battery goes dead, discharges or overcharges	Discharge light problem	Engine coolant temperature light problem	Engine will not run when operator leaves seat	Instrument lights problems	Headlight problem	Fuel gauge does not work properly
See Power Circuit Diagnosis	•	•									•	
See Engine Shutoff Circuit Diagnosis	•	•	•						•			
See Cranking Circuit Diagnosis	•											
Check ground circuit	•	•										
Test battery and battery connections	•											
See Manifold Heater Circuit Diagnosis		•										
See Fuel Supply Circuit Diagnosis		•										
See Charging Circuit Diagnosis						•	•					
See Control Panel Indicator Diagnosis					•		•	•		•		•
See Lights Circuit Diagnosis											•	
Check for shorted circuit			•	•		•						•



THEORY AND DIAGNOSIS

POWER CIRCUIT OPERATION

Function:

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

The power circuits are divided among the unswitched power circuit, switched power circuits (key switch in RUN, START, or AID positions), and secondary power circuits. The secondary power circuits become energized when switched power circuits energize relays, providing current paths to the secondary circuits. The secondary power circuits would not be energized if the relays controlling the current path(s) failed.

Detailed Theory of Operation, Schematics, and Troubleshooting of circuits are provided throughout the electrical section.

Unswitched Power:

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

- Battery Positive Terminal
- Starting Motor Terminal B
- F1 Fuse
- Key Switch Terminal 1
- B Terminal of Alternator
- Manifold Heater Relay Terminal 30
- Engine Run Relay Terminal 30
- F3 Fuse
- Light Switch Terminal B
- Turn Signal Switch Terminal 2
- F2 Fuse
- Accessory Relay Terminal 30

The positive battery cable connects the battery to the starting motor. The starting motor bolt is used as the 12 Volt DC tie point for the rest of the electrical system.

The battery cables and the starting motor tie point connections must be good for the vehicle electrical system to work properly. The ground cable and positive cable connections are equally important. Proper starting motor operation depends on these cables and connections to carry high current.

With the exception of the B terminal of the alternator, the electrical circuit is protected by the fusible link beyond the starting motor tie point. The fusible link is a short piece of wire that is designed to fail if current load is too high or a short occurs.

Switched Power - Run:

In addition to the voltage present at the locations of the unswitched power circuits, voltage must be present at the following components with the key switch in the RUN ("ON") position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminals 3, 4, and 5
- Alternator Terminal IG
- F5 Fuse
- PTO Switch Terminals A, G and H
- X5 Connector (562F Red wire)

NOTE: X5 connector has jumper wire installed unless Mid PTO option is installed.

- Park Brake Switch Terminals A, B, C and D
- K5 Safety Relay Terminals 86 and 30
- K6 Safety Relay Terminal 30
- Seat Switch
- X9 Connector Terminal A
- Cruise Control Switch
- X6 Connector Terminals A and K
- X7 Connector Terminal A
- Accessory Relay Terminal 86
- X3 Connector (573E Org wire); or, X2 Connector (505 Dk Grn wire [573E Org wire - models with only one transmission switch])

NOTE: **For older models:** The S4 Transmission Neutral Switch is installed in collar shift gear drive (CST) and PowrReverser™ (PRT) tractors; a jumper wire is installed in the X2 connector, and the S3 Transmission Neutral Switch is not used.

In hydrostatic drive (HST) tractors the S3 Transmission Neutral Switch is used, and a jumper wire is installed in the X3 connector - eliminating the S4 switch.

For newer models: There is only one main wiring harness connector (X2) for the transmission switch (S4). See serial number breaks on pages 20 and 21.

- Start Relay Terminal 86
- Diode Block Terminal 6
- Engine Run Relay Terminal 86

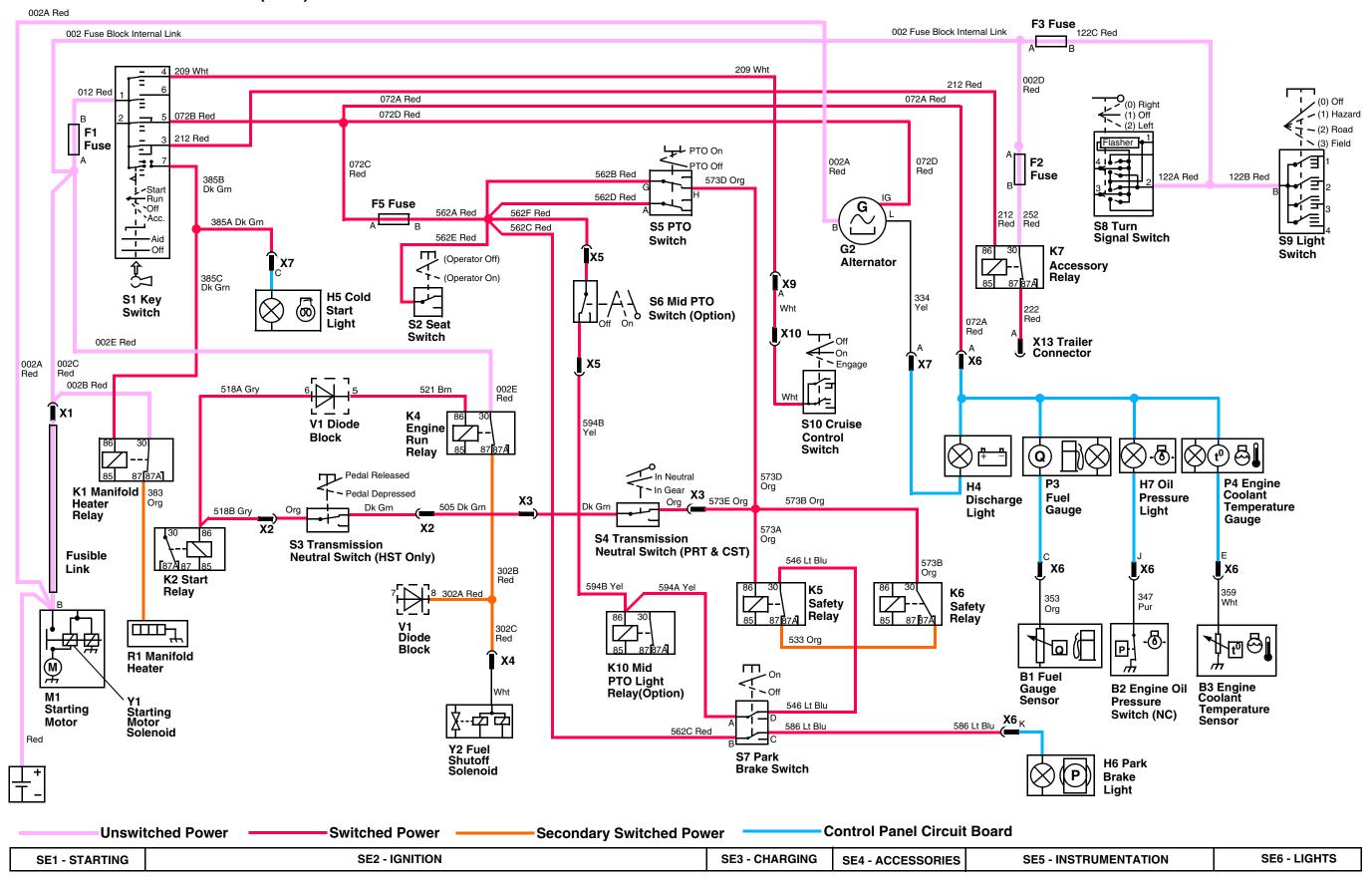
Secondary Switched Power - Run:

Voltage must be present at the following components with the key switch in the RUN ("ON") position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- K5 Safety Relay Terminal 87
- K6 Safety Relay Terminal 87a
- Engine Run Relay Terminal 87
- X4 Connector (302C Red wire)

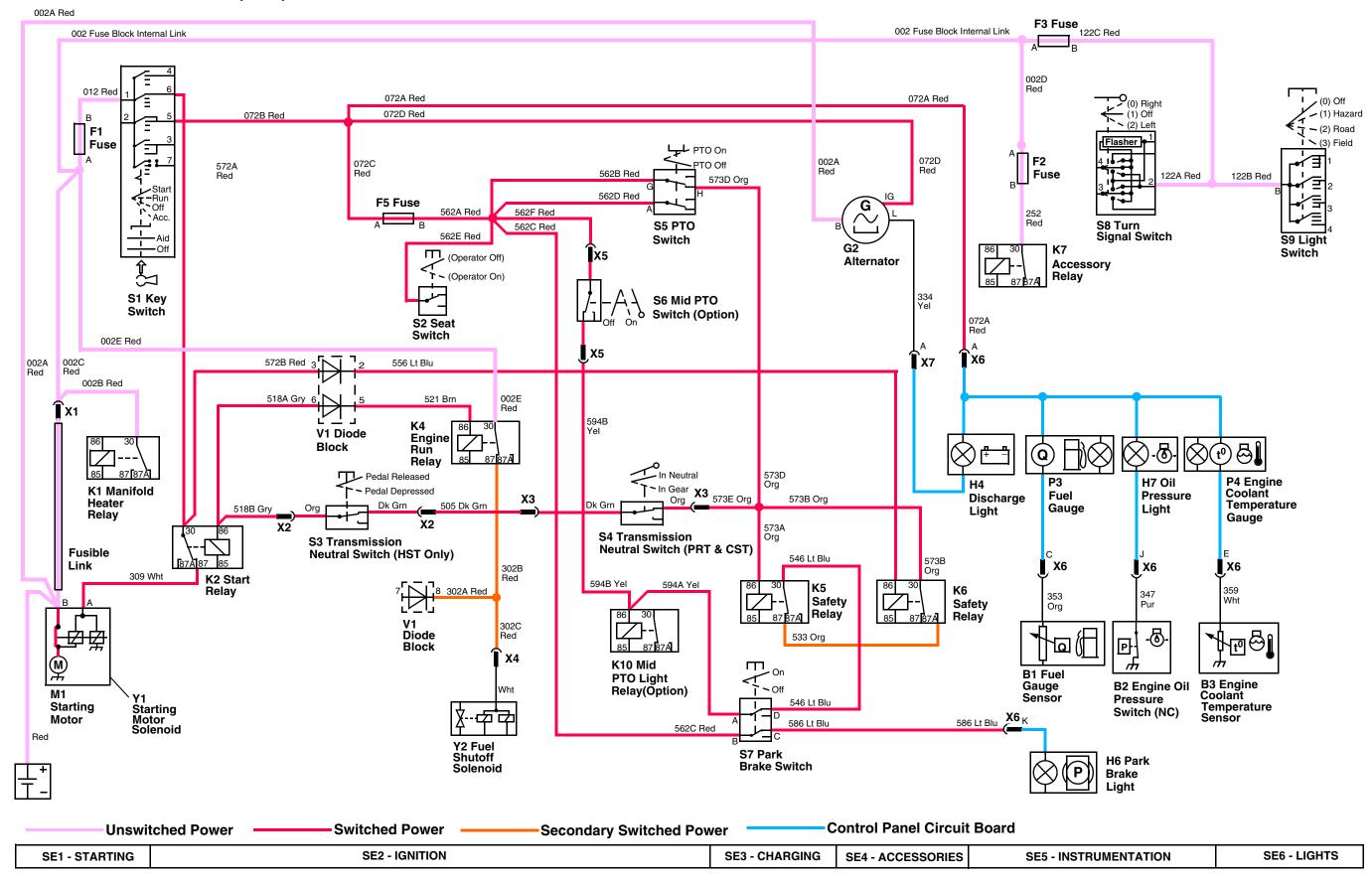


POWER CIRCUIT - RUN / AID (OLD)

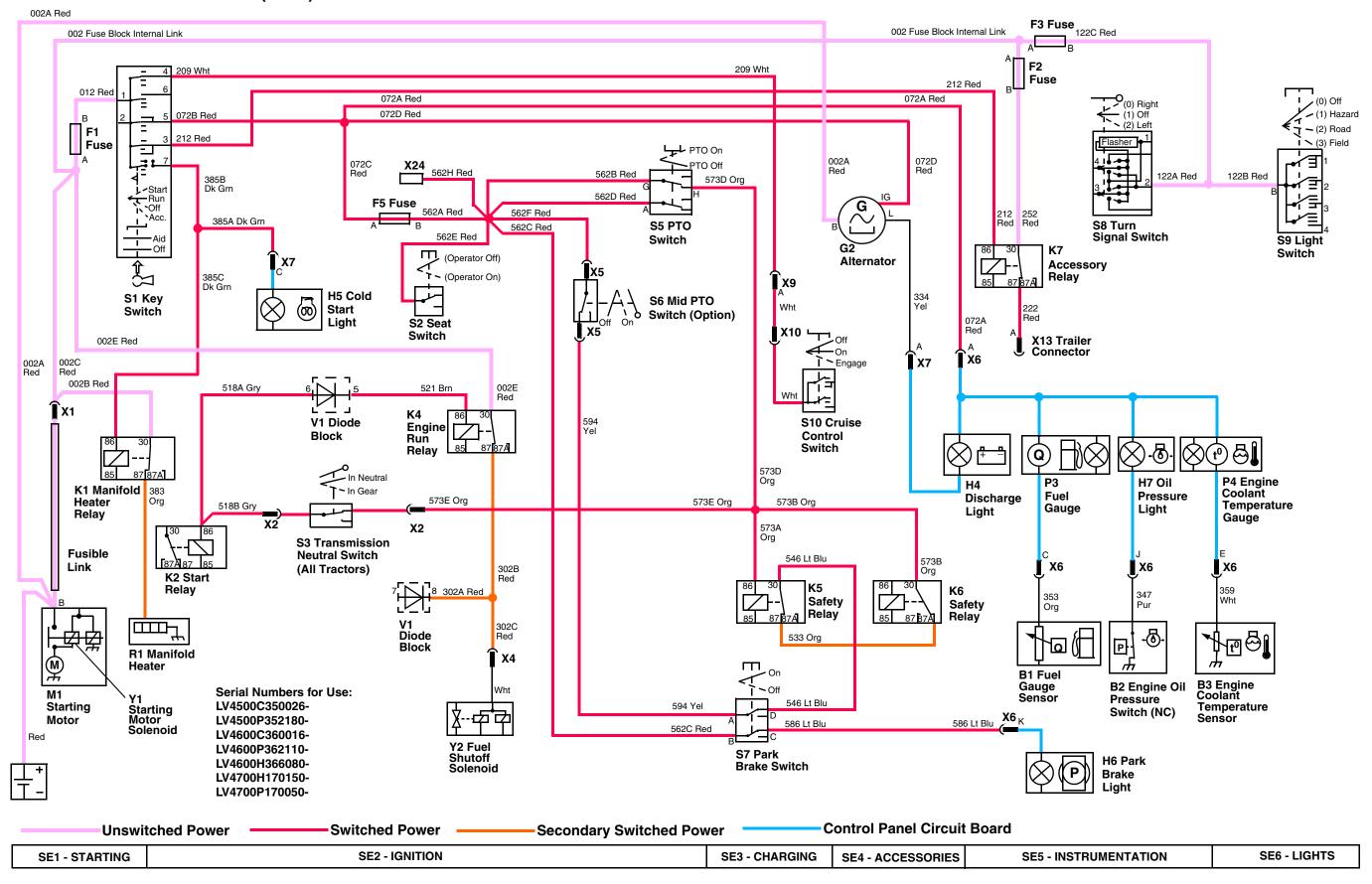


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POWER CIRCUIT - START (OLD)

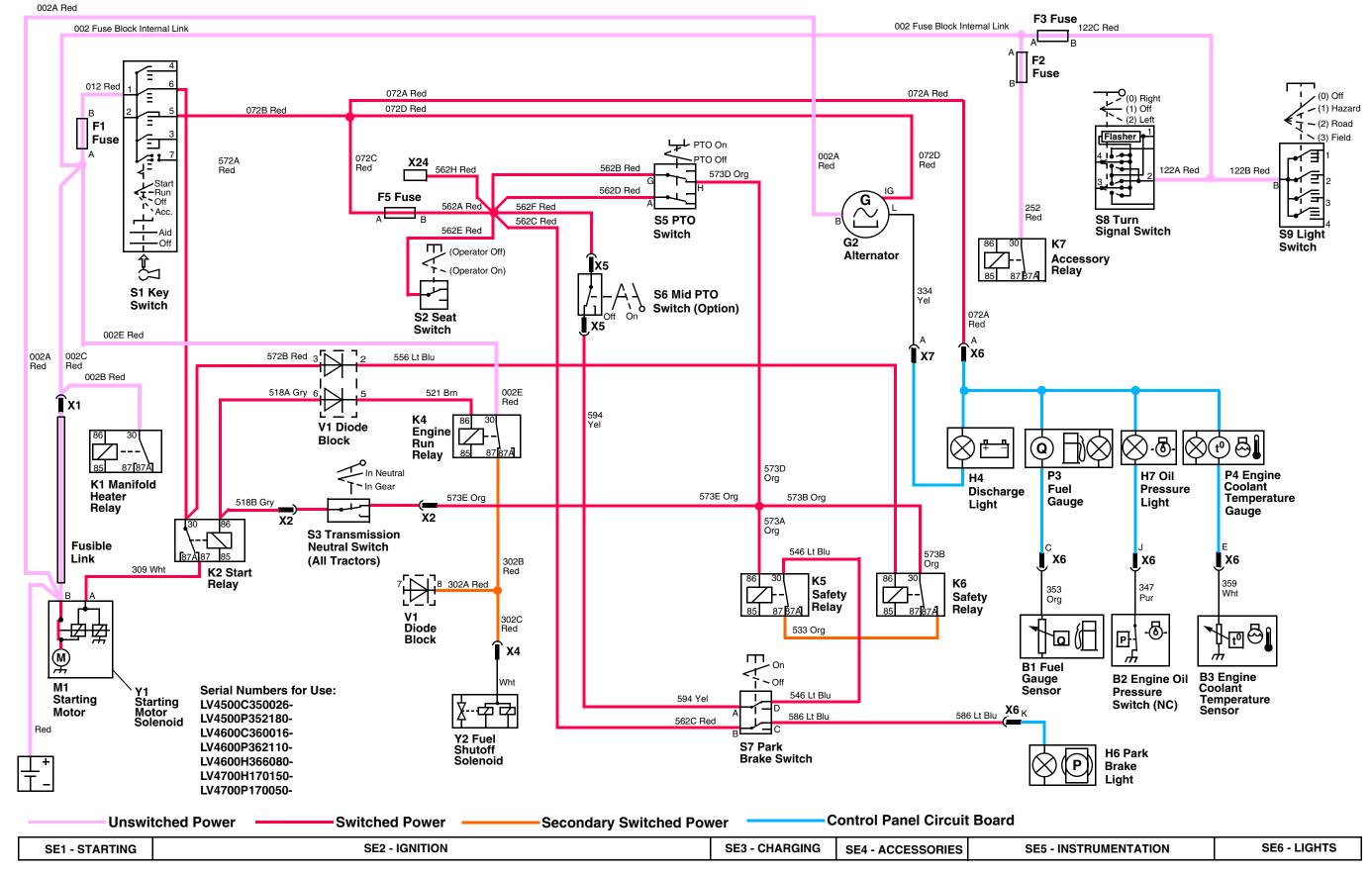


POWER CIRCUIT - RUN / AID (NEW)



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POWER CIRCUIT - START (NEW)



Switched Power - Aid:

Voltage must be present at the following components with the key switch in the AID position (key pushed in when placed in the RUN or START position), transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminal 7
- Manifold Heater Relay Terminal 86

These circuits are controlled by the key switch and are protected by the fusible link and the F1 fuse.

Secondary Switched Power - Aid:

Voltage must be present at the following components with the key switch in the AID position (key pushed in when placed in the RUN or START position):

- Manifold Heater Relay Terminal 87
- Manifold Heater

See "MANIFOLD HEATER OPERATION" on page 36.

Switched Power - Start:

Voltage must be present at the following components with the key switch in the START position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminals 5 and 6
- Start Relay Terminal 30
- Diode Block Terminal 3
- K6 Safety Relay Terminal 86
- Start Relay Coil (If start criteria are met)

NOTE: These components are in addition to the components that would have power with the key switch in the RUN position. However, voltage would not be present at the cruise control switch, or at the accessory relay (terminal 86) with the key switch in the START position.

Secondary Switched Power - Start:

Voltage must be present at the following components with the key switch in the START position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Start Relay Terminal 87
- Starting Motor Terminal A

See "CRANKING CIRCUIT OPERATION" on page 36.

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POWER CIRCUIT DIAGNOSIS

Test Conditions:

• Key switch in OFF position

• Transmission in NEUTRAL

• Park brake ENGAGED

• PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
Starting motor battery (B) terminal	12.4 - 13.2 VDC	Check cable to battery. Test battery.
2. Alternator (B terminal)	12.4 - 13.2 VDC	Check 002A Red cable and connections.
3. Fuse block (F1 fuse)	12.4 - 13.2 VDC	Check fusible link, 002C Red wire and connections.
4. Fuse block (F3 fuse)	Check internal fuse connection in load center (tie to F1 fuse).	
5. Fuse block (F2 fuse)	12.4 - 13.2 VDC	Check 002D Red wire and connections.
6. Accessory relay socket	12.4 - 13.2 VDC	Check F2 fuse, 252 Red wire and connections.
7. Turn signal switch	12.4 - 13.2 VDC	Check F3 fuse, 122C and 122A Red wires and connections.
8. Light switch	12.4 - 13.2 VDC	Check F3 fuse, 122C and 122B Red wires and connections.
9. Key switch	12.4 - 13.2 VDC	Check F1 fuse, 012 Red wire and connections.
10. Manifold heater relay socket (terminal 30)	12.4 - 13.2 VDC	Check fusible link, 002B Red wire and connections.
11. Engine run relay socket (terminal 30)	12.4 - 13.2 VDC	Check fusible link, 002E Red wire and connections.

Test Conditions:

• Key switch in RUN position

• Park brake ENGAGED

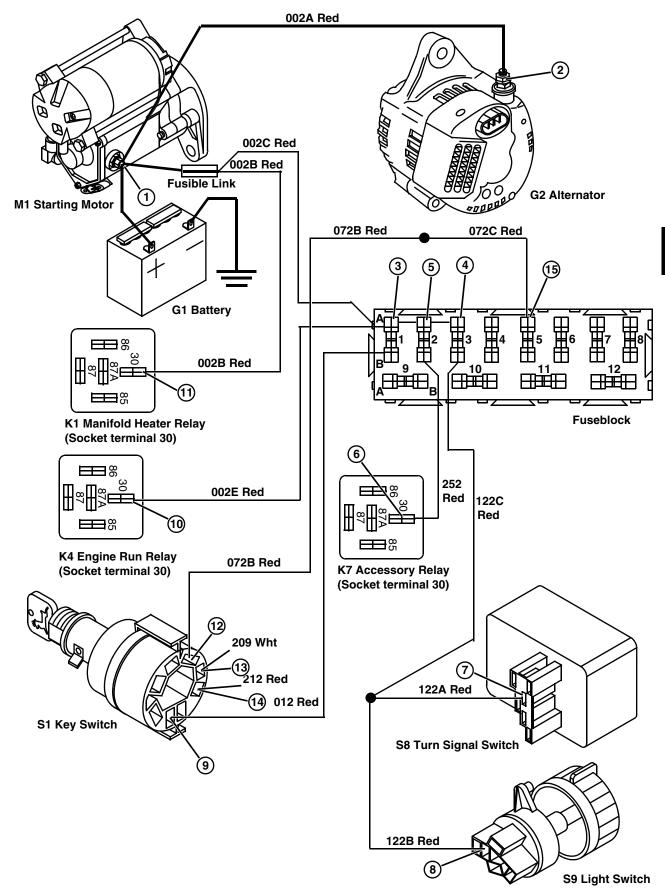
• Engine OFF

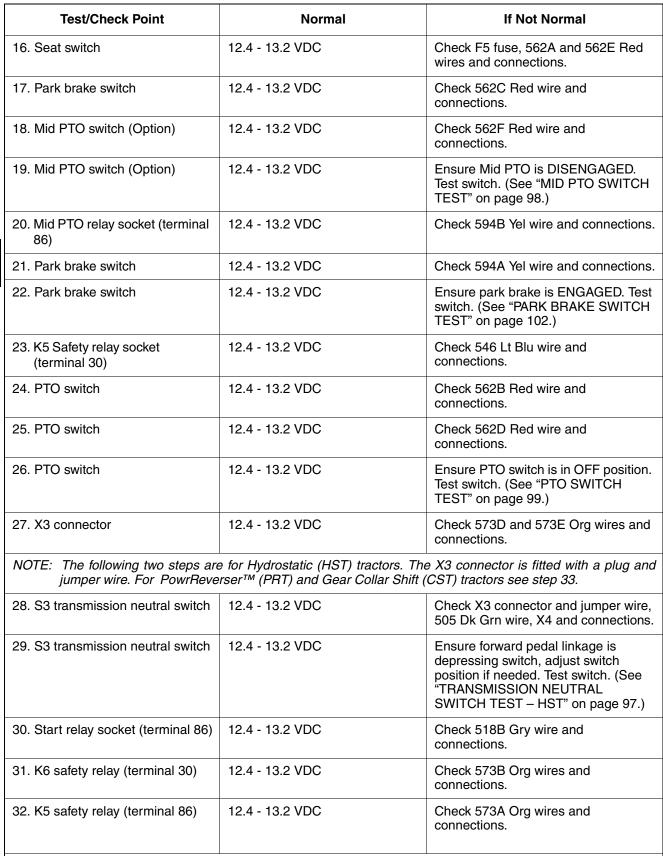
• Transmission in NEUTRAL

• PTO DISENGAGED

12. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as necessary.
13. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as necessary.
14. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as necessary.
15. Fuseblock (F5 fuse)	12.4 - 13.2 VDC	Check 072A and 072B Red wires and connections.

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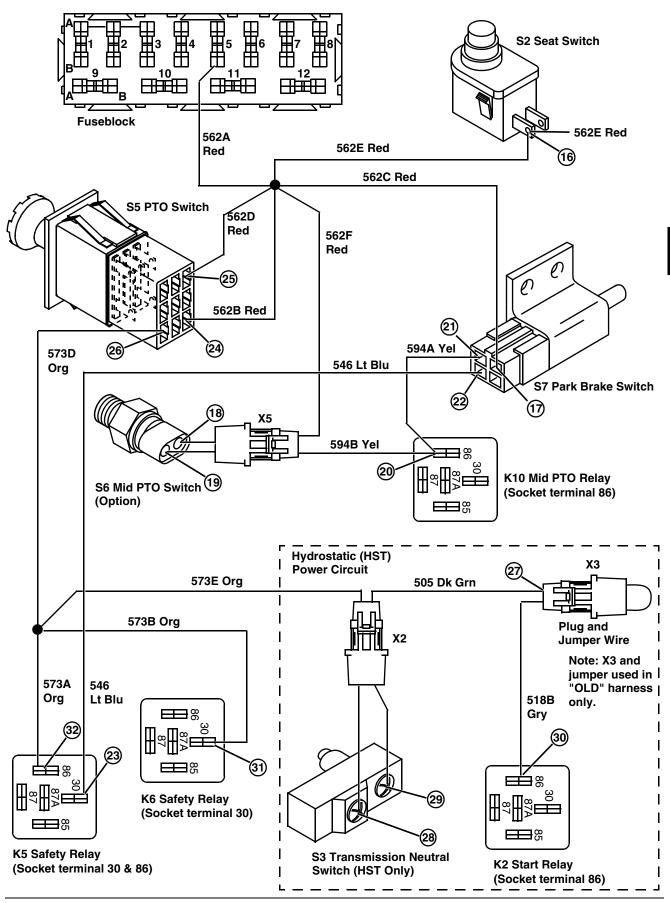




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NOTE: The following two steps are for and PowrReverser™ (PRT) Gear Collar Shift (CST) tractors. The X2 connector is fitted with a plug and jumper wire. For Hydrostatic (HST) tractors see step 28.





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	Test/Check Point	Normal	If Not Normal
•	33. S3 Transmission neutral switch	12.4 - 13.2 VDC	Ensure rear PTO is DISENGAGED. Check 573D and 573E Org wires and connections.
	34. S3 Transmission neutral switch	12.4 - 13.2 VDC	Ensure transmission is in NEUTRAL. Test switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – CST & PRT" on page 96.)
	35. Start relay socket (terminal 86)	12.4 - 13.2 VDC	Check 505 Dk Grn wire, X2 connector and jumper wire, 518B Gry wire and connections.
	36. Diode block socket (terminal 6)	12.4 - 13.2 VDC	Check 518A Gry wire and connections.
	37. Engine run relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure diode block is fully seated. Test diode block. (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.
	38. X6 connector to control panel	12.4 - 13.2 VDC	Check 072B and 072A Red wires and connections.
	39. Park brake switch	12.4 - 13.2 VDC	Ensure park brake is ENGAGED. Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.) Check F5 fuse, 562A and 562C Red wires and connections.
	40. X6 connector to control panel	12.4 - 13.2 VDC	Check 586 Lt Blu wire and connections.
	41. Alternator IG Terminal	12.4 - 13.2 VDC	Check 072B and 072D Red wires and connections.
	42. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.)
	43. X9 connector	12.4 - 13.2 VDC	Check 209 Wht wire and connections.

Test Conditions: Secondary Power

NOTE: The following test is the fuel shutoff solenoid that receives power after the K4 relay is activated when voltage is provided to the relay coil. The circuit needs to have the K4 relay in place to perform these tests. For further detail. See "FUEL SUPPLY OPERATION" on page 42, and "ENGINE SHUTOFF CIRCUIT OPERATION" on page48.

• Key switch in RUN position

Park brake ENGAGED

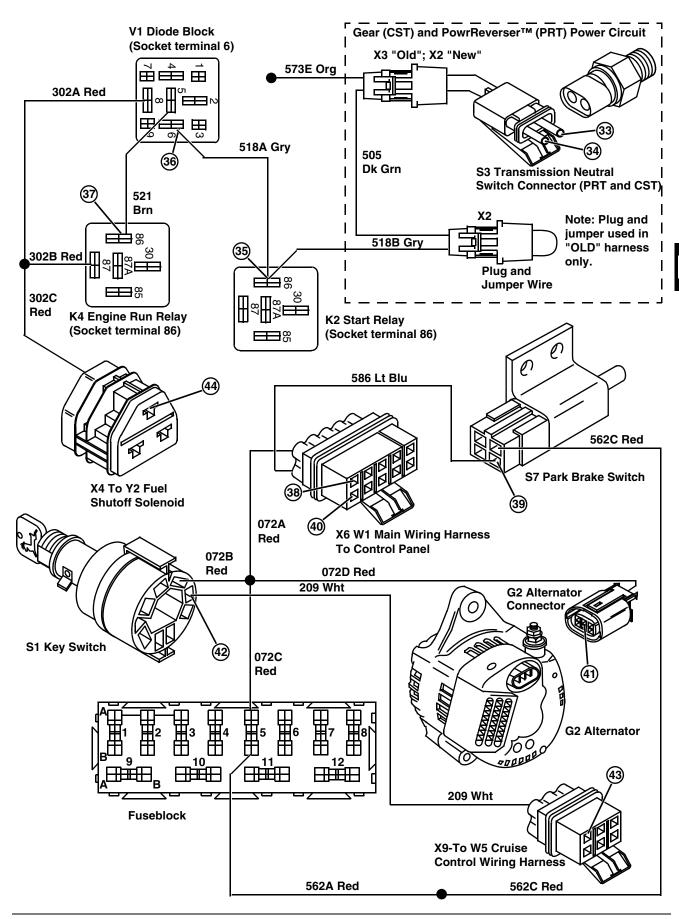
• Engine OFF

- Transmission in NEUTRAL
- PTO DISENGAGED

44. X4 connector to fuel shutoff solenoid	12.4 - 13.2 VDC Note: Battery voltage can not be tested at the diode block socket, as the diode block needs to be in place to energize the engine run relay coil.	Ensure K4 engine run relay coil is powered. See step 37. Check engine run relay. (See "RELAY TEST" on page 91.) Check 302B and 302C Red wires and connections.
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CRANKING CIRCUIT OPERATION

Function:

To energize the starting motor solenoid and engage the starting motor to crank the engine.

Operating Conditions:

- Key switch in START position
- Transmission in NEUTRAL
- Rear PTO DISENGAGED (disengages mid PTO)

Theory of Operation:



The power circuit (fusible link, 002C Red wire, F1 fuse, and 012 Red wire) provides voltage to the key switch.

When placed in the START position the key switch provides current to the start relay contact (572A Red to terminal 30 of start relay).

The start relay coil is energized through a circuit consisting of: the key switch (terminal 5), 072B and 072C Red wires, F5 fuse, 562A and 562B Red wires, PTO switch (OFF position), 573D and 573E Org wires, S4 transmission neutral switch, 505 Dk Grn wire, X2 with jumper wire, and 518B Gry wire on PRT and CST tractors; or, X3 with jumper wire, 505 Dk Grn wire, X2, S3 transmission neutral switch, X2, and 518B Gry wire on HST tractors.

NOTE: The S4 Transmission Neutral Switch is installed in collar shift gear drive (CST) and PowrReverser™ (PRT) tractors; a jumper wire is installed in the X2 connector, and the S3 Transmission Neutral Switch is not used. In hydrostatic drive (HST) tractors the S3 Transmission Neutral Switch is used, and a jumper wire is installed in the X3 connector eliminating the S4 switch.

When the start relay coil is energized, the K2 relay contacts close and current flows to the starting motor solenoid (309 Wht).

With the starting motor solenoid energized, the starting motor solenoid contacts close and high current from the battery passes through the battery cable and solenoid contacts to the starting motor. The starting motor cranks the engine.



CAUTION

To avoid injury, ALWAYS engage park brake when starting the engine.

MANIFOLD HEATER OPERATION

Function:

To provide an added source of heat for combustion.

Operating Conditions:

 Key switch must be in the START or RUN position and pushed in to the AID position.

Theory of Operation:

The ignition system is designed to inject diesel fuel into the piston cylinder where heat from compression ignites the fuel and air mixture.

When starting a cold engine, compression may not provide enough heat to ignite the fuel. The manifold heater is installed to provide added heat to the incoming combustion air.

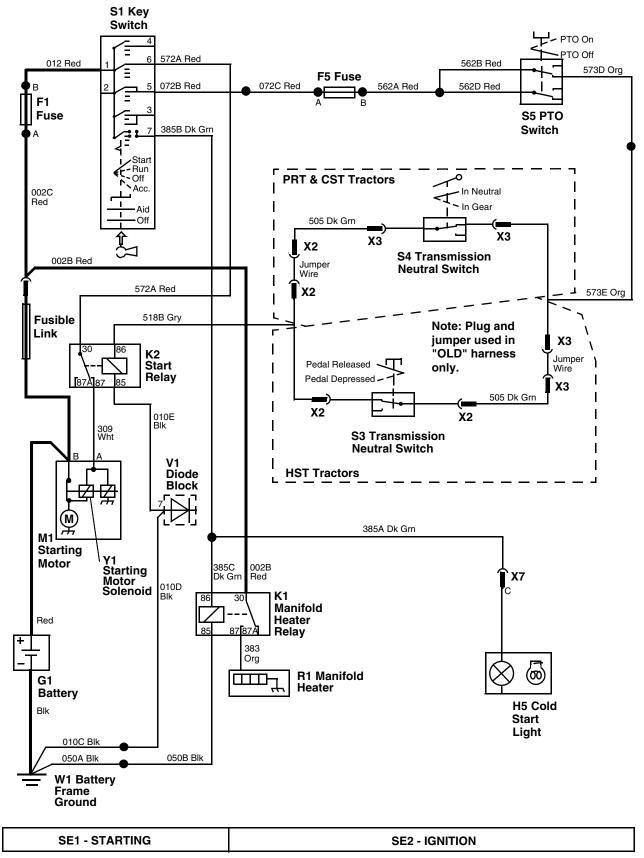
The manifold heater is energized (heated) when the key switch is placed in the AID position (key pushed into switch). The key can be pushed into the AID position with the key in either the START or RUN position. The manifold may be preheated by pushing in the key, with the switch in the RUN position, for up to 3 seconds before turning the key to the START position.

When the key switch is in the AID position, current is provided to the K1 manifold heater relay coil (terminal 86) through the 385B and 385C Dk Grn wires. When the relay coil is energized, the relay contacts close and unswitched power (002B Red wire - terminal 30) flows through the contacts and 383 Org wire to the manifold heater.

The H5 cold start indicator light in the control panel provides a visual indication that the key is in the AID position and the manifold heater relay is being energized. The indicator lamp is powered through the 385B and 385A Dk Grn wires, X7 connector (terminal C), and control panel circuit board. (See "CONTROL PANEL INDICATOR LIGHTS" on page 64.)

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CRANKING CIRCUIT ELECTRICAL SCHEMATIC



CRANKING CIRCUIT DIAGNOSIS

Test Conditions:

- Park brake ENGAGED
- Key switch in OFF position

- Transmission in NEUTRAL
- PTO switch in OFF position

Test/Check Point	Normal	If Not Normal
1. Key switch	12.4 - 13.2 VDC	Check 200 Red wire and F1 fusible link. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)

Test Conditions:

- Park brake ENGAGED
- Transmission in NEUTRAL
- K1 start relay unplugged
- PTO switch in OFF position
- Key switch in START position

2. Key switch	12.4 - 13.2 VDC	Test switch. (See "KEY SWITCH TEST" on page 95.) Replace key switch as necessary.
3. F5 fuse	12.4 - 13.2 VDC	Check 072B and 072C Red wires and connections.
4. PTO switch	12.4 - 13.2 VDC	Check F5 fuse and 562B Red wire and connections.
5. PTO switch	12.4 - 13.2 VDC	Ensure PTO switch is in OFF position. Test switch. (See "PTO SWITCH TEST" on page 99.) Replace switch as needed.
6. Transmission neutral switch	12.4 - 13.2 VDC	Check 573D and 573E Org wires, connector / jumper wire, and 505 Dk Grn wire and connections.
7. Transmission neutral switch	12.4 - 13.2 VDC	Check switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – CST & PRT" on page 96.) or (See "TRANSMISSION NEUTRAL SWITCH TEST – HST" on page 97.) Adjust or replace switch as needed.
8. K2 start relay socket (terminal 86)	12.4 - 13.2 VDC	Check 518B Gry wire and connections.
9. K2 start relay socket (terminal 30)	12.4 - 13.2 VDC	Check 572A Red wire and connections.

Test Conditions:

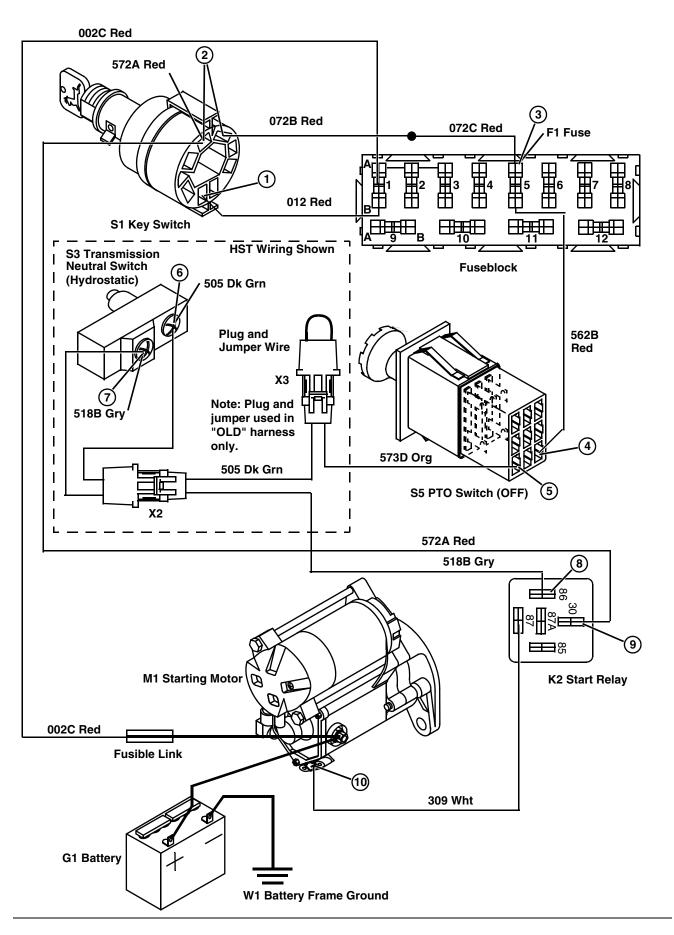
- Park brake ENGAGED
- Transmission in NEUTRAL
- X4 wiring harness connector to fuel solenoid disconnected
- K1 start relay plugged in
- PTO switch in OFF position
- Key switch in START position



CAUTION: Engine may start during this procedure. Disconnect fuel shutoff solenoid.

10. Starting motor	12.4 - 13.2 VDC	Check 309 Wht wire and connections. Check K2 start relay. (See "RELAY TEST" on page 91.) Replace relay as needed.
		Tiopiade relay as fiedded.

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MANIFOLD HEATER CIRCUIT DIAGNOSIS

Test Conditions:

- Park brake ENGAGED
- Key switch in OFF position
- K1 manifold heater relay unplugged

Test/Check Point	Normal	If Not Normal
1. Key switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
2. Manifold heater relay socket	12.4 - 13.2 VDC	Check 002B Red wire and connections. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)



Test Conditions:

- Park brake ENGAGED
- K2 start relay unplugged
- K1 manifold heater relay unplugged
- Key switch in RUN position; key in AID position (pushed in)

3. Key switch	12.4 - 13.2 VDC	Check key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as needed.
4. Manifold heater relay socket	Continuous 12.4 - 13.2 VDC while key switch is in AID position	Check 385B and 385C Dk Grn wires and connections.

Test Conditions:

- Park brake ENGAGED
- K2 start relay unplugged
- K1 manifold heater relay installed in to socket
- Key switch in RUN position; key in AID position (pushed in)

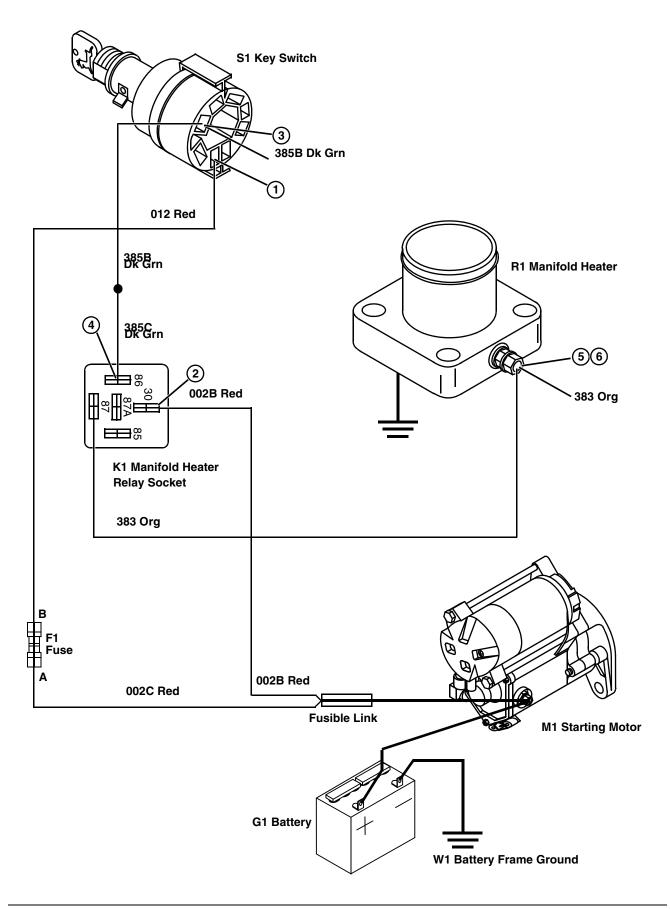
5. Manifold heater	12.4 - 13.2 VDC	Check 383 Org wire and connections. Check K1 relay. (See "RELAY TEST" on page 91.) Replace relay as needed.
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Test Conditions:

- Park brake ENGAGED
- Meter set to ohm scale
- Meter negative lead connected to frame ground
- Key switch in OFF position

6. Manifold heater module	Approximately 0.3 to 0.5 ohm resistance	Check manifold heater element. Replace manifold heater as needed.
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FUEL SUPPLY OPERATION

Function:

To start or stop the supply of fuel to the engine.

Operating Conditions (Starting Tractor):

- Key switch must be in the START position.
- Operator ON seat
- PTO in NEUTRAL
- Transmission in NEUTRAL

Operating Conditions (Running Tractor):



- Key switch must be in the RUN position.
- Operator ON seat
- PTO ENGAGED
- Transmission in any GEAR

Operating Conditions (Running Tractor):

- Key switch must be in the RUN position.
- Operator ON seat
- PTO DISENGAGED
- Park brake ENGAGED

Operator can leave seat. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 48.)

PTO can be ENGAGED

Fuel Supply Theory of Operation

The fuel system is designed to inject fuel into the piston cylinder where heat from compression ignites the fuel and air mixture.

Fuel is provided to the engine when the fuel shutoff solenoid is energized. The fuel shutoff solenoid contains two coils to open the fuel valve. The pull-in coil, in conjunction with the hold-in coil, overcomes the spring loaded fuel valve. The hold-in coil keeps the fuel valve open after the pull-in coil current is reduced through the R2 thermistor.

The fuel shutoff solenoid is initially energized and pulled in when the engine run relay contacts close. Voltage is provided to both of the fuel shutoff solenoid coils (pull-in and hold-in), which provide enough pull on the solenoid plunger to overcome the shutoff solenoid spring.

The fuel shutoff solenoid pull-in coil needs a high current pulse through it to overcome the solenoid spring. After the solenoid opens (overcomes the spring) a lower current will hold the solenoid open. The combination of the K3 fuel shutoff relay and R2 variable thermistor provide a means to reduce the current flow through the fuel shutoff solenoid pull-in coil after the solenoid opens.

The initial high current flows through the 329A Wht wire to the K3 fuel pull-in relay (terminal 30), through the contacts, and through the 319 Wht wire to the R2 variable thermistor. The thermistor has a low resistance to the current initially (lower than the resistance through the K3 fuel shutoff relay coil). As the current flows through the thermistor, it heats up and the resistance through it increases (higher than the resistance through the K3 fuel shutoff relay coil).

While the current flow through the thermistor is reduced, the voltage difference across the thermistor is increased. When the voltage difference is increased enough to activate the coil of the K3 fuel shutoff relay (329B Wht), the coil opens the relay contacts and the variable thermistor is removed from the circuit..

NOTE: The variable thermistor will heat to a maximum temperature of approximately 180° F (82° C) during the brief period of time required to overcome the fuel shutoff solenoid spring.

With the thermistor removed from the circuit, the ground path is removed from the fuel shutoff solenoid pull-in coil through the 329A and 329B Wht wires, the fuel shutoff relay coil, and the 010F, 010E, 010D and 010C Blk wires. A ground path for the fuel shutoff solenoid hold-in coil is provided through the 010N Blk wire

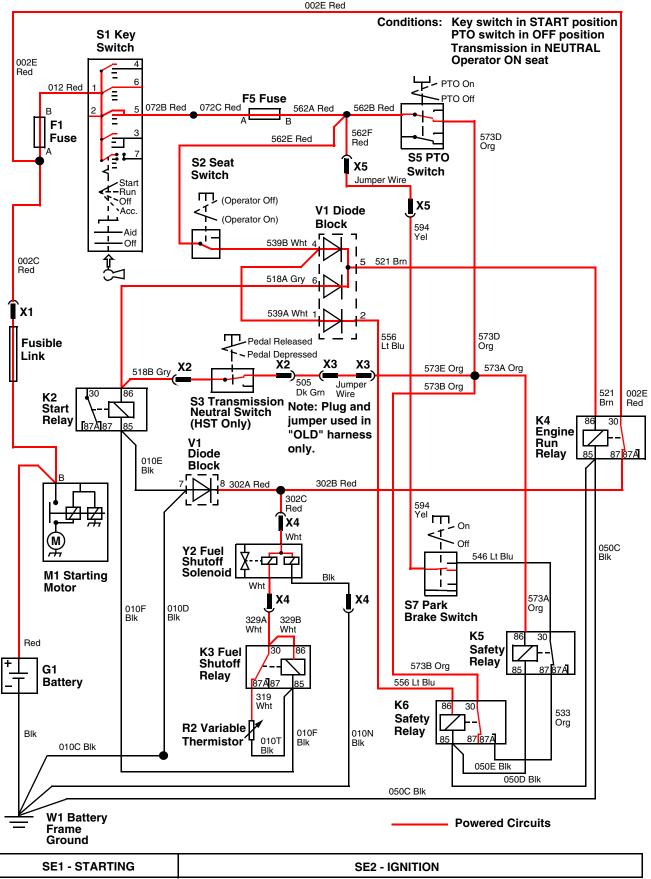
A latching circuit is provided to maintain voltage to the engine run relay after the PTO is ENGAGED. The latching circuit is energized only if the operator is OFF the seat, the PTO is DISENGAGED, and the park brake is ENGAGED. The latching circuit remains energized while the park brake is ENGAGED after the PTO is ENGAGED. This circuit allows the operator to leave the seat, with the park brake ENGAGED and the transmission in NEUTRAL, and ENGAGE the PTO. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 48.)

Fuel is provided to the engine through the Y2 fuel shutoff solenoid provided that operating conditions are met. If the operating criteria are not met, the engine run relay opens and stops voltage energizing the fuel shutoff solenoid coils. The fuel shutoff solenoid closes and fuel to the engine is shut off. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 48.)

NOTE: The S3 transmission neutral switch is shown in this diagnostic section. This switch is used in conjunction with the jumper wire in the X3 connector for tractors with a hydrostatic (HST) transmission. For tractors with a gear shift or PowrReverser™ transmission, the jumper wire is used in the X2 connector and the S4 transmission neutral switch is used in the X3 connector.

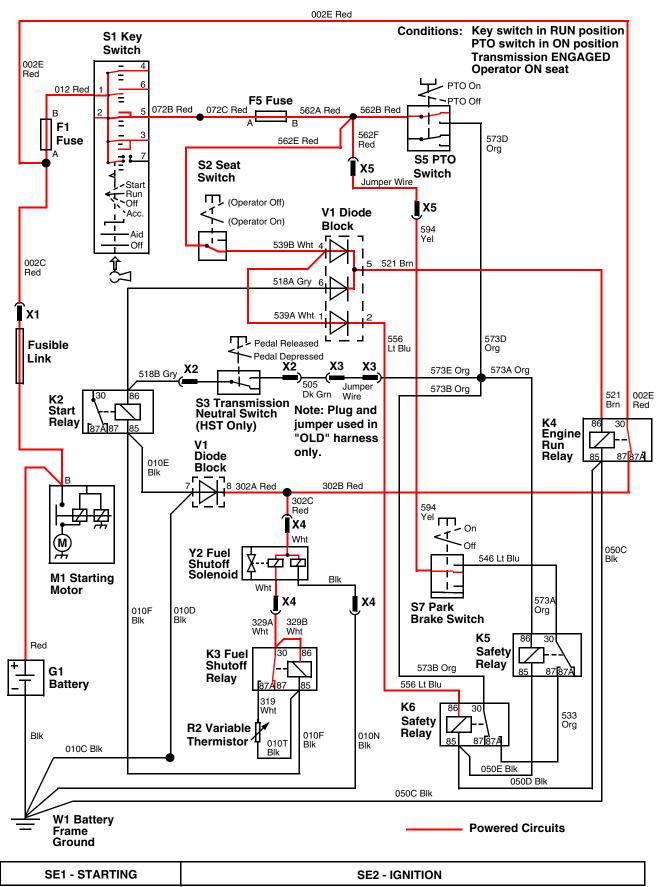
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FUEL SUPPLY ELECTRICAL SCHEMATIC



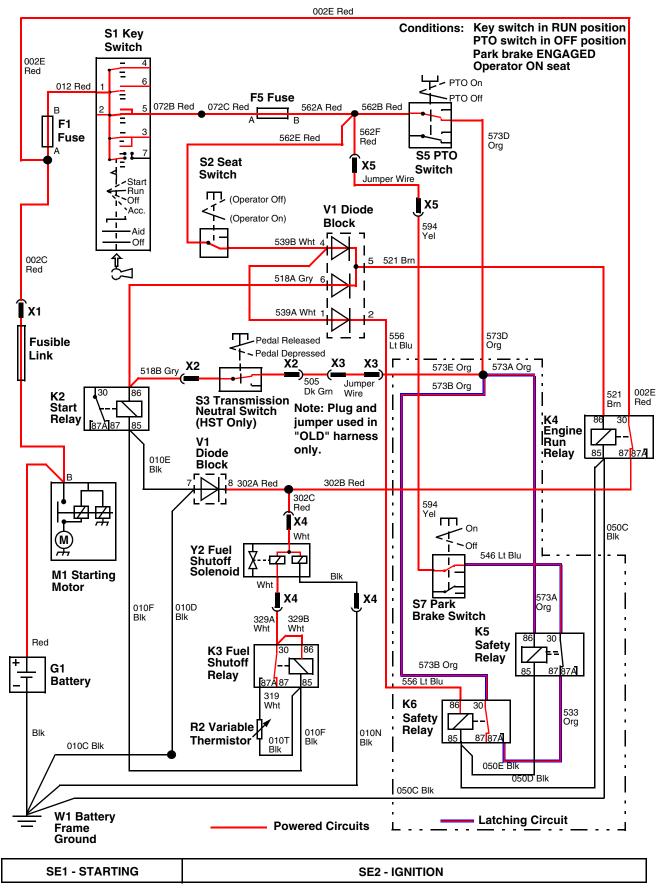


FUEL SUPPLY ELECTRICAL SCHEMATIC



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FUEL SUPPLY ELECTRICAL SCHEMATIC





FUEL SUPPLY DIAGNOSIS

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position (Engine NOT running)
- V1 diode block removed from load center
- PTO switch in OFF position
- Transmission in NEUTRAL
- Seat switch closed (Operator ON seat)

Test/Check Point	Normal	If Not Normal
1. PTO switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
2. Transmission neutral switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
3. Diode block socket (terminal 6)	12.4 - 13.2 VDC	Check transmission switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – HST" on page 97.) Check 518B and 518A Gry wires and connections.
4. Seat switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
5. Diode block socket (terminal 4)	12.4 - 13.2 VDC	Check seat switch. (See "SEAT SWITCH TEST" on page 94.) Check 539B Wht wire and connections.

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in NEUTRAL
- Seat switch open (Operator OFF seat)
- V1 diode block installed; K4 engine run relay unplugged

6. Engine run relay socket (terminal 85)	Check diode block (terminals 6 to 5). (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.
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Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in GEAR
- Seat switch closed (Operator ON seat)

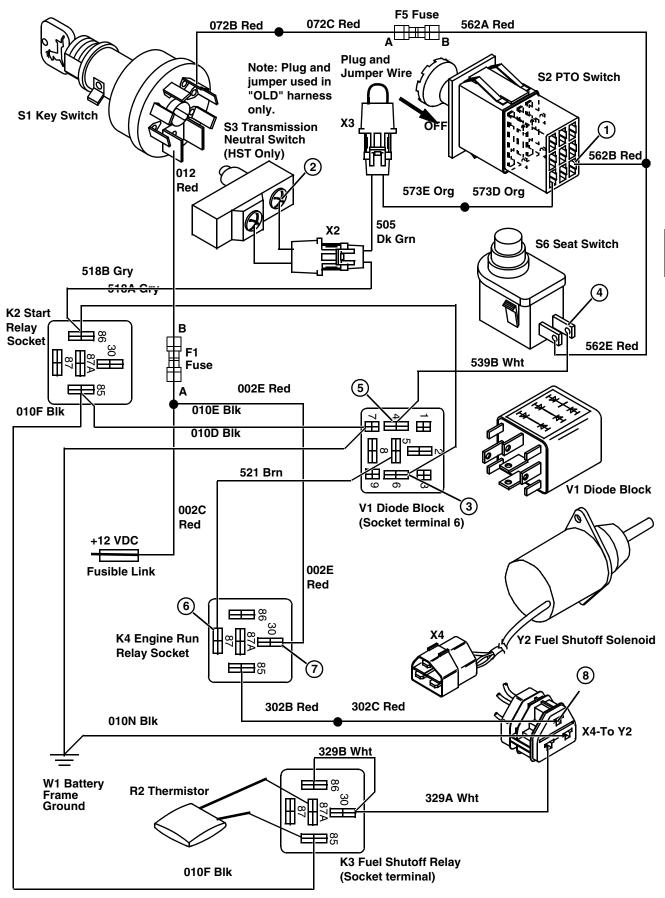
7. Engine run relay socket (terminal 85)	12.4 - 13.2 VDC	Check diode block (terminals 4 to 5). (See "DIODE BLOCK TEST" on page 94.)
		94.)

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in GEAR
- Seat switch closed (Operator ON seat)
- K4 engine run relay installed
- 8. Fuel solenoid connector 12.4 13.2 VDC Check 302B and 302C Red wires and connections.

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ENGINE SHUTOFF CIRCUIT OPERATION

Engine Shutoff Function:

To prevent the tractor engine from being left running in an unsafe condition.

Operating Conditions:

- Engine running (Started with park brake ENGAGED [Grn], PTO OFF [Blu] and transmission in Neutral [Grn or Blu]), Operator On or OFF seat
- Operator on seat



Engine MUST STOP if:

- PTO is ENGAGED, and
- Operator gets out of seat

or

- Transmission is ENGAGED, and
- Operator gets out of seat

NOTE: If transmission is in NEUTRAL and the PTO is disengaged, and then the park brake is set, the operator can leave the seat and the PTO can be reengaged.

or;

- Transmission is in GEAR, and
- Operator gets out of seat

Theory of Operation:

Fuel is supplied to the engine through the operation of the K3 fuel shutoff relay and the Y2 fuel shutoff solenoid, provided that operating conditions are met. (See "FUEL SUPPLY OPERATION" on page 42.)

When the operating conditions exist, and the engine is running, the engine shutoff circuit is used to maintain safe operation of the tractor. If an unsafe condition is created, the engine will stop by having the fuel supply to the engine shut off.

The fuel supply is shut off when voltage to the K4 engine run relay coil is removed, its contacts open, and power to the Y2 fuel shutoff solenoid coils is removed and the solenoid closes.

Power to the K4 engine run relay coil comes from the V1 diode block (terminal 5), and is provided to the diode block (terminals 4 or 6) through several different circuits that allow for a variety of operating conditions to exist and maintain fuel supply to the engine.

The main and most direct circuit, provides power to the K4 engine run relay coil through the key switch, 072B and 072C Red wires, F5 fuse, 562A and 562E Red wires, S2 seat switch (operator ON seat), 539B Wht

wire, V1 diode block (terminals 4 to 5), and 521 Brn wire. This circuit provides voltage to the engine run relay for normal operation of the tractor.

A second circuit provides power to the K4 engine run relay coil through the key switch, 072B and 072C Red wires, F5 fuse, 562A and 562B Red wires, PTO switch (PTO switch in the OFF position), 573D and 573E Org wires, S3 or S4 transmission neutral switch, 518B and 518A Gry wires, V1 diode block (terminals 6 to 5), and 521 Brn wire. This circuit provides voltage to the engine run relay if the PTO is DISENGAGED, and the transmission is in NEUTRAL, with or without the operator in the seat.

A third circuit provides power to the K4 engine run relay coil through the park brake switch and the K5 and K6 safety relays. The park brake switch and the K5 and K6 relays, in conjunction with the PTO switch, create a self-latching circuit. The PTO must be DISENGAGED, the park brake must be ENGAGED, and the operator must be OFF the seat to create the circuit. Once the latch circuit is established, the PTO can be ENGAGED. The latching circuit will remain energized until the operator gets ON the seat and the K6 safety relay coil is energized opening the circuit path through the K6 contacts, or; the park brake switch is DISENGAGED, eliminating power to the circuit.

Power is provided to the S7 park brake switch through the key switch, 072B and 072C Red wires, F5 fuse, 562F Red wire, X5 connector and jumper wire, and 594 Yel wire. With the park brake ENGAGED, power is provided through the park brake switch and 546 Lt Blu wire to the K5 safety relay (terminal 30). Power is provided to the K5 safety relay coil (terminal 86) through the PTO switch (PTO DISENGAGED) and the 573D and 573A Org wires.

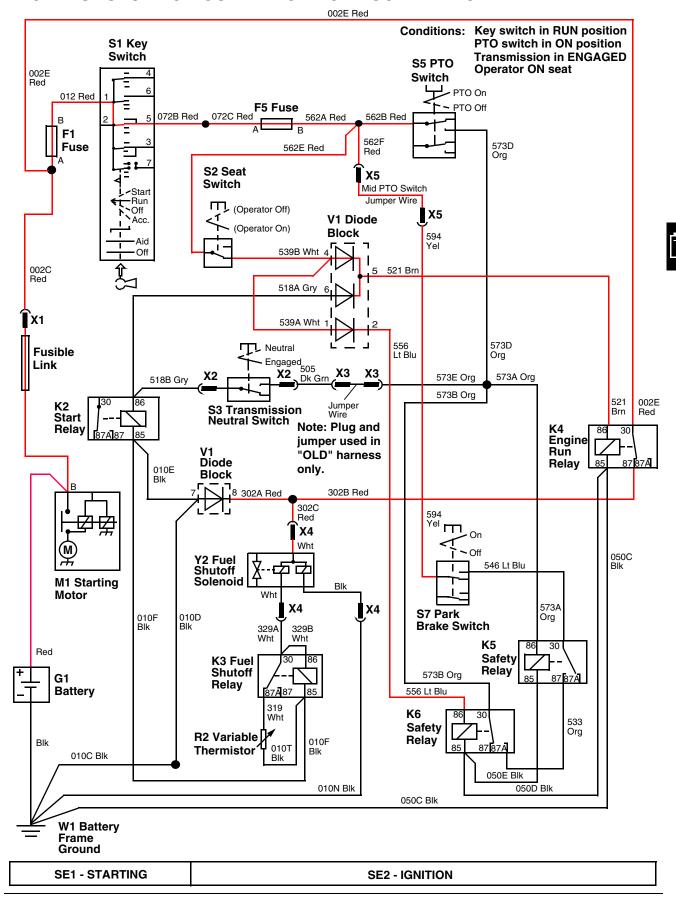
With the K5 coil energized, and power to the K5 contact (terminal 30), power is provided through the K5 contacts and 533 Org wire to the K6 contacts (terminal 87A). The power continues through the K6 contacts, and the 573B and 573A Org wires to the K5 coil (terminal 86).

The PTO can now be ENGAGED and power will remain to the K4 engine run relay through the park brake switch, latching relay circuit, and the same circuit path as provided by the PTO switch without the latching circuit.

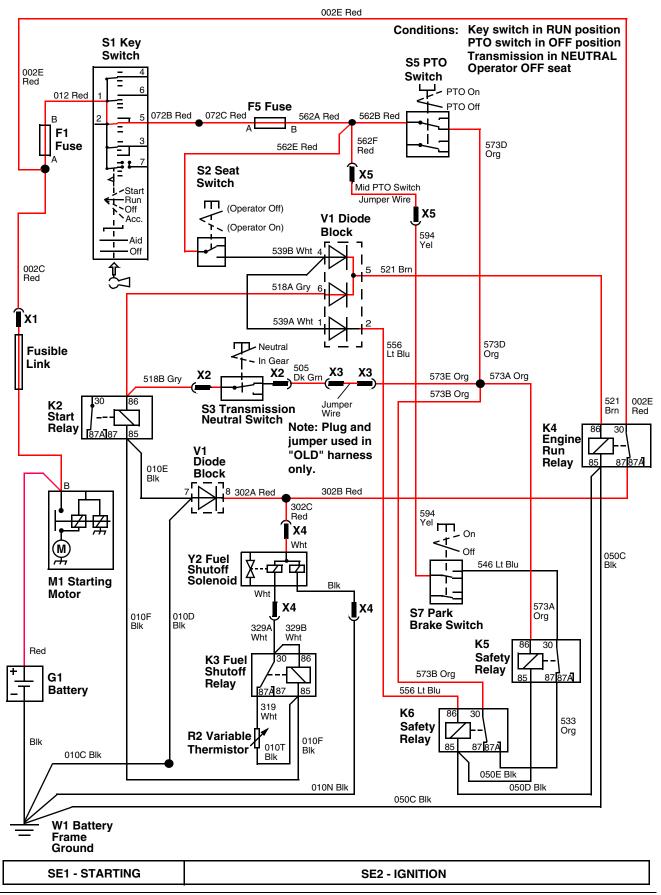
If the park brake is DISENGAGED without the operator ON the seat, the engine will stop.

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ENGINE SHUTOFF CIRCUIT ELECTRICAL SCHEMATIC

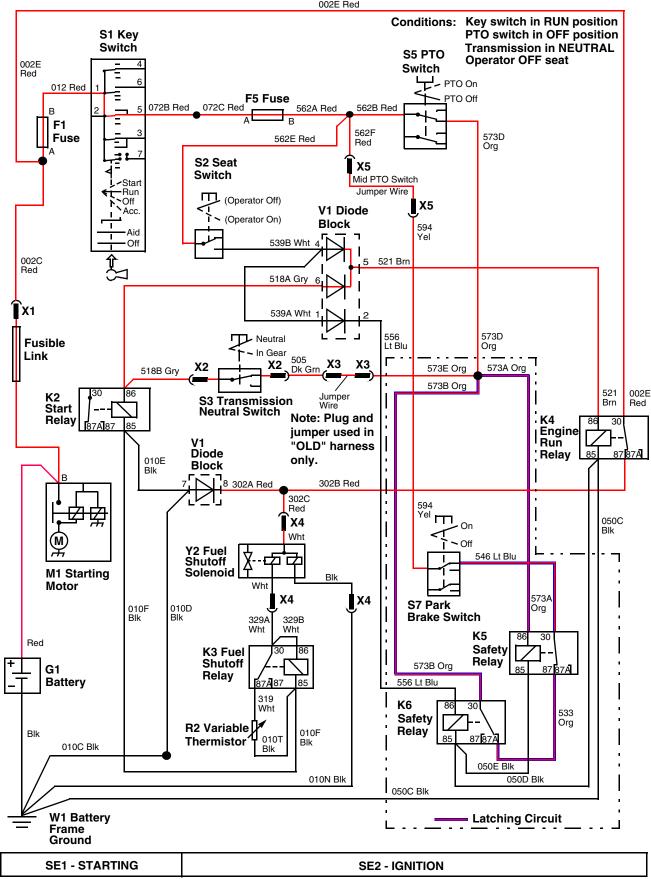


ENGINE SHUTOFF PTO CIRCUIT SCHEMATIC



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ENGINE SHUTOFF LATCH CIRCUIT SCHEMATIC





ENGINE SHUTOFF CIRCUIT DIAGNOSIS

Test Conditions:

Park brake ENGAGED

Transmission in NEUTRAL position

Operator OFF seat

• V1, K2, K4, K5, and K6 removed from load center

• PTO DISENGAGED

• Key switch in RUN position (engine OFF)

NOTE: The S3 transmission neutral switch is shown in this diagnostic section. This switch is used in conjunction with the jumper wire in the X3 connector for tractors with a hydrostatic (HST) transmission. For tractors with a PowrReverser™ (PRT) or gear shift (CST) transmission the jumper wire is used in the X2 connector and the S4 transmission neutral switch is used in the X3 connector. In "NEW" wiring harnesses, there is no X3 connector. All neutral switches are plugged into the X2 connector.



Test/Check Point	Normal	If Not Normal
1. K2 relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure PTO is DISENGAGED and transmission is in NEUTRAL. Check F5 fuse. Test PTO switch. Test transmission neutral switch. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
V1 diode block socket (terminal 6)	12.4 - 13.2 VDC	Check 518A Gry wire and connections.
3. K5 relay socket (terminal 86)	12.4 - 13.2 VDC	Check 573A Org wire and connections.
4. K6 relay socket (terminal 30)	12.4 - 13.2 VDC	Check 573B Org wire and connections.
5. Park brake switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
6. Park brake switch	12.4 - 13.2 VDC	Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.)
7. K5 relay socket (terminal 30)	12.4 - 13.2 VDC	Check 546 Lt Blu wire and connections.
8. Seat switch	12.4 - 13.2 VDC	Check 562E Red wire and connections.

Test Conditions:

- Park brake ENGAGED
- PTO DISENGAGED
- Push and hold seat switch plunger into OPERATOR ON position
- Transmission in NEUTRAL position
- Key switch in RUN position (engine OFF)

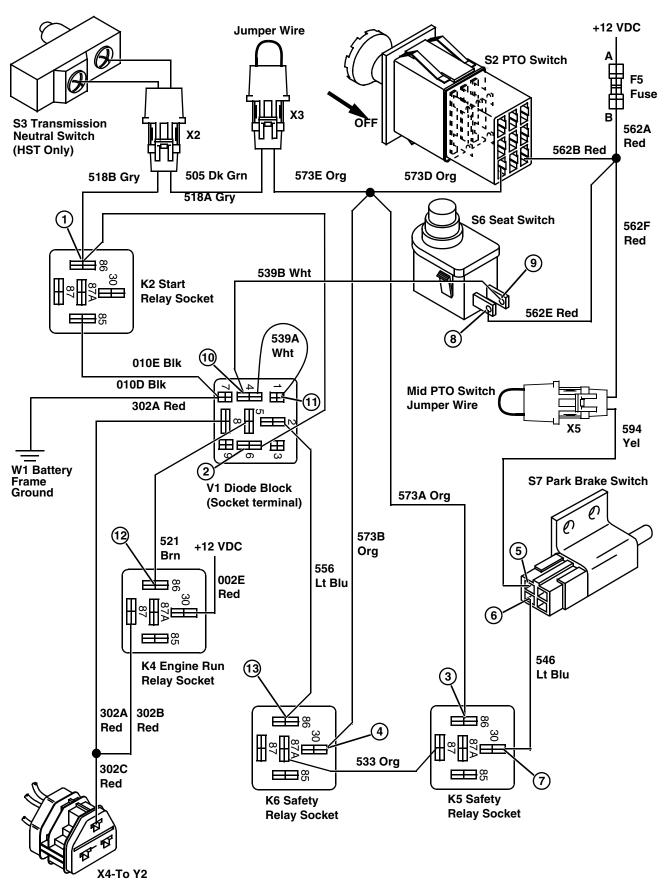
9. Seat switch	12.4 - 13.2 VDC	Test seat switch. (See "SEAT SWITCH TEST" on page 94.) Replace seat switch.
10. V1 diode block socket (terminal 4)	12.4 - 13.2 VDC	Check 539B Wht wire and connections.
11. V1 diode block socket (terminal 4)	12.4 - 13.2 VDC	Check 539A Wht jumper wire and connections.

Test Conditions:

- Park brake ENGAGED
- Operator ON seat
- PTO DISENGAGED
- Transmission in NEUTRAL position
- V1 diode block installed in to load center
- Key switch in RUN position (engine OFF)

12. K4 relay socket (terminal 86)		Test diode block. (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.
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Check 050E, 050D, and 050C Blk wires and

connections.

ENGINE SHUTOFF CIRCUIT DIAGNOSIS		ELECTRICAL - NORTH AMERICAN	
Test/Check Point	Normal	If Not Normal	
Test Conditions: • Park brake ENGAGED • Operator OFF seat • PTO DISENGAGED		UTRAL position alled in to load center position (engine OFF)	
14. K4 relay socket (terminal 86)	12.4 - 13.2 VDC	Test diode block. (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.	
Test Conditions: • Park brake ENGAGED • Operator ON seat • PTO DISENGAGED	Transmission in NE Install K6 safety rela Key switch in RUN	•	
15. K5 relay socket (terminal 87)	12.4 - 13.2 VDC	Test K6 relay. (See "RELAY TEST" on page 91.) Check 533 Org wire and connections.	
Test Conditions: • Park brake ENGAGED • Operator OFF seat • PTO DISENGAGED		UTRAL position alled in to load center position (engine OFF)	
Test Conditions: • After the above conditions are • Place PTO switch in ON positions			
16. K4 relay socket (terminal 86)	12.4 - 13.2 VDC	Check ground circuit of relays. See next step.	
Test Conditions: • Park brake ENGAGED • Operator OFF seat • PTO DISENGAGED	 Gear range lever in Key switch in OFF p K5 relay removed 	NEUTRAL position position (engine OFF)	

Test Conditions: • Gear range lever in NEUTRAL position • Park brake ENGAGED • K5 safety relay installed in to load center Operator OFF seat • Key switch in RUN position (engine OFF) • PTO DISENGAGED

less)

Continuity to frame ground (0.5 ohms or

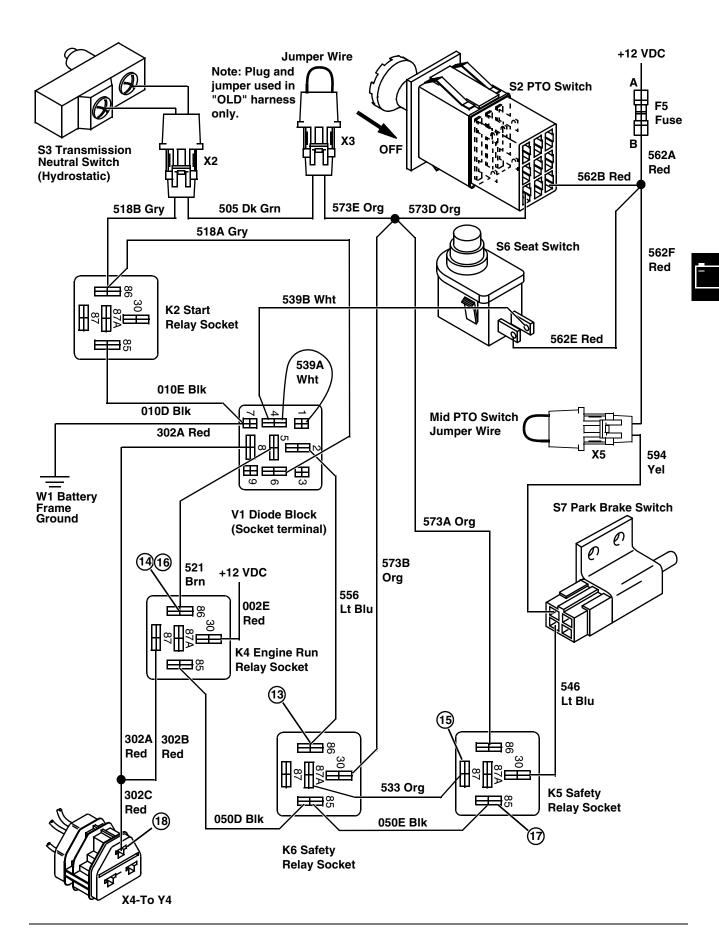
17. K5 relay socket (terminal 85)

Test Conditions:

- After the above conditions are set:
- Place PTO switch in ON position to ENGAGE PTO
- Check for voltage at K4 relay socket (terminal 86); RELEASE park brake

18. X4 connector to fuel shutoff solenoid	NO voltage after park brake is RELEASED	Test K4 relay. (See "RELAY TEST" on page 91.) Replace relay as needed. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
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CHARGING CIRCUIT OPERATION

FUNCTION:

To maintain battery voltage between 12.4 and 13.2 volts.

OPERATING CONDITIONS:

- · Key switch in RUN position
- Engine running

SYSTEM OPERATION:



The charging system consists of the G2 alternator with an integrated voltage regulator/rectifier. Charging output is controlled by a regulator/rectifier. The status of the charge rate is indicated by the H4 discharge light.

With the key switch in the RUN position, battery sensing circuit current flows from battery positive terminal to the starting motor terminal, fusible link F1, 002C Red wire, S1 key switch, 072B and 072D Red wires to the alternator voltage regulator/rectifier. The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

A rotating permanent magnet in the alternator induces AC current in the alternator stator coils. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

If battery voltage is low, the regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit (002A Red). When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

If the alternator output current falls below system usage or is insufficient to maintain a preset voltage, the voltage regulator/rectifier provides current to turn on the discharge light through the 334 Yel wire, X7 connector, and the control panel circuit board runs.

The alternator is grounded through the mounting hardware to the engine.

If the voltage regulator is grounded to the alternator cover, the alternator produces unregulated amperage. (See "UNREGULATED AMPERAGE TEST" on page 87.)

TACHOMETER CIRCUIT OPERATION

FUNCTION:

To indicate engine rpm to the operator.

OPERATING CONDITIONS:

- Key switch in RUN position
- Engine running

SYSTEM OPERATION:

Pulsed current flows from the "P" terminal of the alternator to the control panel (X6 connector, terminal F) through the 325 Dk Grn wire.

HOUR METER CIRCUIT OPERATION

FUNCTION:

To indicate engine hours of use to the operator.

OPERATING CONDITIONS:

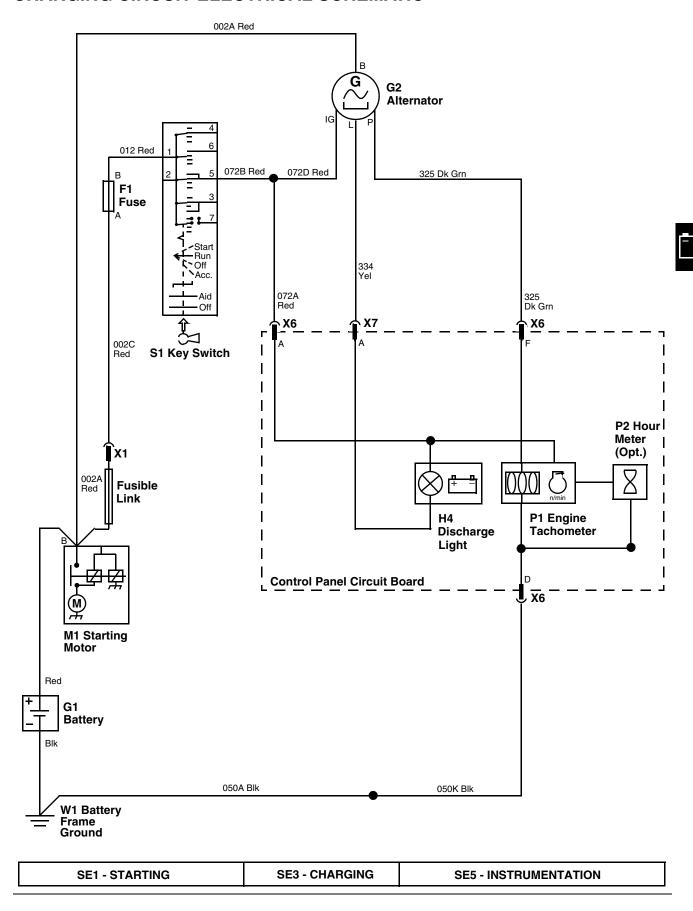
- Key switch in RUN position
- Engine running

SYSTEM OPERATION:

The hour meter is integrated into the control panel and does not have any external wiring. The hour meter operates only when the engine is running. The hour meter uses the engine tachometer circuit for power. If the tachometer is not functioning, the hour meter will not work. See "CHARGING CIRCUIT DIAGNOSIS" on page 58 for information on tachometer and hour meter diagnosis.

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CHARGING CIRCUIT ELECTRICAL SCHEMATIC



CHARGING CIRCUIT DIAGNOSIS

Test Conditions:

• Key switch in OFF position

• Park brake ENGAGED

• Transmission in NEUTRAL position

PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
Battery positive terminal	12.4 - 13.2 VDC	Test battery. (See "BATTERY TEST" on page 85.)
2. Starting motor "B" terminal	12.4 - 13.2 VDC	Check battery and starting motor cable connections.
3. Alternator "B" terminal	12.4 - 13.2 VDC	Check battery negative cable, alternator ground, connections, and engine ground connections.



Test Conditions:

• Engine OFF

• Disconnect alternator connector

• Park brake ENGAGED

• Key switch in RUN position

4. Alternator connector (072D	12.4 - 13.2 VDC	Check 072D and 072B Red wires and connections.
Red wire terminal)		(See "POWER CIRCUIT DIAGNOSIS" on page 30.)

Test Conditions:

• Engine OFF

• Connect alternator connector

• Park brake ENGAGED

• Disconnect control panel connectors

• Key switch in RUN position

5. X6 connector (terminal A)	12.4 - 13.2 VDC	Check 072A and 072B Red wires and connections.
6. X6 connector (terminal F)	0.04 VDC	Check 325 Dk Grn wire and connections.
7. X7 connector (terminal A)	0.45 VDC	Check 334 Yel wire and connections.

Test Conditions:

• Park brake ENGAGED

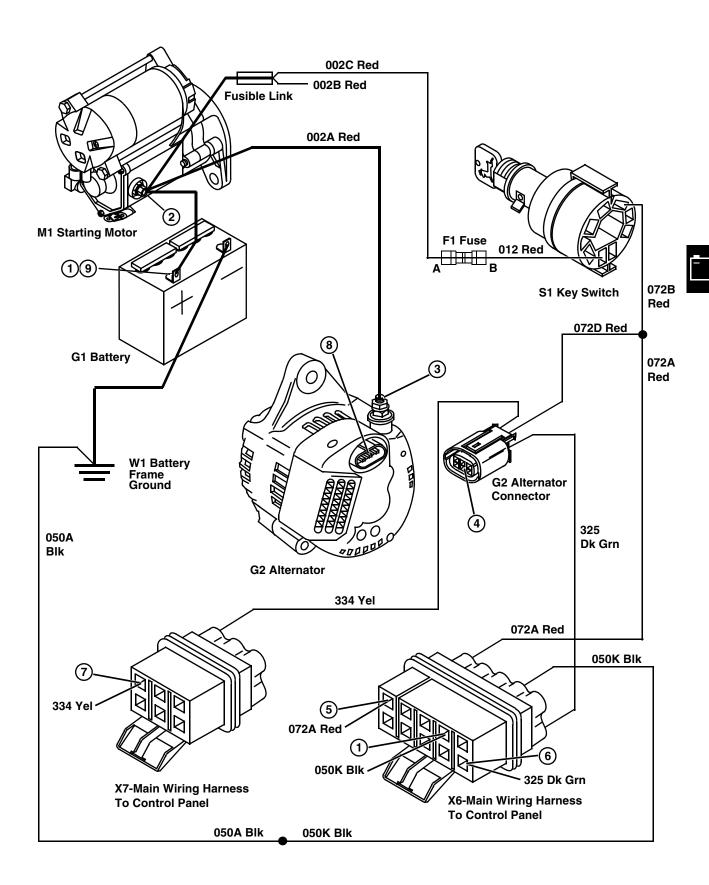
• PTO DISENGAGED

• Transmission in NEUTRAL

• Engine RUNNING

8. Alternator	Minimum 12.4 to 13.2 volts	(See "REGULATED AMPERAGE AND VOLTAGE TESTS" on page 88.) Replace voltage regulator/rectifier.
9. Battery	Voltage above 12.4 - 13.2 VDC.	Check for excessive load on electrical system.

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ENGINE OIL PRESSURE LIGHT

Function:

To alert operator of low engine oil pressure.

Operating Condition:

Key switch must be in RUN or START position.

Theory of Operation:

With the engine OFF and key in RUN position, engine oil pressure will be below 49 kPa (7.1 psi). The oil pressure switch will be in the normally closed position, completing a circuit path to ground and illuminating the light. This informs the operator that the light is functional.

The light goes out when the engine oil pressure is at or above **49 kPa (7.1 psi)**, opens the B2 engine oil pressure switch, and removes the ground circuit from the engine oil pressure light.

ENGINE COOLANT TEMPERATURE GAUGE

Function:

Inform the operator of engine and coolant operating temperature.

Operating Condition:

Key switch must be in RUN or START position.

Theory of Operation:

The engine coolant temperature sensor is a variable resistor, providing a ground circuit path for the temperature gauge. As the engine coolant heats, the resistance increases. The temperature gauge circuitry is part of the tractor control panel.

The engine coolant temperature sensor variable resistance is approximately **40 to 700 ohms**.

FUEL GAUGE

Function:

Inform the operator of the fuel level in the fuel tank.

Operating Condition:

Key switch must be in RUN or START position.

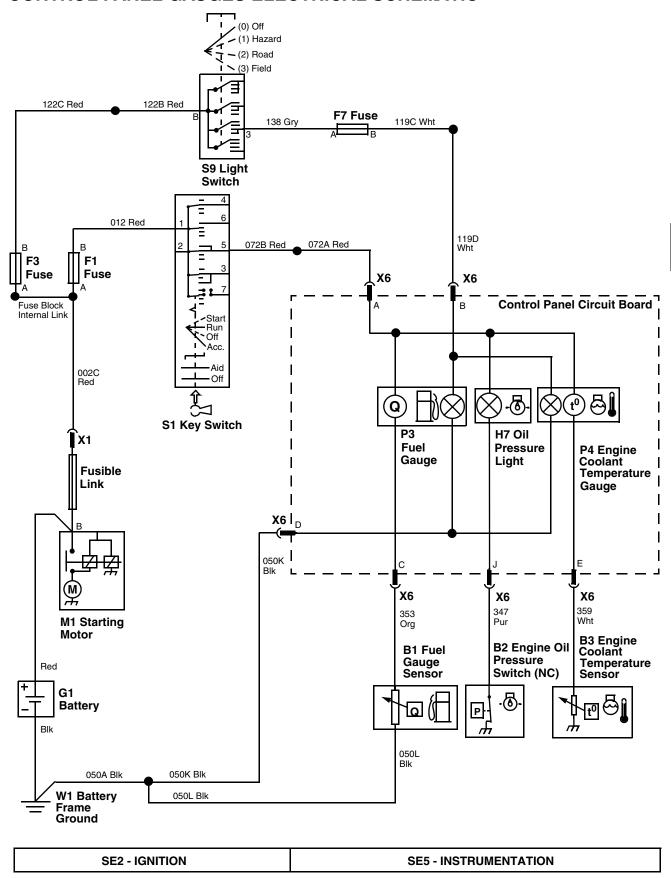
Theory of Operation:

The fuel level in the fuel tank is measured by the B1 fuel gauge sensor. The sensor is a variable resistor. The resistance is set by movement of a mechanical linkage connected to a float in the fuel tank. The 5 to 95 ohm resistance creates a variable voltage difference across the P1 fuel gauge. The voltage difference ranges from approximately **5.72 VDC** (fuel tank FULL) to approximately **0.87 VDC** (fuel tank EMPTY).

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CONTROL PANEL GAUGES ELECTRICAL SCHEMATIC



CONTROL PANEL GAUGES DIAGNOSIS

Test Conditions:

- X6 to control panel disconnected
- Key switch in RUN position, engine OFF
- PTO in NEUTRAL

- Transmission in NEUTRAL
- Park brake ON
- Light switch in ROAD or FIELD position

Test/Check Point	Normal	If Not Normal
1. X6 connector (terminal A)	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 30.)
2. Light switch	12.4 - 13.2 VDC	Check F3 fuse. Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
3. X6 connector (terminal B)	12.4 - 13.2 VDC	Check 119C and 119D Wht wires and connections.
4. X6 connector (terminal D)	Less than 0.1 ohms resistance to ground	Check 050K and 050A Blk wires and connections.



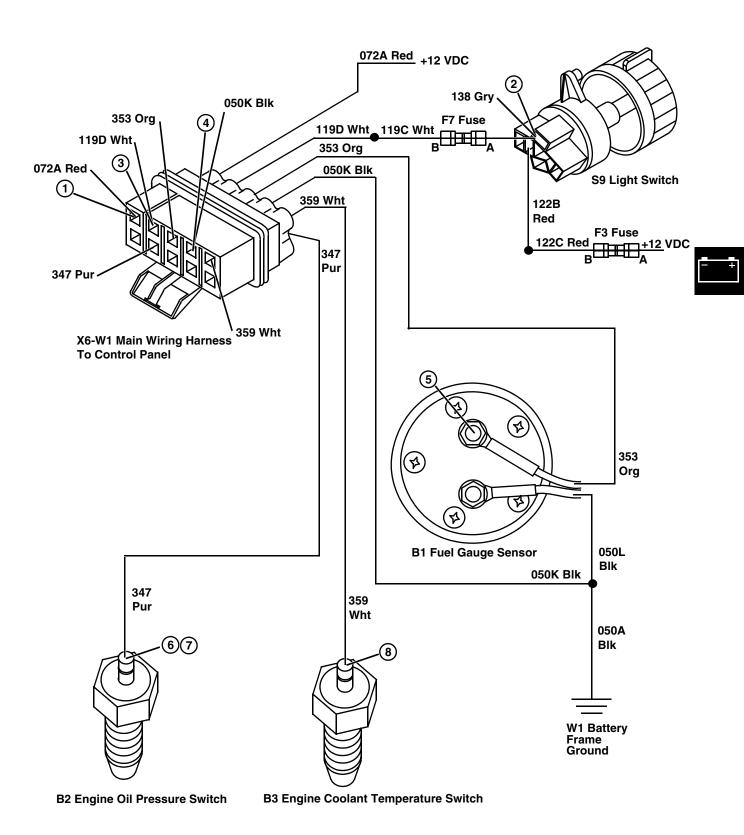
Test Conditions:

- Transmission in NEUTRAL
- PTO in NEUTRAL
- Park brake ON

- X6 to control panel connected
- Key switch in RUN position, engine OFF
- Light switch in OFF position

5. Fuel gauge sensor	Tank empty – approximately 0.1 VDC Tank full – approximately 5.7 VDC	Check 353 Org wire and connections. Check battery negative cable, 050L and 050A Blk wires and connections. Test fuel sensor. (See "FUEL GAUGE SENSOR TEST" on page 102.) Use a jumper wire to connect 353 Org wire to battery frame ground. Fuel gauge should move to maximum position. Gauge does not move Replace control panel.
6. Engine oil pressure switch	Less than 0.1 VDC	Check 347 Pur wire and connections.Test switch. (See "ENGINE OIL PRESSURE SWITCH TEST" on page 92.) Replace switch as needed.
7. Engine oil pressure switch (347 Pur wire lead disconnected)	Less than 0.1 ohms resistance to ground	Check engine ground. If engine ground OK: Replace switch.
8. Engine coolant temperature sensor	Continuity to ground through sensor – resistance depends on engine temperature (40 - 700 ohms). Sensor threads not corroded.	Disconnect temperature sensor lead. Use a jumper wire to connect 359 Wht wire to ground. Temperature gauge should move to maximum temperature position. Gauge does not move Replace control panel. Gauge moves Replace sensor.

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CONTROL PANEL INDICATOR LIGHTS

PTO LIGHT

Function:

To alert operator of PTO being ENGAGED.

Operating Condition:

• PTO switch in ON position.

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Theory of Operation:

With the key in START or RUN position, 12.4 - 13.2 VDC is provided to the PTO switch through the F5 fuse and 562A and 562D Red wires. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)

With the PTO switch placed in the ON position, voltage is provided through the PTO switch contacts (terminals A to B), 574B and 574A Yel wires, and X7 connector (terminal A) to the control panel circuit board. A circuit board run provides voltage to the H3 PTO indicator light.

A ground circuit path for the control panel circuit board is provided though the X6 connector (terminal D), and 050K and 050A Blk wires.

PARK BRAKE LIGHT

Function:

To alert operator of park brake being ENGAGED.

Operating Condition:

- Key switch in START or RUN position
- Park brake ENGAGED.

Theory of Operation:

With the key in START or RUN position, 12.4 - 13.2 VDC is provided to the park brake switch through the F5 fuse and 562A and 562C Red wires. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)

With the park brake ENGAGED, the park brake switch contacts close. Voltage is provided through the park brake switch contacts (terminals B to C), 586 Lt Blu wire, and X6 connector (terminal K) to the control panel circuit board. A circuit board run provides voltage to the H6 park brake indicator light.

A ground circuit path for the control panel circuit board is provided though the X6 connector (terminal D), and 050K and 050A Blk wires.

COLD START LIGHT

Function:

To indicate to operator that voltage is being provided to the manifold heater.

Operating Condition:

 Key switch must be in ON or START position, and pushed into the AID position. (See "MANIFOLD HEATER OPERATION" on page 36.)

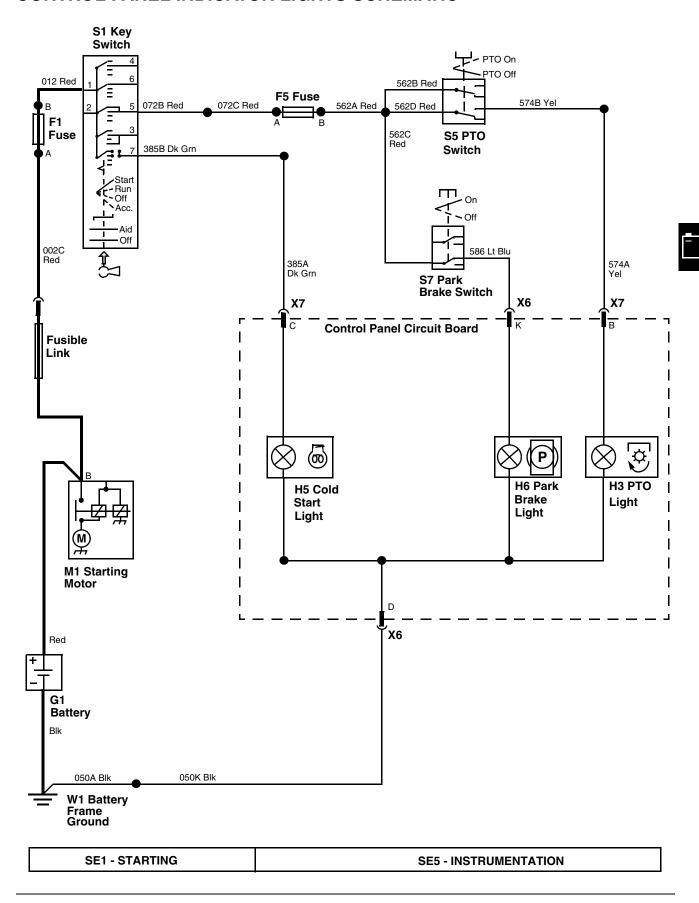
Theory of Operation:

With the key in the START or RUN position, and the key switch in the AID position, 12.4 - 13.2 VDC is provided to the H5 cold start light through the 385B and 385A Dk Grn wires, X7 connector (terminal C), and control panel circuit board.

A ground circuit path for the control panel circuit board is provided though the X6 connector (terminal D), and 050K and 050A Blk wires.

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CONTROL PANEL INDICATOR LIGHTS SCHEMATIC



CONTROL PANEL INDICATOR LIGHTS DIAGNOSIS

Test Conditions:

- Key switch in RUN position, engine OFF
- Transmission in NEUTRAL

• PTO in NEUTRAL

Park brake OFF

Test/Check Point	Normal	If Not Normal
1. PTO switch	12.4 - 13.2 VDC	Check F5 fuse. Check 562A and 562D Red wires and connections.
2. Park brake switch	12.4 - 13.2 VDC	Check F5 fuse. Check 562A and 562C Red wires and connections.



Test Conditions:

- Key switch in RUN position, engine OFF
- Transmission in NEUTRAL
- Disconnect X6 and X7 connectors to control panel
- PTO switch in ON position
- Park Brake ENGAGED

3. Park brake switch	12.4 - 13.2 VDC	Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.) Replace as needed.
4. X6 connector (K terminal)	12.4 - 13.2 VDC	Check 586 Lt Blue wire and connections.
5. PTO switch	12.4 - 13.2 VDC	Test switch. (See "PTO SWITCH TEST" on page 99.) Replace switch as needed.
6. X7 connector (B terminal)	12.4 - 13.2 VDC	Check 574B and 574AYel wires and connections.

Test Conditions:

- Key switch in RUN position, engine OFF
- Transmission in NEUTRAL

- PTO switch in OFF position
- Park Brake ENGAGED
- Connect multimeter to battery frame ground and X7 connector (C terminal). After the connections are made, push key into switch to the AID position.

7. X7 connector (C terminal)	12.4 - 13.2 VDC	Check 385A and 385B Dk Grn wires and connections. (See "MANIFOLD HEATER OPERATION" on page 36.)
		OPERATION" on page 36.)

Test Conditions:

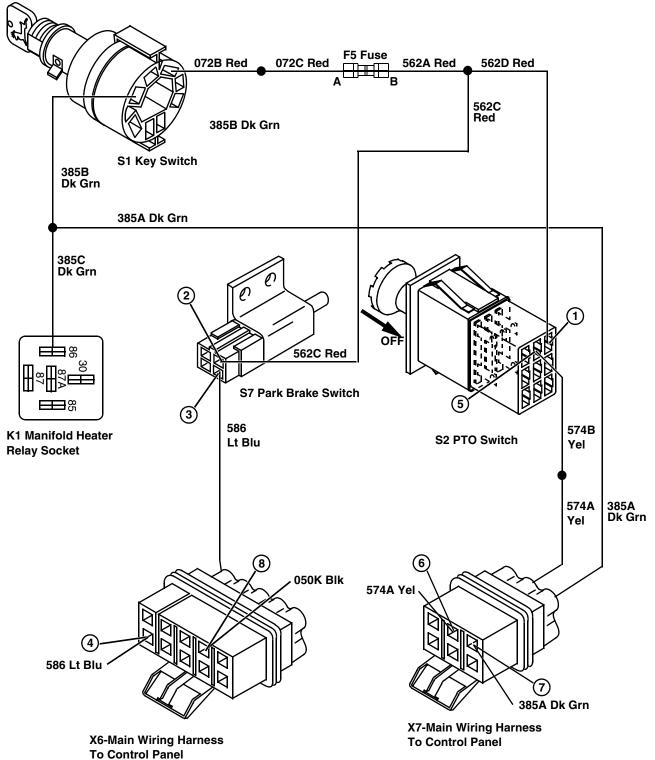
- Key switch in OFF position
- Transmission in NEUTRAL
- X6 and X7 to control panel connected

- PTO switch in OFF position
- Park Brake ENGAGED

8. X6 connector (K terminal)	Continuity to battery frame ground. Less than 0.1 ohms.	Check 050K and 050A Blk wires and connections. Check battery cables for clean, tight connections.
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NOTE: If all of the tests above are performed, and the control panel lamps are good, and the indicator lights still do not work, replace the control panel.

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LIGHTS OPERATION

For older models. See serial number break list on page 14.

Light Switch Function:

Provides power to the headlights, tail lights, hazard lights, work lights and panel lights in combinations, depending upon the position the light switch is placed in.

Operating Conditions:

Light switch in either HAZARD, ROAD or FIELD position.



Theory of Operation:

Power for the light switch is provided through the load center F5 fuse, 122C and 122B Red wires. Power for the turn signal light switch is provided through the F5 fuse, 122C and 122A Red wires.

Light Switch Hazard Position:

In the HAZARD position, voltage is provided from the light switch (terminal 2) through the 103A and 103C Org wires, F8 fuse, and the 118 Gry wire to the X13 Trailer connector (terminal 6). Voltage is also provided from the light switch (terminal 2) through the 103A and 103B Org wires to the S8 turn signal switch.

Light Switch Road Position:

In the ROAD position, voltage is provided from the light switch (terminal 2) through the same circuits as when the light switch is in the HAZARD position.

In addition, voltage is provided from the light switch (terminal 3) though the 138 Gry wire to the F7 fuse. The F7 fuse provides voltage to the LH headlight through the 119C and 119B Wht wires; and to the RH headlight through the 119C and 119A Wht wires. Voltage is also provided to the control panel gauge lights through the 119C and 119D Wht wires and X6 connector (B terminal).

Light Switch Field Position:

In the FIELD position, voltage is removed from the turn signal switch (terminal 1). However, voltage remains to the headlights (light switch terminal 3), and is provided to the work lights (light switch terminal 4).

Voltage is provided from the light switch (terminal 4), through the 143 Org wire to the F6 fuse. The F6 fuse provides voltage, through the 147A, 147B and 147D Pur wires, to the work lights. Voltage is also provided to the X13 trailer connector (terminal 2) through the 147A and 147C Pur wires.

Turn Signal Switch Function:

Provides intermittent power to the tail lights and hazard lights.

Operating Conditions:

- Turn signal switch in the OFF position
- Light switch in either HAZARD or ROAD position; or, turn signal switch in the LEFT position, light switch in any position; or, turn signal switch in the RIGHT position, light switch in any position.

Theory of Operation:

Unswitched power is provided to the turn signal switch through the 122A Red wire (terminal 2). Switched power is provided from the light switch through the 103A and 103B Org wires (terminal 1).

With the turn signal switch in the OFF position, and the light switch in either the HAZARD or ROAD position, voltage enters the turn signal switch through the 103B Org wire (terminal 1). The voltage from the 103B Org wire goes to the flasher unit inside the turn signal switch. The flasher unit produces an intermittent voltage output that is provided to the center contacts of both the LH and RH switch. With the turn signal switch in the OFF position, both the LH and RH switch provide an intermittent output voltage to the wiring harness (terminals 3 and 4).

Intermittent voltage is provided to the LH tail light and LH hazard light through the 125A, 125C and 125D Dk Grn wires. Intermittent voltage is provided to the RH tail light and RH hazard light through the 115A, 115C and 115D Dk Grn wires.

Turn Signal Switch Left Position:

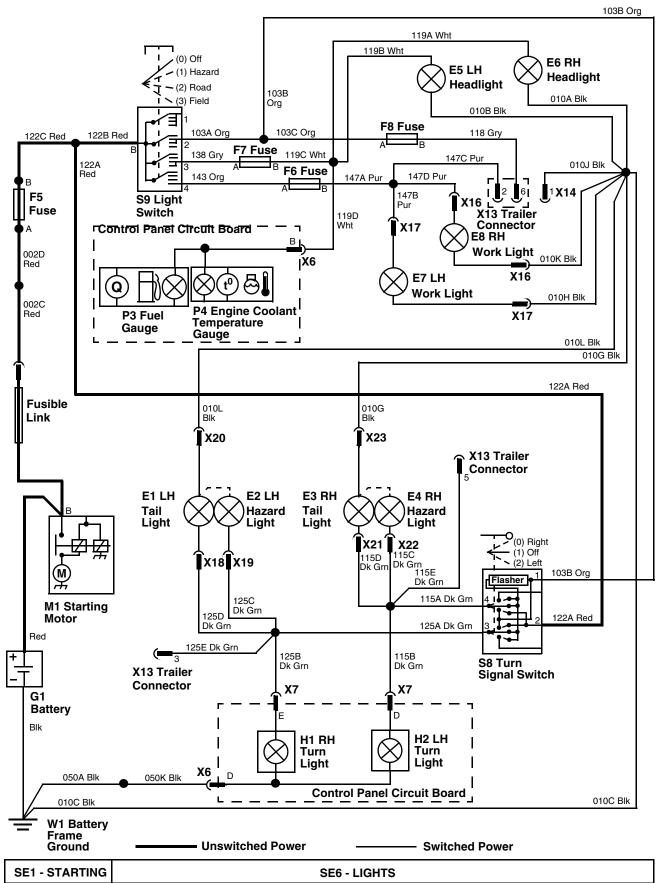
With the light switch in any position, and the turn signal switch in the LEFT position, constant voltage is provided to the RH switch contact. The contact provides constant voltage (terminal 4) to the RH tail light and hazard light. Constant voltage is also provided from the S8 RH switch contact to the flasher unit in the turn signal switch. The flasher unit provides intermittent voltage to the S8 LH switch contact. The intermittent voltage is provided (terminal 3) to the LH tail light and hazard light.

Turn Signal Switch Right Position:

With the light switch in any position and the turn signal switch in the RIGHT position, constant voltage is provided to the S8 LH switch contact. The contact provides constant voltage (terminal 3) to the LH tail light and hazard light. Constant voltage is also provided from the S8 LH switch contact to the flasher unit in the turn signal switch. The flasher unit provides intermittent voltage to the S8 RH switch contact. The intermittent voltage is provided (terminal 4) to the RH tail light and hazard light.

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LIGHTS ELECTRICAL SCHEMATIC



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LIGHTS DIAGNOSIS

Test Conditions:

- Key switch in OFF position
- Engine OFF

- Light switch in HAZARD position
- X7 to control panel disconnected

Test/Check Point	Normal	If Not Normal
1. Light switch	12.4 - 13.2 VDC	Check F3 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
2. Turn signal switch	12.4 - 13.2 VDC	Check F3 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
3. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
4. Turn signal switch	12.4 - 13.2 VDC	Check 103 Org wire and connections.
5. Turn signal switch (115A and 125A Dk Grn wires)	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
6. RH hazard light	Intermittent 12.4 - 13.2 VDC	Check 115A and 115C Dk Grn wires and connections.
7. X7 control panel connector (terminal D)	Intermittent 12.4 - 13.2 VDC	Check 115A and 125B Dk Grn wires and connections.
8. LH hazard light	Intermittent 12.4 - 13.2 VDC	Check 125A and 125C Dk Grn wires and connections.
X7 control panel connector (terminal E)	Intermittent 12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

Test Conditions:

• Key switch in OFF position

• Light switch in ROAD position

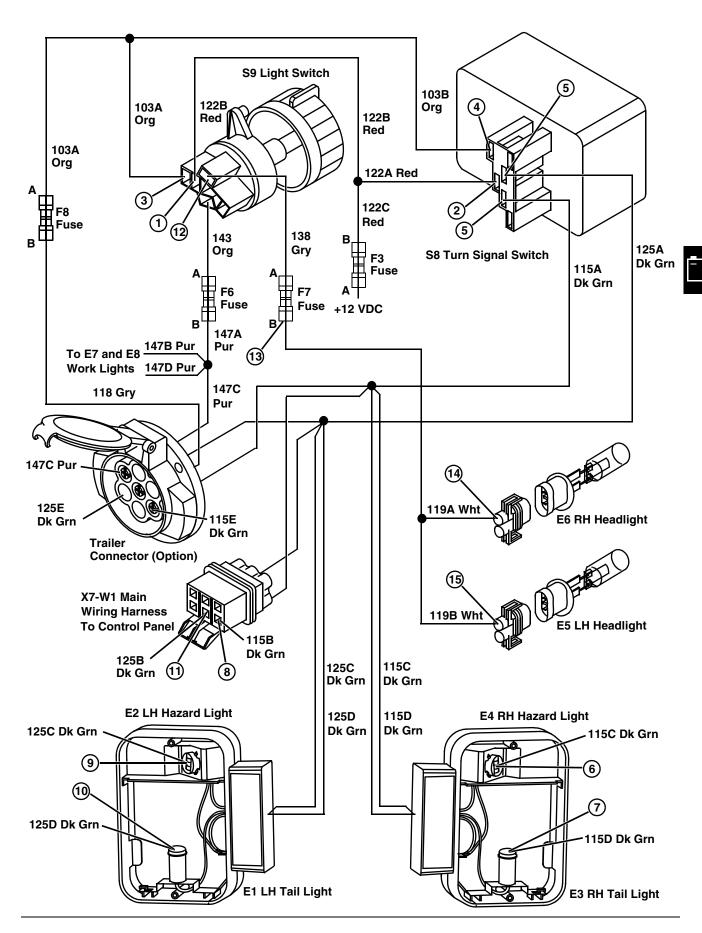
• Engine OFF

• X7 to control panel connected

10. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
11. F7 fuse	12.4 - 13.2 VDC	Check F7 fuse. Check 138A and 138B Gry wires and connections.
12. RH headlight	12.4 - 13.2 VDC	Check 119C and 119A Wht wires and connections.
13. LH headlight	12.4 - 13.2 VDC	Check 119C and 119B Wht wires and connections.
14. F8 fuse	12.4 - 13.2 VDC	Check F8 fuse. Check 138A and 138C Gry wires and connections.
15. RH tail light	12.4 - 13.2 VDC	Check 118A and 118B Gry wires and connections.
16. LH tail light	12.4 - 13.2 VDC	Check 118A and 118C Gry wires and connections.

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Test/Check Point	Normal	If Not Normal

Test Conditions:

- Key switch in OFF position
- Light switch in FIELD position

• Engine OFF

17. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
18. F6 fuse	12.4 - 13.2 VDC	Check F6 fuse. Check 143 Org wire and connections.
19. X13 trailer connector	12.4 - 13.2 VDC	Check 147A and 147C Pur wires and connections.

NOTE: With the light switch in FIELD position, and the turn signal in the OFF position, 12.4 - 13.2 VDC will be provided in the same locations as Steps 12 through 15 above.



Test Conditions:

- Key switch in OFF position
- Light switch in OFF position

• Engine OFF

• Turn signal switch in LEFT position

20. Turn signal switch	12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
21. RH hazard light and RH tail light	12.4 - 13.2 VDC	Check 115A, 115C and 125D Dk Grn wires and connections.
22. X7 control panel connector (terminal D)	12.4 - 13.2 VDC	Check 115A and 115B Dk Grn wires and connections.
23. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
24. LH hazard light and LH tail light	Intermittent 12.4 - 13.2 VDC	Check 125A, 125C and 125D Dk Grn wires and connections.
25. X7 control panel connector (terminal E)	Intermittent 12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

Test Conditions:

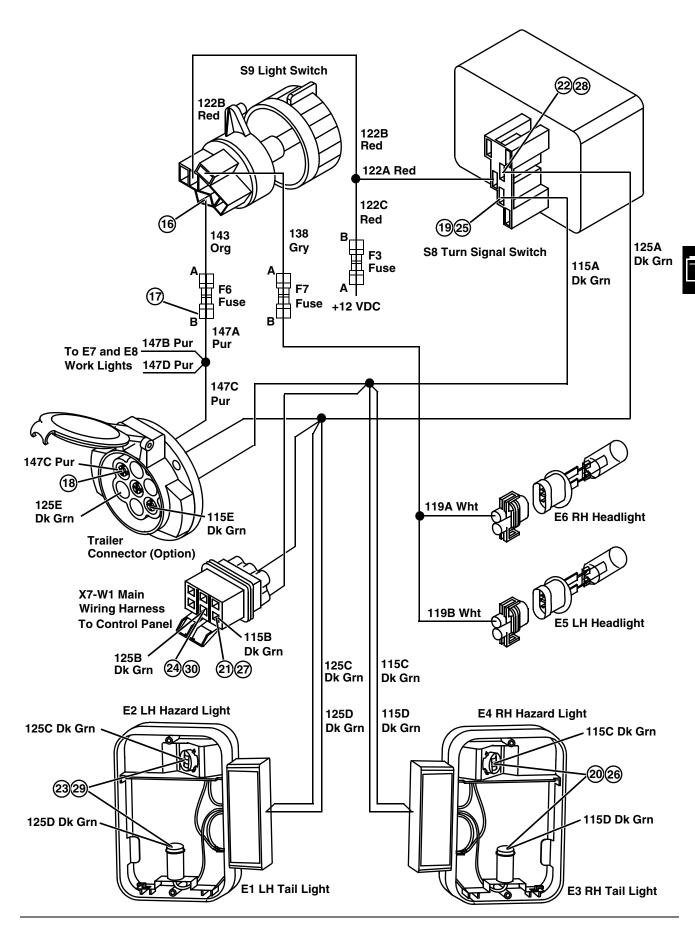
- Key switch in OFF position
- Light switch in OFF position

• Engine OFF

• Turn signal switch in RIGHT position

26. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
27. RH hazard light and RH tail light	Intermittent 12.4 - 13.2 VDC	Check 115A, 115C and 125D Dk Grn wires and connections.
28. X7 control panel connector (terminal D)	Intermittent 12.4 - 13.2 VDC	Check 115A and 115B Dk Grn wires and connections.
29. Turn signal switch	12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
30. LH hazard light and LH tail light	12.4 - 13.2 VDC	Check 125A, 125C and 125D Dk Grn wires and connections.
31. X7 control panel connector (terminal E)	12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

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LIGHTS OPERATION

For newer model 4500 and 4600 tractors and all 4700 tractors. See serial number break list on page21.

Light Switch Function:

Provides power to the headlights, tail lights, hazard lights, work lights and panel lights in combinations, depending upon the position the light switch is placed in.

Operating Conditions:

Light switch in either HAZARD, ROAD or FIELD position.



Theory of Operation:

Power for the light switch is provided through the load center F5 fuse, 122C and 122B Red wires. Power for the turn signal light switch is provided through the F5 fuse, 122C and 122A Red wires.

Light Switch Hazard Position:

In the HAZARD position, voltage is provided from the light switch (terminal 2) through the 103 Org wire to the S8 turn signal switch.

Light Switch Road Position:

In the ROAD position, voltage is provided from the light switch (terminal 2) through the same circuit as when the light switch is in the HAZARD position.

In addition, voltage is provided from the light switch (terminal 3) though the 138 Gry wires to the F7 and F8 fuses.

The F7 fuse provides voltage to the LH and RH headlights through the 119 Wht wires; and voltage to the control panel gauge lights through the 119Wht wires and X6 connector (B terminal).

The F8 fuse provides voltage to the LH and RH taillights and the X13 trailer connector (terminal 6) through the 118 Gry wires.

Light Switch Field Position:

In the FIELD position, voltage is removed from the turn signal switch (terminal 1). However, voltage remains to the headlights and taillights (light switch terminal 3), and is provided to the work lights (light switch terminal 4).

Voltage is provided from the light switch (terminal 4), through the 143 Org wire to the F6 fuse. The F6 fuse provides voltage, through the 147 Pur wires, to the work lights and to the X13 trailer connector (terminal 2).

Turn Signal Switch Function:

Provides intermittent power to the tail lights, hazard lights and control panel indicators.

Operating Conditions:

- Turn signal switch in the OFF position
- Light switch in either HAZARD or ROAD position; or, turn signal switch in the LEFT or RIGHT position with the light switch in any position.

Theory of Operation:

Unswitched power is provided to the turn signal switch (terminal 2) through the 122A Red wire. Switched power is provided from the light switch through the 103 Org wire (terminal 1).

With the turn signal switch in the OFF position, and the light switch in either the HAZARD or ROAD position, voltage enters the turn signal switch through the 103 Org wire (terminal 1). The voltage goes to the flasher unit inside the turn signal switch. The flasher unit produces an intermittent voltage output that is provided to the center contacts of both the LH and RH switch. With the turn signal switch in the OFF position, both the LH and RH switch provide an intermittent output voltage to the wiring harness (terminals 3 and 4).

Intermittent voltage is provided to the LH hazard light through the 125A and 125C Dk Grn wires. Intermittent voltage is provided to the RH hazard light through the 115A and 115C Dk Grn wires.

Turn Signal Switch Left Position:

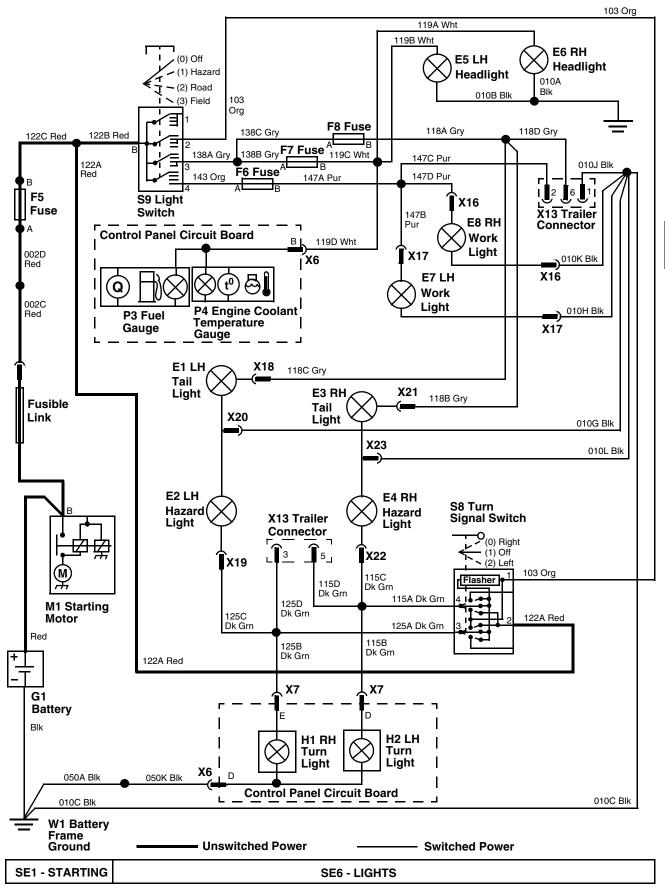
With the light switch in any position, and the turn signal switch in the LEFT position, constant voltage is provided to the RH switch contact. The contact provides constant voltage (terminal 4) to the RH hazard light. Constant voltage is also provided from the S8 RH switch contact to the flasher unit in the turn signal switch. The flasher unit provides intermittent voltage to the S8 LH switch contact. The intermittent voltage is provided (terminal 3) to the LH hazard light, LH turn indicator light on the control panel, and X13 trailer connector (terminal 3).

Turn Signal Switch Right Position:

With the light switch in any position and the turn signal switch in the RIGHT position, constant voltage is provided to the S8 LH switch contact. The contact provides constant voltage (terminal 3) to the LH hazard light. Constant voltage is also provided from the S8 LH switch contact to the flasher unit in the turn signal switch. The flasher unit provides intermittent voltage to the S8 RH switch contact. The intermittent voltage is provided (terminal 4) to the RH hazard light, RH turn indicator light on the control panel, and X13 trailer connector (terminal 5).

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LIGHTS ELECTRICAL SCHEMATIC



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LIGHTS DIAGNOSIS

Test Conditions:

- Key switch in OFF position
- Engine OFF

- Light switch in HAZARD position
- X7 to control panel disconnected

Test/Check Point	Normal	If Not Normal
1. Light switch	12.4 - 13.2 VDC	Check F3 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
2. Turn signal switch	12.4 - 13.2 VDC	Check F3 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 30.)
3. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
4. Turn signal switch	12.4 - 13.2 VDC	Check 103A and 103B Org wires and connections.
5. Turn signal switch (115A and 125A Dk Grn wires)	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
6. RH hazard light	Intermittent 12.4 - 13.2 VDC	Check 115A and 115C Dk Grn wires and connections.
7. RH tail light	Intermittent 12.4 - 13.2 VDC	Check 115A and 125D Dk Grn wires and connections.
8. X7 control panel connector (terminal D)	Intermittent 12.4 - 13.2 VDC	Check 115A and 125B Dk Grn wires and connections.
9. LH hazard light	Intermittent 12.4 - 13.2 VDC	Check 125A and 125C Dk Grn wires and connections.
10. LH tail light	Intermittent 12.4 - 13.2 VDC	Check 125A and 125D Dk Grn wires and connections.
11. X7 control panel connector (terminal E)	Intermittent 12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

Test Conditions:

NOTE: With the light switch in ROAD position, and the turn signal in the OFF position, 12.4 - 13.2 VDC and intermittent 12.4 - 13.2 VDC will be provided in the same locations as Steps 4 through 11 above. These voltages are in addition to the voltage present at the F7 fuse and RH and LH headlights.

• Key switch in OFF position

• Light switch in ROAD position

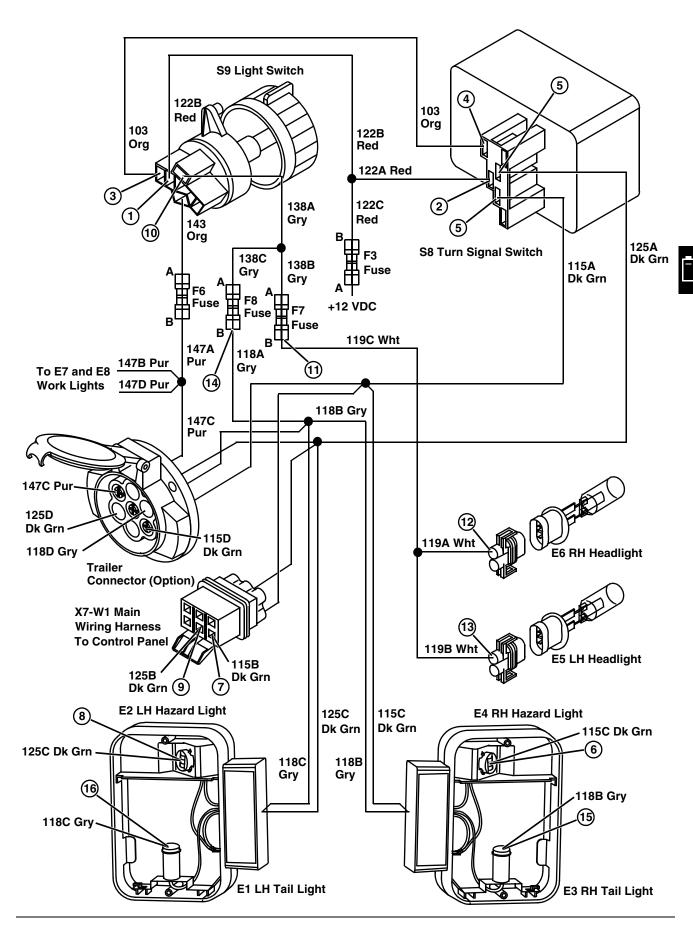
• Engine OFF

• X7 to control panel connected

12. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
13. F7 fuse	12.4 - 13.2 VDC	Check F7 fuse. Check 138 Gry wire and connections.
14. RH headlight	12.4 - 13.2 VDC	Check 119C and 119A Wht wires and connections.
15. LH headlight	12.4 - 13.2 VDC	Check 119C and 119B Wht wires and connections.

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Test/Check Point Normal If Not Normal

Test Conditions:

- Key switch in OFF position
- Light switch in FIELD position

• Engine OFF

16. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
17. F6 fuse	12.4 - 13.2 VDC	Check F6 fuse. Check 143 Org wire and connections.
18. X13 trailer connector	12.4 - 13.2 VDC	Check 147A and 147C Pur wires and connections.

NOTE: With the light switch in FIELD position, and the turn signal in the OFF position, 12.4 - 13.2 VDC will be provided in the same locations as Steps 12 through 15 above.



Test Conditions:

- Key switch in OFF position
- Light switch in OFF position

• Engine OFF

• Turn signal switch in LEFT position

19. Turn signal switch	12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
20. RH hazard light	12.4 - 13.2 VDC	Check 115A, 115C and 125D Dk Grn wires and connections.
21. X7 control panel connector (terminal D)	12.4 - 13.2 VDC	Check 115A and 115B Dk Grn wires and connections.
22. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
23. LH hazard light	Intermittent 12.4 - 13.2 VDC	Check 125A, 125C and 125D Dk Grn wires and connections.
24. X7 control panel connector (terminal E)	Intermittent 12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

Test Conditions:

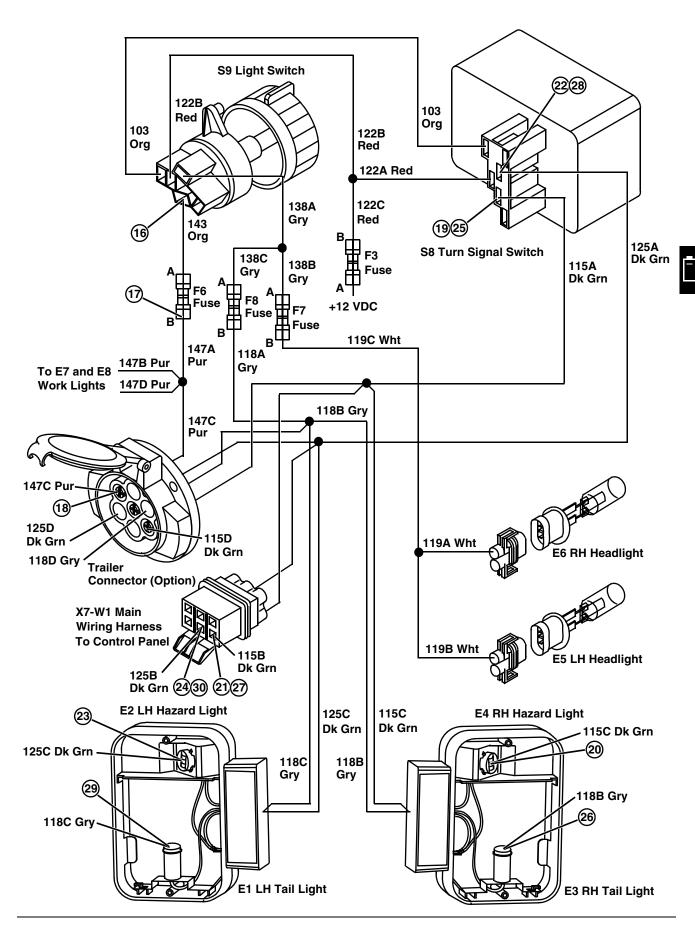
- Key switch in OFF position
- Light switch in OFF position

• Engine OFF

• Turn signal switch in RIGHT position

25. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
26. RH hazard light	Intermittent 12.4 - 13.2 VDC	Check 115A, 115C and 125D Dk Grn wires and connections.
27. X7 control panel connector (terminal D)	Intermittent 12.4 - 13.2 VDC	Check 115A and 115B Dk Grn wires and connections.
28. Turn signal switch	12.4 - 13.2 VDC	Test switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace as needed.
29. LH hazard light	12.4 - 13.2 VDC	Check 125A, 125C and 125D Dk Grn wires and connections.
30. X7 control panel connector (terminal E)	12.4 - 13.2 VDC	Check 125A and 125B Dk Grn wires and connections.

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CRUISE CONTROL

Cruise Control Function:

Provides an electro-mechanical means to control the forward speed of the tractor.

Operating Conditions:

- · Key switch in RUN position
- Brake not depressed
- Cruise control switch momentarily in ENGAGE position, and then released to the ON position.

The cruise control will remain ENGAGED until the brake is depressed; the key switch is turned to the OFF position; or, the cruise control switch is placed into the OFF position.



Theory of Operation:

When the Y3 cruise control electromagnet is energized, the forward pedal is held in whatever position it is in when the magnet is energized. The cruise control magnet is energized through the cruise control relay contacts. The brake switch provides a latching circuit for the cruise control relay. When the brake pedal is depressed, the normally open brake switch contacts open and the latching circuit is removed. With the latching circuit removed, the cruise control relay contacts open, and the cruise control magnet is de-energized, releasing the forward pedal.

Power for the cruise control circuit is provided to the X9 connector, from the key switch (terminal 4), through the 209 Wht wire.

Power is provided from the X9 connector to the cruise control switch through the W4 wiring harness Wht wire, and X10 connector. The cruise control switch is a double pole switch with OFF, ON, and momentary ENGAGE positions.

When the cruise control switch is placed in the momentary ENGAGE position, power is provided through the switch, X10 connector, W4 wiring harness Gry wire, X9 connector, and 238 Gry wire to the K8 cruise control relay (terminal 86). With power provided, the relay coil energizes and the contacts (terminal 30 and terminal 87) close. At the same time (cruise control switch placed in the momentary ENGAGE position), power is provided through the X10 connector, W4 wiring harness Pur wire, X9 connector, and 247 Pur wire to the K8 cruise control relay contacts (terminal 87).

With the contacts closed, power is provided through the relay contacts (terminals 87 and 30) to the cruise control indicator light through the 264B Yel wire, X6 connector (terminal G), and control panel circuit board.

Latching Circuit:

Power is also provided from the cruise control relay

(terminal 30) to the S11 brake switch and Y3 cruise control magnet through the 264A Yel wire, X9 connector, W4 wiring harness Yel wires, and X11 connector and X12 connector respectively.

When power is provided to the cruise control magnet, it is energized and creates a magnetic field that holds the forward pedal in a locked position.

When power is provided to the S11 brake switch, and the brake switch contacts are closed (brake NOT depressed), power is provided through the X11 connector, W4 wiring harness Gry wires, X9 connector and 238 Gry wire to the cruise control relay (terminal 86). This circuit latches the cruise control relay by keeping the cruise control relay coil energized.

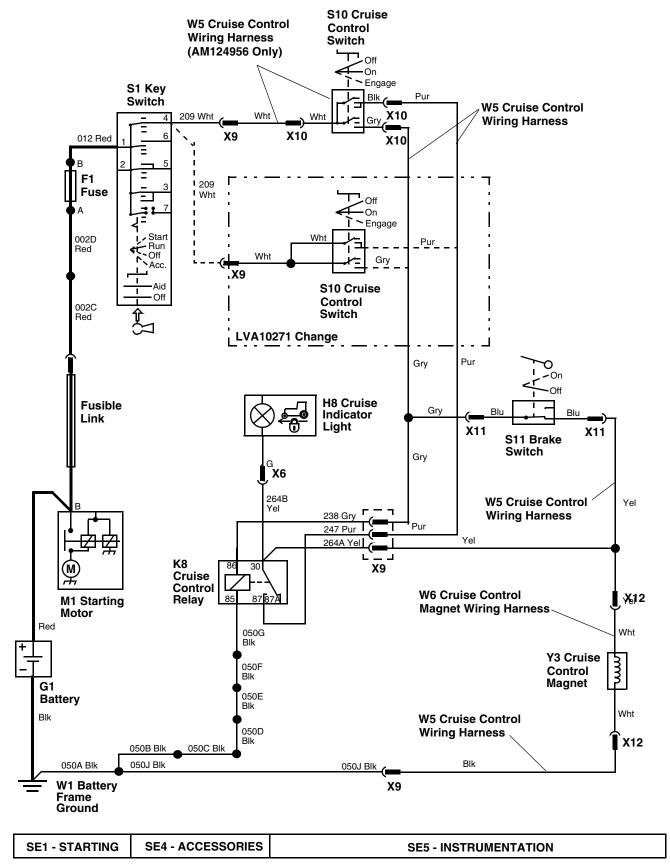
The latching circuit keeps the cruise control relay coil energized until the brake pedal is depressed. When the pedal is depressed, the S11 brake switch contacts open and power is removed from the cruise control relay coil.

When the cruise control relay coil is de-energized, the relay contacts open, and power provided to the cruise control indicator light and the cruise control magnet is removed. Without power, the cruise control magnet releases the forward pedal.

Placing the cruise control switch into the OFF position stops power to the cruise control relay coil and contacts.

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CRUISE CONTROL ELECTRICAL SCHEMATIC





CRUISE CONTROL DIAGNOSIS

Test Conditions:

- Key switch in RUN position, engine OFF
- PTO in NEUTRAL
- Transmission in NEUTRAL

- Park brake ENGAGED
- K8 cruise control relay removed
- X9 disconnected

Test/Check Point	Normal	If Not Normal
31. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as needed.
32. X9 connector (terminal A)	12.4 - 13.2 VDC	Check 209 Wht wire and connections.



Test Conditions:

- X9 connector connected
- X10, X11 and X12 disconnected
- Park brake ENGAGED
- Key switch in RUN position, engine OFF

33. X10 connector (Wht wire	12.4 - 13.2 VDC	Check X9, Wht wire, X10 and connections.
terminal)		

Test Conditions:

• X10 to cruise control switch connected

- Park brake ENGAGED
- Place and hold cruise control switch in ENGAGE position
- Key switch in RUN position, engine OFF

34. K8 relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure cruise control switch is in ENGAGE position. Test switch. (See "CRUISE CONTROL SWITCH TEST" on page 100.) Check X10 connector, Gry wire, X9 connector, and 238 Gry wires and connections.
35. K8 relay socket (terminal 87)	12.4 - 13.2 VDC	Test cruise control switch. Check X10 connector, Pur wire, X9 connector, and 247 Pur wires and connections.
36. X11 connector (Gry wire)	12.4 - 13.2 VDC	Check Gry wire and connections.

Test Conditions:

• Cruise control switch in ON position

K8 relay installed

37. X6 (terminal G)	12.4 - 13.2 VDC	Test K8 cruise control relay.
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Test Conditions:

• Key switch in OFF position

38. X12 to frame ground (Blk wire)	Less than 0.1 ohms resistance	Check Blk wire, X9 connector, and 050J and 050A Blk wires and connections.
39. X9 to X11 to X12 (Yel wires)	Less than 0.1 ohms resistance	Check Yel wires and connections.

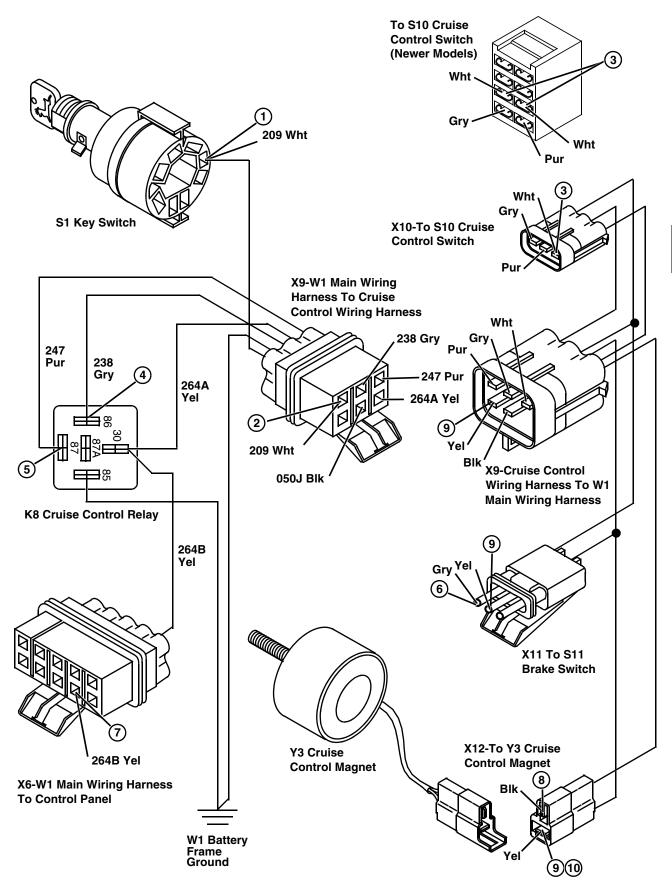
Test Conditions:

- X11 connected
- Key switch in RUN position (Engine OFF)

- Cruise control switch in ON position
- Brake pedal NOT depressed

40. X12 connector (Yel wire)	12.4 - 13.2 VDC	Test brake switch. (See "BRAKE SWITCH TEST" on page 101.)
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TESTS AND ADJUSTMENTS

Common components (such as the key switch, fuel shutoff solenoid, or park brake switch) are cross referenced to this section. The tests and adjustments given in this section can be used by North American or European service technicians.

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. Place PTO in NEUTRAL.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove engine side covers.
- 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) 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 frame ground 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.

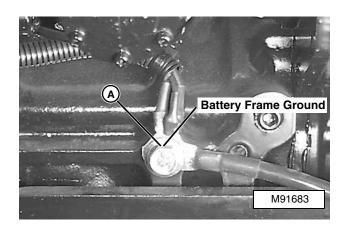
Procedure—VOLTMETER METHOD:

- 1. Park machine on level surface.
- 2. Place PTO in NEUTRAL.
- 3. Turn key switch to ON position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove engine side covers.

- 7. Connect voltmeter negative (black) lead to negative terminal of battery.
- 8. Connect voltmeter positive (red) lead to ground terminal of circuit (A) or component to be tested. Be sure that component circuit is activated (See appropriate circuit operation description) so that voltage will be present at the component. Record voltage. Voltage must be greater than 0, but less than 1.0 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 1.0 volt, the ground circuit is bad. Check for open wiring, loose terminal wire crimps, poor connections, or corrosion in the ground circuit.



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BATTERY TEST



CAUTION

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

Avoid the hazard by:

- 1. Filling batteries in a well-ventilated area.
- 2. Wearing eye protection and rubber gloves.
- 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.
- 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.

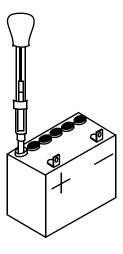
Equipment:

- Hydrometer
- Voltmeter or JTO5685 Battery Tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Clean cable ends, battery terminals and top of battery.
- 7. Remove battery.
- Inspect battery terminals and case for breakage or cracks.

- 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.
- 10. Remove surface charge by placing a small load on the battery for 15 seconds.





11. Use an hydrometer to check for a minimum specific gravity of 1.265 at full charge at 26.7°C (80°F) 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 1.265 with less than 50 point variation, charge battery at 10 amp.
- If all cells are more than 1.265 with less than 50 point variation, load test battery.
- If more than 50 point variation between cells, replace battery.
- Use a voltmeter or JTO5685 Battery Tester to check for a minimum battery voltage of 12.4 VDC.

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.)
- 13. Install battery.

CHARGE BATTERY

Reason:

To increase battery charge after the battery has been discharged.

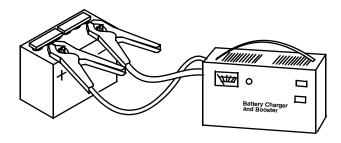
Equipment:

· Battery charger (variable rate).

Procedure:

NOTE: See BATTERY TEST in this group before charging battery.

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove engine side covers.
- 7. Clean cable ends, battery terminals and top of battery.
- 8. Remove battery. Check water level in each cell.
- 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 10 and 11.
- 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 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 at 26.7°C (80°F).
- 15. Load test battery.
- 16. Install battery.

LOAD TEST BATTERY

Reason:

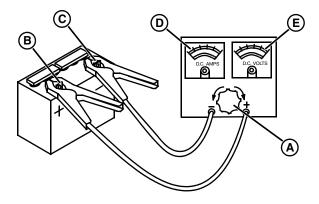
To check condition of battery under load.

Equipment:

JTO5685 Battery Tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Clean cable ends, battery terminals and top of battery.
- 7. Remove battery.



8. Turn load knob (A) counterclockwise to OFF

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position.

- 9. Connect tester positive (red) cable to battery positive (+) terminal (B).
- 10. Connect tester negative (black) cable to battery negative (–) terminal (C).
- 11. Turn load knob (A) of tester clockwise (in) until amperage reading (D) is equal to:
 - cold cranking amperage rating of battery (use blue scale).
- three times ampere hour rating (use black scale).
- 12. Hold for 15 seconds and turn load knob (A) of tester counterclockwise (out) into OFF position.
- 13. 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 AMPERAGE TEST

40 AMP ALTERNATOR

Reason:

To determine charging output of the alternator stator.

Equipment:

• JTO5712 Current Gun

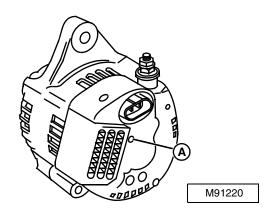
Connections:

1. Put JTO5712 Current Gun over alternator Red wire. Set current gun for DC current.

Procedure:

IMPORTANT: Perform this test quickly to prevent damage to the battery. DO NOT apply full load to battery for more than 10 seconds.

2. Start and run engine at high idle.



Insert a small Phillips screwdriver through the hole

 (A) in rear cover of alternator to ground the
 regulator to the rear cover. Read amperage on
 current gun.



Specifications:

Minimum unregulated amperage 40 amps

Results:

 If reading does not meet specifications, verify voltage at the alternator regulated terminal and good alternator ground. If voltage and ground are OK, replace the alternator.

REGULATED AMPERAGE AND VOLTAGE TESTS

Reason:

To determine the regulated voltage (charging) output of the alternator.

Equipment:

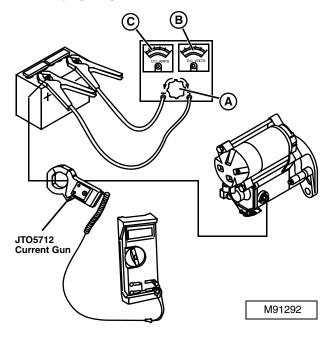
- JTO5712 Current Gun
- Voltmeter
- JTO5685 Battery Tester



Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove engine side covers.
- 7. Disconnect three pin connector from alternator.

NOTE: Battery must be in a good state of charge at 12 to 15 VDC.



8. Connect JTO5712 Current Gun to voltmeter and put around positive (red) battery cable going to starting motor. Set current gun for DC current.

IMPORTANT: Turn load knob (A) fully counterclockwise (out) into OFF position BEFORE making any test connections.

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.

- Turn load knob clockwise (in) until voltage on voltage tester scale reads 11 volts for 5 seconds only to partially drain battery.
- Quickly turn load knob completely counterclockwise (out) to OFF position.
- 12. Start and run engine at **fast idle**. Battery voltage should read **between 12.2 15.0 VDC**.
- 13. Turn load knob clockwise (in) until voltage on tester voltage scale (B) reads 11 volts and look at current gun for a minimum reading of **13.5 amps**.
- 14. Quickly turn load knob completely counterclockwise (out) to OFF position.
- 15. After load test, voltage scale (B) should return to voltage level prior to test.

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 **15.0 VDC**, replace regulator/rectifier.

STARTING MOTOR SOLENOID TEST

Reason:

To determine if starting motor is defective.

Equipment:

Jumper wire



CAUTION

This test will cause engine to turn over. Engine may start. Ensure tractor drive is disengaged. Ensure PTO is disengaged.

Procedure:

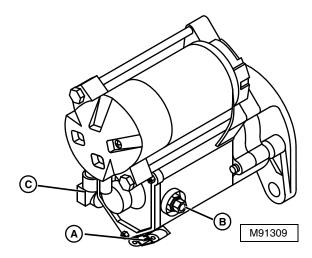
- 1. Park machine on level surface.
- 2. Place drive in NEUTRAL.
- 3. Disengage PTO.
- 4. Turn key switch to OFF position.
- 5. Engage parking brake.

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- 6. Raise hood.
- 7. Remove left engine side cover.
- 8. Disconnect fuel shutoff solenoid wire connector.
- 9. Disconnect 309 Wht wire from starting motor solenoid terminal (A).
- Connect jumper wire to positive (+) battery terminal and briefly jump to starting motor solenoid terminal (A).

Results:

- Starting motor runs—solenoid is good, test cranking circuit wiring.
- Starting motor DOES NOT run—go to next step.
- 11. Remove rubber boot from terminal (B).
- 12. Remove plastic cover from terminal (C).
- 13. Connect jumper wire between starting motor solenoid large terminals (B and C).



Results:

- Starting motor runs—replace starter.
- Starting motor DOES NOT run—check battery cables, then replace starting motor.

STARTING MOTOR AMPERAGE DRAW TEST

Reason:

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

Equipment:

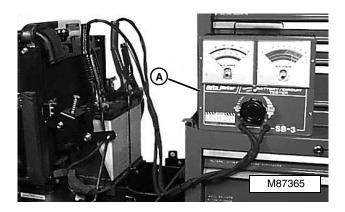
• JTO5685 Battery Tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove engine front and left side covers.
- 7. Test ground connections and battery.
- 8. Disconnect fuel shutoff solenoid connector.

IMPORTANT: Turn load knob (B) fully counterclockwise 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 150 amps, test starting motor No-Load RPM and Amperage to determine if the starting motor is binding or damaged.
- If the starting motor is good, check internal engine components for binding or damage.



NO-LOAD AMPERAGE DRAW AND RPM TESTS

STARTING MOTOR

Reason:

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

Equipment:

- JTO2153 Current Clamp
- JT05791 Multitester
- 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. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove left engine side cover.

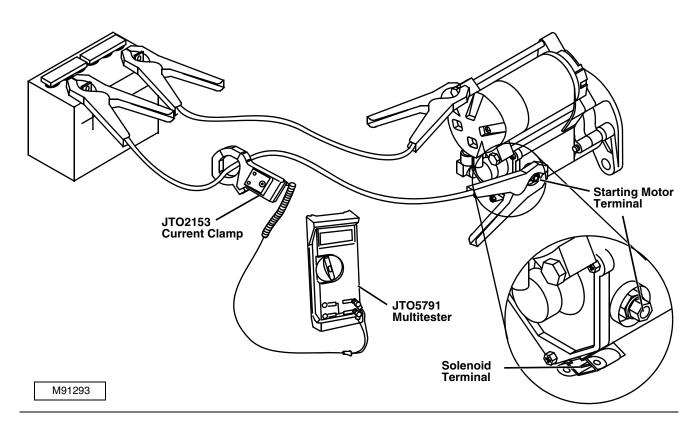
- 7. Remove starting motor assembly from tractor and place starting motor in vice.
- 8. Connect jumper cables to a 12 volt battery
- 9. Connect positive (+) cable to solenoid battery terminal on starting motor.
- 10. Connect negative (–) cable to starting motor body.
- 11. Attach Current Gun to positive (+) cable.

IMPORTANT: Complete this test in 20 seconds or less to prevent starting motor damage.

- 12. Use a jumper wire to briefly connect positive (+) starting motor terminal to solenoid terminal. Starting motor should engage and run.
- 13. Read and record starting motor amperage and rpm.

Results:

- If solenoid "clicks" or chatters and starting motor does not turn, replace starting motor.
- If pinion gear engages and starting motor doesn't turn, replace starting motor.
- If starting motor engages and runs, but amperage is more than 60 Amps at 4440 rpm, repair or replace starting motor.
- If free-running rpm is less than 4000 rpm, repair or replace starting motor.



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RELAY TEST

Reason:

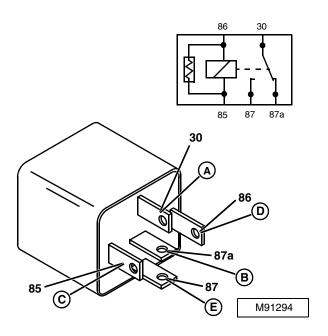
To check relay terminal continuity in the energized and de-energized condition.

Equipment:

- · Ohmmeter or continuity tester
- 12 volt battery and small jumper wires

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Open plastic panel below steering column support.
- 6. Remove relay from fuse and relay load center.
- 7. Check terminal continuity using an ohmmeter or continuity tester.



Results:

- There should be continuity between terminals A (30) and B (87a).
- There should be approximately 80 ohms resistance between terminals C (85) and D (86).
- There should NOT be continuity between any other terminals.
- 8. Connect a small jumper wire from battery positive (+) terminal to relay terminal C (85). Connect a small jumper wire from relay terminal D (86) to battery negative terminal (–).

Results:

- There should be continuity between terminals A (30) and E (87).
- If continuity is NOT correct, replace relay.

ENGINE COOLANT TEMPERATURE SENSOR TEST

Reason:

To verify coolant temperature sensor is functioning properly.

Equipment:

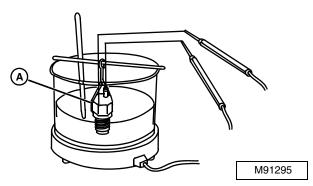
Ohmmeter



Procedure:

NOTE: Perform test with engine at room temperature.

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- Remove engine side covers.
- 7. Disconnect 359 Wht wire from engine coolant temperature sensor.
- Measure resistance between terminal and sensor body.



- 9. If resistance does not meet specification, replace coolant temperature switch.
- 10. Drain engine coolant and remove coolant temperature switch.
- Place sensor (A) in antifreeze solution heated to approximately 96°C (205°F). Measure resistance while sensor is heated.
- 12. If resistance does not meet specification, replace coolant temperature sensor.

Specifications:

Variable Resistance 40 – 700 ohms

ENGINE OIL PRESSURE SWITCH TEST

Reason:

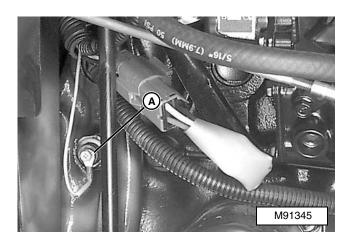
To determine if engine oil pressure switch is functioning properly, to warn operator that oil pressure has dropped below minimum operating pressure.

Equipment:

Ohmmeter

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove right engine side cover.
- 7. Disconnect 347 Pur wire from oil pressure switch (A).
- 8. Connect black lead of ohmmeter to engine block and red lead of ohmmeter to terminal of switch.
- 9. Measure resistance between terminal and engine block.



Results:

- There should be continuity between terminal and around.
- If there is NO continuity between terminal and ground: See Oil Pressure Test. 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.

- 10. Start and run engine.
- 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 meets specification, replace the oil pressure switch.

MANIFOLD HEATER TEST

Reason:

To test proper operation of manifold heater.

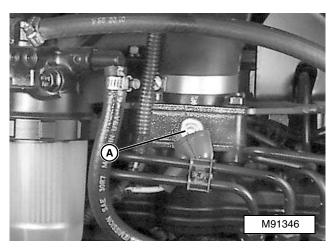
Equipment:

Ohmmeter

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove right engine side cover.
- 7. Remove manifold heater lead from terminal (A).
- Check continuity across terminal (A) and frame ground. The reading should be approximately 0.3

 0.5 ohms.



Results:

If manifold heater does not have approximately 0.3
 - 0.5 ohms resistance, replace heater unit.

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FUSE TEST

Reason:

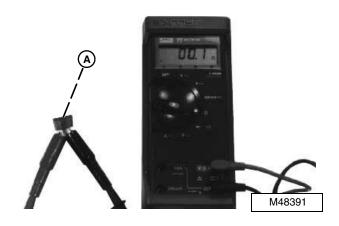
To verify that fuse has continuity.

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.



Results:

• If continuity is not indicated, replace fuse.

CONTROL PANEL LIGHT 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 BLOCK TEST

Reason:

To verify that diodes in diode block are functioning properly.

Equipment:

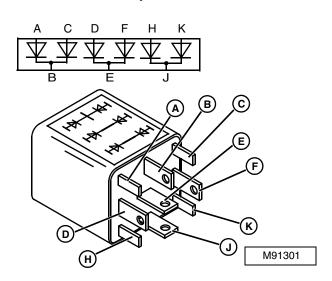
• Ohmmeter, continuity tester or diode tester

Procedure:

NOTE: Terminal positions are indicated on diode block.



- 1. Remove diode block from load center.
- 2. Connect ohmmeter or continuity tester to each diode as indicated in table.
- 3. Check for continuity.



Continuity:

Red Test Lead (+)	Black Test Lead (-)	Continuity
Α	В	Yes
С	В	Yes
D	E	Yes
F	E	Yes
Н	J	Yes
K	J	Yes

- Each diode should have continuity in one direction only.
- If a diode has continuity in both directions, or has no continuity, replace diode block.

SEAT SWITCH TEST

Reason:

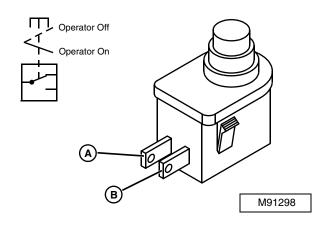
To verify seat switch functions are operating properly.

Equipment:

• Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise seat.
- 6. Disconnect seat switch from wiring harness.



- Check continuity across switch terminals. There should be no continuity.
- 8. Depress seat switch plunger. Continuity should exist between terminals A and B.

Results:

• If any continuity is not correct, replace seat switch.

Results:

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KEY SWITCH TEST

Reason:

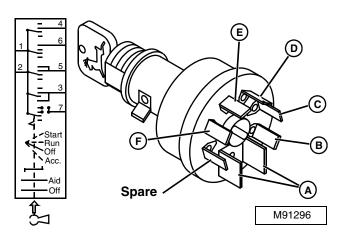
To verify that key switch functions properly.

Equipment:

Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Disconnect and lift control panel.
- 6. Disconnect key switch from wiring harness.
- 7. Remove key switch from tractor.
- 8. Use an ohmmeter or continuity tester to test switch continuity in OFF, RUN, START, and AID (key pushed in) positions.



Key Switch Continuity:

Switch Position	Terminal Continuity
OFF	A and A
ACCESSORY	A and B
RUN	
START	
AID (Key in RUN position & PU	
	A allu F

Results:

• If any continuity is NOT correct, replace the switch.

LIGHT SWITCH TEST

Reason:

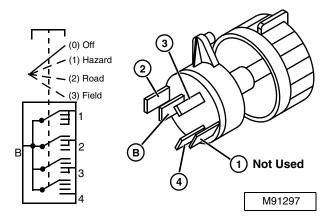
To verify that light switch functions properly.

Equipment:

• Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Remove screws securing control panel and lift control panel.
- 6. Disconnect light switch connector from harness.
- 7. Use an ohmmeter or continuity tester to test switch continuity.



Light Switch Continuity:

Switch Position	Terminal Continuity
OFF	
HAZARD	B and 2
	B and 1
ROAD	
	B and 1
FIELD	
	B and 1

Results:

• If any continuity is NOT correct, replace the switch.



TRANSMISSION NEUTRAL SWITCH TEST – CST & PRT

Reason:

To verify that switch functions properly.

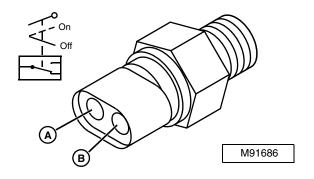
Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Place transmission lever in NEUTRAL.
- 6. Disconnect neutral start switch from harness.
- Check for continuity between terminals (A) and (B).
 If no continuity exists, ensure that selector is in NEUTRAL.

NOTE: For PRT tractors, review "PIP Synopsis".



- If continuity can be obtained when transmission is in NEUTRAL;
- · Place selector in any gear,
- Check for continuity through switch. There should be NO continuity.
- 9. If continuity does not match specifications:
- CST Remove switch(es) from transmission housing.
- PRT Remove switch from PRT valve housing.
- Test switch(es) for continuity. Each switch is normally closed. Depress contact ball on end of switch and check continuity. Switch should be open (NO continuity with ball depressed.
- Replace switch if correct continuity can not be obtained.

Switch Continuity:

Switch Position	Terminal Continuity
NORMALLY OPEN	A and B
BALL DEPRESSED (Closed)	None

Results:

If switch does not match correct continuity readings, replace switch.

PIP Synopsis (Solution Number 47031):

For some PRT tractors there is a potential for the operator to start the tractor while the transmission is in gear. The engine must only start when the dash mounted forward/reverse lever is in the neutral position.

A more positive neutral sensing of the valve spool should be checked for (or added if not installed).

- For tractors A, a special adaptor and activation pin is added between the neutral start switch and shift control valve.
- 2. For tractors B, a special washer is added to shim the neutral start switch.

Tractors A:

LV4500P 150001-253183 LV4500E 155001-259087 LV4600P 160001-263009 LV4600E 166002-269252

Tractors B:

LV4500P 253184-254416 LV4500E 259088-259093 LV4600P 263010-264365 LV4600E 269253-269337

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TRANSMISSION NEUTRAL SWITCH TEST – HST

Reason:

To verify that switch functions properly.

Equipment:

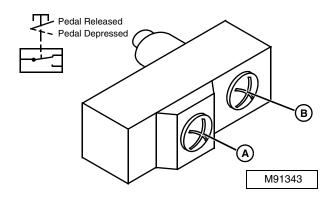
· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Place gear range selector lever in NEUTRAL.
- 6. Disconnect neutral start switch from harness.

NOTE: Switch is normally open. When the pedals are not pushed, the pedal linkage closes the contacts. Depressing either forward or reverse directional pedal allows switch to open.

Check for continuity between terminals (A) and (B).
 If no continuity exists, ensure that directional pedals for transmission are not depressed.



- 8. Press down on forward directional pedal. No continuity should exist between terminal (A) and terminal (B).
- Press down on reverse directional pedal. No continuity should exist between terminal (A) and terminal (B).
- 10. If continuity is not correct, replace switch.
- 11. Adjust switch as needed.
 - Switch should open when forward directional pedal is depressed 0.25 - 0.375 in. (6 - 9 mm).

TURN SIGNAL SWITCH TEST

Reason:

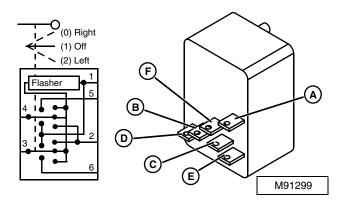
To verify that turn signal switch functions properly.

Equipment:

Ohmmeter

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- Remove screws securing control panel, and lift panel.
- Disconnect turn signal switch connector from harness.
- 7. Use an ohmmeter or continuity tester to test switch continuity in OFF, LH, and RH positions.



Turn Signal Switch Continuity:

Switch Position	Terminal Resistance
OFF	
A to B	25 ohms
A to C	25 ohms
B to C	0.1 ohms
LH POSITION	
A to B	variable
A to C	25 ohms
A to D	open
A to E	
A to F	variable
B to F	o.1 ohms
RH POSITION	A and C

Results:

• If any resistance value is NOT correct, replace the switch.

- +

HAZARD SWITCH TEST

Reason:

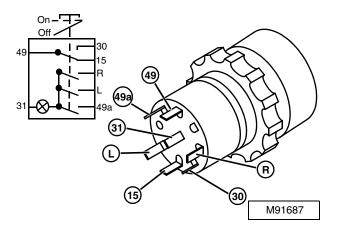
To verify that hazard switch functions properly.

Equipment:

Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Turn key switch to OFF position.
- 3. Engage park brake.
- 4. Remove plastic kick panel from below steering column support.
- Disconnect hazard lights switch connector from harness.
- 6. Use an ohmmeter or continuity tester to test switch continuity in OFF and ON positions.



Hazard Switch Continuity:

Switch Position	Terminal Continuity
OFF (Depressed)	49 and 15
ON (Released)	49 and 30
	49a and R
	49a and L
	R and L
49a to 31 ap	proximately 24 ohms
R to 31	proximately 24 ohms
L to 31	proximately 24 ohms

Results:

 If any resistance value is NOT correct, replace the switch.

MID PTO SWITCH TEST

Reason:

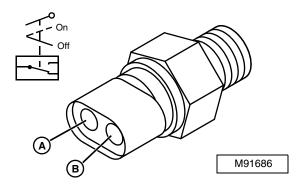
To verify that switch functions properly.

Equipment:

Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Turn key switch to OFF position.
- 3. Engage park brake.
- 4. Disengage PTO.
- 5. Disconnect switch from wiring harness.



- Using an ohmmeter or continuity tester, check continuity through switch. The switch should be closed (continuity with rear PTO DISENGAGED), and the switch should be open (no continuity with rear PTO engaged).
- 7. If continuity does not match specifications:
- Remove switch(es) from transmission housing.
- Test switch(es) for continuity. Each switch is normally closed. Depress contact ball on end of switch and check continuity. Switch should be open (NO continuity) with ball depressed.
- 8. Replace switch if correct continuity can not be obtained.

Switch Continuity:

Switch Position	Terminal Continuity
NORMALLY CLOSED	A and B
BALL DEPRESSED (OPEN)	None

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PTO SWITCH TEST

Reason:

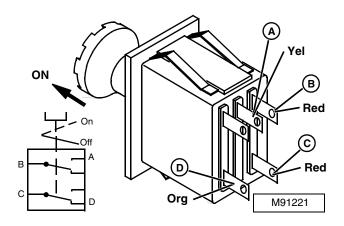
To verify that PTO switch functions properly.

Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Remove plastic kick panel from below steering column support.
- 6. Disconnect PTO switch connector from harness.
- 7. Use an ohmmeter or continuity tester to test switch continuity.



Switch Continuity:

Switch Position	Terminal Continuity
ON	A and B
OFF	C and D

Results:

• If continuity is NOT correct, replace the switch.

2-SPEED PTO SWITCH TEST

Reason:

To verify that switch functions properly.

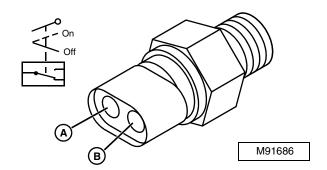
Equipment:

Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Turn key switch to OFF position.
- 3. Engage park brake.
- 4. Disengage PTO. Shift 2-speed PTO selector lever to low (540 rpm) range.
- Disconnect wiring harness connector from PTO speed range switch.





- 6. Using an ohmmeter or continuity tester, check continuity through each switch. One switch should be closed (continuity), and the other switch should be open (no continuity).
- 7. Shift 2-speed PTO selector lever to high (750 rpm) range.
- 8. Using an ohmmeter or continuity tester, check continuity through each switch. The continuity should be reversed through each switch.
- 9. If continuity does not match specifications:
- Remove switch(es) from transmission housing.
- Test switch(es) for continuity. Each switch is normally closed. Depress contact ball on end of switch and check continuity. Switch should be open (NO continuity with ball depressed.
- 10. Replace switch if correct continuity can not be obtained.

Switch Continuity:

Switch Position	Terminal Continuity
NORMALLY CLOSED	A and B
BALL DEPRESSED (OPEN).	None

CRUISE CONTROL SWITCH TEST With AM124956 Wiring Harness

Reason:

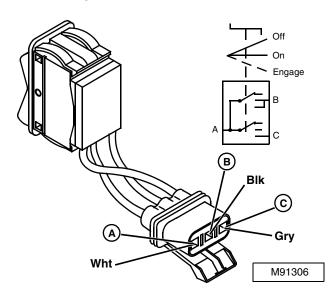
To verify that cruise control switch functions properly.

Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Disconnect and raise control panel.
- 6. Disconnect cruise control switch connector from harness.
- 7. Use an ohmmeter or continuity tester to test switch continuity.



Switch Continuity:

Switch Position	Terminal Continuity
OFF	None
ON	A and B
ENGAGE (momentary)	A, B, and C

Results:

 If continuity is NOT correct, or exists in any other combination than shown above, replace the switch.

CRUISE CONTROL SWITCH TEST With LVA10271 Wiring Harness

Reason:

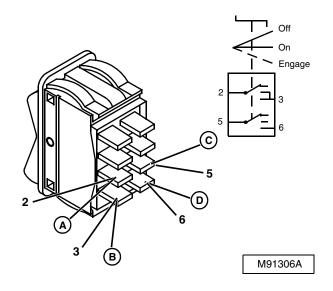
To verify that cruise control switch functions properly.

Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Disconnect and raise control panel.
- 6. Disconnect cruise control switch connector from harness.
- 7. Use an ohmmeter or continuity tester to test switch continuity.



Switch Continuity:

Switch Position	Terminal Continuity
OFF	None
ON	2 and 3
ENGAGE (momentary)	2 and 3, 5 and 6

Results:

 If continuity is NOT correct, or exists in any other combination than shown above, replace the switch.

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CRUISE CONTROL MAGNET TEST

Reason:

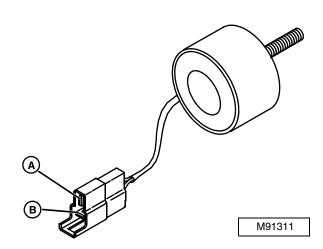
To verify that cruise control magnet is operating properly.

Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- Disconnect cruise control magnet connector from harness.
- 6. Use an ohmmeter or continuity tester to test magnet and housing continuity.



Magnet Continuity:

A to B	Approximately 20 ohms
A to MAGNET HOUSING	None
B to MAGNET HOUSING	None

Results:

 If resistance and continuity are NOT correct, replace the magnet.

BRAKE SWITCH TEST

Reason:

To verify that switch functions properly.

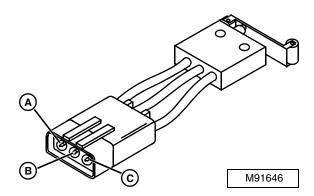
Equipment:

Ohmmeter or continuity tester

Test Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Disconnect brake switch connector.
- Use an ohmmeter or continuity tester to test switch continuity.





Switch Continuity:

Switch Position	Terminal Continuity
RELEASED	B and C
DEPRESSED	A and B

Results:

 If continuity is NOT correct, or continuity exists in any other combination than listed above, replace switch.

Adjustment Procedure:

- 1. Release brake pedal.
- 2. Loosen switch bracket hardware.
- 3. Move switch until switch plunger closes.
- Check that switch does not bottom when brake pedal is released.
- 5. Tighten bracket hardware.
- 6. Check that switch opens when brake pedal is depressed.

PARK BRAKE SWITCH TEST

Reason:

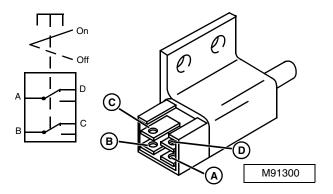
To verify switch functions are operating properly.

Equipment:

Ohmmeter or continuity tester

Test Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Release parking brake.
- 5. Disconnect brake switch connector.
- Use an ohmmeter or continuity tester to test switch continuity.



Switch Continuity:

Switch Position	Terminal Continuity
RELEASED	B and C
	A and D

Results:

 If continuity is NOT correct, or continuity exists in any other combination than listed above, replace switch.

Adjustment Procedure:

- 1. Engage parking brake.
- 2. Loosen switch bracket hardware.
- 3. Move switch until switch plunger is about 3 mm (1/8 in.) from bottoming.
- 4. Check that switch does not bottom when parking brake is fully set. Increase clearance if needed.
- 5. Tighten bracket hardware.
- 6. Check switch operation.

FUEL GAUGE SENSOR TEST

Reason:

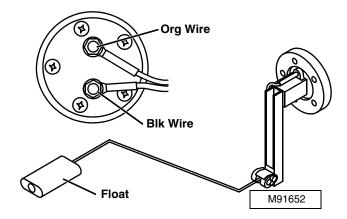
To verify that the fuel gauge sensor is operating properly.

Equipment:

· Ohmmeter or continuity tester

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Engage park brake.
- 4. Raise hood.
- 5. Turn key switch to ON position.
- Disconnect Org wire from fuel sensor and check fuel gauge. The fuel gauge must drop to EMPTY. If not, see "POWER CIRCUIT DIAGNOSIS" on page 30.
- 7. Short the Org wire to the black wire connector on the fuel sensor. The gauge must rise to FULL. If not, test the fuel sensor ground circuit.
- 8. If the gauge does not correctly indicate fuel levels based on the two tests above, proceed to step 9.
- 9. Disconnect fuel gauge sensor wires.
- 10. Remove sensor from fuel tank.
- 11. Using an ohmmeter connected to fuel gauge sensor contacts, check if continuity exists between terminals. If continuity exists, measure resistance across terminals as float and float arm are moved through full range of motion.



Results:

If resistance does not meet specifications, replace fuel gauge sensor.

Specifications:

Variable Resistance 5 – 95 ohms

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FUEL SHUTOFF SOLENOID TESTS

Reason:

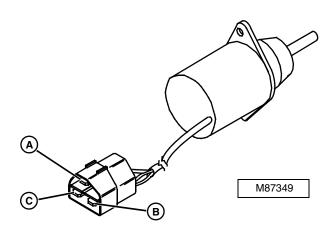
To verify that the solenoid coils are operating properly.

Equipment:

- · Ohmmeter or continuity tester
- Voltmeter

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Raise hood.
- 6. Remove right engine side cover.
- 7. Disconnect fuel shutoff solenoid connector.
- 8. Using an ohmmeter or continuity tester, check if continuity exists between all solenoid terminals.



Results:

If resistance does not meet specifications, replace fuel shutoff solenoid.

Specifications:

A to B	0.4 ohms
A to C	12.4 ohms
B to C	12.0 ohms

 Check for grounds or shorts by connecting tester to one coil terminal and the other to bare metal of coil case.

Results:

Replace fuel shutoff coil if continuity is present.

- 11. Connect fuel shutoff solenoid connector.
- 12. Listen for click when fuel shutoff solenoid pulls in when either:
- Operator on seat with or without park brake engaged and key switch turned to ON position;

or

 Operator off seat with park brake engaged and key switch turned to ON position;

Results:

 If click is not heard when fuel shutoff solenoid pulls in, see "FUEL SUPPLY DIAGNOSIS" on page46.

PTO SOLENOID TEST

Reason:

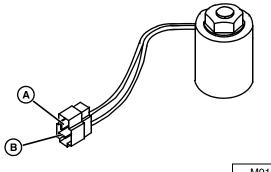
To verify that the solenoid coil is operating properly.

Equipment:

- Ohmmeter or continuity tester
- Voltmeter

Procedure:

- 1. Park machine on level surface.
- 2. Disengage PTO.
- 3. Turn key switch to OFF position.
- 4. Engage park brake.
- 5. Remove tunnel cover and rock shaft valve panel.



M91689

- 6. Disconnect PTO solenoid connector.
- Using an ohmmeter or continuity tester, check if continuity exists between solenoid terminals.

Results:

If resistance does not meet specifications, replace solenoid.

Specifications:

A to B..... 8.0 – 9.0 ohms

9. Check for grounds or shorts by connecting tester to one coil terminal and the other to bare metal of coil case.

Results:

- Replace PTO solenoid if continuity is present from either terminal to solenoid coil case.
- 10. Connect PTO solenoid connector.



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EUROPEAN ELECTRICAL SECTION

The European road homologated tractors have the same electrical circuits as the North American tractors, with the addition of lighting circuits required to meet EEC Machinery Directives.

The main electrical wiring harness is specific to the European models, and is identical among all of the European 4500 and 4600 series tractors.

Lighting additions include the hazard lights switch, flasher relay, brake lights, position lights, and additional control panel indicator lights (2-speed PTO, and trailer indicator lights).

The European tractors have 2-speed PTOs (540 and 750 rpm) with control panel indicator lights.

The European tractor wiring harness contains the same wires (both color and number) as the North American tractors, with additional wires required for the additional circuits.

There are variations between the North American and European main wiring harnesses in connector to wire pin locations and numbers. While some circuits such as the Cranking Circuit may be identical, other circuits contain differences that require using the diagnosis specific to either North American or European tractors.

Common components (such as the key switch, fuel shutoff solenoid, or park brake switch) are cross referenced to the shared Electrical Tests and Adjustments section. (See "TESTS AND ADJUSTMENTS" on page 84.) The tests and adjustments given in this section can be used by any North American or European service technician.

ELECTRICAL SCHEMATIC AND WIRING HARNESS LEGEND

B1—Fuel Gauge Sensor (SE5, W1)

B2—Engine Oil Pressure Switch (SE5, W1)

B3—Engine Coolant Temperature Sensor (SE5, W1)

B4—Horn (SE5, W1)

E1—LH Front Turn/Hazard Light (SE5, W1)

E2—LH RearTurn/Hazard Light (SE5, W1)

E3—RH Front Turn/Hazard Light (SE5, W1)

E4—RH RearTurn/Hazard Light (SE5, W1)

E5-LH Headlight (SE6, W1)

E6-RH Headlight (SE6, W1)

E7—LH Work Light (Option)(SE6, W1)

E8—RH Work Light (Option)(SE6, W1)

E9-LH Front Position Light (SE6, W1)

E10—LH Rear Position Light (SE6, W1)

E11—LH Brake Light (SE6, W1)

E12—RH Front Position Light (SE6, W1)

E13—RH Rear Position Light (SE6, W1)

E14—RH Brake Light (SE6, W1)

E15—License Plate Light (SE6, W1)

F1—Fuse - 30 amp (SE1, W1)

F2—Fuse - 30 amp (Option)(SE4, W1)

F3—Fuse - 30 amp (SE4, W1)

F4—Fuse - 20 amp (SE4, W1)

F5—Fuse - 10 amp (SE2, W1)

F6—Fuse - 20 amp (SE5, W1)

F7—Fuse - 20 amp (SE5, W1)

F8—Fuse - 20 amp (SE6, W1)

F9—Fuse - 20 amp (SE6, W1)

G1—Battery (SE1, W1)

G2—Alternator (SE3, W1)

H1—RH Turn Signal (SE5, W1)

H2—LH Turn Signal (SE5, W1)

H3—PTO Light (NOT USED)

H4—Discharge Light (SE5, W1)

H5—Cold Start Light (SE5, W1)

H6—Park Brake Light (SE5, W1)

H7—Engine Oil Pressure Light (SE5, W1)

H8—Cruise Control Indicator Light (SE5, W1)

H9—Mid PTO Light (SE5, W1)

H10-540 PTO Light (SE5, W1)

H11—750 PTO Light (SE5, W1)



- H12—Bulb Integrity Light (SE5, W1)
- H13—Trailer 1 Light (SE5, W1)
- H14—Trailer 2 Light (SE5, W1)
- H15—Backup Alarm
- K1—Manifold Heater Relay (SE2, W1)
- K2-Start Relay (SE1, W1)
- K3—Fuel Shutoff Relay (SE2, W1)
- K4—Engine Run Relay (SE2, W3)
- K5—Safety Relay (SE2, W1)
- K6—Safety Relay (SE2, W1)
- K7—Accessory Relay (SE4, W1)
- K8—Cruise Control Relay (Option)(SE5, W1)
- K10—Mid PTO Light Relay (Option) (SE2, W1)
- K11—Brake Light Relay (SE4, W1)
- K12—Flasher Relay (SE4, W1)
- M1—Starting Motor (SE1, W1)
- P1—Engine Tachometer (SE5, W1)
- P2—Hour Meter (Option)(SE5, W1)
- P3—Fuel Gauge (SE4, W1)
- P4—Engine Coolant Temperature Gauge (SE5, W1)
- R1—Manifold Heater (SE2, W1)
- R2—Variable Thermistor (SE2, W1)
- S1—Key Switch (SE1, W1)
- S2—Seat Switch (SE2, W1)
- S3—Transmission Neutral Switch (HST) (SE2, W1)
- S4—Transmission Neutral Switch (CST and PRT PowrReverser™) (SE2, W1)
- S5-PTO Switch (SE2, W1)
- S6—Mid PTO Switch (SE2, W1)
- S7—Park Brake Switch (SE2, W1)
- S8—Turn Signal Switch (SE5, W3)
- S9—Light Switch (SE5, W1)
- S10—Cruise Control Switch (Option)(SE5, W1)
- S11—Brake Switch (Option)(SE5, W1)
- S12—Horn Switch (Option)
- S13—Hazard Switch (SE5, W1)
- S14-540 PTO Switch (SE2, W1)
- S15-750 PTO Switch (SE2, W1)
- S16-Brake Switch (SE5, W1)
- V1-Diode Block (SE2, W1)
- W1—Battery Frame Ground (SE1, W1)
- Y1—Starting Motor Solenoid (SE1, W1)
- Y2—Fuel Shutoff Solenoid (SE2, W1)
- Y3—Cruise Control Magnet (Option)(SE5, W1)

Y4—PTO Solenoid (SE2, W1)

CONNECTORS:

- X1—W1 Main Wiring Harness to Fusible Link (SE1, W1)
- NOTE: X2 supplied with cap and jumper wire if X3 is connected to transmission neutral switch on PRT (PowrReverser™) or gear (CST) tractors. X3 supplied with cap and jumper wire if X2 is connected to transmission neutral switch on hydro (HST) tractors.

In main wiring harnesses for tractors with cab version of wiring harness, there is no X3 connector. All tractors have the S3 or S4 neutral switch connected to the X2 connector.

- X2—W1 Main Wiring Harness to W3 HST Transmission Neutral Start Wiring Harness (HST Only) (SE2, W1)
- X3—W1 Main Wiring Harness to S4 (CST and PRT Only) (SE2, W1) Non-cab version tractors only
- X4—W1 Main Wiring Harness to W2 Fuel Shutoff Solenoid Wiring Harness (SE2, W1)
- X5—W1 Main Wiring Harness to S6 Mid PTO Switch (Option) (SE2, W1)
- X6—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X7—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X8—W1 Main Wiring Harness to Control Panel Circuit Board (SE5, W1)
- X9—W1 Main Wiring Harness to W5 Cruise Control Wiring Harness (SE4, W1)
- X10—W5 Cruise Control Wiring Harness to S10 Cruise Control Switch (SE5, W4)
- X11—W5 Cruise Control Wiring Harness to S11 Brake Switch (SE5, W4)
- X12—W5 Cruise Control Wiring Harness to W6 Cruise Control Magnet Wiring Harness (SE5, W5)
- X13—W1 Main Wiring Harness to W7 Trailer Connector Wiring Harness (SE4/SE5/SE6, W1)
- X14—W1 Main Wiring Harness to W7 Trailer Connector Wiring Harness (SE4, W1)
- X16—W1 Main Wiring Harness to E8 RH Work Light (Option) (SE6, W1)
- X15—W1 Main Wiring Harness to W4 PTO Solenoid Wiring Harness (SE2, W1)
- X17—W1 Main Wiring Harness to E7 LH Work Light (Option) (SE6, W1)
- X18—W1 Main Wiring Harness to E1 LH FrontTurn/ Hazard Light

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- X19—W1 Main Wiring Harness to E2 LH Rear Turn/ Hazard Light
- X20—W1 Main Wiring Harness to E9 LH Front Position Light
- X21—W1 Main Wiring Harness to E1 LH FrontTurn/ Hazard Light and E9 LH Front Position Light
- X22—W1 Main Wiring Harness to E10 LH Rear Position Light
- X23—W1 Main Wiring Harness to E11 LH Brake Light
- X24—W1 Main Wiring Harness to E2 LH Rear Turn/ Hazard Light, E10 LH Rear Position Light, and E11 LH Brake Light
- X25—W1 Main Wiring Harness to E3 RH Front Turn/ Hazard Light
- X26—W1 Main Wiring Harness to E4 RH Rear Turn/ Hazard Light
- X27—W1 Main Wiring Harness to E13 RH Rear Position Light
- X28—W1 Main Wiring Harness to E14 RH Brake Light
- X29—W1 Main Wiring Harness to E4 RH Rear Turn/ Hazard Light, E13 RH Rear Position Light, and E14 RH Brake Light
- X30—W1 Main Wiring Harness to E12 RH Front Position Light
- X31—W1 Main Wiring Harness to E3 RH Front Turn/ Hazard Light and E12 RH Front Position Light
- X32—W1 Main Wiring Harness to E15 License Plate Light
- X33—W1 Main Wiring Harness to S16 Brake Switch
- X34—W1 Main Wiring Harness to W8 2-Speed PTO Wiring Harness (Option) (SE2, W1)
- X34A—W1 Main Wiring Harness to S14 (Option) (SE2, W1)
- X34B—W1 Main Wiring Harness to S15 (Option) (SE2, W1)
- X35—W7 Trailer Connector Wiring Harness to Trailer Connector socket
- X36—W1 Main Wiring Harness to H15 Backup Alarm
- X37—W1 Main Wiring Harness to Cab

WIRING HARNESSES:

- W1—Main Wiring Harness
- W1—Main Wiring Harness (Cab Version)

LV4500E359001-

LV4600E369001-

LV4700E179001-

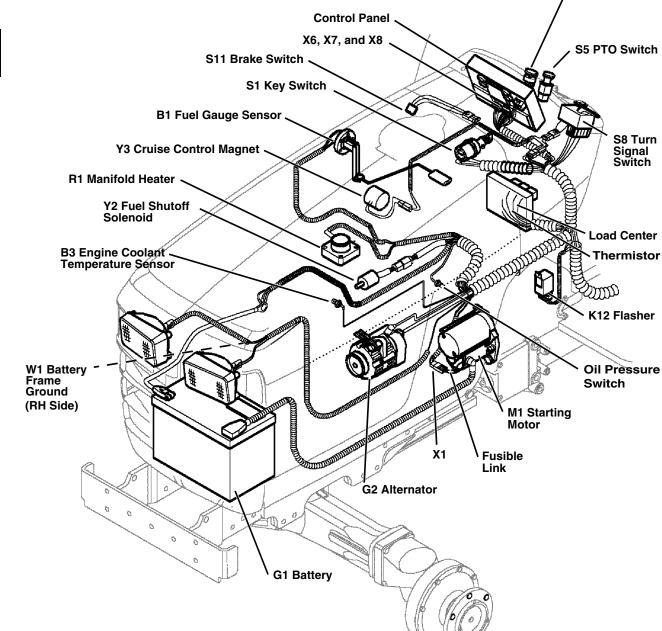
- W2—Fuel Shutoff Solenoid Wiring Harness
- W3—HST Transmission Neutral Start Wiring Harness (included in the W5 Wiring Harness protective wrap)
- W4—PTO Solenoid Wiring Harness
- W5—Cruise Control Wiring Harness
- W6—Cruise Control Magnet Wiring Harness
- W7—Trailer Connector Wiring Harness
- W8—2-Speed PTO Wiring Harness
- For cab wiring harness, see "CAB WIRING HARNESS" on page 188.



S9 Light Switch

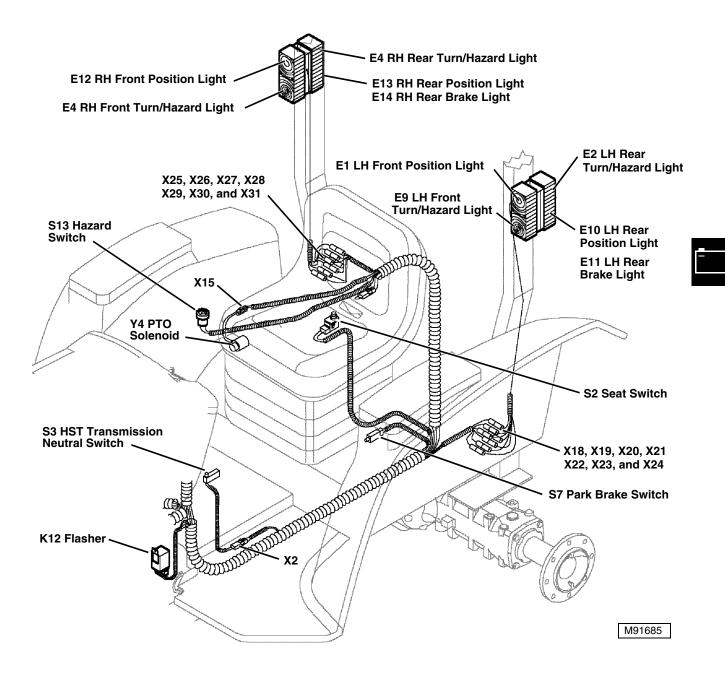
M91684

COMPONENT LOCATION – TRACTOR

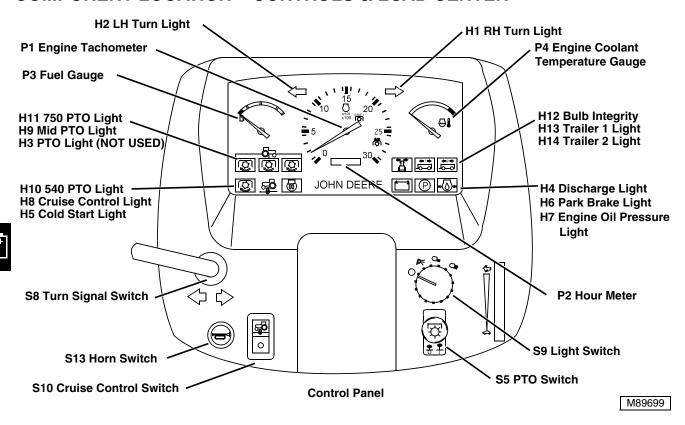


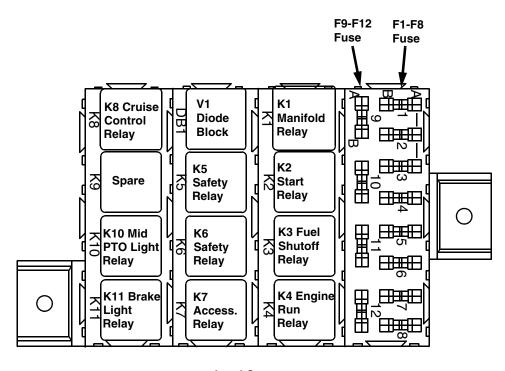


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COMPONENT LOCATION – CONTROLS & LOAD CENTER





Load Center Relays / Diode Block / Fuses

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WIRE COLOR CODES

002B 002C	5.0 5.0 5.0	Red Red	M1, G2 X1 (Fusible Link), K1(30)
002C			
	5.0	Red	l ' '
002D		rieu	X1 (Fusible Link), Splice 002
0020	5.0	Red	Splice 002, F2
002E	1.0	Red	Splice 002, K4(30)
010A	1.0	Blk	E6, Splice 010a
010B	1.0	Blk	E5, Splice 010a
010C	5.0	Blk	W1, Splice 010b
010D	0.8	Blk	DB1-7, Splice 010a
010E	0.5	Blk	DB1-7, K2(85)
010F	0.5	Blk	K2(85), K3(85)
010G	0.8	Blk	Splice 010b, E9
010H	0.8	Blk	Splice 010b, E7
010J	3.0	Blk	Splice 010b, X14
010K	8.0	Blk	Splice 010b, E8
010L	0.8	Blk	Splice 010b, E13/14
010M	0.5	Blk	Splice 010b, X15
010N	1.0	Blk	Splice 010a, X4
010P	1.0	Blk	Splice 101b, S13
010Q	0.8	Blk	Splice 010b, E12
010R	0.8	Blk	Splice 010b, E15
010S	0.8	Blk	Splice 010b, E10/11
010T	(-)	Therm.	K3(85), R2
010U	0.8	Blk	Splice 010a, B4
010V	5.0	Blk	W1, Splice 010a
010X	1.0	Blk	Splice 010a, K12
012	5.0	Red	S1, F1
042A	2.0	Red	F4, Splice 042
042B	1.0	Red	Splice 042, K11(30)
042C	1.0	Red	Splice 042, S13
042D	0.8	Red	Splice 042, X33
050A	2.0	Blk	W1, Splice 050
050B	0.5	Blk	K1(85), Splice 050
050C	0.5	Blk	K1(85), K4(85)
050D	0.5	Blk	K4(85), K5(85)
050E	0.5	Blk	K5(85), K6(85)

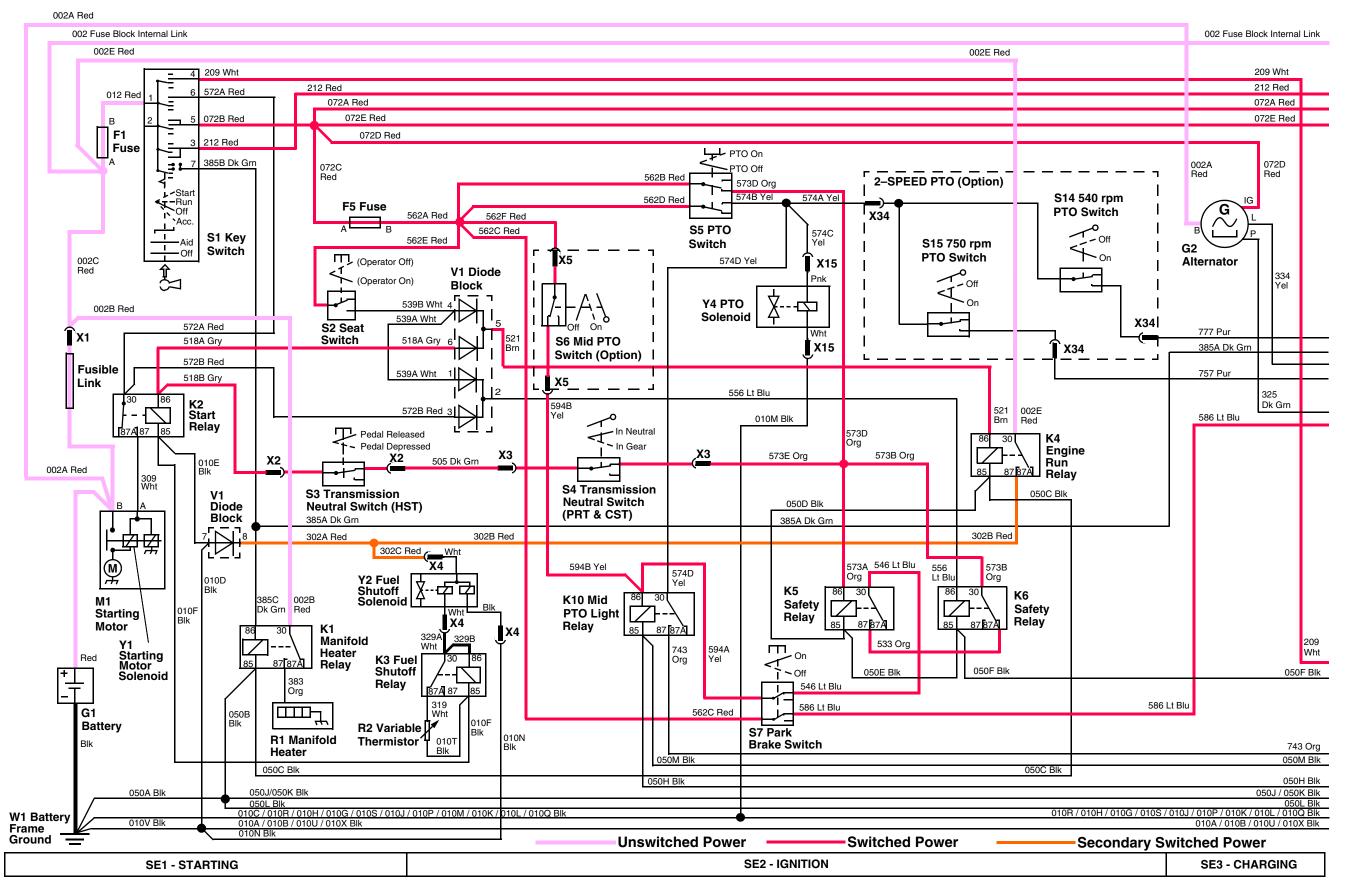
Circuit Number	Wire Size	Color	Termination Points
050F	0.5	Blk	K6(85), K7(85)
050G	0.5	Blk	K7(85), K8(85)
050H	0.5	Blk	K8(85), K10(85)
050J	0.8	Blk	Splice 050, X9
050K	1.0	Blk	Splice 050, X6
050L	0.5	Blk	B1, Splice 050
050M	0.5	Blk	K10(85), K11(85)
072A	1.0	Red	X6, Splice 072
072B	1.0	Red	S1, Splice 072
072C	0.8	Red	Splice 072, F5
072D	0.8	Red	Splice 072, G2
072E	0.8	Red	Splice 072, S13
102	1.0	Red	K12, S13
103A	2.0	Org	S9, Splice 103
103B	2.0	Org	Splice 103, F9
103C	2.0	Org	Splice 103, F8
115A	1.0	Dk Grn	S8, Splice 115
115B	0.8	Dk Grn	X7, Splice 115
115C	0.8	Dk Grn	Splice 115, E4
115D	0.8	Dk Grn	Splice 115, E3
115E	1.0	Dk Grn	Splice 115, X13
115F	1.0	Dk Grn	Splice 115, S13
116	0.8	Lt Blu	X33, K11(86)
118A	2.0	Gry	F8, Splice 118
118B	1.0	Gry	Splice 118, X13
118C	0.8	Gry	Splice 118, E9
118D	0.8	Gry	Splice 118, E13
118E	0.8	Gry	Splice 118, E15
119A	1.0	Wht	E6, Splice 119
119B	1.0	Wht	E5, Splice 119
119C	2.0	Wht	Splice 119, F7
119D	0.8	Wht	Splice 119, X6
122A	0.8	Red	Splice 122, S12
122B	3.0	Red	Splice 122, S9
122C	3.0	Red	F3, Splice 122
125A	1.0	Dk Grn	S8, Splice 125
125B	0.8	Dk Grn	Splice 125, X7
125C	0.8	Dk Grn	Splice 125, E2
125D	0.8	Dk Grn	Splice 125, E1

Circuit Number	Wire Size	Color	Termination Points
125E	1.0	Dk Grn	Splice 125, X13
125F	1.0	Dk Grn	Splice 125, S13
127A	1.0	Pur	Splice 127, S8
127B	1.0	Pur	Splice 127, S8
127C	1.0	Pur	S13, Splice 127
127D	1.0	Pur	K12, Splice 127
128A	2.0	Gry	F9, Splice 128
128B	1.0	Gry	Splice 128, X13
128C	0.8	Gry	Splice 128, E12
128D	0.8	Gry	Splice 128, E10
136A	2.0	Lt Blu	K11(87), Splice 136
136B	1.0	Lt Blu	Splice 136, X13
136C	0.8	Lt Blu	Splice 136, E11
136D	0.8	Lt Blu	Splice 136, E14
138	2.0	Gry	S9, F7
143	2.0	Org	S9, F6
144	0.8	Yel	K12, X8
146	0.8	Lt Blu	K12, X8
147A	2.0	Pur	F6, Splice 147
147B	0.8	Pur	Splice 147, E7
147D	0.8	Pur	Splice 147, E8
148	0.8	Gry	K12, X8
209	0.8	Wht	X9, S1
212	0.5	Red	K7(86), S1
222	2.0	Red	K7(87), X14
238	0.8	Gry	X9, K8(86)
247	0.8	Pur	X9, K8(87)
252	2.0	Red	K7(30), F2
264A	0.8	Yel	K8(30), X9
264B	0.8	Yel	K8(30), X6
302A	1.0	Red	DB1- 8, Splice 302
302B	1.0	Red	K4(87), Splice 302
302C	1.0	Red	Splice 302, X4
309	1.0	Wht	K2(87), M1
319	(+)	Therm.	K3(87a), R2
325	0.8	Dk Grn	X6, G2
329A	1.0	Wht	X4, K3(30)
329B	1.0	Wht	K3(86), K3(30)
334	0.8	Yel	X7, G2

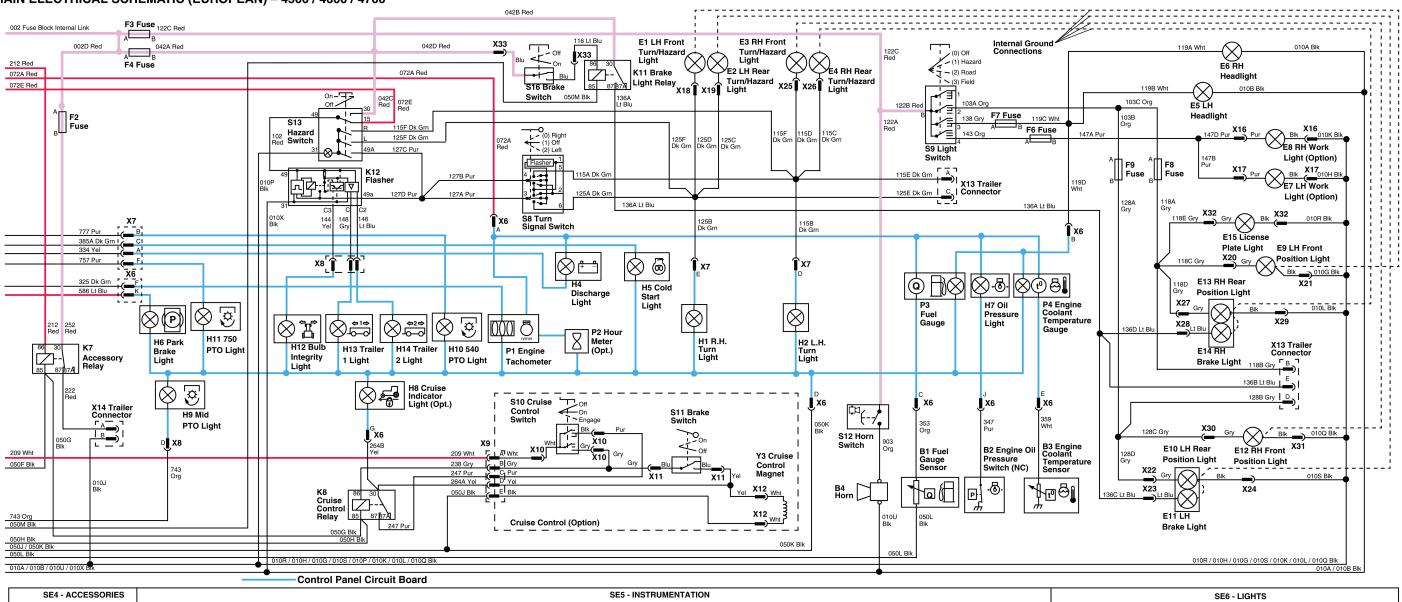
Circuit Number	Wire Size	Color	Termination Points
347	0.5	Pur	X6, B2
353	0.5	Org	X6, B1
359	0.5	Wht	X6, B3
383	3.0	Org	K1(87), R1
385A	0.8	Dk Grn	X7, Splice 385
385B	0.8	Dk Grn	Splice 385, S1
385C	0.5	Dk Grn	Splice 385, K1(86)
505	0.5	Dk Grn	X2, X3 (S4)
518A	0.5	Gry	DB1- 6, K2(86)
518B	0.5	Gry	K2(86), X2
521	0.5	Brn	K4(86), DB1- 5
533	0.5	Org	K5(87), K6(87a)
539A	0.5	Wht	DB1- 1, DB1- 4
539B	0.5	Wht	DB1- 4, S2
546	0.5	Lt Blu	K5(30), S7
556	0.5	Lt Blu	K6(86), DB1-2
562A	8.0	Red	F5, Splice 562
562B	0.5	Red	S5, Splice 562
562C	0.5	Red	Splice 562, S7
562D	0.5	Red	S5, Splice 562
562E	0.5	Red	Splice 562, S2
562F	0.5	Red	Splice 562, X5
572A	1.0	Red	S1, K2(30)
572B	8.0	Red	K2(30), DB1- 3
573A	0.5	Org	K5(86), Splice 573
573B	0.5	Org	K6(30), Splice 573
573D	0.5	Org	Splice 573, S5
573E	0.5	Org	Splice 573, X3
574A	0.5	Yel	X34, Splice 574
574B	0.5	Yel	S5, Splice 574
574C	0.5	Yel	Splice 574, X15
574D	0.5	Yel	Splice 574, K10(30)
586	0.5	Lt Blu	S7, X6
594A	0.5	Yel	S7, K10(86)
594B	0.5	Yel	K10(86), X5
743	0.5	Org	K10(87a), X8
757	0.5	Pur	X34, X7
777	0.5	Pur	X34, X7
903	0.8	Org	S12, B4

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MAIN ELECTRICAL SCHEMATIC – 4500 / 4600 / 4700

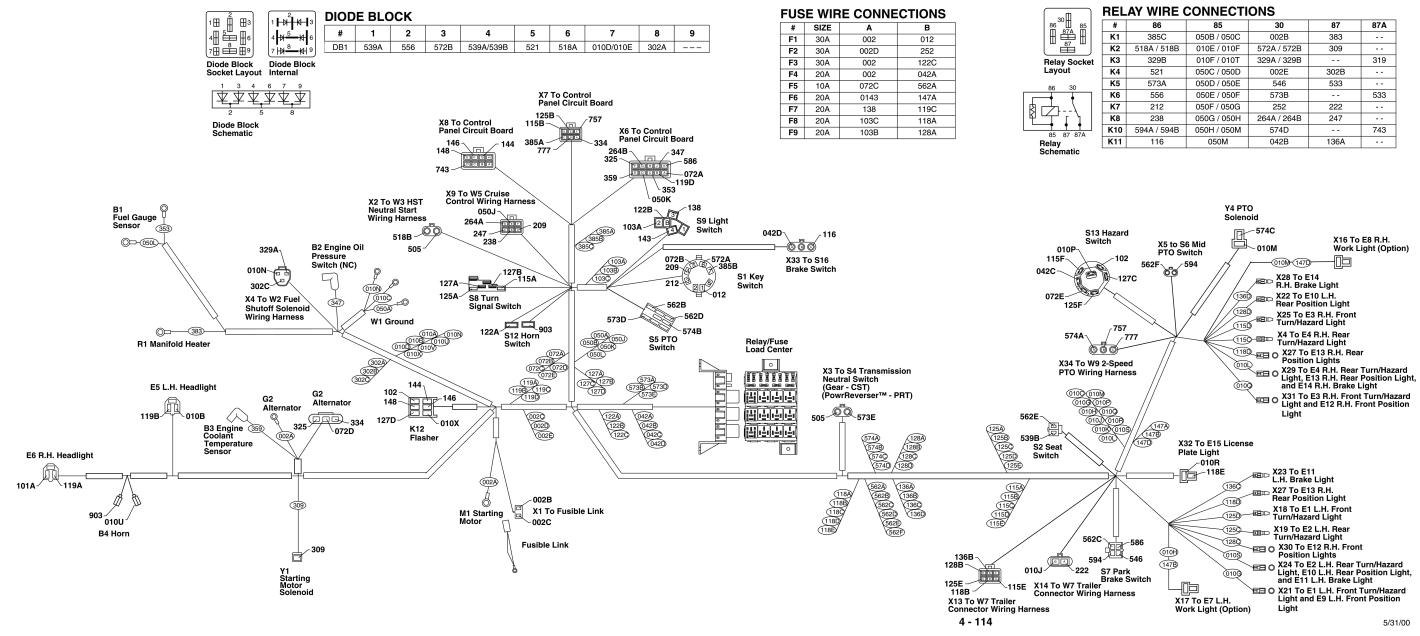


MAIN ELECTRICAL SCHEMATIC (EUROPEAN) - 4500 / 4600 / 4700



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W1 MAIN WIRING HARNESS (EUROPEAN) - 4500 / 4600 / 4700



EUROPEAN (CAB VERSION)

Serial Numbers:

LV4500E359001-

LV4600E369001-

LV4700E179001-

WIRE COLOR CODES

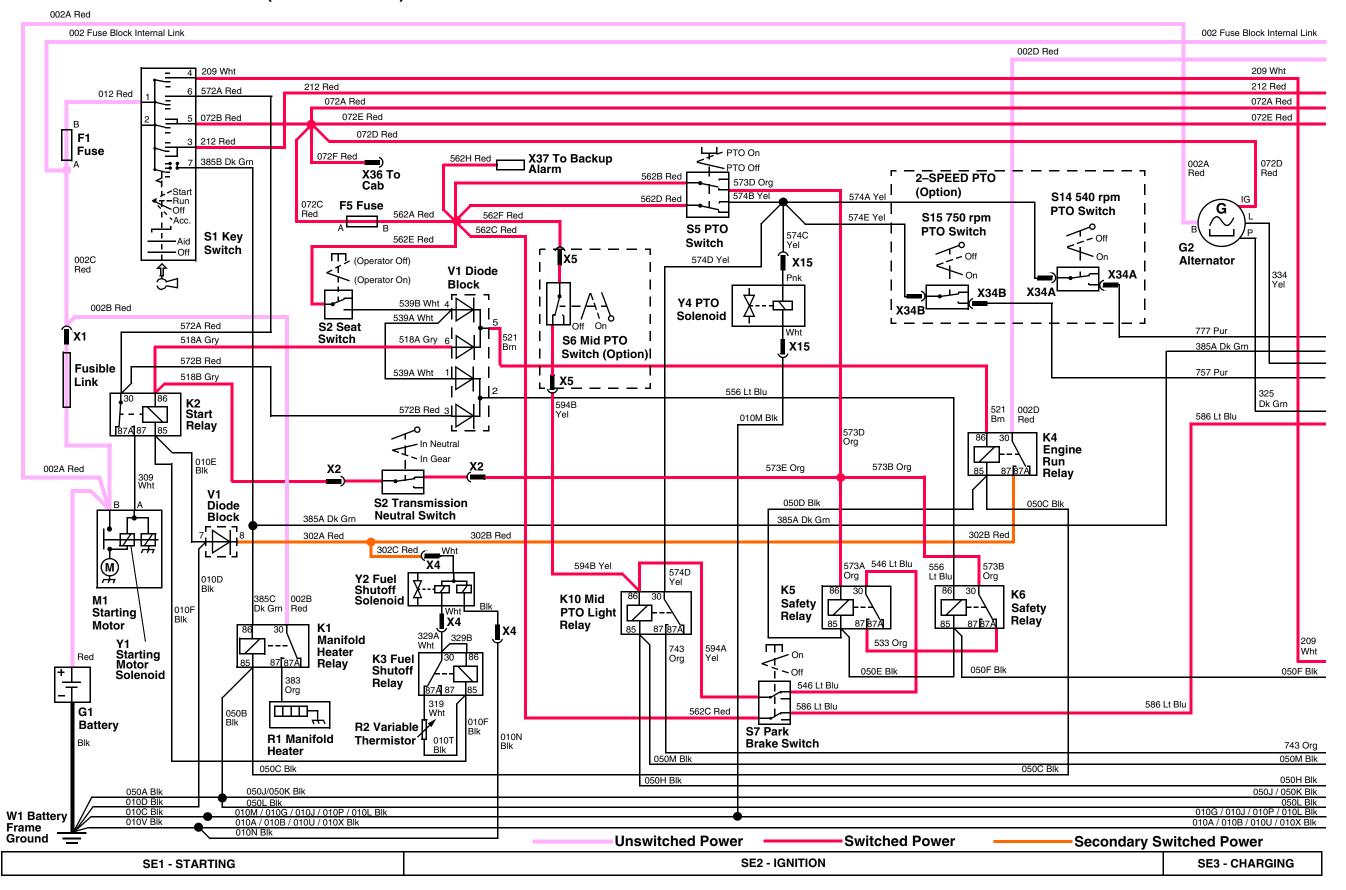
Circuit Number	Wire Size	Color	Termination Points
002A	5.0	Red	M1, G2
002B	5.0	Red	X1 (Fusible Link), K1(30)
002C	5.0	Red	X1 (Fusible Link), F1
002D	5.0	Red	K4(30), F2
010A	1.0	Blk	E6, Splice 010a
010B	1.0	Blk	E5, Splice 010a
010C	5.0	Blk	W1, Splice 010b
010D	0.8	Blk	DB1-7, W1
010E	0.5	Blk	DB1-7, K2(85)
010F	0.5	Blk	K2(85), K3(85)
010G	0.8	Blk	Splice 010b, E9
010J	3.0	Blk	Splice 010b, X14
010L	1.0	Blk	Splice 010b, E13/14
010M	0.5	Blk	Splice 010b, X15
010N	1.0	Blk	Splice 010a, X4
010P	1.0	Blk	Splice 101b, S13
010R	0.8	Blk	Splice 010b, E15
010T	(-)	Blk	K3(85), R2
010U	0.8	Blk	Splice 010a, B4
010V	5.0	Blk	W1, Splice 010a
010X	1.0	Blk	Splice 010a, K12
012	5.0	Red	S1, F1
042A	2.0	Red	F4, Splice 042
042B	1.0	Red	Splice 042, K11(30)
042C	1.0	Red	Splice 042, S13
042D	0.8	Red	Splice 042, X33
050A	2.0	Blk	W1, Splice 050
050B	0.5	Blk	K1(85), Splice 050
050C	0.5	Blk	K1(85), K4(85)
050D	0.5	Blk	K4(85), K5(85)
050E	0.5	Blk	K5(85), K6(85)
050F	0.5	Blk	K6(85), K7(85)

Circuit Number	Wire Size	Color	Termination Points
050G	0.5	Blk	K7(85), K8(85)
050H	0.5	Blk	K8(85), K10(85)
050J	0.8	Blk	Splice 050, X9
050K	1.0	Blk	Splice 050, X6
050L	0.5	Blk	B1, Splice 050
050M	0.5	Blk	K10(85), K11(85)
072A	1.0	Red	X6, Splice 072
072B	1.0	Red	S1, Splice 072
072C	1.0	Red	Splice 072, F5
072D	0.8	Red	Splice 072, G2
072E	0.8	Red	Splice 072, S13
072F	0.8	Red	Splice 072, X37
102	1.0	Red	K12(49), S13(49)
103A	2.0	Org	S9, Splice 103
103B	2.0	Org	Splice 103, F9
103C	2.0	Org	Splice 103, F8
115A	1.0	Dk Grn	S8, Splice 115
115B	0.8	Dk Grn	X7, Splice 115
115C	0.8	Dk Grn	Splice 115, E4
115E	1.0	Dk Grn	Splice 115, X13
115F	1.0	Dk Grn	Splice 115, S13
116	0.8	Lt Blu	X33, K11(86)
118A	2.0	Gry	F8, Splice 118
118B	1.0	Gry	Splice 118, X13
118C	0.8	Gry	Splice 118, E9
118E	0.8	Gry	Splice 118, E15
119A	1.0	Wht	E6, Splice 119
119B	1.0	Wht	E5, Splice 119
119C	2.0	Wht	Splice 119, F7
119D	0.8	Wht	Splice 119, X6
122A	0.8	Red	Splice 122, S12
122B	3.0	Red	Splice 122, S9
122C	3.0	Red	F3, Splice 122
125A	1.0	Dk Grn	S8, Splice 125
125B	0.8	Dk Grn	Splice 125, X7
125C	0.8	Dk Grn	Splice 125, E2
125E	1.0	Dk Grn	Splice 125, X13
125F	1.0	Dk Grn	Splice 125, S13
127A	1.0	Pur	Splice 127, S8
127B	1.0	Pur	Splice 127, S8
127C	1.0	Pur	S13, Splice 127

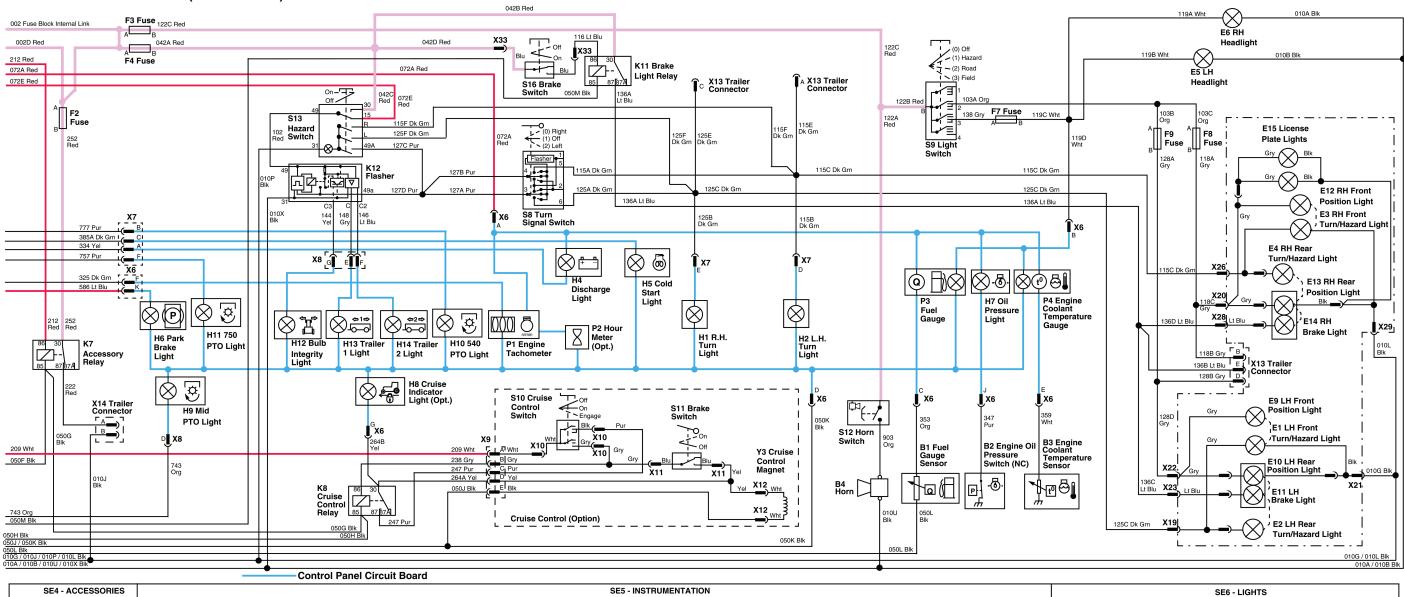
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Circuit Number	Wire Size	Color	Termination Points
127D	1.0	Pur	K12, Splice 127
128A	2.0	Gry	F9, Splice 128
128B	1.0	Gry	Splice 128, X13
128D	0.8	Gry	Splice 128, E10
136A	2.0	Lt Blu	K11(87), Splice 136
136B	1.0	Lt Blu	Splice 136, X13
136C	0.8	Lt Blu	Splice 136, E11
136D	0.8	Lt Blu	Splice 136, E14
138	2.0	Gry	S9, F7
144	0.8	Yel	K12, X8
146	0.8	Lt Blu	K12, X8
148	0.8	Gry	K12, X8
209	0.8	Wht	X9, S1
212	0.5	Red	K7(86), S1
222	2.0	Red	K7(87), X14
238	0.8	Gry	X9, K8(86)
247	0.8	Pur	X9, K8(87)
252	2.0	Red	K7(30), F2
264A	0.8	Yel	K8(30), X9
264B	0.8	Yel	K8(30), X6
302A	1.0	Red	DB1- 8, Splice 302
302B	1.0	Red	K4(87), Splice 302
302C	1.0	Red	Splice 302, X4
309	1.0	Wht	K2(87), M1
319	(+)	Wht.	K3(87a), R2
325	0.8	Dk Grn	X6, G2
329A	1.0	Wht	X4, K3(30)
329B	1.0	Wht	K3(86), K3(30)
334	0.8	Yel	X7, G2
347	0.5	Pur	X6, B2
353	0.5	Org	X6, B1
359	0.5	Wht	X6, B3
383	3.0	Org	K1(87), R1
385A	0.8	Dk Grn	X7, Splice 385
385B	0.8	Dk Grn	Splice 385, S1
385C	0.5	Dk Grn	Splice 385, K1(86)
518A	0.5	Gry	DB1- 6, K2(86)
518B	0.5	Gry	K2(86), X2
521	0.5	Brn	K4(86), DB1- 5
533	0.5	Org	K5(87), K6(87a)
539A	0.5	Wht	DB1- 1, DB1- 4

Circuit Number	Wire Size	Color	Termination Points
539B	0.5	Wht	DB1- 4, S2
546	0.5	Lt Blu	K5(30), S7
556	0.5	Lt Blu	K6(86), DB1-2
562A	0.8	Red	F5, Splice 562
562B	0.5	Red	S5, Splice 562
562C	0.5	Red	Splice 562, S7
562D	0.5	Red	S5, Splice 562
562E	0.5	Red	Splice 562, S2
562F	0.5	Red	Splice 562, X5
562H	0.5	Red	Splice 562, X36
572A	1.0	Red	S1, K2(30)
572B	0.8	Red	K2(30), DB1-3
573A	0.5	Org	K5(86), Splice 573
573B	0.5	Org	K6(30), Splice 573
573D	0.5	Org	Splice 573, S5
573E	0.5	Org	Splice 573, X2
574A	0.5	Yel	Splice 574, X34A
574B	0.5	Yel	S5, Splice 574
574C	0.5	Yel	Splice 574, X15
574D	0.5	Yel	Splice 574, K10(30)
574E	0.5	Yel	Splice 574, X34B
586	0.5	Lt Blu	S7, X6
594A	0.5	Yel	S7, K10(86)
594B	0.5	Yel	K10(86), X5
743	0.5	Org	K10(87a), X8
757	0.5	Pur	X34B, X7
777	0.5	Pur	X34A, X7
903	0.8	Org	S12, B4

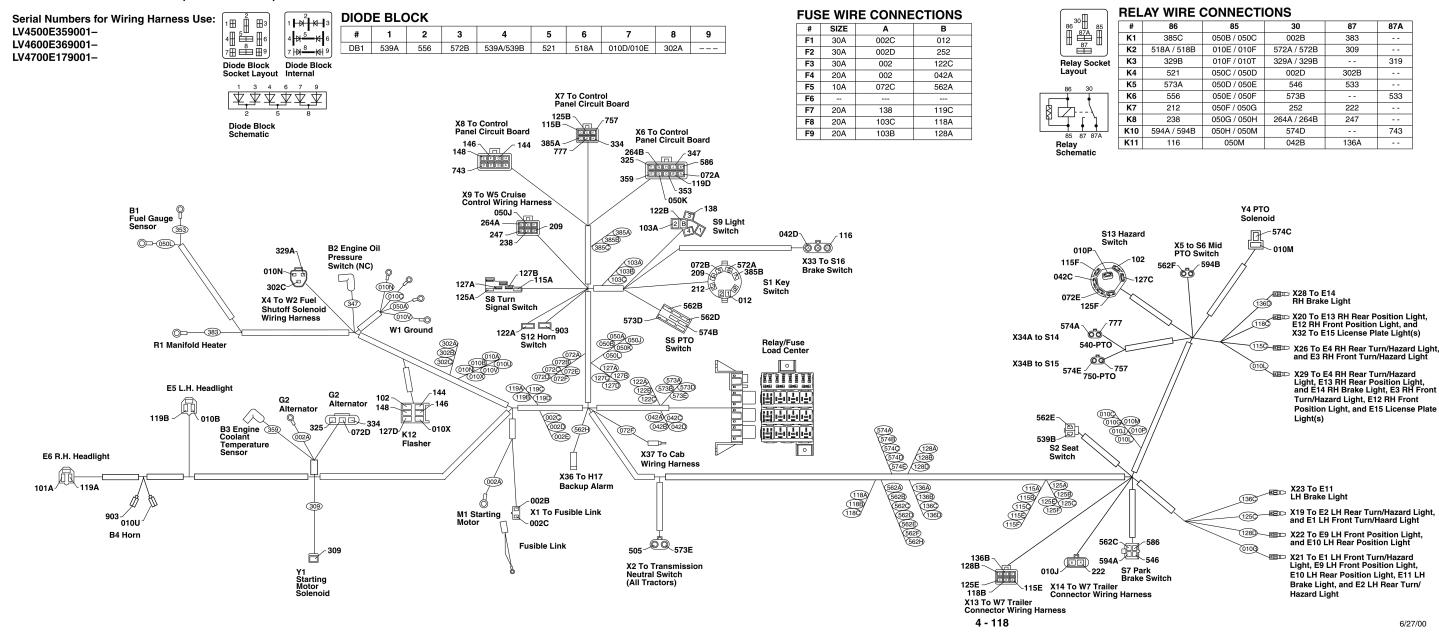
MAIN ELECTRICAL SCHEMATIC (CAB VERSION)



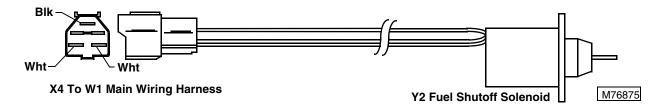
MAIN ELECTRICAL SCHEMATIC (CAB VERSION)



W1 MAIN WIRING HARNESS (CAB VERSION)



W2 FUEL SHUTOFF SOLENOID WIRING HARNESS



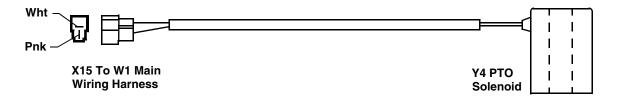
W3 HST NEUTRAL START WIRING HARNESS

(Included in W5 Cruise Control Wiring Harness protective wrap)

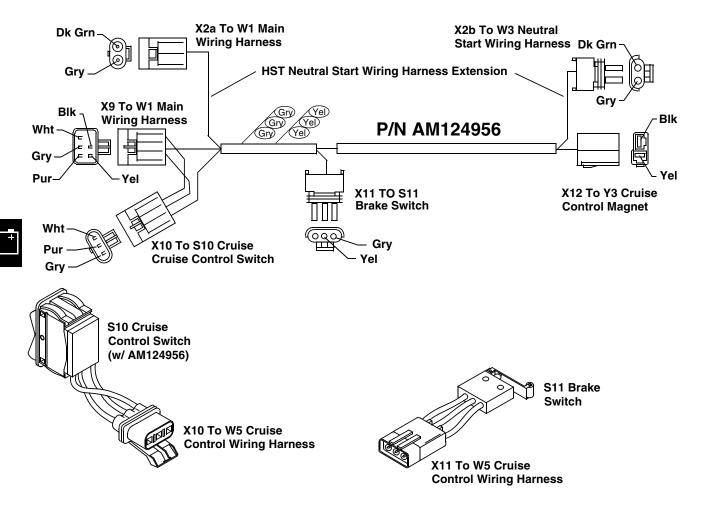


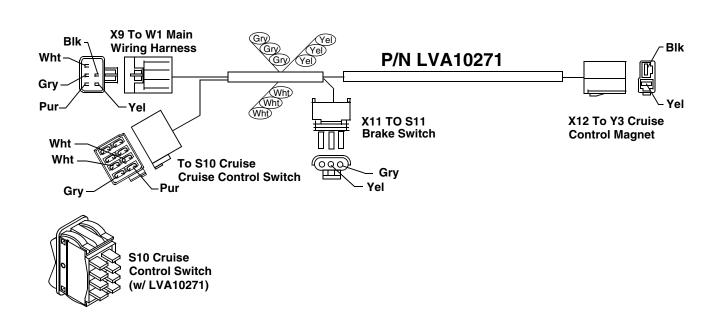


W4 PTO SOLENOID WIRING HARNESS



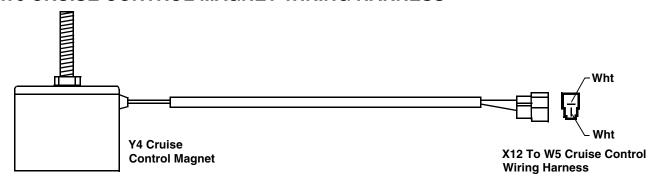
W5 CRUISE CONTROL WIRING HARNESS



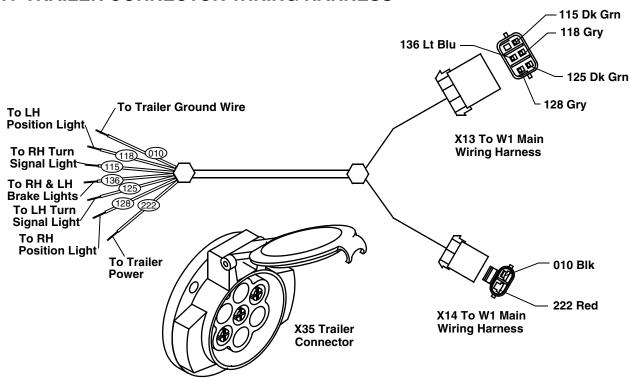


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W6 CRUISE CONTROL MAGNET WIRING HARNESS



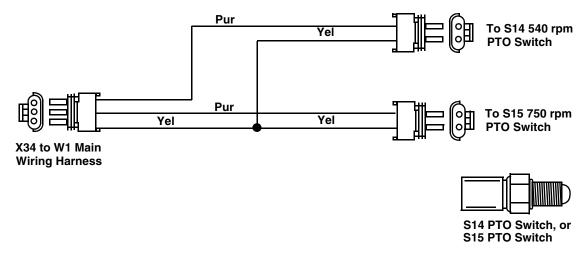
W7 TRAILER CONNECTOR WIRING HARNESS



Circuit Number	Wire Size	Color	Termination Points	Main Harness Connection
010	3.0	Blk	X35 - Pin 3, Ground Wire Socket	X14 (to 010J Blk)
115	1.0	Dk Grn	X35 - Pin 4, RHTurn Signal Light Socket	X13 (to 115E Dk Grn)
118	1.0	Gry	X35 - Pin 5, LH Position Light Pin	X13 (to 118B Gry)
125	1.0	Dk Grn	X35 - Pin 1, LHTurn Signal Light Pin	X13 (to 125E Dk Grn)
128	1.0	Gry	X35 - Pin 7, RH Position Light Pin	X13 (to 128B Gry)
136	1.0	Lt Blu	X35 - Pin 6, LH and RH Brake Lights Socket	X13 (to 136B Lt Blu)
222	2.0	Red	X35 - Pin 2, Power Wire Socket (Accessory)	X14 (to 222 Red)



W8 2-SPEED PTO WIRING HARNESS





NOTE: W8 2-speed PTO wiring harness was incorporated into main wiring harness in later models and cab version wiring harnesses. X34a and X34b on the main wiring harness connect directly to S14 and S15 2 speed PTO switches.

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TROUBLESHOOTING

Problem or Symptom Check or Solution	Starter cranking problems	Engine cranks but will not start	Engine will not shut off	Improper component operating with switch	Engine oil light problem	Battery goes dead, discharges or overcharges	Discharge light problem	Engine coolant temperature light problem	Engine will not run when operator leaves seat	Instrument lights problems	Headlight problem	Fuel gauge does not work properly
See Power Circuit Diagnosis	•	•									•	
See Engine Shutoff Circuit Diagnosis	•	•	•						•			
See Cranking Circuit Diagnosis	•											
Check ground circuit	•	•										
Test battery and battery connections	•											
See Manifold heater Circuit Diagnosis		•										
See Fuel Supply Circuit Diagnosis		•										
See Charging Circuit Diagnosis						•	•					
See Control Panel Indicator Diagnosis					•		•	•		•		•
See Lights Circuit Diagnosis											•	
Check for shorted circuit			•	•		•						•



THEORY AND DIAGNOSIS

POWER CIRCUIT OPERATION

Function:

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

The power circuits are divided among the unswitched power circuit, switched power circuits (key switch in RUN, START, or AID positions), and secondary switched power circuits. The secondary switched power circuits become energized when switched power circuits energize relays providing current paths to the secondary circuits. The secondary power circuits would not be energized if the relays controlling the current path(s) failed.

Detailed Theory of Operation, Schematics, and Troubleshooting of circuits are shown throughout electrical section.

Unswitched Power:

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

- Battery Positive Terminal
- Starting Motor Terminal B
- F1 Fuse
- Key Switch Terminal 1
- Alternator Terminal B
- Manifold Heater Relay Terminal 30
- Engine Run Relay Terminal 30
- F2 Fuse
- Accessory Relay Terminal 30
- F3 Fuse
- Light Switch Terminal B
- Horn Switch
- F4 Fuse
- Hazard Switch Terminal 30
- Brake Switch

The positive battery cable connects the battery to the starting motor bolt (terminal B). The starting motor bolt is used as the 12 Volt DC tie point for the rest of the electrical system.

The battery cables and the starting motor tie point connections must be good for the vehicle electrical system to work properly. The ground cable and positive cable connections are equally important. Proper starting motor operation depends on these cables and connections to carry high current.

With the exception of the alternator B terminal, the electrical circuit is protected by the fusible link beyond the starting motor tie point. The fusible link is a short piece of wire that is designed to fail if current load is too high or a short occurs.

Switched Power - Run:

In addition to the voltage present at the locations of the unswitched power circuits, voltage must be present at the following components with the key switch in the RUN ("ON") position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminals 3, 4, and 5
- Alternator Terminal IG
- F5 Fuse
- PTO Switch Terminals A, G and H
- X5 Connector (562F Red wire)

NOTE: X5 connector has jumper wire installed unless Mid PTO option is installed.

- Mid PTO Light Relay Socket Terminal 86
- Park Brake Switch Terminals A, B, C and D
- K5 Safety Relay Terminals 86 and 30
- K6 Safety Relay Terminal 30
- Seat Switch
- X9 Connector Terminal A
- Cruise Control Switch
- X6 Connector Terminals A and K
- X7 Connector Terminal A
- Accessory Relay Terminal 86
- X3 Connector (573E Org wire); or, X2 Connector (505 Dk Grn wire)

NOTE: The S4 Transmission Neutral Switch is installed in collar shift gear drive (CST) and PowrReverser™ (PRT) tractors; a jumper wire is installed in the X2 connector, and the S3 Transmission Neutral Switch is not used. In hydrostatic drive (HST) tractors the S3 Transmission Neutral Switch is used, and a jumper wire is installed in the X3 connectoreliminating the S4 switch.

- Start Relay Terminal 86
- Diode Block Terminal 6
- Engine Run Relay Terminal 86

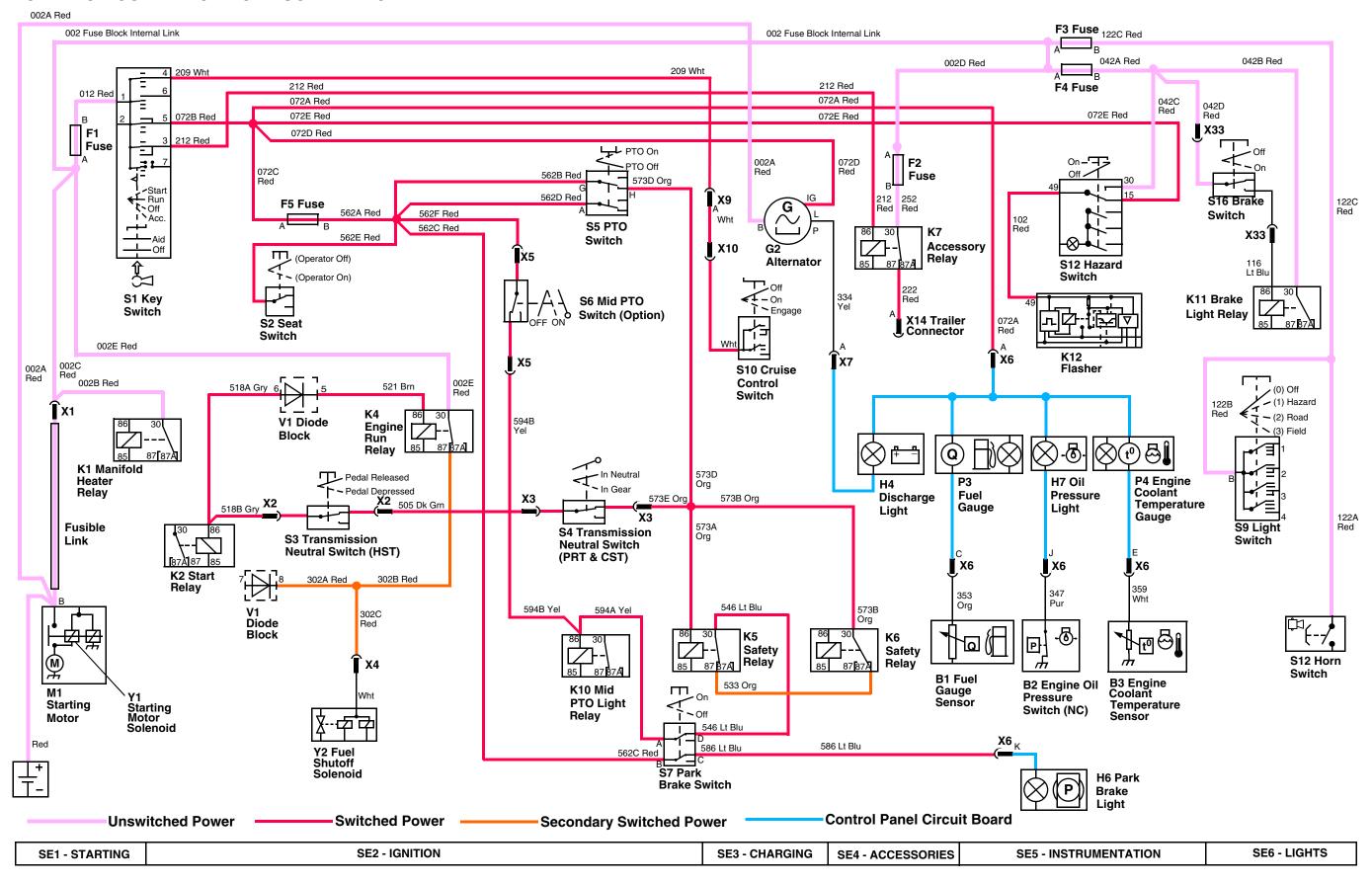
Secondary Switched Power - Run:

Voltage must be present at the following components with the key switch in the RUN ("ON") position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- K5 Safety Relay Terminal 87
- K6 Safety Relay Terminal 87a
- Engine Run Relay Terminal 87
- X4 Connector (302C Red wire)

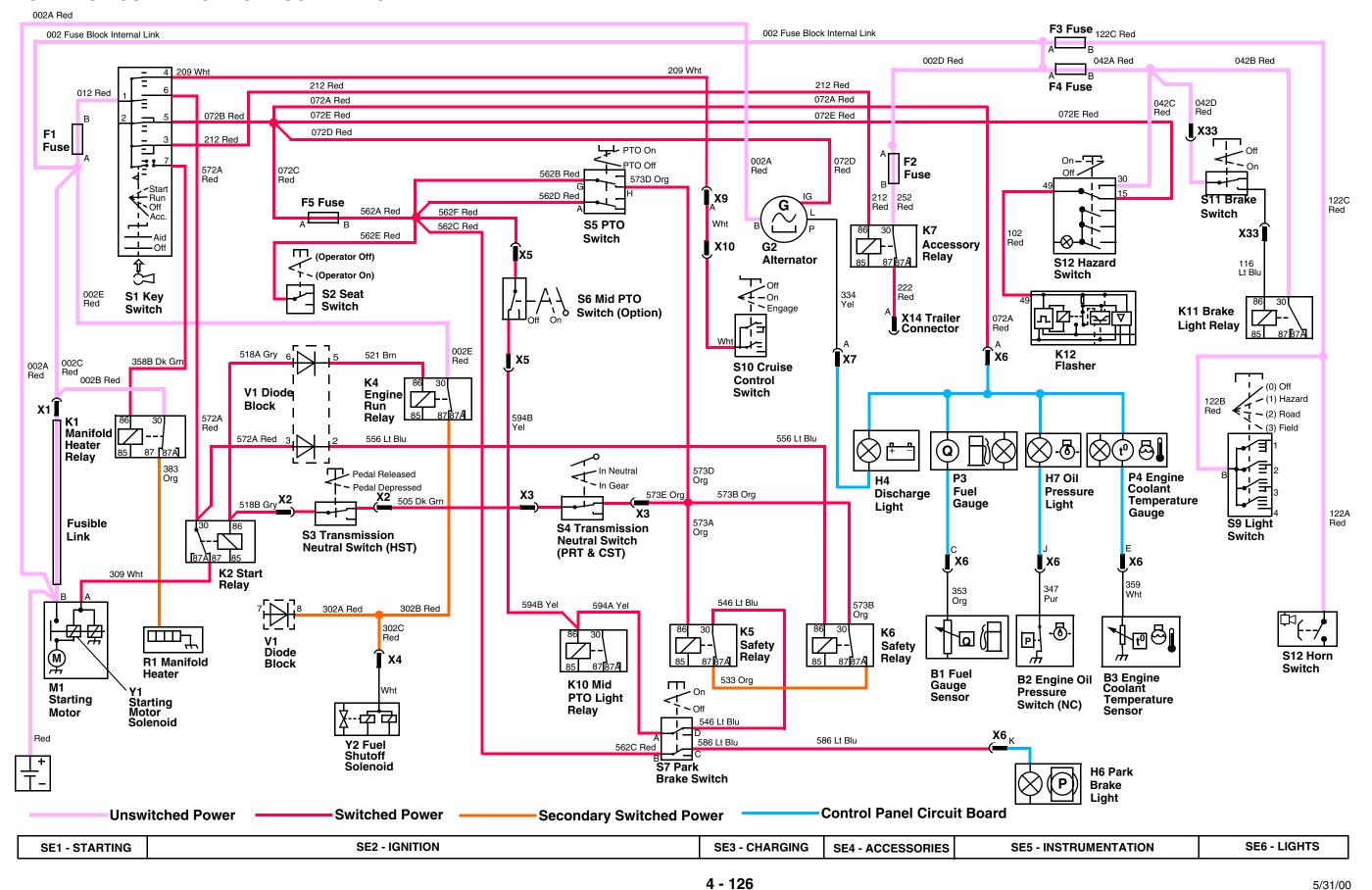
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POWER CIRCUIT ELECTRICAL SCHEMATIC



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POWER CIRCUIT ELECTRICAL SCHEMATIC



Switched Power - Aid:

Voltage must be present at the following components with the key switch in the AID position (key pushed in when placed in the RUN or START position), transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminal 7
- Manifold Heater Relay Terminal 86

These circuits are controlled by the key switch and are protected by the fusible link and the F1 fuse.

Secondary Switched Power - Aid:

Voltage must be present at the following components with the key switch in the AID position (key pushed in when placed in the RUN or START position):

- Manifold Heater Relay Terminal 87
- Manifold Heater

See "MANIFOLD HEATER OPERATION" on page 136.

Switched Power - Start:

Voltage must be present at the following components with the key switch in the START position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Key Switch Terminals 5 and 6
- Start Relay Terminal 30
- Diode Block Terminal 3
- K6 Safety Relay Terminal 86
- Start Relay Coil (If start criteria are met)

NOTE: These components are in addition to the components that would have power with the key switch in the RUN position. Voltage would not be present at the cruise control switch, or at the accessory relay (terminal 86) with the key switch in the START position.

Secondary Switched Power - Start:

Voltage must be present at the following components with the key switch in the START position, transmission in NEUTRAL, PTO(s) in NEUTRAL, park brake ENGAGED, and operator NOT ON seat:

- Start Relay Terminal 87
- Starting Motor Terminal A

See "CRANKING CIRCUIT OPERATION" on page 136.

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If Not Normal

POWER CIRCUIT DIAGNOSIS

Test Conditions:

• Key switch in OFF position

Test/Check Point

• Transmission in NEUTRAL

• Park brake ENGAGED

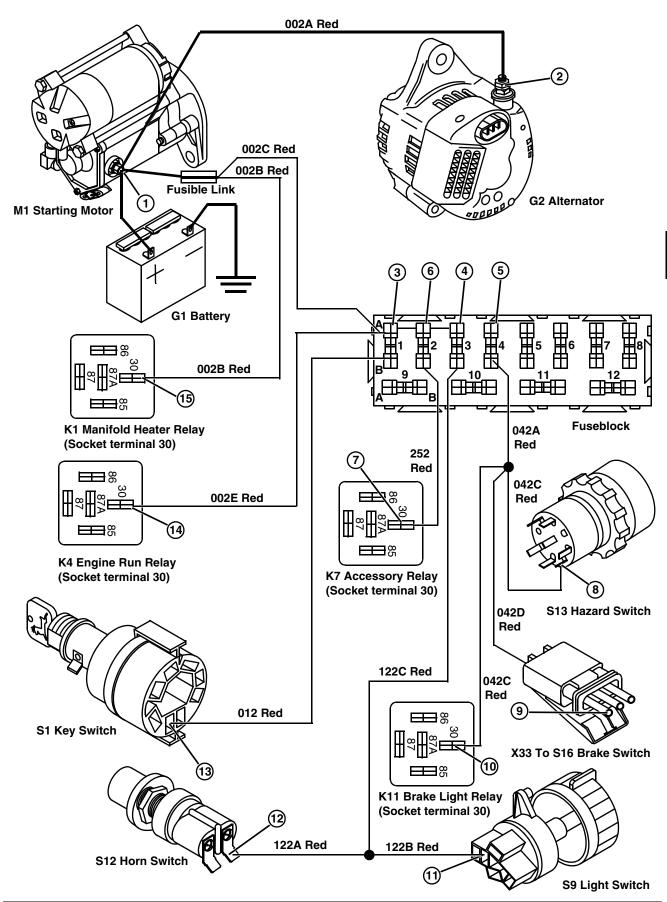
• PTO DISENGAGED

Normal

lest/Check Point	Normal	If Not Normal
Starting motor battery (B) terminal	12.4 - 13.2 VDC	Check cable to battery. Test battery.
2. Alternator (B terminal)	12.4 - 13.2 VDC	Check 002A Red cable and connections.
3. Fuse block (F1 fuse)	12.4 - 13.2 VDC	Check fusible link, 002C Red wire and connections.
4. Fuse block (F3 fuse)	12.4 - 13.2 VDC	Check internal fuse connection in load center (tie to F1 fuse).
5. Fuse block (F4 fuse)	12.4 - 13.2 VDC	Check internal fuse connection in load center (tie to F1 fuse).
6. Fuse block (F2 fuse)	12.4 - 13.2 VDC	Check 002D Red wire and connections.
7. Accessory relay socket	12.4 - 13.2 VDC	Check F2 fuse, 252 Red wire and connections.
8. Hazard switch	12.4 - 13.2 VDC	Check 042A and 042C Red wires and connections.
9. X33 connector to S16 brake switch	12.4 - 13.2 VDC	Check 042A and 042C Red wires and connections.
10. Brake light relay	12.4 - 13.2 VDC	Check 042A and 042C Red wires and connections.
11. Light switch	12.4 - 13.2 VDC	Check F3 fuse, 122C and 122B Red wires and connections.
12. Horn switch	12.4 - 13.2 VDC	Check F4 fuse, 122C and 122A Red wires and connections.
13. Key switch	12.4 - 13.2 VDC	Check F1 fuse, 012 Red wire and connections.
14. Engine run relay socket (terminal 30)	12.4 - 13.2 VDC	Check fusible link, 002E Red wire and connections.
15. Manifold heater relay socket (terminal 30)	12.4 - 13.2 VDC	Check fusible link, 002B Red wire and connections.

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If Not Normal

Test Conditions:

• Key switch in OFF position

Test/Check Point

• Transmission in NEUTRAL

• Park brake ENGAGED

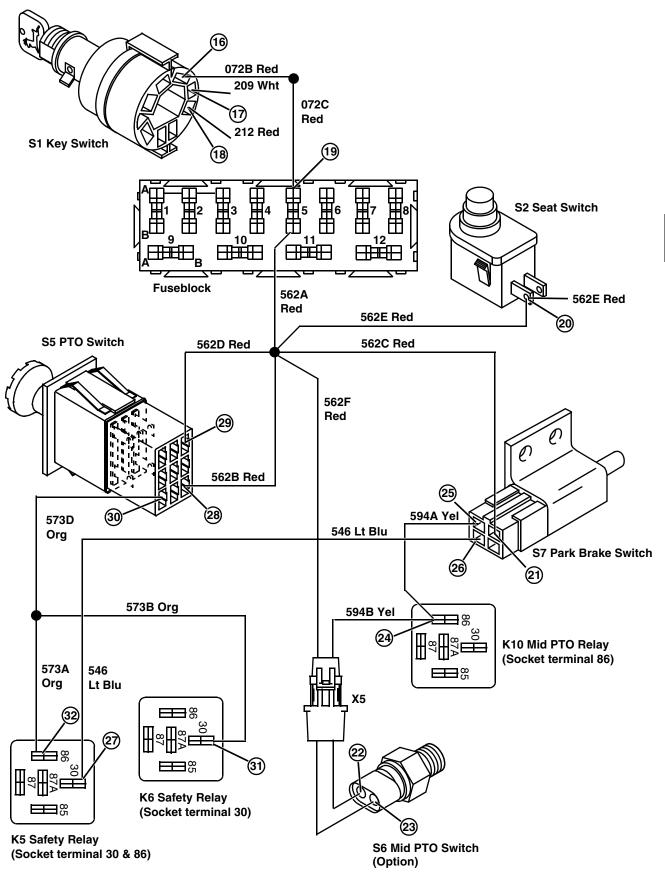
• PTO DISENGAGED

Normal

rest/Check Point	Normai	ii Not Normai
16. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as necessary.
17. Key switch	12.4 - 13.2 VDC	Test key switch. Replace switch as necessary.
18. Key switch	12.4 - 13.2 VDC	Test key switch. Replace switch as necessary.
19. Fuseblock (F5 fuse)	12.4 - 13.2 VDC	Check 072B and 072C Red wires and connections.
20. Seat switch	12.4 - 13.2 VDC	Check F5 fuse, 562A and 562E Red wires and connections.
21. Park brake switch	12.4 - 13.2 VDC	Check 562C Red wire and connections.
22. Mid PTO switch (Option)	12.4 - 13.2 VDC	Check 562F Red wire and connections.
23. Mid PTO switch (Option)	12.4 - 13.2 VDC	Ensure Mid PTO is DISENGAGED. Test switch. (See "MID PTO SWITCH TEST" on page 98.)
24. Mid PTO relay socket (terminal 86)	12.4 - 13.2 VDC	Check 594B Yel wire and connections.
25. Park brake switch	12.4 - 13.2 VDC	Check 594A Yel wire and connections.
26. Park brake switch	12.4 - 13.2 VDC	Ensure park brake is ENGAGED. Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.)
27. K5 Safety relay socket (terminal 30)	12.4 - 13.2 VDC	Check 546 Lt Blu wire and connections.
28. PTO switch	12.4 - 13.2 VDC	Check 562B Red wire and connections.
29. PTO switch	12.4 - 13.2 VDC	Check 562D Red wire and connections.
30. PTO switch	12.4 - 13.2 VDC	Ensure PTO switch is in OFF position. Test switch. (See "PTO SWITCH TEST" on page 99.)
31. K6 safety relay (terminal 30)	12.4 - 13.2 VDC	Check 573B Org wires and connections.
32. K5 safety relay (terminal 86)	12.4 - 13.2 VDC	Check 573A Org wires and connections.



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Test/Check Point	Normal	If Not Normal			
NOTE: The following two steps are for Hydro (HST) tractors. The X3 connector is fitted with a plug wire. For PowrReverser™ (PRT) and Gear Collar Shift (CST) tractors see step 36.					
33. S3 transmission neutral switch	12.4 - 13.2 VDC	Check X3 connector and jumper wire (if used), 505 Dk Grn wire, X4 and connections.			
34. S3 transmission neutral switch	12.4 - 13.2 VDC	Ensure forward pedal linkage is depressing switch, adjust switch position if needed. Test switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – HST" on page 97.)			
35. Start relay socket (terminal 86)	12.4 - 13.2 VDC	Check 518B Gry wire and connections.			
NOTE: The following two steps are for and PowrReverser™ (PRT) Gear Collar Shift (CST) tractors. The X2 connector is fitted with a plug and jumper wire. For Hydro (HST) tractors see step 33.					
36. S3 Transmission neutral switch	12.4 - 13.2 VDC	Ensure rear PTO is DISENGAGED. Check 573D and 573E Org wires and connections.			
37. S3 Transmission neutral switch	12.4 - 13.2 VDC	Ensure transmission is in NEUTRAL. Test switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – CST & PRT" on page 96.)			
38. Start relay socket (terminal 86)	12.4 - 13.2 VDC	Check 505 Dk Grn wire, X2 connector and jumper wire, 518B Gry wire and connections.			
39. Diode block socket (terminal 6)	12.4 - 13.2 VDC	Check 518A Gry wire and connections.			
40. Engine run relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure diode block is fully seated. Test diode block. (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.			

Test Conditions: Secondary Power

NOTE: The following test is the fuel shutoff solenoid that receives power after the K4 relay is activated when voltage is provided to the relay coil. The circuit needs to have the K4 relay in place to perform this test. See "FUEL SUPPLY OPERATION" on page 142, and "ENGINE SHUTOFF CIRCUIT OPERATION" on page 148.

• Key switch in RUN position

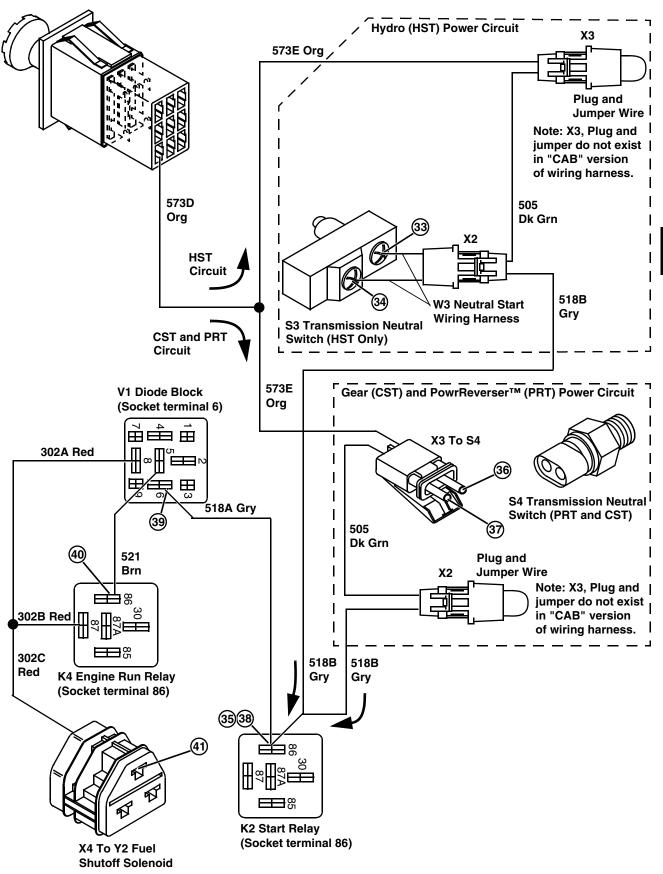
• Park brake ENGAGED

• Engine OFF

- Transmission in NEUTRAL
- PTO DISENGAGED

41. X4 connector to fuel shutoff solenoid	12.4 - 13.2 VDC Note: Battery voltage can not be tested at the diode block socket, as the diode block needs to be in place to energize the engine run relay coil.	Ensure K4 engine run relay coil is powered. See step 37. Check engine run relay. (See "RELAY TEST" on page 91.) Check 302B and 302C Red wires and connections.
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Test Conditions:

• Key switch in RUN position

• Transmission in NEUTRAL

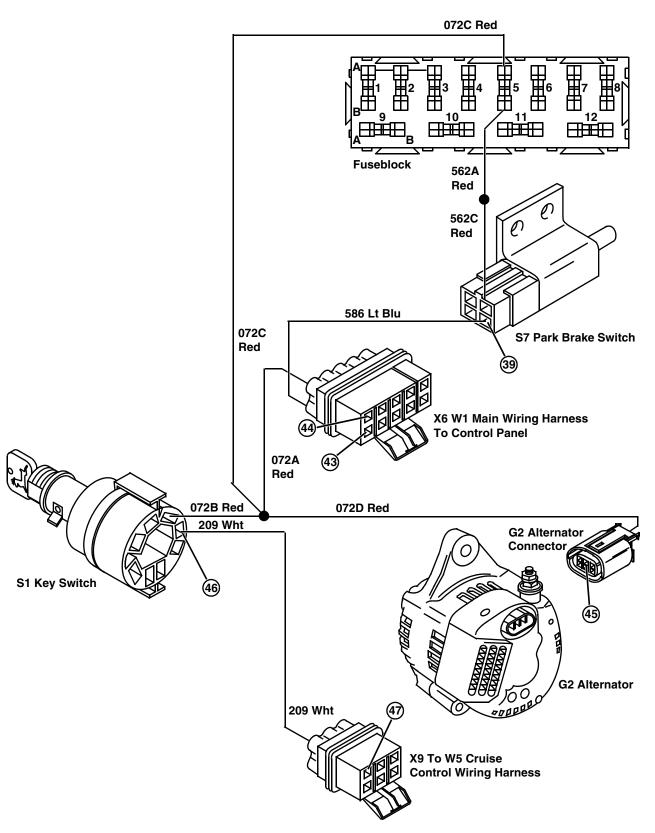
• Park brake ENGAGED

• PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
42. Park brake switch	12.4 - 13.2 VDC	Ensure park brake is set. Check voltage from 562C Red wire. Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.)
43. X6 connector to control panel	12.4 - 13.2 VDC	Check 586 Lt Blu wire and connections.
44. X6 connector to control panel	12.4 - 13.2 VDC	Check 072A Red wire and connections.
45. Alternator IG Terminal	12.4 - 13.2 VDC	Check 072B and 072D Red wires and connections.
46. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.)
47. X9 connector	12.4 - 13.2 VDC	Check 209 Wht wire and connections.



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CRANKING CIRCUIT OPERATION

Function:

To energize the starting motor solenoid and engage the starting motor to crank the engine.

Operating Conditions:

- Key switch in START position
- Transmission in NEUTRAL
- Rear PTO DISENGAGED (disengages mid PTO)

Theory of Operation:



The power circuit (fusible link, 002C Red wire, F1 fuse, and 012 Red wire) provides voltage to the key switch.

When placed in the START position the key switch provides current to the start relay contact (572A Red to terminal 30 of start relay).

The start relay coil is energized through a circuit consisting of: the key switch (terminal 5), 072B and 072C Red wires, F5 fuse, 562A and 562B Red wires, PTO switch (OFF position), 573D and 573E Org wires, S4 transmission neutral switch, 505 Dk Grn wire, X2 with jumper wire, and 518B Gry wire on PRT and CST tractors; or, X3 with jumper wire, 505 Dk Grn wire, X2, S3 transmission neutral switch, X2, and 518B Gry wire on HST tractors.

NOTE: The S4 Transmission Neutral Switch is installed in collar shift gear drive (CST) and PowrReverserTM (PRT) tractors; a jumper wire is installed in the X2 connector, and the S3 Transmission Neutral Switch is not used. In hydrostatic drive (HST) tractors the S3 Transmission Neutral Switch is used, and a jumper wire is installed in the X3 connectoreliminating the S4 switch.

When the start relay coil is energized, the K2 relay contacts close and current flows to the starting motor solenoid (309 Wht).

With the starting motor solenoid energized, the starting motor solenoid contacts close and high current from the battery passes through the battery cable and solenoid contacts to the starting motor. The starting motor cranks the engine.



CAUTION

To avoid injury, ALWAYS engage park brake when starting the engine.

MANIFOLD HEATER OPERATION

Function:

To provide an added source of heat for combustion.

Operating Conditions:

 Key switch must be in the START or RUN position and pushed in to the AID position.

Theory of Operation:

The ignition system is designed to inject diesel fuel into the piston cylinder where heat from compression ignites the fuel and air mixture.

When starting a cold engine, compression may not provide enough heat to ignite the fuel. The manifold heater is installed to provide added heat to the incoming combustion air.

The manifold heater is energized (heated) when the key switch is placed in the AID position. The key can be pushed into the AID position with the key in either the START or RUN position. The manifold may be preheated by pushing in the key, with the switch in the RUN position, for up to 3 seconds before turning the key to the START position.

When the key switch is in the AID position, current is provided to the K1 manifold heater relay coil (terminal 86) through the 385B and 385C Dk Grn wires. When the relay coil is energized, the relay contacts close and unswitched power (002B Red wire - terminal 30) flows through the contacts and 383 Org wire to the manifold heater.

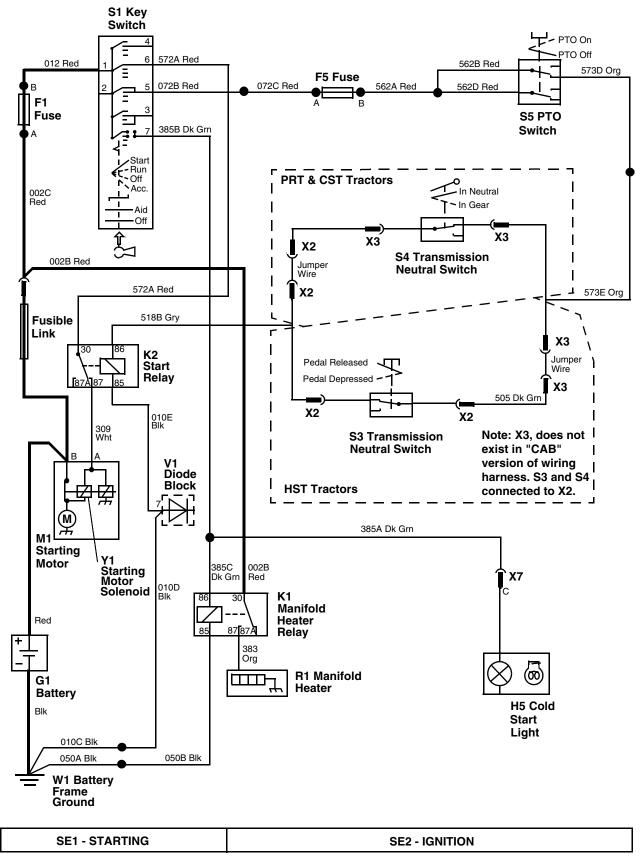
The H5 cold start indicator light in the control panel provides a visual indication that the key is in the AID position and the manifold heater relay is being energized.

With the key in the START or RUN position, and the key switch in the AID position, 12.4 - 13.2 VDC is provided to the H5 start light through the 385B and 385A Dk Grn wires, X6 connector (terminal K), and control panel circuit board.

A ground circuit path for the control panel circuit board is provided though the X6 connector (terminal D), and 050K and 050A Blk wires.

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CRANKING CIRCUIT ELECTRICAL SCHEMATIC





CRANKING CIRCUIT DIAGNOSIS

Test Conditions:

• Park brake ENGAGED

• Key switch in OFF position

• Transmission in NEUTRAL

• PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
1. Key switch	12.4 - 13.2 VDC	Check 200 Red wire and F1 fusible link. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)

Test Conditions:

- Park brake ENGAGED
- Transmission in NEUTRAL
- K1 start relay unplugged
- PTO switch in OFF position
- Key switch in START position

2. Key switch	12.4 - 13.2 VDC	Test switch. (See "KEY SWITCH TEST" on page 95.) Replace key switch as necessary.
3. F5 fuse	12.4 - 13.2 VDC	Check 072B and 072C Red wires and connections.
4. PTO switch	12.4 - 13.2 VDC	Check F5 fuse and 562B Red wire and connections.
5. PTO switch	12.4 - 13.2 VDC	Ensure PTO switch is in OFF position. Test switch. (See "PTO SWITCH TEST" on page 99.) Replace switch as needed.
6. Transmission neutral switch	12.4 - 13.2 VDC	Check 573D and 573E Org wires, connector / jumper wire (if used), and 505 Dk Grn wire and connections.
7. Transmission neutral switch	12.4 - 13.2 VDC	Check switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – CST & PRT" on page 96.) or (See "TRANSMISSION NEUTRAL SWITCH TEST – HST" on page 97.) Adjust or replace switch as needed.
8. K2 start relay socket (terminal 86)	12.4 - 13.2 VDC	Check 518B Gry wire and connections.
9. K2 start relay socket (terminal 30)	12.4 - 13.2 VDC	Check 572A Red wire and connections.

Test Conditions:

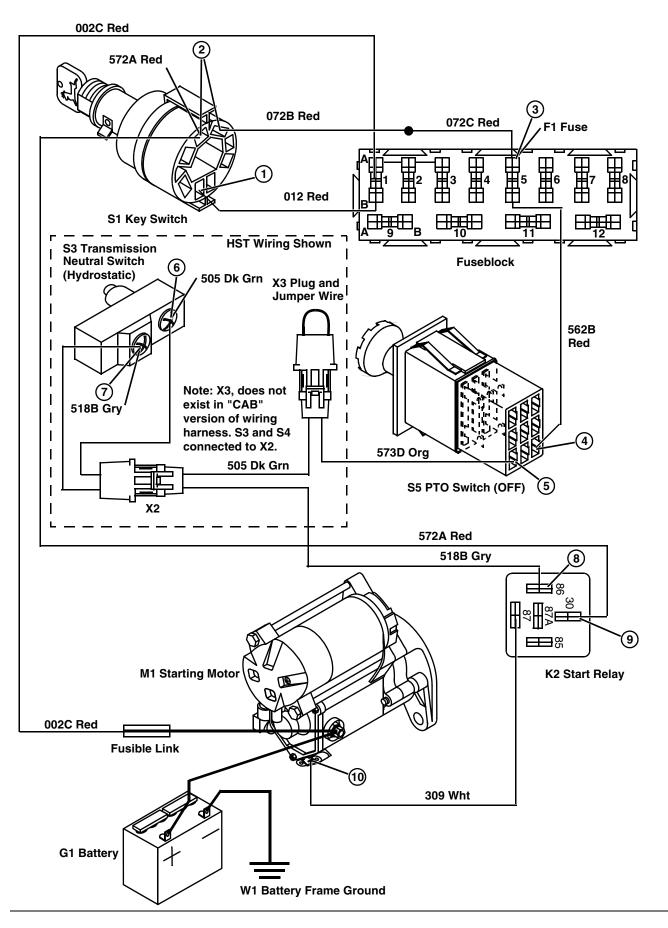
- Park brake ENGAGED
- Transmission in NEUTRAL
- X4 wiring harness to fuel solenoid disconnected
- K1 start relay installed
- PTO switch in OFF position
- Key switch in START position



CAUTION: Engine may start during this procedure. Disconnect fuel shutoff solenoid.

Replace relay as needed.	10. Starting motor	12.4 - 13.2 VDC	Check 309 Wht wire and connections. Check K2 start relay. (See "RELAY TEST" on page 91.) Replace relay as needed.
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MANIFOLD HEATER CIRCUIT DIAGNOSIS

Test Conditions:

- Park brake ENGAGED
- Key switch in OFF position
- K1 manifold heater relay unplugged

Test/Check Point	Normal	If Not Normal
1. Key switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
2. Manifold heater relay socket	12.4 - 13.2 VDC	Check 002B Red wire and connections. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)



Test Conditions:

- Park brake ENGAGED
- Unplug K2 start relay
- Unplug K1 manifold heater relay
- Key switch in RUN position; key in AID position (pushed in)

3. Key switch	12.4 - 13.2 VDC	Check key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as needed.
4. Manifold heater relay socket	Continuous 12.4 - 13.2 VDC while key switch is in AID position	Check 385B and 385C Dk Grn wires and connections.
5. X6 connector to control panel	Continuous 12.4 - 13.2 VDC while key switch is in AID position	Check 385B and 385A Dk Grn wires and connections.

Test Conditions:

- Park brake ENGAGED
- K2 start relay unplugged
- K1 manifold heater relay installed
- Key switch in RUN position; key in AID position (pushed in)

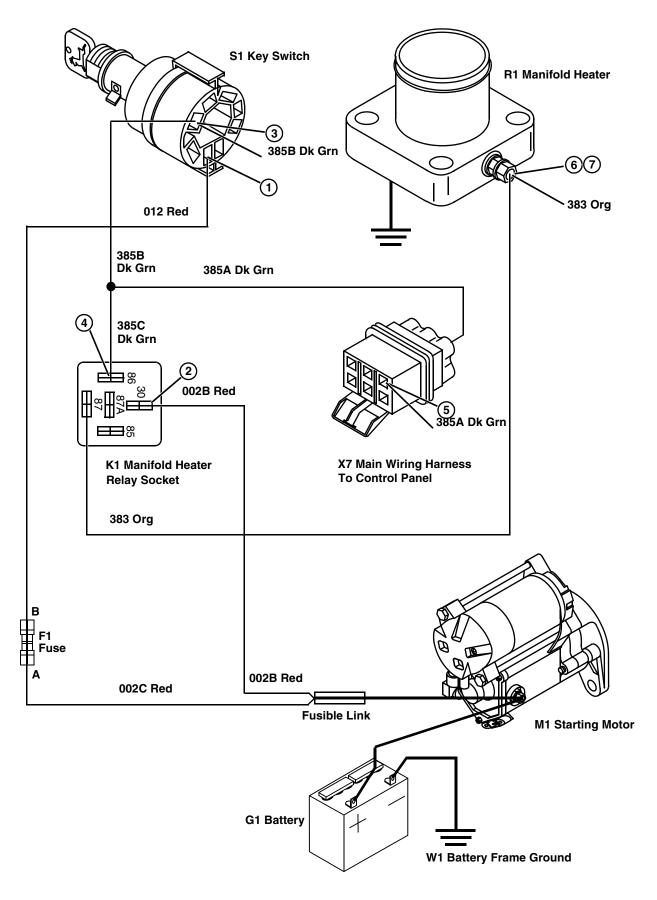
6. Manifold heater 12.4 - 13.2 VDC	Check 383 Org wire and connections. Check K1 relay. (See "RELAY TEST" on page 91.) Replace relay as needed.
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Test Conditions:

- Park brake ENGAGED
- Meter set to ohm scale
- Meter negative lead connected to frame ground
- Key switch in OFF position

7. Manifold heater module Approximates resistance	y 0.3 to 0.5 ohm Check manifold heater element. Replace manifold heater as needed.
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FUEL SUPPLY OPERATION

Function:

To start or stop the supply of fuel to the engine.

Operating Conditions (Starting Tractor):

- Key switch must be in the START position.
- Operator ON seat
- PTO in NEUTRAL
- Transmission in NEUTRAL

Operating Conditions (Running Tractor):



- Key switch must be in the RUN position.
- Operator ON seat
- PTO ENGAGED
- Transmission in any GEAR

Operating Conditions (Running Tractor):

- Key switch must be in the RUN position.
- Operator ON seat
- PTO DISENGAGED
- Park brake ENGAGED

Operator can leave seat. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 148.)

PTO can be ENGAGED

Fuel Supply Theory of Operation

The fuel system is designed to inject fuel into the piston cylinder where heat from compression ignites the fuel and air mixture.

Fuel is provided to the engine when the fuel shutoff solenoid is energized. The fuel shutoff solenoid contains two coils to open the fuel valve. The pull-in coil, in conjunction with the hold-in coil, overcomes the spring loaded fuel valve. The hold-in coil keeps the fuel valve open after the pull-in coil current is reduced through the R2 thermistor.

The fuel shutoff solenoid is initially energized and pulled in when the engine run relay contacts close. Voltage is provided to both of the fuel shutoff solenoid coils (pull-in and hold-in), which provide enough pull on the solenoid plunger to overcome the shutoff solenoid spring.

The fuel shutoff solenoid pull-in coil needs a high current pulse through it to overcome the solenoid spring. After the solenoid opens (overcomes the spring) a lower current will hold the solenoid open. The combination of the K3 fuel shutoff relay and R2 variable thermistor provide a means to reduce the current flow through the fuel shutoff solenoid pull-in coil after the solenoid opens.

The initial high current flows through the 329A Wht wire to the K3 fuel pull-in relay (terminal 30), through the contacts, and through the 319 Wht wire to the R2 variable thermistor. The thermistor has a low resistance to the current initially (lower than the resistance through the K3 fuel shutoff relay coil). As the current flows through the thermistor, it heats up and the resistance through it increases (higher than the resistance through the K3 fuel shutoff relay coil).

While the current flow through the thermistor is reduced, the voltage difference across the thermistor is increased. When the voltage difference is increased enough to activate the coil of the K3 fuel shutoff relay (329B Wht), the coil opens the relay contacts and the variable thermistor is removed from the circuit.

NOTE: The variable thermistor will heat to a maximum temperature of approximately 180° F (82° C) during the brief period of time required to overcome the fuel shutoff solenoid spring.

With the thermistor removed from the circuit, the ground path is removed for the fuel shutoff solenoid pull-in coil through the 329A and 329B Wht wires, the fuel shutoff relay coil, and the 010F, 010E, 010D and 010C Blk wires. A ground path for the fuel shutoff solenoid hold-in coil is provided through the 010N Blk wire

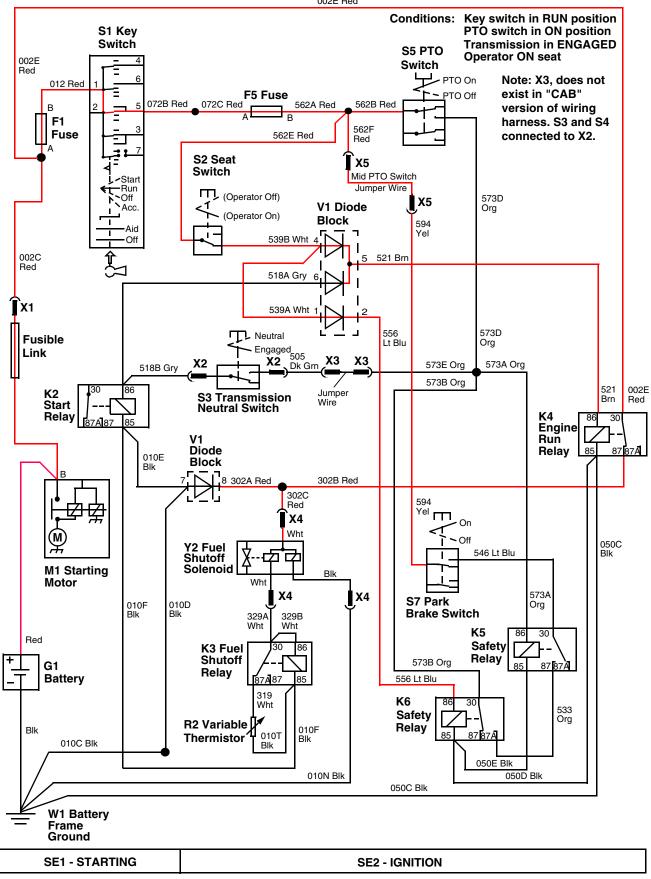
A latching circuit is provided to maintain voltage to the engine run relay after the PTO is ENGAGED. The latching circuit is energized only if the operator is OFF the seat, the PTO is DISENGAGED, and the park brake is ENGAGED. The latching circuit remains energized while the park brake is ENGAGED after the PTO is ENGAGED. This circuit allows the operator to leave the seat, with the park brake ENGAGED and the transmission in NEUTRAL, and ENGAGE the PTO. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 148.)

Fuel is provided to the engine through the Y2 fuel shutoff solenoid provided that operating conditions are met. If the operating criteria are not met, the engine run relay opens and stops voltage energizing the fuel shutoff solenoid coils. The fuel shutoff solenoid closes and fuel to the engine is shut off. (See "ENGINE SHUTOFF CIRCUIT OPERATION" on page 148.)

NOTE: The S3 transmission neutral switch is shown in this diagnostic section. This switch is used in conjunction with the jumper wire in the X3 connector for tractors with a hydro (HST) transmission. For tractors with a gear shift or PowrReverser™ transmission, the jumper wire is used in the X2 connector and the S4 transmission neutral switch is used in the X3 connector.

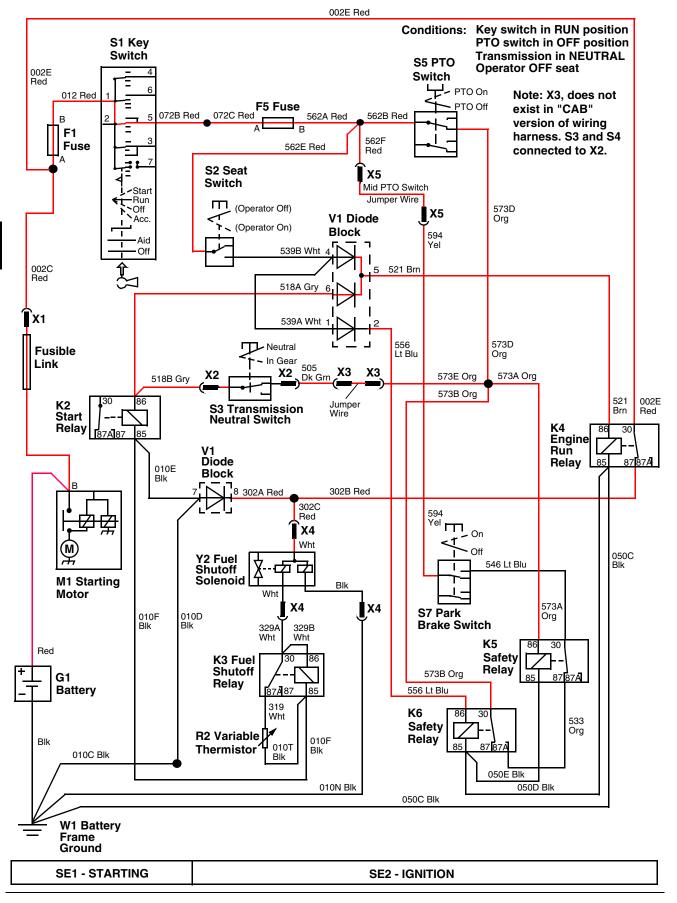
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ENGINE SHUTOFF CIRCUIT ELECTRICAL SCHEMATIC



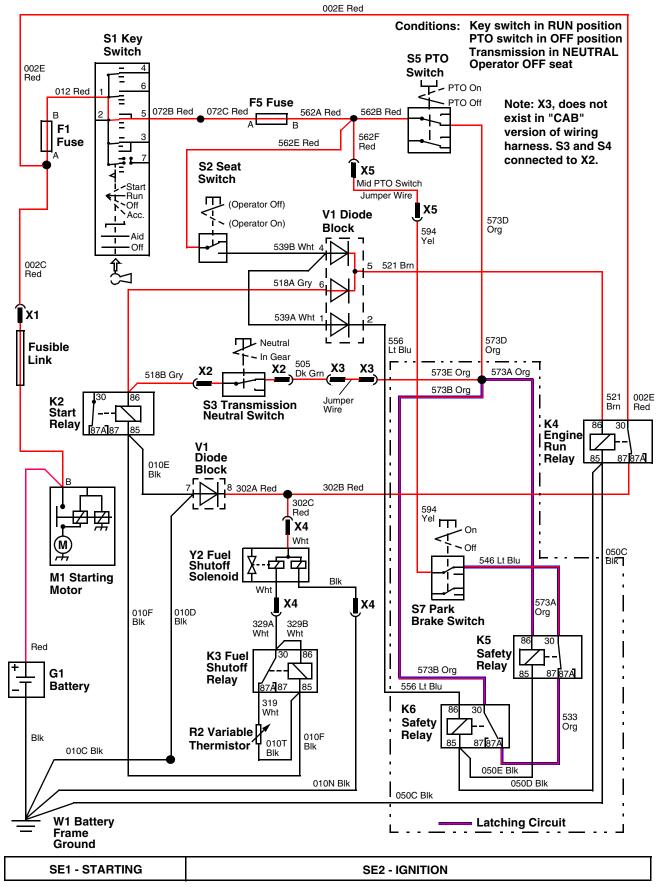


ENGINE SHUTOFF PTO CIRCUIT SCHEMATIC



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ENGINE SHUTOFF LATCH CIRCUIT SCHEMATIC





FUEL SUPPLY DIAGNOSIS

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position (Engine NOT running)
- V1 diode block removed from load center
- PTO switch in OFF position
- Transmission in NEUTRAL
- Seat switch closed (Operator ON seat)

Test/Check Point	Normal	If Not Normal
1. PTO switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
2. Transmission neutral switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
3. Diode block socket (terminal 6)	12.4 - 13.2 VDC	Check transmission switch. (See "TRANSMISSION NEUTRAL SWITCH TEST – HST" on page 97.) Check 518B and 518A Gry wires and connections.
4. Seat switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
5. Diode block socket (terminal 4)	12.4 - 13.2 VDC	Check seat switch. (See "SEAT SWITCH TEST" on page 94.) Check 539B Wht wire and connections.

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in NEUTRAL
- Seat switch open (Operator OFF seat)
- V1 diode block installed; K4 engine run relay removed

6. Engine run relay socket 12.4 - 13.2 VDC (terminal 85)	Check diode block (terminals 6 to 5). (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.
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Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in GEAR
- Seat switch closed (Operator ON seat)

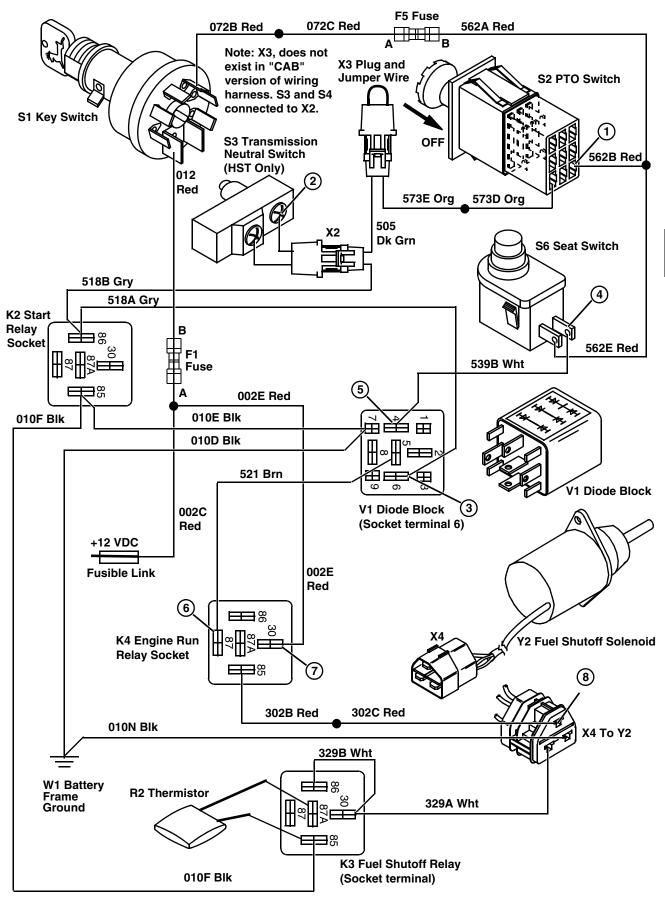
7. Engine run relay socket	12.4 - 13.2 VDC	Check diode block (terminals 4 to 5).
(terminal 85)		(See "DIODE BLOCK TEST" on page
		94.)

Test Conditions:

- Park brake ENGAGED
- Key switch in RUN position
- PTO switch in OFF position
- Transmission in GEAR
- Seat switch closed (Operator ON seat)
- K4 engine run relay imstalled
- 8. Fuel solenoid connector 12.4 13.2 VDC Check 302B and 302C Red wires and connections.

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ENGINE SHUTOFF CIRCUIT OPERATION

Engine Shutoff Function:

To prevent the tractor engine from being left running in an unsafe condition.

Operating Conditions:

- Engine running
- Operator on seat

Engine MUST STOP if:



- PTO is ENGAGED, and
- Operator gets out of seat

or

- Transmission is ENGAGED, and
- · Operator gets out of seat

NOTE: If transmission is in NEUTRAL and the PTO is disengaged, and then the park brake is set, the operator can then leave the seat and the PTO can be reengaged.

or;

- · Transmission is in GEAR, and
- Operator gets out of seat

NOTE: The S3 transmission neutral switch is shown in this diagnostic section. This switch is used in conjunction with the jumper wire in the X3 connector for tractors with a hydrostatic transmission. For tractors with a gear shift transmission the jumper wire is used in the X2 connector and the S4 transmission neutral switch is used in the X3 connector.

In "CAB" version of wiring harness, X3 does not exist. S3 and S4 are connected to X2.

Theory of Operation:

Fuel is supplied to the engine through the operation of the K3 fuel shutoff relay and the Y2 fuel shutoff solenoid, provided that operating conditions are met. (See "FUEL SUPPLY OPERATION" on page 142.)

When the operating conditions exist, and the engine is running, the engine shutoff circuit is used to maintain safe operation of the tractor. If an unsafe condition is created, the engine will stop by having the fuel supply to the engine shut off.

The fuel supply is shut off when voltage to the K4 engine run relay coil is removed, its contacts open, and power to the Y2 fuel shutoff solenoid coils is removed and the solenoid closes.

Power to the K4 engine run relay coil comes from the V1 diode block (terminal 5), and is provided to the diode block (terminals 4 or 6) through several different circuits that allow a variety of operating conditions to exist and maintain fuel supply to the engine.

The main and most direct circuit, provides power to the K4 engine run relay coil through the key switch, 072B and 072C Red wires, F5 fuse, 562A and 562E Red wires, S2 seat switch (operator ON seat), 539B Wht wire, V1 diode block (terminals 4 to 5), and 521 Brn wire. This circuit provides voltage to the engine run relay for normal operation of the tractor.

A second circuit provides power to the K4 engine run relay coil through the key switch, 072B and 072C Red wires, F5 fuse, 562A and 562B Red wires, PTO switch (PTO switch in the OFF position), 573D and 573E Org wires, S3 or S4 transmission neutral switch, 518B and 518A Gry wires, V1 diode block (terminals 6 to 5), and 521 Brn wire. This circuit provides voltage to the engine run relay if the PTO is DISENGAGED, and the transmission is in NEUTRAL, with or without the operator in the seat.

A third circuit provides power to the K4 engine run relay coil through the park brake switch and the K5 and K6 safety relays. The park brake switch and the K5 and K6 relays, in conjunction with the PTO switch, create a self-latching circuit. The PTO must be DISENGAGED, the park brake must be ENGAGED, and the operator must be OFF the seat to create the circuit. Once the latch circuit is established the PTO can be ENGAGED. The latching circuit will remain energized until the operator gets ON the seat and the K6 safety relay coil is energized, opening the circuit path through the K6 contacts, or; the park brake switch is DISENGAGED, eliminating power to the circuit.

Power is provided to the S7 park brake switch through the key switch, 072B and 072C Red wires, F5 fuse, 562F Red wire, X5 connector and jumper wire, and 594 Yel wire. With the park brake ENGAGED, power is provided through the park brake switch and 546 Lt Blu wire to the K5 safety relay (terminal 30). Power is provided to the K5 safety relay coil (terminal 86) through the PTO switch (PTO DISENGAGED) and the 573D and 573A Org wires.

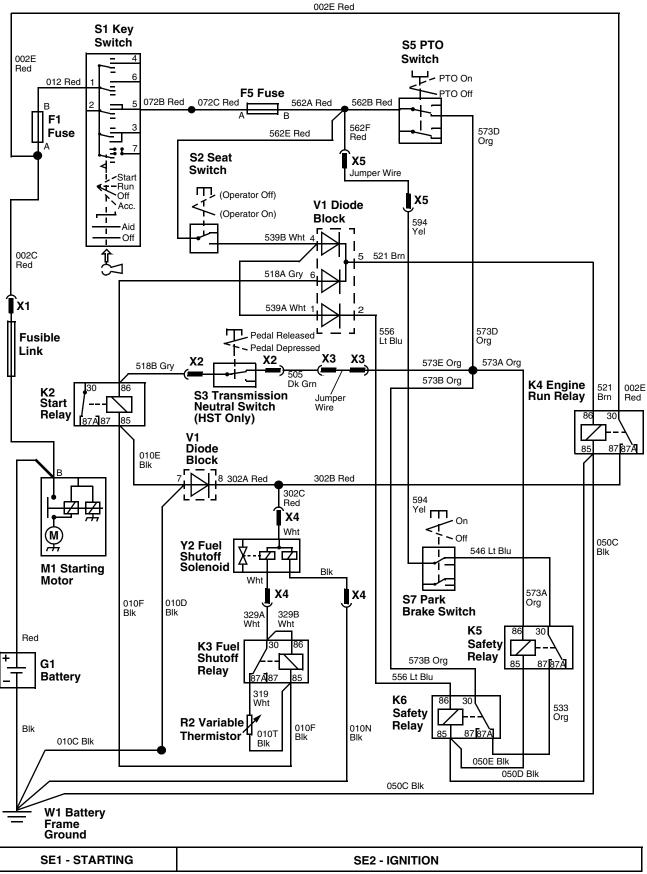
With the K5 coil energized, and power to the K5 contact (terminal 30), power is provided through the K5 contacts and 533 Org wire to the K6 contacts (terminal 87A). The power continues through the K6 contacts, and the 573B and 573A Org wires to the K5 coil (terminal 86).

The PTO can now be ENGAGED and power will remain to the K4 engine run relay through the park brake switch, latching relay circuit, and the same circuit path as provided by the PTO switch without the latching circuit.

If the park brake is DISENGAGED without the operator ON the seat, the engine will stop.

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ENGINE SHUTOFF CIRCUIT ELECTRICAL SCHEMATIC





ENGINE SHUTOFF CIRCUIT DIAGNOSIS

Test Conditions:

• Park brake ENGAGED

• Gear range lever in NEUTRAL position

Operator OFF seat

• V1, K2, K4, K5, and K6 removed from load center

• PTO DISENGAGED

• Key switch in RUN position (engine OFF)

NOTE: The S3 transmission neutral switch is shown in this diagnostic section. This switch is used in conjunction with the jumper wire in the X3 connector for tractors with a hydrostatic transmission. For tractors with a gear shift transmission the jumper wire is used in the X2 connector and the S4 transmission neutral switch is used in the X3 connector. X3 does not exist in "CAB" version of wiring harness. S3 and S4 connect to X2.



Test/Check Point	Normal	If Not Normal
1. K2 relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure PTO is DISENGAGED and transmission is in NEUTRAL. Check F5 fuse. Check jumper wire for S3 or S4.Test PTO switch.Test transmission neutral switch. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)
V1 diode block socket (terminal 6)	12.4 - 13.2 VDC	Check 518A Gry wire and connections.
3. K5 relay socket (terminal 86)	12.4 - 13.2 VDC	Check 573A Org wire and connections.
4. K6 relay socket (terminal 30)	12.4 - 13.2 VDC	Check 573B Org wire and connections.
5. Park brake switch	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
6. Park brake switch	12.4 - 13.2 VDC	Test switch. (See "PARK BRAKE SWITCH TEST" on page 102.)
7. K5 relay socket (terminal 30)	12.4 - 13.2 VDC	Check 546 Lt Blu wire and connections.
8. Seat switch	12.4 - 13.2 VDC	Check 562E Red wire and connections.

Test Conditions:

- Park brake ENGAGED
- PTO DISENGAGED
- Push and hold seat switch plunger into OPERATOR ON position
- Transmission in NEUTRAL position
- Key switch in RUN position (engine OFF)

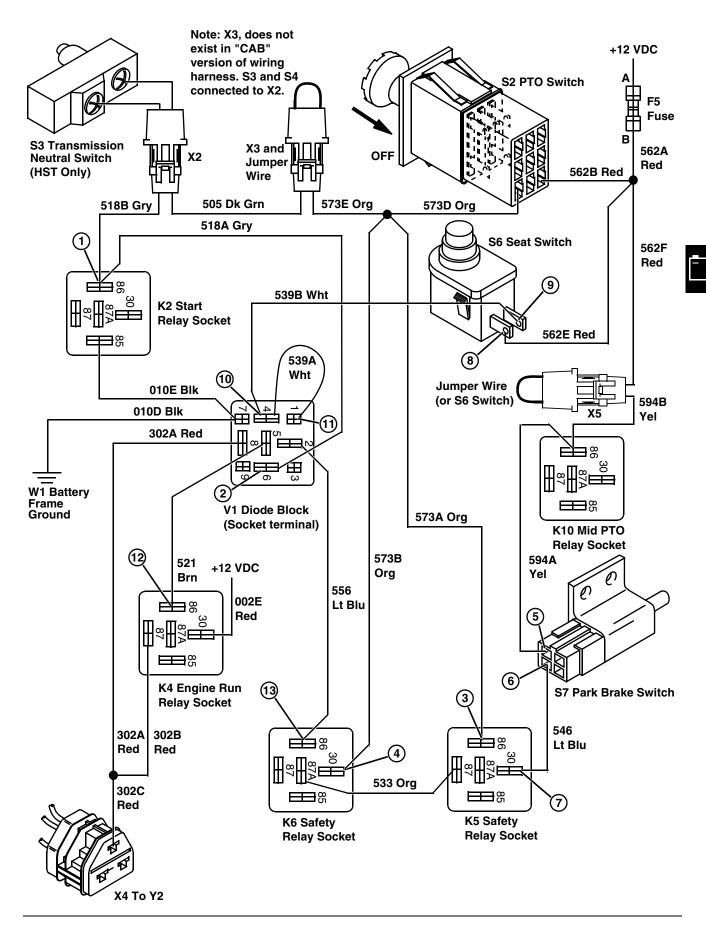
9. Seat switch	12.4 - 13.2 VDC	Test seat switch. (See "SEAT SWITCH TEST" on page 94.) Replace seat switch.
10. V1 diode block socket (terminal 4)	12.4 - 13.2 VDC	Check 539B Wht wire and connections.
11. V1 diode block socket (terminal 4)	12.4 - 13.2 VDC	Check 539A Wht jumper wire and connections.

Test Conditions:

- Park brake ENGAGED
- Operator ON seat
- PTO DISENGAGED
- Transmission in NEUTRAL position
- V1 diode block installed in to load center
- Key switch in RUN position (engine OFF)

12. K4 relay socket (terminal 86) 12.4 - 13.2 VDC	Test diode block. (See "DIODE BLOCK TEST" on page 94.) Check 521 Brn wire and connections.
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Test/Check Point	Normal	If Not Normal
13. K6 relay socket (terminal 86)	12.4 - 13.2 VDC	Test diode block. Check 556 Lt Blu wire and connections.

Test Conditions:

Park brake ENGAGED	 Transmission in NEUTRAL position
Operator OFF seat	 V1 diode block installed in to load center
• PTO DISENGAGED	• Key switch in RUN position (engine OFF)

14. K4 relay socket (terminal 86)	Test diode block. (See "DIODE BLOCK TEST" on
	page 94.) Check 521 Brn wire and connections.

Test Conditions:

- Park brake ENGAGED
 Operator ON seat
 Transmission in NEUTRAL position
 Install K6 safety relay in load center
- PTO DISENGAGED Key switch in RUN position (engine OFF)

15. K5 relay socket (terminal 87) 12.4 - 13.2 VDC	Test K6 relay. (See "RELAY TEST" on page 91.) Check 533 Org wire and connections.
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Test Conditions:

Park brake ENGAGED
 Operator OFF seat
 PTO DISENGAGED
 Transmission in NEUTRAL position
 K5 safety relay installed in to load center
 Key switch in RUN position (engine OFF)

Test Conditions:

- After the above conditions are set:
- Place PTO switch in ON position to ENGAGE PTO

16. K4 relay socket (terminal 86)	12.4 - 13.2 VDC	Check ground circuit of relays. See next step.
Test Conditions:	. Cook yourse laves in	NEUTDAL pasition

17. K5 relay socket (terminal 85)	Continuity to frame ground (0.5 ohms or less)	Check 050E, 050D, and 050C Blk wires and connections.
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Test Conditions:

Park brake ENGAGED
 Operator OFF seat
 PTO DISENGAGED
 Gear range lever in NEUTRAL position
 K5 safety relay installed in to load center
 Key switch in RUN position (engine OFF)

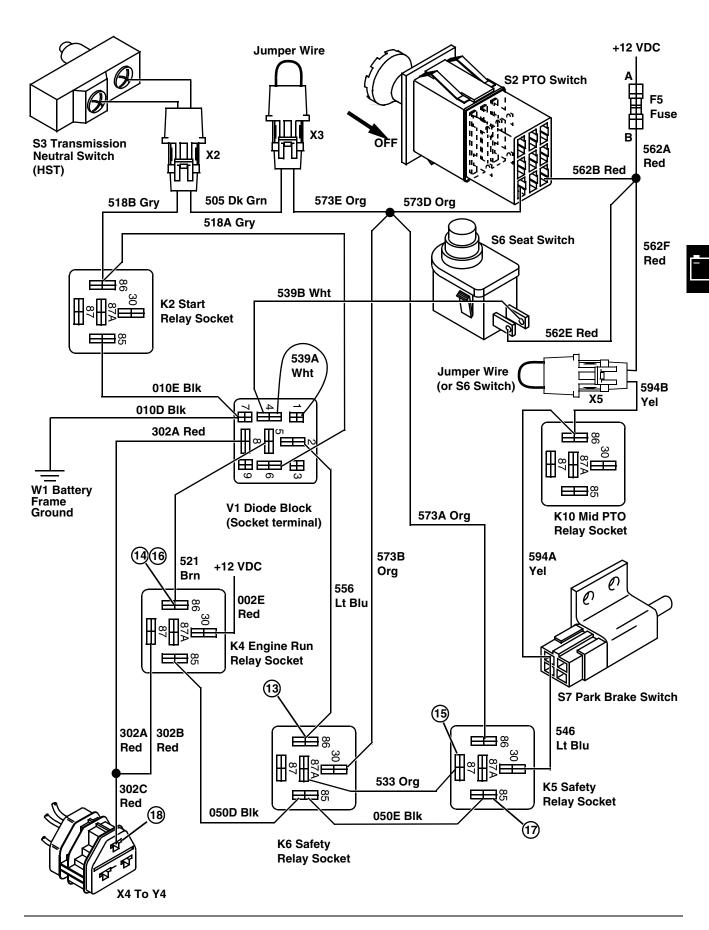
Test Conditions:

- After the above conditions are set:
- Place PTO switch in ON position to ENGAGE PTO
- Check for voltage at K4 relay socket (terminal 86); RELEASE park brake

18. X4 connector to fuel shutoff solenoid NO voltage after park brake is RELEASED	Test K4 relay. (See "RELAY TEST" on page 91.) Replace relay as needed. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)
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CHARGING CIRCUIT OPERATION

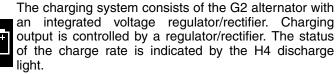
FUNCTION:

To maintain battery voltage between 12.4 and 13.2 volts.

OPERATING CONDITIONS:

- Key switch in RUN position
- Engine running

SYSTEM OPERATION:



With the key switch in the RUN position, battery sensing circuit current flows from battery positive terminal to the starting motor terminal, fusible link F1, 002C Red wire, S1 key switch, 072B and 072D Red wires to the alternator voltage regulator/rectifier. The battery sensing circuit allows the voltage regulator/rectifier to monitor battery voltage.

A rotating permanent magnet in the alternator induces AC current in the alternator stator coils. The AC current flows to the voltage regulator/rectifier. The voltage regulator/rectifier converts AC current to DC current needed to charge the battery.

If battery voltage is low, the regulator/rectifier allows DC current to flow to the battery to charge it through the battery charging circuit (002A Red). When the battery is fully charged, the voltage regulator/rectifier stops current flow to the battery.

If the alternator output current falls below system usage or is insufficient to maintain a preset voltage, the voltage regulator/rectifier provides current to turn on the discharge light through the 334 Yel wire, X7 connector, and the control panel circuit board runs.

The alternator is grounded through the mounting hardware to the engine.

If the voltage regulator is grounded to the alternator cover, the alternator produces unregulated amperage. (See "UNREGULATED AMPERAGE TEST" on page 87.)

TACHOMETER CIRCUIT OPERATION

FUNCTION:

To indicate engine rpm to the operator.

OPERATING CONDITIONS:

- The key switch must be in the RUN position
- Engine running

SYSTEM OPERATION:

Pulsed current flows from the "P" terminal of the alternator to the control panel (X6 connector, terminal F) through the 325 Dk Grn wire.

HOUR METER CIRCUIT OPERATION

FUNCTION:

To indicate engine hours of use to the operator.

OPERATING CONDITIONS:

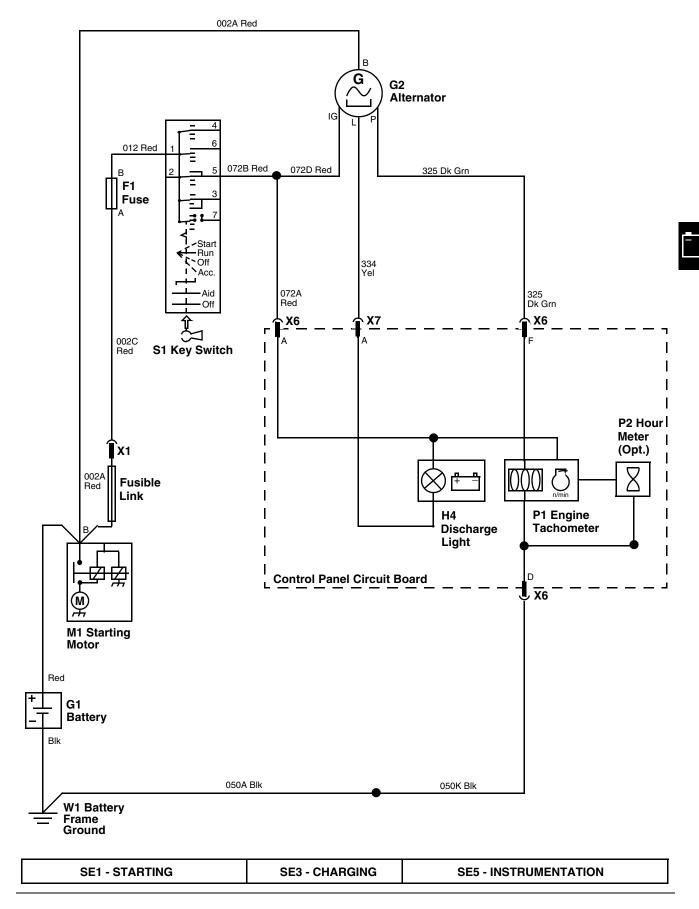
- Key switch in RUN position
- Engine running

SYSTEM OPERATION:

The hour meter is integrated into the control panel and does not have any external wiring. The hour meter operates only when the engine is running. The hour meter uses the engine tachometer circuit for power. If the tachometer is not functioning, the hour meter will not work. See "CHARGING CIRCUIT DIAGNOSIS" on page 156 for information on tachometer and hour meter diagnosis.

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CHARGING CIRCUIT ELECTRICAL SCHEMATIC



CHARGING CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in OFF position
- Park brake ENGAGED

- Gear range lever in NEUTRAL position
- PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
Battery positive terminal	12.4 - 13.2 VDC	Test battery. (See "BATTERY TEST" on page 85.)
2. Starting motor "B" terminal	12.4 - 13.2 VDC	Check battery and starting motor cable connections.
3. Alternator "B" terminal	12.4 - 13.2 VDC	Check battery negative cable, alternator ground, connections, and engine ground connections.



Test Conditions:

• Engine OFF

• Disconnect alternator connector

Park brake ENGAGED

• Key switch in RUN position

	12.4 - 13.2 VDC	Check 072D and 072B Red wires and connections.
Red wire terminal)		(See "POWER CIRCUIT DIAGNOSIS" on page
,		128.)
		·

Test Conditions:

• Engine OFF

• Connect alternator connector

Park brake ENGAGED

• Disconnect control panel connectors

• Key switch in RUN position

5. X6 connector (terminal A)	12.4 - 13.2 VDC	Check 072A and 072B Red wires and connections.
6. X6 connector (terminal F)	0.04 VDC	Check 325 Dk Grn wire and connections.
7. X7 connector (terminal A)	0.45 VDC	Check 334 Yel wire and connections.

Test Conditions:

• Park brake ENGAGED

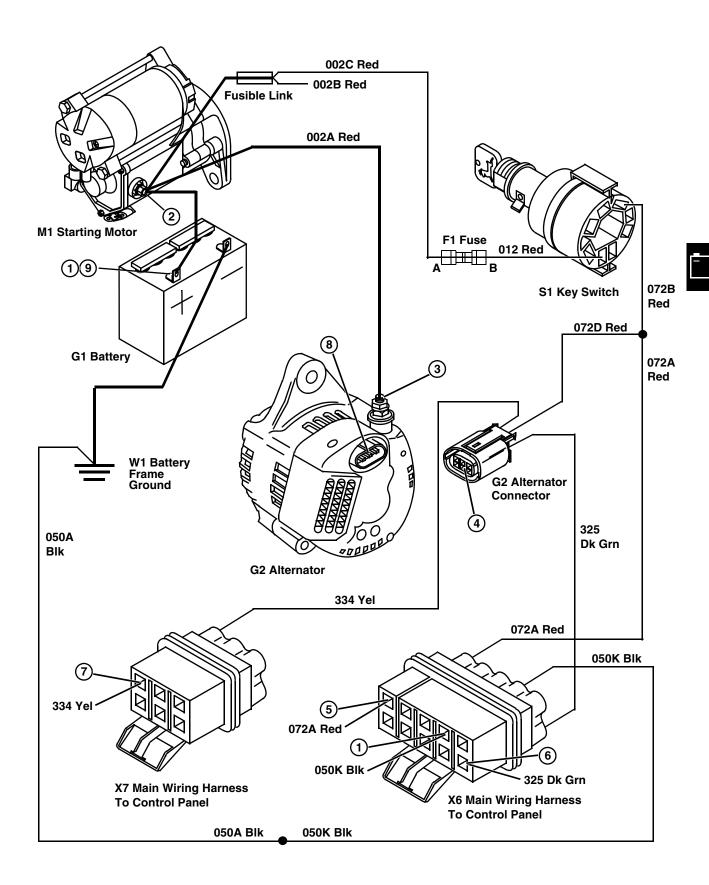
• PTO DISENGAGED

• Transmission in NEUTRAL

• Engine RUNNING

8. Alternator	Minimum 12.4 - 13.2 VDC	(See "REGULATED AMPERAGE AND VOLTAGE TESTS" on page 88.) Replace voltage regulator/ rectifier.
9. Battery	Voltage above 12.4 - 13.2 VDC.	Check for excessive load on electrical system.

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ENGINE OIL PRESSURE LIGHT

Function:

To alert operator of low engine oil pressure.

Operating Condition:

• Key switch must be in ON or START position.

Theory of Operation:

With the engine OFF and key in RUN position, engine oil pressure will be below 49 kPa (7.1 psi). The oil pressure switch will be in the normally closed position, completing a circuit path to ground and illuminating the light. This informs the operator that the light is functional.

The light goes out when the engine oil pressure is at or above **49 kPa (7.1 psi)**, opens the B2 engine oil pressure switch, and removes the ground circuit from the engine oil pressure light.

ENGINE COOLANT TEMPERATURE GAUGE

Function:

Inform the operator of engine and coolant operating temperature.

Operating Condition:

• Key switch must be in ON or START position.

Theory of Operation:

The engine coolant temperature sensor is a variable resistor, providing a ground circuit path for the temperature gauge. As the engine coolant heats, the resistance increases. The temperature gauge circuitry is part of the tractor control panel.

The engine coolant temperature sensor variable resistance is approximately **40 to 700 ohms**.

FUEL GAUGE

Function:

Inform the operator of the fuel level in the fuel tank.

Operating Condition:

• Key switch must be in ON or START position.

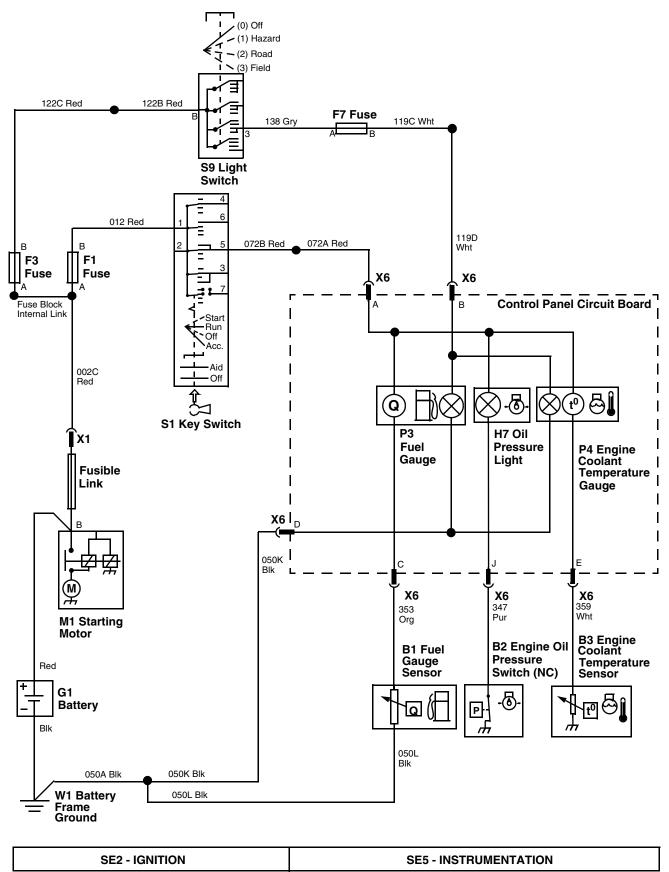
Theory of Operation:

The fuel level in the fuel tank is measured by the B1 fuel gauge sensor. The sensor is a variable resistor. The resistance is set by movement of a mechanical linkage connected to a float in the fuel tank. The 5 to 95 ohm resistance creates a variable voltage difference across the P1 fuel gauge. The voltage difference ranges from approximately **5.72 VDC** (fuel tank FULL) to approximately **0.87 VDC** (fuel tank EMPTY).

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CONTROL PANEL GAUGES ELECTRICAL SCHEMATIC





CONTROL PANEL GAUGES DIAGNOSIS

Test Conditions:

- X6 to control panel disconnected
- Key switch in RUN position, engine OFF
- PTO in NEUTRAL

- Transmission in NEUTRAL
- Park brake ON
- Light switch in ROAD or FIELD position

Test/Check Point	Normal	If Not Normal
1. X6 connector (terminal A)	12.4 - 13.2 VDC	(See "POWER CIRCUIT DIAGNOSIS" on page 128.)
2. Light switch	12.4 - 13.2 VDC	Check F3 fuse. Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
3. X6 connector (terminal B)	12.4 - 13.2 VDC	Check 119C and 119D Wht wires and connections.
4. X6 connector (terminal D)	Less than 0.1 ohms resistance to ground	Check 050K and 050A Blk wires and connections.



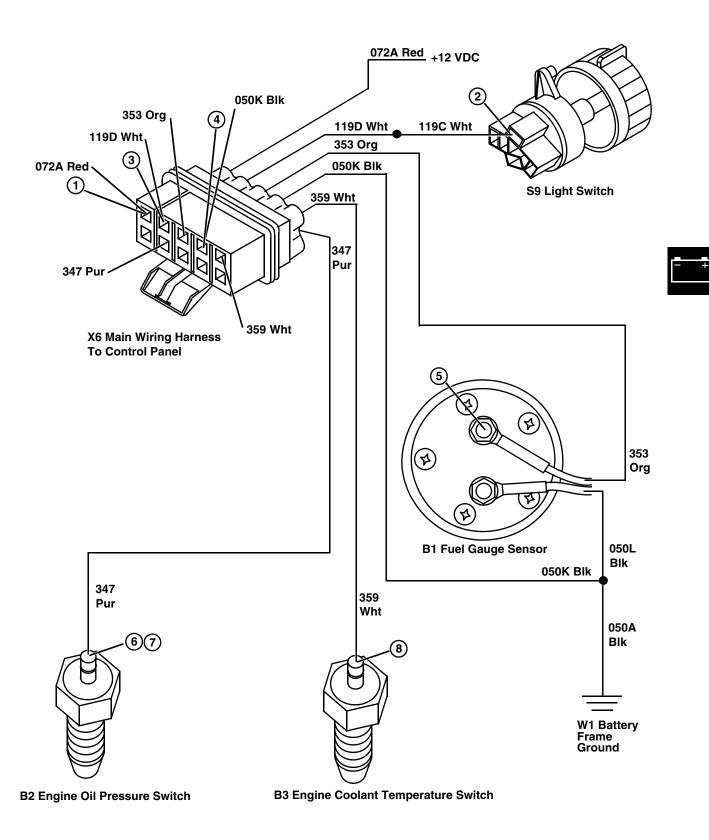
Test Conditions:

- Transmission in NEUTRAL
- PTO in NEUTRAL
- Park brake ON

- X6 to control panel connected
- Key switch in RUN position, engine OFF
- Light switch in OFF position

5. Fuel gauge sensor	Tank empty – approximately 0.1 VDC Tank full – approximately 5.7 VDC	Check 353 Org wire and connections. Check battery negative cable, 050L and 050A Blk wires and connections. Test fuel sensor. (See "FUEL GAUGE SENSOR TEST" on page 102.) Use a jumper wire to connect 353 Org wire to battery frame ground. Fuel gauge should move to maximum position. Gauge does not move Replace control panel.
6. Engine oil pressure switch	Less than 0.1 VDC	Check 347 Pur wire and connections.Test switch. (See "ENGINE OIL PRESSURE SWITCH TEST" on page 92.) Replace switch as needed.
7. Engine oil pressure switch (347 Pur wire lead disconnected)	Less than 0.1 ohms resistance to ground	Check engine ground. If engine ground OK: Replace switch.
8. Engine coolant temperature sensor	Continuity to ground through sensor – resistance depends on engine temperature (40 - 700 ohms). Sensor threads not corroded.	Disconnect temperature sensor lead. Use a jumper wire to connect 359 Wht wire to ground. Temperature gauge should move to maximum temperature position. Gauge does not move Replace control panel. Gauge moves Replace sensor.

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PTO SOLENOID

Function:

To provide hydraulic drive power to the PTOs through an electro-mechanical solenoid.

Operating Condition:

• The PTO switch in ON position.

Theory of Operation:

With the key in START or RUN position, 12.4 - 13.2 VDC is provided to the PTO switch through the F5 fuse and 562A and 562D Red wires. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)

With the PTO switch placed in the ON position, voltage is provided through the PTO switch contacts (terminals A to B) to the PTO solenoid (574B and 574C Yel wires). When the PTO solenoid is energized, hydraulic fluid engages the PTO clutch which couples the PTO input shaft to the PTO output shaft. The 540 rpm, 750 rpm, and mid PTO are driven by the PTO output shaft. They are each driven when mechanically engaged. (See "PTO CLUTCH AND BRAKE THEORY OF OPERATION" in the Final Drive Power Train section.

The PTO solenoid can be energized and open without providing rotation to the PTO shafts.

2-SPEED PTO LIGHTS

Function:

To alert operator of rear PTO being ENGAGED, and which speed range is selected.

Operating Condition:

- PTO switch in ON position
- Rear PTO range selector in either the 540 rpm range or the 750 rpm range.

Theory of Operation:

With the key in START or RUN position, 12.4 - 13.2 VDC is provided to the PTO switch through the F5 fuse and 562A and 562D Red wires.

With the PTO switch placed in the ON position, voltage is provided through the PTO switch contacts (terminals A to B) to the PTO solenoid, 2-speed PTO indicator lights, and mid PTO indicator light.

The 2-speed indicator lights are powered through the 574B and 574A Yel wires to the W8 2-speed PTO wiring harness (X34). The 2-speed PTO wiring harness provides voltage to each of the PTO speed range switches (S14 - 540 rpm and S15 - 750 rpm).

When the rear PTO range selector is placed in the 540 rpm position, the S14 540 rpm PTO switch is closed and provides are current path through the switch, X34 connector, 777 Pur wire, and X7 connector (terminal B) to the control panel circuit board. A circuit board run provides voltage to the H10 540 PTO indicator light.

When the rear PTO range selector is placed in the 750 rpm position, the S15 750 rpm PTO switch is closed and provides are current path through the switch, X34 connector, 757 Pur wire, and X7 connector (terminal F) to the control panel circuit board. A circuit board run provides voltage to the H11 750 PTO indicator light.

A ground circuit path for the control panel circuit board is provided though the X6 connector (terminal D), and 050K and 050A Blk wires.

NOTE: W8 2-speed PTO wiring harness was incorporated into main wiring harness in later models and cab version wiring harnesses (X34a and X34b).

MID PTO LIGHT

Function:

To alert operator of mid PTO being ENGAGED.

Operating Condition:

- PTO switch in ON position
- Mid PTO ENGAGED.

Theory of Operation:

With the key in START or RUN position, 12.4 - 13.2 VDC is provided to the S5 PTO switch through the F5 fuse and 562A and 562D Red wires. Voltage is also provided to the X5 connector and S6 mid PTO switch through the F5 fuse and 562A and 562F Red wires

NOTE: If the Mid PTO is not installed in the tractor, a jumper wire is installed in the X5 connector which replaces the S6 mid PTO switch.

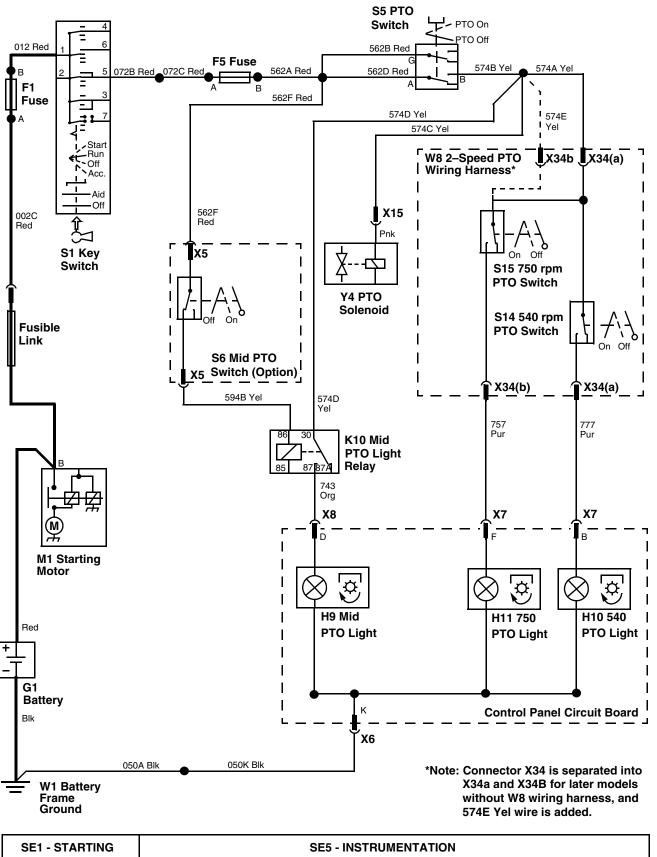
With the PTO switch placed in the ON position, voltage is provided through the PTO switch contacts (terminals A to B) to the K10 PTO relay contacts (terminal 30).

When the mid PTO is engaged, the S6 mid PTO switch is closed. Voltage is supplied through the switch, X5 connector, and 594B Yel wire to the K10 mid PTO light relay coil (terminal 86). When the mid PTO relay coil is energized, the relay contacts close and voltage at the relay contacts (terminal 30) is provided through the contacts to the 743 Org wire and X8 connector (terminal D). A circuit board run provides voltage to the H9 mid PTO indicator light.

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PTO ELECTRICAL SCHEMATIC





PTO ELECTRICAL CIRCUIT DIAGNOSIS

Test Conditions:

- Key switch in RUN position, engine OFF
 - Park brake OFF

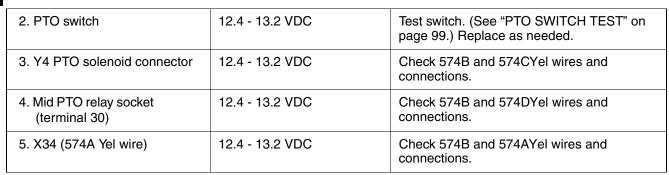
• PTO in NEUTRAL

• Transmission in NEUTRAL

Test/Check Point	Normal	If Not Normal
1. PTO switch	12.4 - 13.2 VDC	Check F5 fuse. Check 562A and 562D Red wires and connections.

Test Conditions:

- Key switch in RUN position, engine OFF
- Transmission in NEUTRAL
- Disconnect PTO solenoid from wiring harness
- Disconnect X6 and X7 connectors to control panel
- PTO switch in ON position
- Park Brake ENGAGED
- Remove K10 relay from socket
- Disconnect W8 wiring harness (X34)



Test Conditions:

- S14 and S15 from W8 wiring harness disconnected
- W8 wiring harness (X34) connected

Note: W8 2-speed PTO wiring harness was incorporated into main wiring harness in later models and cab version wiring harnesses. X34a and X34b replace X34 and become test points 6 and 7. Test point 5 is removed.

6. S15 connector to W8	12.4 - 13.2 VDC	Check X34 connector, W8 wiring harness and connections.
7. S14 connector to W8	12.4 - 13.2 VDC	Check X34 connector, W8 wiring harness and connections.

Test Conditions:

- S14 and S15 to W8 wiring harness connected
- 2-speed PTO selector in 540 rpm position perform test 8

8. X7 connector (B terminal)	12.4 - 13.2 VDC	Check W8 wiring harness, X34 connector, 777 Pur wire and connections. Test S14 switch. (See "2-SPEED PTO SWITCH TEST" on page 99.) Replace switch as needed.
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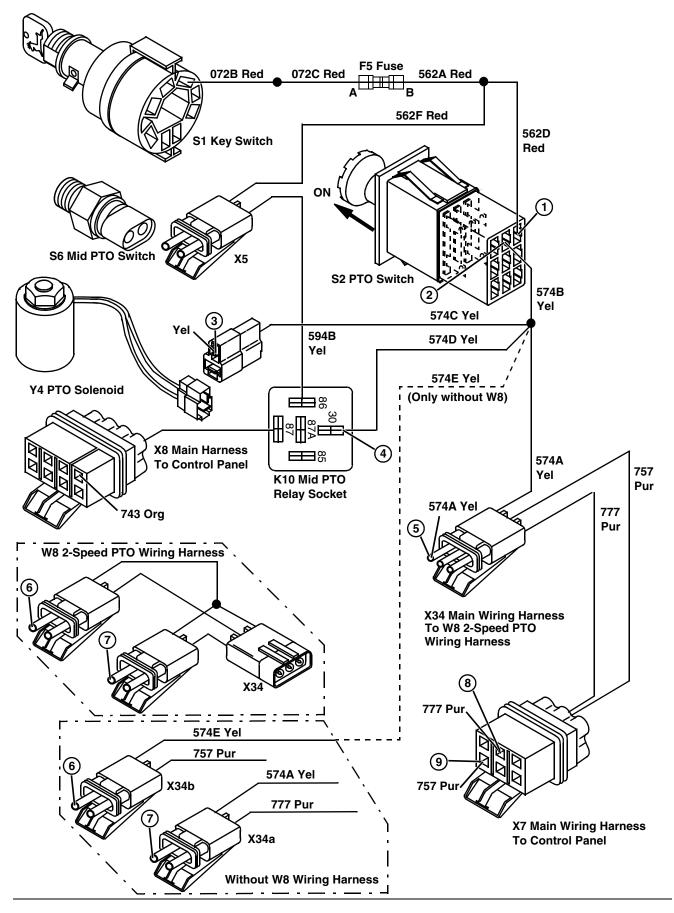
Test Conditions:

- S14 and S15 to W8 wiring harness connected
- 2-speed PTO selector in 750 rpm position perform test 9

9. X7 connector (F terminal)	12.4 - 13.2 VDC	Check W8 wiring harness, X34 connector, 757 Pur wire and connections. Test S15 switch. (See "2-SPEED PTO SWITCH TEST" on page 99.) Replace switch as needed.
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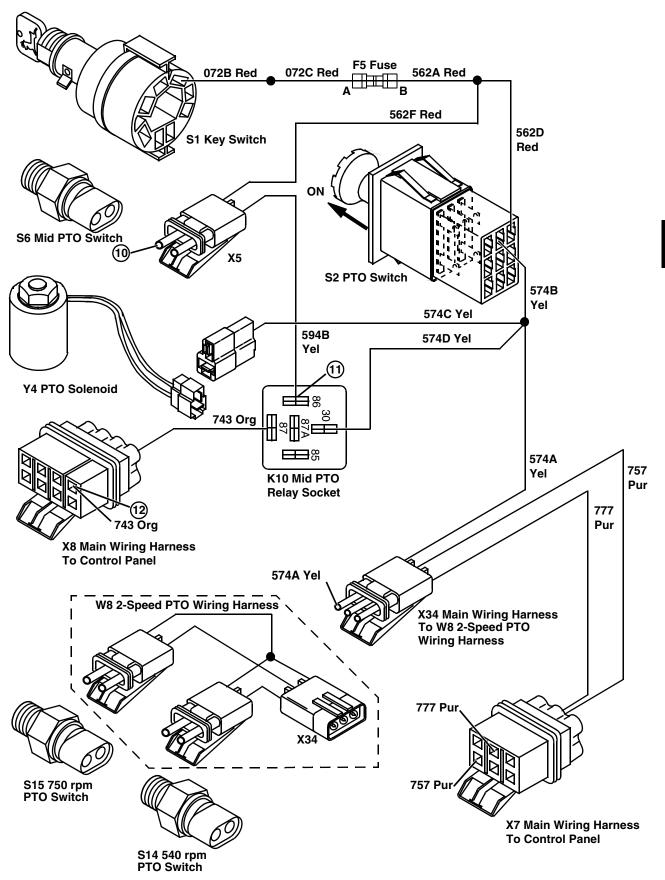
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Test Conditions:

- Key switch in RUN position, engine OFF
- PTO switch in OFF position
- Transmission in NEUTRAL
- Park brake OFF

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Test/Check Point	Normal	If Not Normal
NOTE: If the Mid PTO option is no wire.	oot installed in the tractor, the λ	5 connector will be fitted with a cap and jumper
10. X5 connector to S6 Mid PTO switch	12.4 - 13.2 VDC	Check F5 fuse. Check 562A and 562F Red wires and connections.
Test Conditions:		
• Key switch in RUN position, er	ngine OFF	 PTO switch in OFF position
Transmission in NEUTRAL		 Park Brake ENGAGED
 X5 to S6 mid PTO switch conr 	nected	 K10 relay removed
 Mid PTO selector in ON position 	on	
11. Mid PTO relay socket (terminal 86)	12.4 - 13.2 VDC	Check 594B Yel wire and connections.
Test Conditions:		
 Key switch in RUN position, er 	ngine OFF	 PTO switch in ON position
Transmission in NEUTRAL		 Park Brake ENGAGED
 Mid PTO selector in ON position 		 K10 mid PTO relay installed
12. X8 (743 Org wire)	12.4 - 13.2 VDC	Check 743 Org wire and connections.Test mid PTO relay. (See "RELAY TEST" on page 91.) Replace relay as needed.

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LIGHT SWITCH OPERATION

Function:

Provides power to the headlights, tail lights, hazard lights, work lights and panel lights in combinations, depending upon the position the light switch is placed in

Operating Conditions:

Light switch must be in either HAZARD, ROAD or FIELD position.

Theory of Operation:



Unswitched power for the light switch is provided through the load center F5 fuse, 122C and 122B Red wires. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)

Light Switch Hazard Position:

In the HAZARD position, power is provided to the LH and RH position lights (front and rear), and the license plate light.

In the HAZARD position voltage is provided from the light switch (terminal 2) through the 103A and 103C Org wires to the F8 fuse and F9 fuse.

From the F8 fuse, voltage is provided through the 118A and 118E Gry wires to the license plate light; the 118A and 118C Gry wires to the LH front position light; the 118A and 118D Gry wires to the RH rear position light; and, through the 118A and 118B Gry wires to the X13 trailer connector (terminal B).

From the F9 fuse, voltage is provided through the 128A and 128B Gry wires to the X13 trailer connector (terminal D); the 128A and 128C Gry wires to the RH front position light; and, through the 128A and 128D Gry wires to the LH rear position light.

Light Switch Road Position:

In the ROAD position, power is provided to the LH and RH headlights, the position lights, and the license plate light.

In the ROAD position voltage is provided from the light switch (terminal 2) through the same circuits as when the light switch is in the HAZARD position.

In addition, voltage is provided from the light switch (terminal 3) though the 138 Gry wire to the F7 fuse. The F7 fuse provides voltage to the LH headlight through the 119C and 119B Wht wires, and the RH headlight through the 119C and 119A Wht wires. Voltage is also provided to the control panel gauge lights through the 119C and 119D Wht wires, X6 connector (B terminal) and the control panel circuit board.

Light Switch Field Position:

In the FIELD position, voltage is removed from the position lights and license plate light (terminal 2); voltage remains at the headlights (terminal 3); and, is provided to the RH and LH work lights (terminal 4).

Voltage is provided from the switch (terminal 4) through the 143 Org wire to the F6 fuse. The F6 fuse provides voltage through the 147A, 147B and 147D Pur wires to the work lights.

BRAKE LIGHTS OPERATION

Function:

Provides power to the brake lights.

Operating Conditions:

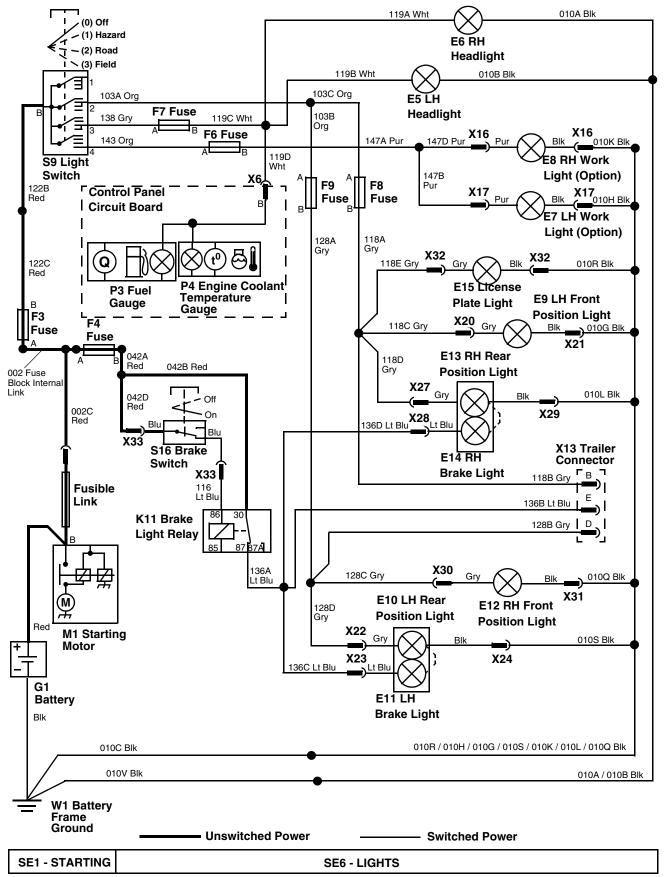
The brake pedal must be depressed.

Theory of Operation:

Unswitched power is provided to the brake switch and the brake light relay (terminal 30) through the F4 fuse, 042A, 042B and 042D Red wires. When the brake pedal is depressed, the brake switch closes. The closed brake switch contacts provide power to the brake light relay coil (terminal 86). When the brake light relay coil is energized, the relay contacts close. The closed contacts provide a current path to the RH brake light through the 136A and 136D Lt Blu wires; the LH brake light through the 136A and 136D Lt Blue wires; and, the X13 trailer connector (terminal E) though the 136A and 136B Lt Blue wires.

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LIGHT SWITCH ELECTRICAL SCHEMATIC



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TURN SIGNAL SWITCH OPERATION

Turn Signal Switch Function:

Provides intermittent power (from K12 flasher) to either the LH front and rear turn/hazard lights, or the RH front and rear turn/hazard lights. Also provides intermittent power to the control panel turn indicator lights.

Operating Conditions:

Key switch in the ON position, hazard switch in the OFF position, and turn signal switch in either LEFT or RIGHT position.

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Theory of Operation:

Unswitched power is provided to the hazard switch (terminal 30) through the F4 fuse, 042A and 042C Red wires. Switched power is provided from the key switch (terminal 5) through the 072B and 072E Red wires to the hazard switch (terminal 15).

With the hazard switch in the OFF position, the switched power is provided through the hazard switch (terminal 15 to terminal 49) and 102 Red wire to the K12 flasher.

The internal circuits of the K12 flasher provide an intermittent output (terminal 49a) if a circuit path is provided, through a load component, to the battery frame ground. The flasher unit in the turn signal switch is not used in this application. Placing the turn signal switch in either the RIGHT or LEFT position provides a circuit path through a load component (turn/hazard lights) to ground.

Right Turn Signal Theory of Operation:

With the turn signal switch in the RIGHT position, and the hazard switch in the OFF position, voltage from the K12 flasher (terminal 49a) enters the turn signal switch (terminal 4) through the 127D and 127B Pur wires. The turn signal switch completes a current path through the switch contacts (terminal 4 to terminal 5). From the turn signal switch (terminal 5), voltage is provided to the RH front turn/hazard light through the 115A and 115D Dk Grn wires; the RH rear turn/hazard light through the 115A and 115C Dk Grn wires; the X13 trailer connector (terminal A) through the 115A and 115E Dk Grn wires, the control panel RH turn light through the 115A and 115B Dk Grn wires; and, the hazard switch (Terminal R) through the 115A and 115F Dk Grn wires.

Each of the turn/hazard lights has a ground connection to the battery frame ground. When power is supplied to the turn/hazard lights, a complete circuit path is formed. When the circuit is formed, the internal circuits in the K12 flasher provide an intermittent voltage output. This intermittent voltage is provided to the turn/hazard lights through the circuit paths described above.

Left Turn Signal Theory of Operation:

With the turn signal switch in the LEFT position, and the hazard switch in the OFF position, voltage from the K12 flasher (terminal 49a) enters the turn signal switch (terminal 3) through the 127D and 127A Pur wires. The turn signal switch completes a current path through the switch contacts (terminal 3 to terminal 6). From the turn signal switch (terminal 6), voltage is provided to the LH front turn/hazard light through the 125A and 125D Dk Grn wires; the LH rear turn/hazard light through the 125A and 125C Dk Grn wires; the X13 trailer connector (terminal C) through the 125A and 125E Dk Grn wires, the control panel LH turn light through the 125A and 125B Dk Grn wires; and, the hazard switch (Terminal L) through the 125A and 125F Dk Grn wires.

Each of the turn/hazard lights has a ground connection to the battery frame ground. When power is supplied to the turn/hazard lights, a complete circuit path is formed. When the circuit is formed, the internal circuits in the K12 flasher provide an intermittent voltage output. This intermittent voltage is provided to the turn/hazard lights through the circuit paths described above.

HAZARD SWITCH OPERATION

Hazard Switch Function:

Provides intermittent power (from K12 flasher) to all of the turn/hazard lights.

Operating Conditions:

Hazard switch in ON position.

Theory of Operation:

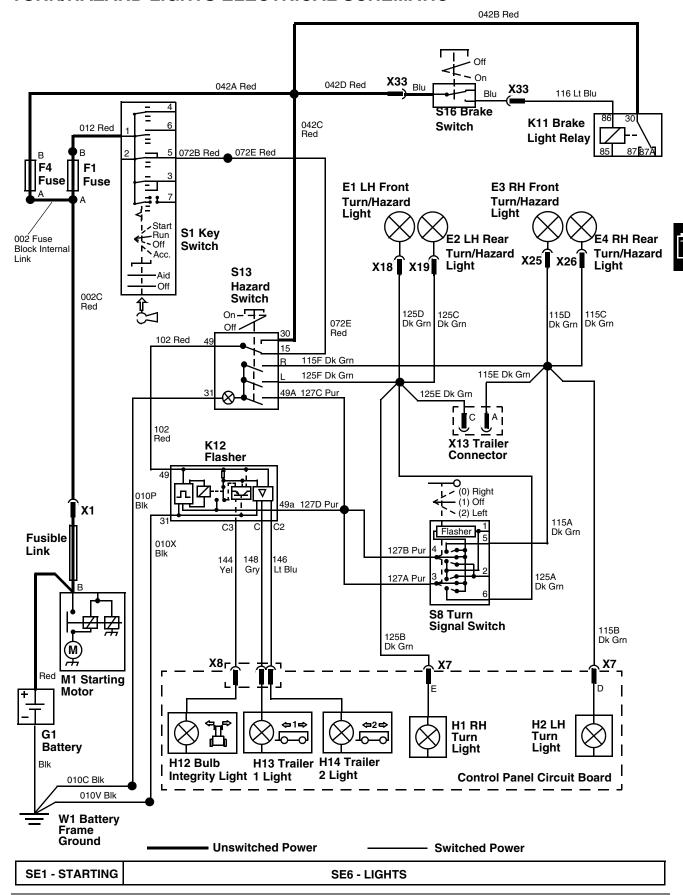
With the hazard switch in the ON position, unswitched power is provided through the hazard switch (terminal 30 to terminal 49) and 102 Red wire to the K12 flasher (terminal 49). The internal circuits of the K12 flasher provide an intermittent output (terminal 49a) if a circuit path is provided, through a load component, to the battery frame ground.

The circuit path is created when the K12 flasher output power is provided to the hazard switch input (terminal 49a) through the 127D and 127C Pur wires. The contacts in the hazard switch (terminal 49a to terminals R and L) complete the circuit path when the hazard switch output power is provided to all of the turn/hazard lights through the 115 and 125 series wires.

The hazard switch contains an indicator light that is provided with intermittent power from the K12 flasher. This is in addition to the intermittent power provided to the LH front and rear turn/hazard lights, the RH front and rear turn/hazard lights, the X13 trailer connector (terminals C and A) and both of the control panel turn indicator lights.

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TURN/HAZARD LIGHTS ELECTRICAL SCHEMATIC



LIGHTS DIAGNOSIS

Test Conditions:

- Key switch in OFF position
- Engine OFF

- Light switch in ROAD position
- X6 connector to control panel disconnected

Test/Check Point	Normal	If Not Normal
1. Light switch	12.4 - 13.2 VDC	Check F3 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)
2. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
3. F7 fuse	12.4 - 13.2 VDC	Check F7 fuse. Check 138 Gry wire and connections.
4. RH headlight	12.4 - 13.2 VDC	Check 119A and 119C Wht wires and connections.
5. LH headlight	12.4 - 13.2 VDC	Check 119A and 119B Wht wires and connections.
6. X6 control panel connector (terminal B)	12.4 - 13.2 VDC	Check 119A and 119D Wht wires and connections.

Test Conditions:

- Key switch in OFF position
- Engine OFF
- Light switch in HAZARD position
- X6 to control panel connected

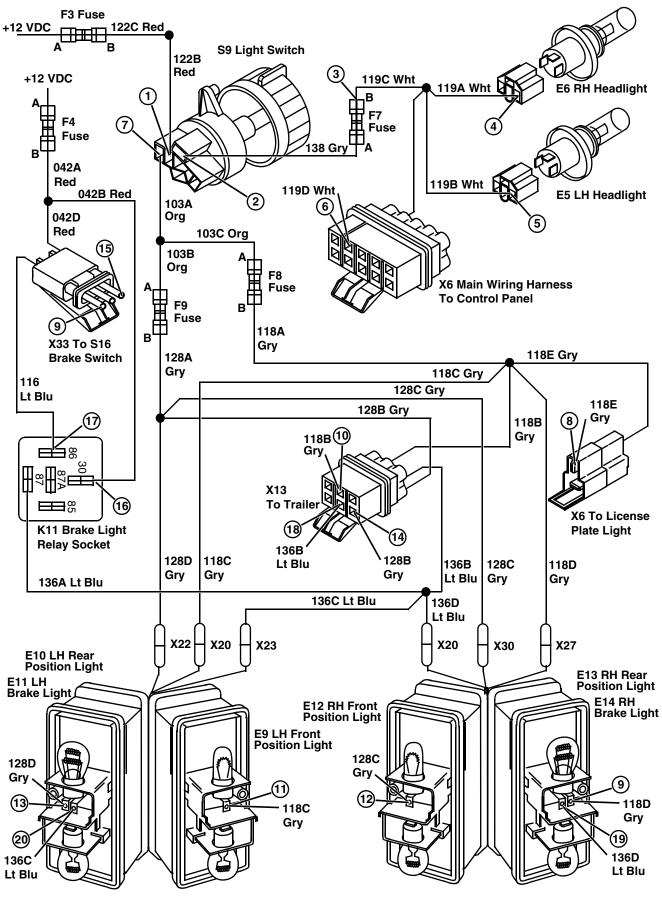
7. Light switch	12.4 - 13.2 VDC	Test light switch. (See "LIGHT SWITCH TEST" on page 95.)
8. X6 to license plate light	12.4 - 13.2 VDC	Check F8 fuse. Check 103A and 103C Org wires and connections. Check 118A and 118E Gry wires and connections.
9. RH rear position light	12.4 - 13.2 VDC	Check 118D Gry wire and connections. Check X27 connector and Gry wire.
10. X13 (terminal B)	12.4 - 13.2 VDC	Check 118B Gry wire and connections.
11. LH front position light	12.4 - 13.2 VDC	Check 118C Gry wire and connections. Check X20 connector and Gry wire.
12. RH front position light	12.4 - 13.2 VDC	Check F9 fuse. Check 128C Gry wire and connections. Check X30 connector and Gry wire.
13. LH rear position light	12.4 - 13.2 VDC	Check 128D Gry wire and connections. Check X27 connector and Gry wire.
14. X13 (terminal D)	12.4 - 13.2 VDC	Check 128B Gry wire and connections.

Test Conditions:

- Key switch in OFF position
- Engine OFF
- Light switch in OFF position
- X33 to S16 brake switch disconnected
- K11 brake light relay removed

15. X33 connector	12.4 - 13.2 VDC	Check F4 fuse. (See "POWER CIRCUIT DIAGNOSIS" on page 128.)
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Test/Check Point	Normal	If Not Normal
16. Brake light relay socket (terminal 30)	12.4 - 13.2 VDC	Check F4 fuse. Check 042A and 042B Red wires and connections.

Test Conditions:

- Key switch in OFF position
- Engine OFF
- Light switch in OFF position
- X33 to S16 brake switch connected
- Depress brake pedal, or: Manually close and hold S16 brake switch

page 101.) Check 042A and 042B Red wires and connections.	17. Brake light relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure brake is depressed. Test brake switch. (See "BRAKE SWITCH TEST" on page 101.) Check 042A and 042B Red wires and connections.
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Test Conditions:

- Key switch in OFF position
- Engine OFF
- Light switch in OFF position
- Install Brake light relay in socket
- Depress brake pedal, or: Manually close and hold S16 brake switch

18. X13 (terminal E)	12.4 - 13.2 VDC	Ensure brake is depressed. Check 136A and 136B Lt Blu wires and connections. Test brake light relay. (See "RELAY TEST" on page 91.) Replace as needed.
19. RH brake light	12.4 - 13.2 VDC	Check 136A and 136D Lt Blu wires and connections. Check X20 connector.
20. LH brake light	12.4 - 13.2 VDC	Check 136A and 136C Lt Blu wires and connections. Check X23 connector.

Test Conditions:

- Key switch in RUN position
- Engine OFF
- Light switch in OFF position
- Turn signal switch in OFF position
- K12 flasher disconnected from wiring harness
- Hazard switch disconnected from wiring harness

21. Key switch (terminal 5)	12.4 - 13.2 VDC	Test switch. (See "KEY SWITCH TEST" on page 95.) Replace as needed.
22. Hazard switch connector	12.4 - 13.2 VDC	Check 072B and 072E Red wires and connections.
23. F4 fuse	12.4 - 13.2 VDC	Replace F4 fuse.
24. Hazard switch connector	12.4 - 13.2 VDC	Check 042A and 042C Red wires and connections.
25. Hazard switch connector	Continuity to ground (0.2 ohms or less)	Check 010P and 010C Blk wires and connections.

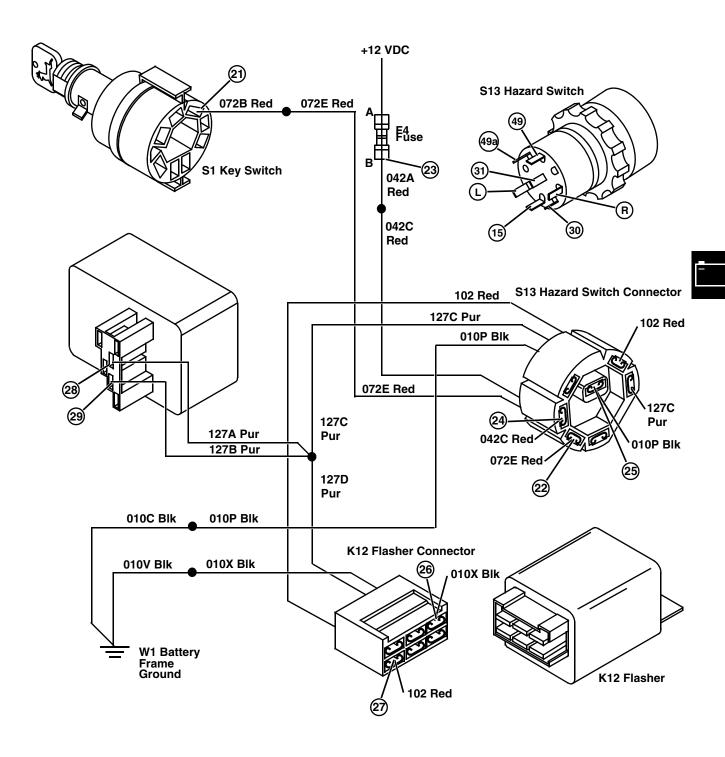
Test Conditions:

- Key switch in RUN position
- Engine OFF

- Turn signal switch in OFF position
- Connect hazard switch to wiring harness
- Hazard switch in OFF position

26. K12 flasher connector	Continuity to ground (0.2 ohms or less)	Check 010X and 010V Blk wire and connections.
27. K12 flasher connector	12.4 - 13.2 VDC	Check 102 Red wire and connections.

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Test/Check Point	Normal	If Not Normal
Test Conditions: • Key switch in RUN position • Engine OFF	Hazard switch in OFF positTurn signal switch in OFF pK12 flasher connected to w	osition
28. Turn signal switch (terminal 3)	7.5 to 8.0 VDC	Check 127D and 127A Pur wires and connections. Ensure voltage to flasher and flasher ground connection - see steps 26 and 27. Replace flasher unit.
29. Turn signal switch (terminal 4)	7.5 to 8.0 VDC	Check 127D and 127B Pur wires and connections. See previous step.



Test Conditions:

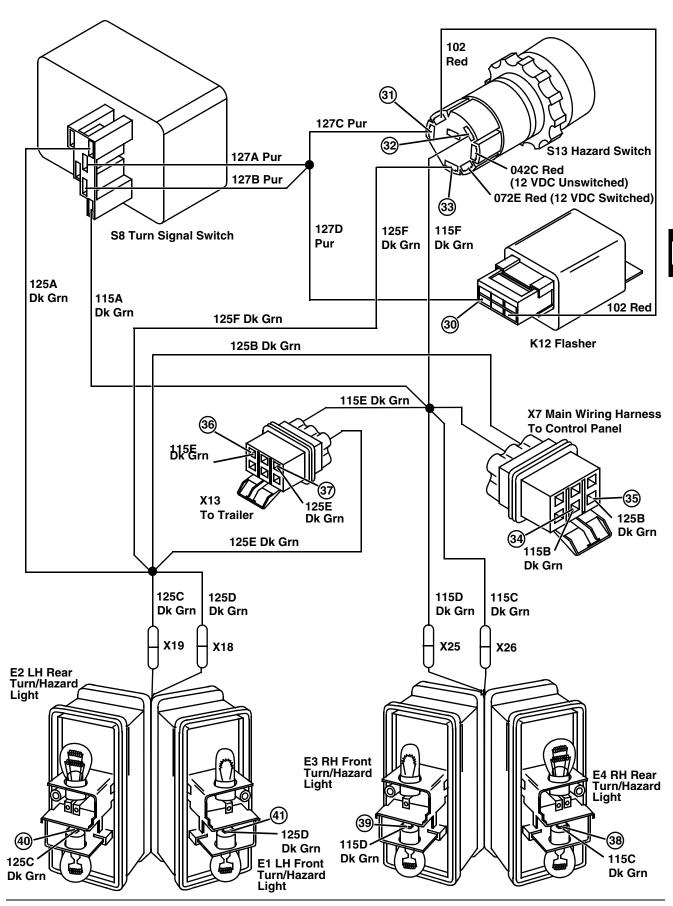
- Key switch in OFF position
- Engine OFF

- Light switch in OFF position
- Hazard switch in ON position
- X7 disconnected from control panel

NOTE: Intermittent voltage to the turn/hazard lights, trailer connector, and control panel indicator lights is provided through the hazard switch when the hazard switch is in the ON position (Steps 30 to 41). Intermittent voltage to the LH or R. H. turn hazard lights, trailer connector, and control panel indicator light(s) is provided through the turn signal switch when the switch is placed in either the LH or RH position (Steps 42 to 45).

30. K12 flasher connector	Intermittent 12.4 - 13.2 VDC	Test hazard switch. (See "HAZARD SWITCH TEST" on page 98.) Replace switch as needed.
31. Hazard switch	Intermittent 12.4 - 13.2 VDC	Test hazard switch. See previous step.
32. Hazard switch	Intermittent 12.4 - 13.2 VDC	Test hazard switch. See previous step.
33. Hazard switch	Intermittent 12.4 - 13.2 VDC	Check 127D and 127C Pur wire and connections.
34. X7 control panel connector (terminal D)	Intermittent 12.4 - 13.2 VDC	Check 115F and 115B Dk Grn wires and connections.
35. X7 control panel connector (terminal E)	Intermittent 12.4 - 13.2 VDC	Check 125F and 125B Dk Grn wires and connections.
36. X13 trailer connector (terminal A)	Intermittent 12.4 - 13.2 VDC	Check 115F and 115E Dk Grn wires and connections.
37. X13 trailer connector (terminal C)	Intermittent 12.4 - 13.2 VDC	Check 125F and 125E Dk Grn wires and connections.
38. RH rear turn/hazard light	Intermittent 12.4 - 13.2 VDC	Check 125F and 125C Dk Grn wires, X26 connector and connections.
39. RH front turn/hazard light	Intermittent 12.4 - 13.2 VDC	Check 125F and 125D Dk Grn wires, X25 connector and connections.
40. LH rear turn/hazard light	Intermittent 12.4 - 13.2 VDC	Check 115F and 115C Dk Grn wires, X19 connector and connections.
41. LH front turn/hazard light	Intermittent 12.4 - 13.2 VDC	Check 115F and 115D Dk Grn wires, X18 connector and connections.

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Test/Check Point Normal If Not Normal

Test Conditions:

Key switch in RUN position

• Engine OFF

Light switch in OFF position

• Turn signal switch in RIGHT turn position

• Hazard switch in OFF position

osition • X7 to control panel connected

NOTE: The following steps to test the turn signal circuits DO NOT cover testing of each component. If a component is not covered in the diagnosis, refer to hazard switch test steps 40 to 41.

42. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test turn signal switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace switch as needed.
43. X13 connector	Intermittent 12.4 - 13.2 VDC	Check 115A and 115E Dk Grn wires and connections.

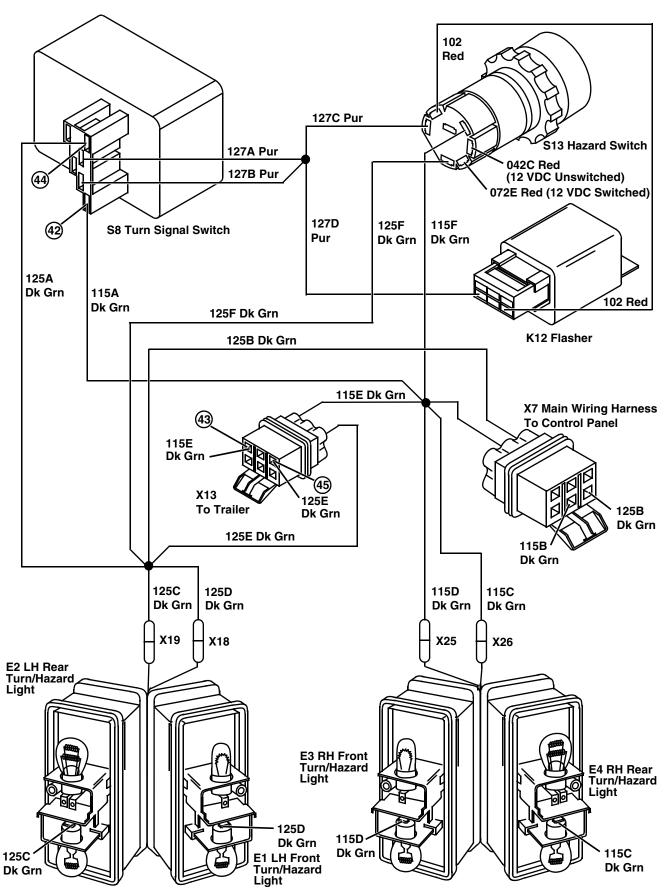


Test Conditions:

- Key switch in RUN position
- Engine OFF
- Light switch in OFF position
- Turn signal switch in LEFT turn position
- Hazard switch in OFF position

44. Turn signal switch	Intermittent 12.4 - 13.2 VDC	Test turn signal switch. (See "TURN SIGNAL SWITCH TEST" on page 97.) Replace switch as needed.
45. X13 connector	Intermittent 12.4 - 13.2 VDC	Check 125A and 125E Dk Grn wires and connections.

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CRUISE CONTROL ELECTRICAL - EUROPEAN

CRUISE CONTROL

Cruise Control Function:

Provides an electro-mechanical means to control the forward speed of the tractor.

Operating Conditions:

- · Key switch in RUN position
- Brake not depressed
- Cruise control switch momentarily in ENGAGE position, and then released to the ON position.

The cruise control will remain ENGAGED until the brake is depressed; the key switch is turned to the OFF position; or, the cruise control switch is placed into the OFF position.



Theory of Operation:

When the Y3 cruise control electromagnet is energized, the forward pedal is held in whatever position it is in when the magnet is energized. The cruise control magnet is energized through the cruise control relay contacts. The brake switch provides a latching circuit for the cruise control relay. When the brake pedal is depressed, the normally open brake switch contacts open and the latching circuit is removed. With the latching circuit removed, the cruise control relay contacts open, and the cruise control magnet is deenergized - releasing the forward pedal.

Power for the cruise control circuit is provided to the X9 connector, from the key switch (terminal 4), through the 209 Wht wire.

Power is provided from the X9 connector to the cruise control switch through the W4 wiring harness Wht wire, and X10 connector. The cruise control switch is a double pole switch with OFF, ON, and momentary ENGAGE positions.

When the cruise control switch is placed in the momentary ENGAGE position, power is provided through the switch, X10 connector, W4 wiring harness Gry wire, X9 connector, and 238 Gry wire to the K8 cruise control relay (terminal 86). With power provided, the relay coil energizes and the contacts (terminal 30 and terminal 87) close. At the same time (cruise control switch placed in the momentary ENGAGE position), power is provided through the X10 connector, W4 wiring harness Pur wire, X9 connector, and 247 Pur wire to the K8 cruise control relay contacts (terminal 87).

With the contacts closed, power is provided through the relay contacts (terminals 87 and 30) to the cruise control indicator light through the 264B Yel wire, X6 connector (terminal G), and control panel circuit board.

Latching Circuit:

Power is also provided from the cruise control relay

(terminal 30) to the S11 brake switch and Y3 cruise control magnet through the 264A Yel wire, X9 connector, W4 wiring harness Yel wires, and X11 connector and X12 connector respectively.

When power is provided to the cruise control magnet, it is energized and creates a magnetic field that holds the forward pedal in a locked position.

When power is provided to the S11 brake switch, and the brake switch contacts are closed (brake NOT depressed), power is provided through the X11 connector, W4 wiring harness Gry wires, X9 connector and 238 Gry wire to the cruise control relay (terminal 86). This circuit latches the cruise control relay by keeping the cruise control relay coil energized.

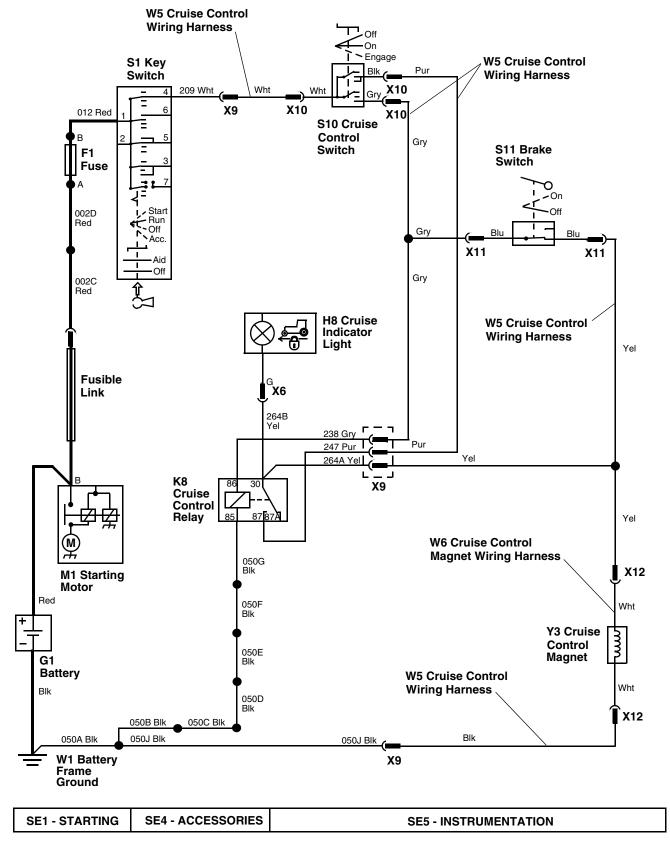
The latching circuit keeps the cruise control relay coil energized until the brake pedal is depressed. When the pedal is depressed, the S11 brake switch contacts open and power is removed from the cruise control relay coil.

When the cruise control relay coil is deenergized, the relay contacts open, and power provided to the cruise control indicator light and the cruise control magnet is removed. Without power, the cruise control magnet releases the forward pedal.

Placing the cruise control switch into the OFF position stops power to the cruise control relay coil and contacts.

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CRUISE CONTROL ELECTRICAL SCHEMATIC



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CRUISE CONTROL DIAGNOSIS

Test Conditions:

- Key switch in RUN position, engine OFF
- PTO in NEUTRAL
- Transmission in NEUTRAL
- Park brake ENGAGED
- K8 cruise control relay removed
- X9 disconnected

Test/Check Point	Normal	If Not Normal
1. Key switch	12.4 - 13.2 VDC	Test key switch. (See "KEY SWITCH TEST" on page 95.) Replace switch as needed.
2. X9 connector (terminal A)	12.4 - 13.2 VDC	Check 209 Wht wire and connections.



Test Conditions:

- X9 connector connected
- X10, X11 and X12 disconnected
- Park brake ENGAGED
- Key switch in RUN position, engine OFF

3. X10 connector (Wht wire	12.4 - 13.2 VDC	Check X9, Wht wire, X10 and connections.
terminal)		

Test Conditions:

X10 to cruise control switch connected

- Park brake ENGAGED
- Place and hold cruise control switch in ENGAGE position
- Key switch in RUN position, engine OFF

4. K8 relay socket (terminal 86)	12.4 - 13.2 VDC	Ensure cruise control switch is in ENGAGE position. Test switch. (See "CRUISE CONTROL SWITCH TEST" on page 100.) Check X10 connector, Gry wire, X9 connector, and 238 Gry wires and connections.
5. K8 relay socket (terminal 87)	12.4 - 13.2 VDC	Test cruise control switch. Check X10 connector, Pur wire, X9 connector, and 247 Pur wires and connections.
6. X11 connector (Gry wire)	12.4 - 13.2 VDC	Check Gry wire and connections.

Test Conditions:

• Cruise control switch in ON position

K8 relay installed

7. X6 (terminal G)	12.4 - 13.2 VDC	Test K8 cruise control relay.

Test Conditions:

• Key switch in OFF position

8. X12 to frame ground (Blk wire)	Less than 0.1 ohms resistance	Check Blk wire, X9 connector, and 050J and 050A Blk wires and connections.				
9. X9 to X11 to X12 (Yel wires)	Less than 0.1 ohms resistance	Check Yel wires and connections.				

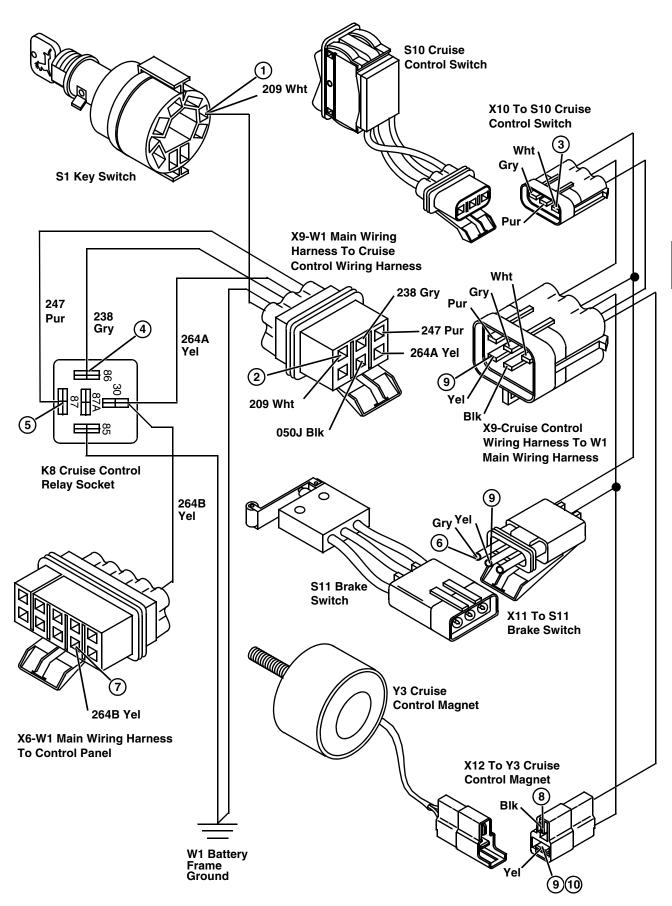
Test Conditions:

- X11 connected
- Key switch in RUN position (Engine OFF)

- Cruise control switch in ON position
- Brake pedal NOT depressed

10. X12 connector (Yel wire) 12.4 - 13.2 VDC	Test brake switch. (See "BRAKE SWITCH TEST" on page 101.)
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EUROPEAN CAB ELECTRICAL SECTION

The European road-homologated tractors fitted with operator's cabs have a main wiring harness that is specific to tractors fitted with cabs. The cab harness is the same for the 4500 and 4600 European models, and meet EEC Machinery Directives.

The cab tractors have most of the same electrical circuits as found on the standard European tractors. The differences to the main tractor harness are as follows:

- The addition of an ignition circuit to trigger the cab power relays (located in the cab overhead console).
- The removal of the work lamp circuits from the main tractor harness. (The work lamps are controlled by cab mounted switches.)

All power for the cab is taken from the battery terminal on the starting motor. A large 60 amp plug-in fuse is located on the left side engine shroud, and protects all the cab power circuits. Smaller plug-in fuses located in the cab overhead console protect individual cab circuits.

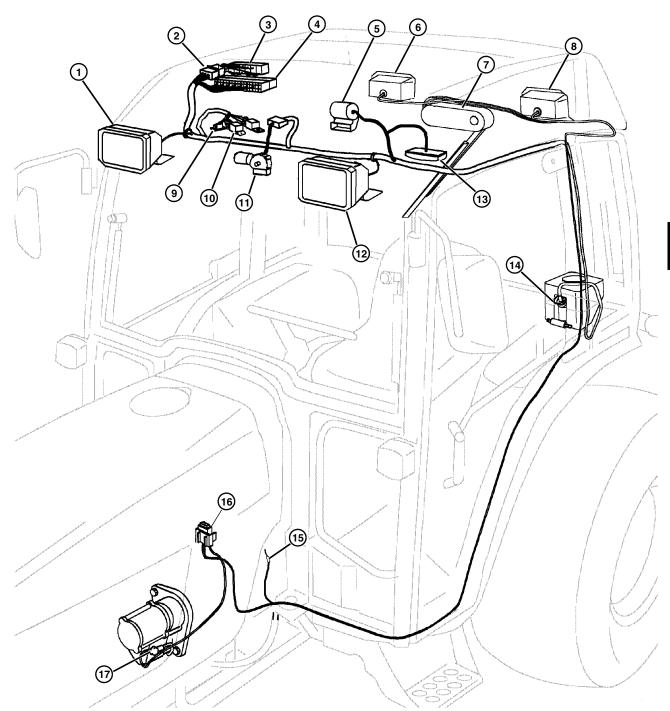
The front and rear turn signals, licence plate lamp, and trailer connector, are powered through the main tractor harness, the same as for the European tractor. Schematics and diagnosis for these circuits start on page 4-91.

Most cab electrical repairs can be diagnosed by lowering the cab overhead console, and accessing the component control switches, relays, and fuses. Repairs to harnesses for rear turn signals, licence plate lamp, trailer connector, rear work lamp, and beacon, can be accessed under padding behind operator's seat.

Only major damage to cab harness would require lifting cab up from tractor to perform repairs. (See Miscellaneous Section for Cab Removal)

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COMPONENT LOCATION – CAB ELECTRICAL



- 1. Right Front Work Lamp
- 2. X2 Connector
- 3. Cab Fuse Panel
- 4. Cab Switch Panel
- 5. Fan Blower Motor
- 6. Right Rear Work Lamp
- 7. Rear Wiper Motor
- 8. Left Rear Work Lamp
- 9. Washer Pump Control Module
- 10. Cab Power Relays
- 11. Front Wiper Motor
- 12. Left Front Work Lamp
- 13. Dome Lamp
- 14. Washer Pump Motor
- 15. Cab X2 Connector
- 16. Cab Main Fuse
- 17. Starter Battery Terminal

CAB SCHEMATIC AND WIRING HARNESS LEGEND

A1—Radio

B5-Left Radio Speaker

B6-Right Radio Speaker

E16—Dome Lamp

E17—Cab Front Work Lamps

E18—Cab Rear Work Lamps

E19—Cab Warning Beacon Lamp

E20—Left Front Cab Turn/Hazard Lamp

E21—Right Front Cab Turn/Hazard Lamp

E22—Left Rear Cab Turn/Hazard Lamp

E23—Right Rear Cab Turn/Hazard Lamp

E24—Cab License Plate Lamp

F10-Main Cab Fuse - 60 Amp

F11—Cab Fuse #1 - 15 Amp - Wiper/Washer

F12—Cab Fuse #2 - 4 Amp - Radio & Dome Lamp

F13—Cab Fuse #3 - 10 Amp - Fan Blower

F14—Cab Fuse #4 - 30 Amp - Work Lamps

F15—Cab Fuse #5 - Beacon

F16—Cab Fuse #6 - Unused

G1—Battery

K13—Cab Power Relay, Front

K14—Cab Power Relay, Rear

K15—Washer Pump Control Module

M1—Starting Motor

M2—Cab Fan Blower Motor

M3—Rear Wiper Motor

M4—Washer Pump Motor

M5—Front Wiper Motor

S1—Key Switch

S17—Cab Fan Blower Switch

S18—Cab Front Work Lamp Switch

S19—Cab Rear Work Lamp Switch

S20—Cab Warning Beacon Switch

S21—Rear Wiper/Washer Switch

S22—Front Wiper/Washer Switch

W1—Battery Frame Ground

W2—Cab Frame Ground

CAB WIRING HARNESS CONNECTORS:

X1—W1 Tractor Main Harness-Fusible Link to Fuse #1

X2—W1 Tractor Main Harness to W9 Cab Main Harness Ignition Signal

X3—W9 Cab Main Harness to Cab Fuse Panel

WIRING HARNESSES:

W9—Cab Main Harness

W10—Cab Left RearTurn Signal Harness

W11—Cab Right Rear Turn Signal Harness

CAB LIGHTS CONTROLLED FROM MAIN WIRING HARNESS

E1-LH Front Turn/Hazard Light

E2-LH RearTurn/Hazard Light

E3—RH Front Turn/Hazard Light

E4—RH RearTurn/Hazard Light

E7—LH Work Light (Option)

E8—RH Work Light (Option)

E9—LH Front Position Light

E10—LH Rear Position Light

E11-LH Brake Light

E12—RH Front Position Light

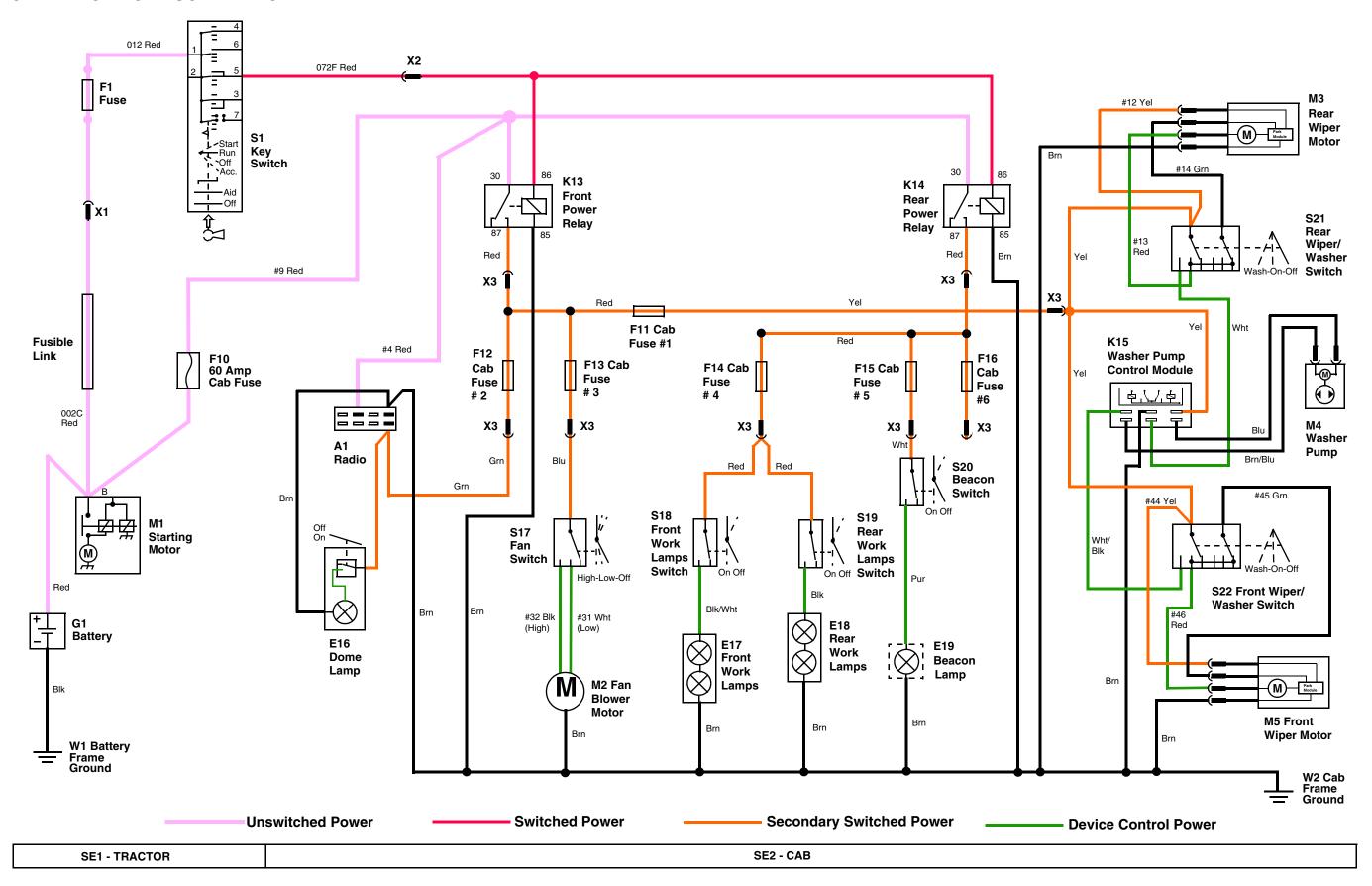
E13—RH Rear Position Light

E14—RH Brake Light

E15—License Plate Light(s)

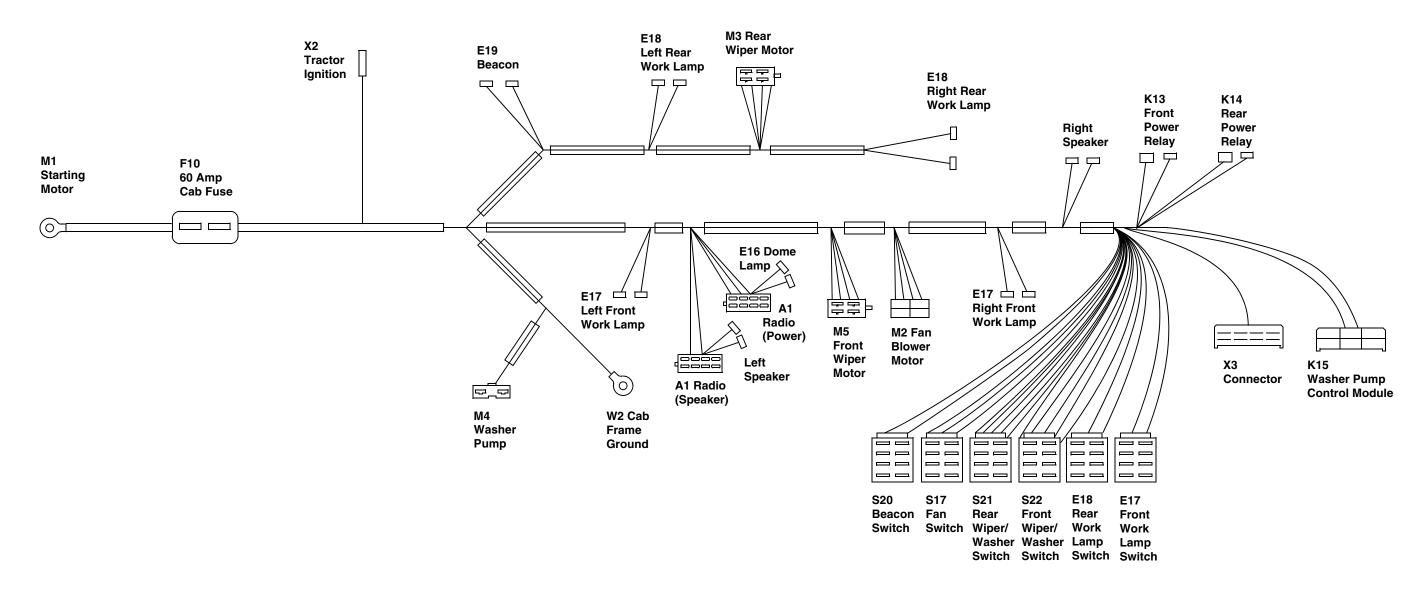
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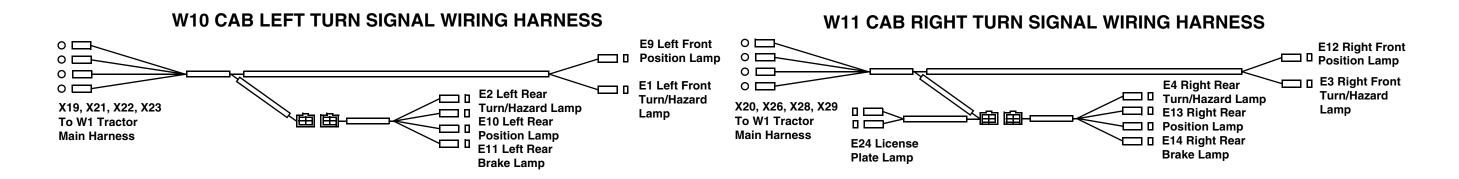
CAB ELECTRICAL SCHEMATIC



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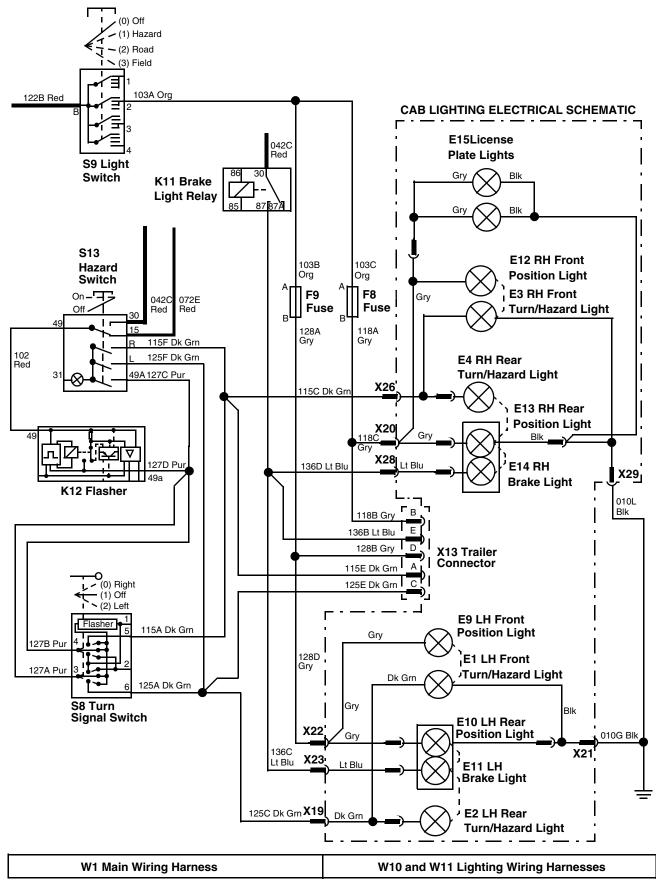
W9 CAB MAIN WIRING HARNESS





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CAB LIGHTING ELECTRICAL SCHEMATIC



- +

CAB ELECTRICAL TROUBLESHOOTING

Problem or Symptom Check or Solution	No cab power. All cab circuits dead.	Cab turn signals not operating.	Cab license plate lamp has no power.	Cab work lamps not operating.	Cab fan blower motor not operating.	No power at wipers and washers.	No power at radio and dome lamp.	Washer pump not operating.	Cab trailer connector not powered.
Check cab main 60 amp fuse.	•								
Check cab power relays are energized when ignition is on.	•								
See "Light Switch Operation" in European Electrical Section.		•	•						
Check F14 cab fuse #4.				•					
Check F13 cab fuse #3.					•				
Check F11 cab fuse #1.						•			
Check cab frame ground behind operator's seat.	•								
Check F12 cab fuse #2.							•		
Check pump washer module.								•	
See "W7 Trailer Connector Wiring Harness" in European Electrical Section.									•



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THEORY AND DIAGNOSIS

CAB POWER CIRCUIT OPERATION

NOTE: See cab electrical schematic for reference while reading this page.

Function:

Provides power to the cab components whenever the battery is connected.

The unswitched power is direct to the cab from the tractor battery.

The switched power is controlled by the tractor ignition circuit, and is only powered when key switch is in RUN, START, or AID positions. It energizes the cab power relays, closing the contacts and allowing current to flow to the cab fuse panel.

The secondary switched power is the current from the cab power relays, through the cab fuse panel, and into the cab switches.

The device control power is the current from a switch to a specific device, which will activate a device directly, or will control a relay which controls a device. It is the power directly controlled by the operator to turn something on or off.

Unswitched Power:

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

- Battery Positive Terminal
- Starting Motor Terminal B
- Cab Main 60 Amp Fuse
- F1 Tractor Ignition Fuse
- Kev Switch Terminal 1
- Cab Power Relays
- Cab Radio Connector

If battery power is not available at the above points, refer back to the "Power Circuit Operation" section of the European Electrical section for theory and diagnosis of tractor power circuits.

Switched Power:

When the key switch is moved to the ON position, control current is sent to the cab via the 072F Red ignition circuit, which pulls in the K13 Front and K14 Rear Power Relays in the overhead console of the cab. The 072F circuit is specific to cab tractors, and is taken from the 072 ignition node shown on the main European tractor schematic.

Secondary Switched Power:

With the cab power relays pulled in and closed, cab power can flow from the F10 60 amp cab fuse, (located in the left-rear engine compartment), through the cab relays, to the cab fuse panel.

The K13 front power relay controls the power for cab fuses 1–3, (radio, dome lamp, wiper/washers, and blower fan)



The K14 rear power relay controls power for cab fuses 4–6, (work lamps, and optional safety beacon).

If fuses are good, power flows to the cab switch panel, radio power connector, dome lamp, and washer pump control module.

Device Control Power:

Individual switches on the cab switch panel route power to the specific electrical devices. All circuits are grounded at cab frame ground, behind operator's seat.

The washer pump is energized by the washer pump control module, located in the cab overhead console. It's operation is covered separately in this section.

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CAB POWER CIRCUIT DIAGNOSIS

Test Conditions:

Key switch in OFF position

• Transmission in NEUTRAL

• Park brake ENGAGED

• PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
Starting motor battery (B) terminal	12.4 - 13.2 VDC	Check cable to battery. Test battery.
2. Tractor fuse panel—F1 fuse.	12.4 - 13.2 VDC	Check fusible link, 002C Red wire and connections.
3. Key switch 012 Red wire.	12.4 - 13.2 VDC	Check F1 fuse, 012 Red wire and connections.
4. 60 amp cab main fuse.	12.4 - 13.2 VDC	Check Red wire and connections between cab main fuse and starting motor B terminal.
5. #9 Red wire at terminal #30 of cab power relays. #4 Red wire at cab radio connector.	12.4 - 13.2 VDC	Check #9 Red wire from cab main fuse in engine compartment to cab overhead console.



Test Conditions:

Key switch in ON position

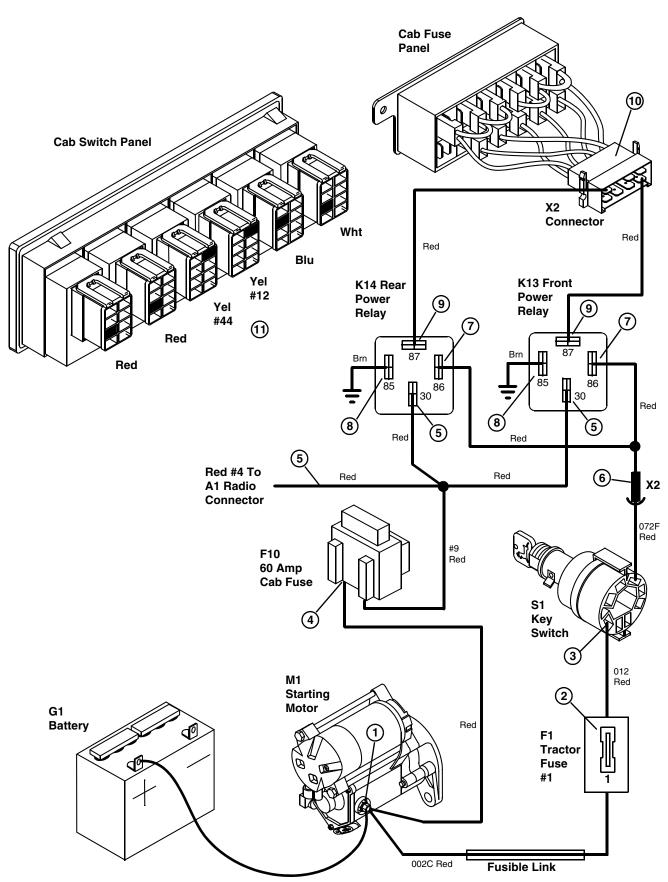
• Transmission in NEUTRAL

• Park brake ENGAGED

• PTO DISENGAGED

Test/Check Point	Normal	If Not Normal
X2 connector of 072F circuit behind tractor fuse panel.	12.4 - 13.2 VDC	See "Power Circuit Diagnosis" in European Electrical section.
7. #86 terminal (red wire) of front and rear cab power relays.	12.4 - 13.2 VDC	Check Red Ignition Wire from tractor X2 connector to cab overhead console.
8. #85 terminal (brn wire) of front and rear cab power relays.	Continuity to cab frame ground located behind operator's seat.	Repair cab frame ground wire.
9. Cab power relays	12.4 - 13.2 VDC at relay terminals 30 (red), 86 (red), and 87 (red).	If power is at terminal 30 and 86, but not at 87, relay is burned out. Replace relay.
10. All fuses in cab fuseblock	12.4 - 13.2 VDC	If no power on any side of any fuse: Check red wires between power relays and cab fuse panel. If power on only one side of a fuse: Replace fuse. If only power to three fuses (1-3 or 4-6): One power relay is defective.
11. Cab switches in overhead console.	12.4 - 13.2 VDC at back of switch panel at wire terminals and cavities marked at right.	Check wires from cab fuse panel to cab switch panel through X3 connector.

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CAB WIPER DIAGNOSIS

Test Conditions:

• Engine OFF • Transmission in NEUTRAL • Park Brake ENGAGED

• Key switch in RUN position • PTO DISENGAGED

WIPER MOTOR CIRCUIT DIAGNOSIS

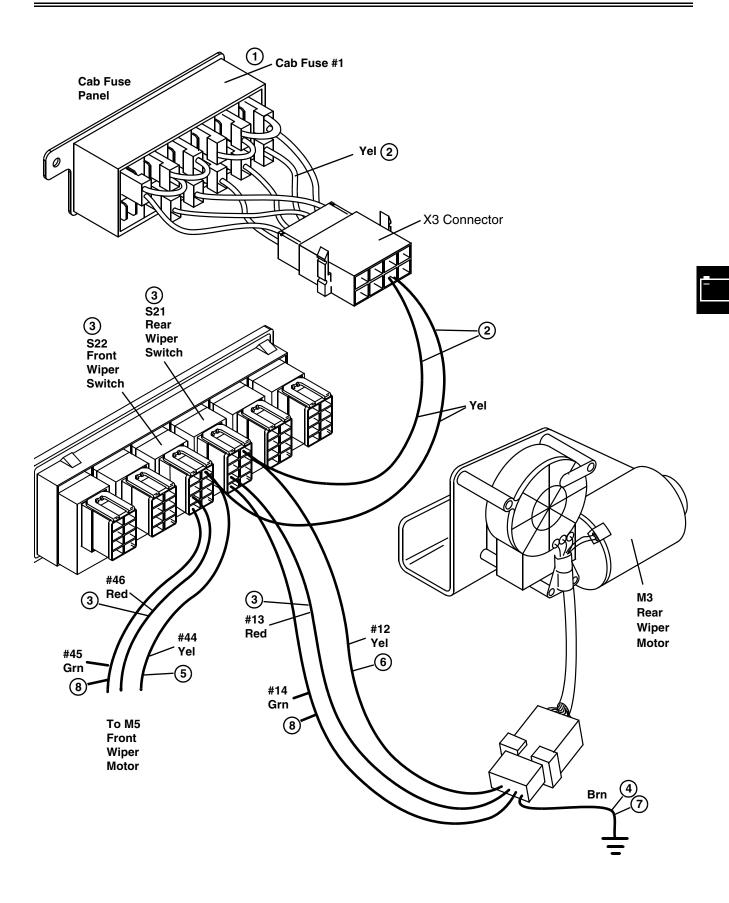
Test/Check Point	Normal	If Not Normal
1. F11 cab fuse #1	12.4 - 13.2 VDC on both sides of fuse.	No power on 1 side of fuse: Replace fuse. No power on both side of fuse: See "Cab Power Circuit Diagnosis" section
Yel wire from cab fuse panel, through X3 connector, to front and rear wiper switches.	12.4 - 13.2 VDC	Repair Cab fuse panel, X3 connector terminals, or Yel wire to front and rear wiper switches.
Wiper switch to ON (middle) position.	12.4 - 13.2 VDC at red wire on back of wiper switch (front or rear), and to wiper motor.	No power at back of switch: replace switch. No power at wiper motor: repair red wire.
Turn wiper switch back to OFF position before performing step 4.		
4. Brn wire at wiper motor.	Continuity to ground. If normal, replace wiper motor.	Repair Brn ground wire to wiper motor.

WIPER MOTOR PARK CIRCUIT DIAGNOSIS

Test/Check Point	Normal	If Not Normal
Perform steps 1–4 above to check power circuit before performing with step 5. Turn key switch to ON position before performing step 5.		
5. #44 Yel wire from front wiper switch to front wiper motor.	12.4 - 13.2 VDC	Repair #44 wire.
6. #12 Yel wire from rear wiper switch to rear wiper motor.	12.4 - 13.2 VDC	Repair #12 wire.
7. Brn wire at wiper motor.	Continuity to ground.	Repair Brn ground wire.
8. Grn wire from wiper motor to wiper switch. (One Grn wire for each wiper.)	12.4 - 13.2 VDC when wiper arm is not in parked position. Circuit remains powered after switch is moved to OFF position, until arm is parked. 0 VDC when arm is parked.	No voltage: (Wiper will not park) Replace wiper motor. Constant voltage (Wiper will not stop) Replace wiper motor.

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CAB WASHER PUMP DIAGNOSIS

Test Conditions:

• Engine OFF

• Transmission in NEUTRAL • Park Brake ENGAGED

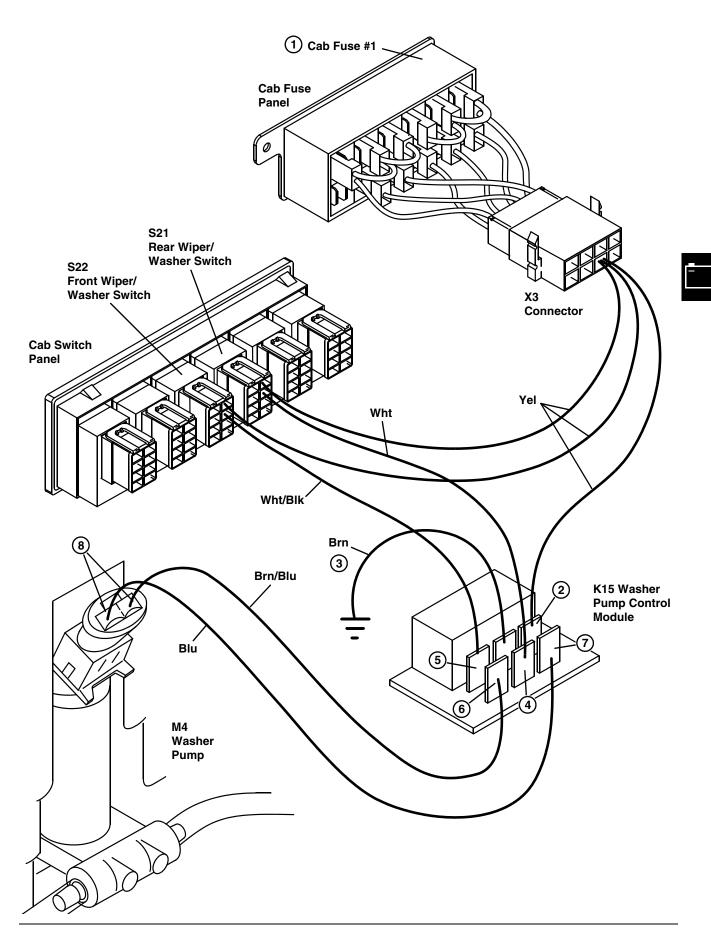
• PTO DISENGAGED

Key switch in RUN position

Test/Check Point	Normal	If Not Normal
1. F11 cab fuse #1	12.4 - 13.2 VDC	No power on both sides of fuse: See "Cab Power Circuit Diagnosis" section. No power on one side of fuse: Replace fuse.
Yel wire at washer pump control module.	12.4 - 13.2 VDC	Repair Yel wire from cab fuse panel, through X3 connector, to pump control module.
Brn wire at washer pump control module.	Continuity to ground.	Repair Brn ground wire.
Wht wire at washer pump control module.	12.4 - 13.2 VDC when rear washer switch is depressed.	Repair Wht wire from rear washer switch to pump control module.
5. Wht/Blk wire at washer pump control module.	12.4 - 13.2 VDC when front washer switch is depressed.	Repair Wht/Blk wire from rear washer switch to pump control module.
6. Brn/Blu wire at washer pump control module.	12.4 - 13.2 VDC when key switch is ON, except when front washer switch is depressed.	Replace washer pump control module.
7. Blu wire at washer pump control module	12.4 - 13.2 VDC when key switch is ON, except when rear washer switch is depressed.	Replace washer pump control module.
8. Brn/Blu and Blu wires at washer pump.	Both wires should have 12.4 - 13.2 VDC when checked between wire and ground. When rear washer switch is pushed, Blu wire becomes ground and pump operates. When front washer switch is pushed, Brn/Blu wire becomes ground, and pump reverses.	If not operating, remove wiring harness and test pump with a 12 volt battery. If pump works, repair wires between pump and control module. If pump does not run, replace pump.

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GEAR POWER TRAIN SPECIFICATIONS

SPECIFICATIONS

GENERAL SPECIFICATIONS

Hydraulic Reservoir Capacity	
Clutch Pedal Free Play	20 mm (0.780 in.)

REPAIR SPECIFICATIONS

TORQUE SPECIFICATIONS

SCV Port Tube Hydraulic Line Nuts
PTO Pressure Tube to PTO Valve Hydraulic Line Nut 40-57 N•m (30-43 lb-ft)
PTO Pressure Tube to Hydraulic Pump Nut
Gear Housing to Transmission Housing Cap Screws 126-154 N•m (95-115 lb-ft)
Center Plate to Housing Cap Screws

SPECIAL OR ESSENTIAL TOOLS



Part Number Part Name

JT07335-1,2,3 Splitting Stands and Brackets

JDG1230 Clutch Alignment Tool

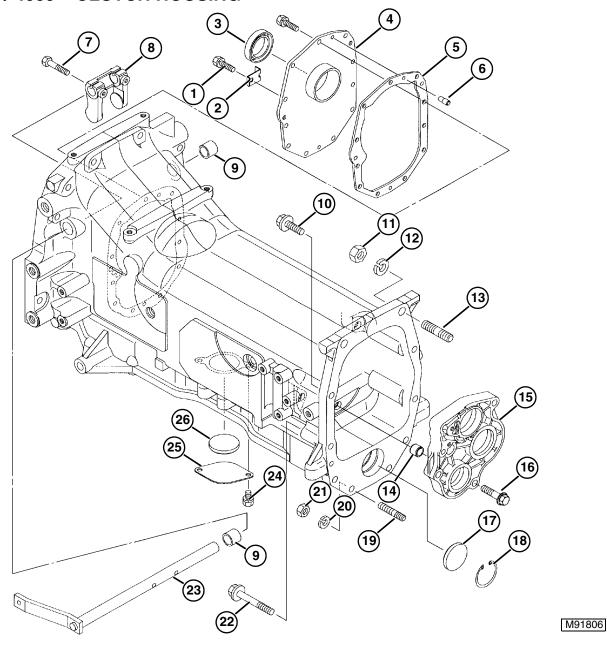
NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

OTHER MATERIALS

Number U.S./Canadian	Name
TY6305	John Deere Clean and Cure Primer
TY15130 / TY15934	John Deere Sealant
TY6333	Moly High Temperature EP Grease
TY22034	John Deere SuperLube ®
TY9370 / TY9477 (#242 LOCTITE [®])	Thread Lock and Sealer (Medium Strength)

COMPONENT LOCATION

4500 / 4600 - CLUTCH HOUSING



- 1. Cap Screw w/Washer
- 2. Hook, Spring
- 3. Seal
- 4. Cover, Front
- 5. Gasket
- 6. Pin
- 7. Bolt

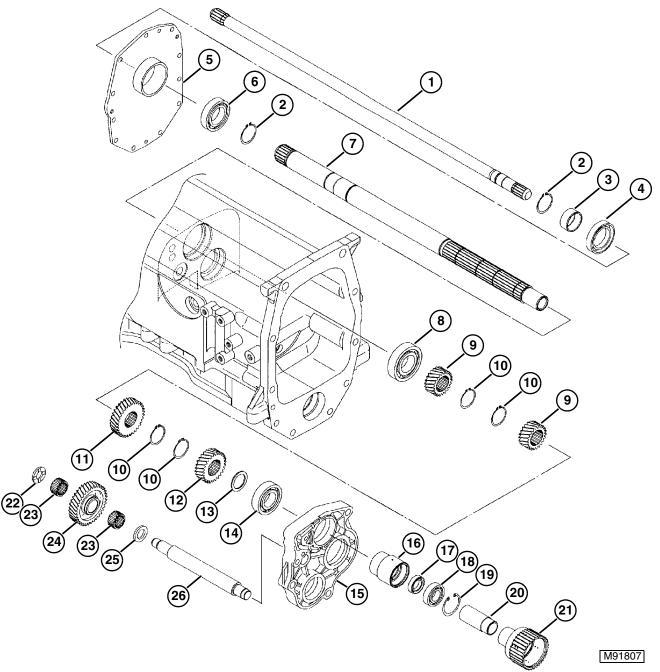
- 8. Yoke, Clutch Shaft
- 9. Bushing, 20x26x22
- 10. Bolt
- 11. Nut
- 12. Washer, Lock
- 13. Stud, 16x45
- 14. Bushing, 13x17x14

- 15. Plate, Center
- 16. Bolt
- 17. Cap, Sealing
- 18. Snap Ring, 55
- 19. Stud, 12x45
- 20. Washer, Lock
- 21. Nut

- 22. Bolt
- 23. Shaft, Clutch Release
- 24. Cap Screw w/Washer
- 25. Cover, Housing
- 26. Cap, Sealing

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4500 / 4600 - MAIN SHAFT



1. Shaft, Main Drive (PTO)

2. Snap Ring, 35

3. Sleeve, Clutch Shaft

4. Seal

5. Cover, Front

6. Bearing

7. Shaft, Main

8. Bearing, Ball

9. Gear (21T)

10. Snap Ring, 34

11. Gear (32T)

12. Gear (27T)

13. Spacer, 30x40x2

14. Bearing, Ball

15. Plate, Center

16. Seal, Case

17. Seal

18. Bearing

19. Snap Ring, 45

20. Spacer, 23x30x39

21. Hub, PTO Splined

22. Bushing, 18x32x8

23. Bearing, Needle

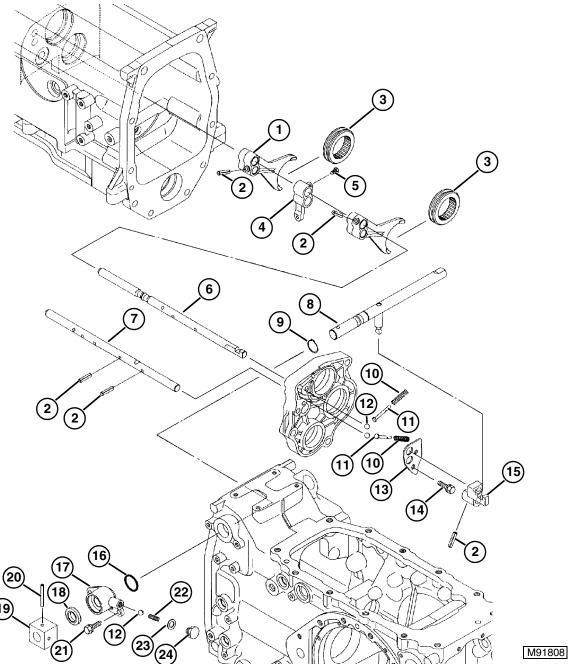
24. Gear, Reverse Idler

25. Washer, 20x32x4

26. Shaft, Reverse Idler



4500 / 4600 - MAIN GEAR



- 1. Fork, Shift
- 2. Pin, Spring 6.0x25
- 3. Shifter
- 4. Switch Arm
- 5. Bolt, Switch
- 6. Shaft, Fork

- 7. Shaft, Fork
- 8. Arm, Shift
- 9. Snap Ring
- 10. Spring
- 11. Pin, 4x35
- 12. Ball, 5/16

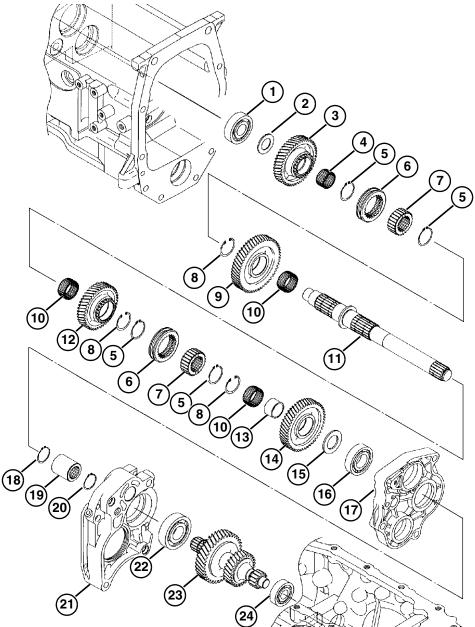
- 13. Plate, Fork Lock
- 14. Cap Screw w/Washer
- 15. Shifter, Main
- 16. O-Ring
- 17. Holder, Shift Arm
- 18. Seal

- 19. Block, Shifter
- 20. Pin, Spring 6.0x50
- 21. Cap Screw w/Washer
- 22. Spring
- 23. Gasket
- 24. Plug

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4500 / 4600 - DRIVEN & REDUCTION SHAFT





1. Bearing, Ball

2. Washer, 20x43x2.5

3. Gear, Driven (46T)

4. Bearing, Needle

5. Snap Ring, 34

6. Shifter

7. Sleeve, Splined

8. Snap Ring, 34

9. Gear (53T)

10. Bearing, Needle

11. Shaft, Driven

12. Gear, Driven (43T)

13. Ring, Inner

14. Gear, Driven (49T)

15. Washer, 30x45x3

16. Bearing, Ball

17. Plate, Center

18. Snap Ring, 30

19. Coupling, Splined

M91809

20. Snap Ring, 30

21. Housing, Bearing

22. Bearing, Ball

23. Gear, Reduction

24. Bearing, Ball

THEORY OF OPERATION

CLUTCH ENGAGEMENT

Function:

To transfer power from the engine flywheel to the main drive shaft.

Theory of Operation:

The drive clutch assembly (A) is splined to the main drive shaft (B). When the clutch pedal is depressed the clutch shaft yoke (C) rotates forward and pushes the clutch release yoke and bearing (D) forward. The clutch release bearing presses the center of the pressure plate diaphragm (E) forward. The pressure plate diaphragm pivots and the outside edges of the diaphragm moves rearward releasing pressure on the pressure plate (F).

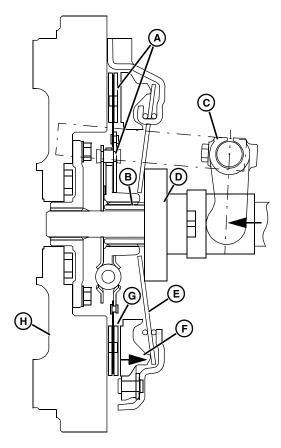
Releasing the pressure on the pressure plate keeps the clutch disk (G) from being pressed against the flywheel (H).

When the clutch pedal is released, the clutch shaft yoke (C) is rotated rearward. Diaphragm compression forces the clutch release bearing (D) to the rear.

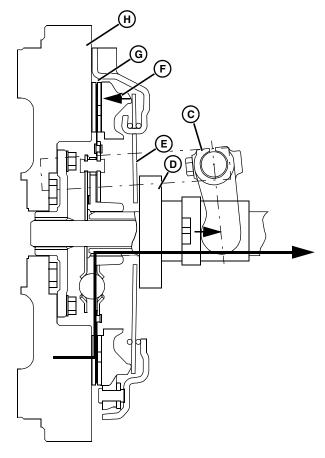
When the clutch release bearing is forced rearward, the inside edges of the pressure plate diaphragm (E) are allowed to move rearward. The outside edges of the pressure plate diaphragm press the pressure plate (F) forward. The pressure plate forces the clutch disk (G) against the flywheel engaging the clutch disk.

When the clutch disk is engaged against the flywheel, power is transferred from the flywheel, through the clutch disk to the main drive shaft. Power is transferred from the main drive shaft to the rear axles through the gear collar shift transmission. See "GEAR COLLAR SHIFT" on page 9.

The PTO drive shaft runs through the center of the main drive shaft and is splined directly to the engine flywheel. See "PTO THEORY OF OPERATION" on page 68 in the Final Drive Power Train section.







CLUTCH ENGAGED

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GEAR COLLAR SHIFT

Function:

To transfer power from the engine clutch to the rear axles.

Theory of Operation:

When the clutch is engaged, there is rotation of the drive shaft (A) which has four gears splined to it.

There are four corresponding gears on the driven shaft (B). Three are directly meshed to the gears on the drive shaft. The three gears on the driven shaft are mounted on roller bearings (C) and turn independently from the driven shaft. Two shift collars (D) are splined to the driven shaft (B) and are shifted forward or backward to engage the drive shaft gears to the driven shaft gears.

Power flow is shown below with the collar shifted into first gear.

The driven shaft is splined directly to the reduction shaft, and transfers power to the reduction shaft of the range gears. (See "RANGE TRANSMISSION" on

page 36 of the Final Drive Power Train section.)

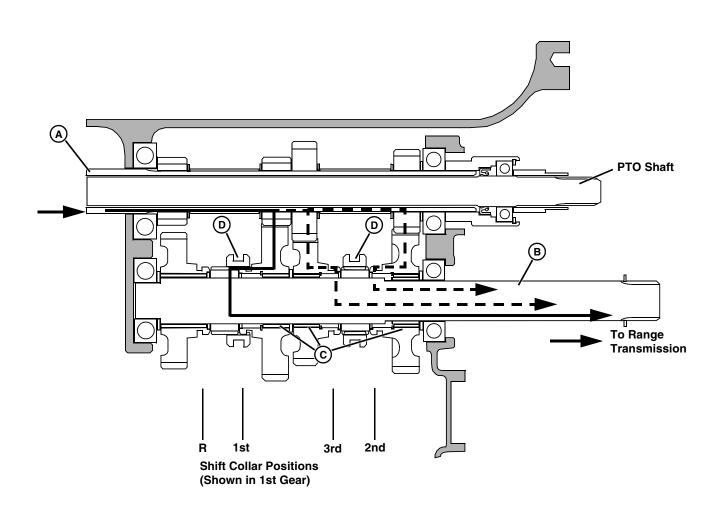
The diagram below shows the front shifter in the rearmost (1st gear) position. Power flow is shown with the solid arrow. Power flow for 2nd and 3rd gear are shown with dashed arrows.

There are four positions for the shifters (from rear to front):

- Rearmost 2nd
- Next forward 3rd
- Next forward 1st
- Most forward Reverse

The reverse gear is driven through a reverse idler shaft and gear. (See "REVERSE COLLAR SHIFT" on next page.)





REVERSE COLLAR SHIFT

Function:

To transfer power from the engine clutch to the rear axles.

Theory of Operation:

When the clutch is engaged, there is rotation of the drive shaft (A) which has four gears splined to it, the front one being the reverse gear.

The reverse gear is constantly meshed with a reverse idler gear (B) on the reverse idler shaft (C). The reverse idler shaft is offset to the left of the drive shaft and driven shaft.

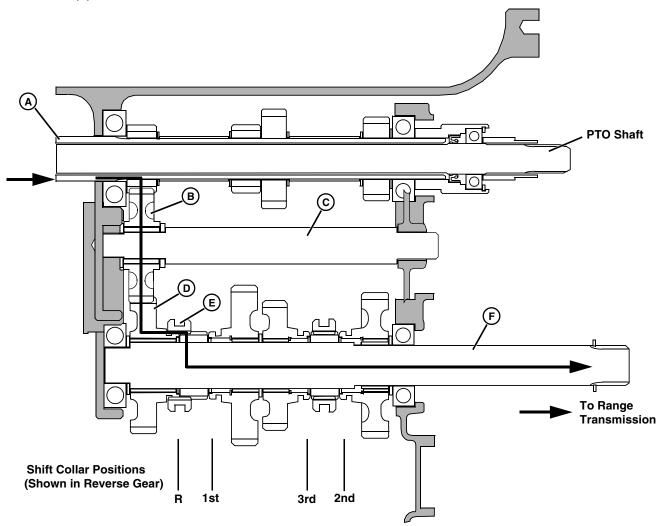
The reverse idler gear is constantly meshed with the reverse gear (D) on the driven shaft. The reverse idler gear and reverse gear on the driven shaft rotate freely on roller bearings.

When the shift lever is placed in REVERSE, linkage and a shift fork move the shift collar (E) forward where it engages the reverse gear and transfers power to the driven shaft (F).

Power flow is shown below with the collar shifted into reverse gear.

The driven shaft is splined directly to the reduction shaft, and transfers power to the reduction shaft of the range transmission.

NOTE: The drive shaft/PTO shaft and the driven shaft are shown farther apart than they are to allow visual representation of the offset reverse idler shaft and gear.



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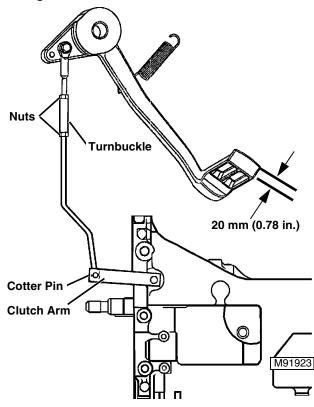
TESTS AND ADJUSTMENTS

CLUTCH ADJUSTMENT

Procedure:

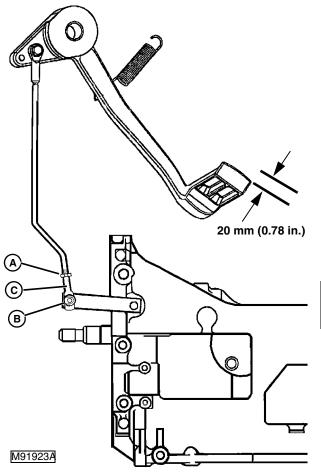
NOTE: Procedure is dependant upon linkage. Use procedure based on which linkage is in tractor.

Linkage with Turnbuckle:



- If linkage or pedal have been removed or disturbed, complete all steps. If linkage has not been removed or disturbed complete only steps 3,7,and 8.
- 2. Remove cotter pin and disconnect clutch rod from clutch arm.
- Hold turnbuckle on clutch linkage and loosen lock nuts.
- Move clutch lever up until release bearing contacts clutch release fingers.
- 5. Hold clutch lever at this position and adjust turnbuckle until linkage will enter clutch arm hole.
- 6. Install clutch rod, washer and cotter pin.
- Adjust turnbuckle until clutch pedal has 20 mm (0.780 in.) free travel measured at center of clutch pedal face.
- 8. Hold turnbuckle and tighten locknuts.

Linkage without Turnbuckle:





- 1. Make sure clutch return spring is correctly installed.
- Depress the clutch pedal and make sure the pedal stem does not contact the head of the brake pivot cap screw.
- 3. Loosen jam nut (A) on yoke (C), and remove pin and clip (B) from assembly.
- Adjust yoke until clutch pedal has 20 mm (0.780 in.) free travel measured at center of clutch pedal face
- When free travel is correct install clip and pin. Hold yoke and tighten jam nut.

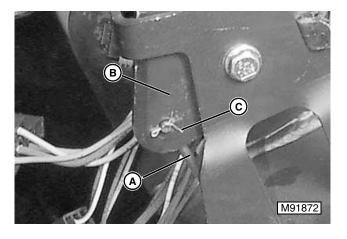
REPAIR GEAR POWER TRAIN

REPAIR

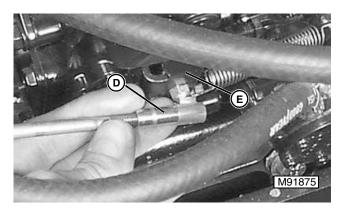
TRACTOR SPLITTING (FRONT)

Prepare the Tractor:

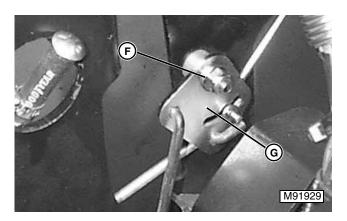
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove side panels.
- 4. Remove hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 5. Remove steering wheel.
- Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- Remove LH and RH cowl panels. (See "COWL PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 8. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 11. Remove key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- Remove fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 14. Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear half of tractor.



15. Remove cotter pin (C) attaching throttle rod (A) to throttle lever (B). Disconnect throttle rod.

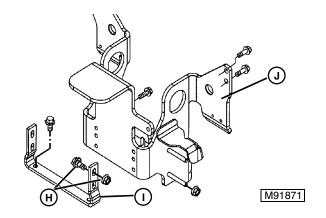


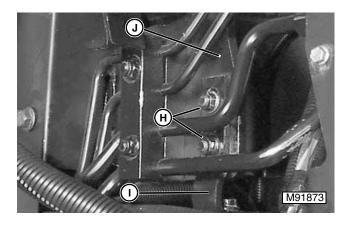
16. If not already done, disconnect throttle linkage (D) from throttle lever (E) on fuel injection pump.



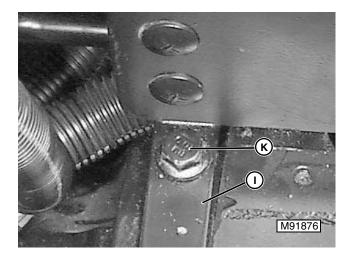
17. Remove lock nut (F). Remove throttle bellcrank and throttle rods (G) as an assembly.



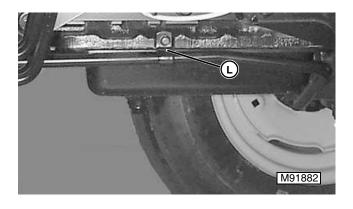




18. Loosen four nuts and carriage bolts (H) attaching U-shaped bracket (I) to pedal support frame (J).



19. Remove two cap screws (K) attaching U-shaped bracket (I) to transmission tunnel.

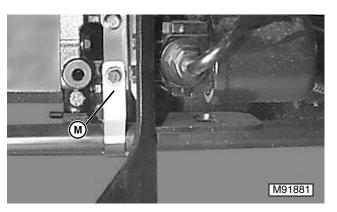


20. On right side of tractor, remove cap screw and tube clamp (L) attaching PTO pressure tube to frame.

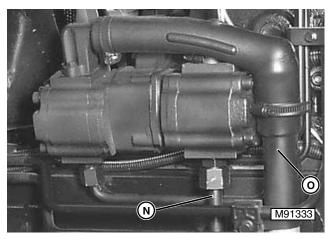
NOTE: Capacity of the hydraulic reservoir is 37 liters (9.8 gal) (39.1 qt).



21. Drain hydraulic oil from reservoir.

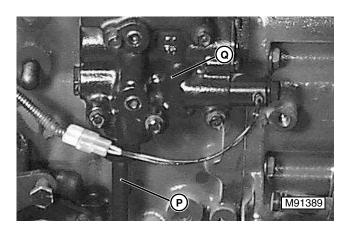


22. Remove cap screw and clamp (M) attaching suction tube to tunnel section.

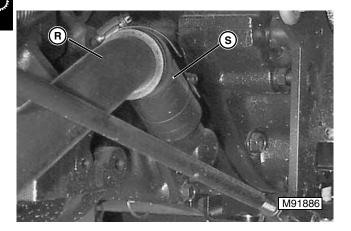


23. Disconnect PTO pressure tube (N) from rear hydraulic pump.

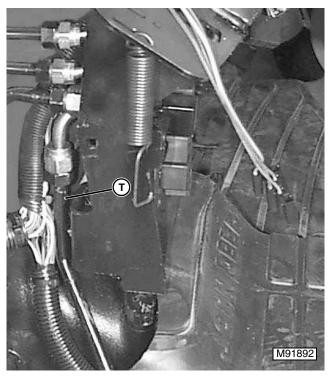
24. Loosen clamp and disconnect suction tube (O) from suction manifold.



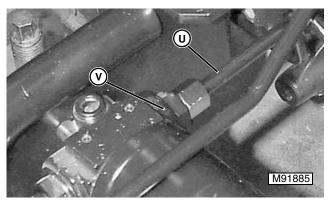
25. Disconnect PTO pressure tube (P) from bottom of PTO valve (Q). Remove tube.



26. Loosen clamp and disconnect suction tube (R) from elbow (S). Remove suction tube.



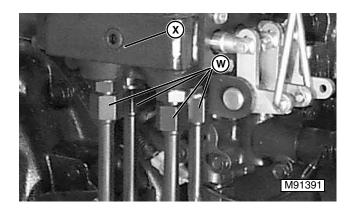
27. Disconnect tube (T) from steering return hose.



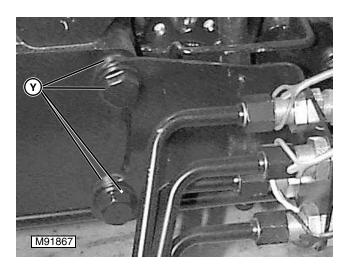
NOTE: Operator's platform removed for clarity.

28. Disconnect tube (U) from RH port of hydraulic oil filter base (V). Remove tube.

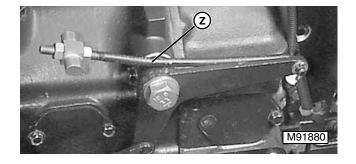
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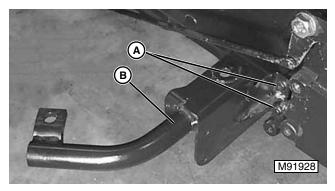
29. If equipped, disconnect four work port tubes (W) from SCV (X).



30. Remove cap screws and spacers (Y) that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.

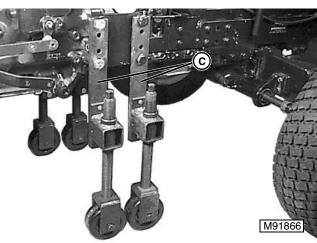


31. If not already removed, lay upper brake rods (Z) across bellcrank pivot to prevent them from becoming damaged when separating tractor sections.



32. Remove two cap screws (A) and RH operator's platform support (B).

Split the Tractor:





- Using cap screws supplied with the splitting stands, secure JTO 7335 splitting stands (C) to the tunnel sections.
- 2. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- 3. Remove nine cap screws and lock washers attaching tunnel section to engine section of tractor. Note length and locations of cap screws when removing.
- 4. Release park brake and place gear shift in NEUTRAL.

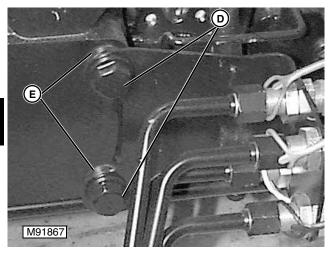
IMPORTANT: Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting tractor.

5. If necessary, use a pry bar to separate the two tractor sections. Lift the steering support slightly to clear the front flange of the tunnel. Split the tractor by rolling the two sections apart.

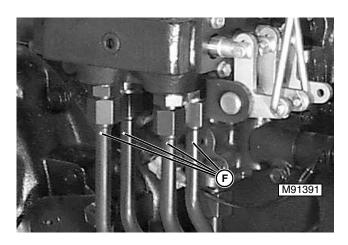
Assemble Tractor Sections:

NOTE: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

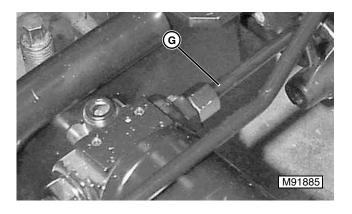
- 1. Align splines on drive shafts and engine flywheel.
- 2. Move tractor sections together and retain with 9 cap screws. Tighten cap screws to 126-154 N•m (95-115 lb-ft).
- 3. Remove splitting stands.



4. If equipped, install SCV tube support bracket and tubes as an assembly. Install 2 cap screws (D) and 2 spacers (E) to attach tube support bracket to frame.

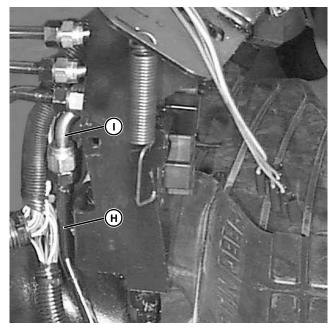


5. Connect four work port tubes (F) to SCV. Tighten to 40-57 N•m (30-43 lb ft).



NOTE: Operator's platform removed for clarity.

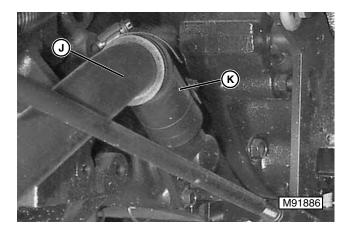
 Connect hydraulic oil tube (G) to RH port of hydraulic oil filter. Tighten to 40-57 N•m (30-43 lb ft).



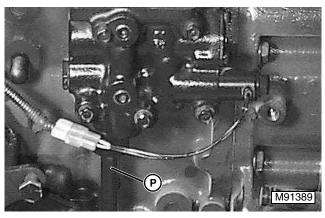
7. Connect tube (H) to steering return hose (I). Tighten to **40-57 Nem (30-43 lb ft)**.

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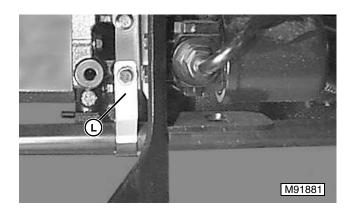




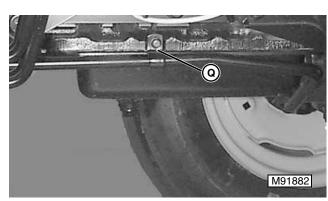
8. Attach suction tube (J) to elbow (K) and retain with clamp.



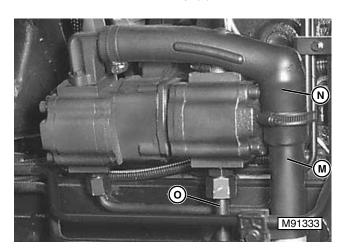
12. Connect PTO pressure tube (P) to bottom of PTO valve. Tighten nut to 40-57 N•m (30-43 lb ft).



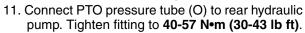
9. Secure suction tube clamp (L) to tunnel section.

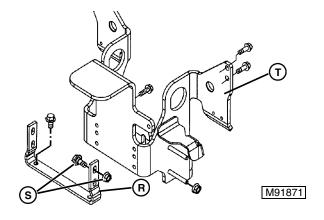


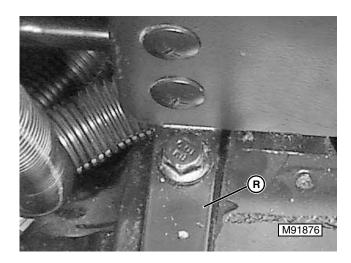
13. On right side of tractor, Secure tube clamp attaching PTO pressure tube to frame.



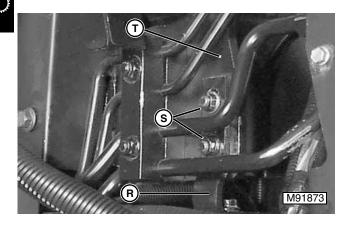
10. Connect suction tube (M) to suction manifold (N) and retain with hose clamp.



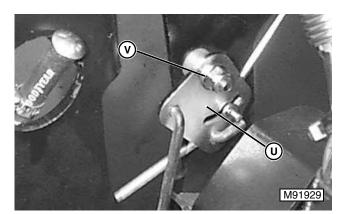




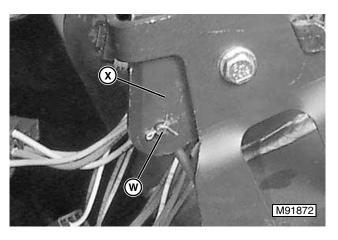
14. Install U-shaped bracket (R) to transmission tunnel, retain with two cap screws. Tighten cap screws.



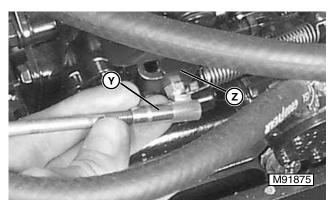
 Install four carriage bolts (S) and nuts attaching Ushaped bracket (R) to pedal support frame (T) and tighten.



 Install throttle bellcrank and throttle rods (U) as an assembly. Retain with lock nut (V).



17. Connect throttle rod (W) to throttle lever (X). Retain with cotter pin.



- 18. Connect throttle linkage (Y) to throttle lever (Z) on fuel injection pump.
- 19. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- Install fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- 21. Install operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 22. Install kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 23. Install floor mat.
- 24. Install key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 25. Install fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)

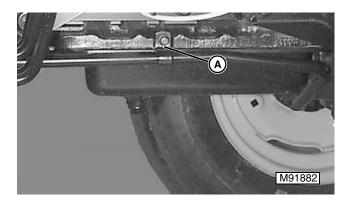
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- 26. Install LH and RH cowl panels. (See "COWL PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 27. Install control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 28. Install steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9 in Miscellaneous Section.)
- 29. Install hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 30. Install side panels.
- 31. Connect battery negative terminal.)

TRACTOR SPLITTING (REAR)

Prepare the Tractor:

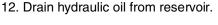
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- 7. Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 8. Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 9. Remove fenders. (See "REAR FENDERS REMOVAL AND INSTALLATION" on page 6 in Miscellaneous Section.)
- Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear half of tractor.

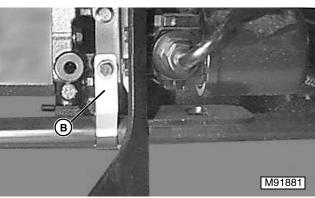


11. On right side of tractor, remove cap screw and tube clamp (A) attaching PTO pressure tube to frame.

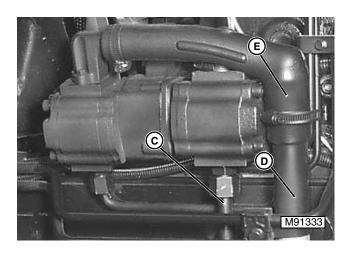
NOTE: Capacity of the hydraulic reservoir is 37 liters (9.8 gal) (39.1 qt).







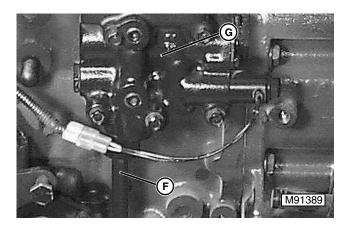
 Remove cap screw and clamp (B) attaching suction tube to tunnel section.



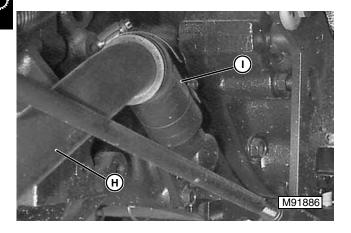
14. Disconnect PTO pressure tube from rear hydraulic pump.



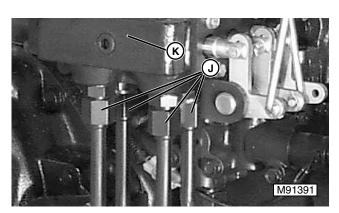
15. Loosen clamp and disconnect suction tube (D) from suction manifold (E).



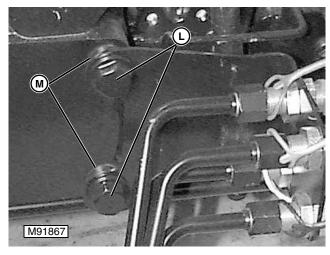
16. Disconnect PTO pressure tube (F) from bottom of PTO valve (G). Remove tube.



17. Loosen clamp and disconnect suction tube (H) from suction elbow (I). Remove suction tube.

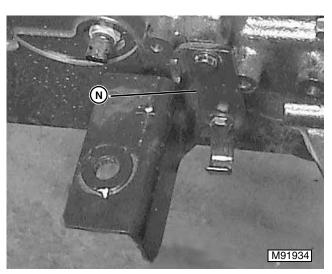


18. If equipped, disconnect four work port tubes (J) from SCV (K).



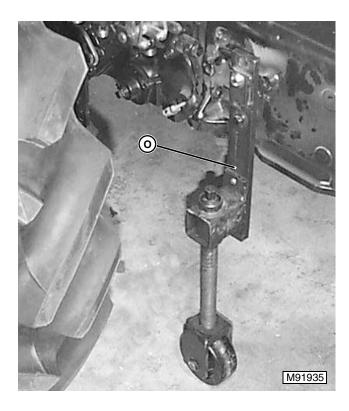
- 19. Remove two cap screws (L) and two spacers (M) that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.
- 20. Remove cotter pin and clevis pin and disconnect brake rods from brake arms at differential housing.

Split the Tractor:

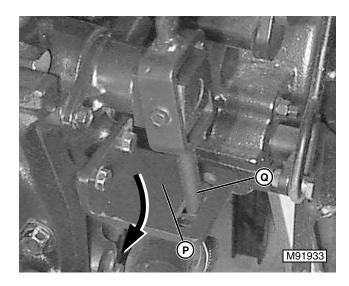


1. Remove cap screws and rear operator's platform bracket on each side.

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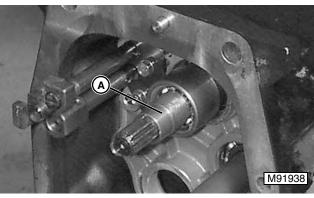
- Using suitable cap screws, secure JTO 7335 splitting stands (O) to the threaded holes in the tunnel section where the operator's platform brackets were removed.
- 3. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- 4. Using suitable stands, support the front and rear of the differential housing.



- On left side of tractor, loosen two cap screws attaching shift lever guide bracket (P). Tilt bracket away from lever until bracket is clear of lever (Q).
- 6. Move shift lever to rearmost position.

- Remove four nuts and lock washers and six cap screws attaching tunnel section to differential housing. Note length and locations of cap screws when removing.
- IMPORTANT: Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half of tractor before splitting tractor.
- If necessary, use a pry bar to separate the two tractor sections. Split the tractor by rolling the front section of the tractor away from the differential housing.

Assemble Tractor Sections:

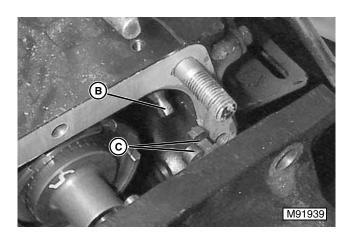




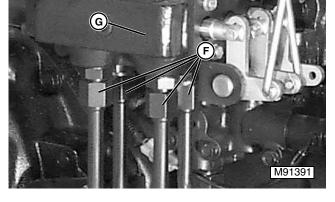
IMPORTANT: Be sure PTO collar (A) is in place on shaft or in end of PTO clutch before assembling tractor sections. Smaller end goes toward PTO clutch.

IMPORTANT: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

- Clean tunnel section mating surfaces and install a new gasket.
- 2. Align splines on drive shafts and couplers.
- 3. Move shift lever to rearmost position.



4. Align end of shift lever(B) inside differential housing with shift yokes (C).

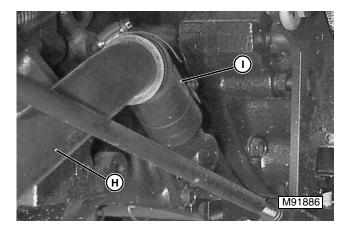


10. Connect work port tubes (F) to SCV (G). Tighten to 40-57 N•m (30-43 lb-ft).

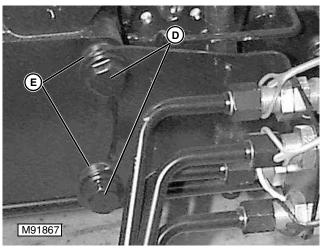


NOTE: Shift lever should move slightly when tractor sections are bolted together.

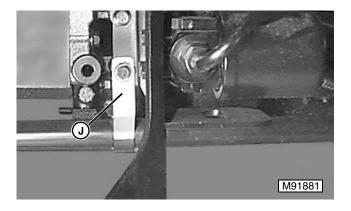
- 5. Move tractor sections together and retain with two large nuts and lock washers.
- 6. Test function of gear shift lever to ensure that shift lever is properly engaging yokes.
- 7. Install two smaller nuts and lock washers and six cap screws. Tighten nuts and cap screws.
- 8. Remove cap screws retaining splitting stands to tractor sections. Remove splitting stands.



11. Attach suction tube (H) to elbow (I) and retain with clamp.

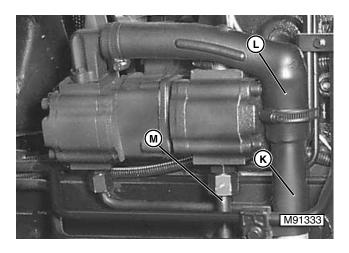


 If equipped, install SCV tube support bracket and tubes as an assembly. Install cap screws (D) and spacers (E) to attach tube support bracket to frame.

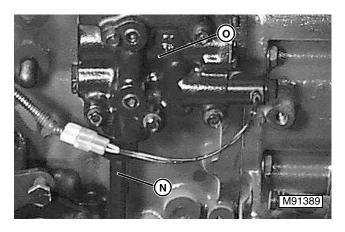


12. Install cap screw and clamp (J) attaching suction tube to tunnel section.

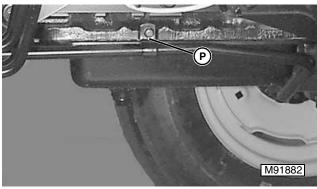
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- 13. Connect suction tube (K) to suction manifold (L) and retain with hose clamp.
- 14. Connect PTO pressure tube (M) to rear hydraulic pump. Tighten tube nut to 40-57 Nom (30-43 lb-ft).



15. Connect PTO pressure tube (N) to bottom of PTO valve (O). Tighten tube nut to 40-57 Nem (30-43 lb-ft).



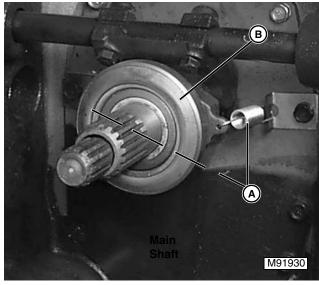
16. On right side of tractor, install tube clamp (P) attaching PTO pressure tube to frame. Retain with cap screw.

- 17. Connect brake rods to brake arms on differential housing. Retain with clevis pins and cotter pins.
- 18. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- 19. Install operator's platform (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 20. Install kick plate (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 21. Install seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 22. Install seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 23. Install rear fenders (See "REAR FENDERS REMOVAL AND INSTALLATION" on page6 in Miscellaneous Section.)
- 24. Install floor mat.
- 25. Install fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 26. Connect battery negative terminal.

COLLAR SHIFT TRANSMISSION REMOVAL/DISASSEMBLY

Procedure:

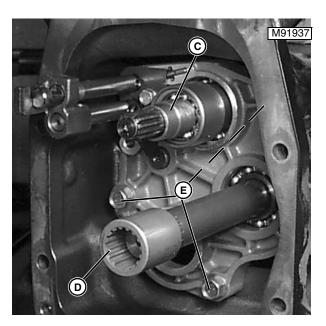
1. Split tractor at clutch housing. See "TRACTOR SPLITTING (FRONT)" on page 12



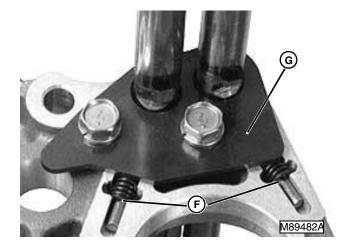


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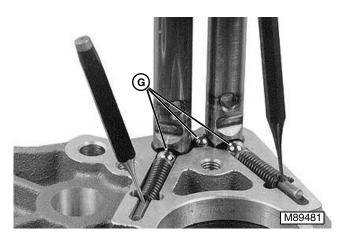
2. Remove clutch release bearing return springs (A) and clutch release bearing (B).



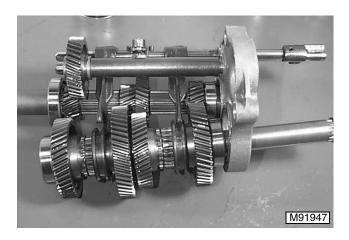
- 3. Remove final transmission case from tunnel. See "TRACTOR SPLITTING (REAR)" on page 19
- 4. Remove PTO shaft spacer (C) from rear of PTO drive shaft or PTO clutch, whichever part it stayed with when rear of tractor was split.
- 5. Slide PTO drive shaft out from main drive shaft toward front end of tunnel.
- 6. Remove splined coupling (D) from driven shaft.
- 7. Remove cap screws (E) securing center plate to tunnel.
- 8. Carefully slide center plate and transmission out of tunnel.
- 9. Visually inspect all parts for wear, cracks or discoloration.
- **Transmission Disassembly:**



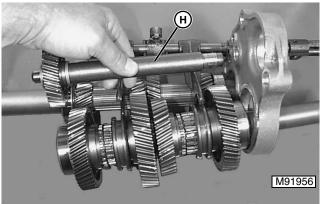
- 10. Place small punches in holes in detent pin assemblies (F) to retain springs on pins.
- 11. Remove cap screws and fork lock detent ball plate (G).
- 12. Slide plate up fork shafts.



13. Remove and inspect three detent balls (G), two springs and two drilled pins . Replace as required.



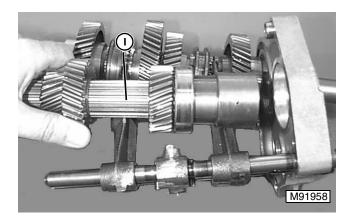
14. Pull shafts back until bearings are free from center plate.



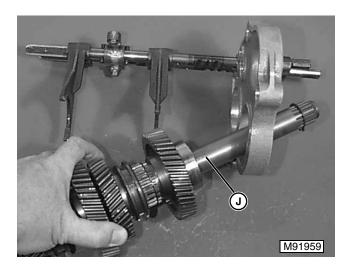
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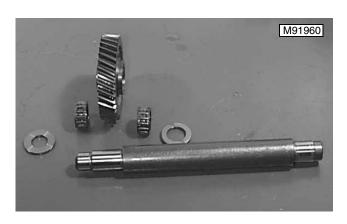
15. Remove reverse idler gear and shaft (H).



16. Remove main shaft assembly (I) from center plate.



17. Simultaneously slide shift forks and shafts back with driven shaft (J) until driven shaft assembly can be removed from center plate.



18. Remove thrust washers, needle bearings, and reverse idler gear from idler shaft.

NOTE: Oil grooves on thrust washers go toward gear.

NOTE: When replacing any gear that has tooth damage, the gear that meshes with the damaged gear must be replaced also.

- 19. Inspect thrust washers for wear or damage. Inspect reverse gear for broken or worn teeth. Inspect bore of gear for wear or damage. Replace as required.
- 20. Inspect bearings and bearing area of idler shaft for wear or damage. Replace as required.
- 21. For reassembly of reverse idler and gear, install large ID thrust washer on shaft, oil grooves toward gear.
- 22. Install needle bearings and gear.
- Install small ID thrust washer, oil grooves toward gear.

Reconditioning Driven Shaft:

1. If not already done, remove splined coupler and snap ring from driven shaft.



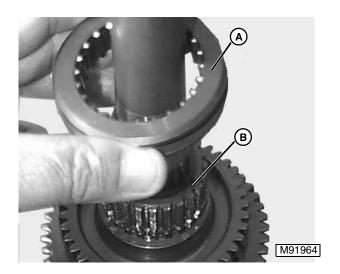


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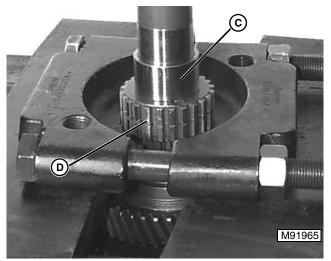
- 2. Press bearing off rear of driven shaft.
- 3. Inspect bearing for discolored or burned balls and/ or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning, excessive looseness or play between balls and races. Replace bearing as required.



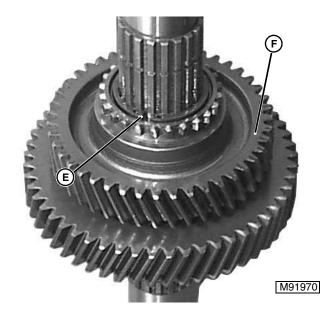
- 4. Remove thrust washer, 49T gear, and needle bearing.
- 5. Inspect gear for broken or worn teeth. Inspect bearing bore of gear for wear. Inspect bearing and shaft for wear or damage. Replace as required.



- 6. Remove shifter (A) and snap ring (B).
- 7. Inspect shifter for broken or worn teeth. Inspect groove surface for wear. Replace as required.



- 8. Press off inner ring (C) and splined sleeve (D)as an assembly.
- 9. Inspect inner ring for any wear or damage on outside diameter.
- 10. Inspect splined sleeve for wear or damage on splines. Replace as needed.



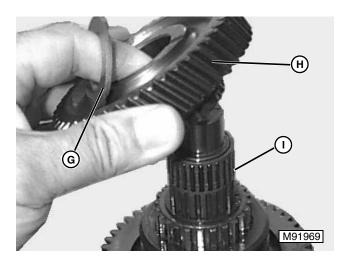
- 11. Remove snap ring (E) and driven 43Tgear (F).
- 12. Inspect driven gear for broken or worn teeth. Inspect bearing bore of gear for wear. Inspect bearing and shaft for wear or damage. Replace as required.

NOTE: The remainder of components are removed from the front end of the shaft.

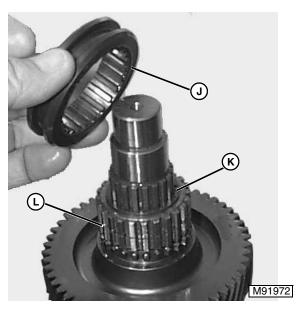
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- 13. Support other end of driven shaft by 46T gear. Press bearing, thrust washer and gear from shaft.
- 14. Inspect bearing for discolored or burned balls and/ or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning, excessive looseness or play between balls and races. Replace bearing as required.

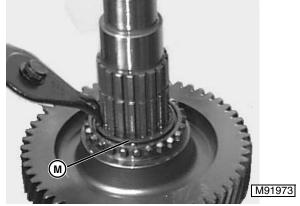


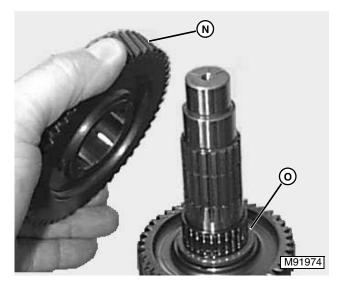
15. Inspect thrust washer (G), 46Tgear (H), and needle bearing (I).



and snap ring (M) under splined collar.





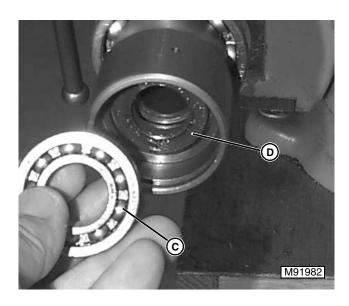


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- 17. Remove 53T gear (N) and needle bearing (O).
- 18. Clean all parts in suitable solvent and dry with compressed air.
- 19. Inspect thrust washer for wear or damage. Inspect gear for broken or worn teeth. Inspect bearing bore in gear for wear or damage. Inspect splined sleeve and shifter ring for wear or damage. Replace parts as required.
- 20. Inspect bearing and all bearing areas of shaft for wear or damage. Replace as required.

Reassembly:

- 1. Reassembly is the reverse order of disassembly.
- 2. Lubricate all bearings before assembly.
- 3. To install inner ring on shaft, first heat inner ring in oil to a temperature of 177°C (350°F). Gently grasp ring with a pliers and install on shaft.



2. Remove bearing (C) and seal from seal case (D).

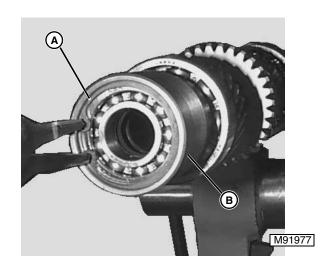


A CAUTION

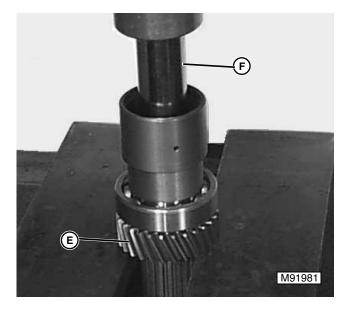
DO NOT heat oil over 182° C (360° F). Oil fumes or oil can ignite above 193° C (380° F). Use a thermometer. Do not allow a flame or heating element to come in direct contact with the oil. Heat the oil in a well-ventilated area. Plan a safe handling procedure to avoid burns.

MAIN SHAFT DISASSEMBLY/ ASSEMBLY

Procedure:

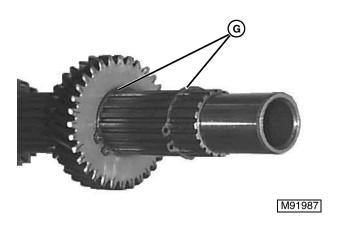


 Remove snap ring (A) from seal case (B) on rear of main shaft.

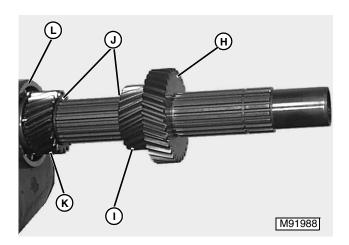


- 3. Place the main shaft assembly in a press and support it the by 27T gear (E). Make sure the support blocks are far enough apart to clear the snap ring under the 27T gear.
- Using an appropriate size socket or bushing driver (F), press gear, washer, bearing, and seal case from rear of main shaft.
- 5. Inspect bearings for discolored or burned balls and/ or races. Check balls and races for spalling or cracking. Roll bearings by hand to check for rough turning, excessive looseness or play between balls and races. Replace bearings as required.
- Inspect gear for wear or damage on inside splines. Inspect outer gear teeth for chips, cracks, or missing teeth. Replace as required.

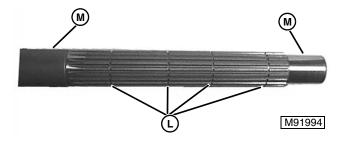
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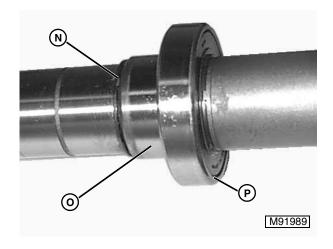
7. Remove snap rings (G) from shaft.



- 8. Slide 32T (H) and first 21T (I) gear off of the shaft.
- Remove snap rings (J), second 21T gear (K), and bearing (L).



 Inspect splines, snap ring grooves (L), and bearing areas (M) for wear or damage. Replace as required.



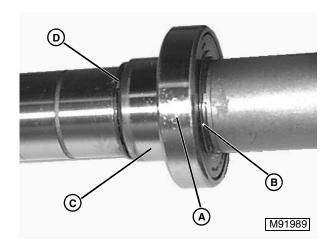
11. If clutch shaft sleeve or bearing need servicing, remove circlip (N) on clutch wear sleeve side and press off bearing (P) and clutch shaft sleeve (O) together.



NOTE: NEVER reuse clutch shaft wear sleeves. The rubber seal on inside of sleeve is destroyed when it is pressed off across snap ring grooves.

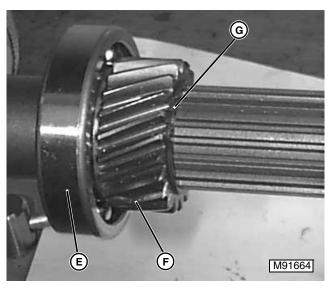
- 12. Clean all parts in solvent. Inspect all parts for wear or damage.
- 13. Inspect bearing for discoloration. Roll bearing by hand to check for rough turning or excessive looseness. Replace bearing as required.

Assembly:



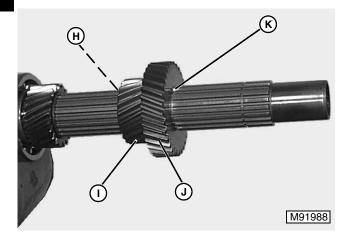
- 1. Press bearing (A) onto engine side of main shaft until it touches inside circlip (B).
- 2. Lubricate inside of clutch shaft sleeve (C) and slide it up against bearing.
- 3. Install outer circlip (D).

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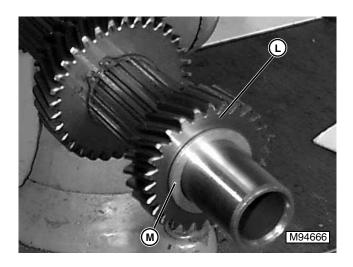


4. Install bearing (E) on splined end of main shaft.

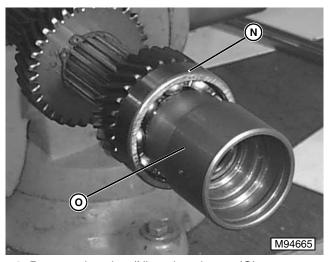
5. Install 21T gear (F) and snap ring (G).



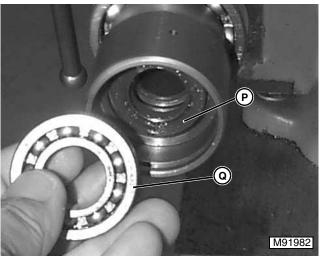
6. Install snap ring (H) in next groove, and install second 21T gear (I), 32T gear (J), and snap ring (K).



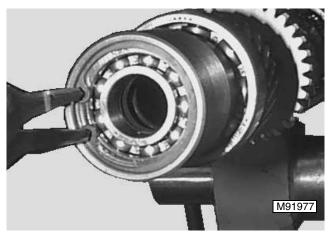
7. Install snap ring in next groove and install 27T gear (L) and spacer (M).



8. Press on bearing (N) and seal case (O).



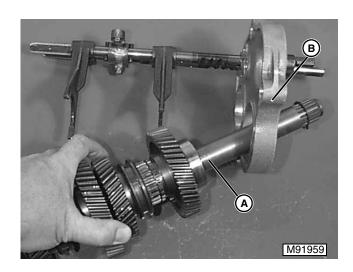
9. Install new oil seal (P) and bearing (Q) inside seal case.



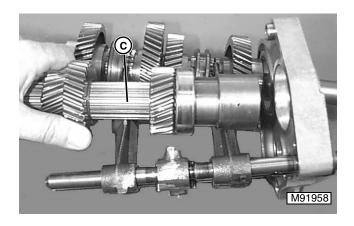
10. Install snap ring.

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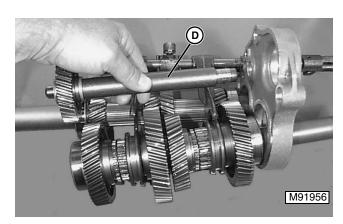
Assemble Shafts to Center Plate:



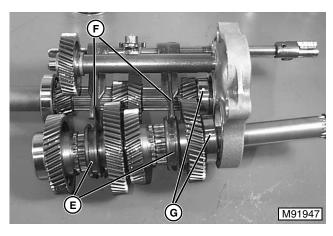
1. Install driven shaft (A) into center plate (B). Do not put bearing into center plate at this time.



2. Install main shaft (C) into center plate. Do not put bearing into center plate at this time.



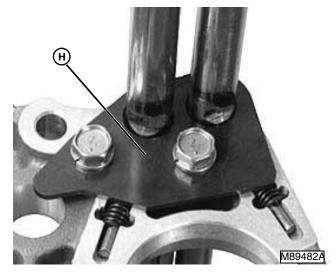
3. Install reverse idler gear (D)and shaft into center plate.



4. While aligning shifters (E) with forks (F), hold shafts together and slide bearings (G) into center plate.



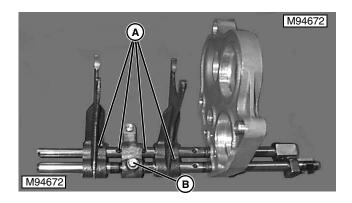
- 5. Lift one of the fork shafts and install detent ball between shafts.
- 6. Install other two detent balls, springs, and pins



7. Install cover plate (H).

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Fork Shaft Disassembly, Assembly:



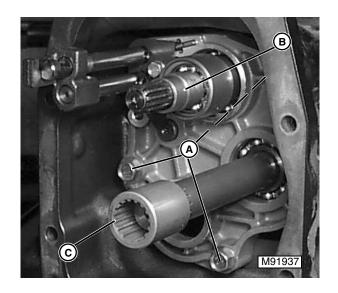
- 1. Remove spring pins (A) from forks and shafts.
- 2. Remove cap screw (B) from switch arm.
- 3. Slide parts off of shafts.
- Inspect all parts for wear or damage, replace parts as required.



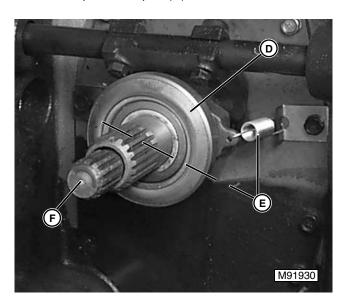
5. Inspect slot in fork shaft (C) and main shifter (D) for wear or damage. Replace worn parts as required.

TRANSMISSION INSTALLATION

NOTE: Extreme care must be taken when inserting main shaft through front oil seal to avoid damage to seal. Either have an assistant help guide the main shaft through the oil seal, or install the transmission with the seal removed from the front cover. Install the seal after the transmission is in the tunnel. Always replace seal if transmission has been removed.



- Install transmission and center plate into tunnel and tighten cap screws (A) to 85 N•m (63 lb-ft).
- Install PTO shaft spacer (B) with smaller end toward PTO clutch.
- 3. Install splined coupler (C).



- 4. Install clutch release bearing (D) on main shaft and attach return springs (E).
- Slide PTO shaft (F) into the main shaft. Install slowly to avoid damage to the rear seal on the PTO end. Ensure PTO shaft is engaged in PTO clutch splines.

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SPECIFICATIONS

HYDROSTATIC PUMP

THE HOUSE HOLD TO SIMIL	
Manufacturer	
Type	
Model	
Displacement (variable) (maximum/rev)	49.2 cm ³ (3.0 cu in.)
Displacement (engine at 2700 rpm)	,
Pressure Relief Valve Setting	
Reverse Pedal Travel Before Tractor Movement	12.7 mm (0.5 in.)
HYDROSTATIC MOTOR	
Manufacturer	FATON
TypeFixed D	
Displacement (fixed)	
Displacement (engine at 2700 rpm)	
Displacement (engine at 2700 fpm)	(20.00 gpin)
TORQUE SPECIFICATIONS	
Pump Main Drive Pressure Relief Valve	143 ± 6 N•m (105 ± 5 lb-ft)
Pump To Backplate Mounting Cap Screws	40 ± 2 N•m (29 ± 2 lb-ft)
Motor To Backplate Mounting Cap Screws	12 ± 2 N•m (105 ± 18 lb-in.)
Charge Pressure Relief Valve	39 ± 2 N•m (29 ± 1 lb-ft)
Backplate To Tunnel Mounting Screws	
Transmission To Tunnel Cap Screws	72-88 N•m (54-66 lb-ft)
Tunnel To Flywheel Housing	126-154 N•m (95-115 lb-ft)
Tunnel To Rear Transmission Housing	126-154 N•m (95-115 lb-ft)
Outer Transmission Lever to Bell Crank Cap Screw	25-30 N•m (18-22 lb-ft)
SCV Hydraulic Tube Nuts	40-57 N•m (30-43 lb-ft)
PTO Pressure Tube Nuts	40-57 N•m (30-43 lb-ft)
Hydraulic Oil Tube Nuts (filter to cooler)	40-57 N•m (30-43 lb-ft)
Servo Cylinder Cover Mounting Screws	7 ± 0.5 N•m (64 ± 4 lb-in.)
Servo Piston Screw Lock Nut	17 ± 1 N•m (155 ± 5 lb-in.)
Servo Valve Mounting Screws	7 ± 0.5 N•m (64 ± 4 lb-in.)
Wear Plate Retaining Screw	1.7 ± 0.1 N•m (15 ± 1 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).

Part Number	Part Name
JT07335-1,2,3	Splitting Stands and Brackets
JDG1239	Hydrostatic Pump Guide Rods
JT03362	10,000 psi Gauge
JT03364	Hose
JT03240	Fitting
JT03264	Female Quick Couple
JT05480	Male Quick Coupler
JT03252	Adapter
JDG 1291	Neutral Creep Adjustment Tool Set



OTHER MATERIALS

Petroleum Grease	Pump and Motor Reassembly
JD Plus 4 [®] , TurfGard [®] , HyGard [®]	Pump and Motor Reassembly
TY16021 Sealant	Hydrostatic Transmission to Tunnel Seal

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THEORY OF OPERATION

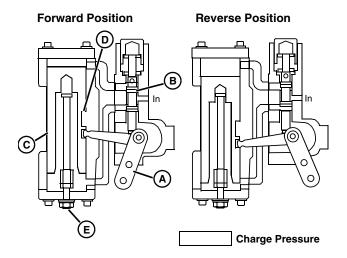
HYDROSTATIC SYSTEM

Function:

The hydrostatic system provides a means to transfer power from the engine to the final drive for the wheels. It also provides infinitely variable speed control, forward and reverse by foot pedal operation.

Servo Control

Transmission output is initiated by movement of the variable displacement pump control lever. As the forward foot control is pressed it moves the servo control lever (A). The lever arm moves a spool (B) inside the servo control, allowing pressurized charge flow past the spool to one side of the servo piston (C).

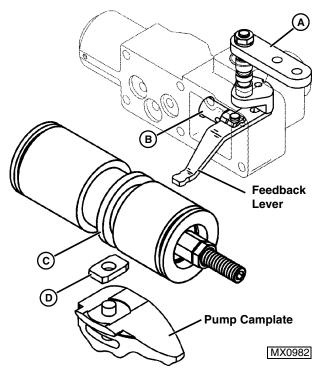


The piston has a notch which holds a piston follower (D). The piston follower controls movement of the variable displacement pump cam plate. Movement of the piston causes the camplate in the hydraulic pump to rotate out of the neutral position.

Maximum displacement of the pump is attained when the control lever is moved to its extreme position. As the camplate attains any position selected by the control lever (foot pedal), it relocates the control valve spool to a metering position. The spool meters the fluid between the spool and servo piston to hold the camplate in its desired position.

Adjustment of the center screw (E) moves the servo position to its neutral position.

When the reverse pedal is pressed, the control arm (A) is rotated in the opposite direction. The control arm shaft and cam move the piston (B) and allow charge pressure oil into the other end of the servo control piston (D).





Principles of Operation:

The hydrostatic system is a closed loop fluid power system that consists of a charge pump on the left front side of the engine, and a piston pump/motor assembly, which is driven by a flex plate/dampener assembly connected to the flywheel.

Charge Pump

The charge pump is a gear type positive displacement pump mounted to the left front side of the engine.

This pump provides pressurized fluid to the SCU. Return oil from the SCU is routed through the filter under the left footrest and then into the hydrostatic pump to operate the servo control, and to provide replacement fluid to the hydrostatic pump.

Hydrostatic Pump

The hydrostatic pump (A) is an axial piston, servo controlled, variable displacement piston pump. It is mounted directly to the inside of the tunnel. The input shaft splines (B) are driven by the flex plate bolted onto the engine flywheel.

Fluid flow is controlled by changing the angle of the cam plate (C). This angle is controlled by the servo control spool valve and piston. Moving the respective directional pedal will move the spool off center which in turn will provide hydraulic assist to the double acting piston which controls the position of the cam plate.

The location, off center, of the cam plate controls the distance the pistons (D) travel inside the piston bore of the rotating assembly. The direction that the cam plate is rotated from center determines the direction of fluid flow (forward or reverse). The number of degrees the cam plate is deflected, determines how much fluid will be displaced (speed).

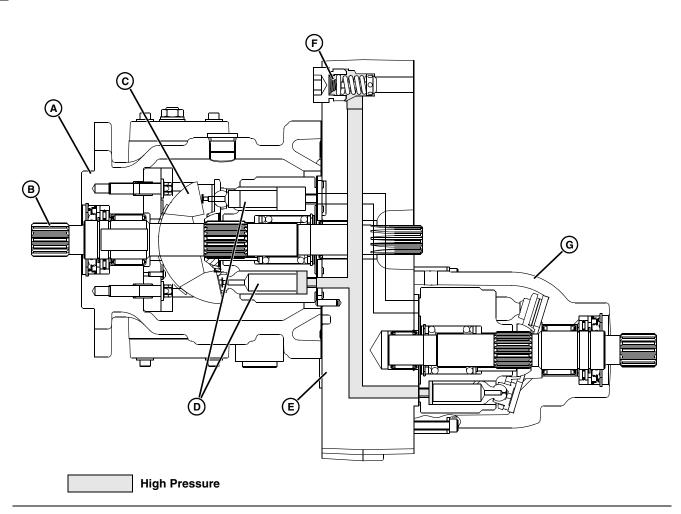
The hydrostatic pump provides hydraulic fluid to the hydrostatic motor through the backplate (E). Hydraulic fluid in the power train circulates in a closed loop. Fluid leaves the hydrostatic pump and flows through the hydrostatic motor and is returned to the hydrostatic

pump, not the reservoir. Fluid that leaves this closed loop circuit, such as case drain, is replenished by fluid from the charge pump. Fluid may also be dumped from the loop if the tractor encounters a heavy load or stalls out. This happens through the high pressure relief valves (F).

• Hydrostatic Motor

The hydrostatic motor (G) is a high torque axial piston motor. The motor is located on the rear of the backplate. The hydrostatic motor drives a shaft to a three speed range gear transmission which transfers power to the wheels. See "RANGE TRANSMISSION POWER FLOW" on page7.





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RANGE TRANSMISSION POWER FLOW

Function:

To transfer power from the hydrostatic transmission to the rear axles.

Theory of Operation:

When the HST transmission is engaged, there is rotation of the output shaft which is connected to the drive shaft (A) with a splined collar.

The drive shaft is connected to the reduction shaft (B) with a splined collar, and directly transfers power to the range gears.

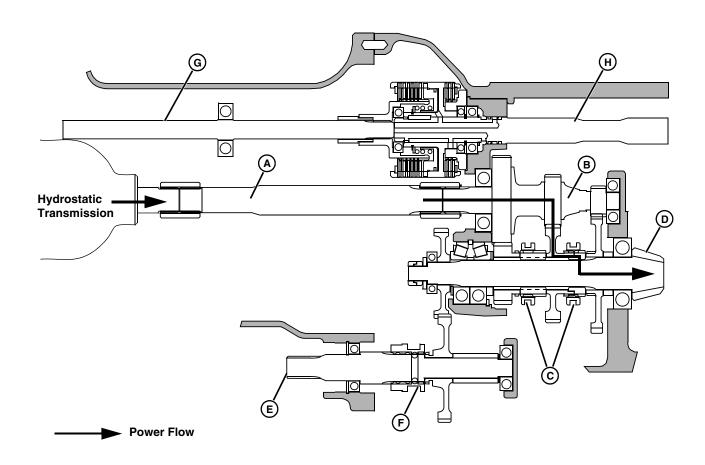
The range transmission shift collars (C) can be shifted to one of four positions. The four positions are the three gear ranges and neutral. (See "RANGE TRANSMISSION" on page 36 of the Final Drive Power Train section.) Power is then transferred to the pinion shaft (D) and the rear axles.

Power may be provided to the front wheels through the front drive shaft (E) if the collar shift (F) is engaged. (See "4-WD POWER OPERATION" on page 37 of the Final Drive PowerTrain section.)

The PTO is operated independent of the HST transmission. The PTO drive shaft (G) is run through the hydrostatic transmission, but connected directly to the engine splined output shaft.

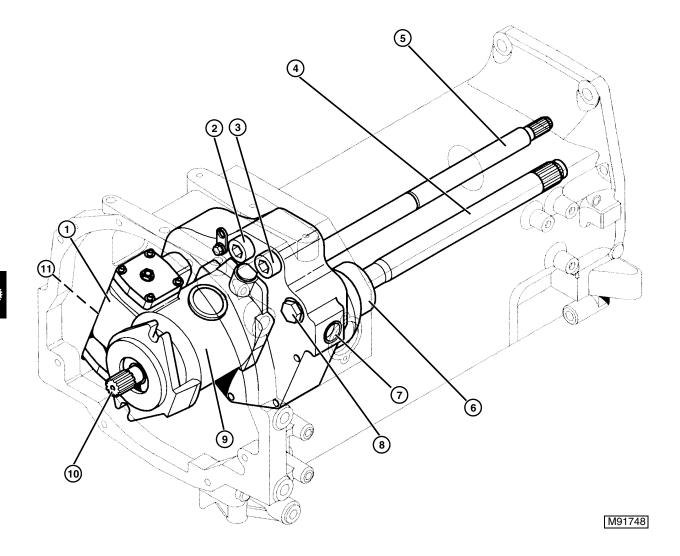
The PTO drive shaft is coupled to the input of the PTO hydraulic clutch. The PTO output shaft (H) provides power from the PTO clutch to the PTO. (See "PTO CLUTCH AND BRAKE THEORY OF OPERATION" on page 68 of the Final Drive Power Train section.)





COMPONENT LOCATION

HYDROSTATIC TRANSMISSION



- 1. Servo
- 2. Forward or Reverse Relief Valve
- 3. Forward or Reverse Relief Valve
- 4. Drive Shaft to Range Transmission
- 5. Drive Shaft, PTO Clutch
- 6. Hydrostatic Motor
- 7. Charge Oil Inlet From Filter
- 8. Charge Oil Pressure Relief Valve
- 9. Hydrostatic Pump
- 10. Input Shaft From Engine
- 11. Control Lever

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TRANSMISSION MAIN PUMP CASE (9) (17)



M91653

- 1. Cap Screws (8)
- 2. Washers (8)
- 3. Cover
- 4. Housing, Main Pump
- 5. O-ring
- 6. Plug
- 7. Gasket
- 8. Orifices (3)
- 9. Servo Valve
- 10. Lever
- 11. Nut

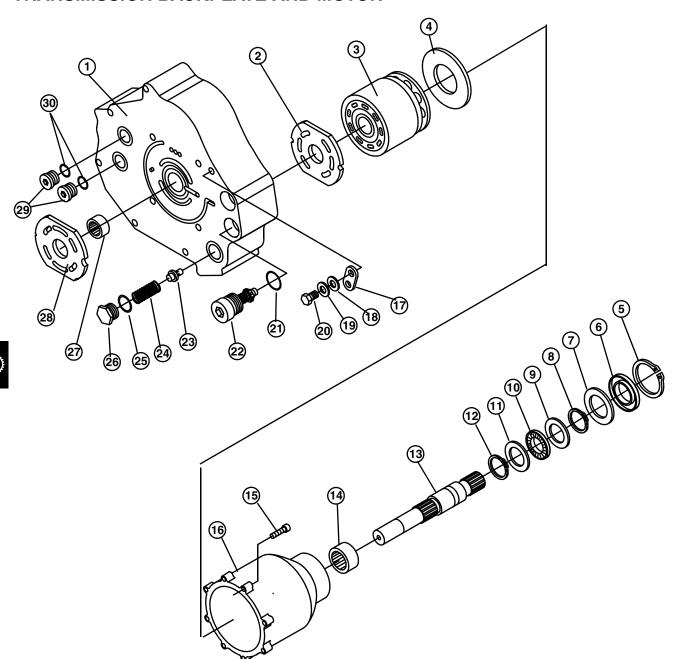
- 12. Lock Washer
- 13. Cap Screws (4)
- 14. Servo Piston Follower
- 15. Screw, Retaining
- 16. Gasket
- 17. Rotating Assembly
- 18. Cam Plate
- 19. Wear Plate
- 20. Cap Screws (2)
- 21. Cradle

- 22. Dowel Bushings (2)
- 23. Lock Nut
- 24. Flat Washer
- 25. Seal Washer
- 26. Cover, Cylinder
- 27. Gasket (2)
- 28. Servo Piston
- 29. Seal
- 30. O-ring
- 31. Ring, Retaining
- 32. Washer, Thrust

- 33. Bearing, Thrust
- 34. Washer, Thrust
- 35. Ring, Retaining
- 36. Washer
- 37. Seal
- 38. Ring, Retaining
- 39. Shaft
- 40. Bearing, Needle

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TRANSMISSION BACKPLATE AND MOTOR



- 1. Backplate
- 2. Plate, Motor Valve
- 3. Rotating Assembly
- 4. Cam Washer
- 5. Ring, Retaining
- 6. Seal
- 7. Washer
- 8. Ring, Retaining

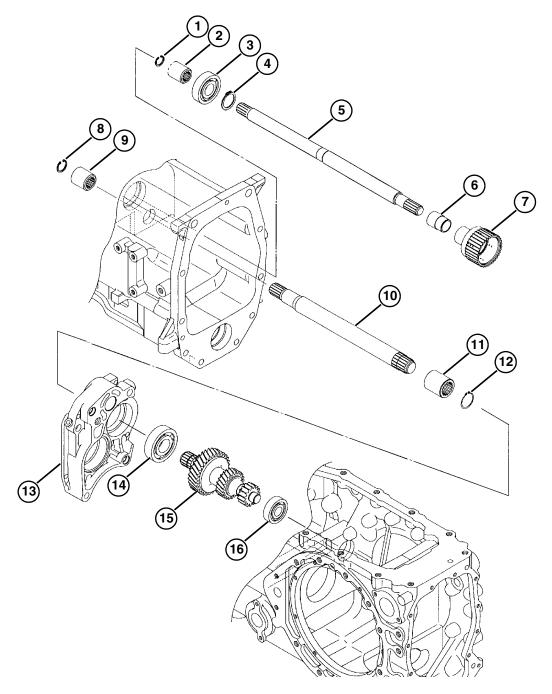
- 9. Washer, Thrust
- 10. Bearing, Thrust
- 11. Washer, Thrust
- 12. Retaining Ring
- 13. Shaft
- 14. Bearing, Needle
- 15. Cap Screw (8)
- 16. Housing, Motor

- 17. Bracket, Lift
- 18. Washer
- 19. Washer, Lock
- 20. Cap Screw
- 21. O-Ring
- 22. Valve, Forward/ Reverse Relief (2)
- 23. Valve, Charge Pressure Relief

- 24. Spring
- 25. O-Ring
- 26. Cap
- 27. Bearing, Needle
- 28. Plate, Pump Valve
- 29. Plug (2)
- 30. O-Ring (2)

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4600 / 4700 - DRIVE SHAFT



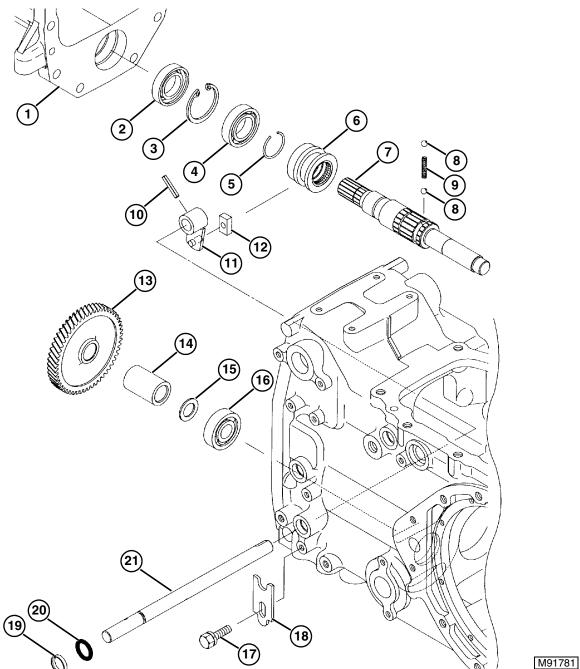


- 1. Snap Ring, 19
- 2. Coupling
- 3. Bearing
- 4. Snap Ring, 25
- 5. Drive Shaft, PTO
- 6. Spacer, 23x30x39
- 7. Hub, Clutch PTO
- 8. Snap Ring, 22
- 9. Coupling
- 10. Drive Shaft
- 11. Coupling
- 12. Snap Ring, 30
- 13. Housing, Bearing

M91804

- 14. Bearing
- 15. Gear, Reduction
- 16. Bearing

4600 / 4700 - FRONT DRIVE





2. Seal

3. Snap Ring, 55

4. Bearing

5. Ring, 35x2.3

6. Slider, Mid

7. Shaft, Front Drive

8. Ball, 1/4

9. Spring

10. Spring Pin, 6.0x32

11. Arm, Front Shift

12. Shoe, Shifter

13. Gear, Front Drive

14. Collar, Front Drive

15. Washer, 20x32x2

16. Bearing

17. Bolt, Flange

18. Plate, Keeper

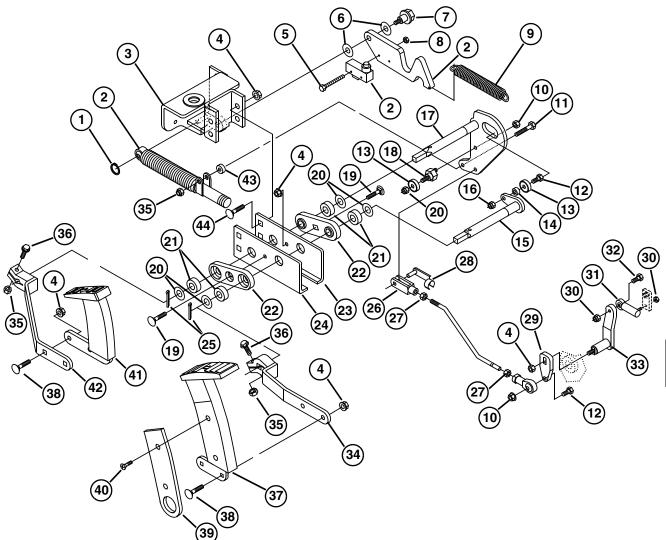
19. Collar

20. Packing

21. Shaft, Range Shift

6 - 12

HYDROSTATIC CONTROL LINKAGE





2. Dampener

3. Bracket

4. Nut

5. Cap Screw

6. Washer

7. Bolt, Shoulder

8. Nut

9. Spring

10. Nut

11. Cap Screw

12. Cap Screw

13. Bearing, Roller

14. Spacer

15. Shaft, Forward

16. Lock Nut

17. Shaft, Reverse

18. Eccentric

19. Bolt, Carriage

20. Washer

21. Bushing

22. Guide, Pedal

23. Bracket

24. Bracket

25. Pin, Cotter

26. Clevis

27. Nut

28. Pin, Clevis

29. Lever

30. Nut, Lock

31. Link, Ball Joint

32. Cap Screw

33. Bellcrank

34. Arm, Forward Pedal

35. Nut, Flange

36. Cap Screw

37. Pedal, Forward

38. Bolt, Carriage

39. Plate

40. Screw

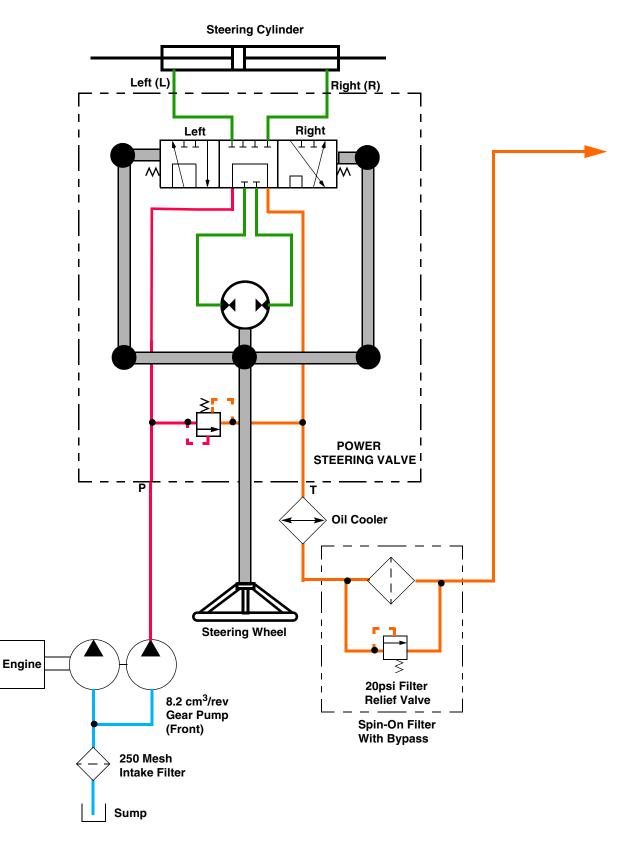
41. Pedal, Reverse

42. Arm, Reverse Pedal

43. Spacer

44. Bolt, Carriage

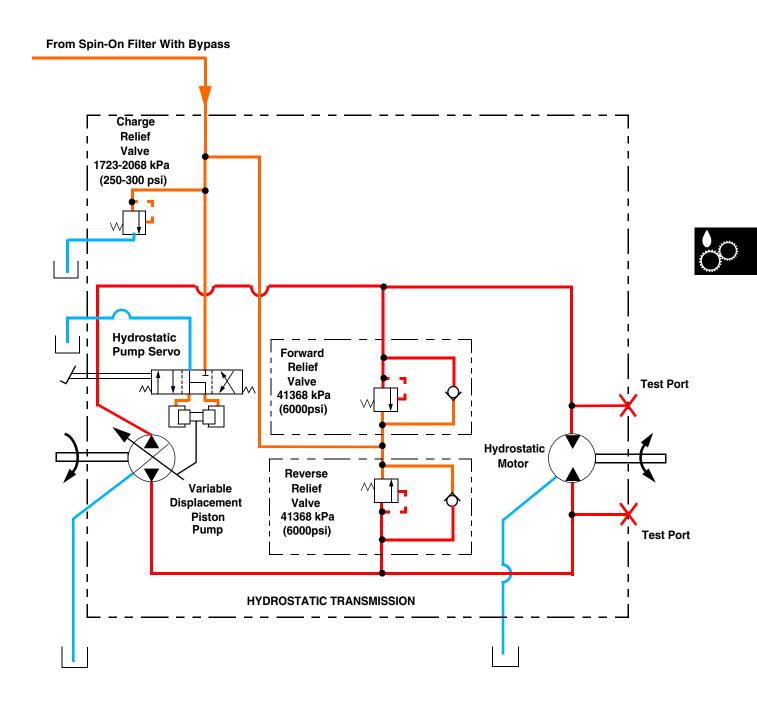
HYDROSTATIC SYSTEM SCHEMATIC



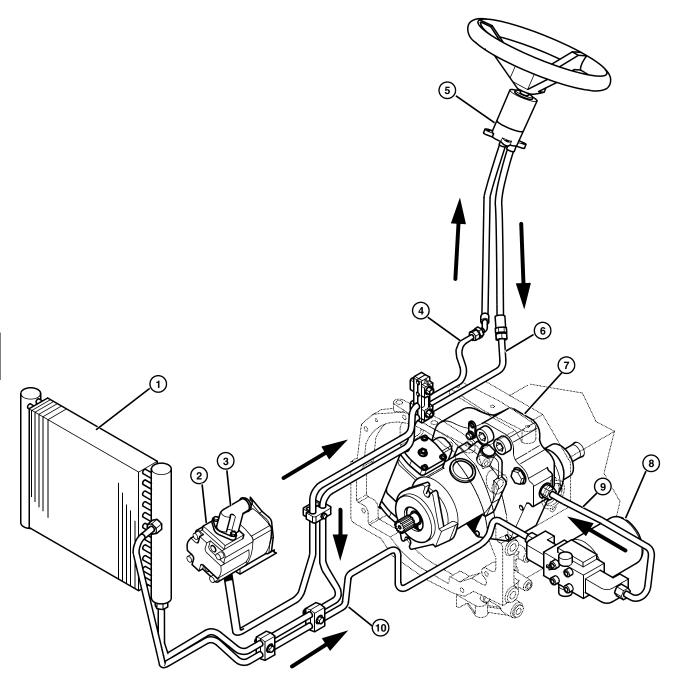


6 - 14

HYDROSTATIC SYSTEM SCHEMATIC



HYDRAULIC HOSES AND LINES



- 1. Hydraulic Oil Cooler
- 2. Front Gear Pump
- 3. Suction Tube Elbow (Oil Supply)
- 4. Steering (Charge Pressure) Supply Line
- 5. Steering Control Unit (SCU)
- 6. Steering Return Line

- 7. Hydrostatic Unit
- 8. Hydraulic Oil Filter
- 9. Cooler Return Line

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TROUBLESHOOTING

Problem or Symptom Check or Solution	Wheels on machine will not rotate	Noisy pump or motor	Sluggish response to changes in speed	Low power	Wheels rotate in one direction only	Tractor Moves Without Pressing Forward or Reverse Pedals	Tractor Does Not Move When Forward or Reverse Pedal are Pressed
Check flex plate coupling between engine and pump	•						
Hydraulic level low in transaxle	•		•	•			
Low charge pressure (see Tests and Adjustments Section)	•		•	•			
Main drive pressure relief valve stuck open (see Tests & Adjustments Section)		•	•	•	•		
Air in system (see "Hydraulic System Bleed Procedure" on page 20)		•	•	•			
Hydrostatic motor output pressure too low (see Tests and Adjustments Section.)			•	•			
Internal pump or motor damage or excessive wear	•	•	•	•			
Parking brake engaged or malfunctioning	•	•					
Pump centering mechanism not properly adjusted			•		•	•	
Gearbox malfunction (see Gear Power Train Section)	•						
Servo valve malfunctioning	•		•		•		
Pedal Neutral Position Not Properly Adjusted						•	
Hydrostatic Control Linkage Worn or Damaged			•		•	•	•



DIAGNOSTICS

Test Conditions:

- Operator in seat
- Key switch in RUN position

Test/Check Point	Normal	If Not Normal	
1. Control pedals. Pedals should move freely.		Check linkage from pedals to pump.	

Test Conditions:

• Start engine and run at slow idle.

Test/Check Point	Normal	If Not Normal		
Directional pedals are in neutral position.	Machine should not creep forward or backward.	Adjust centering of pump control pedals.		
3. Move forward or reverse pedal slowly from neutral to maximum travel speed position.	Machine should accelerate smoothly forward or backwards.	Check fluid reservoir for proper fluid level. Check hydraulic tubing, and connections for leaks. Perform system flow and pressure checks to verify proper operation of charge pump and hydrostatic pump.		
Control pedal in full forward position. Machine should move forward.		Check pedals and forward/reverse linkage for damage. Check forward drive pressure relief valve.		
Control pedal in full reverse position.	Machine should move backward.	Check pedals and forward/reverse linkage for damage. Check reverse drive pressure relief valve.		



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TESTS AND ADJUSTMENTS

HYDROSTATIC PEDAL LINKAGE NEUTRAL ADJUSTMENT

Reason:

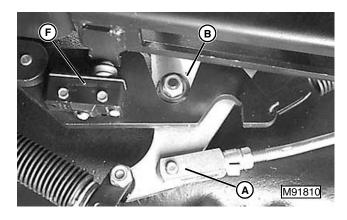
To ensure that tractor does not move or creep unless forward or reverse pedal is depressed.

NOTE: There are two adjustments that affect the neutral position of the hydrostatic pump. The pedal linkage neutral adjustment, and the servo motor neutral adjustment.

Procedure:

To determine which problem is at fault:

- 1. Jack up and support front and rear axles so that tires are off the ground.
- 2. Make sure 4-WD is disengaged.



CAUTION

CAUTION: Avoid injury from moving tractor wheels. Wheels may rotate during tests/ adjustments. Stay clear of moving parts.

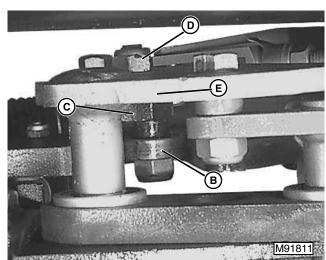
- 1. Disconnect yoke (A) from pedal linkage
- 2. Place range shift lever in A range.
- 3. Start engine and run at fast idle.
- 4. Observe rear wheels for movement.
- 5. Shut engine OFF.

Results:

- If rear wheels rotate with linkage disconnected, perform SERVO MOTOR NEUTRAL ADJUSTMENT.
- If rear wheels rotate with linkage connected and does not creep with linkage disconnected perform PEDAL NEUTRAL ADJUSTMENT below.

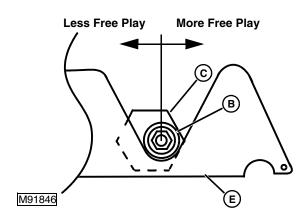
Pedal Neutral Adjustment

1. On the right side of the tractor, under the footrest, locate the roller bearing (B) and eccentric (C).





2. Loosen the locking nut (D) that holds the eccentric (C) to the reverse shaft (E).



- 3. Using a wrench, rotate the eccentric to move the roller bearing forward to increase, or rearward to decrease the amount of freeplay before the tractor moves when the reverse pedal is depressed.
- 4. Tighten the locking nut.
- 5. Start engine and run at high idle.
- Slowly depress REVERSE pedal. Pedal should travel 12.7 mm (0.5 in.) before wheels begin to move.
- 7. Repeat steps 5 through 11 until within specification.

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NOTE: Engine will not start if neutral switch does not close when pedals are released.

8. Move the forward and reverse pedals, and listen for operation (click) of the neutral switch (F). The neutral switch should close when the pedals are released. If no click can be heard, adjust the neutral switch so that switch opens with 6-9 mm (0.25-0.375 in.) of pedal travel.

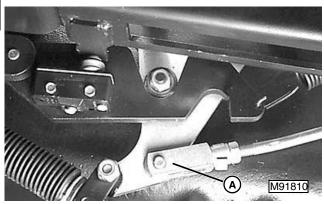
SERVO MOTOR NEUTRAL ADJUSTMENT

Equipment:

• JDG 1291 Neutral Creep Adjustment Tool Set

Procedure:

- 1. Jack up and support front and rear axles so that tires are off the ground.
- 2. Make sure 4-WD is disengaged.



3. Disconnect yoke (A) from the pedal linkage.

NOTE: If tractor does not have an access hole, obtain "HYDRO ADJUSTMENT KIT", LVA10365 which include instructions.



4. Locate rubber plug (B) on tunnel and remove plug.



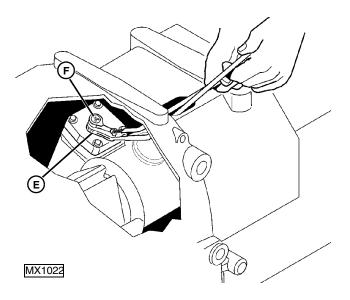
CAUTION: Avoid injury from moving tractor wheels. Wheels may rotate during tests/ adjustments. Stay clear of moving parts.



NOTE: The adjustment of the servo motor is performed by loosening jam nut and adjusting screw (D) inside the tunnel with special tools as shown below.

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- Insert JDTM-618-L tool (E) through access hole and loosen jam nut on servo motor adjusting screw.
- Insert JDTM-66-1 ratchet tool (F) into servo motor adjusting screw.
- 7. Place range trans lever in C (high gear) position.
- 8. Start tractor and run at full throttle.
- 9. Slowly turn the adjusting screw with the ratcheting tool until the rear wheels stop turning.

NOTE: Loosen to reduce forward creep. Tighten to reduce rearward creep.

- 10. If adjustment screw is turned too far, and wheels start turning in the other direction, stop engine. Remove ratcheting tool and change direction. Insert tool, restart engine and move adjustment screw in other direction until wheels stop turning.
- 11. Stop engine and remove tools.
- 12. Install JDTM-618-R tool to jam nut and JDTM-66-1 screw adjusting ratchet set on "off" position. While holding adjusting screw, tighten jam nut.
- 13. Remove tools, start engine and confirm that settings are still correct.
- 14. Reconnect linkage arm to pedal lever.
- 15. Check pedal neutral adjustment and re adjust if necessary.
- 16. Install rubber plug and assemble tractor.

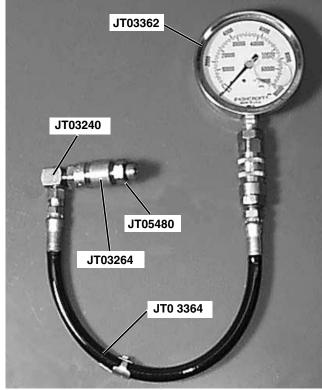
HYDROSTATIC HIGH PRESSURE RELIEF TEST

Reason:

To ensure that internal parts of hydrostatic pump are not worn excessively, and the relief valves are operating properly.

Equipment:

- JT03362 10,000 psi Gauge
- JT03364 Hose
- JT03240 Fitting
- JT05480 Male Quick Coupler
- JT03264 Female Quick Coupler
- JT03252 Adapter





IMPORTANT: Make sure that the hydraulic fluid is between add and full marks on dipstick. Insufficient hydraulic fluid could cause system to run dry and damage pump and motor.

IMPORTANT: Do not allow valves to relieve for more than 10 seconds or hydraulic oil may overheat.

Procedure:

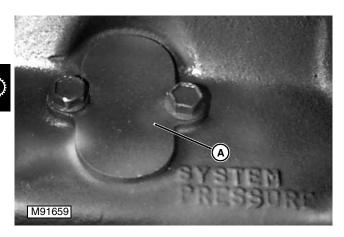
- 1. Park tractor on a level surface.
- 2. Turn key switch to OFF position.
- 3. Make sure 4-WD lever is in unlocked 2WD position.



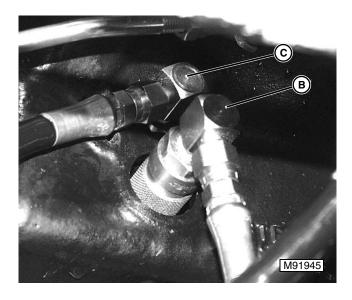
DANGER

Tractor could move suddenly causing severe injury or damage to equipment during test procedure. Perform test in open area. Keep all personnel away from front or rear of tractor.

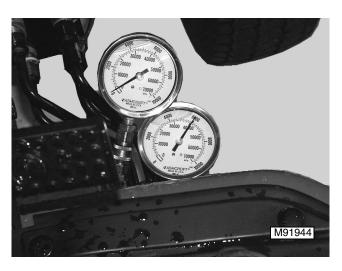
- 4. Start engine and run until hydraulic oil is warm.
- 5. Stop engine.



- 6. Locate test port cover (A) on right front side of
- 7. Remove cover and test port plugs.



- 8. Install one JT05480 male quick coupler into bottom (Forward) test port (B) and JT03252 and JT03240 into top (Reverse) test port (C).
- 9. Attach JT03362 gauge and JT03364 hose to each test port adaptor.



- 10. Position gauges so they can be read from operator's seat.
- 11. Perform test from operators seat. Press and hold right and left brake pedals during test and make sure park brake is engaged. Place range transmission shift lever in 3 (high) position. Start engine and run at full throttle.



CAUTION

If park brake fails to prevent wheels from turning, CEASE TEST IMMEDIATELY. Repair or adjust park brake as necessary before resuming test. (See Brake Section.)

- 12. Slowly depress forward directional pedal and observe gauge. Gauge should slowly rise to approximately 41368 kPa ± 1378 kPa (6000 psi. ± 200 psi) and relief valve will open with an audible squealing noise.
- 13. Repeat same procedure with reverse pedal.

Specifications:

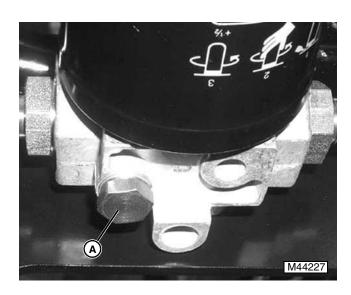
 Pump pressure should reach approximately 41368 kPa ± 1378 kPa (6000 psi. ± 200 psi) in either direction and then relieve.

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Results:

- If pressure will not reach 41368 kPa Maximum (6000 psi Maximum) in either direction, check charge pressure. (See "CHARGE PUMP PRESSURE TEST" on page23.)
- If charge pressure is good and hydrostatic pump pressure will not get up to relief pressure hydrostatic pump is worn or damaged.
- If pressure reaches 41368 kPa (6000 psi) in one direction and not the other, one of the relief valves is defective or the seat is leaking.

CHARGE PUMP PRESSURE TEST



NOTE: Tractors built after 1999 have a test port (A) in the hydraulic filter base located under the left footrest. Determine which filter base is on the tractor and refer to proper section of this procedure.

Reason:

To ensure that charge pump is operating at specified pressure to supply oil to hydrostatic pump.

Tractors manufactured before 1999

Equipment:

- JT03344 2,000 kPa (300 psi) Gauge
- JT03017 Hose With Coupler
- JT03368 Adapter Fitting (3/4 F NPT X 13/16 F ORFS Sw) (2 Required)
- 38H1031 Run Tee (13/16 F ORFS Sw X 13/16 M ORFS X 13/16 M ORFS)
- JT05688 Adapter Fitting (13/16 F ORFS Sw X 1-1/16 M 37°)

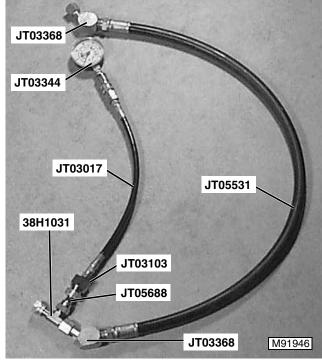
- JT03103 Adapter Fitting (7/16-20 M 37° X 1-1/16-12 F 37°)
- JT05531 1/2 NPT X 3/4 NPT Hose

Procedure:

- 1. Park tractor on a level surface.
- 2. Turn key switch to OFF position.
- 3. Shift transmission to NEUTRAL.
- 4. Engage parking brake.

IMPORTANT: Make sure to relieve system pressure before loosening any system lines or hoses.

- 5. Cycle all controls to relieve any pressure that may be in the hydraulic system.
- Remove the hydraulic tube between the oil filter outlet and tunnel inlet.





- 7. Remove 3/4 NPT F X 1/2 NPT M adapter from JT05531 hose.
- 8. Assemble test equipment as shown and install between oil filter and tunnel inlet.
- 9. Start engine and run at high idle.
- 10. Check pressure reading on gauge.

Specifications:

Charge Pressure1723-2068 kPa (250-300 psi)

Results:

- Charge pressure should reach 1723-2068 kPa (250-300 psi).
- If pressure reading of 1723-2068 kPa (250-300 psi)
 cannot be obtained; the mesh inlet filter may be
 restricted, the suction line may be restricted or
 leaking air, front hydraulic pump may be defective,
 or the charge pressure relief valve is damaged or
 leaking.

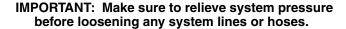
Tractors manufactured after 1999

Equipment:

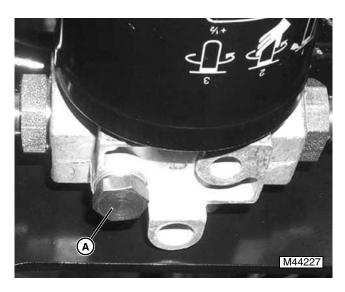
- JTO5480-M14x1.5 Male Quick Coupler
- JTO7041- 2760 kPa (400psi) Gauge
- JTO 3472 Female Quick Coupler

Procedure:

- 1. Park tractor on a level surface.
- 2. Turn key switch to OFF position.
- 3. Shift transmission to NEUTRAL.
- 4. Engage parking brake.



5. Cycle all controls to relieve any pressure that may be in the hydraulic system.



6. Locate hydraulic filter under left footrest and remove plug (A) from filter base.



- 7. Install quick couplers and gauge to filter base.
- 8. Start engine and run at high idle.
- 9. Check pressure reading on gauge.

Specifications:

Charge Pressure1723-2068 kPa (250-300 psi)

Results:

- Charge pressure should reach 1723-2068 kPa (250-300 psi).
- If pressure reading of 1723-2068 kPa (250-300 psi)
 cannot be obtained; the mesh inlet filter may be
 restricted, the suction line may be restricted or
 leaking air, front hydraulic pump may be defective,
 or the charge pressure relief valve is damaged or
 leaking.

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HYDRAULIC SYSTEM BLEED PROCEDURE

Reason:

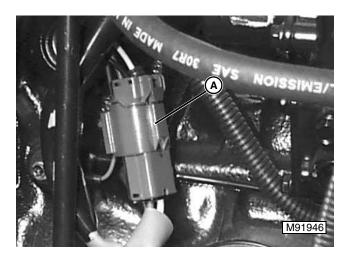
To remove air trapped in the hydraulic system which will prevent proper operation.

Procedure:

IMPORTANT: If contamination is found in hydraulic system filter or inside reservoir, flush entire hydraulic system.

NOTE: Fill the hydraulic oil filter with new oil before installing.

- 1. Install a new hydraulic oil filter.
- Fill the transaxle with specified JDM J20D (preferred) or J20C oil to the proper level on dipstick.
- 3. Disconnect plug (A) to fuel shutoff solenoid.



- 4. Turn the key to START and hold for 10 seconds. Turn the key to OFF.
- 5. Reconnect wires to fuel shutoff solenoid.
- 6. Raise tractor front end and support on suitable stands.
- 7. Start the engine and run at low idle.

IMPORTANT: If steering fails to respond, or pump pressure is not being delivered to steering control unit (SCU), shut engine off and check to see that steering hoses are connected to the correct SCU ports.

- 8. Slowly turn the steering wheel left and right until wheels turn smoothly indicating that any trapped air has been bled back to the reservoir.
- IMPORTANT: If rockshaft fails to react to lift control lever movement, shut engine off and check hose clamps on suction tube elbow and manifold to ensure that they are properly tightened.
- Operate rockshaft several times until it operates smoothly.
- Stop the engine and check the hydraulic reservoir oil level. Fill as needed. Check all line connections for leaks: tighten if necessary.
- 11. Lower the tractor to the ground.
- 12. Drive tractor in forward and reverse several times until transmission operates smoothly.

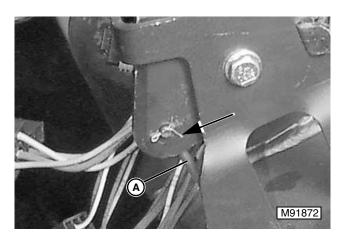


REPAIR

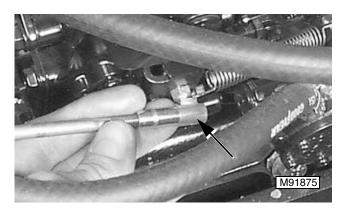
TRACTOR SPLITTING (FRONT)

Prepare the Tractor:

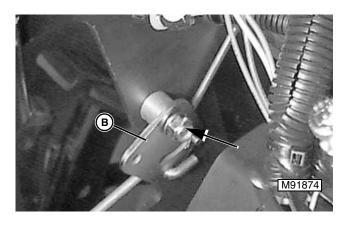
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove side panels.
- 4. Remove hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 5. Remove steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9 in Miscellaneous Section.)
- Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 7. Remove LH and RH cowl panels.
- 8. Remove fuse panel cover.
- Remove key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- Remove fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 12. Remove floor mat.
- 13. Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 14. Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear half of tractor.



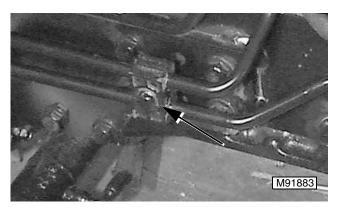
15. Remove cotter pin attaching throttle rod (A) to throttle lever. Disconnect throttle rod.



16. If not already done, disconnect throttle linkage from throttle lever on fuel injection pump.



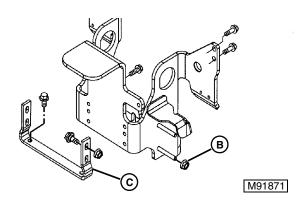
17. Remove lock nut. Remove throttle bellcrank (B) and throttle rods as an assembly.

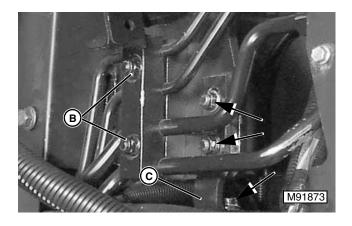


 On left side of tractor, remove cap screw and lock nut securing clamp on hydraulic oil cooler lines. Remove clamp.

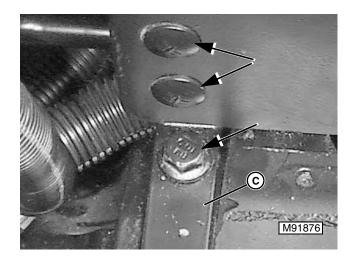




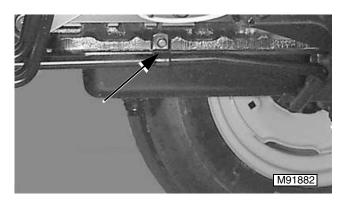




- On left side of tractor, loosen two lock nuts (B) attaching steering tube clamp to pedal support frame.
- 20. Loosen four nuts and carriage bolts attaching U-shaped bracket (C) to pedal support frame.



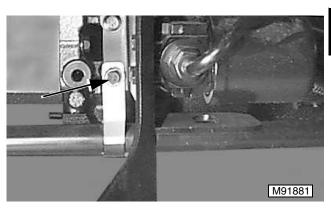
21. Remove two cap screws attaching U-shaped bracket to transmission tunnel.



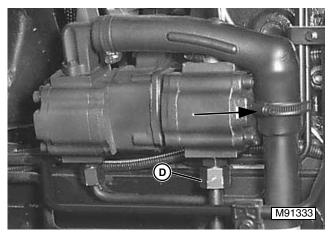
22. On right side of tractor, remove cap screw and tube clamp attaching PTO pressure tube to frame.

NOTE: Capacity of the hydraulic reservoir is **32 liters** (8.4 gal) (33.6 qt).

23. Drain hydraulic oil from reservoir.

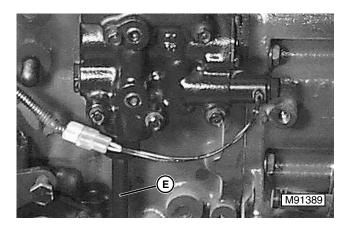


24. Remove cap screw and clamp attaching suction tube to tunnel section.

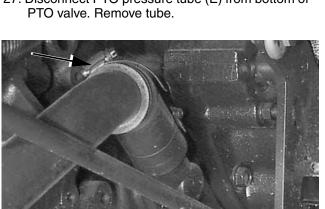


25. Disconnect PTO pressure tube (D) from rear hydraulic pump.

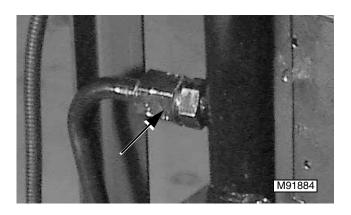
26. Loosen clamp and disconnect suction tube from suction manifold.



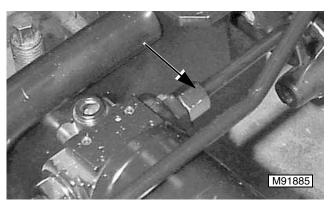
27. Disconnect PTO pressure tube (E) from bottom of



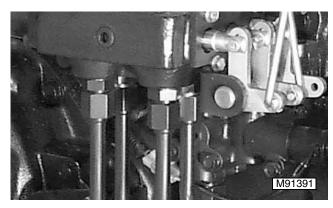
28. Loosen clamp and disconnect suction tube from suction elbow. Remove suction tube.



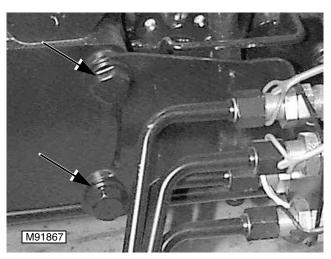
29. Disconnect tube from top port of hydraulic oil cooler.



30. Disconnect tube from RH port of hydraulic oil filter. Remove tube.



31. If equipped, disconnect four work port tubes from SCV.



32. Remove two cap screws and two spacers that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.

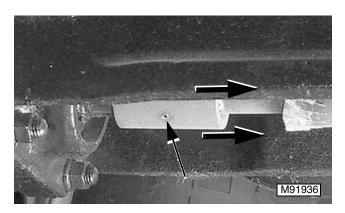
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33. If not already removed, lay upper brake rods across bellcrank pivot to prevent them from becoming damaged when separating tractor sections.

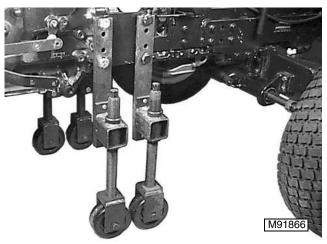


34. Remove two cap screws and RH operator's platform support.

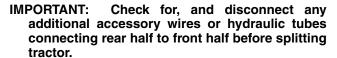


35. If equipped, remove 4-WD drive shaft and couplers by removing split pin and sliding one coupler onto shaft until clear of stub shaft. Lower end of shaft and remove.

Split the Tractor:



- Using eight cap screws supplied with the splitting stands, secure JT07335 splitting stands to the tunnel sections.
- 2. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- Remove nine cap screws and lock washers attaching tunnel section to engine section of tractor. Note length and locations of cap screws when removing.
- 4. Release park brake and place gear shift in NEUTRAL.

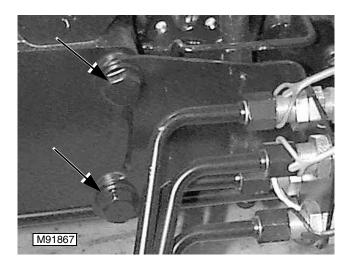


5. If necessary, use a pry bar to separate the two tractor sections. Lift the steering support slightly to clear the front flange of the tunnel. Split the tractor by rolling the two sections apart.

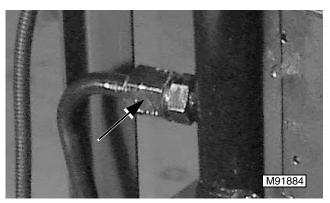
Assemble Tractor Sections:

NOTE: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

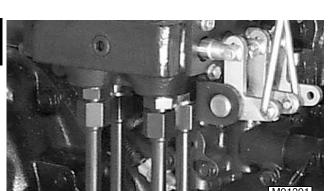
- 1. Align splines on drive shaft and engine flywheel, and, if equipped, 4-WD shaft and coupler.
- 2. Move tractor sections together and retain with nine cap screws. Tighten cap screws to 126-154 N•m (95-115 lb-ft).
- 3. Remove eight cap screws retaining splitting stands to tractor sections. Remove splitting stands.
- 4. If equipped, install 4-WD shaft and couplers.



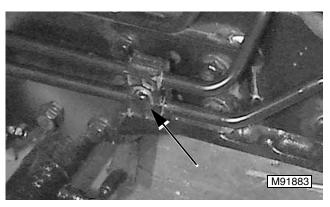
If equipped, install SCV tube support bracket and tubes as an assembly. Install two cap screws and two spacers to attach tube support bracket to frame.



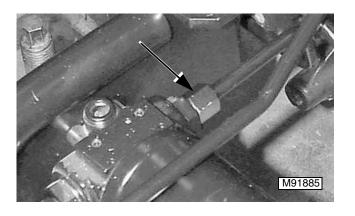
8. Connect tube to top port of hydraulic oil cooler. Tighten to **40-57 N•m (30-43 lb-ft)**.



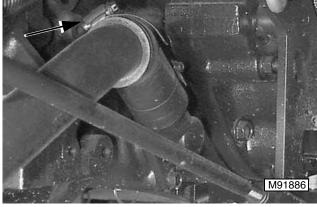
Connect four work port tubes to SCV. Tighten tube nuts to 40-57 N•m (30-43 lb-ft).



On left side of tractor, install clamp on tube from hydraulic oil cooler to oil filter. Retain with cap screw and lock nut.



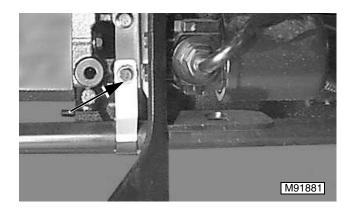
NOTE: Operator's platform removed for clarity.



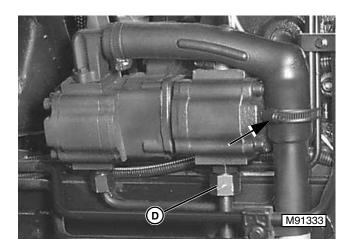
10. Attach suction tube to elbow and retain with clamp.

7. Connect hydraulic oil tube to RH port of hydraulic oil filter. Tighten to 40-57 N•m (30-43 lb-ft).

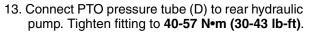
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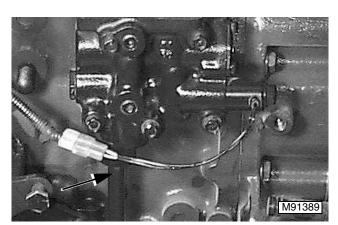


11. Install cap screw and clamp attaching suction tube to tunnel section.

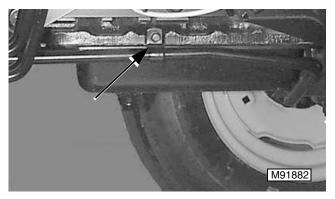


12. Connect suction tube to suction manifold and retain with hose clamp.

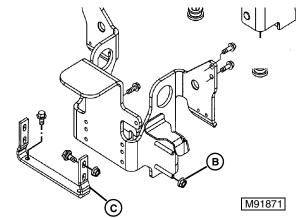




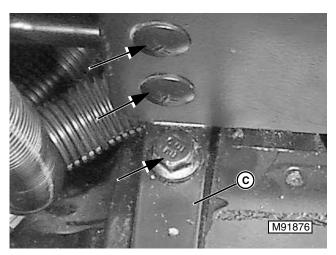
14. Connect PTO pressure tube to bottom of PTO valve. Tighten to 40-57 Nom (30-43 lb-ft).



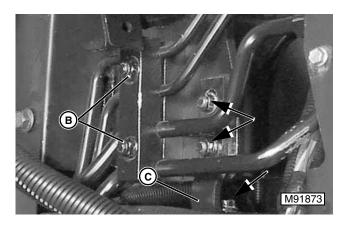
 On right side of tractor, install tube clamp attaching PTO pressure tube to frame. Retain with cap screw.





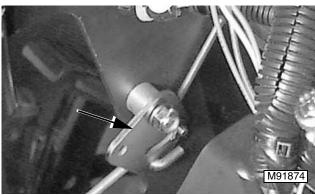


16. Install U-shaped bracket (C) to transmission tunnel, retain with two cap screws. Tighten cap screws.

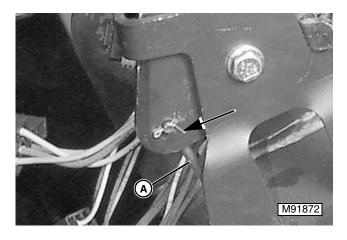


- Install four carriage bolts and nuts attaching Ushaped bracket to pedal support frame and tighten.
- 18. On left side of tractor, tighten two lock nuts (B) loosened at disassembly that attach steering tube clamp to pedal support frame.

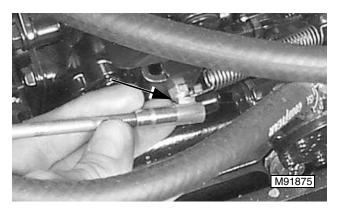




19. Install throttle bellcrank and two throttle rods as an assembly. Retain with lock nut.



Connect throttle rod (A) to throttle lever. Retain with cotter pin.



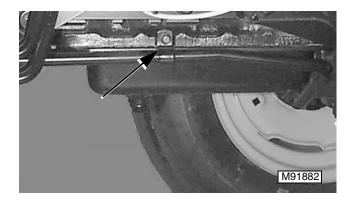
- 21. Connect throttle linkage to throttle lever on fuel injection pump.
- 22. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- 23. Install fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- 24. Install key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 25. Install fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 26. Install LH and RH cowl panels.
- 27. Install control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- Install steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page9 in Miscellaneous Section.)
- 29. Install hood. (See "HOOD REMOVAL AND INSTALLATION" on page11 in Miscellaneous Section.)
- 30. Install side panels.
- 31. Connect battery negative terminal.
- 32. Install operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 33. Install floor mat.
- 34. Install kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 35. Bleed air from hydraulic system. (See "HYDRAULIC SYSTEM BLEED PROCEDURE" on page 25.)

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TRACTOR SPLITTING (REAR)

Prepare the Tractor:

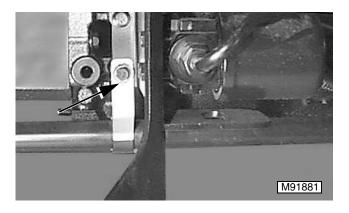
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 4. Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 6. Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- 7. Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 8. Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove rear fenders. (See "REAR FENDERS REMOVAL AND INSTALLATION" on page 6 in Miscellaneous Section.)
- 10. Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear section of tractor.



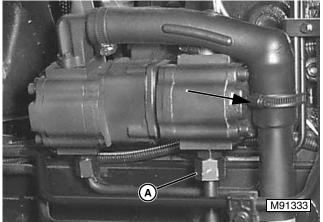
11. On right side of tractor, remove cap screw and tube clamp attaching PTO pressure tube to frame.

NOTE: Capacity of the hydraulic reservoir is 32 liters (8.4 gal) (33.6 qt).

12. Drain hydraulic oil from reservoir.

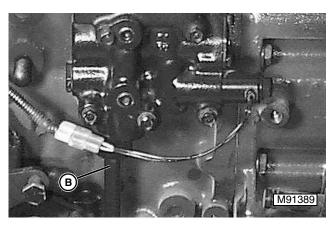


13. Remove cap screw and clamp attaching suction tube to tunnel section.

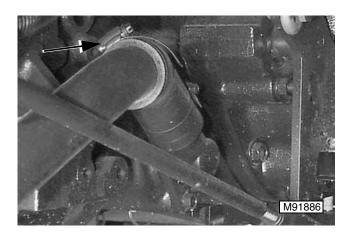




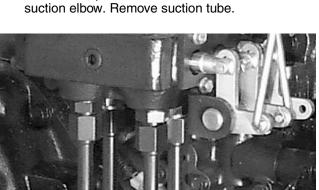
- Disconnect PTO pressure tube (A) from rear hydraulic pump.
- 15. Loosen clamp and disconnect suction tube from suction manifold.



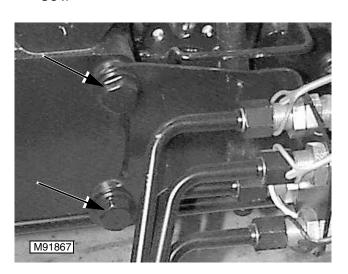
 Disconnect PTO pressure tube from bottom of PTO valve. Remove tube.



17. Loosen clamp and disconnect suction tube from suction elbow. Bemove suction tube

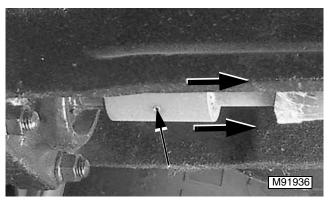


18. If equipped, disconnect four work port tubes from SCV.



19. Remove two cap screws and two spacers that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.

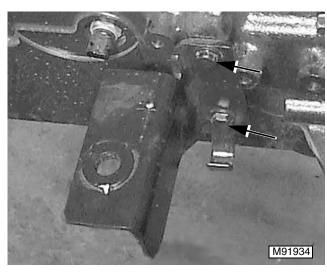
20. Remove cotter pin and clevis pin and disconnect brake rods from brake arms at differential housing.



21. If equipped, remove 4-WD drive shaft and couplers by removing split pin and sliding one coupler onto shaft until clear of stub shaft. Lower end of shaft and remove.

Split the Tractor:

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 Remove four cap screws and two rear operator's platform brackets.

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- Using four suitable cap screws, secure JT0 7335 splitting stands to the threaded holes in the tunnel section where the operator's platform brackets were removed.
- 3. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- 4. Using suitable stands, support the front and rear of the differential housing.
- 5. Remove four nuts and lock washers and 6 cap screws attaching tunnel section to differential housing. Note length and locations of cap screws when removing.

IMPORTANT: Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting tractor.

If necessary, use a pry bar to separate the two tractor sections. Split the tractor by rolling the front section of the tractor away from the differential housing.

Assemble Tractor Sections:

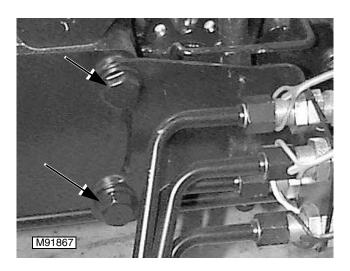


IMPORTANT: Be sure PTO collar is in place on shaft or in end of PTO clutch before assembling tractor sections. Smaller end of collar goes toward PTO clutch.

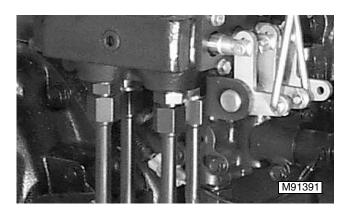
IMPORTANT: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.



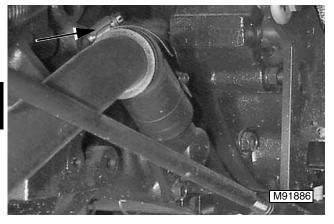
- Clean tunnel section mating surfaces and install a new gasket.
- 2. Align splines on drive shafts and couplers.
- Move tractor sections together and retain with four nuts and lock washers, and 6 cap screws. Tighten nuts and cap screws to 126-154 N•m (95-115 lbft).
- 4. Remove four cap screws retaining splitting stands to tractor sections. Remove splitting stands.
- 5. If equipped, install 4-WD shaft and couplers.



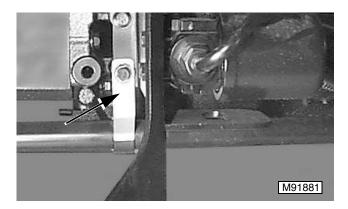
If equipped, install SCV tube support bracket and tubes as an assembly. Install two cap screws and two spacers to attach tube support bracket to frame.



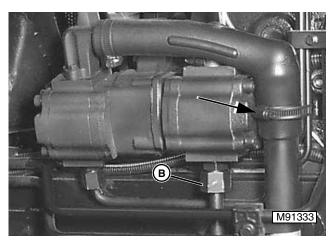
7. Connect four work port tubes to SCV. Tighten to 40-57 N•m (30-43 lb-ft).



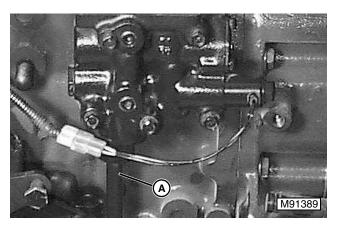
8. Attach suction tube to elbow and retain with clamp.



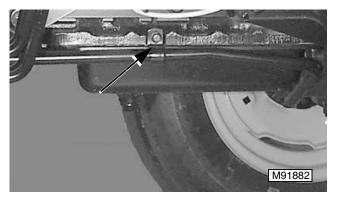
9. Install cap screw and clamp attaching suction tube to tunnel section.



- 10. Connect suction tube to suction manifold and retain with hose clamp.
- 11. Connect PTO pressure tube (B) to rear hydraulic pump. Tighten tube nut to 40-57 Nom (30-43 lb-ft).



12. Connect PTO pressure tube (A) to bottom of PTO valve. Tighten tube nut to 40-57 Nom (30-43 lb-ft).



- On right side of tractor, install tube clamp attaching PTO pressure tube to frame. Retain with cap screw
- 14. Connect brake rods to brake arms on differential housing. Retain with clevis pins and cotter pins.



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- 15. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- 16. Install operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 17. Install kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 18. Install seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- Install seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 20. Install rear fenders. (See "REAR FENDERS REMOVAL AND INSTALLATION" on page 6 in Miscellaneous Section.)
- 21. Install floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 22. Install fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 23. Connect battery negative terminal.
- 24. Bleed air from hydraulic system. (See "HYDRAULIC SYSTEM BLEED PROCEDURE" on page 25.)

HYDROSTATIC TRANSMISSION REMOVAL & INSTALLATION

Special or Essential Tools:

• JDG1239 Guide Rods

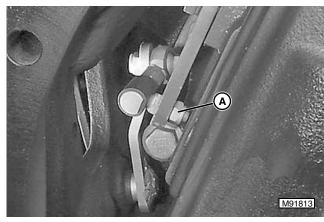
Removal:

 Park tractor on level surface. Stop engine and release hydraulic pressure by operating all controls.



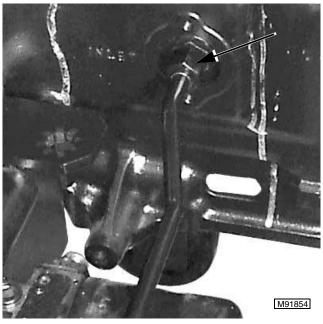
CAUTION: To avoid injury from escaping hydraulic oil under pressure, relieve the pressure in the system by stopping the engine and operating all hydraulic control valves.

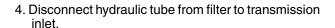
2. Separate tractor engine and tunnel sections. (See "TRACTOR SPLITTING (FRONT)" on page26.)



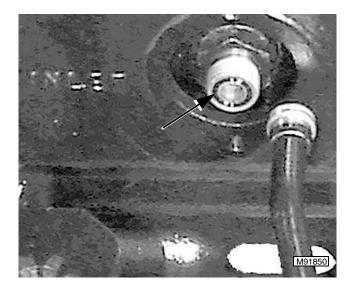
View From Front of Tunnel

3. Remove nut (A) from ball joint and disconnect from the control arm.

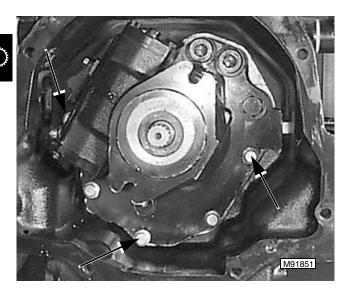




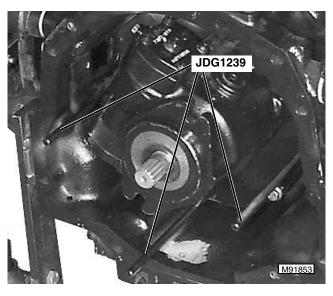




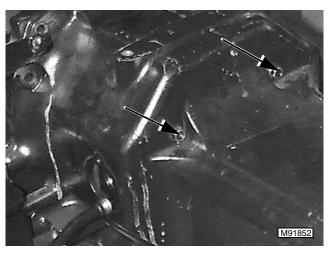
5. Remove adaptor fitting from inlet of transmission.



6. Remove three of the cap screws that fasten the transmission unit to the tunnel and replace with JDG1239 Guide Rods.



7. Remove the two remaining cap screws from inside the tunnel housing.



8. Remove two cap screws from the back side of the tunnel flange.

NOTE: Oil may drain from the pump and motor unit after it is removed. Have a suitable container available to catch excess oil.



Hydrostatic unit weighs approximately 50 kg (100 lbs). Use a suitable lifting device, or obtain assistance when removing unit from tunnel.

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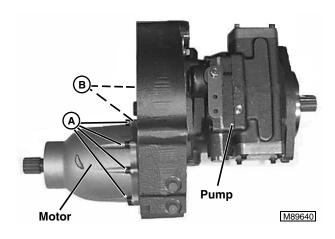
- IMPORTANT: Hydrostatic control linkage may interfere with removal of transmission. Move linkage clear of transmission when sliding transmission out of tunnel to prevent damage.
 - 9. Slide the transmission forward and out of the tunnel on the JDG1239 Guide Rods.
- 10. When the pump is clear of the tunnel, lift and remove from machine.

Installation:

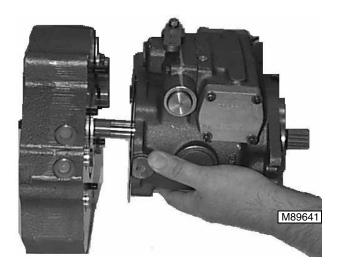
Installation is the reverse of removal.

- Clean flanges of transmission and tunnel before applying sealant.
- Apply TY16021 sealant to flanges of transmission where it contacts the tunnel.
- Tighten cap screws attaching transmission to tunnel to **72-88 N•m (54-66 lb-ft)**.

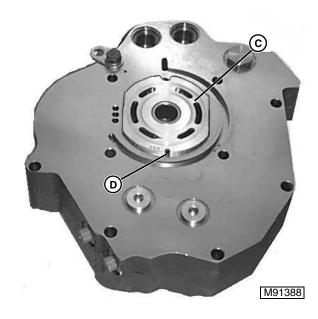
HYDROSTATIC TRANSMISSION DISASSEMBLY



- Remove the mounting screws (A) securing the hydrostatic motor to the backplate and remove the motor assembly.
- 2. Remove the four socket head mounting screws (B) that go through the backplate into the pump.
- 3. Slide the pump assembly from the backplate.



Backplate Disassembly:





- NOTE: Pump and motor valve plates are very similar in appearance, but are not interchangeable. Mark for reassembly with something that will not damage surfaces, such as a permanent ink felt tip marking pen.
 - 4. Mark the valve plates with a permanent marking pen and remove the valve plates (C) from the backplate. The valve plates are not fastened to the backplate, but may adhere slightly due to oil between machined surfaces.
 - 5. In most cases it should not be necessary to remove the spring pin (D) that is used to keep the valve plates properly located. If the pin is tight in the hole and is not damaged, there is no need to replace it. However, if the spring pin is damaged, it can be

removed. In doing so be extremely careful not to scratch the machined surface of the backplate.



6. Mark the forward and reverse relief valves (E) as to which cavity they came from for reassembly purposes. Remove the relief valves from the backplate. Check for damaged springs or seats.



NOTE: The relief valves are dual purpose. The valves contain two springs. The strong spring is a 6000 psi relief valve. There is also a weak spring inside the head that operates a check valve function when the other circuit is being used. There are no serviceable parts in the valve and they cannot be adjusted. If any malfunction is suspected, replace the relief valve.

 Examine the main drive pressure relief valves and seats. The seating area for the check valve and the seats in the backplate should be free of burrs and defects.



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8. Remove the charge pump relief valve (F) and check for damage or debris in spring or seating areas. Clean or replace parts as required.



- 9. Remove plugs (G) and clean out oil passages.
- 10. Inspect the pump side needle bearing. Needles should be free spinning and should not fall out of bearing cage. If the bearing needs to be replaced, it can be pressed out from the motor side of the housing outward.
- 11. Inspect the motor side needle bearing. If the needles remain in the cage and spin freely, there is no need to replace them. If bearing needs to be replaced, use appropriate blind hole puller to remove bearing.

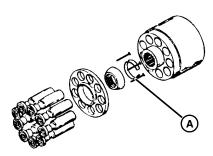


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HYDROSTATIC PUMP DISASSEMBLY



- 1. Remove the rotating assembly from the housing.
- 2. If the pistons did not come out with the piston block, remove the pistons along with the spider and pivot.



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NOTE: Disassembling the piston block assembly is not necessary unless the spring or pins (A) are damaged.

A CAUTION

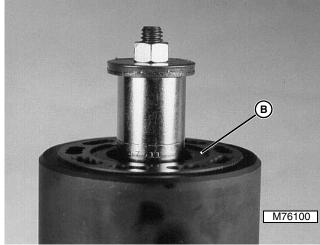
The spring inside the piston block is compressed and should not be removed without compressing the spring first. Use the following procedure to remove the spring safely.

The following parts will be needed to disassemble the piston block:

2 ea	3/8 ID x 1-1/4 in. OD Flat Washers
1 ea	3/8 x 5 in. N.C. Cap Screw
1 ea	3/8 in. N.C. Nut
1 ea 1	/2 in. Drive Socket With 1-1/8 in. OD

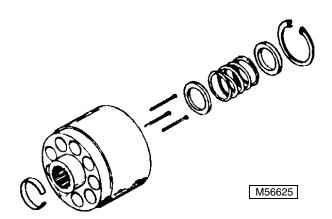


3. Place one of the flat washers over the 3/8 x 5 inch cap screw. Install cap screw through spline end of piston block so that the washer rests on the three pins.





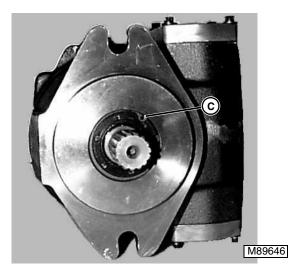
- 4. Place the socket and then the washer over the end of the cap screw.
- 5. Screw the nut on and slightly compress the spring inside the piston block.
- 6. Use retaining ring pliers to remove the internal retaining ring (B).
- Carefully back off tension on nut until spring is slack.
- 8. Remove the nut, washer, and cap screw.



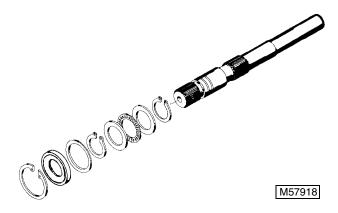
- 9. Remove washers, spring, pins, and pin retainer.
- 10. Inspect parts for wear or damage. Replace as required.

Shaft Removal and Disassembly:



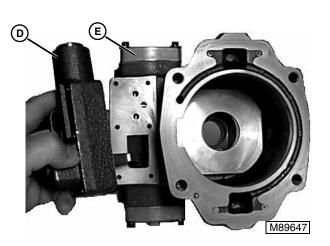


- 1. Remove the seal retaining ring (C).
- Press the shaft out of the housing towards the seal until the seal releases from the bore. Be sure that the shaft is supported below so that it does not drop and become damaged when it releases from the housing.



- 3. Remove the seal and washer.
- 4. Remove the retaining ring from the shaft and remove the thrust washers and thrust bearing.

Servo Control Disassembly:

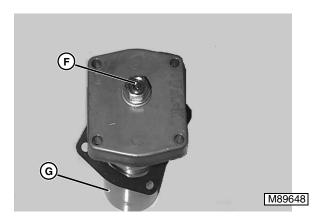


 Remove the servo valve (D) and gasket by removing the six socket head cap screws that fasten the valve to the housing.

NOTE: Mark cylinder caps before removal for proper orientation during reassembly.

2. Remove the plain servo cylinder cap (E).

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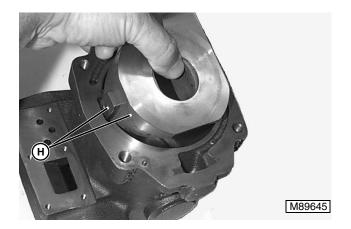


- 3. Remove the four cap screws securing the cylinder cap with the piston adjusting screw (F) in it.
- 4. Carefully push piston (G) and cap out from the opposite end.

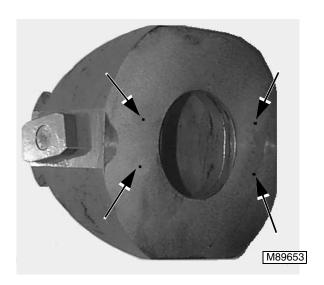
NOTE: Do not pry on cover. Cover is aluminum and is easily damaged.

- If piston removal from cover is necessary; while holding the piston screw with an allen wrench, remove the nut, flat washer, and rubberized seal washer from the piston screw.
- 6. Turn the cover off of the piston screw until it threads completely out of the cover.

NOTE: Do not disassemble the piston any further. The piston spring tension is preset at the time of manufacture. The service piston assembly is only available as an assembled unit.



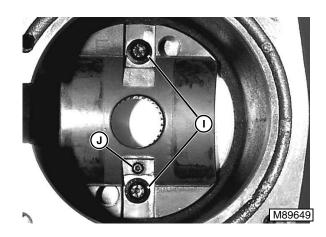
Remove the cam plate and follower (H) from the housing. When removing the cam plate, be careful not to damage the shoe surface.



- 8. Examine the shoe surface of the cam plate, be sure that there are no scratches, grooves, or excessive wear on the shoe surface. Check that the lubrication holes in the cam plate are open.
- 9. Inspect the cradle (wear plate) surface on the back side of the cam plate for excessive wear.



Cradle Removal:



NOTE: The cradle can normally be left in place, but will need to be removed if bearing replacement is required. If cradle is removed cradle retaining cap screws (I) must be replaced.

- The cradle for the cam plate can be removed by taking out the two retaining screws and moving the cradle back and forth to release the dowel bushings that hold the cradle in place.
- 2. Inspect the wear plate. If any irregularities are present it can be replaced by removing the retaining screw (J) and replacing wear plate.

HYDROSTATIC PUMP INSPECTION

- Inspect the needle bearings in the backplate and the pump housing. If the needles remain in the cage and spin freely, there is no need to replace them. If replacement is necessary, bearings may be driven out with a bearing driver.
- 2. If the bearings in the backplate or housing need to be replaced, they can be pressed out with the appropriate size bearing driver.

IMPORTANT: When removing bearing from backplate, be extremely careful to not damage machined surfaces.



 Inspect the bronze side of the valve plate for wear. Replace the valve plate if any wear, scoring, or scratches exist.



- 4. Inspect the piston block surface that makes contact with the valve plate. This surface should be smooth and free of deep scratches.
- 5. Check the piston movement in the block bore. If the pistons are sticky in the bore, examine the bore for scoring or contamination.



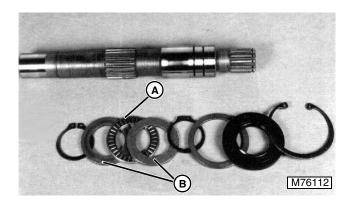
- Examine the outside of the pistons for finish condition. They should not show wear or deep scratches.
- 7. Inspect the shoes for a snug fit on the ball end of the pistons. Check the face of the shoes for a flat smooth surface.
- 8. Examine the spider for wear in the pivot area.
- 9. Examine the pivot to ensure smoothness and no signs of wear.



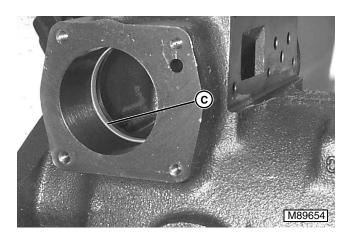
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IMPORTANT: Piston face roll can be caused by towing unit, dry start-up, or loss of charge pressure.

10. Examine the machined surfaces of the backplate.



- 11. Inspect the shaft for fretting in the bearing and spline area.
- Inspect thrust bearing (A) and washers (B) for wear.
- 13. Inspect the servo piston for scratches and wear.
- 14. Replace worn or damaged parts as required.



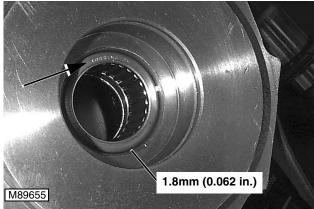
15. Examine the servo piston bore in the pump housing. Replace the seals (C).

HYDROSTATIC PUMP ASSEMBLY

1. Clean all parts in a suitable solvent and dry with lint free rag.

IMPORTANT: Due to extremely tight tolerances and finish of pump internal surfaces it is very important to maintain absolute cleanliness during the assembly of the pump. Coat all internal surfaces with clean 10W30 motor oil when assembling the pump.

Housing, Servo Control and Shaft Reassembly:



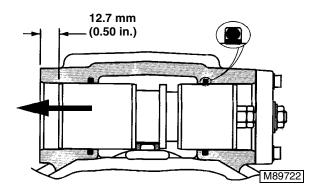


 If the needle bearing was removed from the housing, the new one can be pressed from the outside inward until the bearing race is recessed in the bore approximately 1.8 mm (0.062 in.). Be sure that the numbers on the bearing race are facing to the outside of the housing.



NOTE: The piston is larger than the opening in the gasket, so the gasket must be placed between the piston and the cover before installation of the piston and cover assembly.

2. Install the new cylinder cover gasket over the piston screw and thread piston screw through the cylinder cover.



- Lubricate parts and install the piston into the cylinder. Slide the piston and cap assembly in from the right side as viewed from the front of the pump.
- 4. Tighten the mounting screws on the cover to 7 ± 0.5 N•m (64 ± 4 lb-in.).
- Insert a hex wrench into the end of the piston screw and thread it through the cover until the flat end of the piston is located 12.7 mm (0.50 in.) from the edge of the cylinder.
- 6. Hold the piston screw and install the rubber washer, flat washer, and outside lock nut onto the piston screw. Tighten the lock nut to 17.5 ± 1 N•m (155 ± 5 lb-in.). Recheck measurement before tightening jam nut.
- Install the remaining cylinder cover and gasket.
 Tighten the mounting screws to 7 ± 0.5 N•m (64 ± 4 lb-in.).
- Install the servo valve and gasket onto the housing.
 Be sure the servo valve feed back rod is positioned into the narrow groove on the servo piston. Tighten the mounting screws to 7 ± 0.5 N•m (64 ± 4 lb-in.).
- Place the cradle into the housing, being sure that the dowel bushings are located in the holes in the housing. Draw the cradle tight by evenly tightening the two mounting screws to 36±2 N•m (26±2 lb-ft).
- 10. Install the wear plate onto the cradle and tighten the retaining screw to 1.7 ±0.1 N•m (15±1 lb-in.).
- 11. Place a small amount of petroleum jelly behind cam plate follower to keep it from falling off of cam plate, and install follower on to cam plate.



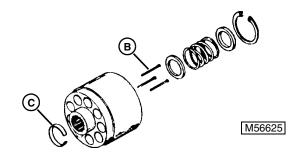
12. Place the cam plate into the housing. Make certain the cam plate follower is correctly positioned in the servo piston groove.



- 13. Install the inside retaining ring (A), thrust washer, and thrust bearing on the shaft. Install the outside thrust washer and retaining ring.
- 14. Install the washer and a new seal onto the shaft.
- 15. Install the shaft into the housing. Tap the shaft seal in with an appropriate size socket or clean piece of pipe just far enough that seal is clear of retaining ring groove. Secure it with the retaining ring.

Rotating Assembly Installation:

 If the piston block assembly was disassembled complete the following. If not, skip to step 11.





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- Install the three pins (B) in oversize grooves in spline end of piston block with the heads facing inside of the block.
- 3. Install the pin retainer (C).
- 4. Install the washers and spring.
- Using same tools used to compress spring during disassembly of block install washer, spring, second washer, cap screw and nut in the piston block.
- 6. Compress spring.
- 7. Install retaining ring.
- 8. Remove spring compression tools from the piston block.



- 9. Place an appropriate size socket in the hole in the piston block to keep the pivot in place while installing the pistons. Slide the pivot down so that the flat side rests on the top of the three pins.
- 10. With the pistons in place in the spider (D), lower the pistons into the piston block.

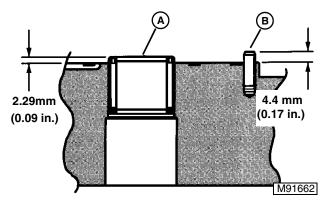
NOTE: It is not necessary to put the pistons in the original position. Any piston can be installed in any hole.



- 11. Tilt the pump housing so that the open end is facing slightly downward, but not so much that the cam plate falls out of position.
- 12. Slide the rotating unit up the shaft until it meshes with the splines on the shaft.







- If the bearings (A) were removed from the backplate, press new ones into position with the proper size bearing driver. The numbers on the bearing should be facing the outside of the backplate. Press the bearing in until 2.29 mm (0.090 in.) of the race remains above the surface of the backplate.
- Install the spring pin(s) (B) (if removed) that is used to position the valve plate. Allow the pin to protrude from the backplate approximately 4.4 mm (0.17 in.).
- 3. Apply a small amount of petroleum jelly to the steel side of valve plate to hold it in place for installation.





Motor Valve Plate

Pump Valve Plate

NOTE: The motor and pump valve plates look similar but they cannot be interchanged. Make sure they are properly oriented on the backplate.

- Install the pump assembly onto the backplate assembly. Make sure valve plate and gasket stay in position.
- 7. Tighten the socket head cap screws to $40 \pm 2 \text{ N} \cdot \text{m}$ (29 ± 2 lb-ft.).

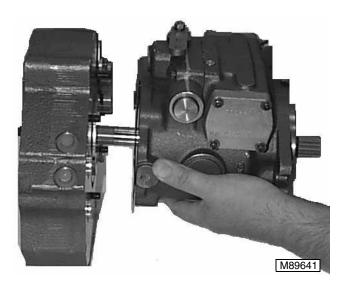
HYDROSTATIC MOTOR DISASSEMBLY

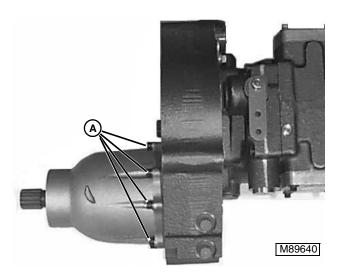
IMPORTANT: The motor body is aluminum and can be easily damaged by steel tools. Be careful to not damage machined surfaces. Do not use screwdriver or other sharp objects to pry motor body from backplate.



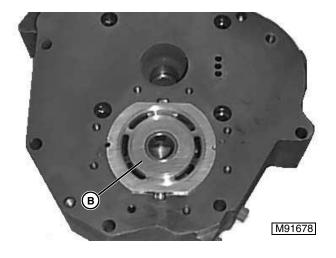


- 4. Install pump valve plate (C) on backplate.
- 5. Place a new gasket on the pump.





 Remove socket head cap screws (A) and tap the motor housing with a plastic mallet to loosen it from the valve plate. Keep the assembly level or tip output end down to keep the rotating assembly from sliding off of shaft. Pull the motor housing, shaft, and rotating assembly away from backplate.



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Remove the valve plate (B). The valve plate is not fastened to the backplate, but may adhere slightly to the backplate due to oil between the machined surfaces.

Rotating Unit Removal and Disassembly:

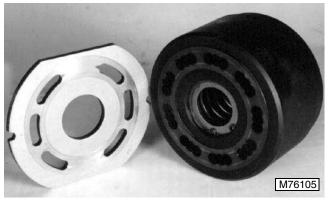


- 1. Invert the motor and remove the rotating assembly from the housing.
- 2. If the pistons did not come out with piston block, remove the pistons along with the spider and pivot.
- 3. Remove cam washer from back of motor housing.

Hydrostatic Motor Inspection:

- Inspect the needle bearings in the backplate and the motor housing. If the needles remain in the cage and spin freely, there is no need to replace them.
- 2. If the needle bearing in the motor housing needs to be replaced, it can be pressed out with the appropriate size bearing driver. If the bearing in the back plate must be replaced it must be pulled out with a slide hammer or blind hole puller.

IMPORTANT: When removing bearing from back plate, be extremely careful to not damage machined surfaces.



- Inspect the bronze side of the valve plate for wear. Replace the valve plate if any wear, scoring, or scratches exist.
- 4. Inspect the piston block surface that makes contact with the valve plate. This surface should be smooth and free of deep scratches.
- Check the piston movement in the piston block bore. If the pistons are sticky in the bores examine the bores for scoring or contamination.





- 6. Remove the pistons and spider assembly.
- Examine the outside of the pistons for finish condition. They should not show wear or deep scratches.
- Inspect the piston shoes for a snug fit on the ball end of the pistons. Check the face of the shoes for a flat smooth surface.
- 9. Examine the spider for wear in the pivot area.
- Examine the pivot to ensure smoothness and no signs of wear.

IMPORTANT: Piston face roll can be caused by towing unit, dry start-up, or loss of charge pressure.

NOTE: Disassembling the piston block assembly is not necessary unless the spring or pins are damaged.

A

CAUTION

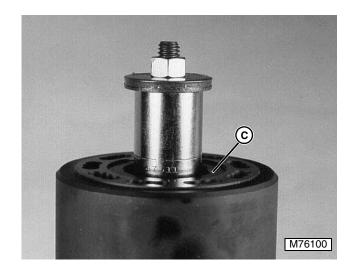
The spring inside the piston block is compressed and should not be removed without compressing the spring first. Use the following procedure to remove the spring safely.

The following parts will be needed to disassemble the piston block:

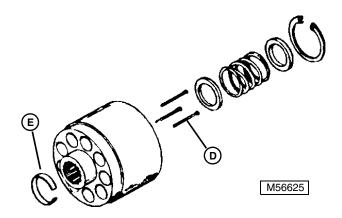




11. Place one of the flat washers over the 3/8 x 5 in. cap screw. Install cap screw through spline end of piston block so that the washer rests on the three pins.



- 12. Place the socket and then the washer over the end of the cap screw.
- 13. Screw the nut on and slightly compress the spring inside the piston block.
- 14. Use retaining ring pliers to remove the internal retaining ring (C).
- Carefully back off tension on nut until spring is slack.
- 16. Remove the nut, washer, and cap screw.



- 17. Remove washers, spring, pins (D), and pin retainer (E).
- 18. Inspect parts for wear or damage. Replace as required.

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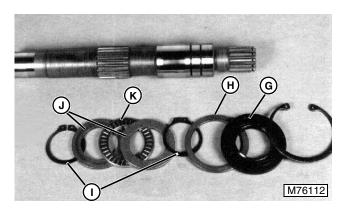
Shaft Removal and Disassembly:



1. Remove the large retaining ring (F) from the housing at the output end of the shaft.



2. Gently tap the shaft with a plastic hammer as shown until the rubber seal releases from the housing.



- 3. Remove the seal (G) and washer (H).
- Remove the retaining rings (I) from the shaft, and remove the thrust washers (J) and thrust bearing (K).
- 5. If the pins and the spring inside the piston block were disassembled, inspect the pins for straightness.
- 6. Inspect the shaft for fretting in the bearing and spline area.
- 7. Inspect the thrust bearing and washers for wear.
- 8. Inspect the cam washer shoe surface. It should be free of scratches and wear marks.

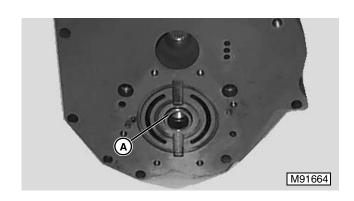


HYDROSTATIC MOTOR ASSEMBLY

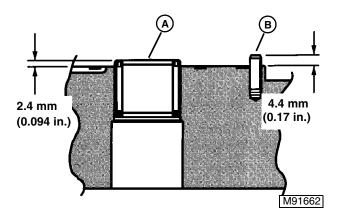
IMPORTANT: Due to extremely tight tolerances, and finish of internal surfaces, it is very important to maintain absolute cleanliness during the assembly of the motor. Coat all internal surfaces with clean 10W30 motor oil when assembling the pump.

Main Shaft Bearing Installation:

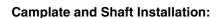
NOTE: All needle bearings (A) are pressed in with numbers facing out.



 If the needle bearings were removed from the backplate or the motor housing, new ones can be pressed in, numbers up, using the correct size bearing driver. The backplate bearing should be pressed in until 2.4 mm (0.094 in.) is left above the bore.



 If spring pin (B) that is used to position the valve plate was removed or damaged, install a new one.
 Allow the pin to protrude from the backplate approximately 4.4 mm (0.17 in.).

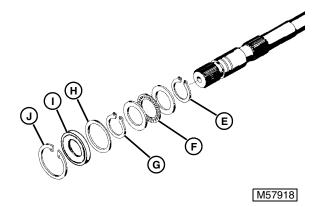




3. The housing bearing (D) should be pressed on the numbered side, from the outside of the housing inward, until the numbered end is recessed 1.78 mm (0.70 in.) into the housing bore.



4. Apply some petroleum jelly to the "THIS SIDE DOWN" side of the cam washer before installing into motor housing so it will stay in place while installing rotating assembly.

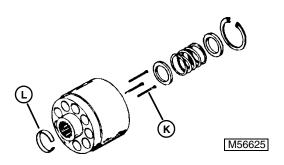


- 5. Install the inside snap ring (E), thrust washer, and thrust bearing (F) on shaft. Install the outside thrust washer and snap ring (G).
- Install the shaft into the housing. Install the washer
 (H) and the new shaft seal (I). Secure them with the retaining ring (J).

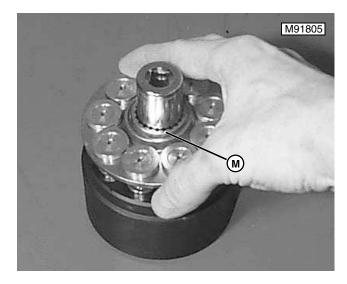
Rotating Unit Assembly and Installation:

 If the piston block assembly was disassembled complete the following. If not, skip to step 10.

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- 2. Install the three pins (K) in oversize grooves in spline end of piston block with the heads facing inside of the block.
- 3. Install the pin retainer (L).
- 4. Install the washers and spring.
- 5. Using same tools used to compress spring during disassembly of block install washer, spring, second washer, cap screw and nut in the piston block.
- 6. Compress spring.
- 7. Install retaining ring.
- 8. Remove spring compression tools from the piston block.

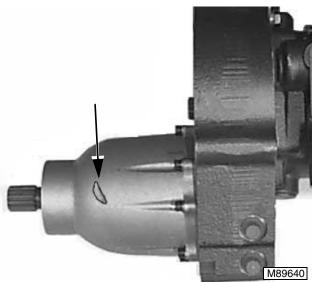


- 9. Place an appropriate size socket in the hole in the piston block to keep the pivot (M) in place while installing the pistons. Slide the pivot down so that the flat side rests on the top of the three pins.
- 10. With the pistons in place in the spider, lower the pistons into the piston block.

NOTE: It is not necessary to put the pistons in the original position. Any piston can be installed in any hole.



- 11. Tilt the motor housing so that the open end is facing slightly downward.
- 12. Slide the rotating unit up the shaft until it meshes with the splines on the shaft.
- 13. Install the roll pin (if removed) that is used to position the valve plate. Allow the pin to protrude from the backplate approximately 4.4 mm (0.17 in.).
- 14. Apply a small amount of petroleum grease to the steel side of valve plate to hold it in place for installation. Place the valve plate in position on the backplate with steel side against backplate.



IMPORTANT: Install motor housing with cam plate slope marking as shown. If installed incorrectly the directional pedal functions will be opposite the way they should be.

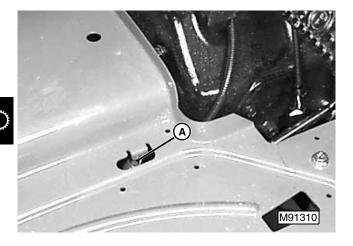
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15. Install the motor assembly onto the backplate assembly with the cam plate marking as shown. Make sure that the valve plate and cam washer stay in position.

IMPORTANT: Tighten the cap screws evenly in such a manner that the mating surfaces remain parallel. Final torque to $12 \pm 2 \text{ N} \cdot \text{m}$ (105 \pm 18 lb-in.).

CONTROL LINKAGE REMOVAL AND INSTALLATION

Removal:



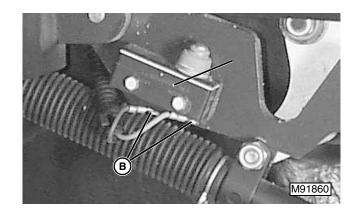
NOTE: Floor mat removed for clarity.



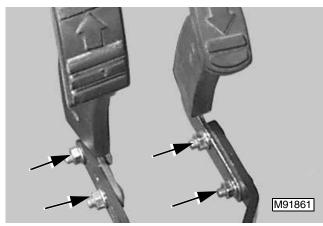
CAUTION

Spring under tension. Wear eye protection and gloves when disconnecting spring to reduce the risk of personal injury.

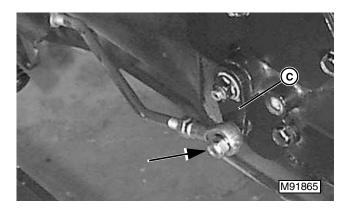
 Disconnect neutral return spring (A) from operator platform. Disconnect from cam follower and remove spring.



Remove two screws (B) and disconnect wiring harness from neutral switch.

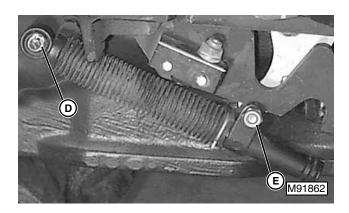


- Remove two nuts and two carriage bolts securing forward pedal to pedal arm. Remove forward pedal
- 4. Remove two nuts and two carriage bolts securing reverse pedal to pedal arm. Remove reverse pedal.

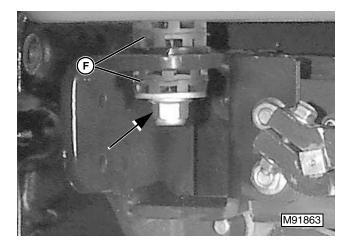


5. Remove cap screw and lock nut securing hydro control rod to hydro control lever (C).

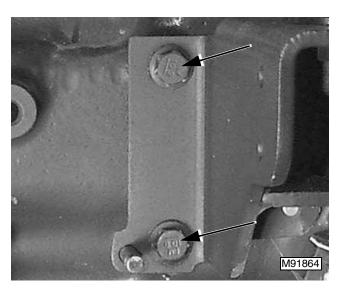
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- 6. Remove snap ring (D) securing dampener to operator platform bracket.
- 7. Remove flange nut (E) securing dampener to reverse shaft. Remove dampener.



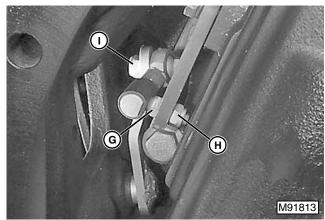
8. Remove lock nut, washer, and lower half of rubber isolator (F) securing operator's platform to bracket.



- Support operator platform bracket and pedal assembly, and remove two cap screws that secure bracket to tunnel.
- 10. Lower pedal assembly and bracket as a unit, and remove from carriage bolt on operator's platform.
- 11. Inspect components for wear or damage. Replace as necessary.

NOTE: The following procedures describe the removal of control linkage located inside the tunnel.

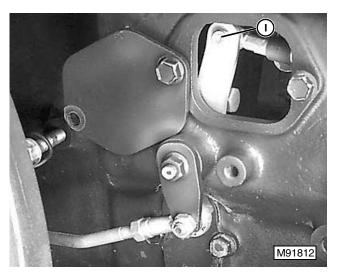
12. Split the tractor between the differential housing and tunnel section. (See "TRACTOR SPLITTING (FRONT)" on pag e26.)





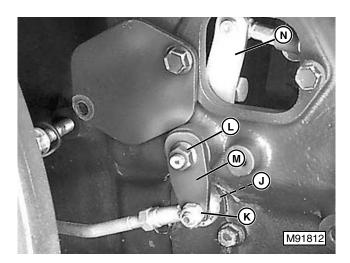
Viewed Into Transmission Tunnel From Front

 Using a wrench, hold ball joint stud (G) and remove lock nut (H) attaching ball joint link to hydrostatic transmission control lever.

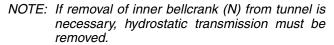


14. Remove one cap screw from cover and move cover aside to access lock nut (I).

 Using a wrench, hold cap screw and remove lock nut (I) attaching link to inner bellcrank. Remove ball joint link.



- Using a wrench, hold cap screw (J) on control rod ball joint end, and remove lock nut (K). Disconnect control rod from outer lever.
- 17. Remove flange nut (L) and outer lever (M).



- 18. Remove hydrostatic transmission. (See "HYDROSTATIC TRANSMISSION REMOVAL & INSTALLATION" on page 37.)
- 19. Remove inner bellcrank.

Installation:

Installation is the reverse of removal.

- Inspect all components for wear, damage, and smooth operation. Replace components as necessary.
- Install new nylon lock nuts where removed. Old lock nuts may become loose over time.
- Tighten flange nut attaching outer lever to inner bellcrank to 25-30 N•m (18-22 lb-ft).

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Hydraulic Reservoir Capa	city	37 liters (9.8 gal) (39.1 q	t)
PRT Clutch Arm Rotation	(No hydrostatic pressure).		3°

REPAIR SPECIFICATIONS

PowrReverser Hydraulic Clutch

PowrReverser Clutch Plates (Minimum Thickness):	
End Plate	4.85 mm (0.191 in.)
Separator Plate(s)	2.85 mm (0.112 in.)
Friction Plate(s)	2.7 mm (0.106 in.)
Clutch Spring (minimum length)	45.5 mm (1.79 in.)

TORQUE SPECIFICATIONS

SCV Port Tube Hydraulic Line Nuts	40-57 N•m (30-43 lb-ft)
PTO Pressure Tube To PTO Valve Hydraulic Line Nut	40-57 N•m (30-43 lb-ft)
PTO Pressure Tube To Hydraulic Pump Nut	40-57 N•m (30-43 lb-ft)
Gear Case To Gear Case Cap Screws	126-154 N•m (95-115 lb-ft)
Center Plate To Housing Cap Screws	85 N•m (63 lb-ft)
Front Cover To Clutch Housing (Tunnel) Cap Screws	23-29 N•m (17-22 lb-ft)
Reverse Case To Front Cover Cap Screws	19-23 N•m (14-17 lb-ft)
PowrReverser Valve Block	
Mounting Valve Block Cap Screws	24.4 N•m (18 lb-ft)
Detent Assembly Cap Screws	19 N•m (14 lb-ft)
Cover Plate Cap Screws	26 N•m (21 lb-ft)
Valve Block To Valve Block Cap Screws	24.4 N•m (18 lb-ft)

SPECIAL OR ESSENTIAL TOOLS

Part Number	Part Name
JDT 24B	Spring Washer Compressor
JTO 7335-1,2,3	Splitting Stands and Brackets
JTO 3349	Adapter
JTO 3017	Hose
JTO 3344	Gauge

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

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OTHER MATERIALS

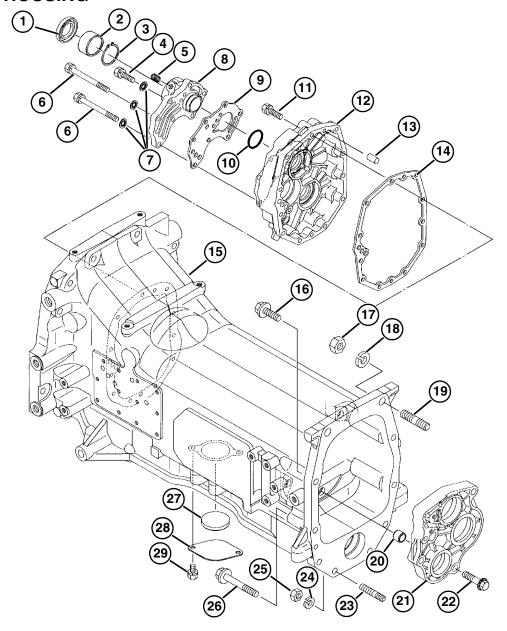
Number U.S./Canadian	Name	Use
TY6305	John Deere Clean and Cure Primer	
TY15130 / TY15934	John Deere Sealant	
TY6333	Moly High Temperature EP Grease	
TY22034	John Deere SuperLube ®	
TY9370 / TY9477 (#242 LOCTITE [®])	Thread Lock and Sealer (Medium Strength)	



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COMPONENT LOCATION

CLUTCH HOUSING





1. Seal

2. Sleeve, 30x35x13

3. Snap Ring, 30

4. Cap Screw /Washer

5. Plug, PT 1/8

6. Screw /Washer

7. Washer, Seal

8. Case, Reverse

9. Gasket, Case

10. Packing

11. Cap Screw /Washer

12. Cover, Front

13. Pin, 8x18

14. Gasket, Front Cover

15. Housing, Clutch

16. Bolt

17. Nut

18. Lock Washer

19. Stud, 16x45

20. Bushing, 13x17x14

21. Plate, Center

22. Bolt

23. Stud, 12x45

24. Lock Washer

25. Nut

26. Bolt

27. Cap, Sealing

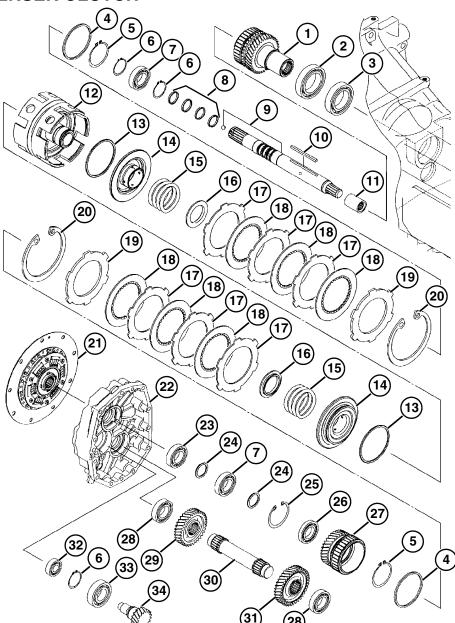
28. Cover, Housing

29. Cap Screw /Washer

M91840

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POWRREVERSER CLUTCH





1. Gear, Clutch (36T)

2. Ball Bearing

3. Ball Bearing

4. Ring, 90

5. Snap Ring, 45

6. Snap Ring, 30

7. Ball Bearing

8. Ring, Seal, 26x30x3

9. Shaft w/Ball (1/4)

10. Key, 5x5x80

11. Splined Coupling

12. Clutch Cylinder

13. Ring, 95

10. I lilig, 33

14. Piston, Clutch

15. Spring, Return

16. Hook, Spring

17. Plate, Friction 3.0

18. Plate, Separator, 130

19. Plate, End 5.0

20. Snap Ring, 130

21. Disk, Damper

22. Cover, Front

,

23. Ball Bearing24. Washer, 30x36x2

o- o - D: --

25. Snap Ring, 55

26. Ball Bearing

27. Gear, Clutch (33T)

28. Ball Bearing

29. Gear, Driven (34T)

M91830

30. Shaft, Transfer P/R

31. Gear, Driven (37T)

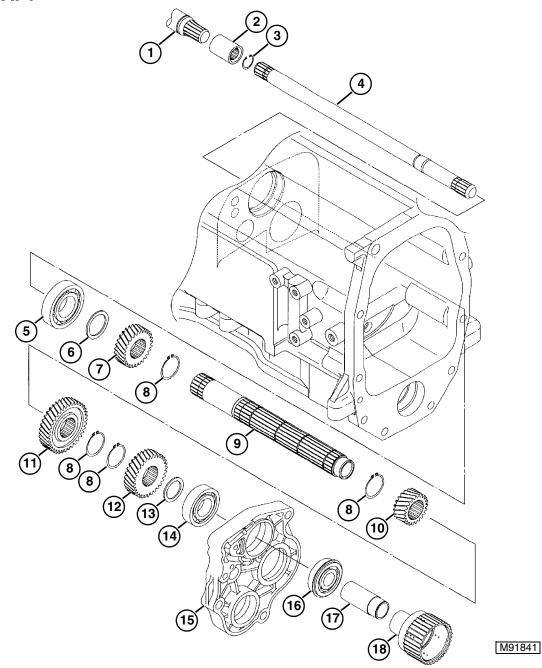
32. Ball Bearing

33. Ball Bearing

34. Gear, Idler (17T)

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MAIN SHAFT





- 1. Shaft, Input
- 2. Splined Coupling
- 3. Snap Ring, 19
- 4. Drive Shaft, PTO
- 5. Ball Bearing

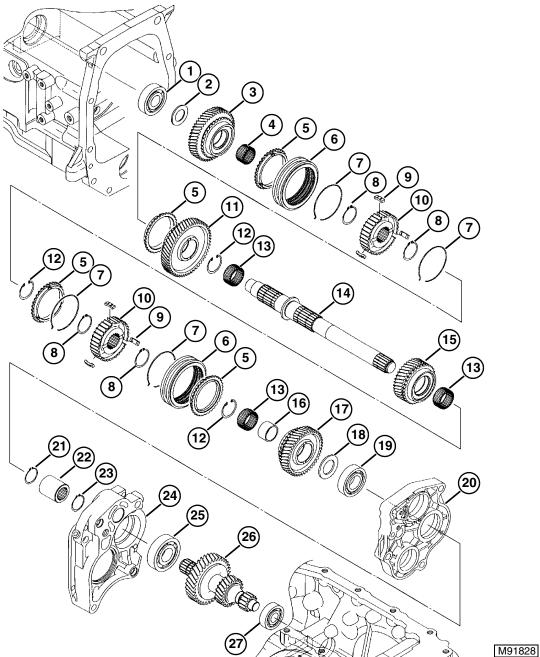
- 6. Spacer, 35x45x2
- 7. Gear, Main (27T)
- 8. Snap Ring, 34
- 9. Shaft, Mid
- 10. Gear (21T)

- 11. Gear (37T)
- 12. Gear, Main (31T)
- 13. Spacer, 30x40x2
- 14. Ball Bearing
- 15. Plate, Center

- 16. Bearing
- 17. Spacer, 23x30x72
- 18. Hub, PTO Splined

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DRIVEN & REDUCTION SHAFT





- 1. Ball Bearing
- 2. Washer, 20x43x2.5
- 3. Gear, Driven (49T)
- 4. Needle Bearing
- 5. Ring, Synchromesh
- 6. Collar, Shift
- 7. Spring, Synchromesh

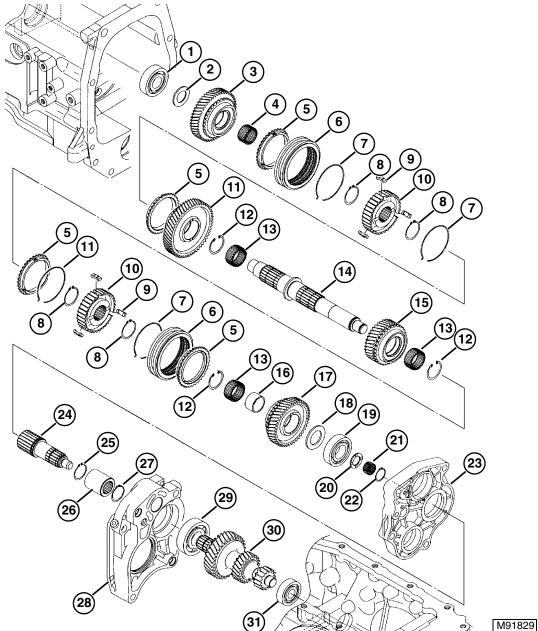
- 8. Snap Ring, 34
- 9. Key, Synchromesh
- 10. Hub, Synchromesh
- 11. Gear, Driven (53T)
- 12. Snap Ring, 40
- 13. Needle Bearing
- 14. Shaft, Driven

- 15. Gear, Driven (38T)
- 16. Ring, Inner
- 17. Gear, Driven (44T)
- 18. Washer, 30x45x3
- 19. Ball Bearing
- 20. Plate, Center
- 21. Snap Ring, 30

- 22. Splined Coupling
- 23. Snap Ring, 30
- 24. Housing, Bearing
- 25. Ball Bearing
- 26. Gear, Reduction
- 27. Ball Bearing

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DRIVEN & REDUCTION SHAFT (CREEPER)





- 1. Ball Bearing
- 2. Washer, 20x43x2.5
- 3. Gear, Driven (49T)
- 4. Needle Bearing
- 5. Ring, Synchromesh
- 6. Collar, Shift
- 7. Spring, Synchromesh
- 8. Snap Ring, 34

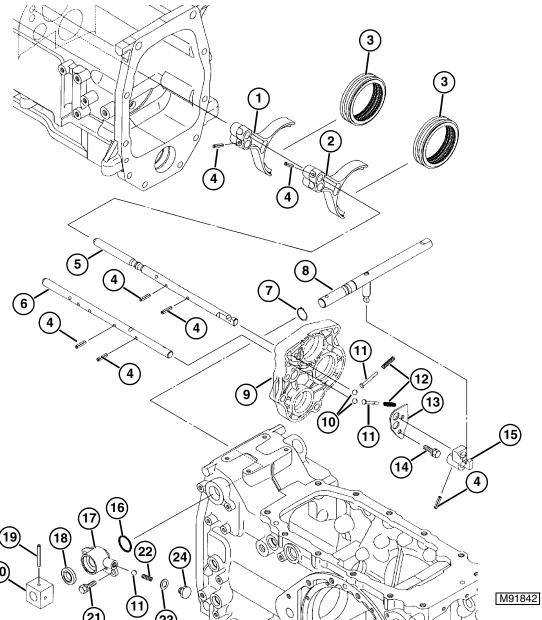
- 9. Key, Synchromesh
- 10. Hub, Synchromesh
- 11. Gear, Driven (53T)
- 12. Snap Ring, 40
- 13. Needle Bearing
- 14. Shaft, Driven
- 15. Gear, Driven (38T)
- 16. Ring, Inner

- 17. Gear, Driven (44T)
- 18. Washer, 30x45x3
- 19. Ball Bearing
- 20. Washer, 20x32x2
- 21. Roller Bearing, Cage
- 22. Snap Ring, 20
- 23. Plate, Center
- 24. Shaft, Connecting

- 25. Snap Ring, 30
- 26. Splined Coupling
- 27. Snap Ring, 30
- 28. Housing, Bearing
- 29. Ball Bearing
- 30. Gear, Reduction
- 31. Ball Bearing

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MAIN GEAR SHIFT





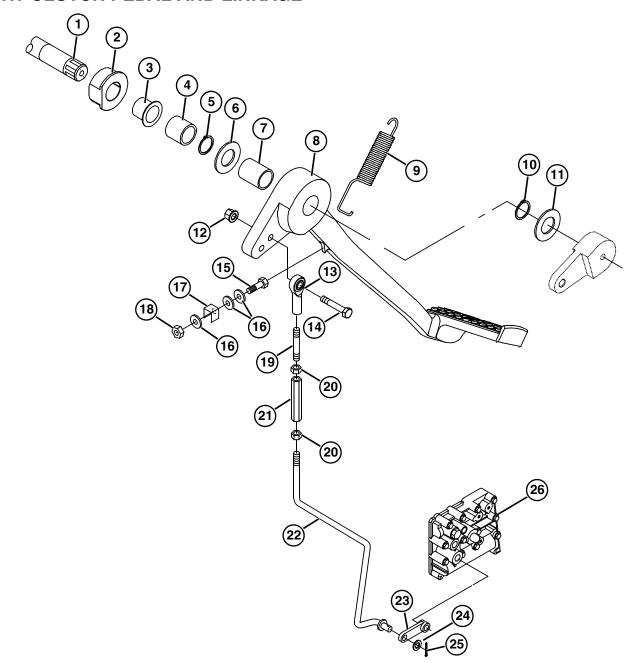
- 1. Shift Fork, 3 4
- 2. Shift Fork, 1 2
- 3. Shifter
- 4. Spring Pin, 6.0x25
- 5. Shaft, Fork (3 4 / 2 3)
- 6. Shaft, Fork (1 2 / 1 R)

- 7. Snap Ring, 20
- 8. Shift Arm, Main
- 9. Plate, Center
- 10. Ball, 5/16
- 10. Daii, 5/10
- 11. Pin, 4x35
- 12. Spring

- 13. Plate, Fork Lock
- 14. Screw /Washer
- 15. Shifter, Main
- 16. O-Ring
- 17. Holder, Shift Arm
- 18. Seal

- 19. Spring Pin, 6.0x50
- 20. Shifter Block
- 21. Cap Screw/Washer
- 22. Spring
- 23. Gasket
- 24. Plug

PRT CLUTCH PEDAL AND LINKAGE





- 1. Shaft
- 2. Bearing
- 3. Bushing
- 4. Spacer
- 5. Snap Ring
- 6. Thrust Washer
- 7. Bushing

- 8. Pedal
- 9. Clutch Spring
- 10. Snap Ring
- 11. Thrust Washer
- 12. Lock Nut
- 13. Spherical Rod End
- 14. Cap Screw

15. Cap Screw (Stop)

22. Rod

23. Lever

24. Washer

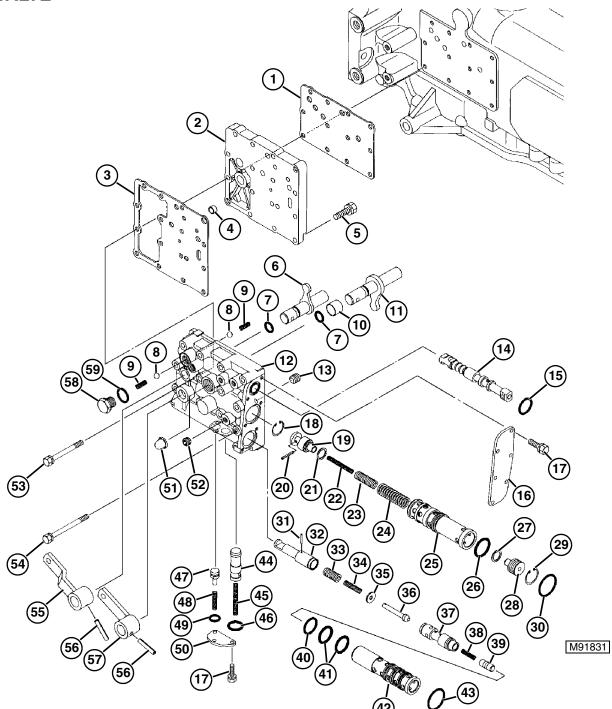
25. Cotter Pin

26. PRT Body

- 16. Washer
- 17. Bracket
- 18. Lock Nut
- 19. Rod
- 20. Nut
- 21. Turnbuckle

6/27/00 **7 - 11**

PRT VALVE

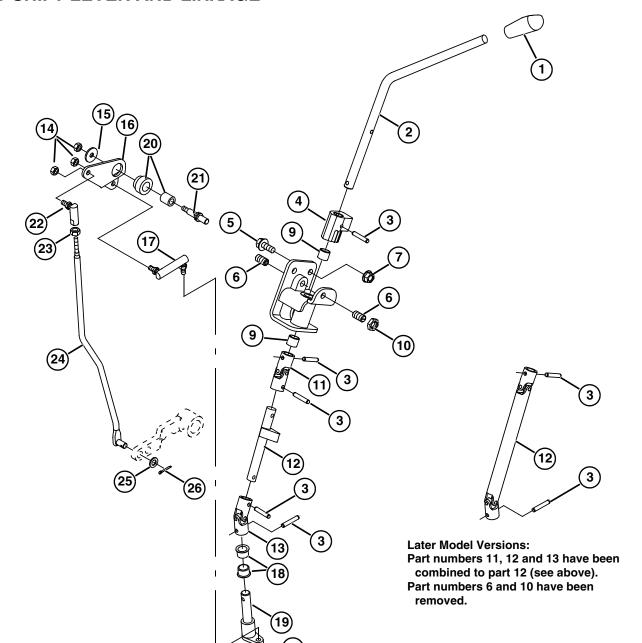




1. Gasket	16. Cover, Spool	31. Pin, 2x18	46. O-Ring, 18
2. Plate, Valve	17. Bolt/Washer	32. Valve, Shift Body	47. Valve, Relief
3. Gasket	18. Snap Ring, 20	33. Spring, CV Outer	48. Spring, Relief
4. Bushing, 11x7	19. Valve, Drive	34. Spring, CV Inner	49. Packing, 12.5
5. Bolt/Washer	20. Spring Pin, 3.0x28	35. Washer, 1.6	50. Cover, Relief
6. Arm, Shift	21. Shim	36. Pin, Guide	51. Strainer
7. Packing	22. Spring, Drive Inner	37. Valve, Inner Body	52. Plug, PT 1/8
8. Ball, 5/16	23. Spring, Drive Center	38. Spring, CV Return	53. Cap Screw /Washer
9. Spring	24. Spring, Drive Outer	39. Valve Pin	54. Cap Screw /Washer
10. Valve, Cut-Off	25. Spool, Drive	40. Packing, 22	55. Shift Arm, Clutch
11. Arm, Clutch	26. Packing	41. Packing, 24	56. Spring Pin, 6.0x32
12. Case, Valve	27. Shim	42. Sleeve, Valve	57. Shift Arm, F/R
13. Orifice	28. Relief Valve, Drive	43. Packing, 29	58. Plug
14. Spool, P/R	29. Snap Ring, 22	44. Valve	59. Packing
15. Packing	30. Packing, 32	45. Spring, Cut-Off	



PRT SHIFT LEVER AND LINKAGE





8. Support

15. Washer

22. Ball Joint

2. Lever, Control

9. Bearing

11. Joint, Universal

13. Joint, Universal

16. Bellcrank

23. Nut

3. Pin, Spring

10. Nut

17. Link

24. Rod

4. Lever

18. Bushing

25. Washer

5. Screw

12. Cam

19. Shaft

20. Bushing

26. Pin, Cotter

6. Plunger

14. Nut, Lock

21. Bolt

7. Nut, Flange

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THEORY OF OPERATION

PRT CONTROL VALVE OPERATION

Lever In Neutral, Clutch Pedal Up

Function:

The PRT control valve routes hydraulic oil to the forward and reverse PRT clutches, and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve
- Lubrication Relief Valve
- Lubrication Cut-Off Valve
- Modulation Valve
- Forward / Reverse Valve

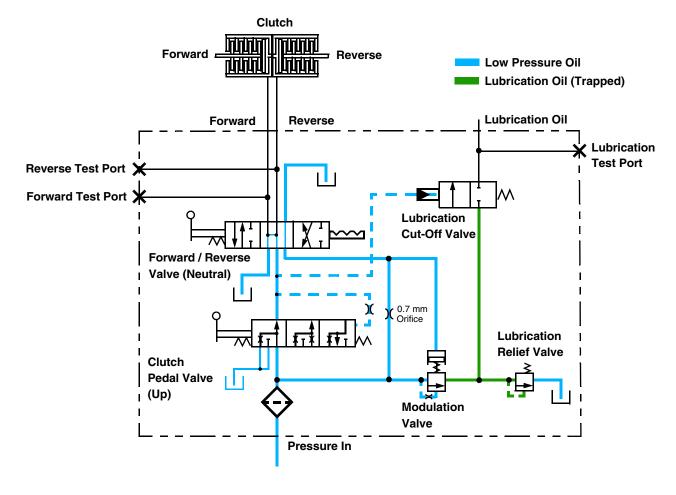
Theory of Operation:

Charge pressure oil flows into the valve, passes through a mesh screen and flows to the modulation valve. Oil entering the modulation valve does not have enough pressure to overcome the spring pressure, and the modulation valve remains closed.

Oil passes through the 0.7 mm orifice, through the forward / reverse valve, and returns to the sump. This oil also flows to the piston side of the modulation valve.

Oil flows through the clutch pedal valve to the forward / reverse valve. With the forward / reverse valve in the NEUTRAL position, oil returns to the sump through the forward / reverse valve sump passage.

Oil pressure between the clutch pedal valve and the forward / reverse valve is insufficient to overcome the spring pressure of the lubrication cut-off valve. With the lubrication cut-off valve unable to open, oil is trapped between the lubrication relief valve, the modulation valve, and the lubrication cut-off valve.





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PRT CONTROL VALVE OPERATION

Lever In Forward, Clutch Pedal Down

Function:

The PRT control valve routes hydraulic oil to the forward and reverse PRT clutches, and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve
- Lubrication Relief Valve
- Lubrication Cut-Off Valve
- Modulation Valve
- Forward / Reverse Valve

Theory of Operation:

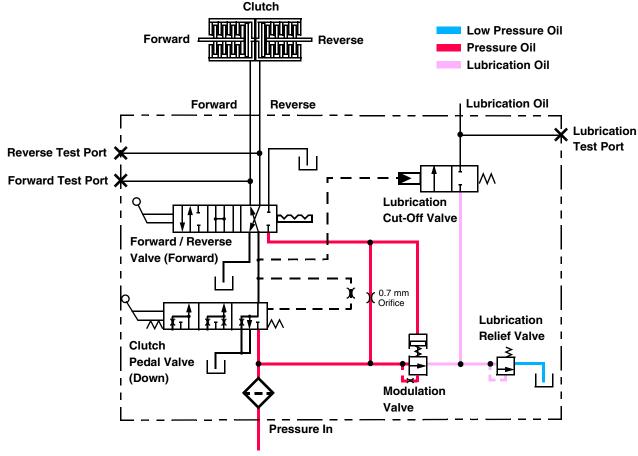
The charge oil passage, and forward / reverse valve oil passage are blocked by the clutch pedal valve (down position).

Under these conditions, the modulation valve relieves the high pressure oil to the lubrication relief valve, which opens, and returns the oil to the sump.

As the clutch pedal is released (returned to the up position) system pressure will increase gradually, and oil will flow through the forward / reverse valve into the forward clutch, and start clutch engagement.

If clutch pedal will not open fully, (pedal stroke adjustment is not correct) tractor forward speed may be reduced because charge oil will continue to flow past the modulation valve, reducing pressure to the forward clutch, and allowing clutch to slip.





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PRT CONTROL VALVE OPERATION

Lever In Forward, Clutch Pedal Up

Function:

The PRT control valve routes hydraulic oil to the forward and reverse PRT clutches, and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve
- Lubrication Relief Valve
- Lubrication Cut-Off Valve
- Modulation Valve
- Forward / Reverse Valve

Theory of Operation:

Charge pressure oil flows through the clutch pedal valve, through the forward / reverse valve, and into the forward clutch pack.

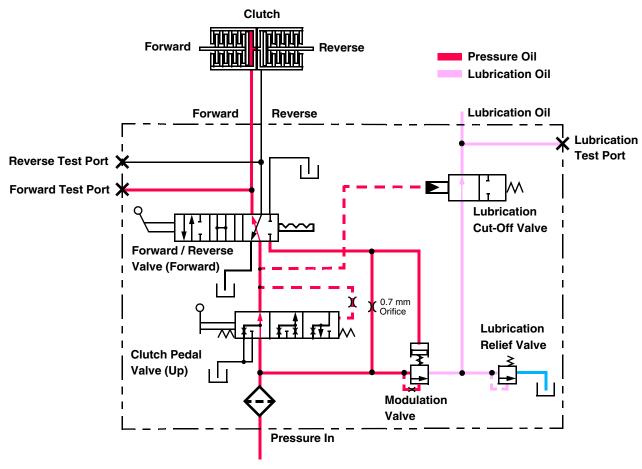
Charge pressure oil also flows into the modulation valve. The modulation valve opens, allowing oil to flow

past the lubrication relief valve to sump. At the same time, charge oil flows through the 0.7 mm orifice, and into the piston side of the modulation valve, causing pressure to push against the valve piston. The piston pushes against the three nested springs contained in the modulation valve, closing the valve. The spring force increases the pressure at which the valve opens. The increased pressure flows through the clutch pedal valve and forward / reverse valve to the forward clutch pack, gradually increasing the oil pressure delivered to the clutch.

The three springs inside the modulation valve also act as an accumulator, allowing oil pressure to increase at different rates (modulate), providing smooth engagement of the clutch pack at different rpm ranges.

As the pressure increases and decreases with clutch valve movement, the lubrication cut-off valve opens and closes. Oil flowing through the lubrication cut-off valve provides lubrication oil to the clutch packs.





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PRT CONTROL VALVE OPERATION

Lever In Reverse, Clutch Pedal Up

Function:

The PRT control valve routes hydraulic oil to the forward and reverse PRT clutches, and controls all functions of the hydraulic reverser.

Major Components:

- Clutch Pedal Valve
- Lubrication Relief Valve
- Lubrication Cut-Off Valve
- Modulation Valve
- Forward / Reverse Valve

Theory of Operation:

Charge pressure oil flows through the clutch pedal valve, through the forward / reverse valve, and into the reverse clutch pack.

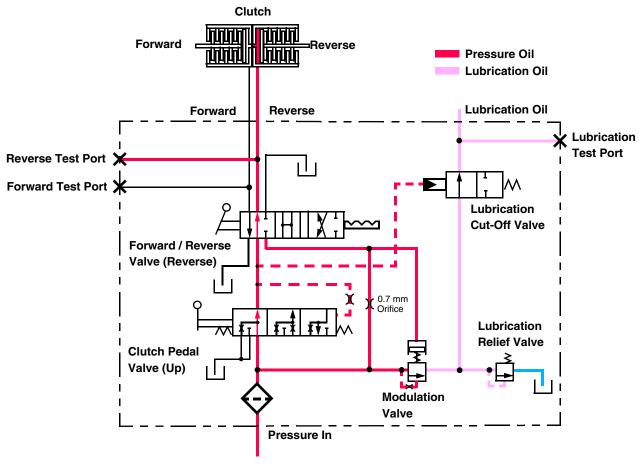
Charge pressure oil also flows into the modulation valve. The modulation valve opens, allowing oil to flow

past the lubrication relief valve to sump. At the same time, charge oil flows through the 0.7 mm orifice, and into the piston side of the modulation valve, causing pressure to push against the valve piston. The piston pushes against the three nested springs contained in the modulation valve, closing the valve. The spring force increases the pressure at which the valve opens. The increased pressure flows through the clutch pedal valve and forward / reverse valve to the reverse clutch pack, gradually increasing the oil pressure delivered to the clutch.

The three springs inside the modulation valve also act as an accumulator, allowing oil pressure to increase at different rates (modulate), providing smooth engagement of the clutch pack at different rpm ranges.

As the pressure increases and decreases with clutch valve movement, the lubrication cut-off valve opens and closes. Oil flowing through the lubrication cut-off valve provides lubrication oil to the clutch packs.





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PRT CLUTCH OPERATION – FORWARD

Function:

To transfer power from the engine flywheel, through the clutch cylinder and then to the mid shaft to rotate the mid shaft in the same direction as the engine flywheel.

Theory of Operation:

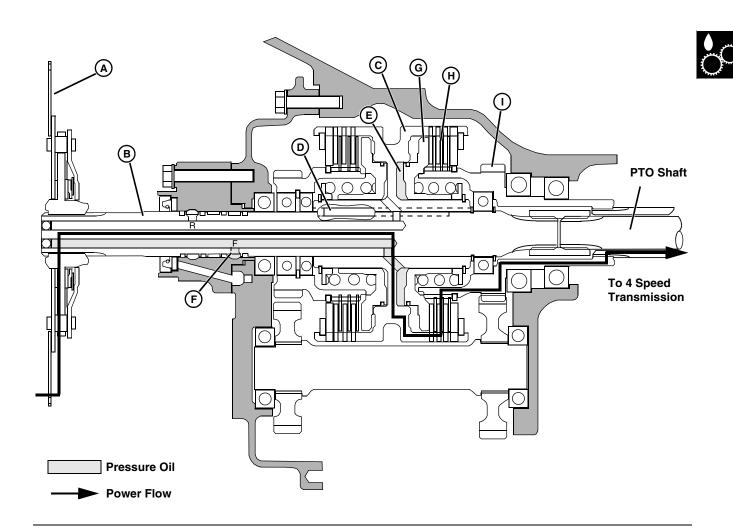
The damper disk (A) is bolted to the engine flywheel and splined to the input shaft (B). The input shaft is connected to the clutch cylinder (C) with a key (D). When the engine is running the clutch cylinder is rotating at the same rpm as the engine.

When the tractor is placed in forward and the clutch is released, pressure hydraulic oil is routed through the PRT valve to the rear half of the clutch cylinder (E) through the reverse case on bolted to the front cover and through a hole (F) bored in the input shaft. See PRT CONTROL VALVE OPERATION "Lever In Forward, Clutch Pedal Up" on page17.

The hydraulic oil forces the clutch piston (G) to press the clutch friction plates (H) together with the separator plates. The friction plates have tangs which fit into slots in the clutch cylinder. The separator plates are splined to the clutch gear (I). When the friction and separator plates are pressed together power is transferred from the clutch cylinder to the clutch gear.

The clutch gear is splined to the mid shaft. The mid shaft has four gears splined to it that are the input gears for the 4 speed transmission. See "4 SPEED TRANSMISSION OPERATION" on page21.

Forward engagement of the PRT clutch causes the mid shaft to rotate in the same direction and speed of the engine flywheel. It operates independently of the PTO shaft which is splined directly to the input shaft. The PTO shaft always operates in the same direction and speed of the engine flywheel.



PRT CLUTCH OPERATION – REVERSE

Function:

To transfer power from the engine flywheel, through the clutch cylinder, idler gear, transfer shaft and then to the mid shaft to rotate the mid shaft in the opposite direction of the engine flywheel.

Theory of Operation:

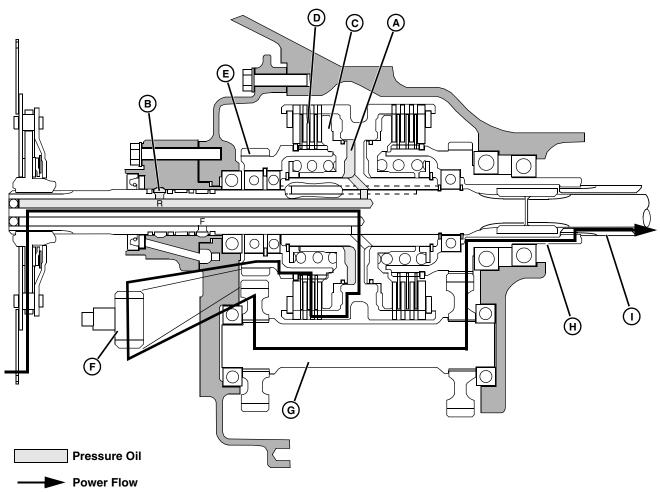
When the tractor is placed in reverse and the clutch is released, pressure hydraulic oil is routed through the PRT valve to the front half of the clutch cylinder (A) through the reverse case on bolted to the front cover and through a hole (B) bored in the input shaft. See PRT CONTROL VALVE OPERATION "Lever In Reverse, Clutch Pedal Up" on page18.

The hydraulic oil forces the clutch piston (C) to press the clutch friction plates (D) together with the separator plates. The friction plates have tangs which fit into slots in the clutch cylinder. The separator plates are splined to the clutch gear (E). When the friction and separator plates are pressed together power is transferred from the clutch cylinder to the clutch gear.

The clutch gear is engaged to the idler gear (F) [shown off center for clarity]. The idler gear is engaged to the transfer shaft (G). The transfer shaft is engaged to the rear clutch gear (H) which is splined to the mid shaft (I).

Reverse engagement of the PRT clutch causes the mid shaft to rotate in the opposite direction of the engine flywheel. It operates independently of the PTO shaft which is splined directly to the input shaft. The PTO shaft always operates in the same direction and speed of the engine flywheel.





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4 SPEED TRANSMISSION OPERATION

Function:

To transfer power from the mid shaft to the driven shaft.

Theory of Operation:

When the PRT transmission is engaged in either forward or reverse, there is rotation of the mid shaft (A) going into the tractor tunnel. There are four gears splined to the mid shaft.

There are four corresponding gears on the driven shaft (B) that are constantly meshed to the four gears on the mid shaft. The four gears on the driven shaft are mounted on roller bearings (C) and turn independently from the driven shaft. Two synchromesh collars (D) are splined to the driven shaft (B) and can be shifted individually forward or backward to engage the driven shaft to the mid shaft.

Power flow is shown below with the left synchromesh collar shifted to engage 1st gear.

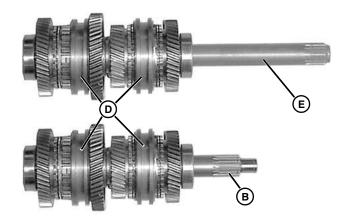
The driven shaft transfers power to the reduction shaft of the range gears.

The driven shaft can be one of two types. A longer straight shaft (E) that is splined directly to the reduction shaft, or a shorter splined shaft (B) that is used if the

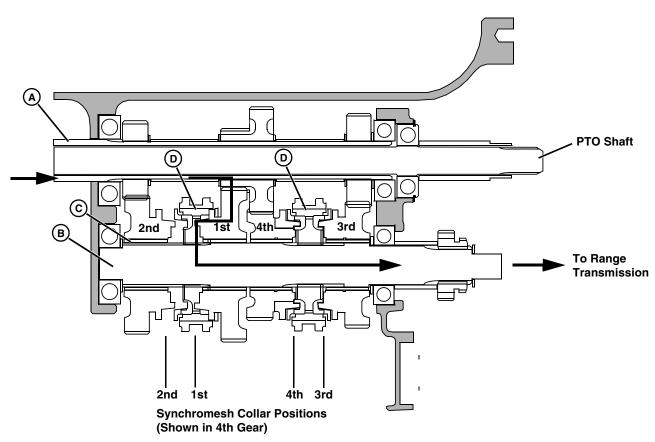
creeper option is installed.

Without the creeper option, power is transferred directly when the driven shaft (E) is connected directly to the reduction shaft with a splined collar.

With the creeper option the shorter driven shaft may be directly coupled to the reduction shaft with the splined creeper gear, or disconnected from the adaptor and have the power routed through the creeper shaft and reduction gears. See "CREEPER OPERATION" on page 22.







CREEPER OPERATION

Function:

To transfer power from the driven shaft, through the creeper gears and then to the range transmission. The creeper operation transfers power from the driven shaft to the reduction shaft through two additional sets of gears to slow the rpm's of the pinion shaft.

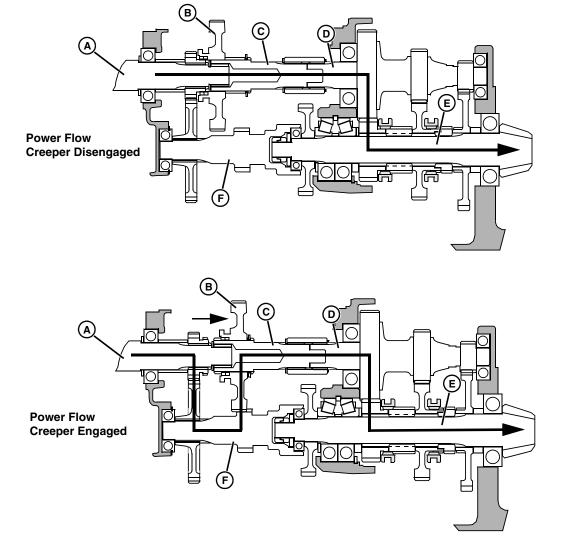
Theory of Operation:

When the creeper is disengaged, power from the driven shaft (A) is transferred directly through the splined creeper gear (B) to the creeper connecting shaft (C). The creeper connecting shaft (C) is splined to the reduction gear shaft (D) with range gears. The range gears supply power to the pinion shaft (E) when it is engaged. Any time the driven shaft is turning, the geared creeper shaft (F) is turning. However, the creeper shaft is not connected to an output and is idling.

When the creeper is engaged, a shift fork moves the creeper gear (B) rearward. The rearward movement disconnects the driven shaft (A) from the creeper connecting shaft (C). The rearward movement engages the creeper gear to the creeper shaft (F) gear.

Power is now transferred from the driven gear (A) to the creeper shaft (F). The creeper shaft drives the creeper gear (B) which is splined to the creeper connecting shaft (C). From the creeper shaft power is supplied to the reduction shaft and the pinion shaft in the same manner as when the creeper is disengaged.





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TESTS AND ADJUSTMENTS

PRT CLUTCH ADJUSTMENT

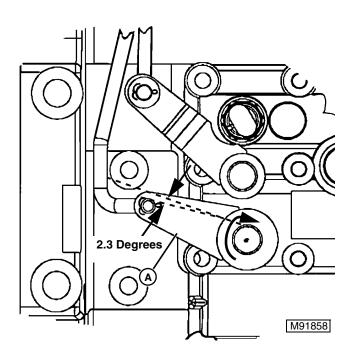
Reason:

To ensure that forward and reverse clutches engage fully, and to prevent clutch slippage which may result in reduced ground speed.

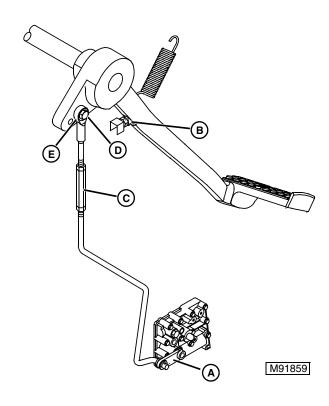
Procedure:

- 1. Remove LH engine side panel.
- 2. Make sure clutch pedal spring is NOT installed.
- 3. Loosen lock nuts and turnbuckle.
- Remove cap screw securing clutch rod to clutch pedal. Remove clutch rod (spherical rod end) from clutch pedal.
- 5. Push clutch pedal down fully and retain in this position.

NOTE: Pedal stop cap screw should be adjusted so that pedal does not contact brake pivot cap screw head.



6. Using an adjustable wrench, turn clutch control arm (A) clockwise until it stops.



NOTE: Disconnect spring to allow free play in pedal.

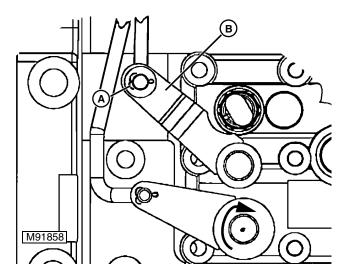
- 7. With clutch pedal fully depressed to clutch stop cap screw (B), and control arm fully rotated clockwise, loosen lock nuts and adjust turnbuckle (C) until cap screw (D) can be placed through spherical rod end (E) and clutch pedal.
- 8. Install cap screw.
- There should not be any free play on clutch control arm. However, there is no hydrostatic pressure from fully rotated (clockwise) to a rotation of 2.3° counterclockwise.

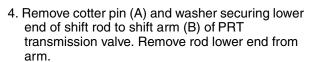


SHIFT LINKAGE ADJUSTMENT

Procedure:

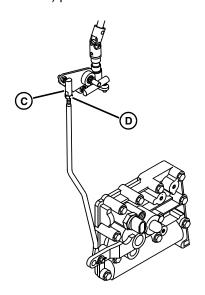
- 1. Remove LH engine side panel.
- 2. Place PRT shift lever in center position.
- Loosen nut locking ball joint to upper end of shift rod.





NOTE: If there are more than one holes in the forward/ reverse shift arm, mark or note which one the lower end of the shift rod goes through.

5. Ensure shift arm of PRT valve is in center (NEUTRAL) position.



- Securely hold ball joint (C), and screw shift rod into or out of ball joint until the lower end of the shift rod aligns with the hole in the PRT shift arm that the shift rod was removed from.
- 7. Insert the shift rod in the PRT shift arm. Secure shift rod with washer and cotter pin.
- 8. Securely hold ball joint and tighten locking nut (D).

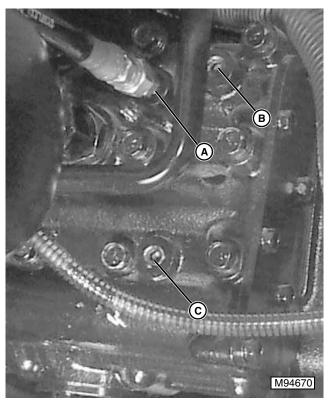
PRT HYDRAULIC PRESSURE TESTS

NOTE: Be sure front gear pump is in good working order, and strainer in inlet port is clean check PRT shift lever linkage adjustment before performing PRT hydraulic pressure tests.

Special or Required Tools:

- JTO 3349 Adapter
- JTO 3017 Hose
- JTO 3344 Gauge

Procedure (Forward and Reverse Pressure):



- 1. Park tractor on a level surface and engage park brake.
- 2. Place range shift and speed shift transmission levers in NEUTRAL.
- 3. If equipped, disengage 4-WD.
- 4. Remove LH lower brake rod.

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- 5. On left side of tractor, below the clutch pedal, locate the PRT transmission valve.
- Remove reverse test port (A) plug and install test equipment.
- 7. Push in clutch pedal.
- 8. Place shift lever in REVERSE.
- 9. Start engine.
- 10. Release clutch pedal.
- Allow two seconds for modulation valve to fully open. Check pressure reading on gauge and record result.
- 12. Shut off engine.

NOTE: When reinstalling test port plugs, seal threads using Teflon[®] tape.

- 13. Remove test equipment and install test port plug.
- Remove forward test port (B) plug and install test equipment.
- 15. Push in clutch pedal.
- 16. Place shift lever in FORWARD.
- 17. Start engine.
- 18. Release clutch pedal.
- Allow two seconds for modulation valve to fully open. Check pressure reading on gauge and record result.
- 20. Shut off engine.

NOTE: When reinstalling test port plugs, seal threads using Teflon[®] tape.

21. Remove test equipment and install test port plug.

Results:

- Pressure on gauge should reach approximately 1723 kPa (250 psi) after 2 seconds.
- If pressure is low:

Check oil filter and bypass and PRT valve hydraulic oil input filter screen.

Measure steering pressure. See "STEERING PRESSURE CHECK" on page 9 in the Steering Section.

PRT valve may have internal leakage. (See "POWRREVERSER CLUTCH VALVE" on page 43.)

 Seals/packings on clutches or drive shaft may be leaking"POWRREVERSER TRACTION CLUTCH" on page39

Procedure (Lubrication Pressure):

- Park tractor on a level surface and engage park brake.
- Place range shift and speed shift transmission levers in NEUTRAL.

- 3. Remove lubrication test port (C) plug and install test equipment.
- 4. Push in clutch pedal.
- 5. Start engine.
- 6. Place forward/reverse (directional) shift lever in FORWARD or REVERSE.
- 7. Release clutch pedal.
- 8. Check pressure reading on gauge and record result.
- 9. Shut off engine.

NOTE: When reinstalling test port plugs, seal threads using Teflon[®] tape.

10. Remove test equipment and install test port plug.

Results:

- Pressure on gauge should read approximately 172 kPa (25 psi).
- If lubrication pressure is low, PRT clutch valve may need to be adjusted, lube oil relief valve may be malfunctioning. (See "PRT CLUTCH ADJUSTMENT" on page 23; or, see "POWRREVERSER CLUTCH VALVE" on page 43.)



REPAIR

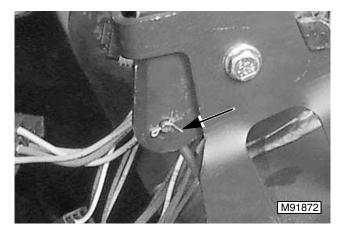
TRACTOR SPLITTING (FRONT)

Special or Required Tools:

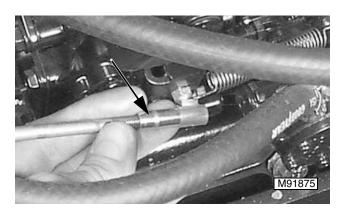
JTO7335 Splitting Stands

Prepare the Tractor:

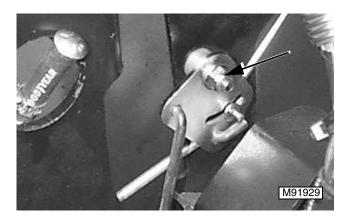
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove side panels.
- 4. Remove hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 5. Remove steering wheel.
- Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 7. Remove LH and RH cowl panels.
- 8. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 9. Remove floor mat.
- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 11. Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- 12. Remove key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- Remove fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 15. Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear half of tractor.



16. Remove cotter pin attaching throttle rod to throttle lever. Disconnect throttle rod.



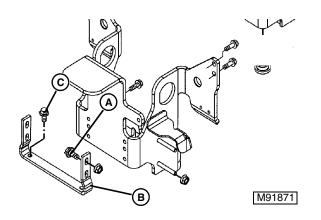
17. If not already done, disconnect throttle linkage from throttle lever on fuel injection pump.

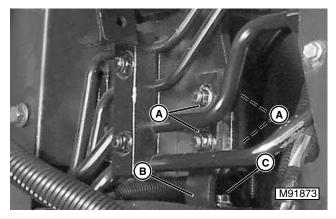


18. Remove lock nut. Remove throttle bellcrank and throttle rods as an assembly.

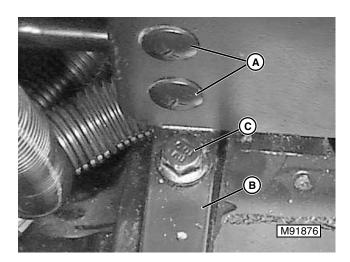


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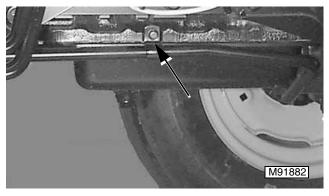




19. Loosen four nuts and carriage bolts (A) attaching U-shaped bracket (B) to pedal support frame.



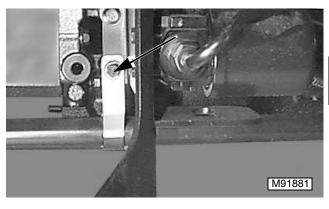
20. Remove two cap screws (C) attaching U-shaped bracket to transmission tunnel.



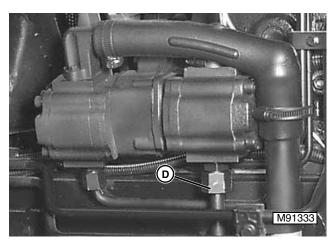
21. On right side of tractor, remove cap screw and tube clamp attaching PTO pressure tube to frame.

NOTE: Capacity of the hydraulic reservoir is **37 liters** (9.8 gal) (39.1 qt).

22. Drain hydraulic oil from reservoir.



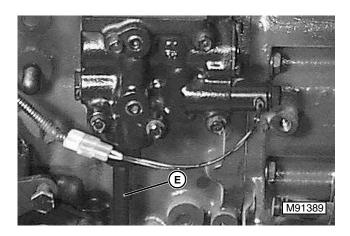
23. Remove cap screw and clamp attaching suction tube to tunnel section.



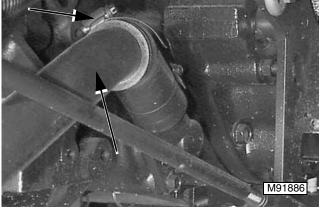
24. Disconnect PTO pressure tube (D) from rear hydraulic pump.



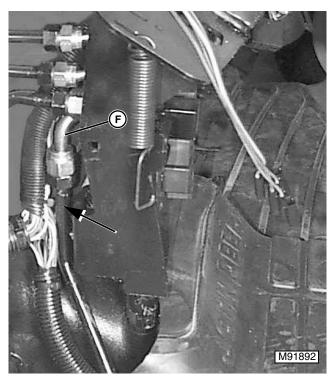
25. Loosen clamp and disconnect suction tube from suction manifold.



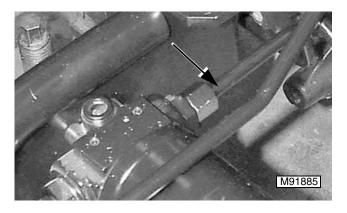
26. Disconnect PTO pressure tube (E) from bottom of PTO valve. Remove tube.



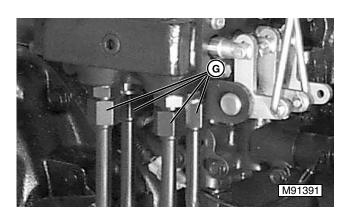
27. Loosen clamp and disconnect suction tube from suction elbow. Remove suction tube.



28. Disconnect tube from steering return hose (F).



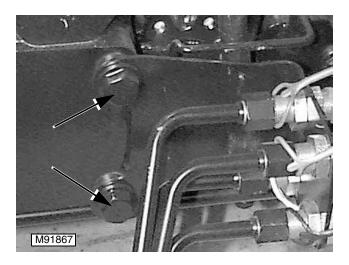
29. Disconnect tube from RH port of hydraulic oil filter. Remove tube.



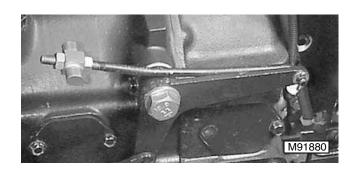


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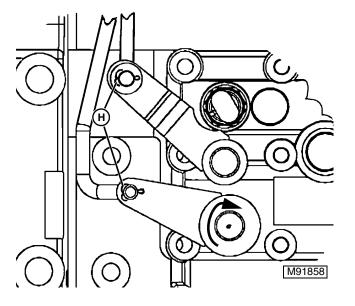
30. If equipped, disconnect four work port tubes (G) from SCV.



31. Remove two cap screws and two spacers that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.



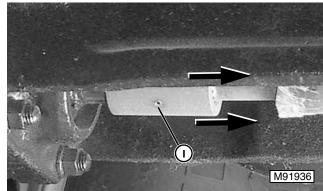
32. If not already removed, lay upper brake rods across bellcrank pivot to prevent them from becoming damaged when separating tractor sections.



 Remove cotter pins (H) and washers from clutch rod and shift rod. Remove rods from PRT clutch and shift arms.

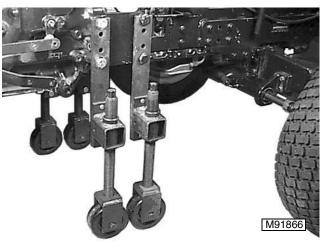


34. Remove two cap screws and RH operator's platform support.



35. If equipped, remove 4-WD drive shaft and couplers by removing split pin (I) and sliding one coupler onto shaft until clear of stub shaft. Lower end of shaft and remove.

Split the Tractor:



- Using eight cap screws supplied with the splitting stands, secure JTO 7335 splitting stands to the tunnel sections.
- 2. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- 3. Remove nine cap screws and lock washers attaching tunnel section to engine section of tractor. Note length and locations of cap screws when removing.
- 4. Release park brake and place gear shift in NEUTRAL.

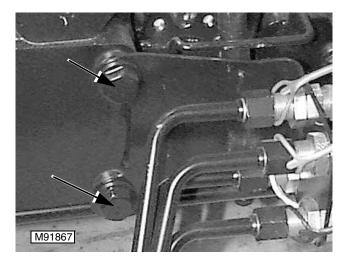
IMPORTANT: Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting tractor.

5. If necessary, use a pry bar to separate the two tractor sections. Lift the steering support slightly to clear the front flange of the tunnel. Split the tractor by rolling the two sections apart.

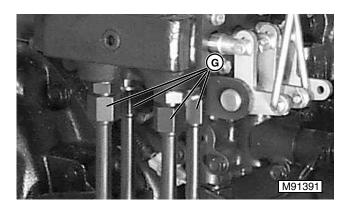
Assemble Tractor Sections:

NOTE: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

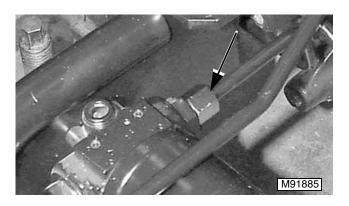
- 1. Align splines on drive shaft and engine flywheel, and, if equipped, 4-WD shaft and coupler.
- 2. Move tractor sections together and retain with nine cap screws. Tighten cap screws to 126-154 N•m (95-115 lb-ft).
- 3. Remove eight cap screws retaining splitting stands to tractor sections. Remove splitting stands.
- 4. If equipped, install 4-WD shaft and couplers.



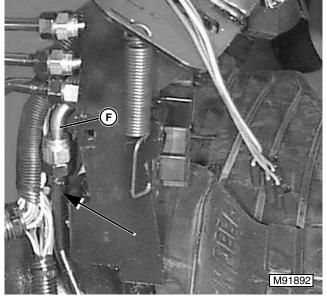
If equipped, install SCV tube support bracket and tubes as an assembly. Install two cap screws and two spacers to attach tube support bracket to frame.



6. Connect four work port tubes (G) to SCV. Tighten to 40-57 N•m (30-43 lb-ft).

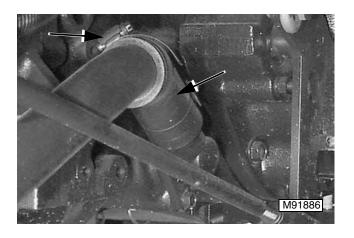


Connect hydraulic oil tube to RH port of hydraulic oil filter.

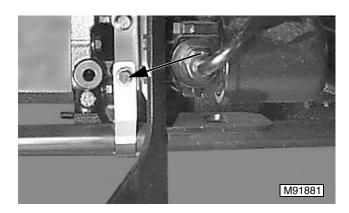


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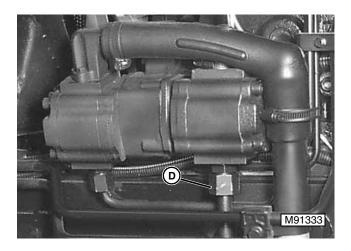
8. Connect hydraulic oil tube to steering return hose (F).



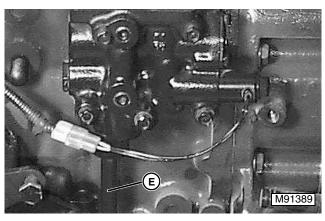
9. Attach suction tube to elbow and retain with clamp.



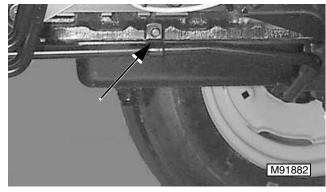
10. Install cap screw and clamp attaching suction tube to tunnel section.



- 11. Connect suction tube to suction manifold and retain with hose clamp.
- 12. Connect PTO pressure tube (D) to rear hydraulic pump. Tighten fitting to 40-57 N•m (30-43 lb-ft).

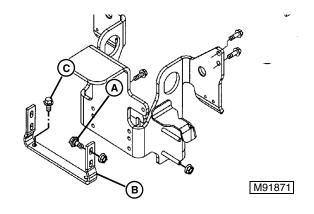


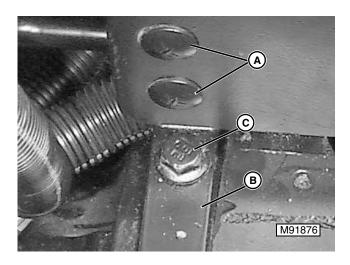
13. Connect PTO pressure tube (E) to bottom of PTO valve. Tighten nut **40-57** N•m (30-43 lb-ft).



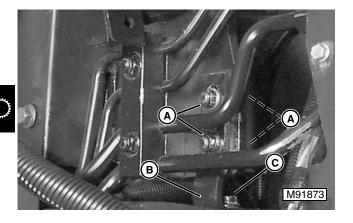


14. On right side of tractor, install tube clamp attaching PTO pressure tube to frame. Retain with cap screw.

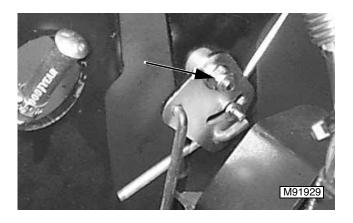




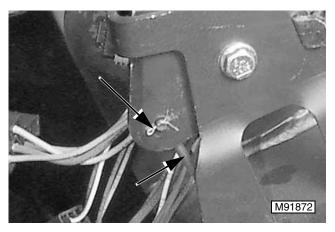
 Install U-shaped bracket (B) to transmission tunnel, retain with two cap screws (C). Tighten cap screws.



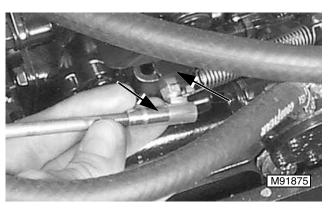
- Install four carriage bolts (A) and nuts attaching Ushaped bracket to pedal support frame and tighten.
- 17. On left side of tractor, tighten two lock nuts loosened at disassembly that attach steering tube clamp to pedal support frame.



18. Install throttle bellcrank and two throttle rods as an assembly. Retain with lock nut.



19. Connect throttle rod to throttle lever. Retain with cotter pin.



- 20. Connect throttle linkage to throttle lever on fuel injection pump.
- 21. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- 22. Install fuel tank. (See "FUEL TANK REMOVAL AND INSTALLATION" on page12 in Miscellaneous Section.)
- 23. Install operator's seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- 24. Install kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 25. Install floor mat.
- 26. Install key switch panel.
- 27. Install fuse panel cover.
- 28. Install LH and RH cowl panels.

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- 29. Install control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- 30. Install steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9 in Miscellaneous Section.)
- 31. Install hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11 in Miscellaneous Section.)
- 32. Install side panels.
- 33. Connect battery negative terminal.

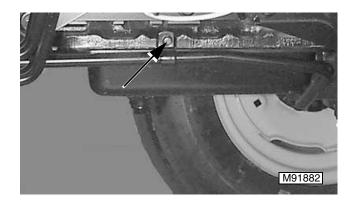
TRACTOR SPLITTING (REAR)

Special or Required Tools:

• JTO7335 Splitting Stands

Procedure:

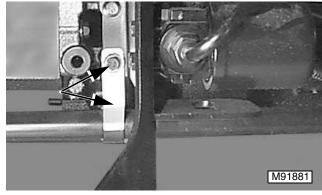
- Park tractor on a level surface. Engage park brake, shut off engine.
- 2. Disconnect battery negative terminal.
- 3. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10 in Miscellaneous Section.)
- Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 6. Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 7. Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in MISCELLANEOUS section.)
- 8. Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- Remove rear fenders. (See "REAR FENDERS REMOVAL AND INSTALLATION" on page 6 in Miscellaneous Section.)
- 10. Locate and disconnect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Unfasten wiring harness from cable clips and move harness away from rear half of tractor.



 On right side of tractor, remove cap screw and tube clamp attaching PTO pressure tube to frame.

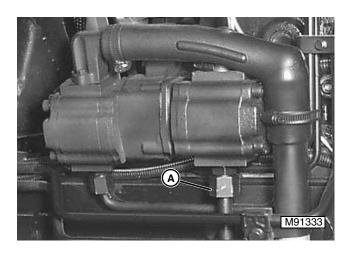
NOTE: Capacity of the hydraulic reservoir is 37 liters (9.8 gal) (39.1 qt).

12. Drain hydraulic oil from reservoir.

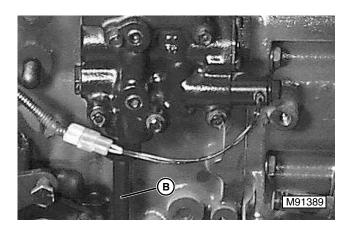


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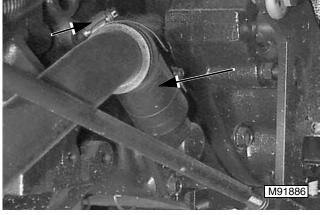
13. Remove cap screw and clamp attaching suction tube to tunnel section.



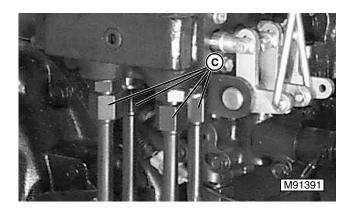
 Disconnect PTO pressure tube (A) from rear hydraulic pump. 15. Loosen clamp and disconnect suction tube from suction manifold.



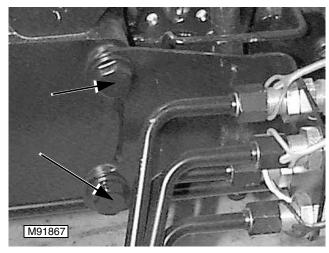
 Disconnect PTO pressure tube (B) from bottom of PTO valve. Remove tube.



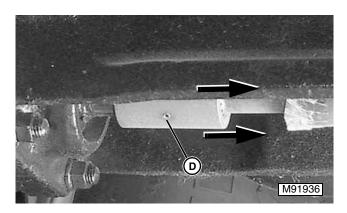
17. Loosen clamp and disconnect suction tube from suction elbow. Remove suction tube.



 If equipped, disconnect four work port tubes (C) from SCV.



- 19. Remove two cap screws and two spacers that attach tube support bracket to frame. Remove tube support bracket and tubes as an assembly.
- 20. Remove cotter pin and clevis pin and disconnect brake rods from brake arms at differential housing.

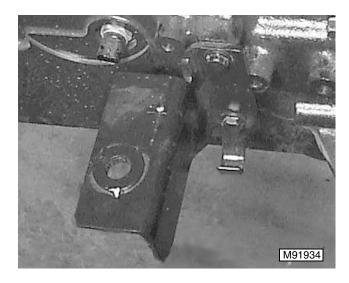


21. If equipped, remove 4-WD drive shaft and couplers by removing split pin (D) and sliding one coupler onto shaft until clear of stub shaft. Lower end of shaft and remove.

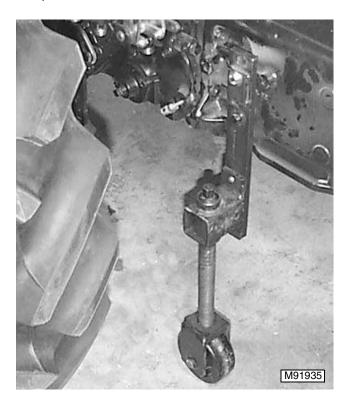




Split the Tractor:



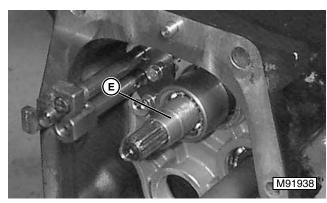
 Remove four cap screws and two rear operator's platform brackets.



- 2. Using four suitable cap screws, secure JTO 7335 splitting stands to the threaded holes in the tunnel section where the operator's platform brackets were removed
- 3. Adjust splitting stands so that wheels contact the floor, and are parallel to the tractor wheels.
- 4. Using suitable stands, support the front and rear of the differential housing.

- Remove four nuts and lock washers and six cap screws attaching tunnel section to differential housing. Note length and locations of cap screws when removing.
- IMPORTANT: Check for, and disconnect any additional accessory wires or hydraulic tubes connecting rear half to front half before splitting tractor
- 6. If necessary, use a pry bar to separate the two tractor halves. Split the tractor by rolling the front section of the tractor away from the differential housing.

Assemble Tractor Sections:



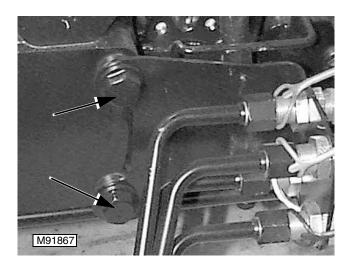


CST Tractor Shown

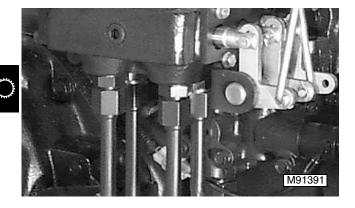
IMPORTANT: Be sure PTO collar (E) is in place on shaft or in end of PTO clutch before assembling tractor sections. Smaller end goes toward PTO clutch.

IMPORTANT: Splines on all drive shafts and couplers must be aligned before tractor sections are bolted together.

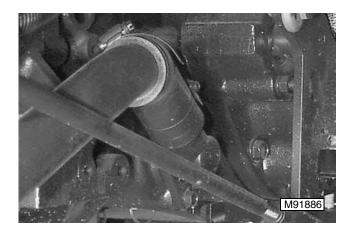
- 1. Align splines on drive shafts and couplers.
- 2. Move tractor halves together and retain with 6 cap screws, four nuts and lock washers. Tighten nuts and cap screws.
- 3. Remove four cap screws retaining splitting stands to tractor sections. Remove splitting stands.
- 4. If equipped, install 4-WD shaft and couplers.



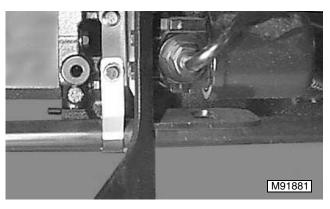
If equipped, install SCV tube support bracket and tubes as an assembly. Install two cap screws and two spacers to attach tube support bracket to frame.



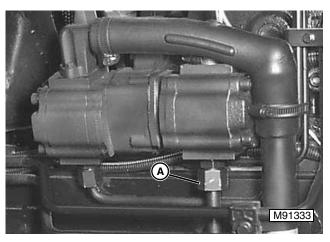
6. Connect four work port tubes to SCV. Tighten to 40-57 N•m (30-43 lb-ft).



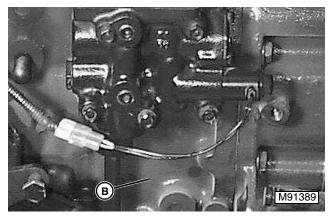
7. Attach suction tube to elbow and retain with clamp.



8. Install cap screw and clamp attaching suction tube to tunnel section.

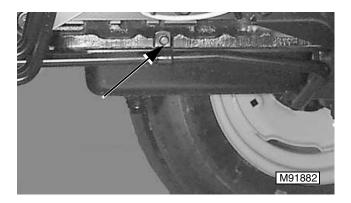


- 9. Connect suction tube to suction manifold and retain with hose clamp.
- Connect PTO pressure tube (A) to rear hydraulic pump. Tighten fitting to 40-57 N•m (30-43 lb-ft).



11. Connect PTO pressure tube (B) to bottom of PTO valve. Tighten to 40-57 Nom (30-43 lb-ft).

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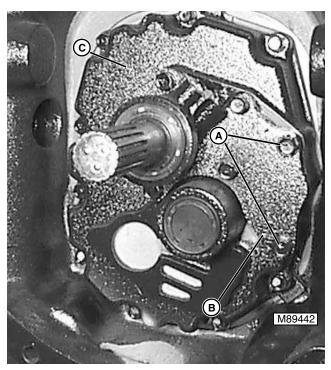
- On right side of tractor, install tube clamp attaching PTO pressure tube to frame. Retain with cap screw.
- Connect brake rods to brake arms on differential housing. Retain with clevis pins and cotter pins.
- 14. Route electrical harness on rear half of tractor. Connect all electrical connectors attaching wiring harness to switches and lights on rear half of tractor. Fasten wiring harness to cable clips. Replace any plastic tie bands removed during disassembly.
- 15. Install operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 16. Install kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 17. Install seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)
- 18. Install seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 19. Install rear fenders. (See "REAR FENDERS REMOVAL AND INSTALLATION" on page 6 in Miscellaneous Section.)
- 20. Install floor mat.
- 21. Install fuse panel cover.
- 22. Connect battery negative terminal.

REVERSE CASE SEAL REPLACEMENT

NOTE: This procedure is different for the two different reverse cases.

 Split the tractor front end from the transmission case at the engine flywheel / transmission case connection. (See "TRACTOR SPLITTING (FRONT)" on page26.)

Procedure 1:



 Remove two cap screws (A) and lock washers securing reverse case (B) (through front cover) to clutch housing tunnel. Remove remaining cap screws securing reverse case to front cover (C).



3. Remove reverse case and gasket.



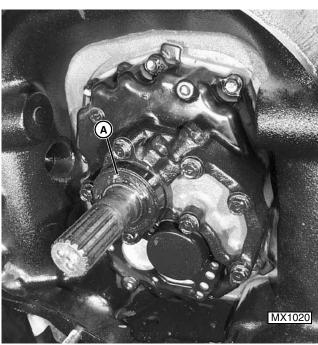
4. Remove seal, sleeve and snap ring from reverse case.



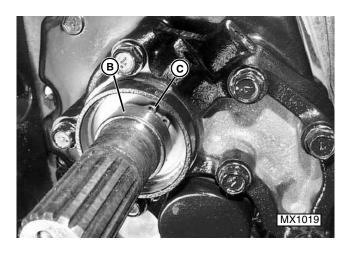
- 5. Remove O-ring and gasket from reverse case. Remove any gasket material from cover.
- 6. Clean ports and channels in reverse case and dry with compressed air.
- 7. Inspect drive shaft bore for wear or scoring.
- 8. Install new front seal, gasket and O-ring
- Install reverse case and cap screws securing reverse case to front cover. Tighten cap screws to 19-23 N•m (14-17 lb-ft).
- Install two cap screws securing reverse case clutch housing (through front cover). Tighten cap screw to 23-29 N•m (17-22 lb-ft).



Procedure 2:



1. Remove seal (A) from drive shaft.



- Remove wear sleeve (B) and snap ring (C). Remove cap screws securing reverse case to front cover.
- Remove cap screws and lock washers securing reverse case to clutch housing tunnel. Remove reverse case and gasket.



- 4. Remove O-ring and gasket from reverse case. Remove any gasket material from cover.
- 5. Clean ports and channels in reverse case and dry with compressed air.
- 6. Inspect drive shaft bore for wear or scoring.
- 7. Install new gasket and O-ring
- Install reverse case and cap screws securing reverse case to front cover. Tighten cap screws to 19-23 N•m (14-17 lb-ft).
- 9. Install two cap screws securing reverse case clutch housing (through front cover). Tighten cap screw to 23-29 N•m (17-22 lb-ft).
- 10. Install snap ring and new wear sleeve to drive shaft.
- 11. Install new seal.

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POWRREVERSER TRACTION CLUTCH

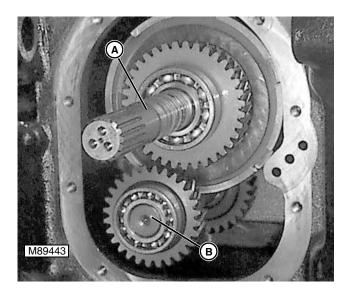
Special or Required Tools:

• JDT 24B Spring Washer Compressor

Removal:

- Split the tractor front end from the transmission case at the engine flywheel / transmission case connection. (See "TRACTOR SPLITTING (FRONT)" on page26.)
- 2. Remove reverse case cover. (See "REVERSE CASE SEAL REPLACEMENT" on page37.)
- 3. Remove remaining cap screws and lock washers securing traction front cover to transmission case (includes two cap screws through reverse case).
- 4. Remove front cover and gasket.

NOTE: Drive shaft, clutch, counter shaft and splined coupling may come out with front cover.



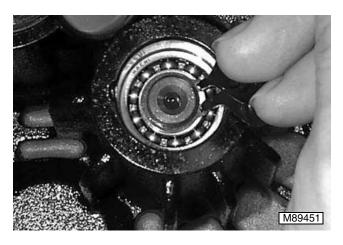
NOTE: When the drive shaft (A) is removed the reverse transfer shaft (B) end bearing will pull out from transmission case and drop. Support reverse transfer shaft with one hand and pull drive shaft froward with the other.

- Remove drive shaft and clutch by pulling straight forward.
- 6. Remove reverse transfer shaft.

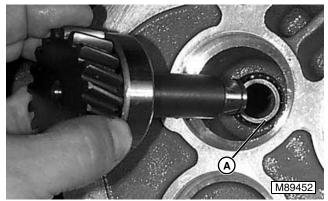
Traction Clutch Idler Gear Removal:

1. Remove front cover from tractor transmission case.

2. Remove idler gear seal from front of front cover.



3. Remove snap ring.





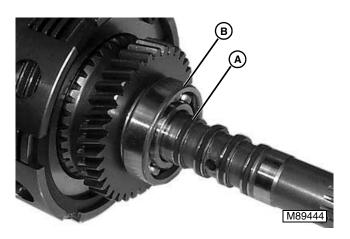
- 4. Remove traction clutch idler gear and bearing.
- 5. Using finger bearing puller, or press, remove bearing (A) from front cover.
- 6. Using a knife edge bearing puller, remove bearing from idler gear shaft.

IMPORTANT: DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.

- Clean bearings in suitable solvent. Dry with compressed air.
- 8. Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.
- Inspect idler gear-17T for damage. Replace as required.
- Inspect idler gear shaft bearing surfaces. If damaged, replace idler gear.
- 11. Install in reverse order of removal. Use new seal.

Traction Clutch Disassembly:

 Remove traction drive shaft and clutch to clean work area.



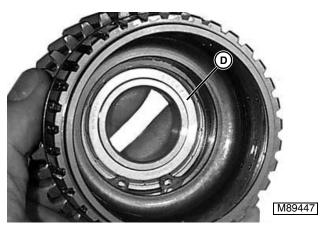
- 2. Remove four split ring seals (A) from shaft.
- 3. Using a knife edge bearing puller, remove bearing (B) from shaft.



4. Remove snap ring (C) from shaft.



5. Remove clutch gear-33T and bearing from shaft.



NOTE: There is a thrust washer located (D) between the two bearings that support the clutch gear-33T. The thrust washer prevents damage to the snap ring. During removal, the thrust washer may stick to either bearing or fall out.



- Remove thrust washer and snap ring from clutch gear-33T.
- 7. Press bearing from clutch gear-33T.



8. Using a knife edge bearing puller, remove bearing from shaft.

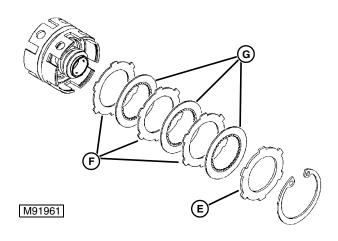
IMPORTANT: DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.

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- 9. Clean bearings in suitable solvent. Dry with compressed air.
- 10. Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.
- 11. Slide clutch assembly off shaft.



- 12. Remove snap ring and clutch plate pack.
- 13. Perform previous step for other side of clutch assembly.

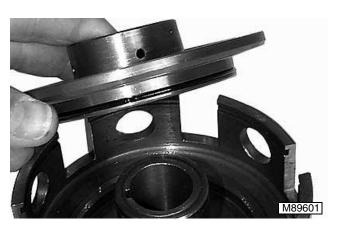


14. Inspect end plate (E), separator plates (F) and friction plates (G) for wear, discoloration, scoring or warping. Measure plate thickness. If plate(s) do not meet minimum plate thickness specification, replace clutch plate pack as a unit.

Specification (Minimum):



- Place clutch body and special tool JDT 24B Spring Washer Compressor on a press or flat jawed vise.
- 16. Compress spring and retaining ring.
- 17. Remove snap ring and slowly release tension on spring.
- 18. Remove snap ring, spring retention plate and spring.



- 19. Remove clutch piston.
- 20. Perform steps 15 through 19 for opposite side.
- Measure length (no load) of each spring. If spring length is less than 45.5 mm (1.79 in.), replace spring.
- 22. Clean clutch body in solvent and dry with compressed air.
- 23. Clean and inspect pistons for wear, corrosion or pitting. Replace as necessary.
- 24. Replace packing on outside of each piston.
- Lubricate all parts with clean, fresh hydraulic oil and reassemble.



Transfer Shaft Disassembly:

- 1. Remove reverse transfer shaft assembly from transmission case with traction clutch assembly.
- 2. Using a knife edge bearing puller, remove bearings, gear-34T and gear-37T from shaft.



IMPORTANT: DO NOT spin bearings using compressed air. Damage to bearing balls, cage and races could result.

- 3. Clean bearings in suitable solvent. Dry with compressed air.
- 4. Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.
- 5. Inspect gear teeth for damage. Replace as required.
- Inspect transfer shaft bearing surfaces. Replace if surfaces are damaged.

Assembly is in reverse order of disassembly.

Installation:

- 1. Remove any old gasket material from clutch front cover and transmission housing tunnel.
- 2. Install idler gear in front cover.
- 3. Assemble transfer shaft if not already assembled. Set transfer shaft aside.
- 4. Install main shaft ball bearing in front cover.
- 5. Align friction plates in clutch, and install rear clutch gear 36T with rear ball bearings.



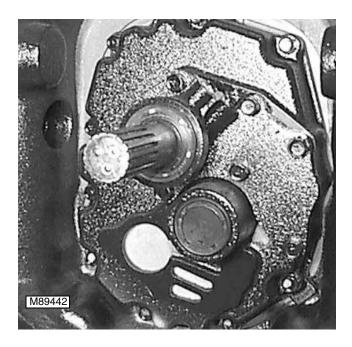
Slide PRT clutch and shaft assembly into front cover until the clutch gear 33T and idler gear 17T almost engage.



- 7. Place transfer shaft assembly (smaller gear-34T toward front cover) next to clutch, engage gears, and slide clutch assembly and transfer shaft assembly into front cover. Ensure transfer shaft front bearing is seated in front cover and all gear teeth are engaged.
- 8. Install new split ring seals on shaft.
- 9. Install entire assembly in clutch housing (tunnel). Rotate clutch shaft as needed to engage splined coupling, and fully seat assembly.
- 10. Install cap screws securing front cover. Tighten cap screws to 23-29 N•m (17-22 lb-ft).



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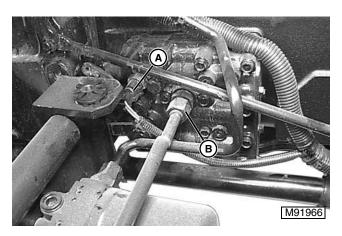


- Install reverse case to front cover. Install two cap screws that go through front cover to clutch housing. Tighten cap two screws to 23-29 N•m (17-22 lb-ft).
- Install remaining cap screws securing reverse case to front cover. Tighten cap screw to 19-23 N•m (14-17 lb-ft).

POWRREVERSER CLUTCH VALVE

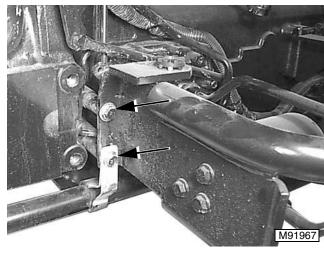
Removal:

- Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- Remove operator's platform. (See "OPERATOR'S PLATFORM REMOVAL AND INSTALLATION" on page 8 in Miscellaneous Section.)
- 3. Disconnect transmission neutral switch wiring harness connector (A).



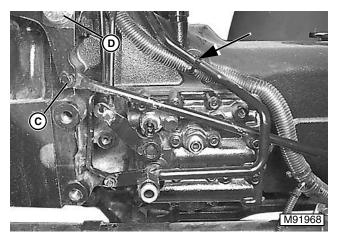
NOTE: When hydraulic line is loosened hydraulic oil in steering block and line will drain. Place suitable (1 gallon) container below line to catch hydraulic oil.

- Loosen hydraulic oil line connections to hydraulic oil filter.
- 5. Disconnect hydraulic line nut (B) to PowrReverser valve, and hydraulic line nut from steering control where it connects to filter assembly.
- 6. Drain hydraulic oil from filter and steering pump (approximately 1 quart).



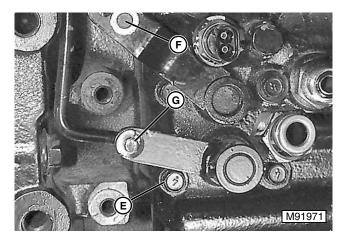


 Loosen two cap screws securing LH footrest bracket to transmission case. Remove cap screws, footrest bracket, filter assembly, and spacers from transmission case.



- 8. Cut and remove tie wrap securing steering return hydraulic line to wiring harness.
- Remove pin and washer (C) from brake rod end. Disconnect opposite end of brake rod from rear axle brake lever.

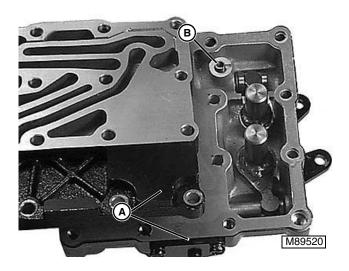
 Loosen brake lever bolt (D) far enough to disconnect and remove brake rod from brake lever. Remove brake rod.



- Depress clutch pedal to expose cap screw (E) behind PRT clutch shift lever. Remove cap screw. Release clutch pedal.
- Remove pin (F) and washer from shift rod end and disconnect shift rod from forward/reverse shift lever on PowrReverser valve.
- 13. Remove pin (G) and washer from clutch rod end.
- 14. Loosen eleven remaining cap screws securing PowrReverser valve to tractor transmission case.
- Remove cap screws and PowrReverser valve from transmission case.

Disassembly:

 Remove four cap screws and lock washers securing PowrReverser valve blocks.



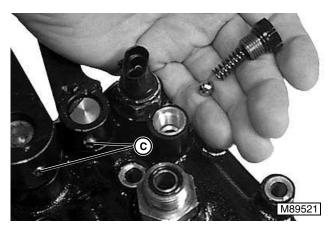
NOTE: Shift spool detent spring and ball may fall out when PowrReverser blocks are separated.

- 2. Separate blocks (A) and gasket.
- 3. Remove shift spool detent spring (B) and ball.
- 4. Inspect hydraulic oil input port filter strainer for debris and intact mesh in strainer. Clean or replace strainer as required.

NOTE: Compressed springs on spools exert slight pressure on side plate.



- Remove three bolts and lock washers, side plate, and packing O-rings from PowrReverser valve. Replace O-rings before reassembly.
- 6. Remove springs and valves. Inspect valves for scratching or other signs of wear. Replace as necessary.
- 7. Do not reinstall valves at this time.



- 8. Turn PowrReverser valve block over and remove and set aside plug, spring and detent ball.
- Using an appropriate punch, remove spring pins (C) from shift arm and clutch arm. Remove shift arm and clutch arm. Replace O-rings on shift and clutch arm shafts.
- 10. Turn PowrReverser valve block over.

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- Remove six cap screw and lock washers, side plate, and O-rings from PowrReverser valve. Replace all O-rings before reassembly.
- 12. Lift lever shafts enough to slide out valve assembly and shift spool.
- 13. Remove drive spool.

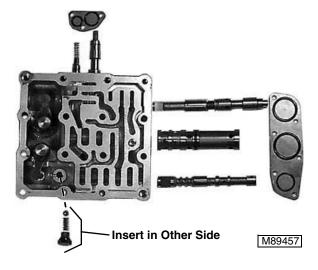


- 14. Separate valve assembly halves. Depress spool guide pin (D), and remove insert pin (E).
- 15. Remove guide pin, spring retention washer and springs from valve half.
- 16. Inspect valve parts for scratching or other signs of wear. Replace as necessary.
- Clean valve parts, lightly coat with clean hydraulic oil, and reassemble.



- 18. Remove snap rings from inside of drive spool.
- Remove spring pin securing relief valve (F) inside drive spool.

- 20. Inspect relief valve surfaces for scratching or other signs of wear. Replace as necessary.
- 21. Inspect three nested springs.
- 22. Clean relief valve parts, lightly coat with clean hydraulic oil and reassemble.
- 23. Clean PowrReverser blocks and cover plates in solvent and dry with compressed air.
- 24. Replace O-ring on drive spool.



- Lightly coat all internal parts with clean hydraulic oil, reassemble spools and insert into PowrReverser block.
- 26. Install new O-rings and secure spool cover plates with lock washers and cap screws. Tighten cap screws securing cover plates to 26 N•m (21 lb-ft).
- 27. Install detent assembly from outside of block and tighten plug to 19 N•m (14 lb-ft). Insert detent ball and spring from inside surface of block.
- 28. Install new gasket between PowrReverser blocks and secure blocks together with four cap screws and lock washers. Tighten cap screws to 24.4 N•m (18 lb-ft).

Installation:

Installation of PRT valve block is done in reverse order of removal.

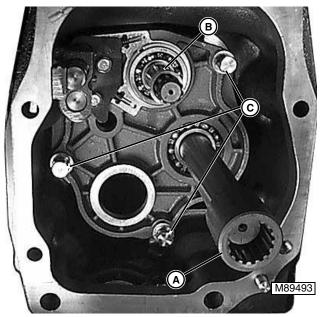
Tighten cap screws securing valve to transmission housing to **24.4 N-m (18 lb-ft)**.

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4-SPEED TRANSMISION

Removal and Disassembly:

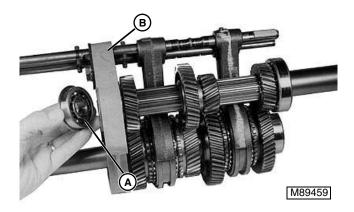
- Split transmission case from rear axle case. (See "TRACTOR SPLITTING (REAR)" on pag e33.)
- 2. Remove splined coupling (A) and PTO shaft spacer (B).



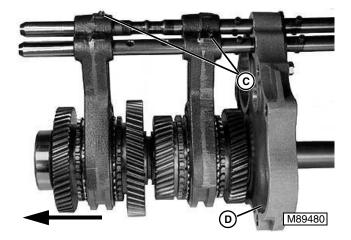


- 3. Remove three cap screws (C) and lock washers securing center plate to transmission case.
- 4. Remove center plate and drive gear assembly to work bench.
- Visually inspect all parts for wear, cracks or discoloration.

Transmission Top Shaft Removal:



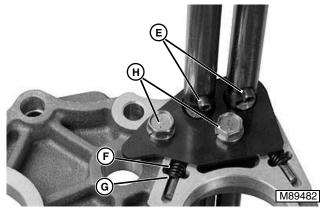
- 1. Using a bearing finger puller (if necessary) remove PTO shaft bearing (A) from center plate (B).
- 2. Remove transmission top shaft from gear cover.



- Drive out rolled pins (C) securing shift forks to fork shafts.
- 4. Slide shift forks and gear assembly away from gear cover (D). Remove shift forks.
- 5. Remove gear assembly.
- 6. Inspect shift forks for wear. Replace as required.

Fork Shaft Detent Inspection:

- 1. Inspect 1st and 2nd gear fork shaft and 3rd and 4th gear fork shaft for wear.
- Inspect four rolled pins in fork shafts (one on each side of gear cover in each shaft) for wear and proper positioning centered through shafts.

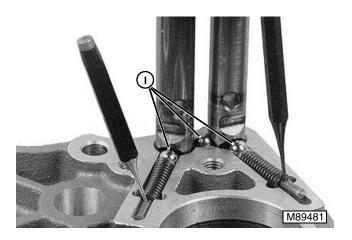


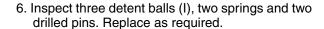
3. Drive out two rolled pins (E) in gear fork shafts.

NOTE: Before removing cover plate holding detent balls and springs, secure springs (F) by inserting pins through holes in drilled pins (G). When cover plate is removed three detent balls may fall out.

- 4. Remove two cap screws (H) and lock washers.
- 5. Slide cover plate up fork shafts.

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NOTE: Center detent ball controls movement of fork shafts allowing only one shaft to move at a time. When 1st and 2nd gear fork shaft is moved, detent ball prevents movement of 3rd and 4th gear fork shaft. When 3rd and 4th gear fork shaft is moved, detent ball prevents movement of 1st and 2nd gear fork shaft.

- 7. Slide cover plate into place and secure with two cap screws and lock washers.
- 8. Remove pins holding springs.
- 9. Drive two rolled pins into fork shafts.

Mid Shaft Disassembly, Inspect and Assembly:

- 1. Clean transmission top shaft, gears and bearings in suitable solvent. Dry with compressed air.
- Inspect both bearings for discolored or burned ball and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

NOTE: If disassembly is required, start by removing end bearing closest to end of transmission top shaft.



- 3. Using a knife edge bearing puller, remove end bearing from shaft.
- 4. Remove spacer and gear-31T (3rd gear).





5. Remove two snap rings, gear-37T (4th gear), spacer and gear-21T (1st gear).



- 6. Remove two snap rings, gear-27T (2nd gear) and thrust washer.
- 7. Using a knife edge bearing puller, remove bearing from shaft.
- 8. Coat all parts in fresh hydraulic oil and reassemble in reverse order of disassembly.

Gear Shaft Disassembly and Inspection:



NOTE: Disassembly of gear shaft is done from each end of gear shaft. Bearings on ends of transmission assembly are press fit on shaft and both bearings must be removed for complete disassembly.



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- 1. Using a knife edge bearing puller, remove end bearing from shaft.
- 2. Remove thrust washer and gear-49T (2nd gear).
- 3. Inspect gear for broken or worn teeth. Inspect tapered surface for wear. Replace as required.
- 4. Remove snap ring (A).



5. Remove synchromesh gears and shift collar as an assembly.



- 6. Remove gear-53T (1st gear) and thrust washer.
- 7. Inspect gear for broken or worn teeth. Inspect tapered surface for wear. Replace as required.

NOTE: Thrust washer has oil passage grooves (B) on one surface. This surface must face gear-53T during reassembly.



- 8. Using a knife edge bearing puller, remove end bearing from other (longer) end of shaft.
- 9. Remove thrust washer and gear-44T (3rd gear).
- 10. Inspect gear for broken or worn teeth. Inspect tapered surface for wear. Replace as required.
- 11. Remove snap ring.

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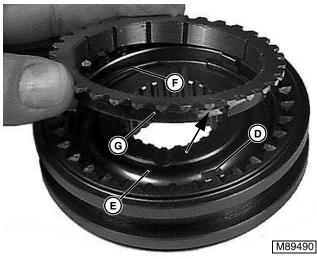
- 12. Remove synchromesh gears and shift collar as an assembly.
- 13. Remove gear-38T (4th gear) and thrust washer.
- 14. Inspect gear for broken or worn teeth. Inspect tapered surface for wear. Replace as required.

NOTE: Thrust washer has oil passage grooves (C) on one surface. This surface must face gear-38T during reassembly.

Synchromesh Gear Disassembly, Inspection and Reassembly:



- 1. Disassemble synchromesh assembly by removing wire ring clips from shift collar and sliding synchromesh ring and ring keys out of shift collar.
- 2. Clean gears, ring and collar in suitable solvent. Dry with compressed air.
- 3. Inspect ring and collar for wear, cracking, broken or missing teeth, and plugged or filled oil lubrication passages. Replace as required.
- 4. Inspect synchromesh gears for wear on tapered surfaces, plugged or filled in internal grooves, broken or missing teeth. Replace as required.



- 5. Coat surfaces of parts with fresh hydraulic oil.
- Insert three ring keys (D) and synchromesh ring (E) into shift collar.
- Install wire clip (F) on each side of shift collar. Ensure wire clip engages all ring keys on each side.
- 8. Place synchromesh gear (G) on each side of shift collar with notches aligned with ring keys.
- 9. Set assembly aside.
- 10. Repeat steps 1 through 9 for second synchromesh gear assembly.



4-Speed Transmission Assembly / Installation:

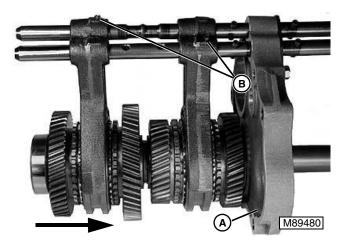
 Assembly is done in reverse order of disassembly. Coat all parts with clean hydraulic oil during assembly.

NOTE: Inner most thrust washers may have oil passage grooves on one surface. This surface must face outward, toward gears 38T and 53T, during reassembly.

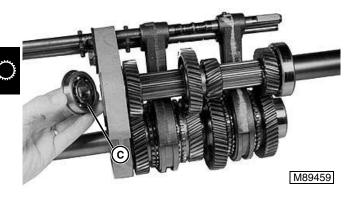
NOTE: Ensure notches on synchromesh gears align properly with ring keys.

2. Fully assemble gear shaft assembly.

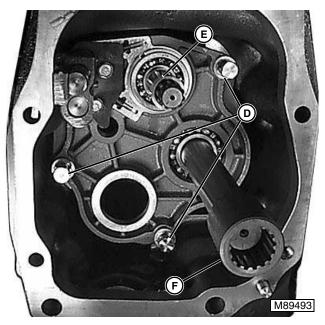
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- Install gear shaft assembly part way into gear cover (A), slide shift forks over fork shafts, align shift forks with shift collars and fully seat all parts into gear cover.
- 4. Install rolled pins (B) securing shift forks to fork shafts.



- 5. Set top shaft assembly onto gear shaft assembly and fully seat end bearing into gear center plate.
- 6. Install PTO shaft bearing (C) in gear center plate.

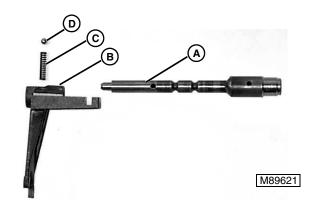


- 7. Install drive gear assembly in transmission case until fully seated.
- 8. Install three lock washers and cap screws (D). Tighten cap screws to **85 N•m (63 lb-ft)**.
- 9. Ensure PTO shaft bearing is fully seated in gear cover.
- 10. Install PTO shaft spacer (E).
- 11. Install spline connector (F).
- 12. Install splined coupling.

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CREEPER OPTION

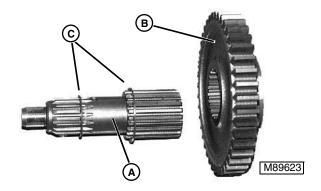
The creeper is a factory installed option and consists of the following parts:



- 1. Creeper shift rod assembly:
- Creeper shift rod (A).
- Shift fork (B).
- Spring (C).
- Detent ball (D).

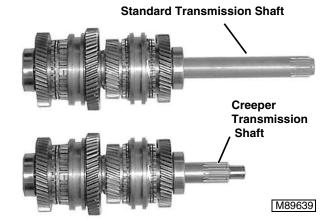


- 2. Creeper connecting shaft assembly:
- Flanged bearing (A).
- Connecting shaft (B).
- Bearing (C).
- Gear-42T (D).

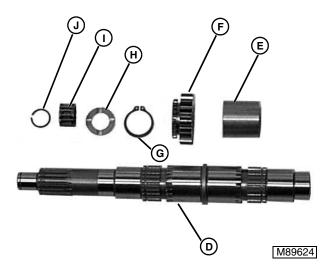


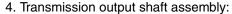
- 3. Stub shaft assembly:
- Stub shaft (A).

- Gear-41T.
- Large and small snap rings (C).



NOTE: Transmission components are all the same except for output shaft as shown.





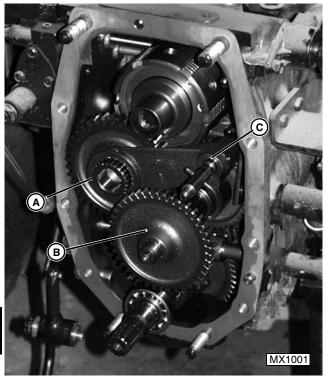
- Output shaft (D).
- Spacer (E).
- Gear-18T (F).
- Snap ring (G).
- Washer (H).
- Needle bearing (I).
- C-Clip (J).





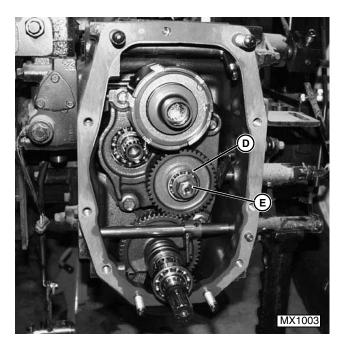
Disassembly and Inspection:

NOTE: Creeper gears are between 4 speed and range transmissions. Perform rear split for service.

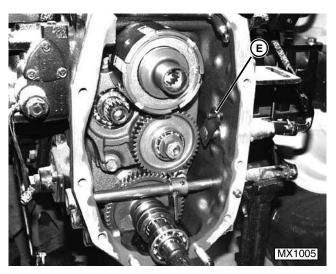


 Creeper gears, shafts (A&B), and shift fork and rod (C) can all be removed together as shown below.



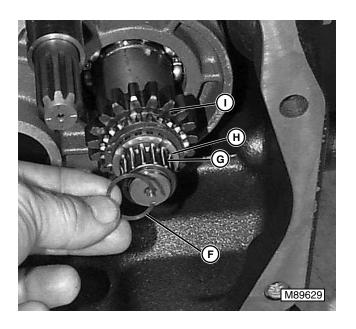


2. Inspect bearing (D). If replacement is necessary, remove eccentric locking nuts (E) and replace bearing.

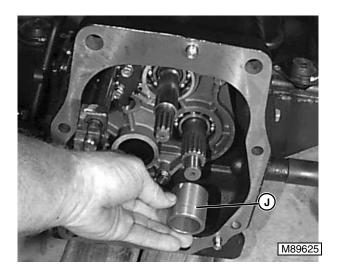


3. Inspect shift shaft, lever, and pin (E) for wear or damage. If replacement of shift shaft is required, range transmission must be removed.

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1. Remove C- clip (F), bearing (G), washer (H), and gear (I).



2. Remove spacer (J) from gear shaft.

3. Inspect all parts, replace as needed.



4. Pry or press bearing off of connecting shaft.



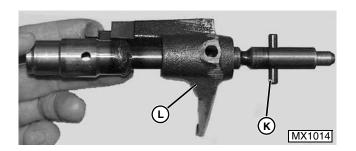
5. Slide 42T gear from shaft. Inspect all parts for wear or damage. Replace as required.



6. Slide 41T gear from stub shaft. Inspect all parts for wear or damage. replace as required.

6/27/00 **7 - 53**





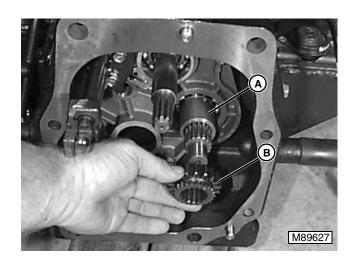
 Drive out roll pin (K). Slide fork (L) off of shaft, being careful not to lose detent spring and ball from hole in fork.



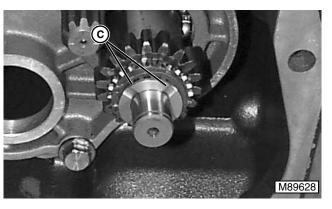


8. Inspect all parts for wear or damage. Replace parts as needed.

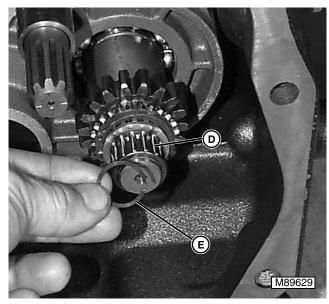
Assembly:



1. Place spacer (A), and 18T gear (B) on gear shaft with external shift splines facing out, and secure with external snap ring.

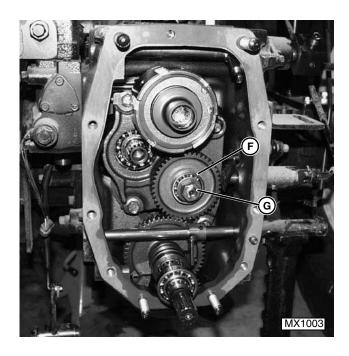


2. Place washer (C), with oil grooves facing out, on gear shaft.



3. Place needle bearing (D) on end of gear shaft and secure with C-clip (E).

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4. If bearing (F) was removed from pinion shaft, install bearing. Place washer and double nut (G) on pinion shaft. Tighten inner nut, and then outer nut to specification.

Specification:

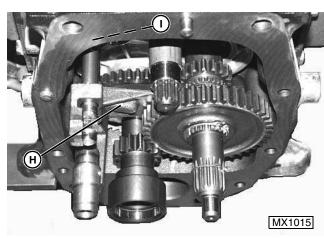
Pinion Nuts............ 78 - 97 Nem (58 - 72 lb-ft).



5. Assemble connecting shaft with 42T gear and bearing as shown.



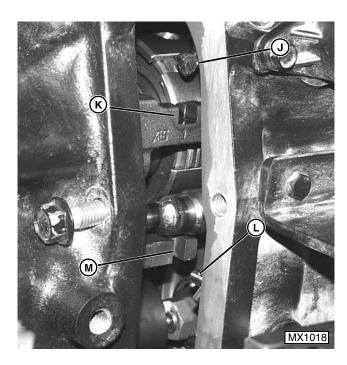
- Assemble stub shaft with snap rings and 41T gear as shown.
- 7. Clean gasket mating surfaces and replace gasket.



 Install shafts and shift fork and rod to back of 4– speed transmission as shown. Make sure the fork (H) is properly engaged in slot in gear and rod (I) is properly seated in hole in bearing housing.



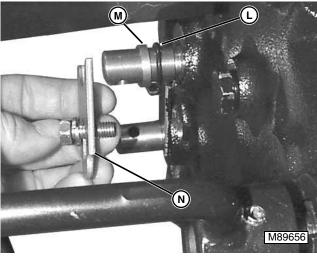
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9. As tractor sections are being joined, make sure transmission shifter (J) engages in shifter slots (K), and creeper shifter (L) engages in shifter slot (M).



10. Join tractor sections together and verify proper shifter operation



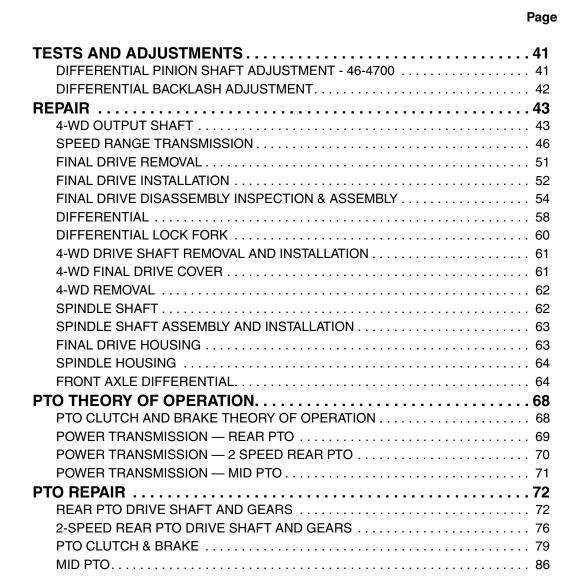
- 11. Place new O-ring (L) on creeper shift shaft. Seat in counterbore in transmission housing.
- 12. Place collar (M) on shift shaft. Seat against o-ring.
- 13. Install plate (N) locating shift shaft in transmission housing, secure with cap screw.
- 14. Install shift lever and linkage.

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Transaxle Oil:	
Туре	John Deere J20D
Capacity:	
PRT and CST	37.0 L (9.8 gal) (39.1 qt)
HST	35.0 L (9.25 gal) (37 qt)
PTO Speeds (At 2664 Engine rpm)	
Rear PTO	
High Speed With Optional 2 speed PTO	•
Front PTO	
4-WD Oil:	John Doors 1900
Type	
Capacity	/ Ille13 (1.0 gal)
DEDAID ODEOLEICATIONS	
REPAIR SPECIFICATIONS	
PTO Clutch/Brake Specifications:	
Minimum Clutch/Brake Plate Thickness (End Plate)	
Minimum Clutch/Brake Plate Thickness (Friction Plates) .	
Minimum Clutch/Brake Disks	,
Interlock Pin Length (minimum)	18.8 mm (0.740 in.)
Pinion and Ring Gear Specifications:	
Differential Ring Gear Backlash	- 0.18 mm (0.005 - 0.007 in.)
Brakes Specifications:	45.00 (4.770 4.775)
Brake Arm Sleeve OD	,
Brake Arm OD	,
Brake Arm OD	
Front Wheel Alignment:	45.16 11111 (1.775 - 1.779 111.)
Toe In Measurement	0 - 3 mm (0 0 - 0 12 in)
Inclination	,
Swing	
Steering Angle:	
Inward	
Outward	
TORQUE SPECIFICATIONS	
PTO Cover Cap Screws	
Final Drive to Transmission Housing Cap Screws	
Final Drive toTransmission Housing Nuts	,
Planetary Pinion Carrier to Axle Bolt	·
Internal (Ring) Gear Cap Screws	·
Ring Gear Cap Screws (4500)	•
Ring Gear Cap Screws (46-4700)	
Eccentric Lock Nut (Lower and Upper)	· · · · · · · · · · · · · · · · · · ·
Mid PTO Housing to Transmission Housing	45 - 50 IN•M (33 - 37 ID-IT)



Front Axle 4-WD

Front Wheel Cap Screws	118 - 147 N•m (87 - 108 lb-ft)
Final Drive Cover Cap Screw	
Differential Carrier to 4-WD Housing Cap Screw ¹ **	61 - 68 N•m (45 - 50 lb-ft)
Tie Rod Nut	115 - 129 N•m (85- 95 lb-ft)
Differential Ring Gear Cap Screws	79 - 88 N•m (58 - 65 lb-ft)
Differential Bearing Retainer Cap Screws	54 - 68 N•m (40 - 50 lb-ft)
Pinion Retaining Nut	258 - 285 N•m (190 - 210 lb-ft)
Hub Shaft Retaining Nut **	447 - 488 N•m (330 - 360 lb-ft)
Cylinder Bracket to Axle Housing Cap Screw **	286 - 316 N•m (211 - 233 lb-ft)
Cylinder Bracket to Cylinder	23 - 29 N•m (22 - 28 lb-ft)
4-WD Housing to Spindle Housing Cap Screw **	286 - 316 N•m (211 - 233 lb-ft)

^{**} Note: Use thread locking compound

SPECIAL OR ESSENTIAL TOOLS

Part Number	Part Name
JDG1169	Clutch Spring Compressor
JT07335-1,2,3	Splitting Stands and Brackets

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



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^{1.} Cap screw size and torque value may increase in later models. Check cap screw size against torque table. See "METRIC FASTENER TORQUE VALUES" on page9 in the Specifications Section.

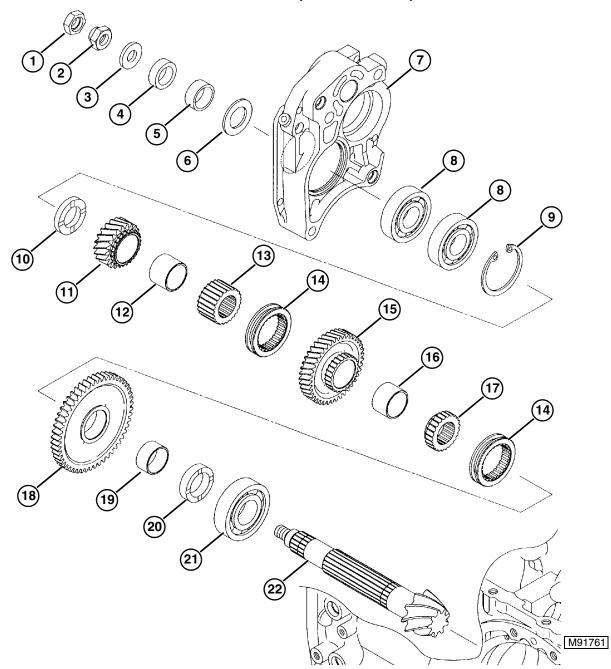
OTHER MATERIALS

Number U.S./Canadian	Name	Use
TY6305	John Deere Clean and Cure Primer	Cleans parts and speeds cure of sealant.
TY15130 / TY15934	John Deere Sealant	Seals transaxle and final drive case halves.
TY6333	Moly High Temperature EP Grease	
TY22034	John Deere SuperLube ®	
TY9370 / TY9477 (#242 LOCTITE [®])	Thread Lock and Sealer (Medium Strength)	
TY6304 (#515 LOCTITE [®])	Loctite Sealant	Seals the front axle final drive cover to the final drive housing. Also applied to the outer surface of the wheel seals.
#262 LOCTITE®	Loctite Thread Lock and Sealer (High Strength)	Apply to front axle spindle housing cap screws and to the 4-WD housing cap screws.
TY15941 (#620 LOCTITE [®])	Loctite Retaining Compound (High Strength)	Seals front axle final drive housing cap.
TY16021	John Deere High Flex Form-In- Place Gasket	Sealing Flange Assemblies
TY15934	John Deere General Purpose Gasket Dressing	Sealing Gaskets and Hoses



COMPONENT LOCATION

4500 - DIFFERENTIAL PINION SHAFT (CST & 2-WD)





- Nut, Upper
 Nut, Lower
- 3. Washer, 16x38x4.5
- 4 5 1: 05 00 46
- 4. Bushing, 25x38x12
- 5. Bushing, 31x40x15
- 6. Washer, 30x45x3

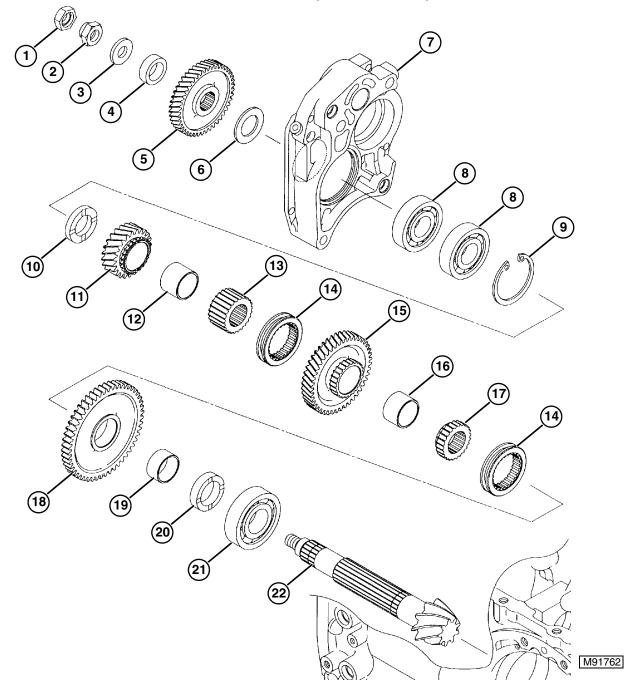
- 7. Housing, Bearing
- 8. Bearing
- 9. Ring, Snap
- 10. Washer, 30x50x8
- 11. Gear (21T)
- 12. Bushing, 34x40x30

- 13. Sleeve, Splined
- 14. Shifter
- 15. Gear, Counter (40T)
- 16. Bushing, 34x40x26
- 17. Sleeve, Splined
- 18. Gear, Counter (53T)

- 19. Bushing, 35x40x19
- 20. Spacer, 35x50x12
- 21. Bearing
- 22. Shaft, Pinion

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4500 - DIFFERENTIAL PINION SHAFT (PRT & 4-WD)



00

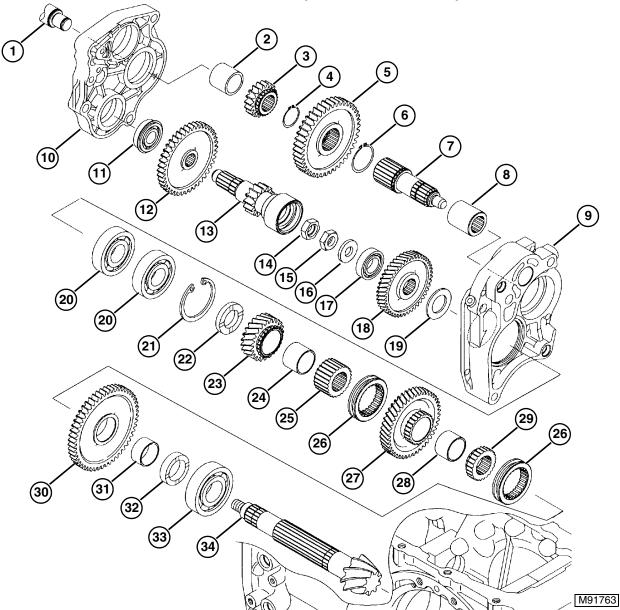
- 1. Nut, Upper
- 2. Nut, Lower
- 3. Washer, 16x38x4.5
- 4. Bushing, 25x38x12
- 5. Pinion, Drive (44T)
- 6. Washer, 30x45x3

- 7. Housing, Bearing
- 8. Bearing
- 9. Ring, Snap
- 10. Washer, 30x50x8
- 11. Gear, Counter (23T)
- 12. Bushing, 34x40x30

- 13. Sleeve, Splined
- 14. Shifter
- 15. Gear, Counter (45T)
- 16. Bushing, 34x40x26
- 17. Sleeve, Splined
- 18. Gear, Counter (53T)

- 19. Bushing, 35x40x19
- 20. Spacer, 35x50x12
- 21. Bearing
- 22. Shaft, Pinion

4500 - DIFFERENTIAL PINION SHAFT (PRT & CREEPER)





- 1. Shaft, Driven
- 2. Bushing, 31x38x33.2
- 3. Pinion, Creeper
- 4. Snap Ring
- 5. Gear, Sliding (41T)
- 6. Ring, Snap
- 7. Shaft, Connecting
- 8. Coupler, Splined
- 9. Housing, Bearing

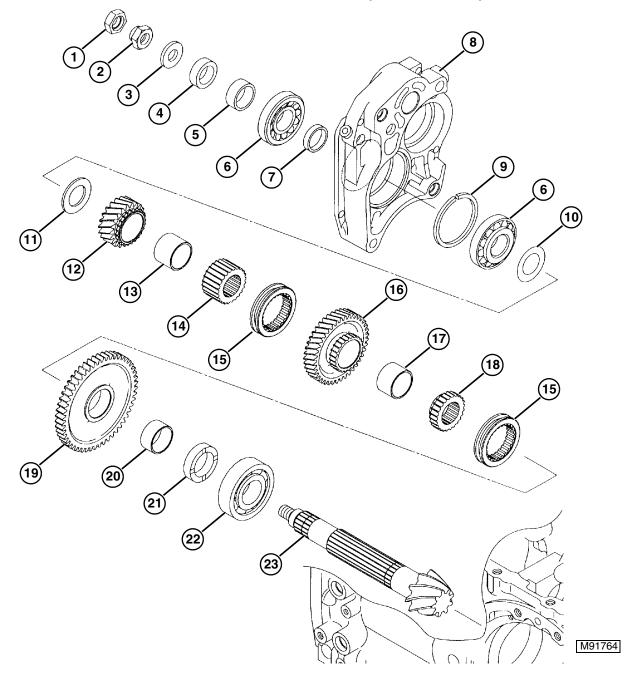
- 10. Plate, Center
- 11. Bearing
- 12. Gear, Creeper (42T)
- 13. Shaft, Creeper
- 14. Nut, Upper
- 15. Nut, Lower
- 16. Washer, 16x38x4.5
- 17. Bearing
- 18. Pinion, Drive (44T)

- 19. Washer, 30x45x3
- 20. Bearing
- 21. Snap Ring
- 22. Washer, 30x50x8
- 23. Gear, Counter (23T)
- 24. Bushing, 34x40x30
- 25. Sleeve, Splined
- 26. Shifter
- 27. Gear, Counter (45T)

- 28. Bushing, 34x40x26
- 29. Sleeve, Splined
- 30. Gear, Counter (53T)
- 31. Bushing, 35x40x26
- 32. Spacer, 35x50x12
- 33. Bearing
- 34. Shaft, Pinion

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4600 / 4700 - DIFFERENTIAL PINION SHAFT (CST & 2-WD)



1. Nut, Upper

7. Spacer, 30x4.5

13. Bushing, 34x40x30

19. Gear, Counter (53T)

2. Nut, Lower

8. Housing, Bearing

. . _

3. Washer, 16x38x4.5

9. Ring, 75

20. Bushing, 35x40x19

4. Bushing, 25x38x12

o.g, . .

21. Spacer, 35x50x12

5. Bushing, 31x40x15

10. Shim(s)*

16. Gear, Counter (40T)

22. Bearing

11. Washer, 30x45x3

17. Bushing, 34x40x26

23. Shaft, Pinion

6. Bearing, Roller

12. Gear, Counter (21T)

18. Sleeve, Splined

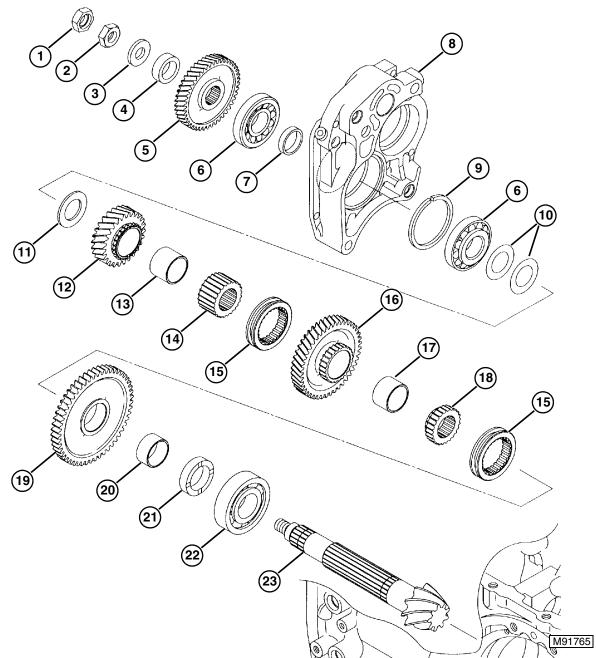
14. Sleeve, Splined

15. Shifter

* Note: Shims may vary in thickness and number for counter shaft adjustment. * Note: Shims may vary in number for pinion shaft adjustment. (See "DIFFERENTIAL PINION SHAFT ADJUSTMENT - 46-4700" on page 41.)



4600 / 4700 - DIFFERENTIAL PINION SHAFT (HST & 4-WD)





1. Nut, Upper 7. Spacer, 30x4.5 13. Bushing, 34x40x30 19. Gear, Counter (49T) 2. Nut, Lower 8. Housing, Bearing 14. Sleeve, Splined 20. Bushing, 35x40x19 3. Washer, 16x38x4.5 9. Ring, 75 15. Shifter 21. Spacer, 35x50x12 4. Bushing, 25x38x12 10. Shim(s), 30x45x0.1* 16. Gear, Counter (45T) 22. Bearing

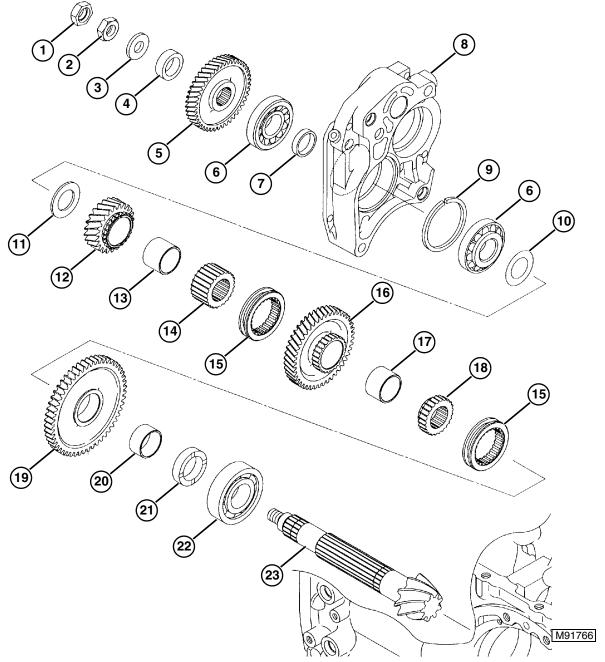
5. Pinion, Drive (44T) 11. Washer, 30x45x3 17. Bushing, 34x40x26 23. Shaft, Pinion

6. Bearing, Roller 12. Gear, Counter (26T) 18. Sleeve, Splined

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^{*} Note: Shims may vary in number for pinion shaft adjustment. (See "DIFFERENTIAL PINION SHAFT ADJUSTMENT - 46-4700" on page 41.)

4600 / 4700 - DIFFERENTIAL PINION SHAFT (PRT & 4-WD)



1. Nut, Upper

7. Spacer, 30x4.5

13. Bushing, 34x40x30

19. Gear, Counter (53T)

2. Nut, Lower

8. Housing, Bearing

14. Sleeve, Splined

20. Bushing, 35x40x19

3. Washer, 16x38x4.5

9. Ring, 75

15. Shifter

21. Spacer, 35x50x12

4. Bushing, 25x38x12

10. Shim(s), 30x45x0.1*

16. Gear, Counter (45T)

22. Bearing

5. Pinion, Drive (44T)

11. Washer, 30x45x3

17. Bushing, 34x40x26

23. Shaft, Pinion

6. Bearing, Roller

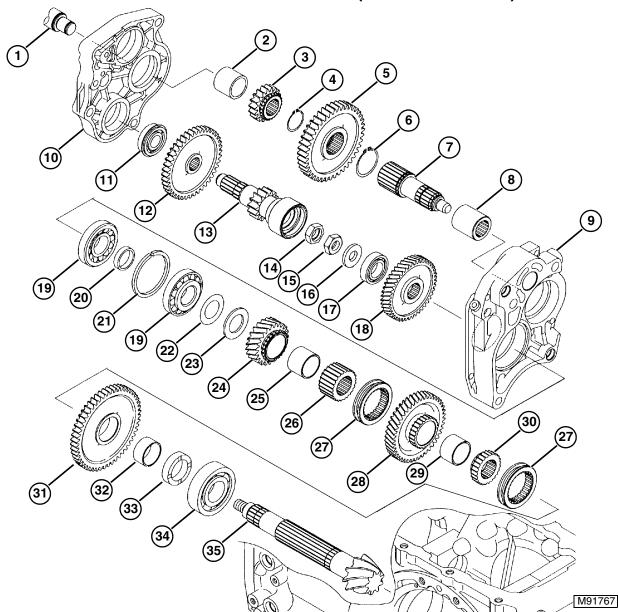
12. Gear, Counter (23T)

18. Sleeve, Splined

* Note: Shims may vary in number for pinion shaft adjustment. (See "DIFFERENTIAL PINION SHAFT ADJUSTMENT - 46-4700" on page 41.)



4600 / 4700 - DIFFERENTIAL PINION SHAFT (PRT & CREEPER)





- 1. Shaft, Driven
- 2. Bushing, 31x38x33.2
- 3. Gear, Creeper
- 4. Snap Ring, 30
- 5. Gear, Sliding (41T)
- 6. Ring, Snap
- 7. Shaft, Connecting
- 8. Coupler, Splined
- 9. Housing, Bearing

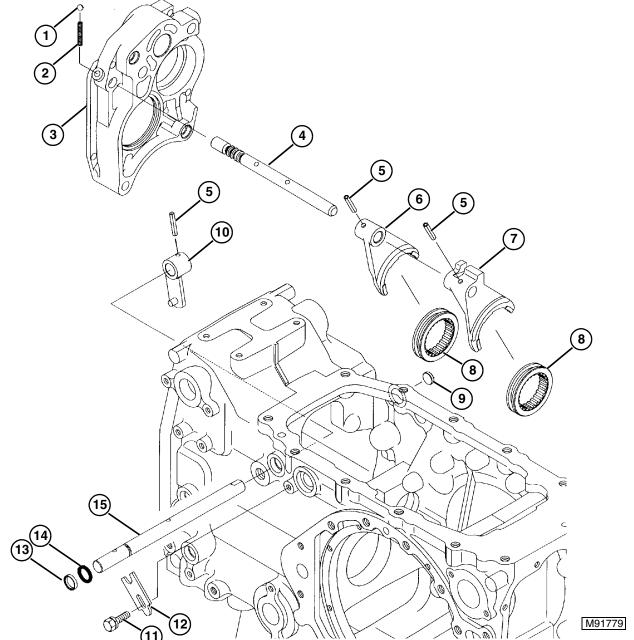
- 10. Plate, Center
- 11. Bearing
- 12. Gear, Creeper (42T)
- 13. Shaft, Creeper
- 14. Nut, Upper15. Nut, Lower
- 16. Washer, 16x38x4.5
- 17. Bearing
- 18. Pinion, Drive (44T)

- 19. Bearing
- 20. Spacer, 30x4.5
- 21. Ring, 75
- 22. Shim, 30x45x0.1
- 23. Washer, 30x45x3
- 24. Gear, Counter (23T)
- 25. Bushing, 34x40x30
- 26. Sleeve, Splined
- 27. Shifter

- 28. Gear, Counter (45T)
- 29. Bushing, 34x40x26
- 30. Sleeve, Splined
- 31. Gear, Counter (53T)
- 32. Bushing, 35x40x19
- 33. Spacer, 35x50x12
- 34. Bearing
- 35. Shaft, Counter

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4500-4700 - RANGE SHIFT

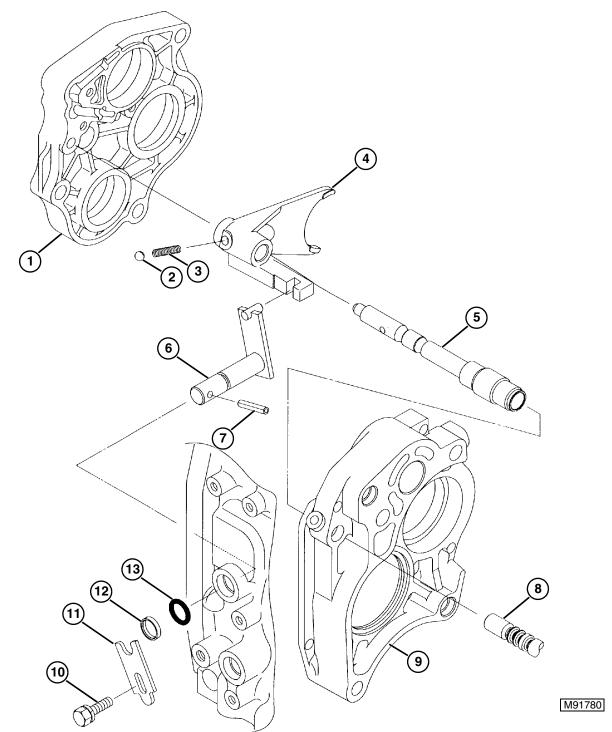


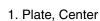


- 1. Ball, 1/4
- 2. Spring, Fork Lock
- 3. Housing, Bearing
- 4. Shaft, Fork
- 5. Pin, Spring 6.0x32
- 6. Fork, Range Shift
- 7. Fork, Range Shift
- 8. Shifter

- 9. Cap, Sealing
- 10. Arm, Range Shift
- 11. Cap Screw w/Washer
- 12. Plate, Retainer
- 13. Sleeve
- 14. Packing
- 15. Shaft, Range Shift

4500-4700 - CREEPER SHIFT





5. Shaft, Creeper Fork

9. Housing, Bearing 13. Packing

2. Ball, 5/16

6. Arm, Creeper Shift

10. Cap Screw w/Washer

3. Spring

11. Plate, Retainer

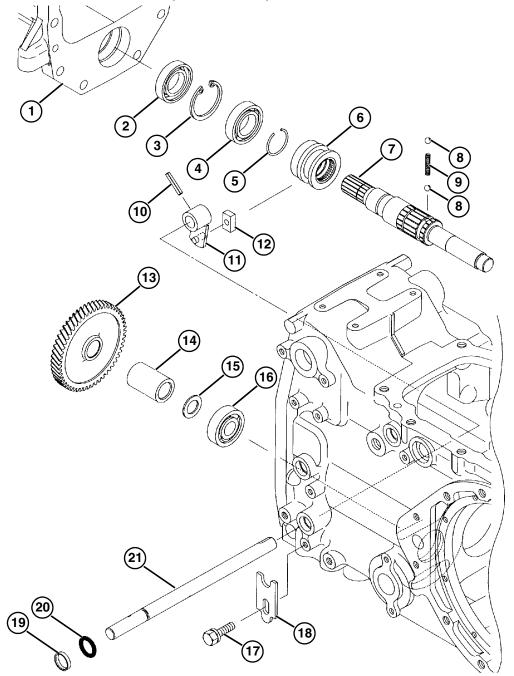
4. Fork, Creeper Shift

7. Pin, Spring - 6.0x32

8. Shaft, Range Shift Fork 12. Sleeve

8 - 14

4500-4700 - FRONT DRIVE (FOR 4-WD)





- 1. Housing, Clutch
- 2. Seal
- 3. Ring, Snap
- 4. Bearing
- 5. Ring, 35x2.3
- 6. Collar, Mid Shift

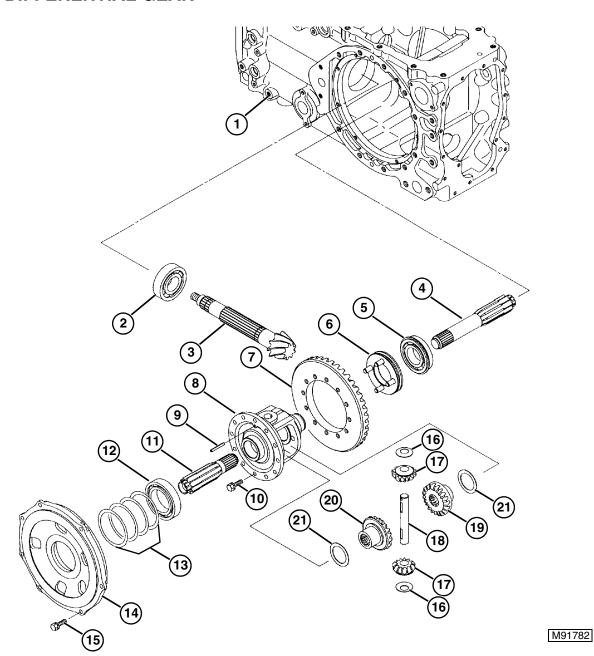
- 7. Shaft, Front Drive
- 8. Ball, 1/4
- 9. Spring
- 10. Pin, Spring 6.0x32
- 11. Arm, Front Shift
- 12. Shoe, Shift Arm

- 13. Gear, Front Drive (53T)
- 14. Sleeve, Front Drive
- 15. Washer, 20x32x2
- 16. Bearing
- 17. Cap Screw w/Washer
- 18. Plate, Retainer

- 19. Sleeve
- 20. Packing
- 21. Shaft, Front Shift

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4500 – DIFFERENTIAL GEAR





1. Housing, Transmission

2. Bearing

3. Shaft, Counter

4. Pinion, RH Final

5. Bearing

6. Collar, Diff. Locking

7. Gear, Ring

8. Housing, Differential

9. Spring Pin, 5.0x40

10. Cap Screw w/Lock Washer

11. Pinion, LH Final

12. Bearing

13. Shims* 0.1, 0.3, 0.5

19. Gear, Diff. RH

20. Gear, Diff. LH

21. Washer, Side Gear

14. Carrier, Differential

15. Bolt, w/Washer

16. Washer, Diff. Pinion

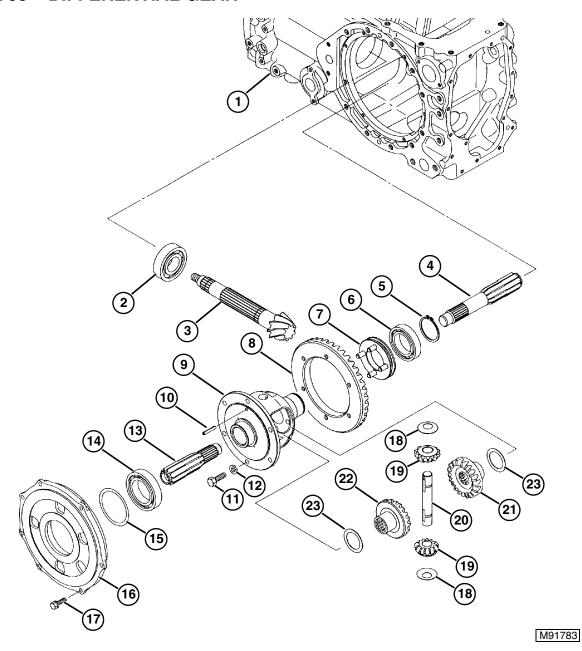
17. Pinion, Differential

18. Shaft, Diff. Pinion

*Note: Shims will vary (as required) for backlash adjustment. (See "DIFFERENTIAL BACKLASH ADJUSTMENT" on page 42.)

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4600 / 4700 - DIFFERENTIAL GEAR





1. Housing, Transmission

2. Bearing

3. Shaft, Counter

4. Pinion, RH Final

5. Snap Ring, 50

6. Bearing, Ball

7. Collar, Diff. Locking

8. Gear, Ring

9. Housing, Differential

10. Pin, Spring - 6.0x36

11. Screw

12. Washer, Lock

13. Pinion, LH Final

14. Bearing, Ball

15. Shim*

16. Carrier, Differential

17. Cap Screw w/Washer

18. Washer, Diff. Pinion

19. Pinion, Differential

20. Shaft, Diff. Pinion

21. Gear, Diff. RH

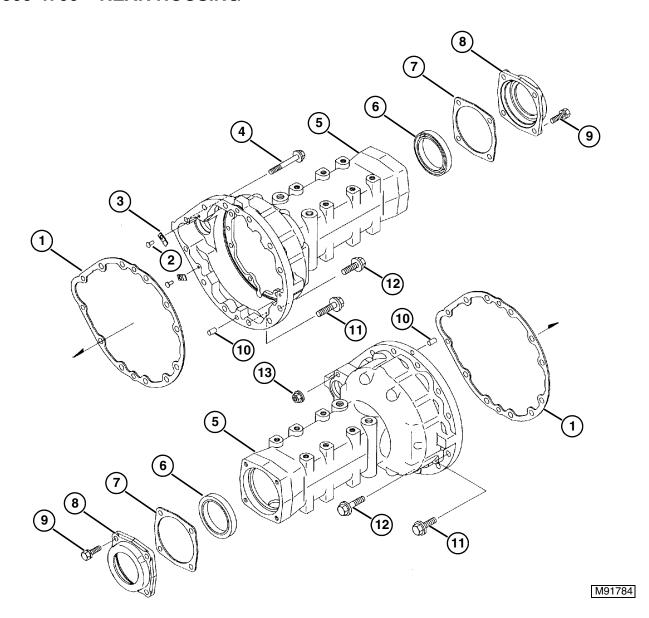
211 0001, 2111111

22. Gear, Diff. LH

23. Washer, Side Gear

*Note: Shim(s) will vary (as required) for backlash adjustment. (See "DIFFERENTIAL BACKLASH ADJUSTMENT" on page 42.)

4500-4700 - REAR HOUSING





1. Gasket

2. Rivet, 6.0x12

3. Plate, Push

4. Bolt, 10x85

5. Housing, Rear Axle

6. Seal, Oil

7. Gasket, Oil Seal Hsg.

8. Housing, Oil Seal

9. Cap Screw w/Lock Washer

10. Pin, 10x18

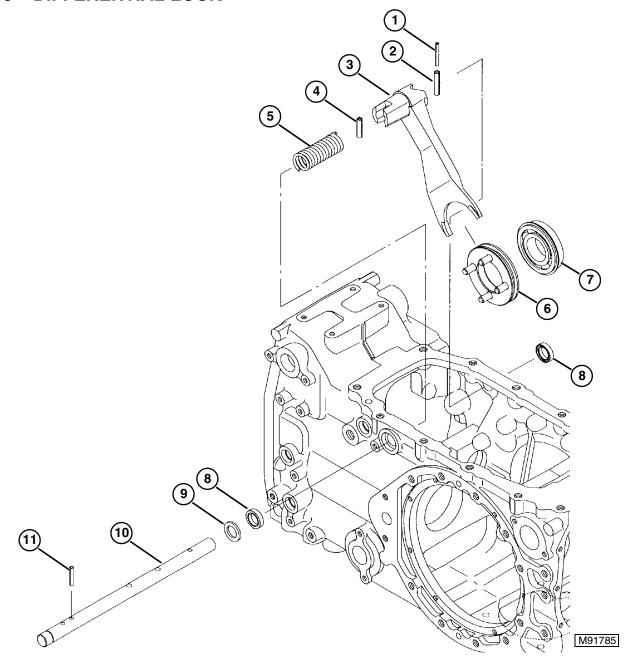
11. Bolt, 12x40

12. Bolt, 12x50

8 - 18

13. Nut

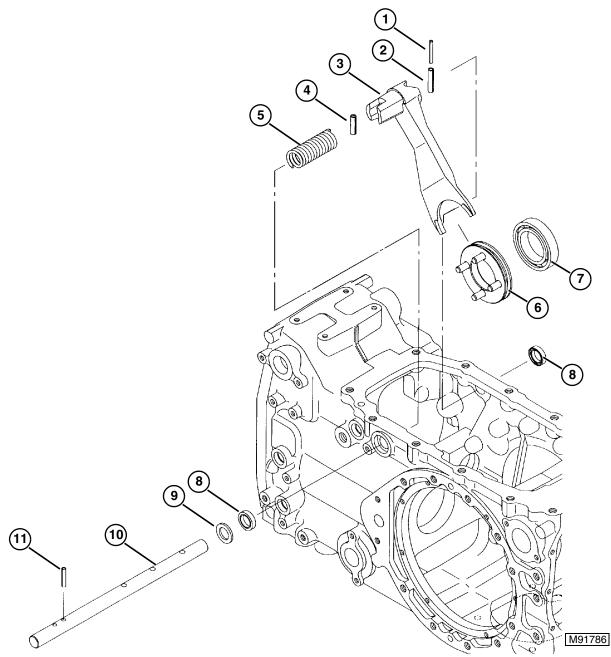
4500 – DIFFERENTIAL LOCK



0

- 1. Pin, 5.0x40
- 2. Pin, Spring 8.0x40
- 3. Fork, Diff. Shift
- 4. Pin, 8.0x32
- 5. Spring, Diff. Lock
- 6. Collar, Diff. Locking
- 7. Bearing
- 8. Seal
- 9. Washer
- 10. Shaft, Diff. Lock
- 11. Pin, 6.0x32

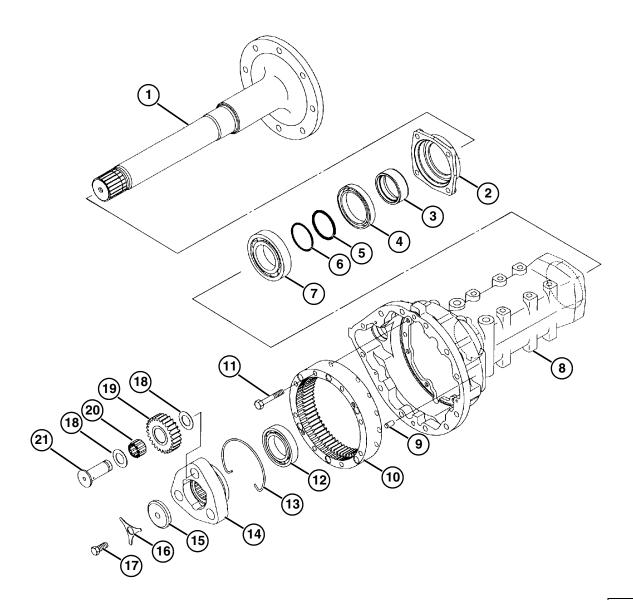
4600 / 4700 - DIFFERENTIAL LOCK





- 1. Pin, 5.0x40
- 2. Pin, Spring 8.0x40
- 3. Fork, Diff. Shift
- 4. Pin, 8.0x32
- 5. Spring, Diff. Lock
- 6. Collar, Diff. Locking
- 7. Bearing
- 8. Seal
- 9. Washer
- 10. Shaft, Diff. Lock
- 11. Pin, 6.0x32

4500 - FINAL PINION AND FINAL GEAR





M91787

٦.	Ax	le, I	К	ear
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7. Bearing, Ball

13. Ring, Retaining, 124

19. Pinion, Planetary

2. Housing, Oil Seal

8. Housing, Rear Axle

14. Carrier, Planetary Pinion

20. Bearing, Needle

3. Sleeve, Seal

9. Pin, 10x18

15. Washer, 13x64x9

21. Shaft, Planetary Pinion

4. Seal, Oil 5. Packing

10. Gear, Internal

11. Cap Screw - 10x65

16. Plate, Lock

6. Spacer

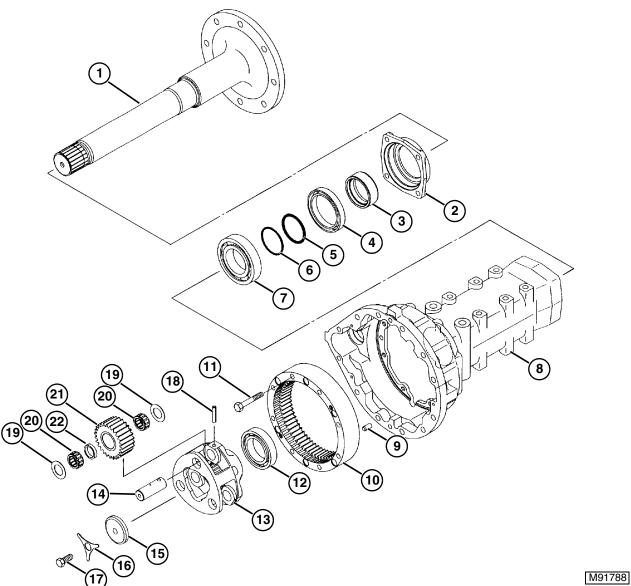
12. Bearing

17. Bolt, 12x30

18. Washer, 25x42x1

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4600 / 4700 - FINAL PINION AND FINAL GEAR



1. Axle, Rear 7. Bearing, Ball

2. Housing, Oil Seal 8. Housing, Rear Axle

3. Sleeve, Seal 9. Pin, 10x18

4. Seal, Oil 10. Gear, Internal

5. Packing 11. Cap Screw - 10x65

6. Spacer 12. Bearing

13. Carrier, Planetary Pinion

14. Shaft, Planetary Pinion

15. Washer, 13x64x9

16. Plate, Lock

17. Bolt, 12x30

18. Pin, Spring - 8.0x40

19. Washer, 25x42x1

20. Bearing, Needle

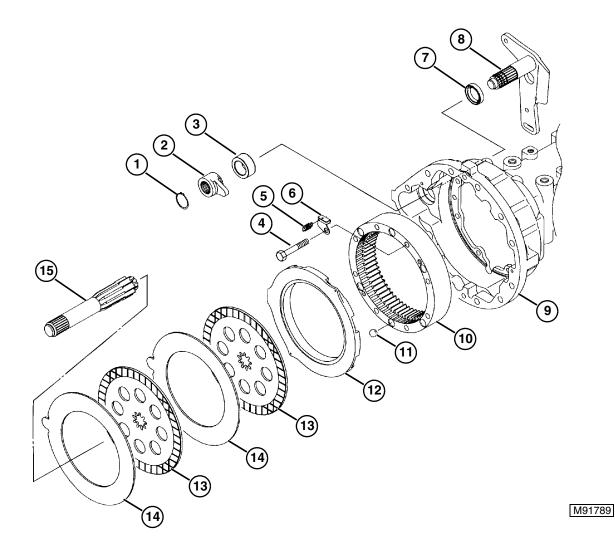
21. Pinion, Planetary

22. Sleeve, 38x34.5x6.5



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4500-4700 - BRAKE





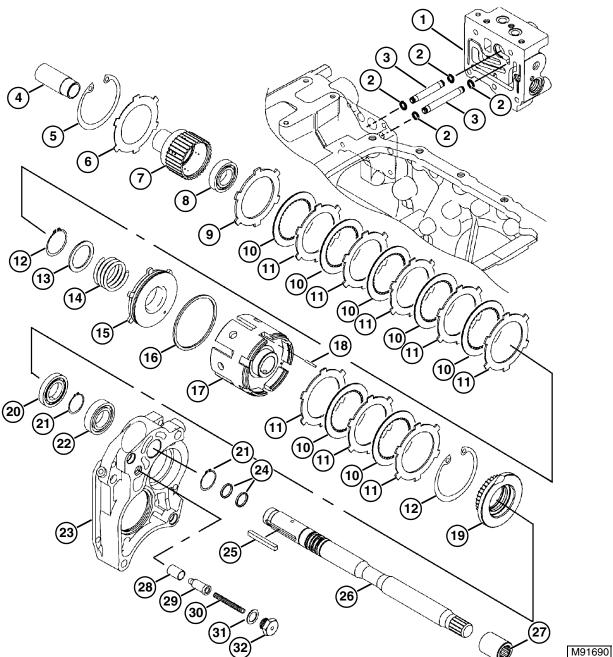
- 1. Ring, Snap 29
- Spring, Actuator
- 9. Housing, Rear Axle
- 13. Disk, Brake

- 2. Cam Lever, RH
- 6. Hook, Spring
- 10. Gear, Internal
- 14. Plate, Brake

- 3. Sleeve, Cam Lever
- 7. Seal
- 11. Ball, 9/16
- 15. Pinion, RH Final Drive

- 4. Cap Screw 10x65
- 8. Arm, Brake
- 12. Actuator, RH

4500-4700 PTO CLUTCH/BRAKE ASSEMBLY





1. Body, PTO Valve

2. Packing

3. Tube, Oil

4. Spacer, 23x30x39

5. Ring, Snap - 95

6. Plate, Retaining

o. Flate, netalling

7. Hub, Clutch

8. Bearing

9. Plate, End - 3.2

10. Disk

11. Plate, Friction

12. Ring, Snap - 95

13. Washer, 40x54x2.3

14. Spring

15. Piston, Clutch

16. O-Ring, 95

17. Cylinder, Clutch

18. Pin, 2.6x19.5

19. Hub, Brake

20. Bearing, Ball

21. Ring, Snap - 30

22. Bearing

23. Housing, Bearing

24. Seal, Shaft

25. Key, 7x5.8x60

26. Shaft

27. Coupling, Splined

28. Bushing, 12x14x20

29. Pin, Brake Anchor

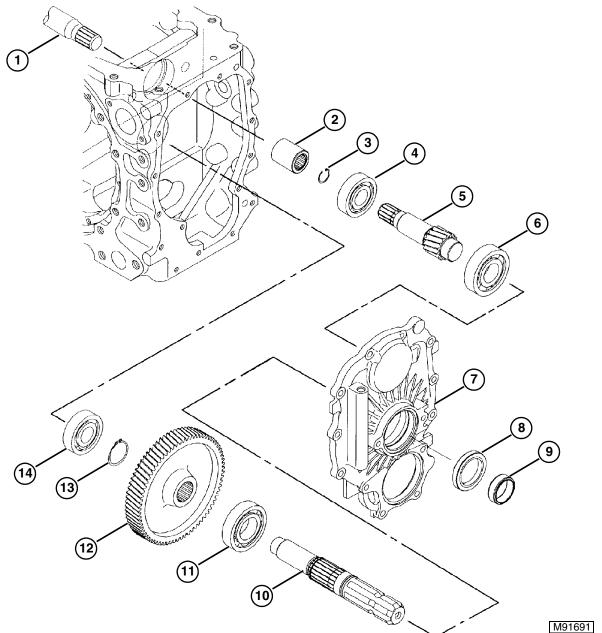
30. Spring, Anchor Pin

31. Gasket

32. Plug

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4500-4700 - REAR PTO SHAFTS



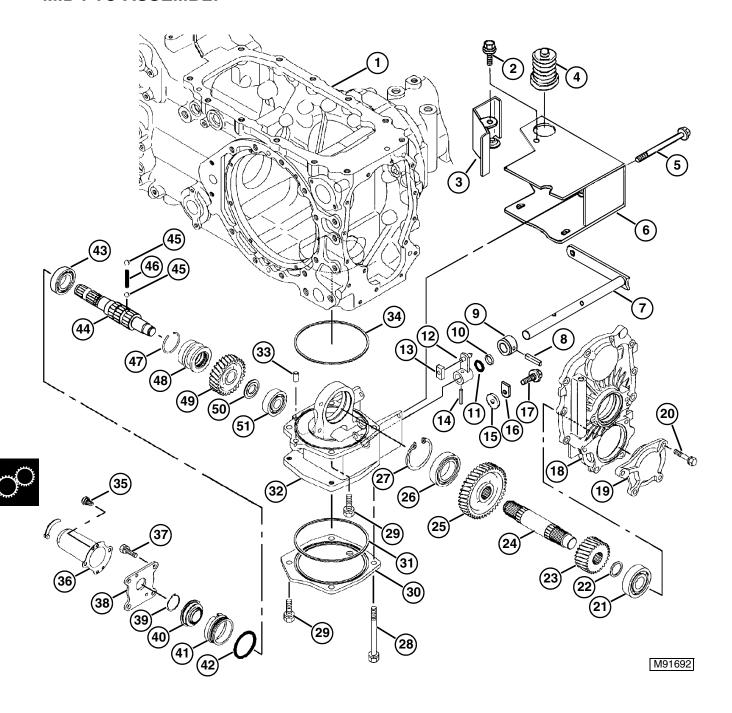


- 1. Shaft, Clutch
- 2. Coupling, PTO Splined
- 3. Ring, Snap 22
- 4. Ball Bearing

- 5. Shaft, PTO Pinion
- 6. Bearing, Ball
- 7. Cover, Rear PTO
- 8. Seal

- 9. Sleeve, Seal
- 10. Shaft, PTO
- 11. Bearing, Ball
- 12. Gear (74T)
- 13. Ring, Snap 34
- 14. Bearing, Ball

MID PTO ASSEMBLY



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51. Bearing, Ball

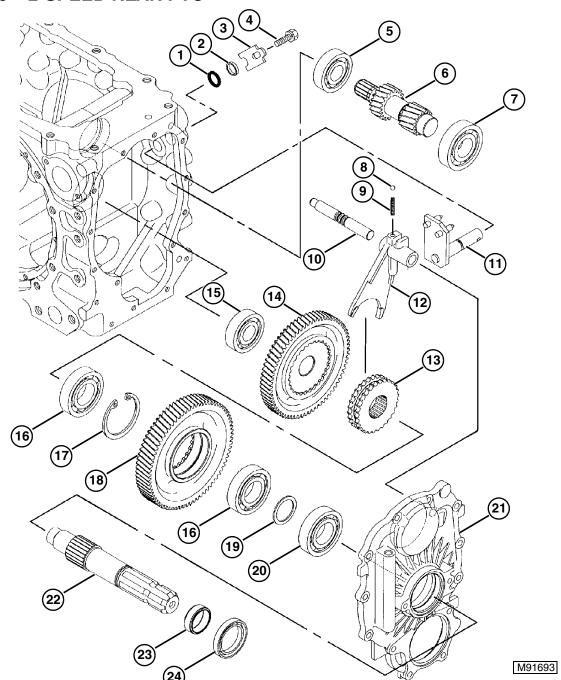
17. Bolt w/Washer

1. Housing, Transmission	18. Cover, Rear PTO	35. Pin
2. Bolt w/Washer	19. Cover, Mid PTO	36. Cover, Mid PTO
3. Cover, Mid PTO	20. Cap Screw w/Lock Washer	37. Cap Screw w/Lock Washer
4. Boot	21. Bearing, Ball	38. Cover, Seal Case
5. Bolt	22. Spacer	39. Ring, Snap - 25
6. Cover, Mid PTO	23. Gear	40. Seal
7. Arm, Mid PTO Shift	24. Shaft, Mid PTO Idler	41. Sleeve, Oil Seal
8. Pin, Spring - 6.0x32	25. Gear	42. Packing
9. Collar	26. Bearing, Ball	43. Bearing, Ball
10. Sleeve	27. Ring, Snap - 68	44. Shaft, PTO Stub
11. Packing	28. Cap Screw w/Lock Washer	45. Ball, 1/4
12. Lever, Shift	29. Cap Screw w/Lock Washer	46. Spring
13. Shoe, Shifter	30. Cover	47. Ring, 35x2.3
14. Pin, Spring - 6.0x32	31. Packing	48. Collar, Shift
15. Washer	32. Case, Mid PTO	49. Gear, Drive
16. Plate	33. Pin, 10x18	50. Washer, 20x40x3

34. Packing



4500-4700 - 2-SPEED REAR PTO





6. Shaft, PTO Pinion

1. O-Ring 7. Bearing 13. Shift Collar 19. Spacer, 35x45x2 2. Collar 8. Ball, 1/4 14. Gear (69T) 20. Bearing 3. Plate, Keeper 9. Spring 15. Bearing 21. Rear PTO Cover 4. Cap Screw and Lock 10. Fork Shaft 16. Bearing 22. Stub Shaft, PTO Washer 5. Bearing 11. Shift Fork Arm 17. Snap Ring, 23. Sleeve, Seal

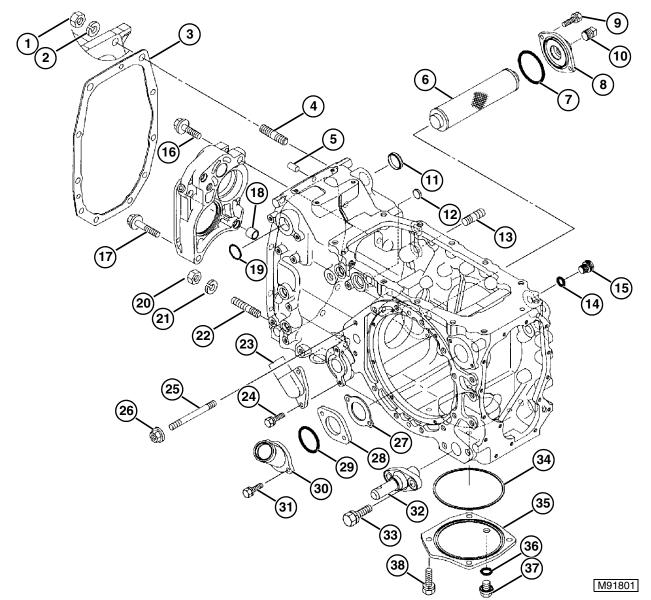
12. Shift Fork

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18. Gear (74T)

24. Seal

4500 - TRANSMISSION HOUSING





1. Nut 11. Cap, Seal 21. Lock Washer 2. Lock Washer 12. Cap, Seal 13. Stud, 16x35 3. Gasket 4. Stud, 16x45 14. Packing 5. Pin, 10x18 15. Plug, 9/16 6. Screen, Suction 16. Bolt 7. Packing

8. Cover, Screen

9. Screw/Washer

10. Plug

17. Cap Screw 18. Bushing, 13x17x14 19. O-Ring 20. Nut

22. Stud, 12x45 23. Flange, Pipe 24. Screw/Washer 25. Stud, 10x90 26. Nut 27. Gasket

28. Spacer 29. O-Ring 30. Filler, Oil 31. Cap Screw/Washer 32. Pin, Lower Link

33. Cap Screw/Washer

34. Packing

35. Cover, Mid PTO

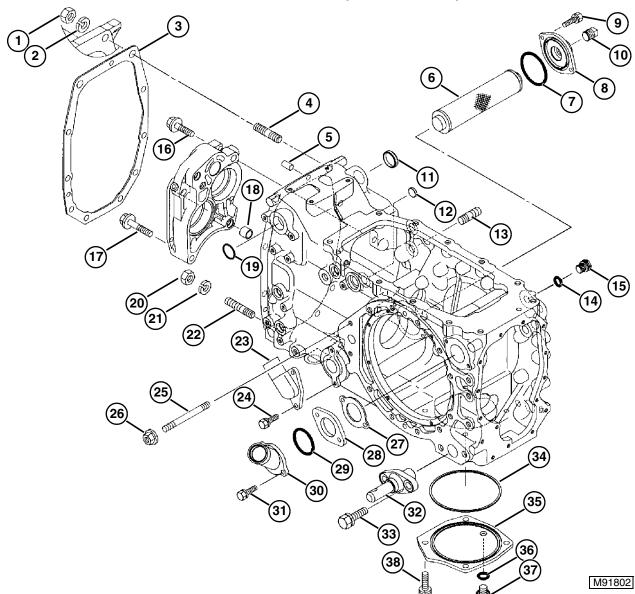
36. Packing

37. Plug

38. Cap Screw/Washer

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4600 / 4700 - TRANSMISSION HOUSING (HST & 2-WD)





1. Nut

2. Washer, Lock

3. Gasket

4. Stud, 16x45

5. Pin, 10x18

6. Screen, Suction

7. O-Ring

8. Cover, Strainer

9. Cap Screw w/Washer

10. Plug

11. Cap, Seal

12. Cap, Seal

13. Stud, 16x35

ro. otaa, rox

14. O-Ring

15. Plug, 9/16

16. Cap Screw

17. Cap Screw

18. Collar, 13x17x14

19. O-Ring

20. Nut

21. Washer, Lock

22. Stud, 12x45

23. Flange, Pipe

24. Cap Screw w/Washer

25. Stud, 10x90

26. Nut

27. Gasket

28. Spacer

29. O-Ring

30. Filler, Oil

31. Cap Screw w/Washer

32. Pin, Lower Link

33. Cap Screw w/Washer

34. O-Ring

35. Cover, Mid PTO

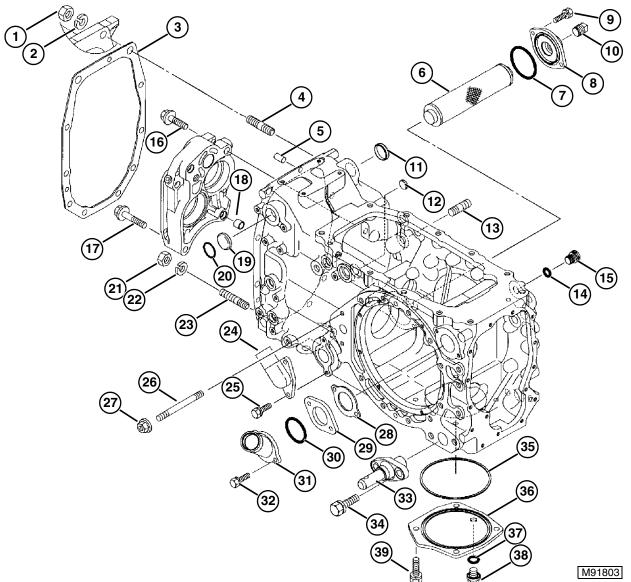
36. O-Ring

37. Plug

38. Cap Screw w/Washer

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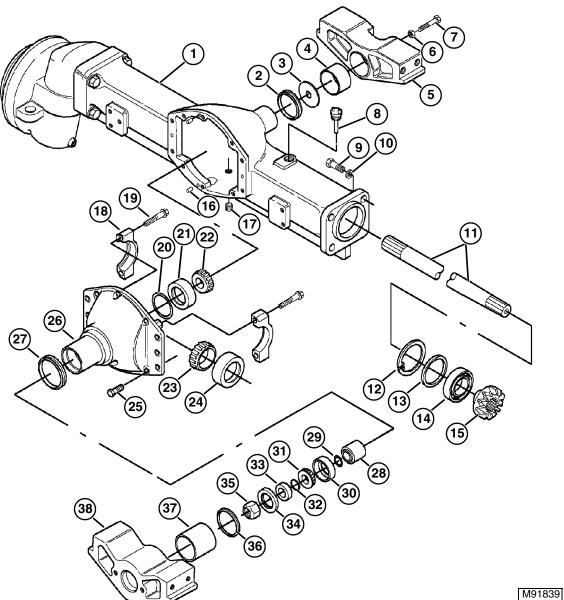
4600 / 4700 – TRANSMISSION HOUSING (HST & 4-WD)





1. Nut	11. Cap, Seal	21. Nut	31. Filler, Oil
2. Washer, Lock	12. Cap, Seal	22. Washer, Lock	32. Cap Screw w/Washer
3. Gasket	13. Stud, 16x35	23. Stud, 12x45	33. Pin, Lower Link
4. Stud, 16x45	14. Packing	24. Flange, Pipe	34. Cap Screw w/Washer
5. Pin, 10x18	15. Plug, 9/16	25. Screw w/Washer	35. Packing
6. Screen, Suction	16. Bolt	26. Stud, 10x90	36. Cover, Mid PTO
7. Packing	17. Cap Screw	27. Nut	37. Packing
8. Cover, Screen	18. Bushing, 13x17x14	28. Gasket	38. Plug
9. Screw w/Washer	19. Cap, Seal	29. Spacer	39. Cap Screw w/Washer
10. Plug	20. O-Ring	30. O-Ring	

4-WD FRONT AXLE HOUSING COMPONENT LOCATION





1. Housing, Axle

2. Seal

3. Washer

4. Bushing

5. Support, Axle

6. Washer

7. Cap Screw

8. Dip Stick / Filler Cap

9. Cap Screw(8)

10. Lock Washer (8)

11. Shaft, Axle

12. Snap Ring (2)

13. Shim (as required)

14. Bearing, Ball (2)

15. Gear, Bevel (12T)

16. Pin, Dowel (2)

17. Plug, Drain

18. Retainer, Bearing (2)

19. Cap Screw (4)

20. Shim (as required)

21. Bearing Cone

22. Bearing Cup

23. Bearing Cup (2)

24. Bearing Cone (2)

25. Cap Screw (12)

26. Cover, Differential

27. Seal

28. Spacer

29. Shim (as required)

30. Bearing Cup

31. Bearing Cone

32. O-ring

33. Seal

34. Spacer

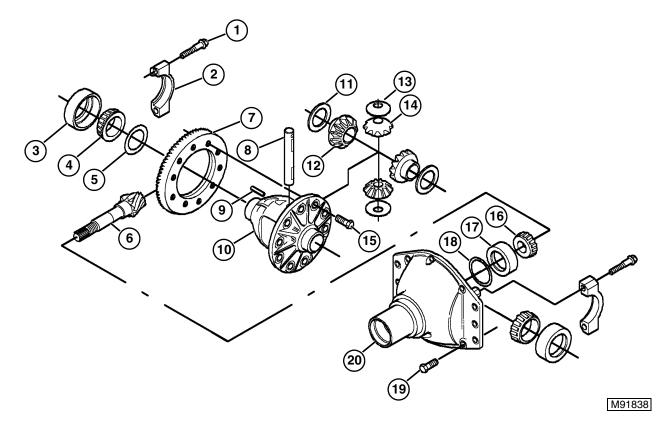
35. Nut 36. Seal

37. Bushing

38. Support, Axle

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4-WD DIFFERENTIAL COMPONENT LOCATION



1. Cap Screw (4)

6. Pinion (11T)

11. Washer, Thrust (2) 16. Bearing Cone

2. Retainer, Bearing (2)

7. Gear, Ring (41T)

17. Bearing Cup

3. Bearing Cup (2)

8. Shaft, Pinion

18. Shim (as required)

4. Bearing Cone (2)

9. Pin

14. Gear, Pinion Bevel (2)

19. Cap Screw (12)

5. Shim (as required)

10. Carrier, Differential

15. Cap Screw (10)

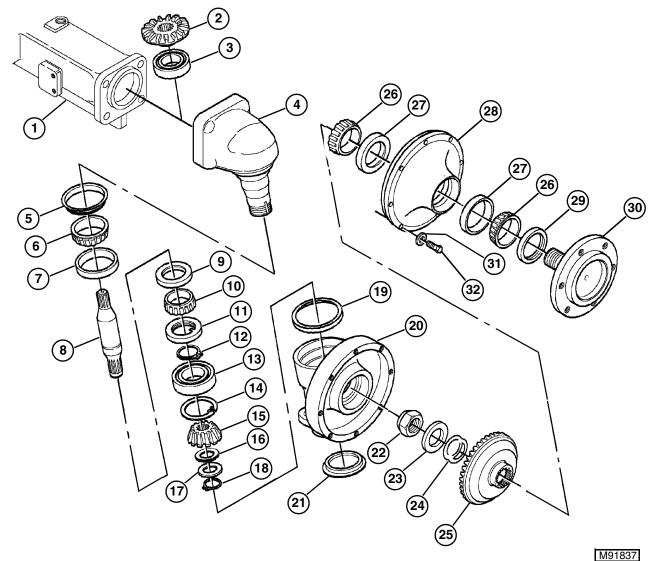
12. Gear, Bevel (2)

13. Washer (2)

20. Cover, Differential



4-WD FINAL DRIVE COMPONENT LOCATION





1. Housing, 4-WD 9. Bearing Cup 17. Washer 25. Gear, Bevel (41T) 2. Gear, Bevel (15T) 10. Bearing Cone 18. Snap Ring 26. Bearing Cone (2) 3. Bearing, Ball 11. Nut 19. Seal 27. Bearing Cup (2) 4. Housing, Spindle 12. Snap Ring 20. Housing, Final Drive 28. Cover, Outer Drive 5. Seal 13. Bearing, Ball 21. Cap 29. Seal 6. Bearing Cone 14. Snap Ring 22. Nut, Spindle 30. Shaft, Hub 7. Bearing Cup 15. Gear, Bevel (12T) 23. Washer 31. Washer (8) 8. Shaft, Spindle 16. Shim (as required) 24. Shim (as required) 32. Cap Screw (8)

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TROUBLESHOOTING

PTO TROUBLESHOOTING CHART

Problem or Symptom Check or Solution	Rear PTO will not engage.	Gear or bearing noise with PTO engaged.	PTO shaft will not stop or slow to stop.	Engine stalls when PTO is engaged.	PTO will not stay engaged.	PTO shaft slows down.	Rear PTO operates, but mid PTO will not engage.	2-speed PTO does not engage.
Low Hydraulic Oil Pressure. (See "SYSTEM RELIEF PRESSURE TEST" on page 27 in Hydraulics section.)								
PTO shaft, gear, or bearing failure.		•		•	•		•	•
PTO clutch for worn or damaged.					•			
PTO brake worn or damaged.			•					
Use higher engine RPM. Check engine performance.				•		•		
Excessive load on PTO output shaft (implement too large). Remove load.				•		•		
PTO solenoid will not engage. (See "PTO SOLENOID TEST" on page 87 in Electrical section.)								
2-speed shift mechanism damaged.								•
Mid PTO shift mechanism damaged or needs adjustment.							•	

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THEORY OF OPERATION

RANGE TRANSMISSION

Operation:

When the transmission is engaged, power from the driven shaft (A) is transferred to reduction shaft (B) through a splined collar. There are three gears on the reduction shaft that are continuously engaged to three gears on the pinion shaft (C). The three gears on the pinion shaft spin freely on the shaft.

Between the three gears on the pinion shaft there are two splined sleeves (D). There are two shifters (E) that slide forward and rearward on the splined sleeves.

The forks secured to the range shift linkage fit into the two shifters (E) and selection of the range shifter moves the forks and shifters forward and rearward. The shifters lock (only one at a time) the gears on the pinion shaft to one of the splined sleeves (D).

The diagram below shows the shifters in the rearmost (1st gear) position. Power flow is shown with the solid arrow. Power flow for 2nd and 3rd gear are shown with dashed arrows.

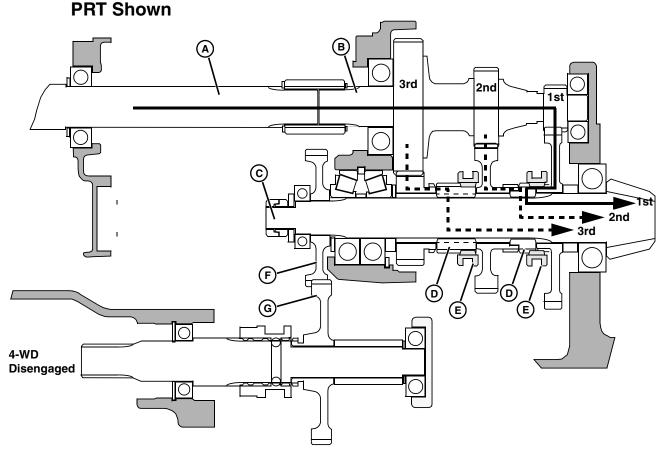
There are four positions for the shifters (from rear to front):

- Rearmost 1st
- Next forward Neutral (no gear locked to sleeves)
- Next forward 2nd
- · Most forward 3rd

4-WD Drive Option

When the pinion shaft is powered, a splined gear (F) provides power to the front drive gear (G) on the front drive shaft. The gear is shown disengaged.

(See "4-WD POWER OPERATION" on page 37.)



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4-WD POWER OPERATION

Operation:

When the transmission is engaged, power from the driven shaft (A) is transferred the pinion shaft (B). (See "RANGE TRANSMISSION" on page 36.)

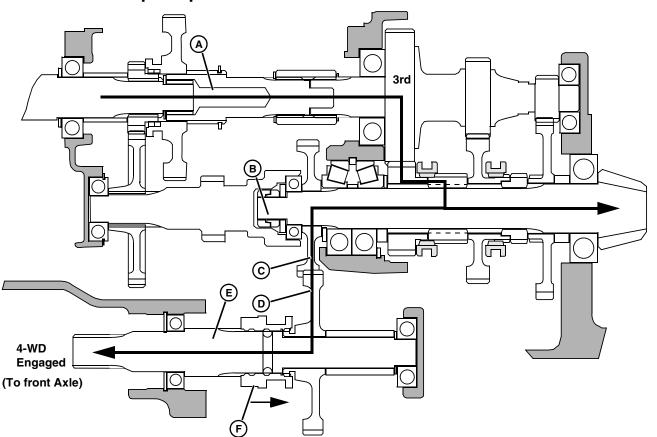
When the pinion shaft is powered, a splined gear (C) provides power to the front drive gear (D) on the front drive shaft.

The front drive gear spins freely on the front drive shaft (E).

When the front wheel drive is engaged, the linkage moves a fork that is fitted into the mid shift collar (F). The mid shift collar is splined to the front drive shaft and moves rearward engaging the front drive gear locking the gear to the shaft. This provides power to the front axle transmission.

The diagram below shows the range shifters in the front (3rd gear) position, and the 4-WD is shown engaged. Power flow is shown with the solid arrow.

PRT With Creeper Option Shown





DIFFERENTIAL POWER FLOW

Function:

To transmit power from the counter shaft to the axle shaft

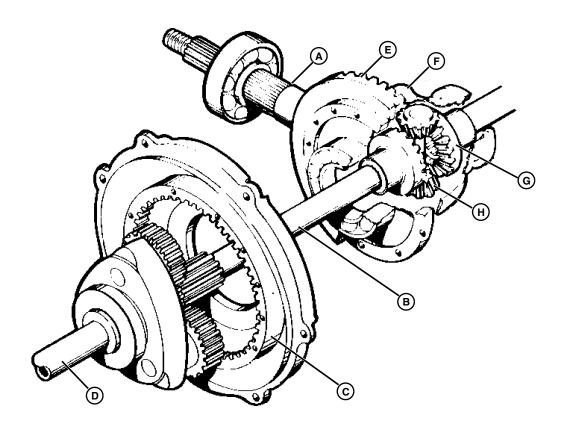
Operation:

Power from the differential drive shaft (A) is transmitted through the differential assembly to the final pinion shaft (B). The final drive pinion shaft is in mesh with the three small gears on the planetary final drive gear assembly (C). Three small gears walk around the inside of the large gear and rotate the planetary assembly. The result is rotation of the axle shaft (D).

The differential assembly is a ring gear (E) bolted to the carrier (F). Inside the carrier are two bevel gears (G) and two bevel pinions (H).

When the tractor turns sharply one axle is held stationary. The result is that the bevel pinions rotate on their own axis and walk around the stationary bevel gears. The turning ring gear transmits power through the pinion to the opposite bevel gear.





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DIFFERENTIAL LOCK OPERATION

Function:

To transmit power to both axles equally.

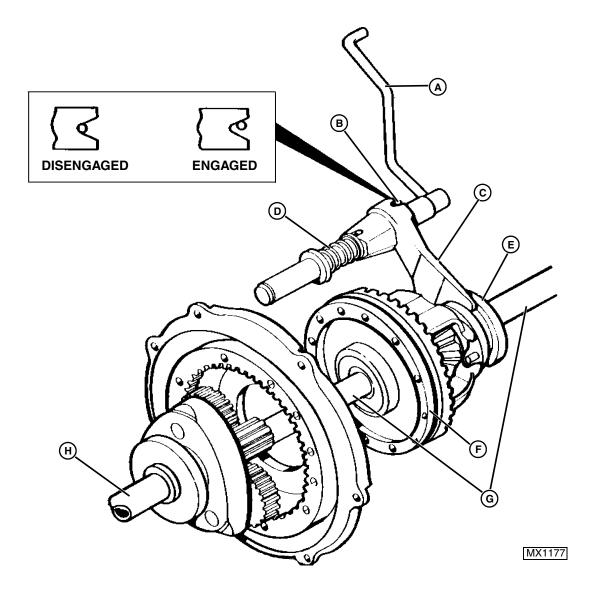
Operation:

Engaging the differential lock locks the two differential output shafts together and keeps an equal amount of power to both axles (eliminates differential action).

Depressing the pedal (A) rotates a pin (B) that sets in the ramp on the fork (C). As the pin rotates it forces the fork to the left. This compresses the spring (D) and forces the differential lock collar (E) toward the differential carrier (F).

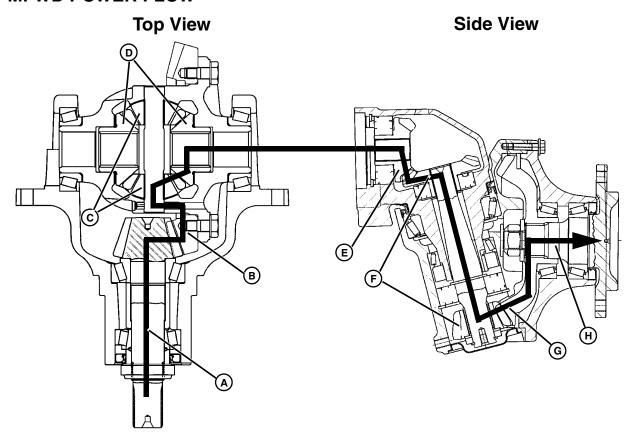
When the pins on the collar align with the holes in the carrier the pins will slip into the holes. Since the collar is splined to the right differential output shaft no differential action will take place and both output shafts (G) turn equally.

When the pedal is released the spring will disengage the differential lock once the torsional forces on the axles (H) is reduced.





MFWD POWER FLOW





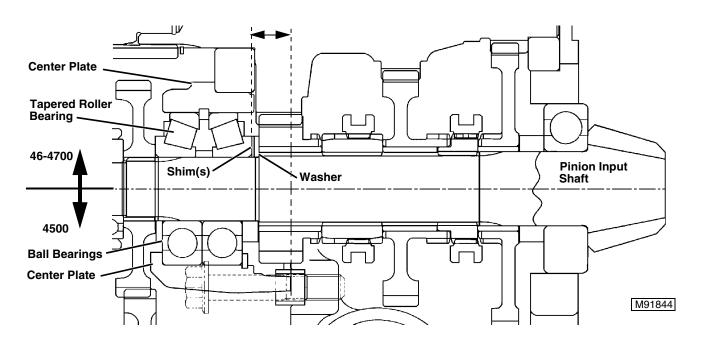
Power from the transaxle is directed through the drive shaft to pinion shaft (A) and ring gear (B). Power then goes from the differential carrier through pin and spider gears (C), to axle drive gears (D).

Power travels out through the axle shaft to drive gear (E). Spindle drive gears and shaft (F), turn final drive gear (G), and axle (H).

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TESTS AND ADJUSTMENTS

DIFFERENTIAL PINION SHAFT ADJUSTMENT - 46-4700

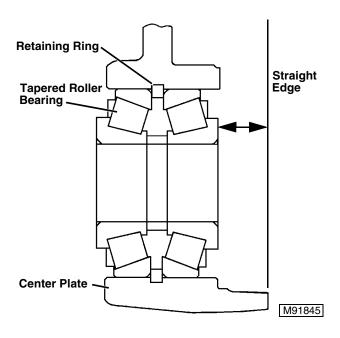


Reason:

To ensure proper gear engagement.

Procedure:

1. Install tapered roller bearings into center plate. Seat bearings against retaining ring.



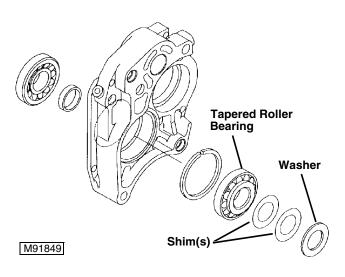
- 2. Place a straight edge across the face of the center plate.
- 3. Measure the distance between the straight edge and the tapered roller bearing face.
- Based on the value of the measurement, refer to Table 1 to determine the number of adjustment shims.

Table 1: 4600-4700 Tractors Only

Dimension		Number of Shims		
Minimum	Maximum			
18.42 mm (0.725 in.)	18.52 mm (0.729 in.)	4		
18.32 mm (0.721 in.)	18.42 mm (0.725 in.)	3		
18.22 mm (0.717 in.)	18.32 mm (0.721 in.)	2 (Standard)		
18.12 mm (0.713 in.)	18.22 mm (0.717 in.)	1		
18.02 mm (0.709 in.)	18.12 mm (0.713 in.)	0		

NOTE: Adjustment shims are available in one size of 0.1 mm (0.004 in.)

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5. Install shim(s) as required, and complete installation of differential drive shaft assembly.

IMPORTANT: Always check and adjust differential backlash after a pinion shaft adjustment.

DIFFERENTIAL BACKLASH ADJUSTMENT



Reason:

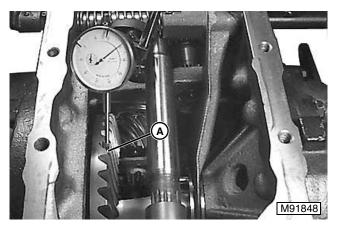
To place the differential ring gear in proper relationship with the differential input pinion shaft.

IMPORTANT: Always check and adjust backlash after pinion shaft adjustment has been made. Do not adjust backlash unless the ring gear was replaced or the amount of shims are in question.

Procedure:

 While slowly rotating the differential housing carrier, use a soft faced mallet to lightly tap the face of the ring gear to move it and the carrier toward the leftside bearing cover.

NOTE: This is to ensure that the carrier and bearings are seated.



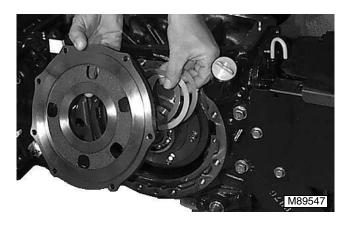
- 2. Attach a dial indicator to the transmission housing.
- 3. Locate the contact point of the dial indicator toward the outer part of the ring gear tooth (A) and as close to perpendicular to the tooth as possible.
- 4. While holding the differential pinion shaft stationary at the pinion, rotate the ring gear and note the backlash reading on the dial indicator.

Specification - 4500-4700:

Backlash 0.13 - 0.18 mm (0.005 - 0.007 in.)

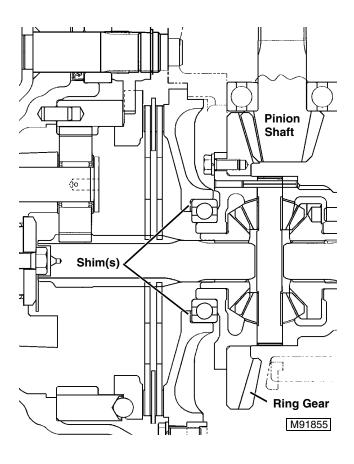
To Adjust Backlash:

1. If not already off, remove left axle housing, and brakes. (See "DIFFERENTIAL" on page 58.)



2. Remove shim(s) located inside cover to increase backlash, or add shim(s) to decrease backlash.

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NOTE: Shims are available in 0.1 mm (0.004 in.), 0.3 mm (0.012 in.), and 0.5 mm (0.020 in.) thicknesses.

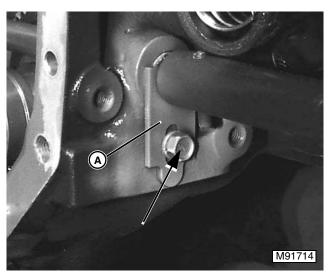
3. Install differential carrier and recheck backlash after removing or installing shims.

REPAIR

4-WD OUTPUT SHAFT

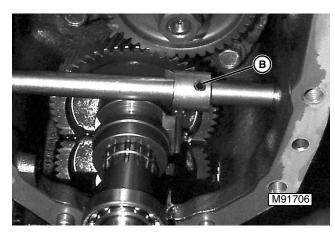
Removal:

- Split tractor at rear of tunnel. See Splitting Tractor (Rear) in the appropriate power train section for the tractor. (i.e. Gear Power Train, Hydrostatic Power Train, PowrReverser Power Train)
- 2. Remove 4-WD shift linkage from bellcrank.

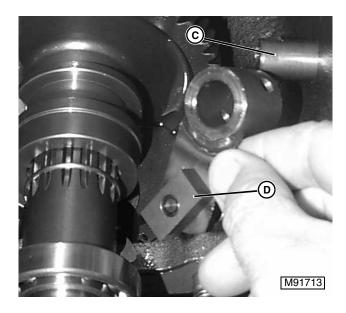


3. Remove cap screw and retainer plate (A) locating front shift shaft in transmission housing.

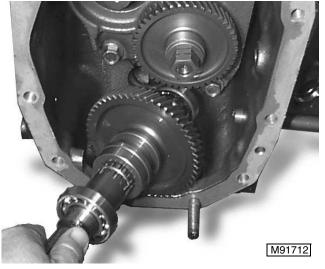




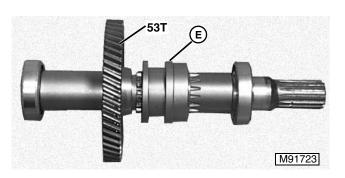
4. Remove spring pin (B) from shift mechanism.



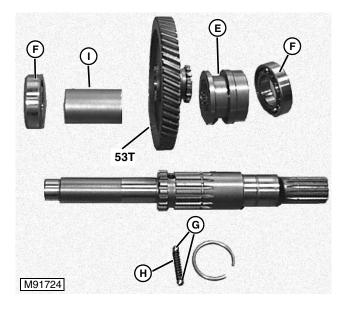
5. Slide shift shaft (C) out far enough to remove front shift arm assembly and shift arm shoe (D).



6. Remove 4-WD front drive shaft assembly from transmission housing.



NOTE: Front drive shaft has two spring loaded detent balls located under shift collar (E). Use care when removing shift collar from shaft.

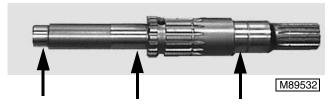


Disassembly:

 Remove shift collar (E), bearings (F), detent balls (G), spring (H), and spacer (I) from front drive shaft.

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

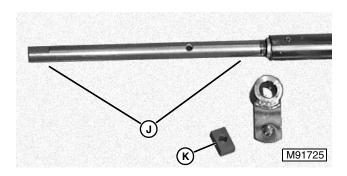
- 8. Clean bearings in a suitable solvent. Dry with compressed air.
- Inspect bearings for discolored, burned balls and/or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.



- Inspect bearing surfaces on shaft for wear or damage. Replace shaft as required.
- 11. Inspect spines on front drive shaft and shift collar for damaged splines. Replace as required.
- 12. Inspect groove in shift collar for scoring or damage. Replace as required.



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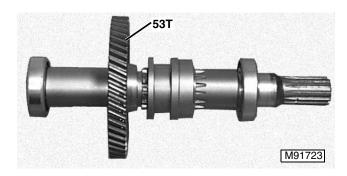
- 13. If not already done, remove front shift shaft assembly from transmission housing.
- Inspect shaft for wear or scoring (J). Replace as needed.
- 15. Inspect shift arm shoe (K). Replace as required.



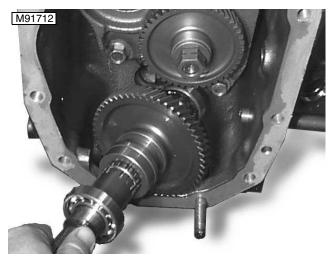
16. Remove O-ring and sleeve from shift shaft hole. Replace O-ring before reassembly.

Installation:

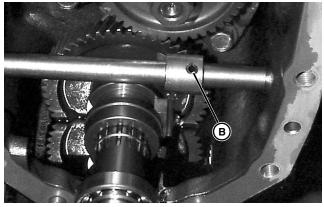
- 1. If removed, install ring on front drive shaft.
- 2. Assemble spring, detent balls, and shift collar on front drive shaft. Install shift collar as shown, with groove towards gear side.



3. Install gear, spacer and bearings as shown.

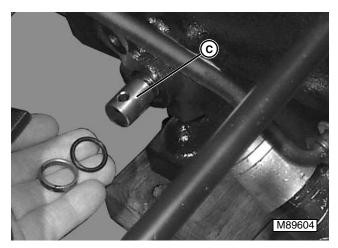


4. Place front drive shaft assembly in transmission housing.



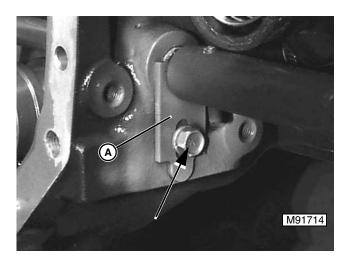


- 5. Install shift shaft, lever, and bearing block.
- 6. Line up holes and install spring pin (B).



7. Place new O-Ring on shift shaft (C). Seat in counterbore in transmission housing.

8. Place collar on shift shaft.

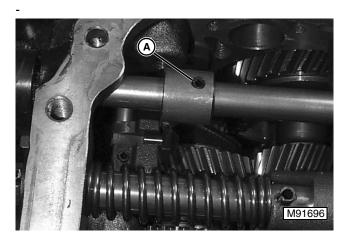


- Install retainer plate (A) locating shift shaft in transmission housing, secure with lock washer and cap screw.
- Place bellcrank on shift shaft. Secure with spring pin.

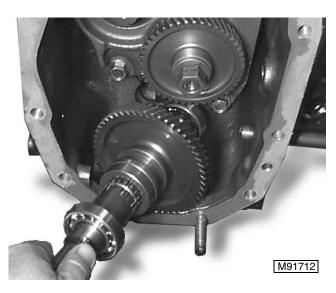
SPEED RANGE TRANSMISSION

Removal:

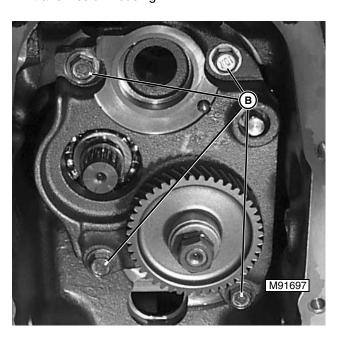
- Split tractor at rear of tunnel. See Splitting Tractor (Rear) in the appropriate power train section for the tractor. (Gear Power Train, Hydrostatic Power Train, or PowrReverser Power Train)
- 2. Remove rockshaft. (See "ROCKSHAFT ASSEMBLY" on page38 in Hydraulics Section.)
- 3. Remove PTO clutch and shaft. (See "PTO CLUTCH & BRAKE" on page 79.)



- 4. Remove spring pin (A) from range shift shaft and shift arm.
- 5. Slide shift arm assembly over to right until it is out of slot on fork.



6. Remove 4-WD front drive shaft assembly from transmission housing.



 Remove cap screws (B) securing bearing housing to transmission housing and slide bearing housing and transmission out.

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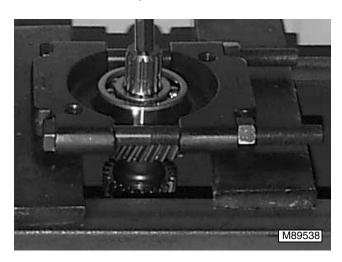
Disassembly:



8. Tap gear reduction assembly out of bearing housing with plastic hammer.



 Remove external snap ring from end of gear reduction assembly.



2. Using a suitable press and bearing removal tools, remove bearings from both ends of the gear reduction assembly.

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

- Clean bearings in a suitable solvent. Dry with compressed air.
- 4. Inspect bearings for discolored, burned, balls and/ or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.

NOTE: Gears on the gear reduction assembly are NOT replaceable. DO NOT attempt to remove gears from shaft.



- 5. Inspect bearing surfaces on gear reduction assembly for wear or damage. Replace as required.
- 6. Inspect spines and gear teeth on gear reduction assembly for damage. Replace as required.



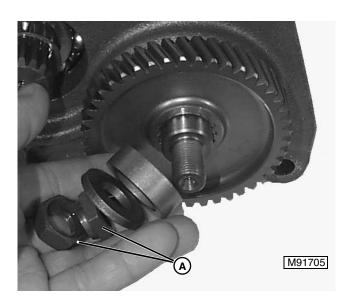
Assembly:

- 1. Press bearings onto gear reduction assembly.
- 2. Install snap ring.

Differential Pinion Shaft Removal & Disassembly:

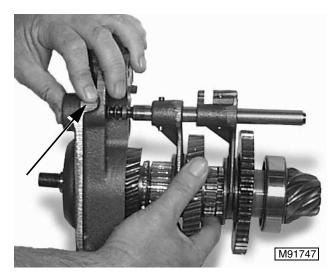
NOTE: Exact parts order varies among tractors.

Variations occur between 4500 and 4700 tractors. Variations also occur among different drives (Gear, Hydro, PRT). See Component Location for specific parts.



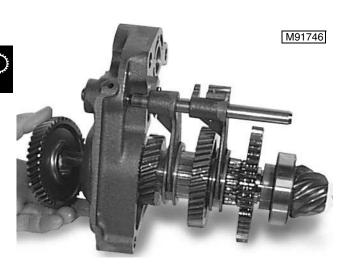
3. Remove eccentric lock nuts (A) (upper and lower), washer and bushing.

NOTE: Gear shown above is used on 4-WD tractors only. Tractors without 4-WD have a second bushing and washer.



NOTE: Bearing housing has a spring loaded detent ball in it for fork shaft. Cover the front and top holes as shown while removing fork shaft to avoid losing parts.

5. Simultaneously slide pinion shaft assembly and shift fork assembly out of bearing housing.



4. Remove gear 44T (4-WD only) and outer bearing from pinion shaft.

NOTE: It may be necessary to pry gear off with two small pry bars or screwdrivers.



6. Remove bearing and spacer (4600-4700 only).

NOTE: 4500 tractors have ball bearings in bearing housing. Ball bearings are secured with a snap ring.

7. Inspect bearings for discolored, burned, rollers and/ or races. Check rollers and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play. Replace bearings as required.

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M91756

- 8. Remove shim(s) and washer (4600-4700 only). Remove washer (4500 only).
- NOTE: Shims are used on 4600-4700 tractors only.
 These shims are used for backlash adjustment. On the 4500 tractors, backlash is adjusted only on differential carrier. (See "DIFFERENTIAL BACKLASH ADJUSTMENT" on page 42.)



M91760

- 9. Remove counter gear and bushing.
- 10. Inspect gear for wear and damage on both sets of teeth. Inspect inside of gear and sleeve for wear or damage. Replace parts as needed.



- Remove outer splined sleeve and shifter from pinion shaft.
- 12. Inspect parts for wear or damage, especially on the inner teeth of the shifter.
- 13. Replace parts as needed.





- 14. Remove second counter gear and bushing from pinion shaft.
- 15. Inspect gear for wear and damage on both sets of teeth. Inspect inside of gear and sleeve for wear or damage. Replace parts as needed.



- 16. Remove inner splined sleeve and shifter from pinion shaft.
- 17. Inspect parts for wear or damage, especially on the inner teeth of the shifter.
- 18. Replace parts as needed.



- 19. Remove first gear and bushing from shaft.
- Inspect gear for wear and damage on both sets of teeth. Inspect inside of gear and sleeve for wear or damage. Replace parts as needed.



- 21. Remove spacer, note that oil grooves face away from bearing.
- 22. Press bearing from shaft.
- 23. Inspect bearings for discolored, burned, rollers and/ or races. Check rollers and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play. Replace bearings as required.
- 24. Inspect gear teeth on shaft for wear or damage. Inspect bearing areas of shaft for wear or damage. Replace shaft as required

Assembly:

Parts are assembled in the reverse order of disassembly.

Tighten eccentric lower lock nut (inside nut) to specification.

Tighten eccentric upper lock nut (outside nut) to specification.

Specification:

Eccentric Lock Nut Torque . .78-97 N•m (58-72 lb-ft)



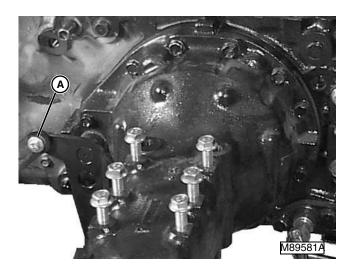
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FINAL DRIVE REMOVAL

Left Hand Final Drive Removal:

NOTE: Final drive/axle housings weigh approximately 68 kg (150 lbs.) each. Be sure to adequately support final drives before removing cap screws securing final drive to transmission housing.

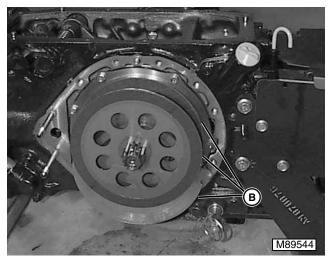
Make sure opposite final drive is adequately supported, if applicable, before removing a final drive.



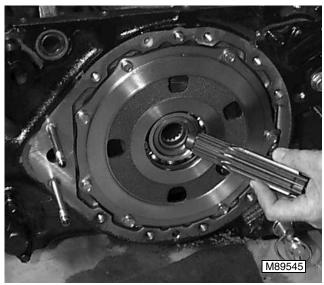
- 1. Remove brake link rod (A).
- 2. Remove cap screws and nuts securing final drive to transmission housing.

NOTE: Be careful when removing final drive from transmission housing, pinions and brake plates may fall out and be damaged.

3. Remove final drive from transmission housing.



4. Remove three brake plates (B) from final drive or transmission housing (illustrated).



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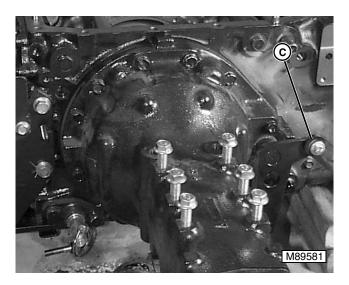
5. Remove left hand pinion from final drive or differential carrier (differential carrier illustrated).

Right Hand Final Drive Removal:

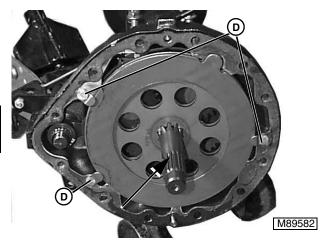
NOTE: Final drives weigh approximately **68 kg (150 lbs)** each. Be sure to adequately support final drives before removing cap screws securing final drive to transmission housing.

Make sure opposite final drive is adequately supported, if applicable, before removing a final drive.

NOTE: Right hand final drive is removed the same as the left hand final drive.



- 1. Remove brake link rod (C).
- 2. Remove cap screws and nuts securing final drive to transmission housing. Separate final drive from transmission housing.



NOTE: Brake plates and disks, and right hand pinion will remain with the right hand final drive.

3. To remove right hand pinion, rotate three lock tabs (D) to clear brake plates. Remove pinion with brake plates and disks. Separate brake plates and disks from pinion.

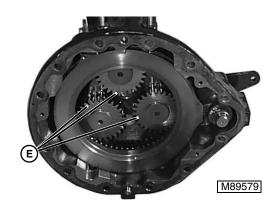
FINAL DRIVE INSTALLATION

Left Hand Final Drive Installation:

NOTE: Final drives weigh approximately **68 kg (150 Ibs.)** each. Be sure to adequately support final drive while installing.



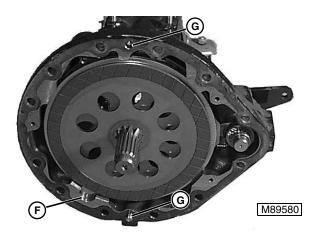
1. Assemble two brake disks and one brake plate on short left hand pinion.



- 2. Orient left hand final drive on lifting device that will allow changes in elevation, and forward and backward movement, necessary to align final drive with transmission housing.
- Place left hand pinion, with brake plates, into left hand final drive aligning teeth of planetary pinions (E) with teeth on left hand stub shaft.



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- 4. Align tab in brake plate (F) with corresponding slot in rear axle housing.
- 5. Make sure two alignment pins (G) are installed in either transmission housing or rear axle housing.
- 6. Align left hand final drive with left side of transmission housing. Rotate differential carrier and/or wheel mounting flange on final drive to facilitate aligning the splines in the stub shaft with the splines in the differential carrier.
- 7. Secure with cap screws with lock washers and two nuts with lock washer.
- 8. Tighten cap screws to specification.
- 9. Tighten nuts to specification.

Specification:

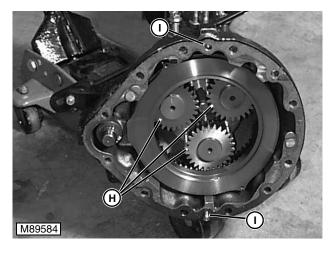
Right Hand Final Drive Installation:

NOTE: Final drives weigh approximately **68 kg (150 Ibs.)** each. Be sure to adequately support final drive while installing.

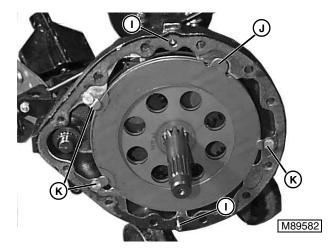


M89583

1. Assemble two brake plates and one brake disk on short right hand pinion.



- Orient left hand final drive on lifting device that will allow changes in elevation and forward and backward movement necessary to align final drive with transmission housing.
- 3. Place right hand pinion, with brake plates, into right hand final drive, aligning teeth of planetary pinions (H) with teeth on right hand pinion.





- Align tabs (J) on brake plate with corresponding slot in rear axle housing. Rotate lock tabs (K) to retain brake plates.
- 5. Make sure two alignment pins (I) are installed in either transmission housing or rear axle housing.
- 6. Align right hand final drive with right side of transmission housing. Rotate differential carrier and/or wheel mounting flange on final drive to facilitate aligning the splines in the pinion with the splines in the differential carrier.
- 7. Secure with cap screws, lock washers, and two nuts with lock washers.
- 8. Tighten cap screws to specification.
- 9. Tighten nuts to specification.

Specification:

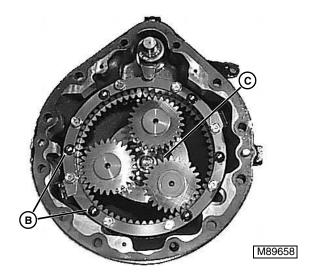
FINAL DRIVE DISASSEMBLY INSPECTION & ASSEMBLY

NOTE: Left hand final drive is shown in the following story. Right hand drive disassembly, inspection and assembly is basically the same.

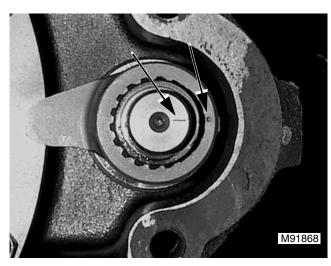
- 1. Remove final drive to be serviced from the machine. (See "FINAL DRIVE REMOVAL" on page 51.)
- 2. If not already done, remove brake plates and pinion from rear axle housing. (See "FINAL DRIVE REMOVAL" on page 51.)



3. Remove the springs (A) that retain the brake plate in the rear axle housing.



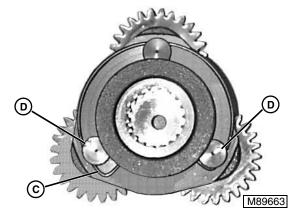
- 4. Remove balls (B) from internal gear.
- 5. Remove lock plate (C) from bolt in center of planetary pinion assembly.
- 6. Remove bolt securing planetary pinion assembly to drive axle. Remove planetary pinion assembly.



NOTE: Snap ring removed for clarity.

- 7. If not already marked, mark end of brake rod and brake cam to facilitate assembly. Remove external snap ring retaining brake cam to brake rod. Remove brake cam and brake rod from rear axle housing.
- 8. Remove brake rod bushing.
- 9. Remove cap screws securing internal gear to rear axle housing.
- 10. Remove internal gear.
- 11. Inspect internal gear for damage. Replace as required.

4500 Planetary Pinions:



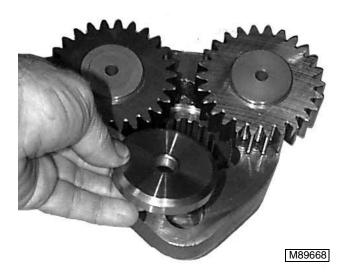
12. From back side of planetary pinion carrier, remove wire ring (C) retaining planetary pinion shafts (D). Drive shafts from planetary pinion carrier.

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NOTE: All three planetary pinion/shaft assemblies are the same. Only one is shown disassembled in the following story. It is recommended if one planetary pinion requires replacing that all three gears and ring gear be replaced. Use new gear shafts and bearings as well.



 Remove washer, gear, bearing, and washer from planetary pinion shaft. Inspect components for damage. Replace as required.



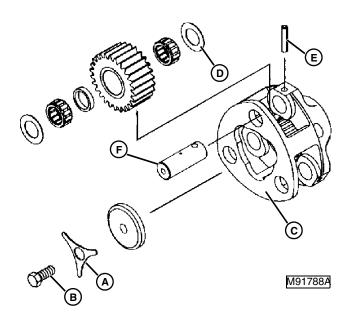
- 14. Remove heavy washer from center of planetary pinion assembly.
- Inspect planetary pinion carrier for damage to planetary pinion shaft bores and/or internal splines. Replace planetary pinion carrier as required.

Reassembly:

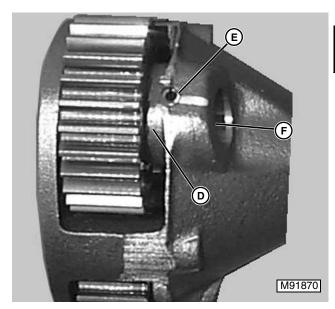
Parts are assembled in the reverse order of disassembly.

 Lubricate bearings with transmission oil before reassembly.

46-4700 Planetary Pinions:

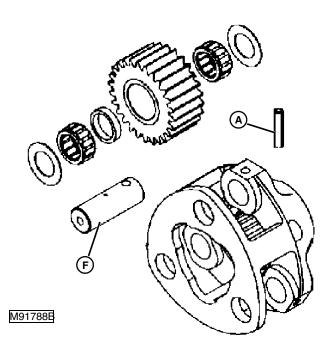


- Remove locking plate (A) from axle bolt and remove bolt (B).
- 17. Remove planetary pinion carrier (C) from axle.



NOTE: Make sure the large washer (D) inside the planetary pinion carrier is against the axle spline hole so it does not interfere with the spring pins (E) as they are driven out.

 Drive the spring pins (E) out of the pinion shafts and remove the shafts (F), washers, bearings, and sleeve.



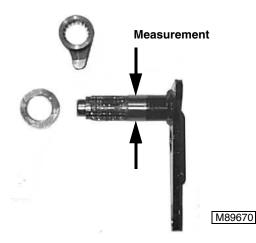
2. Inspect pinion bores, shafts, and bearings for wear or damage. Replace as required.

NOTE: All three planetary pinion/shaft assemblies are the same. Only one is shown disassembled in the following story. It is recommended if one planetary pinion requires replacing, that all three gears and ring gear be replaced. Use new pinion shafts and bearings as well.

Reassembly:

Parts are assembled in the reverse order of disassembly.

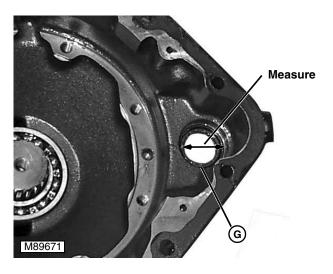
 Lubricate bearings with transmission oil before reassembly.



- 3. Measure brake arm OD If measurement is not within specification, replace brake arm.
- 4. Inspect brake cam for wear and/or damage to splines. Replace as required.
- Measure brake arm sleeve OD and ID If measurement are not within specification, replace sleeve.

Specifications:

Brake Arm Sleeve



6. Measure brake arm bore ID of final drive case. If not within specification, replace rear axle housing.

Specifications:

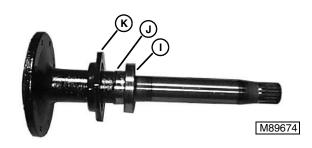
Rear Axle Housing Brake Arm Bore ID 45.08-45.18 mm (1.775-1.779 in.)

7. Replace brake rod seal (G) in rear axle housing.

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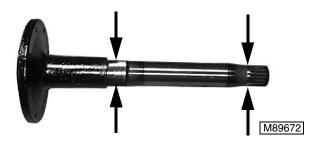
- 8. Remove cap screws (H) securing oil seal housing to end of rear axle housing.
- 9. Drive axle from bearings in rear axle housing.



- Remove bearings (I) from axle and/or rear axle housing.
- 11. Remove seal sleeve (J) from axle. Remove oil seal housing (K) from axle.
- 12. Replace oil seal in oil seal housing.

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

- 13. Clean bearings in a suitable solvent. Dry with compressed air.
- 14. Inspect bearings for discolored, burned, balls and/ or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.



- Inspect rear axle splines for damage. Inspect bearing areas of axle. If worn or damaged, replace axle.
- 16. Inspect bearing areas in rear axle housing. Bearings should be a snug fit. If bearings are loose in housing, replace rear axle housing.

Specifications:

Brake Arm Bushing

Assembly:

Assembly of the final drive is the reverse of disassembly.

- Always use a new axle seal, in oil seal housing, whenever the axle has been removed.
- If seal sleeve has been removed, use new seal sleeve. Be sure to install seal sleeve before installing outer bearing.
- Place oil seal housing on axle and press outboard bearing on axle. Install axle in rear axle housing. Support end of axle and press inner bearing on axle and into rear axle housing.
- Insure that heavy washer is installed in planetary pinion carrier before installing planetary pinions.
 Install wire ring in planetary pinion grooves after pressing them in place.
- Be sure to install lock plate on planetary pinion carrier bolt after tightening bolt to 103-132 Nom (76-98 lb-ft).
- Be sure to install spring hooks on two cap screws when installing differential carrier. Tighten all internal gear cap screws to 44-59 N•m (33-43 lbft).
- When assembling brake cam to brake arm be sure to align match marks.
- Align machined slot in brake plate with brake cam.



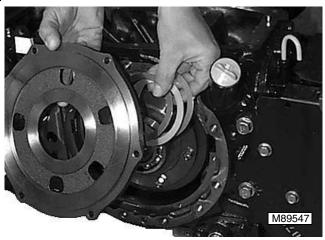
DIFFERENTIAL

Removal:

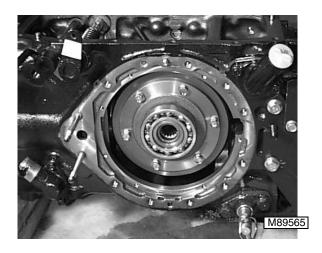
- 1. Remove left hand final drive. (See "FINAL DRIVE REMOVAL" on page 51.)
- 2. Remove differential lock fork. (See "DIFFERENTIAL LOCK FORK" on page 60.)



- 3. Remove final pinion from rear axle housing (if not already done).
- 4. Remove bolts and lock washers securing differential carrier to transmission housing.



5. Remove differential carrier taking care not to damage or loose shims located between differential carrier and differential bearing.



6. Remove differential assembly from transmission housing.

Disassembly:



M89577

- 1. Remove snap ring (A) (4600-4700 tractors) retaining bearing on differential.
- 2. Remove bearing from differential.



3. Remove differential lock collar from differential.

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DIFFERENTIAL



4. Remove bearing from carrier side of differential.

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

- 5. Clean bearings in a suitable solvent. Dry with compressed air.
- 6. Inspect bearings for discolored, burned, balls and/ or races. Check balls and races for spalling or cracking. Roll bearing by hand to check for rough turning or excessive looseness or play between balls and races. Replace bearings as required.



7. Remove six screws (46-4700), or twelve cap screws (4500), and lock washers securing ring gear to differential housing. Remove ring gear.



M89570

8. Drive retaining spring pin into differential housing until it clears pinion shaft.



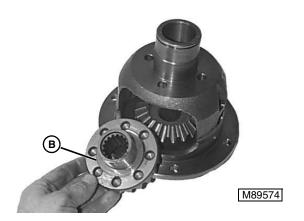
0

9. Remove the pinion shaft from differential housing.



M89572

 Rotate differential gear and remove differential pinions and cupped pinion washers from differential housing.



- Remove the differential gear with differential lock, from differential housing. Note washer located between gear and differential housing.
- Remove the plain differential gear from differential housing. Note washer (B) located between plain differential gear and differential carrier.
- 13. Clean all components in a suitable solvent.
- 14. Inspect all parts for wear and/or damage. Replace as required.

Assembly:

Assembly of the differential is the reverse of disassembly.

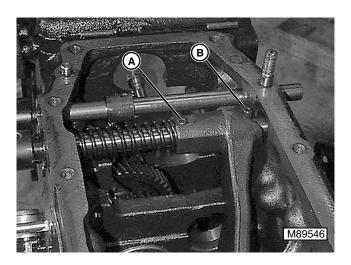
- Apply loctite to threads of ring gear retaining cap screws.
- On 4500 tractors, tighten 8 mm ring gear retaining cap screws to 23-29 Nom (17-22 lb-ft).
- On 4600-4700 tractors, tighten 10 mm ring gear retaining screws to 44-59 N•m (33-43 lb-ft).
- On 4600-4700 tractors, adjust backlash of differential. (See "DIFFERENTIAL BACKLASH ADJUSTMENT" on page 42.)

DIFFERENTIAL LOCK FORK

Removal:

1. Remove rockshaft assembly. (See "ROCKSHAFT ASSEMBLY" on page38 in Hydraulic Section.)

NOTE: The differential lock fork can be serviced without further disassembly of the transmission, however if the differential locking collar requires replacement, the left side final drive and the differential carrier must be removed. (See "DIFFERENTIAL" on page 58.)



2. Drive out the single spring pin (A) and the double spring pin (B) securing the shift fork to the differential lock shaft.

NOTE: Spring is under a small amount of tension until removed from the transmission housing. Use care when removing the spring to avoid loosing it.

- 3. Pull shaft out the side of the transmission housing taking care not to release the spring.
- 4. Remove spring from between differential shift fork and transmission housing.
- 5. Remove differential lock shift fork.

Installation:

Installation of the differential lock fork is the reverse of removal.



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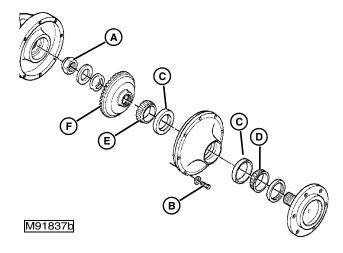
4-WD DRIVE SHAFT REMOVAL AND INSTALLATION

- Remove the cotter pins from the drive shaft splined connectors.
- 2. Support the drive shaft and slide the splined connectors toward the center of the drive shaft, removing the drive shaft from the tractor.
- 3. Installation is the reverse of removal.
- 4. Install new cotter pins to the connectors.

4-WD FINAL DRIVE COVER

Removal and Inspection:

- Drain the differential and the final drive housing being worked on.
- 2. Raise and support the final drive being serviced.
- 3. Remove the wheel and tire from the final drive.
- 4. Remove eight cap screws (A) and washers. Separate the final drive cover and hub shaft from the final drive housing.



NOTE: The final drive cover is sealed to the final drive housing. It may be necessary to pry the cover from the housing using the two reliefs on the sides of the cover.

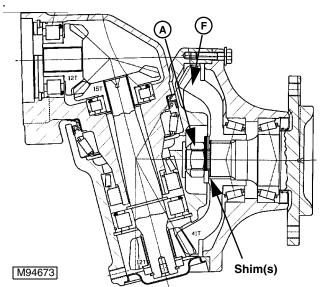
- 5. Secure the wheel end of the hub shaft, remove and discard the retaining nut (B).
- IMPORTANT: The retaining nut (B) on the hub shaft is a special "torque prevailing" nut. ALWAYS replace this nut DO NOT reuse.

 NEVER tighten a torque prevailing nut with an impact wrench. ALWAYS use a torque wrench to correctly tighten torque prevailing nuts.

- 6. Press the hub shaft from the final drive cover, bearings, and bevel gear.
- 7. Disassemble the remaining components from the final drive cover assembly.
- 8. Clean and inspect all parts. Replace any unserviceable components.

Installation:

- 1. Install the bearings cups (C) in the final drive cover.
- Install the hub bearing cone (D) to the outer bearing cup.
- 3. Coat the outer surface of a new hub seal with John Deere Sealant TY6304. Install the new hub seal.
- 4. Install the hub shaft in the bearing cone, cups and final drive cover.
- Install second (inside) bearing cone (E) and bevel gear (F).
- 6. To adjust the bearings:
- Apply 1200 lbs axial load on the web of the bevel gear 41T, while rolling and oscillating the bearings to insure proper seating of the bearing.
- With the load applied, measure the dimension between the gear face and the end of the hub shaft (non threaded portion).
- Select the same thickness shim(s) as the measured dimension, and install the shim(s) to the shaft.

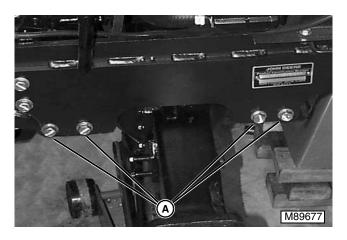




- Apply LOCTITE 262 to the threads, and assemble the washer and new torque prevailing nut to the hub shaft. Tighten the nut to 447 - 488 N•m (330 - 360 lb-ft).
- Verify that the rolling torque of the cover is 1.4 4.1
 Nom (15 35 lb-in.).
- If the rolling torque is not correct, repeat the previous steps.
- Apply John Deere Sealant TY6304 to the mating surface of the final drive cover. Install the final drive cover to the final drive housing. Tighten the cap screws to 30-38 N•m (22-28 lb-ft).

4-WD REMOVAL

- 1. Remove the differential drive shaft.
- 2. Label and remove the power steering hoses from the front axle steering cylinder.
- 3. Raise the front of the tractor and support the frame to allow 4-WD removal.
- 4. Support the 4-WD with a floor jack.



- 5. Remove the axle support mounting cap screws (A).
- 6. Partially remove the axle pin by pulling the pin toward the front of the tractor. Remove and save any shims.



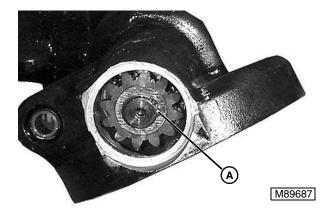
- Remove the axle pin completely. Lower the axle from the frame with a floor jack. Set the axle on a workbench or blocks to disassemble.
- 8. Inspect the axle pin and replace if required.
- 9. Inspect the axle pin bushings in the frame and replace if worn or damaged.

SPINDLE SHAFT

Removal and Disassembly:



1. Carefully remove the spindle cap from the housing.



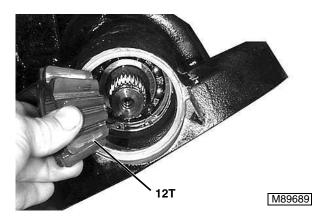
2. Remove the snap ring (A) from the spindle shaft.



3. Remove the washer, shim, and bevel gear from the spindle shaft. Save any shim(s) from between the spacer and the bevel gear.



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4. Remove the bevel gear from the spindle shaft.



5. Remove the snap ring from the spindle housing.



- 6. Remove the spindle shaft and bearing from the spindle housing.
- Remove the snap ring and bearing from the spindle shaft. Inspect all parts, and replace any unserviceable components.

SPINDLE SHAFT ASSEMBLY AND INSTALLATION

- Install the bearing and snap ring on the spindle shaft.
- 2. Install the spindle shaft assembly on the final drive housing.
- Install the internal snap ring in the final drive housing.
- Install the bevel gear 12T, any shim(s), the washer, and snap ring on the spindle shaft.
- Install the final drive cover to the final drive housing, if removed.
- To set the backlash of the lower final drive, shim the bevel gear to achieve 0.64 - 0.76 mm (0.025 -0.030 in.) of end play.
 - The end play sets 0.13 0.18 mm (0.005 0.007 in.) of backlash.
- Apply John Deere TY15941 retaining compound to the final drive housing cap, and install the spindle cap.

FINAL DRIVE HOUSING

Disassembly:

- Remove the final drive cover. (See "4-WD FINAL DRIVE COVER" on page 61.)
- 2. Remove the final drive spindle shaft. (See "SPINDLE SHAFT" on page 62.)
- 3. Remove and discard the retaining nut from the final drive housing.



IMPORTANT: The retaining nut securing the bearing to the spindle housing is a torque prevailing nut. ALWAYS replace this nut. DO NOT reuse.

NEVER tighten a torque prevailing nut with an impact wrench. ALWAYS use a torque wrench to correctly tighten torque prevailing nuts.

- 4. Remove the final drive housing from the spindle housing, and put the final drive housing in a vise.
- Remove the bearing cups and bearing cones from the spindle housing and from the final drive housing. Clean and inspect all components. Replace any unserviceable components.

Assembly:

- 1. Replace the final drive housing seal.
- 2. Install the bearing cups and cones in the housing.
- 3. Install a new bearing retaining nut on the final drive housing. To correctly install the nut:
- Hand start the nut until it comes in contact with the bearing.
- Apply 18 23 Kg (40 50 lbs) compressive force to

the socket. While applying compressive force, tighten the nut to 108.5 N•m (80 lb-ft). Oscillate the final drive housing several times to seat the bearing.

- Loosen the nut one half turn (180°).
- Retighten the nut to 20 27 N•m (15 20 lb-ft).
- 4. Install the spindle shaft. (See "SPINDLE SHAFT ASSEMBLY AND INSTALLATION" on page 63.)
- 5. Install the final drive cover. (See "Installation:" on page 61.)

SPINDLE HOUSING

Removal and Disassembly:

- Remove the final drive housing. (See "4-WD FINAL DRIVE COVER" on page 61.)
- Remove four cap screws fastening the spindle housing to the 4-WD housing.
- 3. Remove the internal snap ring from the spindle housing.
- 4. Remove the bearing and axle gear 12T assembly from the spindle housing.
- Remove the bearing and spindle gear 15T assembly from the spindle housing.
- 6. If necessary, press the gears from the bearings.

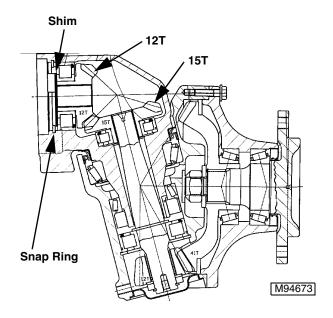
NOTE: The bearings are pressed onto the gears, and are slip fits into the housing.



7. Clean and inspect all parts. Replace any unserviceable parts.

Assembly and Installation:

- Install the bearing and spindle gear 15T assembly to the spindle housing.
- 2. Install the bearing and axle gear 12T assembly to the spindle housing.
- 3. Install the internal snap ring to the spindle housing.
- 4. Set the backlash of the axle gear. To set the backlash:
- Measure the distance between the bearing and the snap ring at several locations.
- Shim the bearing and (axle) gear to 0.15 0.28 mm (0.006 - 0.011 in.) of end play, to achieve 0.10 -0.20 mm (0.004 - 0.008 in.) backlash.



- Apply John Deere TY6304 sealant to the mating surfaces of the 4-WD housing and the spindle housing.
- 6. Install the spindle housing to the 4-WD housing:
- Apply Loctite[®] 262 to the threads, and install four cap screws fastening the spindle housing to the 4-WD housing.
- Tighten the cap screws to 286 316 N•m (211 233 lb-ft).
- 7. Install the final drive housing. (See "4-WD FINAL DRIVE COVER" on page 61.)

FRONT AXLE DIFFERENTIAL

Removal and Disassembly:

- Remove both final drive housings from the 4-WD. (See "4-WD FINAL DRIVE COVER" on page 61.)
- Remove both axle shafts from the 4-WD housing.
- 3. Remove the 4-WD drive shaft. (See "4-WD DRIVE SHAFT REMOVAL AND INSTALLATION" on page 61.)
- 4. Remove twelve cap screws fastening the differential cover to the 4-WD housing.
- Remove the differential cover and differential carrier from the 4-WD housing.
- 6. Remove the cap screws for the bearing caps.
- Remove the differential carrier from the differential cover.
- 8. Remove ten cap screws. Remove the ring gear from the differential carrier.

NOTE: The differential carrier is serviced as an assembly only. Verify parts availability before discarding any parts.

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9. Disassemble the differential carrier assembly.

NOTE: The remove the carrier bearings only if necessary. Return any shims between the bearings and the carrier to their original position.

- 10. Clean and inspect all parts and check parts for wear. Replace any unserviceable parts.
- 11. Remove the pinion nut. Do not discard the nut at this time.
- Remove the differential pinion from the differential cover.

IMPORTANT: The pinion retaining nut is a special "torque prevailing" nut. ALWAYS replace this nut- DO NOT reuse.

NEVER tighten a torque prevailing nut with an impact wrench. ALWAYS use a torque wrench to correctly tighten torque prevailing nuts.

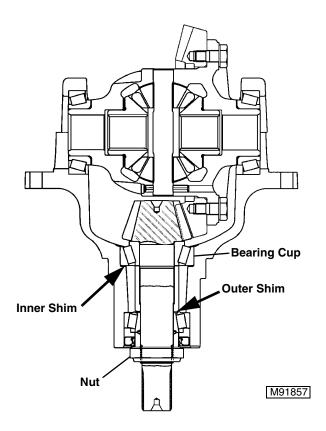
13. Disassemble the pinion shaft assembly.

NOTE: The ring gear and pinion gear are serviced as an assembly. If either the ring gear or pinion has wear or damage both must be replaced.

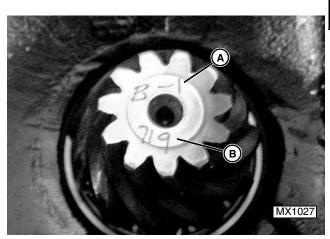
14. Clean and inspect all parts and check parts for wear. Replace any unserviceable parts.

Assembly and Installation:

1. Assemble the bearing cone to the pinion.



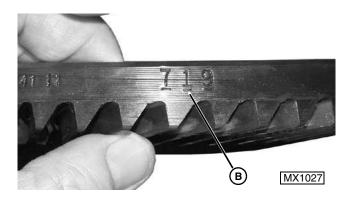
• The inner shim(s) sets the pinion height. If the original pinion is being used, use the original shims, or install new shims the same thickness as the original shims.



- If the pinion is being replaced, notice the (+) or (-) number (A) on the end of the pinion gear. This indicates the best running position of each particular gear set in thousandths of an inch. If the number on the new set is not the same as the number on the one being replaced, adjust the height by adding or removing inner shim(s) from the original shim pack according to the dimension etched in the head of the pinion.
- Example: If the old pinion reads +2 and the new

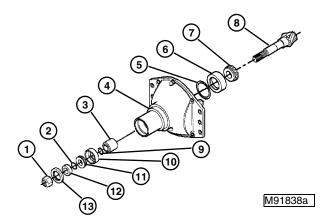


pinion is marked **-1**, add **0.003 in.** shims to the original shim pack.



NOTE: Stamped mark (B) on pinion and ring gear indicate matched set.

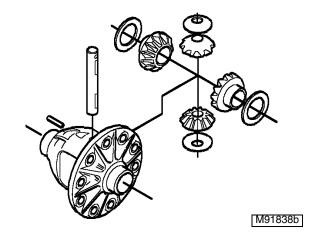
2. Assemble the inner bearing cup and any shims in the differential cover.



1. Nut

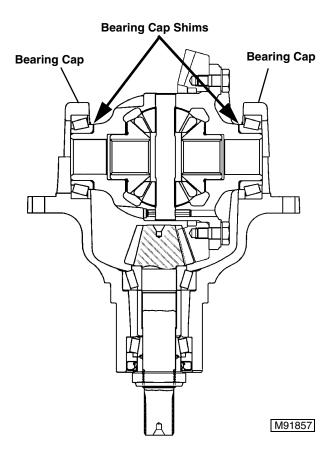
- 8. Pinion
- 2. O-ring
- 9. Outer Shim
- 3. Spacer
- Bearing Cup
- 4. Cover
- 11. Bearing Cone
- 5. Inner Shim
- 12. Seal
- 6. Bearing Cup
- 13. Spacer
- 7. Bearing Cone
- 14. Install the pinion in the differential cover:
- Place the pinion in the cover, and install the spacer, outer shim, bearing cone, O-ring, seal, spacer, and the old nut.
- 15. Tighten the old pinion nut to 258 285 N•m (190 210 lb-ft), and check the rotation of the pinion:
 - It should require 0.8 1.4 N•m (7 12 lb-in.) of torque to rotate on the pinion.

- If the pinion does not turn within specification, adjust the shim pack.
- When the pinion is shimmed correctly replace the old pinion retaining nut with a new pinion retaining nut. Tighten the new pinion nut to 258 285 Nom (190 210 lb-ft), and recheck the rotation of the pinion.



- Assemble the differential components in the differential carrier.
- Install the ring gear to the differential carrier.
 Tighten the ring gear bolts to 79 88 N•m (58 65 lb-ft).
- 18. If removed, install the bearings to the differential assembly.
- 19. Install the differential assembly to the differential carrier.
- 20. Install the bearing caps. Tighten the cap screws for the bearing caps to 54 68 N•m (40 50 lb-ft).
 - The bearing cap shim(s) control the location of the differential carrier and the preload of the bearings.
 If the original carrier, bearings, and gear set are being used, use the original shims, or install new shims the same thickness as the original shims.
 - If the carrier bearings or gear set are being replaced, set the bearing preload and gear backlash by adding or removing shim(s) between the ring gear side bearing and carrier.





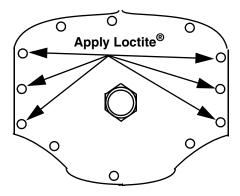
4. Apply Loctite[®] 262 to the six screws on the outside of the differential cover. Tighten the cap screws to **61 - 68 N•m (45 - 50 lb-ft)**.

- Shim the bearings to a preload of 0.03 0.08 mm (0.001- 0.004 in.).
- 1. Install the differential carrier assembly to the differential cover and check gear backlash. Adjust backlash to specification.

Specification

Backlash 0.03 - 0.08 mm (0.001- 0.004 in.)

2. Apply John Deere Sealant TY6304 to the differential cover.



3. Install the differential cover to the 4-WD housing.



PTO THEORY OF OPERATION

PTO CLUTCH AND BRAKE THEORY OF OPERATION

Function:

The PTO clutch provides a means for disengaging the PTO output shaft from the engine. The PTO brake is provided to positively stop the rotation of the PTO system when the PTO clutch is disengaged. The PTO clutch and PTO brake work simultaneously. Both mid and rear PTO's are affected by the operation of the PTO clutch and PTO brake.

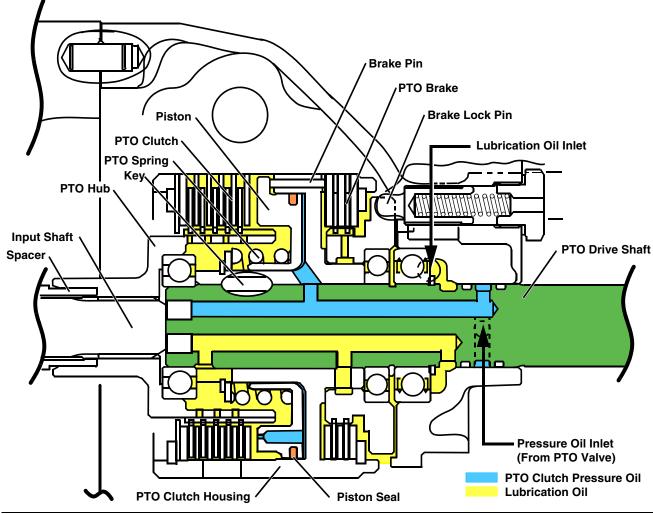
Theory:

The PTO clutch and PTO brake are engaged or disengaged by the operator via the S5 switch on the control panel. This switch operates the Y4 PTO solenoid located on the valve mounted on the right side of the rear case.

The PTO brake contained inside the housing of the PTO clutch/brake unit is a spring loaded multi-plate wet brake and is normally engaged, preventing the PTO clutch shaft from rotating. The PTO clutch is a multi-plate wet clutch and is normally disengaged.

When the Y4 PTO solenoid is energized, pressure oil flows to the piston in the PTO clutch housing. Piston action compresses the PTO spring and applies pressure to the clutch pack; at the same time releasing pressure on the interlock pins and disengaging the PTO brake. Pressure applied to the clutch pack locks the disks (splined to the PTO Hub), to the friction plates (locked to the clutch housing). Power is transferred from the input shaft to the PTO hub, through the clutch plates and disks, to the clutch housing, and finally to the PTO drive shaft. A brake lock pin allows free rotation in one direction to aid in aligning the splines of an attachment driveshaft during hook-up.





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POWER TRANSMISSION — REAR PTO

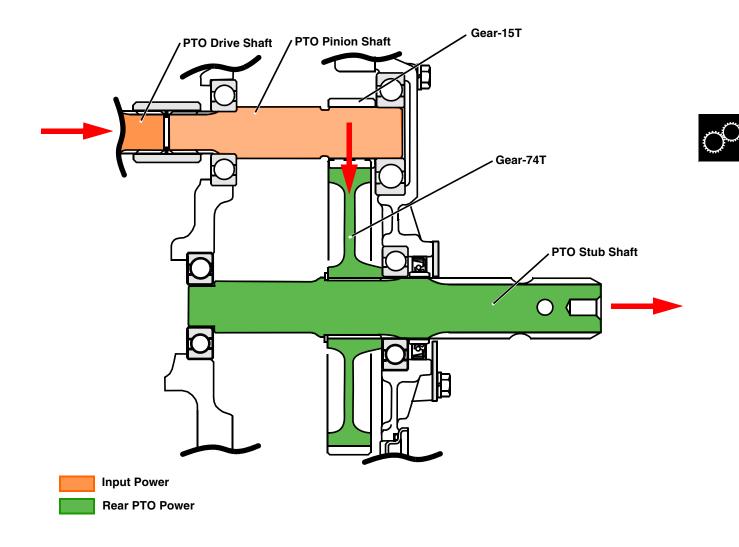
Function:

The rear PTO provides a means for transferring engine power to rear mounted attachments.

Theory:

Power is provided to the PTO gear power train through PTO clutch and PTO drive shaft. Power is not transferred until the operator engages the S5 switch on the control panel; which energizes the Y4 PTO solenoid. (See "PTO CLUTCH AND BRAKE THEORY OF OPERATION" on the previous page.) The PTO driveshaft turns in a counter-clockwise direction and is coupled directly to the PTO pinion shaft. The PTO pinion shaft is a shaft and 15 tooth gear machined as a single part. This 15 tooth gear is in constant mesh with the 74

tooth gear which is splined to the PTO stub shaft, and rotates in a clockwise direction. The rear PTO always turns clockwise when looking at the end of the PTO shaft from the rear of the tractor. The rear PTO runs independently of the tractor forward or rearward motion, or rate of travel. Speed of the PTO is dependent on engine RPM. The rear PTO is limited to 580 RPM at maximum engine speed.



POWER TRANSMISSION — 2 SPEED REAR PTO

Function:

The rear PTO provides a means for transferring engine power at two different RPMs to rear mounted attachments.

Theory:

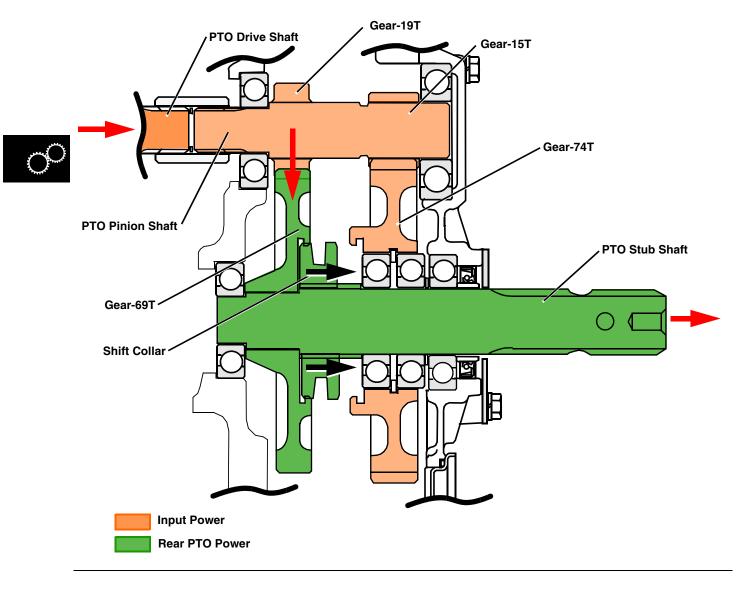
Power is provided to the PTO gear power train through PTO clutch and PTO drive shaft. The PTO driveshaft turns in a counter-clockwise direction and is coupled directly to the PTO pinion shaft. The PTO pinion shaft is a shaft with a 15 tooth and 19 tooth gear machined as a single part. This gears are in constant mesh with the 74 tooth and 69 tooth gears which freely rotate on the PTO stub shaft, and rotate in a clockwise direction.

A shift collar is is splined to the PTO stub shaft. If the

shift collar is centered, neither gear set is engaged. The shift collar is moved forward or backward by the external shift linkage to engage one or the other of the two sets of gears. The ratio of the gears determines the two output speeds of the rear PTO.

The rear PTO always turns clockwise when looking at the end of the PTO shaft from the rear of the tractor. The rear PTO runs independently of the tractor forward or rearward motion, or rate of travel. Speed of the PTO is dependent on engine RPM and which set of gears is selected and engaged. The rear PTO is limited to approximately 580 RPM or 790 RPM at maximum engine speed.

NOTE: The 74T gear is powered continuously when the PTO clutch is engaged. The Mid PTO is powered from the 74T gear and can be operated independently from the 2 speed rear PTO.



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POWER TRANSMISSION — MID PTO

Function:

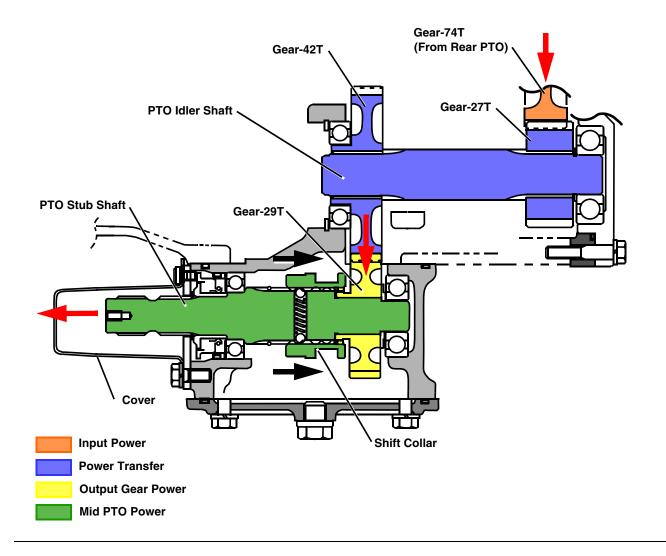
The mid PTO provides a means for transferring engine power to mid mount attachments such as a mower deck. It also provides a means for engaging and disengaging engine power to the mid PTO stub shaft.

Theory:

Power is provided to the mid PTO through the 74 tooth gear in the rear PTO, and rotates in a clockwise direction. (Se "POWER TRANSMISSION - REAR PTO" and "POWER TRANSMISSION - 2 SPEED REAR PTO on the previous two pages.) Power is not transferred until the operator engages the S5 switch on the control panel; which energizes the Y4 PTO solenoid. (See "PTO CLUTCH AND BRAKE THEORY OF OPERATION" on page 68.) A 27 tooth gear is in

constant mesh with the rear PTO 74 tooth gear, and is splined to the mid PTO idler shaft which rotates in a counter-clockwise direction. Power is transmitted through the mid PTO idler shaft to the 42 tooth gear, which is splined to the idler shaft, and is in constant mesh with the 29 tooth gear. The 29 tooth gear spins freely on the PTO stub shaft and rotates in a clockwise direction.

When the operator selects the mid PTO; a shift collar, which is splined to the PTO stub shaft, moves to the rear-most position and engages the cogs machined on the 29 tooth gear, allowing power to be transmitted from the 29 tooth gear to the mid PTO stub shaft.





PTO REPAIR

REAR PTO DRIVE SHAFT AND GEARS

Removal and Installation:

- 1. Park tractor on a level surface, shut off engine, and set park brake.
- 2. If necessary, remove center lift link, draft arms, and adjustable draft links.

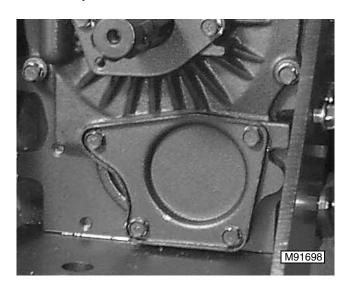


3. Remove four cap screws and rear PTO shield assembly.

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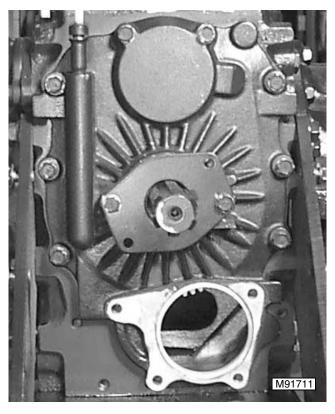
NOTE: Capacity of the hydraulic system is approximately 32 liters (8.4 gal)(33.6 qt).

4. Drain hydraulic oil from reservoir.



5. Remove four cap screws, lower rear cover and Oring.

NOTE: Coupler to PTO drive shaft may fall into differential case when removing rear cover, shafts and gears.



- 6. Remove transmission oil dipstick and set aside.
- 7. Remove eight cap screws. Gently pry around edges of cover to break sealant. Wobble shaft and pull at the same time to remove rear cover, shafts and gears as a unit.

Installation:

Installation is the reverse of removal.

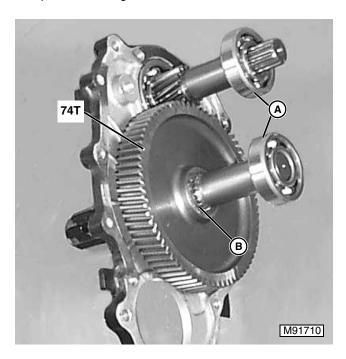
IMPORTANT: Replace all O-rings, gaskets, and seals. Used or damaged O-rings, gaskets and seals will leak.

- Thoroughly clean mating surfaces of rear cover and differential housing to remove all traces of old gasket material.
- · Install a new gasket on rear cover.
- Install a new O-ring on rear lower cover.
- Tighten cap screws, retaining two rear covers, to 15 N•m (132 lb-in.).

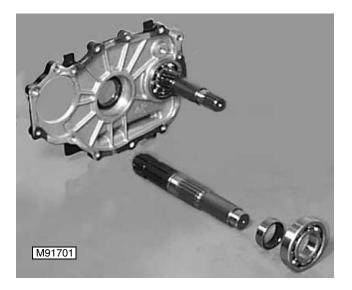
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Disassembly and Assembly:

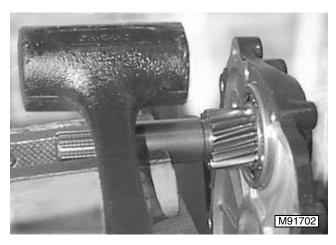
- 1. Remove rear PTO drive shaft and gears as an assembly.
- If not already done, remove coupler from PTO pinion shaft.
- 3. Remove dipstick from PTO cover and set aside to prevent damage.



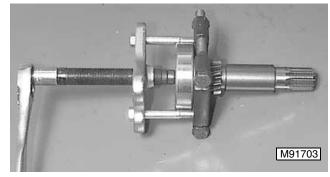
- 4. Using a suitable puller, remove bearings (A) from PTO pinion shaft and PTO shaft.
- 5. Inspect bearings for smooth operation, wear or damage. Replace as necessary.
- 6. Remove snap ring (B) and gear-74T.
- 7. Using a plastic mallet, drive PTO shaft, rear bearing, and seal sleeve out (toward inside of cover).



- 8. Using a press or suitable driver, remove bearing and seal sleeve from PTO shaft.
- 9. Inspect bearing for smooth operation, wear, or damage. Replace as necessary.
- 10. Replace seal sleeve.

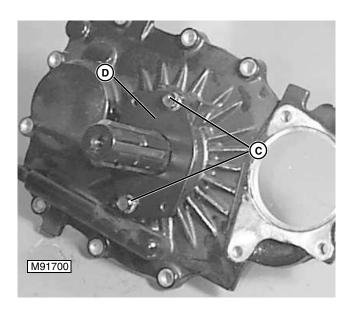


11. Place PTO pinion shaft in a soft-jawed vise. Using a plastic mallet, tap gently on either side of cover to remove cover from pinion shaft and bearing.

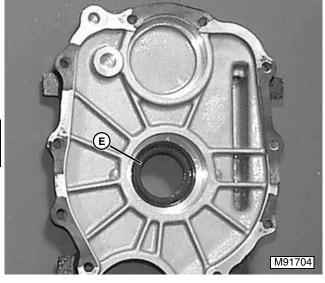




- 12. Using a suitable puller, remove bearing from end of PTO pinion shaft.
- 13. Inspect bearing for smooth operation, wear or damage. Replace as necessary.



14. Remove two cap screws (C) and oil seal plate (D).



15. Using a seal puller or suitable driver, remove seal (E) from rear PTO cover.

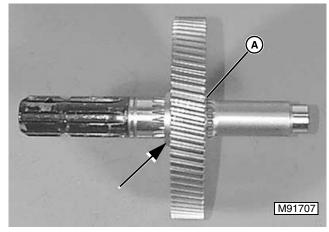
Assembly:

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

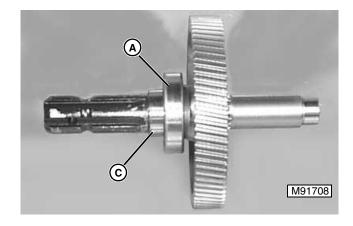
NOTE: Before beginning assembly, be sure that all components are clean, and in good condition.

IMPORTANT: Use liberal amounts of transmission oil to lubricate components as they are assembled. DO NOT use grease or other heavy lubricants unless they are specifically called for in the assembly story.

- Clean mating surface of rear cover to remove old gasket material.
- 2. Using a suitable driver, install new PTO shaft seal in PTO cover.



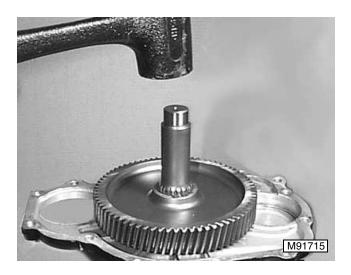
 Install gear-74T onto PTO shaft with raised hub side of gear hub toward attachment end. Install snap ring (A).



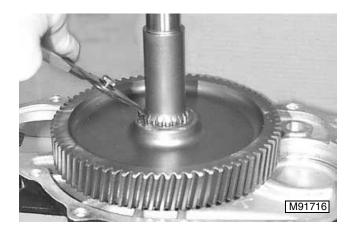
- 4. Using a suitable driver, install bearing (B) onto PTO stub shaft. Bearing should contact gear.
- 5. Using a suitable driver, install seal sleeve (C) onto pinion shaft with flat end against bearing.



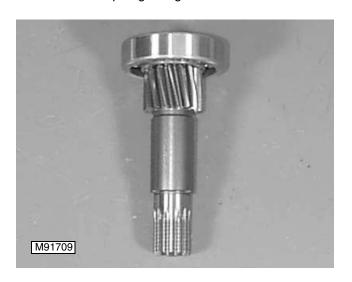
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 Install PTO shaft, gear and bearing into cover as an assembly. Use care to avoid damaging shaft seal. Use a plastic mallet or press to install bearing into bore in rear cover.



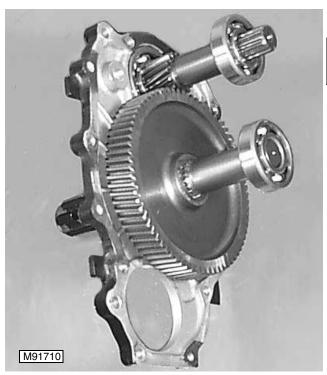
7. Remove snap ring and gear from stub shaft.



8. Using a plastic mallet, install bearing onto plain end of PTO pinion shaft.



- 9. Using a plastic mallet, install pinion shaft and bearing into rear PTO cover until fully seated.
- 10. Install gear 74T onto PTO shaft. Install snap ring.



- 11. Using a suitable driver, install bearing onto splined end of PTO shaft.
- 12. Using a suitable driver, install bearing onto splined end of PTO pinion shaft.

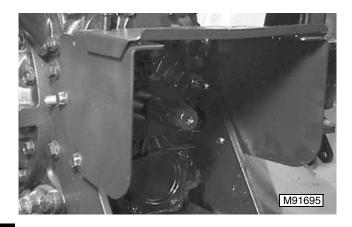
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NOTE: Check shafts to ensure that they are properly installed in cover; if bearings are not fully seated in cover, cover may break when PTO is installed onto transmission housing and attaching cap screws are tightened.

2-SPEED REAR PTO DRIVE SHAFT AND GEARS

Removal and Installation:

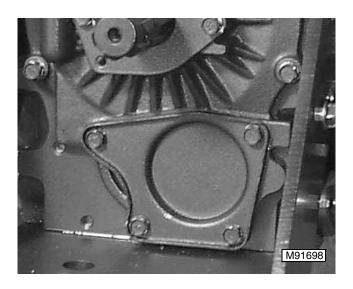
- 1. Park tractor on a level surface, shut off engine, and set park brake.
- 2. If necessary, remove center lift link, draft arms, and adjustable draft links.



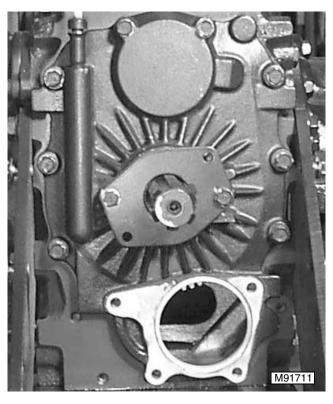
3. Remove four cap screws and rear PTO shield assembly.

NOTE: Capacity of the hydraulic system is approximately 32 liters (8.4 gal)(33.6 qt).

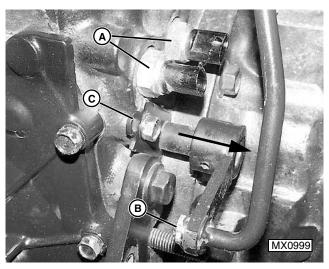
4. Drain hydraulic oil from reservoir.



Remove four cap screws, lower rear cover and Oring.



6. Remove transmission oil dipstick and set aside.



- 7. Remove two PTO switches (A) from case.
- 8. Remove cotter pin (B) and washer securing shift linkage rod to shift lever.
- Remove cap screw and lock plate (C) securing shift shaft to case and slide shaft out as far as possible.
- 10. Remove eight cap screws. Gently pry around edges of cover to break sealant. Wobble shaft and pull at the same time to remove rear cover, shafts and gears as a unit.

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Installation:

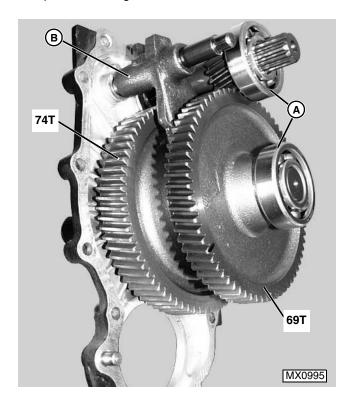
Installation is the reverse of removal.

IMPORTANT: Replace all O-rings, gaskets, and seals. Used or damaged O-rings, gaskets and seals will leak.

- Thoroughly clean mating surfaces of rear cover and differential housing to remove all traces of old gasket material.
- Install a new gasket on rear cover.
- Ensure shifter engages during installation.
- Install a new O-ring on rear lower cover.
- Tighten cap screws, retaining two rear covers, to 15 Nom (132 lb-in.).

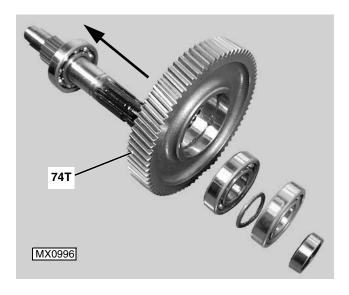
Disassembly and Assembly:

- If not already done, remove coupler from PTO pinion shaft.
- 2. Remove dipstick from PTO cover and set aside to prevent damage.

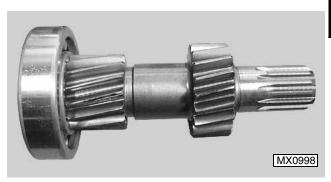


- 3. Using a suitable puller, remove bearings (A) from PTO pinion shaft and PTO shaft.
- 4. Inspect bearings for smooth operation, wear or damage. Replace as necessary.
- Slide shift fork and shaft away from cover and remove.
- 6. Remove rear PTO drive shaft and gears as an assembly.

Remove the 69T gear and shift collar from the PTO drive shaft.

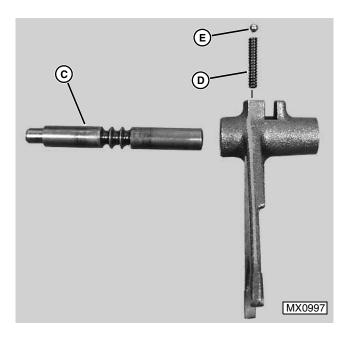


- 8. Using a press or suitable driver, remove shaft from 74T gear, bearing, spacer, second bearing and and seal sleeve.
- 9. Inspect bearings for smooth operation, wear, or damage. Replace as necessary.
- 10. Replace seal sleeve.
- 11. Place PTO pinion shaft in a soft-jawed vise. Using a plastic mallet, tap gently on either side of cover to remove cover from pinion shaft and bearing.

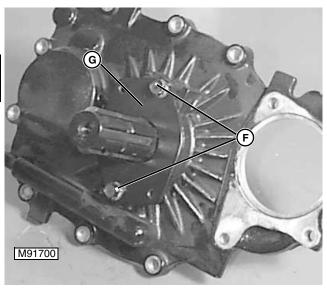


- 12. Inspect PTO pinion shaft bearing for smooth operation, wear or damage. Replace as necessary.
- 13. If necessary, use a suitable puller to remove bearing from end of PTO pinion shaft.

O



- 14. Check that the shifter shaft (C) slides through the fork easily and attains secure detent positions.
- 15. If necessary, slide shifter shaft out of shift fork. Inspect shaft, and spring (D) and detent ball (E).



16. Remove two cap screws (F) and oil seal plate (G).



17. Using a seal puller or suitable driver, remove seal (H) from rear PTO cover.

Assembly:

IMPORTANT: DO NOT spin bearing using compressed air. Damage to bearing balls, cage, and races could result.

NOTE: Before beginning assembly, be sure that all components are clean, and in good condition.

IMPORTANT: Use liberal amounts of transmission oil to lubricate components as they are assembled. DO NOT use grease or other heavy lubricants unless they are specifically called for in the assembly story.

- Clean mating surface of rear cover to remove old gasket material.
- 2. Using a suitable driver, install new PTO shaft seal in PTO cover.
- Using a suitable driver, install bearing onto PTO stub shaft. Bearing should contact shift fork splines.
- 4. Install gear-74T onto PTO shaft. Snap ring inside gear should contact bearing.
- Using a suitable driver, install second bearing onto PTO stub shaft. Bearing should seat inside gear and fit against internal snap ring. Install spacer and then third bearing.
- 6. Using a suitable driver, install seal sleeve onto pinion shaft with flat end against bearing.

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 Install PTO shaft assembly into cover. Use care to avoid damaging shaft seal. Use a plastic mallet or press to install bearing into bore in rear cover.



- 8. If removed, use a plastic mallet to install bearing onto plain end of PTO pinion shaft.
- 9. Using a plastic mallet, install pinion shaft and bearing into rear PTO cover until fully seated.
- 10. Install shift collar and gear 69T onto PTO shaft.



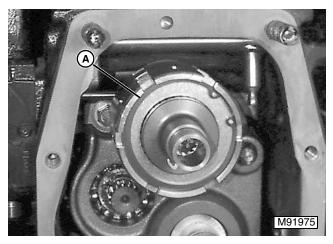
- 11. Install shift fork assembly (I).
- 12. Using a suitable driver, install bearings (J) onto end of PTO shaft and end of PTO pinion shaft.

NOTE: Check shafts to ensure that they are properly installed in cover; if bearings are not fully seated in cover, cover may break when PTO is installed onto transmission housing and attaching cap screws are tightened.

PTO CLUTCH & BRAKE

Removal and Installation:

1. Split tractor at rear of tunnel to access PTO clutch assembly. See Splitting Tractor (Rear) in the appropriate power train section for the tractor. (i.e. Gear Power Train, Hydrostatic Power Train, PowrReverser Power Train)



NOTE: Coupler on rear end of PTO clutch shaft may fall into differential case when removing PTO clutch/brake assembly. Retrieving this coupler may require removal of the rear PTO cover or rockshaft. Use care when removing clutch and shaft to avoid dropping coupler into case.



2. Remove PTO clutch assembly (A) and shaft as a unit.

Installation:

Installation is the reverse of removal.

 Rotate PTO drive shaft during assembly to seat splined coupling.

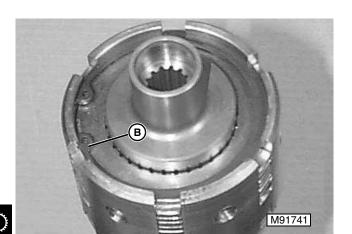
Disassembly and Assembly:

Special or Essential Tools:

• JDG1169 Clutch Spring Compressor



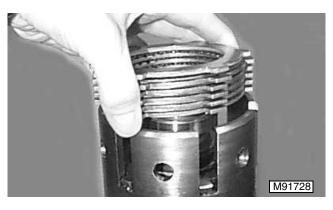
1. If necessary, remove splined coupling (A) from end of shaft.



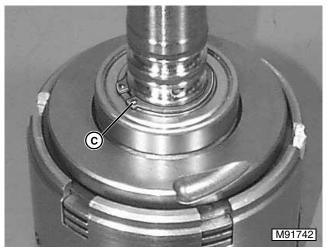
2. Remove large internal snap ring (B) from PTO clutch housing.



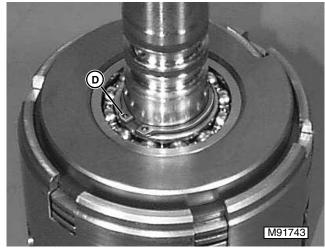
3. Remove clutch hub and retaining plate from clutch cylinder.



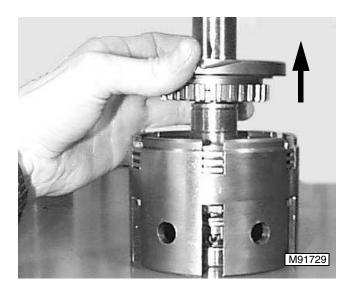
4. Remove clutch plates and disks from clutch cylinder.



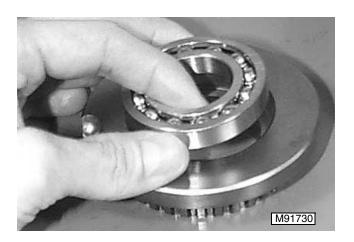
- Remove snap ring (C) retaining bearing to PTO shaft.
- 6. Remove bearing.



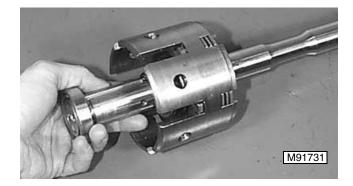
7. Remove snap ring (D) retaining clutch assembly to PTO shaft.



8. Remove brake hub and bearing from clutch cylinder and PTO shaft.



- 9. Remove bearing from brake hub.
- 10. Inspect bearing for smooth operation, damage, or wear. If necessary, replace bearing.



11. Remove PTO shaft and bearing from clutch cylinder as an assembly.

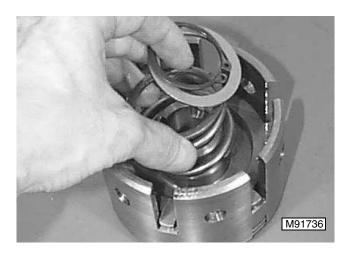


- 12. Remove key from groove in shaft. Inspect key for shearing. Replace as necessary.
- 13. Inspect bearing on shaft for smooth operation, wear, or damage. If necessary, replace bearing.
- 14. Inspect shaft surfaces and splines for damage. Replace if necessary.
- 15. Replace shaft seals (E) on PTO shaft.

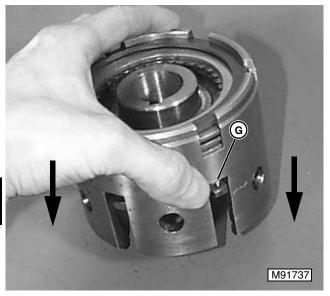




- 16. Place JDG1169 Clutch Spring Compressor over washer in clutch.
- Using a press, compress spring and remove external snap ring (F). Slowly release spring compression.

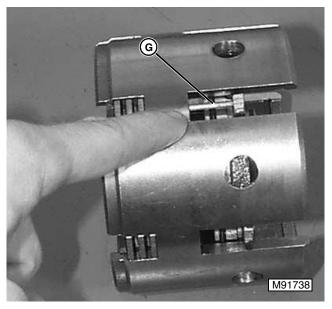


18. Remove external snap ring, washer and spring.



NOTE: When piston is removed, interlock pins (G) will fall out of clutch housing. Use care to avoid losing pins.

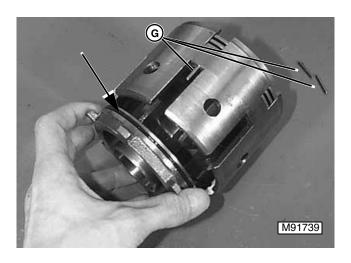
19. Tap clutch housing on bench to partially remove clutch piston from clutch housing.



- 20. Remove three interlock pins (G).
- 21. Measure interlock pins. If pins do not meet length specification, replace pins as a set.

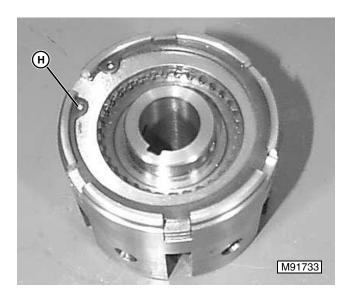
Specification (Minimum):

Pin Length..... 18.8 mm (0.740 in.)



- 22. Remove piston.
- 23. Replace O-ring in outer groove of piston.





24. Remove internal snap ring (H) from brake side of clutch cylinder.



- 25. Remove brake disks and plates from housing.
- 26. Inspect end plate, separator plates and friction plates for wear, discoloration, scoring or warping. Measure plate thickness. If plate(s) do not meet minimum plate thickness specification, replace clutch plate pack as a unit.

Specification (Minimum):

Assembly:

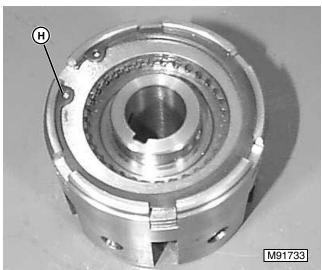
NOTE: Plates in brake pack have external tabs. Disks have internal splines.

IMPORTANT: Soak clutch and brake disks in hydraulic oil for one (1) hour before assembling clutch or brake packs. Failure to complete this step will result in premature clutch failure.

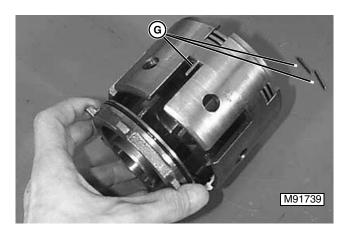


 Assemble brake pack starting with a plate, followed by a disk, followed by a plate, disk, plate. Install into clutch cylinder.





2. Install snap ring (H) to retain brake pack.



- 3. If not already done, replace O-ring on clutch piston, and install into clutch cylinder.
- Install three interlock pins (G) into holes under tabs of piston. Slide piston to bottom of bore to retain pins.



5. Place spring, washer, and snap ring onto center of piston.



Use JDG1169 Clutch Spring Compressor, and a press to compress clutch spring. Install external snap ring (F).



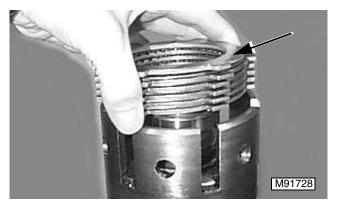
- 7. If removed, install bearing onto PTO shaft.
- 8. Place key in slot in PTO shaft.
- If not already done, replace shaft seals in PTO shaft.



10. Install clutch cylinder onto PTO shaft.

NOTE: Plates in clutch pack have external tabs. Disks have internal splines.

11. Assemble clutch pack starting with a plate, followed by a disk, followed by a plate, disk, plate, disk, plate, disk, plate, disk, followed by the thicker end plate.

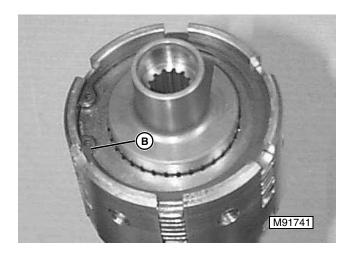


12. Install clutch pack into housing.





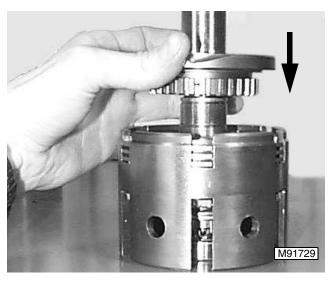
- 13. Align splines on hub with splines on disks and insert hub into clutch cylinder.
- 14. Install retaining plate.



15. Secure hub, clutch pack, and retaining plate with large internal snap ring (B).

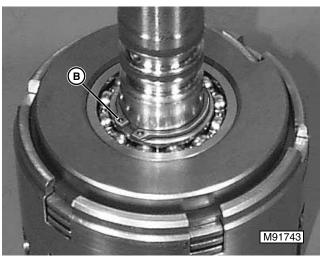


16. Install bearing into brake hub.



NOTE: It may be necessary to align disk splines to allow brake hub to be properly installed.

17. Install brake hub and bearing into clutch cylinder.



18. Install snap ring (D) to retain brake hub and bearing to shaft.





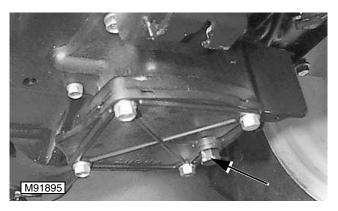
- 19. Install second bearing on shaft, retain with snap ring (C).
- 20. Install splined coupling (if removed with clutch/ brake assembly) and install assembly into transmission housing. (See "PTO CLUTCH & BRAKE" on page79.)

MID PTO

Removal and Installation:

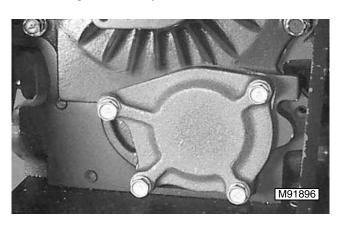
Removal:

- 1. Disconnect shift lever rod.
- 2. If equipped, disconnect mid PTO switch electrical connector.



NOTE: Capacity of hydraulic reservoir is **32 liters (8.4 gallons) (33.6 quarts)**. Have a suitable container ready before removing drain plug.

3. Remove drain plug on bottom cover of mid PTO housing and drain hydraulic oil.

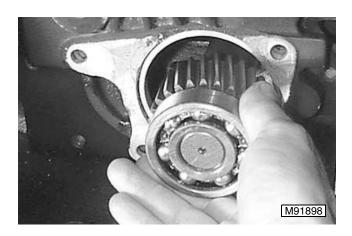


4. Remove four cap screws and lock washers and rear mid PTO cover.

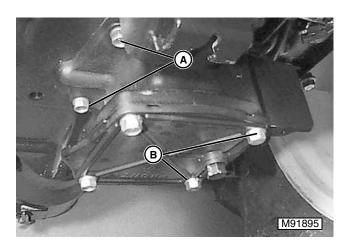
NOTE: Idler shaft assembly may or may not come out with rear cover.



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5. Remove idler shaft assembly if not already removed with cover.



- 6. Remove two short cap screws (A) and lock washers.
- Support mid PTO housing cover, and remove two long cap screws (B) and lock washers. Lower mid PTO cover and case, and remove from transmission housing.

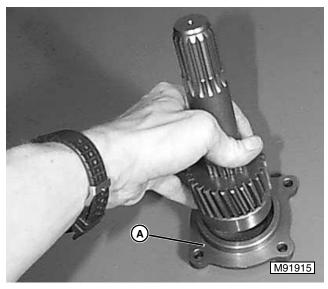
Installation:

Installation is the reverse of removal.

Tighten cap screws securing mid PTO cover to transmission housing to 45-50 N•m (33-37 lb-ft).

NOTE: Replace O-rings. Old O-rings will leak.

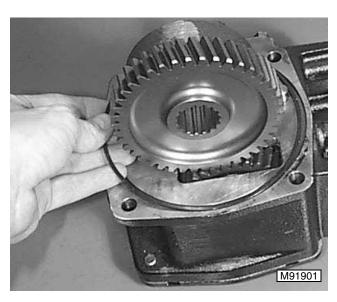
Disassembly and Assembly



 If necessary, remove cover (A) from idler shaft assembly.

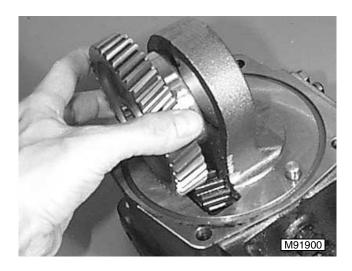


- 2. Using a suitable puller, remove idler gear, washer and bearing from shaft.
- 3. Inspect bearing for wear or damage. Replace if necessary.

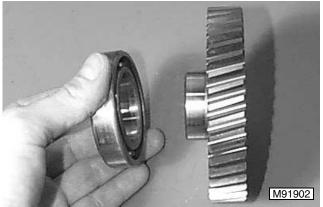


4. Remove O-ring from groove in mid PTO case.

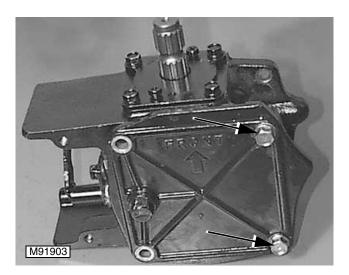




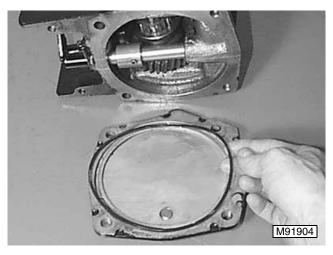
5. Remove drive gear and bearing from case as an assembly.



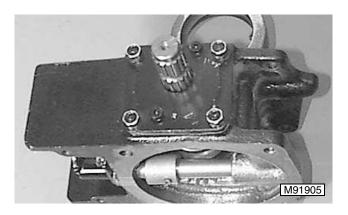
- 6. Using an edge puller, remove bearing from drive gear.
- 7. Inspect bearing for wear or damage. Replace if necessary.



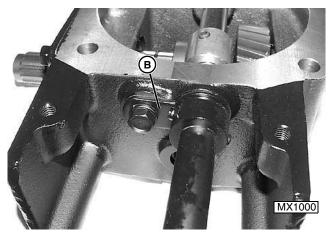
8. On bottom of case, remove two remaining cap screws and lock washers. Remove bottom cover.



9. Remove O-ring from bottom cover.

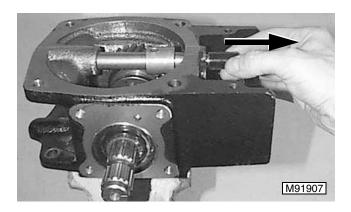


10. Remove four cap screws and lock washers, and seal case cover.



11. Remove cap screw and lock washer. Remove shift arm retaining plate (B).

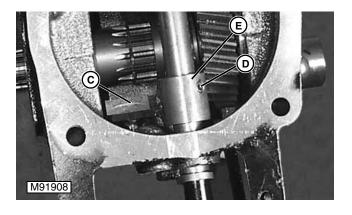
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 Slide shift shaft outward until shift lever clears shift collar.

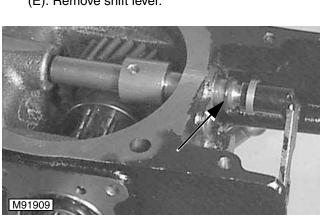


NOTE: Washer between drive gear and inner ball bearing may fall out when PTO stub shaft is removed.

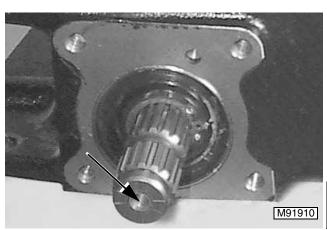


13. Rotate shift arm to allow removal of shifter shoe (C). Remove shifter shoe.

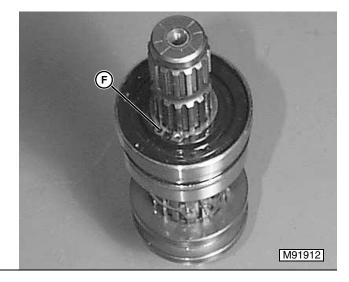
- 14. Remove spring pin (D).
- 15. Slide shift shaft out of case until clear of shift lever (E). Remove shift lever.



16. Remove shift shaft, with retaining ring and O-ring, from case. Replace O-ring.



17. Insert a suitable screw into the tapped hole in the end of the PTO stub shaft. Using a slide hammer, remove the shaft, outer bearing, shift collar, and seals as an assembly. When shaft is removed, gear, washer, and inner bearing will remain in the case.





18. Remove snap ring (F) from PTO stub shaft.

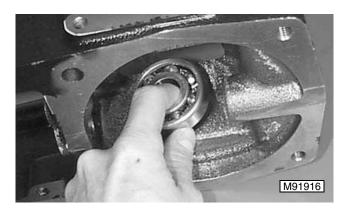


19. Using a press, remove two-piece seal (G) (seal and oil seal sleeve) and bearing from shaft. Inspect bearing for wear or damage. Replace if necessary.

NOTE: Shift collar retains two steel balls under spring pressure. Use care to prevent balls from being lost.



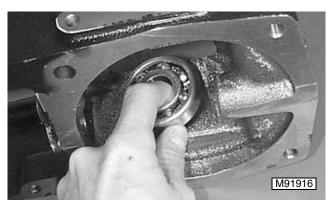
20. Remove shift collar, two steel balls, and spring.



21. Remove inner bearing from case. If necessary, use a suitable puller. Inspect bearing for wear or damage. If necessary, replace bearing.

Assembly:

NOTE: Liberally lubricate all press-fit parts with hydraulic oil to aid assembly.



1. Install inner bearing into case. If necessary, use a suitable driver and plastic mallet.



- 2. If removed, install snap ring onto shaft.
- 3. Install ball, spring and second steel ball into shaft. Retain with shift collar.

NOTE: Replace seals and O-rings. Old seals and O-rings will leak.



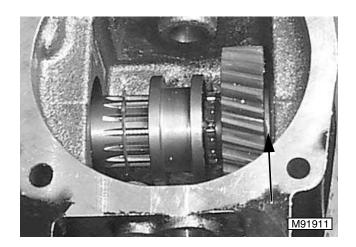
- 4. Install a new O-ring onto outer half of new two-piece seal (G).
- 5. Using a press, install the bearing, oil sleeve seal, and a new seal onto shaft.



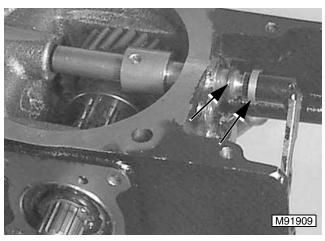


6. Install snap ring (F) onto shaft to retain seal.

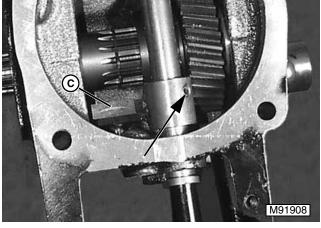
IMPORTANT: Be sure washer and drive gear are properly aligned on shaft before installing shaft into inner bearing. Driving shaft into inner bearing with washer improperly aligned could cause damage to shaft and washer.



7. Using general purpose grease to help hold the parts together, place washer against inner bearing with shoulder side facing bearing. Place gear against thrust washer. Insert shaft assembly into case and through gear and washer. Using a plastic mallet, seat PTO stub shaft assembly into inner bearing and case.

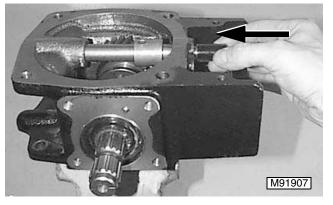


8. Install retaining ring and a new O-ring onto shift shaft. Install shift shaft through shift lever and into case.

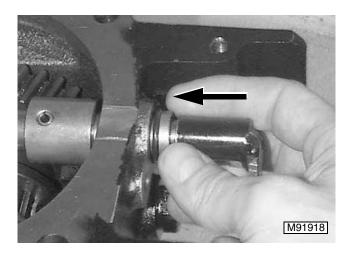




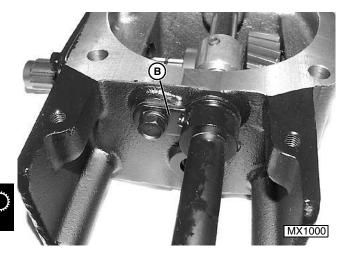
- 9. Install spring pin through shift lever and shift shaft.
- 10. Install shifter shoe (C) onto shift lever pin.



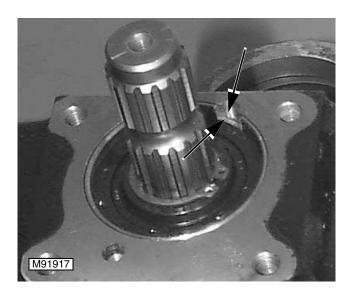
11. Rotate shift shaft so that shifter shoe engages groove in shift collar. Slide shift shaft inward until shifter shoe bottoms out in shift collar groove.



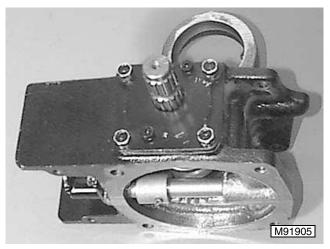
12. Push O-ring and retaining ring into case bore.



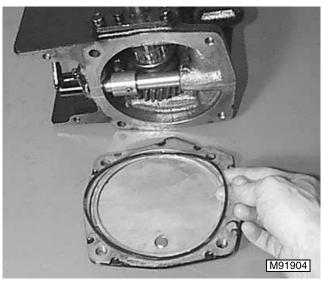
13. Install retainer plate (B), lock washer, and cap screw.



14. Rotate outer portion of oil sleeve seal to align slot with key hole in case.

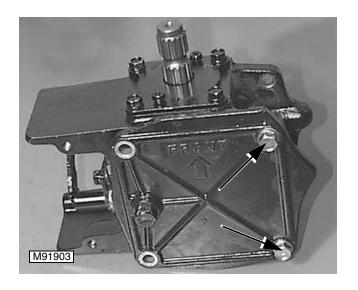


15. Install PTO seal case cover, four cap screws and lock washers.

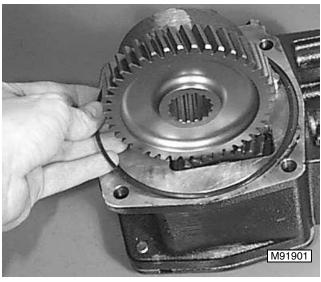


16. Install new O-ring into bottom cover.

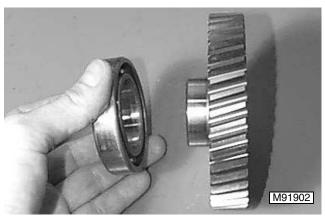
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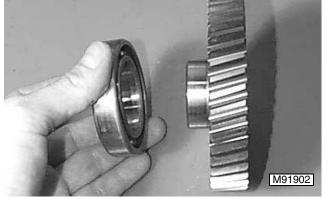
17. Install bottom cover to mid PTO case and secure with two short cap screws and lock washers.

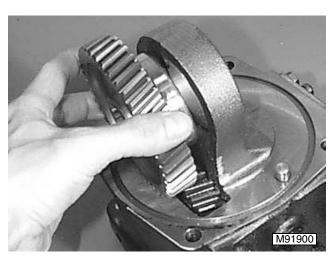


20. Install a new O-ring into groove in case.



18. Install bearing onto drive gear.





19. Install drive gear and bearing into case.



21. Install gear, spacer, and bearing onto idler shaft.



22. Install idler shaft assembly into cover.

23. Install mid PTO assembly into transmission housing. (See "MID PTO" on page86.)

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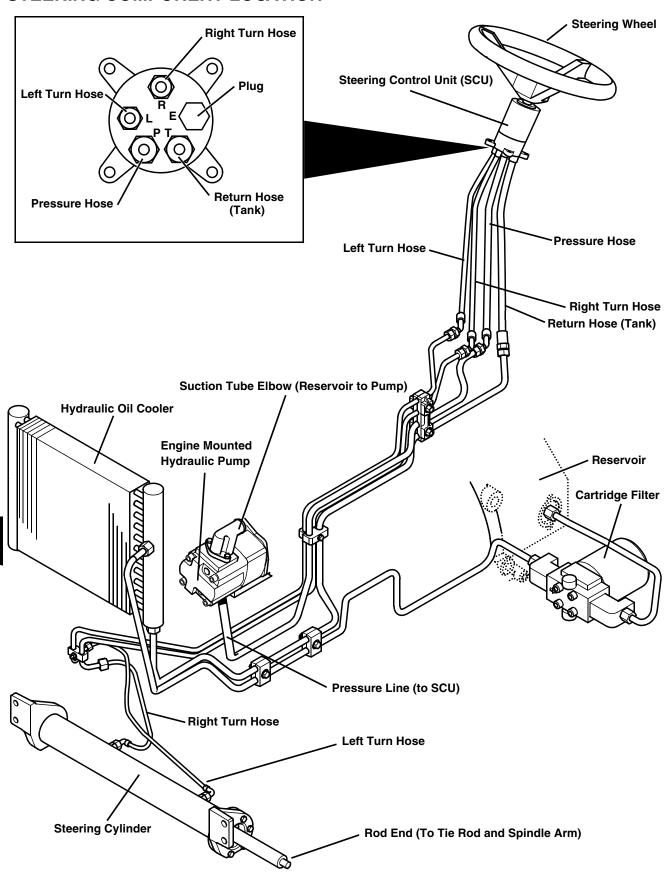
STEERING SPECIFICATIONS

SPECIFICATIONS

S	teering:			
	Steering Wheel O.D			
	Front Steering Angle: Maximum Inside			
	Front Steering Angle: Maximum Outside			
	Maximum Rotation of Steering Wheel - Steering at Maximum Right or Left and Constant Torque Applied to Steering Wheel			
	Toe-In			
To	Forque Specifications:			
	Steering Wheel Nut			
	Wheel Mounting Bolts Front 98 N•m (72 lb-ft) Rear 98 N•m (72 lb-ft)			
	Steering Cylinder Hose Ends Cylinder to Hose			
	SCU Hose Ends Cylinder Tube to Hose at SCU			
	SCU to Tractor Cap Screws			
	Adaptor Fittings to SCU Ports			
	Tie Rod to Spindle Arm Castle Nut (2-WD)			
	Tie Rod to Spindle Arm Castle Nut (4-WD)			
	Tie Rod to Steering Cylinder Rod			
	Steering Cylinder to Mounting Bracket Cap Screws 25 - 31 N•m (18 - 22 lb-ft)			
	Steering Cylinder Bracket to Front Axle Cap Screws 115 - 122 N•m (85 - 90 lb-ft)			
Lı	_ubrication Interval:			
	Tie Rod Ends, Front Axle Pivot Pin (Normal Conditions) Every 50 hours			
	Tie Rod Ends, Front Axle Pivot Pin (Dusty Conditions) Every 10 hours			



STEERING COMPONENT LOCATION



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THEORY OF OPERATION

All Models:

The front hydraulic pump supplies hydraulic pressure to the steering control unit (SCU). The SCU utilizes an open center control valve to operate the steering cylinder. When the steering wheel is turned, the SCU directs hydraulic pressure to the appropriate steering cylinder hose, pushing the steering cylinder ram, which pivots the front spindles and wheels. The SCU has no relief valve. The SCU and steering cylinder are not rebuildable, and must be replaced as complete units.

Hydrostatic Model:

Excess oil from the SCU is sent to the oil cooler, mounted in the front of the tractor. After the oil is cooled, it passes through the filter, and goes to the hydrostatic unit. The hydrostatic unit is a combination motor and pump, and operates as a closed loop. Most of the hydraulic oil delivered to this unit passes by the charge pressure relief valve, and returns to the reservoir. A small amount of oil flows through the hydrostatic unit, providing internal lubrication, then returns to the reservoir.

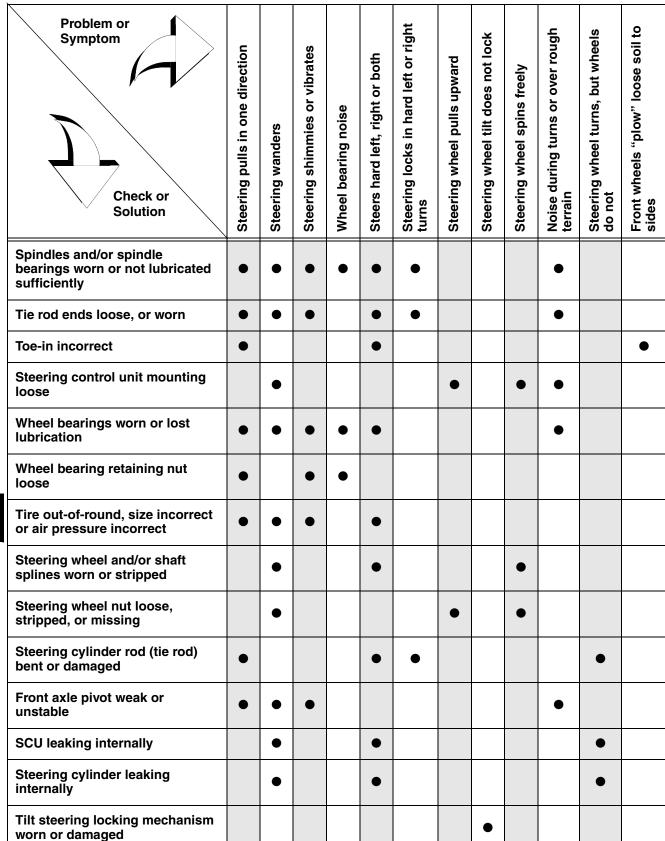
Gear or PowrReverser Model

Excess oil from the SCU passes through the filter (if equipped) and returns to the reservoir.



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TROUBLESHOOTING CHART





STEERING DIAGNOSIS

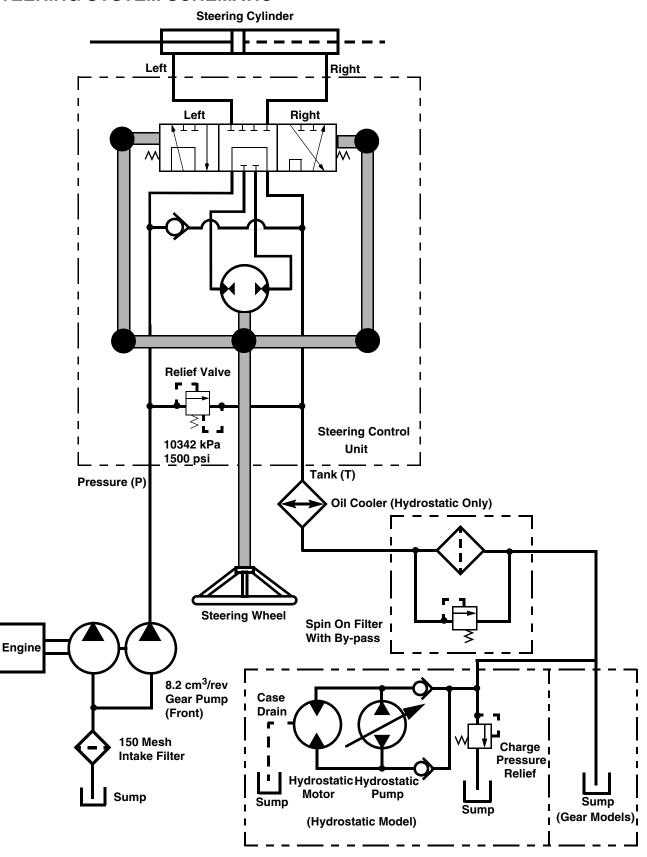
DIAGNOSIS

Test/Check Point	Normal	If Not Normal
1. Rims	Runout not excessive.	Replace rims.
	Wheel bolts tight.	Tighten to specification.
2. Tires	Runout not excessive.	Remount or replace tires.
	Tires properly inflated.	Inflate tires to proper pressure.
3. Wheel bearings	Wheels rotate freely without rough spots.	Replace bearings.
4. Pinion shaft and hub shaft	Assemblies tight and turn smoothly.	Tighten or replace assemblies.
5. Final drive housing	Fastened securely.	Tighten fasteners to specification.
6. Front axle mounting pivot	Pivot bushing not worn or binding.	Replace bushing.
7. Tie rod	Castle nuts tight.	Tighten castle nuts install cotter pin.
	Tie rod (steering cylinder rod) straight, toe-in correct.	Replace worn or damaged steering cylinder, adjust toe-in.
8. Steering cylinder	Assembly fastened securely.	Tighten cylinder.
	Operates from stop-to-stop smoothly with little effort, not leaking.	Replace cylinder.
9. Steering control unit	Fastened securely to frame.	Fasten securely.
	Not leaking.	Tighten fittings, replace SCU.
10. Steering wheel	Installed properly, nut torqued to specification.	Install and tighten properly.
	No cracks or breaks.	Replace as necessary.



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STEERING SYSTEM SCHEMATIC





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TESTS AND ADJUSTMENTS

STEERING SYSTEM TEST

Reason:

To check steering control unit and steering cylinder operation and check for internal leakage.

Tools:

- Torque wrench
- Caps for hydraulic lines

Procedure:

- 1. Run the tractor until the hydraulic fluid is at operating temperature.
- 2. Turn the steering wheel to the full right position. Apply **6.8 N•m (60 lb in.)** constant torque to the steering wheel retaining nut, and count the steering wheel rotations in one minute.
- 3. Repeat the procedure turning the steering wheel to the full left position.
- 4. Stop engine.

Results:

 If the rotation in left or right hand direction exceeds 5 rotations in one minute, the steering system has internal leakage. To determine whether it's the SCU or cylinder that is leaking, proceed as follows:

Procedure:

- 1. Label and remove both left and right hydraulic hoses at the steering cylinder.
- 2. Cap the ends of both hoses.
- 3. Repeat the SCU test.

Results:

- If the rotation speed is now *below* 5 rotations in one minute, replace the steering cylinder.
- If the rotation speed remains above 5 rotations in one minute, replace the SCU.

STEERING PRESSURE CHECK

Reason:

To ensure that steering pump pressure is maintained at correct level for steering without causing damage to the system, and to determine if hydraulic pump is worn.

Equipment:

- JT03375 Adapter Fitting (7/16-20 M 37° X 9/16-18 M ORFS)
- JT03117 0-14000 kPa (0-2000 psi) Pressure Gauge
- JT03017 Hose w/Quick Disconnect Fitting

Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.

IMPORTANT: Make sure to relieve system pressure before loosening any system lines or hoses.

- 3. Cycle all controls to relieve any pressure that may be in the hydraulic system.
- Remove hydraulic hose on left side of steering cylinder.
- 5. Attach gauge to left steering hose.

NOTE: Turning steering wheel to the right will cause hydraulic oil to leak out of disconnected cylinder port. Turn wheel only to left when performing test.



- 6. Start engine and run at high idle.
- 7. Turn steering wheel to the left. While turning wheel, check pressure reading on gauge.

Specifications:

Pressure 10342 kPa \pm 10% (1500 psi \pm 10%)

Results:

- No pressure: Steering hoses may be incorrectly connected to the SCU. Check hose connections.
- Pressure too low: Relief valve in SCU may be stuck open or defective; perform steering system test, (See "STEERING SYSTEM TEST" on page 9), or gear pump may be worn; disassemble and inspect pump. (See "Disassembly and Inspection:" on page34 in the Hydraulics Section).
- Pressure too high: Relief valve in SCU may be clogged or defective.

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TOE-IN ADJUSTMENT 4-WD (EARLY 4-WD)

Reason:

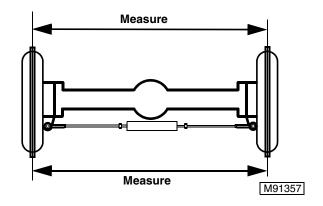
To ensure proper wheel tracking when turning, and to prevent tire scrub and premature tire wear.

Tools:

- Wrenches
- Tape Measure
- Tire scribing tool

Procedure:

NOTE: If both tie rod ends were removed, screw-in the rod end until the distance from the lock nut to the end of the threads is approximately **22 mm** (.875 in). Tighten the lock nuts.



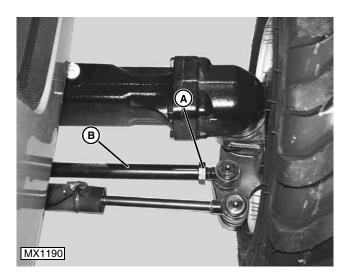


- 1. Jack up front axle so tires are off of floor.
- 2. Rotate tire by hand and scribe a line near the center of each of the front tires.
- 3. Measure and record the distance between the lines at the front and the rear of the tire at about axle height. The front measurement should be **0-3 mm** (**0-0.125 in.**) less than the rear measurement.
- 4. If measurement is not correct, loosen jam nuts on tie rod ends and turn the threaded portion of the rod end using a wrench to increase or decrease the amount of toe until the measured dimension is within specifications.
- 5. Tighten the jam nuts.

Specification:

Toe In..... 0-3 mm (0-0.125 in.)

(LATE 4-WD)



- 1. Jack up front axle so tires are off of floor.
- Rotate tire by hand and scribe a line near the center of each of the front tires.
- 3. Measure and record the distance between the lines at the front and the rear of the tire at about axle height. The front measurement should be **0-3 mm** (**0-0.125 in.**) less than the rear measurement.

NOTE: One of the tie rod ends and jam nut has left hand threads.

- 4. If measurement is not correct, loosen jam nuts (A) on both ends of tie rod and turn the tie rod (B) using a wrench to increase or decrease the amount of toe until the measured dimension is within specifications.
- 5. Tighten the jam nuts.

Specification:

Toe In..... 0-3 mm (0-0.125 in.)

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TOE-IN ADJUSTMENT 2-WD

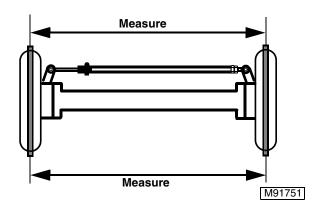
Reason:

To ensure proper wheel tracking when turning, and to prevent tire scrub and premature tire wear.

Tools:

- Wrenches
- Tape Measure
- Tire scribing tool

Procedure:



- 1. Jack up front axle so tires are off of floor.
- 2. Rotate tire by hand and scribe a line near the center of each of the front tires.
- 3. Measure and record the distance between the lines at the front and the rear of the tire at about axle height. Measurement at front of tire should be slightly less than measurement at rear (toed in).
- 4. Compare measurement to specifications, and adjust tie rod to increase or decrease the amount of toe until the dimension is within specifications.
- 5. Tighten the lock nut.

Specification:

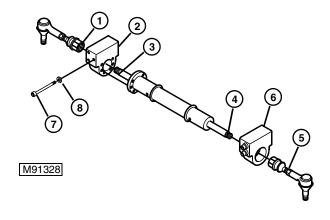
Toe In..... 0-3 mm (0-0.125 in.).

REPAIR

STEERING CYLINDER (DUAL CYLINDER ENDS - 4-WD)

Removal:

 Label and remove both steering hoses from the steering cylinder.



1. Tie Rod

5. Tie Rod

2. LH Bracket

6. RH Bracket

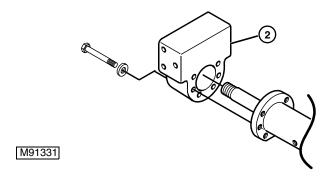
3. Cylinder Rod

7. Cap Screw

4. Cylinder Rod

8. Lock Washer

- 9. Place a wrench on each of the tie rods on the ends of the cylinder rod, and turn to remove one side.
- 10. Place a wrench on the flats, or a suitable tool through the hole in the end of the cylinder rod where the ball joint was removed to prevent the cylinder rod from turning.
- Place a wrench on the remaining ball joint, and remove.
- Remove three cap screws and lock washers on LH bracket attaching steering cylinder and bracket to front axle. Move steering cylinder to left to remove from RH bracket. Remove cylinder.





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STEERING CYLINDER STEERING

- 13. Remove six cap screws and lock washers attaching LH bracket to steering cylinder and remove attaching bracket from cylinder.
- 14. Inspect the steering cylinder for leaks, cracks, rod straightness and smooth operation.

NOTE: The steering cylinder has no serviceable components. If the cylinder leaks or does not meet specifications, the unit must be replaced.

Installation:

- Install the LH mounting bracket onto the steering cylinder and secure with 6 cap screws. Tighten to specification.
- 2. Install the steering cylinder into RH bracket, and secure LH bracket to the front axle with two cap screws. Tighten to specification.
- 3. Connect the steering hoses to the cylinder and Tighten to specification.
- 4. Attach ball joints to steering cylinder rod and tighten to specification.
- 5. Bleed the hydraulic system if required.
- Adjust toe-in. (See "TOE-IN ADJUSTMENT 4-WD" on page10.)

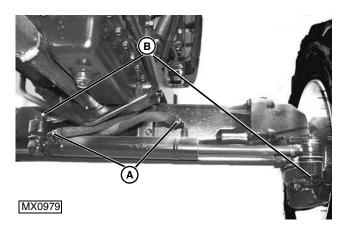
Specification:

Steering Cylinder to



STEERING CYLINDER (SINGLE CYLINDER END - 4-WD)

Removal:



NOTE: Cylinder ball end studs are tapered. Use a tie rod end removal tool to avoid damaging threads if cylinder is to be re used.

- 1. Mark hoses (A) and disconnect from cylinder.
- 2. Remove cotter pins and castle nuts (B).
- 3. Remove cylinder.

Installation:

- 1. Inspect rubber boots on ends of cylinder. Replace boots if necessary.
- 2. Install cylinder and tighten castle nuts to specification. If slots in castle nut do not line up with cotter pin hole, continue tightening nut until next slot lines up.
- 3. Connect hoses to cylinder.

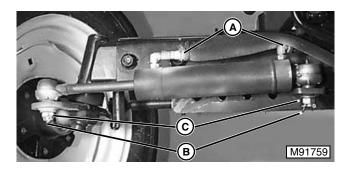
Specification:

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STEERING CYLINDER (2-WD)

Removal:

1. Label and disconnect both steering hoses (A) from the steering cylinder.



- 2. Remove cotter pin (B) and castle nut (C) from spindle arm end of cylinder.
- 3. Using a ball joint separator, disconnect steering cylinder from spindle arm.
- 4. Remove cotter pin and nut from axle end of cylinder.
- Using a ball joint separator, disconnect steering cylinder from bracket on front axle. Remove cylinder.

Installation:

- Attach cylinder to axle bracket and spindle. Secure with castle nuts. Tighten to specification and install cotter pins to secure nuts. If slots in castle nut do not line up with cotter pin hole, continue tightening nut until next slot lines up.
- 2. Connect steering hoses to cylinder.

Specification:

STEERING WHEEL REMOVAL AND INSTALLATION

Removal:

- 1. Remove steering wheel center cap.
- 2. Remove lock nut.
- 3. Remove steering wheel. If necessary, use a suitable puller.

Installation:

NOTE: Lubricate the steering shaft splines with general purpose grease before installing steering wheel to allow easy removal.

- Remove white center cap plastic retaining ring from steering wheel.
- 2. Install steering wheel and retain with nut. Tighten steering wheel nut to specification.
- Install plastic retaining ring to steering wheel center cap.
- 4. Install center cap and retaining ring to steering wheel.

Specification:

Steering Wheel Nut 39-49 N•m (29-36 lb-ft).

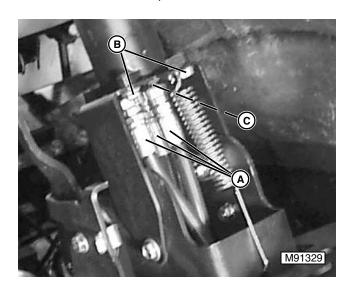
STEERING CONTROL UNIT (SCU) REMOVAL AND INSTALLATION

Removal:

- 1. Remove the steering wheel.
- 2. Remove the control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 of Miscellaneous section.)







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- 4. Label and remove the hydraulic hoses (A).
- 5. Remove four cap screws (B) and star washers. Remove the SCU from the tractor.
- 6. If necessary, remove adapter fittings (C) from the SCU.

NOTE: The SCU has no serviceable components. If the SCU does not meet specifications, the unit must be replaced.

Installation:

- If adapter fittings were removed, inspect O-rings in adapter fittings for cracks or damage. Replace if required.
- 2. Install adapter fittings to the SCU ports. Tighten to specification.

NOTE: Unevenly or improperly torquing cap screws attaching SCU to tractor can result in distortion of the valve body, and premature failure of the SCU.

- 3. Install the SCU to the tractor. Fasten with four cap screws and star washers. Tighten to specification.
- 4. Install the hydraulic hoses to the adapter fittings. Tighten cylinder hoses to specification. Tighten pressure and return hoses to specification.
- 5. Install the control panel lower shroud.
- 6. Install the control panel.
- 7. Install the steering wheel.
- 8. Fill the hydraulic system to the proper level; bleed the system if required.

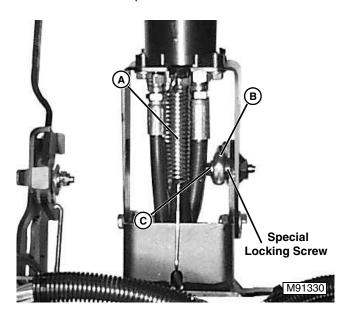
Specification:

SCU Adapter Fittings... 14-19 N•m (115-150 lb-in.). SCU Mounting Cap Screws. 30-38 N•m (22-28 lb-ft). Small Hoses To SCU 19-27 N•m (168-240 lb-in.). Large hoses To SCU 40-57 N•m (30-42 lb-ft).

TILT STEERING MECHANISM REMOVAL AND INSTALLATION

Removal:

- 1. Remove steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 13.)
- Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10 of Miscellaneous section.)
- 3. Remove control panel lower shroud.



- 4. Disconnect tilt return spring (A) from tilt column.
- 5. Lift up on the tilt locking lever (B) to release lock.
- Hold tilt locking lever and remove lock nut (C). Remove tilt locking lever.

NOTE: Locking screw has left-hand thread into steering column.

7. Remove locking screw.

Installation:

- 1. Install locking screw to steering column. Tighten enough to lock column in place.
- 2. Install tilt locking lever into position on locking screw splines.
- Test locking mechanism to be sure that steering column will lock in position securely, and tilt locking lever will not interfere with lower control panel shroud. Adjust if required.
- 4. Install lock nut and tighten.

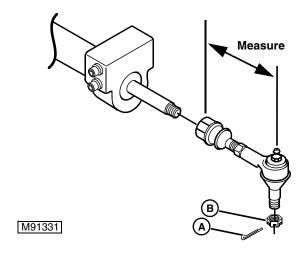
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TIE ROD REMOVAL AND INSTALLATION (EARLY 4-WD)

Removal:

- Measure distance from lubrication fitting on tie rod end to end of ball joint nut on steering cylinder rod. Record measurement.
- 2. Place a wrench on each of the nuts on the ends of the tie rods, and turn to remove one side.
- 3. If necessary, place a wrench on the flats or a suitable tool in the hole in the end of the cylinder rod where the tie rod was removed to prevent the cylinder rod from turning. Place a wrench on the remaining tie rod nut, and remove tie rod.



- 4. Remove cotter pin (A).
- 5. Remove castle nut (B).
- Using a ball-joint separator, separate tie rod from spindle arm.
- 7. Remove tie rod.

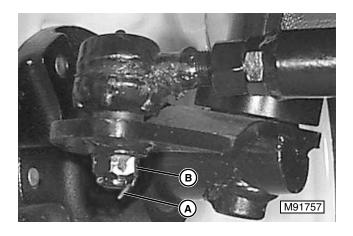
Installation:

- 1. If installing ball joint previously used, inspect boot for damage. If necessary, replace tie rod.
- 2. If installing a new tie rod, loosen locking nut, and adjust tie rod until measurement from lubrication fitting to end of ball joint nut equals that recorded before removal. Tighten locking nut.
- Attach tie rod to cylinder rod and torque to specification.
- 4. Attach tie rod to spindle arm.
- 5. Install castle nut and torque to specification.
- 6. Install a new cotter pin.
- 7. Lubricate tie rod end using general purpose grease. Follow lubrication procedure outlined in the maintenance section of the operator's manual.
- 8. Adjust toe-in. (See "TOE-IN ADJUSTMENT 4-WD" on page10.)

Specification:

TIE ROD REMOVAL AND INSTALLATION (2-WD & LATE 4-WD)

Removal:



- 1. Remove cotter pin and castle nut from each rod end attaching tie rod to spindle arm.
- 2. Using a ball joint separator, disconnect ball joint ends from spindle arms. Remove tie rod.

Installation:

- 1. If installing tie rod end previously used, inspect boot. If necessary, replace tie rod end.
- Insert threaded ends of tie rod ends into holes in spindle arms.
- 3. Install two castle nuts to rod ends.
- 4. Tighten castle nuts (B) to specification.
- 5. Install two cotter pins (A).
- 6. Lubricate tie rod ends using general purpose grease. Follow lubrication procedure outlined in the maintenance section of the operator's manual.
- 7. Adjust toe-in. (See "TOE-IN ADJUSTMENT 2-WD" on page11.)

Specification:

Castle Nuts 75-108 N•m (55-80 lb-ft).

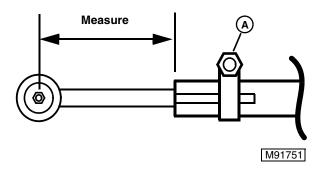
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TIE ROD DISASSEMBLY AND ASSEMBLY (2-WD)

Disassembly:

1. Remove ball joint boots from ball joints and clean parts thoroughly using a suitable solvent.



- Measure length of tie rod from clamped tube end to lubrication fitting on rod end. Record measurement.
- 3. Loosen cap screw and nut (A) on tie rod clamp.
- 4. Remove rod end from tie rod tube.
- 5. Loosen locking nut on adjustable rod end.
- 6. Unscrew adjustable rod end from tie rod.
- 7. Inspect ball joints for damage, wear, and smooth operation. Replace if necessary.

Assembly:

- 1. If installing ball joint previously used, inspect boot. If necessary, replace tie rod end.
- 2. If removed, thread locking nut onto adjustable tie rod end.
- 3. Install threaded rod end into tie rod so that approximately half the threads are showing.
- 4. Install plain rod end into tie rod. Measure from end of tie rod tube to lubrication fitting on tie rod end. Install so that dimension is same as that recorded before disassembly. Tighten clamp to retain rod end in tie rod tube.

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BRAKES SPECIFICATIONS

SPECIFICATIONS

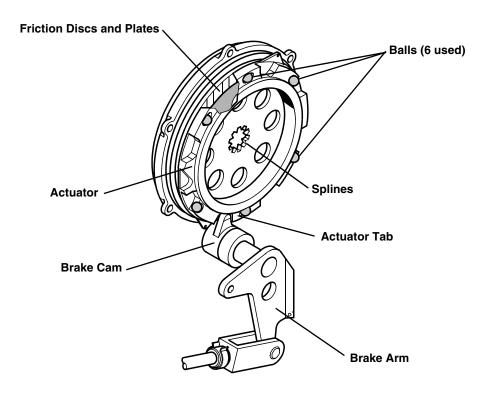
BRAKES

Brake Type	
Brake Pedal Stroke @98N (22 lb) pedal force)	
Pedal Free Play @ 49N (11 lb) pedal force	27 - 35 mm (1.06 - 1.37 in.
Total Brake Actuation	63 - 76 mm (2.5 - 3.0 in.
Pedal Differential	2 mm (0.08 in.) or Less
Parking Brake Pull-In (force required to set)	. 79 - 98 N (18 - 22 lb) at Third Notch
TRANSAXLE OIL	
Туре	John Deere J20E
Capacity:	
PRT and CST	
HST	
TORQUE SPECIFICATIONS	
Rear Wheel Bolts	88 - 108 N•m (65 - 80 lb-ft
Front Wheel Bolts	88 - 108 N•m (65 - 80 lb-ft
Master Brake Link Jam Nut	65 - 71 N•m (48 - 52 lb-ft
Set Screw On Master Brake Pedal (To Shaft)	20 - 25 N•m (15 - 19 lb-ft
Clutch Rod to Clutch Pedal Cap Screw	
Left Hand Brake Lever Cap Screw	



COMPONENT LOCATION

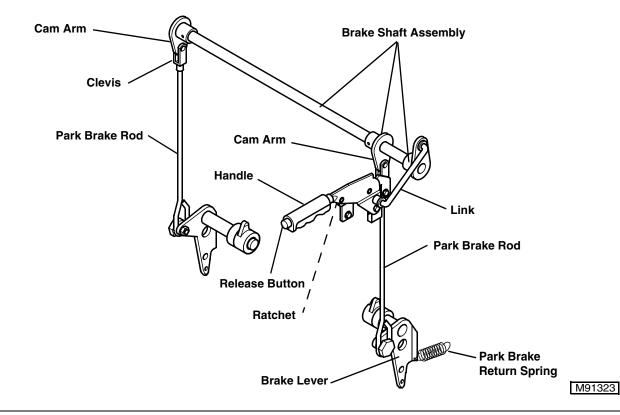
BRAKE HOUSING



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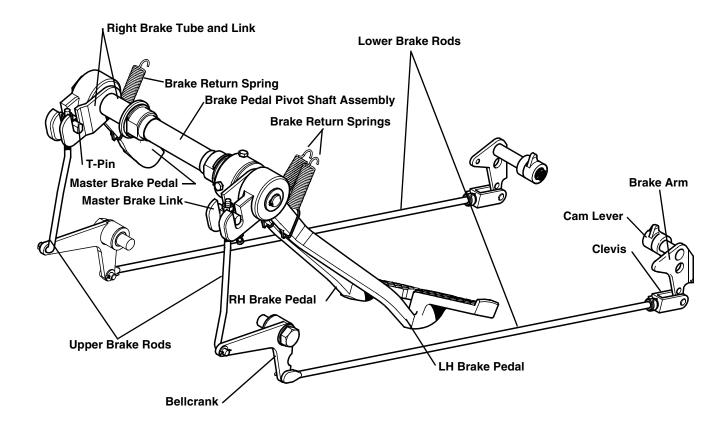
PARKING BRAKE





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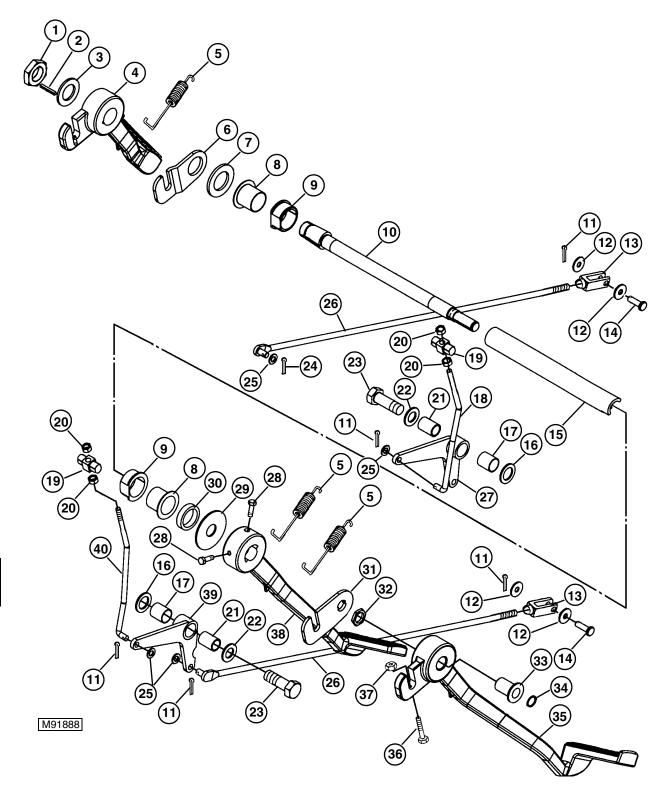
BRAKE PEDALS AND LINKAGE - HST



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BRAKE PEDALS AND LINKAGE - HST





10 - 6

34. Snap Ring

36. Cap Screw

35. Pedal

37. Nut

38. Pedal

40. Rod

39. Bellcrank

BRAKES

11. Cotter Pin

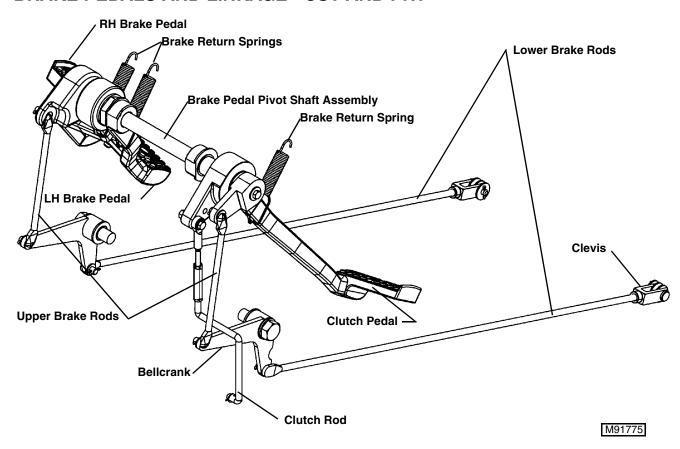
1. Nut 12. Washer 23. Cap Screw 2. Shaft key 13. Clevis 24. Cotter Pin 3. Washer 14. Pin 25. Washer 4. Pedal 15. Tube 26. Rod 5. Spring 16. Washer 27. Bellcrank 6. Lever 17. Bearing 28. Cap Screw 7. Washer 18. Rod 29. Washer 8. Bushing 19. T-Pin 30. Spacer 9. Bushing 20. Nut 31. Lever 10. Shaft 21. Bushing 32. Nut

33. Bushing

22. Washer



BRAKE PEDALS AND LINKAGE - CST AND PRT

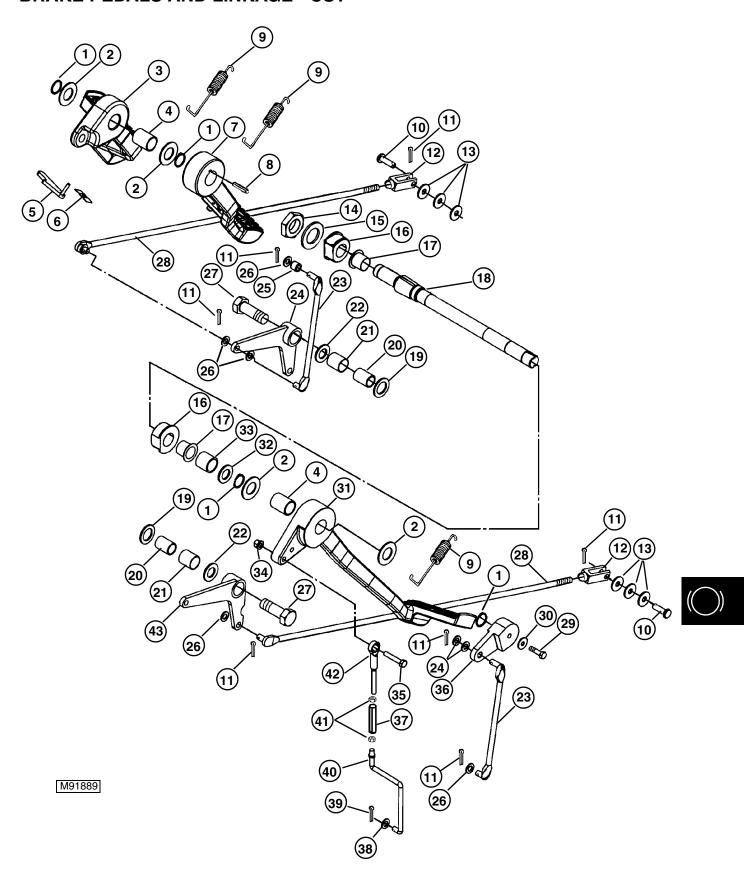




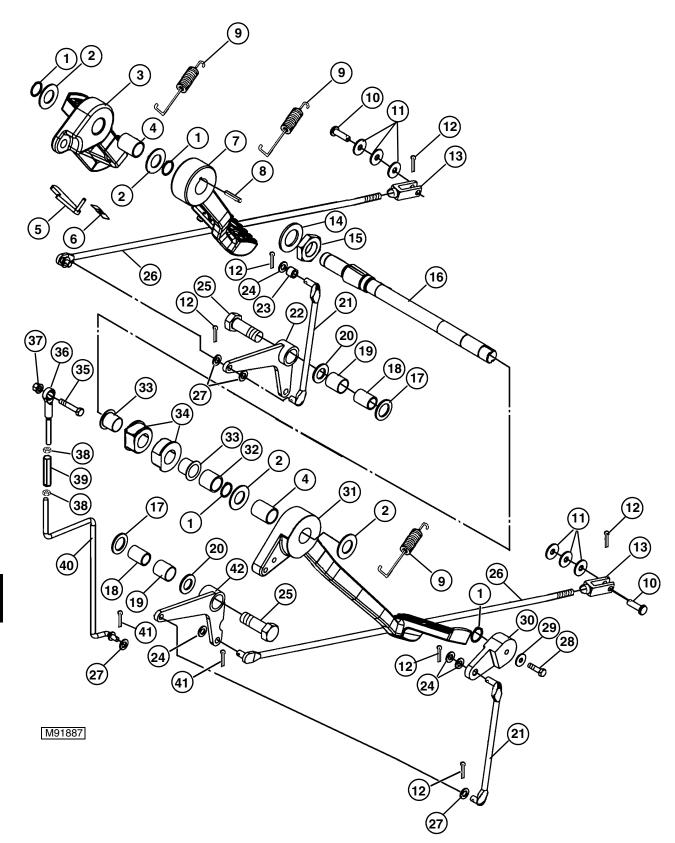
1. Snap Ring	12. Clevis	23. Rod	34. Nut
2. Washer	13. Washer	24. Bellcrank	35. Cap Screw
3. Pedal	14. Nut	25. Bushing	36. Lever
4. Bushing	15. Washer	26. Washer	37. Turnbuckle
5. Arm	16. Bushing	27. Cap Screw	38. Washer
6. Leaf Spring	17. Bushing	28. Rod	39. Cotter Pin
7. Pedal	18. Shaft	29. Cap Screw	40. Rod
8. Shaft Key	19. Washer	30. Washer	41. Nut
9. Spring	20. Bushing	31. Pedal	42. Tie Rod End
10. Pin	21. Bearing	32. Washer	43. Bellcrank
11. Cotter Pin	22. Washer	33. Spacer	

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BRAKE PEDALS AND LINKAGE - CST



BRAKE PEDALS AND LINKAGE - PRT





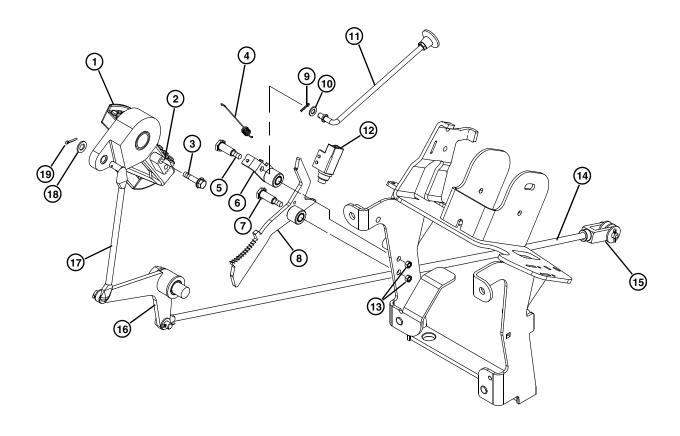
10 - 10 6/27/00

BRAKES

1. Snap Ring	12. Cotter Pin	23. Bushing	34. Bushing
2. Thrust Washer	13. Clevis	24. Washer	35. Cap Screw
3. Pedal	14. Washer	25. Cap Screw	36. Tie Rod End
4. Bushing	15. Nut	26. Rod	37. Nut
5. Arm	16. Shaft	27. Washer	38. Nut
6. Leaf Spring	17. Washer	28. Cap Screw	39. Turnbuckle
7. Pedal	18. Bushing	29. Washer	40. Rod
8. Shaft Key	19. Bearing	30. Lever	41. Cotter Pin
9. Spring	20. Washer	31. Pedal	42. Bellcrank
10. Pin	21. Rod	32. Spacer	
11. Washer	22. Bellcrank	33. Bushing	



CONSOLE MOUNTED PARKING BRAKE





1. Brake Pedal

2. Lock

3. Screw (2 used)

4. Return spring

5. Bolt

6. Bracket, Pivot

7. Bolt

8. Lever

9. Cotter Pin

10. Washer

11. Parking Brake Rod

12. Parking Brake Switch

13. Nut

14. Rod

15. Clevis

16. Bellcrank

17. Rod

18. Washer

19. Cotter Pin

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THEORY OF OPERATION

BRAKES

The brakes on the 45-46-4700 are mechanical wet disc brakes.

The differential carrier support and final drive ring gear are both secured in the final drive housing. The brake friction plates are held in place by tabs. The only rotating components are the brake disks, which are driven by splines on the differential shafts.

When the brake pedal is applied the brake rod pulls the brake lever forward. This rotates the cam lever which rotates the actuator. The balls stay stationary in the socket on the final drive ring gear. The slot that the balls sit in on the actuator are ramped. As the actuator rotates the balls force it toward the carrier support. This compresses the disks between the friction plates and stops rotation of the differential output shaft.

When the brake pedal is released the return springs help pull the actuator back toward the ring gear.

Side Mount Parking Brake

The parking brakes use rods extending from the parking brake shaft assembly down to the brake levers on the final drive case, and are engaged with the park brake lever. The lever is pulled up, pulling the link which turns the park brake shaft. On the park brake shaft are

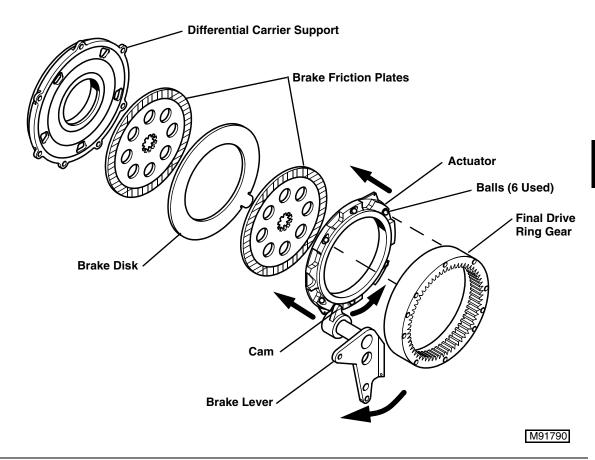
two cam arms which pull the park brake rods. The park brake rods pull the brake levers on the final drive case. The park brake is locked in position by a ratchet on the park brake lever. The brakes are held in position until the park brake release button is pushed, and the park brake lever is pushed down.

Dash Mount Parking Brake

The parking brake operates by locking the brake pedal(s) in an engaged position.

The dash mount parking brake is operated from a control rod that is pulled out while the brake pedal(s) are being held down. When the rod is pulled out, a bracket rotates rearward which pivots a parking brake lever. Teeth on the front of the lever engage with teeth on a lock that is bolted to the brake pedal.

The brake pedal return springs maintain force which holds the parking brake lever in position. The parking brake is released by pushing down on the brake pedal(s) which allows a disengagement of the teeth on the brake pedal and lever. A return spring pivots the rear of the lever upward and the front down, separating the teeth and allowing the brake pedals to be released.





TROUBLESHOOTING CHART

Problem or Symptom Check or Solution	Steering pulls in one direction	Brakes drag (tractor will not move) or slow to release	Brakes not effective	Excessive pedal travel	Noise during braking	Oil leaking from final drive case at brake arm
Brakes improperly adjusted		•	•	•		
Brakes worn/ no longer serviceable			•	•	•	
Brake return spring weak/ damaged/ missing		•				
Brake linkage damaged/ binding		•	•			
Brake lever cam and/ or actuator worn			•	•	•	
Actuator/ balls/ housing worn or damaged			•	•	•	
Brake friction/ stationary plates worn or damaged			•	•	•	
Replace brake arm seal						•



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BRAKES DIAGNOSIS

DIAGNOSIS

Test/Check Point	Normal	If Not Normal
1. Pedals	Smooth operation	Grease pedal shaft assembly/ linkage. Inspect for damage.
	Free play 27-35 mm (1.06-1.37 in.) Total brake actuation 63-76 mm (2.5-3.0 in.) Pedal differential 2 mm (0.08 in) or less	Adjust to specification.
2. Friction material	Friction disc not excessively worn	Replace parts as required.
3. Linkage	Not bent or binding	Adjust to specification, replace damaged parts
4. Actuator and housing	Smooth operation, not worn	Replace worn parts
5. Steel balls	Not pitted or scored	Replace worn parts
6. Park Brake Lever	Smooth operation, not binding	Adjust to specifications, replace damaged parts



TESTS AND ADJUSTMENTS

PARKING BRAKE ADJUSTMENT

Side Mount Parking Brakes:

- 1. Adjust the park brake by removing the clevis pin attaching the park brake rod to the park brake shaft and turning the clevis on the rod.
- Adjust clevis on the left brake until the brake engages with 4 clicks of park brake lever travel. Remove left brake clevis pin, and repeat procedure on right brake. Attach clevises to transmission brake arms.
- Pull the park brake lever. The force required is 79-98 N (18-22 lb) at the third notch of the brake ratchet. At the fourth notch of the brake ratchet, the park brake should be fully engaged.

Dash Mounted Parking Brakes:

The dash mount parking brake lever locks the brake pedal in position. See "BRAKE PEDAL ADJUSTMENT" below.

BRAKE PEDAL ADJUSTMENT

NOTE: (Hydrostatic Model) The locking nuts located on the upper brake rod groove pins at the brake pedal assembly should not be used as an adjustment point. All adjustment should be performed at the rear of the tractor on the lower brake rod clevises attached to the transmission brake arms.

Reason:



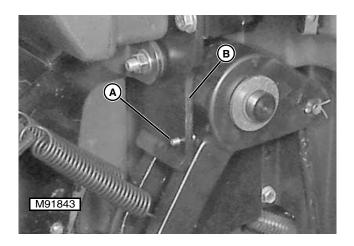
To set the brake linkage free play to allow full pedal movement and full application of the brake discs on the rear axle shafts. The brakes are adjusted using adjustable clevises to lengthen or shorten the brake rods.

NOTE: Perform parking brake adjustment before performing brake pedal adjustments. Setting the parking brake adjustment allows for full release of the parking brake, and removes excess movement in the brake rods.

Tools:

- Ruler
- Pliers

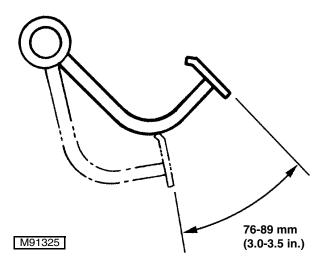
Procedure:



 (CST or PRT Models) Check brake pedals to ensure that they are at the same height. Adjust as required using set screws (A) on brake pedal stop bracket (B).

NOTE: Set screws may not be factory installed. If necessary, install an 8 X 20 mm set screw into pedal stop. Apply TY9370 thread sealant to lock set screw in place.

Remove cotter pin, washer, and clevis pin to disconnect clevis from transmission brake arm.



- 3. Turn clevis on rod to adjust free play.
- Adjust each clevis until the pedal free play is 27 35 mm (1.06 1.37 in.) with 49 N (11 lb) pressure, and the total brake pedal stroke is 76 89 mm (3.0 3.5 in.) with 98 N (22 lb) pressure.
- The difference between left and right side pedal free play (pedal differential) should be less than 2 mm (0.08 in).

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BRAKES REPAIR

Results:

If the brakes are adjusted correctly:

 The wheel brakes will begin engagement when the pedals are depressed 27 - 35 mm (1.06 - 1.37 in.) with 49 N (11 lb) pressure.

REPAIR

BRAKE DISASSEMBLY AND INSPECTION

1. Remove the final drive from the tractor. (See "FINAL DRIVE REMOVAL" on page51 in Final Drive Power Train section.)



A. Friction Plate

C. Friction Discs

B. Tab

D. Lock Tabs

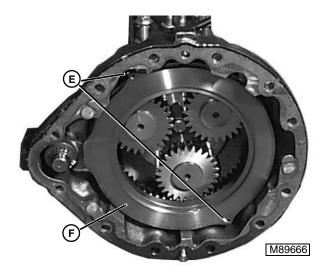
NOTE: Right side final drive housing has three tabs (D) that retain friction discs and friction plates in housing. To remove plates and discs, rotate lock tabs to clear brake plates.



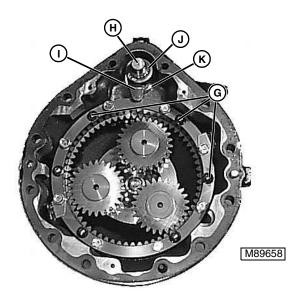
2. Remove the friction plates (A) and friction discs (B) from the final drive housing.

NOTE: If final drive housing is laying on its side, balls will fall out when springs are removed.

BRAKE ASSEMBLY BRAKES



- 3. Remove two springs (E).
- 4. Remove the brake actuator (F) from the final drive housing.
- 5. Inspect all parts for wear or damage. Replace any worn or damaged components.



- 6. Remove six steel balls (G) from the final drive housing.
- 7. If not already marked, mark end of brake lever shaft (H) and cam (I) to facilitate assembly. Remove the snap ring (J) from the brake lever shaft. Remove the cam lever and bushing (K) from the housing.
- 8. Remove the brake lever shaft.
- 9. Inspect the steel balls and ring gear for wear, galling, scratches, or cracking.
- 10. Inspect the brake lever and housing for wear or damage. Replace any unserviceable parts.
- Remove the old sealant from the mounting surfaces of the housings. Clean and inspect the surfaces for wear or damage.

BRAKE ASSEMBLY

- 1. Replace the brake lever seal.
- 2. Install the brake lever, bushing, and cam into the final drive housing. Secure with snap ring.
- 3. Dip the six steel balls in transmission oil. Install the balls into the transaxle housing.
- 4. Dip the brake actuator in transmission oil. Install the brake actuator into the housing.

NOTE: Be certain the steel balls locate into the ramps of the actuator.

- Install the springs onto the actuator and ring gear to retain the steel balls.
- 6. Dip the friction plates and the friction discs in transmission oil. Install the plates into the housing.

NOTE: With the actuator in place, install the first friction disc. Then, install a friction plate, followed by a friction disc, followed by a friction plate.

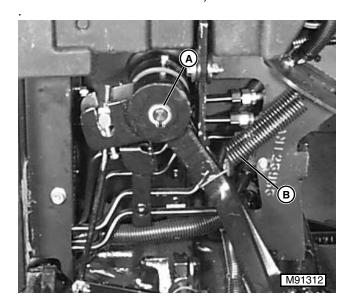
- 7. Hold the plates in place with retaining clips (right-hand side *only*).
- 8. Install the final drive housing to the transaxle. (See "FINAL DRIVE INSTALLATION" on page52 in FINAL DRIVE POWER TRAIN Section.)

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BRAKE PEDAL - HST

Removal:

 Remove upper cowl panels. (See "COWL PANEL REMOVAL AND INSTALLATION" on page 11 in MISCELLANEOUS section.)



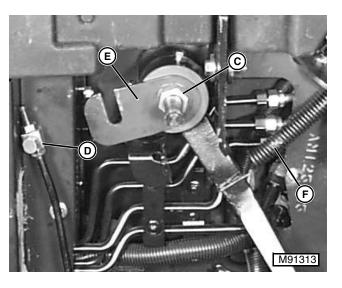
2. Remove snap ring (A) from LH end of brake pedal pivot shaft.



CAUTION

Brake return spring is under high tension. Wear safety glasses and gloves when removing or installing spring from pedal.

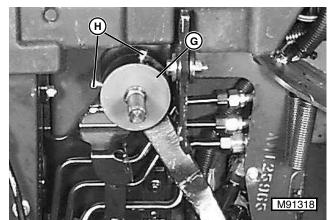
- 3. Disconnect left brake return spring (B) from brake pedal.
- 4. Remove left brake pedal.



5. Remove nut (C).

NOTE: Groove pin location on brake rod is set at the factory. If the groove pin (D) must be replaced, measure and note location before removing. Install new groove pin so that it is in the same location.

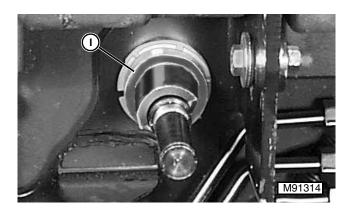
- 6. Move left brake rod and groove pin (D) clear of brake shaft assembly.
- 7. Remove master brake link (E).
- 8. Disconnect right brake return spring (F) from brake pedal.



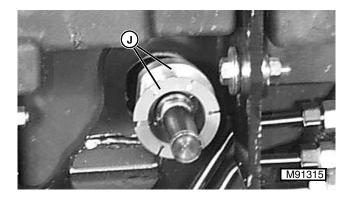


- 9. Remove washer (G).
- 10. Loosen two set screws (H) on right brake pedal.
- 11. Remove right brake pedal.

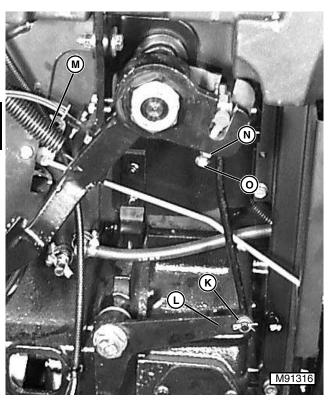
BRAKE PEDAL - HST



12. Remove bushing (I).



13. Remove two flanged bushings (J).



14. Remove cotter pin (K) and washer from bottom of RH brake rod, disconnect brake rod from bellcrank (L) and remove brake rod and groove pin from pedal assembly.

- 15. Disconnect master brake return spring (M) from brake pedal.
- 16. Remove master brake pedal and brake pedal shaft from tractor as an assembly.
- 17. Inspect all parts for wear or damage. Replace any worn or damaged components.

NOTE: If lubrication fitting on RH side of brake pedal assembly is removed or replaced, DO NOT over tighten. Lubrication fitting will bind against master brake shaft. Test by depressing RH brake pedal with brake return springs in place; watch for master brake pedal movement. If master brake pedal moves when RH brake pedal is depressed, lubrication fitting is too tight.

Installation:

Installation is the reverse of removal.

NOTE: Groove pin location on brake rod is set at the factory. If the groove pin must be replaced, measure and note location before removing. Install new groove pin so that it is in the same location.

- Install the pedal shaft assembly into tractor frame and attach the master brake pedal return spring.
- Install the RH brake rod and groove pin into the brake pedal assembly and RH brake bellcrank, and install the washer and cotter pin at bottom of brake rod.
- Loosen the locking nut (N) and tighten the adjuster cap screw (O) on the master brake pedal so that the groove pin is evenly supported by the RH brake link and the adjuster bolt. The groove pin should be level.
- 4. On LH side of tractor, install two flanged bushings, plain bushing and RH brake pedal.



CAUTION

Brake return spring is under high tension. Wear safety glasses and gloves when removing or installing spring from pedal.

- 5. Attach RH brake return spring.
- Install washer, master brake link and jam nut. Tighten jam nut to 65-71 Nom (48-52 lb-ft).

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- 7. Tighten two set screws on RH brake pedal to 20-25 N•m (15-19 lb-ft).
- 8. Move LH brake groove pin and rod into position on master brake link.
- 9. Install LH brake pedal. Retain with snap ring.
- 10. Attach LH brake pedal return spring.

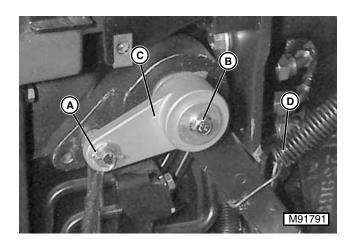
NOTE: If the parking brake has been removed, complete the parking brake installation and adjustment before adjusting the service brakes.

11. Adjust the brakes. (See "BRAKE PEDAL ADJUSTMENT" on page16.)

BRAKE PEDAL - CST AND PRT

Removal:

 Remove upper cowl panels. (See "COWL PANEL REMOVAL AND INSTALLATION" on page 11 in MISCELLANEOUS section.)



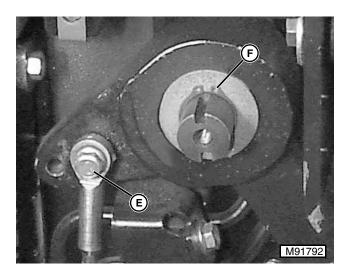
- Remove cotter pin (A) and washer from end of brake rod.
- 3. Disconnect brake rod from brake lever.
- 4. Remove cap screw (B) and washer from end of brake pedal pivot shaft.
- 5. Remove brake lever (C) from end of brake pedal pivot shaft.



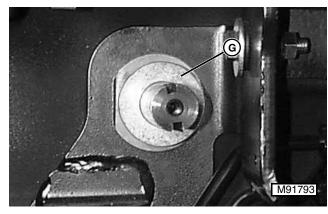
CAUTION

Clutch return spring is under high tension. Wear safety glasses and gloves when removing or installing spring from pedal.

6. Disconnect clutch return spring (D) from clutch pedal.

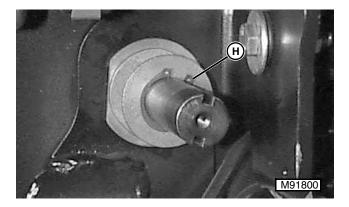


- Remove cap screw (E) and nut holding clutch rod end to clutch pedal. Disconnect clutch rod and set aside.
- 8. Remove snap ring (F) and washer.
- 9. Remove clutch pedal.

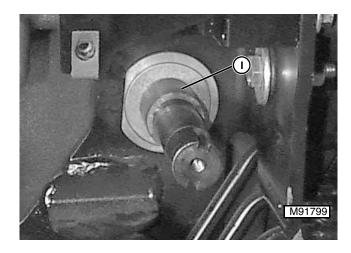




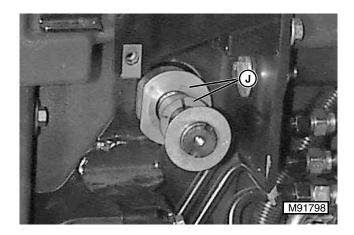
10. Remove washer (G).



11. Remove snap ring (H) and washer.



12. Remove spacer (I).

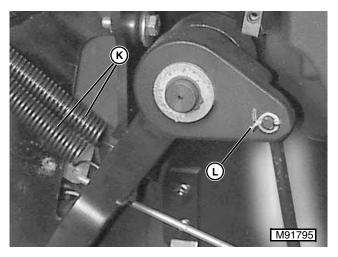


13. Remove washer and two flanged bushings (J).

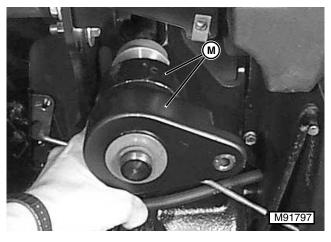


CAUTION

Brake return spring is under high tension. Wear safety glasses and gloves when removing or installing spring from pedal.



- 14. On right side of tractor, disconnect brake return springs (K) from left and right brake pedals.
- Remove cotter pin (L) and washer from RH brake rod.
- 16. Disconnect RH brake rod from brake pedal.



- 17. Remove two brake pedals (M) and pedal shaft from right side of tractor as an assembly.
- 18. Inspect all parts for wear or damage. Replace any worn or damaged components.

Installation:

Installation is the reverse of removal.



CAUTION

Clutch and brake return springs are under high tension. Wear safety glasses and gloves when removing or installing springs from pedals.

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- 1. Install the pedal shaft assembly into tractor frame and attach the two brake pedal return springs.
- 2. Attach RH brake rod to the brake pedal. Retain with washer and cotter pin.
- 3. On LH side of tractor, install two flanged bushings, spacer, and clutch pedal. Retain with washer and snap ring.
- 4. Attach clutch rod to clutch pedal and retain with cap screw and nut. Tighten nut to 36-44 N•m (27-33 Ib-ft).
- 5. Install LH brake lever. Retain with cap screw and washer. Tighten cap screw to 36-44 Nem (27-33
- 6. Attach LH brake rod to brake lever. Retain with washer and cotter pin.
- 7. Attach clutch pedal return spring.

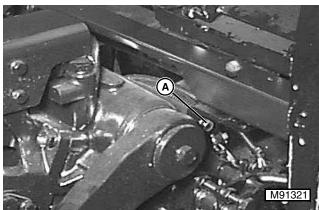
NOTE: If the parking brake has been removed, complete the parking brake installation and adjustment before adjusting the service brakes.

8. Adjust the brakes. (See "BRAKE PEDAL AĎJUSTMENT" on page16.)

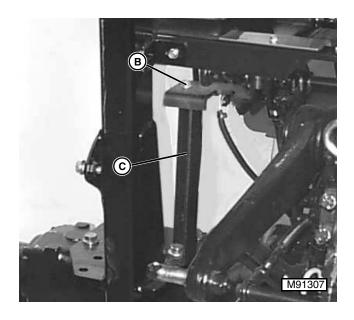
PARKING BRAKE LINKAGE REMOVAL AND INSTALLATION

Side Mount Parking Brake:

1. Remove seat. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page 5 in Miscellaneous section.)



2. Remove two cap screws (A) attaching park brake assembly to transmission rockshaft housing.

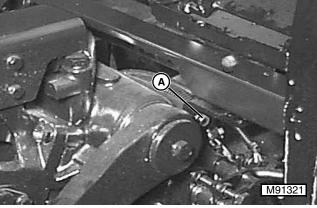


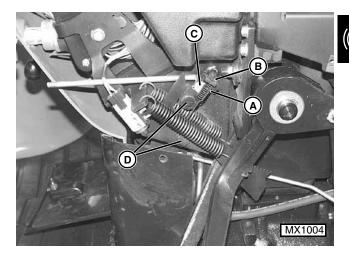
- 3. Remove cap screw (B) and nut attaching park brake assembly to support angle (C).
- 4. Remove two shoulder bolts and nuts attaching park brake rods to brake levers on transmission housing.
- 5. Remove park brake assembly.
- 6. Inspect all parts for wear and damage. Replace as required.

Installation is the reverse of removal.

Dash Mount Parking Brake:

1. Remove RH upper cowl panel. (See "COWL PANEL" REMOVAL AND INSTALLATION" on page11 in MISCELLANEOUS section.)





- 2. Disconnect return spring (A) from bracket (B).
- 3. Remove cotter pin (C) and washer from parking brake rod. Remove rod.

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- 4. Remove bolts (D) and nuts securing bracket and pivot lever.
- 5. Remove bracket and lever.
- 6. Inspect all parts for wear or damage. Pay particular attention to engagement teeth on lever. Replace parts as required.

Installation is the reverse of removal.



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HYDRAULICS SPECIFICATIONS

SPECIFICATIONS

HYDRAULIC SPECIFICATIONS

Measurements at: Engine 2600 rpm Open System Type Working Pressure 17237 kPa (2500 psi) Pump Gear Type Front Pump Capacity 18.2 L/min (4.8 gpm) Rear Pump Capacity 37.5 L/min (9.9 gpm) Rockshaft Lift Cycle Time 2-1/2 to 3 sec. Rockshaft Drop Cycle Time 2-1/2 to 3 sec. Maximum Lift Arm Drop in 5 Minutes (With Rate of Drop/Stop 51 mm (2 in.) Valve Closed) Maximum Lift Arm Raise Height (Measured from slot in left PTO 450±3 mm (17.7±0.12 in.) shield to center of pin in end of lift arm.)

REPAIR SPECIFICATIONS

Rockshaft Specifications:

Splined Sleeve Minimum OD
Lift Arm Raise Angle50°
Lift Arm Lower Angle
Maximum Variance Between Lift Arms
Shaft Bushing Maximum ID

TORQUE SPECIFICATIONS

d----0

SPECIFICATIONS HYDRAULICS

Pump-to-PTO Valve Tube Nuts (Rear Gear Pump)
PTO Clutch Valve-to-Tunnel Cap Screws
Pump-to-Mounting Plate Cap Screws (Front or Rear Gear Pump) 22 N•m (16 lb-ft)
Pump Cover Cap Screws - M8
Pump Cover Cap Screws - M10
Rockshaft Cap Screws
Lift Arm-to-Splined Shaft Cap Screws
Rockshaft Valve-to-Rockshaft Housing Cap Screws
SCV:
Cover Socket Head Cap Screws

S

Cover Socket Head Cap Screws	19 N•m (14.5 lb-ft)
Valve Spring Retainer Plugs	15 N•m (133 lb-in.)
Load Check Valves	24 N•m (18 lb-ft)
Relief Valve	50 N•m (37 lb-ft)
Lever Assembly cap screws	40 N•m (30 lb-ft)

SPECIAL OR ESSENTIAL TOOLS

Part Number	Part Name
JT05689	Adapter Fitting (1-1/16-12 M 37° X 1-14 F ORFS) (2 Required)
JT03012	Adapter Fitting (3/4 F NPT X 1-1/16-12 F 37° Sw) (2 Required)
JT05984	In-Line Flow Meter With Pressure Gauge
JT03377	Hose (3/4 M NPT X 3/4 M NPT X 10') (2 Required)
JTO3363	Pressure Gauge 0-207 kPa (0-30 psi)
JT03344	Pressure Gauge 0-2068 kPa (0-300 psi)
JT03345	Pressure Gauge 0-20684 kPa (0-3000 psi)
BW13586	Ballast Box

OTHER MATERIALS

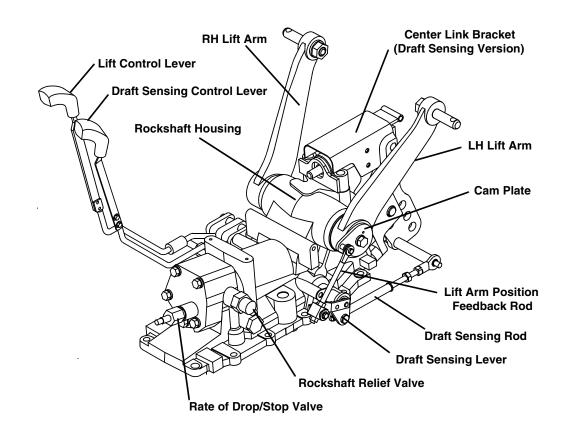


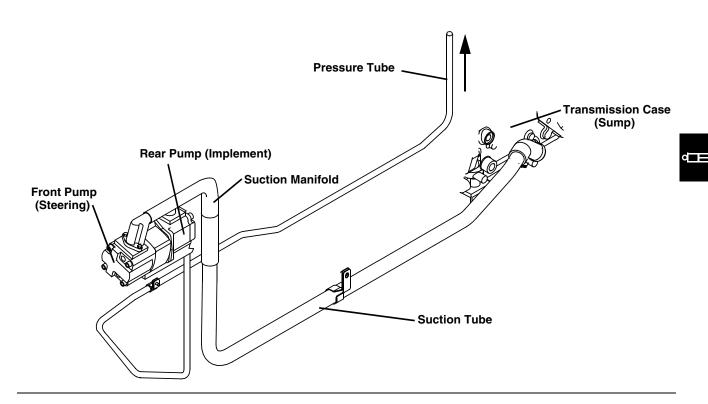
Number U.S.A./Canadian	Name	Use
TY6305	John Deere Clean and Cure Primer	Cleaning gasket surfaces
TY16021	John Deere High Flex Form-In-Place Gasket	Sealing Flange Assemblies Rockshaft to Housing
TY15934	John Deere General Purpose Gasket Dressing	Sealing Gaskets and Hoses
UN6419	JDM J20D HyGard [®] Oil	Transmission/Hydraulic Oil

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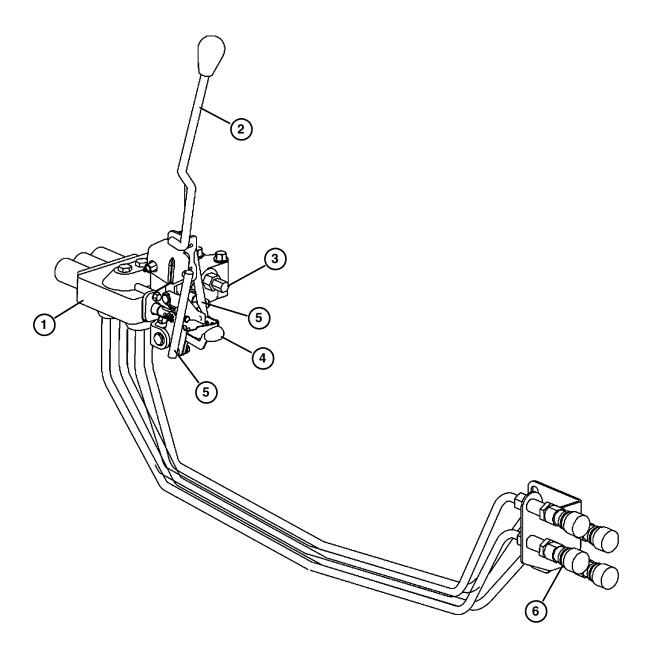
COMPONENT LOCATION

ROCKSHAFT COMPONENT LOCATION





DUAL SCV COMPONENTS



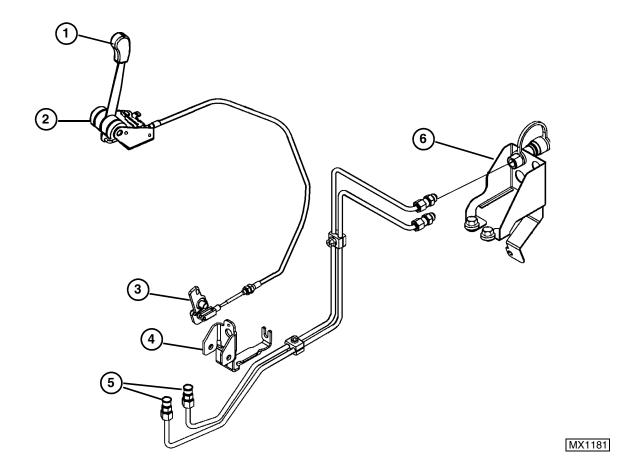


MX1178

- 3 Spool SCV
 Control Lever
- Pressure Relief Valve
- 4. Lockout Control
- 5. Control Rods
- 6. Quick Disconnects to Front of Tractor

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SINGLE AND THIRD SCV COMPONENTS



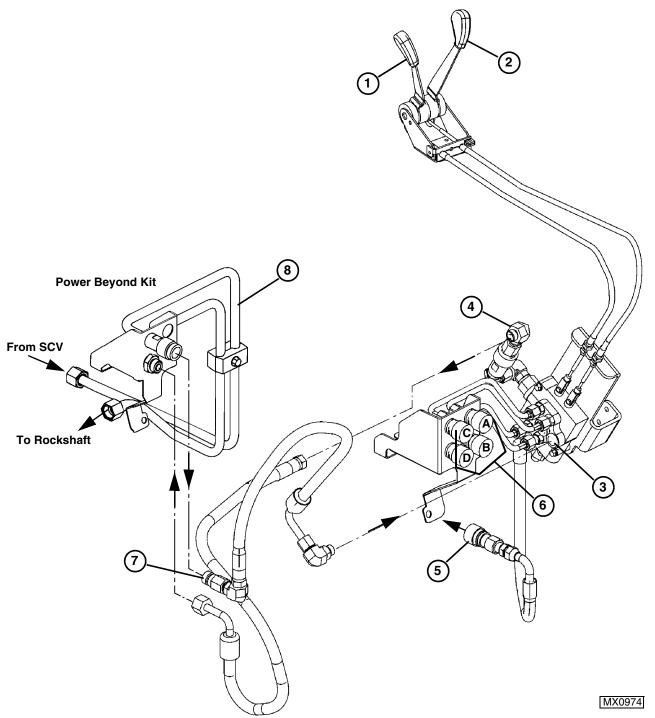


- 1. Control Handle
- 3. SCV Valve Control Lever
- 5. Connectors to SCV

- 2. Bracket Assembly (Fender Mount)
- 4. Mounting Bracket
- 6. Quick Disconnects to Rear of Tractor

NOTE: Items 3 and 5 go to a single spool SCV control valve for the single SCV kit, and to the third spool of the dual SCV valve kit control valve.

FOURTH AND FIFTH SCV with POWER BEYOND COMPONENTS



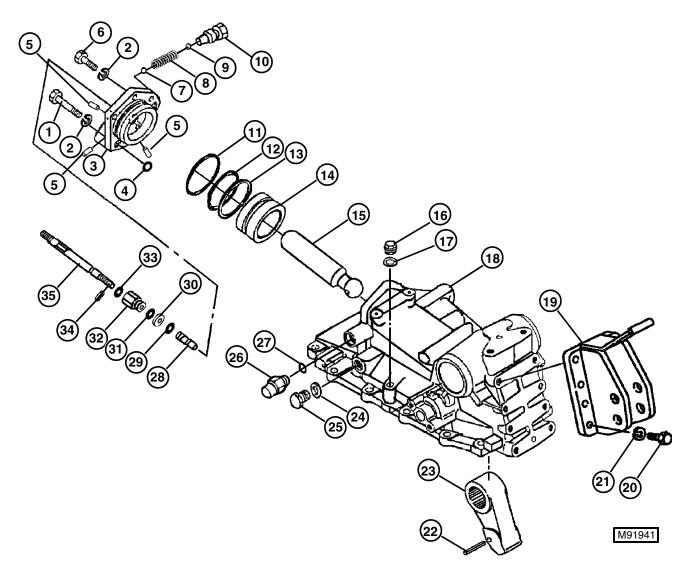


- 1. Control Lever
- 2. Quadrastat Lever
- 3. Pressure Port (IN from Power Beyond)
- 4. Return Port (OUT to Power Beyond / Rockshaft)
- 5. Drain to Sump
- 6. Quadrastatic Ports

- 7. Pressure IN
- 8. Power Beyond Kit (Replaces rockshaft supply tube)

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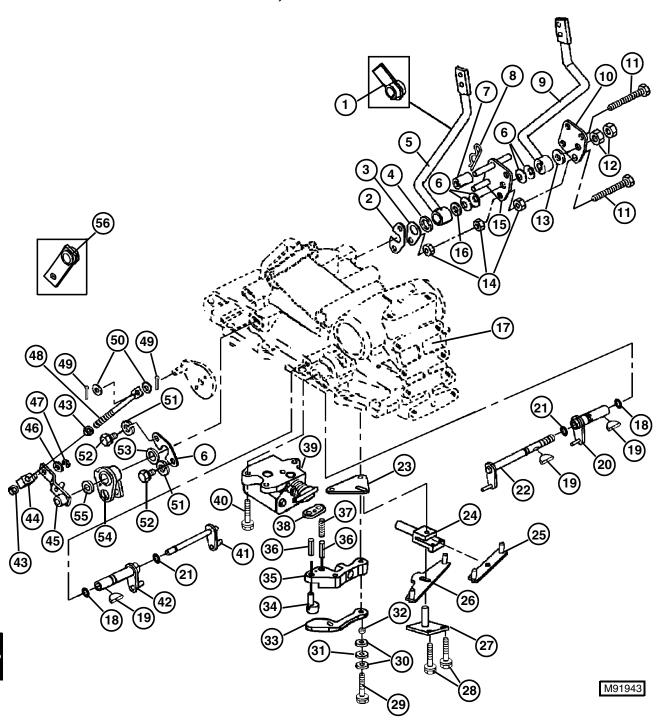
ROCKSHAFT PISTON, ROD, AND RATE OF DROPVALVE



1. Cap Screw	10. Cap	19. Bracket	28. Valve Spool
2. Lock Washer	11. O-Ring	20. Cap Screw	29. O-Ring
3. Cover, Cylinder Head	12. Slip Ring	21. Lock Washer	30. Washer
4. O-Ring	13. Seal	22. Pin	31. O-Ring
5. Plug	14. Piston	23. Arm, Crank	32. Nut, Stem
6. Cap Screw	15. Rod	24. O-Ring	33. O-Ring
7. Ball	16. Plug	25. Plug	34. Pin
8. Spring	17. O-Ring	26. Valve, Relief	35. Stem, Valve
9. O-Ring	18. Housing, Rockshaft	27. O-Ring	

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ROCKSHAFT CONTROL VALVE, PLUNGER ASSEMBLY AND CONTROLS



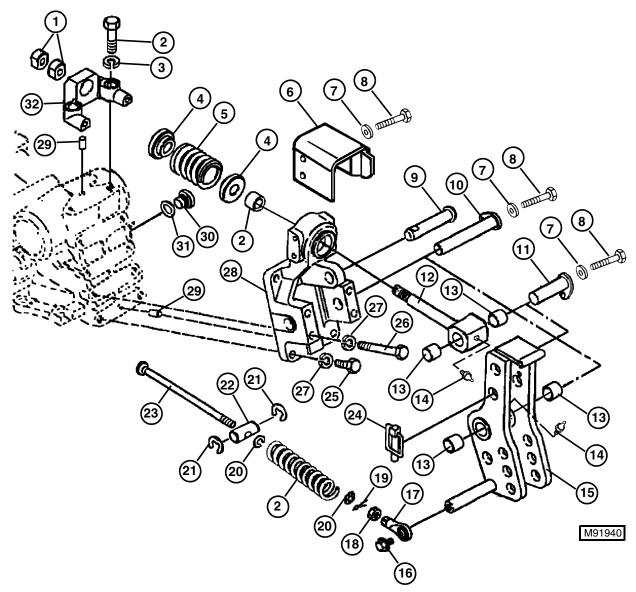
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1. Plate, Lock	15. Plate, Pin	29. Cap Screw	43. Nut
2. Plate, Locking	16. Washer	30. Washer	44. Adjuster
3. Plate, Support	17. Housing, Rockshaft	31. Washer, Wave	45. Lever, Position Feedback
4. Washer, Friction	18. O-Ring	32. Spacer	46. Washer
Lever, Draft Sensing Control	19. Key	33. Plate, Adjustment	47. Snap Ring
6. Belleville Washer	20. Shaft, Lift Control	34. Cam	48. Rod, Lift Arm Position Feedback
7. Gauge, Ring	21. O-Ring	35. Guide, Control	49. Pin, Cotter
8. Pin	22. Shaft, Draft Control	36. Pin, Spring	50. Washer
9. Lever, Lift Control	23. Plate	37. Spring	51. Washer, Lock
10. Plate, Outer	24. Plunger	38. Plate	52. Cap Screw
11. Cap Screw	25. Plate	39. Valve, Rockshaft Control	53. Washer
12. Nut	26. Plate	40. Cap Screw	54. Lever, Draft Feedback
13. Washer, Friction	27. Plate, Pivot	41. Shaft, Position Feedback	55. Washer
14. Nut	28. Cap Screw	42. Shaft, Draft Feedback	56. Plate, Locking



CENTER LINK (DRAFT SENSING VERSION)

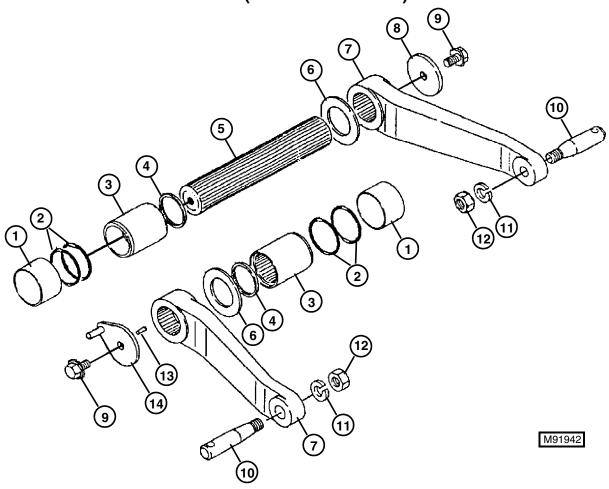




1. Nut	9. Pin	17. Rod End	25. Cap Screw
2. Cap Screw	10. Pin	18. Nut	26. Cap Screw
3. Lock Washer	11. Pin	19. Pin, Cotter	27. Lock Washer
4. Retainer, Spring	12. Guide, Spring	20. Washer	28. Bracket
5. Spring	13. Bushing	21. Snap Ring	29. Pin, Dowel
6. Cover	14. Fitting, Lubrication	22. Pin	30. Plug
7. Washer	15. Bracket	23. Rod	31. O-Ring
8. Cap Screw	16. Cap Screw	24. Pin	32. Holder, Spring

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ROCKSHAFT AND LIFT ARMS (EXPLODED VIEW)



- 1. Bushing
- 2. O-Ring
- 3. Splined Sleeve
- 4. O-Ring

- 5. Shaft, Splined
- 6. Washer
- 7. Arm, Lift
- 8. Washer

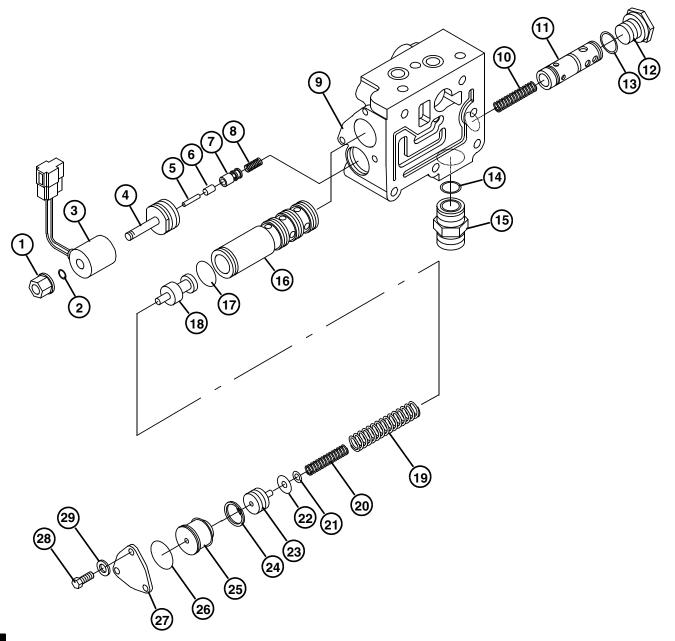
- 9. Cap Screw
- 10. Pin
- 11. Lock Washer
- 12. Nut

13. Pin, Split

14. Plate, Cam



PTO CLUTCH VALVE COMPONENT LOCATION



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8. Spring

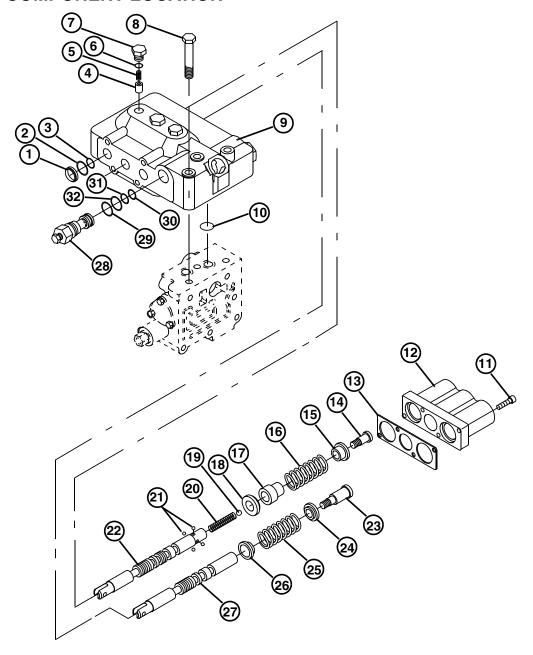
1. Nut (Plastic)	9. Valve Body	17. O-Ring	25. Piston
2. O-Ring	10. Spring	18. Piston	26. O-Ring
3. Solenoid Coil	11. Spool	19. Spring	27. Cover
4. Solenoid Body	12. O-Ring	20. Spring	28. Cap Screw
5. Plunger	13. Cap	21. Shim	29. Lock Washer
6. Piston	14. O-Ring	22. Shim	
7. Spool	15. Adapter Fitting	23. Piston	

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16. Spool

24. Snap Ring

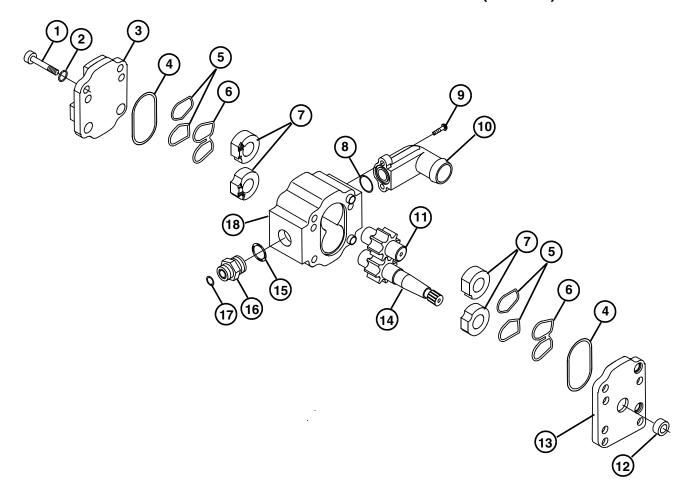
SCV VALVE COMPONENT LOCATION





1. Seal	9. Valve Body 17. Retainer, Spring		9. Valve Body 17. Retainer, Spring		25. Spring
2. Backing Washer	10. O-Ring	18. Spacer	26. Retainer, Spring		
3. O-Ring	11. Cap Screw	19. Ball	27. Spool		
4. Poppet	12. Cover	20. Spring	28. Valve, Relief		
5. Spring	13. Gasket	21. Ball (4 Used)	29. O-Ring		
6. O-Ring	14. Plug	22. Spool	30. O-Ring		
7. Cap	15. Retainer, Spring	23. Plug	31. Backing Washer		
8. Cap Screw	16. Spring	24. Retainer, Spring	32. Backing Washer		

HYDRAULIC PUMP COMPONENT LOCATION STEERING AND HYDROSTATIC CHARGE PRESSURE (FRONT)



- 1. Cap Screw
- 2. Lock Washer
- 3. Cover
- 4. O-Ring
- 5. Backing Rings

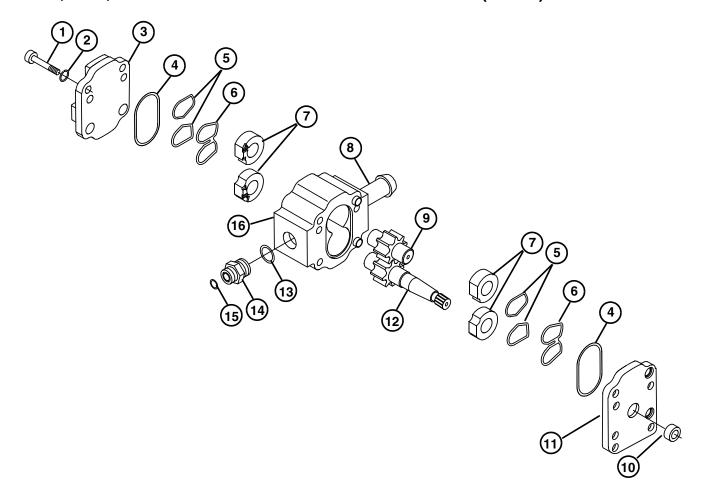
- 6. Formed O-Ring
- 7. Bushings
- 8. O-Ring
- 9. Cap Screw
- 10. Suction Tube Elbow
- 11. Gear, Idler
- 12. Seal
- 13. Cover
- 14. Gear, Drive
- 15. O-Ring

- 16. Adaptor Fitting
- 17. O-Ring
- 18. Housing



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HYDRAULIC PUMP COMPONENT LOCATION SCV, PTO, AND ROCKSHAFT WORKING PRESSURE (REAR)



1. Cap Screw

2. Lock Washer

3. Cover

4. O-Ring

5. Backing Rings

6. Formed O-Ring

7. Bushings

8. Suction Tube

9. Gear, Idler

10. Seal

11. Cover

12. Gear, Drive

13. O-Ring

14. Adaptor Fitting

15. O-Ring

16. Housing



TROUBLESHOOTING CHART

Problem or Symptom Check or Solution	Rockshaft Will Not Raise	Rockshaft Will Not Lower	Rockshaft Does Not Maintain Position	Rockshaft Does Not Operate Smoothly	Draft Arms Do Not Raise To Full Height	Draft Sensing Responds Too Slowly	Draft Sensing Does Not Operate	SCV Attachment Does Not Operate	SCV Attachment Does Not Operate Smoothly	PTO Does Not Operate	PTO Slips or Loses Power	PTO Stops Too Slowly	Raising Lift Arms Engages Relief Valve
Draft Control Response Improperly Adjusted (See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page 33.)						•							
Rockshaft Control Valve Faulty	•	•	•	•	•		•						
Rockshaft Rate of Drop/Stop Valve Improperly Adjusted or Faulty	•	•											
Draft sensing control lever friction Improperly adjusted (See "LIFT CONTROL LEVER" on page 43.)						•	•						
Lift Control Lever Friction Improperly Adjusted (See "LIFT CONTROL LEVER" on page 43.)			•										
Rear Gear Pump Faulty	•			•				•	•		•	•	
SCV Faulty								•	•				
PTO Valve Faulty										•	•	•	
Draft Feedback Linkage Improperly Adjusted (See "DRAFT FEEDBACK LINKAGE ADJUSTMENT (DRAFT SENSING OPTION)" on pag e31.)						•	•						
Rockshaft Position Feedback Linkage Improperly Adjusted (See "ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT" on page 30.)					•								•
Screen Clogged at Rockshaft Inlet	•												

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THEORY OF OPERATION

HYDRAULICS (GENERAL)

Function:

The hydraulic system provides the following:

- · A means of raising and lowering equipment attached to the three point hitch.
- · A means of operating equipment attached to the work ports of the selective control valve (SCV) (if equipped).
- Charge pressure to operate the PTO clutch.
- · Charge pressure to operate the forward and reverse clutches (PowrReverser™ transmission model).
- Hydrostatic transmission charge pressure (hydrostatic model).
- Pressure to operate power steering system.

HYDRAULICS (SCV) (OPTION)

Function:

The selective control valve (SCV) provides a means of operating equipment attached to the work ports of the valve through the quick-disconnect fittings attached to the mounting plate on the tractor frame.

Theory:

The SCV system consists of a gear pump, and a 1 spool or 3 spool cartridge type valve.

Operation:

A 16.8 cm³ per revolution dual gear pump (rear pump) is mounted on the left side of the engine and is gear driven off the engine cam shaft.

Oil is drawn from the transaxle sump through a 150 mesh screen by the gear pump. Oil is pumped, under pressure to the PTO valve inlet port, it travels through the PTO valve, into the SCV.

The SCV consists of a 1 spool or 3 spool directional control valve operated by a control lever mounted to the right side of the operator's seat. An optional auxiliary control lever for operating the third spool of the 3 spool SCV may also be located on the right hand fender. When the SCV control lever is moved, mechanical linkage moves the valve spool, opening the valve and allowing oil to flow to one of the work ports. Tubes attached to the work ports route oil pressure to quickdisconnect fittings to which the attachment is connected. Oil flows through these fittings into the connecting hoses of the attachment, operating the attachment. A mechanical locking device is attached to the valve control lever to prevent lever movement when the attachment is not in use.

HYDRAULICS (ROCKSHAFT)

Function:

The rockshaft provides a means of raising and lowering equipment attached to the three point hitch.

It also provides a means of setting specific operating depths for tillage equipment.

Theory:

The rockshaft hydraulic system consists of the rear gear pump, a system pressure relief valve located inside the SCV, or the manifold block (if equipped), a directional control valve, (inside rockshaft housing) and a lift cylinder connected to the two lift arms through the rockshaft.

Operation:

A 16.8 cm³ per revolution dual gear pump (rear pump) is mounted on the left side of the engine and is gear driven off the engine cam shaft.

Oil is drawn from the transaxle sump through a 150 mesh screen by the gear pump. Oil is pumped, under pressure to the PTO valve inlet port, it travels through the PTO valve, into the SCV (if equipped) or manifold block and into the inlet port of the rockshaft. System pressure is controlled by an adjustable system pressure relief valve mounted in the SCV or manifold block. The system pressure relief valve vents back to the transmission sump through the rockshaft housing. Oil then passes through the rockshaft housing to the rockshaft control valve.

The rockshaft control valve is located inside the rockshaft housing. The control valve has a plate and linkage that senses the position of both the rockshaft control lever position and the position of the rockshaft lift arms. When the rockshaft is not in the same position as the control lever, the linkage either opens or closes the valve. The rockshaft raises or lowers to the correct position and the valve goes into the neutral position where oil is directed to the sump. The rockshaft housing also contains an operator adjustable rate of drop control, lift cylinder, high pressure relief valve, depth control spool valve, and a safety pressure relief valve.

Rockshaft functions; up, down, depth, and, if equipped, draft sensing, are controlled by the operator using the rockshaft control lever(s) (Lift Arm Control and Draft Control), mounted to the right of the operator seat. Moving the lift control lever to the full back position will operate the spool in the draft valve allowing oil to flow into the cylinder. This in turn rotates the rockshaft and raises the lift arms to their full up position. Moving the

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lift control lever to the full forward position will operate the spool in the draft valve allowing oil to flow out of the cylinder. This in turn rotates the rockshaft and lowers the lift arms to their full down position.

A movable mechanical stop is provided on the lift control lever mechanism to allow the operator to limit the movement of the lift control lever.

This allows the operator to repeatedly set the range of movement of the lift arms thus controlling the height at which any attachments operate.

DRAFT SENSING (OPTION):

Function:

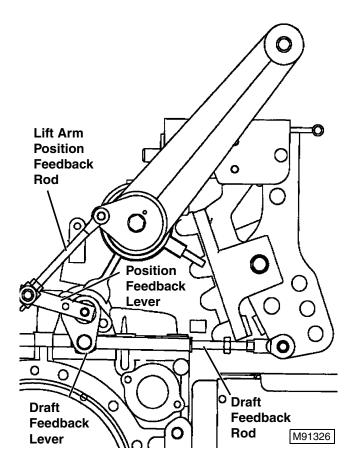
The draft sensing option provides a means of automatically raising a rear mounted implement when heavy draft loads are encountered, reducing traction loss, engine loading, and excessive center link load. It also functions as an automatic depth control which raises rear mounted implements and prevents them from digging too deeply into the soil.

Theory:

The draft sensing system consists of a spring operated center link bracket mounted to the rockshaft case, and a draft feedback rod which is attached to the center link bracket and the draft feedback lever. The draft feedback lever engages the plunger assembly, which operates the rockshaft control valve located inside the rockshaft housing.

When in use, the draft sensing system automatically raises the implement mounted to the three point hitch when a heavy draft load is encountered, reducing implement depth, and center link load. For example, when going up a hill, the front of the tractor raises up, and the rear mounted implement goes down, causing the implement to dig deeper into the soil. The increase in draft load causes an increase in pressure on the center link.





The center link bracket pivots against spring pressure, pushing the draft feedback rod, and turning the draft feedback lever. The draft feedback lever rotates the draft feedback shaft, which engages the plunger assembly (internal), and the rockshaft control valve. This causes the rockshaft control valve to open, allowing oil to flow into the rockshaft cylinder, This moves the piston, which turns the rockshaft and raises the lift arms.

When the draft load is reduced, the spring on the center link mounting bracket returns the center link pivot to its original position, allowing the plunger assembly to return to the position set by the operator. The spring on the rockshaft control valve forces the main spool back, dumping cylinder oil to sump, lowering the 3-point hitch back to the depth determined by the operator. When the rockshaft reaches this point, the feedback mechanism on the rockshaft applies pressure to the plunger assembly and opens the rockshaft control valve slightly, maintaining rockshaft position.

A mechanical interlock prevents the draft sensing system from allowing the implement to lower when draft sensing is engaged, and the lift control lever is moved to the full "up" position.

The result is a reduced load on the center link because the implement is not operating as deep.

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ROCKSHAFT DIAGNOSIS

Test Conditions:

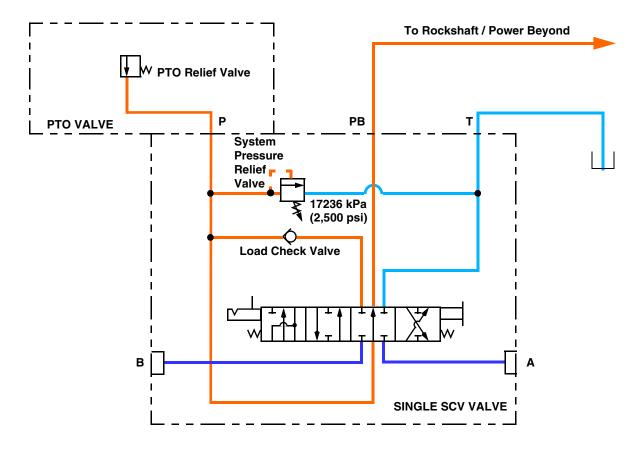
- Tractor sitting on level ground outdoors in an area clear of obstructions.
- Hydraulic oil in reservoir at proper level.
- Speed range selector in NEUTRAL.

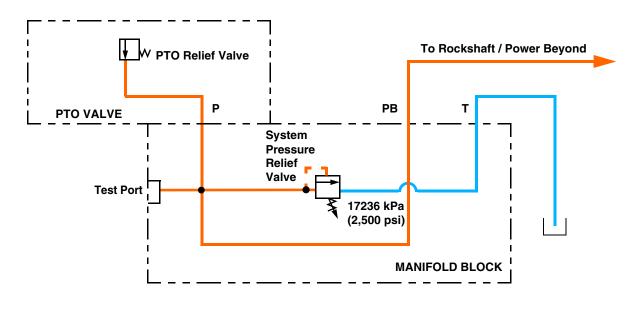
- Park brake engaged.
- Engine running at high idle.
- Sufficient weight on lift arms to allow self-lowering.
- Rockshaft rate of drop/stop valve fully open.

Test/Check Point	Normal	If Not Normal
Move rockshaft lift control to full raise (rearward) position.	Lift arms raise to full lift height.	Perform Rockshaft Position Feedback Adjustment. See "ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT" on page 30.
Move rockshaft lift control to full lower (forward) position.	Lift arms lower to full down position.	Open rockshaft rate of drop/stop valve fully. Make sure draft sensing control lever (if equipped) is in the full forward position. Perform Rockshaft Position Feedback Adjustment. See "ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT" on page 30.
Raise and lower lift arms using rockshaft lift control and draft sensing control lever (if equipped).	Lift arms raise at same speed when using either control lever.	Perform Draft Control Response Adjustment. See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page 33.
Move draft sensing control lever (if equipped) to full rearward position.	Lift arms raise to approximately three-fourths of lift height and stop.	Perform Draft Control Feedback Adjustment. See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page 33.



1 SPOOL SCV AND MANIFOLD BLOCK HYDRAULIC SCHEMATIC





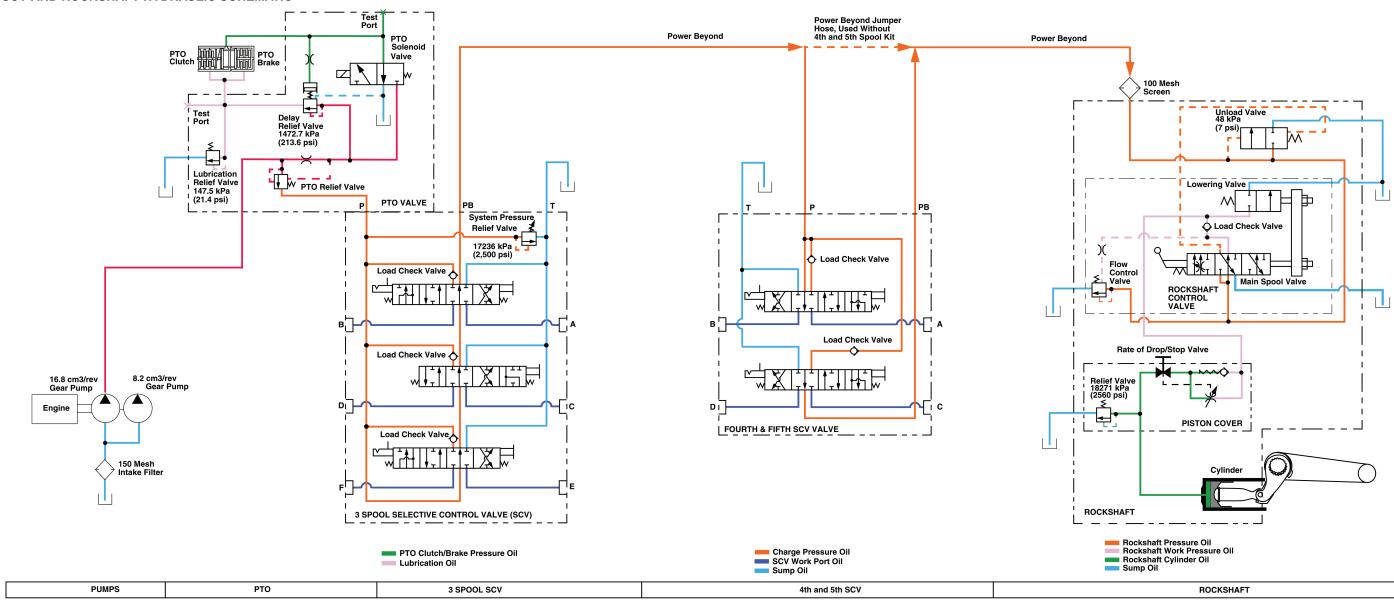


Sump Oil

SCV Work Port Oil
Rockshaft Pressure Oil

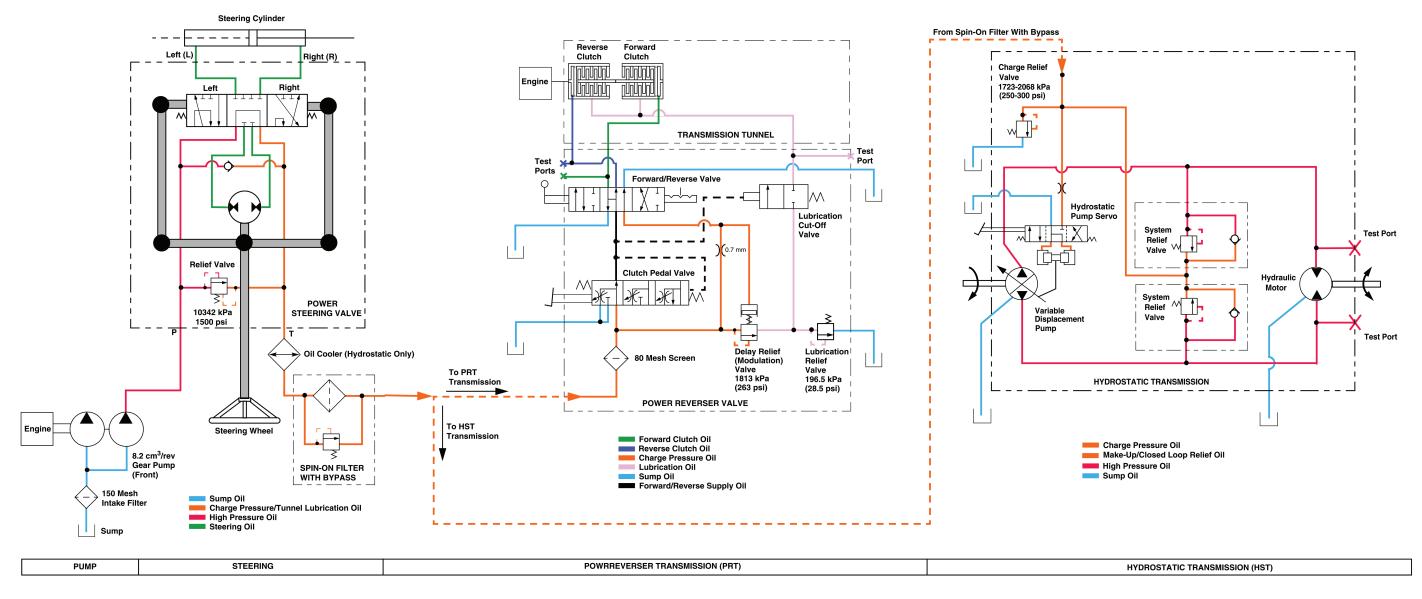
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SCV AND ROCKSHAFT HYDRAULIC SCHEMATIC



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TRANSMISSIONS HYDRAULIC SCHEMATIC



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TESTS AND ADJUSTMENTS

HYDRAULIC SYSTEM BLEED PROCEDURE

Reason:

To remove air trapped in the hydraulic system which will prevent proper operation.

Special or Essential Tools:

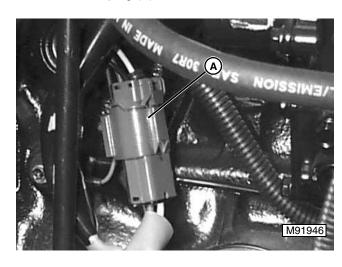
• BW13586 Ballast Box

Procedure:

IMPORTANT: If contamination is found in hydraulic system filter or inside reservoir, flush entire hydraulic system.

NOTE: Fill the new hydraulic oil filter with new oil before installing.

- 1. Install a new hydraulic oil filter.
- Fill the transaxle with specified JDM J20D (preferred) or J20C oil to the proper level on dipstick.
- 3. Disconnect plug (A) to fuel shutoff solenoid.



- Turn the key to START and hold for 10 seconds. Turn the key to OFF.
- 5. Reconnect wires to fuel shutoff solenoid.
- Raise tractor front end and support on suitable stands.
- 7. Start the engine and run at low idle.

- IMPORTANT: If steering fails to respond, or pump pressure is not being delivered to steering control unit (SCU), shut engine off and check to see that steering hoses are connected to the correct SCU ports.
 - 8. Slowly turn the steering wheel left and right until wheels turn smoothly indicating that any trapped air has been bled back to the reservoir.

IMPORTANT: If rockshaft fails to react to lift control lever movement, shut engine off and check hose clamps on suction tube elbow and manifold to ensure that they are properly tightened.

- Operate rockshaft several times until it operates smoothly.
- 10. Stop the engine and check the hydraulic reservoir oil level. Fill as needed. Check all line connections for leaks; tighten if necessary.
- 11. Lower the tractor to the ground.
- 12. (Hydrostatic Model) Drive tractor in forward and reverse several times until transmission operates smoothly.

RATE OF DROP/STOP VALVE ADJUSTMENT

Reason:

To ensure that lift arms lower rear attachment completely and lower it at a safe rate of speed.

Equipment:

• BW13586 Ballast Box

Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to "neutral".
- 3. Install BW13586 ballast box, or approximately 227 kg (500 lb), on the three point hitch.
- 4. Start engine and run at fast idle.
- 5. Put lift control lever in full UP position.
- 6. Raise weight as high as it will go.
- 7. Close rate of drop/stop valve.
- 8. Put lift control lever in full DOWN position.
- 9. Open rate of drop stop valve 1-1/2 to 2 turns.
- 10. Time duration of drop cycle from full up to full down.

Specifications:

Rockshaft Drop Cycle Time. 2-1/2 to 3 seconds



Results:

If the weight lowers slower than specified time, open rockshaft rate of drop/stop valve until specification is met. If weight drop time will not meet specification, the rate of drop/stop valve may be clogged or faulty. (See "ROCKSHAFT PISTON" on page 48.) Or the rockshaft control valve may be faulty. (See "ROCKSHAFT CONTROL VALVE" on page47.)

HYDRAULIC PUMP FLOW TEST

IMPORTANT: When performing system pressure test, DO NOT disconnect hydraulic oil flow to PTO valve. PTO clutches will lose lubricating oil and be damaged.

Reason:

To ensure that hydraulic pump pressure and flow are maintained at sufficient levels for steering, rockshaft, and SCV attachment operation, and to determine if hydraulic pump is worn.

Equipment:

- JT05689 Adapter Fitting (1-1/16-12 M 37° X 1-14 F ORFS) (2 Required)
- JT03012 Adapter Fitting (3/4 F NPT X 1-1/16-12 F 37° Sw) (2 Required)
- JT05469 In-Line Flow Meter Kit
- JT03377 Hose (3/4 M NPT X 3/4 M NPT X 10') (2 Required)

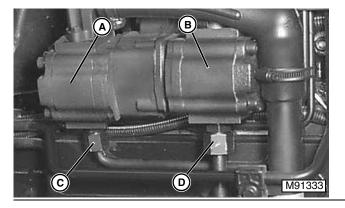
Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.

IMPORTANT: Make sure to relieve system pressure before loosening any system lines or hoses.



3. Cycle all controls to relieve any pressure that may be in the hydraulic system.



To Test Steering pump (A);

- 4. Disconnect line (C) from bottom of pump and connect hose to pump and inlet side of flow meter.
- 5. Place hose from other end of flow meter into transmission oil fill port.

To Test Rockshaft/Hydraulic Pump (B) on tractors without SCVs;

- 1. Disconnect line (D) from pump and PTO valve.
- 2. Connect test equipment between rear pump and PTO valve. Open valve on flow meter fully.
- 3. Start engine and run at high idle.



Do not close valve on flow meter fully. Pump pressure may exceed working pressure of hoses or test equipment.

 Slowly close valve on flow meter until 1342 kPa (1500 psi) pressure is reached. Record flow reading on gauge.

IMPORTANT: Do not close the valve beyond 10342 kPa (1500 psi).

17236 kPa (2500 psi) is system relief and if turned down that far most of the flow would be going over relief and a low flow reading would be obtained. In addition, the flowmeter is rated for about 2000 psi so the risk of damage and injury can occur. 10342 kPa (1500 psi) is enough to determine that there is a good flow out of the pump under load.

Specifications (Minimum):

System Pressure	10342 kPa (1500 psi)
Front Pump (4500)	16.3 L/min (4.8 gpm)
Front Pump (46-4700)	17 L/min (5 gpm)
Rear Pump (4500)	33.6 L/min (8.9 gpm)
Rear Pump (46-4700)	34.8 L/min (9.2 gpm)

Results:

- Pressure too Low: If system pressure reading cannot be reached, mesh filter may be restricted. Suction line may be restricted or leaking air. Pump may be worn. (See "Disassembly and Inspection:" on page34.)
- Flow too low: Mesh filter may be restricted. Suction line may be restricted or leaking air. Pump may be worn. (See "Disassembly and Inspection:" on page34.)

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TRACTORS WITH SCVS

- 1. Install flow meter to SCV ports.
- 2. Start tractor, run at fast idle.
- Operate SCV control lever to direct oil flow to flow meter.
- 4. Slowly close valve on flow meter until 1342 kPa (1500 psi) pressure is reached. Record flow reading on gauge.
- If reading on gauge is close to specification, but will not meet specification, retest using procedure for tractors without SCVs on previous page. This will eliminate any restrictions that may be in the SCV plumbing.

SYSTEM RELIEF PRESSURE TEST

NOTE: On tractors equipped with a manifold block in place of an SCV, system pressure is set at the factory, and should not require adjustment.

IMPORTANT: When performing system pressure adjustment, DO NOT disconnect hydraulic oil flow to PTO valve. PTO clutches will lose lubricating oil and be damaged.

Reason:

To adjust hydraulic pressure so that system pressure is maintained at correct levels to perform work without causing damage to the hydraulic system.

Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.

IMPORTANT: Make sure to relieve system pressure before loosening any system lines or hoses.

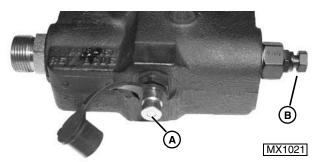
- 3. Cycle all controls to relieve any pressure that may be in the hydraulic system.
- 4. Fully close rockshaft rate of drop valve.

TRACTORS WITHOUT SCV:

Equipment (for tractors without SCV):

- JT03264 Female Quick Coupler
- JT03240 Fitting
- JT03345 0-20684 kPa (0-3000 psi) Pressure Gauge
- JT03017 Hose w/Quick Disconnect Fitting

- 1. Connect pressure gauge to pressure port (A).
- 2. Place rockshaft position lever in "lower" position.



Pressure Manifold Block (without SCV)

- 3. Turn rate of stop/drop valve to fully closed position.
- 4. Start engine and run at high idle.
- Observe gauge and move rockshaft position lever to "raise" position. Record gauge reading when system relieves.
- 6. If system relieves above or below specification adjust relief valve (B) until specification is met.

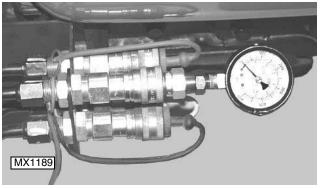
Specification:

System Pressure 17237 kPa (2500 psi)

TRACTORS WITH SCV:

Equipment (for tractors with SCV):

 JTO3345 Pressure Gauge 0-20684 kPa (0-3000 psi) adapted to male SCV quick connector.





 Connect pressure gauge to tractor SCV quick disconnect port.

2. Start engine and run at high idle.



CAUTION

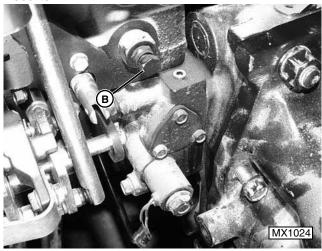
Do not maintain pressure longer than necessary. Pump pressure may exceed working pressure of flow meter. Relieve all pressure before disconnecting test equipment

- 3. Momentarily move SCV control lever to open SCV valve to port with gauge.
- 4. Check pressure reading on gauge.

Specification:

System Pressure 17237 kPa (2500 psi)

Results:



3 Spool SCV

 Pressure too low: Turn system pressure relief valve (B) clockwise until pressure reading is within specification.

NOTE: If system pressure will not meet specification, pump may be worn. Perform system pressure/flow test (See "HYDRAULIC PUMP FLOW TEST" on page26.)

 Pressure too high: Turn system pressure relief valve counter-clockwise until pressure reading is within specification.

PTO VALVE PRESSURE TESTS

Reason:

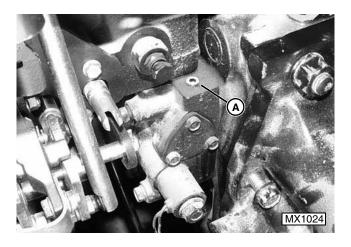
To verify hydraulic pressure in the PTO valve is maintained at correct levels to perform work without causing damage to the PTO clutch, and to verify that lubrication oil is being provided to the PTO clutch.

Equipment:

- JTO5487 1/8 NPT X 7/16-20 M 37° Adapter
- JT03017 Hose With Coupler
- JTO3363 0-207 kPa (0-30 psi) Pressure Gauge
- JT03344 0-2068 kPa (0-300 psi) Pressure Gauge

Procedure:

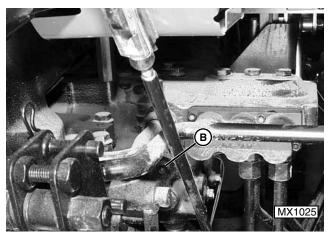
- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL. Stop engine.
- 3. Cycle all controls to relieve any pressure that may be in the hydraulic system.



- 4. Install adapter, hose, and pressure gauge in test port (A).
- 5. Start engine and run at fast idle.
- 6. Engage PTO.
- 7. Verify that pressure is to specification.
- 8. Disengage PTO and stop engine.



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- Remove the pressure gauge from test port (A) and install plug.
- 10. Locate test port (B) on the back of the PTO valve and install adapter, hose, and gauge.
- 11. Start engine and verify that pressure is to specification.

Hydraulic Oil Pressure Specification ±10%

PTO Clutch (Port "A") 1490 kPa (216 psi) PTO Lubrication (Port "B") 39 kPa (5.7 psi)

STEERING PRESSURE CHECK

Reason:

To ensure that steering pump pressure is maintained at correct level for steering without causing damage to the system, and to determine if hydraulic pump is worn.

Equipment:

- JT03375 Adapter Fitting (7/16-20 M 37° X 9/16-18 M ORFS)
- JT03117 0-14000 kPa (0-2000 psi) Pressure Gauge
- JTO3364 Hose with Quick Disconnect Coupler

Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.

IMPORTANT: Make sure to relieve system pressure before loosening any system lines or hoses.

- 3. Cycle all controls to relieve any pressure that may be in the hydraulic system.
- 4. Remove hydraulic hose on left side of steering cylinder.

5. Attach gauge to left steering hose.

NOTE: Turning steering wheel to the right will cause hydraulic oil to leak out of disconnected cylinder port. Turn wheel only to left when performing test.

- 6. Start engine and run at high idle.
- 7. Turn steering wheel to the left. While turning wheel, check pressure reading on gauge.

Specifications:

Pressure 10342 kPa ± 10% (1500 psi ± 10%)

Results:

- Pressure too low: Relief valve in SCU may be stuck open or defective; perform steering system test, (See "STEERING SYSTEM TEST" on page 9 in Steering section), or gear pump may be worn; (See "HYDRAULIC PUMP FLOW TEST" on page 11-26. If pump will not meet specification, disassemble and inspect pump. (See "Disassembly and Inspection:" on page34).
- Pressure too high: Relief valve in SCU may be clogged or defective.

ROCKSHAFT LIFT CYCLE TEST

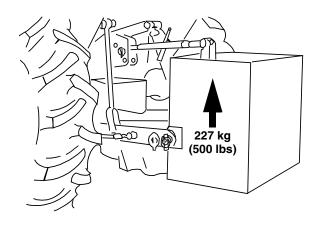
Reason:

To ensure that hydraulic system is functioning correctly and capable of lifting rated load.

Equipment:

BW13586 Ballast Box

Procedure:





- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.
- 3. Install BW13586 ballast box, or approximately 227 kg (500 lb), on the three point hitch.
- 4. Open rate of drop/stop valve completely.
- 5. Start engine and run at high idle.
- 6. Move lift control lever to full UP position.
- 7. Time duration of lift cycle from full down to full up.

Specifications

Results:

If the weight raises slower than specified there may be internal leakage in the lift cylinder or rockshaft control valve.

ROCKSHAFT LEAKAGE TEST

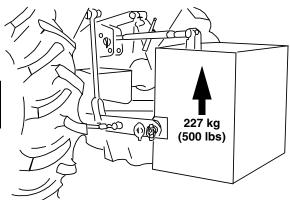
Reason:

To ensure that hydraulic system is functioning correctly and capable of lifting rated load.

Equipment:

• BW13586 Ballast Box

Procedure:



- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL.
- 3. Install BW13586 ballast box, or approximately 227 kg (500 lb), on the three point hitch.
- 4. Start engine and run at high idle.
- 5. Put lift control lever in full UP position.

- 6. Raise weight as high as it will go.
- 7. Close rate of drop/stop valve.
- 8. Shut off engine.
- 9. Measure distance weight drops in 5 minutes.
- 10. Restart engine, **open** rate of drop/stop valve fully and raise weight to full UP position.
- 11. Shut off engine.
- 12. Measure distance weight drops in 5 minutes.

Specifications

Maximum Drop in 5 Minutes 51 mm (2 in.)

Results:

- If the weight drops farther than specified distance with the stop/drop valve closed (first test) there may be leakage in the cylinder, relief valve or drop/stop valve.
- If the weight drops farther with the drop/stop valve open (second test) than it did in the first test, there may be leakage in the rockshaft control valve.

ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT

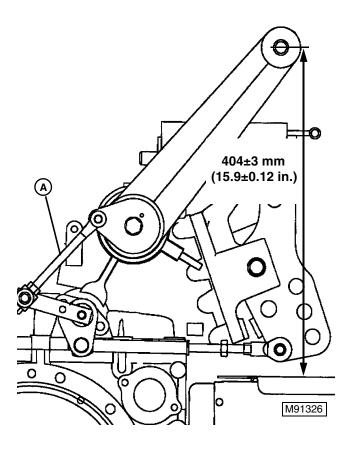
Reason:

To ensure that draft arms raise to maximum lift height without engaging relief valve.

Procedure:

- Position tractor on a level surface and set park brake.
- 2. Shift transmission to NEUTRAL position.
- Position both lift control lever and draft sensing control lever at full forward (down) position and provide enough weight on lift arms to allow self lowering.
- 4. Start engine.
- 5. Move lift control lever (outer) to full raise position (back).





- Measure from the top of the PTO shield to center of pin in end of lift arm. Lift arm should raise to 404±3 mm (15.9±0.12 in.) as shown at right, without engaging the relief valve.
- 7. If specification is not met, shorten the lift arm position feedback rod (A) to increase, or lengthen to reduce the maximum height until within specification. The relief valve should not engage.

DRAFT FEEDBACK LINKAGE ADJUSTMENT (DRAFT SENSING OPTION)

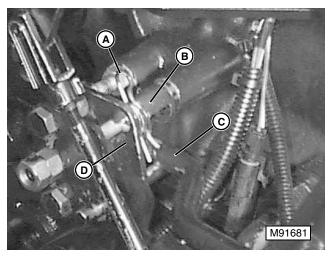
Reason:

To ensure that draft feedback causes lift arms to raise before draft load becomes sufficient to cause traction loss.

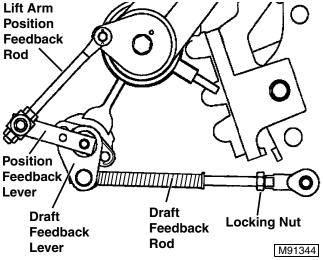
Procedure:

- 1. Adjust rockshaft position feedback linkage. (See "ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT" on page 30.)
- Position tractor on a level surface and set park brake.
- 3. Shift transmission to "neutral".
- 4. Start engine.

5. Very slowly move the draft sensing control lever (inner) rearward. Stop moving the lever immediately when the lift arms start to raise. The lift arms will continue to rise, and then stop.



6. At the base of the draft sensing control lever, remove the retaining pin (A) to release the ring gauge (B). Turn the ring gauge 180°. The ring gauge should *just* pass between the draft sensing control lever (C) and the lever stop pin on the pin plate (D).



- 7. If the clearance is excessive, shorten the draft feedback rod. If the clearance is insufficient, lengthen the rod.
- 8. Repeat previous step until the ring gauge rotates on pin, barely touching the control lever.
- 9. Tighten locking nut on draft feedback rod.
- 10. Reposition the ring gauge to its storage position, and replace retaining pin.
- 11. Move the draft sensing control lever from the adjusted point to full rearward position. The lift



arms should raise to maximum without engaging the relief valve.

NOTE: If draft signals fail to raise draft arms at desired performance, it may be necessary to adjust the draft control response. (See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page 33.).

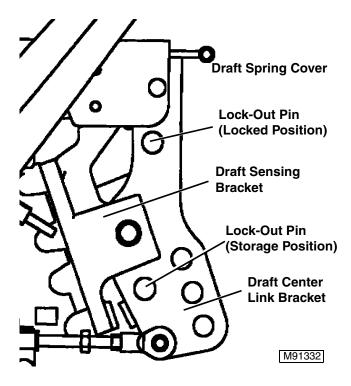
DRAFT CONTROL RESPONSE TEST (DRAFT SENSING OPTION)

Reason:

To ensure that draft sensing mechanism is operating at highest possible efficiency when the draft sensing is engaged.

Procedure:

- If not already done, adjust rockshaft position feedback. (See "ROCKSHAFT POSITION FEEDBACK LINKAGE ADJUSTMENT" on page 30.)
- 2. If not already done, adjust draft feedback. (See "DRAFT FEEDBACK LINKAGE ADJUSTMENT (DRAFT SENSING OPTION)" on page31.
- 3. Park tractor on a level surface and set park brake.
- 4. Shift transmission to "neutral".
- 5. Open drop/stop valve completely.
- 6. Move lift control and draft sensing control levers to full forward (down) position.
- 7. Provide enough weight on lift arms to allow self lowering.
- 8. Remove center link from center link bracket.



- 9. If not already done, move center link lock-out pin from locked position to storage position.
- 10. Install two draft pins in adjacent lower holes in center link bracket. Retain with quick-lock pins.
- 11. Start engine and run at high idle.
- 12. Very slowly move the draft sensing control lever rearward. Stop moving the lever immediately when the lift arms start to raise. The lift arms will continue to rise, and then stop.



CAUTION

The draft sensing spring requires approximately 72 kg (160 lb) of force to compress. If necessary, obtain assistance.

- 13. Place a large pry bar between two draft pins installed in step 10 and pry UP against spring pressure until draft bracket pivots. Draft sensing should cause the draft arms to lower.
- 14. Release pressure exerted on center link with pry
- Pry DOWN against spring pressure until the draft bracket pivots. Draft sensing should cause the draft arms to raise.

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Results:

If the lift arms do not raise or lower, check draft feedback linkage for proper adjustment, excessive wear or damage. Perform adjustment procedures or replace components as necessary.

If the lift arms react too slowly when moving draft bracket, draft control response may need to be increased. (See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page33.)

DRAFT CONTROL RESPONSE ADJUSTMENT

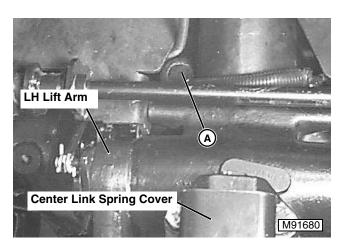
(DRAFT SENSING OPTION)

Reason:

To adjust raise rate generated by draft signals.

Procedure:

- 1. Park tractor on a level surface and set park brake.
- 2. Shift transmission to "neutral".
- 3. Position lift control and draft sensing control levers at full forward position.



- On the left side of the rockshaft, below the seat, remove the adjustment access plug (A) and copper washer.
- 5. Start the tractor.
- 6. Move lift control lever quickly to full raise (rearward) position and observe rate of raise. Return lever to full lower position.
- 7. Move draft sensing control lever quickly to full rearward position, and observe the rate of raise. The factory adjustment should result in equally fast raise rates from the draft sensing control lever and the lift control lever, and equally gradual slowing before stopping (deceleration).

NOTE: The factory adjustment screw setting is at full clockwise, or maximum raise rate. The adjustment screw has a maximum rotational range of 180°.

At maximum counterclockwise rotation the draft sensing control lever may be totally inactive in producing lift arm movement.

- 8. Using a 5mm external hex wrench, turn the adjustment screw counterclockwise and repeat the draft sensing control lever step above to reduce the draft control rate of raise and provide smoother draft response.
- 9. Replace the access plug and copper washer when proper adjustment is obtained.



REPAIR HYDRAULICS

REPAIR

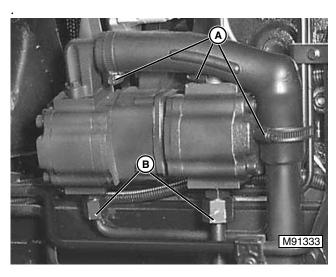
HYDRAULIC GEAR PUMP

The hydraulic pumps are the same on both hydrostatic and gear drive tractors. The only difference in the removal and installation of the two is in the specific routing of the individual pressure hoses/tubes.

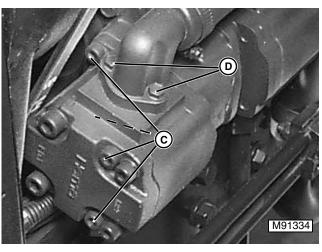
The two gear pumps are identical in design, but each uses different suction tube attaching methods, and they are different displacements.

Removal:

- 1. Remove engine side panels.
- 2. Remove exhaust pipe from muffler



- 3. Loosen hose clamps (A) on suction tube manifold.
- 4. Disconnect suction tube manifold from pump.
- 5. Disconnect pressure tubes (B) from fitting on bottom of pump.



- 6. Remove two long and two short socket head cap screws (C) securing pump to engine drive housing.
- 7. Remove pump.
- 8. Remove fitting from pressure side of pump body.
- 9. (Front Pump Only) Remove two cap screws (D) and suction tube elbow.

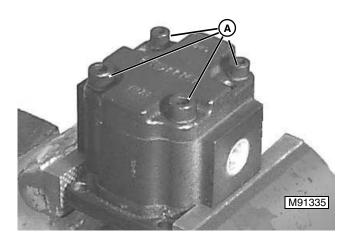
Installation:

IMPORTANT: Replace all O-rings, gaskets, and seals. Used or damaged O-rings, gaskets and seals will leak.

- Install new O-rings on both ends of adapter fitting and secure to pumpbody. Tighten front pump adapter fitting to 21 N•m (15 lb-ft). Tighten rear pump adapter fitting to 28 N•m (21 lb-ft)
- 2. (Front Pump Only) Install new O-ring on suction tube elbow, and secure to pump with two cap screws. Tighten to **9 N•m (84 lb-in.)**.
- 3. Install new gasket on front cover where pump attaches to engine drive housing.
- 4. Align splines on pump input shaft with splines on engine drive. Insert pump into engine housing.
- 5. Secure pump with four socket head cap screws. Tighten to 22 N•m (16 lb-ft).
- Attach pressure tube to adapter fitting. Tighten tube nut on front pump to 50 N•m (37 lb-ft). Tighten tube nut on rear pump to 69 N•m (51 lb-ft).
- 7. Inspect suction tube manifold for damage or cracking. Replace if necessary.
- 8. Attach suction tube manifold to pump. Secure with hose clamp.

Disassembly and Inspection:

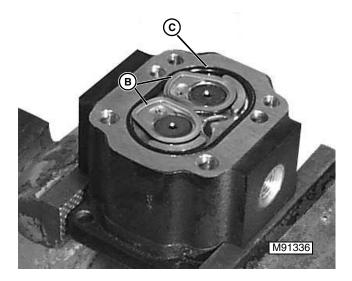
 Remove pump from engine. (See "HYDRAULIC GEAR PUMP" on page34.)



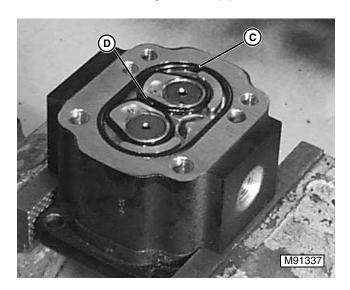
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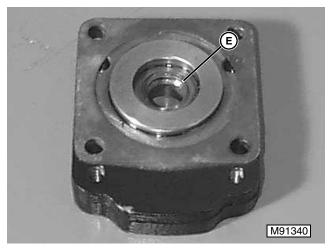
- 2. Remove two large and two small socket head cap screws (A) and lock washers securing pump cover to pumpbody.
- 3. Remove pump cover.
- 4. Inspect pump cover for wear or damage. If necessary, replace pump.



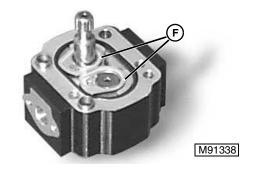
5. Remove two backing washers (B).



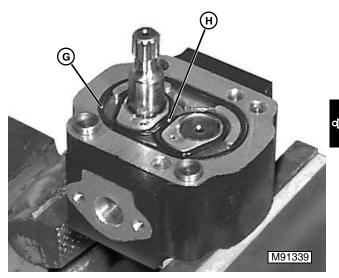
- 6. Remove O-ring (C) and formed O-ring gaskets (D).
- 7. Remove front cover.
- 8. Inspect front cover for scoring, wear, or damage. If necessary, replace pump.



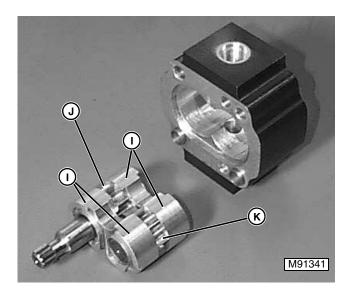
9. Inspect front cover shaft seal for cracks, wear, or damage. If necessary, replace seal (E).



10. Remove two backing washers (F).



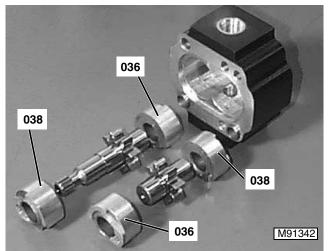
11. Remove O-ring (G) and formed O-ring gaskets (H).

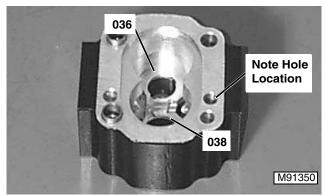


NOTE: Markings on pump bushings varies depending on pump capacity. Markings may vary from what is shown on art.

- 12. Note the location and markings on four bushings (I) to assure correct orientation at assembly.
- 13. Remove four bushings, drive gear (J), and idler gear (K) from pump as an assembly.
- 14. Remove bushings from gears.
- 15. Inspect gears and bushing faces for scoring, excessive scratching, or damage. If necessary, replace pump.
- 16. Inspect input gear shaft splines. If damaged, replace pump.
- 17. Measure gear shaft bearing surfaces. If not within specifications, replace pump.
- 18. Inspect inside of bushings for scoring or excessive scratching. Measure bearing surfaces. Replace bushings if damaged or not within specifications.
- Inspect pump body internal surfaces for scoring or excessive scratching. Replace pump if damaged.

Gear Pump Assembly:





 Lay pump body on a clean, flat surface, and install back bushings into bore as shown. Push bushings to bottom of bore.

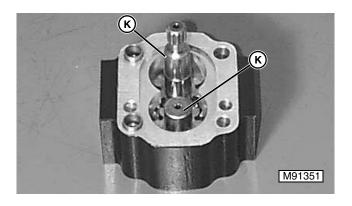
NOTE: Idler gear is symmetrical and can be placed in pump body either end first.



Specifications:

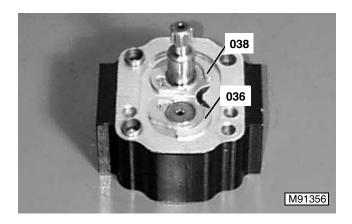
Shaft Bushing Maximum ID . . 19.15 mm (0.754 in.) Shaft Bearing Surface

Front Pump (Steering) 10.37mm (0.408 in.) Rear Pump (Implement).... 21.13 mm (0.832 in.)

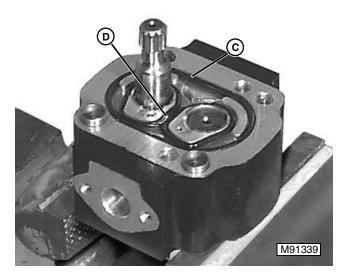


2. Install drive gear and idler gear into pump body and bushings.

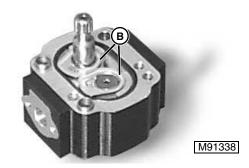
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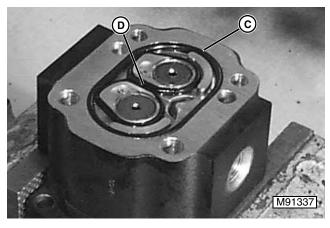
3. Install front bushings into pump body and onto drive gear and idler gear shafts.



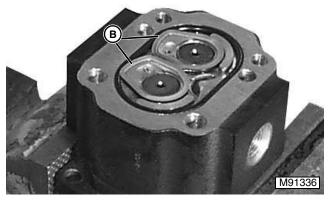
4. Install O-ring (C) and formed O-ring gaskets (D).



- 5. Install two backing washers (B).
- 6. If not already done, install new shaft seal in front cover using a suitable driver.
- 7. Install front cover over drive gear shaft and onto pump body.



8. Turn pump over, and install O-ring and formed O-ring gaskets.



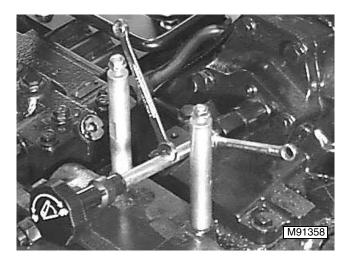
- 9. Install two backing washers.
- Install rear cover and secure with two small (M8), and two large (M10) socket head cap screws.
 Tighten M8 cap screws to 28 N•m (20 lb-ft), and M10 cap screws to 55 N•m (40 lb-ft).
- 11. Install pump. (See "HYDRAULIC GEAR PUMP" on page 34.)



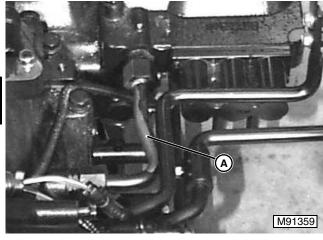
ROCKSHAFT ASSEMBLY

Removal:

- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5 in Miscellaneous Section.)
- 2. Remove kick plate. (See "KICK PLATE REMOVAL AND INSTALLATION" on page8 in Miscellaneous Section.)
- 3. Remove three point hitch. (See "THREE POINT HITCH REMOVAL AND INSTALLATION" on page 4 in Miscellaneous Section.)
- 4. Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page 5 in Miscellaneous Section.)

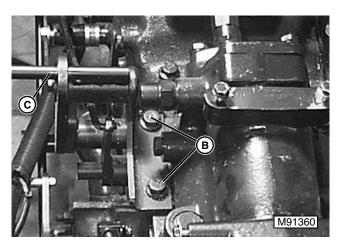


5. Use two 10 mm open end wrenches on the flats on the rate of drop control shafts to separate shaft.

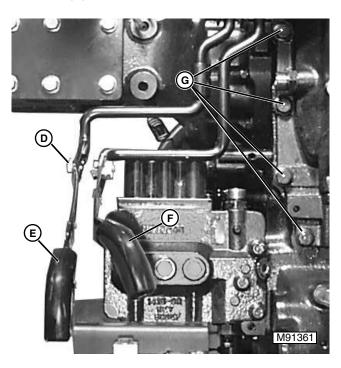


- Remove hydraulic tube (A) from SCV to rockshaft housing.
- 7. Disconnect PTO solenoid connector.

- 8. Disconnect lighting wiring harness on RH side of tractor where wiring harness enters ROPS.
- 9. Move wiring harness clear of rockshaft housing.



10. Remove two cap screws (B). Remove range shift lever (C) and bracket.



- 11. Remove two cap screws (D). Remove lift control lever (E).
- 12. If equipped, remove two cap screws and draft sensing control lever (F).
- 13. Remove ten cap screws (G) securing rockshaft housing to transmission. Gently pry up around edge of rockshaft cover to loosen.



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HYDRAULICS LIFT ARMS



CAUTION

The approximate weight of the rockshaft assembly is 68 kg (150 lb). Do not attempt to remove rockshaft assembly without an assistant or overhead crane.

14. Remove rockshaft housing from transmission.

Installation:

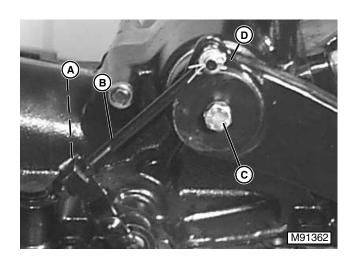
NOTE: Installation is reverse of removal.

- Install a new bead of sealant (TY16021) on transaxle rockshaft mounting surface.
- Tighten ten cap screws to 140 N•m (105 lb-ft).

LIFT ARMS

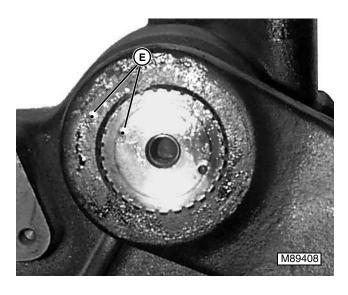
NOTE: Lift arms may be removed with rockshaft assembly installed in tractor. DO NOT remove splined cross shaft unless rockshaft is first removed from tractor. Internal components will fall into transmission if splined cross shaft is removed while rockshaft is attached to transmission.

Removal:

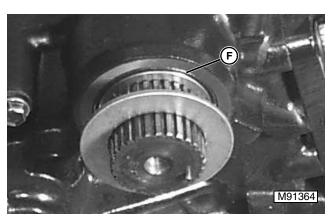


- 1. Remove snap ring (A) and washer from end of adjusting rod (B).
- 2. Remove cap screw (C), lock washer, and large washer from end of rockshaft assembly.

3. Remove cam plate (D), with adjusting rod from end of rockshaft assembly.



- 4. If not already done, use center punch to mark (E) splined cross shaft and lift arm.
- 5. Remove lift arm from splined cross shaft.



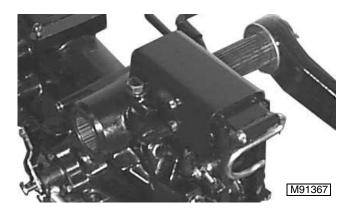
- 6. Remove washer from splined cross shaft.
- 7. Remove outer O-ring (F) from groove in housing.

NOTE: DO NOT remove splined cross shaft unless rockshaft is first removed from vehicle. Internal components will fall into transmission if splined cross shaft is removed while rockshaft is on transmission.

If rockshaft assembly is still installed on transmission, remove right lift arm <u>only</u>.

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LIFT ARMS HYDRAULICS



- 8. Remove right side lift arm and splined cross shaft from housing as a unit.
- 9. Remove rockshaft lever arm, and piston rod from rockshaft housing.

NOTE: If right side lift arm must be removed from splined cross shaft, use center punch to mark shaft and lift arm for alignment.

NOTE: Inner O-ring may come out of bore with splined sleeve when removed.



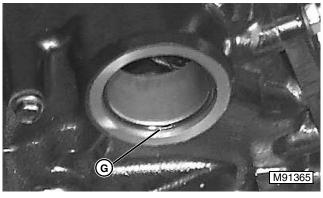


10. Remove two splined sleeves from housing.

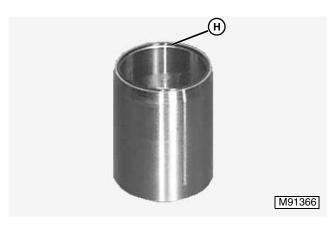
NOTE: Beveled ends of the splined sleeves should face inward.

There is an O-ring in ID of beveled end of

There is an O-ring in ID of beveled end of splined sleeve.



11. Remove inner O-ring (G) from bore of rockshaft housing.



- 12. Remove O-rings (H) from bevelled end of splined sleeves.
- Inspect splines on ID of splined sleeves for damage. Inspect OD for grooves or excessive wear. Replace as required.
- 14. Measure OD of splined sleeves. If not in specification, replace.
- 15. Measure ID of bushing in housing. If not in specification, use bearing puller to remove bushing from housing.

Specifications:

Splined Sleeve Minimum OD. . 59.94 mm (2.360 in.) Bushing Maximum ID. 60.12 mm (2.367 in.)

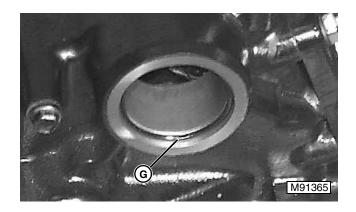
Installation:

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

1. If required, use a piloted bushing driver to install new bushings into rockshaft housing.

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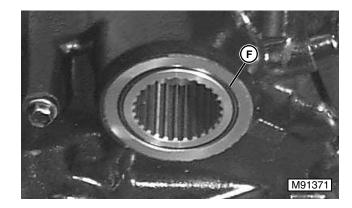
HYDRAULICS LIFT ARMS



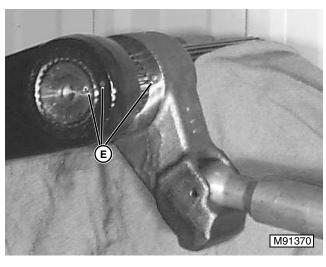
2. Install two new inner O-rings into rockshaft housing against bushings.



- 3. Install new O-rings into bevelled end of two splined sleeves.
- 4. Install right side splined sleeve into rockshaft housing with bevel to the inside.

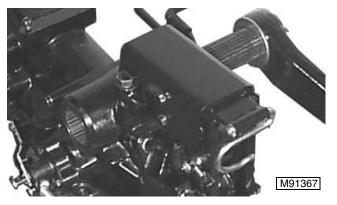


5. Install new outer O-ring (F) into groove between splined sleeve and rockshaft housing.

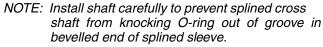


NOTE: Rockshaft lever arm shown for clarity.

 Align punch marks (E) and assemble right side lift arm to splined cross shaft. Secure with large washer, cap screw, and lock washer. Tighten to 68 N•m (50 lb-ft).

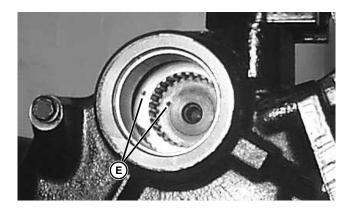


Install washer onto rockshaft against right side lift arm.

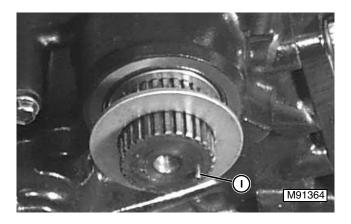


8. Install right side lift arm and rockshaft into right splined sleeve in rockshaft housing.

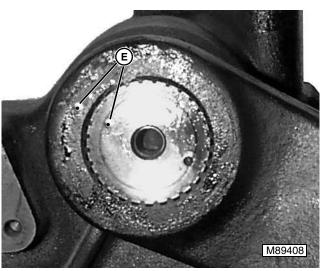
LIFT ARMS HYDRAULICS



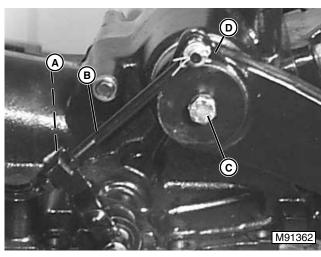
- 9. Align punch marks on splined cross shaft and rockshaft lever arm and install cross shaft through lever arm and into housing.
- 10. Install left side splined bushing into rockshaft housing and onto splined cross shaft.
- 11. Install outer O-ring into groove between splined sleeve and rockshaft housing.



- 12. Install washer onto splined cross shaft.
- 13. Replace pin (I) in splined cross shaft if damaged.



14. Align punch marks on lift arm and splined cross shaft, and install left side lift arm onto shaft.



- 15. Install cam plate (D).
- 16. Install large washer, lock washer, and cap screw (C). Tighten cap screw to **68 N•m (50 lb-ft)**.
- 17. Attach adjusting link (B) and retain with washer and snap ring (A).

NOTE: Whenever the draft mechanism has been disturbed, be sure to perform Rockshaft Position Feedback Adjustment and Draft Feedback Adjustment.

Specifications:

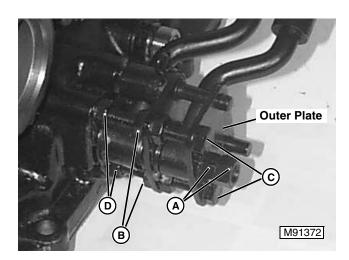
Lift Arm Raise Angle (Above Horizontal) 50)°
Lift Arm Lower Angle (Below Horizontal)20)°
Maximum Variance Between Lift Arms5	;°

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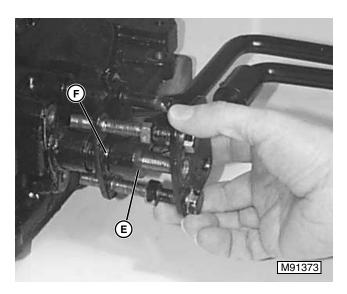
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LIFT CONTROL LEVER

Removal:



- 1. Remove two nuts (A) on control shaft.
- 2. Loosen two outer jam nuts (B).
- 3. Loosen two cap screws (C) until they are free of the housing.
- 4. Remove two inner (D) and two outer (B) jam nuts from cap screws.



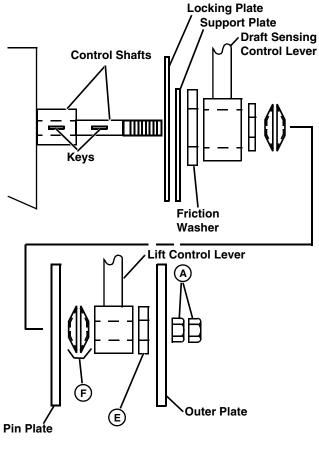
- 5. Remove two remaining jam nuts, two cap screws, and outer plate as an assembly.
- Remove friction washer (E), lift control lever, and two belleville washers (F) and key from control shaft. Inspect friction washer for excessive wear. Replace if necessary.

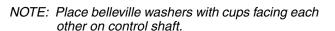
Installation:

Install Control Lever:

NOTE: When assembling, DO NOT lubricate friction washers or control lever friction surfaces.

IMPORTANT: Make sure that Belleville washers are correctly installed with cupped sides of each pair of washers facing each other.



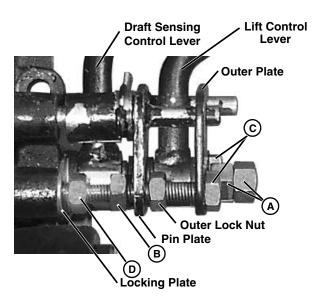


- 1. Install key, two belleville washers, lift control lever, and friction washer onto control shaft.
- Install outer plate, two cap screws and two jam nuts as an assembly.
- 3. Install two inner and two outer jam nuts onto cap screws.
- 4. Install two cap screws into housing. Do not tighten at this time.

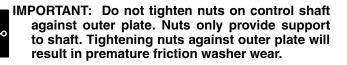
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5. Install two nuts onto control shaft. Do not tighten at this time.

Adjust Control Lever Friction:



- 6. Tighten two cap screws (C) enough that the draft sensing control lever (if equipped) and lift control lever will operate smoothly, but will maintain setting when traveling over rough terrain. The outer plate, and pin plate should be parallel to each other, and 90° to the control shafts.
- 7. Hold each cap screw to prevent it from turning, and tighten two inner lock nuts (D) against the locking plate to lock the cap screws in place.
- 8. Tighten two adjusting nuts (A), and two outer locking nuts (B) against the pin plate. Be sure the pin plate remains parallel to the outer plate, and 90° to the control shafts.
- 9. Check levers for smooth, independent operation and proper feel. Adjust as required.



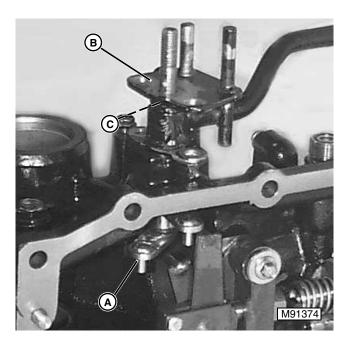
10. Tighten inner nut on control shaft until it contacts outer plate. Loosen inner nut 1/4 turn. Hold inner nut to prevent it from turning, and tighten outer nut against inner nut to lock nuts to shaft.

DRAFT SENSING CONTROL LEVER

Removal:

NOTE: Tractors not equipped with draft sensing option have a locking plate in place of the draft sensing control lever. Removal and installation of this plate is essentially the same.

- 1. Remove lift control lever (See "LIFT CONTROL LEVER" on p a g e43.)
- 2. Remove rockshaft (See "ROCKSHAFT ASSEMBLY" on page38.)

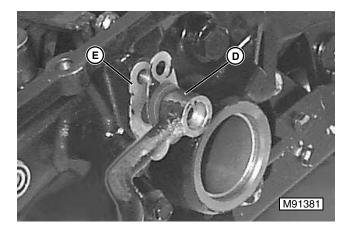


- 3. Slide lift control shaft (A) to inside of rockshaft housing to clear pin plate (B).
- 4. Remove two belleville washers (C) and spacer washer from control shaft.

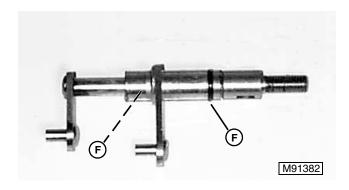
NOTE: Pin plate is pressed into rockshaft housing. Pry outward gently against plate while rotating it back-and-forth to remove.

5. Remove pin plate.

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- 6. Remove draft sensing control lever (D).
- 7. Remove key, friction washer, support plate, and locking plate (E). Inspect friction washer for excess wear. Replace if necessary.
- 8. Slide control shafts to the inside of the rockshaft housing, and remove as an assembly.



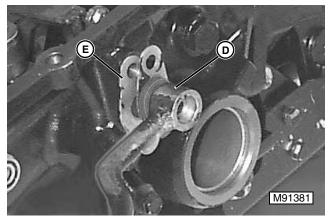
9. Replace O-rings (F) on lift control shaft and draft control shaft.

Installation:

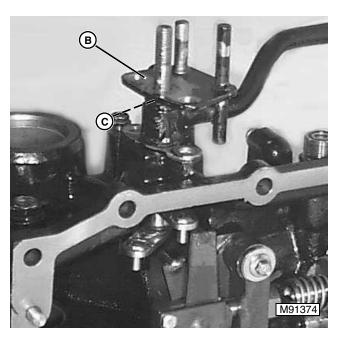
IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

NOTE: Lubricate control shafts with hydraulic oil to ease installation. DO NOT lubricate friction washers or control lever friction surfaces.

 Install lift control shaft and draft sensing control shaft.



- 2. Install locking plate (E), support plate, friction washer, and woodruff key.
- 3. Install draft sensing control lever (D).



NOTE: Place belleville washers with cups facing each other on control shaft.

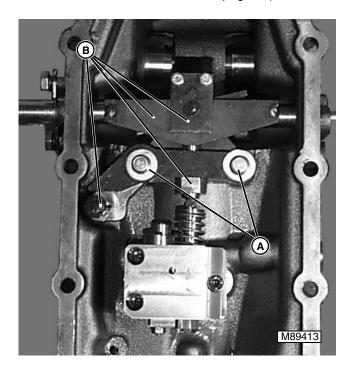


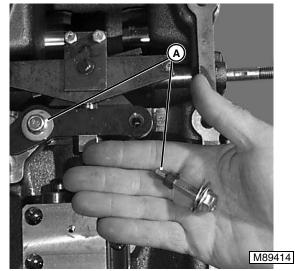
- 4. Install two belleville washers (C) and spacer washer to control shaft.
- 5. Using a plastic mallet, install pin plate (B).
- 6. Install lift control lever (See "LIFT CONTROL LEVER" on page43.)
- Install rockshaft (See "ROCKSHAFT ASSEMBLY" on page 38.)

ROCKSHAFT PLUNGER ASSEMBLY

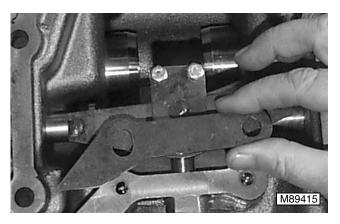
Removal:

 Remove rockshaft from transmission. (See "ROCKSHAFT ASSEMBLY" on page38.)

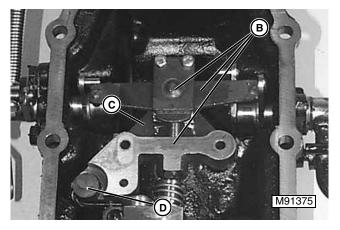




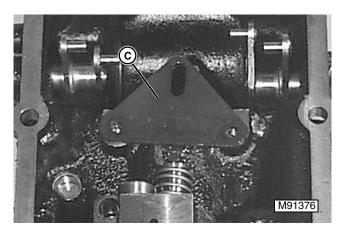
2. Remove the two shoulder bolts (A), washer, wave washer and spacer securing plunger assembly (B) to housing.



3. Remove top plate.



4. Remove plunger assembly (D).



5. Remove triangle plate (C).

NOTE: If sensitivity cam (D) is moved during removal or installation of plunger assembly, perform Draft Control Response Adjustment. (See "DRAFT CONTROL RESPONSE ADJUSTMENT" on page 33.)

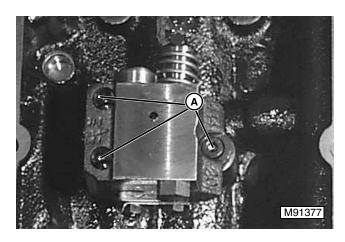
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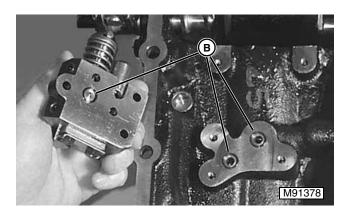
ROCKSHAFT CONTROL VALVE

Removal:

 Remove rockshaft from transmission. (See "ROCKSHAFT ASSEMBLY" on page38.)



- 2. Remove three socket head cap screws (A) securing rockshaft control valve to housing.
- 3. Remove rockshaft control valve.



4. Remove three O-rings (B).

Installation:

 Installation of rockshaft control valve is the reverse of removal.

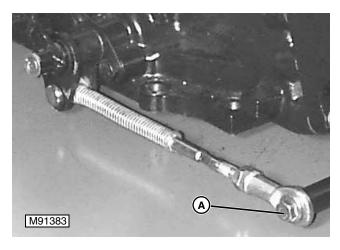
IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

- Make sure that O-rings are installed over correct ports and seated in their respective counter bores.
- Tighten three socket head cap screws to 47 N•m (35 lb-ft).

DRAFT & ROCKSHAFT FEEDBACK SHAFTS

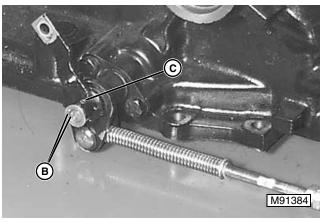
Removal:

 Remove rockshaft plunger assembly, if not already done. (See "ROCKSHAFT PLUNGER ASSEMBLY" on page 46.)



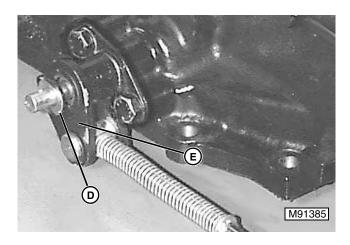
NOTE: Draft sensing version shown.

If equipped, remove cap screw (A) securing draft feedback rod.

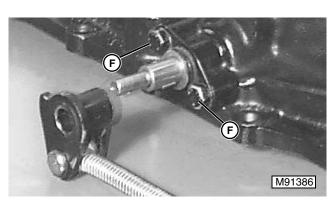




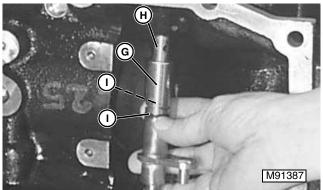
- 3. Use a center punch to mark (B) the location of the position feedback shaft on edge of lever.
- 4. Remove pin (C) securing lever to depth stop shaft. Remove lever.



5. Remove washer (D) and draft feedback lever (E).



- 6. Remove key and washer.
- 7. Remove two cap screws (F), two lock washers, and plate securing draft feedback shaft to housing.



- 8. Remove draft feedback shaft (G) and position feedback shaft (H) from the inside of the housing as an assembly.
- Replace O-rings (I) on draft feedback and position feedback shafts.

Installation:

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

Installation:

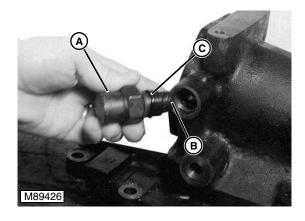
Installation is the reverse of removal.

ROCKSHAFT PISTON

NOTE: Pressure relief valve is factory set and sealed.

DO NOT attempt to disassemble valve, there are no serviceable components in valve. If pressure relief valve does not function correctly replace entire valve.

Removal:



- 1. Remove pressure relief valve (A) from side of housing.
- 2. Inspect valve for damage. Replace as required.
- 3. Replace O-ring (B) and seal washer (C).

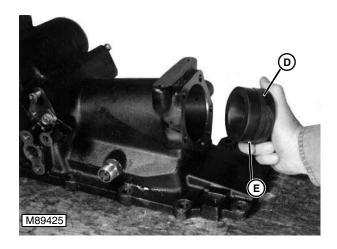




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- 1. Remove five cap screws and lock washers securing cover to housing.
- 2. Remove cover.

NOTE: If cover will not come out of rockshaft housing, remove relief valve or rate of drop/stop valve to allow air to enter housing and release vacuum.

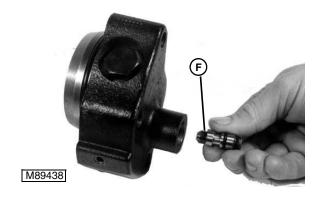


- 3. Remove piston (D) from housing.
- 4. Inspect seal (E). Replace if damaged, or scored.

NOTE: Rockshaft does not have to be removed to replace rate of drop/stop control valve.

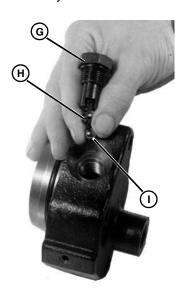


5. Remove rate of drop control valve from cover.



NOTE: Rate of drop spool may be removed by pushing it out from the back side, or pulling it from the cover using a suitable screw.

- 6. Remove rate of drop spool (F) from cover.
- Inspect spool and components, replace O-rings. If spool shows wear and/or damage replace entire spool assembly.



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- 8. Remove relief valve cap (G), spring (H) and ball (I) from cover.
- Inspect spring and ball for damage. Replace as required.
- 10. Replace O-ring in cap.

Installation:

Installation of cap, valves, and piston are reverse of removal.

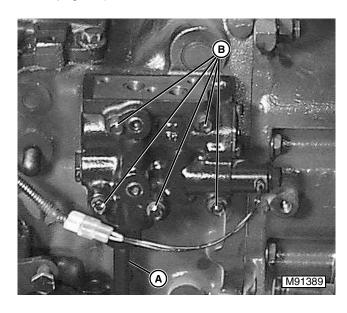
IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

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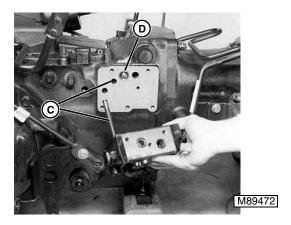
PTO CLUTCH VALVE

Removal:

 Remove SCV or manifold block on top of PTO clutch valve. (See "SELECTIVE CONTROL VALVE" on page52.)



- 2. Label and disconnect solenoid electrical connector.
- 3. Disconnect hydraulic supply tube (A) from bottom port in PTO valve.



- 4. Remove five cap screws (B) securing PTO valve to side of tunnel. Tubes (C) may or may not come out with valve. If tubes come out with valve, remove tubes from valve and replace O-rings.
- Remove lubrication relief valve (D) from tunnel. Inspect valve for excessive wear or damage. Replace if necessary.
- 6. Remove gasket between PTO valve and tunnel.

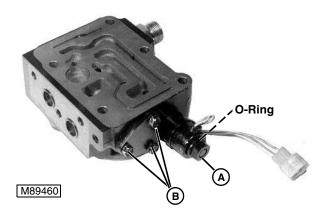
Installation:

Installation of PTO clutch valve is the reverse of removal.

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

- Always use new gasket when installing PTO clutch valve.
- Always use new O-rings.
- Make sure that tubes are correctly installed into tunnel and PTO clutch valve.
- Tighten cap screws securing PTO clutch valve to transmission housing to 22 Nom (16 lb-ft).
- Tighten cap screws securing Block, or SCV valve to PTO clutch valve to 63 Nom (47 lb-ft).

Disassembly and Assembly:



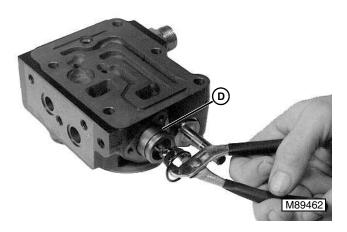
- 1. Remove plastic nut (A) retaining coil on solenoid. Replace O-ring under nut. Remove Coil.
- 2. Remove three cap screws (B) and lock washers securing cover to valve body. Remove cover.



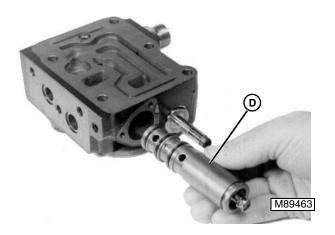
3. Thread one of the cover cap screws into threads on end of piston (C) and use as a puller to remove piston from valve body. Replace O-ring on piston.



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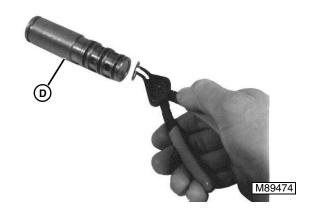
4. Thread one of the cover cap screws into threads on end of delay relief valve spool (D) and using a small pliers remove spool from valve body. Note Oring that will come out of port.



- 5. Remove spool assembly from valve body.
- 6. Remove cap screw from end of spool.
- 7. Replace four O-rings on outside of spoolbody.

NOTE: Spool assembly may be serviced as a unit. If spool body or internal components show signs of wear or damage, check for availability of parts.

NOTE: Spool assembly internal components are under light spring pressure. Use care when removing internal snap ring.



8. To disassemble spool for cleaning, remove internal snap ring from either end of spool. (Illustrated being disassembled from the small end first.)

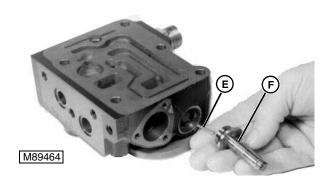


Remove piston and two springs from bore of delay relief valve.





- Remove internal snap ring from opposite end of spool.
- 11. Remove large piston and, if equipped, large and small shims.



- 12. Remove solenoid body from PTO valve block.
- 13. Remove plunger (E) from solenoid body (F).



Remove piston, spool, and spring from PTO valve block.



- 15. Remove cap, spool, and spring from PTO valve block.
- 16. Replace O-ring on cap.

Inspection:

- Clean all components in a suitable solvent.
- Inspect all components for scratches, and/or damage. If any damage is noted or if there are obvious signs of wear replace components as required.

Assembly:

Assembly is the reverse of disassembly.

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

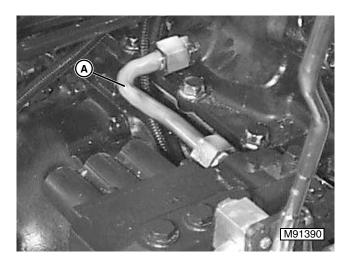
- Lubricate all components with hydraulic fluid during assembly.
- Make sure that spools are inserted into the valve block in the same orientation that they were removed.

SELECTIVE CONTROL VALVE

NOTE: Tractor may be equipped with a manifold block on top of PTO valve. Removal and installation of this block is basically the same as that of the SCV.

Removal:

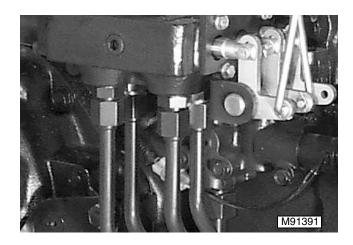
 Remove five cap screws and right panel from SCV and draft sensing control levers.



2. Remove "J" tube (A) from SCV to rockshaft housing.

NOTE: Power Beyond Kit may be installed on tractor. It will be in the place of the "J" tube.

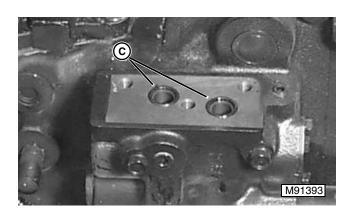
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3. Disconnect four tubes from bottom of SCV.



4. Remove three cap screws (B) securing SCV to PTO clutch valve. Remove SCV.



Replace two O-rings (C) between PTO clutch valve and SCV.

Installation:

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

Installation is the reverse of removal.

- Tighten J-tube ends to 81 89 N•m (60 67 lb-ft).
- Tighten SCV work port tube ends to 51 57 N•m (38 42 lb-ft).

Length of rods from lever to SCV are set at factory. If they must be replaced, reset them to the factory specification. They are:

Front/Back......157 mm Left/Right146 mm

Disassembly, Inspection, and Assembly

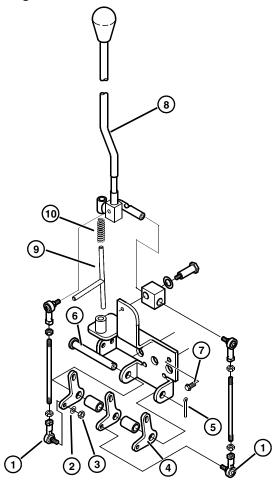
NOTE: Some internal components of SCV are NOT serviceable. If SCV internal components are excessively worn or damaged, check for availability of kits.

1. Remove control valve shift linkage.

NOTE: SCV control linkage may be either a single lock model or a multi-lock model.



Single Lock Control Removal:



- 1. Ball Joints
- 6. Pin
- 2. Washer
- 7. Cap Screw

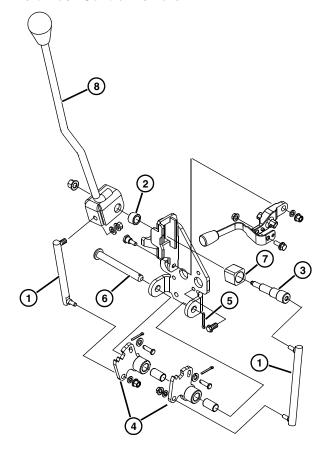
3. Nut

- 8. Lever
- 4. Bellcrank
- 9. Lock Lever
- 5. Cotter Pin
- 10. Spring



- 1. Remove nuts and washers securing ball joints (1) to bellcranks (4).
- 2. Remove four cap screws retaining lever assembly to valve body. Remove lever assembly.

Multi-Lock Control Removal:

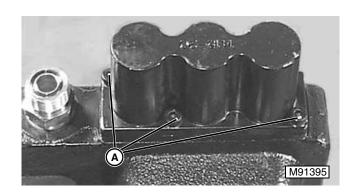


- 1. Link Rod
- 5. Cotter Pin
- 2. Spacer
- 6. Pin

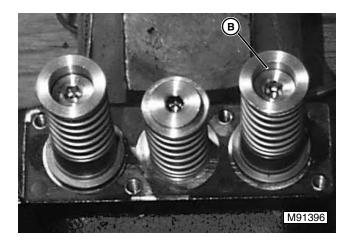
3. Pin

- 7. Guide Bar
- 4. Bellcrank
- 8. Lever
- 1. Remove nuts and washers securing link rods (1) to bellcranks (4).
- 2. Remove four cap screws retaining lever assembly to valve body. Remove lever assembly.

SCV Disassembly:

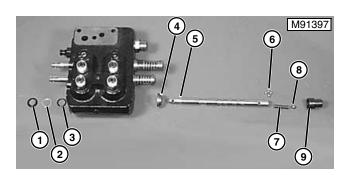


Remove four socket head cap screws (A) on end cover. Remove end cover. Replace end cover gasket.



NOTE: Valve spools are similar. Center valve section does NOT contain a detent assembly.

 Hold spring slightly compressed and remove spring retainer plug (B) and valve spring retainer. Remove spring.



- 1. Seal
- 4. Spacer
- 7. Spring

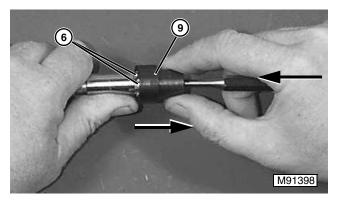
- 2. Washer
- 5. Spool
- Ball

- 3. O-ring
- 6. Small Balls
- 9. Detent Cap

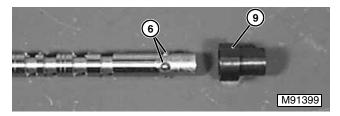
NOTE: Use care when removing valve spool and detent assembly from valve body. Detent cap may come off, and balls may fall out and be lost. Push valve spool out from lever side to remove.

- 10. Slide spool with detent assembly out of valve body.
- Inspect spool and valve body for signs of wear or damage. If worn or damaged, replace entire selective control valve assembly.
- 12. Remove spacer from spool.

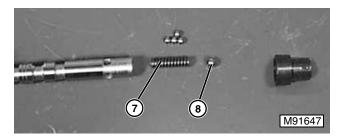
13. Remove seal, backing washer, and O-ring from valve body. Replace O-ring and seal.



14. Remove detent cap (9) by inserting a suitable pin punch into the threaded hole and pressing inward to release spring tension on balls (6). Slide detent cap off end of spool.



- 15. Remove detent cap.
- 16. Remove four small balls.



17. Remove larger ball (8), and spring (7).

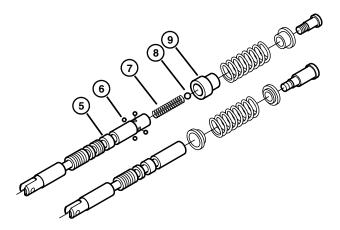


Valve Spools Assembly:

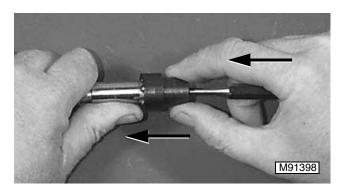
IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

1. Install spring and ball into end of valve spool.

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- 2. Apply a small amount of general purpose grease into the holes for the small balls on the valve spool.
- 3. Insert four small balls into holes in valve spool.
- 4. Slide detent cap over end of valve spool. *Do not slide over balls at this time.*



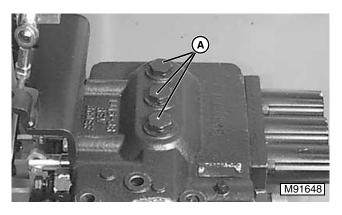
5. Using a suitable pin punch, press on the ball in the end of the spool to slightly compress the spring. Slide detent cap over four small balls.

NOTE: When properly installed, the four small balls will retain the larger ball, and maintain spring pressure on the larger ball.

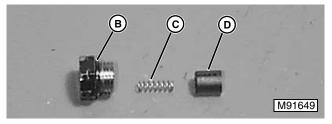
- 6. Install spacer onto spool.
- 7. slide spool into valve body.
- 8. Install O-ring, backing washer, and seal into valve body.
- 9. Install spring, spring retainer, and valve spring retainer plug. Tighten plug to **15 N•m (133 lb-in.)**.
- Install end cover. Retain with four socket head cap screws. Tighten cap screws to 19 Nom (14.5 lb-ft).
- 11. Install lever assembly. Retain with four cap screws. Tighten cap screws to 40 N•m (30 lb-ft).

Load Check Valves:

Removal:



1. Remove valves (A).



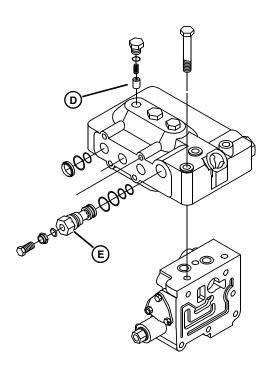
- 2. Replace O-ring (B).
- Inspect spring (C) and valve poppet (D) for wear or damage. Replace if necessary.

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Installation:

Installation is the reverse of removal.

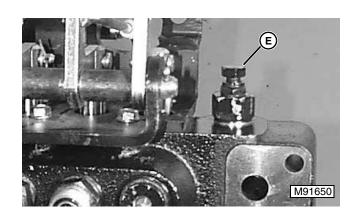


IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

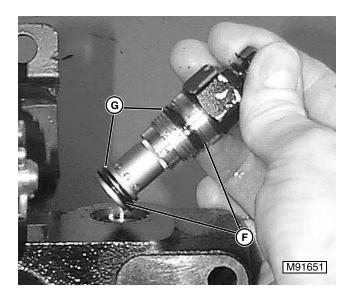
• Tighten check valve to 24 N•m (18 lb-ft).

Relief Valve:

Removal:



1. Remove valve (E).



- 2. Replace O-rings (F) and backing washers (G).
- 3. Inspect valve for wear or damage. Replace if necessary.

Installation:

Installation is the reverse of removal.

IMPORTANT: Replace all O-rings and seals. Used or damaged O-rings and seals will leak.

• Tighten relief valve to 50 N•m (37 lb-ft).

NOTE: If replacement of relief valve was necessary, or if relief valve setting was changed, perform SCV pressure relief valve adjustment. (See "SYSTEM RELIEF PRESSURE TEST" on page 27.)





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MISCELLANEOUS SPECIFICATIONS

SPECIFICATIONS

TORQUE SPECIFICATIONS

Front Wheel Bolt	8 N•m (65 - 80 lb-ft)
Rear Wheel Bolt	8 N•m (65 - 80 lb-ft)
Steering Wheel Nut	9 N•m (29 - 36 lb-ft)
Center Link Bracket Cap Screws	150 N•m (110 lb-ft)
Center Link Spring Holder	95 N•m (70 lb-ft)
Draft Feedback Rod To Feedback Lever	70 N•m (50 lb-ft)

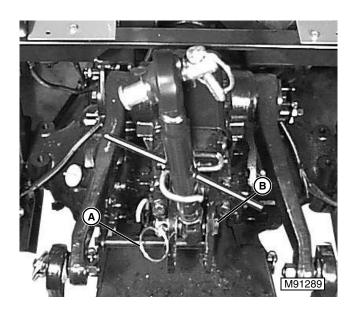


REPAIR MISCELLANEOUS

REPAIR

THREE POINT HITCH REMOVAL AND INSTALLATION

Center Lift Link Removal:



- 1. Disconnect center lift link from storage hook.
- 2. Remove lynch pin (A) from hitch pin (B) attaching center lift link to bracket on rockshaft.
- 3. Support center lift link and remove hitch pin. Remove center lift link.

Installation:

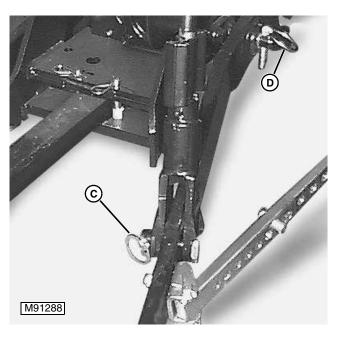
Installation is the reverse of removal.

Draft Arm & Adjustable Sway Bar Removal:



M91290

1. Remove spring clip from clevis pin on front of adjustable sway bar. Remove clevis pin.

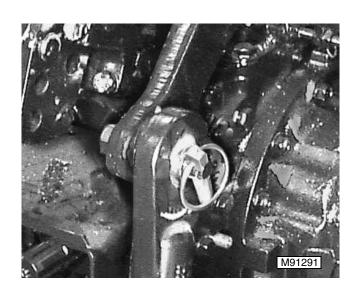


- 2. Remove lynch pin (C) from hitch pin on bottom of lift link. Remove retainer.
- 3. Support draft arm and adjustable sway bar and remove hitch pin.
- 4. Remove lynch pin (D) from anchor pin at front of draft arm.
- 5. Remove adjustable sway bar and draft arm.

Installation:

Installation is the reverse of removal.

Adjustable (RH) and Fixed (LH) Lift Link Removal:



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- 1. Remove lynch pin from rockshaft at top of lift link.
- 2. Remove lift link.

Installation:

Installation is the reverse of removal.

SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION

Removal:

- 1. Disconnect seat switch electrical connector.
- 2. Remove two cap screws at rear of seat support attaching seat support to tractor frame.
- 3. Remove two nuts at front of seat support attaching seat support to operators platform and standoffs.
- 4. Remove seat and seat support from tractor as an assembly.

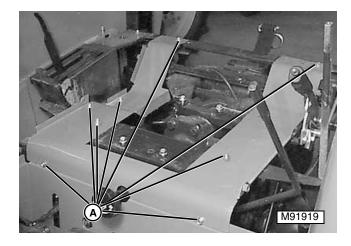
Installation:

Installation is the reverse of removal.

SEAT PLATFORM REMOVAL AND INSTALLATION

Removal:

- 1. Remove cap on range shift knob to left of seat. Remove cap screw and knob.
- 2. (Collar Shift or PowerReverser[™] Tractor) Repeat step 1 and remove gear shift knob.
- If equipped, unscrew and remove 4-WD T-handle knob.
- 4. Remove five cap screws and shift lever gate.
- 5. Unscrew knob on SCV lever and remove.
- 6. Remove five cap screws and SCV/rockshaft control lever gate.
- 7. Remove seat. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page 5.)



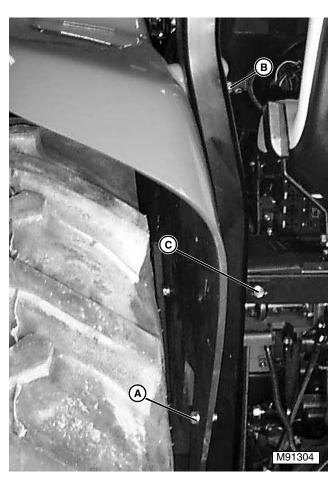
8. Remove eight cap screws (A) and seat platform.

Installation:

Installation is the reverse of removal.

ROLL OVER PROTECTIVE STRUCTURE (ROPS) REMOVAL AND INSTALLATION

Removal:



 Disconnect wiring harness electrical connectors from wiring inside roll bar (warning light connectors, work light connectors, tail light connectors).

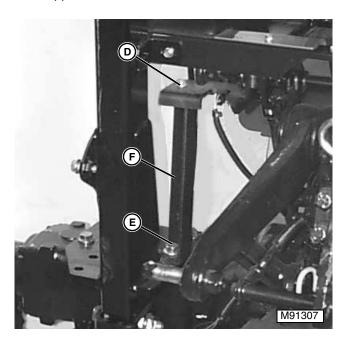


CAUTION

The approximate weight of the ROPS is 57 kg (125 lb). Do not attempt to remove ROPS without an assistant or overhead crane.

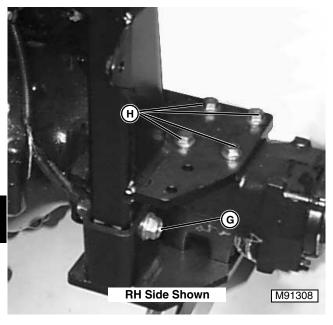
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- 2. Remove two lower cap screws (A) securing LH and RH fenders to ROPS.
- 3. Remove two upper cap screws (B), washers nuts securing LH and RH fenders to ROPS.
- 4. Remove two cap screws (C) securing ROPS to seat support channel.



NOTE: Wheel, tire, and fender removed for clarity.

- 5. On left side of tractor, remove cap screw (D) and nut from top of park brake support angle.
- 6. Remove cap screw (E) securing park brake support angle (F) to axle housing. Remove park brake support angle.



- 7. Remove two cap screws (G) and nuts securing ROPS to support plates on underside of rear axle.
- Remove eleven cap screws (H) attaching ROPS to top of rear axle. Slide ROPS toward rear of tractor, Use care to avoid damage to fenders. Remove ROPS.

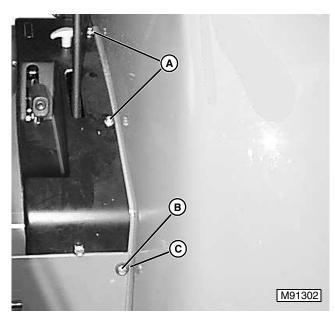
Installation:

Installation is the reverse of removal.

REAR FENDERS REMOVAL AND INSTALLATION

NOTE: The following procedure is for either LH or RH fender.

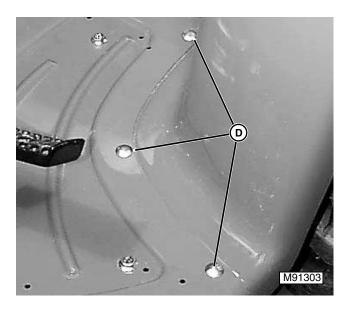
Removal:



- 1. Remove two cap screws (A) securing control lever panel to fender.
- 2. Remove cap screw (B) from rubber isolator (C) securing kick plate to fender.

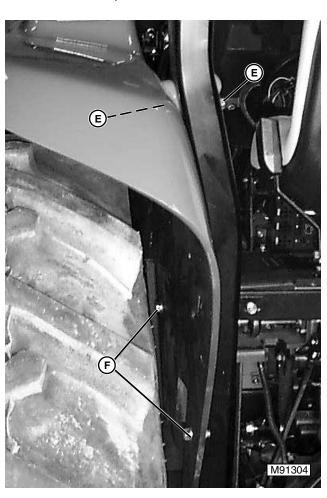
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NOTE: Floor mats removed for clarity.

3. Remove three nuts and carriage bolts (D) securing fender to floor plate.



4. Remove cap screw, fender washer, and nut (E) securing fender to ROPS.

IMPORTANT: It may be necessary for an assistant to support the fender when removing the cap screws securing it to the frame.

Remove two cap screws (F) from fender well area securing fender to frame and ROPS. Remove fender.

Installation:

Installation is the reverse of removal.

FRONT WHEEL REMOVAL AND INSTALLATION

Removal:

- Loosen lug nuts slightly before raising tractor front axle.
- 2. Raise front of tractor and lower onto support stands so that tractor is supported by front axle.

NOTE: If the front wheels are being removed to perform work on the front axles, lower tractor onto suitable stands that will support the tractor by the frame.

3. Remove six lug bolts and wheel.

Installation:

- 1. Install wheels onto axle, insert lug bolts and lightly tighten bolts.
- 2. Raise front of tractor, remove support stands and lower tractor to floor.
- 3. Tighten lug bolts to 88 108 Nem (65 80 lb-ft).

REAR WHEEL REMOVAL AND INSTALLATION

IMPORTANT: If both rear wheels are to be removed, support the tractor frame in a manner that will prevent the frame from pivoting on the front axle.

Removal:

- Loosen lug bolts slightly before raising tractor rear
 axle
- Raise rear of tractor and lower onto support stands so that tractor is supported by rear axle.

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NOTE: If the rear wheels are being removed to perform work on the rear axles, lower tractor onto suitable stands that will support the tractor frame.

3. Remove 8 lug bolts and wheel.

Installation:

- Install wheels onto axle, insert lug bolts and lightly tighten bolts.
- 2. Raise rear of tractor, remove support stands and lower tractor to floor.
- 3. Tighten lug bolts to 88 108 Nem (65 80 lb-ft).

FLOOR MAT REMOVAL AND INSTALLATION

Removal:

- Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10.)
- 2. Remove twelve plastic rivets holding rubber pad to floor plate.

IMPORTANT: (Hydrostatic Model) Use care when removing floor mat from forward and reverse pedals. It may be necessary to remove pedal pads to prevent damage to floor mat.

3. Lift and remove floor mat.

Installation:

Installation is the reverse of removal.

SIDE PANELS, REMOVAL AND INSTALLATION

Removal:

- 1. Raise hood and support with hood prop latch.
- 2. Pull out side panel lock clip and turn to release top of panel.
- 3. Tilt top of side panel out. Lift and remove panel from tractor.

Installation:



- Position the two tabs on bottom of the side panel on the wire loops welded to the tractor frame.
- 2. Lower the side panel into position, making sure the panel lock clips are in the correct position to go through the slots in the top of the side panels.
- 3. Tilt panel into position and onto lock clips. Pull and turn lock clips to lock panel to tractor. Fold lock clips flat.
- 4. Lower the hood.

KICK PLATE REMOVAL AND INSTALLATION

Removal:

- 1. Remove rate of drop knob from control shaft at front edge of seat.
- Remove seat and seat support. (See "SEAT AND SEAT SUPPORT REMOVAL AND INSTALLATION" on page5.)
- 3. Remove seat platform. (See "SEAT PLATFORM REMOVAL AND INSTALLATION" on page5.)
- 4. Remove two cap screws from isolators attaching kick plate to fenders.
- Remove four cap screws through isolators attaching kick plate to operator's platform. Remove kick plate.

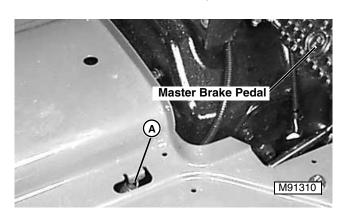
Installation:

Installation is the reverse of removal.

OPERATOR'S PLATFORM REMOVAL AND INSTALLATION

Removal:

- Remove fuse panel cover (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10.)
- 2. Remove floor mat. (See "FLOOR MAT REMOVAL AND INSTALLATION" on page8.)
- 3. Remove kick plate (See "KICK PLATE REMOVAL AND INSTALLATION" on page8.)
- 4. Remove rockshaft rate of drop knob.



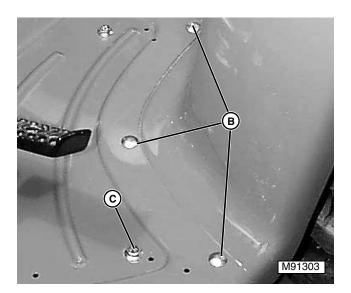
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CAUTION

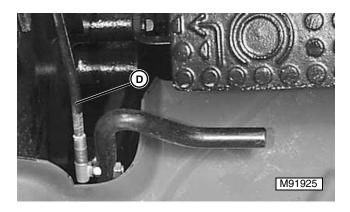
Tensioned Spring. Wear eye protection and gloves when disconnecting spring to reduce the risk of personal injury.

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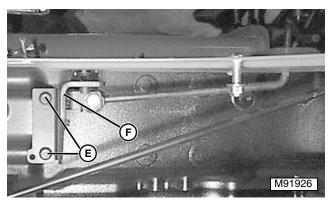
5. (Hydrostatic Model) Detach top of neutral return spring (A) from operator's platform.



- 6. Remove six nuts and carriage bolts (B) securing operator's platform to fenders.
- (HST Model) Remove two nuts and carriage bolts securing forward pedal. Remove pedal. Repeat for reverse pedal.
- 8. Remove six cap screws (C), lock nuts, and washers from rubber isolators attaching platform to frame.



9. (CST and PRT Models) Disconnect foot throttle link(D) at foot throttle.



NOTE: RH wheel and tire removed for clarity.

- 10. Remove two cap screws (E) attaching foot throttle and operator's platform support bracket (F) to tunnel. Remove foot throttle and support bracket as an assembly.
- 11. Lift front edge of operator's platform slightly, and slide forward over top of transmission housing. Lift rear edge of platform to clear seat and SCV lever and remove operator's platform. Inspect rubber isolators for cracks and deterioration. Replace as necessary.

Installation:

Installation is the reverse of removal.

STEERING WHEEL REMOVAL AND INSTALLATION

Removal:

- 1. Remove steering wheel center cap.
- 2. Remove lock nut.
- 3. Remove steering wheel. If necessary, use a suitable puller.

Installation:

NOTE: Lubricate the steering shaft splines with general purpose grease before installing steering wheel to allow easy removal.





- Remove center cap retaining ring from steering wheel.
- Install steering wheel and retain with nut. Tighten steering wheel nut to 39-49 N•m (29-36 lb-ft).
- 3. Install plastic retaining ring to steering wheel center cap.
- 4. Install center cap and retaining ring to steering wheel.

CONTROL PANEL REMOVAL AND INSTALLATION

Removal:

- Disconnect negative (–) battery cable. (See "BATTERY REMOVAL AND INSTALLATION" on page 10.)
- 1. Remove steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9.)
- 2. Remove four screws and lift off the control panel.
- 3. Disconnect wiring harness connectors to control panel.
- 4. Remove control panel.

Installation:

Installation is the reverse of removal.

FUSE PANEL COVER REMOVAL AND INSTALLATION

Removal:

- 1. Remove two cap screws from RH and LH side top edge of cover.
- 2. Open fuse panel door. Remove two cap screws from top edge of cover inside door.
- 3. Tilt top of cover towards seat.
- 4. Lift and remove cover.

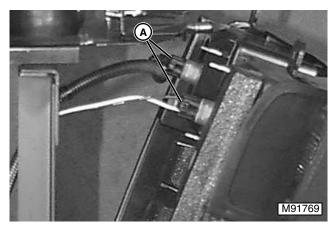
Installation:

Installation is the reverse of removal.

GRILLE REMOVAL AND INSTALLATION

Removal:

- 1. Open hood and support on hood prop latch.
- 2. Remove side panels. (See "SIDE PANELS, REMOVAL AND INSTALLATION" on page8.)
- 3. Pull out 2 panel lock clips and turn to release top of grille.



- 4. Disconnect the headlight connectors (A).
- 5. Tilt top of grille out. Lift and remove grille from tractor.

Installation:

- Slide the bottom of the grille under the battery tray. Insert the locating tabs on the bottom of the grille into the wire loops welded to the tractor frame.
- 2. Connect the headlights.
- Tilt grille into position and onto lock clips. Pull and turn lock clips to lock grille to tractor. Fold lock clips flat.
- 4. Install side panels. (See "SIDE PANELS, REMOVAL AND INSTALLATION" on page8.)

BATTERY REMOVAL AND INSTALLATION

Removal:

1. Remove grille. (See "GRILLE REMOVAL AND INSTALLATION" on page 10.)

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- 2. Disconnect positive and negative battery cables.
- 3. Loosen two nuts (A) and remove battery hold down.
- 4. Remove battery.

Installation:

Installation is the reverse of removal.

KEY SWITCH PANEL REMOVAL AND INSTALLATION

Removal:

- 1. Disconnect battery negative cable. (See "BATTERY REMOVAL AND INSTALLATION" on page 10.)
- Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10.)
- Remove four screws and tilt key switch panel away from console.
- Disconnect key switch electrical connector and remove panel.

Installation:

Installation is the reverse of removal.

COWL PANEL REMOVAL AND INSTALLATION

Removal:

- 1. Remove side panels. (See "SIDE PANELS, REMOVAL AND INSTALLATION" on page 8.)
- 1. Remove steering wheel (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9.)
- Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10.)
- 3. Remove fuse panel cover. (See "FUSE PANEL COVER REMOVAL AND INSTALLATION" on page 10.)
- 4. Remove key switch panel. (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11.)

5. Raise hood and support with hood prop latch.



- 6. Remove cap screw (A) under rear of hood at top front of cowl panel.
- 7. Support panel and remove cap screw (B) from side of panel at bottom. Remove shroud panel.
- 8. Repeat for other side.

Installation:

Installation is the reverse of removal.

HOOD REMOVAL AND INSTALLATION

Removal:

1. Open hood and support on hood prop latch.

NOTE: An assistant may be required to support hood during removal.

- 2. Remove four cap screws and nuts attaching hood to LH and RH hinges.
- 3. Remove hood.

Installation:

Installation is the reverse of removal.

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FUEL TANK REMOVAL AND INSTALLATION

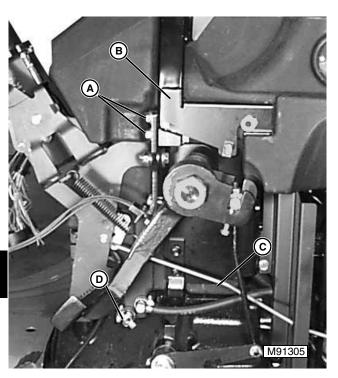
Removal:



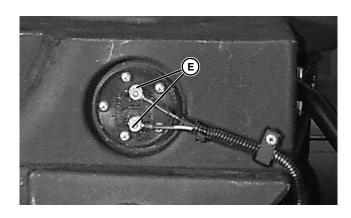
CAUTION

Diesel fuel is flammable! Extinguish all open flames before working on fuel system. Do not smoke.

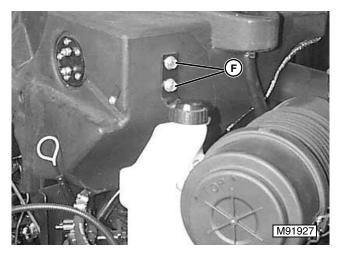
- 1. Park tractor on level surface, shut engine off, engage park brake.
- Allow tractor and engine to cool before attempting to service fuel system.
- 3. Remove engine side panels.
- 4. Remove steering wheel. (See "STEERING WHEEL REMOVAL AND INSTALLATION" on page 9.)
- 5. Remove control panel. (See "CONTROL PANEL REMOVAL AND INSTALLATION" on page 10.)
- Remove key switch panel (See "KEY SWITCH PANEL REMOVAL AND INSTALLATION" on page 11.)
- 7. Remove cowl panels. (See "COWL PANEL REMOVAL AND INSTALLATION" on page 11.)
- 8. Remove hood. (See "HOOD REMOVAL AND INSTALLATION" on page 11.)
- 9. Remove brake pedal shaft. (See "BRAKE PEDAL HST" on page19, or "BRAKE PEDAL CST AND PRT" on page21 in Brakes Section.)



- 10. Remove four cap screws (A) and hood support frame (B).
- Disconnect throttle link (C) at engine by pulling rod outward.
- 12. Drain fuel from tank into a suitable container.
- 13. Label and remove fuel lines from fuel tank.
- 14. Remove fuel overflow drain hose.
- 15. Remove drain cock (D) and fuel hose elbow from fuel tank.

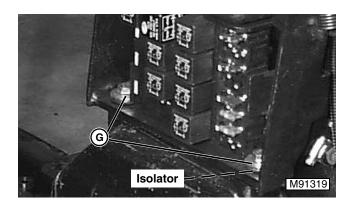


- Loosen screw on clamp holding fuel gauge sender wiring harness to fuel tank. Turn clamp to release harness.
- 17. Remove two nuts (E) and lock washers connecting wires to fuel gauge sender. Remove wires.

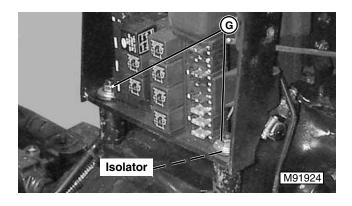


- 18. If necessary, drain coolant overflow tank and disconnect hose from radiator to tank.
- Remove two cap screws (F) and coolant overflow tank.

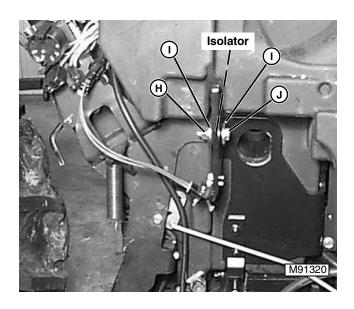
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 (HST Model) Remove two cap screws (G) and washers securing bottom of steering support to frame.



21. (CST and PRT Models) Remove two nuts and washers (G) securing bottom of steering support to frame.



22. Remove two nuts (H), four washers (I), and two cap screws (J) from rubber isolators that secure top of steering support to frame.

NOTE: An assistant may be required to tilt steering support while removing fuel tank.

23. Tilt steering support toward rear of tractor and remove tank from frame.

Installation:

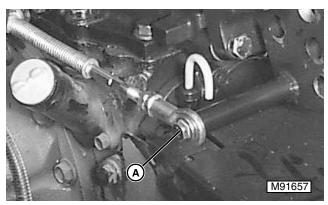
Installation is the reverse of removal.

CENTER LINK BRACKET REMOVAL AND INSTALLATION

Removal:

NOTE: If tractor does not have optional draft sensing unit, there will be a fixed center link at the top rear of the rockshaft housing. Its removal and installation is basically the same as the draft sensing unit outlined in this procedure.

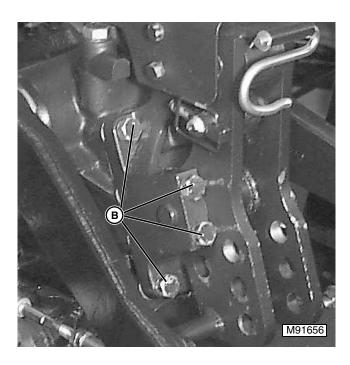
NOTE: Draft sensing center link contains no serviceable components. If center link is damaged, or does not operate properly, entire draft sensing kit must be replaced.



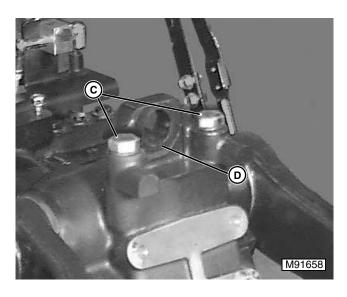
1. Remove cap screw (A) and disconnect draft sensing link (draft sensing option tractors only).



CAB



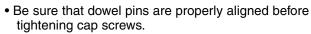
Remove eight cap screws (B) and center link bracket.



3. Remove two cap screws (C) and spring holder (D).

Installation:

Installation is the reverse of removal.



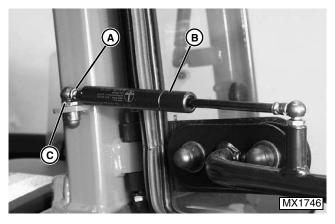
- Tighten cap screws on center link bracket to 150 N•m (110 lb-ft).
- Tighten cap screws on spring holder to 95 Nom (70 lb-ft).
- Tighten cap screw attaching draft feedback rod to feedback lever to **70 N•m (50 lb-ft)**.

CAB

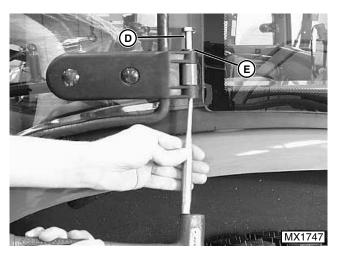
DOOR REMOVAL AND INSTALLATION

Removal:

1. Open cab door.



- 2. Remove clip (A) from damper (B). Disconnect damper from ball joint (C).
- 3. Close and latch door.
- 4. Remove plastic caps from door hinge bolts.
- 5. Remove hex nut and flat washer from threaded end of each hinge bolt.



- 6. Tap hinge bolt (D) with pin punch to remove bolt and flat washer (E). Repeat at other hinge.
- 7. Hold door securely and unlatch to remove.

Installation:

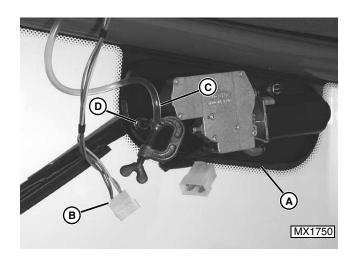
Installation is the reverse of removal. Latch door closed and align hinges before installing hinge bolts. Do not tighten hinge bolts very tight or door will not swing correctly.



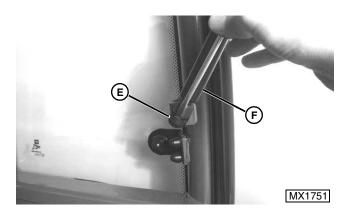
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REAR WINDOW REMOVAL AND INSTALLATION

Removal:



- 1. Pry carefully with a screwdriver to unsnap and remove cover from rear wiper motor assembly (A).
- 2. Disconnect wiring harness connector (B).
- 3. Plug end of washer fluid hose (C).
- 4. Disconnect hose from spray nipple (D).
- 5. Open rear window.

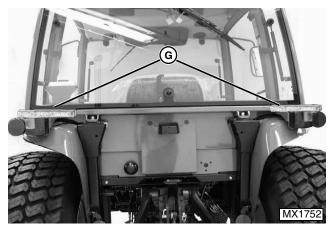




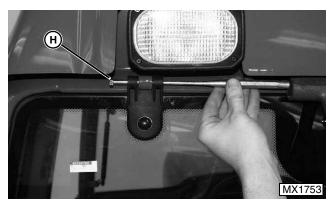
CAUTION

To avoid injury, have an assistant hold window up while disconnecting dampers.

- 6. Insert tip of flathead screwdriver behind clip (E) and disconnect damper (F). Repeat for other damper.
- 7. Close rear window.



- 8. Support rear window on wooden blocks (G).
- 9. Remove plastic caps from rear window hinge bolts.
- 10. Remove hex nut and flat washer from threaded end of each hinge bolt.



- 11. Tap hinge bolt (H) with pin punch to remove bolt. Repeat at other hinge.
- 12. Remove rear window from cab.

Installation:

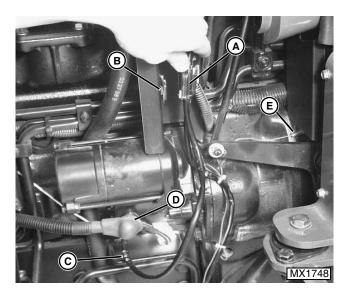
- Installation is the reverse order of removal. Use an assistant to help hold glass in place while aligning hinges. Do not tighten hinge bolts very tight or glass will not swing easily.
- 2. Snap end of dampener back onto post.



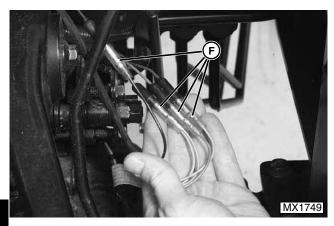
CAB REMOVAL AND INSTALLATION

Removal:

- 1. Disconnect negative cable from battery.
- 2. Drain engine coolant from radiator.
- 3. Remove cab door panels. (See "CAB" on page 14.)
- 4. Remove cab floor mat and all upholstery liners except those covering the fender deck.
- 5. Remove engine side panels. (See "SIDE PANELS, REMOVAL & INSTALLATION" on page 8.)



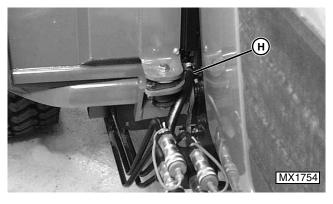
- 6. Release 60 amp fuse holder (A) from mounting clip (B) using tip of flathead screwdriver.
- 7. Remove power lead (C) from starter motor terminal (D).
- 8. Disconnect Red wire bullet connector (E).



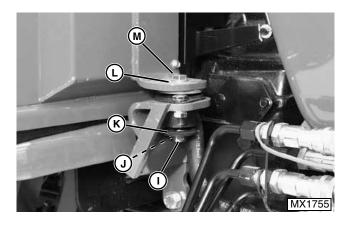
9. Label and disconnect eight bullet connectors (F) under rear of cab (four at each side of rockshaft).



10. Disconnect Brn ground wire (G) from panel behind cab seat. Cut all tie straps as needed to free the ground wire for cab removal.



- 11. Disconnect heater hose (H) at RH and LH sides of tractor. Plug or cap the hoses.
- 12. Disconnect ground wire (if equipped) on front LH side by isolator.



- 13. Remove the following hardware from the two front cab mounts:
 - Lock Nut (I)
 - Flat Washer (J)
 - Rubber Washer (K)
 - Flat Washer (L)
 - Hex Bolt (M)

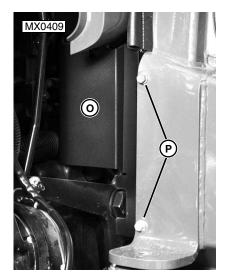
M

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14. Repeat for rear cab mounts (N).



 Remove front splash plate (O) from front of cab by removing cap screws (P) and lock nuts from cab frame. Repeat for other side of cab.

NOTE: Cab must be lifted with a hoist capable of raising cab high enough for front of cab to clear tractor fenders, (if removing from the rear), or for front of cab to clear engine cover, (if removing from the front.)

Have suitable stands ready to support the rear of the cab (after it is removed) to prevent the tail lamps from contacting the ground.

16. The cab is now free to be lifted using an overhead crane. Route lifting straps through main frame of cab, avoiding the fiberglass roof and overhead console. Wrap straps around corners of frame to prevent straps from sliding, and allowing cab to shift while being lifted.

Alternatively, a large fork truck may be used to lift the cab by putting the forks through the rear window opening. Span a 4x4 beam across the door frames inside the cab to prevent tips of forks from contacting overhead console. Cab must be lifted high enough for the front bottom corners of cab to clear tractor fenders.

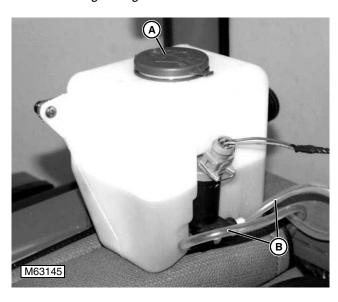


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WINDSHIELD WASHER REPAIR

NOTE: See "CAB WASHER PUMP DIAGNOSIS" on page 4-196 of Electrical Section for diagnosis of windshield washer pump electrical problems.

> See drawing on next page to identify windshield washer components and water line routing through cab frame.



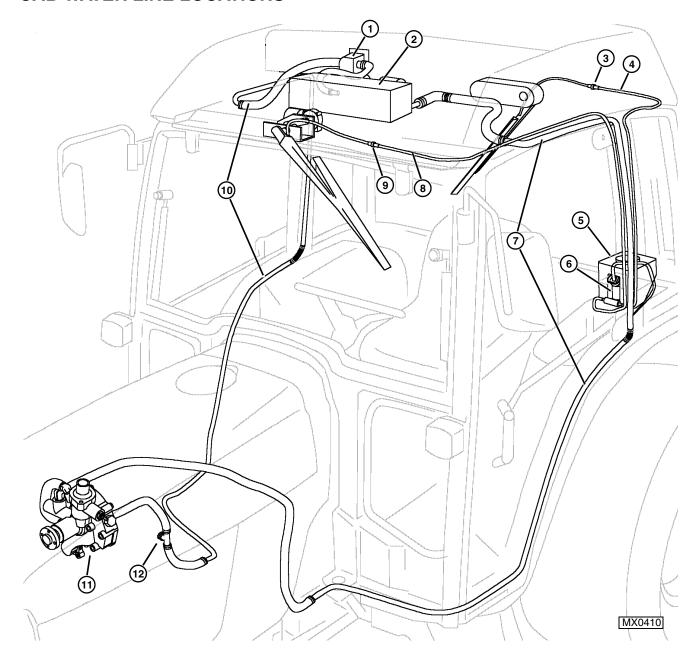
If front or rear washer is not working, check the following items:

- Check vent hole on reservoir cap is clear (A), and that reservoir is full of clean, unfrozen, windshield washer fluid. Listen for pump operation.
- Check that front or rear spray nozzles are not clogged by removing washer hose from nozzle and operating front or rear washer switches. Clean the clogged nozzle with a pin and compressed air.
- If no fluid is discharged from washer hose when pump is operated, be sure check-valve is installed correctly on water line. An arrow on check-valve body indicates direction of flow. (Front check valve is located in roof overhang above windshield. Rear check valve is located inside cab under padding above rear window.) Remove check valve and operate front or rear washer switch to check for fluid flow.
- Check for fluid flow from pump by removing fluid lines (B) from pump ports and operating front or rear washer switches. If no pump output, remove reservoir and flush with clean water until clear.
- If fluid lines are clogged, try to clear with compressed air. Look for pinched line at front or rear washer nozzles. If front fluid line is clogged, cab must be lifted up from tractor to route a new line up cab door post frame. (See "CAB REMOVAL AND INSTALLATION" on page16.)

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CAB WATER LINE LOCATIONS

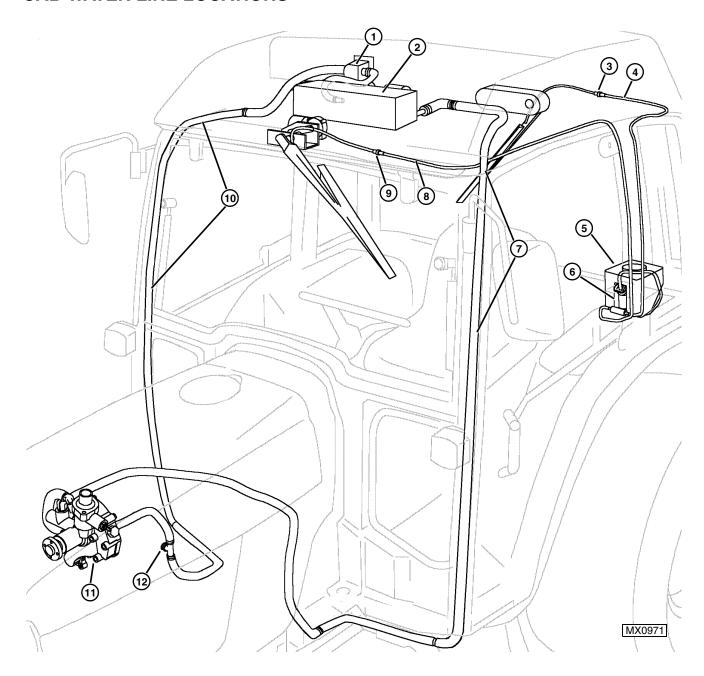


- 1. Heater Control Valve
- 2. Heater Core
- 3. Rear Washer Check Valve
- 4. Rear Washer Fluid Hose
- 5. Washer Reservoir
- 6. Washer Pump
- 7. Cab Heater Water Return Hose/ 11. Water Pump Tube
- 8. Front Washer Fluid Hose
- 9. Front Washer Check Valve
- 10. Cab Heater Water Supply Hose/Tube
- 12. Heater Hose Drain Valve



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CAB WATER LINE LOCATIONS



CAB HEATER REPAIR

NOTE: For blower motor electrical diagnosis, see "CAB POWER CIRCUIT OPERATION" on page 191 of Electrical Section.

- 1. Drain cooling system at drain valve (12) on right rear of engine compartment.
- Lower cab overhead console to access heater control valve (1), heater core (2), and blower motor
- 3. Water lines running inside of cab frame are steel tubing, with rubber hose and clamps at joints, and

require cab to be lifted from tractor to service.

4. Route hose in overhead console to prevent it from kinking when overhead console is raised to install.

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